The Project for Urban Mobility Improvement in Kigali

The 6th Working Group 2 (3. Basic Design of Intersections (Signal System))
22nd Feb. 2023
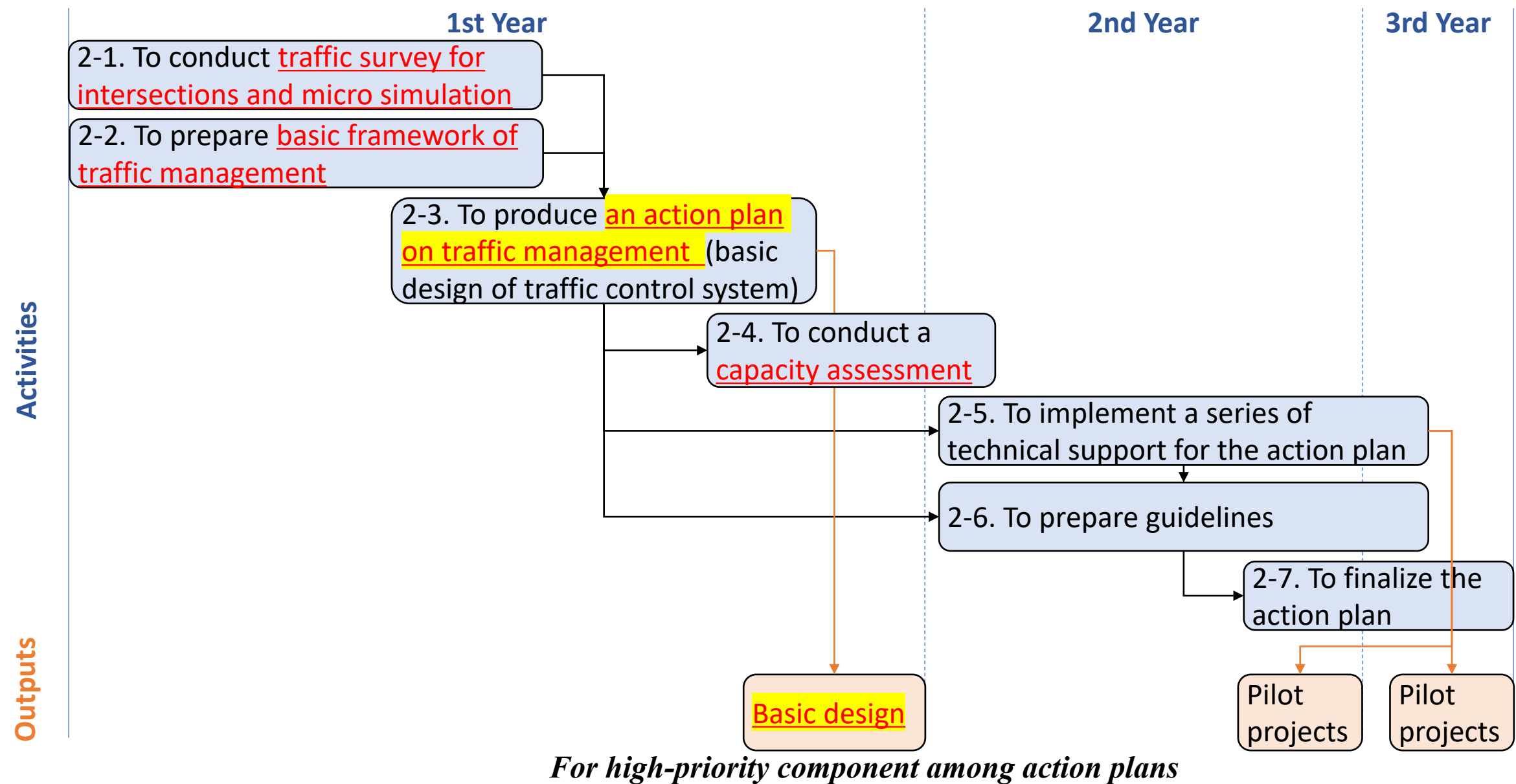
JET Member

Traffic Management System

1. Mr.OKUDA: Smart Traffic/ICT

2. Mr.NODA: Traffic Flow Management/Traffic Control (2)

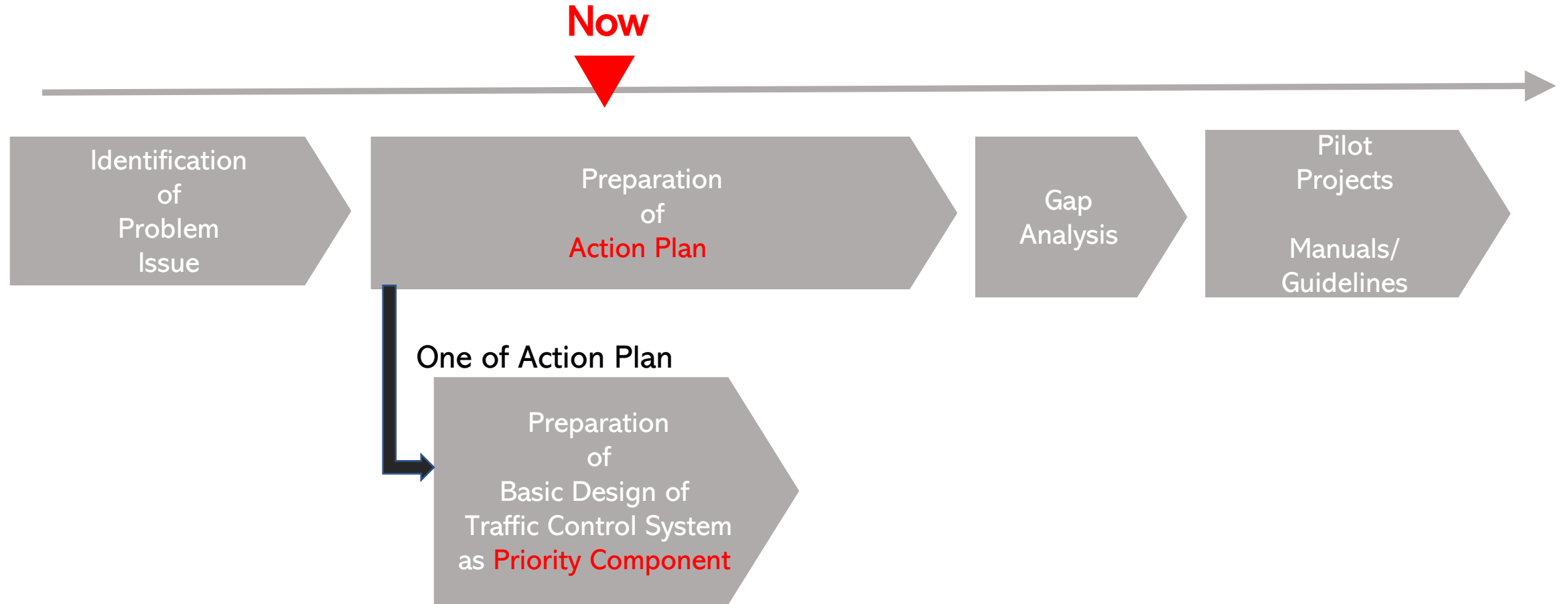3. Mr. OTSUKA: System Design/Communication

AGENDA

I. Basic Design of Signal System

II. Basic Design of Control System

Flow of Activities on Traffic Management
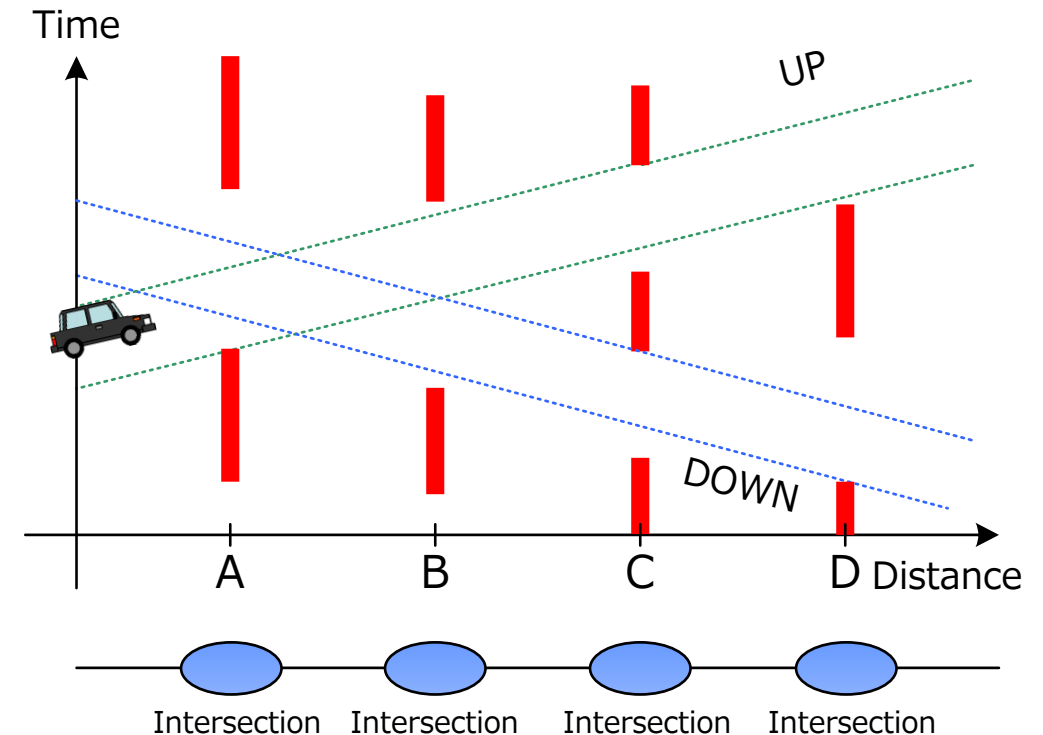
Action Plan and Priority Component

