Rio de Janeiro City Hall
Secretariat for Transport - SMTR

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Digital Ticketing System BID

TERMS OF REFERENCE

February 24, 2022

***In the case of misunderstanding, the Portuguese Version is the valid document.**

INDEX

1. PURPOSE

CONCESSION, on an exclusive basis (except in the MOBILIZATION AND TRANSITION STAGES), for the provision of SERVICES for the organization and operation of the DIGITAL TICKETING SYSTEM (DTS) in all collective public transport systems managed by the MUNICIPALITY OF RIO DE JANEIRO.

2. GENERAL GUIDELINES

2.1. MAIN OBJECTIVES

THE DIGITAL TICKET SYSTEM (DTS) is the set of systems, equipment and services that aim to implement the Fare Policy, the operationalization of the commercialization of TRANSPORT CREDITS, the collection of PUBLIC TRANSPORT FEE, access control and demand monitoring of public transport systems, as well as the management of fares and operational integration between transport systems and the possible INTEROPERABILITY with other TICKETING SYSTEMS.

2.2. CONTRACTING OVERVIEW

For the purposes of defining the CONCESSION's business model, the following components inherent to the operation of the DTS and fee collection were defined:

Table 1 CONCESSION business model

Source:Self elaboration.

Component	Description	Business model
Operation	Media distribution and sales logistics, physical and online points of sale, physical and online service. Marketing and publicity activities.	**It is up to the CONCESSIONAIRE to comply with minimum quantitative criteria in the territory. It can propose partnerships with other private entities to increase its presence throughout Rio's territory.**
Ticket Control	Supply of DTS OPERATIONS CENTER to control ticketing, based on an Account-Based System, for validation of business rules, management of fee collection, sales and service, as well as a data center.	**The CONCESSIONAIRE is responsible for supplying the system. Full visibility by the GOVERNMENT and partial visibility by TRANSPORT OPERATORS.**
Validators	Provision and management of trip validation devices embedded in vehicles or stations.	**CONCESSIONAIRE provides VALIDATORS, with connectivity, and performs technical maintenance throughout the CONCESSION. TRANSPORT OPERATORS install and maintain the internal infrastructure of the vehicles for the installation of the VALIDATORS.**
Collection, Clearing and Clearing	Centralization of fee collection, financial clearing of remuneration rules and payment compensation to TRANSPORT OPERATORS in the MUNICIPALITY	**CONCESSIONAIRE centralizes fare collection and transfers it to the municipal account after using the credits. GOVERNMENT performs payment compensation to TRANSPORT OPERATORS (clearing).**

Below is a matrix for dividing the CONCESSION's responsibilities:

Table 2. Responsibility matrix

Source: Self elaboration.

Category	Activity	Competent Authority	External Agents	
		SMTR	Concess. DTS	transport operators
Fare Policy	Defines Fare Policy and usage rules	✔ PCRJ		
	Conducting bidding and contracting the CONCESSIONAIRE	✔		
	Fare studies and subsidies; Fareparameterization	✔		
Ticket Control	Visibility on DTS OPERATIONS CENTER	✔ Total	✔ Total	✔Partial
	Supply and operation of OPERATIONS CENTER		✔	
	Supply and operation Datacenter and Connectivity		✔	
Sales and Service Operation	In-person and virtual assistance to USERS		✔	
	Ombudsman for USERS	✔	✔	
	USER Registration		✔	
	Certification of free ride programs for those who qualify.	✔	✔	
	Management and connection to the transport credit network		✔	
	Supply and maintenance of ATMs (Automatic Ticketing Machine)		✔	
	Card/Media logistics		✔	
Validators	Supply, technical maintenance and replacement		✔	
	Connectivity to the OPERATIONS CENTER		✔	
	Installation and maintenance in vehicles, stations and terminals			✔
Collection and Distribution	CENTRAL CLEARING HOUSE (CCH) Operation	✔		
	Ordering of subsidies for the system	✔ PCRJ		
	Centralization of farecollection and transfer to CCH		✔	
	Compensation of payments to Operators	✔	✔ (interim)	

2.3. FARE POLICY

The current Municipal Fare Policy is described in ANNEX I.5 - DESCRIPTION OF THE CURRENT COLLECTIVE PUBLIC TRANSPORT SYSTEM. In minimum terms, the DTS must promote the execution of all the Fare Policies practiced in the scope of the transport services available in the City and in the Metropolitan Region of Rio de Janeiro, including the modes of transport managed by the State Government and, among other attributes, the fare of the trip, the benefits and restrictions established according to the user.

In order to advance in Fare Policy, the DTS should manage the posssible coexistence of different types of public fares, including:

- Single Fare within the same system – per trip, per boarding, per elapsed time..
- Different fares within the same system – by zone, by length of trip, by user's trip, by mode of transport.
- Demand management fare policies, such as variations in the amounts charged according to the period of the day (eg, off-peak, peak), week or month.
- Weekly, monthly or annual **pass**, with progressive discount.
- Temporary **pass**, for specific or seasonal events.
- Fare integration within the same mode of transport and between different modes, including modes of transport managed by the Government of the State of Rio de Janeiro.

The possibility of systemic fare integration between collective transport, individual transport (taxis, parking lots) and non-motorized transport (shared bicycle system, scooters) should also be considered.

2.4. DTS MODEL

The CONCESSIONAIRE will be responsible for adopting the DTS model, which may be an Account Based Ticketing System (ABT) or a Card Based Ticketing System.

If the CONCESSIONAIRE adopts the card based system, the specifications and safety requirements specified in item 6.3 must be observed. “Security Processes” and secure hardware must be used for the generation, distribution, recording and use of credits, as indicated in items 3.1. “HSM - Hardware Security Module” and 3.2. “SAM - Secure Access Module”. The CONCESSIONAIRE may also opt for any standard contactless cards, such as Cipurse, MiFare Plus or Calypso, as long as it meets all the specifications of these terms of reference.
If an Account Based System is adopted, each user must have an associated account with a unique identification. In this system, the fare MEDIA to access the transport is an identifier of the registered USER and this identification can be on a simple card, or a mobile application, or a bracelet or any other media that contains the user identification. In this model, there is no balance in the media, all user information (balance, information about usage and recharges, profiles and others) is stored in a centralized system. All pricing mechanism is done in the centralized system. The adoption of this model must provide mechanisms so that there is no loss of data or compromise of the operation in case of unavailability of the connection.

Considering the potential INTEROPERABILITY with TICKET SYSTEMS currently available in the Metropolitan Region of Rio de Janeiro, it is important to emphasize that, whatever the model adopted, it must be possible to interoperate with these other systems, whether based on CHIP CARDS or on accounts, as stipulated in the ANNEX I.7 - CRITERIA FOR THE INTEROPERABILITY OF TICKET SYSTEMS. The DTS,

regardless of whether it is based on accounts or COIN CARD, therefore, must be able to interoperate with other systems based on accounts and/or COIN CARDS in a transparent and secure way, either through integration between systems in the cloud or by reading, recording balance and use of TRANSPORT CARDS.

2.5. MEANS OF PURCHASE AND USE OF CREDITS

The DTS must allow the use of all means of payment authorized by the monetary authority for the purchase of credits by USERS. The GOVERNMENT will evaluate the incorporation of new forms of payment to be used by the CONCESSIONAIRE throughout the CONTRACT. The minimum means of payment to be accepted are:

- **Means of payment for ordinary Users:**
  - Money.
  - Debit or credit bank card.
  - PIX.
- **Means of payment for Transport Voucher:**
  - Dealer direct channel.
- **Means of payment (transport media) - alternatives for the User:**
  - Money, on a transitory basis and upon registration of the transaction in the DTS.
  - Physical transport card.
  - *Virtual TRANSPORT CARD, in wallet applications*.
  - Debit or credit bank card, physical and virtual (optional).
  - QR Code, physical and virtual

The CONCESSIONAIRE may establish agreements with third parties to allow the commercialization of credits through virtual wallets (wallets).

In relation to transport MEDIA (means of using TRANSPORT CREDITS), it should be noted that the fare integration policy must be allowed at least with the use of a physical or virtual TRANSPORT CARD. The use of other MEDIA for fare integration purposes may be possible depending on the technological solution implemented by the CONCESSIONAIRE (example: through the use of an Account Based System, ABT), the processing time of each media (so as not to disrupt the operation of the transport system) and the specifics of the current FarePolicy, and the CONCESSIONAIRE must justify any non-attendance. In the case of adoption of a QR Code, the CONCESSIONAIRE must provide technologies that allow its control and inhibit possible fraud. It must be justified to the GOVERNMENT if the CONCESSIONAIRE considers it not possible to adopt this technology (QR Code) safely.

2.6. INTEGRATION WITH PUBLIC POLICIES

The DTS makes it possible to improve demand management and to supply different areas of municipal public management with data. Immediately, it provides the transport area with all the data related to each USER's travel transaction, segmented according to the fare framework of each group (paid, integrated and free ride programs for those who qualify) and at different levels of consolidation (system, region, operator, line , vehicle, etc.).

This information will be consumed for the definition of public policies in the transport area, for the calculation of the remuneration of collective TRANSPORT OPERATORS, for the calculation of the value of the PUBLIC TRANSPORT FEE, for the calculation of any fare subsidy intended for the collective transport system , for the definition of priority services - as considered by the GOVERNMENT - that require financial support, and for the financial and contractual management of the sector.

The DTS must meet the need for sufficient information for the operation of the remuneration model adopted in the contracts of transport services managed by the GOVERNMENT, in particular for the compilation of the data necessary and required by the economic model from the ticketing records.

The GOVERNMENT will unrestrictedly receive all information produced by the DTS simultaneously to its insertion in the respective DATABASE, applying to the GOVERNMENT and the CONCESSIONAIRE the same rules regarding the General Data Protection Law, as described in **Annex 6. "Guidelines of Personal Data Protection".** Information on the use of credits for the payment of FARES must be submitted to the GOVERNMENT individually per travel transaction, including, at a minimum, the following attributes:

Table 3. Minimum Attributes of the DTS
Source: Self elaboration.

TERRITORIALS	SYSTEMIC	OPERATIONAL	FINANCIAL
• Administrative Regions • Planning areas • Neighborhood • Stations • Terminals • Boarding location	• Identification of the Competent Authority • Identification of the TICKET SYSTEM • Type of transport mode • Line Type (Radial, Diametric, etc.) • Subsystems (Trunk, Feeder, etc.) • Type of Service	• Geolocation • Transaction date and time • Line • Line variations (services) • Line direction • Vehicle Type • Transport operator • User Type • User ID	• Rate Value • Charge limit[1] • discounts and exemptions • Incentives and Restrictions • Fare increase in integration • Integration time • number of embarks • remaining balance

[1]Attribute that allows limiting the use of credits in a certain period (day, interval between charges). Allows you to control especially the use of credits that have some kind of privilege (elderly, for example).

	(Common, Variant, Night, etc.) ● Operation type: Express, Commuter Service ● Intermodal Integration ● Intramodal Integration		

The DTS structure must allow compatibility with the structure of the services monitoring system (fleets, stations, terminals, corridors, etc.), including and allowing the production of demand reports compatible with the measured and the controlled attributes of monitoring system. During the implementation of the system, the CONCESSIONAIRE must understand, under the guidance of the GOVERNMENT, the information structure common to both systems.

The information from the DTS will be used in a subsidiary form, for the definition of public policies related to economic development, land use and the public budget. In order to achieve this function of the DTS, the possibility of grouping mobility demand information for public transport according to different thematic maps used by PCRJ should be considered.

2.7. COMMERCIAL EXPLOITATION

The CONCESSIONAIRE may exploit the MAIN REVENUES from the administration of the PUBLIC TRANSPORT FEE collection, as well as ACCESSORY REVENUES from advertising, management of the commercialization of Transport Tickets and financial revenues from the application of credits sold and not used by users. The details of each class of income are described in the CONTRACT, and can be briefly summarized below:

- **Main Revenue:**
    - Ticketing fee (4.0%) on the TRANSPORT CREDIT used in the Municipal Ticketing system
    - **Accessory Revenue:**
    - Management of the issuance of Transport Vouchers
    - Percentage of convenience services related to the issuance of Transport Tickets, limited to 4.0%.
    - Advertising Revenue (among others):
    - In-App Advertising Exploitation
    - Naming rights
    - Commission on sales and customers prospected through the app
    - Exploitation of Static Advertising on Cards
        - Exploitation of Third Party Static Advertising on Cards
    - Financial income:
        - Revenue on advance purchase credits.
        - Revenue on remaining credits.

- INTEROPERABILITY REVENUES
- Revenues from Integration with Mobility Services

During the term of the AGREEMENT and as provided therein, other ACCESSORY REVENUES may be identified and exploited, with the prior authorization of PCRJ and the consequent participation of PCRJ in its collection.

3. EQUIPMENT SPECIFICATION

This section presents the main equipment that make up the DTS.

3.1. HSM - HARDWARE SECURITY MODULE

The use of HSM (Hardware Security Module) is essential if the CONCESSIONAIRE opts for a CARD Based System. In this case, the HSM must be an appliance-like device, with an interface for connection to a local network, which allows the secure storage of primary keys and the execution of hashing algorithms, symmetric and asymmetric encryption with high volume and high performance.
The main roles assumed by the HSM are:

- File Certifier: allows validating lists, files and records sent and received from sales terminals and VALIDATORS.
- Credit Certifier: authenticates credit transfer request, signs credit cryptograms, generates and signs credit transaction records.
- Travel Transaction Supervisor: validates all travel transactions coming from the system's VALIDATORS.
- Credit Transaction Supervisor: validates each of the credit transactions carried out by the transport media or USER ACCOUNT.
- Certifier of usage and credit transactions stored in digital ticketing: signs bank records associated with DTS usage and credit.

The CONCESSIONAIRE shall use a security system based on the use of HSMs if it chooses a System Based on CHIP CARDS, with the indication of the manufacturer, the supported encryption algorithms, the performance indexes and scalability facilities, which follows all the provisions of **Item 6.3. “Security Processes”.**
The HSM must also be able to:

- Safely generate the primary keys of the security system (one or more batches if necessary).
- Protect generated primary keys. The HSM must fulfill the strict security requirements to ensure that the keys are protected under an inviolable “seal”, that they can never be accessed by any type of intrusion or exported in an open way. In the event of an intrusion attempt, the HSM must destroy critical security keys and parameters.
- Generate and verify transaction log signatures using the generated primary keys.
- Generate and verify file signatures using one of the generated primary keys. Parameter, restriction list, and software files must be signed by the HSM.

- Host and guarantee the cryptographic application that contains the DTS security functions. It must ensure that it is not possible to make undue changes to the application, debug or decompile by reverse engineering and that only properly authorized applications can be placed or updated inside the HSM.
- Backup primary keys and recover such keys only on hardware of the same type, without exposing open keys on any communication channel or to any application outside the HSM.
- Perform symmetric and asymmetric cryptography functions in hardware, with very high performance.
- Generate diversified access keys for USER cards using the generated primary keys.
- Authenticate any application that wishes to use the HSM SERVICES using secure mutual authentication mechanisms.
- Serve as a credit repository.
- Allow hosting multiple cryptographic applications, with independent keys and credit repositories; ensuring non-interference between applications.

To ensure the protection of critical security keys and parameters, the HSM to be offered by the CONCESSIONAIRE must be certified by the FIPS 140-2 level 3 standard. In the event of any intrusion, the HSM must automatically destroy all critical security parameters and security encryption keys stored in it.

The technology that will be adopted for the HSM must allow for an easy and fast scalability, which allows, within a maximum period of 24 hours, to increase the processing capacity of the HSM, executing the following processes during this period:

- Installing and configuring the HSM.
- Secure replication of primary keys.
- Installation and configuration of cryptographic servers to access and use the new processing capacity.

If an Account-Based System is adopted, validation and security operations do not require this hardware and can be performed in the cloud, once the security solutions are implemented and all transactions are auditable.

