CHAPTER 8 SELECTION OF SHORT-TERM INTELLIGENT TRANSPORT SYSTEM MENUS

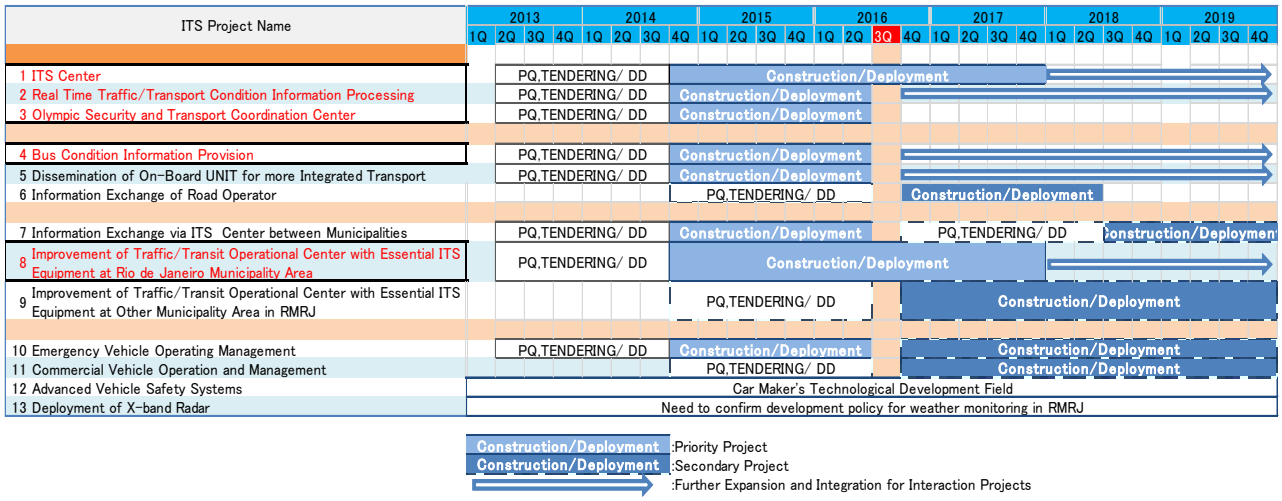
8.1 SELECTION POLICY FOR SHORT-TERM ITS PROJECTS

The short-term projects, which hold the highest priority among the ITS projects in the ITS master plan, were selected for the smooth introduction of ITS in Rio de Janeiro Metropolitan Area. The list of the short-term projects is shown in Figure 8-1 and the implementation schedule was defined based on the following:

1. Immediate effectivity
2. Operability in the short term
3. Achievement of smooth transportation for Rio 2016 Olympic Games

8.2 SHORT-TERM ITS PROJECTS

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 8-1 Short-Term ITS Projects and Their Implementation Schedule

CHAPTER 9 PRELIMINARY DESIGN FOR SHORT-TERM PROJECT

9.1 OUTLINE OF THE PRELIMINARY DESIGN

In accordance with the selection of short-term ITS projects mentioned in Chapter 8, the preliminary design for the six projects shown below was conducted.

- No.1 ITS Center
- No.2 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 in Rio de Janeiro Municipal Area

Each project is an effective countermeasure against traffic congestion in Rio de Janeiro municipal area as mentioned in Chapter 7. However, Project Nos. 1, 2, 3 and 6 should be packaged into one project for more effective and efficient implementation. Therefore, the six projects above are proposed to be classified into three project packages as shown in Table 9-1.

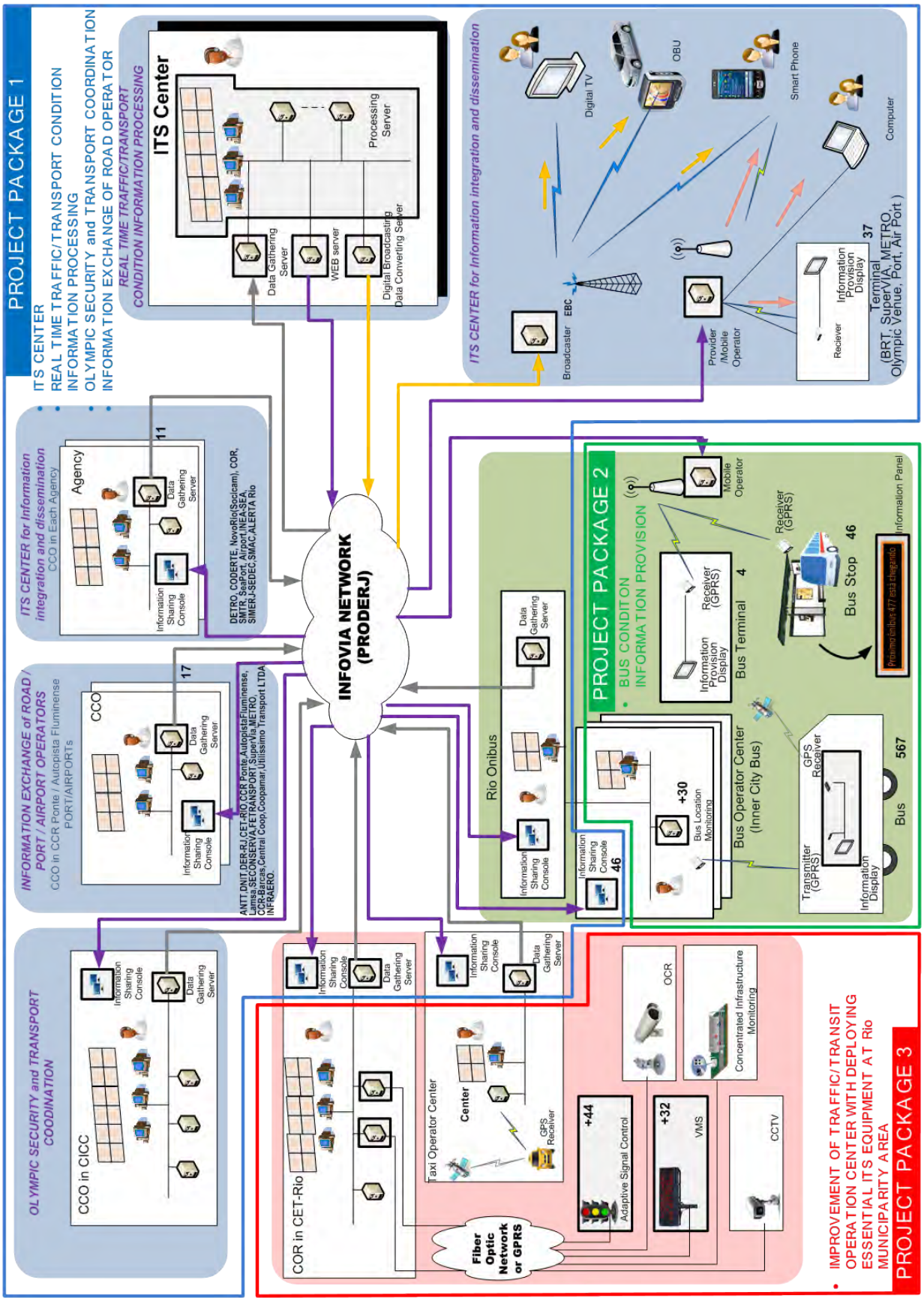
The JICA Study Team has carried out a preliminary study for the three following project packages.

Table 9-1 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 in Rio de Janeiro Municipal Area

Source: JICA Study Team

The overall system diagram in Figure 9-1 shows the classification of the project packages.



Source: JICA Study Team

Figure 9-1 Overall System Diagram

9.2 PROJECT COST

Based on the preliminary design, the project costs of Project Package 1, Project Package 2, and Project Package 3 are estimated as shown in Table 9-2.

This cost estimation is based on the following conditions and assumptions:

- Equipment cost comes from rough order of magnitude (ROM) cost information based on system integrators, past projects' contract price information, and the consultant's experience.
- Installation cost is assumed to be 10% 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 and procurement stages. Consultancy service cost is around 7% of the equipment procurement and installation cost.
- Administration cost is assumed to be 5% of the equipment procurement and construction cost.
- Price escalation is assumed to be 3% of the equipment procurement and construction cost.
- Contingency is assumed to be 10% of the project cost which consists of the equipment procurement and construction cost, consultancy service cost, administration cost, and price escalation.
- Costs for hardware, software and setup shall be included.
- Costs for the establishment of new organization for operation and land acquisition shall not be included.

Table 9-2 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

9.3 IMPLEMENTATION PLAN

Table 9-3 shows the project implementation schedule of Project Packages 1, 2 and 3. These three project packages shall be completed before the commencement of the August 2016 Olympic Games in order to achieve smooth transportation for the games. However, there is insufficient time for a stepwise implementation of each project. Therefore, these projects shall be carried out simultaneously as shown in Table 9-3.

To start each project smoothly and for timely completion until the Olympic games, the following work preparations are essential:

- Determination of counterpart agency for each project; and
- Financial preparation.

One method for financial preparation is to consider the Olympic budget. Another option is to establish a concessionaire under a public-private partnership (PPP) scheme that will complete and operate the project.

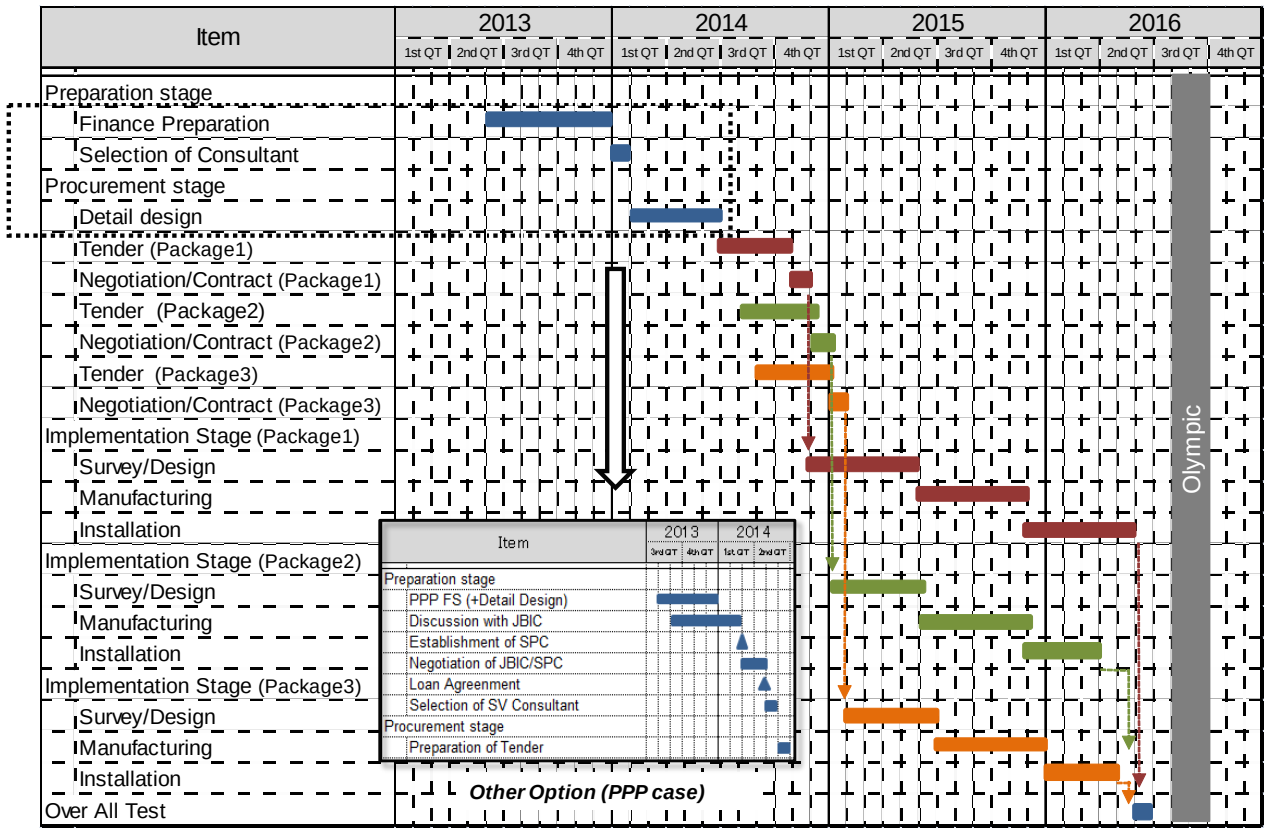
The key milestones to complete the project successfully are as follows:

- Financing shall be prepared by the end of 2013.
- Tender preparation (e.g., detailed design) shall be finished by the middle of 2014.
- Tender shall start in the middle of 2014.

- Project Package 1 shall start by the end of 2014.
- Overall testing for Project Packages 1, 2, and 3 shall be finished by June 2016.

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

Table 9-3 Implementation Plan



Source: JICA Study Team

9.4 PROJECT PACKAGE 1

Project Package 1 consists of the following components:

- ITS Center
- Real Traffic/Transport Condition Information Processing
- Olympic Security and Transport Coordination
- Information Exchange of Road Operator

9.4.1 Grand Design

(1) Objective

The objectives of Project Package 1 are summarized as follows:

- To collect and gather transport/transit-related data and information of the Rio de Janeiro municipal area in a centralized center (ITS Center);
- To process vehicles positioning data (GPS), point data (speed, traffic volume, accident, construction information), transit information (current operation and positioning data), weather (road and area), and disaster information and put them into the GIS engine;
- To provide information on all users and devices via web, FM, and digital broadcasting;
- To exchange information between the ITS Center and security-related agencies (e.g., CICC) for the expansion and improvement of the function of the ITS Center;
- To connect road operators in terms of traffic information;
- To enhance essential information provision to road users; and
- To ensure smoother traffic flow.

(2) Target Area

The target area covered in Project Package 1 is focused on Rio de Janeiro municipal area considering operability in the short term.

(3) Related Stakeholders

There are 30 or more stakeholders related not only with transit/transportation but also with public safety and meteorological observation. The related stakeholders are summarized as follows:

1) Road-related Agencies/Private Companies

ANTT, DNIT, DER-RJ, CET-RIO, SECONSERVA	(Public/Government Company)
CCR Ponte, CCR-Vialagos Autopista Flminense, Lamsa	(Private Company)

2) Transit/Transport-related Agencies

SETRANS, DETRO, CODERTE	
COR, SMTR	
Seaport Authority, Airport Authority	

3) Transit/Transport Operator

Rio Onibus, Central Coop	(Syndicate and Consortium)
FETRANSPOR	(Association)
Super VIA, METRO, CCR Barcas	
Private Bus Companies	
Bus Terminal (Socicam)	
Radio Taxi, Chile Taxi, Coopamar	(Taxi Companies)

4) Freight Operator

Utilissimo Tranportes LTDA	

5) Public Safety Agencies

Civil Defense-SEDEC, SAMU-CBMERJ, BOMBEIRO-CBMERJ, SESEG, SMSDC	

6) Weather/Air Pollution Monitoring Agency

INEA-SEA, SIMERJ-SEDEC, SMAC, SMO	

7) Digital Broadcaster

Broadcaster (Ex) EBC, TV Globo, SBT, TV RECORD, BAND	

(4) Definition of Data/Information to be Gathered and Data Gathering Process

Table 9-4 shows the type of data/information which the ITS Center should gather from each stakeholder. Table 9-5 also shows the gathering process that was clarified through interviews with each stakeholder. In this table, statements in red caption reflect the currently non-existing data or database. Statements in blue caption mean long-term projects. Statements in black caption state that the data/information is currently available.

Table 9-4 Definition of Data/Information

Stakeholders		Gathered and Collected Data/Information from Each Stakeholder
Road-related Agencies/Private Companies	ANTT	-Federal concession road traffic/administrative information
	DNIT	-Federal road traffic/administrative information
	DER-RJ	-State road traffic/administrative information
	CCR-Vialagos	-State road traffic/administrative information
	CET-RIO	-Municipality road traffic/administrative information
	CCR Ponte	-Niteroi Bridge traffic/administrative information
	Autopista Fluminense	-Autopista Fluminense Road traffic/administrative information
	LAMSA	-LAMSA Road traffic/administrative information
	SECONSERVA	-Work zone info with longitude and latitude
	STP (Via Facil) ETC Operator	-Traffic volume information
Transit/Transport-	DETRO	-Interstate and intermunicipal bus operating information and GPS-based

related Agencies		positioning information (will be prepared by DETRO and each bus company)
	CODERTE	-Bus terminal information -Bus arrival information
	Novo Rio (Socicam)	-Bus terminal information -Bus arrival information
	COR	-Weather information, municipal road traffic/administrative information
	SMTR	-Bus operation information from Rio Onibus
	Airport	-Arrival/departure information
	Seaport	-Arrival/departure pier information
Transit/Transport Operator	Rio Onibus	-Bus/BRT operational information -Bus/BRT GPS data -Bus frequency information
	FETRANSPOR	-Bus/BRT stop location information -Bus/BRT lines information (bus network information) -Bus frequency information
	Super VIA	-Rail operational information -Rail timetable
	METRO	-METRO operation information -METRO timetable
	CCR Barcas	-Ferry operation information -Ferry timetable
	Private Bus Companies	-Bus operation information -Bus GPS data -Bus frequency information
	Socicam	-Bus terminal operation information -Bus arrival information
	Central Coop	-Taxi association
	Taxi Companies Radio Taxi, Chile Taxi, Coopamar	-Taxi GPS data (via Auto Cab, Smart Sys)
Air Operator	INFRAERO	-Flight information (departure, arrival, delay and accident) -Meteorological information -CCTV monitoring (airport, taxi parking)
Freight Operator	Utilissimo Tranportes LTDA	-Freight operation information
Public Safety Agencies	Civil Defense-SEDEC	-Emergency information with longitude and latitude
	SAMU-CBMERJ	
	BOMBEIRO-CBMERJ	
	SESEG	
	SMSDC	
Weather/Air Pollution Monitoring Agency	INEA-SEA,	-Rain and water level data of rivers -Air pollution data with longitude and latitude
	SIMERJ-SEDEC	-Weather monitoring and rain monitoring data with longitude and latitude
	SMAC	-Air pollution data with longitude and latitude
	SMO (Civil Defense ALERTA Rio)	-Weather monitoring and rain monitoring data with longitude and latitude

Table 9-5 Data Gathering Process

Stakeholders		Data	Detail
Road-related Agencies/Private Companies	ANTT	In the long term (due to lack of ITS equipment at present)	In the long term (due to lack of ITS equipment at present)
	DNIT	OCR (some)	Point speed data (with longitude and latitude)
	Autopista Fluminense 101 –Upcoming road to RJM-	CCTV Video (107)	CCTV motion picture *Traffic volume *Point speed data (with longitude and latitude)
		VMS (8)	Condition of information provision (with longitude and latitude)
		Mobile VMS (5)	Condition of information provision (with longitude and latitude)
		Speed Gun (23)	Point speed data (with longitude and latitude)
		MOE (2)	Meteorological (with longitude and latitude)
		GPS-Maintenance Vehicle	Condition of distribution (with longitude and latitude)
		Accident Information	Accident point, section, level, and on time situation (with longitude and latitude)
		Work Zone Information	Work zone point, section, roadwork period (with longitude and latitude)
	CCR-Ponte -Upcoming road to RJM-	CCTV Video (28)	CCTV motion picture *Traffic volume *Point speed data (with longitude and latitude)
		VMS (6)	Condition of information provision (with longitude and latitude)
		Mobile VMS (2 or 3)	Condition of information provision (with longitude and latitude)
		OCR (some)	Point speed data (with longitude and latitude)
		MOE (some)	Meteorological (with longitude and latitude)
		GPS-Maintenance Vehicle	Condition of distribution (with longitude and latitude)
		Accident Information	Accident point, section, level, and on-time situation (with longitude and latitude)
		Work Zone Information	Work zone point, section, roadwork period (with longitude and latitude)
	DER -Upcoming Road to RJM-	CCTV Video (12)	CCTV motion picture *Traffic volume *Point speed data (with longitude and latitude)
		VMS (5)	Condition of information

			provision (with longitude and latitude)
		OCR (32)	Point speed data (with longitude and latitude)
		Speed Gun (32+110+15+5)	Point speed data (with longitude and latitude)
		Traffic Count (5)	Point traffic volume (with longitude and latitude)
		Accident Information	Accident point, section, level, and on-time situation (with longitude and latitude)
		Work Zone Information	Work zone point, section, roadwork period (with longitude latitude)
	CCR-Vialagos –State Concessionaire Road-	In the long term (not included in Rio Municipality)	In the long term (not included in Rio Municipality)
	LAMSA -Municipality Road Concessionaire-	CCTV Video (23)	CCTV motion picture *Traffic volume *Point speed data (with longitude and latitude)
		VMS (4)	Condition of information provision (with longitude and latitude)
		Mobile VMS (2)	Condition of information provision (with longitude and latitude)
		Lane Signal (3)	Lane signal provision condition (with longitude and latitude)
		Air Pollution Observation Equipment (3)	Air pollution information (with longitude and latitude)
		GPS-Maintenance Vehicle	Condition of distribution (with longitude and latitude)
		Accident Information	Accident point, section, level, and on-time situation (with longitude and latitude)
		Work Zone Information	Work zone point, section, roadwork period (with longitude and latitude)
	CET-Rio-Municipality Road- ESE	CCTV Video (705)	CCTV motion picture *Traffic volume *Point speed data (with longitude and latitude)
		VMS (34)	Condition of information provision (with longitude and latitude)
		Mobile VMS (14)	Condition of information provision (with longitude and latitude)
		Speed Gun (387)	Point speed data (with longitude and latitude)
		OCR (Many)	Sectional travel speed data (with longitude and latitude)
		Accident Information	Accident point, section, level, and on-time situation (with longitude and latitude)
	SECONSERVA	Work Zone Information	Work zone point, section, roadwork period

			(with longitude and latitude)
	STP (Via Facil) -ETC Operator-	ETC Traffic Data	Traffic volume data (with longitude and latitude)
Transit/Transport-related Agencies	DETRO	Bus Stop Information	Bus stop/terminal information (with longitude and latitude)
		BUS GPS DATA (INTER)	Bus location information Bus lane
		Indicator for checking performance of concessionaires	Concessionaire performance information
	CODERTE	Bus Terminal Monitoring CCTV	Bus stop/terminal information (with longitude and latitude)
		Bus Departure Information	Bus departure information
	Socicam	Bus Terminal Monitoring CCTV	Bus stop/terminal information (with longitude and latitude)
	SMTR	Indicator for checking the performance of concessionaires	Concessionaire performance information
	Seaport	Pier Arrival/Departure Information	Pier number in which ships depart from and arrive at
	Airport	CCTV Data	CCTV motion picture data (with longitude and latitude or ID)
		Arrival/Departure Information	Gate No., arrival/departure time and operational information (check-in, boarding, delay, etc.)
Transit/Transport Operator	Rio Onibus	Bus/BRT Stop Location Information	Bus/BRT stop location information for calculating arrival information of buses (with longitude and latitude)
		Bus/BRT GPS Data	Bus/BRT GPS information for calculating arrival information of buses. Also utilized for checking the performance of concessionaires (with longitude and latitude)
		Bus Frequency Information	Bus/BRT line information for calculating arrival information of buses. Also utilized for checking the performance of concessionaires for each line
		CCTV Static Data	Photo data (with longitude and latitude)
	Private Bus Companies	Bus/BRT Stop Location Information	Bus/BRT stop location information for calculating arrival information of buses (with longitude and latitude)
		Bus/BRT GPS Data	Bus/BRT GPS information for calculating arrival information of buses. Also utilized for checking the performance of concessionaires (with longitude and latitude)
		Bus Frequency Information	Bus/BRT line information for calculating arrival information of

			buses. Also utilized for checking the performance of concessionaires for each line
		CCTV Static Data	Photo data (with longitude and latitude)
	FETRANSPORT	Bus/BRT Stop Location Information	Bus/BRT stop location information for calculating arrival information of buses (with longitude and latitude)
		-Bus/BRT Line Information (Bus Network Information)	Bus/BRT line information for calculating arrival information of buses. Also utilized for checking the performance of concessionaires (with longitude and latitude)
		Bus Frequency Information	Bus/BRT line information for calculating arrival information of buses. Also utilized for checking the performance of concessionaires for each line
	Super VIA	CCTV Data	CCTV motion picture data (with longitude and latitude or ID)
		Rail Operation Information	Delay, accident information (with longitude and latitude or section information)
		Rail Timetable Information	Timetable information
	METRO	CCTV Data	CCTV motion picture data (with longitude and latitude or ID)
		METRO Operation Information	Delay, accident information (with longitude and latitude or section information)
		METRO Timetable Information	Timetable information
	CCR Barcas	CCTV Data	CCTV motion picture data (with longitude and latitude or ID)
		Ferry Operation Information	GPS data and operation information
		Ferry Timetable Information	Timetable information
	Central Coop-Association of Taxi Companies-	None	None
	Taxi Companies - Radio Taxi - Chile Taxi - Coopamar	Taxi GPS Data *From Auto Cab, Smart Sys, etc.	Real-time congestion information with link
	Airport	CCTV Data	CCTV motion picture data (with longitude and latitude or ID)
		Arrival/Departure Information	Gate No.,,arrival/departure time, and operation information (check-in, boarding, delay, etc.)

		MOE	Meteorological data on time (with longitude and latitude)
Freight Operator	Utilissimo Tranportes LTDA	Cargo GPS Information	Real-time congestion information with link
Public Safety Agencies	-Civil Defense SESEC -SAMU-CBMERJ -BOMBEIROCBMERJ -SESEG -SMSDC	Data gathered at CICC shall be integrated	Data gathered at CICC shall be integrated
Weather/Air Pollution Monitoring Agency	INEA-SEA	Rain Gauge (11) Water Level Gauge (11) SOx, NOx, PM (37) Thermometer (37)	Rain, water level, SOx, Nox, PM, thermometer data on time (with longitude and latitude)
	SIMERJ	Rain Gauge (11) Anemovane (11) Thermometer (11) Hygrometer (11) Aerotonometer (11) Solar Meter (11)	Rain, wind, temperature, humidity, atmosphere, solar data on time (with longitude and latitude)
	SMAC Monitorar Rio	SO_2, NOx, PM10, O_3, NO_2 (8)	SO_2, NOx, PM10, O_3, NO_2, air pollution data on time (with longitude and latitude)
	SMO (Civil Defense ALERTA Rio)	Rain Gauge (31) Anemovane (2) Thermometer (2) Hygrometer (2) Aerotonometer (2) Solar Meter (2)	Rain, wind, temperature, humidity, atmosphere, solar data on time (with longitude and latitude)

The gathered data shown in Table 9-5 above can be summarized in Table 9-6 as follows:

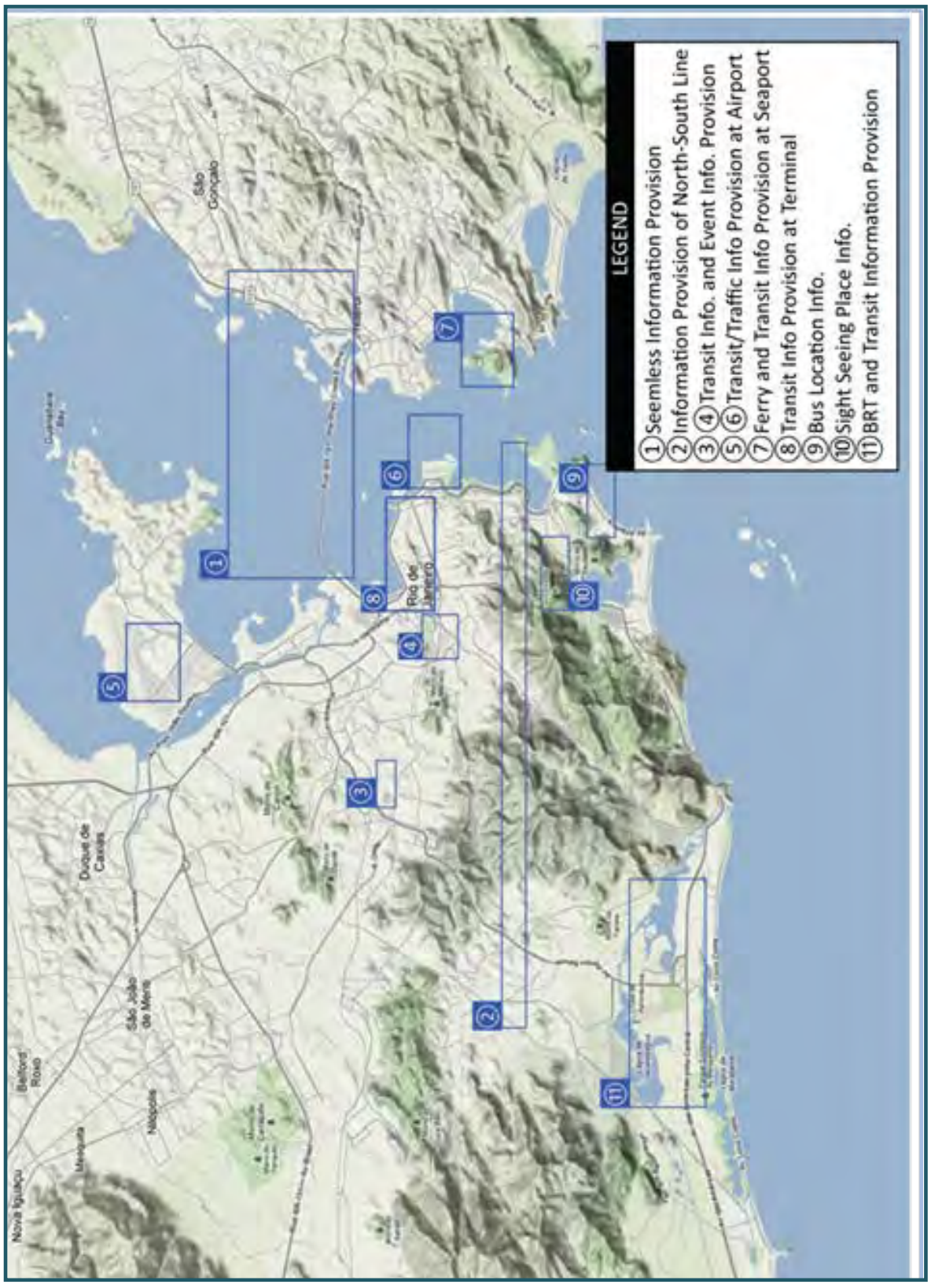
Table 9-6 Categorizing the Processed Data

No.	Input Data	Processed Data at ITS Center	Remark
1	CCTV Video (R) 1	Real-time road traffic volume data	Motion Picture Analysis (MPA) Traffic volume data will be utilized for obtaining traffic conditions such as incoming and outgoing traffic, and hourly and daily traffic.
2	CCTV Video (R) 2	Real-time traffic speed data	MPA This data shall be integrated with the probe data (No.13, 14, 15, 16, and 17).
3	VMS	Information provision condition	Gathering information regarding provision condition in real time
4	Mobile VMS	Information provision condition	Gathering information regarding provision condition in real time
5	OCR 1	Real-time traffic sectional speed data	This data shall be integrated with the probe data (No.13, 14, 15, 16, and 17).
6	OCR 2	Real-time traffic volume data	Traffic volume data will be utilized for obtaining traffic conditions such as incoming and outgoing traffic density, and hourly and daily traffic.
7	Speed Gun	Real-time traffic point speed data	This data shall be integrated with the probe data (No.13, 14, 15, 16, and 17).
8	Traffic Count	Real-time traffic volume data	Traffic volume data will be utilized for obtaining traffic conditions, such as incoming and outgoing traffic, and hourly and daily traffic .
9	Accident	Real-time accident incidence information	Accident information shall be provided on time such as location, category, level, and condition. This will be utilized for real-time traffic information.
10	Work Zone	Information on work zone conditions	Work zone information shall be provided in advance such as location, category, level, and condition. This will be utilized for real-time traffic information.
11	Lane Signal	Lane signal information	To know the regulations of traffic direction in real time
12	ETC	ETC-based real-time traffic data	Traffic volume data will be utilized for obtaining traffic conditions such as incoming and outgoing traffic, and hourly and daily traffic.
13	GPS-Maintenance Vehicle	GPS positioning data of maintenance vehicle	For the public Data shall be processed for checking the operating performance for agencies. A performance checking report shall be generated automatically, hourly, daily, and monthly.
14	GPS-Taxi	GPS positioning data of taxi	For the public and users Data shall be processed as real-time traffic congestion information, which is integrated with the point speed data and real-time traffic data. Note: Taxi status data shall also be gathered in the ITS Center such as wiper movement information, with or without passenger, etc.
15	GPS-Bus	GPS positioning data of bus	For the public Data shall be processed for checking the operating performance for agencies. A performance checking report shall be generated automatically, hourly, daily, and monthly. For users The data shall be processed as real-time traffic

			congestion information, which is integrated with the point speed data and real-time traffic data. Bus arrival information shall be calculated using digital road maps, line data of buses, terminal and bus stops, XY data, GPS online data and congestion data in real time generated by data number no. 14 and 15.
16	GPS-BRT	GPS positioning data of BRT	For the public Data shall be processed for checking the operating performance for agencies. A performance checking report shall be generated automatically, hourly, daily, and monthly. For the users (some parts are already done) Bus arrival information shall be calculated using digital road maps, line data of buses, and terminal XY data.
17	GPS-Cargo	Cargo GPS information	For the public and users Data shall be processed as real-time traffic congestion information, which is integrated with the point speed data and real-time traffic data.
18	Flight Information	Flight information	Flight departure, arrival, delay and accident information
19	CCTV Video of Taxi Parking at Airport	Taxi demand and supply information	Installed CCTV images at taxi parking area shall be gathered for monitoring the current demand and supply status of taxis at the airport
20	CCTV Video at Transit-Public Transportation-	CCTV information for monitoring current condition	Installed CCTV images at public areas shall be gathered for monitoring the current conditions at public spaces for safety purposes
21	Air Pollution Data	Real-time air pollution data	Air pollution data shall be utilized to assess the effect of traffic on the air.
22	Weather Data	Real-time weather data	Real-time weather information shall be provided to users on time.
23	River Level data	Real-time river level data	Real-time river level information shall be provided to users on time.

