Office of Transport and Traffic Policy and Planing
Ministry of Transport

Program Management Services : PMS

Inception Report




Avantgarde Capital Co., Ltd.
Korea Smart Card Co., Ltd.
PSK Consultants Co., Ltd.

JANUARY 2013

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Acronym

Acronym	Full Name
AVM	Added Value Machine
ACH	Automated Clearing House
AFC	Automatic Fare Collection
BMTA	Bangkok Mass Transit Authority
BTSC	Bangkok Mass Transit System Public Company Limited
BTS	Bangkok Mass Transit System
BMCL	Bangkok Metro Public Company Limited
BEP/BXP	Bus Entry Processor/ Bus Exit Processor
BRT	Bus Rapid Transit
CID	Card Initialization Device
CPD	Card Personalization Device
CCH	Central Clearing House
CCH DRS	Central Clearing House Disaster Recovery Site
CCS	Central Computer System
CPEX	Chao Phraya Express Boat Co., Ltd.
CSC R-W	Contactless Smart Card Reader-Writer
DES	Data Encryption Standard
EXAT	Expressway Authority of Thailand
KMF	Key Management Facility
MCBF	Mean Cycle Before Failure
MTTR	Mean Time To Repair
MAC	Message Authentication Code
NFC	Near Field Communication
PID	Passenger Information Display
PIN	Personal Identification Number
POS	Point of Sale
RF	Radio Frequency
RFID	Radio Frequency Identification
SAM	Security Access Module
SAN	Storage Area Network
SARL	Suvarnabhumi Airport Rail Link
KT	The Krungthen Thanakom Co., Ltd.
TVM	Ticket Vending Machine
TCC	Transaction Collection Center
WACC	Weighted Average Cost of Capital

Chapter 1. Introduction

1.1. Background

Bangkok and vicinity is the center of Thailand's economic. Many people travel to the center of city to work every day and causing traffic. A lot of cost and time is loss each day. Moreover, traffic also damages health and environment.

By observing developed countries transporting system, common ticket system creates a huge of benefits since people can use one single ticket to travel in every mode of transportation for example MRT, buses, boats and expressway. Common ticket system helps to reduce ticket costs and entry fees for those who use more than one mode of transportation. It does bring convenience to use and save overall travel time

Office of Transport and Traffic Policy and Planning (OTP) under Ministry of Transportation (MOT) has studied the implementation of common ticket system in transit systems (MRT, rail system, buses, boats and express way) and non-transit system. This action also supports The National Economic and Social Development Plan 11, which focuses on the development of competitiveness of Thailand among other countries and promotes environmental sustainability. It also supports the strategy of government to expand rail system to reduce traffic in the center of city.

The cabinet meeting on 3 May 2012 approved OTP to operate Program Management Service (PMS) under 10 million US dollars budget to employ the expertise for the first four years of system preparation with the aim to have common ticket system physically implemented. Moreover, there will be subsequent 13 million US dollars budget for the setup of Central Clearing House (CCH).

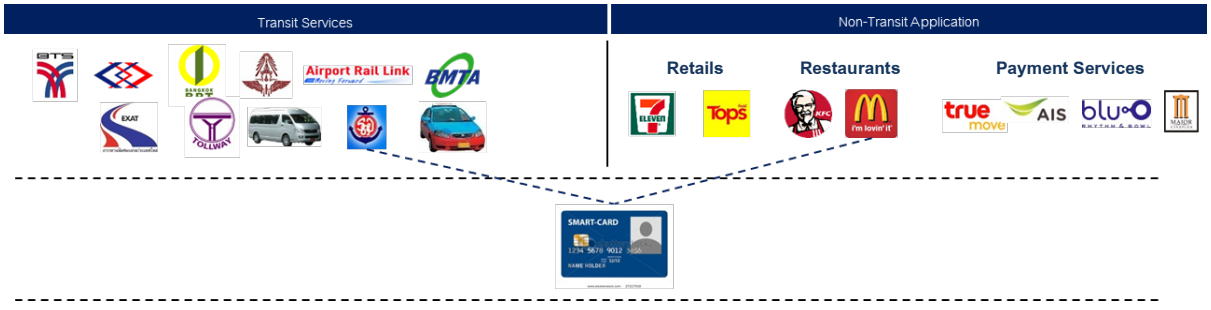
After the visit of Prime Minister on 9 January 2012, to MOC, the Prime Minister has emphasized on deliveries the government policies declared to the House of Representatives. The policies include the implementation of common ticket system and to introduce 20 THB flat fare in any practically possible route. The MOT is to be collaborating with Ministry of Finance on the matter. Later parliament committee meeting on 2 April 2012, OTP was approved to manage common ticket system by using 714.83 million baht from Development Policy Loan (DPL), 305.30 million baht is for Program Management Services (PMS) and 409.53 million baht is for Central Clearing House. (CCH)

In the common ticket system management committee 3-3/2012 on 11 July 2012, the meeting passed the resolution for related authorities in MOT to follow the policy created by Deputy Minister (Dr. Chutchad Sithipan) that the following targets must be achieved

- Organizations under MOT supervision must use common ticket under one standard, but no limit to the number of card issuers. This will create unity and efficiency in the system.
- Common ticket management unit shall have appropriate mission and capabilities. If there exists external expertise in some area, Those should be outsourced for example the CCH
- The operation standardize must be concluded as soon as possible to be reference for other organization. The standard shall be used in the currently developing to Automatic Fare Collection. (AFC)

Therefore, OTP employed advisory team to operate the Program Management Services (PMS). This included providing technical support on operation and development of common ticket, set up the CCH and promote the use of one common ticket in transportation and other activities. The program will increase the efficiency of transport system, and provide people with a more accessible and convenient transport system, life in many other developed countries.

Figure 1.1-1 Guideline of common ticket system



1.2. Objectives

To procure advisors to provide technical support in the operation and management of common ticket system, monitor the regulation, report and knowledge transfer to the duty staffs in the early state. The operation must be in accordance to the laws and regulations and meet the international standard and quality. The objective includes;

1. Crafting of policies and management plan for common ticket system
2. Developing of Common Ticketing System and common ticket standardization. Preparing the operation of Central Clearing House (CCH)
3. Establishment of Common Ticketing Office (CTO), which shall be able to efficiently manage common ticket system

1.3. Scope of advisory services

The following lists are the scopes that required advisory to manage and operation.

1.3.1. Crafting of policies and management plan for common ticket system

1. Review of the reports and information related to the successful development of common ticket system
   - Study of Common ticketing to encourage countries utilization of travel or transit system and establishment of CCH (OTP 2008)
   - Bangkok Mass Rapid Transit Integrated Ticketing Project
   - Study of Common ticket development for public transportation in Bangkok area
   - Study of common ticket systems in developed countries
   - Other related reports
2. Review the previous studies and identify loopholes, risks and mitigation
3. Study of successful common ticket system and technology of the operation in developed countries. Such as, Micropayment and Near Field Communication
4. Suggest development policy and operation plan of common ticket system, to be integrated with public transportation currently in operation and in the process of future operation. Together, consider common ticket in non-transit sector.
5. Investigate the requirements of study and investigate the concession contract between current operators.
6. Conduct the meetings or seminars to brainstorm from stakeholders hat lead to the creation of policy and pinpoint the direction of common ticket development

1.3.2. Developing of common ticketing system and common ticket standardization

1. Specify primary requirements and guidelines for common ticket development
2. Specify various standards required for example, card, reader, interfaced protocol and interfaced document
3. Conceptual design of common ticket system, and CCH including details on data format, data connection between front-end revenue collection and back-end revenue management. The design shall include:
   - The design shall be suitable with the international ended use, with focus on utilization, efficient space, low effects to current operation, safe, and effective with world class standards.
   - Specify the between front-end revenue collection and back-end revenue management.

- Design the operation of CCH and CTO.

4. Prepare documents are required for tending of common ticket system developers and CCH, which consists of
   - Documentary forms
   - In tenderize terms and conditions of contracts
   - Regulations between the parties
   - System design framework
   - System implementation
   - Other related works
5. Prepare the budget for tenderize common ticket system developers and CCH
6. Develop process plans for implementation precisely and integration with existing operator while minimizing the interruption

1.3.3. Acquisition of developers

PMS advisory must acquire any expertise to develop common ticket system and CCH. The following lists are required to be done by advisor

- Support each process of acquiring, tendering, including announcement and responds to inquiries.
- Support and advise the selection committee, including setting criteria
- Support the selection committee negotiate the price, including technical and financial aspects
- Prepare the documentations terms

1.3.4. Supervision and monitoring of the common ticketing developer's execution and the CCH's establishing

1. Support in supervising the common ticket developers and CCH according to the terms and condition in outsourcing contracts
   - Support in implementation and testing of CCH
   - Support the connection between front-end revenue collection and back-end revenue management
   - Support in inspection and testing of whether common ticket system
   - Support in supervising the contractors throughout the operation and maintenance period.

2.Support the supervising and contract management

- Support the inspection of design to ensure its compliance with employer's requirements, outline design specifications and conceptual drawings
- Support the inspection of the implementation according to the guideline and standard of common ticket developers
- Support in supervising the operation to ensure the timelines
- Support in acceptance of work
- Support in investigation of the workloads to prepare receipts and invoice for common ticket developers and set up CCH
- Support in investigation and advise on any claims arise from the contract
- Inspect the works
- Organize the documents and important notes and deliver to management unit
- Ensure the contractor delivers work procedures and conduct knowledge transfer
- Commissioning and testing
- Support in inspection of periodic maintenance during advisory contract period

1.3.5. Support in The academic technology and establishment of the Common Ticket Office (CTO)

1. Study and specify roles, duties and rules and regulation of the organization and appropriate workforce refined as criteria to select suitable officers
2. Support in advise the suitable organization structure which has flexibility and
3. Support in preparing academic documents and set up common ticket management unit, including draft of laws, rules and regulations
4. Develop operation policy and strategy for CTO impact
5. Set primary criteria for CCH and evaluation method
6. Develop operation and maintenance regulation for CCH
7. Coordinate the establishment of common ticket management system so it can immediately operate at same time as common ticket system and CCH operation
8. Setting up operation policy and strategy and give advices to management unit.

1.3.6. The technology transfer at the beginning of the common ticketing system operation and CCH's operation

1. Advisory must purpose development plans for common ticket operation and CCH within timeline and plans to transfer all knowledge and responsibilities to management unit of common ticket office in the end of contract term

2. Propose improvement plans about technology used in other common ticket operation and CCH
3. Advise on the improvement of potential of management unit. The following lists are requirements in management unit that advisory will conduct
   - Workshops
   - Develop and improve of competency of the management unit
   - Transfer knowledge from organizations with success in common ticket system
4. Advice and give suggestion during the first period of operation Specify policy and strategic plan for operation and maintenance in order to make the system perform efficiently.

1.3.7. Supports in the implementation of the pilot project

1. Support the setup of common ticket by developing pilot project on the current operation projects
2. Evaluate and conclude all the problems arise during the operation of pilot project. Give suggestion for later improvement

1.3.8. Public relation

The advisor is required to promote and give knowledge about common ticket operation system to public before official operation

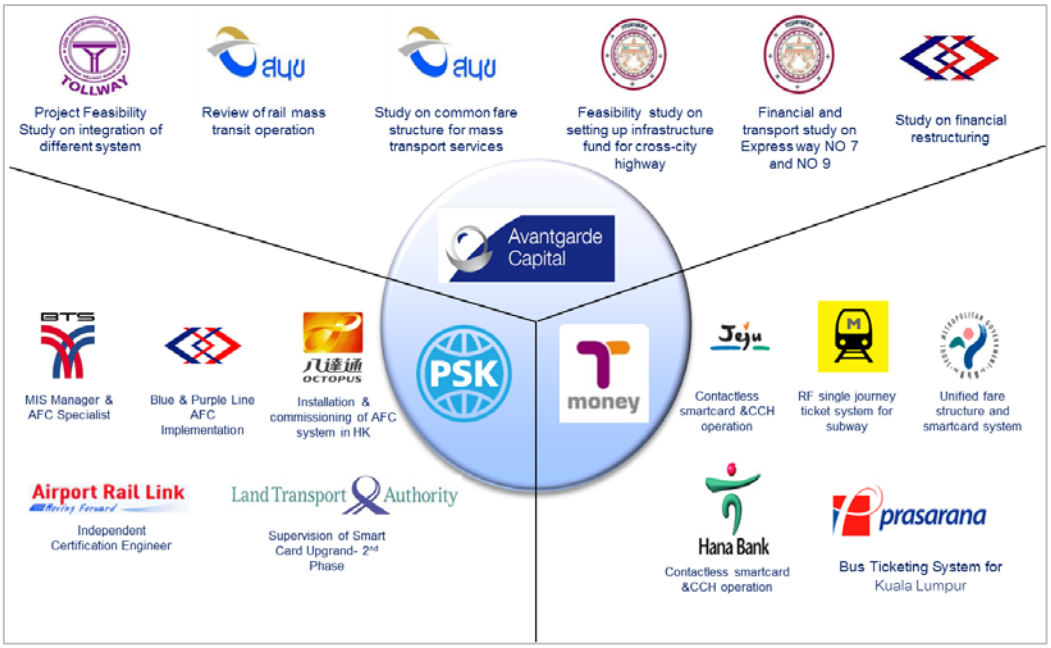
Chapter 2. Group of Advisors

2.1. The Advisors Overview

According to the cabinet meeting Chapter 3.4 as of 23 August, 2012, the government intended to improve the urban living quality by beginning the construction of 10-line sky train projects, developing the common ticketing system with flat fare of 20 baht, and therefore improving residence quality for low income people. Program Management Services ("PMS") is vital to the development of Thailand public transportation as it is a key mechanism to make the government intentions viable.

PMS can be divided into 8 main parts as indicated in Chapter 4. The important parts include designing standards for operation of common ticketing system, CCH, CTO, and pilot project. These activities require experienced advisors in 3 fields: financial management, traffic and fare collection planning, and design and monitoring common ticketing system. Therefore, the group of advisors who specialize in each scope of the whole project has been created to facilitate the needs and objectives of common ticketing system development.

Figure 2.1-1 Company Credentials



2.1.1. Avantgarde Capital Co., Ltd. ("AgC")

AgC is a boutique financial advisory firm providing project management and financial advisory services. AgC has extensive experiences in the development of public transportation fees system and the feasibility studies of intercity highway development.

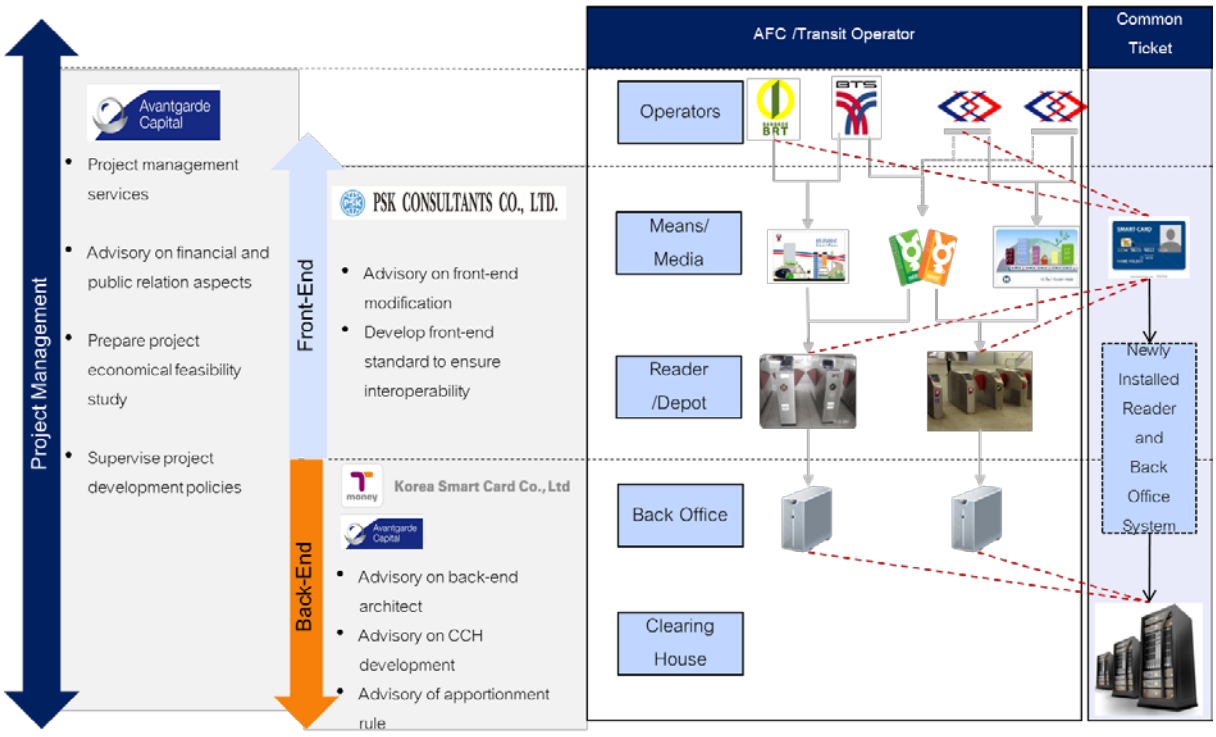
2.1.2. PSK Advisor Co., Ltd. ("PSK")

PSK Advisors is a consulting firm specialized in planning and designing the transport systems, public infrastructure, and urban development. PSK staffs have experiences in various areas of engineering consult fields e.g. project master plan, feasibility study, detailed engineering design, construction supervision and project management with clients from both government and private sectors from many countries. PSK has many professionals from Thailand, the USA, Japan, and Australia. The credentials include project management, installment, system test, and maintenance of common ticketing systems of BTS, MRT, and ARL. Furthermore, PSK also has similar experiences in Hong Kong and Singapore.

2.1.3. Korea Smart Card Co., Ltd. ("KSCC")

KSCC developed expertise in common ticketing system development including design, control, installment supervision, test, and maintenance. In Korea, KSCC has installed automatic ticket system of more than 400 rail and subway stations, 15,000 public buses, 10 ferries, and 120,000 taxicabs. Moreover, KSCC also has done similar work in New Zealand (Wellington and Oakland), Malaysia (Kuala Lumpur), and Columbia (Bogota).

Figure 2.1-2 Responsibilities and expertise of each advisory



2.2. Avantgarde Capital Co., Ltd

2.2.1. Company Background

Avantgarde Capital Co., Ltd. was founded in 2006 with paid-up capital amounting to THB 12 m. AgC provides investment banking and business restructuring services. AgC has teams of professionals with extensive knowledge of related fields such as finance, economics, accounting and engineering.

Expertise in capital markets, AgC expertise in crafting and analysis of various methods of fundraising activities. As AgC has developed authentic proficiency in business system, the provided services are effective and viable to implement.

Each executives of AgC has more than 10-year experiences in local and international advisory deals, AgC teams have wide ranging industry experience across public and private sectors. Therefore, it is a firm belief that the advices and services from AgC professionals will maximize clients' benefits.

2.2.2. Location

The Millenia Building, Room no. 1905, 19th Floor, 62 Langsuan Road, Bangkok 10330
Telephone: 02-651-8787
Fax: 02-651-8788
Website: www.agc.co.th

2.2.3. Company Registration

Since 22 December 2006, AgC has been registered with the Department of Business Development, Ministry of Commerce in accordance with Thai Civil and Commercial Code. AgC has been given an approval by Security and Exchange Commission Thailand and Ministry of Finance as a Licensed Financial Advisory

2.2.4. Scope of Services

AgC provides integrated service in financial advisory including;

- Financial Due Diligence
- Debt and Equity Capital Market Financing
- Merger and Acquisitions
- Independent Financial Opinion
- Financial Strategy Formulation

- Organization Financial Strategy and Policy Analysis
- Financial and Corporate Restructuring
- Risk Management
- Project Financial Feasibility Study

2.2.5. Company Credentials

- Office of Transport and Traffic Policy and Planning, Ministry of Transport: The Study of Fare System Development of Public transportation and Connection
- Office of Transport and Traffic Policy and Planning, Ministry of Transport: The Study of Rail System Operation Management
- Office of Transport and Traffic Policy and Planning, Ministry of Transport: The Study of Rail system Management and Construction
- Department of Highways, Ministry of Transport: The Study of Traffic and Financial Impact of Closed System on Highway no. 7 and 9
- Department of Highways, Ministry of Transport: The Study of Guideline to Set Up Inter-City Highway Development Fund
- Don Muang Tollway Plc.: Feasibility Study of Financial Restructuring
- Don Muang Tollway Plc.: Financial Feasibility Study of Interconnection Project between Don Muang Tollway and Srirach Highway

2.3. Korea Smart Card Co.,Ltd

2.3.1. Company Background

Established in 2003, Korea Smart Card Co., Ltd (KSCC) is the developer and operator of the smart card application named T-Money which is used for the mega scale public transportation management. KSCC is responsible for enhancing the use of Seoul Metropolitan Government's new transportation system which was launched in 2004. Subsequently, KSCC integrated common ticketing system into taxi and Incheon public bus system in 2007 and 2008 respectively.

KSCC is accepted as the first operator of smart card system that provides various beneficial services with just one card. The system also supports touch-screen function, card reader, and many devices that have over million users per day. Therefore, T-Money is renowned from all over the world as the most technologically advanced fare collection system.

The great accomplishment in Seoul led to expansions of the system into other cities e.g. Pohang, Jeju, Undong, Taejon, Kimje, and other areas. Eventually, the integration of common ticketing system was enacted in 2009.

Such system, including automatic fare collection (AFC), is one of the biggest transportation management system which are mainly used in many countries such Newzealand (Wellington and Oakland), Malaysia (Kuala Lumpur), and Columbia (Bogota).

KSCC has become one of prospered service providers in transportation related business as it can effectively manage mass transportation system which services over 20 million people in Seoul. Given such inestimable success, it is hardly to find other similar fims that provide the same quality services as KSCC did.

2.3.2. Location

Seoul City Tower, #581,Namdaemunro 5ga, Joong-gu, Seoul, Korea
Tel: 82-2-2288-7600 / FAX : 82-2-2288-7601
Email: info@koreasmartcard.com
Website: www.koreasmartcard.com

2.3.3. Company Registration

KSCC is registered with Korea Department of Business in October 7, 2003. The registered number is 104-81-83559.

2.3.4. Types of Services

- Software development service, Technologyinformation system, VAN, LAN and WAN system
- Mobile network service
- Other communication services
- Electronic currency payment system
- Software development and supply consulting service
- Electronic card and safery management of system
- Other functions related to smart card system

2.3.5. Scope of Services

1. Smart card
   - Design format and structure of the card
   - Advice type of card suitable to work function
   - Create card database
2. Automatic Fare Collection System
   - Software development service of fare collection system for every modes of transportation i.e. sky train, railtrain, public bus, and highway
   - Design and develop automatic fare collection system
3. Business value-added system
   - Credit and debit card syste,
   - NFC - USIM
   - Compliance with NON TRANSIT

2.3.6. Company's Credentials

- Over 81 million T-money card users
- Over 38 million mobile devices which operated under T-money system
- Closed system compatible to other card issuers (3 large issuers and credit cards issued by 12 issuers)
- Infrastructure of AFC and T-money was installed to over 400 subway and rail stations, 10 ferries, and 120,000 taxis
- Over 80,000 outlets outside transportation points
- Over 40 million transactions per day
- Over USD 19 million collection per day

- Utilization of 100% in subway system, 98% in public bus, and 62% in Taxi

2.4. PSK Advisor Co., Ltd

2.4.1. Company Background

Founded by the group of experienced engineers from Thailand, the USA, Japan, and Australia, PSK has been registered with Thai Consult Database Center, Public Debt Management Office, Ministry of Finance with the propose to provide the services which consist of planning and design of transport systems, public infrastructure, and urban development. It has been enlisted an engineering advisor under Thai law since 2011.

PSK serves both public and private organizations. Its staffs have experiences in all areas of project master plan, feasibility study, detailed engineering design, and construction supervision. with the objectives: Responsibility, Professionalism, Independence, and Creativity. PSK has the unique blend of technical expertise associating with a value-based company culture. PSK aspire to become an integral part of the infrastructure development to improve the quality of life for event people.

2.4.2. Location

1199 Piyavan Tower, 15th Floor, Suite A, Phahonyothin Rd., Samsen Nai, Phaya Thai, Bangkok 10400
Tel 0-2617-0429
Fax 0-2617-0426
E-mail: info@pskadvisors.com
Website www.pskadvisors.com

2.4.3. Company Registration

As of 20 June, 2011, PSK had registration no. 0125554011160 with the Department of Business Development, Ministry of Commerce in accordance with Thai Civil and Commercial Code. Since 27 January 2012 PSK has been registered with Thai Consult Database Center, Public Debt Management Office, Ministry of Finance.

2.4.4. Types of Services

1. Project Master Planning
    - Short term immediate solution
    - Long term plan
2. Project Feasibility
    - Project demand Forecast

- Preliminary design
- Economic evaluation
- Financial evaluation

3. Project Development and Design
   - Architectural design
   - Structural design
   - Project cost estimate
   - Bidding preparation documents
4. Project Evaluation
   - Project monitoring
   - Post evaluation

2.4.5. Scope of Services

1. Transportation model and data base
   - Nation level
   - Bangkok and nearby level
   - Area level
   - Micro level
   - Data base development
   - Logistic data base
   - Geometric
2. Urban transport
   - Sky train
   - Bus rapid transit
   - Express way, High way, bridge, and underground tunnel
   - Non-motorized transport
   - National transport infrastructure Road, High way, bridge
   - Inter-city rail
   - High speed train
   - Distribution center
   - Cargo area
   - Air port
   - Harbor
   - Pipe transport system Urban and civic design
3. Urban and civic design

- Urban planning
- Landscape planning
- Architectural design

2.4.6. Company Credentials

- Consulting Services for The Comprehensive Study on the Master Plan for Nationwide Transport System in Egypt
- Planning road and public transport infrastructure and forecasting land, marine, and air traffic volume
- Surveying and analyzing the solutions to solve traffic problem from rama 9 to sukhumvit
- Surveying, analyzing, and forecasting traffic volume on road and junction to solve traffic problem and economic evaluation of the project
- Surveying and analyzing traffic volume to enhance the efficiency of network between main road and outer belt
- Study on strategic development of Thai inter-city highway
- Surveying traffic volume on road and junction to create strategic development of thai inter-city highway, examining from origin to destination of the route using
- Development Concept & Overall Program for Transportation Systems Routing Hub Siting of Myanmar SuperAxis
    - Acquire the socio-economic data and the transport data as well as port demand and hub demand data
    - Analyze past greenfield project with similar characteristics
    - Forecast the demand for Transport along the SuperAxis
- Study on JICA's Human Resource Development Project in Automobile Sector
    - Analyze the features and challenges of JICA's Automotive Human Resource Development Project (AHRDP)
    - Identify the quantitative and qualitative impact of the AHRDP project on the local business communities with a questionnaire survey

Chapter 3. Model and Methodology

Program Management Services (PMS) is very essential to the development of Thailand mass transit system. It enables service providers to provide convenience to passengers on all 10 routes MRTs. Moreover, it leads to the practicability of the 20-Baht-flat-fare-collection government policy. The execution of the program comprises the standardization of common tickets in Thailand, the administration of CCH, and CTO, as well as the pilot program for the use of common tickets. There are altogether eight main tasks for this program.

Work 1: Policy making and common ticketing system management planning

The execution of this task comprises eight main stages, and has the work period of three months. The first month involves reviewing literature and information associated with program management services in Thailand, foreign countries, as well as technologies used with common tickets. Data collection and literature review in the first month would lead to the proposition of models and details of the development and execution strategy of common tickets in Thailand mass transit system in the second month. A survey of current fare collection method would be carried out afterwards. This also involves assessing stakeholders' comments and suggestions. This would lead to the definition of common ticket development policy, development model, and contract management with the current service providers in the third month.

Work 2: *Common ticketing system standardization and preparing details for the common ticketing developer procurement and the Central Clearing House (CCH)* establishment

The execution of this task would take approximately four months. The first month involves defining system technical specifications and development model of common ticket in Thailand. This would be carried out concurrently with the conceptual modeling, as well as standardizing peripheral systems associated with the common tickets; for instance, cards and card readers. The process of modeling and standardizing would take approximately three months. Related documents would be proposed by the advisor, in order to procurement a developer and to establish CCH, as well as to estimate expenses in procuring common ticket system and its usage strategy.

Work 3: Supports of the common ticketing developer procurement and establishment of the CCH

This stage would take approximately four months. During the first two months, there would be program advertisement, and committee appointment. In addition, elucidating and answering questions would be carried out. The following month involves comment evaluation. For the documentation, it would take half a month. This task takes altogether four months.

Work 4: Supports of the supervision of the common ticketing developer's execution and the CCH establishment

This stage would take approximately 24 months. In the first three months, the advisor would provide support in the regulation and management of design contract to be correspondence to the system specification. Moreover, the advisor would specify time range for system installation and compilation of documents for the common ticket developer to finish within 18 months. It would take another six months for system testing. After the 24-month period, advisor would investigate maintenance provided by developer until contract termination. This stage takes altogether 40 months.

Work 5: The academic technology supports and the Common Ticket Office (CTO) establishment

This stage takes approximately 26 months. Advisor would review appropriate organizational patterns, as well as law and regulations associates with organization establishment in the first month. Then, the appropriate organizational pattern would be proposed to the OTP in the third month. In the second month, the advisor would prepare documentation related to the establishment of CTO, strategy development, specification of CTO qualifications, as well as development of regulations and system maintenance. It would take three months to follow up the establishment and the operation of CTO. The advisor would provide academic support during the operation. This would take altogether 26 months.

Work 6: The technological instruction at the beginning of the common ticketing system operation and CCH's operation

The advisor would provide academic and management support, as well as provide consultations regarding the improvement of technologies related with the CCH, and suggestions to the potential enrichment of associated organizations. This involves providing practical training by experts (both Thais and foreigners), 10 workshops, 2 overseas training and technology transfer, 1 overseas on-job training once, and 2 domestic on-job training. This stage takes 48 months.

Work 7: The pilot project supports

This takes altogether 24 months. During the first four months, the advisor would develop the system with the Expressway Authority of Thailand, the Department of Highways, and Don Muang Tollway Public Co., Ltd. The main vehicles using these three systems are personal cars. The following six months, the advisor would develop a common ticket system with 4 mass transit systems: purple-line MRTA, airport rail link, BTS, and BRT. This is also connected with non-transit systems. After the connection, the advisor would include other service providers to the system; for example, BMTA, and other electric train routes. This process takes six months. It

takes additional 8 months to connect all the systems. Then, the advisor would evaluate and provide conclusions regarding the problems, as well as provide solutions.

Work 8: Public relation and public participation

The execution of this task can be carried out throughout the whole operation of the project. The advisor would establish an information center and public relation unit in the first month. This is to regulate the public relation activities, organize meetings, and publishing media to publicize the project.

3.1. Policy making and common ticketing system management planning

Objectives :

The objective is to specify policies and management plans for the common ticket system that is appropriate and practical to Thailand. The policies and the plans are scrutinized by stakeholders, business owners, government, and associated organizations, as well as literature on the development of common ticket system overseas, which elaborates advantages, drawbacks, and difficulties.

Models and Methodology

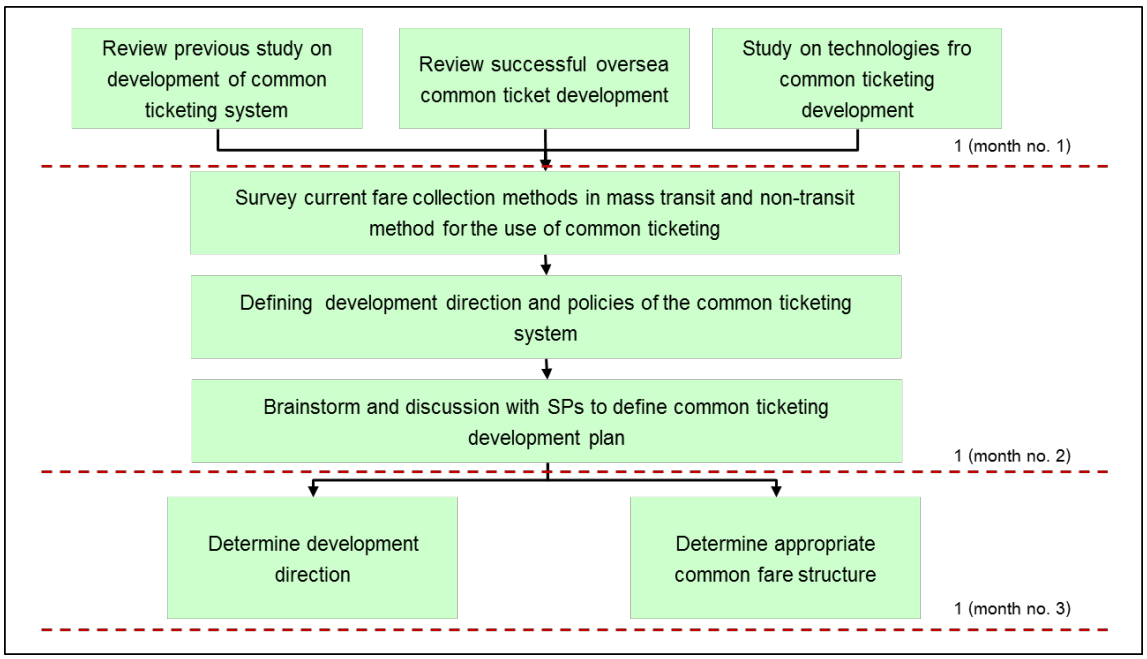
According to the scope of work section 3.1, the objective is to specify policies and management plans for the common ticket system that is appropriate and practical to Thailand. This involves discussion with stakeholders includes business owners, government, and associated organizations, as well as literature review on the development of common ticket system overseas, which elaborates advantages, drawbacks, and difficulties. This main task is to review literature on the operation of common ticket systems in foreign countries and related technologies, to propose models and details of developmental policies and plans, to survey the current fare collection methods, to define models and developmental, and to define fare collection policy and contract management with the current service providers.

This process takes three months. The first month involves reviewing literature related to common ticket development both overseas and Thailand, as well as related technologies. From the review, it enables the advisor to propose developmental strategies for Thailand common ticket system in the second month. After that, the advisor would survey the current fare collection method system, comment from stakeholders, methods to engage the common ticket system, directions for the development, specification of fare rate, and the contract management with the current service providers in the third month.

Expected Outcomes

From the review, advantages and drawbacks in the development of the common ticket system overseas, and comments from stakeholders would enable the advisor to improve and to develop and specify policies and plans for common ticket system in Thailand.

Figure 3.1-1 Work Plans for Policies and Management Plans for Common Ticket System



3.1.1. Review on the Development of Common Ticket System in Thailand

To conduct a literature review on the development of successful common ticket systems in foreign countries and in Thailand, the advisor would review and analyze literature related to the system

1. The study project on the use of common ticket system and the establishment of CCH
2. Reports on Thailand: Bangkok Mass Rapid Transit Integrated Ticketing Project
3. Report on Bangkok common ticket system development project
4. Oversea common ticket system study project
5. Report on the customization of Bangkok metropolitan mass transit system

The review on overseas and Thailand common ticket systems, as well as technologies in the development of common ticket system, enables the advisor to specify policies and management plans.

3.1.2. Review on the Overseas Common Ticket System

The Advisor would review the systems used in foreign countries, in order to plan the development of common ticket system in Thailand. The review would focus only on the successful countries.

1) Hong Kong

The project started in 1997, having OCTOPUS Co., Ltd. as a card issuer and service provider. The card is called OCTOPUS Card. The card is a microprocessor type, using Felica

technology. It can be used with electric trains and taxi. It also provides parking service and other services.

Figure 3.1-2 OCTOPUS Card

2) Singapore

The project started in 2002, having EZ-Link Co., Ltd. as a service provider. The card is called EZ-Link Card. The card is a microprocessor type, using Felica or CEPAS technology. It can be used with product purchasing, identification card, entertainment, library, and logistics in Singapore.

Figure 3.1-3 EZ-Link Card

3) Japan

The project started in 2001, having zonal card issuers and service providers; for example, Suica card is a microprocessor type, using Felica technology. It can be used with electric trains, public buses, taxi, gas station, convenient store, and restaurants.

Figure 3.1-4 Suica Card

4) Korea

The project started in 2003, having a cash card service providers, credit card service providers, and bank as card issuers. KSCC is a middle service provider to the clients. The card is called T-Money Card. The card is a microprocessor type, using Mifare technology. It can be used with taxi, public buses, convenient stores, restaurants, and cinema.

Figure 3.1-5 T-Money Card

5) England

The project started in 2007, having Transys Co., Ltd. as a card issuer and service provider. The card is called Oyster Card. The card is a microprocessor type, using Mifare technology. It can be used with electric trains in London, public buses, rails, and DLR.

Figure 3.1-6 Oyster Card

The review found that overseas common ticket system can be categorized into three systems:

1. Closed System is a system specifically used by transit providers. Passengers may use the system to pay fare or other services of the providers or their representatives.
2. Closed Multipurpose System is a system specifically used by transit providers, and is extended to non-transit businesses. Passengers may use the system to pay fare or other services of the providers or their representatives.
3. Open System is a system which the passengers may use the medium issued by issuers (e.g. banks) to pay fare or services. This system has clearing houses as regulators, and there is settlement among different service providers similar to credit cards.

