The Federative Republic of Brazil

Rio de Janeiro State Secretariat of Transportation - SETRANS Rio
Rio de Janeiro Municipal Secretariat of Transportation – SMTRio
Federal District Secretariat of Transportation - SETRANS-DF
Traffic Department of Federal District - DETRAN DF

Study On
The Introduction of Intelligent Transport Systems
In The Federative Republic of Brazil

FINAL REPORT

Summary

June, 2013

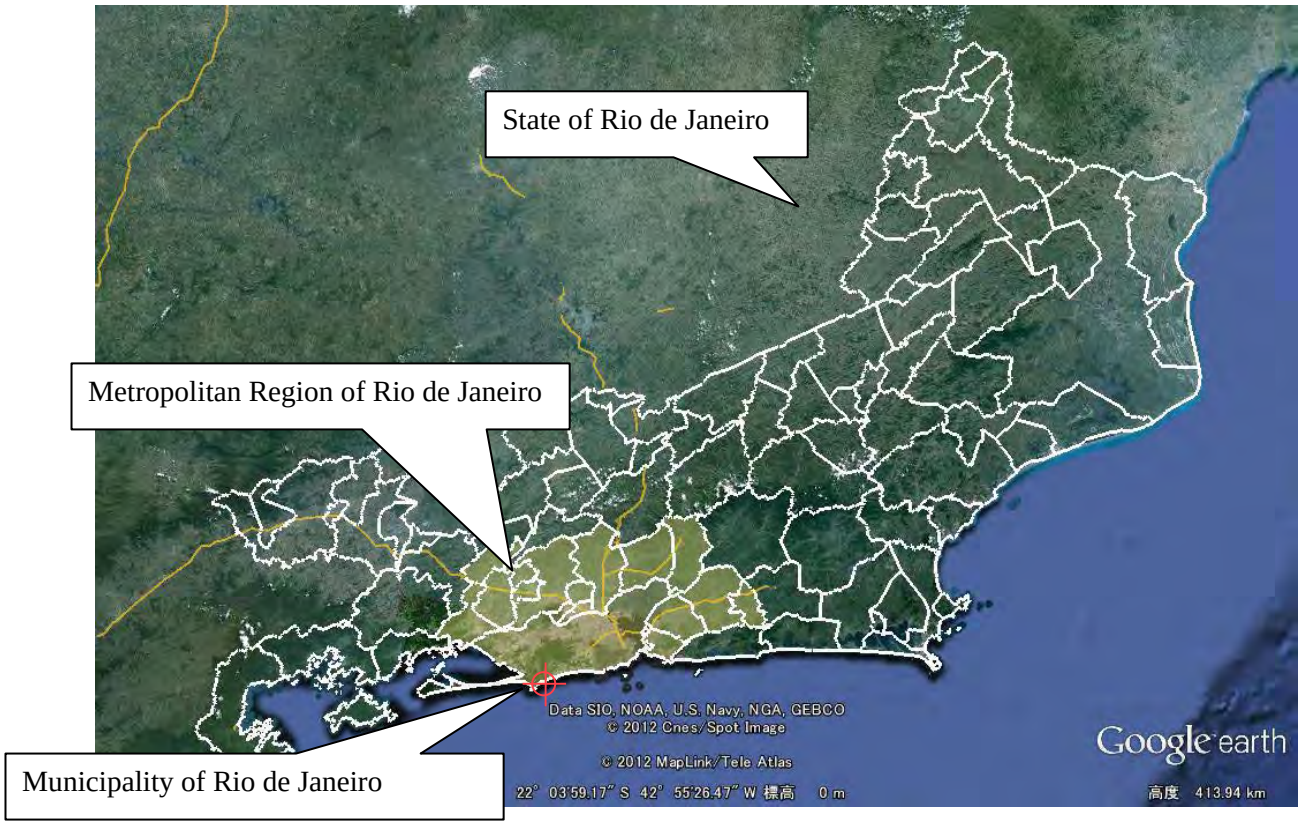
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.
NIPPON KOEI LATIN AMERICA - CARIBBEAN Co., Ltd.

LOCATION MAP

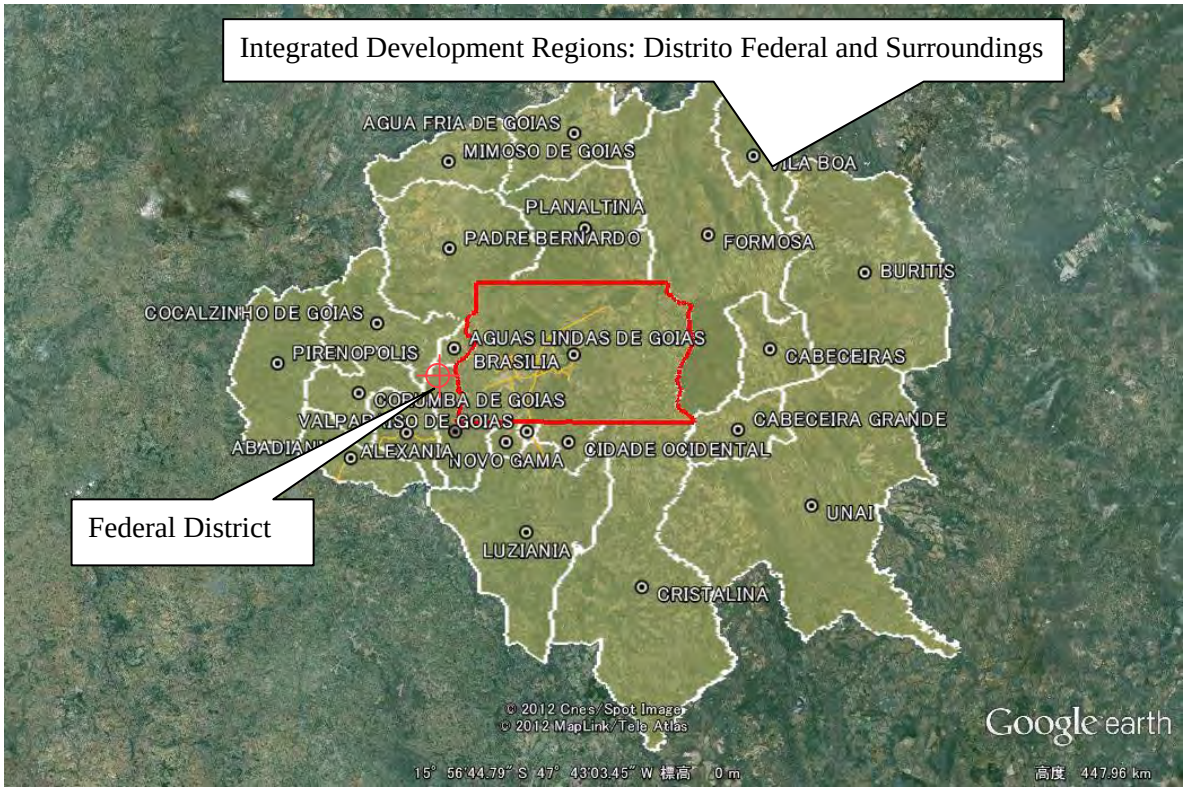
Source: Open Street Map

Location Map of the Study Area 1 - Entire Brazil



Source: JICA Study Team

Location Map of the Study Area 2 - Rio de Janeiro



Source: JICA Study Team

Location Map of the Study Area 3 - Federal District

TABLE OF CONTENTS

A. OUTLINE OF THE PROJECT AND RECOMMENDATION BY THE STUDY

1. FORMULATION OF THE ITS MASTER PLAN FOR RIO DE JANEIRO

1.1 DEFINITION OF THE ITS MASTER PLAN DEVELOPMENT POLICY

Considering the circumstances, the JICA Study Team proposed thirteen ITS projects, which are shown below.

Table A-1 Proposed ITS Projects

No.	ITS Project Name
1	ITS Center
2	Real Time Traffic/Transport Condition Information Processing
3	Olympic Security and Transport Coordination Center
4	Bus Condition Information Provision
5	Dissemination of On-board Unit for More Integrated Transport
6	Information Exchange of Road Operators
7	Information Exchange via ITS Center between Municipalities
8	Improvement of Traffic/Transit Operational Center with Essential ITS Equipment in Rio de Janeiro Municipal Area
9	Improvement of Traffic/Transit Operational Center with Essential ITS Equipment in Other Municipal Areas in RMRJ
10	Emergency Vehicle Operating Management
11	Commercial Vehicle Operation and Management
12	Advanced Vehicle Safety Systems
13	Deployment of X-band Radars

Source: JICA Study Team

1.2 DEPLOYMENT PLAN FOR ITS PROJECTS EQUIPMENT AND ECONOMIC ANALYSIS

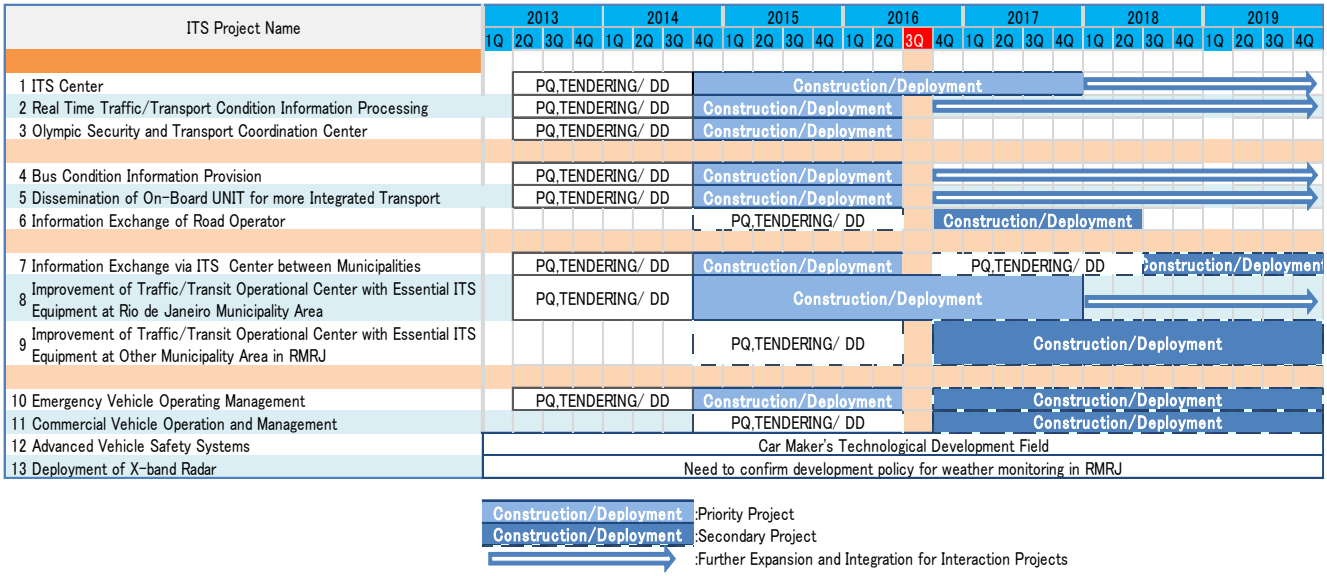
Based on t the ITS services and facilities necessary for each target, how to deploy ITS facilities required by each target was considered. Then, based on the results and interviews with road administrators, the current situation of with/without ITS facilities and management condition was organized. And the placement of the new ITS facilitation and ITS deployment plan for each individual service were considered.

And Study Team conducted the economic evaluation of main project by traffic simulation. As a result, proposed ITS project is effective for Rio de Janeiro.

1.3 IMPLEMENTATION SCHEDULE

Milestone of ITS projects for Rio de Janeiro is Olympic Games Rio 2016. For short term projects shall focus on Rio de Janeiro municipality area to archive Olympic game success. However, objectives of ITS is not only Olympic games, but also traffic/transit management for daily life.

Hence, implementation schedule was developed considering four (4) major aspects like; 1.Olympic Period, 2.Rio de Janeiro Municipality Area, 3.Information Integration and Existing System Utilization, and 4.Security and Transport. The implementation schedule is below;



*1Q; From January. **PQ; Procurement DD; Detailed Design

Source: JICA Study Team

Figure A-1 Implementation Schedule

2. PRELIMINARY DESIGN FOR SHORT TERM PROJECT

2.1 SUGGESTION

In consideration of smooth implementation of the project packages and effective usage of the ITS system, the following activities are recommended;

2.1.1 For smooth and successful implementation of project packages

(1) Task force project team

Several stakeholders are included in this project. It is expected that there will be modification to the stakeholders' existing subsystems for gathering ITS information through the ITS Center. Understanding and cooperation between the stakeholders listed in this study are essential for successful implementation.

Therefore, steering committee meetings shall be held periodically. A strong leadership identified by the project task force team is also necessary. The team shall be established as soon as

possible. The team shall conduct the preceding works until handing the work over to the operational organization of the ITS Center.

