2. Case Study 1: Industrial Zone in Yangon

2.1 South Dagon Industrial Zone

There are nine industrial zones in Yangon. From among them, IT Working Group chose South Dagon Industrial Zone for the case study. South Dagon Industrial Zone is in South Dagon Township, Yangon, about 9 km North East of downtown Yangon. The South Dagon Industrial Zone consists of three zones: Zone (1), Zone (2), and Zone (3). Fig. 2.1-1 shows the overview of the industrial zone. In the centre of the zone, a railway runs from northwest to southeast. The railway has Industrial Zone station at the centre of the zone. The railway divides the zone into two: Industrial Zone (1) at the west side of the railway; Industrial Zone (2) and Zone (3) at the east side of the railway. Industrial Zone (2) is divided into two blocks by a creek.

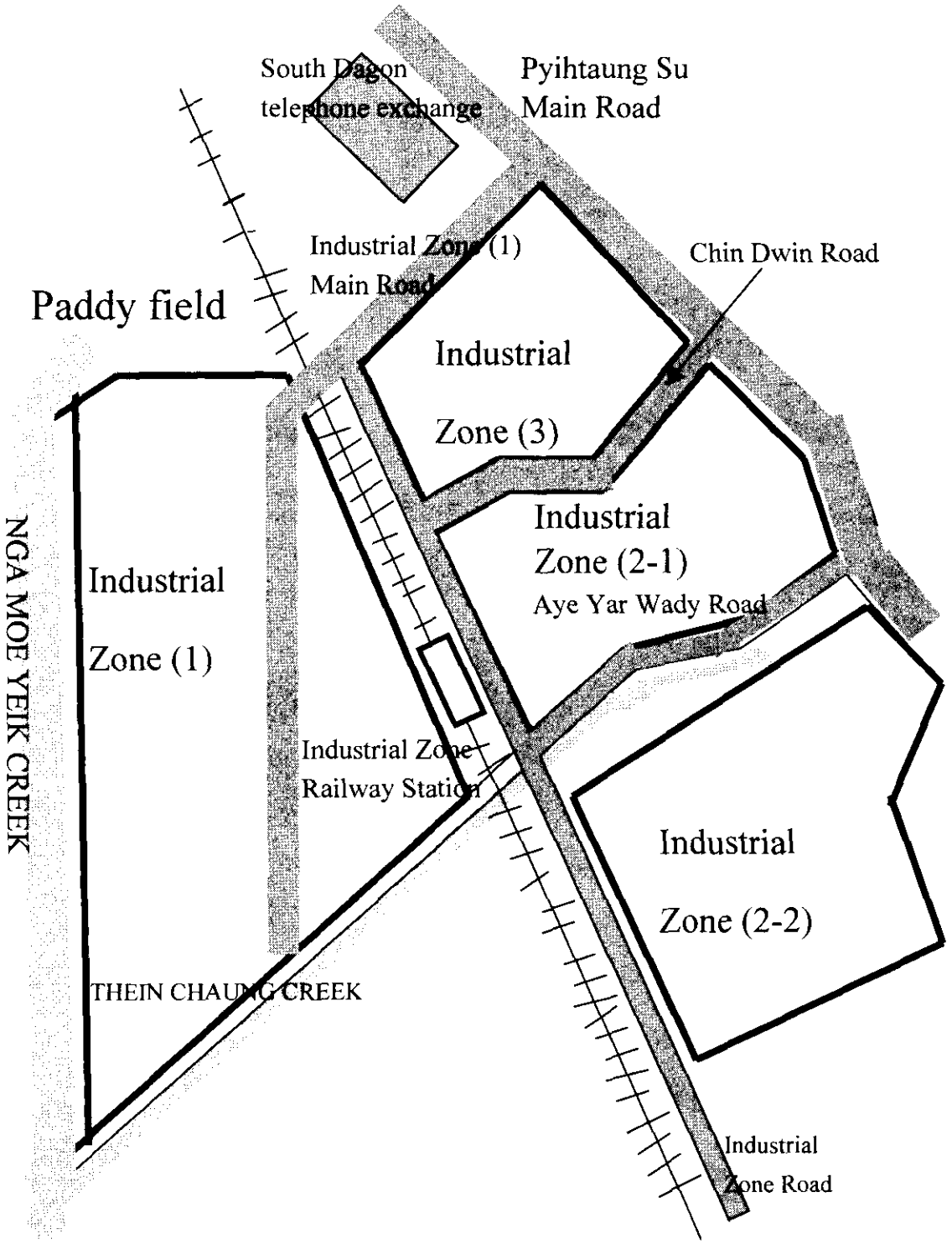
The government designated the area as an industrial zone in 1992. The area was paddy fields then. As the government owns land, it evacuated farmers and developed the land for factories. The government made roads and allotted lots to factories. Government also provided with 3-year tax incentives to factories. The industrial zone started operation in 1996. Many factories have been built and some are being built now. Some areas are lively but other areas still have empty lots.

The infrastructure of South Dagon Industrial Zone is very poor. Roads are narrow and not paved. They are bumpy and have many water pools, making difficult for cars to run. Electricity often blacks out. Many factories cannot get any telephones, even though South Dagon telephone exchange is very close to the industrial zone.

Although the infrastructure of the industrial zone is not good, the industrial zone has its merits. It is close to the centre of Yangon and it has lively neighbourhood, which provides factories with customers and workers. Because most factories run labor-intensive businesses, the industrial zone needs a lot of workers.

The paper deals Industrial Zone (1), (2), and (3) separately, because each zone has its own telecommunication needs and geographic features.

Fig. 2.1-1 Overview of South Dagon Industrial Zone

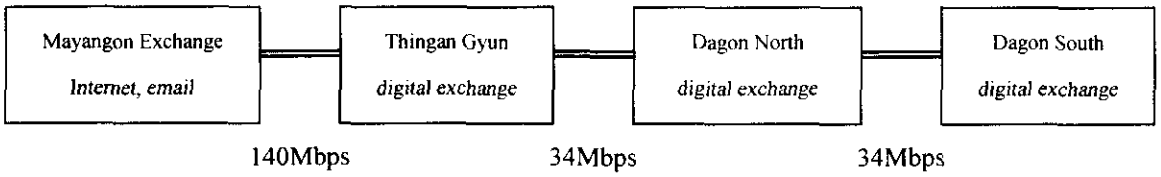


2.2 Available networks

South Dagon Industrial Zone is only 9 km northwest of downtown Yangon and is near the centre of South Dagon Township. The zone can use telecommunication networks provided by Myanmar Posts and Telecommunications (MPT) and Bagan Cybertech (BCT). Both organisations' networks provide telephone and data communication (email and the Internet) services each.

South Dagon telephone exchange accommodates this Industrial Zone. The telephone exchange is very close to the industrial zone, especially Zone (3). The telephone exchange connects by optical fibre with Dagon North exchange, which connects via digital switches to Mayangon telephone exchange, where email and Internet servers are located.

Fig. 2.2-1 Connection Diagram from Dagon South to Mayangon exchanges

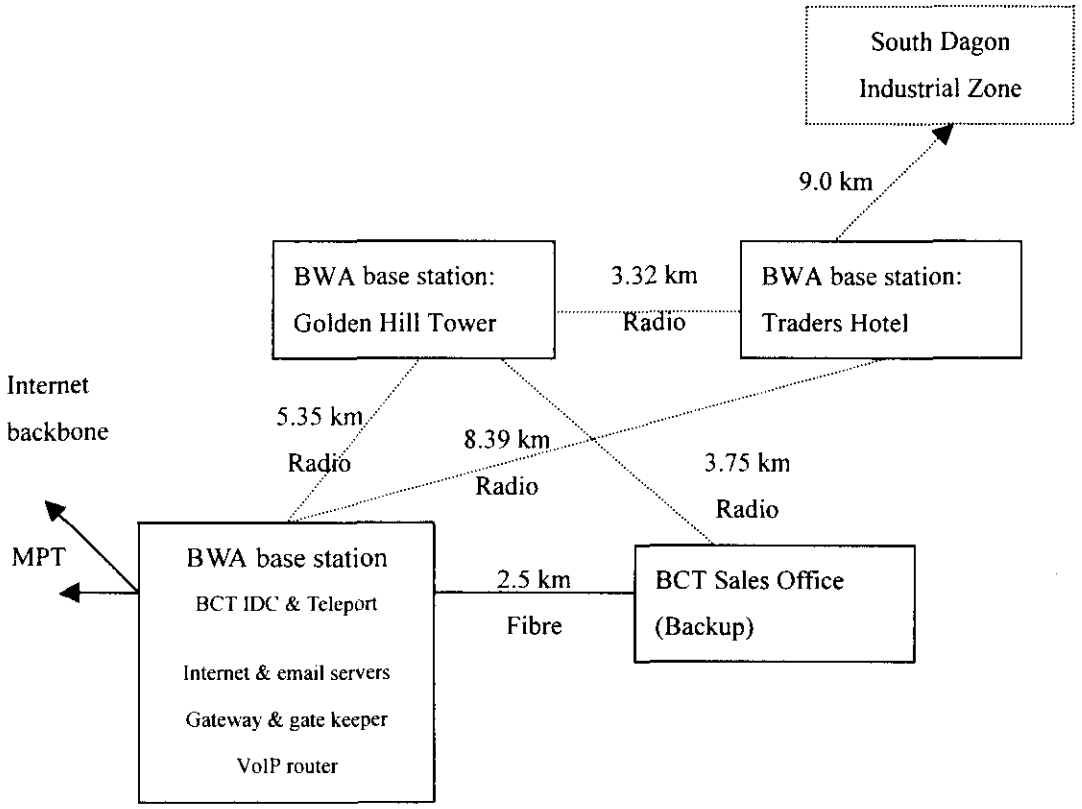


South Dagon exchange is a remote switching unit (RSU) operated from North Dagon exchange. South Dagon exchange has 1,470 subscriber terminals in capacity and all the terminals are already used. To accommodate new subscribers, the switch needs to be expanded and cables need to be installed.

The telephone exchange has a tower for mobile communication, although it is not used yet. Nevertheless, the radio waves reach to this area and people can use mobile phones in this area.

BCT's network for Broadband Wireless Access (BWA) is also available. BCT has started BWA service on 1 September 2002 using the BCT base station. The base station covers the area within 5 km radius. Base stations at Golden Hill Tower and Traders Hotel will begin operation at the end of September. The base station at Traders Hotel will cover the area up to 15 km radius. BWA service uses IP-based wireless LAN technology, which works well with data communication. The network is as follows:

Fig. 2.2-2 BCT's BWA network



BCT's BWA radio can reach to South Dagon Industrial Zone (1) because its output transmission power is 1 W (30 dBm) and its radio reaches up to 15 km.

BCT serves the Internet and email, and it can connect telephone calls to MPT's telephone network. BCT's network has a gateway and a gatekeeper in the BCT IDC & Teleport building.

2.3. Case Study of Zone (1)

2.3.1 Characteristics of Zone (1)

Fig. 2.1-1 shows the overview of the industrial zone. Zone (1) has about 2.02 km^2 and is surrounded by paddy fields on the north, the railway on the east, and creeks on the south and west. South Dagon Industrial Zone (1) started operation in 1996. The size of one plot ranges from 650 to 40,500 m^2. Already 171 factories are in operation, 45 have just been built and preparing for operation, and 5 are under construction. They are mainly large factories. About 20 % of the zone is still vacant. The consultants made a tour of Chairman's factory Newest Garment Manufacturing Co., Ltd. It is a garment factory that producees clothes. An American company orders and buys clothes. A Taiwanese company designs and makes arrangements. Newest Garment imports cloth

and cuts, sews, and checks. The business model is triangle international cooperation. The company depends on email for international communication. Before the introduction of email, it used fax and was charged heavily. It has seven engine generators and uses them according to the load. It hires 530 employees, mainly young female employees. Employees commute from neighbour communities and Newest Garment provides the employees with commuting bus service. The company is one example of factories, but it typifies this zone. The factories in this zone produce 25 types of products, including garment, plastics, and foodstuffs. The sales reaches 100 billion kyats (about US$ 100 million). They can afford buying own diesel engine generators. In this zone, they can afford better infrastructure and services. Better infrastructure will give factories better operation and more competitive edge.

2.3.2 Telecommunication status

Although 171 factories operate, MPT has installed only 95 telephones and 10 pay phones, according to data from MPT's Yangon Auto Telephone. Almost half of the factories do not even have any telephone. According to factory owners, the telephone quality is also poor with noise and telephones being out of order often. The chief engineer of MPT's Yangon Auto Telephone admitted that the switch in the area often overflows.

This zone is close to South Dagon Telephone exchange. The closest length from the exchange is about 1 km. However, the farthest subscriber is 4km away because this zone is big.

2.3.3 Telephone demand survey at Zone (1) committee office

The consultants visited Zone (1) committee office on 9 September 2002 to interview its chairman, vice chairman, and secretary. They say that factory owners want at least three telephone lines for telephone (voice), fax, and email (Internet). They say "at least" and the consultants assumed that one telephone line is too few. It should be appropriate to assume one factory needs two telephones, one fax, and one data line on an average. Zone (1) has 171 factories in operation and another 45 factories preparing for operation. About 20 percent of the land is vacant now and factories will have been built in five 5 years, covering all the lots with factories. The total number of factories will be 270 (=(171+45)/(1-0.2)) then.

2.3.4 Evaluation of telecommunication demand

A factory needs two telephones, one fax, and one data communication line on average. Regarding data communication, the faster transmission speed is, the better the quality is. However, data communication is mainly used for email, and the Internet is not widely used. Therefore, 64 kbps

is enough for the time being.

Integrated Service Digital Network (ISDN) can offer two 64 kbps channels. An analogue telephone line can transmit up to 56 kbps, and so an analogue telephone line will do. To make calculation simple, the paper assumes one factory needs one telephone line for data communication. Therefore, 1 factory needs 4 telephone lines: 2 lines for telephones, 1 line for a fax, and 1 line for data communication. Because 1 factory needs 4 telephone lines and the number of factories is 270, Zone (1) needs 1,080 telephone lines.

Telecommunication requirement is also calculated with transmission speeds. If transmission data is not compressed, 1 telephone needs 64 kbps, and 1fax needs 64 kbps. Data transmission needs 64 kbps. Telephone data can be compressed up to 8 kbps and fax data 32 kbps. Because voice with 8 kbps is not good, this case study adopts a 16-kbps compression. Table 2.3.4-1 shows the total transmission demand for one factory.

Table 2.3.4-1 Total transmission speeds for 1 factory

Media	Basic speed	Compressed	Recommendation
Telephone (2 lines)	64+64 kbps	Up to 8+8 kbps	16+16 kbps
Facsimile	64 kbps	32 kbps	32 kbps
Data communication	64 kbps	64 kbps	64 kbps
Total transmission speed	256 kbps	112 kbps	128 kbps

One factory needs 128 kbps. If all of the factories use 128 kbps and the number of factories reaches 270, the total transmission speed reaches 128×270=34,560 kbps. Because all the factories do not fully use all the communication at the same time, about the 50% of 34,560 kbps are enough. The total Zone (1) needs 17.3 Mbps.

2.3.5 Evaluation of telecommunication systems

Three types of networks are available: MPT's fixed telephone network, MPT's mobile phone network, and BCT's data network. Because BCT's network has just started its BWA service and it covers the Industrial Zone (1), it is possible for a factory to mount an antenna and a wireless LAN system to get a service. However, in this case study, heavy traffic is expected from the Industry Zone (1) and the BWA base station covers a wide area, BWA traffic becomes heavy and obstructs the service. Therefore, the construction of a new base station in Industrial Zone (1) is

an option. Table 2.3.5-1 shows the possible expansion systems and their pros and cons.

The table shows that fixed telephone, mobile phone, and wireless LAN systems have their merits and demerits. Because Zone (1) has many big factories and large data transmission demand. The wireless LAN system is the best choice. The paper studies the installation of a base station for BWA service.

However, in the real world, customer demand varies from person to person. One person may choose a fixed phone and another may choose a mobile phone. Telecommunication operators will build fixed telephone, mobile phone, and wireless LAN networks, and let users choose whichever they like. Competition among the networks makes service better, cheaper, and more reliable.

