

Acknowledgements

The Consultant of the Study of Common Ticketing to Encourage Greater Utilization of Travel on Transit System and Establishment of Central Clearing House received excellent cooperation and support from various parties concerning the convenience, smoothness and successful achievement of the objectives for this project.

The Consultant wishes to thank the Steering Committee of this project for giving valuable comments and suggestions as well as assistance to the Consultant to ensure the convenience and coordination necessary with all of the various agencies concerned. The Consultant also thanks all representatives from the concerned agencies who provided the Consultant with the data and information essential for the study, and who co-operated in seminars for the purpose of exchanging of ideas about the project to enable the work of the Consultant to be more comprehensive.

The Consultant thanks the Director of the Office of Transport and Traffic Policy and Planning and all the staff of the Office for their suggestions and co-operation, including their help in facilitating the work of the Consultant in all aspects.

Lastly, the Consultant sincerely thanks the Office of Transport and Traffic Policy and Planning for the trust given to the Consultant through the course of the project.

The Consultant

Content

	Pages
Acknowledgement	
Figures	ii
Tables	iii
Definition	iv
Section 1 Introduction	1
1.1 Objectives of the Study	2
1.2 Study Framework	2
Section 2 Operational Framework for Common Ticketing System and Central Clearing House	4
2.1 Common Ticketing System	4
2.2 Common Ticketing System and Setting Up of Central Clearing House in Thailand	5
Section 3 Standard and Structure of Common Ticketing System and Central Clearing House	9
3.1 Card Type and Common Card Definition	9
3.2 Overview Structure of Automatic Fare Collection System in the Common Ticketing System	11
3.3 Communication System	15
3.4 Central Clearing House System	20
Section 4 Central Clearing House Mechanism for the Common Ticketing System	25
4.1 Related Laws on the Operation	25
4.2 Format of the Common Ticketing System Organization	27
4.3 Organization Structure of the Common Ticketing System	29
Section 5 Success Factors of Common Ticketing System in Thailand	34
5.1 Setting up the Organization and Development Plan for the Common Ticketing System and Public Relations	34
5.2 Road Map on Setting Up the Common Ticketing System Organization and Operation Plan	37
5.3 Feasibility and Return of Investment in the Common Ticketing System	40

Figures

	Pages
Figure 1.2-1 Result of the Study for Actual Operation	3
Figure 2.1-1 Common Ticketing System Components	5
Figure 2.2-1 Operational Framework for the Common Ticketing and Central Clearing House for Thailand	8
Figure 3.1-1 Card Type and Common Card Definition	11
Figure 3.2-1 Overall Structure of Automatic Fare Collection System in Thailand	14
Figure 3.3-1 Overview Structure of Data Communication of Common Ticketing System in Thailand	17
Figure 3.3-2 Overview Standard of File Transfer of Common Ticketing System in Thailand	19
Figure 3.4-1 File Transfer of Fare Collection System to the Central Clearing House	21
Figure 3.4-2 Main Components of Web Services Technology	22
Figure 3.4-3 The Central Clearing House for Transit and Non-Transit	23
Figure 3.4-4 Structure of Devices within the Central Clearing House	24
Figure 4.1-1 Related Laws on the Operation of the Common Cards (E-Cards)	26
Figure 4.1-2 Related Laws on the Operation of the Central Clearing House	27
Figure 4.3-1 Organization Structure of the Common Ticketing System Phases 1 and 2	32
Figure 4.3-2 Organization Structure of Joint Venture Company (Business Unit) to Operate the Common Ticketing System	33
Figure 5.1-1 Examples of Advertising Media for the Common Ticketing System	36
Figure 5.2-1 Implementing Steps for Setting Up the Common Ticketing System Organization	40

Tables

		Pages
Table 3.1-1	Comparison between Memory with Security Logic Card and Memory with CPU Card	10
Table 3.2-1	Data System between Tiers in the Structure of Automatic Fare Collection System for Thailand	13
Table 5.1-1	Plan for Setting Up and Operation of the Common Ticketing System Organization for Thailand	35
Table 5.3-1	Guideline for Management/Format of the Common Ticketing System Operation and Setting Up the Central Clearing House	42

Definitions

Terms

Acceptance Rate

Acceptance Speed

Add Value Machine (AVM)

AFC Gate, Automatic Ticketing Gate

Antenna

Anti-Collision

Audit Register Data

Automated Clearing House (ACH)

Automatic Fare Collection (AFC)

Automatic Gate

Automatic Vending Machine

Back-End Applications

Bangkok Mass Transit Authority (BMTA)

Bangkok Mass Transit System Public
Company Limited (BTSC)

Bangkok Mass Transit System (BTS)

Bangkok Metro Public Company Limited
(BMCL)

Bank Note Acceptor Unit

Blacklist

Bus Entry Processor/ Bus Exit Processor
(BEP/BXP)

Bus Rapid Transit (BRT)

Definitions

The accuracy of a transaction that can be accepted.

The speed at which a transaction is accepted.

The self-service equipment to top-up money on cards.

The barrier between the paid and non-paid areas of the station through which passengers must pass.

A wire or rod to send and receive signals.

The prevention of duplicate card reading.

Data which is registered for investigation.

The automated revenue management system which controls the accumulation of common ticketing transactions, and the clearing and settlement of revenue among operators.

The equipment that automatically admit passengers on insertion of the correct fare in an acceptable form, which may be coins, tokens, tickets, or fare cards.

The electronic gate between the paid and non-paid areas of the station through which passengers must pass.

The machine used for selling tickets and topping up stored value tickets.

The Revenue Management System.

A government service provider that provides bus services in Bangkok in the form of regular bus, air-conditioned bus, minibus, minor-road (soi) bus and air conditioned van.

The operator of the (BTS) elevated mass rapid transit system in Bangkok.

Elevated mass rapid transit system in Bangkok (Green Line).

The operator of the underground mass rapid transit system in Bangkok (Blue Line).

The bank note acceptor consists of the bank note transport, the sensor module and the data module.

A list or register of persons who, for any reason, are denied a particular privilege, service, mobility, access or recognition.

The ticket reader which is installed at the entrance and exit of the Bus for passengers to check information stored in the tickets.

A public bus transport system that provides a service with higher frequency, higher quality and higher speed than an ordinary bus line and is usually segregated from other.

Definitions (Continued)

Terms	Definitions
Card Holder	A person who has a common ticketing card.
Card Initialization Device (CID)	Smart Card preparation machine.
Card Issuer	An organization which issues common ticketing cards.
Card Personalization Device (CPD)	Smart Card preparation machine with card holder's personal information.
Card Type	Smart Card Technology which is used for common ticketing such as Types A, B, or C, etc.
Central Clearing House (CCH)	The central revenue management organization which is in charge of clearing and revenue settlement among members.
Central Clearing House Disaster Recovery Site (CCH DRS)	Backup facility for the Central Clearing House in case of emergency.
Central Computer System (CC)	Central Computer of the Automatic Fare Collection System.
Central Computer Workstation	Workstation client of the Central Computer.
Chao Phraya Express Boat Co., Ltd. (CPEX)	An operator of passenger boat services along and across the Chao Phraya River.
Clearing	The process of exchanging and reconciling payment items that result in a transfer of funds from one financial institution to another.
Clearing House	The revenue management organization that is in charge of clearing and revenue settlement among members.
Coin Acceptor Unit	A device that determines whether a coin is, or is not, counterfeit. These devices are used in vending machines that accept payment and dispense a ticket to a customer.
Composite Data Element	Data element with a large number of sub-elements.
Constructed Data Element	Data element with a fixed number of sub-elements.
Contacted Smart Card	A smart card with a chip that makes contact with electrical connectors that can read and write information when it is inserted into a reader.
Contactless Smart Card	A smart card that uses radio frequencies to provide a wireless connection to the card reader.
Contactless Smart Card Reader-Writer (CSC R-W)	The machine using for reading and writing the data in the contactless smart card.
Concession Management	The management of a business or businesses operated under a contract or license associated with a degree of exclusivity in a certain business or a defined geographical area.
Cryptographic Keys	A piece of information (a parameter) that determines the functional output of a cryptographic algorithm or cipher.

Definitions (Continued)

Terms	Definitions
Data Element	ISO8583 Data element consisting of a single piece of information.
Data Encryption Standard (DES)	The Data Encryption Standard (DES) is a block cipher (a form of shared secret encryption) that was selected by the National Bureau of Standards as an official Federal Information Processing Standard (FIPS).
Disk Mirroring	Disk Mirroring stores the same data set on two separate disks at once. If one disk fails, all the information is still available on the other disk.
Distributed Architecture	A distributed system consists of multiple autonomous computers that communicate through a computer network.
Expressway Authority of Thailand (EXAT)	The state-owned enterprise responsible for development and operation of the tolled expressway network in Thailand.
External Storage	A device for storing information (data) that is not permanently fixed inside a computer.
Fare Media	The ticket or card use by the passenger for the purpose of travel.
File Transfer	The transmission of files over a computer network or the Internet.
Firewall	A Firewall is a system designed to prevent unauthorized access to or from a private network connected to the internet that can be implemented in hardware or software, or a combination of both to block messages that do not meet the specified security criteria.
Float	Cash prepaid by card holders to card issuers in payment for products or services to be provided.
Front-End Applications	Fare and non-fare collection systems.
Integrated Fares Central Computer	Central computer of the common ticketing system that manages the integrated fares applications.
Interfaced Document	Standard format for transmission of data or messages.
Interfaced Protocol	The standard which is used for communication.
Inter-Operated SAM	Security Access Module which can be used by operators.
Key Management	Key management is the provision made in a cryptography system design.
Key Management Facility (KMF)	The Cryptography system that is related to the generation, exchange, storage, safeguarding, use, vetting, and replacement of keys.
Magnetic Strip Card	A magnetic strip card is a type of card capable of storing data by modifying the magnetism of iron-based magnetic particles on a band of magnetic material on the card.

Definitions (Continued)

Terms	Definitions
Mean Cycle Before Failure (MCBF)	The typical number of times that the unit can be turned on and off before a mean failure in the population tested.
Mean Time To Repair (MTTR)	The average time needed to restore an item of equipment to its full operational capability after a failure.
Message	Data transmitted between computer systems.
Message Authentication Code (MAC)	The information used to authenticate a message.
Multiple Issuer	More than one card issuer in a common ticketing system.
Multiprocessing	Multiprocessing is the coordinated processing of programs by more than one computer processor.
Near Field Communication (NFC)	A short-range high frequency wireless communication technology.
Network Manager	An application that runs on a single console and enables a user to view network services, individual components or reports on network status, and allows the user to modify configurations.
Network System Management	Network System Management is a combination of hardware and software used to monitor and administer a network.
Non-Transit	A non public transportation service.
Non-Transit Provider	A non public transportation service provider.
Non-Transit Acquirer	An acquirer that accumulates non-transportation data or user transactions.
Open System	A system that enables a card issuer to provide a card containing the issuer's own function, but with an open architecture that permit the addition of other applications.
Operator Central Computer	The central computer of the service provider.
Operator Station Computer System	The station computer of the service provider.
Paper Magnetic Strip Card	A type of card capable of storing data by modifying the magnetism of iron-based magnetic particles on a band of magnetic material on the paper card.
Parallel Processing	The simultaneous use of more than one CPU or processor core to execute a program or multiple computational threads.
Passenger Information Display (PID)	Visual display screen provided by the operator at each station to enable passengers to view time schedules or any information related to operator services.
Peer to Peer Clearing and Settlement	The clearing and settlement process directly made between Operators' Computer systems.

Definitions (Continued)

Terms	Definitions
Personal Identification Number (PIN)	A Personal Identification Number (PIN) is a secret numeric password shared between a user and a system that can be used to authenticate the user to the system.
Plastic Magnetic Strip Card	The type of card capable of storing data by modifying the magnetism of iron-based magnetic particles on a band of magnetic material on the plastic card.
Point of Sale (POS)	The location at which cards, tokens or tickets are sold to customers, and data on payments and transactions is captured using a variety of devices including computers, cash registers, optical and bar code scanners, contact smart card readers or contactless smart card readers.
Prepaid Card	A card capable of storing monetary value in advance of use.
Public Control	Regulation by a dedicated public sector organization or government agency.
Public-Private Partnership	Public-private partnership (PPP) describes a government service or private venture which is funded and operated through a partnership of government and one or more private sector companies.
Radio Frequency (RF)	An electromagnetic wave used for communication by point-to-point, point-to-multipoint or broadcasting.
Radio Frequency Identification (RFID)	Radio frequency identification (RFID) is a generic term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object or person by wireless, using radio waves.
Reconciliation	The process of comparing and matching transaction records from the accounting records against those shown on a member's statement.
Re-Personalized	Re-formatting and customizing the data stores in the Smart Card.
Request-Response	This is a message exchange pattern in which a requestor sends a request message to a replier system which receives and processes the request, ultimately returning a message in a response. Also known as request-reply.
Reversible Gate	An automatic gate that can be set to entry or exit.
Router	A router is a device connected to at least two networks, (commonly two LANs, two WANs or a LAN and an ISP network) that moves data between networks or between a network and the internet.
Sales and Load Agent	Persons who have the authorization to sell common ticket cards and top-up value on common ticket cards.

Definitions (Continued)

Terms	Definitions
SAN Switch	A SAN switch or Fiber Channel switch is a network switch that is compatible with the Fiber Channel (FC) protocol and allows the creation of the network of Fiber Channel devices that form the core component of most storage area networks and allows many-to-many communications, device name lookup, security, and redundancy.
Security Access Module (SAM)	Smart card in a reduced form factor similar to a Sim card. SAM cards are usually used to hold cryptographic keys inside point of sale terminal units.
Security Key	The user's private key to prevent other users of using the computer for unauthorized access.
Service Provider	Providers of products and services that accept common ticketing cards for payment.
Settlement	The process of making payments of the net amounts due to service providers as a result of transactions made by customers or between service providers.
Single Issuer	The only card issuer in a common ticketing system.
Single Journey Token	A token with a stored value amount for a particular single journey that is captured and retained at the exit gate.
Single Purse/ Single E-Purse	The Single Purse/ Single Electronic Purse is the common instrument of electronic payment used by a consumer to pay for transactions with one or more service providers.
Smart Card	A smart card (chip card, or integrated circuit card (ICC)), is any pocket-sized card with embedded integrated circuits that can process data.
Station/Depot/Interchange Computer System	A network of fare collection equipment and computers at stations and depots connected by the communication channels to provide real time data on earnings, passenger flow analysis, blacklisting of specified cards, etc.
Storage Area Network (SAN)	A dedicated network of hardware and software that is separate from LANs and WANs that is used to connect storage resources with servers.
Supervisor	A person responsible for the routine management of a team of staff , a set of equipment or a network of computers.
Suvarnabhumi Airport Rail Link (SARL)	The elevated rail line between Suvarnabhumi Airport and Bangkok city centre (Makkasan Area).
The Krungthep Thanakom Co., Ltd. (KT)	A private sector who is responsible on the operation of Bus Rapid Transit services in Bangkok.

Definitions (Continued)

Terms	Definitions
Ticket Vending Machine (TVM)	A device installed at the un-paid area in the station that accepts payment, and issues Tickets, including tops up stored value tickets.
Token	A fare media used for single journey tickets.
Transaction Collection Center (TCC)	The center for transaction data collection.
Transaction Fee	The fee charged for undertaking a transaction process.
Transaction Processing	The process, by which customer payments and customer and service provider data, is recorded successfully or is cancelled if not completed successfully.
Transit	A public transportation service.
Transit Acquirer	An acquirer that accumulates transportation data and user transactions.
Transit Consortium	An association of transport organizations.
Transit Provider	An organization that provides transportation services.
Transmission Control Protocol/Internet Protocol (TCP/IP)	The Internet Protocol Suite (commonly known as TCP/IP) is the set of communications protocols used for the Internet and other similar networks that includes the Transmission Control Protocol (TCP) and the Internet Protocol (IP).
Usage Data	Transaction Data.
Weighted Average Cost of Capital (WACC)	A calculation in which the cost of each category of a firm's capital is proportionately weighted and then summed.
Wireless Access Point	A Wireless Access Point (WAP) is a device that allows wireless communication devices to connect to a wireless network using Wi-Fi, Bluetooth or related standards.

