New Delhi, 24th September, 2010.

To,
1.   Principal Secretary (Urban Development), all States/UTs
2.   Principal Secretary (Transport), all States/UTs
3.   Principal Secretary, Local Self Government (Punjabm, Rajasthan and   Kerala)
4.   Municipal Commissioners of all Mission Cities
5.   Managing Directors of all Metro Rail Corporations
6.   Managing Directors of all State Transport Undertakings.

Sub: Common Mobility Card and Automatic Fare Collection Systems   across India.

....

Sir,

Kindly refer to this Ministry's letter of even number dated 23.04.2010 and 19th July, 2010 engaging M/s. UTITSL, a fully owned PSU of Ministry of Finance, Government of India for rolling out the Common Mobility Card and Automatic Fare Collection System (AFC) across India. For rolling out a Common Mobility Card and Automatic Fare Collection System across India it is important that national standard specifications are framed for the same so that the various systems can be integrated seamlessly and interoperability can be ensured. Accordingly, M/s.UTITSL have submitted a draft interface specifications with the AFC vendor which will have to be implemented alongwith other deliverables for AFC systems in all public transit operators, toll etc.

1.   **CMC Concept Overview Document** - This outlines the project at the national, city and public transport operator levels. It explains the way the various aspects of the system integrate and operate.

2.   **AFC Integration overview** - This document outlines how AFC systems should interface to the national CMC scheme via interfaces to the city central transaction settlement house. Sections within this document can be inserted into future AFC tender documents.

2.   You are requested to go through the same and offer your comments within 15 days directly to M/s. UTITSL (Shri Punit Saxena, CEO, UTITSL - e-mail:punit.saxena@utitsl.co.in) with a copy to this Ministry. If no comments are received within 15 days, it would be presumed that there are no comments to offer. Since the document is bulky, it has been hosted on Ministry's website i.e. urbanindia.nic.in/moud/programme/ut/ut.PDF and can be downloaded from there. However, a soft copy is also being e-mailed. Based on the suggestion/comments received, the document would be reviewed and Naional Standards finalized and adopted.

Yours sincerely,

Sd/-
(S. K. Lohia)
Officer on Special Duty (UT)
Tel:23061114
FAX:23061102
Email:sk.lohia@nic.in

Copy to:

1. Chairman, Railway Board, Rail Bhawan, New Delhi.
2. Joint Secretary, Deptt. of Road Transport and Highways, New Delhi.
3. Shri Punit Saxena, CEO, M/s. UTIITSL, Plot No.3, Sectgor-11, CBD
    Belapur, Naavi Mumbai-400 614 for information and necessary follow up.
4. DG, Bureau of Indian Standards, New Delhi with a request to review and offer
    commernts so that the National Standard can be finalised.

(S. K. Lohia)
Officer on Special Duty (UT)

Infrastructure Technology And Services

Ref No UTIITSL/ CTO/ CMC-AFC/ 2010-11 / 83

September, 17, 2010

Shri S K Lohia
Officer on Special Duty (UT)
Ministry of Urban Development
(Metro Rail Cell)
Nirman Bhawan,
NEW DELHI 110 001

Sir,

Sub:- <u>**Common Mobility Card and Automatic Fare Collection System**</u>

We are pleased to convey that the first version of the interface specification that AFC vendors have to implement along with other deliverables for AFC systems in a PTO has been completed.

The following documents are enclosed herewith for your perusal in this regard..

1) Common Mobility Card Concept overview
2) AFC Integration Overview

Thanking you

Yours faithfully,

Deepak Kumar
Chief Technology Officer

Common Mobility Card

CMC-00001 Concept Overview

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1 Overview

One of the major bottlenecks in promoting the use of public transport is its lack of seamless connectivity. One of the important activities of seamless connectivity is ticket integration. The technology today makes it feasible to provide ticket integration in the form of a common ticket by way of a Contactless Smart Card which can work as per the fare system of the issuing operator and as an e-purse to enable ticketing on other operators' network.

The National Urban Transport Policy envisages a single ticket over all systems of public transport. This will promote the user to perceive it as a single system and will increase its popularity and acceptability. For the operators, such a system will be cost effective, dynamic and robust. It also envisages that a single agency should take responsibility for coordination to make this successful through a common planning and management of the solution.

Thus, the all India Common Mobility Card (CMC) based on contactless smart card technology has been chosen as the solution to provide a common ticket across different operators (both Government and private) as an integrated approach for the utmost convenience of the common man. Since transport planning and coordination of all urban transport systems is a subject matter of the Ministry of Urban Development (MoUD), Government of India, the CMC will be issued under the aegis of MoUD as per applicable guidelines of the Reserve Bank of India (RBI) and as per other applicable laws of the country. On a national scale it will be ruled by certain specifications and adhere to some standards to make the interoperability seamless and technically possible.

This document outlines the Common Mobility Card scheme at the national, city and public transport operator levels. It explains the way the various aspects of the system integrate and operate.

CMC, apart from being used across any public transportation system like in buses, trains, metros, ferries, taxis (future), autorickshaws (future), will also be used for other application or transactions like:

- Toll collection on Indian national highways
- Retail payments
- Utility payments
- Parking at city car parks etc.

UTITSL has been selected as the body to carry out this CMC project. UTITSL is a government entity and is a registered Non Banking Financial Institution (NBFI) in India under the Reserve Bank of India (RBI) guidelines.

For a CMC to be successful there is a prerequisite that common standards be adopted at the national level, between PTOs, including those collecting fares for transit services. The various interface specifications and standards will be issued by MoUD to make the interoperability seamless and technically possible

2   Acronyms

Acronym	Description
AFC	Automated Fare Collection
CCH	Central Clearing House
CD	Configuration Data
CMC	Common Mobility Card
CSC	Contactless Smart Card
CTSH	City Transactions Settlement House
KMF	Key Management Facility
NTSH	National Transactions Settlement House
PTO	Public Transport Operator
SAM	Security Access Module
TSH	Transaction Settlement House
UD	Usage Data

3   Terminology

This section clarifies the terminology used in this document.

3.1   Common Mobility Card (CMC)

The CMC is a definition of a contactless smart card's data layouts & access rules. The CMC is described by standardised Specifications which detail all things necessary to issue, add value to and consume value from a CMC.

The CMC definitions will include a standard interoperable Purse feature, and dedicated space allocated for AFC Systems to store local fare products.

In addition to the Card Specifications, the CMC scheme includes a complete set of standards ranging from security key management through to system interfaces. In order for a CMC to be accepted by an AFC System, both the CMC Card Issuers (UTITSL) and the AFC System must be certified to comply with the CMC standards.

3.2   National Transaction Settlement House (NTSH)

As the name implies, there is only one Central Transaction Settlement House. This National facility moves transactions between the Participants, and provides financial management services to support including clearing and settlement of funds between the Participants.

In addition, the NTSH will provide centralised management of the security infrastructure supporting the CMC system, including management, distribution and hotlisting of Security Access Modules (SAM's) and the security keys they contain. NTSH will manage and provide keys used for accessing the common Purse on the CMCs.

City level Systems may have their own "City Transaction Settlement House" where they deal with multiple service providers and clear/settle transactions between them, not to be confused with this Transaction Settlement House which operates at the national level.

3.3   Participants

Participants in the CMC scheme can take one or more of the following roles:

- Card Issuer – collects funds paid by CMC Cardholders to Reload Agents and holds those funds until the card holder uses them. Transfers money to the Service Provider when supplied with transactions substantiating the value of the goods/services provided to the CMC Cardholder.

  UTITSL will be the Card Issuer.

- Reload Agent – collects cash from a CMC Cardholder and loads value onto their CMC. Funds are remitted to the Card Issuer who will generally pay the Reload Agent a fee for the service.

- Service Provider – deducts funds from a CMC in exchange for goods or services. Sends transactions for these fund deductions to the CCH, and receives funds from the Card Issuers as a result of the CCH's daily clearing and settlement process. The most common Service Provider will be a Public Transport Operator (PTO) providing rail or bus or metro rail services to CMC card holders.

Some Participants, such as Public Transportation Organisations, may fill all 3 roles, as well as engage 3rd parties to act as Reload Agents.

3.4   City Transaction Settlement House (CTSH)

A CTSH manages all aspects of clearing and settlement of fare collection for a Participant or group of Participants, including issuance and personalisation of cards, headquarters systems (for fare configuration management and distribution, transaction consolidation and reporting) and financial management within the PTO's of the City.

Most importantly from a CMC perspective, a CTSH provides all the capabilities necessary to provide cardholder support – management of lost/stolen cards, replacement of broken cards, refunding of balances and so forth. It also manages the bank interface for bank linked top-ups on CMC

A CTSH may be implemented on behalf of a single PTO or a City with multiple PTOs. A CTSH allows multiple disparate parties to share fare products providing seamless travel, with defined financial benefits, for their patrons (e.g. discounts for transferring from one mode of transit to another, or a "monthly pass" valid on multiple modes of transit). Within the city's system, the CMC acts as a container for those local fare products.

To interoperate within the CMC scheme, an City TSH which issues CMC-compliant cards must be able to send CMC-related transactions to the NTSH when a other city card is used, as well as receive CMC-related transactions where a CMC they issued is used in a other city system.

3.5   Automated Fare Collection System (AFC System)

An AFC System manage all aspects of fare collection and retail payments for a PTO, including card reading validators on vehicles and rail platforms, transaction collection points (such as bus depot computers or rail station computers), and headquarters systems providing configuration and reporting services.

The system also manages the reloads and refunds of the CMC products. An AFC System may be implemented on behalf of a single PTO or a City with multiple Public Transport Organizations. A set of City AFC Systems can be combined together to create a Regional AFC System, which will interface with a CTSH.

To interoperate within the CMC scheme, an AFC System must be able to send CMC-related transactions to the City TSH for further processing.

