PART II :

FRAMEWORK FOR RIP

PART II FRAMEWORK FOR RIP

CHAPTER 1 RIP FRAMEWORK

1.1 Objective of the Formulation of RIP Framework

RIP was launched in 2000 by MECM. However, it is still under pilot stage and implementing and managing organization remain tentative. Objective and target group of RIP are also yet to be defined in detail. Before formulating the Action Plan, therefore, framework of RIP was worked out to set up a clear framework for the full scale implementation of RIP.

Process of RIP framework formulation is shown below.

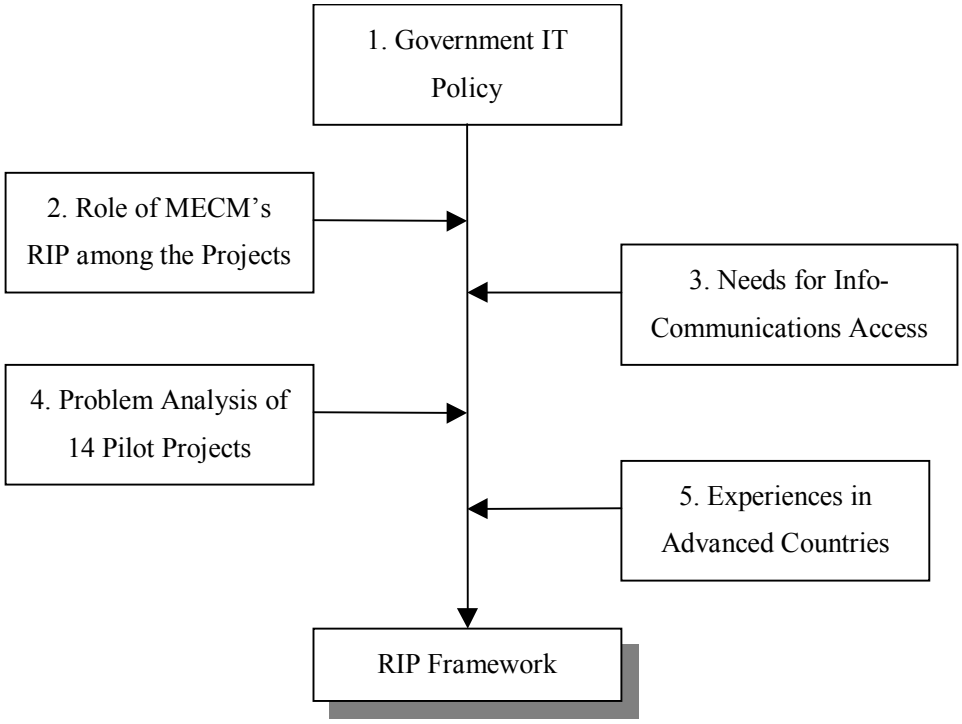


Figure II.1.1 : Formulation Process of the RIP Framework

1.2 Objective and Target Area of RIP

The current Five Year Plan, as well as Vision 2020, stipulates the importance of the bridging the digital divide between urban and rural areas. The objective of RIP is to improve the info-communications access in the rural communities and thereby to contribute to accomplish the goal of this national policy. Considering the characteristics of the objective and the low income level of the rural residents relative to the urban, it is recommended that RIP should be implemented as a public undertaking.

The target area for locating RIC should be semi-urban/semi-rural areas where telecommunication facility for Internet access is available. Remote rural areas should be the responsibility of the Ministry of Rural Development (MORD). Hence, district centers and mukim centers are considered to be appropriate locations for RIC.

1.3 Project Period of RIP

Considering the rapid change of IT environment as well as the national five year plan periods, project period of RIP should be from 2003: Mid term review year of the 8th Malaysia Plan, through 2008: Mid term review year of the 9th Malaysia Plan.

1.4 Target Group

i) Primary target group

The primary target group should be the age group above the secondary-school age, i.e., above 17 years of age who are not taken care of by the projects of the Ministry of Education (MOE).

ii) Inclusion of the younger generation

Considering the low percentage of school attendance in the rural community, many young people are left behind regarding IT education. This young age group is also included in the target group.

iii) Discouraging use by small children

To facilitate the use by target groups, use of RIC by small children, i.e., under 10 years old, should be discouraged.

1.5 Concept of RIP and Scope of RIC

Reflecting the objectives of RIP, the concept of RIP is formulated as follows.

- Providing Internet access stations.
- Considering gaps in info-communications facilities and people's income between urban and rural areas, the Internet service is provided free of charge.
- All generations of users are welcome to use RIC, though priorities are set, except small children.
- Information service regarding the local community is provided as one sphere of regional development.
- IT training is carried out for improving the low IT literacy of the rural people.

In line with the above-mentioned RIP concept, RIC should provide the following services/functions.

i) Provide Internet access terminals in the places to which rural residents can afford good access and let the residents use Internet freely and free-of-charge.

ii) Develop and update the local homepages to provide useful and interesting information for the rural residents.

iii) Hold IT beginners' courses frequently to raise the IT literacy level of the rural residents.

iv) Transfer the homepage updating skills to RIC Committee and Task Force members.

v) Based on the above i) through iv), activate the social and economic activities in the community.

The services of i) through iv) above should be the core services of RIC and should be provided throughout the project period free-of-charge. RIC activities mentioned in v), is a desirous perspective of RIC and should be promoted. Those activities should be carried out with the initiative of the concerned organizations and enterprises in the communities. Both the costs and revenues attributable to the implementation of those activities should be borne and belong to these concerned organizations. It is noted that the priority should be placed on the provision of the core services of RIC.

CHAPTER 2 DESIROUS PERSPECTIVE OF RIC

If any additional activities can be carried out utilizing the facility and software equipped to provide the core services, it would be a desirous perspective of RIC on the condition that they should contribute to the promotion of social activities and regional economy. These additional activities are expected to contribute to the enhancement of the living standard, income level and formation of the knowledge economy.

Though the scope and degree of the additional activities depend on the external conditions and the eagerness of the communities, they may include the followings.

i) Enhancement of community activities

- External conditions: Eagerness of the communities
- Utilization of the software applications developed in the model projects, i.e., E-reservation, E-public comments and E-greeting card.
- Activities may include setting up of the community electronic bulletin board and electronic regional forum and publication of mail magazine.

ii) E-Government related services

- External conditions: Progress of the E-Government
- Activities may include down-loading of the official documents and various application forms, renewal of the driving license, provision of public service information and information about tenders by the ministries and the local governments.

iii) E-commerce related activities

- External conditions: Progress of the electronic authentication of personal identity, assurance of the security and settling the accounts
- Activities may include advertisement of local products and enterprises and receiving the orders and virtual mall.

For the additional activities, using RIC for sizable length of time is not considered for developing the software, etc. except for the short time use including uploading of software applications, checking the orders for the products, etc. In case conflicts take place for using RIC between the core service and additional activities, priority should be given on the former. All the costs for additional activities should be borne by the parties concerned and not by RIC and all the revenues should belong to the parties concerned.

Whether or not the additional activities should be allowed should be discussed and decided by RIC Committee and the decision should be informed to MECM. Unless they disturb the core services, in principle MECM should respect the committee's decision.

PART III :

IMPLEMENTATION AND EVALUATION OF THE MODEL PROJECTS AND FEED BACK TO ACTION PLAN

PART III IMPLEMENTATION AND EVALUATION OF THE MODEL PROJECTS AND FEED BACK TO ACTION PLAN

CHAPTER 1 SELECTION AND FORMULATION OF THE MODEL PROJECTS

1.1 Objectives of the Model Project Implementation

Objectives of the model project implementation should be as follows.

i) to formulate and implement model projects for RICs and make them successful models for RICs.

ii) to verify the effectiveness of the components and contents of RICs proposed in the interim plan in the field and to provide the feedback of or to work out an appropriate action plan for the RIP.

1.2 Selection of the Model Project Sites

1.2.1 Selection Criteria

The 3 model project sites were selected based on the following agreement and criteria.

(1) Compliance with the agreement between the Malaysian side and Japanese side

According to the agreement between the Malaysian side and Japanese side, 3 model projects should be selected in total, one in Peninsular Malaysia and one each in the states of Sabah and Sarawak. The one in Peninsular Malaysia should be selected from among the 14 on-going pilot RICs and the other 2 should be newly set up.

(2) MECM's criteria to select RIC locations applied for setting up the pilot RICs

The location or the community where the model RIC should be set up should comply with the MECM's criteria for setting up RICs, including the on-going pilot RICs. Namely, the population should be less than 10,000, average monthly household income should be less than RM1,500, telephone lines should be available, transport access should be there.

(3) Conformity to the RIP principle with regard to the site conditions

Model project sites should be located in rural areas but not in remote rural areas.

(4) Availability of public buildings for setting up the model RIC

Public buildings for setting up the model RICs should be available and cooperation of the owners/administrators of the buildings should be secured.

1.2.2 Selected Model Project Sites

Considering the above, in the Selangor state Sg.Air Tawar was selected as a model which is located at the center of 2 mukims. This RIC is one of the 14 on-going pilot RICs.

In the Sarawak state, Bau, located a 1 hour distance from Kuching, the state capital, was selected as the model project site which is a district center. In the Sabah State, Kota Marudu located a 3 hours from Kota Kinabaru, the state capital, which is a district center, was selected as the model project site.

1.3 Formulation of the Model Projects

The 3 model projects were formulated at the selected sites to serve for the above-mentioned objective of the model projects. Accordingly, the following 3 models were formulated.

1.3.1 Sg.Air Tawar Post Office Model: Revitalization Model for the Pilot RICs

Most of the pilot RICs are not actively operated and need to be revitalized. Trials should be made on how to make them active and thereby to get feedback to the revitalization of the on-going pilot RICs. Considering that inactiveness is partly attributable to the inadequate management of RIC operation and maintenance of the equipment, emphasis for upgrading was placed on these aspects rather than the facility and equipment. Facility and equipment were kept basically the same as at the pilot stage except for adding one more PC with one more fixed telephone line. Space for the RIC also remained the same as it had been as the pilot.

Major emphasis of upgrading was placed on:

- Revitalization of the activities of the RIC Committee
- Activation of the community involvement
- Provision of a local homepage and updating by the RIC Committee/Task Force
- Provision of intensive IT training for beginners and a training course for the RIC Committee/Task Force for homepages and updating

1.3.2 Bau Civic Center Model: Non Post Office Model

Though, post offices have advantages, they also have demerits including:

- A part of the existing post office space is made available for the RIC. The RIC space is, therefore, just sufficient for placing 2 to 3 PCs. In the case of the 14 pilot RICs, 2 PCs were installed.
- RIC operation hours must be same as the business hours of the post offices. Namely, 8 am to 5 pm except for lunch hour. Post offices are closed on Sundays. On Saturdays, some are open in the morning and some closed the whole day.

The Bau model was formulated to overcome the above-mentioned demerits of the post office type RIC.

A Civic Center community hall or was selected for establishing the RIC. One room with about 60 m2, which is large enough to house 5 PCs, was provided for the exclusive use by the RIC. The Civic Center, belonging to the Sarawak State Government, was made available for RIC management through cooperation between MECM and the State Government /Civic Center. To verify the demand for using RICs at night and on weekends, trial operations were made during these hours.

1.3.3 Kota Marudu Model: Multi-station and High-speed Model

In case one building cannot provide the necessary space for an RIC, additional buildings should be utilized for establishing the RIC. Namely, more than one station should be set up which form a network connected by a telecommunication facility.

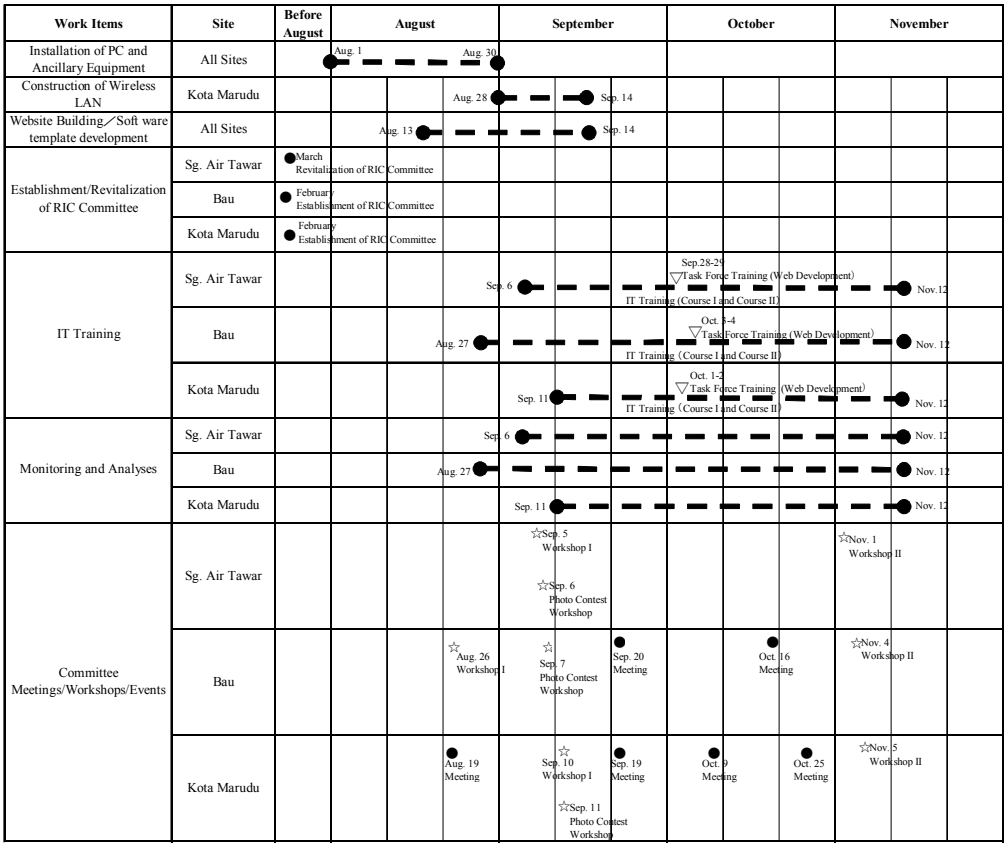
In formulating the Kota Marudu model, a network was established. Three RIC stations were set up, one in the post office as the main station, one in the state library and one in District Office. High-speed wireless communication system was established to connect the 3 stations to enable Internet access from all the 3 stations. Leased line was applied to verify the need for high-speed access. In the 3 stations, altogether 5 PCs were installed. The three stations were under the supervision of Pos Malaysia, the State Library and the District Office and the effectiveness of the overall cooperation among these was also verified.

CHAPTER 2 IMPLEMENTATION SCHEDULE, ORGANIZATIONAL STRUCTURE AND MONITORING FOR THE MODEL PROJECTS

2.1 Schedule of Model Project Implementation

The construction of wireless LAN, web page building, and software application template development started in mid-August, before the establishment of RICs. During these works, Workshop I was held at Bau on August 26, at Sg. Air Tawar on September 5, and at Kota Marudu on September10. The model projects themselves started on the following day of the workshop at the three RICs. Because Sg. Air Tawar is one of the existing RICs and the RIC itself had been opened since 2000, two existing PCs were replaced with new ones with an additional new one. The model project at the three RICs was completed on November 13. During this period, MECM and the Study Team supported the RIC activities by overseeing RICs, holding workshops, and periodically participating in the meetings.

Implementation Schedule for the Model Projects



2.2 Organizational Structure of the Model Project Implementation

Responsibility of the implementation rested on the Malaysian side while Japanese side extended the full support for the implementation through the Team.

On the Malaysian side, MECM was the executing body assuming the final responsibility for the implementation. In particular, Communications and Multimedia Division assumed the direct responsibility with the cooperation of IT Division in the field of the Web contents development and maintenance.

At the model project sites, RIC Committee and Task Force were formed to cooperate with MECM/Team for RIC operation, in particular organizing workshops, IT training, publicizing the RIC activity and promoting community participation. Owner organizations of the model RIC stations/buildings extended the cooperation in overall supervision of the buildings and assuring the security.