Now

Identification of Problem Issue

Preparation of **Action Plan**

Gap Analysis

Pilot Projects

Manuals/ Guidelines

One of Action Plan

Preparation of Basic Design of Traffic Control System as **Priority Component**
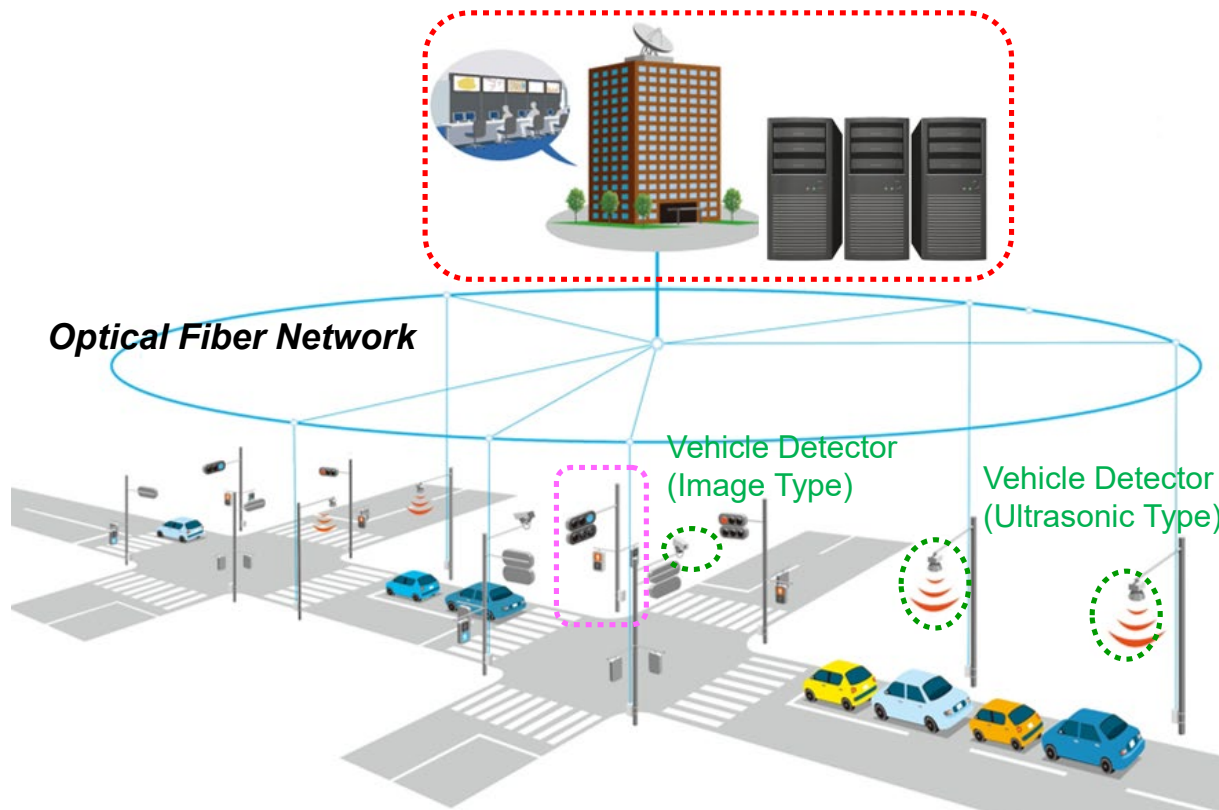
I. Basic Design of Signal System

Basic Design of Signal System
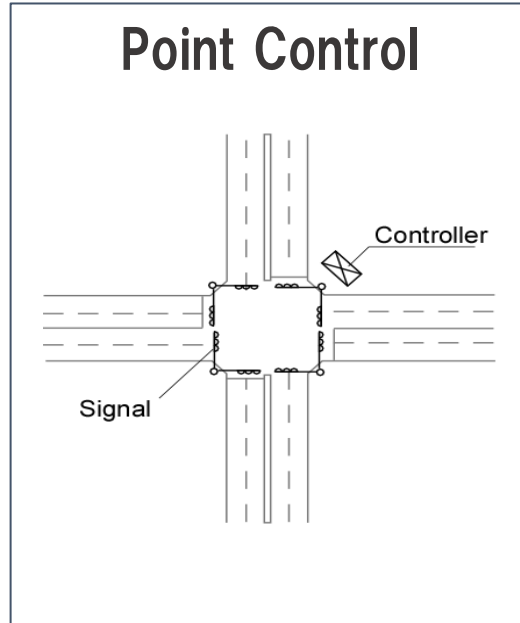
--Overall System Image--

<Key Points>

- Minimizing the waiting time by optimizing the traffic signal parameter based on the real-time traffic data collected by the vehicle detectors.
- Traffic data can be accumulated for data analysis and utilization.

Optical Fiber Network

Vehicle Detector
(Image Type)

Vehicle Detector
(Ultrasonic Type)

Time

UP

DOWN

A   B   C   D   Distance

Intersection   Intersection   Intersection   Intersection

Basic Design of Signal System

--Signal Control Method--

Point Control

Applied in the intersection which is isolated, and the distance from adjacent intersection is far.

Coordinated Control

Coordinated by offset
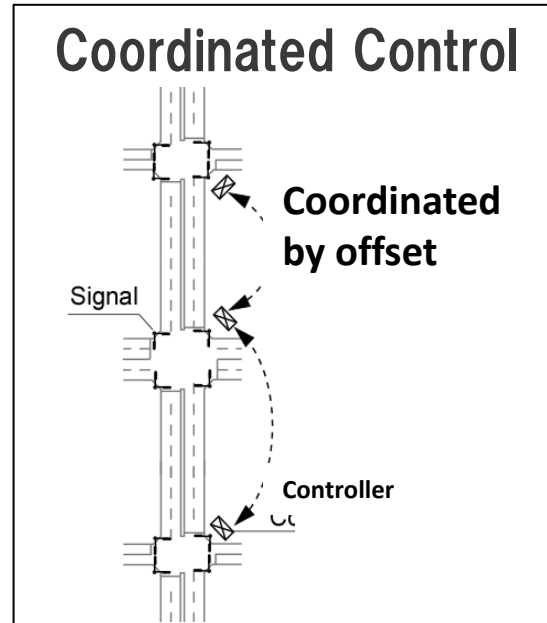
Applied in the continuous intersections of which distance from adjacent intersection is close.
(In this case, point control produce more wasted time)
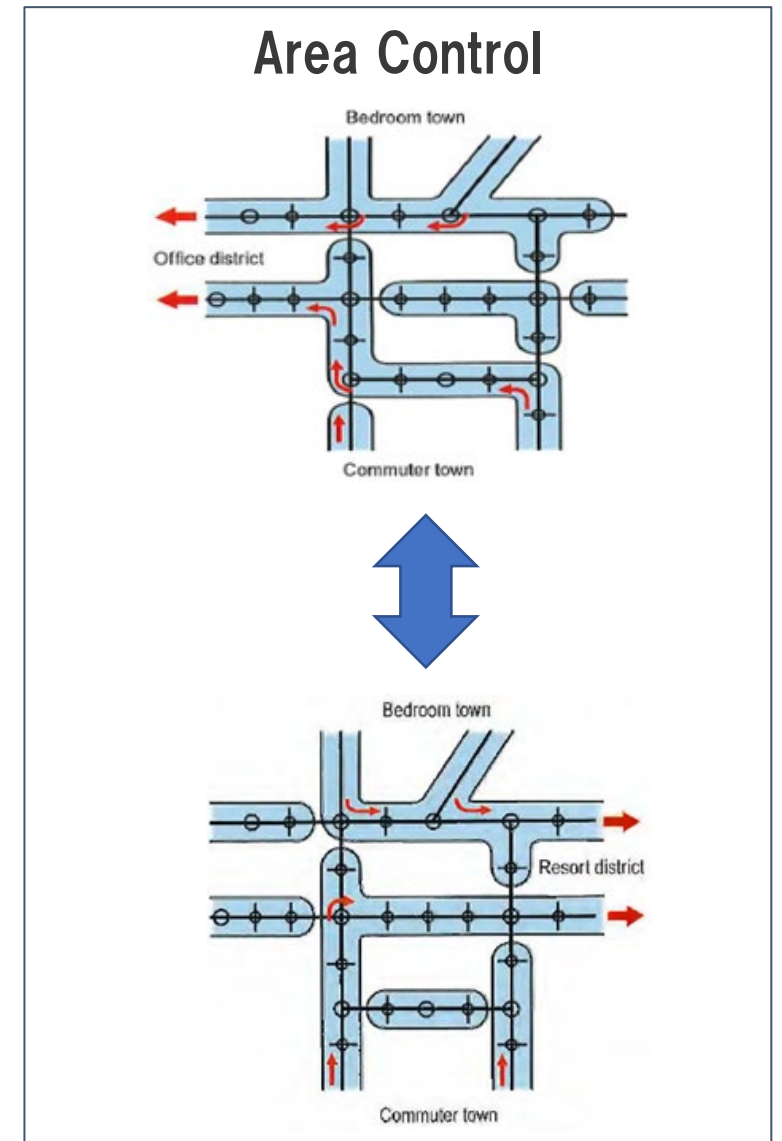
Area Control

