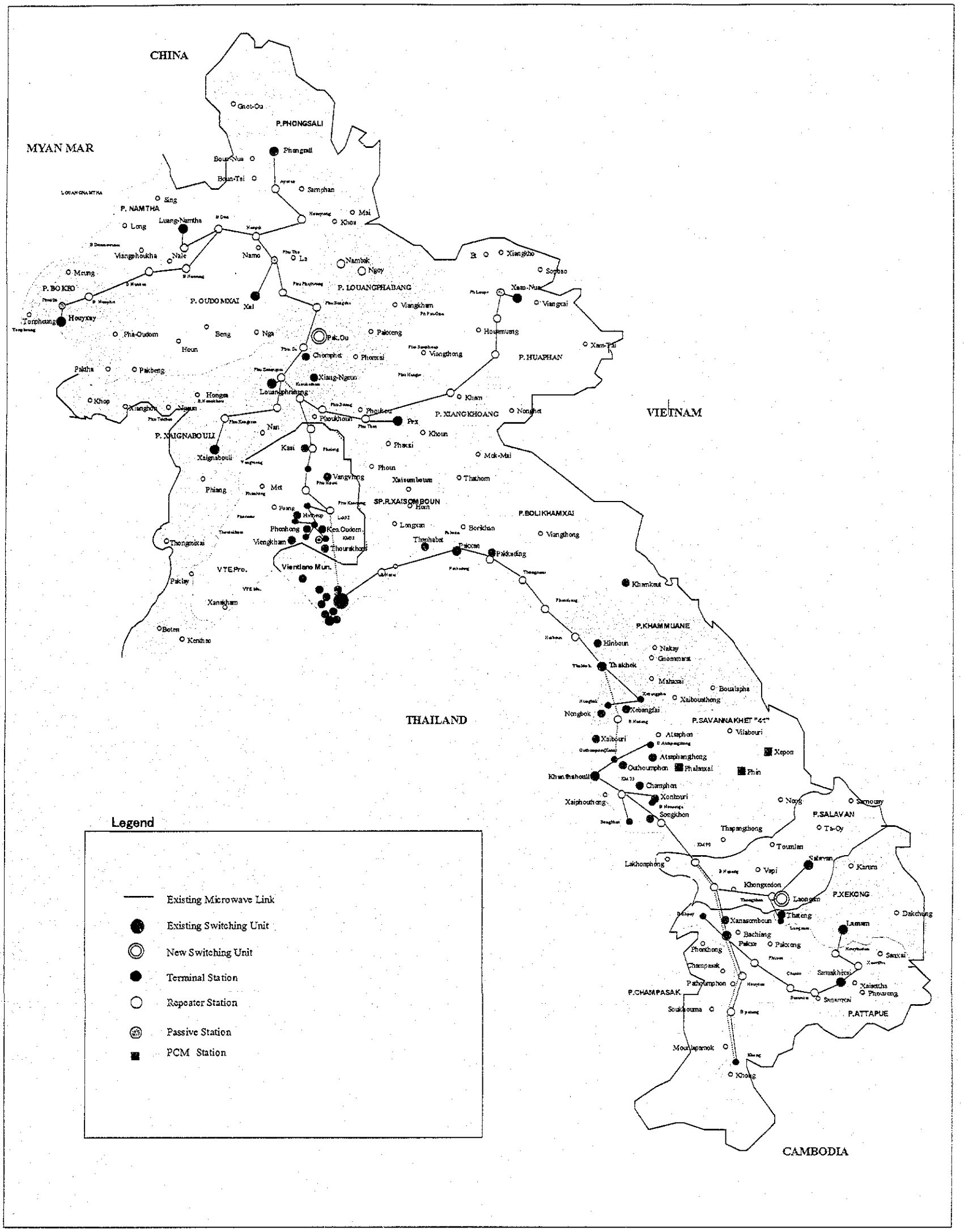


Fig. 7.25 The Configuration of Switching until 2005

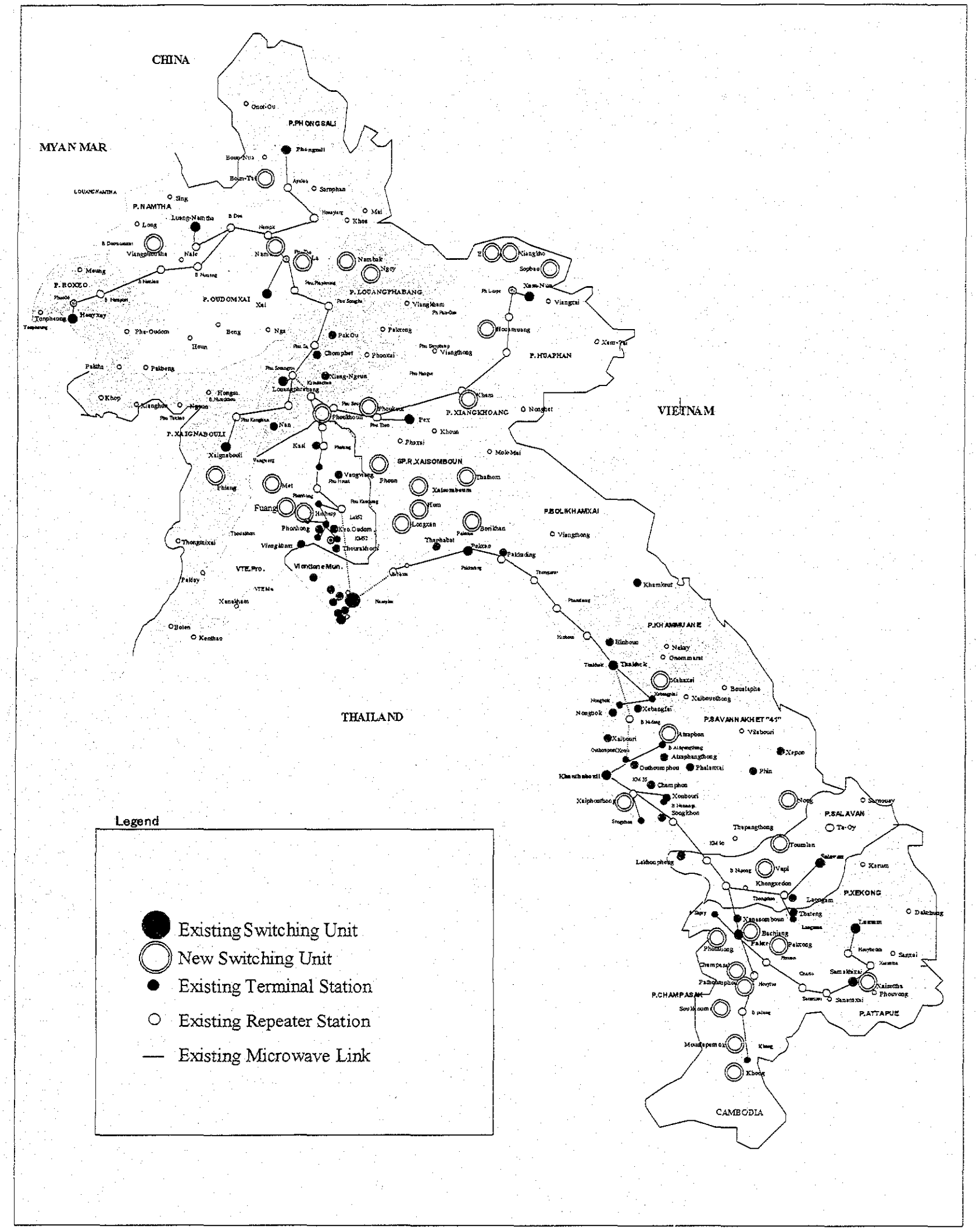


Fig. 7.26 Switching Expansion Plan until 2010

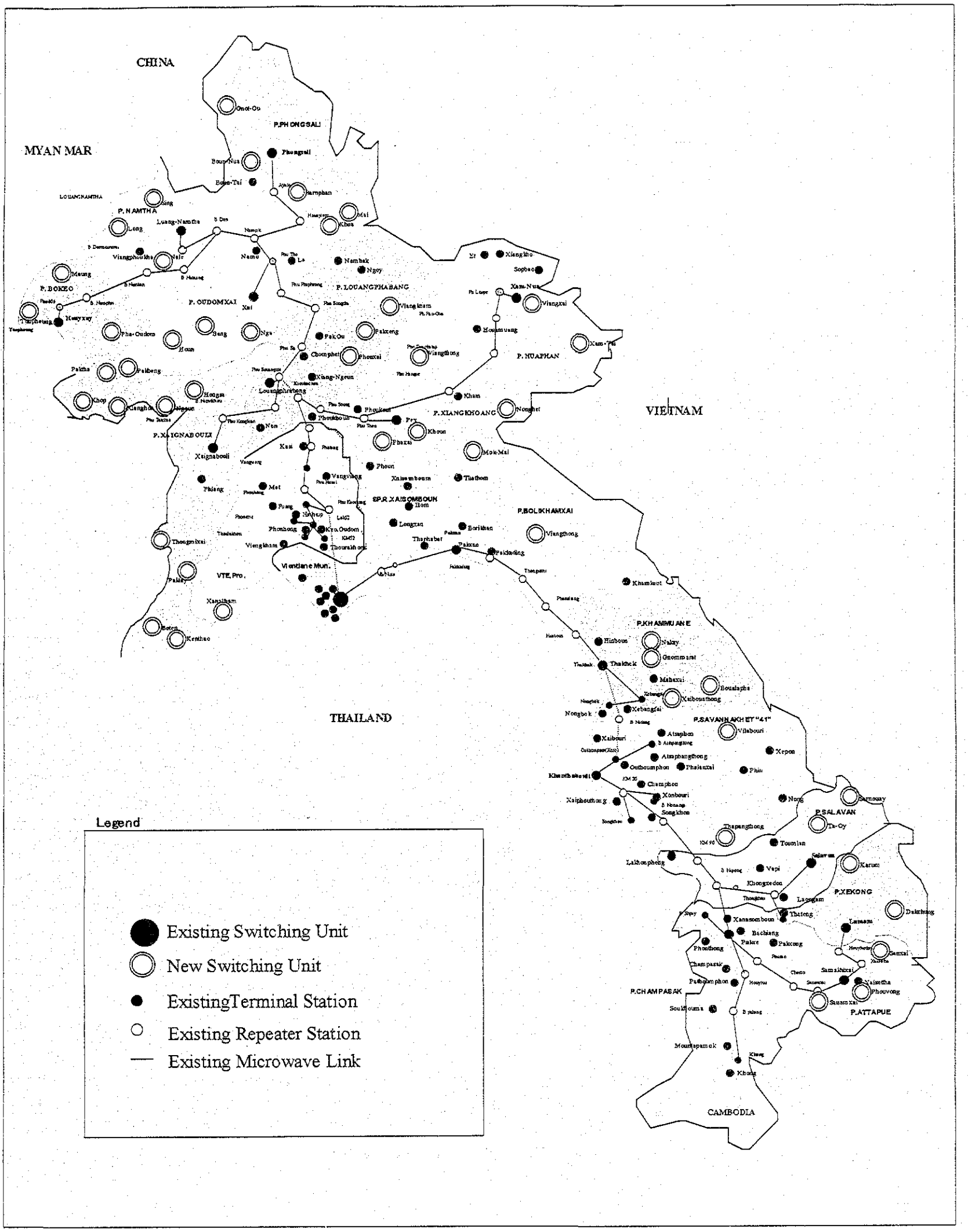


Fig. 7.27 Switching Expansion Plan until 2015

(1) Future full-Digital Network Structure

Due to limitations of the function of switch such as number of routes, route sizes, and tandem routing facilities, a hierarchical structures have been utilized in the past network.

According to the ITU-T (former CCITT) Recommendation E.172, the network structure for circuit switched services shall be non-hierarchical. The LAO transit switching network is almost a mesh structure except for the southern parts. For the structure to a future non-hierarchical network, it is recommended that the number of network levels be reduced to two as follows:

1) Trunk network (transit Switches and combined Switches including international gateways).
2) Local network (local Switches and combined Switches/local tandem).

The upper level consists of the trunk network for international and long-distance traffic (inter-regional, intra-regional) and the GSM mobile switching center(s).

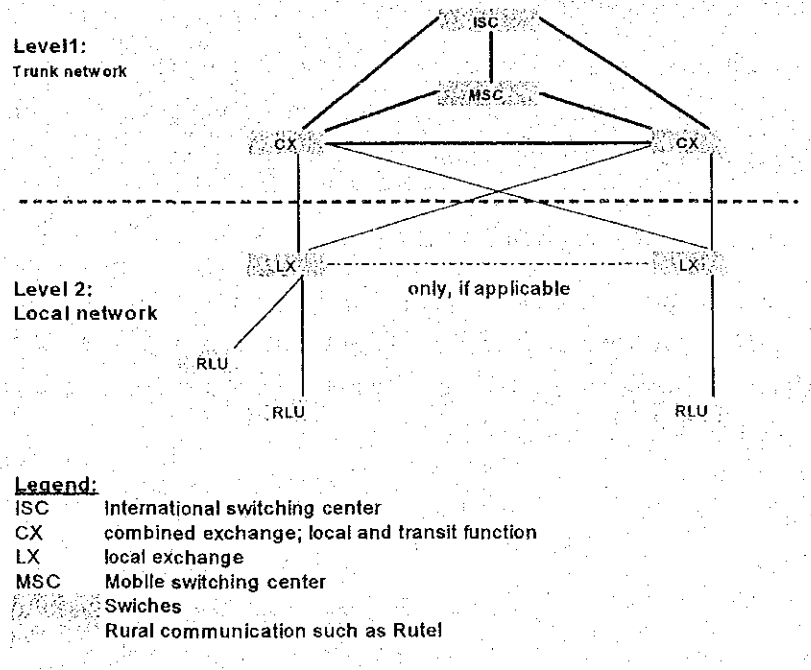


Fig. 7.28 One of possible Future Network Structures for Fixed Telephone services

Future level 1 Trunk network shall be constructed with 4 main CX of Vientiane, Savannaket, Champasack, Luangprabang and ISC in Vientiane.

(2) Signaling System

Signaling system between digital switches in the Lao P.D.R. is used SS No.7 signaling system. For some international circuits, the No.5 signaling system is still used. Based on a bilateral agreement, No. 5 will be replaced by SS No. 7 in the near future.

As for the topology of the Lao P.D.R., the capital Vientiane is located in the center of the country and the telephone service area are extended to north and to the south area. Traffic between north area and south area will be carried through the toll switches installed in major cities. Direct circuits to connect the cities located in the north and south are not so many. As a result, introduction of new Signal Transfer Points (STP) into the Telephone network are not required.

