Program Management Services: PMS

Policy Report

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Condition

This document is prepared by consulting consortium including (1) Avantgarde Capital Co., Ltd. (2) Korea Smart Card Co., Ltd. (3) PSK Consultants Co., Ltd., which are selected as the consultants for the Program Management Service (PMS) for the Office of Transport and Traffic Policy and Planning (OTP). The objectives of the project include (1) To set policy and operating plan for common ticketing system (2) To develop common ticketing system and its associated standards and (3) To prepare readiness of Central Clearing House (CCH). This document is under confidential privilege between OTP and the consultants, which will only be used for the project's objectives by OTP.

This document is prepared under considering information received from OTP and/or other organizations, studies of other consultants, public information, and interview and questions made with organizations associated with this project. To be used as basic information in making common ticketing system and central clearing house development plan based on determined objectives of the project, the consultants have examined sources of such information and use with care, but not including the certification correctness of the information received by OTP, other consultants and/or other organizations. Therefore, use of information from this document for publicizing or reference purposed must be decided with own considerations.

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Acceptance Rate	อัตราความแม่นยำในการตรวจรับ
Acceptance Speed	อัตราความเร็วในการตรวจรับ
Add Value Machine (AVM)	เครื่องเติมเงินบัตรโดยสาร
AFC Gate, Automatic Ticketing Gate	ประตูกั้นในระบบจัดเก็บค่าโดยสารอัตโนมัติ
Antenna	สายอากาศ
Anti-Collision	การป้องกันการอ่านบัตรซ้ำซ้อนกัน
Audit Register Data	ข้อมูลการลงทะเบียนตรวจสอบ
Automated Clearing House (ACH)	ระบบคำนวณดุลบัญชีอัตโนมัติ
Automatic Fare Collection (AFC)	ระบบจัดเก็บค่าโดยสารอัตโนมัติ
Automatic Gate	ประตูกั้นอัตโนมัติ
Automatic Vending Machine	เครื่องจำหน่ายตั๋วอัตโนมัติ
Back-End Applications	ระบบจัดการรายได้
Bangkok Mass Transit Authority (BMTA)	องค์การขนส่งมลชนกรุงเทพ (ขสมก.)
Bangkok Mass Transit System Public Company Limited (BTSC)	บริษัท ระบบขนส่งมวลชนกรุงเทพ จำกัด (มหาชน)
Bangkok Mass Transit System (BTS)	ระบบรถไฟฟ้า BTS
Bangkok Metro Public Company Limited (BMCL)	บริษัท รถไฟฟ้ากรุงเทพ จำกัด (มหาชน)
Bank Note Acceptor Unit	ชุดรับธนบัตร
Blacklist	บัญชีรายชื่อที่มีการใช้งานไม่ถูกต้อง
Bus Entry Processor/ Bus Exit Processor (BEP/BXP)	เครื่องอ่าน/ตัดเงินบัตรโดยสารที่จุดทางขึ้นและทางลงบนรถโดยสาร
Bus Rapid Transit (BRT)	รถโดยสารประจำทางด่วนพิเศษ
Card Holder	ผู้ถือบัตร
Card Initialization Device (CID)	เครื่องเตรียมข้อมูลบัตรโดยสารอัจฉริยะ
Card Issuer	ผู้ออกบัตร
Card Personalization Device (CPD)	เครื่องเตรียมข้อมูลบัตรโดยสารอัจฉริยะเฉพาะบุคคล
Card Type	ชนิดบัตรที่ใช้สำหรับตั๋วร่วม
Central Clearing House (CCH)	ศูนย์การบริหารจัดการรายได้
Central Clearing House Disaster Recovery Site (CCH DRS)	ศูนย์การบริหารจัดการรายได้สำรองกรณีเกิดเหตุฉุกเฉิน
Central Computer System (CC)	ระบบคอมพิวเตอร์ส่วนกลาง
Central Computer Workstation	เครื่องลูกข่ายระบบคอมพิวเตอร์ส่วนกลาง

Chao Phraya Express Boat Co., Ltd. (CPEX)	บริษัท เรือด่วนเจ้าพระยา จำกัด
Clearing	บริการหักบัญชี
Clearing House	ศูนย์การบริหารจัดการรายได้
Coin Acceptor Unit	ชุดรับเหรียญ
Composite Data Element	ข้อมูลที่ไม่มีการจำกัดจำนวน Data Element
Constructed Data Element	ข้อมูลที่มีการจำกัดจำนวน Data Element
Contacted Smart Card	บัตรโดยสารอัจฉริยะแบบสัมผัส
Contactless Smart Card	บัตรโดยสารอัจฉริยะแบบไร้สัมผัส
Contactless Smart Card Reader- Writer (CSC R-W)	เครื่องอ่าน/เขียนบัตรโดยสารอัจฉริยะ
Concession Management	การบริหารสัมปทาน
Cryptographic Keys	กุญแจในการเข้ารหัส
Data Element	ส่วนประกอบข้อมูล
Data Encryption Standard (DES)	มาตรฐานการเข้ารหัสแบบ DES
Disk Mirroring	การบันทึกข้อมูลด้วย Disk 2 ชุดที่มีข้อมูลเหมือนกัน
Distributed Architecture	สถาปัตยกรรมแบบกระจาย
Expressway Authority of Thailand (EXAT)	การทางพิเศษแห่งประเทศไทย
External Storage	อุปกรณ์บันทึกข้อมูลภายนอก
Fare Media	ตั๋วโดยสาร
File Transfer	การรับส่งข้อมูล
Firewall	เครื่องมือหรืออุปกรณ์ป้องกันระบบเครือข่ายจากการบุกรุกของการสื่อสารจากเครือข่ายภายนอกที่ไม่ได้รับอนุญาต
Float	มูลค่าเงินที่ยังไม่ได้ใช้
Front-End Applications	ระบบจัดเก็บรายได้
Integrated Fares Central Computer	ระบบคอมพิวเตอร์ส่วนกลางของระบบตั๋วร่วม
Interfaced Document	มาตรฐานรูปแบบข้อมูลที่ใช้ในการติดต่อสื่อสาร
Interfaced Protocol	มาตรฐานวิธีที่ใช้ในการติดต่อสื่อสาร
Inter Operated SAM	กุญแจความปลอดภัยระหว่างระบบ
Key Management	ระบบบริหารกุญแจความปลอดภัยอิเล็กทรอนิกส์
Key Management Facility (KMF)	ระบบบริหารจัดการความปลอดภัยข้อมูลบัตรโดยสาร
Magnetic Strip Card	บัตรโดยสารแถบแม่เหล็ก
Mean Cycle Before Failure (MCBF)	ค่าเฉลี่ยจำนวนรอบที่ใช้งานได้
Mean Time To Repair (MTTR)	ค่าระยะเวลาเฉลี่ยในการซ่อมแซมอุปกรณ์หรือระบบ
Message	ข้อความ / ข้อมูลที่ใช้ในการส่ง

Message Authentication Code (MAC)	ข้อความที่ใช้สำหรับการตรวจสอบผู้ส่ง
Multiple Issuer	ผู้ออกตั๋ว (บัตร) โดยสารร่วมแบบหลายราย
Multiprocessing	การประมวลผลการทำงานหลายๆ งานพร้อมกัน
Near Field Communication (NFC)	เทคโนโลยีการสื่อสารไร้สายระยะสั้น
Network Manager	ส่วนบริหารจัดการเครือข่าย
Network System Management	การบริหารระบบเครือข่าย
Non-Transit	ไม่ใช่ระบบขนส่ง
Non-Transit Provider	ผู้ให้บริการธุรกิจอื่นที่ไม่ใช่ระบบขนส่ง
Non-Transit Acquirer	ผู้รวบรวมข้อมูลการใช้งานของธุรกิจที่ไม่ใช่ระบบขนส่ง
Open System	ระบบเปิด
Operator Central Computer	ระบบคอมพิวเตอร์กลางของผู้ให้บริการแต่ละราย
Operator Station Computer System	ระบบคอมพิวเตอร์ศูนย์ควบคุมย่อยของผู้ให้บริการแต่ละราย
Paper Magnetic Strip Card	บัตรโดยสารแถบแม่เหล็กแบบกระดาษ
Parallel Processing	การประมวลผลพร้อมๆ กัน
Passenger Information Display (PID)	จอแสดงข้อมูลแก่ผู้โดยสาร
Peer to Peer Clearing and Settlement	การชำระดุลและหักบัญชีระหว่างระบบ 2 ระบบ
Personal Identification Number (PIN)	รหัสบุคคล
Plastic Magnetic Strip Card	บัตรโดยสารแถบแม่เหล็กแบบพลาสติก
Point of Sale (POS)	เครื่องจำหน่ายตั๋วโดยสาร
Prepaid Card	บัตรแบบชำระเงินล่วงหน้า
Public Control	ภาครัฐควบคุม
Public-Private Partnership	หุ้นส่วนระหว่างภาครัฐและภาคเอกชน
Radio Frequency (RF)	คลื่นความถี่วิทยุ
Radio Frequency Identification (RFID)	เทคโนโลยีการระบุลักษณะคนหรือสิ่งของด้วยคลื่นความถี่วิทยุ
Reconciliation	การคำนวณดุลบัญชี
Re-Personalized	การบันทึกข้อมูลซ้ำลงบัตร
Request-Response	การร้องขอและการตอบสนอง
Reversible Gate	ประตูกั้นสองทิศทาง
Router	อุปกรณ์ค้นหาเส้นทาง
Sales and Load Agent	ตัวแทนจำหน่ายตั๋วร่วม
SAN Switch	อุปกรณ์เชื่อมโยงเครือข่ายของระบบ SAN สำหรับเชื่อมโยง Server หลายๆ ตัว ให้สามารถเข้าถึง Storage ได้
Security Access Module (SAM)	ระบบรักษาความปลอดภัย

Security Key	กุญแจอิเล็กทรอนิกส์สำหรับระบบรักษาความปลอดภัย
Service Provider	ผู้ให้บริการ
Settlement	บริการชำระดุล
Single Issuer	ผู้ออกตั๋ว (บัตร) โดยสารร่วมแบบรายเดียว
Single Journey Token	เหรียญโดยสารชนิดเที่ยวเดียวไร้สัมผัส
Single Purse/ Single E-Purse	กระเป๋าเงินอิเล็คทรอนิกส์แบบเดี่ยวในบัตรอัจฉริยะ
Smart Card	บัตรอัจฉริยะ
Station/Depot/Interchange Computer System	ระบบคอมพิวเตอร์สถานี
Storage Area Network (SAN)	ระบบ Storage ที่มีการเชื่อมโยงเข้ากับ Server หลายๆ ตัวเข้าด้วยกัน เพื่อประโยชน์ของการบริหารจัดการข้อมูลทั้งหมดจากที่เดียว
Supervisor	ผู้ควบคุมระบบ
Suvarnabhumi Airport Rail Link (SARL)	ระบบขนส่งทางรถไฟเชื่อมท่าอากาศยานสุวรรณภูมิและสถานี
The Krungthep Thanakom Co., Ltd. (KT)	รับส่งผู้โดยสารอากาศยานในเมือง
Ticket Vending Machine (TVM)	บริษัท กรุงเทพธนาคม จำกัด
Token	เครื่องจำหน่ายตั๋วโดยสารอัตโนมัติ
Transaction Collection Center (TCC)	ตั๋วโดยสารชนิดเหรียญ
Transaction Fee	ศูนย์กลางการทำรายการ
Transaction Processing	ค่าธรรมเนียมการใช้บริการ
Transit	ระบบจัดการข้อมูลการทำรายการ
Transit Acquirer	ระบบการขนส่ง
Transit Consortium	ผู้รวบรวมข้อมูลการใช้งานด้านระบบขนส่ง
Transit Provider	องค์กรกลางด้านการขนส่ง
Transmission Control Protocol/Internet Protocal TCP/IP	ผู้ให้บริการระบบขนส่ง
	มาตรฐานการติดต่อสื่อสาร TCP/IP
Usage Data	ข้อมูลการใช้งาน
Weighted Average Cost of Capital (WACC)	ต้นทุนของเงินทุนเฉลี่ยถ่วงน้ำหนัก
Wireless Access Point	อุปกรณ์รับ-ส่งสัญญาณเครือข่ายท้องถิ่นไร้สาย

Chapter 1 Introduction

In The Common Ticket System Policy and Program Management Service Report, the consultants have summarized the work processes according to the scope of work indicated in section 3.1, covering the Term of Reference (TOR) and the common ticket program management system. In addition, a development policy of the common ticket system has been presented to all stakeholders: public sectors, mass transit providers, retail business owners, and general public. Presently, the consultants are in the process of modifying the roadmap for the development of the common ticket system according to stakeholders' advices. Work processes elaborated in this report comprise the following sections:

1. Reviewing literature and technical reports related to common ticket program management system. The consultants had reviewed altogether five technical reports, to analyze advantages and disadvantages of successful common ticket systems in other countries: Hong Kong, Singapore, Japan, the Republic of Korea, Taiwan, and Australia.
2. Surveying common ticket development technologies to apply with Thailand common ticket system. This includes a survey on EMV (Europpay, Master Card VISA), which is a standard developed for product purchasing. EMV has been widely accepted in global scale. The survey was also made on Near Field Communication (NFC), which is a wireless communication technology that can be active within a range of 10 centimeters. This technology was developed by SONY and NXP. NFC operates at 13.56 Hz
3. Proposing a roadmap and details for the development of common ticket system used for public mass transit. The consultants had studied fare collection systems presently used by existing service providers. The consultants also consulted with the representatives from Ministry of Transportation, Department of Highways, Public Debt Management Office, Bank of Thailand, BMCL, BMTA, BTS, and Thai Smart Card Co. Ltd. The purposes were to uncover basic requirements and to specify strategies to develop the common ticket system.
4. Surveying existing fare collection systems used by mass transit service providers, as well as approaches to participate in using common ticket system. The consultants had surveyed the current fare collection systems and equipment standards to design front end system and interfacing. The consultants had compared and analyzed advantages and disadvantages of each card development alternative.
5. Public Hearing on the specification of common ticket development strategies. The objectives of the Public Hearing were to determine direction and standard for the common ticket system. The system must have universal standard, as well as effectiveness, modernity, and security. The system must be operable for both transit and non-transit services. The development of common ticket system will support government's strategy in mass transit utilization and reduce traffic problem in Bangkok. The Public Hearing involved lecture and discussion from by the consultants, and the experts from

private sector related to common ticket system. The hearing session provided opportunities for the participants to share ideas and suggestions. There were 310 participants including executives, representatives from government sector, transit sector and private sectors attending..

6. Specifying common ticket development strategies, directions and development processes. The strategies shall support all models of transit and non-transit systems, and scalability of the central clearing house. It must ensure accuracy, reliability, and transparency. The consultants had also considered the strategies for the common fare system.

Chapter 2 Review studies and operational reports associated with Common Ticket Program Management System

2.1 Review Studies and Operational Reports Associated with Common Ticket Program Management System

To determine policies and operational plans for the program management services, the consultants had reviewed study reports related to common ticket system and the use of common ticket system in other countries. This was to analyze directions and patterns, system structure, pros and cons, in order to determine the development direction. The consultants had assessed five reports including:

1. Study on use of common ticket system to promote mass transit system and the establishment of central clearing house
2. Thailand: Bangkok Mass Rapid Transit Integrated Ticketing Project
3. Mass transit common ticket in Bangkok Metropolitan project
4. Mass transit fare system and connection project
5. Thailand: Integrated Ticketing Terms of Reference: Integrating Mass Rapid Transit in Bangkok (Phase II)

The consultants also assessed the development of successful common ticket systems in 8 countries: Hong Kong, Singapore, The Republic of Korea, Japan, Great Britain, Taiwan, Malaysia and Australia.

2.2 Review Thailand Common Ticket Development Report

2.2.1 Study on the of common ticket system to promote mass transit system and the establishment of central clearing house

Study on the use of common ticket system to promote mass transit system and the establishment of central clearing house was made by AMP Consultants Co., Ltd, AMP Development Co., Ltd, AMR Asia Co., Ltd, Gsoft Co., Ltd, and Planpro Co., Ltd. in July 2009.

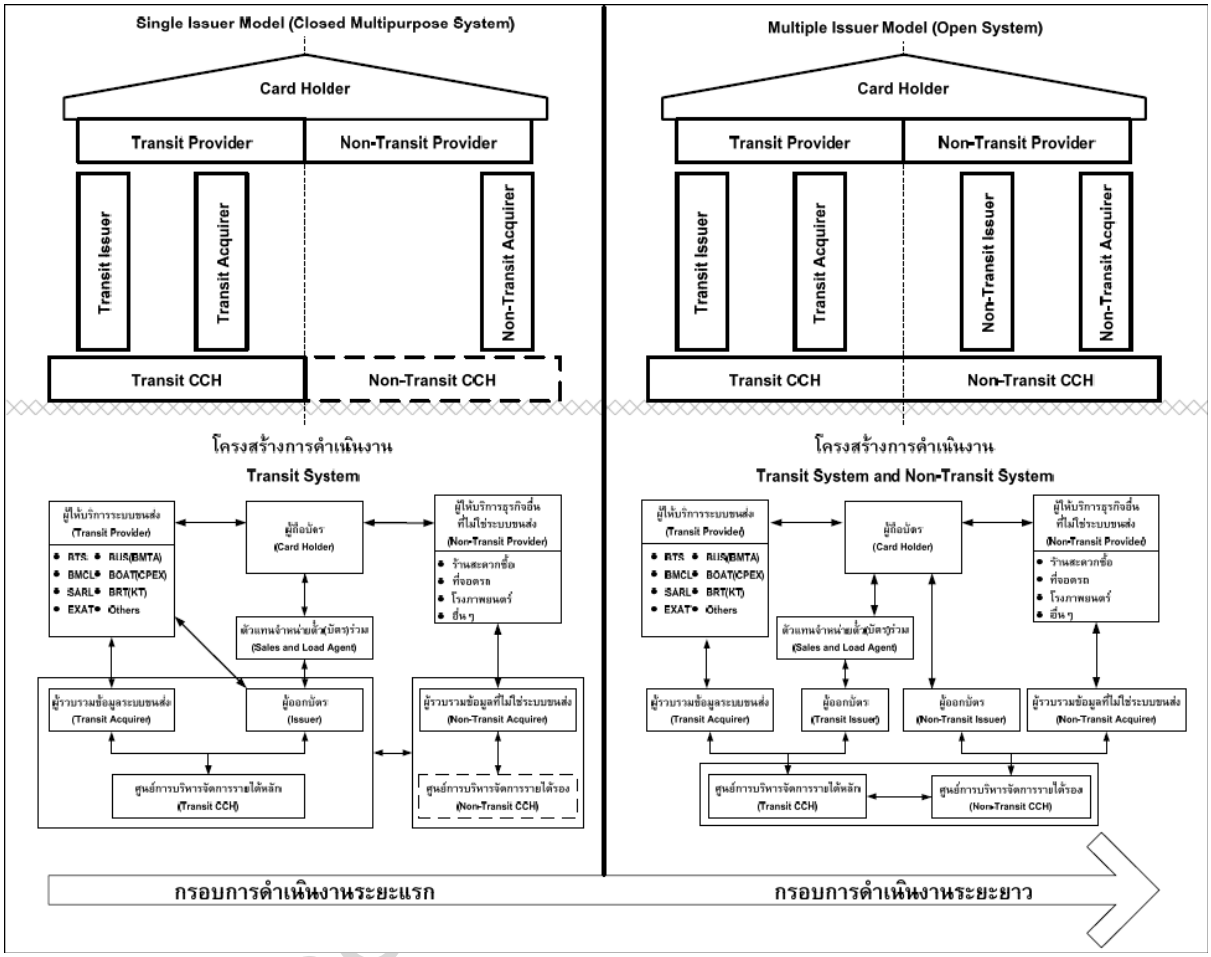
The objectives of the study are as follows:

1. To study and review automatic fare collection systems currently used in rail mass transit systems. The study also considered a direction to use the common ticket system.
2. To propose card standards and structure which will be used in all mass transit systems in Bangkok and vicinity. It also included standards and technical specifications of both front-end and back-end applications, as well as those of interfaced document and interfaced protocol. This is to ensure security of data transfer between back-end application and central clearing house.
3. To consider and propose tangible directions for the operation of the common ticket system, the establishment of central clearing house, to ensure the long-term used of the system.

1) Concept for the Development of Common Ticket System and Structure

This report proposes a direction for the operation of common ticket system in Thailand. The development is divided into two phases. The system will be implemented in transit in the first phase. It will be further implemented in non-transit section during the second phase.

Figure 2.2-1 Thailand Common Ticket and Central Clearing House Operational Framework



Source: The consultants studied the common ticket systems to promote the use of mass transit and the establishment of central clearing house

1.1) Operation of Common Ticket System in Transit in the First Phase

The operation covers both transit and non-transit by focusing use of common ticket in transit services; for example, BTS, BMCL, SARL, and BRT, as well as other mass transit services. There will be only one authorized card issuer (single issuer) in the system. The passengers may use the ticket in any transit systems. Transactions data will be sent to central clearing house to operate proceed and conclude details of money transfer to bank daily.

Regarding the service providers who do not currently have automatic fare collection system, such as public buses, and express boats, such operators need to design, develop, and install fare collection systems that correspond to the operational conditions of the common ticket.

1.2) Long-Term Operation of Common Ticket System in both Transit and Non-Transit Services

There will be multiple issuers that operate under the common same standards. Ticket holders may use the ticket for transit services or product purchasing. This can be further developed into E-Money.

In long run, there should be only one clearing house to ensure the effectiveness of the system. Transactions from both transit and non-transit sectors must be transferred to the central clearing house to operate.

2) Concept for Organization Type

Generally, there is an organization that manages the operation of common ticket system so called Common Ticketing Office. The organization is responsible for 1) determine specification of standard policies of the tickets and equipments, as well as card issuing and selling and 2) establish central clearing house system (CCH).

The type of organization of the office can be defined from the aforementioned responsibilities:

1. The organizations are sole responsible for the two major duties.

   Table 2.2-1 Advantages and Disadvantages Single Ticketing Office

• Can effectively specify management policies as it operates under common standards and regulations • Can reduce time-span and processes required in the establishment of new organizations which might join the system	• The office must initiate the operation of the system. Moreover, the office must maintain quality of service.

2. The office is responsible for some duties, such as VISA and Master Cards. The office would specify operational policies, processes, and system standards. Any operators who are interested in joining the system must operate under the framework specified by the office. The designed system must be able to apportion revenue. Each operator may have its own clearing house, which is connected to the central clearing house. Each operator also have authorization in issuing and selling the tickets.

Table 2.2-2 Advantages and Disadvantages of Partially Responsible for the Tasks

• The operation can be initiated with a single entrepreneur. Each entrepreneur may have its own marketing strategies.	• Each entrepreneur has its own card reader system. Thus, the purchasing cannot be made in a high number. This might lead to the increase of the price.

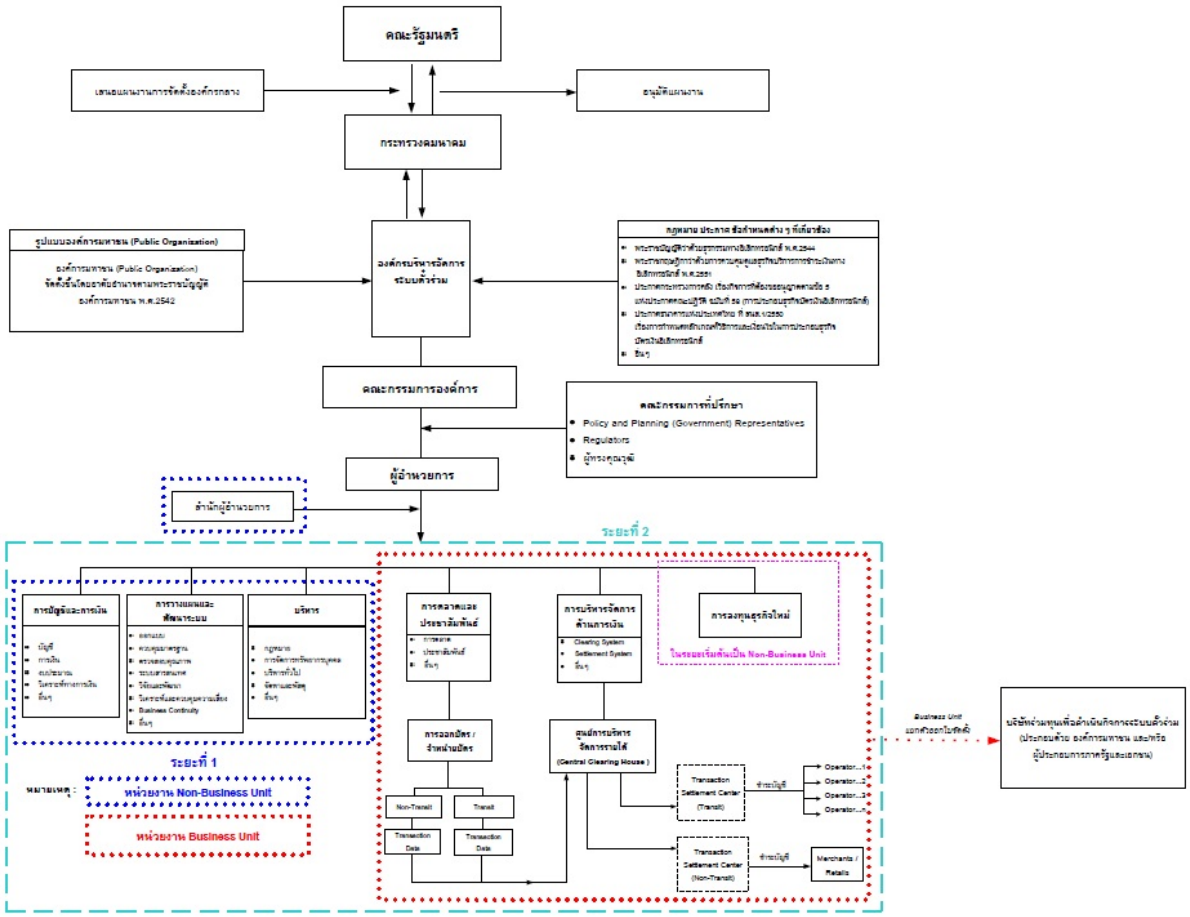
This report proposes that the common ticketing office for Thailand should be as follows:

Organization Pattern Single common ticketing office should be applied. This would ensure expense reduction and regulation control.

Should be Public Sector rather than private sector, as a governmental sector has higher potential in the investment during infant phase of the project, which probably involves purchasing, outsourcing, and planning. It could be in a form of governmental sector, public enterprise, or public organization. The report suggests that the office should be in a form of public organization, as it has autonomy in managing its revenue, personnel, and functions.

The structure of the common ticketing office comprises two sectors: 1) Non-Business Unit and 2) Business Unit. The establishment of the office can be divided into two phases:

Figure 2.2-2 Common Ticketing Office Structure: Phase 1 and 2



Source: The consultants has assessed the use of common ticket system to promote public mass transit and the establishment of central clearing house

Besides the operation of the common ticket system, the jointly setup organization must receive permission from the Bank of Thailand, as the operation involves electronic transactions and e-money cards.

3) Tickets

The consultants suggest that thermal paper tickets be used during the beginning phase of the Bangkok mass transit. Contactless smart cards should be used in the BMTA air-conditioned buses with routes connecting to BTS or MRT. The ordinary buses will continue to use the existing systems; however, they can use the common ticket system in the future.

Thermal paper tickets will be installed in every air-conditioned buses. If the passenger transfers to another bus within 2 hours, they will get discount when buying ticket next time.

Contactless smart card should be installed only on air-conditioned buses have routes passing BTS or MRT.

Analysis on Advantages and Disadvantages of the Concept

Advantages

1. Low investment
2. Small impact to change of consumer's behaviors
3. Take less time for the initiation and system installation

Disadvantages

1. Low ticket effectiveness
2. High cost
3. Non-sustainable development

Modification Plans

To ensure passengers' convenience, the ticket system should be user friendly. Therefore, the selected system should be identical for the entire transit system. This can be improved from thermal card to smart card.

4) Investment Analysis

The consultants have analyzed financial return of the common ticket system, with the following assumptions:

4.1) Revenue projection from common ticket transactions

Revenue Projection of common ticket is calculated from number of transactions and fare fee rate. Number of transactions is estimated from transit transactions which will be commenced from 2013.

Common ticket system in the beginning stage would concentrate on transit services. After the system has become more popular to the public, it would be extended to non-transit services.

To determine the transaction fee for both transit and non-transit services, base case assumption using cost plus will be applied to determine average transaction fee throughout the project. It is set that the return equals weighted average cost of capital of 10% since the project will be funded using only owner's capital without lending. As a result, the transaction fee of this study is 0.22 baht/transaction.

4.2) Estimated revenue from common ticket custom rate

The custom rate would be charge from the user at the amount of THB 80, which is equal to the cost of the ticket. Another THB 50 would be charged as deposit. The total amount would be returned to the users once they return the ticket.

4.3) Estimated investment

Investment is divided into two proportions: 1) equipment, devices, management software, all of which cost approximately THB 400.67 million and 2) Office equipment, which costs around THB 8.85 million.

4.4) Estimated Operational Cost

1. Staff

The number of staff would be increased each year from 28 staffs to 45 staffs throughout the project life. The estimated cost for the increase of staff is THB 14 million during the first year; which should be increased to THB 21 million, THB 27 million, and THB 33 million in 5th, 10th, and 15th of the operation, respectively.

2. Public Relation

The cost for public relation in prior to the project launch would be around THB 100 million, and would have been decreased to THB 60 million per year after the project have been launched.

3. Operational and Maintenance Cost

Operational and maintenance cost for the first four years would be around THB 142 million, or THB 35.5 million per year. For non-transit services, another THB 30 million would be deducted, as it does not include the operational software.

4. Common Ticket top-up fee

It is anticipated that around 80% of the users would regularly use the tickets. Approximately THB 200 would be added in each topping up transaction, which typically done three times a month. The top-up fee is at 0.3% of the topped up amount.

5. Rental space and Public Utility

Space renting would cost around THB 500 per square meter, while public utility would cost around THB 100 per square meter.

6. Others Office Costs

Other office costs for each personnel would be around at THB 115,000 per year.

4.5) Estimated Initial Investment

Initial project investment is estimated at THB 730 million – for equipment and devices, and project expenses for the first four years. It is anticipated that the project will not have any income from the operation.

The payback period of the project would be at 9.3 years, calculated from NPV of THB 622 million and FIRR of 18.9%

However, the estimation is based on the hypothesis that the operation begins in 2013.

2.2.2 Thailand: Bangkok Mass Rapid Transit Integrated Ticketing Project

Thailand: Bangkok Mass Rapid Transit Integrated Ticketing Project, by CECI Engineering Consultants, Inc., in February 2009, studied the development of fare system. The objectives are to study and review automatic fare collection systems which are currently in used. The purpose is to consider development directions of the common ticket system, which would eventually encourage passengers to use more public transit services.

1) Concepts for common ticket development/common ticket structure

Some transit providers in Bangkok, such as BTSC and BMCL, currently do not have common ticket system, causing inconvenience for the passengers as they have to pay for different fare rates. Passengers also have to pay for entrance fee when they are transferred to other transit services. This might discourage people from using mass transit.

Thus, a common ticket is very essential, as it can bring a standardized and fair fare rate. It would eventually attract people to use more mass transit services. Common ticket system requires a central clearing house or CCH and a common ticketing office or CTO.

2) Directions for specifying organizational type

For the modification process of the existing ticket system to common ticket system can be made in two methods:

1. Having multiple clearing house. Thus, the passengers do not need to change transit tickets; they can use the same ticket in every transit service. However, each service provider needs to implement front-end and back-end systems, as well as their own clearing houses. This method would cost high investment to all service providers.
2. Establishing common ticketing office, which is responsible for managing CCH, defining standards and issuing common tickets. The passengers are required to change their tickets; however, the investment in lower than the first method and have higher system effectiveness as there is only one CCH.

The consultants suggest that the second method be implemented. This can also reduce risks in security management.

During early stages, the passengers may need to use different tickets for each system and the common tickets may not be entire in used. Thus, system of each mass transit must be able to support both types of tickets. For fare collection and revenue apportionment, they would be carried out at CCH.

In regards to the establishment of CTO, there must be a governmental sector under the Ministry of Transport responsible for making a proposal for the CTO's establishment; then, it must be proposed to the cabinet. The CTO will take responsibilities for hiring consultants, project managing, regulating which might set a sub-committee to set policy and regulating mechanism as well as direction to set up CCH.

CTO set-up method approach should be done by a 'Built-Operate-Transfer' scheme. The developer would be responsible in developing the back-end system and operating and perform maintenance during the first three years after delivering the project. During this period, they will be required to provide training to CTO staffs.

3) Fare Rate

A distance-based fare system is suitable for the implementation. Moreover, a fare rate of all train routes, as well as other providers should be a uniform fare. The tickets should have various types:

- Regular price single journey ticket, and special price tickets for students, the disabled, and elderly.
- Stored Value Card
- One-day card, monthly card

To initiate the aforementioned fare policies, the government must take its direct regulation.

During early stages, flat fare rate might not be operable; thus, the current rate must still be in use. However, flag-fall can be implemented when the passengers transfer to different transit services. The discount might be subsidized by the government. This can increase competitiveness of the common ticket system.

4) Tickets

This report has mentioned BTS and MRTA tickets, which have both single-journey type and day-limit type.

BTS Tickets are classified into three types:

1. Single journey ticket; using magnetic stripe. This type can be used for only a single journey. The card would be retained at the exit.
2. Stored-value tickets are smart pass (IC cards). They can be used for multiple trips, as the card has an outstanding balance still remains. The tickets will not be retained at the exit.
3. Day-limit type can be classified into two types:
   - One-day ticket; using magnetic stripe. This type can be used for unlimited trips, within one day.
   - Monthly ticket; IC cards. The number of trips the passengers can be transported is stored in the card. This type can be issued only to students and adults.

MRT Tickets are classified into three types:

1. Single journey token

- Adults: regular distance-based pricing
- Children/Elderly: special distance-based pricing

2. Stored-value tickets (Smart cards)
   - Adults
   - Students
   - Children / Elderly
3. Day-limit tickets (IC cards). This type allows unlimited trips. One-day, three-day, and monthly cards are available for this type.

In prior to the initiation of the common ticket system, common standards for all systems must be established; especially for single-journey ticket and stored-value ticket. The passengers should receive the same benefits or discount across all systems.

For the future plan of MRT, the service provider is advised to offer 50% discount for children, students, disabled, and elderly for the single-journey tickets, and also waive the boarding fare for transferring from the first line to the second line. For stored-value tickets, students and disabled should be offered some discounts. The tickets can be specially designed for these groups of passengers; for example, by printing their photos on their personal tickets. For day-limit type, the provider is advised to offer two more types for this ticket category. First, there should be day-limit tickets that allow unlimited trips. Time limits of the tickets should be at 3 days, 7 days, and 30 days. Second, there should be day-limit tickets that allow limited trips. Day limit should be at 30 days, whereas the number of trips should be specified at 20, 30, and 40 trips. The first type is suitable for tourists, who do not typically know the number of trips they would take. The second type is suitable for routine use.

Table 2.2-3 Advised MRT fare rate

Adults, children, elderly	Adults, students[1/], concessionaires, elderly	Adults, children, students[1/]

[1/] Personal tickets for students and concessionaires should be under the supervision of the government, and should be restrained from false use.

Remark: The definitions of children, elderly, concessionaires, and students must be consistent throughout all MRT lines

Advantage Analysis

Advantages

1. There are various types of tickets offered. This can answer all users' needs.
2. Passengers are benefited from offered discounts. This encourages them to use more MRT.

Disadvantages

1. High investment for multiple types of tickets
2. Ticket system modification for both BTS and MRT needs high investment

Directions for Modification

In order to standardize ticket systems, new ticket standards and effective front-end application must be considered. They must be able to support other transit systems, as well as non-transit services, which might join the system in the future.

5) Investment Analysis

The estimated cost for the establishment of CTO and related systems is THB 400 million, which is classified as THB 217 million for investment and THB 113 million for operational cost. CTO incomes are contributed by ticket selling and transaction fee. CTO would be self-operable if the number of daily transaction reaches 1.5 million. If all providers join the common ticket system, CTO would be able to operate without subsidization from the government.

2.2.3 Study project on the extension of common ticket system for public transit in Bangkok Metropolitan

The study is carried out by JMP (Thailand) Co., Ltd, in May, 1992. The objective of the study is to develop a common ticket for public transit in Bangkok and vicinity area.

1) Ideas for the development of the common ticket system / System structure

Fare collection management is very important for traffic management. This report focuses on the extension of the common ticket system to BMTA. Ninety percent of passengers in Bangkok rely on this transit service.

For a fare collection system of the service that has high numbers of passengers, the passengers should be required to use only one ticket throughout their entire trips.

The current fare collection system still uses a very basic system, which is a paper ticket. The passengers are required to pay their fare on the buses. Some of them may have purchased in advance. Microbuses collect the fare by using fare collection boxes and thermal paper tickets. Train passengers need to purchase the paper tickets at the stations. From all of the transit systems, mass rapid transits appear to have the most advanced fare collection technologies.

Other countries tend to implement smart card technology for fare collection systems, such as Hong Kong, Great Britain, and Finland. They are all successful in the implementation.

This report concludes that BMCL should implement thermal paper tickets and implement smart cards for the common tickets. The system should be initiated with air-conditioned buses that can connect to BTS or MRT. After the operation has become successful, it can be extended to other transit services and non-transit services. Nevertheless, during early stages, it must be done concurrently with the existing fare collection system, as there might be a lot of passengers who are not ready to use the new system. More importantly, employment status and rights of BMTA officers must be carefully considered.

2) Directions

BMTA is a state owned enterprise and the only agent that is responsible for operating and regulating public buses in Bangkok Metropolitan area. The establishment of a new company to develop the new system must consider the existing system. The new company should have every type of providers hold the shares, while BMTA is the major share holder at 51%.

For the settlement and clearing house system in the new company, commercial banks would take major roles for the operation. Thus, the proportion of the shares held by commercial banks must also be considered.

The structure of a new company can be specified as follows:

3. The company takes sole responsibilities

Table 2.2-4 Advantages and disadvantages of having company limited taking sole responsibilities

• For the shares held by BMTA, they might not have to be purchased by cash. The value of the shares can be evaluated from assets possessed by BMTA. • The new company will be a state owned enterprise, similar to BMTA. This can provide support for BMTA officers, in case of transferring. • Ensure convenience in operation. However, the first phase should rather focus only on BMTA tickets.	• The company is registered as a juristic person. The operation must ensure legally correctness as defined by BMTA regulations

4. The company is responsible for the ticketing system. BMTA still manage the operation of the buses.

Table 2.2-5 Advantages and disadvantages of having BMTA taking sole responsibilities

• BMTA is still responsible for providing services. There is no requirement for transferring the assets to the new company. • Typically, the clearing house is a non-profit organization. Their incomes are contributed by transactions. Thus, there would be no increase of the fare.	• BMTA needs to invest on the share of the new company. It might be difficult for BMTA, if they is facing difficulties in liquidity. • This method might face managerial and operational problems.

The report suggested that, for long-term development, BMTA initiate the cooperation and investment among service providers, such as BTS, BMCL, and other providers.

3) Tickets

The consultants define ticket standards as follows

- Contactless smart cards
- Using ISO 7816-4 and ISO 1443 or ISO 18092
- Compatible with transit and non-transit services
- Have memory and enable encryption
- 3DES/PKI security standard

3.1) Operations during early stages are divided into three parts:

Existing service providers

- Selling new tickets in parallel to the tickets of the existing system
- Modify data structure of cards, if the existing systems already are smart cards
- The cards of the existing system would be set expiry date
- The cards of the new system must be compatible with the existing systems

New service providers

- Using card technology that is compatible with the common ticket system
- May use the common tickets in parallel to the current tickets

Non-transit service providers

- Using card technology that is compatible with the common ticket system
- Define compatible e-wallet structure
- Define structure of specific data of non-transit businesses
- Specify rights in accessing specific data of non-transit providers

3.2) Long-term operation plans

- Using smart cards that are compatible with both transit and non-transit services
- Define common data structure
- Define specific data of non-transit services on the common ticket (if needed)
- Define common security system and electronic key
- Modify data structure on the cards and compatibility of applications

Advantage Analysis

Advantages

1. Can operate in both transit and non-transit services
2. The operation covers all ranges of business
3. Modern card technologies

Disadvantages

1. Long operational time period to complete
2. High investment

Modification directions

The study was outdated and was not correspond to current contexts.

2.2.4 Study on fare system of all public transit services and interfacing processes

The study on fare system of all public transit services and interfacing processes is carried out by Avantgarde Capital Co., Ltd and AMP Consultants Co., Ltd, in December 2009. The objectives are as follows:

1. Study, analyze, and advice on the development of transit systems in Bangkok Metropolitan area, by emphasizing unity and benefits of the passengers.
2. Study and analyze fare cost, to define fare rate and common fare structure that are suitable for the operation of transit systems in Bangkok Metropolitan area.
3. Study, analyze, and defining model for making an integrated system, to bring about a good level of service.
4. Study managerial direction and fund-raising for the development of transit systems in Bangkok Metropolitan.
5. Providing consultation regarding technical information of the operation for the Office of Transport and Traffic Policy and Planning, in form of In-House Technical Arms.

1) Directions for common ticket development

Integration among transit systems – BTS, public buses, and water transit – is very important for reducing traffic congestion. The integration would become more successful if the ticket system has a fair fare rate. However, different service providers presently define their own fare rates, which could lead to difficulties in common ticket system.

2) Directions for fare rate

Directions for defining fare rate should correspond to fare rate in Bangkok and vicinity area. The fare rate must benefit both passengers and transit providers.

Appropriate fare rate must reflect the net cost of the fare. It must consider affordability for the passengers. The study indicates that the fare rate should be calculated as

Fare rate = Direct Cost + Adjusted Factor

Direct cost of service might be varied in different providers. Adjusted factor is the cost for preparing the operation of common ticket system.

The consultants have studied fare structure of Asian and European countries. The consultants also have evaluated other contexts, such as policies, physical, managerial, and social contexts. The consultants suggest that the fare structure can be defined in four ways:

Table 2.2-6 Possible fare structure for Bangkok Metropolitan area

	Distance-Based Fare	Coarse –Based Fare	Flat Fare throughout the System	Concentric Zonal Fare
Structure	Fare rate is based on the distance each passenger take. This type reflects the actual cost and is fair for both passengers and service providers.	Similar to distance-based; however, the fare is increased for every specific distance. This type is fair, and convenient for fare collection.	This structure is convenient for the passengers; however, it does not reflect the actual cost of the service.	Combination between distance-based and flat-fare rate. Passengers who travel within the same zone would require paying the same fare rate; however, the rate would be changed when they travel across different zones.
Advantages	• Fair rate • Correspond to the actual service cost • Compatible with the use of smart cards • Enable service providers to extend their services	• Convenient for fare collection \	• Benefit passengers who travel a long distance • Convenient for fare collection • Low investment for ticket cost	• Fair for all passengers • Easy to plan for the transportation • Reduce congestion in urban area
Disadvantages	• Complex structure • Cost more for passengers who need to travel a long distance	• Cost more for passengers who need to travel a long distance • Difficult for revenue apportionment	• Not fair for passengers who travel a short distance • Government needs to subsidize the cost	• Difficult to implement on public buses • The passengers who travel for a short distance, but across different zones may need to pay more • If smart cards were used, it would be similar to the

	Distance-Based Fare	Coarse –Based Fare	Flat Fare throughout the System	Concentric Zonal Fare
				distance-based structure • Difficult revenue apportion

Source: Study on fare system of all public transit services and interfacing processes by Avantgarde Capital and AMP Consultants

The criteria for selecting the most suitable fare rate structure are as follows:

1. Fairness between passengers who travel different distances.
2. Benefits for low-income passengers and those who live in the suburbs
3. Ability to attract passengers to use mass transit, to reduce traffic congestion
4. Flexibility for system extension to other transit systems
5. Applicability
6. Number of passengers

Six criteria are evaluated by giving score, from 0 to 4, to each criterion. Four is the maximum, whereas 0 is the minimum.

Table 2.2-7 Evaluation Results

Criteria	Structure 1	Structure 2	Structure 3	Structure 4
	Distance-based	Coarse Distance-based	Flat	Zone
Fairness between passengers who travel different distances	4	3	1	2
Benefits for low-income passengers and those who live in the suburbs	1	1	4	2
Ability to attract passengers to use mass transit, to reduce traffic congestion	1	1	0	4
Flexibility for system extension to other transit systems	4	4	1	2
Applicability	4	4	2	1
Number of passengers	3	2	1	4
Total score	17	15	9	15

Source: Study on fare system of all public transit services and interfacing processes by Avantgarde Capital and AMP Consultants

The most suitable structure is the **distance-based** fare structure. The second, third, least suitable structure are zonal, coarse-distance, and flat-fare structure, respectively.

To define the rate, the providers need to consider the willingness-to-pay and ability-to-pay, cost, and benefits. Some discounts should be offered to attract the passengers to use the system. However, the discount must contribute to optimum fare rate. The government may provide support in two ways: 1) direct support by subsidizing the cost or 2) indirect support by providing some benefits for the passengers who use the system.