An AFC System will use the CMC interface specifications to:

1) Deliver configuration data to the CMC reader and Security system

2) Read and Write to CMC-compliant cards using the CMC-provided security mechanism

3) Generate CMC-compliant Transactions and send them to the CTSH

4) Transaction and configuration data delivery done through the Site Computers and AFC HQ systems. A generic flow is as defined in Figure 3: NTSH System Data Flow

4 CMC Usage and Fund Flows

This section describes the flows and its business implications, when the CMCs are used in the different AFC systems.

This section will look at the flows from purely business perspective and will detail the roles and responsibilities of the various stakeholders in the CMC system

The various stakeholders in the CMC system are defined in section 2

This document is restricted to Purse as a product, as its envisaged that each city will have their own unique Pass products, which will be handled by them at the CTSH level. This document will detail the working of the Purse Product on the CMC across the entire India

4.1 CMC Procurement, Initialisation, Application Loading Distribution

This is a responsibility of the individual City Issuer (CTSH). Its envisaged that MoUD with the help of UTI TSL will procure the cards for the entire CMC scope and will deliver it to different Cities for initialising their products and personalisation details before being sold to the card holders

The Purse Product area on the card will be defined by NTSH and its responsibility of the CTSHs to include the same on the CMCs initialised and issued by them

4.2 Issue card/purse (to cardholder) and Accept refundable card deposit

CTSH will appoint Load Agents, who could be the PTOs in the City AFC System, for the work of issuing and accepting deposit on the CMC and Purse Products. Load Agents will collect the money from the Card Holders for the Issue of Purse and Deposit on the CMC. Please refer to Figure 1: CMC Funds and Data Flows for the fund flows along with the data flows that happen for these operations.

4.3 Load Purse

CTSH will appoint Load Agents, who could be the PTOs in the City AFC System, for the work of loading the Funds on the Purse Products. Load Agents will collect the money from the Card Holders for the loading of Purse on the CMC. Please refer to Figure 1: CMC Funds and Data Flows for the fund flows along with the data flows that happen for these operations.

4.4 Use Purse (Usage)

Card Holders carrying a valid CMC loaded with a Purse Product will be entitled to use the funds for the various activities described in this document. The purses will be used for availing services provided by different PTOs in the AFC System. On availing the services appropriate funds will be deducted for the Purse by the devices in the AFC System. These devices will generate appropriate Usage Data for the deduction, which will be used by the CTSH (for domestic usage) and by NTSH (for other city usage). Please refer to Figure 1: CMC Funds and Data Flows for the fund settlement of these deductions.

4.5 Card and Purse Refunds

Refunds of the Card and Purses will happen in the exact reverse order as that of the Issue. CTSHs may appoint agents, who may be different or same as the Load Agents described under section 4.2 Issue card/purse (to cardholder) and Accept refundable card deposit. The fund flows for these operations will also be in the exact reverse order as that of Issue.

4.6 Settlement of Funds

NTSH and CTSH will summarise all the usages, top-ups and refunds throughout the day's operation. These summaries will be used as part of the end of day process to calculate the settlement summaries. These summaries will be calculated by CTSHs for the settlement of domestic usages and by NTSH for other city usage.

The actual fund transfers as referred to in the Figure 1: CMC Funds and Data Flows will be performed as part of the CMC System and are based on the Net Settlement rules prescribed by RBI.

Each PTO will hold an Account with the CTSH, which will effect the settlement between the PTOs and the Card Issuer at the end of day as described above, for domestic usage.

Each CTSH will hold an Account with the NTSH, which will effect the settlement between the various CTSHs and the respective Card Issuers at the end of day as described above.

For the funds settled by the NTSH to respective CTSHs, these will be settled by the CTSHs to their respective PTOs under that AFC System

Figure 1: CMC Funds and Data Flows

5   High Level Architecture

The following diagram illustrates the transaction flows and relationships within the system.
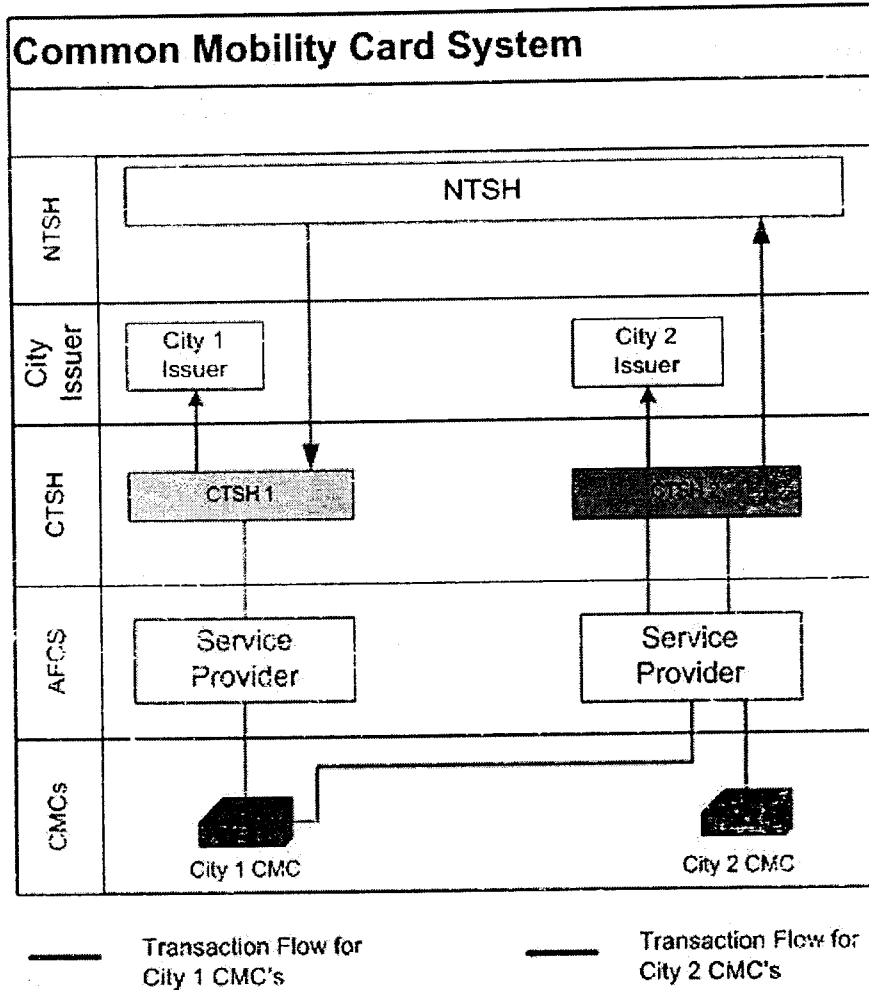

Common Mobility Card System

Figure 2: CMC High Level Architecture

At the highest level, Figure 2 shows three key elements of the architecture:

1)   CTSH's directly process transactions related to CMC's for which they are the issuer. See for example the City 1-issued CMC on the left – when the City 1 CTSH receives a transaction from that card, it processes it directly.

2)   CTSH's send transactions related to CMC's issued by other CTSH's to the NTSH for processing. See the City 1-issued CMC on the right generating a transaction for the City 2 CTSH. When the City 2 CTSH recognises that the transaction came from a City 1-issued CMC, it forwards the transaction to the NTSH for further processing.

3)   CTSH's process transactions from the cards they issue, when they arrive from the NTSH, which are used in the other city systems. See the transaction that the City 1-issued CMC sent to the City 2 CTSH which has been forwarded to the NTSH and on to the City 1 CTSH.

6   Detailed Data Flow

Figure 3 illustrates the data flows for some specific scenarios. Different components of the architecture have been numbered, and explanations for each component's processing are detailed in the sections below.
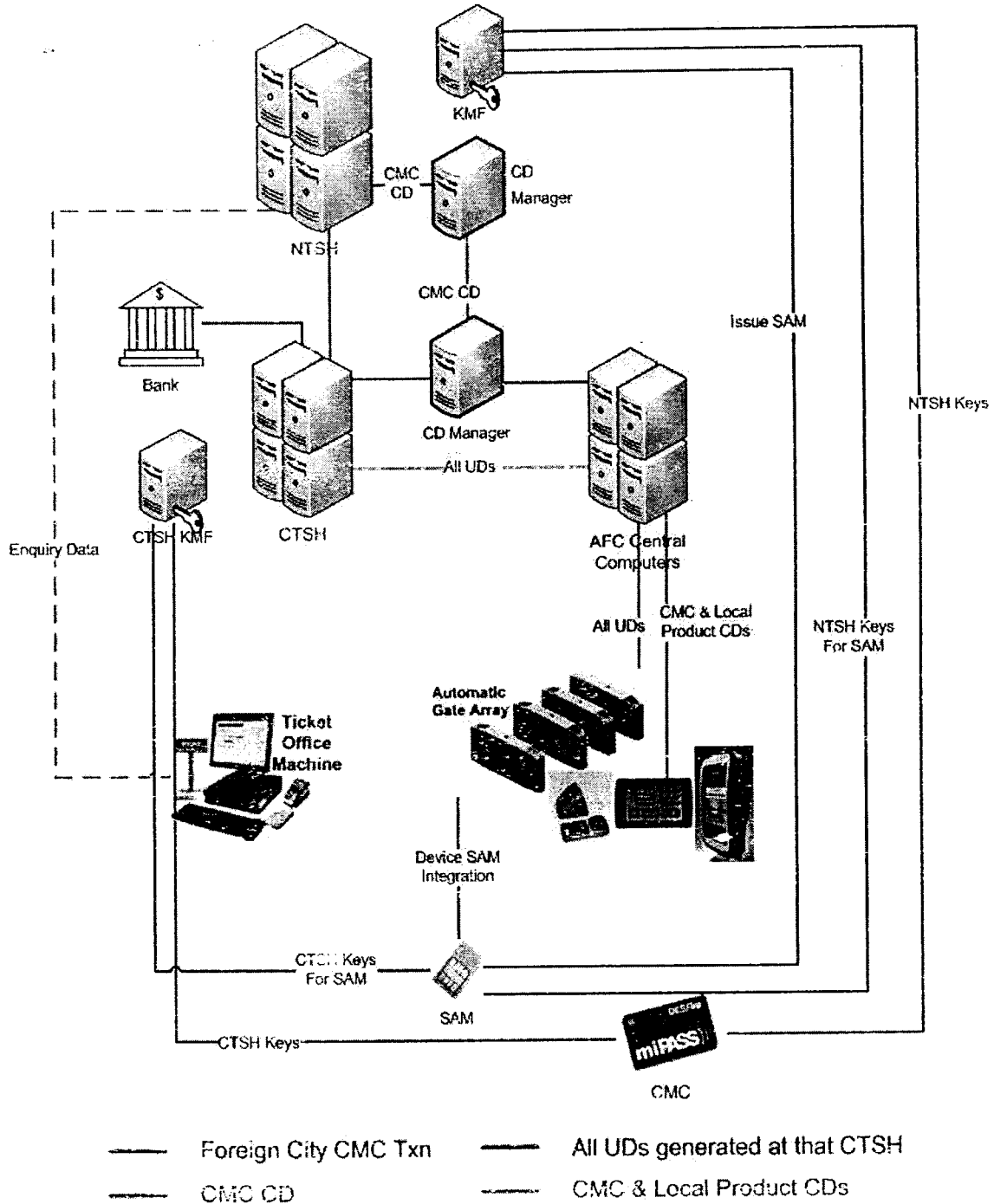

Figure 3: NTSH System Data Flow

6.1   NTSH Processing

The NTSH will manage Clearing and Settlement of transactions from the Common Purse on CMC's when the CMC is used in an AFC system that is not its home system.