3.1.3. Proposing the study on the technologies for the development of common ticket system

The advisor would study the system used overseas, in order to find the advantages and drawbacks, and the technologies which are appropriate to Thailand and to compare and contrast the respective technologies and products.

1) Tickets

1.1) Paper Tickets

The tickets clearly indicate related details, such as fare, departure station and destination. This type of tickets is used with public buses, trains, and public boats.

1.2) Magnetic-Stripe Card

This type of card writes and reads data on high core magnetic-stripe. It has lower cost and is reusable; however, it causes risk in system faults because the cards can be jammed in the system. Moreover, its moving parts cause system friction which increases system deterioration. This system is currently used in BTS.

1.3) Contact Smart Card

This type of card writes and reads data on the card. It has two types of memories: read only memory (ROM), and electrically erasable programmable read only memory (EEPROM). This type does not cause system faults.

1.4) Contactless Smart Card/Token

This type of card reads and writes data on the card. It has high reading and writing speed. It requires only 10 centimeters of operation proximity. This system does not cause system faults, as it contains no moving parts which cause system friction. This system is currently in used in single journey ticket in MRT and airport rail link, as well as stored value card in BTS, MRT, and airport rail link.

1.5) Near Field Communications (NFC)

NFC is a high frequency wireless technology which is able to operation within low distance (approximately 10 centimeters). This technology developed from ISO 14443 (contactless card, RFID). NFC contains both card and reader within a single unit. NFC apparatus is able to communicate with the ISO 14443 smart card and card readers, as well as other NFC peripheral parts. Hence, this system is able to operate with contact infrastructure which is currently in use in public transportation and product purchasing. This technology was first aimed to be implemented in mobile phones.

Users would be able to touch their mobiles on a reader to operate the system by using NFC technology. This is similar to smart cards. The mobiles are able to store users' purchasing accounts (e.g. credit card account or card value). In addition, users can select their accounts to be deducted in purchasing.

In sum, for short range contactless smart card and mobile phones, NFC is a suitable system for fare paying in prospective mass transit systems. This system can replace the magnetic card. The advisor suggests mass transit providers to replace the magnetic type to the contactless smart type before launching new electric train routes. This helps saving investment in purchasing magnetic cards to implement in the system. Within the next five years, MRT might have to consider using NFC, if mobile phone manufacturers delivered more NFC mobile phones into the market.

Medium range and long range contactless smart card, including biometrics, might not be suitable for mass transit in the prospective 10 years. Nevertheless, if technological, legal, and privacy limitations can be overcome, these technologies could possibly be the next generation of mass transit cards.

Figure 3.1-7 Types of Short Range Smart Card

Type	Standard	Series	Brand	Capacity (EEPROM)	Speed	Material	Serving Districts
Short Range Smart Card	ISO/IEC 14443 A	MIFARE Ultralight C 13.56MHz	NXP Semiconductors	512 bits, 192 bytes, 1 Kbyte, 4 Kbyte	106 Kbit/s	Paper/Plastic	Mainly Asia areas
	ISO/IEC 14443 A	C. Ticket 13.56MHs	ASK	256/512 bits and 1024 bytes	106 Kbit/s	Paper	E.g.: Protugal
	ISO/IEC 14443 B	MM4000L	Motorola	8 Kbits	106 Kbit/s	Plastic	
	ISO/IEC 14443 C	Felica 13.56 MHz	SONY	4 Kbytes	212 Kbit/s	Plastic	E.g.: Japan. , Hong Kong, Shanghai, Shenzhen, Delhi, India and Thailand

Figure 3.1-8 Different Types of Cards used in Different Countries

Cards	ISO 14443	Interface	Multi-operator systems	Memory capacity
Mifare 1	**A**	Contactless	London, Taipei	1 kbytes
Mifare 4K	**A**	Contactless	The Netherlands, Denmark	4 kbytes
Mifare DESFire	**A**	Contactless	Nanjing, Oslo, Seattle	4 or 8 kbytes (28 contracts)
CT 4004-4008-4016 (Mifare ProX*)	**A**	Dual interface	Not yet	4, 8 or 16 kbytes (10 contracts)
Smart MX *	**A**	Dual interface	Not yet	8 kbytes or 72 kbytes
GTML+	**B**	Dual interface	Not yet with this new card Paris (GTML), Lisbon (GTML2)	2 kbytes (8 contracts)
CD 21	**B**	Dual interface	Not yet with this new card	2 kbytes (8 contracts)
CT 4002	**B**	Dual interface	Naples	2 kbytes (10 contracts)
Felica RC-S833	**no**	Contactless	Hong Kong, Singapore	1,5 kbytes

(*) E-purse compliant

2) Front-End System

This involves the study of models and methods to interface front-end systems of service providers who require the use of common ticket system. If the service providers are currently offering their services to passengers, the interfacing of the common ticket system must not interfere with the current services.

3.1.4. Proposing methods and details of development strategies and operation plans of common ticket system with public transportation

The success of the system requires cooperation for both government and private sectors. In addition, it requires a careful study on the details of the system, which support the definition of development strategies and operation plans. The overall operations of the advisor are elaborated as follows:

1) Defining Objectives and Strategies

This involves reviewing related studies, both from Thailand and foreign countries, and the current operational contexts. Interfacing technologies, law contexts, regulations would be examined, to define development objectives. The advisor would then analyze the details, to specify the operations to modify the system and other contexts, to be correspondence with the defined development plans of the common ticket system.

2) Consulting with Stakeholders

To specify the most suitable development strategies and minimize investment of the system, the advisor would consult with associated government and private sectors. The consultation with the government sector involves important policies; for example, fare rate regulation, financial support from the government, and possibility to encourage the use of common ticket system. The advisor would also discuss with service providers that currently use an automated fare collection (e.g. BTS, BTSC, and BRT). This is for the understanding of the technologies, data access and equipment related to automated fare collection systems, in order to plan the prospective development strategies.

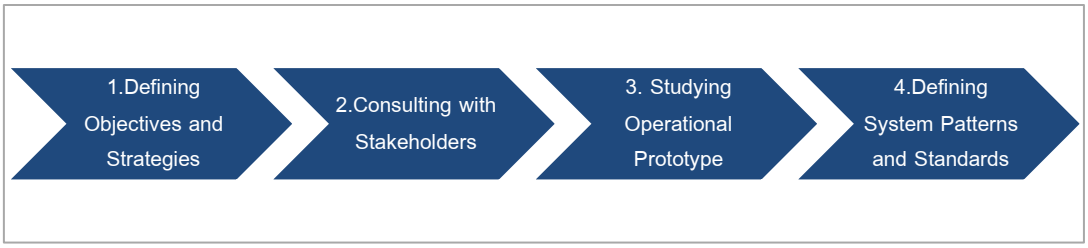
3) Studying Operational Prototypes

Carry out discussions, gathering comments and suggestions from the successful CCH in different countries, such as Korea and Singapore. The advisor would present the pre-defined patterns; then, the modification would be carried out after receiving comments.

4) Defining System Patterns and Standards

After defining objectives and discussing with stakeholders, the advisor would define the specifications of system equipment, interfacing and modification plans. The common ticket system can be divided into two major sectors: front-end system, and back-end system. Front-end comprises connecting and transferring of data related with passengers, such as the purchasing of cards and topping up card balance, ticket structure, ticket read/write machines, and central computer. Back-end comprises CCH system, revenue distribution, and settlement system. The advisor would define standards of the respective contexts; for example, daily usage, processing speed, data structure, ticket capacity, data back-up system, and scheduling daily settlement.

Figure 3.1-9 The Overall Operation



To enable practicability and effectiveness of the system development, the advisor would propose the methods and details of strategies and operation plans.

Development methods should be divided into two phases: within transit system, and non-transit system. This should specify appropriate execution time periods.

Development methods have three objectives:

- Improving the current ticketing system, and interfacing with the new system
- Developing an automated ticket system for public buses and boats
- Integrating the use of the card both in transit and non-transit systems

Besides development methods, organizational structure is also important. Duties should be clearly defined, and there should be a business department to support the use of the ticket in non-transit businesses, which requires strong encouragement. Public relations are needed to

- Acknowledge
- Increase interest and motivation
- Increase knowledge and understanding

Besides strategically development, firm operations and cooperation from government and private sectors are needed. The cooperation should comprise

- Comments from business owners
- Collection and distribution of revenue
- Investment plans and revenue distribution management
- Factors of distributing and selling the cards
- Management after route extension
- Joints of new business owners
- Multi-Applications

These factors require careful consideration for a sustainable development of the common ticket system.

3.1.5. Surveying current fare collection methods in mass transit and non-transit and methods for the use of common ticket 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 investigation and the study on fare collection systems, as well as consultation with associated sectors.

The survey indicated that, besides paper tickets, there is a use of smart cards. There are two types of smart cards currently in use: memory card (e.g. Type A Mifare 1k), and microprocessor card (e.g. Type A Mifare 4k and Type C (Felica)). The cost of memory cards is lower than that of the microprocessor cards; however, the memory cards have lower security and are less flexible in multi-application usage. The microprocessor cards have stronger security. They also support multi-application and are more flexible. Nevertheless, a major drawback of microprocessor cards is that the development and the standardization of the cards are not universal. Manufacturers can always restrict specifications of the operating system and peripheral parts per se. This may lead to the monopolization of the system.

Table 3.1-1 Types of Smart Card Used in Thailand

System	Single Journey Ticket	Store Valued Ticket
MRTA	Contact-less Token: Type C (Felica)	Smart Card: Type A (Mifare 1k) และ Type C (Felica)
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)
BMTA	Paper Ticket	-
Boats	Paper Ticket	-
Express Ways	Cash	Easy Pass (RFID and Mifare)

Besides the use in transit, the most effective way of using the common ticket system is to integrate it with non-transit businesses; for example, using the card at convenient stores, or banks. This would specify a model for transit providers from both government and private sectors to use and to develop the common ticket system.

For financial viability of common ticket operation, a joint of mass transit providers is very important. Government sectors should encourage this by providing share to new providers. The role of the government sectors also includes the regulation of fare rate.

In the study process, the advisor would study the potential and readiness of the transit providers, to grasp the ideas of characteristics and the management of common ticket system. The advisor would also propose the integration of the use of common ticket between government sectors and private sectors. The effectiveness of the system depends on the earnestness of both sectors

- Cooperation Agreement
- Investment on infrastructure by government sectors
- Investment plans under PP scheme
- Establishment of Central Clearing House
- Encouragement plans for the joint of private sectors
- Other support for the stakeholders
- Establishment of Transport Oriented Development Fund
- Implement law and regulations which support the operation of the common ticket system; for example, electronic financial transactions, radio-frequency communications, traffic, and account management.
- Further study to support the operation of the common ticket system; for example, market analysis

Besides the support of common ticket system by investing on infrastructure, and law and regulations, government sectors can be benefited from CCH by fleet management and monitoring

For the basic joint strategy of mass transit in Thailand, an additional way for common ticket would be added, and a transponder would be added to the express way. These are illustrated in Figure 3.1-10 and Figure 3.1-11, respectively.

Figure 3.1-10 Basic Joint Strategy for AFC

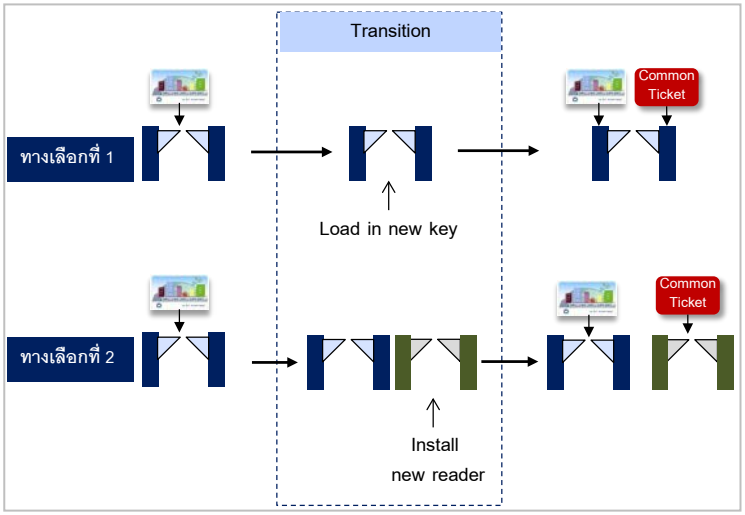
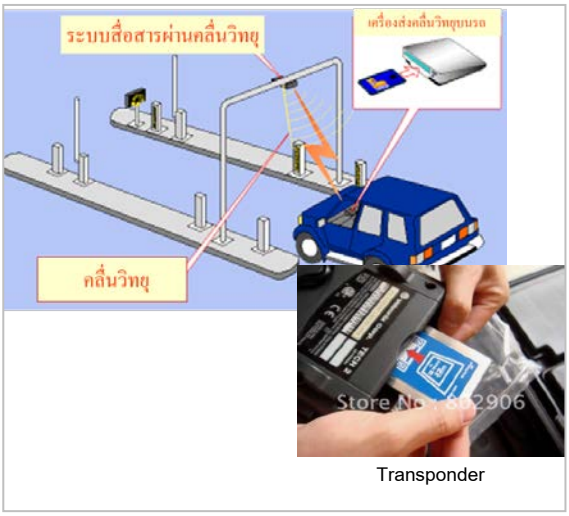
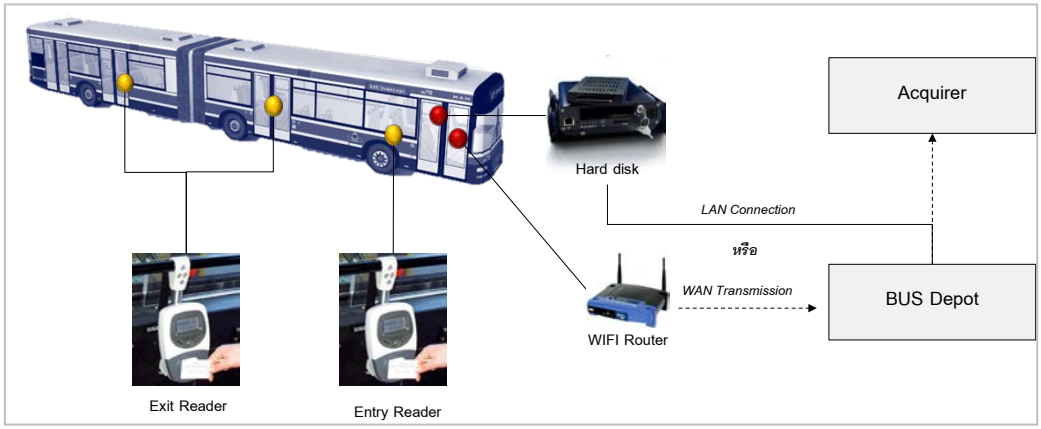


Figure 3.1-11 Basic Joint Strategy for ETC



Public buses currently do not have an automated fare collection system, as well as its equipment. The development of common ticket system to implement in buses requires investment on the equipment. At the very first stage, semi-online system, which is now used in Seoul, would be installed in the buses. They are for the fare collection and usage data collection. These data are stored on a Hard Disk. When the buses are parked in the garage, the data would be transferred through WiFi network to a central computer to process primary data. They would be further transferred to the CCH to be computed for the revenue distribution.

Figure 3.1-12 Joint Strategy with Buses



3.1.6. Brainstorming for the definition of common ticket developmental strategies

The advisor would hold seminars to receive comments from stakeholders whom were invited from government sectors; for example, representatives from Ministry of Transportation and Office of Transport and Traffic Policy and Planning, State Railway of Thailand, MRTA, Traffic and Transportation Department, BMTA, Bank of Thailand. The representatives from private sectors would also be invited; for example, BTS, Chao Phraya Express Boat, Transit providers, banks, and other entrepreneurs who are interested in using common tickets. The seminars may include mass media from television and newspaper. The participants would be approximately 300 people.

It is expected to receive comments and interest from the participants. The advisor would apply the comments received from the seminars to improve the final version of the study report. The results are expected to be practical and realistic for the implementation in near future.

Figure 3.1-13 Seminar with the stakeholders

The seminars would increase the understanding towards the operation plans of the common ticket system, ticket standards; data transfer standards, revenue distribution, front-end / back-end application equipment, as well as establishment model of the clearing house.

3.1.7. Defining development direction and policies of the common ticket system

The advisor would use an open system to define the development policies of the common ticket system. It has a multi-issuer structure and supportive preparation.

Card issuing can be done by transit and non-transit sectors, as well as banks that hold issuer license. The advisor would specify the directions of duties and responsibilities of these following units:

1. CTO
2. Central Clearing House
3. Card Issuers
4. Loading Agents
5. Settlement Banks
6. Transit Acquirers
7. Transit service providers
8. Non-transit service providers

The details of the definition are as follows:

1) Duties and Responsibilities of CTO

- CTO controls all standards
- Authorization card issuing, loading agents and data collection for system connection
- Examine and control the operation of CCH
- Examine and control transportation data collection which delivered to the Office of Transport and Traffic Policy and Planning for planning and specifying policies
- Support the Office of Transport and Traffic Policy and Planning in controlling policies and supporting common ticket fare board
- Propose a fare structure to the fare board

2) Duties and Responsibilities of CCH

- Request payment from card issuers. Transaction details would be collected from transportation destination and outside transportation stations.
- Insert transaction data file collected from common ticket payment to a database in real time. The completeness and correction would be examined when the transaction data are written onto the database.
- Payment from transaction data, transit fare, and product purchased by the cards would be processed. The payment records would be transferred to card issuers. The revenue would be distributed to transit providers, operational sectors, and non-transit service providers. The system would keep statistics of the system operation.
- Ensure the correctness of balance top-up among subsystems

3) Duties and Responsibilities of Card Issuers

- Card issuers are responsible for the transactions related to bank cards. The issuers have privilege to authorize the use of application, load, installation, delete, extradition, personalization, and restriction.
- The application covers load, installation, delete, extradition, and personalization of the third party.
- It is responsibility of card holders to ensure their own security, from pre-issuance production processes to post-issuance processes, as well as final decommissioning.
- Card issuers define operational results of the application and the use of application.

4) Duties and Responsibilities of Loading Agent

- Loading Agents would load card balance by using application, personalization and customization of data. Final domain keys might be provided on the cards.
- Must provide equipment for card holders to load the balance (e.g. e-wallet).
- Loading Agent must be able to provide service for round trip ticket
- E-wallet must be convenient and reliable

5) Duties and Responsibilities of Settlement Banks

- Settlement banks ensure reliability, security and transparency of balance transfer. This process must be authorized by law and certification.
- Settlement banks must present rules, requirements, and processes to all stakeholders, and must clearly explain and elaborate all possible risks in the payment.
- Settlement banks define risk management standards and present to them to stakeholders, as well as operate risk management.
- Settlement banks must complete the adjustment of obligations within the same day as the transaction.
- Settlement banks must issue a report of settlement
- Settlement banks must have a reliable system, as well as security and transparency which are acknowledged by stakeholders.

6) Duties and Responsibilities of Transit Acquirer

- Data collection system can be compared with trusted 3rd party settlement server. It works as a center of revenue management data transfer. Hence, data collection must be reliable and secure. System structure comprises:
- Data encryption

- Transaction log
- Retrieval of batch transactions
- Back-up support

7) Duties and Responsibilities of Transit Providers

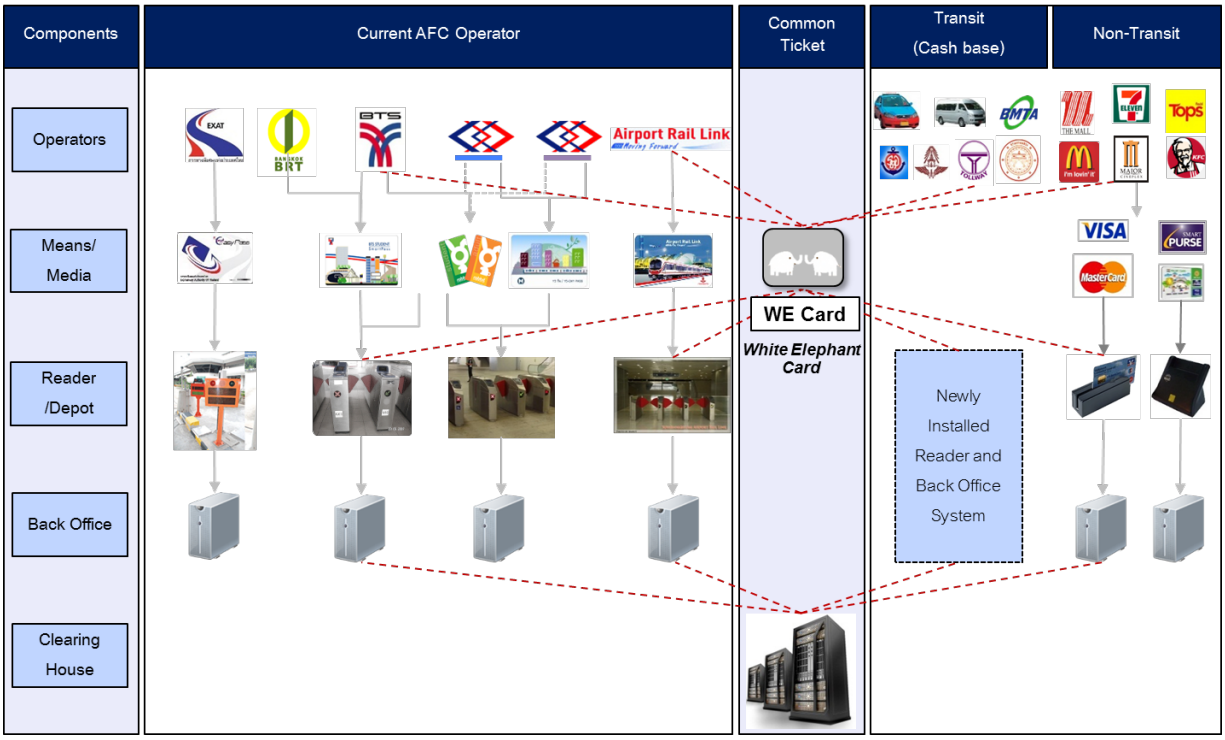
- Provide system for smart card payment
- Regulate and customize fare in accordance with fare policies
- Have reliability and able to achieve objectives
- Able to transfer payment data on e-transaction to other providers
- Develop cooperation in revenue collection and distribution
- Develop utilization of mass transit properties
- Develop report on usage; compare contract regulation and certify the results
- Regulate and ensure safety in services

8) Duties and Responsibilities of Non-Transit Providers

- Process payment transaction for management, information systems for operation, account processing, and statistical records.
- Manage payment of non-transit providers
- Process payment transaction in non-transit businesses
- Statistical data on payment / Processing transaction account file for non-transit sectors

The concept of the common ticket system is illustrated on the following figure. The common ticket system can be integrated with the current system. It also supports the AFC system and flat-fare policy of the government.

Figure 3.1-14 The concept of the common ticket system



3.2. Common ticketing system standardization and preparing details for the common ticketing developer procurement and the Central Clearing House (CCH) establishment

Objectives

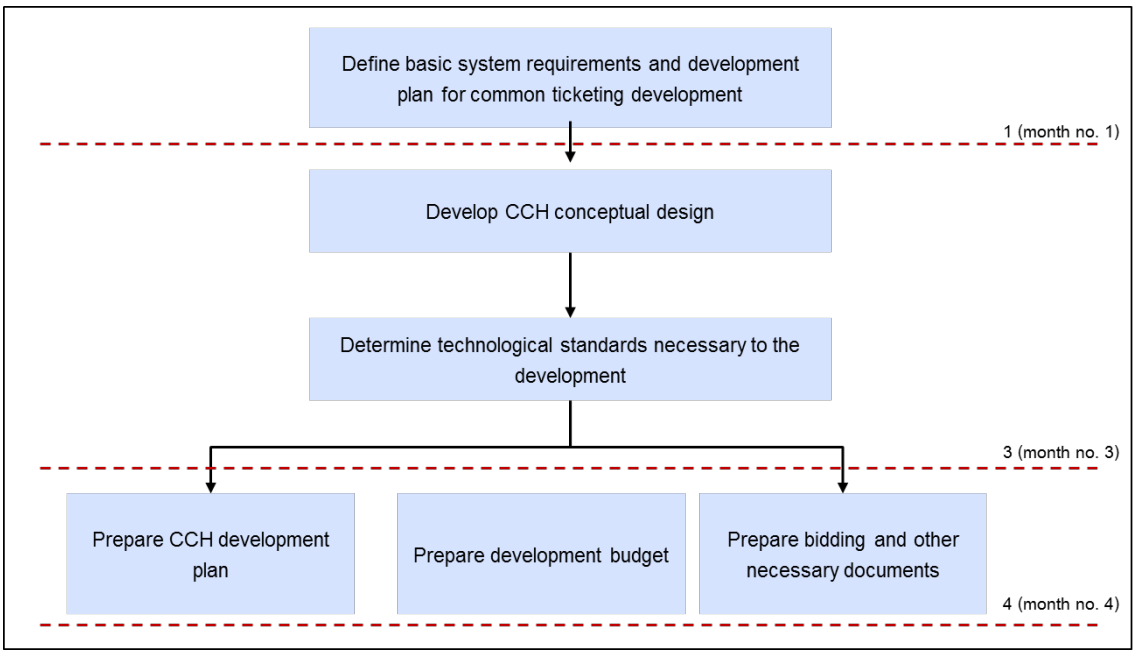
The objective is to ensure that the system meets universal standards. It must be effective, updated, secure, and suitable for Thailand mass transit. The establishment of CCH is a major task of the development of the common ticket system. If the standards match with Thailand mass transit, it would encourage the use of mass transit systems. The advisor has experience in the management and structural refinement of common card and CCH. Hence, the advisor has potential to design a common ticket system which meets universal standards.

Models and Methodologies

Section 3.2 on the work contract comprises basic system requirements and development plans definition of the common ticket system, as well as standardization, conceptual design, documentation preparation for prospective developer and establishment of CCH, estimation of investment, and operational plan for the system.

This stage takes approximately 4 months. The first three months involves defining basic requirements, developmental direction. This would be done concurrently with the conceptual design, the establishment of CCH, standardization, and estimation of expenses. These are illustrated in Figure 3.2-1

Figure 3.2-1 Standardization of Common Ticket System and Preparation of information for Procurement of Developers, and Establishment of CCH



Expected Outcomes

- Standardized, updated, secure conceptual design which interest business owners to use the common ticket system.
- Documentations for co-developers and establishment of CCH
- Investment in finding co-developers and the establishment of CCH
- Work plan for the use of common ticket system and processes of the work

3.2.1. Defining the system's basic requirements and developmental plans for the Common Ticket

The advisor would propose the basic requirements as follows:

1. The cards are ISO14443 A and ISO14443 B. They must pass acknowledged and certified security tests, such as EAL4+ 3DES and Cipurse
2. Card structure must be open for the integration with the current system. The conceptual design must examine requirements from stakeholders.
3. The specification of basic requirements must be carried out by experienced team that works with AFC in Thailand - SRET, BMCL, BTS and BRT. The advisor must have an understanding on the modification of front-end systems to be integrated with the new system. The integration must consider
   - Card readers
   - Data/file structure and interfacing standard between each tier
4. Requirements from both government sector and service providers are needed for service modification of the service providers (i.e. BMCL, ARL, BTS, SRT). The requirements must support product design, report system, and subsidiarity.
5. New ticket structure must be interoperable with the current one. It must not cause any conflicts. It must also covers backward integration and must not cause any expenses to the transit providers. This also depends on the providers how much of changes they are willing to accept.
   - Security
   - Key Management System of cards and card readers
   - Card logical access
   - Security Access Module (SAM)
   - Information exchange
   - Physical and secure area access to CCH, including entry, security system, and CCTV. The physical location must be safe from anticipated natural disasters.

3.2.2. Conceptual design for common ticket system and CCH

Conceptual design of common ticket and CCH must match with contract section 3.2.3 and requirement section 2.2.1, as well as standard section 2.2.3.

The integration among front-end systems of each provider and back-end system of the CCH must be considered. Thus, both systems must be interoperable in secure, effective, and standardized ways. Design processes would be later proposed by the advisor. The model is elucidated as follows:

1. Study data pattern and integration of front-end system of the respective providers, to illustrate the details of the integration.
2. Study advantages and drawbacks of back-end systems used in other countries and adapt them to Thailand CCH.
3. Form cooperation among service providers and stakeholders, to specify interfacing systems; especially, front-end and back-end systems.
4. Basic design process covers
    - Common ticketing system (Frontend)
    - Basic design must enables service providers to use the common ticket system
    - Data configuration
    - It is an interfacing between front-end and back-end system. It also connects with other subsystems; for example, financial management, and business analysis.
    - CCH
    - CTO
    - Technical management between CCH and CTO
5. Modify basic requirement draft

Generally, CCH is categorized by settlement methods: local, integrated, and mutual settlement.

Concept of CCH	Exp.	Pros	Cons
Local settlement	— Close system; the cards can be used uder restricted conditions — Personalized settlement	— Easy installation — Easy to understand and collecting data — Support personalization	— Inflexible — Fare policies and settlement depends on local SP
Integrated settlement	— Support multiple SP's — Settlement from multiple service providers — Integrated apportionment & report — Integrated allocation and reports	— Support integrated fare — Facilitate mass transit and private transit — Provide convenience to passengers — Have multiple types and prices of cards	— Complex installation, collection, and business policies
Mutual settlement	— Multiple responsive CCH — Mutual settlement between	— Maintain current service providers	— Complicated installation, collection and settlement

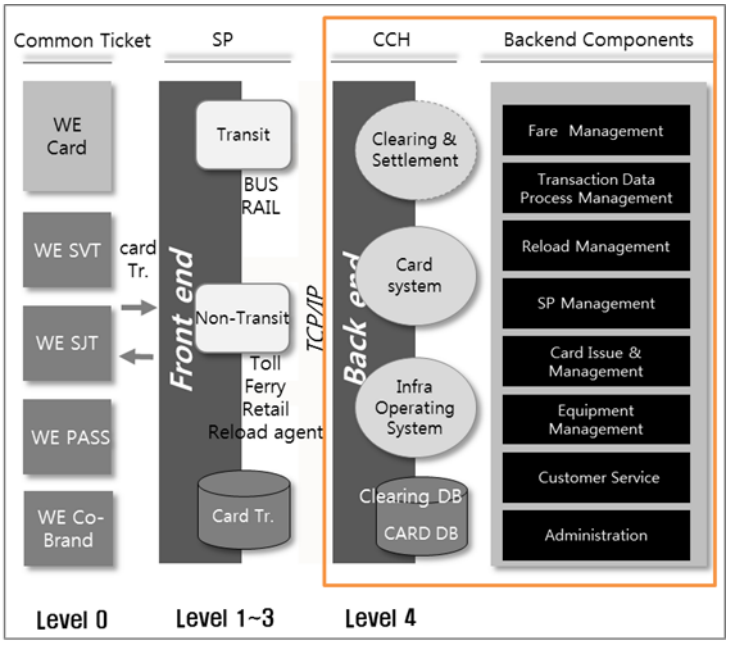
	CCSand CCS (or CCH)		– Difficult to ensuring data integrity – Difficult to ensure data completeness

Integrated settlement is the most suitable for the design and definition of fare collection of the common ticket system, as it has many advantages: supportive to multiple card issuers and service providers; have multiple types of cards.

1) Integrated Settlement Concepts

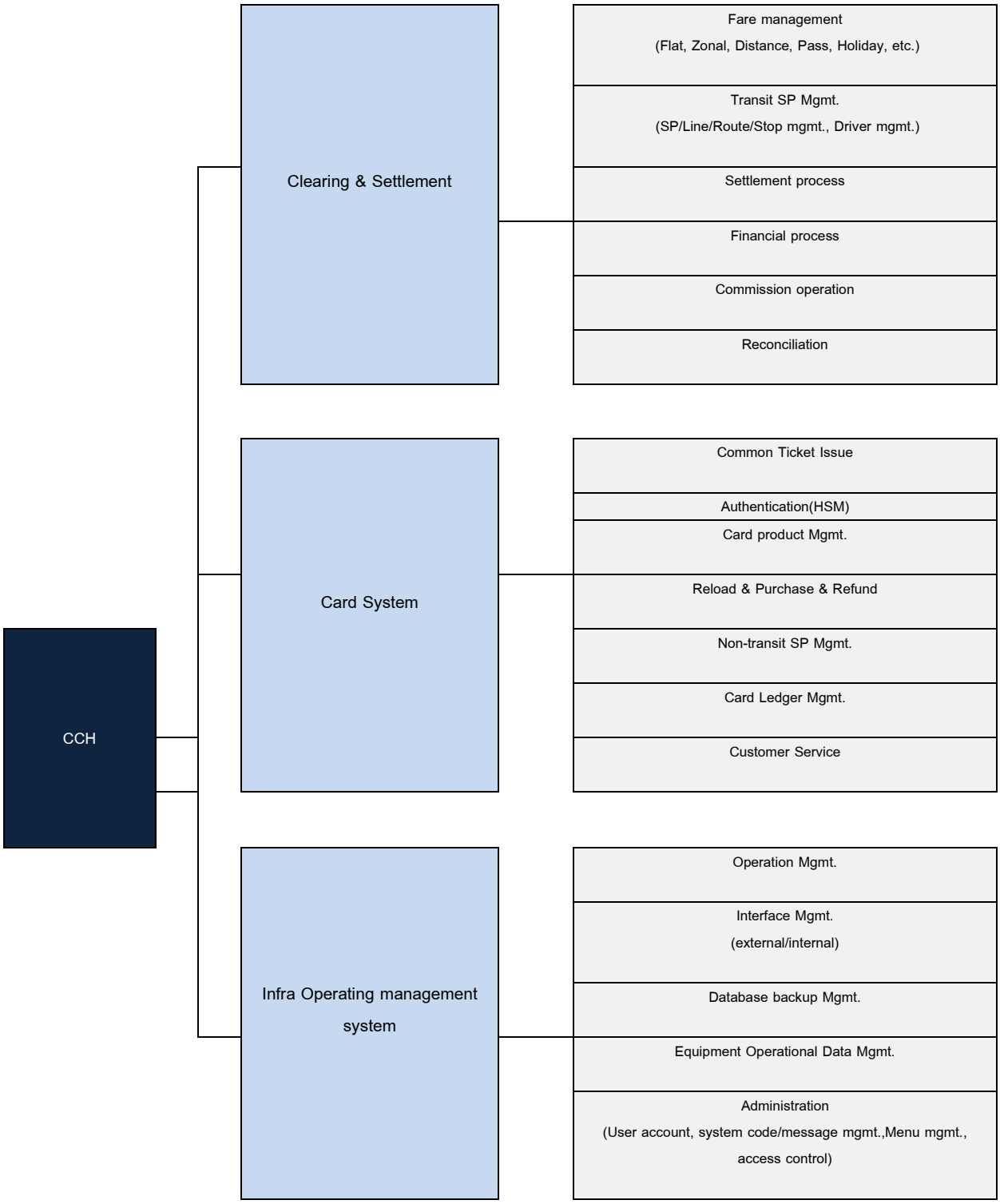
Backend system should be the center for settlement, card management, and operational infrastructure management. The system must be flexible in managing data from both transit and non-transit sectors.

Figure 3.2-2 Structure and Components of CCH



Major components of Central Clearing House

Figure 3.2-3 Patterns and Components of Central Clearing House



These components are needed to be considered for the successful common ticket design.

2) Backend Infrastructure Architecture Directory

2.1) Open Architecture

Backend system should be developed on an open architecture. This is to ensure stability, standardization, and universality.

2.2) Flexibility and Standardization

CCH should classify transactions in accordance with business transactions by using XML codes. This enables the policy makers to plan and to operate in more convenient ways (e.g. fare modification, service improvement, card types, and transportation types)

2.3) Reliability, Stability, and Maintenance

Backend system should strengthen reliability and stability of the system, as well as lower maintenance cost, even the system has been extended.

2.4) Maximized Utilization

Backend system should be operable during system faults.

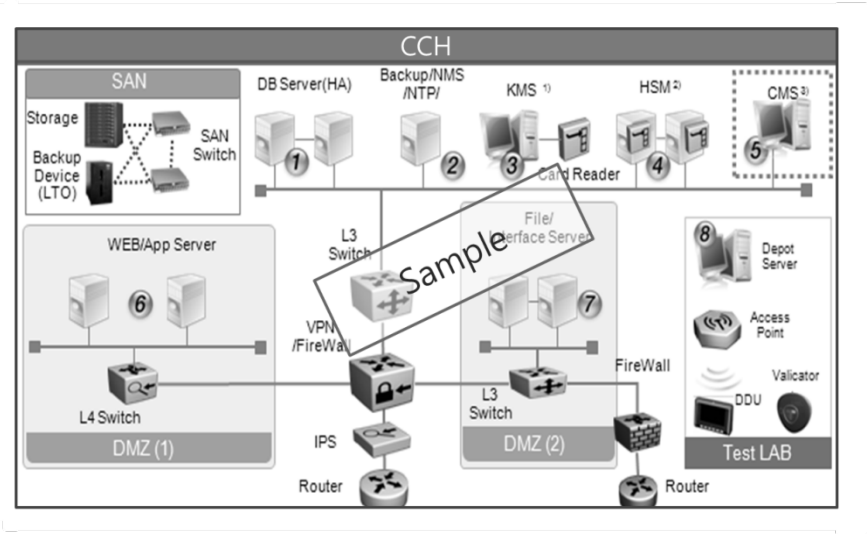
2.5) Data Monitoring and Protection

To prevent the loss of important data, such as transportation data, backend architecture should be able to monitor and trace data transfer between CCS and CCH. The components of CCH must be developed to be responsive to the needs of different users and physical locations.

