An American Public Transportation Association Fare Collection Standard Written by and for the Transit Industry

Applying the Contactless Fare Media System (CFMS) Standard – Real World Training for Real Applications

Seminar Participant Workbook

APTA 2007 Fare Collection Workshop
March 26, 2007
8:30 a.m. to 11:30 a.m.
Los Angeles, California

Acknowledgements

This workbook was prepared by members of the APTA Universal Transit Fare System Task Force and APTA staff, including:

Seminar Outline

The seminar schedule is as follows:

08:30 a.m. to 08:45 a.m.	Introduction
08:45 a.m. to 09:00 a.m.	Smart card fare collection systems overview
09:00 a.m. to 09:30 a.m.	CFMS overview and its application to a smart card fare collection system
09:30 a.m. to 09:45 a.m.	Using the CFMS
09:45 a.m. to 10:00 a.m.	Break
10:00 a.m. to 10:45 a.m.	Case study exercises
10:45 a.m. to 11:00 a.m.	Evolution of the contactless fare payment
11:00 a.m. to 11:15 a.m.	Closing comments and questions
11:15 a.m. to 11:30 a.m.	Complete participant questionnaire

Materials in this workbook are presented in the same order.

1 Introduction

What is the CFMS?

What is a smart card fare collection system?

How are smart cards and the SFMS related?

How do I use the CFMS?

Anything new coming down the pipeline?

Welcome to the APTA training seminar "Applying the Contactless Fare Media System Standard (CFMS) – Real World Training for Real Applications".

This seminar provides an introduction to how transit agencies can apply the CFMS to real world transit applications through instruction, case studies and hands on learning.

Most agencies procure fare collection systems quite infrequently. As a result, agencies often don't have a good starting point for developing the requirements of a new fare collection system. The CFMS provides a framework that can be used as a tool to initiate the dialogue about the needs of the agency, and the collection of information necessary for defining what the new fare collection system should be able to do.

1.1 Course Objectives

While certainly not all agencies have or are contemplating the installation of a smart card fare collection system, consumer preferences are shifting away from cash to other payment means. Therefore, fare collection professionals at transit agencies should at least become familiar with the technology and its implementation, in order to be able to make better decisions about the type of fare collection system that is best for their agency.

This seminar is designed for transit agency management and technical staff whose work includes some responsibilities relating to the design, implementation, operation and maintenance of fare collection systems. The material is presented assuming that seminar participants have a working knowledge of business application software (word processing, spreadsheets, e-mail, web browsers, etc.) and a basic understanding of a database and its use.

Consultants, integrators and product suppliers who take the seminar will also benefit as they will gain greater familiarity with the CFMS, and be better prepared to work with their customers in the design, development and implementation of a contactless fare media system.

The main objective of the seminar is to ensure that participants understand **that the CFMS is primarily about standardizing the formats of the data and messages required by a smart card based fare collection system.** At the end of the seminar, participants should:

- Have knowledge about the primary components of smart card systems.
- Understand which components of systems are impacted and supported by the CFMS.
- Know how the CFMS should be applied to a particular smart card system project.
- Gain insight in how agencies can use the framework provided by the CFMS during a smart card system implementation.
- Be better prepared to manage and oversee the vendor(s) implementing a CFMS compliant system.

Participants will take away a better understanding of applying the CFMS, and a step by step process for specifying technical details of the standard as part of a smart card fare system procurement specification. This seminar does not address system security. While very important, security is only covered in Part IV of the CFMS as a guideline, rather than as a set of specifications and/or requirements.

The seminar has been organized to provide information in the following order:

- What is the CFMS?
- What is a smart card fare collection system?
- How are smart cards and the CFMS related?
- How do I use the CFMS?
- Anything new coming down the pipeline?

The instructors recognize that seminar participants may find some of the issues and concepts presented confusing. This should not be a cause to worry. Participants are encouraged to ask the instructors for clarification as required. They are here to help as best as they can.

Participants are asked to provide their name and contact information on the seminar sign in sheet. APTA intends to issue information bulletins after the Fare Collection Workshop in response to questions and comments that the instructors are not able to respond to during the workshop.

1.2 What is the CFMS

A smart card fare collection system consists of a variety of software applications, hardware, functions and activities. The CFMS only applies to the data needed to operate a smart card fare collection system. Specifically, it defines the following:

- The specification for components of the data architecture and requirements for the selection and structuring of those components for use on a contactless smart card

or more properly, a Proximity Integrated Circuit Card (PICC), which forms the foundation for the system.

- The specification for components and structure of messages between the Regional Central System (RCS) and the Agency Central Computer or sub-system controller.
- Recommendations (informative only) for data security.

The agencies, vendors and consultancies participating in the development of the CFMS agreed that these were the most critical aspects of a smart card fare collection system that needed to be standardized in order to achieve interoperability. All components from the card reader (referred to as the Card Interface Device or CID) through to the Agency Central Computer system are, for the purposes of the CFMS, considered a vendor "black box. This still provides system interoperability while maximizing innovation and minimizing regional integration concerns.

The CFMS currently consists of five parts, which cover the following:

- Part I is an introduction to the other four parts, describing the how, where and why on the use of the CFMS. Part I also includes a glossary of the terms and acronyms used in the CFMS.
- Part II defines the data format used on PICCs, enabling a consistent and uniform method for storing, retrieving and updating data from contactless fare media used in transit applications. The data format described by Part II enables the design of data records that cover the known requirements of fare payment systems for public transit and associated private transit systems operating in the United States. These range from flat fares to distance based fare, and allow for wide choice of special fares such as discounts, express run premiums, etc. The data structure defined in Part II can accommodate 256 distinct Product Types available to each Agency (253 pass types, one stored value (or purse type), one account linked and one AutoValue based product type). While CFMS defines a comprehensive set of data objects, most systems will require the use of only a subset of these objects to support its fare policies or that of several agencies participating in a regional fare payments program.
- Part III describes a uniform and consistent method for transit agency fare collection systems to communicate with a common Regional Central System (RCS), defining the necessary structure and components of the messages. Part IV is a guidelines and best practices document, providing a description of the terminology associated with security programs for fare collection systems and suggests the basic steps and considerations that should be employed in order to define, implement, and manage a security program for a regional PICC-based fare collection system.

- Part V has yet to be developed. It will define the product submission requirements, test methods and procedures, test apparatus, and reports needed to test, confirm, and report conformance with the CFMS.

Although Parts II and III of the CFMS define a comprehensive set of data and messages, it is unlikely that all data and messages will be used in one system. It is expected that a subset of data and messages will be selected, based upon the functions, fare products and business rules of the system being implemented.

For now, the CFMS only applies to the data formats and messages associated with a fare collection system that uses full featured PICCs (contactless smart cards that meet certain minimum criteria described in the CFMS). However, agencies and regions implementing limited use cards can still benefit from using the CFMS, even if their system design exceeds the scope of the CFMS. Future releases of the CFMS will include modifications to extend the standard to disposable or limited use PICCs, as well as other form factors.

1.3 Standards and Fare Collection Systems

The CFMS can be applied to contactless fare collection systems where two or more transit agencies share a common PICC and one or more common fare products for fare payment. Nonetheless, the CFMS can also be applied to single agency systems where the agency desires to implement a system that is based on industry accepted design principles and which might at some point become part of a regional system.

However, it is not sufficient for an agency or region to specify CFMS compliance in its system procurement to implement a smart card fare collection system. Decisions need to be made about equipment requirements, overall design, as well as the business rules and fare policies under which the system will operate. Until Part V of the CFMS (certification and testing) is published sometime in 2008, agencies and/or regions also may wish to develop testing and certification criteria for the products they are implementing. For interoperability, there must be appropriate interagency agreements in place in the geographic region.

There are other standards that are complementary to the CFMS which must be considered when implementing a fare collection system These include:

- ISO/DIS 24014-1:2005, Public transport — Interoperable fare management system — Part 1: Architecture
- ISO/IEC 14443, Identification cards–Contactless integrated circuit(s) cards–Proximity cards, an international standard for PICCs that is structured in four numbered parts.
- ISO 7816:4, Identification cards–Integrated Circuit Cards, part 4 of the international standard for integrated circuit cards.

- ISO 3166, Codes for the representation of names of countries and their subdivisions, an international standard that provides a consistent number based scheme for identifying countries.

A conscientious approach to implementing a smart card fare collection system would also include a review of relevant studies, guides and white papers. APTA has published several documents that agencies and regions may find useful:

- Automatic Fare Collection System Planning and Implementation Guidelines (Technical Report)
- The Major Business Issues in Establishing and Operating Regional Transportation Payment Systems and Clearinghouses (Technical Report)

Trends in Electronic Fare Media Technology (Technical Report)

1.4 Using the workbook

This workbook serves as the foundation for the training seminar. It includes most of the material presented by the instructors, thereby reducing the amount of note-taking required by seminar participants. However, it also has some additional information, making it a useful reference document that seminar participants can return to as required at a later date.