This means that the NTSH will perform following functions:

- Manage Common Mobility Purse Access Keys on the CSC
- Manage Common Mobility Purse Configuration Data
- Clearing and Settlement of Common Mobility Purse Usage and Top-up transactions between the home CMC CTSH and the CTSH where the CMC has been used

All the transactions generated at the various AFC systems for CMC's issued by other AFC system will be transmitted to the NTSH for financial processing.

Due to the complexities and varied fare rules for usage of Period and Multi-ride Pass fare products across the length and breadth of India, it's not possible for the NTSH to participate in the processing of fare products, and therefore fare products will not be interoperable between cities. Fare products will be managed independently by the interoperable between cities. Fare products will be managed independently by the CTSH's, which will be the Issuers of these products. More information can be found in section 6.2.

The settlement agreements between the NTSH and CTSH's are discussed in section 7.

6.2   CTSH Processing

A CTSH will act as the Issuer and Clearing House for city level clearing and settlement and Product Management. A CTSH must follow standards set by the NTSH in order to accept CMC's issued by other CTSH's and have the CMC's they issue accepted by other CTSH's.

By following the NTSH Specifications, transactions generated by the AFC Systems falling under a CTSH will seamlessly integrate with the NTSH, without any adaption or translation.

A CTSH will assume three different roles in the CMC scheme:

(a) Provide financial management for all transit fare products stored on the CMC's they issue (e.g. period passes and multi-ride passes). This includes all card and product management, inter-operator financial processing (apportionment, clearing, settlement etc.).

(b) Receive funds from the NTSH's settlement process for CMC transactions it forwarded, and remit funds to the NTSH for CMC transactions received by other CTSH's. NTSH will settle and clear all the CMC Purse related transactions send from CTSH's, which are generated by the CMC Purses issued outside the City. It will in turn assume the responsibility of settling the transactions with the operators falling under its purview. For assuming this role it will establish a settlement agreement with NTSH. The details of which are discussed in section 7

(c) With respect to its role as CTSH and Issuer for CMC related fare products, all other related responsibilities will also fall under the CTSH:

    (i)   CMC Transaction Claims Management

    (ii)   CMC Product Master Management

    (iii)   CMC Sales Configuration Data Management

    (iv)   CMC Product Usage and Top-up settlement & reconciliation with PTOs for all the transactions rated as 'On us'.

         All the transactions generated by the cards issued by the City System, used inside the same City System are referred to as 'On us' transactions.

    (v)   Management of CMC Product Transactions and Issuer Validations

6.3 AFC Systems

AFC Systems will act as accumulators for the transactions generated by the individual service providers and reload agents in a city system. The transactions accumulated will be processed within the AFC System and its associated CTSH, and will be used for reconciliation between the local participants and CTSH.

Systems at this level will also act as managers for local:

- Device Management
- Fare Table Authorisation
- Service Provider Specific Functions

AFC systems must comply with the standards specified by the CMC scheme.

6.4 CMC Transactions

As discussed in the earlier sections of this document, it's envisaged that a de facto standard for CSC Readers will be established for all the devices being commissioned after the CMC System is implemented.

This means that there will be a standard for the transaction formats being generated by these devices. The devices with standard CSC reader installed will generate the transactions in the pre defined format, which is defined alongside the standards for CMC System and card.

These transactions will have ability to seamlessly integrate with the NTSH, without any adaption or translation in between.

Also the configuration data for generating these transactions is envisaged to be defined by the India Wide standard having capability for easier integration with the Fare Rules and CSC layout.

7 Inter City CMC Example

The goal of the CMC system is to allow a CMC-compliant card issued in one city to be used in another CMC-compliant AFC System. In order to achieve this goal, a countrywide smartcard standard must be adopted at the national level, and implemented by all AFC systems.

Since each CMC is issued by a specific City TSH, it will be able to support local transit products, including local transit passes and multi-ride products. Any issues requiring customer support will be provided by the PTO of that card's "home" AFC System.

When a CMC is used in its home AFC System, its transactions will be processed by that City TSH locally.

When a CMC is used in a "other city" AFC System, only the Common Mobility Purse will be accessible. These transactions will be recognised by the City TSH as requiring processing from the NTSH, so will be forwarded there for clearing and settlement.

The NTSH executes 3 main actions when it receives a transaction from a host City TSH:

- CMC Transactions are logged for reporting

- CMC Transactions are summarised for clearing and settlement – each day the National CCH will exchange funds with every Participant, either a deposit or a withdrawal depending on their net position at the end of CMC transaction processing

- CMC Transactions are sent to their "home" City TSH where they can be processed to manage fraud, card master data for refund/replacement management as well as logged for reporting

In addition to the three main functions, the NTSH provides the following additional functionality in support of the CMC scheme:

- Management of common Security Access Keys on the CMC

- Common Mobility Purse Sales Configuration Data Management

- Management of Validations for Common Mobility Purse Transactions

8 A Proven Scalable Architecture

The architecture described here is well known and proven in both the AFC and banking industries.

The MasterCard and Visa networks, while massive, are architected along similar lines. In their systems, a card issued by one bank can be accepted by a merchant who settles their transactions with a completely different bank. The CCH ensures the banks transfer the correct funds from the cardholder's account to the merchant's account.

What is different between the bank card systems and the suggested CMC scheme is that the CMC cards will carry value on their chip directly and provide payment authorisation directly from the card. In order to provide the appropriate security for such a wide range of payment amounts, the bank systems maintain cardholder accounts in the back office which then requires network-based authorisation. This makes the bank card systems substantially more complex. Since the CMC scheme is not a general payment scheme required to support payment of large amounts, such complexity can be avoided.

The card-based nature of the CMC scheme with a CCH is also well proven at the city level, as it has been deployed in numerous cities around the world, including Hong Kong, Singapore, Beijing. Seattle, San Francisco, Stockholm, Gothenburg and Rome.

The key modification necessary to implement a card-based CCH scheme at the national scale is to separate the Card Issuer functionality from the Central Clearing House. This multi-issuer approach is also proven, and has been shown to scale up very well.

9   CMC Card Data Format

The impact of the card selection goes a long way in the successful implementation of the CMC project. Some of the considerations are as follows:

- To be suitable, the data modelling has to be broad enough to be used on a national basis.

- Non-standard cards (i.e. not ISO14443) will not be supported to avoid any severe hardware impact.

Thus, a contactless ISO14443 Type A card has been selected for the CMC project.

A Contactless Smart Card is divided in number of sectors dependent on the size of the card. Each sector is an array of 4 blocks with 16 bytes of data each block. The last block in the sector is reserved for the Sector Keys.

For better understanding of the Card Layout please refer to the Figure 4: CMC Conceptual Card Layout

As each sector can be associated with different attributes, a specific sector will be assigned for storing information for the Common Mobility Card Purse. The security keys for this sector will be managed and controlled by NTSH. The keys will be loaded on the CMC along with keys for other sector at the time of Initialisation.

Other sectors are deemed to be controlled by the CTSH for maintaining local fare products, Personalisation Information and other Trip-related data for use of the Card within AFC Systems under its issuing CTSH.

Apart from transit application, the card will also be set up to add following facilities in addition to transit. All other blocks on the card can be used to store data specific to different facilities like

- Personalisation
- Passes
- Utility Payments
- Retail Purchases
- Toll Payments
- Parking etc.