2.6) Hardware / Network Architecture

Backend system should be composed of multifunction hardware. It should support system readiness, effectiveness, and security. The architecture is illustrated as follows:

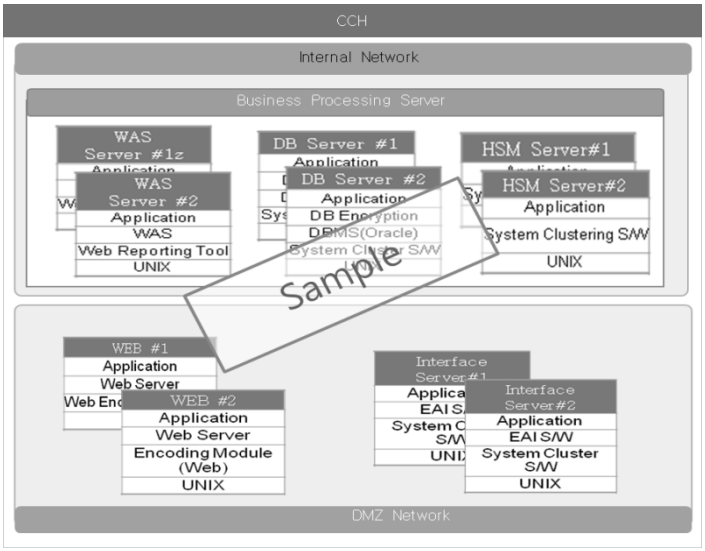
Figure 3.2-4 Backend Hardware and Network Architecture



2.7) Architecture

Software architecture of backend system comprises databases, equipment, operating system and other software from different vendors. The software would be integrated to create a solution which is operable and measurable on an open platform.

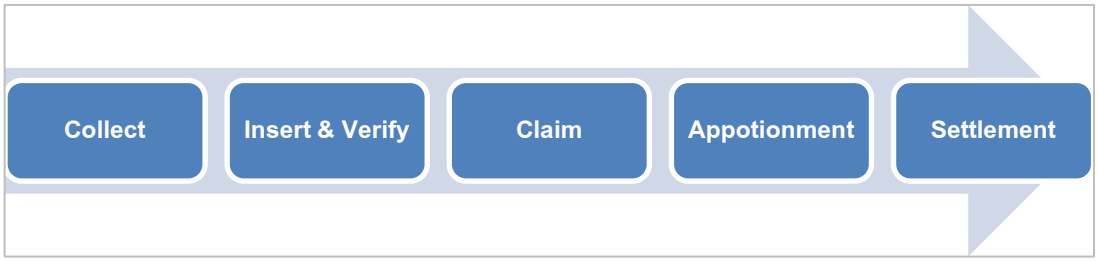
Figure 3.2-5 Backend S/W Architecture



2.8) Settlement and Liquidation

This system deals with settlement, service provider management, commission management, and fare information.

Figure 3.2-6 Settlement Processes



1. Collect transaction files from service providers
2. Insert Database of raw data (Transaction Files)
3. Verify raw data
4. Apportionment
5. Settlement according to fare policy and rules engine

3.2.3. Study on the extension of common ticket usage to business transactions

The advisor would investigate activities of common ticket users to study the possibilities to extend the use of common ticket system. This can be classified in accordance with age groups, occupations, and life styles. The investigation can also be applied to a market study, as well as the applications of the common ticket system.

1) Parking Lot

Parking lot ticket is an important application of common ticket. It increases the convenience of users, as they do not have to retrieve a new ticket when using the parking lot. The balance can be deducted from the ticket when users leave the parking lot.

2) Cash Card

Cash cards can be used to purchase products from stores which support the common ticket system; for example, convenient stores, supermarket, gas station, and fast-food restaurants. Because these stores provide services to a variety group of clients, they can also be top-up agents. They can also create promotions to induce the clients.

Figure 3.2-7 Cash Card

3) Membership Privilege

Common ticket can also be applied with membership cards that contain values, such as spa, sport clubs, sport complex, fitness, hotels, and tutoring school services. The members do not have to carry multiple cards to use with different services. The card value can also be checked with each service providers.

Figure 3.2-8 Membership Privilege

4) Public Welfare

Government sectors may use the common ticket system to support low-income citizens, by providing subsidization. This may include subsidization for students, support on public health services, living expenses, and natural disaster compensation.

3.2.4. Standardization of common ticket

The objective of this stage is to define common ticket and CCH standards, to procure common ticket developers and to establish the CCH. The model includes:

1. The advisor would review and study standards which are related to the common ticket system currently in use, as well as those successful systems. These would be adapted to the system used in Thailand.
2. The advisor would review and study automated fare collection systems and common ticket systems currently in used in Thailand, to consider the standardization of frontend and backend interfacing.
3. The advisor would take the study results to define standards of the common ticket system. This covers both frontend and backend systems. The levels of service are as follows:
    - Reader
    - Business Rule
    - Interfaced Concept
    - Security Concept
    - Network Configuration
    - Back End Financial Management System
    - Back End Data Recovery Requirement
    - Back End Apportionment Concept
    - Back End Entitlement Concept
    - Back End Settlement Concept

The standards must cover cards, equipment, frontend, and backend as follows:

- Card
- Reader
- Business Rule
- Interfaced Concept
- Security Concept
- Network Configuration
- Back End Financial Management System

- Back End Data Recovery Requirement
- Back End Apportionment Concept
- Back End Entitlement Concept
- Back End Settlement Concept

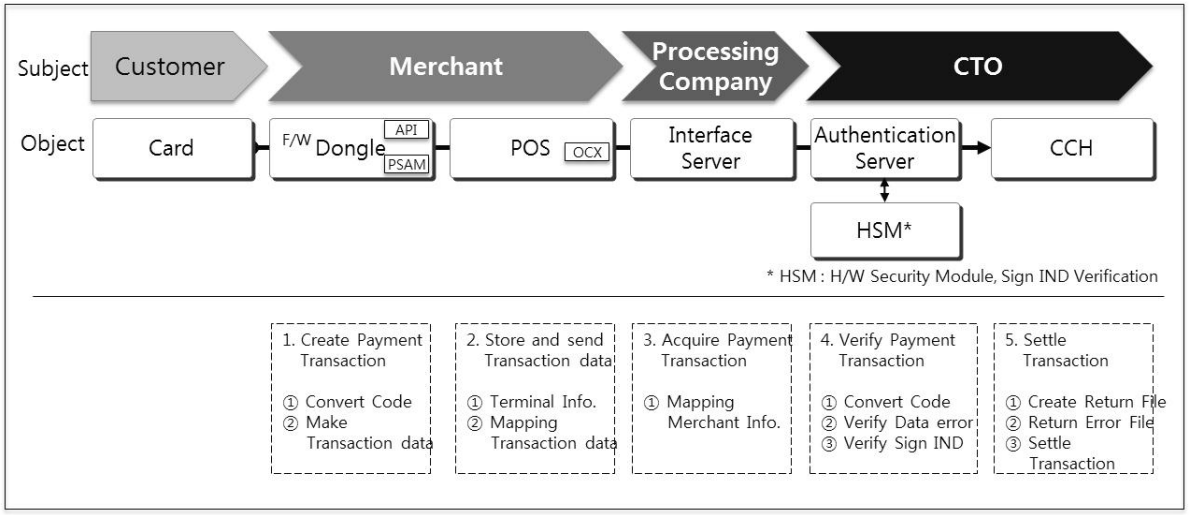
The standards must be consistent to universal standards. It must ensure effectiveness, modernity, security, and interoperability.

3.2.5. Definition of Standards for the Extension of Common Ticket System in Non-Transit Businesses

The advisor must have an understanding towards business rules, in order to extend the common ticket to non-transit businesses. Data from the transactions can be used to design a system which supports non-transit activities.

- Payment transaction
- Collect and transfer transaction data
- Collect payment data
- Verify payment data
- Settlement

Figure 3.2-9 Definition of Standards for the Extension of Common Ticket System in Non-Transit Businesses



3.2.6. Study on Extension Model in Novel Innovations

To study common ticket system innovations and application model

1. The advisor would study advantages and drawbacks of each innovation
   - NFC (Near Field Communication)
   - Touch and Go
   - EMV (Euro pay, Master and Visa)

2. The advisor would analyze the methods of applying the innovations to the common ticket system in Thailand
    - NFC (Near Field Communication)
    - Touch and Go
    - EMV (Euro pay, Master and Visa)

3.2.7. Documentation preparation for common ticketing developer and CCH procurement

To find developer of the system and CCH, it requires experts who have experience in designing and developing both systems. They must support both transit and non-transit systems. The developers of both systems should be the same organization. If they are from different organizations, consortium or joint venture must be formed. The auction should be done internationally.

Investment for the establishment of CCH should not exceed 13 million US dollars. In addition, it must be an e-auction. Other auction methods should be permitted by the Office of Transport and Traffic Policy and Planning.

It is anticipated that the investment of the development of common ticket system and CCH could exceed a financial limit acknowledged by the Public Debt Management Office. If the Office of Transport and Traffic Policy and Planning cannot increase the limit, the tenderers are allowed to propose their project under the limit of 13 million US dollars. This is sufficient for implementing hardware, but not software, modification of PMS, and/or providing non-transit services which use the common ticket system.

In the primary stage, the advisor would prepare documentation which includes

1) Procurement Form

The forms would rely on Thai Government Procurement regulations, which the processes are as follows:

1.1) Advertise for qualified candidates

- Contract details
- Experience and portfolio
- Potential of personnel, equipment, and workshop
- Financial status
- Selection criteria
- Venue for procurement form distribution

1.2) Basic qualification document may include

- Evidence which indicates potential, readiness in personnel, equipment, workshop, and finance.
- Announce qualified candidate name list
- Contract details
- Experience and portfolio
- Specify Date/Time for closing auction
- Venue for auction form pick-up
- Loan sources and tenderer name list

1.3) Tender form may include

- Invitation to Tender
- Instruction to Tenderers
- Form of Tender
- Form of Contract
- Conditions of Contract
- Technical Specification
- Standard Requirement of Loan Source
- Other

1.4) Contract Documents

- Contract Documents
- Obligation of the Contractor
- Obligation of the Employer
- Value of Work and Completion Time
- Notice
- Integration
- Counterparts

- Conditions of Contract

2) General Conditions and Contract-Specific Conditions

General conditions rely on the English version of Contract defined by the Procurement Board

- Definitions and Interpretations
- Performance Security
- Assignment and Subletting
- Drawings
- General Obligations

- Care of Works
- Insurance of Works
- Damage to Persons and Property
- Liability Insurance
- Compliance with laws and Regulations
- Etc.

Contract-Specific conditions would specify only conditions which are related and important to the development of common ticket system and the establishment of CCH; for instance,

- Contracts with transit and non-transit service providers
- Specify modification criteria of PMS of mass transit providers to be compatible with the common ticket and CCH.
- Other specifications, such as technology transfer.
- Support the extension to non-transit
- Provide sufficient amount of top-up agents
- Rights of system owner

3) Other Specifications for Contract Partners

The specifications may cover the following:

- Provide financial sources other than the DPL loan source
- Support the negotiation between mass transit providers and non-transit businesses
- Specify modification criteria of PMS of mass transit providers and non-transit businesses
- Provide technology transfer

4) Scope and Framework of System Design

Scope and framework of system design cover cards, equipment, frontend, and CCH. This may comprise standards and qualifications, as well as design concepts of the system. This may include:

- PMS
- Front-end system
- CCH
- Card issuing
- Top-up
- Settlement
- Transit and non-transit data collection

- Security structure and standards of cards
- Modification of the existing system to be compatible with the new system
- Specification of card types and reports
- Interfacing of front-end system and CCH
- Integrated settlement which supports multiple card issuers, service providers, card types, and products
- Other

5) Scope and Framework of System Development and Installation

The installation of common ticket system and CCH involve hardware installation, development, and system testing. Modification of the existing systems to be operable with the new system can be concluded as follows:

5.1) CCH

- Prepare location for Server installation
- Server installation and other equipment
- Database development
- CCH application development
- Data receive test
- Applications test

5.2) Front-End

- Existing gate, card issuing booths, top-up booths, Station Computer and central computer of the providers must be tested
- Installation of readers, card issuing booths, and top-up booths.
- Modification of station computer and central computer to be operable with the common ticket and CCH
- Front-end test
- Front-end and CCH test

6) Other related works

This may involve discussion between transit and non-transit, technology transfer, and system maintenance.

3.2.8. Fundamental cost estimation for common ticketing developer procurement and CCH establishment

The advisor would estimate primary investment on the procurement and CCH establishment. The budget estimation shall comprises

1) Equipment

This includes miscellaneous parts, including office stationery

2) Software

This includes PMS which monitor CCH, front-end, and back-end.

3) Operation

1. Personnel salary
2. Operation and maintenance cost
3. Top-up custom
4. Space renting
5. Public utility
6. Depreciation
7. Other

An example of investment estimation on the use of common ticket system on mass transit and the establishment of CCH is elaborated in table 3.2-1 and 3.2-2

Table 3.2-1 Investment Estimation

Item	Investment (Million Baht)
Equipment and apparatus investment	211.84
PMS investment	188.83
Office stationary	8.86
Total	409.51

Table 3.2-2 Operation Investment Estimation

Item	Cost
Personnel	First year 14 M.Baht/Year Fifteenth year 33 M.Baht/Year
Public Relations	60 M.Baht/Year
Operational and maintenance cost	35.5 M.Baht/Year
Top-up custom of common ticket	0.3 % of loaded value
Space Renting	500 Baht / m2
Public Utility	100 Baht / m2
Depreciation	20 % of property life
Other	115,000 Baht / Person / Year

3.2.9. Preparation plan and works priority for starting the common ticket system

The operational plan for the use of common ticket system is pivotal to the success of the system. The advisor would prepare the plan and the processes of the activities. This can be divided into two phases:

1) Standardize and specification of common ticket

The objective of this phase is to prospect standards and specifications; this comprises

1. System Study
    - Tickets
    - Data collection system
    - Interface Protocol standards
    - Front-end
2. Financial system study
3. State system standards and specification

2) Cooperation between stakeholders

Cooperation between stakeholders is essential for the sustainable development of the system. The cooperation should cover:

- Concepts from each business
- Revenue distribution
- Investment and revenue distribution plan
- Card issuing and selling factors
- Extension management
- Joint management
- Other applications

3) Organization Establishment

Establishment of organization is important. There should be effective management, duty clarification, and should have business department to support non-transit sectors.

4) Route Modification

The routes of all service providers must not be in conflict

5) Development of Common Ticket System to other Service Providers

There are some service providers that do not implement any automated fare system. Thus, an automated system is required to be developed first.

6) Application of the Ticket to Associated Routed

Presently, BRT, ARL, BTS, and MRT are ready to use the common ticket system. The most convenient method is to modify the front-end system to be operable with the common ticket system.

7) Public Relation and public participation

The public relation has main objectives to

- Acknowledge the public
- Increase interest and motivation
- Support learning and understanding

8) Extension to Non-Transit

The use of common ticket in non-transit businesses increases the convenience of users, as they do not have to carry multiple cards.

3.3. Supports of the common ticketing developer procurement and establishment of the CCH

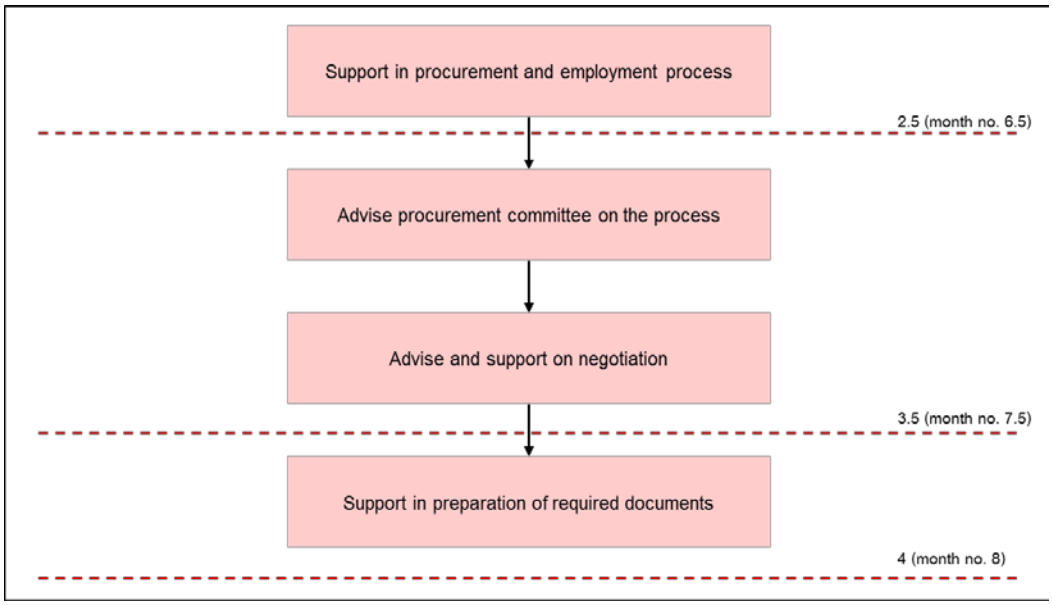
Objectives

The objective is to find a developer for the common ticket system, and to establish CCH. The plan is to call for a tender, to discuss documents related to tender, to define tender criteria, and to make a contract worth the developer.

Models and Methodology

This stage takes approximately 4 months. The first two months, tender announcement would be publicized, and there would be board appointment. It would take around half a month to prepare the documents.

Figure 3.3-1 Approached and Methodologies



Expected Outcomes

1. Evaluation criteria for developer
2. Developer with qualifications appropriate for the project

The processes of developer procurement are as follows:

- Make an announcement for qualified candidates
- Public relation
- Discuss with the applicants
- Receive qualification documents
- Evaluate applicants' qualifications
- Announce qualified applicant name list

- Call for tender
- Distribute tender documents
- Receive tender
- Evaluate applicants' qualifications
- Discuss with the tenderers
- Tenderers propose technical propositions
- Evaluate tenderers' propositions
- Announce selected tenderer
- Tender envelop opening
- Negotiate tender
- Accept tender envelop
- Negotiate contract conditions
- Sign the contract

3.3.1. Procurement process supports

The advisor would provide support in the preparation of announcement contents, procurement processes, and discussion with tender candidates and applicants. The advisor would also develop website for the tender that includes necessary contacts: contact number, fax number, and email.

3.3.2. Support and suggest to the procurement committee in the proposal consideration and suggest any related criteria

The advisor would define qualifications and criteria in selection of qualified candidates for tender, as the development of the common ticket system and the CCH requires experts who have experience in supervising similar projects. Technical propositions may include 3 major parts: 1. Related experience of the applicant, 2. Model of Project Execution, and 3. Experience in design, installation, and operation.

The advisor would estimate the investment, which covers hardware, PMS software, and other expenses.

3.3.3. Support the procurement committee in negotiation such as technical, cost and conditions

The advisor would provide support the procurement board in evaluating the applicants on each criterion, and in negotiation with the tenderers on technical requirements and investment budget.

3.3.4. Documentation preparation for contract signing

The advisor would prepare the contract between the Office of Transport and Traffic Policy and Planning and the developer. The contract might also cover transit and non-transit providers.

3.4. Supports of the supervision of the common ticketing developer's execution and the CCH establishment

Objectives

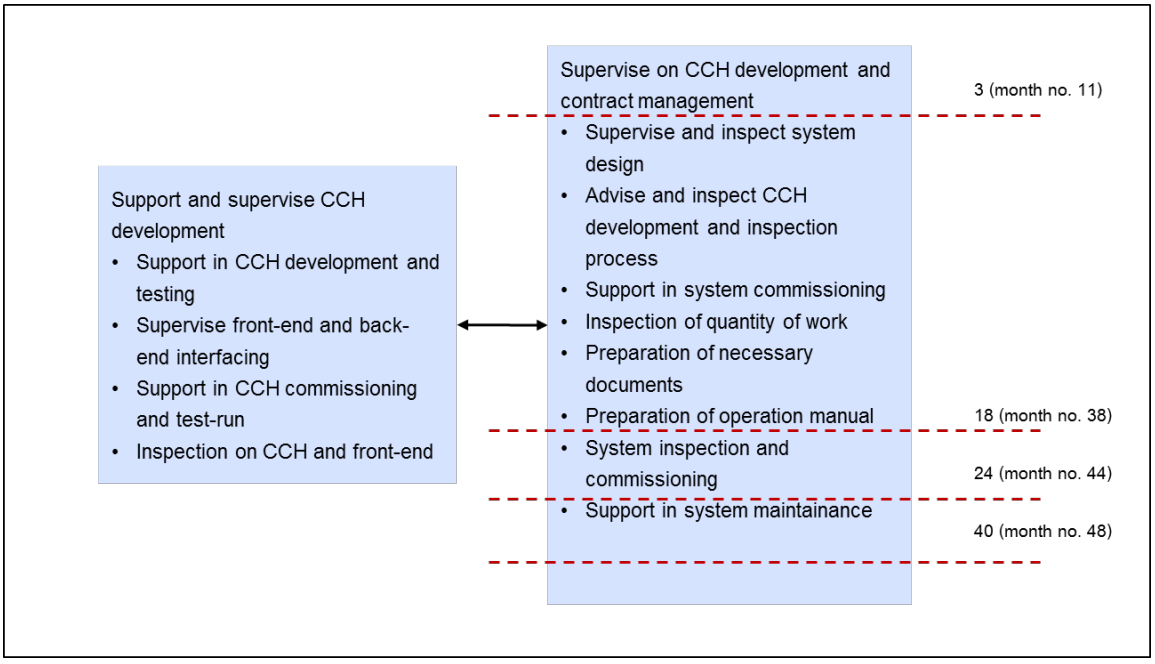
The objective is to provide support in the regulation of operation of system developer and the establishment of CCH to be carried as written and specified in plans and contracts.

Models and Methodology

The objective as specified in section 3.3 of consulting contract is that the advisor must provide support in regulating the operation of the system developer. The operation must be carried out as specified in the contract and the plans. It must be completed within the defined time span.

This stage would take approximately 24 months. In the first three months, the advisor would provide support in the regulation and the management of contract, as well as the system handbook. This must be finished within 18 months. The following six months would be taken to test the system. After the 24-month period, the advisor would also evaluate the maintenance as indicated in the contract. The overall processes take 40 months. This is illustrated in figure 3.4-1.

Figure 3.4-1 Models and Methodology in Operation Regulation Support



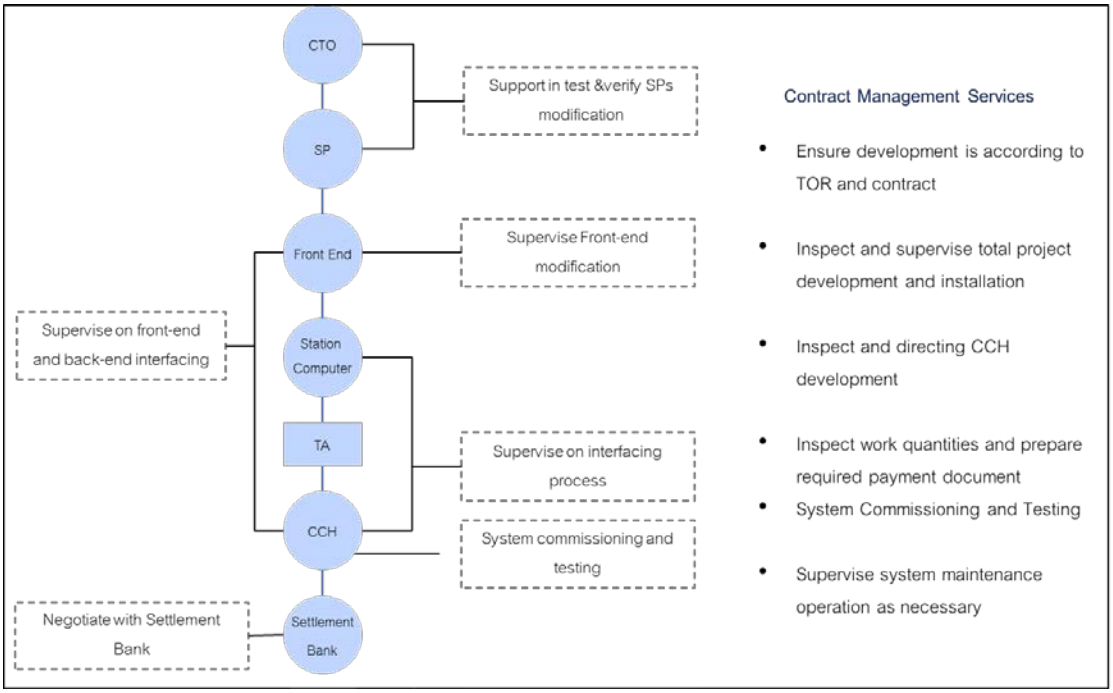
Expected Outcomes

1. Developer operates effectively as indicated in TOR
2. Effective common ticket system as indicated in TOR

3.4.1. Support the supervision of the common ticket developer and CCH accord to the contract's condition

To regulate the operation of system developer and the establishment of CCH, the advisor proposes a model as illustrated in figure 3.4-2.

Figure 3.4-2 A Model to Regulate the Operation of System Developer and the Establishment of CCH



1) The advisor would regulate and monitor system and test CCH development

A testing system must be developed and installed at the actual site. Front-end testing must be done in a specified time-span.

During the test, testers and other equipment in the AFC, and PMS must be installed and currently in operation.

In case that there were system faults, the test period must be extended. No system faults are allowed in the last month of the test period. All AFC equipment must be tested and verified.

Developer must find personnel, equipment, testers, vehicles, hardware, and other materials. The installation must be dome legally. If the software in CCH was changed, the developer must notify the CTO and it must be tested in prior to the implementation.

2) The advisor would provide support in organizing meeting and cooperation between AFC developer and front-end developer. The advisor would also provide advices in the integration of front-end and back-end to supplier.

The advisor would provide support in organizing meeting and cooperation between AFC developer and front-end developer. The advisor would also provide advices in the integration of front-end and back-end to supplier.

3) The advisor would regulate the correctness of common ticket system and CCH

- Review Design of the common ticket system and CCH
- Test and verify the correctness of the common ticket system
- Propose validation methodology and cross check
- The test must follow requirement section 2.2.2 and 2.2.3
- Review Design of the common ticket system and settlement system of the CCH
- Test and verify the correctness
- Propose validation methodology and cross check

3.1) Card

The card must be a microprocessor type and have memory capacity of 4 kB. This should refer to the requirements from all products.

3.2) Reader

- The reader should be able to read type A, B, C and NFC
- SAM must be able to write 4 systems
- Reading proximity should be 10 centimeters away from the antenna
- Other Fare Media should be 5 centimeters away from the antenna
- Must be able to support 3DES, AES and EL4+ encoding
- Serial connection should be implemented, to ensure stability

3.3) Business Rule

Business process and rules of transit cards and non-transit cards should be separated; however, it should cover:

- Card data management must be clearly defined for the common understanding of the providers
- Card management (e.g. card types, card substitution, card operation)
- Fare policies of each provide
- Security management, including standards, policies, being extension supportive
- Product Interoperability

Business rule might cover

1. Discount
    - Discount at Point of Sale
    - Discount at Top Up
    - Discount for Bulk Sales
    - Company Group Discount
    - Bonus Points Added at Exit Gates, Redeemable at Exit Gates
    - Inter-modal Transfer Discount with other Rail Transit Systems
    - Inter-modal Transfer Discount with Bus
    - Head Home/Return Discount
    - Station Specific Promotion
    - Discount Coupons
2. Bonus
    - Bonus Fare Value at Point of Sale
    - Bonus at Top Up
    - Bonus Points Added at Exit Gate Redeemable at Ticket office
3. Special Tickets
    - 24-hour Pass
    - Combined Value and Trip Cards

3.4) Interface Document

ISO 8583, which is a standard for financial transaction, would be used.

3.5) Interfaced Protocol

This depends on data types and security requirement. There are several protocols, such as SSL, FTP, SFTP, HTTPS (web service)

3.6) Security Interface

Cards and readers would have PKI and/or 3DES security encoding, which have high security and processing speed. Encoder would be stored as SAM (Security Access Module) or HSM (Hardware SAM). The access to SAM key cannot be done remotely.

3.7) Network Configuration

Network security would follow data transfer protocol. The security comprises many components: firewalls, V-LANs (Virtual LANs), and VPN (Virtual Private Networks). To ensure multiple-layer security, data would be transferred on the TCP/IP (V4) protocol. This protocol physically comprises E1/T1/Ethernet/Fibre/ADSL/Microwave Link, based on installation, location, and other conditions.

4) **The advisor would monitor PMS and the interfacing between frontend and CCH of the providers. This must be done within a specified time span and maintenance.**

- Follow up and propose operation modification model if there was any operational delay
- Provide advices and suggest solutions
- Review and propose service level agreement during O&M between service provider and CCH

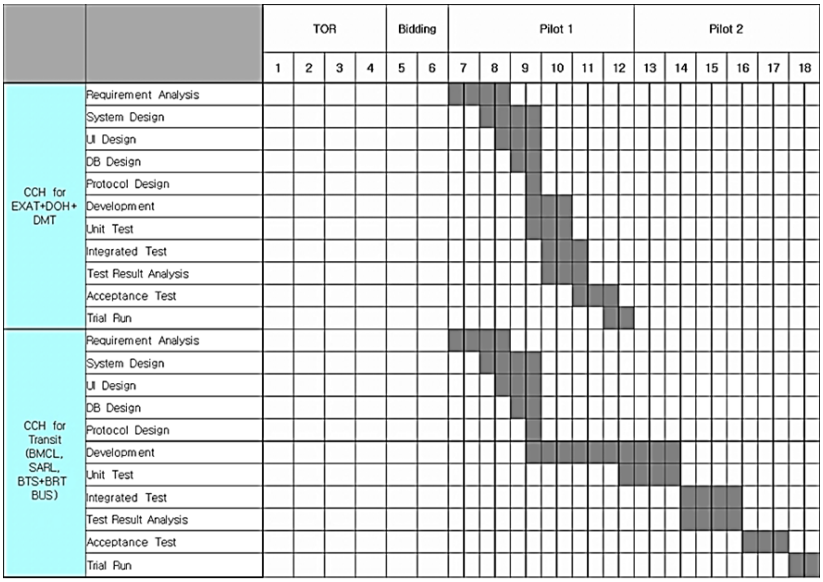
3.4.2. Supervision and contract management supports

To ensure the correctness of the development of common ticket system and CCH

1) **The advisor would regulate and manage the development as defined in the contract. Backend system must be tested, monitored, and verified. This comprises:**

- Requirement Analysis
- System Design
- User Interface Design
- Database Design
- Protocol Design
- Development test
- Unit Test
- Integrated Test
- Test Result Analysis
- Acceptance Test
- Trial Run

Figure 3.4-3 Framework for Testing, monitoring, and Verification



2) The advisor would provide support in the designing of frontend systems of the service providers who participate in the pilot program by

- Revise requirements of CCH, service providers, and government sectors
- Outline design specification from the developers of GS, Frame work, template
- Verify conceptual design drawings
- Organize design workshop to verify designs
- Prepare documents for the verification results

3) The advisor would provide support for the development and installation of frontend systems of service providers who participate in the pilot program by

- FAT Test of frontend and CCH
- SIT Test of frontend
- System Integration Test: SIT
- Integration Test of frontend
- Software test of SAT system
- Prepare documents on the SAT software test results
- T&C
- Prepare documents on the T&C results
- Trial Run
- Prepare documents on the Trial Run results

4) The advisor would provide support in monitoring and regulating the operation of common ticket system developer and the establishment of CCH by

- Participate in weekly/monthly project meeting

- Prepare progress report for government sectors

5) The advisor would provide support in verifying and giving consent to acceptance test by participate in the acceptance test or payment schedule

6) The advisor would provide support in operation verification and prepare an invoice

- Verify the operation whether it has been carried out as defined in the contract
- Prepare verification document
- Propose payment balance

7) The advisor would provide support in verifying and giving advices related to contract or requests

- Revise requests from the developer and provide suggestions in negotiation with employer
- Estimate additional value of the work

8) The advisor would provide support in verifying design and suggest ideas to modify contract conditions

9) The advisor would provide support in establishing file system to be delivered to CTO

10) The advisor would follow up the developer and the establishment of CCH, prepare operation handbook, and organize workshops for CTO personnel

- Revise operation handbook and organize workshops for the personnel
- Revise Business Continuity Plan (BCP)
- Prepare recovery plan, and its demonstration
- Follow up the developer in preparation of operation handbook for CTO, which has to cover:
  - Equipment used, including series, serial number, location and procurement
  - Certify document
  - Software serial number
- The advisor would verify operation handbook before delivering to CTO
- The advisor would follow up the developer in documenting equipment and maintenance files
- The advisor would regulate all documents associated with the contract. CTO reserves the rights to copy and distribute.
- The training must cover PMS, general information, statistics, and CTO
  - Provide training on PMS

- Provide training on statistics, reports, and evaluation

11) The advisor would test and validate the system by

- Phrasal testing
- Commissioning and testing
- Validating backend system by Independence Certification Engineer (ICE)

12) The advisor would provide phrasal support in maintenance

- Revise and analyze problems as per requested
- Prepare KPI and data lost prevention

13) The advisor would provide service level agreement between CTO and service providers

- Backend must be developed as defined in contract of CCH and CTO
- Frontend must meet employer's requirements, accordingly to outline design specifications and conceptual drawings
- Frontend must be developed as defined in contract of CCH and CTO
- Common ticket system development and CCH must be as defined in the contract
- Verification reports and consents in the development of common ticket system and establishment of CCH
- Development verification and prepare invoice for the developer
- Verification results and additional comment associated with contract (if any)
- Verification results of the designs
- KPI, file index, and important memos for CTO
- Operation and training handbook for CTO personnel
- Commissioning and Testing and ICE Certification
- Phrasal verification as defined in PMS contract
- Service level agreement between CTO and service providers

3.5. The academic and technological supports and the CTO establishment

Objectives

The objective of this task is to study organizational structure and related law and regulations, in order to propose an appropriate organizational pattern. The advisor would study advantages, drawbacks, effectiveness, and difficulties of the establishment. The study would be proposed to the Office of Transport and Traffic Policy and Planning and associated sectors.

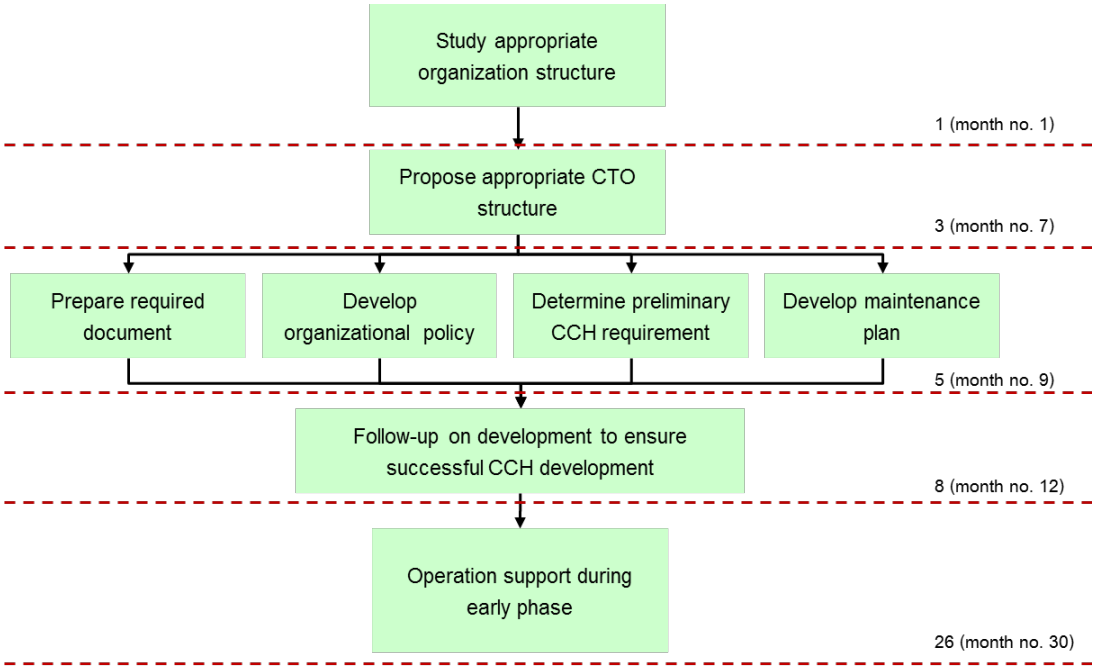
This also includes documentations for both government and private sectors.

This stage also involves the study and analysis of information for operational plans and strategies for CTO, to ensure operation flow.

Models and Methodology

This stage takes approximately 26 months, as illustrated in figure 3.5-1. In the first month, the advisor would study organizational pattern and related law and regulations, in order to propose an appropriate organizational pattern. The study would be proposed to the Office of Transport and Traffic Policy and Planning in the third month. Documents for government and private sectors, study and analysis of information for operational plans and strategies, CTO specifications, and operational and maintenance criteria would be prepared in the second month. The advisor would follow up and the work to ensure the complete of CTO.