To conclude the financial analysis of the development of common ticket system

- Fare rate structure: Distance-based; THB 2 / Kilometer
- Entrance fee :THB 18 (Ceiling THB 40)
- Concession : PPP Gross Cost Concession
- Financial model projection of 30 years (2010 – 2039)

From the evaluation of the cash flow in transit systems, such as BTS and its extensions, BMCL, airport rail link, express boats, air-conditioned buses, and the consultants anticipate that the cash flow might be negative during the first five years. However, it would return for at least THB 2.3 trillion to the government within 30 years.

3) Revenue Apportionment

Revenue apportionment can be made in three alternatives:

1. Apportion to the first service provider; the revenue might be apportion to other providers in smaller proportions
2. Apportion according to the distance passengers travel on each transit system
3. Equal proportion to all providers

Nevertheless, revenue apportion must also consider the fare structure and fare collection system.

2.2.5 Thailand: Integrated Ticketing Terms of Reference: Integrating Mass Rapid Transit in Bangkok (Phase II)

Integrating Mass Rapid Transit in Bangkok report (Phase II) was studied by Asian Development Bank (ADB) and Thai government in July 2550. The purpose of this report is to study and analyze obstacles and solutions

that occurred during integrated all transportation systems. Other than that, it would help setting up of a working committee and organization, which is responsible for operator and finance.

1) The development of common ticket

Thai government is developing 5 priority lines of mass rapid transit system for the Bangkok Metropolitan Region (BMR) with a total length of 118 km with an estimated total investment of around US $4.5 billion. This is a subset of the previous MRT 10 lines plan proposed by the previous government during 2549. The objective is to offer mobility in Bangkok to relieve road traffic congestion and thus better integrating Bangkok and supporting the economy. The analytical work and strategic advice on options for progressing MRT in an integrated way were instrumental in achieving a common understanding of development need for MRT in Bangkok include:

1. Specification and procurement of services in a way that encourages integration of MRT services. Even though each mass rapid transit line will be operated by several companies, the study showed that a gross cost concession contract for MRT would be preferred. Under a gross cost concession which collected revenue will be delivered to the government, then the government will allocate such revenue to each service provider.
2. Development of a common electronic ticketing system for rail or bus and other public transport modes.
3. Setting standard fare, which is fair to passengers to increase number of passenger
4. Common public relation for all public transport modes.

2) Roadmap on setting up common ticket project

2.1) Revenue apportionment from concession system

Previous studies found that fare collection system from existing concession, which have multiple service providers is not so efficient. Thus, future MRT lines should utilize a standardized gross cost concessions model, which would provides greater control of ticketing policy of the government to set policy and support the project to be successful.

Table 2.2-8 Ticketing Characteristics of MRT Concession Models

Characteristic	Net cost concession	Gross cost concession
Fare revenues retained by:	Concession	Government
Shortfall topped up by:	Government	Not applicable
Fare levels controlled by:	Concession	Government
Fare products controlled by:	Concession	Government
Ease of implementation of common fares	Complex	Simple

Characteristic	Net cost concession	Gross cost concession
Ease of revenue management for common ticketing	Complex	Not required
Dependency on clearinghouse:	High	Minimal

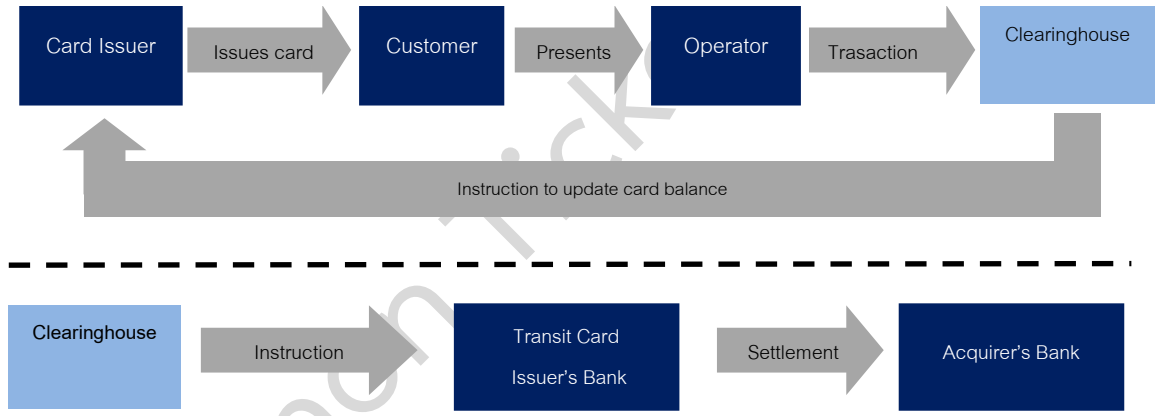
2.2) Technical Option

Technical option to be applied for a single card system is to set a card standard, which allows all companies to issue cards, a single clearing house, which can support connectivity with other equipment. The strategic implementation of an open standard will limit the impacts of any possible vender lock-in.

2.3) Business Model

Under existing operation of the mass rapid transit, which are owned and operated by the service providers. However, for the future system, the government will collect and apportion the revenue to each service provider. The business model of the common ticket is to have government to own the system and issue card. This will benefit for making agreement among related parties and their roles and responsibilities.

Figure 2.2-3 Issuer-Acquirer Business Structure – Card Use Application



2.4) Financing Options

Design, Build and Operate and Maintain (DBOM) contract with a single turnkey contractor with government obtaining budget and paying for the delivery of on-going operational services out of fare revenues.

Ticketing concession (likely based upon PPP principles) with the concessionaire providing the system using their own budget and taking risk, this will be reimbursed over time.

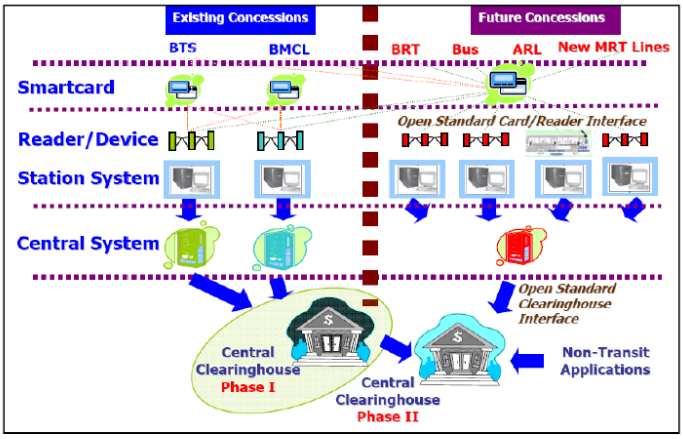
In conclusion, it can be assumed in either case that under the recommended gross cost from of MRT operating concession, fare revenue would be remitted to the government.

3) Ticket

This report mainly describes about common ticket, which can be divided into 2 phases;

3.1) Interim State Common Ticket

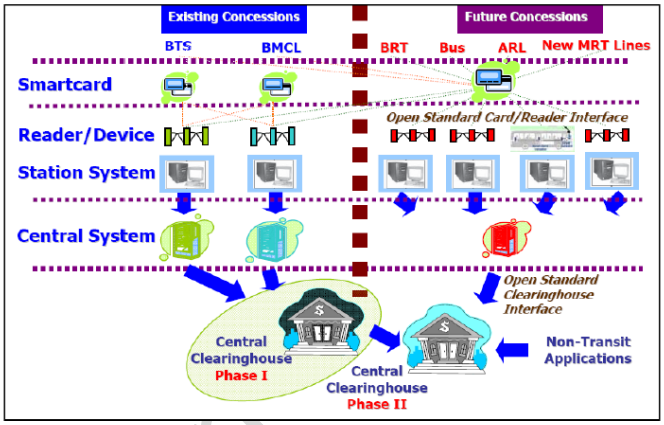
Figure 2.2-4 Common Ticketing (Interim State)



- Adopt new system with new operators.
- The integration between BTS and BMCL, it requires card, reader and connection with clearinghouse.
- Develop clearing house so the existing and new one can work together.
- Connect between BTS/BMCL clearing house with new clearing house system.

3.2) End State Common Ticket

Figure 2.2-5 Common Ticketing (End State)



- Adopt new system with new operators.
- At the final state, the integration between BTS and BMCL, it requires card, reader and connection with clearinghouse.
- Develop clearing house so the existing and new one can work together.
- Connect between BTS/BMCL clearing house with new clearing house system.

In conclusion, the common ticket should be

- Smart Card
- Single card
- Single issuer
- Be able to use with every systems of mass transit

<u>Analysis of cards' properties listed above</u>

<u>Advantages</u>

1. The users are more comfort since they have no need to carry many cards.
2. Easy to manage since there is only one issuer.

Disadvantages

1. High investment

Solutions

In order to minimize investment cost, existing cards should be allowed to be used in the system. There must be some modification in readers.

2.3 Assessing Common Ticket System in other countries

2.3.1 Hong Kong Special Administrative Region of the People's Republic of China (Hong Kong)

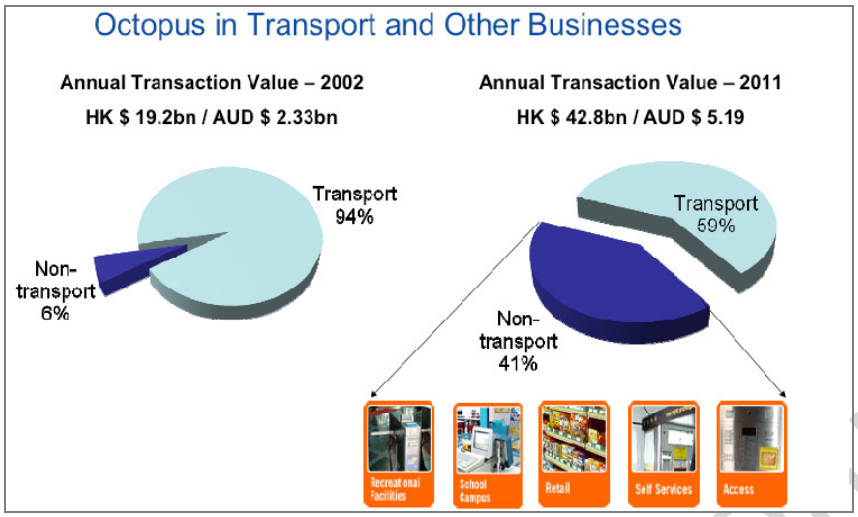
1) General Information

Hong Kong is the first country to implement the common ticket system and smartcard, the card is called "Octopus" launched in 1997 while it took 3 years to be implemented by Octopus Card Limited (OCL), which operates the common ticket system and smartcard as a card issuer and operate the clearing. OCL was a subsidiary of Octopus Holdings Limited, established in 1997 by 5 major transportation service providers, including MTR Corporation Limited (MTRC) (which has an agreement with the government to manage KCRC's asset for 50 years since 2007), Kowloon-Canton Railway Corporation (KCRC), KMB Public Bus Services Holdings Limited (KMB), Citybus Limited (Citybus) and Hongkong and Yaumatei Ferry (which transferred all of its shares to New World First Bus Services Limited).

The first phase of the Octopus Card's implementation, the card was utilizable only within transit mode and expand its market to non-transit mode in 2000, when Octopus Card are utilizable with most transit mode which are buses, subways, rails, ferries, taxis, coaches including merchandise and service purchasing such as department stores, restaurants, theaters, hospitals, gyms, parking lots and public services.

In 2002-2011, there were 5,200 transportation service providers and 1,200 retails participated with the Octopus. It indicates that between 2002 and 2011, there were 6% and 41% increasing in transit and non-transit mode respectively.

Figure 2.3-1 Proportion of Octopus's users in transit and non-transit between 2002-2011



Source: 170http://www.OCTOPUS.com.hk/

Currently, 90% of transit payments are made by Octopus Card and only 10% using single journey magnetic card or cash, while the fare is controlled by the government in the Fare Adjustment Mechanism.

In addition, Octopus developed the e-ticket system as well as the automatic fare collection system in other countries such as Netherland, United Arab Emirate (Dubai) and New Zealand (Auckland).

2) Organization's structure

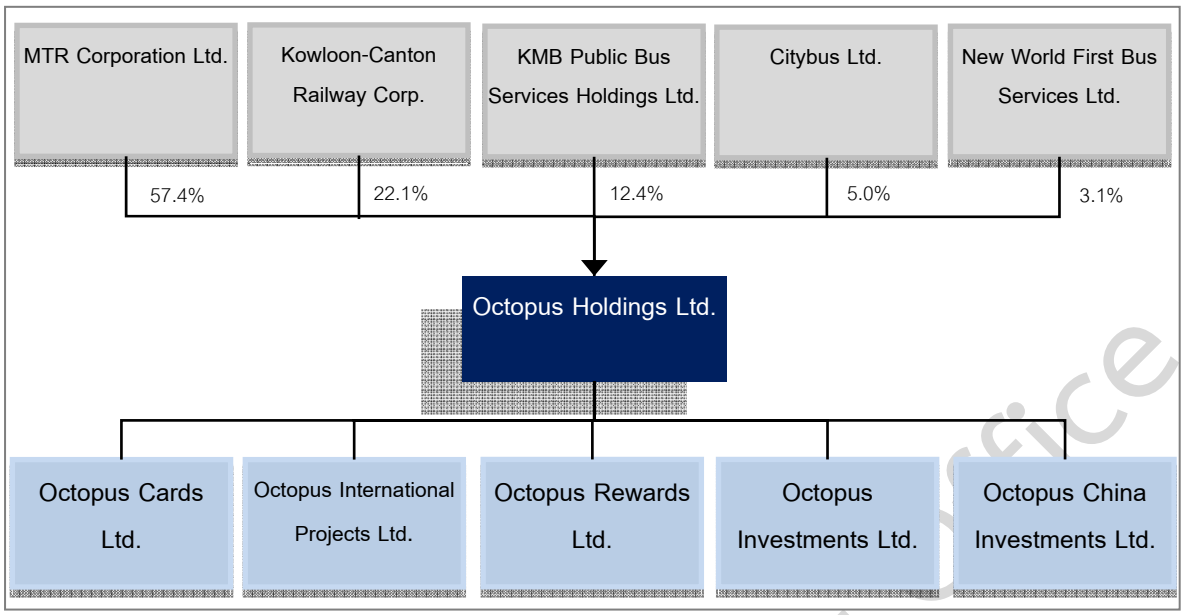
Octopus Holdings Limited's shares are owned by the transportation operators which are

1. MTR Corporation Ltd. (A rail operator)
2. Kowloon-Canton Railway Corp. (A rail construction operator)
3. KMB Public Bus Services Holdings Ltd. (A Hong Kong public bus operator)
4. Citybus Ltd. (A public bus operator)
5. New World First Bus Services Ltd. (A public bus operator)

In addition, Octopus Holdings Ltd. has 5 subsidiaries working as support business units of Octopus Holdings Ltd. which includes;

1. Octopus Cards Ltd. who operates contactless smart card payment system
2. Octopus International Projects Ltd. who provides an Automatic Fare Collection system in Hong Kong and internationally
3. Octopus Rewards Ltd. who develops and manages the customer loyalty platform
4. Octopus Investments Ltd., which is an investment holding company
5. Octopus China Investments Ltd., which is an investment holding company involving with China's projects

Figure 2.3-2 Octopus Holdings Limited's organization structure



3) Card utilization

The service emphasized on Customer Loyalty Program, with a few fare discount, but continuously expand the service spots to facilitate users and develop the stations' facilities.

The business expansion includes both card's utilization expansion and motivate the service providers to participate in the program such as,

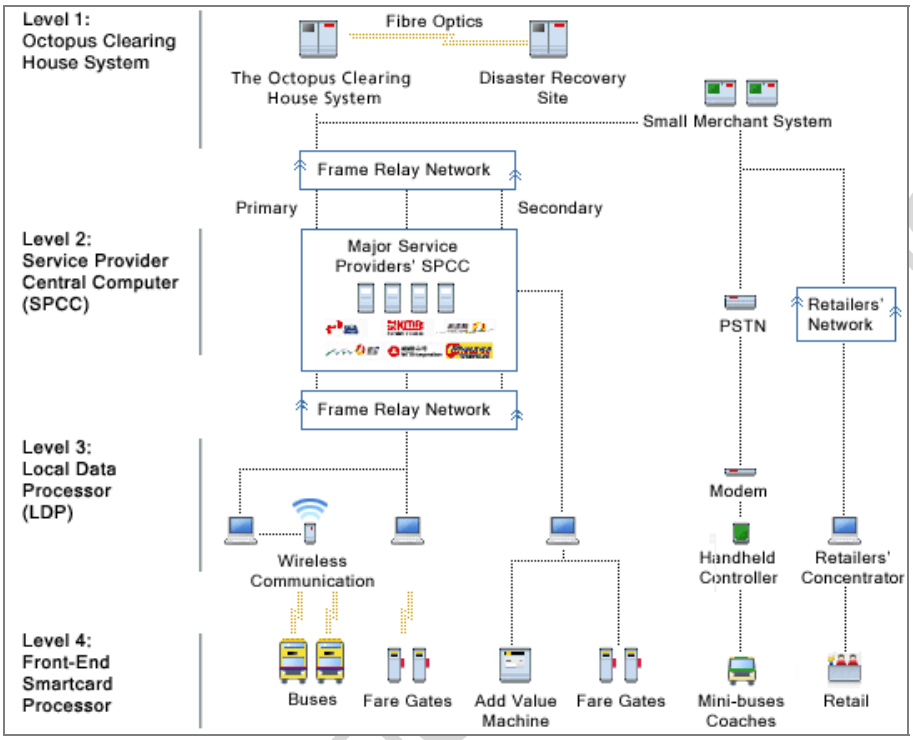
- Clearing fee for the low-end transit services to induce the operators in escalating increasing with inverse variation with transaction
- Expansion firstly in the transit mode to a stable point, then expand to the non-transit market
- Undertake the Transit Oriented Development (TOD) such as retails, MRT shopping mall and build residents around the stations
- Provide top-up points at convenience stores
- Make profit from charging higher fee for non-transit mode
- Conduct the Reward Program as a Customer Relationship Management to attract more users and build customer loyalty
- Expand Octopus market to China (Cross boarder) such as OCL-Lingnan Tong (LNT) and OCL-Shenzhen-Tong (SZT)

As for the fare policy, it adopts a distance-based fare for subway and a flat fare for bus, to induce users while set lower fare than single journey trip as well as a ceiling rate for the distance-based.

4) Common ticket

Octopus Card is a Microprocessor using Felica technology, an off-the-shelf-product. ERG Company firstly developed the system and OCL, then developed and modified the card function to suit Hong Kong accordingly.

Figure 2.3-3 Current system of Octopus



Source: 171http://www.OCTOPUS.com.hk/

Now, Hong Kong has started to study on NFC technology and EMV standard, but there is still no development to implement such technologies with the system but only specific services which accept EMV Card such as Airport Express Line. However, in 2001 Hong Kong ordered 20 million cards from Felica (Sony) for by then, existing cards replacement.

5) Common ticket's success

Hong Kong's common ticket system is one of the most successful system in the world with currently 22 million active cards in the system and 12 million transaction per day (60% transit and 40% non-transit) or about HKD 130 million per day.

6) Common ticket card

There are 3 types of Octopus Card which are

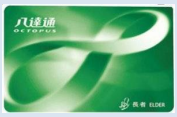
1. On-Loan Octopus: for children, adults, and seniors which the users have to deposit an amount of money and refund when return
2. Sold Octopus: which is tailor-made card sold to users without deposit

3. Bank Issued Octopus: which is issued by authorized banks and is able to use as an Octopus card

Figure 2.3-4 Octopus Card

7) Card price

Table 2.3-1 Card prices

Card Type	Price (Hong Kong Dollar)
Adult 	150
Senior 	70
Children 	70

Source: Mass Transit Railway Corporation (Hong Kong)

However, the price is subjected to HKD 50 deposit, which will be refunded when the card is returned.

8) Fare

Table 2.3-2 MTR fare comparison between Octopus and Single journey

Origin/ Destination	Octopus card (HKD)	Single Journey (HKD)
within Island Line	4.0-7.3	4.0-8.0
Island Line/ Tsuen Wan Line/ Kwun Tong Line/ Tseung Kwan O Line	8.6-12.5	9.0-12.5
Island Line/ Tung Chung Line/ Disneyland Resort Line	4.0-22.9	4.0-25.5

Island Line/ West Rail Line	8.6-24.9	9.0-26.5
Island Line/ East Rail Line	10.0-44.8	11.0-46.5
Island Line/ MaOn Shan Line	13.8-18.6	15.5-20.5

Source: Mass Transit Railway Corporation (Hong Kong)

Singapore

1) General Information

The common ticket in Singapore was initiated by Transit Link Pte Ltd, which is a public sector. Transit Link introduced Transit Link cards, funded by its government, in year 2000. The cards were a magnetic-stripe type. The public bus fare rate was step-up-based, while electric train was distance-based.

In 2002, **Land Transport Authority (LTA) established** EZ Link, which is a private sector. EZ link was responsible for issuing smart cards called EZ-Link. The cards were used in public buses and electric trains.

LTA holds 100 percent of EZ-Link shares. The company has a registered capital of SGD 14.51 Million, which is equivalent to 340 Million Baht. The EZ-Link was responsible for selling and managing EZ-Link card as well as managing the central clearing house for both transit and non-transit service providers who use the technology of EZ-Link.

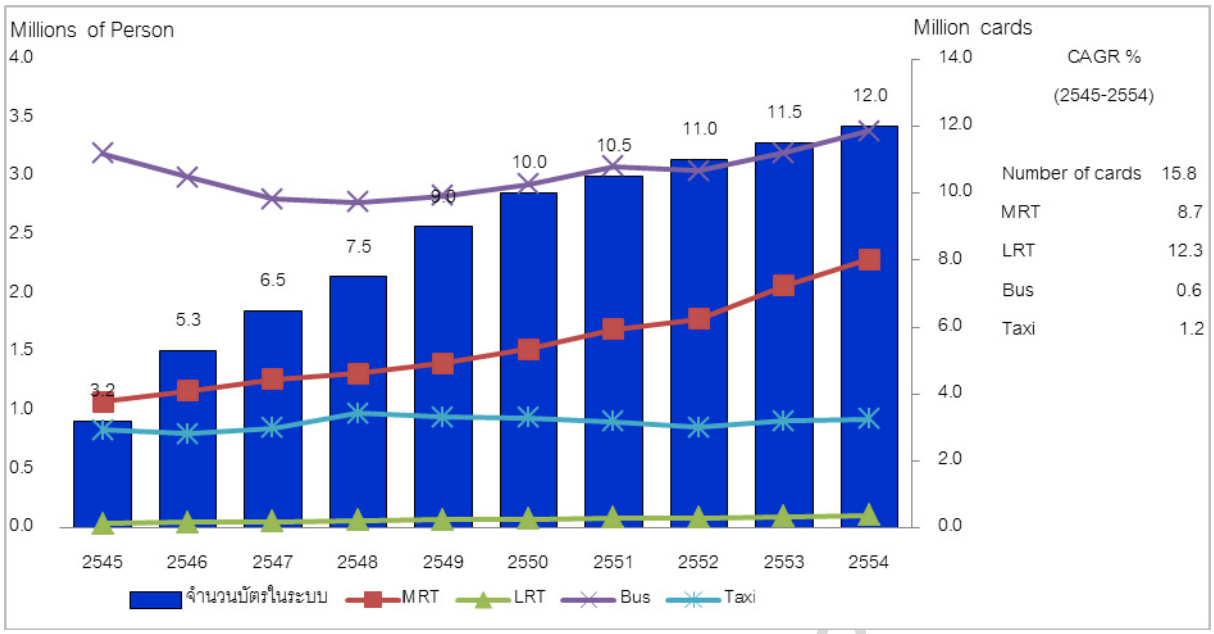
EZ-Link can be used to pay the fare for Light Rail Transit (LRT), Mass Rapid Transit (MRT), and taxi. Moreover, it can perform payment transactions with convenient stores, restaurants, school canteens, and other public services. EZ-Link has been further developed to replace national ID cards, student cards, and military ID cards.

From 2002 to 2008, more than 10 million EZ-Link had been issued. EZ-Link introduced a new type of card "CEPAS" **(Contactless e-Purse Application, Prepaid Card)** and Symphony for ePayment (SeP) system in December 2008. The new technologies enabled EZ-Link to cover a wider range of its service. Presently, more than 12 million EZ-Link cards are used in the system.

Figure 2.3-1 Evolution of Cards Used in Singapore

Developed by TransitLink Pte Ltd	Developed by LTA	Developed by LTA
Issued by TransitLink Pte Ltd	Issued by EZ-Link Company (Single)	Issued by EZ-Link Company, LTA and NETS (Multiple)
Fare Media: Magnetic	Fare Media: Contactless Smart Card Felica communication Felica Standard	Fare Media: Contactless Smart Card Type B communication CEPAS Standard

Figure 2.3-2 Average Number of Passengers for Each Type of Transit and the numbers of EZ-Link Cards

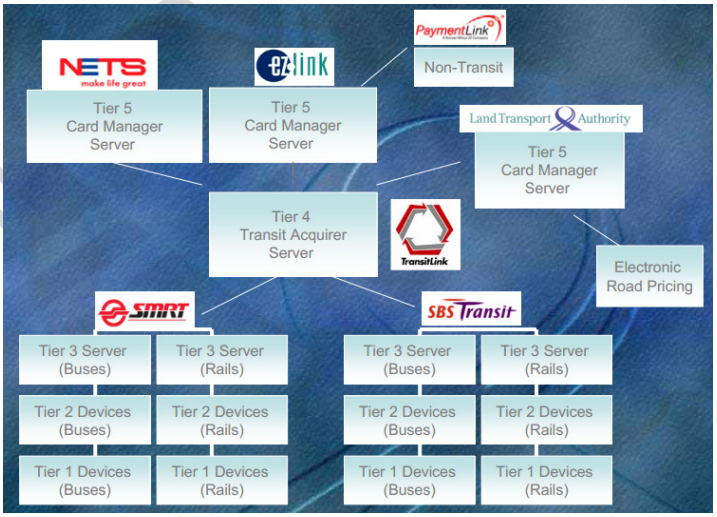


Source: EZ Link

From the figure, it is indicated that EZ-Link contributes to the increase of the average number of passengers. The consultants suggest that EZ-Link contribute more to MRT and LRT than to public buses and taxi.

Besides EZ-Link/Transit Link cards, CEPAS also integrates the cards that have been issued by NETS, which is a CTO. The government has planned to link all the systems; nevertheless, it is not yet successful.

Figure 2.3-3 Interoperability of Common Ticket in Singapore

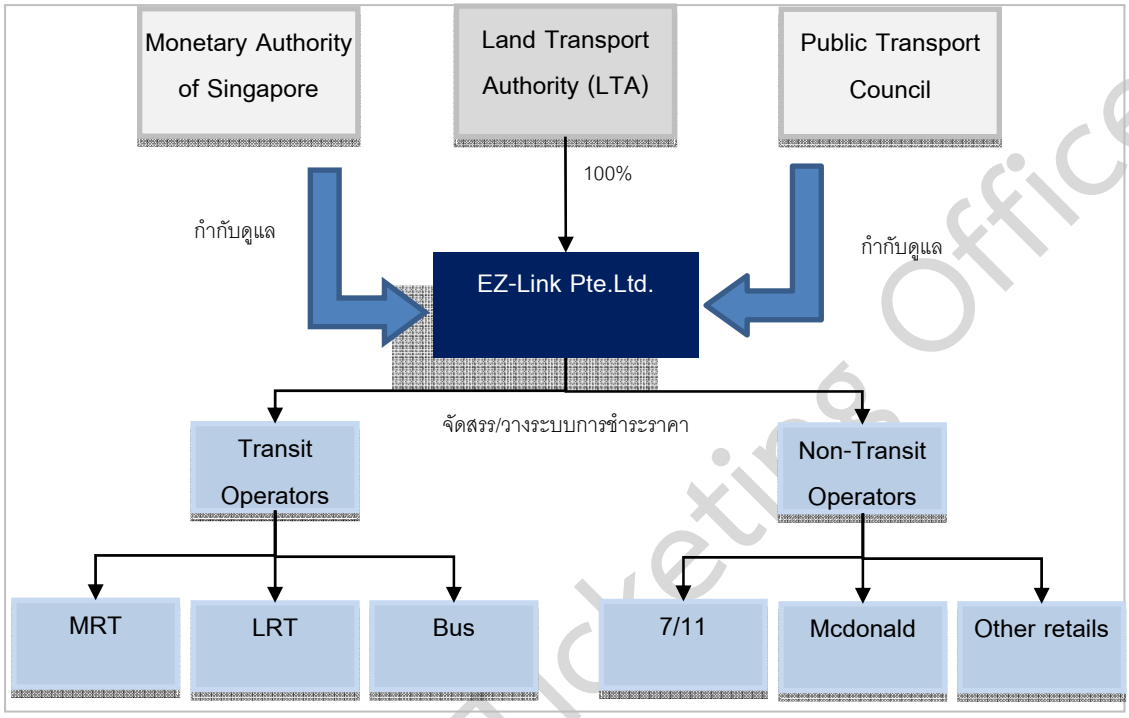


There are multiple card issuers in Singapore; however, there is only one Transit Acquirer (Transit Link). This enables the government to survey and gather information for transit planning.

2) CTO Structure

EZ-Link holds 100 percent shares; however, it is regulated by Monetary Authority of Singapore and Public Transport Council. It is sole responsibilities of EZ-Link in selling the cards, as well as regulating transit and non-transit payment systems.

Figure 2.3-4 EZ-Link Pte. Ltd. Structure

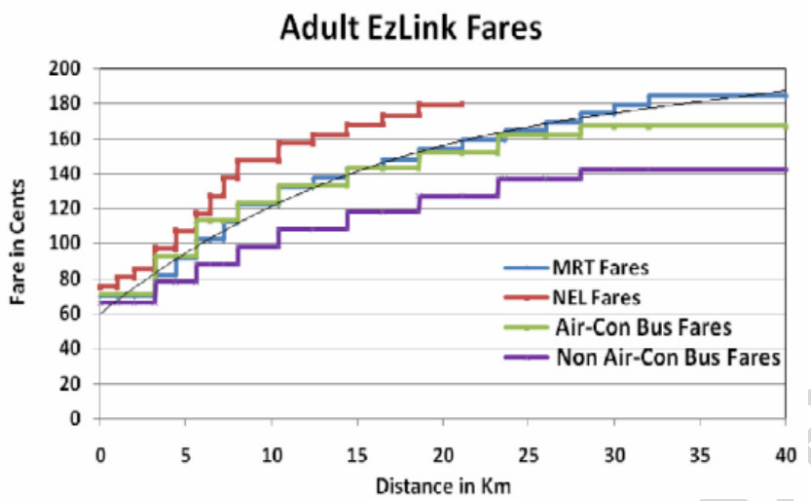


Source: EZ Link

3) Policies

- The government invested for the infrastructure
- System development is initiated from a proven system. Singapore chose Sony FeliCa cards, and ERG central clearing house system. ERG, which was successful in Hong Kong, was further developed to SeP.
- Specify attractive fare rate
- Lower EZ-Link fare rate to be 25% less than that of single journey
- Halve EZ-Link fare rate for elderly and children

Figure 2.3-5 EZ-Link fare rate for adults



- Fare rate should be correspond to a high quality service level
- Establish central clearing house, which would assist the government in surveying information required for transit strategies
- EZ-Link has its own customers. The business can be extended to non-transit sections

4) Systems

EZ-Link was firstly a microprocessor card that has the FeliCa technology. In 2002, smart cards were introduced to the system; however, the fare rate remained the same.

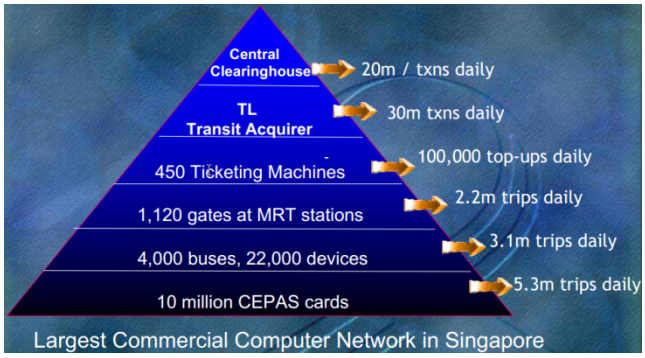
In 2004, the government established CEPAS standards, which are particularly designed for common ticket system in Singapore. CEPAS supported Type A, B, and C interfaces. However, CEPAS is currently able to support only type B.

Symphony for ePayment (SeP) were developed for approximately four years, and was firstly used in 2010. The fare rates for public buses and mass rapid transit were changed to be distance-based.

5) Success

Eleven million EZ-Link cards have been issued, of which eight million are circulated in the system. There are approximately 20 million transactions carried out EZ-Link cards each day.

Figure 2.3-6 EZ-Link Usage



6) Common Ticket

There are four types of EZ-Link cards:

1. EZ-Link is a top-up card for children, adults, and elderly. The minimum value of the card of at SGD 12; the passengers may use only SGD 7, as SGD 5 is a non-return value. The card can be topped up at Passenger Service Center counter, 7-11, credit cards. The minimum top-up value is SGD 10, and the maximum value is SGD 500.

Figure 2-1Singapore Common Ticket

EZ-Link Season Pass allows unlimited usage within a specified time period. There are weekly and monthly cards, which can be further categorized into two categories:

Table 2.3-1 Weekly and Monthly Cards Fare Rates

	Enhanced [1/]	Basic [2/]
Weekly	SGD 50	SGD 45
Monthly	SGD 190	SGD 170

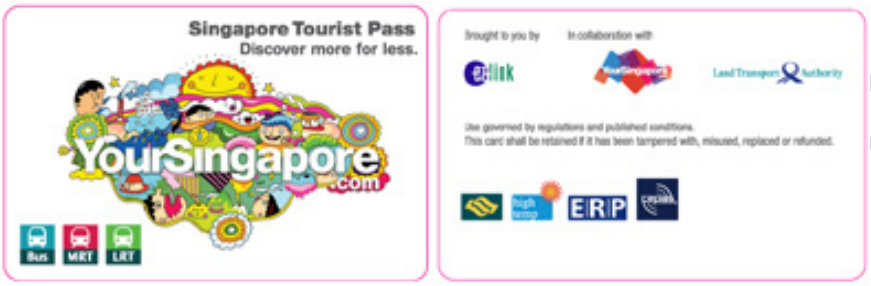
Remark:

[1/] Enhanced-type allows unlimited usage in trains and public buses

[2/] Basic-type allows unlimited usage in buses, but allows only four rounds for trains

2. Singapore Tourist Pass is particularly designed for tourists. The cards unlimited usage on trains, trains, and public buses within a specific time range. A day pass costs SGD 10, 2-day pass costs SGD 16, and a 3-day pass costs SGD 20. The users have to SGD 10 for the deposit; however, it can be returned within 5 days. This type of card cannot be used with express mass rapid transit, such as Express, Fast Forward, Night Rider, Nite Owl, Chinatown Direct, and Jurong Island and Bus Plus services.

Figure 2.3-7 Singapore Tourist Pass



3. Co-brand cards are issued by authorized agents. They can be used as EZ-Link cards. The examples of co-brand cards are POSB Everyday Card, Citibank SMRT Card, HSBC Revolution Card, ANZ Platinum Card,FEVO Prepaid MasterCard, and PAssion Card.

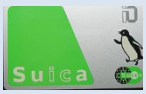
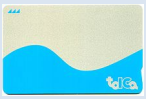
Figure 2.3-8 Co-brand Cards

Japan

1) General Information

There are several types of common tickets used in Japan. Each type offer services in different areas.

Figure 2.3-9 Common Tickets in Japan

Cards	Operators	Area	Example
Suica	JR East	Greater Tokyo Area, Sendai and Niigata	
Toica	JR Central	Greater Nagoya and Shizuoka Prefecture	
Icoca	JR West	Greater Osaka, Okayama and Hiroshima Prefectures	
Kitaca	JR Hokkaido	Sapporo	
Sugoca	JR Kyushu	Fukuoka Prefecture	
Pasmo	Pasmo Corporation	Greater Tokyo Area	
Manaca	Nagoya City Transportation Bureau	Nagoya	
Pitapa	Surutto Kansai Association	Greater Osaka, Okayama and Shizuoka	

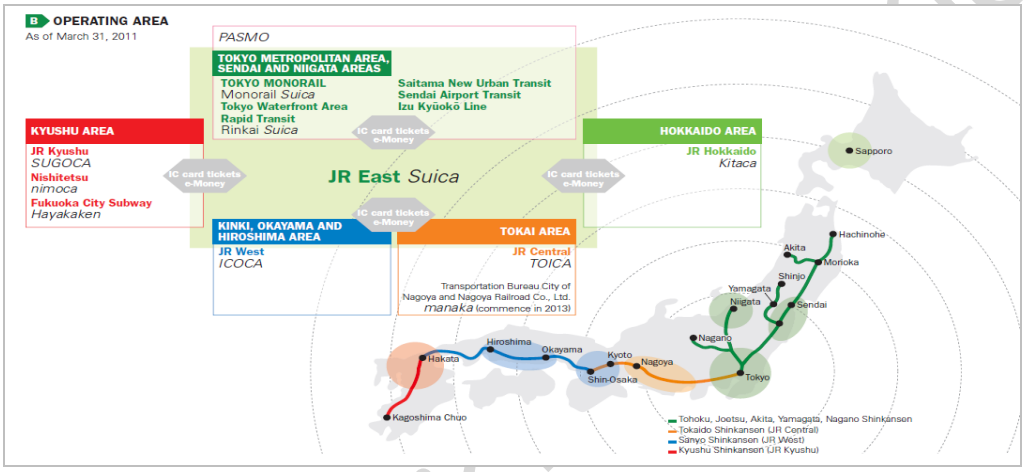
Suica is, however, the most used type of card; and it covers most of the area. There are presently 40.74 million [1] Suica cards in the system. Suica is the most developed card, compared to other types.

JR EAST initiated the use of Suica in 2001. It was a microprocessor card, using RFID technology which was developed by Sony, known as FeliCa. It was firstly used in mass rapid transit then, it was extended to public buses and taxi, as well as other non-transit services. Suica covers the area of Kanto region, Sendai area, and Nigata area

[1] Source: FY2012.3 Financial Results Presentation,https://www.jreast.co.jp/e/investor/pdf/2012_presentation.pdf

Figure 2.3-10 บัตร SUICA Card

Figure 2–1 Service of Suica



Source: East Japan Railway Websites

PASMO was firstly used in 2007, having Tokyo Metro as the card issuer. Tokyo Metro service covers mass rapid transit and public buses in Tokyo. However, there are altogether 12 service providers for the trains and 77 service providers for the buses.

Figure 2.3-11 บัตร PASMO

Both SUICA and PASMO use FeliCa technology; however, they have different data structure standards. Nevertheless, their systems support interoperability.

Figure 2.3-12 Systems in prior to Interoperability

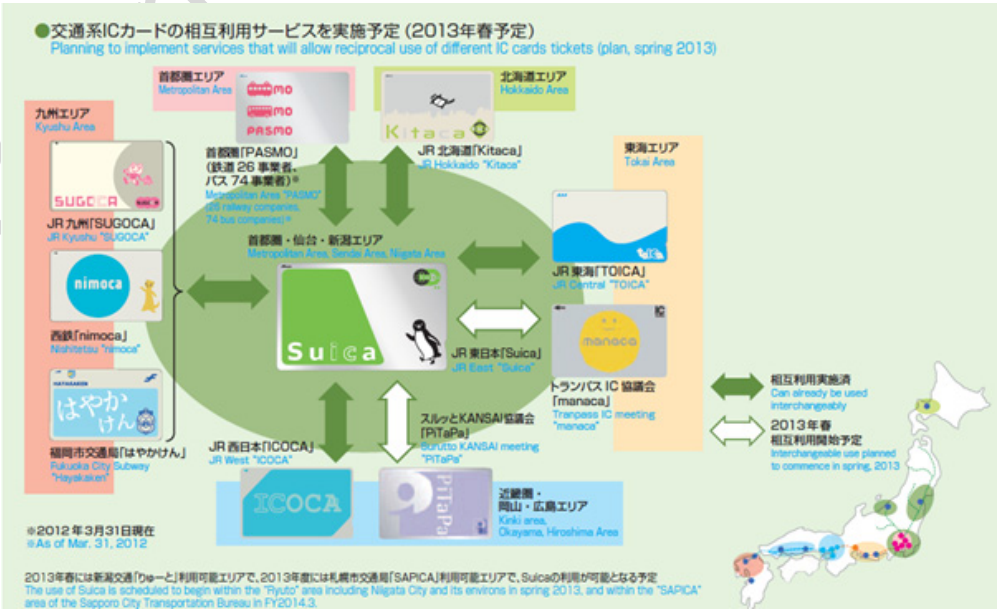
○ : interoperable × : not interoperable

Present (as of Oct.2011)		Cards									
		Suica	PASMO	Kitaca	TOICA	manaca	ICOCA	PiTaPa	SUGOCA	nimoca	Hayakaken
Area	JR EAST	○	○	○	○	×	○	×	○	○	○
	Pasmo	○	○	×	×	×	×	×	×	×	×
	JR Hokkaido	○	×	○	×	×	×	×	×	×	×
	JR Central	○	×	×	○	×	○	×	○	×	×
	Tranpass IC Association	×	×	×	×	○	×	×	×	×	×
	JR WEST	○	×	×	○	×	○	○	○	×	×
	Surutto Kansai Association	×	×	×	×	×	○	○	×	×	×
	JR Kyushu	○	×	×	○	×	○	×	○	○	○
	Nishi-Nippon Railroad	○	×	×	×	×	×	×	○	○	○
	Fukuoka City Transportation	○	×	×	×	×	×	×	○	○	○

JR Group has made a contract to create interoperability among all systems in Japan that use FeliCa. The development has been expanded from the interoperability between Suica and Pasmo.

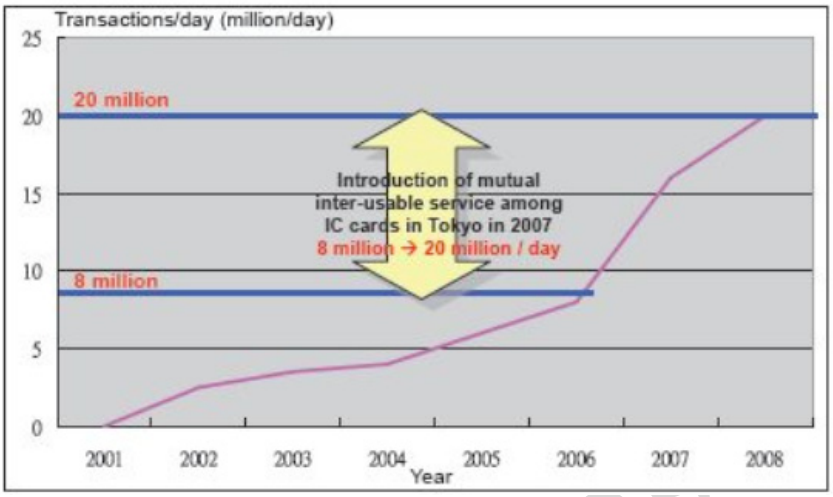
In 2008, JR Group cooperated with Central Japan Railway to create interoperability with TOICA, and extended to Tokai, Kinki, Okaya, and Hiroshima area. JR group also cooperated with Hokkaido Railway Company to create interoperability with Kitaca in 2009; then, with Kyushu Railway Company and Nishi-Nippon to create interoperability with SUGOCA and Nimoca in 2010; then, with Fukuoka Transportation Bureau to create interoperability with HAYAKAKEN in 2011.

Figure 2.3-13 Interoperability between SUICA and other cards



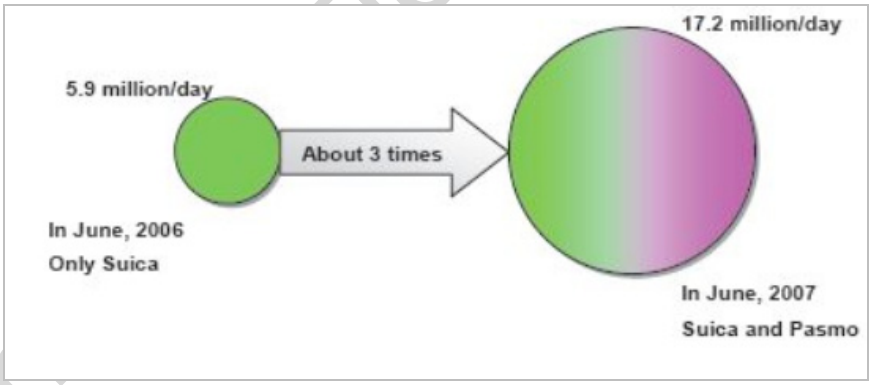
Source: SUICA Website

Figure 2.3-14 Common Ticket Usage



Source: SUICA Website

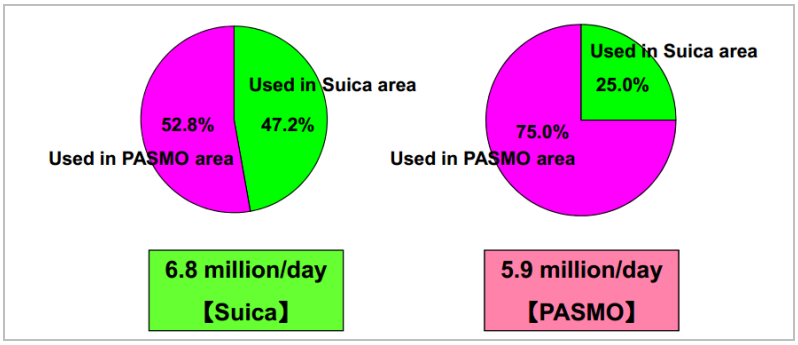
Figure 2.3-15 SUICA usage before/after integration with PASMO



Source: SUICA Website

Statistic in 2007 indicated that the interoperability between SUICA and PASMO dramatically increased the number of users; from 2 million to 20 million. In 2010, there were more than 40 million SUICA and PASMO users. Majority of users were from transit transaction.