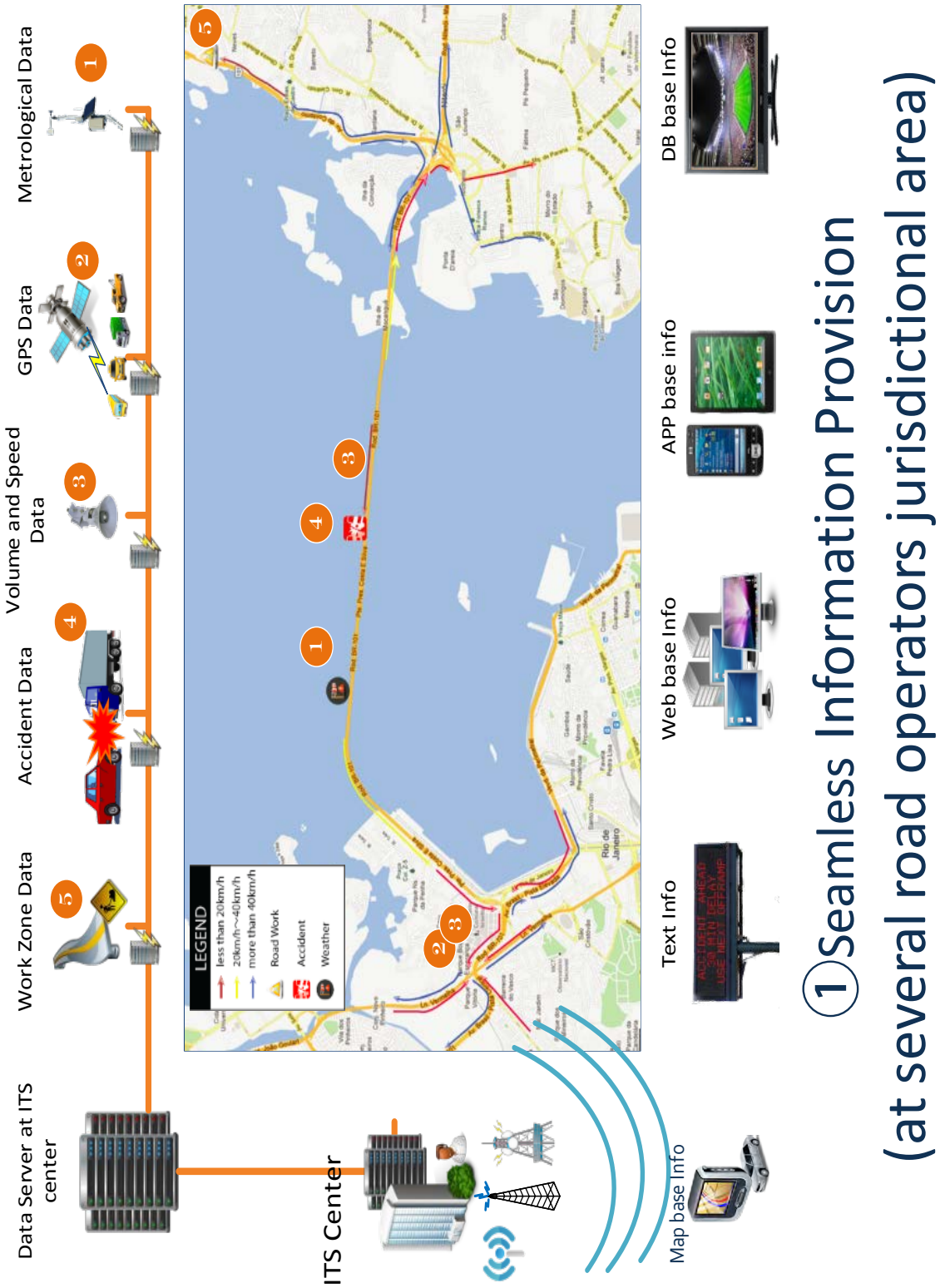
(5) Sample Contents

As for example, from the Figure 9-2 to the Figure 9-8 shows sample contents of project package 1.



Source: JICA Study Team

Figure 9-2 Sample Contents of Project Package 1 (1/7)



Source: JICA Study Team

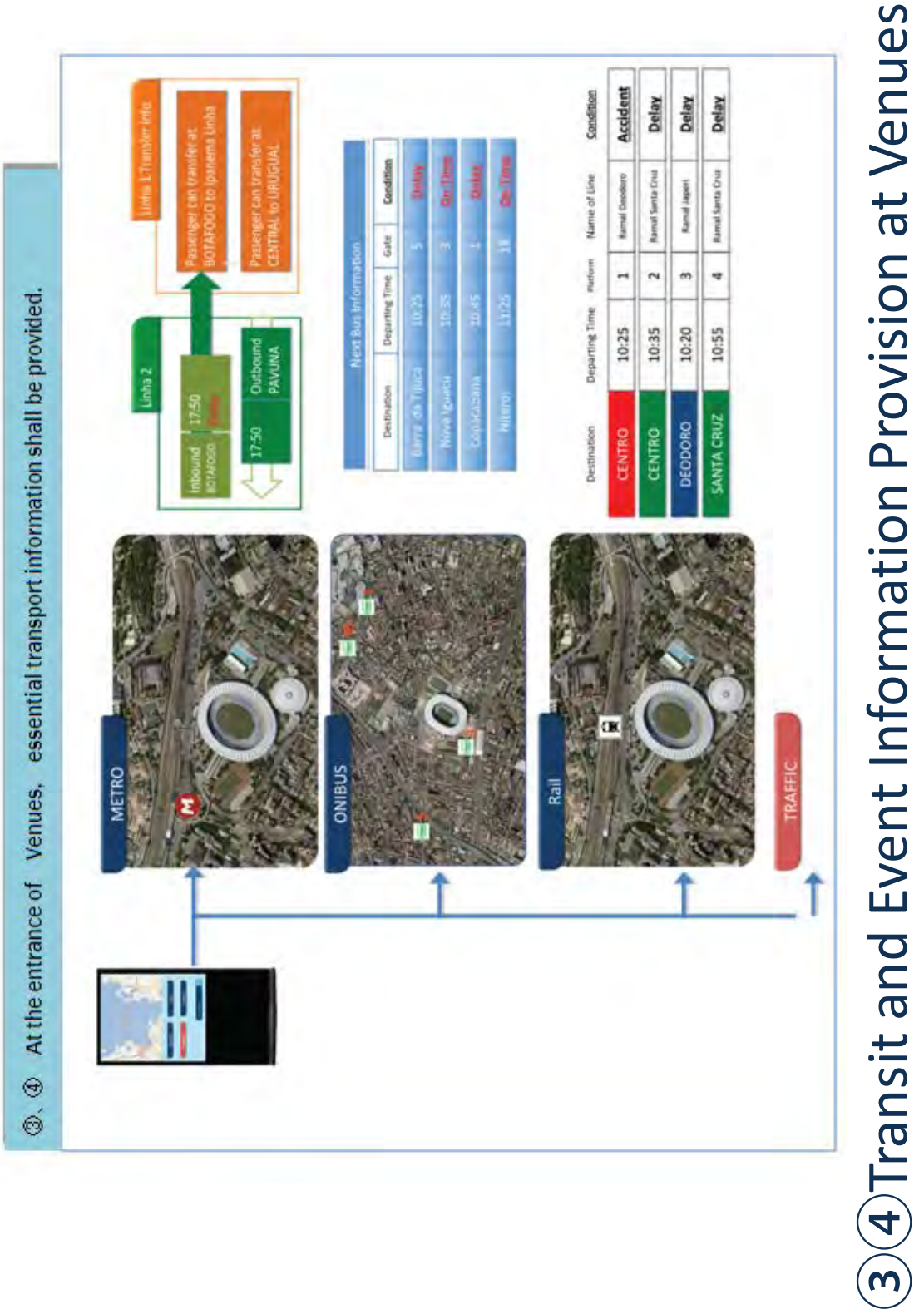
Figure 9-3 Sample Contents of Project Package 1 (2/7)

ITS Center can provide a route information based upon the processed real-time congestion data. Drivers can decide the fastest way destination.

②Information Provision North and South Line

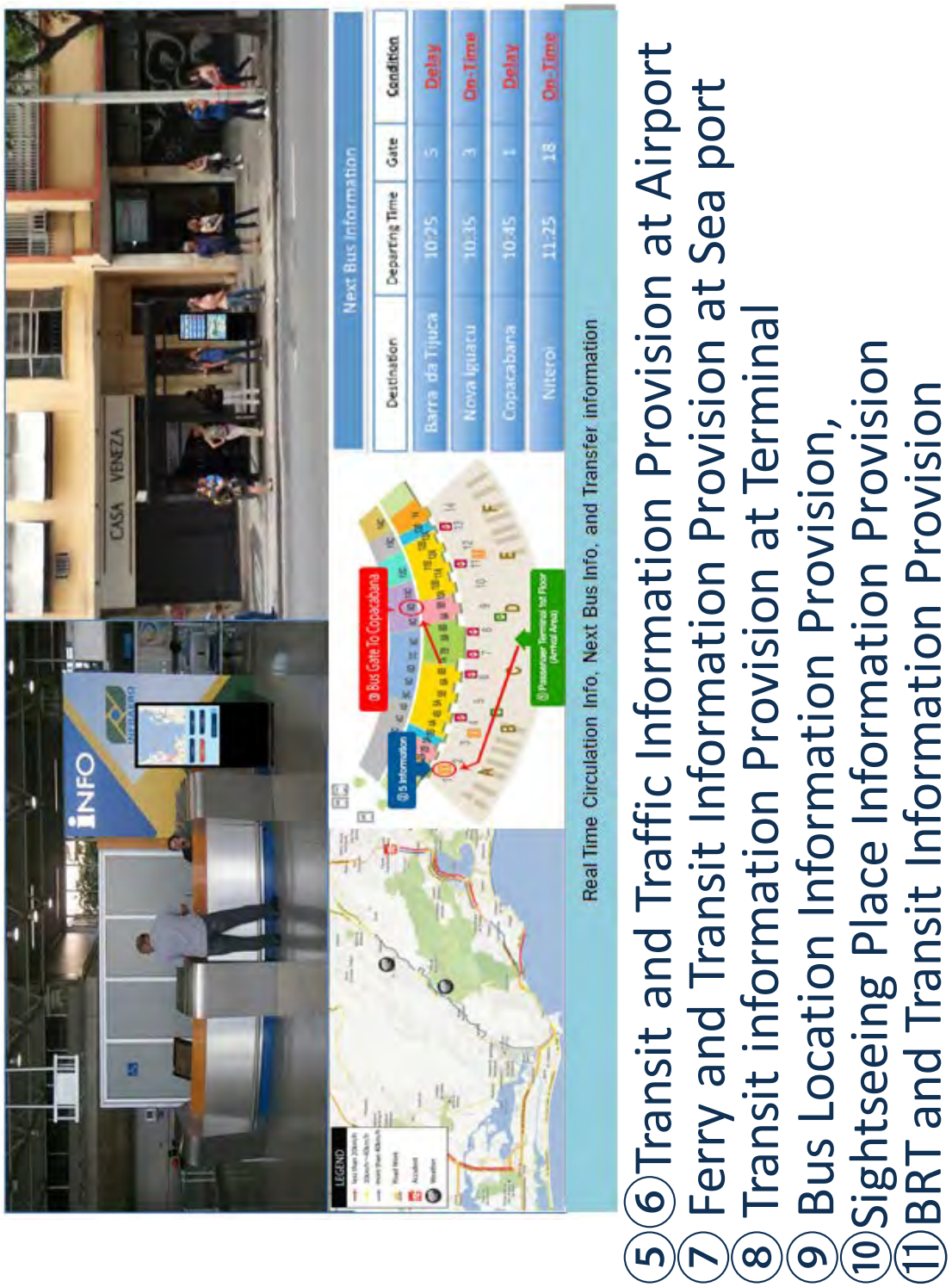
Source: JICA Study Team

Figure 9-4 Sample Contents of Project Package 1 (3/7)



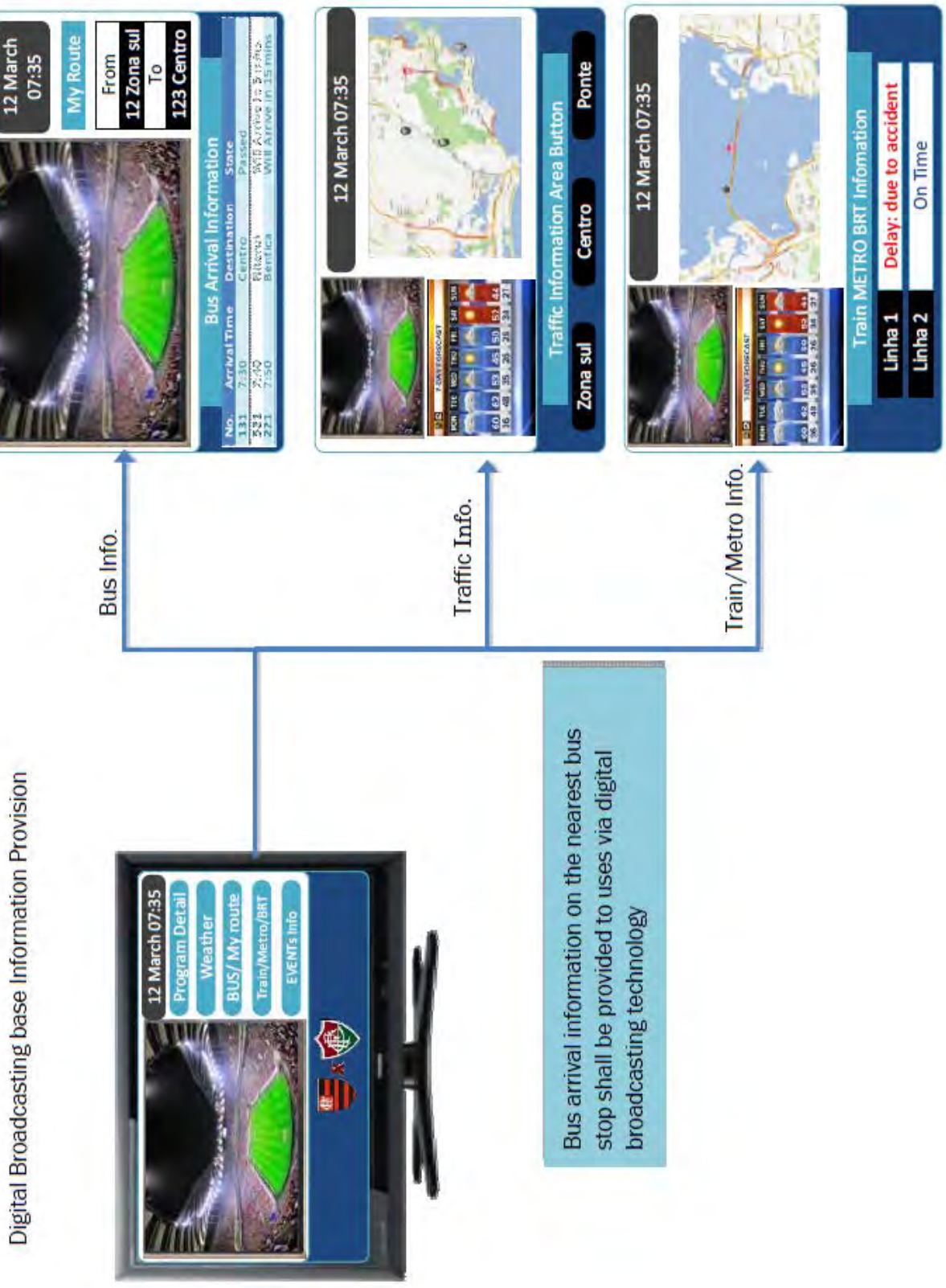
Source: JICA Study Team

Figure 9-5 Sample Contents of Project Package 1 (4/7)



Source: JICA Study Team

Figure 9-6 Sample Contents of Project Package 1 (5/7)



Source: JICA Study Team

Figure 9-7 Sample Contents of Project Package 1 (6/7)

Source: JICA Study Team

Figure 9-8 Sample Contents of Project Package 1 (7/7)

9.4.2 Basic Design

(1) Basic Requirement

1) Equipment

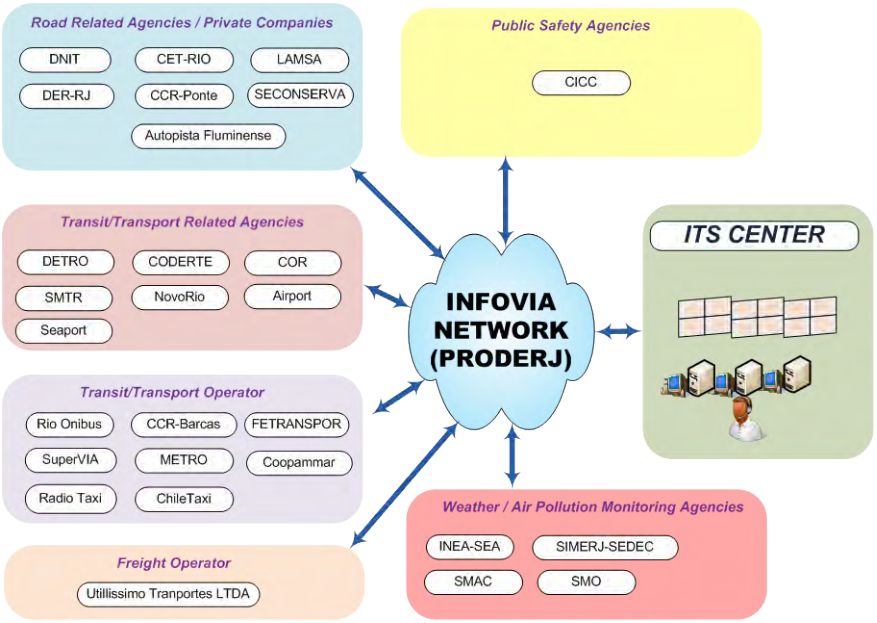
The ITS Center consists of several components which manage the system entirely and encourage data exchange with the stakeholder. The basic requirements of the ITS Center are as follows:

- The ITS Center system shall gather all necessary information on a real-time basis.
- The ITS Center system shall store the gathered and processed data into the database so that each data can be utilized as statistics.
- The ITS Center system shall be able to provide processed information through terrestrial digital broadcasting and internet to users who have mobile phones, smart phones or personal computers.
- The ITS Center system shall be able to monitor and manage the operational status of the equipment subsystem which is installed by each stakeholder.
- The ITS Center system shall operate continuously, 24 hours a day and 7 days a week, with a redundant system configuration.
- Each stakeholder shall be provided with a function to change the format of the information gathered by their subsystem. The information shall be made into a common protocol (NTCIP) to integrate the information into the ITS Center.

2) Network

It is essential to secure a reliable communication infrastructure between the ITS Center and the stakeholders for gathering and distributing real-time information.

The INFOVIA Network is a governmental communication infrastructure administered by PRODERJ of the Rio de Janeiro State Government. The network also has high reliability and stability. The INFOVIA Network is considered a reasonable and appropriate communication infrastructure to exchange information between the ITS Center and the stakeholders.



Source: JICA Study Team

Figure 9-9 Conceptual Diagram of Communication Network

(2) Essential Equipment and Functional Requirement

The essential equipment for the ITS Center were classified into:

- Data Gathering System
- Data Storage System
- Processing System
- Distribution System
- Monitoring System
- Power Supply System

A new building for the ITS Center is also required to securely install the equipment.

The essential equipment and functional requirement are shown in Table 9-7. The quantity of the equipment specified in Table 9-7 is aggregated as shown in Table 9-8.

Table 9-7 Essential Equipment and Functional Requirement

Class	Essential Equipment	Functional Requirement
Data Gathering System	Data Gathering Server	[Functional Requirement] • The server shall be deployed in each agency to gather essential data for ITS Center operation. The data shall be changed into the NTCIP as a standard protocol to assure interoperability and interchangeability between the ITS Center and the stakeholders. • Information security measures such as firewall shall be prepared [Hardware Configuration] • Rack-mounted server for the ITS Center • Tower-type server for the stakeholders [Installation Location] • Total: 30 sets ITS Center: 1 set 29 Stakeholders: 1 set each • For data gathering servers installed in the 29 stakeholders, modification of existing system in each stakeholder shall be conducted to send the information to the data gathering server.
Data Storage System	Probe Data Storage Server	[Functional Requirement] • The server shall contain all probe-related data for real-time processing of traffic congestion information and past mining data. In addition, it is important that weather information, incident information and event information are tagged and stored as past probe data to conduct data mining process. Basically, the server shall gather the following items: • Taxi, Bus, and BRT GPS information - X,Y,Z geocoding data - Velocity and acceleration - Date, weather, and incidents (if possible) • The server shall store the data and information for at least 2 years and shall be able to backup the data in an external storage device. [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Point Data Server	[Functional Requirement] • The probe data above shows congestion information as line data after processing. Point data can show point speed and traffic volume at a specific location in terms of traffic. • The server stores not only traffic data but also the following data: - Point speed data (from OCRs or speedometers) - Traffic volume data (from OCRs or speedometers) - Meteorological data - Air pollution data - Field equipment condition such as VMS, arrow signals at tunnels • The server shall store data and information for at least 2 years and be able to make a backup in an external storage device. [Hardware Configuration]

		• Rack-mounted server [Installation Location] • ITS Center: 1 set
	Transit Data Server	[Functional Requirement] • The role of the transit data server is to store all public transportation-related information as follows: - Route/lines - Frequency/timetable - Fare - Contact information [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Incident Monitoring Data Server	[Functional Requirement] • The server shall store incident information via traffic/transportation operators, road maintenance agencies or companies, and security monitoring agencies including the following: - Accident (type, location, duration) - Work zone (type, location, duration) - Disaster (type, location, level, duration) • The abovementioned data should be geocoded. • The server shall store the data and information for at least 2 years and be able to make a backup in an external storage device. [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Weather Monitoring Server	[Functional Requirement] • Geocoded weather data shall be stored by the server. The server shall gather and store the following data from related agencies: - Weather - Meteorological warning message [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	CCTV Data Server	[Functional Requirement] • The server shall store fixed-type CCTV data on road network for obtaining real-time velocity, traffic volume, and density of specific road network location. Other CCTV data shall be monitored at the ITS Center, although not necessary stored as database. • The server shall store the data and information for at least 2 years and be able to make a backup in an external storage device. [Hardware Configuration] • Rack-mounted server

		[Installation Location] • ITS Center: 1 set
Processing System	Velocity Information Generating Server	[Functional Requirement] • The server shall generate real-time velocity information on the road network from several sources such as probe data, past probe data, point traffic, and speed data. • The server shall have the following functions: - Map matching function for GPS point data - Converting function from point to line data - Average speed calculating function from traffic volume and speed based on traffic engineering theory - Data mining function from past data - Data fusion function of real-time data and past data [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Traffic Volume Processing Server	[Functional Requirement] • The server shall process real-time aggregated traffic volume. The aggregation process shall be conducted for a certain period of time such as: - Per minute - Per 5 minutes - Per 60 minutes - Per 12 hours - Per 24 hours • All processed data should be tagged with geocoded data to monitor incoming/outgoing volume in the monitoring area to grasp current traffic condition. [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Motion Picture Analysis Server	[Functional Requirement] • The server shall process motion picture analysis on fixed CCTVs to obtain real-time traffic volume and its aggregation. The aggregation process shall be conducted for a certain period of time such as: - Per minute - Per 5 minutes - Per 60 minutes - Per 12 hours - Per 24 hours • All processed data should be tagged with geocoded data to monitor incoming/outgoing volume in the monitoring area to grasp the current traffic condition. • As a result of motion picture analysis, the speed data of certain sections of the road can also be obtained. These data shall be integrated as point volume/speed data to analyze real-time traffic congestion monitoring by velocity information generating server

		[Hardware Requirement] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Bus Arrival Information Calculation Server	[Functional Requirement] • The server shall calculate the next bus arrival information based on bus GPS information and real-time traffic information which is generated by the velocity information generating server. • If there is no congestion on the road network, the calculation shall be conducted using the regulatory speed and distance of the next bus stop from the current position. [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Fixed Route Travel Time Calculation Server	[Functional Requirement] • The server shall calculate real-time travel time information on several important fixed routes on the road network,considering the real-time traffic congestion situation calculated by the velocity information generating server. • If there is no congestion on the road network, the calculation shall be conducted using the regulatory speed and distance of the starting point of the fixed route. [Hardware Requirement] • Rack mount type [Installation Location] • ITS Center: 1 set
	Weather Information Processing Server	[Functional Requirement] • The server shall provide weather information with geocoded data, chart and graphs. [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Incident Information Processing Server	[Functional Requirement] • The server shall provide incident information with geocoded data, chart and graphs. If there is CCTV near the incident, CCTV information shall be viewed on the monitoring display. [Hardware Requirement] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Report Generating Server	[Functional Requirement] • The server shall generate daily and monthly reports depending on the

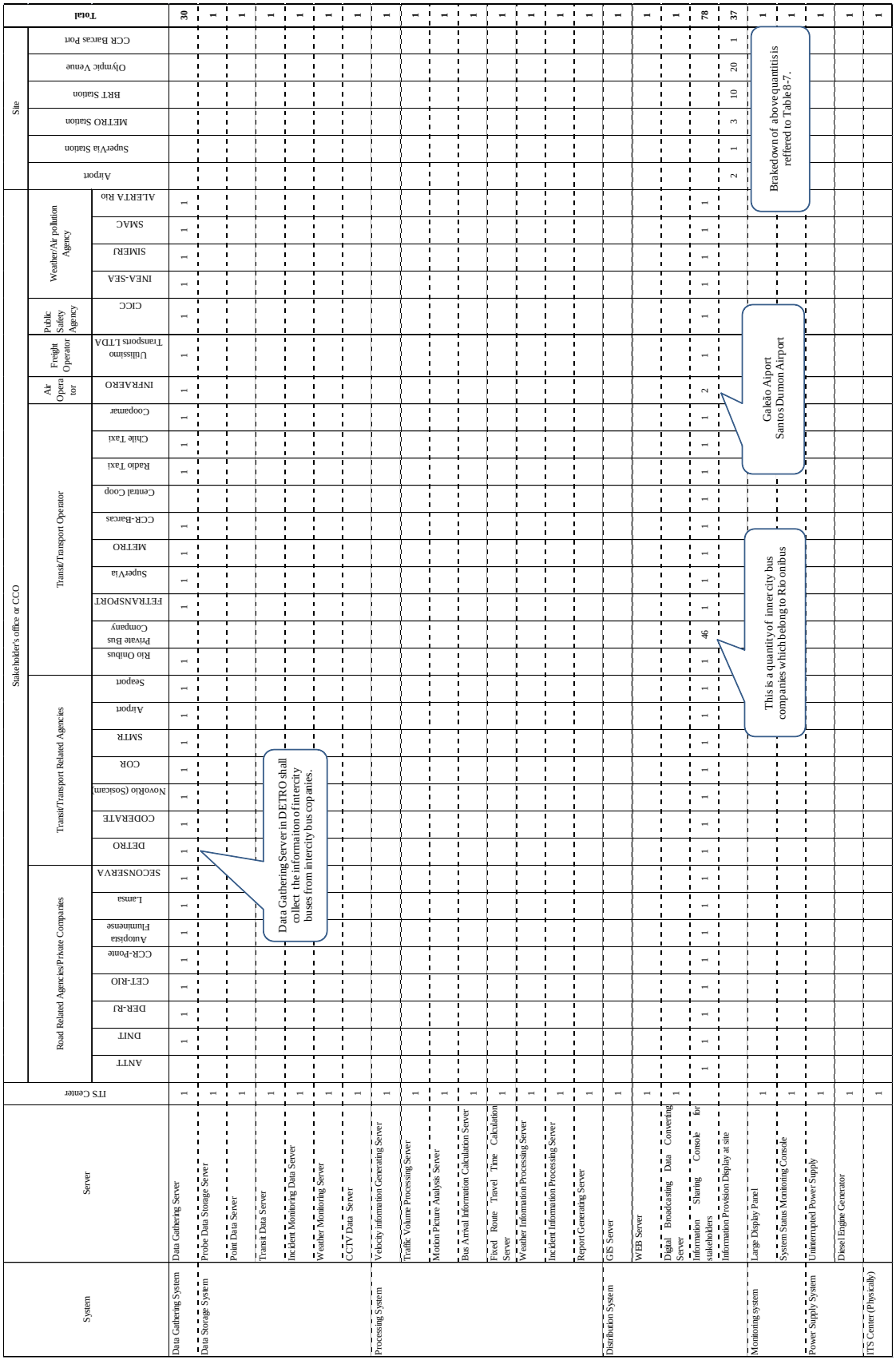
	–Concessionaires Monitoring -	contract. [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
Distribution System	GIS Server	[Functional Requirement] • The server shall provide the following: - Digital road map (basic map) - Digital road map (with arrow to provide traffic congestion) - Equipment location and current information provision situation map - Real-time congestion information map - Real-time incident information map (accidents, work zone, and disaster) - Real-time weather information map - Real-time public transport situation information map - Fixed important routes travel time information map [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Web Server	[Functional Requirement] • The server shall provide web contents of ITS information upon the request of clients using hyper text transfer protocol (HTTP). • Information security measures such as firewall shall be prepared. [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Digital Broadcasting Data Converting Server	[Functional Requirement] • The server shall enable the users to receive the ITS information processed in the ITS Center through their mobile/smart phones with one-seg tuner or digital television with full-seg tuner. • The format of the contents to be broadcasted to the users will be Ginga-NCL, which is the standard specification on data broadcasting for Brazilian Terrestrial Digital TV. The contents shall be delivered to the broadcaster and treated as input of their broadcasting. • Information security measures such as firewall shall be prepared. [Hardware Configuration] • Rack-mounted server [Installation Location] • ITS Center: 1 set
	Information Sharing Console	[Functional Requirement] • The console shall access the web server to display processed information such as: - Seamless traffic condition information

		- Route information based on processed real-time congestion - Transport information - Transit information - Bus location information - Weather information - Air pollution information [Hardware Configuration] • Desktop computer: 1 set [Installation Location] • 78 stakeholders: 1 set each
	Information Provision Display	[Functional Requirement] • The information provision display shall provide the information below. The information to be displayed shall be customized according to the installation location. - Transit and traffic information at airport - Ferry and transit information provision at seaport - Transit information provision at terminal - Bus location information provision - Sightseeing place information provision - BRT and transit information provision [Hardware Configuration] • LCD display (outdoor type) • Control unit • Network equipment - GPRS transceiver [Installation Location] - Airport 2 (Galeão, Santos Dumon) - SuperVia 1 (Central) - METRO 3 (Centro, Botafogo, Ipanema) - BRT 10 (5 lines x 2) - Olympic venues 20 (4 areas x 5) - Barcas 1 (Total: 37 sets)
Monitoring System	Large Display Panel	[Functional Requirement] • The monitoring system shall display various kinds of static and dynamic information for the system operator to take necessary action. The essential information to be displayed are as follows: - Equipment location and status on the map - Road, traffic, and weather condition on the map - Transport operation condition - CCTV video image - Weather information and weather warning message - Date and time [Hardware Configuration] • Large display panel: approximately 10 m x 5 m • Desktop computer for large display panel [Installation Location] • ITS Center: 1 set
	System Status Monitoring Console	[Functional Requirement] • The system status monitoring console shall display the current condition of the equipment and network on the ITS Center. This

		system shall detect device failure and communication failure, and inform them to the operator in the ITS Center [Hardware Configuration] • Desktop computer for system status monitoring [Installation Location] • ITS Center: 1 set
Power Supply System		[Functional Requirement] • The power supply system shall provide reliable and stable electric power to the equipment of the ITS Center. The system consists of an uninterrupted power supply (UPS) and a diesel engine generator. The UPS shall compensate stable power supply to the equipment when commercial power is down. [Hardware Configuration] • UPS for server room • Diesel engine generator [Installation Location] • ITS Center: 1 set
ITS Center (Physical)		[Functional Requirement] • The center shall provide a secured space with air conditioning to install the following equipment: - Servers and network equipment in the server room - Operation consoles in the operation room - UPS in the power supply room • Total floor area is assumed at approximately 30 m x 30 m.