3.2. SAM - SECURE ACCESS MODULE

The Secure Access Module (SAM) is used to restrict access to USER data and transport credits, provide encryption algorithms and regulate the behavior of applications that handle this information. If the CONCESSIONAIRE opts for an Account-Based System, a virtual SAM may be implemented by software, and if it is a CARD-Based System, it must be implemented by hardware.

The CONCESSIONAIRE will be responsible for making available all the SAMs necessary for the operation of the DTS, including those necessary due to the signing of INTEROPERABILITY agreements.

The SAM must be compatible with ISO-7816 and in ID-000 format. It must be protected against unauthorized access, in accordance with the Common Criteria EAL 5+ standard or higher. This protection is necessary as the SAM, in a security model with symmetric cryptography, will be used in the DTS, in the case that a System Based on CHIP CARDS is implemented, it will store the primary keys of the system and the algorithms that allow the execution of operations cryptographic using these keys.
The SAM must allow:

- Obtain diversified keys for each USER account and each type of data stored in it, providing access only to the data that each application handles, depending on the profile defined in the SAM itself, using diversification factor a unique number assigned to the USER in the DTS.
- Verify electronic signatures for each data type.
- Generate new signatures for new USER ACCOUNT data.
- Check signatures for packages that contain parameters, restriction lists, and new software versions.
- Sign records containing transaction information.
- Sign files to be sent to DTS.
- Automatically update with new software versions received.

It is also important to point out that the SAM to be adopted must allow the storage of several applications separately, each one with its set of keys, to guarantee secure INTEROPERABILITY between different credit issuers of the transport system. The SAM must allow the physical separation of the keys and applications of each issuer and the individual assignment of permissions to obtain access keys issued by the other issuers, according to the criteria used in the creation of the SAM. In this way, it is expected that the SAM to be adopted allows the integration of several emitters within the same chip, in order to guarantee INTEROPERABILITY and avoid any physical restriction related to the SAM slots available in the VALIDATORS (for example, VALIDATORS that have only 2 slots SAM).

3.2.1. TYPES OF SAMs

The MEDIA used must be protected with specific keys (different from each other). This allows granting access permissions to the transport USER's data according to the profile of the application that uses them (MEDIA broadcast, credit sale, credit use, etc.). This concept makes it possible to classify SAMs according to the type of application that will use them:

- **Validator SAM:** For systems based on CHIP CARDS, it allows reading the entire content of the USER's transport and account data, checking signatures, changing the data of the last transaction and the balance, signing the new data derived from this change. In account-based systems, it allows the generation of secure communication channels between the VALIDATOR and the DTS or with the USER's MEDIA. That is, regardless of the System model to be implemented, this SAM must be used.
- **Points of Sale SAM (ATM and POS):** allows reading the entire content of the USER's transport and account data, checking signatures, changing the data of the last recharge and the balance, signing the new data derived from this change. As will be detailed in **Item 5.2. "Advance Credit Marketing"**, the CONCESSIONAIRE may choose either to maintain an exclusively online credit distribution network or to use a hybrid alternative, with offline ATM and/or POS equipment. In the case of operations with offline sales, this type of Point of Sale SAM is necessary to guarantee the security of credits sold in ATM and POS equipment operating offline. This SAM is only necessary if the CONCESSIONAIRE opts for a CARDBased System
- **Issue SAM:** Allows initializing USER cards and adding USERS and new accounts to the DTS, recording signed data and access keys. This SAM is only necessary if the CONCESSIONAIRE opts for a CARD-Based System. If the model adopted is Based on Accounts, a security solution must be implemented that guarantees the control and traceability of the inclusion and maintenance of users, accounts and balances.

3.2.2. STATE MACHINE

If a system based on CHIP CARDS is adopted, the SAM module must be able to control the flow of applications installed on the DTS equipment. For this, SAM uses a State Machine, which forces applications to execute specific business rules, in a certain order, and defines state transitions that guarantee a safe flow of operations.

Each type of SAM has its own State Machine, to perform its own operations in a secure sequence. Each State Machine operation in SAM must generate a state hash code derived from the data used in the operation, which will serve as input in the next phase of the process. Here is a typical order of execution that should be used as a guide for implementing the State Machine:

1. Provide card read access keys, based on serial number.
2. Verify electronic signature of all card data. If any integrity problem is detected, return to the initial state of the State Machine.
3. Generate electronic signatures for the new card data, using current and new data as a reference for validation. This operation will depend on the type of SAM, which will define the levels of access to the different types of card data.

4. Generate transaction registration signature, according to the type of operation..

3.3. VALIDATOR

The VALIDATOR is a device which its main function is to verify that the USER is authorized to travel and to grant access. To allow access, the VALIDATOR must check the USER's credentials, account credit and travel status. This process is carried out through the SAM associated with the TICKET SYSTEM in which the USER is registered. If the prerequisites are met, the transaction is registered and sent to DTS for further processing. The result of the transaction must be informed through the VALIDATOR display, light signals and differentiated sound signals, mainly for accessibility purposes. The VALIDATOR must also allow the control of the vehicle operator's service, through operations such as opening and closing of service and half-trip transaction, as detailed in **Item** 5.7.2. “Operational Media Issuance”.

To operate in the DTS, VALIDATORS must meet the following minimum requirements:

- NFC-Near Field Communication reader, maximum operating distance of 100 mm.
- Reading and processing time of a maximum of 100 ms per SAM chip in the case of CHIPCARD transactions and up to 700 ms for other types of transactions (online transactions and EMV card transactions, among others)
- Enable secure payment processing for multiple payment methods, considering the following communication standards:
- Contactless electronic card, compatible with ISO 14443 A/B.
    - QR Code.
    - EMV devices.
- GPS internal to the VALIDATOR or eventually integrated into the vehicle monitoring GPS to record geopositioning information for transactions carried out in the vehicle.
- Allow wireless communication in a secure way and/or, through an exclusive, non-public and non-identifiable Wi-Fi network, for the transmission of stored data to the DTS, updating of parameters, software, restriction lists and recharging.
- Have at least four ID-000 sockets for SAM chip, and communication interface in operational state with this device.
- Possess a facial recognition camera integrated into the VALIDATOR, for user identification. All usage transactions must be registered by the camera, and those belonging to users whose fare benefit recognition is necessary (e.g.free-of-charge benefits) must be validated by the DTS. The facial recognition process is described in 6.1.3 Facial Recognition of free-of-charge Beneficiaries. The camera can be an integral part of the validator or be safely packaged in an external cabinet, with the same characteristics as the validator

in terms of protection degree IP 54 and IK equal to or greater than 7, solutions that have apparent physical connections between the equipments.

- Possess a QR code reader.
- Enable connection with additional devices to extend control functionality (eg integrated digital camera, sound signals, light signals, etc.) via RS232 and/or RS485 and/or USB and/or Ethernet ports, or equivalent.
- Capacity to store data referring to trips made for at least 30 (thirty) days in a secure, encrypted form - following the standards of ES256, SHA256, TKIP or equivalent regulations - and non-volatile, ensuring possible recovery at any time.
- Enable DTS firmware and keys update without removing the VALIDATOR from the vehicle.
- Graphic display for communication with the USER.
- Light and sound signals to indicate the USER transaction status.
- Electronically control access blocking/unblocking.
- Protection degree IP 54 and IK equal to or greater than 7.
    - VALIDATORS on board railway trains (example: VLT trains) must also follow the EN50155 standard, with protection against vibration, electrical, water and dust.
    - Maximum transaction time:
    - Reading of distinct SAMs: occurrence of time greater than 100 milliseconds per SAM in up to 0.001% of the passages.
    - Non-EMV card: occurrence of time greater than 700 milliseconds in up to 0.001% of the passes.
    - EMV card: occurrence of time greater than 2 seconds in 0.001% of the passages.
    - QR Code: occurrence of time greater than 1 second in 0.001% of the passages.
- Error rate in the accounting of transactions less than 0.001% (1 error per 1 million transactions).
- Mean time between failures (MTBF) of 40,000 hours.
- Ensure transaction security using the SAM module as a reliable mechanism to:
    - Verification of the authenticity of the MEDIA data presented by the USER.
    - Execution of operations following a State Machine that guarantees a safe cycle of operations.
    - Updating the MEDIA balance and travel data, in those applicable, maintaining its integrity.
    - Generation of electronic signatures that authenticate transactions.

The CONCESSIONAIRE must ensure that the VALIDATORS, that are available by the CONCESSIONAIRE, are capable of performing the following operations:

- It must be prepared to receive various types of data files from the DTS, from the fare policy criteria and from all associated credit issuers: USER restriction list parameters, VALIDATOR and SAM software, and even files containing new keys of the system, to record in the SAM. The files received will be electronically signed and the VALIDATOR, through SAM, will be able to validate and to interpret them properly.
- You must send the USER and SERVICE transaction files to DTS, signed by the VALIDATOR SAM, immediately after they are carried out, in case the equipment is online or as soon as possible.
- Check the presence of the SAM module and prevent any operation if it is absent.
- Execute the VALIDATOR SAM State Machine commands in the established order.
- Receive and update new software versions.
- Mediate the SAM software update.
- Allow updating of SAM primary keys.
- Interact with GPS to produce geo-referenced data.
- Enable the migration of cards from the current system to the new one, when applicable.
- Integrate with other equipment through mutual authentication, through SAM.
- Have the following controls in relation to the turnstile:
    - Automatic detection, by the validator, of the type of sensor used in the turnstile
    - Control of reverse turns of the turnstile;
    - Control of turns not authorized by the validator;
    - Partial turn control
    - Turnstile reset control
    - Control and synchronization of turnstiles odometers, when applicable.

In the case of multiple VALIDATORS operating in parallel in a vehicle, station or terminal, the VALIDATORS must allow their intercommunication in a network, ensuring that, in the event of a device failure, the others assume control of the management of the operational parameters (line definition , direction, time, etc.).

The CONCESSIONAIRE is responsible for the provision, technical maintenance and eventual replacement of the VALIDATORS as specified in **Item 4.2**. “Supply of Validators and Approval of Systems and Equipment”, according to the service levels defined in **ANNEX I.4 - “TABLE OF PERFORMANCE AND INFRINGEMENTS INDICATORS”**. The CONCESSIONAIRE must maintain a system for recording and monitoring calls/incidents regarding the availability of the VALIDATORS. The measures and models of VALIDATORS must observe the physical characteristics of the environments where such equipment already exists, ensuring that there will be no impact on TRANSPORT OPERATORS.

3.4. AUTOMATIC TICKETING MACHINES (ATM)

The automatic ticketing machines (commonly known as ATMs) will be installed by the CONCESSIONAIRE in places with great circulation of USERS, according to the guidelines in **Item** 4.4. “Establishment of the Sales and Service Network”, with the aim of providing the sale and recharge of credits online, issuing a QR Code and transferring amounts to the USER's current account at the DTS.

All financial transactions will be authorized through a Transmission Control Protocol (TCP) service, which must implement a protocol based on the ISO-8583 standard.

ATM must meet the following operational and architectural requirements:

- Equipment with anti-vandalism mechanisms that can be used in environments subject to humidity and water splashes;
- Touch screen monitor of at least 15 inches.
- Polyphonic Audio Device with voice-over capability.
- 60 or 80 mm thermal printer, with automatic cutting system.
- Easy paper change mechanism.
- Insertion of cash from the front.
- Accept all Brazilian currency on the date of publication of the notice.
- Acceptance of new currency and coins upon reconfiguration.
- Keyboard with braille dial.
- Cash acceptance rate greater than 95%.
- Accept transactions with credit and debit cards and PIX.
- Storage safe, with automatic self-closing mechanism and sensors.
- NFC reader, compatible with ISO 14443 A/B, EMV contactless.
- Remote, real-time monitoring mechanisms of machine sensors and equipment screen.
- Ethernet and 4G connectivity.
- Card issuance.
- Mean time between failures (MTBF) of 40,000 hours.
- If installed on:
    - Indoor environment: IP 53 degree of protection.
    - Outdoor environment or on public roads (example: VLT system ATMs): necessarily have a touch screen monitor and waterproof and dustproof pin pad, with IP 65 degree of protection.

ATMs must attend the ABNT NBR 15250:2005 to guarantee universal accessibility for USERS.
The CONCESSIONAIRE is responsible for the installation, maintenance and eventual replacement of ATM machines, according to the service levels defined in **Annex 4. “Performance Indicator Table”.** The CONCESSIONAIRE must maintain a system for recording and monitoring calls/incidents regarding the availability of ATMs.

The CONCESSIONAIRE shall guarantee the repair of ATMs within the deadlines defined below. The deadlines will be counted from the identification or communication of the problem until its complete resolution.

Table 4. ATM repair deadlines
Source. Self elaboration

Case	Tram stations and other Transport Stations and Terminals (BRT and SPPO) where there is only 1 ATM	ATMs in other locations
Partially inoperative ATM (with unavailability of some means of payment, but it is still possible to use another means of payment to carry out the recharge)	6 hours	48 hours
ATM totally inoperative	3 hours	24 hours

The minimum recharge value in cash at ATMs must be compatible with the value of the PUBLIC FARE. ATM measurements and models must observe the physical characteristics of the environments where such equipment already exists, ensuring that there will be no impact on TRANSPORT OPERATORS. At the CONCESSIONAIRE's discretion, some assistance related to problems with the card, card issuance and request for benefits, photo capture may be added to part of these automatic ticketing machines.

3.5. POINT OF SALE (POS)

The point of sales (POS) is used in sales operations to the USER assisted by a professional. The POS is a device that allows the recharge of credits in the MEDIA or USER ACCOUNT through online transactions, both of credits paid at the time of recharge, and, in the case of CARD Based Systems, of prepaid credits previously marketed (reload by list on server). In addition, the equipment must allow the issuance of a QR Code, if this means of payment is adopted by the CONCESSIONAIRE.

To carry out recharging operations, the POS must connect to an online network. On the DTS side, recharges will be authorized through a TCP service, from the Online Recharge Server, which must be accessed via a protocol based on the ISO-8583 standard.

The POS must have, at least, the following minimum requirements:

- NFC reader, compatible with ISO 14443 A/B., EMV *contactless*.
- PCI DSS (Payment Card Industry – Data Security Standard) certification for credit and debit card transactions.
- Enough non-volatile memory to store parameters and logs of transactions and operations performed in the last 7 days.
- Graphic display for user interface.
- Thermal printer for issuing sales receipts and QR codes.
- Communication interface with DTS: Ethernet, Wi-Fi or 4G.

4. PREPARATION

4.1. MOBILIZATION AND TRANSITION PLAN

Within 15 (fifteen) calendar days from the START ORDER, the CONCESSIONAIRE shall present the Mobilization and Transition Plan of the Current TICKET SYSTEM, which includes the detailment of the necessary activities and the steps described below.

The Mobilization and Transition Plan must consider the following Stages, which must have a maximum period of 18 (eighteen) months:

1. PARTIAL MOBILIZATION STAGE: Within 6 (six) months from the START ORDER, the CONCESSIONAIRE must implement the DTS throughout the BRT SYSTEM, including the VALIDATORS and the ATMs/POS at the stations. This Stage will be called PARTIAL MOBILIZATION STAGE. The conclusion date will be marked by the PARTIAL OPERATION STARTING DATE, when the DTS will become operational in the BRT SYSTEM.
2. COMPLETE MOBILIZATION STAGE: Within 15 (fifteen) months from the START ORDER, the CONCESSIONAIRE must implement the DTS in all other Public Transport Systems Granted and Permitted by SMTR, including the VALIDATORS and the respective ATMs/POS. This Stage will be called the FULL MOBILIZATION STAGE. The conclusion date will be marked by the COMPLETE OPERATION START DATE, when the DTS will become operational in all Collective Public Transport Systems in the Municipality of Rio de Janeiro
3. TRANSITION STAGE: The TRANSITION STAGE corresponds to the period in which the current TICKET SYSTEM and the DIGITAL TICKET SYSTEM coexist. This Stage must have at least 3 (three) months and begins with the COMPLETE OPERATION STARTING DATE and its conclusion will be marked by the EXCLUSIVE OPERATION STARTING DATE.

