Network Implement of Thai Farmers Bank

By

Mr. Piboon Ponprasit

Final Report of the Three - Credit Course
CS 6998 System Development Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer Information Systems
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The Graduate Schools of Assumption University has approved this final report of the three-credit course, CS 6998 System Development Project, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer Information Systems.

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ABSTRACT

This project seeks to improve wide area networks of Thai Farmers Bank by improve the communication network to support new applications that require more resource towards networking and new networks must be take care easy.

There are many problem of existing network that should to improve, first it can not support voice, image or new applications which use high resources, second the reliability of network is lower than 95% and third it is hard to manage.

The benefits of network implementation are increase reliability to 99.5%, more bandwidth to support voice, image and new service, improve response time and manage easy by use new network management system. The costs of networks are about 400 million baht and will involve a payback period in three and a half years. Techniques to evaluate this project by measuring network availability and response time of transaction.

The results of the project meet requirements but will be tuning to maximize availability, improved response time of application that runs on network.

ACKNOWLEDGEMENTS

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I. INTRODUCTION

1.1 Background of the Project

Globally all banks are facing the same issues: reducing margins on interest based revenue, increasing costs of service provision, increased service demands from customers, competition from overseas banks, competition from other financial organizations, competition from non financial organizations and deregulation of the financial markets.

To reduce cost and improve service can be done many ways but to improve network of the banks is another way that can make it. Thai Farmers Bank is choosing this way to reduce cost and improve service.

Thai Farmers Bank is the third bank of Thailand. As of June 30 1997, the Bank recorded assets is Bt703,537 million, deposits is Bt499,287 million, lending is Bt563,272 million. The Bank enjoyed an operating profit of Bt 6,14.01 million before tax.

Thai Farmers Bank has its main corporate Headquarters at Ratburana and 529 branches throughout Thailand. In the metropolitan area of Bangkok there are about 205 branches and "up country" about 328 branches.

There are 2 main computer sites in the city of Bangkok, which are located at Ratburana, Phaholyothin. The 44 network nodes in the metropolitan area of Bangkok and 22 network nodes exist in up country areas.

Thai Farmers Bank has started this project in 1996 by using Chula Unisearch and Consultel Australia to co-operate with Thai Farmers Bank team to analyse and design. It started to implement framed relay network in the second quarter of 1997. In its implementation plan it has deviated into two phases. It has just finished implementing frame relay network in phase I, which covers 201 branches in the metropolitan area of

Bangkok and 179 branches up country. It is beginning to implement frame relay network in phase II which covers 4 branches in the metropolitan area of Bangkok and 149 branches Up Country and it will be complete by the end of 1998. That makes the network of Thai Farmers Bank to be a fully frame relay network.

Network topology of Thai Farmers Bank is designed to be a three-level hierarchical network. It has 2 primary network sites and it has 93 secondary network node link to these two primary sites. These network nodes have a F/R switch and have two high speed link connected by F/R switch to two primary network sites. Both links will act as a redundant back up to each other and also do load-balancing traffic. The tertiary site which are branches will be connected to secondary network nodes by FRAD to the F/R switches at network node. There is a dial backup at branches connected to network nodes in case the main link to network node is down. We have two E3 leased lines connected by ATM switch between two primary sites to handle data traffic between the primary sites. We have designed two 34Mbps in order to have redundancy and these two E3 links can also do load balancing. The speed of links between the secondary network node and the primary site will be from 64Kbps to 2Mbps depending on the load of data traffic that each network node must handle. The link speed between branches and network node will be from 19.2Kbps to 64Kbps. For more reliability, branches will have dial backups to other network nodes in case the main link is down.

The network of Thai Farmers Bank is a centralized network system with two mainframes at each primary site. The mainframe at Headquarters Ratburana is the main production system and have the sever at branches to have access to the database. The one at Phaholyothin is the back up system for disaster recovery.

1.2 Objective

The objectives of Network Implementation of Thai Farmers Bank are as follows:

1. Scalability & Reliability

Two things that the bank is concerned about in designing network is Scalability & Reliability. The network must be able to expand as the businesses grows without affecting the existing network. Two redundant links from network node to primary site and dial back up at branches will increase the reliability of the network. Most of the leased lines in our network are digital so they are more reliable and stable in transmitting data across network.

2. Readiness for new application & voice

The network must be able to handle new applications that have been developed in both front office and back office application, such as Signature Verification, Lotus Notes and also voice traffic. With a high-speed link of our network, it is ready for implementing a new application at the branches and also for the voice traffic.

3. Manageability

The network must have good management system that is easy to manage and can which monitor the entire network device in the network. It must be able to provide the information about the behavior of the network traffic such as traffic load, transmission error, and the status of each device and connectivity of each link.

1.3 Scope

This project will cover only major parts of Network Implementation that can be categorized as following.

1. Evaluation of current network

It will cover general bank topology, voice network, wide area network, banking data network telecommunications network and network analysis.

2. Network Requirement

It will cover business objective, banking network requirements, wide area network requirements, and voice network requirements

3. Network design

It will cover access nodes in the wide area network, Ratburana to Phaholyothin link, satellite overlay network, and the managed bandwidth enterprise network

4. Network Implement

It will cover cost, schedule, purchasing, and installation.

II. EXISTING SYSTEM

This section describes the Bank's existing system (1995) before implementing and then presents an evaluation of each based broadly on the following criteria:

- ability to meet customer requirements;
- ability to be managed;
- resilience to network failures;
- appropriateness of the technology; and
- ability to be expanded to meet future business requirements.

2.1 Background of the Organization and Bank Topology

2.1.1 Background of the Organization

The Telecommunications Department is responsible for Telecommunications and Information Technology. It is organized into five groups, each with its own functional responsibilities and staff. Information Systems are divided into two departments, Processing and Engineering. The first is responsible for the daily implementation, operation and maintenance of the banking host and branch network. The latter is responsible for development and maintenance of new and existing banking applications on the host computers. Also, the Branch Administration Department is responsible for specification and provision of all branch equipment.There is a Technology Planning Committee consisting of 14 senior executives and includes a specialist working group on which the Telecommunication Department is represented.

Clearly the responsibility for the provision and integration of all network equipment is distributed over several different Departments, each responsible for their own performance. Over time the banking network will become more like an application on a Wide Area Enterprise Network. The three different networks (voice, LAN/WAN and banking) therefore can be considered as simply applications with different

protocols, to be transported over a homogeneous telecommunications transmission network. There is a need now for the roles and responsibilities for ownership of the management of the network to be addressed, so that a framework of principles for the standardization of hardware, software, network management, operational and maintenance practices, security, training and support can match the rapid change in, and expansion of, the Bank's systems and service.

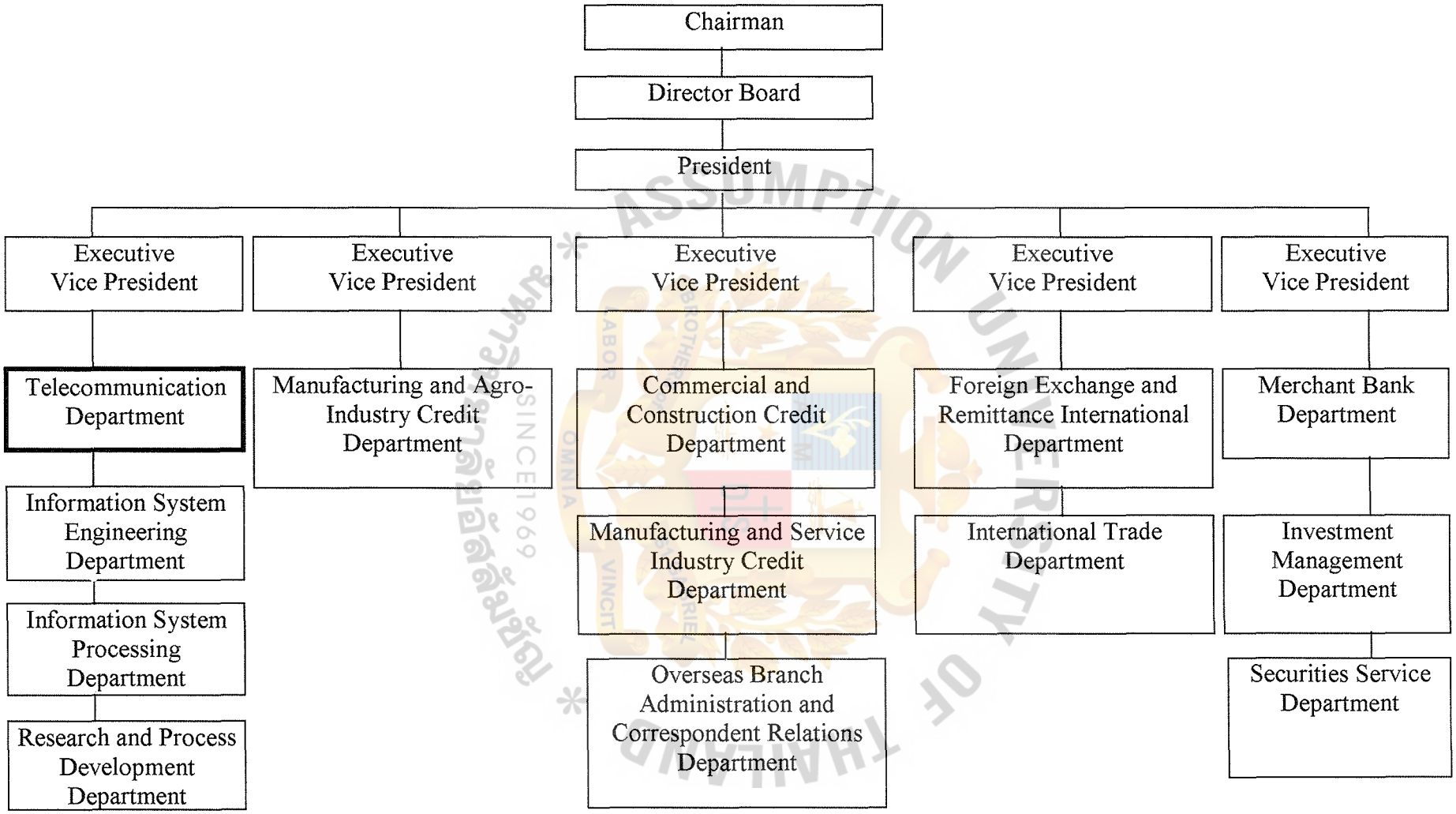

Figure 2.1. Organization Chart of Thai Farmers Bank.

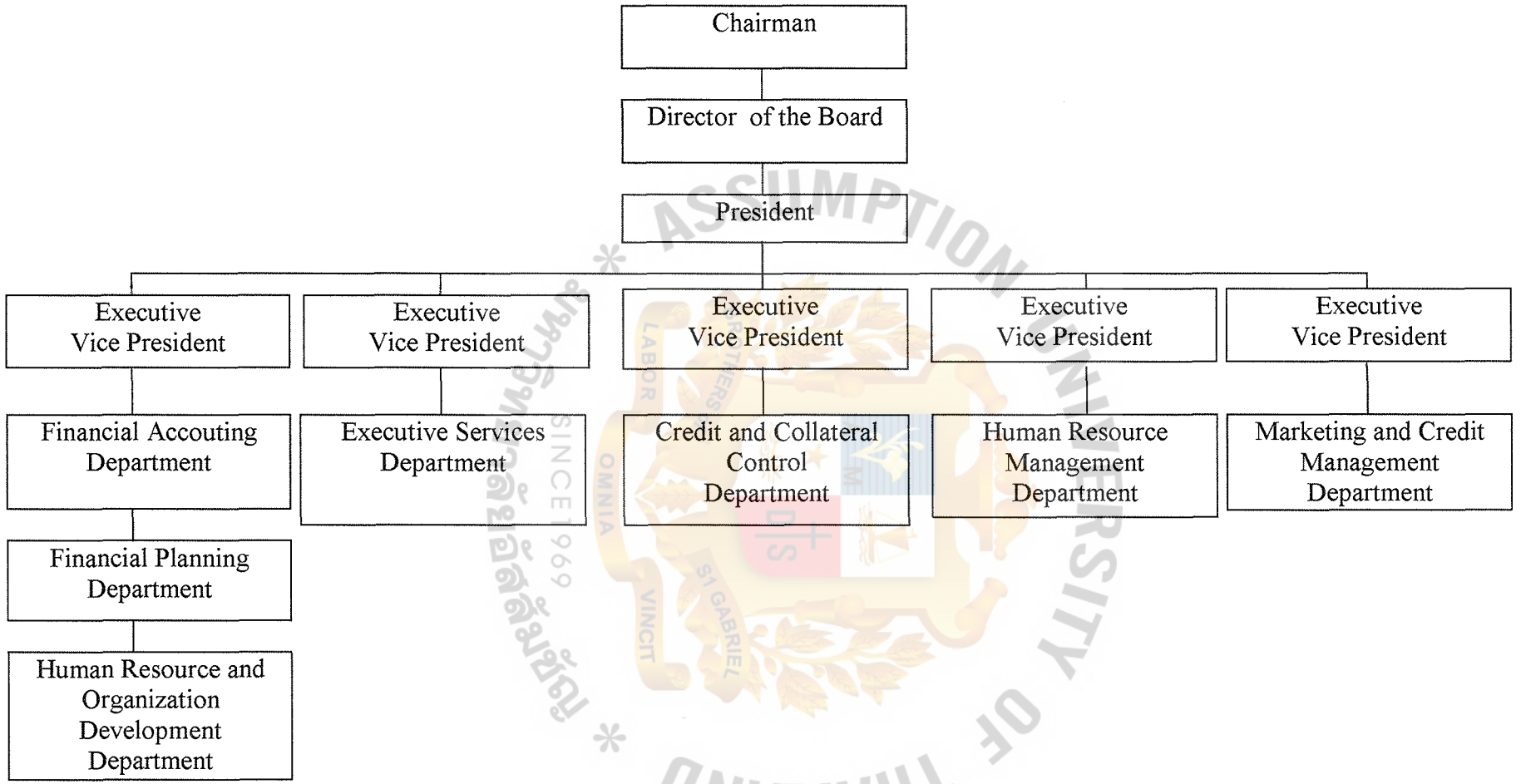

Figure 2.2. Organization Chart of Thai Farmers Bank.