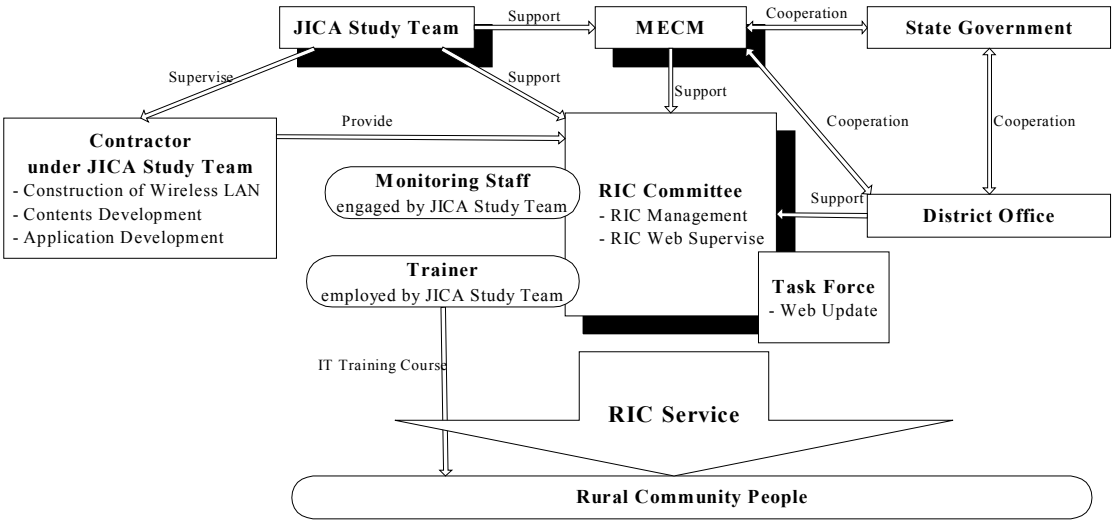


Figure III.2.1: Organization of the Model Project

2.3 Bearing of the Implementation Costs

The cost bearing for the model projects should be in basic agreement with the cost bearing principle for the future RICs. Considering the objectives and roles of the RICs which should serve the public interests, in particular the interests of the rural people, costs required for the investment and operation and maintenance should mostly be borne by the Government, i.e., budget allocated for RIC projects for the 8th Malaysia Plan. In particular, all the investment and replacement costs should be borne by the Government.

All the investment costs were met by the Government except for the following items, which are provided by JICA at her expense.

Bearing of the investment costs of the model projects is given below.

Bearing of the Investment Cost

	Items of Capital Cost	MECM	JICA
1	Purchase cost of computer systems		
1.1	Computers	√	
1.2	Peripheral Equipment	√	
2	Purchase cost of the equipment for the communication infrastructure		
2.1	Equipment for the Telephone Lines	√	
2.2	Equipment for Wireless LAN		√
3	Purchase cost for software		
3.1	Operating Systems	√	
3.2	Application Software		√
4	Cost of the application software development		
4.1	Cost of RIC Web Site Development		√
5	Cost of the Site Preparation		
5.1	Computers and Telecommunication	√	
5.2	Wireless LAN		√
6	Furniture		
6.1	Furniture for Computer and Peripheral Equipment	√	

All the running costs were met by the Government except the costs for building maintenance and personnel to supervise the RIC use, which were met by the organizations who own or manage the buildings as shown in the following table and printer paper cost by the respective communities/RIC Committees.

Bearing of Running Costs

	Item	MECM	JICA	RIC Committee	Civic Center	Post Office	Library	District Office
1	Maintenance Cost of Hardware and Software	√						
1.1	Computer Systems (PCs And Peripheral Equipment)	√						
1.2	Equipment related to Communication	√						
1.3	Wireless LAN System		√					
1.4	Up date of OS(Windows XP)	√						
1.5	Up date of Application Software	√						
2	Charge for Internet Use	√						
2.1	Charge of ISP registration, Annual subscription fees, ISP access fees	√						
2.2	Communication Access Charges	√						
3	Charge for Web Server use	√						
3.1	Web Hosting	√						
4	Supplies	√						
4.1	Printing paper	-						
4.2	Ink cartridges / Toner cartridges	√						
4.3	Recording media (Compact disks / Floppy disks)	√						
5	Personnel expenses							
5.1	Monitoring staff for RIC Systems		√					
5.2	Instructors for IT Training		√					
6	Charge for Electricity							
6.1	Bau				√			
6.2	Kota Marudu					√	√	√
6.3	Sg. Air Tawar					√		
7	Publicity							
7.1	Pamphlet making cost for Publicity			√				

2.4 Monitoring of the Performance and Use of the Model Projects and Feedback

Monitoring items for model projects are the indicators for the performance of the activities in model projects. To select the monitoring items for model projects, at first, the activities to solve the problems in existing RICs were formulated based on the problem structure in Section 4.2.3 of Part I. Next, the monitoring items for each formulated activity are selected. The process to formulate the monitoring items in model projects are shown in Figure III.2.2.

CHAPTER 3 IMPLEMENTATION, EVALUATION AND FEED BACK OF TELECOMMUNICATION INFRASTRUCTURE AND FACILITIES

3.1 Outline

3.1.1 Basic Components of the Three Model RIC Projects

(1) Communication Infrastructure

The model projects were carried out in Selangor, Sg. Air Tawar. Sarawak, Bau. and Sabah, Kota Marudu.

Two New RICs were established, one in the Civic Center in Bau and the other in the Post Office in Kota Marudu. Sub-RICs were established, one in each in a library and District Office in Kota Marudu.

The info-communication infrastructure, particularly Internet access, for the 3 model project sites is as shown below.

Sg. Air Tawar: Telephone line

Bau: Telephone line and CDMA FWA service for data communication

Kota Marudu: Telephone line and leased line

Experiments were carried out to confirm and compare the capacity of each Internet access line.

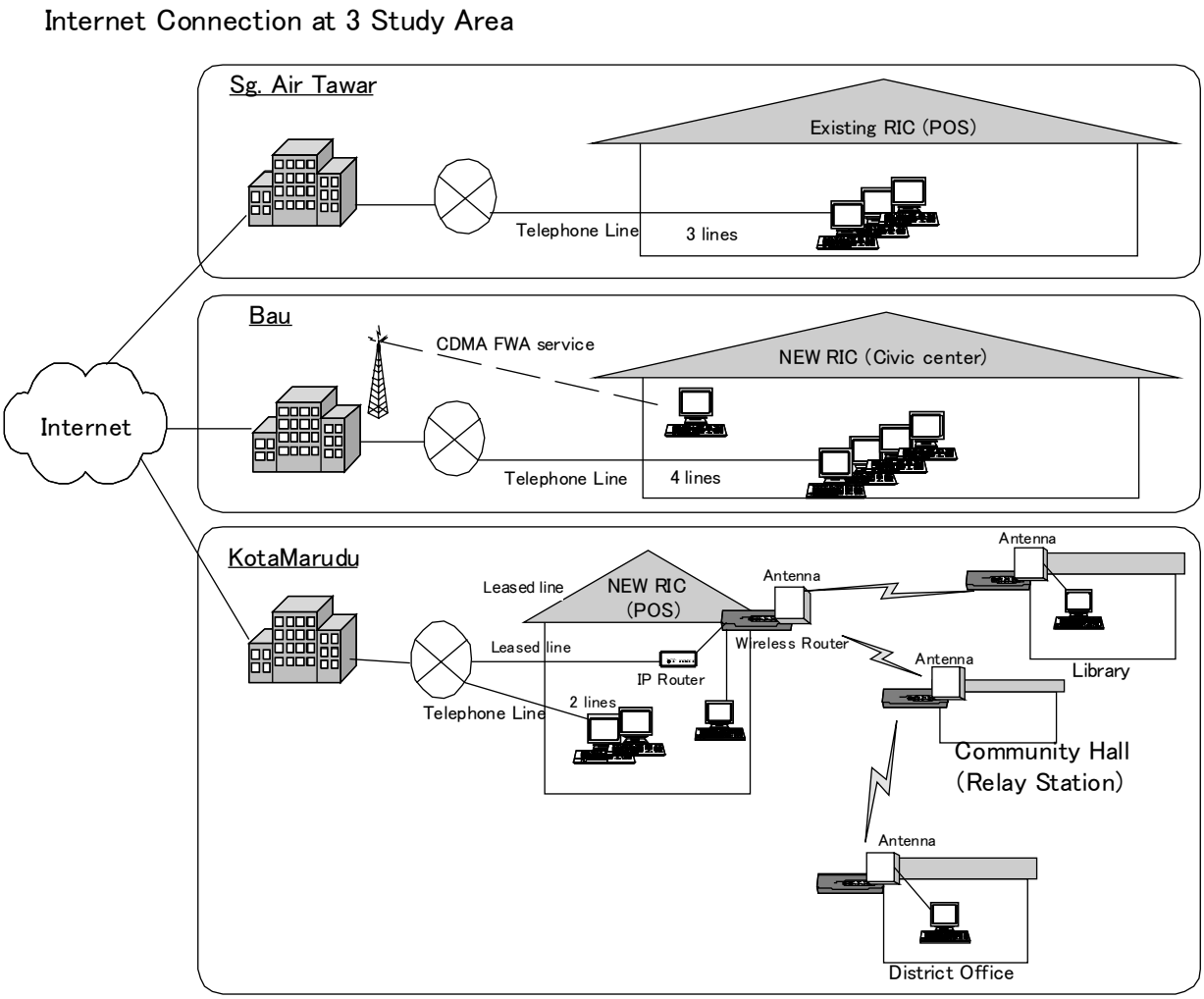


Figure III.3.1: Internet Connection at the Three Model Project Sites

(2) Experiment on Communication Infrastructure

(a) Objective

The experiment was carried out to confirm the performance of the communication infrastructure as shown below in order to design the optimal Internet access line for the RIC.

(i) Capacity of the communication infrastructure

- Telephone line
- CDMA FWA (Fixed wireless access) service
- Leased line

(ii) Internet access method

- Direct hookup

- Using IP router

(iii) Performance of the Wireless IP router (including relay)

(b) Evaluation items

Results of the experiment were checked for:

- Stability: Frequency of failure
- Capacity: Transmission speed (Maximal value)

(c) Location of the experiment

(i) Sg. Air Tawar, Selangor

- Telephone line
- Telephone line using IP router

(ii) Bau. Sarawak

- Telephone line
- CDMA FWA service

(iii) Kota Marudu, Sabahb

- Telephone line
- Leased line using IP router
- Leased line using IP router and Wireless IP router
- Leased line using IP router and Wireless IP router through Relay station

The contents of experiments are illustrated in the subsequent figure.

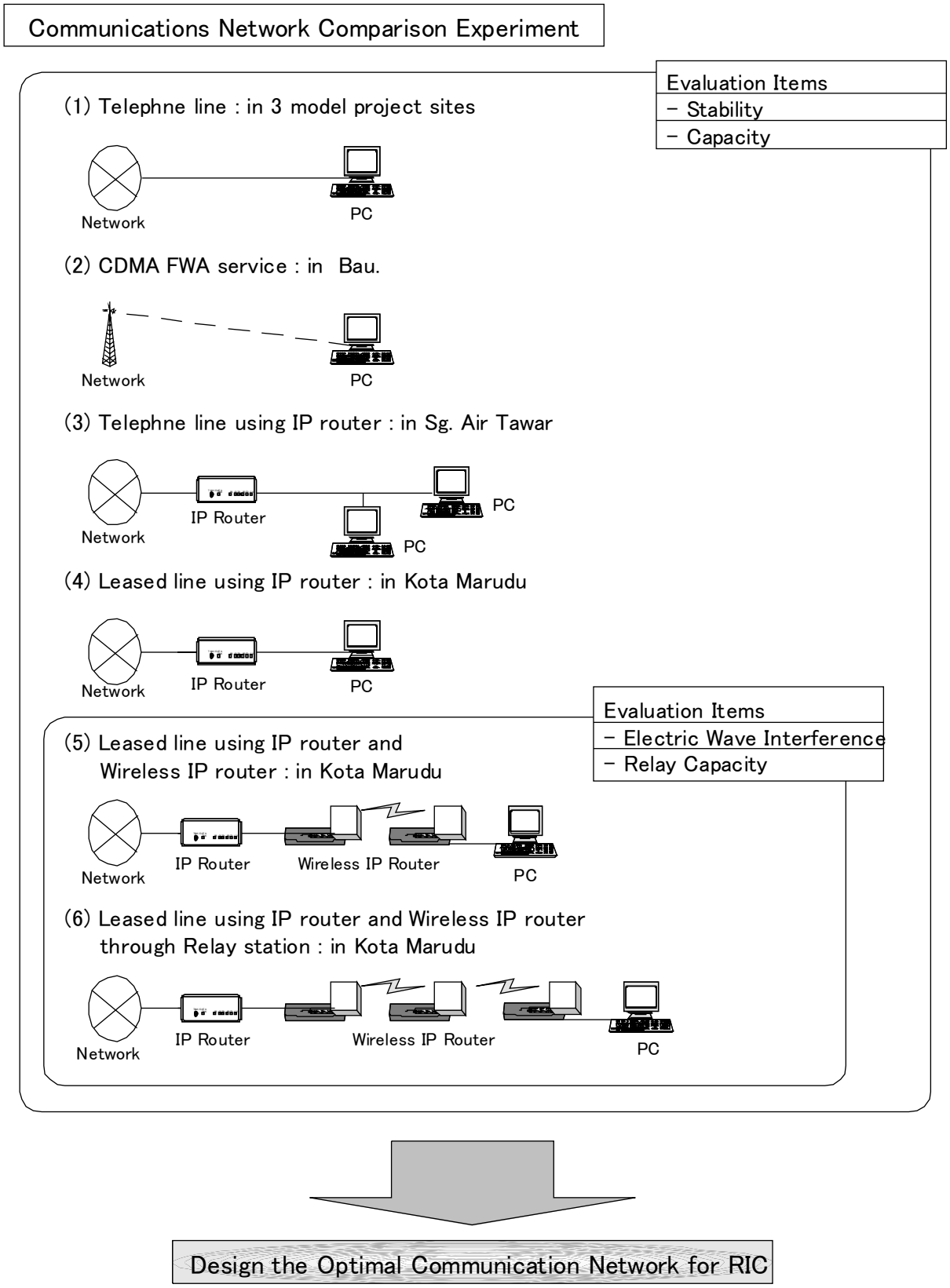


Figure III.3.2: Outline of Communications Network Comparison Experiment

3.1.2 Outline of the Sg. Air Tawar Model Project

The RIC was established about two years ago in the post office. There were two computers that were used mainly for Internet access for users. Two existing computers were replaced with two new ones, and one additional new computer was installed for the model project. This computer will be used to access the Internet and to update the homepage.

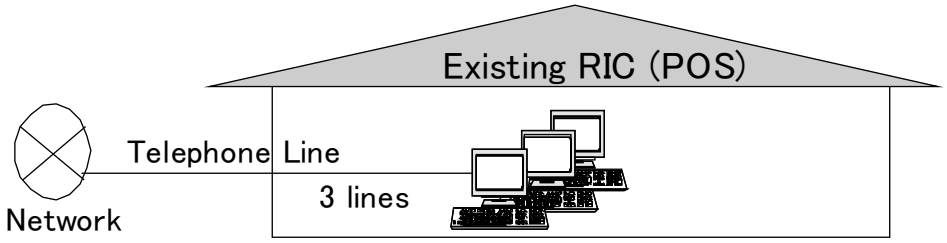


Figure III.3.3: Outline of Network at Sg. Air Tawar

(1) Location of the RIC

- Post Office

(2) Hardware system configuration

- Three personal computers
- Three UPS
- One Printer
- One Scanner
- One HUB

(3) Communication infrastructure

- Three telephone lines
- One IP router (for the experiment)

3.1.3 Outline of Bau Model Project

A new RIC was established in the Civic Center in Bau, and five personal computers were installed, mainly for Internet access for users. One of these five computers was also used to update the homepage and another one will be used to perform an experiment on FWA (fixed wireless access) service usage for data communication.