Seminar participants are encouraged to use this workbook to follow along with the seminar instructors, adding their own notes as appropriate. However, to gain the most from the training, seminar participants are encouraged to not only listen to the instructors, but to also ask questions, share their experiences with others, and engage in dialogue and debate.

The workbook also includes exercises that will provide for hands on training during the seminar. This workbook is intended to be used together with the CFMS version 1.0 during the seminar.

1.5 Course Design

It is APTA's intent to deliver training that is relevant to its members. The new CFMS is different from most other APTA standards in that it defines requirements for certain aspects of the technical design of systems rather than codifying best practices. As such, it is expected that as users gain experience using the CFMS, they will have suggestions for improvements and development of the standard. The same applies to this workbook and training seminar.

Participants are encouraged to provide APTA feedback on how this workbook and seminar can be improved to better suit their needs by completing not only the course evaluation form, but also by contacting APTA's Universal Transit Fare System Task Force directly at:

> Martin P. Schroeder
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2 Smart Card Fare Collection Systems Overview

What is the CFMS?
What is a smart card fare collection system?
How are smart cards and the SFMS related?
How do I use the CFMS?
Anything new coming down the pipeline?

In order to determine how to apply the CFMS, it is first necessary to have a basic understanding of the primary elements that constitute any smart card based fare collection system. This section will describe general system architectures for both single operator and regional systems.

2.1 Single Agency System

A single agency system is characterized by:

- Fare products are only valid for one transit agency
- There is no exchange of fare information, or related financial information, with another transit agency

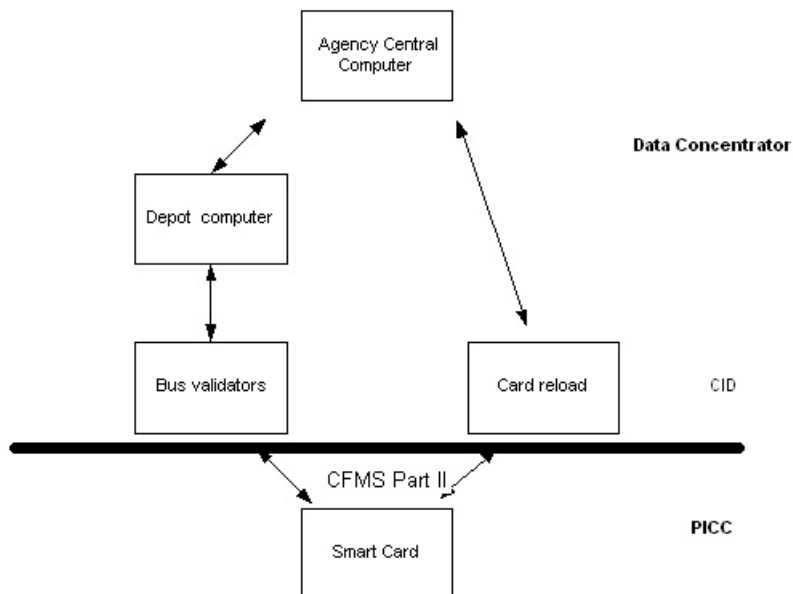Figure 1 shows a typical system architecture for a single agency system.

Figure 1

The primary system components of this are:

- PICC or smart card: contains the data required by the transit system to enable calculation of fare, to define specific fare products stored on the PICC and transaction history and other information necessary to support cardholder service functions.
- CID: a contactless smart card reader combined with memory, a processor and a software application used to pay for fares, reload value onto a PICC, or interact with the PICC for some other reason, such as to query the value of fare products on the PICC.
- Data Concentrators: Equipment used to collect transaction data from a number of PICCs at one location for transmission to the Agency Central System, or to distribute data sent from the Agency Central System to the PICCs. Examples are Depot Computers at bus garages, and Station Computers at rail stations. Normally Data Concentrators are employed when it is not possible or practical to have a PICC communicate directly to the Agency Central Computer. As shown in the diagram, it is possible for CIDs to communicate directly with the Agency Central System thereby negating the need for data concentrators.
- Agency Central Computer: Performs the central data and equipment management functions for the fare collection system, including fare payment transaction processing, PICC reload transaction processing, PICC hotlisting, action list processing, and CID configuration management. The Agency Central Computer frequently interacts with the transit agency financial computer system to provide summary information on the value of fares paid and PICC reloads performed .

The areas of a single agency system addressed by the CFMS are

- the PICC data format (Part II)
- the PICC to CID interface commands (Part II)
- data security (Part IV)

2.2 Regional System

A regional system is characterized by:

- Two or more transit agencies that accept one or more common fare products
- A central (e.g. regional) entity and associated processes that support and allow for the storage, validation, reporting and reconciliation of transactions performed using the common fare products, settlement of funds between the appropriate transit agencies based upon the reconciliation, and management of centralized services (e.g. autoload, card registration, card hotlisting).

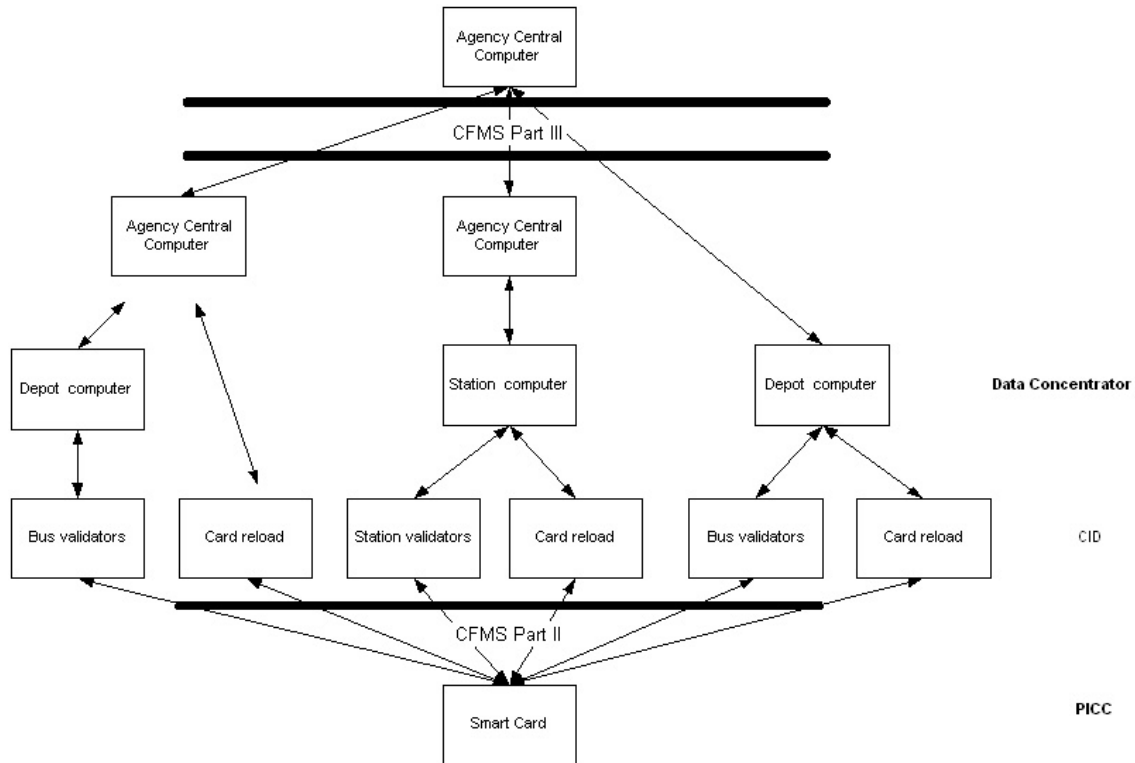A typical regional system architecture is shown in Figure 2.

Figure 2

The main system components of a regional system are the same as those for a single agency system. The addition for a regional system is the Regional Central System, which interacts with each single agency system in order to perform the central management functions for the regional program including fare payment transaction processing, PICC reload transaction processing, PICC hotlisting, and action list processing for the regional fare products. It may also be responsible for CID configuration management related to the regional fare products. Responsibility for single transit agency specific fare products may remain with the associated Agency Central Computer, although this is often also performed by the Regional Central System on behalf of the transit agency.

The Regional Central System usually interacts with the financial institutions for each transit agency to post settlement instructions based upon the reconciliation it has performed although the interaction with a financial institution may be performed at the agency level as well. It also provides information (e.g. reports, data feeds) to each transit agency individually on the activities performed on their behalf.