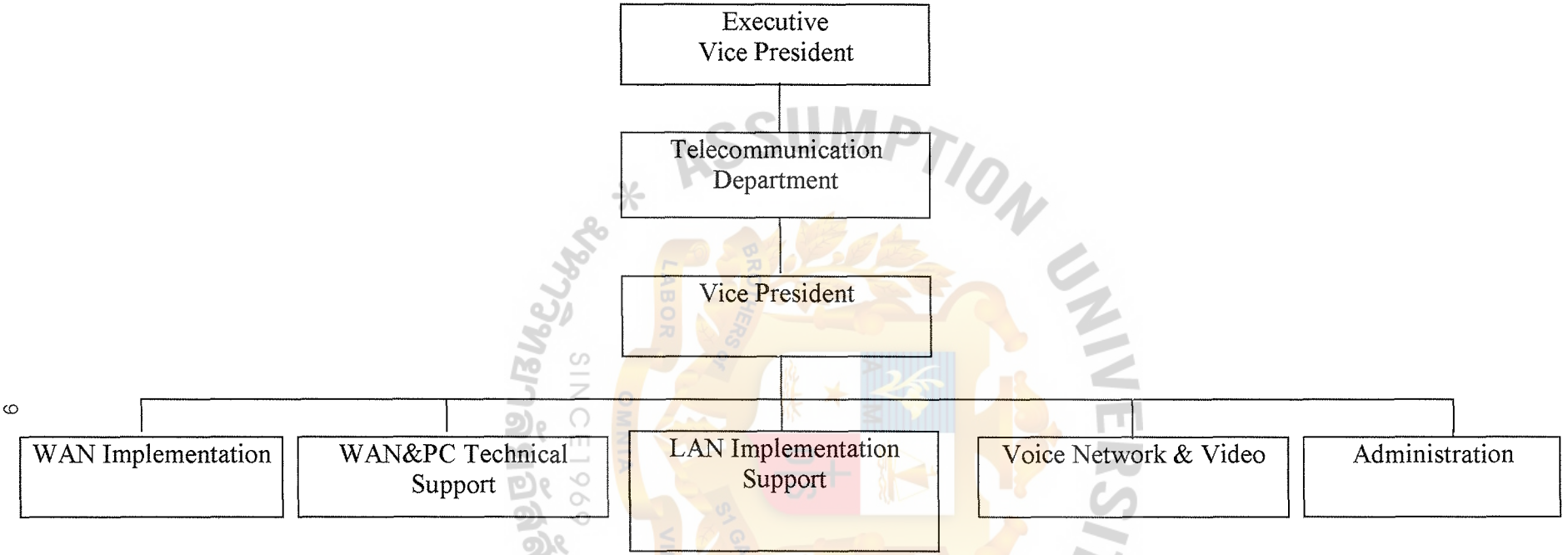

Figure 2.3. Organization Chart of Telecommunication Department.

2.1.2 Background Bank Topology

In 1995 Thai Farmers Bank had its main corporate Headquarters at Phaholyothin and some 470 branches throughout Thailand. In the metropolitan area of Bangkok there are about 174 branches and in "up country" locations about 202 branches.

There are 3 main computer sites in the city of Bangkok: Phaholyothin, Ratburana, Silom, Suapa and Talad Plu are major branches, which also house transmission network nodes.

Phaholyothin

Phaholyothin is the current Head Office (1995) with:

- 27 bank Departments;
- A bank branch;
- A number of host computers for specific banking applications;
- A number of file servers distributed across Departments for departmental applications and for access to other host computers;
- A telecommunications operation center housing a range of telecommunications equipment (voice band modems, TDM/statistical multiplexers, satellite modems, voice codecs, voice data multiplexers, network management systems, etc);
- A 6 meter diameter satellite earth station, located on the roof, providing access to the Thaicom satellite for private Single Channel Per Carrier (SCPC) lines carrying voice and data traffic to three branches of Chiang Mai, Hat Yai and Khonkaen;
- A point to point digital microwave link providing access to Samart's Time Division Multiple Access (TDMA) VSAT network for private data traffic to remote branches;
- A PABX for telephone services ; and

• A mixture of UTP-5, STP and coax (RG-62) cabling for data terminals and twisted pair copper for voice.

Silom

• Silom has the following features:

• One host computer used both for on-line development of new applications and as a disaster recovery site for the primary host at Head Office;

• A PABX serving the branch;

• Data communications equipment links to HO and other branches.

Ratburana

Ratburana was constructed some 11 km from the existing HO. It was completed in 1996, and some 20 Departments were to be relocated to new HO. The new HO will consist of three buildings, namely:

• The new corporate Headquarters, comprising a 42 story building to accommodate the 20 banking departments, recreational and staff support services;

• A large bank branch in a low rise building of 5 storeys;

• A five store Computer Center with LAN servers, host computers, Front End Processors, printers, an operations center, and utilities (uninterruptible power supplies and building services).

• Key features of the telecommunications design include:

• A structured voice, data and power cabling system;

• Raised floors in each building and on each floor for equipment cabling flexibility;

• Recessed power, voice and data outlets on the floor;

• UTP-5 (100 Mbps twisted-pair) cabling for both voice and data;

• 126 pair fibers optical cable linking the computer building with the office building, including a physically separate redundant path of equal capacity; and

• 12 fibers pair from each floor to the basements in each building.

2.2 Evaluation of the Current Network

2.2.1 Voice Network

2.2.1.1 Network Description

The principal features of the TFB voice network are:

• Leased lines are provided in Bangkok between major sites but not to metropolitan or country branches except for 3 sites connected by satellite (64 kbps SCPC).

• Redundancy (back-up) to the TOT network is provided by TOT ISDN services and by access to the TelecomAsia network;

• Standards have been established for PABX selection:

- Nortel Meridian (large sites)

- Fujitsu (metropolitan and large country sites)

- Panasonic (all small branches by 1996);

• The 6 main sites will be connected in a fully-integrated network after Ratburana is occupied;

• Voicemail is to be trialed to add value to telephone use and reduce operator load;

• Telephone information management systems (TIMS) are being purchased to:

- Allow proper dimensioning of exchange routes to PABXs to meet demand

- Verify public network bills

- Prepare to allocate costs to each department.

The following network of PABX's located in Thai Farmers Bank branches (including 2 for Ratburana):

Table 2.1. Diagram of PABX Network.

PABX Type/Model	No. in Bangkok	No. Up Country
Meridian SL-1	6	0
Fujitsu/630	134	12
Panasonic/1232	36	57
Panasonic/616	0	137

Other details are:

- Long distance and out of hours calls are available generally only to executives;
- Because the Panasonic PABX's (model 1232) do not have auto attendant features, these will be relocated from metropolitan Bangkok branches to "up country" branches and replaced with Fujitsu (model 630);
- The Fujitsu (model 63) PABX is ISDN capable and ISDN will be used in future when the TOT Network is ISDN capable;
- TFB plan to upgrade large up country branches from their existing Panasonic (model 1232) to Fujitsu (model 630);
- By the end 1996 TFB expected all 476 branches to have at least a Panasonic PABX;
- PABX lines are a mixture of two wire analogue and 2 Mbps direct in-dial (DID) from TOT with digital DID via TelecomAsia provided as back up;
- When the new HO PABX is installed, the analogue circuits will be replaced with Primary Rate digital ISDN services between the new Head Office and the existing Head Office and both Silom and Suapa centers. E&M voice circuits from the Meridian PABX at the existing HO are statistically multiplexed with data by a TDM (which has a built in ADPCM voice compression);

- Voice over the SCPC circuits are compressed to 14.4 kbps, then multiplexed with data, prior to modulation by a satellite modem;
- PABX Management is performed jointly by one TFB person plus support through a contract with the vendor;
- Callers to Telephone Banking are not queued if the system is busy;
- A manually prepared telephone directory is updated once or twice per annum;
- International customers dialing into TFB complain of a poor grade of service. This is due to poor circuit dimensioning on the concatenated CAT-TOT-TFB links;
- There are plans to use videoconferencing for meetings between the new and existing Head Offices and perhaps some "up country" sites via PC-based video codecs;
- The Overseas TFB Branches use the public telephone network for all voice and data communications with TFB HO in Thailand;
- TFB customers and internal staff complain about the directory assistance. In particular difficulties are caused by the limited skills of operators and problems in finding numbers because the on line directory is in English, which allows multiple spellings of Thai names.

2.2.1.2 Voice Network Evaluation

Dual satellite hops for private voice communications between the three sites serviced by SCPC satellite is generally regarded as undesirable because of delay and echo. However, this is a limited arrangement for access to three branches at present and only a few users are affected.

For customer support, video and telephone banking and incoming international customer calls, the dimensioning of facilities and circuits requires immediate attention in order to reduce customer complaints in these areas.

An international Toll Free number for TFB customers in other countries is not available, this is considered essential in TFB expansion of its network overseas.

In 1994 telephone service accounted for about 73% of total telecommunications network service costs of B171 million. This is slightly higher than for some comparable banks in Australia, where the ratio tends to be closer to 50% to 60%. No adjustment has been made for telephone tariff differences between countries. The implication is that there may be potential for the more efficient usage of the telephone, and for saving a proportion of the annual expenditure of some 125 million Baht TFB's intention to provide new Telephone Information Management Systems (TIMS) at the main Bangkok sites, demonstrates that the Bank realizes the value of TIMS in optimizing network capacity, allocating costs to used departments, and generally managing usage.

Since both the Nortel and Fujitsu PABXs are capable of Least Cost Routing (optimum alternate route choice), the technical potential exists to extend the private line network to the branches, giving improved calling performance and reduced costs. Not enough traffic data will be available to determine the costs involved in establishing a private network design until the new TIMS are operational.

Consideration should be given to providing small queuing systems with appropriate messages on Home Banking lines: this reduces customer dissatisfaction, gives information about success rates, and substantially increases the traffic throughput of the Home Banking systems by "feeding" calls to operators from the queue.

The absence of an automated directory production tool and lack of on-line directory assistance needs to be addressed to improve the level of service provided by both the Telecommunications Department to the Bank staff and by the bank to its clients. The effectiveness of Directory Assistance, while a significant efficiency issue for internal communications, is a key issue for world-class Customer Service Support.

2.2.2 Banking Data Network

2.2.2.1 Network Description

TFB has 10 major hosts supporting some 31 existing applications and 17 applications planned to be implemented (timeframe undetermined).

The following table summarizes host and applications:

Table 2.2. Summary of Host and Applications.

Host	Applications
ES9121/620	domestic banking & CARDPAC (bank owned credit card)
Tandem	ATM, Base 24
AS/400	trade finance & international Trading Funds & Management (TFAM)
DEC	SWIFT
ES9121/480	disaster recovery, applications development, CIS, Financial Information Control System (FICS) & PIS
INFOBOT	telephone banking
IBM Series 1	video banking
IBM MIP/PC	VISA
IBM Series 1	MasterCard
Hypercom NAC	EFTPOS

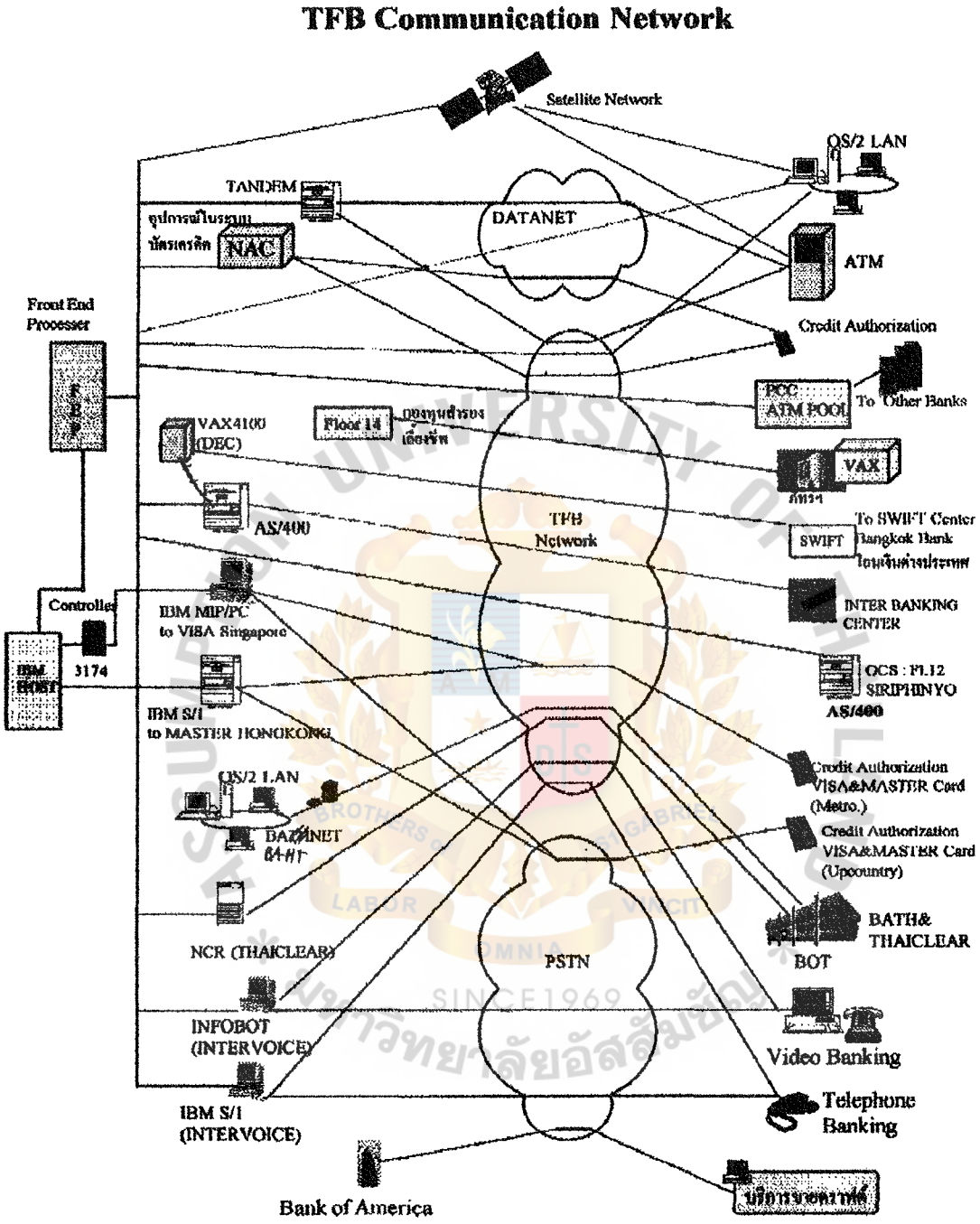

Figure 2.4. Diagram of Banking Data Network.

Two alternative configurations have been proposed after relocation to the new Head Office at Ratburana. In both cases the disaster recovery site at Silom is to be

relocated to the new Head Office, re-equipped until in full production capability, then brought on line as the primary banking center with the existing Head Office as the disaster recovery site. Silom will thereafter operate as a bank branch only.