Figure 3.5-1 Model for Academic, technological support and CTO establishment



Expected Outcomes

1. Propositions to government sectors regarding the establishment of CTO and CCH
2. Suggestions and comments from associated sectors
3. Readiness of related documents
4. Details of operational plans, strategies, defined duties, and risk prevention
5. CTO has an understanding of duties and work processes, and is able to effectively perform operation
6. Effective cooperation

3.5.1. Study of the organization's structure, responsibilities, laws, regulations and specify the staff positions conform to the CTO at the beginning of the operation

The advisor would study appropriate organizational pattern, related law and regulations, as well as allocate personnel as needed.

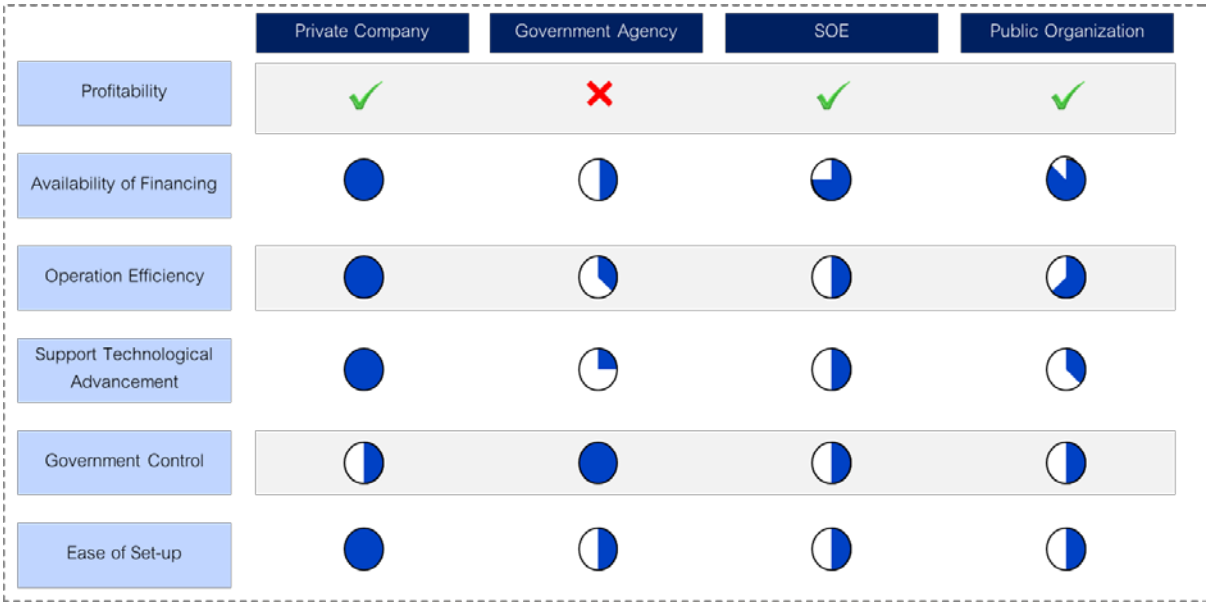
1) Organizational Pattern

Organizational patterns cover

1. Government sector
2. State Enterprise
3. Public organization
4. Company Limited
5. Public Limited Company
6. Partnership

The advisor would study each pattern, model, and time span required for the establishment; compare and contrast advantages and disadvantages of each pattern to find the most suitable pattern for CTO. The advisor would study the organizations from at least 3 different countries. In addition, prior studies of the Office of Transport and Traffic Policy and Planning would be studied; as illustrated in Figure 3.5-2

Figure 3.5-2 Advantage and drawback comparisons



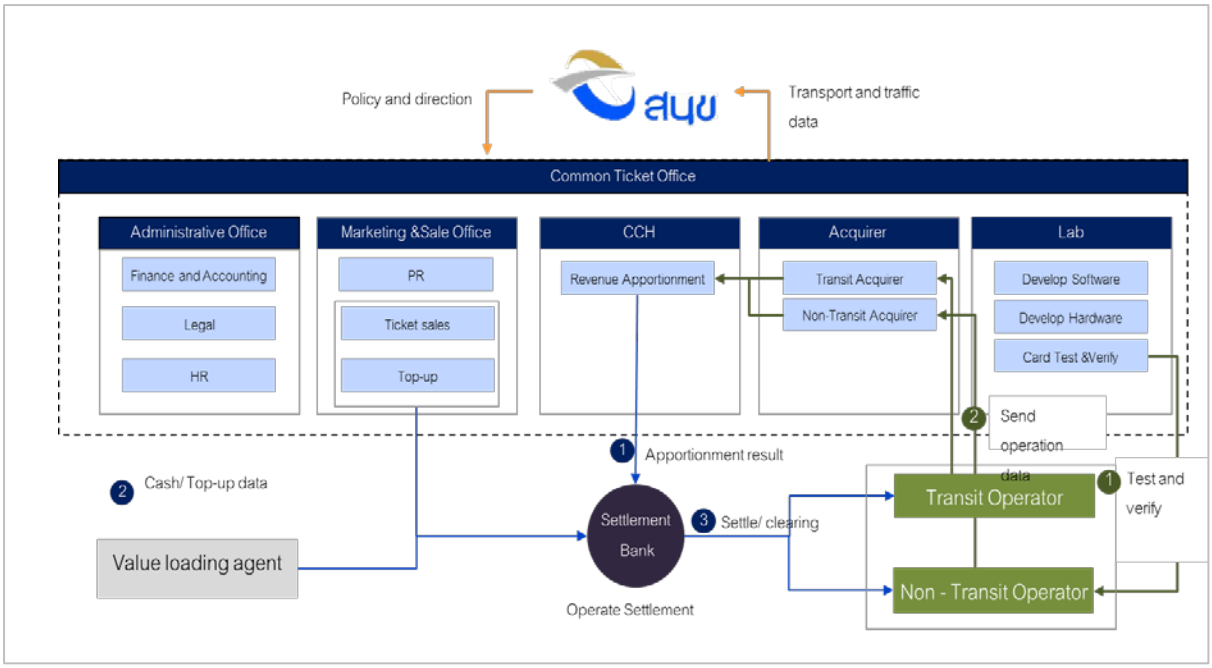
2) Role and Duty

The advisor would study all relevant activities related to CTO, both in transit and non-transit businesses, to define roles and duties of CTO. This involves

1. Defining operational policies and processes
2. Defining standards for activity and system standards
3. Giving consents or authorization to non-transit and transit providers
4. Regulating the operation as defined standards
5. Operation of CCH
6. Clearing
7. Settlement
8. Card selling and issuing

The advisor would analyze the relation of the above act ivies under different contexts, to select the most suitable organizational pattern for the CTO. This must ensure the convenience of passengers and clients. The defined roles and duties must be responsive to service providing and management.

Figure 3.5-3 Model for the Definition of Role and Duty of CTO



3) Law and Regulation

CTO needs to consider law and regulation related to common ticket system, even there is no such rule in the present. Nevertheless, there is an act related to electronic transactions or e-money. It is under the supervision of 2 ministries:

1. Ministry of Finance: regulate e-money-related act
   - Declaration of the Revolutionary Council No.58; declared on 26th day of January B.E.2515
   - Notification of Ministry of Finance; declared on 4th day of October B.E.2547
2. Ministry of Information and Communication Technology: regulate e-transaction-related act
   - Electronic Transaction Act B.E.2544
   - Royal Decree on the exemption of Electronic Transactions Act B.E.2551

Bank of Thailand is responsible for the enforcement of the 4 acts, including regulation of e-payment, and e-money. The advisor would study the 4 acts to consider what are permitted by law and what are not. The activities which needed to be carried out by law include

1. E-Money Card Issuing

   The analysis on the 4 acts indicate that card issuers must be a juristic person (i.e. company limited or public company), which has registered capital stocks of 200 million baht and must have a letter of permission from the Finance Minister. The letter of request must be submitted via Bank of Thailand and must be registered with Bank

of Thailand. To use a card that is usable with non-transit services, the service providers must request for permission from the Bank of Thailand.

2. Clearing House

Clearing house, according to the 4 acts, can be established as

- Government sector

  This would be exempted from sending notification to Bank of Thailand. Nevertheless, the registration must be taken place if the cards were used in only transit services; permission must be given by Bank of Thailand if the cards were also used in non-transit services.

- Juristic person (Registered partnership, company limited, public company limited)

  This type is allowed for only transit services.

- Juristic person (Company limited, public company limited)

  This type is allowed for transit and non-transit services; both of which require permission from the Bank of Thailand.

4) Regulation

For mandatory regulations for CTO, card issuers, and CCH, the advisor would define specific regulations which are in accord to organizational pattern, roles, duties and law.

5) Organizational structure and Personnel Allocation

The advisor needs to define roles and duties in associated organizations. At the beginning, the advisor would define job description for each work sector, and quantity of work – for personnel allocation and defining anticipated salary.

3.5.2. Appropriate custom rate for CTO

The advisor would consider the custom rate collected from transit and non-transit providers based on case studies from other countries. The rate would be high in the beginning phase and would be continuously decreased when numbers of passengers are increasing. Nevertheless, the rate must be permitted by the Board.

3.5.3. The organization forming suggestion with flexibility and efficiency in operation

The advisor would propose an appropriate organizational structure to the Office of Transport and Traffic Policy and Planning, as well as its advantages and limitations. The office would consider the proposition in different contexts, and provide comments and suggestions.

3.5.4. The academic documentation preparation and CTO establishment at the starting of the operation including procedures plan support and issue related laws and regulations

The advisor would prepare the Office of Transport and Traffic Policy and Planning academic documents for different purposes, which might include presentation to different sectors. Moreover, the advisor would provide support in establishing CTO in the beginning operation stage.

1. If CTO was to be a government sector/NGO, the advisor would provide related documents and draft of legislation.
2. If CTO was to be a company limited/public company limited, the advisor would cooperate with legal experts of the Office of Transport and Traffic Policy and Planning in preparation of documents related to CTO establishment.

Work processes of each organizational pattern are as follows:

1) Government sector/State Enterprise

1. Office of Transport and Traffic Policy and Planning proposes the concept to Ministry of Transportation
2. Ministry of Transportation drafts an establishment bill and propose it to the cabinet for an approval
3. The cabinet approve the policy in principle and assign the case to the Office of the Council of State
4. The cabinet proposes the bill to the house of parliament for an approval
5. Announced in a government gazette
6. Establishment of CTO

2) Public Organization

2.1) By a Royal Decree

- Office of Transport and Traffic Policy and Planning proposes the concept to Ministry of Transportation
- Ministry of Transportation drafts a royal decree on the establishment of CTO and propose it to the cabinet for an approval
- The cabinet approves in principle the royal decree and pass it to associated sectors
- Ministry of Transportation passes the policy to the Office of the Public Sector Development Commission

- Office of the Public Sector Development Commission proposes to the cabinet for an approval
- Announced in a government gazette
- Establishment of a public organization

2.2) By an Act

- Office of Transport and Traffic Policy and Planning proposes the policy to Ministry of Transportation
- Ministry of Transportation drafts an act and propose it to the cabinet for an approval
- Cabinet approves in principle and passes the act to associated sectors
- Cabinet proposes the act to the house of parliament for an approval
- Announced in a government gazette
- Establishment of a public organization

3) Company Limited

- At least 3 promoters prepare a memorandum of association
- Promoters prepare share subscription
- Establishment meeting
- Promoters handover the business to the directors
- The board calls for share payment for at least 25 percent
- The directors register the company

4) Public Company Limited

- At least 3 promoters prepare a memorandum of association
- Promoters prepare share subscription
- Placement of shares to promoters or public offering by filings to the Securities and Exchange Commission
- Establishment meeting
- Promoters transfer the business to the directors
- The board calls for a full share payment
- The directors register the company

3.5.5. Operational policy and strategic plan development of CTO

1) Operational processes to prevent any effect that might occur in CTO

After defining roles and duties of CTO, the advisor would define the scope of operation and work plans. The advisor would then prepare a risk management plan, which covers operational

risk, technical risk, personnel risk, and financial risk. Risk management processes are as follows:

1. Risk identification
2. Risk analysis
3. Risk control management
4. Risk control
5. Risk survey and monitoring

Besides prevention, the advisor would prepare basic solutions to tackle the problems. Nevertheless, there are many delicate situations. Hence, the solutions require definite scope and processes.

2) Study regulations and support for electronic transaction permission to ensure the readiness at the beginning of service providing

The advisor would study regulations related to the establishment of CTO; especially when CTO organizational pattern is associated with approval of Bank of Thailand. The advisor would conduct a study on required time span, steps, and processes.

3.5.6. CCH's and CTO's fundamental standardization and evaluation method

To define basic specifications of CCH and CTO, and operation evaluation methods and criteria for CCH and CTO

1. The advisor would study standards of CCH and CTO operation from existing common ticket system in Thailand and foreign countries
2. The advisor would define basic specifications and evaluation criteria of CCH, such as
   - Management indicator
   - Accuracy/reservation and restoration criteria
   - Data center server readiness criteria
   - Data center network service criteria
3. The advisor would define basic specifications and evaluation criteria of CTO, such as
   - Management indicator
   - Accuracy/reservation and restoration criteria
   - Data center server readiness criteria
   - Data center network service criteria

The expected outcomes of the operation are

- Basic specifications of CCH
- Basic specifications of CTO

- Operation evaluation methods of CCH
- Operation evaluation methods of CTO

3.5.7. CCH's operation and maintenance regulations development under the CTO's supervision

Prepare operation handbook and maintenance of CCH under the supervision of CTO as specified as follows:

1. The advisor would prepare maintenance handbooks for software, hardware and network, and classify all equipment for reliability and effectiveness. Operational manager and maintenance manager would follow these processes, and the advisor would provide support when necessary. The handbooks prepared by the advisor are:
   - Maintenance handbook
   - Handbook of maintenance direction for network system
2. The advisor would prepare plans related to system defects, which covers restoration processes that can be predicted from the defects themselves, as well as solutions, maintenance plans, analysis and other operations.

3.5.8. Operators procurement and support

The operation of common ticket system might be executed by a sector in CTO or an outsourcing company. This must be carried out by calling for tender, which have to consider technical propositions that are close to system requirements. The advisor would study, provide suggestions, and compare among outsourcing companies, as well as CTO sector.

3.5.9. Coordination for the completion of the CTO establishment and CCH operation

1) Personnel have been trained in a virtual operation

CTO personnel, especially technical personnel, would be given trainings from developers, as well as development and installation observation, and also participate in system testing that are related to transit and non-transit providers, the operation of CCH, CCH, and the integration of both systems.

2) Involve in operation initiation

To ensure that CTO would involve since the launching, the advisor believe that there should be an establishment of organization and procurement of personnel; especially, managerial level and technical experts.

3) System test and validation

To ensure that the operation of CCH can support data sent from service providers and able to connect to their frontend system, system developer would test and validate the operation of CCH, analyze, evaluate, and produce a test report.

3.6. The technological instruction at the beginning of the common ticketing system operation and CCH's operation

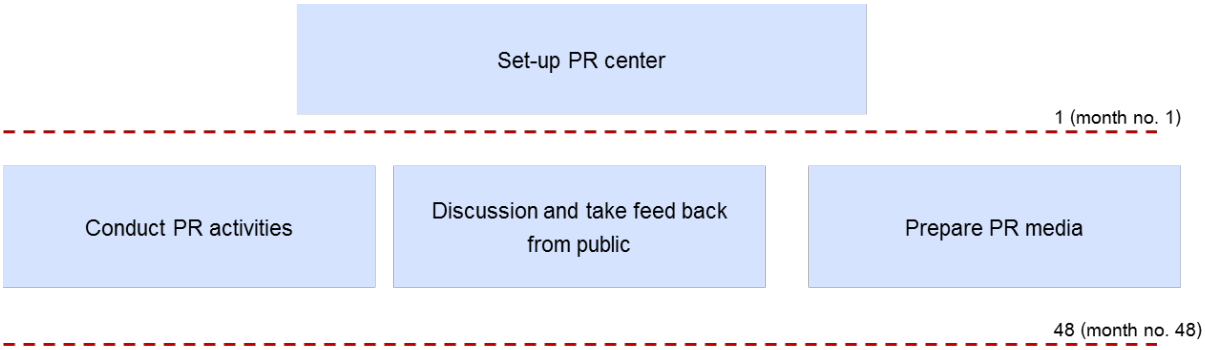
Objectives

To provide technology transfer to the personnel of the Office of Transport and Traffic Policy and Planning, by organizing seminars, domestic and aboard visiting, and observing common ticket operation.

Models and Methodology

The advisor would propose a common ticket PMS, as well as technologies related to CCH and other sectors, and provide suggestions and workshop training by experts from Thailand and foreign countries. The operation is illustrated in Figure 3.6-1

Figure 3.6-1 Technology Transfer Model



The advisor would provide 10 workshop training, 2 technology transfers in foreign countries, on job training, and 2 trainings in Thailand, as presented in Table 3.6-1

Table 3.6-1 Technology Transfer Plans

Operating plan/activities	Operating peroid (Month)										
	2	4	6	12	18	24	30	36	40	44	48
Technology transfer workshop 10 times	●										
1st workshop		●									
2nd workshop			●								
3rd workshop				●							
4th workshop					●						
5th workshop						●					
6th workshop							●				
7th workshop								●			
8th workshop									●		
9th workshop										●	
10th workshop											●
Technology transfer abroad 2 times											
1st technology transfer			▲								
2nd technology transfer						▲					
On the job training abroad				■							
On the job training Thailand			■			■					

Expected Outcomes

1. Overall common ticket management
2. Technology handbook
3. Increasing of organization potential
4. Increase organization abilities
5. Common ticket technology transfer

3.6.1. Common ticketing management suggestion and supports for CTO

The advisor would prepare short-term, intermediate, and long-term plans to increase awareness of associated organizations, as well as prepare documents of the PMS which cover

- Overall picture of PMS
- Government policies
- Technology handbook
- Activities
- System limitations and restrictions
- Readiness of organization after the termination of PMS
- Operation and potential evaluation plans

3.6.2. Technological improvement suggestion for CTO and CCH

The development of common ticket system and CCH must support the existing system. There might be some difficulties that restrict system completeness. The advisor would provide suggestions on technology modification.

3.6.3. CTO's performance improvement suggestion

1) Workshops

Workshops would be organized to increase the potential of CTO. The advisor would provide workshops, both practical and theoretical. The advisor may propose the processes in the workshops as follows:

- Distribute common ticket handbook in prior to the workshop
- Explain the overall picture of common ticket PMS
- Explain overall picture of work structure of respective technologies to executives and technical-level to the operators
- Discuss and answer questions
- Provide system test
- Mock-up delicate situations
- Revise training results
- Evaluate workshop participants by examinations
- Advisor and technology transfer agents would standby at the actual site for a certain period

Ten workshops would be provided to Office of Transport and Traffic Policy and Planning personnel and associated sectors.

2) On the Job Training

The advisor would provide technology transfer trainings by experts from the countries which successfully implemented the common ticket system. The activities would involve at least 15 participants. Two training sessions would be organized in Thailand or experts from other countries would be invited to provide consultation at the beginning of the operation.

3.6.4. Advisory and suggestion to the CTO during the start of the operation

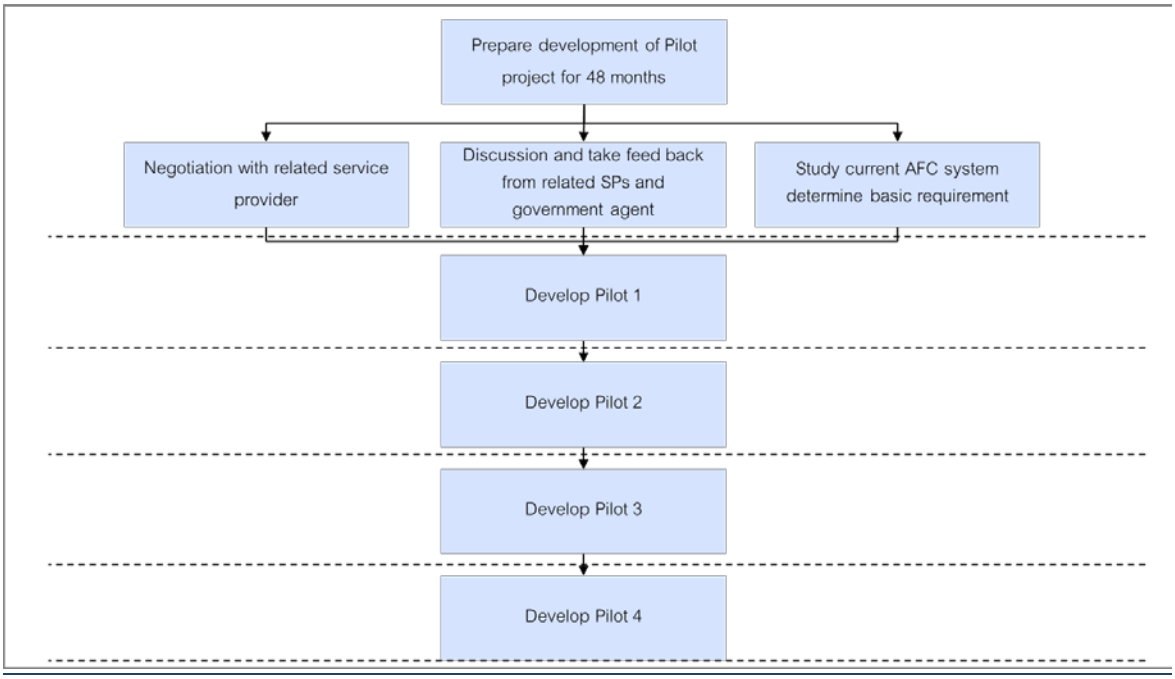
At the launching period of the system, the advisor and developers would provide consultation to the CTO, in addition to technology trainings, to be proactive to delicate situations.

3.7. The pilot project supports

Objectives

The main objective of this task is to operate the pilot program, which integrates all the systems to operate the common ticket, as well as evaluate, summarize existing problems and provide solutions to improve the integration.

Models and Methodology



1. Prepare the pilot program throughout the 48-month period or even before the beginning of the period.
2. Discuss with associated government sectors and transit providers, and receive comments regarding the development of the common ticket system.
3. Carry out the 4 phases of pilot program as indicated in 3.7.1

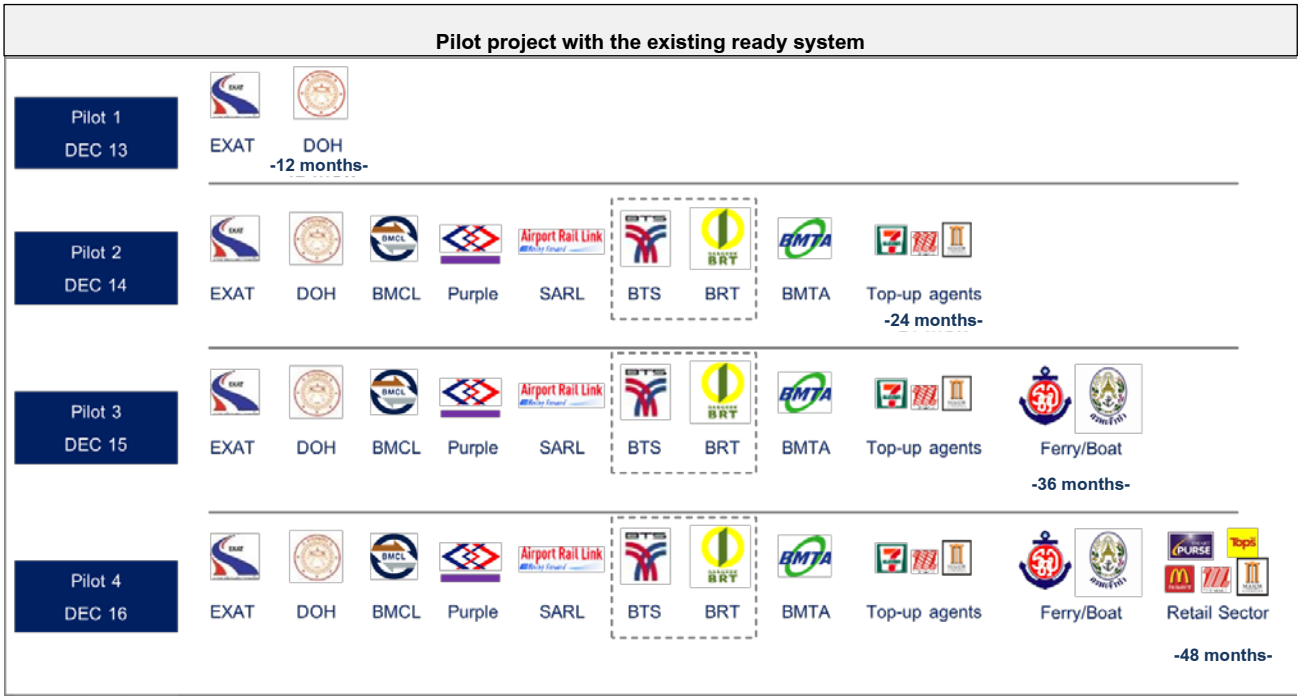
Expected Outcomes

1. Phase 1: The common ticket system must be able to support the use of ticket with expressways and highways.
2. Phase 2: Include the use in public buses and railways. Develop value loading system.
3. Phase 3: Include the use in water transportation
4. Phase 4: Include the use in non-transit sectors.

3.7.1. The starting of the common ticket system support by development suggestion

The development of the pilot program for the use of common ticket in Thailand is planned to be executed as illustrated in figure 3.7-1

Figure 3.7-1 Pilot Program Plans



1) Phase 1: Integration with Expressways and Highways

The advisor would propose a system to collect fare to the Department of Highways, Expressway Authority of Thailand, and Don Muang Tollway Public Co., Ltd. There are two possible solutions.

Pattern 1: Long Range Reader System

Using an active card and a long-range reader, without having drivers to stop at toll booths. This technology is also known as EASY PASS. Data collection would be done at ETC Acquirer, and transferred to a center at the Expressway Authority of Thailand to be further sent to the Office of Transport and Traffic Policy and Planning.

Pattern 2: Touch & Go System

Using Touch & Go system on mass transit. Data collection would be done at ETC acquirer and sent to the Expressway Authority of Thailand. The data would be further sent to the CCH. This system requires improvements on software, and card reader installation on toll booths.

2) Phase 2: Integration with public buses and railways

Public railways, electric trains, and public buses would be included in the common ticket system in the second phase. The operation of the second phase relies on 1. CCH and 2. Frontend modification to be operable with the CCH. Frontend modification has two major parts 1. Modification of existing AFC operators and 2. Installation of future AFC operators.

Transit providers which currently have automated fare collection (i.e. ARL, MRT, BTS, and BRT) require card reader installation, to integrate the existing to the CCH. The processes and methodologies depend on negotiation with operators. Failure in negotiation would have an impact on the success of system integration. The operation is also restricted to the contracts.

For the integration of the systems with transit providers which currently do not have an automated fare collection system, the CCH must consider reader and its equipment to be compatible with the specifications defined by the advisor, in order to ensure that the providers could be integrated to the new system.

Moreover, in the second phase of the pilot program, the advisor would also develop a system for top-up agents. The topping-up has two main focuses: 1. Electric train passengers, which the topping-up can be done at each station and 2. Public buses passengers, which the topping-up can be done at convenient stores.

3) Phase 3: Integration with water transportation

In the third phase, the system would be extended to be used in water transportation. This may be integrated with Chao Phraya Express Boat service and other service providers.

Presently, water transportation does not have any automated fare collection system. Hence, the integration requires reader, central computer, and other apparatus installation.

4) Phase 4: Integration with non-transit sectors

To extend the system to non-transit businesses, the advisor would survey usage behaviors from passenger, which are classified by age groups, occupations, and life styles. They survey could indicate possible applications of the system in non-transit businesses.

4.1) Cash Card

The use of common ticket as cash card can be implemented in stores which support the system; for example, convenient stores, supermarkets, gas stations, and fast-food restaurants. Besides purchasing products and services, these stores could also be top-up agents.

4.2) Parking Lot

The use of common ticket in parking lot service increases convenience of the drivers. The drivers do not have to pick up new tickets upon the arrival and do not have to return the

ticket when they leave the lot. Service fee can be automatically deducted from the common ticket.

4.3) Membership Privilege

Common ticket provides convenience to users in purchasing of course services.

The integration with non-transit sectors, the advisor needs to consider the stores which currently have AFC system. Thus, the new system can easily be integrated with the existing one. There might be investment on the installation on the stores which do not have any AFC system.

3.7.2. Evaluation and problems conclusion derived from the pilot project and resolution suggestion

In the pilot program, the advisor must evaluate and summarize existing problems, such as

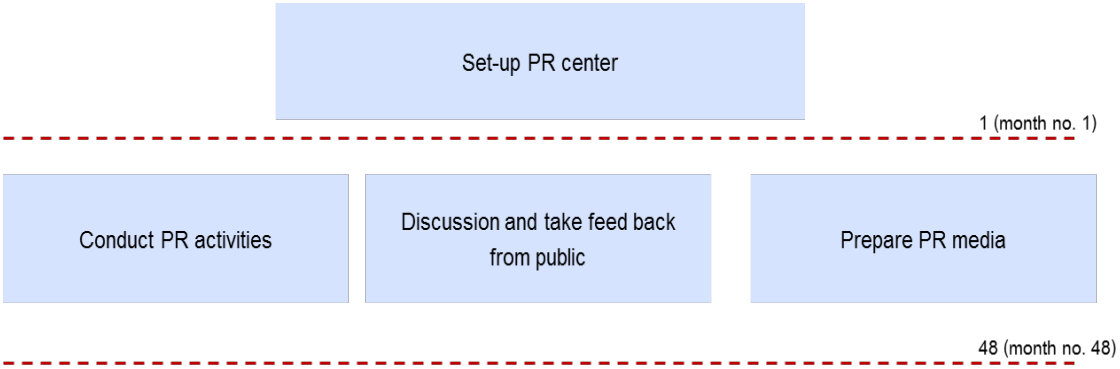
- Problems on the integration, which can also be caused by some restrictions in contract
- Problems on the current contracts with the operation, which interferes with the integration
- Technical problems
- Incompatibility of software

In some cases, incompatibility of the systems may cause the inability to integrate the systems. The pilot program must be able to advice and provide suggestions for system integration.

3.8. Public relation and public participation

The objective is to acknowledge the public and associated sectors, in order to create understanding, trust, and interest towards the project. The target group for the public relation is Bangkok metropolitan mass transit passengers, business owners, government sectors, private sectors, and laypersons. The contents to be publicized are general news of the project, sale support, and customer privilege. The operational period covers from the beginning of ticket selling to the extension of service area. The responsible sector is the public relation and information unit.

Figure 3.8-1 Publicized Information



3.8.1. Information and PR center establishment

The advisor would establish the unit which has responsibilities to follow up and cooperate public relation activities. This might be the same unit as the CCH, which also supports public relation. The operational model of this unit include

1. Project website www.commonticket.co.th (or other URL)
2. Project Fanpage www.commonticket.co.th (or other URL)
3. Venue of the project
4. Hotline
5. PO box

3.8.2. Public relation events organizing

The activities are classified into two main parts:

1) Public relation with the transit sectors

To provide information of the project, as well as processes and methodologies, and to answer questions and comments from the sectors. This would encourage the interest of the associated sectors to join the project. There would also be 7 seminars held to publicize the project; 300 participants would be invited to join the seminars.

2) Public relation with the laypersons

This is done by organizing events to publicize the project throughout 48-month period. The events would be held in open spaces, which can be easily accessed by people.

3.8.3. Management of comments and complains

1) Seminars to receive comments

Seven seminars would be held to receive comments from the users, as well as stakeholders. The comments would be used to improve the development of the common ticket system.

2) Seminars to publicize project information

Six seminars would be held to publicize news and other information of the project, as well as the development of the common ticket to be responsive to users' needs. Common tickets launched in the pilot project would reach 100,000 tickets in its amount.

Figure 3.8-1 Seminars



3.8.4. Advertising and printing media

Utilize different types of media to publicize the information of the project. The media includes television, radio broadcast, advertisement, press, online media, advertisement boards on BTS and MRT, as well as DVD and document. The contents include objectives, main contents, and expected outcomes of the project.

Figure 3.8-2 Examples of Media

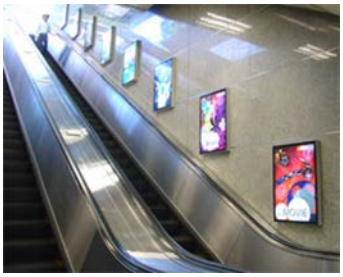


Table 3.8-1 Public Relation Plan

Operating plan/activities	Operating peroid (Month)										
	2	4	6	12	18	24	30	36	40	44	48
Information review and operational planning	—	—	—	—	—	—	—	—	—	—	—
Public relation	—	—	—	—	—	—	—	—	—	—	—
Coordination with related organizations/sectors	—	—	—	—	—	—	—	—	—	—	—
Project's information publication	—	—	—	—	—	—	—	—	—	—	—
Seminar to receive comments 7 times											
1st seminar		●									
2nd seminar			●								
3rd seminar				●							
4th seminar					●						
5th seminar						●					
6th seminar							●				
7th seminar									●		
Project's information publication activities 6 times											
1st publication activity		▲									
2nd publication activity				▲							
3rd publication activity						▲					
4th publication activity							▲				
5th publication activity								▲			
6th publication activity										▲	

Chapter 4. Program preliminary information

4.1. The Development of the Mass Public Transportation system in Bangkok Metropolitan

The advisors will study the development of the mass public transportation system in Bangkok Metropolitan. In a current, traffic and transportation are one of the most vital problems in Thailand, specifically in Bangkok Metropolitan Region. Traffic and transportation issues not only have an impact on country's economy but also result in an economic devastation. The World Bank estimated that around 160,000 million baht was lost from Thai economy annually. The economic devastation was measured by taking into account the loss of fuel and health problems in the country. Not only loss incurred in terms of monetary value, but the traffic and transportation problems also inflate travelling time, increase motor expenses as well as worsen the air pollution from which the rising of death rate has been proven as a result.

Office of Transport and Traffic Policy and Planning (OTP) estimated that from 21 million commuting times, which is the total daily commuting times in Bangkok Metropolitan, more than 50 percent are the commuting using private vehicles as shown below in Figure 4.1-1.

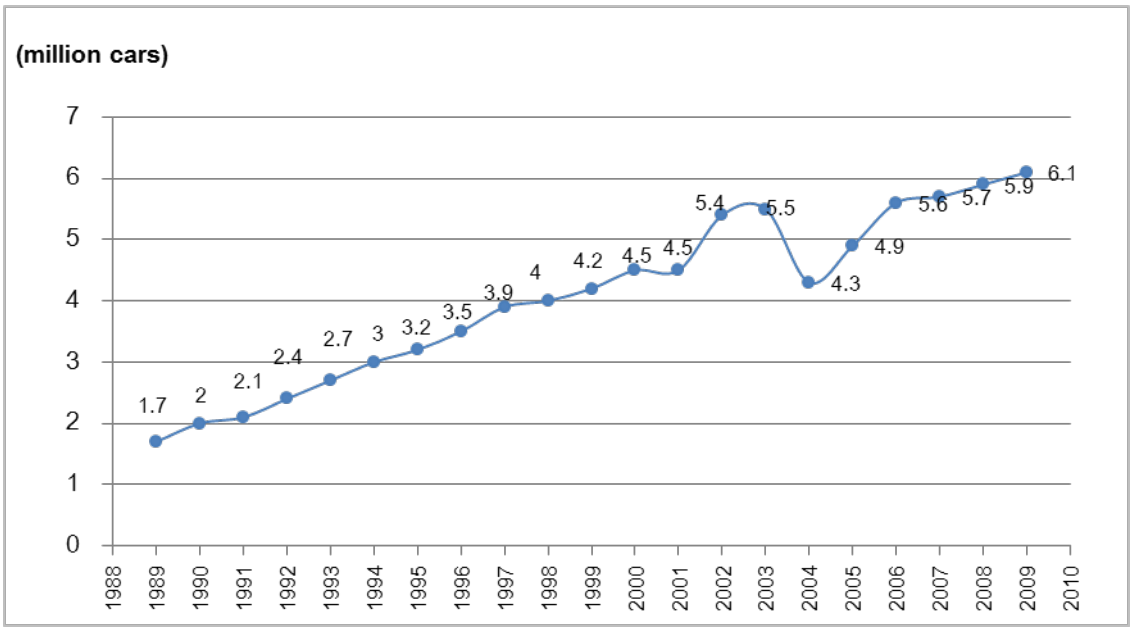
Figure 4.1-1 Transportation proportion in Bangkok

In addition, the private vehicles usage rate has been found to be continuously increased. Figure 4.1-2 depicts the amount of cars in Bangkok Metropolitan which has increased in average 4 percent per year, while the traffic road capacity has not been expanded at the same rate. This difference eventually results in the traffic congestion and other various traffic problems.

There are many factors that bring about such difference. Currently, it's much easier for Thai people to purchase their own car due to more supporting term and conditions, for example, car-purchasing contract by installment is common these days. Additionally, there are limitations for road construction in Bangkok Metropolitan such as insufficient civil budget and lifestyle of Bangkok people. An inconvenience of a current public transportation system makes it even more difficult for Bangkok people to change their preference of using their private vehicle. Figure 4.1-2

shows the amount of private car registration with the Department of Land Transport from year 1986 to 2010.

