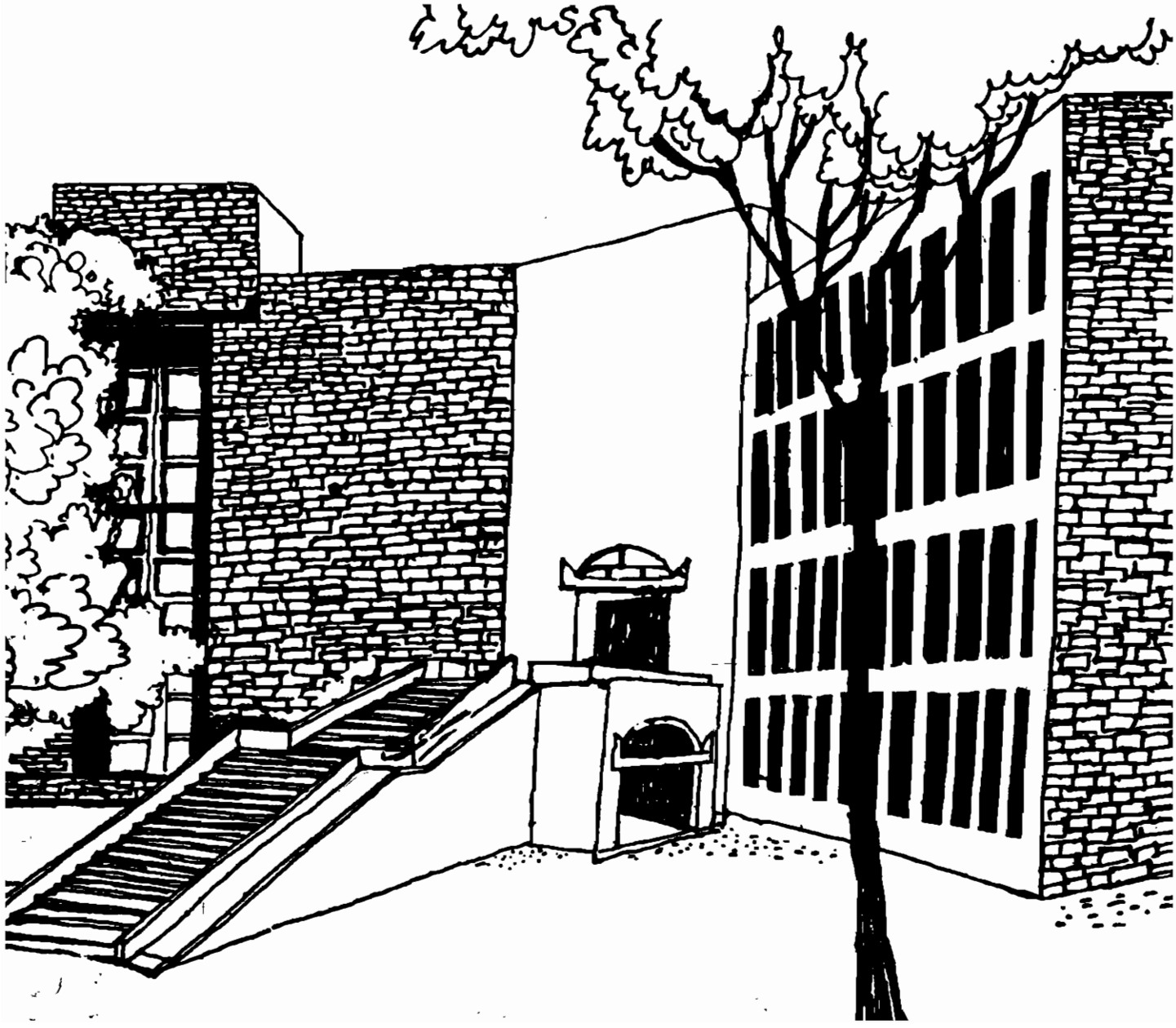
विद्याविनियोगाद्विकासः
IIM
AHMEDABAD

# Working Paper



# REVIEW OF THAI TELECOM SECTOR

By

Rekha Jain

W P No. 1222
December 1994



The main objective of the working paper series of the IIMA is to help faculty members to test out their research findings at the pre-publication stage.