(2) Operational organization for ITS center

The ITS Center will be a newly established and built facility in Project Package 1. To commence the operation of the ITS Center smoothly at the same time as the Olympic Games and to adequately and promptly deal with casual system problems during operation, the establishment of an operational organization is needed by August 2015, one year before the completion of the project.

2.1.2 For effective usage of ITS system

(1) Effective usage of Adaptive Signal Control system

Many signalized intersections will be controlled according to the traffic situation automatically or manually by COR. When public transport signal priority is activated in case of a disaster emergency or VIP transport, the nearby intersection areas shall be activated and controlled according to the schedule of prioritized public transport. Such coordination shall be done among CICC, SEDEC, and other related agencies.

(2) Effective usage of VMS system

Any related agency will be able to know the traffic situation through several display devices. Road operators can also get important related traffic information from computer monitors that are directly connected to the ITS Center. Thus, the road operator shall operate the VMS messages to show important information such as accidents or traffic congestion.

(3) Coordination among Olympic Support Parties and Agencies

The proposed ITS system will be able to gather traffic information from related agencies and disseminate it not only to other agencies but also to the public through information provision display. These displays will be installed at Olympic stadiums and venues, terminals and through personal telephone, internet and at OBUs of cars.

For the effective usage of the ITS system for the smooth operation of the Olympic Games, coordination meetings among Olympic support parties and agencies are important.

3. PRELIMINARY ITS MASTER PLAN FOR FEDERAL DISTRICT

3.1 ITS PROJECTS CONCEPTUAL DESIGN

As a result, 34-sub systems were selected and grouped into five subcomponents: 1. Data Base/Data Processing (1 subsystem); 2. Information Exchange/System Integration (6 subsystems); 3. Information Provision (10 subsystems); 4. Traffic Monitoring/Control, Public Transport Monitoring/Coordinating, and Concessionaire Operation Monitoring (13 subsystems); 5. Traffic Demand Management (4 subsystems).

These five subcomponents should then be deployed into one regional Traffic/Transportation Management Center (T2MC-DF). The deployment should be step-wise and divided into 3 phases as follows:

- Visualization Phase (Short-term): The short term goal of T2MC-DF is to visualize current traffic/transportation conditions in real-time. Existing System Utilization, Information Exchange, and Cross Jurisdictional Cooperation System Agreements are the core components. In this phase coordination between DNIT, DER, DETRAN-DF, DFTRANS, METRO and Weather Monitoring Agencies is essential.

- System Expansion Phase (Mid-term): The mid-term goal of T2MC-DF is to expand the ITS related traffic systems such as CCTVs, traffic volume detection, speed detection, Dynamic Signal Optimization System, and VMS. Mass transit systems are also considered, such as Operation Center, GPS Monitoring System, Concessionaire Report Generating System. In this phase, more advanced communication/information systems are deployed, such as public transportation priority system, information provision system, and real- time congestion communication with car navigation system.

- Traffic Demand Management Phase (Long Term): The long term goal of T2MC-DF is to control traffic demand by deploying systems for real time control. These systems will be developed on top of existing systems already developed in the previous phases. High Occupancy Vehicle (HOV), Electronic Road Pricing (ERP), Park and Ride Provision, and Dynamic Reversible Lane System are the systems to compose the final phase of the T2MC-DF.

This overall system organization and concept assumed the following development context: Maximum Utilization of Existing Systems; Essential Information Exchange among operators; Centralized Center Development and a Seamless Interstate (RIDE area) System Operation Structure.

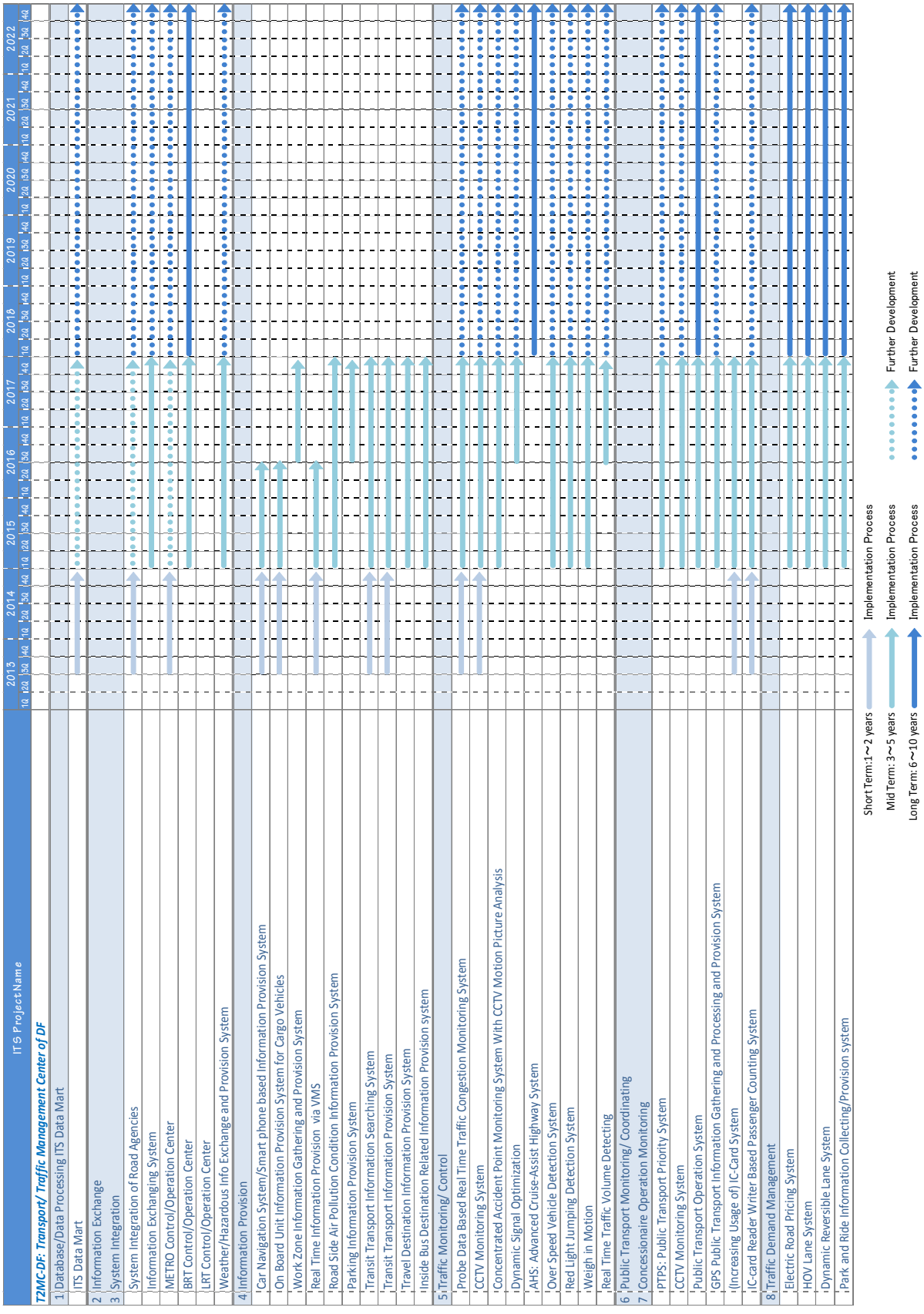
3.2 PROPOSAL FOR DEVELOPMENT SCHEDULE

The development of T2MC and its subsystems shall be paced according to the 3 phases of implementation: Visualization Phase (Short-term), System Expansion Phase (Mid-term) and Traffic Demand Management Phase (Long Term). Short-term systems should be implemented in no more than one year; mid-term systems should be considered step-wise between 2 and 5 years; and long-term systems should be considered between 5 and 10 years – upon successful implementation and operation of phases 1 and 2. Further refinement of schedule may be needed upon development of a complete Master Plan.

3.3 NEXT STEP FOR THE DF ITS PRELIMINARY MASTER PLAN

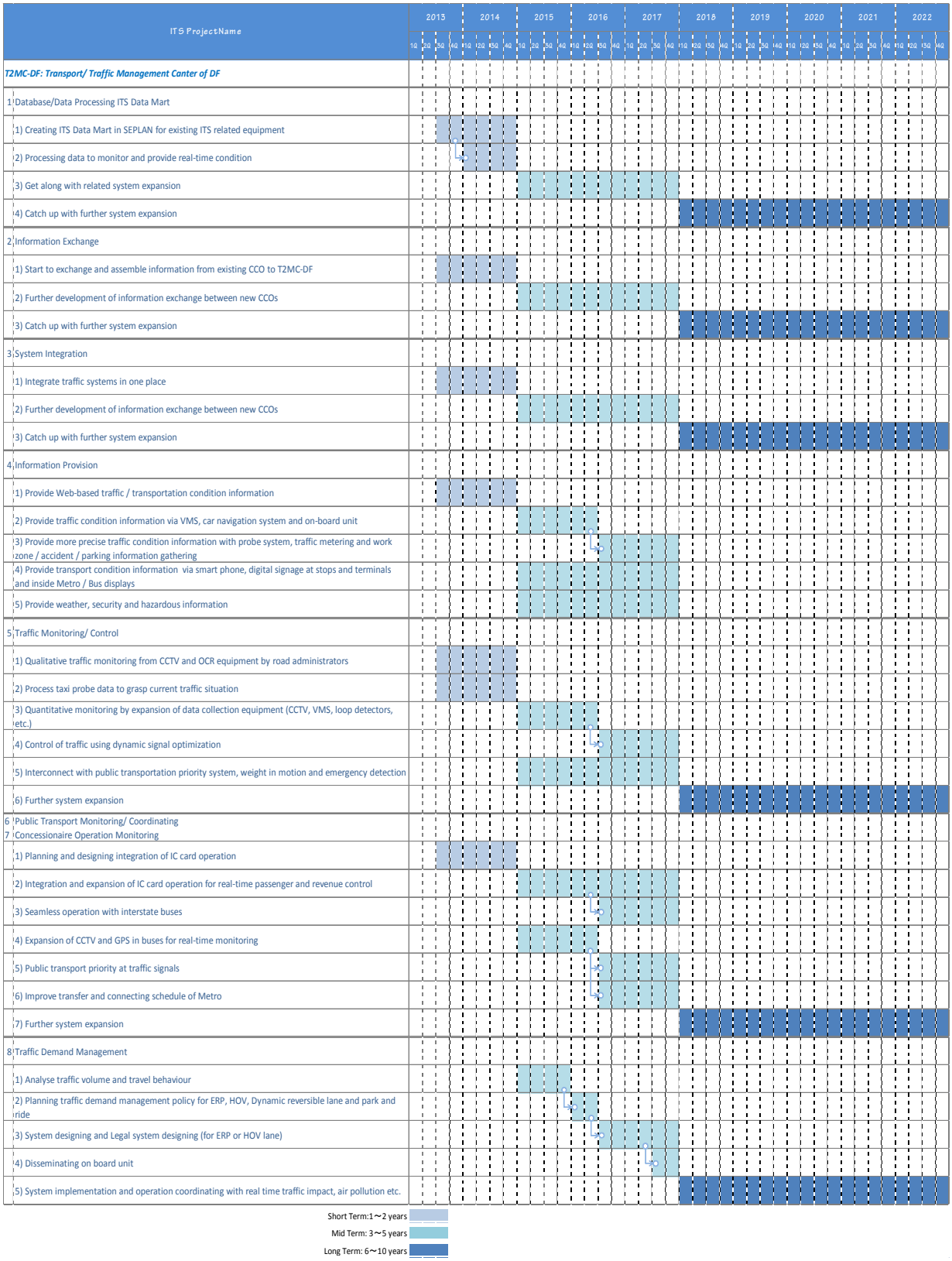
The DF ITS Preliminary Master Plan should be used as the starting point for the development and implementation of ITS systems proposed in this study. A complete master plan shall also include additional data collection such as traffic volume, travel time, and speed data during peak periods, detailed analysis of traffic demand and network (simulation), detailed communication and ITS architecture, and basic design of the suggested systems as next steps. In addition, an update of the current conditions may be needed depending on the timeframe.