(3) National Transit Switch (Toll Switch)

Toll and local combined switches (TLS) which fullfill the function as for the National Transit are already installed in such major provinces as Luang Phabang, Sabannakhet (Khanthabouly), Champasack (Pakse)

In accordance with the increase of telephone numbers, for Vientiane, and Luang Phabang, Sabannakhet (Khanthabouly), and Champasack (Pakse) provinces are required to install a new switching system for toll transit.

(4) Local Switch and Remote Switch

For such small cities as a final capacity being less than 2,000 subscribers, it is recommendable to introduce Remote subscriber unit with V5.2 inter face. For such province center of small capacity being less than 10,000 subscribers shall be installed local switch of small type.

7.4.5 Transmission Network Planning

(1) Networks Design Policy and Expanding Target

In the accordance with network planning described in Table 7.1 in Chapter 7, the transmission networks should be planned as follows:

1) Microwave transmission networks

a) Microwave transmission networks will be not applicable for long distance transmission due to the reasons described in above (2), therefore new long distance networks should not be considered any more in Lao P.D.R..

b) Microwave transmission networks are utilized by the personal microwave link shown in Fig. 7.29 and will be recommend for short distance transmission for the following reasons:

- Low power consumption of 1/4 approx. comparatively with present PDH type 34 Mbps system (400 W approx.)
- Applicable with Mobile Sub-scribers Communication Networks (Cellular Networks)
- Easy installation because of simple system configuration and one small antenna with outdoor unit.
- Easy operation and maintenance owing to separated design by indoor unit and outdoor unit in the configuration.

2) OFC Transmission Networks

The expansion of OFC transmission networks will consist of the following five-(5) items:

a) To consider to ETL/Phase-2, 3 and GMS-OFC route plan
b) To expand to all districts and villages that needs a telecommunication service as realization of universal access up to 2015.
c) To provide a redundancy network in the case of trouble at main network.
d) To install high reliable OFC cable with bigger transmission capacity
e) Easy maintenance and operation

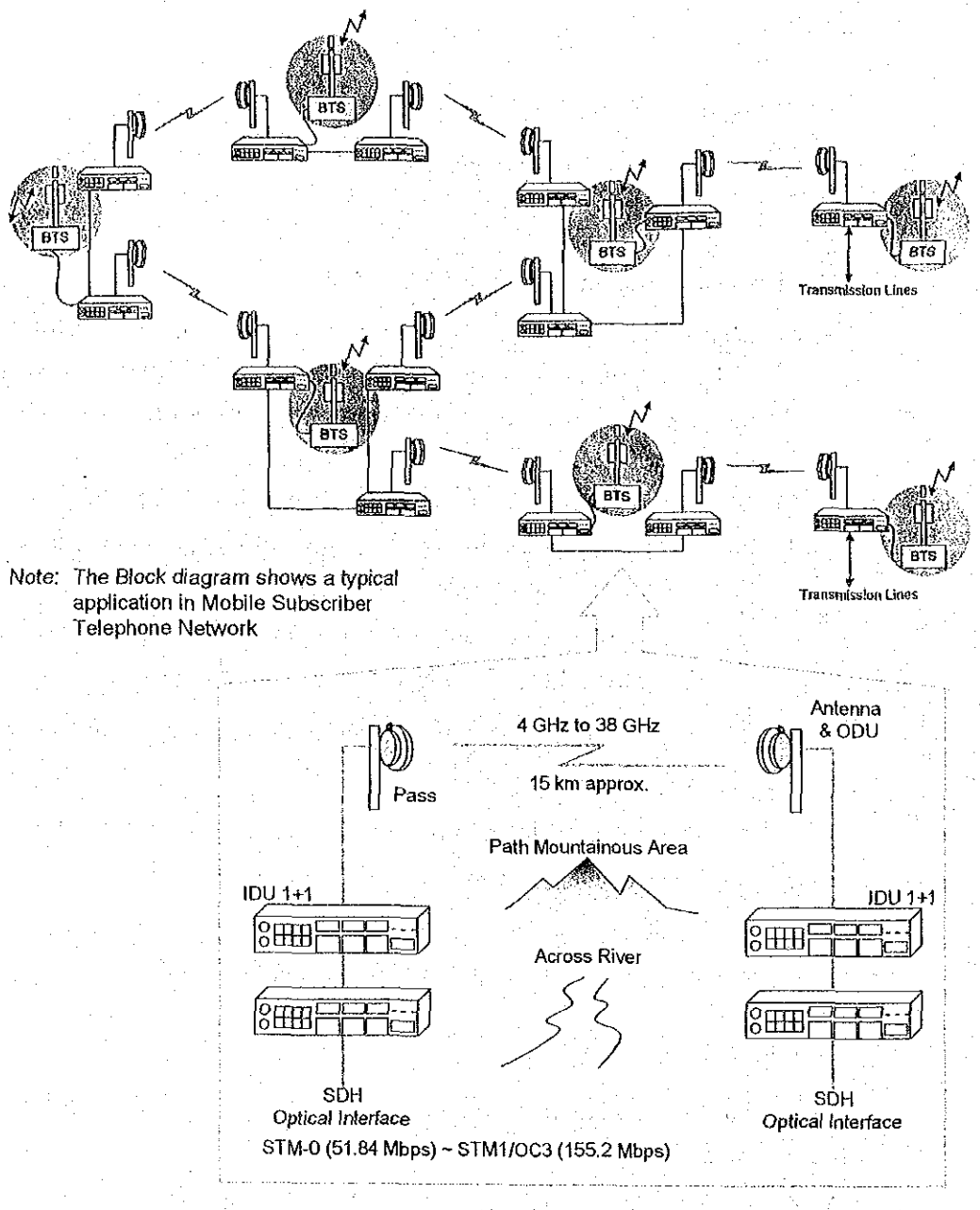


Fig. 7.29 System Diagram of SDH Personal Microwave Link

To achieve the goods stated above, the target period which is divided into 3 phases found at the bellow:-

Table 7.13 Expanding Target of Transmission Networks and Capacities

	2004 - 2005	2006 - 2010	2011 - 2015
Target	To access areas for Vientiane Mun and P. Vientiane, other major districts along with Route 13 (Fig. 7.30).	To access area especially for major and others districts along with national roads (Fig. 7.31).	To access service areas especially for the remote districts and villages (Fig. 7.32).
Development	• To install distance up to 2,362 km approx. • Capacity of OFC: Refer to Table 7.14	• To install distance up to 904 km approx. • Capacity of OFC: Refer to Table 7.14	• To install distance up to 2,973 km approx. • Capacity of OFC: Refer to Table 7.14

(2) Considerable OFC transmission networks design to each route is as follows.

a) Buried cable is recommended, especially in the mountainous area, so that disconnection of the cable will be reduced.

b) Installation of backup networks of main routes is recommended if national road condition will be reconstructed up to 2015.

e) Provision of the network managing system is recommended for stable operation and easy maintenance.

7.4.5.1 Synchronization Network Plan

(1) Issue and Problem for Present Synchronization Network

There are no synchronization networks to be provided from master clock oscillator at the present time in Lao P.D.R..

(2) Development Target

1) Requirement

The configuration of each digital transmission network and switching system has a synchronized clock pulse signaling throughout Lao P.D.R. The master clock is capable of providing synchronization to individual plesiochronous clocks in Vientiane to 2005 and 2010 in other provinces.

2) Digital transmission networks and digital switching systems are operated independently by plesiochronous clocks. Usually, the time accuracy of plesiochronous clocks generated by individual plesiochronous clocks is not accurate enough. In this case, communications quality will be

influenced due to mutual timing errors, which produces frequency slip problems on the telephone, data and ICT communications networks.

Therefore, a synchronization network should be provided for existing digital transmission networks and switching systems and other related facilities. The synchronization network development plan is considered as follows:

(a) Synchronization network

The synchronization network consists of the master clock, individual slave clocks and clock pulse signal distributes. A master clock station should be used by the existing rubidium clock oscillator of the switching system (model F-150) installed in the 1995 at the Numphou main station in Vientiane and should be connected with all digital transmission network and digital switching systems.

(b) Master Clock Oscillator

This master station (master clock oscillator) generates a highly accurate clock signal. Its clock pulse signal is distributed to sub-master stations (slaving) through the networks as shown in Fig. 7.33.

The other sub-stations (slaving) will regenerate clock pulse signal, synchronized with the master clock pulse signal and will provide a tributary clock pulse signal up to the clock end stations in terminal regions.

(c) Phase Variation

As the clock stations receive signals from the standard clock, the deviation accumulates in a long term. In order to comply with ITU-T G Recommendations, the clock paths from the master clock to the clock stations have to be designed in a way not to exceed to deviation over 10 micro seconds.

Table 7.14 OFC Transmission Networks

P/J No.	Cable Section of the Route	Project Plan of 2004		Project Plan of 2005		Method of Cable Installation
		Distance approx. (km)	Recommended System Capacity	Distance approx. (km)	Recommended System Capacity	
1.	M. Pakse to M. Saravane	108	STM-16			(1), (2)
2.	M. Pakse to M. Samakkhixay	216	STM-4			(1)
3.	M. Pakse to Cambodia border via Khong	108	STM-4			- ditto -
4.	M. Thakhek to Xeno via M. Nongbok & Xaybuly			100	STM-16	(1)
5.	M. Phoukhoune to M. Xamneua			180	Phu.Samphtan STM-16	(1), (2)
				63	Samphton ~ M.ET STM-4	
6.	M. Luangprabang to M. Xay	207	STM-16			- ditto -
7.	M. Xay to M. Luangnamtha	108	STM-16			- ditto -
8.	M. Xay to M. Phongsaly			162	STM-4	- ditto -
9.	Sylom (KM21) to M. Phoukhoune	108	STM-4			- ditto -
10.	M. Xaysomboun to Vangvieng2			108	STM-4	- ditto -
11.	M. Luangnamtha to M. Huoixai			153	STM-4	- ditto -
12.	M. Luangprabang to M. Xayabury	594	STM-4			- ditto -
13.	M. Luangnamtha to M. Long via M. Sing			72	STM-4	- ditto -
14.	M. Khanthabouly to M. Xonbuly via M. Champhone			75	STM-4	- ditto -
	Total	1,449		913		

P/J No.	Cable Section of the Route	Project Plan of 2010		Project Plan of 2015		Type of Cable Installation
		Distance approx. (km)	Recommended System Capacity	Distance approx. (km)	Recommended System Capacity	
1.	M. Thathoom to M. Toomlam			647	STM-16	(1), (2)
2.	Phusongcha to Phu Samphtan	180	STM-16			- ditto -
3.	M. Xaysomboun to M. Thathom	80		40	JC point STM-4	- ditto -
				40	JC point to M.Thathom STM-16	
4.	M. Feuang to M. Met		STM-4	50		- ditto -
5.	M. Saravane to M. Samuoi	108	STM-4			- ditto -
6.	M. Pakse to M. Phonthong	54	STM-4			(1)
7.	M. Xay to M. Houayxay via M. Ngeun			315	STM-4	(1), (2)
8.	M. Beng to M. Nga			45	STM-1 or less	- ditto -
9.	M. Huoixai to Tonpheung			45	STM-1 or less	- ditto -
10.	M.Viengphoukha to M. Nalae			45	STM-1 or less	- ditto -
11.	M. Paktha to M. Pha oudom			45	STM-1 or less	- ditto -
12.	M. Long to M. Meung			45	STM-1or less	- ditto -
13.	M. Phongsaly to China border via M. Nhot ou			108	STM-4	- ditto -
14.	Houngteng to M. May			72	STM-4	- ditto -
15.	M. Khua to M. Samphanh			45	STM-1 or less	- ditto -
16.	M. Hongsa to Phu Tathao			45	STM-4	- ditto -
17.	M. Chomphet to M. Ngeun			135	STM-4	- ditto -
18.	M. Xaybury to M. Botene via M. Parklai			180	STM-4	- ditto -
19.	M. Xanakharm to Sylom (KM21)			198	STM-4	- ditto -
20.	M. Hinheup to M. Viangkham			90	STM-1 or less	- ditto -
21.	M. Paklai to Xanakharm			36	STM-1 or less	- ditto -
22.	M. Park ou to Pak xeng via M. Phonxay			54	STM-1 or less	- ditto -
23.	Xamneua to Vietnam border via M. Et	108			STM-4	- ditto -
24.	M. Xamneua to M. Xamtay			108	STM-1 or less	- ditto -
25.	M. Kham to M. Nonghed			45	STM-4	- ditto -
26.	M. Pek to M. Xaysomboun via Phun	90			STM-1 or less	- ditto -
27.	M. Thathom to M. Morkmay			27	STM-1 or less	- ditto -
28.	M. Xaysomboun to M. Longsane	45			STM-1 or less	- ditto -
29.	M. Pakxanh to M. Bolikhanh	27			STM-1 or less	- ditto -
30.	M. Thakhek to M. Mahaxay	45	STM-16			(1), (2)
31.	M. Mahaxy to Vietnam border			135	STM-4	- ditto -
32.	M. Xaybuathong to M. Bualapha			54	STM-1 or less	- ditto -
33.	M. Atsaphangthong to M. Atsaphone	27			STM-1 or less	- ditto -
34.	M. Khanthabouly to M. Xayphoothong	50			STM-1 or less	- ditto -
35.	M. Lakhonepheng to M. Thapangthong			54	STM-1 or less	- ditto -
36.	M. Samuoi to M. Nong	63			STM-1 or less	- ditto -
37.	M. Saravane to M. Kgrum			45	STM-1 or less	- ditto -
38.	M. Khongxedone to M. Vapy	27			STM-1 or less	- ditto -
39.	M. Lamarm to Vietnam border via M. Dakcheung			90	STM-4	- ditto -
40.	M. Samakkhixay to Combodia border via M. Xaysetha			90	STM-4	- ditto -
41.	M. Parklai to M. Thongmixai			45	STM-1 or less	- ditto -
42.	M. Saravane to M. Toomlam	50			STM-16	- ditto -
43.	M. Pek to Junction point of Route 1/5			50	STM-16	- ditto -
	Total	904		2,973		