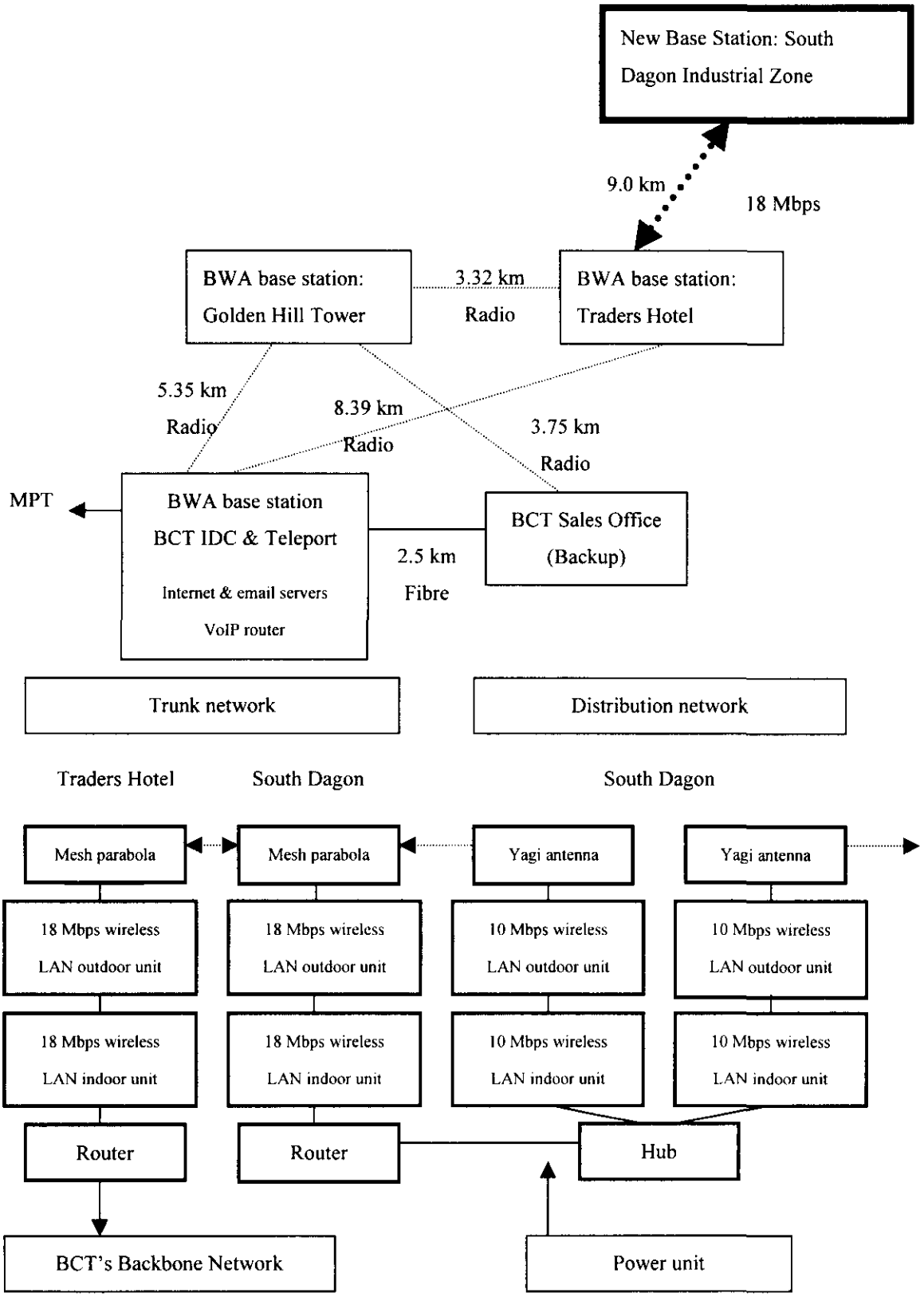
Table 2.3.5-1 Possible expansion systems and their pros and cons

System	MPT's fixed telephone			MPT's mobile	BCT's BWA	
	Copper cable distribution	Optical and copper cable hybrid	WLL	Mobile phone	BWA (No network expansion)	BWA (Installation of base station)
Building (tower)	Existing	Container or hut for RT	Existing	Existing(Tower is build)	Existing	Tower
Facilities	Switch Civil & cable	Switch Civil & cable	Switch, WLL equipment	Mobile phone base station	-	Wireless LAN base station
Construction period	About 1 year	About 1 year	About a half year	About a half year	Immediate	Short
Service opening work	Dropwire, telephone set	Dropwire, telephone set	Subscriber station, telephone set	Cellular phone	Wireless LAN equipment, IP phone	Wireless LAN equipment, IP phone
Telephone service	Good	Good	Good	Fair	Fair	Fair
Data service	Good	Good	Good	Not good	Good (when traffic is light)	Good
High speed transmission	DSL is necessary for higher speed	Optical fibre can be used.	Difficult	Difficult	Difficult (Too much traffic)	Good
Expansion	Not easy	Not easy	Easy	Easy	Difficult	Easy
Network (/line)	US$ 450-550	US$ 500-600	US$ 600	US$ 500	--	US$ 200
Terminal cost	US$ 20	US$ 20	US$ 60	US$ 120	US$ 1,950	US$ 1,950
Evaluation from users' view	Charge is low. No need of power supply.	Charge is low. No need of power supply.	Charge is low. Need power supply.	Charge is middle. Suitable for people moving around.	Charge is high. Customers can get this quickly.	Charge is high. Customers can get this quickly. Good for high-speed transmission.
Total Evaluation	Good	Fair	Not good	Good	Good	Excellent
Remark	Fixed telephone and mobile phone are offered by MPT and used to capacity. On the other hand, BCT's BWA service has just started, and has capacity to accommodate new users. Regarding cost, the figures are rough estimate, and give only rough ideas.					

2.3.6 Expansion basic design

Fig. 2.3.6-1 shows the basic design for installation of a base station.

Fig. 2.3.6-1 Basic expansion design



2.3.7 Expansion workload

As it uses wireless LAN systems, the expansion is very easy. The system in South Dagon might be installed at one of factories, as is the case at Golden Hill Tower and Traders Hotel.

Table 2.3.7-1 Workload for installation of the base station

Item	Workload	Item	Workload
18 Mbps Wireless LAN unit	2	Router	2
Mesh antenna	2	Hub	1
10 Mbps Wireless LAN unit	2	Power unit	1
Yagi antenna	2		

2.3.8 Cost and charge

Telephone network installation cost per subscriber might be higher than wireless LAN network cost. However, Telephone charges are low in Myanmar. This is because of the government's pricing policies. On the other hand, BWA charge is high compared with low charges of telephone service. Therefore, customers may hesitate to use BWA service. This might distort the healthy expansion of the IT infrastructure. MPT should adjust the prices so that it can earn enough money to expand and improve telephone service on the nation including rural areas.

As for the data communication service, BCT almost monopolises. Other companies should be allowed to enter the data communication business so that competition will bring down the price. In order to facilitate the IT infrastructure, introduction of market economy is recommended. Tables 2.3.8-1 to 3 show the telecommunication prices.

Table 2.3.8-1 BWA service prices for individual (business or personal)

Plans	Speed	Monthly fee	Free hours	Additional	Email accounts
Standard 128	128 kbps	US$ 35	20 Hrs	US$ 2.5/Hr	1
Unlimited 128	128 kbps	US$ 70	Unlimited	-	1
Standard 256	256 kbps	US$ 50	25 Hrs	US$ 3/Hr	1
Unlimited 256	256 kbps	US$ 95	Unlimited	-	1

One-time activation fee: US$ 1,950

Voice Usage fee: US$ 20/month (optional)

Table 2.3.8-2 Internet and email tariff of MPT

Particulars	Rates in US$			Rates in Kyats		
	Email only	Internet only	Internet + Email	Email only	Internet only	Internet + Email
Initial fees	200	200	300	40,000	40,000	60,000
Annual fees	60	504	564	12,000	100,800	112,800
Usage fees	3 (1 hr)	65 (30 hr)	65 (30 hr)	600 (1 hr)	13,000 (30hr)	13,000 (30 hr)
Additional usage fees	-	2 (1 hr)	2 (1 hr)	-	400 (1 hr)	400 (1 hr)
Deposit	30	30	30	6,000	6,000	6,000

These prices are for dial-up connection and do not include telephone charges.

Table 2.3.8-3 Telephone tariff

Category	Particulars		Rates
Subscription and shifting charges	Subscription fee		200,000 Kyats
	Drop wire within 200 m		7,000 Kyats
	For every 10 m exceeding 200 m		350 Kyats
	Phone (All in US$)		*60 US$*
Local call fees	Particulars		Rates in Kyats
	Automatic services		3.00 per call
	Manual services		No charge
	Local call from public booth		3.00 per call
Long distance call fees	Distance in miles	For the first 3 minutes	For additional minutes
	1 to 50	6.30	2.10
	51 to 100	9.00	3.00
	101 to 200	16.20	5.40
	201 to 300	19.80	6.60
	301 and above	24.30	8.10

US$ 1 equals to about 1,000 Kyats as of September 2002. Telephone fees are very low compared to email and Internet charges.

2.3.9 Conclusion

Because Industrial Zone (1) has high telephone and data communication demand, the paper recommends construction of a new BWA base station with wireless LAN systems. However, how much the factories use BWA service depends on prices. Current BWA and telephone prices might discourage possible users to choose BWA service. Therefore, paper also urges that in

order to facilitate the use of BWA service, telecommunication prices should be based on costs. In order to lower email and Internet charges, the environment for competition should be promoted.

2.4. Case study of Zone (2)

2.4.1 Characteristics of Zone (2)

Zone (2) consists of two blocks divided by a small creek: the northern block and the southern block. Fig. 2.1-1 shows the overview of the industrial zone. Zone (2) was designated as an industrial zone in 1992 and started its operation in 1996.

The northern block has 0.35 km^2 and is surrounded by Chin Dwin Road on the north, Pyihtaung Su Main Road on the east, Aye Yar Wady Road on the south, and Industrial Zone Road and the railway on the west. The southern block has 0.6 km^2 and is surrounded by the creek on the North, Pyihaung Su Main Road on the east, Shwe Li Street on the south, and Industrial Zone Road and the railway on the west.

Zone (2) is divided into 1,741 lots most of which are small and measure 12×18 (m). At present, 1,114 small factories have been built. According to a person in charge, only 557 factories are in operation. Another 242 factories are under construction. The factories produce about 15 types of products; steel products on the top and followed by plastics, foodstuffs, and wood products.

2.4.2 Telecommunication status

According to the information from Yangon Auto Telephone, MPT has provided 202 telephone lines. This area is close to South Dagon exchange office. Even the farthest subscriber is 1.5 km away to the exchange office. Therefore, MPT distributes cables directory without using cross-connection cabinets. Residents in the area can use cellular phones also.

2.4.3 Telephone demand survey at Zone (2) committee office

The consultants visited Zone (2) committee office to study telephone demand on 13 September 2002. The chairman said that one factory needs at least one telephone and one fax. If all the 1,741 lots have factories (optimistic view), the zone needs about 3,500 subscriber lines. If operating 557 factories have 2 telephone lines, it needs about 1,200 lines now. If suspended factories are included, it needs 2,300 lines.

2.4.4 Evaluation of telecommunication demand

Telecommunication demand in Zone (2) is high and strong. Telephones are for business use and crucial to run their business. As mentioned before, if operating 557 factories have 2 telephone lines, it needs about 1,200 lines.

Email and Internet demand is considered low because factories in this zone are small and run by family members. If 15 percent of operating 557 factories use 1 telephone line for data communication, the zone needs additional 84 telephone lines.

Zone (2) still has a lot of vacant lots that will be occupied by factories. When the expansion of the telecommunication network is planned, the network should accommodate not only present demand but also future demand appearing in about five years. The future demand is calculated with its growth rate. The average growth rate of Gross National Product (GNP) over the past two years (1998-2000) was 5.6 %. The third economic development plan expects a 6 % growth annually. The growth rate in agriculture field was low at 3 % (1997) that lowered the total growth rate. In the industrial field, especially the processing industry, the growth rate is high. The growth rate in the industrial field over the past two years (1998-2000) was 32 %. It may be alright to assume that the annual growth rate of this industrial zone is 10 %. The telecommunication demand will be 1,927 lines (1,198×1.15). Table 2.4.4-1 shows the telephone demand in 5 years.

Table 2.4.4-1 Telephone demand in 5 years

	Telephone	Fax	Data	Total
Present demand	557 lines	557 lines	84 lines	1,198 lines
New demand in 5 years	340 lines	340 lines	49 lines	729 lines
Demand in 5 years	897 lines	897 lines	133 lines	1,927 lines

2.4.5 Evaluation of telecommunication systems

Zone (2) has high telecommunication demand with about 1,200 lines. It will increase to about 1,900 lines in five years. The distance between the telephone exchange and the farthest subscriber is 1.5 km. Table 2.4.5-1 compares telecommunication systems, taking this environment into account.

Table 2.4.5-1 Comparison of telecommunication systems

System	MPT's fixed phone			MPT's mobile	BCT's BWA
	Copper cable distribution	Optic and Copper hybrid	WLL	Mobile phone	Wireless LAN
General application	Good	The distance is short. The merit of using optic fibre is little.	Telephone density is high. The merit of using radio equipment is low.	Good, especially for business people moving around.	Data traffic is small. The merit of using wireless LAN is small.
Network (cost/line)	US$ 450-550	US$ 500-600	US$ 600	US$ 500	--
Terminal cost	US$ 20	US$ 20	US$ 60	US$ 120	US$ 1,950
Evaluation by users	Charge is low. No need of power supply.	Charge is low. No need of power supply.	Charge is low. Need power supply.	Charge is middle. Suitable for people who move around.	Charge is high. Customers can get this quickly. Need power supply.
Total Evaluation	Excellent	Fair	No good	Good	No good

2.4.6 Conclusion

The consultants recommend that the copper cable distribution is the best with low cost because the area is small and close to a telephone exchange and telephone density is high. Mobile phones are also useful and MPT should start the construction of the mobile base station at South Dagon exchange because the tower is already built.

2.5 Case study of Zone (3)

2.5.1 Characteristics of Zone (3)

Fig. 2.1-1 shows the overview of the industrial zone. Zone (3) has 0.22 km^2 and is surrounded by Industrial Zone (1) Main Road on the north, Pyihtaung Su Main Road on the east, Chin Dwin Road on the south, and Industrial Zone Road and the railway on the west.

Zone (3) is divided into 1,251 lots. About 800 factories and shops are operating in this zone. Because most of the lots are small, factories take up more than one lot. Actually, most of the lots are occupied. They are mainly manufacturing steel and iron products, and selling raw materials, metal working tools, and machine parts. Among the products, steel products top the list followed by machine parts.

2.5.2 Telecommunication status

According to Yangon Auto Telephone, MPT provided 418 fixed telephones and 12 cellular phones. This area is close to South Dagon exchange with the distance between the exchange and

farthest subscriber being 1 km. Therefore, copper cable is directly distributed without a cross-connection cabinet.

2.5.3 Telephone demand survey at Zone (3) committee office

The consultants interviewed a person in charge at Zone (3) committee office on 13 September. He said each factory needs at least two telephones. He said factories do not need a fax, email, or the Internet. However, the consultants consider that if we had interviewed factory and shop owners, they might have answered differently.

If operating 800 factories and shops get 2 telephone lines each, 1,600 telephone lines are necessary.

2.5.4 Evaluation of telecommunication demand

The consultants toured the area and found out that almost all the factories and shops are working lively and telephone demand for business must be pretty high. Almost all the demand is for business use.

It is considered shops and factories use faxes for their business, but they use one line as a fax out of two telephone lines. Because factories in this area are small and run by family members, the demand for email and the Internet may be small. If 15 % of 800 shops and factories use one telephone line each for data communication, they need additional 120 lines.

Because this area has only a few vacant lots left, new factories will not be built. The difference between 800 operating businesses and 1,251 lots is that one factory uses more than one lot. The future demand and present demand are the same with 1,720 lines.

2.5.5 Evaluation of telecommunication systems

Zone (3) has only 0.22 km^2 but its telephone demand is 1,720 lines. The farthest subscriber is only 1km away from the telephone exchange. The evaluation results are almost the same with those of Zone (2). Table 2.5.5-1 shows the evaluation.

Table 2.5.5-1 Comparison of telecommunication systems

System	MPT's fixed phone			MPT's mobile	BCT's BWA
	Copper cable distribution	Optic and Copper hybrid	WLL	Mobile phone	Wireless LAN
General application	Good	The distance is short. The merit of using optic fibre is little.	Telephone density is high. The merit of using radio equipment is low.	Good, especially for business people moving around.	Data traffic is small. The merit of using wireless LAN is small.
Network cost (/line)	US$ 400-500	US$ 500-600	US$ 600	US$ 500	--
Terminal cost	US$ 20	US$ 20	US$ 60	US$ 120	US$ 1,950
Evaluation by users	Charge is low. No need of power supply.	Charge is low. No need of power supply.	Charge is low. Need power supply.	Charge is middle. Suitable for people moving around.	Charge is high. Customers can get this quickly. Need of power supply
Total Evaluation	Excellent	Fair	No good	Good	No good

2.5.6 Conclusion

The consultants recommend that the copper cable distribution be the best with low cost because the area is small and close to a telephone exchange and telephone density is high. Mobile phones are also useful and MPT should start the construction of the mobile base station at South Dagon exchange because the tower is already built.

2.5.7 Supplement

In this case study, the areas are close to the exchange and the optical fibre and copper cable hybrid system is not the best choice. Because it has its merits, this section studies the basic design.

The section supposes Zone (2) and Zone (3) adopt optical fibre and copper cable hybrid.
First, calculates transmission speeds from telephone demand.