Applied in the area which has close-distance intersections. (Focus the most effective route according to traffic conditions)

Basic Design of Signal System
--Signal Control Method--

Selection of Signal Control method

- **Point Control**: Adjust Signal timing based on traffic inflow to the intersection
- **Coordinated Control**: Signal timing synchronized to Key intersections based on traffic inflow/que length
- **Area Control**: Key intersection changed to based on traffic inflow /que length

Selection of Key intersection method.

- Most Complicated Phases within coordinated/Area control intersections
- Based on Traffic volume and que length
- End of Coordinated Control (if not include above)

Que length measurement.

- Based on the *Que length survey*, necessity and location of Ultrasonic sensor was decided

Basic Design of Signal System
--Signal Control Method --

Current Idea of Signal Control Method
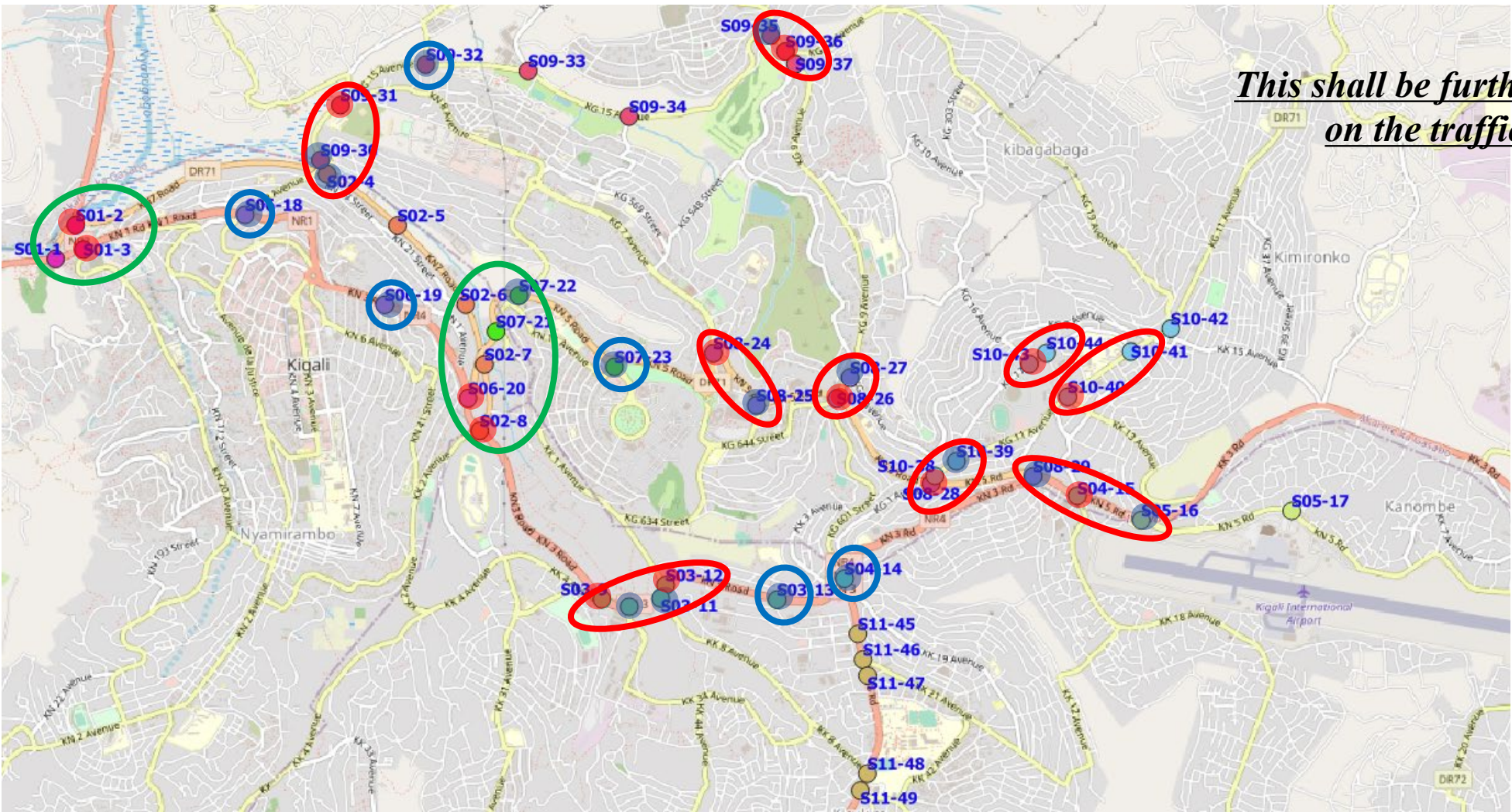
This shall be further considered based on the traffic survey result

Signal Control

🟢 :Area Control

🔴 :Coordinated Control

🔵 :Point Control

Sensor Type

🔴 :Key Intersection
   -Camera Type Sensor
   -Que Length Sensor

🔵 :Isolated/Important Intersection
   -Camera Type Sensor

Intersection Equipment Layout Design

--Basic Concept of Intersection Equipment Layout Design

(A) Key Intersection

(B) Non-key Intersection (Important/Actuated)