The areas addressed by the CFMS for a regional system are

- the PICC data elements and format (Part II)
- the PICC to CID interface commands (Part II)
- the content and structure of messages sent to or from the Regional Central System (Part III)
- data security (Part IV)

3 CFMS overview and its application to a smart card fare collection system

What is the CFMS?

What is a smart card fare collection system?

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How do I use the CFMS?

Anything new coming down the pipeline?

As stated earlier, the primary purpose of the CFMS is to standardize the formats of the data on PICCs, and the messages that are passed between an Agency Central System or an Agency sub-system, and a Regional Central System. Figures 1 and 2 in the previous section illustrated the overall data flows through a smart card based fare collection system, identifying the parts covered by the CFMS.

3.1 What the CFMS includes

The CFMS defines the following:

Relating to the PICC (smart card)

- Data Object types and definitions (core, fare product and extension objects)
- Data Element definitions
- Minimum card memory requirement
- PICC requirements (e.g. full function with Card Operating System)
- Adherence to ISO 14443

Relating to the PICC to CID interface

- Specific Application Protocol Data Unit (APDU) commands (minimum requirements) as defined in ISO 7816:4

Relating to the Agency Central System to Regional Central System Interface

- Message types for communication between the Agency Central System and the Regional Central System
- Data Objects used within messages
- Data Element definitions used within data objects
- Message protocol (XML)

3.2 What the CFMS excludes

In addition to defining data and message components and formats, implementing a smart card fare collection system requires the determination of design specifications that are not covered in the CFMS, including:

Relating to the PICC (smart card)

- Card Operating System (COS) (other than required APDU commands)
- Data Object selection, organization or file structure (although a recommendation is provided)
- Security mechanisms
- Agency or regional fare products supported
- Use of optional data objects and elements

Relating to the PICC to CID interface

- Command/message sequencing
- Order of operations

Relating to the CID

- No aspect of the CID is covered by the CFMS.

CID to Data Concentrator Interface

- No aspect of the CID to Data Concentrator Interface is covered by the CFMS.

Data Concentrator

- No aspect of the Data Concentrator is covered by the CFMS.

Data Concentrator to Agency Central Computer Interface

- No aspect of the Data Concentrator to Agency Central Computer Interface is covered by the CFMS.

Agency Central Computer

- No aspect of the Agency Central System is covered by the Standard.

Relating to the Agency Central Computer to Regional Central System Interface

- Message type selection, organization, or sequencing
- Fare policy data definition (e.g. fare tables)
- Security (some messages are provided to support key management without dictating how they should be used)
- Use of optional data objects and elements

Regional Central System

- No aspect of the Regional Central System is covered by the CFMS.

An additional list of specific exclusions is described in Part I, section 1.3 of the CFMS.

3.2.1 Benefits of standard based on current practices

In order to support any smart card-based fare collection program, the agency (or agencies participating in a regional program) must define the data elements, data structure and messaging solution that will be employed to enable support for the applicable fare policies and business rules defined for the program. Prior to the introduction of the CFMS, agencies typically relied on consultants to develop a data specification specific to the agency or region or allowed a single system integrator to employ a proprietary specification to the system design. Use of CFMS enables agencies to avoid the cost of developing such a specification while ensuring the data solution is comprehensive, highly flexible, non-proprietary, and has been vetted with leading industry experts. In addition to these core benefits, use of CFMS may provide any or all of the following additional advantages:

- Provides a mechanism for national recognition and approval of CFMS as a national standard.
- Ability to procure selected system edge components (e.g,, cards, readers) from a variety of vendors.
- Where CFMS Part III-compliant messages are supported throughout the system, ability to procure and integrate selected system equipment components from a variety of vendors.
- Where CFMS Part III-compliant messaging is supported at the Agency Central Computer level, ability for legacy fare collection systems (which are not necessarily compliant with other aspects of CFMS) to participate in a regional program with other, similarly compliant systems.
- Ability to procure, integrate and support secondary systems and networks, such as a retail merchant-operated card reload system, from a variety of vendors.
- Avoid legal and contractual issues associated with the use of proprietary data and messaging structures.

- Encourages card and reader manufacturers to develop and market CFMS-compliant products, thus creating a nationally-based free market (with corresponding price reductions and unrestricted supply) for such products.
- Encourages new product and software application developers to create ancillary products, services and applications that can be comfortably integrated with an agency or regional central system/program.
- Establishes an environment that facilitates and may ultimately evolve into multi-region and, ultimately, national interoperability of transit fare payment system

4 Using the CFMS

| What Is the CFMS? |
| What Is a smart card fare collection system? |
| How are smart cards and the SFMS related? |
| How do I use the CFMS? |
| Anything new coming down the pipeline? |

This section gives an outline of the activities that have to be performed, and the questions that have to be answered, before a determination on the application of the CFMS can be made.

When considering the application of the CFMS, it is necessary to determine the general and specific environment in which the fare system (or systems) will be used. This environment must be defined, at a minimum, in terms of the fare collection program's objectives, business rules and governance. Also, consideration should be given to how the system and agency requirements might evolve in the future during the life of the new system.

The intent of the CFMS is to establish a level of commonality between two or more agency systems participating in a regional program for PICC-based fare payments. In other words, agencies who share PICCs based on the CFMS should be equally able to read. update and exchange data.

The CFMS can be used as a reference in the acquisition of equipment, goods, and services, eliminating the need for each transit agency to develop their own PICC data and messaging formats and communication protocol and/or to rely on the proprietary offerings of a vendor. It is expected that, once suppliers have designed compliant systems, there will be more uniformity and therefore lower cost to the transit agency for non-recurring engineering.

It is not necessary for a transit agency to use all parts of the CFMS. For example, Part II (the card format) has been developed to support a wide variety of fare structures, modes (rail, bus, etc.), and operating practices. It is unlikely that any one agency (or, for that matter, region) will use all of the features embodied in this standard. However, by using the CFMS for the applicable tariffs, there is a strong assurance that the agencies in the region will have the flexibility to implement fare policies as their environments evolve, without endangering their common use of the PICC.

Nonetheless, to assure interoperability and to take advantage of all of the benefits offered by the standard, users must comply with the mandatory requirements of all parts of the CFMS. For example (again using Part II), while particular product objects may not be used, the Directory Index Object must be present as specified. While one agency may elect to be non-compliant with selected, mandatory parts of the CFMS, it is likely that the system will not be interoperable with other agency systems within the same region that are fully compliant with the CFMS.

It is important to understand that the CFMS addresses only a few key elements of a regional smart card system, and is not, in itself, sufficient to be used as a specification to build a system. Many other technical aspects must be defined and decisions must be made in order to procure/design systems, achieve interoperability and enable a regional program to be effectively implemented. Examples of such decisions include (but are not limited to) the following:

- Choices of fare products.
- Definition of how fare products will work (for example, expiration of "transit day," term of rolling period passes, age qualifications for special fares, etc.).
- Central file structures and where the various databases will be maintained.
- Frequency of data exchange and reconciliation between various participants.
- Security, confidentiality and privacy of the data.

In addition, where multiple transit agencies are joining together in the operation of a fare collection system, they will need the political and organizational agreements appropriate to establish cooperation, and a means of enforcing compliance among all participants who may be procuring related equipment, supplies and services.

4.1 Organization and Governance

As implied above, numerous decisions relating to the governance of the regional program must be made in order to allow that program to be implemented and/or to serve the needs of the region's transit patrons and service providers. The CFMS requires that certain services be managed centrally in order to appropriately use certain data objects and messages that are defined within the standard. Chief among these services are:

- the establishment and management of autoload services (if any are offered)
- card hotlist management and distribution
- fraud analysis and management
- interagency financial reconcilement and settlement
- CFMS implementation rule setting and compliance management
- Regional fare product management.

4.2 Application assessment (defining a decision process for applying CFMS)

In order for the CFMS to be used for a regional system under consideration, it is necessary for a set of key criteria to be met. These are as follows:

- The system shall have:

- o Two or more transit agency participants.
- o At least one common regional product that is accepted by all transit agency participants (e.g. T-purse).
- o A system architecture that allows information to be securely transferred between a single entity (Regional Central System) and all devices where a smart card can be used to pay for a fare or reloaded with value or fare products.

- The Regional Central System shall:

  - o collect all transaction records created from fare payments or reloads performed by the smart cards.
  - o process all transaction records to determine the financial settlement for all transit agency participants.
  - o manage and distribute hotlist and actionlist information.

