CHAPTER 8

RURAL TELECOMMUNICATIONS

CHAPTER 8 RURAL TELECOMMUNICATIONS

8.1 Current Situation in Lao P.D.R.

8.1.1 General view

The total telephone subscribers and telephone density are 82,000 and 1.46 respectively at the end of 2001 according to World Telecommunication Development Report of ITU. For the purpose of assisting various studies and comparison, telephone density of Japan in 1952 was 1.8 which show very similar situation to present Lao P.D.R. The world trend indicates that during the GDP per capita is lower, the telephone density disparity between and urban and rural areas is larger reflecting the income disparity between such areas. As the consequence, there will be many villages and communities without telecommunication facilities in Lao P.D.R. today.

On the other hand, "Socio-Economic Development Strategy for 2020, 2010 and Five Years Socio-Economic Plan (2001-2005)" approved on 13 February 2001 in Vientiane emphasizes the eight priority programs of the Government. The communication is included there and other telecommunications related sectors such as electricity network expansion projects, hydro-power project, cross-country high way development projects, and transportation system are also included. If the projects of such related sectors are well accomplished as planned, it will greatly contribute to the realization of telecommunications facilities even in rural areas of Lao P.D.R. Otherwise the telecommunications facility realization without the assistance of the development of other sectors will fall in prohibitive high cost.

8.1.2 Rural Telecommunications Network being installed by LTC (Rutel)

Through the financial support from the Government of Germany, the rural telecommunications network using point-to-multipoint radio system called as D-MAS is being expanded starting from Phase I and reaching to Phase V which is expected to complete in 2004. After completion of this Project, around 2,200 telephone terminals will be served by this network. However, this figure of around 2,200 terminals is very small number compared with the total number of villages in Lao P.D.R. which is said to be 11,386. When considered that cities or towns will be given more than one telephone, many villages will remain without telecommunication facilities. The planned network until Phase IV is shown in Fig. 8.1.

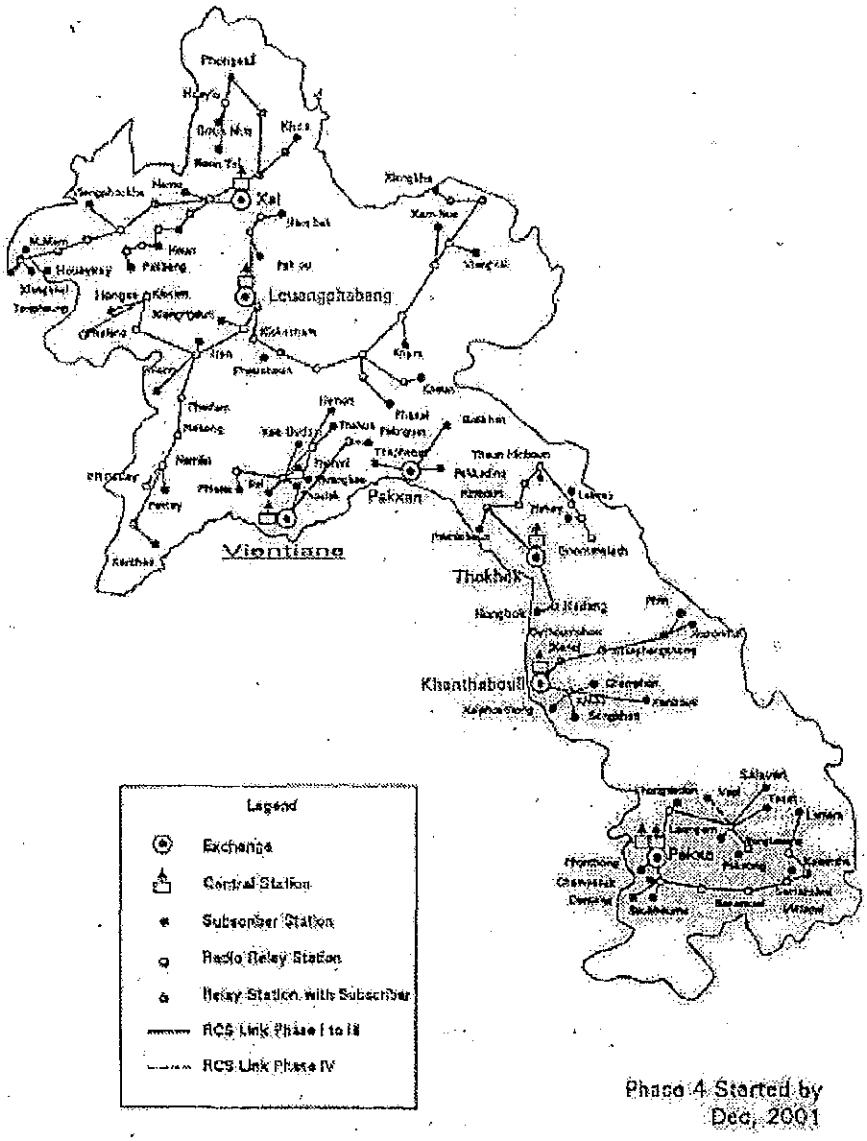


Fig. 8.1 Rutel Network Configuration

8.1.3 Telecommunications Network for the Ministry of Health

For providing the least communication link between the Health Care related Offices in Provincial Cities and District towns, and Health Posts in isolated rural areas, initially JICA of Japan installed 27 radio communication terminals under the project of Provisional Health Care. This Project is being followed up by an NPO called as BHN Association of Japan. Already the radio communication terminals have been installed in 89 sites and further 67 terminals will be installed within 2 to 3 years. The installation sites of this Project called as EPISN (Extension Program for Immunization Special Network) are shown in Fig. 8.2.

As the radio terminals in this EPISN network are armature radio type for saving the cost and the network can not access to the public telephone network, this EPISN network shall be regarded as the temporary emergent solution for healthcare service in rural areas before the arrival of ordinary public telephone service in these sites.

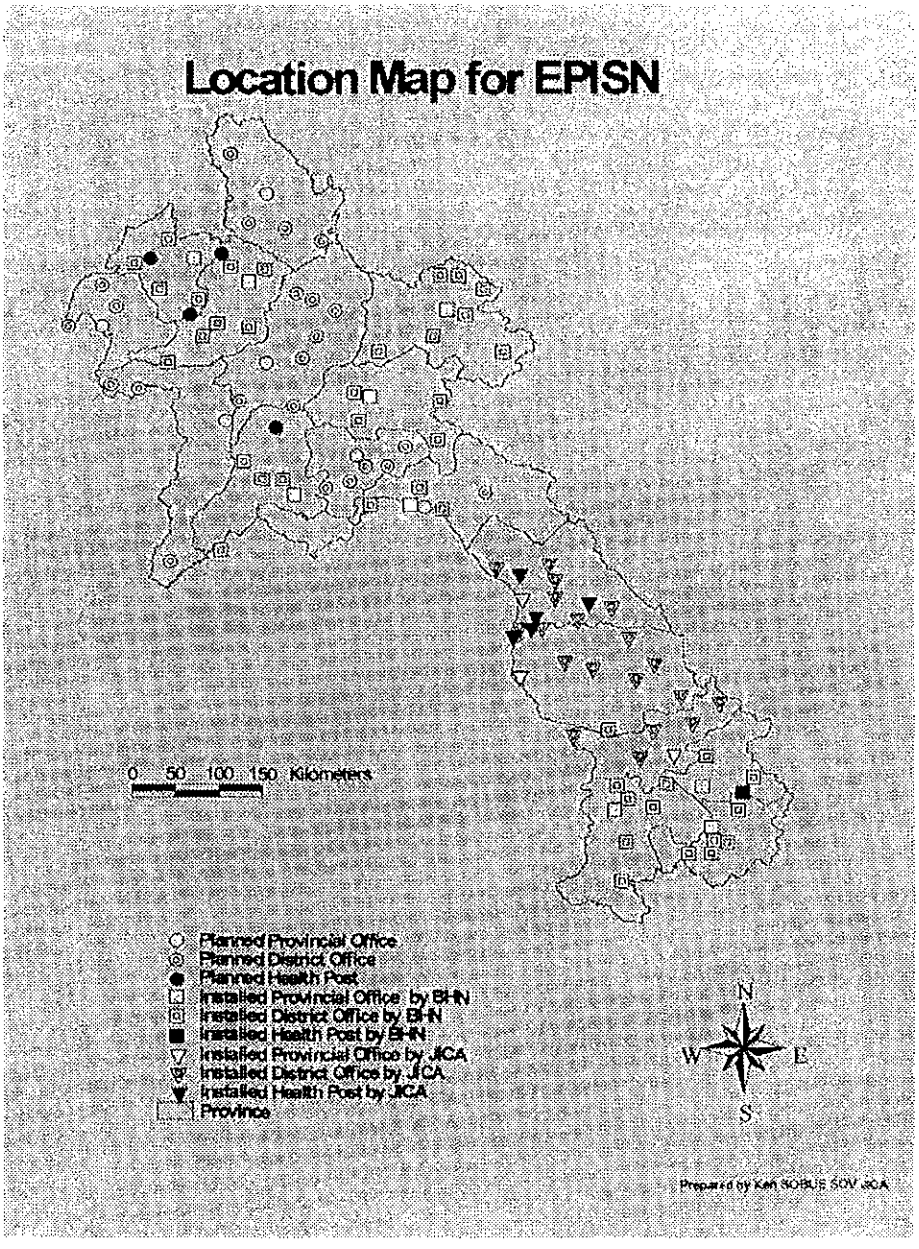


Fig. 8.2 EPISN Location Map

8.2 Rural telecommunications of the world

8.2.1 ITU's activity

(1) Since 1970s ITU has been emphasizing the importance of supplying telecommunications facility in remote and rural areas. The Handbooks related to rural telecommunications have been published and various Study Groups have been setting up and worked with changing titles related to the development of rural telecommunications. The most recent development was the publication of "NEW TECHNOLOGIES for RURAL APPLICATIONS, Final report of ITU-D Focus Group 7 " published in 2001. As the rural development is ever continuing important task in developing countries, ITU will still continue to study the issue of rural telecommunications until developing countries become developed countries as telling about Japanese experience and world trends later.