Table 2.5.7-1 Necessary transmission speeds

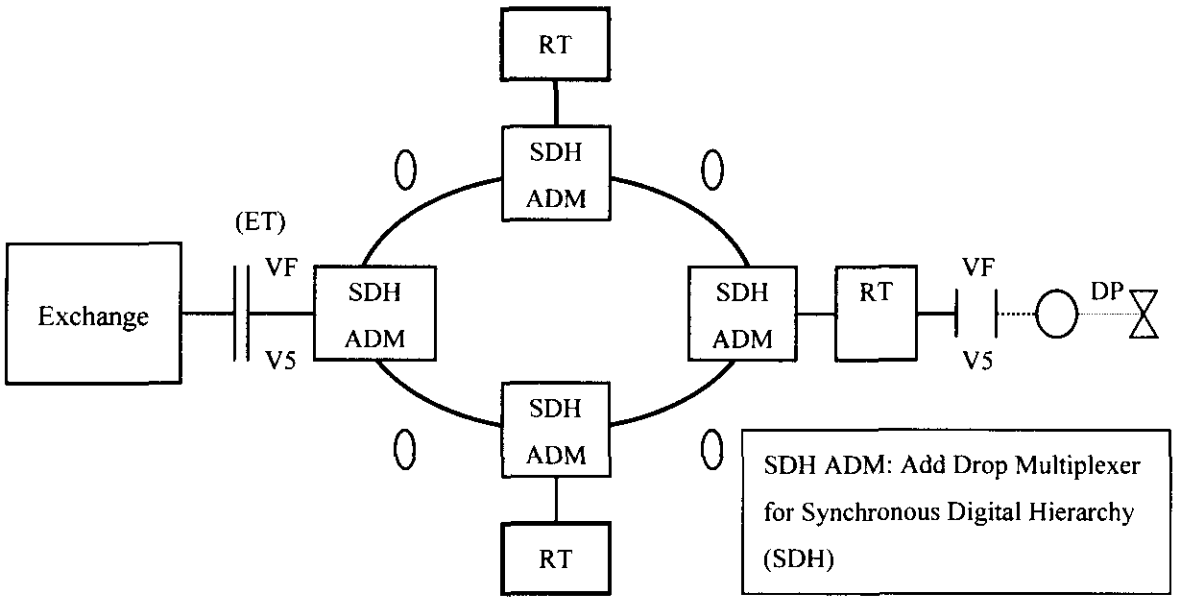
	Demand in 5 year	Transmission speed conversion rate	Transmission speed
Zone (2)	2,900 lines	64 kbps/line	186 Mbps
Zone (3)	1,720 lines	64 kbps/line	110 Mbps
Total	4,620 lines	64 kbps/line	296 Mbps

The transmission speed requires 2 systems of STM-1 (155 Mbps) or 1 system of STM-4 (600 Mbps).

Optical fibre cable can be used commonly by Zone (2) and Zone (3). The number of cores for the optical fibre is 4 or 6.

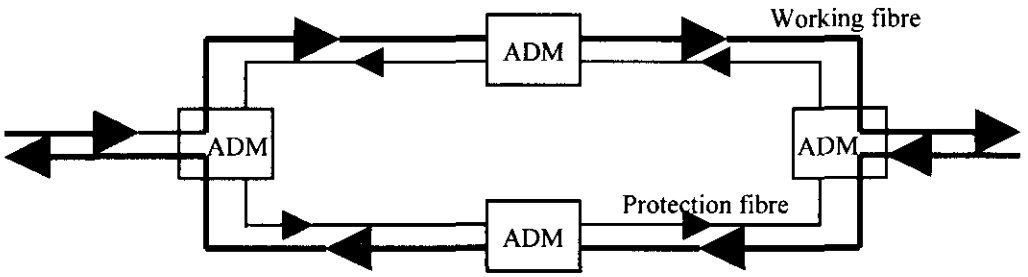
Figures 2.5.7-1 and 2.5.7-2 show an example of ring distribution.

Fig. 2.5.7-1 SDH Ring Optical Access Network Topology



Optical fibre ring networks have a unidirectional method and a bi-directional method. The unidirectional self-healing SDH ring network is common.

Fig. 2.5.7-2 Unidirectional self-healing SDH ring network



3. Case Study 2: Industrial Zone in Mandalay

3.1 Mandalay Industrial Zone

Mandalay Division has 3 industrial zones. The zones have gotten attention due to the production of the first local jeeps in the country. Although, there are 3 industrial zones in Mandalay Division, Madalay Industrial Zone is the only industrial zone in Mandalay city. Mandalay Industrial Zone was first formed in 1990. About 1,200 factories once shifted to the zone, but the poor infrastructure made 500 factories move out. In 1995, a ten-mega-watt transformer was installed with the donation from local industries and the support from the government. After that, Mandalay Industrial Zone has been running very well and has over 1,300 factories now.

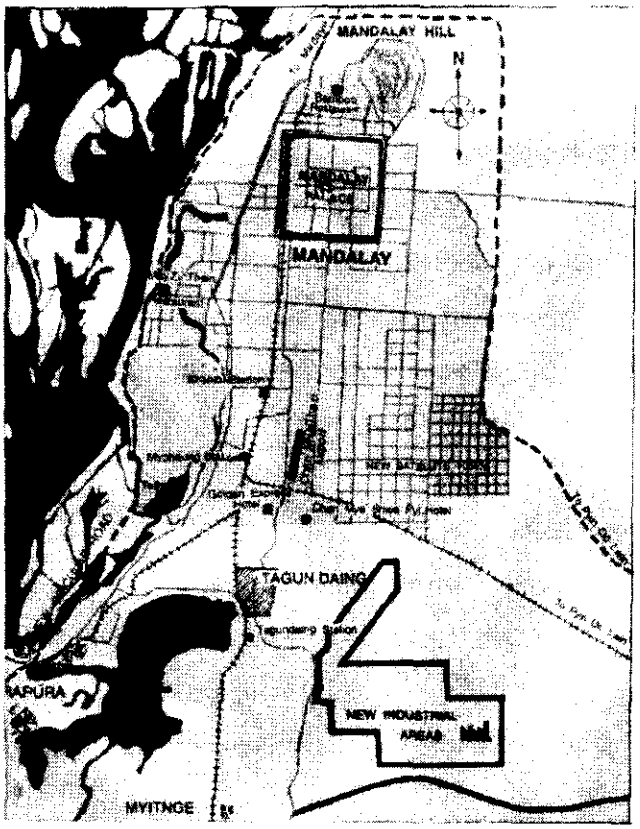
3.2 Characteristics of Mandalay Industrial Zone

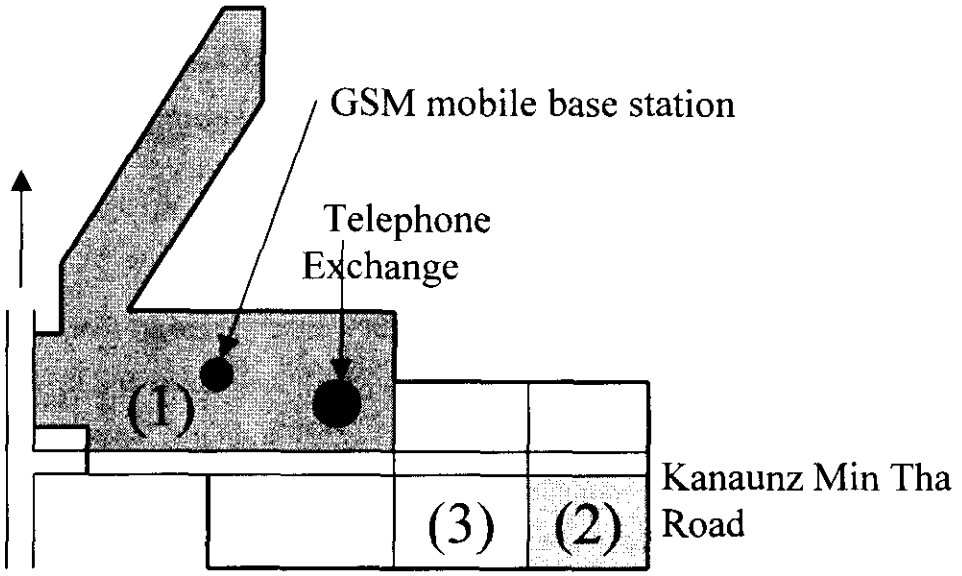
Mandalay Industrial Zone is in the southern part of Mandalay about 15 km south of downtown. The zone consists of two industrial blocks, block No. 1 and block No.2, which are located in the northern and southern parts of the zone respectively. Mandalay Development Company expects the two blocks will be fully occupied in 3 years and has started developing block No. 3. Fig. 3.2-1 shows the location of Mandalay Industrial Zone.

Block No.1 is in the northern part of the industrial zone and takes up the major part of the zone. In the northern and western parts of Block No.1, many large factories are operating. Block No.2 is in the southeastern part of the zone. Block No. 3 is on the south of Block No.1 and buildings are being built but none has been completed.

Mandalay Industrial Zone has the area of 4 km^2 (1,000 acres). There are more than 1,300 factories that produce 13 types of commodities. The guidance of State Peace and Development Council gives the following production items priority: (1) agricultural machineries, (2) machine spare parts, (3) import substitution commodities, and (4) machinery part for government factories. The initial investment to the zone was about 7,300 million kyats. The average annual production is about 4,500 million kyats.

Fig. 3.2-1 Overview of Mandalay Industrial Zone





There are few export-oriented factories and only 8 percent of the total products are exported. Wood products rank first in the export products followed by cane furniture. Mandalay Industrial Development Committee believes that export volume can only be increased through more investment, technology, and the total quality management (T.Q.M.) system. More than 8,500 skilled workers and 25,000 daily workers are working. Table 3.2-1 describes the numbers of factories by product types.

Table 3.2-1 Factory types in Mandalay Industrial Zone

No.	Product type	Large	Middle	Small	Total
1	Food stuff	65	57	39	161
2	Clothing	-	2	3	5
3	Construction material	24	5	16	45
4	Personal use products	22	18	17	57
5	House-hold products	-	-	1	1
6	Raw material	10	4	22	36
7	Mineral and oil related products	5	14	85	104
8	Agricultural machineries	1	-	1	2
9	Machinery and machine spare parts	-	2	10	12
10	Electrical appliances	4	1	1	6
11	Copper works	-	29	-	29
12	Work shops and general	22	66	666	754
13	Others	-	-	160	160
	Total	153	198	1,021	1,372

Source: Presentation material of Mandalay Industrial Zone Development Committee on 9 September 2002.

3.3 Telecommunication status

Fixed telephones and mobile phones are available in Mandalay Industrial Zone. MPT built a telephone exchange almost at the centre of the zone and installed Chinese digital switch (SP30CN, BM) and optical fibre SDH junction transmission equipment. The exchange started telephone services on 4 October 2000.

Switch capacity is 3,400 lines, but the number of subscriber cable pairs is only 2,400 (six 300 pairs and three 200 pairs). MPT has connected 1,537 lines so far. MPT has equipped 32 ISDN (two 64 kbps channels and one data channel) lines.

There is no problem of transmission loss because the area is within 1 km from the exchange. According to a hearing survey, subscribers are satisfied with the telephone service and quality because telecommunication facilities are new and rarely become out of order. As for cable distribution, MPT adopts the direct distribution method near the exchange and the cross-connection cabinet method in the other area. The MDF has forty-eight 100-pair mini-blocks on the vertical side. The building has enough space for the increase of the capacity and the premises are also large.

MPT's GSM base station is not in the same premises but near the exchange. It covers the industrial zone.

There aren't any access points for the Internet and email now. Users have to call access point in Yangon to use the Internet or email. The Internet and email are not commonly used in Mandalay. BCT is planning to start Internet and email services in October 2002. It also plans to start Broadband Wireless Access (BWA) service at the same time.

3.4 Telephone demand survey

The consultants interviewed employees of small factories. They want one telephone and one fax. They did not answer clearly about the need for email and the Internet.

Later, the consultants talked with a member of Upper Myanmar Computer Federation. She runs a computer school in downtown Mandalay. She uses a telephone and a fax but does not use email or the Internet. To use email or the Internet, she has to call an access point in Yangon and pay long distance charges. It may be cheaper for her to call by telephone or fax than use email. So even a Computer Federation member does not use email or the Internet in Mandalay. It is no wonder that ordinary people do not want to use email and the Internet.

3.5 Evaluation of telecommunication demand

The demand in Mandalay Industrial Zone is for business use and is crucial for running business. Regarding email and the Internet, there is no demand now because there is no access point in Mandalay. But BCT is going to offer email and Internet services. Then, factories will understand the benefits of email and the Internet soon. Therefore, in this case study, a near future demand for email and the Internet will be forecast by referring to the case study of South Dagon Industrial Zone. Then, the demand will be included in the total telecommunication demand.

The paper forecasts the demand for telephone lines by factory sizes. Table 3.5-1 shows the predicted telephone demand.

Table 3.5-1 Demand for telephone lines by factory sizes

	Telephone	Fax	Email & Internet	Total
Large factories	2	1	1	4
Middle size factories	1 to 2	1	0.1 to 0.2	3
Small factories	1	1	0	2

The total demand of the zone is calculated by using the number of factories. Table 3.5-2 shows the total demand.

Table 3.5-2 Total demand

	Number of factories	Telephone lines	Sub total
Large factories	153	4	618
Middle size factories	198	3	594
Small factories	1,372	2	2,744
Total	--	--	3,956

Mandalay Industrial Zone Development Committee expects that currently vacant lots will be fully used in 3 years and the development of No.3 block will be continuing. Therefore, taking an annual growth rate of the area into account, the demand in 5 years is calculated. The paper has adopted the annual growth rate of 10 % for South Dagon Industrial Zone (2). The growth rate is adopted again here and that will make the demand in 5 years about 6,500 (3,956*1.15)

3.6 Evaluation of telecommunication systems

Mandalay Industrial Zone will have a demand of as many as 6,500 telephone lines in 4 km^2, and almost all the subscribers are within 1 km radius from the exchange. Mandalay Industrial Zone Exchange was built in 2000 and telecommunication facilities are all new. The building and premises have enough space for the expansion of the facilities. Regarding junction, optical fibre cable has enough spare cores.

Taking those advantages into account, it will be the best method to expand using existing

telecommunication facilities. That means the expansion with the copper cable distribution method.

Table 3.6-1 Comparison of telecommunication systems

System	MPT's fixed phone			MPT's mobile	BCT's BWA
	Copper cable distribution	Optic and Copper hybrid	WLL		
General application	Good	The distance is short. The merit of using optic fibre is little.	Telephone density is high. The merit of using radio equipment is low.	Good, especially for business people moving around.	Data traffic is small. The merit of using wireless LAN is small.
Network cost (/line)	US$ 400-500	US$ 500-600	US$ 600	US$ 500	--
Terminal cost	US$ 20	US$ 20	US$ 60	US$ 120	US$ 1,950
Evaluation by users	Charge is low. No need of power supply.	Charge is low. No need of power supply.	Charge is low. Need power supply.	Charge is middle. Suitable for people moving around.	Charge is high. Customers can get this quickly. Need power supply.
Total Evaluation	Excellent	Fair	No good	Good	No good

3.7 Conclusion

The consultants recommend the fixed telephone expansion with copper cable distribution. It costs the lowest because the area is small and close to a telephone exchange and telephone density is high.

4. Case Study 3: Bank Telecommunication Network

4.1 Banks in Myanmar

Myanmarese banks have characteristics. Only government banks can do foreign banking. Private banks do only domestic banking. Foreign banks cannot do any banking in Myanmar. Although many foreign banks, such as Tokyo Mitsubishi and Sumitomo Mitsui, are in Myanmar, they can only collect information and advise their customers rather than do banking.

4.2 Bank networks

The consultants interviewed three large banks in Yangon. All three banks have similar networks. Table 4.2-1 describes the network situation.

Table 4.2-1 Bank network situation

Item	AWB Bank	KBZ Bank	MMB Bank
Head office	Yangon	Yangon	Yangon
Number of branches (in Yangon)	39 (--)	22 (6)	25 (10)
Number of employees	3,400	--	1,100
Telephone network	MPT's telephone lines. Head office: 20-30 Branch: 3-4 each	MPT's telephone lines. Head office: 15 Branch: 5 each	MPT's telephone lines. Head office: 50 Branch: 3-4 each
Data network	BCT'sVSAT	BCT's VSAT (128 kbps)	BCT's VSAT
Application	Email, banking data (branch to branch)	Email, Banking data (branch to branch) reporting	Email
ATM	0	0	11 (Yangon only)
ATM connection	--	--	Leased lines (ATM to the head office)
Problems	VSAT is expensive and not reliable. VSAT is not good for a telephone. Leased lines are expensive.	VSAT is expensive and not reliable Leased lines are prohibitively expensive.	--
Others	It wants to centralise DB. For that purpose, a reliable data network is necessary.	It plans to use iPSTAR as a backup.	It plans to install ATMs in Mandalay

The consultants obtained KBZ bank's branches and its network. KBZ bank has 22 branches, and Table 4.2-2 shows their location.

