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## **SOUTH AFRICAN NATIONAL ROADS AGENCY LIMITED**

**STANDARD SPECIFICATIONS FOR OPERATIONS AND  
MAINTENANCE: ELECTRONIC TOLL COLLECTION  
(ETC)**

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## 1. DEFINITIONS AND TERMS PERTAINING TO THIS DOCUMENT

### 1.1 INTERPRETATION

- 1.1.1 The abbreviations and definitions below are applicable to this Standard Specification only and may contain definitions from other reference documents that are modified. For purposes of this document, the following rules of interpretation shall apply:
- 1.1.1.1 Any reference to any statute, regulation or other legislation shall be a reference to that statute, regulation or other legislation as at the signature date, and as amended or substituted from time to time;
  - 1.1.1.2 If any provision in a definition is a substantive provision conferring a right or imposing an obligation to any Party then, notwithstanding that it is only in a definition, effect shall be given to that provision as if it were a substantive provision in the body of this document;
  - 1.1.1.3 Where any term is defined other than the definition section, that term shall bear the meaning ascribed to it wherever it is used;
  - 1.1.1.4 Where any number of days is to be calculated from a particular day, such number shall be calculated as excluding such particular day and commencing on the next day. If the last day of such number so calculated falls on a day which is not a business day, the last day shall be deemed to be the next succeeding day which is a business day;
  - 1.1.1.5 Any term which refers to a South African legal concept or process (for example, without limiting the foregoing, winding-up or curatorship) shall be deemed to include a reference to the equivalent or analogous concept or process in any other jurisdiction in which this document may apply or to the laws of which a Party may be or become subject;
  - 1.1.1.6 The use of the word “including” followed by a specific example/s shall not be construed as limiting the meaning of the general wording preceding it and the *eiusdem generis* rule shall not be applied in the interpretation of such general wording or such specific example/s.
  - 1.1.1.7 Should there be any conflict between terms defined in this document and terms defined elsewhere, then the definition in this Standard Specification shall prevail when using this document (applicable to this document only).

### 1.2 ABBREVIATIONS

AARTO	-	Administrative Adjudication of Road Traffic Offences
AcK	-	Access Key
AID	-	Application Identifier
ANPR	-	Automatic Number Plate Recognition
ASN.1	-	Abstract Syntax Notation 1 according to ISO/IEC 8824-1
AuK	-	Authentication Key
AVC	-	Automatic Vehicle Classification/Classifier
BCD	-	Binary Coded Decimal
BST	-	Beacon Service Table
CEN	-	Comité Européen de Normalisation (European Committee for Standardisation)
CRC	-	Cyclic Redundancy Check
CTROM	-	Comprehensive Toll Road Operations and Maintenance
DES	-	Data Encryption Standard
DSRC	-	Dedicated Short-Range Communication
EFC	-	Electronic Fee Collection
EID	-	Element ID

ERM	- Electromagnetic compatibility and Radio spectrum Matters
ETC	- Electronic Toll Collection
ETSI	- European Telecommunications Standards Institute
GSS	- Global Specification for Short-Range Communication
IA	- Issuing Authority
IEC	- International Electrotechnical Commission
IIN	- Issuer Identification Number
ISO	- International Organisation for Standardisation
MAcK	- Master Access Key
MAuK	- Master Authentication Key
MII	- Major Industry Identifier
MIS	- Management Information System
MMI	- Man-Machine-Interface
MNPR	- Manual Number Plate Recognition
MSB	- Most Significant Bit
NaTIS	- National Traffic Information System
OBE	- On-Board Equipment
OBU	- On-Board Unit (used interchangeable with OBE and Tag)
OCR	- Optical Character Recognition
OHLS	- Over Head Lane Sign
ORT	- Open Road Tolling (also known as Multi-lane Free-Flow Tolling)
PAN	: Personal Account Number
RSE	- Road Side Equipment
RTTT	- Road Traffic and Transport Telematics
SAM	- Secure Application Module
SANRAL	- South African National Roads Agency Limited
SAPS	- South African Police Services
TA	- Toll Agency
TCH	- Transaction Clearing House
VES	- Video Enforcement System
VLN	- Vehicle License Number
VOSI	- Vehicle(s) of Special Interest
VPC	- Violation Processing Centre
VST	- Vehicle Service Table

### 1.3 DEFINITIONS

3 <sup>rd</sup> Identifier	:	shall mean an Identifier (such as an Electronic License Disk) which might be utilised in future in addition to the Tag and VLN Identifiers, and for which the Tolling System must make allowance in the data structures.
A1	:	shall mean the version of the specification "Interoperable EFC Transaction using Central Account based on DSRC" - Alcatel CGA, Combitech Traffic Systems AB, Kapsch, CSSI version ER 9_1.3, June 1999.

Access Credentials	:	shall mean data that is transferred to the Tag, in order to establish the claimed identity of the Road Side Equipment application process entity.
Access Key (AcK)	:	shall mean the security key used during the creation and verification of Access Credentials.
Account Issuing Authority	:	shall mean an authority registered with SANRAL as capable of issuing ETC accounts to a Road User whose contract is with that authority. This capability shall be limited to the TCH once the TCH is deployed.
Actual Class (AC)	:	shall mean the Vehicle Class as identified and allocated at the Toll Agency with the aid of images through a manual and/or automated process, as appropriate for the Toll Agency
Administrative Adjudication of Road Traffic Offences (AARTO) Act	:	shall mean the Administrative Adjudication of Road Traffic Offences Act, 1998 (Act No. 46 of 1998) as amended.
Attribute	:	shall mean application information formed by one or by a sequence of data Elements, and is managed by different actions used for implementation of a transaction.
Authentication Key (AuK)	:	shall mean a security key used in the cryptographic transformation of data in the creation of an Authenticator.
Authenticator	:	shall mean data appended to, or a cryptographic transformation of, a data unit that allows a recipient of the data unit to prove the source and/or the integrity of the data unit and protect against forgery.
Automatic Number Plate Recognition (ANPR)	:	shall mean an automated process to recognize a Vehicle Licence Number (VLN) from a digital image of the Vehicle Licence Number plate by means of Optical Character Recognition (OCR).
Automatic Vehicle Classifier (AVC)	:	shall mean the combination of devices and sensors which determines the required physical characteristics of a vehicle and classifies the vehicle uniquely into one of the Vehicle Classes, as per the classification scheme. Automatic Vehicle Classification shall have a corresponding meaning.
Back Office System	:	shall mean the back office system that allows a Toll Agency to execute the administration, accounting, transaction processing, control and management functions of the toll collection process in a computerised way. The Back Office System, inter alia, collects information from the toll lanes and provides functionality to control the toll collection process. The Back Office shall be required to interface to the TCH, which shall manage all ETC accounts nationally. The Management Information System (MIS) shall have a corresponding meaning.
Bank Issued Card(s)	:	shall mean a card issued by a commercial bank.
Business Rules	:	shall mean the rules that supplement SANRAL's requirements and consider primarily the commercial and operational relationships between entities and others involved in providing or using the overall ETC service. This relates primarily to the conditions under which a service will be provided, the principles (rules) to ensure



		uniformity of the service and the charges that may be levied for that service.
Class Discrepancy	:	shall mean a difference in the class indicated for the vehicle on the Validation Lists or determined by the Toll Agency through a manual classification process, and the class determined by the AVC.
Comprehensive Toll Road Operations and Maintenance (CTROM) Contract	:	shall mean the Comprehensive Toll Road Operations and Maintenance type contracts that are currently utilized at some SANRAL managed Toll Plazas in South Africa.
Compliant and Complete Transaction Record	:	shall mean a Transaction Record that <ul style="list-style-type: none"> <li>(a) Has been accurately captured and framed;</li> <li>(b) Contains the required minimum information and images (if relevant); and</li> <li>(c) Is appropriately encrypted.</li> </ul>
Compliant and Incomplete Transaction Record	:	shall mean a Transaction Record where some required Transaction Record information is not available, and is not due to any negligence of the Toll Agency.
Concessionaires	:	shall mean those entities who have entered into a concession contract with SANRAL pursuant to the provisions of Section 28 of the SANRAL Act to design, construct, finance, operate and maintain a portion of a national road.
<i>ContractSerialNumber</i>	:	shall mean the Attribute as is defined in [ISO 14906].
CTROM Specifications	:	shall mean the Comprehensive Toll Road Operations and Maintenance type specifications that are currently utilized at some SANRAL managed Toll Plazas in South Africa.
Conventional Toll Plaza	:	shall mean a Toll Plaza consisting of toll lanes (physically separated from one another by toll islands) and toll booths, usually under a canopy, for the collection of tolls either manually or also by means of automatic coin and/or card machines and which may or may not include mixed manual/ETC lanes.
CTROM Operator	:	shall mean the Person appointed by SANRAL and who has concluded an agreement with SANRAL to execute the works specified within the CTROM Contract.
Customer	:	shall mean a Road User who has registered a Customer Account.
Customer Account	:	shall mean an account set up by a Customer with the TCH for the payment of ETC fees.
Customer Account Identification Card	:	shall mean a credit card sized card with a unique identification number printed, indicated in a bar code and encoded on a magnetic stripe that is linked at the TCH to a Customer Account and allows easy reference to the specific Customer Account when presented at an appropriate terminal.
Customer Agreement	:	shall mean an agreement issued by the TCH and accepted by the Customer that defines the obligations of the Customer and the TCH in relation to the operation of the Customer Account.

Dedicated Short-Range Communication(s) (DSRC)		shall mean wireless communications between a Tag (or On-Board Equipment) and a Tag Reader (or Road Side Equipment) over a short distance, based on a standard protocol as defined in this Standard Specification.
Electronic Toll Collection (ETC)	:	shall mean a transaction where a vehicle is identified electronically by means of a Tag, the Vehicle Licence Number or electronic means in order to effect the payment of toll.
Electronic Toll Collection (ETC) Incident	:	shall mean in terms of Electronic Toll Collection (ETC), any unusual occurrence, reportable action, activity or alarm generated during an ETC transaction for whatever reason.
Electronic Toll Collection (ETC) Violation	:	shall mean any illegal action performed during an ETC transaction, whether or not such an action has a financial impact.
Element	:	shall mean in the context of Dedicated Short-Range Communication, a directory on the Tag (or On-Board Equipment) containing application information in the form of Attributes.
EN 15509	:	shall mean the current or updated version of the specification "Electronic fee collection – Interoperability application profile for DSRC" published by CEN, Brussels, November 2007, further specified in clause 6.2.1.2.
Exempt Vehicle	:	shall mean a vehicle for which the Toll Agency shall grant free passage as approved by the Minister of Transport and published in the Government Gazette from time to time.
Global Specification for Short-Range Communication (GSS)	:	shall mean the version of the specification "Global Specification for Short Range Communication" - Bosch Telecom GmbH, Alcatel CGA, Combitech Traffic Systems AB, version 2.0, February 1999.
Green List	:	shall mean a list of Identifiers associated with vehicles that are entered onto a valid Customer Account together with any discount rights associated with each vehicle.
Grey List	:	shall mean a sub-set of Identifiers held on the Green List where the balance of a pre-paid account is below a pre-determined limit.
Hybrid Toll Plaza	:	Means a toll plaza consisting of Conventional Toll Plaza lanes and dedicated or express Electronic Toll Collection (ETC) lanes, usually under the same canopy.
Identifier	:	shall mean a unique parameter that is linked to a vehicle that enables that vehicle to be uniquely identified for tolling purposes. This may be the 3 <sup>rd</sup> Identifier, Vehicle Licence Number or Personal Account Number (PAN) for a Tag that was issued to a Customer, which is associated with that specific vehicle.
Issuer Identification Number (IIN)	:	shall mean the number that identifies the major industry and the Tag issuer and that forms the first part of the primary account number.
Legacy Customer Accounts	:	shall mean existing ETC based customer accounts set up with already established Toll Agencies at the time that the TCH becomes operational. These accounts will be

migrated to the TCH.

Management Information System (MIS)	:	See Back Office System.
Master Access Key (MAcK)	:	shall mean the security key from which the Access Key is derived, based on the algorithm defined in this specification. Protected Elements within the Tag (or On-Board Equipment) can only be accessed by presenting valid Access Credentials that have been calculated by Road Side Equipment that has knowledge of the Master Access Key.
Master Authentication Key (MAuK)	:	shall mean a security key from which an Authentication Key is derived based on the algorithm defined in this specification. With knowledge of a Master Authentication Key the Road Side Equipment or the Transaction Clearing House can verify Authenticators calculated by the Tag (On-Board Equipment).
Non-Compliant Transaction Record	:	shall mean a Transaction Record where some information is not available due to the Contractor's negligence.
On-Board Equipment (OBE)	:	shall mean equipment located within the vehicle or on a motorcycle and supporting the information exchange with the Road Side Equipment. It is composed of the Tag (On-Board Unit) and other sub-units whose presence have to be considered optional for the execution of a transaction.
On-Board Unit (OBU)	:	shall mean the minimum component of an On-Board Equipment, whose functionality always includes at least the support of the DSRC interface, and is also known as a Tag.
Open Road Tolling (ORT)	:	shall mean the levying and collection of toll in a free-flow electronic tolling environment without the use of toll lanes as at Conventional or Hybrid Toll Plazas, also known as "Multi-lane Free-Flow Tolling".
Open Road Tolling (ORT) Contractor	:	shall mean the Person named as contractor for the Gauteng Open Road Tolling Project, by SANRAL, and the legal successors in title to this Person.
Opt-in Toll Agency	:	shall mean a Toll Agency using the services of the VPC to recover unpaid toll fees and Customer Accounts not guaranteed by the TCH. A Toll Agency may either have the authority to choose to opt into this service, or in the case where it does not have such authority, such as at SANRAL owned Toll Plazas which are operated by a Toll Agency other than SANRAL, be required to use this service.
Opt-out Toll Agency	:	shall mean a Toll Agency not using the services of the VPC to recover unpaid toll fees and Customer Accounts not guaranteed by the TCH. A Toll Agency may either have the authority to choose to not utilise this service, or in the case where it does not have such authority, such as at SANRAL owned Toll Plazas which are operated by a Toll Agency other than SANRAL, be required not to use this service.
Overhead Lane Sign (OHLS)	:	Shall mean the illuminated sign located on the leading edge of the Toll Plaza canopy to inform Road Users, on

approaching the Toll Plaza, which toll lanes are open or closed to traffic and which may also serve as an indication of which method/s of payment is/are accepted in such toll lane.

Person	:	shall mean any natural or juristic person, and any unincorporated association.
Personal Account Number (PAN)	:	shall mean a unique Identifier number that is stored on a Tag and that is used to uniquely identify a Tag and may be associated with a Customer Account. <i>PersonalAccountNumber</i> shall designate the attribute stored on the Tag and shall have a corresponding meaning.
Red List	:	shall mean a list of Identifiers (such as Personal Account Numbers, VLNs, or even 3 <sup>rd</sup> Identifiers) generated by the TCH that is used to indicate to Toll Agencies that the associated vehicle is not associated with a valid Customer Account, even though the Identifier may appear on the Green List. The Red List may also include the VOSI list.
Registered Vehicle Class (RVC)	:	shall mean the Vehicle Class linked to the Identifier on the Customer Account. The Registered Vehicle Class will appear in the Validation Lists.
Road Side Equipment (RSE)	:	shall mean equipment located at a fixed position along the Toll Road, i.e. at any type of Toll Plaza catering for ETC, for the purpose of communication and data exchanges with the On-Board Equipment of passing vehicles.
Road Side System (RSS)	:	shall mean the system, including the hardware and software, located on a gantry and within a Technical Shelter at a Tolling Point, to enable the classification and capturing of a Transaction Record of a particular passing vehicle in order to effect the payment of toll.
Road User	:	shall mean any user of a Toll Road, regardless of whether the user has a Customer Account or not.
SANS 1795 Standard	:	shall mean the specifications issued by the South African Bureau of Standards (SABS) for road traffic law enforcement, which includes the "SANS 1795-0 Road traffic law enforcement systems, Part 0: General Requirements", the "SANS 1795-5 Road traffic law enforcement systems, Part 5: Data capturing and recording devices for road traffic law enforcement" and any other specification which might be developed and issued by the SABS to regulate the Vehicle License Number, Tag and Tag reading process.
Scene Image	:	shall mean the contextual image captured by a camera located at a specific Toll Plaza that is legally compliant and certified in accordance with the SANS 1795 Standard.
South African National Roads Agency Limited (SANRAL)	:	shall mean the South African National Roads Agency Limited established pursuant to section 2 of the SANRAL Act, or its legal successors in title and/or its lawful assigns;
South African National Roads Agency Limited (SANRAL) Act	:	shall mean the National Roads Agency Limited and National Roads Act, 1998 (Act No. 7 of 1998) as amended.

Standard Specification	:	shall mean this Standard Specification for Operations and Maintenance: Electronic Toll Collection (ETC), (also known as Volume 2 Book 5) issued by SANRAL.
Tag	:	shall mean any DSRC based electronic equipment installed within a vehicle or onto a motorcycle, and is also known as an OBU.
Tag Reader	:	shall mean the beacon or antenna that will communicate with a Tag via the DSRC interface, and can include the functionality to program a Tag.
Tariff	:	shall mean the charge applied to a vehicle for a chargeable event. It will include the nominal (undiscounted) tariff and any discounts that are allowed.
Toll Agency (TA)	:	shall mean either the ORT Contractor, a CTROM Operator, a Concessionaire, or other entity responsible for the collection of tolls and/or providing customer services and/or providing the Tolling System on a Toll Road falling within its ownership or entitlement mandate.
Toll Plaza	:	shall mean a structure on a Toll Road where toll is payable, or any electrical, electronic or mechanical device on a Toll Road for recording the liability to pay toll, or any combination of such a structure and such a device.
Toll Road	:	shall mean that portion of a national road which has been declared a Toll Road in terms of the SANRAL Act and which may contain one or more Toll Plazas.
Tolling System(s)	:	shall mean all the equipment, including hardware and software, utilized by the Toll Agency to execute and control the entire toll collection process, including that of unpaid toll fees and overdue account payments, and includes the data communication systems and interface to the TCH and VPC and, if applicable.
Tolling Point(s)	:	shall mean the location(s) along a toll road at which the obligation to pay toll is electronically recorded by an ORT Tolling System.
Transaction Clearing House (TCH)	:	shall mean the entity that will contract, administer and manage all Customer Accounts nationally, and who will carry out all such account based transaction processing and clearing. The TCH entity is owned by SANRAL, and will be managed by a TCH management committee.
Transaction Record	:	shall mean a record created by the Tolling System for an ETC transaction relating to the passage of a single vehicle through a Toll Plaza, containing relevant information about the passage and applicable images, and for which information shall be appended by the TA's Back Office System as well as the TCH and VPC if appropriate.
Validation List(s)	:	shall mean a generic term for the Green, Grey, and Red Lists.
Vehicle Class	:	shall mean the categorization of vehicles as indicated in the classification scheme or published in the Government Gazette for the purpose of assigning a Tariff to any vehicle.
Vehicle Licence	:	shall mean the unique alphanumeric string of characters

Number (VLN)		allocated by the NaTIS to each vehicle and shown on the Vehicle Licence Number plate.
Vehicle(s) of Special Interest (VOSI)	:	shall mean an Identifier associated with a vehicle which is of particular interest to the VPC or an enforcement agency and for which a real-time warning should be provided by the Tolling System when the vehicle passes a Toll Plaza.
Violation Processing Centre (VPC)	:	shall mean the entity responsible for processing all violations from Opt-in Toll Agencies. The VPC entity consists of SANRAL.

## **2. PURPOSE, SCOPE AND REFERENCE DOCUMENTS**

### **2.1 PURPOSE AND SCOPE**

- 2.1.1 The purpose of this Standard Specification is to identify and state the technical specifications and operational requirements that all Toll Plazas and Open Road Tolling (ORT) projects must conform and adhere to in order to guarantee an interoperable South African Electronic Toll Collection (ETC) system, to establish the one central account principle. That is to enable the Toll Agencies (TA) in South Africa to acquire or get issued with interoperable ETC Tags (or On-Board Units) from prequalified suppliers, while still enabling the Road Users to use one Tag regardless of which TA's Toll Roads they are using.
- 2.1.2 This Standard Specification shall further identify, formulate and define the technical specifications, requirements and protocols for common interfaces.

### **2.2 STANDARDS AND SPECIFICATIONS**

- 2.2.1 This Standard Specification is based on a number of international technical documents (of which the versions and amendments, where applicable, are described in more detail in clause 6.2.1).
- 2.2.2 The DSRC interface specified in this document is based on the standards developed by Technical Committee 278 of the European Committee for Standardisation (CEN), as indicated in clause 6.2.1.
- 2.2.3 The Toll Agency shall comply with the EN 15509 standard and with other standards as is indicated in clause 6.2.1. The Toll Agency shall also support legacy Tags based on the A1 and GSS specifications.
- 2.2.4 The Toll Agency shall not deviate from the EN 15509 standard, and the additional requirements or relevant amendments made by this specification to the EN 15509 standard.

### **2.3 REFERENCE DOCUMENTS**

- 2.3.1 The following specifications, excluding that listed in clause 2.2 above, are referenced within this specification:
  - 2.3.1.1 Transaction Clearing House interface document (which will be available from the date the TCH is deployed)
  - 2.3.1.2 Business Rules and merchant agreement (which will be available from the date the TCH is deployed)
  - 2.3.1.3 Project specification for account migration strategy (which will be available from the date the TCH is deployed for every project that implemented ETC prior to the deployment of the TCH)

### 3. IMPLEMENTATION APPROACH AND MIGRATION PATH

#### 3.1 THE POTENTIAL LEVELS OF DSRC INTEROPERABILITY

- 3.1.1 For information, interoperability is possible at the following levels (refer Figure 3-1: Potential levels of interoperability):
- 3.1.1.1 Level 1: Smart card to Tag interface (if used with a removable smart card)
  - 3.1.1.2 Level 2: Tag to Tag Reader interface
  - 3.1.1.3 Level 3 & 4: Tag Reader and/or ETC controller to lane controller or Road Side System interface
  - 3.1.1.4 Level 5: Back Office System/MIS to Transaction Clearing House (TCH) interface
- 3.1.2 For ETC interoperability in the South African context, standardisation is required at level 2 (one Tag for any Toll Road) and level 5 (one account regardless of which Toll Roads are used).
- 3.1.3 The one Tag principle requires the implementation of technical- and procedural interoperability, while the one account principle requires the implementation of contractual- and procedural interoperability.
- 3.1.3.1 **Technical interoperability** ensures physical link connectivity between Tags and Tag Readers. It allows Tags and Tag Readers to be procured from different industry sources as specified herein so that data can be exchanged between any Tag and Tag Reader.
  - 3.1.3.2 **Procedural interoperability** ensures data connectivity between subsystems of the ETC system, i.e. Tags and Tolling Systems (for ORT and Conventional or Hybrid Toll Plaza implementations) programmed for different applications and charging mechanisms and the Transaction Clearing House (TCH).
  - 3.1.3.3 **Contractual interoperability** ensures data and/or financial reconciliation between the TCH and different Toll Agencies who accommodate ETC, to implement the required technical and procedural measures and put appropriate agreements in place to achieve and regulate the exchange of data and fees to and from the TCH.