(2) Year 1983 was "WORLD COMMUNICATIONS YEAR" designated by United Nation. For supporting the vision of UN, ITU studied under the cooperation of OECD on the importance of telecommunications for the development. The result was published as TELECOMMUNICATIONS FOR DEVELOPMENT in June 1983. Its Chapter 4 is devoted to THE ROLE OF TELECOMMUNICATIONS IN RURAL DEVELOPMENT. The initial intension was to clarify the role of the telecommunications for the development in the numerical figures. However because of the difficulty of the separate estimation of the contribution of the telecommunications from other related matters, the Report could not reach to the original intention, but some study results are often cited in various occasion. Examples are shown below:

1) Indian case

Only 140,000 telephone(or 6.9% of total) were located in the 580,000 villages which account for 80% of the country's population in 1980.(The situation is not much different from today's Lao P.D.R.)

The first assumption is that people in the remote rural areas do not really need a telephone; In fact, when a village telephone is available, it is used primarily for long-distance calls and serves as a vitally important substitute for personal travel.

The second assumption is that the telephone is used primarily by the more affluent segments of the population and does not benefit the poorest people; In fact, the utilization patterns of public village telephones shows that even the poorest people make use of public telephone when there is one and are in

fact prepared to devote a substantial part of their money income to pay for vitally important long-distance calls.

The third assumption is that even if the telephone is important for the rural population, it is in practice impossible to provide adequate facilities, given the population dispersion in rural areas, the high cost of installing and maintaining telephone facilities and low level of revenues associated with rural telephones. Solution to this problem; Providing India's 580,000 villages with a public telephone is a daunting task, and for the moment it is financially unjustified, since a large proportion of these villages are very small. It would also mean that most of telephones would grossly under-utilized. The most realistic solution, tested at the Economic Study Cell of the Indian Ministry of Communications, is to provide access to the telephone within a radius of five kilometers. The telephone would not reach every village or hamlet, but no villager would have to travel more than 5 km to reach to a telephone. The projections made by Economics Study Cell show that a total of only 45,000 "access points" or long-distance public telephones would be sufficient to provide some form of service to all of the country's population. (According to resent informal report, India is still straggling on a half way to the target.)

The benefit of telephone is shown in Fig. 8.3 by the comparison of the cost difference between the travel cost by bus and long-distance call cost, for the fulfillment of transferring information. As the distance becomes longer, the benefit of telephone increases.

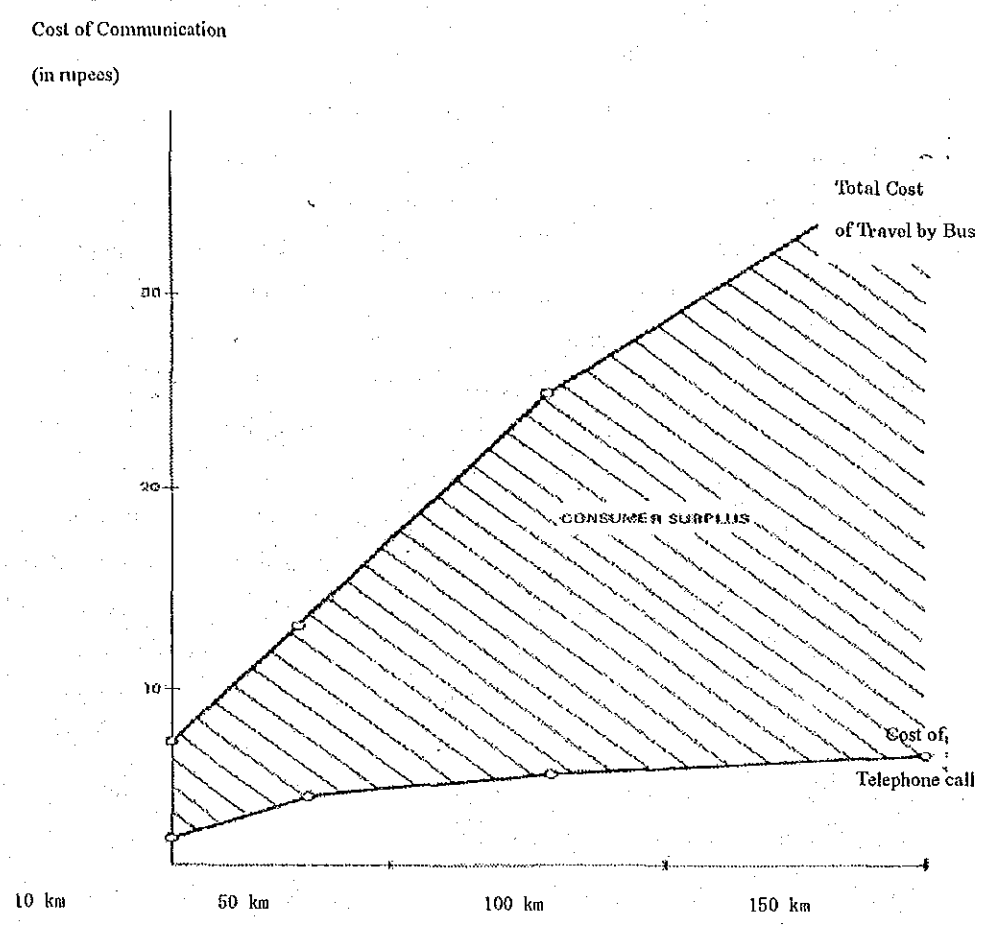


Fig. 8.3 The cost of long-distance communications by telephone and bus

2) Egyptian case

The study in rural areas was carried out by a Dean and his colleagues of University of Cairo in collaboration with MIT of USA. The study was the comparison of the telephone availability in the emergency cases of calling fire brigade or a physician in case of a serious accident or health problem.

The results show that the measurable benefit of the telephone turn out to be approximately 85 times higher than the costs of communications.

3) Cost for rural telecommunications

Under the framework of this ITU-OECD Project, CIT-Alcatel prepared cost comparison of urban and rural telecommunications costs based on a number of experiences in developing countries as shown in Table 8.1.

Table 8.1 Indicative cost per line of urban and rural telecommunications

(Index 100 = cost per line in urban areas)

	Cost per line in urban areas	Cost per line in rural areas
Subscriber connection	40	400
Investment in exchanges	30	60
Investment in transmission equipment	20	20
Investment in land and building	10	20
Total cost per line	100	500

This Table shows that the cost of installing telephone in rural areas is five times more expensive than urban areas, where the line part is 10 times. This is the average of many cases in the world. While the rural areas in Lao P.D.R. will be under much more harsh situation even though some technological development has been realized for rural telecommunications.

8.2.2 Japanese experience

(1) History

World War II brought the number of telephone in Japan to half of that of before the War. The government recognized the importance of telecommunications for the recovery of the economic activities and introduced many measures including the preference for urban areas on recovery and investment rather neglecting rural areas. These policies were widely accepted by the people for about 15 years. However, along with the steady increase of telephone density in urban areas contrasting that of rural areas, disparity of telephone service in urban and rural areas became apparent and rural community began to introduce " Wired broadcasting" similar to the system seen in Phongsary as for the substitutional method of ordinary telephone service. The request of telephone service in rural areas became stronger and at the same time the Diet also passed the request to NTT in 1663 for making effort to offer better service in remote and rural areas. (National telephone density was about 5 at this point.)

NTT sincerely acknowledged the long time preference to urban areas and relative negligence of rural areas, and immediately tackled to various measures to solve this problem always stressing the importance of rural telecommunications. However, it took nearly 15 years for rural telecommunications services reached to the same level of urban services. It was 1978. This experience will tell important lesson. NTT had big amount of revenues from urban services and introduced various technology to rural areas gradually improving service level, but took a

long years to bring up the telecommunications services in rural areas to mach to those of urban areas. The rural portion to urban area is smaller in Japan compared with the proportion in Lao P.D.R.

(2) Development of rural telecommunications

Various measures and steps for the improvement of rural telecommunications in Japan were taken as shown below:

a) Connection of Wired Broadcasting Network subscribers who are commonly connected to the Wired Broadcasting Network as if multiparty lines, to PSTN of NTT through manual connection

b) Installation of public telephone where at least 50 households exist regardless the cost (sometimes telephone poles were newly constructed for more than 10 km to comply to this rule)

c) Introduction of multiparty (5 to 10 subscribers by 1pair line) switching system

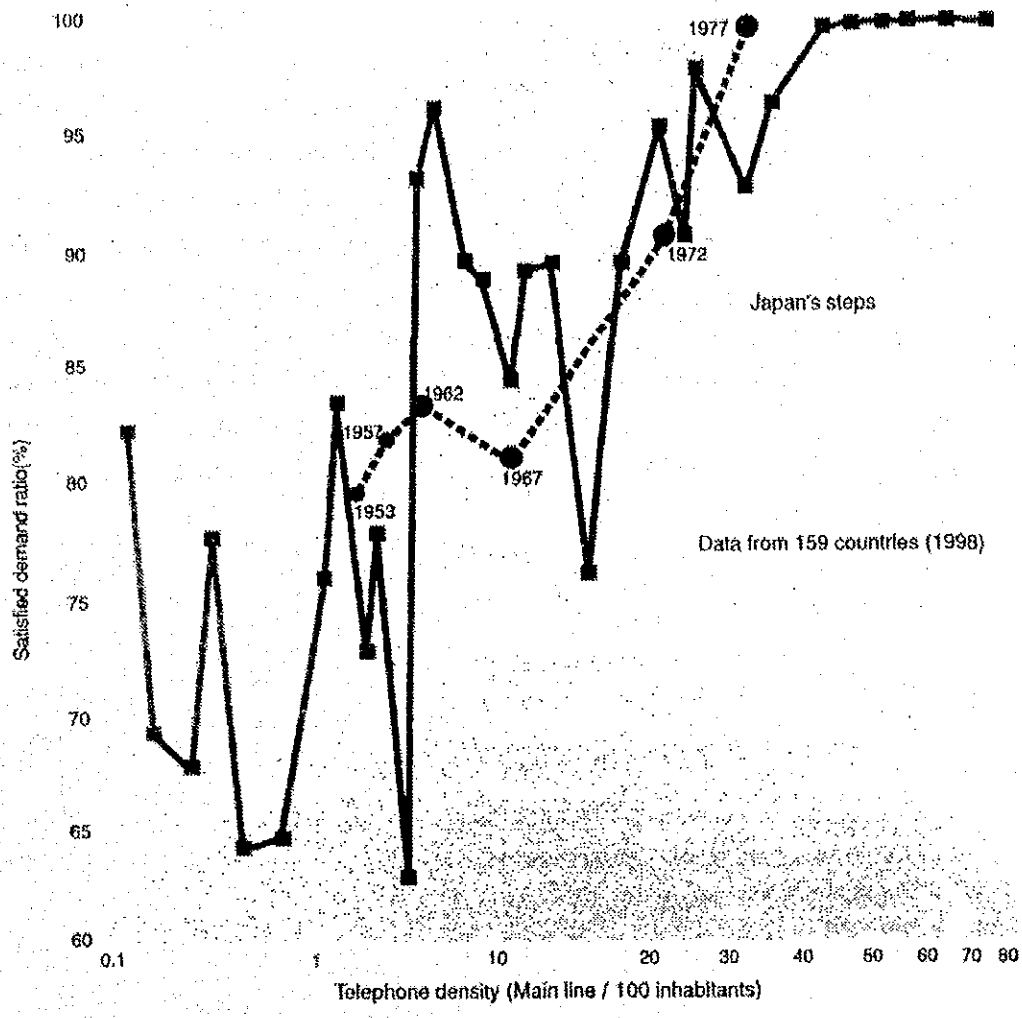
d) Improvement of above system to 2 parties