Section 1 Introduction

The main purpose of the common ticketing system in Thailand is to promote efficient travel using public mass transit in the same manner that has been carried out successfully in many other countries where one passenger card can be used for through travel on almost all of the mass transit systems and can be applied to non-transit services. Such common tickets provide much more convenience to users. The application of the common ticketing system to Bangkok and its vicinity will also be efficient, and will support other measures to lessen traffic problems. Therefore, the establishment of the common ticketing system will be worthwhile.

Users of the common ticketing system will only have an understanding of the way in which they can use their passenger cards. Users do not need to be aware of all of the technical details that sit behind the cards. The passenger cards are dependent upon inter-relationships with other components of the system including, for example, the standard of cards, the devices, the data transfer system, and especially the setting up of the organization to be responsible for the common ticketing system and the Central Clearing House (CCH), which is essential for the common ticketing management and the allocation of revenue among operators. The common ticketing system is, therefore, much more complex than a single card.

The successful development of common ticketing systems in some overseas countries has required continuous development in stages over periods of up to ten years. The development of the common ticketing system to encourage travel using the mass transit network in Thailand is thus challenging and should be brought forward for implementation with urgency.

The advantages and disadvantages of several types of common ticketing system in overseas countries, including techniques for successful and efficient management, have been studied in this project. The study placed emphasis on the functional design of each component of both present and future systems. The implications of the findings of this study have been considered for development of the common ticketing system to ensure that the impact on passengers will be minimized and to optimize the capital investment by considering whether any operator has already made similar investment of his own.

This study, therefore, emphasized how each mass transit operator could use the same common ticketing system or how the common ticketing system could be applied to other non-transit activities. The study aimed at (1) technology and the generally accepted standards for common ticketing systems, not referring only to any special system or card and, (2) the setting up of the Central Clearing House that is the main element for successful management of the common ticketing system with the purpose of coordination of and linking between mass transit systems.

1.1 Objectives of the Study

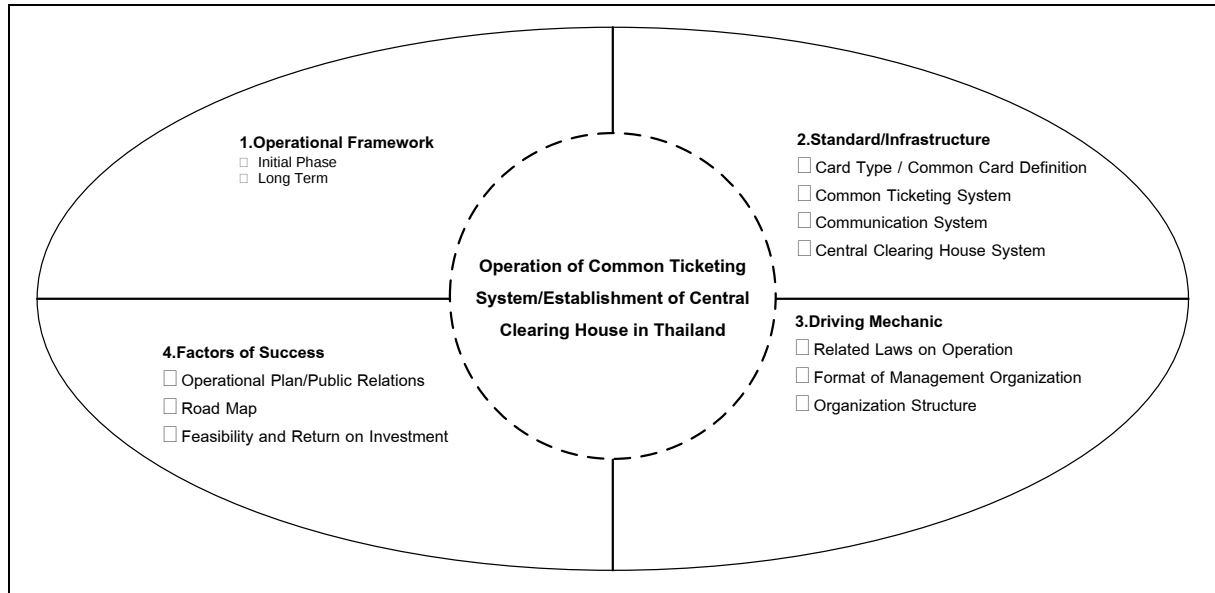
- 1) To study and review the present system of automatic fare collection on mass rapid transit by considering the steps toward the development of a common ticketing system in order to minimize effects on existing passengers and to save on capital investment,
- 2) To recommend the standard of cards to be used in the common ticketing system for all mass transit systems in Bangkok and its vicinity, including the preparation of standards and technical specifications for Front-End Applications, Back-End Applications and technical specifications for Interfaced Documents and Interfaced Protocols to be used safely for file transfer between the Central Clearing House and Back-End Applications, and
- 3) To consider and recommend guidelines for the management and format of common ticketing system operations, and for the possibility of setting up a Central Clearing House for all mass transit systems in Bangkok and its vicinity in both the early stages and in the long term.

1.2 Study Framework

The method of this study is divided into 4 main steps that can be summarized as follows:

- To study and review the existing common ticket systems, technologies and standards of passenger cards for mass transit in Thailand, and in other countries with particular emphasis on those countries where the common ticketing system is being used successfully, including the application of such systems to other activities, in order to set guidelines for future development of the common ticketing system in Thailand. Given the fact that Thailand still lacks of experience in this field, it is therefore necessary to refer to the experience of successful development from abroad in order to apply suitable methods, and reduce the risk to success in developing the system in Thailand,
- To study and review the laws and regulations concerning on the enforcement of electronic financial business and common ticketing systems including suitable operational alternatives for Thailand,
- To organize workshops and seminars for the exchange of ideas from stakeholders in Bangkok and its vicinity, then the information and suggestions from participants of the workshops and seminars have been applied to the operational framework and standard of the system including guidelines, steps and coordination of the use of the common ticket system, and
- To set up the operational framework and standards for the common ticketing system and the Central Clearing House including guidelines, steps and methods of coordination in order to expedite the setting up of the Central Clearing House and the common ticketing system based on experience abroad and application of the results of the study to Thailand.

The results of the study in terms of the operation of the common ticketing system and the establishment of the Central Clearing House can be summarized in 4 main items (Figure 1.2-1). Details of each item are presented below.



Source: The Consultant

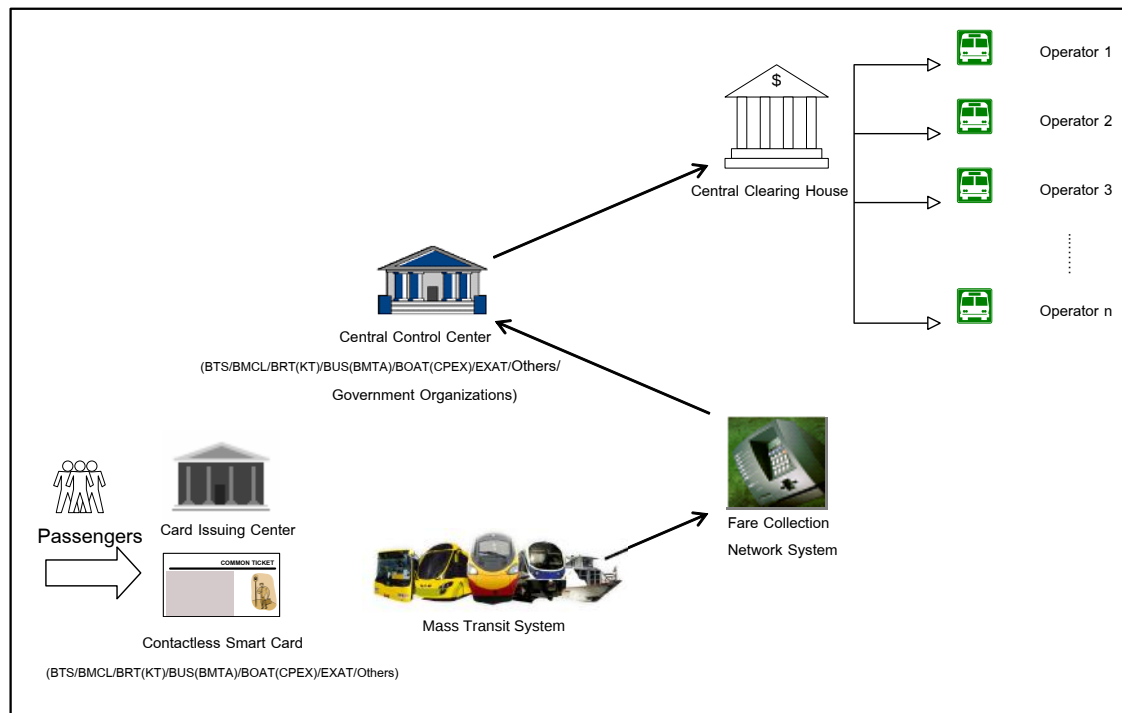
Figure 1.2-1 Result of the Study for Actual Operation

Section 2 Operational Framework for Common Ticketing System and Central Clearing House

2.1 Common Ticketing System

A Common Ticketing System is a system that enables passengers of transit services to use a single card to travel on multiple transit systems or routes. The system provides not only convenience for passengers, but can also implement cheaper fares for passengers on connecting systems in accordance with policies and conditions of business agreements between operators participating in the common ticketing system. The components of the common ticketing system comprise (Figure 2.1-1):

- (1) Passengers are the persons who use the common cards on the transit network that are provided by various operators. They may also use the cards in other non-transit businesses.
- (2) The common cards are Contactless Smart Cards carrying monetary value that can be topped up and can be used on the transit services provided by various service providers.
- (3) The transit operators are those who provide transit services, collect fares, issue cards and top up card values for service users.
- (4) Devices capable of reading and writing data on the cards are installed on transit vehicles or in transit terminals. The installed devices may be different according to the design and character of the operators. For example, BTS, BMCL or SARL installed Automatic Fare Collection (AFC) devices at the Automatic Ticketing Gate or AFC Gate while BRT(KT), Bus(BMTA) or BOAT(CPEX) and others such as EXAT may install Fare Collection Devices on the buses.
- (5) The Card Issuing Center plays the roles of issuing the common cards, defining the coverage, controlling the usage of the common cards, and delivering the cards to the operators or to the points of sales such as bus terminals, counters services and sales agents.
- (6) The Central Control Center is responsible for collection of details on the usage of cards. The Central Control Center maintains the system for control and allocation of revenue from fare collection to relevant operators. The allocated revenue will be transferred to the operators' accounts on a day to day basis. The Central Control Center is also equipped with a system capable of checking for fake cards or irregular usage of cards and for confiscating false cards.
- (7) The Central Clearing House is the center for collection of financial data from the operators' systems. The Central Clearing House evaluates the revenue of each operator and reports to the banks or other financial institutes concerned.



Source: Modified from the Study on the Development of Common Ticketing for Public Transport Project, Department of Land Transport

Figure 2.1-1 Common Ticketing System Components

2.2 Common Ticketing System and Setting Up of Central Clearing House in Thailand

There are three main systems for common ticketing and for setting up and managing the Central Clearing House.

- (1) A Closed System is for Transit Operators.
- (2) A Closed Multipurpose System is for Transit Operators and Non-Transit businesses joining the system and accepting the same payment media.
- (3) An Open System is the system where passengers can use payment media issued by multiple issuers, for example, by using a card issued by a bank for payment for fares or for services or other goods at the points of sales and services of various operators including groups of representatives or joint venture companies.

Most operations normally use a Closed Multipurpose System with only a single issuer in the early stages as it is not as complicated as an Open System.

In several countries operations have been extended to establish open systems. Cooperation with banks and other businesses is an important factor in developing the payment system to establish an open system for wider usage. The system consists of multiple issuers such as banks. Although the system is more complex through an additional layer of technology, the total cost of operation can be reduced in the long term.

At present, both transit and non-transit operators in Thailand are familiar with smart cards and have been using them for their own businesses. It is expected that the existing operators and new ones will join the

common ticketing system in the future. In order to enable actual and efficient operation of a common ticketing system suitable for the circumstances of the country, the system development should be divided into 2 stages. The first stage in the short term should only be for transit system and the second stage should be for both transit and non-transit systems in the long term (Figure 2.2-1).

2.2.1 The Initial Phase of Common Ticketing System Operation for Transit

The operation covers both transit and the non-transit operators. However, the use of the common ticketing system is mainly for transit networks such as BTS, BMCL, SARL, BRT(KT), BUS(BMTA) and BOAT(CPEX) or others. The system has only a single Card Issuer. Passengers can use the stored value card in various different transport systems as well as to pay for commodities and other services available in the common ticketing system. Transaction data for the usage of cards for Transit and Non-Transit will be collected and sent to the Central Clearing House for reconciliation with the file transfer to the banking system each day.

At present, there are only Acquirers for Non-Transit in the Common Ticketing System. In the future, once the Central Clearing House is set up, transaction data will be sent directly to the Sub-Clearing House of the Non-Transit operators.

The transit operators presently using the automatic fare collection system (BTS, BMCL and SARL) will have to upgrade their systems to cope with the application of the cards. For example, the selling of cards will place emphasis on new cards issued in the common ticketing system while also allowing the parallel use of the existing passenger cards of each operator. Improvements will need to be made in the structure of the existing cards to enable their use in the common ticketing system. Improvements will also be needed in the Front-End system and the Back-End system to enable transfer of files to the Central Clearing House and to allow the installation of the Security Access Module (SAM) of the system into card readers.

Existing transit operators with no automatic fare collection system such as bus operators, passenger boat operators, or future new transport operators providing new mass rapid transit routes will have to design, develop and install the proper fare collection system appropriate to both their own operation, and to the common ticketing system.

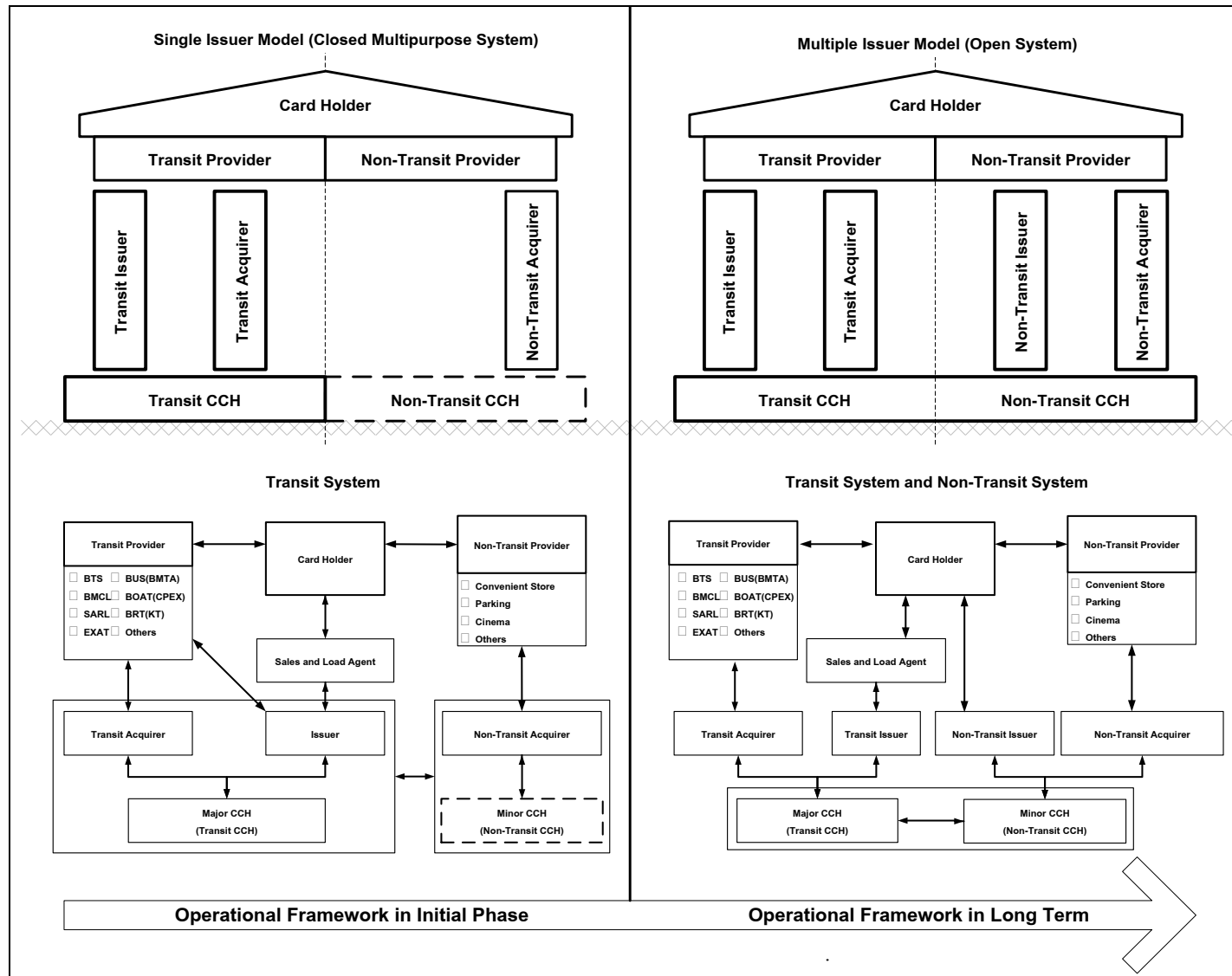
2.2.2 The Long Term of Common Ticketing System Operation for Transit and Non-Transit

In the longer term, the operation of the Common Ticketing System will be an open system with multiple issuers of cards based on a common standard. These multiple issuers include issuers of cards in the transit system, banks, and other non-transit issuers of cards in the non-transit sector. The card holders can use their cards in the transit system as well as to pay for goods and services joined in the common ticketing system, or they can use cards issued by other issuers in the transport system and extend the use of cards as E-Money.