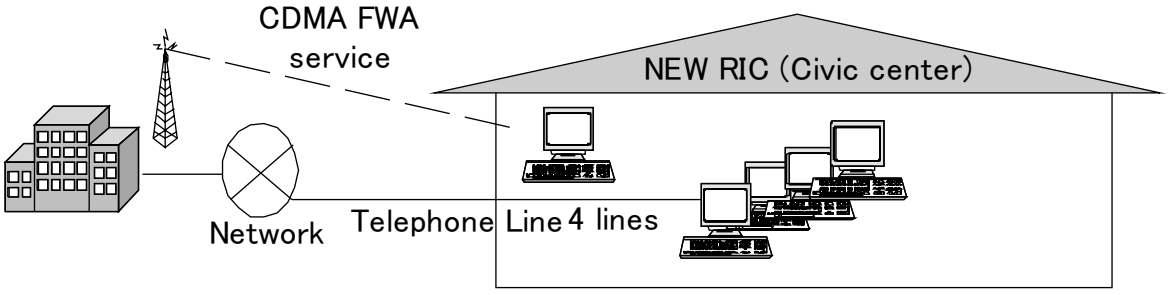


Figure III.3.4: Outline of Network at Bau

(1) Location of the RIC

- Civic Center

(2) Hardware system configuration

- Five personal computers
- Five UPS
- Three printers
- One scanner
- One HUB

(3) Communication infrastructure

- Four telephone lines
- One fixed wireless code division multiple access (CDMA)

3.1.4 Outline of the Kota Marudu Model Project

(1) Wireless LAN Experiment

Kota Marudu was selected to conduct a wireless LAN experiment through comparative analysis on the locational environment of each site in view of operation performance. These characteristics are shown below;

Site Selection for Target Wireless LAN Experiment

	Sg. Air Tawar	Bau	Kota Marudu
Public facilities	Library Village Office	No space is available in the Post Office for PC installation RIC is to be located at Civic Center	Community Hall Library District Office
Relay Experiment	Secondary school is located within four kilometers. High steel tower is required for relay experiment due to the existence of a fairly large plantation on the line.	Bau is hilly and is difficult to get long distance clear path for relay experiment.	Relay experiment is considered possible by a route of POS → Community Hall → District Office and about five meter high pole is enough for smooth connection.
Long distance Experiment (2～3km)	High steel tower is required to get a two to three kilometer path in the rural area like the targeted model project region due to the presence of a plantation where 20 meter high trees are abundant. Actually, 50 meter high steel tower was installed at the CDMA communication to get required clearance, but this is too large in the mini-powered wireless IP LAN experiment to be carried out in the Study.		
Management	It is observed that POS is worried about management burden of RIC.	Community is well developed and key persons including school teaching staff are available.	Post Office, Library, and District Office can conduct management and maintenance of the system.
Overall Evaluation	Difficult	Not possible	Appropriate

(2) Outline of Communication Infrastructure

An RIC and two Sub-RICs were established. Wireless LAN was tested.

A computer was installed mainly for Internet access for users in the library and the district office, and they were connected to a Wireless IP Router for the wireless LAN experiment. In the post office, three computers were installed mainly for Internet access for users. One of these three computers was used to update the home page and another one was connected to the Wireless IP Router for the Wireless LAN experiment.

The routes of Internet access on the wireless LAN are shown below.

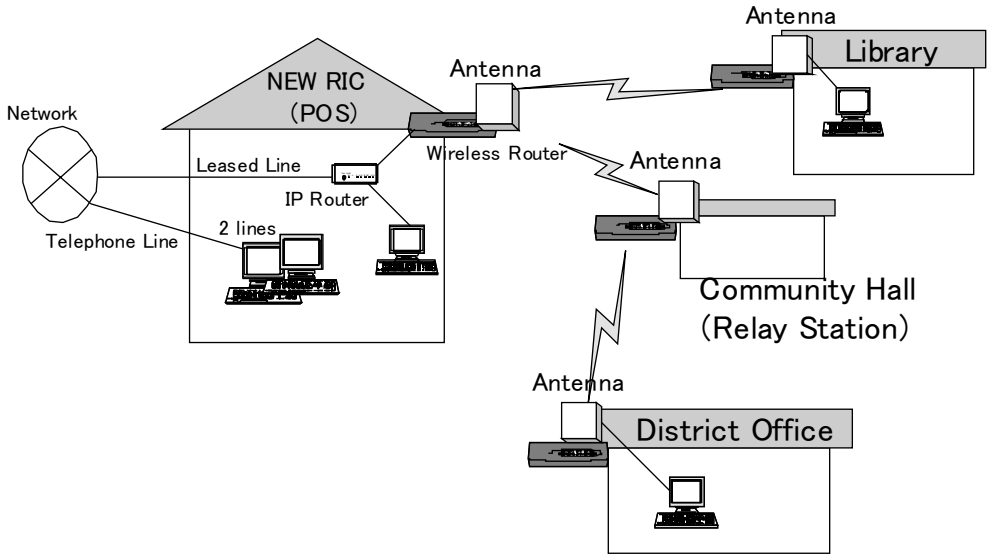


Figure III.3.5: Outline of Network at Kota Marudu

- Computer in the post office

  This computer is connected to a leased line for Internet access through the IP router in the post office

- Computer in the library

  This computer is connected wirelessly to the leased line through the wireless IP router in the library and the IP router in the post office

- Computer in the district office

  This computer is connected to the leased line through the wireless IP router in the district office, the two wireless IP routers at the relay station in the community center and the wireless IP router in the post office.

(a) Location of the RIC

- Post Office
- Library (Sub-station)
- District Office (Sub-station)

(b) Hardware System Configuration

Hardware systems installed are as follows.

(i) Post Office

- Three personal computers

- Two printers
- One Scanner

(ii) Library

- One personal computer
- One printer

(iii) District Office

- One personal computer
- One printer

(c) Communication Infrastructure and Equipment for Wireless LAN Experiment

Communication infrastructure and equipment for Wireless LAN experiment installed as follows.

(i) Post Office

- One leased line
- Two telephone lines
- One IP router
- One wireless IP router (Based on IEEE 802.11 b)
- One antenna

(ii) Library

- One wireless IP router (Based on IEEE 802.11 b)
- One antenna

(iii) District Office

- One wireless IP router (Based on IEEE 802.11 b)
- One antenna

(iv) Community Hall (Relay station)

- Two antennas
- Two Wireless routers (Based on IEEE 802.11 b)

3.2 Performance

3.2.1 Performance and Use of Sg. Air Tawar Model Project

(1) System configuration

The system configuration of RIC in Sg. Air Tawar is illustrated below.

Sg.AirTawar Layout

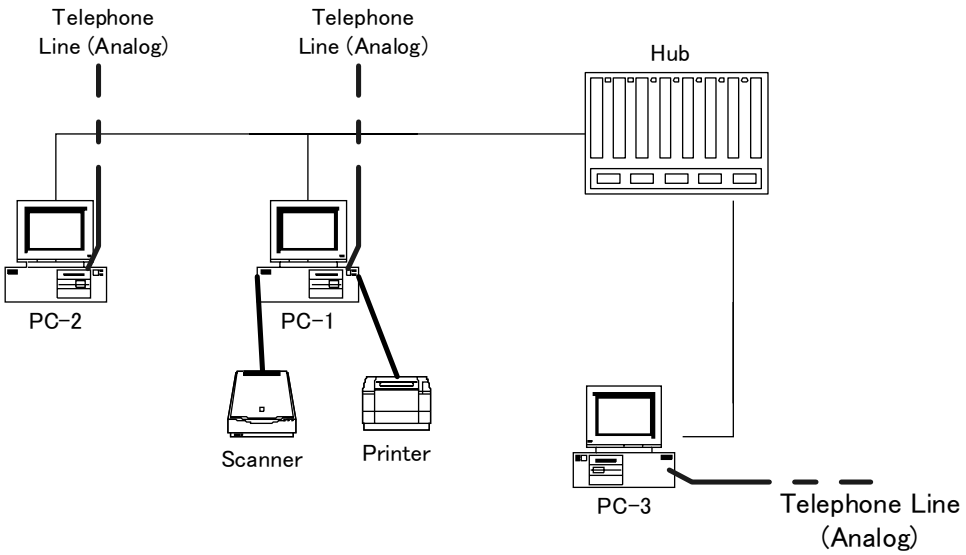


Figure III.3.6: System Configuration of Sg. Air Tawar RIC

(2) Computer specification and equipment

Main Computer Specification

Hardware	Software
1.CPU : Pentium4 1.8GHz	1. WindowsXP
2. RAM : 256MB	2. OfficeXP
3. HD : 40GB	3. Self Tutorial
4. FD	
5. LAN card	
6. Modem card	
7. USB port × 4	

Personal Computer

PC No.	Place	Installed Software and Peripherals
PC-1	Post Office	Photoshop, Illustrator, Front Page CD-R/RW, Scanner
PC-2	Post Office	
PC-3	Post Office	External Speaker

Other PC Peripherals

Name	Place
Printer (LBP-2000)	Post Office
Hub	Post Office

(3) Experiment on Communication Infrastructure

1) Summary of the experiment

The experiment was carried out to confirm the performance of the communication infrastructure as shown below in order to design the optimal Internet access line for the RIC.

The following experiment was done in Sg. Air Tawar.

(a) Performance of telephone line (direct hookup)

(b) Performance of telephone line (using IP router)

The contents of experiments are illustrated in the subsequent figure.

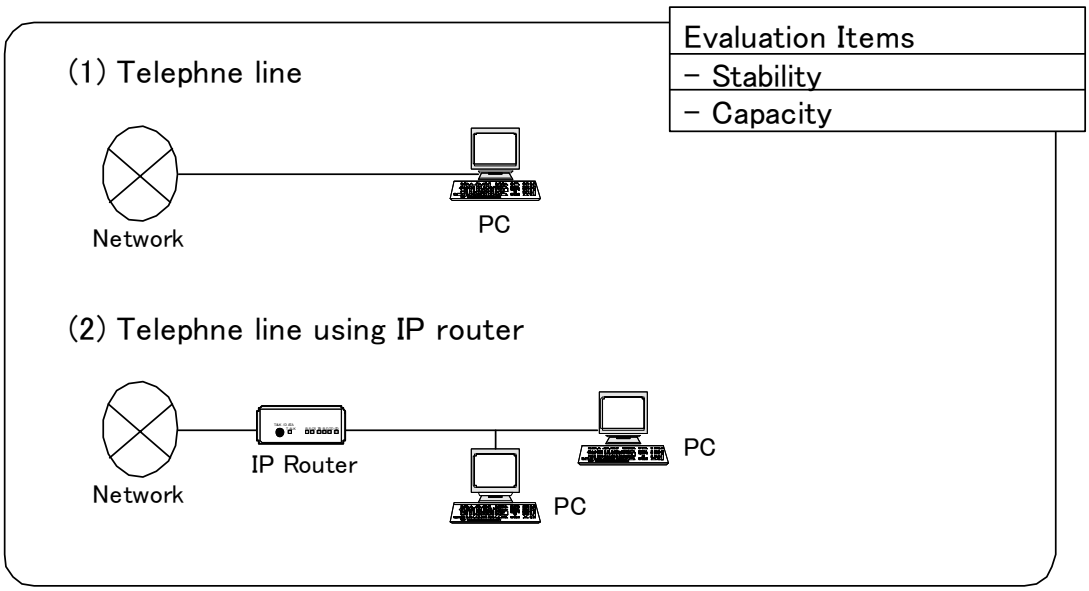


Figure III.3.7: Contents of Experiments

Results of the experiment are checked for the following

(i) Capacity

The following transmission speed of the Internet was measured.

- Download speed
- Upload speed

(ii) Stability:

The following frequency of delayed response was measured.

- Time series behavior of packets round-trip

2) Measuring method

(a) Capacity: Transmission speed of Internet

The time required to transmit 200KB of data was measured and then transmission speed was calculated.

(i) Speed measurement site

Three speed measurement sites were used, and the maximum speed was recorded out of each three measurements. There are 15 to 20 hop counts between the PC in RIC and the measurement sites. There are also 15 to 20 hop counts between the PC in the RIC and "Yahoo.com" which is one of the most often used sites in Malaysia or the RIC sites.

(ii) Measurement time

- Morning (at about 8 to 9 am)
- Afternoon (at about 12 to 1 pm),
- Evening (at about 5 to 6 pm)

(b) Stability: Frequency of delayed response

The status of communication between the PC at the RIC and the next hop router is verified by a Ping test. Round trip time of packets is measured as follows

- Amount of transmission data: 1KB
- Measurement interval: 10 sec.

- Number of times of measurement: 360 times

3) The result

(a) Performance of telephone line (Direct hookup)

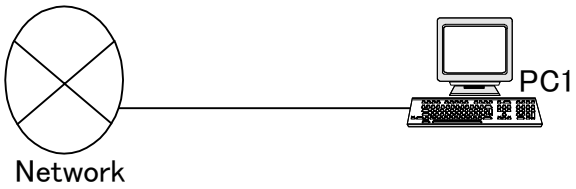


Figure III.3.8: Network System with Direct Hookup

(i) Capacity: Transmission speed of Internet

- Download speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	37.97kbps
Noon	37.08kbps
Evening	39.00kbps
Average	38.02 kbps

- Upload speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	32.10kbps
Noon	37.05kbps
Evening	37.43kbps
Average	35.53 kbps

(ii) Stability: Frequency of delayed response

Time series behavior of packet round-trip is shown below.

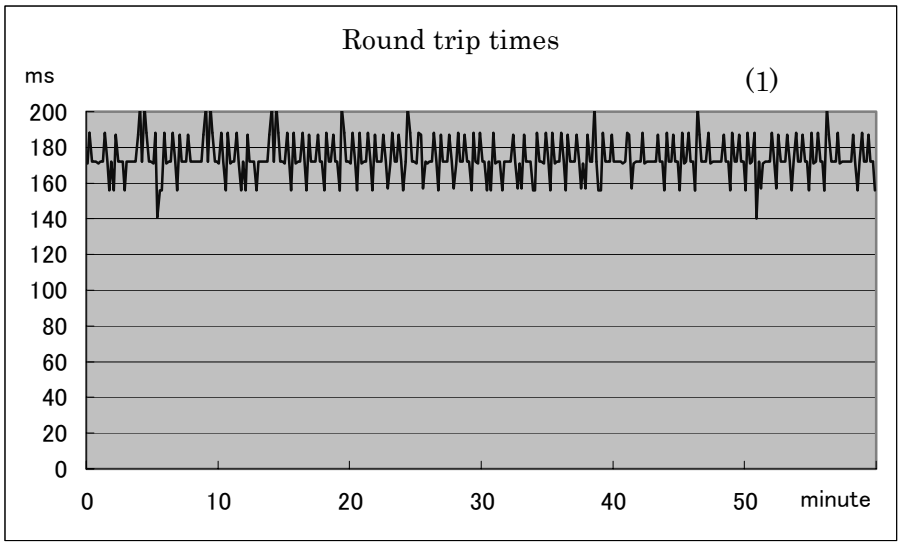


Figure III.3.9: Time Series Behavior of Packet Roundtrip Times with Direct Hookup at Sg. Air Tawar RIC (1)

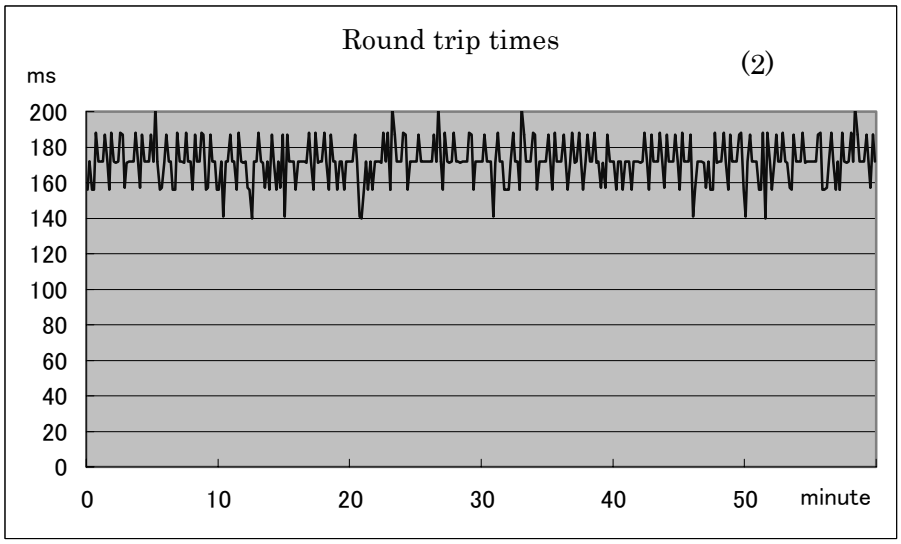


Figure III.3.10: Time Series Behavior of Packet Roundtrip Times with Direct Hookup at Sg. Air Tawar RIC (2)

During the measurement, line disconnects have not occurred.

The period of time for packet round-trip when 1 KB is transmitted is 160-200 ms.

(b) Performance of telephone line (using IP router)

The result when two PCs share one line is shown below.

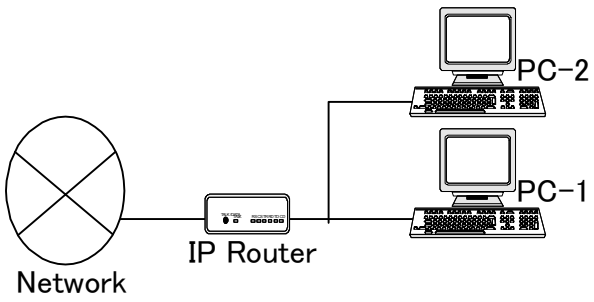


Figure III.3.11: Network System with IP Router

(i) Capacity: Transmission speed of Internet

- Download speed

The maximum speed when two PCs start to download simultaneously is shown below.

	Transmission speed
PC1	18.70kbps
PC2	17.44kbps
Average	18.07kbps

- Upload speed

The maximum speed when two PCs start to upload simultaneously is shown below.