Table A-2 DF Implementation Plan



Source: JICA Study Team

Table A-3 Work Plan



Source: JICA Study Team

B. RESULT OF STUDY

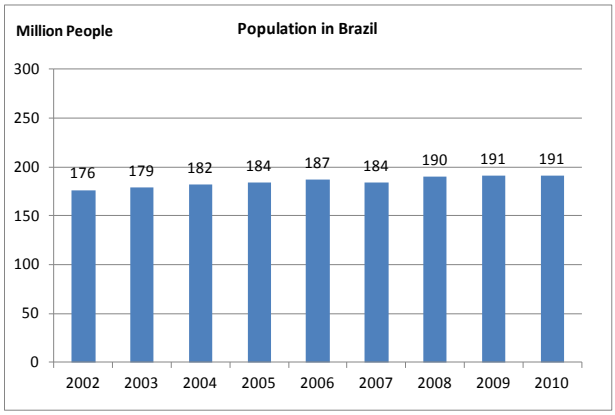
1. STUDY BACKGROUND AND OBJECTIVES

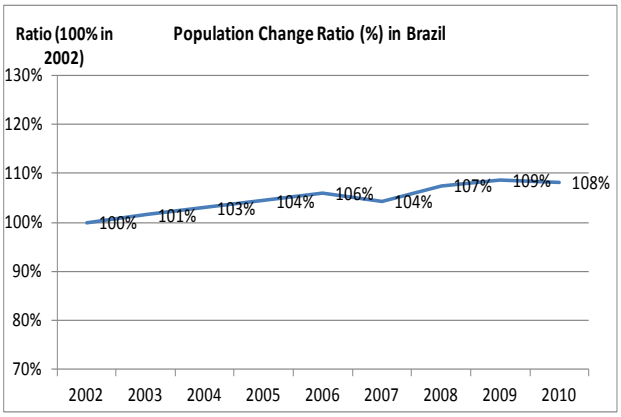
1.1 STUDY BACKGROUND

Brazil, as its stable and healthy economic development, shows GDP growth rate at 7.5% in 2010. After Lehman's fall, Brazilian economy quickly recovered by their strong economic potentials such as high domestic consumption, various types of export industries, vast agricultural land and abundant natural resources. Brazil is not only an agricultural country but also an industrial country as typified by small jet industry which is most highly ranked in the world and has full-set industrial base.

Gracing at the transportation figures, the domestic sales of new cars in 2011 is over 3.4 million, and it's ranked at No. 4 in the world, next to Japan. The rapid growth of number of vehicles is one of the major causes of the serious congestion in the major cities in Brazil.

Brazilian government is urgently developing the city and transportation infrastructure for upcoming well-known international events such as FIFA World Cup at 12 Brazilian cities in 2014 and Olympic Games in 2016 at Rio de Janeiro. Rio de Janeiro, the second largest city in Brazil, has 11 million population in the metropolitan area and 6 million in the city. They are now preparing for these two big events. The mass-transit network for subways and buses are already well developed .However the traffic congestion becomes quite serious during the rush hour in the morning and evening, which is known as social problem. Thus, it's not enough to accommodate all traffic/transport demand. In addition, frequent floods occur in recent years due to the weakness of infrastructure. Hence, proper information management and provision to the users is urgently needed to achieve risk and crisis management, together with overcoming the weakness of existing infrastructure.





Source: IBGE Prepared by JICA Study Team

Figure B-1 Population and Growth of GDP per Capita of Brazil

1.2 STUDY OBJECTIVES

The objective of the study is to assist the Rio De Janeiro Metropolitan Area and Federal District to improve and modernize the traffic and transportation system in each city by applying ITS, through formulating a Master Plan for ITS development and prioritizing ITS projects in Rio De Janeiro Metropolitan Area that could be implemented in a phased manner and assist for preliminary design for the Short Term Plan.

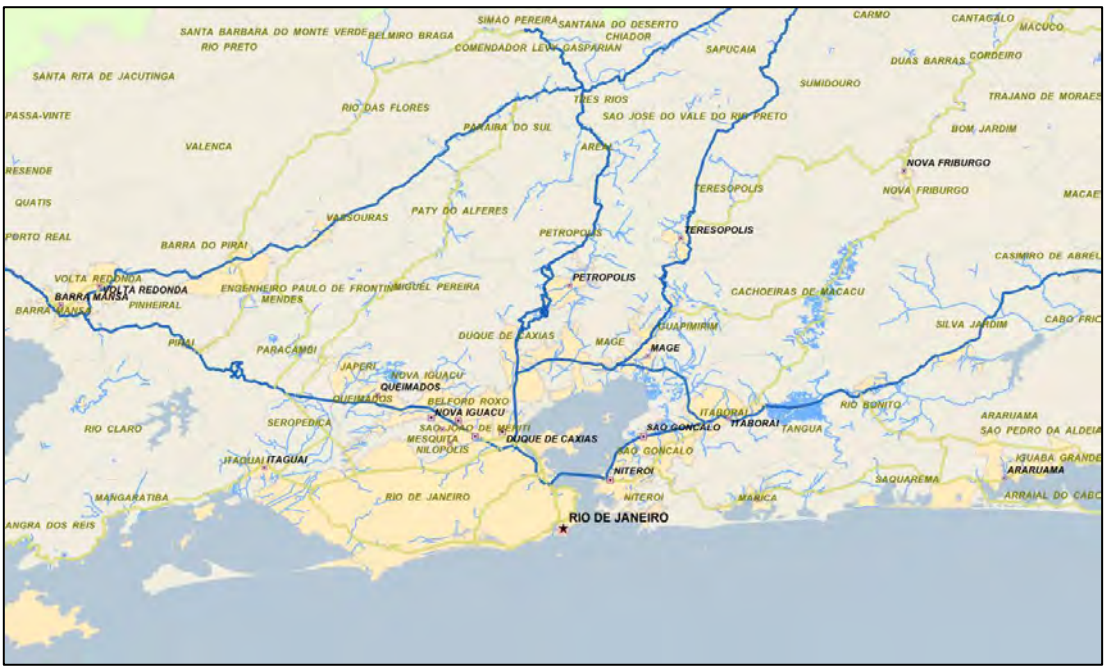
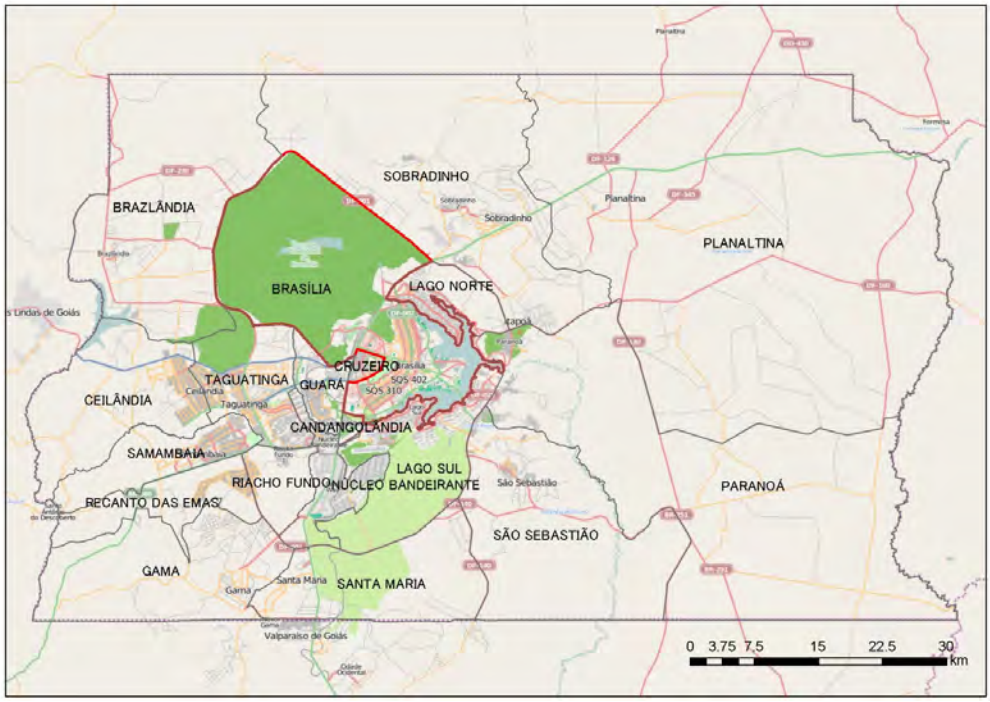


Figure B-2 Rio De Janeiro Metropolitan Area



Source: JICA Study Team

Figure B-3 Federal District

1.3 SCOPE OF WORKS

The five technical approaches are set out in order to fulfill the objectives of the study.

Approach1: ***Preparation of ITS Master Plan Based on ITS Architecture***
Approach2: ***ITS Study Based on Brazilian- Japanese Technology Exchange***
Approach3: ***Study for Disaster-Related ITS***
Approach4: ***Study on Short Term ITS Menus***
Approach5: ***Area-Wise Traffic/Transportation Analysis and Evaluation of ITS Menus***

The Study is divided into two stages with the following objectives:

Phase-1: Formulation of ITS Master Plan for Rio de Janeiro

Phase-2: Preparation of Preliminary Design for Short Term Plan for Rio de Janeiro and Preliminary ITS Master Plan for Federal District

The workshop will be held at the following period:

1st Seminar: At the end of Formulation of Draft ITS Master Plan for Rio de Janeiro

2nd Seminar: At the end of Preparation of Preliminary Design for Short Term Plan for Rio de Janeiro and Preliminary ITS Master Plan for Federal District

2. RESULT OF STUDY

2.1 CURRENT ITS CONDITIONS AND ISSUES IN RIO DE JANEIRO

2.1.1 Regional /Traffic Conditions and Issues

(1) Regional Conditions and Issues

Based on regional characteristics and issues of Rio de Janeiro, which should be considered in ITS Master Plan, are;

> Rapid Growth of Economic and Good development of Competitiveness
> Gentle curve of increasing of population BUT high density of city central
> Ranked 27th of International Events
> Existing of Mixed Zone; Residential District and Slope
> Disaster; Torrential Rain, Flood and Land Slide
> Air Condition and other Environmental Aspect

(2) Traffic Conditions and Issues

Based on traffic / transportation characteristics the issues of Rio de Janeiro, which should be considered in ITS Master Plan, are;

> The number of bus passengers is more than 3 million per day. But a quarter of them still pay in cash.
> The number of cars and passengers of rail / metro are increasing.
> Mass transport is important mode for Rio people. In Niteroi the modal share of car is high.
> Travel speed is lower especially in the evening
> The number of traffic accident is higher on Av. Brasil

2.1.2 Current Condition of ITS

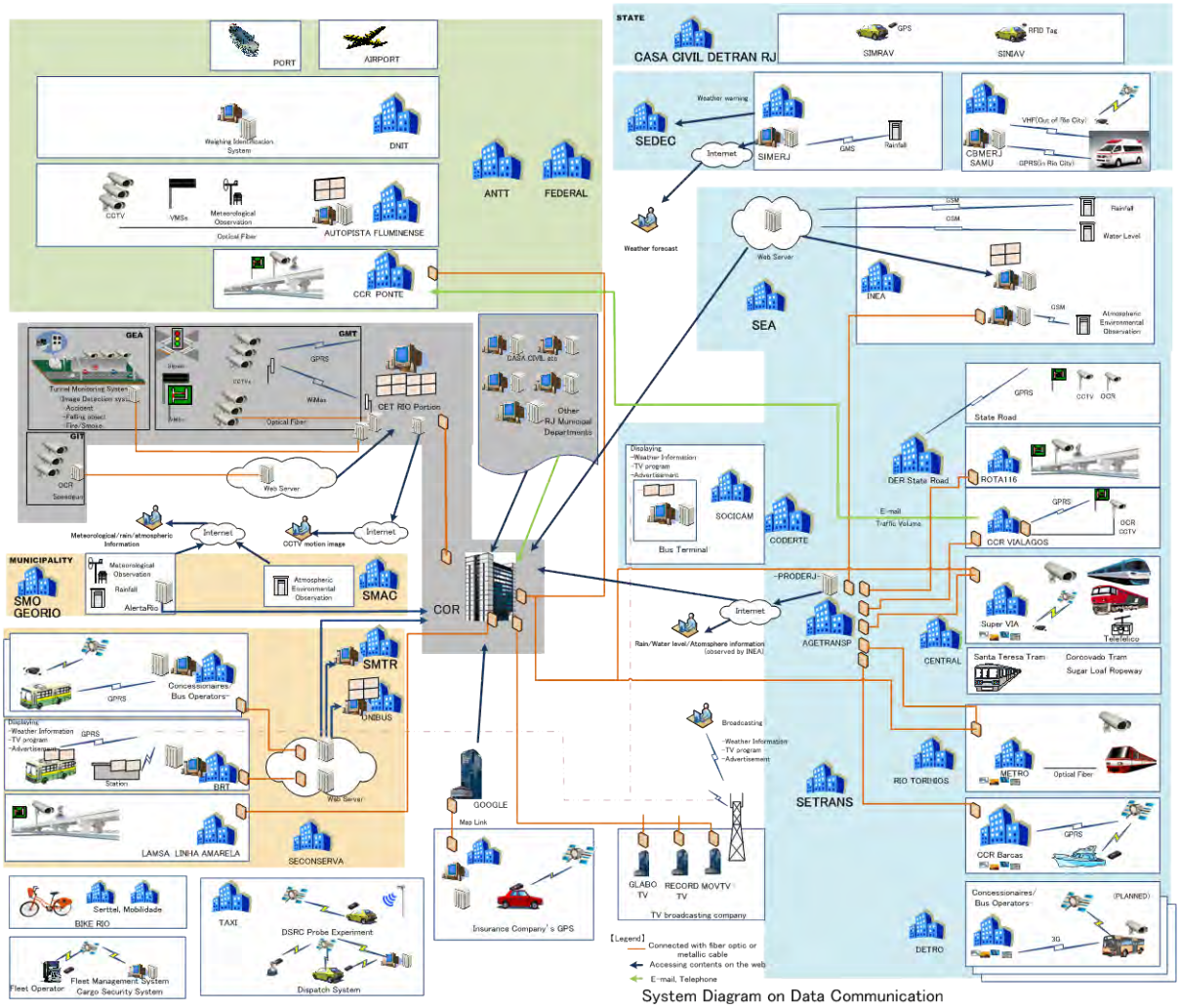
In Rio de Janeiro systems are developed each agencies separately. It means that all Systems have developed already, but there are some rooms for further development. In addition, some systems are disconnected due to lack of entire future plan. Therefore, a key issue is increasing needs for “Integration” in Rio de Janeiro Metropolitan Area.