Detailed information about Key Management is given under Section 10.1 CMC Security Model.
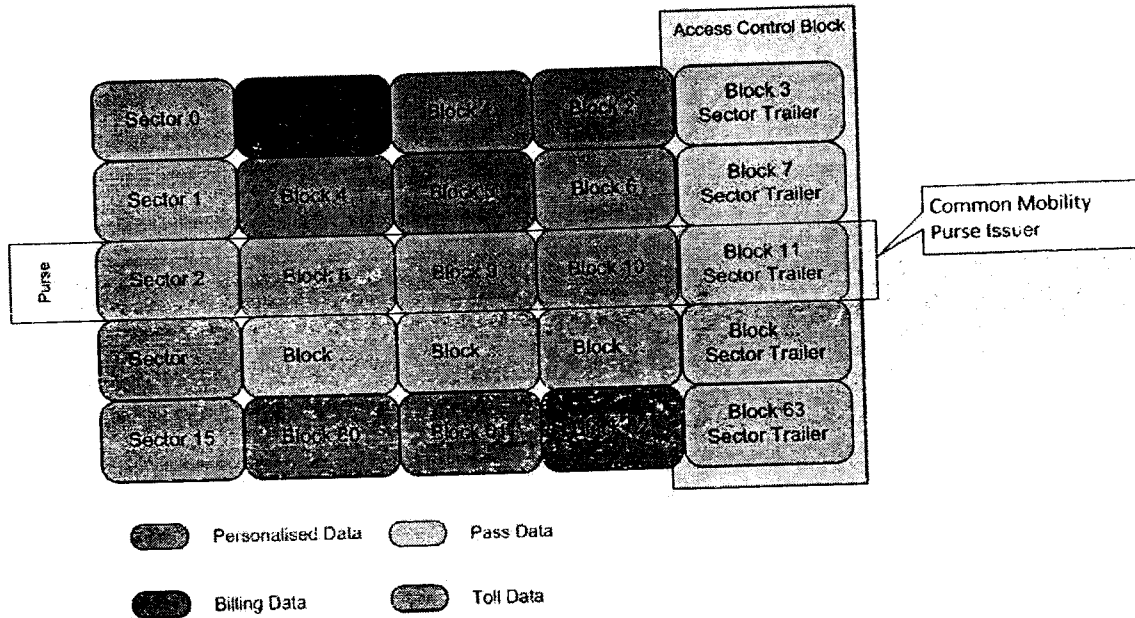
Figure 4: CMC Conceptual Card Layout

The CMC Card Data Format Specification will provide the information necessary for CMCs to be initialised, personalised and used.

9.1 CMC Security Model

As per the previous section, this emphasises the importance of having a common standardised card layout. Along with the standard Card Layout, it's of utmost important to have a standardised practice for Key Management. The keys to be managed will be divided into broadly three categories:

- Common Mobility Purse Keys
- Non Common Mobility Purse Keys
- Other Data (Active Fare, Personalise, non-Transit Usage) Keys

Key Management for the categories depicted in Figure 4

As can be seen the Keys for Common Mobility Purse Product related sectors will be owned and managed by the NTSH. The entity will download the Keys to Card Initialisation Devices and PTO Devices for Card Initialisation and Common Mobility Purse Usage respectively.
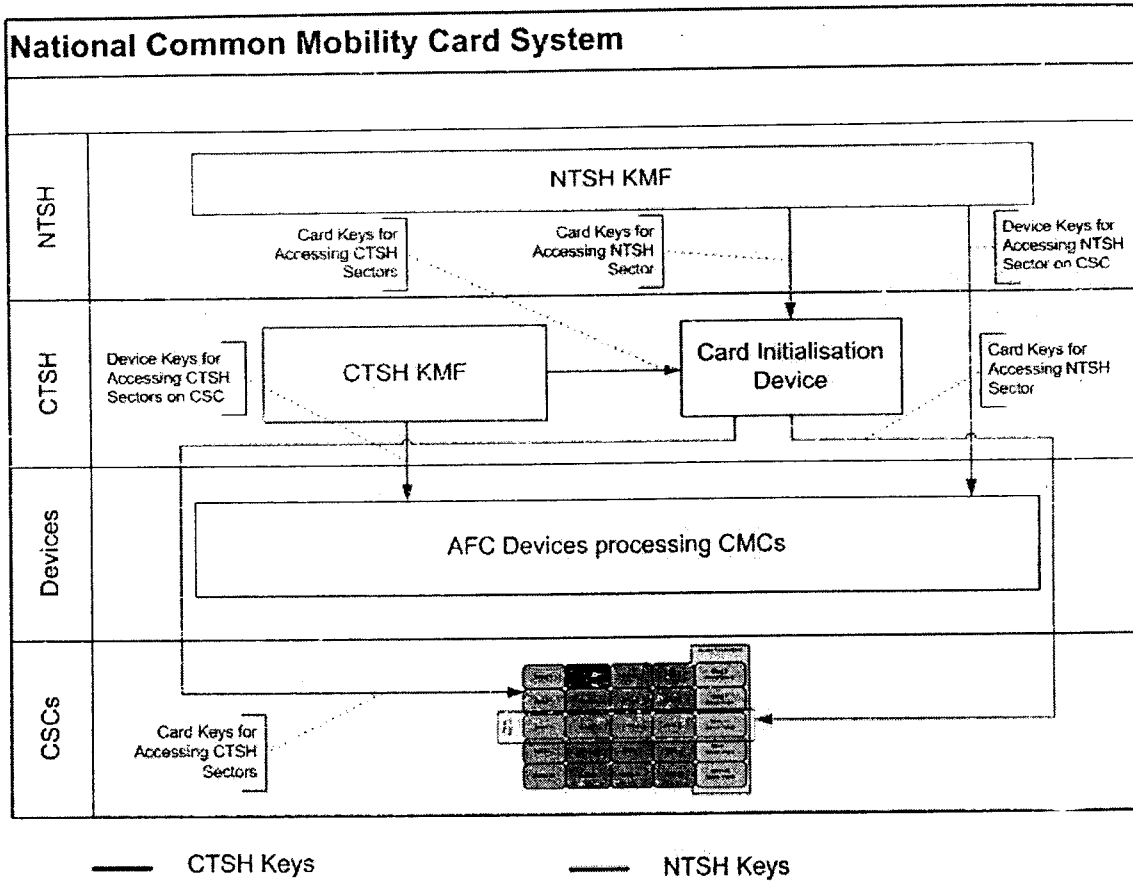
Figure 5: CMC Key Management

9.2 CMC SAM Interface Specification

All CMC Card Readers will contain a CMC Security Access Module which will manage CMC-related keys and security. This specification will enable application developers to utilise the features of the SAM to complete CMC transactions.

To ensure consistent security, CMC SAM's will be centrally issued by UTITSL.

9.3 CMC Card Reader Specification

The specifications for Card Data Format and Key Management are necessary for the success of the CMC implementation. Additionally, a consistent CSC Reader for all AFC devices will ensure a consistent card holder experience no matter what AFC System is used. Some salient features of the Reader are as follows:

- ISO/IEC 14443 Compliance, like Type A & C

- Standard API for communicating with the CMC Card Data Format Specification

- Standard API for communicating with the Device Controllers and Application

- Standard API to support the CMC SAM, as in section 9.2

9.4   CMC Usage Data Specification

A standard transaction format permits integration between CTSH implementations and the NTSH. As all CMC transactions will be cleared and settled by the NTSH, they have to comply with the specified format.

In addition to sending transactions compliant with this Specification, CTSH's must accept transactions in this same format that the NTSCH has routed from other city CTSH's, and process them accordingly.

9.5   CMC Online Enquiry Specification

In order to protect the AFC systems, some transactions must occur "online". This Specification details how online enquiries will be processed, by both the AFC System making the enquiry and the CTSH receiving the enquiry (via the NTSH).

Online Enquiry may be used for:

- Actionlist processing in other city AFC Systems
- Reload in other city AFC Systems
- Threshold Autoload in other city AFC Systems
- Online enquiries for customer support
- Reversals and Refunds

10   Settlement Agreements

As defined in earlier sections of this document the management of products is distributed between the NTSH, which manages the CMC and its Purse, and CTSH's, which manage local fare products.

This segregation of duties entails to segregation of Settlement Agreements between different parties for different product related transactions.

In general there will be two sets of agreements between the PTOs and CTSH's level viz.

- Settlement for all the non-Common Mobility Purse Product transactions

- Settlement for all intercity usage outside home city Common Mobility Purse Product transactions. This is maintained separately to correlate it with the similar agreement between the NTSH and the CTSH

The settlement agreements between the CTSH and NTSH will cater for all the intercity usage CMC Purse related transactions. This will coincide with the arrangement of NTSH being the CTSH of all the Common Mobility Purse Products used outside the home CTSH and CTSH's acting as Acquirers for usage of the CMC Purse with the PTOs under their purview.

It's worthwhile to note that this arrangement will require necessary changes on the CSC Layout as well as transactions formats. This is due to especially the dual role performed by CTSH viz.

- Apportionment, Clearing and Settlement as well as Issuer (product management) for all local fare products used under its own AFC system

- Acquirer for all CMC Purse transactions on by CMC from other CTSH's

In a nutshell the settlement of Common Mobility Purse Product transactions will be two layered, as follows:

- NTSH settling for all the intercity usage transactions with the CTSH
  All the transactions generated by the cards issued by the any City System, used outside the same City System are referred to as intercity usage transactions.
  These transactions will be settled to the AFC Providers of the card usage city by the Issuer of the City, which issued the card.
- CTSH settling the same transactions with its related operators