	Transmission speed
Morning	16.87kbps
Noon	16.49kbps
Average	16.68kbps

(ii) Stability: Frequency of delayed response

Time series behavior of a packet round-trip on PC-1 while web access or mail exchange (transmission-and-reception) is performed on PC-2 is shown below.

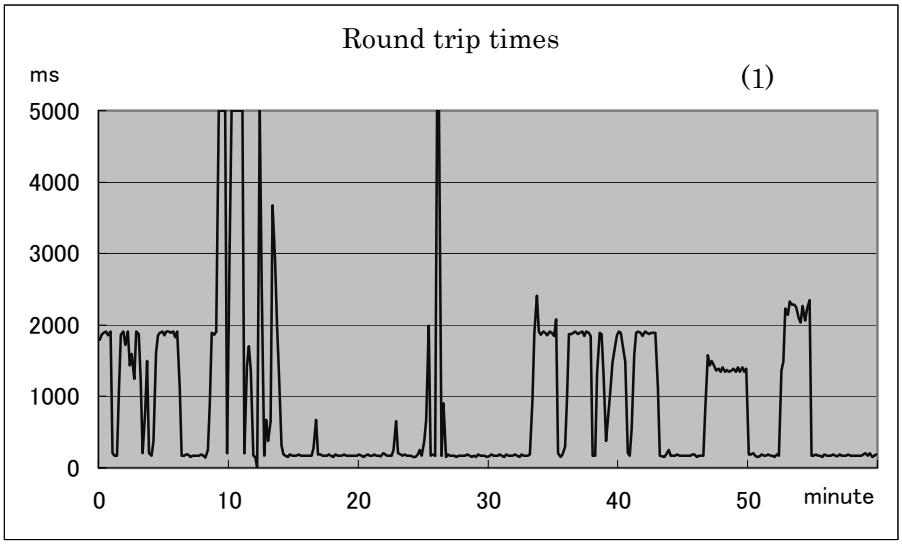


Figure III.3.12: Time Series Behavior of Packet Roundtrip Time on PC-1 with IP Router at Sg. Air Tawar (1)

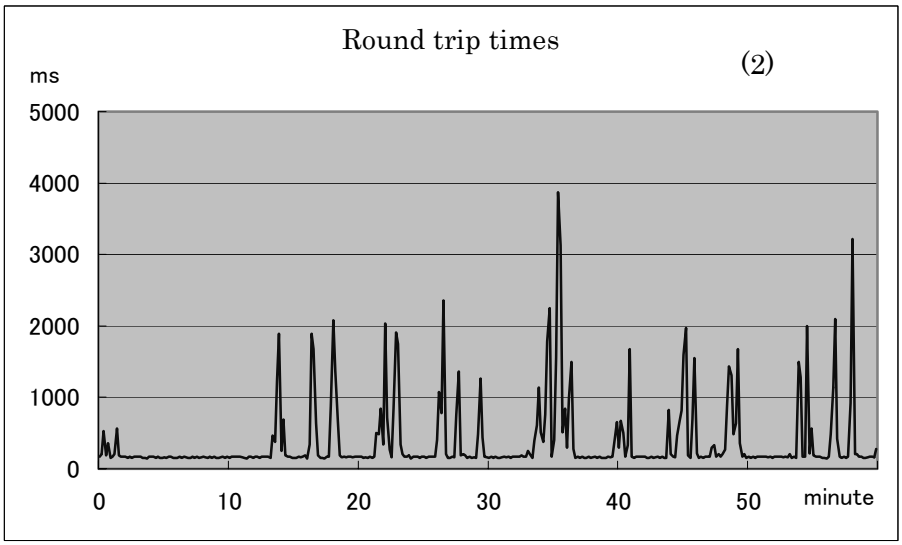


Figure III.3.13: Time Series Behavior of Packet Roundtrip Time on PC-1 with IP Router at Sg. Air Tawar (2)

The period of time for a packet round-trip on PC-2 is unstable when web access is performed using PC-1.

Time series behavior of a packet round-trip on PC-2 while web access is performed on PC-1 is shown below.

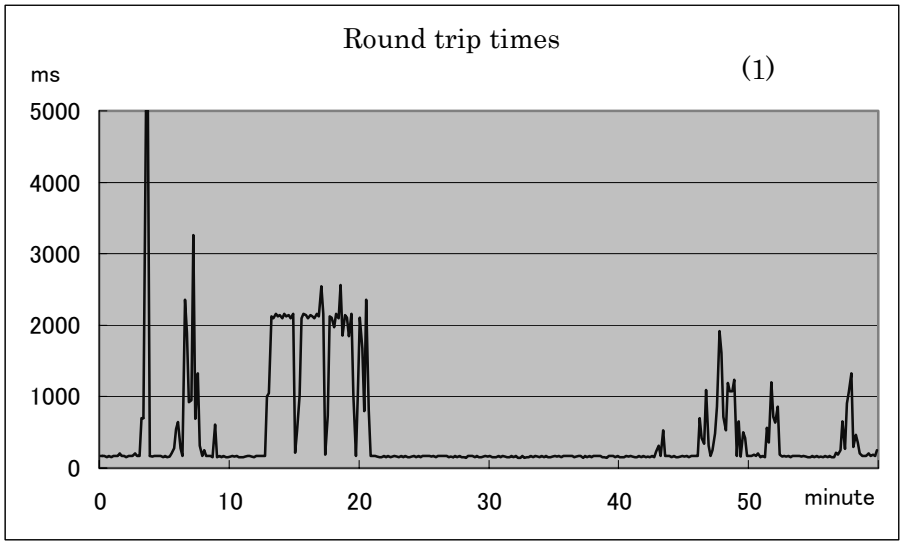


Figure III.3.14: Time Series Behavior of Packet Roundtrip Time on PC-2 with IP Router at Sg. Air Tawar (1)

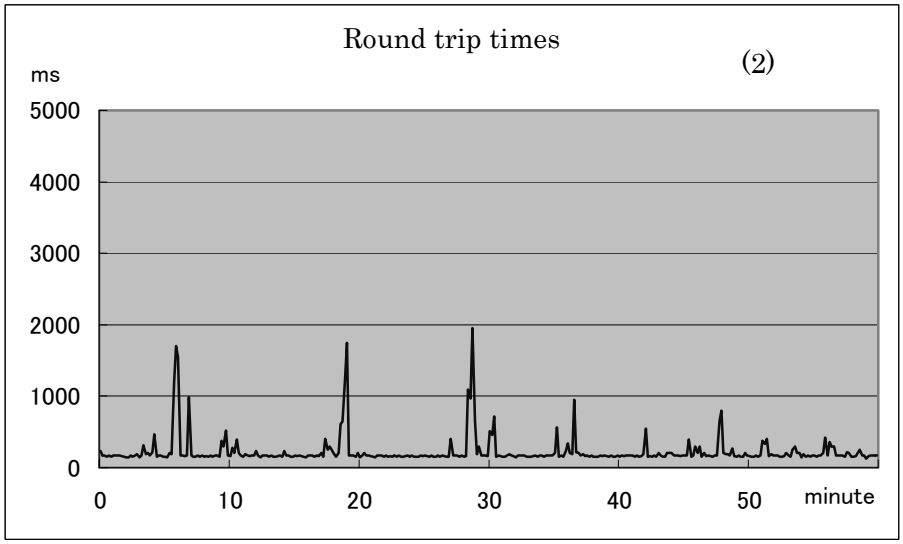


Figure III.3.15: Time Series Behavior of Packet Roundtrip Time on PC-2 with IP Router at Sg. Air Tawar (2)

The period of time for a packet round-trip on PC-2 is unstable when web access is performed using PC-1.

However during the measurement, line disconnects and communication incapability have not occurred.

4) Trace route and number of Hops

(i) Trace route to "Web site for RIC"

The trace route and the number of Hops to "www.sgairtawar.idesa.org.my " are shown below.

Tracing Route to www.sgairtawar.idesa.org.my

Number of Hops	IP address of site
1	210.187.128.177
2	210.187.15.237
3	202.188.61.68
4	210.187.132.65
5	210.187.135.1
6	202.188.0.2
7	202.188.0.11
8	202.188.2.110
9	202.188.245.16 (www.sgairtawar.idesa.org.my)

(ii) Trace route to "Other popular site"

The trace route and the number of Hops to "Yahoo.com" are shown below.

Tracing Route to www.yahoo.com

Number of Hops	IP address of site
1	210.187.128.177
2	210.187.15.233
3	210.187.129.65
4	210.187.133.65
5	210.187.135.2
6	208.222.10.77
7	152.63.54.118
8	152.63.54.1
9	152.63.52.229
10	166.90.50.133
11	209.247.10.237]
12	64.159.0.218
13	64.159.2.105
14	64.152.69.30
15	66.218.71.86 (www.yahoo.com)

3.2.2 Performance and Use of Bau Model Project

(1) System configuration

The system configuration of the RIC in Bau is illustrated below.

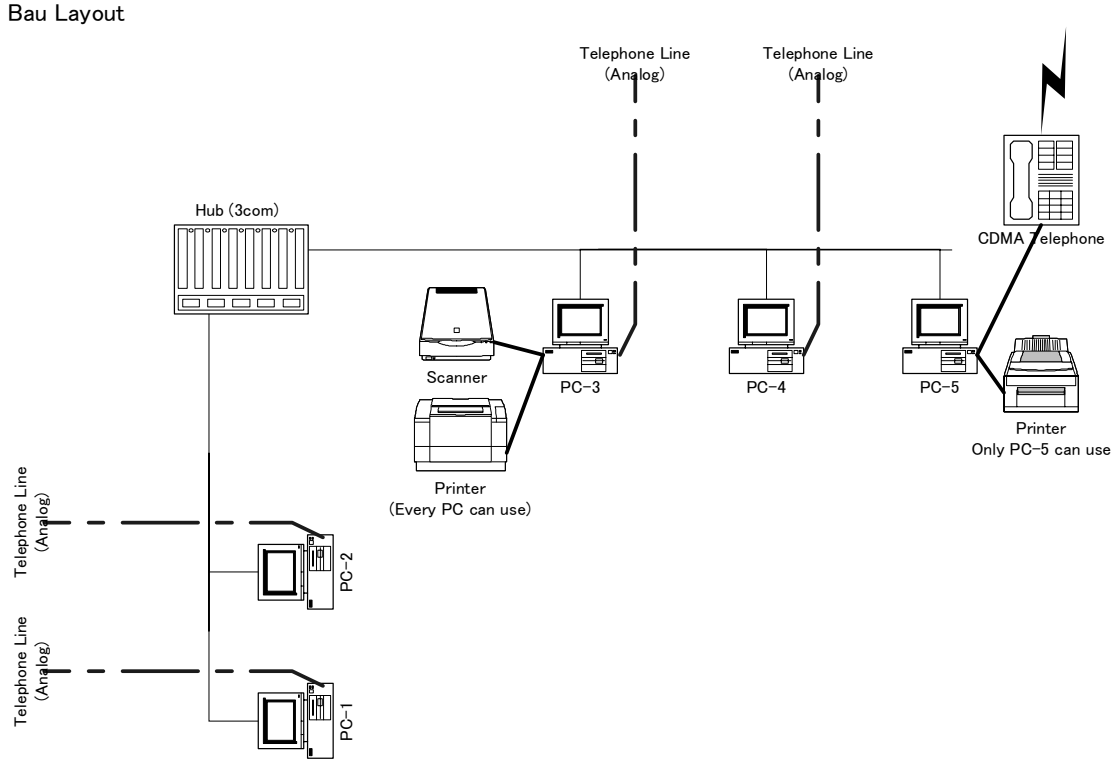


Figure III.3.16: System Configuration of Bau RIC

(2) Computer specification and equipment

Main computer specification

Hardware	Software
CPU : Pentium4 1.8GHz	1. WindowsXP
2. RAM : 256MB	2. OfficeXP
3. HD : 40GB	3. Self Tutorial
4. FD	
5. LAN card	
6. Modem card	
7. USB port × 4	

Personal Computer

PC No.	Place	Installed Software and Peripherals
PC-1	Civic Center	CD-RW
PC-2	Civic Center	
PC-3	Civic Center	
PC-4	Civic Center	PhotoShop, FrontPageScanner
PC-5	Civic Center	

Other PC Peripherals

Name	Place	Memo
Printer	Civic Center	Two
UPS	Civic Center	Each PC
Hub	Civic Center	

(3) Experiment on Communication Infrastructure

1) Summary of the experiment

The experiment was carried out to confirm the performance of the communication infrastructure as shown below in order to design the optimal Internet access line for the RIC.

The following experiment was done in Bau.

(a) Performance of telephone line

(b) Performance of CDMA FWA service

The contents of experiments are illustrated in the subsequent figure.

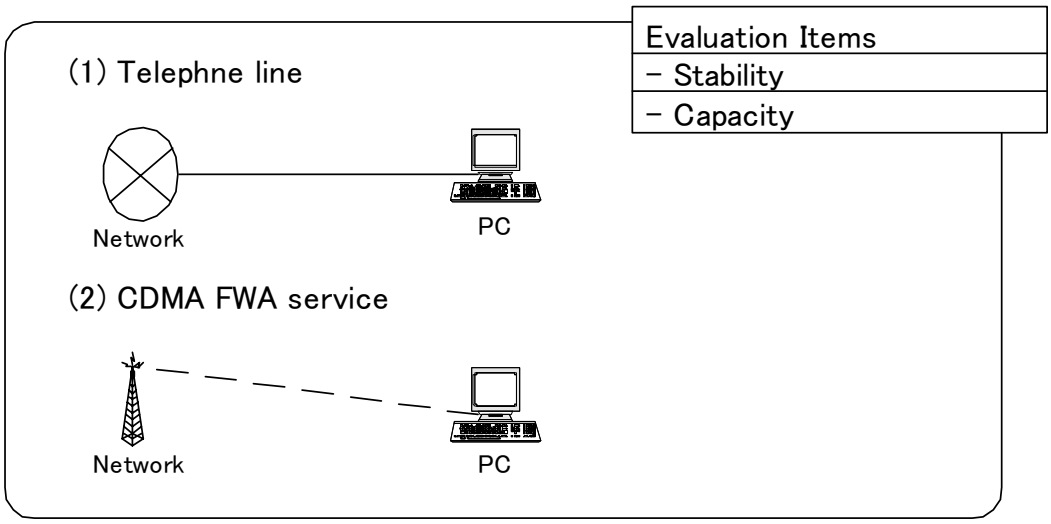


Figure III.3.17: Network System with Tel. Line and CDMA FWA

Results of the experiment are checked for the following

(i) Capacity

The following transmission speed of the Internet was measured.

- Download speed
- Upload speed

(ii) Stability

The following frequency of delayed response was measured.

- Time series behavior of packets round-trip

2) Measuring method

(a) Capacity: Transmission speed of the Internet

The time required to transmit 200KB of data was measured and then transmission speed was calculated.

(i) Speed measurement site

Three speed measurement sites were used, and the maximum speed was recorded out of each three measurements. There are 15 to 20 hop counts between the PC in the RIC and the measurement sites. There are also 15 to 20 hop counts between the PC in the RIC and "Yahoo.com" which is one of the most often used sites in Malaysia or the RIC sites.

(ii) Measurement time

- Morning (at about 8 to 9 am)
- Afternoon (at about 12 to 1 pm)
- Evening (at about 5 to 6 pm)

(b) Stability: Frequency of delayed response

The status of communication between the PC at the RIC and the next hop router is verified by a Ping test. Round trip time of packets was measured as follows

- Amount of transmission data: 1KB
- Measurement interval: 10 sec.
- Number of times of measurement: 360 times

3) The result

(a) Performance of telephone line (Direct hookup)

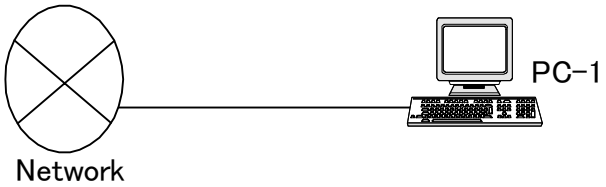


Figure III.3.18: Network System with Direct Hookup

(i) Capacity: Transmission speed of the Internet

- Download speed

The maximum speed of each period of time are shown below.

	Transmission speed
Morning	34.576kbps
Noon	32.948kbps
Evening	34.634kbps
Average	34.05 kbps

- Upload speed

The maximum speed of each period of time are shown below.

	Transmission speed
Morning	39.30kbps
Noon	40.40kbps
Evening	40.59kbps
Average	40.10 kbps

(ii) Stability: Frequency of delayed response

Time series behavior of packet round-trip is shown below.