Source: JICA Study Team

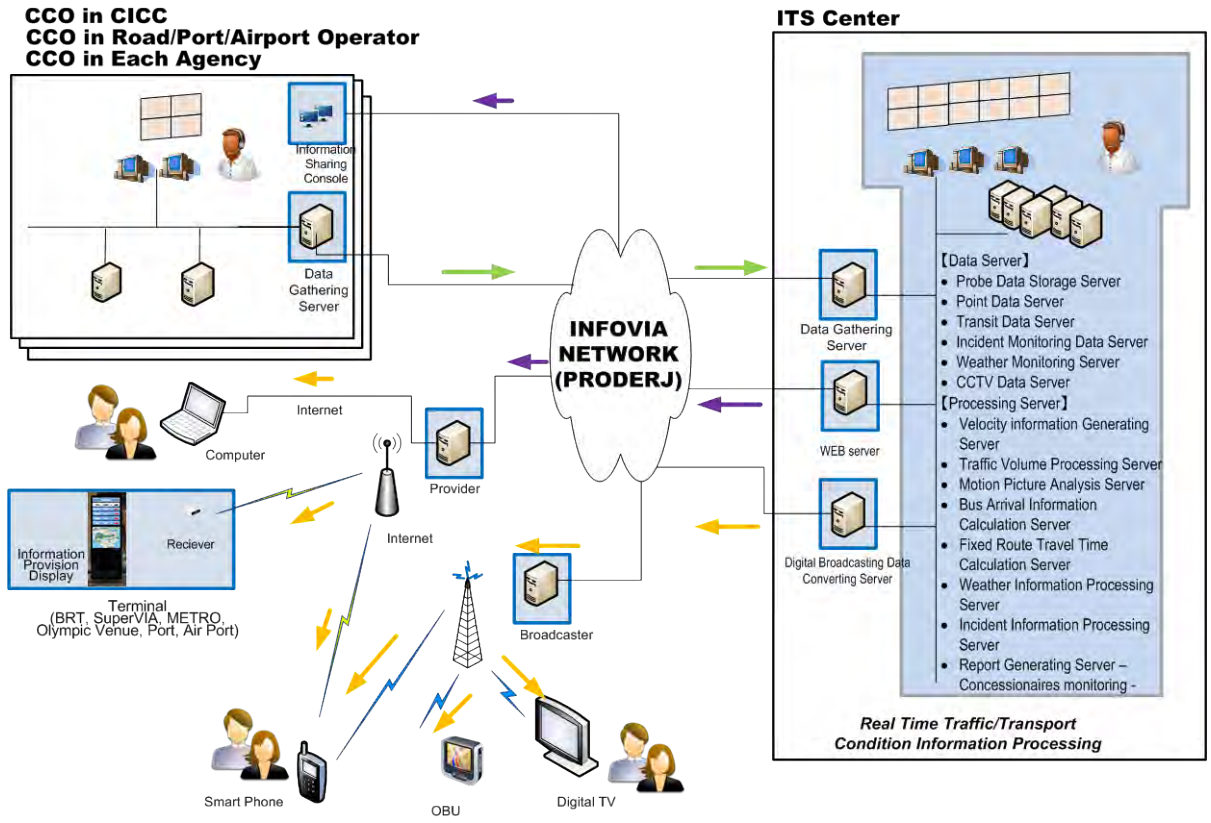
Table 9-8 Quantity of Essential Equipment



Source: JICA Study Team

(3) System Diagram

The system diagram of Project Package 1 is shown in Figure 9-10. In Project Package 1, the stakeholders transmit their information to the ITS Center through the INFOVIA Network. The ITS Center organizes the integrated information to provide it to users through various kinds of communication method such as the internet, smart phone, digital broadcasting, etc. The integrated information is also returned back to each stakeholder through web browsing on a personal computer (information sharing console) in Project Package 1.



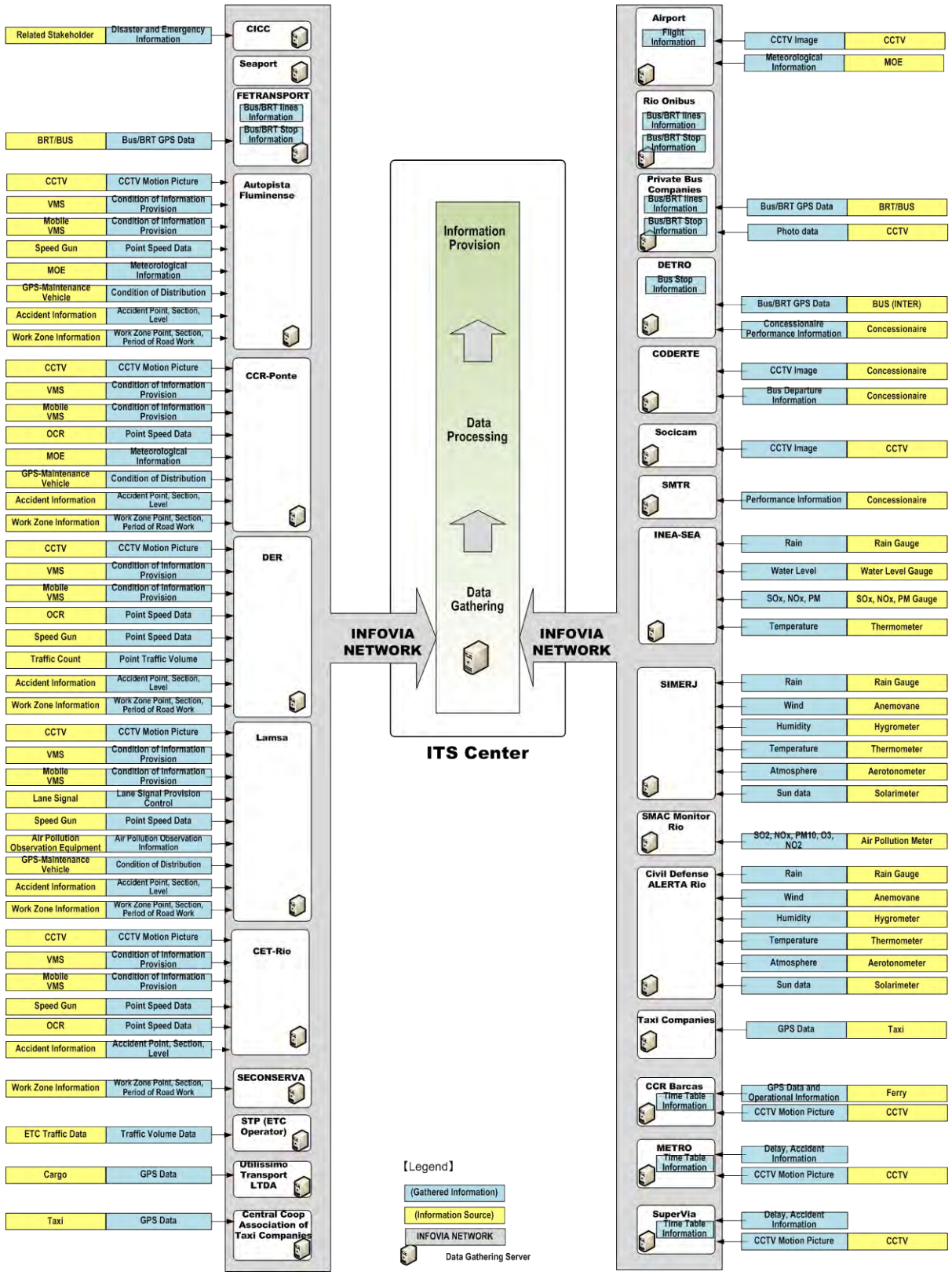
Source: JICA Study Team

Figure 9-10 System Diagram of ITS Center and Related Systems

(4) Data Flow

i) Data Gathering Process for the ITS Center

Figure 9-11 shows the flow of data gathering from the stakeholders. The stakeholders have subsystems to manage their equipment. The information are then transmitted to the ITS Center through the INFOVIA Network. In order to transmit the information gathered by their subsystems, data gathering server shall be installed at each stakeholder for changing the format of the information from the subsystems into the NTCIP.

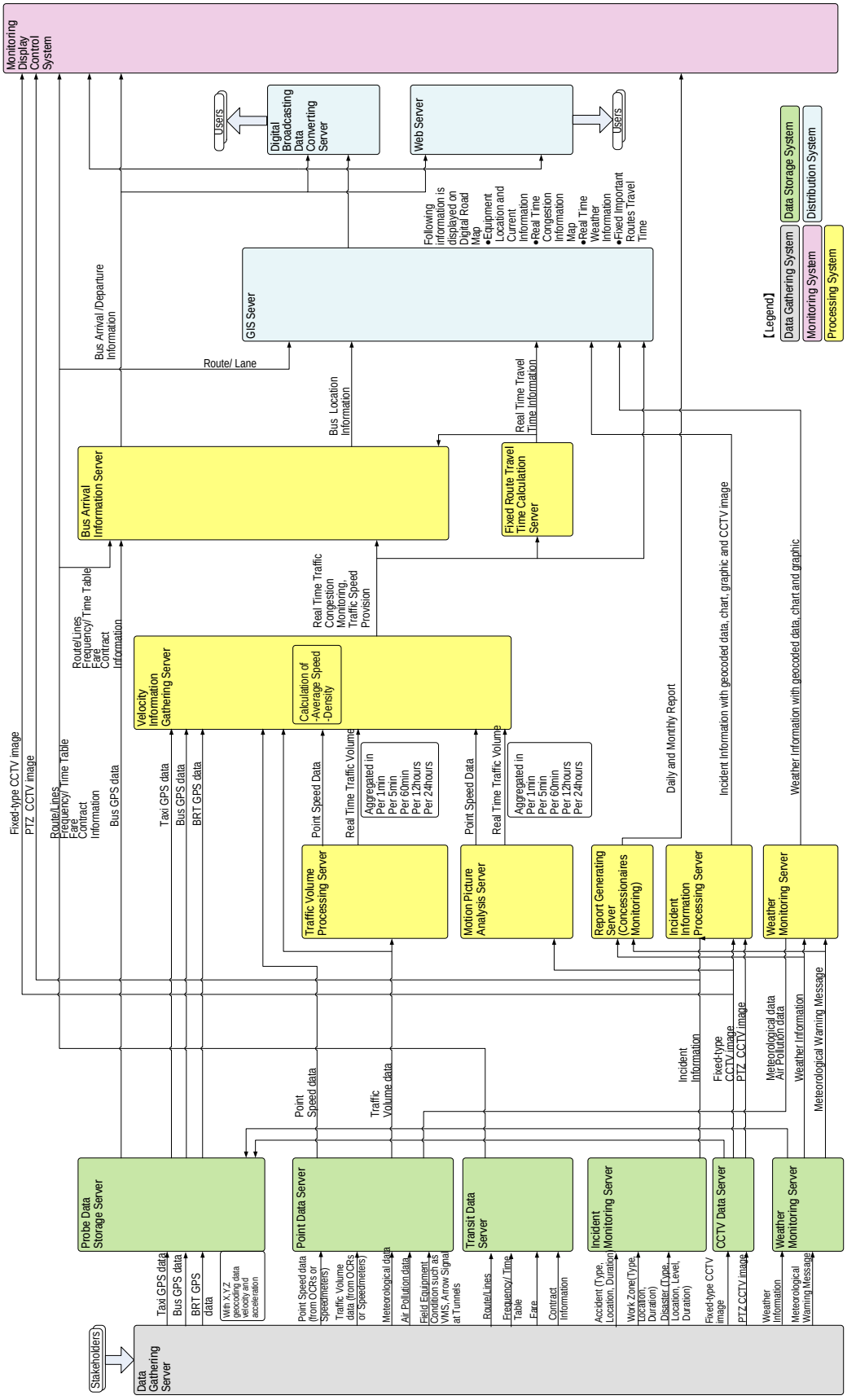


Source: JICA Study Team

Figure 9-11 Flow of Data Gathering

ii) Data Processing Flow in the ITS Center

Data processing flow in the ITS Center is shown in Figure 9-12. Raw data such as GPS data from probe cars, CCTVs, and speed meters, as well as point speed data and point traffic data from OCRs shall be forwarded to the processing system to calculate the average speed, density, real-time traffic congestion, and real-time travel time information. These processed information shall be utilized in the calculation of bus arrival information and fixed route travel time information. All processed data shall be geocoded for mapping its layout in the GIS server. The data storage system shall store and archive raw and past data. Such data shall be fed back for calculation of real-time traffic congestion information.



Source: JICA Study Team

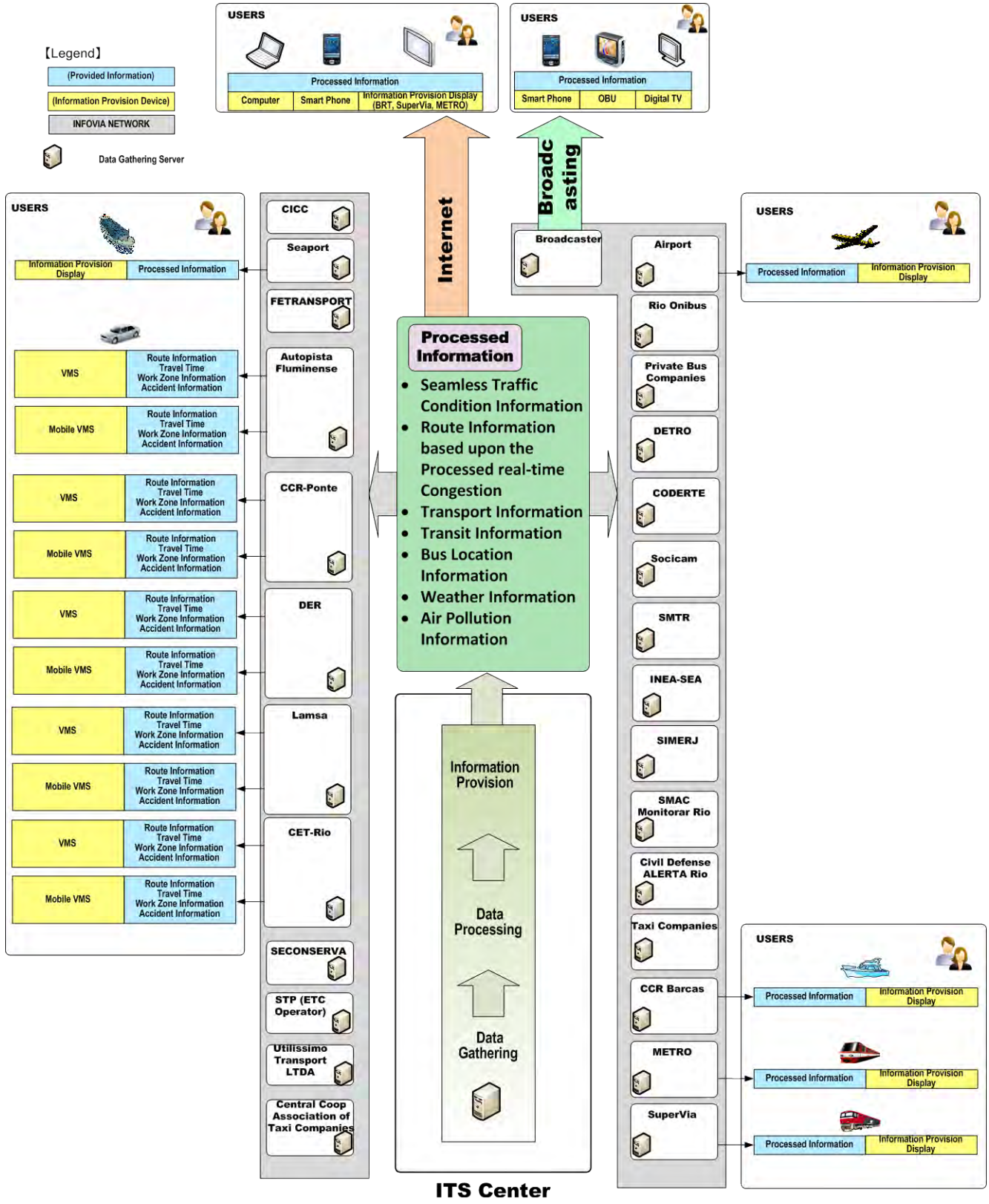
Figure 9-12 Flow of Data Processing

iii) Information Provision Process

Figure 9-13 shows the flow of information provision from the ITS Center. Information processed in the ITS Center shall be provided to the stakeholders and users through several different methods.

Firstly, the processed information is sent back to the stakeholders through the INFOVIA Network so that stakeholders can monitor the real-time condition of traffic and transportation in Rio de Janeiro Metropolitan Area. Based on the information, stakeholders shall operate their own information provision systems such as VMSs or information panels to provide useful and necessary information to the users.

Alternatively, there are two methods to provide the processed information to users. One method is through the internet and the other is through data broadcasting service provided by digital terrestrial broadcasting. The users can access their desired information anytime and anywhere by operating their computer, smart phone or through a digital TV or an on-board unit with digital TV tuner.



Source: JICA Study Team

Figure 9-13 Flow of Information Provision

(5) Cost Estimation

Based on the essential equipment shown in Table 9-7 and their unit prices, the cost of Project Package 1 is estimated in Table 9-9.

Table 9-9 Cost of Project Package 1

Project Package 1 Exchange rate : BRL1=JPY 46.92 as of March 26, 2013

No.	Item	Quantities	Unit Cost (1000JPY)	Total (1000JPY)	Total (1000BRL)	Remarks
Equipment						
1	**Data Gathering System**			1,240,000	26,428	
1-1	Data Gathering Server for ITS center	1	80,000	80,000	1,705	hardware/software
1-2	Data Gathering Server for Stakeholders	29	20,000	580,000	12,361	hardware/software
1-3	Modification of Existing System	29	20,000	580,000	12,361	software
2	**Data Storage System**			300,000	6,394	
2-1	Probe Data Storage Server	1	80,000	80,000	1,705	hardware/software
2-2	Point Data Server	1	80,000	80,000	1,705	hardware/software
2-3	Transit Data Server	1	50,000	50,000	1,066	hardware/software
2-4	Incident Monitoring Data Server	1	20,000	20,000	426	hardware/software
2-5	Weather Monitoring Server	1	20,000	20,000	426	hardware/software
2-6	CCTV Data Server	1	50,000	50,000	1,066	hardware/software
3	**Processing System**			490,000	10,443	
3-1	Velocity information Generating Server	1	100,000	100,000	2,131	hardware/software
3-2	Traffic Volume Processing Server	1	100,000	100,000	2,131	hardware/software
3-3	Motion Picture Analysis Server	1	80,000	80,000	1,705	hardware/software
3-4	Bus Arrival Information Calculation Server	1	50,000	50,000	1,066	hardware/software
3-5	Fixed Route Travel Time Calculation Server	1	40,000	40,000	853	hardware/software
3-6	Weather Information Processing Server	1	40,000	40,000	853	hardware/software
3-7	Incident Information Processing Server	1	40,000	40,000	853	hardware/software
3-8	Report Generating Server	1	40,000	40,000	853	hardware/software
4	**Distribution System**			585,500	12,479	
4-1	GIS Server	1	90,000	90,000	1,918	hardware/software
4-2	WEB Server	1	60,000	60,000	1,279	hardware/software
4-3	Digital Broadcasting Data Converting Server	1	80,000	80,000	1,705	hardware/software
4-4	Information Sharing Console	78	1,000	78,000	1,662	hardware
4-5	Information Provision Display	37	7,500	277,500	5,914	hardware
5	**Monitoring system**			77,000	1,641	
5-1	Large Display Panel	1	16,000	16,000	341	hardware
5-2	Desktop computer for Large Display Panel	1	11,000	11,000	234	hardware/software
5-3	System Status Monitoring System	1	50,000	50,000	1,066	hardware/software
6	**Power Supply System**			30,000	639	
6-1	Uninterrupted Power Supply	1	15,000	15,000	320	
6-2	Diesel Engine Generator	1	15,000	15,000	320	
	Sub total			2,722,500	58,024	1～6
7	**Installation and Test**	1		272,250	5,802	1～6 *10%
	Sub total			272,250	5,802	
Civil Construction						
8	**ITS Center (Physically)30m x30m**	1	90,000	90,000	1,918	
	Sub total			90,000	1,918	
Total				**3,084,750**	**65,745**	

Source: JICA Study Team

(6) Implementation Plan

Table 9-10 shows the implementation schedule for Project Package 1 including preparation, procurement and implementation stages, and commissioning test. The implementation plan is proposed on the basis of the following conditions:

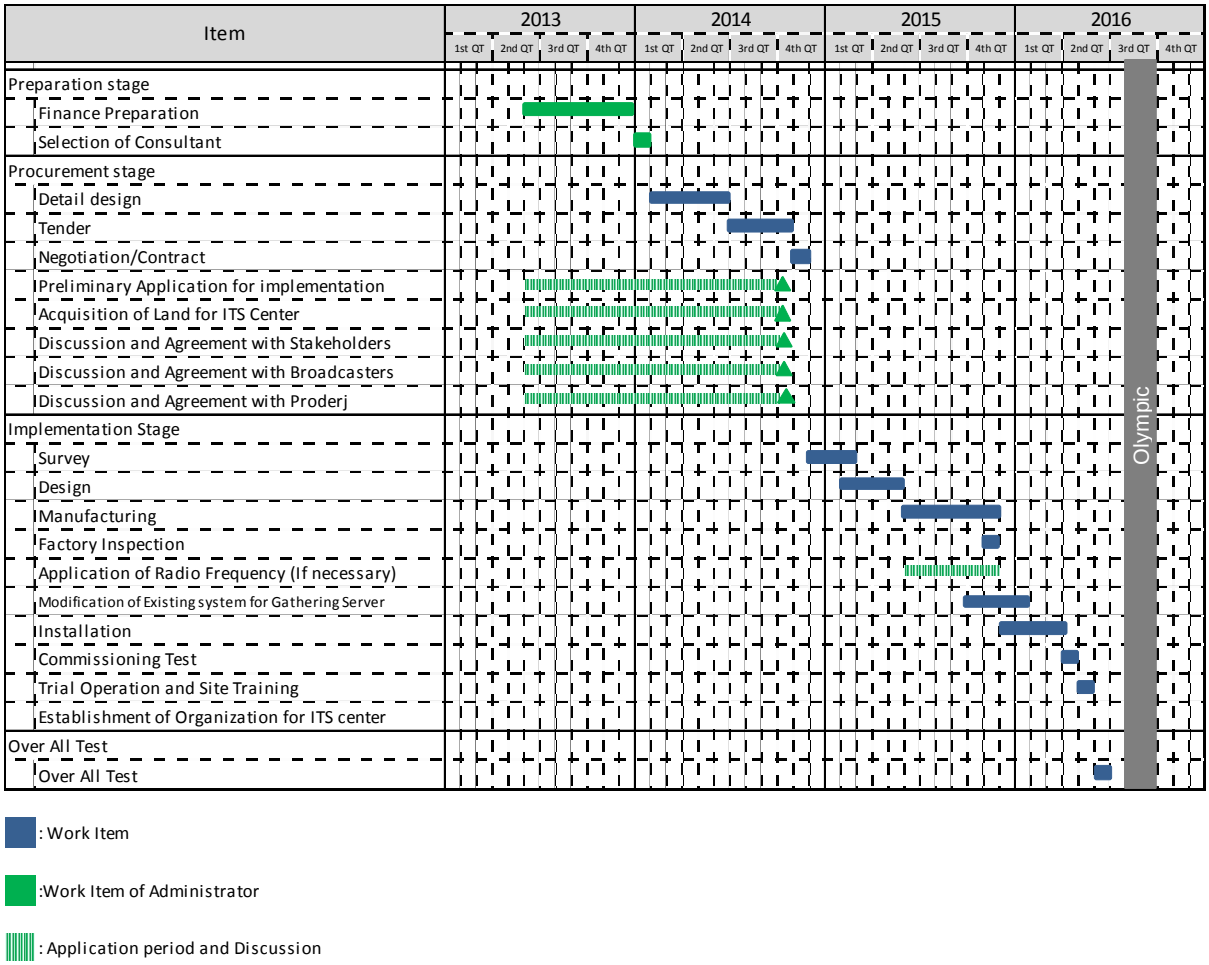
1) Preparation Stage
   - Financial preparation shall be completed by the end of 2013 and before the commencement of the preparation of the financial source for procurement and implementation stages.

2) Procurement Stage
   - The period for the procurement stage including detailed design, tender and contract is expected to be ten months. This stage shall be completed by November 2014.
   - The location of the ITS Center is not yet determined. The location and acquisition of land for the construction of the ITS Center shall be conducted before the contract (by October 2014).
   - The following agreement shall be made by October 2014:
     - Agreement with the stakeholders about the location of the equipment to be installed in the stakeholder's premises
     - Agreement with the broadcaster about data broadcasting to users
     - Agreement with PRODERJ about the utilization of the INFOVIA Network

3) Implementation Stage
   - Implementation will commence in December 2014 after the contract.
   - The implementation period will be 18 months, including survey and design (6 months), manufacturing (6 months), factory inspection (1 month), modification of existing system for the information gathering server (4 months), equipment installation (4 months), commissioning test (1 month), and trial operation and site training (1 month).
   - An organization for the operation of the ITS Center shall be established by August 2015, one year before the Olympic Games.

4) Overall Test
   - The overall commissioning test shall be conducted in June 2016 before taking-over in order to check the interconnection among the equipment of Project Package 1, Project Package 2, and Project Package 3.

Table 9-10 Implementation Schedule for Project Package 1



Source: JICA Study Team

(7) Operation Plan

Operation and maintenance (O&M) work is necessary for the overall system including Project Package 1, Project Package 2, and Project Package 3. However, the JICA Study Team focused on the O&M tasks for the ITS Center in Project Package 1 because the ITS Center will be a newly established and built facility, and the O&M work for other facilities in Project Package 1, Project Package 2, and Project Package 3 will be included in the existing O&M tasks.

1) Operation and Maintenance Work for the ITS Center

i) Operation Work

The ITS Center system is planned under the concept of disseminating ITS information automatically from gathered data without human modification and decision. Therefore, the operation work for the ITS Center system involves supervising the functional health of the system by monitoring the system display. Once a problem is detected, the operator will make suitable and quick countermeasure according to the troubleshooting indication showed on the system monitoring display. The operator shall supervise the system for 24 hours continuously; two operators x four-shift system (three shifts + one day off) are necessary.

ii) Maintenance Work by Operator

Other than the above operation work, the following maintenance tasks by operators are also necessary to keep the performance of the ITS Center system, which controls the overall system of Project Package 1, Project Package 2, and Project Package 3.

- Set up of basic ITS facility data of the system

The basic ITS facility data such as bus stop, VMS, director, etc. will be installed to meet the traffic volume and traffic situation needs. Therefore, such basic ITS facility data will be designed for easy set up by the operator. Changes in the basic ITS facility data shall be made according to the existing conditions and scheduled improvements of the ITS facility.

iii) Maintenance Work by Technical Engineer

The following maintenance work shall be done by the technical engineer dispatched from the contracted maintenance company.

- Check the system periodically

To confirm that the system is functioning well and to prevent future problems, periodical checking by the technical engineer is important.

- Emergency activity for recovering the system

Once a system problem is detected, the system shall be recovered as soon as possible. Emergency activity and countermeasures to recover the system by the technical engineer are necessary.

- Update of map data

It is necessary for the map data to be consistent with the actual traffic situation as much as possible. Therefore, map data shall be updated to the latest version periodically by the technical engineer. The latest version of the procurement fee and installation fee (e.g., 2 engineers x 5 days) is included in the updating cost.

iv) Other Related Tasks for Operation

Besides the above direct operation and maintenance tasks, the following supportive works are also important:

- Development of the system

System application shall be developed and improved in harmony with the needs of the ITS services. Two permanent staffs for the development of the ITS system is necessary.

- Administrative tasks

Several administrative tasks including ordering from and contracting with the technical company for maintenance and some service company for training services are necessary.

One office manager and one administrative staff are necessary.

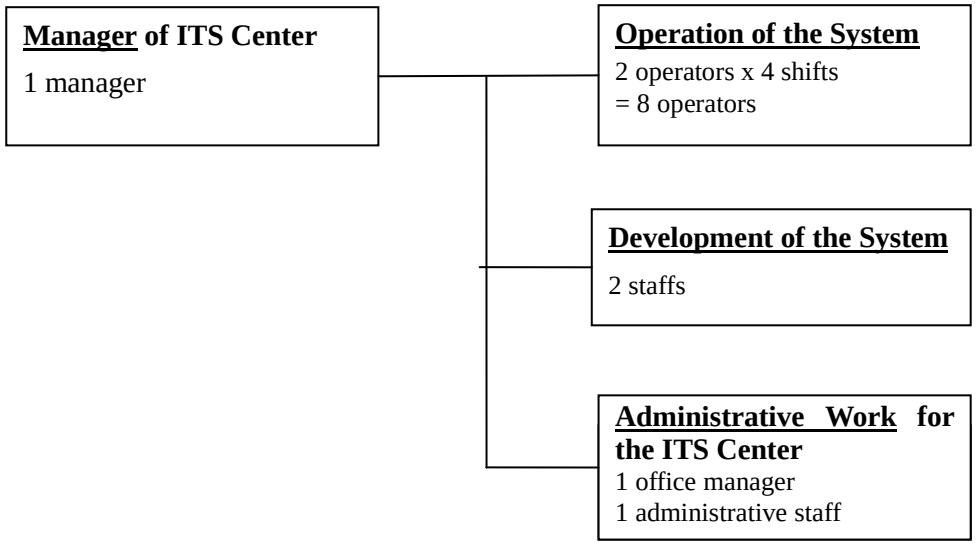
- Management tasks

Management tasks by one manager for all activities related to the ITS Center are necessary.

- Training of staff

For transferring the technology to the new staff and improving their skills to operate the system more efficiently, timely and periodical training of staffs is very important. However, such work can be done by another existing division or other company.

The proposed organization for the ITS Center is shown in Figure 9-7 below.



Source: JICA Study Team

Figure 9-14 Proposed Organization for the ITS Center

2) Operation and Maintenance Cost of the System

In consideration of the above operation and maintenance tasks, the following costs will be estimated:

-Staff cost for operation work

-Staff cost for development work

-Staff cost for administrative work

-Staff cost for manager

-Maintenance cost for checking the system

-Maintenance cost for emergency activity

-Maintenance cost for updating the map data

As major utility costs, the cost of the INFOVIA Network for communicating with related agencies and the cost of electric power for the ITS Center shall also be considered.

The cost for operation of the ITS Center is shown in Table 9-11.

Table 9-11 Cost for Operation

	Item	Unit Cost	Set	Cost (BRL/year)
1)	Operation work 2 operators x 4 shifts	2.000～3.000 R$/MM	8 MM x 12 months	192.000～288.000
2)	Development work 2 staffs	5.000～7.000 R$/MM	2 MM x 12 months	120.000～168.000
3)	Administrative work 1 office manager 1 administrative staff	 5.000～7.000 1.000～3.000 R$/MM	1 MM x12 months	72.000～120.000
4)	Management work 1 manager	13.000～15.000 R$/MM	1 MM x 12 months	156.000～180.000
5)	Maintenance work			
	Periodical checking of the system	5.000 R$/day	10 days/year	50.000
	Emergency activity for recovering the system (depending on the type of trouble)	5.000 R$/day	10 days/year	50.000
	Update of map data (including installation)	50.000 R$/year	1 year	50.000
6)	Other costs			
	INFOVIA Network communication fee	10.000 R$/year	1 year	10.000
	Electricity fee for ITS Center	100.000 R$/year	1 year	100.000
Total				800.000～1,016,000

Source: JICA Study Team

9.5 PROJECT PACKAGE 2

Project Package 2 covers the following system:

- Bus condition information provision in the Rio de Janeiro municipal area

9.5.1 Grand Design

(1) Objective

The objective of Project Package 2 is summarized as follows:

> To enhance passenger satisfaction by providing bus-related information to users at bus stops, terminals, and inside the bus.

Information provision via web, smart phone, and digital broadcasting shall be covered by the ITS Center (Project Package 1).

(2) Target Area

Project Package 2 shall cover only information provision system at bus stops, terminals, and inside the buses. The number and location to be deployed shall be clarified in Section 9.5.2.

(3) Related Stakeholders

The related stakeholders of Project Package 2 are mainly transit/transport-related agencies and operators as shown below.

1) Transit/Transport-related Agencies
   DETRO
   SMTR
2) Transit/Transport Operator
   FETRANSPOR (Association)
   Bus Terminal Operator
   Private Bus Companies
3) Others
   Mob TV

(4) Definition of Data/Information

Table 9-12 shows the kind of data/information which the ITS Center should gather from each stakeholder involved with Project Package 2.