In the long term, the Central Clearing House should be developed into the Single Clearing House system in order to achieve the highest efficiency in operation. Both the transit and non-transit systems must link and transfer files on all transactions to the Central Clearing House for reconciliation in order to clear the account for each operator.

However, existing transit operators have to improve their Front-End systems by updating the programs controlling card reading devices in the system so that the standardized data structure in the cards issued by non-transit issuers can be read. Transit operators are also required to install within their card readers the SAM for the non-transit system.

Non-transit operators have to improve their Front-End systems by updating the programs controlling the card reading devices within the system so that the standardized data structure in the cards issued by the transit operators can be read. The non-transit operators also have to install the SAM of the transit system into their card reading devices. The process is the exchange of the security modules of the transit operators to install into the non-transit system while the security module of non-transit systems is installed in the transit system.



Source: The Consultant

Figure 2.2-1 Operational Framework for the Common Ticketing and Central Clearing House for Thailand

Section 3 Standard and Structure of Common Ticketing System and Central Clearing House

3.1 Card Type and Common Card Definition

The card type for the common ticketing system must be standardized for common usage and not depend on any specific system. The cards should at least meet the technical standard as follows:

- To be contactless smart cards that meet the standard of ISO 7816-4 and ISO 14443 or ISO 18092 for card Types A, B or C
- To be used and support both transit and non-transit operation
- To have memory with security logic card or memory with CPU card, and
- To support the safety standard of 3DES/PKI.

The structural standard/common card definition specifies that the cards must be useable commonly in the same manner as the use of e-purse. The design of the common card definition must incorporate the actual and flexibility of usage both in transit and non-transit activities. The standard of data structure of the card must be acceptable according to international standards.

At present, contactless smart cards have been used in Thailand in transit applications (i.e. BTS, BMCL, and SARL) and in non-transit such as the use of smart purses. To minimize the negative effects in expanding the existing usage of smart cards and to support other transit systems in the future, the data structure and the common card definition should be clearly defined and should incorporate the following features as a minimum:

- For transit, the cards must support common payment for every mass transit system based on the principle of adding to and deducting from the value of the electronic money in the single purse,
- For non-transit, the cards must support micro payment,
- The data structure within the cards must be flexible to support other additional activities by which the issuers can add and control new applications within the cards, and
- To ensure the security of the value of electronics money within cards, the electronics keys controlled and managed by the Central Clearing House will be used for monitoring card data.

Since the data definitions are primary used for the design of the system, details of data collection, principles and methods of security control should be disclosed once the system is designed and started operating, so that the system developers can continue with further development of the system.

The fact that each operator has his own conditions of doing business as well as his particular needs for using the common cards (for example, discount and promotion of sales) and no common agreements on businesses are in place, the definition of common cards is limited. However, for best practice for easy management of data within cards, the data structure within the cards should consist of 3 parts as (Figure 3.1-1):

- Common Data Area
- Provider Specific Area
- Card Manufacturer Area

The Common Data Area is the central processing unit of the system that operators can use to access data such as information on card holders and the electronic purse. The Provider Specific Area contains data that is accessible only to individual operators. The Card Manufacturer Area contains the unchangeable data of the manufacturer.

The data structure was designed to be used with two types of smart cards as (1) Memory with Security Logic Card, and (2) Memory with CPU card without processing capacity. The processing capacity of the data structure is not used at present, but in the future, when all the cards are changed to the type that contains the CPU, there should be improvement in the data structure according to the capacity of the cards. Comparison of the two types of cards, can be seen in Table 3.1-1.

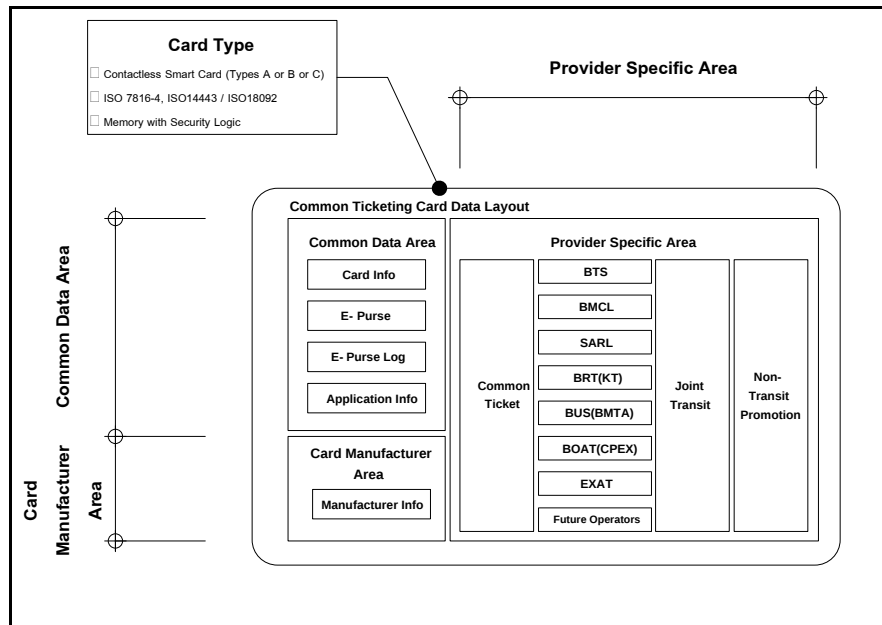
Table 3.1-1 Comparison between Memory with Security Logic Card and Memory with CPU Card

Comparison of Capacity	Memory with Security Logic Card	Memory with CPU Card
Applications	Single Application	Multi Applications
Data Storage	Only for Data	Programs and Data
Data Processing	At Front-End System only	At Front-End System or at cards
Data Security	Moderate	High
Access to Data	Fixed Algorithm depending on manufacture	Flexible to CPU capacity
Price	Low	High

Source: The Consultant

In general, the cards can be used by combining the E-Purse and data in the Common Data Area. All the operators, transit and non-transit, can commonly use the cards without limitation on number of operators since they use data in the Single E-Purse.

The Provider Specific Area is used in other cases than the E-Purse. The additional data are stored in this area for both transit and non-transit systems and includes (i) transit data on common tickets, specific data as required by the system of each operator such as type of cards and method of card control, and (ii) non-transit data such as information on sales promotion.



Source: The Consultant

Figure 3.1-1 Card Type and Common Card Definition

3.2 Overview Structure of Automatic Fare Collection System in the Common Ticketing System

The basic structure of the automatic fare collection system in the common ticketing system is divided into 5 tiers. Tier 1 consists of the cards. Tier 2 consists of the card reader devices. Tier 3 and Tier 4 are parts of the Station and the Central Station of operators, and Tier 5 is at the highest level in the hierarchy containing the Central Clearing House (CCH) (Figure 3.2-1).

Communication and file transfer among Tiers 1, 2, 3 and 4 can be done off-line in order to increase speed. Communication and file transfer between Tier 4 and Tier 5 must be on-line since the computers must be linked together for transfer of files, for checking of data in details as well as for clearing of accounts among operators. The overall structure of the automatic fare collection of the common ticketing system in each tier can be summarized as follows:

(1) Tier 5: Central Clearing House System

This Tier acts as the center receiving data from the operators for clearing of accounts, calculation of debt, and management of cards. It should include the following:

- Key Management
- Participant Management
- Transaction Processing
- Clearing System Management for received data for payment calculation to each operator
- Card Management
- Loyalty System Management
- Security

(2) Tier 4: Operator Central Computer/Acquirer

The Operator Central Computer operates together with the Central Control Computer on transfer of device data and transactions on payment/added up value. The operation of this tier should include:

- Business Management
- Fare Management
- Device Management
- Financial Reporting for the financial transactions occurring within each service provider's computer system
- Network System Management
- Security
- Transaction Processing

(3) Tier 3: Operator Station Computer System

The Tier collects and stores the station data of each operator and includes the management of the following:

- Device Control
- Transaction Processing
- Financial Reporting for the financial transactions occurring within the station computer system
- Network System Management
- Security
- Card Management

(4) Tier 2: Device composing of devices and programs that are defined by business reference for transactions of payment and top up of card value.

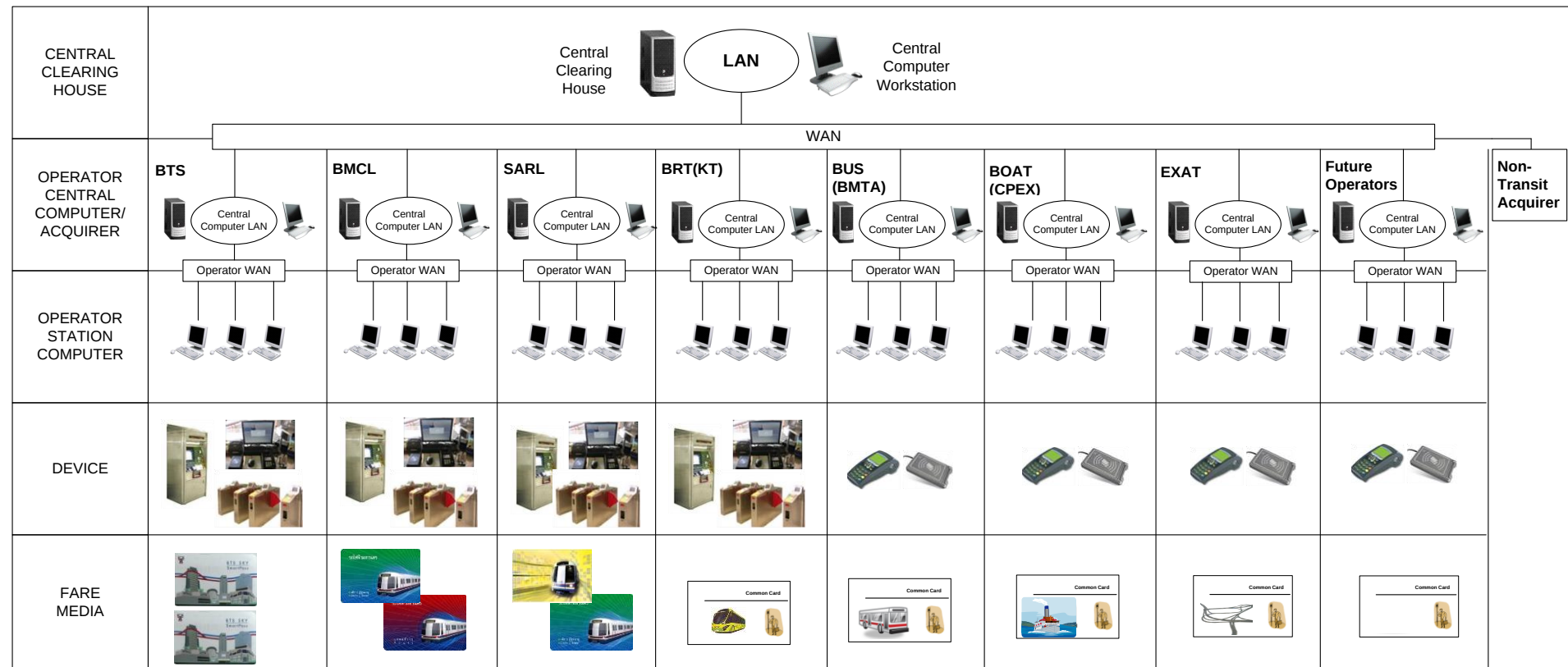
(5) Tier 1: Fare Media for storing of data necessary for the fare collection system.

Data between Tiers and the Structure for Automatic Fare Collection System for Thailand can be summarized as shown in Table 3.2-1 and Figure 3.2-1.

Table 3.2-1 Data System between Tiers in the Structure of Automatic Fare Collection System for Thailand

Central Control Center / Central Clearing House Tier	- Back-End Application Management and Reconciliation	- System Management
	- Money Transfer	- Reporting
Data Setting Up	Data Application	
- Data on false card	- Listing	
- Program (Management Program)	- Payment	
- Data on Device Setting	- Add up card value	
- Specification	- Automatic adding up card value	
- Business Reference	- Recording	
Operator Central Computer / Acquirer Tier	- Device management	- Reporting
	- Fare structure	- System monitoring
Data Setting Up	Data Application	
- File transfer to sub-control center	- File transfer to Central Control Center	
- Management of devices under control	- Recording	
	- Warning	
	- Repair and maintenance	
Operator Station Computer System Tier	- Data collection	- System management
	- Verifying of data	- Setting up of system value
		- Management of devices under control
Data Setting Up	Data Application	
- Device setting up	- Point of payment (station)	
- Device checking	- Date-Time of payment	
- Program Controlling	- Device identification	
- Data on false cards	- Add up value of card	
Device Tier	- Operation	- Setting up card value
	- List collection	- Security check of card
Data Setting Up	Data Application	
- Card checking	- Value of payment	
- Remaining Value	- Type of payment	
- Automatic add up of value	- Add up value	
Fare Media Tier	- Device checking	- Data collection
	- Electronics key	

Source: The Consultant



Source: The Consultant

Figure 3.2-1 Overall Structure of Automatic Fare Collection System in Thailand

For the standard and technical specifications of devices, the main purpose of dividing the automatic fare collection system into several tiers is, as mentioned earlier, to guide the operators in the acquiring of devices in the future so that they can be linked with the existing system. The additional devices must be commonly operated with the existing system to ensure that there is benefit in using them. Although such devices are widely used, it will be necessary to ensure that the capacity of their memory will be sufficient to support the particular task of data collection within the system.

From the analysis of the overall structure of devices and computer systems for common ticketing, the design and size specification of the system have been made to suit the target of work. The system can support the operation for at least 5 years. Appropriate investment budget and forecast earnings have also been considered.

In addition to the components within the Central Clearing House, consideration has also been given to the data and network security system, the data backup system and Web Services Technology to enable communication between applications constructed from different architectures, languages and databases.

The standards and technical specifications of the devices for the operation of the common ticketing system include not only Automatic Fare Collection (AFC) for Mass Rapid Transit and Bus Rapid Transit (BRT), the Communication System, and the Central Clearing House System, but it also covers other systems and devices such as the systems of fare collection on buses and passenger boats, and the collection of payments for the goods and services of non-transit operators.

The mentioned standards may require to be adjusted to allow for the specific requirements of new transit systems of small size and with volumes of transaction lower than that specified in the standard so that they can join the system in the future as they wish.