The Settlement Agreement relationship is illustrated in Figure 6: CMC Settlement Agreements.
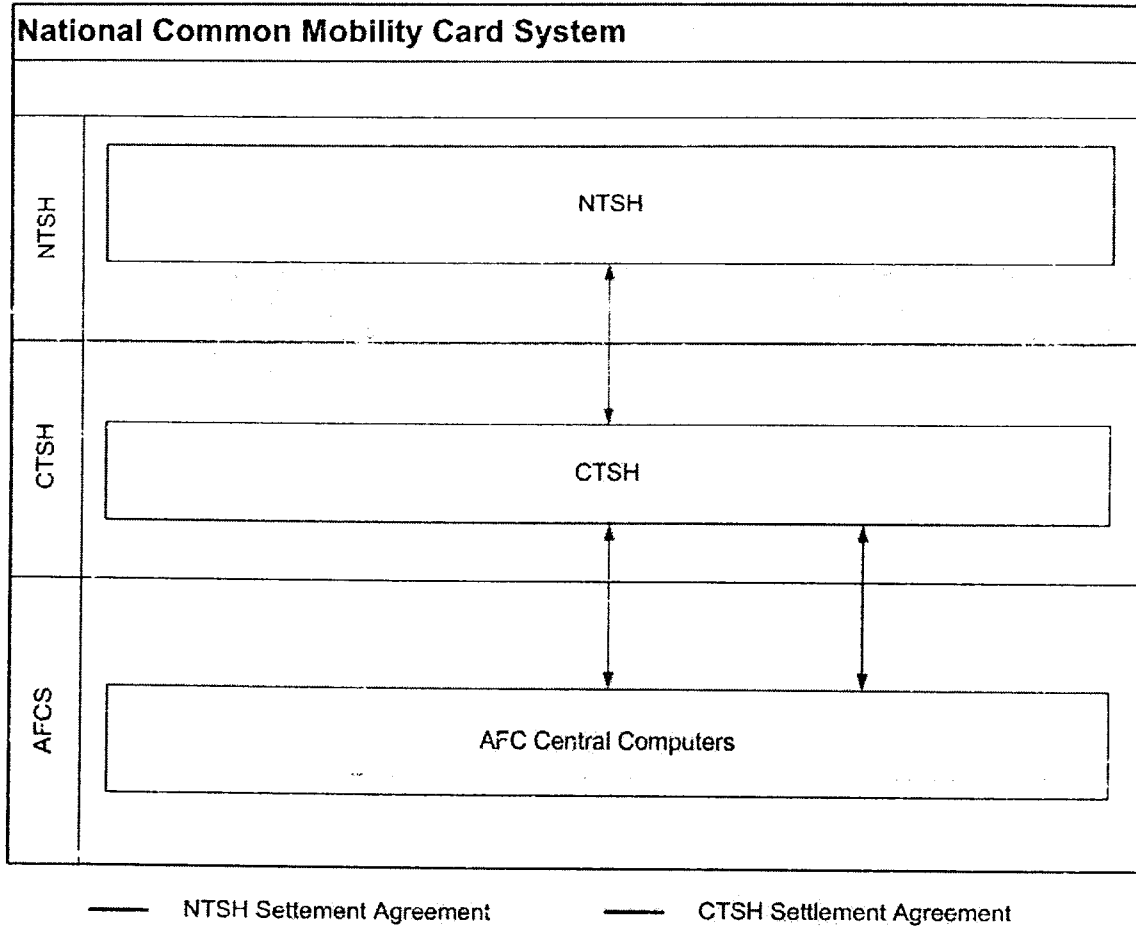
National Common Mobility Card System

| NTSH Settement Agreement | CTSH Settlement Agreement |

Figure 6: CMC Settlement Agreements

11   Smart Card, SAM and Reader Certification Guidelines

Achieving consistent passenger experience across multiple AFC systems which form part of the Common Mobility Card is critical for success. The CMC card, the CMC Security Access Module (SAM) and the CMC Reader are key elements in achieving this goal. This consistency is primarily focused on their experience of the interaction between the card and the card readers. In addition the security of the customer's funds and the constraints card issuers place on the usage of the system affect the overall experience.

There are three key components of the CMC System that contribute to a consistent cardholder experience.

- The smartcards need to behave consistently
- The SAM must be carefully managed to ensure system-wide security and integrity.
- The card readers contribute significantly to a consistent cardholder experience.

11.1   National CMC Scheme Accreditation

Card readers are frequently tuned to perform consistently with a selected card. For each combination of smartcards procured from different vendors, a combined tuning is required to be ascertained, and all readers physically modified to match that tuning. Multiple cards of the same technology from different vendors still makes reader tuning challenging.

Selecting readers for the CMC system and their AFC systems must come via a CMC certification process whereby readers are 'CMC approved' before use in any AFC system which forms a part of the CMC scheme.

The AFC Contractor shall engage with the CMC Accreditation Authority to execute the required certification tests to verify that the AFC Contractor's AFC system and devices comply with the CMC specifications. Any change to the AFC Contractor's system or devices after Accreditation shall require re-accreditation according to the CMC Accreditation requirements.

CMC Accreditation Authority shall provide Accreditation Test Results to the National CMC System Authority, and the National CMC System Authority shall issue an Accreditation Certificate to the AFC Contractor.

The AFC Contractor shall be responsible for all interaction with the CMC Accreditation Authority and the National CMC System Authority to achieve the Accreditation Certificate.

The AFC Contractor shall provide the Accreditation Certificate to the UTITSL.

The AFC Contractor shall cover all costs of Accreditation.

11.2   SAM

The SAM is a component installed in each device that the device's software application uses in its interaction with the smartcards via the card reader. The SAM contains the security keys used to unlock data on the smartcards and to control card reading and writing. Thus the SAM is a vital piece of the overall system's security and integrity.

Because it plays a vital role in the management of security within the CMC system and its AFC systems, the definition of the SAM's functionality needs to tightly defined, thoroughly tested for compliance, and carefully integrated into the system.

Since the SAM represents the integrity of the entire CMC system, the supply chain for this component needs to be managed by UTITSL to ensure the consistent procurement of SAMs, and to securely manage the delivery of SAMs to the city PTO's and their AFC vendors, registration of SAMs and hotlisting.

The PTOs in each city must procure CMC SAMs from UTITSL, and only transactions digitally signed by CMC SAMs will be accepted by the city and national back office systems.

Appendix A List of Indian and International Standards

CMC will follow Indian and international standards. Some of the relevant standards have been noted below

Standard	Description
Certificates of Authorisation issued by the Reserve Bank of India under the Payment and Settlement Systems Act, 2007 for Setting up and Operating Payment System in India	The Payment and Settlement Systems Act, 2007 along with the Board for Regulation and Supervision of Payment and Settlement Systems Regulations, 2008 and the Payment and Settlement Systems Regulations, 2008 have come into effect from 12th August, 2008.
	The 'payment system' operators require authorisation by the Reserve Bank of India to set up and operate in India under the Payment and Settlement Systems Act, 2007
ISO/IEC 14443-2:2010	Contactless Smart Card Standard
	This standard specifies the characteristics of the fields to be provided for power and bi-directional communication between proximity coupling devices (PCDs) and proximity cards or objects (PICCs).
	It does not specify the means of generating coupling fields, nor the means of compliance with electromagnetic radiation and human exposure regulations, which can vary according to country.
ISO/IEC 7816-6:2004	Contactless Smart Card Reader/ Writer
	This standard specifies the Data Elements (DEs) used for interindustry interchange based on integrated circuit cards (ICCs) both with contacts and without contacts. It gives the identifier, name, description, format, coding and layout of each DE and defines the means of retrieval of DEs from the card.
Sections 43A, 67C and 79 of The Information Technology (Amendment) Act (India), 2008 for Data Protection and Privacy	43A Compensation for failure to protect data: a body corporate handling any sensitive personal data or information in a computer resource controlled/operated by it has to follow reasonable security practices – failure to do so may result in loss of information which will make it liable to pay compensation. For this section, government requires DSCI views on "reasonable security practices and procedures", and on "sensitive personal data or information".
	67C Preservation and retention of information by intermediaries: intermediary has to preserve and retain information for specified duration, in a manner and format as may be prescribed by the government. If

	an intermediary intentionally or knowingly contravenes such provisions he is liable to imprisonment up to three years.
	79 Exemption from liability of intermediary in certain cases: under certain conditions intermediary is not liable for third party information or data. But on receiving actual knowledge, or on being notified by the government that any information residing in his computer resource is being used to commit an unlawful act, if the intermediary fails to remove or disable access, he shall become liable for punishment.
Issuance and Operation of Pre-paid Payment Instruments in India (Reserve Bank) Directions, 2009	Policy relating to the regulation of the issue and operation of pre-paid instruments in India and the directions to every system provider, system participant and any other person proposing to issue pre-paid payment instruments.

Common Mobility Card

CMC-00003 AFC Integration Overview

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1   Introduction

1.1   Purpose

The purpose of this document is to provide an overview of the CMC scheme and how the AFC system and devices integrate with the scheme.

Section 3 is designed to be cut-and-pasted into a City's RFP, section by section, to aid in the procurement of an AFC solution which will be integrated with the overall CMC scheme.

1.2   Scope

The scope is limited to an overview of the CMC scheme architecture and interfaces, and key aspects associated with integration of an AFC system and devices.

Warning: *This document does not cover a complete AFC solution procurement. Many aspects of an AFC solution procurement are omitted (e.g. device management, fare management) and the contractual parameters around AFC solution procurement (e.g. commercial terms, service levels, environmental limitations, performance requirements, etc.) are not specified.*

1.3   Terminology

The following table lists the terms and definitions used in this document.

Abbreviation	Term	Definition
	Product	Smartcard-based contract for transit services (e.g. period pass, multi-ride).
AFC	Automated Fare Collection	
CD	Configuration Data	
CMC	Common Mobility Card	
CTSH	City Transaction Settlement House	
MQI	Message Queue Interface	
NTP	Network Time Protocol	
NTSH	National Transaction Settlement House	
SAM	Security Access Module	
XDR	External Data Representation	
XML	Extensible Markup Language	

Table 1: Terminology

1.4   References

The list of documents that are referenced by this document is defined in Table 3: CMC Specifications.

1.5   Premises

The architectures defined in this document are based on the following premises:

Cards

- The CTSH will own and manage all of the cards (card issuer) that are intended primarily for use within that city. Card Issuer for all the CTSHs will be UTITSL.

Purses

- The CTSH will own and manage all of the cards (card issuer) that are intended primarily for use within that city.
- A purse issued in one city may be used in any other city to pay for travel on a transit service in that city.
- A purse issued in one city may be loaded in any other city. Note that this specifically excludes autoloading (Bank linked load).
- Purse fares are configured in the AFC system.

Products

- Products are supported by the CMC scheme but they are considered private and managed by the CTSH outside of the CMC scheme.
- The CTSH will manage all of the products that are intended for use within that city.
- A product issued in one city can only be used in that city (e.g. intercity transit passes are not supported).

Autoload

- Autoload is limited to purse value (i.e. not products).
- A purse with an autoload facility can only be autoloaded in the city in which it was issued.

Card & SAM Hotlists

- The NTSH will manage and distribute to all cities hotlists of cards and SAMs that are suspected of fraudulent use within the national scheme.
- The CTSH will be responsible for fraudulent cards and SAMs until a specified period (e.g. one day) after the CTSH has advised the NTSH of the fraudulent card or SAM.
- The CTSH will manage and distribute to all AFC systems within that city hotlists of cards and SAMs that are not valid for use within the city (e.g. cloned cards, stolen SAMs).
- When a card is blocked, both the card, purse and products will be invalid for further use.