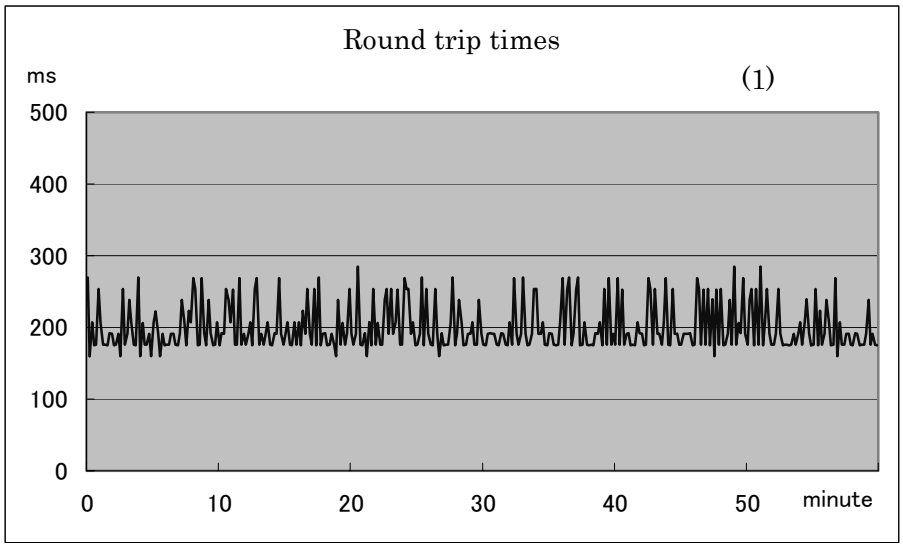


Figure III.3.19: Time Series Behavior of Packet Roundtrip with Direct Hookup at Bau RIC (1)

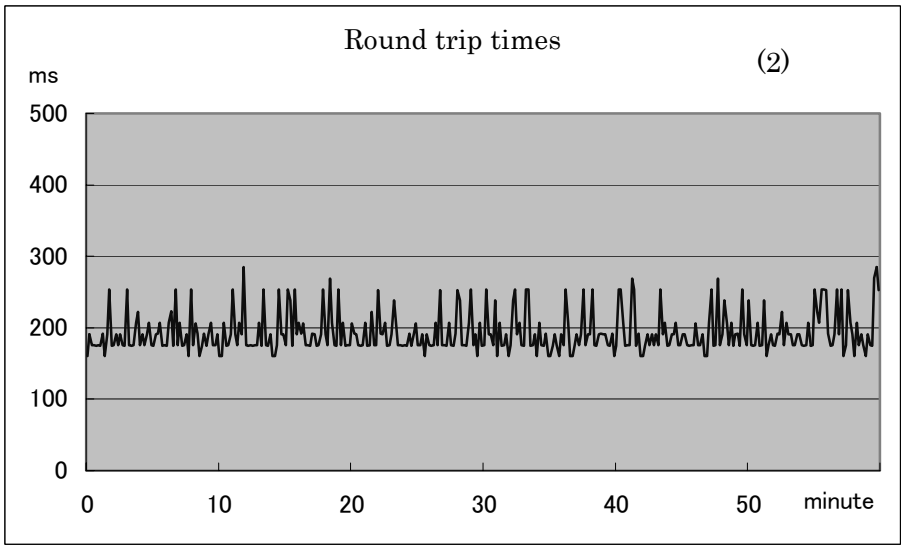


Figure III.3.20: Time Series Behavior of Packet Roundtrip with Direct Hookup at Bau RIC (2)

During the measurement, line disconnects have not occurred.

The period of time for a packet round-trip when 1 KB is transmitted is 170-230 ms.

(b) CDMA FWA service

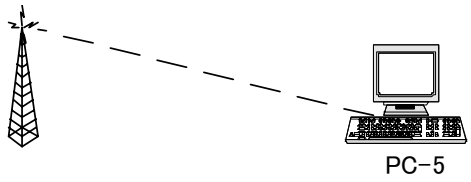


Figure III.3.21: Network System with CDMA FWA

(i) Download speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	41.625kbps
Noon	42.411kbps
Evening	42.029kbps
Average	42.02 kbps

(ii) Upload speed

The maximum speed when two PCs start to upload simultaneously is shown below.

	Transmission speed
Morning	7.48kbps
Noon	7.64kbps
Evening	7.64kbps
Average	7.59kbps

(iii) Speed and stability of the communication line itself

Time series behavior of a packet round-trip is shown below.

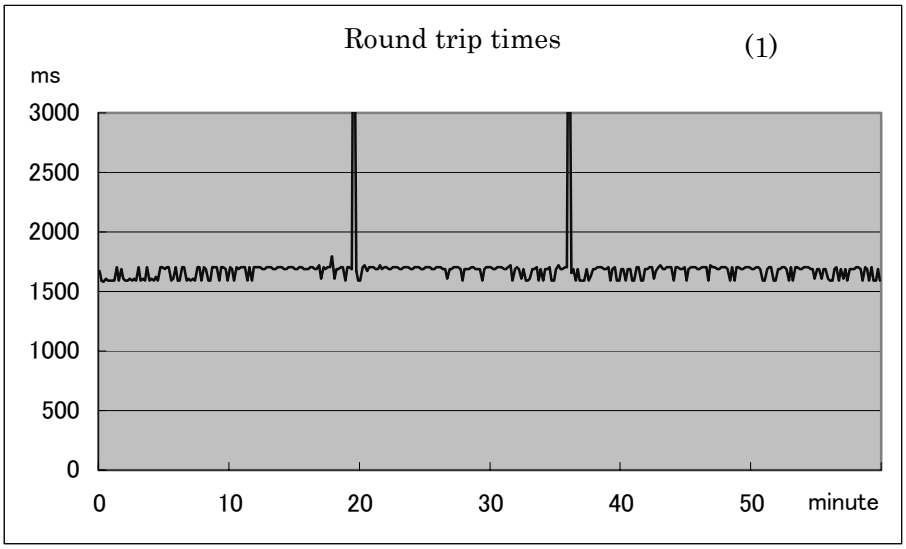


Figure III.3.22: Time Series Behavior of Packet Roundtrip with CDMA FWA at Bau RIC (1)

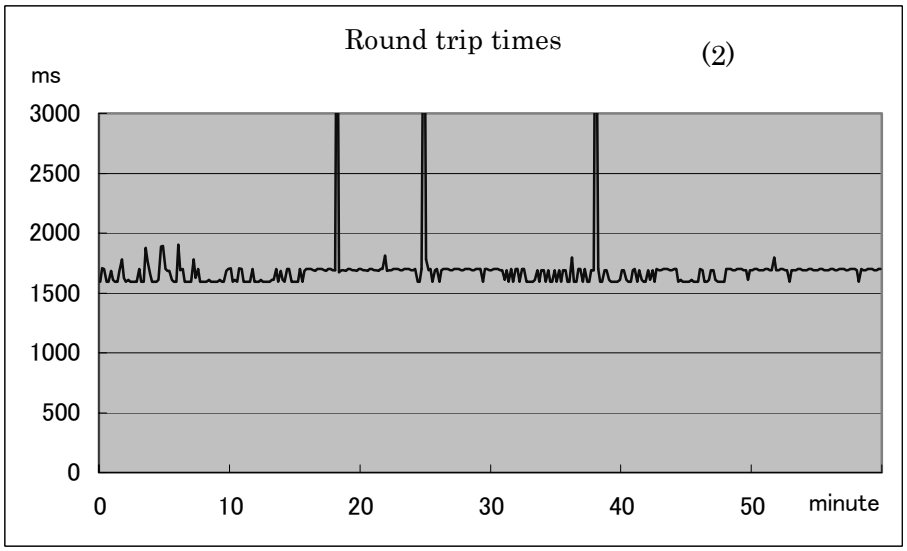


Figure III.3.23: Time Series Behavior of Packet Roundtrip with CDMA FWA at Bau RIC (2)

The period of time for a packet round-trip through the telephone line is more stable than that of CDMA FWA service.

During the measurement, line disconnects did not occur.

4) Trace route and number of Hops

(i) Trace route to "Web site for the RIC"

The trace route and the number of Hops to "www.bau.idesa.org.my" are shown below.

Tracing Route to www.bau.idesa.org.my

Number of Hops	IP address of site
1	203.106.173.1
2	203.106.173.20
3	203.106.48.173
4	202.188.3.67
5	203.106.253.133
6	203.106.128.65
7	202.188.0.2
8	202.188.0.11
9	202.188.2.110
10	202.188.245.16 (www.bau.idesa.org.my)

(ii) Trace route to "Other popular sites"

The trace route and the number of Hops to "Yahoo.com" are shown below.

Tracing Route to www.yahoo.com

Number of Hops	IP address of site
1	203.106.173.1
2	203.106.173.20
3	203.106.48.173
4	202.188.3.67
5	203.106.253.133
6	203.106.128.69
7	202.188.0.13
8	202.188.2.154
9	202.71.96.77
10	202.71.96.46
11	202.71.96.53
12	64.86.173.49
13	64.86.80.34
14	64.86.83.133
15	209.0.227.33
16	209.247.10.197
17	64.159.1.130
18	64.159.2.41
19	64.152.69.30
20	66.218.71.89 (www.yahoo.com)

3.2.3 Performance and Use of Kota Marudu Model Project

(1) System configuration

(a) Post Office

The system configuration is illustrated as shown below.

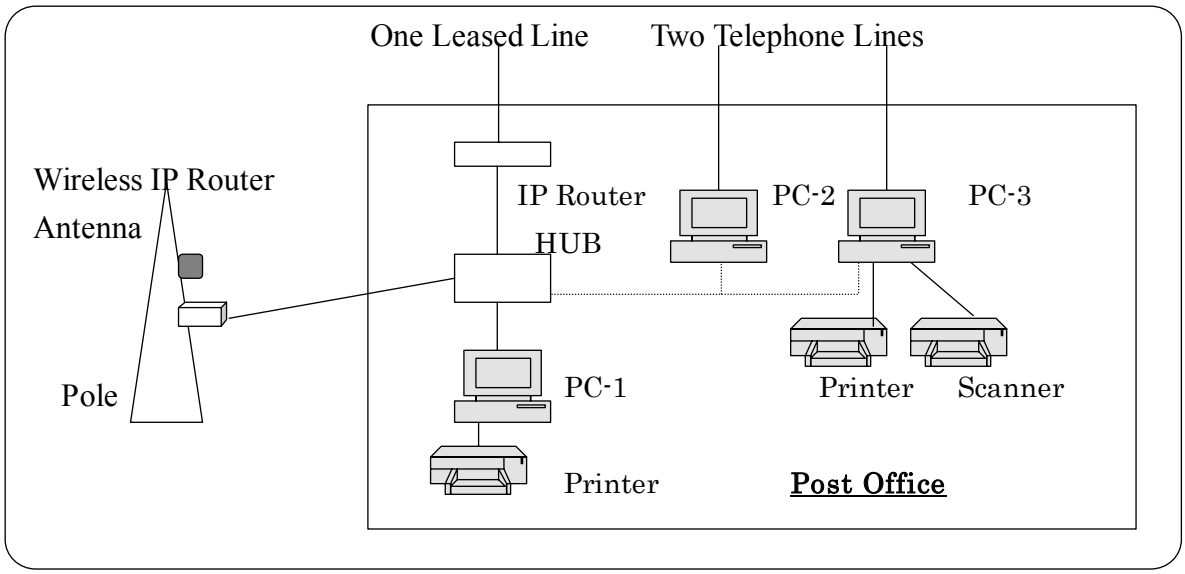


Figure III.3.24 : System Configuration at Post Office of Kota Marudu

Installation and construction works was performed as shown below.

(i) Construction of pole

- Supply and construction of a pole
- Supply of a flat plate floor mounting panel and accessories.
- Construction of concrete foundation
- Supply and installation of support strings

(ii) Installation of air terminal rod for lightning protection

(iii) Installation of IP router, wireless IP router, Antenna

(iv) Installation of cables, wiring materials and wiring

- Power cable, wiring material and wiring
- Grounding wire, wiring materials and wiring
- LAN cable, wiring materials and wiring

(v) Supply of customize mounting brackets

(b) Library

The system configuration is illustrated as shown below

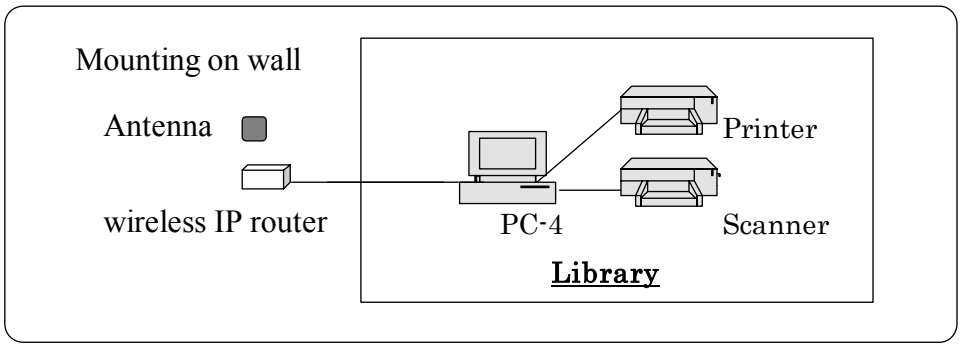


Figure III.3.25 : System Configuration at Library of Kota Marudu

Installation and construction works were performed as shown below.

(i) Mounting on wall

- Supply of a flat plate floor mounting panel and accessories
- Supply and installation of support strings

(ii) Installation of air terminal rod for lightning protection

(iii) Installation of wireless IP router and antenna

(iv) The cables, wiring materials and wiring

- Power cable, wiring material and wiring
- Grounding wire, wiring material and wiring
- LAN cable, wiring material and wiring

(v) Supply of mounting brackets

(c) District Office

The system configuration is illustrated as shown below.

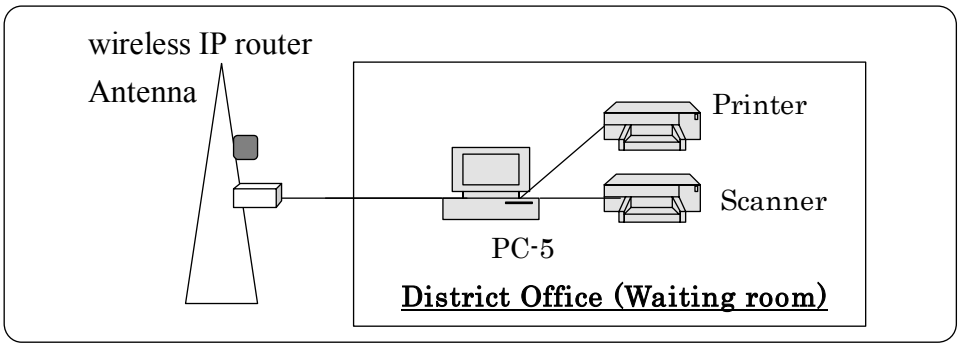


Figure III.3.26 : System Configuration at District Office of Kota Marudu

Installation and construction works were performed as shown below.

(i) Construction of pole

- Supply of flat plate floor mounting panel and accessories
- Construction of concrete foundation
- Supply and installation of support string

(ii) Installation of air terminal rod for lightning protection

(iii) Installation of wireless IP router and antenna

(iv) The cables, wiring materials and wiring

- Power cable, wiring material and wiring
- Grounding wire, wiring material and wiring
- LAN cable, wiring material and wiring

(v) Supply of customize mounting brackets

(d) Community Hall

The system configuration is illustrated as shown below.

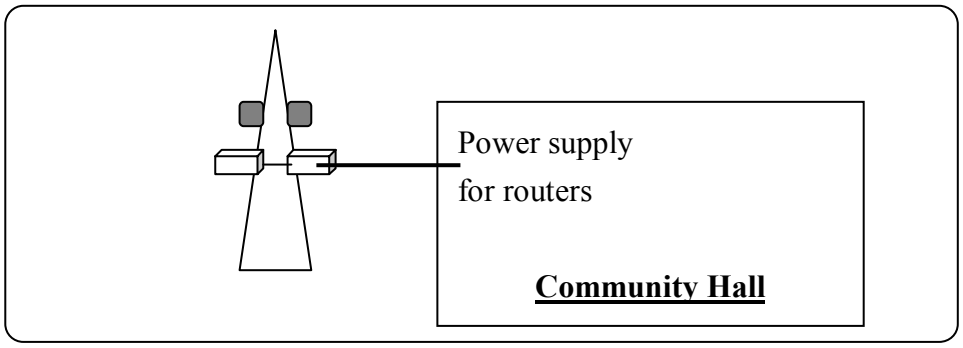


Figure III.3.27 : System Configuration at Community Hall of Kota Marudu

Installation and construction works were performed as shown below.