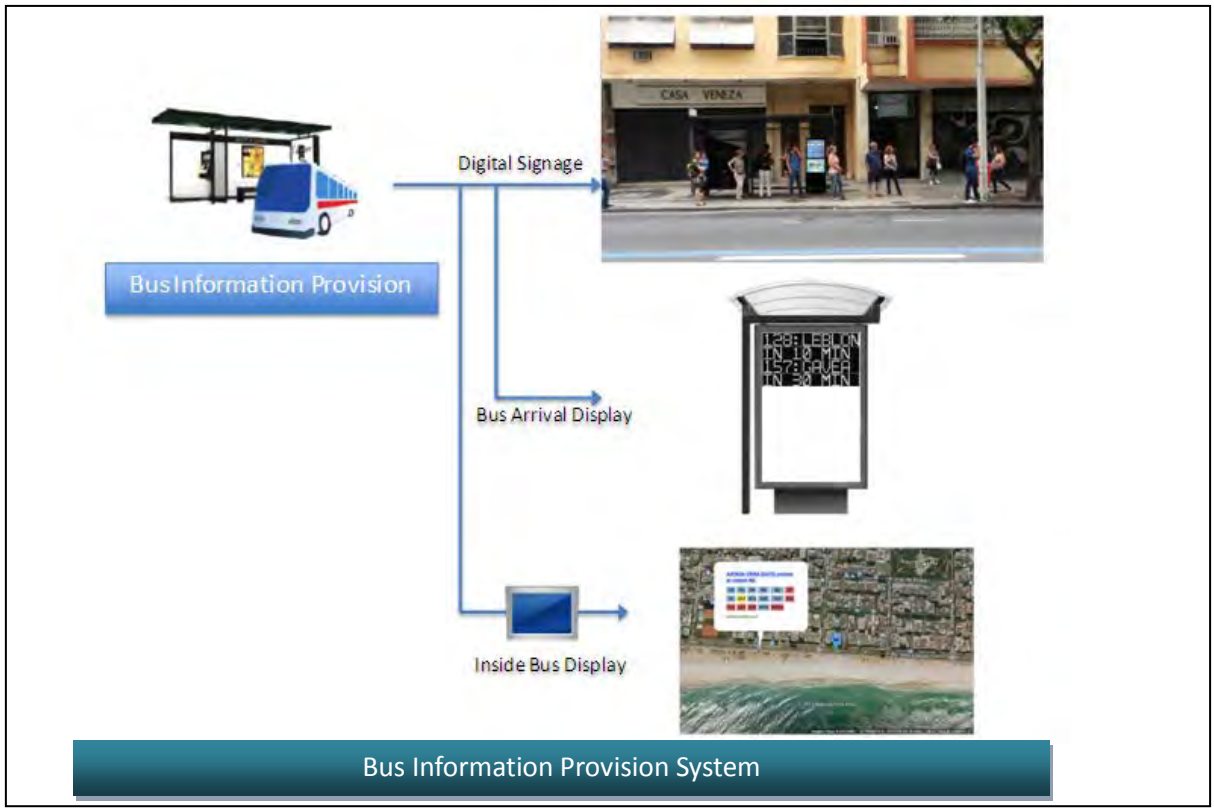
Table 9-12 Definition of Data/Information

Stakeholders		Gathered and Collected Data/Information
Transit/Transport-related Agencies	SMTR/DETRO	Processed information shall be provided via the ITS Center
Transit/Transport Operator	FETRANSPOR	Bus operating line data, bus stop/terminal geocoding data
	Private Bus Companies	GPS data
	Bus Terminal Operators	Bus departure timetable
	Mob TV	Current bus position information provision inside bus
Information Provider	ITS Center	Traffic information, estimated bus arrival time information, transfer information, etc.

Source: JICA Study Team

(5) Sample Contents

As for example, the Figure 9-15 shows sample contents of project package 2.



Source: JICA Study Team

Figure 9-15 Sample Contents of Project Package 2

9.5.2 Basic Design

The bus condition information provision system shall consist of the following equipment:

- Information provision board at bus stops
- Digital signage at terminals
- Bus location monitoring system
- Inside bus information monitor

(1) Number of Equipment to be Deployed

The target area of deployment is the central area of Rio de Janeiro to expand the provision of bus operation information to residents, visitors, and tourists. The number of equipment to be deployed is summarized in Table 9-13.

Table 9-13 Number of Equipment to be Deployed in the Short Term

Equipment	Installation Location	Current Condition	Target
Information Panel at Bus Stops	Bus stops	0 stop	46 stops
Information Provision Display at Terminals	Bus terminals	1 terminal (Novo Rio)	4 terminals (including Novo Rio)
Bus Location Monitoring System	Bus companies	0 company	30 companies
Inside Bus Information Display	Bus vehicles	Not confirmed	567 vehicles

Source: JICA Study Team

1) Information Provision Panel at Bus Stops

- [Existing]

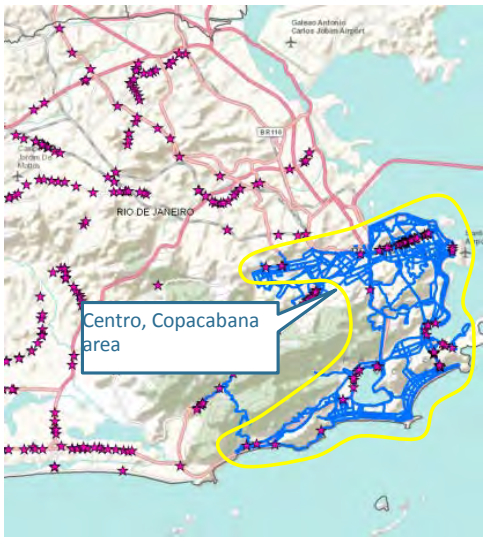
There are 2,136 bus stops with shelter. However, no information provision board at bus stop is installed.

- [Proposed]

About 500 stops along arterial roads shall be selected.

- [For Short Term]

Bus stops in the Centro and Copacabana areas are the only ones considered. (Note that bus stops along Av. Pres. Vargas are not selected because the Procopio Ferreira Terminal will provide the same information.) As a result, 46 stops are selected as shown in Table 9-14 below.



Source: JICA Study Team

Figure 9-16 Deployment of Information Provision Panel at Bus Stop

Table 9-14 Proposed Bus Stops for Information Provision Panel

no	Latitude	Longitude	NAME
1	-22.90985	-43.16835	Av. General Justo, lado oposto ao Aeroporto Santos Dumont (PRACA)
2	-22.90733	-43.16840	Av. General Justo, No 365A
3	-22.90857	-43.16830	Av. General Justo, 160
4	-22.92730	-43.20937	Av. Paulo de Frontim, 619
5	-22.95692	-43.17762	Av. Lauro Sodre, em frente ao Shopping Rio Sul
6	-22.95687	-43.17763	Av. Lauro Sodre, em frente ao Shopping Rio Sul
7	-22.95680	-43.17767	Av. Lauro Sodre, em frente ao Shopping Rio Sul
8	-22.95672	-43.17765	Av. Lauro Sodre, em frente ao Shopping Rio Sul
9	-22.95633	-43.17752	Av. Lauro Sodre, em frente ao Shopping Rio Sul
10	-22.95630	-43.17752	Av. Lauro Sodre, em frente ao Shopping Rio Sul
11	-22.95625	-43.17752	Av. Lauro Sodre, em frente ao Shopping Rio Sul
12	-22.95615	-43.17747	Av. Lauro Sodre, em frente ao Shopping Rio Sul
13	-22.95593	-43.17752	Av. Lauro Sodre, em frente ao Shopping Rio Sul
14	-22.94280	-43.17680	Praca Nicaragua, Lado Oposto, Sentido Copacabana
15	-22.94330	-43.18057	Av. Das Nacoes Unidas, lado oposto Ed. Argentina Sentido Copacabana
16	-22.94593	-43.18187	Av. Das Nacoes Unidas, lado oposto ao No 316 Sentido Copacabana
17	-22.95298	-43.17243	Av. Pasteur, em frente ao Instituto Benjamin Constant
18	-22.95422	-43.16843	Av. Pasteur, No 458
19	-22.95307	-43.17177	Av. Pasteur, oposto ao No 280, em frente ao Iate Clube do RJ
20	-22.95223	-43.17342	Av. Pasteur, oposto ao No 350, em frente ao Iate Clube do RJ
21	-22.96322	-43.17432	Av. Princesa Isabel, No. 186b
22	-22.96262	-43.17462	Av. Princesa Isabel, No.254
23	-22.96243	-43.17472	Av. Princesa Isabel, No.282
24	-22.96202	-43.17495	Av. Princesa Isabel, No.334
25	-22.97787	-43.22277	Rua Mario Ribeiro No 193, Sentido Lagoa
26	-22.97783	-43.22270	Rua Mario Ribeiro No 193, Sentido Lagoa
27	-22.96890	-43.21735	Av. Borges de Medeiros, em frente ao Clube Naval
28	-22.96508	-43.21563	Av. Borges de Medeiros, lado oposto a Paroquia Sao Jose
29	-22.96795	-43.21758	Av. Borges de Medeiros, 2895, esquina com Rua General Garzon
30	-22.96407	-43.21450	Av. Borges de Medeiros ao lado da Igreja Sao Jose da Lagoa
31	-22.97230	-43.21748	Av. Borges de Medeiros, Sentido Sentro 32 Metros Antes do Posto Br
32	-22.96280	-43.20495	Av. Borges de Medeiros, 100 Mts antes da Av. Epitacio Pessoa (Baixo Bebe)
33	-22.96267	-43.20603	Av. Borges de Medeiros, L.O. ao no 74 da Rua Profo Abelardo Lobo
34	-22.99205	-43.23362	Av. Niemeyer, Lado do Mar, em frente ao Hotel Sheraton
35	-22.99815	-43.26572	Auto Estrada Lagoa Barra, Esquina com Rua Herbert Moses
36	-22.99902	-43.27065	Auto Estrada Lagoa Barra, sentido Barra, na baia do novo terminal
37	-22.99903	-43.27072	Auto Estrada Lagoa Barra, sentido Barra, na baia do novo terminal
38	-22.99903	-43.27078	Auto Estrada Lagoa Barra, sentido Barra, na baia do novo terminal
39	-22.99855	-43.25658	Av. Prefeito Mendes de Moraes, Proximo a Av. Niemeyer, Sentido Leblon
40	-22.91092	-43.21420	Pc da Bandeira, lado oposto a Defesa Civil Estadual
41	-22.91642	-43.25263	Rua Visconde de Santa Isabel, No 34, em frenta a 9a RA
42	-22.91648	-43.25330	Rua Visconde de Santa Isabel, No 56
43	-22.91702	-43.26115	Rua Visconde de Santa Isabel, canteiro central, lado oposto ao no 337
44	-22.91702	-43.26120	Rua Visconde de Santa Isabel, canteiro central, lado oposto ao no 337
45	-22.94813	-43.18118	Av. Nacoes Unidas, sentido centro, proximo a praca Pimentel Duarte na calcada da praia
46	-22.94375	-43.18062	Av. Nacoes Unidas, sentido Centro, proximo a passagem subterranea, na calcada da praia

2) Information Provision Board at Terminals

- [Existing]

Information provision boards shall be installed only at Novo Rio Terminal in Rio Municipality. Other than the Novo Rio Terminal, there are two interstate bus terminals in RMRJ, 18 intercity bus terminals in RMRJ, and 24 local terminals in Rio Municipality.

- [Proposed]

All terminals shall have an information provision board.

- [For Short Term]

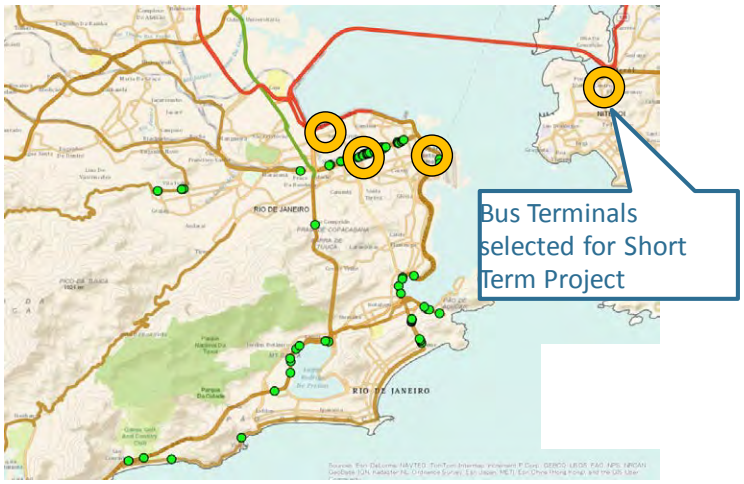
The following four major terminals in RMRJ and Rio Municipality, as shown in Figure 9-17, shall be selected:

Novo Rio

Roberto Silveira (Niteroi)

Procopio Ferreira (Central do Brasil)

Misericordia (Praça XV)



Source: JICA Study Team

Figure 9-17 Deployment of Information Provision Board at Bus Terminals

3) Bus Location Monitoring System

- [Existing]

Only Rio Onibus operates a monitoring system to administer 46 bus companies in Rio Municipality. Meanwhile, there are 208 bus companies in RMRJ.

- [Proposed]

All bus companies in RMRJ shall have a bus location monitoring system.

- [For Short Term]

Bus companies which operate in Centro and Copacabana shall be considered. InterSul and InterNorte are major consortiums in the Centro and Copacabana areas with 30 bus companies belonging to these two consortiums. Therefore, 30 companies shall be selected.

Source: JICA Study Team

Figure 9-18 Jurisdiction Area of InterNorte and InterSul

4) Inside Bus Information Monitor

- [Existing]

The number of bus vehicles is 9,000.

- [Proposed]

About 3,000 of the 9,000 vehicles operating in the Centro and Copacabana areas where tourists mainly visit shall be selected.

- [For Short Term]

Vehicles which stop at bus stops are considered for the short-term project and those along Av. Pres. Vargas will be the target. Vehicles which belong to InterSul and InterNorte consortiums are selected. The number of vehicles is 567.

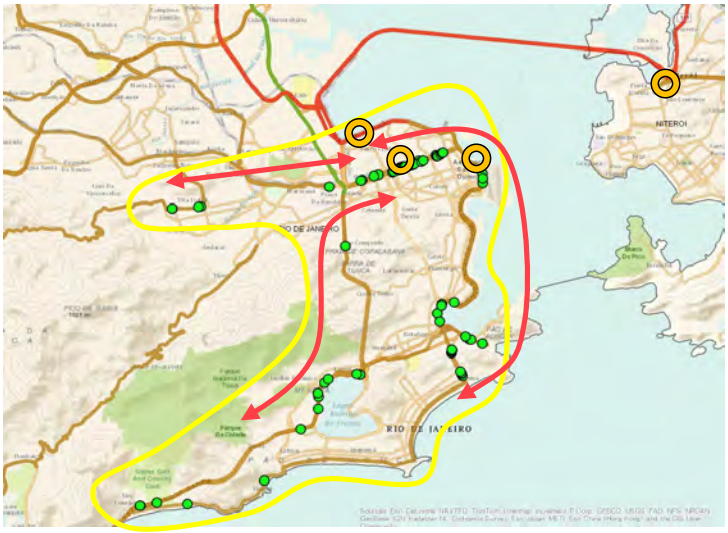


Figure 9-19 Buses Proposed for the Introduction of Inside Bus Information Monitor

(2) Essential Equipment and Functional Requirement

The functional requirement of the equipment is shown in Table 9-15

Table 9-15 Essential Equipment and Functional Requirement

Essential Equipment	Functional Requirement
Information Panel at Bus Stops	[Functional Requirement] • Information to be provided: - Bus arrival information (destination, line number, and estimated arrival time) - The information shall come from the ITS Center through GPRS. [Hardware Configuration] • Information panel (outdoor type) - LED display • Network equipment - GPRS transceiver [Installation Location] • Bus stop (46 stops)
Information Provision Board at Terminals	[Functional Requirement] • Information to be provided: - Bus arrival/departure information (destination, line number, bus stop number, and estimated arrival/departure time - The information shall come from the ITS Center through GPRS. [Hardware Configuration] • LCD color display (outdoor type) • Information provision display control unit • Network equipment - GPRS transceiver [Installation Location] • Bus terminal (4 major terminals)
Bus Location Monitoring System	[Functional Requirement] • The bus location monitoring server shall have the following functions so that the bus companies will manage bus operation: - Gathering the bus location using GPS data - Operational management Vehicle No. Route Itinerary Number of passengers at each stop Name of bus driver and fare collector - Reading the IC card data from the reader for billing management - Displaying the location of the buses on the map - Storage database for bus stops, terminals bus, lines and surrounding facilities [Hardware Configuration] • Bus location monitoring server

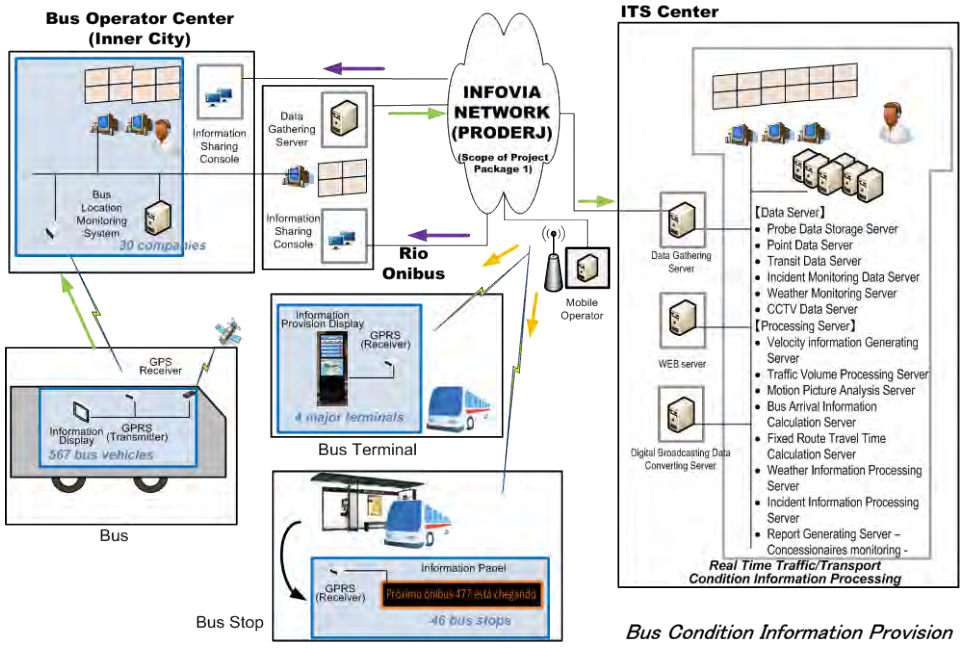
	• Wall-mounted display • Network equipment - GPRS transceiver [Installation Location] • Bus company (30 companies)
Inside Bus Information Display	[Functional Requirement] • Information to be provided: - Next bus stop (provided according to GPS data) - Facility information close to the bus stop (provided according to GPS data) [Hardware Configuration] • Inside bus information display - LCD color display • Inside bus information display control unit - Utilizing database of bus stops, terminals bus lines and surrounding facilities to provide facility information close to the bus stop when bus approaches the bus stop [Installation Location] • Bus (567 vehicles)

Source: JICA Study Team

(3) System Diagram/Data Flow

i) System Diagram

Figure 9-20 shows the system diagram of bus information provision system. The equipment highlighted in blue is the scope of Project Package 2. Information gathering from the bus companies to the ITS Center is covered in Project Package 1.

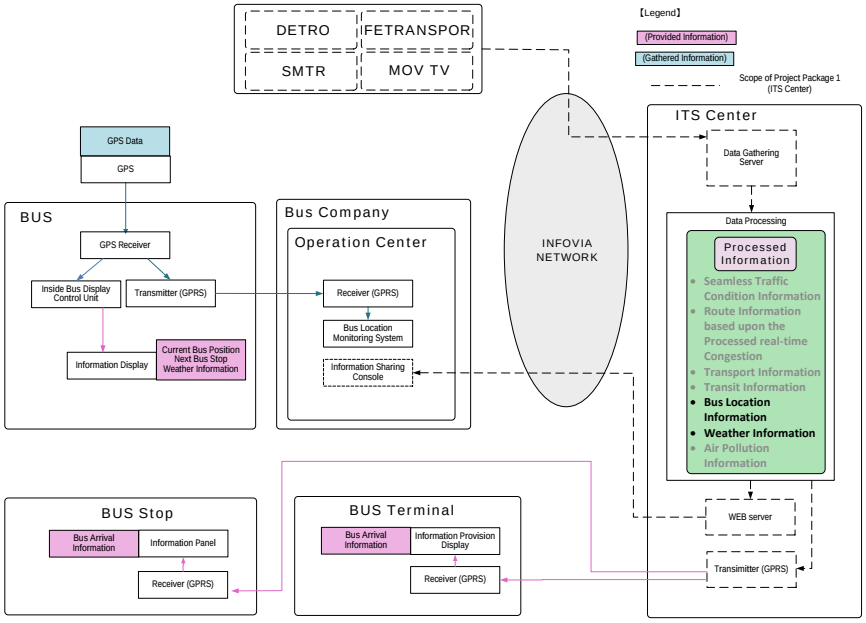


Source: JICA Study Team

Figure 9-20 System Diagram of Bus Condition Information Provision

ii) Data Flow

Figure 9-21 shows the data flow of the bus information provision system.



Source: JICA Study Team

Figure 9-21 Data Flow of Bus Condition Information Provision

(4) Cost Estimation

Based on the essential equipment shown in Table 9-15 and their unit prices, the cost of Project Package 2 is estimated in Table 9-16.

Table 9-16 Cost of Project Package 2

Project Package 2 Exchange rate : BRL1=JPY 46.92 as of March 26, 2013

No.	Item	Quantities	Unit Cost (1000JPY)	Total (1000JPY)	Total (1000BRL)	Remarks
Equipment						
1	Information Panel at Bus stops			207,000	4,412	
1-1	Information Panel	46	4,000	184,000	3,922	
1-2	Network Equipment	46	500	23,000	490	
2	Information Provision Display at Terminals			30,000	639	
2-1	Information Provision Display	4	5,000	20,000	426	
2-2	Information Provision Display Control Unit	4	2,000	8,000	171	
2-3	Network Equipment	4	500	2,000	43	
3	Bus Location Monitoring System			915,000	19,501	
3-1	Bus Location Monitoring Server	30	30,000	900,000	19,182	With wall-mounted Display
3-2	Network Equipment	30	500	15,000	320	
4	Inside Bus Information Provision System			1,871,100	39,879	
4-1	Inside Bus Information Display	567	800	453,600	9,668	
4-2	Inside Bus Information Display Control Unit	567	2,000	1,134,000	24,169	
4-3	Network Equipment	567	500	283,500	6,042	
	Sub total			3,023,100	64,431	
5	Installation and Test	1		302,310	6,443	1～4 *10%
	Sub total			302,310	6,443	
Total				3,325,410	70,874	

Source: JICA Study Team

(5) Implementation Plan

Table 9-17 shows the implementation schedule for Project Package 2 including preparation, procurement, implementation, and commissioning test. The implementation plan is proposed on the basis of the following conditions:

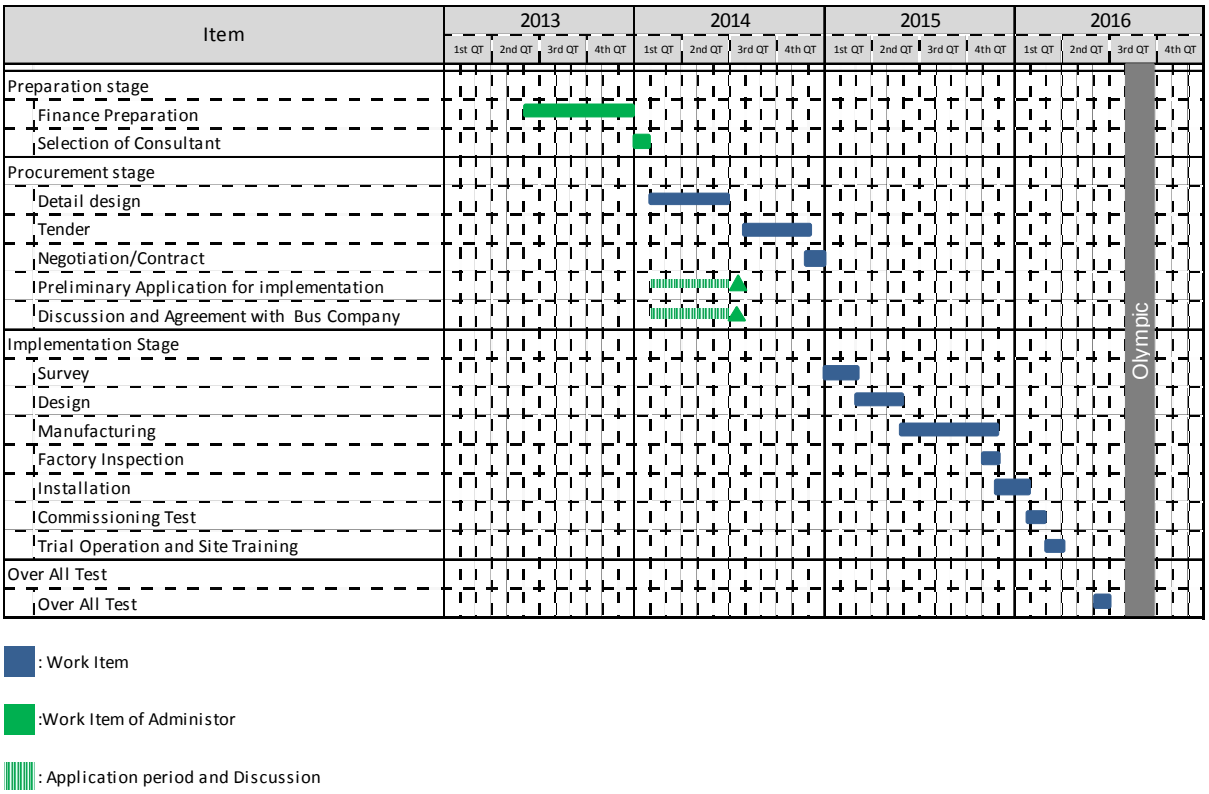
1) Preparation Stage
   - Financial preparation shall be completed by the end of 2013 before commencement of the preparation of the financial source for procurement and implementation stages.

2) Procurement Stage
   - The period for the procurement stage including detailed design, tender, and contract is expected to be 11 months and shall be completed by December 2014.
   - According to the information from a private broadcasting company, they have developed their bus location information provision system which includes inside bus information provision and bus arrival/departure information provision. They are currently promoting the system to bus companies. The consultant who will conduct the detailed design shall clarify the bus companies targeted for Project Package 2 according to further surveillance or interview with bus companies during the detailed design stage.
   - Preliminary application for installation of the equipment shall be made to related agencies, mobile operators, and bus companies.

3) Implementation Stage
   - The implementation will commence in February 2015 after the contract.
   - The implementation period will be 15 months including the survey and design (5 months), manufacturing (6 months), factory inspection (1 month), equipment installation (2 months), commissioning test (1 month), and trial operation and site training (1 month).

4) Overall Test
   - The overall commissioning test shall be conducted in June 2016 before taking-over to check the interconnection among the equipment of Project Package 1, Project Package 2, and Project Package 3.

Table 9-17 Implementation Schedule of Project Package 2



Source: JICA Study Team

9.6 PROJECT PACKAGE 3

Project Package 3 covers the following system:

- Improvement of the Traffic/Transit Operational Center with essential ITS equipment in the Rio de Janeiro municipal area.
- The system has the following three components: 1) existing gathered data integration, 2) expansion of adaptive signal control, and 3) installation and control of additional variable message signboard (VMS) system.

9.6.1 Grand Design

(1) Objective of the Short-term Project

The objective of Project Package 3 is summarized as follows:

To expand and improve the function of the existing ITS equipment for a smoother and smarter transportation and transit.

As presented above, component 1 will be covered by the ITS Center section of Project Package 1. Therefore, this section covers components 2 and 3 only as part of the basic design of this project package. The three components are discussed below.

1) Existing Gathered Data Integration
   - Utilization of OCR point speed data and traffic volume data, CCTV motion picture data (by the ITS Center of Project Package 1)
   - Utilization of work zone point data information, tunnel monitoring data (by the ITS Center of Project Package 1)
   - Bus/BRT GPS information and operational information (by the ITS Center of Project Package 1)
   - Taxi dispatching GPS data (by the ITS Center of Project Package 1)
2) Expansion of Adaptive Signal Control
   - Dynamic traffic signal optimization
3) Installation and Control of Additional VMS System
   - Additional VMS for more information provision

(2) Target Area

The target locations of components 2 and 3 shall be in the Rio de Janeiro municipal area. Details of the location are clarified in Section 9.6.2.

(3) Related Stakeholders

Related stakeholders of Project Package 3 are shown below.

1) Road-related Agencies/Private Companies

Public/Government Company: CET-Rio, SECONSERVA

CET-Rio, SECONSERVA	(Public/Government Company)

2) Transit/Transport-related Agencies

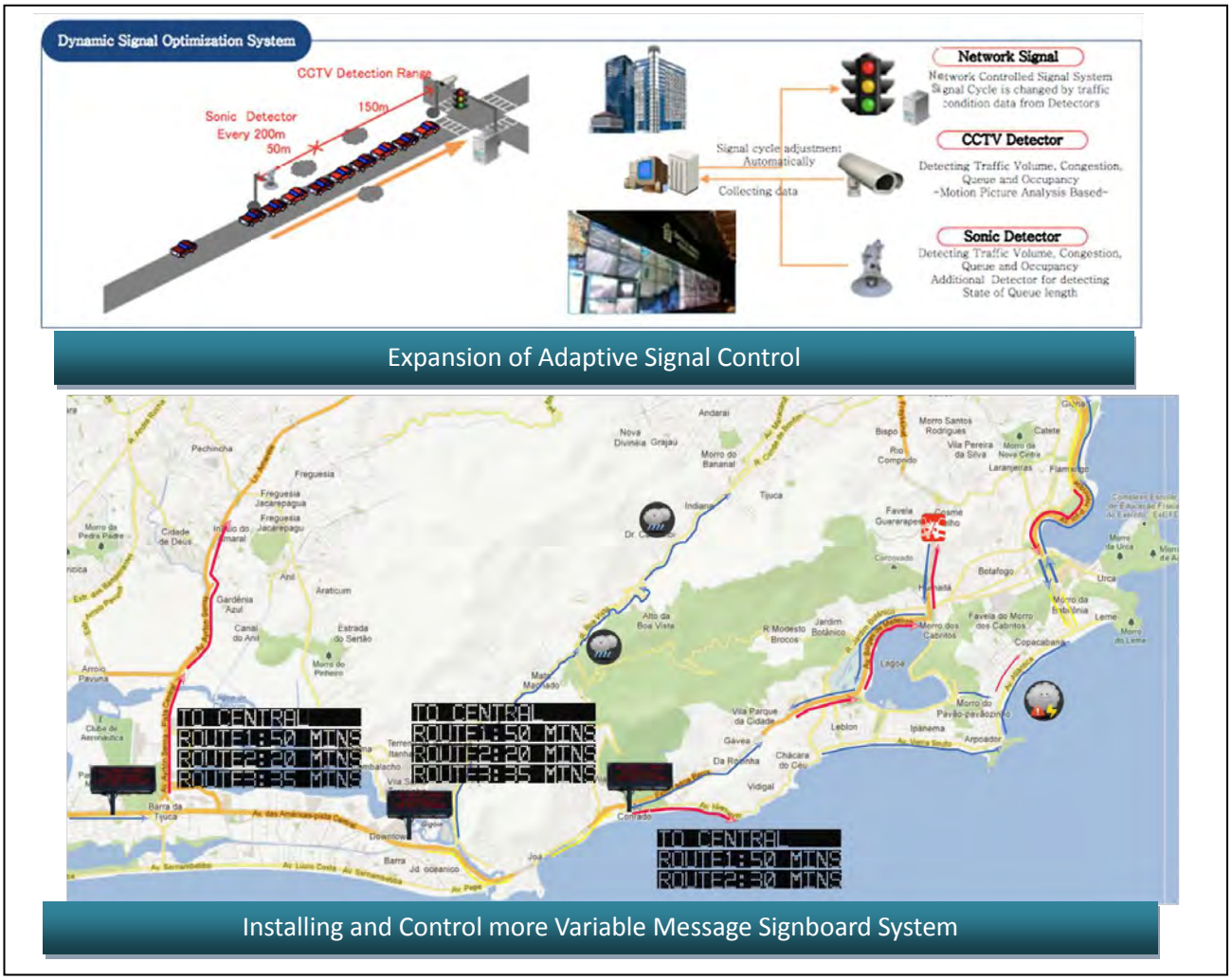
SMTR	

3) Transit/Transport Operator

Rio Onibus, Central Coop	(Syndicate and Consortium)
FETRANSPOR	(Association)
Super VIA, METRO, CCR Barcas	
Private Bus Companies	
Socicam	(Bus Terminal Operator)
Taxi Association	
SMARTSIS	(Taxi Dispatching System Operator)
Radio Taxi	(Taxi Dispatching System Operator)

(4) Sample Contents

As for example, the Figure 9-22 shows sample contents of project package 3.



Source: JICA Study Team

Figure 9-22 Sample Contents of Project Package 3

9.6.2 Basic Design

Project Package 3 consists of the following two components:

- Expansion of adaptive signal control
- Installation and control of additional VMS

(1) Number of Equipment to be Deployed

The target area for deployment is the central area of Rio de Janeiro to expand the provision of bus operation information to residents, visitors, and tourists in this area. The number of equipment to be deployed is summarized in Table 9-18.

Table 9-18 Number of Equipment to be Deployed in the Short Term

Equipment	Installation Location	Current Condition	Target
Dynamic Signal Optimization System	Intersection	30 intersections	+44 intersections
Variable Message Signboard System	Arterial Road	34 units 32 units operated by Rio Municipality 2 units operated by DER	+32 units in Rio Municipality

Source: JICA Study Team

1) Expansion of Adaptive Signal Control

- Existing

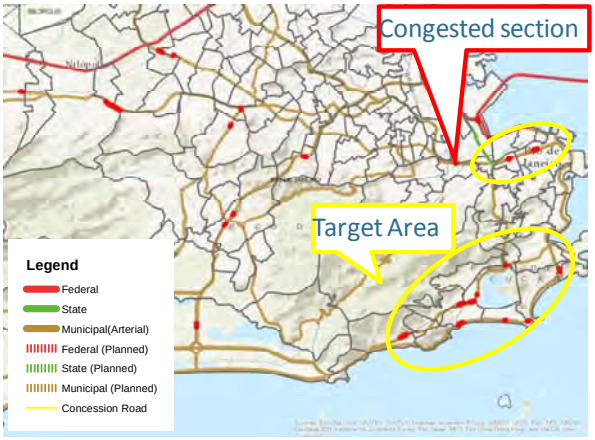
There are about 2265 intersections in Rio Municipality. Adaptive signal control system has already been deployed in 30 intersections.

- Proposed

Traffic signals at 435 intersections along the arterial road are proposed to be replaced with the adaptive signal control system as first priority based on the result of travel time survey conducted in this study. Furthermore, 995 intersections along other main roads are proposed as second priority.