(Note): (1) Overhead by pole
(2) Buried cable

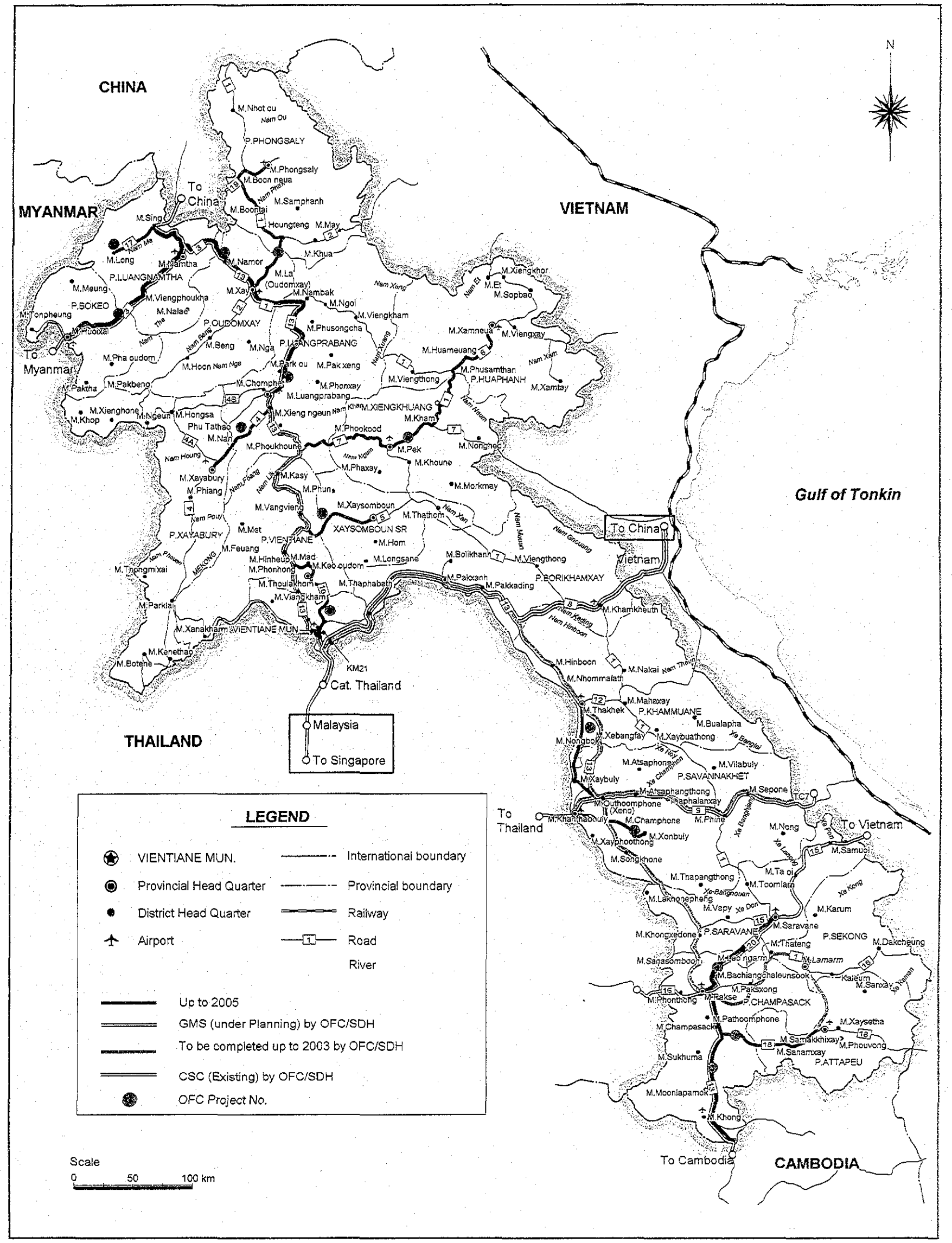


Fig. 7.30 OFC Transmission Network (2004 - 2005)

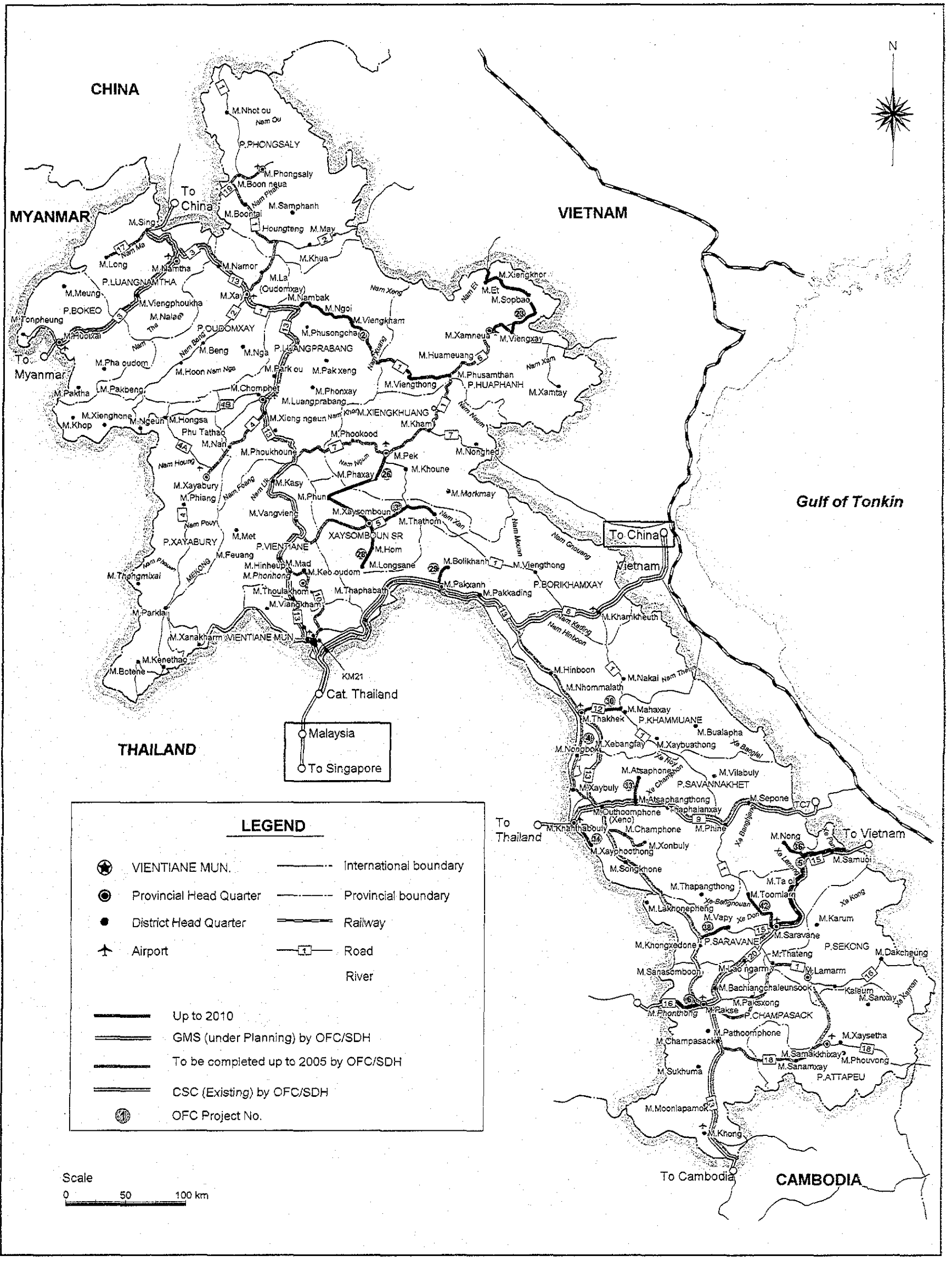


Fig. 7.31 OFC Transmission Network (up to 2010)

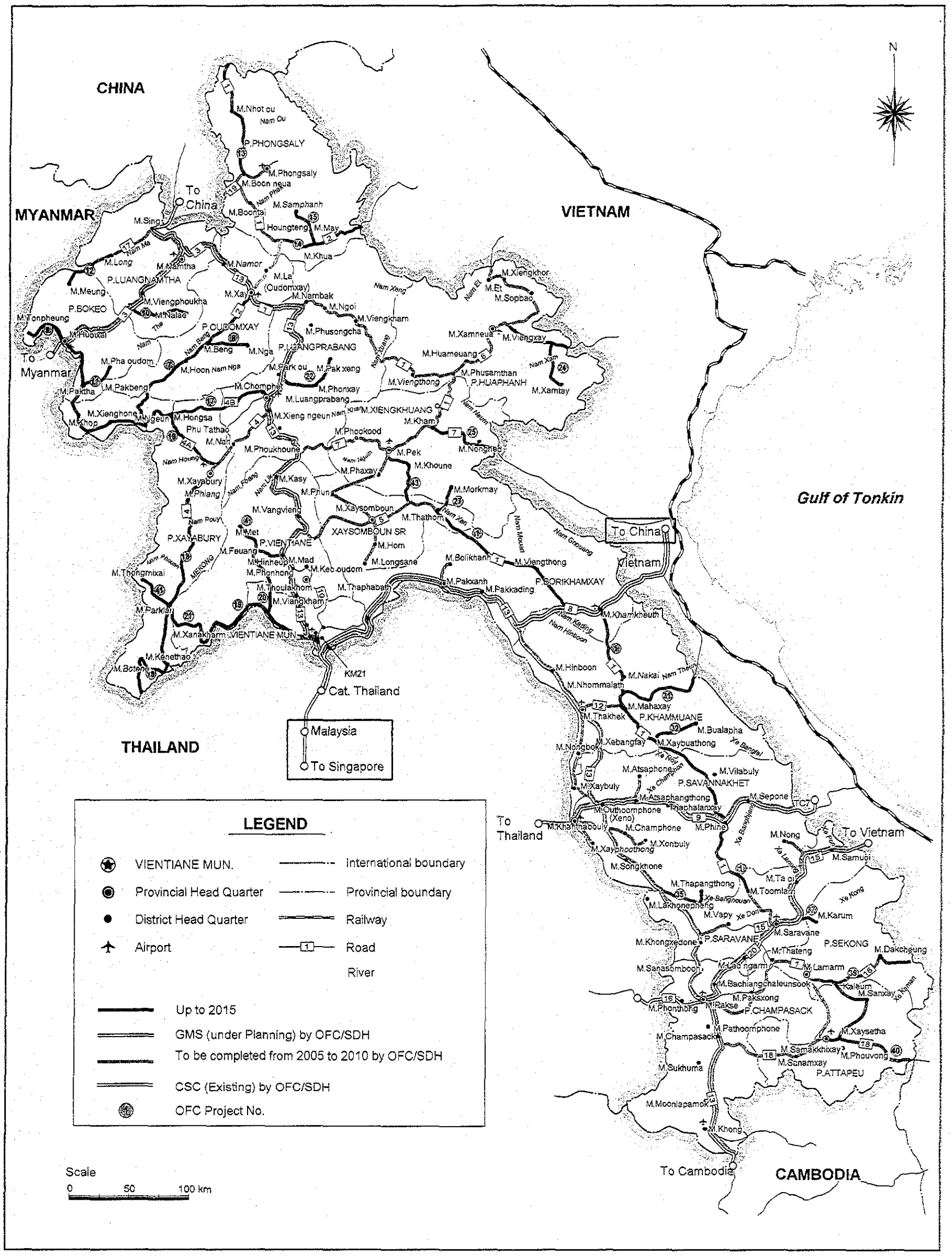


Fig. 7.32 OFC Transmission Network (up to 2015)

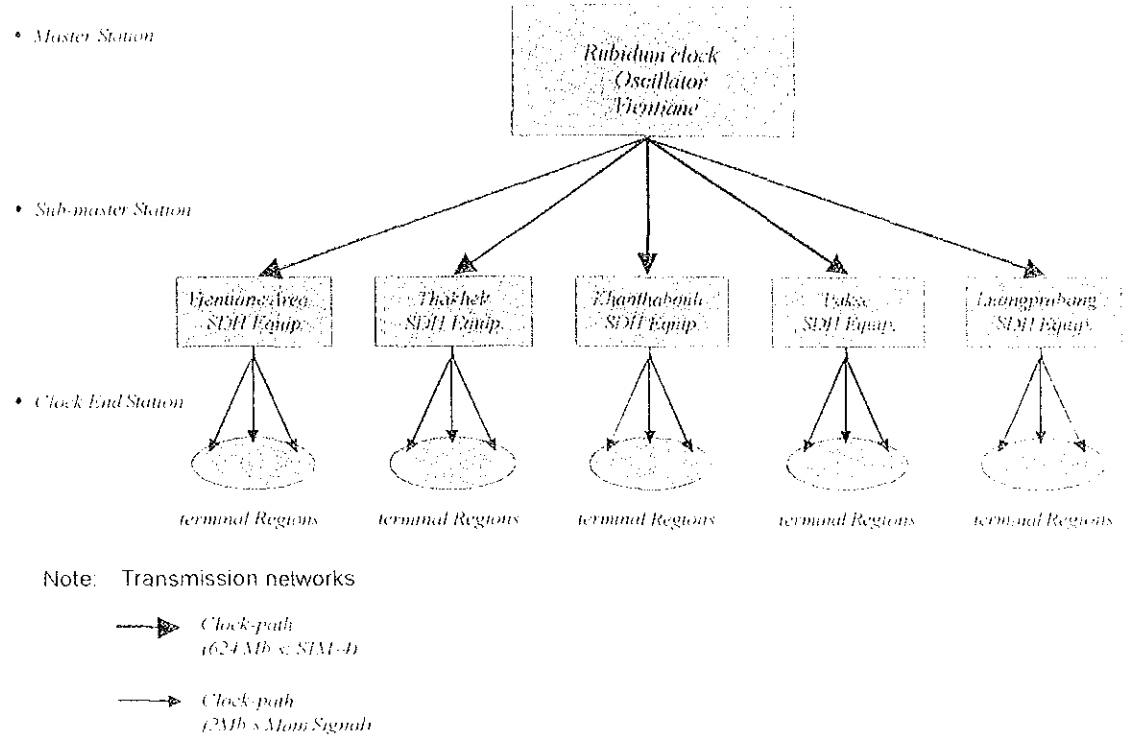


Fig. 7.33 Configuration of Interprovincial Synchronization Network Plan (Reference only)

(3) Proposal of Inner City Link in Vientiane

As Vientiane is the center of politic and economic activity, the information traffic will flow from/to Vientiane concentrated.

The Study Team would like to propose Optical Inner City Link Network in Vientiane that shall be combined with existing Optical Inner City Link. Refer to Fig. 7.34.