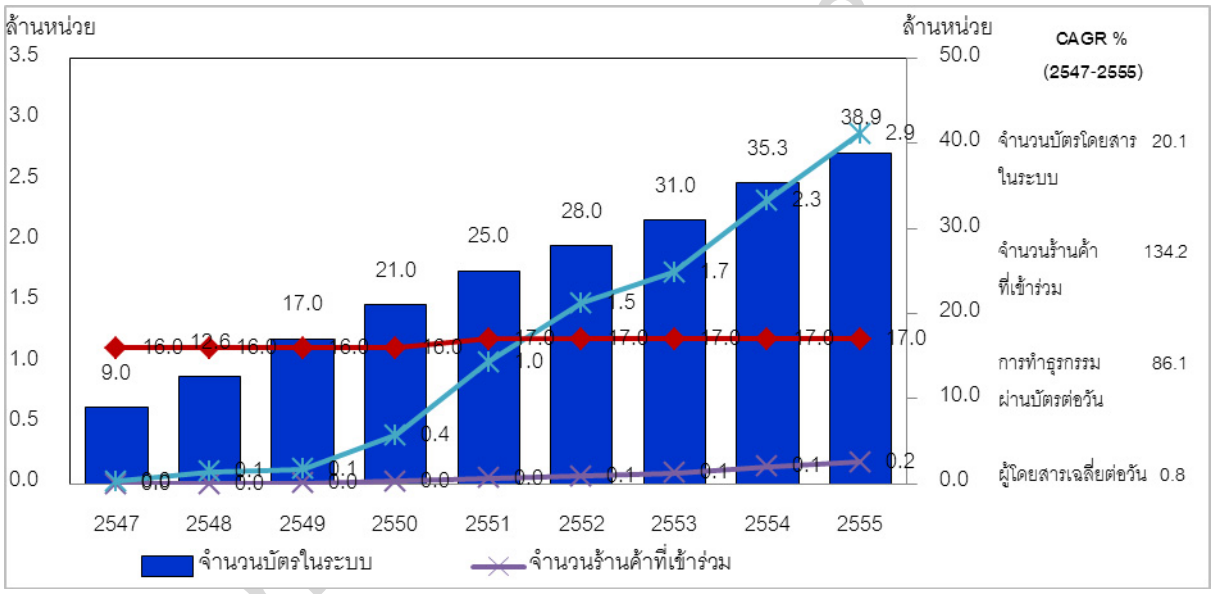
Figure 2.3-16 Proportions of SUICA and PASMO users (July 2010)



Source: SUICA Website

Although the interoperability between SUICA and PASMO increased the number of users, the two systems have their own clearing house systems. Thus, it increased the expense on the clearing house.

Figure 2.3-17 Average numbers of passengers, transaction, and common tickets in Suica



Source: East Japan Railway Company Annual Report 2012 as of 31 March 2012

Besides mass rapid transit, Suica can also be used with taxis and public buses, as well as using as a cash card to make a purchase in convenience stores, vending machine, and Nartita airport.

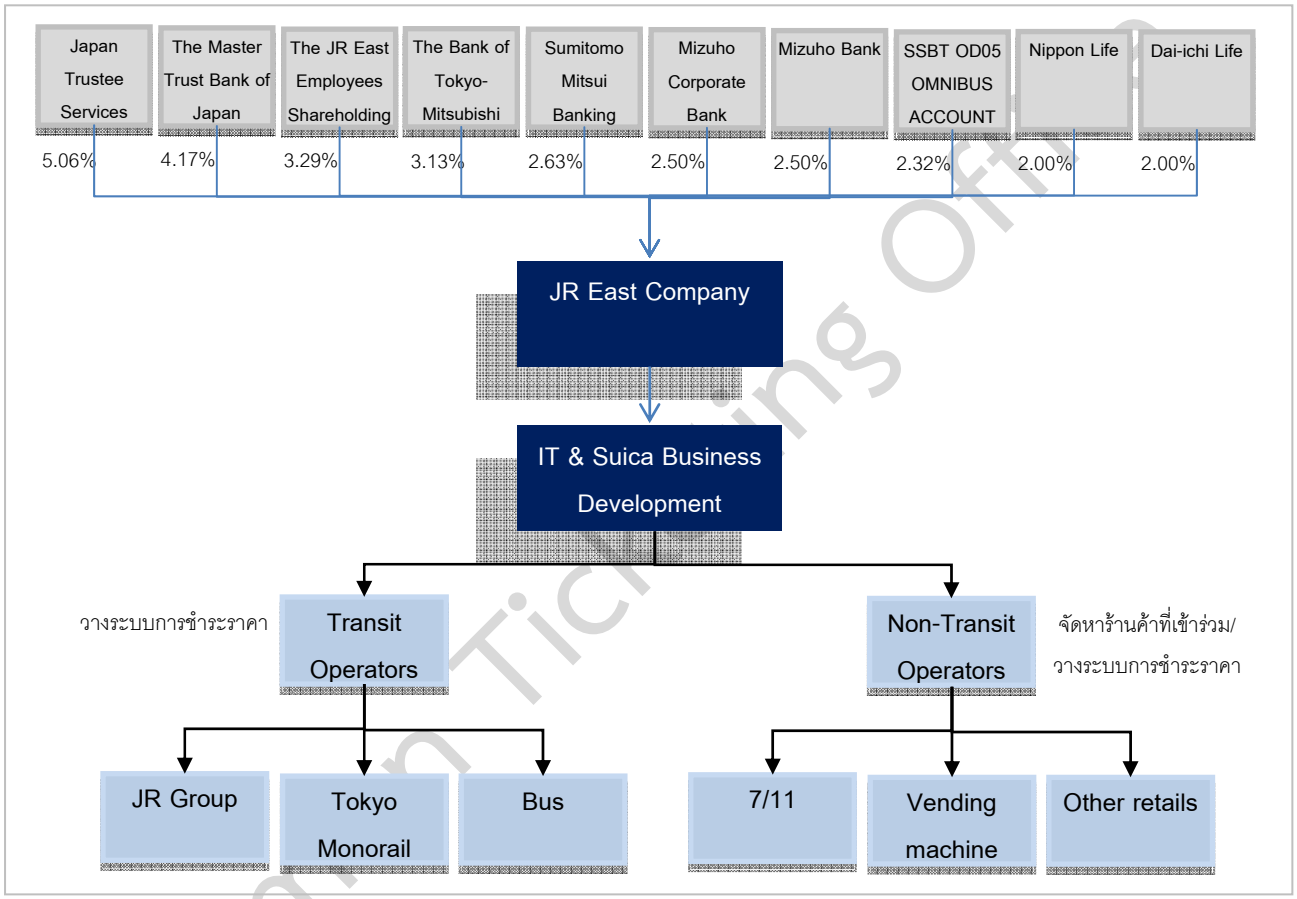
Figure 2.3-18 Places and services that use Suica

2) CTO Structure

East Japan Railway used to be a subsidiary of Japanese National Railways. In 1987, Japanese government reformed the Japanese National Railways into seven public companies, each of which is responsible for different areas. East Japan Railway services cover Tokyo, Yokohaya, Nagoya, Kyoto, and Osaka.

In 2002, East Japan Railways registered in the Tokyo Stock Exchange. The top 10 stockholders are:

Figure 2.3-19 JR East Company Structure

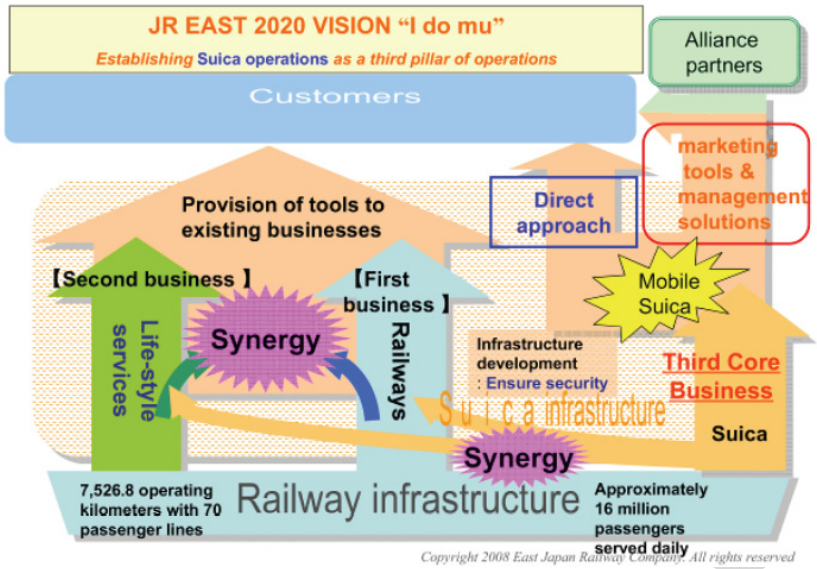


Source: East Japan Railway Company Annual Report 2012 as of 31 March 2012

3) Policies

- Initiate the business from mass rapid transit to reduce operational cost
- Integrate SUICA with Life-style services
- JR EAST made a policy and plan for selling SUICA under the name of JR EAST 2020 VISION "I do mu"

Figure 2.3-20 JR East Visions towards the development of SUICA

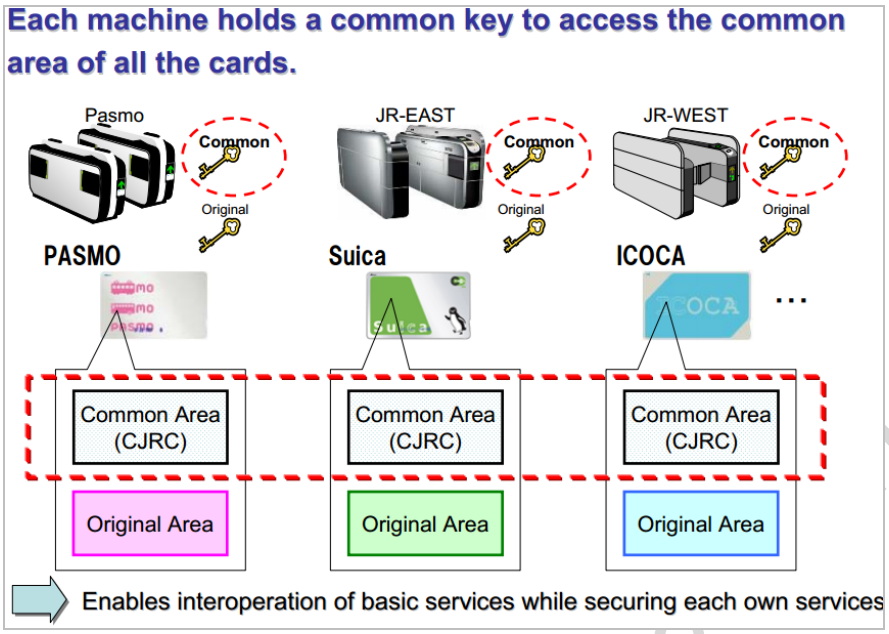


- Use SUICA information to extend the market to non-transit services, including Mobile SUICA
- Ensure interoperability
- Do not make common fare
- JR EAST used its large number of customers to attract other entrepreneurs to join the business.

4) Common Ticket

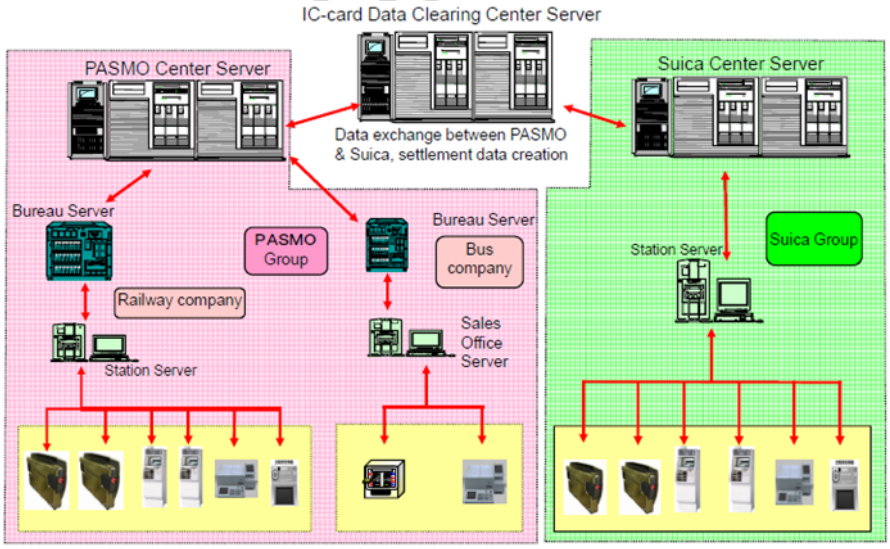
SUICA, PASMO and other cards use FeliCa technology. Thus, it is easy for interoperability. This can be made by designing central data and central key, but still retain specific space for each service provider.

Figure 2.3-21 Common Ticket in Japan



Suica and PASMO cooperated to establish common IC-Card Data Clearing Center. Both Suica's and Pasmo's acquirer would send transaction data to the clearing center, and would receive settlement data in return.

Figure 2.3-22 Interoperability between Suica and Pasmo



5) Success

- There are 40 million Suica cards circulated in the system. The services cover 2,990 transit stations and more than 175,000 stores. There are approximately 35 million transactions per day.
- JR EAST stores (around 15,000) have 3 million transactions that are from Suica.
- There are other 100,000 stores that accept Suica. They have around 20 million transactions each day.
- There are other 74,000 stores that have around 12 million transactions per day
- Good user experience
- Highest interoperability
- Have a single standard, as Suica uses off-the-shelf technology

6) Common Tickets

There are four types of Suica cards:

1. Regular-type Suica card. The minimum value is JPY 2,000; only JPY 1,500 can be used, while JPY 500 is the deposit.
2. Suica card commuter. This type allow unlimited trips between two stations. Extra charge would be added if the trip is made to other stations.
3. JR East Pass. This type allows unlimited usage. It is suitable for tourists and the passengers who travel across regions.

Table 2-1 East Pass Fare Rate

	Type	Basic			Express	
		Adults +26 yrs	Teenagers 12-25 yrs	Children 6-11 yrs	Adults +12 yrs	Children 6-11 yrs
EAST PASS	5 Days	JPY 20,000	JPY 16,000	JPY 10,000	JPY 28,000	JPY 14,000
	10 Days	JPY 32,000	JPY 25,000	JPY 16,000	JPY 44,800	JPY 22,400
	4 Days (no start date)	JPY 20,000	JPY 16,000	JPY 10,000	JPY 28,000	JPY 14,000

4. Co-Issued Suica. This type is issued by JR East and other providers, such as Monorail Suica cards, Rinkai Suica card, and JAL Card Suica.

2.3.2 Republic of Korea

1) General information

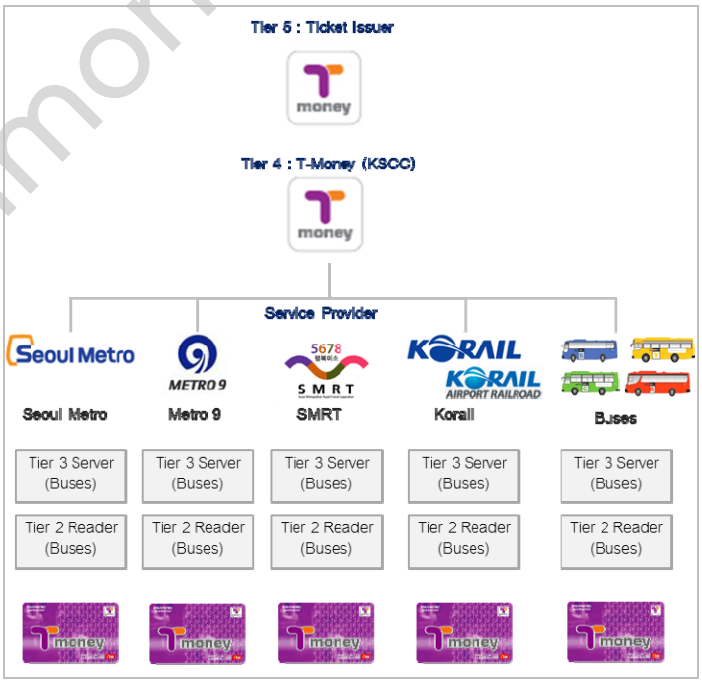
The common ticket system firstly started from the implementation of the AFC system in the subway and bus systems to solve the traffic problems, and then continue to expand into the non-transit system. The bidding of common ticket system implementation was held by the Seoul Metropolitan Government, Korea Smart Card Co., Ltd. (KSCC) won the concession. KSCC is owned by LG CNS Co., Ltd, equipment providers, 13 financial institutions and Seoul Metropolitan Government holds 26% of shares and supervises the KSCC's operation. KSCC modified the existing fare collection system to meet the standard set by the government.

The common ticket called T-Money Card, which is a Microprocessor, was launched in 2003. The cards were issued by the service providers of cash, credit card and banks while KSCC was the intermediary between service providers and issuers. The T-Money Card originally uses the MIFARE Classic technology which is an off-the-shelf-product to meet the card launching schedule, and then develop its own standard afterward. The T-Money Card is now accepted by subways, taxis, buses, retails, theaters and restaurants. However, both standard remain in the system of which about 60% are Type A.

Moreover, there is another major clearing house which is Cashbee of Lotte which also started from using MIFARE Classic technology but with different cards data structure from KSCC's. The Cashbee uses the KSCC's standard version 2.0 while the system is able to read many card standards.

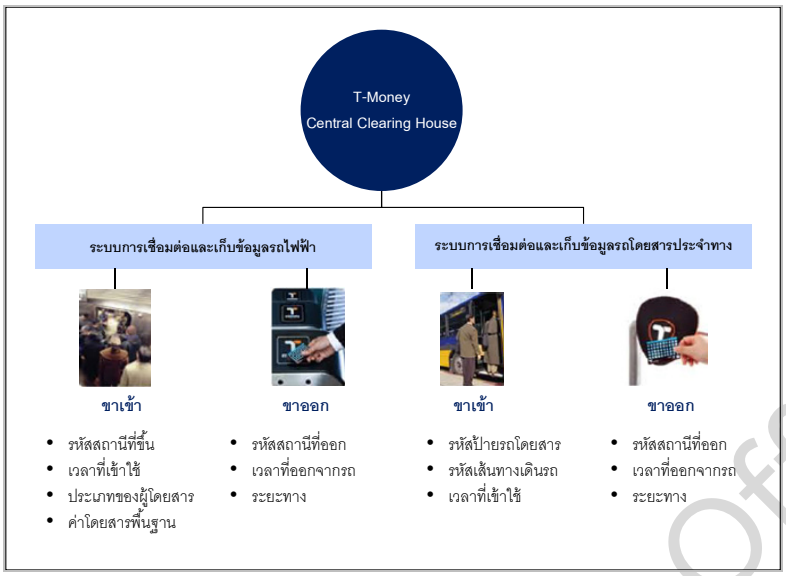
However, the T-Money Card has market share as followed, 93% of buses, 100% of subways and 30% of taxis, and is usable in Seoul and other cities such as Incheon and Busan.

Figure 2.3-5 AFC system



Source: Korea Smart Card Co., Ltd.

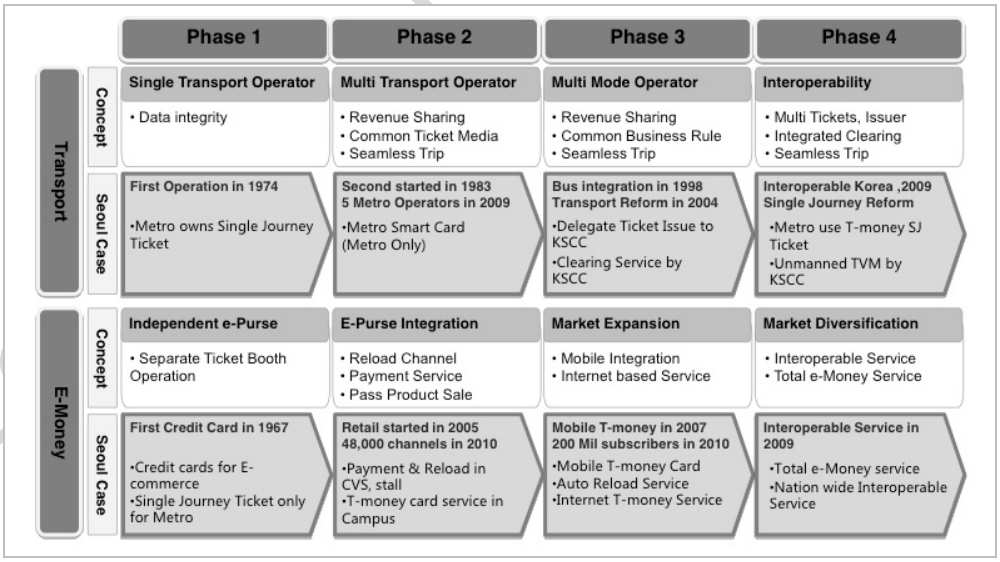
Figure 2.3-6 T-Money's CCH data delivery



Source: Korea Smart Card Co., Ltd.

KSCC's common ticket system management is a large system, capable to handle numerous transactions with one of the world's highest performance. Republic of Korea is one of the most successful in implementation of a whole new system from the Seoul Public Transport Reform including rerouting the bus and speed bus routes, define new parking spot and improve the rail network with new fare.

Figure 2.3-7 T-Money's evolution



Source: Korea Smart Card Co., Ltd.

The travel fares of the transit mode are determined and controlled by the government to prevent the operators to over gain while subsidize in the case of loss. Thus, the operators have a limit to invest in improving the facilities in the stations.

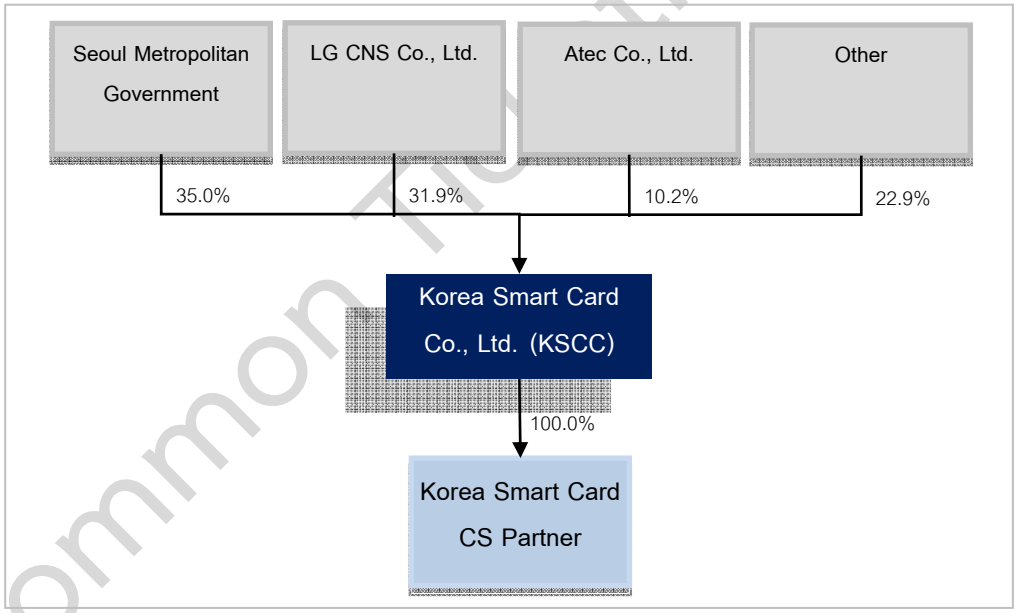
The case of Republic of Korea is similar to the Singapore's, which it set up its own standard and the government takes responsible for the system's improvement concerned on security issues.

2) Organization's structure

Korea Smart Card Co., Ltd. (KSCC) was established from the cooperation of Government and private sectors and has 3 major shareholders which are

1. Seoul Metropolitan Government who manage the Seoul's transportation
2. LG CNS Co., Ltd. which is an information technology service provider)
3. Atec Co., Ltd which is an information technology service provider for transportation cards, screens and system.

Figure 2.3-8 KSCC's structure



Source: Korea Smart Card Co., Ltd.

2.1) Policies

1. Rerouting the bus routes to reduce traffic problems
2. The local government is responsible for the transportation management
   - The local government define the fares
   - Transfer fee subsidy

- Reduce the revenue handling cost of metro operators by undertaking a feasibility study of AFC system operational expense between operating on its own and outsource to a transportation service provider and found out that 35% (about 65 million won) will be reduced within 6 years period if outsourcing
- T-Money Card is accepted by KTX train which is an inter-provincial train

Table 2.3-3 Comparison of AFC system operational expense

Approximately 35% reducing cost effect compared with direct operation of metro operator. Outsourcing brings about 65 Million cost reduction during 6 years

Case	2004	2005	2006	2007	2008	2009	Total
[Case 1] Directly provide service By operators(metro)	5	22	16	30	27	89	**189**
[Case 2] Outsource service	10	20	21	23	24	25	**124**

2.2) Common ticket system

Started from Upass card which is a MIFARE Classic technology and change to T-Money which is a KSCC Card Standard version 2.5

KSCC designed the whole system, outsourced to the third party to develop the card OS according to the KSCC's standard, assigned LG CNS to develop the CCH and modify the AFC level 2 and 3 of most of the existing operators and also outsourced server management to LG CNS.

2.3) Success of the common ticket system

- 45 million cards issued
- 35 transaction per day consist of 11.2 million of subways, 8.95 million of buses, 8.32 million of cars and the rest of other transit and non-transit mode
- 24,000 readers are installed for buses, 10,000 readers for subways, 89,000 for taxis and 50,000 for the non-transit

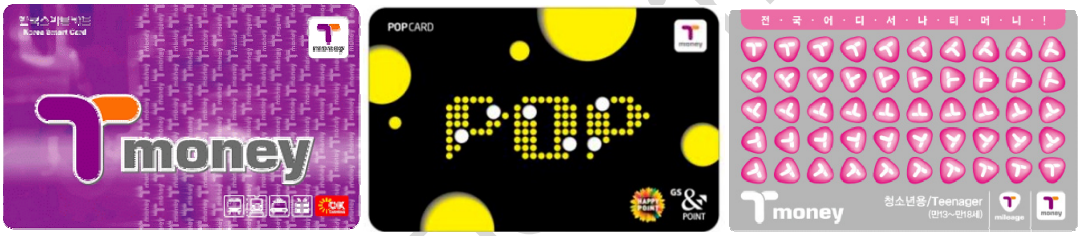
2.4) Common ticket

- Basic Card
- Seoul City Pass
- Affiliated Card which is issued by the affiliated entities and is able to use as a T-Money card
- Internet T-Money is an electronic device which can be top-up online

Figure 2.3-9 Internet T-Money

- Accessory is a portable digital device
- Mobile which contains T-Money chip and is used as a T-Money card when touch with readers
- On Demand which is a tailored-made card

Figure 2.3-10 T-Money cards



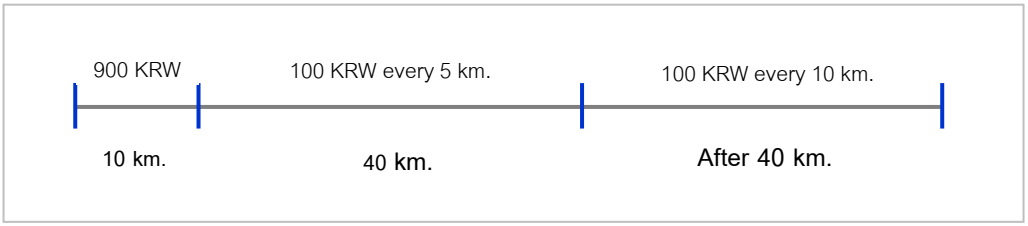
However, there are 3 ways to top-up which are online top-up, mobile top-up and top-up agents

2.5) Fare

Table 2.3-4 Fare table

Type of transportation	Condition
Buses	Flat fare KRW 900 or KRW 1,700 for interregion buses
Subways	• Basic fare KRW 900 for the first 10 km. and • Distance-based fare KRW 100 for every 5 km. to 40 km. and • KRW 100 for every next 10 km.
Transfer	Free transfer between bus to bus or bus to subway within 30 minutes (maximum 5 times)

Figure 2.3-11 Subways fare by using T-Money



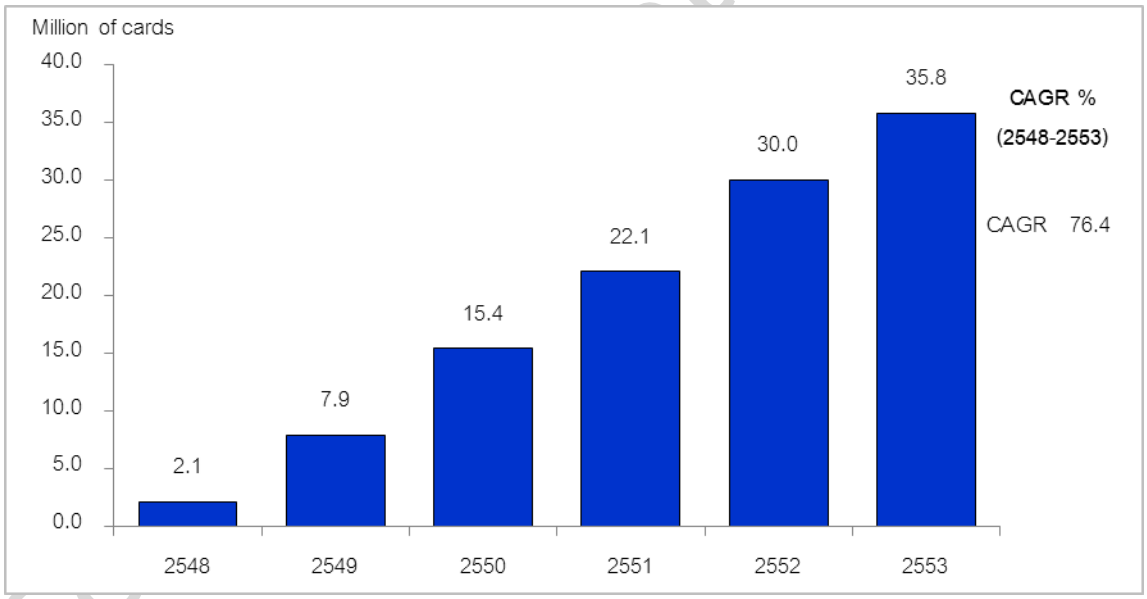
Source: Korea Smart Card Co., Ltd.

2.3.3 United Kingdom (London)

1) General information

The common ticket system in London started in 2003 and is administered by Transport for London (TfL) which is an integrated body under the Mayor of London. TfL is responsible for capital's transportation and operates according to the Mayor's policies which include London's buses, London Underground, Docklands Light Railway (DLR), London Overground, Tramlink, London River Services and Victoria Coach Station. The common ticket called "Oyster" card which is accepted by most of the transit mode.

Figure 2.3-12 Number of cards issued between 2005-2010



Source: Transport for London

The federal government developed the ITSO standard applied with the transportation smartcard within the United Kingdom but it is not generally adopted and only some cities adopted such ITSO due to its high cost of modification. However, TfL hired MTRC Company from Hong Kong to study in the standard and decided to choose an off-the-shelf-product which is MIFARE Classic to implement the common ticket and launch the Oyster in Greater London in 2003. The launch of Oyster card is emphasized on reduces transit operation cost and it is the reason that leads Oyster to its success. Currently, Oyster card is accepted bu London

Underground, buses, the Docklands Light Railway (DLR), London Overground (LO) and National Rail within the London Fare Zone.

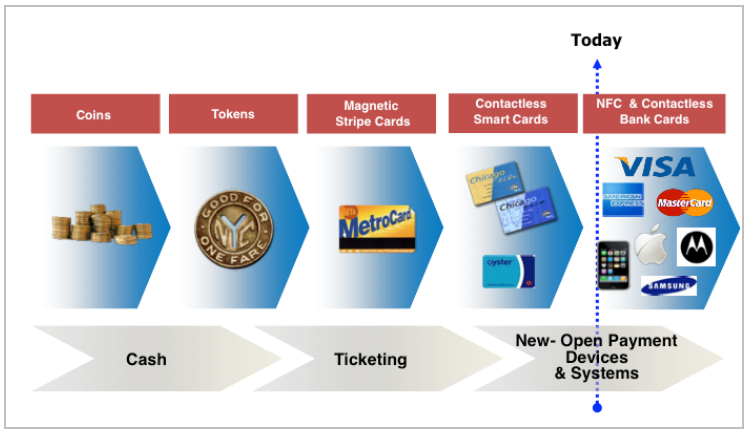
In 2009, there MIFARE Classic was hacked, TfL decided to modify the Oyster card for security and changed to MIFAE DESFire EV1 and terminated MIFARE Classic in 2010. Since both MIFARE Classic and MIFARE DESFire EV1 are off-the-shelf-products and are developed by the same service developer, the data from MIFARE Classic is possible to be transferred to MIFARE DESFire EV1.

Figure 2.3-13 Oyster card

The TfL's Management of Oyster is a good example for implementing the common ticket system. It emphasizes on the transit mode and the long run operation. TfL chose to use the MIFARE DESFire EV1 which is an off-the-shelf-product instead of implementing its own standard. It also planned to have banks issue the cards with EMV (Europay, Master and Visa) standard, that way, TfL only emphasizes on improving, its services and cost reduction. Moreover, TfL will change to Open Loop Account Base system, which requires a stable infrastructure and communication network, which TfL has planned and studied for the implementation in the future.

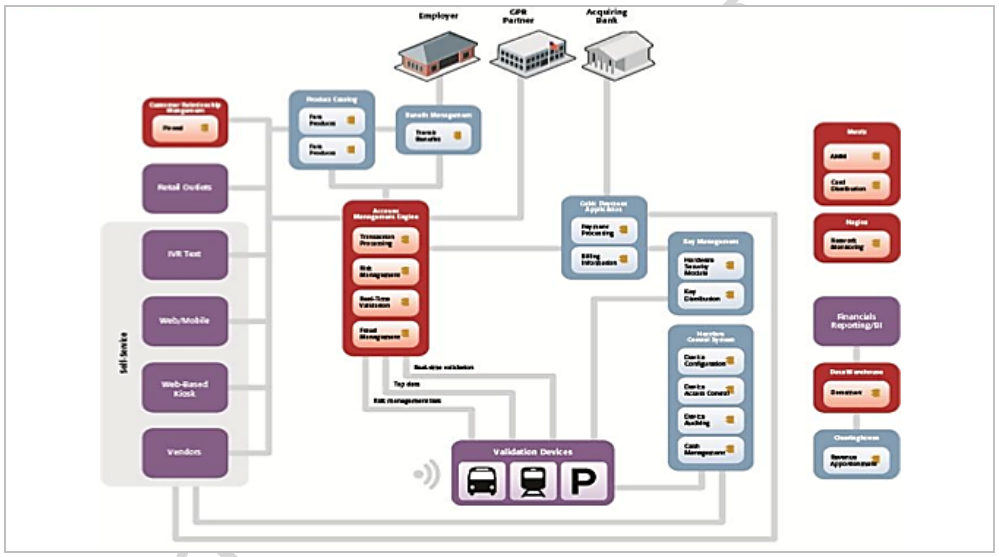
TfL planned to start using the EMV standard in 2014. However, it still has problem with the speed (500 msec/transaction, currently) which needs improvement to meet the EMV standard's requirement and also in the process of testing the NFC technology.

Figure 2.3-14 Common ticket system innovation in London



Source: Transport for London

Figure 2.3-15 Open Payment AFC System in London



Source: Transport for London

TfL will gather transportation data and hire a private organization to operate the AFC system and CCH, and also implement the Vision 2030 policies which includes BRT and Bike Lane and sidewalk expansion to serve the increasing passenger transportation.

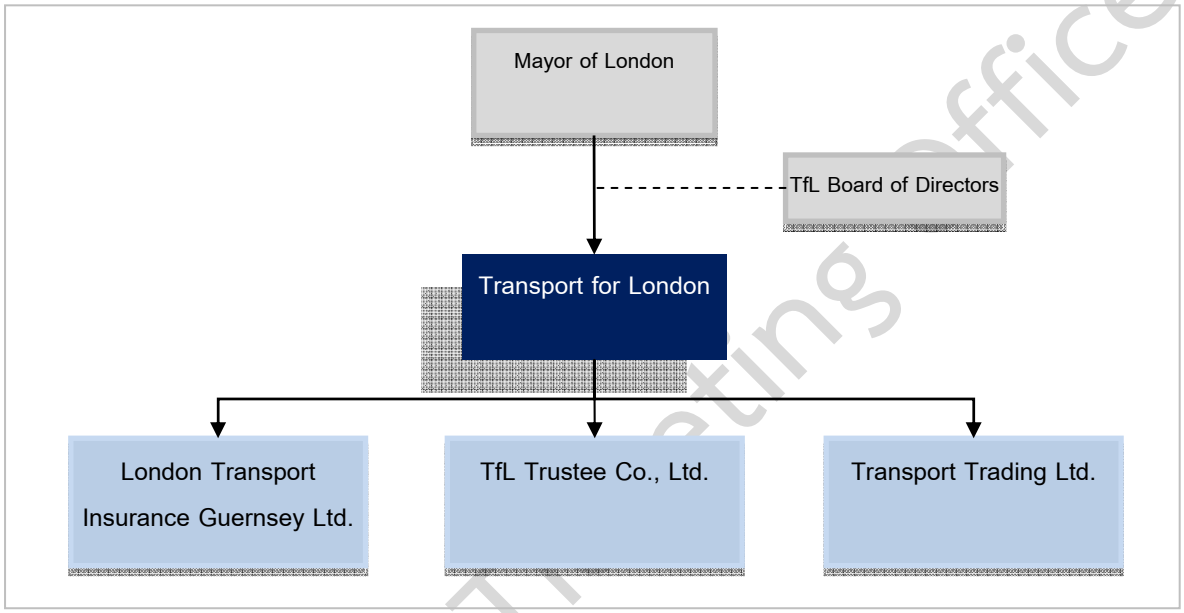
2) Organization's structure

TfL is a government body under the Mayor of London established in 2000, responsible for the Capital's transportation. TfL operates under the Mayor's strategy in transportation. In addition to TfL's aforementioned responsibilities, TfL is also responsible for managing the Congestion Charge, maintaining the 580 km. roads and traffic lights, and promoting a range of walking and cycling.

In addition, TfL has 3 subsidiaries which are

1. London Transport Insurance Guensey Ltd. which is an insurance company provides service to TfL and its subsidiaries
2. TfL Trustee Co., Ltd., a trustee of the TfL Pension Fund
3. Transport Trading Ltd., a holding company for all transport operators, operates certain trading activities

Figure 2.3-16 TfL's structure

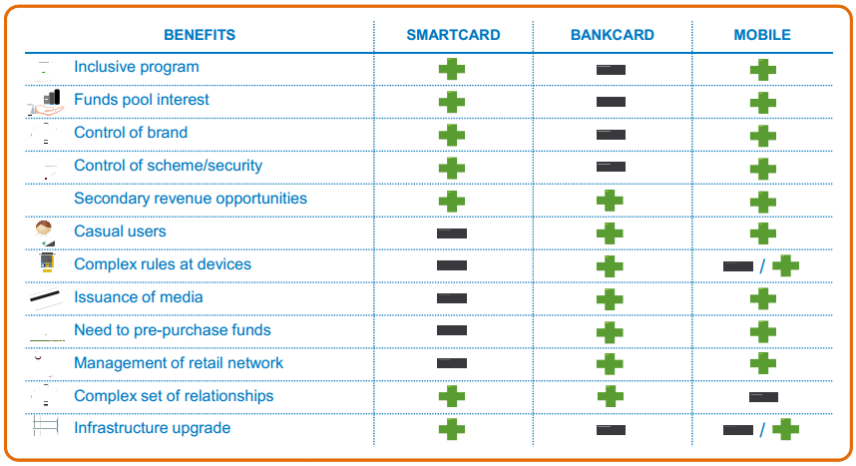


Source: Transport for London

3) Policies

1. Using oyster card allows users to pay lower fare rate than single journey ticket for 15-50% based on distance
2. The Oyster off-peak fare is slightly lower than the peak fare
3. A large customer base of Oyster may attracts banks to participate in Account Base System (EMV Standard) which banks are interested in Micropayment business. TfL and the banks agreed to develop in 2014 with a condition that the banks shall pay £ 6 for each fault to TfL
4. TfL has been studied on innovations by comparing advantages of the Smartcard, Bankcard and Mobile shown in the Figure 2.1.2-32 and foreseen an opportunity to change to Bankcard or Mobile (NFC Technology) in the future

Figure 2.3-17 Smartcard, Bankcard and mobile comparison



BENEFITS	SMARTCARD	BANKCARD	MOBILE
Inclusive program	+	–	+
Funds pool interest	+	–	+
Control of brand	+	–	+
Control of scheme/security	+	–	+
Secondary revenue opportunities	+	+	+
Casual users	–	+	+
Complex rules at devices	–	+	– / +
Issuance of media	–	+	+
Need to pre-purchase funds	–	+	+
Management of retail network	–	+	+
Complex set of relationships	+	+	–
Infrastructure upgrade	+	–	– / +

Source: Transport for London

5. TfL has an operational expense comparison between managing Oyster itself and outsourcing, which is found that the expense can be reduced if outsourced the operation to banks.

4) Common ticket system

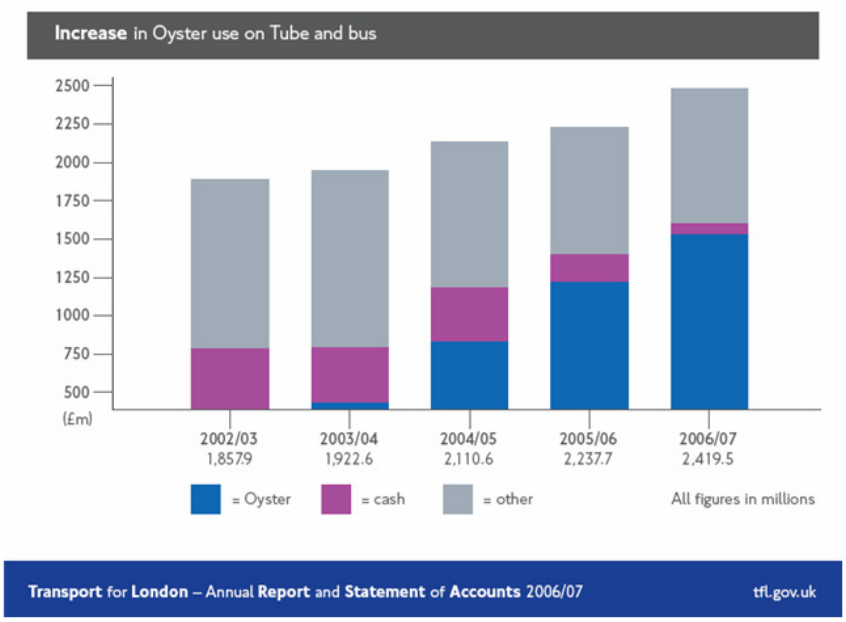
Oyster card is MIFARE DESFire EV1 technology.

The CCH was developed by Cubic, which has outstanding capacity of data management that includes users data, that can be used to calculate the repairing cost and make decision on salary base and staff promoting automatically. Currently Cubic is developing NEXT Fare system to support the Account Based System of TfL for the launch in 2014. The system will contain the same capability with EMV feature. The banks will be card issuers whose network will be interfaced with the system to manage the EMV card.

5) Success of common ticket system

- 43 million cards issued
- 6 million transaction per day
- 80% of transportation payment in Greater London are using Oyster

Figure 2.3-18 Increasing in Oyster users



Source: Transport for London

6) Common ticket

The Oyster card is able to use on 2 systems which it will automatically switch between 2 systems. The 2 systems include

1. Pay as you go which is a stored value card that applies the distance based fare which will be deducted from the card. However, the fare of using card is lower than cash payment
2. Travelcard is classified to weekly, monthly and annual card.