A typical branch consists of:

- A 16 Mbps Token Ring OS/2 server with a number of workstations running generally CT-2 for interaction with the ES9121 host. MS Windows is not used in any branch. The OS/2 server also acts as a gateway using Communications Manager/2 Gateway (SDLC over Token Ring).
- The branch hardware and software can be generalized as shown in the following table:

Table 2.3. The Branch Hardware and Software.

Hardware & Software Description					
Server	Teller/Back office/platform W/S	Printers	Server	Teller/Back office/platform	Platform Software
PS/2 486DX2/66, 8Mb RAM, 1Gbyte HDD, 14" Monitor, Lanstrmr MC 32 NIC, 4.10Gb DAT tape	486DX2/50, 4Mb RAM, 270M HDD, 14" Monitor, IBM ISA T/R NIC	Passbook, IBM Laxmark, Epson LQ, HP Scanjet II	OS/2, v2.2,3.0 Entry, IBM LANDP/2 v2.0, COM Man 2, SYTOS Plus for OS/2	CT/DOS RT v1.3, LAN requester, IBM LANDP/DOS v2.0	OS/2 v2.21, COM Man/2, LAN requester, Client enabler dist, IBM LANDP/D OS v2.0

- ATM machine(s), either IBM, Fujitsu or NCR, all running SNA.
- Some specific facts about Thai Farmers Bank's banking system:
- VISA network is connected to the VISA node in Singapore;
- MasterCard network is connected to the MasterCard node in Hong Kong;
- SWIFT is interconnected to the Thailand node in the Bangkok Bank;
- Exchange rate fixed once per day and down loaded from the AS/400 to the ES9121;
- the Bank has a centralized, real time transaction accounting system;
- Connection between the Tandem and the ES9121 is via the FEP;
- The IBM ES9121 at HO and Silom are interconnected through a high speed backbone via the FEP;
- The AS/400 and ES9121 at Silom are interconnected via an FEP and only file transfers occur between them;
- At end of each day, tape backups are physically transported from HO to Disaster recovery site at Silom;
- All banks in Thailand pool some of their ATMs. These ATMs are interconnected at a Processing Computer Center. The protocol is IBM Bisynch (BSC) and ID checking is performed by a Tandem in the PCC;
- TFB ATMs connected directly to TFB's host (via the 3745 Front End Processor) have about a 3 to 4 second response time and are reliable. ATMs in the pool have a high unavailability due to congestion and line outage;
- TFB ATMs connected to the pool have reduced functionality, ie cannot pay utilities bills, for example;
- Access table is used to limit 3270 users to certain applications on the ES9121 for security;
- Databases from FICS to the EIS are manually exported by tape each day;

• Other Banking Applications include:

- OCS - On-line Collection System (debt monitoring, loan status etc),

- CQ - Cheque Collection (manual entry of cheque details),

- RMDS - Report Management Distribution System (branch information available next working day after reconciliation and download from Host).

2.2.2.2 Banking Data Network Evaluation.

For major processing sites, the redundant hosts at Silom and the plans to relocate to the new Head Office provide opportunities to trade off performance, capability and cost.

A complete and comprehensive Information Systems Disaster Recovery Plan does not appear to be available. The network redundancy issues and implications for the role of communications in recovery of the major sites flow directly from the IS Recovery Plan. Therefore it is not possible at the present time to develop a comprehensive and satisfactory Network Disaster Recovery Plan.

Although equipment is available to perform real-time mirroring to protect data and permit rapid restoration after mainframe faults, this is not currently in operation. Consideration should be given to providing an automated and highly secure data storage facility for real time back up of banking data.

The EIS system could be automated and integrated with the LAN to provide real time access to on-line information for management reporting.

A comprehensive, centralized management system is required to collectively manage all the hosts. In developing such a management system, consideration should be given to reducing the number and type of different hosts vice provision of an integrated management system. The training of suitable staff and the procedures for

operations and maintenance should be reviewed to ensure that the quality of service advertised by the bank can be achieved.

The resources required to implement the 17 new banking applications must be quantified and the applications rollout planned to ensure that effective co-ordination and support for the new services and applications are available prior to service launch.

2.2.3 Telecommunications Network

2.2.3.1 Network Description

The Thai Telecommunications industry is undergoing constant change as new services and vendors enter the market. Design network teams have continued to analyze the available services and their tariffs, as more information becomes available.

A number of the Bank documents analyzed by the design network teams have provided the following information:

Lists of the data communications network nodes, equipment type, speeds and transmission facilities;

- Lists of branches that use TDMA VSATs;
- Models of Codex multiplexers by region and node type; large node (greater than 10 branches) or small nodes;
- Diagram of the VSAT network;
- Diagram of the SCPC network;
- Diagrams showing each of the banking services and their interconnection from user to host;
- An outline of communications software type, version and interface type and quantity;
- Alternative representations of the current, and proposed 64 kbps, network;
- An outline of telecommunications costs;
- An outline of network management systems.

The following figure will show existing network of Thai Farmers Bank (or TFB NETWROK).

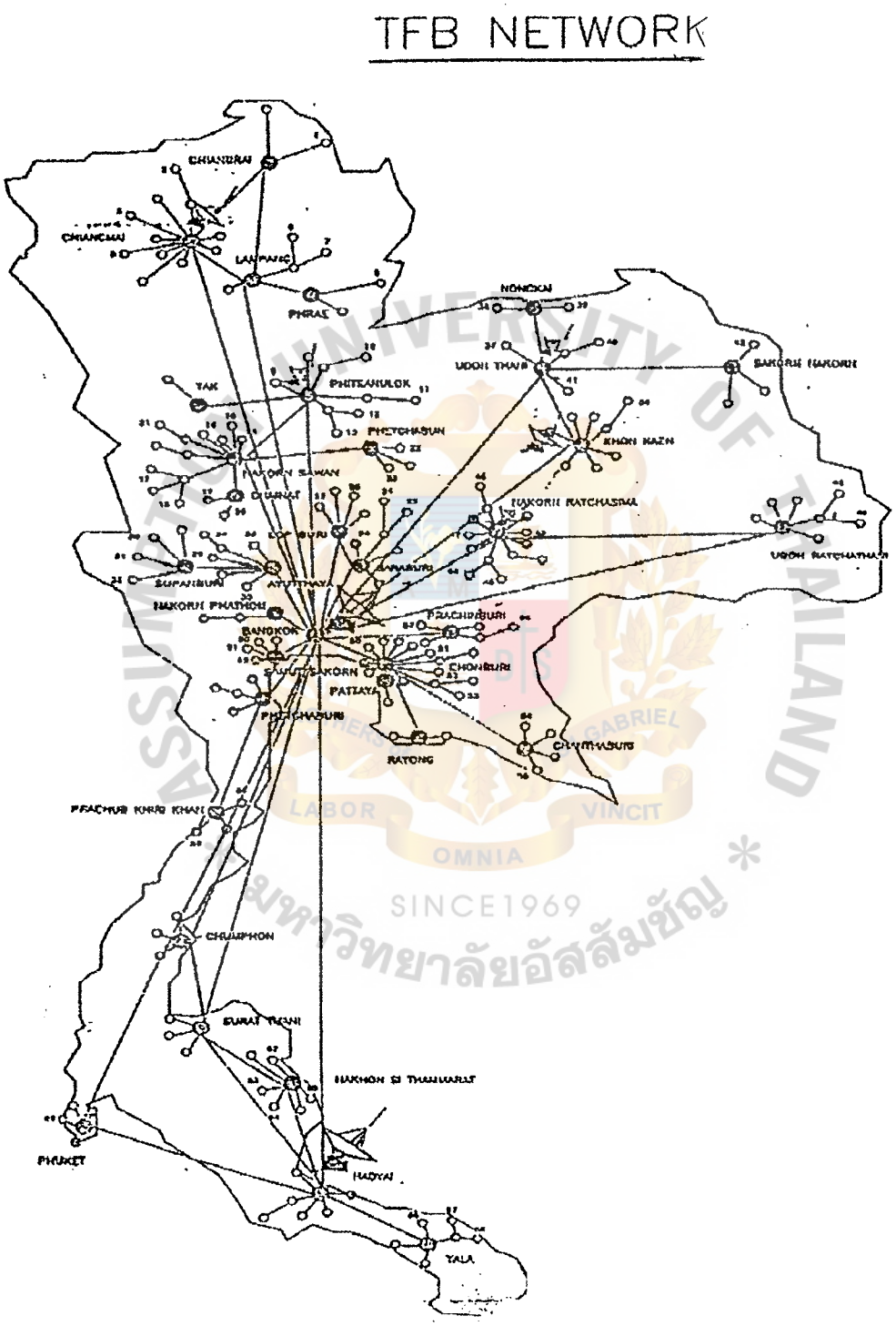

Figure 2.5. Diagram of TFB Network.

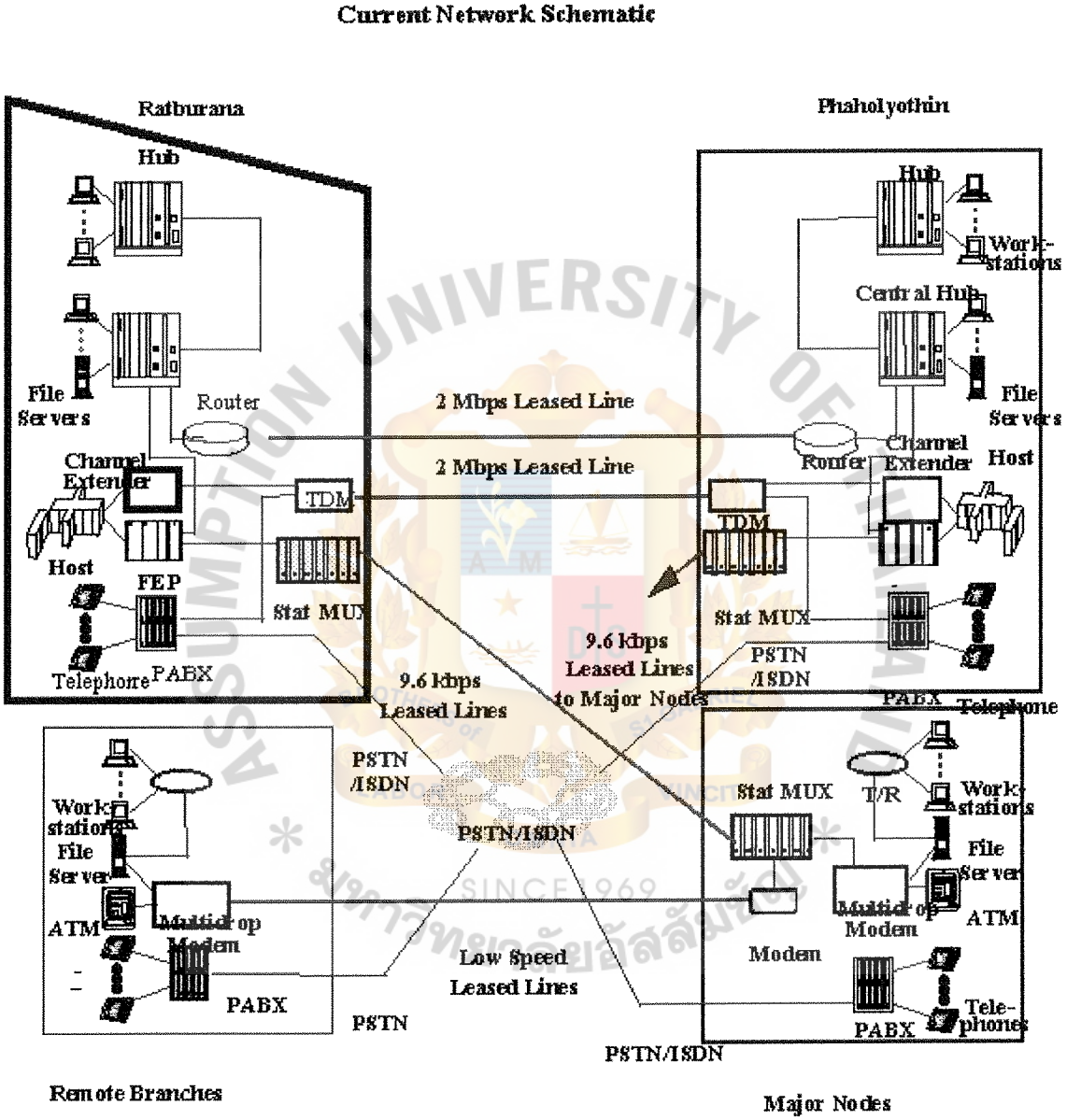

Figure 2.6. Diagram of Existing TFB Network.

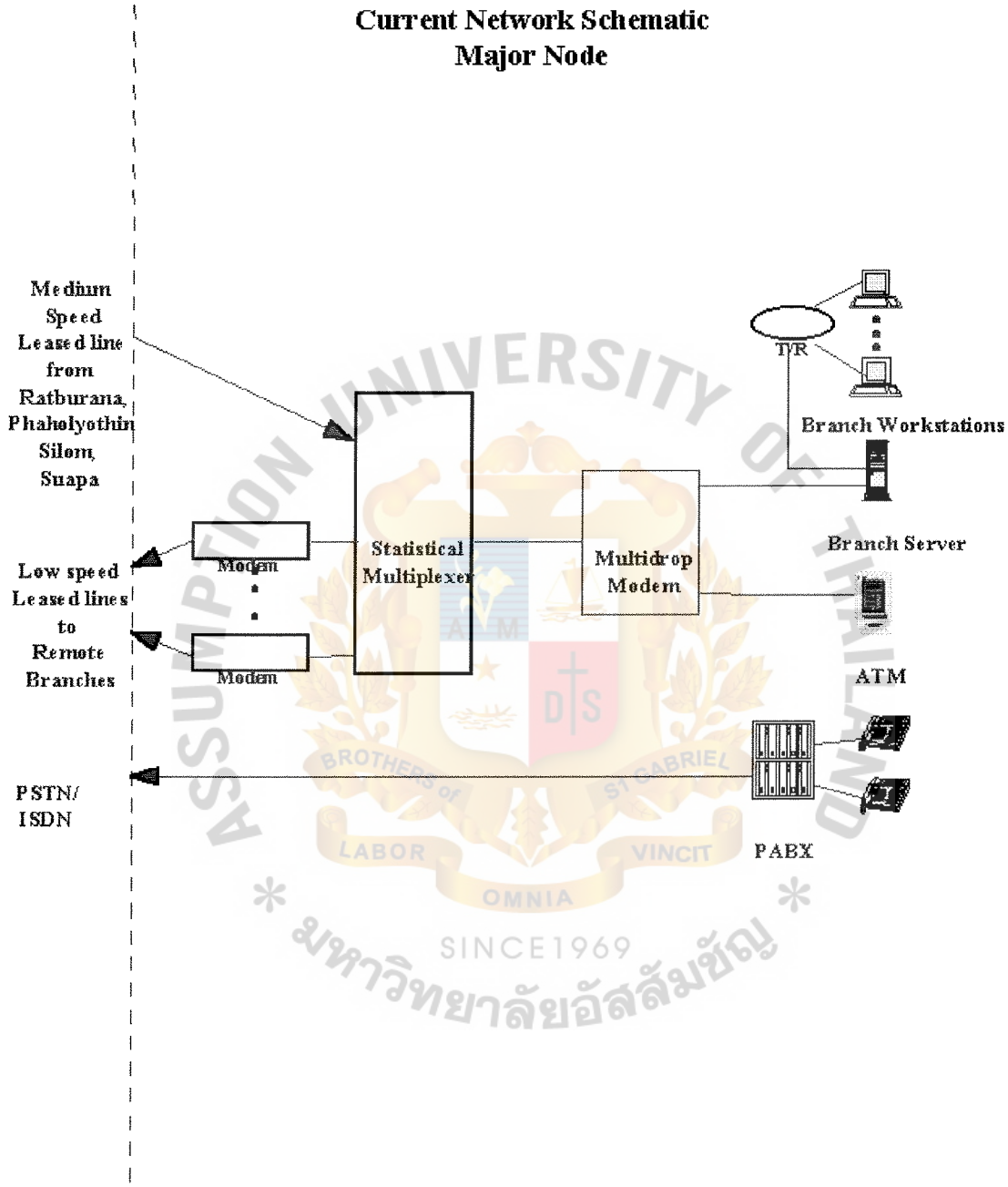

Figure 2.7. Diagram of Existing Major TFB Network.