(1) ITS Facilities

The ITS equipment and facilities are administered on the roads of Rio de Janeiro Metropolitan Area. These are 1.Traffic light system, 2.VMS, 3.OCR/Speed Gun, 4.CCTV, 5.Electronic Toll Collection (ETC), 6.Meteorological and Atmospheric Sensors, 7.DSRC Probe System.

(2) Overall System Diagram and ITS Related Agency

Overall System Diagram is shown below. Information gathered in COR and AGETRANSP is displayed individually and not unified. There is also no intercommunication network line between COR and AGETRANSP, therefore, information on public transportation is unshared.



System Diagram on Data Communication

Source: JICA Study Team

Figure B-4 Overall System Diagram

From the above system diagram, information, which is collected and distributed by the ITS-related agencies, is summarized in next page.

Table B-1 ITS Related Agencies

Concessionaires/Agencies		Information to be Collected	Other Agencies which Information is Distributed	Method
Federal Government				
Autopista Fluminense		CCTV OCR/Speed gun Metrological information	- - -	
CCR Ponte		CCTV OCR/Speed gun Metrological information	COR - -	Metallic cable
State Government				
DER-RJ		CCTV OCR/Speed gun	- -	
Rota116		CCTV	AGETRANSP	Metallic cable
CCR Vilagos		CCTV OCR/Speed gun	AGETRANSP -	Metallic cable
SuperVia		CCTV Operation information	AGETRANSP AGETRANSP	Metallic cable Telephone
Metro		CCTV Operation information	AGETRANSP AGETRANSP	Metallic cable Telephone
CCR Barcas		CCTV Operation information	AGETRANSP AGETRANSP	Metallic cable Telephone
SIMERJ-CESTAD-Civil Defense-SEDEC		Meteorological information	-	
INEA-SEA		Meteorological information Atmospheric information	COR COR	Internet Internet
AGETRANSP		CCTV (Rota 116, CCR-Vialagos, SuperVia, Metro, CCR-Barcas) Operation information (Rota 116, CCR-Vialagos, SuperVia, Metro, CCR-Barcas)		Metallic cable Telephone
Municipality				
SMAC (MonitorAr Rio)		Atmospheric information	COR	Internet
CET-Rio-SMTR	GMT	CCTV Signal	COR COR	Fiber optic Fiber optic
	GEA	Tunnel CCTV	COR	Fiber optic
	GIT	OCR/Speed gun	COR	Internet
Onibus		Bus location	COR	Internet
SMO (AlertaRio)		Meteorological information Atmospheric information	COR COR	Internet Internet
Maplink		GPS data in taxi	COR	Internet
COR		Atmospheric information (SMAC, SMO) Meteorological information (INEA, SMO) CCTV (CET-Rio, CCR-Ponte) Signal (CET-Rio) VMS (CET-Rio) Tunnel CCTV (CET-Rio) OCR/Speed gun (CET-Rio, LAMSA LINHA)		

Source: JICA Study Team

2.1.3 Plans

The summary of traffic/transport related plan and urban development plan is shown below.

Table B-2 Related Plans

Plan	Summary
PDTU/RMRJ	-Study for the Master Plan for Urban Transport in the Metropolitan RMRJ -This study was conducted for the following four goals; 1. To clarify the current situation of demand and supply of transport in RMRJ; 2. To formulate alternatives of the transport system in the Metropolitan Region, 3. To formulate a policy of investment in road infrastructure and public transport; and 4. To provide a direction that allows the implementation of ongoing processes of planning. -Now updating *Current conditions, assumption of demand estimations and policies of alternatives and comparison should be considered in formulating the ITS master plan.*
Transport Strategic Plan	-This document sets out a comprehensive view of Rio's transport plans for the Olympic Games. -Aim: To provide vision, major concepts, and key initiatives which will Guide the planning and delivery of the Olympic and Paralympic Transport services. -Mission: To deliver Transport services of the highest level of safety, comfort, quality, reliability, and efficiency to all clients, while minimizing the impact on the citizens of Rio. *Keywords from the mission of this plan have to be considered in the mission of ITS master plan.*
PAC, PAC2	-Four-year investment plan authorized by the federal government. -Aim: To accelerate the national economy in Brazil, especially, investment in PAC2.
PPA	-The Multi-Year Plan of the state of Rio de Janeiro for four years prepared by the state government. -The challenges of this program are as follows: 1. To strategically develop and transform economic growth; 2. To aid the ongoing process of modernization; 3. To invest in the 2014 World Cup and 2016 Olympics; and 4. To generate employment and income, technological innovation and management, competitiveness, reduction of inequalities, and improve the general well-being of the public.
Strategic Plan 2012–2031	-This plan has ten goal. ☐ Health: quality of life for the population. ☐ Prosperity: economy will be boosted by a mix of international and national favorable environments. ☐ Efficiency: continuous conscious effort to combat all sources of waste. ☐ Education: children attending schools longer and better access to higher level of education. ☐ Safety: continued democracy and protection of the rights to life and freedom. etc,,,
Strategic Plan 2009–2012	-The objectives of the government are as follows: 1. Improve the quality of public services; 2. Protect and recover public space and natural assets of the city; 3. Ensure greater equality of opportunities for young people and children in Rio; 4. Establish the necessary conditions for sustainable economic growth; 5. Promote the development of the economy; etc,,,
Development Map in the State of Rio de Janeiro	-This strategic vision has been built and validated in meetings and workshops to consolidate the elements of the Map Development: Objective Indicators, Goals, and Strategic Actions. -This is a reference to envisage a better place to live, work, and invest in by 2015 in the state of Rio de Janeiro in Brazil by achieving sustainable development.

Source: JICA Study Team

From the above, keywords for the policy of ITS Master Plan could be extracted as follows.

・Strategic Plan:

Equitable, Plural, Educated, Healthy, Safe, Prosperous, Efficient, Innovative, Sustainable, Solidary

・Transport Strategic Plan for the Rio 2016 Olympic and Paralympic Games:

Safety, Comfort, Quality, Reliability, Efficiency, All Clients

2.2 SUPPLEMENTARY TRAFFIC SURVEY

The supplementary traffic survey is conducted by the study team. Initially, three main Transportation Master Plans were reviewed and used as guidelines to develop the traffic demand modeling. The base year for the survey was 2011 and the target years are 2016 and 2021. The 2011 scenario was calibrated and validated by existing traffic counts and socioeconomic data. Then, OD data was grown to estimate 2016 and 2021 scenarios. In addition, Olympic Games scenarios were also analyzed in 2016 as part of the macro-scale analysis. Several ITS strategies were also tested in a meso and micro-scale scenarios.

Table B-3 Outline of Supplementary Traffic Survey

Survey	Method	Coverage
1.Traffic Count Survey	Traffic Count (For ea direction, 15	・12 locations (15hrs) ・Five classification
2.Travel Time Survey	Actual driving survey by passenger car.	・15 routes ・Three (3) round trips every routes for three (3) time zones
3.Existing Traffic Count Data Analysis	Summarize existing traffic count data	・CET-Rio – 297 locations ・SMTR － 33 locations
4.CCTV Image Processing	Count by image processing traffic volume	・CET-Rio － 7 locations

Source: JICA Study Team

In addition, Study Team conducted the accessibility and information survey for public transport users conducted during the months of September and October and 2012. A complete inventory of stops/stations and terminals was prepared for all modes in the RMRJ by the project team. Key issues observed include overall station/stop conditions; accessibility and mobility; direction signs; maps, route and travel time information, and user safety. Then an assessment of each mode is presented, and recommendations to improve accessibility and information for users are made.

2.3 COMPARATIVE ANALYSIS AMONG MEGACITIES, OLYMPIC HOST CITIES, AND RIO DE JANEIRO

The Study Team compared the city of Rio de Janeiro: mega-cities with Olympic–cities. For the first comparison, Rio was put in perspective in terms of basic public transportation infrastructure and ITS features with Tokyo, New York, London, Paris and Sao Paulo. The second comparison, the characteristics of the Olympic Games of Sydney (2000), Athens (2004), Beijing (2008) and London (2012) are contrasted with Rio de Janeiro plan for 2016. The analysis shows that Rio de Janeiro is focusing on BRT systems while the other cities focused on rail and metro systems. In addition, Rio has the largest Olympic area when compared to the other host cities, therefore investments in congestion/incident management programs and coordination efforts among different operators and stakeholders will be the key for the success of the 2016 Games.

Table B-4 Summary of Transport Aspect of Olympic Cities

	Sydney 2000	ATHENS 2004	Beijing 2008	London	Rio2016
Main Olympic Area	89 km2	128 km2	159 km2	155 km2	511 km2
Population	4.6 Million	3 Million	7.5 Million	8.2 Million	6.3 Million
Main Transit for Olympic Transport	Rail/Metro Bus	Metro/Tram Bus	Rail/Metro Bus	Metro -improvement-Bus	4 BRT Metro –line4- Rail-new vehicle
Dedicated Lane Buses	Some	3 Routes	34 Routes 285.7km	240km	More than 150km
ITS	-Traffic Control Center, Field Equipment and systems -R$65million -Co-Operation with Security Transit and Olympic Stadium Management	-Traffic Control Center, Field Equipment and systems -Co-Operation with Security, Transit and Olympic Stadium Management	-Traffic Control Center, Field Equipment and systems -Co-Operation with Security, Transit and Olympic Stadium Management	Traffic Control Center, Field Equipment and systems -Co-Operation with Security, Transit and Olympic Stadium Management	***Traffic*** *Control Center, Field Equipment and systems* *-Co-Operation with* ***Security****,* ***Transit*** *and Olympic Stadium Management PROGRESS?*

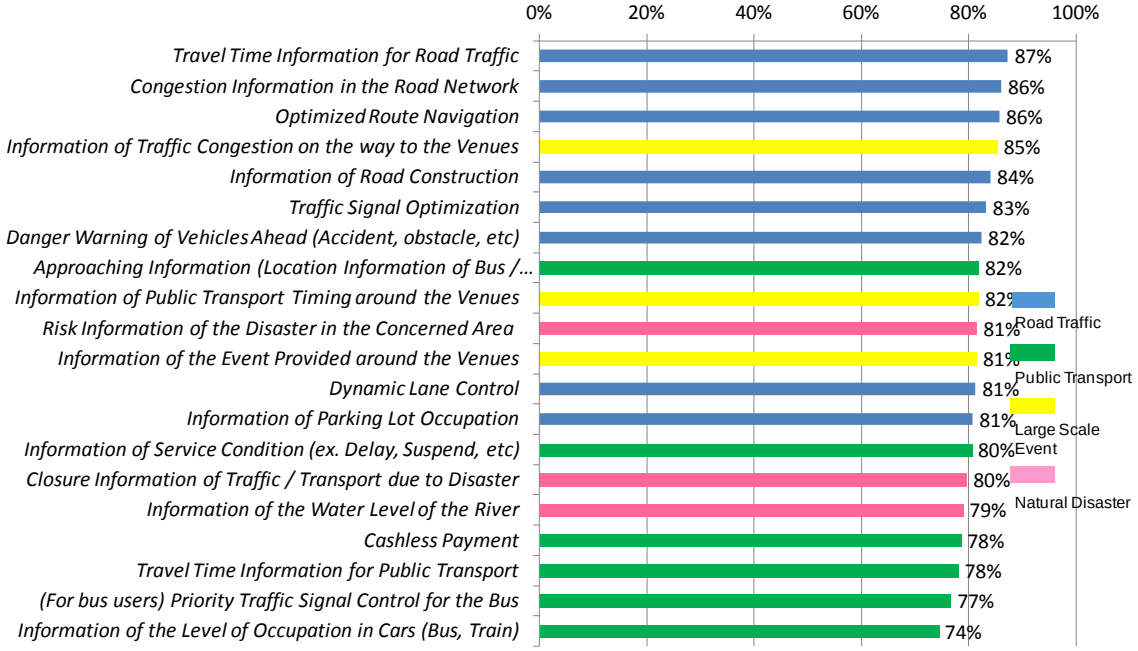
Source: JICA Study Team

2.4 CLARIFICATION OF ITS NEEDS

For the purpose of clarifying the ITS needs of travelers and ITS-related entities, questionnaires to travelers and interviews with transportation agencies have been conducted.