There are 3 types of the cards which are

1. Children card for students age 18 and older, 16-18 years old, 11-15 years old and 5-10 years old
2. Adult card
3. Concession card for seniors, disabilities and veterans

Figure 2.3-19 Oyster card

7) Fares

1. Tube, DLR and London Overground

Distance	Pay as you go (£)		Travelcard (£)		
	Peak	Off Peak	Week	Month	Annual
Only Zone 1	2.1	2.1	30.4	116.8	1,216.0
Zone 1-2	2.8	2.1	30.4	116.8	1,216.0
Zone 1-4	3.8	2.7	43.6	167.5	1,744.0
Zone 1-6	5.0	3.0	55.6	213.6	2,224.0

2. National Rail Services

Distance	Pay as you go (£)		Travelcard (£)		
	Peak	Off Peak	Week	Month	Annual
Only Zon 1	2.2	1.7	30.4	116.8	1,216.0
Zone 1-2	2.4	1.9	30.4	116.8	1,216.0
Zone 1-4	3.6	2.5	43.6	167.5	1,744.0
Zone 1-6	5.7	3.5	55.6	213.6	2,224.0

3. Bus and Tram

Card type	Pay as you go (£)	Travelcard (£)		
		Week	Month	Annual
Fare	1.4 (Maximum 4.4)	19.6	75.3	784.0

Source: Transport for London

2.3.4 Republic of China (Taiwan)

1) General information

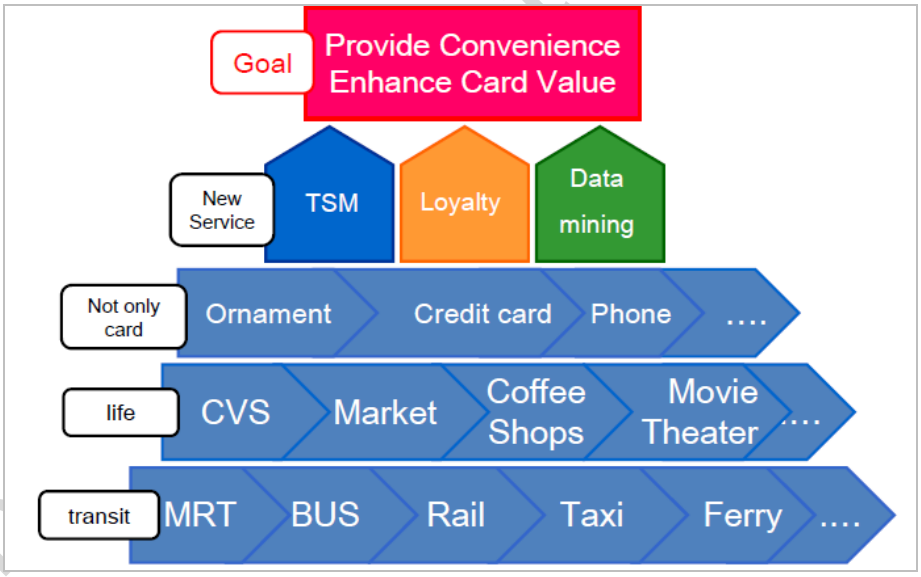
The common ticket project started in 2545 by Easy Card Corp. which the government hold 40% of shares and 60$% of shares held by banks and operators. Easy Card Corp. is an issuer and the operator of Easy Card which is a Microprocessor card using MIFARE which is an off-the-shelf-product. The beginning of the common ticket system was accepted by subways and buses, and in 2014 the service will be expanded to ferries. In 2009, the common ticket the service expand to interregion buses, and in 2010, expand to non-transit business for Small Value Payment which has more than 39 chain stores or more than 2,000 stores.

Figure 2.3-20 Easy Card

Currently, Taiwan has developed the Loyalty Program which has 3 phases which are

1. Anonymous: to expand the service points or stores to attract more user and may provide some discount
2. Register: to gather data for the customer data base purpose. It may provide promotion other than discount for registered users such as point collection to exchange for souvenirs or trips
3. Data mining marketing: which is a data management technique for marketing planning to serve customers' need

Figure 2.3-21 Taiwan's Loyalty Program



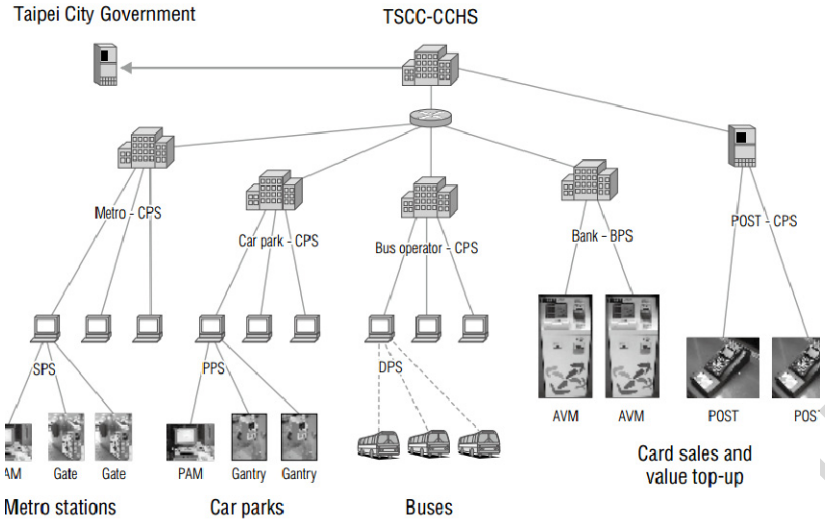
2) Policies

The advantages of Taiwan's common ticket system implementation is the gradually development in transit system until the system is stable and then expand to the non-transit system. However, due to the legal obstruct, the expansion to non-transit system is relatively slow.

3) Common ticket system

The Easy Card uses MIFARE technology.

Figure 2.3-22 Taiwan Common Ticketing System Architecture

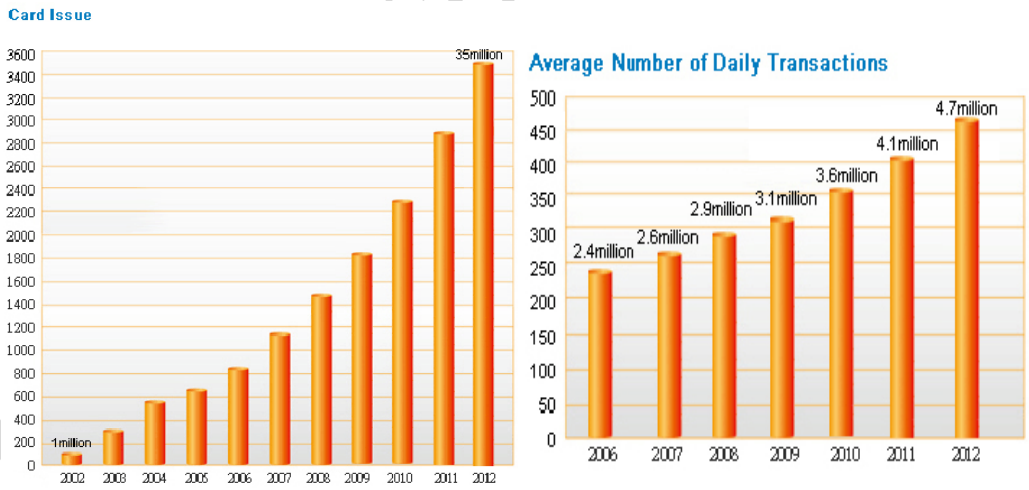


Source: Japan Railway & Transportation Review No. 50 – Sep 2008

Hyweb Company is an operator of the CCH (Transportation Smart Card Ticketing Center (TSCC) in Taiwan)

4) Success of common ticket system

Figure 2.3-23 Number of cards issued and transaction of Easy Card



Source: www.easycard.com.tw

- More than 35 million cards issued (As of 2012)
- 4.7 million transactions per day
- 60% of utilization in Taipei and 40% of the surrounding areas
- The utilization initially started with the governmental transit system, then expand to the private transit and non-transit system

5) Common ticket

1. Adult Easy Card: which applies regular fare rates
2. Student Easy Card: which applies special fare rates. The users are required to have student ID card to identify themselves otherwise pay the regular fare rate.
3. Concession Easy Card: which applies special fare rates. The concession card is for persons over 65 years old, children with no ID card and person who registered as disabilities.

6) Fares

Every types of card are available and can be top-up at any subway station and convenience stores such as 7-Eleven, Family Mart, Hi-Life and OK which has or

Card Price

The subway stations sell adult and children card for NT$ 500 which contains NT$ 400 usable value and NT$ 100 deposit. Concession card for NT$ 300 which contains NT$ 200 usable value and NT$ 100 deposit.

Convenience stores such as 7-Eleven, Family Mart, Hi-Life and OK sell every types of card for NT$ 200 which contains NT$ 100 usable value and NT$ 100 deposit.

Every types of card can be top-up to NT$ 10,000

2.3.5 Malaysia

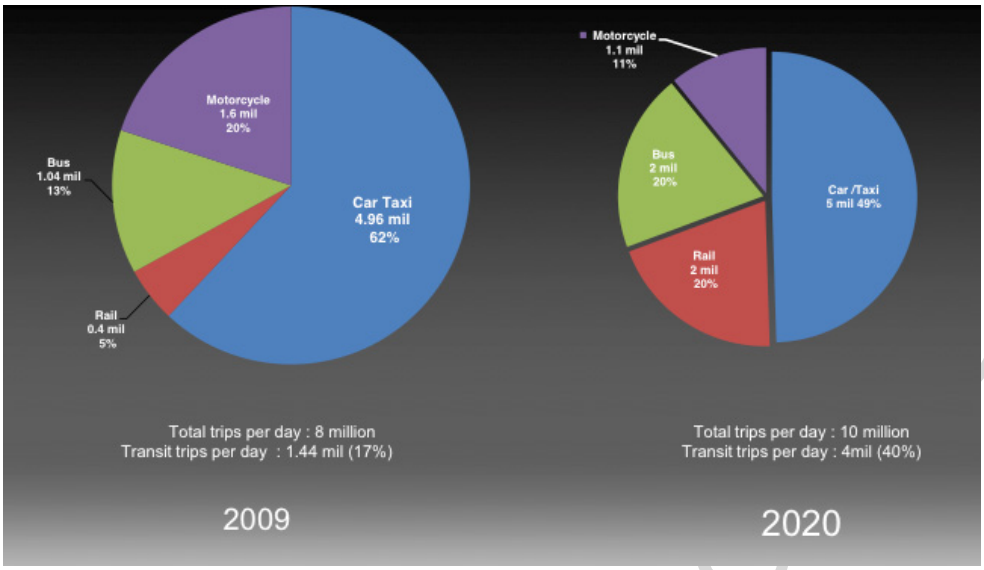
1) General Information

The development of the common ticket was initiated in 1994 by Teras Teknologi (TERAS). The ticket was named Touch 'n Go (TnG). It was firstly used in 1996 in express and highway.

Figure 2.3-23 Touch'n Go

Touch'n Go is a microprocessor type, using Mifare technology which an off-the-shelf-product. The ticket became successful with the express way. It was then extended to be used in railway and other businesses. There are 26 express way providers, 4 public bus service providers, 46 parking lot, 3 theme parks, and other 31 shops using the cards.

Figure 2.3-24 Expected growth of Malaysian Mass Transit



Source: TERAS

It is expected that the number of TnG used in railways will be increased from 0.4 million rounds to 2 million rounds per day in 2020, while the number in public buses will be increased from 1 million to 2 million.

2) Policies

- The use in express ways has increased
- The market share in mass transit should be increased within the next 10 years
- There must be a lot of reload kiosks to support value topping up
- There are more than 2,000 gas stations
- There are more than 3,000 ATMs and bank branches
- There must be automatic reload agents. This can be cooperated with the banks that have more than 100 kiosks
- Study and review topping up via mobile and the Internet

3) Systems

- TnG uses Mifare technology
- Clearing house was developed from the express way; however, it had some limitations. Presently, TnG has been consulting with consultants, such as OCL, regarding the development of a new clearing house.

4) Success

- There are more than 10 million users of TnG
- There are more than 2 million transactions
- The use of TnG in transit systems is 76% from all transactions

5) Common Tickets

There are four types of Touch 'n Go cards:

5.1) Touch 'n Go Card

Regular type of card for all ages and genders. The users may customize the screened photo on the cards (also called photo card).

5.2) Zing card

TnG cooperated with other providers in issuing Zing card. This type of card can be used with credit cards, such as AEON, CIMB bank, May Bank, and AFFIN Bank.

6) XS Card

XS cards are issued particularly for office workers, to help them reducing the cost of living. The card can be categorized as: biz XS card and fleet XS card. Biz XS card covers services on electric trains, express ways, and parking fee; however, the fleet XS card does not cover the express way service and parking lot service.

6.1) Special Common Ticket

Special common tickets are particularly designed accordingly to providers' demands. The main purpose is normally to promote the business.

7) Card Issuing Agents and Top-up agents

The regular can be found at any Touch 'n Go centers, train stations, and gas stations. The card value is at RM 10 (deposit RM 0.50).

Zing cards can be purchased from the providers. XS cards can be purchased by office workers of the companies that join the program.

There are various card values: RM10, RM20, RM35, RM50, RM100, RM200, RM500, and RM1,500

Source: http://www.easycard.com.tw/english/easycard/index.asp

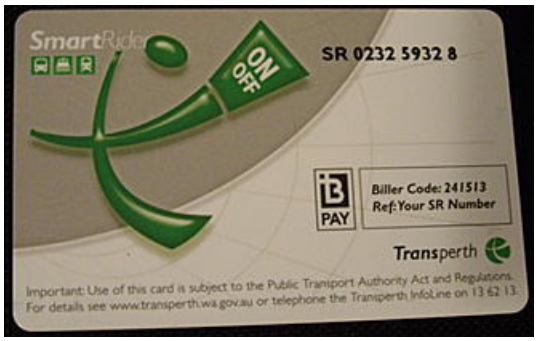
http://www.touchngo.com.my/

2.3.6 Australia

1) General Information

The development began in 2004, by having Rapis KL that is a card issuer for mass transit in Perth and Eastern Australia. The card is called SmartRider Card. SmartRider is a microprocessor card, using Mifare technology. It can be used with trains, buses, and parking lot.

Figure 2.3-25 SmartRider



Besides Perth, Sydney and New South Wales also use common ticket system. The system was initiated in 1998, as the government wanted it to be used in Sydney Olympics 2000; however, it was not successful. The system was eventually terminated in 2008. In 2009, the system was reviewed. The system uses an off-the-shelf product and an infrastructure maintenance system from Great Britain. However, there is also a clearing house system that was established by the Australians. In 2011, Opal ticket has been used in Sydney mass transit.

Figure 2.3-26 Opal

Chapter 3 Assessing Technologies for the Development of the Common Ticket System

3.1 Micropayment system

Micropayment is a type of electronic cash card that is used to purchase products and services with small amount. Examples of the cards are BTS card and prepaid card. To indicate the maximum amount that can be paid by a micropayment, it depends on the cost of living in each country. Two types of micropayments currently used in Thailand are:

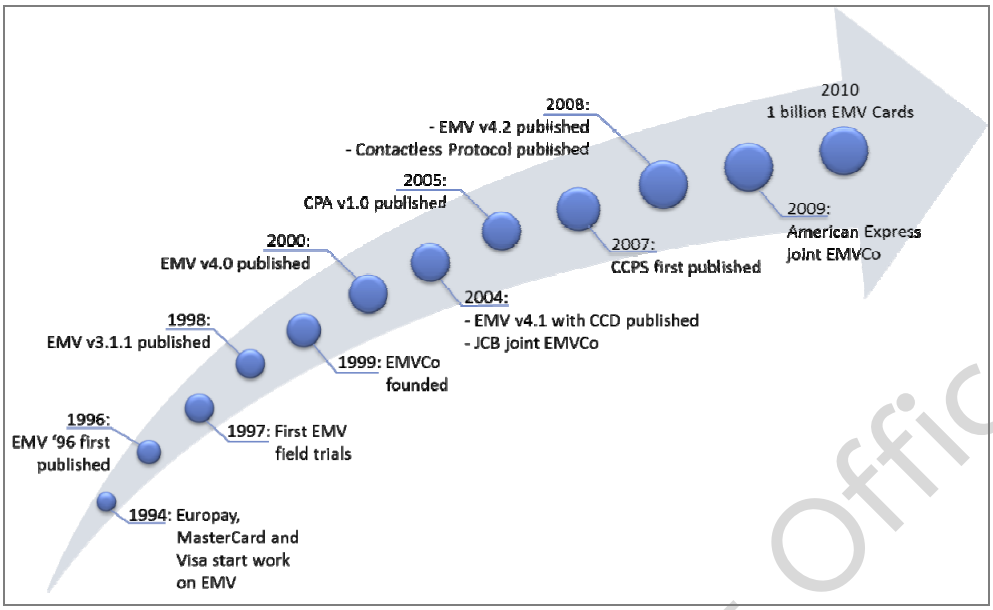
1. Transit sector: BTS, MRT, and ETC Easy pass
2. Non-transit sector: Value Card, Telephone Card, and Online Game Card

Figure 3.1-1 Micropayment cards in Thailand

3.2 EMV System

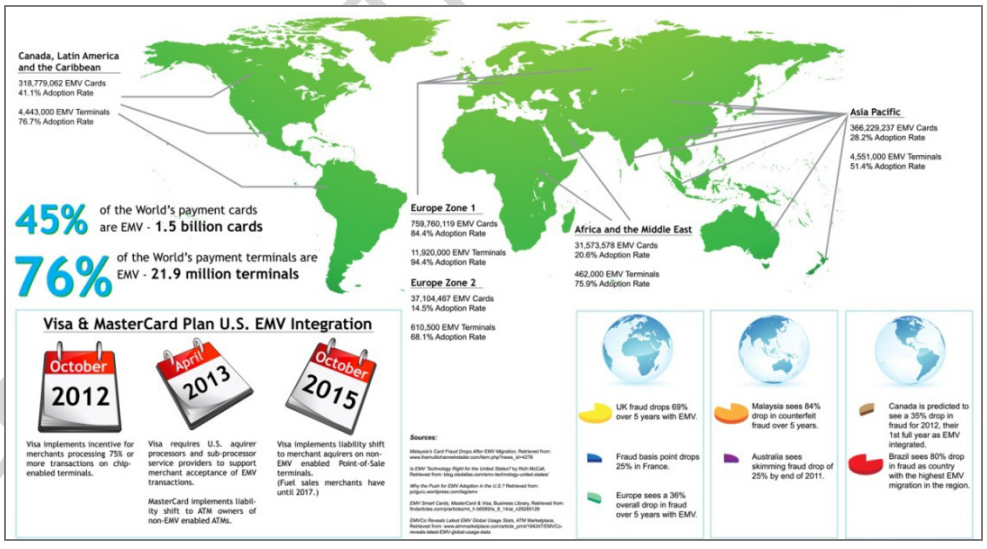
EMV stands for Europay, MasterCard and Visa. EMV is a standard for an IC Chip for a payment system. It was developed by Europay, MasterCard, and Visa, which is also operates as its central clearing house (CCH). EMV standardizes the operation between the cards that have IC Chip and Terminals. Many service providers later joined the system; for example, JCB, American Express, and Discover/Diners Club.

Figure 3.2-1 EMV Standards Evolution



EMV controls the connections at all levels, including physical level, electronic data transfer level, and application level. The standards are based on ISO/IEC 7816 (for contact cards) and ISO/IEC 14443 (for contactless cards. EMV Chip is responsible for data storage, data processing, as well as data encryption and decryption.

Figure 3.2-2 Number of Cards and Terminal used Worldwide



Source: 186http://itpm.ca

The use of EMV standards began in 1997, by changing from magnetic stripe card to EMV. Presently, 45% of the credit cards are EMV type; majority of them are contact-card type. Fifty-five percent of the credit cards are still magnetic-stripe cards. Seventy-six percent of the terminals are able to support EMV. The countries that use EMV cards are elaborated in figure 3.2-3.

Figure 3.2-3 Countries that use **EMV**, classified by geographical locations

Canada, Latin America and The Caribbean	Asia Pacific	Africa and the Middle-East	Europe Zone 1	Europe Zone 2
Canada Mexico All Central American Countries All South American Countries All Carribbean Countries	Australia New Zealand Greater China Japan North & South Korea Mongolia India Sri Lanka Bangladesh Bhutan Nepal South & South-East Asia	All African Countries The Middle East Levant	Andorra Austria Belgium Bulgaria Cyprus Czech Republic Denmark Estonia Finland France Germany Gibraltar Greece Greenland Hungary Iceland Ireland Israel Italy Liechtenstein Latvia Lithuania Luxembourg Malta Netherlands New Caledonia Norway Poland Portugal Romania Slovak Republic Slovenia Spain Sweden Switzerland Turkey UK	Albania Armenia Azerbaijan Belarus Bosnia & Herzegovina Croatia Georgia Kazakhstan Kyrgyzstan Macedonia Moldova Serbia & Montenegro Tajikistan Turkmenistan Russia Ukraine Uzbekistan

* Data from the United States has not been incorporated into EMVCo's reported statistics. Accordingly, it is not incorporated into the defined regions.

Source: 187http://www.nfcworld.com

The statistics in the year 2010 indicates that EMV cards have been issued for approximately 1 billion cards; and 15.4 million for the terminals.

Figure 3.2-4 EMV Number of Cards and Terminals, classified by geographical locations

Region	EMV Cards	Adoption Rate	EMV Terminals	Adoption Rate
Canada, Latin America, and the Carribbean	182,185,043	26.4%	2,000,000	55.6%
Asia Pacific	305,126,927	26.6%	3,200,000	41.6%
Africa & the Middle East	16,841,874	13.7%	348,000	62.5%
Europe Zone 1	555,688,434	65.4%	9,400,000	84.7%
Europe Zone 2	22,817,271	11.5%	457,800	61.2%
United States†				
TOTALS	1,082,659,549	36.0%	15,405,800	65.0%

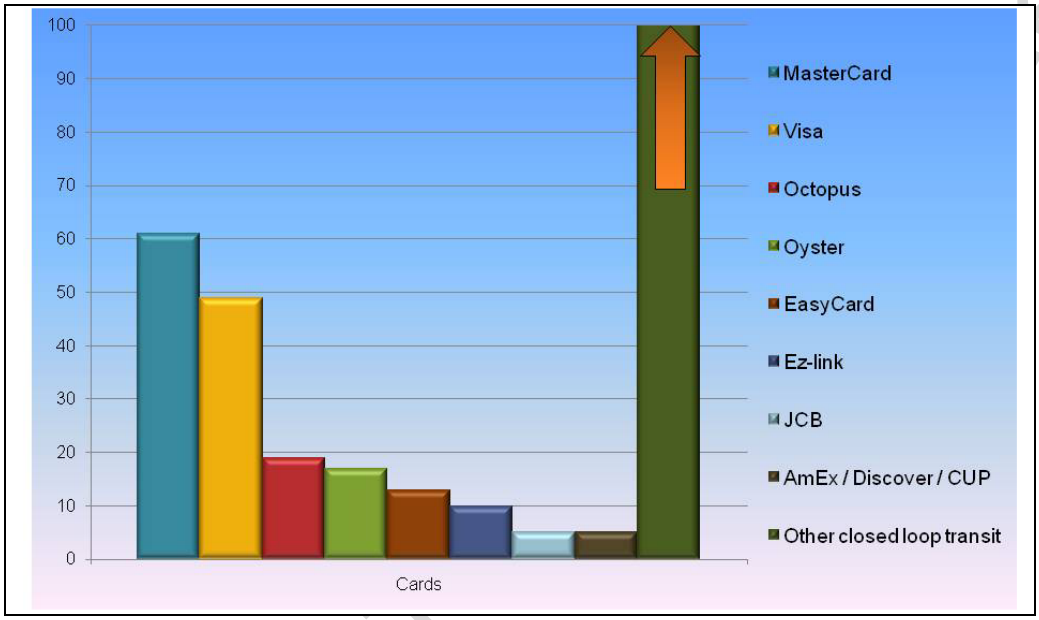
* Figures reported in September 2010 and represent the latest statistics from American Express, JCB, MasterCard and Visa, as reported by their member financial institutions globally.
† Figures do not include data from the United States.

Source: http://www.nfcworld.com

Some countries have considered implementing EMV in mass transit; for example, Great Britain and South Africa.

From the figure 3.2-5, it can be seen that contactless EMV market is larger than common ticket market, such as Oyster and Octopus. Nevertheless, EMV market has a very small portion compared to all types of transit tickets. Thus, EMV providers must increase the number of the customers in prior to the application of EMV in transit systems.

Figure 3.2-5 Contactless Smart Card Usage



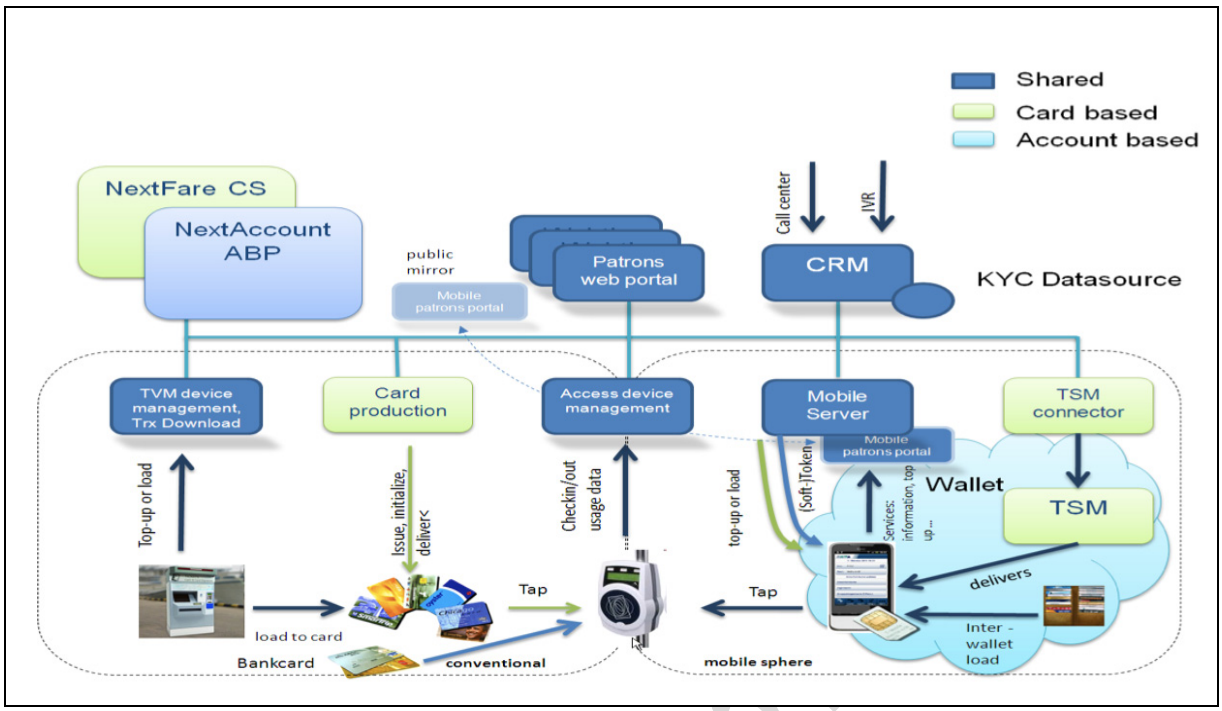
Source: http://www.mercatoradvisorygroup.com

EMV has higher security level than other ticket systems; however, it still has slow data processing speed. This can be difficult for implementing an EMV system.

For the use of EMV in London, card readers have been replaced by newer readers which are able to read EMV. EMV is an account based system or online system, issued by banks or central clearing house.

Central clearing house is responsible for fare rate specification, while the banks are responsible for card issuing and settlement. However, the responsibilities may vary in different countries; for example, in Chicago, the common ticketing office is only responsible for card issuing, while other responsibilities are responsible by the banks.

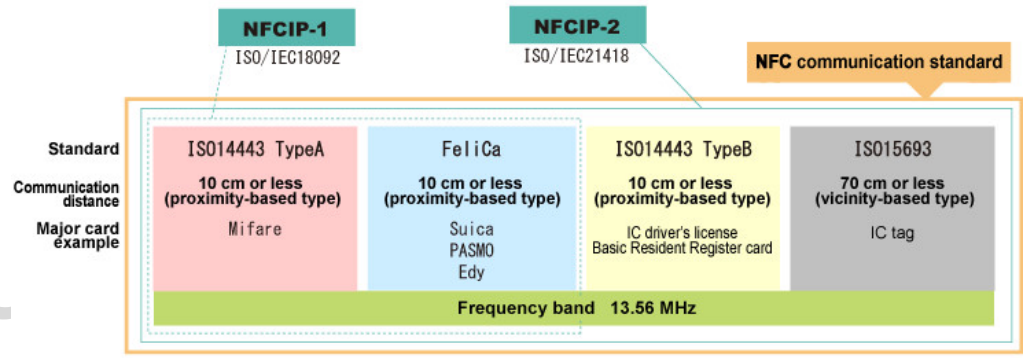
Figure 3.2-6 London Account Based System



3.3 Near Field Communication (NFC)

NFC is a contactless technology that can operate within a ten-centimeter range. This technology is used for the communication among electronic equipments that are in close proximity to each other. It was developed by SONY and NXP. NFC operates in 13.56 MHz, and use ISO/IEC 14443 (A and B), ISO/IEC 18092 (NFCIP-1), ISO/IEC 21418 (NFCIP-2), and JIS X 8319 standards.

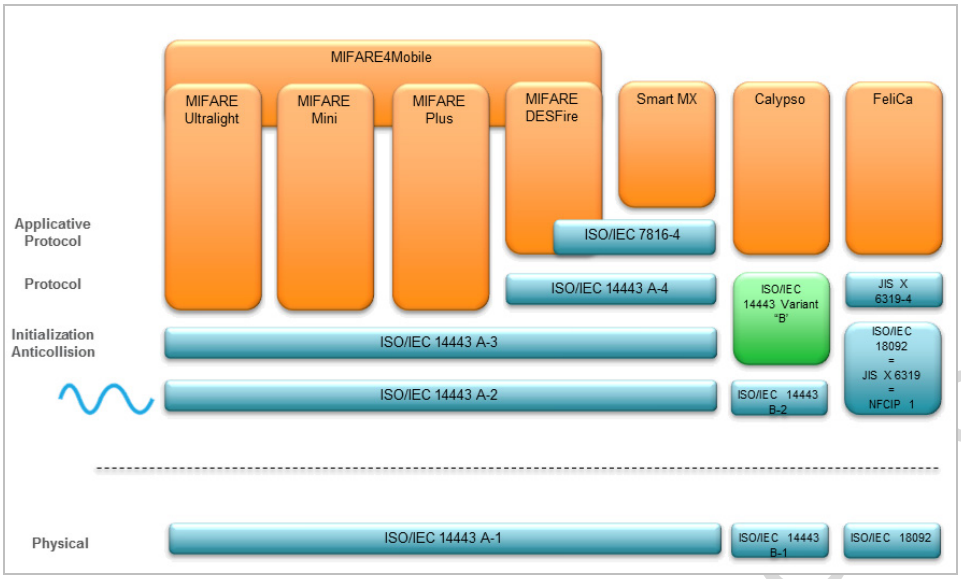
Figure 3.3-1 NFC standard's readers



Source: http://www.toppan-tl.co.jp

Presently, there are chips which are off-the-shelf-products that support NFC; for example, Infineon's chip which is embedded in BlackBerry Smartphones, NXP in Samsung Galaxy III, SONY's chip in SONY Phone.

Figure 3.3-2 Off-the-shelf-products that support NFC



Source: http://www.smartcartalliance.org

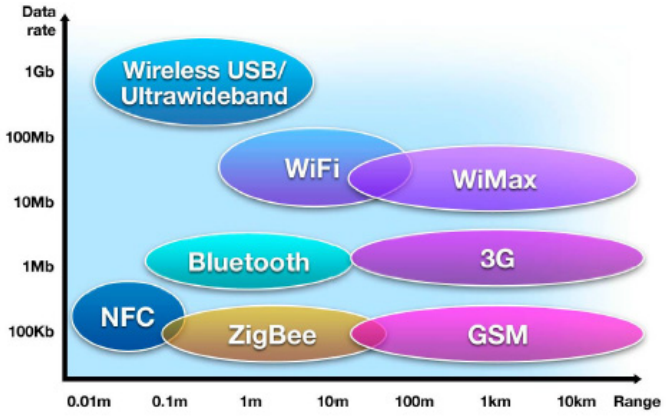
Figure 3.3-3 NFC Application

Source: http://www.intechopen.com

NFC has been currently in use in various systems:

1. Equipment that has NFC chip can operate if it was a ticket (e.g. mass transit ticket, movie ticket, and credit card)
2. Peer-to-Peer communication between NFC equipment. The equipment must be in very close proximity of at most 10 centimeters. Data transfer can be made without using any connection network, such as GPRS, EDGE, or 3G.

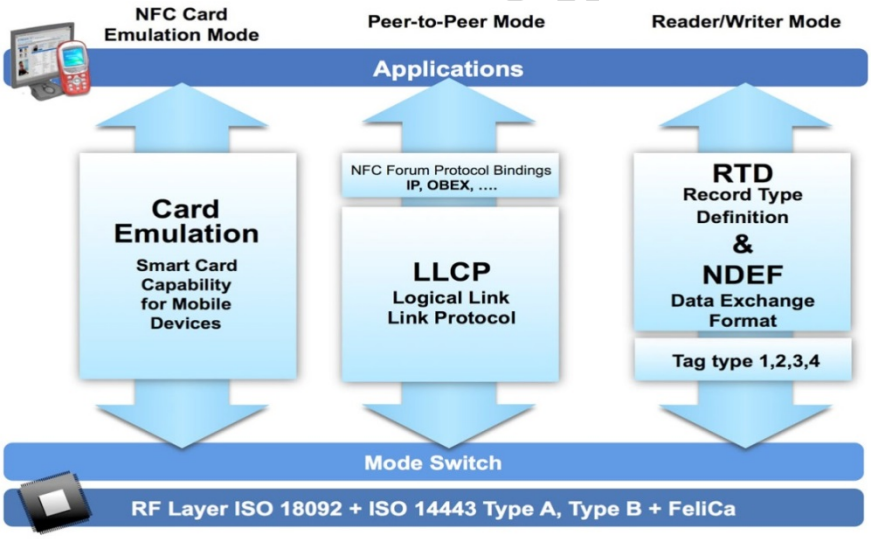
Figure 3.3-4 Operational Proximity and Data Reading Speed of Each Contactless Technology



Source: http://www.nfc-forum.org

3. Work as RFID reader/writer. NFC-embedded phone has a reader that operates in ISO/IEC 14443 (A and B), ISO/IEC 18092 (NFCIP-1), ISO/IEC 21418 (NFCIP-2), and JIS X8319 embedded within. The reader is able to read and write data from NFC Tag or RFID sticker.

Figure 3.3-5 NFC Technology and Different Smart Card Standards



Source: http://www.nfc-forum.org

Major components of NFC Phone

1. Built-in Antenna and NFC chip
2. Secure Element that is used to store highly secure data, such as debit card or credit card, as well as other banking applications. NFC chips can be embedded in the equipment in three different methods:
   - In the equipment itself
   - In a SIM card
   - In external storage, such as SD card

Advantages

1. NFC (ISO/IEC 18092 (NFCIP-1), and ISO/IEC 21418 (NFCIP-2) standards are operable with smart-card readers that have the ISO/IEC 14443 (A and B), ISO/IEC 18092 (NFCIP-1), ISO/IEC 21418 (NFCIP-2) and JIS X8319 standards.
2. The users may develop their own application, or download from other providers, such as from the Android market or from the App Store.
3. The equipment that has an NFC chic can be used in different applications, besides payment. Users may download a ticket or top-up their balance over-the-air (OTA). It can also interact with users through GUI.

Disadvantages

1. Phones are unable to operate when they run out of battery.
2. The choices of NFC Phones are limited at the present
3. NFC Applications are developed by different developers. Thus, they do not use a shared account.
4. Using NFC on different platforms still needs consensus and development of security system.

In conclusion, NFC technology can be used in Thailand; especially with smartphone users, which is expected to continuously increase in its number.

Chapter 4 Proposing Methods and Details for the Development and Operational Plan for in Public Transit Common Ticket System

4.1 Proposing common ticket system development method

The development requires cooperation from both governmental and private sectors. It also requires detailed studies on its system to specify developmental policies. The overall processes are as follows:

4.1.1 Objectives and Policies

This involves reviewing related studies and existing operational environment, including connection technologies, legal contexts, and other regulations. The consultants would analyze all details regarding the requires activities.

4.1.2 Consulting with Stakeholders

To develop an effective common ticket system that covers mass transit services, there must be a design for the interfacing between the new and the existing systems, as well as the automatic fare collection system. Therefore, the design and details of the common ticket system must have been surveyed and studied, as well as consulted with all stakeholders.

The consultants would evaluate potential and readiness of transit providers, as well as other factors that are highlighted by the stakeholders. The objectives of the survey are as follows:

- To survey the cooperation in the common ticket system
- The survey the ideas regarding common ticket developmental processes
- To evaluate the existing systems and infrastructure
- To survey problems/obstacles in joining the project, as well as other advice

4.1.3 Survey and propose the model for the operation of the common ticket system

The consultants would consult and survey the comments and suggestions from successful common ticketing office in other countries; for example, the Republic of Korea and Singapore. The consultants would propose the pattern, and specify roles and duties of each sector which involves the management of common ticket.

4.1.4 Specifying system patterns and standards

After specifying the objectives and the consultation with stakeholders, the consultants would specify equipment standards, modification and interfacing methods, and other systems. The common ticket system comprises two main parts: front-end and back-end systems. Front-end system includes connection and transferring of data that are related to passengers. Back-end system includes central clearing system, revenue apportionment system and settlement system. There must also be the standards for data network interfacing, which comprises interface document and interface protocol. Selected protocol depends on the data types and security requirements.

4.2 Primary information of Fare Collection System

Besides paper tickets, there are two types of smart cards currently in use in Thai public transit: 1) Memory cards (e.g. Type A Mifare 1k and 2) Microprocessor (e.g. Type A Mifare 4k and Type C (Felica). Memory card has lower cost than the microprocessor type; however, its security level is lower and do not have flexibility for multiple application. Microprocessor is more secure than the memory card; however, this technology allows the developers to define their own standards. This might lead to the monopoly of the system.

Table 4.2-1 Smart Card Currently Used in Thailand

System	Tickets	
	Single Journey Ticket	Stored Value Ticket
MRTA	Contact-less Token: Type C (Felica)	Smart Card: Type A and Type C
BTS	Magnetic-Stripe Card	Smart Card Type A (Mifare1k)
Rabbit Card	-	Smart Card Type A (Desfire EV1)
Airport link	Contact-less Token: Type A (Ultralight Mifare)	Smart Card:Type A (Mifare 4k)
BRT	Thin Card: Type A (Ultralight Mifare)	Smart Card Type A (Mifare)
BMCL	Paper Ticket	-
Express Boats	Paper Ticket	-
Express Ways	Cash	Easy Pass (RFID and Mifare)

From table 4.2-1, smart cards currently used in Thailand still lack of the common system. Each system has its own design and standards, including the fare rate.

4.3 Surveys for the ideas and comments related to current fare collection method and approach to join Common Ticket Project

Consultants have met every parties, government regulators and private operators, to present PMS project and gather their opinions. At the first meeting, the consultants briefly described about the overall of Common Ticket project, purposes, and connection among issuers, operators, clearinghouses and related entities. Project timeline, fare policy and top up method.

4.3.1 Summary of appointment and discussion topics

With 90 days of operation, the consultants have discussed with 9 entities, 4 from government regulators, 4 from operators, and 1 retailer as indicate in table 4.3-1

Table 4.3-1 Summary of appointment and discussion topics

Company	Date	Discussion Issues
Government – Policy Level		
Ministry of Transport (MOT)	4 March 2013	Inform about PMS project and scope of study. Roadmap to set up common ticket policy, fare structure, revenue apportionment, guideline to set up CTO, top up methods and gather opinions.
Public Debt Management Office (PDMO)	14 March 2013	Inform about PMS project, set up format and investment source of fund for setting CTO. Consult about any restrictions related to project operation.
Bank of Thailand (BOT)	19 March 2013	Inform about PMS project, set up format and investment source of fund for setting CTO. Consult about restriction related to do any cash transaction.
Transit operators		
Bangkok Metro Company Limited (BMCL)	5 March 2013	Inform about PMS project, timeline, discussion topic and gather comments from operators.
Chao Praya Express	6 March 2013	Inform about PMS project, timeline, discussion topic and gather comments from operators.
Department of Highway (DOH)	11 March 2013	Inform about PMS project, timeline, discussion topic and gather comments from operators.
Mass Rapid Transit Authority of Thailand (MRTA)	12 March 2013	Inform about PMS project, timeline, discussion topic and gather comments from operators.
Bangkok Mass Transit System (BTS) and Bangkok Metro Public Company Limited (BMCL)	19 March 2013	Inform about PMS project, timeline, discussion topic and gather comments from operators.
Retail		
Thai Smart Card Company (TSC)	26 February 2013	Inform about PMS project, timeline, discussion topic and listen to comments from operators. Purpose for incorporation with our pilot project.

4.3.2 Discussion Topics

The overall of presentation can be concluded as listed below

1) **The overall picture of Common Ticket**

Consultants believe that by using only one ticket in every mode of transportation, passengers will get more convenience. One ticket can act as a purse for express ways, buses, BRT, BTS, MRT, Airport Link, taxis, public van. The central clearing house will act as collector and allocate money to each operator.

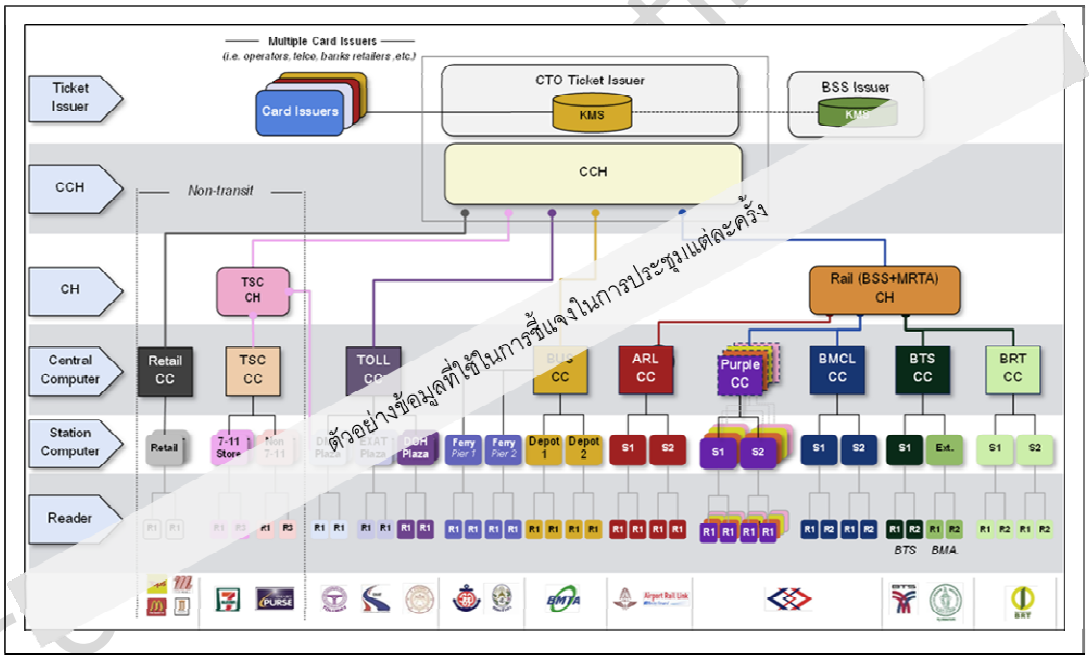
2) Benefits of Common Ticket

The benefits can be divided into 3 parts, (A)Providing convenience to the customers. They can carry only one ticket to use in every mode of transportation. Moreover, they can use Common Ticket to purchase goods and get some entrance fees discount in some cases. (B) The government can create any policy through Common Ticket such as fare policy. In addition, they can get information from usage traffic in order to improve transportation system. (C) The operators will get more customers while reduce the usage of single journey ticket. Thus, it reduced operating cost.

3) The connection of central clearinghouse

Consultants purpose the idea how to connect between transit, non-transit operators and fees allocation from central clearinghouse.

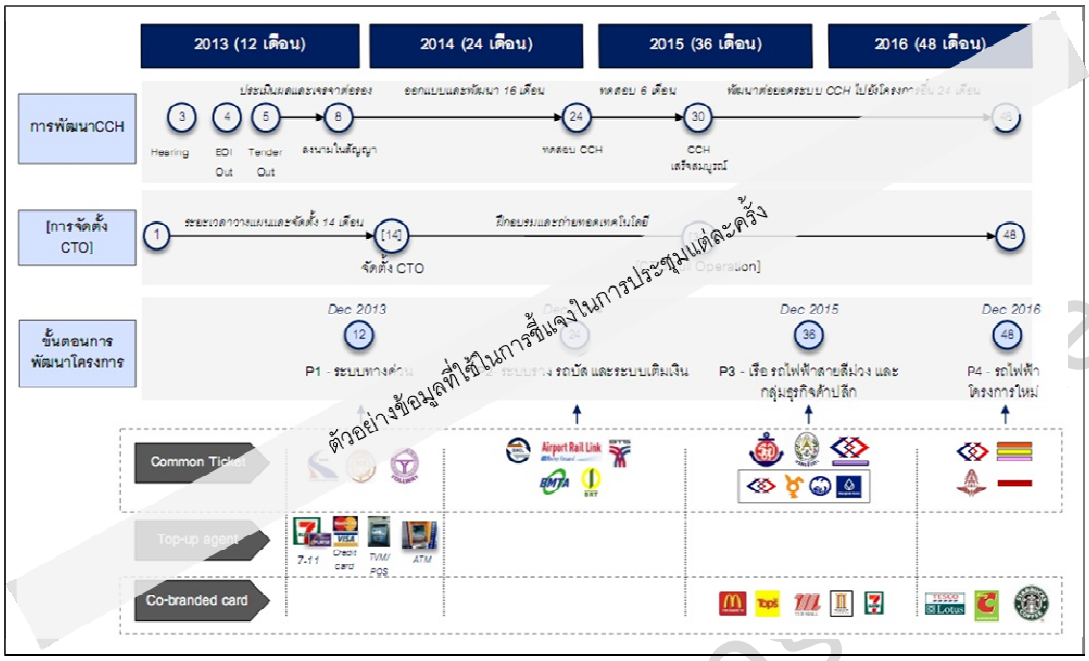
Figure 4.3-1 The connection of central clearinghouse



4) Timeline and important activities

Consultants presented the development and operation timeline. Therefore, the operators can be prepared itself to meet the timeline.