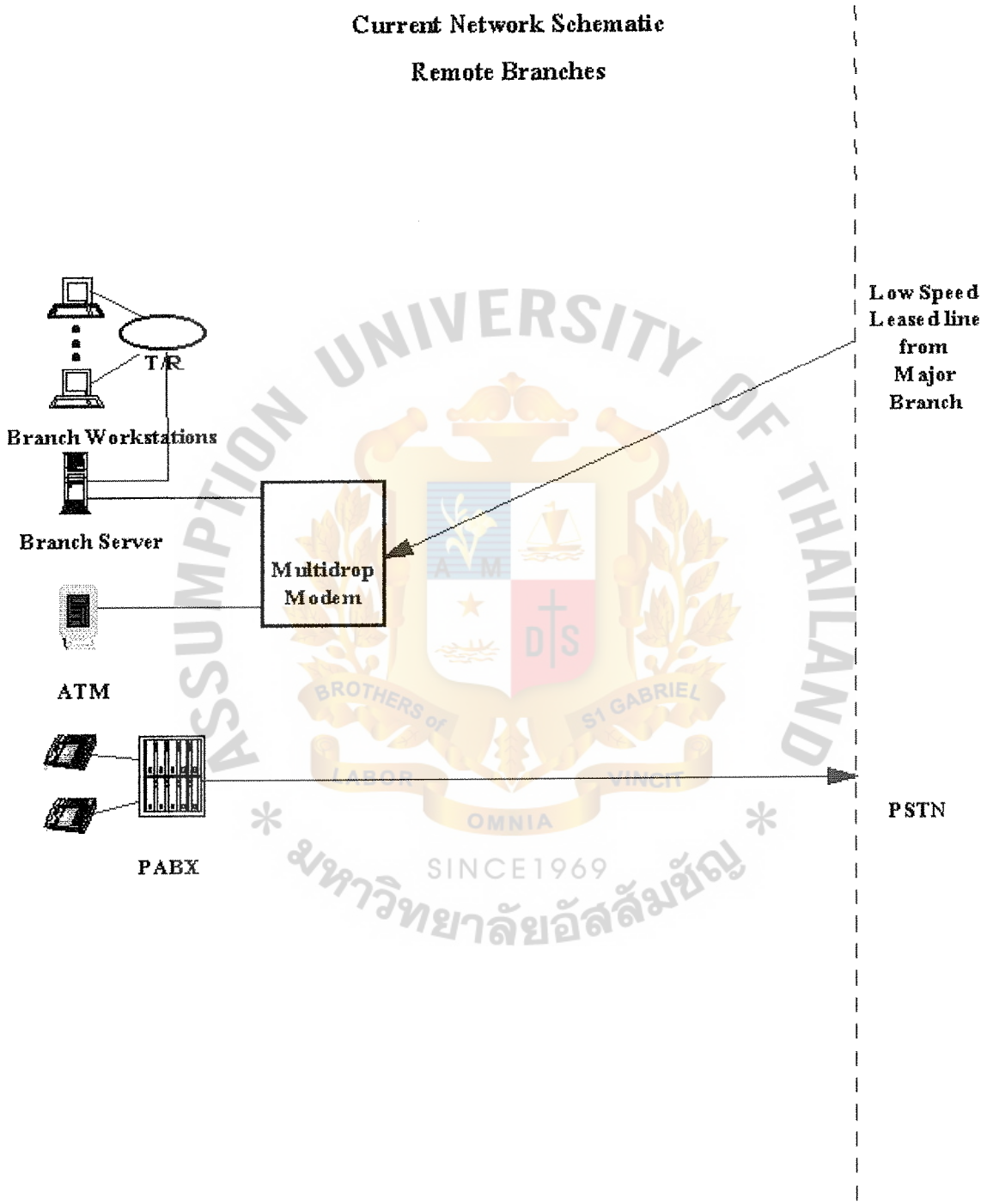

Figure 2.8. Diagram of Existing Branches TFB Network.

Some observations of the network made by the consultants are:

1. The Bank network FEP interfaces are either:

- RS232/V.24 for V.32 and V.26 bis modems (low speed);
- V.35 higher speed (64 kbps).

2. V.35 interfaces are gradually being introduced as TOT provides high speed links.

3. No network Management System, only communications equipment management:

- CODEX 9800;
- ALTOS 6800;
- CODEX 9110.

4. The high speed backbone is 2 Mbps point to point .

5. All voice and data circuits are interconnected at the MDF in the PABX room.

6. SCPC equipment consists of a satellite modem, voice codec, voice and data multiplexer and a data multiplexer. It occupies one full rack for the three SCPC circuits. A 6m antenna is on the roof.

7. TDMA equipment also in one rack, multiplex data circuits onto one 64 kbps bearer, via microwave to Samart Telecom's satellite and TDMA hub.

8. There appears to be in excess of 10 vendors products for similar equipment, none are integrated, there is poor cabling and management systems are not integrated and are primitive.

9. Thai Farmers Bank's network is serviced by:

- Samart Telecom's for TDMA data VSAT;
- Samart for SCPC voice and data;
- CAT for international services;
- TOT for leased domestic data circuits;
- TOT for PSTN.

10. Only one ATM is interconnected via the TDMA VSAT due to the high cost.

11. TDMA network only used for branch banking (SNA - X.25 protocol conversion).

12. At HO, about 10 FEP ports are connected to the X.25/SNA converter then to the digital microwave link.

13. The Codex 9800 is used for outgoing streams only and 5 months data is kept.

14. The ALTOS uses sub-channel access to list and configure remote modems.

Traffic statistics for Thai Farmers Bank tellers and ATMs have been provided as well as channel utilization on various links over a 5 day period. A network analyzer was used to determine network utilization on the same channel as ATM transactions to correlate data and provide a basis for network capacity forecasts. These results are summarized as follows:

During 1100 - 1500 hours, Friday:

- Teller machines sends an average of 80 characters per transaction and a maximum of 256 characters, the host responds with about 3 frames of 240 characters;
- ATM sends an average of 120 characters per transaction, the host responds with about 80 characters;
- ATM response time is about 3 - 5 seconds in Bangkok and 5-8 seconds in upcountry;
- Teller terminal response time is about 2 - 3 seconds;
- Line utilization for a big branch is approximately 30% on a 4800 bps link.

2.2.3.2 Telecommunications Network Evaluation.

In 1994 telephone service accounted for about 73% of total telecommunications network service costs of B171 million, indicating (as stated above) that some unquantified potential exists for cost savings.

The fragmented collection of different existing network diagrams was shown in figure 2.4 to 2.8. This drawing depicts TFB's network, its applications, IT topology, telecommunications topology, equipment, protocols and service providers.

In essence the network is inefficient for two major reasons:

- SDLC is routed across the WAN using multiplexers and multidrop modems;
- The network is restricted by the limitations imposed by the network service providers.
- Possible use of low cost access routers at each node and branch may provide the following benefits:
- Serial interface to modems or higher speed data channels where available. Note this is a migratable approach, whereas the current use of multiplexers and modems is not;
- Improved data traffic routing on the basis of Class of Service and least cost path;
- Ability for comprehensive management of the network.

The inability of the existing network management system to provide proactive management of the network is due to the limitations of the network equipment elements. A network management system is essential in ensuring that the Telecommunications Department can support the level of service demanded by business managers and customers.

2.2.4 Network Traffic

2.2.4.1 General

Design network teams were provided with small amounts of information about the TFB banking network, including link utilization bandwidth statistics, teller and ATM transaction data, and line traces of an SNA link. This section is a summary of design network teams analysis of this data.

2.2.4.2 Wide Area Link Bandwidth Utilization Statistics.

Information on the bandwidth utilization statistics on the links forming the Thai Farmers Bank wide area network for the two month period from late December 1994 to late February 1995. The statistics were generated from the Codex 9800 NMS.

Design network teams then analyzed the statistics to ascertain the peak percentage link utilization usage of each TFB link.

The analysis found that the busiest times of the month are normally at the beginning and at the end of the month. The analysis also found that while most wide area link peaks were 50% or less, some of the major links have peaks of 70% to 80%. These links are shown in the table below:

Table 2.4. Link Utilization of Existing Network.

Link Name	Link Speed	Link Type	Peak Link Utilization	Date	Day	Time
BKK-Khonkaen	9.6	Microwave	81%	5-Jan-95	Friday	11:35 am
BKK-NK. Sawan	9.6	Terrestrial	81%	26-Jan-95	Thursday	4:42 pm
BKK-Khonkaen	9.6	Satellite	76%	10-Jan-95	Tuesday	12:38 pm
BKK-Ubol	7.2	Terrestrial	74%	24-Jan-95	Tuesday	1:14 pm
BKK-Cholburi	9.6	Terrestrial	73%	4-Jan-95	Wednesday	11:44 am
BKK-Cholburi	9.6	Terrestrial	73%	4-Jan-95	Wednesday	1:05 pm
BKK-Khonkaen	9.6	Microwave	72%	5-Jan-95	Friday	12:29 pm
BKK-Ubol	7.2	Terrestrial	72%	10-Jan-95	Tuesday	12:03 pm
BKK-Korat	12.0	Terrestrial	71%	7-Feb-95	Tuesday	9:17 am
BKK-Korat	12.0	Terrestrial	70%	25-Jan-95	Wednesday	2:23 pm
BKK-Udon	14.4	Terrestrial	70%	11-Jan-95	Wednesday	12:47 pm

Many of the above links are composite links used to consolidate multiplexed traffic onto a single link. Therefore, they will need to be improved in capacity to cope with the expected increase in traffic which will arise as a result of the introduction of new applications. Links with peaks less than this may be gradually upgraded as a lower priority.

2.2.4.3 Banking Transaction Data

Daily banking transaction data for both tellers and ATMs was provided for the month of May 1995. This data was analyzed to determine the peak transaction times of the month. From the analysis, it is understood that banking transactions are completed on-line in real time and that there is no storage, backup or transmission of transactions or other information in a batch mode after the close of business.

ATMs

The peak days of the week for ATMs (i.e. the days with the most transactions) are Monday and Friday, except for ATMs in shopping centers or holiday areas where the transactions are constant all throughout the week. The most heavily used ATMs support over 500 transactions/day.

From interviews, it was ascertained that ATMs currently have an estimated availability of 80% up time, and the Bank would like to see this increased to at least 95%.

Tellers

For tellers, the peak days are also Mondays and Fridays, and the days before and after public holidays. Most TFB branches do not have a peak of more than 2,000 transactions/day, except for the big ones: Phaholyothin, Suapa and Silom (10,000/day), Chiang Mai (3,000/day), Khonkaen (3,500/day), Phuket (4,350/day) and Hat Yai (4,000/day). Overall, the Bank processes approximately 500,000 transactions a day.

It is estimated that branches with around 2,000 transactions/day would employ approximately 5 full-time tellers, each with a computer terminal. Back office staff would probably share one PC between two or three people. Therefore, it is estimated that each branch of this size would employ on an average, about 7 to 8 terminals.

III. SYSTEM ANALYSIS

3.1 General

The purpose of this section is to analyze the business environment within which the bank operates and the broad technical requirements for its telecommunication network in order to provide guidance for the enterprise network design activity and to establish criteria to verify that the enterprise design meets the future business and technical needs of Thai Farmers Bank.

The analysis and conclusions of this section are based on a number of interviews with the Bank's staff and on business and technical documentation provided by the Bank.

3.2 Analysis of the External Environment

The principal areas to be considered in the external environment are:

- Market demand, regulation and competition;
- Customer perceptions of Thai Farmers Bank; and
- International developments in technology and banking.

3.2.1 Market Demand, Regulation and Competition

Following the liberalization of financial system and easing of foreign exchange restrictions as well as the introduction of BIBF to Bangkok and the provincial areas by The Bank of Thailand in recent years, the competition in banking has become very keen. All the local banks have considerably invested their computer system, set up their network and provided on-line service for their front office banking, credit card, ATM, and EFTPOS. They are either using mainframes or super minicomputers for their front office on-line service; Tandem computers and IBM series 1 for their ATM and credit card application. While Token-ring based PC LAN or Ethernet LAN is being used to link the teller systems of the branch offices with the host computers at the head office,

large banks tend to move slower to develop their computer and network systems in response to rapidly changing new technology. While small banks once used to be inadequately equipped with computer facilities, they are unencumbered with legacy systems and ca now can move freely to gain advantage through investment in newer technology.

With the advent of the electronic clearing house (to be inaugurated soon), and all the electronic, telephonic and video-home banking means available, banks are fiercely competing to attract more deposits, more credit card customers and providing better services to customers. It is most likely that those banks, which have incorporated the latest information technology, will have leading edge over others and will win the competition.

3.2.2 Customer Perceptions of Thai Farmers Bank

Customer satisfaction and customer opinions about the services of the Bank have been analyzed using the following resources:

1) Information for management and planning provided by the Bank;

2) Information from reports of previous research about customer satisfaction with the Bank's services;

3) Interviews with the Bank's executives; and

4) Interviews with Bank customers.