## POSSIBLE LEVELS OF DSRC INTEROPERABILITY

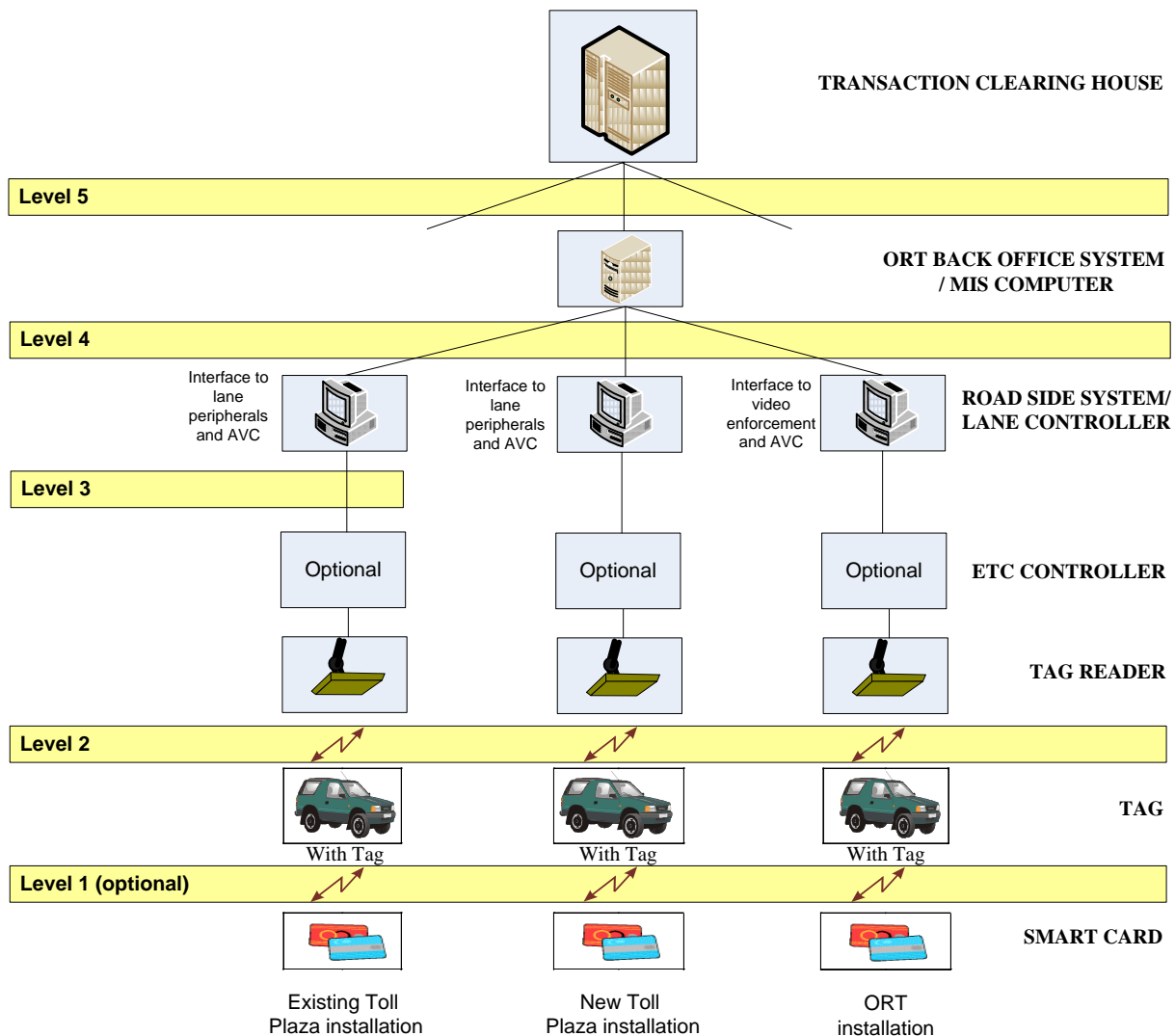


Figure 3-1: Potential levels of interoperability

### 3.2 NATIONAL INTEROPERABILITY VIA THE TCH

- 3.2.1 The implementation plan for Electronic Toll Collection (ETC) in South Africa is to, on a national scale, obtain interoperability through a Transaction Clearing House (TCH), i.e. a central account system. The TCH will undertake central ETC Customer Account management and transaction clearing services in respect of all ETC transactions, including those ETC transactions generated (and to be generated in the future) on Toll Roads implementing ETC, and those ETC transactions taking place and/or that will take place on the Concession roads. The Concessionaires are independent Toll Agencies obliged to transfer all ETC transaction data (excluding violation enforcement related data, which is not obligatory and is only required from Opt-in Toll Agencies) to the TCH in accordance with an agreement to be set-up with the Concessionaires.
- 3.2.2 Any references to the TCH in this Standard Specification are merely an indication of the TCH's responsibilities, and more detail on the TCH interface shall be made available in the TCH interface specification (as referenced in clause 2.3).
- 3.2.3 Further, a Violations Processing Centre (VPC) shall provide for the processing and collection of unpaid toll fees and unpaid Customer Accounts, the managing of evidence related to exceptions, and the possible administration of prosecuting procedures as required by the AARTO process. Toll Agencies may have the option to process their violations through the VPC, referred to as Opt-in Toll Agencies, or to handle violations internally themselves, referred to as Opt-out Toll Agencies. It is

envisaged that Toll Agencies that operate in an ORT or non-barrier ETC environment may elect to use the services of the VPC. Opt-in Toll Agencies (participating Toll Agencies) shall transmit all ETC transactions to the TCH who shall in turn submit all potential violation transactions (i.e. unpaid transactions, including those not allocated to an account) to the VPC for further processing. Associated images shall be transmitted with the transactions, in accordance with the requirements of the applicable legislation and/or SANS 1795 Standard. Administration fees and fines shall be defined by the VPC for each participating Toll Agency (and for each route, if the same Toll Agency is participating in the VPC with more than one route) based on the costs incurred and the income received by the VPC in processing the respective Toll Agency's violations. The VPC shall allow violators the opportunity to avoid the court system process by paying the toll plus predefined fees and fines to resolve the initial toll infringement within a specified period of time.

- 3.2.4 Any references to the VPC in this Standard Specification are merely an indication of the VPC's responsibilities and more detail on the VPC interface, which interface is provided through the TCH, shall be made available in the TCH interface specification (as referenced in clause 2.3).
- 3.2.5 Tolling Systems utilising ETC and implemented after the TCH is deployed, must be made interoperable with the TCH from the date of implementation and shall not be subject to a migration path.
- 3.2.6 Tolling Systems with ETC, implemented before the TCH is deployed, must allow for migration of Tags and ETC accounts to the TCH to achieve national interoperability. This migration shall allow for an interim phase, as is specified in clause 3.4. The follow-up phase, in which the TCH is deployed, is specified in clause 5. A project specific account migration strategy will be required for every project that implements ETC before the TCH is deployed.
- 3.2.7 SANRAL intends to prequalify Tag suppliers and to maintain a list of prequalified suppliers from which Tags must be procured. Once the TCH is established all Tags will be procured by the TCH only (from the prequalified Tag suppliers). All the Tags procured shall be EN 15509 compliant.

### 3.3 DSRC INTEROPERABILITY REQUIREMENT

- 3.3.1 The DSRC part of this specification is based on the EN 15509 European Standard that defines an application profile from a set of base standards according to the concept of "International Standardised Profiles (ISP)" as defined in ISO/IEC TR 10000-1. The objective is to provide technical interoperability between EFC DSRC-based systems in South Africa. However the Toll Agency shall note the following:
  - 3.3.1.1 EN 15509 forms the basis of the interoperable DSRC transaction and its associated parameters. These parameters, indicated in *italics* within this Standard Specification, are defined in the application interface definition, EN ISO 14906, developed by CEN, together with the International Organisation for Standardisation (ISO).
  - 3.3.1.2 Tag Readers will also be required to communicate to legacy Tags that comply with the GSS version 2.0 and A1 version ER 9 1.3 specifications. Toll Agencies shall avail themselves of the implemented standards and methods utilised for the legacy Tags and shall note that it is a requirement to communicate with these legacy Tags.
  - 3.3.1.3 SANRAL requires a Tag certification process for every Tolling System whereby a compliance certificate is issued to SANRAL (refer to testing in clause 9.4.3)

### 3.4 INTEROPERABILITY OF ETC TOLLING SYSTEMS DEPLOYED BEFORE THE TCH

- 3.4.1 This phase is applicable to systems where ETC was rolled-out (from the time that this specification was made available until such time that the TCH is available), but for which the TCH was not yet deployed and available.
- 3.4.2 "Internal" clearing (or account management and settlement), shall be accomplished by the implemented Tolling System, but account management and settlement between different Tolling Systems or different toll routes shall not be allowed. It shall be the responsibility of the Toll Agency controlling such a route to implement all the required account management and settlement (e.g. per route pre-paid or post-paid transactions) between the various Toll Plazas. The Toll Agency shall be responsible for the installation and maintenance of all equipment necessary for establishing and

maintaining the account management and settlement services and for setting up and maintaining all agreements and service levels with other third parties.

- 3.4.3 The ETC Tags shall also be capable of being accepted by other TAs by means of an initial multiple account system.
- 3.4.4 The Toll Agency shall allow for ETC Tags linked to Bank Issued Cards, and for route or Toll Plaza based accounts, which shall accommodate both pre-paid and post-paid payment methods. Any such links to a Bank Issued Card shall be accomplished in the MIS or Back Office System and not on the Tag itself (not implemented via on-Tag balances).
- 3.4.5 An ETC account shall be registered as follows. An Account Issuing Authority enters into an agreement with a specific Road User to enable the Road User to make use of ETC, in which case the Road User will become a Customer. In order to allow one TA to register the Customers of another Account IA certain user information is required by the TA. The information required shall be obtained from the Customer and means that the Customer shall have to register and apply for such an account at the other TA. The Customer therefore personally provides the information required by each *ContractProvider*.
- 3.4.6 On the ETC application form provided by the Toll Agency, the Customer shall be informed that he/she can not use ETC on other ETC routes unless he/she has registered and created an account at that particular route.
- 3.4.7 The Customer shall also be informed on the ETC application form that the Tag account shall be ceded to the Transaction Clearing House (TCH), once the TCH is deployed and that the Customer Account details shall have to be updated frequently by the Customer.
- 3.4.8 The Toll Agency shall not refuse a Road User the use of ETC, if ETC is available, and if the Road User complies with the rules and regulations laid down by the Toll Agency. Should a Customer require accounts at multiple TAs, the use of a single Tag shall still be possible albeit with multiple accounts.
- 3.4.9 The Toll Agency shall procure Tolling Systems that comply with the requirements of this specification and shall procure Tags from prequalified Tag suppliers that comply with the standards and requirements of this specification.
- 3.4.10 For this phase, Tags shall be issued as follows:
  - 3.4.10.1 Any Account IA can issue the Tags, with the understanding that provision is made for more than one TA to use the identification information of the ETC Tag. In order for another TA to use the Tag, an agreement between the Account IA and the TA needs to be established whereby the TA is granted the right to read the relevant identification information from the Tag (i.e. the security related information relevant to the Tag needs to be exchanged between the Account IA and the TA as described in clause 6.8 of this specification). The Toll Agency shall not refuse a reasonable request from a TA requiring the necessary information to read the information from the Tag.
  - 3.4.10.2 The Tags sold shall be linked to the Toll Agency's Tolling System, so that the sale of Tags, deposits and user details can be recorded. These user details shall be linked to the unique Personal Account Number (PAN) stored on the Tag.
  - 3.4.10.3 Any deposit required by the Toll Agency, to enable such an account, shall be paid by the Customer to the Toll Agency.
  - 3.4.10.4 It shall remain the responsibility of the Toll Agency to utilise the Tag in accordance with this specification and to procure Tags that conform to this specification.
- 3.4.11 It shall also remain the responsibility of the Toll Agency to:
  - 3.4.11.1 Manage the ETC accounts and keep hotlists and security keys for his own use.
  - 3.4.11.2 Apply all the discounts as is required.
  - 3.4.11.3 Make allowance for Exempt Vehicles (credit granted transactions) if Tags are issued to organisations such as South African Police Services (SAPS), ambulances, etc.

- 3.4.11.4 Define Customer Account contract establishment and termination rules. This contract shall give details of the cost of a yearly subscription and of the guarantee deposit, the conditions of use of the ETC system and termination clause as well as the condition that accounts will be ceded to the TCH and all relevant information will be transferred and utilised by the TCH once it becomes operational.
- 3.4.11.5 Procure Tolling Systems that will be able to communicate to Tags that comply with this specification.
- 3.4.12 It is the responsibility of the Toll Agency to ensure that all relevant sub-contractors are compliant, and that the Tags and Tolling System is interoperable with the Tags and Tolling Systems of other TA's that are already in use.
- 3.4.13 The Toll Agency shall ensure that the all the account related information is transferred or migrated to the TCH during the implementation of the TCH (implementation of national interoperability), so that the TCH can take over and manage all ETC accounts in South Africa.
- 3.4.14 The Toll Agency shall at the end of this phase, transfer all the rights and obligations associated with the Tags, including the ownership, to the TCH.
- 3.4.15 The Toll Agency shall ensure that the migration of accounts to the TCH shall be undertaken once the TCH is deployed and that this process shall be subject to comprehensive testing, before the accounts are activated on the TCH.

### **3.5 INTEROPERABILITY VIA THE TRANSACTION CLEARING HOUSE (TCH)**

- 3.5.1 This implementation shall commence once SANRAL has establish a national Transaction Clearing House (TCH). The TCH shall be responsible for Tag transactions country wide, as well as Vehicle License Number (VLN) transactions for ORT type applications, subject to certain Business Rules. It should be noted that the VLN transactions are also categorised as ETC transactions.

## **4. ETC TAGS, TAG READERS AND TRANSACTIONS**

### **4.1 TAGS AND TAG READERS**

- 4.1.1 The Tags will be procured by the TCH (once the TCH is deployed) and will be distributed to TAs in accordance with Business Rules and contractual agreements. A TA shall be provided with access to the TCH through a TCH interface, if the TA agrees to provide Customer service facilities on behalf of the TCH, on which accounts can be created and managed and for which accounts Tags can be issued. The TCH may procure different Tags according to the needs of different Road Users (i.e. Tags may differ for motorcycles and heavy vehicles) and in accordance with SANRAL's requirements. If the TCH has not been deployed yet, then a TA can procure Tags from SANRAL prequalified Tag suppliers in accordance with this specification. The TAs will be granted the right to read all other Tags (i.e. the security related information relevant to the Tag needs to be exchanged between the TCH and the TA) forming part of this nationally interoperable scheme.
- 4.1.2 The ETC Tag Reader installed by the Toll Agency shall be able to communicate with all the Tags procured by the TCH. As such, sample Tags from all the prequalified Tag suppliers as well as the legacy Tags, shall be tested and made to function accordingly, provided that such Tags meet the relevant standards and certification requirements.
- 4.1.3 All Tags to be supplied and distributed must be readable, must interface with all existing Tolling Systems within South Africa and must comply with the requirements of this Standard Specification.
- 4.1.4 Toll Agencies shall therefore be required to:
  - 4.1.4.1 Issue Tags to Customers and capture all required Customer information, in accordance with the stated requirements;
  - 4.1.4.2 Upgrade all existing Tag Readers and Tolling Systems or provide new Tolling Systems to conform to this Standard Specification to ensure technical and procedural interoperability;
  - 4.1.4.3 Test all implementations together with sample Tags of all the prequalified Tag suppliers as well as existing (legacy) Tags; and
  - 4.1.4.4 Require all future Tag Readers and ETC Tolling Systems to conform to this Standard Specification.

### **4.2 DSRC IMPLEMENTATION**

- 4.2.1 The Toll Agency shall ensure that all the different ETC Tags are suitable for use in the following types of ETC lanes under all possible traffic and weather conditions:
  - 4.2.1.1 Dedicated ETC lanes;
  - 4.2.1.2 Mixed ETC lanes;
  - 4.2.1.3 Express ETC lanes; and
  - 4.2.1.4 Open Road Tolling or Multi-lane Free-Flow Tolling applications.
- 4.2.2 Even if ETC is implemented on a Toll Road which does not have such a lane, the Tag shall have all the characteristics to enable it to function on the implemented, as well as those types of ETC lanes described above.

### **4.3 PERFORMANCE REQUIREMENTS**

- 4.3.1 The system shall maintain a Tag read accuracy better than 99.5% for Conventional or Hybrid Toll Plazas for speeds up to 80km/h, which shall be defined as the number of Tags read successfully out of the total number of vehicles with Tags mounted on the windshields which passed the Toll Plaza. The Tag read accuracy for ORT type applications shall be 99.5% for all vehicles passing a Tolling Point for speeds up to 160km/h (as is defined above for Conventional or Hybrid Toll Plazas).

- 4.3.2 Since these performance requirements are related to the combination of a Tag Reader and Tag, it shall be the responsibility of each Tag and/or system supplier to provide the following:
- 4.3.2.1 A compliance statement in accordance with the test requirements of clause 9.3.1 that the Tags and/or system meets the above mentioned performance requirements;
  - 4.3.2.2 Proof from both the Tag and system supplier, demonstrating the capability of achieving the DSRC capture rate specified in clause 4.3.1, in accordance with the test requirements of clause 9.4 (inclusive of a test procedure of how this requirement was proven); and
  - 4.3.2.3 In the case where both the Tag Reader and Tags comply with the DSRC capture rate specified in clause 4.3.1 above, yet the combination of components fails to achieve the requirement, it shall be the responsibility of both parties to liaise and find an acceptable solution that yields compliance.

#### 4.4 LICENSING AND APPROVALS

- 4.4.1 The Toll Agency shall be responsible for obtaining all the licenses and approvals that might be required for using the relevant DSRC system within South Africa.
- 4.4.2 The DSRC equipment installed shall adhere to all national and regional laws and regulations concerning such equipment and the Toll Agency shall ensure that emitted energy levels do not constitute a safety hazard of any kind.

#### 4.5 DATA SECURITY

- 4.5.1 The Tag shall be designed in such a way that it shall restrict access to protected Attributes stored in the Tag, to the placing of unauthorised data into the Tag, to the unauthorised modification of data stored in the Tag and to the unauthorised use of commands to initiate the Tag actions. The DSRC system shall prohibit the use of “playback” of a previous transaction as a valid new transaction.
- 4.5.2 In addition, the design of Tags shall prohibit reasonable physical access to components necessary for processing and storage of data within the Tag.

#### 4.6 CUSTOMER INTERACTION

- 4.6.1 Customer interaction or feedback shall be provided via a buzzer. Due to the varying noise conditions the Tag will operate in, the buzzer shall be loud enough to ensure the driver takes notice. The frequency and duration of the audible indication shall be designed so that critical indications use more penetrating frequencies and/or longer duration tones to ensure they are recognised.
- 4.6.2 As a minimum, the following indications shall be provided via the Tag from the TAs Tolling System, and which information shall be obtained from the Validation Lists:
  - 4.6.2.1 Transaction OK ( $SET\_MMI = 0$ ), Tag buzzer signal set to 1 “beep”;
  - 4.6.2.2 Transaction Not OK ( $SET\_MMI = 1$ ), Tag buzzer signal set to 4 “beeps”, as is specified in clause 4.5.2.4 for “Contact the Toll Agency or TCH”.
  - 4.6.2.3 Low Balance ( $SET\_MMI=2$ ), Tag buzzer signal set to 2 “beeps” (Note: this information is available from the TCH issued Grey List);
  - 4.6.2.4 Contact the Toll Agency or TCH ( $SET\_MMI = 1$ ), Tag buzzer signal set to 4 “beeps” (Note: this shall include for incidents when the Tag battery is low or expected to be low);
  - 4.6.2.5 No Signal ( $SET\_MMI = 255$ ).
- 4.6.3 The Tag shall not require any user interaction that would be considered a hazard to a Road User driving a vehicle.
- 4.6.4 It should also be noted that although not explicitly specified within this document, certain customer interactions via the Tag’s MMI shall be accomplished by means of the Validation Lists. As an example, it may be required to signal a Customer to “Contact the Toll Agency or TCH (MMI = 1)” in the case where his/her Tag’s battery is low, or for any other predetermined criteria which requires the

Customer to contact the relevant Toll Agency or TCH. Further details of such defined events may be obtained from the TCH interface document (as referenced in clause 2.3).

#### **4.7 MOUNTING**

- 4.7.1 Tags may be issued to different types of vehicles, including motorcycles, which may require the use of a different Tag and/or Tag bracket.
- 4.7.2 Location of the Tag shall be standardised for the layer 1 technology that will be implemented (i.e. as specified by EN 15509).
- 4.7.3 Although the Customers are expected to mount the Tags themselves, appendix J of EN 15509 shall be used by Toll Agencies as a mounting guideline.
- 4.7.4 Tag characteristics may vary between vehicles even when properly installed. The Toll Agency shall ensure that the Tag Reader installed is capable of addressing any such variations. In addition, a number of vehicles utilise windshields that contain materials in their construction that may adversely interfere with communications with Tags mounted within the vehicle (e.g. windshields containing a metallic material). The Toll Agency shall ensure that, if assistance is required from a Customer, that the Tag is mounted in such a manner or position so that there is minimal interference from metallic materials in the windshield. Most manufacturers make provision for this by having a Tag mounting position on the windshield that is free from such materials.

#### **4.8 SIZE OF TAG**

- 4.8.1 The Tag size shall be such that it could be mounted inside the windscreen without obscuring the view of the driver. The Tag shall comply with South African regulations and restrictions for objects mounted, or objects to be mounted, within a motor vehicle.

#### **4.9 APPLICABLE TARIFF**

- 4.9.1 Two different classification schemes shall be utilised in South Africa. The classification scheme for Conventional and Hybrid Toll Plazas is an axle based scheme whereas the classification scheme for ORT implementation is a volumetric based scheme, i.e. based on the length, width and height of a vehicle.
- 4.9.2 A Toll Agency shall be responsible to calculate the applicable Tariff based on the applicable Vehicle Class and shall apply any regional discount for which the Road User qualifies. The Toll Agency shall forward both the nominal and discounted tariff for each vehicle to the TCH.
- 4.9.3 Any Class Discrepancies (differences between the measured class and the Registered Vehicle Class available from the Validation List) or if no class measurements are available, shall be resolved by the Toll Agency itself.
- 4.9.4 In this regard, the TCH may forward Vehicle Class Customer queries to the Toll Agency for resolve. It should be noted that the TCH will utilise the agreed Business Rules to adjudicate class discrepancy queries from Customers, and may have to give the benefit to the Customer in the absence of evidence to the contrary.

#### **4.10 ACCOUNT REGISTRATION**

- 4.10.1 The Toll Agency shall be able to register Customer Accounts through a TCH interface, as is specified in clause 4.1.1. The information that will have to be captured shall be defined and specified in the TCH interface document.

#### **4.11 COMMUNICATION TO THE TCH**

- 4.11.1 The Toll Agency shall be responsible to establish a reliable bi-directional data link to the TCH and shall ensure that transactions are transmitted to and information downloaded from the TCH.

#### 4.12 **VEHICLE LICENSE NUMBER**

- 4.12.1 The TCH shall have the capability to create and manage Vehicle License Number (VLN) accounts. This capability is primarily to cater for Road Users that do not have a Tag. All VLN transactions shall contain the VLN, suitable images of the VLN and an image of the vehicle as a whole (referred to as a Scene Image), as is specified in clause 7.4.2. The requirements for images shall be specified in the SANS 1795 Standard.
- 4.12.2 The TCH will have a limited capability in managing VLN transactions. If the TCH can not cater for the relevant VLN transaction, then the VLN transaction will be passed onto the VPC for further processing. It should be noted that the VPC is only available to Opt-in Toll Agencies, as is described in clause 3.2.3.



## **5. CONTRACTUAL INTEROPERABILITY**

### **5.1 INTRODUCTION**

5.1.1 Contractual interoperability is concerned with specifying and agreeing on the following aspects:

- 5.1.1.1 Responsibilities of all Toll Agencies in the hierarchy;
  - 5.1.1.2 Conditions and terms on which payment will be made to Toll Agencies; and
  - 5.1.1.3 Migration of all the Toll Agency accounts and ownership thereof to the Transaction Clearing House.
- 5.1.2 The implementation strategy allows for the implementation of ETC before the TCH is deployed. This interim phase is described in clause 3.4.

### **5.2 TCH INTEROPERABILITY STRATEGY**

- 5.2.1 In order to extend ETC to a broader group of Road Users and to enable them to use only one account, irrespective of how many ETC Toll Roads are used, a national ETC Customer Account will be implemented. This will occur when the TCH is deployed.
- 5.2.2 More detail on the TCH interface shall be made available in the TCH interface specification (as referenced in clause 2.3).
- 5.2.3 As part of the information exchange function, the TCH will make Validation Lists available at regular intervals, which intervals shall be a configurable parameter with defaults to be specified in the TCH interface document:
- 5.2.3.1 a Red List containing the relevant identification information of all illegal (e.g. black-listed, lost, stolen, etc.) ETC Tags and VLN accounts;
  - 5.2.3.2 a Grey List containing the relevant identification information of all ETC Tags and VLN accounts with a low balance, or any other predefined criteria which shall result in customer interaction via the Tag's MMI; and
  - 5.2.3.3 a Green List containing the relevant identification information of all valid ETC Tags and VLN accounts.
- 5.2.4 A Vehicle of Special Interest (VOSI) list shall also be utilised, which will contain relevant identification information of vehicles that might be stolen, etc. The presence of a vehicle that appears on the VOSI list shall be reported to the police.
- 5.2.5 The Customer Accounts and funds will be held by the TCH and the TCH shall:
- 5.2.5.1 accommodate interfacing with all TAs (i.e. accept the relevant transaction files from the TAs and make available relevant files for the TAs who will be responsible for downloading Validation Lists from the TCH);
  - 5.2.5.2 reject ETC transactions that do not comply with the minimum requirements and for which the applicable toll Tariff could not be recovered due to incorrect or insufficient transaction information;
  - 5.2.5.3 post the ETC transaction to the correct ETC account, based on the Tag and/or VLN Identifiers transmitted with the transaction and after verifying the ETC transaction against relevant Validation Lists;
  - 5.2.5.4 manage all Customer Accounts and collect monies due from every Customer, including charge backs;
  - 5.2.5.5 pay TAs for all the valid ETC transactions (with accurate and sufficient transaction information) and recover all transaction or processing fees from each TA (based on the number and type of transactions that were processed);
  - 5.2.5.6 establish merchant agreements with the Toll Agencies that shall regulate the payment of fees and valid transactions; and

- 5.2.5.7 issue statements and tax invoices for ETC transactions made on all interoperable toll lanes to all Customers and Toll Agencies.
- 5.2.6 It shall further be the responsibility of the TCH to:
  - 5.2.6.1 keep stock control of the Tags and manage Tag security keys.
  - 5.2.6.2 establish procedural and contractual interoperability relationships with TAs by means of appropriate Business Rules.
  - 5.2.6.3 establish a Customer Agreement with each Customer.
  - 5.2.6.4 provide a call centre, website and interfaces for Customer and account queries.
  - 5.2.6.5 provide software, documentation and training to TAs that agree to provide Customer service facilities on behalf of the TCH.
  - 5.2.6.6 establish interface principles, provide interface details and test all interfaces with TAs.
- 5.2.7 The TCH shall allow for the possibility to implement harmonised discounts (i.e. discounts not dependant on a specific TA's plazas).