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD - 380 015
INDIA

**Abstract**

The Thai economy has been registering high economic growth rates since late eighties. The average growth rate has been around 10 percent per annum. Consequently, the business opportunities have increased, creating a demand for greater telecom services. However, the investments in telecom sector and level of telecom service has not been able to keep up with the demand. Thailand has a telephone density of only 3 percent compared with an average of 9 in other ASEAN countries. In this scenario, the Thai government brought about telecom reforms to respond to the growing needs of the economy. This paper documents the status of Thai telecom sector and discusses the policy reforms and their impact on telecom sector. This paper also compares the Thai initiative with reform programs in some other Asian countries.

## Review of Thai Telecom Sector[1]

The Thai economy has been registering high economic growth rates since late eighties. The average growth rate has been around 10 percent per annum. Consequently, the business opportunities have increased, creating a demand for greater telecom services. However, the investments in telecom sector and level of telecom service has not been able to keep up with the demand. Thailand has a telephone density of only 3 percent compared with an average of 9 in other ASEAN countries. Exhibit 1 shows the comparitive performance of Thai telecom sector in relation to other ASEAN and neighbouring countries. Though the telecom investment as a percentage of revenue was more than 40 percent, telecom services contribute to only 0.6 per cent of GDP. Waiting list for phone was more than a million despite increasing the number of telephones installed by 800,000. R&D labs and skilled personnel are scarce. In this scenario, the Thai government brought about telecom reforms to respond to the growing needs of the economy.

This paper documents the staus of Thai telecom sector and the policy reforms. In the light of policy reforms taking place across many Asian and developing countries, it attempts to assess the Thai initiative.

## Telecom Sector

### Organization

Telecom services are under the overall control of Ministry of Transport and Communication. Until 1954 Department of Posts and Telecommunication under the ministry was responsible for the provision of postal and telecom services. In 1954, the postal and telecom operations were separated by carving the Telephone Organization of Thailand (TOT) from the department by a legislative act. The primary objective of TOT was to operate domestic telephones and provide telecom connectivity to Laos and Malaysia. In 1977, another act created Communication Authority of Thailand (CAT) from the department to operate postal services and the remaining international telecom services.

Establishment of TOT and CAT effectively separated the operations from the department. The department currently manages and controls radio frequency allocations, coordinates domestic communication via satellites and is Thailand's representative in international fora. It is also engaged in the study of advanced telecom technology and preparation of proposals for government's action.

Both TOT and CAT are state owned enterprises and as providers of public utilities are expected to remit not less than 30 percent of their annual net profit to the government. Financial performance parameters for TOT are provided in Exhibit 2.

Ministry of finance oversees and controls all financial matters related to state enterprises including monitoring and evaluation of their operations and expansion projects greater than one billion baht. National Economic and Social Development Board, and the Prime Minister's Office reviews new investment plans of more than 1 billion baht for state level enterprises. The Budget bureau allocates

---

1 This work was supported by IDRC.

budgetary funds for state enterprises and determines the amount of enterprise profit to be remitted to the centre. National Audits Office audits acounts of state enterprises.

**Network**

Existing telecom services are provided through five telephone areas with Bangkok and its surrounding metropolitan areas constituting one region, and the four provincial areas constituting the rest of Thailand. The switching technology varies from mechanical to digital. Thailand's trunk network is three level deep in Bangkok and surrounding areas and four level deep in provincial areas. It consists of 74 primary exchanges, 20 secondary exchanges and 7 tertiary exchanges and a number of local exchanges. Each tertiary exchange is linked to the international switching centre. Exhibit 3 provides data on the growth of various telecom services.

Though the fixed network extends upto the district level, there are certain sub-districts that are not connected to an exchange. Out of a total of 8000 sub-districts, only 2000 have an exchange within 4 km. Another 1800 are located within 30-50 km of local exchanges and are served by Multi Access Radio Receivers through public phones in the sub-district town. In order to improve the service levels, the government plans to provide long distance connectivity to the sub-district level by 1996 and to every village by 2001.

With the opening of the sector to private sector participation, 8 local and international groups have submitted bids for 9000 million Baht rural public telephone system. A number of other projects for provision of infrastructure have also been worked out. The details are provided in Exhibit 3.