e) Finally up-grading to ordinary telephone

8.2.3 Lesson from other countries

The ITU Association of Japan is publishing "World Telecommunications Visual Data Book" every year using mainly published figures of ITU. There, a chart of "Satisfied demand ratio and telephone density" is found as shown in Fig. 8.4. This chart can be understood that the all telephone demand of the whole country will be satisfied when the national mean telephone density reaches to around 40 per 100 population. This figure in Japanese case is around 30. At that circumstances, the telephone service in rural areas will reach to the same level of urban areas, and until that time the rural telecommunications services will remain different from urban users in telephone demand satisfaction and various telecommunications services but the difference will be narrowed year by year.

In these aspects, the rural telecommunications in Lao P.D.R. will remain beyond 2015.



(Note) Satisfied demand ratio = Number of main telephones / Total demand
Total demand = (main telephone lines) + (waiting applicants)

Fig. 8.4 Satisfied demand ratio and telephone density

8.3 Importance of Public Telephone

The first target of rural telecommunications is to provide the least communication measures to isolated rural communities, as explained in the Case Study of India. In this concept, public telephone or community telecenter (according to recent ITU term) shall play central role. In this context, Lao P.D.R. whose national telephone density is still low and having many no-telephone community should make big effort to provide public telephones. When telephone density raises, the relative importance of public telephone will gradually decrease because the ordinary telephone will be found everywhere. ITU also acknowledges the importance of public telephone as listed in "Teleaccessibility" in various statistics. Fig. 8.5 shows the world trends of public telephone based on ITU statistics.

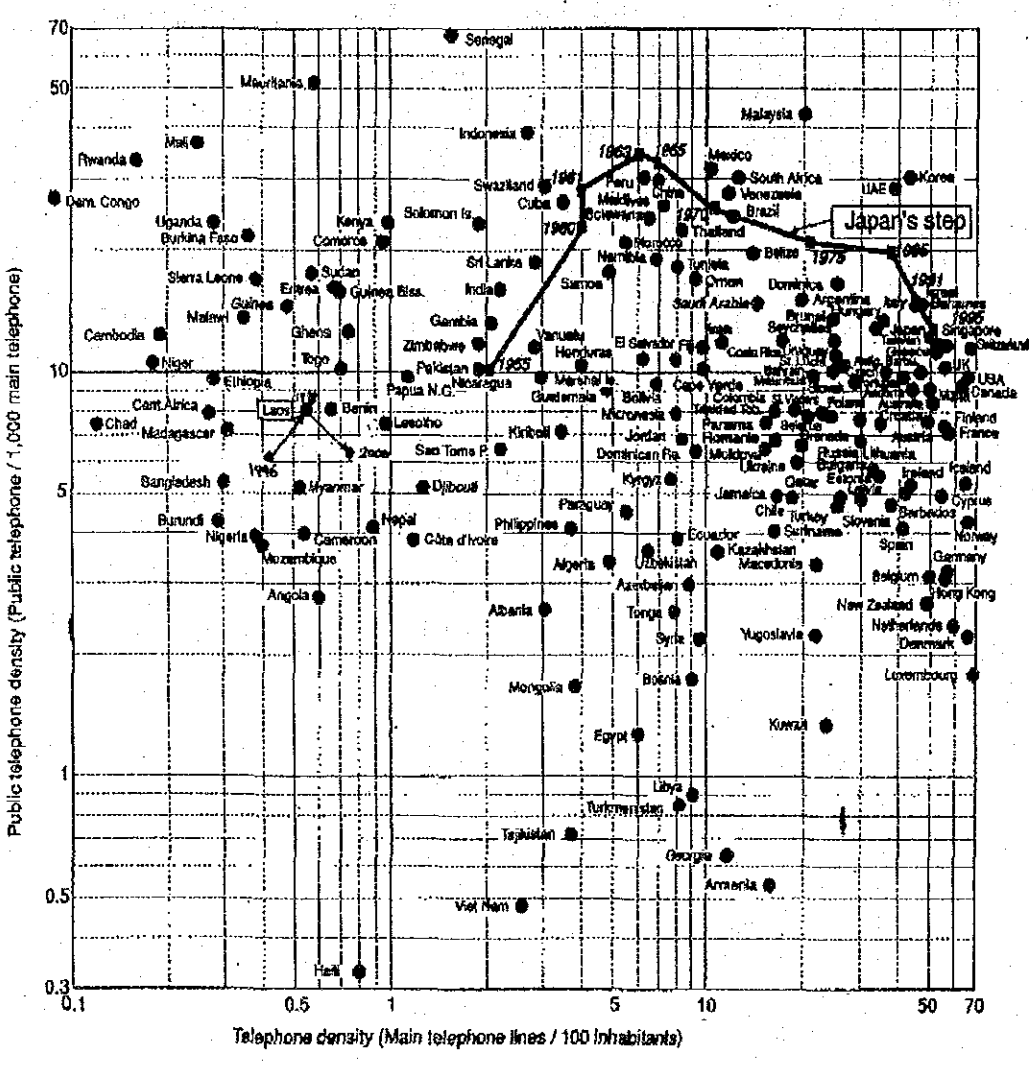


Fig. 8.5 Public Telephone Density in 1988 based on ITU

In Fig.8.5, Japanese trend is plotted showing yearly figures from 1955 to 1998. When NTT of Japan could not response to many telephone demands because of shortage of fund, NTT instead installed public telephone with much enthusiasm than installing individual telephone by thinking public telephone could be used by much more people, partially answering to the desire of having telephone facility individually. Along with the increase of ordinary telephone, the ratio of public telephone to ordinary telephone decreased gradually.

When looking at the case of Lao P.D.R., from 1998 to 2000 the public telephone density to ordinary telephone density dropped. This means much more effort was concentrated to ordinary telephone than public telephone. During low telephone density period, high consideration of installing the public telephone shall be emphasized.

8.4 Practical Approach in Lao P.D.R.

8.4.1 General Consideration

The continuous mountainous areas in Lao P.D.R. will impose the most difficult questions in the world for rural telecommunications. The single solution will not be able to answer rural telecommunications, and the most adequate method to suit to each environment shall be chosen.

In general, when road condition will make possible, the telephone poles were raised along the road and open wire or cable were installed previously, or optical fiber cable will be laid along the road now a days. However, as such preferable situation of road is now rare in the rural areas in Lao P.D.R., the alternative shall be found. The rural telecommunications shall be considered as one of the important infrastructure, and rural telecommunication development project shall be always included within the integrated rural development project.

Beside the provision of telecommunication facility to rural community, the availability of telecommunications along the highway brings high efficacy for reporting and avoiding further troubles of car accident, land slide or tree falling.

The practical classification for the implementation of the rural telecommunications will be as follows:

- Where the power supply is available
  The co-installation of telecommunications cable with power lines using the poles of power lines is strongly recommended. If the plan of the installation of power line is being planed in near future, this opportunity shall not be missed.
- For the purpose of ensuring the least communication method, Rutel shall be fully utilized. Furthermore, Rutel or similar systems shall be expanded even in

the future.

- When the mobile telecommunications service area is being expanded along the road, the mobile terminals shall be installed as the fixed public telephones in the communities which are situated along the mobile telephone service areas.
- Where the above proposing methods are practically impossible, through using the near-by tower of microwave transmission, D-MAS or similar systems shall be introduced.
- The region being difficult for the installation of optical fiber cable shall still rely on the radio system such as microwave system as the trunk transmission system. Therefore, the structural strengthening of microwave tower, improvement of access road to the tower, improvement of the power supply facility specially considering rainy season shall be implemented seriously.

8.4.2 Implementation methods

(1) Continual expansion of Rutel Project

Rutel Project continuing until 2004 as Phase V will install around 2,200 terminals. However this scale is not enough for the country like Lao P.D.R. whose 80% population are farmers. The technology like D-MAS used in Rutel is the most effective one to provide the telecommunications facilities to the widely scattered demands. As the consequence, the further continuation of Rutel Project beyond Phase V is quite important to provide the least telecommunications facilities to rural communities, when considered the existence of more than 11,000 villages. The areas other than (b) and (c) of below will be obliged to relay on this kind of technology.

(2) Rural Telecommunications along the optical fiber cable to Provincial municipalities

"Socio-Economic Development Strategy For 2020, 2010 and Five years Socio-Economic Plan (2001-2005)" insists that " By the year 2005, the construction of tar paved roads from Vientiane municipality to other provincial municipalities will be completed."

In coincidence with this road upgrading work, optical fiber cables shall be installed along the roads. On this occasion, some pairs of metallic cable will be installed together with optical fiber cable for both aerial and buried installations. The metallic cable will link District Centers with the Provincial Municipality and also be used for the connection of public telephones and ordinary subscriber telephones.