SAMs:

- SAMs are required in all devices that transact with CMC-compliant smartcards.
- The NTSH will manage all SAMs, which are used to secure the cryptographic keys and provide cryptographic functions.
- CTSH system operators will procure SAMs from the NTSH operator.

Keys

- The NTSH will manage the cryptographic keys used to secure cards, purses and data within the national scheme.

2 For insertion in AFC tenders under the CMC initiative

It is intended that all of the following sections will be inserted in future AFC tenders issued by UTITSL on behalf of the Common Mobility Card initiative.

The following sections are not complete AFC Specifications – each section needs to be included into the relevant section of the AFC Tenders.

2.1 Warnings

Warning: *CMC Scheme security requirements do not cover all of the security requirements of an AFC solution, as they are only specific to the data and security of the CMC system. Specification of AFC security requirements is the responsibility of UTITSL (e.g. anti-virus and updates, firewall configuration, etc.)*

Warning: *The testing requirements are specific to the CMC scheme and do not cover all of the testing requirements of an AFC solution – other testing requirements must be specified according to the CTSH requirements to ensure effective operation of the supplied AFC system and devices (e.g. system performance, reliability, availability, and all functional requirements).*

Overall Test Planning for AFC system delivery will also need to be articulated by UTITSL (e.g. extent of FAT, SAT, SIT, Pilot testing, etc.).

3   AFC System to CTSH Interface

It is a requirement of the AFC supplier to interface to the City Transaction Settlement System or CTSH. The CTSH is provided by UTITSL and provides the following services for the city:

Clearing and Settlement	Validates the transactions and settles the financial value between participants in the CTSH scheme. Allows authorised manual adjustments.
Fee Management	Calculates and charges fees to CTSH scheme participants using fee agreements.
Claim Management	Processes and settles claims submitted by CTSH scheme participants.
Configuration Data Management	Manages the administration, generation and distribution of city configuration data.
Card Management	Validates the card transactions and processes them to the associated card account.
Purse/Product Management	Validates the purse/product transactions and processes them to the associated purse/product account.
Online Enquiry	Processes online enquiry requests related to cards, purses, products and cardholders.
Hotlist Management	Maintains, generates and distributes the hotlist of cards and SAMs that are not valid for use in the scheme.
Report Management	Generates the financial and operational reports required by the CTSH.
Autoload Management	Manages the autoload accounts and recovery of funds from the cardholder.
Actionlist Management	Maintains the actionlist of purses that require their autoload facility enabled or disabled.
Card Services	Provides the issuer card services, such as card initialisation, refund and replacement.

3.1   Business Architecture Overview

This section provides an overview of the business services provided by each participant within the CMC system as shown in Figure 1: Business Architecture Diagram.
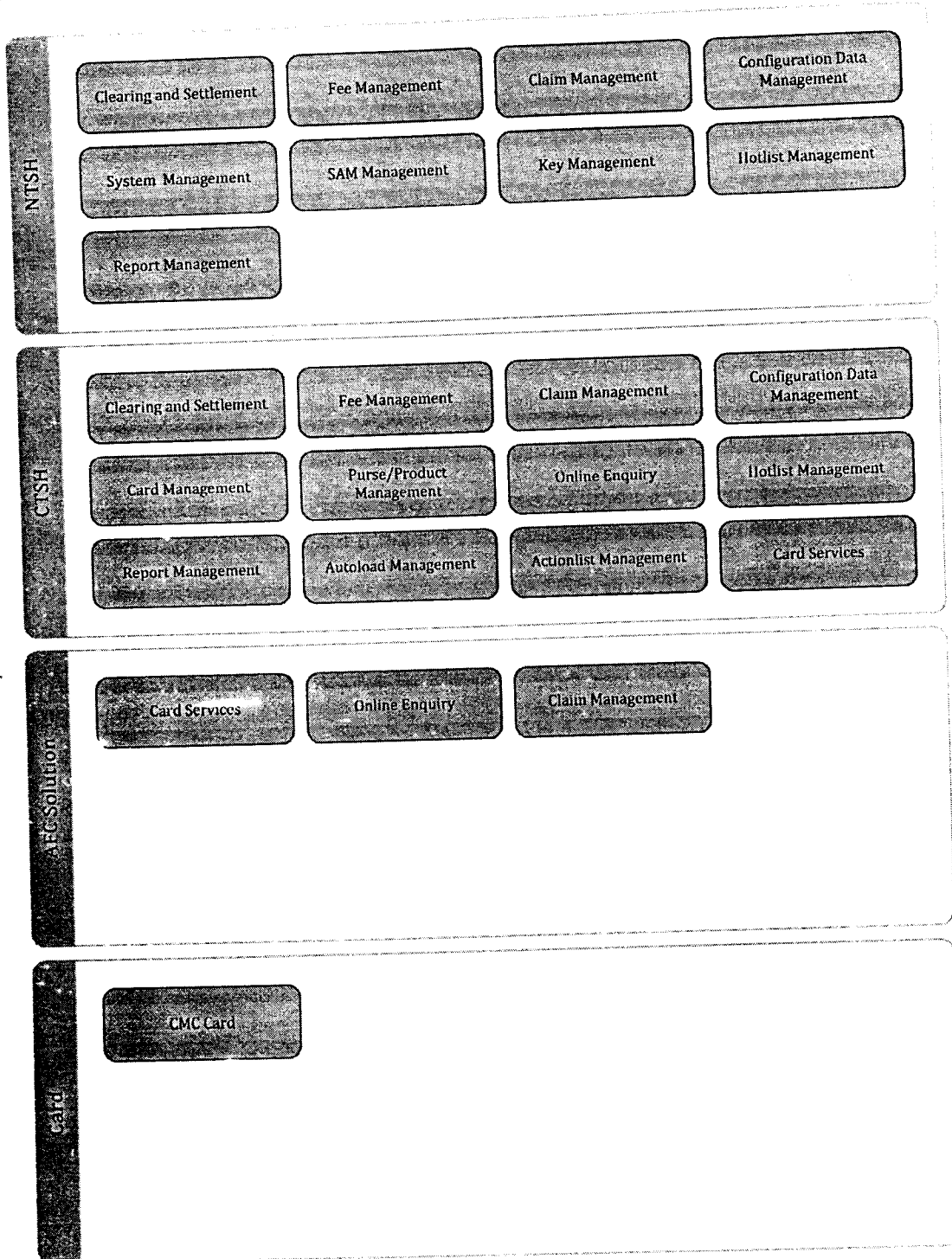
Figure 1: Business Architecture Diagram

3.2   AFC Solution Overview

3.2.1   NTSH

The following section outlines the function of the NTSH. The NTSH will be provided by UTITSL.

The NTSH provides the following services:

Clearing and Settlement	Validates the transactions and settles the financial value. Allows authorised manual adjustments.
Fee Management	Calculates and charges fees to system participants using fee agreements.
Claim Management	Processes and settles claims submitted by system participants.
Configuration Data Management	Manages the administration, generation and distribution of national configuration data.
System Management	Manages the system participants and also involves definition of system policies.
SAM Management	Initialises SAMs ready for distribution to system participants.
	This service shall allow the issue of a new SAM, including injecting the required cryptographic keys for the common purse into the SAM and generation of a SAM issue transaction (which shall then be sent to the NTSH system).
Key Management	Generates and distributes cryptographic keys used within the system.
Hotlist Management	Combines and distributes the hotlist of cards that are not valid for use in the system.
Report Management	Generates the financial and operational reports used by the NTSH.

3.2.2   CTSH

The following section outlines the function of the CTSH. The CTSH will be provided by UTITSL.

The CTSH provides the following services:

Clearing and Settlement	Validates the transactions and settles the financial value. Allows authorised manual adjustments.
Fee Management	Calculates and charges fees to system participants using fee agreements.
Claim Management	Processes and settles claims submitted by system participants.
Configuration Data Management	Manages the administration, generation and distribution of city configuration data.

Card Management	Validates the card transactions and processes them to the associated card account.
Purse Management	Validates the purse transactions and processes them to the associated purse account.
Online Enquiry	Processes online enquiry requests related to cards, purses and cardholders.
Hotlist Management	Maintains, generates and distributes the hotlist of cards that are not valid for use in the system.
Report Management	Generates the financial and operational reports required by the CTSH.
Autoload Management	Manages the autoload accounts and recovery of funds from the cardholder.
Actionlist Management	Maintains the actionlist of purses that require their autoload facility enabled or disabled.
Card Services	Provides the issuer card services, such as card initialisation, refund and replacement.