2.4.1 Survey on ITS Needs of Users

The ITS needs of travelers are summarized in below.

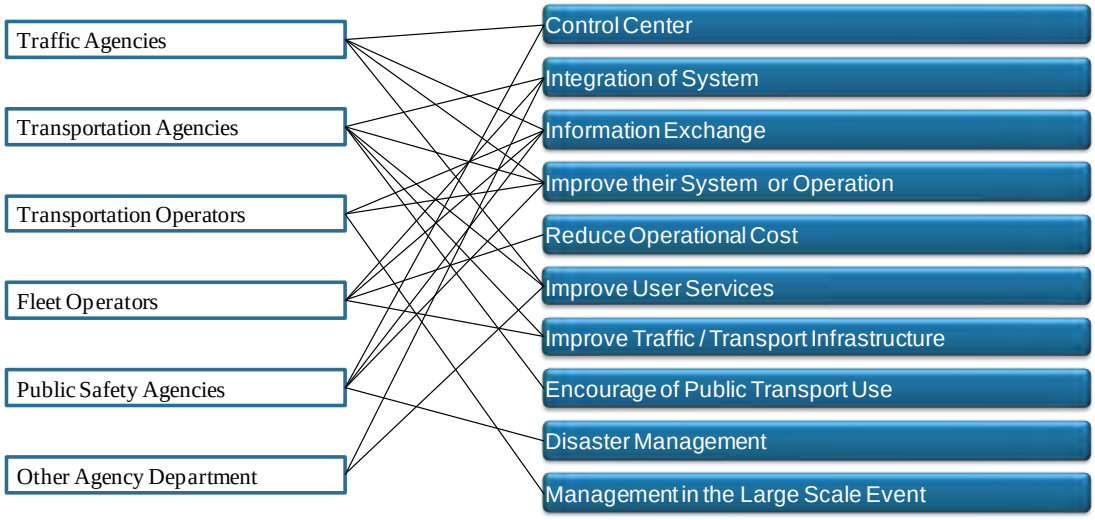


Source: JICA Study Team

Figure B-5 ITS needs of travelers

2.4.2 Interviews on ITS Needs of Transportation Agencies

The ITS needs of transportation agencies are summarized in below.



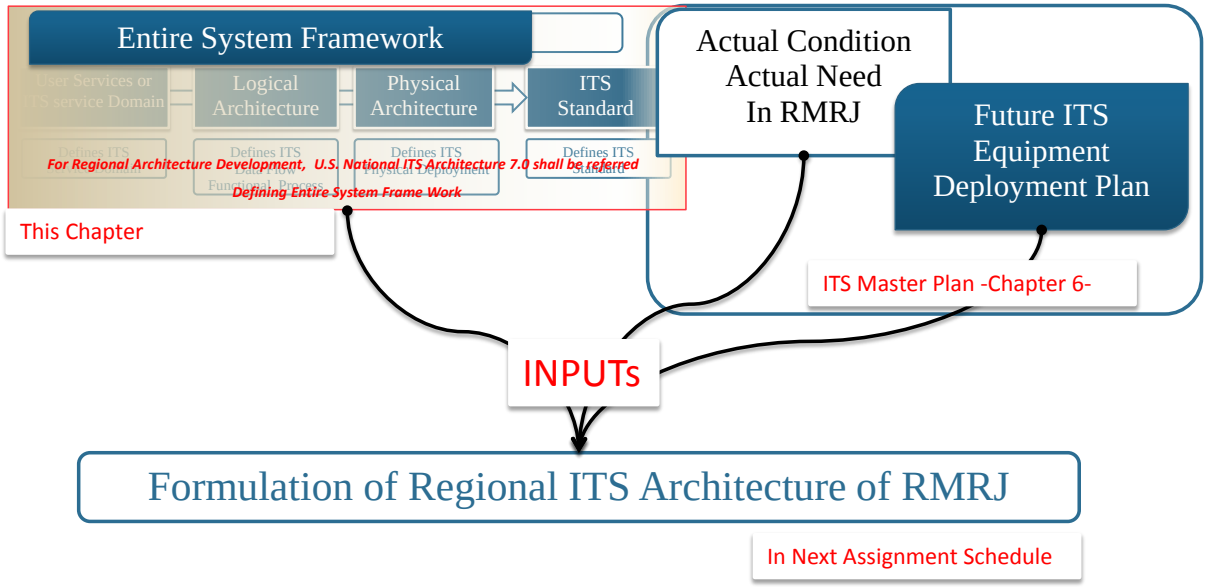
Source: JICA Study Team

Figure B-6 ITS needs of transportation agencies

2.5 SETTING A FRAMEWORK FOR AN ITS MASTER PLAN IN THE RIO DE JANEIRO METROPOLITAN AREA

It is necessary to establish an entire ITS framework to develop the ITS master plan of Rio de Janeiro Metropolitan Area. In this chapter, the JICA Study Team set the framework for the ITS master plan utilizing the existing ITS architectures around the world. The National ITS Architecture of the U.S., which is aligned with the ISO reference model, was set by the Brazilian Standard Organization as the standard for the development of the nationwide ITS in Brazil. In terms of formulating the ITS master plan in other states and municipalities, it will be useful to refer to the National ITS Architecture of the U.S. until ABNT has set the national architecture in Brazil.

The Study Team formulated the ITS master plan consisting of an entire framework of ITS, with current conditions, issues, and needs. In addition, cost estimate, economic analysis, and implementation schedule planning were also conducted. As for the regional ITS architecture of Rio de Janeiro Metropolitan Area, this shall be developed taking into account the future development plans of ITS.



Source: JICA Study Team

Figure B-7 Direction of Development of the Regional ITS Architecture of RMRJ

2.6 FORMULATION OF THE INTELLIGENT TRANSPORT SYSTEM MASTER PLAN OF RIO DE JANEIRO

2.6.1 Definition of the ITS Master Plan Development Policy

The main purpose of ITS master plan is to integrate all of existing systems for securing inter-operability between stakeholders to enhance the efficiency of transport systems. Considering this characteristics of ITS, the policy of ITS master plan shall follow existing comprehensive plan or strategic plan for Rio de Janeiro state and municipality government.

The study team conducted review of two related plan; one is 'STRATEGIC PLAN' from state government, and the other is 'TRANSPORT STRATEGIC PLAN' from Rio de Janeiro municipality government, and set a unified policy for ITS master plan on Rio de Janeiro Metropolitan Area.

Considering these reviews, the study team set up the policy for ITS master plan on Rio de Janeiro metropolitan area by factorizing meaning of essential aspects and keywords and doing verification of ITS cover area in general.

Policies of ITS master plan are set below;

1. ***Promote efficient system management and operation***
2. ***Enhance the integration and connectivity of the transportation system***
3. ***Promote and enhance the environmental and economic sustainable development***
4. ***Develop the economic diversity of the metropolitan area by enhancing productivity, and efficiency***
5. ***Increase the safety and Security of the transportation system***

Development policy of ITS master plan shall include wide range of perspectives, characteristics; user needs to achieve sustainable development. Based on this policy, component of ITS master plan such as ITS projects, deployment plan, and selection of short term projects are studied.

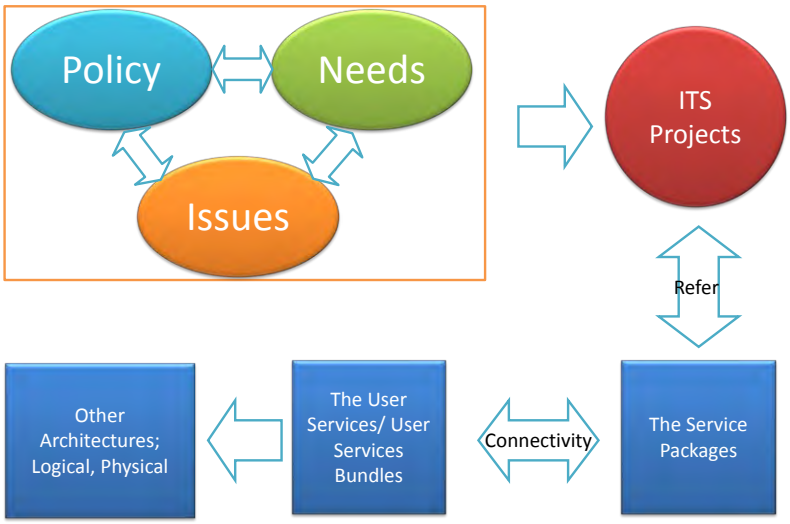
2.6.2 Formulation of ITS Master Plan for Rio de JANEIRO

The study team identified functional requirement, checked matching condition of needs and user services and services packages, developed ITS projects based on both aspects (ITS architecture and current issues and ITS needs), and planned deployment schedule.

Conceptual Design for ITS Projects

(1) Study on Essential ITS Projects for Rio de Janeiro Metropolitan Area

Coverage of ITS projects shall focus on issues, needs, and policy aspects. Furthermore, it shall be adaptive to ITS architecture such as the service packages and user services and bundles. Next figure shows how each perspective is considered, developed and connected to develop the ITS Projects for Rio de Janeiro metropolitan area.



Source: JICA Study Team

Figure B-8 Developing Process of ITS Projects

(2) Conceptual Design for ITS Projects

Considering the circumstances, the JICA Study Team proposed thirteen ITS projects, which are shown below.

Table B-5 Proposed ITS Projects

No.	ITS Project Name
1	ITS Center
2	Real Time Traffic/Transport Condition Information Processing
3	Olympic Security and Transport Coordination Center
4	Bus Condition Information Provision
5	Dissemination of On-board Unit for More Integrated Transport
6	Information Exchange of Road Operators
7	Information Exchange via ITS Center between Municipalities
8	Improvement of Traffic/Transit Operational Center with Essential ITS Equipment in Rio de Janeiro Municipal Area
9	Improvement of Traffic/Transit Operational Center with Essential ITS Equipment in Other Municipal Areas in RMRJ
10	Emergency Vehicle Operating Management
11	Commercial Vehicle Operation and Management
12	Advanced Vehicle Safety Systems
13	Deployment of X-band Radars

Source: JICA Study Team

Deployment Plan for ITS Projects Equipment

Based on t the ITS services and facilities necessary for each target, how to deploy ITS facilities required by each target is considered. Then, based on the results and interviews with road administrators, the current situation of with/without ITS facilities and management condition was organized. And the placement of the new ITS facility and ITS deployment plan for each individual service were considered.

Rough Cost Estimate

The rough order of magnitude estimate is brought to conduct the rough cost estimate of each ITS project. The following table shows a list of the ITS project and a result of the rough cost estimates.

Table B-6 ITS project and Rough Cost Estimation

No.	ITS Project Name	Amount (R$)	Amount (JPY)
1	ITS Center	59.900.000	2,371,000,000
2	Real Time Traffic/Transport Condition Information Processing	45.900.000	1,815,000,000
3	Olympic Security and Transport Coordination Center	48.900.000	1,936,000,000
4	Bus Condition Information Provision	122.300.000	4,840,000,000
5	Dissemination of On-Board Unit for more integrated Transport	344.900.000	13,643,000,000
6	Information Exchange of road operators	55.400,000	2,193,000,000
7	Information Exchange via ITS Center between municipalities	58.100.000	2,299,000,000
8	Improvement of Traffic/Transit Operation Center with Essential ITS Equipment at Rio Municipality Area	245.600.000	9,716,000,000
9	Improvement of Traffic/Transit Operation Center with Essential ITS Equipment at Other Municipality Area in RMRJ	204.700.000	8,096,000,000
10	Emergency Operating Management	18.500.000	733,000,000
11	Commercial Vehicle Operation and Management	17.600.000	696,000,000
12	Advanced Vehicle Safety Systems	Up to car industrial maker's technological development	
13	Deployment of X-band Radars	4.600.000	182,000,000

Source: JICA Study Team

Economic Analysis

Economic Analysis is conducted for each proposed ITS menu. The analysis was utilized macro/meso/micro simulation, and the effect by with/without ITS menu was calculated and evaluated.

The results of economic evaluation indicate that all the projects are economically feasible with EIRR higher than the opportunity cost of capital (>12%), B/C higher than unity (>1.0) and positive values of NPV (> 0). This is because that ITS project is not large scale infrastructure and is low cost compared to normal public works, such as bridge construction, and the effect of these project is high, therefore the benefit is high.