- For Short Term

From the viewpoint of intersections extracted from congested areas, 44 intersections along the arterial roads are proposed to be replaced with adaptive signal control system in Project Package 3 as first priority. The proposed intersections are listed in Table 9-19 below.



Source: JICA Study Team

Figure 9-23 Deployment of Adaptive Signal Control

Table 9-19 Proposed Intersections for Adaptive Signal Control

No.	Latitude	Longitude	Intersection
1	-22.96187	-43.20774	Av. Alexandre Ferreira x R. Maria Angelica
2	-22.90503	-43.17036	Av. Alfred Agache x Ladeira da Misericordia
3	-22.97545	-43.18762	Av. Atlantica x R. Bolivar
4	-22.97418	-43.18686	Av. Atlantica x R. Constante Ramos
5	-22.97124	-43.18427	Av. Atlantica x R. Figueiredo de Magalhaes
6	-22.98202	-43.18960	Av. Atlantica x R. Francisco Sa
7	-22.97770	-43.18866	Av. Atlantica x R. Miguel Lemos
8	-22.96819	-43.18032	Av. Atlantica x R. Republica do Peru
9	-22.96667	-43.17774	Av. Atlantica x R. Rodolfo Dantas
10	-22.97233	-43.18548	Av. Atlantica x R. Santa Clara
11	-22.97001	-43.18296	Av. Atlantica x R. Siqueira Campos
12	-22.96315	-43.21250	Av. Borges de Medeiros x Av. Lineu de Paula Machado
13	-22.96538	-43.21600	Av. Borges de Medeiros x R. Batista da Costa
14	-22.96496	-43.21567	Av. Borges de Medeiros x R. J J Seabra
15	-22.97723	-43.21938	Av. Borges de Medeiros x R. Mario Ribeiro
16	-22.96654	-43.21668	Av. Borges de Medeiros x R. Saturnino de Brito
17	-22.96442	-43.21487	Av. Borges de Medeiros x Trav. Ped.
18	-22.96303	-43.21011	Av. Borges de Medeiros x Trav. Ped.
19	-22.96315	-43.20724	Av. Borges de Medeiros x Trav. Ped.
20	-22.96279	-43.21181	Av. Borges de Medeiros x Via de Ligacao (Sem Codigo)
21	-22.97464	-43.21816	Av. Borges de Medeiros x Via de Ligacao (Sem Codigo)
22	-22.98657	-43.22218	Av. Delfim Moreira x Av. Bartolomeu Mitre
23	-22.98621	-43.21967	Av. Delfim Moreira x R. Cupertino Durao
24	-22.98681	-43.22362	Av. Delfim Moreira x R. Gal Venancio Flores
25	-22.98789	-43.22721	Av. Delfim Moreira x R. Jeronimo Monteiro
26	-22.96241	-43.20394	Av. Epitacio Pessoa x R. Frei Solano
27	-22.96261	-43.21193	Av. Lineu de Paula Machado x Via de Ligacao (Sem Codigo)
28	-22.96315	-43.21250	Av. Lineu de Paula Machado x Via de Ligacao (Sem Codigo)
29	-22.90229	-43.18401	Av. Mal. Floriano x R. Camerino
30	-22.99316	-43.25272	Av. Niemeyer x Av. Aquarela do Brasil
31	-22.99421	-43.23383	Av. Niemeyer x Subida do Vidigal - Av. Pres. Joao Goulart
32	-22.99930	-43.26696	Av. Pref Mendes de Morais x Trav. Ped.
33	-22.90188	-43.17937	Av. Rio Branco x Av. Pres. Vargas
34	-22.89636	-43.18140	Av. Rio Branco x Av. Rodrigues Alves
35	-22.97878	-43.22639	Av. Rodrigo Otavio x Av. Visc de Albuquerque
36	-22.99419	-43.25708	Etr. da Gavea x Trav. Ped.
37	-22.96145	-43.17475	R. Barata Ribeiro x Av. Princesa Isabel
38	-22.96067	-43.20314	R. Fonte da Saudade x Trav. Ped.
39	-22.98677	-43.19172	R. Francisco Otaviano x Trav. Ped.
40	-22.96032	-43.20367	R. Humaita x Trav. Ped.
41	-22.97806	-43.22244	R. Mario Ribeiro x R. Minist Raul Machado
42	-22.96301	-43.17500	R. Minist Viveiros de Castro x Av. Prado Junior
43	-22.96081	-43.20440	R. Prof Saldanha x R. Prof Abelardo Lobo
44	-22.98695	-43.19082	R. Raul Pompeia x R. Francisco Otaviano

Source: JICA Study Team

2) Expansion of Variable Message Signboard System

- Existing

There are 36 VMSs in Rio Municipality (34 VMSs operated by Rio Municipality and 2 VMSs operated by DER).

- Proposed

It is proposed that additional 107 VMSs be installed for conducting sufficient information provision to road users.

- For Short Term

A total of 32 VMSs around the Olympic Lane shall be considered based on the result of travel time survey conducted in this study. The proposed location is listed in Table 9-20.

Source: JICA Study Team

Figure 9-24 Deployment of VMS

Table 9-20 Proposed Location of VMSs

No.	Latitude	Longitude	Street
1	-23.014889	-43.302660	Praca Jornalista Maria Filho
2	-22.964989	-43.203764	Avenida Epitacio Pessoa
3	-22.938208	-43.183209	Rua Pinheiro Machado
4	-22.962217	-43.357319	Avenida Ayrton Senna
5	-22.875170	-43.279136	Avenida Pastor Martin Luther King Junior
6	-22.965280	-43.394742	Avenida Salvador Allende
7	-22.884175	-43.405636	Avenida Marechal Fontenele
8	-22.865123	-43.421085	Avenida Brasil
9	-22.885138	-43.298441	Avenida Dom Helder Camara
10	-22.887328	-43.286545	Avenida Dom Helder Camara
11	-22.874802	-43.266093	[Minor Road]
12	-22.870466	-43.268232	Estrada do Timbo
13	-22.867575	-43.247554	[Minor Road]
14	-22.819343	-43.284489	Avenida Brasil
15	-22.823286	-43.313296	Avenida Meriti
16	-22.822629	-43.326273	[Minor Road]
17	-22.826310	-43.348235	[Minor Road]
18	-22.858508	-43.379609	Rua Joao Vicente
19	-22.867575	-43.413264	Estrada Sao Pedro de Alcantara
20	-22.969772	-43.187609	Rua Barata Ribeiro
21	-22.970823	-43.186611	Avenida Nossa Senhora de Copacabana
22	-22.972136	-43.185470	Avenida Atlantica
23	-22.972595	-43.184971	Avenida Atlantica
24	-22.977806	-43.223663	Rua Mario Ribeiro
25	-23.011019	-43.372117	Avenida Lucio Costa
26	-22.913121	-43.226779	[Minor Road]
27	-22.905294	-43.210361	[Minor Road]
28	-22.905228	-43.209577	Avenida Francisco Bicalho
29	-22.908381	-43.199951	Avenida Presidente Vargas
30	-22.907855	-43.200236	Avenida Presidente Vargas
31	-22.903849	-43.178061	Avenida Rio Branco
32	-22.908118	-43.172356	Avenida Presidente Antoio Carlos

Source: JICA Study Team

(2) Essential Equipment and Functional Requirement

i) Dynamic Signal Optimization

Table 9-21 Essential Equipment and Functional Requirement

Essential Equipment	Functional Requirement
Dynamic Signal Optimization System	[Functional Requirement] • The detectors shall count the traffic volume, speed, and vehicle type and send it to a traffic signal server in COR through signal controller at intersections. [Hardware Configuration] • Signal with signal controller • Sensor - Image recognition type (installed at intersection) - Loop-coil type or ultrasonic type (installed approximately 200 m before the intersection. Specified clearance between the intersection and sensor shall be decided during the detailed design stage) • Network equipment - GPRS or fiber optic [Installation Location] • 44 intersections
Signal Control Server (Signal Optimization Software)	[Functional Requirement] • The signal optimization software shall control the signal dynamically according to traffic conditions in order to alleviate traffic congestion. [Hardware Configuration] • Server with display for server maintenance [Installation Location] • COR: 1 set

Source: JICA Study Team

ii) Variable Message Signboard System

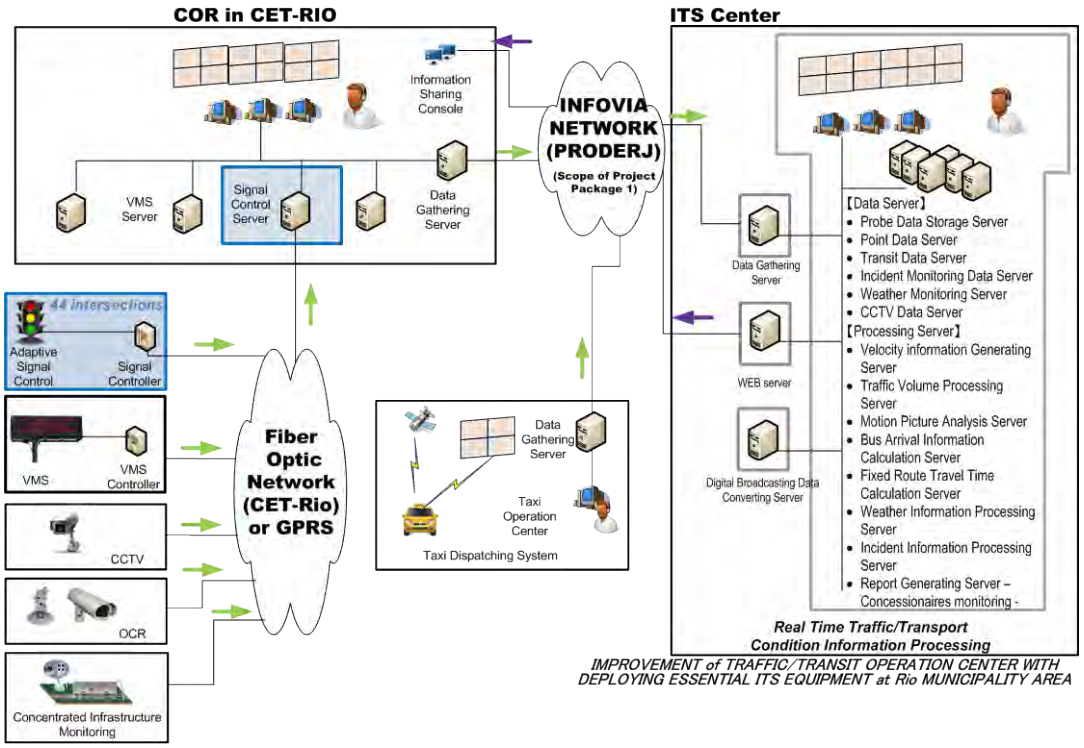
Table 9-22 Essential Equipment and Functional Requirement

Essential Equipment	Functional Requirement
Variable Message Signboard System (VMS system)	[Functional Requirement] • Communication control function - Communicating with the VMS server in COR through communication network - Receiving display data from the VMS server and sending back the operating status data to the server • Display control function - Changing the contents on the display based on the display data from the server • Monitoring function - Monitoring the display condition and sending it to the server. • Local operation function - Controlling the VMS manually at the site

	[Hardware Configuration] • VMS VMS Board (Type A) - LED display unit (4 lanes with approximately 10 characters) - Supporting structure (cantilever type) VMS Board (Type B) - LED display unit (3 lanes with approximately 25 characters) - Supporting structure (gantry type) Either Type A or Type B shall be selected according to the volume of information to be provided. • VMS controller • Network equipment - GPRS or fiber optic [Installation Location] • Arterial road: 32 locations
Variable Message Signboard System (VMS system) Server	[Functional Requirement] • Message indication function • The following three contents shall be displayed on the VMS board for the road users to take necessary actions: - Location: indicates where the incident occurred. (distance (xx km ahead) or specific location (xxx tunnel)) - Incident; indicates what happened at the location. (accident, congestion, road maintenance, weather condition) - Action: indicates what action the road user should take. (slow down, take caution, use right/left lane) • Message creation and editing function - Manual composition The system operator shall input text messages through the keyboard of the operator console in COR. - Combination of predefined phrase The system operator shall select from a list of ready-made message (frequently used words or phrases such as “accident”, “construction work”, etc.). - Graphic symbol marks Graphic symbol mark which shows typical incidents shall be provided to complement the text message. [Hardware Configuration] • Server with display for server maintenance [Installation Location] • COR: 1 set

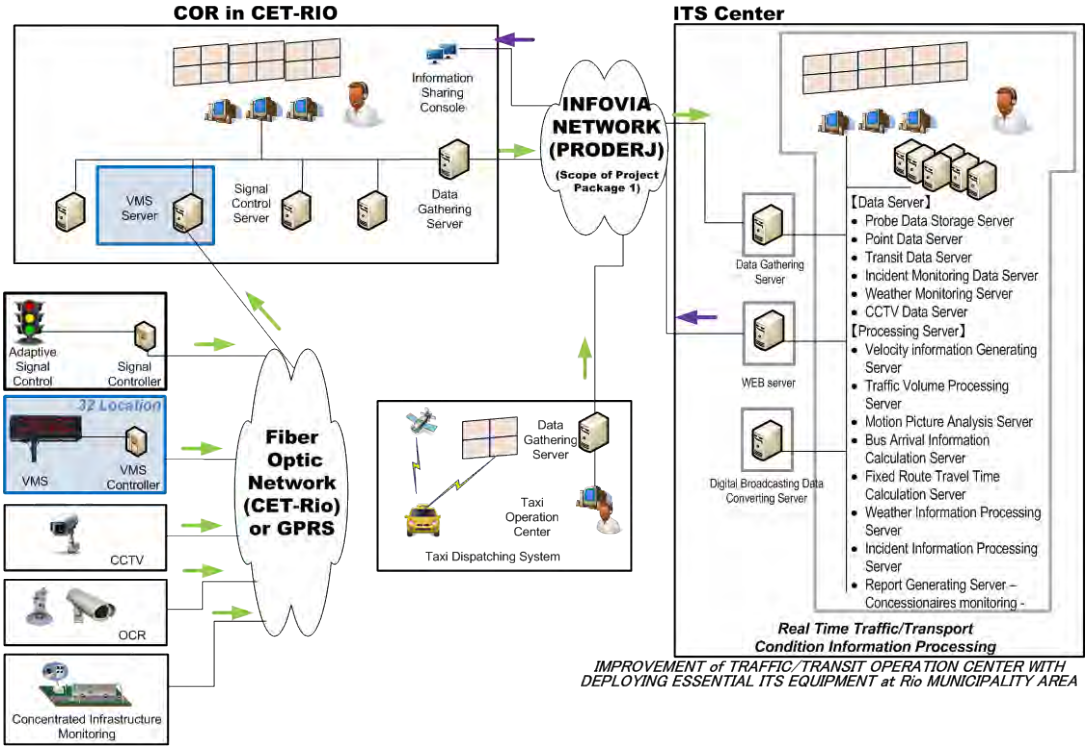
Source: JICA Study Team

(3) System Diagram



Source: JICA Study Team

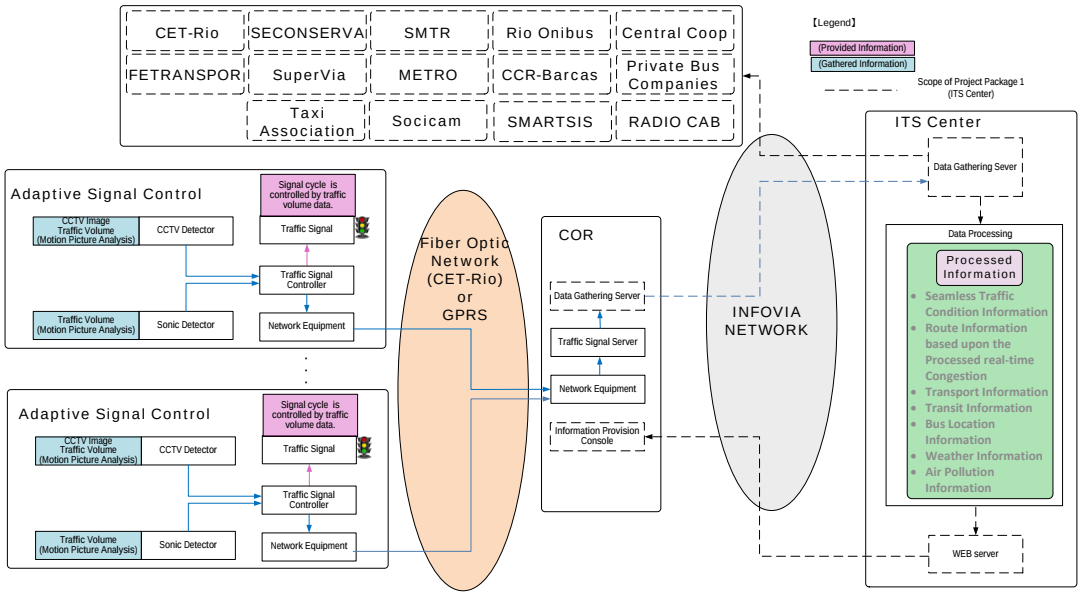
Figure 9-25 System Diagram of Dynamic Signal Optimization



Source: JICA Study Team

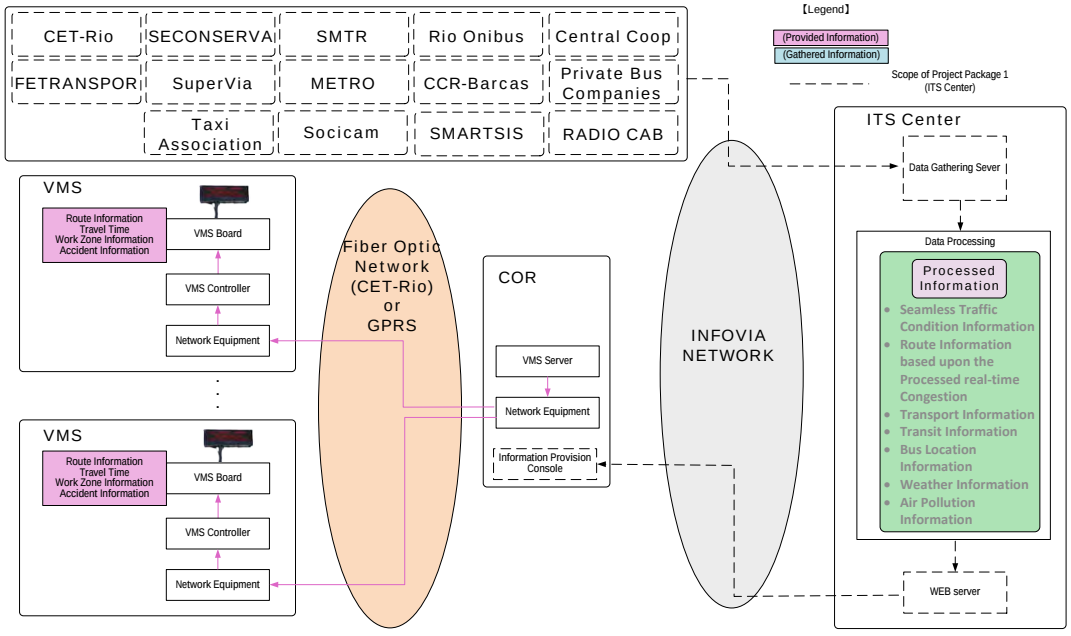
Figure 9-26 System Diagram of Variable Message Signboard System

(4) Data Flow



Source: JICA Study Team

Figure 9-27 Data Flow of Dynamic Signal Optimization



Source: JICA Study Team

Figure 9-28 Data Flow of Variable Message Signboard System

(5) Cost Estimation

Based on the essential equipment shown in Table 9-21 and Table 9-22 and their unit prices, the cost of Project Package 3 is estimated in Table 9-23.

Table 9-23 Cost of Project Package 3

Project Package 3 Exchange rate : BRL1=JPY 46.92 as of March 26, 2013

No.	Item	Quantities	Unit Cost (1000JPY)	Total (1000JPY)	Total (1000BRL)	Remarks
Equipment						
1	Dynamic Signal Optimization System			502,000	10,699	
1-1	Signal with Signal Controller (4sets)	44	6,000	264,000	5,627	
1-2	Sensor(Image recognition Type) (4sets)	44	2,000	88,000	1,876	
1-3	Sensor(Loop-coil Type or Ultrasonic Type) (4sets)	44	2,000	88,000	1,876	
1-4	Network Equipment	44	500	22,000	469	
1-5	Signal Control Server	1	40,000	40,000	853	
2	Variable Message Signboard System (VMS system)			546,000	11,637	
2-1	VMS Board (4 lanes with 10 characters)	32	12,000	384,000	8,184	including supporting structure
2-2	VMS Controller	32	3,000	96,000	2,046	
2-3	Network Equipment	32	500	16,000	341	
2-4	Variable Message Signboard System (VMS system) Server	1	50,000	50,000	1,066	
	Sub total			1,048,000	22,336	
3	Installation and Test	1		104,800	2,234	1～2 *10%
	Sub total			104,800	2,234	
Total				1,152,800	24,569	

Source: JICA Study Team

(6) Implementation Plan

Table 9-24 shows the implementation schedule for Project Package 3 including preparation, procurement, implementation, and commissioning test. The implementation plan is proposed on the basis of the following conditions:

1) Preparation Stage

- Financial preparation works shall be completed by the end of 2013. The works shall be finished before the commencement of the preparation of the financial source for the procurement and implementation stages.

2) Procurement Stage

- The procurement period, which includes the detailed design, tender, and contract, will be 12 months and shall be completed by January 2015.
- In this stage, preliminary application for the installation of equipment shall be made to CET-Rio.

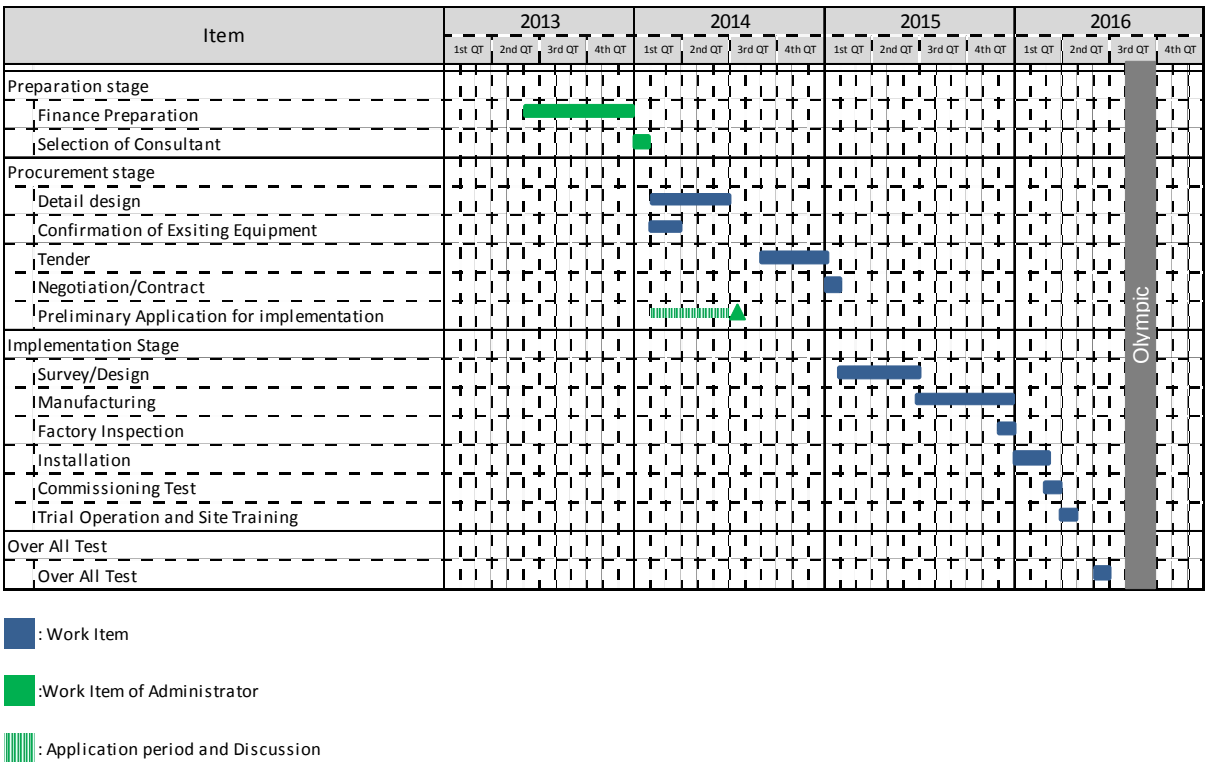
3) Implementation Stage

- The implementation will commence in February 2015 after the contract.
- The implementation period will be 15 months including survey and design (5 months), manufacturing (6 months), factory inspection (1 month), equipment installation (2 months), commissioning test (1 month), and trial operation and site training (1 month).

4) Overall Test

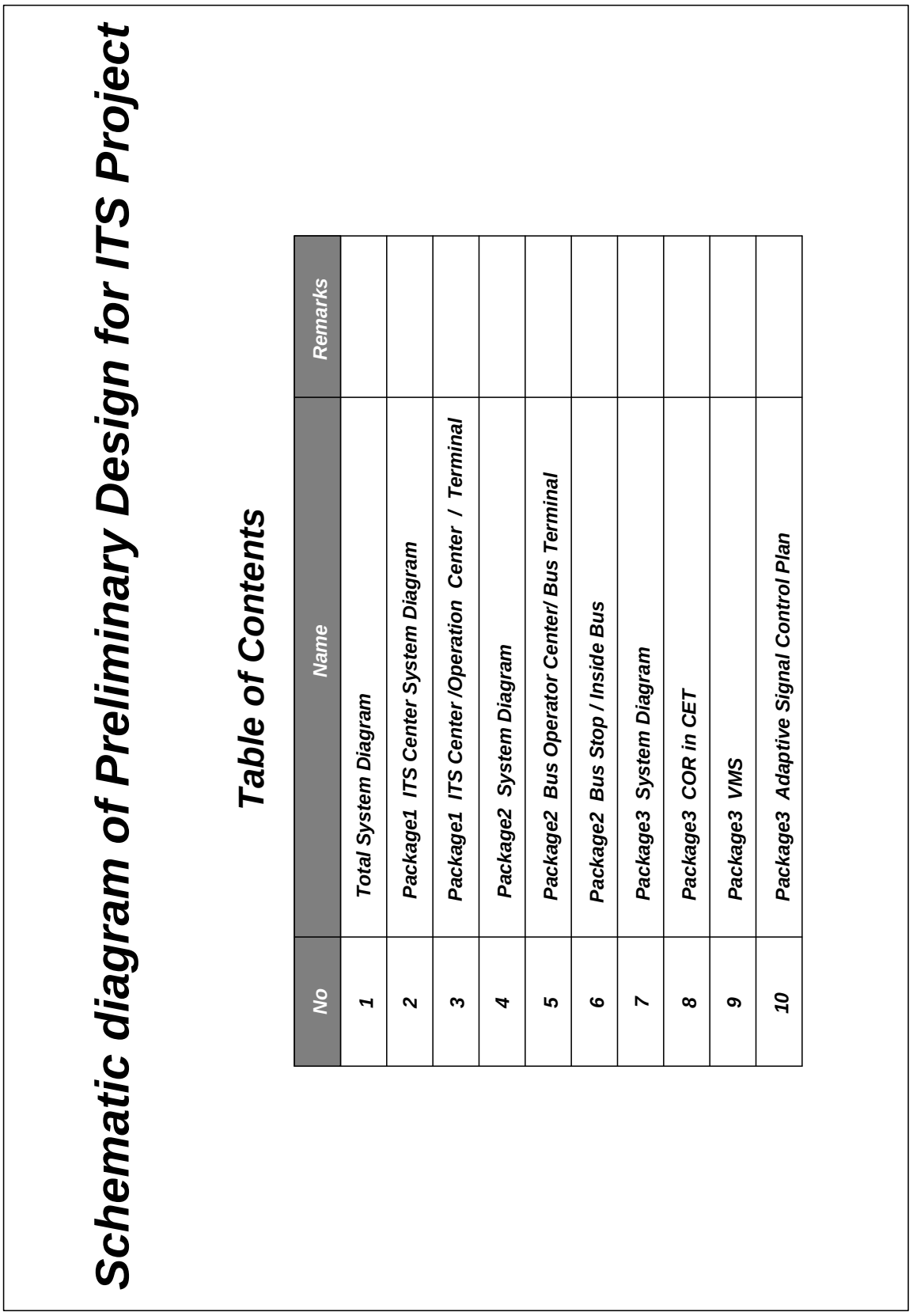
- The overall commissioning test shall be conducted in June 2016 before taking over to check the interconnection among the equipment of Project Package 1, Project Package 2, and Project Package 3.

Table 9-24 Implementation Schedule of Project Package 3



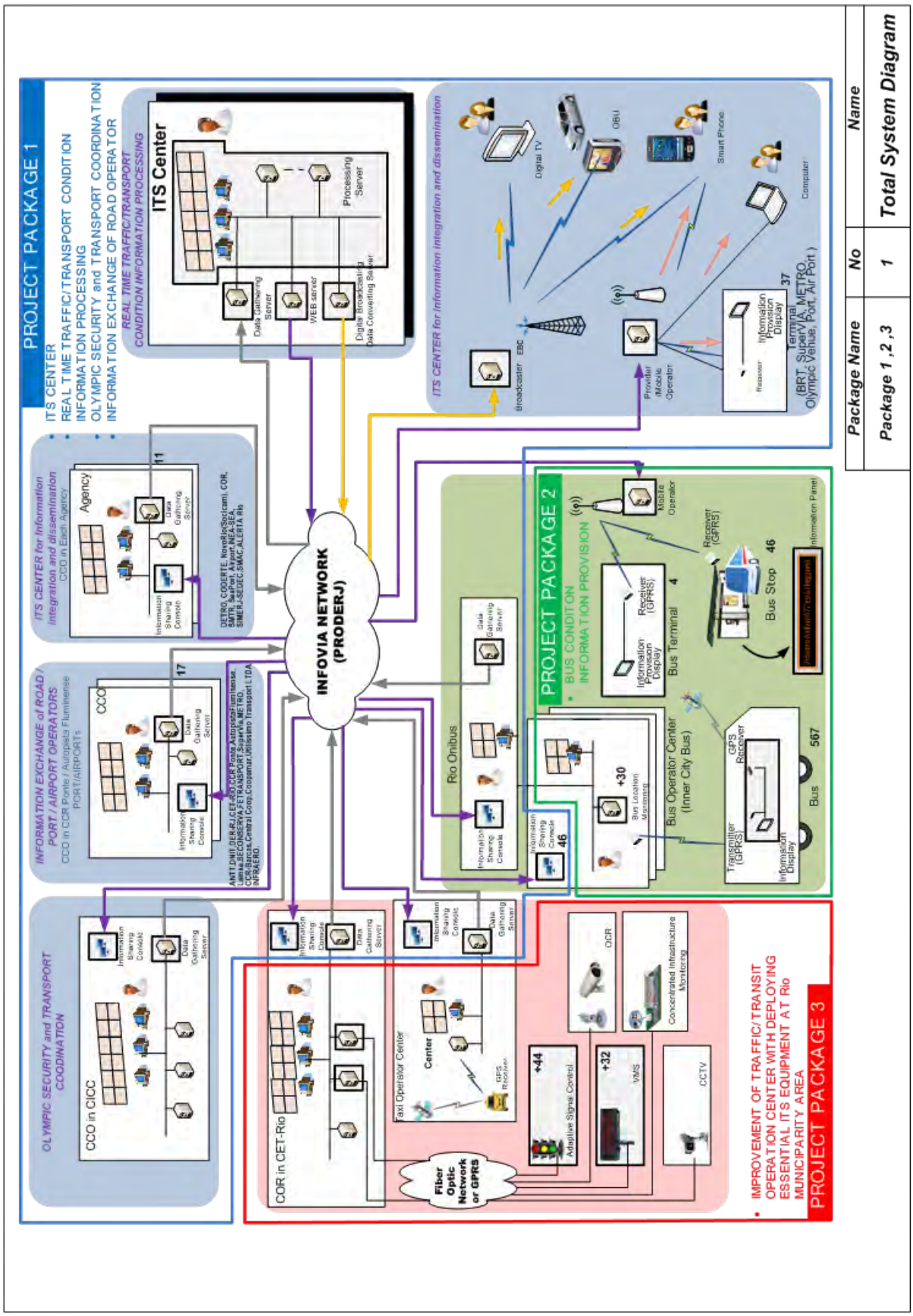
Source: JICA Study Team

As preliminary design for each ITS project, from the Figure 9-29 to the Figure 9-39 shows schematic diagram for each project package.