(3) Rural Telecommunications within the service area of cellar mobile telephone

As shown in the service area expansion plan of mobile telephone in Chapter 7, along the main national roads the mobile telephone becomes usable. The fixed use of mobile terminal will be used as public telephone. If an antenna fixed on the top of pole is added, the usable area of this method will be extended compared with ordinary mobile terminal. This kind of usage is now very common in the rural area of Cambodia.

(4) VSAT system

This VSAT system will not be suffered from the problems of unavailability of wired transmission system or difficulty of radio propagation of land radio system. At any place, VSAT system can supply communication facility. However, the installation cost, power consumption and communication cost will prevent the wider usage of this system. Only special sites such as isolated mining site, industrial site or electric power generation site will accept the usage of this kind of system.

General view of rural telecommunications is shown in Fig. 8.6.

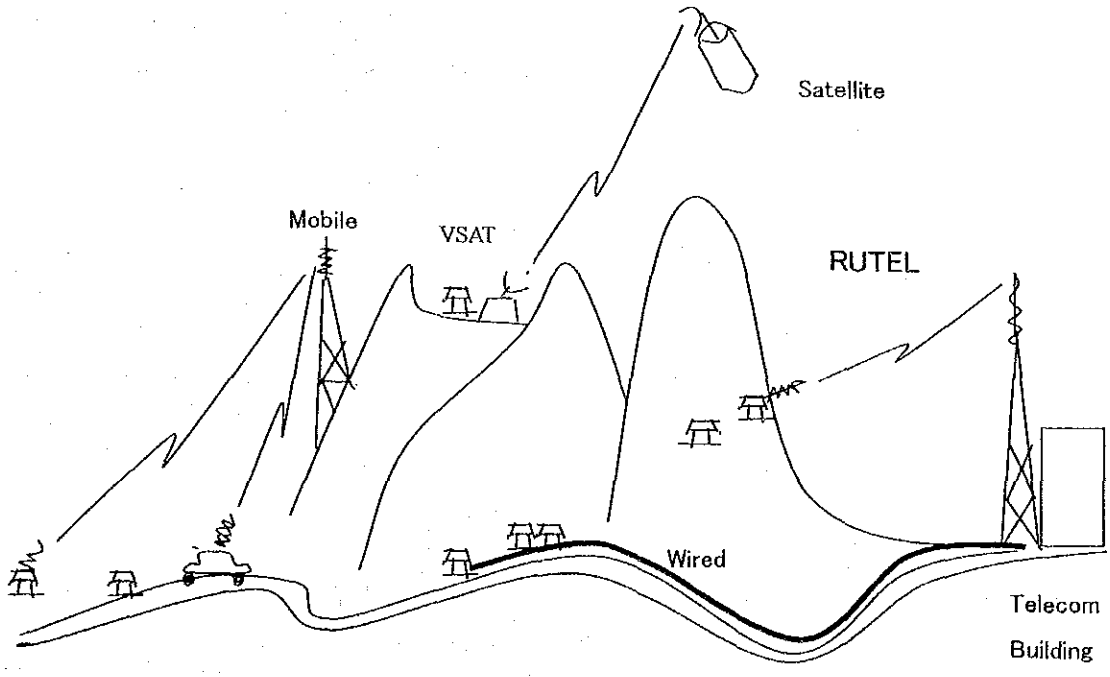


Fig. 8.6 General View of Rural Telecommunications

8.4.3 Power Supply issue

All telecommunications facilities need power supply of whatever type. There is no problem if commercial power supply is available.

However, according the above cited "Socio-Economic Development Strategy for 2020, 2010 and Five years socio-economic development plan V (2001-2005)" tells:

- "The electricity network needs to be expanded to all part of country and used as an engine for development of economic sectors by installation of the electricity network from north to south and provide significant access to those production zone geared to steadily enhance the industrialization process" in A basic development strategy from now to 2020 and 2010.
- "Number of village and household access to electricity will increase around 40% and 60%" in Five years socio-economic development plan V (2001-2005).

These contents can be understood as ubiquitous availability of commercial service being around 2020 or beyond. Then rural telecommunications need special consideration for power supply.

The ITU recently published "NEW TECHNOLOGIES for RURAL APPLICATIONS-Final report of ITU-D Focus Group 7 ". It is proposing various power supply systems for rural telecommunications and IT system. Those are:

a) Battery
b) Solar power
c) Wind energy
d) Micro-hydro power
e) Hybrid power system

The rural telecommunications in Lao P.D.R. shall choose adequate power system matching to each environment.

8.5 Funding Problem

The rural telecommunications are, except very few special cases of the world, not profitable, and the wider deployment of the rural telecommunication service in Lao P.D.R. will need a large amount of fund. Rural areas are quite large compared with urban areas. The profit from the urban area service will not be large enough for the wider installation of rural telecommunications facility.

Based on these aspects, special consideration will be needed for the development

of rural telecommunications. The possible solutions will be as follows:

(1) Telephone service integration in Integrated Rural Development Project activated and supported by the government of Lao P.D.R. for the purpose of the eradication of poverty from rural communities. The Integrated Rural Development Project shall include the telecommunications facility together with power supply, road pavement, encouraging money-earn agriculture products and traditional folk crafts suitable for exportation accompanied with housewives small enterprise supporting micro financing.

(2) As mentioned in Chapter 6 Telecommunications Policy, Law and Regulation, Universal Service Fund is frequently argued under the multi-operators environment. Effective establishment of this Fund will have the possibility of relieving the funding for the rural telecommunications projects. One of the way of thinking the practical implementation is that the total cost of this long term plan is around 300 million US$ and the estimated rural project cost is around 10% of the total, therefore, based on the assumption that the investment in urban areas brings revenue which is corresponding to investment, the 10% revenue (not profit) from fixed and mobile network operators shall be transferred to Universal Service Fund. The accounting for Rural Telecommunications shall be separated from ordinary telephone service and the fund will be given to the operator who invests for Rural Telecommunications. In addition, when the revenue from operating the Rural Telecommunications cannot cover even with every efforts, the Fund shall subsidize it.

(3) As the widely accepted concept, the telecommunications business will be profitable if well managed, however, the rural telecommunications will be generally non-profitable with small number of exceptions in the world. Therefore the assistance from developed countries can be expected specially for rural telecommunications under the understanding that the telecommunications is Basic Human Needs

8.6 Scale of Implementation

As mentioned earlier, the items and level of telecommunications services in rural areas consisted with around 11,000 villages will not reach to those of urban areas even in 2015. The telephone demands will not be fully satisfied in isolated rural areas, even though certain level of services will be provided in every rural communities.

It is a bold but probably realistic assumption that on average 2 telephone lines will

be supplied in every rural communities on the assumption of 1 line for local governments, 1 line for shop and public telephone under the common usage. This figure is average and smaller communities will have less and larger communities will have more. This means around 22,000 telephone lines will be working in rural areas in Lao P.D.R. in 2015. This figure is around 10 times of that of 2004.

The preference order of installation shall be as follows:

(1) The population along the national roads will be more intense compared with remote and isolated areas. There will be urgent needs to report road traffic accidents and road damage caused by landslide or falling trees. Considering these conditions, rural telecommunications shall be provided along the national roads as the prior choice. On the other hand, mobile telephone service area will expand quickly along the national roads as shown in Figs. 7.47, 7.48 and 7.49.

The easiest and cheapest method of telephone installation in these areas is the fixed usage of mobile telephone handset using mobile telephone service infrastructure. Presently, this method can be commonly seen everywhere in Cambodia. Along with expansion of mobile telephone service areas, this rural telephone service shall be expanded.

(2) However, there will be distant areas from the national roads worth consideration of supplying telecommunications service. There the system similar to Rutel Project shall be considered even though the installation cost is rather expensive. And VSAT system shall be implemented where the site is very isolated but very important such as mining, special industry, or sight seeing site.

(3) As mentioned earlier, whenever the optical fiber cable is installed underground or aerially, the metallic cable installation with it shall be considered for the connection of telephones not far from the exchange. This item becomes sometimes first or second priority.

The installation cost of rural telecommunications is assumed following:

(1) Installation using mobile telephone system is assumed as $300 per telephone, under the consideration of additional cost of mobile terminal without the infrastructure cost.

(2) Installations of similar systems to Rutel Project, VSAT and metallic cable are assumed as $3,000 per telephone with some cost reduction from current $5,000 Rutel Project.

As the preference of installation is given to fixed usage of mobile telephone and

others are considered as unavoidable cases where the mobile service will not reach in near future. The percentage for mobile system usage is thought to be 70% and the remaining will be 30%.

The total cost for the installation of 22,000 rural telephones is assumed to be $ 24,420,000

(1) The installation speed until 2015 is assumed gradual increase. And, the resulting installation from 2003 to 2005 is 4,000 costing $4,440,000.

(2) The installation during the next period until 2010 will be 8,000 costing $8,880,000.

(3) The installation during the following period until 2015 will be 10,000 costing $11,100,000.

CHAPTER 9

OPERATION AND MAINTENANCE

CHAPTER 9 OPERATION AND MAINTENANCE

9.1 Strategy and Organization

(1) Important items to offer the better services

1) Trouble clearing side

If possible, staff should find causes of equipment trouble in advance.

The staff should protect reoccurrence of the same trouble.

The staff should recover trouble quickly.

It is very important to reduce trouble clearing times for the better customer satisfaction. For this purpose, the target of trouble clearance time shall be set. Then adequate statistic shall be edited and compared with international trends, for example by referring ITU publications, so as to know own performance.

For shortening the trouble clearance time, the installation and adequate functioning of Spare Parts Centers are indispensable.

The shortening of trouble duration depends on the length of time which is needed to carry the repair parts from a part center to repairing site.

It will be advisable to have a Central Spare Parts Center in Vientiane for storing expensive and rarely failed parts, and Provincial Spare Parts Centers attached to Provincial Operation and Maintenance Centers so as to facilitate O&M activities.

2) Traffic management side

It is important to measure the carrying traffic of equipment periodically for switching network. This action is related with knowing of adequacy of the size of equipment and this will lead to the improvement of call complete rate resulting in increased revenue.

3) Action to subscriber complain

The subscriber complains to test board will be consisted of no-functioning of telephone, busy, inferior speech quality, interruption of communication and so on.