(i) Construction of pole

- Supply and construction of a pole
- Supply of flat plate floor mounting panel and accessories
- Construction of concrete foundation
- Supply and installation of support strings

(ii) Installation of air terminal rod for lightning protection

(iii) Installation of wireless IP router and antenna

(iv) The cables, wiring materials and wiring

- Power cable, wiring material and wiring
- Grounding wire, wiring material and wiring
- LAN cable, wiring material and wiring

(v) Supply of customize mounting brackets

(vi) Built of fences

The layout of the wireless LAN experiment is shown in Figure III.3.28.

(2) Computer specification and equipment

Main computer specification

Hardware	Remarks
1.CPU : Pentium4 1.8GHz	1. WindowsXP
2. RAM : 256MB	2. OfficeXP
3. HD : 40GB	3. Self Tutorial
4. FD	
5. LAN card	
6. Modem card	
7. USB port × 4	

Personal Computer

PC	Place	Installed Software and Peripherals	Remarks
PC-1	POS	Scanner	
PC-2	POS		
PC-3	POS		
PC-4	Library	Scanner	
PC-5	District Office	PhotoShop, FrontPage CD-RW Scanner	

Other PC Peripherals

Name	Place	Remarks
Printer	POS	
Printer	POS	
Printer	Library	
Printer	District Office	
UPS		Each PC
Hub	POS	
Hub	Library	
Hub	District Office	

(3) Equipment for Wireless LAN

The following equipment and materials shall be procured.

(a) Number of equipment

Number of equipment to be supplied is shown below.

	Equipment	Quantity	Remarks
1	Wireless IP router (RGW2400/OD)	6 set	1 set is as a spare.
2	Interface cable	6 pair	1 pair is as a spare.
3	IP router (CISCO805)	1 unit	For leased line
4	Patch antenna	5 unit	1 unit is as a spare.
5	Cardioids antenna	1 unit	For Post Office

(b) Equipment specification

Equipment specifications shall be as shown below.

SPECIFICATIONS <Wireless IP router>		
Radio Part	Modulation Techniques	DSSS (Direct Spread Spectrum System)
	Frequency	2.4GHz Band
	Channel	13ch
	Antenna Power	10mW/MHz
	Transmission Rate	11Mbps
	Base Band Modulation	PSK or CCK
	Link range	1km
	Interface	10/100BASE-T (RJ45)
LAN Part	Interface Transmission Protocols	Ethernet/IEEE802.3
	Routing Protocols	RIPv2
	Power	AC240V
Others	Temperature conditions	-10～50 (Degree Celsius)
	Electric power	10W 15VA
	IP allocation	DHCP(dynamic host configuration protocol)
	Management Protocols	SNMP(simple network management protocol)
	OS(Operating system)	NetBSD

SPECIFICATIONS <Antenna>	
Regulation	Patch Antenna
Frequency	2400-2500MHz
Angle of beam spread	60°
Regulation	Cardioid Antenna
Frequency	2400-2500MHz
Angle of beam spread	140°

(4) Experiment on Communication Infrastructure

(a) Summary of the experiment

Experiment was carried out to confirm the performance of the communication infrastructure as shown below in order to design the optimal Internet access line for the RIC.

The following experiment was carried out in Kota Marudu.

i) Performance of telephone line

ii) Performance of leased line: at post office

iii) Performance of leased line through wireless IP router: at library

iv) Performance of leased line through relay station: at district office

The contents of experiments are illustrated in the subsequent figure.

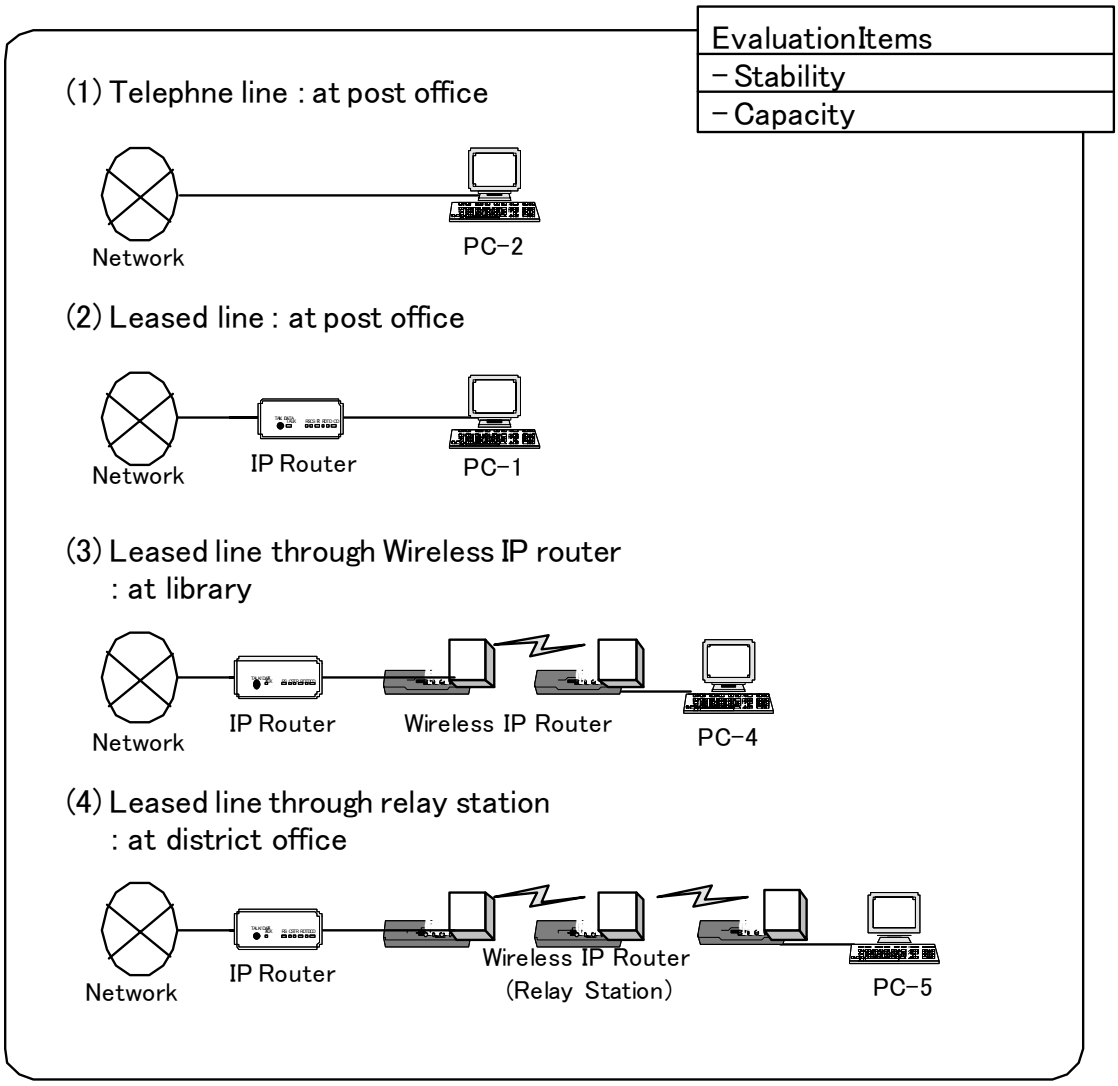


Figure III.3.29 : Contents of Experiments of Stability and Capacity at Kota Marudu

Results of the experiment were checked for the following aspects.

(i) Capacity

The following transmission speed of Internet was measured

- Download speed
- Upload speed

(ii) Stability

The following frequency of delayed response was measured.

- Time series behavior of packets round-trip

(b) Measuring method

(i) Capacity: Transmission speed of the Internet

The time required to transmit 200KB of data was measured and then transmission speed was calculated.

i) Speed measurement site

Three speed measurement sites are used, and the maximum speed is recorded out of each three-time measurement. There are 15 to 20 hop counts between PC in RIC and measurement sites. Because there are also 15 to 20 hop counts between PC in RIC and "Yahoo.com" which is one of the most often used sites in Malaysia or the RIC sites.

ii) Measurement time

- Morning (at about 8 to 9 am)
- Afternoon (at about 12 to 1 pm)
- Evening (at about 5 to 6 pm)

(c) Stability: Frequency of delayed response

The status of communication between the PC at RIC and the next hop router is verified by Ping test. Round trip time of packets is measured as following

- Amount of transmission data: 1KB
- Measurement interval: 10 sec.
- Number of times of measurement: 360 times

(d) The result of Internet access experiment

(i) Performance of telephone line

System network with telephone line is shown below.

Figure III.3.30 : System Network with Telephone Line

i) Capacity: Transmission speed of the Internet

- Download speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	44.6kbps
Noon	42.205kbps
Evening	41.454kbps
Average	42.75kbps

- Upload speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	40.72kbps
Noon	38.42kbps
Evening	43.83kbps
Average	40.99kbps

ii) Stability: Frequency of delayed response

Time series behavior of packet round-trip for two hours is shown below.

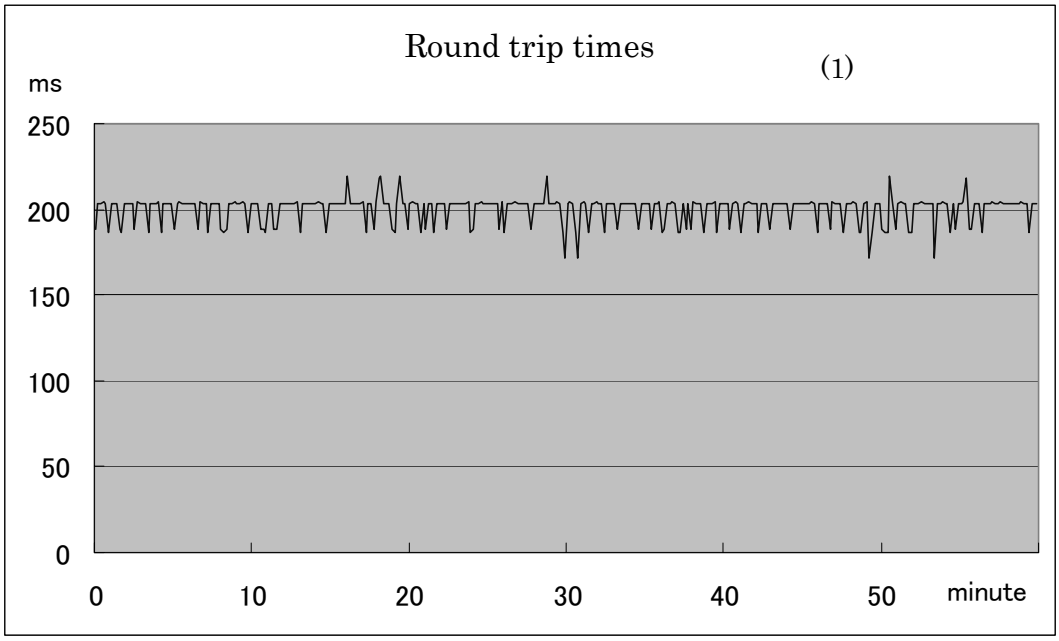


Figure III.3.31: Time Series Behavior of Packet Roundtrip with Direct Hookup at Kota Marudu (1)

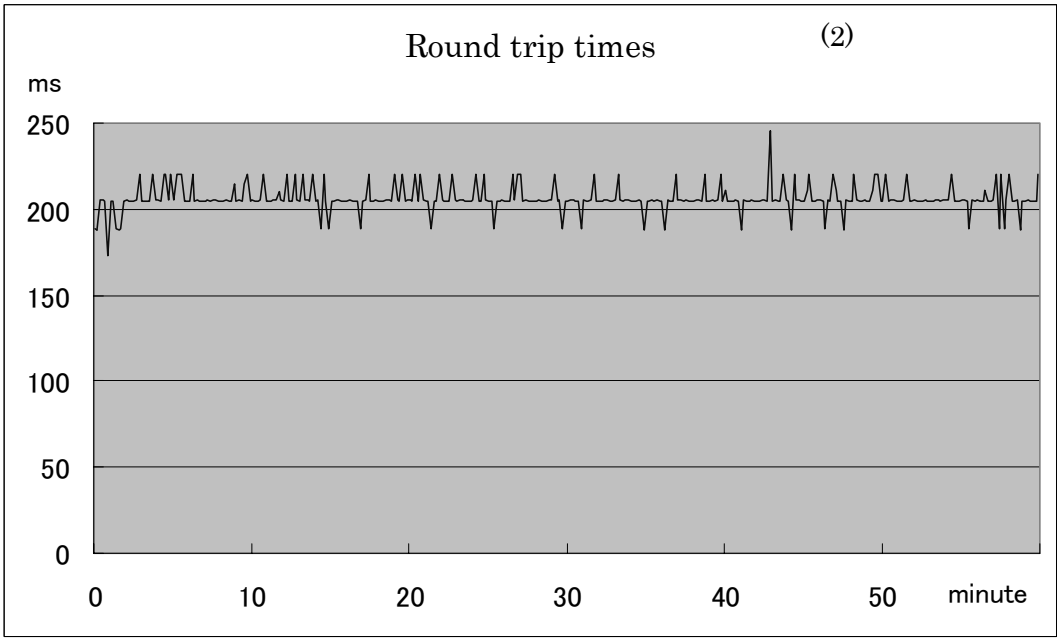


Figure III.3.32: Time Series Behavior of Packet Roundtrip with Direct Hookup at Kota Marudu (2)

During the measurement, disconnects of line have not occurred.

The period of time for packet round-trip when 1 KB is transmitted is 180-220 ms.

(ii) Performance of leased line: at post office

System network with IP router is shown below.

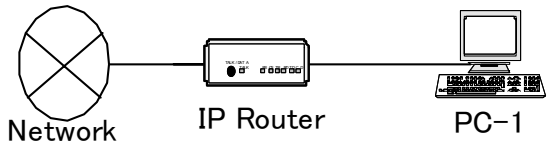


Figure III.3.33 : System Network with IP Router

i) Capacity: Transmission speed of Internet

- Download speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	111. 489kbps
Noon	110. 036kbps
Evening	110. 435kbps
Average	110.65 kbps

- Upload speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	122. 30kbps
Noon	121. 39kbps
Evening	122. 77kbps
Average	122.15 kbps

ii) Stability: Frequency of delayed response

Time series behavior of packet round-trip for two hours is shown below.

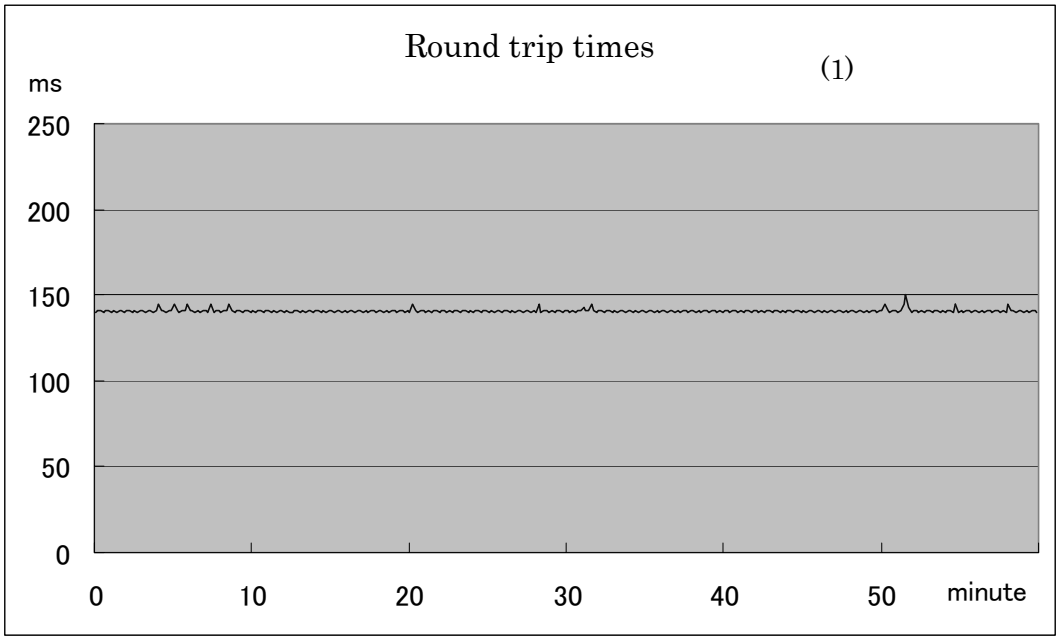


Figure III.3.34: Time Series Behavior of Packet Roundtrip with IP Router at Kota Marudu (1)

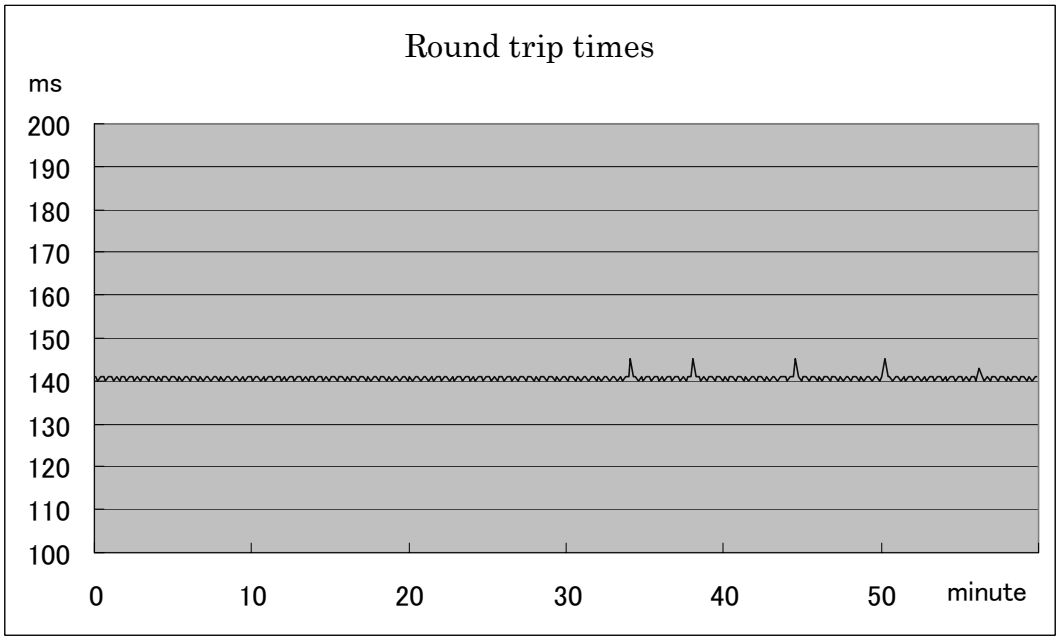


Figure III.3.35: Time Series Behavior of Packet Roundtrip with IP Router at Kota Marudu (2)

During the measurement, disconnects of line have not occurred.