Figure 4.1-2 The amount of cars registered with the Department of Land Transport

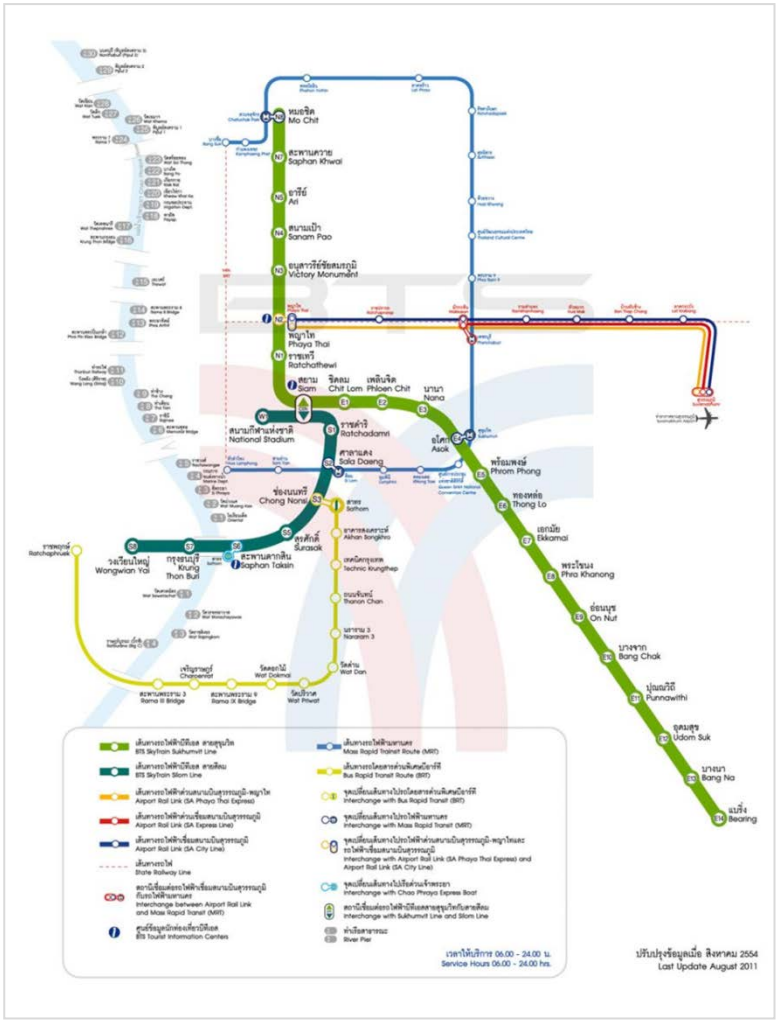


Source: Department of Land Transport

Presently, Bangkok has 4 major public transportation systems as shown in Figure 4.1-3 which are;

1. Bangkok Mass Transit System Skytrain (BTS – Sukhumvit and Silom line): BTS is Sky train which is directly governed and administered by Bangkok. BTS now covers 29 Kilometres with 29 stations. The service has been provided since year 1999. There are currently around 510,000 passengers using BTS per day.
2. Metropolitan Rapid Transit Chaloem Ratchamongkhon Line (MRT): MRT is Subway train which is governed and administered by MRTA. MRT now covers 20 Kilometres with 18 stations. The service has been provided since year 2003. There are currently around 250,000 passengers using MRT per day.
3. Airport Link: Airport Link is Sky train connecting between BTS Payathai station and Suvannabhummi Airport. Airport Link is under the control of State Railway of Thailand. Airport Link now covers 29 Kilometres with 7 stations. The service has been provided since 2010. There are currently around 40,000 passengeres using Airport Link per day.
4. Bus Rapid Transit (BRT): BRT is an Express bus providing services on Narathiwatrachanakarin Rd. and Rama III Rd. BRT is directly governed under Bangkok. BRT now covers 17 Kilometres with 12 stations. The service has been provided since year 2010. There are currently 15,000 passengers using BRT per day.

Figure 4.1-3 Current mass public transportation system in Bangkok



However, from total 21 million commuting times in Bangkok, only 4 percent are the proportion of the commuting using public transportation which is considered as a very low level. Due to an insufficient coverage of the current public transportation system as well as an inadequate safety and convenience function in providing their services, people in Bangkok still prefer to use their private vehicles. As a result, the development of the mass public transportation system to be effective and efficient is necessary.

4.1.1. Mass Rapid Transit (MRT)

MRT is a mass public transport operating in special separate railways. Its maximum capacity per route is 90,000 passengers per hour. The two-level train can be designed to attain the maximum capacity. Compared to other pubic transports in the city, MRT has the longest operating distance between stations. In city area, MRT train operates approximately 30-60 kms/hour in average and high speed function will be utilized in metropolitan region where the distance between the two stations become farther. The service with high-speed function is called Regional express or Commuter rail system. The train operating in this service is driven

on the metal railway and the electricity would be charged to the train through the top-roof system.

MRT is considered as a public-mass type of transport and operates on various types of railway, for instance, Underground or Subway railway, Elevated railway and Tube or Metro. This public-mass type of transport is categorized in Rail Rapid Transit transportation system. When categorized by function, MRT will be categorized as a public transport operating on certain route with fixed schedule and providing a regular commercial service for a specific service fees charged in return.

At present, there are 3 main routes in Bangkok Metropolitan where MRT is operating;

- Mochit- Baring and National Stadium Station – Wong Wean Yai route administered by BTS
- Bang sue- Hua Lumpong route administered by BMCL
- Phayathai-Suvannabhummi route administered by SRT

In developing MRT, the study of public-mass rail transportation framework was performed in year 1994. During the study, the development plan was scheduled from year 2004 to year 2008. However, the plan could not be kept on track due to many obstacles and changing arose such as the changing of the economic and social conditions as a result of an economic crisis, the alteration of people lifestyle and travelling behavior as well as the recent expansion of the city to the outbound area of Bangkok.

Therefore, OTP conducted another study under the project named Mass Rapid Transit Master Plan in Bangkok Metropolitan Region or M-MAP, with the purpose to renew the public-mass rail transportation framework for Bangkok Metropolitan. From the study, OTP proposed the new 20-year project (from year 2010 to year 2029) constructing 12 network routes covering 509 kms, of which 8 routes are primary lines and the rest are feeder lines.

According to the framework, the development can be divided into 3 phases which are;

- An Intensive phase endorsed by the cabinet resolution in 1996, consisted of extending the service lines in medium to high condensed living area; and in city business district and commercial area. The service lines are expected to be able to commence their services during year 2016- year 2018 for which the area covered will be around 370 sq.m. and the service capability will be around 3.3 million people as shown in Figure 4.1-4
- An Extension phase to be completed in year 2019, consisted of extending the primary service lines and feeder lines to connect living community areas, business and commercial areas. When this phase is completed in year 2019,

MRT in Bangkok Metropolitan will cover in total 391 kms or 525 sq.m. service area and capable to service around 3.8 million people as shown in Figure 4.1-5.

- An Extension phase to be completed in year 2029, consisted of extending the primary service lines and feeder lines to outbound communities and commercial estate. After this phase is completed, MRT in Bangkok Metropolitan will cover in total 509 kms or 680 sq.metres service area and capable to service around 5.13 million people as shown in Figure 4.1-6.

Due to changing of government policy, there are 2 lines that were cancelled which are Light-blue line (Din Daeng- Sathon) and Grey line (Watcharaphon-Lat Phrao-Rama IV and Rama IX Bridge).

Figure 4.1-4 An incentive phase endorsed by cabinet resolution in 1996

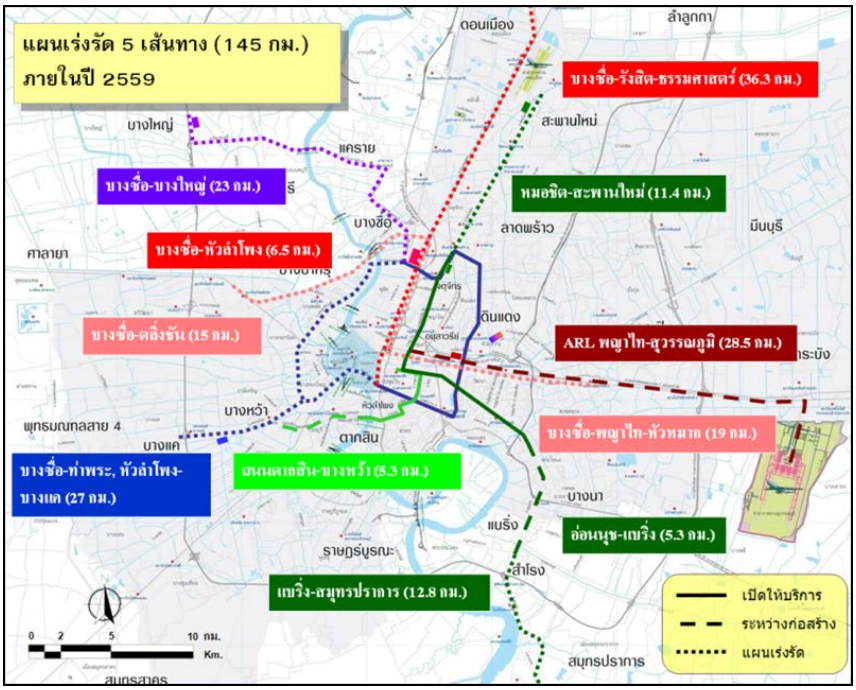


Figure 4.1-5 An extension phase to be completed in 2019

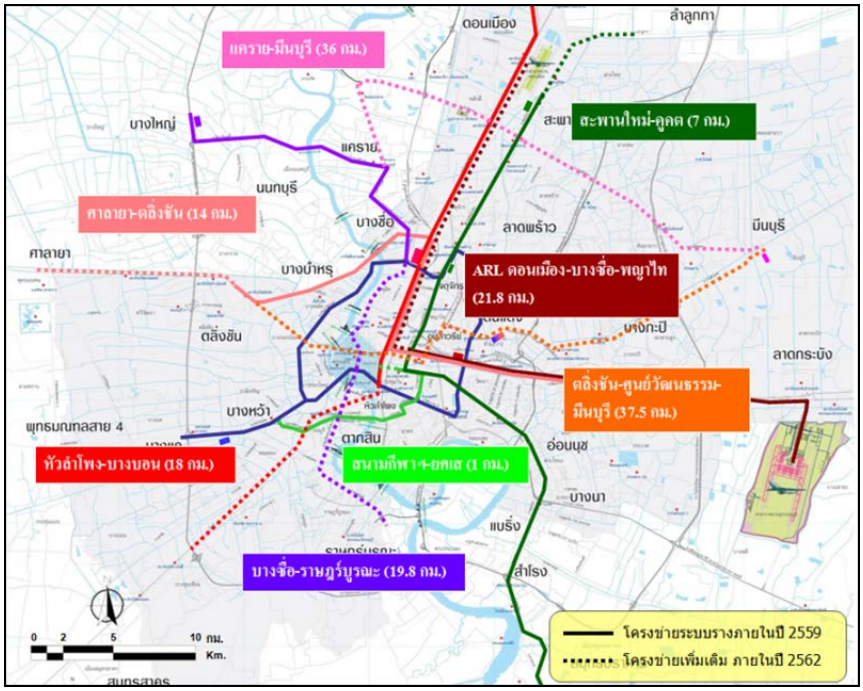
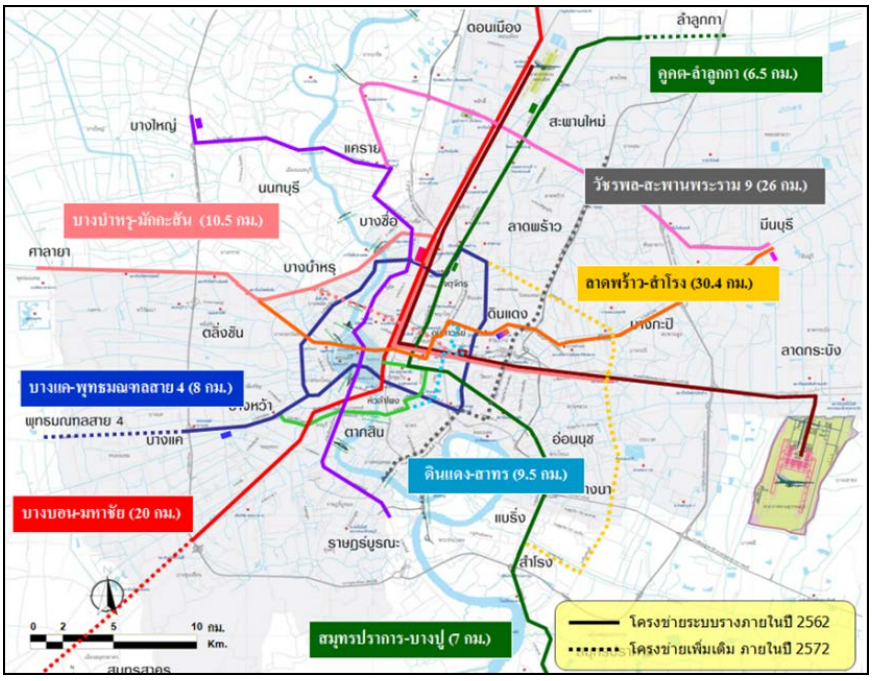


Figure 4.1-6 An extension phase to be completed in 2029



Ministry of Transport has considered the development of 10 new service lines by mainly taking into account the country's promptness and people demand.

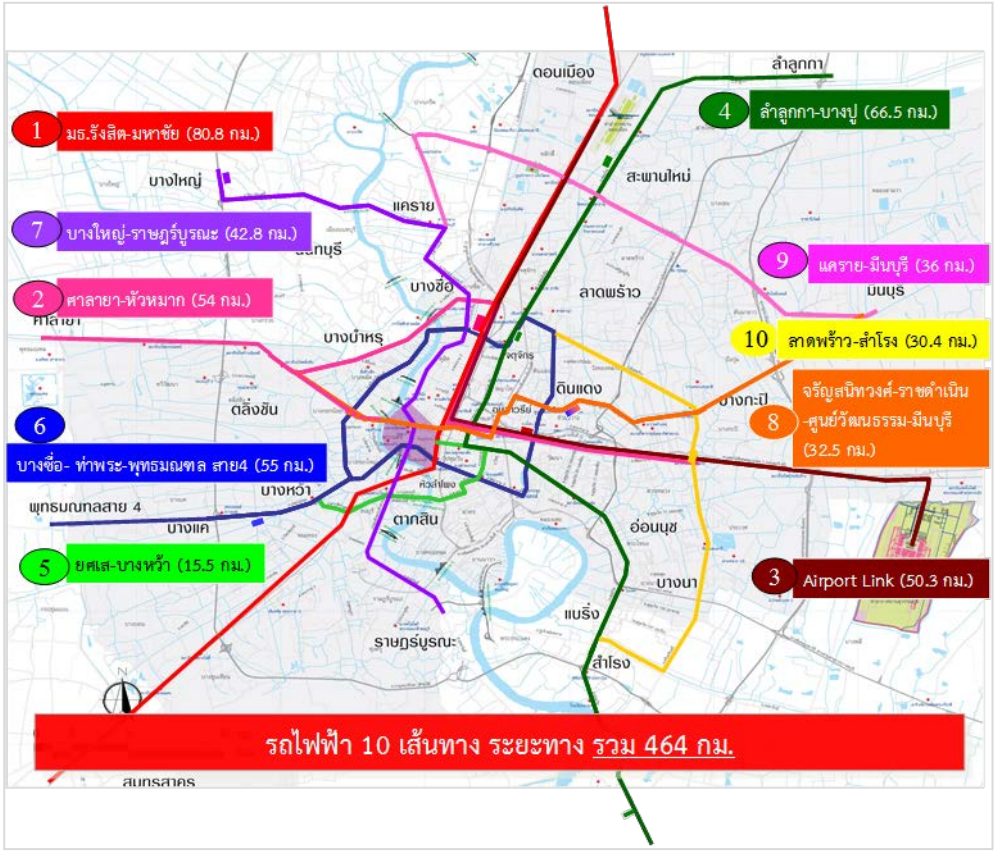
The benefits of the 10 service lines development project are not only enable people from outbound metropolitan to efficiently and effectively commute to inbound Bangkok region but also enable low-income people to stay in outbound area where the rent is cheaper.

The stations along the 10 service lines are listing in Table 4.1-1 and Figure 4.1-7

Table 4.1-1 The 10 service lines development project

Project (Service line)	Area covered	Distance
1. Dark Red	Thammasat Rungsit–Mahachai	80.8 kms.
2. Light Red	Salaya-Hua Mak	54.0 kms.
3. Airport Rail Link	Don Meung Airport-Suvannabhummi Airport	50.3 kms.
4. Dark Green	Lam Luk Ka- Bang Pu	66.5 kms.
5. Light Green	Yot Se-Bang Wa	15.5 kms.
6. Blue	Bang Sue-Hua Lamphong- Tha Phra-Phutthamonthon 4	55.0 kms.
7. Purple	Bang Yai-Rat Burana	42.8 kms.
8. Orange	Taling Chan-Min Buri	32.5 kms.
9. Pink	Khae Rai-Min Buri	36.0 kms.
10. Yellow	Lat Phrao-Samrong	30.4 kms.
Total		**464.0 kms.**

Figure 4.1-7 The summary of 10 service line development project by the government



4.1.2. Feeder System

Feeder system is the system that supports the primary system. As it's impossible for the primary system to fully cover all areas, the feeder transports will commute people from the area with high rate of travelling demand but, without the primary transports, to the nearest primary transportation system. Moreover, the feeder lines also connect to other types of transports such as other land transports, water transport, air transport, etc.

Feeder system can be divided, according to its service function, into 2 sub-systems which are Feeder system and Supporting Feeder System.

Feeder system in Thailand is currently consisting of;

1) Bus Rapid Transit; BRT

BRT is a latest form of public land transport and has been very successful in many countries, especially in North America, South America, Asia and Europe, in solving traffic problems in city area. BRT combines good qualities of both regular public bus and rail-bus service. BRT operates on a separate traffic lane which makes BRT more effective than a regular public bus. In other words, the service operation of BRT is somehow similar to the rail-bus service but more efficient in terms of costs.

At present, BRT has 1 service line from Sathon Road to Ratchada-Ratchapreuk Junction as shown below in Figure 4.1-8. A plan to develop new 12 service lines for BRT is now during the study. Figure 4.1-9 depicts the example of BRT services system in Bangkok.

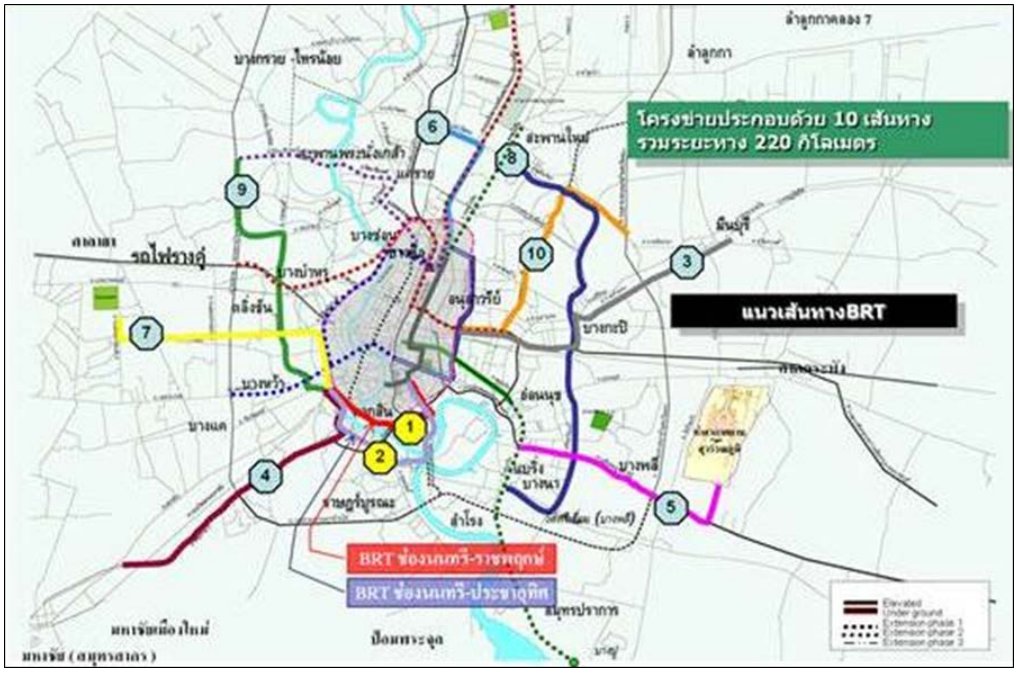
Figure 4.1-8 BRT first service line

Figure 4.1-9 The example of BRT services system in Bangkok

In development BRT projects in Bangkok, OTP is now preparing the framework of BRT service line, consisted of 10 service lines covering 220 kms (including 2 previous service lines which are Non si-Ratchapreuk and Non si- Prachauthit) as shown in Figure 4.1-10

From the forecast, providing these 10 service lines are entirely constructed and open to provide full service, there will be around 830,000 passengers using BRT service per day (in year 2017)

Figure 4.1-10 BRT Framework by OTP



2) Monorail

Monorail is normally used for special commercial purpose or for tourism. However, in Japan, Monorail has been used for public transportation.

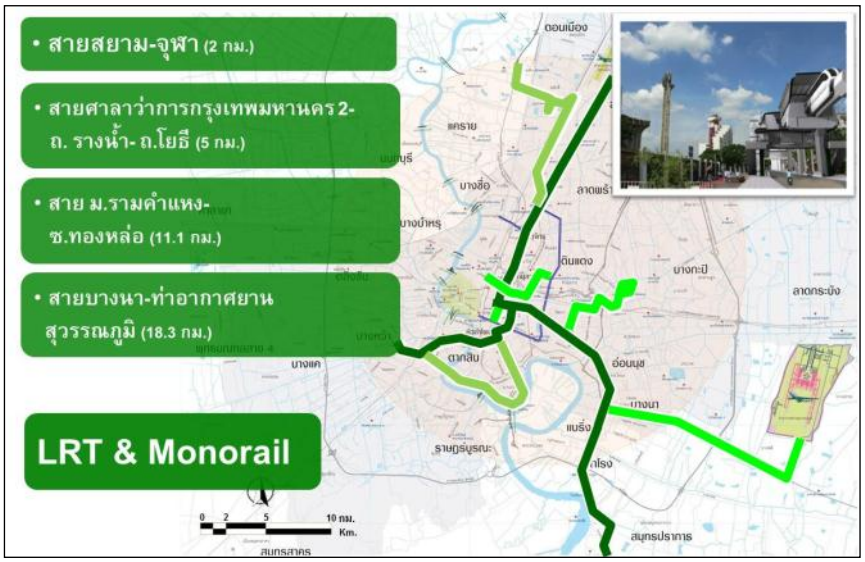
Monorail is considered as low capacity type of transport compared to other public transports as it is normally used in tourism industry. In big cities such as Tokyo and Osaka, monorail normally operates and functions in Feeder system. However, it can also function as a primary transport in medium-size city. Monorail can be categorized into 2 types which are Suspended Monorail and Straddle Monorail.

In building a monorail, some constructing materials and some required functions e.g. an emergency fire and safety system can cause a negative effect on the appearance of its structure. Additionally, other structures on the ground might also be necessary such as a structure for a passage to link the monorail to other public transportation services.

Bangkok has planned 4 service lines for Monorail as shown in Figure 4.1-11, consisted of;

- Siam-Chula line, in total 2kms
- Bangkok Metropolitan Administration 2- Rang Nam Road- Yothee Road, in total 5 kms
- Ramkamheang University – Thong Lor, in total 11.1kms
- Bang Na – Suvannabhummi Airport, in total 18.3 kms

Figure 4.1-11 Bangkok Monorail Plan



3) Public Bus

With area-coverage intensity, high frequency of service provided, certain stopping points, capability to carry great amount of passengers and ability to feed the passengers to other types of public transports, the public bus is a public land transport which is the most extensive and popular types of public transports nowadays. There are both air-conditioned and non air-conditioned buses; and the service providers are from both government and private sectors. The main service provider of a public bus in Bangkok is Bangkok Mass Transit Authority or BMTA as shown in Figure 4.1-12

Figure 4.1-12 Public Bus

The public bus currently provides services in Bangkok Metropolitan, Nonthaburi, Nakornpathom, Pathumthani, Samutsakorn and Samutprakarn or 108 routes in total. There are 3,509 buses (as at September 2011), of which 1,659 buses are non-air-conditioned buses, 1,850 air-conditioned buses. In addition, there are also 4,016 buses operated by private sector, both air-conditioned and non-air-conditioned, 844 minibuses, 2,312 small-sized pickup, 5,315 air-conditioned vans and 213 CNG vans. In total, there are 16,209 public buses currently covering 445 routes.

There has been a process to improve and upgrade public bus system. The new bus system is called Metrobus of which the service provider is private sector. The Metrobus service areas cover Bangkok Metropolitan Region. Metrobus's main qualities focus on convenience, safety, unpolluted energy usage, and high-technology application. Therefore, Metrobus has become another choice of public transports for people. However, speediness of service is considered as low since Metrobus is still operating in an ordinary (non-separate) traffic lane. Figure 4.1-13 shows the Metrobus picture.

Figure 4.1-13 Metro bus

4) Public van

Public van has low capacity in carrying passengers of which the maximum capacity is 14 passengers. Its good qualities are convenience, speediness and community proximity. The

service areas covered are both within the Metropolitan and also between the provinces where the distance is not more than 400 kms. The service structure is not much different compared to the public bus such as there are certain routes in providing the services, however, the stopping point is uncertain as it depends on the demand of the passengers. It is more appropriate to categorize the public van in Feeder system as it is capable to run in an area with narrow space and faster than a regular public bus. Figure 4.1-14 depicts the public van.

Recently, the number of public vans has been increasing continuously, both with a legal registration and a non-legal one. The standard of its service is still varied. From the statistics, the public van is a public transport which often has an accident. The main causes of an accident are such as the driver does not drive within the speed-limit, the illegal modification to increase carrying capacity, etc. Therefore, the public van is still perceived as a public transport providing under-standard services.

Figure 4.1-14 Public Van

5) Small pick-up van

Small pick-up van is a public transport which has been providing services for a long time. The carrying capacity and speediness are considered as low level. Pick-up van can provide services both on main road and the street having narrow space, however, the stopping point is not certain. Good qualities of a small pick-up van are it enables flexibility for passengers to hop on and off upon their request and therefore is quite convenient for short-distance travelling. However, with considerably low and varied safety standard in providing services, the small pick-up van is more proper to be the feeder transport which commute the passengers to the primary transports; or commute the tourists travelling in short-distance among the tourist places. Figure 4.1-15 depicts the small pick-up van.

Figure 4.1-15 Small pick-up van

6) Public boat

Water transport is the oldest type of transport in Bangkok. It used to be the most common way people used to travel in the past. However, due to city development and road construction, travelling by boat is much less prevalent nowadays. There are currently a few routes for the public boat service as followings;

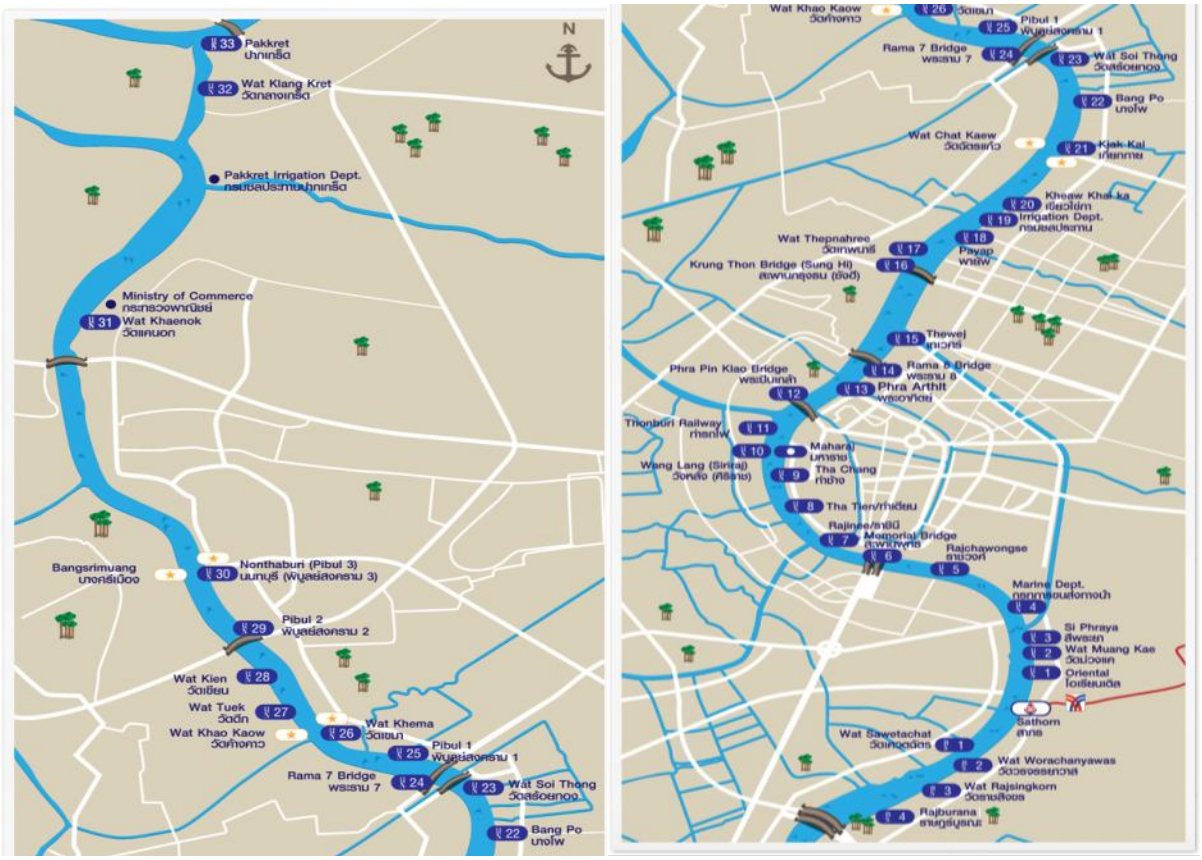
6.1) Chao-praya express boat

Chao praya express boat provides services along the Chao praya river startring from Pak Kret, Nonthaburi province to Ratburana, Bangkok. There are 4 service types as followings;

- Regular boat (non-flagged): providing service from Nonthaburi to Wat Rachasingkhorn. Fees charged is 10-14 Baht based on the travelling distance.
- Express boat with orange flagged: providing service from Nonthaburi to Wat Rachasingkhorn. Fee charged is fixed at 15 Baht.
- Express boat with green flagged: providing service from Pak Kret – Nonthaburi-Sathorn. Fees charged is 13-32 Baht based on the travelling distance.
- Express boad with yellow flagged: providing service from Nonthaburi-Sathron-Ratburana. Fees charged is 20-29 Baht based on the travelling distance.

Aside from the Chao Praya express boat, there is also the tourist boat which charging the service fees for 150 Baht per day. The tourist boat provides the services for the entire day and covers 8 wharfs including Sathon wharf, Oriental wharf, Si Praya wharf, Ratchawong wharf, Tha Tien wharf, Maharach wharf, Wang Lung wharf and Pra Arthit wharf.

Figure 4.1-16 Chao Praya express boat routes



6.2) Chao Praya Ferryboat

Chao Praya Ferryboat operates 24 hours to commute the passengers crossing 2 sides of Chao Praya River. The fees charged is 3-10 Baht depend on time of service.

6.3) Klong San Sab boat

Klong San Sab boat provides service, since year 1990, in Klong San Sab which is linked to Klong Maha Nak. The operating route starts from Sri Boonreung wharf in Bang Kapi district to Paan Fah Lilad bridge wharf in Pom Plab Satruphai district. There are 27 wharfs altogether along the route covering around 18 kms.

4.2. Summary of the development of Mass Public Transportation System in Bangkok Metropolitan Region

At a current, as the coverage of the primary transportation system is not completed, travelling behaviors in different areas are still different from one another and there is no certain structure for mass public transportation in Bangkok Metropolitan. The inconvenient level and safety standard are also varied from area to area. Due to the city expansion which cause severe traffic problems in the region, the government has then launched the projects to develop Mass Rail Transit system to be the primary transportation system of Bangkok Metropolitan as well as issued new rules and regulations to improve the standard of the mass public transportation and to provide more effective and efficient services for people.

The advisors will perform the study to develop the public land transportation system in Bangkok Metropolitan. The development plan would follow the Radial-Circumferential Network theory, the theory focusing on designing the road network in Radial and Circumferential style. This theory is believed to be suitable for Bangkok which is considered as a big city with monocentric and surrounded by the development of commercial districts and communities in outbound areas. The Radial and Circumferential Network would ease the travelling from outbound areas to the center of the city; and support the traffic dispersion from the city. Although this theory will increase the travelling time but it would help solving traffic issues as well as support Bangkok to be the polycentric city.

At present, the road network as shown in Figure 4.2-1 consists of following zones;

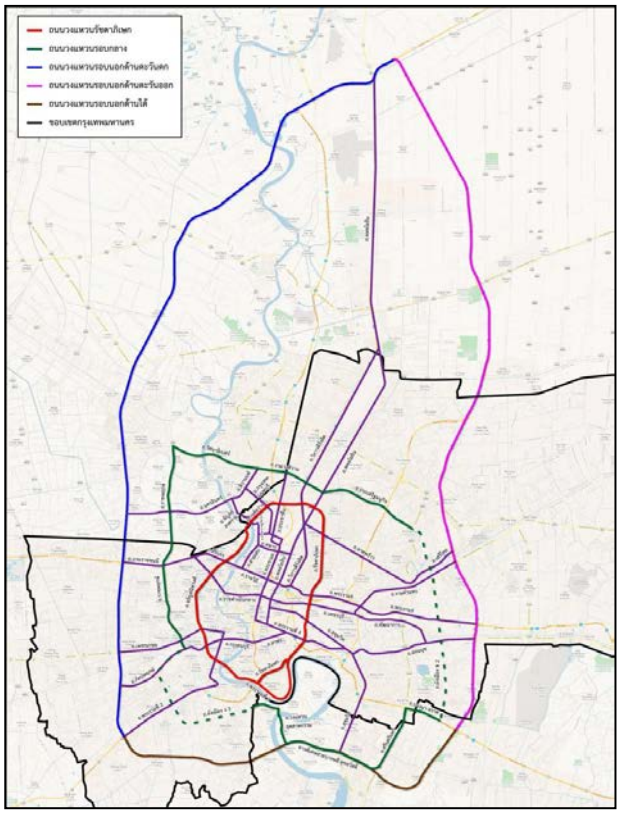
4.2.1. Circumferential

The study of circumferential road zone will be performed. The functions of this zone are to merge and disperse the traffic. The traffic amount in and out in this zone will be monitored and controlled to increase the traffic efficiency. The circumferential road zone includes;

1. Ratchadaphisek circumferential: consisted of 6 main road which are Ratchadaphisek Rd, Asoke-Din Deang, Asokemontri, Rama III (partially), Charansanitwong and Wongsawang
2. Center circumferential (the circumferential between the Outer circumferential and Ratchadaphisek circumferential): this circumderential covers areas in Bangkok, Nonthaburi province and Samutprakarn provice. The main roads include Rachapruek Rd, Ratanathibeth, Ngamwongwan, Prasertmanukrit, Pung Meung Ch.2, Bangna-Trad, Sri Nakarin, Bang pli-Suk Sawat Motor way, Industrial zone and Pung Meung Ng.3
3. Outer circumferential (Karnchanaphisek Rd): consisted of 3 sub-zone as followings;

- Western outer circumferential covering 68 kms (starting from Bang Khun Tien Interchange, Bangkok; to Phahonyothin Road, Thailand Route 32 or Asia Route in Ayutthaya province
- Eastern outer circumferential covering 63 kms (starting from Phahonyothin Road, Wang Noi, Ayutthaya province; to Bang Na – Bang Prakong, Bang Pli, Samutprakarn), and
- Southern outer circumferential covering 34 kms (starting from Karnchanaphisek (East), Bang Pli, Samutprakarn; to Karnchanaphisek (West), Bang Khun Tien, Bangkok)

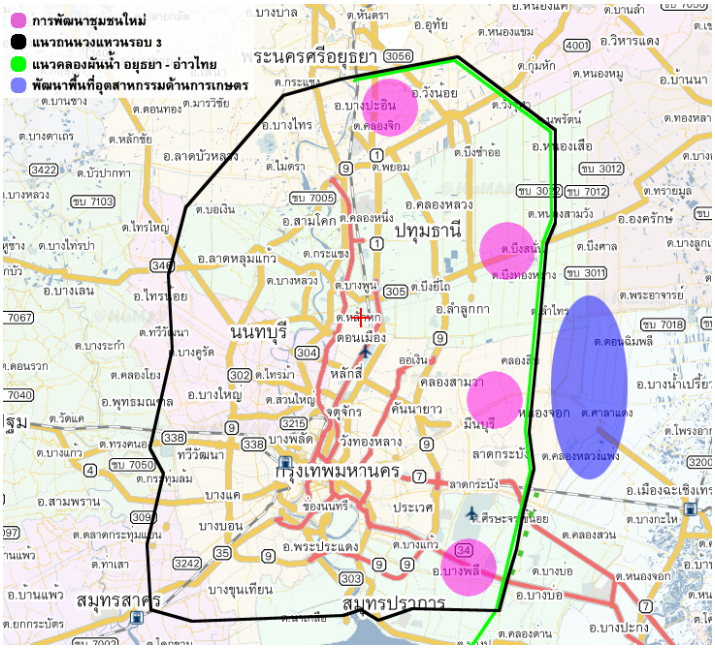
Figure 4.2-1 Map of Circumferential project



Parking will be prohibited along the entire outer circumferential zone. The main objective of this zone is to connect Bangkok, Nonthaburi province, Pathumthani, Samutprakarn and Ayutthaya province and to solve traffic problem in Bangkok Metropolitan Region as well as being the main highway to other regions.