Received complain shall be immediately tested, and be classified which section among outside plant, switching and transmission be informed for

trouble clearance. At this instance, complain detail and test result shall be informed not verbally but in the form of written or recorded information to the alerted section.

The concerning section shall immediately tackle to the problem, and after clearance of trouble the cause of trouble shall be reported back to the test board. The staff of test board shall record the cause of trouble as well as the time of trouble recovery. This procedure is quite important for further actions as shown below:

- Trouble rate calculation, typically number of reported troubles per subscriber per year; this figure is very often referred in international comparison for the quality of service.
- Preventive maintenance for changing the part apt to become failure beforehand. This kind of work is typical for changing the worn cable.
- Establishment of maintenance policy based on statistical analysis of troubles.

(2) Training of O&M staff

For the better performance of O&M, training shall be given the preference position in the whole organization activities.

Training facilities such as TCTI shall be enlarged and enhanced in Vientiane as the major training site, and the provinces will have smaller size training facilities for minor training courses and on the job training.

There shall be not only courses for new technology but also courses for conventional system and equipment.

Shortage of instructors shall be resolved by the instructors who have received the training through the suppliers training courses.

Difficulty of foreign language should be solved by training of mother language instructors. These instructors first of all should be trained a foreign language. However, as not all manuals supplied to equipment sites can not be translated to Lao language, O&M staff should have foreign language skill such as English.

(3) Organization of Operation and Maintenance

Organization of Operation and Maintenance will consist of National center, Provincial centers, and Subcenters as shown in Fig. 9.1.

The National center will be located in Vientiane, and its function will be different from other centers and it will supervise the status of international and national

networks through observing traffic flow and fault in the networks. This center will cooperate with Provincial centers for lessening the traffic overload or clearing major troubles in various part of the country.

The Provincial centers in total 18 are located in each Provinces (including Vientiane Municipality). It will be also staffed with service staff who attend directly to the visiting customers for settling the bill, requesting new telephone subscription, attending to public telephone for international or long distance calls and so on. The Spare Parts Centers in each Province will co-locate together.

Technical staff will perform the routine test of switching system, transmission system, and radio system. The test board to receive customer complain is located together and each customers trouble report is tested and adequate technical staff will be dispatched. Same can be said for attending to miscellanies alarms from various equipment.

The servicing level of fault repairs is classified as followed for example:

The sections of switching, transmission, and radio are 24 hours attendance.

The section of outside plant is 8 hours in day time only.

The fault repair of rural communication system will be performed by above four sections, and the fault repair of mobile communication system is thought to be performed by different organization such as different company.

Subcenters will be allocated in the places where it takes more than half day trip by vehicle from Provincial Center to a repairing site. However Subcenters are regarded as the temporary organization until road condition is improved and travel time is shortened, and it can be expected that the necessity of having Subcenter will disappear before 2015.

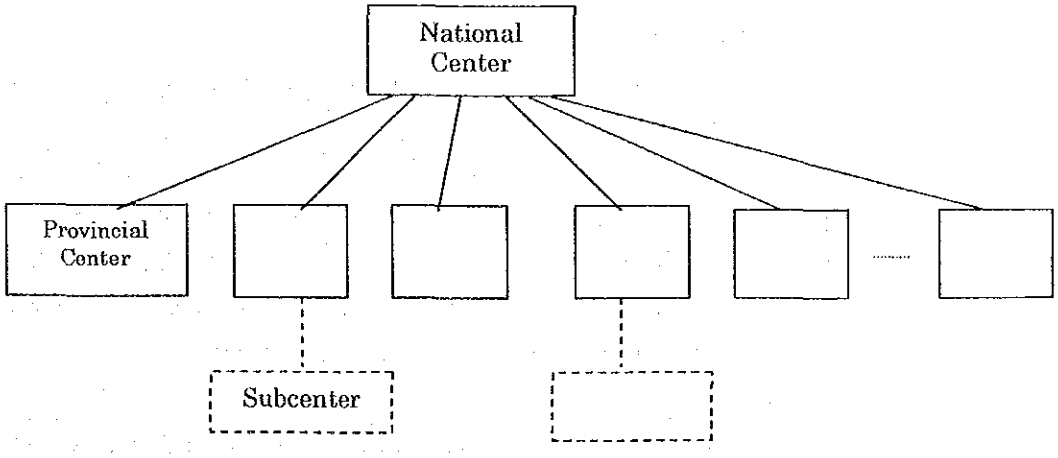


Fig. 9.1 Operation and Maintenance Organizations

9.2 Switching Network

The network expansion is a continuous process over the years to come in Lao P.D.R.. The O&M strategy and the O&M concept have to be adapted in accordance with the network development.

At present, all exchanges (except remote exchange) are manned and controlled locally. Only in some cases the control from one site to some other sites is made possible, in general no centralized Operation and Maintenance (O&M) is introduced in the telecommunications network of Lao.

However, the implementation of the new O&M concept must be aligned with the network expansion. In addition, the introduction of the Telecommunication Management Network (TMN) recommended by ITU-T must not be ignored.

The Mean Time between Failures (MTBF) for digital equipment is very high and as a consequence it has become normal proceeding to operate digital equipment regularly unattended and to send maintenance personnel to the site only in case of alarms indications.

9.2.1 Switching system Operation and Maintenance Structure

(1) O&M for Switching system

When reviewing and rearranging O&M for switching system, the future migration to the O&M Center must be borne in mind. Due to the wide variety of actions involved, and due to their different nature, a one-to-one integration of three functions of O&M explained below is to be considered.

The following three functions must be considered separately concerning their migration to the OMC:

- Customer service operations
  Directly related to service provision (such as setting up new subscribers, changing subscriber profiles etc.)
- Network Operations and management
  Such as setting up new trunks and junction lines, amendment of routing tables, monitoring the indicators of traffic and services, traffic data collection and processing, etc., this kind of jobs will be on the highest level in network management, and thus, be implemented rather later time.
- Maintenance of switches
  This function is very switching system oriented. In general, the system shall not require any preventive maintenance except for input/output devices. It is expected that only large exchanges will be attended by maintenance staff at

day time. Night time control of switches will be undertaken via O&M centers. Maintenance effort shall be restricted to the replacement of PCB (Printed Circuit Board) in most of the cases.

Diagnostic software and fault detection hardware are included in the switching system for automatic detection of software and/or hardware faults. If a fault is detected by automatic detection, report is produced immediately at output devices located in exchanges and/or remotely in OMCs. The fault processing program performs the following functions:

- Fault detection
- Fault analysis and diagnosis
- Fault isolation and display of diagnosis result
- System reconfiguration to restart call processing

(2) From Local O&M to Centralized O&M

Migration from Local O&M to Centralized O&M applied for digital exchanges shall be carried out in the following way:

- All exchanges to be monitored and supervised shall be connected to OMC where operation is performed during normal working hours.
- Remote Switching Units (RSU), smaller- and medium-sized digital exchanges are run unattended.
- In larger exchanges or the exchange situated at a geographical centre position amongst unattended exchanges, maintenance personnel are deployed during normal working hours,
- In each province center, maintenance personnel may be deployed all day around depending on the necessity.
- If a fault occurs in an unattended exchange, the alarm will be recognized and analysed in the OMC. During normal working hours a maintenance technician or engineer will be sent to the exchange to clear the fault. As for outside normal working hours, a decision shall be made first based on the alarm indications as to whether the fault needs immediate attention or whether fault clearing can be postponed to normal working hours.

This O&M organization is arranged with the aim to reduce operation and maintenance staff costs and better utilization of specialized manpower. Normally, one digital exchange does not create enough work volume to justify full time staffing.

However, the decisive factor is traveling time to the unattended exchanges. The traveling time contributes to its full extent to the down time and thus directly to

the degradation of the quality of service and reduces the actual working time of the staff.

As for the allocation of exchanges to OMCs is concerned, the following rules should be applied:

- All exchanges in the province where the OMC is located shall be allocated to that OMC.
- OMC's should take over monitoring and supervision of the exchanges allocated to them outside normal working hours.
- All exchanges in a province, which does not have an own OMC, shall be allocated to that OMC in an adjacent province, which has the lowest work load, in order to keep the work load as balanced as possible. A good indication for the workload in an OMC is the amount of number of switches and subscribers located in its service area..

9.2.2 OMC Arrangements for Network Operation and Management

As a long-term target, 4 Operation and Maintenance Centres (OMC) should be established in Lao P.D.R., i.e.: in Luangphabang, Vientiane, Khantabouli and Champasack. They should be collocated with the transit switching centers.

For the OMCs outside Vientiane, an implementation schedule with priorities dependening on the size (amount of subscribers and of exchanges and RSUs in the service area) must be established.

The recommended allocation of provinces and exchanges in these provinces to the OMCs is given below:

Table 9.1 OMC Arrangements for Switching System

OMC	Province	No. of fixed Lines as of 2015	No. of mobile telephone as of 2015
Luangphrabang (Northern region)	Phongsaly Luangnamtha Bokeo Oudomxay Luangphrabang Houaphan Sayboury Xiengkhouang Total	68,000	82,000
Vientiane (Central Region)	Vientiane municipality Vientiane province Bolikhamsay Total	248,000	404,000
Kanthabouly (Southern region 1)	Khammoune Savannakhet Total	70,000	107,000
Pakse (Southern region 2)	Saravane Sekong Champassak Attapeu Total	51,000	67,000

9.3 Transmission (MW/OFC/Mobile) Network

9.3.1 Microwave Transmission Networks

The current situation of maintenance management in LTC has specified to the maintenance team how to provide own facility to backbone and Spur network as shown in Fig. 7.5. Therefore, this description only provides ETL facility.

(1) Currently ETL has a few microwave transmission networks, which are linked mostly in Vientiane Municipality and used for satellite earth communication and BTS mobile transmission network.

1) Recommendation for maintenance structure

a) To organize one team which consists of at least 3 maintenance staff in the Saylom office up to 2005. After that an increase in maintenance staff is no longer necessary because there will be no more installations.

b) To set up repair shop as well as logistic for spare parts to maintain the facility in the Saylom office. The number of staff would be 2 for each office.