Table 4.2-2 KBZ bank's branches and their location

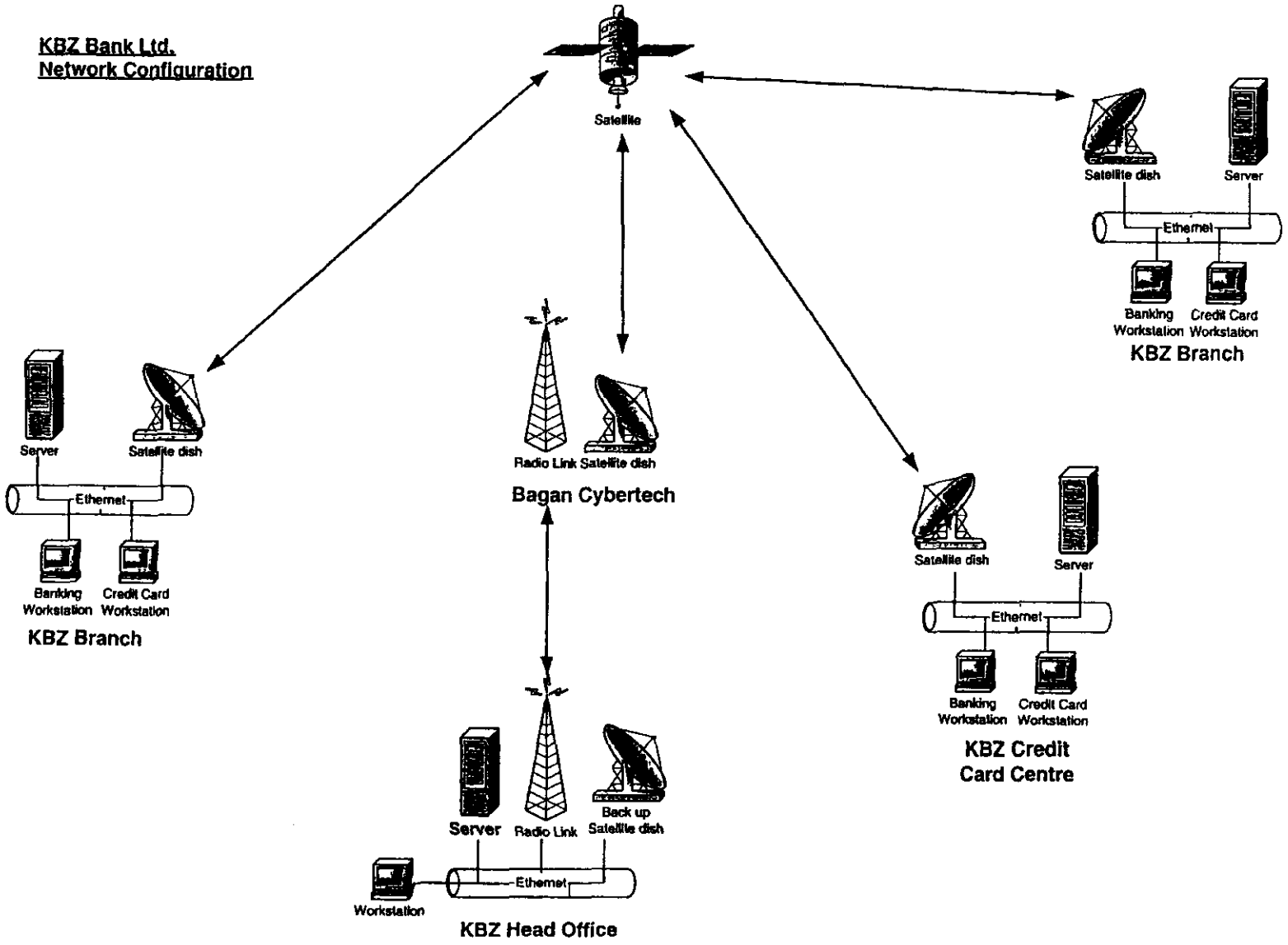
No.	Location	No.	Location
1	Yangon, HO, Kamayut Branch	12	Muse, Muse Branch
2	Yangon, Lanmadaw Branch	13	Kathaung, Kathaung Branch
3	Yangon, Mingalazay Branch	14	Pakokku, Pakokku Branch
4	Yangon, Bayintnaung Branch	15	Myeik, Myeik Branch
5	Yangon, Shwegondaing Branch	16	Pharkant, Pharkant Branch
6	Yangon, Pazundaung Branch	17	Maungtaw, Maungtaw Branch
7	Mandalay, 80th Street Branch	18	Hinthada, Hinthada Branch
8	Mandalay, Zegyo Branch	19	Sittwe, Sittwe Branch
9	Taunggyi, Taunggyi Branch	20	Myitkyina, Myitkyina Branch
10	Tarchileik, Tarchileik Branch	21	Bamaw, Bamaw Branch
11	Lashio, Lashio Branch	22	Mawlamyaing, Mawlamyaing Branch

Note: Head office is No.615/1, Pay Road, Kamayut Township, Yangon.

Fig. 4.2-1 shows its data communication network. The network is not for an online system. It is rather a wide area network (WAN).

According to the hearing, the biggest network problem for the banks should be data communication networks. All of them use BCT's VSAT service, but it is expensive and not reliable (Capacity may be too small and the service is a best effort type meaning the service does not guarantee the nominal transmission speed. This is not BCT's fault). In this case study, the report delves into the best system to network the head office and branches using KBZ bank as an example.

Fig. 4.2-1 KBZ Bank's data communication network



4.3 Telecommunication status

According to MPT's Yangon Auto Telephone, MPT offers leased line services. Because lines are in short for even telephones, MPT does not have enough facilities for leased lines. MPT has the optical fibre junction network in Yangon, but it is for telephones. MPT does not have spare capacity for leased lines. Therefore, it is difficult for customers to use leased lines.

The consultants obtained part of lease line charges. Table 4.3-1 describes the charges.

Table 4.3-1 Lease line charges

Lease line charges
Rental charges for one leased line = Annual fee + Installation charges
Annual fee = US$ 700 (both for fibre and copper)
Installation charges = US$ 146 (copper cable per 1 km) US$ 831 (copper cable per 10 km) US$ 26.2 (fibre cable per 1km) US$ 28 (fibre cable per 10 km)

There are official prices for initial charges. Because MPT is in short of money, it asks customers pay all of the cost the installation needs. The Japanese embassy backed up that fact. When it wanted an optical fibre access line, it was asked to pay all the money to construct and hand over the cable to MPT.

4.4 Evaluation of telecommunication systems

According to the hearing survey, the banks are not satisfied with BCT's VSAT service. They claim that service is expensive and not reliable. Actually, it is not BCT's fault. The VSAT service uses Internet protocol (IP). It makes the service a best effort type, not guaranteeing a nominal transmission speed. If other subscribers use large data, the line is jammed and the transmission speed is lowered. Satellite communication is expensive. BCT leases transponders of communications satellites from a Thailand company.

If the three banks were in Japan, they would have chosen leased lines. They can also choose data packet services, such as frame relay, or IP virtual private network (IP-VPN) service. The

telecommunication infrastructure in Japan is well developed. All of its trunk and junction transmission is digital, using mainly optical fibre cable. As for access lines, if a customer wants a transmission speed of over 128 kbps, they will be optical fibre. The carriers in Japan offer various services from which customers can choose according to their needs.

Using communication satellite service is a good way when one has many branches in different places. However, if reasonable leased line services had been offered, banks would have chosen leased line services. In this case study, the consultants assume leased line services are available at reasonable prices, which might not be true now. Table 4.4-1 shows comparison of possible services.

Table 4.4-1 Comparison of data transmission services

	Communications satellite	Leased circuits (Access line uses cable)	Leased circuits (Access line uses IP-based wireless)
General application	Many branches	Small to medium number of branches	Small to medium number of branches
Merit	Cover wide area. Easy and quick to get the service.	Reliable. Security is good. Transmission speed can be very high.	Cover middle range of area. Faster than the wired system.
Demerit	Transmission speed is not high. Expensive.	It takes time to get the service, especially when the network is not developed.	The security may not be as good as cable.

4.5 Evaluation of network

Fig. 4.5-1 illustrates the location of the branches and MPT's transmission network. This figure tells the connection between the head office in Yangon and each branch. Table 4.5-1 describes transmission systems between head office in Yangon and each branch.

Table 4.5-1 Transmission systems between head office and its branches

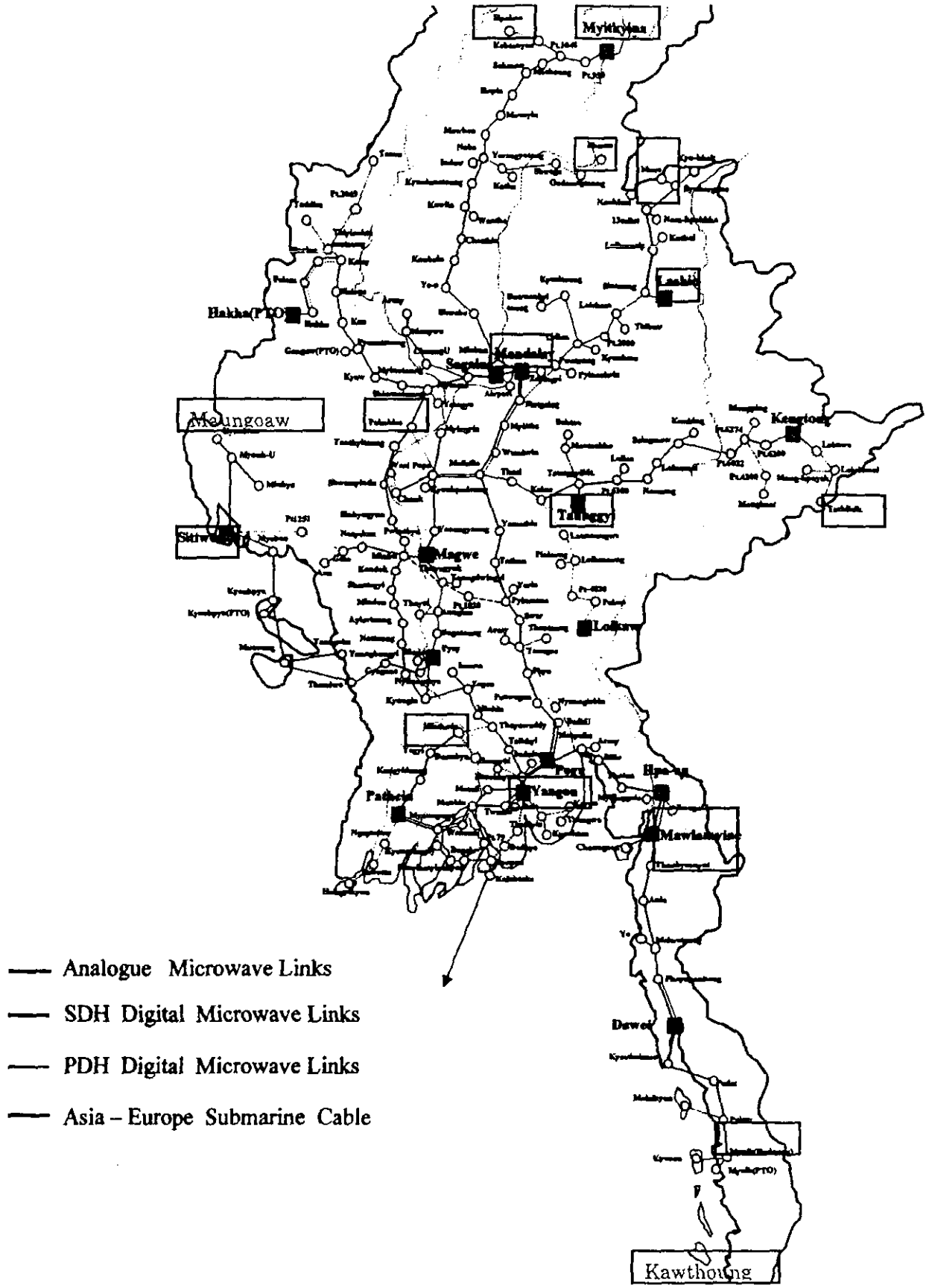
No.	Location	Transmission system
1	Yangon, HO, Kamayut Branch	Optical fibre PDH
2	Yangon, Lanmadaw Branch	Optical fibre PDH
3	Yangon, Mingalazay, Branch	Optical fibre PDH
4	Yangon, Bayintnaung Branch	Optical fibre PDH
5	Yangon, Shwegondaing Branch	Optical fibre PDH
6	Yangon, Pazundaung Branch	Optical fibre PDH
7	Mandalay, 80th Street Branch	Optical fibre PDH
8	Mandalay, Zegyo Branch	Optical fibre PDH
9	Taunggyi, Taunggyi Branch	Radio PDH
10	Tarchileik, Tarchileik Branch	Radio PDH
11	Lashio, Lashio Branch	Radio PDH
12	Muse, Muse Branch	Radio PDH
13	Kathaung, Kathaung Branch	--(No trunk link)
14	Pakokku, Pakokku Branch	Radio SDH
15	Myeik, Myeik Branch	Radio Analogue
16	Pharkant, Pharkant Branch	Radio PDH
17	Maungtaw, Maungtaw Branch	Radio Analogue
18	Hinthada, Hinthada Branch	Radio PDH
19	Sittwe, Sittwe Branch	Radio Analogue
20	Myitkyina, Myitkyina Branch	Radio SDH
21	Bamaw, Bamaw Branch	Radio PDH
22	Mawlamyaing, Mawlamyaing Branch	Radio Analogue

Note 1: The location of Pharkant Branch is not clear, it is assumed to be Hpakant.

2: Actual connection is combination of several systems. The worst system of the connection is written. (For example, if the link uses optical fibre SDH, radio PDH, and radio analogue, it is classified as radio analogue.)

Unlike our expectation, the branches are not in the central area of the country rather they are located near the border areas. Those areas may be rich because of border trade. There are still radio analogue systems to connect between the head office in Yangon to the branches, and even no trunk telephone line. This does not necessarily mean the area does not have any communication methods though. MPT is now trying to change analogue systems to SDH systems. For the moment, a nation wide digital bank network has to wait.

Fig. 4.5-1 Transmission backbone network and KBZ branches



4.6 Networking of branches in Yangon

It is difficult to connect all the branches with leased lines now. Is it possible to connect branches in Yangon with leased lines? There are 6 branches in Yangon. They are connected to the head office in Yangon via satellite communication. It looks like a waste to connect two points a few km away via satellite communication. There should be a lot of transaction among branches in Yangon because customers can go easily to other branches instead of their home branches. As the data of a customer is stored in his home branch, another branch has to get that information to offer the customer a banking service.

In this section, the network is divided into two sub-networks: a sub-network in Yangon and a sub-network outside of Yangon. The network envisaged here is the following.

Fig. 4.6-1 New networks

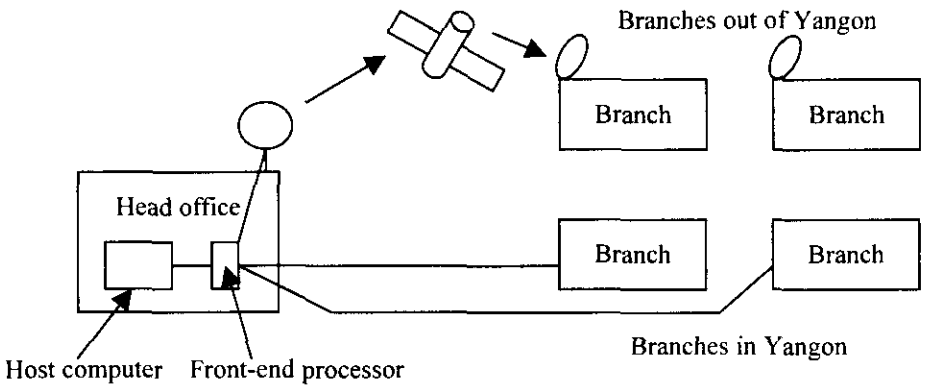


Fig. 4.6-1 shows the bank needs to have two networks. It looks double investment, but the bank's equipment is almost the same. So having two networks is not a problem. If the bank can have a solid network in Yangon, it may be able to do online banking in Yangon.

4.7 Networking with wireless LAN

Figure 4.7-1 shows the distances from the head office to each branch. The longest distance is 7.7 km between the head office and Pazundaung Branch. The signals from the head office can reach the branch because the wireless system can reach up to 15 km. But Shwegondaing Branch is at the good place so signals can be relayed there. Fig. 4.7-2 shows the block diagram.