**Transmission Equipment**

The transmission network has fibre optic for more than 50 percent of the trunk. The rest of the transmission media on the trunk route is also digital. Copper wire transmission is largely now limited to local exchange to subscriber link. Majority of switching equipment suppliers also supply of transmission equipment. Thailand has no indigenous fibre optic manufacturing industry.

***International Services***

International services are largely operated by CAT. Most of the international traffic is through satellites, undersea cables or fibre optic links.

## Policy Reforms

Creation of TOT and CAT led to major changes in the structure of telecom sector. Carving of TOT from the existing department reduced some of the operational responsibility of the department. Subsequent creation of CAT further reduced department's role in operations.

TOT and CAT are wholly state owned enterprises. There is a plan to privatize both organizations. Consultants' assistance in drawing up privatisation plans for each have been sought.

Besides the structural reforms, private participation in the sector with the objective of augmenting resources in the centre was adopted as a policy. Since 1990, private sector has been allowed to co-invest

with TOT in the provision of basic services as well as to provide non-basic services such as cellular mobile, paging and satellite services etc. The mechanism for this involvement is usually through Build Operate and Transfer schemes, since the Thai laws do not allow for telecom equipment for service provision to be owned by private parties. The private entity provides the finances and technology, creates the infrastructure, transfers it to TOT/CAT and operates it for them. The revenue generated is shared with TOT/CAT during the contract period. After 1996, it is envisaged that private firms would be allowed to operate even basic services without license from TOT.

***Basic Services***

Two private firms, Telecom Asia Corporation Public Company and Thai Telephone and Telecom Company have been allowed to lay down telephone lines. They will lay down 2 million lines in Bangkok and 1 million lines in provincial areas respectively. It is estimated that license for an additional 8 million lines will be provided in the eighth five year plan (1997 -2001). After 1993, TOT will not install additional line capacity. It will however continue to upgrade its existing network and digitalize. All further expansions to the network will be by Telecom Asia and Thai Telephones and Telecom.

***Cellular Mobile, Satellite, Paging and Other Systems***

TOT and CAT have awarded licenses to private companies to set up mobile phone exchanges, base stations and provide training on network operations, maintenance and management. Currently all operators use analog technology which will have to be upgraded to digital. By 1991, the base of mobile phones as a percentage of main lines was 14 percent, already more that in more industrialized countries such as Japan, Korea and Australia.[2]

In the area of satellites, TOT has given a 15 year concession to a private company to construct and complete within a year, 10 ground based satellite communication stations. VSAT networks as alternative to fixed line networks have been operational in Thailand through private participation. However, they have not proved to be profitable since the geographical scope and type of services are limited. Licences for paging and other systems have been given to a number of private firms (Exhibit 2)

***Value Added Services, Datanet***

Networking services are provided with assistance from private parties. The network is available only in Bangkok. TOT turned down an offer by the participating company to extend the reach to provincial cities as TOT plans to extend its own scope of activities in this area. In 1989, CAT launched its own datacom services using a packet switched network.

## Financing

The government has attempted to address the financing of infrastructure expansion and upgradation partly by involving the private sector. Many of the Thai telecom companies are quoted on the stock exchange. However, availability of foreign exchange is a matter of concern. In order to reduce dependence on

---

2 Asia-Pacific Telecoomunication Indicators (ITU, Geneva, 1993), Figure H and Table 20.

foreign exchange, it is now mandatory for equipment and services contract with foreign supplies to specify the percentage of local content.

The most prominent private operators are Shinawatara group and United Communication Industry (UCom). They dominate the mobile telephone market and hold licenses in datacom, paging and trunked mobile radio markets. Shinawatara group plans to launch Thailand's first satellite. UCom has plans to operate gateway for 7 countries as a part of global satellite communication, Shinawatara has a higher public profile controlling 2 or the 4 publicly traded communication stock with a 5% holding in 3rd. Telecom Asia and TT&T are also emerging as significant players.

## Consequences of Policy Changes

As a consequence of introduction of reforms, number of available telecom services have increased (Exhibit 2). The response of the private sector has been very positive. A number of them have been granted "concessions" and are involved in provision of services.

### Internal Streamlining

TOT has changed it's organizational structure to reflect its need to respond to a changed environment. It has set up two new divisions: Bureau of Privatization and Special Office of Local Telephone Concessions. Bureau of Privatization Affairs is responsible for management of projects that TOT jointly carries out with private companies and manages issues related to restructuring of TOT from a state owned company to a private owned company (at least partially). The Special Office Of Local Telephone Concession has four departments: contracts, computerized support, technical and metropolitan and provincial network.