- Fare payment media shall be a smart card with:

  - o a minimum of 2K of memory.
  - o a Card Operating System (COS) that allows for the creation of a file structure.
  - o supports the minimum required APDU command set.
  - o is compliant to ISO 14443 and identified components of ISO 7816.

In some circumstances, it may be possible for a subset of the CFMS to be applied if not all these criteria is met. For example, a single agency system may apply Part II of the Standard even though Part III is not applicable.

4.3 Implementation

The technical portion of the implementation of a smart card fare collection system, while significant, is not necessarily the most difficult part of the project. Rather, the information gathering and document development is a time consuming exercise, which requires at least some measure of meaningful involvement by agency staff. Past experience has shown that business and operational issues are as much, if not more challenging than the technical issues. Unfortunately, it is not uncommon for agencies to procure advanced fare collection systems before making some of the key business and operational decisions, resulting in difficult and delayed implementations.

The following is a partial list of some documents that may need to be created as part of a smart card fare collection project. Not all of the documents may be required for every

project. Some documents may be regional only, some agency only and some may be required at both levels.

- User Requirements
- Business Plan
- Governance Agreement
- Business Agreement(s)
- Fare Policies
- Finance Plan
- Sales & Marketing Plan
- Customer Service Plan
- Detailed Program CPM (Critical Path Method) Schedule
- Concept of Operations
- Operating and Business Rules
- Clearinghouse Operating Rules
- Test Plans
- Certification Plans
- Maintenance Plan(s)
- Interface Requirements (for as many interfaces as exist)
- Key Management Plan & Operation
- System Architecture
- Disaster Recovery Plan
- Plan for Transition from old to new functionality
- Bank certification test plan
- PICC purchase specification(s)

Other documents may be required depending upon agency preferences:

- Add Value/Vending machine screen flow diagrams
- Fare gate high level logic diagrams
- Add Value/Vending machine high level logic diagrams
- Farebox and Bus Driver Panel high level logic diagrams

The CFMS is a tool that agencies and regions can use to supplement a few of these documents. Fare collection system projects are much more likely to be completed on time, and on budget, if the participating agencies have a good understanding of the business rules, fare policies and fare products that they wish to implement. However, often these are not described in the precise terms needed to configure software applications. Agencies can use the CFMS to facilitate and support the design process where the use of PICC-stored information in fare calculation and/or the transfer of data between the regional central system and agency system are involved.

Figure 3 illustrates the basic steps for creating a system implementation specification to be used during the implementation of a CFMS compliant system.
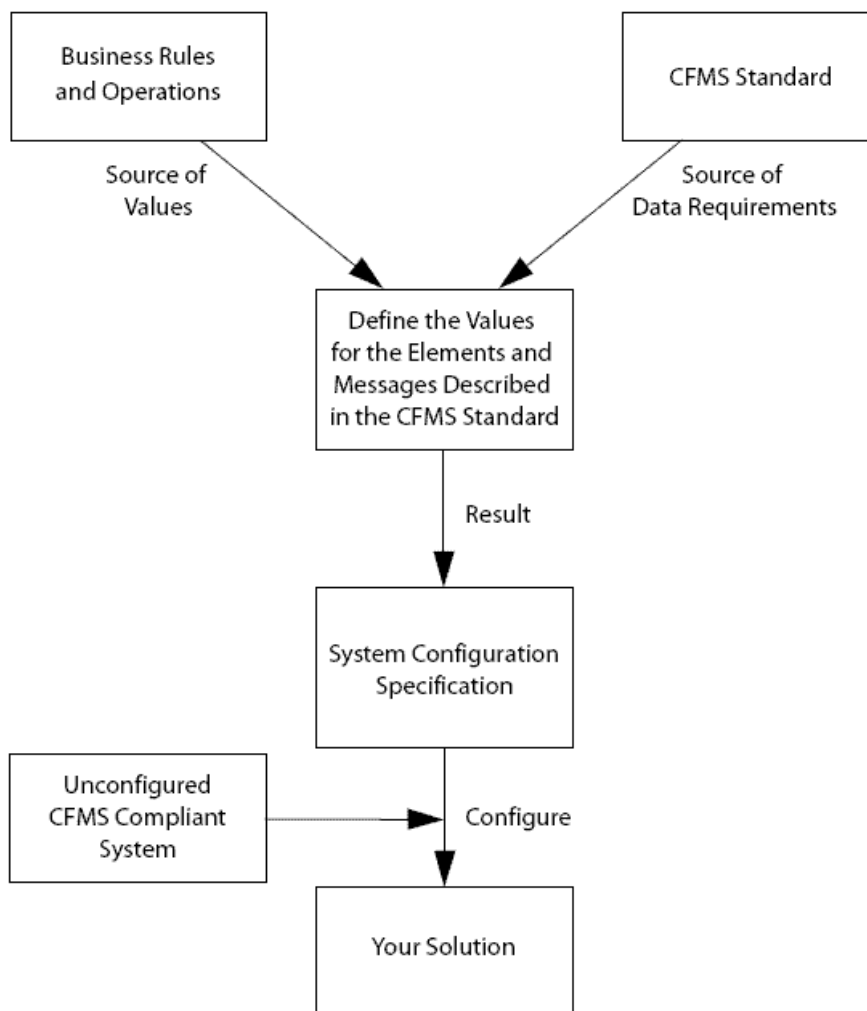
Figure 3

The steps are:

1. Collect and document business and operational rules relating to fare collection, fare policies and fare products using the CFMS to determine what information will need to be collected for system configuration.
2. Using the information collected in Step 1, apply values (or range of values) to the data and message requirements in the CFMS. The result should be a relatively comprehensive system configuration specification document.

3. This document can then be used to configure the fare media and clearinghouse application, as well as the various sub-system applications that together comprise the regional fare collection system.

4.3.1 Collecting requirements (understanding your business rules)

Business rules is a general term used to describe all the policies, procedures and practices that an agency applies to collect and manage its fare revenues. This covers a very broad range of areas from fare product pricing and definitions of customer groups to personal information privacy and fare revenue accounting rules. Many of these business rules are not usually well documented or even well understood. It is not unusual that during the process of documenting these rules, agencies find they do not have internal agreement on what the rules are, how they should be interpreted, or how they should be applied.

However difficult, agencies that take the time at the start of a new fare collection system implementation to try and document their business rules as best as they can will find that the project proceeds much more smoothly. In the case of regional system implementation, new business rules need to be established that govern the relationship between agencies, and address issues such as revenue sharing and distribution. In 2003, APTA published a document *"Options for Addressing the Major Business Issues that Must Be Resolved in Establishing and Operating a Regional Transportation Payment System and Clearing House"*, which was prepared by the Business Process Work Group of the Financial Management Committee under the UTFS Task Force. This document is a useful starting point for the development of inter-agency business rules for a regional fare payment system.

Notwithstanding the above, if the agency has a basic understanding of the CFMS, it should be a key tool used by agencies to collect the necessary configuration information. As stated earlier, the CFMS was designed so that the data formats and messages it defines could be used to support the diverse fare policies of nearly all U.S transit agencies. While this extensive flexibility suggests that only a subset of the data elements, objects and messages defined within the CFMS will be applied by any single agency or multi-agency (regional) system, the CFMS can still be used to determine which values need to be determined to configure a fare collection system. This in turn can be used to develop a series of questions that can be used to help define the business rules.

Example 1

This example shows that the CFMS allows for a variety of rules to be set for determining when value should be automatically loaded onto a PICC (if a customer joins such a program). By becoming familiar with the CFMS, an agency who may not have knowledge about autoload programs would become at least aware of such a possibility, and then could at least consider such a program for its new fare collection system.

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Object:	Stored Value and T-Purse Product
Element:	RtsAutoSubscribe
Values:	0-3
Description:	This data element enables the three possible modes of Autoload subscription requested either by the patron or organization issuing the product value. A value of 0 means that the transit application does not have an Autoload feature. A value of 1 means that when a fare product such as Stored Value or T-Purse reaches or becomes less than a predetermined value, additional value is added to the fare medium. A value of 2 means that the Stored Value or T-Purse will be replenished at a given point in time. For example, if $20.00 is to be reloaded onto the fare medium every 15th of the month, this will continue to occur as long as the element is set to 2, or a maximum fare medium value stored is achieved. The value of 3 simply allows for both the recurring and threshold to take place. In this case, recurring with a predetermined amount, such as that offered by a "Smart Benefits" program would be loaded on a given date. To supplement this value, a threshold value may also be set up that ensures that the patron will not run out of value even if the recurring Smart Benefits fund were exhausted.
Related Questions:	Will our system have an Autoload feature? If yes, will it be a threshold or recurring Autoload or both?