Fig. 4.7-1 Location of branches

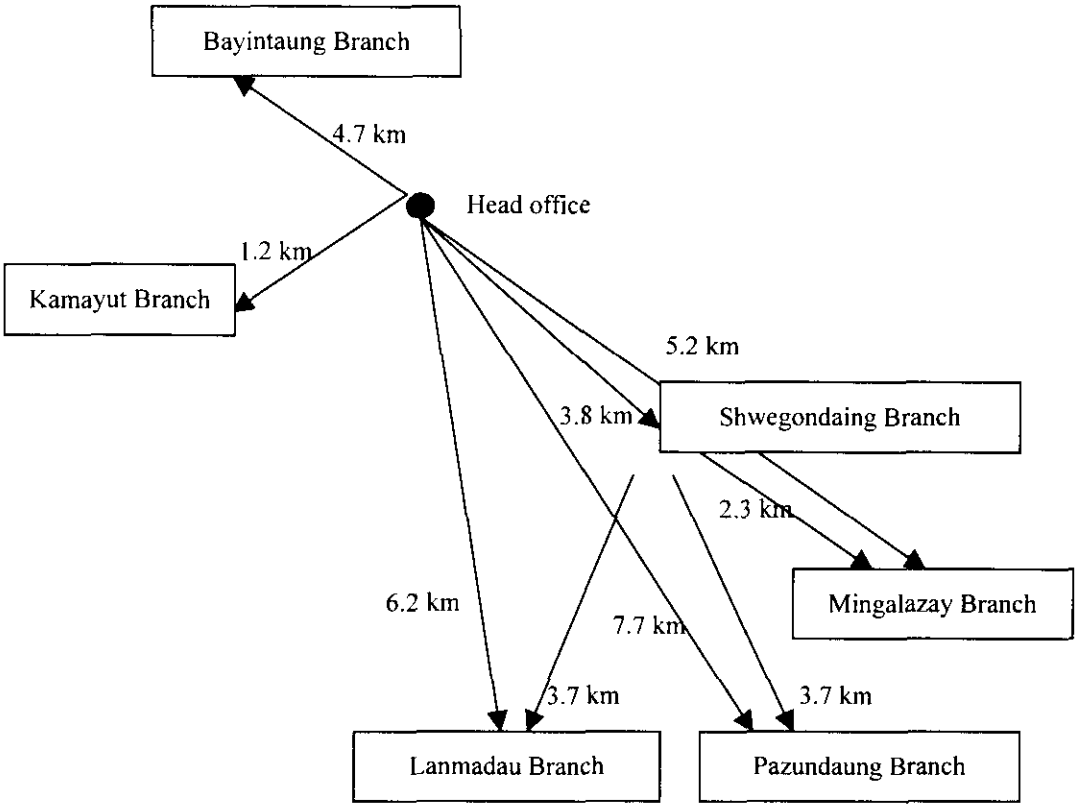
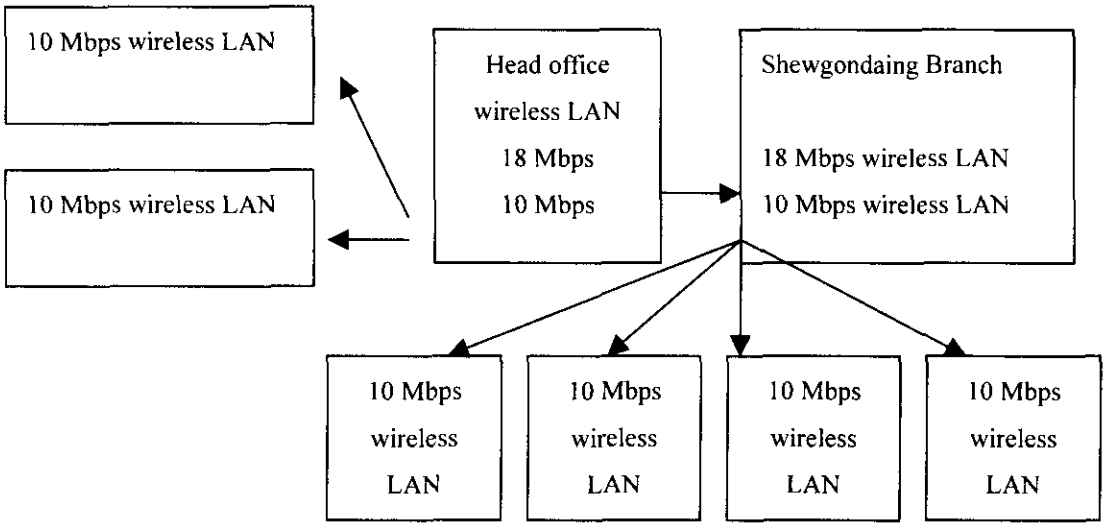


Fig. 4.7-2 Wireless LAN block diagram



This system is technically feasible. This system uses ISM (Industry, Science, and Medicine) band and does not need to apply for its use in Japan. It is different in Myanmar where the private sector is not allowed telecommunication by itself, but if BCT builds this network, it should be no problem.

4.8 Networking with cable

In Yangon, there is an optical fibre junction network. The transmission systems are mainly 34 Mbps PDH and 140 Mbps PDH. They are mainly used to connect telephone switches for voice communication. (See Table 4.8-1 and Fig. 4.8-1)

Table 4.8-1 Transmission system in Yangon

No.	System	Number of links	Ratio (%)
1	8 Mbps PDH	2	5.2
2	34 Mbps PDH	11	29.0
3	140 Mbps PDH	24	63.2
4	155 Mbps SDH	1	2.6
Total		38	100

Nowadays, 600 Mbps SDH and 2.4 Gbps SDH have become common thanks to the development of transmission technology. The same optical fibre cables can be used for SDH systems. By only changing transmission systems to SDH systems, the junction transmission increases the capacity by more than 4 to 8 times.

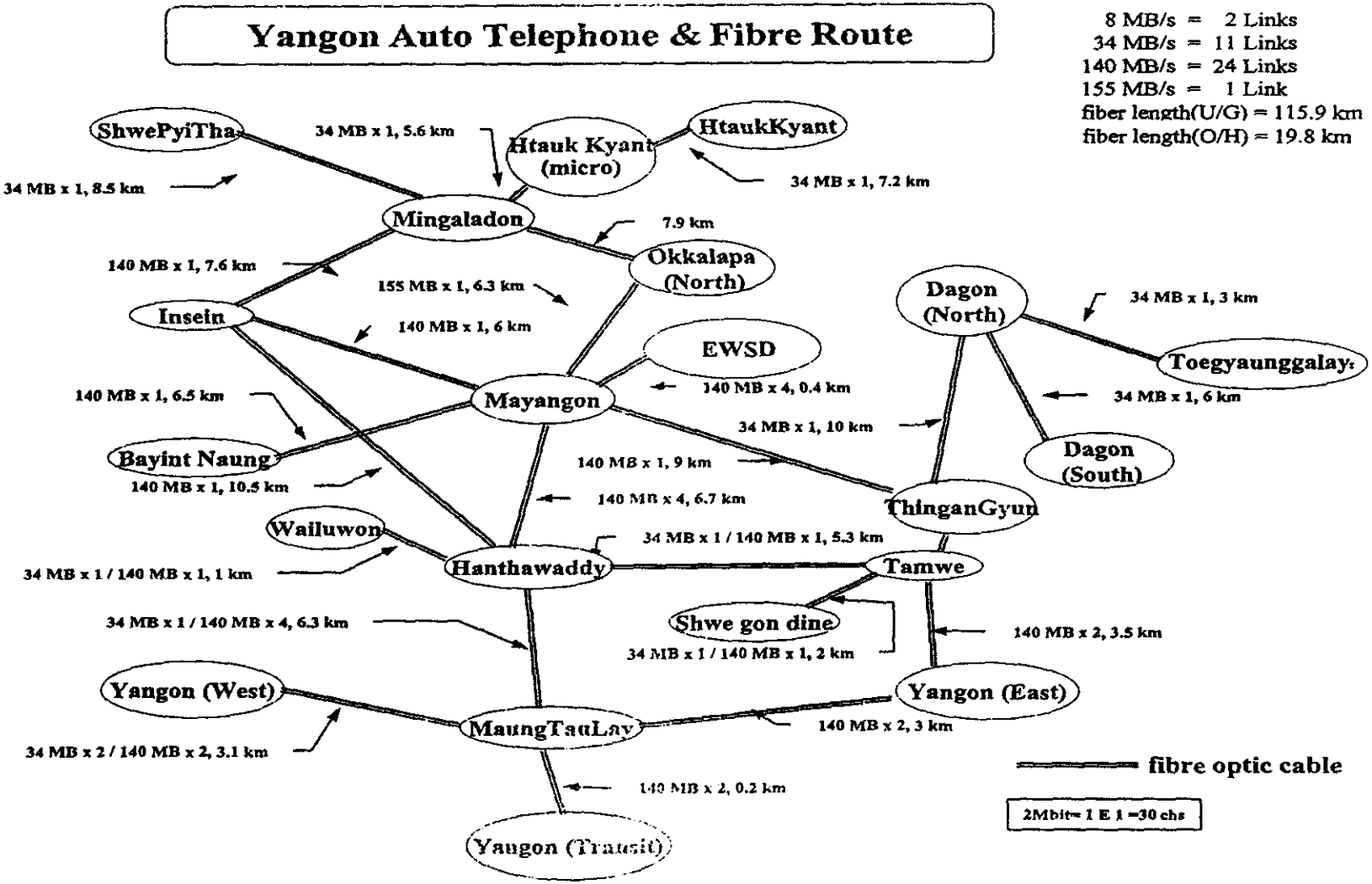
Subscriber cable is also a problem. Usually, a copper cable can send 64 to 128 kbps digital signals by using digital equipment. In Myanmar, subscriber cables are old and not good. To use the digital network, it may be necessary to replace old copper cable with new copper cable or optical fibre cable.

Table 4.8-2 networking with cable

No.	Cable	Measure
1	Junction	Increase transmission capacity by changing to 600 Mbps SDH systems or 2.4 Gbps SDH systems.
2	Subscriber	If cable is not good enough, replace with new copper cable or optical fibre cable

Considering subscriber cable situation, this method is not as good as using wireless LAN systems.

Fig. 4.8-1 Optical fibre junction network



4.9 Leased line policy

In order to develop the IT industry, computerisation in companies are imperative. However, computerisation will necessitate computerisation of all the systems in the company including branches. To network a head office and its branches, the network infrastructure is necessary, especially digital leased lines are necessary. The careers should consider not only telephones but also leased lines.

4.10 Conclusion

Banks' networks use BCT's VSAT service. But if there had been digital leased lines, banks would have chosen leased lines. The report conducted a case study using KBZ bank's network as an example. The results are:

(1) To replace VSAT service nationwide is difficult now because the bank has many branches near border areas where digital network is not available.
(2) To replace VSAT service in Yangon is possible.
(3) In Yangon, networking between the head office and branches by wireless LAN systems is good.
(4) Another way is to increase junction capacity by replacing old transmission equipment with new SDH equipment. The increased capacity can be used for leased lines. Subscriber cable may be replaced with new copper cable or optical fibre cable.

In order to facilitate the IT industry, MPT should offer leased lines with reasonable prices. Especially the use of IP-based wireless LAN systems should be considered.

5. Case Study Virtual: Rural Telecommunication Networks

5.1 Rural community model

In this section, instead of applying telecommunications systems to the real site, they are applied to a rural community model. Japanese members visited a rural village and its vicinity in the northeast outskirt of Yangon. Based on the trip and available documents, the Japanese group decided to make a rural community model.

Table 5.1-1 shows how large land one family farms. Data is as of March 1973 and old, but it may not have changed much. The average area of 21,489m^2 equals to 147×147m^2.

Table 5.1-1 An average area of farm land

Type	Number of farming families	Area	Area/farming family
Landed farmer	2,766,237	13,462,726 acre (54,481,767,000 m^2)	4.87 acre (19,708 m^2)
Tenant farmer	1,593,732	9,671,288 acre (39,138,349,000 m^2)	6.07 acre (24,564 m^2)
Total	4,359,969	23,134,014 acre (93,620,116,000 m^2)	5.31 acre (21,489 m^2 =147×147m^2)

Source: Ministry of Planning and Finance, Report to the People by the Government of the Union of Burma on the Financial, Economic and Social Conditions for 1972-73. Figures are as of March 1973.

Japanese members visited Thak Tookam village, 30 km northeast of downtown Yangon. It is close to Yangon, but surrounded with paddy fields. The village has 49 telephones, but only one channel of digital cordless link connects to MPT's telephone switch. A telephone operator connects telephones with a manual board. Table 5.1-2 shows the figures a poster of the village described.

Table 5.1-2 Figures of Thaik Tookam village

Item	Numbers	Remark
House	458	
Family	620	162 (620-458) families live together
Population	2,497	4.0 people/family
Farmers	368	252 (620-368) do other jobs
Paddy area	3,504 acres 14,180,197 m^2	9.5 acres/farmer 38,533 m^2 (=196×196m^2)
Bean field	3,190 acres	Total equals to paddy area. Because of double-cropping, they are counted two times.
Groundnut field	314 acres	
Tractor	24	
Thresher	1	
Hand tractor	5	
Car	2	

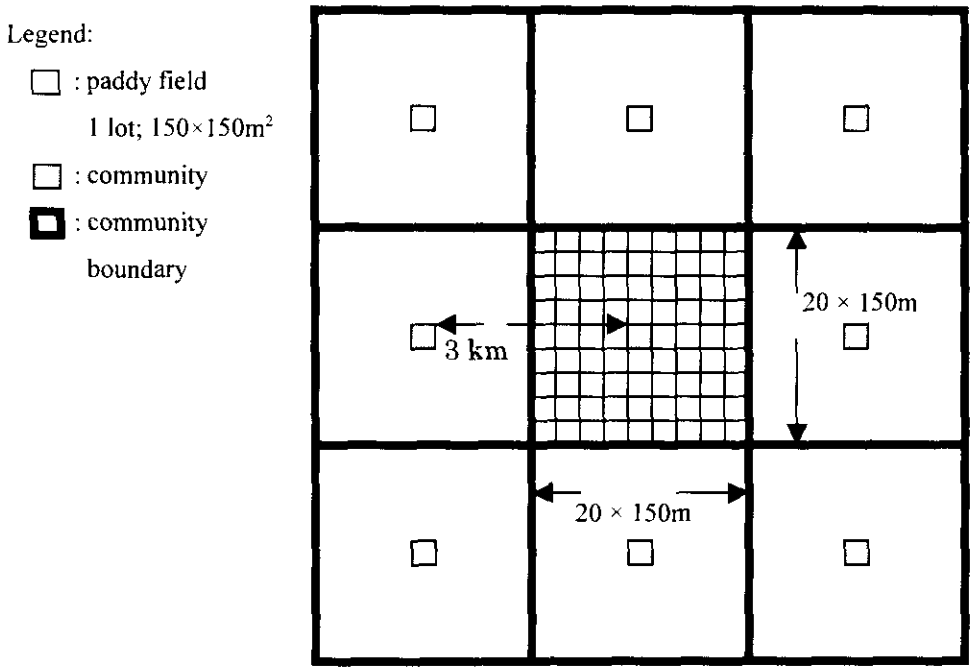
The Japanese group interviewed the head of the village. He answered he has 40 acres (161,874m^2=402×402m^2). He hires four labourers to farm the land. That may explain too small number of farmers and large area per farmer. Labourers might not be counted as farmers. When paddy field (3,504 acres) is divided by total number of families (620), the number becomes 5.7 acres (22,871 m^2=151×151 m^2). This figure nearly equals to the figure in Table 5.1-1.

Common sense tells that one family can farm up to 10 acres (40,469m^2=201×201m^2). When a village becomes big, people have to work as teacher, shop owner, restaurant owner, etc.). Those numbers have to be taken away from the number of farmers. To make the argument simple, however, the report supposes that 1 village family has 1 farm lot that is a square with 1 side being 150 m.

According to what the Japanese group heard, the number of families a village has varies from 200 to 600. Taking the centre, let's make it 400.

To make the model simple, let's consider that the model village has 400 families, farming 150×150 m^2 paddy field each. Fig. 5.1-1 shows the model village.

Fig. 5.1-1 Rural community model



Assumption:

A lot (paddy field) is square with one side measuring 150 m.

One village consists of 400 families.

Other villages are the same. The length between a village and a next village is 3,000 (20 × 150) m.

One village has

Village office	1
Primary school	1
Library	1
Clinic	1
Monastery	1

Telephone demand: 5 telephones for 1 village

Many families may share one telephone line.

IT demand: Occasional email and the Internet

Village office, primary school, library and clinic may have one IT terminal.

5.2 Rural telecommunication systems

In order to provide the telecommunication service to each community, there are possible measures. Typical of them are as follows:

(1) Satellite communication
(2) Mobile communication
(3) Point-point micro radio
(4) Point-point VHF radio
(5) Point-multi-points radio
(6) Digital cordless phone
(7) IP-based wireless LAN

Some of them are old analogue systems. All of them except wireless LAN are for the telephone service. The aim of those systems is to connect villages by telephone as cheap as possible. Most of them are not good to build the infrastructure for IT because the transmission speed is slow. On the other hand, the IP-based wireless LAN system is fast. It easily networks IT terminals. The aim of wireless LAN system is not only providing telephones but also giving access to email and the Internet. It gives possibility to villagers, enabling them to access information and send information.

The wireless LAN gives easy connection among villagers with high-speed transmission. It can facilitate villagers to exchange information among them. One demerit is that it needs power supply.

This case study of IT working Group focuses the study on wireless LAN. One reason is that if telephones are provided with old telephone technology, they may be replaced by IP technology. The VoIP technology is going to prevail over traditional telephones.

5.3 Local area network

Wireless LAN system is suitable for making a local area network with high-speed transmission. The high-speed transmission allows users to send many types of data, such as voice, image, and video images. There are two types of wireless LAN systems: wireless LAN system for distribution and wireless LAN system for a trunk line.

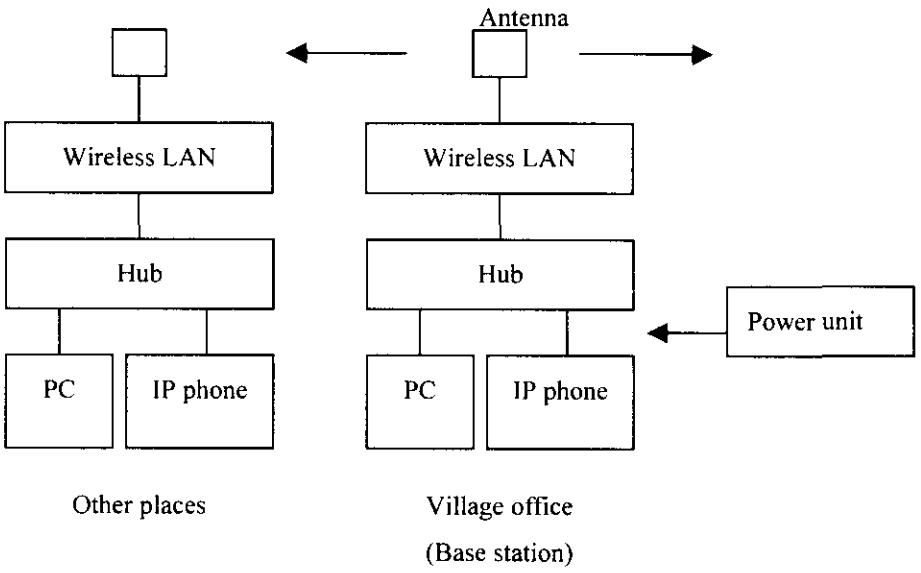
The wireless LAN for distribution can network places in a village. Table 5.3-1 shows places to

be networked. Figure 5.3-1 shows the network diagram.