Figure 4.3-2 Timeline and important activities



Other than that, the consultants explored for additional opinions that relate to the development of Common Ticket project. There are 2 main topics, which are

4.1) Fare structure and apportionment

- Bus system: there is flat fare for those who used Common Ticket. The user can transfer to other bus routes without any fees. However, one must re-entry the system within 30 minutes.
- Rail system: Common Ticket holder will get entrance discount. The government is in consideration process whether it will be paid in form of subsidy.

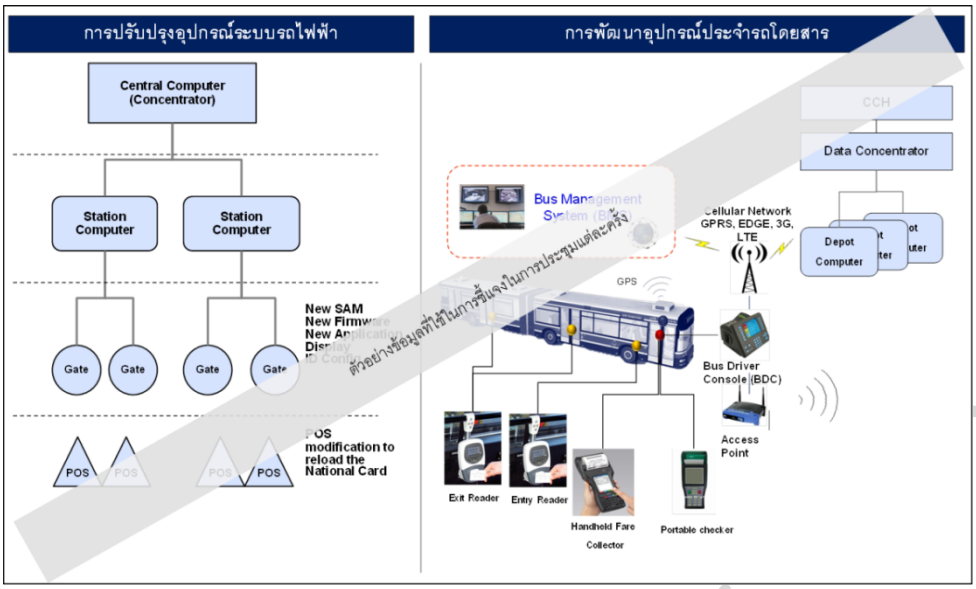
4.2) Front-end modification

- Rail system: there will be some modification with readers while remain the same card reader. Therefore, the machine can be read both existing and new cards.
- There will be additional machine placed in cash booths of the toll system.
- There will be additional machine placed in the front and back door inside the buses.

5) Estimated budget for project operation

The consultants purposed the budget to be used in front-end modification in order to connect with fare collection system in each operator.

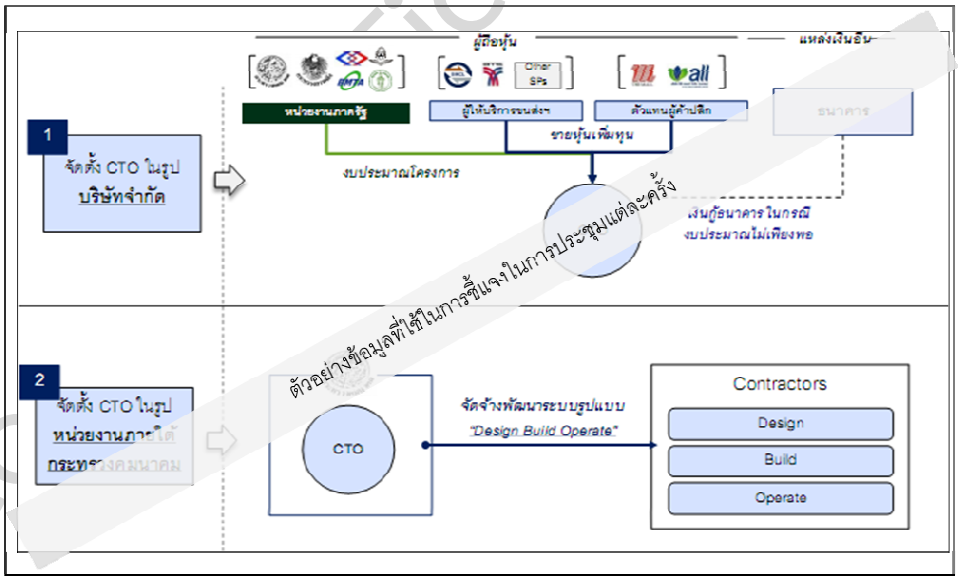
Figure 4.3-3 Estimating budget for project operation



6) CTO structure

There are 2 options for CTO structure, which are a limited company or organization under Ministry of Transport

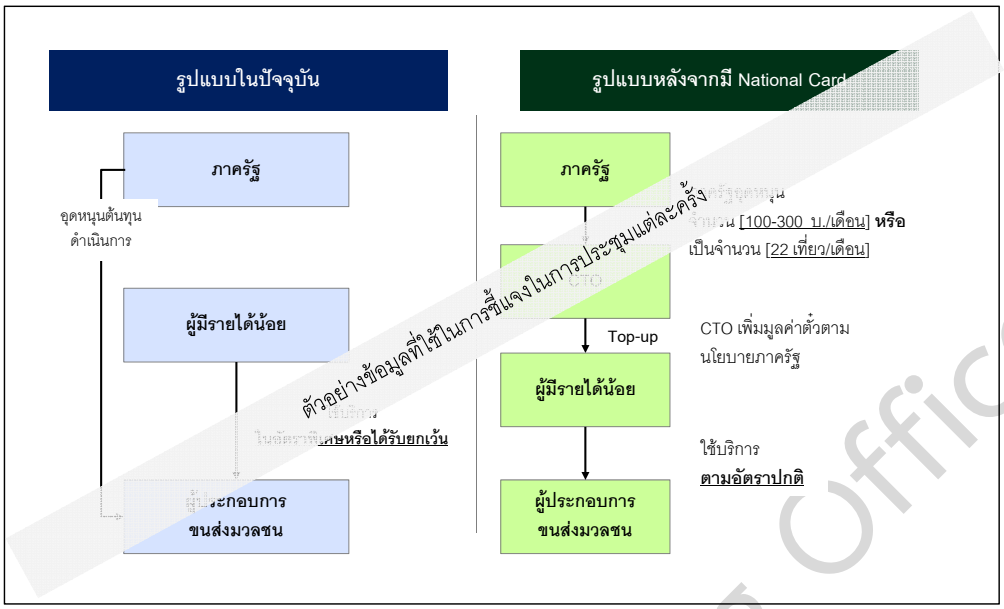
Figure 4.3-4 CTO structure



7) Concession card

The consultants purposed a method to automatic top-up to concession cards. The needy or person who are classified as concession groups can register for this special benefit.

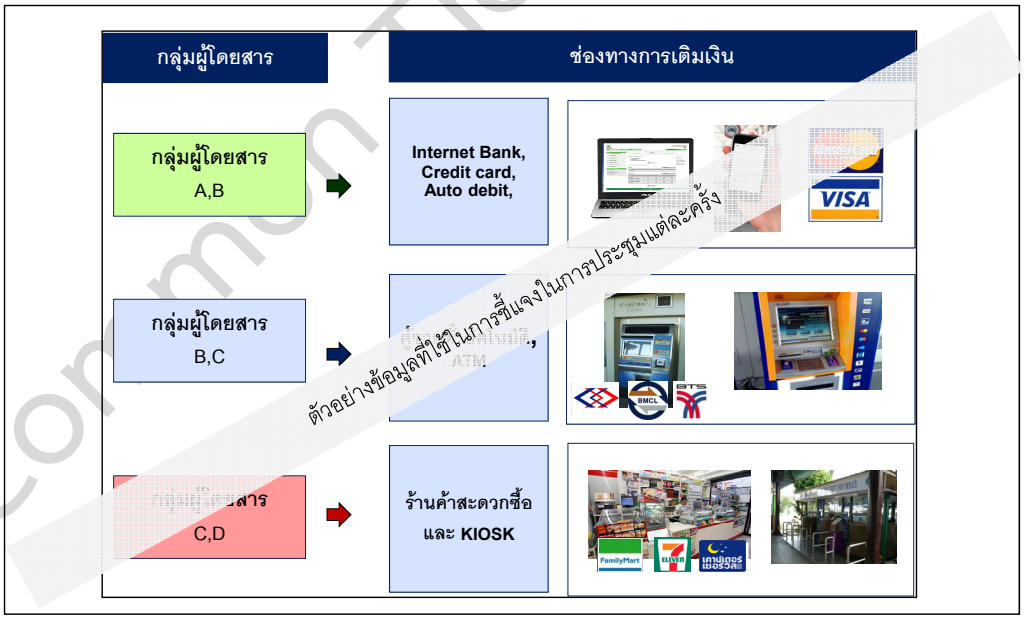
Figure 4.3-5 Concession card



8) Card top-up

There are variety methods to top up money into the cards, which are internet banking, credit card, auto debit, automatic ticket machine, ATM and convenience stores.

Figure 4.3-6 Card top-up



4.3.3 The conclusion of opinions from the visit with operators

1) Ministry of Transport

Topic	Opinions	Suggestions
Fare structure and apportion	Noted	• **Fare rate and Subsidy Policy**: The business model proposed by the consultants highly relies on government subsidy. However, the fare rate is being considered.
Front-end modification	Noted	
Estimated budget for project operation	Noted	
CTO structure	Noted	
Concession card	Noted	
Card top-up	Noted	

2) Department of Highway

Topic	Opinions	Suggestions
Fare structure and apportionment	Noted	• **Difference of VAT system**: Currently, DOH and EXAT have cooperated to use one ticket to pay the fares of express ways under both agencies. As a government agency, DOH will transfer whole amount of revenue to government and will reimburse later while EXAT, as a state enterprise, will deduct VAT before making the transfer. Therefore, the transferred amount from both enterprises will be different. • **Certainty of income distribution process**: The process regarding the extent of information sharing has not been clearly agreed from related parties.
Front-end modification	Noted	
Estimated budget for project operation	Noted	
CTO structure	Noted	
Concession card	Noted	
Card top-up	Noted	

3) Public Debt Management Office (PDMO)

Topic	Opinions	Suggestions
Fare structure and apportionment	Noted	• **Corporate Structure of CTO**: CTO should be set up as "Private Company" employed by the government. The initial investment amount of THB 400 million is from approved government budget. Other
Front-end modification	Noted	
Estimated budget for project operation	Noted	

Topic	Opinions	Suggestions
CTO structure	Noted	investments will be from fundraising of other service providers. Additionally, PDMO suggested that the consultants discuss about the issues of setting up CTO with SEPO and Office of the Council of State of Thailand. • **Bidding Methodology**: The method can be either Detail Design or Design, Build, and Operate.
Concession card	Noted	
Card top-up	Noted	

4) **Bank of Thailand**

Topic	Opinions	Suggestions
Fare structure and apportionment	Noted	• **The Approval of Electronic Transaction**: BOT suggested about electronic transaction for the guideline to set up project income distribution center. The project has to submit document for the approval 2 months before the execution.
Front-end modification	Noted	
Estimated budget for project operation	Noted	
CTO structure	Noted	
Concession card	Noted	
Card top-up	Noted	

5) **Mass Rapid Transit Authority of Thailand (MRTA)**

Topic	Opinions	Suggestions
Fare structure and apportionment	Noted	• **Data Concentrator of Central Clearing House**: Since the blue line and purple line are connected, there should be the Data Concentrator to manage the revenue collection system of one-way card and store-value card before transferring the data to Central Clearing House –CCH. Thus, riders will not need to move across the system. However, the Data Concentrator may not be needed if CCH can begin operation before the commencement of the purple line as CCH can mutually collect the data and manage the revenue of both lines. • **Business model**: CTO's business model should be more studied and specified for future development.
Front-end modification	Noted	
Estimated budget for project operation	Noted	
CTO structure	Noted	
Concession card	Noted	
Card top-up	Noted	

6) Chao Praya Express

Topic	Opinions	Suggestions
Fare structure and apportionment	Noted	• **Barrier of Close System Design:** As Chao Phraya Express boat piers are open system, their area are used for many purpose, e.g. commercial, leisure, and even residential. Thus CTO equipment is difficult to be monitored. • **Government Assistance in the connection:** Since the piers belong by Marine Department while the pavilions belong by Treasury Department, the cooperation from both parties is needed if there are renovations. Moreover, it may need the government coordination for pier connections.
Front-end modification	Noted	
Estimated budget for project operation	Noted	
CTO structure	Noted	
Concession card	Noted	
Card top-up	Noted	

7) Bangkok Mass Transit Authority (BMTA)

Topic	Opinions	Suggestions
Fare structure and apportionment	Noted	• **Certainty of Format and Schedule of Equipment Installation:** CTO will be simultaneously implemented with the 3,183-bus project from BMTA. The consultants expect to apply CTO to BMTA project within April, 2014, and principally designed the format of equipment installation. The buses are required to have 2 doors as customers have to tap the card at front door and tap the card to pay the fare when leaving at rear door. However, BMTA cannot certainly assure the design of the busses.
Front-end modification	Noted	
Estimated budget for project operation	Noted	
CTO structure	Noted	
Concession card	Noted	
Card top-up	Noted	

8) Bangkok Mass Transit System (BTS) and Bangkok Metro Public Company Limited (BMCL)

Topic	Opinions	Suggestions
Fare structure and apportionment	Noted	• **Business Model:** CTO's business model should be more studied and specified for future development. • **Further Development from BTS:** Advisors should consistently develop CTO from existing BTS system.
Front-end modification	Noted	
Estimated budget for project operation	Noted	
CTO structure	Noted	

Topic	Opinions	Suggestions
Concession card	Noted	
Card top-up	Noted	

9) Thai Smart Card Company

After the visit Thai Smart Card Company, the consultants earned more knowledge about the operation of company. The main business of company is offer transaction making through smart chip technology so the customers have no need to carry cash. In the same time, the retailers got the data from customers' behavior. Currently, there are 2-3 million users and they can top up via 7-11 convenience stores in Thailand totally of 7,000 branches. The company already put huge investment in top-up system so it would be a support to PMS project. However, the company suggested the consultant ask for corporation from banks.

First visit is mainly for overall discussion. The consultants planned to re-visit the operators many times to deeply discuss about the interface of system and equipment modification in order to connect with central clearinghouse system.

4.4 Common Ticketing Office Developmental Plan

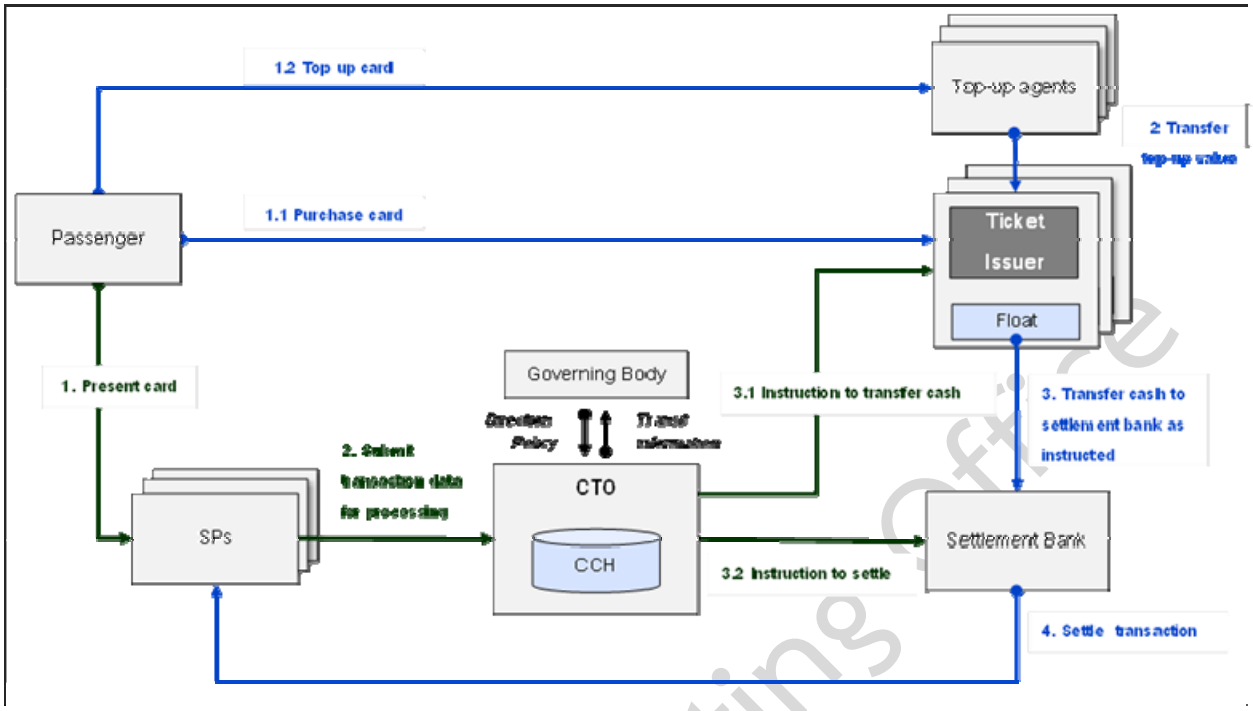
The consultants suggest that the office must have policies that rely on governmental support as less as possible. The office must be designed to be able to bring about its own income, and must support scalability. There should also be multiple card issuers. The consultants believe that the roles and responsibilities of each sector should be as follows:

4.4.1 Stakeholders

The common ticket system involves

- Common Ticket Office : CTO
- Central Clearing House : CCH
- Transit Services Providers : Transit SPs
- Non-transit Services Providers : Non-transit SPs
- Ticket Issuers
- Top-up Agents
- Settlement Banks

Figure 4.4-1 Common Ticket Operation



1) Common Ticket Office : CTO

CTO is responsible for the control and management of common ticket used in all transactions, including payment for both transit and non-transit sectors. CTO is also responsible for the control, regulation, and modification of central standards of the common ticket system. The main duties of CTO are as follows:

- Control, regulate, and modify standards and details of equipment and apparatuses related to the common ticket system; for example, card details, card readers, and interface protocols.
- Validate equipment standards, including tickets, readers, and machines. Issuers and operators must be authorized by the CTO.
- Gather Information from transit services; then, analyze and create reports for governmental sectors
- Specify directions; controls and investigate the operation of central clearing house, to ensure correctness, reliability, verifiability, and maintenance
- Define policies and regulations regarding card usage, data, pre-paid payment, and card loss cases

CTO should be established as a governmental sectors under the regulation of Ministry of Transportation, or a company limited, which the shares are hold by the government and business partners.

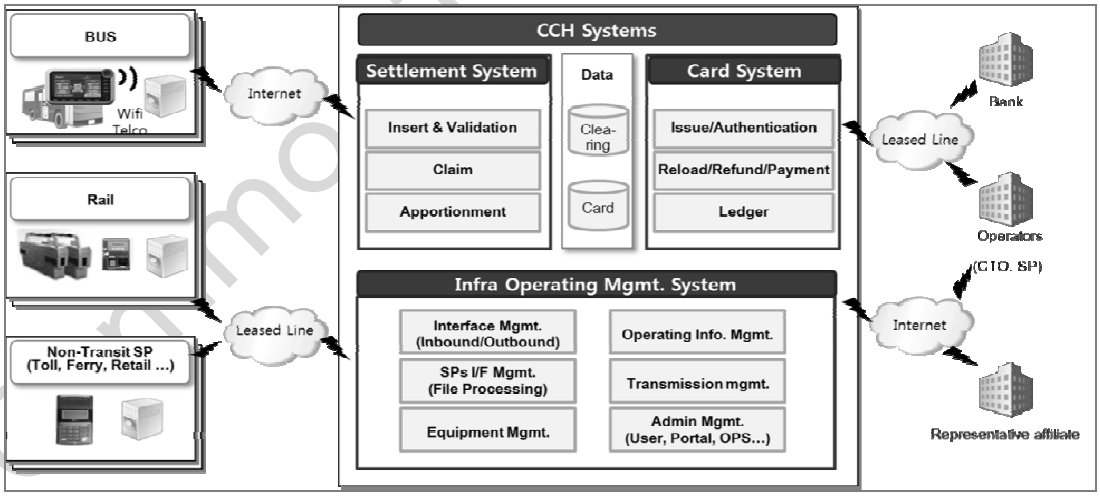
2) Central Clearing House : CCH

Central Clearing House or CCH is another main component of a common ticket system. The house deals with the gathering of transaction data, processing and calculating of data, as well as revenue apportionment. Processes data will then be sent to a settlement bank. Duties of CCH are as follows:

- Gather all transaction data, including fare and other payment. The data are retrieved from data reception (from front-end equipment). CCH is also responsible for data verification and data transformation. If there are faults occur with the data, CCH is responsible for the correction. CCH's responsibilities also cover designing and selling tickets, as well as transaction verification.
- Collect and manage common ticket data. CCH is responsible for controlling and modifying ticket database. Common ticket system must be correspond to defined policies.
- Revenue apportionment. Calculated data would then be sent to settlement banks. CCH is responsible for processing the collected data and apportioning revenue accordingly to defined regulations.

Nevertheless, the pattern for the development of central clearing house can be made in to different ways: 1) CTO cooperates in the development of CCH, and is also responsible for system management and daily operation or 2) CTO recruits an outsourcing agent to be responsible for the aforementioned duties, while CTO is responsible for monitoring CCH performance.

Figure 4.4-2 CCH System



3) Transit Services Providers : Transit SPs

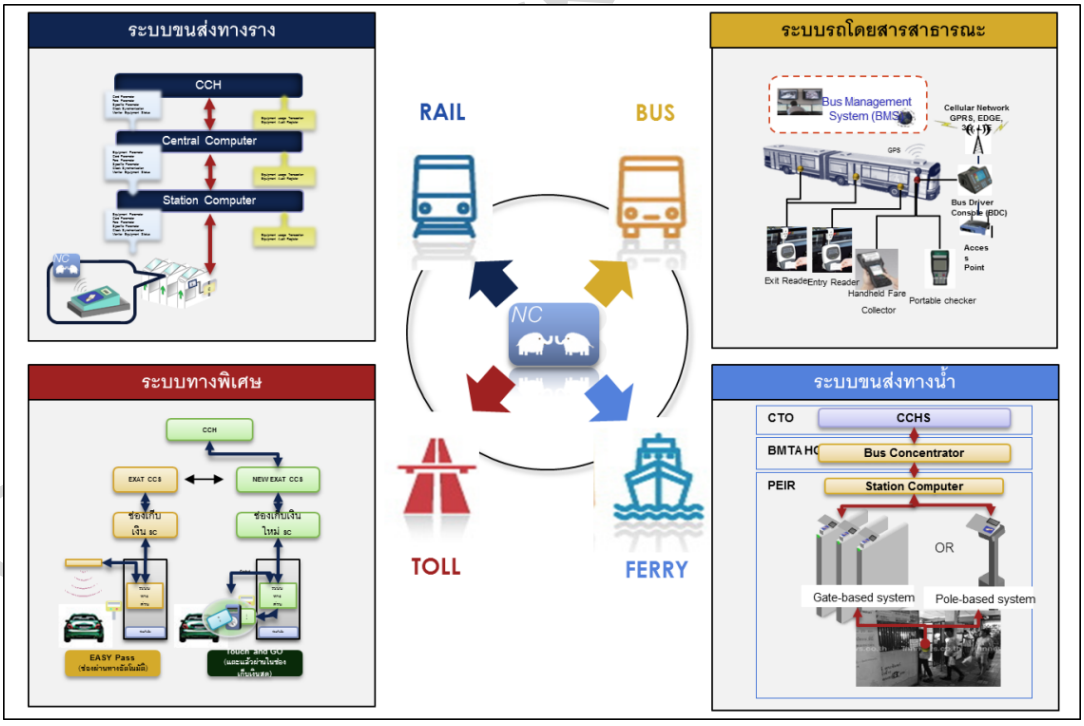
There are four categories of transit services: rail, land transit, express ways, and water transit. Transit service providers are responsible for collecting data to send to CCH, under the standards defined by CTO. To perform such operation, transit providers require automatic fare collection (AFC) systems. The systems represent require modification on front-end equipment, to make it compatible with a common ticket system.

For the providers which presently do not have an AFC system, they are required to invest on AFC equipment, such as card readers, etc., that corresponds to the standards defined by CTO. CTO is responsible for providing advices on the development of an AFC system, as well as participating in system testing. Directions for front-end equipment modification are as follows:

- Renovating and modifying the existing equipment, including gates, readers, and central computer. The system must ensure data interfacing with CCH. Transit systems that are currently in this process are MRTA (purple line), local train (red line), as well as other electric trains.
- Public buses currently do not have an AFC system. They require a whole system of AFC to be installed. Public buses are different from railways. Thus, the installation is needed to consider the convenience of the passengers. A reader must be installed on the bus; and the data are stored in bus driver console.
- Touch & Go should be used with the express ways; by installing the system at the fare booths.

Main advantage of transit providers for joining the common ticket system is that they do not have to manage their own clearing houses. CTO would be responsible for entire processes

Figure 4.4-3 Front-end modification



4) Ticket Issuers

Ticket issuers link all secors of common tickets to the passengers. The issuers are responsible for public relations, fare collection, and other types of payment. Major responsibilities of ticket issuers are:

- Supervising transactions which are related to bank cards, by issuing and selling tickets, giving authorization for any related operations, such as operational application, load, install, delete, extradition, personalization, or restrain the operation of third-person application.
- Issuers are responsible for ensuring security for the users, including pre-issuance production processes, post-issuance processes, and final decommissioning.
- Issuers define the results of the application used in supporting ticket operation, and authorize the use of application on the tickets.

5) Top - up Agents

Top-up agents are responsible for topping up ticket balance. The agents can be either CTO or other providers, such as convenience stores and counter service.

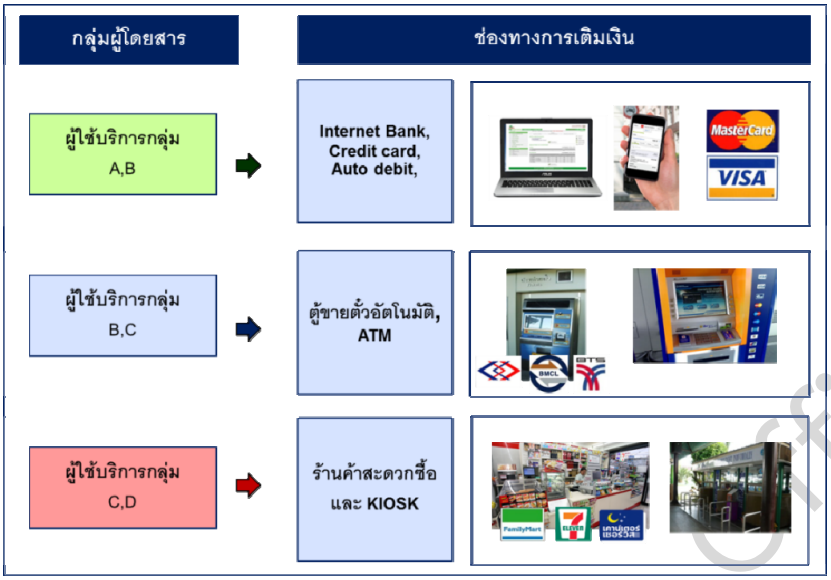
- Top – up Agents would add up the balance by an application, and/or define personalization/customization. This would be done accordingly to security policies.
- Provide equipment for users to top up the balance.
- Loading Agent must support multiple-trip tickets, such as monthly tickets and round-trip tickets.

The methods for topping up should cover all range of users. The users can classified as: high-income users (A, B groups), middle-income users (B,C groups), and low-income users (C,D groups).

For A and B groups, the topping up processes should be made via the Internet, as these groups of users have demands for convenience and are familiar with online transactions. B and C groups typically are office workers or civil officers. These groups are more familiar with top-up kiosks and ATMs. C and D user groups are more familiar with topping up via convenience stores, such as 7-11 and MaxValue.

Topping up agents are a major key to the success of the common ticket system. The number of available agents should be as high as possible. The consultants believe that there should be attractive advantages offered for top-up agents, such as commission or some extra charges when the users using the services.

Figure 4.4-4 Topping-up Methods

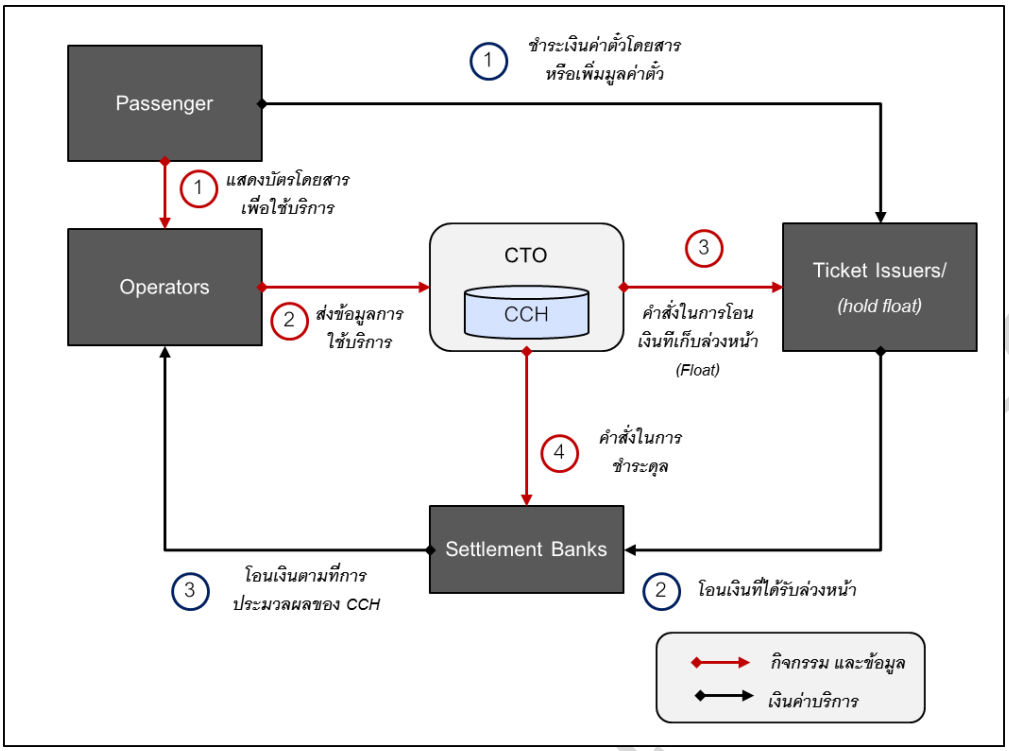


6) Settlement Bank

Settlement bank is responsible for transferring money to the stakeholders, such as transit providers and stores that join the common ticket system. The responsibilities of settlement bank are as follows:

- Ensure security, transparency, punctuality and reliability of the settlement. The settlement bank should be legally authorized an licensed.
- Define risk management policies, as well as inform the stakeholders regarding the policies.
- The settlement should be made within the same day as the transaction.
- The settlement bank must issue a letter or a report for every settlement period.
- The settlement bank must have a reliable and secure settlement system. The settlement must be transparent and acceptable by stakeholders.

Figure 4.4-5 Settlement system



7) Summary

Organization/Sector	Responsibilities
Common Ticket Office (CTO)	– Define common ticket equipment standards. Develop and modify standards to ensure operation effectiveness – Manage and regulate CCH – Verify and authorize card issuers – Modify front-end system – Issue and sell tickets
Central Clearing House (CCH)	– Revenue apportionment – Collect and manage transactions – Monitor and manage common ticket – Establish and regulate operations
Transit/Non-transit Services Providers (SPs)	– Provide transit services – Provide non-transit services
Top-up agents	– Top up card balance (both balance and rounds)

Ticket Issuers	– Issue tickets – Collect transaction data for the settlement bank

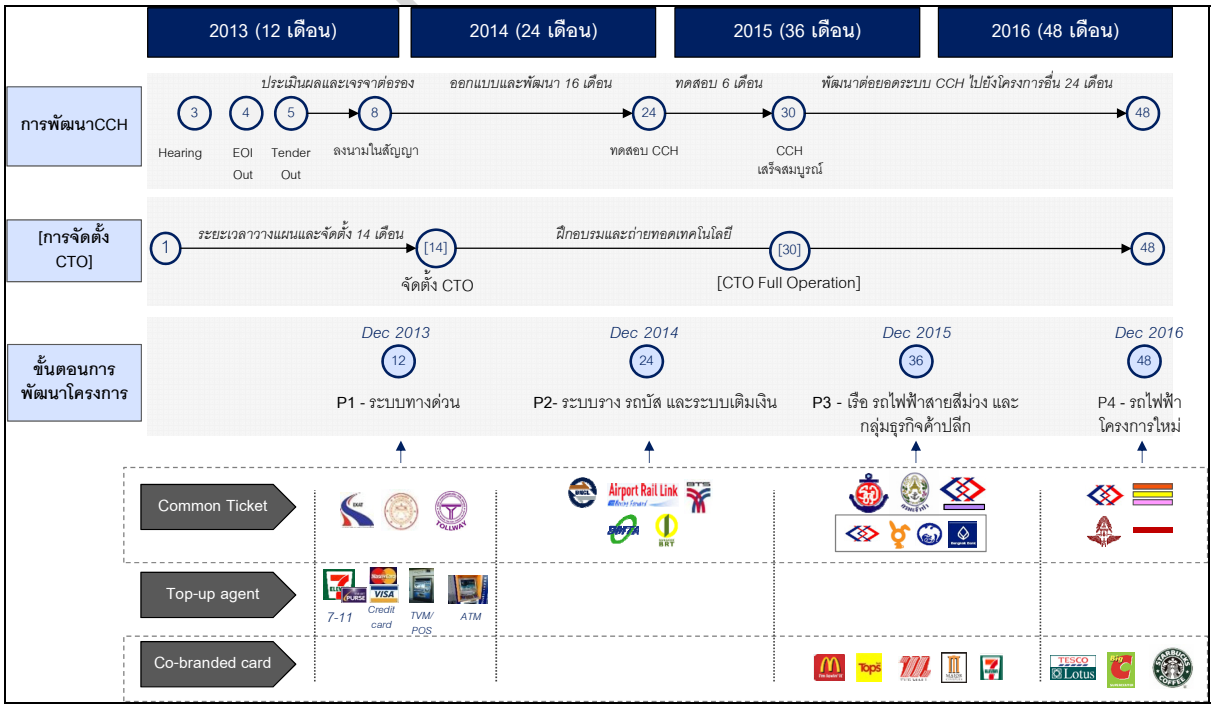
4.4.2 Overall plans and operation time-span

The consultants have defined framework for the project. The time-span for the project would take altogether 48 months, which can be briefly discussed as follows:

- Task 1 : Defining policies and plans for the program management system
- Task 2 : Defining common ticket standards, recruiting common ticket developers, and establishing CCH
- Task 3 : Recruiting common ticket developers and establishing CCH
- Task 4 : Monitoring common ticket developer's performance and establishing CCH
- Task 5 : Academic and Technology support and the establishment of CTO
- Task 6 : Technology transferring during the infant stage of the common ticket system and CTO
- Task 7 : Common ticket pilot project
- Task 8 : Public relation and public involvement

Major activities of common ticket project are the development of CCH, which takes 24 months. The establishment of CTO would take around 14 months. Training and other processes would take around 14 months.

Figure 4.4-6 Operational processes of the development of the common ticket system



8) CCH development activities

Activities for the development of CCH are as follows:

1. Gathering opinions from the public for 3 months. The activities involves seminars regarding the directions of the development of the common ticket system.
2. Send out express of Interest within a 4-month period. This process involve publicizing the project.
3. Defining common ticket equipment standards, to ensure universality, effectiveness, modernity, and security. This process would take four months. It covers:
   - Defining basic system requirements and the directions for the development of the common ticket system.
   - Defining equipment standards, such as card, reader, interfaced protocol, and interfaced document
     - Initiate conceptual design of the common ticket system and CCH, including the interoperability of front-end application and back-end application.
       - Ensure convenience, utility, security, effectiveness, and universal standards
       - Ensure interfacing between front-end and back-end
       - Define work diagram of CTO and CCH
   - Prepare documents for common ticket developer recruitment
     - General document
     - General conditions and contract conditions
     - Partner regulations
     - System framework and scope
     - System installation framework and scope
     - Others
   - Estimate investment budget and cost in recruiting common ticket developers and the establishment of CCH.
   - Prepare work plans for the common ticket project
4. Request for Proposal within five months. The documents would be delivered to qualified tenderers. Tenderers evaluation would be carried out in various processes: 1) evaluate qualification 2) evaluate technical proposal and 3) evaluate price proposal. For tender processes and developer recruitment, the consultants would provide support as follows:
   - Supporting in all recruitment processes
   - Supporting and providing advices to bidding committee regarding qualifying tenderers and consideration criteria

- Supporting the committee in the negotiation in pricing
- Supporting in contract preparation

5. After a developer has been recruited, it would take approximately 16 months in designing and developing the system, and would take around 6 months for system testing. The consultants would provide assistance as follows:
   - Assist in the regulating and monitoring developer's performance and the establishment of CCH as defined in the contract
     - Provide assistance in developing and testing CCH
     - Provide assistance in monitoring the interfacing of front-end and back-end systems
     - Provide assistance in validating the correctness of common ticket system and CCH
     - Provide assistance in validating CCH and the interfacing between front-end and back-end systems
   - Provide assistance in regulation and management as defined in the contract
     - Validating the design to be correspond to employer's requirements, outline design specifications, and conceptual drawings
     - Validating the development and installation to be correspond to the development framework of common ticket system and CCH
     - Validate and monitor operation processes of the developer and the establishment of CCH
     - Validate the results at the end of each stage
     - Validate the results and workload
     - Collect and validate the design and installation to be correspond to the contract
     - Commissioning and testing

9) CTO development activities

CTO development activities are as follows:

1. The consultants anticipate that the development of CTO would take around 14 months. This depends on the organizational pattern of CTO.
   - Survey the most appropriate organizational pattern, duties, regulations, law, and number of required staff
   - Assist the preparation of academic documents and the establishment of CTO
   - Develop operational policies and strategies for CTO

2. After the establishment of CTO, the consultants believe that it would take another 16 months to prepare for the operation. This involves setting up organization structure, defining strategies and directions, and recruiting and training personnel.
   - Workshop
   - Enhance the capability of CTO
   - Transfer technologies from the organizations which are successful with the common ticket systems

10) Pilot project activities

Pilot project activities involve:

1. Within the 12th month of the project or within 2013, the consultants would initiate the use of common tickets in express ways and Don Muang Tollway, as well as making the topping up available at convenience stores, credit cards, ATMs, and other top-up points. Touch & Go would be used in the express ways, by installing readers at the toll booths.
2. After the first phase of the pilot project, the consultants would extend the system to railways, mass rapid transit, MRT, raillinks, BMCL, and BRT, as well as enable the common fare system. This phase would be done in 2014.
3. The third phase of the pilot project would be done in 2015. The common ticket can then be used in express boats, convenience stores, and purple line trains. CTO would then recruit and authorize multiple issuers.
4. The fourth phase would be done in 2016. The common ticket will be able to operate in its full scale. The system would be able to support any new train systems, as well as other interested entrepreneurs.

Chapter 5 Surveys of existing service providers on fare collection systems and attention in participation

5.1 Surveying current Fare Collection Methods in Transit Operators for the use of Common Ticketing System

An effective development of common ticket system requires a system design which enables the interfacing with the current systems, as well as an automated fare collection system. Therefore, the design requires an examination and the study on fare collection systems, as well as consultation with associated parties.

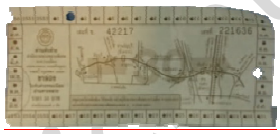
5.2 Current Fare Collection system for Public Transportation in Bangkok Metropolitan

5.2.1 Types of ticket

There are many types of tickets which currently used in public transportation in Bangkok Metropolitan, such as paper ticket, magnetic ticket, and contactless smart card. For those public transports which used automated fare collection, most of them used contactless smart card as summarized in table 5.2-1

Table 5.2-1 Types of ticket used in Public Transportation in Bangkok Metropolitan

Transit System	Single Journey Ticket (SJT)	Store Valued Card (SVC)
Blue line Train (MRT)	Contactless Smart Token (CST) 	Contactless Smart Card (CSC) 
Airport Rail Link (SARL)	Contactless Smart Token (CST) 	Contactless Smart Card (CSC) 
Green line Train (BTS)	Mag-Stripe 	Contactless Smart Card (CSC) 
Metro Bus (BRT)	Contactless Smart Ticket (CST) 	Contactless Smard Card (CSC) 
Rabbit Card	N/A	Contactless Smart Card (CSC) 

Bangkok Mass Transit Authority (BMTA)	Cash (Paper Ticket) 	Paper Ticket 
Public Boat	Cash (Paper ticket) 	-
Express way	Cash (Paper ticket)  	Easy Pass (long-range RFID) IC Card (Mifare)  

From table 5.2-1 it seems that in the past most ticket was the paper ticket, which clearly stated the price and the destination. The paper ticket can be found in early public transport system such as boat, train and bus

Currently, many transportation systems in Bangkok and the vicinity have adopted new technology to improve their services by develop automated fare collection system to facilitate both service provider as well as passenger. This fare media is called Contactless Smart Card or Ticket/Token.

5.2.2 Interfacing System

The Contactless Smart Card or Ticket/Token is widely used in public transportation around the world due to the fact that it can be reusable, which leads to low life cycle cost and low maintenance fee because the equipment has no moving parts. This type of ticket can be found in mass rapid transit including Blue Line (MRT), Green Line (BTS), Metro Bus (BRT) and Airport Rail Link (SARL). According to the survey, passengers are satisfied with Contactless Smart Card because it is convenient, fast and able to get discounts.

Contactless Smart Card Technology can be divided into 3 types, which are A, B, and C. Each type has different qualifications and standard as following:-

Table 5.2-2 Comparison of qualifications of each type of contactless Smart Card

Reference Standard	ISO/IEC14443-A	ISO/IEC14443-B	ISO/IEC18092 JIS 6319-4
Common Product Name	Mifare	Calypso	FeliCa
Advocator	– Phillips (NL) – Infineon (GR) – STMicroelectronics(CH) – Renesas(JP)	– MOTOROLA(US) – Infineon (GR) – Inside(FR) – STMicroelectronics(CH)	– SONY(JP)
Bit Coding (PCD → PICC)	Modified Miller	NRZ	Manchester
Bit Coding (PICC → PCD)	Manchester	NRZ	Manchester
Modulation	ASK100%	ASK10% PICC → PCD: BPSK	ASK10%
Carrier	13.56 MHz Sub-carrier: Fc/16 (847 KHz)	13.56 MHz Sub-carrier: Fc/16 (847 KHz)	13.56 MHz No Sub-carrier
Communication Speed	106 Kbps~ 10-multiple higher allowed	106 Kbps~ 10-multiple higher allowed	212 Kbps~ 30-multiple higher allowed
Communication Type	Asymmetric Use Sub-carrier for PICC → PCD	Asymmetric Use Sub-carrier for PICC → PCD	Symmetric No Sub-carrier
Anti-Collision Detection	Bit Collision Time Slot	Slot-Marker	Time Slot
Security	Bit stream cipher DES/3DES	DES/3DES	DES/3DES
Business Cases	More applications -Phillips Mifare IC card	Less applications - MOTOROLA M-	Medium applications

	spec -Access Control ID Card -Global Platform CPU Card -Re-loadable transport card	Smart Mercury MM IC card spec - Global Platform CPU Card - Re-loadable transport card	- Sony FeliCa IC card spec - Re-loadable transport and non-transport card
Physical Characteristics	ID1[ISO/IEC7810] 85.6mmx54.0mmx0.76mm Token	ID1[ISO/IEC7810] 85.6mmx54.0mmx0.76mm Token	Card/Token
Card Structure / Data Format	No (Define:DESFire)	No	Predefine

Source: Asian Development Bank (ADB) and FeliCa updates

From above table, the significant differences are card structure and data format which is predefined in Felica but not in some of Mifare Type A and Type B. This makes Mifare Type A and Type B are more flexible than Felica but more control is needed since the maintenance cost is higher.

Contactless Smart Card/Token which are currently used can be defined into 2 categories which are Memory card, such as Type A Mifare Classic and Microprocessor card, such as Type A (DesFire) and Type C (Felica). The Memory card is cheaper than Microprocessor card but has less security and flexibility in expansion of Multi-Application function. The disadvantage of microprocessor card is high risk of being manipulated by suppliers because they might be able to set unique operation system and equipment.