2) Main maintenance works

a) To conduct daily, weekly and monthly routine checks for all microwave communication system including power facilities in Vientiane Municipality.

b) To recover the system when trouble occurs in the site.

c) To maintain and calibrate the testing equipment.

d) To record routine check data, trouble record and solution with the use of a PC. However for the case of the PC being unavailable, the maintenance procedure is recommended in Fig. 9.2.

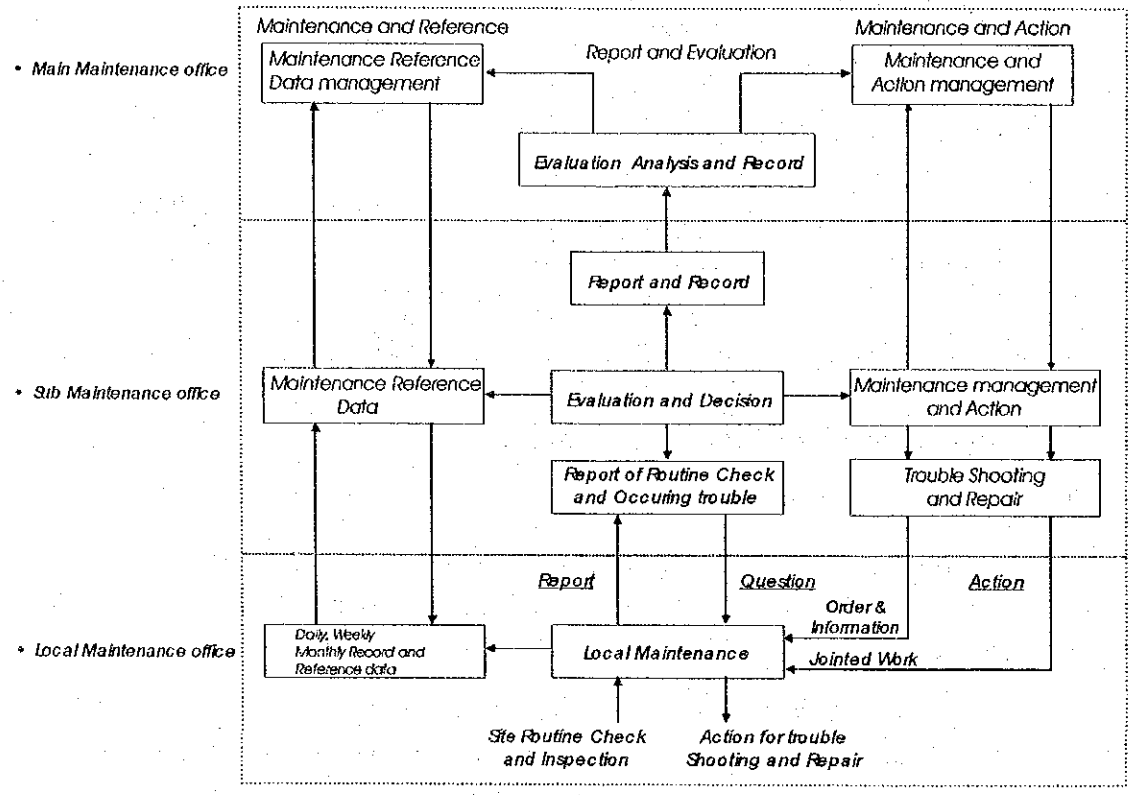


Fig. 9.2 Maintenance Management and Action Procedure

9.3.2 OFC Transmission Networks

(1) Current Situation

ETL has only OFC SDH network such as STM-16 CSC from Lao/Vietnam border to Vientiane Municipality as described in Fig. 7.14 at the present time. Therefore, maintenance shall be performed approximately 450 km of the OFC transmission system by 4 staff members at the KM21 in Vientiane Municipality .

Other networks are undergoing to implement in the phase 2 project until 2003 and the maintenance staff will immediately require to be maintained for approximately 1,643 km.

(2) Up to 2005

Other networks will be implemented as phase 3 and 4 up to the year 2005. In this case, a total of approximately 2,362 km of OFC will become necessary to provide the sufficient maintenance up to 2005 (Refer to Fig. 7.30 and Table 7.14).

For this reason, maintenance sections in provincial districts such as Houixai, Xay, Luangprabang, Thakhek, Khanthabouly, Pakse and other districts should be constructed.

The total number of maintenance staff required will be shown by Table 9.3.

(3) Up to 2010

The network will be installed approximately 904 km according with the demand forecast (Fig. 7.31 and Table 7.14) and total distance of the OFC transmission network will reach 3,266 km up to 2010.

For this reason, the maintenance sections will be structured in Phongsaly, Luangnamtha, Xaysomboun SR, Pek, Xamneua, Paksxong, Saravane, Lamam, Samak Khixay and other districts.

Therefore, the total number of maintenance staff required will be shown by Table 9.4.2

(4) Up to 2015

The approximately 2,973 km network will be newly installed according with the demand forecast (Fig. 7.32 and Table 7.14) and total distance of OFC will reach to approximately 6,239 km in provincial districts.

For this reason, the maintenance sections will be structured in Khamkheuth, Pine, Khong, Parlai, Meung and other local districts considering the recommendation to minimize recovery time in case of network trouble.

Therefore, the total number of maintenance staff required will be shown by Table 9.4.3.

1) Recommending maintenance system and tools

   a) The network managing system shall be provided at cable connecting points, terminal equipment, relay equipment and power supply unit in the transmission system. The network managing system is designed by integrated management of SDH FOTS, SDH MUX and SDH microwave on a common and platform (Fig. 9.3).

This system provides the following performance for the operation, administration, and maintenance :

- Fault management for network alarm and monitoring, etc.
- Performance management for performance data display, etc.
- Configuration management for building of overall network, protection switching, route sections and maintenance functions.

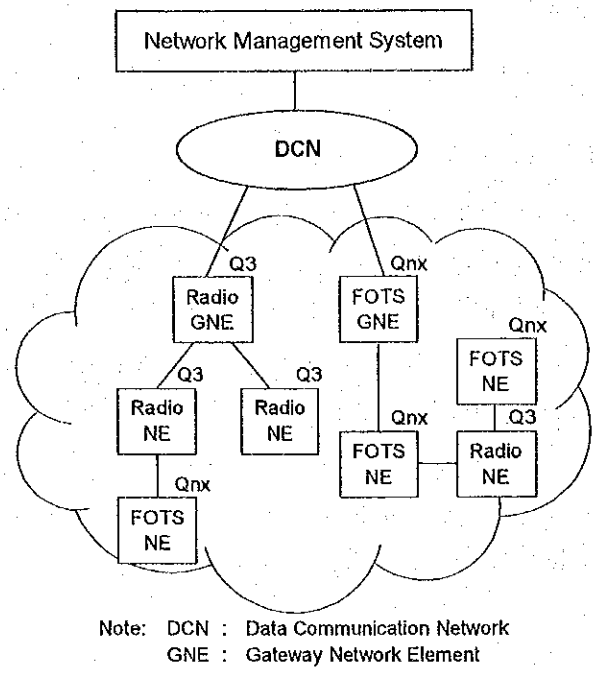


Fig. 9.3 System Configuration Architecture (Reference only)

b) In the above system, most of the maintenance management will be conducted through the present data in the networks. However, it is also preferred to be configured into a Maintenance Management Computer Network to ensure the best maintenance service as shown in the Fig. 9.4.

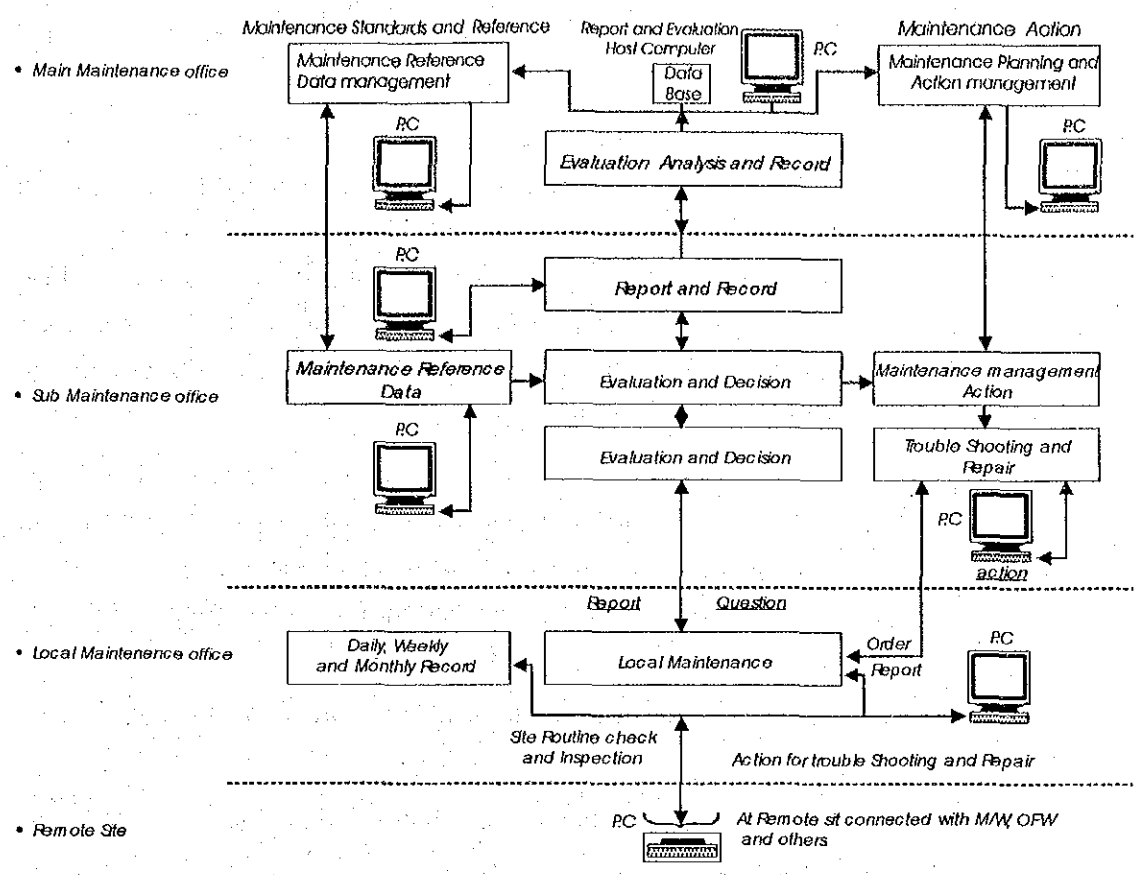


Fig. 9.4 Maintenance Management Computer Networks System

c) To provide sufficient test equipment for maintenance work.

d) To provide maintenance patrol car mounted with test equipment, HF/VHF radio, and cellar mobile telephone to communicate with home district station.