The CONCESSIONAIRE shall officially notify the GOVERNMENT, at least one (1) month in advance, of the expected date for the PARTIAL OPERATION START and the expected date for the FULL OPERATION START. The GOVERNMENT will verify that all activities provided in the respective MOBILIZATION STAGE have been completed to authorize the respective START OF OPERATION (PARTIAL or FULL) on the date proposed by the CONCESSIONAIRE.

4.1.1. MOBILIZATION STAGE

As mentioned in item 4.1 Mobilization and Transition Plan, the MOBILIZATION Stage is subdivided into two distinct sub-stages: PARTIAL MOBILIZATION AND FULL MOBILIZATION. Some activities, however, are common to both MOBILIZATION stages, since they are structural conditions for the whole system. Are they :

1. **Implement, Customize and Parameterize the DTS:** The DTS, including the provisions of Item **6.1**. "DTS Operations Center", must be fully operational and functional within 30 (thirty) days before the PARTIAL OPERATION STARTING DATE. All functionalities must have been tested and stressed within 7 (seven) days prior to the PARTIAL OPERATION STARTING DATE.
2. **Issue new MEDIA or TRANSPORT CARDS for both free-of-change and common users,** as defined in **Item 5.1. "Issuing cards".**
3. **Prepare and deliver the Personal Data Protection Compliance Program,** as per **Annex 6. "Personal Data Protection Guidelines".**
4. **Prepare and deliver the Risk Response Plan and Contingency Plan,** as per **Item 6.4. "Risk Management and Contingency Plan".**

4.1.1.1. PARTIAL MOBILIZATION STAGE

Initiated on the DATE OF THE START ORDER and with a maximum period of 6 (six) months, the PARTIAL MOBILIZATION STAGE aims to implement the DTS in all stations and terminals of the BRT SYSTEM. In addition to the activities described above, the PARTIAL MOBILIZATION STAGE includes the following activities:

1. **Migrate or insert all basic information** necessary to use the system, such as fleets, operators, lines and others, to the BRT SYSTEM;
2. **Train employees of the GOVERNMENT to use the DTS OPERATIONS CENTER,** in sufficient quantity to monitor the BRT SYSTEM, including preparation of a reference booklet, within 30 (thirty) days before the PARTIAL OPERATION STARTING DATE

3. **Prepare and apply the Partial Operation Communication Plan,** previously approved by the GOVERNMENT, to clarify to citizens how the transition to the new model in the BRT SYSTEM will take place, according to **Item 4.6. "Communication Plan".**
4. **Provide Validators** so that, at the end of the PARTIAL MOBILIZATION phase, all VALIDATORS for the BRT SYSTEM are active and ready to operate with the new DTS, as per **Item 4.2. "Supply of Validators and Approval of Systems and Equipment".**
5. **Train employees of the BRT SYSTEM TRANSPORT OPERATOR(S)** in order to prepare them to interact with the new DTS OPERATIONS CENTER;
6. Provide **the sales network** for the BRT SYSTEM, defined in **Item 4.4. "Establishment of the Sales and Service Network"**, including training the attendants who will work at the face-to-face stations.

4.1.1.2. COMPLETE MOBILIZATION

From the DATE OF THE START ORDER and with a maximum duration of 12 (twelve) months, the COMPLETE MOBILIZATION STAGE aims to complete the implementation of the DTS in all public transport systems under municipal management. In addition to the activities described above, it includes the following activities:

1. **Migrate or insert all the basic information** necessary to use the system, such as fleets, operators, lines and others, for other modes of transport under municipal management;
2. **Train the other employees of the GOVERNMENT to use the DTS OPERATIONS CENTER** with the preparation of a course with no limit of participants and a reference booklet, within 30 (thirty) days before the COMPLETE OPERATION STARTING DATE.
3. **Prepare and apply the Communication Plan for the Complete Operation and Transition,** previously approved by the GOVERNMENT, to clarify to citizens how the transition to the new model will take place, as per **Item 4.6. "Communication Plan".**
4. **Provide Validators for other municipal transport modes so that,** at the end of the FULL MOBILIZATION phase, all VALIDATORS are active and ready to operate with the new DTS, as per **Item 4.2. "Supply of Validators and Approval of Systems and Equipment".**
5. **Train employees of TRANSPORT OPERATORS of other modes of transport under municipal management,** in order to prepare them to interact with the new DTS OPERATIONS CENTER;
6. Provide **the sales network,** defined in **Item 4.4. "Establishment of the Sales and Service Network"**, including training the attendants who will work at the face-to-face stations.

4.1.2. TRANSITION STAGE

The TRANSITION Stage begins on the COMPLETE OPERATION STARTING DATE and must have a minimum term of 3 (three) months and ends on the EXCLUSIVE OPERATION STARTING DATE. In this Stage, the current TICKET SYSTEM and the DTS will coexist and the USERS and TRANSPORTATION OPERATORS will probably have to use two cards and two types of VALIDATORS.

The DTS VALIDATOR must operate in parallel with the current TICKET SYSTEM VALIDATOR, as shown in Figure 5, and must at least account for the transactions carried out in both systems. The DTS VALIDATOR must be installed at the turnstile, so all requests for the release of the turnstile made by the VALIDATOR of the current TICKET SYSTEM must be accounted for.

Credits from the current TICKET SYSTEM provider may be used in municipal transport systems if issued before the COMPLETE OPERATION START DATE. From the COMPLETE OPERATION START DATE, TRANSPORT CREDITS for municipal systems must be exclusively issued by the CONCESSIONAIRE. The CONCESSIONAIRE will be paid only for the TRANSPORT CREDITS that are marketed and processed by the CONCESSIONAIRE.

At the end of the TRANSITION Stage, the GOVERNMENT will determine to the TRANSPORT OPERATORS, under penalty of revocation and non-renewal of the license of their respective vehicles, the withdrawal of the respective SAMs and/or VALIDATORS from the vehicles, stations and terminals of the municipal systems. If there is INTEROPERABILITY agreement with the current TICKET SYSTEM, the SAMs of both systems will be integrated into the DTS VALIDATOR.

During the TRANSITION Stage, the CONCESSIONAIRE shall make available, in addition to the planned sales network, mobile sales points in the quantities and locations described in **item 4.4. “Establishment of the Sales and Service Network”.**

TRANSPORTATION OPERATORS may receive their fare revenues from different sources, according to the TICKET SYSTEM used by the user, and the resources may come from the current TICKET SYSTEM, from the new CONCESSIONAIRE (on an interim basis) or from the CLEARING HOUSE, from DTS data, as detailed in **Item 6.2. “Financial Management of Sales and Cearing House”**

4.2. SUPPLY OF VALIDATORS AND APPROVAL OF SYSTEMS AND EQUIPMENT

4.2.1.SUPPLY OF VALIDATORS

The CONCESSIONAIRE must provide the TRANSPORTATION OPERATORS with the necessary and sufficient quantity of VALIDATORS for all modes of transport according to the schedule established in the table below. The CONCESSIONAIRE undertakes the provision of SAM chips for the new DTS and chips for connectivity between the VALIDATORS and the DTS in sufficient quantity for all modes of transport under municipal management in operation.

During the entire CONCESSION period, the CONCESSIONAIRE must carry out technical maintenance, repair or free exchange of equipment or parts that suffer damages as a result of the regular use. In other cases, exemplified below, the costs of maintenance will be charged to the TRANSPORTATION OPERATOR at prices to be defined by the CONCESSIONAIRE upon prior approval by the GOVERNMENT:

- When the equipment is opened, adjusted or repaired by people or companies not approved and authorized by the CONCESSIONAIRE;
- When equipment is used with unauthorized software;
- When the equipment is not properly functioning due to vandalism, theft, theft, misuse, unauthorized modification of facilities, flooding, action of water or other liquids, fire, vehicle destruction, physical impacts and other abuses to the improper handling of the equipment or software.

To guarantee the timeliness of any exchanges, the CONCESSIONAIRE must guarantee a technical reserve of 5% (five percent) of the total amount of VALIDATORS, SAM chips and communication chips throughout the contractual term. The technical reserve referring to the VALIDATORS of TRANSPORT OPERATORS of the VLT, BRT and SPPO (common buses) systems must be delivered and managed by themselves.

The CONCESSIONAIRE must submit the Plan for the Supply of VALIDATORS to the GOVERNMENT within 30 (thirty) days of the START ORDER, containing procedures and schedule for the supply of VALIDATORS in line with the amount shown in Table 5, as well as details of the procedures to guarantee the timeliness of any necessary exchanges. The GOVERNMENT will have 5 (five) business days to validate the Plan and, if rejected, the CONCESSIONAIRE will have 5 (five) business days to present a new version.

On the PARTIAL OPERATION STARTING DATE, the CONCESSIONAIRE must have provided the VALIDATORS of the BRT System currently in operation. On the COMPLETE OPERATION STARTING DATE, the CONCESSIONAIRE must have

provided the VALIDATORS for all modes of transport, stations and terminals in the column “YEAR 1 - COMPLETE OPERATION” of Table 5. All VALIDATORS must be new and in accordance with the specification of the item - “3.3 Validator”.

This Plan must be conducted together with TRANSPORT OPERATORS, who will be responsible for providing the infrastructure and for installing the VALIDATORS provided by the CONCESSIONAIRE in its vehicles, stations and terminals. The GOVERNMENT shall have the obligation to demand that the TRANSPORTATION OPERATORS, in a schedule compatible with the Plan for the Supply of Validators, the installation of the VALIDATORS provided by the CONCESSIONAIRE in the vehicles, stations and terminals under their management. The GOVERNMENT will have the prerogative and obligation to inspect the vehicles, stations and terminals under the management of the TRANSPORT OPERATORS and may or may not grant the license to vehicles that do not meet the planned installation, sealing them, withdrawing them from circulation and applying the applicable contractual sanctions.

The CONCESSIONAIRE shall make available, upon delivery of the VALIDATORS to the TRANSPORT OPERATORS, material clarifying of the conditions for installation, observing definitions of positioning and universal accessibility defined by the GOVERNMENT in relation to equipment consider in the Municipal Law No. 6.268/2017, ordinary care procedures, in addition to the communication mechanisms and channels for TRANSPORTATION OPERATORS to report problems.

After installing the new VALIDATORS, the CONCESSIONAIRE shall provide visual identification for vehicles, stations and terminals, indicating the new features available (payment via EMV bank cards, cell phone approximation via NFC, QR Code and others). Visual identification can be provided gradually, as the VALIDATORS are installed, so that at the beginning of the operation it is already possible to use these forms of payment in some vehicles.

Table 5. Schedule for Implementation of Validators Throughout the Concession

Source: Self Elaboration.

Mode of Transport	Component	Status	Quantity	Distribution of Validators throughout the concessions						Source
				Year 1 (6 months) Partial operation	Year 2 (15 months) Complete operation	Year 2	Year 3	Year 4	Total	
VLT	Stations	Operating	29	-	40	-	-	-	**40**	VLT
VLT	compositions	Operating	32	-	896	-	-	-	**896**	VLT
VLT	Station	To Operate	1	-	16	-	-	-	**16**	CDURP
BRT	Station	Operating	125	518	-	-	-	-	**518**	BRT
BRT	Terminals	Operating	8	98	-	-	-	-	**98**	BRT
BRT	Stations	To Operate	18	-	128	62	-	-	**190**	SMTR
BRT	Veículos	To Operate	69	-	-	-	69	-	**69**	SMTR
BRT	Terminals	To Operate	4	-	42	24	-	-	**66**	SMTR
SPPO Conv.	Vehicle 1 turnstile	Contract Fleet	2.961	-	2.392	592	-	-	**2.961**	SMTR
SPPO Exec.	Vehicle 1 turnstile	Contract Fleet	516		413	103			**516**	SMTR
SPPO	Vehicle 2 turnstiles	Contract Fleet	2.990	-	2.392	3.588	-	-	**5.980**	SMTR
STPL	Vehicle	Operating	2.279	-	2.010	269	-	-	**2.279**	SMTR
STPL	Vehicle	To Operate	1.113	-	-	1.113	-	-	**1.113**	SMTR
STPC	Vehicle	Operating	580	-	561	90	90	-	**740**	SMTR
STPC	Vehicle	To Operate	558	-	-	140	209	209	**558**	SMTR
Total				**616**	**8.867**	**5.981**	**368**	**210**	**16.041**	-
Total in addition with 5% of the Technical Reserve				**647**	**9.310**	**6.279**	**386**	**221**	**16.843**	-
Total Accumulated throughout the concession including 5% of T. Reserve				**647**	**9.957**	**16.236**	**16.623**	**16.843**	**16.843**	-

4.2.2. APPROVAL OF SERVICES, SYSTEMS AND EQUIPMENT

The GOVERNMENT will authorize the start and the CONCESSIONAIRE will carry out the process of approval of any services, equipment, third-party systems, including interfaces with any TICKETING SYSTEMS of other modes of transport, considered for the operation of SERVICES necessary for the operation of the DTS. The GOVERNMENT must approve the protocol to be followed for approval and the CONCESSIONAIRE will be responsible for monitoring the procedure, informing the results to the GOVERNMENT, before the beginning of use.

The approval process must consist of two stages. In the first phase, called technology transfer, there will be the release of technical material relevant to the development of interfaces with the DTS, together with mass of data for testing, access to the approval website and supplies of system cards with approval keys, when necessary. The monitoring of the process must be carried out by a responsable technician of the CONCESSIONAIRE. After the technology transfer, the second phase begins, in which the third party can request to proceed to the approval test, which consists of a battery of tests, which proves the total adherence of the equipment/software to the DTS. Upon successful completion of the approval test, the product will receive a certificate of adherence. Otherwise, the applicant may choose to withdraw from the process or schedule a new approval test.

4.3. INTEROPERABILITY WITH OTHER ISSUERS

With the entry into operation of the DTS CONCESSIONAIRE, there will be at least four Ticketing Systems in the Metropolitan Region of Rio de Janeiro. Immediately, in addition to the new municipal system, there will be the Metro system (Giro card), the Supervia system and the RioCard system in intercity modes (ferries, buses and intercity vans). It is also expected that the Government of the State of Rio de Janeiro will contract an operator for metropolitan ticketing.

Thus, for the purpose of INTEROPERABILITY of credits between modes of transport and easiness for the USER to move around, the CONCESSIONAIRE may enter into legal transactions for INTEROPERABILITY, on its own initiative or on the initiative of the GOVERNMENT, in order to facilitate INTEROPERABILITY between systems, and always with the final consent of the GOVERNMENT. The CONCESSIONAIRE shall make efforts to conclude the agreement, presenting all the actions and negotiations carried out and the agreements signed must maintain the economic-financial balance of the CONTRACT.

The INTEROPERABILITY agreements must follow minimum guidelines stipulated by the GOVERNMENT as per **Annex 7. "Criteria for the Interoperability of Ticketing Systems"**. The DTS must be prepared so that transactions between different ticketing systems take place in accordance with the practices indicated by ISO 24.014-1 and that there is INTEROPERABILITY both with CARD Based Systems and Account Based Systems.

The CONCESSIONAIRE must be able to receive records of beneficiaries of the intermunicipality fare integration policy (eg: Single Intermunicipality Ticket) and provide an API (Application Programming Interface) or file containing all transactions of these beneficiaries that occurred in municipality's transport modes for access by the Government of State of Rio de Janeiro and the TICKETING SYSTEMS issuing credit from their concessionaires and licensees.

4.4. ESTABLISHMENT OF THE SALES AND SERVICE NETWORK

The CONCESSIONAIRE must provide service and sales channels to USERS of the PASSENGER public transport system. These channels must allow to USERS the sale, charging and recharging of credits and the identification of balances in their respective ACCOUNTS and/or CARDS.