### 5.3 RESPONSIBILITIES OF THE TOLL AGENCY

#### 5.3.1 ETC Tolling System

- 5.3.1.1 It shall be the responsibility of the Toll Agency to implement an ETC system fully compliant with the requirements addressed above and within this specification. It shall further be the responsibility of the Toll Agency to guarantee the ability of their Tolling System or equipment to be able to communicate with all the different Tags issued by:
    - a. the TCH; and
    - b. by other Toll Agencies, prior to the existence of the TCH.
  - 5.3.1.2 It shall be the responsibility of the Toll Agency to prove that the ETC equipment is compliant with that specified herein.
  - 5.3.1.3 If the systems of the TA are found not to be interoperable with the TCH, then the Toll Agency will have to modify his system to interface with the TCH.
  - 5.3.1.4 It shall be the responsibility of the Toll Agency to ensure that the Tolling System provides all data necessary, whether read from the Tag or generated by the system, in order for the TCH to process ETC transactions received from the TAs.
  - 5.3.1.5 In the case of an improper ETC transaction at the Toll Agency's Toll Plaza or Tolling Point, it shall be the responsibility of the Toll Agency to pursue the matter further and to correct and collect any outstanding transaction information, if possible. The Toll Agency shall ensure that his Tolling System records and stores the required information relating to each and every ETC transaction for a minimum period of 3 months or as the contract specific requirements dictate per project.
  - 5.3.1.6 TAs shall be reimbursed in accordance with the established Business Rules.
  - 5.3.1.7 The information and transaction formats required for interfacing to the TCH are defined in the TCH interface document. The TA shall provide for and implement the interface in accordance with this TCH interface document.
  - 5.3.1.8 Data read from the Tag shall be defined as the final relevant Attributes retrieved from the Tag after all communication, cryptographic transformations, error correction and/or re-reads, as defined by EN 15509, have been completed by the Tolling System and the Dedicated Short-Range Communication (DSRC) session has been completed. The utmost care shall be taken to ensure the correctness of data read from a Tag.
- #### 5.3.2 Discounts
- 5.3.2.1 The respective Toll Agency is responsible for determining which Tag Identifiers are eligible for discount and for applying the appropriate discount to the toll amount before it is forwarded to the TCH.

5.3.2.2 In addition to the above discounts, the TCH shall allow for the possibility to implement harmonised discounts (i.e. discounts not dependant on a specific TA's plazas).

### 5.3.3 Exempt Vehicles

5.3.3.1 The Toll Agency may be required to issue Tags to organisations such as the South African Police Services (SAPS), ambulances, etc. and all exemptions which the Minister of Transport may grant through the use of legislation and Government Gazette notices from time to time. These accounts can be recognised from details contained within the relevant Validation Lists. The Toll Agency shall allow for this option in his system.

### 5.3.4 ETC Incident

5.3.4.1 An ETC Violation or incident shall be defined as any illegal action or when insufficient or invalid data is collected for an ETC transaction, whether or not such an action has a financial impact. Each time the presence of a vehicle is detected by the classification and detection equipment without the transaction having been concluded satisfactorily, an ETC Incident shall be registered and resolved by the Toll Agency before such a transaction is forwarded to the TCH.

5.3.4.2 Care shall be taken that data read from other Tags present in a toll lane is not included in the Transaction Record, if a vehicle not equipped with a Tag or equipped with a faulty Tag causes the ETC Incident.

5.3.4.3 It shall always remain the responsibility of the Toll Agency to collect tolls in accordance with the requirements of the relevant specifications (and contracts), irrespective if such a ETC transaction is an ETC Violation or incident.

5.3.4.4 In the event of an ETC Incident generated during an ETC transaction session, such an incident shall be recorded (to cater for any Customer queries at a later stage), together with the following data generated by the system:

- a. Date of occurrence
- b. Time of occurrence
- c. Toll Plaza or Tolling Point identification
- d. Lane and/or equipment identification
- e. Direction of travel
- f. Relevant transaction data and supporting images, if required.
- g. Unique transaction serial number.

5.3.4.5 The Tolling System shall be able to, as a minimum, take appropriate action for ETC Incidents that may include:

- a. ETC Violations for Conventional or Hybrid Toll Plazas and ORT applications, as applicable
  - i) Run-through: When a vehicle passes through a Toll Plaza and for which no registered Identifier (either VLN and/or PAN as applicable per application) could be captured for any reason excluding faulty tolling equipment.
  - ii) Vehicle rollback: Once an ETC transaction (i.e. including VLN transactions as applicable per application) has been completed for a specific vehicle but the vehicle hasn't completely left the tolling zone and then reverses back through the tolling zone for whatever reason.
  - iii) Vehicle standing in reading zone: When a vehicle remains in the tolling zone for a period long enough to induce a second ETC transaction (either Tag and/or VLN as applicable) for the specific vehicle.
  - iv) Vehicle re-entry: When an ETC transaction (VLN and/or PAN as applicable per application) has been completed with a vehicle and the vehicle has moved out of the tolling zone for a period of sufficient length that the Tolling System will try generate a second transaction upon the vehicle re-entering the zone (not applicable to recurrent valid transactions at the same Toll Plaza).

- v) Wrong direction: When the Tolling System detects a vehicle entering the tolling zone in the direction apposed to the normal flow of traffic (this includes bi-directional toll lanes at Conventional or Hybrid Toll Plazas where the normal flow of traffic would be that in which the lane has been set up).
  - vi) Invalid Identifier: When a vehicle with an invalid Identifier (such as an invalid or fraudulent Tag as described below in 5.3.4.5 d) and/or with an unrecognisable VLN etc. as applicable per application) passes through a Toll Plaza without providing a valid method of payment.
  - vii) Any other ETC Violations.
- b. ETC Violations for Conventional or Hybrid Toll Plaza applications only
- i) Vehicle tailgating: When a vehicle without a Tag closely follows a vehicle with a Tag so that there is not enough time for the Tolling System to close the barrier and prevent the passage of the vehicle without the Tag.
  - ii) Vehicle waiting in the lane for a free passage: When a vehicle without a Tag waits for a vehicle with a Tag to open the barrier, in the case where a vehicle can fit in between the reading zone and the barrier.
  - iii) Any other ETC Violations.
- c. Discrepancies
- i) Class Discrepancies:
    - The Toll Agency shall measure the class of the vehicle by means of an AVC and shall use this measured class to verify the applicable Registered Vehicle Class, which shall be available from the Validation Lists. The Toll Agency shall add the class determined by the system user or toll operator (manual classification) to the Corrected Class field of the particular Transaction Record, if the AVC measured class is not accurate or if the AVC class was not measured at all. At no stage shall it be possible to alter already populated data within a Transaction Record by any means to ensure auditability and data integrity.
    - Should there be a discrepancy between the Registered Vehicle Class and the AVC class determined by the Toll Agency's AVC (or determined by the manual classification), the Toll Agency shall either verify the classification through the use of captured images or in the absence of any supporting evidence, utilise the Business Rules to determine the applicable class and resulting Tariff.
  - ii) Identifier Discrepancies:
    - Such as where the captured VLN does not match the registered Vehicle License Number for a specific Tag Identifier used during a transaction or vice versa.
    - Where the front and rear captured VLN's do not match etc.
  - iii) Image capturing requirement:
    - The requirement for an image of a Vehicle License Number and/or Scene Image implies the implementation of a Video Enforcement System (VES) or video image capturing system. If video image capturing is not deployed, the Toll Agency shall be prepared to accept any risks associated with such discrepancies. (Refer to clause 7.4.2 for more information on video enforcement.)
- d. Invalid Tags
- i) Invalid *PersonalAccountNumber* (PAN) or issuer number;
  - ii) Issuer Identifier (*IssuerIdentifier* subset of the *ContractProvider* Attribute);
  - iii) Tag validity (*PaymentMeansExpiryDate*);

- iv) *PersonalAccountNumber* on Red List (It is not within the scope of this specification to detail the procedures to be taken, such as confiscation of the Tag, should such a Tag be discovered in the lane. Such procedures shall be agreed upon between the Toll Agency and the TCH. The minimum enforcement requirements are however listed in clause 6.6.)
  - v) Data exceptions as defined in clause 6.6;
  - vi) Invalid account details (e.g. Tag on the Red List, insufficient funds, card or Tag expired, no payment, etc.)
  - vii) Corrupted or invalid data read from the Tag (e.g. invalid control digit within PAN, etc.);
  - viii) An aborted Tag transaction, for whatever reason;
  - ix) A Tag authentication error or any Tag or OBE containing or using invalid security keys (e.g. the Tag uses incorrect or invalid security keys in order to calculate the OperatorAuthenticator, used during the Tag authentication process).
- e. Low balance account
- i) Typically low balance ETC Incidents include the following:
    - Near limit of post-paid accounts, if applicable
    - Low balance for pre-paid accounts
  - ii) The financial value for the “low balance” shall be determined by the TCH. Any additional requirements on how the Toll Agency shall warn the Customer (apart from the Tag buzzer specified in clause 4.6.2), shall be specified in the TCH interface document.
  - iii) With the occurrence of such an incident, the Tolling System (Road Side Equipment) shall be required to initiate the buzzer via the Man-Machine Interface (MMI) of the Tag.
  - iv) At Conventional or Hybrid Toll Plazas, the Toll Agency shall further display all the relevant messages (e.g. “Please proceed”, “Paid thank you”, or “Low balance”) to the Road User as required in the applicable project specifications.
- f. Multiple Tags within a vehicle
- i) When transactions occur with multiple Tags in one vehicle, the Tolling System of the Toll Agency shall eliminate inappropriate duplicate billing through proper post-processing of the transactions and shall ensure that only one transaction (i.e. one Transaction Record sent to the TCH) will take place.
  - ii) The Toll Agency shall resolve the multiple transaction issue by selecting the most appropriate Tag Identifier through a post-processing process, by considering possible discrepancies between the measured Vehicle Class and the Registered Vehicle Class, discrepancies between the registered VLN and the captured VLN (if applicable) and any other images which might assist in the selection process.

### 5.3.5 Enforcement of ETC Incidents

5.3.5.1 In the event of an ETC Incident generated during an ETC transaction, such an incident or unusual occurrence shall be recorded by the Back Office System / MIS. Should such an ETC Incident be generated for an ETC account holder, the following shall apply:

- a. If the ETC Incident influenced the accuracy or sufficiency of a transaction in any way, such data alone might not be sufficient to invoice an account holder or Customer Account. The Toll Agency shall record all the relevant data and shall (which may be requested by the TCH if necessary) provide an indication that the accuracy of some data may be compromised within the Transaction Record, as detailed in the TCH interface specification (as referenced in clause 2.3). It shall in all cases remain the responsibility of the Toll Agency to prove the validity of the transaction. This shall include a clear image of the

vehicle (with the make, model and Toll Plaza location clearly distinguishable) and its VLN, if a Video Enforcement System (VES) is utilised.

- b. If the ETC Incident influenced the Vehicle Classification received from the AVC, the data read from the Tag can still be used for invoicing the Customer Account, based on the Registered Vehicle Class on the Validation List linked to the Tag Identifier (read from the Tag). If the TA can prove that the Vehicle Class is different to that contained on the Validation List, then this Vehicle Class shall be utilised. Clause 5.3.4.5 a shall then apply.
- c. Further details for reporting ETC Incidents are defined in the TCH interface document.

5.3.5.2 Then, if the ETC session was processed in a boom- or barrier-controlled ETC lane, the Toll Agency shall decide if the vehicle will be allowed to proceed (although such action might result in non-payment by the TCH, dependant on the applicable Business Rules).

5.3.5.3 If the ETC session was processed in an ORT type application (i.e. there is no means to stop the vehicle), an ETC Violation shall be recorded and images taken of the front and rear Vehicle License Number (VLN) as well as a profile or Scene Image of the vehicle. These images shall be forwarded to the TCH by the Toll Agency together with the transaction details.

5.3.5.4 Should a vehicle equipped with an invalid Tag (as specified in clause 5.3.4.5 d) proceed through an ETC lane, such an action shall be considered an ETC Violation.

5.3.5.5 The Toll Agency merchant agreement shall regulate the payment or non-payment of invalid Tags.

#### 5.3.6 Back Office System / MIS

5.3.6.1 It shall be the responsibility of the Toll Agency to ensure that the Back Office System / MIS will generate the following records based on data received from the Tolling System. This transaction, and any ETC Incident indications, shall be transmitted by the Toll Agency to the TCH.

5.3.6.2 ETC Transaction Record: (Note: the format of the ETC Transaction Record is defined in the TCH interface document)

- a. An ETC Transaction Record shall be generated for each ETC transaction regardless of the payment or discount offered. The Transaction Record shall include, as a minimum, the following fields, if the data is available and applicable:

**Table 5-1: Transaction Record fields**

No	Field / description of field
1	Session identification (unique Transaction Record number)
2	Date and time of transaction ( <i>SessionTime</i> )
3	Toll Agency identification ( <i>SessionServiceProvider</i> )
4	Plaza or Tolling Point identification ( <i>LocationOfStation</i> )
5	Lane identification, Tag Reader and equipment identification ( <i>SessionLocation</i> )
6	Tag identification, which shall include:
6.1	• Manufacturer identifier ( <i>ManufacturerID</i> as part of the VST) <sup>(a)</sup>
6.2	• Equipment class ( <i>EquipmentClass</i> as part of the VST) <sup>(a)</sup>
6.3	• <i>EFC- ContextMark</i>
6.4	• PAN ( <i>PersonalAccountNumber</i> )
6.5	• Tag validity ( <i>PaymentMeansExpiryDate</i> )
7	Vehicle Class from the Validation List ( <i>SessionClaimedClass</i> )
8	AVC equipment used for classification
9	Vehicle Class determined by the AVC
10	Corrected Class as determined by manual validation

No	Field / description of field
11	Equipment within certification status i.e. the certification status of each applicable RSS unit used during the transaction in accordance with the SANS 1795 Standard
12	VLN image status indicator, e.g.:
12.1	• Front image captured
12.2	• Rear image captured
12.3	• Side view captured (Scene Image)
12.4	• Different front and rear image
12.5	• No image captured
13	Vehicle Licence Number from ANPR, if ANPR is available
14	ANPR confidence level, if ANPR is available
15	3rd Identifier equipment ID number for future use
16	Validation List(s) used to process the Transaction Record
17	Active Tag status on the Validation List(s) used
18	VOSI and abnormal high vehicle indicators
19	Relevant image files (Note: The first time the Tag is used, which may be ascertained from the transaction counter portion of <i>EquipmentStatus</i> or possibly via the Validation Lists, the Toll Agency will treat it as a potential violation and shall capture images, if available, and add the VLN and Vehicle Class to the Transaction Record)
20	Tariff table identifier number
21	Nominal tariff of the Transaction Record
22	Discount types applied by the Toll Agency, if any
23	Discount amounts applied by the Toll Agency, if any
24	Exempt / free passage Transaction Record indicator
25	Net Transaction Record value i.e. the Transaction Record value after discounts etc. are applied
26	MNPR Vehicle Licence Number, if MNPR was performed
27	Identifier of the system user who performed the MNPR, if MNPR was performed
28	Vehicle Licence Number from Validation List(s) ( <i>VehicleLicensePlate Number</i> )
29	Vehicle Licence Number discrepancy detected indicator i.e. either between front and rear VLN, or between the captured VLN and the registered VLN for the Tag used during the transaction.
30	Transaction Record identifier type, e.g. PAN, VLN, 3rd Identifier, <i>ContractSerialNumber</i> none
31	ETC Session type ( <i>SessionType</i> as detailed in Annexure A)
32	Initial Transaction Record compliancy indicator (Compliant and Complete -, Compliant and Incomplete - or Non-compliant Transaction Record, as further defined in the TCH interface document)
33	Potential unrecoverable Transaction Record / Potential violation indicator i.e. an indication to the TCH or VPC that there may be insufficient information collected during the transaction.
34	Manually imported Transaction Record indicator i.e. any Transaction Record manually imported into the Tolling System for whatever reason e.g. communication network failure etc.
35	Retransmitted transaction indicator <sup>(b)</sup>
36	<i>EquipmentStatus</i> (Tag transaction counter)

No	Field / description of field
37	Authentication information that, depending on the context (see clause 6.8 for more detail), will consist of
37.1	<ul style="list-style-type: none"> <li>Operator Authenticator (<i>OperatorAuthenticator</i>, <i>RndRSE</i>, <i>KeyRef[AuKey_Op]</i>)</li> </ul>
37.2	<ul style="list-style-type: none"> <li>Issuer Authenticator (<i>IssuerAuthenticator</i>, <i>RndRSE</i>, <i>KeyRef[AuKey_Iss]</i>),</li> </ul>

- a. This field is not mandatory, but the data may be collected and used for statistical purposes by the Toll Agency or TCH.
- b. This field refers to the retransmission of a Transaction Record to the TCH and not to the retransmission of data within the Tolling System itself.

5.3.6.3 It shall be at the discretion of the Toll Agency to install a Video Enforcement System (VES) at Conventional or Hybrid Toll Plazas. The Toll Agency shall accept all risks associated with not having a functional VES.

5.3.6.4 A Toll Agency may have the authority to elect to participate in central violation processing (Opt-in Toll Agency) via the Violation Processing Centre (VPC), which shall utilise the captured Identifier, including the VLN, as well as a profile or Scene Image(s) to try and recover the toll fees. Opt-in Toll Agencies shall provide the necessary images as required by the VPC.

#### 5.3.7 Tag issuer

5.3.7.1 The TCH shall be the Tag issuer or Account Issuing Authority. A TA shall only be allowed to distribute Tags and register Customer Accounts, if the TA agrees to provide Customer service facilities on behalf of the TCH and hence becomes an appointed agent of the TCH or Account IA. The detail requirements are defined in the TCH interface document.

5.3.7.2 The Toll Agency shall be required to accept and process transactions for Tags issued prior to the existence of the TCH.

#### 5.3.8 Customer Agreements

5.3.8.1 All information and identification data supplied by a Road User in a Customer Agreement shall be treated as confidential and not disclosed to other authorities or individuals. User data necessary to complete a transaction and coded onto the Tag shall be protected from unauthorised access by means of an encryption algorithm using the Access Credentials calculated from the Access Key.

#### 5.3.9 Validation Lists

5.3.9.1 The Validation Lists comprise a Green, Grey and Red List, which are described in clause 5.2.3. The TCH shall generate and make these lists available for download at set intervals. The TA shall ensure that the latest Validation List is downloaded into his Tolling System.

5.3.9.2 The format of and frequency of when Validation Lists will be made available are specified within the TCH interface document.

#### 5.3.10 Merchant agreements

5.3.10.1 A merchant agreement will be established between the Toll Agency and the TCH. This agreement shall regulate the payment of valid transactions received from the TA and shall define the fees to be paid over to the TCH.

### 5.4 PAYMENTS AND FEES

5.4.1 Transaction data will be transmitted by the relevant TAs to the TCH and payments will be made in accordance with the agreed Business Rules and merchant agreements.

5.4.2 The following responsibilities shall be assigned to the TCH and Toll Agency:



#### 5.4.2.1 Toll Agency

- a. It shall remain the responsibility of the Toll Agency, to provide on a regular basis to the TCH complete and correct details of ETC transactions for all ETC transactions belonging to account holders registered with the TCH (Customer Accounts).
- b. It shall further remain the responsibility of the Toll Agency to prove the validity of any transaction, especially for those:
  - i) that are not accepted by the TCH.
  - ii) for which a query from either an account holder or the TCH exists.
  - iii) for which a discrepancy exists between data read from the Tag (or associated with the Tag via the PAN and Validation Lists) and data determined by the Toll Agency's Tolling System.

#### 5.4.2.2 TCH

- a. It shall remain the responsibility of the TCH to:
  - i) disburse the corresponding sums to the TA for all the valid ETC Transaction Records forwarded and accepted by the TCH in accordance with the merchant agreement.
  - ii) recover payments for valid Transaction Records from the Customer
  - iii) issue VAT invoices on request to the Customers on behalf of SANRAL or the applicable Toll Agency
- b. Failure to collect the moneys from the Customers shall not warrant the TCH not to pay a TA. This will be subject to the Business Rules and merchant agreement.
- c. A transaction shall be waived if the TCH, after receiving such a transaction, can prove that a Tag's PAN or other applicable Identifier was included on the relevant Red List within the agreed period before the invoiced transaction has occurred and is defined in the Business Rules and merchant agreement.
- d. The TCH shall manage all the Customer Accounts and shall be responsible for the collection of all due funds from account holders, the management of deposits made, etc.

### 5.5 INVOICES AND STATEMENTS TO ACCOUNT HOLDERS

- 5.5.1 It shall remain the responsibility of the TCH to issue on behalf and in the name of SANRAL or the relevant Toll Agency if applicable, all relevant invoices (e.g. tax invoice), account statements or other documentation (as required by law), regardless of where such an account's ETC transactions have been generated. The TCH shall further provide all the necessary account services, i.e. account, balance, payment and transaction queries.
- 5.5.2 Receipts, statements, pro-forma tax invoices and/or tax invoices to be issued by the TCH are specified in the TCH interface specification (as referenced in clause 2.3)..

### 5.6 MAINTENANCE SERVICES

- 5.6.1 Toll Agencies shall ensure that all the Tags, Tag Readers and Tolling Systems are inspected and maintained regularly and in accordance with the manufacturer's specifications so that failures can be minimised.
- 5.6.2 Toll Agencies shall ensure that adequate spare part levels are kept so that ETC lane failures can be rectified as soon as possible.
- 5.6.3 The preventative maintenance procedures that need to be carried out shall be clarified during the procurement stage so that the required maintenance can be monitored and validated.
- 5.6.4 All the maintenance requirements shall be clearly specified and shall be made available during the procurement stage.

5.6.5 The maintenance activity shall be specified in the relevant project specifications.

## **6. PROCEDURAL INTEROPERABILITY**

### **6.1 INTRODUCTION**

6.1.1 Procedural interoperability is concerned with:

- 6.1.1.1 Specifying the requirements, specifications, standards, protocols and procedures necessary to create a common interoperable communication interface between the On-Board Equipment (Tag) and Road Side Equipment (as part of the Tolling System).
- 6.1.1.2 Providing common technical rules, Business Rules and procedures necessary to facilitate central account interoperability in South Africa.

### **6.2 DSRC REQUIREMENTS**

6.2.1 Relevant Standards

- 6.2.1.1 The transaction is specified according to the existing European set of standards regarding DSRC. To obtain interoperability, additional industry specifications are also used.
- 6.2.1.2 The DSRC system shall comply with the following latest version of standards and specifications, including the standards and specifications on which they are based, if applicable. These standards and specifications shall be pertinent, except where this document specifically indicates amendments to such a document. For undated references, the latest edition of the publication referred to applies (including amendments).
  - a. [EN 15509] EN 15509 – “Road Transport and Traffic Telematics – Electronic fee collection – Interoperability application profile for DSRC”, CEN Central Secretariat, Brussels, November 2007.
  - b. [CEN\_Pr] EN 13372 – “Road Traffic Transport Telematics (RTTT), Dedicated Short Range Communication (DSRC), Profiles for RTTT Application”, CEN Central Secretariat, Brussels, July 2004.
  - c. [CEN\_AI] EN ISO 14906 – “Road Traffic and Transport Telematics (RTTT), Electronic Fee Collection (EFC) Application Interface Definition for Dedicated Short Range Communications”, CEN Central Secretariat, Brussels, 2004.
  - d. [CEN\_L1] EN 12253 – “Road Transport and Traffic Telematics – Dedicated Short-Range Communication – Physical Layer using microwave at 5,8 GHz”, CEN Central Secretariat, Brussels, July 2004.
  - e. [CEN\_L2] EN 12795 – “Road Transport and Traffic Telematics – Dedicated Short Range Communication (DSRC) – DSRC Data Link Layer: Medium Access and Logical Link Control”, CEN Central Secretariat, March 2003.
  - f. [CEN\_L7] EN 12834 – “Road Transport and Traffic Telematics – Dedicated Short Range Communication (DSRC) – DSRC Application Layer”, CEN Central Secretariat, November 2003.
- 6.2.1.3 The DSRC system shall operate as specified in the presence of radio frequency interference or noise, electrical interference and mechanical interference from sources such as, but not limited to, all Tolling Systems, electrical appliances, lightning, other toll equipment in and/or near toll booths, lighting, power tools, power lines, mobile and portable communications radios, cellular telephones, speed radar sources and detectors, refrigeration units, windscreen wipers, defrosters and any moving parts.