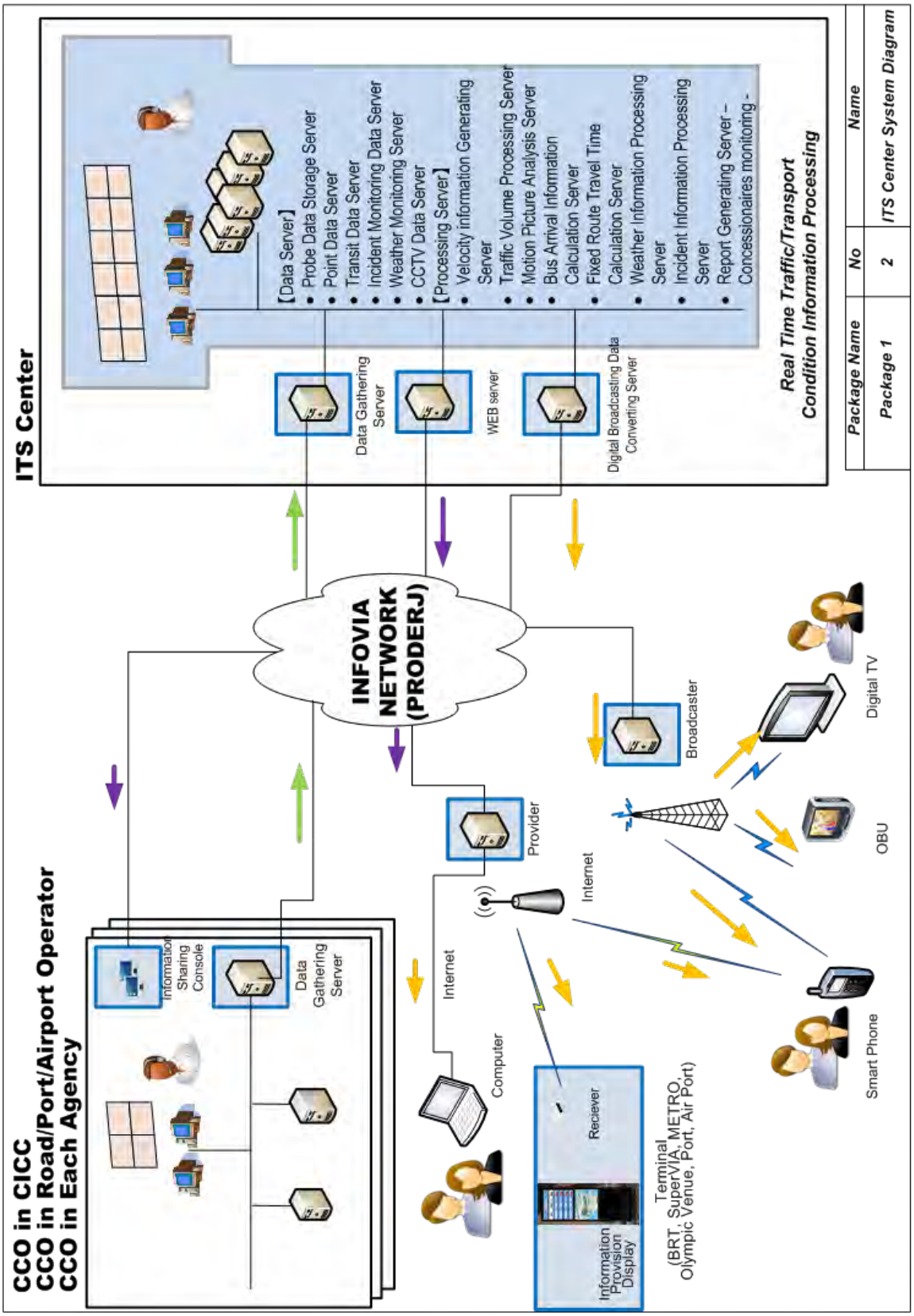
Source: JICA Study Team

Figure 9-29 Schematic Diagram of Preliminary Design for ITS Project (1/11)



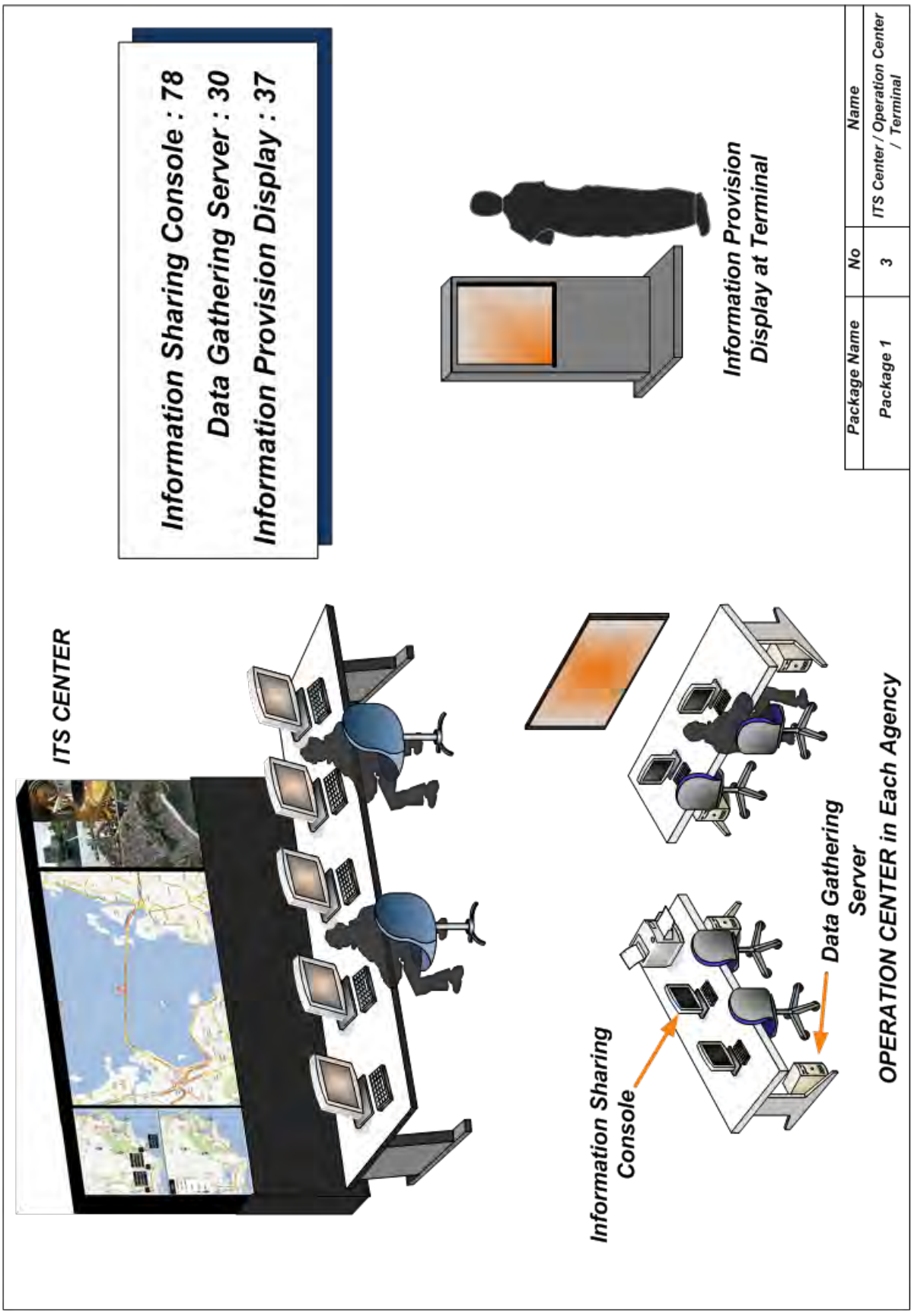
Source: JICA Study Team

Figure 9-30 Schematic Diagram of Preliminary Design for ITS Project (2/11)



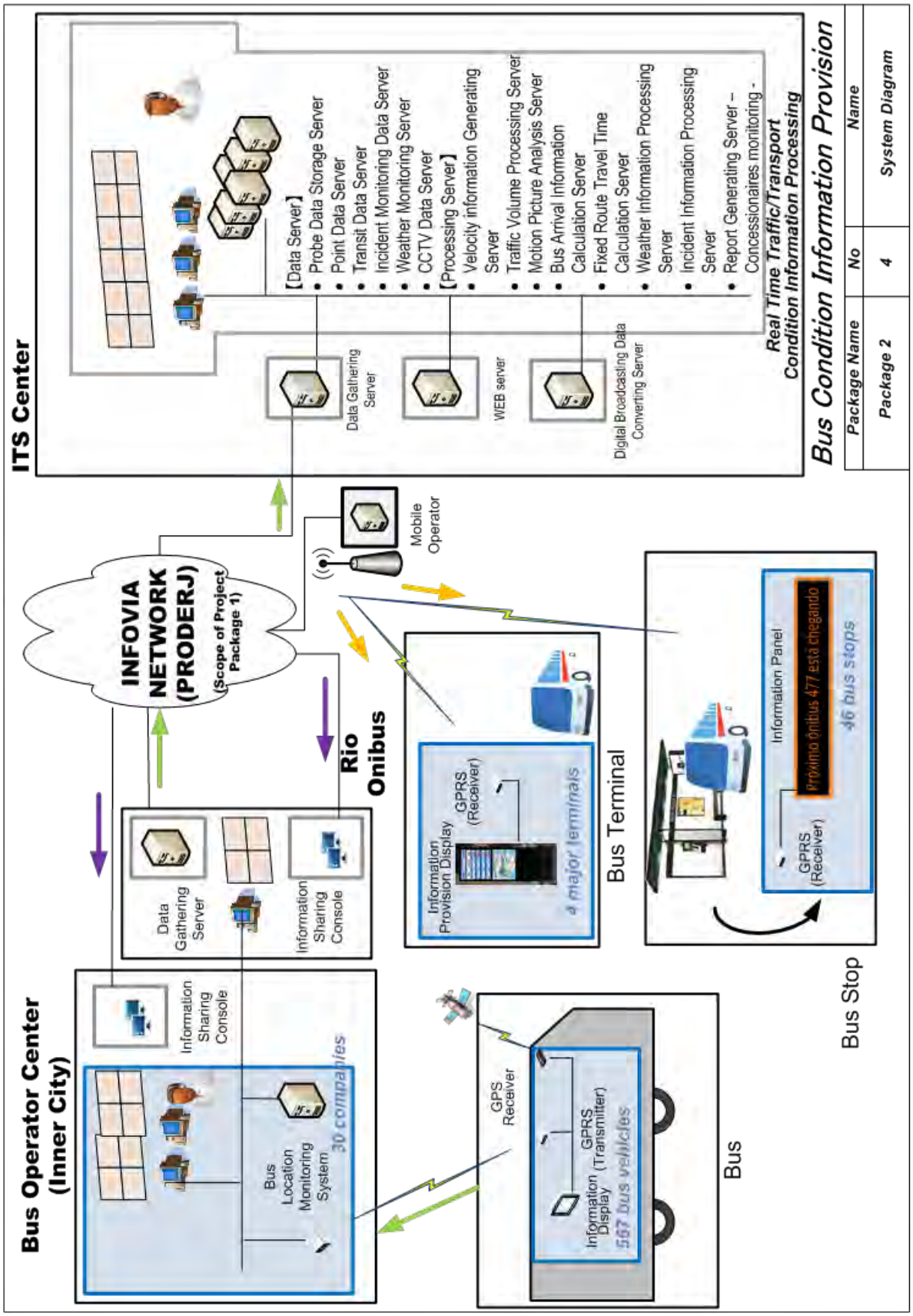
Source: JICA Study Team

Figure 9-31 Schematic Diagram of Preliminary Design for ITS Project (3/11)



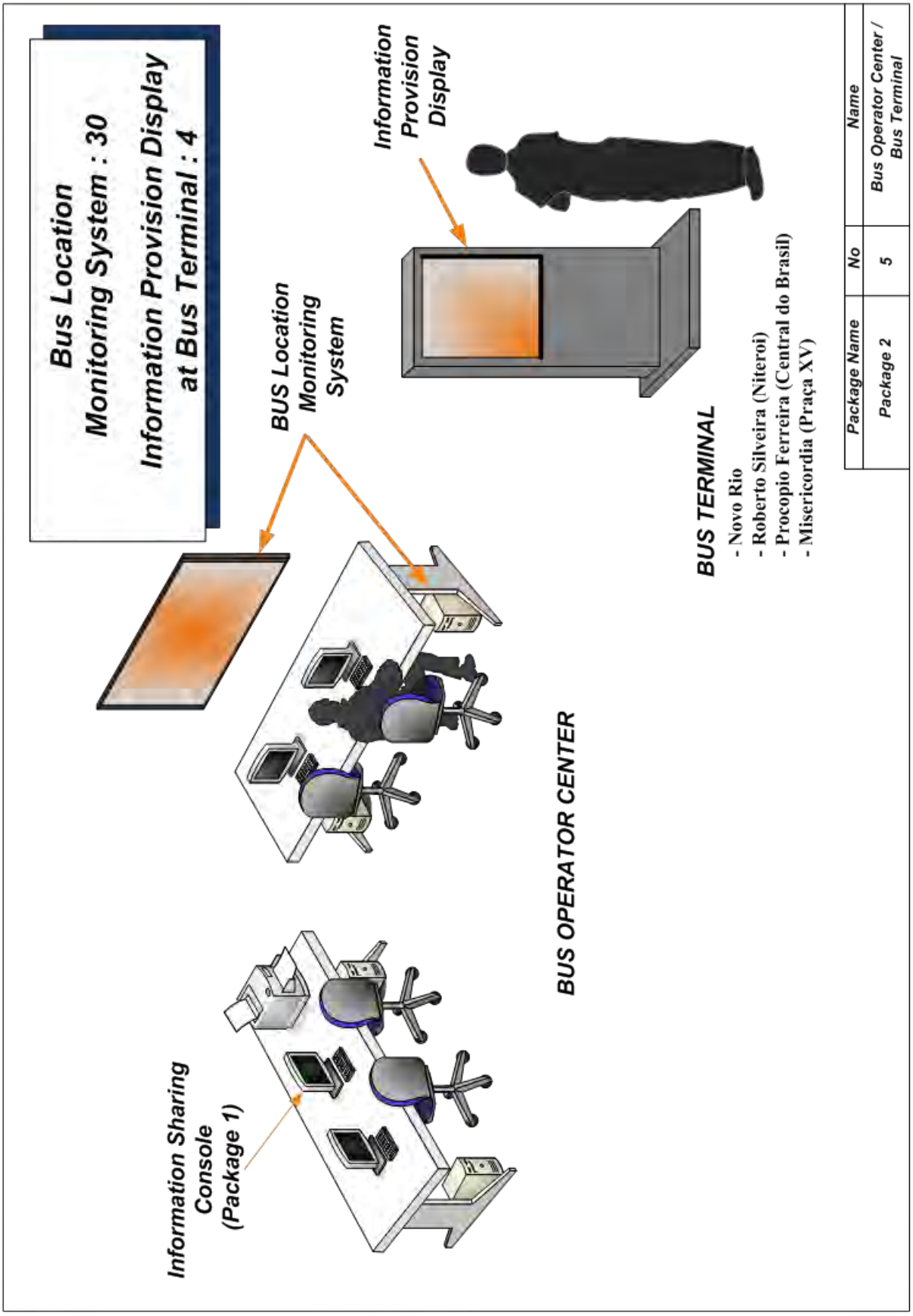
Source: JICA Study Team

Figure 9-32 Schematic Diagram of Preliminary Design for ITS Project (4/11)



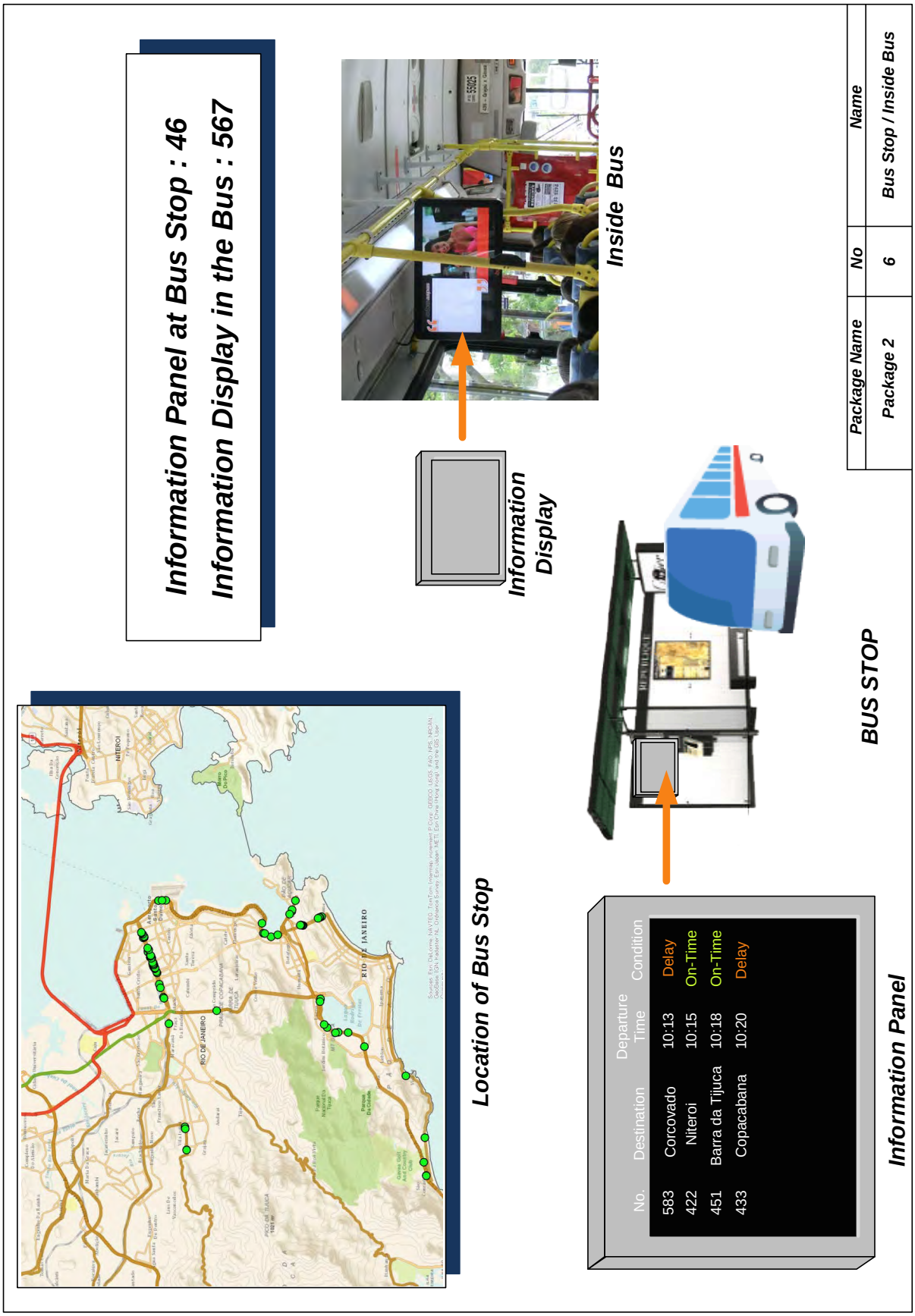
Source: JICA Study Team

Figure 9-33 Schematic Diagram of Preliminary Design for ITS Project (5/11)



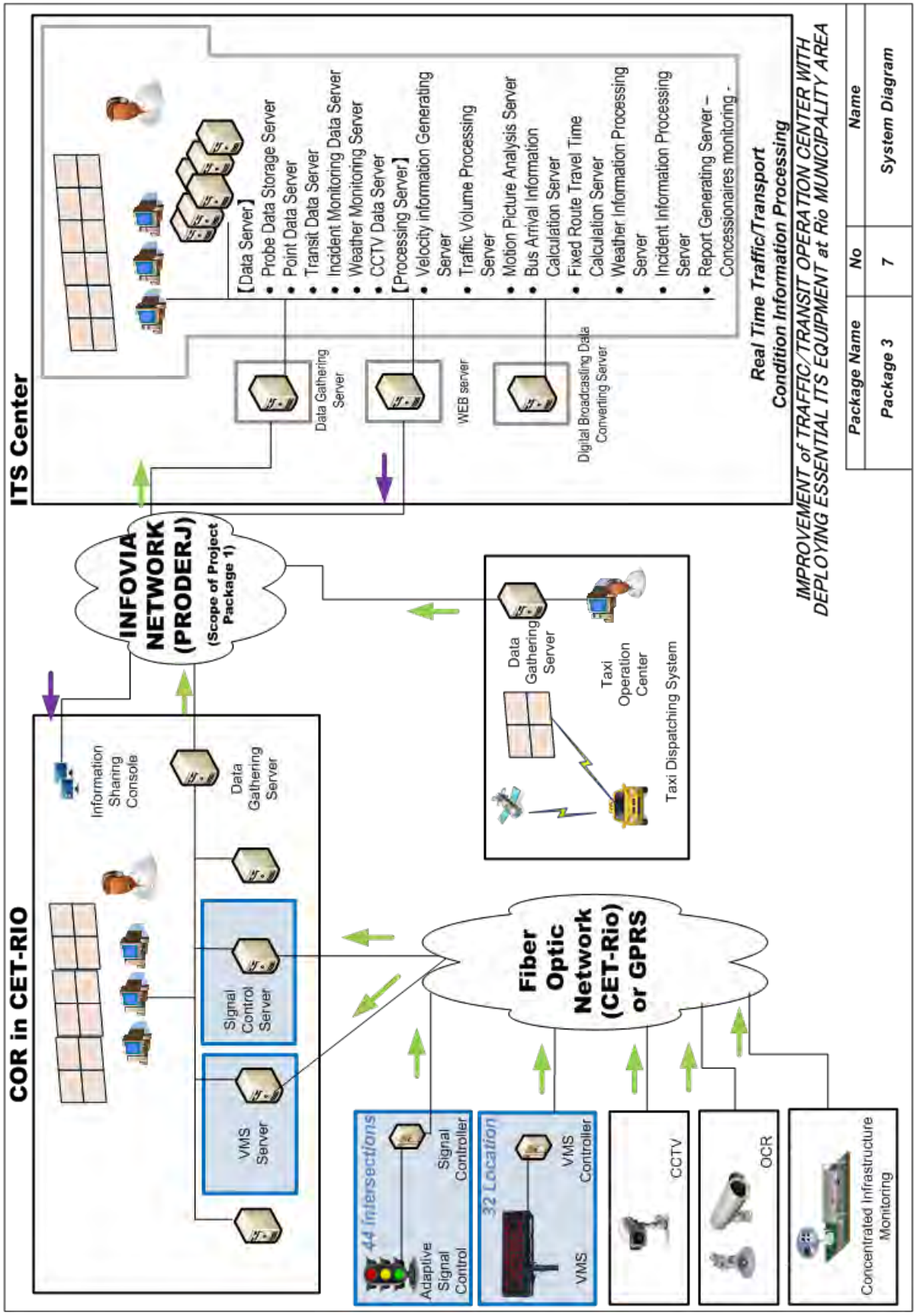
Source: JICA Study Team

Figure 9-34 Schematic Diagram of Preliminary Design for ITS Project (6/11)



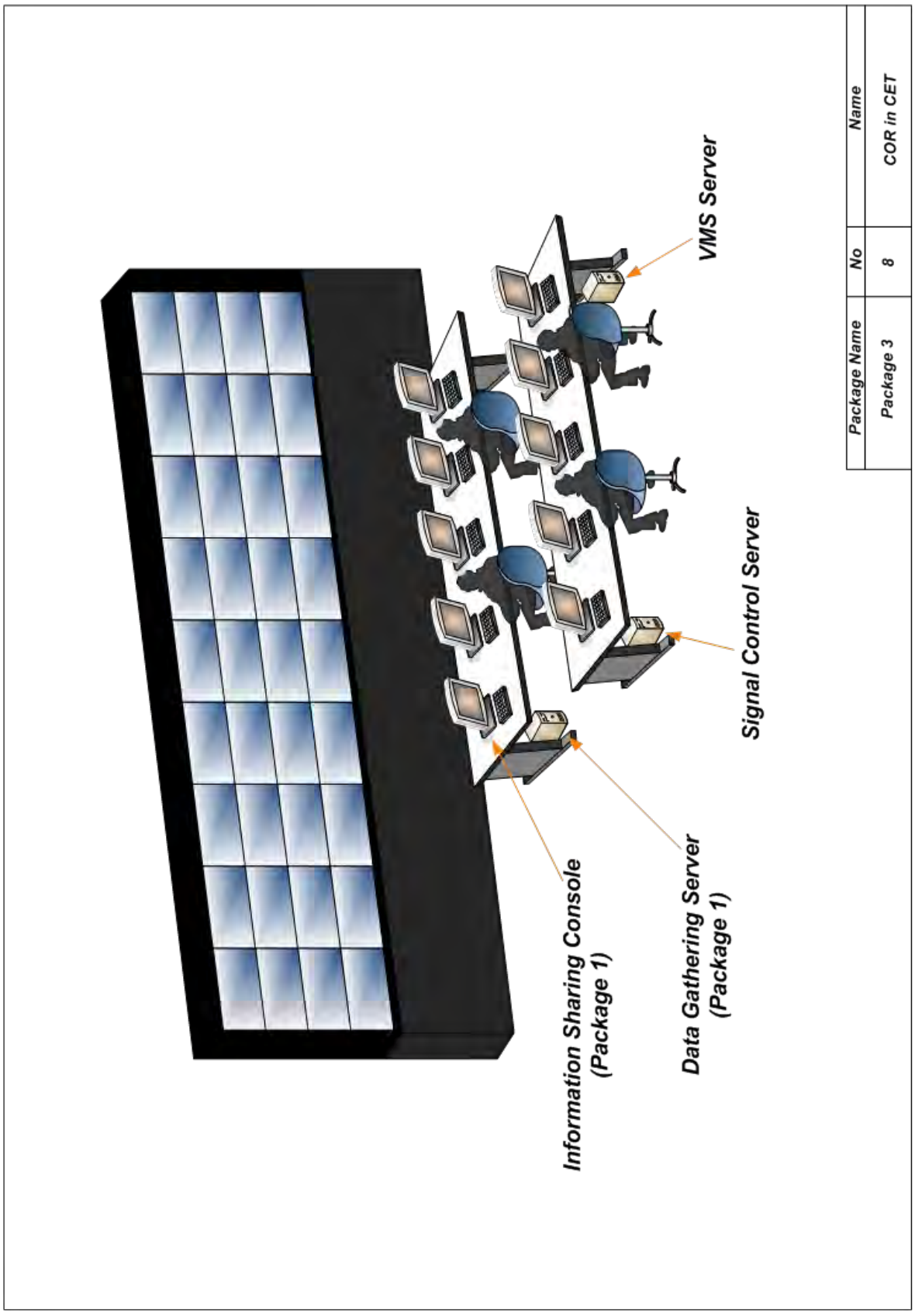
Source: JICA Study Team

Figure 9-35 Schematic Diagram of Preliminary Design for ITS Project (7/11)



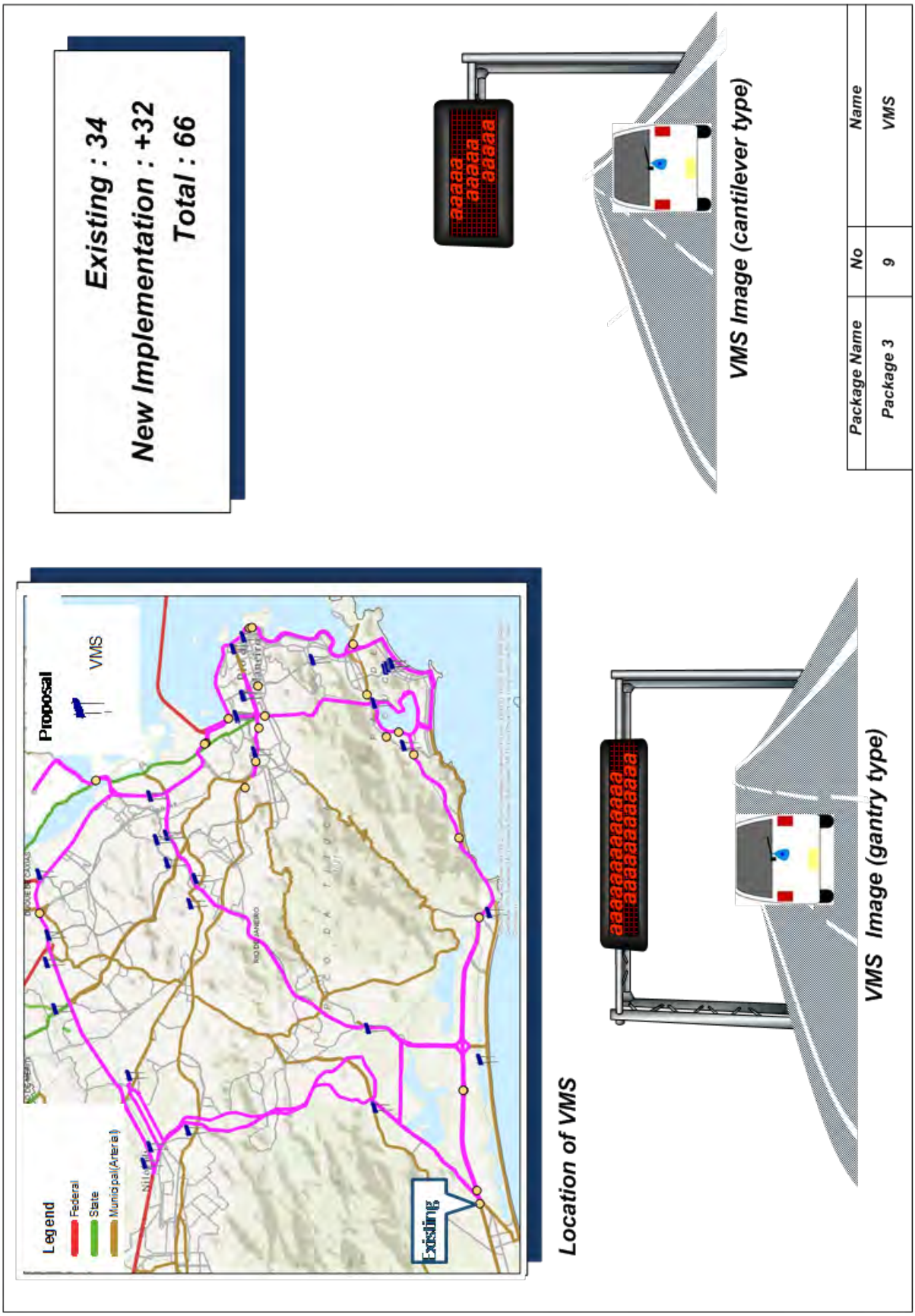
Source: JICA Study Team

Figure 9-36 Schematic Diagram of Preliminary Design for ITS Project (8/11)



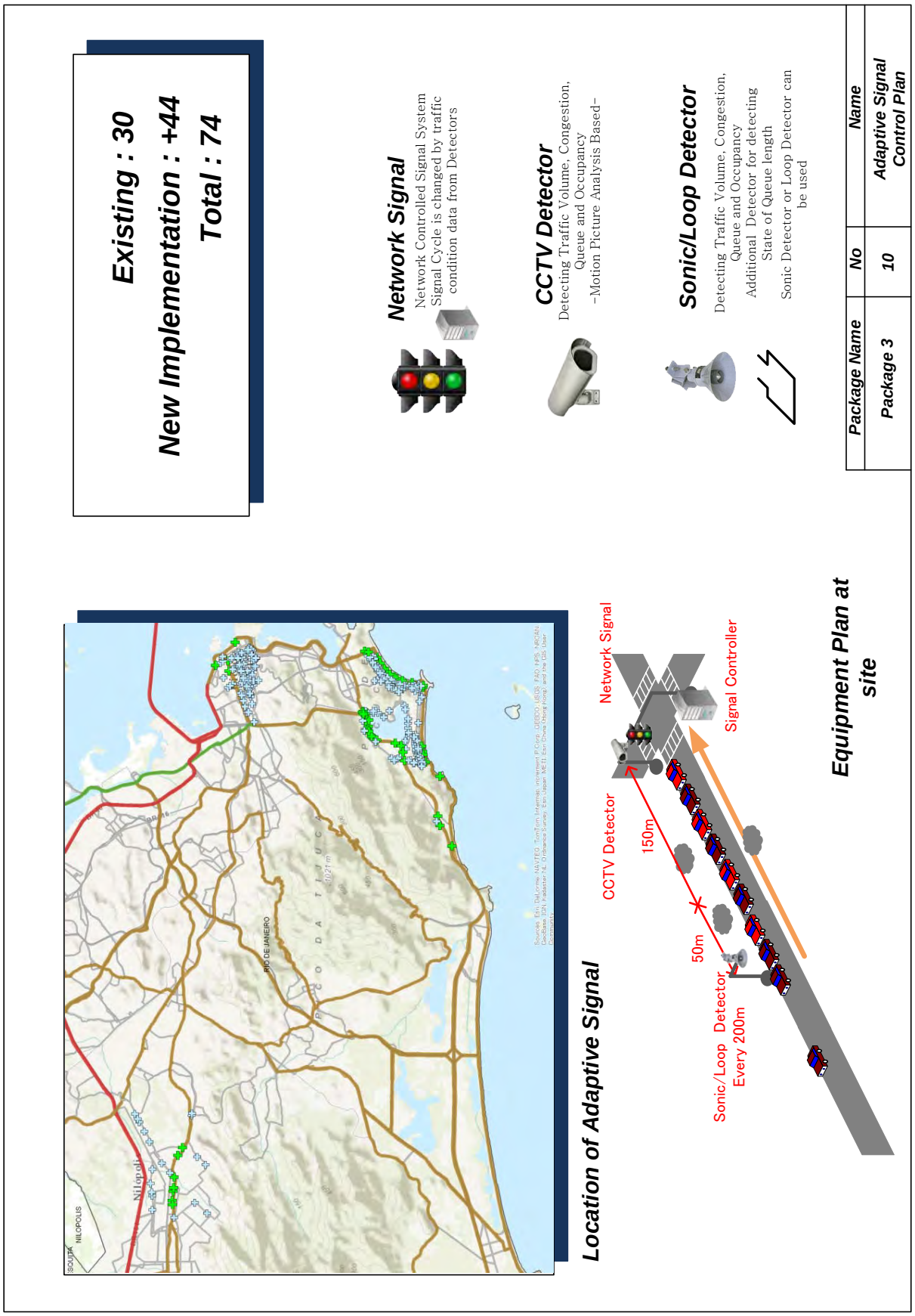
Source: JICA Study Team

Figure 9-37 Schematic Diagram of Preliminary Design for ITS Project (9/11)



Source: JICA Study Team

Figure 9-38 Schematic Diagram of Preliminary Design for ITS Project (10/11)



Source: JICA Study Team

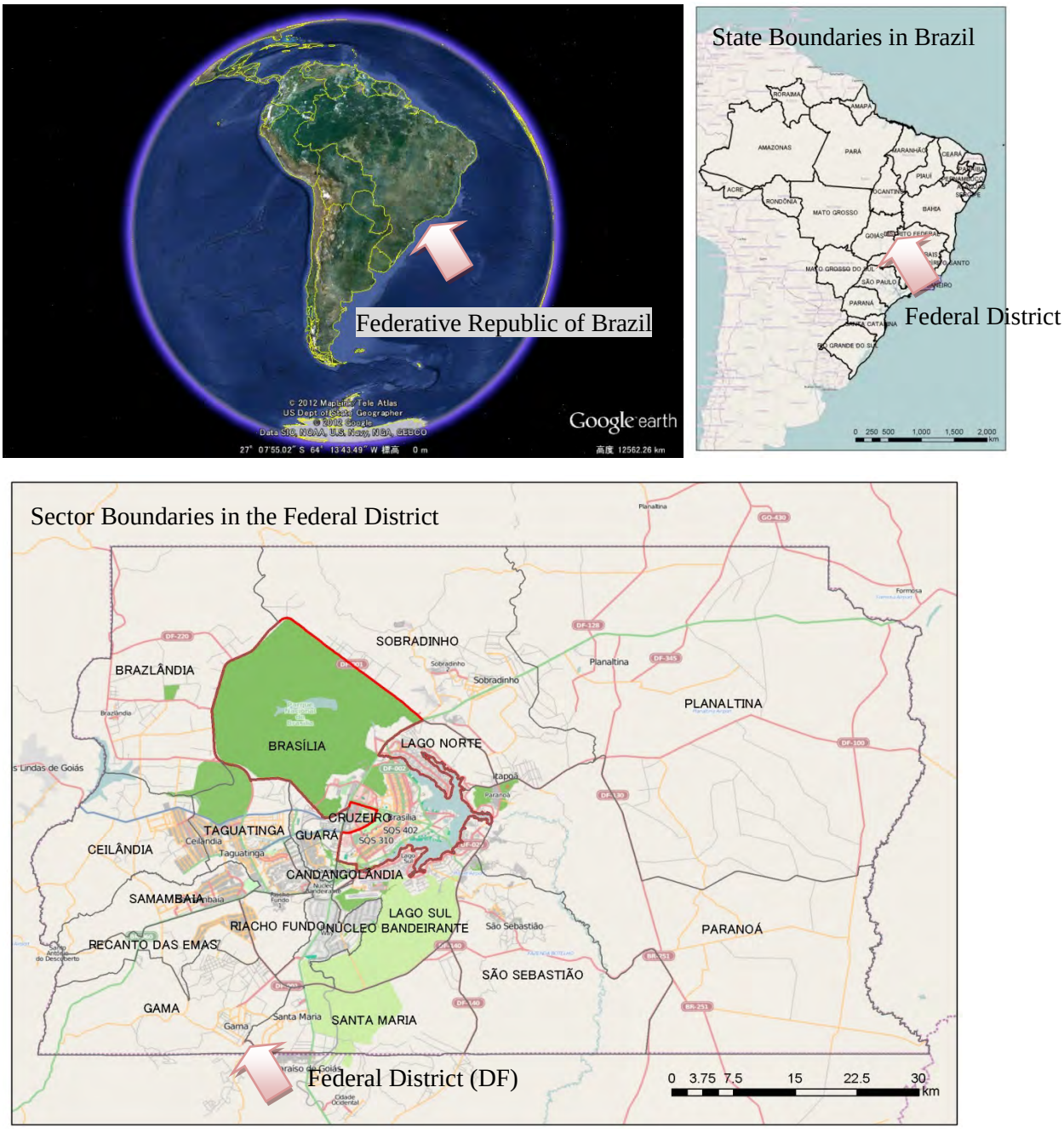
Figure 9-39 Schematic Diagram of Preliminary Design for ITS Project (11/11)

CHAPTER 10 CLARIFICATION OF CURRENT ITS CONDITION IN THE FEDERAL DISTRICT

10.1 REGIONAL CHARACTERISTICS OF THE FEDERAL DISTRICT

10.1.1 Administration

The Federal District (*Distrito Federal*: DF) is located in the central area of Brazil, as shown in the map in Figure 10-1.