Table 5.2-3 Example of smart card/token used in Thailand

Seq.	Operator	Average no. of passengers per day (million time / ride)	Store Valued Card (SVC)	Single Journey (Ticket/Token)	Card Reader	Fare Structure
Transit System						
1	Blue Line	0.25	MIFARE Classic (Type A)	Sony FeliCa (Token)	A, B, C	Moving Zone
2	Green Line	0.53	MIFARE Classic (Type	Magnetic	A, B, C	Moving

Seq.	Operator	Average no. of passengers per day (million time / ride)	Store Valued Card (SVC)	Single Journey (Ticket/Token)	Card Reader	Fare Structure
			A)			Zone
3	Airport Rail Link	0.04	MIFARE Classic (Type A)	MIFARE Ultralight (Type A)	A, B, C	Moving Zone
4	BRT	0.01	MIFARE Classic (Type A)	MIFARE Ultralight (Type A)	A, B, C	Flat
Common Ticketing System						
1	Rabbit Card	0.40	MIFARE DESFire EV1 (Type A)	N/A	A, B	Moving Zone
Non-Transit System						
1	Thai Smart Card	0.50	MIFARE	N/A	A	N/A
2	Major Cineplex	TBD	MIFARE	N/A	A	A
3	BBL (Rabbit)	0.01>	MIFARE DESFire EV1 (Type A)	N/A	A, B	A, B

From above table, it showed that most of public transportation system and non-transit business in Bangkok Metropolitan used contactless smart card/token Type A and once comparing the qualifications of each ticket type can be summarized in table 5.2-3

Table 5.2-4 Comparison of common ticket technology in Thailand

Qualifications	Type A	Type B	FeliCa
Improvement of fare collection	Low	High	Medium
Investment of fare collection system in new transportation system that does not share stations with existing system	Low	High	Low
Investment of fare collection system in new transportation system	Low	High	High

that shares station with existing system			
Investment in card provision	Low	Low	High
Compatibility with NFC system	Easy	Difficult	Easy
System Efficiency	Good	Good	Excellent
Risk of outdated technology	Medium	Low	High
Expansion and acceptance level	Easy	Difficult	Difficult

From above comparisons, Felica Technology is the best in term of technical factors especially for large system with sufficient usage. However, it might not be suitable for small or medium size system which expanding to bigger system because cost per unit for small purchasing amount is quite high. However, when consider all factors including technique, investment, and complexity of development, found Type A Technology might be considered as the most suitable card for common ticketing system in Thailand because it is the most widely used option.

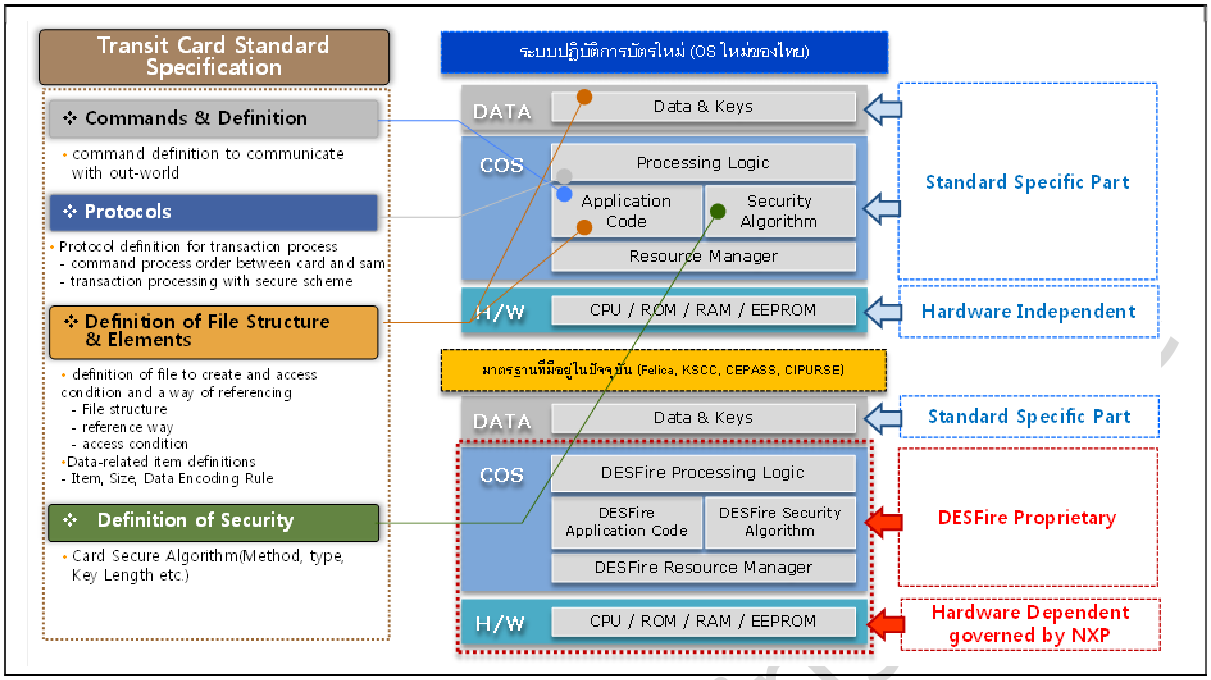
5.2.3 Card Operation System (OS)

Apart from Card Technology which has been described earlier, the card operating system can be classified into two groups; Standard Operation System and Custom Operation System. The card standard is the most importance and needs to choose wisely for appropriate usage as it will become the card standard for common ticketing in Thailand. Selecting Card Standard will also affect to entirely system starting from Reader, Front-End throughout Back-End system.

Each ticket has different specification which also a key factor to determine reader. All future system such as the extension system of the Green and New lines, bus system, express way system, which will have more than 10,000 units, or 10 times of the current system of BTS, BMCL and ARL all together. Software development will be necessary while hardware replacement is not yet required since most system already support all kinds of basic modification.

Even though, each card has different specification. That's mean the design of entire system must be aligned with single card standard. Changes will definitely affect to whole system which leading to additional investment.

Figure 5.2-1 Comparison of Card Operation System



From figure 5.2-1, there are two options to develop card standard which are 1) Off the shelf Specification that already available in the market and it could be customized with its own data file structure 2) Customized Specification which need design of the whole system including data file structure, Operating system. This option is detail-oriented, complexity and time consuming. When the development has been successfully completed, this specification is an intellectual property of Kingdom of Thailand. Furthermore, modification can be done easily and more flexible. Details for both options can be summarized as below:-

1) Off the Shelf Specification (Card OS) that already available in the market

This option is very easy, convenient and fast due to the fact that the standard specification has been used worldwide and low risk.

1.1) Points to be consider:

a) This option will support bidder who will develop current system by offering NXP (Mifare DESfire) technology. There is a possibility to use this card, which are currently used by 75% of operators around the world such as Dubai, USA, Great Britain, New Zealand, Australia, Spain, Beijing (China), Turkey, Czech Republic and Thai etc.

b) If bidder offers Sony (FeliCa) technology, which is high quality and more efficiency because it is closed system. Cost of maintenance is might be quite high and it may affect long-term investment for each operator. Currently, operators in Japan and Hong Kong are considering a shifts to NXP product or develop their own card.

c) The possible option then goes to Mifare DESfile, which is widely used and eases to interfacing with current systems. Moreover, cost of investment is quite low, since there is no investment on Back-end modification and Front-end modification cost is small.

2) Customized Specification which can be adjusted all 3 elements

This option is suitable for the national card as it is 100% designed for Thailand standard. However, there are many risks in term of card operating system (card OS), and the investment could be higher than the first option.

2.1) Points to be consider:

a) South Korea and Singapore are role-model countries which developed their system from the same practice. KSCC who is one of consortium member in this project is familiar with this pattern and they constantly developed their own system.

b) Readiness of the development team and standard-certifying organization are needed in order to develop/certify this specification. Otherwise, dependency on the external experts, which might be from South Korea and Singapore will also be required

c) CEPAS is an open system which has been used in Singapore, after that they decided to stop using FeliCa system in year 2004 which is similar to KSCC case. Even though CEPAS is an open system, but it still needs cooperation from developer to modify any changes unless Thailand has ability to develop the system by ourselves.

d) Although this option is selected, dependency on chip or other device suppliers are still needed for designing their product to compatible to our standard.

e) There is a new open system called CIPURSE which collaborative between large companies such as Samsung and Infineon. Although it is outstanding idea to develop new system, but the adoption is still limited. Therefore, sustainability and certainty of collaboration among the big companies are suspected, which might be seen in case of Sony and Ericsson or Siemens and Alcatel.

Since card operating system is very importance to determine other relevant system, the consultants have studied the advantages and disadvantage of these two options as described in figure 5.2-2

Figure 5.2-2 Comparison between the advantage and disadvantage of each card operating system

	ระบบปฏิบัติการบัตรใหม่ (OS ใหม่ของไทย)	มาตรฐานที่มีอยู่ในปัจจุบัน (Felica, KSCC, CEPASS, CIPURSE)
ราคาบัตร	กำหนดต้นทุนของบัตรได้จากการแข่งขัน	ราคาบัตรขึ้นอยู่กับการกำหนดของผู้ผลิตแต่ละราย
การผูกขาดของผู้จำหน่าย	ไม่ผูกขาด	ต้องซื้อจากกลุ่มVendor ผู้ผลิตบัตรแต่ละประเภท
การแข่งขัน	ผู้ผลิตทุกรายมีการแข่งขันเท่าเทียมกันหมด	ผู้ผลิตที่ดำเนินการอยู่ก่อนแล้วมีความได้เปรียบ
การพัฒนาต่อยอดระบบ NFC, EMV และอื่นๆ	สนข.หรือ CTO สามารถพัฒนาได้เอง	ต้องCompatible กับมาตรฐานของผู้ผลิต
ระบบปฏิบัติการ	ต้องวางหลักเกณฑ์ทดสอบ และมีออกการรับรองมาตรฐานจาก สนข. หรือ CTO ใหม่	เป็นระบบที่มีสามารถรับรองประสิทธิภาพจากระบบที่เคยใช้งานได้ในระดับนานาชาติ
ความรับผิดชอบในการพัฒนามาตรฐาน	สนข. หรือ CTO	ผู้จำหน่ายชิป/ผู้พัฒนาระบบปฏิบัติการ
ความรับผิดชอบในการพัฒนาระบบความปลอดภัย	สนข.หรือ CTO	ผู้พัฒนาระบบปฏิบัติการ
ระยะเวลาที่ใช้ในการดำเนินการ	ประมาณ 4 เดือน	ประมาณ 2 เดือน

The card standard should not specify any particular specification with regard to the operating system, in order to create fairness among bidders and shall open the opportunity for both options as mentioned earlier.

5.3 Participation and integration between each transit operator

Numbers of people who travel around Bangkok Metropolitan have been increased and cause congested traffic nowadays. Common ticketing system creates huge benefit by facilitating people and encouraging them to use public transportation as well as reduce traffic in Bangkok Metropolitan.

In order to achieve the target, the integration between each transit operator is needed to be completed as much as possible. A precise plan is helps to optimize all problem and difficulties from existing operators who have their own system. Below diagram showed the integration of each transit operators.

Figure 5.3-1 Structure of common ticketing system (Scenario 1)

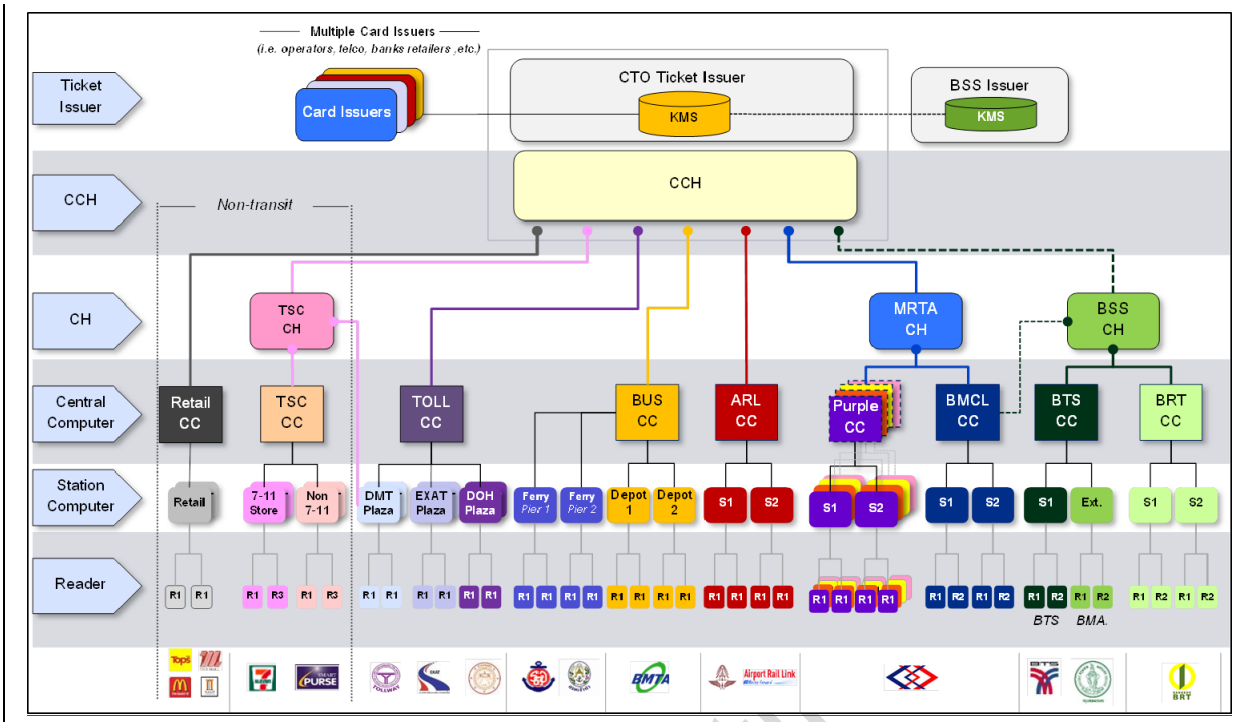
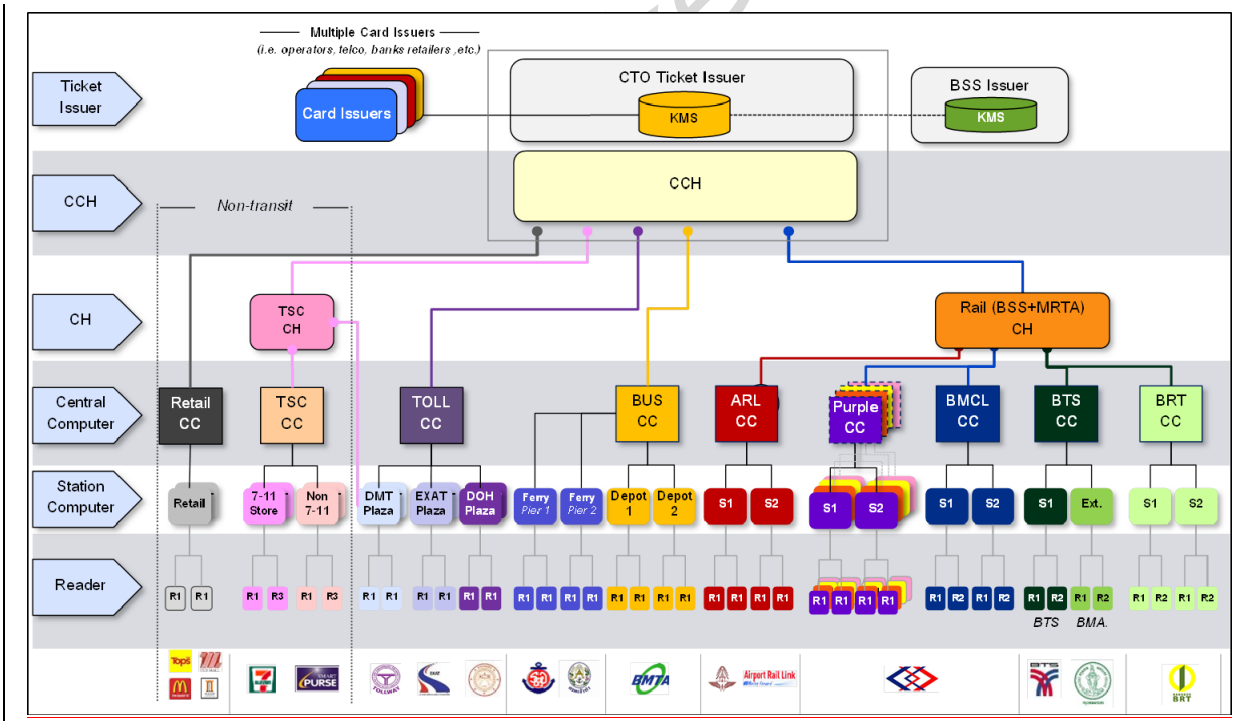


Figure 5.3-2 Structure of common ticketing system (Scenario 2)



5.3.1 Central Clearing House (CCH) Establishment

The objective to setup CCH is to collect all acquired data as well as clearing and settle the revenue for all operators. CCH will under supervision of Common Ticketing Office (CTO). All CCH regulation must be authorized by CTO.

5.3.2 Integration with rail operator

Mass rapid transit system consists of 2 major parts which are underground (blue line) train (MRT), Sky train (BTS), Airport Rail Link and other future systems which are operated by MRTA and SRT.

Currently, BSS Clearing House (BSS-CH) acts as data acquirer for Rabbit card. This card is able to use in BMCL and BTS system only. However, both operators could probably extend their services to other public transportations. The consultants also found that MRT setup MRTA-CH to handle all transaction fee between purple line and other systems.

That means CCH might be set up under 2 scenarios as illustrate in figure 5.3-1 and figure 5.3-2

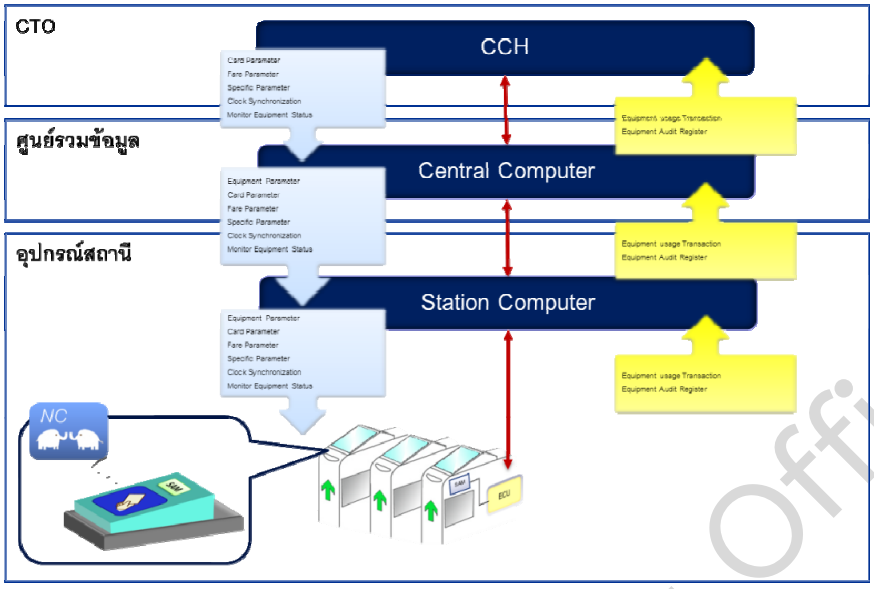
Scenario 1: Both MRTA-CH and BSS-CH integrated directly to CCH. In this practice, MRTA-CH will act as data acquirer and feed all information to CCH. Furthermore, MRTA-CH also act as Clearing House for single journey ticket. Whereas BSS-CH also gathers the information from both main and extended services including BRT data and settlement the revenue once transaction has been made by rabbit cards.

Scenario 2: Merge MRTA-CH and BSS-CH under Rail-Clearing House system (Rail-CH), all data will send from Rail-CH to CCH directly.

To standardize central clearing, it needs to modify the Front-end system as well as all electronic devices including reader, key management, station computer, central computer and firmware as illustrated in figure 5.3-3. However, the modification will depend on each operator.

In the future, all extended services such as purple & red lines shall apply the same standard of common ticketing system.

Figure 5.3-3 Front-end Modification on rail system

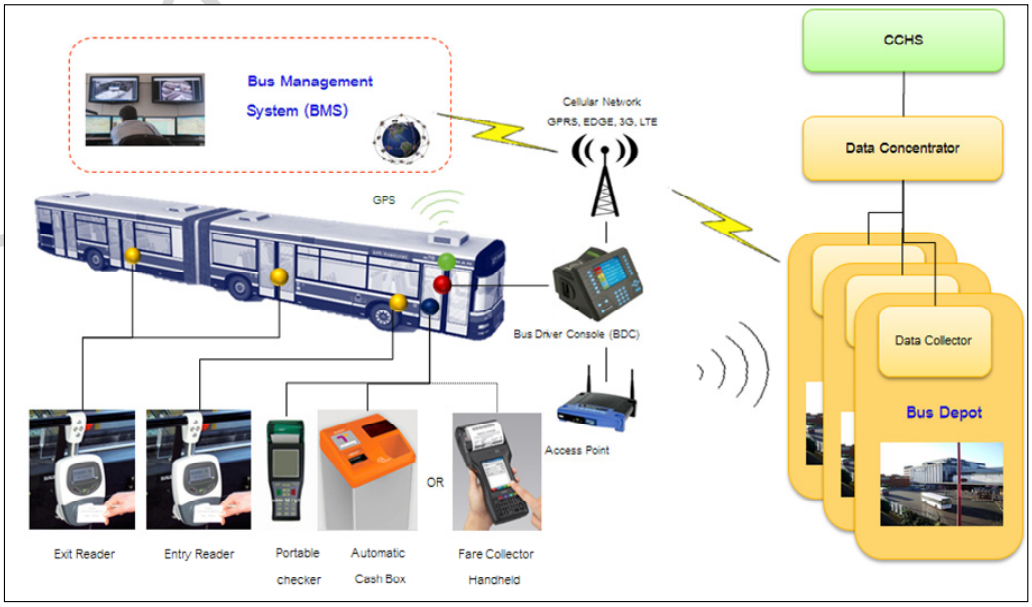


5.3.3 Integration with public bus

According to the survey, public buses do not yet have automated fare collection system, and related equipment. The development of common ticket system to be implemented on the buses requires investment. At the first stage, they need to install 2 readers on a bus as shown in figure 5.3-4, then data can be retrieved after tab-in/tab-out. Data collection will automatically be stored in Bus Driver Console (BCD) and also be integrated with Bus Depot Computer that will transfer all data to CCH accordingly.

Besides fare structure for air-conditioned bus which relies on distance-based, it is necessary to have GPS on the bus as well as to setup Bus route system in order to calculate the correct fare. The consultants would expect to install all devices which showed in figure 5.3-1 and 5.3-2

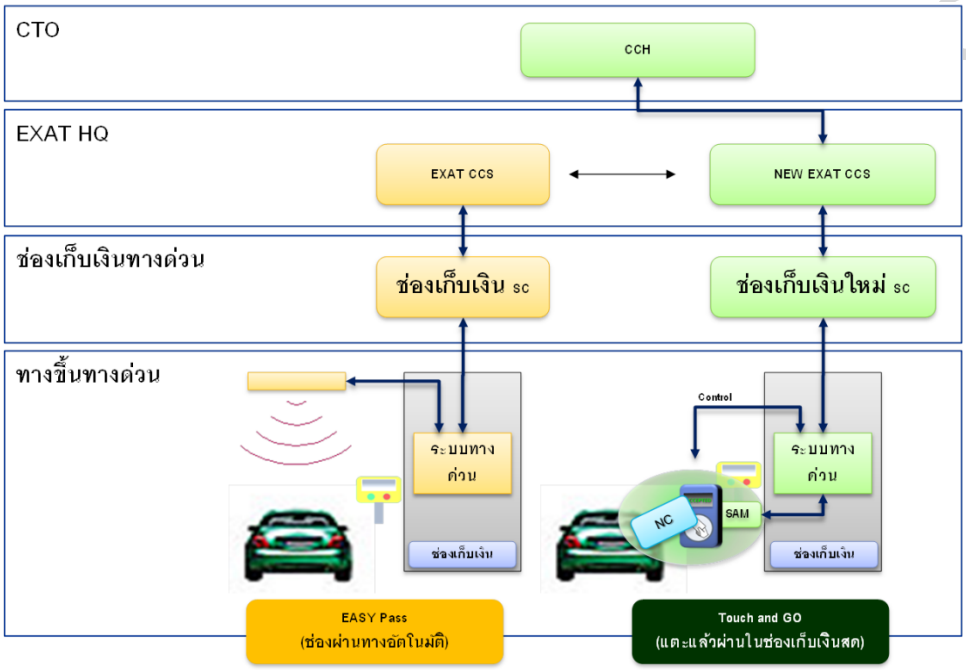
Figure 5.3-4 Bus Management System



5.3.4 Integration with EXAT system

Card operating system for Easy Pass is Long-range readers; this technology is a different system compared with others system since no data is stored in the card. The consultants consider setting up a new system called Touch & GO system in order to allow passenger to touch a card with reader as illustrated in figure 5.3-5 and this system requires improvements on software, and card reader installation at the toll booths and data collection shall be done at data acquirer as shown in figure 5.3-1 and 5.3-2.

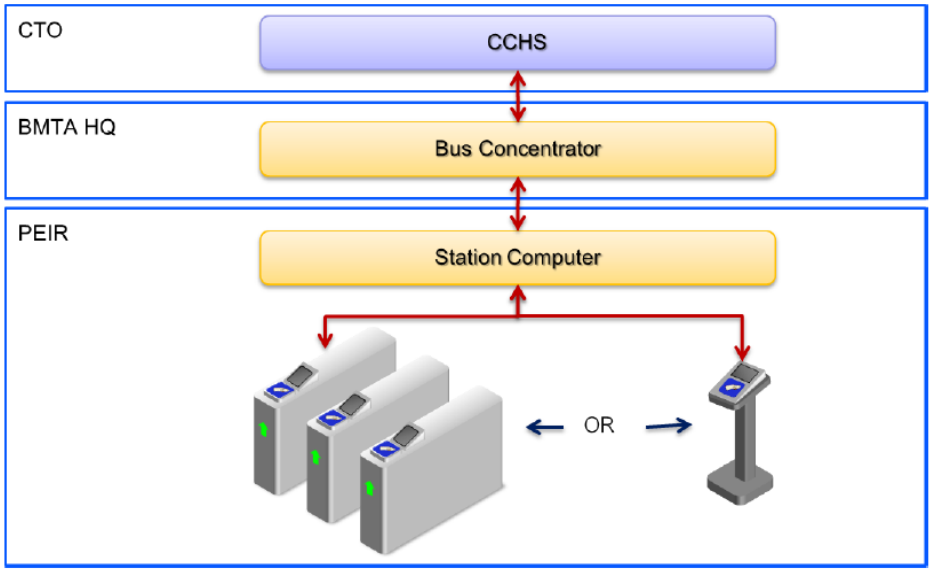
Figure 5.3-5 Fare collection system for Touch & Go



5.3.5 Integration with water transportation

Presently, water transportation does not have automated fare collection system similar to public bus operators. Hence, the integration requires reader, central computer, and other devices. Since the river piers are open areas that allow people to moving in freely, to install reader without full control may create a lot of damage. Collaboration from related organization to support a closed system is needed.

Figure 5.3-6 Integration of water transportation



5.4 Fare structure of common ticketing system

The most essential part to define fare structure of common ticketing system is to manage the coverage of mass transportation networks and provide the service with fair price and to make benefits for all passengers. There are 3 common fare structures that could be applied for common ticketing system which are Flat Fare per journey, Flat fare per transportation mode and Distance based, with waived/discounted entrance fee. The consultants will study each structure and propose to relevant organizations accordingly.

5.4.1 The objective of setting fare structure of common ticketing system

The consultants have an opinion that all operators should apply the same common fare structure in order to have efficiency system and integration.

The objectives to develop common fare structure can be summarized as followings;

1. Entire system including collecting fee should be developed in the same direction.
2. Suitable fare structure due to the fact that passengers shall not pay for all the entrance fees, especially those passengers who travel across different transportation modes.
3. Simply fare structure that create better understanding to passenger
4. Fare structure for common ticketing system is also stimulating passenger to buy store-valued ticket which leads to overall satisfaction.
5. Motivation campaign for government to promote public transportation.

Below are key factors to develop common fare structure:-

1. Collaboration from private sector, especially adjust current fare policy.

2. Supportive from government to subsidize the decrease revenue which occurs from common fare adoption.

3. Physical structure of Central Clearing House (CCH) and might revenue policy apportionment for each operator.

4. Existing devices that currently used and all data transaction

5. Regulation or limitations of each operator

5.4.2 Common fare structure development

The consultants would suggest to develop common fare structure along with physical connection of the Front-end system. The consultants also reviewed on oversea and Thailand common ticketing system to ensure that there is no affects to the operation of existing operators.

1) Fare structures used in Thailand and other countries

1.1) Distance-based Fare

This fare will be varied according to actual travelling distance (per kilometer). It will reflect actual cost, which is fair for both passengers and operators. The fare is calculated, as follow.

$$\text{Fare from A to B} = [a1 + b1(x1)] + [a2 - d + b2(x2)] + \ldots + [an - d + bn(xn)]$$

Given xn = Travelling distance on system n where x1+ x2+…+xn = distance from A to B

an = Initial charge of system n

bn = Fare varied by distance of system n

d = Discount when travelling by using multiple systems

Table 5.4-1 Comparison of advantages and disadvantages of Distance-based Fare

Advantages	Disadvantages
- The fare reflects the actual usage i.e. Passenger who travels in longer distance will have to pay more. - The fare structure that relates to the distance will be stable, which reflects the actual cost, payback and benefits to operators - It is easy to be used with Smart Card. - It is suitable for having many operators in multiple systems as well as expanding the route.	- More complicated transporting system will give more choices for passengers to plan their journey as each route costs differently. - It might not attract passengers who live in remote area as they have to pay higher fare.

1.2) Coarse Distance-based Fare

Coarse Distance-based Fare will be similar to Distance-based fare but the rate will be assigned for particular distance range. For instance, the rate will be fixed for the first 5 kilometers. Then the rate will be increased for every 3 more kilometers. The Pros and Cons will be similar to the Distance-based fare but the rate is more understandable and memorable.

Even though, the fare structure seems to be more understandable for passengers, revenue apportionment for operators gets more complicated because the fare is not directly varied the distance.

The discount for Distance-based fare can still be applied for the Coarse Distance-based fare but it will be more complicated. This calculation can be used with both stored value card and single ticket.

Table 5.4-2 Comparison of advantages and disadvantages of Coarse Distance-based Fare

Advantages	Disadvantages
- It is convenient for the passenger when making a payment and getting some change.	- Fare rate will be less correlation from the distance. - It is more difficult to allocate revenue.

1.3) Flat Fare throughout the System

This alternative is simple as the passengers pay flat rate for the whole trip. The passenger can travel anywhere in the system that shares the same structure and also change mode of transportation within the designated timeframe. This structure will be worthwhile for passenger who has long distance travel. This might lead to the difficulty in setting the price. That is, setting the high price to cover the cost for long distance trip will not attract the passenger who travels in short distance. But if set price is too low, it might not be able to cover the cost.

Flat fare throughout the system will be suitable for transporting system with single operator because it is easy to manage and able to use open ticket technology, which has lower cost than other methods. However, if there are multiple operators, the revenue apportionment will be complicated since the fare does not increase when the distance gets farther. In additional, it is difficult to check actual usage that each passenger travels in each system unless closed ticket technology is used, which will increase the cost.

Table 5.4-3 Comparison of advantages and disadvantages of flat fare throughout the System

Advantages	Disadvantages
- Flat fare is worthwhile for passengers who have long distance travel and live in distant area. - It is convenient for passenger to make a payment and get some change.	- Flat fare is not worthwhile for passengers who have short distance travel. - This structure used revenue from short distance travel to cover the cost of long distance travel.

- Cost of ticket is lower than other structure.	- If the price is set at low rate, the government has to pay more subsidies. - Revenue apportionment is complicated if there are many operators.

1.4) Concentric Zonal Fare

Fare Calculation for concentric zonal fare structure is a combination between distance-based fare and flat fare throughout the system. Passenger who travels within the zone pays the same fare and is able to change the route within timeframe. This structure has been used in many European countries and Australia. The idea is setting central business district to be center zone and setting surrounding areas to be rural zones. The structure of fare is explained, as follow.

Passenger travels within 1 zone Fare is equal to d

Passenger travels across 1 zone Fare is equal to d + e

Passenger travels across 2 zones Fare is equal to d + e + f

Table 5.4-4 Comparison of advantages and disadvantages of concentric zonal fare

Advantages	Disadvantages
- It is fair for both passengers who have short and long distance travel. - It is easy for the passenger to plan the trip as the price is calculated by how many zones he has to pass. - It can help reduce the density of passenger in inner city.	- It is difficult to adapt to the system having many bus routes since record of hopping on and off the bus needs to be collected. - Passenger who travels in short distance but needs to pass 2 zones might have to pay more than one who travels farther but within the zone. - If smart card technology is adopted, zonal fare will not be superior to distance-based fare. - Revenue apportionment is complicated and difficult.

Table 5.4-5 Summarized of current fare structure from each operator

Operators	Fare Structure	Fare Price (Baht)
BTS-initial	Moving Zone	15-40
BTS-SLM Extension1(S7-S8)	Moving Zone	

Operators	Fare Structure	Fare Price (Baht)
BTS-SLM Extension2(S9-S12)	Moving Zone	TBD
BTS-SKV Extension1(E10-E14)	Flat Fare	15
BMCL	Distance Based	15-40
SARL	Moving Zone	15-45
BRT	Flat Fare	10
BMTA Bus (A/C)	Distance Based	10-18 for white-blue bus 11-23 for yellow-orange bus (Euro 2)
BMTA Bus (Non A/C)	Flat Fare	6.50 for normal routes 8.50 for express way routes 8 for normal bus service during 23:00-05:00 hrs.
Private Bus (A/C)	Distance Based	11-23
Private Bus (Non A/C)	Flat Fare	8
Van	Distance Based	15-40
CPEX	Flat Fare	No Flag (10,12,14) depending on routes Orange Flag (15) Yellow Flag (20,29) depending on routes Green Flag (13,20,29) depending on routes
Saen Saep Express Boat	Distance Based	10-20
EXAT	Flat Fare, Distance Based	45-280 depending on vehicle type, enter and exit station

Operators	Fare Structure	Fare Price (Baht)
Don Muang Tollway	Flat Fare, Moving Zone	25,35,60,85,90, and 125 depending on vehicle type and exit station 60,85,90 and 125 depending on vehicle type and enter station

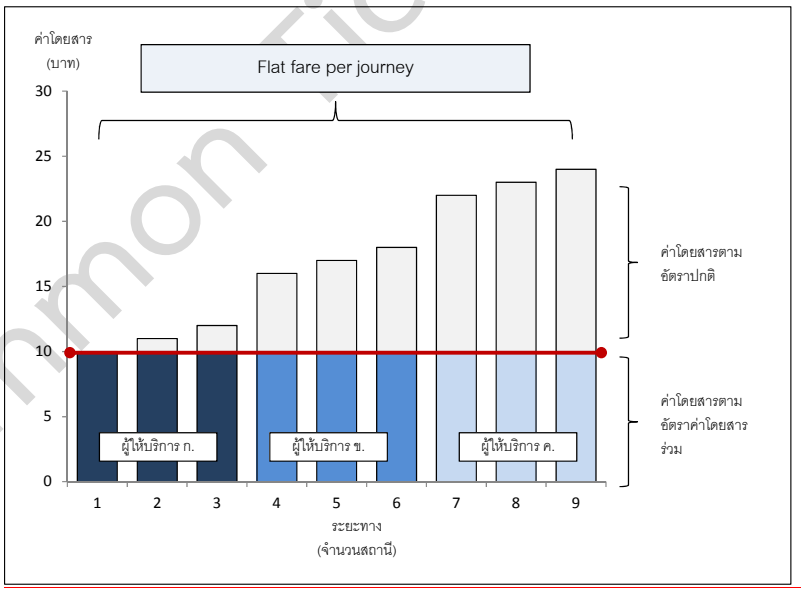
5.4.3 Common Fare Structure

According to the study which already implemented in many countries, it can describe in 3 options. Details are as below.

1) Flat fare per journey

In this structure, passengers pay only once with lower-than-average rate. They can go anywhere in the system without paying more if they change the system. This technique is very effective in attracting passengers to use common fare system because they will know exactly how much they have to pay, which is lower than normal price. However, government has to pay higher subsidy to operators than other structure.

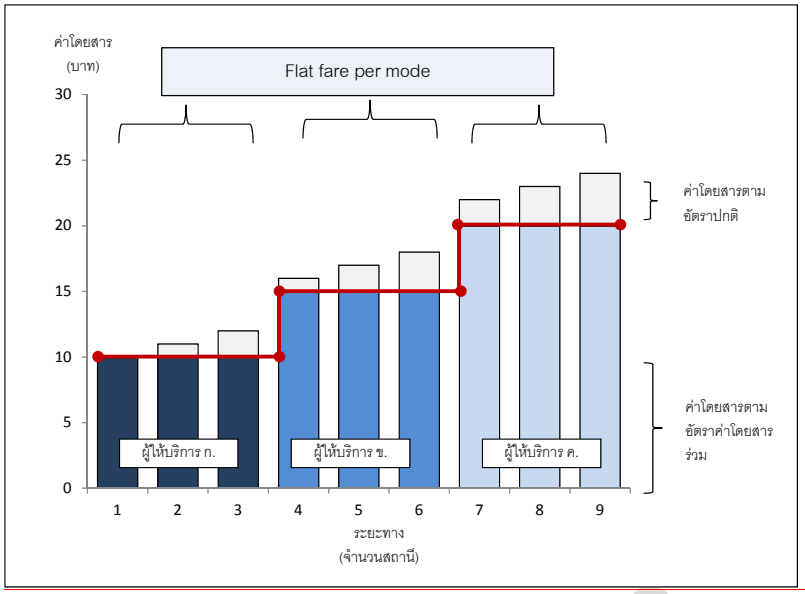
Figure 5.4-1 Flat fare per journey Structure



2) Flat fare per transportation mode

This fare structure will be paid once for the trip in one transportation mode and will be paid more when mode of transportation changes. In this case, government will pay fewer subsidies than the first structure.

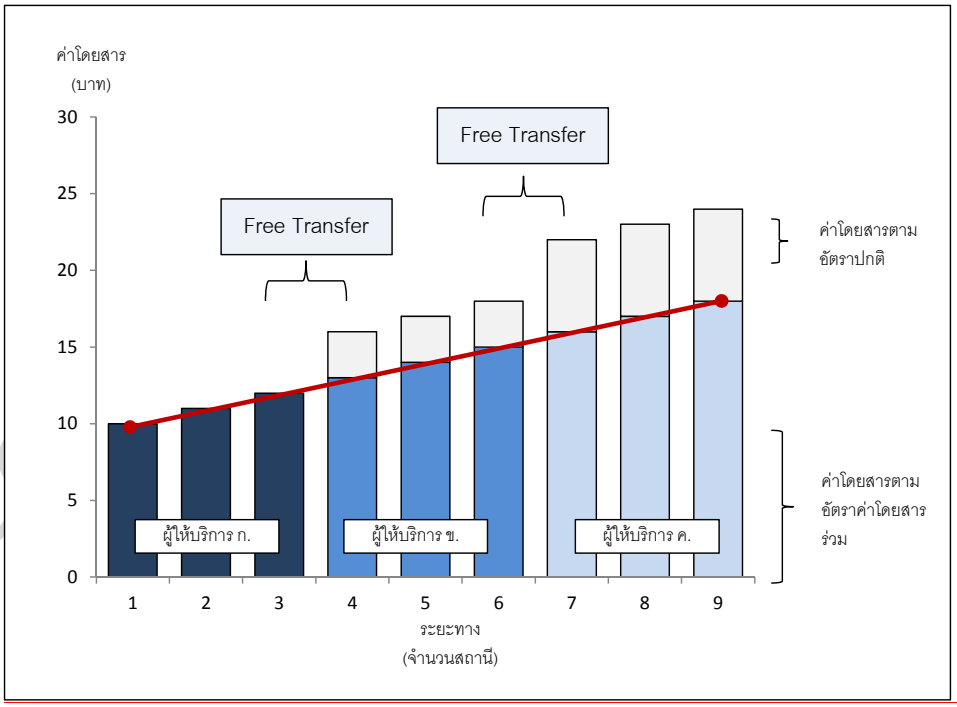
Figure 5.4-2 Flat fare per transportation mode Structure



3) Distance based, with waived/discounted initial fee

The fare will be calculated by actual distance but there will be an exemption or discount for initial fee to attract more customers. This structure needs the least subsidy from government, which is for the initial fee only.

Figure 5.4-3 Distance based, with waived/discounted initial fee Structure



5.4.4 Comparison of Advantages and disadvantages of each common fare structure

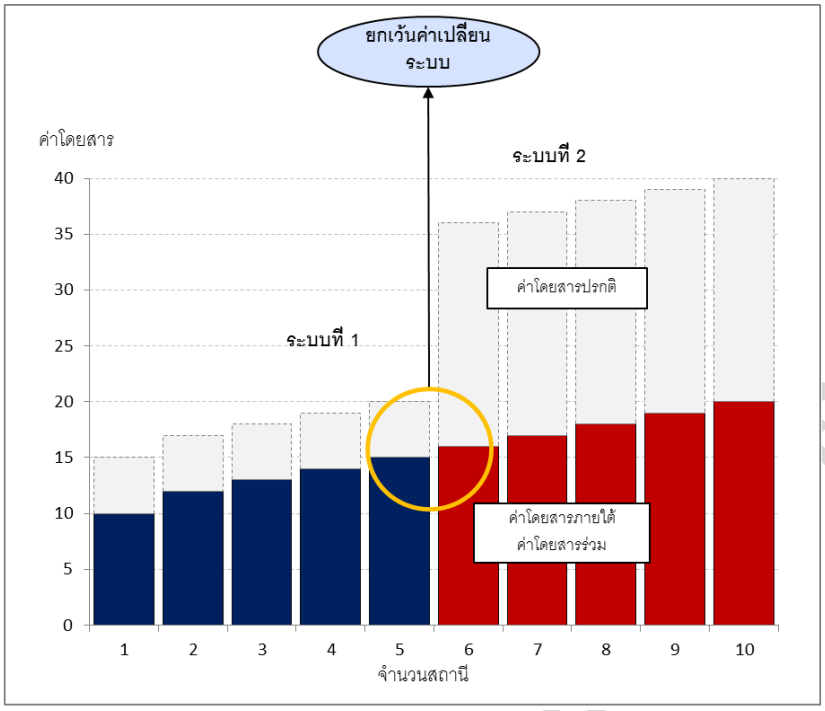
1) Comparison of Advantages and disadvantages of each fare structure

Table 5.4-6 Comparison of Advantages and disadvantages of each fare structure

Common fare structure	Advantages	Disadvantages
Flat fare per journey	- Fare calculation is easy to understand - Passenger pay only once with lower-than-average rate and can travel across other system without extra payment	- Government has to pay high subsidy to operators than other structure - Most complicated structure in term of revenue distribution
Flat fare per transportation mode	- Fare structure has less complexity than Flat fare per journey	- Fare structure did not attractive if compared to the first structure - Structure is not fair to passenger - Government will pay fewer subsidies than the first structure
Distance based, with waived/discounted initial fee	- Fare structure is easy to understand and less complexity - Government will subsidy only the initial fee	-

After considered above comparison, the consultants would have an opinion that Distance based, with waived/discounted initial fee is a suitable fare structure as it is fair to all passenger and also cost-saving when travel across transportation mode. Besides, it has less affect to current fare structure of existing operators and government has to subsidy only the initial fee.

Figure 5.4-4 Distance based, with waived/discounted initial fee



Refer to detail from figure 5.4-4, it seems that passengers who travel in more than one system will have to pay the initial fee only once and will pay the additional fare according to actual distance. This could be affected to operator due to less income. However, this fare structure would get more attention from passenger that leading to increasing income later on. Government will subsidize those defiant. Subsidy approach is still under consultation with related parties.

The consultants suggest to adjust only the initial fee and remains other fare structure according to current standards set by each operator. The suitable common fare structure can be summarized in the below table.