## 6.3 GENERAL DESCRIPTION OF THE DSRC SYSTEM

### 6.3.1 Compliance

- 6.3.1.1 The DSRC system shall comply with this Standard Specification and with the standards mentioned above (refer to clause 6.2.1.2).

### 6.3.2 Communication Link

- 6.3.2.1 The interoperable transaction specified in the remainder of this document is based on a CEN compatible DSRC-link for Road Side Equipment to vehicle communications and an ETC application, as specified by the EN 15509 "Road Transport and Traffic Telematics – Electronic fee collection - Interoperability Specification for DSRC".
- 6.3.2.2 The remainder of clause 6 gives a brief overview and also provides technical information of a typical interoperable transaction. It is noted that [EN 15509] is based on the idea of implementing a central EFC account.
- 6.3.2.3 The Tag shall comply with DSRC profiles P0 / P1 and parameter set L1-B as specified in [CEN\_Pr]. The RSE shall support the full spectrum of possible Tag DRSC implementations complying with DSRC profiles P0 / P1, parameter set L1-B as specified in [CEN\_Pr].

### 6.3.3 Personalisation Process

- 6.3.3.1 It shall be noted that there will be no personalisation of Tags by any TAs or by the TCH (for example, no Vehicle Class shall be stored on the Tag). All personalisation shall be performed by the Tag manufacturer who will be supplied with predefined values (or a specified range of values) for certain Attributes on the Tags. This shall allow for a process where Tags can be issued to an anonymous Road User for example.
- 6.3.3.2 This should not be confused with Attributes modified during a transaction as this is a separate process. Personalisation only refers to the initial configuration of Attributes on the Tag before it is issued.

### 6.3.4 Tag Configuration Process

- 6.3.4.1 During the account registration process the TCH shall capture the *PersonalAccountNumber* (PAN) data element (which forms part of the *PaymentMeans* Attribute) from the Tag. This PAN will then serve as the unique Identifier on the Tag which shall uniquely link it to the Customer Account being registered. Before this has been done the Tag will not appear on the Green List and may be refused at certain Conventional or Hybrid Toll Plazas. It should be noted that the account number contained within the *PersonalAccountNumber* data element need not be the same account number used for the Customer Account held at the TCH.
- 6.3.4.2 The TCH will issue the *PersonalAccountNumber* (PAN) range of numbers, thereby ensuring that the PAN will not be duplicated and that each Tag will have a unique PAN. This will be utilised by the Tag manufacturer to configure the Tag..
- 6.3.4.3 In addition, it shall be possible to link multiple Tags to a single Customer Account by using each Tag's associated PAN and creating an association to it on the Customer Account.
- 6.3.4.4 Once a Customer or Road User has applied for an ETC account with the TCH, the TCH will issue a Tag to the Customer via authorized Tag distribution outlets.

### 6.3.5 Identification

- 6.3.5.1 Each Tag will be identified by a unique serial number, both in plaintext and encoded within a barcode, printed either directly onto the Tag or on labels (stickers). This serial number shall consist of the Tag's encoded PAN which may then be read at the TCH using a barcode scanner in order to capture the Tag's PAN and link it to a Customer Account.
- 6.3.5.2 The unique PAN shall be limited to 16 digits i.e. 6 digits for the Issuer Identification Number (IIN) and 10 digits for the unique account number and control digit.
- 6.3.5.3 The barcode encoding shall conform to the ISO/IEC 15417:2007 – Information Technology – Automatic Identification and Data Capture Techniques – Code 128 barcode symbology specification.

### 6.3.6 Scalability of the Attributes utilised in this Standard Specification

6.3.6.1 This Standard Specification lists the detail of the required Attributes only, but this shall in no way preclude the use of other EN 15509 Attributes in future, nor the way in which they are used. As long as the Attributes and their required usage (as per this Standard Specification, or any additions to this specification) conform to their proposed usage as per EN 15509, then any such change will not constitute a variation on this specification.

## 6.4 AMENDMENTS TO [EN 15509]

6.4.1 Amendments to [EN 15509] are indicated in the following tables.

6.4.2 Notes on the headings in the table below:

*“Reference” refers to [EN 15509] sections. Where no “Section to be replaced” is indicated, the text and/or instruction indicated in “Replace with” shall be added. “Replace with” text items in quotation marks (i.e. “...”) shall be included as text in [EN 15509]. Where quotation marks are not used, the “Replace with” text shall be read as an instruction.*

**Table 6-1: Amendments to [EN 15509]**

#	Reference	Section to be replaced	Replace with:
a)	Section 5.1.3, page 16. 1st sentence.	The OBU shall support the DSRC Layer 7 services and EFC functions, defined in EN 12834 and EN ISO 14906:2004, 7.2, in Table 1.	“The OBU shall support the DSRC Layer 7 services and EFC functions, defined in EN 12834 and EN ISO 14906:2004, 7.2, in Table 1, the SetMMIRq values (128-254) are reserved for SANRAL use.”
b)	Section 5.1.4, page 17. 1 <sup>st</sup> and 2 <sup>nd</sup> sentence.	The addressing of the EFC system and application data shall conform to the rules defined in 5.3 in EN ISO 14906:2004.  The EFC attributes in Table 2 as defined in EN ISO 14906:2004 (in Clause 8 and Annex A) and in EN 12834, shall be implemented in the OBU:	“The addressing of the EFC system and application data shall conform to the rules defined in 5.3 in EN ISO 14906:2004.  The EFC attributes in Table 2 as defined in EN ISO 14906:2004 (in Clause 8 and Annex A), in EN 12834, and further defined in this Standard Specification, shall be implemented in the OBU:”
c)	Section 5.2.4, page 20. 1 <sup>st</sup> sentence.	The RSE shall support any OBU complying with 5.1.4.	“The RSE shall be able to support any OBU complying with clause 6 of this Standard Specification. Additionally the RSE shall support any OBU complying with the data requirements of security level 0 as defined in EN 15509.”
d)	Section 5.1.4, page 18. Table 2 “ApplicationContextMark” Remarks	An octet string that is sent from the OBU in the Initialisation phase (VST) that contains the identification of a specific DSRC application context. For EFC the first 6 octets always will contain the EFContextMark. Length varies between security levels (see Annex A for details).	“An octet string that is sent from the Tag in the Initialisation phase (VST) that contains the identification of a specific DSRC application context. For EFC the first 6 octets always will contain the EFContextMark. Length varies between security levels. While the RSE shall be able to handle data contents for security level 0 and level 1, the OBU shall transmit the data contents conforming with security level 1. (See Annex A for details). “

**Table 6-2: Implemented Attributes**

Name of the Attribute (EID>0)	Attr. ID	Length (Octets) <sup>(a)</sup>	Type	Access <sup>(b)</sup>	Protection
APPLICATION CONTEXT					
ApplicationContextMark	N/A	6 or 16 <sup>(c)</sup>	N/A	Read only	DES
CONTRACT					
EFC-ContextMark	0 <sub>10</sub>	6	Choice 32 <sub>10</sub>	Read only	DES
PAYMENT					
PaymentMeans (including PAN)	32 <sub>10</sub>	14	Choice 64 <sub>10</sub>	Read only	DES
VEHICLE					
VehicleLicensePlateNumber <sup>(d)</sup>	16 <sub>10</sub>	17	Choice 47 <sub>10</sub>	Read only	DES
VehicleClass <sup>(d)</sup>	17 <sub>10</sub>	1	Choice 49 <sub>10</sub>	Read only	DES
VehicleDimensions <sup>(d)</sup>	18 <sub>10</sub>	3	Choice 50 <sub>10</sub>	Read only	DES
VehicleAxles <sup>(d)</sup>	19 <sub>10</sub>	2	Choice 51 <sub>10</sub>	Read only	DES
VehicleWeightLimits <sup>(d)</sup>	20 <sub>10</sub>	6	Choice 52 <sub>10</sub>	Read only	DES
VehicleSpecificCharacteristics <sup>(d)</sup>	22 <sub>10</sub>	4	Choice 54 <sub>10</sub>	Read only	DES
EQUIPMENT					
EquipmentOBUID	24 <sub>10</sub>	5	Choice 56 <sub>10</sub>	Read only	DES
EquipmentStatus (transaction counter)	26 <sub>10</sub>	2	Choice 58 <sub>10</sub>	Read/Write	DES
RECEIPT					
ReceiptData1 (last) <sup>(d)(e)</sup>	33 <sub>10</sub>	28	Choice 65 <sub>10</sub>	Read/Write	DES
ReceiptData2 (penultimate) <sup>(d)</sup>	34 <sub>10</sub>	28	Choice 65 <sub>10</sub>	Read/Write	DES
PRIVATE USE					
OperatorSpecificData1 – OperatorSpecificData24	87 <sub>10</sub> - 110 <sub>10</sub>	Variable	Octet String	Read/Write	DES
RESERVED <sup>(f)</sup> ManufacturerSpecificData1 – ManufacturerSpecificData17	111 <sub>10</sub> - 127 <sub>10</sub> 128 <sub>10</sub> - 144 <sub>10</sub>	Variable	Octet String	No Access	-

- Including the length determinant as defined in ISO/IEC 8825-2 (packed encoding rules for ASN.1 is used in EN ISO 14906).
- The read and write columns denote read and write operations during an EFC DSRC transaction (not other possible situations).

- c. Tags programmed according to this specification shall always have a length of 16 octets i.e. support security level 1, whereas RSE shall support an ApplicationContextMark of both 6 and 16 octets i.e. security level 0 and 1 as per this specification.
- d. This Attribute shall not be used during an EFC DSRC transaction as outlined within this specification. However to comply with EN 15509, OBEs still need to make this data Attribute available for later use (potentially through operators). Note: Any fields not used shall be filled with '0's (binary) on the Tag unless explicitly defined.
- e. Subsets of this Attribute shall be generated by and captured by the RSE as part of the Transaction Record as specified within this specification.
- f. This set of attributes is reserved for Tag specific implementation, such as for the storage of Authentication Keys etc.

**Table 6-3: Amendments to [EN 15509] continued**

#	Reference	Section to be replaced	Replace with:
e)	Section 5.1.4, page 18. Table 2 "PaymentMeans (including PAN)" Remarks	Includes: <ul style="list-style-type: none"> <li>• The Personal Account Number, including the Payment Means Issuer.</li> <li>• The PAN Expiry Date</li> <li>• The payment means Usage Control</li> </ul>	Includes: <ul style="list-style-type: none"> <li>• The Personal Account Number, including the Payment Means Issuer According to ISO 7812.</li> <li>• The PAN Expiry Date (Payment means expires at 24:00.00 on PaymentMeansExpiryDate )</li> <li>• The payment means Usage Control (Reserved for SANRAL use.)</li> </ul>
f)	Section 5.1.4, page 18. Table 2 VehicleLicensePlateNumber Remarks	More specific and limited in scope than in EN ISO 14906	"VehicleLicensePlateNumber is not used in the reference transaction and shall be zeroed."

**Table 6-4: VehicleLicensePlateNumber format**

CountryCode / AlphabetIndicator	Size = 14	Value: ASCII code of each character
2 Octets	1 Octet = 0Eh	14 Octets

## 6.5 TYPICAL TRANSACTION OVERVIEW

6.5.1 A typical transaction overview is provided in Figure 6-1.

Phase	RSE		OBE
Initialisation	INITIALISATION.request (BST)	→	
		←	<b>INITIALISATION.response (VST)</b> <ul style="list-style-type: none"> <li>EFC-ContextMark <ul style="list-style-type: none"> <li>ContractProvider</li> <li>TypeofContract</li> <li>ContextVersion</li> </ul> </li> <li>AC_CR-KeyReference</li> <li>RndOBE</li> </ul>
Presentation	<b>GET_STAMPED.request</b> <ul style="list-style-type: none"> <li>AC_CR [RndOBE, AcK]</li> <li>PaymentMeans, including PAN</li> <li>EquipmentStatus</li> <li>RndRSE</li> <li>KeyRef (AuKey_Op)</li> </ul>	→	
		←	<b>GET_STAMPED.response</b> <ul style="list-style-type: none"> <li>PaymentMeans, including PAN</li> <li>EquipmentStatus</li> <li>OperatorAuthenticator</li> </ul>
Presentation for Tag issued by another Account IA	<b>GET_STAMPED.request</b> <ul style="list-style-type: none"> <li>AC_CR [RndOBE, AcK]</li> <li>EquipmentStatus</li> <li>RndRSE</li> <li>KeyRef (AuKey_Iss)</li> </ul>	→	
		←	<b>GET_STAMPED.response</b> <ul style="list-style-type: none"> <li>EquipmentStatus</li> <li>IssuerAuthenticator</li> </ul>
Receipt	<b>SET.request</b> <ul style="list-style-type: none"> <li>AC_CR [RndOBE, AcK]</li> <li>EquipmentStatus(Transaction counter)</li> </ul>	→	
	<b>SET_MMI.request</b>	←	<b>SET.response</b> <b>Set_MMI.response</b>
Tracking Or Closing	<b>ECHO.request</b>	→	
	Etc...	←	<b>ECHO.response</b>
	<b>EVENT_REPORT.request (Release)</b>	→	

**Figure 6-1: Typical transaction overview<sup>(1)</sup>**

- 1 It is noted that this figure represents a general application overview of a DSRC transaction between RSE and an OBU as specified within this specification, attributes and data not explicitly stated but required for an EN 15509 compliant transaction are however inferred (such as additional data transmitted as part of the BST and VST).

**Table 6-5: Amendments to [EN 15509] continued**

#	Reference	Section to be replaced	Replace with:
g)	Section,C.4.4 ICS proforma for Tag ,page 36, Table C.3 —Security level ,4 <sup>th</sup> column, 3rd row (Security level 1: status)	'o'	"m"
h)	Section,C.4.4 ICS proforma for Tag ,page 36, Table C.5 — DSRC L7 and EFC functions,4 <sup>th</sup> column, 9 <sup>th</sup> row (AC_CR support: status)	'c.1'	'm'
i)	Section,C.4.4 ICS proforma for Tag ,page 37, Table C.7 – Security requirements,4 <sup>th</sup> column,12 <sup>th</sup> row (AccessKeys: status)	'c.1 '	'm'



#	Reference	Section to be replaced	Replace with:
j)	Section,C.4.4 ICS proforma for Tag ,page 37, Table C.7 – Security requirements,4 <sup>th</sup> column,13 <sup>th</sup> row (AC_CR: status)	'c.1 '	'm'
k)	Section,C.4.4 ICS proforma for Tag ,page 37, Table C.7 – Security requirements,4 <sup>th</sup> column,14 <sup>th</sup> row (AC_CR-KeyReference: status)	'c.1 '	'm'
l)	Section,C.4.4 ICS proforma for Tag ,page 37, Table C.7 – Security requirements,4 <sup>th</sup> column,15 <sup>th</sup> row (RndOBU: status)	'c.1 '	'm'
m)	Section,C.4.4 ICS proforma for Tag ,page 37, Table C.8 – Security requirements,4 <sup>th</sup> column,4 <sup>th</sup> row (AccesCredentials calculation: status)	'c.1 '	'm'
n)	Section,C.4.4 ICS proforma for Tag ,page 42, Table C.27 — Security level,4 <sup>th</sup> column, ,3 <sup>rd</sup> row (Security Level 1: status)	'o'	'm'
o)	Section,C.4.4 ICS proforma for Tag ,page 42, Table C.29 — L7 and EFC functions,4 <sup>th</sup> column,9 <sup>th</sup> row (AC_CR support: status)	'c.1 '	'm'
p)	Section,C.4.4 ICS proforma for Tag ,page 43, Table C.31 — Security requirements,4 <sup>th</sup> column,12 <sup>th</sup> row (AccessKeys: status)	'c.1 '	'm'
q)	Section,C.4.4 ICS proforma for Tag ,page 43, Table C.31 — Security requirements,4 <sup>th</sup> column,13 <sup>th</sup> row (AC_CR: status)	'c.1 '	'm'
r)	Section,C.4.4 ICS proforma for Tag ,page 43, Table C.31 — Security requirements,4 <sup>th</sup> column,14 <sup>th</sup> row (AC_CR-KeyReference: status)	'c.1 '	'm'
s)	Section,C.4.4 ICS proforma for Tag ,page 43, Table C.31 — Security requirements,4 <sup>th</sup> column,15 <sup>th</sup> row (RndOBU: status)	'c.1 '	'm'
t)	Section,C.4.4 ICS proforma for Tag ,page 43, Table C.32 — Security requirements,4 <sup>th</sup> column,4 <sup>th</sup> row (AccesCredentials calculation: status)	'c.1 '	'm'

## 6.6 EXCEPTION AND INCIDENT HANDLING

6.6.1 The following table summarises the actions to be taken by the ETC application when an ETC Incident or Violation occurs:

**Table 6-6: Actions to be taken on identified exceptions**

#	Exception	Action
a)	Tag does not respond to BST	Launch exception handling procedure <sup>1</sup>
b)	Corrupt VST received from Tag No contract in VST accepted by RSE	Transaction release Launch exception handling procedure <sup>1</sup>
c)	GET.response not received GET_STAMPED.response not received	Store transaction record Transaction release Launch exception handling procedure <sup>1</sup>
d)	Contract in Red List	Store transaction record Notify transaction result (not OK), (Set MMI=1) Transaction release Launch exception handling procedure <sup>1</sup> Further action as specified in inter Toll Agency merchant agreement
e)	Access to Tag denied	Store Transaction Record Notify transaction result (not OK), (Set MMI=1) Transaction release Launch exception handling procedure <sup>1</sup> Further action as specified in inter Toll Agency merchant agreement

#	Exception	Action
f)	Operator Authenticator not correct	Store Transaction Record Notify transaction result (OK), (Set MMI=0) Transaction release Launch exception handling procedure <sup>1</sup> Further action as specified in inter Toll Agency merchant agreement
g)	Registered Vehicle Class does not match the measured class	Store Transaction Record Notify transaction result (OK), (Set MMI=0) Transaction release TA to resolve Class Discrepancy by means of images, if available Complete the transaction
h)	SET.response not received	Store Transaction Record Transaction release

<sup>1</sup> It is up to the discretion of the Toll Agency on how the details of the exception handling procedure will be implemented. For the purpose of enforcement this procedure will as a minimum define the Tag as *invalid* for the remainder of the transaction. See clause 5.3.5 for additional details on the handling of ETC Incidents.

## 6.7 DEFINITION OF ATTRIBUTES IMPLEMENTED

- 6.7.1 The Attributes implemented have been defined in EN ISO 14906. It shall be the responsibility of the Toll Agency to liaise with the following authorities to determine the exact value of these fields.
- 6.7.2 For the purposes of harmonisation, where the responsible party is not indicated as SANRAL, the Toll Agency shall submit a proposal to SANRAL for approval

**Table 6-7: Definition of Attributes implemented**

Attr ID	Attribute	Data Element (DE)	Length of DE	Responsible entity	Assignment on Tag	Comment
	<b>APPLICATION</b>					
-	Application identifier (AID)		-	South African National Roads Agency	01 <sub>16</sub>	ETC
	<b>CONTRACT</b>					
0	EFC-ContextMark	CountryCode (Subset of ContractProvider)	10 bits	Internationally assigned	10001 <sub>2</sub> 11000 <sub>2</sub>	South Africa
		Issuer Identifier (Subset of ContractProvider)	14 bits	South African National Roads Agency	00 <sub>2</sub> 0000 <sub>2</sub> 1000 <sub>2</sub> 0000 <sub>2</sub>	EFC IAP
		TypeOfContract	2 octets	ContractProvider specific	0xxx <sub>2</sub> xxx <sub>2</sub> xxxx <sub>2</sub> xxx <sub>2</sub>	ContractProvider specific (non-interoperable contract)
				South African National Roads Agency	1xxx <sub>2</sub> xxx <sub>2</sub> xxxx <sub>2</sub> xxx <sub>2</sub>	Reserved for harmonised payment First two octets defines context of OperatorSpecificData assignment. Assigned by South African National Roads Agency, as indicated below.
					80 <sub>16</sub> 0D <sub>16</sub>	TCH account
		ContextVersion <sup>(1)</sup>	1 octet	ContractProvider specific	xx <sub>16</sub>	This defines the context of the specific set of keys stored within a set of Tags issued by a specific ContractProvider.
	<b>PAYMENT</b>					

Attr ID	Attribute	Data Element (DE)	Length of DE	Responsible entity	Assignment on Tag	Comment
32	PaymentMeans	Personal Account Number <sup>(2)</sup>	10 octets	South African National Roads Agency	XX <sub>16</sub> XX <sub>16</sub> XX <sub>16</sub> XX <sub>16</sub> XX <sub>16</sub> XX <sub>16</sub> XX <sub>16</sub> XX <sub>16</sub> XX <sub>16</sub> XX <sub>16</sub>	<p>The PAN consists of:</p> <ul style="list-style-type: none"> <li>• Issuer Identification Number (IIN) which consists of the Major Industry Identifier (MII, 1 BCD digit) and Tag Issuer (5 BCD digits) and identifies the issuer of the PAN.</li> <li>• Individual account number (variable length, max 12 BCD digits, see ISO 7811-3) which identifies a Customer Account at the TCH.</li> <li>• Control digit (1 BCD digit), providing a means to check that the PAN has not been modified. The control digit shall be calculated on preceding digits and be computed according to the Luhn formula for a modulus 10 check digit (see Annex B in ISO 7812-1).</li> <li>• Padding bits set to 1<sub>2</sub>, in order to accomplish a total PAN length of 10 octets</li> </ul> <p>Note: The PAN is limited to 16 decimal digits for this specification i.e. 6 digits for IIN and 10 digits for the account number and control digit. The entire PAN must however be 10 octets in length.</p>
		PaymentMeans ExpiryDate	2 octets	South African National Roads Agency	00 <sub>16</sub> 00 <sub>16</sub>	Expiring date of payment means. Payment means expires at 24h of PaymentMeans ExpiryDate.
		PaymentMeans UsageControl	2 octets	South African National Roads Agency	00 <sub>16</sub> 00 <sub>16</sub>	No specified restrictions
	<b>RECEIPT</b>					
33	ReceiptData1 <sup>(5)</sup> (last)	SessionTime	4 octets	RSE Specific <sup>(5)</sup>	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	Date and Time of session with a two second resolution. Time easy to decode into a displayable format by Tag. Date and time value assignment – Octet Aligned [01.01.1990, 00:00:00]... [31.12.2116, 21:59:58], then rollover.
		SessionServiceProvider	3 octets	RSE Specific <sup>(5)</sup> (South African National Roads Agency)	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	Identifier of a TA. Value range {AA..ZZ & 0..16383} (as defined in Annexure A)
		LocationOfStation	2 octets	RSE Specific <sup>(5)</sup>	00 <sub>16</sub> 00 <sub>16</sub>	Toll Plaza code defined by the service provider. Value range { 0..65535} (as defined in Annexure A)
		SessionLocation	1 octet	RSE Specific <sup>(5)</sup>	00 <sub>16</sub>	Travel direction + Lane Code. Value range {0/1 + 0..127} (as defined in Annexure A)
		SessionType	1 octet	RSE Specific <sup>(5)</sup>	00 <sub>16</sub>	Designates the type of service station. (as defined in Annexure A)

Attr ID	Attribute	Data Element (DE)	Length of DE	Responsible entity	Assignment on Tag	Comment
		SessionResult	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionTariffClass	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionClaimedClass	1 octet	RSE Specific <sup>(5)</sup>	00 <sub>16</sub>	Service provider specific Vehicle Class as on the Validation List(s).
		SessionFee	4 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionContract Provider	3 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionTypeOf Contract	2 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionContext Version	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		ReceiptData Authenticator	4 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
34	ReceiptData2 (penultimate)	SessionTime	4 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionServiceProvider	3 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		LocationOfStation	2 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionLocation	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionType	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionResult	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionTariffClass	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionClaimedClass	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionFee	4 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionContract Provider	3 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionTypeOf Contract	2 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		SessionContext Version	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		ReceiptData Authenticator	4 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
	<b>VEHICLE</b>					
16	VehicleLicensePlate Number	VehicleLicensePlate Number	17 octets	RSE Specific <sup>(5)</sup>	00 <sub>16</sub> .. 00 <sub>16</sub>	Service provider specific Vehicle License Number as on the Validation List(s).
17	VehicleClass	VehicleClass	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
18	VehicleDimensions	VehicleLengthOverall	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.