(C) Non-key Intersection (Normal)
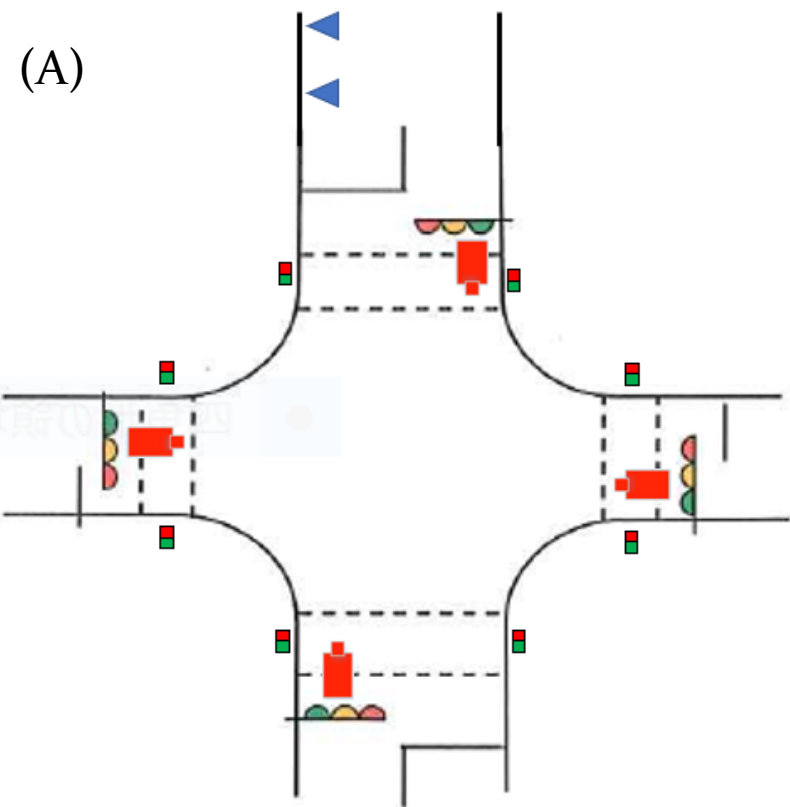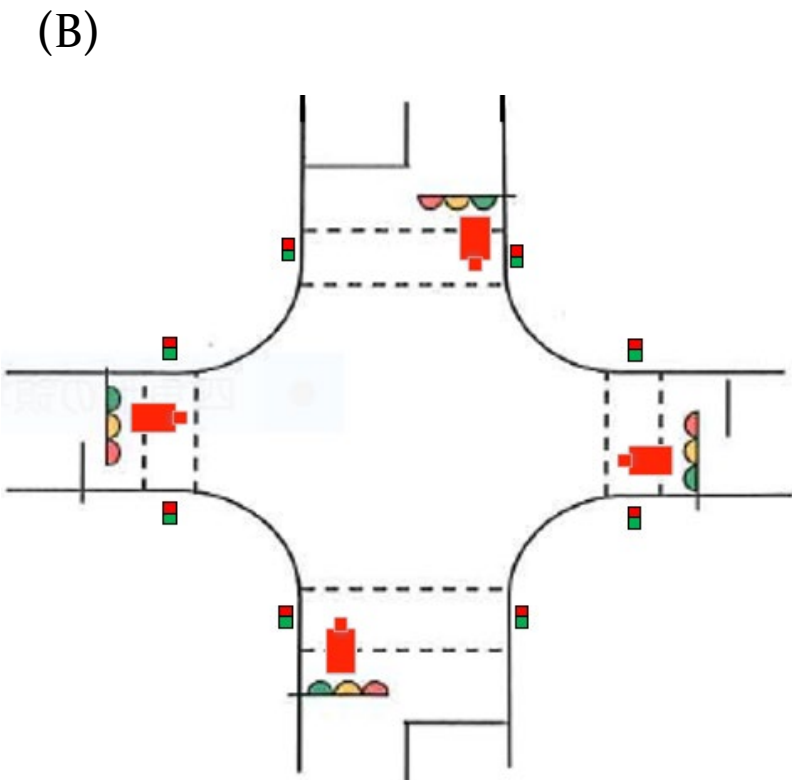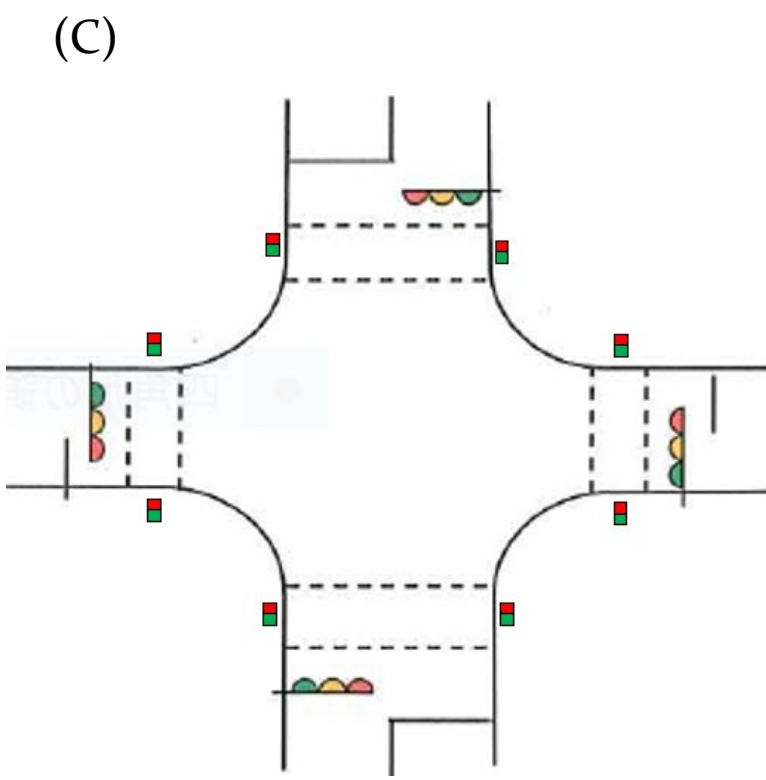
	(A) Key Intersection	(B) Non-key Intersection (Important/Actuated)	(C) Non-key Intersection (Normal)
Traffic signals	O	O	O
Camera type sensor	O	O	
Queue length sensor	O		
Optical beacon	(O)	(O)	(O)

Intersection Equipment Layout Design

--Basic Concept of Traffic Signal Layout--

<Layout Image of Typical Intersection>

<Key Points>
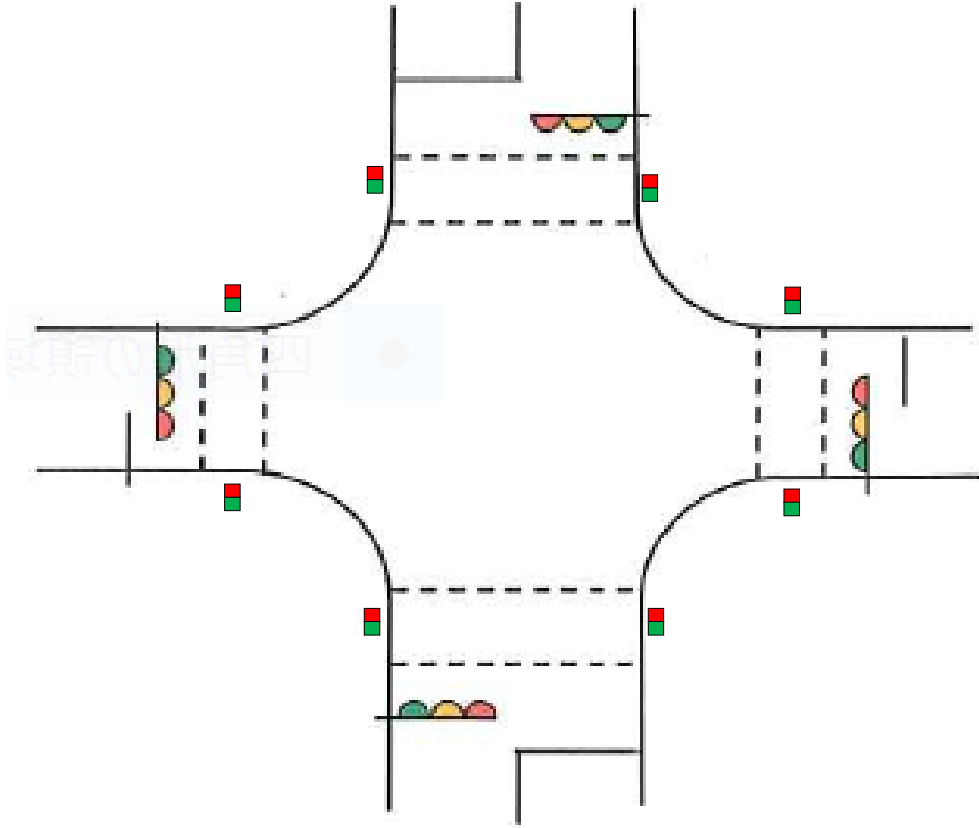
1. Vehicle Traffic Signal
- ■ It should be installed back of the pedestrian crossing so that drivers can intuitively recognize the size of intersection.
- ■ It should be installed at the position confronting the approaching vehicles for good visibility.

2. Pedestrian Traffic Signal
- ■ It should be installed at the position confronting the approaching pedestrians for good visibility.