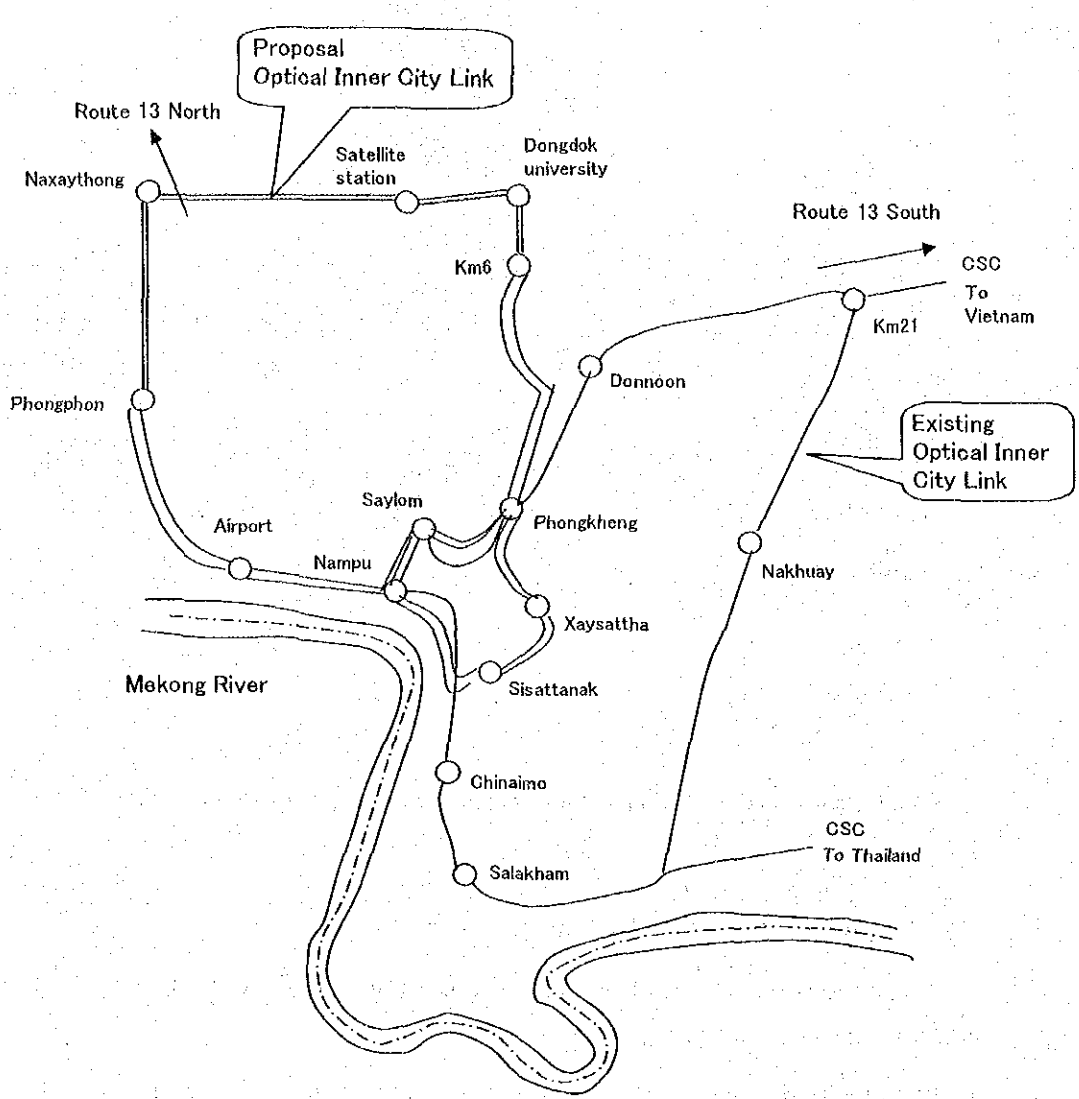


Fig. 7.34 Optical Inner City Link - Proposal and Existing Network

7.4.6 Outside Plant Planning

(1) Primary Cable Capacity

The following Table shows required number of primary cable pairs which should be installed in Lao until programmed years 2005, 2010 and 2015.

The Study Team adopted the average standard rule to multiply 1.4 times of Planned Switching System Capacity for primary cable.

This ratio 1.4 usually are considered to cover dividing loss of cables in connection with distribution cables to be set for different direction and spare pairs required for maintenance.

Table 7.15 Primary Cable Capacity

Vientiane and other cities		**Existing Capacity**	**2005**		**2010**		**2015**		**Increased ratio at 2015 year**
			Increase		Increase		Increase		
Vientiane Area (Municipality & Province)	SW Capacity	34,321	25,848	60,169	100,600	160,769	74,850	235,619	
	OSP Capacity	47,000	37,273	84,273	140,840	225,077	104,790	329,867	7.02
Big City & its' Suburban Area (Savannakhet,Pakse,Thakhek,Paxan,Luangprabang)	SW Capacity	16,340	16,712	33,052	59,250	92,302	48,280	140,582	
	OSP Capacity	17,900	28,373	46,273	82,950	129,223	67,592	196,815	10.99
Other Provinces	SW Capacity	8,684	2,892	11,576	15,540	27116	35,420	62,536	
	OSP Capacity	12,158,	4,049	16,207	21,756	37,963	49,586	87,551	7.2
Total	SW Capacity	59,345	45,452	104,797	175,390	280,187	158,550	438,737	
	OSP Capacity	77,058	69,695	146,717	245,546	392,263	221,968	614,233	7.99

Source: Study Team

N.B. The above figures include pairs for ADSL demand in the country as follows;

Year	2005	2010	2015
ADSL	750	1,200	2,100

(2) Distribution Cable Capacity

1) Year 2005

Thinking of efficient use of finance under very limited resources to be allocated for telecommunications, the Study Team should like to recommend concentration of efforts for rehabilitation of Vientiane Cable Networks.

Because of characteristic of rehabilitation works, the Study Team would suggest to use multiply ratio: 1.2 in place of standard 1.4 for the sake of aiming at full use of distribution cable pairs to save money. (Existing cables were laid out with equal 1.0 ratio without any spares.)

Ratio 1.2 shall be set for the purpose of preserving maintenance spare cables and to cover loss of fluctuation of demand by the district at a minimum level.

2) Year 2010

After completion of rehabilitation works of cable networks in Vientiane in the year 2005, there shall still remain difficult rehabilitation works of cable networks in the remaining local cities and towns in Lao most probably.

All the efforts of rehabilitation works should be concentrated for recovery of quality of service and connection of new subscribers in the remaining cities and towns from the period of 2005 up to 2010 with full and efficient use of any and every possible finance available to the purpose.

The Study Team should like to recommend the same multiply ratio of 1.2 between primary cable and secondary distribution cables under the same intention as explained in the case of Vientiane.

3) Year 2015

The Study Team esteems that the period between the year 2010 to 2015 shall be the final stage of the program to catch up with the average standard level of countries by maintaining quality of service.

Telecommunications systems are connected on the global scale. Quality of Service should be maintained on the equal level in the end of this program.

Cable allowance of primary cables between switching systems should maintain standard 1.4 multiply ratio in the year 2015.

Also, distribution cables throughout the country should recover 1.4 multiply ratio as standard at the year 2015.

At the same time, the Study Team should like to suggest that metallic and optical cable systems are presently looked upon as the most stable and standard systems of the world under the situation.

But the Study Team forecast that there shall be many technical innovation to break through conservative cable systems during the time span until year 2015 probably by some versatile radio systems of brand new era though the Study Team have WLL and radio LAN systems with limited use and limited cost efficiency.

The figures shall not be changed by the progress but hardware shall have every possibility of being transferred.

7.4.7 IP Network Planning

7.4.7.1 Current Status of IP Network

(1) Current ISP has independently owned their backbone network and connections to the foreign country is different. For example, e-mails from Laotel to Planet are transferred via foreign IX (internet exchange) or ISPs.

(2) At present, access lines to the ISPs are mainly by dial-up. However, LTC limits the number of terminating circuit because a dial-up line is used only for the termination and LTC is paid only monthly fee. (They insist that they are loosing opportunity by utilizing the circuits only for terminating calls not receiving fee for originating calls.)

(3) Promoting ICT, each ministry installs dial-up servers and access servers individually and separately though those servers are possible to share. This is because the leadership of MCTPC is not sufficient to persuade them to unify.

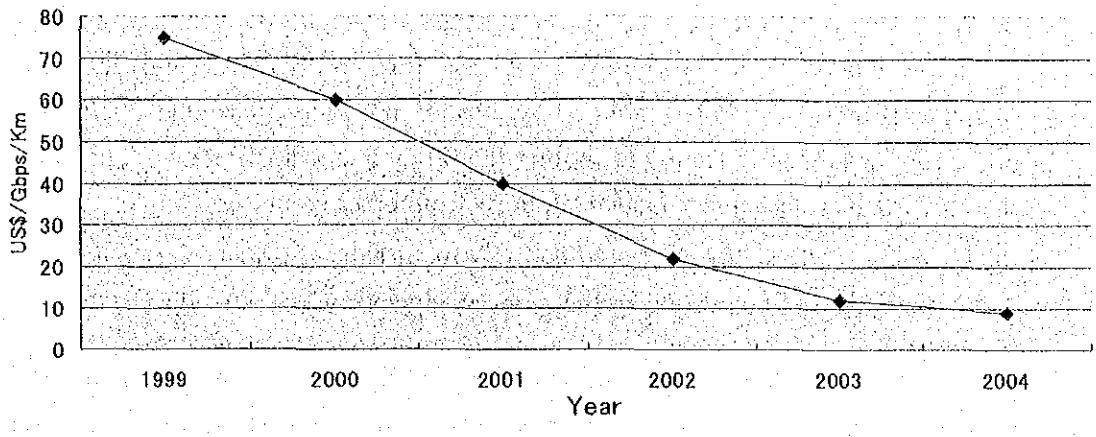
(4) Also, the increase of telecommunication line is necessary to catch the need for accessing the IP network in whole country anywhere else.

7.4.7.2 Direction for the Future

(1) IP network should be developed not only for providing the Internet access services, but also for introducing efficiently ICT applications planned for future Lao P.D.R.. MCTPC should collect and unify all opinions about the telecommunication infrastructure for ICT from ministries, and should actively develop IP services and invest necessary equipment.

(2) A termination occurring in the circuit of the Switching System means that the originating caller exists and telecommunication provider gets earned from the caller. Telecommunication provider should invest necessary circuits for terminating dialup calls, when ISP requests. In other words, because a connection is completed by both originating and terminating, it is not correct to limit a number of lines when the line is used only for terminating dial-up calls. Also, if the telecommunication provider worries about the congestion caused by such terminating calls, the provider should disperse in the different exchanges.

(3) The price of the equipment that configures next generation IP network will fall down its price by rapid technology improvement. The Fig. 7.35 shows that the decrease cost of Gbps/Km. Because of this, it is desirable to make use of such equipment actively.

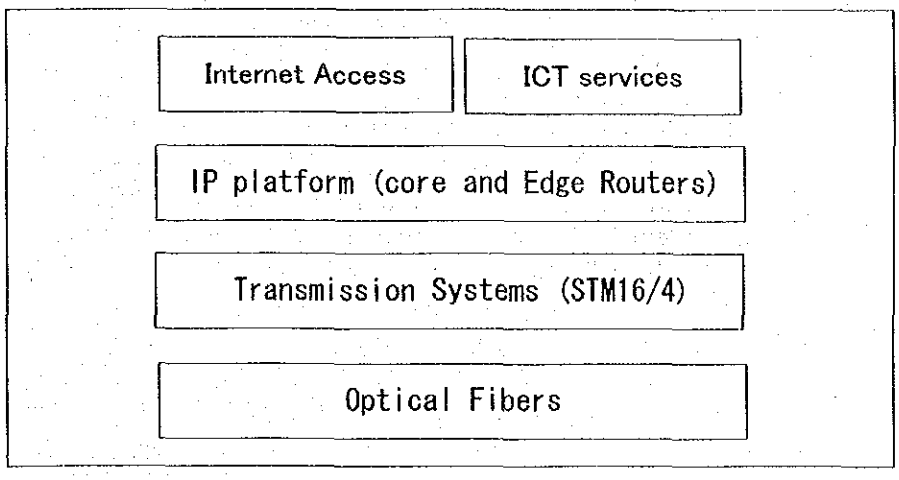


Source: IP Core Network Analyst, 2001June

Fig. 7.35 A rapid cost down of current equipment

(4) It is urgently important to develop the general-purpose IP network that enables various types of ICT services together with accessing the Internet in order to accelerate ICT service. MCTPC should adjust the requirements of each ministry, and it leads the development of unified infrastructure for the future as soon as possible.

The network consists from fiver optics, transmission systems with the large capacity and IP platform such as routers. Internet access and ICT services are efficiently provided over the IP platform that is layered shown in Fig. 7.36.



Source: JICA Study Team

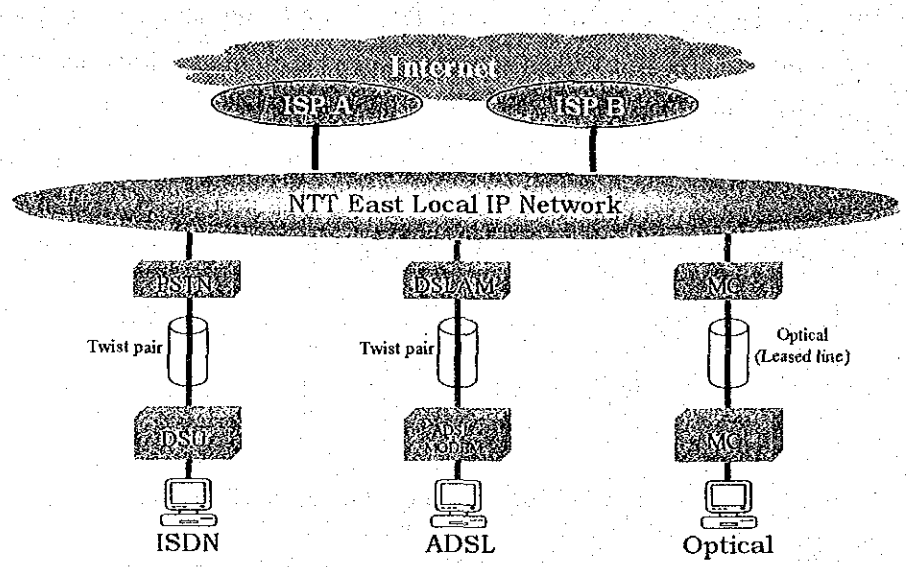
Fig. 7.36 Layered platform

For the development of the IP network effectively, efficiently, and rapidly, it is desirable that ETL executes the development as a leader. Developing a single complete IP network, it is necessary for a large fund to invest successively. Also, common IP network is preferable to avoid multiple incomplete and overlapped infrastructures for ICT. Timing is another important factor for IP network to match the growing ICT need and financial supports from other countries.

(5) However, ETL should provide this infrastructure the reasonable price not only to the ministries but also to the network service providers as well.

The Study Team shows that IP infrastructure by NTT East as an example. NTT East is providing the IP infrastructure for ISPs and companies to access to their destination ISPs. Japanese ADSL providers and ISPs can provide their services by utilizing IP infrastructure supplied by NTT East without any additional routers or leased lines.