The service and sales channels are made up of four types: physical points with face-to-face service, ATM machines, simple POS points of sale and online service. These channels must allow the use of any means of payment authorized by the monetary authority and at least payment in cash, by debit/credit card or PIX. The GOVERNMENT may define a minimum charging/recharging value.

Regardless the chosen means , the channels must provide customized service for people with hearing and visual impairments and be physically adapted to serve people with locomotor disabilities, in the case of physical points, observing the provisions of Federal Law No.13.146/2015 and respective regulatory norms.

The CONCESSIONAIRE shall adopt, use and respect the social name of trans people, in any form of service to the USER, being subject to the applicable contractual and legal sanctions in case of non-compliance.

The CONCESSIONAIRE, in addition to the entire sale, loading, credit consultation and use operation, must:

- Provide its customers with a technical assistance service to solve errors and other problems that may be presented by payment media issued by the concessionaire.

- Establish and inform USERS about the procedure to be taken in case of loss, theft, or misplacement of the payment MEDIA issued by the concessionaire.
- Issue and provide a recharge receipt, at the request of the USER, in the amount of electronic credits loaded. The text of the receipt must be previously approved by the GOVERNMENT.
- Communicate and make available to the GOVERNMENT a link to access the website, hosted by the CONCESSIONAIRE, with a list of the addresses of the registered sales and/or recharging points, directly or via third-party subcontracting, containing at least the name and address, longitude and latitude, and ideally corporate name, CNPJ, days and hours of operation and other information that is relevant to the legal entity that effectively manages the point of sale and/or recharge, as well as the inclusions and exclusions and changes of points of sale and/or recharge. These must be previously approved by the GOVERNMENT, and must be updated in the access link immediately after each change.
- Provide a ticketing system (call registration), in order to record all USERS' demands, through any channel, including service time and solution presented. The system should also allow the evaluation of the USER's satisfaction, the recording the time elapsed between the notification of the problem and its solution and the type of problem presented, for the purpose of monitoring and corrective measures, under the knowledge and possible action of the Government. The GOVERNMENT must have access to the ticketing system, especially identifying the calls whose service time exceeds the limits defined in **ANNEX I.4 - "PERFORMANCE AND VIOLATION INDICATOR TABLE".**

The CONCESSIONAIRE shall build a service network for the USER, preferably and primarily in the non-face-to-face mode, through telephone, communication applications (eg: Whatsapp and Telegram), internet site, dedicated applications for cell phones with Android and iOS operating systems, with functionalities of chatbots. The phone call must be free for the USER. The non-face-to-face service network must include English and Spanish.

In addition to non-face-to-face service, the CONCESSIONAIRE shall install physical service stations for USERS, in a quantity compatible with the demand and distribution of USERS in the region served, and distribute ATM capable of solving common problems, including diagnosis and correction of faults in transport cards, issuance of a new card, transfer of credits, balance and statement consultation, blocking and unblocking of cards and recording of occurrences. The CONCESSIONAIRE shall monitor the fluctuation of supply and demand for service in the physical channels for the sale of TRANSPORT CREDITS, in order to prevent queues and reduce the USER's waiting time, observing the provisions of **ANNEX I.4 - "TABLE OF INDICATORS OF PERFORMANCE AND INFRINGEMENTS".**

The CONCESSIONAIRE shall carry out an annual USER satisfaction survey, with a methodology and procedure defined with the consent of the GOVERNMENT and maintain mechanisms for monitoring the experience of USERS in order to promote constant improvements to the design of service channels and dialogue with USERS.

4.4.1.NETWORK OF FACE-TO-FACE SERVICE TO THE USER AND BENEFICIARIES OF FREE OF CHARGE

The CONCESSIONAIRE must provide 12 (twelve) sitesfor face-to-face service to common and free of charge USERS, in facilities with accessibility for people with disabilities and reduced mobility. The installation of the face-to-face service network will be authorized in the public places listed below. The CONCESSIONAIRE may, upon approval of the GOVERNMENT, propose the allocation of service stations in alternative locations, within 500 meters of the originally designated locations. The implementation schedule of the face-to-face service stations is shown in Table 6 below and it must be considered that the station must be operational within 15 days before the end of the corresponding Stage.

Table 6.Location of Points under the SMTR Concession

Source: Self elaboration.

Stage	AP1	AP2	AP3	AP4	AP5
PARTIAL MOBILIZATION STAGE (6 months)	• São Sebastião Administrative Center (CASS)	• SMTR Headquarters (Botafogo)	• Terminal Paulo da Portela Madureira	• Terminal Alvorada • Terminal Jardim Oceânico	• Terminal Campo Grande • Terminal Santa Cruz
COMPLETE MOBILIZATION STAGE **(up to 18 months)**	• Terminal Gentileza	-	• Terminal Fundão-Aroldo Melodia	• Terminal Recreio • Terminal Taquara	• Terminal Sulacap • Terminal Mato Alto

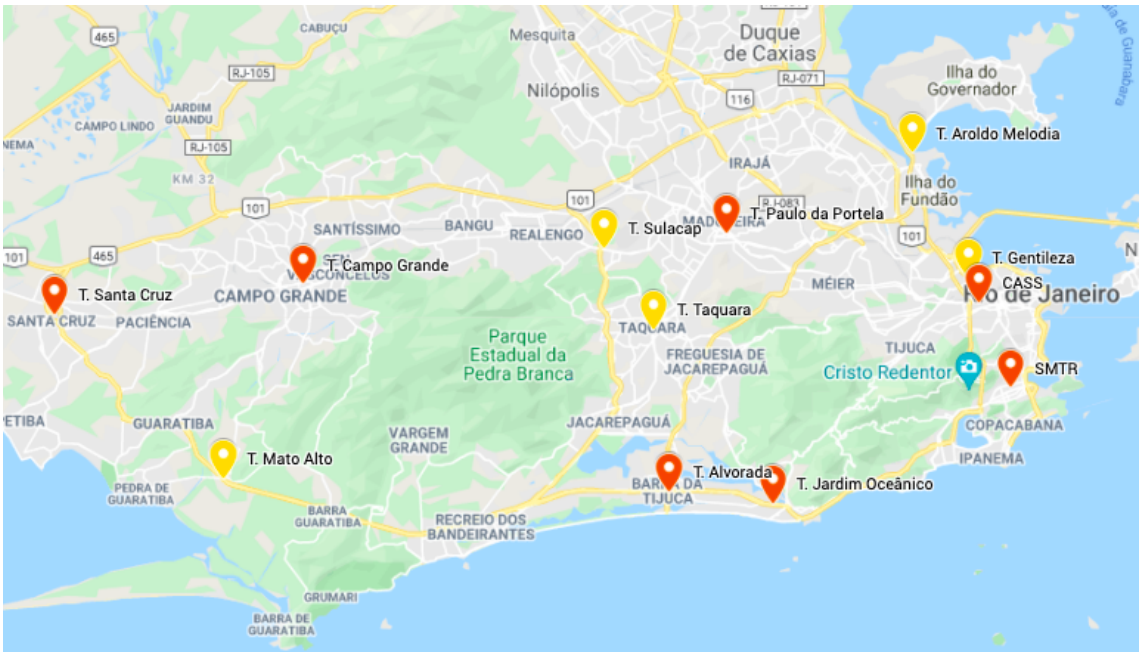

Figure 1. Distribution of the face-to-face service network in the city of Rio de Janeiro
Source: Elaborated by the author.

The face-to-face service must work during business hours and all locations must be able to provide free services and be prepared to serve people with disabilities and reduced mobility in accordance with the provisions of Federal Law No.13.146/2015. The service to free-of-charge beneficiaries will be carried out according to rules established or to be established in GOVERNMENT legislation.

If during the CONCESSION there is evidence of a reduction in the use and idleness of the face-to-face service network due to the increase in digital service, the minimum number or location of service stations may be reviewed by the GOVERNMENT.

4.4.2. FACE TO FACE SALES NETWORK

The CONCESSIONAIRE shall provide services through a network of points of sale (POS and ATM) installed in commercial networks and places with a high concentration of USERS of public transport. This network shall have a retail service profile and can be operated directly by the CONCESSIONAIRE or through its agreements with specialized networks that serve this type of market, including the networks that operate card machines at commercial points.

The size of the network will be determined by the number of inhabitants of each neighborhood in the city, according to data from the IPP (Instituto Pereira Passos - PCRJ), and its expansion will be defined in two phases:

- In the PARTIAL MOBILIZATION STAGE, the CONCESSIONAIRE must offer at least 7 Face-to-Face Service Points and 154 ATMs for the BRT and SPPO System, described in this section, which must be implemented 15 (fifteen) days before the STARTING DATE OF THE PARTIAL OPERATION .
- In the COMPLETE MOBILIZATION STAGE, the CONCESSIONAIRE must offer a network that includes the existence of one point of sale for every 5,000 inhabitants, that is, a minimum of 1,098 points of sale, including 12 Face-to-Face Service Points and 233 ATMs, which must be implemented 15 (fifteen) days before the COMPLETE OPERATION STARTING DATE.
- By the end of YEAR 3, the CONCESSIONAIRE shall increase the network of its sales and credit recharge to one point of sale for every 2,500 inhabitants, that is, a minimum of 2,204 points of sale, including 12 FAce-to-Face Service Points and 233 ATMs .

This proportion may be reviewed by the GOVERNMENT throughout the CONTRACT, in case the change in the recharge pattern by USERS and the idleness of the points of sale is observed. After the installation of the entire sales network, the closing of the sale of tickets in cash on board the vehicles will be evaluated.

Table 7.Distribution of the Service Network and Sales Points by Phase
Source:Self elaboration.

Type	Minimum Quantitative		
	PARTIAL MOBILIZATION STAGE 6 MONTHS	**COMPLETE MOBILIZATION STAGE 15 MONTHS**	**YEAR 3 36 MONTHS**
Service Points	7	12	12
ATM	154 ATMs (BRT and SPPO)	233 ATMs (+40 VLT and +39 BRT TransBrasil)	250 ATMs
POS	-	853 POS	1.942 POS
Total Sales Points	-	**1.098** Proportion 1:5.000 inhabitant	**2.204** Proportion 1:7.500 inhabitant.

The CONCESSIONAIRE may include, exclude and modify the location of the points of sale according to the change in the demographics of the city's neighborhoods, maintaining at least the stipulated point of sale/number of inhabitants ratio. Any change in its sales network must be previously communicated to the GOVERNMENT and must be updated on its website and in its application. For purposes of calculating the dimensioning of the network, the number of ATM terminals, the number of simple POS points of sale and the face-to-face service points for USERS must be considered.

The CONCESSIONAIRE shall provide a minimum of 250 (two hundred and fifty) ATM machines to be installed in locations established by the GOVERNMENT throughout the CONCESSION. The CONCESSIONAIRE shall make ATM machines available at VLT Stations and make sales channels (ATM machines or POS points of sale) available at BRT and SPPO Stations and Terminals, according to the minimum quantity stipulated below, reaching a minimum total of 233 ATMs in municipal systems to be implemented up to 15 (fifteen) days before the COMPLETE OPERATION STARTING DATE. The remaining 17 (seventeen) ATMs (to total the 250 provided) will have their locations defined by the GOVERNMENT. The CONCESSIONAIRE may suggest installation locations for approval by the GOVERNMENT, depending on the observed demand.

The CONCESSIONAIRE may install sales channels (ATM machines or POS sales points) at Metro, Ferry and Supervia Stations and Terminals, being responsible for establishing commercial agreements with these TRANSPORTATION OPERATORS for their availability.

The CONCESSIONAIRE shall maintain a communication channel with TRANSPORT OPERATORS, to prioritize the maintenance of ATMs in the field, in order to guarantee better availability and service to users.

Table 8. Number of points of sale of Transport System
Source:Self elaboration.

Municipal Systems
Mandatory Availability ATMs and POS

BRT and SPPO		
Station	**Minimum quantity ATM**	**Total quantity ATM e POS**
Terminal Campo Grande Terminal Alvorada	3 (6)	6 (12)
Stations: Taquara, Tanque, Praça Seca, Manacéia, Paulo da Portela, Jardim Oceânico, Vicente de Carvalho, Mato Alto, Salvador Allende, Magarça, Penha 1, Pingo D'água, Curral Falso e Barra Shopping	2 (28)	4 (56)
Terminal SPPO: Padre Henrique Otte e Procópio Ferreira	1 (2)	2 (4)
Other BRT Stations - Existing (118)	1 (118)	2 (236)
Other BRT Stations - To operate (22)	39	78
Total	**Minimum 193 ATM**	**Total 386**

VLT	
Station	**Minimum quantity ATM**
Bus station	3
Santos Dumont	3
Other Stations	1 (34)
Total	**Minimum 40 ATM**

State Systems

Optional availability of Points of Sale (which may be ATMs and/or POS)

Metro	
Station	**Quanti ty.**
Carioca	2
Jardim Oceânico	2
Pavuna	2
Cinelândia	2
Central	2
Vicente de Carvalho	2
Total	**12**

Superway	
Station	**Quantity.**
Central	12
Madureira	2
São Cristóvão	2
Deodoro	2
Santa Cruz	2
Campo Grande	2
Total	**22**

Ferry	
Station	**Quantity**
Praça XV	2
Paquetá	2
Cocotá	2
Total	**6**

During the TRANSITION STAGE, in addition to the sales network provided above, the CONCESSIONAIRE must provide mobile sales points at least at the BRT, SPPO and VLT stations and terminals listed in Table 8 and following the same amount stipulated for ATMs and POS. Mobile points of sale must be available at least during peak hours, between 6:00 am and 9:00 am and 4:00 pm and 7:00 pm.

If the CONCESSIONAIRE proves, throughout the CONCESSION, a reduction in the use and idleness of the (ATM) sales network due to the increase in digital sales and/or in sales terminals (POS), the minimum number of ATM machines or its location may be reviewed by the GOVERNMENT.

4.4.3.SERVICE AND SALE ONLINE AND VIA APP

The CONCESSIONAIRE shall provide online sales and service, through a website and application compatible with Android and iOS, with at least the following characteristics and functionalities:

- Allow the USER to register and collect the necessary documentation for the creation and maintenance of the transport account.
- Integrate, if possible, to the Federal Government's unique identification - GOV.BR;
- Associate means of payment to the transport account, allowing movement and balance control by MEDIA used by the USER.
- Allow the USER to define a security limit (minimum balance), generating an alert.
- Allow automatic transfer of credits between wallets, as long as there is no specific restriction on a particular type of credit, with the USER's prior authorization or on demand.

- The USER through his account may indicate USERS dependents and transfers of credits from his account to his dependent automatically or on demand.
- Define the order of use of the wallets associated with the transport account, according to criteria defined by the USER, respecting the general rules of priority for the use of credit pre-established in the DTS.
- Have control of a current account containing all credit and debit transactions carried out by the USER in its various portfolios.
- Each account must have indicated which MEDIA it is associated with and its current balance, including any negative balances arising from the interval between the use of a "non-loadable" media (non-exclusive bank card for transport) and its financial settlement.
- Transactions of use, in addition to details of the vehicle and line that was carried out, must allow the USER to view on a map the location where the operation was carried out.
- Have access control methods that ensure that the USER performs its transactions from a single cell phone and that access is carried out only with its authorization.
- In case of exchange or loss of a cell phone, the USER must have methods to disable the application on a particular cell phone and activate it on another.
- Generate a ticket in the wallet or QR Code for use as a means of payment.
- Allow for the purposes of use, if necessary for the payment of the fare, the composition of balances from more than one wallet.
- Allow opening a ticket in the service system, when the USER needs to report a problem or deal with a question. This information must be stored in the DTS at the disposal of the GOVERNMENT.
- Make chat available for USERS service.