Intersection Equipment Layout Design

--Basic Concept of Traffic Signal Layout--

<Layout Image of Deformed Intersection>

<Key Points>
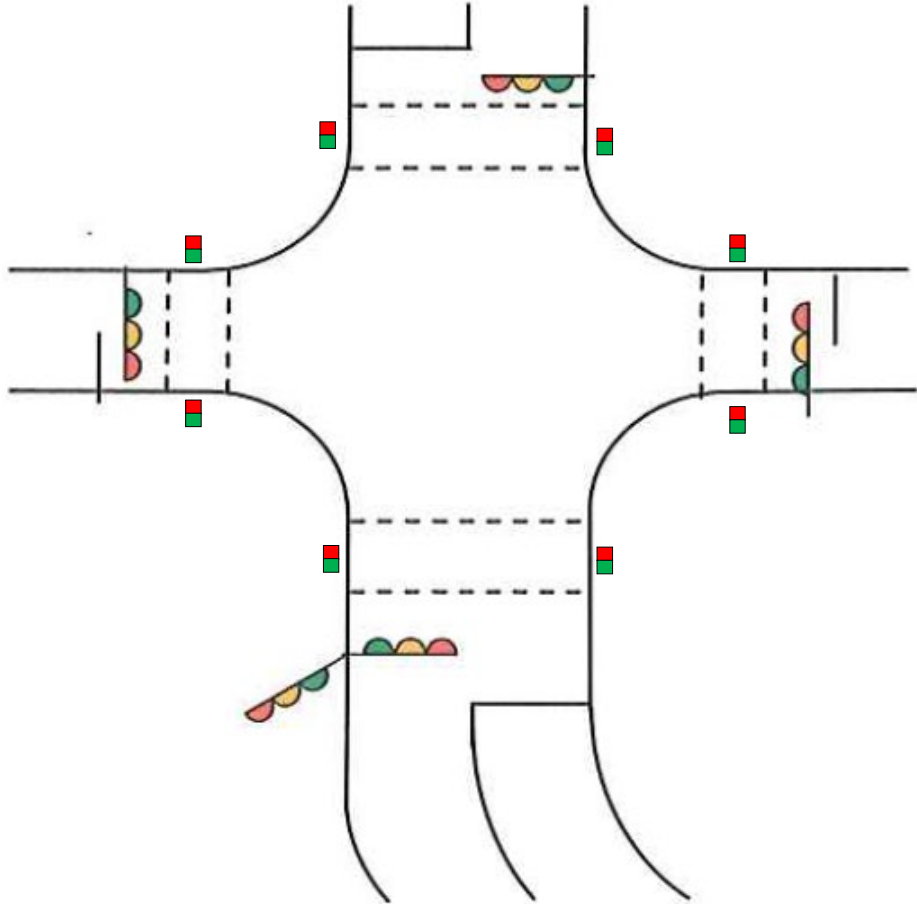
■ Supplemental traffic signal should be installed for good visibility.
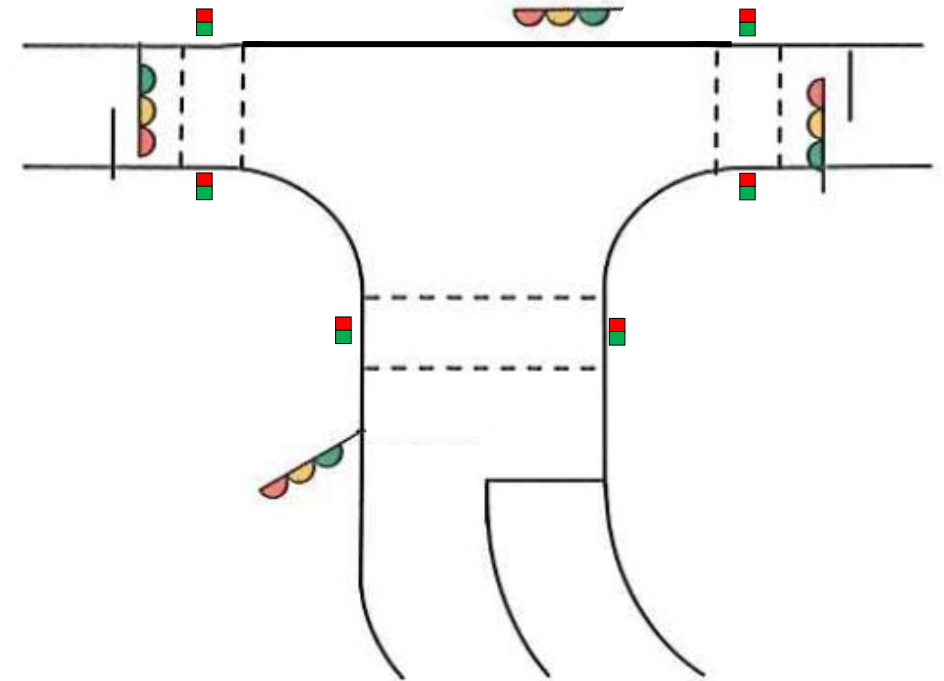
Intersection Equipment Layout Design

--Basic Concept of Vehicle Detector Layout

① Vehicle Detector (Camera type sensor)
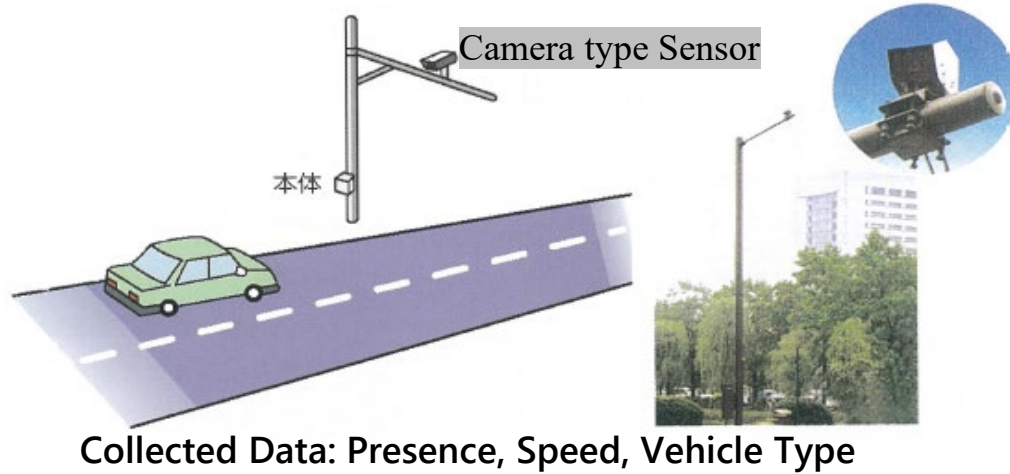
Camera type Sensor

本体

Collected Data: Presence, Speed, Vehicle Type

② Vehicle Detector (Ultrasonic sensor)

Ultrasonic Sensor Head

本体　　約5m

Collected Data: Presence, Speed
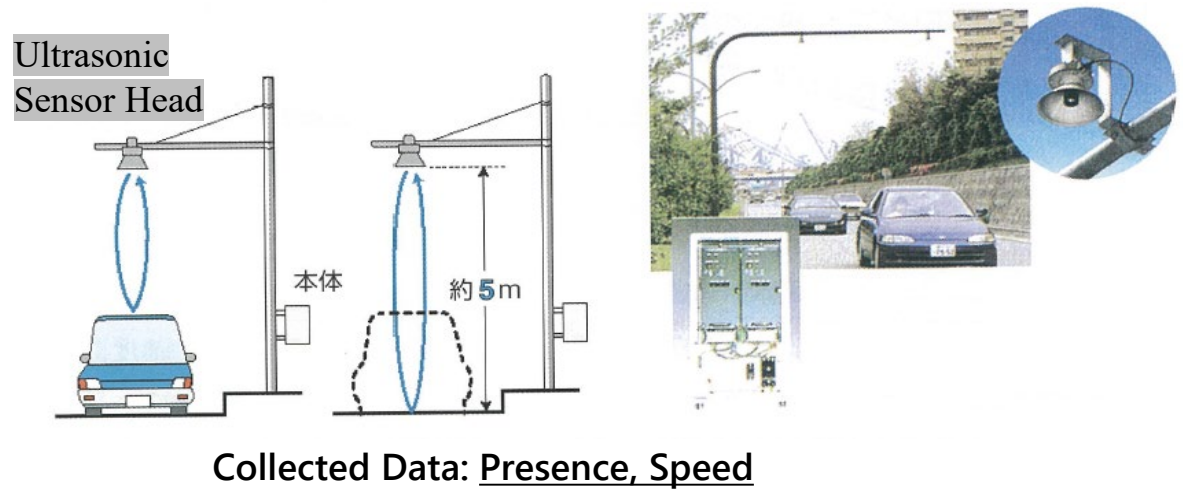
Intersection Equipment Layout Design

--Basic Concept of Vehicle Detector Layout at Key Intersection

Camera type sensor

1st Ultrasonic sensor   2nd Ultrasonic sensor

Measurement area(up to 150m)

Que length/Traffic Speed
Traffic count/occupancy

Que detection/
Occupancy

Que detection/
Occupancy

Signal Controller

300m   200-300m

Key Intersection with long queue (more than 150m)

Camera type sensor

Measurement area(up to 150m)

Que length/Traffic Speed
Traffic count/occupancy

Signal Controller

Key Intersection with short queue (less than 150m)

Intersection Equipment Layout Design
--Basic Concept of Bus Priority Signal Control

<Method of Bus Priority Signal>

Install Sensor on pole at 100m(approx.) before intersections.
Detect the DBL Bus with OBU on the Bus

Predict Bus Passage Times and Signal Control as:
  –Extension of Green signal time
  –Shortening of Red signal time

Come On Time!