Table 5.3-1 Possible telecommunication sites

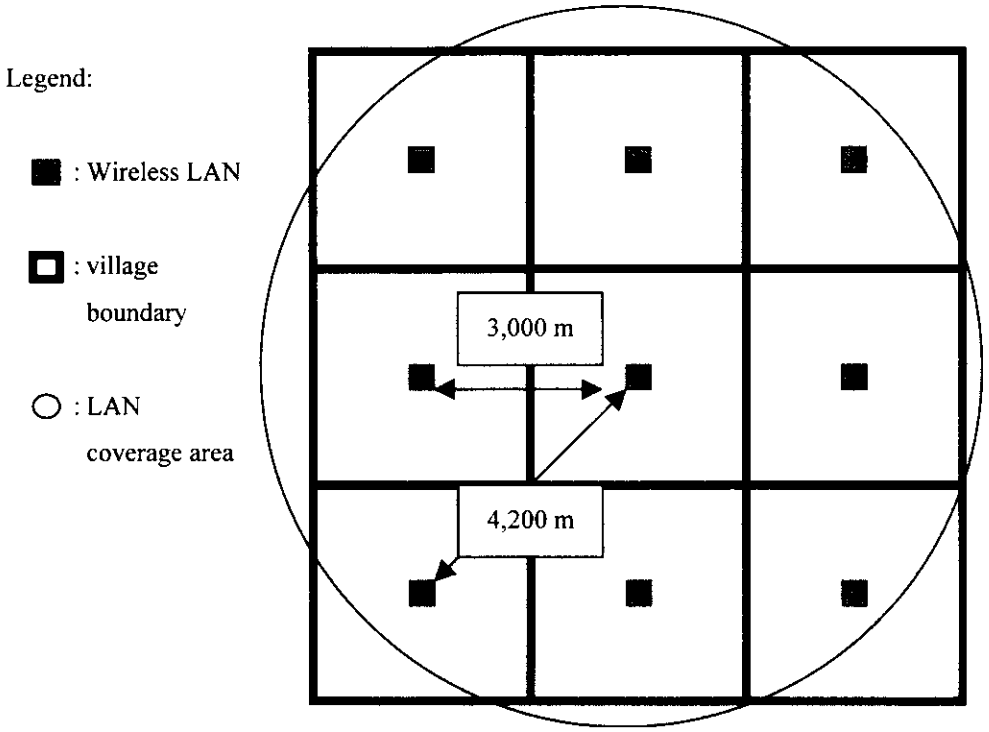
Place	Equipment	Remark
Village office	Wireless LAN, IP telephone, PC	Base station
Primary school	Wireless LAN, IP telephone, PC	
Clinic	Wireless LAN, IP telephone, PC	
Library	Wireless LAN, IP telephone, PC	
Monastery	Wireless LAN, IP telephone	

Fig. 5.3-1 Wireless LAN network



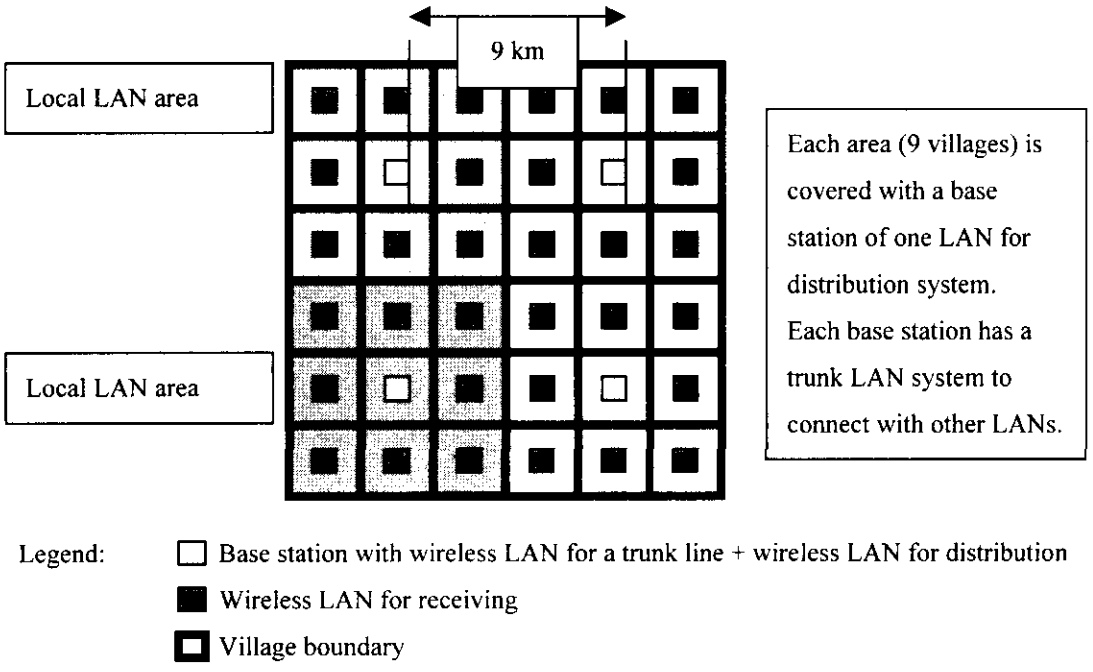
The Wireless LAN system can network not only a village but also several villages. The wireless LAN system can cover about 5-km radius, one LAN network can cover 9 villages.

Fig. 5.3-2 One wireless system covering 9 villages



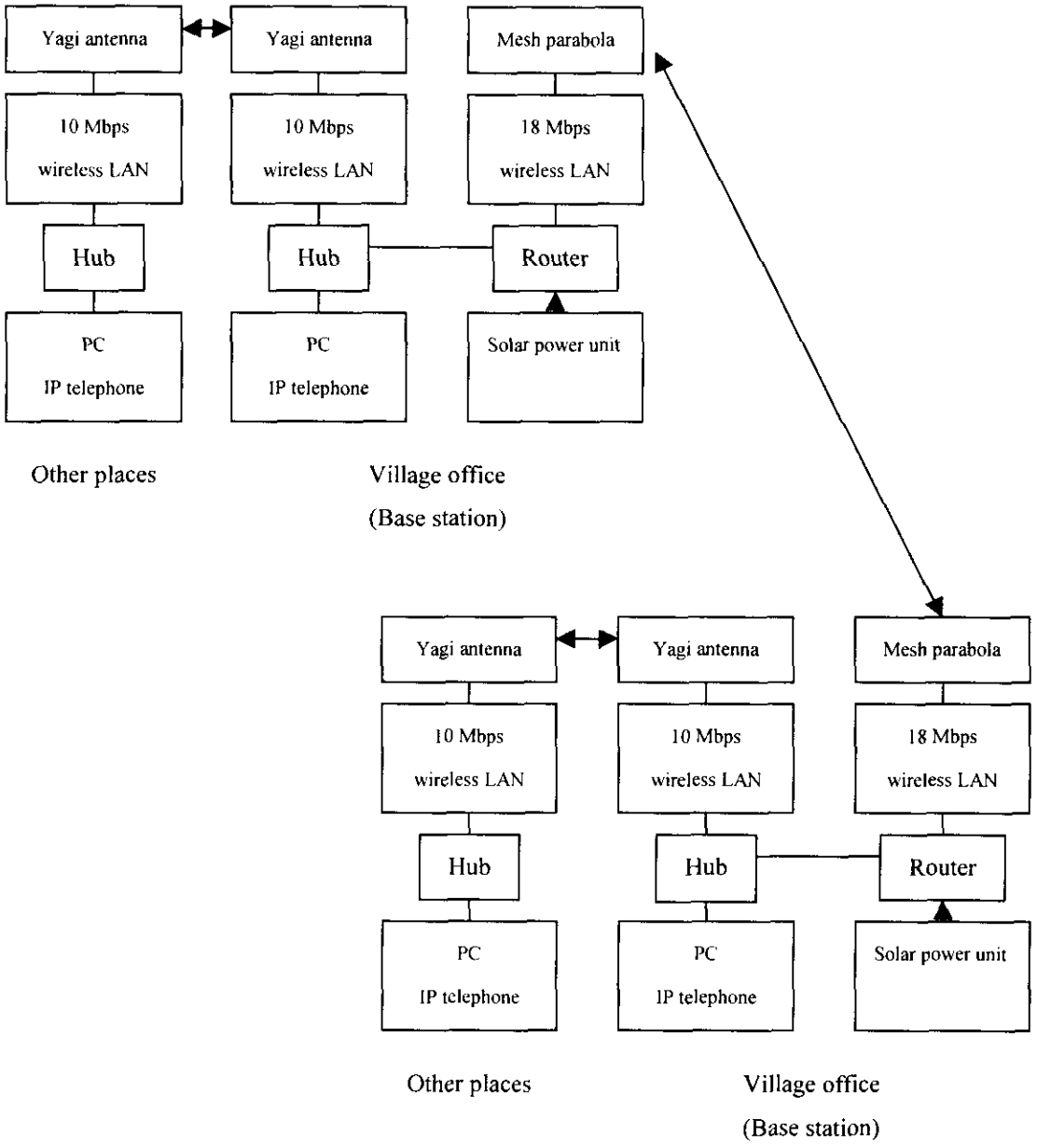
In order to cover wider area, it can use wireless LAN for a trunk line. It can reach 10 km. By using wireless LAN for a trunk line and wireless LAN for distribution, it can cover wider area.

Fig.5.3-3 Example pf one wireless LAN network covering 36 villages



By using wireless LAN systems for a trunk line, the wireless LAN can cover wider area. The transmission speed is fast. The speed of wireless LAN for distribution is 10 Mbps, and that for a trunk line is 18 Mbps. It has enough speed for communication within the network.

Fig. 5.3-4 Wireless LAN network diagram



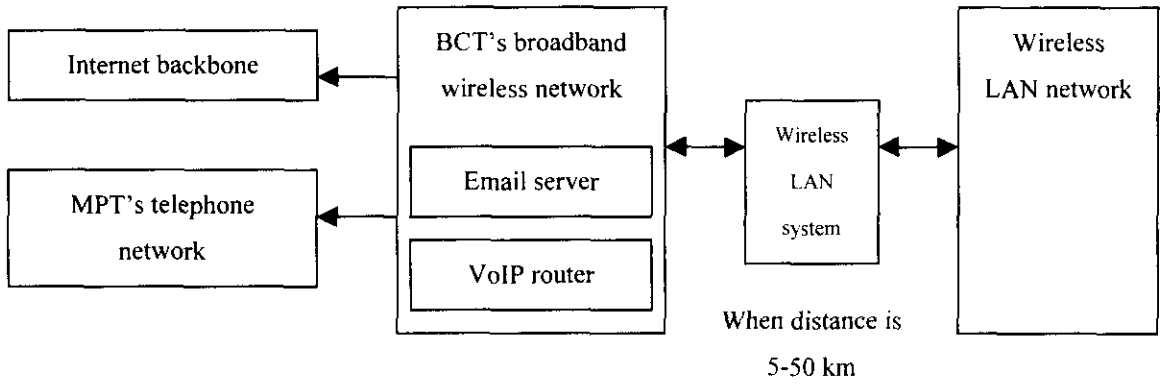
The wireless LAN system gives connection. But if the villages want to use email, it needs an email server. An email server can be installed in the network or an email server outside of the LAN can be used. Connecting this LAN with ISP's network or MPT's network will enable villagers to use email, the Internet or speak people using MPT's telephone. Beginning next section, the paper considers how to connect with other networks.

5.4 Connection with other networks

5.4.1 BCT's broadband wireless network

BCT offers BWA service using broadband wireless IP network, which is a similar network with this wireless LAN network. If a village is close to the BCT's broadband network, connecting wireless LAN systems to BCT's broadband network is the best. BCT offers BWA service in Yangon and Mandalay. If BCT's network and this wireless LAN are within the reach of the radio, they can be connected. If the distance between the both networks is larger, wireless LAN systems can relay between them.

Fig. 5.4-1 Connection between BCT's network and the wireless LAN network

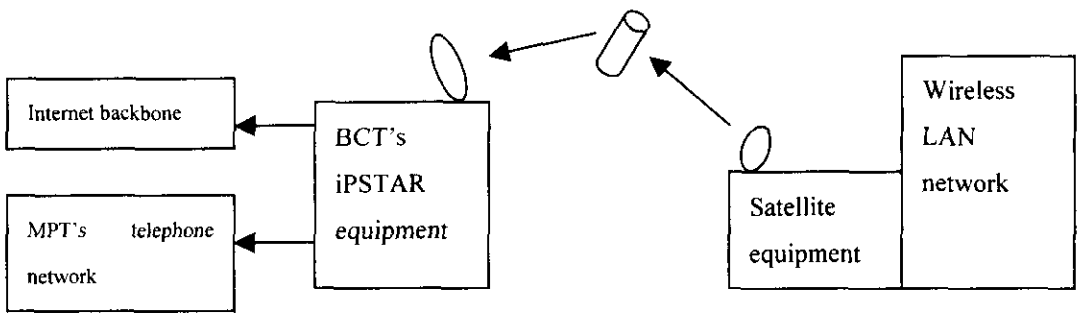


This connection enables people on the wireless LAN network to use every service BCT' BWA offers.

5.4.2 BCT's iPSTAR network

BCT offers a satellite communication service called iPSTAR. The service of iPSTAR is inexpensive IP communication.

Fig. 5.4.2-1 Connection with BCT's iPSTAR network

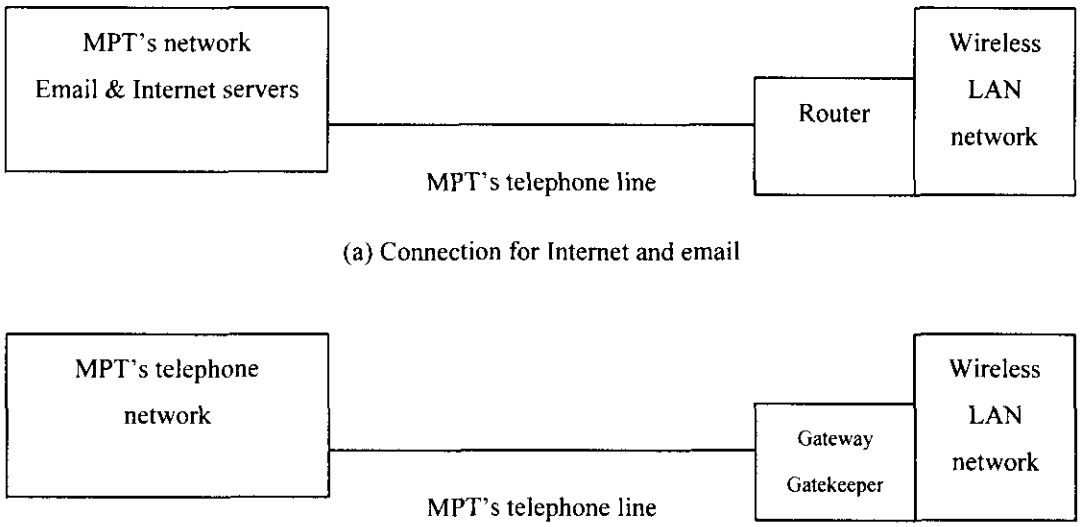


One of the merits is that a satellite remote terminal can be built anywhere in the country. One of the demerits is the speed of satellite communication is not fast. With many villages networked, there may be some traffic jam. Using email may be no problem, but using outgoing and incoming telephone calls to/from MPT's telephone network may have a problem.

5.4.3 MPT's telephone network

MPT's telephone network can be connected. Fig. 5.4.3-1 shows how to connect both networks.

Fig. 5.4.3-1 Connection between MPT's network and the LAN



(a) Connection for Internet and email

(b) Connection for voice

Both networks have different mechanisms, and so the connection becomes a little complicated. The transmission speed of MPT's telephone line is up to 64 kbps and slow. The gateway and gatekeeper are expensive.

5.5 Conclusion

The IP-based wireless LAN system is expected to provide an important method to bridge the digital divide in rural areas in Myanmar where the legacy system of conventional telecommunication infrastructure hardly exists. It can be also economically more efficient in some cases since it can avoid the duplication of building telephone network and then, IP network. Wireless LAN system is good for networking places in a village and in several villages. Its transmission speed is high and it will open new communication opportunities.

The connection outside can be secured even in the remotest areas through VSAT and satellite

broadband network. Connection with BCT's iPSTAR is available any remote areas and is also good for connecting wireless LAN, but rental charge of iPSTAR may have to be transferred to clients. Connection with the telephone network of MPT requires additional equipment such as gateway keeper and gateway router, because both systems use different protocols.

The location of the pilot project could be anywhere. Considering the rental charge of satellite, however, the first pilot project should locate in the vicinity of Yangon (for example, within 50km), where the connection to BCT, or MPT is made through radio. If the power supply is not available, diesel generator, or solar panel is needed.

The project should cover installation of appropriate infrastructure, development of applications, operation, training and study on the effects. The purpose of the project will be to develop a model which can be replicated in other villages in Myanmar.

III. ICT Industry in the Union of Myanmar

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Summary

1. Recognition of the ICT revolution

The great Iron Bridge of Shropshire, England which was completed in 1779 stands as a monument symbolising the Industrial Revolution and its afterwards. The Industrial Revolution was said to have been a 'revolution of power' and included the development of the steam engine by James Watt in 1765 as well as other advancements. Prior to that time, sources of power in the world were limited to harnessing natural forces and the utilisation of human strength. Even Leonardo da Vinci, the active genius of the 15-16th century, had been unable to think of other power mechanisms.