In order to upgrade its managerial skills, TOT has made arrangements with local universities for conducting short term management development programs. In addition, TOT passed a personnel bye-law in 1993 by which TOT is responsible for arranging for special curricula for any person who has not completed a university education. There is a mandate from top management to desig new personnel systems and streamline existing systems.

### Competition

TOT has been awarding licenses for provision of basic and value added services to private companies. However, there is competition only in some segments. This competition is largely because CAT also provides similar services either through private companies or by itself.

### Access to Technology and Human Resources

The indigenous Thai industry is very limited. Some managers felt that this was because Thai's had traditionally supported turnkey projects without investing in development of indigenous industry or people. In moving towards a more open economy, Thai government has supported setting up R&D labs with foreign participation. Some foreign companies have agreed to set up training schools for TOT. The government has now made it mandatory for every foreign contract to hav a fixed percentage of manpower from Thailand. TOT also plans to enter the switching segment. With these initiatives, it is hoped that requisite manpower and technology will be available indigenously.

**Assessment of Changes**

1. In the current scenario both TOT and CAT are involved in policy making, regulation and operations. It is commonly held that amalgamation of any of the three functions is not in the interest of the overall functioning of the sector. Many developing countries undertaking reforms programs have ensured varying degrees of separation between these functions. For example, in Malaysia, legislation was enacted in 1987 to separate Jabatan Telekom Malaysia (JTM), the government telecom monopoly into two parts - the regulatory unit called JTM and an operating company called Syarikat Telekom Malaysia (STM), a government owned company. STM was issued a license by Minister of Telecommunication to operate the basic telecom network as a monopoly for a period of 20 years. In 1990, STM was partially privatized by selling a part of the shares to the public and renamed Telekom Malaysia (TM). TM was listed on the Kuala-Lumpur stock exchange on 7.11.90. The ministry was responsible for policy making.

In terms of the sequencing of reforms proposed in an ITU Report [1989], the fundamental underlying issue that must be addressed in telecom reform is effective separation of the basic function of policy making, operational management and regulation. The second level consideration is that of access to capital and human resources. The third level concern is introduction of competition for efficiency in the telecom sector. Competition is considered to be a more important factor than ownership in introducing efficiency. Further, the order in which structural adjustments take place will also determine their effectiveness [Melody, 1990]. It is also argued that before separation of policy, regulation and operations and introduction of competition, a firm regulatory regime must be in place.

***Effective separation of policy, regulation and operations***

Using the ITU framework to assess the Thai initiative, it may be argued that there has been very little attempt to separate the three functions viz policy, regulation and operations. In reality regulation is rather weak, coming directly either from the top-level or being pressed by state owned companies.

Though increasing number of functions of the earlier department of posts and telecom have been distributed to TOT and CAT, a corresponding increase in its' role and responsibility has not taken place. The creation of TOT and its separation from the department did not result in benefits that would have emerged had the department been made into a regulatory body, and the TOT an operator. In this context, the role of the department needs to be reviewed. Traditionally, such departments have been converted to regulatory bodies. For example, in Malaysia, when STM was carved out of JTM, the latter became the regulator. Although JTM was the regulatory body, there were areas where the ministry (the policy making body) encroached upon its functions. In practice, the regulatory bodies carved only out of erstwhile government departments may not be effectively able to regulated. It normally does not have the requisite skills and experience or judicial powers. Most developing countries have had problems in management of regulation. Therefore if department is turned into a regulatory body, it would need to be strengthened by having adequately trained multi-disciplinary staff in policy analysis, finance, economics etc. In addition the regulatory body must be equipped with at least some judicial powers.

**Acess to capital and human resources**

Access to capital and human resource is likely to be bottleneck in the speed with which the benefits of the reform program become available. Part of the finances for expansion will be available from the private sector. Thailand, like other developing countries, faces foreign exchange problems, especially for import of equipment. Financing for rural sector needs to be addressed. Even though a private company

plans to lay down lines in provincial areas TOT needs to ensure that telecom access is available in farflung rural areas. The private company could limit its operations to the most profitable provincial areas.