Customers' satisfaction and mission come from the following major services:

1) Cash deposit service;

2) Credit service;

3) ATM service;

4) Smart card service;

5) Safe deposit service;

6) Payment of utilities service;

7) Quick deposit cheque service; and

8) Telephone banking service.

The satisfaction of the Bank's customers in the above services can be classified into 5 levels: the highest satisfaction, high satisfaction, medium satisfaction, low satisfaction and the lowest satisfaction.

The Level of Customers' Satisfaction

TFB Major Services	Level of Satisfaction
Cash Deposit	High
Credit	Medium
ATM	Medium
Smart Card	High
Safe Deposit	Highest
Utility Payment	Medium
Quick Deposit Cheque	High
Telephone Banking	Medium

In comparing customers' satisfaction of Thai Farmers Bank's service with customers' satisfaction of 2 major competitor banks, Bangkok Bank and Siam Commercial Bank, by using the number 1 representing the most satisfaction, 2 representing medium satisfaction, and 3 representing the least satisfaction, the comparison is held in 8 major services as the following:

Service	TFB	Bangkok Bank	Siam Commercial Bank
Cash Deposit	1	2	1
Credit	1	3	2
ATM	1	2	3
Smart Card	1	2	2
Safe Deposit	1	3	2
Utility Payment	2	2	2
Quick Deposit Cheque	1	2	2
Telephone Banking	2	2	2
Total for all services	1	3	2

The problem of main 8 services can be classified into 3 major parts as follows:

1) Problems from Thai Farmers Bank's computer system

2) Problems from telecommunication system, especially infrastructure

3) Problems from other services not related to telecommunication and computer systems

The effect from Thai Farmers Bank's computer system to ATM, smart card and telephone banking is less than the effect from telecommunication system. Telecommunication infrastructure is mostly under the responsibility of TOT and TA. Some services are not convenient to use for example, using long-digits code number, the screen running with fast speed that the user can not read, etc. These problems might be caused by the computer system that they can be mostly solved in software. The problem from telecommunication infrastructure is hard to solve because it is not under the responsibility of Thai Farmers Bank's staff directly, but solving problems in computer network are available.

The other service problems which are not related to telecommunication infrastructure and computer problems can be listed by important levels as follows:

1) Some services take long time even after re-engineering

2) Lack of flexibility in using customers' documents or customers' basis that in some cases requested services are denied

3) Parking area in some branches is not enough

4) The bank does not serve customers equivalently

5) The officers lack of knowledge about bank services especially, new services.

Customers' Opinion

In opinion analysis, the following factors listed below are used in considering image of TFB compared with other two major competitive banks, Bangkok Bank and Siam Commercial Bank.

- Vision
- Investment strategy
- Asset
- Network system / No. of branches / No. of officers
- Cash services
- Profit/Benefit from security investment
- Technology
- Computer system
- Management development
- Customer satisfaction using bank's major services
- Service fee collected from customers
- Social service of bank
- Information of bank

The image of Thai Farmers Bank, Bangkok Bank and Siam Commercial Bank in the point of view of the Bank's customers, general persons, mass media, security investors and TFB's officers, can be rated by number 1 (for the best), number 2 and number 3 respectively as shown in the following:

Group	TFB	Bangkok Bank	Siam Commercial Bank
TFB's customers	1	2	1
General Persons	1	2	1
Mass media	1	3	2
Security investor	1	2	2
TFB's officers	1	3	2
Total for all services	1	3	2

From the result of opinion analysis at this present time, Thai Farmers Bank has the best image from all of the classified groups, the next is Siam Commercial Bank and Bangkok respectively.

The issues that create negative images for Thai Farmers Bank comparing with other competitive banks are security (customers use service without guards) and interest rates.

3.2.3 International Development in Banking Technology

Globally all banks are facing the same issues: reducing margins on interest based revenue, increasing costs of service provision, increased service demands from customers, competition from overseas banks (with no local domestic base, e.g. in Thailand - Citibank), competition from other financial organizations (e.g. American Express), competition from non financial organizations (e.g. General Motors) and deregulation of the financial markets.

Banks are looking at lower cost methods to deliver services to their domestic customers. An extensive branch network is seen as an asset which enables a bank to

service all customers. In reality the costs of maintaining and staffing the branches is a substantial overhead. To leverage the asset the branch has become the sales center for all bank products and services.

To reduce costs, labor intensive activities such as cheque processing and balancing, filing and customer records (the "back office"), are being concentrated into regional service centers. Support functions for both customers and the bank, such as credit card help desks and branch technical support have been concentrated in national centers. In some banks even loan approval has been transferred out of the branch and to regional lending centers.

The branch is left to concentrate on customer relationships and business generation. The specially designed "back office" centers process the daily work more efficiently. Theoretically fewer staff are required to process the work and the branch staff become experts on servicing the customer. This works well and successful examples can be found in many countries. This success is however based on successful use of telecommunications technology. Without high quality voice and data communications connecting the branches to the "back office" service centers, the process will not work. In addition computer systems must be developed to support these centers.

Providing technology is capable of supporting "back office" service centers, then consideration should be given to this manner of processing. A full cost benefit analysis must be performed to ensure that real benefits can be achieved over the long term.

Customer and internal support centers, the Help Desks, must be able to provide an adequate service via telephone. In addition telecommunications and technology tools must be available for central support to be effective. Substantial cost savings can be made by centralization of these functions, particularly where they are provided 24 hours

per day 7 days per week. Services from the telecommunications companies have a substantial bearing on the potential success of these centers. Toll free "800" numbers where the customer can dial from anywhere free of charge is of particular advantage. A single "National Number" which the customer can use anywhere in Thailand to call the bank would also be a major service improvement. These services enable the effective use of Call Center technology to improve telephone customer service and reduce costs. Call fees must be built into service charges.

In summary, Banks generally regard technology as the mechanism to reduce costs and improve service to customers. Electronic services delivered directly or indirectly to the customer by telecommunications is the current priority. The long term goal is substantial reductions in the costs associated with the bank branches. The technologies being developed to support this include:

- Extensions of telephone banking by the use of Screen Telephones using ordinary telephone lines;
- Extensions of electronic banking into additional service areas (EFTPOS in Taxis);
- Extensions of PC (Video) banking into personal cash flow management services;
- Extended ATM capabilities for better processing of deposits;
- Extension of plastic card services to incorporate credit/debit and cash cards into one card (Smart Card);
- Direct customer telecommunications connection for the transmission of transactions, applications etc (payroll, Letters of Credit, Roll Over instructions etc);
- Centralized, highly automated back office processing centers;
- Image processing to capture, transmit and store information;
- Electronic archiving (long term electronic filing with electronic access);

• Electronic documents (electronic forms provided by system and completed on the screen);

• The use of CD technology to provide stable information to branches (e.g. signatures, ledger sheets);

• Alliances between major organizations to issue specific plastic cards to the customer base of the organization. (not affinity cards, but loyalty cards e.g. Telstra, General Motors Australia and ANZ Bank.

3.3 Analysis of the Internal Environment

The principal areas to be considered in the internal environment are:

1) Business strategy and new services

2) Thai Farmers Bank planning processes; and

3) Thai Farmers Bank existing information network.

Changes in the nature of bank business in recent years indicate that future profit growth will come not from interest on lending, but from fees associated with bank services. Broad plans exist for a wide range of future services to be delivered through bank branches and directly to customers through telecommunication services. Thai Farmers Bank has led the trend in Thailand towards direct fees for banking services and intends to remain at the forefront. There are indications (such as the present regulation requiring four up-country branches for each new city branch) that in the future, provision of new ATMs may be regulated. Provision of new ATMs, and new types of ATM both connected to and independently from branches, is therefore a high priority.

A number of existing services will be upgraded and a number of new services will be offered through branches, such as:

• On line cheque clearance from branches other than the customer's home branch;

• Buying and selling of equities;

• Deposit in open-ended (non-maturing) funds;

•Issue of closed-ended (fixed term) securities

•Foreign-currency ATMs;

•Relationship cards (all accounts consolidated) and other smart card services;

•Fast customer account opening;

•On-line cashing of bills at the counter;

•On-demand issue of cards at branches; and

•Real estate sales.

In addition, the following services are proposed:

• Trading equities in the secondary market, permitted by legislative changes associated with the Security Exchange Commission;

• Use of electronic trading to provide services to Thai and overseas firms for trading in various financial instruments.

Thai Farmers Bank is a leader in the introduction of business process re-engineering to Thailand. Some success has been achieved in introducing process re-engineering to branch banking in order to improve the efficiency of existing services and improve the culture for the efficient introduction of new services. The extreme resource demand caused by training and the re-engineering of information systems to support the new processes have resulted in a lower rate of progress than was expected.

A significant feature of many new services is the need to embed a digital encoded image of a customer signature in the data communications transmitted between the branch and head office in order to facilitate signature verification. This has significant telecommunications implications.

3.3.1 Internal Business Planning Processes

Internal Business Planning Processes and Internal Information Systems Planning Processes have a determining impact on a planning of telecommunication system and services. Therefore these are of interest in understanding how to improve telecommunication planning in order to meet the future requirements of the business.

Business Planning in Thai Farmers Bank is categorized by a strong focus on the marketplace. Thai Farmers Bank is market driven. There is no formal regular annual cycle of business planning. Therefore inputs on business planning necessary for the planning of telecommunication are obtained through day to day contact between business unit.

3.4 Strategic Analysis

The business environment in Thailand and internationally is highly favorable to the continued growth of Thai Farmers Bank revenue and profit. The bank has been successful in using information systems and telecommunication technology to deliver banking services in a way which is very competitive by regional standards and which generally compares well with international practice, recognizing the nature of the market place in Thailand.

There is a strong link between the business strategy of maximizing profit through banking services and the use of advanced information and telecommunication systems. The following factors determine the demand which will be placed on the telecommunication systems of the future:

1) The desire for customers to have access to banking services regardless of their location and independently of the need to travel to a branch;

2) The substantial growth of existing services, particularly those delivered at branches;

3) The considerable transmission demands of proposed future services, particularly those which require embedded signature images for verification; and

4) The increased future use of video, image and other multi-media interactive services.

The outlook is for rapid growth of telecommunications traffic, quickly exceeding the capacity of the existing network, and growing without any apparent limitation.

A network capable of carrying the telecommunications traffic required to support implementation of the proposed new services in the medium term (say 3 to 4 years) could be characterized as follows:

- Optical fiber and broadband digital microwave radio links interconnecting major capital city administration and information systems;
- Digital services connecting capital city systems to branches at speeds between 64 Kbps and 2 Mbps using both terrestrial and satellite services;
- Significant use of personal computers for both home banking and small business banking;
- Advanced information systems supporting branch banking on a largely automated basis and limiting the growth of branch staff; and
- Multi-media terminals being used at branches and special banking centers allowing customers to have direct personal access to interactive banking services.

At the present time, Branch banking operations are significantly affected by the inability of the existing public telecommunications service providers to provide adequate services. In particular:

- Existing services are not sufficiently reliable, resulting in delays providing on-line customer services (both over-the-counter branch services and ATM services, operational inefficiency associated with recovering from data errors, and excessive response time at banking terminals;
- In addition, demand for higher-speed services (both switched and leased lines) cannot be met, partly to the delay in implementation of ISDN;

• Growth is made extremely difficult by the delays and uncertainties in the ordering of new services and the unavailability of leased lines to some of the more remote areas of Thailand.

The current difficulty in maintaining existing services is such that the Bank has sometimes provided capital to TOT to acquire equipment required by TOT to provide services to the Bank, and also has made special arrangements with TOT to allow bank technicians to access and maintain TOT equipment, since TOT is unable to respond adequately to faults.

The following factors are limiting the rate of new services deployment and therefore of future revenue growth:

1) Planning and development of new information and telecommunications systems;

2) Staff training;

3) Availability of leased telecommunications lines, especially up-country; and

4) Education of up-country customers to accept and use new services.

Of these factors, the lack of availability of telecommunications lines is the most serious. Current network reliability and capacity are now at unsatisfactory levels

Because of the nature of the current telecommunications regulatory process in Thailand, it is unlikely that existing or new service providers will develop new networking infrastructure at a speed sufficient to provide the telecommunications services required by Thai Farmers Bank to grow without restriction.

3.4.1 Strategic Options

The provision of adequate telecommunications capacity is of fundamental importance to the future growth of the banking business. There are two principal strategies available to the Bank to maximize as far as possible the availability of telecommunications capacity, and these are described below.

3.4.1.1 Optimize the Existing Network

Thai Farmers Bank must use every means at its disposal to achieve maximum availability and throughput with the existing private and public telecommunications infrastructure. This will require appropriate consideration in the enterprise network design, and careful use of network management technology and techniques to ensure that available capacity is maximized and traffic flows are optimized. It also requires improved planning processes, to ensure that demands on the network can be anticipated and effectively met.

3.4.1.2 Alternative Transmission Paths

There are new telecommunication services that can provide media to Thai Farmers Bank for example TA (can service only Bangkok area), UIH and TT&T (can service only upcountry areas). These vendors are the alternative transmission paths for new network design.

Thai Farmers Bank has recently acquired equity in WorldSat, a company with good prospects as an alternative supplier of satellite communications services. This is no doubt a good investment from a business point of view. However, in the context of the Bank's urgent need for improved telecommunications services, it represents an acquisition of great potential strategic significance. It is recommended that the bank consider ways of using its capital and influence to fully understand, influence and directly facilitate the provision of new telecommunications services in Thailand, of which it will be a leading consumer.

3.5 Technical Requirements

3.5.1 General

This section outlines the technical requirements of the future Thai Farmers Bank network. These were identified through interviews and from the analysis of information provided to the consultants by Thai Farmers Bank.

TFB will be moving its main computing and communications equipment to a new head office in late October 1995, with the main move to commence in December 1995. The IBM ES9121/480 mainframe based in Silom will be relocated in October and upgraded in 1996, and will ultimately become the main processing computer for the core of the Bank's banking applications.

Due to the complexity of the Thai Farmers Bank network, it is challenging in the available time to define in detail the technical requirements. However, based on the information obtained so far, the following sections outline the understanding of the technical requirements of the bank in the future.

3.5.2 Current and Future Banking Applications

From the provided information, there are a number of identified banking applications which the Bank is currently using or desires to use in the future. In particular an important list comes from the Business Process Re-engineering group, which outlines a number of applications which it believes may benefit the Bank in the coming years.

In the technical requirements of the networking infrastructure the consultants have identified three main banking application areas, as follows:

1) TFB applications, including those deployed throughout the wide area network and those used only at (or between) Head Offices.