Attr ID	Attribute	Data Element (DE)	Length of DE	Responsible entity	Assignment on Tag	Comment
		VehicleHeightOverall	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		VehicleWidthOverall	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
19	VehicleAxles	VehicleFirstAxleHeight	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
		VehicleAxlesNumber	1 octet	N/A	00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
22	VehicleSpecific Characteristics	VehicleSpecific Characteristics	4 octets	N/A	00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub> 00 <sub>16</sub>	This Data Element does not form part of the Transaction Record.
	<b>EQUIPMENT</b>					
24	EquipmentOBUID	EquipmentOBUID	5 octet		04 <sub>16</sub> xx <sub>16</sub> xx <sub>16</sub> xx <sub>16</sub> xx <sub>16</sub>	Unique Identification number of Tag within the context of the associated manufacturer.
26	EquipmentStatus	EquipmentStatus(Transaction counter) <sup>(3)</sup>	2 octets	SessionServiceProvider	rrrr <sub>2</sub> cccc <sub>2</sub> cccc <sub>2</sub> cccc <sub>2</sub> <sup>5</sup>	Where – “rrrr” indicates reserved for assignment by the TCH (4 bits), and – “cccc .. cccc” indicates the sequential transaction counter (12 bits)..

<sup>1</sup> The ContextVersion is used to distinguish between different sets of keys used by an Account IA. Each Tag is pre-programmed with a set of keys according to EN 15509 (indicated in Table 6-9). However, should a situation arise where a different set of keys need to be used in a new batch of Tags the ContextVersion shall be used to differentiate between these different sets of keys belonging to the same Account IA. This requirement necessarily requires that the Road Side Equipment be able to both store and use more than one set of keys supplied by a specific Account IA.

<sup>2</sup> Care must be taken by the TCH and Toll Agency not to issue duplicate PersonalAccountNumbers for different contracts (i.e. no duplication for any two (2) different contracts).

<sup>3</sup> The RSE of the TA shall use parts of the Attribute EquipmentStatus, during an ETC transaction, as a transaction counter. The Attribute shall be read and written back to the OBE with the counter incremented for every transaction that leads to transaction data being sent to the EFC Provider.

<sup>4</sup> Note that a reference to “RSE specific” here refers to the fact that these data elements are populated with data other than that from the Tag itself i.e. this data is generated by the RSE.

<sup>5</sup> Although this Attribute is not used during the DSRC transaction between RSE and OBU, certain Data Elements of this Attribute shall be generated and stored by the RSE as part of the Transaction Record as indicated by “RSE Specific”.

6.7.3 Legacy Tags will be distinguished from Tags that conform to this specification by the use of *EFC-ContextMark* as presented above in Table 6-7. All that need be noted is that Tags that conform to this specification use values that are unique from any other legacy Tags previously issued.

6.7.4 The following additional Attributes shall be implemented and may be used at the discretion of the TA, subject to SANRAL’s approval, for the allocation of operator specific data.

**Table 6-8: Additional Attributes implemented**

Attr ID	Attribute	Length (DE)	Read/Write	Responsible party	Access	Comment
87 <sub>10</sub> - 110 <sub>10</sub>	OperatorSpecificData1 – OperatorSpecificData24	Variable	Read / Write	TA specific	Protected	For temporary storage of TA specific data

- 6.7.5 The use of the additional Attributes indicated in Table 6-8 shall be governed by the following criteria:
- 6.7.5.1 Should the Toll Agency require the use of any of the allocated additional Attributes indicated in Table 6-8 it shall present a proposal (including the number of Attributes and intended use of each Attribute in detail) in writing, with adequate motivation, to SANRAL for approval.
- 6.7.5.2 If the proposal is accepted, SANRAL will then assign certain Attributes in the available range for exclusive use to the Toll Agency for their proposed use.
- 6.7.5.3 The Toll Agency shall not use any Attribute (or set of Attributes) within the range specified in Table 6-8, unless approval has been obtained from SANRAL first.
- 6.7.6 The Toll Agency shall not overwrite or modify any Attributes other than those explicitly indicated as being modified during the interoperable transactions described within this document (refer to Figure 6-1), unless explicit approval has been obtained for such a modification from the TCH or SANRAL. Failure to adhere to this will make the Toll Agency liable for the resulting damages incurred by the relevant TA and/or SANRAL.
- 6.7.7 Although the abovementioned Attributes in Table 6-8 are protected by means of Access Credentials any additional security required by the Toll Agency, or at SANRAL's discretion, shall be addressed and fully managed by the Toll Agency pending SANRAL's approval of the proposed scheme.

## 6.8 SECURITY SCHEME

- 6.8.1 Security measures are necessary in order to protect the integrity of the security keys. All the Tag security keys belong to the Account IA, who is required to calculate and/or specify them and distribute them to the Toll Agency/ies. It is the Account IA's responsibility, or the appointed agent of the Account IA, to configure Tags with these security keys and to ensure the integrity of these keys during any such process. The Toll Agency shall submit full details of its security plan to protect the security keys received from the Account IA to SANRAL for approval.
- 6.8.2 The European Standard EN 15509 allows for the implementation of two different levels of security (i.e. security level 0 and security level 1), for this specification the following is required:
- 6.8.2.1 RSE shall implement both security levels 0 and 1 as defined in section 5.2.5 of EN 15509, and.
- 6.8.2.2 any Tags issued after the TCH has been established shall comply with security level 1, as defined in section 5.1.5.3 of EN 15509.
- 6.8.3 The associated security related data elements that are used for data exchanges over the DSRC interface are defined in section 5.1.5 of EN 15509 and later within this section of the specification.
- 6.8.4 EN 15509 provides a security and Attribute authentication scheme based on two types of master security keys. These are the Master Access Key and Master Authentication Keys.
- 6.8.5 Master Access Key (MAck)
- 6.8.5.1 Knowledge of this key is necessary in order to access/modify the contents of a protected Attribute.
- 6.8.5.2 In conformance with [EN 15509] a key derived from the MAck, known as the Access Key (Ack), is used to calculate Access Credentials which must then be presented to a Tag during the DSRC information exchange in order to gain access (either read or write) to any protected Attributes within the Tag. Details of the cryptographic procedures involved in the calculation of Access Credentials are given in [EN 15509].

## 6.8.6 Master Authentication Keys (MAuK)

- 6.8.6.1 Master Operator Authentication Keys (MAuK\_Op): Knowledge of this key is necessary to check the validity of the data supplied by the OBE (or Tag) to the RSE by means of an Operator Authenticator generated by the OBE. In conformance with [EN 15509] more than one Operator Authentication Key (AuK\_Op) is stored in the Tag. Each of these is derived from a different MAuK\_Op.
- 6.8.6.2 Master Issuer Authentication Keys (MAuK\_Iss): Knowledge of this key is necessary for the Account IA (where the User Account is located) to check the validity of any claim supplied by another Account IA for settlement between these two Account IA's. In conformance with [EN 15509] more than one Issuer Authentication Key (AuK\_Iss) is stored in the Tag. Each of these is derived from a different MAuK\_Iss.
- 6.8.6.3 Authentication Keys (AuK) for security level 0 shall be allocated as indicated in Table 6-9.

**Table 6-9: Assignment of Security Keys (ref. Table 3, page 19, of [EN 15509])**

Attribute Name	Key reference number	Length (Octets)	Comments
AuthenticationKey1 <sup>(1)</sup>	111 <sub>10</sub>	8	Keys in the Account IA domain
AuthenticationKey2 <sup>(1)</sup>	112 <sub>10</sub>	8	
AuthenticationKey3	113 <sub>10</sub>	8	The implementation of these keys is optional, but will not be part of the interoperable transaction.
AuthenticationKey4	114 <sub>10</sub>	8	
AuthenticationKey5 <sup>(2)</sup>	115 <sub>10</sub>	8	Interoperable Keys
AuthenticationKey6 <sup>(2)</sup>	116 <sub>10</sub>	8	
AuthenticationKey7 <sup>(2)</sup>	117 <sub>10</sub>	8	
AuthenticationKey8 <sup>(2)</sup>	118 <sub>10</sub>	8	
KeyRef		1	Reference to AuK used for the computation of the Authenticators
RndRSE		5 = 1+4	Random number, containing SessionTime, from RSE used for the computation of Authenticator.

<sup>1</sup> Derived from the Master Issuer Authentication Keys (MAuK\_Iss), belonging to the Account IA security domain and are known only by a specific Account IA.

<sup>2</sup> Derived from the Master Operator Authentication Keys (MAuK\_Op), belonging to the interoperable domain and are known by all the TAs.

- 6.8.6.4 For security level 1 the OBE/RSE shall support calculation of Access Credentials for protection of user related data (or any other Attributes that are protected) on the OBE in conjunction with the security level 0 requirements as defined in [EN 15509]. These calculations shall be performed according to Appendix B.3 in the [EN 15509] standard. This requires the additional security data elements, indicated in Table 6-10, to be implemented and handled by the OBE/RSE.

**Table 6-10: OBE/RSE security related data for handling of Access Credentials (ref. Table 4, page 19, of [EN 15509])**

Attribute Name	Length (Octets)	Comments
AccessKey <sup>(1)</sup>	8	Interoperable key
AC_CR	1+4	Access credentials calculated by the RSE and the OBU using RndOBU and the Access Key (AC_CRKey).

Attribute Name	Length (Octets)	Comments
AC_CR-KeyReference	2	Reference to the key generation and the diversifier for the computation of AC_CR.
RndOBE	5 = 1+4	Random number (nonce) used together with AccessKey (referenced through AC_CR-KeyReference) to calculate the Access credentials.

<sup>1</sup> Derived from the Master Access Key (MAcK), belonging to the interoperable domain and is known by all TAs.

6.8.6.5 Details of the cryptographic procedures involved with both authentication keys and Access Credentials are provided in [EN 15509].

6.8.6.6 Two types of authenticators can be defined:

a. Operator Authenticator

- i) The authentication keys AuK\_Op, inside the OBE, are derived from the master keys MAuK\_Op with the combination of the Attributes *PersonalAccountNumber* and *ContractProvider* as detailed in [EN 15509].
- ii) All Toll Agencies are able to verify the Operator Authenticator, as the keys employed are from the interoperable domain.
- iii) Four generations of AuK\_Op keys will be stored in the OBE (i.e. AuthenticationKey5-8 as detailed in Table 6-9 above), with the key reference values from 115 to 118 (This feature allows changing the key in operation if there is suspicion that it has been compromised).
- iv) One of the Master Keys in this domain will be distributed from the Account IA to all other TAs who shall then be able to check that the Tag is authentic.

b. Issuer Authenticator

- i) The authentication keys AuK\_Iss, inside the OBE, are derived from the master keys MAuK\_Iss with the combination of the Attributes *PersonalAccountNumber* and *ContractProvider* as detailed in [EN 15509].
- ii) Only the Account IA (of the OBE) is able to verify the value of Issuer Authenticator, as the keys employed are from the Account IA domain.
- iii) Two generations of AuK\_Iss keys will be stored in the OBE (i.e. AuthenticationKey1 and 2 as detailed in Table 6-9 above), with the key reference values 111 and 112 (This feature allows changing the key in operation if there is suspicion that it has been compromised).
- iv) This Authenticator will have to be presented in all claims submitted by the Toll Agency to an Account IA other than the TCH if this is ever necessary.

6.8.6.7 The Authentication Keys (AuK) must be securely protected by the OBE by a Secure Application Module (SAM). If any attempt of removing the SAM from an OBE is detected the keys shall be destroyed. Thereby ensuring only genuine OBEs will send correct Issuer Authenticator and Operator Authenticator.

6.8.6.8 The Authentication Keys (AuK) shall be derived from the payment information and any attempt of splitting the payment information from the secret keys will cause incorrect authenticators.

6.8.7 Security data flow

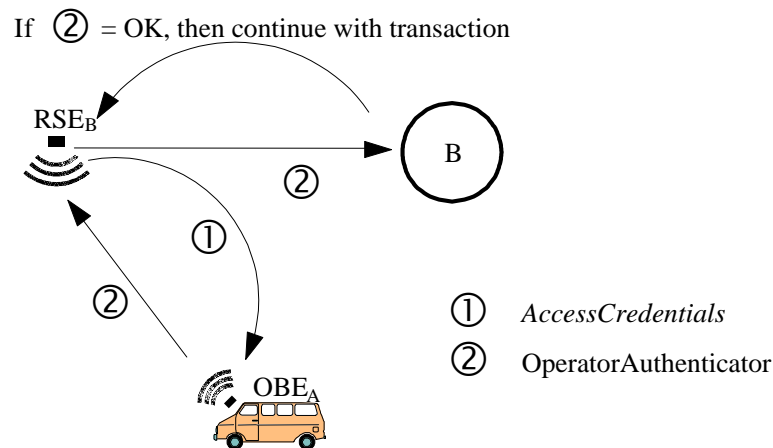
6.8.7.1 The Toll Agency shall allow for the following possibilities:

a. Transaction is executed by ContractProviderA, who is also the Account IA

- i) Valid Access Credentials need to be presented by the RSE in order to access Attributes on the OBE. *ContractProviderA* knows the MAcK, which belongs to the interoperable domain, and therefore can compute the Access Credentials.



- ii) *ContractProviderA* needs proof that the OBE is valid (i.e. is connected to a valid account). The OBE generates an Operator Authenticator using a key from the group *AuKey\_Op*. *ContractProviderA* can check the validity of this authenticator as it issued the *MAuK\_Op* (which also belongs to the interoperable domain).
- b. Transaction is executed by *ContractProviderB*, who is NOT the Account IA



**Figure 6-2: Security data flow for situation where the Account IA does not execute the transaction**

- i) In order to access the OBE, *ContractProviderB* shall obtain the relevant *MAcK* and *MAuK* from *ContractProviderA* i.e. the Account IA.
- ii) Valid Access Credentials need to be presented by the RSE in order to access Attributes on the OBE. *ContractProviderB* knows the *MAcK*, which belongs to the interoperable domain, and therefore can compute the Access Credentials.
- iii) *ContractProviderB* needs proof that the OBE is valid (i.e. is connected to a valid account). The OBE generates an Operator Authenticator using a key from the group *AuKey\_Op*. *ContractProviderB* can check the validity of this authenticator as the *MAuK* belongs to the interoperable domain.
- c. It should also be noted that although only account management and settlement with a single Account IA is described here, the remote possibility of account management and settlement between different Account IA's does exist, and as such must be catered for with the use of Issuer Authenticators. The details of this procedure do not form part of this specification and reference can be made to [EN 15509], if further details are required.

#### 6.8.8 Secure distribution and storage of cryptographic keys

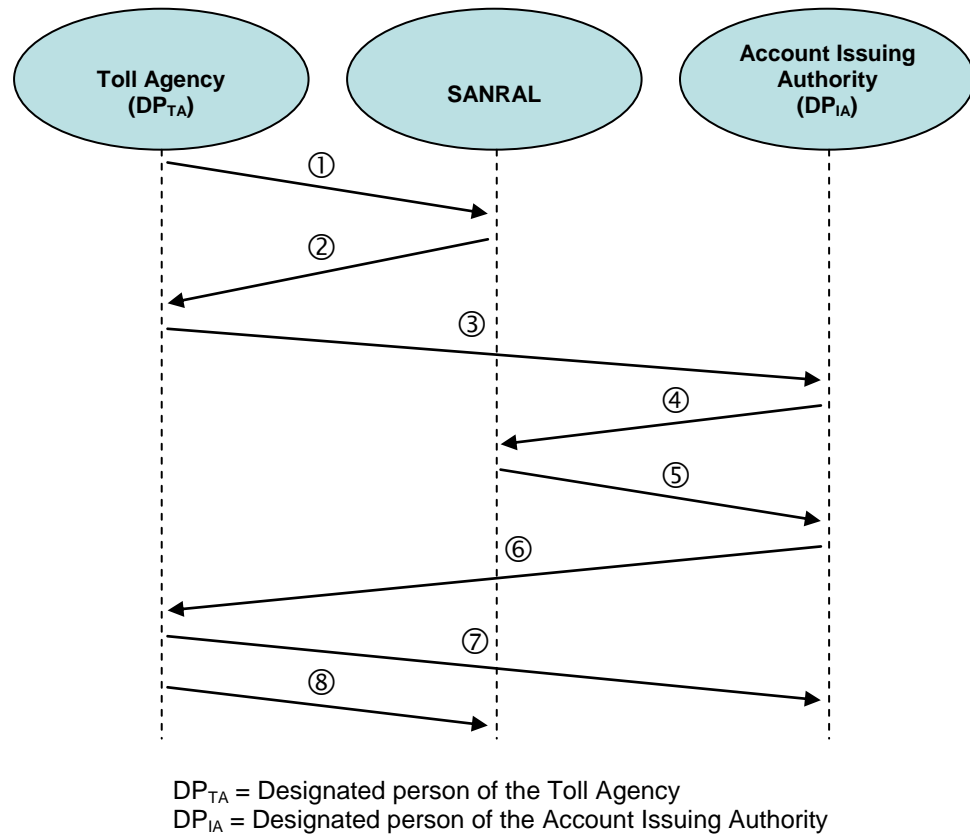
6.8.8.1 In order to ensure the secure distribution of the cryptographic keys, the following scheme shall be used:

- a. Designation of responsible person
  - i) Once the Toll Agency has determined its intent to install an ETC system, the Toll Agency shall designate one person (hereafter referred to as *the designated person*) within the company who shall be responsible for the security of the ETC system. Likewise, the Account IA will have one person (also referred to as the designated person) who shall be responsible for the security of the security keys.
  - ii) The designated person shall be required to liaise with the TCH on all security-related issues. The designated person's details shall be submitted to the TCH and SANRAL in writing on the official letterhead of the Toll Agency. In this context, the TCH will be the Account IA that plans to start issuing Tags and therefore generates the relevant security keys associated with the Tags.

- iii) SANRAL shall then register the designated person as the Toll Agency's designated contact person in this regard. The following details are required for registration:
    - Full names and surname.
    - Telephonic contact details where the person can be reached during working hours.
    - Physical and postal addresses.
    - Fax number.
    - E-mail address.
    - Emergency contact details where the person can be reached in case of emergency.
  - iv) Under no circumstances shall the designated person delegate any of his/her responsibilities to another person unless such an arrangement has been reached with the TCH in advance.
  - v) Should the designated person, for whatever reason, be unable to perform his/her duties or ends his/her services with the Toll Agency the following shall apply: The Toll Agency shall make provision to designate another person within the company and provide the TCH and SANRAL with his/her relevant details (as stated above). In the case where the designated person ends his/her services with the Toll Agency, this shall be done at least one week before the original designated person leaves the services of the Toll Agency. In the case where the designated person is unable to perform his/her duties, the Toll Agency will immediately inform the TCH and SANRAL of the situation.
- b. Generation of relevant security keys by the Account IA
- i) The Account IA will be responsible for the generation of the relevant security keys as required and described in this section (i.e. clause 6.8) for Tags issued by it.
  - ii) Should the Toll Agency ever act as an Account IA (i.e. issue Tags), the Toll Agency shall ensure that such keys are generated according to accepted cryptographic principles and guidelines for the generation of cryptographically strong keys. If a third party generates the keys, the Toll Agency shall ensure that such keys are securely delivered to the Toll Agency.
  - iii) The secure generation and delivery of such keys will therefore always be the responsibility of the Account IA and shall be securely managed by the designated person once delivery to the Toll Agency has been affected.
- c. Distribution of relevant security keys
- i) Should the Toll Agency plan to implement an ETC system, the Toll Agency will request the relevant security keys from the relevant Account IA. Such keys will only be requested once the Toll Agency has registered a designated person.
  - ii) In order for TAs to exchange the relevant security keys with the Account IA, the scheme illustrated in Figure 6-3 will be used. This scheme consists of the following steps (the numbers below correspond to the numbers in Figure 6-3):
    1. The designated person of the Toll Agency ( $DP_{TA}$ ) shall request the TCH and SANRAL for the contact details of the designated person of the Account Issuing Authority ( $DP_{IA}$ ). Such a request shall be in writing (either hard copy or electronic submission will be acceptable), but shall always be on a document containing the official letterhead of the Toll Agency.
    2. SANRAL will forward the required information to the  $DP_{TA}$ .
    3. The  $DP_{TA}$  shall then proceed to telephonically contact the  $DP_{IA}$  (based on the contact details obtained from SANRAL) and inform him/her of the intention to

obtain the relevant security keys from the Account IA. This shall also be confirmed in writing, if required by the DP<sub>IA</sub>.

4. After being contacted by the DP<sub>TA</sub>, the DP<sub>IA</sub> shall request confirmation of the contact details of the DP<sub>TA</sub> from SANRAL.
5. SANRAL will forward the required information to the DP<sub>IA</sub>, whereupon the DP<sub>IA</sub> shall confirm if these details are the same as that of the person that contacted him/her. If these details are not the same the DP<sub>IA</sub> shall immediately notify SANRAL and the TA – the remainder of this procedure should then be ignored.
6. Once the details of the designated person of the DP<sub>TA</sub> have been confirmed, the DP<sub>IA</sub> will then encrypt the Account IA's relevant security keys and store it on an electronic data storage device. This electronic data storage device and the security key references shall then be couriered by a trusted party of the Account IA to the DP<sub>TA</sub>, or may be transmitted electronically by the Account IA to the DP<sub>TA</sub> if deemed appropriate. Details regarding the format and security scheme used to encrypt the relevant security keys and data shall be provided to the DP<sub>TA</sub> by the Account IA.
7. Upon receipt of the sealed envelope from the DP<sub>IA</sub>, the DP<sub>TA</sub> shall telephonically confirm to the DP<sub>IA</sub> both receipt of the sealed envelope containing the relevant security keys of the Account IA and whether or not the envelope was still sealed upon receipt. This shall be confirmed in writing, if required by the DP<sub>IA</sub>. If the DP<sub>IA</sub>'s envelope was not sealed upon receipt the keys shall be deemed compromised and the procedures described in clause 6.8.8.1 e will be followed.
8. Finally, the DP<sub>TA</sub> shall confirm with SANRAL that the relevant security keys have been successfully obtained. Such a confirmation shall be either in writing or per electronic means, but always on a document containing the official letterhead of the Toll Agency. This confirmation will allow SANRAL to keep track of which TAs have received relevant security keys.



**Figure 6-3: Scheme for distribution of security keys**

- iii) The TA shall not make any copies of the relevant security keys received from the Account IA. Care shall be taken to ensure that only the relevant designated persons know these keys.
- iv) Note however that the third step (i.e. step ③) could potentially contain a request from the Toll Agency pertaining to all relevant security keys (including those issued by other entities and that will form part of this nationally interoperable scheme) belonging to SANRAL. The Toll Agency can therefore, within the same request, either specifically state which security keys it requires or make a general request for information regarding all relevant security keys. The Account IA will then respond accordingly in step ⑥.
- v) It is noted that only the Master Access Key (i.e. the MAck), a Master Operator Authenticator key (i.e. a MAuK\_Op), as well as the corresponding key reference number, and the relevant EFC-ContextMark need to be exchanged. The Account IA shall however also indicate which key reference number needs to be used by the Tag in order to calculate the *IssuerAuthenticator* (i.e. the AuKey\_Iss).
- d. Entering and storage of security keys in the Tolling System
  - i) Upon receipt of the relevant security keys the designated person of the Toll Agency shall proceed to enter it into the system. Entering such keys into the Tolling System shall preferably be an automated process without the relevant security keys ever being visible throughout the process. This process may also be conducted manually by first decrypting the relevant security keys into plaintext and then manually entering the keys into the system, in which case only the designated person shall be allowed to enter these keys into the system or know the values thereof.
  - ii) The designated person shall then proceed to destroy the record of the said relevant security keys received from the Account IA. Should it be necessary to later re-enter

the relevant security keys into the system, the relevant security keys shall again be obtained as per the procedures described in clause 6.8.8.1 c above.

- iii) Once the relevant security keys are entered into the system care shall be taken to ensure that they are never stored in any plain text format within the system. In addition, no person with a good knowledge of the Toll Agency's Tolling System and having the appropriate tools, except the designated person, should be able to retrieve a copy of the relevant security keys (received from the Account IA) from the system in any reasonable way. This principle shall hold for all levels of the Toll Agency's Tolling System (i.e. all equipment hardware and software included in levels 3, 4 and 5 of Figure 3-1), inclusive of the RSE.
- e. Revocation or change of security keys
  - i) A key shall be deemed compromised if:
    - 1. any TA has reasonable proof that any person other than a designated person and the appointed third party that generated the relevant keys of an Account IA has knowledge of such a key; and
    - 2. either the TCH, SANRAL or the Account IA itself has deemed such reasonable proof sufficient.
  - ii) The Toll Agency shall therefore report to SANRAL any knowledge of a possible compromised key, together with reasonable proof that such a compromise exists.
  - iii) Once a key has been deemed compromised, the TCH shall notify all registered designated persons using such a key of the relevant compromise.
  - iv) Should such a compromised key be:
    - 1. A Master Operator Authenticator Key (MAuK\_Op): All affected TAs shall then cease to use the affected security key and only use security keys that are not compromised. Should all the keys from the Operator Authenticator group for a specific set of Tags be compromised (i.e. for all key reference numbers 115<sub>10</sub>, 116<sub>10</sub>, 117<sub>10</sub> and 118<sub>10</sub> in Table 6-9), all Tags issued from then on shall contain keys derived from a new set of MAuK\_Op and contain a new ContextVersion.
    - f. A Master Issuer Authenticator Key (MAuK\_Iss): The Account IA shall notify all TAs of what the new key reference number is they should use, if so required by the Account IA. This notification shall be in writing. The TAs shall then be required to acknowledge, in writing, the receipt of such a notification. All transactions processed after such acknowledgement of the notification shall then contain an *IssuerAuthenticator* based on the new key reference number obtained from the Account IA.
    - g. An Access Key: All TAs shall take note. All new Tags issued by the Account IA shall then contain keys based on a new MAcK and a new ContextVersion.
  - v) Should an Account IA plan to issue Tags with a different *ContextVersion* as the previous Tags issued, the Account IA shall notify all designated persons whom previously requested relevant security keys, at least one month prior to the start of issue. The procedure described in clause 6.8.8.1 c shall then be repeated in order to obtain the security keys relevant to the new *ContextVersion*.