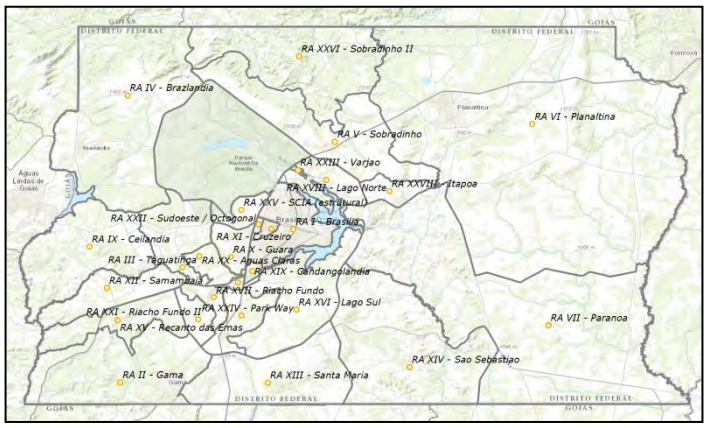
Source: Google Earth, Open Street Map

Figure 10-1 Location of DF

The DF is divided into 31 administrative regions (Regiões Administrativas: RAs) as shown in Table 10-1. These RAs function as typical cities but they do not have mayors or municipal assemblies. Instead, DF RAs are managed by regional administrators and secretaries. Brasília is the main RA with the vast majority of jobs concentrated on it. Brasília also hosts the federal agencies, the Senate, Congress, and ministries.

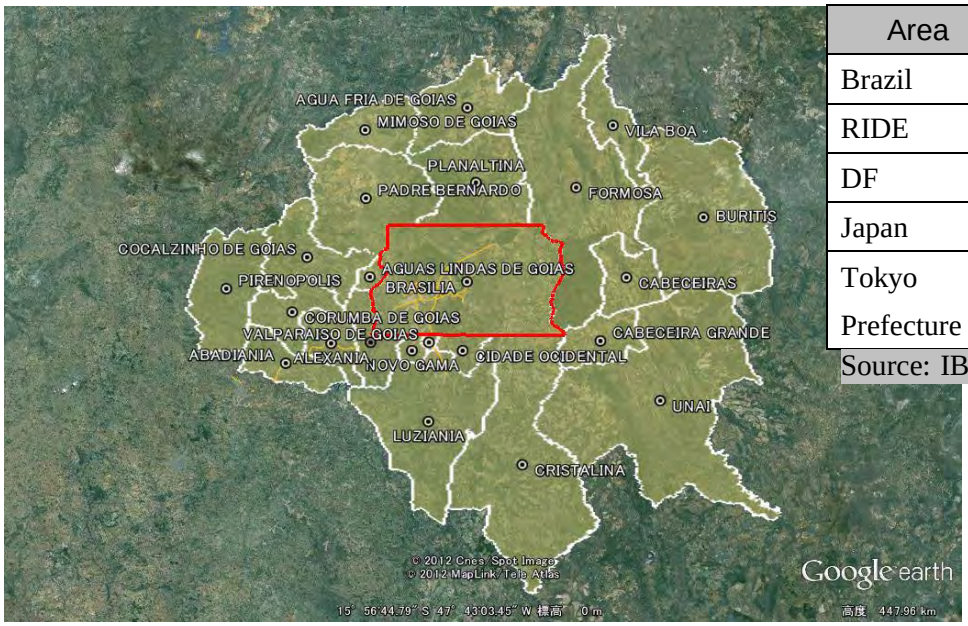
Table 10-1 Administrative Division in DF

Regiões Administrativas (RAs)	Área (km²)
Distrito Federal (DF)	5,789.16
RA I – Brasília	450.20
RA II – Gama	276.34
RA III – Taguatinga	105.00
RA IV – Brazlândia	474.83
RA V – Sobradinho	287.60
RA VI – Planaltina	1,534.69
RA VII – Paranoá	853.33
RA VIII – Núcleo Bandeirante	5.00
RA IX – Ceilândia	230.33
RA X – Guará	37.50
RA XI – Cruzeiro	2.80
RA XII – Samambaia	102.60
RA XIII – Santa Maria	215.86
RA XIV – São Sebastião	383.71
RA XV – Recanto das Emas	101.22
RA XVI – Lago Sul	183.39
RA XVII – Riacho Fundo	25.50
RA XVIII – Lago Norte	64.60
RA XIX – Candangolândia	6.61
RA XX – Águas Claras	31.50
RA XXI – Riacho Fundo II	30.60
RA XXII – Sudoeste / Octogonal	6.20
RA XXIII – Varjão	1.50
RA XXIV – Parque Way	64.20
RA XXV – SCIA (Estrutural)	29.00
RA XXVI – Sobradinho II	285.00
Jardim Botânico	0.00
RA XXVIII - Itapoá	0.00
S I A	0.00
Vicente Pires	0.00



Source: CODEPLAN Companhia de Planejamento do Distrito Federal – 2010

The administrative division of Brazil consists of 26 states and one DF. Similarly, metropolitan regions, which are not political organizations, are defined by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística: IBGE). The RIDE of DF and surrounding areas consist of the DF and 21 municipalities as shown in Figure 10-2 (See Table 2-1 of Chapter 2).



Area	[sq km]
Brazil	8,514,861
RIDE	55,435
DF	5,802
Japan	377,950
Tokyo Prefecture	2,103

Source: IBGE, The Statistics

Source: Google earth

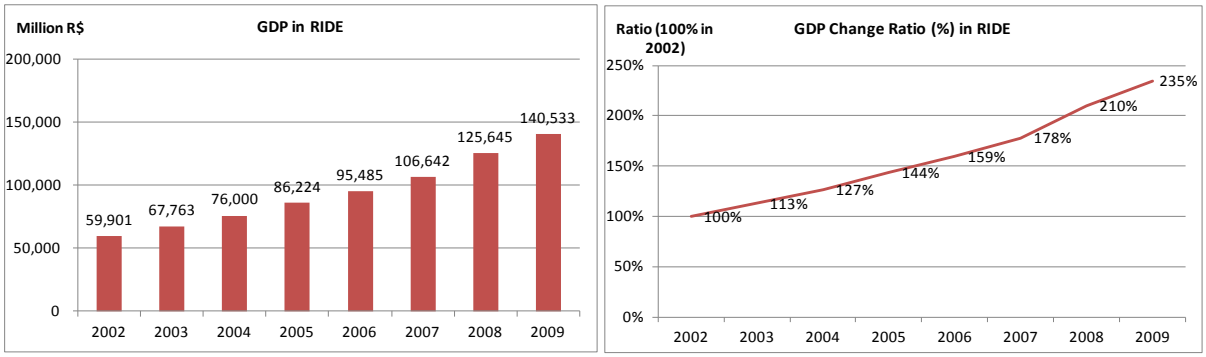
Figure 10-2 Administrative Boundaries of RIDE from DF and Surrounding Areas

10.1.2 Economy of DF

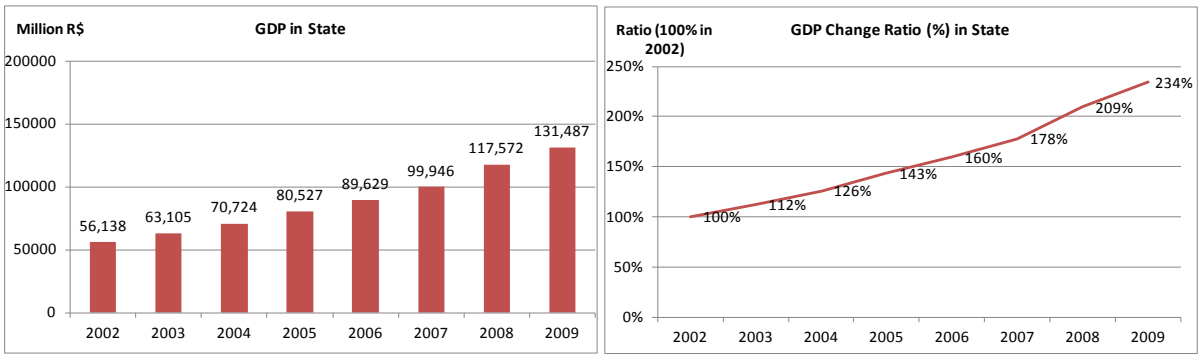
(1) GDP Trend in DF

The GDP (current prices) in the DF has also been increasing for the past eight years. The GDP in 2009 was about 2.3 times higher than in 2002, as shown in Figure 10-3.

[RIDE]



[DF]



Source: IBGE

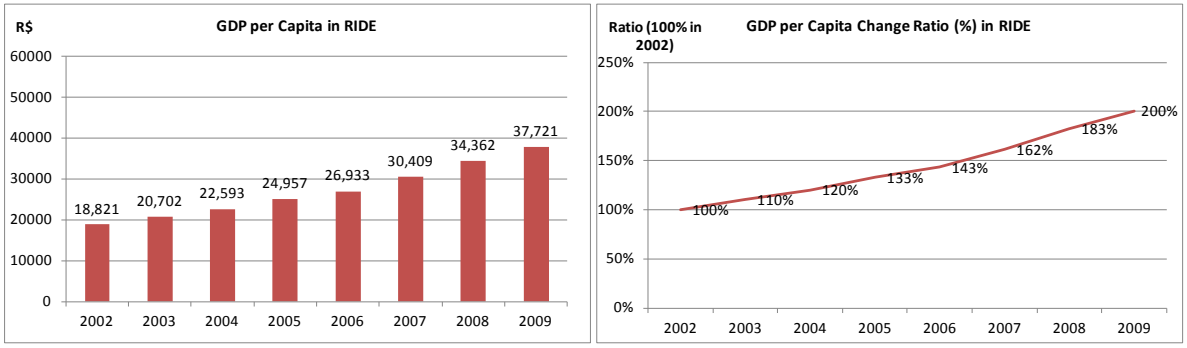
Figure 10-3 GDP (Current Prices) Trend in the DF

(2) GDP per Capita in DF

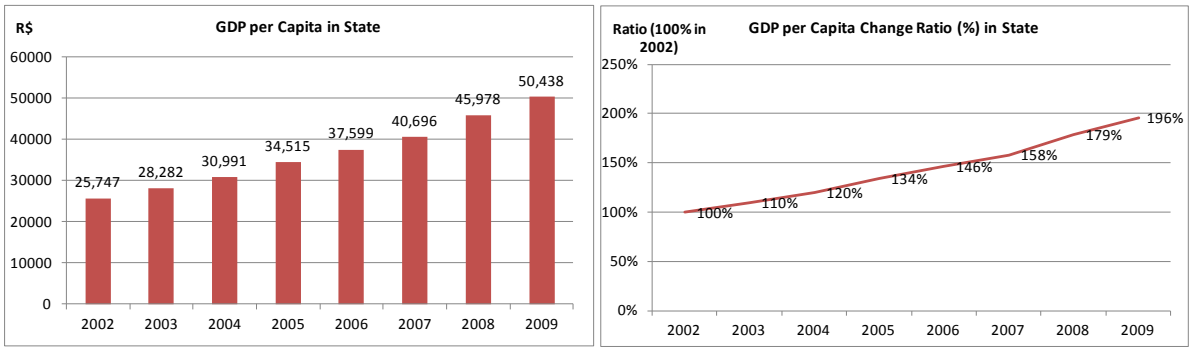
1) Trend in the DF

The GDP (current prices) per capita in the DF has also been increasing for the past eight years. GDP per capita in 2009 was almost double of that in 2002 as shown in Figure 10-4.

[RIDE]



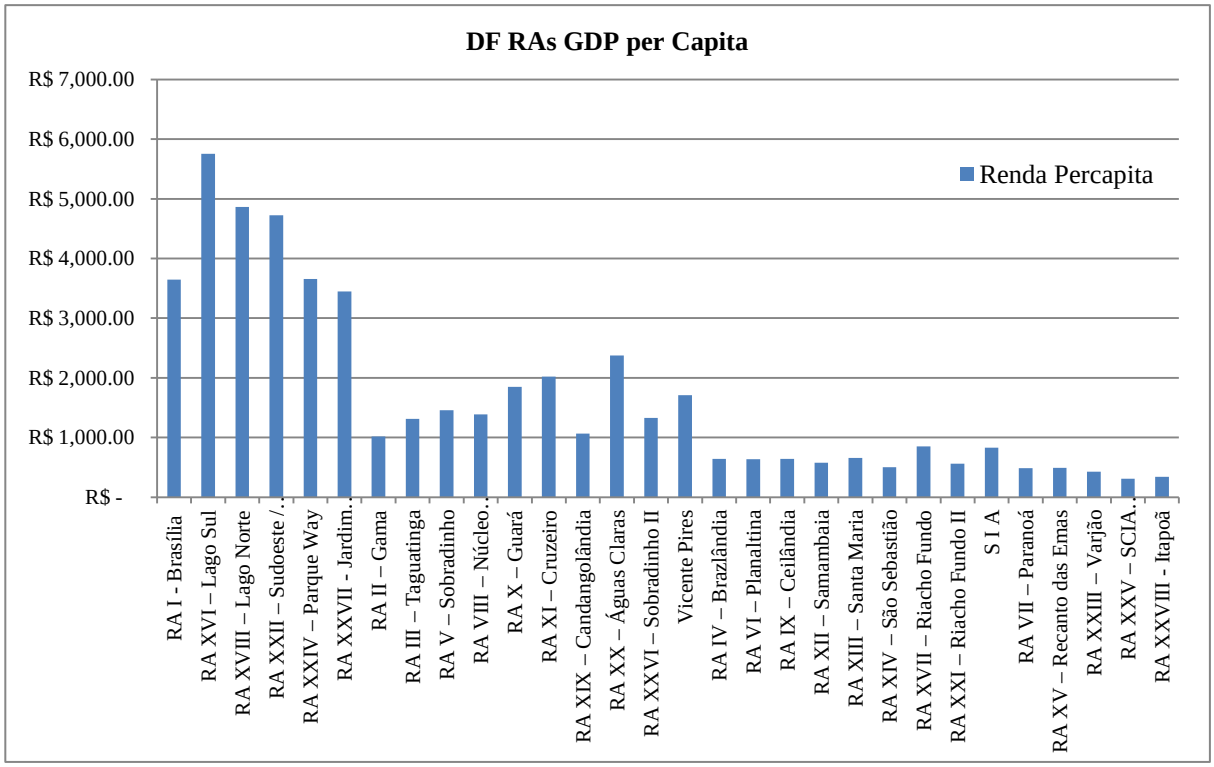
[DF]



Source: IBGE

Figure 10-4 Trend of GDP (Current Prices) per Capita in the DF

The DF RAs GDP per capita is shown in Figure 10-5. It can be noted that Brasília and immediate satellite cities (Lago Norte, Lago Sul, Sudoeste Octogonal, and Parque Way) are the richest areas. This reflects the job concentration in the region.

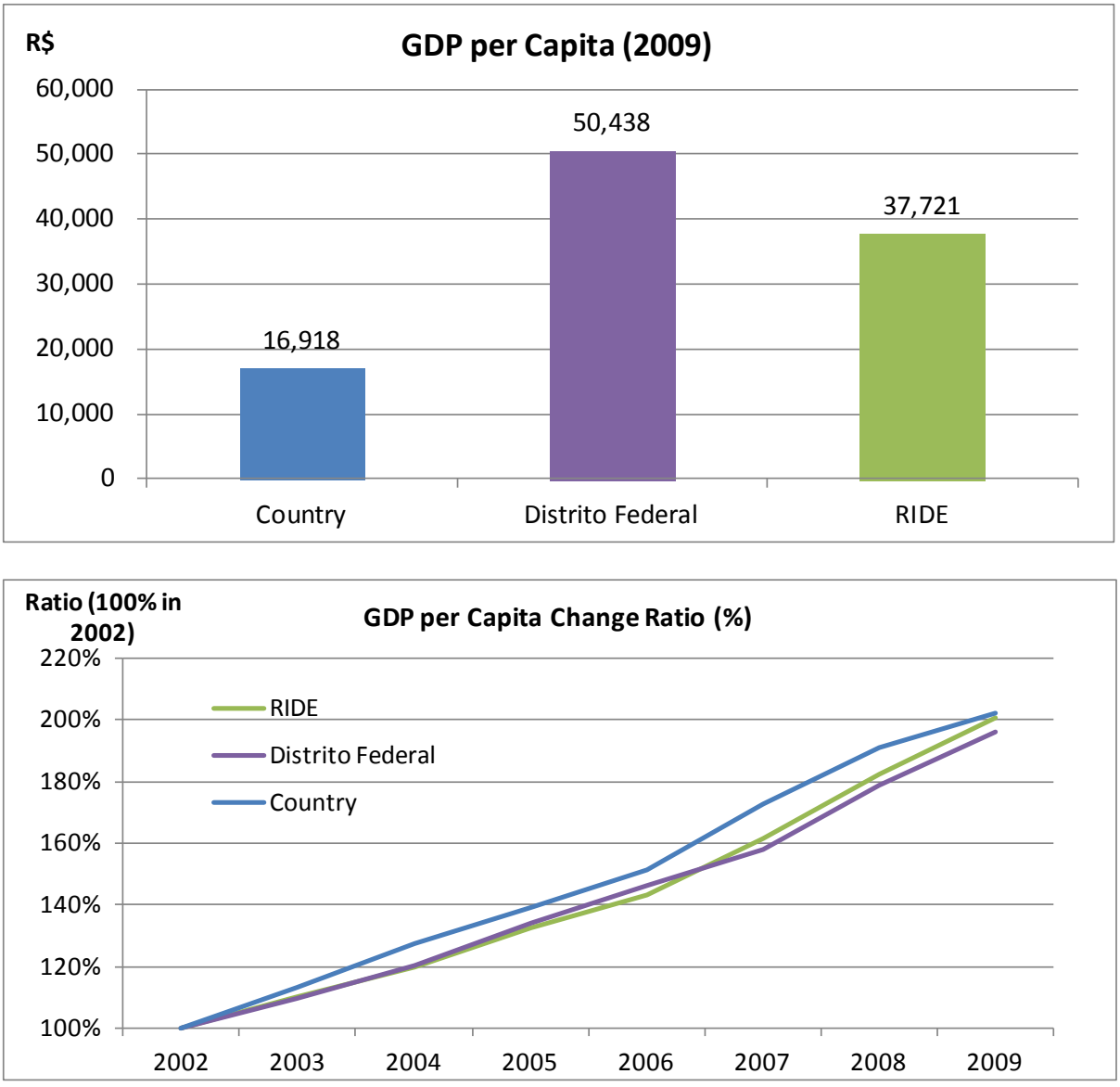


Source: CODEPLAN Survey

Figure 10-5 2011 GDP per Capita in 2011 of the DF RAs

2) Comparison of GDP Data in Brazil

As shown in Figure 10-6, the DF GDP (current prices) per capita is the largest when compared among the country and RIDE's GDP per capita. In terms of trends, RIDE's GDP per capita has grown faster than the DF and the country. Thus, this data shows that the DF and surrounding areas have a large potential for growth and are expanding economically.



Source: IBGE

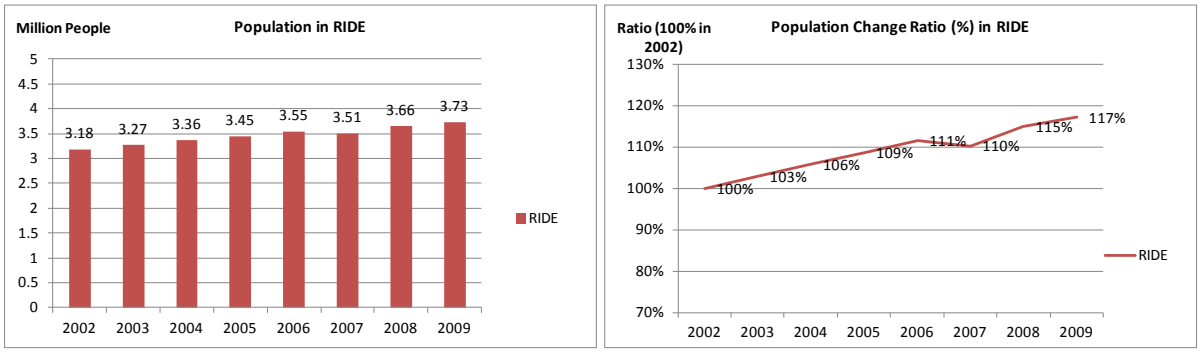
Figure 10-6 Trend of GDP (Current Prices) per Capita in the DF

10.1.3 Population in DF

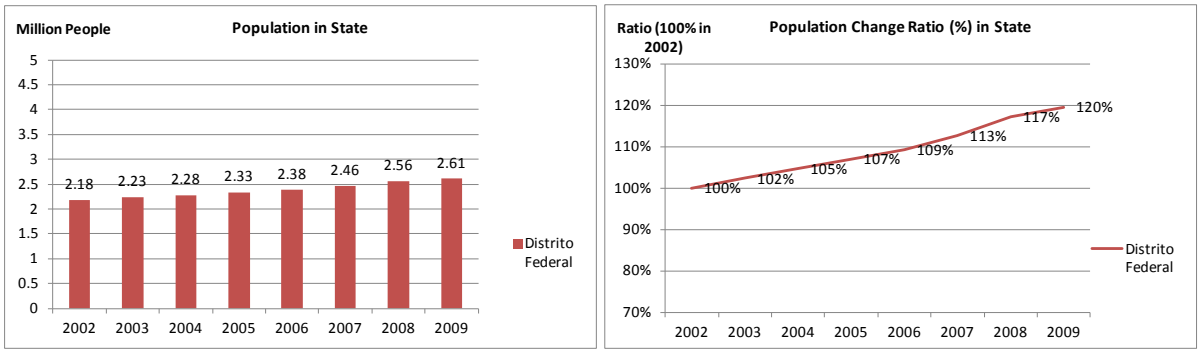
(1) Trend

The population increase ratio in the RIDE and DF is higher than that of Brazil. The population not only in DF but also in RIDE has been increasing in recent years. Figure 10-7 illustrates the population growth since 2002 in RIDE and DF.

[RIDE]



[DF]

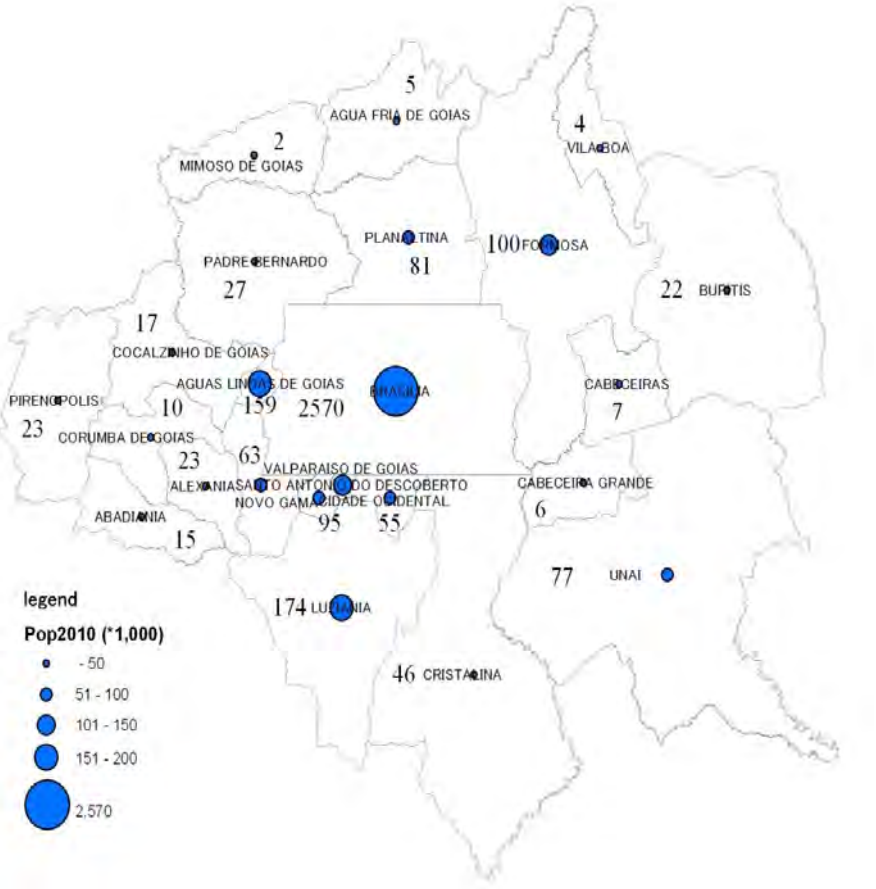


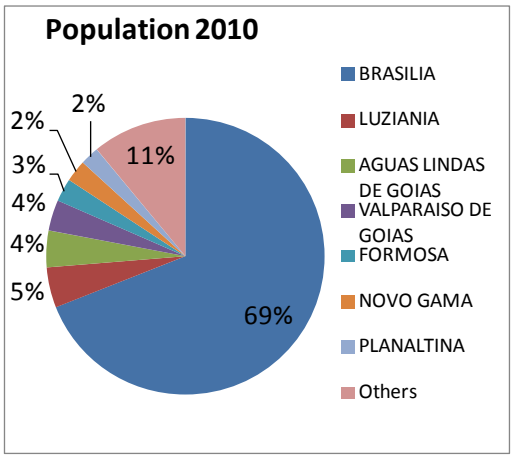
Source: IBGE

Figure 10-7 Population Trend in DF

(2) Distribution

The DF is the 20th largest state in terms of population in Brazil. The population growth ratio between 2001 and 2011 of DF is in the range from 1.19 to 1.25, which is relatively high in Brazil. Figure 10-8 shows the growth around the main regions in Brazil. The population in RIDE is concentrated in the DF (Brasilia and satellite cities) and some surrounding cities such as Luziania and Aguas Lindas de Goias. In RIDE, the population share of the DF (Brasilia and satellite cities) is about 70% as shown in Figure 10-16.



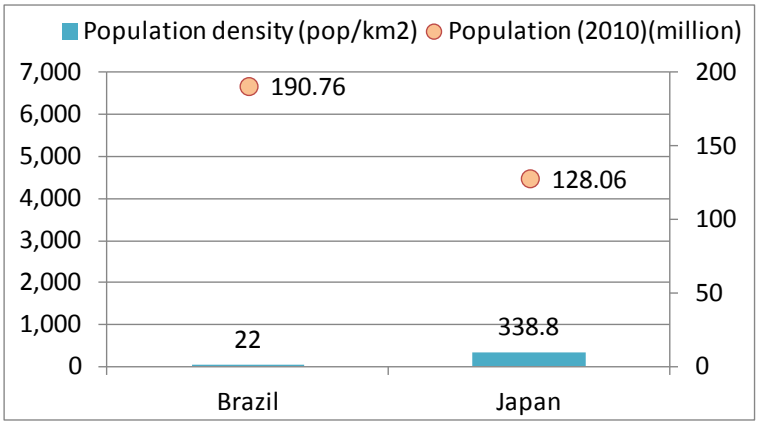


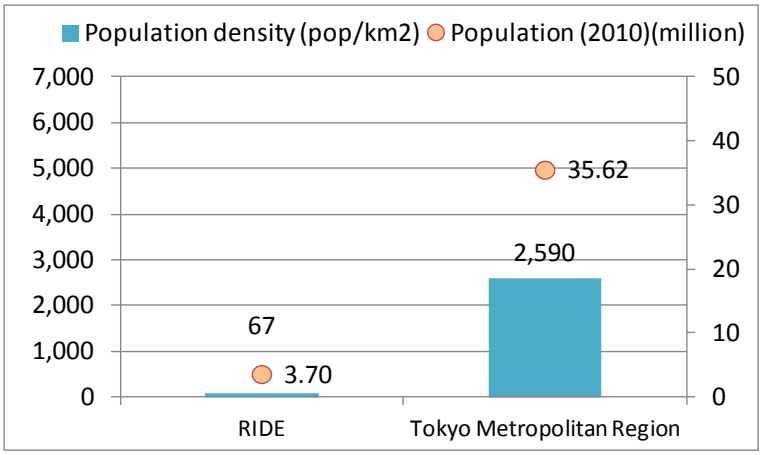
Source: IBGE, Figure made by the JICA Study Team

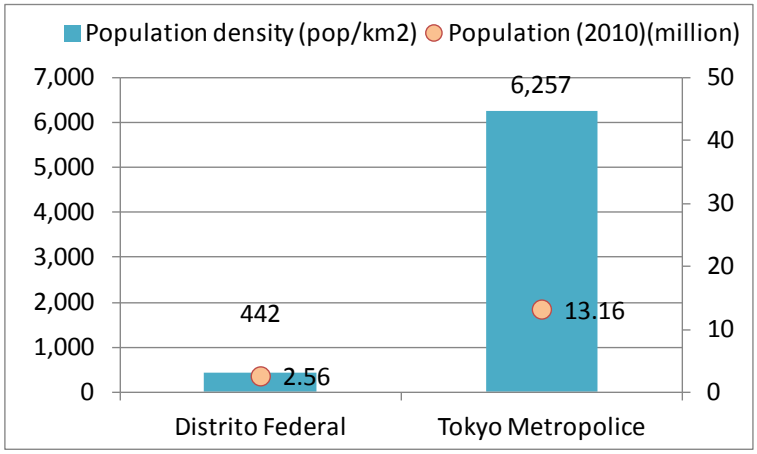
Figure 10-8 Population Distribution of Cities in RIDE

(3) Population Density

The population density was compared between Brazil and Japan and between RIDE/DF and Kanto/Tokyo. For each scale, the population density in Japan is much higher than in Brazil. As the DF is a planned city, its population density seems to have been kept adequately low.