Extension of Green signal time

Shortning of Red signal time

Extension of Green signal time

Note)
Sensor location shall be considered after Bus Stop and before Signal

<Target Root for DBL and location of Bus Priority Signal>

CBD Bus Terminal

Dedicated Bus Lane

Remera Bus Terminal

Grade separation

● **Intersection with Bus Priority Signal System**

<Sensor >

II. Basic Design of Control System

Action Plan and Priority Component

--As a sample-

	Short Term	Middle Term	Long Term	
1. Monitoring Signal Interchange	20-30	30-50	50-70	
2. System Function	Signal Control CCTV Monitoring	+Probe analysis +Information Provision through Internet/VMS	+Camera analysis including Incident detection etc.	
3.DBL	1 Route	+ 3 Route	+ 4 Route	
4.Video wall	55inc x 6 (TMC) 55inc x 8 (TCC)	55inc x 10 (TMC) 55inc x 12 (TCC)		

Priority Component

Action Plan

Outline of Configuration for Priority Component

Priority Component

- **Traffic Control Center at RNP and Traffic Management Center at COK**
- **Data /Application Server at National Data Center**
- **Signal Control and CCTV management**
- **Using MPLS network of KTRN for Optical Network for Signal Control**
- **Internet Communication for Traffic information with Agencies**
- **Bus Priority Signal at intersection for DBL route**

Remaining Action Plan.

- Information provision including VMS and public PC/SMS
- Probe Data processing and analysis
- CCTV analysis and incident detection
- Disaster Recovery

System Configuration --Basic Concept of Priority Component

RNP

Command & Cordination Centre

- Call Center

Event Management Sever

CCTV Server

Mobile Radio Controller

Traffic Control Centre

Video Wall
-Monitoring traffic status
-Camera monitoring

WorkStation
-Manual signal Control
-Monitoring Traffic status
-Traffic Event Management
-Communication with Site
-Information provision for accident

Mobile Radio Controller

Event Managent Terminal

MPLS 300Mbps

COK

Traffic Management Centre

Video Wall
-Monitoring traffic status
-Camera monitoring

WorkStation
-Traffic Data analyze
-Signal parameter set
-Input Road construction/Close location
-Traffic Planning
-Check information provision
 (VMS/PC/SMS)

Road Construction Management Server

CCTV

- PTZ Camera
- TID Camera

CCTV (Exists)

- CCTV-1 Controller

RNP Network

CCTV Management Server

Signal

Signal

Traffic Sensor (Camera Type)