2) Maintenance work

Maintenance work is generally as follows:

a) Each maintenance section will be responsible in maintaining good operation in territory of their facilities (FOTS) in the transmission networks.

Likewise, it will be responsible for the recovery to the normal operation in case of trouble or system shutdown within 4 hours at the flat area or 6 hours at the mountainous area which will depend on the distance to the trouble site or point according with CSC operational requirement in Lao P.D.R..

b) Maintenance staff shall routinely check all facilities in the terminal stations for daily, weekly and monthly reports.

Likewise, maintenance staff is responsible for the recovery of the operation, finding the source of trouble and should report the result to the maintenance section immediately after recovery. If maintenance staff section has difficulty to recover at the troubled site due to unknown reason, the staff should request necessary information from maintenance base section, as well as bringing of spare parts and a PC unit.

c) The logistic in the maintenance section should prepare all PC units for replacement of the troubled parts. The Repair shop should set up the maintenance tools and provide all test equipment. Further, Transportable-type Engine generators should be brought to the site if necessary.

d) Maintenance section should plan and control how to procure spare parts.

e) Newly recruited technical staff shall be trained at site by OJT (On Job Training) from 2004 up to 2015.

f) One of transmission network routing switch is shown in Fig. 9.5. .

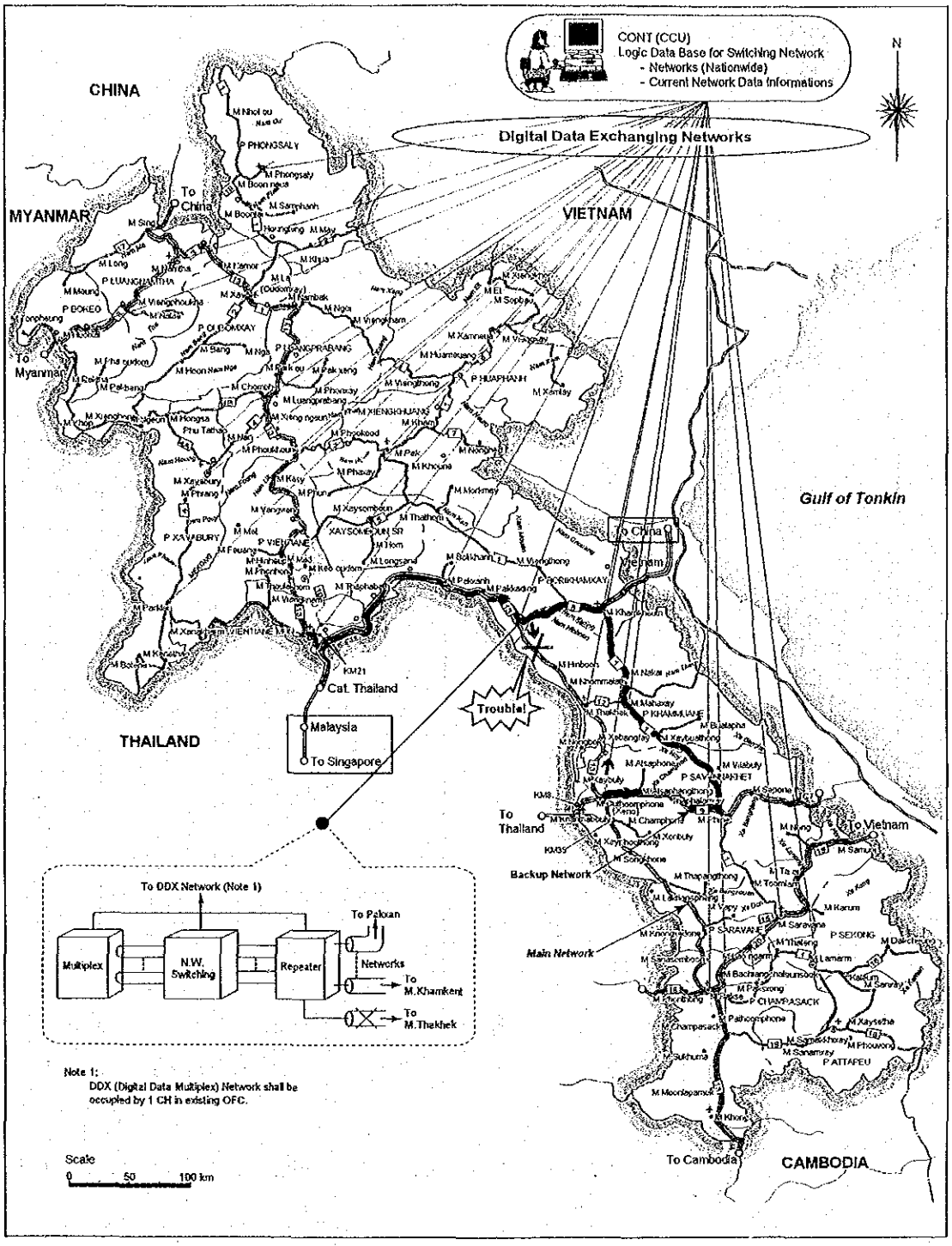


Fig. 9.5 Typical Route Switch for Main Network Trouble

9.3.3 Mobile Telephone Network

The current situation of maintenance management in LTC has already specified to the maintenance team how to provide own facility as shown in the Table 7.14. Therefore, this description only provides ETL as the maintenance structure and works.

(1) Maintenance Section Structure

Currently ETL is undergoing the implementation and planning as shown in Table 9.2.

Table 9.2 Installation Plan of BTS

No.	Province Name	Total up to 2005	From 2006 to 2010	Total up to 2010	From 2011 to 2015	Total up to 2015	Grand Total
1	VIENTIANE MUNICIPALITY	58	15	73	12	85	85
2	VIENTIANE PROVINCE	12	2	14	5	19	19
3	XAYSOMBOON SPECIAL REGION	0	1	1	5	6	6
4	CHAMPASACK	8	10	18	12	30	30
5	SARAVANE	1	6	7	8	15	15
6	ATTAPEU	0	2	2	9	11	11
7	SEKONG	0	4	4	5	9	9
8	SAVANNAKHET	9	6	15	13	28	28
9	KHAMMUAN	5	3	8	9	17	17
10	BORIKHAMXAI	10	7	17	6	23	23
11	XIENGKHUANG	0	5	5	7	12	12
12	HUAPHAN	0	3	3	10	13	13
13	LUANGPHRABANG	7	11	18	9	27	27
14	XAYABURY	0	3	3	12	15	15
15	OUDOMAXAY	0	3	3	8	11	11
16	BOKEO	0	2	2	2	4	4
17	LUANG-NAMTHA	4	0	4	10	14	14
18	PHONGSALY	0	1	1	15	16	16
Total		114	84	198	157	355	355

Therefore, the maintenance staff should be provided to the related districts as shown in the Tables 9.3, 9.4 and 9.5.

(2) Main Maintenance Work

a) To conduct daily, weekly and monthly routine checks for all microwave communication system including power facilities in Vientiane Municipality and other provinces.

b) To recover the system immediately when trouble occurs.

c) To inspect the service coverage in Vientiane Municipality and other provinces.

d) To maintain and calibrate the testing equipment.
e) To record the resulting data of routine check, trouble and solution by using PC. However if the PC is not available, the maintenance work shall follow the procedure of Fig. 9.2.

9.3.4 Satellite Earth Transmission

The maintenance management of ETL has already specified to the maintenance team how to provide own facility as shown in Fig. 7.13. Therefore, this description only provides the following main maintenance works.

a) To conduct daily, weekly and monthly routine checks for satellite earth communication system including, antenna, coaxial cables, power facilities such as UPSs and engine generators.
b) To recover the system immediately when trouble occurs.
c) To maintain and calibrate the testing equipment.
d) To record routine check data, trouble record and solution with the use of PC.

9.4 Outside Plant

As a whole, the maintenance activity is well carried out despite difficult situations.

Summary: Following are common maintenance work.

9.4.1 Current Status of OSP Maintenance Activities

(1) Current operation

1. Daily fault repairing works
2. Restoration works of the damaged cables
3. Preventive Maintenance work
4. New connection or change of connection of subscriber

(2) Fault Occurrence

1) Faults on primary cables, secondary cables and drop wires are many due to outside facilities. The causes are vehicle accident, excavator of road work, electrical short circuit, and lightning.

2) Major Faults in the Year 2001 is as follows;

- Optical fiber cables were cut by excavators and auger machines - 6 times / Year, 2001.

- The primary and secondary cables are cut by vehicle accidents - 20 times/ Year, 2001
- Electricity induction to cables and DP - 15 times / Year, 2001.

3) According to the information from maintenance center in Vientiane and other provincial offices, the percentage of the faults in the network portion at the drop wires is 80~90% (different according to areas) .

4) The existing fault ratio on subscriber network portion in Vientiane is 4.92 faults per 100 subscribers per month(Nov.2001).

5) The target criteria of the fault ratio have not been authorized.

6) The target of the maximum time to complete repair work is not established.

Example: Recovery time exceeding three days time is 87.1% of total faults in Nov. 2001.

Problem identified

- Drop wires are very close to the power line and sometimes the electricity induction damages telephone set and fuse in the MDF when two cables touch with each other. Even worse, some circuit on line card of the corresponding user is damaged.
- It is observed that the long recovery time is caused by the replacement of long portion of drop wires and complicated wiring.

9.4.2 Current status of OSP Maintenance Center

(1) Human resources for maintenance Center in Vientiane and Provinces

1) Vientiane Center
2) Provincial Centers
3) Working hours 8 A.M. to 5 P.M.