There is also a plan to build the new circumferential as a part of Chao Praya Controlling Project, Ayutthaya- Thai Gulf to protect the flooding problem which is currently the main issues in Thailand. Figure 4.2-2 shows the map of the new circumferential project.

Figure 4.2-2 The map of the 3rd circumferential project



4.2.2. Radial; consisted of the following roads

1. Main Northern Roads; for example, Pracharat 1, Bangkok-Nonthaburi, Prachachuen, Wibhavadi, and Phahonyothin (Highway no.1)
2. Main Southern Roads; for example, Sukhumvit, King Taksin, Suksawat and Rama 2
3. Main Eastern Roads; for example, Lad Phrao, Sereethai, Rama 9, Ram kamheang, Petchaburi, Patanakarn, Onnuch and Rama 4
4. Main Western Roads; for example, Sathon, Ratchapreuk, Kalapapreuk, Petchkasem (Highway no.4) King Pinklao, Ratvithi, Sirithon, Rachadamnen Klang and Baromrach-chonnanee

These main radial roads will connect city center and communities with other road networks; as well as to support the dispersion of the traffic from center of Bangkok

In addition, to further improve the traffic in Bangkok, there is the development of various routes of motorway. Figure 4.2-3 shows the map of motorways which include;

- Chalemmahakorn Motorway
- Sri-Rach Motorway
- Chalongrach Motorway
- Burapavithi Motorway
- Udonrathaya Motorway
- S1 Motorway

- Bangpli-Suksawat Motorway

Figure 4.2-3 Map of the current Motorways

In addition, there are plans to further develop Motorways in the future as followings;

1. Initial phase projects (2011-2020)
   - Sri-Rach – Outer circumferential Motorway project
   - 3rd stage Expressway- Northern line (N1+N2+N3)
   - Eastern outer circumferential Motorway phase 1 (Bang Yai- Bang Khun Tien)
   - Western outer circumfertial- Dao Kanong Motorway
   - Sri-Rach – Dao Kanong Motorway
2. Medium-term projects (2021-2030)
   - Centralization/ Dispersion Road (C/D Road) Motorway
   - Suvannabhummi Motorway
   - Sri Nakarin – Bang Na – Samutprakarn
   - 3rd state Expressway – Northern line E-W Corridor (Eastern)
   - Bang Poon- Thanyaburi – Eastern outer circumferential
   - Bang Klo – Industrial zone circumferential
   - 3rd stage Expressway – Southern line S2 (Bang Na - Sam Rong)
   - Rama 2 Expressway – Petchkasem - Nonthaburi
3. Long-term projects (2031-2040)

- Sri-Rach – Government complex Motorway
- 2nd stage Western outer circumferential Motorway (Bang Yai – Bang Pa-in)
- Chalongrach – Phahonyothin Motorway
- Chalongrach – Klongsong Motorway
- Udonrathaya – Western outer circumferential Motorway
- Western outer circumferential – Nakornpathom Motorway
- Ratanathibeth – Udonrathaya – Phahonyothin Motorway
- Klong song – Phahonyothin Motorway

4.2.3. The Development of an Intelligent Public Land Transportation

Advisors will perform the study of the development of road system by applying technology in providing services. Recently, the technology called Easy Pass, as shown in Figure 4.2-4, was brought to collect toll fees in Motorways to solve traffic problem around toll collection entrance area. Furthermore, CCTV and Traffic Board Screen, as shown in Figure 4.2-5 and Figure 4.2-6, was used in many areas in Bangkok to monitor traffic conditions and to advise the travelers/pedestrians the current traffic conditions in specific areas respectively.

Figure 4.2-4 : Motorway Easy Pass

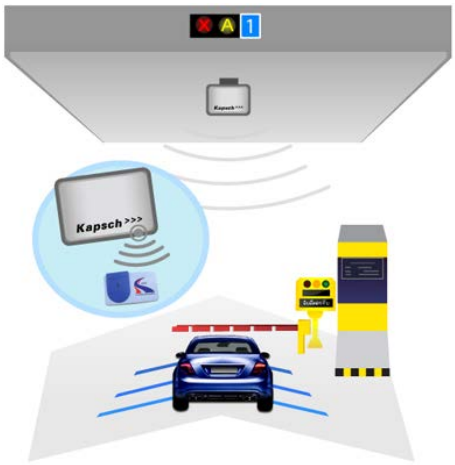
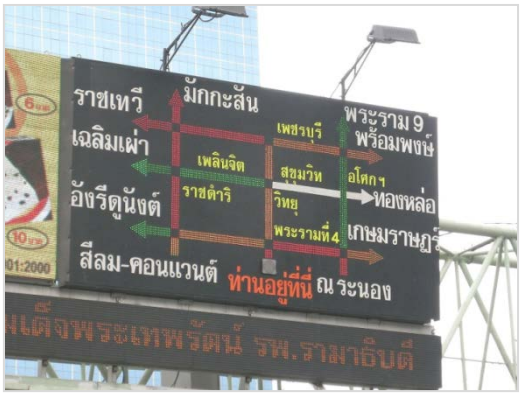


Figure 4.2-5 CCTV in Bangkok

Figure 4.2-6 Traffic Board screening the traffic condition



4.2.4. Summary of the Development of Public Road Transportation System in Bangkok Metropolitan Region

Circumferential and Radial theory will be applied for the development of public road transportation system in Bangkok to support Bangkok to change from monocentric city to be polycentric city. New Motorway projects and new technologies will also be introduced to increase the efficiency and effectiveness of traffic system in Bangkok Metropolitan Region.

4.3. Current system for collecting transportation fees both for public transportation and land transportation in Bangkok Metropolitan Region

4.3.1. Ticket types

From preliminary survey of transportation in Thailand, there are 2 kinds of tickets; paper ticket and smart card. The smart cards are either using memory (such as Type A Mifare 1k) or microprocessor (such as Type A Mifare 4k และ Type C (Felica)). The good quality of memory smart card is that it is cheaper than microprocessor smart card. But its weakness is that using the memory smart card is less secure and it can only be used for just one time. On the other hand, using a microprocessor smart card requires the development of new technology which is different in different part of the world. The equipment used for the microprocessor smart card is quite specific which can cause the problem of monopolizing use of the microprocessor smart card.

Table 4.3-1 Current Fare Media in Thailand

System	One-way ticket	Rechargeable ticket
MRTA	Contact-less Token: Type C (Felica)	Smart Card: Type A (Mifare 1k) และ Type C (Felica)
BTS	Magnatic	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)
BMTA	Paper ticket	-
Boat	Paper ticket	-
Motorway	Cash	Easy Pass (RFID and Mifare)

The smart card can be used not only for public transportation but also for highways and tollways as well. On top of this, the use of the smart card could be extended to all other commercial business and banking. The conclusion of using a smart card for both public and private sector is yet to be determined, but it is quite promising in the future.

4.3.2. Current Fare Structure

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

4.4. *Roles of the common ticketing system in the development of public and land transportation in Bangkok Metropolitan Region*

Advisors will perform the study of the common ticketing system. The development of common ticketing system is one of an essential part in integrating development of public transportations which include rail transports, bus transports, motorway or expressway transport. This development will include the using of common ticket, common fare rate and manage the coverage of mass transportation network to provide the services with fair price and the ultimate benefits for all passengers.

4.4.1. Roles in integrating the fees collection system

Presently, the service providers of various public transports, both government and private sectors, are interested to apply the technology of common ticketing system in their services, for example MRT projects under the administration of MRTA such as MRT Purple line covering Bang Ya-Bang sue and Red line covering Bang Sue – Taling Chan; or Bus Rapid Service projects (BRT) under the administration of Bangkok such as BRT route Mo Chit – Government Complex – Nonthaburi and route Sathon – Suksawas, etc.

Therefore, the common ticketing system plays a very vital role in considering software standard as well as all equipment and tools for an automatic fare collection system (AFC). In addition, the common ticketing system also convince the development of fare collection system to be under the same standard for all public transports which result in the complete integration of an entire mass public transportation system.

As the development of the common ticketing system will support mass usage and also cover various travelling services, it believes that the mass public transportation system in Thailand will operate more effectively and will help to reduce the preference of using private vehicles. In addition, the use of the common ticket could be extended to all other commercial businesses other than travelling. The integration of using the common ticket will enhance the convenience and support the cash management of the business to be more effective.

4.4.2. Roles in determining the service fares

At present, Bangkok Metropolitan Region has many concessionaires for the mass public transports for which each concessionaire has their own specific method in determining the service fares. As a result, the current practice is considered as the main obstacle for the government to step in and determine the new service fares policy. Besides, the current automatic fare collection system (AFC) was developed under the different software which is another difficulty for data integration which cause the development of the common fare is impossible due to the information insufficiency.

Once the development of the common ticketing system is implemented according to the government policy, the government, in a form of designated private or enterprise sector, will be able to step in and effectively control the transport service fares as well as be able to determine the fare structure. The application of common fare policy will be considered of which the fare determined might be at the level lower than the operating costs. Subsidy from the government will be injected to subsidize the responsible private or enterprise body.

In preliminary phase, the government might determine the Flat Fare as the fare collection policy. Under the flat fare policy, the travelers can change type of transport without paying an initial fee. This policy will create fairness for the passengers travelling in short distance but need to change type of transport back and forth as they do not need to pay the duplicated initial fees. The policy will result in the integration of mass public transportation and inland transportation.

4.4.3. Roles in supporting an important information for planning and the developing the traffic system

In developing the common ticketing system, it is necessary to specify the technology standard of the smart card, the standard of the information within the card, the standard of all equipment and tools used to read the card and the standard of the information network. All of these factors will support the acquirer their collection of daily mass public transports travelling data to further submit to the government sector for conducting the traffic plan and developing the mass public transportation.

The implementation of the common ticketing system will utilize an effective information system technology so that the report of daily usage of mass public transport in Bangkok Metropolitan or within country could be done quickly. As a result, the responsible traffic planner will be able to effectively plan the traffic based on precise and real-time information as the information can be sorted out daily. Such information system will also enable the data presentation to be in various forms so that it will better suit each specific analysis. The data can also be used as a reference data in various projects.

4.5. Factors to be considered in determining the common ticketing policy

4.5.1. Fairness of the common fares

After reviewing the different common fares structure used in different countries, the advisors will suggest an appropriate option for Bangkok Metropolitan. To come up with an appropriate structure of the common fares for the mass public transportation system in Bangkok Metropolitan, both quantitative and qualitative factors were used in the selection process.

1) Influential factors on the fares Policies determination

From the review of various common fare structures applied in various foreign countries, the advisor found that the determination of the common fares in each country potentially depends on 4 main influential factors including;

Table 4.5-1 Influential factors on the fares determination

Policy factors	– Public Service Obligation – Cooperation policy with private sectors – Fuel and Environmental policy – Risk-related policy
Physical factors	— Mass Rail Transportation network and connection — Land utilization characteristics (Monocentric, Polycentric, etc.) — Station structure and the previous fare collection technology
Management and Administration factors	— Management and Administration of Public Transportation — Regulatory Framework
Social factors	— Payment method preference (cash, credit card, cash card, etc) — Familiarity of travelling fares in the city

2) Fare Structures

The advisor selected the fare structure by considering advantages and disadvantages of 4 alternatives, which are 1) Distance-based Fare, 2) Coarse Distance-based Fare 3) Flat Fare throughout the System and 4) Concentric Zonal Fare. After that, they set up some criteria to select the most suitable fare calculation for public transportation.

2.1) Distance-based Fare

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

$$\textbf{Fare from A to B} = [a_1 + b_1(x_1)] + [a_2 - d + b_2(x_2)] + \ldots + [a_n - d + b_n(x_n)]$$

Given xn = Travelling distance on system n where $x_1 + x_2 + \ldots + x_n$ = 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

From this calculation, passenger will pay fare according to actual usage while having a discount when travelling by using multiple systems. There will be expense deduction in managing common ticket system, which will decrease revenue of service provider of each system. However, other types of revenue will increase when there are more passengers travelling.

The main hypothesis of this analysis is that the Government will manage all network including BTSC and BMCL with Gross Cross Concession method. Even though, the passenger will pay the fare with the same a and b value for each transporting system, revenue apportionment for each operator will be varied depending on cost of operation and how they negotiate with the Government.

This structure will be suitable when having many operators in the system as the fare calculation and revenue apportionment is quite straightforward. That is, the fare will increase when the distance increases. The maximum fare might be set up so that the fare for travelling on long distance will not be too high.

In addition, the discount might be given when the passenger travels in multiple systems. This might be done by deducting the discount from the initial charge (a) or giving a transfer rebate as done in Singapore.

However, pay as you go method might not attract much passenger because one who travels in long distance will have to pay more. They might choose other alternatives such as private car or taxis. Moreover, when the rail development project finishes, travelling from one place to another can be done in many routes. This will result in complication in calculating the fare as the fare might be varied if the passenger uses different route between origin and destination.

The summary of advantages and disadvantages of Distance-based Fare is shown in Table 4.5-2

Table 4.5-2 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 and payback the 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 to 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.

2.2) 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 the same 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 altered by the distance.

The discount calculation 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 store valued card and single ticket.

The summary of advantages and disadvantages of Coarse Distance-based Fare is shown in Table 4.5-3

Table 4.5-3 Comparison of advantages and disadvantages of Coarse Distance-based Fare

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

2.3) Flat Fare throughout the System

This alternative is simple as the passengers pay flat rate fare 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 price high to cover the cost for long distance trip will not attract the passenger who travels in short distance. But if the price is set too low, it might not be able to cover the cost.

Flat fare throughout the system will be suitable for transporting system with one 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 addition, 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.

In overall, revenue apportionment from using flat fare throughout the ssystem tends to be lower than other structure because in reality; it is hard to set a price too high. Therefore, the government is responsible to pay more subsidies to operators. Furthermore, there might be fare revision every time the network expands or more operators join the system. The summary of advantages and disadvantages of flat fare throughout the system structure is shown in Table 4.5-4

Table 4.5-4 Comparison of advantages and disadvantages of flat fare throughout the system structure

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. • Cost of ticket is lower than other structures.	• Flat fare is not worthwhile for passengers who have short distance travel. • This structure uses revenue from short distance travel to cover the cost of long distance travel. • If the price is set at low rate, the government has to pay more subsidies. • Revenue apportionment is complicated if there are many operators.

2.4) Concentric Zonal Fare

Fare calculation for concentric zonal fare structure is a combination between ddistance-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 centre zone and dividing 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

In this case, zoning has to be done carefully for the fairness of majority in the area. Zoning will depend on how the area is used and how population scatters as well as the distance of other transporting system running in parallel with concentric zone, which should not be much different. After adopting this method, zoning of track system in Bangkok metropolitan area can be shown in Figure 4.5-1. However, there might be a problem with passenger who has a short

trip (i.e. 1 or 2 stations) but has to cross the zone so he has to pay more than one who has longer trip but still within the zone.

The more zones are divided, the more similar in fare calculation to distance-based fare. On the other hand, if there are not many zones, the fare calculation will be more similar to flat fare throughout the system.

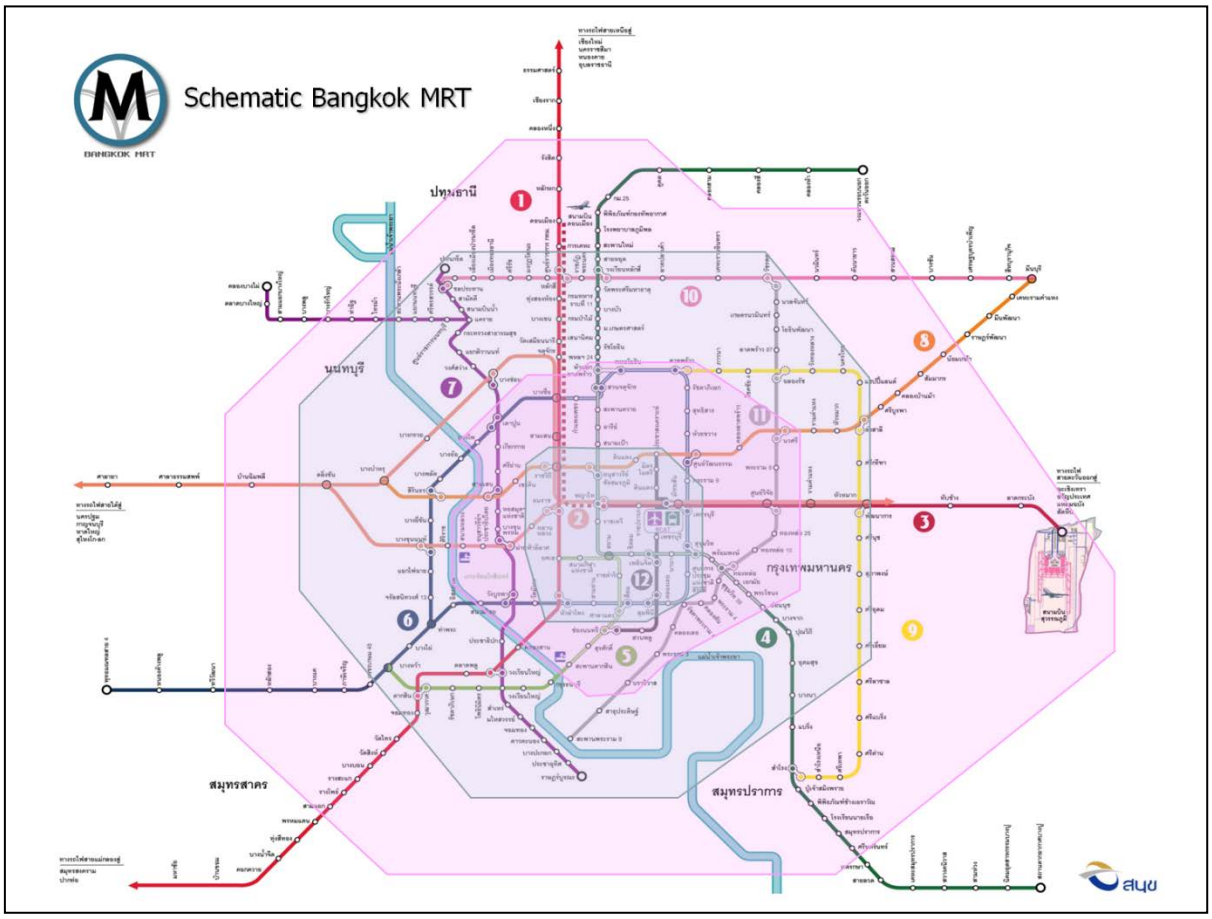
Concentric zone will support Orbital Movement especially when public transportation system has concentric zone route. The system will help lower number of passengers who travel across the inner city.

Practically, passenger who uses store-valued card will be deducted the fare according to the zone he travels. When the network development completes as in figure 4.1-2, passenger can choose to travel in shorter distance but needs to pass metropolitan area, which is more crowded (across multiple zones) or detour route that has longer distance but within only one zone, which leads to lower fare.

In the case that passenger uses a single ticket; the price will be varied according to number of zones the passenger has to pass. The ticket machine can provide alternatives for passenger to opt for shorter but higher price or longer distance but lower price.

In terms of revenue apportionment, it will be more flexible than the flat fare but still complicated because it uses one rate for travelling within the zone.

Figure 4.5-1 Schematic Bangkok MRT



The summary of advantages and disadvantages of concentric zonal fare structure is shown in Table 4.5-5

Table 4.5-5 Comparison of advantages and disadvantages of concentric zonal fare structure

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 lines 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.

There must be a limit for duration per ride that passenger can stay in the system to prevent passenger to use one ticket to travel more than 1 round. This case might occur easily when the connection of each system is not closed. For instance, in current green and blue system, passenger can walk out of one system before entering another. If there is no limit for duration

per ride, some passengers might walk out of the system to do some errand then entering the system to continue the trip (This means passenger travels more than 1 round.).

To decide which structure to be adopted, following factors should be considered. The point will be given comparatively based on benefits of passengers.

Fairness to passengers who have diverse travel distance

Suitable fare structure should be fair for both passengers who have short and long travel distance. That is, fare price per kilometre should not be much fluctuated.

Benefits for passengers with low income and living in remote areas

In case of Bangkok metropolitan area, one who lives in remote area tends to have lower income than the one who lives in inner city. This group of people is indirectly forced to use private car or public transportation that has low standard. Adopting common fare system will provide better alternatives in travelling to this group of people.

Ability to encourage passenger to avoid crowded area (inner city)

Normally metropolitan area is the center of business and economic activity that leads to high volume of travel. There will be high density of passenger in this area especially in rush hours. Therefore, when public transport network has been developed to cover the city area, effective common fare should provide alternatives for passenger and help reduce the trip that passes inner city. That is, it will encourage passenger who does not have destination at inner city to take detour route.

Ability to support the expansion of public transportation network

Common fare structure that is suitable for Bangkok metropolitan region should be flexible to support public transportation that will increase in the future so that there is no need to revise fare rate every time there is new transportation scheme in the system.

Complication in Implementation

Since there are many organizations responsible for public transportation in Bangkok metropolitan region, common fare structure should not change the way each organization works. Revenue apportionment should be clear and simple. This will ease the negotiation process between governmental sectors and private operators.

Number of passengers using public transportation

Good common fare structure should attract people to use more public transportation. This will be considered by total number passengers for the whole network and service level that should not be too high in some particular area.

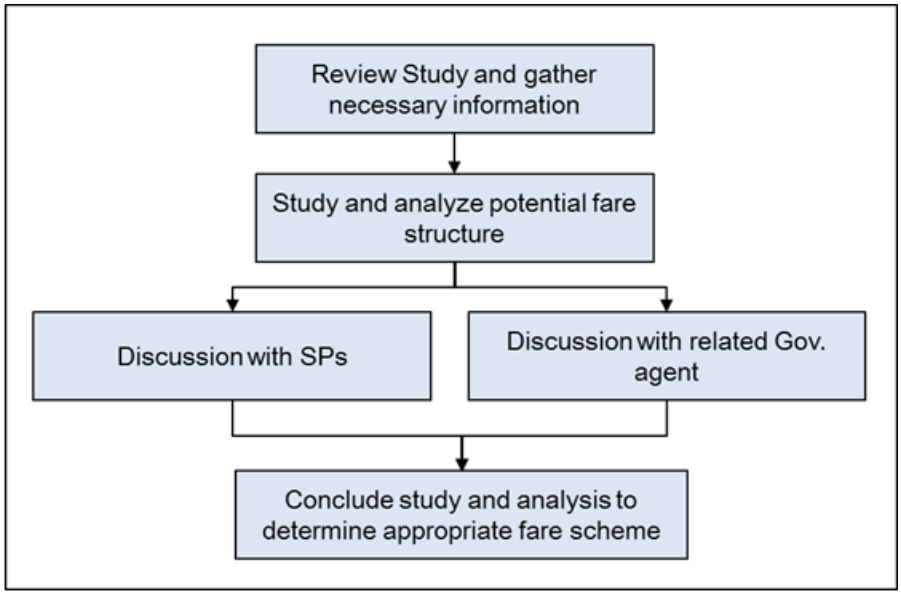
3) Common Fare Structure

To set common fare structure, many governmental methods should be considered to attract passengers to use common fare. The techniques include discount for the beginning period of common fare adoption such as setting the fare at 20 Baht for the whole trip or exemption of initial charge when the passenger changes mode of transportation. To do so, the government has to pay subsidy for missing revenue to operators. In order to set up techniques and policy related to establishing common fare structure, following factors and impacts should be considered.

- Government policy related to common fare structure
- Government cost that will incur in each method
- Impact on number of passenger and efficiency of each technique to attract passengers
- Regulations or limitations regarding fare collection of service provider.
- Technological limitations in revenue apportionment

Common fare procedures can be divided into 5 activities including study, result revision, and consulting with governmental units and service provider, as shown in Figure 4.5-2.

Figure 4.5-2 Chart of activities related to common fare specification



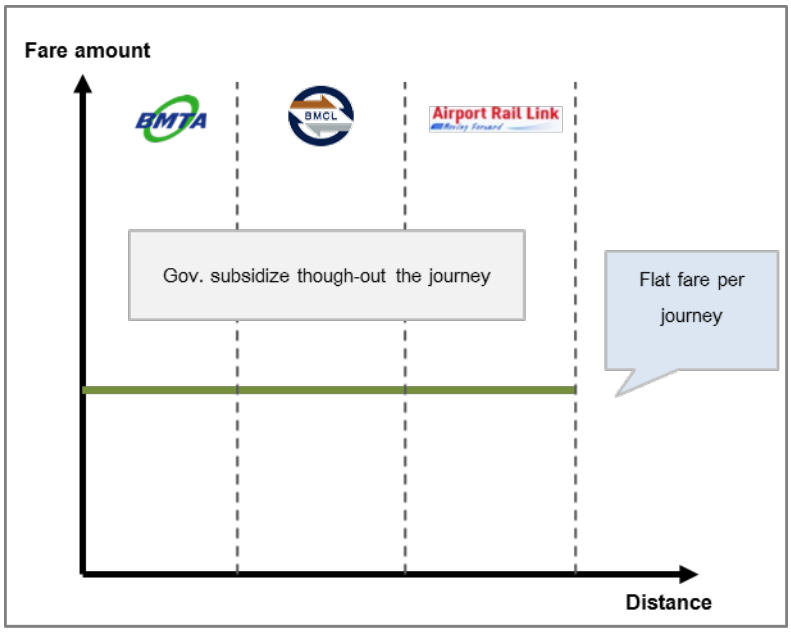
There are 3 main common fare structures that could be applied to Thailand's transportation system, as follows.

3.1) 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.

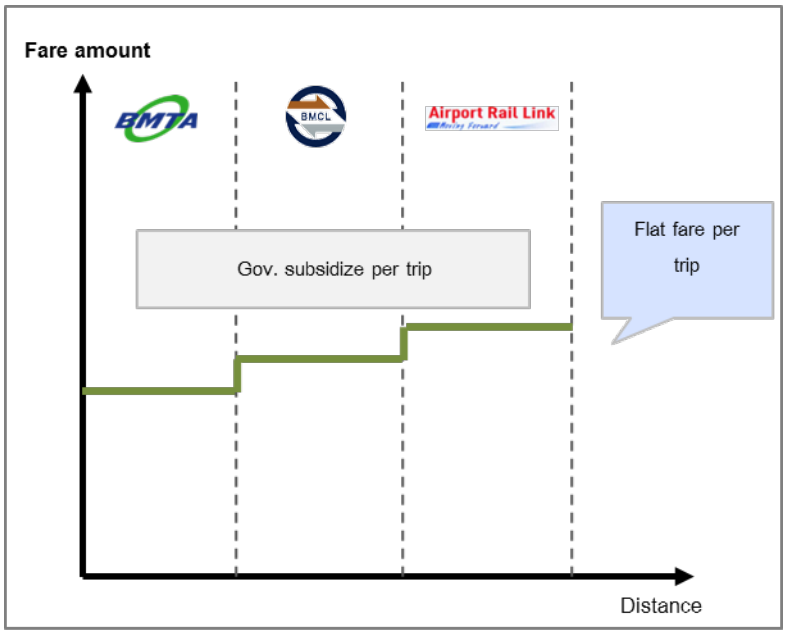
Figure 4.5-3 Flat fare per journey



3.2) Flat fare per transportation mode

Fare in this 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.

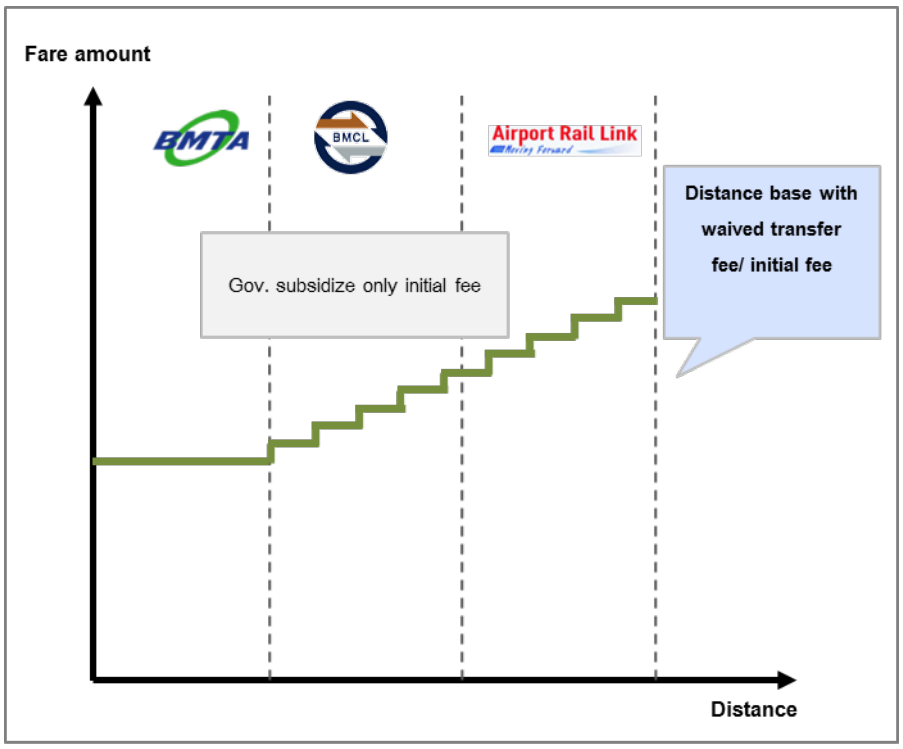
Figure 4.5-4 Flat fare per transportation mode



3.3) 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 4.5-5 Distance based, with waived/discounted initial fee



4.5.2. Approach for fare allocation to service providers

To develop common ticketing system, it is important to consider how to allocate fare to service providers. That is, technology will be used to help collect data of usage of each system to calculate fare for each operator and to allocate or clear debt within designated timeframe. This will be done 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 payback to each operator's account.

CCH needs to launch policy or approach to allocate revenue between operators in the system. This has to be done by thorough study regarding limitations or contracts with each operator. Moreover, demand survey including opinion of related parties should be conducted. Related parties include governmental sectors responsible for policy setting, public transportation service provider, and settlement service provider.

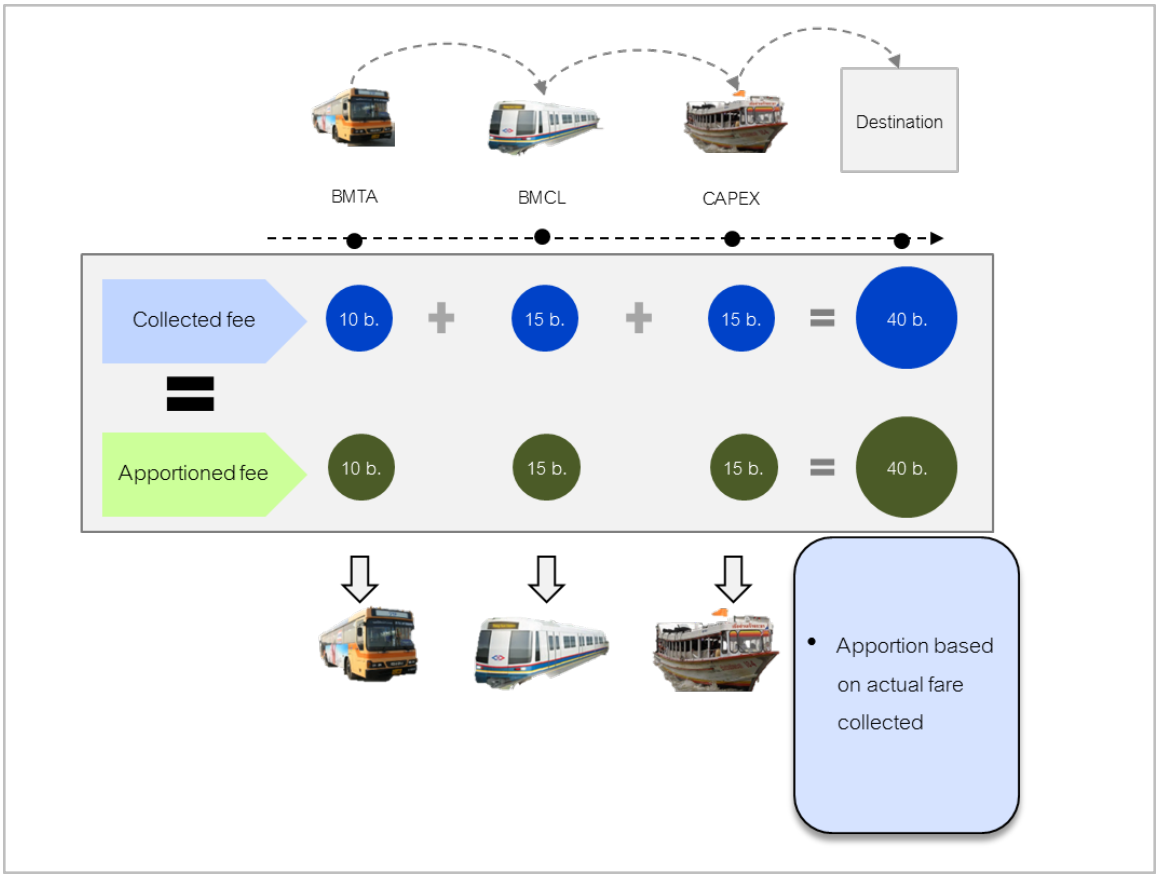
Revenue apportionment approaches that are used and successful overseas can be divided into 2 main structures, which are 1) non-common fare apportionment and 2) common fare apportionment.

1) Non-common fare apportionment

This structure refers to fare allocation 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 allocation. CCH will request fare rate from ticket issuer and top-up agent to distribute service fee that was previously collected to each service provider.

One-time apportionment is not suitable for common fare structure because collected fare will be equal to apportioned fare as shown in the figure below.

Figure 4.5-6 Non-common fare apportionment

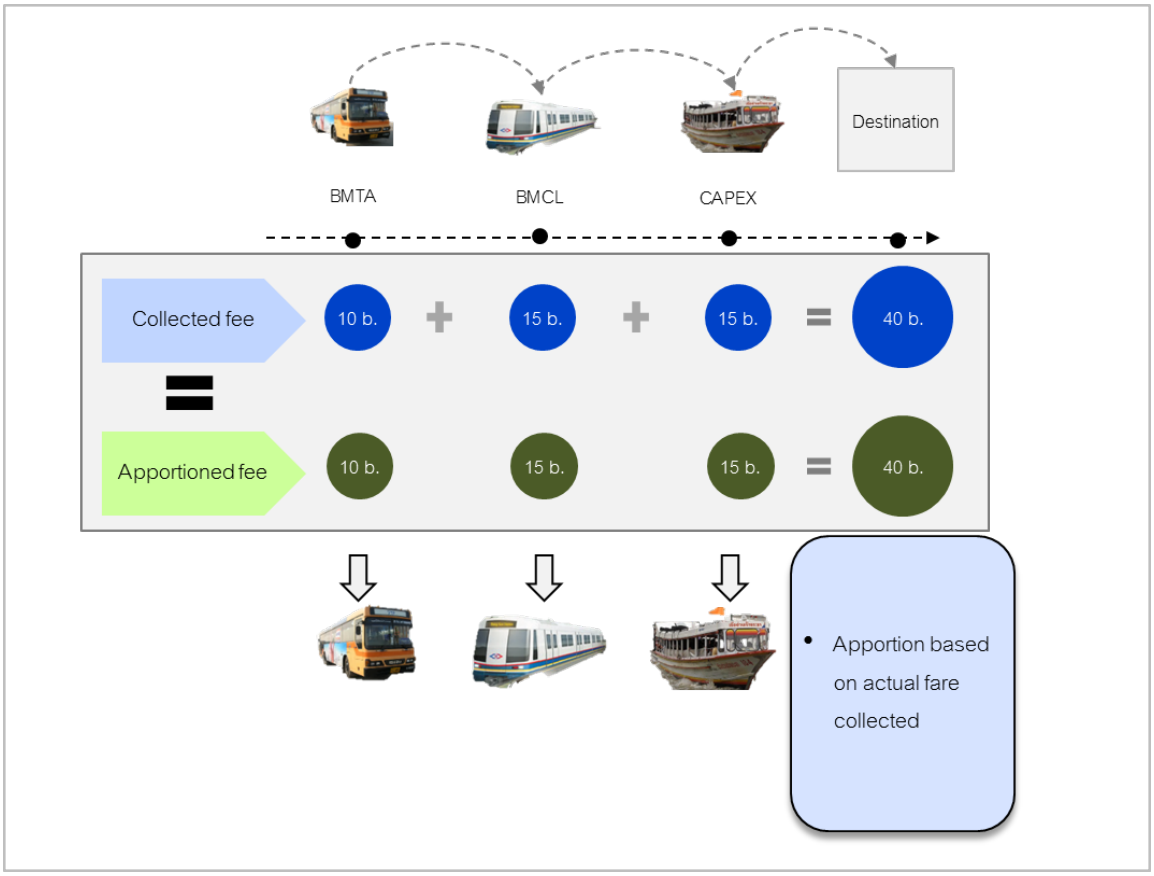


2) Common fare apportionment

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

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.