Que Length Sensor

Signal Controller

Bus Sensor

OBU

Intersections

MPLS 10/30Mbps

Signal Control Server -BTPS

CCTV image

Traffic Data

National Data Centre

Video management Server
-Incident detection
-Image analysing

Probe Data Server
-Probe data
-Travel time

Big Data storage

Traffic Event management Server

Traffic Data Server
-Intersection traffic data

Information Provision/VMS Server

Probe Processing

Internet Server

VMS

MPLS VPN 10Mbps

VMS Controller

Taxi Operator

MPLS VPN 50Mbps

Internet

Related Government Agencies

Internet

SMS/Mobile

Computer

Disaster Recovery Centre

Recovery Data Server

Exist System

Action Plan

: Priority Comporment

: Prepared by Rwanda side for Priority Comporment

Video wall Image and Layout Plan of Operation Room
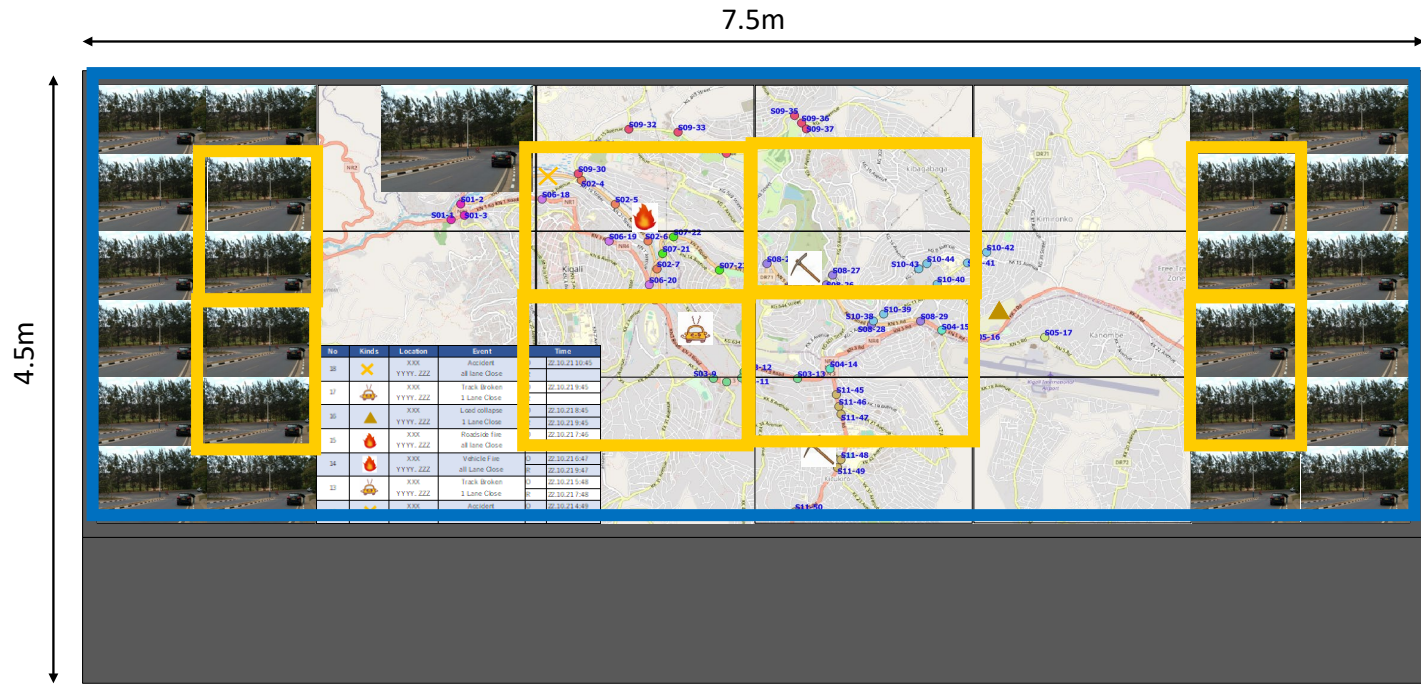
-At Traffic Control Centre(RNP) -
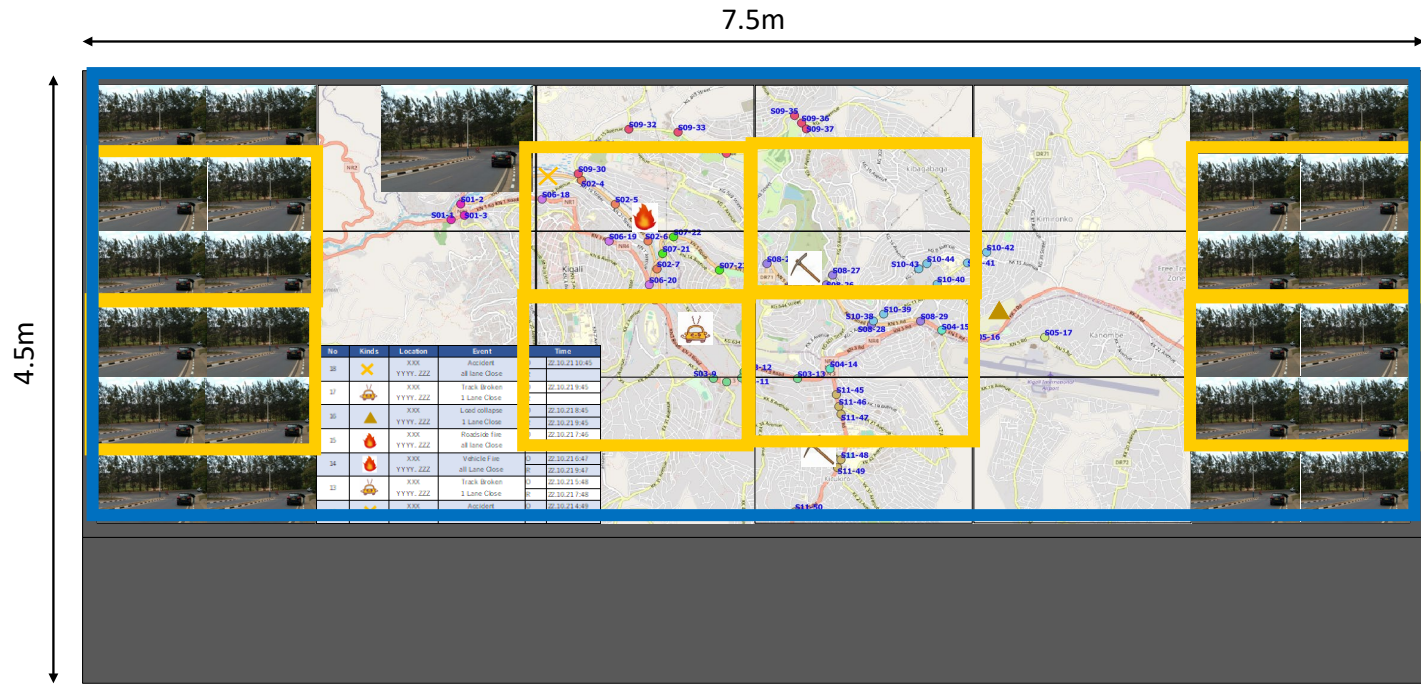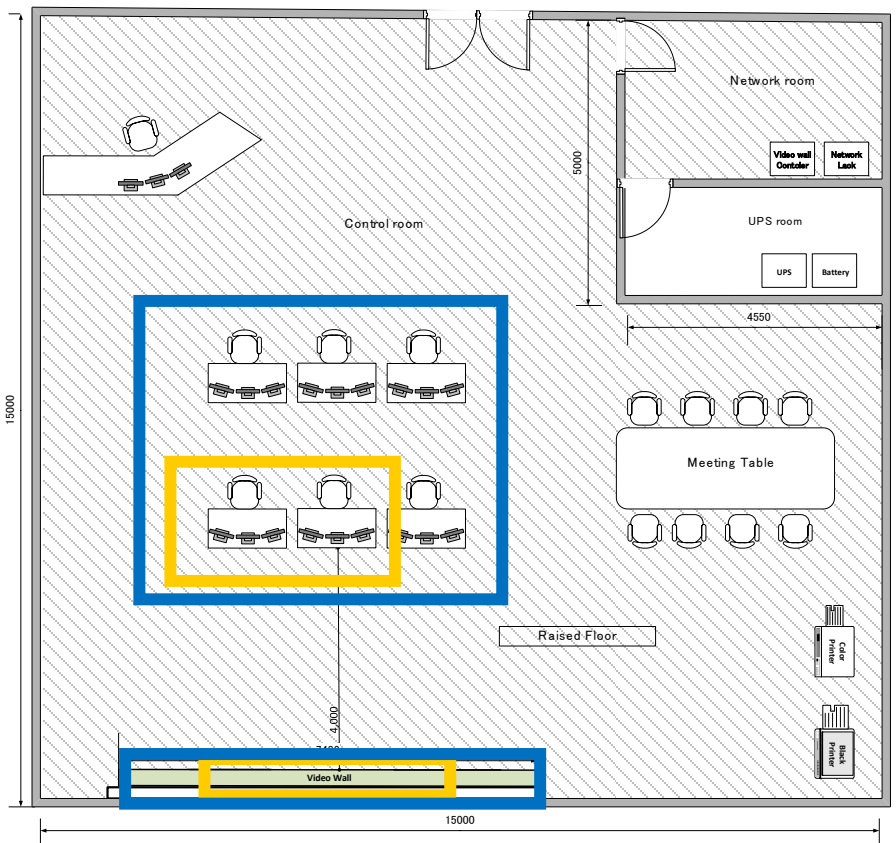
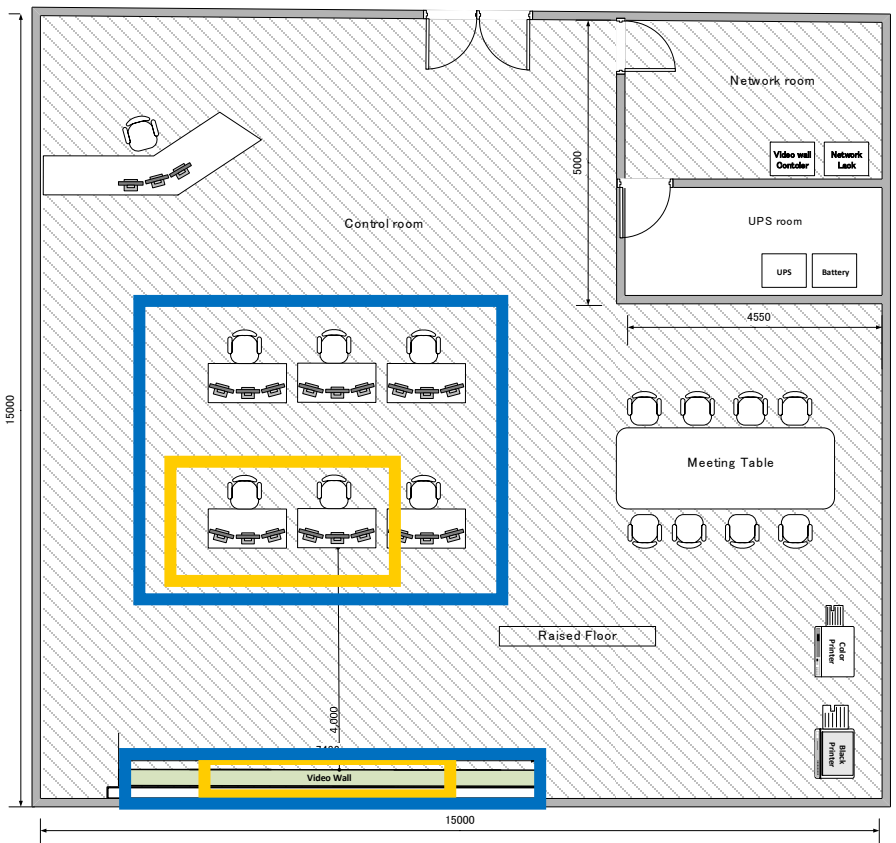-Video Wall Image-

-Layout Plan-

	Priority Component
	Action Plan

Video wall Image and Layout Plan of Operation Room
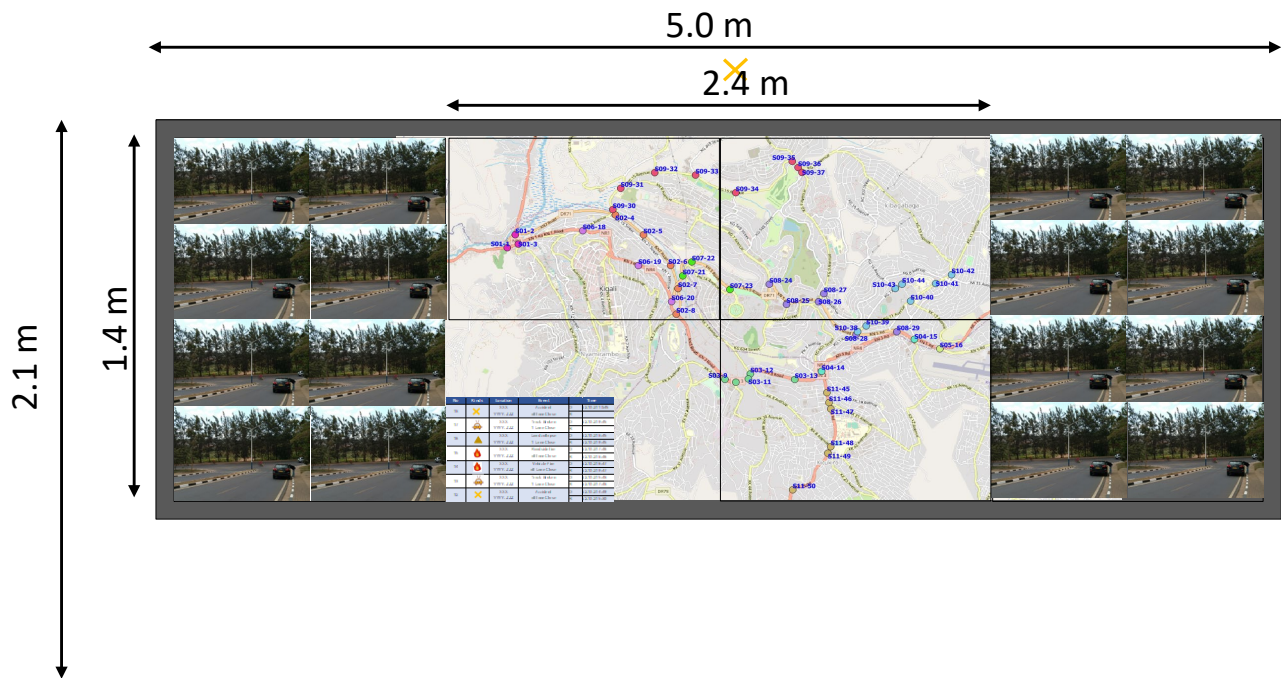## -At Traffic Management Centre(COK)-