ETL is wished to provide the IP network which is available for such commonness, too. The outline of this network is shown in the Fig. 7.37.



Note: NTT provides access ports to the ISPs at the all NTT offices

Source; NTT EAST

Fig. 7.37 Common IP Network Infrastructure

7.4.7.3 IP Infrastructure for Lao P.D.R.

(1) The necessity of the IP infrastructure and problem caused by the VoIP

The world shifts from the existing TDMA circuit exchange to the IP packet based infrastructure. Telecommunication technology is also shifting from the existing digital switch to assured bandwidth for each user to the IP packet switch utilizing the bandwidth with the delay.

The IP infrastructure is strongly supported and believed the possible next generation network for the future around the world. The IP infrastructure is also important because it is available as an infrastructure of ICT.

Therefore, the Study Team assumes that the IP infrastructure and the Internet should actively carried out under the strong government leadership from the early beginning because the network for the ICT should be carried out by the government in Lao P.D.R.. On the contrary, it may sound ironical that IP infrastructure can be used as the next generation voice communication with VoIP.

At present, a bargain international telephone call utilizing VoIP is provided in the Internet cafe of Vientiane. VoIP's poor quality at present is from the limitation of the bandwidth of the connection lines to the Internet. However, it is a matter of course, VoIP is increasing in Lao P.D.R.. Therefore, it is said that whenever the speed of the Internet is improved, VoIP would not be replaced the existing telephone environment at one time.

The telecommunication providers in Lao P.D.R. or MCTPC afraid of the VoIP and regulate the Internet, it consequently causes the delay of the introduction of the Internet. Ironically, it cannot be avoided that the use of telephone decreases gradually over a long period of time while the IP infrastructure develops. The Study team recommends that VoIP should be developed to utilize for the development of telecommunication as a whole.

ETL began an experiment of VoIP in 2001 to connect with the Thai expecting a cheaper telephony service. As for the application of VoIP for the toll calls, a connection with the existent telephone network is not difficult to realize.

AT&T Jens, the subsidiary company of AT&T in Japan, applied VoIP to the international telephone calls between Japan and the United States in 1997. There was no problem in the communication quality as well, and many competitors followed to use VoIP for long distance calls, and price destruction was started.

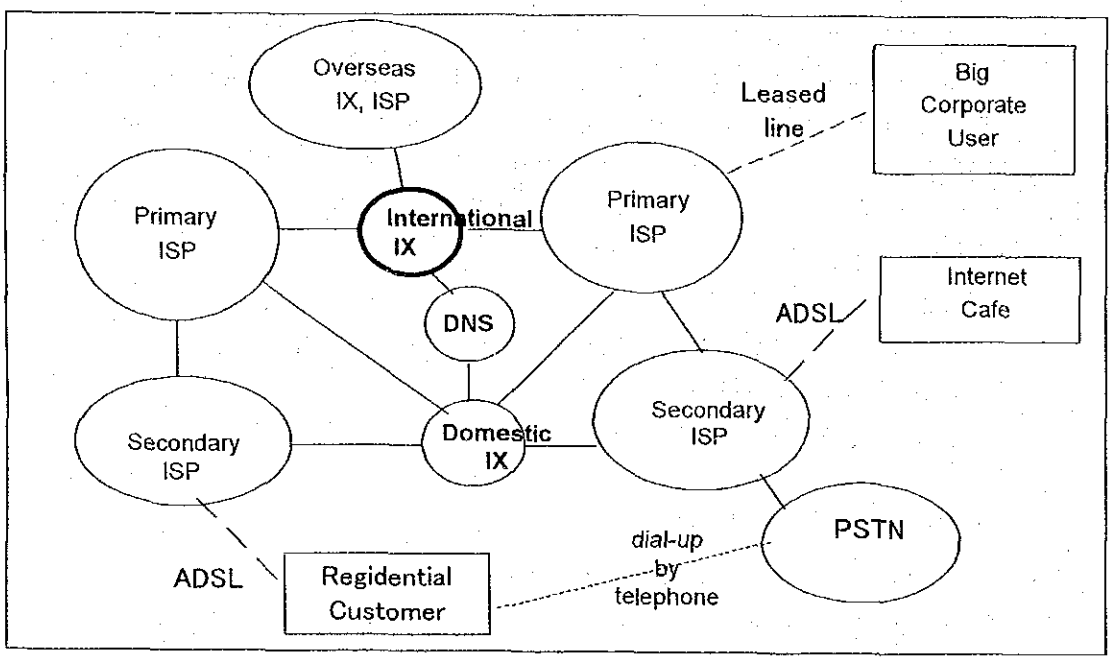
In the conclusion, as in the country which IP infrastructure has been developed proceeds VoIP actively as the lowering telephone service price. It is desirable to adopt VoIP in Lao P.D.R. actively and to keep a balance with the development of the existent telephone services from now on.

(2) Necessity of IX (Internet Exchange) and DNS

IX is the inter-exchange point of the interface for interconnecting ISPs. Interconnecting ISPs are necessary for communication between different ISPs when data has to be exchanged. An IX is required to provide a high-speed interconnection when interconnect two ISPs. Not only high-speed routing, but also high-speed switching and high-speed backbone circuits are necessary.

International IX will be necessary to show the inter-connecting point with the foreign ISPs. In Lao P.D.R., there is no international IX nor official DNS which represent Lao in the internet world. The team recommends that IX together with official DNS should be in service as soon as possible.

Some example of IX and DNS is shown in Fig. 7.38 where showing domestic IX and international IX. Also, two types of ISPs are shown to present primary and secondary ISPs. The direct connection with IXs exists for the difference.



Source: JICA Study Team

Fig. 7.38 IX, DNS and ISPs

(3) Inter connection with the IP network and the PSTN.

The IP network will be integrated with the PSTN in chapter 7.1. An interconnection with the IP network and the PSTN is necessary to communicate with each other. In the chapter, it is stated that the IP network should be prepared and expanded to meet the actual IP demand for the time being. Also, it is stated that it should be integrated after reaching to a certain scale, this is partly because

the demand for IP is rather small than telephone demand. Dropping the equipment cost rapidly is also another reason.

Thus the interconnection with IP network is necessary.

Therefore, VoIP(Voice over IP network) calls are characterized by three types. VoIP calls are carried within the same network, a VoIP call is forwarded to the PSTN and some toll calls originated in PSTN once forward to VoIP transit network further forward back to PSTN. For VoIP calls originated in the IP network and forwarded to the PSTN, the interconnection is necessary.

For the former case, it is up to various ISPs and the telecommunication providers. On the other hand, for the second case interconnection with PSTN utilizes Enum (E-numbering). Enum is standardized by ITU to interchange the numbers between IP address and telephone numbers. As VoIP protocol is still underdevelopment, during 2002-2003, the Study Team recommends that operators should wait for the completion of standardization for implementation.

For the interconnection, two kinds of devices are necessary between the existing PSTN and the IP network. The signaling gateway which exchanges telephone number information and status of the callers (such as line busy) and media gateway that changes a voice signal to IP packets are necessary. Refer to the chapter of ICT for the details.

(4) About the development plan of the IP network

Backbone should be prepared immediately with utilizing ETL development plan. This is the beginning of the IP infrastructure in Lao P.D.R..

1) IP infrastructure should be prepared in 2003 with utilizing city link (city loop).

IX and DNS that make the domain name "la" active should be provided to enhance the Internet infrastructure as soon as possible.

High-speed IP access services such as ADSL or wireless access services should be provided in the center by 2005. Also, the dialup access for ordinal users is important to increase the number of people who utilize the Internet services.

High-speed IP access services should be gradually expanded toward 2015 from the city center to the urban areas where high schools, vocational schools, public spaces exist.

2) IP network in the metropolitan areas network are introduced in 2005. This is because those major cities are the key cities for the development of ICT.

3) Other province center cities

The IP network infrastructure is necessary as well, at least one dialup access point in each province center so that everyone in each province can access the Internet of ICT application. It is because reduction of the differences in access between the cities should be minimized. And, there will be some provinces where ADSL service is provided in 2015, depending on the possible demand.

First, dialup services are installed in major provinces where optical backbone is completed toward 2010. Afterward, all province centers are going to provide dialup services by 2015.

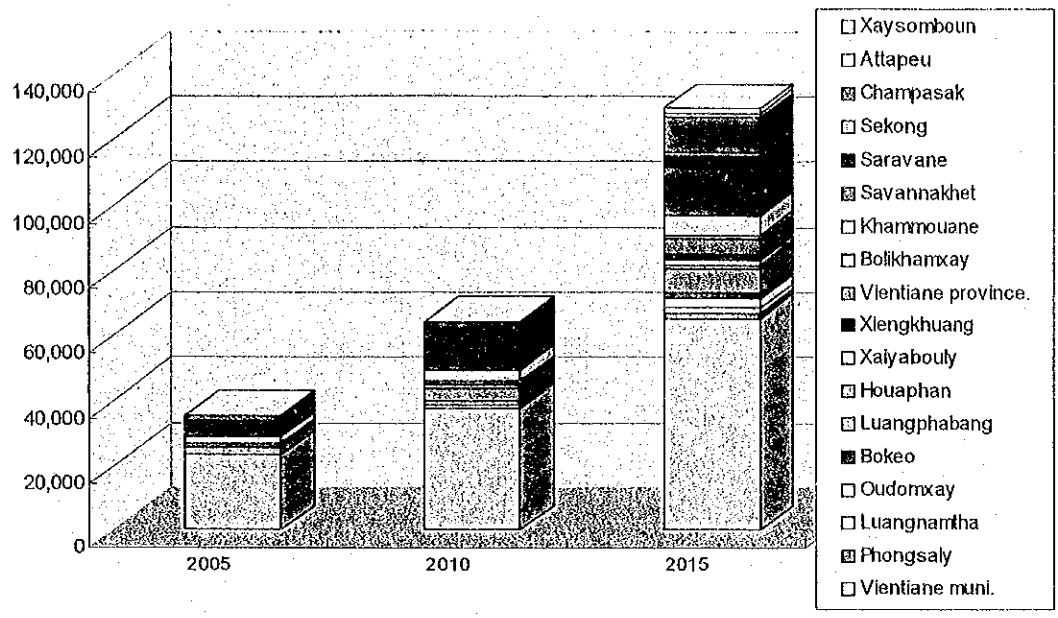
And, from the cost of implementation at 2015, installing routers in every province is not economical and the dialup servers are connected to the nearest province centers where the edge router is installed.

The study team estimated the possible Dial-up ports and the number of ADSL ports installed in the Table 7.16 and based on the demand forecasted in Chapter 4.

Table 7.16 Dial-up ports and the number of ADSL ports installed in each periods

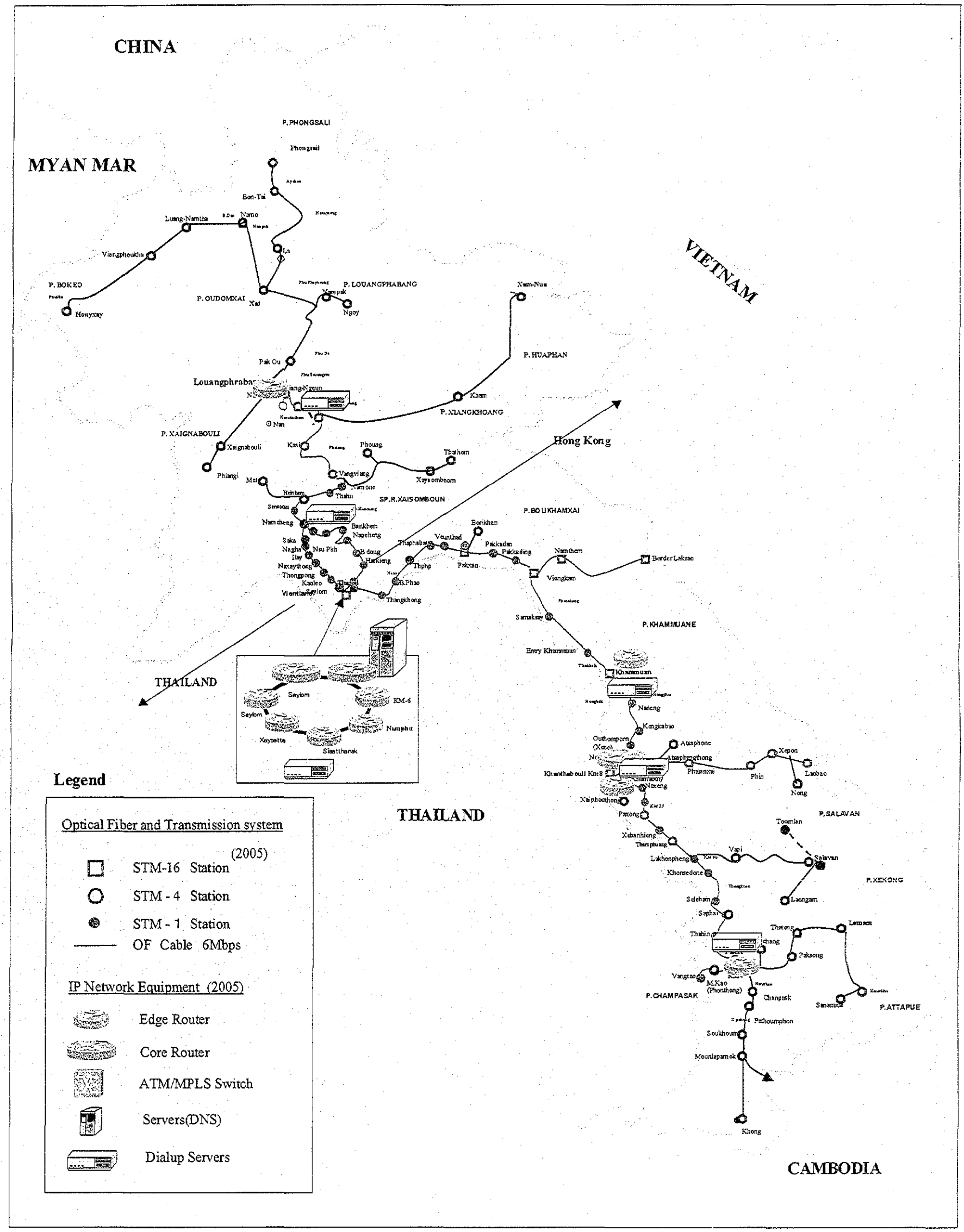
City	Dial-up				ADSL			
	2002	2005	2010	2015	2002	2005	2010	2015
Vientiane muni.	300	1,050	1,550	2,200		500	750	1,100
Phongsaly				50				
Luangnamtha			50	50				50
Oudomxay			50	100				50
Bokeo				50				
Luangphabang	80	100	150	250		50	100	100
Houaphan				50				50
Xaiyabouly			50	50				50
Xiengkhuang				50				50
Vientiane province		50	50	150			50	50
Bolikhamxay				50				
Khammouane		100	150	200		50	50	100
Savannakhet	80	200	300	500		100	150	250
Saravane			50	100				50
Sekong				50				
Champasak		100	250	350		50	100	200
Attapeu				50				
Xaysomboun				50				
Total	460	1,600	2,650	4,350		750	1,200	2,100