It is said that the 'ICT revolution' of the 21st century will equal the Industrial Revolution of the 18-19th century. The essence of the ICT revolution comprises a 'revolution in information transmission' via the Internet, and its effects will include the realisation of 'information sharing on a global scale.' In the history of man, various information transmission means have been used such as fire signals, the written letter, the telephone, and wireless communications, etc. But there had been no method of global information transmission that was capable of overcoming the barriers of distance and time.

However, the technology of the Internet has enabled information transmission to be conducted on a global scale at an extremely low cost. And it also has allowed rapid information transmission to take place between any corner of the globe in a wide range of formats including text, voice, images, animation and shared information. The ICT revolution continues to advance as computer and Internet technology merges on a worldwide level. Clearly, information and communication technology will serve as a fundamental basis for global society in the 21st century.

2. Development of the ICT industry

ICT-related business consists of four main pillars: ICT infrastructure (telecommunication networks), hardware, software, and contents. The telecommunication industries of advanced nations such as Japan have experienced growth, and businesses in this field have changed significantly. However taking into consideration Myanmar's current status, it remains difficult for private companies to freely enter the telecommunications industry in the country. In the hardware sector, the area of PC-assembly could possibly hold potential, yet as long as foreign companies are discouraged from investing in Myanmar, the possibility of further expansion in the hardware sector will be limited.

On the other hand, the software sector depends largely on the knowledge and ability of engineers, and it is highly possible that this area could experience considerable growth as an industry in Myanmar, similar to India. It is therefore necessary to place focus on outsourcing business-related initiatives that incorporate a customer base in surrounding countries in the future, even if the initial efforts include serving as subcontract businesses of companies in countries such as India and China, etc. In addition, it is also necessary to create Myanmar's own original product brands in the future. There are a number of problems that first must be overcome however.

In addition, it is recommended that Myanmar concentrate on contents-related business areas such as e-Learning, music, images, pictures/paintings, and video games, etc. in the future. Participation from an eclectic talent pool of human resources such as software engineers, painters, composers, musicians, photographers and producers is required for contents-related business, and it will have a very substantial impact on society in Myanmar.

3. Problems regarding ICT industry development

There are some problems that need to be solved in order to develop the ICT industry in Myanmar. They include: completely opening up access to the Internet; liberalisation of the import/export of equipment related to ICT and priority focus plans for the ICT industry; deregulation in the mobility of human resources; and deregulation regarding investment from foreign countries. These problems will remain insurmountable unless there is active cooperation on the part of the Myanmar government, and proactive support measures are also essential.

1. Myanmar ICT Industry

1.1 Hardware – current status and problems

In Myanmar, annual domestic sales of personal commuters (PCs) grew by approximately 30% from the previous year, exceeding 25,000 units. As of 2001, more than 250,000 PCs were in use in the country. However, Myanmar's domestic market is not large enough for the country's Information and Communications Technology (ICT) industry to grow in the future.

Myanmar depends on imports for much of the main units, peripheral equipment and parts for PCs, and only assembly are done domestically. However, due to the foreign exchange situation, importers have difficulty in acquiring foreign exchange funds. That is to say, that even if importers domestically sell products which have been imported from neighbouring countries using foreign currencies, they cannot easily exchange the obtained domestic currency for foreign currencies, which hampers their business.

Today, ICT technology is closely associated with communications networks, so we cannot expect any progress of the technology without such communications networks being available. In Myanmar, because of government restrictions with regard to information and communications, and partly because of poor quality of terminal communications lines, the use of networks by most companies is limited to in-house LANs (Local Area Networks) and to the inter-company WANs (Wide Area Networks) which are just being started.

In Myanmar, 80% of the people live in rural areas, compared to only 20% in urban areas. Therefore, the utilisation of ICT for the nation's development requires communications networks between urban and rural areas. However, the construction of such communications networks requires a huge amount of money, so efficient ways must be found to achieve them whilst taking into account the needs of future technological advances.

1.2 Software – current status and problems

In the software development industry, there are only some ten major software development companies, including ACE Data, MCC and KMD. But a look at participants in the ICT Exhibition indicates that the number of venture capital companies (e.g. M.N.T.) established by young entrepreneurs in their 20s and early 30s, has been increasing. It is also estimated that the number of such companies will have reached 50 during 2002. However, in order for such software ventures to succeed, continuing work and the securing of a sufficient number of high quality engineers

are important factors. Also important is to gain collaboration not only within Myanmar, but also with neighbouring countries.

Generally, excellent engineers will leave for nearby countries to seek job opportunities. However, many of the jobs they can get abroad will be development work for downstream processes in which they are engaged in internal design and coding according to the specifications required by the client. Accordingly, they might not get many opportunities of experiencing upstream process development tasks, including system analysis and project management. Even if they could by chance get such upstream work, it will take many years for them to gain the confidence of clients.

What should be emphasised is that creating domestic demands for system development projects in Myanmar is critical for improving the quality of the Myanmarian engineers. Even if they obtain foreign cooperation, the Myanmarian participants must retain the initiative to challenge to manage projects, analyse operations, create data models and undertake designing. To this end, the Myanmar government should not await the private sector's demands for systems, but should take the initiative to actively create demands for system development, and should establish development projects to provide more business opportunities to engineers in the country.

1.3 Export potential

Myanmarian ICT engineers are of high quality and have enough potential to take substantial roles in an international market if they could accumulate experience. The improvement of communications networks, as infrastructure, can attract many businesses, not only for software development services but also as a location for English-speaking call center facilities. Also, they might be able to engage in works such as designing by CAD or CAM and creating software contents.

With regard to software development, the Myanmarian development companies would be able to take charge of the operations of foreign businesses while cooperating with advanced companies in neighbouring countries. But, on the other hand, they might possibly be reconciled to working as subcontractors to foreign companies. The Myanmarian development companies need a lot of practical experience with software development in order to attain a major status in the international market. Until then, they have no choice but to work as subcontractors, but this is in no way desirable for Myanmarian companies in the future.

Particularly, in the case of business received through the operations of foreign industry, there is little opportunity for the Myanmarian engineers to experience the upstream process of ICT, and such opportunities are difficult to gain through subcontracted work. Consequently, experience of domestic system development is important for Myanmar, and promotion of large- to medium-sized development projects centering on the electronic government (e-Government) plan must be effective in order to acquire the technical capabilities to appeal to foreign companies. Through system development performance, the country must nurture its engineers who could handle the whole processes of system development.

Next, the development of various kinds of business package software for domestic medium- and small-sized companies should be promoted. The development and sales of business solution software such as accounting systems, sales management systems, inventory control systems, personnel management systems and so on, which a broad range of medium- and small-sized companies might use, will not only help encourage domestic companies to utilise these systems, but will also accumulate and strengthen a broader range of ICT technology.

If the Myanmarian development companies, based on these system development performances, start to export business solution software, they might be able to accept outsourcing orders from foreign companies and collaborate with such companies as a regional base for world software development.

2. Myanmar ICT Park as an Incubator

2.1 Myanmar ICT Park

2.1.1 Location/facility overview

Myanmar ICT (MICT) Park is a 7.55 acres (30,554 square meters) facility adjacent to the north of Yangon Computer University, and has an office building, four production buildings and a refectory building. Myanmar's Lieutenant General Khin Nyunt, Secretary 1, was invited to the grand opening ceremony held on 21 January, 2002. This facility can accommodate 30 companies but has already achieved full occupancy. One foreign company from each of Malaysia and Singapore is housed in the facility.

Bagan Cybertech Co. Ltd., the second ISP (Internet service provider) company in Myanmar, was established and started business in December 2000. Bagan Cybertech constructed the Bagan International Data Center & Teleport adjacent to the MICT Park, in cooperation with Shin Satellite Public Company Limited of Thailand, and is the only Internet service provider in the MICT Park. Connected with the telecommunications satellite ThaiCom, and the submarine cable SEA-ME-WE3, Bagan Cybertech can offer higher access speed up to a maximum 128 Kbps within the MICT Park.

This means that a private company has finally entered the market in which Myanmar Posts and Telecommunications (MPT), a government agency, had previously held a monopoly. Though it is a welcome move in view of the progress of electronic dealing through the Internet (e-Commerce) in Myanmar, and for the development of the MICT Park, the Myanmar government should not forget, referring to past experience, that it is necessary to continue to make efforts to implement measures that will not make foreign companies feel it risky to enter the Myanmar market.

The Myanmar government has already approved the next stage expansion project of the MICT Park, which plans to eventually enlarge the park to 34 acres. One of the requirements for the MICT Park to succeed is to ensure that leading foreign companies recognise and invest in the Park. However, it is well known that the Internet has promoted globalisation of the ICT field, and a mere policy of lifting the ban on Internet service does not attract the investment of leading foreign companies. An important point is to make foreign companies recognise the benefits of the MICT Park and give them a strong incentive to invest in the Park, a policy with the strong support of the Myanmar government is required.

2.1.2 Telecommunication/Internet access

Until now, Myanmar has significantly lagged behind the rest of the world in the information and telecommunications industry. Although the Myanmar government has begun the partial improvement of domestic communications networks by placing orders with Chinese companies, because of the government's restrictions on communications with other countries the benefits and economic effects of the Internet have been significantly diminished. Indeed, in December 1999, the operations of the private Internet Service Provider (ISP) were suddenly stopped, which has given foreign media and companies a feeling of distrust concerning the proclaimed lifting of the ban on the Internet by the Myanmar government.

Since then, foreign companies have feared that Myanmar might return to the past in which the means of telecommunications with the country were limited to telephones and facsimiles, until such time as the Ministry of Communications, Posts & Telegraphs takes over the ISP service in Myanmar. Therefore, the Myanmar government must ensure that it does not make potential foreign companies, intending to go into the MICT Park, feel the same kind of entry risk again.

Restrictions on the use of the Internet mean that continuing use of the Internet service is dangerous for ICT-related foreign companies. This risk will make otherwise-willing foreign companies hesitate to go into the MICT Park. Although the establishment of the MICT Park and Bagan Cybertech is a welcome move in view of the progress of the ICT industry in Myanmar, the Myanmar government should not forget that it is necessary to continue to make efforts to implement measures that will not make foreign companies feel it dangerous to enter the Myanmar market.

2.1.3 Manpower availability

In Myanmar, there are about 100 engineers with international licenses for handling computer hardware. Their main jobs are the installation of PCs and their peripheral equipment, and the solving and troubleshooting of problems that have occurred. However, the scope of their current tasks is limited to the maintenance of parts or devices, monitors and power supply equipment, and lacks the hardware-related skills of handling any essential part. In future, it will become important for the Myanmarian engineers to learn the skills of maintaining the motherboard and peripheral devices, and of handling the interface with various industrial products.

In Myanmar, there are 200 engineers with international licenses including MCSE (Microsoft Certified Systems Engineer), and about 20 engineers with other licenses including MCP (Microsoft

Certified Professional), CAN (Certified Novell Administrator), and CNE (Certified Novell Engineer). However, there are only a few people who have been certified as network construction engineers by major vendors like AT&T or Krone. Additionally, there are more than 1,000 people who have received a basic education as network engineers in schools and so on, but they are critically short of opportunities for practical experience within Myanmar. Even if they can obtain domestic opportunities of gaining such experience, most tasks they can engage in are limited to those related to construction or maintenance of LANs, including the setup of network servers, management of networks and handling of the Internet systems.

From today, Myanmarian engineers must focus on learning skills such as construction and management skills in inter-company networks and WAN, construction skills in networks with hierarchical structures, wireless skills, and Internet security skills, in order to gain international recognition for their high technical capabilities.

The number of proficient software programmers working for companies is approximately 100 in FORTRAN and COBOL, 400 in VB, 100 in C++, 200 in ASP and HTML, 200 in SQL and Oracle, and 100 in other languages. Most of their jobs have been performed under the Microsoft Development Environment, on development works under the client server environment and on development operations related to the making and coding of in-house project designs according to client specifications.

Meanwhile, there are more than 8,000 students who have finished courses in software science and technology in colleges and so on, and some of them are engineers who have even participated in small-sized system development projects. However, there is the problem that practical opportunities to learn and improve skills in companies are few.

Further, the number of advanced engineers who could handle system analysis, project management, and so on, is very few. The number of those who have finished theoretical training in this discipline in colleges amounts to nearly 1,000, a few of whom have gained practical experience. These engineers often go abroad to seek business opportunities. Although this is important in respect of gaining experience of various operations, there are very limited opportunities abroad to engage in operations such as system analysis and project management, both of which are essential to advanced engineers. Therefore, creating domestic demands for system development projects is imperative for encouragement of the professional skills of Myanmarian engineers.

2.1.4 One-Stop Windows

Myanmar does not have the legacy system. It is because of this great benefit that Myanmar could focus on the construction of One-Stop Windows by using the most advanced technology without worrying about the many constraints contained in the legacy system.

In order to promote the development of One-Stop Windows, introduction of database systems for service-demanders is a top priority. Specifically, the Myanmar government should construct a database system to collect and manage the registers of births, addresses, marriage, and so on, by assigning numbers such as national security numbers to all nationals.

Also, the Myanmar government must develop integrated data dictionaries by processing and defining the vocabulary that each government office uses. This is because the inconsistency of vocabulary used by the various government offices is often the greatest obstacle to implementing One-Stop Windows.

Along with the development of the above database system, improvement of the telecommunications infrastructure will make the following possible: 1) on-line processing including applications and reporting; 2) implementation of government agency networks; and 3) implementation of national and regional networks. Also, security measures are extremely essential to implementing One-Stop Windows. For that purpose, the Myanmar government should seek to create a Public Key Infrastructure (PKI) as a certification system for identification, and should nurture specialists of various types in encryption technology. In particular, the government must adequately prepare to prevent critical risk factors like cyber-terrorism, by establishing an anti-terrorist team of specialists, or similar other precautions.

2.2 Lessons from other software park initiatives in Asia

Asian countries that have recognised the importance of the IT revolution are designing their ICT strategy and making efforts to gain leadership in the 21st century.

In Singapore, for example, the government has formulated an ICT strategy for the 21st century called "Infocomm 21 Masterplan", which aims to make Singapore a key regional telecommunications hub in the world economy. For that purpose, the Singapore government has devised the following strategy: 1) development and dissemination of interactive, high-speed broadband networks; 2) construction of new capabilities and promotion of innovation in main growth areas; and 3) strengthening of strategic partnerships and coalitions with other countries.

In Malaysia, the government is promoting a project called "Multimedia Super Corridor", under which Malaysia aims to become a member of the developed countries by 2020. The following is an overview of the project: 1) Urban planning in the 21st century – "Cyberjaya", the premier intelligent city and "Putrajaya", the new administrative center; 2) seven basic policies – i) e-government, ii) human resources development, iii) creation of an R & D centre, iv) training base for manufacturing industry, v) creation of various applications, vi) encouragement of e-government and electronic transactions by using multipurpose cards, and vii) legislation of new laws and regulations related to ICT; 3) attracting leading ICT-related companies through the following measures – tax privileges, lower communications charges, deregulation of foreign currency exchange, and liberalisation of employing foreigners, etc.

As mentioned above, neighbouring countries around Myanmar have each designed their ICT strategy and constructed a lot of facilities similar to the MICT Park. Each country aims not only to attract leading foreign high-tech companies to improve the international competitiveness of domestic industry, but also utilise two features of the ICT Revolution (i.e. Information Transmission and Information Sharing) to help promote the modernisation and progress of the individual country.

Key industries, including automobiles, require higher technical capabilities in a broad range of areas including manufacturers of steel frameworks and parts manufacturers. However, the software industry is considered to be "easy to nurture, as is the case in India, because the industry can generate profits with limited capital investment, provided it nurtures highly-skilled human resources", and the industry would probably for a short period be able to help promote the modernisation of a country.

In Myanmar, the MICT Park has just reached the starting line, and therefore it is difficult to say that the park is superior to similar facilities in other countries. The lifting of the ban on the Internet service within the MICT Park has met merely minimum standards, and so it is a little unlikely that this measure alone could help attract the investment of many leading foreign companies and promote the modernisation of the country. Further, preferential measures to give incentives to foreign companies to invest in Myanmar are imperative.
For that purpose, the Myanmar government will constantly have to study the current state of facilities similar to the MICT Park in other countries, and discover their preferential measures. It must also work with the private sector to make the MICT Park more attractive. Several examples are given below of major facilities similar to the MICT Park.

2.2.1 Multimedia Super Corridor

In 1991, Prime Minister Mahathir Mohamad of Malaysia announced in his speech the national plan called "Vision 2020", by which Malaysia aims to become a member of the developed countries by the year 2020. Vision 2020 intends that Malaysia will make efforts to achieve economic growth by an average of 7% per annum until the year 2020, and expand the gross domestic product (GDP) by nine times, and the per capita income by four times, by the year 2020. To achieve the above goals, Vision 2020 proposes the strategic growth of industry by promoting the Multimedia Super Corridor (MSC) as a development project.

The core of the MSC project is a "Multimedia Super Corridor", which stretches from the Kuala Lumpur City Centre. As part of the MSC project, a couple of new towns have been built in the suburbs of Kuala Lumpur. One is the "Putrajaya" to which the government agencies plan to move to establish the centre of electronic government, and the other is the "Cyberjaya" to which telecommunications companies, R&D facilities, universities and so on will be attracted.

Potential companies willing to do business in the MSC will be able to gain MSC status on application. The application forms will be screened by the inquiry committee. MSC-status companies can share in preferential treatment such as a maximum 100% tax exclusion, tax exemption for multimedia equipment, deregulation of foreign currencies, and liberalisation of employment of foreigners.