3.3 Data Architecture Overview

This section specifies the data flows within the CMC system as shown in Figure 2: Data Architecture Diagram. The AFC system and devices, which shall be provided by AFC vendors, are shown in yellow on the diagram.
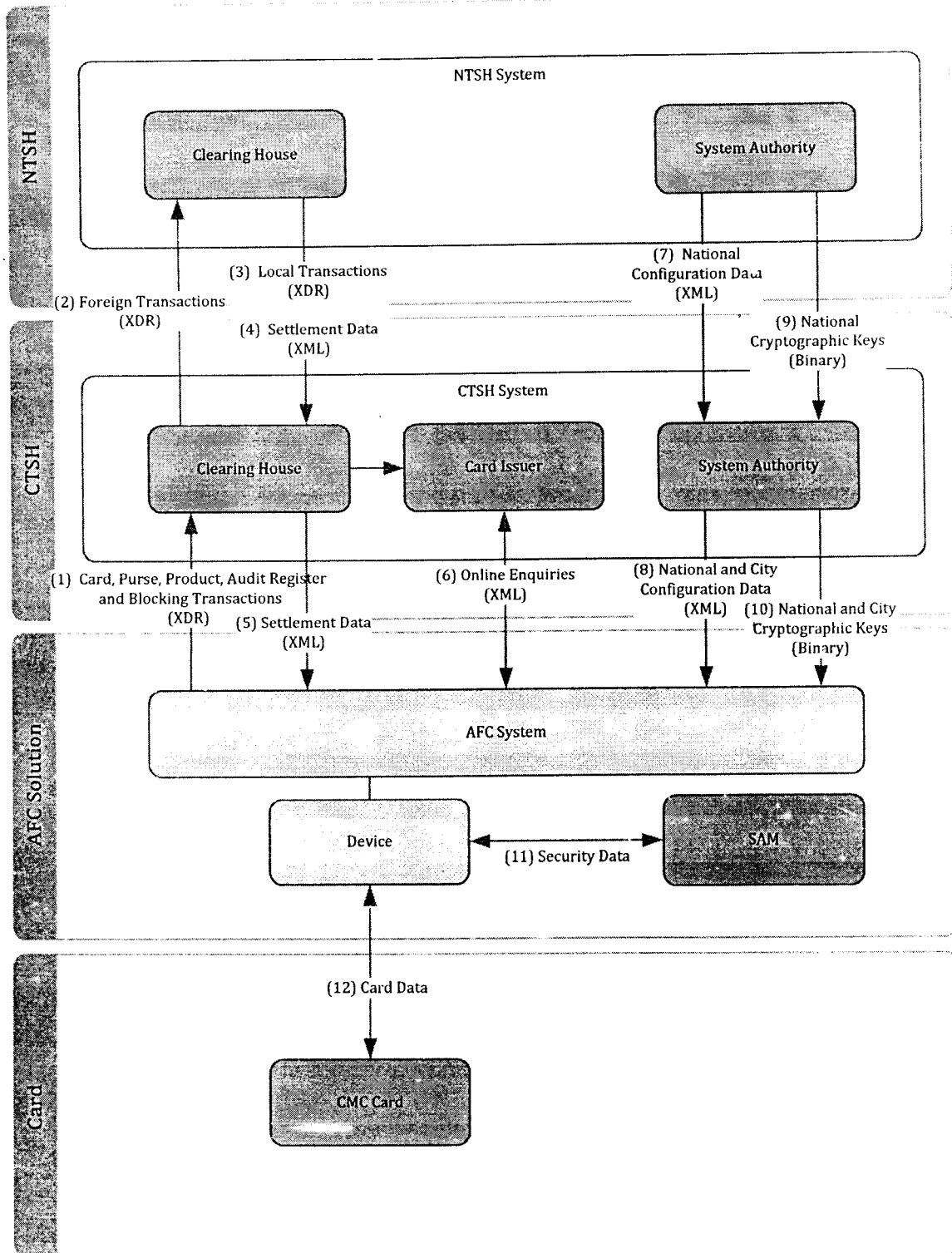
Figure 2: Data Architecture Diagram

The table below briefly defines each of the data flows shown in Figure 2: Data Architecture Diagram that apply to the AFC Solution. The item numbers in the table below correspond to the numbers assigned to each data flow shown on the diagram.

Item	Data	Description	Format
(1)	Card, Purse, Product, Audit Register and Blocking Transactions	The card, purse, product, audit register and blocking transactions for all cards used within the city AFC system.	XDR
(5)	Settlement Data	The daily settlement positions calculated by the CTSH and used by the AFC System to reconcile.	XML
(6)	Online Enquiries	The enquiries sent by the AFC System to obtain the data required for card services, such as card refund.	XML
(8)	National and City Configuration Data	The national configuration data combined with the configuration data that applies to the city AFC system.	XML
(10)	National and City Cryptographic Keys	The cryptographic keys used to secure the city specific data, such as city specific transit passes.	Binary
(11)	Security Data	Data transmitted to and received from the SAM for security purposes.	Binary
(12)	Card Data	Data read from and stored on the CMC card.	Binary

Table 2: Data Flows

The AFC Solution shall comply with the data flows defined in Table 2: Data Flows and Table 3: CMC Specifications.

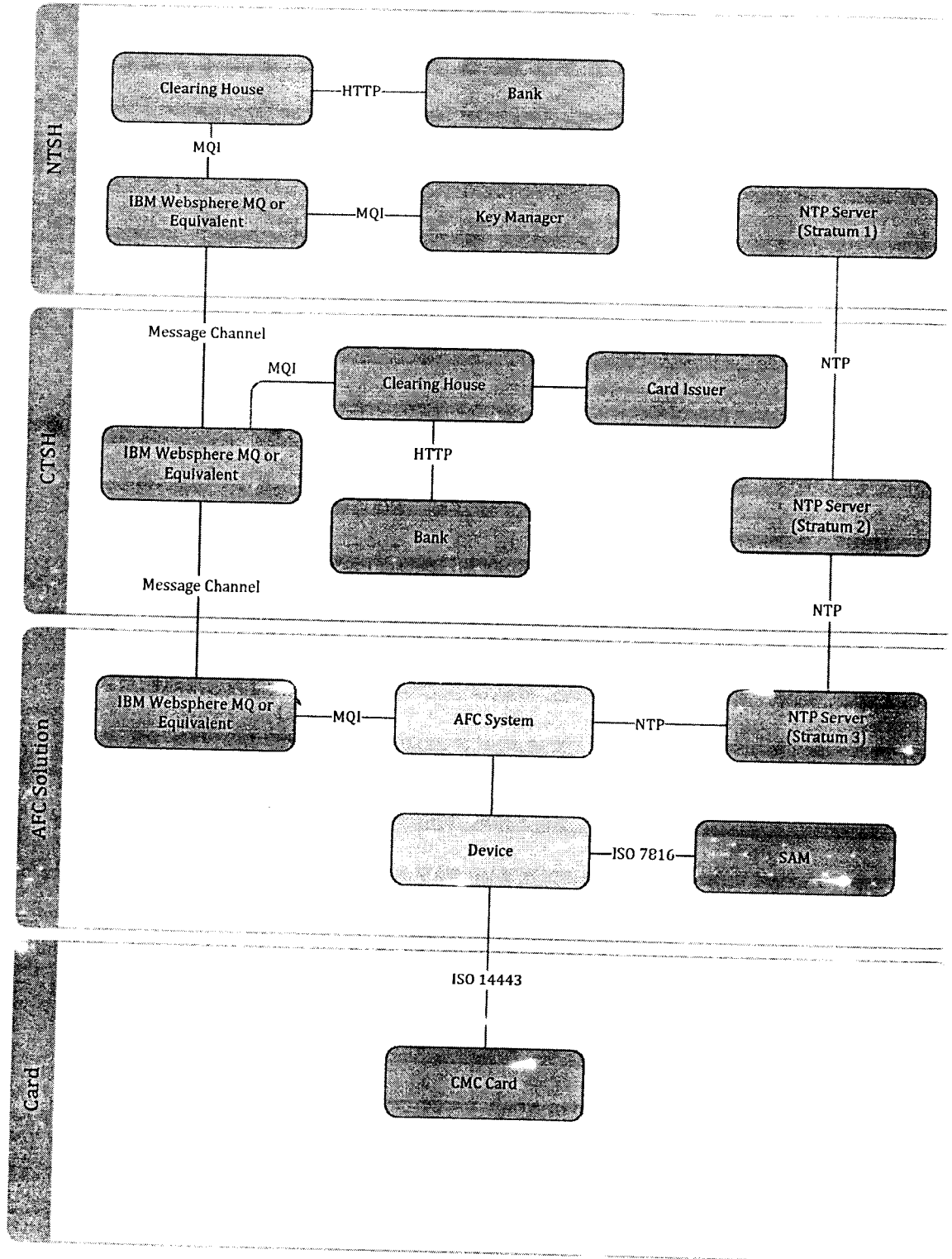## 3.4   System Architecture Overview

Figure 3: System Architecture Diagram

This section provides requirements of the systems and interfaces of the CMC system as shown in Figure 3: System Architecture Diagram.

The AFC system and devices, shown in yellow on the diagram, shall be provided by the AFC Contractor.

AFC System Interfaces

The AFC system shall exchange data with the CTSH system via enterprise class messaging service like IBM Websphere MQ or approved equivalent. AFC Contractor shall supply all necessary client-side licenses and integration works required to exchange such data.

AFC Contractor shall supply all hardware and software necessary to connect the AFC solution to the CTSH.

The AFC system shall exchange with the CTSH system the data defined in Figure 2: Data Architecture Diagram and Table 2: Data Flows.

The AFC system shall synchronise its computer clocks via the Network Time Protocol (NTP), as specified in Internet RFC 1305, using the CTSH-provided NTP server as the source.

Reader/ Device Interfaces

All AFC reader/ devices supplied by the AFC Contractor shall communicate with the CMC card using international standard ISO 14443, Type A & C.

All AFC reader/ devices supplied by the AFC Contractor shall communicate with the SAM using an interface that complies with international standard ISO 7816. The SAM will be provided by UTITSL.

All AFC reader/ devices supplied by the AFC Contractor shall utilise an external source for clock synchronisation, and maintain a maximum +/- 4 second clock drift. AFC Contractor shall propose a clock synchronisation method. NTP, GPS or 3G/GPRS sources are preferred.