Note: Depending on the values selected for RtsAutoSubscribe, other elements will need to be assigned values for the value at which the threshold Autoload feature is invoked, or the recurring date on which a specific value is added to the fare medium.

Example 2

Similarly, this example shows that the information needed to configure a clearinghouse message can again be the impetus for an agency to consider how it wants to operate under a new fare collection system.

Message:	401 – Use of Regional T-Purse
Purpose:	Documents the use of the regional T-Purse only to pay for transit service.
Message contents:	MessageIdentifier, MessageVersion, MessageRevision, LocationDataObject, VehicleDataObject, EquipmentDataObject, PICCDataObject, DateAndTimeDataObject, EmployeeDataObject, ActionEventDataObject, AuthenticationDataObject, TAPOAsRead, PHPOAsRead, RegionalTPurseObjectAsWritten,

RegionalTPurseXAsWritten, THOAsWritten, THOXAsWritten, UseDeductDataObject, UseValidationDataObject

Related Questions: Since each message is made up of many objects, each of which consists of a set of elements, a message can have numerous related questions. However, many messages use the same set of core objects, so the exercise does not have to be repeated for each message. For message 401, one key question is whether the fare collection system has a proof of payment policy, and uses zones or distance for determining fare. LocationDataObject has an optional element location-ID-destination which would be required to allow the clearinghouse to verify that the correct fare was paid.

4.3.2 Define the values for the required data and messages

The information collected in the previous step can then be used to create a configuration document. For CFMS compliant systems, a starting point could be to assign values to all elements, objects and messages described in the standard. This would include determining which elements, object and messages would be needed and used for the new system.

4.3.3 Configure the new fare collection system

Once the system design is set, the values for the required data and messages that had been established earlier can then be used to configure the transit application to the agency or region's requirements.

Most often, technical design decisions are primarily the responsibility of the vendor or integrator. However, one of the benefits of implementing a contactless fare media system that is compliant with the CFMS is that any application or device supplied as part of the system can be configured according to the applicable formats described in the CFMS. The intent is that if agencies select a contactless fare medium and clearinghouse application that is compliant with the CFMS, sub-system suppliers (fareboxes, faregates, TVMs, etc.) that have products that can read and write to CFMS fare media and send and receive CFMS messages will largely require configuration (in accordance with the agency or region's implementation rules) rather than software customization in order to meet the agency requirements.

As described in Section 3.2, the CFMS does not address the full scope design requirements for a smart card fare collection system. For example, as shown in Figure 4, decisions need to be made about the sequence of actions that take place when a PICC communicates with a CID during a transaction. This includes determining file structure, sequence and priority of commands, etc.
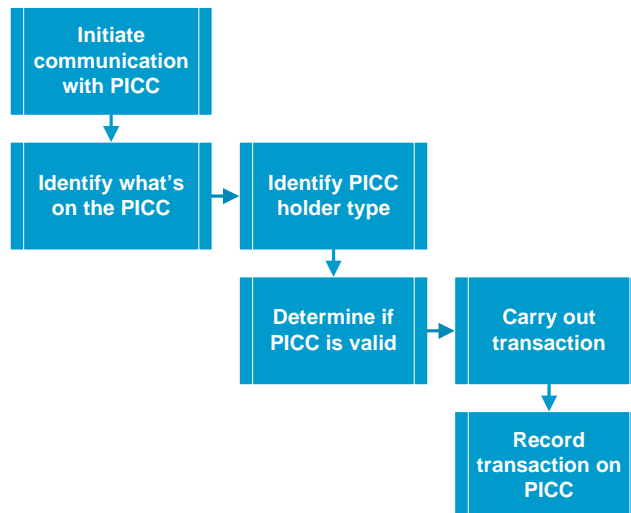

Figure 4

5 Case Study Exercises

The CFMS is very flexible, and can accommodate a wide range of policies, business roles and product applications. These case study exercises provide an opportunity to practice the technique taught in the previous section of the seminar for using the CFMS as a tool in the development of a smart card fare collection system configuration specification. Issues related to security program planning and implementation (Part IV of the CFMS) are not covered. While this is an important aspect of a smart card fare collection system, it is best taught as its own separate subject.

Specifically, for the purposes of these exercises, we ask that you put yourself in the role of a member of a team that needs to determine what card data objects and regional clearinghouse messages will need to be used to configure a contactless fare media system based on the business rules described or implied in the scenarios presented. As well, you will need to determine the values or range of values for the data elements contained in the data objects and messages. Please note, the case study exercise is meant to be illustrative, not exhaustive, and therefore, uses only a very small portion of the data and message definitions described in the CFMS.

Two case studies are presented. The first case study will be an instructor-led exercise where all the seminar participants will together determine the solution. For the second case, the participants will be split into smaller groups that will each develop their own solution.

For both case studies, the instructor will provide worksheets with a series of questions (and some of their corresponding CFMS elements, objects and messages) to help in the development of the solution. For both case studies, a series of questions are provided to help in the development of the solution. As a reference, a much more extensive set of questions that is better representative of what data needs to be collected to design and configure an actual contactless fare media system is provided as Appendix A of this workbook.

5.1 Completing the case study exercises

The following points may make the case study exercise a little easier:

- The background information in a case study is incomplete – just like the real world.
- You'll need to make reasonable assumptions about unknowns. Use the experience of your group members to define these assumptions. State your assumptions in the notes column of the case analysis worksheet. Use the comments section of the worksheet to expand on your assumptions, explain your choices and decisions, etc.

- There is no "best" solution. The rationale and process of arriving at the configurations information are the most important factors for the purposes of these exercises.
- You'll need to be realistic about solutions. No project has unlimited funds, so your aim is to create a configuration specification that meets the business needs of the agencies described in the scenarios in the most efficient manner.
- Feel free to ask the seminar instructor questions about the scenarios, or the exercise, at any time.
- Remember that the purpose of the case study exercise is to practice the methodology presented in the previous section of the course as opposed to ensuring your solution is any good.
- Most importantly - have fun!

5.2 Case Study 1

The first case study exercise will be carried out by together by all seminar participants with instructor guidance.

5.2.1 Scenario

Salem and Eugene are two towns located 2 miles apart on the Susquehana River in Pennsylvania. Up until the late seventies, Salem's main employer was the PennMetals steel mill, employing 5,000 workers, almost all of whom lived within the town limits. In Eugene, the main employer was Blackface Mines, who operated a coal mine in town, employing 2,500 workers.

Each town has had its own small public transit system since the late sixties, primarily for the transport of workers to their jobs. However, today, the towns have grown, with each having a population of almost 30,000. The steel mill and mine have closed, being replaced by dozens of small and medium sized technology and financial services businesses, whose offices are primarily located along Route 505 which joins the two towns, and in the town centers. Due to the steep valley topography, urban sprawl has been limited to the land between the two towns, in effect creating one contiguous urban area. This population and employer concentration has driven demand for public transit, and each transit agency has been running bus lines to the other agency's town center.

Salem and Eugene are not willing to consider merging their public transit systems. However, almost 25% of each agency's customers have to use both transit systems to get to their destination. In order to improve customer convenience, the two agencies have initiated discussions about implementing a regional fare collection system that uses contactless fare media.

Salem Transit operates 20 buses, carrying 3,000 passengers every weekday, and has a flat fare based pricing policy. It currently offers the following fare products:

Single Ride Tickets
Youth (3 to 17 years)	$1.00
Honored Citizen (65 years or older, persons with disabilities)	$1.50
Adult	$2.00

Monthly Passes
Youth	$15.00
Honored Citizen	$22.00
Adult	$40.00

Salem Transit buses are fitted with 15 year old fareboxes, which accept $1 bills and coins. No transfer privileges are offered. Passes and single ride tickets are sold at the Salem Transit Administrative Offices, as well as at the 3 Piggly Wiggly grocery stores in town, which receive a 5% commission from all fare product sales.

Eugene Transit operates 25 buses, carrying 3,500 passengers every weekday, and also has a flat fare based pricing policy. It currently offers the following fare products:

Single Ride
Youth (3 to 17 years)	$0.75
Honored Citizen (65 years or older, persons with disabilities)	$0.50
Adult	$1.50

30 Day Rolling Pass
Youth	$10.00
Honored Citizen	$5.00
Adult	$30.00

Eugene Transit buses are fitted with 20 year old fareboxes, which only accept coins for payment. No transfer privileges are offered. The 30 Day Rolling Passes and single ride tickets are sold from 10 ticket vending machines located at several municipal facilities, as well as at 4 mini-malls around town.

While the two agencies recognize the need to provide their customers with more convenient means of fare payment, they are not willing to accept each other's fare products, believing that any fare revenue sharing scheme would be too contentious. Therefore, any new fare collection system would need to allow customers to carry both agency's fare products on their contactless fare media.