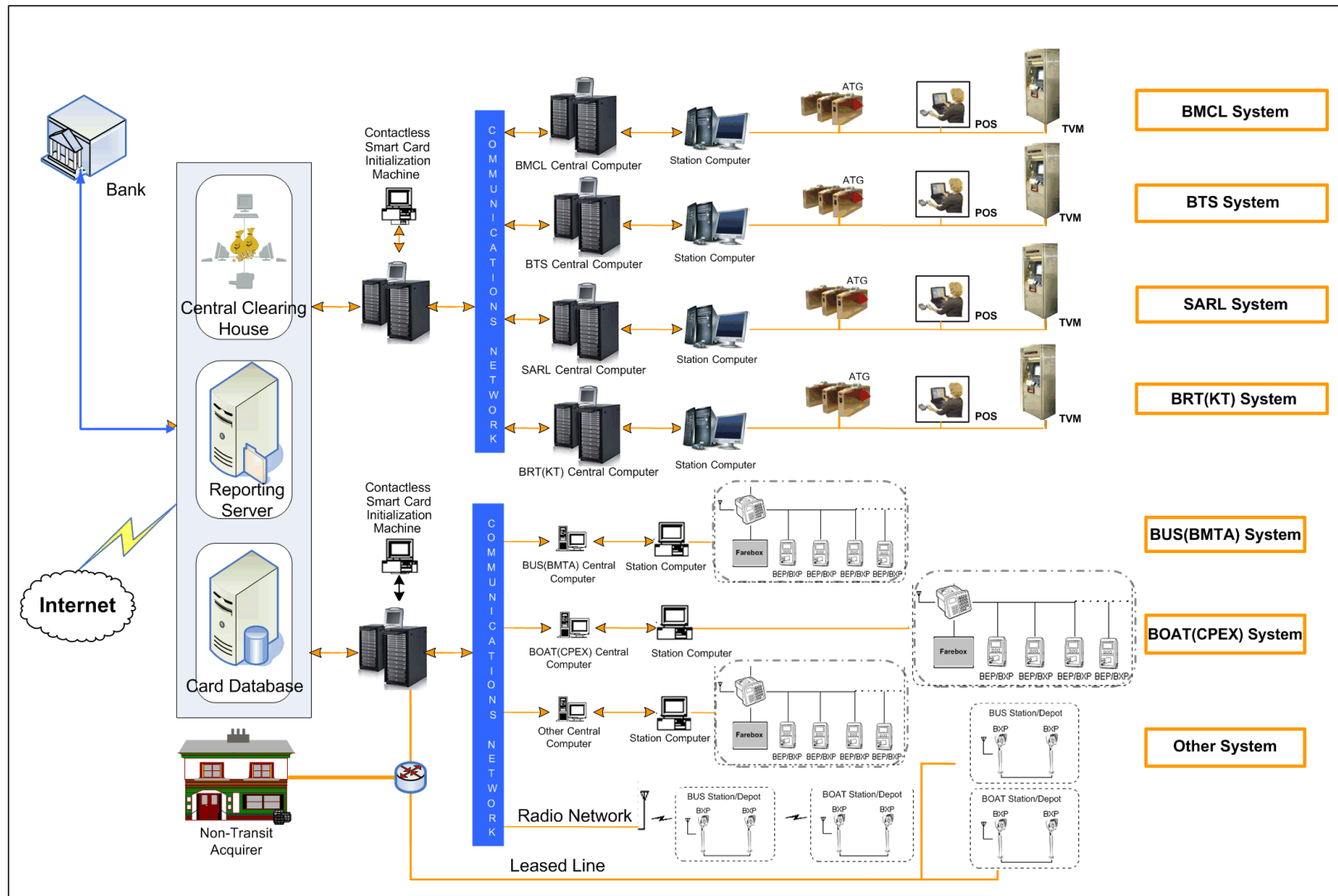
3.3 Communication System

The overview structure for Data Communication of Common Ticketing System in Thailand (Figure 3.3-1) is the communication between the banking computer system, the Central Computer System and the operator computer centers of BTS, BMCL, SARL, BRT, BUS (BMTA), BOAT(CPEX) and other public mass transit and non-transit operators.

The system of each operator, both transit and non-transit, consists of a computer network to collect data on cards and usage of cards including the issue of cards and the transfer of files to the Central Computer System of the Common Ticketing System through the network system.

Communication between devices in the same system can be carried out directly through cable using a Serial Port (RS 232), a Parallel Port (IEEE 1284), or a USB Port, or through computer networking using Transmission Control Protocol/Internet Protocol (TCP/IP) through a Local Area Network (LAN).

Communication for longer distances and between other systems can be carried out through the Wide Area Network (WAN). The WAN can be provided as either a Private Network using Optical Fiber Transmission, or by leasing a service from a Network Service Provider. This could take the form of a High Speed Leased Circuit, an Asynchronous Digital Subscriber Line (ADSL), Dark Fiber, General Packet Radio Service (GPRS), Worldwide Interoperability for Microwave Access (WI-MAX, IEEE 802.16, IEEE 802.16a), Microwave Transmission, and Satellite Communication. Key considerations in the selection of service from the Network Service Providers should be the stability and security of data and system operation including budgeting, communication between systems or between organizations.



Source: The Consultant

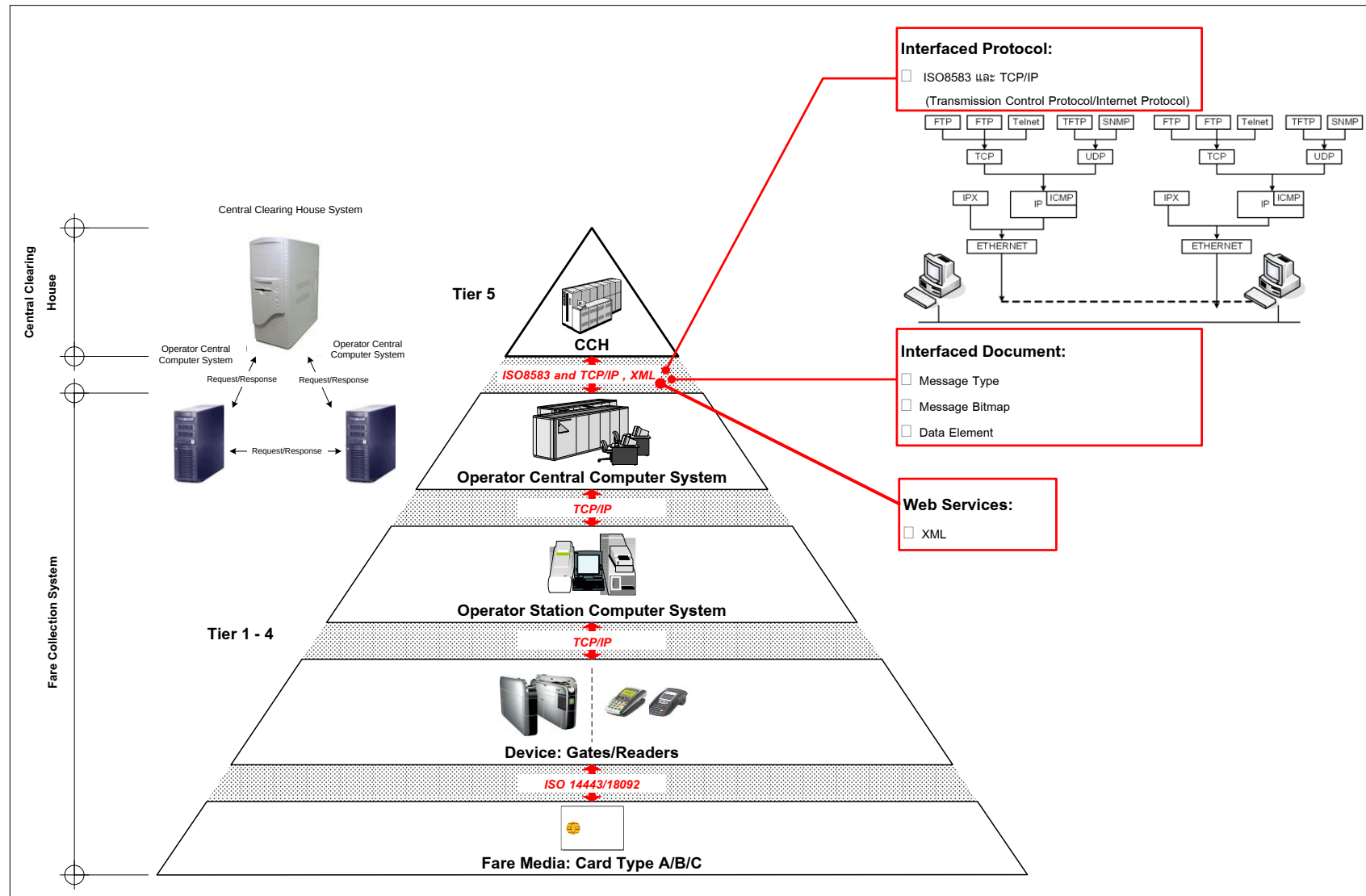
Figure 3.3-1 Overview Structure of Data Communication of Common Ticketing System in Thailand

An important operation for both transit and non-transit is file transfer. The standard Interfaced Document and Interfaced Protocol should be set up for file transfer between Tiers in the structure for Automatic Fare Collection of the Common Ticketing System in order to ensure security of file transfer between the Central Clearing House and each Operator Clearing House using the Common Ticketing System such as the existing MRT lines and other transit systems in the future.

The main purpose of the application of standards is to enable operators to maintain interoperability and allow the development of new systems for file transfer from the Operator Central Computer system (Tier 4) to the Central Clearing House (Tier 5) using the presented standard format and method.

The standard also covers the format and method of file transfer between Tiers within each Operator System (Tier 1-Tier 4). The standard of Interfaced Protocol for communication from a card to card reader (Tier 1-Tier 2) is the standard communication ISO 14443 or ISO 18092 while communication between card readers to the Operator Central Computer (Tier 2-Tier 4) should be by a TCP/IP standard that is widely used. The standard Interfaced Document (Tier 4-Tier 5) should apply according to the ISO 8583 standard that is widely used in the transfer of financial files and is sufficiently flexible to be used for both transit and non-transit. The said Interfaced Document is composed of 3 main elements, namely, (1) Message Type, (2) Message Bit Map, and (3) Data Element.

Standard File Transfer (Interfaced Document and Interfaced Protocol) for the Common Ticketing System is shown in Figure 3.3-2.



Source: The Consultant

Figure 3.3-2 Overview Standard of File Transfer of Common Ticketing System in Thailand

3.4 Central Clearing House System

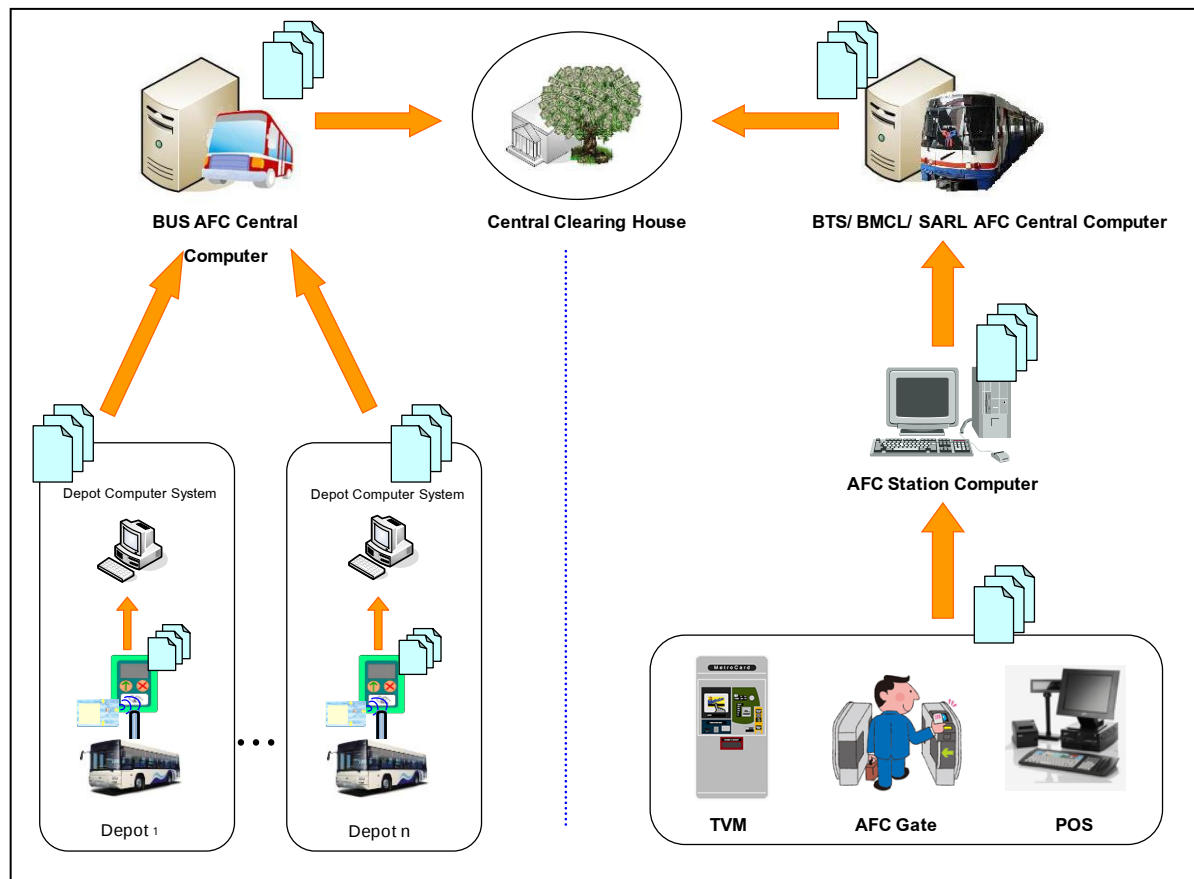
Communication within the Central Clearing House will be carried out through a LAN communication network. The security within the Central Clearing House will be protected by a Firewall against access from outside networks. Communication and file transfer from Transit operators such as BTS, BMCL, SARL, BRT(KT), BUS(BMTA), BOAT(CPEX), and Non-Transit or other operators in the future to the Central Clearing House may be carried out through Web Services or, alternatively, the whole transactions for each day can be sent in Batch files once or twice a day or to an agreed timetable. The operators can lease the service network from the Network Service Provider for communication to the Central Clearing House.

The Central Clearing House is an extremely important component in the Common Ticketing System since it is the center for file transfer. Besides the specifications to support the operation of the Common Ticketing System, there should be other considerations as follows:

- The Central Clearing House should be capable of supporting at least 10,000,000 transactions per day while each operator should be capable to support at least 1,000,000 transactions per day with the capability to expand the capacity up to 2,000,000 transactions per day. Therefore, the Central Clearing House requires not only to support the transactions from the transit operation, but to have reserve capacity for incoming Non-Transit systems in the long term.
- In addition to the main channel of file transfer from each operator to the Central Clearing House, there is a need to have a reserve or back-up system in case of error. This reserve system is the Disaster Recovery Site (DRS) that operates as a small Central Clearing House from a secure but remote location.

Also communication between operators requires both devices and channels of file transfer of the Front-End system and Back-End system to their own Clearing Houses. The Central Clearing House, then, plays an important role as the coordinator for fast, smooth and efficient operation of the operators' systems and the transfer of files to other systems in the future.

Some operators may wish to communicate and transfer files by an Off-line System (for example, the BUS). However, collection of fare data at the Depot and file transfer to AFC Central Computer is more or less similar to file transfer on the On-line System used by BTS and BMCL. Therefore, file transfer to the Central Clearing House can be carried out either using the Online System or the Offline System (Figure 3.4-1).