Source: JICA Study Team



Source: JICA Study Team

Fig. 7.39 Estimated dial up ports installed



Legend

Optical Fiber and Transmission system (2005)

- STM-16 Station
- STM - 4 Station
- STM - 1 Station
- OF Cable 6Mbps

IP Network Equipment (2005)

- Edge Router
- Core Router
- ATM/MPLS Switch
- Servers(DNS)
- Dialup Servers

Fig. 7.40 IP Network Plan (2005)

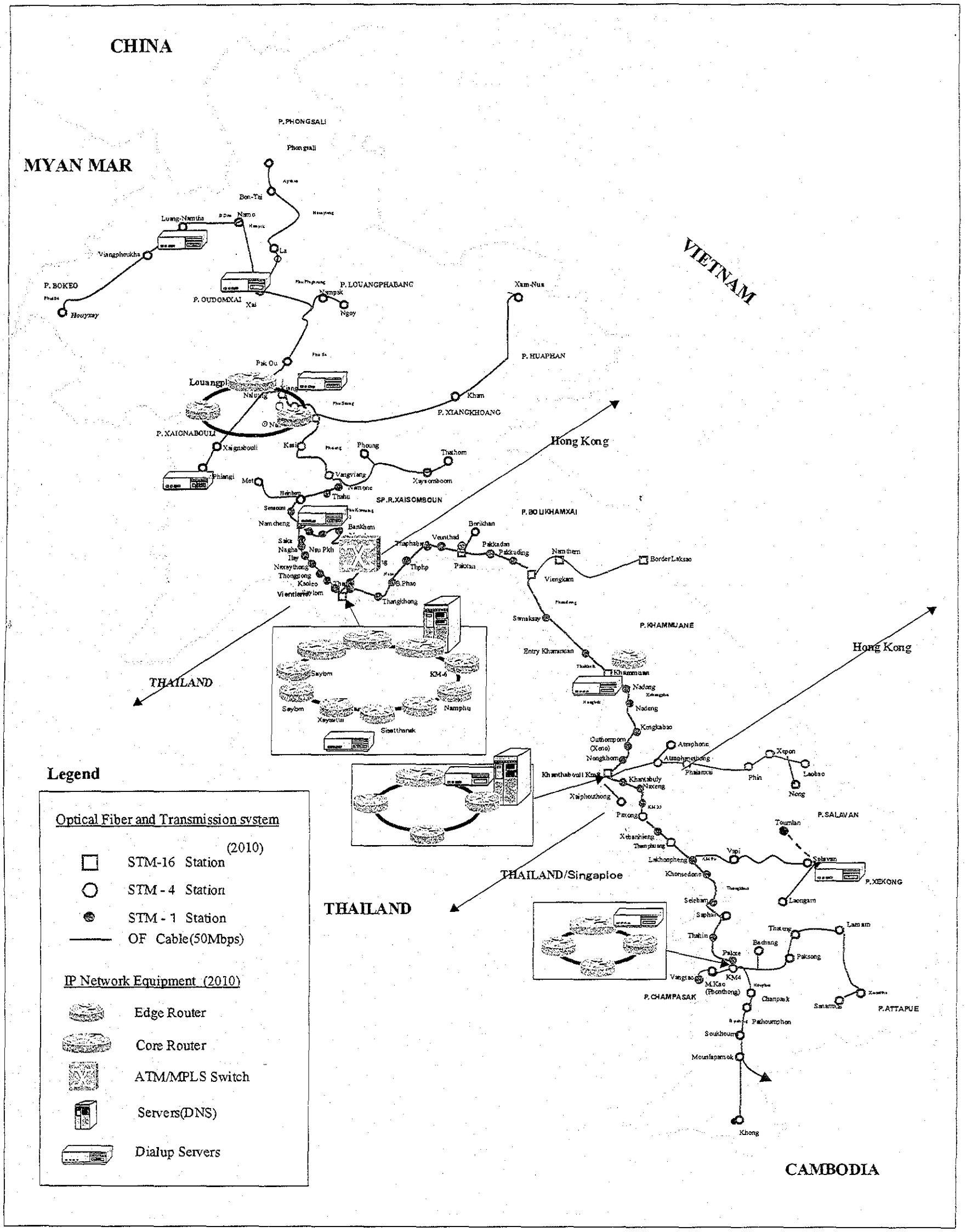


Fig. 7.41 IP Network Plan (2010)

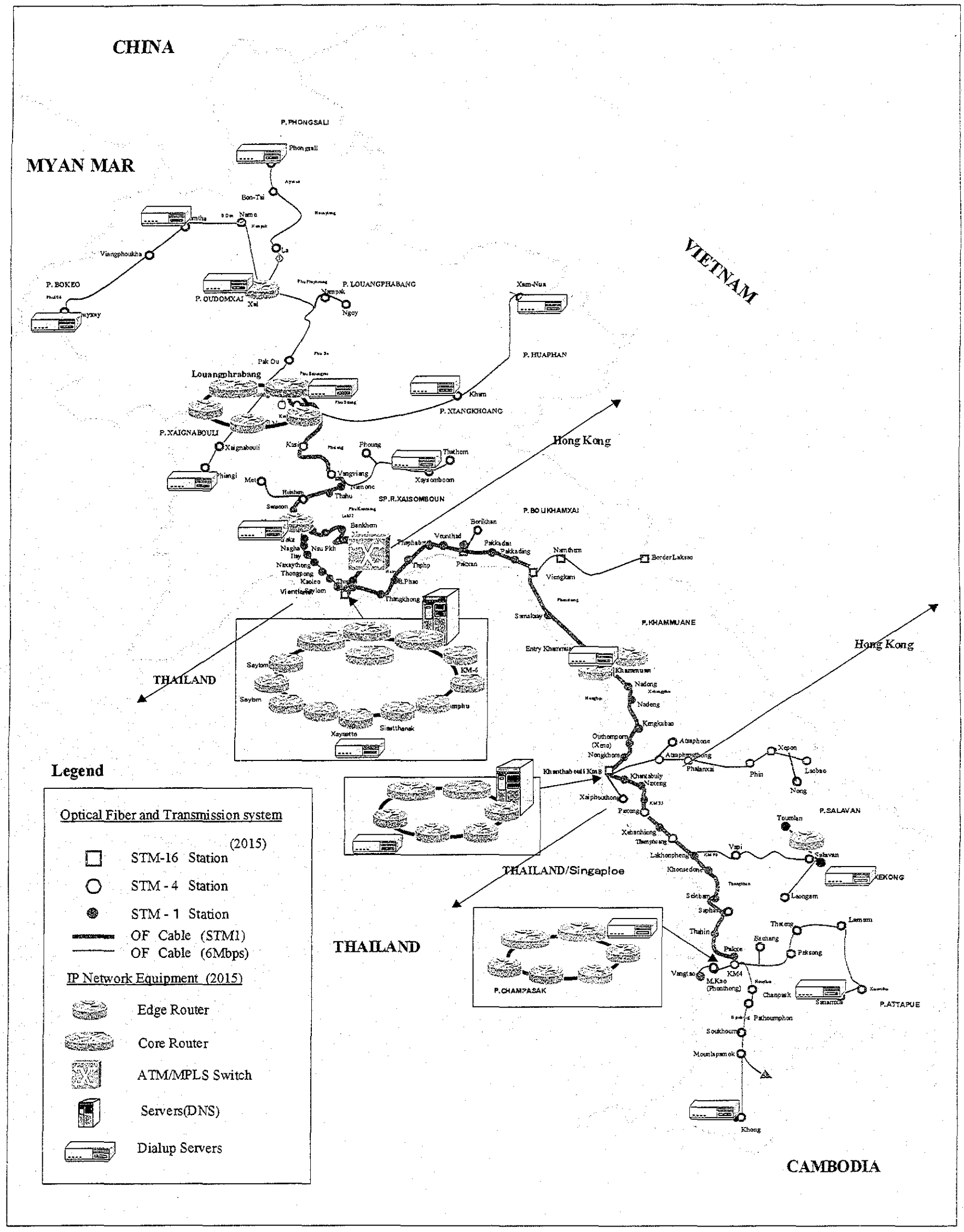
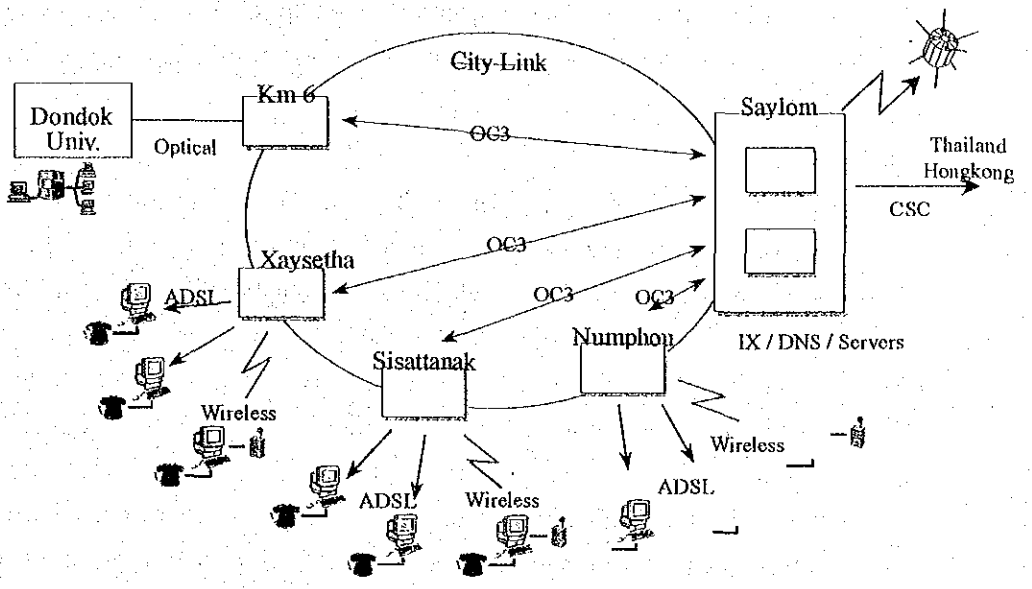


Fig. 7.42 IP Network Plan (2015)

7.4.7.4 IP Network Development Plan for Vientiane

In this section, the introduction of a high speed IP infrastructure for the Lao P.D.R. is outlined. IP services should be provided in a competitive environment, however, this chapter only looks at this from a technological viewpoint and considers the possibilities. The actual installation should be discussed with the regulators and users.



Source: JICA Study Team

Fig. 7.43 Typical IP Network structure for City Link

(1) IP-based Network 2002-2005 (Fig. 7.40)

(a) Limited High-speed IP Access services in Vientiane

IP services should be provided in two ways, namely high-speed access for limited users and dial-up access for the public, in order to improve IP access speed in Vientiane.

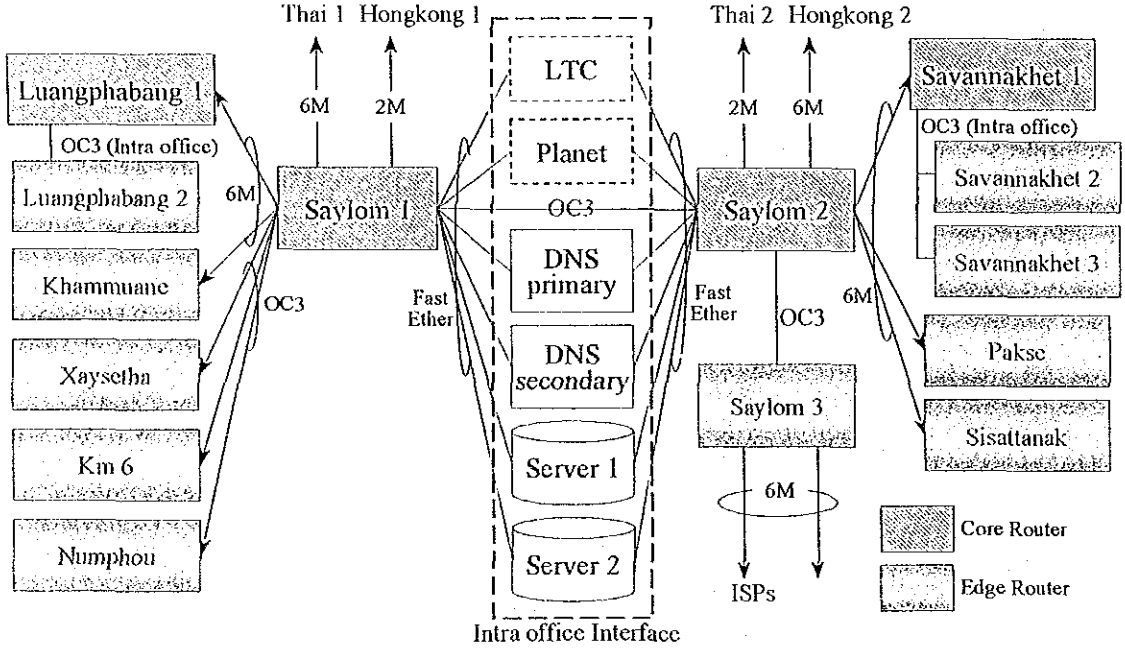
In Vientiane, broadband IP services are provided along with city links. City links consist of SDH equipment and optical fibers. The proposed IP network will provide an OC3 interface to the edge routers which are interconnected to the core routers at the center. Edge routers are located at the telecom offices where SDH equipment or SDH ADM(add drop multiplexer) equipment is located. This is shown in Fig. 7.43.

(b) Wireless and ADSL for early users

Wireless and ADSL can be used to connect users to the edge routers. As there are wireless access limitations and the subscriber loop that can be used, as the access line is limited, these services are only provided in limited areas. Service range of wireless LAN such as IEEE 802.11b (10Mbps) is limited to several hundred meters. ADSL is able to provide 1.5 Mbps to 8 Mbps should be utilized in most of all the cases when high speed access is necessary. Earliest installation may be done on the new metallic cables in addition.