Table B-7 Result of Economic Evaluation

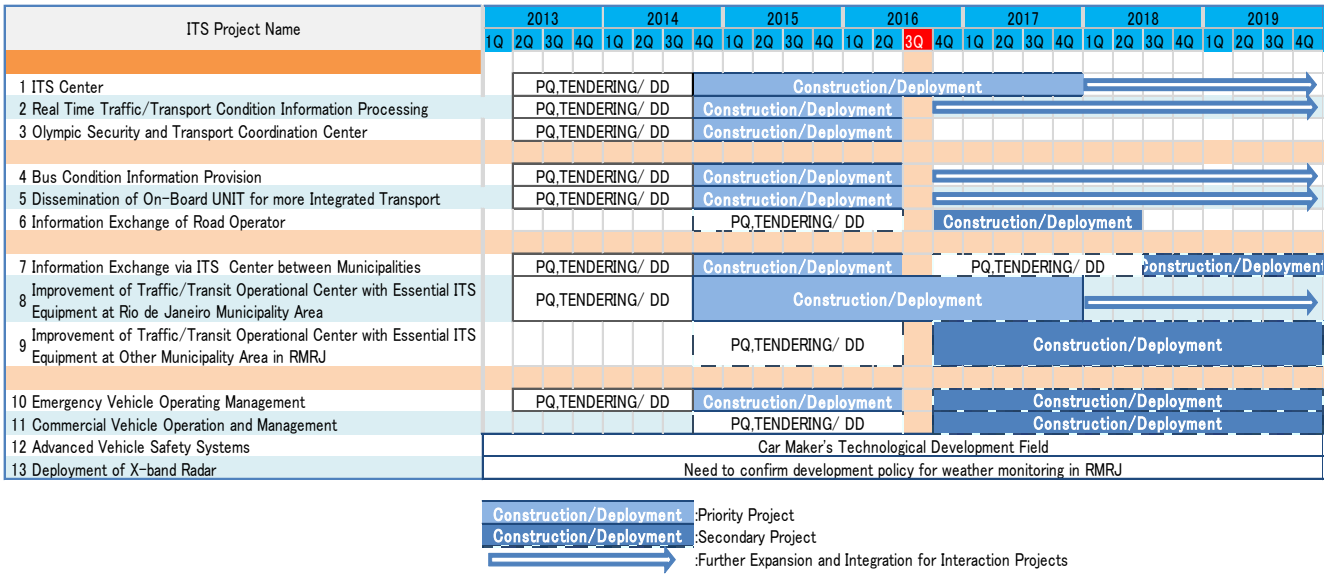
	EIRR	B/C	NPV
1.Bus Information Provision	32.9%	4.22	R$183 million
2.ITS Center	44.3%	4.99	R$225 million
3.BRT Priority System	75.3%	8.86	R$290 million
4.ETC	51.9%	5.89	R$72 million
5.ERP	23.2%	6.18	R$695 million

Source: JICA Study Team

Implementation Schedule

Milestone of ITS projects for Rio de Janeiro is Olympic Games Rio 2016. For short term projects shall focus on Rio de Janeiro municipality area to achieve Olympic game success. However, objectives of ITS is not only Olympic games, but also traffic/transit management for daily life.

Hence that, implementation schedule is developed considering four (4) major aspects such as 1.Olympic Period, 2.Rio de Janeiro Municipality Area, 3.Information Integration and Existing System Utilization, and 4.Security and Transport. The implementation schedule is below;



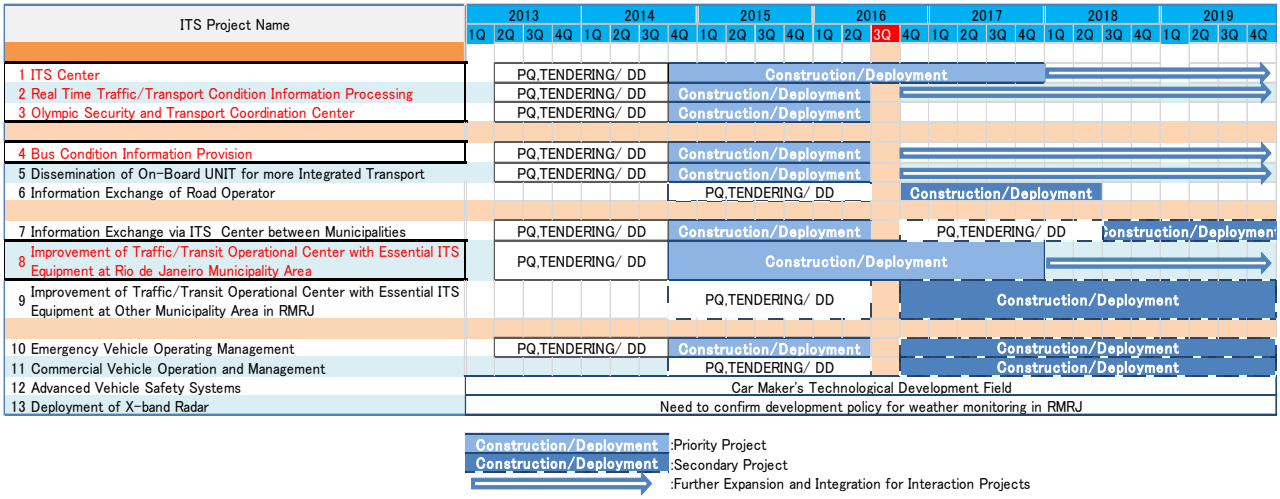
*1Q; From January. **PQ; Procurement DD; Detailed Design

Source: JICA Study Team

Figure B-9 Implementation Schedule

2.7 SELECTION OF SHORT TERM ITS MENUS

Five of the highest priority ITS projects were selected based on the conditions described above. Although Project Nos. 5, 7, and 10 were selected as priority projects in the implementation schedule, they are not considered essential to achieve smooth transport for the Olympic Games.



Source: JICA Study Team

Figure B-10 Short-Term ITS Projects and Their Implementation Schedule

2.8 PRELIMINARY DESIGN FOR SHORT TERM PROJECT

2.8.1 Outline of the Preliminary Design

The preliminary design for the six (6) projects shown below is conducted.

- No.1 ITS center
- No.2 Real Time Real Time Traffic/Transport Condition Information Processing
- No.3 Olympic Security and Transport Coordination Center
- No.4 Bus Condition Information Provision
- No.6 Information Exchange of Road Operator
- No.8 Improvement of Traffic/Transit Operational Center with Essential ITS Equipment at Rio de Janeiro Municipality Area

Each project is effective for countermeasures against traffic congestion in Rio de Janeiro municipality area. However, projects No.1, No.2, No.3 and No.6 should be combined into a project package for a more effective and efficient implementation.

Therefore the six (6) projects above are proposed to be classified into three (3) project packages as follows. The JICA study team has carried out a preliminary study for following three (3) project packages.

Table B-8 Project Package

Project Package No.	ITS Project	
Project Package 1	No.1	ITS Center
	No.2	Real Time Traffic/Transport Condition Information Processing
	No.3	Olympic Security and Transport Coordination Center
	No.6	Information Exchange of Road Operator
Project Package 2	No.4	Bus Condition Information Provision
Project Package 3	No.8	Improvement of Traffic/Transit Operational Center with Essential ITS Equipment at Rio de Janeiro Municipality Area

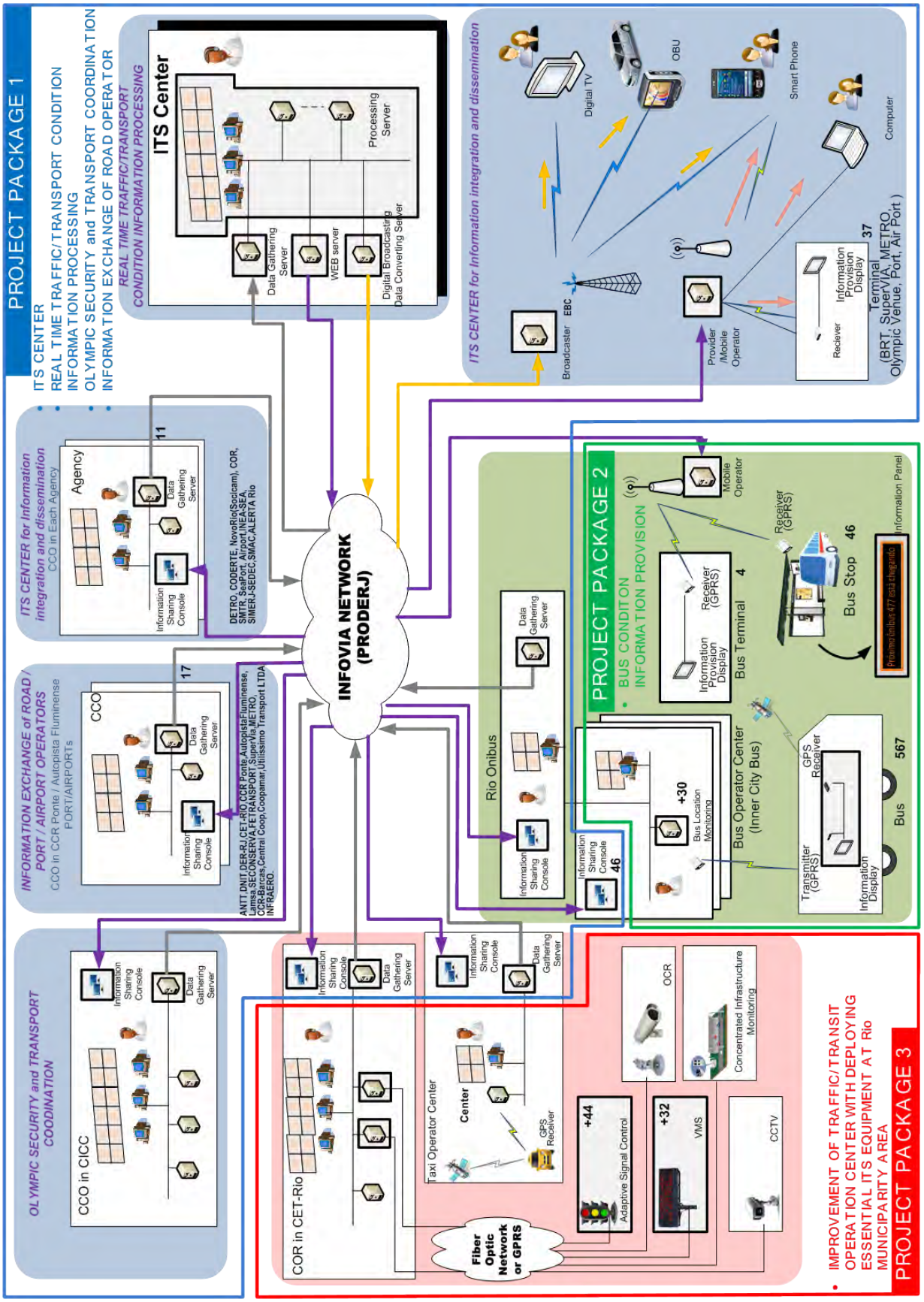
Source: JICA Study Team

2.8.2 Project Cost

Based on the preliminary design, the project cost for Project Package 1, Project Package 2 and Project Package 3 is estimated as shown in Table B-9.

This cost estimate is based on the following conditions and assumptions;

- Equipment cost comes from Rough Order Magnitude (ROM) cost information based on system integrators, past projects contract price information and the consultant's experience.
- Installation cost is assumed to be ten (10) percent of the equipment cost.
- Consultancy service is taken into consideration from the viewpoint of proper design, schedule and quality management of implementation during the design stage and procurement stage. Its cost is around seven (7) percent of the equipment procurement and installation cost.
- Administration cost is assumed as five (5) percent of the equipment procurement and construction cost.
- Price escalation is assumed as three (3) percent of the equipment procurement and construction cost.
- Contingency is assumed as ten (10) percent of the project cost which consists of the equipment procurement and construction cost, consultancy service cost, administration cost and price escalation.
- Including costs for hardware, software and setup
- Not including costs for establishment of new organization for the operation and land acquisition.