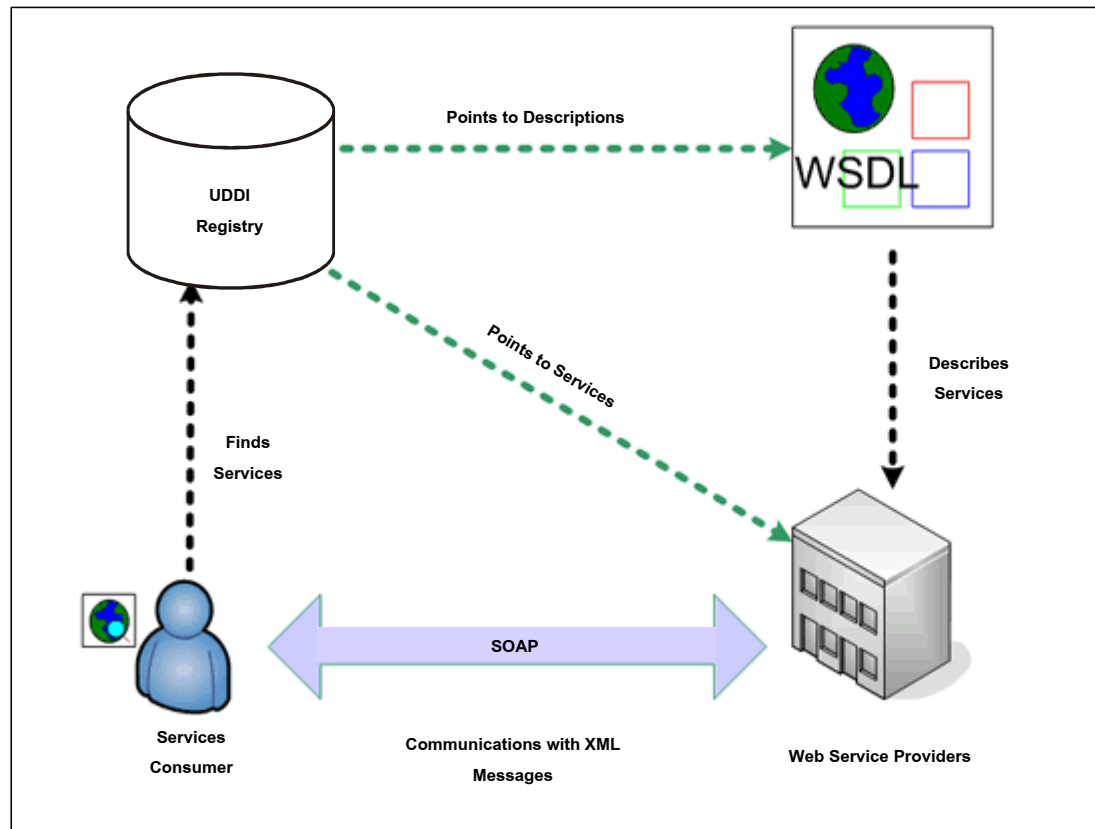
Source: The Consultant

Figure 3.4-1 File Transfer of Fare Collection System to the Central Clearing House

The existing technologies that are widely accepted and used for coordination across the systems are Web Services that enable communications between Applications even though they may be constructed in different architectures, languages or databases. The different applications can be interfaced through XML, the communication media for computer networks such as internet, leased circuit, Frame Relay, or MPLS.

The Web Services (Figure 3.4-2) should consist of 4 main standards as follows:

1. XML (Extended Markup Language) is the standard language supported by all systems. Data under the XML structure can be easily processed automatically. The XML, then, is used as standard language in data exchange of Web Services,
2. SOAP (Simple Object Access Protocol) is one of the standard technologies of Distributed Objects operating by the transfer of files using the internet in the format of XML so that the program can operate across the system through the internet,
3. WSDL (Web Services Description Language) is the standard language used for describing program usage in the XML standard. The WSDL is the manual of the system for using the Web Services, and
4. UDDI (Universal Description, Discovery, and Integration) is the standard system used in describing and searching for Web Services. The Service Providers can register with UDDI through the WSDL file describing details of the services to be provided and the requestors can search and communicate automatically with the Service Providers through Web Services.



Source: cmsthailand.com

Figure 3.4-2 Main Components of Web Services Technology

The main components of Web Services Technology can be summarized according to the steps of operation as follows:

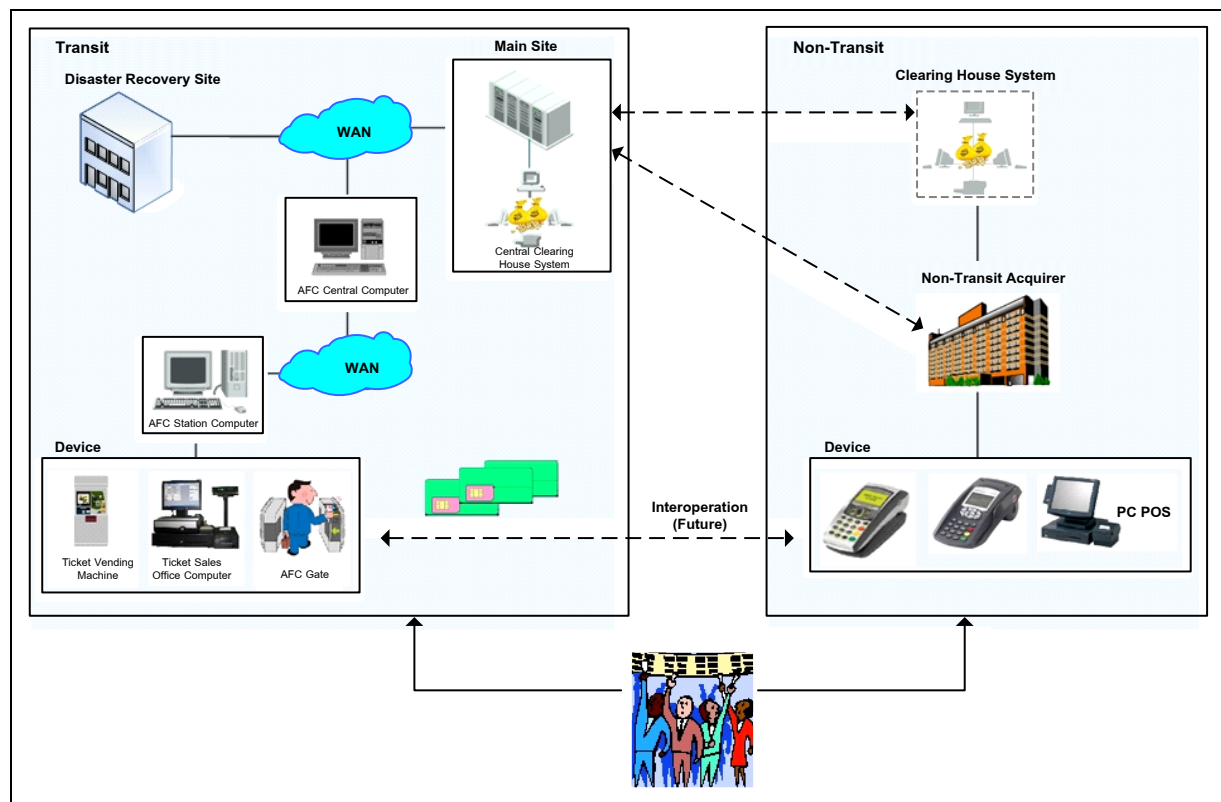
- (1) Service Providers who construct the system of Web Services,
- (2) Registration of Web Services with organizations providing the UDDI System,
- (3) Install UDSL files within the registered UDDI system,
- (4) Service Consumers search for required system or service on the UDDI System,
- (5) After acquiring the required systems or services, the services consumers can take the WSDL file for usage through their own system, and
- (6) Services Consumers can communicate and request system or service directly to Service Provider through SOAP within their own system.

Since Web Services operate on the internet that is, at present, protected by various security technologies, and the Web Services can operate through the Firewall since the SOAP is transferred through the HTTP Protocol. In addition, the Web Services have security systems compliant with the standard PKI (Public Key Infrastructure) such as MD5 (Message Digest), SSL (Secure Socket Layer), and PGP (Pretty Good Privacy). There is confidence that the Web Services are supported by security standards.

In order to have a common standard in communication between the Operator Center Computer and the Central Clearing House, and between other organizations and the Central Clearing House, communication through Web Services technology should be selected as it is internationally accepted as the most appropriate method of communication. In addition, it is being promoted as an important tool for doing business in the future. Many business organizations are now applying the use of Web Services in their businesses to provide services required by their customers and to create good relationships with other business in the future.

Since the Central Clearing House requires high security and stability, there should be a reserve system for communication and file transfer as well as a reserve system for the Disaster Recovery Site in case of emergency if the main system fails due to, for example, fire or earthquake.

The structure of devices within the Central Clearing House and communication with the operator through Batch Files or Web Services is shown in Figures 3.4-3 and 3.4-4.

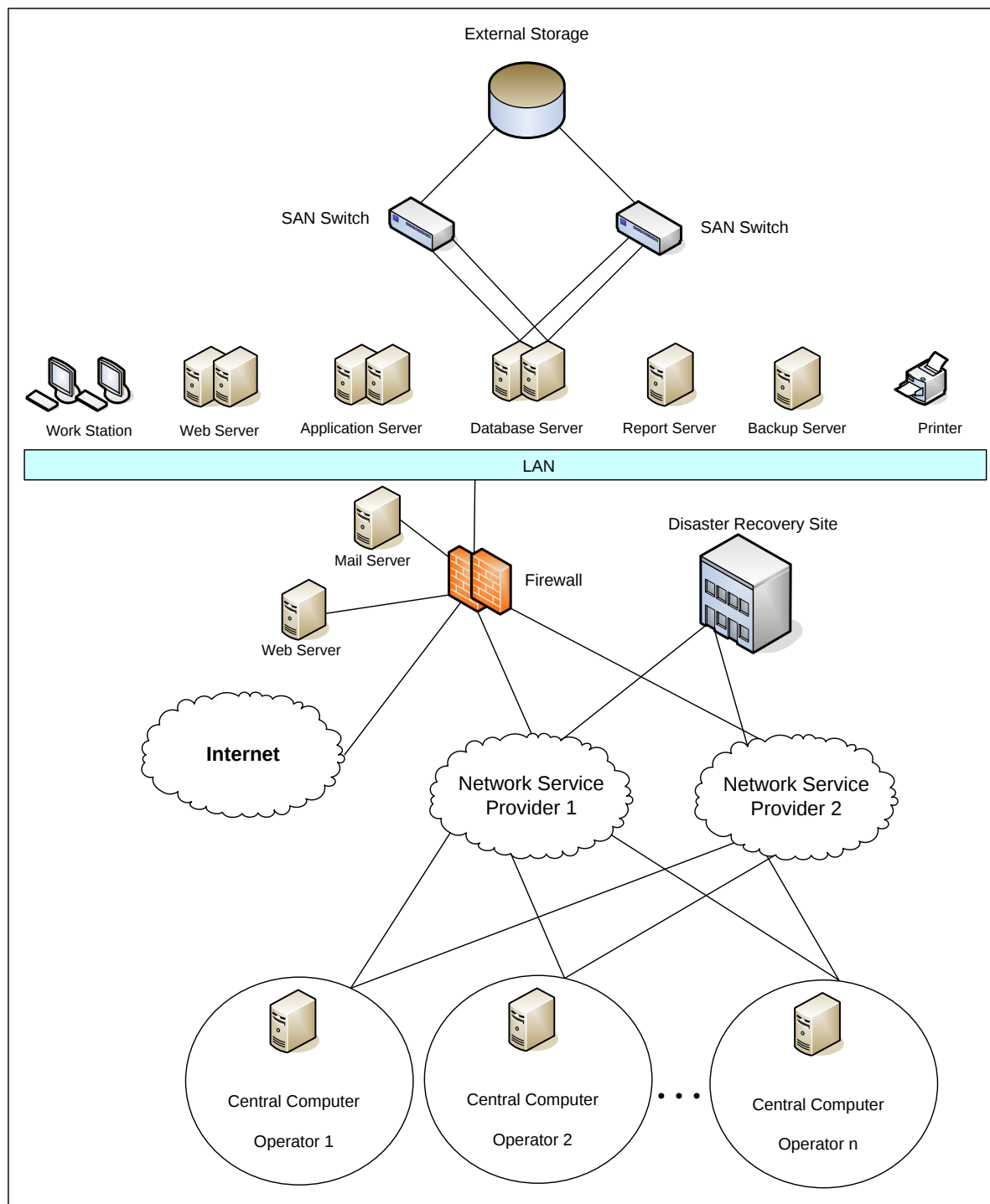


Source: The Consultant

Figure 3.4-3 The Central Clearing House for Transit and Non-Transit

In Figure 3.4-4, file transfer through the Network Service Provider must be communicated to 2 Network Service Providers, the main channel and the reserve channel. Since the transactions all have to be cleared within a day, the reserve channel is necessary in order to maintain the benefit to each operator. However, the reserve may not need to operate at the same speed as the main channel. Communication through other

media such as ISDN or Dial-up Modem may be utilized in accordance with agreements between the Central Clearing House and the Operators.



Source: The Consultant

Figure 3.4-4 Structure of Devices within the Central Clearing House

Section 4 Central Clearing House Mechanism for the Common Ticketing System

The Central Clearing House Mechanism for the Common Ticketing System consists of 3 parts as (1) related laws on the operation, (2) type of organization for the Common Ticketing System, and (3) the organization structure for the Common Ticketing System. Details of each part are as follows:

4.1 Related Laws on the Operation

At present, there is no law to directly promote the business operation of a Common Ticketing System in Thailand. It is essential to have such law or to amend existing laws for this purpose. There are 4 existing laws related to the electronics business activities or E-Money under the responsibilities of 2 ministries as follows:

(1) The Ministry of Finance is responsible for laws and regulations concerning E-Money as:

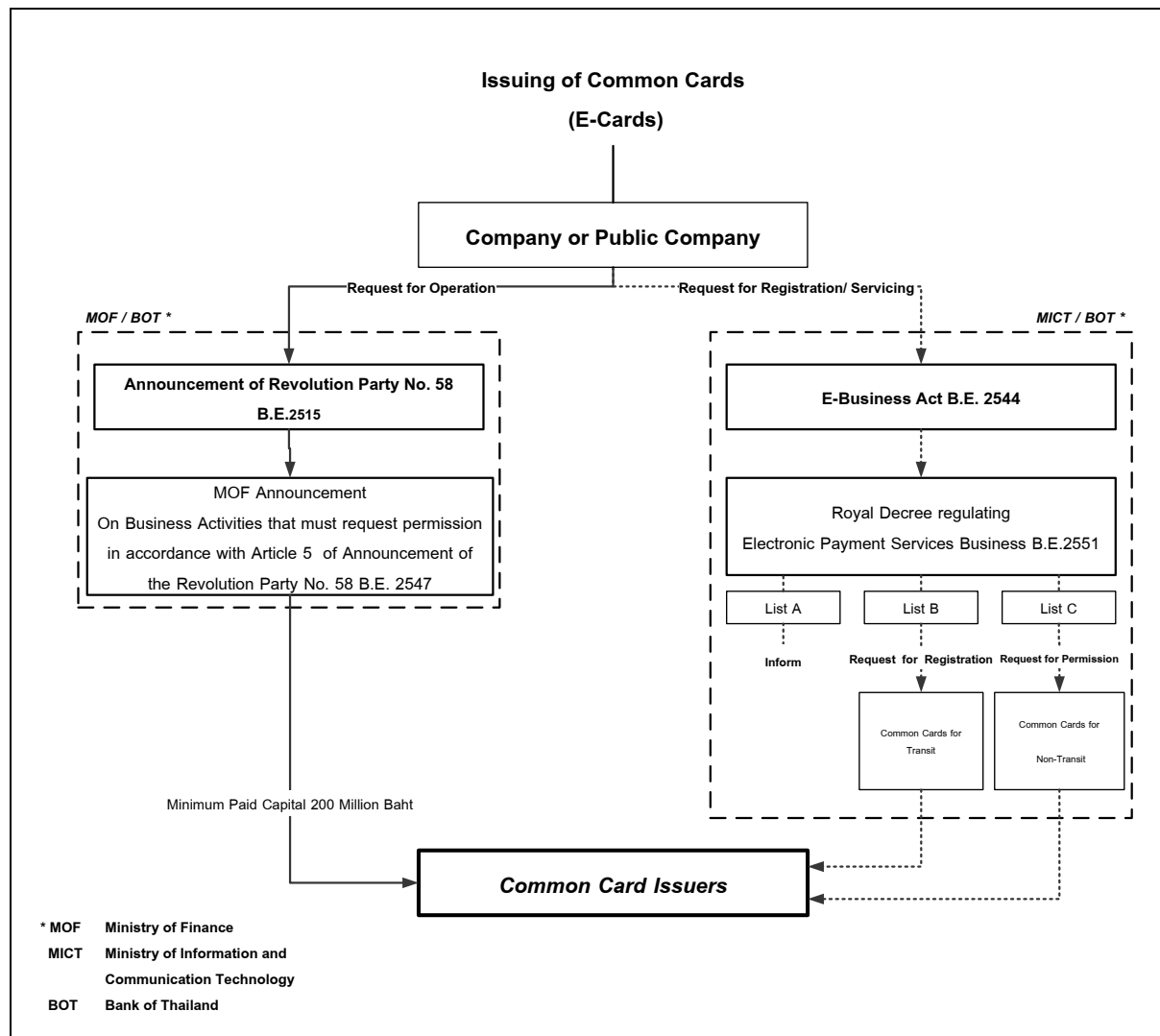
- Announcement of the Revolution Party No.58 dated 26 January B.E.2515
- Ministry of Finance Announcement on Business Activities that must request permission in accordance with Article 5 of the Announcement of the Revolution Party No. 58 (E-Cards) dated 4 October B.E.2547

(2) Ministry of Information and Communication Technology that is responsible for E-Business as:

- Electronics Business Act B.E.2544
- The Royal Decree regulating Electronic Payment Services Business B.E.2551

The enforcement of the laws and announcements mentioned above is under the authorization of the Bank of Thailand. The enforcement can be considered in 2 categories as follows:

In case of Common Ticket or E-Cards to be used for travel in more than one transit system as agreed, the Multiple Issuers are considered to be both the operators of E-Cards and the operators of E-Payments. In addition, they are required to be the legal persons of companies or public company types with registered paid capital investment of not less than two hundred million Baht and they must receive permission from the Minister of Finance by submitting a request through the Bank of Thailand. These operators have to register with the Bank of Thailand before commencing their business. In the case where E-Cards can also be used in Non-Transit applications, the issuers of common cards must receive permission from the Bank of Thailand before commencing their services (in this case, they are not eligible to request registration with the Bank of Thailand) (Figure 4.1-1).