(c) Introduction of Core and Edge Routers

To start IX and DNS services to the Lao P.D.R., several numbers of edge routers and core routers are introduced during this period. One of the core routers may work as the IX which interconnects ISPs. ISPs may use ADSL or a high-speed wireless link to the edge routers. The core routers in Vientiane are providing IX functions to the whole network together with DNS server. Detail configuration is shown in the Fig. 7.44. Two core routers (Saylom1 and Saylom2) are interconnected with each other and provide international IX functions. Also those core routers are connected to edge routers in City Links and other cities. For the international connections, two links to Thailand and Vietnam are connected to this core router.



Source: JICA Study Team

Fig. 7.44 IP Network structure of 2004-2005

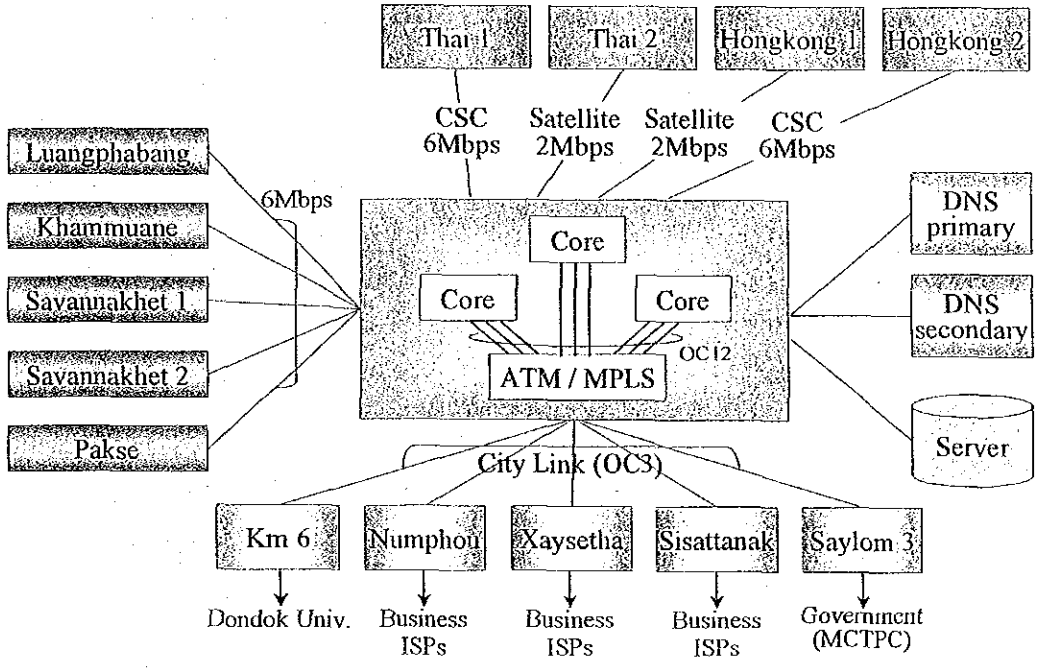
(2) IP-based Network 2006-2010 (Fig. 7.41)

(a) Vientiane

Routers can be used to configure leased lines, but the number of ports in routers is limited and the access speed is over OC3 and hence it is not economical to configure the network only by routers. The Study Team recommends ATM or MPLS that is useful for multiplex leased lines at various speeds shown in Fig. 7.45.

With the widespread introduction of ADSL services in Vientiane, and limited introduction to the major cities, ADSL will become a well-known service for the Internet and will be applied for ICT services. The growing demand for high speed Internet access in Vientiane may cause an increase in the number of core and edge routers. Several core routers are interconnected.

One of the core routers in Savanakhet will work as the secondary IX which interconnects ISPs in Thailand and Vietnam by alternative route.



Source: Study Team

Fig. 7.45 IP Network configured with ATM/MPLS Switch (2006-2010)

(3) IP Network 2011-2015 (Fig. 7.42)

(a) High-speed access in Vientiane

IP and Internet services will become commonplace in Vientiane. The network may be used for many applications and a limited number of users are provided high-speed access through optical fibers. ADSL services are common to ordinal users who need speed higher than 1.5 Mbps. They may utilize ADSL services for voice services.

(b) Wireless and ADSL for all the provinces

Wireless access is provided to users in most of province centers by use of fiber backbone network and edge routers.

7.4.7.5 Necessary facilities for IP infrastructure

IP or the Internet users are increasing rapidly in the Table 7.16. Necessary equipment for providing IP infrastructure is estimated based on the number of possible users and equipment such as SDH transmission installed. One case study is given in the following.

(a) Dial-up

Dial-up access servers are necessary to provide the services. The server is able to provide the 50 users or 50 lines to 5,000 users in a single server. The Study Team introduced one server at one location with 50 users in the planning.

(b) ADSL

For the ADSL access services, DSLAM is required at the stations. One DSLAM can provide services up to 1,000 users. However, from the geographical location and reliability, more than 2 DSLAM reequipped in the Table 7.17.

(c) Edge and Core Routers

Necessary Routers for core and edge are estimated based on the Table 7.16 and 7.6. Note that at lease two core routers are necessary for reliability for IX. One core router is equipped in each province center where necessary. For the IP network interfaces are provided to those areas where no routers are installed, ADSL users and dial-up users are routed to the nearest province centers by utilizing the backbone.

(d) Total Cost for IP network

From the Table 7.17, 7.18, necessary cost is calculated shown in the Table 7.19.

Table 7.17 Estimated numbers of servers necessary

City	Dial-up				ADSL DSLAM			
	2002	2005	2010	2015	2002	2005	2010	2015
Vientiane muni.	2	15	20	50		2	3	4
Phongsaly				1				
Luangnamtha			1	1				1
Oudomxay			1	1				1
Bokeo				1				
Luangphabang	1	1	2	2		1	1	1
Houaphan				1				1
Xaiyabouly			1	1				1
Xiengkhuang				1				1
Vientiane province		1	1	2			1	1
Bolikhamxay				1				
Khammouane		1	1	2		1	1	1
Savannakhet	1	1	2	4		1	1	2
Saravane			1	1				1
Sekong				1				
Champasak		1	2	4		1	1	1
Attapeu				1				
Xaysomboun				1				
Total	4	20	32	76		6	8	16

Source: JICA Study Team

Table 7.18 Estimated numbers of routers necessary

City	Edge Router				Core Router			
	2002	2005	2010	2015	2002	2005	2010	2015
Vientiane muni.		5	7	9		2	3	4
Phongsaly								
Luangnamtha								
Oudomxay				1				
Bokeo								
Luangphabang		1	2	3			1	2
Houaphan								
Xaiyabouly								
Xiengkhuang								
Vientiane province				1				
Bolikhamxay								
Khammouane		1	2	2				
Savannakhet		2	3	4		1	1	2
Saravane				1				
Sekong								
Champasak		1	3	4			1	2
Attapeu								
Xaysomboun								
Total		10	17	25		5	6	10

Source: JICA Study Team

Table 7.19 Estimated cost

Unit US $

Type	2005	2010	2015
Dialup	20,000	120,000	440,000
ADSL	1,125,000	607,500	945,000
Edge Router	870,000	548,100	487,200
Core Router	2,725,000	490,500	1,526,000
Interface	675,000	324,000	378,000
Server	500,000	250,000	1,000,000
MPLS/ATM		1,000,000	
NMS	200,000	200,000	200,000
Sub Total	6,115,000	3,540,100	4,976,200
Installation	611,500	354,000	498,000
Total	6,726,500	3,894,100	5,474,000

Source: JICA Study Team

7.4.8 Other Networks

(1) Mobile Telephone Networks

However, ETL is now in the process of increasing their subscribers capacity in the phase-2 project for approximately 10,000 or more subscribers due to the increasing applications mainly in Vientiane Mun and Vientiane province as shown in Table 7.15.

Those BTS stations will be service to mobile subscribers up to the end of 2003 according to their implementation plan.

Both type of BTS transmitter output power used for LTC and ETL are at 20 Watts approximately in the range of 900 MHz band deviated by 45 MHz between transmitting and receiving frequency.

The service coverage of mobile telephones will be able to obtain approximately 10 km radius in Vientiane Mun and approximately 9 km due to site condition in the mountainous districts such as Xiengkhuang, Oudomxay, Luangprabang and others.

2) Southern provincial regions

The mobile telephone center (BSC2) of LTC is located at the Khanthabouly District in Savannakhet and is controlling up to 6 BTS (Base Telephone System), serving Khanthabouly, Pakanh, Thakhek, Xeno, Saravan and Pakse in the Southern provincial regions.

The subscriber capacity will be approximately 30,000 altogether for the mobile telephone network from Khanthabouly. The BTS is similar to Vientiane area and its service coverage will be approximately 9 to 10 km in all districts.

Also ETL has planned to expand in their phase 2 project, which will provide service in the area up to 2003.

The communication system of mobile telephone network uses in TDMA (Time Division Multiple Access) mostly in the range of 900 MHz band or 1.8 GHz band due to frequency allocation in some districts. A typical system is shown in Fig. 7.46 (reference only).

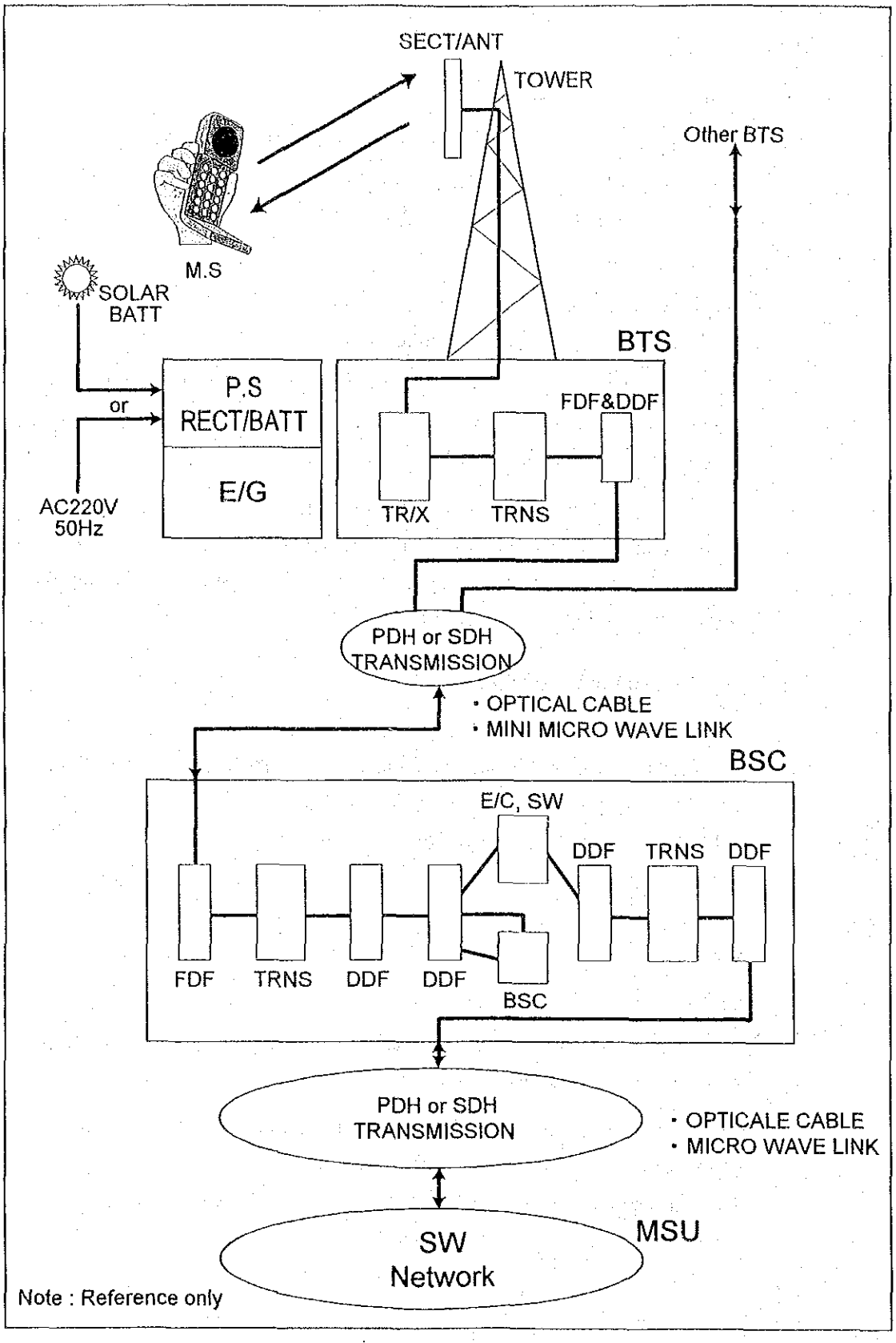


Fig. 7.46 Typical Mobile Subscriber Telephone System

3) International telephone call

The Mobile subscriber system connects with a Satellite Earth station located in Nathom through ETL-Microwave radio link after switching international switch.

(2) Issue and problems for the mobile subscriber telephone

1) Power source to BTS facility

Power source in most of districts in the provincial area are not available or unstable.

2) Frequency interference

A frequency allocation will be difficult to assign. Only in the range of 900 MHz band due to frequency interference.

3) Calling access from neighborhood countries

A Mobile Subscriber will be able to call theoretically without International telephone access because of the same system.

(3) Design policy and expanding target

In accordance with network planning described, the subscribers demand and current telecommunications conditions including national strategies, which were mentioned in the preceding chapter, mobile communications service plans provide the following three-(3) environments.

1) To increase opportunities to all the districts and villages who need mobile communication service as realization of universal accesses.

2) Most efficient and convenient mobile communication tools.

3) Easy maintenance and operation.

To achieve the plans mentioned above, the target period which consists of 3 phases is indicated at the table below.

Table 7.20 Expanding Target of Mobile Services

	2001 - 2005	2006 - 2010	2011 - 2015
Target	To increase service areas especially for Vientiane Mun and other major districts along with Route 13.	To enforce service area especially for major districts and others along with national roads.	To increase service areas especially for the remote districts and villages.
Development	• To provide services to 117,000 approx. subscribers • Expansion of GSM system • Calling rate: 0.12 approx.	• To provide services to 273,000 approx. subscribers • Expansion of GSM system • Calling rate: 0.08	• To provide services to. 657,000 subscribers • Expansion of GSM system • Calling rate: 0.06
Expected area	Refer to Fig. 7.47	Refer to Fig. 7.48	Refer to Fig. 7.49

4) Considerable network design to the system

a. Ensure less frequency interference to be allocated for each BTS facilities.

b. Provide a high efficiency type solar battery if necessary for power source of BTS facilities.

c. Provide a small 2 kW type of engine generate to each BTS facility as use for back-up power source.

d. Completely prohibit direct accessing by pass of International telephone switching network. For its implementation, there should be a discussion among the neighboring countries such as Thailand, Vietnam, Cambodia, Myanmar and Chin a in assigning the operating frequency to the new BTS facility.

e. Install the Network Managing System to ensure operation and maintenance.