Source: JICA Study Team

Figure B-11 Overall System Diagram

Table B-9 Project Cost

No.	Item	Amount (R$)	Amount (JPY)	Remarks
1	**Equipment Procurement and Construction Cost**	**162,000,000**	**7,564,000,000**	
1-1	Project Package 1 ITS Center Real Time Traffic/Transport Condition Information Processing Olympic Security and Transport Coordination Center Information Exchange of road operators	66,000,000	3,085,000,000	
1-2	Project Package 2 Bus Condition Information Provision	71,000,000	3,326,000,000	
1-3	Project Package 3 Improvement of Traffic/Transit Operation Center with Essential ITS Equipment at Rio Municipality Area	25,000,000	1,153,000,000	
2	**Consultancy Service (Design and Supervision)**	**11,340,000**	**529,480,000**	**1. x 7%**
3	**Administration Cost**	**8,100,000**	**378,200,000**	**1. x 5%**
4	**Price Escalation**	**4,860,000**	**226,920,000**	**1. x 3%**
5	**Project Cost**	**186,300,000**	**8,698,600,000**	**1.+2.+3.+4.**
6	**Contingency**	**18,630,000**	**869,860,000**	**5. x 10%**
	TOTAL PROJECT COST	**204,930,000**	**9,568,460,000**	**5. +6.**

Source: JICA Study Team

2.8.3 Implementation Plan

Table B-10 shows project implementation schedule on Project Package 1, Project Package 2 and Project Package 3. These three (3) packaged projects shall be completed by the commencement of the Olympic Games on August 2016 to achieve smooth transport for the games. However there is not enough time to implement each project stepwise; therefore these projects shall be carried out simultaneously as shown in Table B-10.

To start each project smoothly and complete until Olympic Games, the following work preparation is essential;

- Determination of counterpart agency for each project
- Financial Preparation

One method for financial preparation is to consider the Olympic budget. Another option is to establish a concessionaire as the scheme of PPP (Public Private Partnership) which will complete and operate the project.

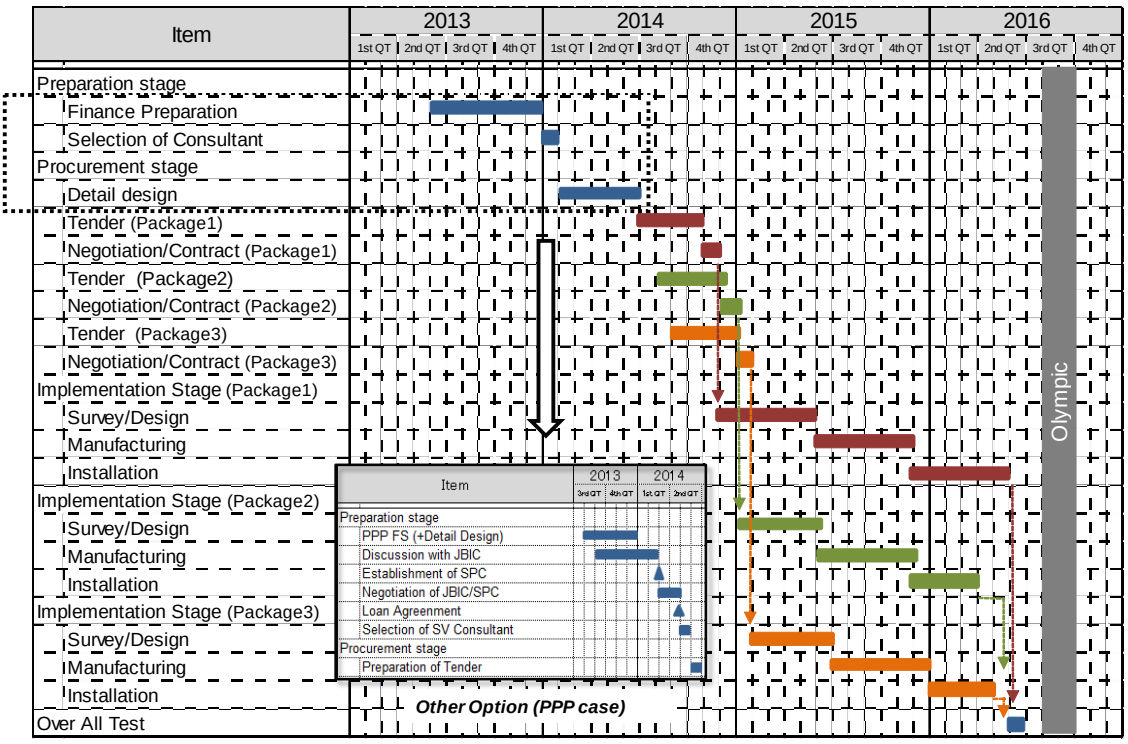
The key milestones to complete the project successfully are shown as follows;

- Finances shall be prepared by end of 2013.
- Preparation of tender (such as Detail Design) shall be finished by middle of 2014
- Tender shall start at middle of 2014.

- Project Package 1 shall start at the end of 2014.
- Overall test including Project Package 1, Project Package 2 and Project Package 3 shall be finished by June 2016.

For PPP, JICA has a scheme, called public-private partnership feasibility study (PPP-FS), for procurement of financial resource by utilizing private fund. Following this scheme, financial resource for the detailed design will be prepared.

Table B-10 Implementation Plan



Source: JICA Study Team

2.8.4 Suggestion

In consideration of smooth implementation of the project packages and effective usage of the ITS system, the following activities are recommended;

(1) For smooth and successful implementation of project packages

Task force project team

Several stakeholders are included in this project. It is expected that there will be modification to the stakeholders' existing subsystems for gathering ITS information through the ITS Center. Understanding and cooperation between the stakeholders listed in this study are essential for successful implementation.

Therefore, steering committee meetings shall be held periodically. A strong leadership identified by the project task force team is also necessary. The team shall be established as soon as possible. The team shall conduct the preceding works until handing the work over to the operational organization of the ITS Center.

Operational organization for ITS center

The ITS Center will be a newly established and built facility in Project Package 1. To commence the operation of the ITS Center smoothly at the same time as the Olympic Games and to adequately and promptly deal with casual system problems during operation, the establishment of an operational organization is needed by August 2015, one year before the completion of the project.

(2) For effective usage of ITS system

Effective usage of Adaptive Signal Control system

Many signalized intersections will be controlled according to the traffic situation automatically or manually by COR. When public transport signal priority is activated in case of a disaster emergency or VIP transport, the nearby intersection areas shall be activated and controlled according to the schedule of prioritized public transport. Such coordination shall be done among CICC, SEDEC, and other related agencies.

Effective usage of VMS system

Any related agency will be able to know the traffic situation through several display devices. Road operators can also get important related traffic information from computer monitors that are directly connected to the ITS Center. Thus, the road operator shall operate the VMS messages to show important information such as accidents or traffic congestion.

Coordination among Olympic Support Parties and Agencies

The proposed ITS system will be able to gather traffic information from related agencies and disseminate it not only to other agencies but also to the public through information provision display. These displays will be installed at Olympic stadiums and venues, terminals and through personal telephone, internet and at OBUs of cars.

For the effective usage of the ITS system for the smooth operation of the Olympic Games, coordination meetings among Olympic support parties and agencies are important.

2.9 CURRENT ITS CONDITION IN FEDERAL DISTRICT

2.9.1 Regional /Traffic Conditions and Issues

(1) Regional Conditions and Issues

Based on regional characteristics the issues of Federal District, which should be considered in ITS Master Plan, are;

> Rapid Growth of Economic and Good development of Competitiveness

> Gentle curve of increasing of population and population density is not high

> Increasing demand of in-bound tourism to DF and 4rd largest country is Italy

> Potential to hold more Large Scale Events.

> Torrential rain in the Rainy Season

(2) Traffic Conditions and Issues

Based on traffic / transportation characteristics the issues of Federal District, which should be considered in ITS Master Plan, are;

> Dependent on Cars within DF (Modal Share of Cars: About 50%)

> Number of Cars in DF is increasing

> Accident Caused by Collision is Dominant

> Bus Trips between DF and Surrounding Cities

> Large amount of trips by bus from surrounding cities to DF

> Peak hour of Metro is as follows:

Suburb to Central DF -> 6 AM

Central DF to Suburb -> 6PM

2.9.2 Current Condition of ITS

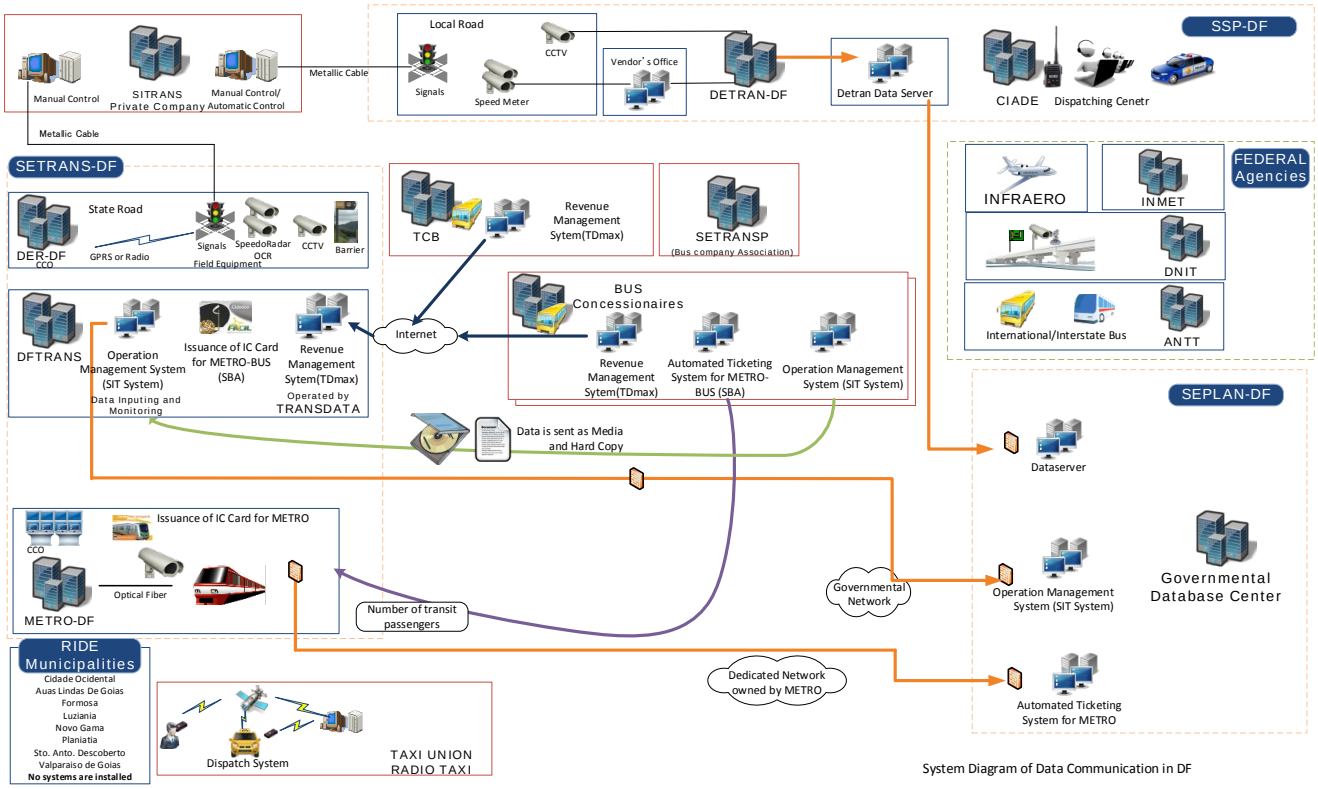
In Federal District systems are installed by some agencies, but these agencies are not integrated with each system and related information. And traffic information was not share with cities around DF.Therefore, a key issue is the increasing need for “Integration” in the Federal District and Surround cites.

(1) ITS Facilities

The ITS equipment and facilities are administered on the roads of DF. These are 1.Traffic light system, 2.OCR equipment, 3.CCTV, and 4.Meteorological and Atmospheric Sensors.

(2) Overall System Diagram and ITS Related Agency

Overall System Diagram is shown below. It shows the relation of the ITS-related agencies in the DF. Most agencies collect information traffic data such as volume, speed, and CCTV image, but do not integrate/share the information.



System Diagram of Data Communication in DF

Source: JICA Study Team

Figure B-12 Overall System Diagram

From the above system diagram, the information collected and distributed by ITS-related agencies are summarized below

Table B-11 ITS Related Agencies

Concessionaires/Agencies	Collected Information	Other Agencies to which Information is Distributed	Method
Federal Government			
DNIT	OCR/Speed meter	-	
ANTT	Operation information	-	
INMET	Meteorological information	Civil Defense, SSP, Public, etc	Telephone, E-mail, Internet
DF			
DFTRANS	Operation information	-	Internet
METRO-DF	CCTV Operation information	- -	Fiber optic
DETRAN-DF	OCR/Speed meter Signal	- SITRAN	Hard copy (CD-R) Metallic cable
DER-DF	CCTV OCR/Speed meter Signal	- - SITRAN	Fiber optic Telephone Metallic cable
SEPLAN	Data collection	-	Fiber optic
CIADE	Emergency information	Civil Police, Fireman. Others	Telephone/Radio
SSP-DF	Basic security information		

Source: JICA Study Team

2.9.3 Plans

The summary of traffic/transport related plan and urban development plan is shown below.