5.2.2 Case 1 Solution Development

During actual configuration specification development, you would use the CFMS to identify the questions you need to answer before values can be assigned to required elements, objects and messages. For the purposes of this exercise, a sampling of possible questions has been prepared, showing which element/object/message definition they are related to as well as where applicable, the possible values accommodated by the CFMS.

As a collaborative exercise with everyone attending the seminar, use the information provided in the scenario, as well as reasonable assumptions, to fill in missing information in the worksheet provided by the instructor.

NOTE: The Rts (for Regional Transit System) is used as a general engineering practice to help identify the data elements that are defined in Part II of the CFMS (as opposed to Part III, which uses the same element names, but without the prefix).

5.3 Case Study 2

For Case Study 2, you will be asked to split into small workgroups and complete the workbook together.

5.3.1 Scenario

St. Paul, Idaho and Wilsonville, Washington are two border cities that have experienced rapid growth as retirement communities over the last ten years due to their favorable climate, access to a wide range of recreational activities and their proximity to the southwest Washington wine growing region.

St. Paul, with a population of 40,000, is on the edge of the Green Mountains State Park, and at the base of Big Cliffs Mountain ski resort. The city's economy is based on a wide range of services, including a renown health spa and a large hospital specializing in geriatric care.

Wilsonville is a city of 50,000, and the main economic driver is Southwest Washington University, a private college with 15,000 students most who are in engineering and natural science programs focused on the sustainable development and environmental programs.

The two cities have been lobbying their respective legislatures for many years to enable the creation of a bi-state regional transit agency. However, until Idaho and Washington political leaders can reach consensus on state funding levels of public transit, this seems unlikely. Until then, each city will need to continue to operate its own transit system, even though each system's routes cross extensively into each other's jurisdictions.

Recent surveys have shown that 40% adults in the region use each agency's system at least twice each month.

As a stop gap measure, the two cities have decided to implement a regional fare collection system that uses contactless fare media so as to improve customer convenience.

St. Paul Transit operates 50 buses, carrying 8,000 passengers every weekday, and has a flat fare based pricing policy. It currently offers the following fare products:

Single Ride Tickets
Youth (3 to 17 years) $1.50
Honored Citizen (65 years or older, persons with disabilities) $2.00
Adult $3.00

Monthly Passes
Youth $20.00
Honored Citizen $30.00
Adult $75.00

St. Paul Transit buses are fitted with 10 year old fareboxes, which accept $1 and $5 bills and coins. Transfers are issued and are valid for two hours. Passes and single ride tickets are sold at the St. Paul Transit Administrative Offices, as well as at 15 7-Eleven convenience stores in town, which receive a 3% commission from all fare product sales.

Wilsonville Transit operates 75 buses, carrying 12,000 passengers every weekday, and also has a flat fare based pricing policy. It currently offers the following fare products:

Single Ride
Youth $0.50
(3 to 17 years or a current Southwest Washington University Student ID)
Honored Citizen (65 years or older, persons with disabilities) $0.75
Adult $1.00

30 Day Rolling Pass
Youth $7.00
Honored Citizen $10.00
Adult $15.00

Wilsonville Transit buses are fitted with 15 year old fareboxes, which only accept coins for payment. Transfers are issued and valid for one and half hours. The 30 Day Rolling Passes and single ride tickets are sold from 10 ticket vending machines located at several municipal facilities, as well as at 4 mini-malls around town and the Student Activities Center at Southwest Washington University.

While the two agencies recognize the need to provide their customers with more convenient means of fare payment, given the pricing of the fare products is currently vastly different, they have no means to establish a revenue sharing scheme without running afoul of their respective state legislatures. Therefore, any new fare collection system would need to allow customers to carry both agency's fare products on their contactless fare media.

However, both agencies agree that the new fare collection system should maximize convenience to customers. Therefore, the agencies agree that all web sales and ticket vending sales will accept both credit and debit cards for payment. The system will include a regional transit purse that can be used on either system. Autoload services based on a $10 threshold will be offered to customers as an option. St. Paul Transit will also offer a recurring autoload service for its monthly passes.

5.3.2 Case 2 Solution Development

As with Case 1, use the information provided in the scenario and make reasonable assumptions to fill in missing information in the worksheet provided by the instructor.

6 Extended use of CFMS

What is the CFMS?
What is a smart card fare collection system?
How are smart cards and the SFMS related?
How do I use the CFMS?
Anything new coming down the pipeline?

The CFMS was intended for application of contactless smart cards, but can also be applied to a variety of other types of contactless payment mediums and form factors which are being introduced in pilot payment systems within the US. Mobile phones, fitted with an appropriate microprocessor and antenna, can be loaded with a transit application configured to the CFMS thus providing interoperability across transit systems employing CFMS. A similar approach could be taken with contactless bank cards provided that such cards can accommodate a transit application using a data structure that conforms to the requirements defined within CFMS.

6.1 Next steps for the CFMS

The CFMS in its present four-part form represents the basis of a fare system data and messaging standard. This current version provides the necessary tools to define the data and messaging components of an interoperable fare system dedicated to preserving an open-architecture environment. However, to improve upon its versatility, certain additions are foreseen.

The planned additions address four basic areas:

- The development of limited-use cards.
- The development of a test methods specification for system performance assurance.
- A refinement of the security guideline to codify a more consistent approach to specifying security.
- The development of a sub-system interface standard, somewhat similar to Part III of the current release, but applied at a lower point in the information processing stream between a subsystem computer and the transaction or settlement central system computer.

7 Closing comments and questions

This concludes the formal portion of the seminar. Hopefully, participants now understand that the CFMS is more than just a standard to add as a compliance requirement during the procurement of the new fare collection system. System configuration is painstaking, detailed work and the CFMS can help add some welcome structure to that task.

While it is hoped that agencies will begin to require compliance with the CFMS when procuring smart card fare collection system, at minimum the participants in this seminar should now be more knowledgeable buyers of fare collection systems. Participants should now:

- Have knowledge about the primary components of smart card systems.
- Understand which components of systems are impacted and supported by the CFMS.
- Know how the CFMS should be applied to a particular smart card system project.
- Have insight in how agencies can use the framework provided by the CFMS during a smart card system implementation.
- Be better prepared to manage and oversee the vendor(s) implementing a CFMS compliant system.

8 Participant Questionnaire

Participants are encouraged to provide feedback to the instructors about the seminar. The instructors will be available to discuss any outstanding questions. Those that cannot be answered at the seminar will be researched and a response sent by e-mail to the individuals who provided their contact details.

APTA would appreciate if participants would complete and submit the seminar questionnaire and feedback form before leaving the room.

Appendix A: Question Reference List

The following table contains a list of questions, which associated links to the elements, objects and messages in the CFMS, to assist in the configuration of the CFMS and determination of values to suit a particular application. The questions, and references to the relevant sections of the CFMS, provide valuable assistance in understanding the scope of CFMS.

The table is not exhaustive in identifying all elements of CFMS that should be considered. There are details and decisions that can only considered during a detailed design process when specific information relating to the application is available. For example, encryption key related areas are not included for consideration in the table.

NOTE: The Rts (for Regional Transit System) is used as a general engineering practice to help identify the data elements that are defined in Part II of CFMS (as opposed to Part III, which uses some of the same element names, but without the prefix).

	Question	Object	Element	Value Range	Message	Ref	Notes
Application Questions							
1	In which country is the PICC (card) issued?	Transit Application Profile Object (TAPO) LocationDataObject	RtsCountryID country-ID	0-1023 e.g. 840 = USA	A0101 PICC Initialized A0102 PICC Issued A0103 PICC Registered A0818 Direct a PICC Data Change	II-5.2 III-5.2.1	Based upon ISO3166 codes
2	In which region is the PICC (card) issued?	Transit Application Profile Object (TAPO) LocationDataObject	RtsRegionID region-ID	0-255		II-5.2 III-5.2.1	Value determined by each country, but fixed once set.
3	Who is the PICC (card)	Transit Application Profile Object (TAPO)	RtsIssuerID	0-1023 e.g.		II-5.2	Value determined by type of issuer, and