Sources: IBGE and the Statistics Bureau of Japan

Figure 10-9 Population Density of Brazil and Japan

Table 10-2 shows the detailed population and density information for each DF RA. It can be noted that Ceilândia is the most populated city, with around 16% of DF's population. On the other hand, Brasília only holds 8.2% percent of DF's population.

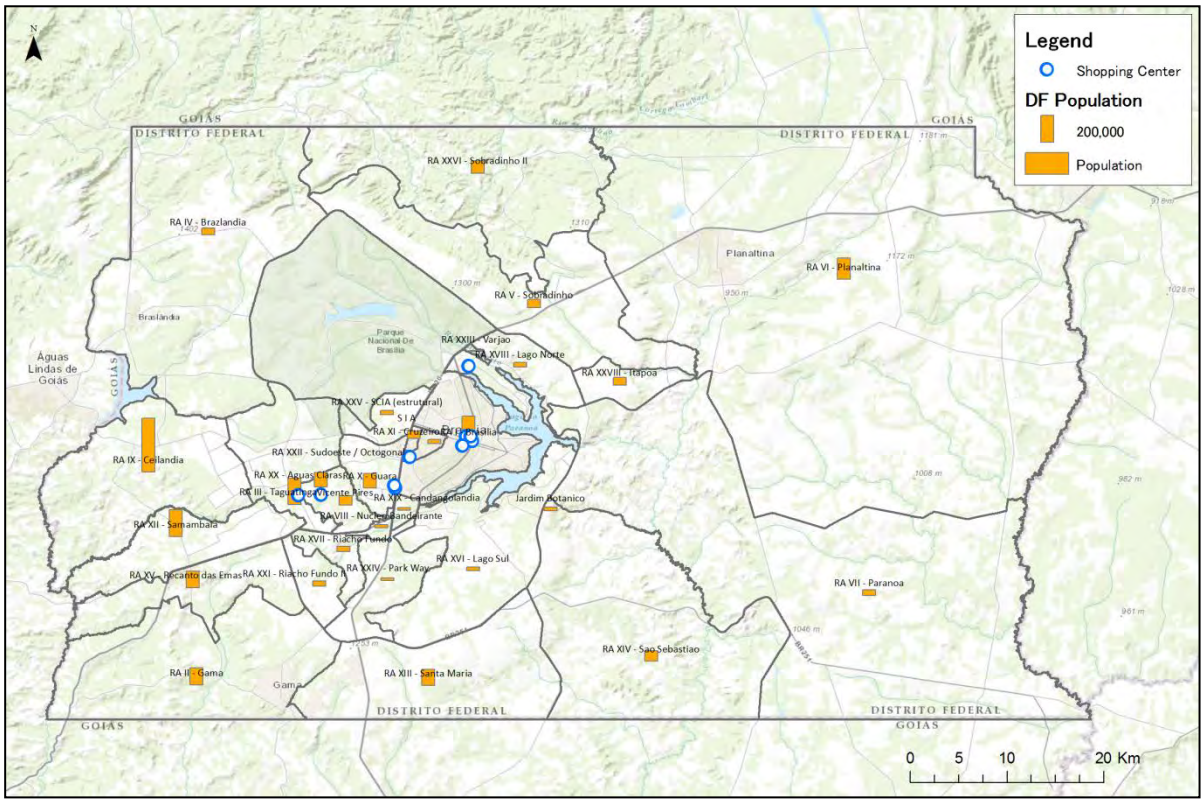
Table 10-2 DF RAs Demographic Information

Administrative Regions	Population 2011	% Pop. 2011	Area (km²)	Density (pop/km²)
Distrito Federal	**2,556,149**	**100.0%**	**5,789.16**	**441.54**
RA I – Brasília	209,926	8.2%	450.20	466.29
RA II – Gama	127,475	5.0%	276.34	461.30
RA III – Taguatinga	197,783	7.7%	105.00	1,883.65
RA IV – Brazlândia	49,418	1.9%	474.83	104.08
RA V – Sobradinho	59,024	2.3%	287.60	205.23
RA VI – Planaltina	161,812	6.3%	1,534.69	105.44
RA VII – Paranoá	42,427	1.7%	853.33	49.72
RA VIII – Núcleo Bandeirante	22,569	0.9%	5.00	4,513.80
RA IX – Ceilândia	404,287	15.8%	230.33	1,755.25
RA X – Guará	107,817	4.2%	37.50	2,875.12
RA XI – Cruzeiro	31,230	1.2%	2.80	11,153.57
RA XII – Samambaia	201,871	7.9%	102.60	1,967.55
RA XIII – Santa Maria	119,444	4.7%	215.86	553.34
RA XIV – São Sebastião	77,793	3.0%	383.71	202.74
RA XV – Recanto das Emas	124,755	4.9%	101.22	1,232.51
RA XVI – Lago Sul	29,677	1.2%	183.39	161.82
RA XVII – Riacho Fundo	35,268	1.4%	25.50	1,383.06
RA XVIII – Lago Norte	33,526	1.3%	64.60	518.98
RA XIX – Candangolândia	15,953	0.6%	6.61	2,413.46
RA XX – Águas Claras	109,935	4.3%	31.50	3,490.00
RA XXI – Riacho Fundo II	37,051	1.4%	30.60	1,210.82
RA XXII – Sudoeste/Octogonal	51,565	2.0%	6.20	8,316.94
RA XXIII – Varjão	9,021	0.4%	1.50	6,014.00
RA XXIV – Parque Way	19,648	0.8%	64.20	306.04
RA XXV – SCIA (estrutural)	32,148	1.3%	29.00	1,108.55
RA XXVI – Sobradinho II	94,279	3.7%	285.00	330.80
Jardim Botânico	23,856	0.9%	0.00	-
RA XXVIII - Itapoá	56,360	2.2%	0.00	-
S I A[1]	2,448	0.1%	0.00	-
Vicente Pires	67,783	2.7%	0.00	-

Source: CODEPLAN

(4) Urban Sprawl and Shopping Center Location

The population distribution in each RA is illustrated in Figure 10-10. The location of the main shopping centers around DF is also shown. It can be noted that the population in DF is mainly distributed in the northeast, western, and southwest regions. Such distribution profile indicates an urban sprawl, although most jobs are located in Brasilia. In addition, majority of the shopping centers are located around Brasília, which is a concern during peak periods. Interviews with stakeholders indicated that such developments generated bottlenecks and queuing back up.



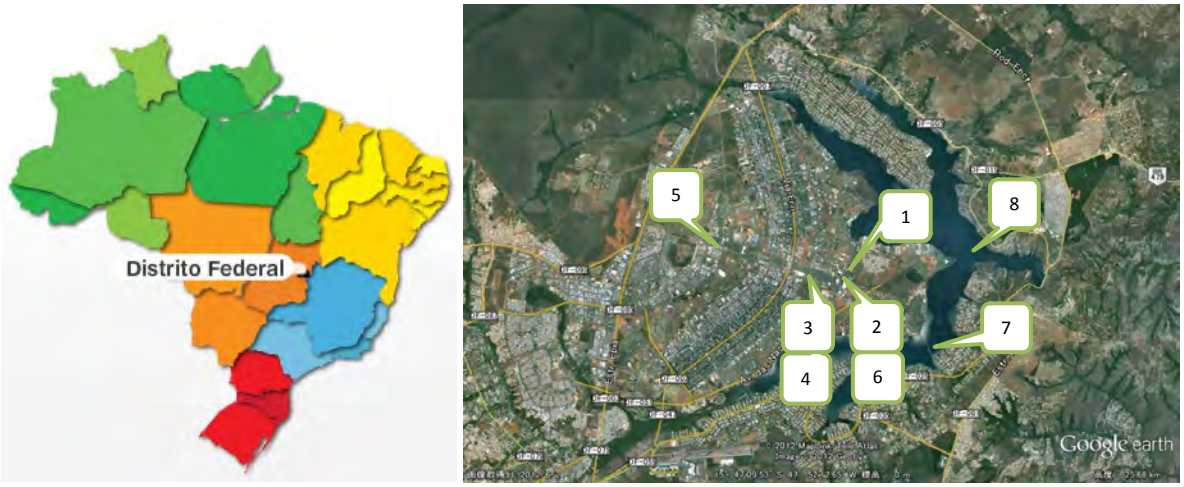
Source: JICA Study Team

Figure 10-10 Population and Main Shopping Centers of DF

10.1.4 Sightseeing Resources and Statistics

(1) Sightseeing Resources Location

On the website of the Ministério do Turismo, it is possible to search the main tourist destinations. The sightseeing resources locations in the DF shown on the website are as follows:



No	Type	Destination	Photo
1	Architecture	Palácio do Planalto	
2	Architecture	Congress	
3	Architecture	Cathedral of Brasilia	
4	Architecture	National Museum	
5	Architecture	JK Memorial	
6	Architecture	Praça dos Três Poderes	
7	Infrastructure	Juscelino Kubitschek Bridge	
8	Nature	Lake Paranoá	

Source: Ministério do Turismo

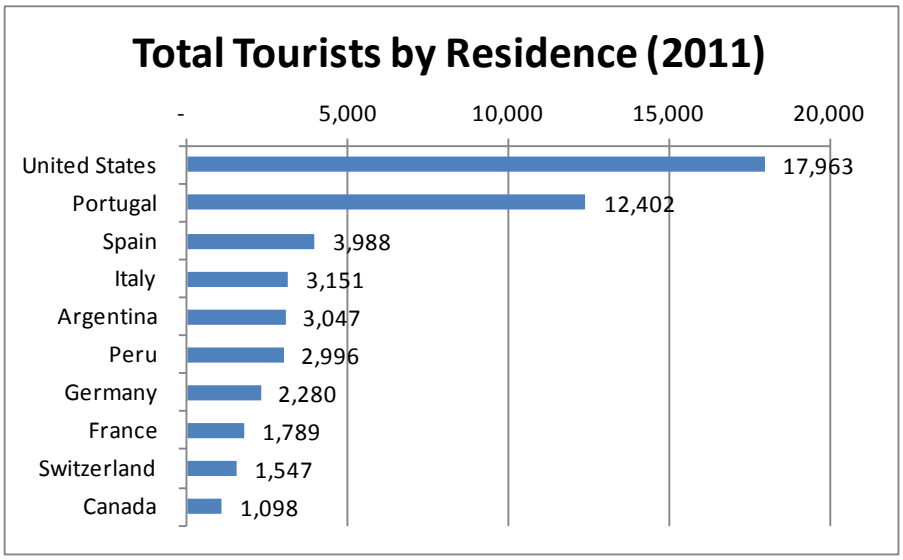
Figure 10-11 Main Sightseeing Locations in the DF

(2) Inbound Tourists to DF

The number of inbound international tourists to the DF is small but the increase in ratio between 2010 and 2011 is the highest in Brazil.

1) Origin Countries of Tourists

The majority of international inbound tourists to the DF are from the United States and Portugal. In addition, it should be noted that Spain and Italy are the third and fourth largest tourist origins to the DF.

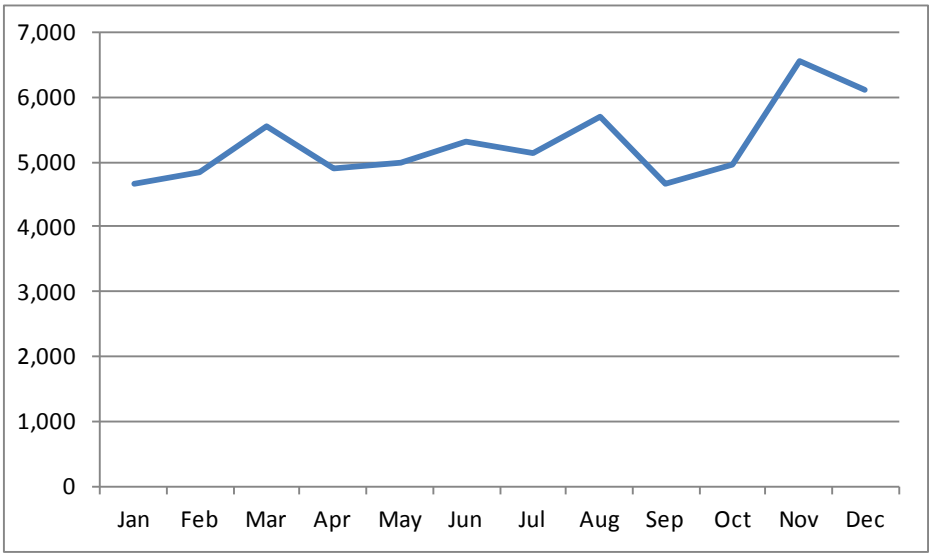


Source: Ministério do Turismo

Figure 10-12 Inbound Tourists to the DF by Country of Origin

2) Monthly Tourist Arrivals

The DF has the monthly peak of inbound tourists in November and December.

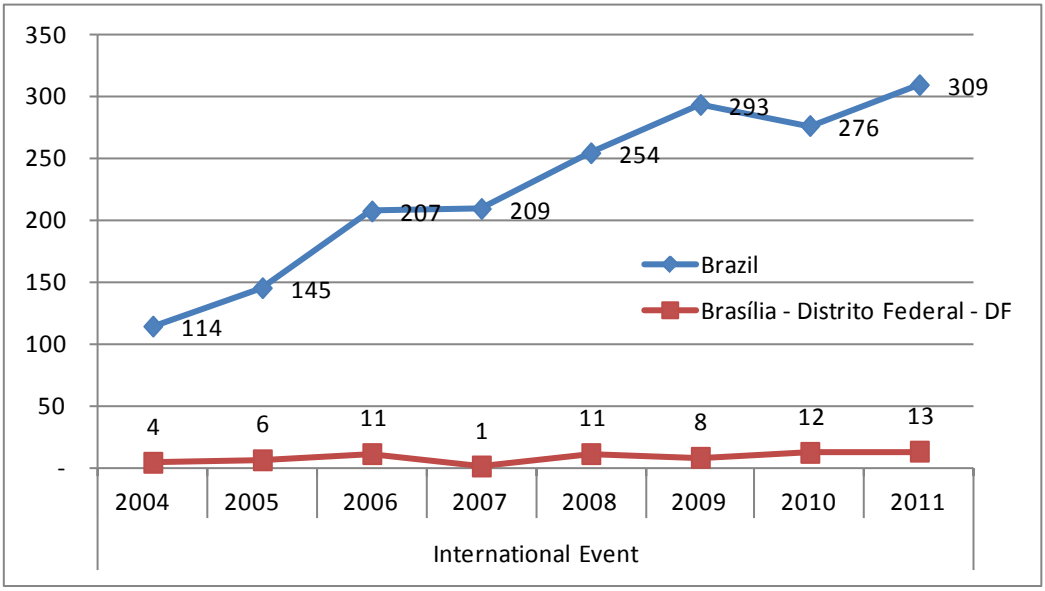


Source: Ministério do Turismo

Figure 10-13 Monthly Tourist Arrivals to the DF

(3) International Events

The number of international events in the DF is relatively small compared to other cities in Brazil.



Source: Ministério do Turismo

Figure 10-14 Characteristics of International Events in Brazil

(4) Important Large-scale Events

1) Venues for Large-scale Events

Brasilia has the "Parque de Exposições Granja do Torto," in which auditoriums, social clubs, stadiums, sports gymnasiums, hotel rooms and salons, business centers, rooms for festival, rooms for shows, and mansions for social events are located, which has a large demand for big events.

Source: Google Earth

Figure 10-15 Location of Parque de Exposições Granja do Torto

2) Upcoming Large-Scale Events

Four large-scale events are scheduled in the DF for the next two years as shown in Table 10-3.

Table 10-3 Upcoming Large-scale Events in the DF

No.	Event	Location	Date	No. of Visitors
1	FIFA Confederations Cup	Belo Horizonte, Brasília, Fortaleza, Recife, Rio de Janeiro, Salvador	15-30 June 2013	On average, more than 60,000 fans will watch each of the 16 matches
2	FIFA World Cup	Belo Horizonte, Brasília, Cuiabá, Curitiba, Fortaleza, Manaus, Natal, Porto Alegre, Recife, Rio de Janeiro, Salvador, São Paulo	12 June-13 July 2014	About 3.7 million tourists

Source: JICA Study Team

i) FIFA Confederations Cup (http://www.fifa.com/confederationscup/index.html)

This competition is held every four years. In recent years, it has been seen as a warm-up event in the host country of the next FIFA World Cup. Brazil will host the next FIFA Confederations Cup in June, 2013. Matches will be held in six different cities including Brasilia.

ii) FIFA World Cup (http://www.copa2014.gov.br/en)

The FIFA World Cup is one of the biggest sporting events held every four years. Brazil will host the next FIFA World Cup in 2014. Matches will be held in 13 cities including Brasilia.

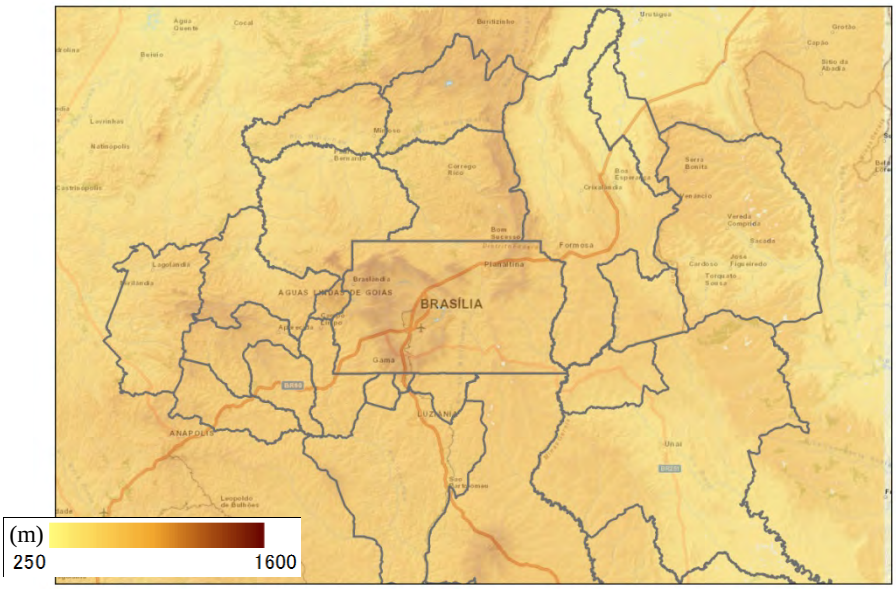
10.1.5 Geography and Natural Environment

(1) Geographic Conditions

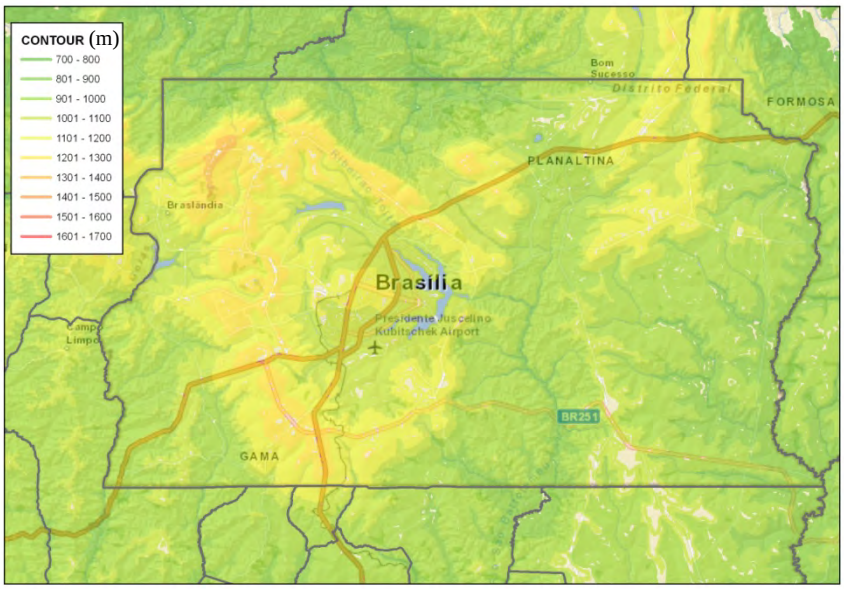
1) Contours

Using the meshed altitude data derived from the Space Shuttle Radar contour, altitude figures were developed as shown in Figure 10-16. The RIDE is located in the inland mountainous region. The figures also show that the DF, especially Brasilia, is located on a plateau (also known as planalto central). In the central area of the DF, water bodies such as lakes and hills are located close to populated areas.

[RIDE]



[DF]



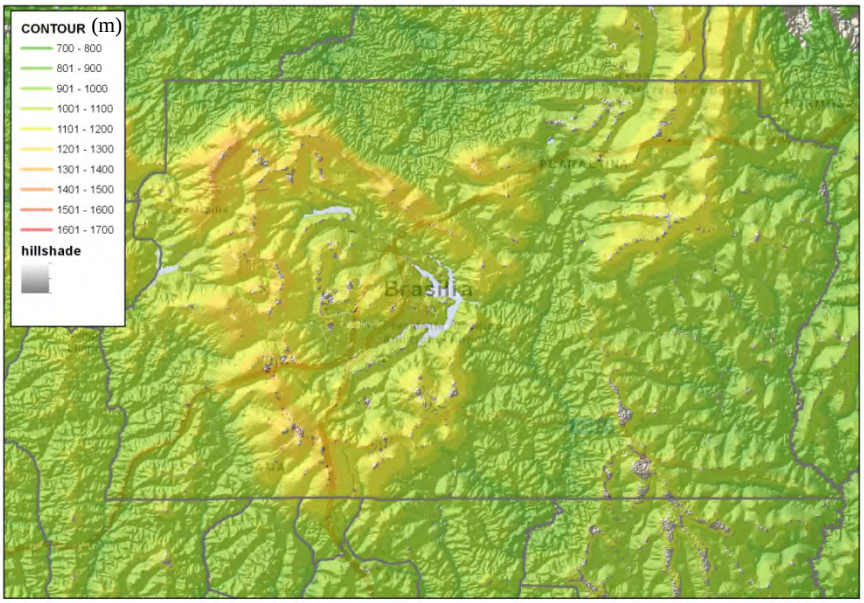
Source: Shuttle Radar Topography Mission (SRTM) (http://www2.jpl.nasa.gov/srtm/)

Figure 10-16 Contours in RIDE and DF

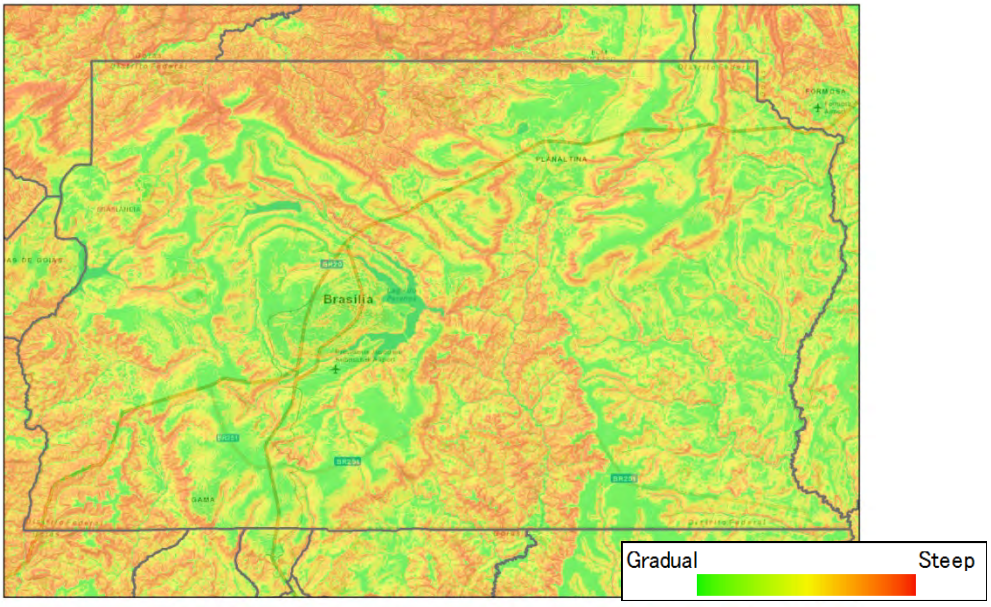
2) Topological Features in the DF

Through spatial analysis, topological features such as hill shade and slope angle were calculated. As shown in Figure 10-17, the DF is located on a plateau and surrounded by hills. In the case of torrential rain, this topological configuration could lead to potential flooding at nearby urban areas.

[Hills and Contour]



[Slope]



Source: Shuttle Radar Topography Mission (SRTM) (http://www2.jpl.nasa.gov/srtm/)

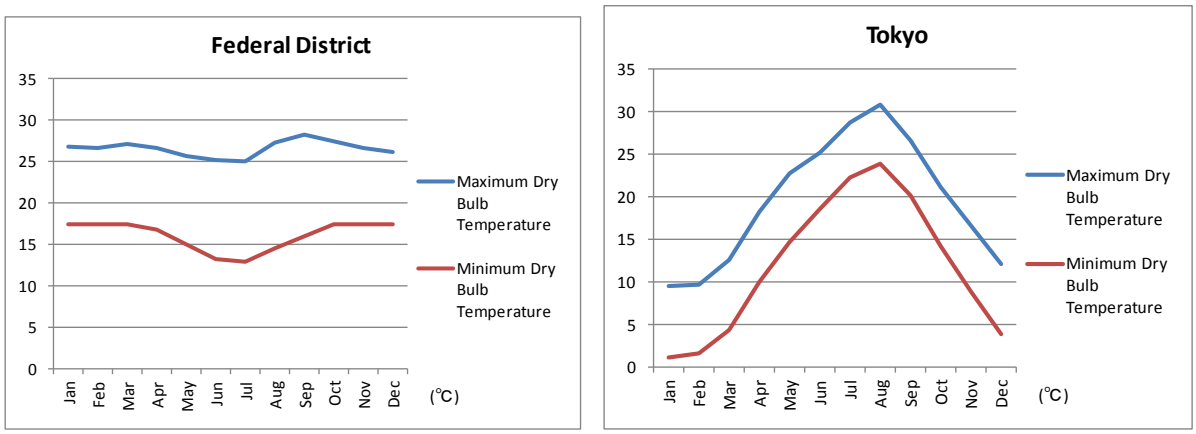
Figure 10-17 Topographic Characteristics of the DF

(2) Weather Conditions

The DF has mainly two seasons during the year: the rainy season and the dry season.

The rainy season occurs from October to April while the dry season occurs from May to September. During the rainy season, precipitation in the DF is higher than in Tokyo.

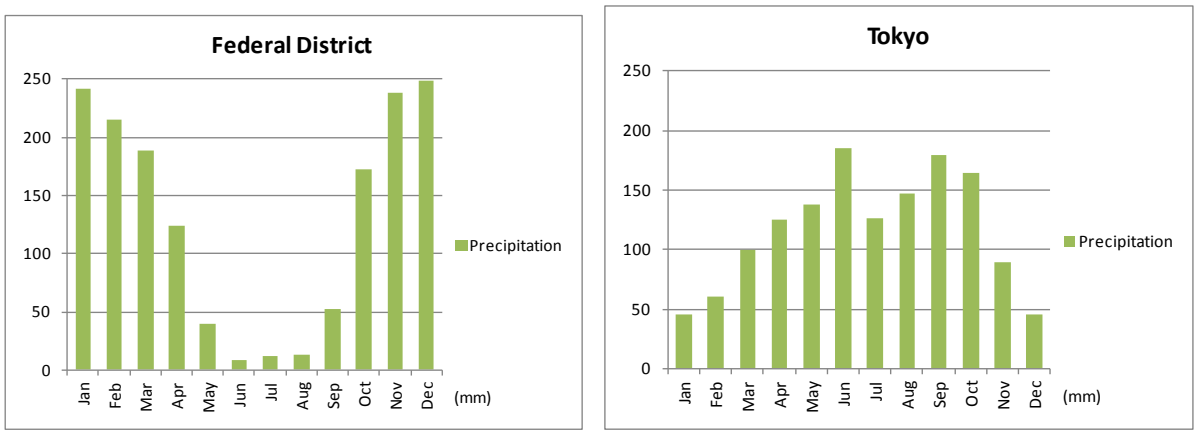
[Temperature]



Source: UNdata (United Nations Statistics Division)

Figure 10-18 Temperatures in DF and Tokyo

[Precipitation]



Source: UNdata (United Nations Statistics Division)

Figure 10-19 Precipitation Comparison in the DF and Tokyo

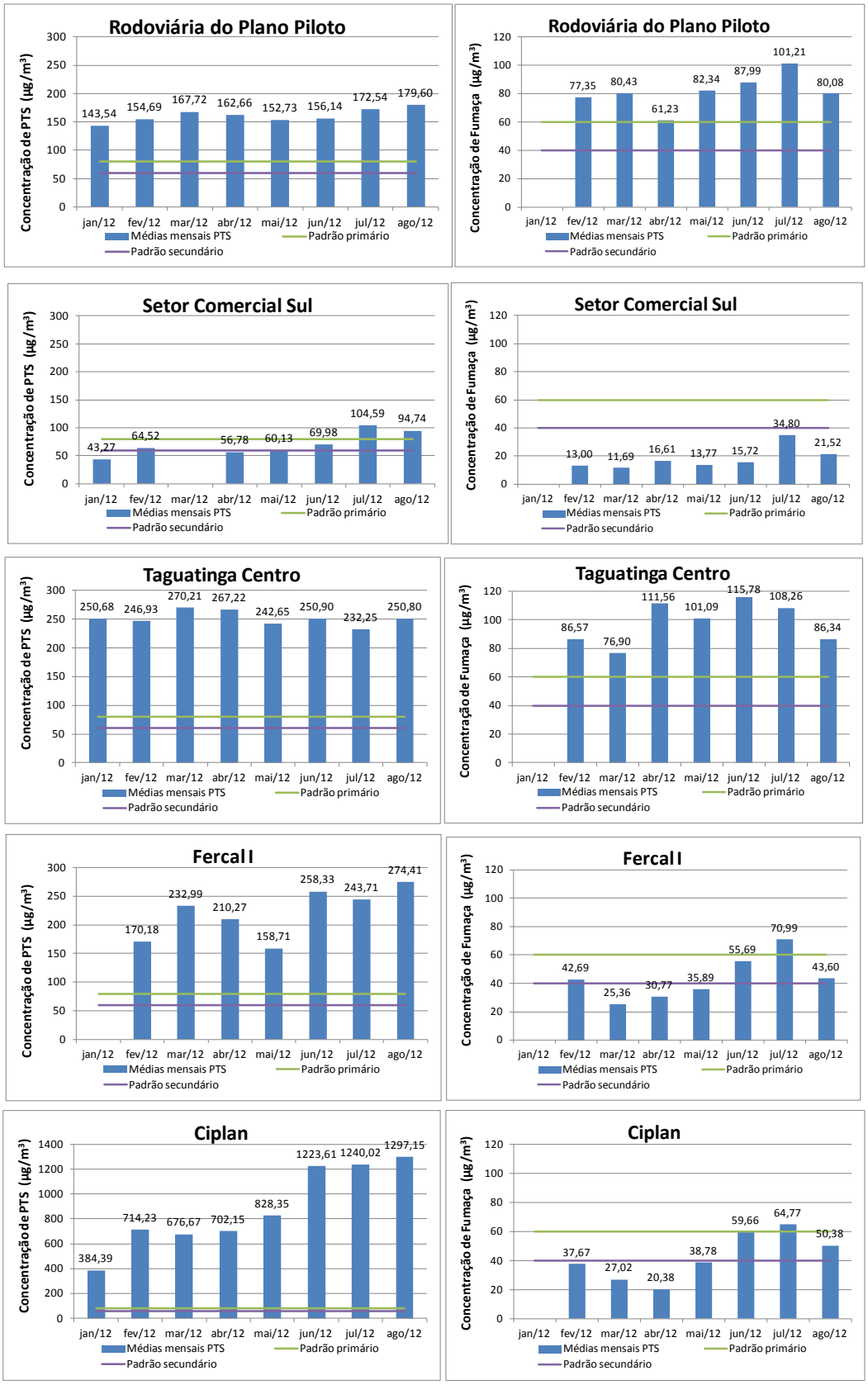
(3) Air Quality

In DF, the air quality is monitored by the Instituto Brasilia Ambiental (IBRAM). The institute was created on 28 May 2007 to be the executing agency of public environmental policy and water resources in the DF.

The IBRAM has administrative, financial, and patrimonial autonomy, thus it may enter into contracts, agreements, and partnerships with private and public institutions, national and international, and cooperatives. It was established as an independent agency linked to the Department of State for Urban Development and Environment (Secretaria de Desenvolvimento Urbano e Meio Ambiente: Seduma).

The institute conducts daily air quality monitoring and water levels of rivers. The results are published on its website. Examples of monitoring results are shown in Figure 10-33, which was downloaded from the IBRAM website.

Based on the figures shown in the next page, the Persistent Toxic Substances (PTS) and smoke levels have exceeded the standard in many locations, indicating poor air conditions.



Source: IBRAM

Figure 10-20 Air Quality Monitoring Result