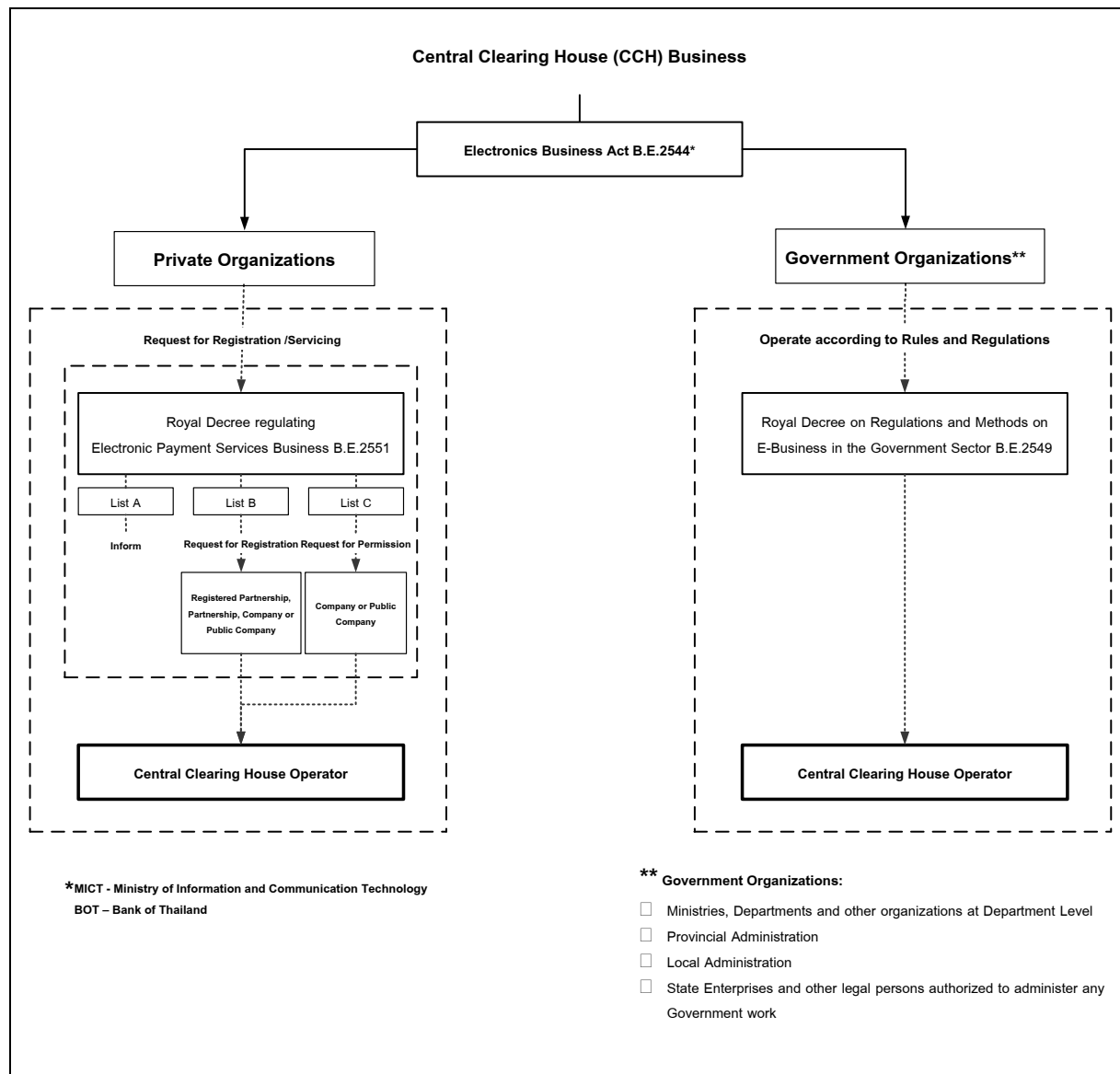


Source: The Consultant

Figure 4.1-1 Related Laws on the Operation of the Common Cards (E-Cards)

The operator of the Central Clearing House (CCH) who provides services in clearing and settling accounts including E-Payment services through any device or through the network must be the legal person for the type of company or public company and the service will be considered as E-Payment in accordance with List C and must receive permission from the Bank of Thailand before commencement of the service (Figure 4.1-2).

However, the Electronics Business Act B.E.2544 specifies the exception that, in the case that the service provider of E-Business is a government organization according to the definitions of Ministry, Department, other organizations with the status equal to the Department, Provincial Administration, Local Administration, State Enterprise, including legal persons authorizing to operate the government work, these organizations and persons are exempted from the requirement to inform, register, or receive permission prior to commencement of the service, but they have to operate in accordance with the Royal Decree on Regulations and Methods of E-Business in the Government Sector B.E. 2549.



Source: The Consultant

Figure 4.1-2 Related Laws on the Operation of the Central Clearing House

4.2 Format of the Common Ticketing System Organization

From the review of experience in common ticketing business system in foreign countries (e.g. Hong Kong, Singapore and England), it can be summarized that the existence of only one central organization taking responsibility for the management of the common card system will enable unity of management, minimization of expenditure, and ease of operation according to the specified standard especially when there is only one common fare collector. The common card business in Thailand is a public service that the government has to take responsibility for, and it is of importance in economic and security terms, Thailand should, therefore, adopt the format of setting up a single organization to be responsible for the common card system. Such a single organization should be in the government sector rather than in private sector since the government sector is capable of high investment, especially in the early stages of design and defining the

standard of the common cards when the organization has to pay for the management, design and definition of standards. On the other hand, the organization will not earn any income and has to be supported continuously to provide the budget for all the expenses necessary to ensure progress.

It is considered that the organization to be responsible for the Common Ticketing System should be within the government sector. The service provider in the government sector can be formed as the normal government, state enterprise, public organization, or even a special administration. However, from the comparative analysis, it is found that the Public Organization under the Public Organization Act B.E. 2542 should be the best format of organization to be responsible for the Common Ticketing System as it has several strengths including independence in the management of its own assets, personnel and mission. The Organization is not under the normal government rules. The Executive Board of the Organization is also independent. Once a person is selected as a member of the Board, he/she is eligible to stay on in the position until the end of his/her term and dismissal can be made only in the cases of bad behavior or inefficiency.

Once the organization of any format is set up to be responsible for the Common Ticketing System, the operation of the common cards relating to the E-Cards and E-Business Services must comply with the relevant laws and regulations. The Bank of Thailand (BOT) is authorized to take control and supervision of the operators providing E-Business and E-Payment.

The Organization or the Joint Venture Company to be responsible for the Common Ticketing System has to keep account of the Float from the consumers. The law requires that the operator of E- Cards (Common Tickets) has to clearly separate the Float account from the revolving fund of the operator¹ and such Float has to be deposited with any commercial bank or financial institution. The outstanding amount of deposit in the account at anytime must not be less than the outstanding Float and such deposit can be used only for clearing of E-Payment². In practice, the Central Clearing House will only provide an account clearing service among Transit and Non-Transit operators while the settlement of accounts shall be done by the commercial banks receiving Float deposits.

The Bank of Thailand cannot play the role of the Organization to be responsible for the Common Ticketing System since it is not an objective of the Bank in maintaining the financial stability and the stability of financial institutions' systems and payment systems. The Bank of Thailand can create or support the creation of the payment system service to be provided by the Central Clearing House. The Bank of Thailand, therefore, may support the Organization to be responsible for the Common Ticketing System in the servicing of account reconciliation among the service providers.

¹ Article 5.4 of Notification of BOT No. SNS 1/2550 Regarding Rules, Procedure and Condition in Operating E-Cards Business.

² Article 5.5 of Notification of BOT No. SNS 1/2550 Regarding Rules, Procedure and Condition in Operating E-Cards Business.

4.3 Organization Structure of the Common Ticketing System

The organization structure for the introduction and operation of the Common Ticketing System can be divided into 2 parts as (1) the Non-Business Unit that is responsible for design and infrastructure, and (2) the Business Unit that generates revenue and is able to set up a joint venture company in the future. The operation of the common ticketing system organization can be considered in 2 phases as described below:

4.3.1 Setting Up The Common Ticketing System Organization : Phase 1

Since the organization to be responsible for the Common Ticketing System is a major part of the system, once the Cabinet has approved this Project, the organization should be set up in a suitable format with urgency. The objectives, authority and responsibilities of the organization should be clearly specified and should include the operational coverage of the system and other related activities that the organization may wish to undertake in the future. The organization should be under the umbrella of the Ministry of Transport and should be set up in the first phase in the format of a Public Organization under the Public Organization Act B.E. 2542 as follows:

In the initial phase, the Public Organization to be responsible for the Common Ticketing System should consist of only 4 units of operation (1 office, 3 departments) that are Non-Business Units:

- 1) **Office of the Director** that is responsible for the secretarial work of the Director, the meetings of the Board of Directors and other works assigned by the Director,
- 2) **Department of Planning and System Development** that is responsible for planning, system design, testing, monitoring, analyzing and controlling of risks, business continuity operation, information technology, and research and development of the Common Ticketing System,
- 3) **Administrative Department** that is responsible for clerical work, legal procedure, personnel management, and procuring of supplies, and
- 4) **Account and Financial Department** that is responsible for accounting, finance, budgeting, financial analyzing, reimbursing of expenses for system planning and development, organization expenditure and other expenses after account clearing.

4.3.2 Setting Up The Common Ticketing System Organization : Phase 2

After the Organization to be responsible for the Common Ticketing System is set up and the design and development of the infrastructure of the system is completed under Phase1, the mission of the Organization will be changed in Phase 2. Three new business units will be added to the existing structure making a new organization structure of seven units as:

- 1) **Office of the Director** that is responsible for the secretarial work of the Director, the meetings of the Board of Directors and other works assigned by the Director,
- 2) **Department of Planning and System Development** that is responsible for planning, system design, testing, monitoring, analyzing and controlling of risks, business continuity operation, information technology, and research and development of the Common Ticketing System,
- 3) **Administrative Department** that is responsible for clerical work, legal procedure, personnel management, and procuring of supplies,
- 4) **Account and Financial Department** that is responsible for accounting, finance, budgeting, financial analyzing, reimbursing of expenses for system planning and development, organization expenditure and other expenses after account clearing,
- 5) **Marketing and Public Relations Department** that is responsible for public relations on the common ticketing and for conducting strategic planning for sales of common cards at points of sales, and through the media, including the future promotion of other products,
- 6) **Financial Management Department** that acts as the Central Clearing House (CCH). The most important unit of this Department is the Transaction Settlement Center for the usage of common cards in Transit and Non-Transit, and
- 7) **Department of New Business Investment** that is responsible for development and investment in the common ticketing business, and in related businesses in other parts of the country such as Chiangmai, Pattaya, Had Yai and Phuket, as well as in other countries such as Vietnam, Laos, Cambodia and Southern China.

The business units that can generate revenue profit from the Common Ticketing System can be formed into a new private sector organization in the future in the format of a joint venture company in which the private transit operators can become the share holders. This method can help to promote good coordination among all the Transit operators that will enable success for the Common Ticketing System business in the short period.

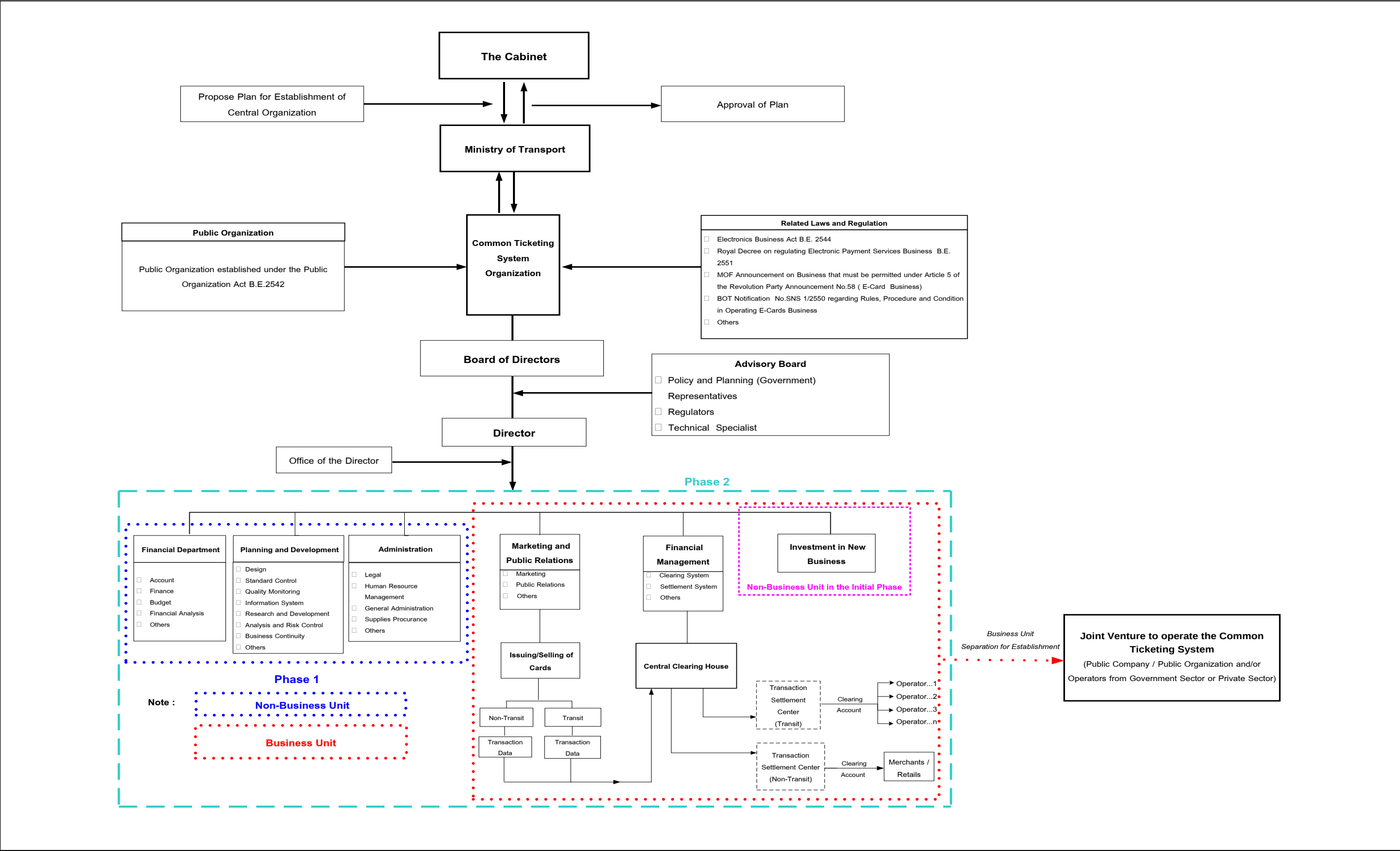
The organization structure of the Common Ticketing System in Phases 1 and 2 are shown in Figures 4.3-1 and 4.3-2.