The period of time for packet round-trip when 1 KB is transmitted is about 140 ms.

Communication line was very stable.

(e) Performance of leased line through wireless IP router: at library

System network with wireless IP router at the library is shown below.

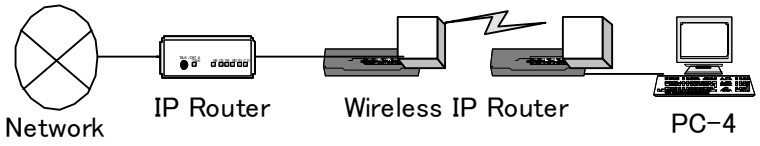


Figure III.3.36 : System Network with Wireless IP Router at Library

(i) Capacity: Transmission speed of Internet

- Download speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	103.452kbps
Noon	106.938kbps
Evening	110.242kbps
Average	106.88kbps

- Upload speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	121.64kbps
Noon	121.88kbps
Evening	121.87kbps
Average	121.80kbps

(ii) Stability: Frequency of delayed response

Time series behavior of packet round-trip for two hours on PC-4 at library while web access or mail exchange is performed on PC-1 at post office is shown below.

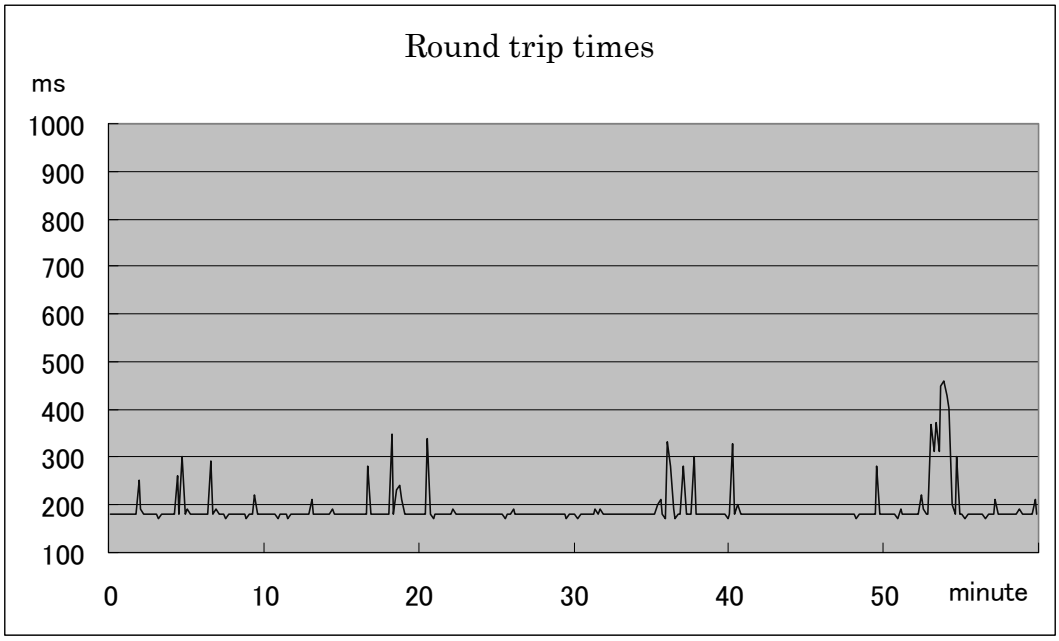


Figure III.3.37: Time Series Behavior of Packet Roundtrip with Wireless IP router at Kota Marudu (1)

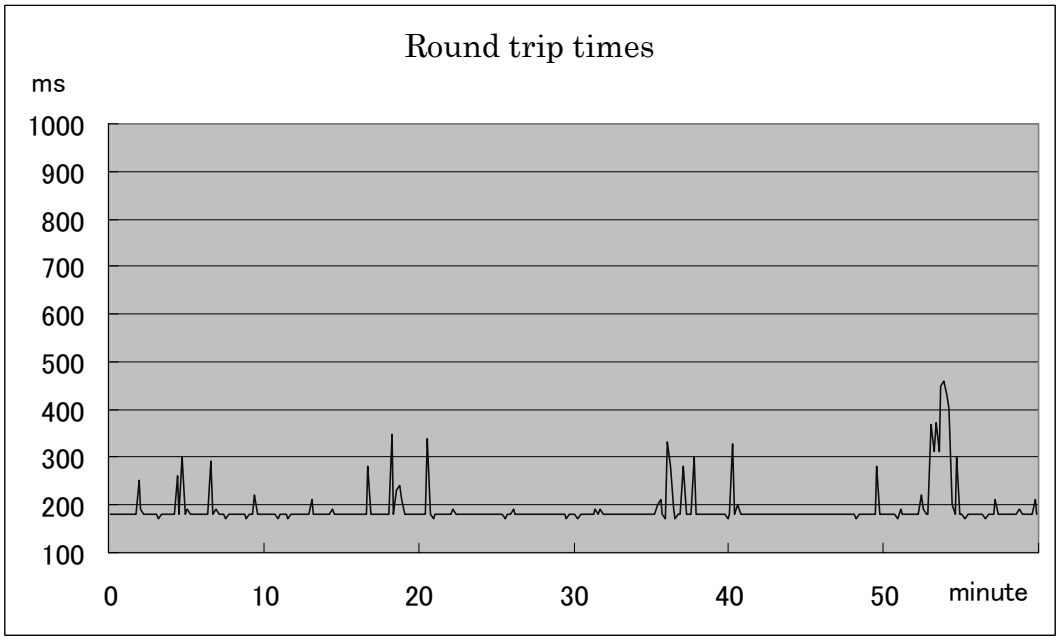


Figure III.3.38: Time Series Behavior of Packet Roundtrip with Wireless IP router at Kota Marudu (2)

During the measurement, disconnects of line have not occurred.

The period of time for packet round-trip on PC-4 is a bit unstable when web access is performed by PC-1. But there are a few influences on the communication line in comparison with the case that telephone lines are used

at the same time.

(f) Performance of leased line through relay station: at district office

System network through the relay station is shown below.

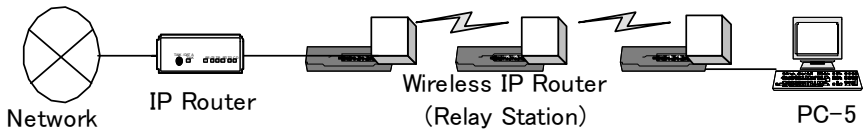


Figure III.3.39 : System Network through Relay Station

(i) Capacity: Transmission speed of Internet

- Download speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	109.845kbps
Noon	107.497kbps
Evening	110.036kbps
Average	109.126kbps

- Upload speed

The maximum speeds of each period of time are shown below.

	Transmission speed
Morning	120.97kbps
Noon	121.39kbps
Evening	121.45kbps
Average	121.27kbps

(ii) Stability: Frequency of delayed response

Time series behavior of packet round-trip for two hours on PC-5 at district office while web access or mail exchange is performed on PC-1 at post office is shown below.

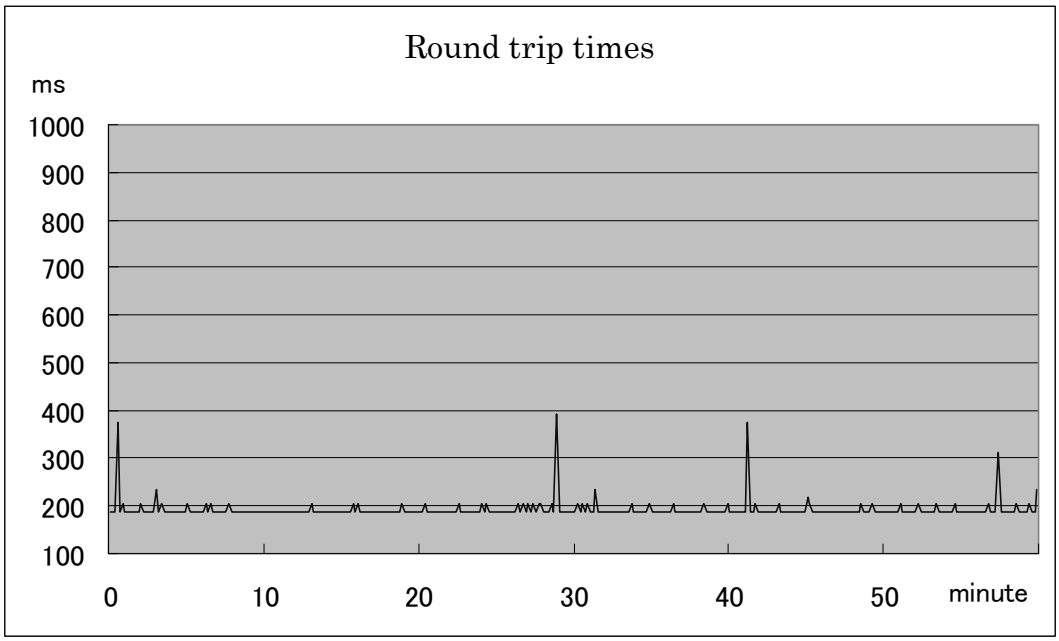


Figure III.3.40: Time Series Behavior of Packet Roundtrip through Relay Station at Kota Marudu (1)

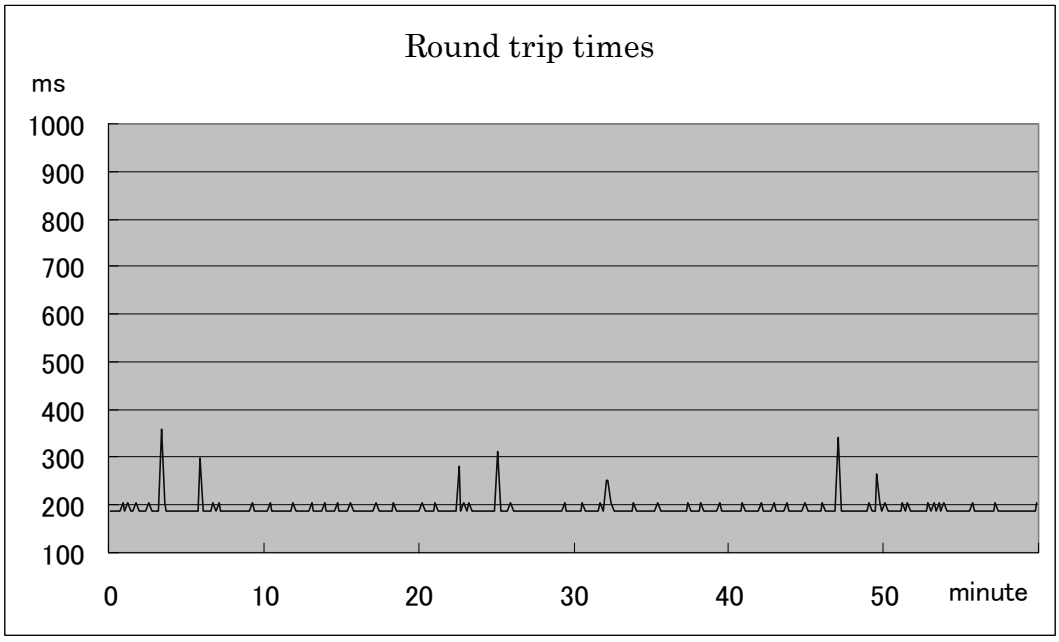


Figure III.3.41: Time Series Behavior of Packet Roundtrip through Relay Station at Kota Marudu (2)

During the measurement, disconnects of line have not occurred.

The period of time for packet round-trip on PC-5 is a bit unstable when web

access is performed by PC-1. But there are a few influences on the communication line in comparison with the case that telephone lines are used at the same time.

(5) Experiment on wireless LAN

(a) Summary of the experiment

Experiment was carried out to confirm the performance of the wireless LAN.

The following experiment was carried out in Kota Marudu

i) Radio frequency interference survey

ii) Performance of the relay station

The contents of experiments are illustrated in the subsequent figure

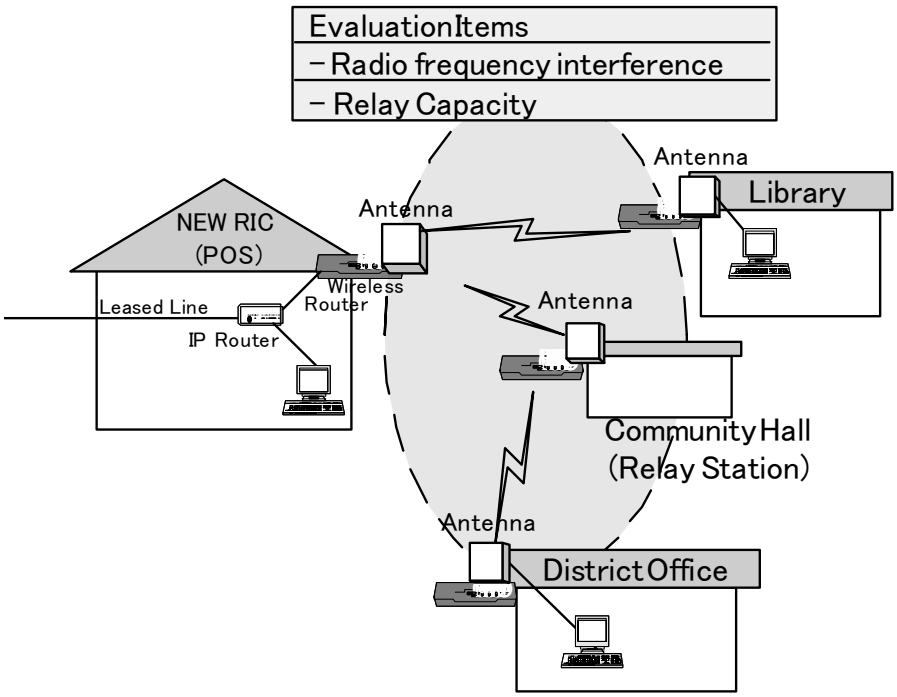


Figure III.3.42 : Contents of Experiments of Radio Frequency and Relay Capacity at Kota Marudu

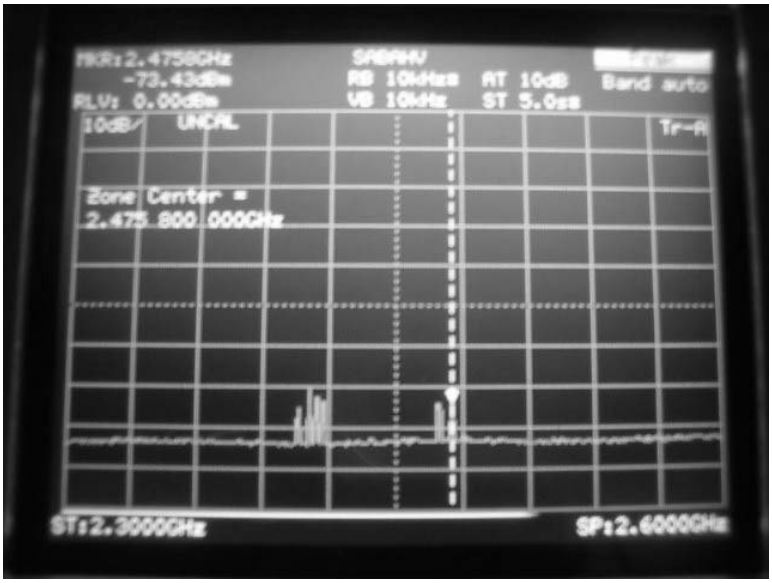
(b) The result of measuring performance of the wireless LAN

(i) Radio frequency interference survey

Radio frequency interference survey was performed on newly built wireless LAN stations.