The website and web application must contain information on the location of the face-to-face sales points. All relevant and useful information for transport USERS must also be posted on the website and in the web application. Both the website and the web application must meet the same availability index defined for the DTS OPERATIONS CENTER. The website and the web application must be available to USERS 30 (thirty) days before the STARTING DATE OF THE PARTIAL OPERATION. The website must:

- Have responsive layout on desktop devices in Google Chrome, Microsoft Edge, Safari, Mozilla Firefox browsers;
- Have responsive layout on mobile and tablet devices in Google Chrome and Safari browsers;
- Attend the accessibility recommendations of the WCAG (World Content Accessibility Guide), and must pass without errors the ASES WEB validation resource (http://asesweb.governoeletronico.gov.br/), of the Federal Government;
- Attend HTML5, CSS and EcmaScript standards.

- Be adapted to serve people with disabilities, when applicable, and provide an interface and customized service for people with hearing and visual impairments, according to the requirements of Federal Law No.º 13.146/2015.
- Provide English and Spanish languages.

All interfaces will have all functional elements fully translated into Brazilian Portuguese, including but not limited to page titles, texts, controls, labels, legends, menus, system messages and field tips.

The incorporation of the DTS web application and website into another already built by the CONCESSIONAIRE or one of the COMPANY'S CONTROLLING COMPANIES is allowed. However, an exclusive dedicated version must be made available for use in the transport system of the Municipality of Rio de Janeiro, containing only the functionalities of this item, for USERS who want to choose a direct access to the platform.

4.5. REGISTRATION OF USERS, INFRASTRUCTURE AND OPERATION

The DTS will consist of a set of databases necessary for the operation of fare collection and demand control. The most relevant ones will be presented below:

4.5.1. USER REGISTRATION

The DTS is intended to serve USERS registered in the system itself and must offer solutions for the use of transport services by USERS who choose not to register.

In the construction of the DTS, the characterization of the USERS of public transport must be considered, according to their link to different public policies applicable to each particular situation. This contributes to the correct allocation of transport system costs in the city budget. Public policies that directly impact the cost of services are:

- **Education,** including discounts and exemptions granted to students under specific legislation.
- **Health,** including temporary or definitive benefits granted to USERS with diseases provided for in specific legislation.
- **Social protection,** including USERS protected by specific regulations, especially the elderly.
- **Transport,** including all USERS not covered by the previous policies, and those who use intra- and inter-modal integration.

- The DTS must allow the inclusion of other public policies that may be defined by the GOVERNMENT and that establish links with relevant categories of USERS.

USERS can be classified according to their condition or situation. These characteristics are relevant to the definition of their classification in the Fare Policy.

- The **"condition"** defines a group of USERS with a non-reversible characteristic. Typically, this group includes the elderly and people with permanent disabilities.
- The **"situation"** defines the group of USERS that do not belong to the group defined as "condition". In this group, USERS may belong to different categories, even simultaneously, for purposes of fare classification.
    - Among the categories of USERS belonging to this group, we highlight workers in the formal economy (who have access to transport vouchers), students of schools authorized to receive partial or full free of charge benefits, by specific legislation, people with reduced mobility or chronic diseases.
    - New situations may be created in accordance with the Fare Policy defined by the GOVERNMENT, (example: discounts for teachers and the unemployed). Non-registered (unidentified) USERS will be included in the "situation" profile group.
    - USERS who are in more than one "situation" and who use transport cards must carry out their trips using a single card, which will contain credits corresponding to each of the situations stored separately (example: credits in the student profile wallet and common credit purchased by the USER). The DTS shall establish hierarchy criteria in the collection of FARES, in the situation where the same media contains more than one type of credit. This hierarchy will be established by the GOVERNMENT.

The DTS must also allow the segmentation of USERS, according to the payment of the FEE. All PUBLIC TRANSPORT FARE payment transactions must generate a record of the respective amount transacted in the respective database, including the amount corresponding to the free-of-charge beneficiaries. The following categorization may be used and may be updated in accordance with the GOVERNMENT:

- **Paying users** are those whose PUBLIC TRANSPORT FARE for use is greater than BRL 0.00 and are subdivided into:
    - **Exclusive users:** are those who use only one mode of transport/vehicle to carry out their trip. They can pay the full PUBLIC TRANSPORT FARE or PUBLIC TRANSPORT FARE with a partial discount, according to the definitions of the Fare Policy.

- **Integrated users:** These are those who use more than one mode of transport/vehicle to carry out their trip.
- Integration can be done within the same transport mode (intramodal integration) or more than one transport mode (intermodal integration).

    - In the case of integration, it can be operational only or operational and include fare. In the first case, the USER pays the exclusive full PUBLIC TRANSPORT FARE in each mode of transport/vehicle accessed and, in the second case, the integrated PUBLIC TRANSPORT FARE is lower than the sum of the exclusive full PUBLIC TRANSPORT FARE.
    - Another type of integration is the one that establishes the validity of the PUBLIC TRANSPORT FARE for a period determined by the Fare Policy. In this case, for each shipment there may or may not be a fare increase, also according to the fare policy.

- **Free of charge users** are those who enjoy a full discount on the basic PUBLIC TRANSPORT FARE defined by the fare policy. These USERS receive benefits derived from age, illness or any other legally established criteria.

For USERS who wish to register in this program, this registration must be unique and will consist of utilitarian data, of a mandatory nature, for the identification of the USER, including name, date of birth and CPF, and, to establish a communication channel with him, residence address, electronic address (e-mail) and telephone.

Upon registration, the USER will be asked, on a non-mandatory basis, to provide the Social Identification Number - NIS and other information to build a socio-economic profile, based, for example, on Critério Brasil, of the Brazilian Association of Research Companies. The CONCESSIONAIRE shall encourage USERS to respond to a survey for socio-economic characterization. Any and all information to be requested from the user must have prior authorization from the GOVERNMENT.

For USERS who do not wish to register, DTS must offer the possibility of acquiring individual MEDIA (ex: CARDS without registration, physical QR Code) and the use of means of payment embedded in bank cards (debit/credit) , mobile phone applications and other technologies with a similar effect. The fare rules for the use of the transport system will be defined by the GOVERNMENT and the DTS must consider the possibility of having variable rules, depending on whether or not the USER registers.

As a rule, USERS who are entitled to fare benefits, in the form of discounts or gratuities, must provide a greater set of information than those who pay the full PUBLIC

TRANSPORT FARE. For the registration of USERS with fare benefits, the information structure must include the elements that enable them to receive these benefits, including, for example, proof of age, school enrollment and medical certificates, among other aspects.

The CONCESSIONAIRE may establish agreements with public and private agents that participate in the process of issuing credits and MEDIA, such as the Municipal Department of Education, Departments of Health and Social Assistance, for assessment of fare benefits; Centralized Death Registration Service, for the cancellation of cards and information certifiers, especially regarding the framing of the legislation on gratuity for the elderly.

The GOVERNMENT will establish the concession rules, including requirements to be met by interested parties, the period for granting the benefit, procedures and rules in relation to companions, the responsibilities of the entities involved (City Hall's Department of Education, Department of Health, among others) and service deadlines. It must also regulate the procedures related to the use and eventual suspension or cancellation of benefits. The CONCESSIONAIRE will be responsible for operationalizing the registration of free-of-charge users in its system, and may use technology resources to facilitate and speed up the process, provided that there is no impact or burden on the beneficiary. The GOVERNMENT will also supervise the process, monitor the use and evaluate each policy.

When registering the USER, DTS must offer the MEDIA alternatives for the payment of the FARE. In this sense, there will be no automatic issuance of a TRANSPORT CARD to the registered USER, although there may be, however, the association of a USER to more than one MEDIA. The GOVERNMENT will establish the categories of USERS who will be required to use physical or virtualized transport cards, especially with regard to those covered by the legislation dealing with discounts and fare exemptions.

4.5.2. REGISTRATIONS OF THE DTS OPERATIONAL INFRASTRUCTURE

The records of the DTS operation infrastructure contain information related to the equipment, agents and operational elements involved in the operation of the DTS. If any record is already available in existing systems of the GOVERNMENT, the possibility of integrating or replicating the data must be evaluated, to avoid rework. The best way for integration or replication must be a consensus between the technical teams of the CONCESSIONAIRE and the GOVERNMENT. The most relevant records are those that include:

1. **Fleet:** elements necessary to identify the vehicles of TRANSPORT OPERATORS covered by the DTS technological platform. Other elements

include the vehicle's identifying order number, physical characteristics, the vehicle's link to an operator, and the location of the garage in which it is based.

2. **Validators:** equipment identification, associated SAM identification, manufacturer, model, link to an operator, vehicle or line of locks, year of manufacture, date of inclusion in the DTS and maintenance history.
3. **Public transport lines/connections:** standardized identification, indicating mode, line, starting and terminal points, operator, area of operation, among other characteristics to be included, at the discretion of the GOVERNMENT.
4. **Operators:** legal or natural persons authorized to operate in the transport system. The registration must include the name of the operator, the address of the garage(s), the person responsible for the DTS and other necessary elements.

4.5.3. INFRASTRUCTURE DATABASE OF THE COMMERCIALIZATION OF TRANSPORT CREDITS

The records of the credit commercialization infrastructure contain information about the CONCESSIONAIRE's agents and partners in the provision of the credit commercialization SERVICES intended for the payment of FARES and in the face-to-face service of USERS. The most relevant entries are:

1. **Credit sales network operators -** contains the identification and characterization of the companies responsible for the commercialization of credits, including the address of the operational headquarters, those responsible for the operation and for the financial relationship with the CONCESSIONAIRE, the installation addresses of the sales and recharge equipment and respective SAM. Include flexible/mobile sales points, if any.
2. **Accredited for the sale of Transport Voucher -** contains the identification and characterization of companies specialized in this activity, including the address of the operational headquarters, those responsible for the operation and for the financial relationship with the CONCESSIONAIRE, the addresses of installation of the charging equipment, if any.
3. **Companies that purchase Transport Voucher -** directly through the CONCESSIONAIRE's own channels.
4. **Banks and other partner entities -** contains information on companies specialized in the operation of financial transactions, responsible for customers who will use banking and similar MEDIA in the payment of FARES directly with the VALIDATORS, including the address of the operational headquarters, those responsible for the operation and for the financial relationship with the CONCESSIONAIRE.
5. **Educational establishments -** contains information about the institutions that offer courses covered by the legislation that allows the GRANTING of free of charge benefits to enrolled students.

6. Public bodies and entities - contains information on public bodies and entities involved in the GRANTING process of tariff benefits, such as Health and Social Assistance Departments.

4.5.4. REGISTRATION OF DTS OPERATING PARAMETERS

The DTS operating parameter records are developed for the operation of the sale and use of credits in accordance with the current Fare Policy defined by the GOVERNMENT, including business rules and fare parameter tables related to the collection value and the respective rights of usage contained in that value. By definition, any and all changes to this registration must be authorized by the GOVERNMENT to take effect.

4.6. COMMUNICATION PLAN

The CONCESSIONAIRE must submit within 60 (sixty) days of the DATE OF THE START ORDER for the GOVERNMENT to validate the first version of the Communication Plan, specific for the PARTIAL, COMPLETE AND TRANSITION STAGES, called Mobilization and Transition Communication Plan , considering the implementation in the BRT System (PARTIAL MOBILIZATION), the implementation in other municipal transport modes (FULL MOBILIZATION) and the coexistence of the DTS with the current TICKETING SYSTEM (TRANSITION).

This plan should include clarification to USERS that a new TICKETING SYSTEM will be implemented, how it will work, what the new functionalities will be, when the operation will start, how the migration will take place, and provide guidelines on how the USER can purchase the new transport cards. The execution of the Mobilization and Transition Communication Plan must start 30 (thirty) days before the STARTING DATE OF THE PARTIAL OPERATION and must be updated and restarted 30 (thirty) days before the START OF THE FULL OPERATION, as provided for in **Item** 4.1. “Mobilization and Transition Plan” and must include the alteration of posters at stops, stations, terminals and vehicles with information on payment and validation.

During the entire term of the AGREEMENT, whenever necessary to communicate any change, permanent or temporary, in the provision of the SERVICES, the CONCESSIONAIRE must present and execute a Communication Plan, which must be validated by the GOVERNMENT.

All marketing, communication and dissemination actions by the CONCESSIONAIRE must be previously approved by the GOVERNMENT, including the Brazilian Law for the Inclusion of Persons with Disabilities and use various communication channels, such

as radio, television, internet, social networks, folders, billboards, printed newspapers, etc.

4.7. CONSOLIDATED MOBILIZATION TABLE

At the end of the PARTIAL and FULL MOBILIZATION stages, the CONCESSIONAIRE shall make the deliveries described in the Table below.

Table 9. DELIVERY TABLE FOR STARTING THE EXCLUSIVE OPERATION
Source: Self elaboration.

ACTIVITIES	PARTIAL MOBILIZATION STAGE (up to 6 months)	FULL MOBILIZATION STAGE (Partial Mobilization plus items below) (up to 15 months)
Delivery of the Mobilization and Transition Plan	Report	-
Delivery of the implementation and parameterization of the DTS	system and its mirror to SMTR in operation (Partial)	system and its mirror to SMTR in operation (Complete)
SMTR Team Training Delivery	Training carried out (Partial Operation)	Training carried out (Operation Complete)
Delivery of the Validators Supply Plan	Report	-
	647 units at BRT system	9,957 units total (+9,310 units SPPO, VLT, STPL, STPC)
Delivery of the Communication Plan	Report	-
Execution of the Communication Plan	Report of communication actions performed for the Partial Operation	Report of communication actions performed for the Complete Operation
Availability of the Service Network	7 Face-to-face Service Points in operation	12 Face-to-face Service Points in Total in operation (+5 Service Points)
	154 ATMs (BRT e SPPO)	233 ATMs (+40 un. VLT + 39 units BRT TransBrasil)
	-	853 POS
Website online	Website	Website
Web Application available in Android and IOS version	Application	-
Other service channels (whatsapp, chat, etc.)	Service channels in operation	-
Free of charge cards benefits	Report on the number of cards delivered	Report on the number of cards delivered
Transport Cards/Accounts	Number of cards/Accounts delivered report	Number of cards/Accounts delivered report
Delivery of the Personal Data Protection Compliance Program (LGPD)	Report	-

Activation of the Personal Data Protection Compliance Program	Starting date	-
Delivery of the Risk Management Plan and Contingency Plan	Report	-
Activation of the Risk Management Plan and Contingency Plan	Starting date	-

5. OPERATION

5.1. ISSUE OF CARDS

The CONCESSIONAIRE is responsible for acquiring, issuing and distributing the transport MEDIA, whether physical, through a TRANSPORT CARD or printed or digital QR Code for all types of USERS. **The first delivery of physical TRANSPORT CARDS for USERS who opt for this type of MEDIA will be free of charge until the START OF THE EXCLUSIVE OPERATION** (for regular users, not considering free-of-charge users, such as the elderly). The CONCESSIONAIRE may require the user to register in the system, for the purpose of issuing this free of charge card and to avoid issuing more than one TRANSPORT CARD per user. The CONCESSIONAIRE must present the number of cards issued free of charge per location daily, for validation purposes by the GOVERNMENT.

For users who have full discount in the transport fee, the issuance of transport MEDIA, whether physical, through a TRANSPORT CARD, printed QR Code, wristband or other, or digital, must always be carried out free of charge, respecting the current policy. In the transition to DTS, the CONCESSIONAIRE must allow the withdrawal of the card at the face-to-face service stations or opening of a virtual account and must issue all necessary free cards until the START OF THE EXCLUSIVE OPERATION. The CONCESSIONAIRE shall customize tactile Braille marking on transport cards for people with disabilities who request this feature. The procedure for implementing this measure must be regulated later by the GOVERNMENT.

5.2. EARLY CREDIT SALES

The CONCESSIONAIRE's action must have as a priority, including in the development of the system, the expansion of the use of electronic and digital means as a way of paying the FARES. In this sense, the USER should be encouraged to purchase the credit independently, without the need for assistance or attendance at a physical location.