An important task in the MSC project is the development of business applications called "Flagship Applications". This task has two main sub-tasks. One is the promoting of the Multimedia Development business, and the other is the creation of a Multimedia Environment optimising the multimedia of participants in the MSC. Flagship Applications include on one hand electronic government, multi-purpose cards, smart schools and telemedicine as the Multimedia Development elements and, on the other hand, an R & D cluster, worldwide manufacturing webs, and borderless marketing, as the Multimedia Environment.

Further, the improvement of IT-related laws and regulations (e.g. revision of copyright law, computer crime law, digital signature law, telemedicine law and electronic government law) is under way. By the end of 2001, the number of MSC-status companies had reached 621.

As mentioned above, Malaysia has strategically worked to nurture the ICT industry. In particular, what is worthy of note is not only the improvement of institutions and circumstances, but also

the government-initiated software development of the Flagship Applications.

2.2.2 Neusoft Darian International Software Park

In Darian, the province of Lianing in northeast China, the Neusoft Group (Liu Jiren, Chairman & CEO), the largest software development group in the country, has launched the expansion of Neusoft Darian International Software Park in order to attract the Japanese ICT companies. Japanese government officials from the Ministry of Foreign Affairs and the Ministry of Economy, Trade and Industry, as well as about 100 people from 45 companies, participated in the cornerstone laying ceremony.

The park, with a total investment of 1.2 billion yuan (¥18 billion) and a site area of 450,000 square meters, is co-financed by the Neusoft Group and other Chinese private companies. Under the plan, personnel training facilities were established, including the Neusoft Institute of Information Technology of Northeastern University, the first specialist ICT private university in China. The park is expected to accommodate 15,000 software developers and achieve an annual sales of US$300 million (¥34.8 billion) by the year 2006 on completion of the park.

In China, the central and local governments have come up with radical policies, such as to provide financial aid covering 70% of the salaries of full-time workers who have completed graduate school, in order to encourage the IT industry, especially the software development industry. These policies also hope to promote the improvement of infrastructure, including the business process and function, in order to ensure that foreign companies can invest without concern, thereby fostering foreign involvement.

Further, approximately 400 educational institutions across the country are training ICT engineers and producing about 100,000 potential engineering graduates every year. Over the next three years, the Chinese government plans to double the number of such annual graduates to 200,000.

3. Create Supporting Environment for ICT Industry

3.1 Government as big buyer

Information processing technology needs not only theory but also practical experience. Theory learnt at school is mastered through practical experience, and fully utilised as applicable technology. As mentioned above, the number of potential ICT engineers is increasing in Myanmar, but they do not have enough opportunities to do business, thus causing a situation in which unused manpower is a waste of treasure.

One possible solution to such a deadlock is to let the potential ICT engineers go abroad and gain practical experience. However, employers often only assign them helper status, and seldom provide opportunities to engage in key operations of system development such as system analysis and project management, through which they could learn advanced skills.

Consequently, in order to improve the quality of the ICT engineers in Myanmar, the implementation of domestic large- and medium-sized system development projects and the engineers' participation in such projects are necessary. Myanmarian project managers must plan and promote the system development projects, and the Myanmarian ICT engineers should analyse the operations, construct operational models and data models, and further promote, through their own efforts, a series of processes from design, production, and test, to transition to and management of full-scale operation.

However, it is difficult to expect the domestic private sector to demand such large- and medium-sized system development projects, and therefore they require the strong support of the Myanmar government. Consequently, following the example of U.S. President Franklin D. Roosevelt's New Deal policy of 1933, implemented to end the Great Depression which began in 1929, it would be effective for the Myanmar government to give a lead with a system development project related to electronic government, designed to stimulate domestic ICT demands in Myanmar.

3.2 Incentives for foreign investment

Recently, with the acceleration of globalisation, transnational investment as well as trade in products and services is becoming indispensable for the international business of developed countries' industries. Japanese companies have, through investment etc., been expanding and promoting the creation of an international labour network which mainly covers the East Asia

region (ASEAN nations, China, Korea, Taiwan and Hong Kong).

Investment from developed countries is important for Myanmar in nurturing its domestic ICT industry. Also important is a positive attitude toward promoting the Myanmar economy through the active attracting of foreign investment in response to globalisation.

Construction of the MICT Park is a first step in attracting foreign investment. Also effective are the following preferential treatment measures: first, lifting the ban on the Internet service, and then telephone cost reduction, tax credits, tax exemptions on multimedia equipment, "most-favoured-nation" treatment for foreign companies, promotion of employing foreigners, and so on. Further, projects initiated by the Myanmar government, including the electronic government project, are also considered to provide good opportunities for attracting foreign investment.

3.3 Venture capital

A lot of ICT-related venture capital companies established by young executives participated in the ICT Exhibition held in the autumn of 2001, impressing with their enthusiasm for the ICT business. Most visitors coming to view the exhibition also eagerly paid attention to the exhibited PCs and software, many of which gave them great expectations for the future.

Unshackling of the Internet service, tax credits, preferential tariff on ICT equipment and parts, preferential treatment measures in emigration/immigration control, and so on, are important for venture capital companies to succeed in business in the ICT industry. However, it then becomes all the more imperative to solve financial problems in order to help them continue in business. In view of some information saying that venture capital companies cannot easily obtain loans from private banks, it might be effective to set up a special loan scheme, or similar, through which government-affiliated financial institutions provide the necessary loans.

3.4 Market intelligence information

The ICT Revolution has made possible worldwide information sharing, which has further expanded the market to the extent at which the emergence of a global market would not be a dream. Demand and supply information from every corner of the world will flow in real time all over the world. Accordingly, products will naturally flow into the market where the rate of return is the highest, as a result of which the price of products will be globally equalised.

Market intelligence is a basic mechanism by which to share such market information around the

world, making available various kinds of information such as most noteworthy products, products most attractive to consumers, news of competitors, and information on clients' planning for bulk purchase. Eventually, information suppliers will emerge, providing such market intelligence information globally.

Take, for instance, the domestic grain market in Myanmar. If information on each local market price flows in real time throughout the country, grain sellers will naturally try to sell their produce in the local market where the price is highest, and grain buyers will want to purchase grain in the local market where the price is lowest. Consequently, demand and supply relations will cause price equalisation in every local market. As a matter of course, someone will try to gain profit margin through speculation, but because the number of market participants will significantly increase, such speculators who aim at an extraordinary pricing will need a large amount of money and the attempt will become difficult to achieve.

In future, market participants using ICT technology will be able to trade freely in every local market in Myanmar. Then, because market intelligence is going to be even more important, professional suppliers of this information will attract attention. Further, if information suppliers who globally provide market intelligence cover the Myanmar market, Myanmar may come to be regarded as a trade partner (i.e. member of the world market), which may help expand trade volume.

4. Marketing in Japan and Collaboration with Japan

4.1 Japanese language initiatives

In establishing collaboration with Japanese companies in the ICT industry, Japanese language ability is an important factor. Indeed, in some fields of the industry, technical capabilities are thought much more of than language abilities and Indian engineers are working at some major computer manufacturing companies. But, in fact, they could not get jobs in software houses, which constitute a vast majority of firms in the computer industry.

Major reasons why the Indian engineers are not able to get jobs in the Japanese market, though doing well in the U.S. market, are the Indians' particular business sense, differing from the Japanese one, and their poor Japanese language ability. As far as the Myanmar engineers are concerned, their business sense, differing from that of the Indians, would be relatively acceptable to Japan, and also foreign engineers with a certain level of Japanese language ability would probably be acceptable to many Japanese software houses.

The level of Japanese language ability required to do business is to have a certificate for the third grade of the Japanese Proficiency Test, or at least to be at the same level as that proficiency grade, and to have Japanese language ability which is not merely general but is specific to ICT operations. That is, it is necessary to thoroughly understand specifications written in Japanese and to be able to create programs.

Generally, it is said that it takes at least 200 hours for non-Japanese speaking people to learn the Japanese language to an extent at which they can achieve the above-mentioned level. Recently, however, a new Japanese language instruction method has been developed, which can halve the time needed to some 100 hours. The introduction of such new instruction methods may have to be considered.

4.2 Overcoming of cultural wall

In collaborating with Japanese companies, the factor of cultural differences between Japan and Myanmar is more important than that of Japanese language ability. When the cultural basis of both people is different, because each considers its culture to be common sense their cooperative activities might be severely hampered by the difference.

Indeed, a Japanese company manager, having employed Myanmarian engineers, said, "We gave

them jobs for two years, but finally felt we had to give up waiting for them to progress to the level at which we could assign them work to do. I'm afraid it's impossible that the Japanese side of the partnership will entrust a task to the Myanmar side after they go back to their own country". That is, the problem may not be the quality of specifications made to commission a work, but rather the cultural differences of how to read between the lines of specifications. If this hypothesis is true, the following conclusion is also true: even if Japanese companies tried to educate Myanmarian engineers about specialised knowledge related to the ICT industry and the Japanese language, these efforts will not bear fruit in the business.

Consequently, we recommend the following approaches to overcome the cultural barriers:

(1) Find well-experienced engineers willing to cooperate in developing software through collaboration between Japan and Myanmar.
(2) Also find Japanese companies willing to cooperate, and ask them to offer specific deals.
(3) Make the engineers understand the contents of deals beforehand in Japan.
(4) The Myanmar side will select participating engineers, and organise a software development project in the MICT Park.
(5) The Japanese government will dispatch engineers to Myanmar who thoroughly understand the deal's contents, and make them participate in the software development project in Myanmar.
(6) The Japanese engineers will explain requirements, instruct in the development process, and transfer knowledge of project management to the Myanmarian engineers.
(7) The Japanese engineers will verify the specifications the Myanmar engineers make, and improve the quality of specifications to the level that the Japanese side expects. Also, the Japanese engineers will check the quality of completed software, and raise the quality to the level where such software could be delivered to the Japanese companies.

The above recommendation is designed not to demand that the Myanmar engineers reach the level that Japanese companies want, but to ask them to understand the cultural differences and the quality level that the Japanese side expects. This can be achieved through the cooperative software development operations between the adequately qualified Myanmar engineers and the dispatched Japanese engineers, and then to improve the Myanmar side to the level that they can independently accept orders for software development. If the Myanmar engineers experience several software development projects during a period of at least two years, they will be able to attain a reasonable level.

4.3 Branding strategy

In order to impress the Myanmarian ICT brand identity upon Japan and the world, its ICT industry needs to establish credibility. For that purpose, above all things, Myanmar must gain credibility as a nation, which will be difficult to achieve if it frequently changes its system, revokes its approval, and so on.

The Myanmar government must recognise that revocation of a provider's license and shutdown of Internet access, as has actually happened in the past, will be enough reason for potentially interested foreign companies to hesitate to do business with Myanmar. A sudden revocation of trade permits and business license will also be enough reason for them to get a similar negative impression. Further, government control of information will cause Myanmar to lose credibility as a nation. Therefore, Myanmar should promote the lifting of the ban on the Internet, and so on.

Next, in order to establish credibility in the ICT industry, the Myanmarian engineers must continue to make steady efforts to gain credibility as a potential partner of leading foreign companies. It goes without saying that it is important that individual engineers are appreciated, not only for their technical capabilities but also for their punctual performance and observance of contracts from foreign companies. It is also important that advanced engineers should not easily change their occupation. Further, information disclosure is essential to establish a Myanmar brand identity. For example, it is effective to publicise cases of domestic software development, and so on, through the Internet and other media.

Meanwhile, it will take a long time for the Myanmar brand to be recognised worldwide. But, just as the Indian engineers are recognised in the United States and they succeeded in establishing the Indian brand identity, it is naturally expected that successful cases in a particular developed country will accelerate the establishment of brand identity in other developed countries. Consequently, if Myanmar closely collaborates with Japan and makes it a top priority to establish the Myanmar brand identity in Japan, it may have a great influence on other countries.

4.3.1 Qualification / accreditation, TickIT, ISO9001, CMM, etc.

In respect of the software development process, it is generally said that the process is invisible and unidentifiable, and depends greatly on the capabilities of individual engineers, therefore the results are erratic. Further, referring to the future, development tools and techniques will soon become out of date because technologies will progress and change significantly.

However, if we compare "good performance" organisations and "not-so-good performance" organisations in software development, we can clearly find some differences between them.

Organisations with problems in software development have the following features:

(1) "Not-so-good performance" organisations do not calculate schedules and costs related to the software development on realistic bases, therefore they continue to experience chronic cost overrun and to lower the quality and performance under the tight schedule imposed by clients.
(2) "Not-so-good performance" organisations tend to reduce or curtail quality improvement operations, including reviews or tests, due to delays in the schedule.
(3) "Not-so-good performance" organisations do not have any rules or regulations about the software development operations or, even if they do, such rules or regulations are neither observed nor enforced.

On the other hand, "good performance" organisations in software development have the following features:

(1) "Good performance" organisations define the software development process and clarify individual duties and obligations.
(2) "Good performance" organisations precisely communicate the conditions of the software development to all staff, and they perform their duties efficiently.
(3) "Good performance" organisations implement, and never curtail, necessary processes including reviews or tests.
(4) "Good performance" organisations have a quantitative mechanism in order to judge the quality of software and analyse any problems of the development process.
(5) "Good performance" organisations calculate schedules and costs related to the software development on the basis of past performances.

Software development organisations are always making various efforts to establish such an ideal development style, but it will take a long time and will not be quickly achieved. Continuous efforts are required.

TickIT, ISO9001 and CMM (Capability Maturity Model), are standards to evaluate the level of organisations working on software development, and such standards are beginning to be recognised internationally. Namely, although individual engineers' skills are very important, the focus is going to be on organisations' operational procedures, quality management methods and

the level of the management in itself. In order to develop more high quality software, what is required is not the individual engineers' skills, but a structure of arranging and controlling an organisation's operational procedures.

Furthermore, when Japanese software development companies bid for development projects in government software procurement, they tend to be assessed according to their CMM status, and those companies are also disclosing their CMM status to improve their publicity. Consequently, in doing software development business with the world's leading companies, software development companies should be encouraged to obtain CMM or other reliable status/ certifications.

5. Future Agenda

The Industrial Revolution in the 19th century is said to have been the "Power Revolution", including the invention of the steam engine. Before then, people lived only on natural power and human power, and even the genius da Vinci could not imagine the other kinds of power sources. The British Empire, which once ruled much of the world as the greatest power, was supported in its expansion by new motive powers. And some countries of America, Asia and Africa with only the power of nature and human strength became a colony of European countries one after the other.

Today, the "ICT Revolution" in the 21st century is said to be equivalent to the "Industrial Revolution" of the 19th century. The essence of 'ICT revolution' is 'Information transmission revolution' by the Internet and the effect is that 'Information sharing' in the world scale became possible. In the past, people have used beacon fires, letters, telephone, wireless and so on as a means of communication, and have never before known such a global means, reducing time and distance dramatically. History says that the emperor Qin Shi Huangdi, around 220 BC, who reconstructed the Great Wall on a large scale, could be informed of an invasion of the Huns in a few days. However, Internet technology makes it possible to communicate information on a global scale in a matter of seconds. Accordingly, people have become able to communicate and share information with other people half a world away in a short period of time, through the instantaneous transmission of letters, voices, still pictures and moving pictures.

At present, the ICT Revolution is under way on a worldwide scale by means of the fusion of the above-mentioned computer technology and Internet technology, and therefore it is no exaggeration to say that ICT is a foundation of industry. Recognising this, in order to nurture the ICT industry in Myanmar it is desirable that the Myanmar government should implement the following policies:

(1) Full lifting of the ban on the Internet

It is important that the country displays a positive attitude toward keeping up with the ICT Revolution. From the viewpoint of foreign companies, it is not natural that the use of the Internet is limited to only a few organisations, and then only within the MICT Park. Restrictions on the use of the Internet will probably be considered to be evidence of the country's negative attitude toward the ICT Revolution, the result of which will be to give negative impressions to foreign companies.

(2) Liberalisation of import/export and preferential treatment

The ICT industry has responded to globalisation (i.e. integration of the world market). Transnational corporate collaboration (e.g. international cooperation in the software development sector and a 24-hour call center) contributes to the promotion of business on a global basis. In view of such globalisation trends, a country where foreign trade and foreign exchange are restricted may be excluded from business partnership status. Foreign trade of at least the relevant products and parts should be liberalised, and foreign countries should be encouraged by preferential treatment to enter the domestic market in order to stimulate the ICT industry.

(3) Deregulation of human resources movement

The software development industry in developed countries is troubled by a chronic shortfall of manpower, and international industrial cooperation has consequently become common practice. Above all, India and China have rapidly grown as regional hubs of software development, and have attracted attention all over the world.

In such circumstances, the globalisation of business inevitably progresses and transnational corporate collaboration becomes common. At the same time, engineers working in this industry are unavoidably required to do business worldwide, and the movement of human resources is inevitable.

In developing systems, and when problems occur, engineers in charge often have to be immediately dispatched to solve the problems. Time-consuming departure formalities and passport formalities prevent engineers from responding to such emergency situations, and therefore the movement of ICT engineers should be radically deregulated.

(4) Deregulation of foreign investment

The ICT Revolution significantly reduces information communication costs, and therefore the activities of the ICT industry are extending over national boundaries and being promoted through global corporate collaboration. Accordingly, capital partnerships are established for strengthening industrial relations, and investment is made for acquiring bases.

For that purpose, transparency and "most-favoured-nation" treatment are necessary. The former is to disclose the contents of legislation related to foreign investment, and the latter is to treat foreign companies equally, irrespective of nationality. Conversely, regulations against foreign investment carry the risk of making the country's ICT industry weaker.

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