For the recommendation in amending of law concerning the Common Ticketing System, there is a remark that, at present, there are 4 laws and regulations concerning the common card business under 2 ministries, (1) Ministry of Finance and, (2) Ministry of Information and Communication Technology. In practice, the Bank of Thailand is authorized to control solely the operators of E-Cards and the operators of E-Payment, but the operators of E-Cards have to be under the enforcement of the laws and regulations under the responsibilities of the two ministries. The issuers of the E-Cards must be the legal persons for companies or public companies that have paid up share capital of not less than two hundred million Baht and must obtain permission in writing from the Minister of Finance. Request for such permission must be submitted through the Bank of Thailand (in accordance to the announcement of the Ministry of Finance on subject on 5 types of business that must receive permission in accordance with Article 5 of the Announcement of the Revolution

Party No. 58 (E- Business) dated 4 October B.E.2547) and has to be registered with the Bank of Thailand prior to servicing (Royal Decree on E-Payment B.E.2551).

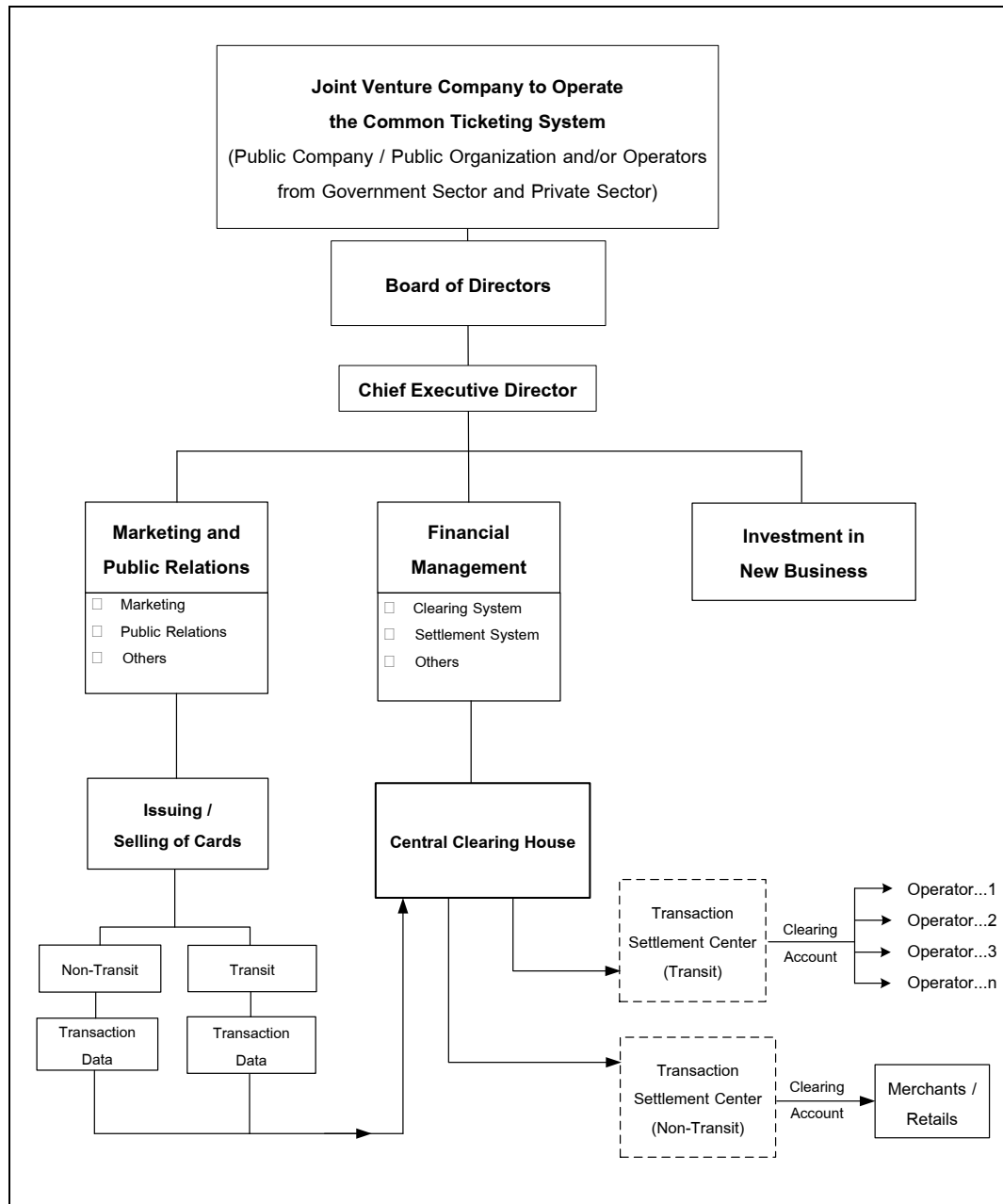
The legal requirements specifying that the operators of E-Cards have to ask for permission to do business creates more problems for the operators in the case where the two Ministries have different policies, The government sector, through the Ministry of Finance and the Ministry of Information and Communication Technology, should agree among themselves which Ministry will be solely responsible for E-Cards and E-Business, so that potential future problems can be avoided. At the same time, the laws and regulations under the other Ministry should be transferred to the Ministry in charge of the work. Primarily, the Ministry of Information and Communication Technology should be in sole charge of the E-Business, as it is responsible for this work at present.

In the process of the setting up of the organization to be responsible for the Common Ticketing System, the format of the organization as well as the stages of work to be carried out should be clearly specified. The Ministry, as the main organization, should collaborate with other concerned organizations in proposing to the Cabinet for approval to set up a suitable organization to be responsible for the Common Ticketing System.



Source: The Consultant

Figure 4.3-1 Organization Structure of the Common Ticketing System Phases 1 and 2



Source: The Consultant

Figure 4.3-2 Organization Structure of Joint Venture Company (Business Unit) to Operate the Common Ticketing System

Section 5 Success Factors of Common Ticketing System in Thailand

The operation of the Common Ticketing System is divided into two phases, namely, (i) the initial Phase (4 years) that places emphasis on mass transit operators including BTS, BMCL, SARL, BRT(KT), BUS(BMTA), BOAT(CPEX) and others, and (ii) the long term (10 years) that will start when the common ticketing system is playing a more important role in passenger transport. The purpose of the long term operation is aiming at the expansion of the operation to cover other activities in the Non-Transit sector. To achieve the success of operation in both phases, an operation plan is needed to minimize the risk of failure. Such a plan should be considered in three parts as (1) Setting up the Organization and Development Plan for the Common Ticketing System and Public Relations, (2) Road Map Plan, and (3) Worthiness of Investment in the Common Ticketing System in Thailand.

5.1 Setting up the Organization and Development Plan for the Common Ticketing System and Public Relations

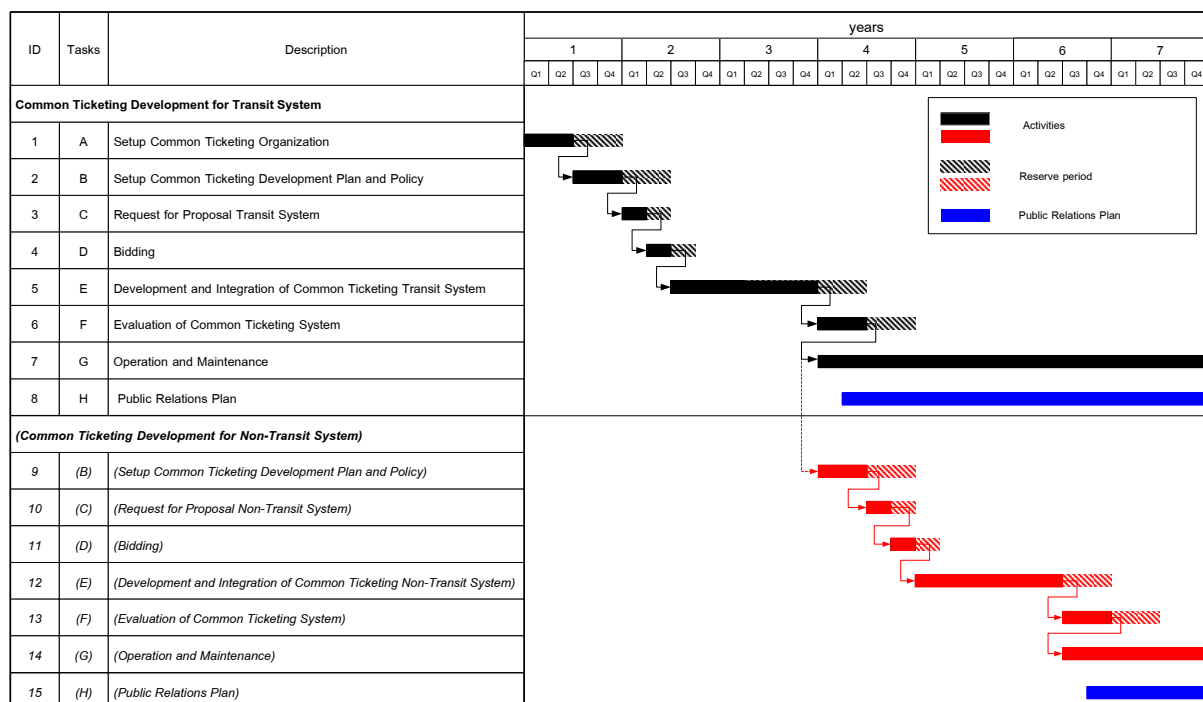
Since the setting up of an organization to be responsible for the Common Ticketing System has not been carried out before in Thailand, it is, therefore, essential that the plan sets out clearly every step of the operation, and that it must be supported by the government in supervising, policy making and guiding of operations. Cooperation from the related transit operators is also essential to make sure that the common ticketing system introduced is appropriate for the transit system. The establishment of the Common Ticketing System Organization should consist of the following important components:

- Setting up the Organization and Development Plan for the Common Ticketing System and Public Relations in the Initial Phase contains 8 activities as (1) Setting up Common Ticketing Organization, (2) Setting up Common Ticketing Development Plan and Policy, (3) Request for Proposal from Transit System, (4) Bidding, (5) Development and Integration of Common Ticketing Transit System, (6) Evaluation of Common Ticketing System, (7) Operation and Maintenance, and (8) Public Relations Plan. The activities in the Long Term Phase are similar to those in the Initial Phase. The Operation and Maintenance activities are to be continuously implemented throughout the period of operation of the Common Ticketing System.
- The period of operation in the Initial Phase, not including the Public Relations Plan, is (i) at least 3 years and 6 months in the case of no delay, or (ii) at least 4 years in the case of some justifiable delay.
- The proper and soonest time to set up the Common Ticketing System Organization, that its operation can best cover the wide range of transit projects, is the year 2010 (by accelerating all the activities in the Plan to be completed within 3 years and 6 months) as this can be coordinated with the construction and service commencement plans of the related Transit of 18 projects, or about 75%, operated within Bangkok and its vicinity.

- For Transit projects that are unable to join the Common Ticketing System in the initial Phase, it will be possible to apply the standard technologies of the system to their operations under the Transitional Arrangements for the operation of other transit systems. Other transit systems, including buses and boats, that are not ready to join the system at the beginning, for whatever reason, can also apply the common ticketing standard in their operation. To avoid delay in the commencement of the system, other transit systems may join the system after it has been operated for some period.

The Plan for Setting up and Operation of the Common Ticketing System Organization for Thailand is shown in Table 5.1-1.

Table 5.1-1 Plan for Setting Up and Operation of the Common Ticketing System Organization for Thailand



Note: (1) Initial Phase (Emphasizes on Transit System) Activities A – H

(2) Long Term Phase (Extended to cover Non-Transit) Activities (B) – (H)

Source: The Consultant

For the Public Relations, the operation of the Common Ticketing System in both the Initial Phase and the Long Term needs to carry out public relations activities so that service users and operators are aware of, and support the system to achieve the laid down objectives. A public relations plan has to be prepared. It should be sub-divided into 2 groups, i.e., consumers and operators.

The public relations for consumers should consist of press releases, advertising, and the provision of information on common ticketing services (example in Figure 5.1-1), and should be divided into 2 phases:

- (1) First Phase or Pioneering Phase for the period of 3 months before the commencement of service to inform people and consumers about the detail and benefits of common card services through advertisements that give information to the target groups. Sales promotions such as discounts should be provided in order to encourage greater use of the services. The operation in this phase is expected to require a budget of up to 35 million Baht.

- (2) Second Phase or the Maintain/and Reminder Phase that will be continuously implemented for at least 12 months to remind and encourage the usage of services and maintain the good image of the Common Ticketing System. This can be carried out by the dissemination of information and image promotion through support activities. This Phase will require a budget of at least 60 million Baht.

The strategy for advertising and public relations focuses on 2 groups as (1) school and university student group, and (2) working person group. The advertising should take place during periods when schools and universities are opened, and should be carried out through the mass media as television, or radio, or advertising boards at the points of maximum travel (Figure 5.1-1). Advertisement and public relations among the operators should be carried out in the format of seminars to disseminate knowledge about the common card system, and should be carried out 2-3 times in the year before the commencement of the system. The estimated budget is about 1.5 million Baht.

There must be follow-up and evaluation of the advertising plan from time to time according to the activities carried out under the plan, for example, monitoring of the mass media, checking the amount of service usage, monitoring the opinion of website visitors, and opinion surveys using questionnaires.



Source: The Consultant

Figure 5.1-1 Examples of Advertising Media for the Common Ticketing System

5.2 Road Map on Setting Up the Common Ticketing System Organization and Operation Plan

The implementation of the plan for setting up the Common Ticketing System Organization during years 2010-2013 should be started in the Ministry of Transport. Implementation should take place in a number of steps as follows: (i) preparation and setting up of the Common Ticketing System Organization, (ii) the Common Ticketing System Organization and the Consultant sets up the policy and plan for the Common Ticketing System and prepares bidding documents for acquiring the designer and developer of the system, (iii) the Common Ticketing System Organization opens bidding for the selection of designer and developer for the system, (iv) the winner of the bidding starts designing, developing and setting up the Common Ticketing System and the Central Clearing House, and (v) the Common Ticketing System Organization and the project Consultant jointly test and evaluate the Common Ticketing System with details in each step as follows (Figure 5.2-1):

Step 1 Preparation and Setting up the Common Ticketing System Organization: 6 months (Quarter 1 to Quarter 2 of year 2010)

(1) Ministry of Transport

Draft the Project on Design and Development of the Common Ticketing System and the Setting Up of the Common Ticketing System Organization with details on project justification, program of work and estimation of capital investment and propose to the Cabinet for approval.

Prior to submission of the proposal to the Cabinet, the Ministry of Transport may need to consult with relating organizations such as the Ministry of Finance, the Office of the Economic and Social Development Board, the Budget Bureau, the Ministry of Interior, the Bangkok Metropolitan Administration, organizations providing services as SRT, MRTA, BMTA, BMCL, BTS, as well as other related Non-Transit organizations.

The main issues, that have to be proposed to obtain approval from the Cabinet, should be as follows:

- (1.1) Request for approval to undertake the Project for design and development of the Common Ticketing System and the Setting Up of the Common Ticketing System Organization.
- (1.2) Request for approval for the Ministry of Transport to set up the Committee on the Development of the Common Ticketing System, and setting up the Common Ticketing System Organization. The composition and functions of the Committee should be clearly defined. The Committee should include at least representatives as members of the Board from the Ministry of Finance, the Office of the Economic and Social Development Board, the Bureau of the Budget, the Ministry of Interior, the Bangkok Metropolitan Administration, transit organizations such as SRT, MRTA, BMTA, BMCL, BTS, and specialists from other organizations including Non-Transit organizations. The secretary of the Board should be a representative from the Ministry of Transport or the MRTA.

The Committee should be responsible for giving advice, supervision of the operation of the Project, and the setting up the Common Ticketing System Organization as (i) Preparation for setting up Common Ticketing System Organization, (ii) Preparation of documents and hiring the consultant, and (iii) Follow up and supervise setting up of common ticketing system organization.

Since the Committee on the Development of the Common Ticketing System and Setting Up the Common Ticketing System Organization is a specific temporary committee, once the Common Ticketing System Organization has been formed, this Committee should be dissolved. This Committee will not be responsible for control and supervising the government sector in transit concessionaires.