The sale of electronic credits in advance must be carried out in units of the CONCESSIONAIRE or by accredited third parties and subcontractors. As for the type of advance selling, it is needed:

- Sales terminals (POS), assisted by attendants.
- (ATM), operated by the USERS themselves.
- website and web application (apps).

The CONCESSIONAIRE may choose to operate credit trading equipment (POS, ATM) in a 100% online format (with equipment connected to the internet) or hybrid, that is, with POS and ATM equipment enabled to sell credits offline. POS and ATM equipment must carry out the credit recharge process upon authorization of a secure element validated via SAM or HSM. After validation, the credit is transferred to the transport MEDIA, in the case of Card-Based Systems, or to the USER'S ACCOUNT.

The basic functions to be performed by points of sale are:

- Charging with electronic credits, with the help of HSM (online recharge) or SAM chip (offline recharge).
- Verification of data stored in physical MEDIA, in the case of Card-Based Systems (expiration period, HOLDER and balances).
- Recording of recharge operations.
- Transmission of recharge transactions carried out.
- Automatic updating of parameters and software versions of credit sales equipment, through connection with the DTS Online Recharge Server.
- Receipt of cash referring to the value of the sale of electronic credits, or payment via debit or credit card.
- Receipt provision.

In addition, the CONCESSIONAIRE shall provide a systemically constructed commercialization structure to serve buyers of credits related to the Transport Ticket, aimed at legal entities, employers of formal labor. The ticketing market, for this group of buyers, works together with companies that sell social benefits, including Transport Vouchers (companies commonly called ticket holders). Thus, for this segment, the CONCESSIONAIRE must develop a digital solution for direct service to companies and to service intermediary companies in the benefits' purchase process, an established and consolidated market in the country. It is mandatory to provide a free version of the solution for employers who wish to carry out the acquisition of Transport Voucher autonomously.

With the consent of the GOVERNMENT, the DTS may allow the establishment of a maximum balance limit in the MEDIA, to mitigate the impacts of potential fraud. The DTS must allow the existence of a negative balance in the MEDIA or ACCOUNT, as long as they are linked to REGISTERED USERS. The negative basic amount will be established jointly with the GOVERNMENT and is intended to enable the use of the SERVICES in fortuitous situations of absence of sufficient balances on the cards or in the transport account or in the event of failures in the communication between the DTS and the vehicles.

The CONCESSIONAIRE may offer to USERS, through credit analysis, credit limits higher than those agreed with the GOVERNMENT, being responsible for the risk of

possible default, and the CONCESSIONAIRE must transfer the credit to the GOVERNMENT after use. The CONCESSIONAIRE may also offer a solution for the post-payment of the PUBLIC TRANSPORT fares to USERS.

5.3. AVAILABILITY OF CREDIT ON TRANSPORT CARDS

In the case of Systems Based on CHIPCARDS, the purchase of credit, in the case of USERS who use the physical transport card, requires a second operation, commonly called recharging , which is the transfer of the purchased amount to the referred card. In the case of credit purchases on the physical network, the recharging operation is completed at the time of purchase. When the purchase takes place through a website or web application, the recharging will be carried out transparently at the VALIDATORS, ATM machines and POS sales terminals in the system at a maximum period of 30 (thirty) seconds.

The most common way of using this process is the Transport Voucher acquired by companies to make available to their employees. The DTS must allow the issuance of a tax coupon that allows proof of the expense corresponding to the acquisition of credits. MEDIA on the restricted list cannot be reloaded. Both the recharging transaction and the blocking transaction must be signed and made available to the GOVERNMENT.

The availability of credits for the School category, students benefiting from total or partial exemption, must be carried out through a periodic automatic recharging list, with an interval and number of trips defined by the GOVERNMENT. This recharging list must be able to be parameterized directly in the DTS, in order to provide flexibility for the GOVERNMENT to change it independently, without the need for intervention by the CONCESSIONAIRE.

5.4. USE OF CREDITS

Depending on whether a CARD-Based System or an Account-Based System model was adopted, the FARES will be charged for each TRANSPORT CARD passage in the VALIDATORSor in the online account, according to the fares values associated with the USER and the type of credit in use. The use also includes the verification of the right and validity for access to the transport of USERS with free of charge or other active fare benefit, by means of a facial recognition camera and the release of access through the turnstile.

The VALIDATOR will be connected to the DTS OPERATIONS CENTER during the entire operation of the transport services. Considering that the premise of full availability of communication is difficult to perform, the DTS must provide for contingencies for charging during periods of “no communication”, with emphasis on USERS who do not use a physical TRANSPORT CARD. The periods of “no communication” cannot exceed 5 (five) minutes.

On a temporary basis and at the discretion of the GOVERNMENT, USERS may also use money for payment on board the vehicles. The end of the acceptance of cash onboard will begin after a specific release act by the GOVERNMENT. The DTS shall control the totality of turnstile transactions and register the use and the totality of the amounts collected in cash in the vehicles and urban equipment, for the purpose of meeting and settling accounts related to the payment of the remuneration of TRANSPORT OPERATORS.

The CONCESSIONAIRE shall maintain control of all security modules (example: SAM access) installed in the VALIDATORS , being responsible for the risks of fraud and systemic failures. The TRANSPORT OPERATOR will be responsible for installing, maintaining the on-board equipment and making it available for use. Any new installation or maintenance must be previously reported to the DTS CONCESSIONAIRE for control.

The information generated in the usage transactions must be signed and made available to the GOVERNMENT. In the VALIDATORS, the system parameters, the fare structure and the restrictive list will be registered to avoid the use of MEDIA with irregularities. Irregular transactions must be subject to financial replacement by the CONCESSIONAIRE. The inclusion of MEDIA in the restrictive list must be carried out online or within a maximum of 60 (sixty) seconds after the irregularity is registered.

The main activities performed by the VALIDATORS in controlling access, use and fare policy must be:

- Reading and processing of information contained in the MEDIA used by the transport USER, with the aid of the SAM module.
- Verification of the presence of the transport MEDIA in a restrictive list. In the event of an impediment to use, the MEDIA status will change from active to blocked and the USER will receive visual and acoustic information of rejection.
- GPS request for the current geographic coordinate and its inclusion in the current transaction.
- Recording information and capturing transaction data, sending it online to the DTS OPERATIONS CENTER within 30 (thirty) seconds after the transaction, and, in the case of a fare ticket, recording the corresponding PUBLIC TRANSPORT fare debit in the USER'S ACCOUNT or on the TRANSPORT CARD.
- Presentation of visual and acoustic information of rejection of the transport MEDIA, indication of released ticket, debited amount, balance, request for resubmission of MEDIA and others.
- Activate the turnstile control, allowing or not the release of the ticket according to the result of the MEDIA processing. It should be noted that the VALIDATORS must be able to control all the turnstiles of the TRANSPORT OPERATORS.
- Keep the authorization of passage active, after considering the authorization of passage valid and cancel it automatically only after the USER passes through the turnstile.
- Prevent a valid USER's right to travel from being canceled due to incorrect use by the USER immediately preceding it, such as, for example, incomplete movement of the turnstile (partial stroke).
- Update with new versions of parameters and restrictive lists only after checking the reliability of this information through verification by the SAM module.
- The VALIDATOR must record information regarding other events such as:

    - Individualized use transactions of each transport MEDIA, containing at least the following information: USER identifier, logical number of the MEDIA, type of MEDIA, date and time of the transaction, vehicle order number, line, direction of travel, type of transaction (ex: debit, type of gratuity, etc.), geolocation of the transaction, type of fare, amount debited, signature of the transaction.
    - Irregular MEDIA, with code of the reason for the refusal.
    - Occurrences of failures during operation.
    - MEDIA canceled for being on the restrictive list.
    - Start and end times of services and half trips.
    - MEDIA blocked.
    - Management of information stored in the VALIDATOR, such as parameters, restrictive list, recharge list, FAREs, new versions of the VALIDATOR's own software, among others.

The DTS must be able to cope with the use of credits from different sources, including the issuers of other titles and transport credits that operate in operational and fare agreements with the municipal transport system (for example, Metro, Supervia, or RioCard intermunicipal ticketing system , as well as any new system to be contracted by the State of Rio de Janeiro) - as mentioned in **Item** 4.3. “Interoperability with other Issuers”, in addition to other credit issuers, such as bank cards or digital financial solutions.

Fares paid in cash are attributed to the driver's MEDIA. For DTS, the transaction will be associated with a registered USER and must be associated with a TRANSPORT OPERATORS. The CONCESSIONAIRE shall account for and report these amounts at the DTS OPERATIONS CENTER. These amounts will not be transferred by the TRANSPORT OPERATORS to CCH, but will be deducted from their respective remuneration by the GOVERNMENT.

5.5. CANCELLATION AND UNLOCKING OF MEDIA AND REFUND OF CREDITS

In case of loss, theft or damage to the physical MEDIA or at the request of the USER, it may be canceled through the CONCESSIONAIRE, generating a protocol, which may be used for the acquisition of a new MEDIA and the refund of existing electronic credits, in case it is a CHIPCARD. In the case of exchange of defective cards, the exchange shall be free of charge to the USER.

The cancellations will be inserted in the restrictive lists of use and transmitted to the VALIDATORS of the system, updating a local restrictive list in each VALIDATOR and general for all systems related to the DTS. In the case of canceled MEDIA, from the moment the USER requested the cancellation with the CONCESSIONAIRE's system, DTS must calculate the balance to be refunded, leaving this amount available in the USER'S ACCOUNT. The cost of issuing new media may be deducted from the balance available for refund.

Blocking and respective unblocking transactions should be implemented in the use of transport media in cases where this type of process is justified, such as sending Cards by mail.

5.6. BALANCE INQUIRY

Equipment must be made available for checking balances in the USER's account and/or physical TRANSPORT CARDS at face-to-face service points and ATM machines. The USER ACCOUNT balance can also be consulted directly online through the DTS website or web application where, in addition to the balance, all transactions

carried out in the period defined by the USER and a summary per wallet used must also be presented.

5.7.OPERATION OF VALIDATORS

5.7.1. GEOLOCALIZATION OF EVENTS

Through the geo-positioning device embedded in the vehicles, whether it is built-in or external and integrated into the VALIDATOR, storage will be carried out in the VALIDATOR of the generating event, the vehicle's geo-location and time in the following events:

- The Start and the end of a journey (vehicle activation).
- the Start and the end of a trip (by connection direction).
- the Presentation of the MEDIA of the means of payment to the VALIDATOR and the release of the turnstile.
- the Loss of communication with the DTS.
- the Re-establishment of communication with the DTS.

The information collected will be sent by the VALIDATOR to the DTS, in real time when the VALIDATOR is online or immediately after the reestablishment of communication with the DTS, with a maximum period of 30 (thirty) seconds. The CONCESSIONAIRE shall also provide an API with the geo-positioning of vehicles, to be used for monitoring by the GOVERNMENT, with vehicle position updating at most every minute.

5.7.2. OPERATIONAL MEDIA BROADCAST

The operation of the VALIDATORS requires that the professionals of the transport operator companies have access to them in a safe and controlled way. For that, there is the operational MEDIA, which, through a TRANSPORT CARD or cell phone application, allows the configuration and parameterization of the VALIDATOR.

The CONCESSIONAIRE is responsible for issuing and controlling the operational MEDIA or for making available an application to identify the driver and inspectors, the start of the line and the openning and closing services. The media for identifying drivers and inspectors must be personalized.

Considering the current operational demand for access management and control of fare exemptions, such as the elderly, students and people with disabilities and chronic diseases, who may not have a boarding pass, the CONCESSIONAIRE is responsible for issuing operational MEDIA for each type of discount for use by teams of

TRANSPORT OPERATORS. This allows the TRANSPORTATION OPERATOR to account for the different types of users who are authorized to enjoy free of charge access without the need for validation (for example, seniors who use free of charge service upon presentation of an identity card to prove their age, without using specific MEDIA) .

The operational MEDIA should also consider access management for users who pay in cash in the vehicle, while this mode of travel payment is available.

The verification of the authenticity of the driver's operational MEDIA and the generation of a signature for the journey initiation, service opening and closing and trip opening and closing transaction will be carried out through the VALIDATOR's SAM. These transactions must be reported to the GOVERNMENT. These processes can be done in an automated way, with the DTS pairing with the GOVERNMENT's fleet monitoring system.

The DTS must allow the integration of the VALIDATORS with any existing Operation Support System ("OSS"), performing the line control, direction, date and time in an automated way, according to the detailed functional and technical specification documentation available, where there is OSS implemented.

5.8. EQUIPMENT CONNECTIVITY WITH DTS

The CONCESSIONAIRE shall dimension, implement, operate and maintain all communication networks, physical or not, for data transfer, between the equipments installed in the commercialization units, in the USER service units and the DTS. These communication networks must have reliability and availability characteristics that allow the following operations to be carried out online, and at most every 30 (thirty) seconds:

- Transmission of all sales transactions of credits pending connection by the equipment.
- Receipt of new versions of parameters and software for updating by the equipment.

The responsibility for maintaining all communication networks, physical or not, for data transfer between the VALIDATORS installed in the vehicles and transport infrastructures and the DTS will be the of the CONCESSIONAIRE, which must allow the following online operations in a maximum of every 30 (thirty seconds):

- Reception of all transactions for the use of credits and fleet monitoring, pending connection, by the equipment.

- Transmission of new versions of parameters and software for updating by the equipment.

In the case of multiple VALIDATORS operating in parallel in a vehicle, station or terminal, the CONCESSIONAIRE can perform the redundant centralization of external data communication.

6. MANAGEMENT

6.1. DTS OPERATIONS CENTER

The CONCESSIONAIRE shall implement, operate and maintain the DTS OPERATIONS CENTER, backoffice for data processing, control of the USER's current account, registrations, commercialization and use transactions, travel registration, monitoring, service to the USER, being able to carry out it in own or third-party equipment.

The DTS OPERATIONS CENTER must have the following minimum functionalities:

- Management and Monitoring of DTS indicators:
  - Management of Credit Issue Transactions.
  - Management of Records, according to **Item 4.5. "Register of USERS, Infrastructure and Operation".**
  - Management of Credit Trading Transactions.
  - Transaction Management of Services to USERS and Fare Exemptions Control.
  - Management of Credit Usage Transactions.
  - Fraud Control Management and Facial Recognition.
  - Management of PERFORMANCE INDICATORS, as per **ANNEX I.4 - "TABLE OF PERFORMANCE INDICATORS AND INFRINGEMENTS".**

- Reports. It must be possible to make them available through web-services and export the data in commercial formats CSV, XLS, XML or formatted TXT:

  - Sale of TRANSPORT CREDITS, broken down by selling channel, type of charge and type of MEDIA;
  - Number of purchasers of transport vouchers, broken down by sales channel, location and sales frequency;
  - Number of passengers and use of TRANSPORT CREDITS, with aggregated and individualized data, for common users and free of charge benefits;

- Occurrences of loss of CARDS, broken down by type of CARD, as well as quantity of issuing duplicates and replacement of TRANSPORT CREDITS;
- Quantitative and composition of the fare revenue collected, broken down by type of transport, passenger and applicable fare;
- Quantitative and composition of accessory revenues arising from the exploitation of the DTS by the CONCESSIONAIRE;
- Quantitative amount of fees charged to OPERATORS for services provided through the DTS, as well as control and monitoring of the amount of passengers transported, to ensure the correct calculation of the amounts due to each OPERATOR, observing the integrations between modes and the current fare policy;
- Updated data on the functioning of the systems that make up the DTS; and
- Treatment, within the databases linked to the DTS, of managerial information on the CONCESSION progress.

- Integration with other systems:
  - Fleet Monitoring System: the DTS OPERATIONS CENTER must allow association with usage data and work orders made available by the fleet monitoring system in use by the GOVERNMENT, to generate operational quality reports and support planning.
  - Integration with Thematic Maps: the DTS OPERATIONS CENTER must consider the possibility of grouping information on mobility demand for public transport according to different thematic maps used by PCRJ.