2) Connections which are external to the bank, such as SWIFT, ATM pool, MasterCard, Visa and cheque clearing facilities.

3) Dial-up banking services, such as credit authorization and PC banking.

Each of these categories are described in the subsequent sections below.

3.5.2.1 Thai Farmers Bank Applications

TFB currently operates a "mainframe-centric" architecture which means that most of its banking applications at branch level are performed on-line through the wide area network to the IBM mainframe, using the SDLC/SNA protocol. The major applications used were identified in Section 2.

From the information received, a number of important applications have been identified by the Bank as being required to be introduced (or started to be introduced) into the Head Office(s) and ultimately the branches. Some of the applications identified, in order of priority, are shown in the table below:

Table 3.1. Application of Thai Farmers Bank.

Application	Computing Platform	Deploy at Head Office?	Deploy to Branches?
Operation Information Network	Windows NT	✓	✓
Executive Information System	DEC VAX	✓	✓
Electronic Mail	Lotus Notes	✓	✓
Videoconferencing	TBD	✓	
Document/Image Management Workflow Electronic Forms	Lotus Notes?	✓	✓
Data Warehouse	TBD	✓	
Client/Server Query & Reporting	Clients: PCs Servers: various	✓	✓

Table 3.2. Application of Thai Farmers Bank (continued).

Application	Computing Platform	Deploy at Head Office?	Deploy to Branches?
Electronic Cheque Clearing	TBD	✓	✓
Electronic Data Interchange	TBD	✓	
Expert Systems	TBD	✓	✓
Desktop Videoconferencing	TBD	✓	✓
Computer Based Training / Video on Demand	TBD	✓	✓
Video Broadcast	TBD	✓	✓

Although no formal implementation timeframes for the above applications have been indicated by the Bank, it is understood that within two years most of them are to be at least started.

From the analysis of this information, a number of important issues have been identified:

1) The bandwidth requirements for the applications in the list are ever increasing and most of them will be implemented all the way to the branches.

2) The implementation of such applications in the Head Offices will be relatively easy, compared to their deployment in the Bank branches. The Head Offices will have relatively high-bandwidth backbones to run applications over whereas the branches must rely on the low-bandwidth wide area network to deliver the same application.

3) The wide area network designed must accommodate these future applications while continuing to support the on-line banking applications currently delivered.

4) The move to introduce Lotus Notes into the Thai Farmers Bank network will necessitate the routing of LAN-based protocols, which requires the implementation of a different networking architecture than the current "host-centric" one.

5) The computing platforms on which the above applications are based are disparate and use different protocols, necessitating the need for some standards setting for the both the IT and networking components.

6) The existing networking infrastructure in its current form **will not** be able to support these applications and requires a substantial upgrade. This is likely to incur substantial costs for both networking equipment and telecommunications services.

3.5.2.2 Third Party Applications

A number of important banking applications are being used by the Bank which use wide area network links to "third party" computer systems or applications. These are required to provide a range of services to TFB customers and were identified in Section 2 above. The list below offers a brief recap of some of the important external applications which are currently used:

Table 3.3. Third Party Applications.

Application	Computing Platform	End connection
Visa	MIP/PC	Visa Singapore
MasterCard	IBM Series 1	MasterCard Hong Kong
SWIFT	DEC VAX 4100	
ATM Pool	Tandem	PCC and on to other banks
THAICLEAR	NCR	Bank of Thailand
BAHTNET	OS/2 LAN	Bank of Thailand
Credit Authorization	Hypercom NAC	Various retail outlets

Apart from these important applications, the bank is likely to introduce more applications requiring external connections, as follows:

Table 3.4. Future Third Party Applications.

Application	End connection
Securities	Stock Exchange
EDI	Various organizations within and external to Thailand
Insurance	Insurance Companies
Links to international branches	Various locations overseas
Others?	TBD

The existing and identified external application sources must be connected by reliable data communications links enabling the applications to run efficiently and effectively. A number of issues must be taken into account when designing such links to external sources:

1) The Quality of Service provided;

2) Security;

3) Sufficient link bandwidth;

4) Reliability and availability.

3.5.2.3 Access from External Sources

The last category is those applications which the Bank provides to external users. These applications are used to grant users outside of the bank access to particular applications such as the following:

Table 3.5. Application of Thai Farmers Bank that is Provides to External User.

Application	Computing Platform	Access Mechanism
Phonebank	INFOBOT	PSTN or TFB network
PC Banking ("Video Banking")	INFOBOT	PSTN or TFB network
Point of Sale (POS)	Hypercom NAC	PSTN
Non-secure Banking Functions or General TFB Information	World Wide Web Server	TCP/IP connection to Internet service provider?

It is likely that the majority of customers will use the PSTN to access these applications, however, larger customers may be given special access and/or applications which they can use autonomously. The issues here are as follows:

1) Availability of applications and providing enough outside lines (or whatever other relevant infrastructure is needed) to enable reliable user access.

2) Ensuring that the provided applications and communications are secure, in order to prohibit outsiders from gaining unauthorized access to other the Bank applications.

3.5.2.4 Summary

As explained in the previous sections, there are several different areas of focus for Thai Farmers Bank computing applications which need to be drawn together when looking at the technical requirements. All have an influence on the optimum networking architecture.

The increase in banking applications, coupled with the necessity to route LAN-based data will certainly require an increase in bandwidth throughout the TFB network. This will require some analysis to ascertain the measure of benefit that the delivery of

such applications to the Bank (and external) users, compared to the up-front and annual cost of delivering them.

3.5.3 Available Data Communications Services

3.5.3.1 Current Services

Section 2.2 identified the telecommunications services currently being used in the TFB network. The services used consist of both terrestrial and satellite services, as well as using the PSTN.

The network design team have also attempted with some difficulty to ascertain from contacted carriers of the available data communication services which may be used in the future and their associated costs. From our brief review, the available data services are shown in the table below.

Table 3.6. Current Service of Data Communication.

Service	Available Speeds	Availability	Service Provider / Comment
PSTN	via modems with speeds between 1.2 to 34.8 Kbps	Now	TOT, TA, TT&T
Datanet	19.2-64Kbps V24,V.35	Now	Shinawatra Datacom Ltd
DDN	V.24 ,V.35,G.732	Now	TOT
ISDN	Basic Rate Service Primary Rate Service	Now Future	TOT (some area)

Further, service providers such as TelecomAsia(TA), UIH and TT&T are introducing infrastructure enabling the provisioning of data communications services when they are finally granted the concessions. Indeed, TFB has already specially negotiated links to their major nodes using TelecomAsia services. However,

TelecomAsia services are limited to the Bangkok metropolitan area and TT&T to the up-country areas.

Alternatives to terrestrial services include services already used by the Bank, including SCPC and VSAT technology. Although, these services tend to be expensive to procure and operate, they do provide an alternative service for redundancy purposes. For locations with line of sight, microwave links are another alternative technology. Determining an alternative overlay network via satellite will require analysis of appropriateness of satellite access technology (SCPC, DAMA, TDMA, CDMA), cost effectiveness (and regulatory requirements) of Satellite Provider (Thaicom, AsiaSat, PanAmSat, JCSAT and INTELSAT) and transponder type (Ku or C band).

It is recognized that the reliability and availability of data communications services in Thailand is potentially not as high as in other countries, and this has been taken into account by the consultants. However, it is understood that new infrastructure is rapidly being added, generating constant performance improvements.

3.5.4 Networking Requirements

3.5.4.1 General

This section briefly outlines the networking requirements for a new enterprise network for Thai Farmers Bank. Rather than listing in detail each individual system and protocol, it provides a structure around which a number of design blueprints can be developed. This section is broken down into the networking requirements of the Head Office(s), the major network nodes and the wide area network, and each individual category is described in more detail below.

3.5.4.2 Head Offices

The move to the new Head Office at Ratburana brings with it additional issues to those of a single Head Office, such as the requirement for a new high-speed network

backbone infrastructure for the new building. The fact that the majority of staff are moving to Ratburana but the mainframe at Phaholyothin will continue to be the prime computer, means that a high-speed broadband connection between the two Head Offices will be required.

At present, it is understood that a 2 Mbps link and several 19.2 kbps links are to be provided between the two buildings, however with the introduction of more banking applications, a much higher bandwidth link is likely to be required in the near future. Options here include an optical fiber link or a high-speed microwave link between the two buildings. However, both options have large drawbacks, the first being the cost of installation, the second having reliability and line-of-sight constraints.

The new Head Office, with its installed base of UTP and optical fiber cabling, has been more than adequately cabled to provide high-bandwidth within the 42-storey building and also to the Computing Centers building. However, the installation of high-bandwidth networking equipment is also required to provide a backbone fast enough to deliver services such as desktop videoconferencing between floors. Networking products now exist which provide both LAN-switching and ATM backbone switching and these are ideal products to deploy at the new Head Office.

The technical requirements for both Head Offices are to provide infrastructure to support IBM SNA-type and LAN-based protocols, as well as future real-time applications such as videoconferencing and computer-based training. In fact, eventually all of the applications defined in the earlier section above will need to be supported by the networking infrastructure.

3.5.4.3 Major Nodes

Besides the two Head Offices, there presently is a meshed core of 2 Mbps links between the major branches: Silom, Suapa and Talad Plu. These nodes form the basis

of the wide area multiplexer network. At present, 2 Mbps links may be sufficient to provide redundancy and bandwidth sharing, although they may need upgrading when the new banking applications come on-line. Further analysis is required to ascertain whether the major nodes of the network should remain where they are, whether new nodes should be added, or whether these nodes can be removed. Such technical issues will be resolved in the next Stage of the project which is the design stage.

3.5.4.4 Wide Area Networking Infrastructure

The present wide area networking infrastructure is the single biggest area of concern at present. Although providing a reasonable level of reliability and bandwidth, it cannot possibly support the envisaged new high-bandwidth applications which are likely to be introduced over the next few years. Therefore, a major technical requirement is the introduction of networking equipment into the wide area network which will either reduce bandwidth requirements or increase the bandwidth of wide area links. A number of options may exist, the ones presently identified are as follows:

1) Deployment of Front End Processors (FEPs) in major up-country nodes, connected to the central mainframe via high-speed wide area data communications links.

2) Replacement of the Codex multiplexers with multi-protocol routers or network processors which will allow the seamless transmission of SNA and LAN-based data with bandwidth on demand.

3) The introduction of an overlay network which will support the new banking applications, while only moderately improving the existing networking infrastructure as required.

Each option has its advantages and disadvantages over the others. However, each provides the basis for the generation of an enterprise design blueprint, the subject of the next Stage of this project.

With the development of a new wide area network infrastructure comes other issues, all of which will be addressed in the design of the network:

1) Redundancy - the ability to re-route data through alternative nodes with low latency is seen as an important design criterion.

2) Load sharing - with redundant links, bandwidth can be shared or automatically reallocated over multiple links to the same destination.

3) Prioritization of data traffic - this is an important issue if the same networking infrastructure is to support a number of different data sources and protocols: e.g. mainframe, LAN, printer, image and real-time data.

4) Backup communication links - where they are justified as being important.

3.5.4.5 Summary

Each separate category has its own unique networking requirement. The challenge is to design a network which will integrate all the networking elements together with maximum efficiency, reliability and flexibility, while enabling the Bank to fulfil its business objectives.

3.5.5 Network Management Requirements

At present, there is only limited network management of network elements in the Bank network, mostly through the Codex 9800 NMS. This system enables management of the Codex multiplexers and collects some statistics on the wide area network.

The only other NMS identified is the one used to control the Scitec Maxima bandwidth managers. This merely requires a dumb terminal connection to one of the ports on the Maximas.

At present, it is understood that although network bandwidth utilization statistics are stored on magnetic tape for three months, little if any analysis of the data is performed, and the data is discarded thereafter.

Although these NMS's provide some good management capabilities, modern NMS's provide many more powerful utilities and have the potential to anticipate problems before they occur. It recommends that the Bank procure network management system(s), which will enable the pro-active and integrated management of the following elements:

1) Configuration and management of all networking equipment used in the TFB network from a single terminal.

2) Monitoring, statistics, design, and analysis applications which will enable TFB telecommunications operators to pro-actively manage the network.

3) User hierarchies, access control, device allocation and configuration management.

4) Fault management facilities, such as alarm generation, disaster recovery procedures, redundancy.

5) Performance requirements such as bandwidth management, load balancing and sharing, user response times and future expansion.

6) Management of both IBM SNA-type network elements and LAN-based network elements.

7) Security of the network, including such items as network addressing conventions, firewalls, and the prevention of viruses and hackers.

8) Cable management, to ensure that cables have been installed, tested and labeled to recognized industry standards and to enable the easy identification of cable routes.

9) Asset management infrastructure for the identification of networking equipment, its quantity, type, location, cost, depreciation and expected lifetime.

10)Management of telecommunications leased line availability and quality.

Although it is doubtful whether the above elements can be managed within a single platform, they have been identified as being important criteria for the selection or design of network management systems.

3.5.6 Security Requirements

From the evaluation of the TFB network, there is no encryption of the transaction data sent over the wide area network between the ATM or teller and the FEP. This poses a significant security risk, from threats existing both internally and externally to the Bank. At present the full display of teller transactions appears on line traces taken at the FEP. This data contains the customer's name, full account details and the nature of the transaction, all of which is highly sensitive information.

So there is a definite need to give detailed consideration to improvements in the security of the handling of commercially sensitive information within the Bank's information systems and networks, especially when it is transmitted outside the Bank. Consideration should be given to use of encryption wherever sensitive data is transmitted.

3.5.7 Implementation Timescale

The definition of an implementation timescale is difficult, taking into account the fact that the Bank does not have its own identified timeframe for the introduction of many new banking applications. Indeed, market demands may cause new or unforeseen applications to arise which may change the networking requirements and hence the implementation timescale. Given this, the best estimated timing of the deployment of new networking infrastructure to support the applications identified in Section 3.2.1 is given below:

Table 3.7. Timing to Implement New Application.

Application	Computing Platform	Head Office	Branches
Operation Information Network	Windows NT	1Q96	1/2Q96
Executive Information System	DEC VAX	4Q95	2Q96
Electronic Mail	Lotus Notes	4Q95	2Q98
Videoconferencing	TBD	2Q96	N/A
Workflow Electronic Forms	Lotus Notes	2Q96	2Q98
Data Warehouse	TBD	3Q96	N/A
Client/Server Query & Reporting	Clients: PCs Servers: various	3Q96	3Q96
Electronic Cheque Clearing	TBD	4Q96	4Q97

The above timeframes are at best estimates and thus serve only as a guide. They may not reflect the priority that the Bank is in the current process of setting (or will be setting in the future) or the ease or difficulty with which such applications are deployed considering all organizational implications.