- (1.3) Request for approval of the appropriate format for the Common Ticketing System Organization, i.e. (i) a public organization, (ii) a state enterprise established under a special act, (iii) a state enterprise as company with 100 % of share capital held by the government (Ministry of Finance), or (iv) a common company (private sector).
- (1.4) Request for approval for the Ministry of Transport to hire a consultant to provide advice to the Ministry and the Committee in the setting up of the Common Ticketing System organization, formation of policy and plan for the design and installation of the Common Ticketing System, setting up of the Central Clearing House and management of the system. The work of the consultant would include providing advice to the Common Ticketing System Organization in preparing the bidding document for acquiring the designer/developer and installer of the system, and for setting up of the Central Clearing House.
- (1.5) Request for approval of budget to be used during the fiscal years 2010-2013, that the Bureau of the Budget has to allocate for the Project.

(2) The Committee on the Development of Common Ticketing System and Setting Up the Common Ticketing System Organization

The Committee is responsible for the work as specified in (1.2), as well as to carry on the related work under the relevant laws and regulations in order to set up the Common Ticketing System Organization, including providing advice in relation to the request for permission to operate the electronics business from the Bank of Thailand.

(3) The Common Ticketing System Organization

The responsibility of the Organization will be as specified within the objectives when it was set up, and as specified within the related laws (concerned with state enterprises, public organization and/or civil acts etc.).

**Step 2 Setting Up the Policy and Plan for the Common Ticketing System and Preparation of Bidding Documents: 9 months
(Quarter 3 of year 2010 to Quarter 1 of year 2011)**

The Common Ticketing System Organization, through consultation with the Consultant (hiring from (1.4)), sets up the policy and program for the Common Ticketing System in detail, prepares the bidding documents, sets the criteria for bidding evaluation and bidding priority, negotiation with the selected bidder including administration of the purchasing, supervising and testing of the system installed by the selected bidder.

**Step 3 Opening of Bidding for Selection of Designer and Developer of the System: 3 months
(Quarter 2 of year 2011)**

The Common Ticketing System Organization, through consultation with the Consultant, opens bidding and selects the designer and developer of the System and the Central Clearing House.

**Step 4 Designing and Developing of the System and Setting Up the Central Clearing House: 18 months
(Quarter 3 of year 2011 to Quarter 4 of year 2012)**

The winner of the bidding starts the design development of the system and sets up the Central Clearing House in accordance with the framework set by the Common Ticketing System Organization.

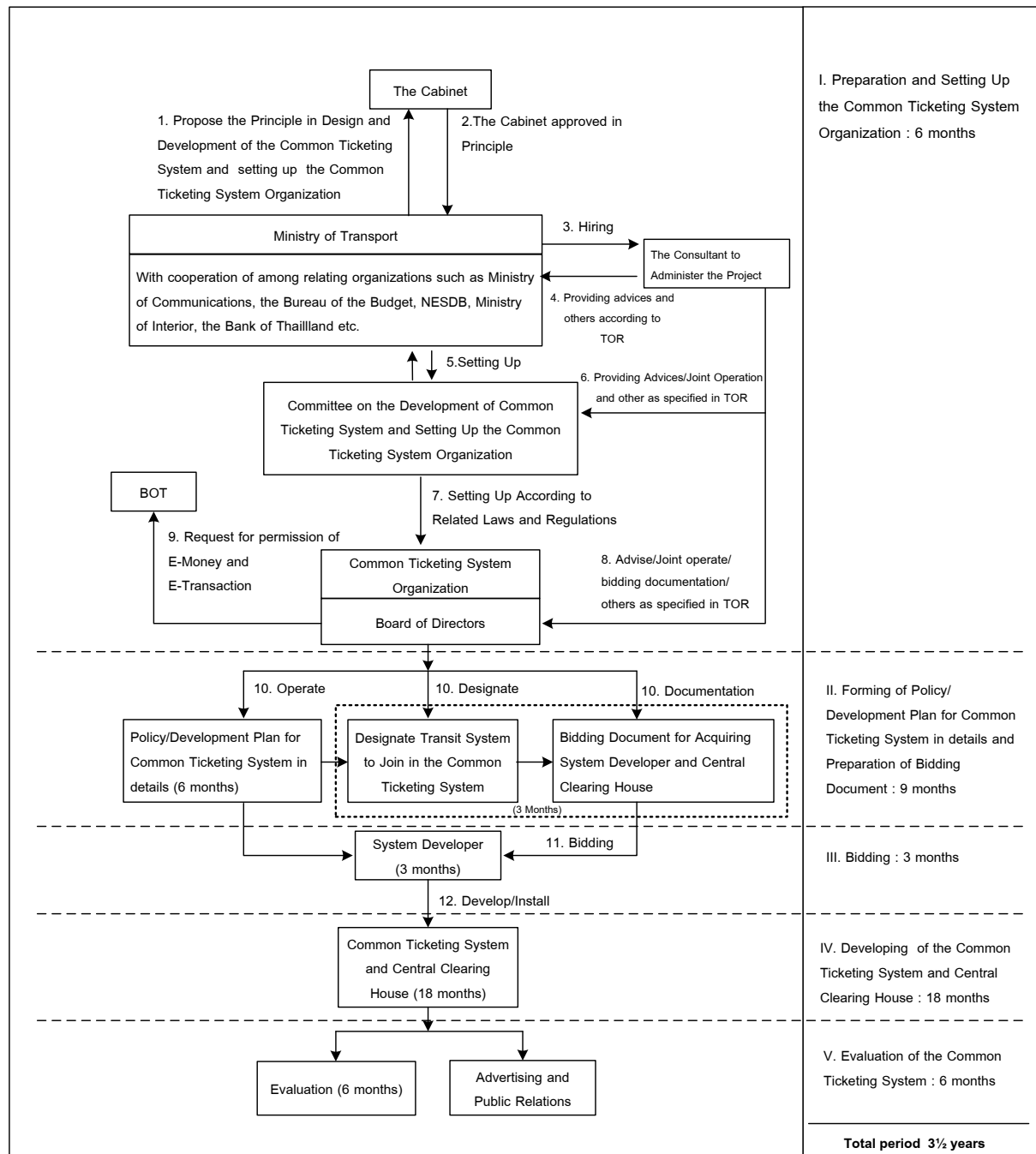
**Step 5 Testing and Evaluating the Common Ticketing System: 6 months
(Quarter 1 to Quarter 2 of year 2013)**

After the completion of system development and setting up of the Central Clearing House, the Common Ticketing System Organization and the Project Consultant will test and evaluate the system to make sure that it can operate efficiently. The period of test and evaluation will be 6 months. In the meantime, the advertising and public relations plan should have been prepared. The advertising and public relations activities will be operated in 2 periods: (1) the pioneering period to inform people and consumers about details and benefits of the Common Ticketing System should run for 3 months, and the activities should end at the same time as completion of the evaluation of the system, and (2) the sustaining period for the advertising and public relations activities to be continuously operated for at least 12 months.

The role of the Consultant to the Project will be completed at the end of 12 months after the commencement of service of the Common Ticketing System. The Common Ticketing System Organization or other organization that is responsible the operation of the system will be responsible for the operation and maintenance of the system. The initial phase will focus on servicing future new MRT systems, but the existing MRT and other Transit providers should be persuaded to join the system as soon as possible in order to enable the Common Ticketing System to deliver success.

There are 6 Transit projects that will have already been opened and/or tested during the period before completion of the setting up of the Common Ticketing System Organization, or before Quarter 2 of year 2013 (the case without delay). They are (1) the Green Line MRT (Taksin-Thanon Taksin), (2) the BRT (Chong Nonthree-Rajapruek), (3) the Airport Rail Link (Makkasan-Suvarnabhumi), (4) the Green Line MRT (On-Nooch-Sam Rong), (5) the Green Line MRT (Thanon Taksin-Petchakasem (Bang Waa)), and (6) the BRT (Mhor Chit-Soon Rajakarn). In order to enable these projects to develop their own systems and to be able to join the Common Ticketing System in the future, the appropriate government offices and the transit operators should be urged to apply the functional design specified in this report to their own systems, so that they will be adopt the same standards and be able to join the system, once the setting up of the Common Ticketing System is completed.

Details of the mentioned steps can be summarized as in Figure 5.2-1.



Source: The Consultant

Figure 5.2-1 Implementing Steps for Setting Up the Common Ticketing System Organization**5.3 Feasibility and Return of Investment in the Common Ticketing System**

From the study and project evaluation of the investment, it can be summarized from financial analysis of transactions of service users under the specified situations that the return on investment is higher than the weighted average cost of capital (WACC) which is 10 %. The base case of analysis on the assumption that the mass transit rail system will be opened for service in each year after the commencement of the Common Ticketing System starting from year 2013, is the situation that yields the lowest return on capital investment giving a Net Present Value of 622 million Baht with the rate of return of the project at 18.9 % and the longest payback period of about 9.3 years.

To consider the risk of the project through sensitivity analysis, it is found that investment factors (changes in prices of system hardware and software) do not have a substantial effect on the return of investment. Changes in operating expenditure also do not have a significant effect on the return on investment. The main factor that affects risk is the volume of transactions by passengers using the transit system. Changes in the number of transactions will affect the return on investment of the project in terms of Net Present Value, Rate of Return of the Project, and the payback period. Expansion of the system into the non-rail transit sector (BMTA Buses, and BRT) is the factor that helps increase significantly the Rate of Return on Investment of the Project, especially the transactions of bus passengers (BMTA).

The volume of Non-Transit transactions is one of the most important factors affecting the return on investment. A decrease in the volume of Non-Transit transactions, or a decision by the Non-Transit operators not to join the system will reduce the Net Present Value and the Rate of Return of the Project, including a significantly longer payback period, especially in the base case where the Non-Transit not joining in the system makes the investment worthless. The sensitivity analysis also shows that, in the base case, if the volume of transactions decreases by 24 % from the estimated value or the fee is decreased to 0.16 Baht per transaction, the FIRR will be 10% or equal to the cost of investment.

From the analysis based on the assumptions on differences of costs and revenue during the operation of the project solely by the government sector, and by joint operation by the government sector and the private sector, the Net Present Value under the risk on Value for Money (VfM) will be -27 million Baht.

However, if the government sector can manage the cost of operation with similar efficiency to the private sector, the value of VfM will be 48 million Baht showing that investment solely by the government will obtain significantly higher financial return than joint investment between the government sector and the private sector.

The efficient management of operating cost may be difficult under the government organization structure but the neutral and independent operation of the Common Ticketing System Organization can only be properly obtained from the government sector. Therefore, the organization structure of the organization should be close to the organization structure in the private sector in order to gain efficiency in management of cost and revenue.

Therefore, the success of the project depends on persuading and coordinating all Transit and Non-Transit operators to participate in the project as soon as they can, while the construction of the infrastructure and the management must be completed in accordance with the steps and timeframe set in the plan.

In summary, the success of the Common Ticketing System in Thailand depends on a clear scope of operation, the setting up of the Common Ticketing System Organization in accordance with the time frame, including aiming the advertising and public relations activities at the right target groups in order to attract them to make continuous use of services. Completion of the implementation of the Common Ticketing System in the initial Phase with no delay will be within 3 years and 6 months, but it may take up to at least 4 years in the case of justifiable delay. The operation should be carried out according to the guidelines as summarized in Table 5.3-1.

Table 5.3-1 Guideline for Management/Format of the Common Ticketing System Operation and Setting Up the Central Clearing House

Guideline for Administration/Management	Objectives	Development of Common Ticketing System	
		Initial Phase	Long Term
1. Operation Framework Within the system Stakeholders in the system : - Card Holders - Transit Providers - Sales and Load Agents - Transit Issuers - Transit Acquirers - Transit Business - Non-Transit Acquirers - Clearing House Entity - Non-Transit (only in long term)	To create clear understanding and to make known the common targets of all parties concerned	In the initial phase to support the Transit System in Bangkok and its vicinity. Since each Transit operator may not be ready to join in the system at the same time, the existing operators as BTS, BMCL, and SARL, that already use automatic fare collection system have to improve their systems so that they can support the usage of Common Cards. New operators who do not have automatic fare collection must plan for the development of their fare collection systems to support the use of common cards in future.	To expand the system to Non-Transit business along with supporting the Transit System to cover all systems within Bangkok Metropolitan Administration and its vicinity.
2. The Organization With the structure as follows: - Solely operated by the Common Ticketing System Organization - Public Organization according to the Public Organization Act B.E. 2542 - The structure is divided into 2 units as a Non-Business Unit to design and construct the infrastructure, and a Business Unit that can create revenue and be able to set up the Joint Venture Company. The format of the joint venture company will be considered as appropriate. To execute the right in the operation of the Common Ticketing System, the public company can authorize the right to operate the common cards within the Business Unit to the joint venture company under the agreement in writing the time span and the conditions as set in the Royal Decree on Setting Up of the Public Organization.	Define the format and organization structure for the efficient management of the Common Ticketing System and to enable the development of the common ticketing system to deliver the objectives.	Setting up the Common Ticketing System Organization in the initial Phase can be done after the project has been approved by the Cabinet and must be carried out in accordance with the related laws. The Organization is consisted of 4 units (1 Office, 3 Departments): Office of the Director that is responsible for the secretarial work of the Director, meetings of the Board of Directors and the Consultant, and other works as assigned by the Director. Planning and System Development Department that is responsible for planning and designing system. risk taking analysis, Business Continuity, including information technology system, and research and development of the Common Ticketing System. Administrative Department that is responsible for clerical work, legal work, human resource development, purchase, etc. Account and Financial Department that is responsible for accounting, finance, budgeting, financial analysis, and supervising the reimbursement of the department of planning and system development, and other expenses of the organization including expenditures after account clearing.	The Common Ticketing System Organization in Phase 2, after the design and development of infrastructure has been completed, will be expanded by Business Units within the organization structure. The Business units are: Marketing and Public Relations Department responsible for public relations with consumers, and sales strategy in selling common cards at points of sales, and through other media including future extension of products. Financial Management Department that acts as the Central Clearing House (CCH). The important unit of this Department is the Transaction Settlement Center for the usage of common cards in Transit and Non-Transit. New Business Investment Department responsible for development of and investment in the common ticketing business and in related businesses in other parts of the country such as Chiangmai, Pattaya, Had Yai, Phuket, as well as in other countries such as Vietnam, Laos, Cambodia, and Southern China. The full structure of the organization will consists of 7 Units of Non-Business and Business. The Business Units can be separated for setting up of joint venture company to operate the common ticketing system in the future.
3. Action Plan Operate in the same manner for both periods as : - To set up the work unit to take care of the common ticketing system within 6 months - To set up the policy and operation plan within 6 months - To specify the Transit systems to join in the common ticketing system within 3 months - To seek the licensed person to operate the common ticketing system within 3 months - To start the development and installation of the system for operation within 18 months - To test the installed system and evaluate the expected problem within 6 months - To operate and maintain the system continuously	To enable actual operation of the common ticketing system and reduce the risk of failure of the project.	The initial phase starting from year 2010 for a period of 3 years and 6 months with expected completion of the work at the earliest at the end of quarter 2 of year 2013. In case of delay for 6 months, the work will be completed at the earliest at the end of year 2013. The plan for advertising and public relations is divided into 2 phases: - First phase or pioneering phase within 3 months prior to the commencement of service to communicate to people and consumers information about and benefits of common cards through advertising to the target groups and in the format of sales promotion such as discounting to encourage more usage requiring a budget of 35 million Baht. - Second phase or maintaining/and reminding phase for a continuous period of at least 12 months to remind and encourage continuous usage of service and to keep a good image of the system through advertising to provide information and promote the image with support activities requiring a budget of at least 60 million Baht. In addition, there will be a public relations plan for operators in the format of seminars to provide knowledge of the common ticketing system, held 2-3 times in the year before the commencement of the system and requiring a budget of 1.5 million Baht.	In the long term , the operation will expand to cover the business of Non-Transit starting from quarter 1 of year 2013 for a period of 3 years with completion expected at the earliest at the end of quarter 4 of year 2015. In case of delay for not more than 6 months, operation under the plan is expected to be completed at the earliest at the end of quarter 2 of year 2016. The public relations plan should be carried out in a similar way to that of the initial phase.

Source: The Consultant