## 6.9 TOLLING SYSTEM INTERFACE

### 6.9.1 Interface responsibility

- 6.9.1.1 It shall be the responsibility of the Toll Agency to generate and forward all relevant data necessary for account management and settlement. This data shall be generated and forwarded to the TCH in the correct format for the specific Toll Plaza/s under its control. It shall be the responsibility of the TCH to interpret the data received from these relevant TAs, provided that such data complies with the requirements as specified in the TCH interface document. All

Tolling System interface hardware and software necessary to comply with the requirements of this specification shall be the responsibility of the TA.

- 6.9.1.2 Should such data received from a TA however be corrupt, incomplete or otherwise ambiguous it shall remain the responsibility of the TCH to notify such a party thereof in a satisfactory manner. Such data shall be subject to Business Rules.

#### 6.9.2 Definition of Communications Protocol

- 6.9.2.1 In all cases the information distributed between the various Toll Agencies (including central hosts) of each TA shall comply with requirements within the TCH interface specification (as referenced in clause 2.3).

#### 6.9.3 Definition of Message Content

- 6.9.3.1 The information and format of the information that shall be transmitted to and made available by the TCH is specified in the TCH interface document. The data that makes up a Transaction Record is specified in clause 5.3.6.2.

##### 6.9.3.2 Identification data

- a. This shall include all data necessary to unambiguously identify:
- i) The purpose of the message (i.e. request, notification, acknowledgement, etc.)
  - ii) The sender of a message
  - iii) The receiver of a message
  - iv) The message itself

##### 6.9.3.3 Services offered

- a. This shall include a list of all services offered.

##### 6.9.3.4 Fare details

- a. This shall include inter alia a fare table for each of the relevant plazas under the TA's control.

##### 6.9.3.5 Customer data

- a. This shall include specific Customer or user data as is applicable.

##### 6.9.3.6 Apportionment data

- a. This shall include all relevant apportionment rules that might apply to a relevant message. For example, this could include specific rules that might have to be applied when forwarding payment to the *SessionServiceProvider* or Account IA.

##### 6.9.3.7 Reconciliation Data

- a. This shall be used to send transaction totals (i.e. not individual transactions).

##### 6.9.3.8 Authorisation data

- a. This shall be used to obtain on-line authorisation from the TCH for a particular transaction, where this might be applicable.

##### 6.9.3.9 Transaction details

- a. This shall contain all the relevant transaction details to claim and clear a particular transaction. This shall include the ETC Transaction Record details, but might also include other relevant session data.

##### 6.9.3.10 Security data

- a. This shall include all the relevant security data, including access keys and security related information, to enable authentication and decryption of Attributes.

##### 6.9.3.11 Account status data

- a. This shall include Validation List compiled by the TCH at specified frequencies.

6.9.3.12 Equipment status data

- a. It shall be possible to send or request information on the status of specific ETC equipment following a discrepancy for a particular situation.

6.9.3.13 Event exception data

- a. This shall include information pertaining to the completion of an information transfer or transaction in the event of irregularities or fraud.

6.9.3.14 Payment method acceptance data

- a. This shall include data from the TCH regarding rules and information on acceptance of a specific payment method (e.g. conversions, required authentication, maximum values, etc.).

6.9.3.15 Data pertaining to payment of TAs

- a. This shall include all non-DSRC transaction data required to complete payment of a TA by the TCH and could include, for example, information such as:
  - i) TA's VAT number
  - ii) Date of invoice
  - iii) Value of invoice
  - iv) Transactions included in invoice
  - v) Due date
  - vi) Days outstanding

## **7. TECHNICAL INTEROPERABILITY**

### **7.1 INTRODUCTION**

7.1.1 Technical interoperability is concerned with:

- 7.1.1.1 Specifying the technical details necessary in specifying unambiguously the interfaces defined previously.
- 7.1.1.2 Defining the support systems necessary for an interoperable South African ETC system.

### **7.2 READER TO TAG INTERFACE**

7.2.1 The Tag Reader to Tag interface requirements are discussed within the [EN 15509] standard. Specific details can be obtained in EN 13372 and EN ISO 14906 and within the DSRC CEN layers i.e. EN 12253, EN 12795, EN 12834 as referenced in EN 15509.

### **7.3 SUPPORT SYSTEMS**

7.3.1 Vehicle classification

- 7.3.1.1 The Vehicle Class definition is dependent on the specific TA and/or type of Tolling System utilised. ORT type systems shall have volumetric or overhead gantry mounted AVC's whereas Conventional and Hybrid Toll Plazas shall typically have axle based AVCs, as is specified in the project specifications and required for vehicles as provided in the Government Gazette.

### **7.4 ENFORCEMENT SYSTEMS**

7.4.1 Enforcement shall be required as described in clause 5.3.5. The Toll Agency shall implement enforcement based on the understanding that failure to do so will exclude him from any assistance on ETC Violations, discrepancies and Tags regarded as invalid Tags (refer to clause 5.3.4.5 d). Opt-in Toll Agencies will also be allowed to make use of the centralized violation processing at the VPC. It shall be noted that an Opt-in Toll Agency shall be required to provide evidential records consisting of images that shall be admissible in court, if the VPC is to prosecute offenders. The following methods of enforcement shall be allowed:

7.4.2 Video Enforcement System (VES) or Image Capturing System

- 7.4.2.1 As is stated above, video enforcement shall be optional for Conventional or Hybrid Toll Plaza systems.
- 7.4.2.2 Video enforcement shall provide for a clear image or set of images of a vehicle's front and/or rear Vehicle License Numbers (VLNs). The VES shall by means of Optical Character Recognition or by means of a manual operator assisted process identify the complete VLN, for inclusion in the Transaction Record.
- 7.4.2.3 A Scene Image (profile of vehicle) shall be captured so that a vehicle can be unambiguously associated with the violation at the specific location, in such a manner that the vehicle characteristics (make, model and colour) shall also be clearly distinguishable.
- 7.4.2.4 The transaction data as defined in clause 5.3.6.2 shall be stored, together with the VES determined Vehicle License Number and Scene Image (profile of vehicle).
- 7.4.2.5 The image taken of the vehicle and associated VLN shall be treated as evidence of the specific ETC Incident. This evidence therefore has to be unambiguous, comply to the requirements for prosecution as stipulated by the VPC, shall be stored and handled in a secure way and shall be destroyed as soon as the enforcement fee has been paid. The evidence shall always be treated as confidential.
- 7.4.2.6 Opt-in Toll Agencies will have to provide front and rear Vehicle License Number images and a Scene Image, so that the VPC can attempt to recover the fees by means of the VLN. The Scene Images shall, as is stated above, be regarded as evidence of the specific vehicle at that



location. All image capturing equipment and associated images shall conform to the requirements of the SANS 1795 Standard, if the images are to be used by the VPC (or in a court of law) as evidence of a transaction or violation.

- 7.4.2.7 Video capturing may be implemented to enforce or provide evidence of Class Discrepancies and may be implemented in combination with one of the above enforcement methods.
- 7.4.2.8 The project specific requirements shall dictate what enforcement methods need to be provided and the Toll Agency shall ensure compliance to such project specifications.
- 7.4.3 Physical Enforcement Systems for Conventional or Hybrid Toll Plazas (e.g. barrier)
  - 7.4.3.1 Physical enforcement systems shall provide for a high-speed barrier (boom) mechanism capable of deterring vehicles from proceeding through a lane. It shall deny a vehicle access through the lane until a valid transaction for the specific vehicle has been completed.
  - 7.4.3.2 The physical enforcement system for ETC applications shall react and open or close a lane in less than one (1) second.
  - 7.4.3.3 The Toll Agency shall take full responsibility for physical enforcement and shall not be remunerated by any other party should such enforcement fail, although the Account IA may be approached by the Toll Agency to act against violators if evidence of the identity of the offending vehicle can be provided.

## **8. ROADSIDE SIGNAGE FOR CONVENTIONAL OR HYBRID TOLL PLAZAS**

### **8.1 INTRODUCTION**

- 8.1.1 The signage specified in this clause of the Standard Specification is limited to the signage that is required for Conventional or Hybrid Toll Plazas and not for ORT applications. The signage for ORT type applications shall not require signage at Tolling Points but shall indicate that the route is a Toll Road and the Tariffs applicable for travelling on the route. This signage (for ORT type applications) shall be specified in the respective project specifications.
- 8.1.2 The Toll Agency shall be responsible for the supply and installation of all signage indicating information regarding the payment methods allowed at a Toll Plaza and in which lanes the payment method is allowed. The information given to Road Users on these signs shall comply with the laws and regulations for such installations like the latest addition of the South African Road Traffic Signs Manual. It shall also comply with this specification in order to ensure uniformity and to prevent confusion of the Road User at different plazas in South Africa.
- 8.1.3 All proposed signs shall be submitted for approval to the South African National Roads Agency Limited.

### **8.2 RESPONSIBILITY**

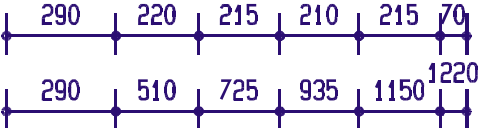
- 8.2.1 The Toll Agency shall be responsible for the supply and installation of roadside signage to relay all required information to the Road Users, when nearing and when at a Toll Plaza or when entering a Toll Road.

### **8.3 GENERAL FORMAT**

- 8.3.1 The colour of the signage and lettering size shall be confirmed after consultation with the South African National Roads Agency Limited (SANRAL). The letter type shall conform to German DIN 1451 standard. Figure 8-1 shows typical examples. The colour of all signage shall be Class 1 retro-reflective material. All materials shall comply with SABS 1519 standards. Drawings of signage shall be presented to SANRAL for approval before manufacturing commences.

COLOUR :  
BLACK SEMI-MATT  
SERIES : DIN B  
LETTER SIZE :  
UPPER CASE : 280mm  
LOWER CASE : 200mm

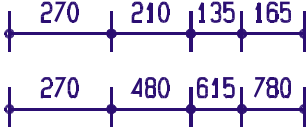
Manual



290	220	215	210	215	70
290	510	725	935	1150	1220

COLOUR :  
WHITE CLASS 3  
SERIES : DIN B  
LETTER SIZE :  
UPPER CASE : 280mm  
LOWER CASE : 200mm

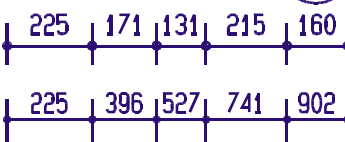
Auto



270	210	135	165
270	480	615	780

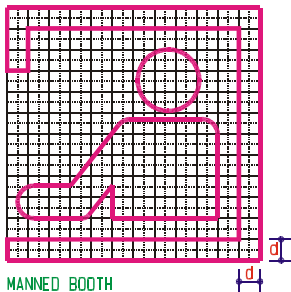
COLOUR :  
BLACK SEMI-MATT  
SERIES : DIN B  
LETTER SIZE :  
UPPER CASE : 280mm  
LOWER CASE : 200mm

e-tag

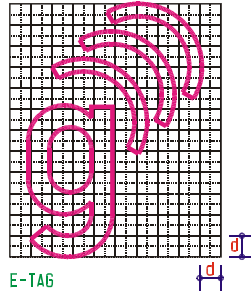


225	171	131	215	160
225	396	527	741	902

SYMBOL COLOUR:  
BLACK SEMI-MATT



SYMBOL COLOUR:  
BLACK SEMI-MATT



SYMBOL COLOUR:  
BLACK SEMI-MATT

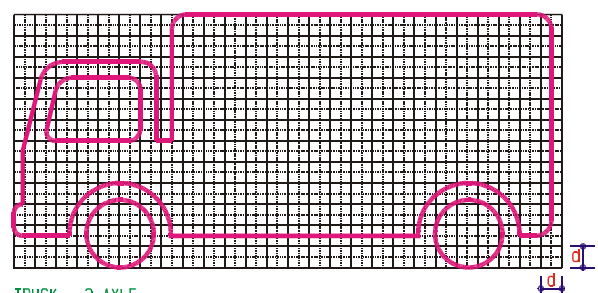


Figure 8-1: Typical sign lettering and symbols (not to scale)

## 8.4 OBJECTIVES

- 8.4.1 The objective of standardising road signage is to prevent confusion of the Road User, improve traffic safety by simplifying Road User decisions ahead of the Toll Plazas and Tolling Points and to improve the service level.
- 8.4.2 The Road User has to be able to absorb the traffic situation at the Toll Plazas and Tolling Points, obtain information about where to drive and select the correct lane.

## 8.5 INFORMATION TO ROAD USERS

- 8.5.1 The information relayed to the Road User shall be provided at the following positions:
  - a. Ahead of the Toll Plaza
  - b. At the Toll Plaza selecting the correct lane

- c. At the Toll Plaza on the canopy
- d. By means of ordinary traffic signs and signals

#### 8.5.2 Before a Toll Plaza

- 8.5.2.1 When the Road User approaches the Toll Plaza and is not familiar with the locality, he will need information such as what payment methods are accepted and what enforcement method is used, if applicable.
- 8.5.2.2 Colour coding with Class 1 material will be used to indicate the different payment methods. Orange will be used to indicate Electronic Toll Collection, turquoise to indicate automatic card lanes and grey to indicate normal manual lanes.
- 8.5.2.3 The size of the lettering shall typically be 280mm for upper case and 200mm for lower case letters. A typical sign indicating the different payment methods are indicated below:

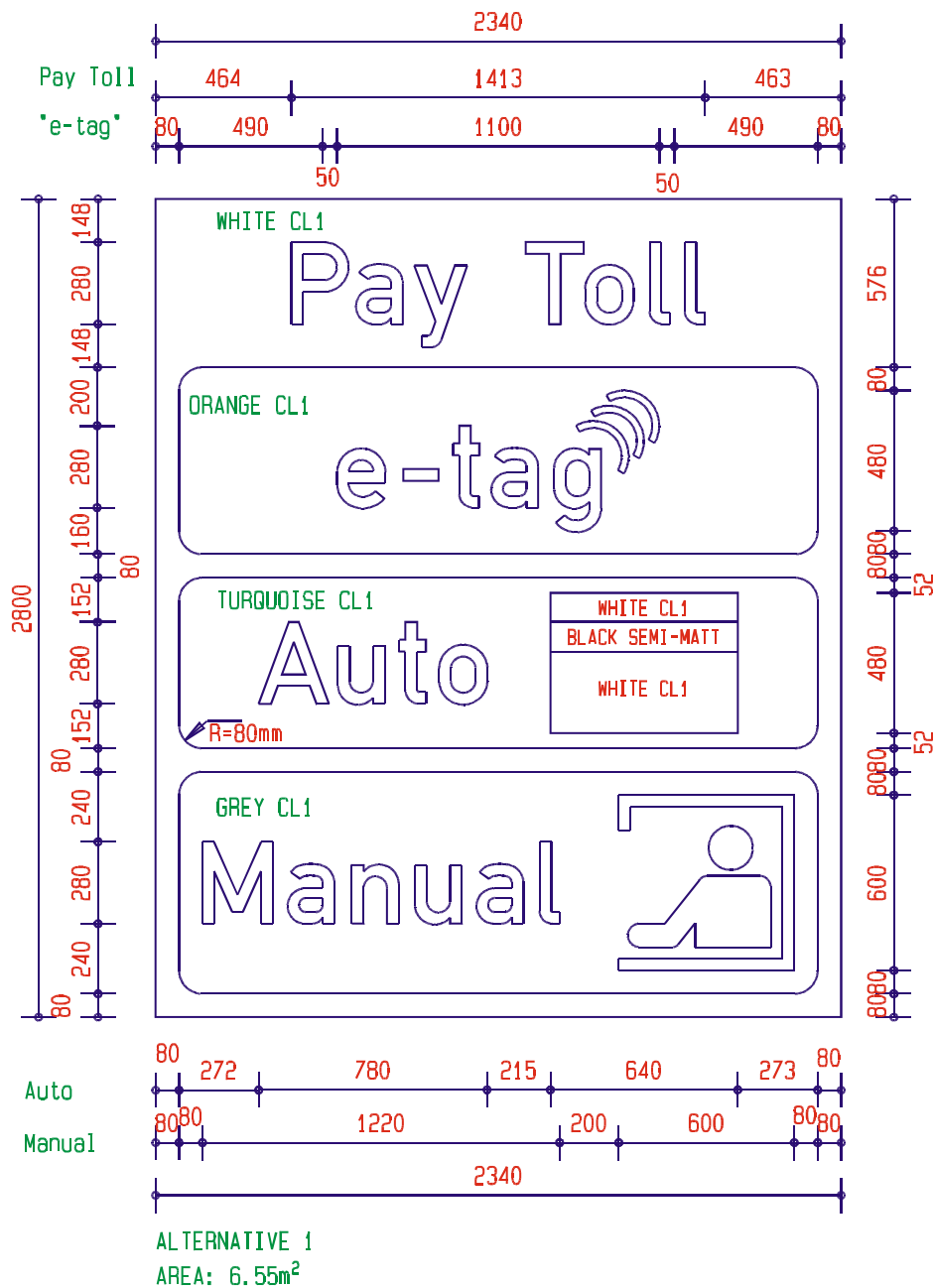


Figure 8-2: Typical sign indicating different payment methods when nearing Toll Plaza

### 8.5.3 At the Toll Plaza selecting the correct lane

- 8.5.3.1 For Toll Plazas that include more than one lane, and where each lane can be assigned to different payment methods, information signs must be provided to the Road User. Signs on a gantry will explain what payment method is required in that particular lane and any possible restrictions regarding Vehicle Classifications will also be displayed.
- 8.5.3.2 Where necessary, the signs shall be automatically changeable to enable operators to change the payment methods allowed in a lane.
- 8.5.3.3 It is important that the information regarding differences between the lanes is provided to the Road User prior to the Toll Plaza. Symbols or writing can be placed on gantries or signposts next to the road, and hence reduce the possibility for last minute confusion. Colour coding the different payment methods is proposed to further accommodate the decision process of the Road User. Orange will be used for ETC lanes, turquoise for automatic card lanes and grey for manual lanes.
- 8.5.3.4 There will be many different factors that influence the signage. Hence it will be the responsibility of the Toll Agency to design the layout and signage at each Toll Plaza according to the latest edition of the South African Road Traffic Signs Manual and this specification. The proposed signage drawings shall be submitted to the South African National Roads Agency Limited for approval before manufacturing commences.
- 8.5.3.5 Typical signage when nearing the plaza is indicated below in Figure 8-3 and Figure 8-4. These signs will be mounted on posts next to the road. Full details including the size of the sign shall be submitted to SANRAL for approval. The size of the lettering shall typically be 350mm for upper case and 250mm for lower case for these signs. The colour of the sign indicating ETC will be orange, with black lettering.

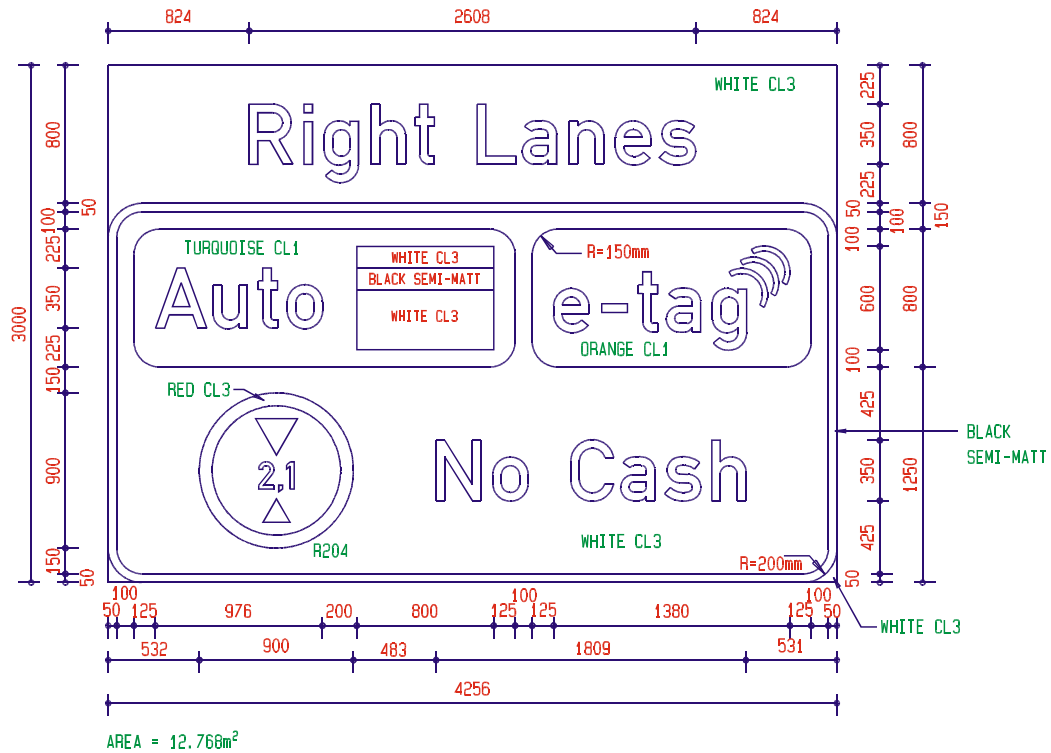


Figure 8-3: Typical sign on a signpost when nearing the Toll Plaza: Auto (card-only) and ETC lanes for light vehicles

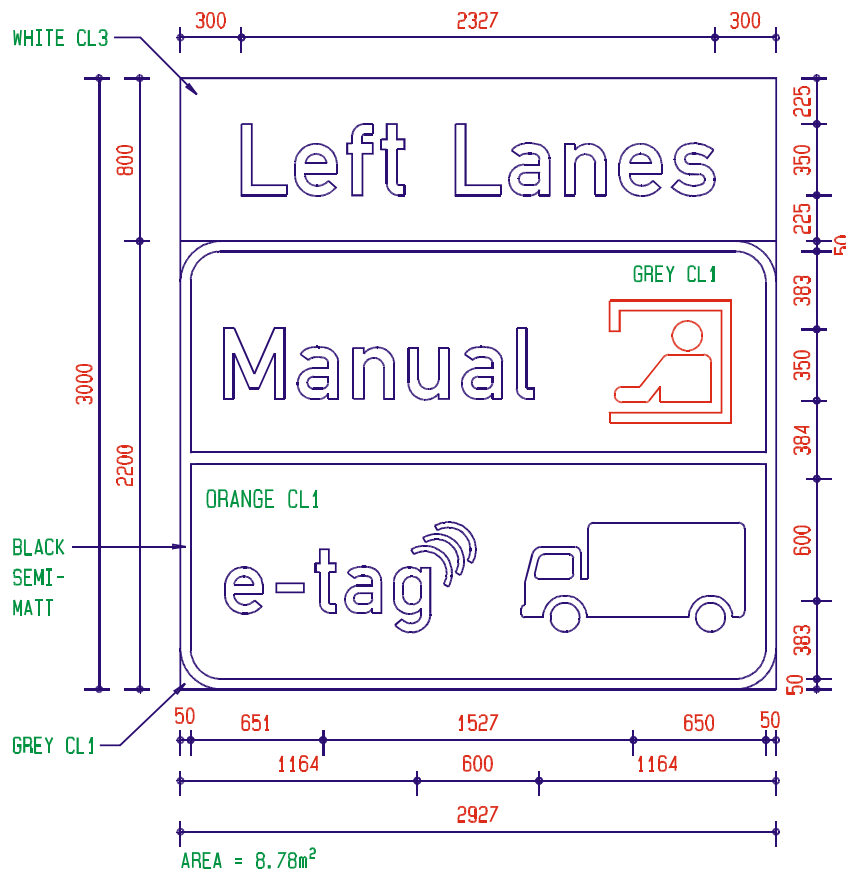
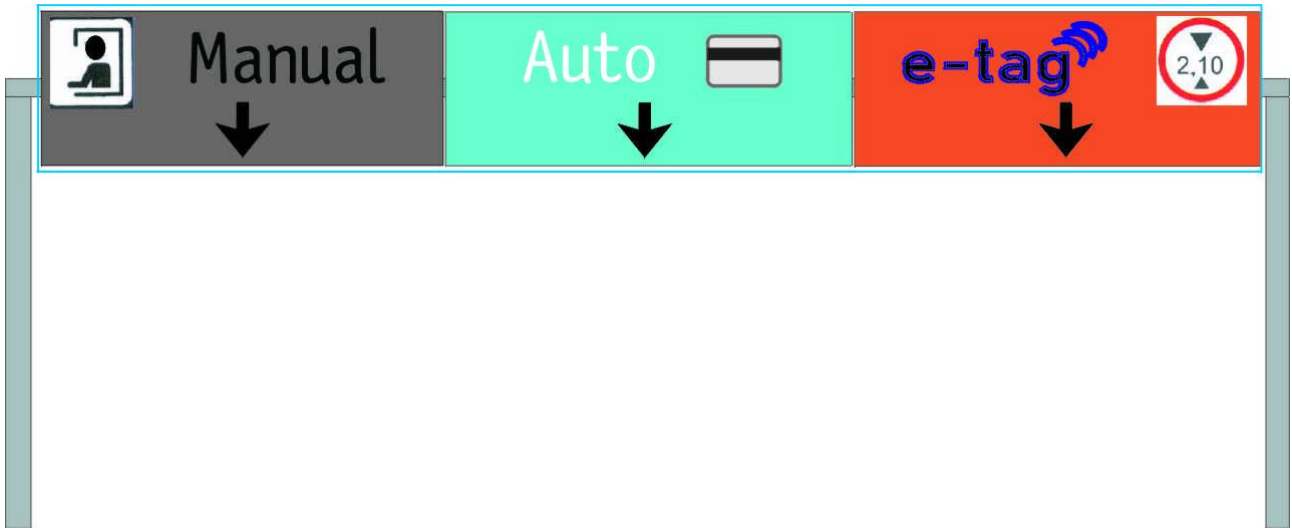