-Video Wall Image-

-Layout Plan-

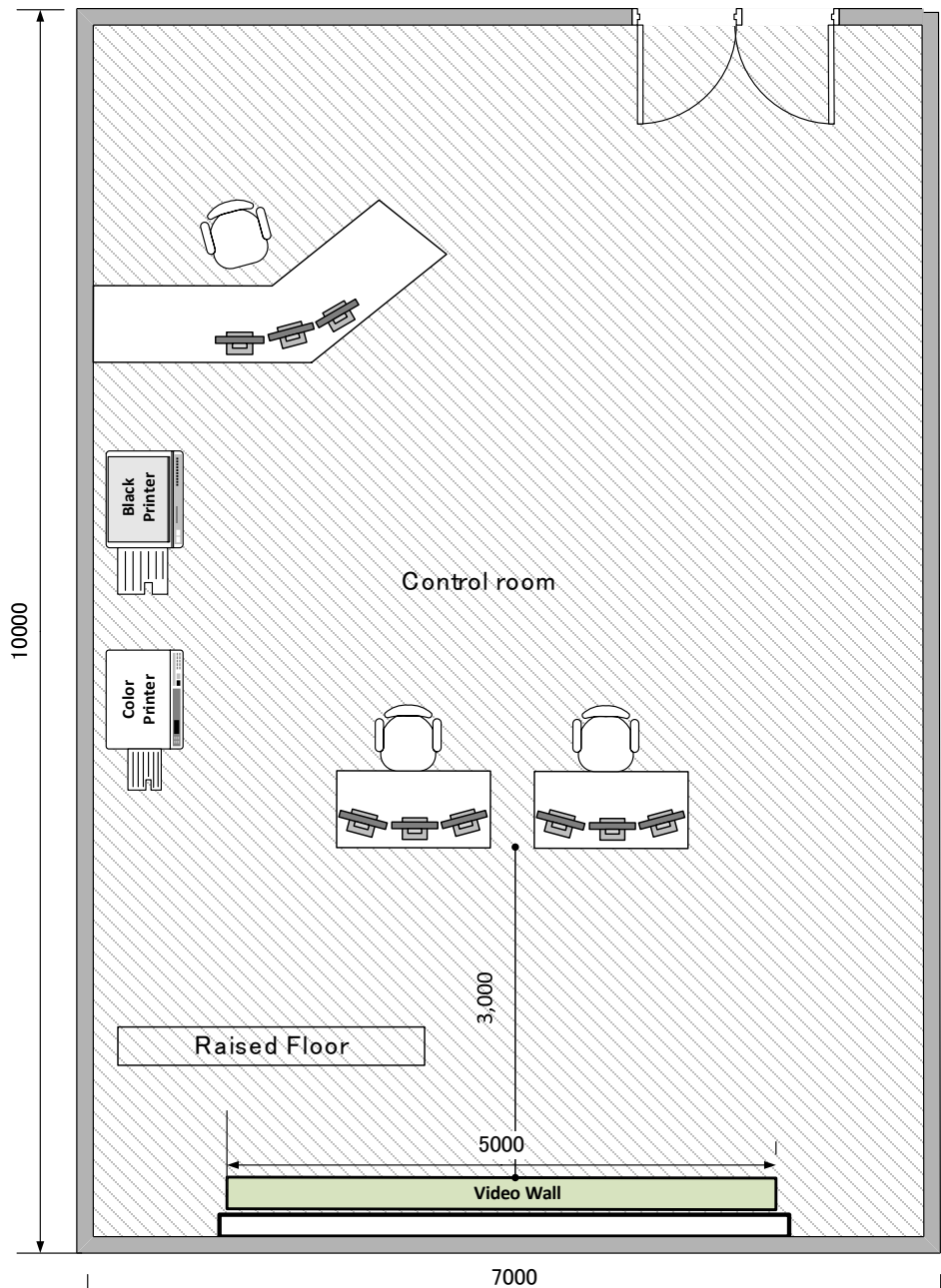|	Priority Component

	Action Plan

Video wall Image and Layout Image of Operation Room for Priority Component

-At Traffic Control Centre(RNP) -
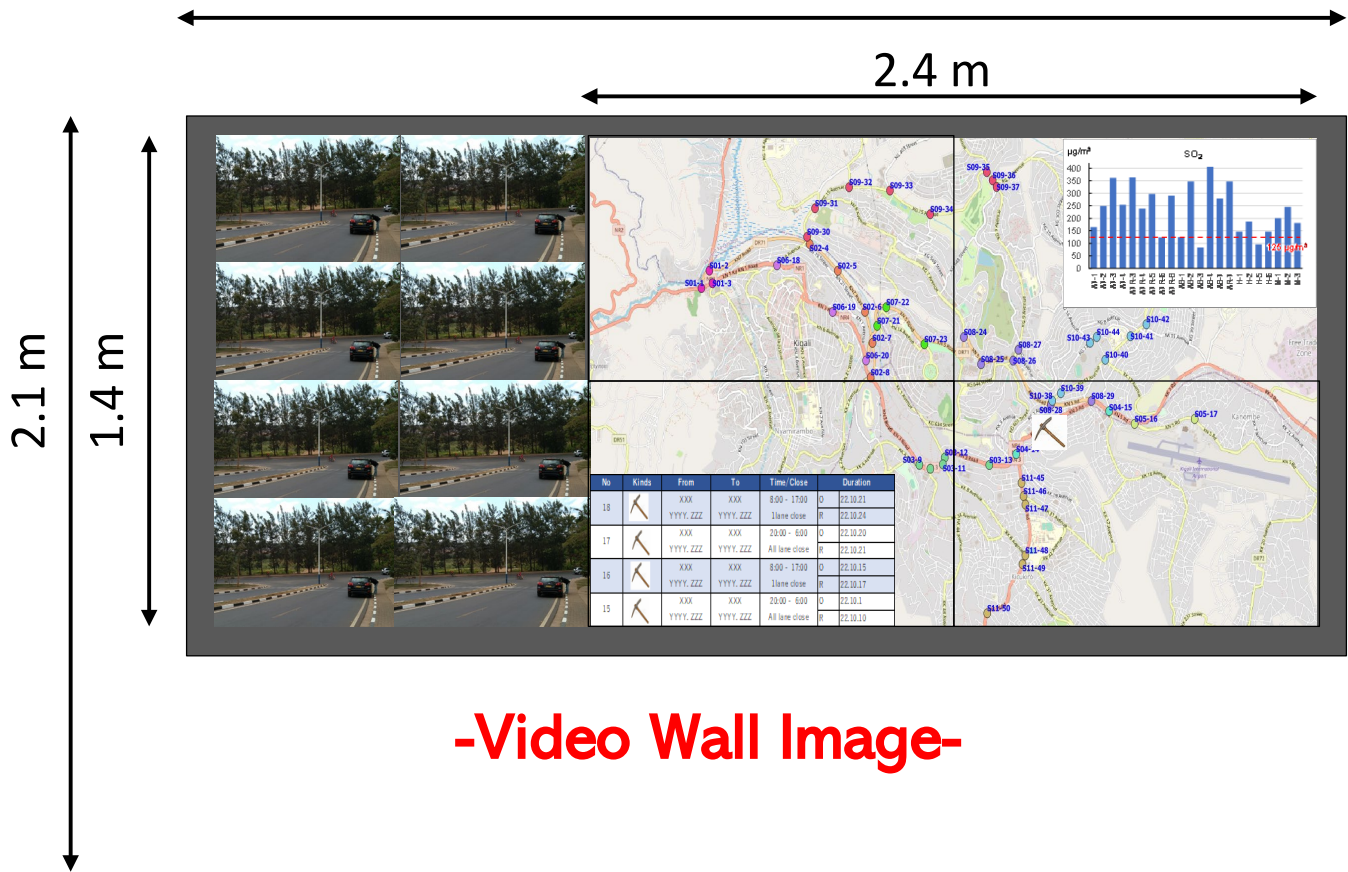

-Video Wall Image-

Video wall Image and Layout Image of Operation Room for Priority Component

-At Traffic Management Centre(COK)-

2.4 m

2.1 m

1.4 m

-Video Wall Image-

Control room

Color Printer

Black Printer

Raised Floor

Video Wall

8000

5000

2,500

3700