Figure 4.5-7 Common fare apportionment



4.5.3. Service fee collection scheme

1) Fee calculation scheme

Since the role of each operator and environment of automated collection system vary, service fee calculation scheme is different. Fee calculation can be divided into fixed fee and variable fee. To give an advice in the calculation, the advisor will consider cost of investment in the system and operating cost, amount of usage in each period, and operating standard of the system. Still, fee calculation depends on the negotiation. Service fee can be divided by types of operation of related parties, as follows.

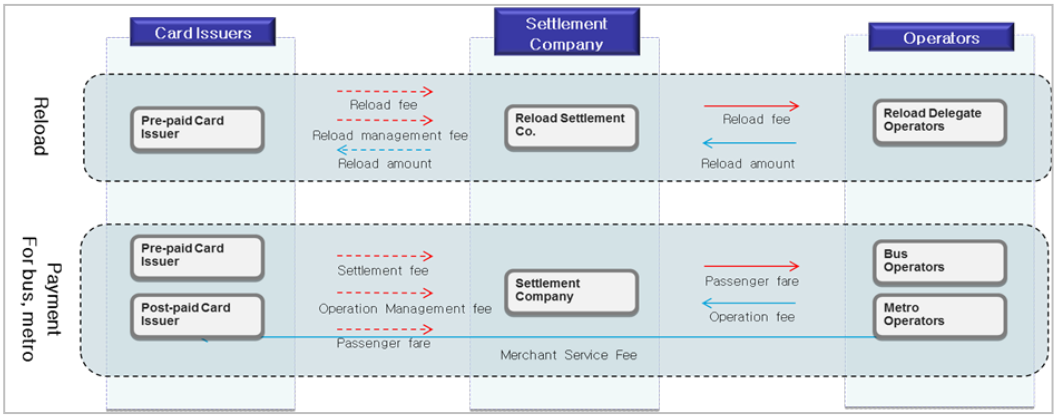
Table 4.5-6 Fee collection structures

Card issuer fee	Service fee for shops	Fee paid by allied shops (public transportation operator, shops, etc.) to card issuing company in case the card is used to pay in shops

	Fee for top-up fee agent	Top-up fee paid by card issuer to top-up fee agent
	Top-up management fee	Fee paid by card issuing company to settlement operator
AFC owner (operating and maintain company)	Operating fee	Fee paid to outsourcing company for operating and maintenance AFC equipments and system
	Management fee	Fee paid by card issuing company to O & M company for managing action lists (hot lists) of each card
Central Clearing House (CCH)	Account clearing fee	Fee paid by card issuing company to CCH for information collection, settlement, and service allocation

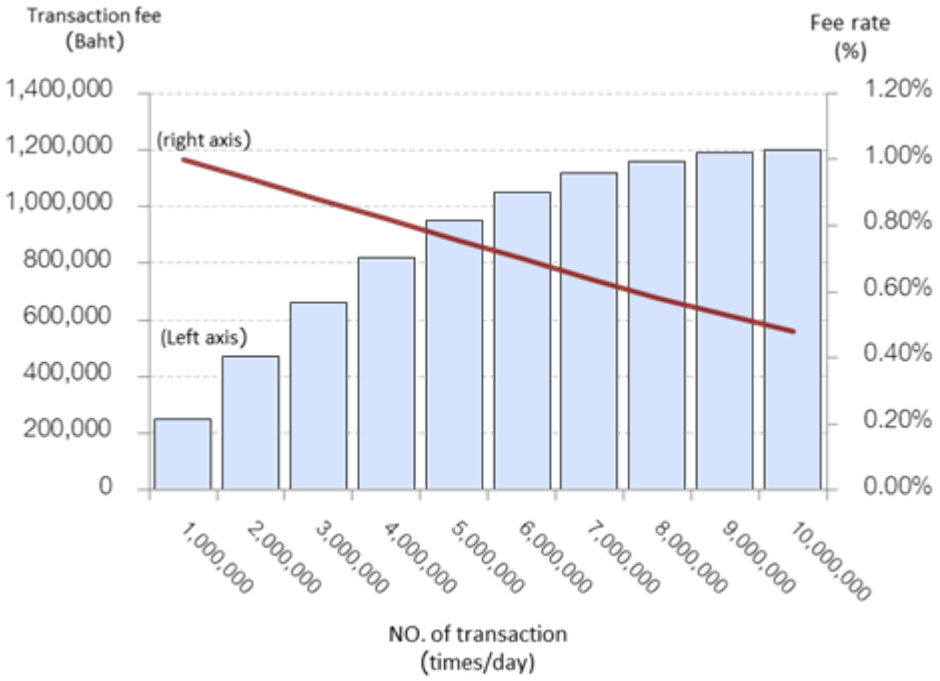
2) Cash flow in fee collection process

Figure 4.5-8 Example of service collection process



According to the figure above, there are 2 main payment activities, which are 1) fee payment for card top-up, which is paid by card issuer to top-up agent and settlement agent by calculating from money topped up or money paid from the card, and 2) fee payment for information collecting and settlement service, which is paid among public transportation operator, card issuer, and settlement agent and calculated from number of usage or percentage of fare. However, the percentage of this calculation should be revised to be reverse variation by value or number of payment each day as shown in figure below.

Figure 4.5-9 Fee collection revised by number of activities



Setting fee rate to be reverse variation by number/value of payment in each day, will support revenue management in the beginning of the project where number/value of payment is not that high and create fairness for operator later when number/value of payment increases.

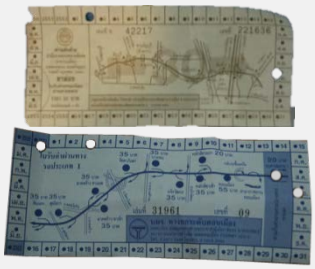
4.6. Technical factors in developing common ticket system

4.6.1. Proper technological ticket that is suitable for common ticket system

There are many types of tickets currently used in public transportation system in Bangkok metropolitan area, such as paper ticket, magnetic ticket, and contactless smart card (used by system that has automated income collection) as summarized in table 4.6-1.

Table 4.6-1 Types of ticket used in public transportation in Bangkok metropolitan area

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)	บัตรแถบแม่เหล็ก (Mag-Stripe) 	Contactless Smart Card (CSC) 
Metro Bus (BRT)	Contactless Smart Ticket (CST) 	Contactless Smart Card (CSC) 
Rabbit Card	N/A	Contactless Smart Card (CSC) 
Bangkok Mass Transit Authority (BMTA)	Cash (paper ticket) 	Paper ticket 

Transit System	Single Journey Ticket (SJT)	Store Valued Card (SVC)
Public boat	Cash (paper ticket) 	-
Express way	Cash (paper ticket) 	Easy Pass (long-range RFID) IC Card (Mifare) 

From table 4.6-1, it can be seen that in the past most ticket was paper, which clearly stated the price and destination. It can be found in public boat, train, and bus.

Currently, many transportation systems in Bangkok metropolitan area have adopted new technology to assist in providing service. This helps improved automated fare collection system to create convenience for both service provider and user. The technology is called Contactless Smart Card or Ticket/Token.

Contactless Smart Card is widely used in public transportation around the world be case it is reusable leading to low life cycle cost and low maintenance fee because the equipment nas no moving parts. This type of ticket can be found in MRT, BTS, BRT, and SARL. According to the survey, users are satisfied with Contactless Smart Card because it is convenient, fast, and they also get discount for a store valued card.

Contactless Smart Card technology can be divided into 3 types, which are A, B, and C. Each type has different qualifications and standards, as follows.

Table 4.6-2 Comparison of qualifications of each type of contactless smart card

Item	Type A	Type B	FeliCa
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 spec — Access Control ID Card — Global Platform CPU Card — Re-loadable transport card	Less applications —MOTOROLA M-Smart Mercury MM IC card spec —Global Platform CPU Card —Re-loadable transport card	Medium applications — 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 the table above, it can be seen that significant difference is Card Structure/Data Format, which is predefined in Felica but not in some of MIFARE Type A and Type B. This makes MIFARE Type A and B more flexible than Felica but more control is needed as well since system maintenance cost is high.

Contactless Smart Card/Token that is currently used can be divided into 2 main categories, which are Memory, such as Type A Mifare Classi and Microprocessor, such as Type A DESFire and Type C (FeliCa). The memory card is cheaper than the microprocessor but less security and flexibility in expansion of Multi-Application function. The disadvantage of microprocessor card is that it has high risk of being manipulated by producers because they can set unique operation system and equipment.

The study showed that there are approximately 7 million passengers using public transportation in Bangkok metropolitan area daily. In the future, if common ticket system is adopted in other transportation system in major cities, it is expected that there will be at least 10 million passengers per day. The study also showed that Mag-Stripe Card/Ticket was used in the system that has automated collection system long time ago and is still used with Single Journey Ticket; SJT even Store Valued Ticket; SVT has been introduced. On the other hand, the new system that just adopted automated collection system uses Contactless Smart

Ticket/Token; CST for single ticket and Contactless Smart Card; CSC for store valued card, as shown in table 4.6-3.

Table 4.6-3 Examples of ticket types used overseas

No.	City/Country	Average passenger per day (Million trips)	Store Valued Card	Single Ticket	Fare Structure
1**	Tokyo-Yokohama	42.16	Sony FeliCa	Magnetic	Distance
2	Mexico City	28.82	MIFARE Classic (Type A)	Magnetic	Flat/Pass
3	Moscow	27.59	MIFARE Ultralight (Type A)	MIFARE Ultralight (Type A)	Flat/Pass
4	Shanghai	16.71	MIFARE Classic (Type A)	MIFARE Ultralight (Type A)	Moving Zone
5**	Osaka-Kobe-Kyoto	16.58	Sony FeliCa	Magnetic	Distance
6**	Hong Kong	12.68	Sony FeliCa	MIFARE Ultralight (Type A)	Distance
7**	Seoul	12.58	Type A & Type B Controller	MIFARE Ultralight (Type A)	Distance
8	Mumbai	10.60	MIFARE DESFire (Type A)	MIFARE Ultralight (Type A)	Moving Zone
9	Beijing	8.60	MIFARE Classic (Type A)	MIFARE Ultralight (Type A)	Flat/Pass
10	Buenos Aires	8.08	MIFARE Classic (Type A)	Magnetic	Flat/Pass
11	Sao Paulo	7.34	MIFARE Classic (Type A)	Magnetic	Flat/Pass
12*	London	7.21	MIFARE DESFire (Type A)	Magnetic	Fixed Zone
13	Paris	6.85	Type B - Calypso	Magnetic	Fixed Zone
14	Manila	6.60	Magnetic	Magnetic	Flat/Pass
15	New York	6.03	MIFARE DESFire (Type A) (Trial)	Magnetic	Flat/Pass
16**	Singapore	5.79	Type B Controller	MIFARE Ultralight (Type A)	Distance

* Cities with Common Ticketing and Central Clearing House for Transit

** Cities with Common Ticketing and Central Clearing House Transit and Non-Transit

Note: Most cities do NOT require central clearing house because government is entitle of all revenue from fare boxes therefor those cities may implement only common ticketing system, while few cities where have both government whom are entitle of revenue from fare boxes therefor thesr cities require both common ticketing and central clearing house to apportion the entitle revenue to service providers.

From the table, it showed that Felica is superior to other technology in terms of long term improvement. However, Table 4.6-3 showed that most cities use Type A technology. After considering the fare structure, it can be seen that the system that use Memory Card, such as Mifare Classic or Mifare Plus, use Flat Fare structure. On the other hand, the system that uses Microprocessor Card has Zonal or distance based fare structure, which are more complicated. Moreover, the card can be used with goods payment and non-transit service as well.

Moreover, the international survey showed that Mifare technology is widely used and accountable for 75%. In Thailand, the list of transportation system and non-transit business using contactless smart card is shown below.

Table 4.6-4 Examples of smart card/token used in Thailand

No.	System	Number of users per day (Million)	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 A)	Magnetic	A, B, C	Moving 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, B, C	Flat

				A)		
Common Ticketing System						
1	Rabbit	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
	BBL (Rabbit)	0.01>	MIFARE DESFire EV1(Type A)	N/A	A, B	A, B

The table showed that most public transportation system and non-transit business use contactless smart card/token Type A. The comparison of qualifications of each ticket type is summarized in table 4.6-5.

Table 4.6-5 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 shrare stations with existing system	Low	High	Low
Investment of fare collection system in new transportation system that shrares stations with existing system	Low	High	High
Investment in card provision	Low	Low	High
Compatiblity 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 all the comparisons, Felica technology is the best in terms of technical factor especially for large system with sufficient usage. However, it will not be suitable for small or medium system that is expanding because cost per unit for small purchasing amount of cards is quite high. When consider all factors including technique, investment, and complication in improvement, Type A technology is the most suitable card for common ticketing system in Thailand.

In terms of single ticket, Type A technology or Felica in form of contactless Smart Ticket/Token (CST) can be used. For the transportation system that still use magnetic card, it is suggested to use the card until it reaches end of useful life then change to Type A in the form of Contactless Smart Ticket (CST). Since station level equipment (SLE), such as automated selling machine (TIM, ITM, and TVM), card capturing, and card transport module of automated gate was

designed to use with card only, it is not suitable for token type. However, Type A and Felica should not be used simultaneously because it will slow down processing speed of the system.

Besides predefined-standard Type A DESFire and FeliCa, there are Type A and B technology that the developer created their own standard, such as CEPAS, CIPURSE, which if it is published and disclosed, it will be called open standard. Since developer can create standard without limitations, it is suitable to use with common ticketing system in Thailand (Type A and FeliCa) as shown in the comparison table below.

Table 4.6-6 Comparison of each ticket types

	SVT / PASS					SJT	New Media
	CEPAS	**CIPURSE**	**DESFire**	**KSCC**	**FeliCa**	**Ultralight**	**NFC**
Card Standard	ISO/IEC 14443	ISO/IEC 14443	ISO/IEC 14443-A	ISO/IEC 14443	JIS X6319-4	ISO/IEC 14443-A	ISO/IEC 18092
	ISO 7816	ISO 7816	ISO 7816	ISO 7816		ISO 7816	ISO/IEC 14443
							JIS X6319-4
Structure Standard	SS518:2006	CIPURSE	DESFire	T-Money	Suica / OCL	Ultralight	NFCIP-1 & 2
Card Structure	Standard	Standard	Standard	Custom	Custom	Standard	Standard
Data Structure	Standard	Custom	Custom	Custom	Custom	Custom	Custom
Card OS	Standard	Custom	Standard	Custom	Custom	Standard	Standard
RF Protocol	Type A and B	Type A or B	Type A	Type A and B	Type C	Type A	Type NFC, A, B and C
Card Type	Type B Controller	Mifare Controller	Mifare DesFire	Type A Controller	Sony (JP) Panasonic	Mifare Ultralight	NFC Controller
	Mifare Controller	Type B Controller	or Mifare controller	or Type B Controller			USIM A or B or C
Security	3DES / AES	AES	3DES / AES	3DES / AES	3DES / AES	DES / 3DES	3DEC / AES
Chip Supplier	Inside (FR) Infineon (GR) ST Micro (CH) Renesas (JP) Oberthur (FR) G&D (GR) Gemalto (NL)	NXP (NL) Infineon (GR) ST Micro (CH) Renesas (JP) Oberthur (FR) G&D (GR) Gemalto (NL)	NXP (NL) ST Micro (CH) Renesas (JP) Oberthur (FR) G&D (GR) Gemalto (NL) Watchdata (US)	NXP (NL) Infineon (GR) ST Micro (CH)	Sony (JP)	NXP (NL) Infineon (GR) ST Micro (CH) Renesas (JP) Oberthur (FR) G&D (GR) Gemalto (NL) Watchdata (US)	NXP (NL) Sony (JP) Infineon (GR) ST Micro (CH) Renesas (JP) Oberthur (FR) G&D (GR) Gemalto (NL)
Deployment	Singapore	Madrid (2013)	Global	Korea	Japan / HK	Global	Korea / SG
Proven on Transit	Yes	**No**	Yes	Yes	Yes	Yes	Yes
Proven on Non- Transit	Yes	**No**	Yes	Yes	Yes	No	Yes
NFC							
NFC Controller	Communicatio n only	Communicatio n only	Yes	Communicatio n only	Yes	Yes	Yes
Embedded Secure Element	No	Yes	Yes	No	Yes	Yes	Yes
External SE USIM / SD card	Required	Choice	Choice	Required	Choice	Choice	Choice
Communication Standard	Type B	Type A / B	Type A	Type A	Type C	N/A	Type A /B
Proven NFC Case	**Trial**	**No**	Yes	Yes	Yes	N/A	Yes
Cross Boarder NFC	Trial	No	No	Trial	No	N/A	Trial
System Comparison							
Card Flexibility	High	High	Medium - High	High	High	Low	Medium - High
Implementation time frame	Medium	Slow	Fast	Medium	Medium	Fast	Medium
Security	High	Higher	High	High	High	Low	High

	SVT / PASS					SJT	New Media
	CEPAS	CIPURSE	DESFire	KSCC	FeliCa	Ultralight	NFC
Chip/Card Suppliers	5<	5<	5<	5<	**24**	5<	5<
AFC SI Software Suppliers	**1**	**1**	10<	3<	3<	10<	3<
AFC Equipment Suppliers	5<	**1**	10<	5<	5<	5<	3<
Proven Common Ticketing (5M+)	Yes	**No**	Yes	Yes	Yes	N/A	N/A
Overall Risk	**Medium - High**	**High**	**Low**	**Medium**	**Medium-High**	**Low**	**Medium**
Cost Comparison							
Card Price	Medium - High	Medium - High	Medium	Medium - High	High	Low	Highest
Initial Implementation Cost	Medium	High	Low	High	High	Low	High
Upgraded existing systems in Thailand	Complex	Moderate	Simple	Complex	Complex	Simple	Moderate
Individual implementation	Medium	Medium	Low	Medium	Medium	Low	Medium
Overall implementing cost	**Medium - High**	**Medium - High**	**Low**	**Medium - High**	**High**	**Low**	**Medium - High**

The table showed that Cipurse technology is not actually used with transportation system and non-transit business. Moreover, the technology has not developed to be used with NFC. Therefore, it is risky and not suitable to use with common ticketing system in Thailand at the moment.

Another risky technology is FeliCa. Since there are not many chip producers, it is not suitable to use in Thailand. Even though CEPAS is an open system that can be developed further, it has only one developer in Singapore. As a result, it is not suitable to be used in Thailand.

Card structuring process has to consider card operating system, radio frequency protocol, card structure, and data structure, as follows.

1) Card Operating System (OS)

Besides the point in 4.6.1, there are 2 more factors to be considered, which are standard OS and custom OS. The advantages and disadvantages of the 2 factors are as follows.

Table 4.6-7 Comparison between Standard OS and Custom OS

Topic	Standard OS (Memory)	Standard OS (Microprocessor)	Custom OS
Duration of OS development	Fast	Fast	Slow
Development cost	Low	Low	High
Security	Medium	High	High
Risk of finding developer	Low	Low	High
Future development	Easier	Easier	Harder
Ticket system in Thailand	SARL, BRT, BMCL, BTS	BSS	Thai Smart Card
Current common ticket system	N/A	SUICA, Pasmo, Octopus, Tfl	CEPAS, T-Money, CIPURSE

After considering all factors, standard OS is the most suitable OS for common ticketing system in Thailand.

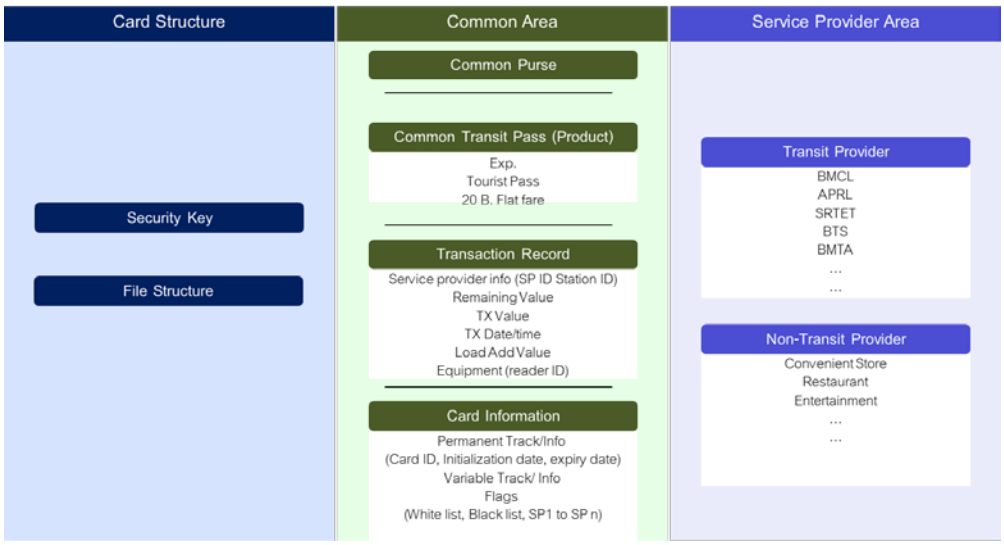
2) Radio Frequency Protocol (RF Protocol)

RF Protocol refers to the process of reading and writing data in the card via radio frequency. This process should be standardized, which is determined along with ticket selection. Since standardized method can be used with every reader, it has lower risk than custom method.

3) Card Structure

In general, card area can be divided into 3 parts, which are Card Structure Area, Common Area, and Service Provider Area, which cannot be modified. The components of each area are as follows.

Figure 4.6-1 Examples of card area allocation



3.1) Card Structure Area)

Card/File Structure identifies area allocation in the card, type of data, and size of data. In terms of security, which is an important aspect of the card, there are 2-3 main types of encryption that are suitable for current situation, which are DES/3DES and AES, as follows.

DES (Data Encryption Standard)

DES is an encryption using Block cipher, which was developed from algorithm of IBM Lcifer.

Nowadays, DES can be separated into DES 64 bit and DES 128 bit. Even though 128 is used, DES can be cracked. Consequently, Triple-DES (3DES) is developed for higher security.

3DES is an encryption standard that was created to solve security problem of DES. It takes 3 times of algorithms to encrypt, in which each time it takes different key to enter. Therefore,

there are 3 keys (56 bit each) used in 3DES. With its high security level, 3DES is another encryption standard widely used at the moment.

AES (Advanced Encryption Standard)

AES (Advanced Encryption Standard) or Rijindael use block sized 128 bit and key sized 128, 192 and 256 bit. It is one of the most popular encryption that was developed to replace DES.

Table 4.6-8 Comparison of advantages and disadvantages between AES and 3DES

	AES	3DES	DES	F2F or Aiken Biphase
Year of Development	2000	1998	1979	N/A
Encryption key	Stronger	Strong	Shorter and Weaker	N/A
Block Size	Longer	Long	Shorter	N/A
Security	Higher	High	Lower	Lowest
Processing Time	Lower	High	Higher	Highest
Brute-force attack	Could not be determined	2030	1998	N/A

F2F encryption standard (frequency/double frequency) or Aiken Biphase was developed from ISO/IEC-7811, which is the encryption by changing magnetic pole that occurs when using magnetic ticket given bit 1 for changing magnetic pole and bit 0 for not changing. This type of encryption has low security level. Later on, smart card was developed. It has Build-in security technology, such as Mifare Crypto so it is more secured. When store valued cards are more widely used, security level has to increase as well. It can be seen that encryption system as DES, 3DES, and AES have been more secured and replaced old build-in security.

The significant difference is DES use only 56 bit key, 3DES has 168 bit while AES can support 128, 198, and 256 bit. This made AES more durable against brute-force attack.

In conclusion, normal security systems use 3DES although it can be used up to year 2030. That is because it is more suitable for current usage than AES, which has higher security level but has low processing time.

From the comparison above, 3DES should be the most suitable standard at the moment. However, if the system has developed, it can adopt AES or higher standard in the future.

3.2) Common Area

- Common Purse for storing value to pay for fare or price of goods and services
- Common Transit Pass to collect travel mileage of all participating systems
- Transaction Record for collecting all information of card usage for central revenue apportionment to process

- Card Information containing card number, type of card, start date and expiry date

3.3) Service Provider Area

It is the area for public transportation operator and non-transit business operator to use card for promotional purposes, such as SAR< BMCL, 7-Eleven, etc.

4) Data Structure

Data structure should be customized because fare policy and business rules should be considered to separate between common Area and Service Provider Area. Business rules should cover following topics.

- Card information management should be defined to create mutual understanding
- Ticket management, such as type of ticket, start date, the change of ticket, etc.
- Fare policy of each service provider, such as fare and promotion
- Card Security including standards and policy that need to be clear support future usage
- Product Interoperability that supports many system

The summary of product used in current transportation system is shown below.

Table 4.6-9 The summary of product used in current transportation system

Product		Usage regulation and fare rate						
		ARL	MRT	BTS	BRT	BSS	BMTA	EXAT
Single Journey Ticket ; SJT								
Recycle	Single ticket can be reusable until it reaches the maximum reusability, expiration, or deteroration.	✓	✓	✓	✓	X	✓	✓
Child	Passenger for this type of ticket must have qualification as stated in the policy.	X	✓	✓	X	X	N/A	X
Student	This type of ticket can be used with students or university students.	X	✓	X	✓	X	✓	X
Adult	This ticket is for regular passengers.	✓	✓	✓	✓	X	✓	✓
Elder	User of this ticket must be an elderly under Elderly act B.E. 2546 and present ID card when purchasing the ticket.	X	✓	X	✓	X	✓	X
Veteran	User of this ticket must hold Veteran card or badge under Veteran regulation B.E. 2522 and preset card or badge when purchasing the ticket.	N/A	N/A	N/A	✓	N/A	✓	X
Disable	The user of this ticker must be disabled person who can be visibly perceived or hold any club for disabled.	X	✓	X	✓	X	✓	X

Product		Usage regulation and fare rate						
		ARL	MRT	BTS	BRT	BSS	BMTA	EXAT
Public Service Obligation; PSO	Ticket user is regular passenger.	✓	X	X	X	X	✓	X
Single ticket with limited amount of reusability	Single ticket with limited amount of reusability	X	X	X	X	X	X	X
Alternative Media	Cost of fare media bear by other issuer or NFC	X	X	X		Feb 2013 with AIS	X	X
Store valuedd Ticket; SVT								
Child	Passenger for this type of ticket must have qualification as stated in the policy.	X	✓	X		X	X	X
Student	This type of ticket can be used with students or university students.	✓	✓	X	X	✓	X	X
Adult	This ticket is for regular passengers.	✓	✓	✓	✓	✓	X	✓
Elder	User of this ticket must be an elderly under Elderly act B.E. 2546 and present ID card when purchasing the ticket.	✓	✓	X	X	✓	X	X
Veteran	User of this ticket must hold Veteran card or badge under Veteran regulation B.E. 2522 and preset card or badge when purchasing the ticket.	N/A	N/A	N/A	X	N/A	X	X
Disable	The user of this ticker must be disabled person who can be visibly perceived or hold any club for disabled.	X	X	X	X	X	X	X
Public Service Obligation; PSO	This ticket is for regular passengers.	✓	X	X	X	X	X	X
Period Pass								
Limited Time, Limited Trip								
Child	Passenger for this type of ticket must have qualification as stated in the policy.	X	X	X	X	X	X	X
Student	This type of ticket can be used with students or university students.	X	X	✓	X	✓	✓	X
Adult	This ticket is for regular passengers.	X	X	✓	X	✓	✓	✓
Elder	User of this ticket must be an elderly under Elderly act B.E. 2546 and present ID card when purchasing the ticket.	X	X	X	X	X	N/A	X
Veteran	User of this ticket must hold Veteran card or badge under Veteran regulation B.E. 2522 and preset card or badge when purchasing the ticket.	N/A	N/A	N/A	N/A	N/A	N/A	X
Disable	The user of this ticker must be disabled person who can be	X	X	X	X	X	N/A	X

Product		Usage regulation and fare rate						
		ARL	MRT	BTS	BRT	BSS	BMTA	EXAT
	visibly perceived or hold any club for disabled.							
Public Service Obligation; PSO	This ticket is for regular passengers.	X	X	X	X	X	X	X
Limited Time, Unlimited Trip								
Child	Passenger for this type of ticket must have qualification as stated in the policy.	X	X	X	X	X	X	X
Student	This type of ticket can be used with students or university students.	X	X	X	X	X	X	X
Adult	This ticket is for regular passengers.	X	✓	✓	X	X	X	X
Elder	User of this ticket must be an elderly under Elderly act B.E. 2546 and present ID card when purchasing the ticket.	X	X	X	X	X	X	X
Veteran	User of this ticket must hold Veteran card or badge under Veteran regulation B.E. 2522 and preset card or badge when purchasing the ticket.	X	X	X	X	✓	X	X
Disable	The user of this ticker must be disabled person who can be visibly perceived or hold any club for disabled.	X	X	X	X	X	X	X
Public Service Obligation; PSO	This ticket is for regular passengers.	X	X	X	X	X	X	X
Ticket Promotion								
Fixed Journey	There will be a discount for travelling between 2 given stations.	X	X	X	X	X	X	X
Return Home	There will be a discount for the second trip when using the destination of the first trip to be the origin of the second trip.	X	X	X	X	X	X	X
Frequency Flyer	There will be bonus when number of trips reaches the given number.	X	X	X	X	X	X	X
Bonus Period	There will be bonus when travelling within designated timeframe.	X	X	X	X	X	X	X
Lucky Draw	There will be bonus point when presenting ticket at the given station within timeframe.	X	X	X	X	X	X	X
Station Specific	There will be a discount when checking in or out the given station within date and timeframe.	X	X	X	X	X	X	X
Terms of Use								
Period of each day	Peak and off-peak period	✓	X	X	X	X	X	X
Group of day	Weekdays, weekends, and holidays	X	X	X	X	X	X	X

Product		Usage regulation and fare rate						
		ARL	MRT	BTS	BRT	BSS	BMTA	EXAT
Cross Transit Promotion								
Bonus Trip	There will be bonus trip when purfchasing common ticket.	X	X	X	X	X	X	X
Intermodal Transfer Discount	There will be a discount for chainging transportation system.	X	X	X	X	X	X	X
Transit Mode								
Single Operator	Ticket can be used with identified system, such as BMCL, SRTET, BTSC, BMTA, CPEX	X	X	X	X	X	X	X
Single Mode	Ticket can be used with identified mode of transportation, such as sky train, train, airport rail link, bus, metro bus, boat, etc.	X	X	X	X	X	X	X
Multi Modes	Ticket can be used within group of transportation mode, such as BTS and MRT, train and bus, train and boat, bus and BRT, or stated otherwise.	X	X	X	X	X	X	X
Touch and go card								
Period of each day	Peak and off-peak period	X	X	X	X	X	X	✓

5) Interoperability

The most important aspect for interoperable system is having no conflict between card structure and existing card system. Common card should have backward compatibility to be completely interoperable without incurring high cost.

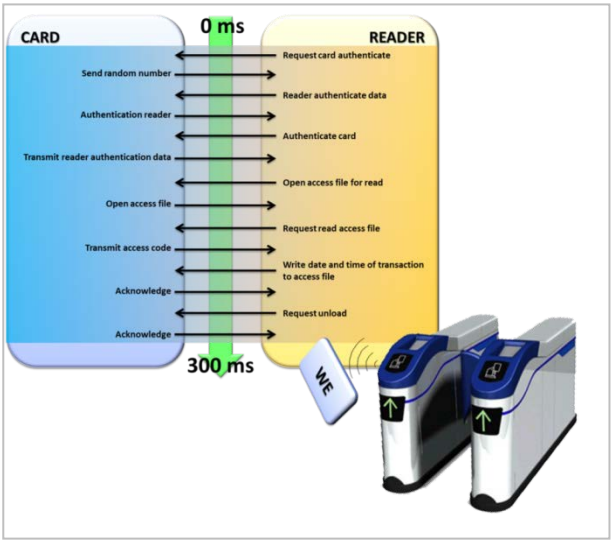
4.6.2. Front-end technology suitable for developing common ticket system

Factors of front-end system that should be considered are as follows.

1) Card / Reader Interface

Card reader will read and write data on the card via RF protocol with Security access module (SAM) to secure data during the process. Read/write process is shown in figure 4.6-2.

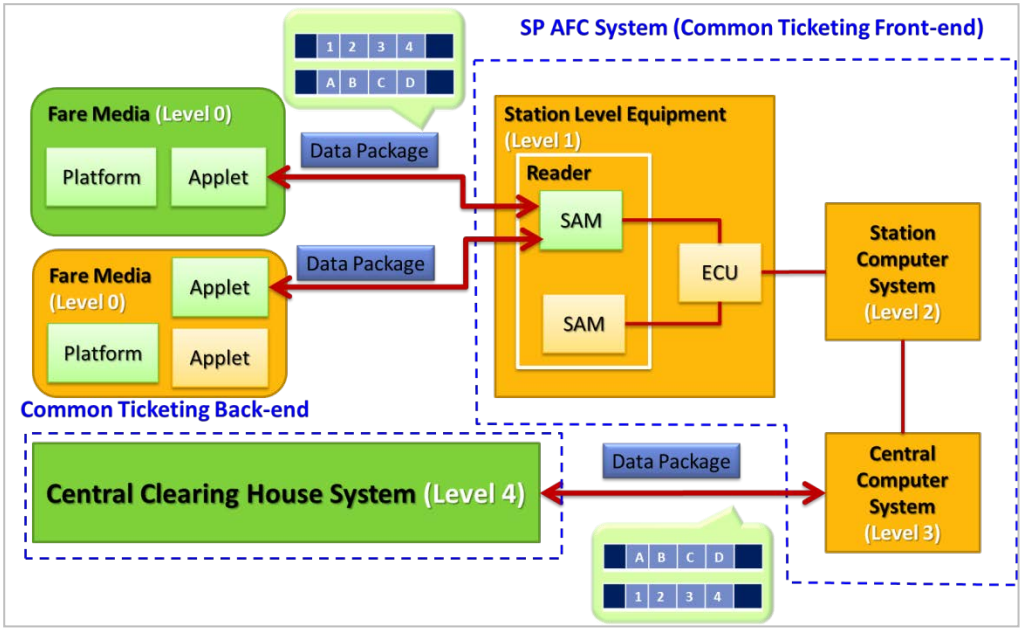
Figure 4.6-2 Process of card reader/writer in transportation system



2) Front-end; Level 1 - 3

Station Level Equipment (SLE; Level 1) will process operating result and store transaction data from Fare Media; Level 0 and SAM of common ticket on Station Computer; SC; Level 2 and Central Computer; CC; Level 3, which are service providers' equipment. Then this information will be passed to Central Clearing House System; CCH; Level 4. The requirements of common ticket should be relevant with storage capability of current system, number of routes and station, and fare chart structure.

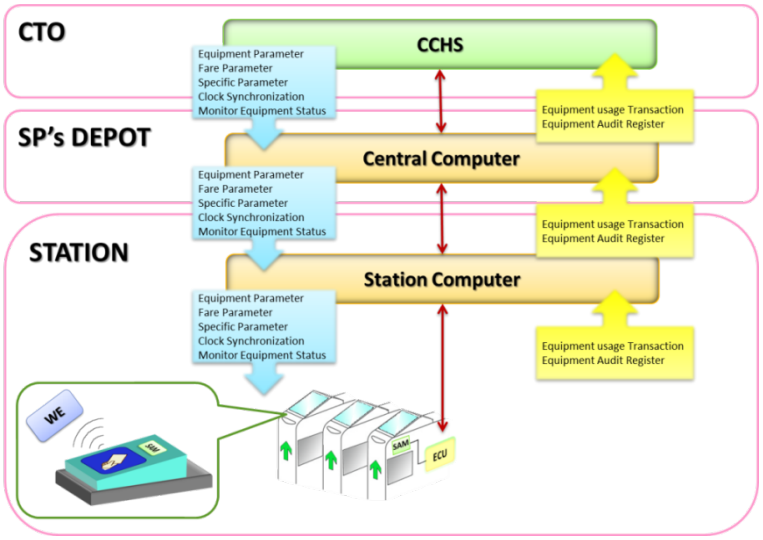
Figure 4.6-3 Procedure of Front-end equipment connection



Form and information in automated income collection system should have following structures.