Figure 8-4: Typical sign on a signpost when nearing the Toll Plaza: Manual and ETC lanes for heavy vehicles

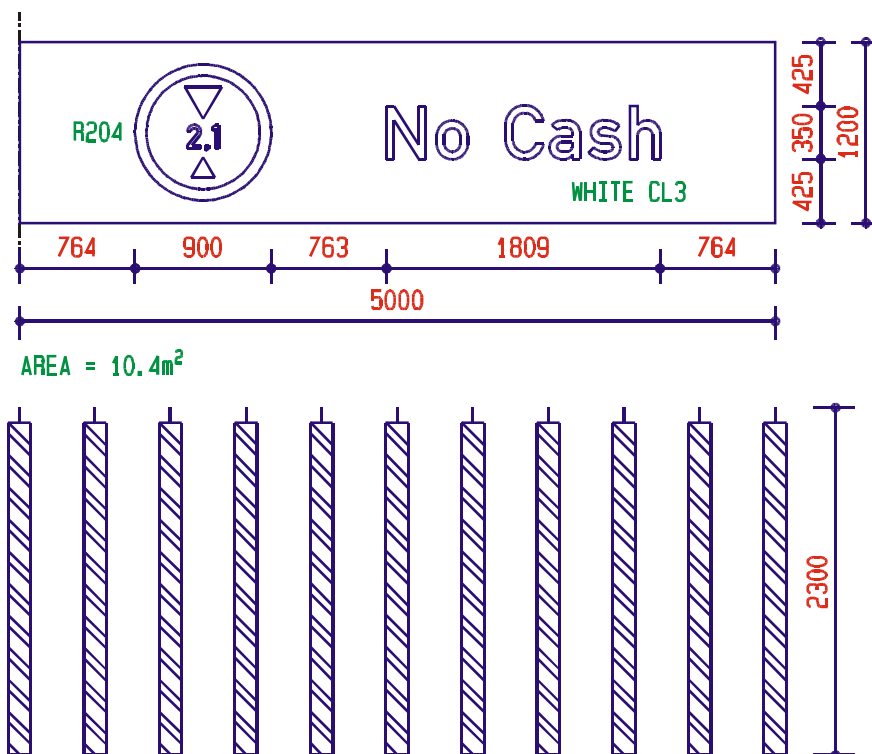
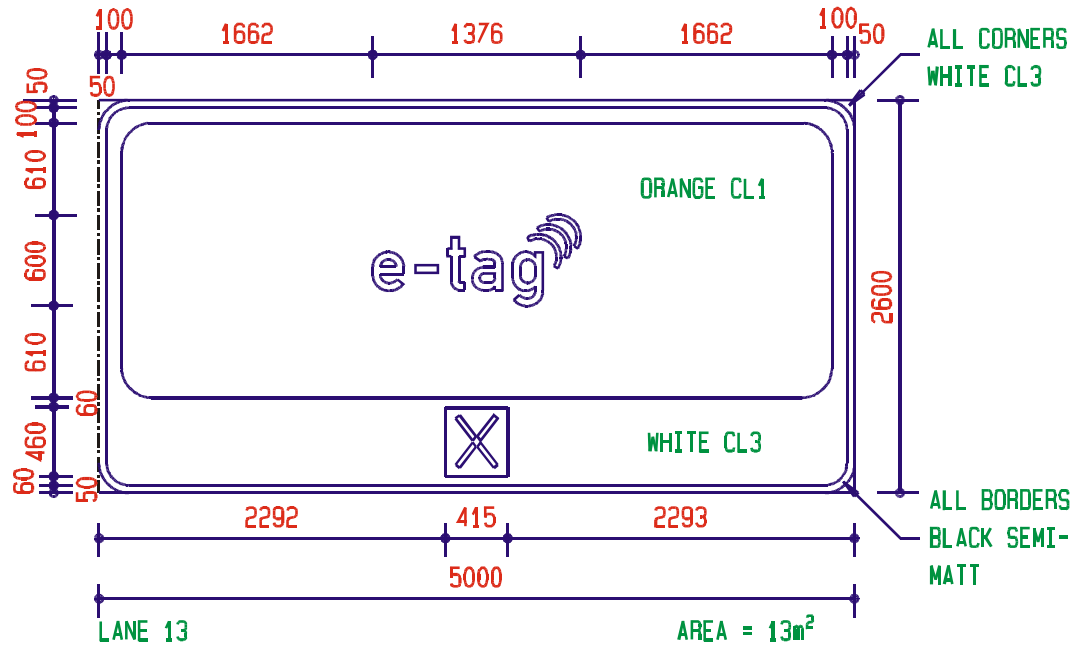
- 8.5.3.6 A gantry may be erected to assist with lane selection, either before or after the taper in the road for the Toll Plaza. The signs on the gantry shall typically look as indicated in Figure 8-5. Full details including the size of the sign shall be submitted to SANRAL for approval. The letter size of the signs on the gantries shall typically be 350mm for upper case and 250mm for lower case letters. Please note that these signs are typical and can be presented with or without height restrictions.



**Figure 8-5: Typical sign on a gantry, to assist with lane selection.  
ONLY FOR ILLUSTRATIVE PURPOSES**

## **8.6 FIXED SIGNS ON THE TOLL PLAZA CANOPY**

- 8.6.1 The Toll Agency shall supply fixed signage on the canopy indicating the payment method to be used in dedicated or express ETC lanes. Depending on the type of lane, the required sign shall be installed above mixed ETC lanes on the front of the canopy. Fixing detail shall be on the top of the canopy in the middle of the lane. The Over Head Lane Signs (OHLS) shall be mounted on the front of the canopy, below this sign. Please note that these signs are typical and can be presented with or without height restrictions.
- 8.6.2 The fixed signs shall typically be as indicated in Figure 8-6 and Figure 8-7. Full details including the size of the sign shall be submitted to SANRAL for approval. The letter size shall typically be 350mm for upper case and 250mm for lowercase letters.
- 8.6.3 It is not a requirement that signage be provided indication the payment method in all dedicated manual lanes. Signage for dedicated manual lanes must though be provided at plazas where the traffic volumes require it and confusion would be prevalent should the signs not be provided.



The chevrons are Ø150mm white PVC pipes with red retro-reflective tape.

## 8.7 CHANGEABLE MESSAGE SIGNS

- 8.7.1 Signage shall be provided to indicate to the Road User which lanes are mixed ETC lanes. Signage that needs to change to indicate to Road Users the payment method allowed in a lane (ETC, cards, cash) shall form part of this scope of works.



- 8.7.2 Depending on the type of lane, the required sign shall be installed above mixed ETC lanes above the canopy. Fixing detail shall be on the canopy in the middle of the lane. The OHLS or lane open/closed sign shall be mounted on the canopy, below the changeable sign.
- 8.7.3 The message on the message sign shall be changeable from the lane controller at the tollbooth to indicate to the Road User the mode of operation and payment methods allowed at any stage. The sign shall indicate the message to the Road User by means of scrolling fixed elements or a scrolling curtain with luminaries behind the curtain illuminating it.
- 8.7.4 When a lane is opened as a dedicated ETC lane, the lane controller shall relay a message to the changeable sign that the lane is only accepting ETC Customers. When a lane is opened as a mixed lane, the lane controller shall relay a message to the changeable sign indicating the lane is opened for all type of transactions as per Figure 8-8, or accepting only ETC and card transactions as per Figure 8-9. When the lane is opened in manual mode only, the lane controller shall relay a message to the changeable sign indicating either "Manual" or a blank white screen.
- 8.7.5 A sensor shall be installed to detect and determine the current position of all mechanical signs to ensure the correct message is displayed. This status will be displayed on the Tolling System terminal in the tollbooth and on the display unit in the control room. This switching of the changeable signs shall be done from the tollbooth in the particular lane, or from the control room where no Tolling System terminal is present.
- 8.7.6 Full details including the size of the sign shall be submitted to SANRAL for approval. The size of the lettering will be typically 350mm for upper case and 250mm for lowercase letters. Orange will be used for ETC lanes, turquoise for automatic card lanes and grey for manual lanes.

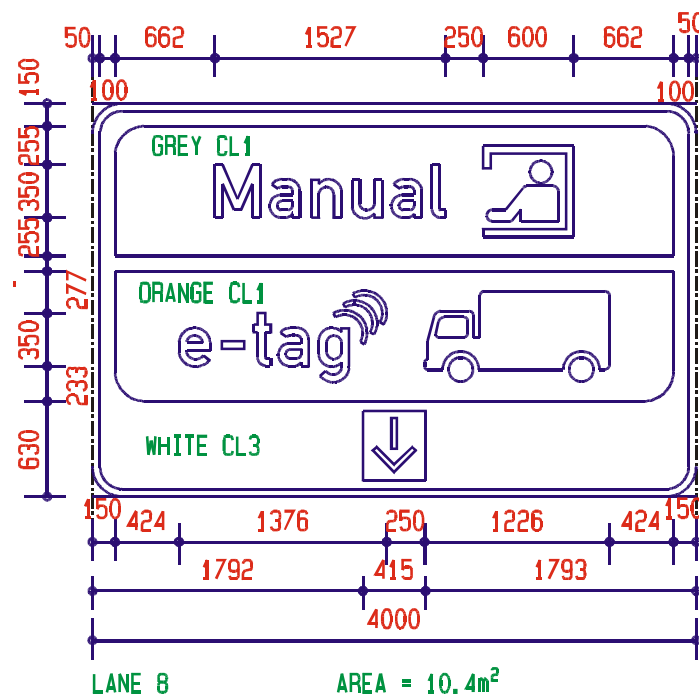


Figure 8-8: Typical changeable sign for mixed ETC/ cash / card lane.

**Note:** In the example, it is assumed that the plaza is also equipped with light-vehicle only ETC lanes. Heavy vehicles must therefore utilise the ETC facilities in the manual lanes.

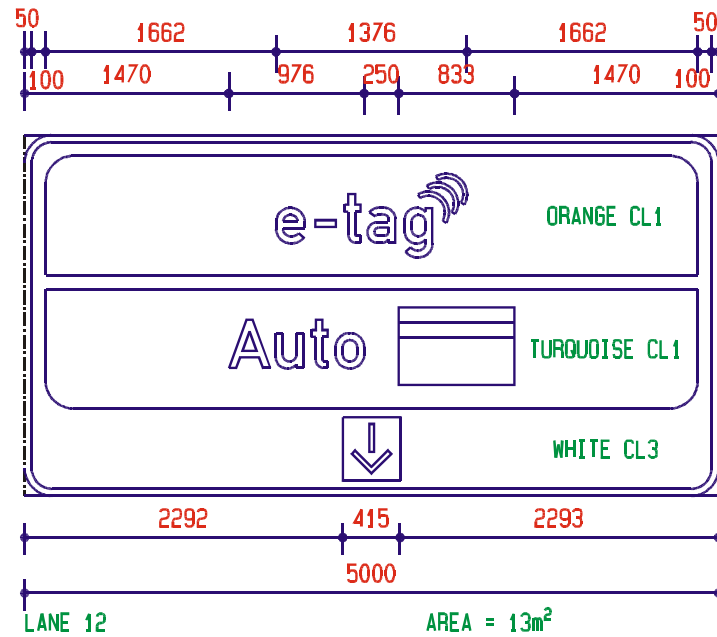


Figure 8-9: Typical changeable sign for mixed ETC/ card operation mode

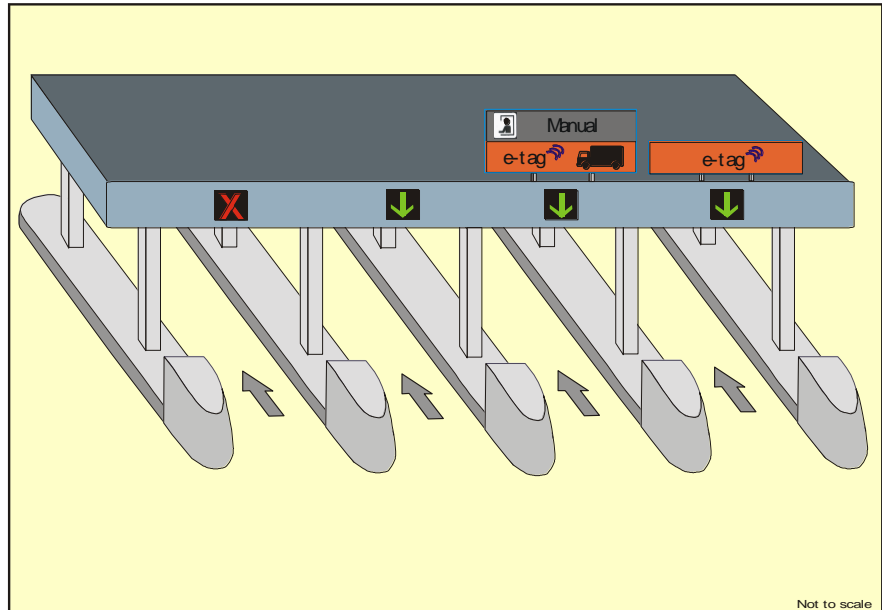
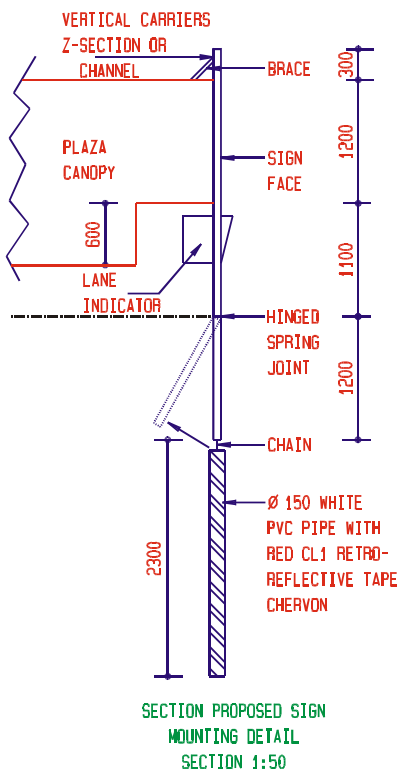
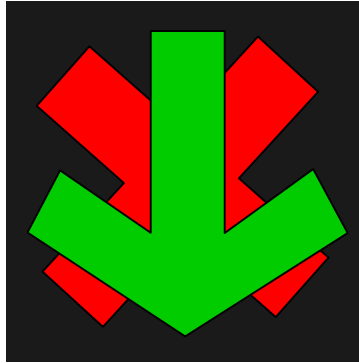


Figure 8-10: Typical signage configurations and installations on a canopy

## 8.8 OVERHEAD LANE SIGNS

- 8.8.1 An indicator shall be provided above each toll lane indicating clearly whether the lane is in open or closed mode. Refer to the previous signs and specifically to Figure 8-10. This indicator shall consist of a red cross indicating that the lane is in a closed state. Typically a green arrow shall indicate that the lane is in an open state. A typical configuration of such an OHLS is depicted in Figure 8-11.



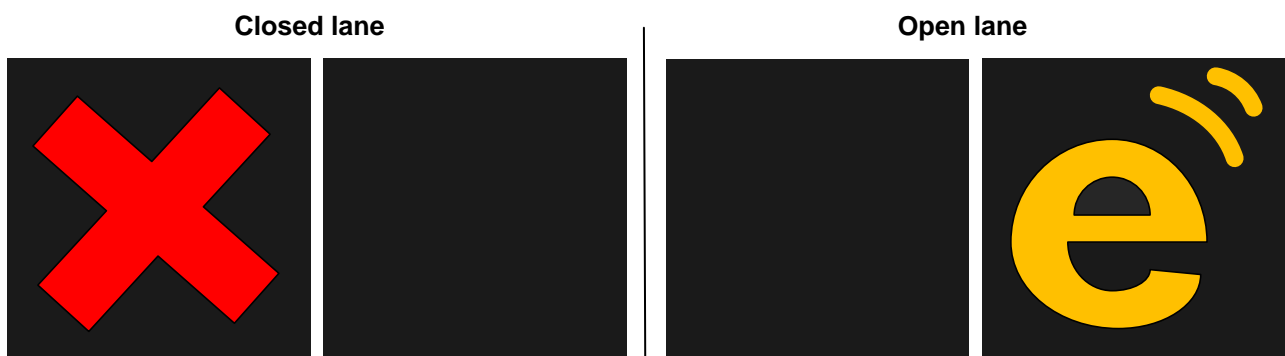
**Figure 8-11: Typical OHLS**

- 8.8.2 An alternative option to the fixed ETC canopy sign shall be an amber coloured letter “e” OHLS, depicted in Figure 8-12. The use of this sign shall indicate the acceptance of Tags (or e-tag).



**Figure 8-12: Typical ETC OHLS**

- 8.8.3 This ETC OHLS, together with the green arrow and red cross sign in Figure 8-11, shall be used as is indicated in Figure 8-13 for a dedicated ETC lane in both an open and closed state:



**Figure 8-13: Typical OHLS configuration for a closed and open dedicated ETC lane**

- 8.8.4 The ETC OHLS of Figure 8-13, together with the green arrow and red cross sign in Figure 8-11, shall be used as is indicated in Figure 8-14 for a mixed ETC lane in both an open and closed state:



**Figure 8-14: Typical OHLS configuration for a closed and open mixed ETC lane**

- 8.8.5 The design of the ETC OHLS in Figure 8-12 shall be submitted to SANRAL for approval. The ETC OHLS design shall be of the same standard and size as for the lane open or lane close (green arrow and red cross) OHLS indicated in Figure 8-11.

## **8.9 INSTALLATION OF SIGNAGE ON CANOPY**

- 8.9.1 The signage shall typically be mounted as indicated in Figure 8-10 on top of, or at the front of the canopy, above the OHLS. Concrete and steel canopies will require different mounting details. The mounting detail and positioning of the signage on the canopy shall be submitted to SANRAL for approval for each plaza. Wiring shall be required to the changeable signs, to accommodate the message changing of the signs, as well as the monitoring of the message on the signs. After installation of signage on the canopy, consideration shall be given to the upgrade of the lightning protection on the canopy to include the protection of the signs. Where ample light is not already available at all times of the day, the Toll Agency will supply illumination for the signs on top of the canopy.

## **8.10 TOLL PLAZA ROAD MARKINGS**

- 8.10.1 The Toll Agency shall be responsible to provide road markings clearly indicating to Road Users the lanes that are only used for dedicated ETC or express ETC payment. This is to avoid as far as possible confusion from the Road User and to prevent the unnecessary closing of ETC lanes due to Road Users without Tags blocking the dedicated ETC lanes. The road markings colour will be orange indicating ETC lanes. The block markings will be 3000mm long and 1000mm wide as indicated in Figure 8-15 and shall be painted on the road surface 3000mm apart. Please note that the blocks shall be hollow blocks i.e. not painted in the centre of the block. Road paint shall comply to SABS 731. The length of the road marking shall depend on the site, but will typically start 50 m away of the canopy area and follow into the lane. Note that the painting of the road markings will mainly be on block paving. The layout of the road painting shall be submitted to SANRAL for approval before any painting commences.

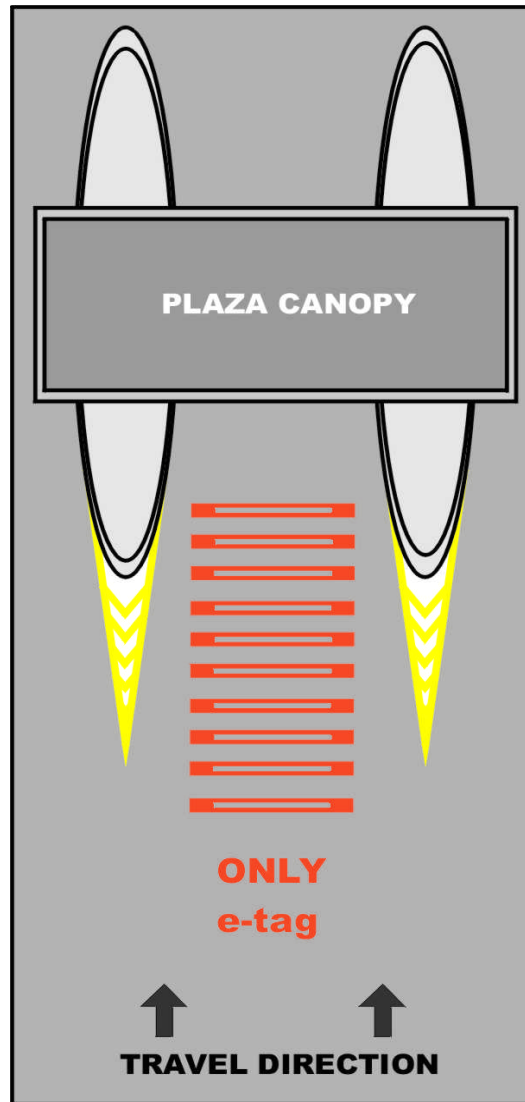


Figure 8-15: Typical drawing for road markings for dedicated ETC or express lanes

## 9. TESTING AND CERTIFICATION

### 9.1 INTRODUCTION

9.1.1 A four-step approach for testing an ETC system is specified:

- a. Test individual components or equipment for conformity with the applicable standards to ensure that all suppliers, contractors or sub-contractors have implemented this Standard Specification in the same way.
- b. Validate the individual DSRC equipment components for their ability to be interoperable.
- c. Validate the integrated performance of the DSRC equipment for its ability to function properly.
- d. Verify the integrated performance of the DSRC equipment to provide continuous and regular service.

9.1.2 Steps b) and c) can be conducted simultaneously, but the distinction between interoperability validation of individual components b) and proper-function validation within the system as a whole c), shall be clearly made.

### 9.2 APPROACH

9.2.1 The following test standards and specification shall be used by the Toll Agency to ensure compliance with these testing requirements. If any amendments have to be made, it shall be indicated within the Toll Agency developed test procedure. For undated references, the latest edition of the publication referred to applies (including amendments).