The CONCESSIONAIRE's DTS OPERATIONS CENTER shall meet the requirements of high reliability, integrity, availability and confidentiality, in order to meet the SERVICE levels defined in **ANNEX I.4 - "PERFORMANCE AND INFRINGEMENT INDICATOR TABLE".** The CONCESSIONAIRE shall provide a link with a panel showing the availability of all components of the DTS OPERATIONS CENTER, including the contingency environment, so that they can be monitored by the GOVERNMENT (communication links, servers, databases and any other component of the system architecture and relevant to its availability).

The databases necessary for the storage of information for all DTS applications - such as transport cards and accounts, registrations, travel transactions, electronic credit sales and others, as well as the bases used in the administration of DTS security (dynamic key files and certificates) - must be kept safe, stored in a redundant way that allows high reliability and with sufficient capacities to guarantee access to any data of the DTS for the period in which the CONTRACT is active, with maintenance of backups.

All information contained in the databases must be protected against unauthorized changes in the different authorization levels, always accompanied by signatures that certify such information as reliable, in order to allow authenticity checks in eventual audit processes..

6.1.1. DATA CENTER PCRJ

The CONCESSIONAIRE, as an integral part of its supplies, must maintain systems, equipment and communication links that ensure that the GOVERNMENT has a replicated database separate from the CONCESSIONAIRE's production database, being an exact copy, in real time and exclusive access by the GOVERNMENT, hereinafter referred to as Data Center PCRJ.

The Data Center PCRJ shall allow access to the DTS mirrored data by the GOVERNMENT for analysis it deems necessary, and enable the GOVERNMENT to access through it the HSM and systems related to the generation of credits, an exclusive function of the GOVERNMENT, and validation of signatures, to carry out, independently from the CONCESSIONAIRE, the process of generating credits and validating all transactions generated by the system.

6.1.2. ACCESS TO INFORMATION BY TRANSPORT OPERATORS

The CONCESSIONAIRE shall provide the TRANSPORT OPERATORS with the means to access data on their operation and on all transactions collected by DTS that took place in their vehicles, stations or terminals. To this end, the data belonging to each of the TRANSPORT OPERATORS must be accessible in real time, in data views that exclusively allow the visualization of information and sufficient data so that it can fully perform its operation and can audit the data when it finds it convenient. It should also be possible to make it available via web-services and export the data in commercial formats CSV, XLS, XML or formatted TXT.

The CONCESSIONAIRE must be able to make available to TRANSPORT OPERATORS the possibility of registering different agents for access to the OPERATIONS CENTER, with each agent having a user and password individualized to the system.

TRANSPORTATION OPERATORS may request, at their own expense, the creation by the CONCESSIONAIRE of new equipment (hardware), systems (software), products and specific promotions for their respective systems. The GOVERNMENT must consent to these solutions and may set maximum prices to be respected by the CONCESSIONAIRE in order to implement them.

6.1.3. FACIAL RECOGNITION OF BENEFICIARIES OF FARE EXEMPTIONS

The facial recognition method is composed of two processes: capture and validation. The capture process takes place in the VALIDATOR, when the TRANSPORT MEDIA is presented. If the presented MEDIA is capable of facial recognition validation, the VALIDATOR will store a set of user photos during the MEDIA presentation.

It is up to the CONCESSIONAIRE to define the number of photos necessary for the management of fare exemptions and fraud reduction. The collected images will be sent to the DTS to carry out the semi-automatic validation process. The DTS must be able to execute algorithms to compare the previously stored images collected from the beneficiary of the fare exemption with those collected on board, during the presentation of the MEDIA by the USER. If satisfactory compatibility levels previously defined by the CONCESSIONAIRE are reached in this comparison, the transaction is approved. If the compatibility levels with the previously registered images are not reached, a human evaluation process is opened that will require a CONCESSIONAIRE agent to validate or deny the transaction. In case the transaction is refused, the GOVERNMENT must be alerted to take the appropriate measures.

Eventually, following criteria of the comparison algorithm, the images collected during the MEDIA presentation can become part of the set of images of the beneficiary of the fare exemption.

The images collected during the presentation of the MEDIA by the USER must be stored for a period of not less than 6 (six) months.

As this is SENSITIVE DATA, **ANNEX I.6 - "PERSONAL DATA PROTECTION GUIDELINES"** should include a specific topic on the treatment, access and manipulation of this data.

6.2. FINANCIAL MANAGEMENT OF SALES AND CLEARING HOUSE

The CONCESSIONAIRE shall centralize the funds raised by the electronic sale of TRANSPORT CREDITS in a single account. TRANSPORT CREDITS can be used in any transport system, following the established INTEROPERABILITY rules.

In the case of use in municipal transport, the amount referring to the TRANSPORT CREDITS sold by the CONCESSIONAIRE and used must be transferred within D+1 business day, from the date of use, to the MUNICIPALITY'S CENTRAL CLEARING HOUSE (CCH), subtracted from the TICKET FEE due to the CONCESSIONAIRE by the administration of DTS and applied to the Performance Reduction, as described in **ANNEX I.4 - "TABLE OF PERFORMANCE INDICATORS AND INFRINGEMENTS".**

The TICKET FEE due to the CONCESSIONAIRE will also apply to the amounts received in cash by TRANSPORT OPERATORS directly in the vehicles, considering that they must be processed by the DTS for the purpose of settling accounts, the TICKET FEE due to the CONCESSIONAIRE and any Performance Reductions will apply. In this way, the CONCESSIONAIRE, through the DTS, must control all turnstiles release transactions and account for TRANSPORT CREDITS sold in cash by each TRANSPORT OPERATOR. These amounts will not be transferred by TRANSPORT OPERATORS to CCH, but will be deducted from their respective remuneration.

The management and clearing of credits collected by the DTS will be carried out in five consecutive stages, namely:

- **Data classification:**
  - On a daily basis, DTS will process the data on the use of transport credits with a view to classifying them into paying or free of charge USERS and exclusive USERS (of each municipal transport system) or integrated between modes.
  - Transactions will also be classified as complete, that is, they have the record of the TRANSPORT OPERATORS involved, or incomplete, that is, integration transactions without the registration of the origin of the integrated Transport Operators.
  - Likewise, the DTS will classify the CREDITS of NON-REGISTERED USERS acquired with more than 1 year, as remaining credits to be transferred to the CCH.
- **Processing:**
  - DTS will process complete and incomplete transactions as valid on a daily basis, reporting such transactions separately in the processing reports.

- The DTS will promote automatic adjustments as incomplete transactions are being integrated, converting them into complete transactions.
- Likewise, the data transmitted and referring to days that have already passed will be processed on the current day, in order to integrate the compensation of the respective current day.
- Processing for verification of pending integration and data transmitted with delay will be carried out daily.
- The processing report with the total amount of transactions collected and processed will be consolidated until 8:00 (eight) am..

- **Sale off:**
  - Daily, until 12:00 (twelve) hours (noon), the CONCESSIONAIRE will transfer to CCH the values of TRANSPORT CREDITS used and processed, as well as the credits of UNREGISTERED USERS sold and not used with more than 1 (one) year.
  - At this stage, the CONCESSIONAIRE will transfer the net amounts, discounted from the TICKET FEE that it is entitled to, applying the Performance Discounts.
  - The CONCESSIONAIRE will issue and send to the GOVERNMENT a processing report (clearing) referring to the total transmitted to the CCH.
- **Transaction verification:**
  - Without prejudice to similar actions by the GOVERNMENT, the CONCESSIONAIRE shall routinely verify the presence of anomalous records in the commercialization transactions and use of TRANSPORT CREDITS, including, but not limited to:
    - Cards or other MEDIA whose credit origin is unknown.
    - Integration transactions without matches between two databases, without pending processing.
    - Cards or other MEDIA whose amount of use is beyond the credits available therein.
    - Use of blocked cards.

The remuneration of TRANSPORT OPERATORS will be calculateda posteriori, by the GOVERNMENT. The GOVERNMENT will have full and unrestricted access to information held by the CONCESSIONAIRE and passed on to CCH. TRANSPORT OPERATORS will have access to essential information for managing their operation.

If there are commercial INTEROPERABILITY agreements signed, the CONCESSIONAIRE must verify and request from other credit issuers the values for use in municipal systems, transferring such values to the DTS, which will transfer the CCH, discounting the PERFORMANCE DISCOUNT of the CONCESSIONAIRE'S TICKET RATE. Alternatively, credits sold by the CONCESSIONAIRE must also be transferred to other ticketing systems, upon proof of use, in accordance with the

INTEROPERABILITY rules established with these other ticketing systems. It should be noted that TRANSPORT CREDITS sold by the CONCESSIONAIRE and used in other interoperable systems are not transferred to the municipality's CCH, but directly from the CONCESSIONAIRE to other credit issuers.

6.2.1. TRANSITORY CLEARING OF PAYMENTS TO TRANSPORT OPERATORS

As long as the MUNICIPALITY'S CENTRAL CLEARING HOUSE (CCH) is not instituted by a specific instrument, the CONCESSIONAIRE will carry out the distribution and clearing of payments to TRANSPORT OPERATORS, considering the PUBLIC TRANSPORT FARE applied to each system, the respective number of paying passengers and the Fare Policy defined by the Authority, including integration between modes and time intervals of a new embark, among other factors, as described in **ANNEX I.5 - "DESCRIPTION OF THE CURRENT COLLECTIVE PUBLIC TRANSPORT SYSTEM".**

The CONCESSIONAIRE will transfer the net amounts, deducted from the TICKET FEE that it is entitled to and the Performance Reduction. The Performance Reductions must be transferred by the Concessionaire to the current account indicated by the GOVERNMENT.

The transitory scheme of payments to TRANSPORT OPERATORS will occur according to the following frequency:

- VLT, SPPO and BRT): 5 times a week.
- STPL and STPC: 2 times a week, on days to be defined.

Daily, the CONCESSIONAIRE will issue and send to the GOVERNMENT a processing report (clearing) referring to the total distributed to the operators and the total net performance reduction.

6.3. SECURITY PROCESSES

The processes listed in this section mostly apply to CARD Based Systems. In the case of Account Based Systems, part of the processes may exist in a modified/simplified form and the CONCESSIONAIRE shall guarantee the security of transactions in each of the processes below.

6.3.1. SECURITY OF CREDIT GENERATION AND STORAGE

In the case of CARD Based Systems, credit generation must be carried out in a controlled and secure environment. The main actors in this process are two hardware elements, the Credit Card and the Credit Repository, which run applications with access to cryptographic SERVICES located on each device.

The Credit Generation Card must be a Smart Card with contactless, compliant with ISO 7816. It is a card exclusively owned by the GOVERNMENT, responsible for generating credit, which stores a password that will be requested in this process. The Credit Repository must be a secure device, FIPS 140-2 level 3, for which the HSM described above can be used.

In order to generate the credit, a secure communication channel must be established between the Card and the Repository, in which both participants mutually authenticate each other and after this authentication, the data passes through encrypted. Using asymmetric encryption algorithms, such as RSA, the credit generated in a given origin, the Credit Card, can be deposited only in the destination that started the “conversation” with it, the CREDIT REPOSITORY, because in this channel a message encrypted from one of them can only be deciphered by the other element.

The CONCESSIONAIRE may offer another form of credit generation that meets the security requirements described, provided that it is duly justified and approved by the GOVERNMENT.

In the case of Account-Based Systems, the CONCESSIONAIRE must present the user's current account control process that guarantees the integrity of the virtual wallet regarding the credits made by the user.

6.3.2. SECURITY OF THE GENERATION, STORAGE AND TRANSPORT OF PRIMARY KEYS

The process described below must be attended if adopted a CARD System Based. In this model, the primary keys form the basis of the DTS's security system. They will be used to derive credit access keys and in all encryption algorithms used in security processes. Due to the high computational cost of asymmetric encryption algorithms, symmetric encryption keys and algorithms such as AES must be adopted.

The information map (mapping) and set of keys of the DTS will be the property of the GOVERNMENT. The encryption algorithms may belong to the CONCESSIONAIRE and must be able to be all abstracted through an API, which will be the same API that will

be available, documented and supported by any and all approved suppliers and systems, as defined in **Item 4.2. "Supply of Validators and Approval of Systems and Equipment"**. It should be noted that key generation protocols and encryption algorithms cannot restrict the use of different physical TRANSPORT CARD technologies (Mifare Plus, Cipurse, Calypso, etc.).

The keys must be generated in a secure environment, using dedicated hardware (HSM) that guarantees the protection of the keys. In this process, the keys will never be able to travel in the open, therefore, the generation process needs to be done entirely within this hardware.

Another important requirement that the security system to be presented by the CONCESSIONAIRE must attend is the secure transport of keys from the HSM to the SAM, during the latter's initialization process. Keys cannot travel open (cleartext) over the network, nor be exposed to any application at any time.

To do so, it is necessary to create a transport key within the HSM, using a procedure that uses two or more passphrases, held by representatives of the GOVERNMENT, to generate the transport key. Using the same passphrases it is possible, at SAM startup, to use the same algorithm, generate and store the same transport key in it.

All lists, parameter files, software files for the VALIDATOR, sales terminal (POS) and SAMs must be signed by the HSM installed in the CONCESSIONAIRE's DTS OPERATIONS CENTER, in the role of File Certifier.

In the case of Account Based Systems, the CONCESSIONAIRE must put in place an equivalent process that guarantees the integrity of the keys and tokens used in the DTS.

6.3.3. TRANSPORT MEDIA SAFETY

The security system to be adopted in the DTS, if a System Based on CARDS is used, with regard to the transport media used by the USER, must have the following characteristics:

- Use access keys diversified by the MEDIA's serial number, which must be unique, whether physical or digital. This security measure prevents the cloning of the MEDIA in case the keys of a specific media are broken.
- Separate different types of data into different sectors (issuance, usage restrictions, travel, recharges, balances), to allow the GRANTING of different access permissions.
- For each type of data use dedicated keys (different from each other). This allows granting access permissions to data according to the profile of the application that uses them. Example: the VALIDATOR uses a SAM that grants

access to change balance and travel; the sales terminal uses a SAM that guarantees writing access to the recharge and balance sectors.
- Use electronic signatures as data integrity certificates. This ensures that data remains protected, even in the event of a key break. Electronic signatures must also be diversified according to the MEDIA's serial number. This makes it possible to adopt signature typing strategies, according to the type of data to be signed.
- Use access conditions (access bits) that allow the exchange of keys and the access conditions themselves, in the case of physical media.
- Implement key decrement and diversification counters using the USER ID that prevent mirroring fraud (previously stored card image copy), especially in the case of physical MEDIA.
- Protect sectors not used by the DTS with diversified access keys, different from the keys of the other sectors used, especially in the case of physical media.

The keys and algorithms that allow the generation of electronic signatures must not be part of the system's applications, and must be protected in SAMs and HSMs.

6.3.4. CREDIT TRANSFER FROM HSM TO SAM FROM POS/ATM

In the case of CARD-Based Systems, with the objective of guaranteeing greater availability in the recharge networks, maintaining the same security levels, the POS/ATM SAM can store electronic credits, which will be transferred to the USER'S MEDIA, when recharges are carried out.

SAM must keep a certain amount of electronic credits (balance) stored (parameterized), which will be used to load the USER's media. When this balance reaches a certain value (parameterized), the credit sales application requests the online transfer of electronic credits from the HSM application to the SAM, using the ISO-8583 protocol.

The condition established for the HSM application to transfer the requested electronic credits is the sending to the HSM of all cargo transactions carried out. The HSM application must reconcile the SAM balance with the values used in the loads.

To ensure the traceability of this process, the HSM application must generate a record that identifies the electronic credit transfer log transaction to the SAM. This transaction must be signed, attribution only to the HSM application. As a minimum, the transfer log must contain the following fields:

- USN (Unique Sequence Number) of the transaction.
- SAM ID.
- Transfer transaction amount.
- Previous SAM balance (before transfer).