The main objective of this survey is to determine whether a proposed Microwave Link using a certain frequency band is suitable for implementation from a Maximum Permissible Interference Level (MPIL) point of view.

The results of radio frequency survey are shown below.

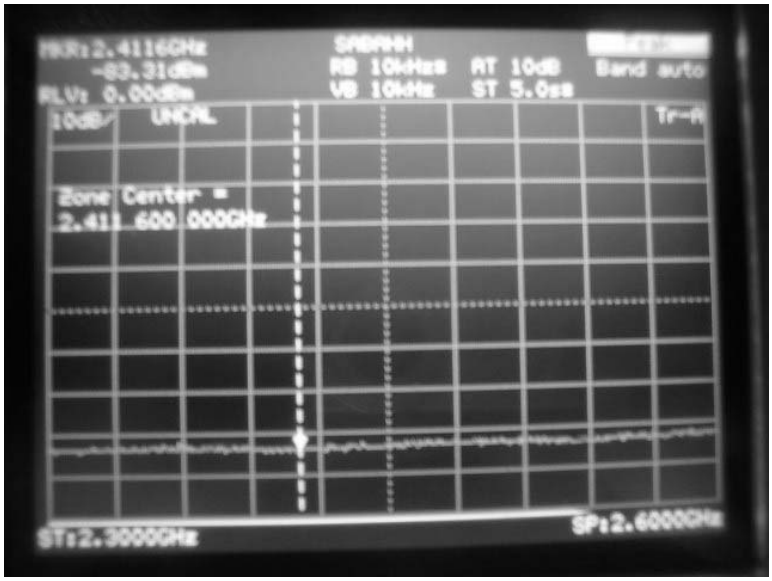


Frequency: 2.3-2.6 GHz

Azimuth: 0-360 degree

Figure III.3.43 : Results of Radio Frequency Survey (Picture A)

The signals were detected in above Picture A (frequency 2.3-2.6GHz) by the spectrum analyzer when the wireless IP router was switched on.



Frequency: 2.3-2.6 GHz

Azimuth: 0-360 degree

Figure III.3.44 : Results of Radio Frequency Survey (Picture B)

None detected above Picture B (frequency 2.3-2.6GHz) from all directions by the spectrum analyzer when the wireless IP router was switched off.

Radio frequency interference couldn't be discovered in this experiment.

(ii) Performance of the relay station

The effective speed between following each place was compared, and the performance of the relay station was verified.

i) Post Office – Library

ii) Post Office – District Office

iii) Library – District Office

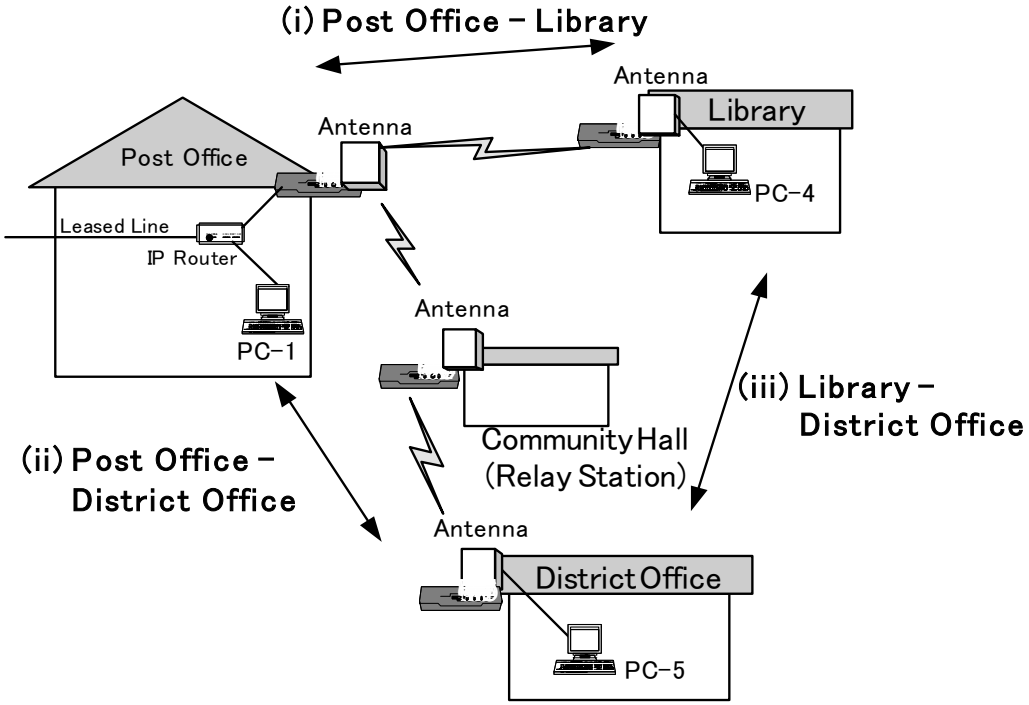


Figure III.3.45 : Contents of Experiments of Ping Test at Kota Marudu

The time required to transmit 20KB of data was measured by Ping test and then transmission speed was calculated.

The maximum speeds are shown below.

	Number of hops	Transmission speed
(i) Post Office - Library	1	2.73Mbps
(ii) Post Office – District Office	2	2.02Mbps
(iii) Library – District Office	3	1.17Mbps

When 1 wireless router is relayed, 30-50% of the communication speeds decline.

(6) Trace route and number of Hops

(a) Trace route to "Web site for RIC"

The trace route and the number of Hops to "www.kotamarudu.idesa.org.my" are shown below.

Tracing Route to www.bau.idesa.org.my

Number of Hops	IP address of site
1	203.106.120.1
2	202.188.3.1
3	202.188.3.3
4	203.106.255.237
5	202.188.1.66
6	203.106.240.193
7	202.188.0.11
8	202.188.2.214
9	202.188.245.16 (www.kotamarudu.idesa.org.my)

(b) Trace route to "Other popular sites"

The trace route and the number of Hops to "Yahoo.com" are shown below.

Tracing Route to www.yahoo.com

Number of Hops	IP address of site
1	203. 106. 120. 1
2	202. 188. 3. 1
3	202. 188. 3. 3
4	203. 106. 255. 237
5	202. 188. 1. 66
6	203. 106. 240. 193
7	202. 188. 0. 13
8	202. 188. 2. 154
9	202. 71. 96. 77
10	202. 71. 96. 46
11	202. 71. 96. 53
12	64. 86. 173. 49
13	64. 86. 80. 34
14	64. 86. 83. 133
15	209. 0. 227. 33
16	209. 247. 10. 197
17	64. 159. 1. 130
18	64. 159. 2. 41
19	64. 152. 69. 30
20	66. 218. 71. 86 (www.yahoo.com)

3.3 Evaluation and Feedback

(1) Transmission speed of Internet access (Capacity)

Average transmission speeds of each model project are shown below.

RIC	Method	Transmission speed (kbps)	
		Download Speed	Upload Speed
Sg. Air tawar	Telephone line: Direct hookup (1line/PC)	38.02	35.53
	Telephone line: Using IP router (1line/2PCs)	18.07	16.68
Bau	Telephone line:	34.05	40.10
	CDMA FWA	42.02	7.59
Kota Marudu	Telephone line	42.75	40.99
	Leased line	110.65	122.15
	Leased line ＋ Wireless IP router	106.88	121.80
	Leased line ＋ Relay station	109.13	121.27

(2) Frequency of delayed response (Stability)

Frequencies of delayed response (Stability) of each communication infrastructure are shown below.

RIC	Method	Frequency of delayed response (Number of Measuring times :720, Measuring time :2 hours)	Number of disconnection (Measuring time :2 hours)
Sg. Air tawar	Telephone line: Direct hookup (1line/1PC)	None	None
	Telephone line: Using IP router (1line 2PCs)	Scores of times	None
Bau	Telephone line:	None	None
	CDMA FWA	Several times	None
Kota Marudu	Telephone line	None	None
	Leased line	None	None
	Leased line ＋ Wireless IP router	None	None
	Leased line ＋ Relay station	None	None

(3) Response time

Web access response times of each communication infrastructure are shown below.

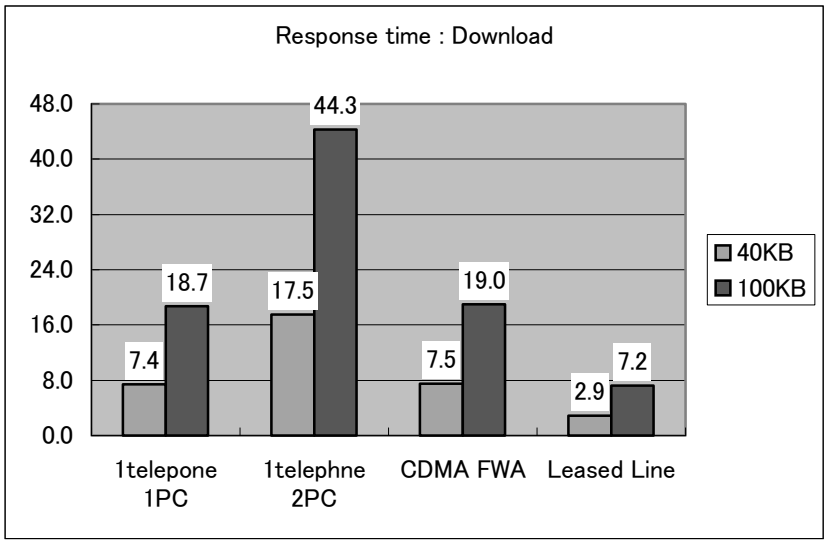


Figure III.3.46: Response Time of Download by Connection Type

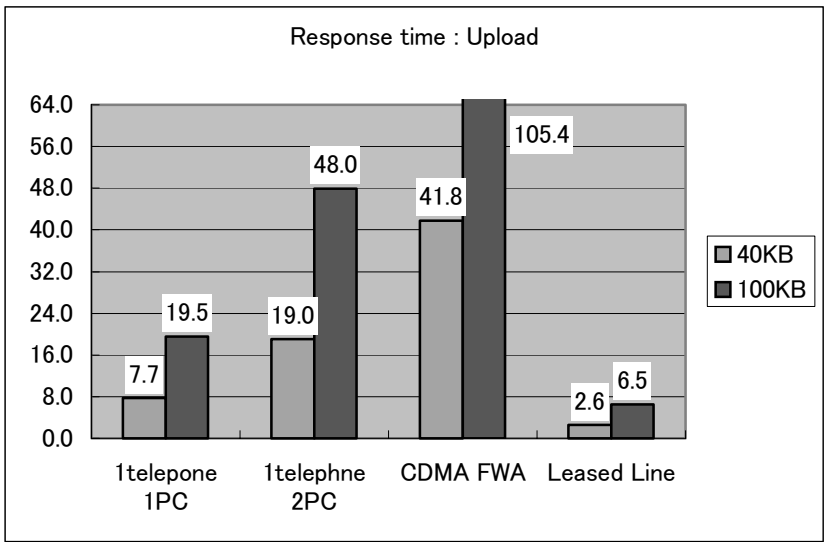


Figure III.3.47: Response Time of Upload by Connection Type

(4) Comparison and evaluation among the 3 Model Projects

Though the communication environments of the existing RICs consist of two telephone lines and two personal computers, the following new Internet access methods were developed and verified as feasible on this project.

- Telephone line using IP router (1 telephone line, 2 personal computers)
- Telephone line
- CDMA FWA
- Leased line
- Leased line through Wireless IP router (including relay)

(a) Telephone line using IP router (1 telephone line, 2 personal computers)

- When Internet access was simultaneously performed from two sets of PC's, execution speed was about 10 kbps and evaluated as very slow. "**Eight Second Rule**" (there is a finding by a US research company, that it is not desirable for a site to keep users waiting for more than 8 seconds when EC site is built) cannot be applicable to the usual HP (about 50kB).
- However, considering the number of RIC users, it is not a cause of concern when two sets of PC's share a single line because simultaneous access is infrequent.
- Moreover, since WindowsXP has a gateway function in which a telephone line is sharable, a special investment is unnecessary and can introduce RIC at the lowest price.

(b) Telephone line (1 telephone line, 1 personal computer)

- The execution speed is kept about 40kbps; it has no disadvantage for browsing the usual HP.
- Since the speed never fell drastically during the experiment, it is also no problem to use from the viewpoint of stability.

(c) CDMA FWA

- The communication speed downstream is about the same as an ordinary telephone line, which presents no problem in communication with many downloads such as Web browsing.
- Though stability is slightly inferior to fixed-line telephone, it is no obstruction for Web browsing.
- On the other hand, the speed upstream is extremely slow (one fifth of an ordinary telephone call), it is not adequate to update Web contents.

(d) Leased line

- The execution speed is more than 110kbps for download and more than 120kbps for upload, (both are a little less than triple the speed of a telephone line), which is considered as very fast.
- It is quite feasible to transmit contents such as a picture (100kB) within 8 seconds (cf. Eight Second Rule).
- The satisfaction level of RIC users is the highest.

- The line has the highest stability among all the experimental communication lines.

(e) Leased line through Wireless IP router (including relay)

- The effective speed of the LAN is about 2.5Mbps without relay and is less than 2.0Mbps with relay. It is very fast compared with Internet access speed.
- It is also completely satisfactory for stability.
- It operates without influence from the peculiar climate of Malaysia such as squalls.
- It is rare that radio frequency interference exists with a frequency of 2.3-2.6 Ghz in rural areas, therefore, there is no problem of interference.

As mentioned above, the experiment using a leased line through wireless IP router was successful. Followings are the major findings and verifications.

(i) Expansion of scope of RIC activity

- The scope of RIC activity can be expanded by establishing RIC stations at public facilities such as a libraries and district offices other than post office.
- Internet access can be provided without regard to the business hours of the post office.
- The scope of RIC activity can be expanded by using a wireless router relay station.

(ii) Countermeasures for problems in regional communication infrastructure

- The RIC installation became possible in an area where the new installation of telephone lines is difficult or takes a long time with the condition that the existing telephone line be in the range of a 1 kilometer radius of the RIC targeted area.
- In the near future, when the high-speed backbone like ADSL is laid down in the main parts of the district, it will be able to generate a benefit on a large area due to extending the range of impact using wireless LAN.

- Wireless LAN can contribute to the Internet diffusion in the future rural area.

(iii) Operation / Expenses of RIC

- These experiments using a wireless LAN and a leased line were the first trial in a rural district in Malaysia; it was confirmed to be greatly efficacious for the community computerization and for bridging the digital divide.
- However, the manufactures' agent used on this project is only situated in KL, the cost and time required for periodical maintenance and repair is high. Arranging bases of wireless LAN vendors in the provincial capitals is a minimum condition for using wireless LAN in the rural districts.
- In order to utilize a wireless LAN for RIC, it is necessary to solve the following problems.
- Adequacy of maintenance structure
- Adoption of private engineers

In this project, we have taught the know-how for construction or operation through on the job training (OJT) to the person in charge of communication at MECM. However, it is difficult for the government employees, who are often transferred to a different department, to engage in construction and operation continuously with full knowledge since wireless LAN uses the latest technology. If LAN based RIC is built, it is necessary to engage an engineer from the private sector to be assigned to the appointed department.

From the above, developing this method on a large scale cannot be recommended at this time due to the organization structure of MECM and the fact that maintenance structures in rural areas have not been established.

Broadband such as ADSL is expected to progress rapidly in Malaysia after 2005. The areas omitted from broadband coverage due to problems such as the distance from a telephone switching station will be greatly disadvantageous. In order to bridge such digital divide, extending the range of broadband by using wireless LAN is useful.

In the future, if laptop PCs are used in rural districts, it will be possible to use the Internet from near (within about 50 m) a wireless LAN type RIC, as long as the

laptop has a mobile LAN card (IEEE802.11b).