Table 5.4-7 Public Bus fare structure

	ค่าโดยสารปัจจุบัน		บัตรโดยสารร่วม	
	รถโดยสารธรรมดา	รถโดยสารปรับอากาศ	รถโดยสารธรรมดา	รถโดยสารปรับอากาศ
ค่าแรกเข้า	อัตราคงที่ 6.5 บ. ถึง 7บ.	10 บ – 12 บ.	[10	อัตราปรกติ
ค่าเปลี่ยนระบบ (เปลี่ยนรถ)		เต็มอัตรา	เปลี่ยนรถ 2 ครั้งไม่มีค่าใช้จ่าย 3 เที่ยว ภายใน 20 ก.ม. แรก ต้องเข้าระบบใหม่ภายใน 30 นาที	
ค่าโดยสารต่อเนื่อง		2-3 บ. /โซน	-	อัตราปกติ
ค่าโดยสารสูงสุด		23 บ.	อัตราปกติ ลบส่วนลด	อัตราปกติ ลบส่วนลด

Table 5.4-8 Public Rail fare structure

	ค่าโดยสารปัจจุบัน			บัตรโดยสารร่วม		
	MRTA	BTS	SARL	MRTA	BTS	SARL
ค่าแรกเข้า	15 บ.	15 บ.	15 บ.	ได้รับส่วนลดค่าแรกเข้า		
ค่าเปลี่ยนระบบ	เต็มอัตรา			รางไปราง: ได้รับส่วนลด โดยเปลี่ยนได้ 2 ครั้ง รถเมล์ไปราง: ได้รับส่วนลด โดยเปลี่ยนได้ 1 ครั้ง		
ค่าโดยสารต่อเนื่อง	2-3 บ. / สถานี	5 บ./ สถานี	5 บ./สถานี	อัตราปกติ		
ค่าโดยสารสูงสุด	40 บ.	40 บ. (+15 บ.)	45 บ.	อัตราปกติ ลบส่วนลด		

All details of common fare structure can be summarized as below:

1) Exemption of transfer fee

Based on common fare structure that passenger who travels and pay one initial fee and be able to change transportation mode within a number of transfer and determined timeframe.

1.1) Bus-to-Bus transfer

1. Passenger who takes a public bus and will have 2 free transfers with paying transfer fee full fare. The passengers will have to pay full fare for the next transfer.

2. In case of transferring from one to another regular bus which has the same flat fare structure, passenger will be allowed for 2 free transfers. However, if they transfer from a regular bus to an air-conditioned bus, they will get discount equaling to the initial fee they have paid for the first bus and then pay the normal rate for the air-conditioned bus.

3. In case of transferring from bus to rail, passenger will get discount the equaling to the initial fee they have paid for the bus and this will be allowed once.

4. Every transfer must be done within restricted timeframe. The consultants would suggest to set 30 minutes as a timeframe after getting off from previous bus and distance from first departure will be within 20 kilometers.

5. From first scenario in figure 5.4-5, passengers pay full fare for the first bus and will be waived. In case of regular bus or will get discount in case of air-conditioned bus for the next 2 trips. From 4th trip onward, the passengers will have to pay full price.

1.2) Rail-to Rail transfer

1. Passenger will get some discount from the first trip to be considered as initial fee discount.

2. In case of transferring from one to another line, they will get exempt of transfer fee equaling to the initial fee from the first trip. Transfer can be made twice. Each transfer must be made within 30 minutes

3. Full fare shall be applied in the third transfer.

4. From first scenario in figure 5.4-5, passenger will get a initial fee discount. They can have 2 transfers without paying additional initial fee. Passengers will have to pay full fare from the 4th trip onwards.

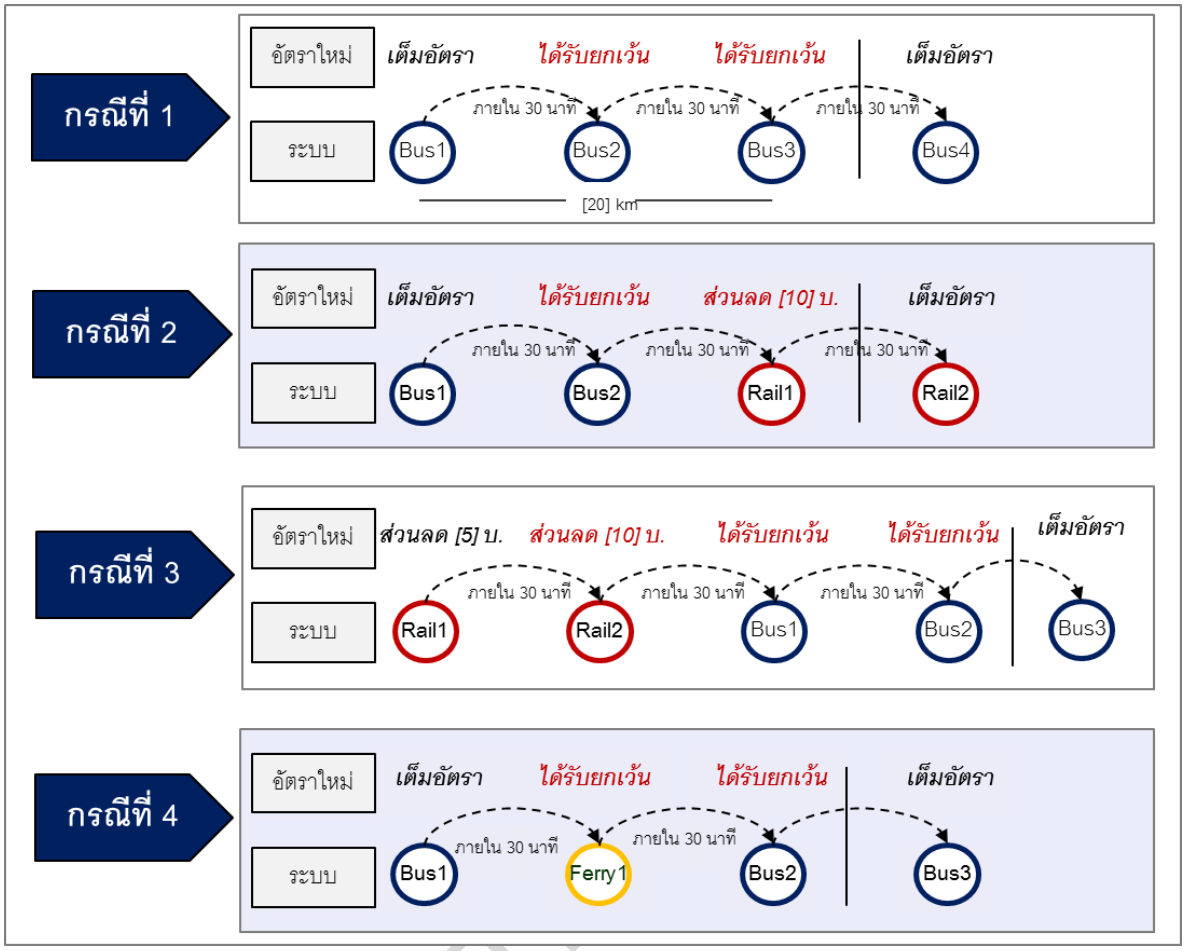
1.3) Bus – to – Rail transfer

1. Passenger who travels by bus and then transfer to rail system will get one initial fee discount and need to pay full initial fee for next transfer. The initial fee discount equals to the first initial fee paid for the first trip. As illustrated in figure 5.4-5, passengers pay full initial fare when taking bus as their first trip and will get initial fee exempting for next bus transfer. In case of the second transfer (3rd trip), the passengers will get a transfer fee discount equaling to initial fee paid for the bus previously token. Then if the passengers transfer to any system, they have to pay the full fare set by each operator.

2. Passenger who take mass rapid transit as their first trip and transfer to a bus, they will be waived from the initial fee of the bus for 2 transfers as shown in figure 5.4-5. Additionally, they will have get initial fee discount for the first rail trip and another discount from another rail transfer fee.

3. Common fare structure will also be applied to Ferries. Then, they will also receive discount for next 2 bus transfers. After that, the passengers will have to pay the full amount set by each operator with the same structure as bus, which is shown in scenario 4 in figure 5.4-5

Figure 5.4-5 Example Scenario of each fare structure



2) Approach for fare apportionment to service providers

To develop common ticketing system, it is important to consider how to apportion fare to the service providers. That is, technology will be used to help collect data transaction of each system to calculate fare for each operator and to apportion or clear such revenue within designated timeframe. This will be made by Central Clearing House (CCH), which will gather travel information from transit acquirer then process revenue apportionment and pass the information to settlement Bank to transfer money to each operator's account.

Revenue apportionment approaches that are used successfully oversea can be divided into 2 main structures, which are 1) non-common fare apportionment and 2) common fare apportionment.

2.1) Non-common fare apportionment

This structure refers to fare apportionment to each operator based on actual payment. Each operator will submit service information, such as number of passengers, distance, and total fare, to CCH to process fare apportionment. CCH will request fare rate from ticket issuer and top-up agent to distribute service fee that was previously collected by each service provider.

Figure 5.4-6 Example of non-common fare apportionment

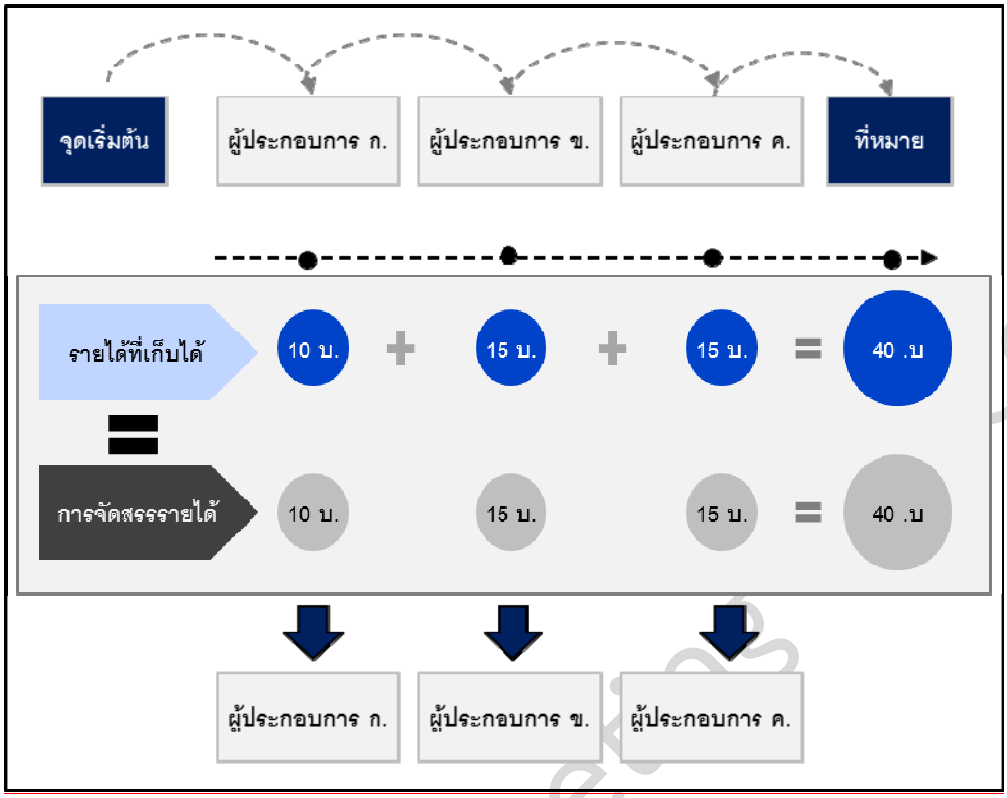
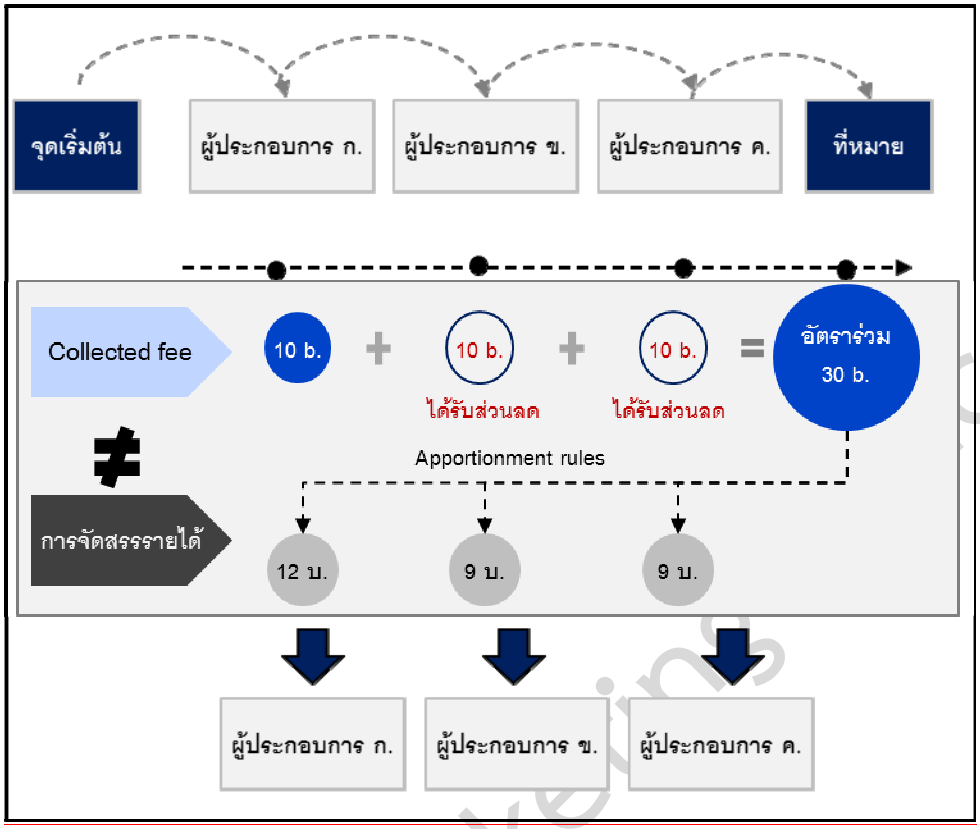


Figure 5.4-6 presented the case which revenue apportionment without common fare structure. Revenue apportion to each operator will be equally to the regular rate. In case that common fare structure is developed, this apportionment rule will not apply.

2.2) Common fare apportionment scheme

Aggregated payment is used to assign revenue in case of common fare scheme, and/or fare discount, or initial fee exemption is adopted. CCH will collect all fare revenue and apportion to each operator according to the apportionment rules. After that, the information will be passed to settlement bank to transfer a payment.

Figure 5.4-7 Example of common fare apportionment



However, actual fare collection might be less than expected because discount or initial fee exemption might be given. Therefore, the government is responsible for subsidy for the difference.

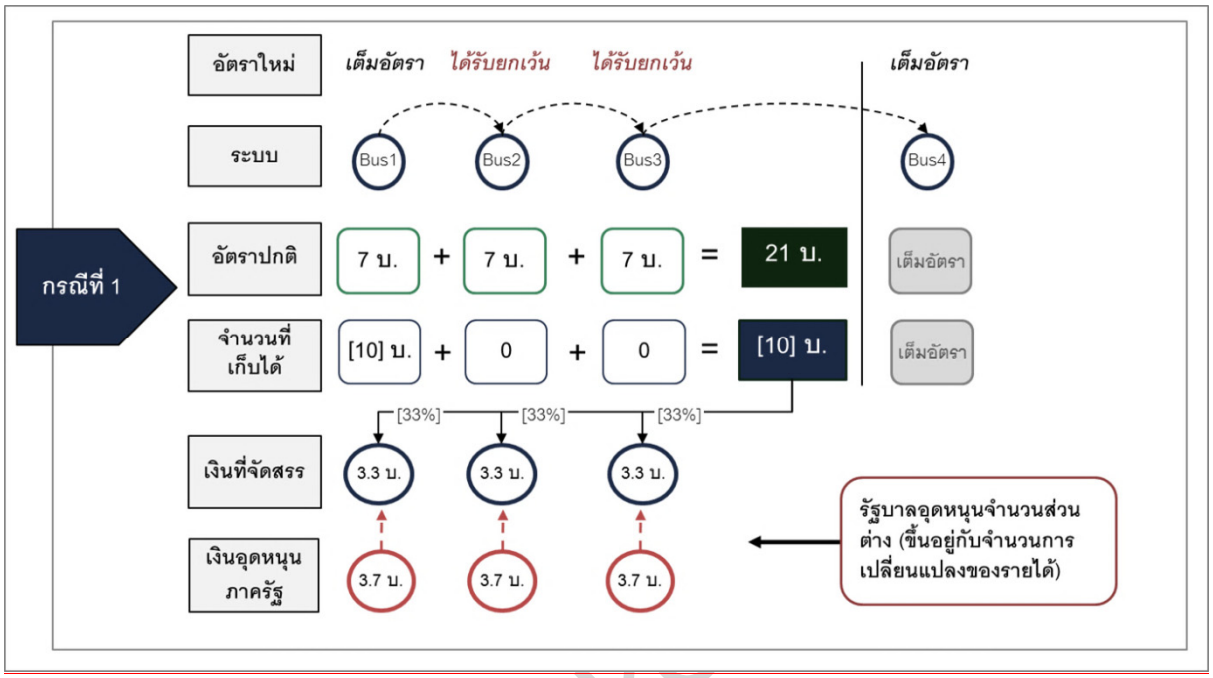
The advisor would consider that the apportionment rules for each operator shall be based on the actual revenue. That means any operators who get the highest fare also get highest revenue allocation as per below calculations:

$$\text{Revenue from operator A} = [\text{Actual fare revenue} \times \frac{\text{Fare A (based on current fare structure)}}{\text{Aggregate fare based on regular fare structure}}] + \text{Subsidy from Government}$$

Revenue from operator A	: Total revenue operator A should be apportioned based on common fare structure. Operator A means any operation who provide public transportation service such as Bus operator, Rail operator that participated this project only but excluded non-transit operator.
Actual fare revenue	: Total fare revenue which collected from a passenger in any single journey. This includes all fare revenue collected from all transportation modes travelled, which equals total regular fares deducted by initial fee and transfer fee discounts in such journey.
Fare A (current fare structure)	: All fares that passenger needs to pay to operator A, which based on regular fare structure.
Aggregate fare from all operators	: Total fares that should have been paid to each operator based on their regular fare structures by passenger such as each operator which calculated by current fare structure of each operator
Subsidy from Government	: Subsidy from government to support each operator

According to above apportionment rules, each operator will get the revenue apportionment based on current fare structure that collected from passenger and can summarized as following:-

Figure 5.4-8 Example of apportionment scenarios 1 - Same operator



Referring to figure 5.4-8, passenger starts his journey by taking a bus and gets off to transfer to another 2 buses (same bus operator and same fare structure). Passenger pays full fare when taking Bus 1 and gets exemption when transferring to Bus 2 and 3 respectively. Total fare which based on current fare structure equal to THB 21 (THB 7 + THB 7 + THB 7) However, The actual fare collected from passenger is only THB 10. Hence the Apportionment shall be as below.

Revenue of Bus 1 = (Actual fare x current fare from Bus 1) + Subsidy from government

Aggregate fare based on regular fare structure

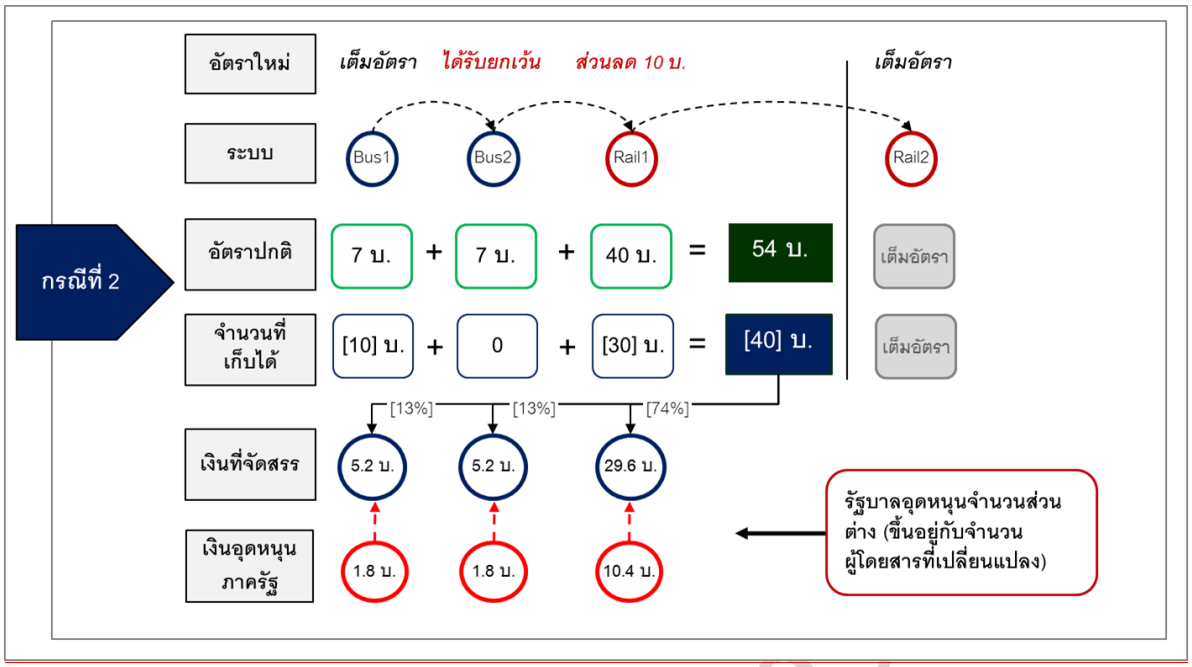
Revenue of Bus 1 = (THB 10 x THB 7) + Subsidy from government

THB 21

Revenue of Bus 1 = THB 3.3 + Subsidy from government

Based on above apportionment rule, Bus 1 will receive THB 3.3 or 33% of the actual amount.

Figure 5.4-9 Example of apportionment scenario 2 - Difference operators



From figure 5.4-9, in this scenario passenger travels by 2 buses and one rail (BTS) Total fare is THB 54 (THB 7 + THB 7 + THB 21) However, the actual fare that collected from passenger is THB 40 and could be described as below.

Revenue of Rail 1 = (Actual fare x current fare from Rail 1) + Subsidy from government

Aggregate fare based on regular fare structure

Revenue of Rail 1 = (THB 40 x THB 40) + Subsidy from government

THB 54

Revenue of Bus 1 = THB 29.6 + Subsidy from government

According to above apportionment rule, operator Rail 1 got THB 29.6 or 74% of the actual fare and operator Bus 1 and Bus 2 will receive THB 5.2 or 13% of the actual fare.

These apportionment methods have been considered from proportion of operating cost and still on preliminary study and wait for the comment/approval from authorized parties.

Chapter 6 Opinions and recommendation hearing for common ticketing development policy

6.1 Principle and reason

There are lots of people travels to the center of Bangkok every day; most of them are for working purpose. Traffic congestion and carbon dioxide emission impact population health and environment. In order to solve such problems, many large cities adopt common ticket to be used in their transportation systems. For example; train system, public bus, ferry, and express way. Other than discount that ones can benefit from using common ticket, they can also reduce ticket purchasing time and entrance fees for multiple journeys. Office of Transport and Traffic Policy and Planning (OTP) has been hiring a group of consultants to operate Program Management Service (PMS) according to the cabinet is resolution on 3 May 2555; "Single Standard, Multiple Issuers for every operator under Ministry of Transport." The project will last 48 months. The major objectives are create policy and standard that related to common ticket, set criteria for developers, establish the Central Clearing House, technology transfer and publicize related information to public and private sectors.

The consultant groups set up the first Public Hearing about "Roadmap and Central Standard for Common Ticket Operation in Thailand." Dr. Chula Sukmanop is the chairman of the event that held on 22 March 2556 during 9.00-12.30 at Bussarakum Room, Amari Atrium Hotel.

6.2 Purpose

The purpose of this event was to gather to any comments and recommendation in order to draw roadmap and central standard for common ticket operation. Since the operators run the companies daily so they know possible obstacles. Therefore, comments from operators are very necessary to create high standard and quality. The development of common ticket is formed to promote public transportation and lead to reduction of traffic in the end.

6.3 Meeting Format

Meeting format is arranged by PMS consultants in lecture style and a discussion forum with question and answer session at the end of meeting. The following parts are the sequent of lecture.

1. Lecture by Dr. Eum Sung Jick, the expertise in traffic planning and common ticket. He presented the development of common ticket in Korea and other countries.
2. Lecture by Avantgarde Capital under the topic of "Roadmap of common ticket operation." He presented the overview of current common ticket operation and idea for the future, structure of common ticket program, guideline for fare structure, fare apportionment among the operators and timeline for the PMS project.
3. Lecture by PSK Consultant under the topic of "Central Specification for Common Ticket." He presented front-end specification and the interface, the composition of fare collation system, fare

collection structure, the adjustment of current equipments and their expenses. Following by the presentation of back-end specification.

4. Lecture by Bangkok Smart Card System and Thai Smart Card representatives. He presented the historical operation performance, roadmap and opportunity to join common ticket project.

6.3.1 Attendances

Organization under Ministry of Transport

(1) Permanent Secretary of Ministry of Transport

(2) Permanent Secretary of Ministry of Transport (Supervision Unit)

(3) Permanent Secretary of Ministry of Transport (Infrastructure Development Unit)

(4) Permanent Secretary of Ministry of Transport (Transport Unit)

(5) Head of Inspector, Ministry of Transport

(6) Inspector, Ministry of Transport

(7) Experts specialize in Law, Ministry of Transport

(8) Director General, Department of Highway

(9) Director General, Department of Rural Roads

(10) Director General, Department of Land Transport

(11) Director General, Marine Department

(12) Director General, Department of Civil Aviation

(13) Director of Bureau of Policy and Strategy

(14) Managing Director of Airport of Thailand

(15) Board Director of Thai Airway

(16) Managing Director of Transport Co., Ltd.

(17) Director of Bangkok Mass Transit Authority

(18) Governor of Expressway Authority of Thailand

(19) Director of Aeronautical Radio of Thailand

(20) Governor of State Railway of Thailand

(21) Chairman of Mass Rapid Transit Authority of Thailand

(22) Officer of Office Transport and Traffic Policy and Planning

Other Government Departments

(1) Director General of Bureau of Budget

(2) Secretary of Office of the National Economic and Social Development Board

(3) Director General of State Enterprise of Policy Office, Ministry of Finance

(4) Director General of Public Debt Management Office, Ministry of Finance

(5) Director General of Traffic and Transportation Department

(6) Governor of Bank of Thailand

(7) Director General of Office of the Consumer Protection Board

(8) Director General of Electronic Transactions Development Agency

(9) Director General of Asian Development Bank

(10) Director General of Transport Institution, Chulalongkorn University

Private Entities

(1) Director General of Transport Institution, Chulalongkorn University

(2) Executive Director of Bangkok Smart Card System

(3) Managing Director of Bangkok Metro Public Company

(4) Managing Director Expressway Authority of Thailand

(5) Chief Executive Office of Smart Traffic Company

(6) Managing Director Thales (Thailand) Ltd.

(7) Managing Director of Bank of Ayudhya Public Company

(8) Managing Director of Krung Thai Bank Public Company

(9) Managing Director of Siam Commercial Bank Public Company

(10) Managing Director of Kasikorn Bank Public Company

(11) Managing Director of Bangkok Bank Public Company

(12) Managing Director of Isalamic Bank of Thailand

(13) Managing Director of Chao Praya Express Boat

(14) Managing Director of TOT Public Company

(15) Managing Director of CAT Telecom Public Company

(16) Chief Executive Officer of Siam FamilyMart

(17) Managing Director of The Krungthep Thanakom Company

(18) Managing Director of Sun 108 Company

(19) Chief Executive Officer of Major Cineplex Group

(20) Managing Director of Bangkok Mass Transit Authority (BMTA)

(21) Managing Director of Thai Smart Card Company

(22) Managing Director of CP All Company

(23) Managing Director of Chan Wanich Security Printing Company

(24) Managing Director of Advance Info Service Company

(25) Managing Director of Total Access Communication Company

(26) Managing Director of True Move Company

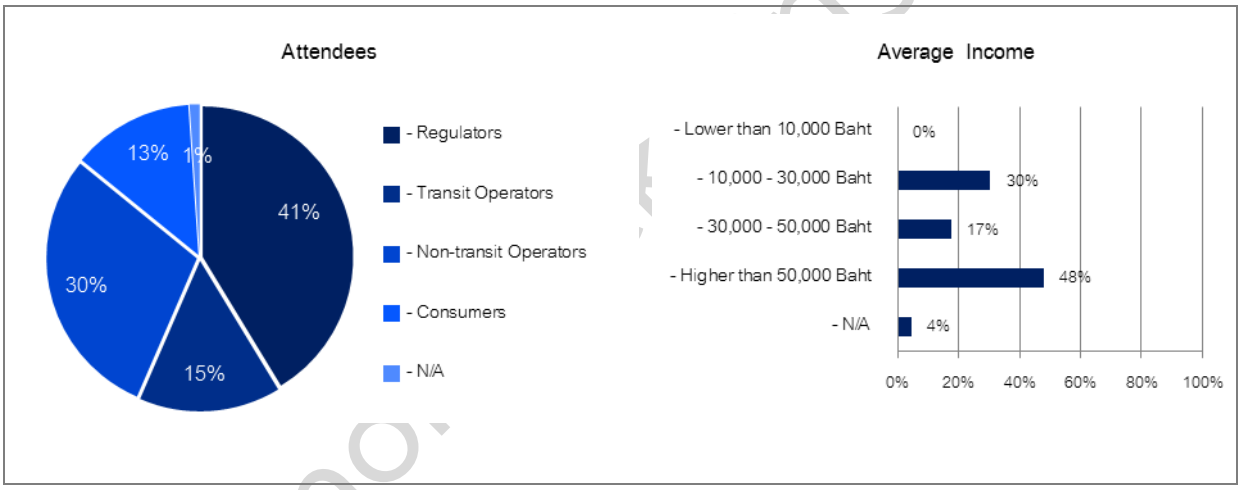
(27) Press from Ministry and related

6.3.2 Conclusion

1) General Information

There are 310 attendances from regulators, transit operators, non-transit operators and representative from public and private entities. There are 92 responses, which 56% of them came from regulators and transit operators.

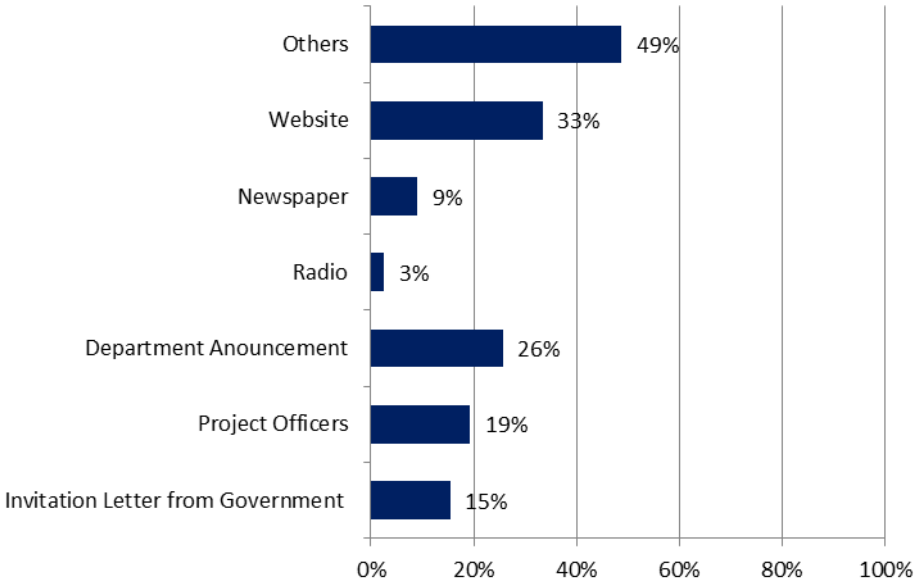
Figure 6.3-1 Results from questionnaire



2) Source of Information about Common Ticket Project

68% of attendees acknowledged about the PMS project from invitation letters from government and project officers. Other than that, they perceived the information from newspaper, website, department announcement, etc.

Figure 6.3-2 Source of Information about Common Ticket Project

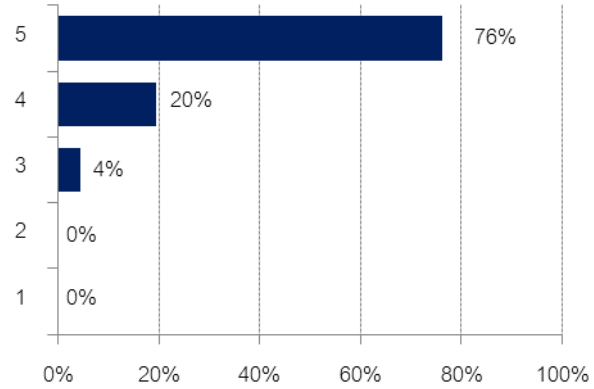


3) Opinions toward PMS

3.1) Response from questionnaires

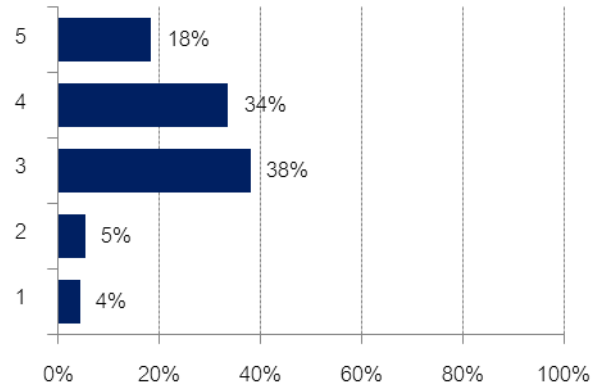
5 = Most agree 1 = Least agree

1. Do you agree with the implementation of Common Ticket Project?



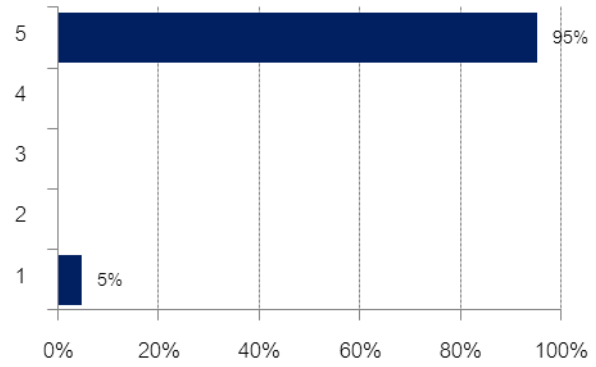
76% of attendances agree with PMS project. Only 4% feels impassive toward the project.

2. How far do you know about common card and common fare?



52% of attendances understand about common ticket project quite well. In conclusion, most of the attendances understand the usage and benefit of common ticket so it would not be too hard for them to adopt this project.

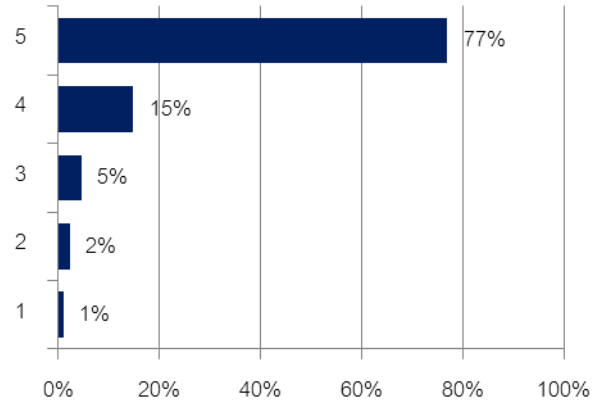
3. Do you think this project should implement common card or common fare? (1=Common Card, 5=Common Fare)



95% agree that common ticket should be common fare type.

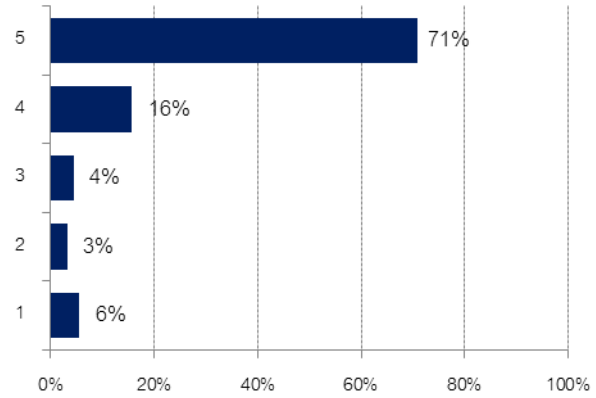
5 = Most agree 1 = Least agree

4. Do you agree with the creation of Single National Standard for Common Ticket Project?



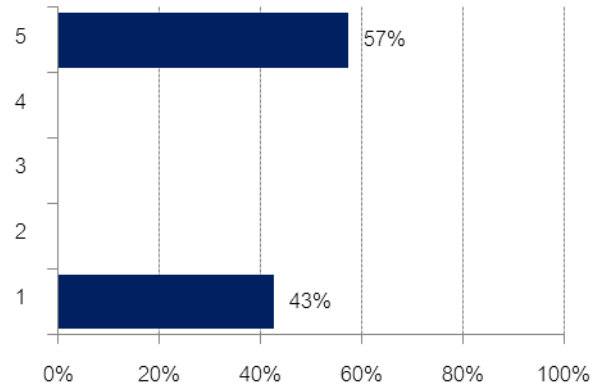
77% of attendances agree that the government should set up Single National Standard.

5. Do you agree whether there must be more than 1 issuer in Common Ticket Project?



71% of attendances agree that there should be more than 1 issuer.

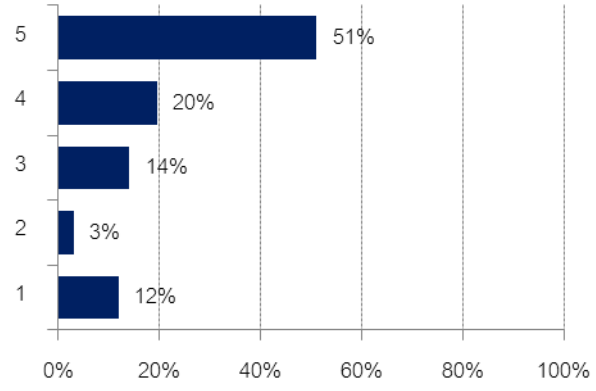
6. Do you think whether CTO should be government organization or private enterprise? (1=Government, 5=Private Enterprise)



57% of attendances suggest that the CTO be a private company. However, there is not significant difference between those who choose government enterprise.

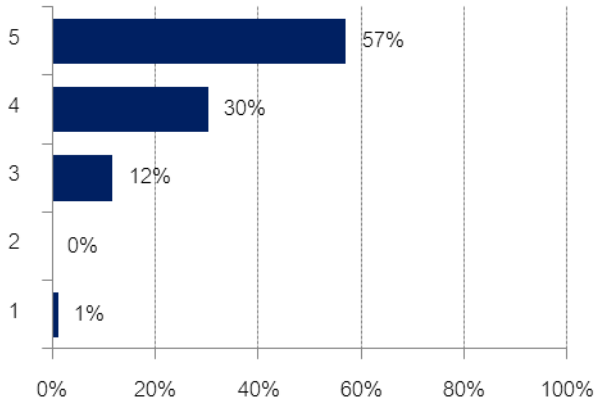
5 = Most agree 1 = Least agree

7. Do you agree with government subsidy to support Fare structure in Common Ticket Project?



71% of attendances agree that government should support in fare structure.

8. Do you agree with the study and establish the operation of Common Ticket Office



87% of attendances strongly agree and support Common Ticket Project.

3.2) Suggestions on the development plan of Common Ticket Project in Thailand

1. **Suggestion on commercial aspect of project development**
   - Business model should be precise and clear.
   - The business model must has minimum impact on existing AFC system, and the card design must allow for interoperability across all mode of public transportations
   - Business model that need not to rely on the government or to support government policy. (Ex. 20 Baht flat fare)
   - Business model should answer passenger's need in order to create sustainable satisfaction.
2. **Transportation Connectivity Division**
   - The system should include inter-city transportation system such as inter-city buses, trains and airplanes.
   - Uses of common ticket system should cover private buses
   - The common ticket that can be used with railway system should be implemented as fast as possible.
3. **Card Usage and Operating System**
   - Can be able to pay transaction via mobile phone.
   - If one lost the card, what is the policy to manage unused money.
   - Common ticket system should be connected with identification card system. Therefore, the government can allocate subsidy to specific group of person.

   The national standard should be set up first. It seems to be impossible to integrate all card systems.

4. Fare Policy
   - Fare structure should be set at appropriate level, not too low.
   - Concession fare price for no-income group.
   - Is the government subsidy for only Thais or every rider?
   - If reader on the bus is broken, can the riders get off the bus?
5. Public Relation
   - Arrange public events regularly in order to receive opinions and comments.
   - Widely promote and educate about Common Ticket Project to every level of population.
   - The meeting should be arranged for relevant organizations. Therefore, they are directly acknowledge and be able to plan further actions.
   - The handout should point out the project plan and key milestones Therefore, the audience would know the improvement of project.

3.3) Pictures for Public Hearing Event

The opening of Public Hearing Event

The opening of Public Hearing Event

Speech by Dr.Eum, Sung Jick

PMS advisory team

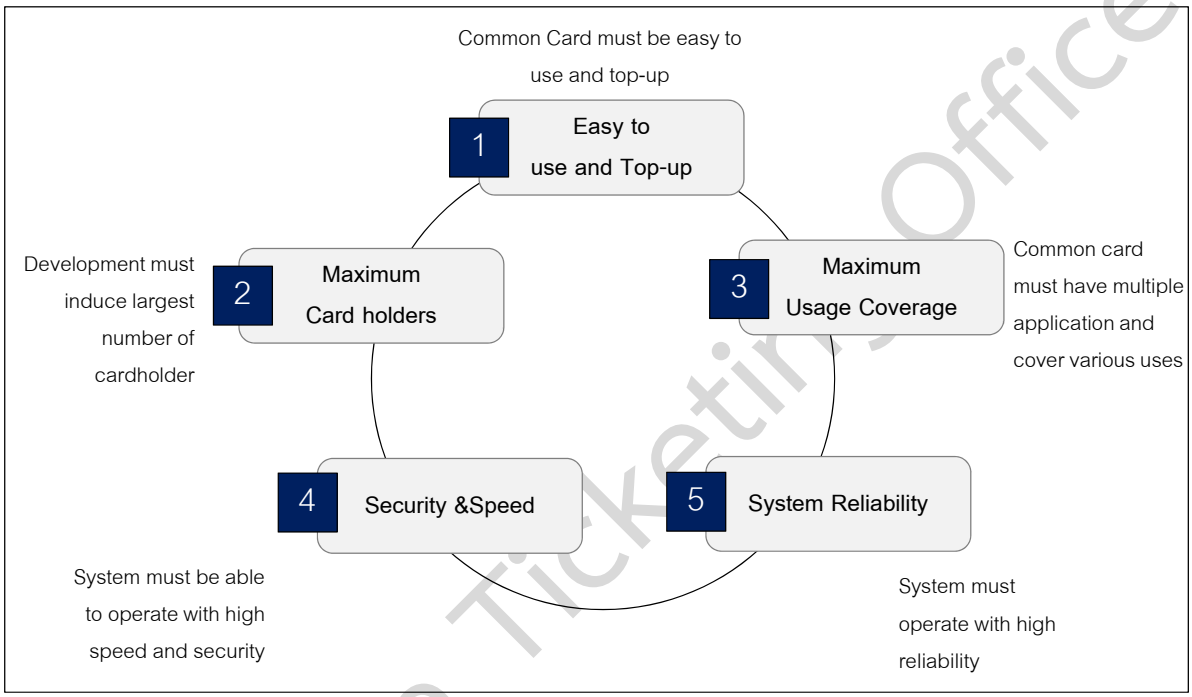
Chapter 7 Common Ticket System Development Policy

7.1 The Importance of Common Ticket System, and the Development Considerations

To be successful in developing common ticket system, many factors should be taken into consideration. For examples, providing the ease of use to card holder, fairness for each sector participated in a common ticket system and diverse and extensive the use of the card.

7.1.1 Factors in consideration for development of a common ticket system

Figure 7.1-1 Important factors for common ticket system



1) Common ticket should easy to use and Top-up

Apart from being convenient in terms of single card for all transportation modes, the common ticket should be easy to use and top-up. Fare structure should not be complicated and should promote fairness to passenger by excluding the initial fee when transfer. Top-up system is another factor that could promote the usage of new card system. Therefore, it is better to have wide range of top-up channels and cover all group of card holders.

2) Common ticket requires persuading to have maximum card holder

To be successful in developing this new system, it is necessary to have a large number of card holders in the system. A large number of card holders will encourage more service providers participate in the system. Accordingly, such service providers will also lead to an increasing in number of card holder continue as a cycle. The examples of success card systems are “Suica card” in Japan and “EZ link card” in Singapore which have around 30 million and 10 million card in circulation respectively. Both card share the same success factor of having maximum card holder at the starting period. Thus, the system should have special

campaign to promote the system and attract the card holder as much as possible. The consultants recommend to have variety of fare products to cover diverse customer needs.

3) Common ticket should provide maximum usage coverage

As mention above, system coverage is one of the success factors for common ticket system. As a result, the system need to have wide coverage including both transit and non-transit systems. For example, the card could be a media of payment for all transportation system along with the benefit from cashless system that the card holder also able to use the card in convenient stores and any other service providers. The card should become part of card holder's daily life.

4) Common ticket should able to use with speed and secure

Not only the speed and security of system but also its reliability that are important. Since the system have to deal with many stakeholders, transactions and information, there is high risk of failure such as loss of data during transfer. To protect and limit the risk, the system should be stable and reliable since a single minor mistake could damage the entire system. This factor is very concerned of the consultants thus, in system selection process, we carefully planning for both front system, back system and back-up systems.

5) Common ticket should have a reliable system

Common ticket system standard is another factor of usage decision. The card must be preceded the reading quickly and safely. Such factor will assist in term of comfort and speed in traveling or making transaction via card. This would lead to the increase of common ticket since it could response to user's need.