(4) Cost Estimate

Costs for mobile facilities are shown in Table 11.6 in Chapter 11.

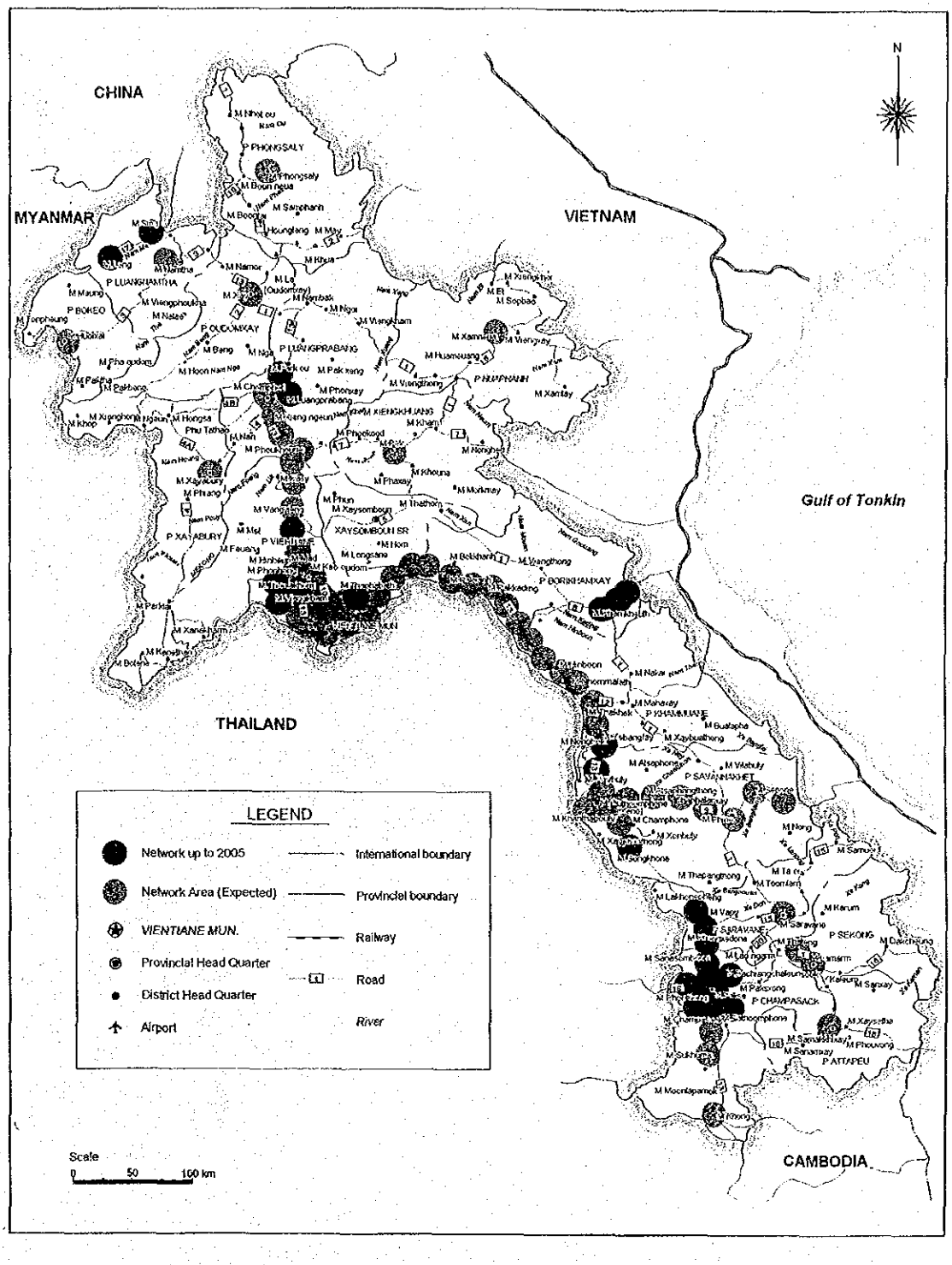


Fig. 7.47 Mobile Subscriber Telephone Network up to 2005

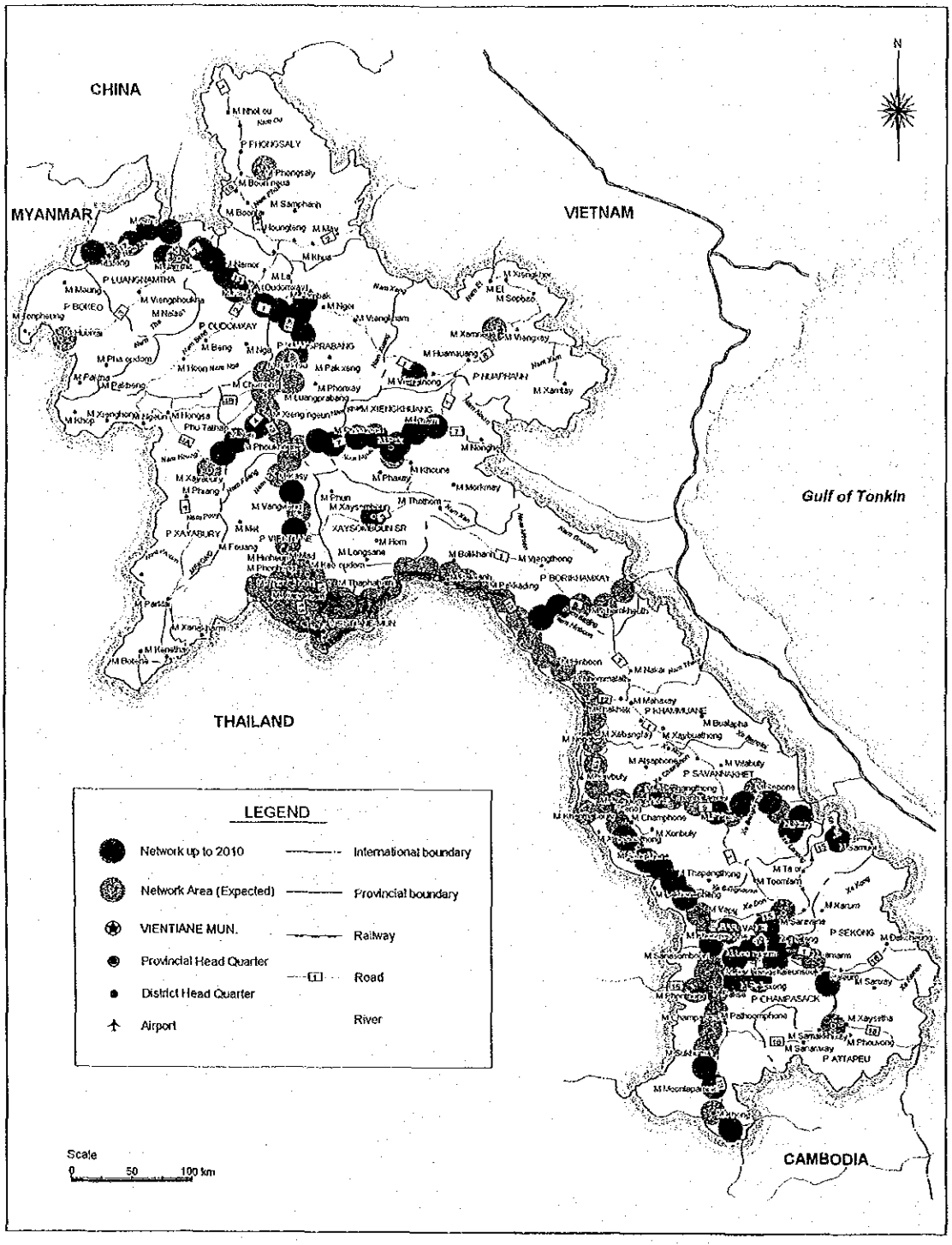


Fig. 7.48 Mobile Subscriber Telephone Network up to 2010

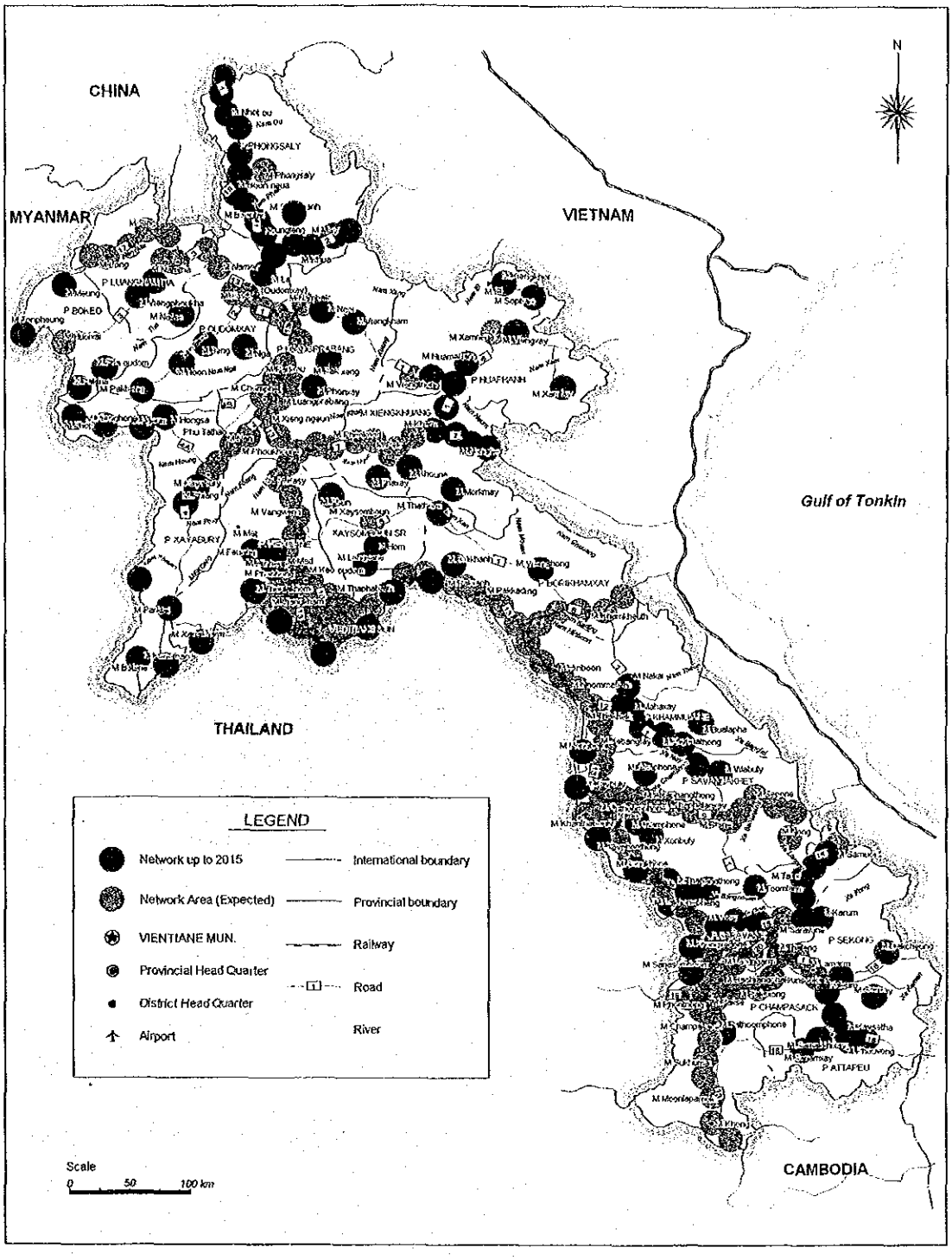


Fig. 7.49 Mobile Subscriber Telephone Network up to 2015

(5) Satellite Earth Communications Facility

Improvement Design and Expanding Target

1) The back up antenna

The back up antenna system is of a similar type that can switch automatically or manually from the present antenna and vice versa.

2) The additional access link

The additional access link is an OFC (Optical Fiber Cable) implemented as a STM-1/SDH and will use a main network instead of the present microwave radio link.

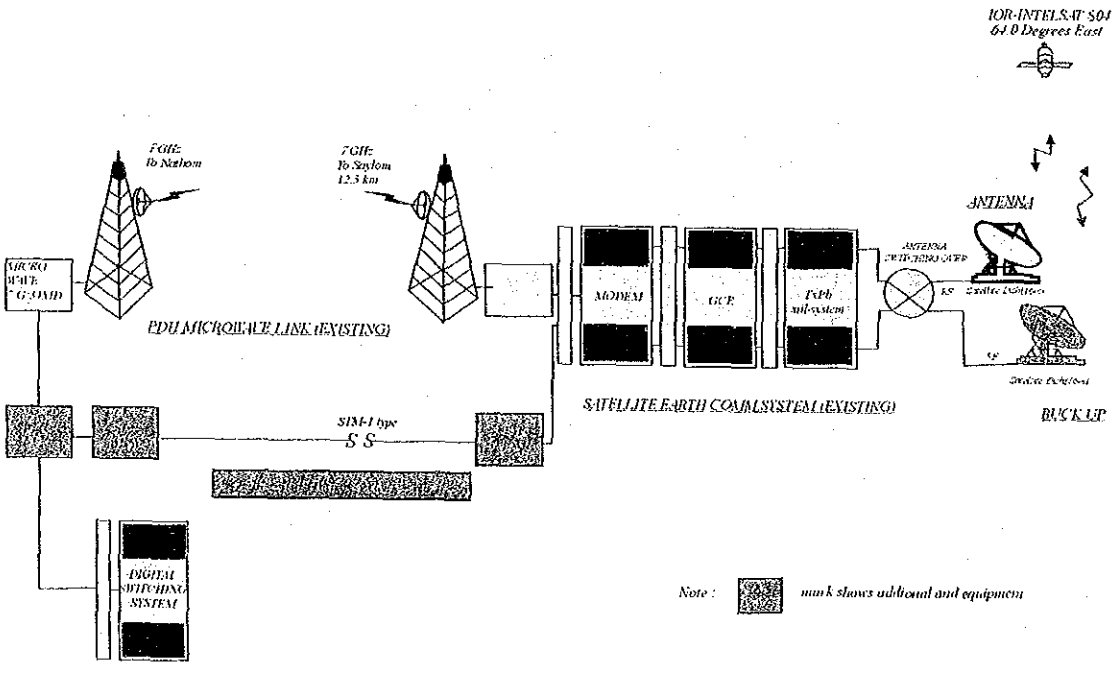


Fig. 7.50 Duplicate Access Links and New Additional System of STD-01A