9.2.1.1	[prEN 15876-1]	prEN 15876 -1:2008 - Electronic fee collection– Conformity evaluation of on board unit and roadside equipment to EN 15509 - Part 1: Test Suite structure and test purposes.
9.2.1.2	[TS 14907-1 – EFC TP]	CEN ISO/TS 14907-1 RTTT – EFC – Test procedures for user and fixed equipment – Part 1: Description of test procedures
9.2.1.3	[TS 14907-2 – EFC TC]	CEN ISO/TS 14907-2 RTTT – EFC – Test procedures for user and fixed equipment – Part 2: Conformance test for the onboard unit application interface
9.2.1.4	[ETSI DSRC L1 – test methods]	EN 300 674, RTTT; Technical characteristics and test methods for DSRC transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8GHz Industrial, Scientific and Medical (ISM) band
9.2.1.5	[ETSI DSRC L1 – tests]	ETSI EN 300 674-1, Electromagnetic compatibility and Radio spectrum Matters ERM; RTTT; DSRC transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band; Part 1: General characteristics and test methods for Road Side Units (RSU) and On-Board Units (Tags)
9.2.1.6	[ETSI DSRC L1 – Radio tests RSU]	ETSI EN 300 674-2-1, Electromagnetic compatibility and Radio spectrum Matters ERM; RTTT; DSRC transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band; Part 2: Harmonized EN under article 3.2 of the R&TTE Directive; Sub-part 1: Requirements for the Road Side Units (RSU)
9.2.1.7	[ETSI DSRC L1 – Radio tests TAG]	ETSI EN 300 674-2-2, Electromagnetic compatibility and Radio spectrum Matters ERM; RTTT; DSRC

transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band; Part 2: Harmonized EN under article 3.2 of the R&TTE Directive; Sub-part 2: Requirements for the On-Board Units (TAG)

- |          |                            |   |
|----------|----------------------------|---|
| 9.2.1.8  | [ETSI DSRC L2 – PICS]      | ETSI TS 102 486-2-1, Electromagnetic compatibility and Radio spectrum Matters ERM; RTTT; Test specifications for DSRC transmission equipment; Part 1: DSRC data link layer: medium access and logical link control; Sub-Part 1: Protocol Implementation Conformance Statement (PICS) proforma specification |
| 9.2.1.9  | [ETSI DSRC L2 – TSS&TP]    | ETSI TS 102 486-1-2, Electromagnetic compatibility and Radio spectrum Matters ERM; RTTT; Test specifications for DSRC transmission equipment; Part 1: DSRC data link layer: medium access and logical link Control; Sub-Part 2: Test Suite Structure and Test Purposes (TSS&TP)                             |
| 9.2.1.10 | [ETSI DSRC L2 – ATS&PIXIT] | ETSI TS 102 486-1-3, Electromagnetic compatibility and Radio spectrum Matters ERM; RTTT; Test specifications for DSRC transmission equipment; Part 1: DSRC data link layer: medium access and logical link control; Sub-Part 3: Abstract Test Suite (ATS) and partial PIXIT proforma                        |
| 9.2.1.11 | [ETSI DSRC L7 – PICS]      | ETSI TS 102 486-2-1, Electromagnetic compatibility and Radio spectrum Matters ERM; RTTT; Test specifications for DSRC transmission equipment; Part 2: DSRC application layer; Sub-Part 1: Protocol Implementation Conformance Statement (PICS) proforma Specification                                       |
| 9.2.1.12 | [ETSI DSRC L7 – TSS&TP]    | ETSI TS 102 486-2-2, Electromagnetic compatibility and Radio spectrum Matters ERM; RTTT; Test specifications for DSRC transmission equipment; Part 2: DSRC application layer; Sub-Part 2: Test Suite Structure and Test Purposes (TSS&TP)   |
| 9.2.1.13 | [ETSI DSRC L7 – ATS&PIXIT] | ETSI TS 102 486-2-3, Electromagnetic compatibility and Radio spectrum Matters ERM; RTTT; Test specifications for DSRC transmission equipment; Part 2: DSRC application layer; Sub-Part 3: Abstract Test Suite (ATS) and partial PIXIT proforma  |

### 9.3 TESTING OF INDIVIDUAL COMPONENTS (STEP A)

#### 9.3.1 Responsibility

- 9.3.1.1 It shall remain the responsibility of the Toll Agency planning to purchase or install any individual ETC component addressed within this specification, to submit to the South African National Roads Agency (SANRAL) for approval:
- a. A compliance statement from the supplier of the ETC equipment regarding conformance to the standards and specifications specified in clause 6.2.1.2 and to this Standard Specification, item by item for each numbered clause or sentence of this specification.

### 9.4 INTEROPERABILITY AND FUNCTIONALITY TESTS (STEPS B AND C)

#### 9.4.1 Responsibility

- 9.4.1.1 It shall remain the responsibility of the Toll Agency utilising any individual ETC component addressed within this specification to:

- a. Describe in a test plan or test procedure how the ETC components will be validated and obtain approval from SANRAL for this plan or procedure.
- b. Provide the validation test results to SANRAL for approval.
- c. Execute a Tag test validation for prequalified Tags and/or legacy Tags from already existing ETC installations, if applicable.
- d. Any equipment that has failed such validation tests shall not be considered by the Toll Agency for purposes of installation or integration within his facilities.
- e. The Toll Agency shall only install or use equipment that has been certified as "Acceptable ETC equipment within South Africa".

#### 9.4.2 Relevant aspects to be validated

##### 9.4.2.1 The aspects that are relevant for the validation of the ETC components are:

- a. The implementation of such a component according to this Standard Specification.
- b. The integration of the DSRC components within the ETC system.
- c. The ETC system's interoperability with prequalified Tags
- d. The ETC system's interoperability towards already existing Tags (legacy Tags).
- e. The enabling of multi-scenario support for the Tag (i.e. a Tag is capable of working in mixed, dedicated and express lanes as well as ORT type ETC set-ups).
- f. The interoperability of such an ETC component with similar components from different manufacturers.

#### 9.4.3 ETC validation test requirements

9.4.3.1 Validation of ETC equipment shall be done as part of an acceptance test activity. This activity shall be certified by the Toll Agency before inviting SANRAL to witness the tests. Tests, reviews, audits and demonstrations can be used during acceptance test activities in order to show compliance to relevant specifications, however demonstrations alone shall not be deemed sufficient. Thus, lower level validation activities must focus on conformance testing of the equipment used in the demonstrations.

9.4.3.2 It is assumed that validation of all possible instances is not feasible for reasons of limited time and budget constraints. It is noted that it is of utmost importance that the completeness of the validation activities are maintained. This implies that all validation aspects need to be covered and that only the number of tests shall be reduced for a specific validation aspect. Therefore, the Toll Agency performing the acceptance test shall make provision for the following:

- a. The Tolling System, including the RSE and Tag Reader, shall be involved in the validation tests.
- b. Tests with real equipment shall be conducted and shall include the following validation methods:
  - i) Laboratory tests (real equipment in controlled environment).
  - ii) Field trials (real equipment in real, uncontrolled environment).
- c. For these validation methods, at least one of the following scenarios shall be tested. The scenario to be tested shall be dependant on the application utilised by the Toll Agency. If both scenarios will be implemented, then both shall be tested.
  - i) Dedicated or mixed ETC lane set-ups (single lane, slow vehicle speed, but within the overall specified ETC accuracy levels).
  - ii) ORT set-up (multiple lanes, vehicle speed at the maximum specified speed and overall specified ETC accuracy levels).



#### 9.4.4 Tag validation test requirements

9.4.4.1 The ETC System shall be able to successfully communicate with the Tags from all the pre-qualified Tag suppliers and from existing ETC toll roads in South Africa and a Toll Agency shall test and certify the Tags as specified in the following procedure:

- a. Up to ten (10) sample Tags from every one of the prequalified Tag suppliers as well as from all the Toll Agencies that supplied Tags in South Africa, shall be tested and made to function according to this Standard Specification by the Toll Agency, first through a validation and certification process undertaken by the Toll Agency, and then through a certification process witnessed by SANRAL, at any designated test location where the Tag Reader has been installed. Should the tests with SANRAL fail, the Toll Agency shall be required to retest the sample Tags within one month from the initial tests, and shall carry all the retesting costs;
- b. If the Tags do not function accordingly, then the Toll Agency shall be responsible to rectify the problem and to liaise with the Tag supplier and/or relevant Toll Agency (whether it be a Concessionaire, CTROM Operator, etc);
- c. If the Toll Agency cannot read or communicate with a specific Tag due to a Tag error, then the Toll Agency shall provide the reasons why the Tag could not be read and what solutions can be implemented to correct this. In this case, the Toll Agency shall still liaise with the Tag supplier and/or relevant Toll Agency in order to find solutions for the problem. Apart from the legacy Tags, the Toll Agency will not be held responsible for EN15509 Tags that fail certification due to their non-compliance with the EN 15509 standard;
- d. The Tag testing and certification process witnessed by SANRAL will be subject to a minimum three (3) week notification period.

9.4.4.2 The following tests shall be performed on each Tag:

- a. For each Tag at least the following shall be validated:
  - i) The encoding
  - ii) The memory management
  - iii) The access and application instance implementation
  - iv) The Attribute authentication
  - v) The derivation of keys
  - vi) The compliance with [EN 15509]
- b. The implementation of each communication layer shall be validated. The following layers shall be considered:
  - i) Physical layer (layer 1);
  - ii) Data link layer (layer 2); and
  - iii) Application layer (layer 7).
- c. The implementation of the transaction sequence shall be validated. At least the following components shall be considered:
  - i) Initialisation phase
  - ii) Security initialisation
  - iii) Presentation phase
  - iv) Receipt phase
  - v) Tracking phase
  - vi) Closing phase

#### 9.4.5 Requirements for test plans and test results

##### 9.4.5.1 The following minimum information shall be included within the test documentation:

- a. For each validation activity, the following information shall be provided within an SANRAL approved documented test procedure:
  - i) The validation method.
  - ii) The objective of the validation activity, addressing what identified validation aspect the activity contribute to, as well as what would be the consequences if the activity is not performed.
  - iii) Criteria that must be satisfied upon which the validation activity shall be considered to be successful; in case the validation activity can be subdivided into separate sub-activities (e.g. multiple test runs), the criteria shall be specified for each sub-activity.
  - iv) Definition of input conditions or scenarios, if applicable, e.g.:
    - Environmental and/or weather conditions.
    - Traffic scenarios.
    - Drivers, including driver instructions.
    - Equipment and tools used.
  - v) A detailed work plan that serves as the guideline for the execution of the activities. This should include, for each activity or sub-activity, at least the following information:
    - Sequence number.
    - Task description.
  - vi) Test preparation and planning details, which shall include (where applicable):
    - Vehicle or vehicle group details.
    - Driving details.
    - Location(s).
    - Start of validation activity.
    - Estimated duration.
    - Partners involved.
  - vii) Validation test results, which shall include:
    - Summary of test results.
    - Detailed test results and test data.
  - viii) Reports concluding whether the ETC component can be considered to have passed or failed the validation.

#### 9.4.6 Validation tests and results

9.4.6.1 Validation tests for step B and C shall be performed by the Toll Agency. All results shall be submitted to SANRAL, including the test procedure (specification), for approval. Approval of such test procedures and results shall not imply that equipment or systems comply with specific requirements and specifications within this document, unless such an aspect has been specifically and unambiguously validated and the results included in the documentation submitted to SANRAL.

9.4.6.2 SANRAL shall be notified of the occurrence of such testing no later than two weeks before the testing is due and SANRAL shall have the option to attend these tests.

- 9.4.6.3 After approval of the test procedures and results, suppliers can request for equipment that has been validated (i.e. as being interoperable and functioning properly) to be certified with SANRAL as “Acceptable ETC equipment for South Africa”.
- 9.4.6.4 OBE and RSE will be certified separately i.e. any OBE or RSE model not already certified as “Acceptable ETC equipment for South Africa” will have to be tested and certified with SANRAL before such equipment is considered for implementation.

## 9.5 VERIFICATION OF REGULAR SERVICE (STEP D)

### 9.5.1 Responsibility

- 9.5.1.1 The Toll Agency operating ETC equipment addressed within this specification shall over a certain period of time after implementation, regularly conduct verification tests on ETC equipment components, in order to establish if such equipment or its components meet the requirements as addressed within this specification.
- 9.5.1.2 SANRAL reserves the right to audit the system of the Toll Agency should problems with regard to interoperability of ETC services occur. The Toll Agency shall not withhold any reasonable request from SANRAL or its appointed party for access to data, equipment, documentation or other resources required in the due course of the audit. The cost of such an audit will be borne by SANRAL unless the Toll Agency’s system is found during the audit to be non-complaint with the requirements and specification contained within this document, in which case the cost of the audit will be borne by the Toll Agency.

### 9.5.2 Verification tests and results

- 9.5.2.1 The Toll Agency shall monitor the relevant ETC equipment in real ETC situations over a period of time, in order to establish the continuous provision of regular service and conformance of such equipment to the specifications addressed herein.
- 9.5.2.2 If such equipment fail to provide continuous provision of regular service or do not entirely conform to the specification addressed herein, the Toll Agency shall submit a report to SANRAL. Such a report shall state what equipment has failed to provide regular service and why it is deemed that such a failure has occurred.
- 9.5.2.3 Based on the contents of this report, failure of such equipment to provide regular service shall justify the removal of such equipment from the “Acceptable ETC equipment within South Africa” certified list. Such equipment shall only be returned to the list if a TA or manufacturer of the said equipment can beyond reasonable doubt demonstrate that such equipment is providing a regular service.
- 9.5.2.4 Equipment or systems found to be non-complaint with any aspect of this specification during the course of its usage or during an audit, even after such equipment or system has passed the validation or verification tests, shall be deemed non-compliant. The Toll Agency shall therefore endeavour to rectify such non-compliance as soon as possible. Unless otherwise indicated by SANRAL, the costs of such rectification shall be for the Toll Agency’s account. In addition, failure of equipment to be rectified shall justify the removal of such equipment from the “Acceptable ETC equipment within South Africa” certified list.

## 9.6 CERTIFICATION

### 9.6.1 Certification is divided into the following two categories:

- 9.6.1.1 Validation tests performed by the Toll Agency as addressed in clause 9.4.
- 9.6.1.2 Certification as acceptable ETC equipment within South Africa.
- 9.6.2 Passing of the aforementioned validation tests shall make such a component eligible for certification of acceptable ETC equipment within South Africa.
- 9.6.3 Certification as acceptable ETC equipment shall be managed by SANRAL. After approval of the validation test results by SANRAL, such equipment shall be certified as “Acceptable ETC equipment within South Africa”.

- 9.6.4 Components that are certified as such equipment do not need to be validated again, unless such equipment has been revoked. Revocation of such equipment from the certification list therefore implies that such equipment must again undergo validation tests.

## **ANNEXURE A: STANDARDIZED PARAMETERS FOR TRANSACTION RECORDS AND ATTRIBUTES**

## 10. PARAMETERS FOR TRANSACTION RECORDS AND ATTRIBUTES

### 10.1 VALUE DESIGNATION FOR STANDARDISED PARAMETERS

- 10.1.1 The format of the different Toll Agencies, Toll Plazas or Tolling Points shall be as is defined in the Tables below (note that Lane/Tag Reader ID (*SessionLocation*) shall utilise the relevant lane number as is defined in the project specification and the Tag Reader identification shall be obtained from the manufacturer).

**Table 10-1: Toll Agency (*SessionServiceProvider*) parameter table**

Toll Agency ( <i>SessionServiceProvider</i> )	Value Designation 3 Octets (AA..ZZ & 0..16383)
Gauteng Open Road Tolling	GP0
N1 South	NS1
N1 North	NN1
N2 South	NS2
N2 North	NN2
N3 Concession (N3TC)	NC3
N3 Mariannhill	MN3
N4 Magalies	NW4
N4 West Concession (Bakwena)	NC4
N4 East Concession (TRAC)	NE4
N17	NR17
N2 Tsitsikamma	TN2
N1 Huguenot (Tunnel)	HN1

**Table 10-2: Toll Plaza (*LocationOfStation*) parameter table**

Toll Plaza	Virtual Plaza ( <i>LocationOfStation</i> )	Value Designation 2 Octets (0..65535)
Baobab	Baobab Mainline North	268
Baobab	Baobab Mainline South	269
Brits	Brits Mainline East	388
Brits	Brits Mainline West	389
Capricorn	Capricorn Mainline North	112
Capricorn	Capricorn Mainline South	113
Carousel	Carousel Mainline North	260
Carousel	Carousel Mainline South	261
Carousel	Hammanskraal Remote Ramp North	256
Carousel	Hammanskraal Remote Ramp South	257
Carousel	Maubane Remote Ramp North	259
Carousel	Maubane Remote Ramp South	258
Carousel	Murrayhill Remote Ramp North	254
Carousel	Murrayhill Remote Ramp South	255
Carousel	Wallmanstall Remote Ramp North	252
Carousel	Wallmanstall Remote Ramp South	253
Dalpark	Brakpan Remote Ramp East	185
Dalpark	Brakpan Remote Ramp West	186

<b>Toll Plaza</b>	<b>Virtual Plaza (LocationOfStation)</b>	<b>Value Designation 2 Octets (0..65535)</b>
Dalpark	Dalpark Mainline East	183
Dalpark	Dalpark Mainline West	184
De Hoek	De Hoek Mainline North	262
De Hoek	De Hoek Mainline South	263
Diamond Hill	Cullinan Remote Ramp East	400
Diamond Hill	Cullinan Remote Ramp West	401
Diamond Hill	Diamond Hill Mainline East	396
Diamond Hill	Diamond Hill Mainline West	397
Diamond Hill	Donkerhoek Remote Ramp East	398
Diamond Hill	Donkerhoek Remote Ramp West	399
Diamond Hill	Ekandustria Remote Ramp East	404
Diamond Hill	Ekandustria Remote Ramp West	405
Diamond Hill	Valtaki Remote Ramp East	402
Diamond Hill	Valtaki Remote Ramp West	403
Doornpoort	Doornpoort Mainline East	328
Doornpoort	Doornpoort Mainline West	329
Doornpoort	K99 East Ramp Remote Ramp East	368
Doornpoort	K99 East Ramp Remote Ramp West	330
Doornpoort	K99 West Ramp Remote Ramp East	331
Gosforth	Gosforth East Local Ramp East	171
Gosforth	Gosforth East Local Ramp West	172
Gosforth	Gosforth Mainline East	169
Gosforth	Gosforth Mainline West	170
Gosforth	Gosforth West Remote Ramp East	173
Gosforth	Gosforth West Remote Ramp West	174
Grasmere	Grasmere Local Ramp North	108
Grasmere	Grasmere Local Ramp South	109
Grasmere	Grasmere Mainline North	106
Grasmere	Grasmere Mainline South	107
Grasmere	Grasmere Remote Ramp North	110
Grasmere	Grasmere Remote Ramp South	111
Huguenot Tunnel	Huguenot Mainline North	217
Huguenot Tunnel	Huguenot Mainline South	218
Kranskop	Kranskop Local Ramp North	118
Kranskop	Kranskop Local Ramp South	119
Kranskop	Kranskop Mainline North	116
Kranskop	Kranskop Mainline South	117
Machadodorp	Machado Mainline East	175
Machadodorp	Machado Mainline West	176
Magalies	Pelindaba Satellite Plaza East	157
Magalies	Pelindaba Satellite Plaza West	158
Magalies	Quagga Mainline East	120
Magalies	Quagga Mainline West	121
Mariannhill	Mariannhill Mainline North	124
Mariannhill	Mariannhill Mainline South	125
Middelburg	Middelburg Mainline East	155
Middelburg	Middelburg Mainline West	156

<b>Toll Plaza</b>	<b>Virtual Plaza (LocationOfStation)</b>	<b>Value Designation 2 Octets (0..65535)</b>
Mooi	Mooi Local Ramp North	163
Mooi	Mooi Local Ramp South	164
Mooi	Mooi Mainline North	161
Mooi	Mooi Mainline South	162
Mooi	Treverton Remote Ramp North	167
Mooi	Treverton Remote Ramp South	168
Mooi	Wimpie Remote Ramp North	165
Mooi	Wimpie Remote Ramp South	166
Mtunzini	Dokedweni Remote Ramp North	98
Mtunzini	Dokedweni Remote Ramp South	99
Mtunzini	Mandeni Remote Ramp North	60
Mtunzini	Mandeni Remote Ramp South	61
Mtunzini	Mtunzini Mainline North	100
Mtunzini	Mtunzini Mainline South	101
Mtunzini	Mtunzini Local Ramp North	102
Mtunzini	Mtunzini Local Ramp South	103
Mtunzini	Mtunzini Remote Ramp North	104
Mtunzini	Mtunzini Remote Ramp South	105
Mvoti	Mvoti Mainline North	126
Mvoti	Mvoti Mainline South	127
Nyl	Nyl Local Ramp North	130
Nyl	Nyl Local Ramp South	131
Nyl	Nyl Mainline North	128
Nyl	Nyl Mainline South	129
Nyl	Sebetiela Satellite Plaza North	159
Nyl	Sebetiela Satellite Plaza South	160
Oribi	Izotsha Remote Ramp North	140
Oribi	Izotsha Remote Ramp South	141
Oribi	Oribi Local Ramp North	136
Oribi	Oribi Local Ramp South	137
Oribi	Oribi Mainline North	134
Oribi	Oribi Mainline South	135
Oribi	Oribi Remote Ramp North	138
Oribi	Oribi Remote Ramp South	139
Oribi	Umtentweni Remote Ramp North	142
Oribi	Umtentweni Remote Ramp South	143
Pumulani	Stormvoël N Ramps Local Ramp North	291
Pumulani	Stormvoël S Ramps Local Ramp South	292
Pumulani	Zambesi Ramp Plaza Local Ramp North	293
Pumulani	Zambesi Ramp Plaza Local Ramp South	294
Swartruggens	Swartruggens Mainline East	308
Swartruggens	Swartruggens Mainline West	309
Tonga	Tonga Local Ramp North	146
Tonga	Tonga Local Ramp South	147
Tonga	Tonga Mainline North	144
Tonga	Tonga Mainline South	145
Tonga	Tonga Remote Ramp North	148



<b>Toll Plaza</b>	<b>Virtual Plaza (LocationOfStation)</b>	<b>Value Designation 2 Octets (0..65535)</b>
Tongaat	Tongaat Remote Ramp South	149
Tsitsikamma	Tsitsikamma Mainline East	212
Tsitsikamma	Tsitsikamma Mainline West	213
Tugela	Tugela East Satellite Plaza North	265
Tugela	Tugela East Satellite Plaza South	264
Tugela	Tugela Mainline North	179
Tugela	Tugela Mainline South	180
Vaal	Vaal Mainline North	34
Vaal	Vaal Mainline South	33
Verkeerdevlei	Verkeerdevlei Mainline North	348
Verkeerdevlei	Verkeerdevlei Mainline South	349
Wilge	Wilge Mainline North	182
Wilge	Wilge Mainline South	181

**Table 10-3: Gauteng ORT Tolling Point (LocationOfStation) parameter table**

<b>Gantry Identification</b>	<b>Gantry Name (LocationOfStation)</b>	<b>Value Designation 2 Octets (0..65535)</b>
TG001	Scientia	1001
TG002	Waterkloof	1002
TG003	Airforce	1003
TG004	Technopark	1004
TG005	Nelmapius	1005
TG006	Samrand	1006
TG007	New Road	1007
TG008	Jukskei	1008
TG009	Woodmead	1009
TG010	Main Road	1010
TG011	Curzon	1011
TG012	Hans Strydom	1012
TG013	9th Avenue	1013
TG014	Gordon	1014
TG015	New Canada	1015
TG016	Rand Show	1016
TG017	Diepkloof	1017
TG018	Buccleuch	1018
TG019	London Road	1019
TG020	Modderfontein	1020
TG021	Linksfeld	1021
TG022	Kloof	1022
TG023	Geldenshuys	1023
TG024	Rand Airport	1024
TG025	Heidelberg	1025
TG026	TG026 is not utilized and is reserved for future use	1026
TG027	TG027 is not utilized and is reserved for future use	1027
TG028	Ridgeway	1028
TG029	Kliprivier	1029
TG030	Comaro	1030
TG031	Reading	1031
TG032	Bedfordview	1032

Gantry Identification	Gantry Name (LocationOfStation)	Value Designation 2 Octets (0..65535)
TG033	Rietfontein	1033
TG034	Atlas	1034
TG035	Tom Jones	1035
TG036	TG036 is not utilized and is reserved for future use	1036
TG037	Erasmus Park	1037
TG038	Pierre van Reineveld	1038
TG039	Rietvlei	1039
TG040	Olifants	1040
TG041	Railway	1041
TG042	Tembisa	1042
TG043	Emperor's	1043
TG044	Griffiths	1044
TG045	Isando	1045

10.1.2 It shall be noted that *SessionLocation* will indicate the relevant lane identification as is specified in the relevant project specification (refer to the table below).

**Table 10-4: Lane/Tag Reader ID (*SessionLocation*) parameter table.**

Lane/Tag Reader ID ( <i>SessionLocation</i> )	Direction for MSB (0 or 1 in binary)	Value Designation 0..127
Conventional and Hybrid Toll Plazas		
Lane identification	0 = North; 1 = South	Numerical part of lane number as is specified in the project specification
ORT applications		
Tag Reader identification	0 = North; 1 = South	Numerical number for Tag Reader starting with 1 for reader closest to the left shoulder (slow lane)

**Table 10-5: Type of ETC Transaction (*SessionType*) parameter table.**

Type of ETC Transaction ( <i>SessionType</i> )	Value Designation 1 Octet ( 0..254)
Free Flow Toll (ORT)	0
Dedicated ETC	1
Mixed ETC	2
Express lane ETC	3

10.1.3 The format of the different Vehicle Classes shall be as is defined in the table below.

**Table 10-6: Vehicle Class parameter table**

Vehicle Class ( <i>VehicleClass</i> )	Value Designation 1 Octet ( 0..254)
Conventional and Hybrid Toll Plazas	
Class 1	1

Vehicle Class ( <i>VehicleClass</i> )	Value Designation 1 Octet ( 0..254)
Class 2	2
Class 3	3
Class 4	4
ORT applications	
Class A1	5
Class A2	6
Class B	7
Class C	8