Though TOT has taken some initiative in upgrading the quality of telecom related education and training, it would need to be more aggressively planned. It could for example, require that the "concessions" that private companies get, would be tied some training component for TOT staff.

Even though TOT has restructured and initiated many training programs etc, it has not acquired a focus to train for customer service. That may largely be due to the fact that it expects the private operators to operate the services and only share the revenue with it. However, it needs to draw up some long term plans as to what happens once the "concession" period is over.

**Introduction of Competition**

One of the important conditions for introduction of efficiency is competition. Lack of competition is likely to reduce the efficiency of the sector. Of course, it is also argued that competition leads to duplication of resources, which many developing and newly industrialized countries can ill afford. Thus based on this rationale, if the government policy is not to support free competition, it must allow competition at least on a limited basis. The current situation is where instead of having a monopoly telecom provider, there are a number of "monopoly" providers, each operating singly in its own domain. Competition exists only in very limited segments such as cellular mobile.

**Regulatory Issues**

1) Though private sector has been allowed to participate in the provision of services, a number of issues need to worked out. There are no guidelines as to how the interconnection issues between the various operators would be resolved. Even though TOT is supposed to own all infrastraucture after the private operator builds it, management of interconnection between different technologies of varied operators is not likely to be a trivial task.

2) Performance monitoring guidelines have not been specified. In the absence of an autonomous regulatory body, it would be difficult to monitor performance of private companies.

**Overall Impact on the sector**

Many studies in the past have claimed that privatization and deregulation work only when the initial network has reached a certain level of penetration. This was the environment in which countries such as USA, UK and Japan had implemented telecom reforms. Other studies have argued that it is not the initial level of penetration that determines the success or otherwise of the reforms, but the potential for growth [Mohammed, 1990]. In this context, Malaysia successfully introduced reforms at a stage when its telephone density was 10% and its growth rate of economy was 12% - 13% and telecom sector was growing at the rate of 15% -18%. The Thai economy has been registering high growth rates and moving from an agrarian economy to a manufacturing and service oriented one. This translates into a growing demand for telecom services thus creating an environment for successful introduction of reforms.

TOT has so far limited its role to allocating "concessions". The areas where private participation has been allowed are the areas where TOT has no prior experience. Arrangements whereby TOT staff could have been involved with private operators would have helped TOT to gain experience.

In the absence of adequate strengthening of TOT's skill in non-basic services and presence of competition in its core area of business ie. basic services TOT needs to evaluate its' role for the future. Since TOT does not plan to lay down any more lines, and competition in basic services may be introduced from 1996, TOT needs to define and articulate its business focus for the future.

## Future

The government plans to set up a National Telecom Commission which will have a regulatory function. It will include representatives from TOT, CAT, department, Ministry and private companies, judiciary councils etc. In this context, the role of the department needs to be reviewed.

Management of employee union, provident fund and training are crucial to the success of converting a government agency to a partially private one. Malaysia was able to successfully privatise STM, by handling each of these issues judiciously.

With privatization of TOT, commercial accounting and other practices will have to be followed. Training to design new systems and implement them would need to be undertaken.

## References

ITU, The Changing Telecommunication Environment: Policy Considerations for the Members of the ITU, Report of the Advisory Group on Telecommunication Policy, ITU, Geneva, 1989.

Melody, W.H. (1990) Telecommunication Reform: Which Sectors to Privatize, ITU Conference, October 13-15, Geneva.

Mohamed, S.H., Manickam, S. and Devi R. (1992) " Getting to Grips With The Privatization Of Telecommunication in Malaysia", *PTC, 1992, Honolulu.*

**Exhibit 1**
**Thai telecom sector performance in relation to ASEAN and neighbouring countries**

**Comparative Telecom Investments**

| Country | GDP/Capita US $ | Main Lines/ 100 (92) | Telecom/Inv Revenue | Telecom Inv.% of UDP |
|---|---|---|---|---|
| Hong Kong | 14340 | 49.1 | 12.0 | 0.1 |
| Singapore | 14487 | 40.8 | 48.2 | 1.6 |
| Korea | 6540 | 35.7 | 53.1 | 1.1 |
| Malaysia | 2584 | 11.2 | 46.1 | 1.1 |
| Thailand | 1644 | 3.3 | 42.3 | 0.6 |
| Philipines | 718 | 1.0 | 49.6 | 0.7 |