- Date/Time (hh:mm) of the transfer.
- Current SAM balance (after transfer).
- Log signature.

The application executed on the server must store in the DATABASE, for each transaction, a record, called the electronic credit transfer log, which is a “clone” of the card image, prior to the recharge process, to guarantee the return in case of error in recharging the current credit.

6.3.5. SECURITY OF CREDIT TRANSFER FROM SAM TO TRANSPORT MEDIA

In the case of CARD-Based Systems and in the condition that the CONCESSIONAIRE chooses to carry out offline recharge operations, it must use a secure local repository for credit storage, the POS SAM.

The process of recharging electronic credits in the transport MEDIA (physical or virtual wallet-type card) of USERS requires a security element at the Point of Sale, the PDV SAM, which guarantees the safe transfer of credit stored on it to the MEDIA of the USER and a Credit Certifier (HSM) to be accessed remotely in the need to restore the local POS balance.

With the objective of guaranteeing greater availability in the recharge networks, maintaining the same security levels, the PDV SAM can store electronic credits, which will be transferred to the USER's MEDIA, when recharges are carried out.

In this process, the SAM is responsible for providing the transport MEDIA with the amount of the electronic credit and for generating the signatures of the new transfer data. The new signatures and the access key itself for writing the new signed data are provided by SAM. Reloading can only be performed if the integrity of the MEDIA is confirmed before the operation, which must be done by the SAM.

To ensure the traceability of this process, the SAM application must gather in a record that identifies the transaction, called the recharge log, the information that characterizes it and must generate a signature for this set of data. As a minimum, the reload log must contain the following fields:

- Type of MEDIA used.
- Credit type (eg common, Transport Voucher).
- Type of credited wallet (common or special).
- Transaction NSU (Unique Sequence Number).
- USER identifier.
- MEDIA identifier.

- Transaction value.
- Travel counter.
- Recharge counter.
- Recharge date/time.
- Date/time of credit purchase (different from the previous field in case of prepaid credits).
- Log signature.
- MEDIA balance.

The application executed on the servers must store in the DATABASE, for each transaction, a record, called the electronic credit transfer log, which is a “clone” of the card image, prior to the recharge process, to guarantee the return in case of an error in recharging the current credit.

6.3.6. CREDIT CERTIFICATION

In case of CARD Based Systems, the credit certification can be done centrally via the CONCESSIONAIRE's HSM accessed online or locally via the SAM of the sales terminal (POS/ATM).

The online network uses an ONLINE RECHARGE SERVICE or Credit Server, which acts as a “bridge” between the HSM, in the role of Credit Certifier, and the sales terminal. HSM's mission is to allow the secure transfer of credits to the USER's MEDIA. The HSM must allow the execution of the following sequence of operations to, upon request, carry out the credit recharge in a given MEDIA:

- Authenticate the credit transfer request: The vending terminal will send a signed request so that the HSM can trust the origin of the packet. This subscription will have the POS serial number as a diversification factor. The package will also have transaction counters to prevent package replay fraud.
- Produce and sign credit cryptogram for recharge and data update of the last recharge of the MEDIA, whose only possible destination is the MEDIA whose data were received in the previous credit request.
- Generate and sign online credit transaction record, which must be entered in the DATABASE by the Credit Server, to ensure traceability of the process;
- Calculate the writing key for updating data in the USER MEDIA.
- Send a credit package “stamped” by the HSM, containing a writing key, which can only be interpreted by the credit applicant.

The credits to be transferred to the USER'S MEDIA may also come from the SAM installed in the credit sales equipment. The SAM module will be supplied with credits through an online transaction that takes place through the ONLINE RECHARGE SERVICE, which accesses the HSM CREDIT REPOSITORY to transfer them to SAM and thus enable their offline distribution. This operation is described in **Item 6.3.4.**

“Credit transfer from HSM to SAM from POS/ATM”. In this recharge mode, the SAM performs the same sequence of operations described above for the HSM.

6.3.7.SUPERVISION OF TRAVEL AND CREDIT TRANSACTIONS

Whatever the System model adopted, in the role of Supervisor of Travel Transactions originated in the VALIDATORS, the HSM installed in the DTS must be able to guarantee the validation of each of the travel transactions received at the DTS OPERATIONS CENTER. All received transaction data, including the signature, must be stored in the DATABASE, which makes it possible to keep a complete record that can be audited at any time. The response time required in **ANNEX I.4 - “PERFORMANCE AND INFRINGEMENT INDICATOR TABLE”** must be guaranteed due to the high transaction volumes.

In the role of Inspector of Credit Transactions originated in sales terminals, the DTS's HSM must be able to guarantee, with high performance, the validation of each of the credit transactions carried out at these terminals. Due to the high volume, the HSM must present the response levels required in **ANNEX I.4 - “PERFORMANCE AND INFRINGEMENT INDICATOR TABLE”** to check these signatures.

6.3.8. INFORMATION SECURITY

Regardless of the system model adopted, the DTS must have automatic auditing routines that validate the integrity of all its processes, such as, for example, the consistency of the balance of a USER account through its debits and credits.

Audit routines must define automatic mechanisms and associated procedures that record all important DTS activities. Some features of these routines are:

- Log of relevant activities, that is, any activities that could potentially be related to some type of attack.
- The audit scheme should cause the least possible impact on the normal routines of the DTS, without compromising performance and availability.
- Audit information must be stored uniformly and easily accessible for consultation and interpretation, with a retention period of at least five years.
- Audit information must be protected from attack.
- Identification and authentication are related to audit routines. The DTS must be able to correctly identify the entity responsible for the registered operation.

The DTS must maintain a database on operations carried out and respective participations of entities, allowing the specific examination of the actions of one or more entities. The records in the DTS database must always be accompanied by signatures created in such operations, which certify the authenticity of these data. These signatures must be generated with the help of HSMs installed in the DTS OPERATIONS CENTER

6.4. RISK MANAGEMENT AND CONTINGENCY PLAN

The CONCESSIONAIRE shall develop a Risk Management Plan for the DTS, considering the guidelines listed below and submit it to the GOVERNMENT for consideration and approval, implementing it at the time of entry into production. The first version of the Plan must be delivered within 60 (sixty) days from the date of the START ORDER and revised whenever necessary or at the request of the GOVERNMENT. PCRJ will have 5 (five) business days to validate the Plan and, if rejected, the CONCESSIONAIRE will have 5 (five) business days to present a new version. The Risk Management Plan must be activated (implemented) 30 (thirty) days before the STARTING DATE OF OPERATION.

All actions provided for in the Contingency Plan must attend the Brazilian Law for the Inclusion of Persons with Disabilities. Risk Management comprises the Risk Response Plan, Preventive Action Plan and Contingency Plan. In these Terms of Reference, the Preventive Action Plan and the Contingency Plan will be consolidated into a single document, hereinafter called the Contingency Plan.

Risk Management must address the following categories of vulnerabilities and threats:

- Internal frauds.
- External frauds.
- Labor demands and poor workplace safety.
- Inappropriate practices relating to customers, products and SERVICES.
- Damage to physical assets owned or in use involved in Digital Ticketing
- Events that cause the interruption of Ticketing activities.
- Failures in information technology systems.
- Failures in the execution, meeting deadlines and management of the activities involved in Digital Ticketing

In addition to the Plans mentioned above, Risk Management must provide for:

- Documentation and storage of information regarding associated losses, when the indicated risk occurs.
- Preparation, on an annual basis, of reports that allow the identification and timely correction of control and risk management deficiencies.

- Carrying out, on an annual basis, evaluation tests of the implemented risk control systems.
- Elaboration and dissemination of the operational risk management policy to the institution's staff, at its various levels, establishing roles and responsibilities, as well as those of outsourced service providers.
- Implementation, maintenance and dissemination of a structured communication and information process.
- Existence of an operational risk management structure capable of identifying, evaluating, monitoring, controlling and mitigating risks, including those arising from outsourced services.

6.4.1. RISK RESPONSE PLAN

The Risk Response Plan must contain the identification, assessment, monitoring, controlling and mitigation of the risk of each operational process, with at least the following information:

- Type of risks - threat or opportunity.
- Risk identifier - unique code to identify the risk.
- Risk category - type of risk based on an analytical risk structure pre-defined by the CONCESSIONAIRE.
- Risk description - text containing the cause, risk and effect.
- Probability - chance that the risk will happen (rank from 1 to 5).
- Impact - impact if the risk happens (rate 1 to 5).
- Responsible for the risk – appointed by the CONCESSIONAIRE who will monitor and trigger responses to the risk. Each risk must have at least one designated owner and one surrogate.
- Risk Score - result of the product of probability and risk impact.
- Risk trigger - signal that indicates that the risk event has happened or is about to happen.
- Risk response strategy - may be to improve, exploit, share, avoid, mitigate, transfer, actively accept or passively accept (see Table below).
- Risk response - action that will be taken in relation to the risk. It can be preventive (containment - performed before the risk event occurs) or reactive (contingency - performed when the risk event occurs).
- Risk Response Responsible – who will trigger the planned risk response.

A given risk may have one or more strategies, as well as one or more responses.

Table 10. Risk Assessment and Strategies
Source: Risk Management Methodology

Risk	Strategy	Description
Threats	To prevent	Eliminate risk by avoiding it altogether.

	Mitigate	Reduce the probability and/or impact of the risk.
	Transfer	Pass the cost of the consequence to a third party.
	To accept	Active: planning actions (Contingency Plan) and establishing a Contingency Reserve (time, money or resources) to deal with risks when they occur. Passive: does nothing, only documents and handles the problem if it occurs (Wrack Action).
Opportunities	To explore	Eliminate the uncertainty of a risk by making the opportunity happen.
	Improve	Increase probabilities and/or impacts by maximizing the main drivers of this risk.
	Share	Assign ownership to third parties so they can better capture the opportunity.
	To accept	Passive: does nothing, deals with risk when it occurs.

For the purposes of these Terms of Reference, only preventive and reactive actions will be defined for the risks considered critical (high/medium probability and high/medium impact), which will be consolidated in the document called the Contingency Plan.

6.4.2. CONTINGENCY PLAN

The DTS contingency plan must provide for all actions and measures for prompt execution, to ensure the continuity of processes, in cases of abnormal occurrence such as loss or deterioration of the SERVICES, whose consequences may cause damage or serious damage to people or property, the CONCESSIONAIRE, the USERS, the GOVERNMENT or third parties.

Everything that has a high or medium probability of generating an abnormal occurrence of high or medium impact must have a preventive attitude, corresponding to actions and measures in the contingency plan of the DTS. It must also define responsibilities, establish an organization to respond to emergencies, deliver and be responsible for keeping updated during the term of the CONTRACT, a list of service levels, people, their contacts and time to resolve the problem , and contain detailed information about the characteristics of the abnormal occurrence. It should be developed with the aim of training, organizing, guiding, facilitating, streamlining and standardizing the actions necessary for the control and combat responses to abnormal occurrences (risk planning and disaster recovery).

It should also describe the measures to be taken, including the activation of manual processes, to make your vital processes work again fully, or in a minimally acceptable state, as soon as possible, thus avoiding a prolonged stoppage that could generate greater losses, such as loss of data, information and revenue, government sanctions and legal problems.

Your items must be documented and this documentation must be updated whenever necessary. Periodic tests on the plan are also necessary to verify that the process remains valid. The detailing of the measures should be sufficient and necessary for their quick execution.

The contingency plan must contain, at a minimum:

- For each risk associated with critical processes, probable duration of effects, resulting consequences and maximum acceptable limits for permanence of the failure without activating the respective contingency measure.
- Identification of the measures for each failure, that is, a list of measures to be put into practice if the failure occurs, including communication to the CONCESSIONAIRE, USERS, the GOVERNMENT and even the press.
- Definition of the necessary actions for the operationalization of the measures whose implementation depends on the acquisition of physical and/or human resources.
- Implementation of some form of monitoring that allows quick action in abnormal or emergency cases, with clear criteria for activating the plan according to criticality.

All employees of the CONCESSIONAIRE must be familiar with the plan, in order to avoid hesitation or loss of time that could cause greater problems in a crisis situation.

The CONCESSIONAIRE will be responsible for any possible damage caused by the lack of the contingency, or by the delay in its implementation. The CONCESSIONAIRE shall describe how it will perform the SERVICES when abnormalities occur involving any of the processes, such as: intrusion attacks, detection of fraud, misuse of the system, breach of card security, access security modules (SAMs) , private keys, encryption, passwords, software, occurrence of employee downtime, etc. It must, in addition, provide for redundancies to maintain the levels of SERVICE with regard to:

- Reliability and availability of communication networks.
- Reliability and availability of DTS OPERATIONS CENTER servers
- Reliability and availability of HSMs installed in the DTS OPERATIONS CENTER
- Reliability and availability of equipment installed in sales units and vehicles.

Contingency procedures should include:

- Regular backup maintenance of databases.
- Signaling of possible preventive maintenance, with precise indication of its duration, frequency, start and end times, persons responsible, procedures to be adopted, subject to prior communication and authorization by the GOVERNMENT. Preventive maintenance that prevents the system from

functioning will be considered as periods of unavailability, impacting the respective SERVICE level **(ANNEX I.4 - "PERFORMANCE AND INFRINGEMENT INDICATOR TABLE").**

- Maintenance of a "contingency site" in another physical location, always updated. The contingency site must be configured to immediately and transparently take over for the USER in the event of incidents on the main site. The return of the operation to the main site, after stabilization, should also be transparent. This cross-site conversion cannot, in any way, lead to data loss or integrity problems.
- Possess complete and up-to-date images of vital servers for operation.
- Keeping passwords in a safe place, but easily accessible to authorized persons in the event of an emergency.
- Professionals prepared for immediate action.
- Redundant hardware
- Documentation of operational and contingency processes always updated.

In addition, the DTS must be provided with resources that allow:

- Electricity contingency of at least 2 hours, for the operation of ATM and POS equipment installed in terminals and places of great circulation.
- Contingency of data communication with the DTS OPERATIONS CENTER for the operation of recharge equipment installed in terminals and places of great circulation.
- The rapid exchange of keys or cryptographic algorithms of HSMs and Security Access Modules (SAM), in case of breach of security.

6.5. INDEPENDENT AUDIT FIRM

The CONCESSIONAIRE will be responsible for hiring an independent audit firm every 2 (two) years to certify the security processes described in the Terms of Reference, as described in **ANNEX I.9. CRITERIA FOR INDEPENDENT AUDIT**. The first audit cycle shall take place 1 (one) year after the BEGINNING ORDER.

6.6. END OF CONTRACT TRANSITION

Six months before the end of the CONCESSION, the transition to the new CONCESSIONAIRE must begin.

All data and keys generated during the CONCESSION are the property of the GOVERNMENT. The CONCESSIONAIRE shall transfer all encryption keys in use to the GOVERNMENT or any new provider.

The CONCESSIONAIRE shall install the perpetual use license for the system and the infrastructure database to be made available by the GOVERNMENT, delivering the following documentation:

- System Installation Manual and/or System Installation Playbook;
- Solution Architecture Design, specifying:
    - Software architecture, containing all components, their interactions, technologies used and dimensioning of resources;
    - Infrastructure and services architecture, considering contingencies. The scheme of infrastructure resources and services necessary to support the solution must be presented, including databases, server instances, balancing, redundancies;
    - Specification and sizing of the hardware and software infrastructure for hosting the solution in infrastructure provided by the GOVERNMENT.
- Data Dictionary and physical model of the bases used.

The GOVERNMENT may request any other document it deems necessary to absorb knowledge of the system and the database. The CONCESSIONAIRE shall also hold meetings for technology transfer with the possible new provider and GOVERNMENT, as well as develop programs for data migration, if necessary.

The amounts of TRANSPORT CREDITS acquired by USERS (REGISTERED and NOT REGISTERED) and not used, must be transferred to the GOVERNMENT at the time of termination of the CONTRACT with the financial income obtained by the application in SELIC rate or Certificate of Deposit rate Interbank (CDI).