	Question	Object	Element	Value Range	Message	Ref	Notes
	issuer?			1 = New York City Transit Authority 2 = New Jersey Transit 3 = Port Authority Trans Hudson (PATH) 4 = Port Authority AirTrain 5 = Long Island Railroad 6 = Metro-North Railroad 7 = Hudson-Bergen Light Rail 8 = New York Waterway 9 = Staten Island Ferry 10 = NFTA 11 = NYC DOT 12 = PATCO 13-63 are reserved for future transit agency IDs			issuer ID
4	On what date will the transit application on the PICC no longer be valid?	Transit Application Profile Object (TAPO)	RtsTransitExpirationDate	Date in format ddmmyy		II-5.2	
		Transit Application Profile Object (TAPO)	RtsTransitValidityPeriod	0 = valid upon issue 1 – 7 = years prior to expiry data when application becomes valid		II-5.2	
Cardholder Questions							
5	Is the patron eligible for age-based discounts?	PICC Holder Profile Object (PHPO)	RtsProfileBirthDate	Date in format ddmmyy		II-5.3	
6	Is there a	PICC Holder Profile Object	RtsProfileStartDate	Date in format		II-	

	Question	Object	Element	Value Range	Message	Ref	Notes
	validity period for the discount?	(PHPO)		ddmmyy		5.3	
		PICC Holder Profile Object (PHPO)	RtsProfileExpireDate	Date in format ddmmyy		II-5.3	
7	What is the cardholder preferred language (for screen displays / messages?	PICC Holder Profile Object (PHPO)	RtsProfileLanguage	0-128, e.g 0 = English, 1=Spanish		II-5.3	
8	In what patron group (e.g. Senior, student) does the cardholder fall?	PICC Holder Profile Object (PHPO)	RtsProfileCode	0-65536 e.g. 1 = Full Fare or General Fare (default, permanent full fare) 2 = Child 3 = Student 4 = Senior 5 = Youth 6 = ADA Patron 7 = Promotional	A0418 PICC Profile Data Changed B0121 Fare Policy Framework – Regional Profile Codes	II-5.3	
			RegionalProfileCodeDescription	Name		III-6.1	Name of profile used for displaying or printing
9	Did the patron pay a deposit to obtain this card?	PICC Holder Profile Object (PHPO) BatchEncoldingDataObject	RtsDepositPaid DepositAmount	0 = No deposit 1-15 = Deposit paid lookup table code 0 - 65535		II-5.3 III-5.2.9	Used to determine refund if applicable
10	Is the cardholder's personal information recorded (apart from date of birth)?	PICCHolderInfoDataObject				III-5.2.10	Name, address, telephone, email
Agency Questions							

	Question	Object	Element	Value Range	Message	Ref	Notes
11	What agencies are participating in the regional program and/or have products loaded on this card?	LocationDataObject	Agency-ID	0-255	B0123 Fare Policy Framework –Agency IDs	III-5.2.1	Assign an ID for each participating Agency
		Directory Index Object (DIO)	RtsAgencyAProductsFileID	0-15 0 = no Agency specific products 1-15= file ID		II-5.1	Repeated for Agency B, C, D if necessary
		Directory Index Object (DIO)	RtsAgencyAProductsQty	0-7 = number of products for Agency (e.g. 0=1 product, 1=2 etc.)		II-5.1	Repeated for Agency B, C, D if necessary
		Directory Index Object (DIO)	RtsAgencyAID	0-255 = Agency ID e.g. 1 = New York City Transit 2 = New Jersey Transit 3 = Port Authority Trans (PATH)* 4 = Port Authority AirTrain 5 = Long Island Railroad 6 = Metro-North Railroad 7 = Hudson-Bergen 8 = New York Waterway 9 = Staten Island Ferry 10 = NFTA 11 = NYC DOT 12 = PATCO		II-5.1	Repeated for Agency B, C, D if necessary
			AgencyDescription	Name		III-6.1	Agency name shown when displayed or

	Question	Object	Element	Value Range	Message	Ref	Notes
							printed
Regional Product Questions							
12	Is there a Regional T-Purse?	Directory Index Object (DIO)	RtsTPurseFileID	0= not regional T-purse 1-15 = T-purse file ID	A2770 Regional T-Purse Loaded A2775 Regional T-Purse Unloaded A0401 Use of Regional T-Purse A0325 Out of Region T-Purse Loaded A0414 Use of Regional T-Purse on an Out of Region PICC	II-5.1	
13	Are there any other regional products (apart from T-purse)?	Directory Index Object (DIO)	RtsRegionalProductsFileID	0 = no other products 1 -15 = file ID for products	A2780 Regional Pass Product Loaded A2785 Regional Pass Product Unloaded A0402 Use of Regional Pass Product with or without a step-up fare B0122 Fare Policy Framework – Regional Product IDs	II-5.1	
		Directory Index Object (DIO)	RtsRegionalProductsQty	0-7 = number of regional products (e.g. 0=1 product, 1=2 etc.)		II-5.1	
14	If so, what other information is available to define how those products are used/applied?	RegionalProductOpParamsDataObject	DayConstraints TimeConstraints PeriodContraints FixedorFloating RideConstraints OtherConstraints	0 – 255 0 – 255 0 – 255 0 – 255 0 – 255 0 - 255		III-5.2.15	Parameters governing use of Regional Product
		RegionalProductCostDataObject	RegionalProductCost RegionalProductFaceValue RegionalProductApportionmentValue RegionalProductRetailValue	0 – 65535 = RtsProfileCode for this set of costs 0 – 4 million 0 – 4 million 0 – 255		III-5.2.16	Price and cost per regional product per patron type/class (as specified by RtsProfileCode)

	Question	Object	Element	Value Range	Message	Ref	Notes
			RegionalProductDescription	Name		III-6.1	Description of regional product used for displaying or printing
Agency Product Questions							
15	Are there any fare products that are valid only for a specific Agency?	Product Index Object (PIO)	RtsProduct1AgencyID	0-255 = Agency ID that owns the product	A2781 Agency Pass Product Loaded A2786 Agency Pass Product Unloaded A2771 Agency Stored Value Product Loaded A2776 Agency Stored Value Product Unloaded A0403 Use of Agency Specific Product with or without a step-up fare A0405 Use of Agency Stored Value Product A0416 Product Blocked A0417 Product Unblocked A0419 Use of Stored Value from Multiple SV Sources A0816 Block a Product A0817 Unblock a Product	II-5.5	Each product needs to be defined with an associated agency and product type.
		Product Index Object (PIO)	RtsProduct1TypeCode	0 = Expired 1 = Account Linked Product 2 = Time based Pass Product or Transfer 3 = Trip or Ride based Pass or Transfer Product		II-5.5	

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	Question	Object	Element	Value Range	Message	Ref	Notes
				4 = Threshold or Recurring Autoloaded Pass Product 5 = T-Purse or SV Product 6 = Threshold or Recurring Autoloaded SV Product 7 = AutoValue Product			
T-Purse and SV Purse Questions							
16	Has an autoload service been established for the T-Purse or for any Agency specific Stored Value purse?	Stored Value (SV) & T- Purse Product Objects (SV&TPPO)	RtsAutoSubscribe	0-3 0 = Field not used 1 = Threshold 2 = Recurring 3 = Recurring & Threshold	A0710 Set up Stored Value or Regional T-Purse Threshold Autoload A0715 Withdraw Stored Value or Regional T-Purse Threshold Autoload A2712 Stored Value Threshold Autoload Setup Response A2713 Regional T-Purse Threshold Autoload Setup Response A2717 Stored Value Remove Threshold Autoload Setup Response A2718 Regional T-Purse Remove Threshold Autoload Setup Response A0302 Regional T-Purse Autoloaded (Threshold or Recurring) A305 Agency Specific Stored Value product Autoloaded (Threshold or Recurring) A0770 Direct a Load of Stored Value A0775 Direct an Unload of Stored Value	II-5.12	This field represents the Autoload subscription indicator for this load

	Question	Object	Element	Value Range	Message	Ref	Notes
17	If so, what type of autoload service is it?	Stored Value (SV) & T- Purse Product Objects (SV&TPPO)	RtsRecurringAutoloadType	0-7 0 = Field is not used 1 = Weekly 2 = Monthly 3 = Bi-Annual [every 6 months] 4 = Annual 5-7 Reserved for future use	A0750 Set-up Stored Value or Regional T-Purse Fixed Recurring Autoload A0755 Withdraw Stored Value or Regional T-Purse Fixed Recurring Autoload A2752 Stored Value Fixed Recurring Autoload Setup Response A2753 Regional T-Purse Fixed Recurring Autoload Setup Response A2750 Stored Value Fixed Recurring Autoload Setup and Value Loaded Response A2751 Regional T-Purse Fixed Recurring Autoload Setup and Value Loaded Response A2755 Stored Value Remove Fixed Recurring Autoload Setup and Value Unloaded Response A2756 Regional T-Purse Remove Fixed Recurring Autoload Setup and Value Unloaded Response A2757 Stored Value Remove Fixed Recurring Autoload Setup Response A2758 Regional T-Purse Remove Fixed Recurring Autoload Setup Response	II-5.12	Used to differentiate from SV Autoload types
		Stored Value (SV) & T- Purse Product Objects (SV&TPPO)	RtsAutoloadThreshold	0 = Field is not used 1 = balance is equal to or less than zero down to but not less than the PICC deposit	A2710 Stored Value Threshold Autoload Setup and Value Loaded Response A2711 Regional T-Purse Threshold Autoload Setup and Value Loaded Response	II-5.12	The value in this field is used to identify the general parameter that triggers an autoload function.