**Exhibit 2**
**Financial Performance Parameters of TOT**

| Fiscal Year | Comparative Income Statement for the Past 5 years (Unit: Million Baht) | | | | |
|---|---|---|---|---|---|
| | 1992 | 1991 | 1990 | 1989 | 1988 |
| Operating Revenues | | | | | |
| Local Service | 10911.0 | 9615.1 | 8382.7 | 6844.9 | 5870.4 |
| Trunk Service | 9315.7 | 8350.0 | 6980.2 | 5457.4 | 4489.9 |
| Other Service | 2056.0 | 1631.3 | 1047.3 | 903.9 | 678.3 |
| Revenue from Franchises and Joint Investment | 221.7 | 75.8 | - | - | - |
| Total Operating Revenues | 22504.4 | 19672.2 | 16410.2 | 13206.2 | 11038.6 |
| Total Expenses | 8486.7 | 6786.0 | 5872.9 | 4895.3 | 4497.6 |
| Operating Income | 14017.7 | 12886.2 | 10537.3 | 8310.9 | 6541.0 |
| Net Profit | 11533.7 | 10453.1 | 8041.2 | 5787.7 | 2727.7 |

| Financial Ratio and Rate of Increase for the Past 5 years | | | | | |
|---|---|---|---|---|---|
| Fiscal Year | 1992 | 1991 | 1990 | 1989 | 1988 |
| Operating Ratio | | | | | |
| Inclusive of Depn. | 37.71 | 34.50 | 35.79 | 37.07 | 40.74 |
| Exclusive of Depn. | 22.14 | 21.37 | 22.81 | 23.61 | 25.74 |
| Annual Revenue Increase | | | | | |
| Local Service | 13.48 | 14.70 | 22.47 | 16.60 | 16.19 |
| Trunk Service | 11.57 | 19.62 | 27.90 | 21.55 | 25.95 |
| Other Service | 26.03 | 55.76 | 15.86 | 33.26 | -14.05 |
| Revenue from Franchises and Joint Investment | 192.93 | 100.00 | - | - | - |
| Operating Revenue | 14.40 | 19.88 | 24.26 | 19.64 | 17.35 |
| Bad Debt Expenses | 557.47 | -4.44 | 12.50 | 100.00 | -100.00 |
| Operating Expenses | 25.06 | 15.55 | 19.97 | 8.84 | 4.47 |
| Annual Operating Income Increase | 8.78 | 22.29 | 26.79 | 27.06 | 28.22 |
| Annual Net Income Increase (Decrease) | 10.34 | 29.99 | 38.94 | 112.18 | 8.92 |
| Rate of Return on the Average | 39.30 | 46.91 | 46.13 | 40.10 | 35.71 |
| Ratio between Equity and Long-term Debt | 52:48 | 54:46 | 62:38 | 68.32 | 78:22 |
| Internal Funding of Total Asset | 87.54 | 38.60 | 51.40 | 43.70 | 30.10 |
| Account Receivable/ Operating Revenues | 18.81 | 16.22 | 17.89 | 19.02 | 19.99 |