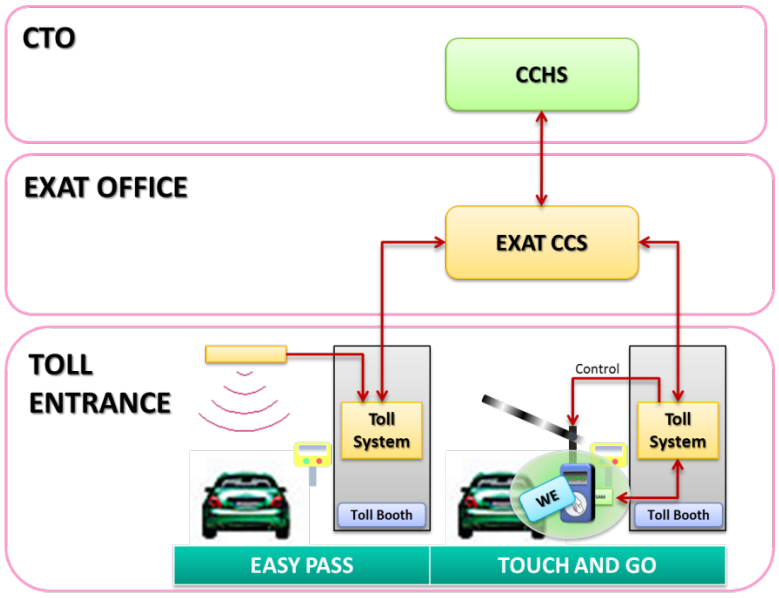
2.1) BTS system

Figure 4.6-4 Basic structure of BTS income collection system



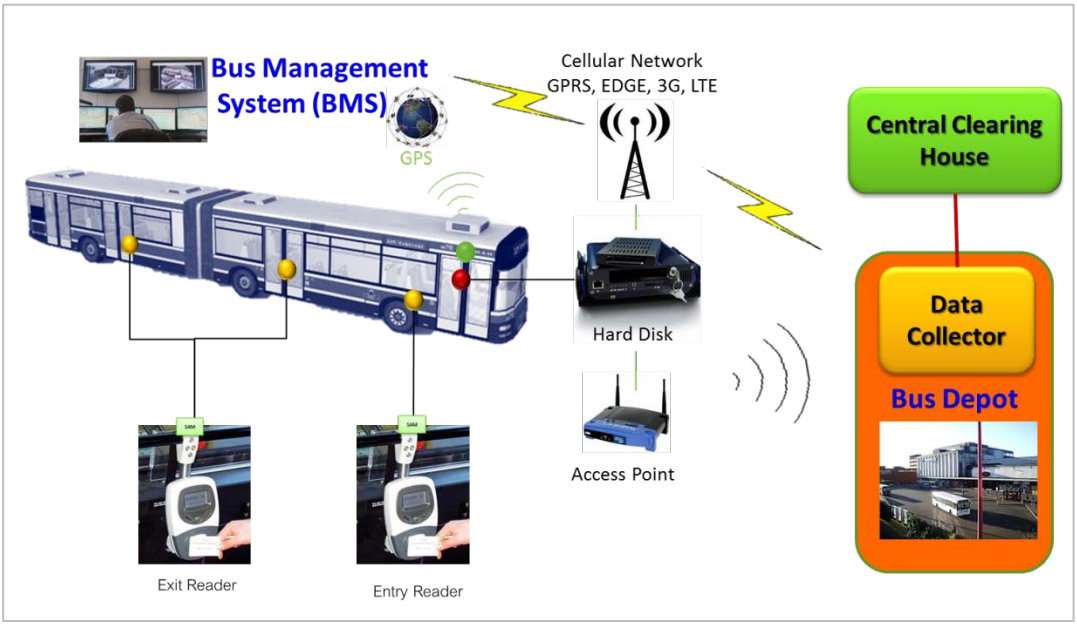
2.2) Express way system

Figure 4.6-5 Basic structure of express way income collection system



2.3) Bus system

Figure 4.6-6 Basic structure of bus income collection system



3) Connection between Service Provider Central Computer SPCC and Central Clearing House CCH Interface

The CCH system architecture has to coordinate with Central Back Office in many ways including:

Coordination with user in terms of data processing

- Electronic money transfer has to relate to Settlement Fund Transfer
- Coordination with Local Payment Systems about direct withdrawal from Autoload Requests
- Revision of card issuer information from Initialisation and Personalisation process has to relate to card management system
- Coordination with customer service center

However, if CCH would like to coordinate with service providers' system to expand usability of Central Back Office Solution, the system must have financial management, storage and business analysis, and reporting functions.

Chapter 5. Operating plan and reports

5.1. Operating plan

The PMS advisor has the project's operational concept which consists of sequential procedures as indicated in the Table **5.1.1**

From the aforementioned project's operational concept, it demonstrates the chart of the consecutive operational procedures as the advisors' operational chart consists of the works from the starting of the project until the completion of the project, total of 48 months period. The operations as below;

- Work 1: Policy making and common ticketing system management planning
- Work 2: Common ticketing system standardization and preparing details for the common ticketing developer procurement and the Central Clearing House (CCH) establishment
- Work 3: Supports of the common ticketing developer procurement and establishment of the CCH
- Work 4: Supports of the supervision of the common ticketing developer's execution and the CCH establishment
- Work 5: The academic technology supports and the Common Ticket Office (CTO) establishment
- Work 6: The technological instruction at the beginning of the common ticketing system operation and CCH's operation
- Work 7: The pilot project supports
- Work 8: Public relation and public participation
- Work 9 : Additional proposal other than stated in the TOR
- Work 10 : Documentation and reports

From the study and analysis stated in the 6.1, and for the propose of the project, the advisor implemented a 48 months period operational timeline conformed to the operational procedure by taking works' priority including the continuance between the works and personnel's capacity into consideration as demonstrated in **Table 5.1-1.**

Table 5.1-1 Project's operational timeline

Number	Work details	Month																																															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1	**Work 1 : Policy making and common ticketing system management planning**																																																
	1.1 Review on the Development of Common Ticket System in Thailand																																															
	1.2 Review on the Overseas Common Ticket System																																															
	1.3 Proposing the study on the technologies for the development of common ticket system																																															
	1.4 Proposing methods and details of development strategies and operation plans of common ticket system with public transportation																																															
	1.5 Surveying current fare collection methods in mass transit and non-transit and methods for the use of common ticket system																																															
	1.6 Brainstorming for the definition of common ticket developmental strategies																																															
	1.7 Defining development direction and policies of the common ticket system																																															
2	**Work 2: Common ticketing system standardization and preparing details for the common**																																															
	2.1 Defining the system's basic requirements and developmental plans for the Common Ticket																																															
	2.2 Conceptual design for common ticket system and CCH																																															
	2.3 Conceptual design for common ticket system and CCH Standardization of common ticket																																															
	2.4 Documentation preparation for common ticketing developer and CCH procurement																																															
	2.5 Fundamental cost estimation for common ticketing developer procurement and CCH establishment																																															
	2.6 Preparation plan and works priority for starting the common ticket system																																															
3	**Work 3 : Supports of the common ticketing developer procurement and establishment of**																																															
	3.1 Procurement process supports																																															
	3.2 Support and suggest to the procurement committee in the proposal consideration and suggest any related criteria																																															
	3.3 Support the procurement committee in negotiation such as technical, cost and conditions																																															
	3.4 Documentation preparation for contract signing																																															
4	**Work 4: Supports of the supervision of the common ticketing developer's execution and**																																															
	4.1 Support the supervision of the common ticket developer and CCH accord to the contract's condition																																															
	4.2 Supervision and contract management supports																																															
5	**Work 5 : The academic technology supports and the Common Ticket Office (CTO)**																																															
	5.1 Study of the organization's stucture, responsibilities, laws, regulations and specify the staff positions conform to the CTO at the beginning of the operation																																															
	5.2 The organization forming suggestion with flexibility and efficiency in operation																																															
	5.3 The academic documentation preparation and CTO establishment at the starting of the operation including procedures plan support and issue related laws and regulations																																															
	5.4 Operational policy and strategic plan development of CTO																																															
	5.5 CCH's and CTO's fundamental standardization and evaluation method																																															
	5.6 CCH's operation and maintenance regulations development under the CTO's supervision																																															
	5.7 Coordination for the completion of the CTO establishtment and CCH operation																																															
6	**Work 6: The technological instruction at the beginning of the common ticketing system**																																															
	6.1 Common ticketing management suggestion and supports for CTO																																															
	6.2 Tachnological improvement suggestion for CTO and CCH																																															
	6.3 CTO's performance improvement suggestion																																															

ลำดับที่		รายละเอียดของงาน	เดือนที่																																														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
7	**Work 7 : The pilot project supports**																																																		
	7.1	The starting of the common ticket system support by development suggestion				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	7.2	Evaluation and problems conclusion derived from the pilot project and resolution suggestion				--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8	**Work 8 : Public relation and public participation**																																																		
	8.1	Information and PR center establishment	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	8.2	Public relation events organizing				●	--	--	--	●	--	--	--	●	--	--	--	--	--	●	--	--	--	--	--	●	--	--	--	--	--	--	--	●	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	●
	8.3	Management of comments and complains	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	8.4	Advertising and printing media				●	--	--	--	●	--	--	--	●	--	--	--	--	--	●	--	--	--	--	--	●	--	--	--	--	--	--	--	●	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	●
9	**Work 9 : Additional proposal other than stated in the TOR**																																																		
	9.1	Appropriate fare study	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9.2	Approtionment study	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9.3	Fare colllection study	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9.4	Operator procurement and supports	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9.5	Commercial transaction expansion of the common ticket study	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9.6	Standard establishment for the commercial transaction related	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9.7	The common ticket innovation study	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9.8	The common ticket Top-up service study	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	9.9	Business Continuity Program study	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10	**Operational plan and reports**																																																		
	10.1	Inception report	●																																															
	10.2	Progress reports			●			●			●			●			●			●			●			●			●			●			●			●			●			●			●			●
	10.3	Comon ticketing policy and plan			●																																													
	10.4	Standard establishment				●																																												
	10.5	Optional suggestion for the procurement				●																																												
	10.6	Suggestion of basic qualifications for the operators' front-end and back-end																																																
	10.7	Comon ticket developer and CCH procurement documentation				●																																												
	10.8	CTO establishment suggestion				●																																												
	10.9	First pilot project summary																		●																														
	10.10	Suggestion report for common ticketing operation																														●																		
	10.11	Evaluation report of the common ticket developer and CCH]																																				●												
	10.12	Draft of final report																																														●		
	10.13	Final report and executive summary																																																●

5.2. Document and reports submission

The advisor shall completely execution within 48 months from the signing date. The 30 reports in Thai and English (except for the progress reports, draft of final report, final report and executive summary) will consist of main content as below;

(1) **Inception report**

To demonstrate the methods and procedures of the project within 1 month

(2) **Progress reports**

To report the project's progression including problems/obstructs every 3 months for the total of 30 reports in Thai and English

(3) **Common ticketing policy and plan report**

Within the 3rd month after the signing date

(4) **Standard establishment report**

Card, Reader, Interfaced Protocol and Interfaced Document standard development within the 4th month of after the signing date

(5) **Optional suggestion for the procurement**

Within the 4th month of after the signing date

(6) **Basic qualifications for the operator's front-end and back-end suggestion report**

Within the 4th month of after the signing date

(7) **Common ticketing developer and CCH procurement documentation**

Within the 4th month of after the signing date

(8) **CTO establishment suggestion**

Within the 4th month of after the signing date

(9) **First pilot project summary**

Within the 18th month of after the project's starting date and the pilot project's completion date

(10) **Suggestion report for common ticketing operation**

Within the 30th month of after the signing date

(11) **Evaluation report of the common ticket developer and CCH**

within the 36th and 46th month of after the project's starting date

(12) **Draft of final report**

Total of 30 reports in Thai within the 46th month of after the signing date

(13) **Final report and executive summary**

Total of 100 reports in Thai and English within the 48th month of after the signing date

(14) **Specific technical reports**

Specific technical reports of at least 5 studies after the completion of such study

Electronic report submission

(1) All the reports, except for the CTO and CCH procurement shall be in the form of E-Book saved in DVD for the total of 100 DVDs

(2) All the reports shall be in the form of electronic file and amendable file in portable hard disk for the total of 2 disks

Chapter 6. The management organization and human resources

6.1. The management organization of the project

The advisor assigned the project's staffs accord to the propose of the project and demonstrated in the **Figure 6.1-1** and **Figure 6.1-2**

1) The project management team

The project manager and the project assistant manager operate the management of the project accord to the purpose of the project where the scope of works indicated in the TOR and act as the center of the coordination

2) The expert team

Consist of 5 expertise field which are;

- Financial business field
- Legal and contract field
- Public transportation planning field
- Public relation field
- Engineering field

3) Support staff

Consists of experts from several fields such as common ticketing system, transportation and traffic engineering and designing who will support the aforementioned main expert.

Figure 6.1-1 Project's key staffs structure

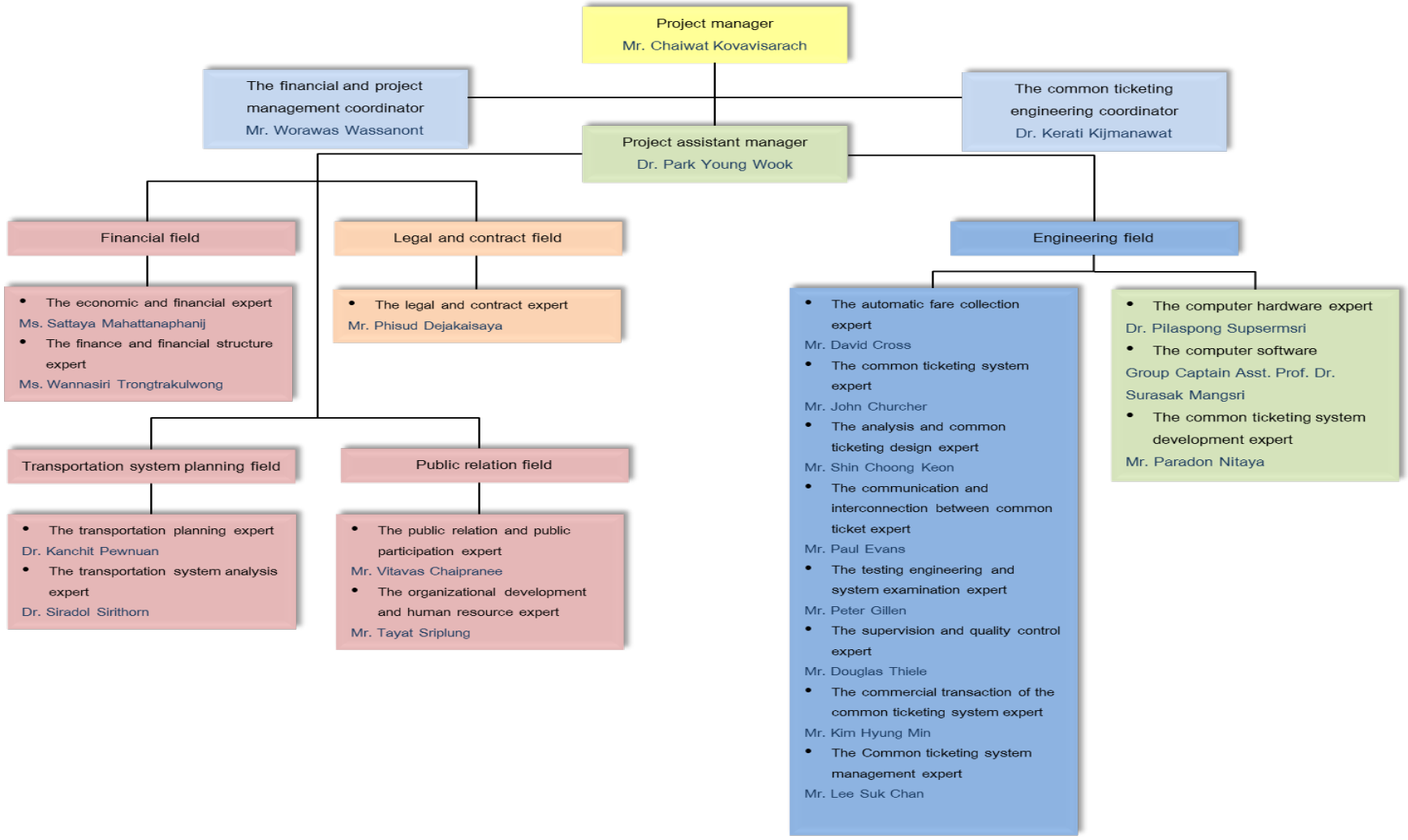


Table 6.1-1 Key staffs operational plan

Subjects TOR	Work	Detail \ Key staffs	1. The project manager	2.The project assistant manager	3.The common ticketing system expert	4.The automatic fare collection expert	5.The analysis and common ticketing design expert	6.The communication and interconnection between common ticket expert	7.The computer hardware expert	8.The computer software expert	9.The economic and financial expert	10.The legal and contract expert	11.The organizational development and human resource expert	12.The supervision and quality control expert	13.The testing engineering and system examination expert	14.The transportation planning expert	15.The transportation system analysis expert	16.The public relation and participation expert	17.The finance and financial structure expert	18.The commercial transaction of the common ticketing system expert	19.The common ticketing system development expert*	20.The financial and project management coordinator*	21.The common ticketing engineering coordinator*	22.The common ticketing system management expert *
Work 1: Policy making and common ticketing system management planning																								
1.1	3.1.1 3.1.2	Review on the Development of Common Ticket System in Thailand	2	2	3	3					3					1	1			3			2	3
1.2	3.1.1 3.1.2	Review on the Overseas Common Ticket System	2	2	3	3					3					1	3			3			2	3
1.3	3.1.3	Proposing the study on the technologies for the development of common ticket system	2	1	1	1	1	1	1	1						3	3		1	1			1	1
1.4	3.1.4	Proposing methods and details of development strategies and operation plans of common ticket system with public transportation	2	2	2	2	2	2	2	2						1	1			1			1	2
1.5	3.1.5	Surveying current fare collection methods in mass transit and non-transit and methods for the use of common ticket system	2	2	2	2	2	2	2	2	2	3				2	2	1	2	2	2	2	2	2
1.6	3.1.6	Brainstorming for the definition of common ticket developmental strategies	2	2	2	2	2	2	2	2	2	3				2	2	1	2	2	2	2	2	2
1.7	3.17	Defining development direction and policies of the common ticket system	1	1	2	2	2	2	2	2	2	3				2	2	1	2	2	2	2	2	2
Work 2: Common ticketing system standardization and preparing details for the common ticketing developer procurement and the Central Clearing House (CCH) establishment																								
2.1	3.2.1	Defining the system's basic requirements and developmental plans for the Common Ticket	2	1	1	1	1	1	1	1						3	3		1	1			1	1
2.2	3.2.2	Conceptual design for common ticket system and CCH	2	1	1	1	1	1	1	1						3	3		1	1			1	1
-	3.2.3	Conceptual design for common ticket system and CCH Standardization of common ticket	2	1	1	1	1	1	1	2	2	2	3		3				3	1	1		1	1
2.3	3.2.4	Definition of Standards for the Extension of Common Ticket System in Non-Transit Businesses	2	1	1	1	1	1	1	1						3	3		1	1			1	1
-	3.2.5	Study on Extension Model in Novel Innovations	2	1	1	1	1	1	1	2	2	2	3		3				3	1			1	1
2.4	3.2.6	Documentation preparation for common ticketing developer and CCH procurement	2	1	1	1	1	1	1	1		1	3	2	2	3	3		1	1			1	1
2.5	3.2.7	Fundamental cost estimation for common ticketing developer procurement and CCH establishment	2	1	1	1	1	1	1	1						3	3		1	1			1	1
2.6	3.2.8	Preparation plan and works priority for starting the common ticket system	2	1	1	1	1	1	1	1		1	3	2	2	3	3		1	1			1	1
Work 3: Supports of the common ticketing developer procurement and establishment of the CCH																								
3.1	3.3.1	Procurement process supports	2	2	2	2	2	2	2	2		1	3	2	2	3	3		1	1			1	1

Subjects TOR	Work	Detail \ Key staffs	1. The project manager	2.The project assistant manager	3.The common ticketing system expert	4.The automatic fare collection expert	5.The analysis and common ticketing design expert	6.The communication and interconnection between common ticket expert	7.The computer hardware expert	8.The computer software expert	9 The economic and financial expert	10.The legal and contract expert	11.The organizational development and human resource expert	12.The supervision and quality control expert	13.The testing engineering and system examination expert	14.The transportation planning expert	15.The transportation system analysis expert	16.The public relation and participation expert	17.The finance and financial structure expert	18.The commercial transaction of the common ticketing system expert	19.The common ticketing system development expert*	20.The financial and project management coordinator*	21.The common ticketing engineering coordinator*	22.The common ticketing system management expert *
3.2	3.3.2	Support and suggest to the procurement committee in the proposal consideration and suggest any related criteria	2	2	1	1	1	1	1	1		1	3	2	2	3	3		1	1			1	1
3.3	3.3.3	Support the procurement committee in negotiation such as technical, cost and conditions	2	2	1	1	1	1	1	1		1	3	2	2	3	3		1	1			1	1
3.4	3.3.4	Documentation preparation for contract signing	2	2	1	1	1	1	1	1		1	3	2	2	3	3		1	1			1	1
Work 4: Supports of the supervision of the common ticketing developer's execution and the CCH establishment																								
4.1	3.4.1	Support the supervision of the common ticket developer and CCH accord to the contract's condition	2	2	1	1	1	1	1	1		1	3	2	2	3	3		1	1			1	1
4.2	3.4.2	Supervision and contract management supports	2	2	1	1	1	1	1	1		1	3	2	2	3	3		1	1			1	1
Work 5: The academic technology supports and the Common Ticket Office (CTO) establishment																								
5.1	3.5.1	Study of the organization's structure, responsibilities, laws, regulations and specify the staff positions conform to the CTO at the beginning of the operation	1	2	3	3	3	3	3	3	1	1	1	3		3		3	1	3	3	1	3	3
5.2	3.5.3	The organization forming suggestion with flexibility and efficiency in operation	1	2	3	3	3	3	3	3	1	1	1	3		3		3	1	3	3	1	3	3
5.3	3.5.4	The academic documentation preparation and CTO establishment at the starting of the operation including procedures plan support and issue related laws and regulations	1	2	3	3	3	3	3	3	1	1	1	3		3		3	1	3	3	1	3	3
5.4	3.5.5	Operational policy and strategic plan development of CTO	1	2	3	3	3	3	3	3	1	1	1	3		3		3	1	3	3	1	3	3
5.5	3.5.6	CCH's and CTO's fundamental standardization and evaluation method	1	2	3	3	3	3	3	3	1	1	1	3		3		3	1	3	3	1	3	3
5.6	3.5.7	CCH's operation and maintenance regulations development under the CTO's supervision	2	1	1	1	1	1	1	2	2	2	3		3				3	2	2		2	2
9.4	3.5.8	Operators procurement and support		2	3	3	3	3	3	3				3		3		3		3	3		3	3
5.7	3.5.9	Coordination for the completion of the CTO establishment and CCH operation	1	2	3	3	3	3	3	3	1	1	1	3		3		3	1	3	3	1	3	3
Work 6: The technological instruction at the beginning of the common ticketing system operation and CCH's operation																								
6.1	3.6.1	Common ticketing management suggestion and supports for CTO	2	1	1	1	1	1	1	2	2	2	3		3				3	2	2		2	2
6.2	3.6.2	Technological improvement suggestion for CTO and CCH	2	1	1	1	1	1	1	2	2	2	3		3				3	2	2		2	2
6.3	3.6.3	CTO's performance improvement suggestion	1	2	3	3	3	3	3	3	1	1	1	3		3		3	1	3	3	1	3	3
6.4	3.6.4	Advisory and suggestion to the CTO during the start of the operation	1	2	3	3	3	3	3	3	1	1	1	3		3		3	1	3	3	1	3	3

Subjects TOR	Work	Detail \ Key staffs	1. The project manager	2.The project assistant manager	3.The common ticketing system expert	4.The automatic fare collection expert	5.The analysis and common ticketing design expert	6.The communication and interconnection between common ticket expert	7.The computer hardware expert	8.The computer software expert	9 The economic and financial expert	10.The legal and contract expert	11.The organizational development and human resource expert	12.The supervision and quality control expert	13.The testing engineering and system examination expert	14.The transportation planning expert	15.The transportation system analysis expert	16.The public relation and participation expert	17.The finance and financial structure expert	18.The commercial transaction of the common ticketing system expert	19.The common ticketing system development expert*	20.The financial and project management coordinator*	21.The common ticketing engineering coordinator*	22.The common ticketing system management expert *
Work 7: The pilot project supports																								
7.1	3.7.1	The starting of the common ticket system support by development suggestion	2	1	1	1	1	1	1	2	2	2	3		3			1	3	2	2		2	2
7.2	3.7.2	Evaluation and problems conclusion derived from the pilot project and resolution suggestion	2	1	1	1	1	1	1	2	2	2	3		3			1	3	2	2		2	2
Work 8: Public relation and public participation																								
8.1	3.8	Information and PR center establishment	2	2	3	3	3	3	3	3	3	3	1	3	3	3	3	1	3	3	3	2	2	3
8.2	3.8	Public relation events organizing	2	1	1	1	1	1	1	2	2	2	3		3				3	2	2		2	2
8.3	3.8	Management of comments and complains	2	1	1	1	1	1	1	2	2	2	3		3				3	2	2		2	2
8.4	3.8	Advertising and printing media	2	1	1	1	1	1	1	2	2	2	3		3				3	2	2		2	2
Work 9: Additional proposal other than stated in the TOR																								
9.1	4.5.1	Appropriate fare study	1	3	3	3	3	3	3	3	1	1	2	3	3	2	2	1	1	3	3	1	3	3
9.2	4.5.2	Apportionment study	1	3	3	3	3	3	3	3	1	1	2	3	3	2	2	1	1	3	3	1	3	3
9.3	4.5.3	Fare collection study	1	3	3	3	3	3	3	3	1	1	2	3	3	2	2	1	1	3	3	1	3	3

1 - เกี่ยวข้องมากที่สุด 2 - เกี่ยวข้องมาก 3 - เกี่ยวข้องปานกลาง

6.2. The key staffs' duties and responsibilities

The advisor assign duties and responsibilities of the key staffs for the propose of the project as below;

The project's management team

(1) The project manager : Mr. Chaiwat Kovavisarach

- Manage, including analyze and resolves any obstruct
- Act as the advisor's agent in coordinating with other organizations
- Manage overall works of the project

(2) The project assistant manager : Dr. Park Young Wook

- Support the Project manager in overall management
- Establish the project policies and plans accord to the purpose of the project

(3) The common ticketing engineering coordinator : Dr. Kerati Kijmanawat

- Coordinate and support the project manager

(4) The financial and project management coordinator : Mr. Worawas Wassanont

- Coordinate and support the project manager

Financial expert team

(1) The economic and financial expert : Ms. Sattaya Mahattanaphanij

- Study and analyze in the economic, financial and investment field

(2) The finance and financial structure expert : Ms. Wannasiri Trongtrakulwong

- Study and analyze in the banking and financial field

Legal and contract expert team

(1) The legal and contract expert : Mr. Phisud Dejakaisaya

- Advise and suggest in the legal and contract field

Public transportation planning expert team

(1) The transportation planning expert : Dr. Kanchit Pewnuan

- Suggest the method and procedure in the related field

(2) The transportation system analysis expert : Dr. Siradol Sirithorn

- Analyze and study in the traffic related field

Public relation expert team

(1) The public relation and participation expert : Mr. Vitavas Chaipranee

- Execute the public relation, seminar and project promotion tasks

(2) The organizational development and human resource expert : Mr. Tayat Sriplung

- Suggest the method and procedures in establishment of the CCH

Engineering expert team

(1) The automatic fare collection expert : Mr. David Anthony Cross

- Suggest and define the concept of fare collection
- Establish the standard of the card type, structure and common card definition

(2) The common ticketing system expert : Mr. John Churcher

- Establish the standard of the card type, structure and common card definition
- Prepare standards and technical qualification of interfaced document and interfaced protocol

(3) The analysis and common ticketing design expert : Mr. Shin Choong Keon

- Establish the standard of the card type, structure and common card definition
- Prepare standards and technical qualification of interfaced document and interfaced protocol

(4) The communication and interconnection between common ticket expert : Mr. Paul Antony Evans

- Establish the standard of the card type, structure and common card definition
- Prepare standards and technical qualification of interfaced document and interfaced protocol

(5) The testing engineering and system examination expert : Mr. Peter Gillen

- Plan, study and analyze the basic information of the testing system

(6) The computer hardware expert : Dr. Pilaspong Supsermsri

- Study, analyze and design computer hardware system

(7) The computer software expert : Group Captain Asst. Prof. Dr. Surasak Mangsing

- Study, analyze and design computer software system

(8) The supervision and quality control expert : Mr. Douglas Thiele

- Study, analyze and quality control

(9) The commercial transaction of the common ticketing system expert : Mr. Kim Hyung Min

- Study, analyze in the commercial transaction field

(10) The common ticketing system development expert : Mr. Paradon Nitaya

- Establish the standard of the card type, structure and common card definition
- Suggest the establishment form of the CCH

(11) The common ticketing system management expert : Mr. Lee Suk Chan

- Suggest the method to manage the common ticketing system

6.3. Key staffs schedule

The advisor proposed the key staffs operators in the Table 6.3-1 which consists of details of the key staff and operational period throughout the project

Table 6.3-1 Key Staff Schedule

Number	Position	Name	Operational period (month)																																														Total period (month)		Total
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Thais	Foreigners	
	The project management team																																																		
1	The project manager	Mr. Chaiwat Kovavisarach																																															34		34
2	The project assistant manage	Dr. Park Young Wook																																																28	28
3	The common ticketing engineering coordinator	Dr. Kerati Kijmanawat																																															15		15
4	The financial and project management coordinator	Mr. Worawas Wassanont																																															24		24
	Financial expert team																																																		
5	The economic and financial expert	Ms. Sattaya Mahattanaphanij																																															32		32
6	The finance and financial structure expert	Ms. Wannasiri Trongtrakulwong																																															32		32
	Legal and contract expert team																																																	
7	The legal and contract expert	Mr. Phisud Dejakaisaya																																															32		32
	Public transportation planning expert team																																																		
8	The transportation planning expert	Dr. Kanchit Pewnuan																																															20		20
9	The transportation system analysis expert	Dr. Siradol Sirithorn																																															15		15
	Public relation expert team																																																		
10	The public relation and participation expert	Mr. Vitavas Chaipranee																																															38		38
11	The organizational development and human resource expert	Mr. Tayat Sriplung																																															36		36
	Engineering expert team																																																		
12	The automatic fare collection expert	David Anthony Cross																																																19	19
13	The common ticketing system expert	John Churcher																																																21	21
14	The analysis and common ticketing design expert	Shin Choong Keon																																																20	20
15	The communication and interconnection between common ticket	Paul Antony Evans																																																20	20
16	The testing engineering and system examination expert	Peter Gillen																																																18	18
17	The computer hardware expert	Dr. Pilaspong Supsermsri																																															34		34
18	The computer software expert	Group Captain Asst. Prof. Dr. Surasak Mangsing																																															34		34
19	The supervision and quality control expert	Douglas Theile																																																18	18
20	The commercial transaction of the common ticketing system exp	Kim Hyung Min																																																17	17
21	The common ticketing system development expert	Mr. Paradon Nitaya																																															31		31
22	The common ticketing system management expert	Lee Suk Chan																																																20	20
		Total																																															**377**	**181**	**558**

6.4. The appropriation of the key staffs

The advisor presented the key staffs for the purpose of the project as demonstrated in **Table 6.4-1** and demonstrate each principle personnel's detail resume at the end of this chapter.

Table6.4-1 The key staffs qualification and experiences conclusion

Position	Name-Surname	Education	Experiences	Experiences in brief
The project manager	Mr. Chaiwat Kovavisarach	● Master degree of Business Administration ● Master degree of Engineering ● Bachelor's degree of Engineering	25	Has more than 25 years experiences of vary projects such as the project of rail public transportation under construction advisory project and the study and analysis of the method of the inter-state road fund establishment
The project assistant manager	Dr. Park Young Wook	● Doctoral degree of Science in Mathematics ● Master degree of Economic, Statistics, Science in Mathematics ● Bachelor's degree of English Language and Literature	36	Has more than 36 years experiences of vary projects such as Development of AFC System for Bogota, Development of WBS(World Best Software) AFC Standardization, Development of AFC system for Sang-joo and Moon-kyung City project
The common ticketing engineering coordinator (Other positions stated in the TOR)	Dr. Kerati Kijmanawat	● Doctoral degree of Logistic planning, Transportation and city planning Engineering ● Master degree of Logistic Planning Engineering ● Bachelor's degree of Construction Engineering	13	Has more than 13 years experiences of vary projects such as the project of management and development of the BRT-SDC and the feasibility study project of designing the cargo by train between Thailand's gulf and Andaman border
The financial and project management coordinator (Other positions stated in the TOR)	Mr. Worawas Wassanont	● Master degree of Business Administration ● Master degree of Industrial Engineering	13	Has more than 13 years experiences of vary projects such as the study of the traffic and financial effects and study of financial resolution and investment method in the 3 lines extensions of the sky train

Position	Name-Surname	Education	Experiences	Experiences in brief
		• Bachelor's degree of Industrial Engineering		
The economic and financial expert	Ms. Sattaya Mahattanaphanij	• Master degree of International Business Administration • Bachelor's degree of Business Administration (Finance)	25	Has more than 25 years experiences of vary projects such as the study of the traffic and financial effects and study of financial resolution and investment method in the 3 lines extensions of the sky train and debt restructuring of the Public transportation co., Ltd. project
The finance and financial structure expert (Other positions stated in the TOR)	Ms. Wannasiri Trongtrakulwong	• Master degree of Business Administration (Finance) • Bachelor's degree of Accounting	20	Has more than 20 years experiences of vary projects such as the study of the traffic and financial effects and study of financial resolution and investment method in the 3 lines extensions of the sky train
The legal and contract expert	Mr. Phisud Dejakaisaya	• Master degree of Laws • Diploma of Laws • Bachelor's degree of Laws	32	Has more than 32 years experiences of vary projects such as PPP advisory to the Ministry of Finance and Legal advisory to the Department of Energy Business
The transportation planning expert	Dr. Kanchit Pewnuan	• Doctoral degree of Engineering • Master degree of Engineering • Bachelor's degree of Engineering	38	Has more than 38 years experiences of vary projects such as appropriation of cargo station in main cities and border provinces
The transportation system analysis expert	Dr. Siradol Sirithorn	• Doctoral degree of Logistic Engineering • Master degree of Logistic Engineering • Bachelor's degree of Construction Engineering	18	Has more than 18 years experiences of vary projects such as the project of transportation and traffic survey for the Angthong province's model scheme and the project of genius traffic route system to Suvarnabhumi airport
The public relation and public	Mr. Vitavas Chaipranee	• Bachelor's degree of Science	30	Has more than 30 years experiences of vary projects

Position	Name-Surname	Education	Experiences	Experiences in brief
participation expert				such asโครงการ Unseen Thailand และโครงการ Unseen Paradise
The organizational development and human resource expert	Mr. Tayat Sriplung	● Master degree Management Information System ● Bachelor's degree Information System ● Bachelor's degree of accounting	29	Has more than 29 years experiences of vary projects such as Mitrphol Co., Ltd. and 124 Management Consulting co., Ltd.
The automatic fare collection expert	Mr. David Cross	● Bachelor's degree of Electrical & Electronic Engineering	30	Has more than 30 years experiences of vary projects such as BTS Extensions AFC for Krungthep Thanakom Co. project and ICE Bangkok Airport Rail-link
The common ticketing system expert	Mr. John Churcher	● Bachelor's degree of Electrical and Electronics Engineering with Management Studies	28	Has more than 28 years experiences of vary projects such as Department of Transportation and Communications' AFC systems upgrade and integration and Ticketing system for the Gautrain
The analysis and common ticketing design expert	Mr. Shin Choong Keon	● Master degree of Business Administration ● Bachelor's degree of Electric Computing Engineering	27	Has more than 27 years experiences of vary projects such as Incheon Transfer Interoperability Project
The communication and interconnection between common ticket expert	Mr. Paul Evans	● Bachelor's degree Electronic Engineering	25	Has more than 25 years experiences of vary projects such as SRT Southern Double Tracking (Chumpuan Section) Tender Preparation project and BTS Skytrain Sukhumvit Extension- Railway Systems
The testing engineering and system	Mr. Peter Gillen	● Bachelor's degree Transport	30	Has more than 30 years experiences of vary projects

Position	Name-Surname	Education	Experiences	Experiences in brief
examination expert		Administration Engineering		such as BTS Skytrain Sukhumvit Extension- Railway System project and Express Rail Link, Kuala Lumpur
The computer hardware expert	Dr. Pilaspong Supsermsri	• Doctoral degree of Electrical Engineering • Master degree of Electrical Engineering • Bachelor's degree of Computer Engineering	40	Has more than 40 years experiences of vary projects such as Suvanrabhumi airport project and Thailand's distribution center to European countries project
The computer software expert	Group Captain Asst. Prof. Dr. Surasak Mangsing	• Doctoral degree of Computer Science • Master degree of Computer Science • Master degree of Computer Engineering • Bachelor's degree of Structures, Materials, and Fluid Engineering	28	Has more than 28 years experiences of vary projects such as CIO 2 network project, and Design of Intelligent Tutoring System for Collaborative Problem Based Learning
The supervision and quality control expert	Mr. Douglas Thiele	• Master degree of Scientific Studies Computer Science • Diploma of Computer Science • Bachelor's degree Engineering Metallurgy	33	Has more than 33 years experiences of vary projects such as Dubai Metro Maintenance Management System (MMS) and Taiwan Shinkansen Corporation (TSC) databases for multi-project
The commercial transaction of the common ticketing system expert	Mr. KimHyung Min	• Master degree of Business Administration	24	Has more than 24 years experiences of vary projects such as Mobile T-money 2.0 Launch,และโครงการ

Position	Name-Surname	Education	Experiences	Experiences in brief
(Other positions stated in the TOR)		• Bachelor degree of Business Administration		Nationwide Ministop Convenience Store Payment Expansion
The common ticketing system development expert (Other positions stated in the TOR)	Mr. Paradon Nitaya	• Master degree of Business Administration • Bachelor's degree of Electrical and Computer Engineering	14	Has more than 14 years experiences of vary projects such as Pre-Op of Bangkok Mass Transit Silom Extension and HK MTRCL. Review of strategy for revenue collection system
The common ticketing system management expert (Other positions stated in the TOR)	Mr. Lee Suk Chan	• Master degree of Computer and Communication Engineering • Bachelor's degree of Electric Engineering	19	Has more than 19 years experiences of vary projects such as Daejon Subway System Upgrade and Snapper NZ P4 project