(2) Maintenance Tools and Testing Equipment

Fault locationing is being executed by cut-and try method instead of measurement by fault locator or other testing equipment. Staff usually owns only megger (insulation resistance tester) and simple testers.

Problem identified

- Number of personnel is not enough compared with the number of faults occurred.
- Human skills are not equal among staff and they need to have more training.

- Shortage of proper tools causes many faults eventually. It is observed that difficulties to provide the proper maintenance tools and test equipment are due to the financial problem.

9.5 Number of Staff

In Vientiane, there will be officers of MCTPC and various personnel working in the head quarters of telecommunications operating companies for fixed and mobile networks. The number of these personnel is assumed around 2,000 in 2015. As for the operation and maintenance, the number of necessary personnel of different technical and hierarchical category is calculated for each Province. Regarding ICT, routers and other user related systems are assumed to be operated by private sectors. The resulting number of personnel is shown in Tables 9.4.1, 9.4.2 and 9.4.3. The real site of stationing of staff inside the Province shall be decided by considering the traveling time for operation and maintenance. That is from the only one site of Provincial Capital where service area is small and road condition is good to several District cities/towns in addition of Provincial Capital where service area is wide and road condition is not preferable.

Table 9.3 Allotment of Staff in 2005

Category / Province	Switching				Transmission				Mobile				Outside plant				ICT	Commercial	Total
	Manager	Engineer	Technician	Worker	Manager	Engineer	Technician	Worker	Manager	Engineer	Technician	Worker	Manager	Engineer	Technician	Worker			
Vientiane Mun	10	16	50	6	5	9	25	5	3	5	15	3	23	35	129	46	2	20	407
Phongsaly	1	1	1	1	2	3	5	2	2	3	5	2	1	2	6	2	0	4	43
Luangnamtha	2	3	9	1	2	3	5	2	2	3	5	2	4	6	24	8	0	4	85
oudomxay	1	2	4	1	2	3	5	2	2	3	5	2	2	3	13	4	0	4	58
Bokeo	1	1	1	1	2	3	5	2	2	3	5	2	1	2	6	2	0	4	43
Luangprabang	1	1	4	1	3	5	15	3	3	5	15	3	2	3	13	4	2	8	91
Huaphanh	1	2	4	1	2	3	5	2	2	3	5	2	2	3	13	4	0	4	58
Xayabury	1	1	1	1	2	3	5	2	2	3	5	2	1	2	6	2	0	4	43
Xiengkhuang	1	2	4	1	2	3	5	2	2	3	5	2	2	3	13	4	0	4	58
Vientiane Prov	1	2	4	1	3	5	15	3	2	3	5	2	2	3	13	4	2	4	74
Borikhamxay	1	2	6	1	5	8	20	3	2	3	5	2	3	4	16	6	0	5	92
Khammuane	2	3	10	1	3	5	15	3	2	3	5	2	5	7	25	10	2	5	108
Savannakhet	3	6	18	2	5	8	20	3	3	5	15	3	8	12	46	16	2	7	182
Saravane	2	2	8	1	5	8	20	3	2	3	5	2	4	6	20	8	0	4	103
Sekong	1	0	1	1	2	3	5	2	2	3	5	2	1	1	5	2	0	4	40
Champasack	2	3	8	1	3	5	15	3	3	5	15	3	4	6	22	8	2	7	115
Attapeu	1	0	1	1	2	3	5	2	2	3	5	2	1	1	4	2	0	4	39
Xaysomboun SR	0	0	0	0	2	3	5	2	0	0	0	0	0	0	0	0	0	4	16
Total	32	47	134	23	52	83	195	46	38	59	125	38	66	99	374	132	12	100	1,655

Table 9.4 Allotment of Staff in 2010

Category / Province	Switching				Transmission				Mobile				Outside plant				ICT	Commercial	Total
	Manager	Engineer	Technician	Worker	Manager	Engineer	Technician	Worker	Manager	Engineer	Technician	Worker	Manager	Engineer	Technician	Worker			
Vientiane Mun	29	44	140	16	2	3	5	2	2	3	5	2	66	98	360	131	4	35	947
Phongsaly	1	2	4	1	2	3	5	2	1	2	3	1	2	3	13	5	1	5	56
Luangnamtha	2	3	8	1	2	3	5	2	1	2	3	1	4	6	22	8	1	5	79
oudomxay	2	3	9	1	2	3	5	2	1	2	3	1	4	6	24	8	1	5	82
Bokeo	1	2	4	1	2	3	5	2	1	2	3	1	2	3	11	4	1	5	53
Luangprabang	5	7	23	3	2	3	5	2	2	3	4	2	11	16	60	21	2	15	186
Huaphanh	1	2	7	1	2	3	5	2	1	2	3	1	3	5	17	6	1	5	67
Xayabury	1	2	5	1	2	3	5	2	1	2	3	1	2	3	13	4	1	5	56
Xiengkhuang	2	3	10	1	2	3	5	2	1	2	3	1	5	7	25	5	1	5	85
Vientiane Prov	3	4	12	1	2	3	5	2	1	2	3	1	6	9	31	12	2	5	104
Borikhamxay	3	6	18	2	2	3	5	2	1	2	3	1	7	11	41	14	1	8	130
Khammuane	3	5	16	2	2	3	5	2	2	3	4	2	8	12	46	16	1	8	140
Savannakhet	9	13	42	5	2	3	5	2	2	3	4	2	20	30	108	40	2	10	302
Saravane	3	4	13	1	2	3	5	2	1	2	3	1	6	9	33	12	1	5	106
Sekong	1	2	5	1	2	3	5	2	1	2	3	1	2	3	13	4	1	5	56
Champasack	6	9	29	3	2	3	5	2	2	3	4	2	14	21	75	27	2	10	219
Attapeu	1	2	6	1	2	3	5	2	1	2	3	1	3	4	16	6	1	5	64
Xaysomboun SR	1	2	4	1	2	3	5	2	2	3	5	2	2	3	11	4	1	5	58
Total	74	115	355	43	36	54	90	36	24	42	62	24	167	249	919	327	25	146	2,788

Table 9.5 Allotment of Staff in 2015

Category / Province	Switching				Transmission				Mobile				Outside plant				ICT	Commercial	Total
	Manager	Engineer	Technician	Worker	Manager	Engineer	Technician	Worker	Manager	Engineer	Technician	Worker	Manager	Engineer	Technician	Worker			
Vientiane Mun	39	57	183	21	3	5	10	3	2	3	5	2	86	129	472	172	4	50	1,246
Phongsaly	3	4	13	1	2	3	5	2	1	2	3	1	6	9	33	12	2	7	109
Luangnamtha	2	4	12	1	2	3	5	2	1	2	3	1	5	8	30	10	2	7	100
oudomxay	3	5	15	2	2	3	5	2	1	2	3	1	7	10	40	14	2	7	124
Bokeo	2	4	12	1	2	3	5	2	1	2	3	1	5	8	30	10	2	7	100
Luangprabang	7	10	34	4	2	3	5	2	2	3	4	2	16	23	86	31	2	20	256
Huaphanh	3	4	14	2	2	3	5	2	1	2	3	1	7	10	36	13	2	7	117
Xayabury	4	5	16	2	2	3	5	2	1	2	3	1	8	12	42	16	2	7	133
Xiengkhuang	3	4	13	2	2	3	5	2	1	2	3	1	6	9	35	12	2	7	112
Vientiane Prov	5	7	21	2	2	3	5	2	1	2	3	1	10	15	55	20	2	7	163
Borikhamxay	5	8	25	3	2	3	5	2	1	2	3	1	12	18	64	24	2	10	190
Khammuane	4	7	23	3	2	3	5	2	2	3	4	2	11	16	58	22	2	10	179
Savannakhet	10	17	52	6	2	3	5	2	2	3	4	2	24	36	134	48	2	15	367
Saravane	3	5	15	2	2	3	5	2	1	2	3	1	7	10	40	14	2	7	124
Sekong	2	4	11	1	2	3	5	2	1	2	3	1	5	8	28	10	2	7	97
Champasack	10	14	45	5	2	3	5	2	2	3	4	2	21	31	117	42	2	15	325
Attapeu	2	4	12	1	2	3	5	2	1	2	3	1	5	8	30	10	2	7	100
Xaysomboun SR	3	4	13	1	2	3	5	2	1	2	3	1	6	9	33	12	2	7	109
Total	110	167	529	60	37	56	95	37	23	41	60	23	247	369	1,363	492	38	204	3,951

9.6 Supporting Facilities

9.6.1 Network Management Centers

The enlargement of network and the increase of complexity along with increasing importance of telecommunications services in the social and political activities request higher reliability and survivability of the telecommunications networks.

When network expands, the rate of fault occurrence and traffic overload in some section of network because of natural disaster or special social or political events will happen more frequently.

For always keeping the health of the network, adequate network management facilities shall be implemented to international and national networks. The place having such facilities will be called as Network Management Center, and this kind of Centers for international and national networks shall be located in Vientiane.

The major functions of Centers are as follows;

a) Network display indicating network trouble such as fault in transmission system and switching system or traffic overload.

b) Automatic change of transmission route based on installed program or manual change in the case of trouble occurrence in the transmission route.

c) Adequate change of traffic flow within network by changing the route of connection for the case of unusual traffic increase or network trouble.

d) Sometimes suppression of traffic becomes to be necessary. Technically various methods can be implemented.

e) Communication or order transferring channel or facilities will be needed between Center and provincial and district O&M sites for national network management. Similar facilities will be also considered for international network.

Note: For better functioning, transmission system shall be loop configuration.

9.6.2 Telecommunication Management Network

The better management of network needs transfer of various information including present traffic information, charging information and other management related information. To facilitate such functions, ITU has been continuing the study of TMN for long years.

Lao P.D.R. shall consider the implementation of TMN in future, even though the full configuration will not be considered.

9.6.3 OSP Maintenance Center

The almost all trouble for each subscriber occurs in outside plant including wiring inside subscriber's domicile. Therefore the maintenance of outside plant plays the important part to keep better QoS. A facility equipped with all testing, repairing, information storage as well as transporting facilities will lead to the efficient daily work for outside plant, This kind of concentrated facility is called as OSP Maintenance Center which is very successfully functioning in Indonesia. Beside above mentioned O&M organization, this kind of Center will be worth consideration.