3.5.8 Conclusion

The technical requirements identified in the above sections serve to set a framework for the design of a new networking infrastructure. Together with the strategic requirements identified in the previous sections of this document, the technical requirements will be addressed in the next stage of the project which is the design stage.

3.6 **Vision, Mission, Goals and Objectives**

3.6.1 Vision, Mission & Objectives

As a result of interviews, discussions and an analysis of market and business drivers the following findings are offered for your consideration.

The overall vision of the Bank would appear to be best expressed as follows:-

3.6.1.1 Vision

"That Thai Farmers Bank is the pre-eminent bank in Thailand, providing the best possible service to all clients while meeting shareholders expectations and fulfilling social obligations".

The mission statement derived from the vision indicates direction:-

3.6.1.2 Mission

"To be a world class bank through the provision of professional banking services by establishing best practice in all activities through process re-engineering and continuous improvement".

From the mission a number of objectives can be developed, these objectives coupled with the mission, products, threats, opportunities and requirements can be used as the basis for the strategy of the bank. Understanding the strengths and weaknesses of the Bank and the national infrastructure are an essential part of the process of generating a strategy. Having established the overall approach, time can then be applied to the objectives. This results in the current and future strategy.

3.6.1.3 Objectives

The business objectives of the Bank can best be described as:-

- Protect existing market share
- Improve services to customers
- Create business growth in identified sectors

- Be positioned to take benefit of market opportunities
- Leverage the benefits of the branch network
- Make wider use of electronic transactions
- Make the branches become the focus for selling all services
- Develop new products and services
- Use banking and other technology developments as a means to establish business advantage
- Maintain or improve margins
- Move business from interest based revenue to fee based revenue
- Reduce operating costs
- Establish continuous improvement processes
- Maintain or improve profile in the market

A number of generic products or service improvements have been identified as providing the vehicles which will achieve these objectives. There are other specific business products being developed by individual business units as part of their business plans. These however will make use of the generic service capabilities.

New/Improved Products & Services

- Improved customer access to cash nationwide
- Improved deposits process nationwide
- Extended product sales through branches (e.g. insurance, Unit Trusts etc)
- Extended services through branches (e.g. "top up" smart card electronic purse)
- Email and electronic documents (e.g. Letter of Credit applications)
- EDI payments processes for commercial customers
- Extended electronic credit transactions from customers (e.g. payroll, dividends, etc.)

- Extended electronic payment transactions from customers (e.g. investments, insurance, credit card payments.)
- Cash Management services for commercial and high net worth individuals
- Extended electronic securities and custodial services
- Extended debit and credit card services (e.g. smart cards, credit scoring and approval at branches)
- Support and advice for small business customers (fee based)
- Extended Video banking to provide a wider range of services
- Extended telephone banking to include more services
- Interactive Television banking and payments services

The new and improved products/services put demands on the branches and other service outlets. The demands generate business requirements to support the delivery of these services. These business requirements are essential to the success of the extended customer service.

Business Requirements

- A single view of all customer relationships with the bank (not account)
- A customer can conduct business at any branch
- A single credit exposure/risk view of the customer available electronically
- Faster response to customer service needs
- Stable, reliable and available technology services
- Direct electronic access to the Bank for commercial and high net value individuals (those customers providing a good return to the bank)
- Branch and other bank staff trained in and knowledgeable of the new products and services

In addition to the business requirements the management of the Bank need certain additional information to support the operation and decision processes. These management requirements can be summarized as:-

Management Requirements

- Improved management information for decision support
- Improved financial information for decision support
- Improved corporate (Thai Bank) information to branches
- Risk and exposure reporting
- Business view of customers (customer profitability)
- Product costing
- Improved customer information for marketing (cross selling)
- Electronic document preparation and handling
- EMAIL for all offices
- Security and protection of network and bank data bases
- Fall back, alternate routing and recovery
- Computer Based Training for staff
- Video Based Training

The Product/Service, Business and Management Requirements generate demands on the computer systems and applications. There are also specific application demands which the businesses have identified or will identify. Other demands are generic in nature and can best be described thus:-

Systems Requirements

- A single logical data base for all customer information
- The ability to deliver all products and services to all branches
- Local printing and processing capacity in all branches

- Electronic customer identification and verification in all branches
- Standard access and interface rules between applications
- New products to provide electronic delivery and collection (business applications)
- Simplified screens for staff to provide services and products
- Improved processes using electronic documents
- Re-engineered processes
- New product application development (business applications)
- EMAIL application
- Electronic Document Processing system
- Automated workflow systems

Each activity of unit of the Bank should have a mission statement that reflects the task, the contribution and the relationship of the unit to the business. This applies equally to technology services as to the business generators.

With an understanding of the demands and expectations of the business the Telecommunications Group can develop a mission statement.

3.6.2 Telecommunications Mission

A Suggested Definition suitable mission statement for Telecommunications would be:-

"To provide quality telecommunications services through the improved management of advanced telecommunications resources in support of the current and future business strategies of the Bank".

Having established the generic product and requirement set the requirements for the telecommunications area can be identified as:-

3.6.2.1 Telecommunications Service Requirements

- Provide voice and data telecommunications access to all branches and offices of Thai Farmers Bank
- Provide redundant access to major sites for network fault recovery
- Support all Teller sales and transaction activities
- Support all ATM activities
- Support Customer Information System access
- Support Credit, Debit and Smart Card activity at branches and remote sites (POS)
- Support information distribution to branches and offices
- Provide electronic software distribution to branches
- Support videoconferencing
- Provide telephone access for banking services
- Provide network access for external parties (firewalls, security & authentication)
- Establish change control and problem/fault management procedures
- Monitor Network Performance
- Proactively manage the network
- Measure and report network performance
- Provide central support for communications users (HELP Desk for branches)
- Manage variations in bandwidth requirements
- Establish standard connection procedures
- Establish standard branch installation needs
- Toll free numbers for customer access to service desks
- Single Nationwide number for customer access to the Bank (at local call cost)

Prior to establishing the strategy four further considerations have to be made. The strengths and weaknesses need to be established and the threats and risks of the market

place assessed and understood. Some strengths are also potential weaknesses. The difference between the two is the manner in which the item at issue is used.

3.6.3 Strengths, Weaknesses, Threats and Risks

3.6.3.1 The Branch Network

The branch network is a substantial asset, it is nationwide, is under Bank control and provides physical access to the total population. The interconnection of the branches to Head Office, computing services, payment systems, clearing and settlement systems are reliant on the telecommunications services provided by the Telecommunications Unit of the Bank.

The branch network offers the opportunity to provide improved access to Bank services and products. These can be delivered to the whole country and customers travelling through Thailand could be serviced at any branch no matter where their account is held. The cost to competitors of establishing a similar branch network is prohibitive. Each time a customer uses a branch there is an opportunity to sell additional services. The branch has the capability of being a focus for the local community.

The branch network is a substantial cost overhead. There are a significant number of buildings and a substantial number of staff. To provide service the branch needs sophisticated equipment and communications. Staff and management have to be trained in both products and services and how to sell them. Processes have to provide a good level of service. Adequate authority needs to exist at branch level to satisfy customer demands.

While some more recent competitors do not have the national representation neither do they have the operational overheads of the branch network. Without a branch network they do not have the social obligations of providing banking service to all.

They are able to choose their customers. This enables them to provide selective quality service against which Thai Farmers will need to compete.

The large domestic base of customers is an essential asset from which the Bank draws strength. At the same time to provide all services to every customer can be extremely expensive and may result in a less than adequate service to the high value customer who needs rapid response and a higher level of service. It may be necessary to differentiate service levels dependent on client type.

3.6.3.2 The Telecommunications Network(s)

The Bank has extensive voice and data telecommunications servicing the whole organization. These are essential elements of daily work. Without these services the bank could not survive. Telecommunications service customers both directly (ATMs and remote access) and indirectly (branch terminals). As more services and products are delivered through the branch network the structure and capacity of the telecommunications network will need to grow.

Telecommunications availability from the service companies is the biggest single weakness that the bank has. It is a substantial exposure and needs to be addressed. It is the single factor that will limit the growth of the bank. This is not within the control of the Telecommunications Department, it is a matter of national infrastructure. The strategy of the bank will be severely limited unless lines and services are available to the capacity needed.

It should not be thought that a telecommunications network offers competitive advantage of itself, it is what is done with the network to deliver services and products. Providing they are prepared to invest, competitors can rapidly build their own telecommunications networks providing the services are available from the telecommunications suppliers. An extensive private network is an asset and can provide

higher levels of service, availability, reliability and lower costs than is available to others.

The competitive strength of network assets is not fully appreciated. Normally domestic banks own the individual or shared national ATM network. Unfortunately rather than protect this asset, in most countries ATM networks have been opened to all banks for a transaction fee. Why domestic banks should be so generous as to provide other competitors with nationwide access is not easily understood. Consideration should be given to protecting service delivery capabilities to make nationwide access difficult for competitors.

3.6.3.3 Reduced Interest Margins

The decrease in interest margins is not unique to Thailand. However many banks with large domestic customer bases have managed to maintain a better margin than those servicing other market segments. Traditionally pass book savings accounts have carried low interest rates providing a good margin for the banks. Where banks have dispensed with passbook accounts this source of revenue has disappeared.

Other sections of the market, such as small business services are increasingly fee based. It has proven difficult to change the retail customer to accept fees/charges for account keeping and governments have intervened to have charges removed or reduced.

To reduce risks of loss of revenue, existing products with good margins should be retained. If revenue is to be earned from fees then new products must be fee based from their introduction.

IV. SYSTEM DESIGN

4.1 Enterprise Network Requirement

4.1.1 General

As noted in the previous section (section III) which evaluated TFB's existing network and determined it requirements, the bank has three distinct networks, namely:

- a Banking network;
- a Wide Area Network (WAN); and
- a Voice network.

all of which are inter-related but not homogeneously integrated.

In designing the Enterprise Network Blueprint a concept was developed of one network supporting three "users", each having its own unique set of technical requirements and business focus. It was useful to review each network's existing configuration with a view to defining what network requirements each supports, so that the network can maintain balance between conflicting technical requirements and the business objectives.

4.1.2 Business Objectives

The Enterprise Network must:

a) Have a **high availability** if the objectives of workflow re-engineering are to be achieved;

b) Provide **significantly more bandwidth** to support new banking services (signature verification), corporate initiatives (video broadcast and video kiosk) and workflow practices (Lotus Notes and electronic mail);

c) Provide **measurable performance improvement** to support both front office and back office functions to improve the customer's perception of TFB and streamline TFB's banking practices;

d) Be **manageable** to guarantee performance, reliability and availability;

e) Be **cost efficient**;

f) Be **migratable** to meet new banking services and practices by utilizing Network Services Providers future offerings and advancements in technology.

4.1.3 Banking Network Requirements

4.1.3.1 Overview of Existing Network Configuration

TFB has begun relocating its banking host computers from Silom to the new Head Office Computer Center (level 3) at Ratburana. It is intended that these hosts be upgraded to full production capability within about 6 months and that Phaholyothin becomes the new disaster recovery site and also serves as the development platform for new services and maintenance of existing ones.

The primary host is an IBM ES9000 to which some 6 other hosts are interconnected. There is no management system of any kind on any of the hosts. The ES9000 hosts at Ratburana and Phaholyothin are planned to be interconnected via high speed channel extenders over a number of leased 2 Mbps and 19.2 kbps lines to provide backup on a regular basis. However, there does not appear to be any documented comprehensive disaster recovery plan.

The Bank's network is largely a star topology (with a few triangulated paths for overflow and redundancy) of leased land lines, three SCPC satellite circuits to remote major branches and some 35 VSAT's providing banking applications. All provide front and back office functions via multidrop modems and statistical (or time division multiplexers) at major nodes.

4.1.3.2 Network Requirements

The absence of a comprehensive disaster recovery plan and strategy is of major concern because whilst regular scheduled back-ups are performed, TFB has no

procedure for catering for a major catastrophic failure of one site. A range of different hosts provide a range of services and applications, but the two sites do not have the same hosts (other than the ES9000) and applications and services are distributed across the hosts across the two sites.

Although equipment is available on the market to protect data by real-time mirroring, this is not currently in operation. The performance of the network is inconsistent, as its availability is heavily dependent upon availability and reliability of TOT provided leased land lines. Branch terminal response is also inconsistent due to the nature of the protocol (SNA/SDLC) routed across the network.

The primary requirements of the bank's network are therefore to:

- improve response time for both front and back office applications;
- increase availability to support new and existing services and branch applications;
- increase bandwidth to support new banking services.

4.1.4 WAN Network Requirements

4.1.4.1 Overview of Existing Network Configuration

This section focuses on the design of the wide area networking (WAN) infrastructure required to support the delivery of current and future TFB computer applications to its branches. It sets the scene for the specification of the new WAN blueprint in the following sections.

The present TFB wide area network is characterized by multiplexer-based networking infrastructure, enabling the delivery of SNA 3270 applications to remote bank branches. IBM 3745 front end processors (FEPs) provide the connections to both the IBM ES9000 mainframe and the wide area network. There are five major nodes in the metropolitan area which are connected via 2 Mbps links, and these serve as the concentrators for the Central, Northern, North-Eastern, Southern and metropolitan

network nodes. Motorola Codex multiplexers are installed at most TFB branches and these provide the delivery of mainframe-based data to the branches.

A branch is characterized by a link connected to a multi-drop modem which provides connection to both an OS/2 LAN server and an Automatic Teller Machine. A token ring LAN connects the LAN server and a number of teller devices together.

The existing WAN network topology is basically a classical "hubs and spokes" network, where nodes in the major cities in Thailand serve as the concentrators for surrounding banking branches. The major nodes are connected to Bangkok and often another nearby hub for redundancy or load sharing purposes. In the past, the existing TFB wide area network has been able to support the delivery of banking applications to each branch with reasonable efficiency. However, large demands are now being placed on it to support an ever-increasing amount of data traffic and to deliver new banking applications which may or may not be based on a mainframe-centric infrastructure.

In particular, the needs of the WAN identified in the previous sections will not be met with any efficiency with the current networking infrastructure in place. Moreover, they necessitate a substantial upgrade of networking and telecommunications infrastructure, requiring significant expenditure on equipment and services. To some extent this can be justified because (from examination of the networking equipment Asset Register), the Written Down Value of most Codex multiplexers is only 10 Baht.

After relocation, the Wide Area Network will consist of backbone routers, each equipped with a 2 Mbps serial WAN interface for interconnection between them via a dedicated leased line. For redundancy, the same routers will be equipped with a 64 kbps serial WAN interface interconnection between them via another dedicated lease line. From our understanding, the telecommunication network in Bangkok generally cannot provide physically diverse paths.