The AFC Contractor shall develop APIs in accordance with CMC specifications for:

- CMC Card Data Layout Specification
- Device Card Usage Specification
- Man-Machine Interface Specification
- Support for the CMC SAM Interface Specification

3.5 Integration and Testing

3.5.1 AFC System and Devices

The AFC system and devices shall comply with the following CMC specifications:

For better clarity please refer to the diagrammatic representation of various interfaces in

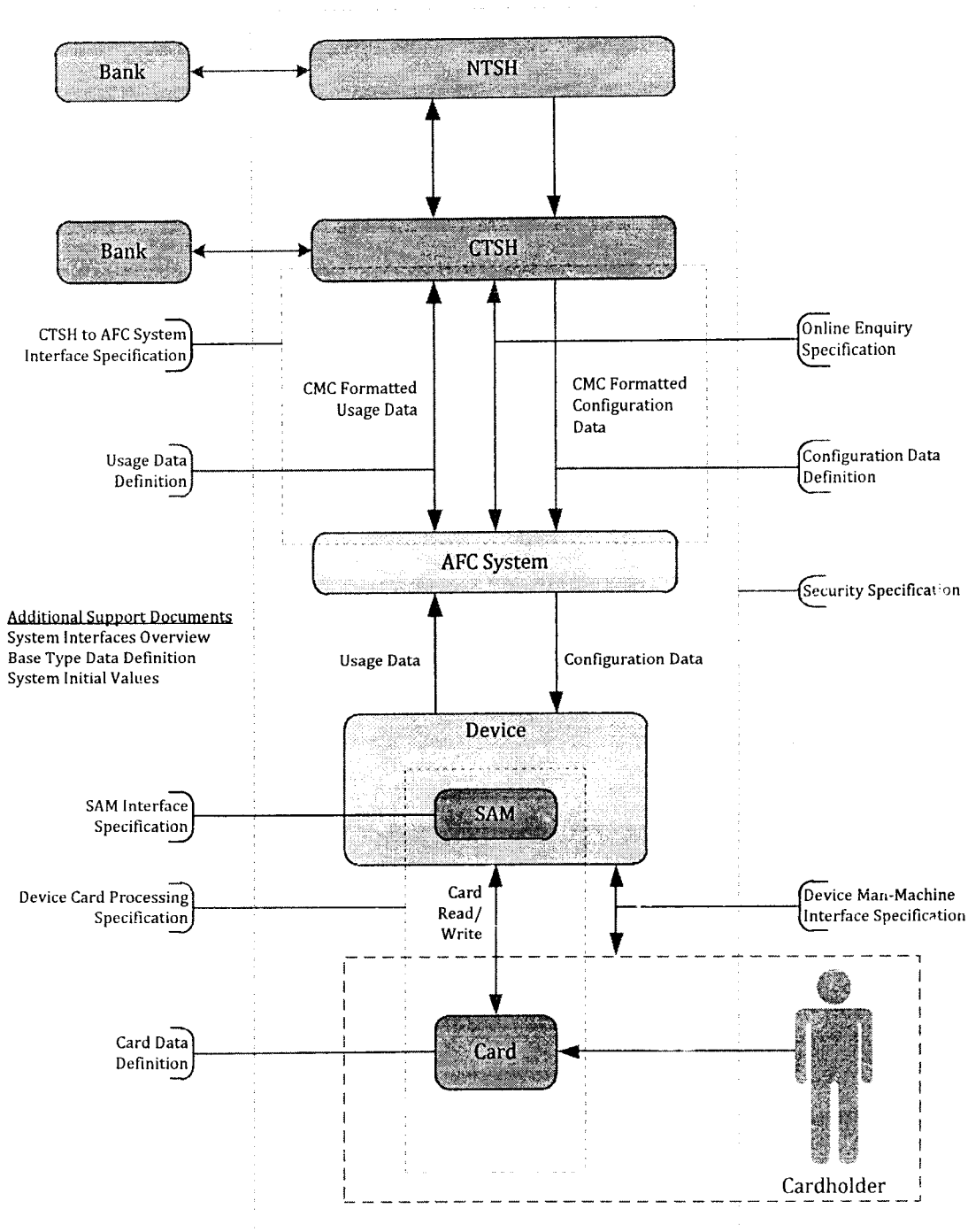CMC specifications that apply to the AFC system and devices

Figure 4: CMC Specifications Diagram

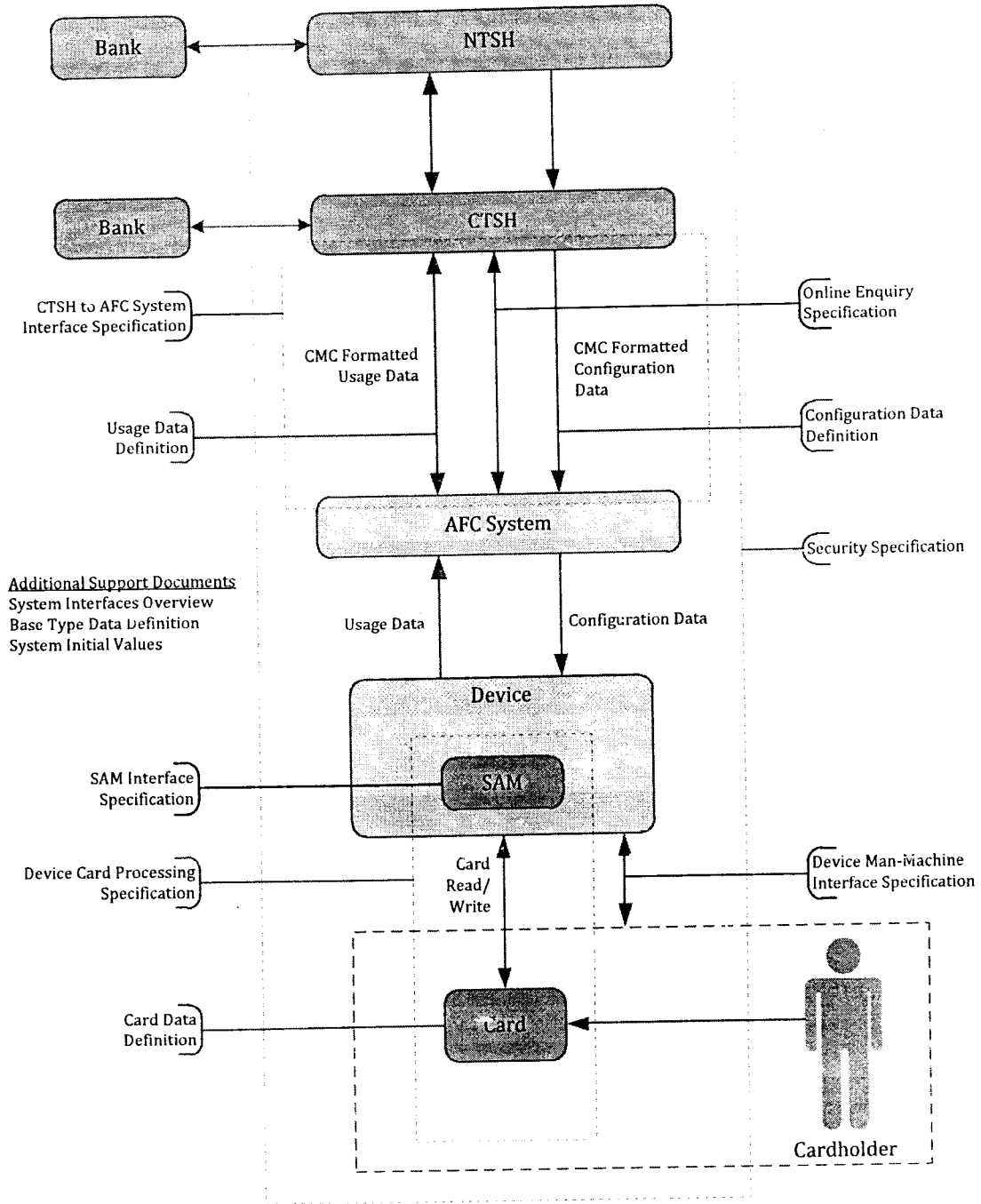CMC specifications that apply to the AFC system and devices

Figure 4: CMC Specifications Diagram

Specification	Description
System Interfaces Overview	Specifies the purpose of each specification and its relationship to the other specifications.
CTSH to AFC System Interface Specification	Specifies the interface between the CTSH and AFC systems, including the data and protocols used.
Configuration Data Definition	Specifies the data structures and elements used to configure system functionality.
Usage Data Definition	Specifies the data structures and elements of the transaction, audit register and settlement data.
Card Data Definition	Specifies the data structures and data elements of the card.
Base Type Data Definition	Specifies the common data types used throughout the specifications.
Online Enquiry Specification	Specifies the online enquiry request and response data structures and elements.
Device Card Processing Specification	Specifies how the device performs each type of card transaction.
SAM Interface Specification	Specifies the interface to the SAM, including the application protocol for commands.
Device Man-Machine Interface Specification	Specifies the minimum audio, visual and interactive behaviours of devices the cardholder shall use, in order to bring about consistency within the different AFC solutions and reduce cardholder confusion.
Security Specification	Specifies security requirements for all aspects of the CMC system.

Table 3: CMC Specifications

3.5.2   National CMC System Accreditation

The AFC Contractor shall provide references and examples to demonstrate experience with similar accreditation processes.

The AFC Contractor shall engage the CMC Accreditation Authority to execute the required certification tests to verify that the AFC Contractor's AFC system and devices comply with the CMC specifications.

Any change to the AFC Contractor's system or devices after Accreditation shall require re-accreditation according to the CMC Accreditation requirements.

CMC Accreditation Authority shall provide Accreditation Test Results to the National CMC System Authority, and the National CMC System Authority shall issue an Accreditation Certificate to the AFC Contractor.

The AFC Contractor shall be responsible for all interaction with the CMC Accreditation Authority and the National CMC System Authority to achieve the Accreditation Certificate.

The AFC Contractor shall provide the Accreditation Certificate to the UTITSL and to the PTO.

The AFC Contractor shall cover all costs of Accreditation.

3.5.3 Security

The AFC Contractor's delivered systems shall comply with the CMC security specification, which includes the following CMC system security requirements:

- Key management – AFC contractor will procure SAM from UTITSL
- Data security
- Card security

3.5.4 CTSH Integration Testing

This involves connecting the AFC system and devices to the CMC integration test facility and executing a series of integration tests.

The AFC Contractor shall submit all necessary equipment, software and documentation to the CTSH test bed for integration testing.

All works required for integration testing shall be executed by the AFC Contractor, in cooperation with the CTSH operator.

All Contractor works shall conform to the CTSH Test Plan, to be provided by CTSH operator, which may include a live Pilot Test.

The AFC Contractor shall provide references and examples to demonstrate experience with similar integration projects.

3.5.5 Production Rollout

AFC Contractor shall be responsible for all system rollout preparation, deployment and commissioning.

UTITSL shall provide AFC Contractor with National CMC system information required for deployment. Incorporation of such information into the AFC Contractor's AFC solution shall be entirely at AFC Contractor's expense.