**Exhibit 3**
**Growth of various telecom services**

**Growth from 1988 - 1992**

| | 1992 | 1991 | 1990 | 1989 | 1988 |
|---|---|---|---|---|---|
| Telephone Exch. Bldg. | 876 | 526 | 400 | 348 | 310 |
| Metro Telecom Area | 156 | 98 | 78 | 72 | 69 |
| Prov. Tele. Area | 720 | 428 | 322 | 276 | 241 |
| No. of Switching Eqpt. | | | | | |
| Metro Telecom Area | 245 | 158 | 125 | 117 | 115 |
| Crossbar system | 41 | 41 | 41 | 42 | 43 |
| SPC System | 204 | 117 | 84 | 75 | 72 |
| Prov. Telecom Area | 776 | 471 | 362 | 317 | 281 |
| Crossbar System | 84 | 88 | 92 | 94 | 92 |
| SPC System | 692 | 383 | 270 | 223 | 189 |
| Metro & Prov. Telecom Area | 1021 | 629 | 487 | 434 | 396 |
| Crossbar System | 125 | 129 | 133 | 136 | 135 |
| SPC System | 896 | 500 | 354 | 298 | 261 |
| Telephone Line Cap. | | | | | |
| Metro Telecom Area | 1354410 | 1204106 | 1125602 | 1011498 | 946574 |
| Crossbar System | 344574 | 344574 | 344574 | 354574 | 364374 |
| SPC System | 1009836 | 859532 | 781028 | 656924 | 582200 |
| Prov. Telecom Area | 811591 | 665163 | 559358 | 481940 | 439106 |
| Crossbar System | 131230 | 135030 | 135730 | 139446 | 137246 |
| SPC System | 680361 | 530133 | 423628 | 342494 | 301860 |
| Metro & Prov. Telecom. Area | 2166001 | 1869269 | 1684960 | 1493438 | 1385680 |
| Crossbar System | 475804 | 479604 | 480304 | 494020 | 501620 |
| SPC Sys. | 1690197 | 1389665 | 1204656 | 999418 | 884060 |
| Main Telephone Station | | | | | |
| Metro Telecom Area | 1159227 | 1044295 | 900941 | 792203 | 686151 |

**Exhibit 3 : Contd...**

| | 1992 | 1991 | 1990 | 1989 | 1988 |
|---|---|---|---|---|---|
| Crossbar System | 338480 | 334623 | 327136 | 329864 | 338140 |
| SPC System | 820747 | 709672 | 573805 | 462339 | 348011 |
| Prov. Telecom Area | 630802 | 508865 | 423581 | 365811 | 319721 |
| Crossbar System | 115056 | 117761 | 115556 | 120479 | 116246 |
| SPC System | 515746 | 391104 | 308025 | 245332 | 20347 |
| Metro & Prov. Telecom Area | 1790029 | 1553160 | 1324522 | 1158014 | 1005872 |
| Crossbar System | 453536 | 452384 | 442692 | 450343 | 454386 |
| SPC System | 1336493 | 1100776 | 881830 | 707671 | 551486 |
| Cellular Mobile Telephone Exchange | 6 | 5 | 1 | 1 | 1 |
| Cellular Mobile Telephone Line Cap. | 75289 | 62303 | 43752 | 39861 | 15390 |
| Metro Telecom Area | 30000 | 30000 | 20000 | 20000 | 8990 |
| Prov. Telecom Area | 45289 | 32303 | 23752 | 19861 | 6400 |
| Cellular Mobile Main Tele Stn. | 47289 | 42712 | 31981 | 20936 | 10612 |
| Metro Tele.Area | 23829 | 23490 | 18865 | 12659 | 6667 |
| Prov. Tele.Area | 23460 | 19222 | 13116 | 8277 | 3945 |
| No.of Lines Installed | 278742 | 239439 | 172281 | 163825 | 108814 |
| Metro Tele.Area | 156416 | 153891 | 113732 | 116834 | 74507 |
| Prov. Tele.Area | 122326 | 85548 | 58549 | 46991 | 34307 |
| Employee | 20855 | 19682 | 18788 | 18243 | 17956 |
| Line Capacity/Employee | 108 | 99 | 93 | 82 | 78 |
| Metro Tele.Area | 108 | 97 | 94 | 84 | 80 |
| Prov. Tele.Area | 120 | 104 | 90 | 78 | 74 |
| Line Cap./100 Popn. | 4.22 | 3.50 | 3.06 | 2.69 | 2.53 |

**Exhibit 4**
**Details of Concessions**

**Major "Concessions" Granted in Telecom Sector**

| Product/Service | Company | No.of Years | Year in which granted | Authority Granting License |
|---|---|---|---|---|
| Telephone Lines 2 mm | Telecom Asia | 25 | 1991 | TOT |
| Telephone Lines 1 mm | IT&T | 25 | 1992 | TOT |
| Public Phones | Advanced IS | 15 | 1990 | TOT |
| International Credit Card Phone | Phonecard | 15 | - | CAT |
| Satellite | Shinwan-tara | 30 | 1991 | MOTC |
| Datanet | United Telecom | 10 | 1989 | TOT |
| NMT-900 | Advanced IS | 20 | 1990 | TOT |
| AMPS-800B | Total Access Communication | 15 | 1990 | CAT |
| Satellite Data Voice | 5 companies | 15 | | PTD, TOT, CAT |