	Question	Object	Element	Value Range	Message	Ref	Notes
				value 2 = [Lookup Tag-1] 3 = [Lookup Tag-2] 4 = [Lookup Tag-3] 5 = [Lookup Tag-4] 6 = [Lookup Tag-5] 7 = reserved for future use Lookup tags point to configuration files, or database tables that indicate the actual value at which to perform Threshold Autoloads.	A2715 Stored Value Remove Threshold Autoload Setup and Value Unloaded Response A2716 Regional T-Purse Remove Threshold TP & TP & SV Autoload Setup and Value Unloaded Response		
		Stored Value (SV) & T- Purse Product Objects (SV&TPPO)	RtsSVThresholdLoadAmount	0-32767		II-5.12	Value to Add for a Threshold Autoload.
		Stored Value (SV) & T- Purse Product Objects (SV&TPPO)	RtsSVRecurringLoadAmount	0-3276		II-5.12	Value to add for a Recurring Autoload.
		Stored Value (SV) & T- Purse Product Objects (SV&TPPO)	RtsCurrencyCode	0 = Field not used 1 = US Dollar (default) 2 = Canadian Dollar 3 = Mexican Peso 4 = Pound Sterling 5 = Japanese Yen 6 = Euro 7 = Reserved for future use		II-5.12	If set to 0, currency is determined from the RtsCountryID field
Pass and Transfer Product Questions							
	For each pass or transfer product on the PICC (card), the following have to be determined:						
18	Is autoload allowed?	Pass and Transfer Product Objects (P&TPO)	RtsAutoloadSubscribed	0-3 e.g. 0 = Not Subscribed 1 = Subscribed	A0730 Set-up Regional/Agency Specific Pass Product Setup Autoload A0735 Withdraw Regional/Agency	II-5.11	Autoload selection for the product

	Question	Object	Element	Value Range	Message	Ref	Notes
					Specific Pass Product Setup Autoload		
					A2732 Agency Pass Product Autoload Setup Response		
					A2733 Regional Pass Product Autoload Setup Response		
					A2737 Agency Pass Product Remove Autoload Setup Response		
					A2738 Regional Pass Product Remove Autoload Setup Response		
					A2730 Agency Pass Product Autoload Setup and Initial Load Response		
					A2731 Regional Pass Product Autoload Setup and Initial Load Response		
					A2735 Agency Pass Product Remove Autoload Setup and Product Unloaded Response		
					A2736 Regional Pass Product Remove Autoload Setup and Product Unloaded Response		
					A303 Regional Pass Product Autoloaded		
					A304 Agency Specific Pass Product Autoloaded		
					A0780 Direct a Load of Regional/Agency Specific Pass Product		
					A0785 Direct an Unload of Regional/Agency Specific Pass Product		
19	What type of product is it?	Pass and Transfer Product Objects (P&TPO)	RtsProductType	0-255 e.g. for NYCT	A0411 Product Activation (First use of rolling product)	II-5.11	Codes are specific to each agency

	Question	Object	Element	Value Range	Message	Ref	Notes
				0 = T-Purse or [SV] in all cases 1 = 2 Ride Pass 2 = Weekly Off peak Pass 3 = Rolling monthly unlimited pass 4 = Rolling monthly Transit Center pass 5 = 3-day unlimited tourist pass 6 – 253 = additional products 254 = AutoValue 255 = Account Linked			
20	Where is the pass valid?	Pass and Transfer Product Objects (P&TPO)	RtsLocationEncoding	0- 4,294,967 e.g. Sector/Route/Sector Encoding Bits Denotation 0 – 10 Valid Sector a 11 – 21 Valid Sector b 22 – 31 Valid Route Number connecting Sectors a & b Point to Point Encoding: Bits Denotation 0 – 15 Point a = RtsLocationID a [0-65,535] 16 – 31 Point b = RtsLocationID b [0-65,535]		II-5.11	Indicates the location validity of the Pass Product within the Region.
21	Is it a ride-based product?	Pass and Transfer Product Objects (P&TPO)	RtsRemTrips/Rides	0-63		II-5.11	Number or trips or rides associated with the product
22	If time limited	Pass and Transfer Product	RtsExpDate	ddmmyy		II-	Date that the product

	Question	Object	Element	Value Range	Message	Ref	Notes
	pass products exist, what is their period of validty?	Objects (P&TPO)				5.11	expires
23	If transfers exist, for how long are they valid?	Pass and Transfer Product Objects (P&TPO)	RtsExpTime	0-1439	A0409 Transfer with or without a step-up fare	II-5.11	Time in minutes past midnight that the product expires
Account Linked Product Questions							
24	Is there an Account Linked product?	Directory Index Object (DIO)	RtsALROFileID	0= no account linked product 1-15 = account linked reference product file ID	A0805 Setup/Update an Account Linked Product A0855 Withdraw an Account Linked Product A0205 Account Linked Product Loaded A255 Account Linked Product Unloaded A0412 Use of Account Linked Product	II-5.1	
25	Are there limits on the number of fare payments that can be performed using the ALPO in a given period of time? What is the duration of that time period?	Account Linked Product Object (ALPO)	RtsCountTimePeriod	0-1439		II-5.13	Minutes that the maximum number of transaction applies to.
		Account Linked Product Object (ALPO)	RtsPeriodStartTime	Hhmm		II-5.13	Time of day when count period starts
		Account Linked Reference Object (ALRO)	RtsPeriodCountLimit	0-31		II-5.14	Maximum number of transactions in a period that are allowed
26	Is there a limit on the total	Account Linked Reference Object (ALRO)	RtsConsumerValueLimit	0-63 (units)		II-5.14	Maximum value of transactions that can

	Question	Object	Element	Value Range	Message	Ref	Notes
	value of fare payments that can be made in a period of time?						be performed in a day with the Account Linked product.
27	What nation's currency is applied to fare payments using the ALPO?	Account Linked Product Object (ALPO)	RtsCurrencyCode	0 = Field not used 1 = US Dollar (default) 2 = Canadian Dollar 3 = Mexican Peso 4 = Pound Sterling 5 = Japanese Yen 6 = Euro 7 = Reserved for future use		II-5.13	If set to 0, currency is determined from the RtsCountryID field
28	Is the bankcard associated with the ALPO identified on the card?	Account Linked Reference Object (ALRO)	RtsBankcardPAN	0 – 999 9999 9999 9999 9999		II-5.14	The Bankcard (credit or debit card) Primary Account Number, used by the Back end system for payment
		Account Linked Reference Object (ALRO)	RtsBankcardExpDate	mmyy		II-5.14	Bankcard expiration date
Autovalue Product Questions							
29	Is there any autovalue (bonus) scheme associated with the card or transaction?	AutoValue Product Object (AVPO)	RtsAutoValueType	0-31 0 = Reserved 1 = Valued Fare in USD 2 = User defined 3-24 = User defined 25-31 = Reserved	A320 Autovalue Product Loaded A321 Autovalue Product Unloaded A0415 Use/Travel on an Autovalue Product A0820 Setup/Update an Autovalue Product A0821 Withdraw an Autovalue Product	II-5.17	The manner in which the accumulation of units results in a fare bonus has to be determined by the Agencies involve.d
Equipment and Employee Questions							
30	In which physical location did the transaction	LocationDataObject	RTSLocationID Location-ID	0 - 65,535		III-52.1	IDs for each station, depot or other physical location within an agency system should be

	Question	Object	Element	Value Range	Message	Ref	Notes
	occur?						unique.
31	What other data is available to determine where a transaction occurred?	VehicleDataObject	vehicle-ID route-ID zone-ID run-ID	0 - 65,535 0 - 65,535 0 - 65,535 0 - 65,535		III-5.2.2	Define unique IDs for all possibilities in the system
32	To identify the equipment used to perform the transaction?	EquipmentDataObject	Location-ID CIDID RtsCIDID	0- 4 million 0 - 65535 0 - 65536		III-5.2.3	Unique IDs [within the Region] for Devices
33	To identify employees that can service equipment?	EmployeeDataObject	EmployeeID EmployeeType EmployeePICCID	0 – 4 million Name PICC serial number		III-5.2.5	Unique ID for employees that can log into equipment