7.1.2 Expected benefits for each stakeholder

According to the studies on common ticket system in other countries, the consultants found that a common ticket system could add value to whole transportation system. It provides a more convenient system for passengers and also encourages people to leave their car to use more public transport. This would help government budget on traffic policy and pollution problems. Nevertheless, common ticket system also gives more effective and efficient way of fare collection and clearing house system, result to lower operation cost. The benefits to each stakeholder could be summarized below.

Benefits to passenger

- Convenient provided by single common card that allows passenger to use all transportation modes.
- Cashless society, people can use common card interchangeable with cash in daily life
- People receive a lower fare especially in transit system due to exemption or discount of initial fee

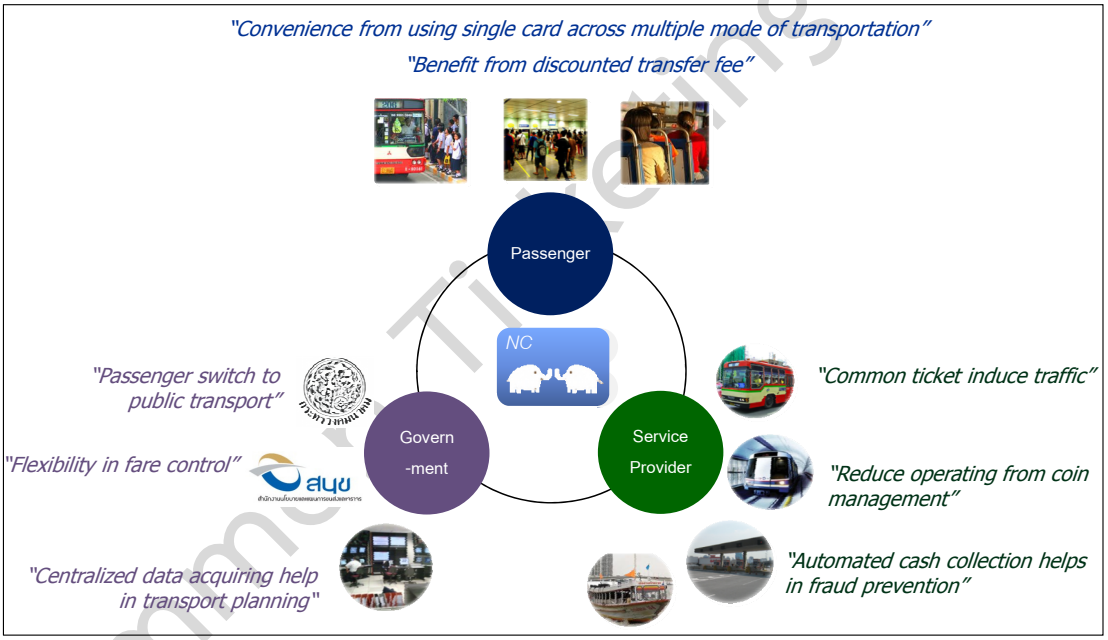
Benefits to government

- Government have more flexibility and more control of fare structure
- Able to collect transportation information for further planning
- Get an opportunity to attract people to use more public transport
- Able to set a standard of Automatic fare collection system (AFC) to be a foundation of other developments in the future

Benefits to service providers

- Get additional value and opportunity from higher of number of passenger
- Reduce the operating cost by reducing the single trip card
- Have a higher reliability in fare collection system and clearing system

Figure 7.1-2 Benefit of Common Ticket System to all Stakeholders



7.1.3 Examples of benefits from common ticket system in other countries

1) London, United Kingdom

Transportation system in London is one of the largest systems in the world. It has to have high proficiency to support 8 million users. Transportation in London consists of many transportation mode so called Multi-modal transportation. For system management, Bus system, Light rail transit system (LRT) and Mass transit system (MRT) are managed by Transportation of London (TfL). And Heavy rail services system is under management of National Rail Train Operating Companies (TOCs).

In 1983, common ticket system was officially established in London as the "Travelcard" system with the main purpose to be as a central clearing house for all transportations.

After the common system had been implemented, it resulted to an increase in public transport passengers. The study of Fairhurst (1993) – Transportation Research Board[2], it found that, with the Travelcard system, a number of passenger on Tube System increased more than 10 percent since the Travelcard system had been operated. Similarly, average travel distance rose more than 30 percent.

For bus system, a number of passenger grew over 16 percent during 1983-1993 with higher travel distances ascent more than 20 percent. Furthermore, Transportation of London also developed common fare system and flat fare system for all transportations in London. With the new fare rate and common ticket system, Bus passenger rose around 32 percent during 1999-2005. The common ticket and common fare system lift up transportation in London to the new level. The systems provide convenient to all Londoner with cashless society. Cash payment went down and left only 3 percent of all transactions. Also, the boarding time left only 2-3 second as blink of eyes.

2) New York, United States of America

Transportation in New York city is also in the world top ten biggest transportation system. It covers various of transportation modes and serves more than 8 million people in the city. Metropolitan Transportation Authority (MTA) responsible for setting the policy, strategic planning accompanied by managing the entire transportation systems in New York and nearby areas. MTA's organization is divided to specific units such as MTA New York City Bus and MTA Metro-North Railroad (MNR).

[2] Fairhurst (1993) Transportation Research Board – National Research Council, 2004 Transit Cooperative Research Program Report 95 : Transit Pricing and Fares – Traveller Response to Transportation System Changes.

For automatic fare collection system, it operated by using MetroCard as a media of collection. The MetroCard is a common ticket in New York city which can be used interoperability with all transportation modes and also support for common fare system. The details of MetroCard development summary are below.

Table 7.1-1 Summary of MetroCard system development

Year of developments[3]	Details
1994 - 1997	MetroCard Pilot project, the card can be used on some MRT stations and some routes of Bus.
May 1997	Completely developed MetroCard system and MetroCard can be used for all transportations.
July 1997	Officially initiate common fare system. The passenger can transfer between each transportation mode interchangeable without initial fee (Free-transfer). For example, transit from Bus system to MRT system without paying additional initial fee.
1998 – present	Further development of MetroCard to have more variety of Fare Product. For example, unlimited trip card within 7 days or 1 month.

From the survey, it shown that a number of Bus passenger increased after the common ticket system had been operated. The bus passenger rose around 40 percent in rush hour with growth of 20 percent during 1997-1998 while the MRT passenger increased around 17 percent.

Table 7.1-2 Examples of an increasing in number of passenger

Examples[4]	Year	Benefits
London, UK	1983 - 1992	10% increase on Tube 16% increase on Bus
London, UK	1999/2000 and 2005/2006	32% increase (across all modes)
Change fare structure to Flat fare Brighton and Hove, UK	2002	Increase in bus passenger from 5% to 8%
Develop to common ticket system West Midlands, UK	1972 - 1981	Passengers increase on average of 7% in every transportation mode
Develop fare structure to common fare Zurich, Switzerland	n/a	Passengers increase on average of 12%

[3] Schaller 2002 'New Fare Discounts for Transit Riders in New York City"

[4] Booz &co. 2009, The benefits of simplified and integrated ticketing public transport

Examples[4]	Year	Benefits
Cologne-Bonn, Germany	2004	Over 1/3 of population use public transport more than once per week
Flanders, Belgium	2007	200% increase (across all modes)
Dresden, Germany	1998 - 2008	11% increase on monthly & yearly tickets
Vienna, Austria	2006 - 2008	Increase in the number of travellers using public transport
New York, USA	1998	40% increase in bus 17% increase in rail
Washington DC, USA	1999	22 million increase in rail and bus services
South East Queensland, Australia	2004 - 2005	2004/2005 – 9.7% increase (across all modes) 2005/2006 – 11.6% increase (across all modes)

3) Thailand example of increasing in passenger according to connectivity between each transportation mode

According to the study on common ticket benefits in other counties, it indicated that the common ticket system could encourage people to use public transport 10 to 15 percent more. This would help government in solving traffic problem and could also consider as a help to public transport operators.

Nevertheless, for Thailand, the common ticket system have not been fully develop and implemented. There are only incomplete minor developments from Bangkok Smart Card System (BSS). Hence, to study the effect of a connection between each transportation on number of passenger, the consultants consider that study of passenger growth on BTS green line from 2003 to 2012 would be appropriated case to see the trend of passenger when BTS expanded and connected its lines with other lines.

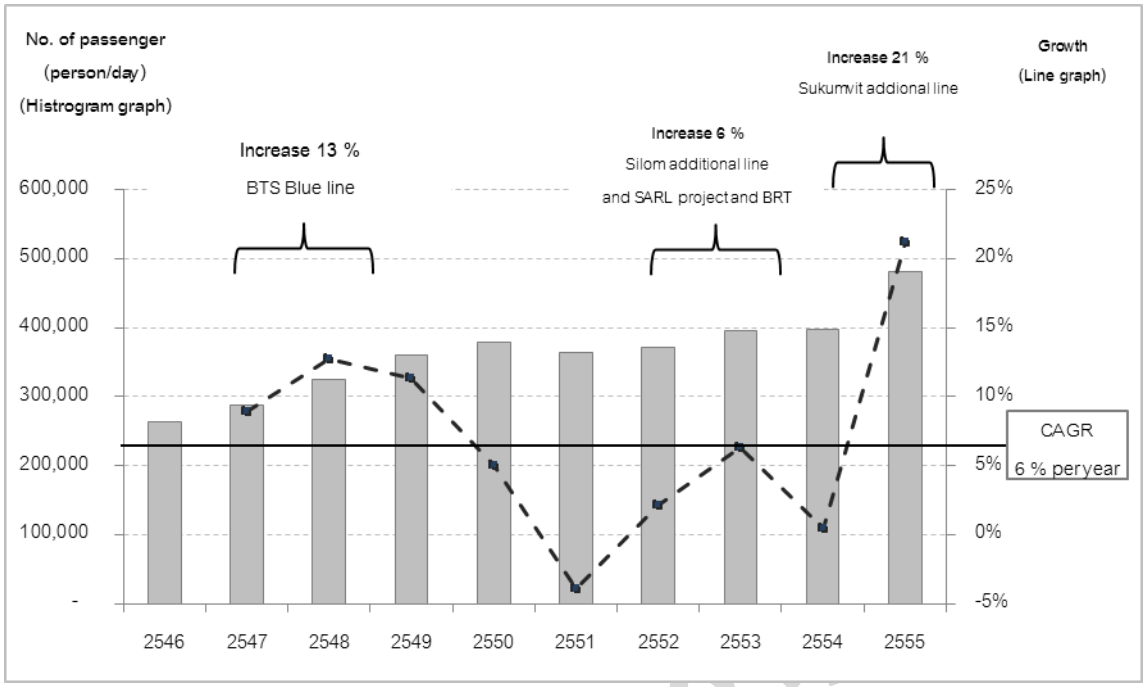
In the past, the number of passengers using the BTS Skytrain increased significantly after a major transit route to other lines, including the opening of rail transport network connection such as MRT (MRT Blue line) in July 2004, the express bus (bus BRT) in the May 2010, the Suvarnabhumi Airport Link (Bangkok Airport Rail Link) in August 2010, and the extension lines on both BTS Skytrain Silom Line and Sukhumvit Lines on 15 November 2009 and 12 August 2011, respectively. The details of BTS Skytrain passengers growth during 2003 to 2012 is shown in the table below.

Table 7.1-3 Number of BTS passenger[5]

As of March, 31		
Year	Total annual passenger (Million people)	Average passenger (Trips/day)
2003	96,491,000	264,359
2004	105,093,000	287,926
2005	118,465,000	324,562
2006	131,887,000	361,334
2007	138,558,000	379,611
2008	133,128,000	364,734
2009	135,939,000	372,436
2010	144,474,000	395,819
2011	145,189,000	397,778
2012	176,044,000	482,312

[5] Filing of BTSGF

Figure 7.1-3 Growth of BTS passenger in the past 10 years from 2003 to 2012



From the data in Figure 7.1-3, the number of BTS Skytrain passengers has been growing continuously. The average number of passengers per day was 264,359 people in the year ended March 31, 2003 and increase to 482,312 people per day in the year ended March 31, 2012, representing an average growth rate per year in 10 years (CAGR) of around 6 percent. Moreover, the table also noted that there are 3 periods that the passenger grows higher than the average passenger growth rate of 6% as following.

- Average number of passengers per day, up from 287,926 per day in 2004 to 324,562 per day in 2005, representing a growth rate of 13%. During this year, Metro Blue Line had operated for the first time and connect to the BTS Skytrain at 3 stations; Saladaeng station, Mo Chit station and Asoke station. It is believed that the above growth rate results from the connection between BTS and MRT.
- Number of passengers per day, up from 372,436 per day in 2009 to 395,819 per day 2010, representing a growth rate of about 6%. It is analyzed that this increasing result from BTS Skytrain Silom Line extension in the Thonburi station and Wong Wian Yai station on May 15, 2009 and the opening of the Airport Link transit, which is connected to the Phaya Thai station and BRT bus service, which connects to the Narathiwas station in 2010.
- Number of passengers per day, up from 397,778 per day in the year ended 31 March 2011 to 482,312 per day in the year ended 31 March 2012, representing a growth rate of around 21%. It is analyzed that this increasing result from BTS Skytrain Sukhumvit Line extension of new 5

stations which are Punnawithi station, Udomsuk station, Bangjak station, Bang Na station and Bearing station.

From the study, it shows that an increasing in passengers are from more connection between transportation systems that can encourage people to use more public transport. However, due to limit access to information, the analysis does not take into account of other factors which might affect the number of passengers, for examples, number or frequency of bus services in each station, or other social and economic factors such as the population, income level and the structure of passenger fares, etc.

4) Summary of factors from common ticket program that could affect a number of passenger

From the review of common ticket and fare structure development that is successful in other countries. It shows that the success of common ticket helped convince passengers to use more public transport. The important factors can be summarized as follows.

- Common ticket provides convenient to card holder. It represent as one card for all transportation so that people can carry only one card for all transportation modes. Moreover, common ticket also convenient in term of middle of payment and substitute the cash system. Since the cash system is inefficient way, common ticket system will reduce time of buying ticket at the machine and helps reducing traffic at the station. After fully implement, consultants believe that common ticket system can attract people to use more public transport.
- New common fare structure is easy to understand. The passenger is able to calculate the fare easily and accurately; the easier to understand, the more convenient people would get.
- Passengers benefits from discount fares. In particular, the exemption and/or discount of transit fee in new system make the passengers get in public transport at a lower rate.

7.1.4 External benefits to Public

Even though reducing the fare rate would negatively affect the revenue of transport operators, it can cost up to 400 million baht per year assuming that the fare had been reduced from 21 baht to 15 baht. However, this negative impact can be compensated with externality benefits that citizen and government will receive as following.

1) Reduce traffic density

Apart from convenient, in term of time saving, that can get by using public transport, cost of transportation is another criteria, when people decide their transportation mode. A cheaper fare rate is a good incentive for people to leave their cars and switch to public transport. Once, a number of car on the road decreases, it helps reducing the traffic density and lowering traffic problem. Government indirect benefits or externality

could be the budget saving for solving traffic problem. Moreover, better traffic condition would also benefit people that using car is inevitable. This people can use their personal car in better traffic condition. Nonetheless, the magnitude of this externality depends on the decreasing rate of car usage. The more car abandon is the more externality benefit.

2) Reduce air pollution

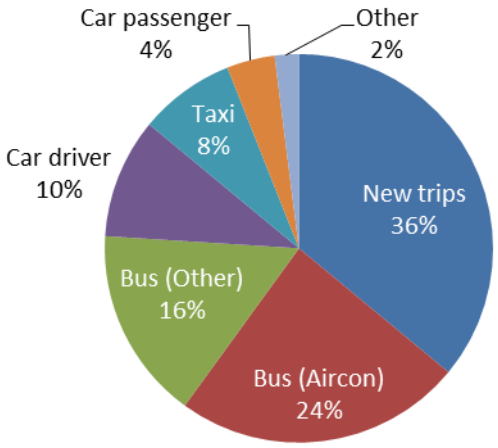
In the same way, if car usage decreases, it will also help air condition. The air condition will be better as the air pollution decreases. Citizen would have better environment and government can save budget for solving air pollution.

3) Government and citizen can help save energy, reduce the use of fuel, that will benefit the whole country.

As a result from lower car usage, in addition to better traffic and air condition, this program also benefit to everyone in the country since lower car usage and better traffic result to lower fuel consumption. It can support government policy of energy saving.

From the study, BTS passengers in year 2001are people who switched from following modes of transport.

Figure 7.1-4 Sources of BTS passenger



Source: PAS/EPS (2001), Integrating Mass Rapid Transit in Bangkok (Phase2)

According to the chart above, it shows that in year 2001 around 10 percent of BTS and MRT passengers are people who switched from driving car and 40 percent switched from using public bus.

It indicates that the externalities from better traffic condition, lower air pollution and energy saving are effect of 50 percent of BTS passenger who changed their transportation mode from on the road to BTS or MRT.

From study, PAS/EPS (2001) Integrating Mass Rapid Transit in Bangkok (Phase2), the externality benefits can be calculated up to 6 thousand million baht or around 515 million baht per year.

7.2 Common Ticket Development Policy and Common Ticket Office Operation Policy

7.2.1 Overview of Common Ticket Office :CTO

The current automatic fare collection (AFC) system is stand-alone. Each service provider has to manage the collection system by itself. Such system has barriers to connect the revenue collection systems from each provider and therefore impede the development of common ticket system, which allows the use of one ticket to travel through various public transportations (e.g., bus, sky train, and express way). The ticket also can be developed to support other commercial transactions.

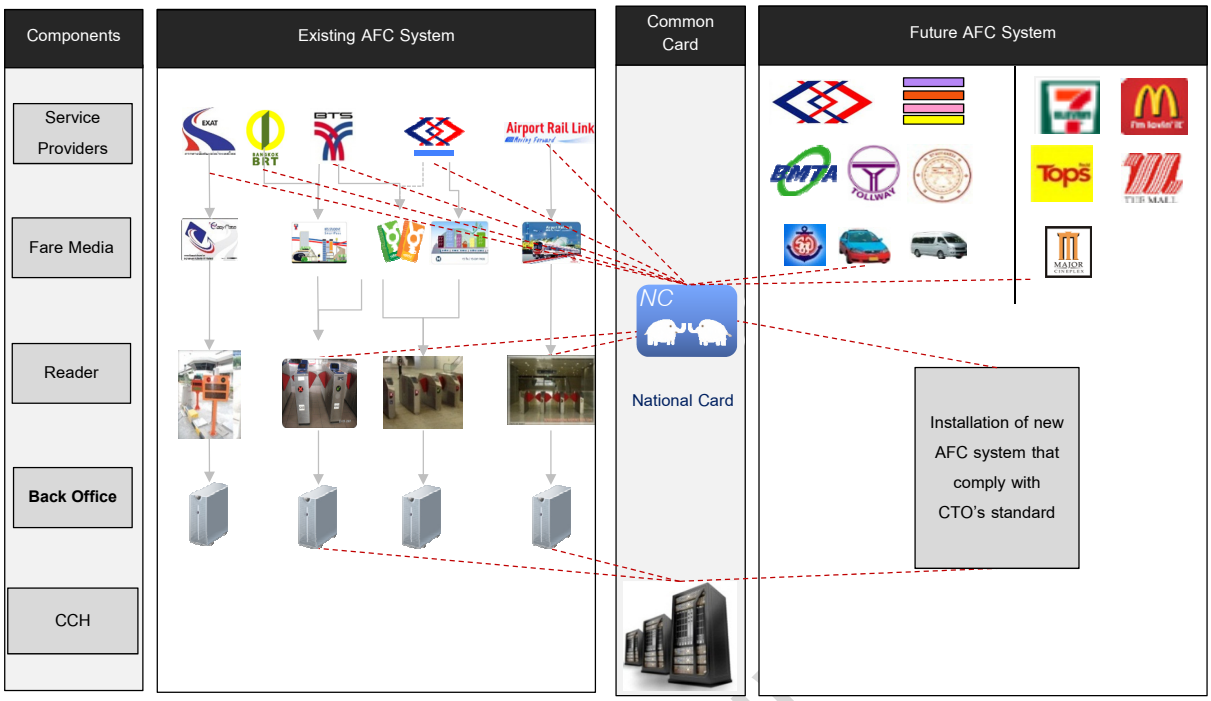
Additionally, as the coordination of revenue collection systems of each service provider have not been viably implemented, the common ticket system is hard to be developed. Therefore, the Government has to establish the Common Ticket Office: CTO to become the main agency who is responsible for super visioning the system effectively. Moreover, the Government has also to develop Central Clearing House: CCH for the connection of fare collection system.

According to CTO's operating structure, CTO is accountable for collecting and apportioning the revenue, in accordance with the initial principal, of service providers in both transit and non-transit sectors. CCH will collect and evaluate the information regarding the services from each provider and then submit the result to banks for payment process.

For the success of development, the important factors are as follows;

1. The universal application of the ticket
2. The support to non-transportation sectors
3. Single standard with different card issuers
4. Scalability
5. Ability to make the transaction accurate, reliable, transparent, and timely payment

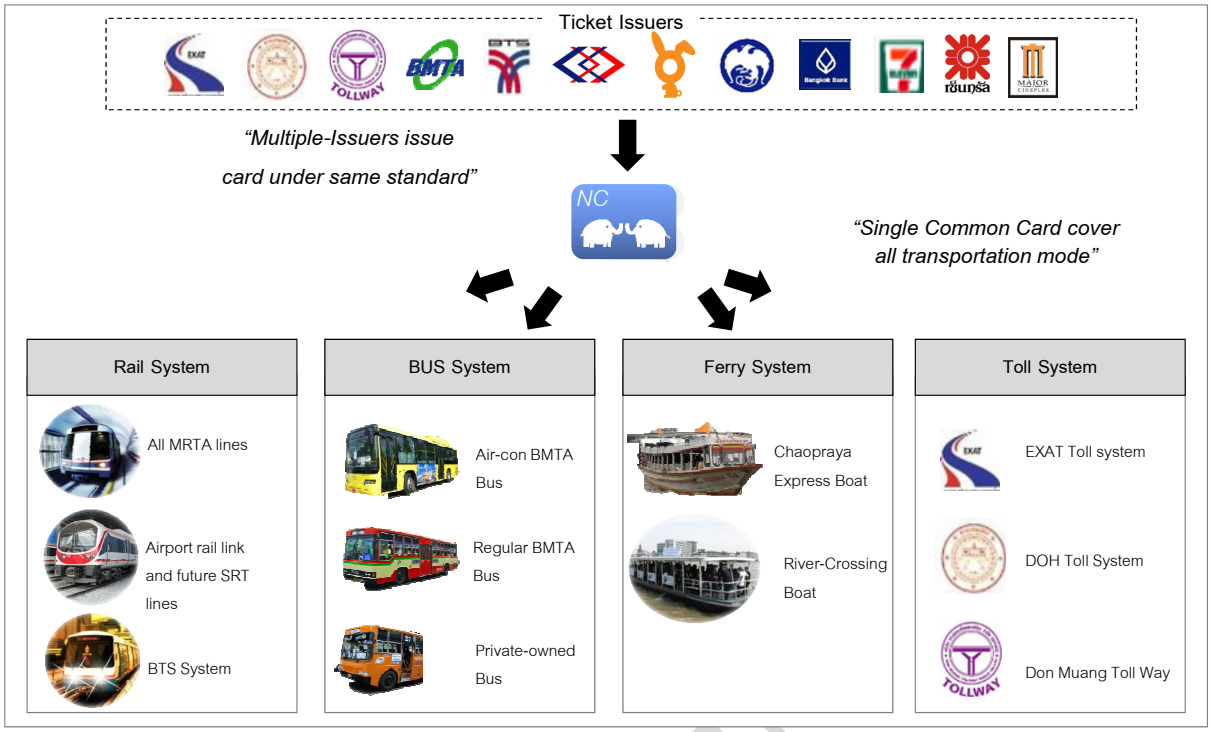
Figure 7.2-1 Uses of Common Ticket



7.2.2 Single-Standard and Multiple-Issuers Policy

To implement the common ticketing system effectively and fairly to every party, the consultants believe that the single-standard and multiple-issuers scheme is the most suitable policy for the system implementation. Such policy specifies that there can be many card issuers, whose qualifications are in accordance with the guideline indicated by CTO, and the issued cards have to comply with single standard for the fare collection process both in transit and non-transit sectors

Figure 7.2-2 Single Standard – Multiple issuers



7.2.3 Co-branded card

To make common ticketing system available for various uses, the consultants suggest that the policy allow other service providers in both transit and non-transit to issue the card. This will support the use of common ticket and thus enhance its varieties.

The coordination of card issuance with financial institutions and other commercial sectors will allow customers to deduct the payment directly from debit/credit file and support other marketing activities such as reward points or any discount promotion.

One successful example is the case of Taipei Smart Card Corporation (TSCC), which is responsible for common ticketing system management in Taipei. The company cooperated with the commercial banks in designing the system to function transit file and debit/credit file in single card. Moreover, cardholders can easily top up money in the card by deducting automatically from credit card. The fee for such service is USD 15, or THB 450, per one user and charged at first time only. TSCC expects to issue 2.2 million tickets within 3 years[6].

[6] Sources: Co-branded Multiplication contactless smart card

Figure 7.2-3 Example of Co-branding card issuance

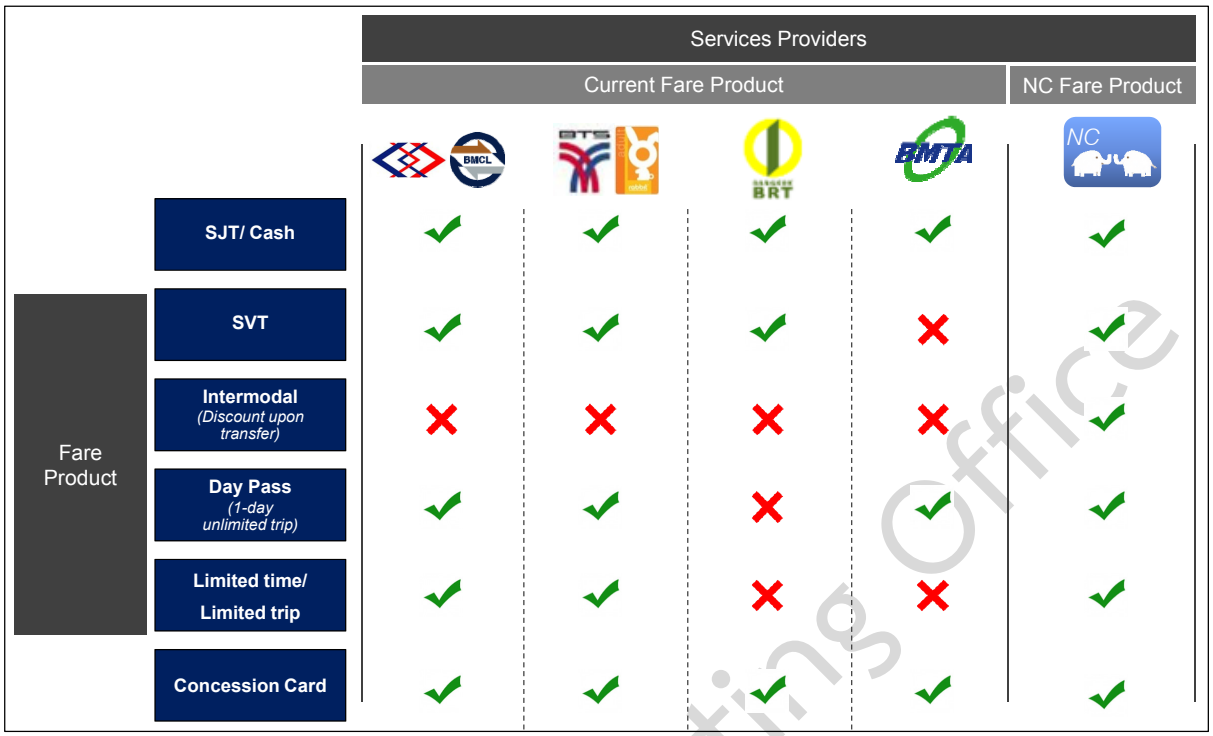
7.2.4 Card Management Policy and Fare Products

Topics		Details
Card Usage	Card personalization	▪ Include details of cardholder such as name, address, age, and contract number. ▪ The card personalization benefit in contacting cardholders if they loss their cards and assigning the right to other people.
	Card activation	▪ Card will be activated once first top-up.
	Card lost condition	▪ The conditions of card lost have to be clearly indicated. ▪ Principally, the card is lost by the following conditions; - The cards have not been used or topped-up for 5 years. - Cardholders report the card lost. After 5 years, the system will delete the information of the card and transfer the remaining money to the specific cash account for card lost condition. ▪ Once card is lost, the system will terminate the availability of card within 30 minutes for misuse and fraudulent protection.
	Claim of card lost	▪ Cardholders can reimburse the remaining money in their card only in case of personalized card. ▪ The process will be completed within 14 days. ▪ Such conditions aims to prevent the excess of unessential information in the system.
	Max. card balance	▪ The maximum balance is THB 10,000. ▪ The amount can be adjusted according to cardholders' needs, e.g. the

Topics		Details
		maximum balance can be reduced in case of youth.
	Max. top-up per time	▪ Max top-up per time is THB 1,000. The top-up limit is 10 times per day.
	Max. negative balance	▪ Maximum negative balance is the payment of current travel route.
Card Issuing	Ticket issuer	▪ The system supports multiple issuers who have the qualifications in accordance with the standard proposed by CTO. ▪ The issuance has to conform with the standard proposed by CTO who is responsible for testing and issuing the certification.
	Co-branded	▪ The system allows non-transit operators to participate in card design, enhancing the use of card beyond the transportation sector.
	Post-paid/ Pre - paid	▪ Card issued by CTO will be pre-paid and stored value but the system also supports the post-paid card if other parties issue such card.
Fare Product	Fare Product	▪ Apart from storing value, the card also supports fares of other products in accordance with the riders' needs.
	Unlimited Trip Product (Period pass)	▪ The product includes unlimited one-day trip card. ▪ The card type can be either multi-sector or single-sector transportation. ▪ The price depends on types of card.
	Trip-based product	▪ Trip-based feature such as travelling up to 40 trips within 30 days. ▪ The price depends on a number of trip and types of transportation.
	Fixed - Journey	▪ Limit the route of travel such as from home to office ▪ The price will be lower from that of normal card.

1) **Type of Common Fare Product**

Figure 7.2-4 ตารางเปรียบเทียบผลิตภัณฑ์ค่าโดยสาร



2) From those shown in Type of Common Fare Product

Figure 7.2-4, it shown these tickets are provided with a wide range of fare products and covers all forms of money. Initially, it is expected that the products consist of single-trip card, stored-value card with a discount or exemption of transit fee (Free or discount-transfer), daily tickets (Day pass) which passengers able to use unlimited public transport within a specified period. It may be during a time of 1 day, 7 days or 15 days, which is a card that passengers can use the transport model number to like 30 to 30 days, or 45 to 30 days and the card.

3) Policy on Single Journey Ticket

The policy on single journey ticket (SJT) is required when there is 'common paid area' exist between two different public transportation modes, as the SJT system need to accommodate transaction clearing between these modes. In addition, the fare media used in SJT system is needed to be identical in both form factor and interfacing standard to enable interoperability between two different public transportation modes. For example, magnetic single journey ticket is not applicable for token-based reader. Thus there is need to determine the common single journey fare media to be used across all single journey ticket system.

Table 7.2-1 Comparison of Available SJT Fare Media

Magnetic	FeliCa		MIFARE			Type B
	Lite	Lite S	Ultralight	Ultralight C	Ultralight EV1	Low Cost Contactless

							Ticket
Card Standard	ISO/IEC 7810, ISO/IEC 7811, ISO/IEC 7812, ISO/IEC 7813, ISO 8583, and ISO/IEC 4909	ISO/IEC 18092	ISO/IEC 18092	ISO/IEC 14443-A, ISO 7816	ISO/IEC 14443-A, ISO 7816	ISO/IEC 14443-A, ISO 7816	ISO 14443B, ISO 15693
Chip	(Hi-Core)	RC-S965	RC-S966	Ultralight	Ultralight C	Ultralight EV1	Inside (Pico Pass), Samsung, Infineon
RF Protocol	N/A	Type C	Type C	Type A	Type A	Type A	Type B
Security	N/A	3DES	3DES	N/A	3DES	ECC	DES/3DES
Speed	N/A	~202 kbits/sec	~202 kbits/sec	~106 kbits/sec	~106 kbits/sec	~106 kbits/sec	~106 kbits/sec
Card Price	Lowest	High ~THB 28/0.5M	Medium ~THB 14/0.5M	Low ~THB 7.5/1M	Low ~THB 9/1M	Low ~THB 7.5/1M	High
Life Cycle	~5 yrs	~7 yrs or 50,000 cycles	~7 yrs or 50,000 cycles	~5 yrs or 10,000 cycles	~5 yrs or 10,000 cycles	~5 yrs or 10,000 cycles	~10 yrs or 100,000 cycles
Deployment	Bangkok, Japan	India, Bangkok	Expected launch 2013	Singapore (2012), Atlanta, Bangkok, Miami, San Francisco, Dubai, Oslo, Amsterdam, and Moscow	Hong Kong	Expected launch 2013	Singapore (2007-2012), Korea

Currently, there are different types and forms of products used as fare media in public transport system. Each of which has different characteristics and functions, which can be summarized as follow

Table 7.2-2 The Single Journey Ticket Fare Media in Existing Transportation System

Modes	Fare Media	Technology
BMCL (MRTA)	Contactless Smart Token (CST) 	Product: Sony FeliCa RF Protocol: Type C Reader type C ,B ,A :

Suvarnabhumi Airport Rail Link	Contactless Smart Token (CST) 	Product: MIFARE Ultralight RF Protocol: Type A Reader type C ,B ,A :
BTS	Magnatic Stripe Card 	Product: Magnetic RF Protocol: N/A Reader type C ,B ,A :
BRT	Contactless Smart Ticket (CST) 	Product: MIFARE Ultralight RF Protocol: Type A Reader type C ,B ,A :

To determine the common fare media for all single journey ticket system, it is needed to consider the technology, and the form factor of single journey ticket currently in use. For the case of BMCL (MRTA-Blue line), the token form media is used, thus the other line that may linked to MRT blue line is needed to accept token based fare media as well. There are 4 options in choosing appropriate fare media for common single journey ticket system as follow,

1. Uses the fare media currently in use (FeliCa Lite; RC-890)

   PROs Do not require to modify the current single journey ticket reader.

   CONs The fare media currently in used is slightly outdated, and there is newer version of technology to replace them. To continue to use their fare media may incurred unnecessary cost, as the supply of current fare media may be reduce.

2. FeliCa (FeliCa Lite S) - Token

   PROs The newer version of FeliCa token can supplied with much lower cost, and it is capable of higher processing power, and has better security.

   CONs FeliCa Lite S fare media is not backward compatible with existing or earlier version of firmware. Thus it is required to modify readers' firmware and hardware to accept FeliCa Lite S

3. Mifare (Mifare Ultralight, Mifare Ultralight C)

   PROs Mifare Ultralight C is capable of data processing with higher security compare to the single journey ticket in used today. Also Mifare Ultralight C has considerably lower cost compare to FeliCa Lite S.

   CONs Mifare Ultralight C has lower processing power, and there is also need to modify current reader to accept Mifare Ultralight C. Anyhow, the scale of hardware modification is much smaller comparing to the case of adopting FeliCa Lite S.

4. Type B Fare media

PROs Type B Fare media generally has lower cost, and high security than the existing single journey fare media. However the Type B Fare media still has higher cost than Mifare Ultraligh C.

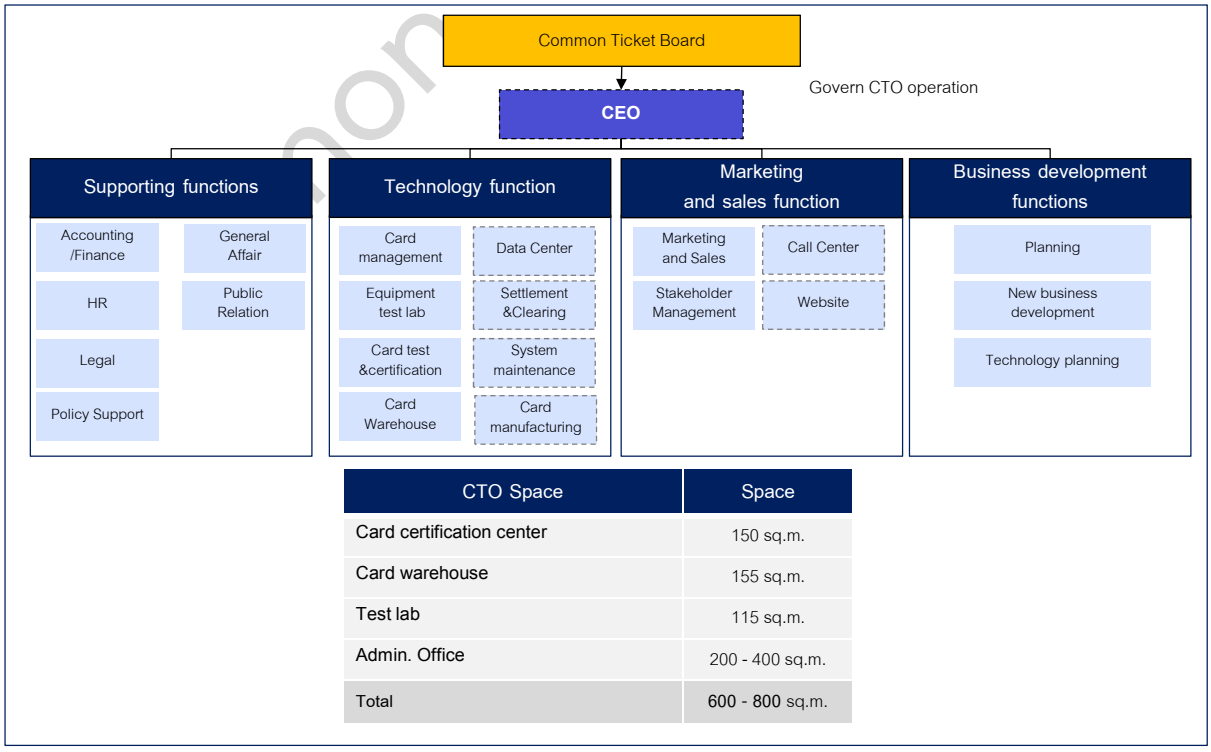
CONs Type B fare media has lower processing power compare to the current fare media. Also, it is required to modify the existing firmware and hardware (readers) to be compatible with Type B fare media

Figure 7.2-5 Example of recyclable single journey ticket

7.2.5 CTO organization structure

CTO's organization is designed to consist of 4 main functions include, Technology function, Business development functions, Marketing and customer relationship function and Business development function. The consultants estimated that the number of employee required for operation is 50 persons as show in Figure 7.2-6 , and the required office space is approximately 600 sq.m. to 800 sq.m.

Figure 7.2-6 CTO organization structure



CTO Space	Space
Card certification center	150 sq.m.
Card warehouse	155 sq.m.
Test lab	115 sq.m.
Admin. Office	200 - 400 sq.m.
Total	600 - 800 sq.m.

The details of each function can be described as follow

Table 7.2-3 Roles and responsibilities of each function under CTO

Functions	Roles and responsibilities
Supporting functions	– General administrative functions include, accounting and finance function, human resource management, legal function and other supportive function – Public relation management to ensure passengers' awareness on common ticket usage. PR function is also responsible for informing the public about benefits of common ticket – General affair function is mainly responsible for supporting function, include documentation, meeting arrange
Technology function	– Technology function is responsible for system management, hardware and software maintenance, key &card system management and to provide technological support. – The function is also responsible for maintain and update card standard. – Assist other ticket issuers in card development, and also responsible for certify the card issuance by other parties
Marketing and sales function	– Marketing and sales function is assigned to carry out key marketing activities including campaigning product launching and advertisement. This aims to increase number of cardholders.
Business development function	– Business development function has its roles in development of common ticket system expansion plan. The common ticket system has goal in maximizing uses of common card, and to ensure that common ticket system is coped with most recent technology.

7.2.6 CTO's nature of operation

The nature of CTO operation involve a number of operating cost and expense necessary to operate common ticket system. As such, CTO business is designed to generate several stream of revenue to offset the operating cost and expense incurred. With this in mind, the consultants will develop CTO to be able to operate in a sustainable manner and require least amount of government aid.

Anyhow, as CTO is required to conduct its business as public services, rather than business-oriented nature. Thus the design of CTO's business model shall has the following considerations,

1. CTO's business shall create fair competition among every stakeholder, and the CTO's policy must not bias toward any specific operator.
2. Transaction fee or any other related fees will be set at a reasonable level that does not result in financial burden to involved parties.
3. CTO's top priority is to create maximum satisfaction to passengers and cardholders.
4. CTO may generate revenue up to the level that just meet the operating cost and shall not view profit-maximizing as its goal

Details of CTO may be described as follow,

4) Sources of CTO revenue

4.1) Revenue from Clearing fee (or transaction fee)

Clearing fee will come from providing clearing services for any transaction resulted from using common ticket, and may come from revenue apportionment services. The fee is paid by transit and non-transit operators to CTO for the amount of transaction rendered to that operator. The clearing fee is calculated as a percentage of the total fares value apportioned by CTO, whereby the percentage may vary base on the size of transaction.

4.2) Revenue from Card test and certification fee

Apart from roles in transaction clearing, CTO also take roles in card testing and certification fees. Under the 'single standard, multiple-issuers' scheme, any party is allowed to issue the common card. Anyhow each party who wishes to issue their own card needs to have their cards tested and certified by CTO to ensure that each common card issued will follow the same national card standard and specification set by CTO. Rendering such service may result in certain expense and cost, namely card testing expenses, cost of personnel required for card testing and certification and cost of equipment required for such operation. As a result CTO may need to charge certain fees from ticket issuer for services of card test and certification. The final fees may be calculated as a one-time fee basis, or base on the number of card issued basis. The final solution is yet to be determined by the governing bodies.

4.3) Revenue from co-branded card

Similar to multiple ticket issuer schemes, CTO business also allows for co-branded card issuance, whereby any transit or non-transit operator may partner with CTO to issue co-branded card. Co-branded card still retain all transit products and it may also has additional features that are tailored specify to each co-branded card issuer. Some financial institution may wish to partner with CTO to issue co-branded card that can be used for both typical fare payment and debit/credit card payment. For rendering such services, CTO may charge the co-branded card issuers for some amount of fee. The co-branding fee may have similar nature to those of royalty fee, whereby the fee is calculated as a percentage of total transaction value.

4.4) Revenue from card sales

Apart from generate revenue from charging services fee, CTO also has revenue from sales of common card. However, since CTO is established to serve public rather than to maximize its profit, thus the card pricing will be at the level that cover the cost of card production only. In any case, CTO also distribute the common card to certain groups of passenger without any charge for card, the group include seniors, veterans, student, children, handicap and low-income group.

5) Cost and operating expenses (Variable cost)

5.1) Cost of card production

Cost of card production incur for every card produced, the cost include cost of chip procurement, cost of COS (Chip operating system) development, cost of printing and other related cost such as card transportation, card inventory management. This cost is varied to the number of card produced, whereby currently the cost is approximately THB 31- THB 33 per card.

5.2) Settlement fee

The role of transaction settling is assigned by CTO to financial intuition (or settlement bank), this roles cover transfer of money as instructed by CTO's transaction clearing function. This action associate with the cost of settlement, where the settlement bank may charge CTO for the service render as a percentage of total transaction value. The fee is known as settlement fee, and the fee rate may vary depends on business negotiation between CTO and the settlement bank.

5.3) Top-up fee

The transaction fee is the commission fee paid by ticket issuers to top-up agent, whereby the top-up agent may include convenient stores, ATM and internet banking services. The fee rate charged of every top-up depends on business negotiation with the top-up agent. The commission fee scheme is designed to incentivize the top-up agent to expand their top – up channels and expected to result in increase convenience to passenger as a whole. Under the case that CTO issues the common card, CTO will bear this expense as well.

6) Cost and operating expenses (Fixed cost)

6.1) Personal expenses

The personal expenses include salary, employee benefits and compensation expenses incurred to employing staff to operate and maintain the common ticket system. CTO is expected to employ up to 45-50 staffs in four different functions consist of Technology function, Business development functions, Marketing and customer relationship function and Business development function, and the management level. Anyhow the number of staff may vary base on size of CTO business, given that CTO is planned to expand its business in the future.

6.2) System Maintenance

The operation of common ticket system involve installation and maintaining a number of sophisticate system include central clearing house system, card management system, back-up and recovery system and top-up system. There system, both hardware and software requires constant maintenance by system specialists and may incur system maintenance cost to CTO

6.3) Telecommunication

The common ticket system involve with large amount of important data communication from front-end equipment to back-end system, the transfer of data include transfer of transaction data, top-up data and apportionment data. To ensure that the transfer of data is done in very secure and timely manner, CTO need to lease telecommunication line and related facility to uses exclusively in transferring common ticket data.

6.4) Rental expenses

CTO operations also involve with renting of office space to house operating staff and other related equipment, and thus may incur related rental expenses.

6.5) Other expenses

Other miscellaneous expenses related to operation of CTO may include office supply, lighting and power expense depreciation and travel expenses