Table B-12 Related Plans

Plan	Summary
PDTU/DF	-The PDTU/DF refers to the Master Plan for Urban Transport in the Metropolitan Region of DF approved in 2010. -The goals of the PDTU/DF are the following: 1.Improve general conditions of population movement in urban areas in the DF and surrounding areas, 2.Develop actions in the short, medium, and long term, and 3.Prioritize the desires and needs of the population. *Current conditions, assumption of demand estimations and policies of alternatives and comparison should be considered in formulating the ITS master plan.*
PAC, PAC2	-Four-year investment plan authorized by the federal government. -Aim: To accelerate the national economy in Brazil, especially, investment in PAC2.
PPA	-This is the Multi-Year Plan of the DF for four years prepared by the state government. -The challenges of this program are as follows: 1. To suggest plans and give answers for sustainable development of the DF; 2. To solve the problems arising from the growth in the DF ; 3. To transform city worldwide reference in Brasilia, capital of a true human development; 4. To modernize public administration; and 5. To achieve good quality in the provision of public services.
ITS Related Plan	ITS Brasília, Traffic Control Center at DETRAN-DF, ANTT Inter State Bus Monitoring Center on DF, etc,,,

Source: JICA Study Team

From the above, keywords for the ITS Master Plan formulation could be extracted as follows.

Actions in short-, medium- and long-term
Sustainable Development
Worldwide City
Improve Public Administration
Quality of Public Services
Population Desires

2.10 PRELIMINARY ITS MASTER PLAN FOR FEDERAL DISTRICT

2.10.1 ITS Projects Conceptual Design

(1) System Organization

As a result, 34-sub systems were selected and grouped into five subcomponents: 1. Data Base/Data Processing (1 subsystem); 2. Information Exchange/System Integration (6 subsystems); 3. Information Provision (10 subsystems); 4. Traffic Monitoring/Control, Public Transport Monitoring/Coordinating, and Concessionaire Operation Monitoring (13 subsystems); 5. Traffic Demand Management (4 subsystems).

These five subcomponents should then be deployed into one regional Traffic/Transportation Management Center (T2MC-DF). The deployment should be step-wise and divided into 3 phases as follows:

- Visualization Phase (Short-term): The short term goal of T2MC-DF is to visualize current traffic/transportation conditions in real-time. Existing System Utilization, Information Exchange, and Cross Jurisdictional Cooperation System Agreements are the core components. In this phase coordination between DNIT, DER, DETRAN-DF, DFTRANS, METRO and Weather Monitoring Agencies is essential.

- System Expansion Phase (Mid-term): The mid-term goal of T2MC-DF is to expand the ITS related traffic systems such as: CCTVs, traffic volume detection, speed detection, Dynamic Signal Optimization System, and VMS. Mass transit systems are also considered such as: Operation Center, GPS Monitoring System, Concessionaire Report Generating System. In this phase, more advanced communication/information systems are deployed such as: public transportation priority system, information provision system, and real- time congestion communication with car navigation system.

- Traffic Demand Management Phase (Long Term): The long term goal of T2MC-DF is to control traffic demand by deploying systems for real time control. These systems will be developed on top of existing systems already developed in the previous phases. High Occupancy Vehicle (HOV), Electronic Road Pricing (ERP), Park and Ride Provision, and Dynamic Reversible Lane System are the systems to compose the final phase of the T2MC-DF.

This overall system organization and concept assumed the following development context: Maximum Utilization of Existing Systems; Essential Information Exchange among operators; Centralized Center Development and a Seamless Interstate (RIDE area) System Operation Structure.

2.10.2 Rough Cost Estimation for Short Term Project

The following table shows a list of the ITS project and a result of the rough cost estimation.

Table B-13 ITS project and Rough Cost Estimation

No.	ITS Project Name	Amount (R$)	Amount (JPY)
1	Project 1: Database/Data Processing ITS Data mart	14.000.000	638,000,000
2	Project 2: Information Exchange Project 3: System Integration	8.000.000	339,000,000
3	Project 4: Information Provision	4.000.000	188,000,000
4	Project 5: Traffic Monitoring/Control	9.000.000	338,000,000
5	Project 6: Public Transport Monitoring/Coordinating	2.000.000	61,000,000
	(Total)	37.000.000	1,614,000,000

Source: JICA Study Team

2.10.3 Proposal for Development Schedule

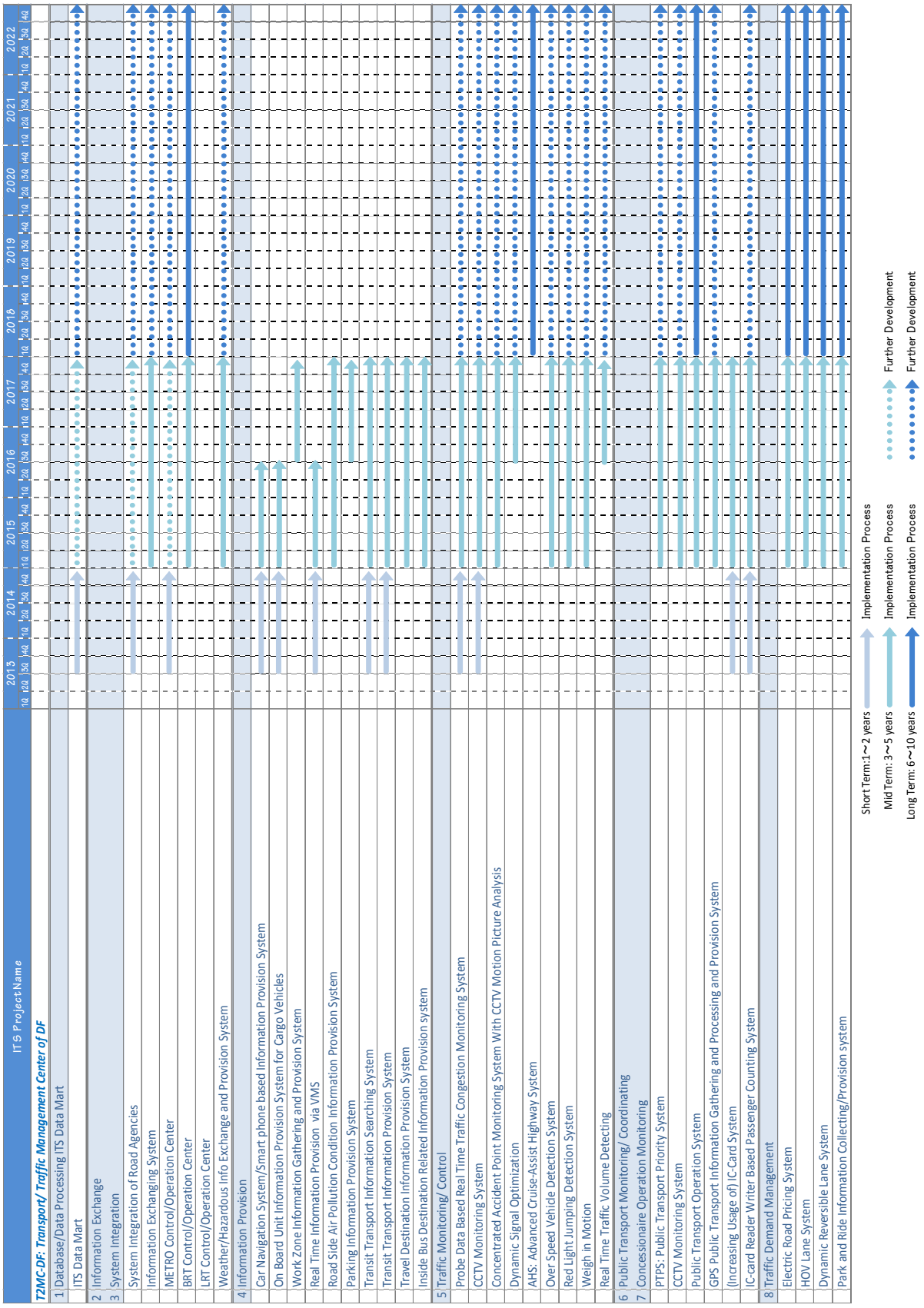
The development of T2MC and its subsystems shall be paced according to the 3 phases of implementation: Visualization Phase (Short-term), System Expansion Phase (Mid-term) and Traffic Demand Management Phase (Long Term). Short-term systems should be implemented in no more than one year; mid-term systems should be considered step-wise between 2 and 5 years; and long-term systems should be considered between 5 and 10 years – upon successful implementation and operation of phases 1 and 2. Further refinement of schedule may be needed upon development of a complete Master Plan.

The schedule for implementation is shown in the tables in next pages. Table B-14 (Implementation Plan) describes when each project shall be implemented and Table B-15 (Work Plan) describes necessary tasks and work flow for implementation.

2.10.4 Next Steps

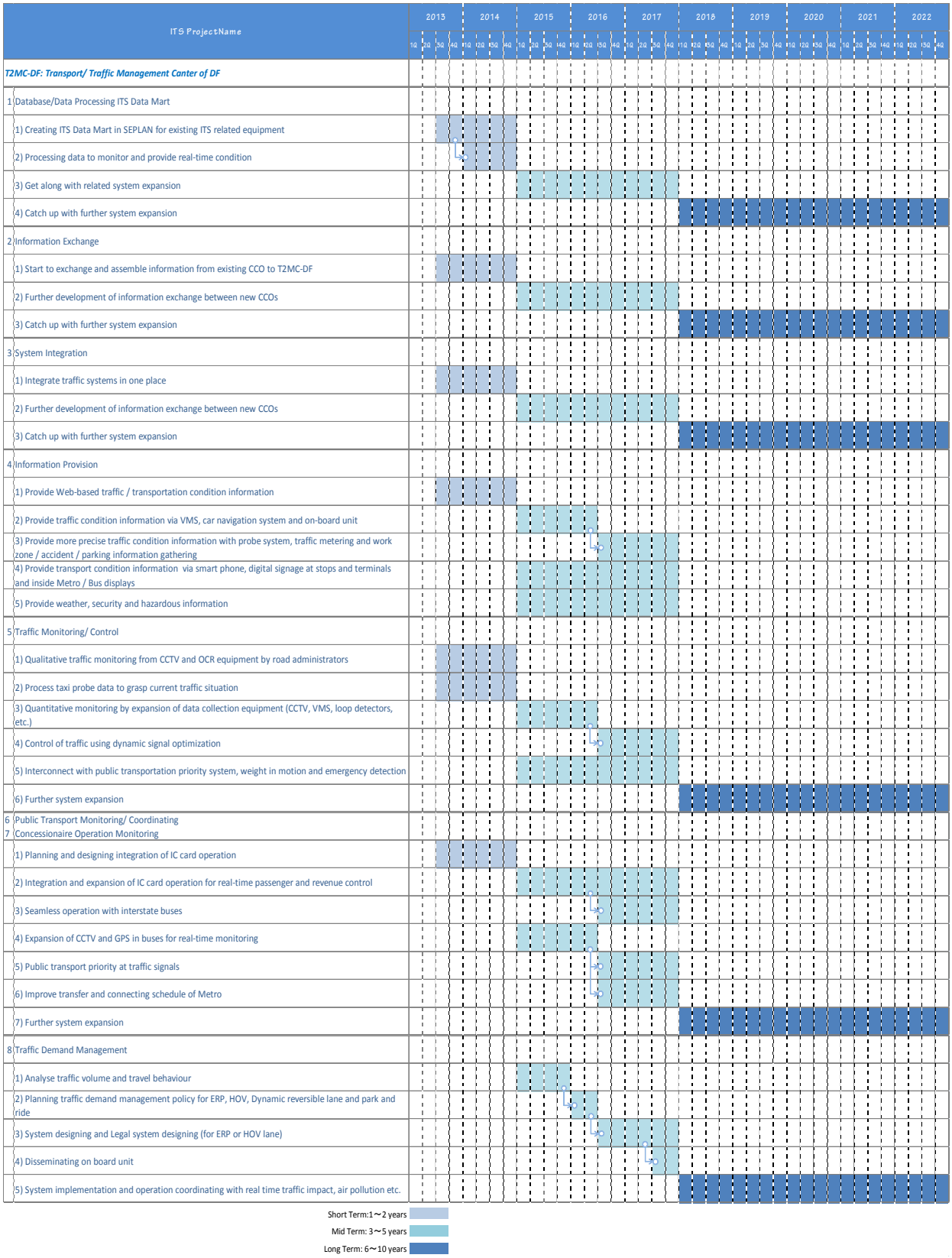
The DF ITS Preliminary Master Plan should be used as the starting point for development and implementation of the ITS systems here proposed. A complete Master Plan shall also include additional data collection such as volume, travel time and speed data during peak periods; detailed analysis of traffic demand and network (simulation); detailed communication and ITS architecture; and basic design of the suggested systems as next steps. In addition, update of current conditions may be needed depending on the timeframe.

Table B-14 DF Implementation Plan



Source: JICA Study Team

Table B-15 Work Plan



Source: JICA Study Team