4.1.4.2 Wide Area Network Requirements

A number of critical design criteria were identified in the earlier Needs Analysis, which the new WAN infrastructure must support. These are restated below.

- Necessary Elements

The following aspects of the new network have been identified as necessary and must be included in the new network's design:

1) Increased bandwidth and improve response times on the major composite links;

2) The ability to support a mixture of SNA and LAN-based protocols for the transmission of both new and existing applications all the way to remote branches;

3) The timely transmission of data from end to end using an efficient delivery mechanism;

4) An upgrade path to important future technologies such as Asynchronous Transfer Mode;

5) The majority of network elements must be manageable from a central network management platform;

6) The implementation of more security facilities such as encryption in the WAN.

- Desirable Elements

The following elements have been assessed as being desirable but not essential requirements of the new WAN infrastructure:

1) The elimination of end-to-end SDLC polling throughout the network as this presently is a large consumer of bandwidth;

2) The routing of data through network nodes, enabling intelligent decision-making for traffic transmission, the ability to load-share traffic and the minimization of traffic transmitted through the central nodes;

3) The ability for remote users using devices such as POS terminals to dial into the TFB network for the cost of a local call;

4) Duplication of telecommunications facilities at a separate disaster recovery site;

5) Cost-effective provisioning of telecommunications services.

4.1.5 Voice Network Requirements

4.1.5.1 Overview of Existing Network Configuration

Each of the four major Offices in Bangkok is equipped with Meridian SL-1 digital and ISDN-capable PABX's. Each interconnects to the TOT via 2 Mbps digital direct in-dial(DID) with diversity to be provided via 2 Mbps digital direct in-dial (DID) lines via Telecom Asia.

All other branches within Bangkok and at major up-country branches are equipped with Fujitsu ISDN-capable PABX's, but until ISDN is generally available throughout Thailand, connection will be via 2-wire to the PSTN. All other remote branches use Panasonic PABX's. Least cost routing is not implemented.

Some voice circuits are compressed and transported across the data network to between the four major Bangkok sites and three major up country sites via satellite. Where private leased circuits are available (ie to Chiang Mai, Hadyai and Khon Kaen) call-back to the "A Party" on circuit available is provided, but overflow into the public network is not.

4.1.5.2 Voice Network Requirements

The relatively high recurrent expenditure on voice is related to the lack of availability of leased circuits which forces all long-distance traffic onto the public network, and the absence of a call data recording system to manage voice traffic.

In considering the network as one homogeneous entity transporting all services including voice, the primary objective must be to reduce overall voice costs by integrating voice with banking and LAN data in a manageable manner.

4.2 Enterprise Network Design Blueprint

4.2.1 Overview

The Enterprise Network proposed by design network team has four elements, shown conceptually in Figure 4.1 They are:

1) a "star network" of leased 64 kbps circuits from Ratburana to major bank branches or nodes (as shown in Figures 4.1 and 4.2) with access devices integrating voice, LAN and banking applications;

2) a star network of 64 kbps of leased (for Bangkok area) and satellite links (for upcountry area)64 Kbps links from Phaholyothin to major bank branches or nodes to improve network availability;

3) a broadband point to point digital link high speed between Ratburana and Phaholyothin;.

4) Asynchronous Transfer Mode (ATM switch) at both Ratburana and Phaholyothin

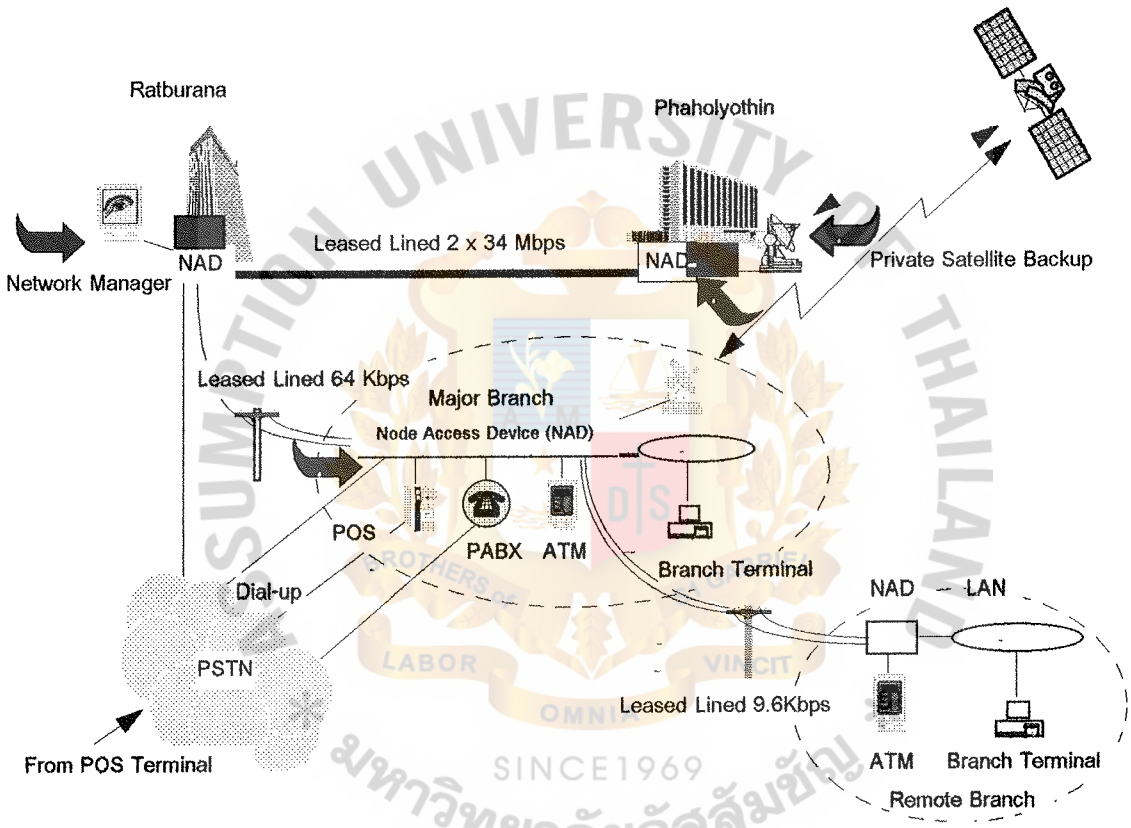

Figure 4.1. Conceptual Diagram of Enterprise Design Elements.

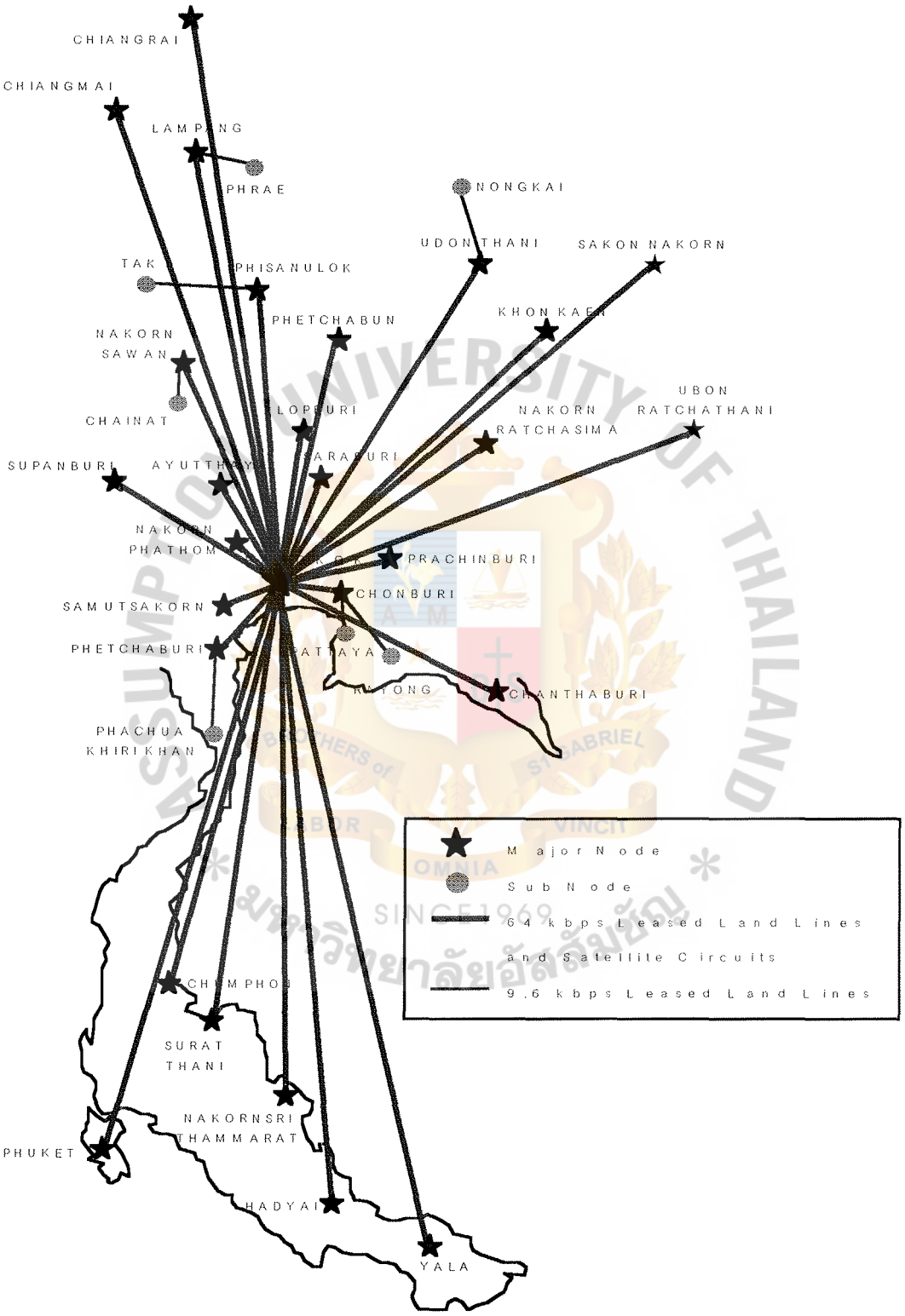

Figure 4.2. Star Network of 64 Kbps.

4.2.2 Access Nodes in the Wide Area Network

Given the need to support a potentially significant number of new applications in the future, it is apparent that TFB requires a new infrastructure based upon networking equipment which can support a number of networking protocols, as well as a number of networking interfaces, such as Ethernet, Token Ring, both low and high speed serial interfaces, and SDLC dial-up.

4.2.2.1 Backbone Network Protocol

- General

The need for an efficient backbone protocol is considered an imperative part of the network design. For the TFB network the backbone protocol must comply with the following criteria:

1) Must be able to transfer both SNA and LAN-based traffic;

2) Must be able to be routed through many network nodes;

3) Must provide scalable bandwidth and be easily upgradable on demand;

4) Must have a migration path to future technologies such as ATM;

5) Must be able to prioritizes disparate data traffic streams;

6) Must be supported on a number of different hardware platforms;

The number of protocols which can support the above criteria is limited; however the consultants have identified the following protocols as being suitable:

- TCP/IP;
- Frame Relay.

An analysis of each protocol is given in the sections below:

- TCP/IP

TCP/IP has rapidly become the routable backbone protocol of choice for enterprise networks. Its flexibility and availability worldwide make it a popular technology to deploy.

Advantages

1) Through its deployment in the Internet, it is an industry standard and hence is supported by the majority of network equipment vendors;

2) It is supported in a LAN as well as WAN environment;

3) It provides a number of standard useful program interfaces. e.g. FTP, SNMP and Telnet;

4) It has in-built routing characteristics using protocols such as RIP and OSPF;

5) It can transport LAN-based protocols easily through an enterprise network;

6) It can transport SNA-based traffic through the use of standards based protocols such as Data Link Switching (DLSw) or encapsulation, however this is sometimes inefficient.

Disadvantages

1) Its addressing scheme requires deployment throughout the TFB network and a massive amount of administration and management is needed;

2) TFB staff do not have much experience with the protocol and substantial training will be required, requiring a large investment of time and money;

3) There is a relatively large protocol overhead associated with each TCP/IP packet, which consumes link bandwidth and hence reduces efficiency;

4) Although supported in a LAN environment, because TCP/IP is a layer 3 protocol, the migration to a switching technology such as ATM is more difficult;

5) Bandwidth allocation and channel prioritization can be difficult;

6) TCP/IP is really only meant to support data transfer - voice and video cannot be sent without difficulty or performance degradation;

7) The protocol does not come with many security features which may be required in a banking environment;

- Frame Relay

Frame Relay is an international standard protocol which provides link layer packet switching throughout an enterprise network. It was specifically designed for high-speed LAN interconnection over a wide area network through the configuration of virtual circuits.

Advantages

1) It is extremely flexible in the use of link bandwidth as it has a very low protocol overhead and allows for the dynamic allocation of link bandwidth and data bursts, through the committed information rate (CIR) and other parameters;

2) Once a circuit is set up, Frame Relay provides a fast end-to-end data pipe, allowing the seamless transfer of data from source to destination. This enables a large variety of data traffic (LAN, SNA, etc.) to be carried efficiently and to be quickly transmitted through a wide area network;

3) Frame Relay can be supported in either a point-to-point, private or public network, or any combination of the three. Fast packet switching through network nodes is possible, as are alternate routing and load balancing;

4) Most networking vendors now support Frame Relay and a wide selection of equipment is available in the marketplace;

5) Frame Relay support is now available in IBM's product range, enabling the direct connection of networking equipment such as 3745, 3172, and 3174. IBM's routers also support Frame Relay serial interfaces. IBM have also brought out a new range of

networking equipment utilizing the Frame Relay protocol which can interface to TFB's existing legacy equipment. These are all important advantages when introducing Frame Relay into the TFB network;

6) Frame Relay can support voice and video as well as data, and provides a migration path to other switching technologies such as ATM;

Disadvantages

1) Frame Relay requires reliable transmission circuits and there is no node-to-node acknowledgment of data as there is with X.25;

2) Frame Relay is a synchronous protocol and therefore will not operate in an asynchronous network environment;

3) As Frame Relay is a packet switched technology, some configuration is needed to optimize channel prioritization of data streams.

4.2.2.2 Remote Node Configuration

At present, each branch has a multi-drop SDLC Link connecting an Automatic Teller Machine and an OS/2 LAN server with SDLC polling sent throughout the network. To support connection to Frame Relay, each branch requires the deployment of a either a multi-protocol router with a Frame Relay interface and a Token Ring interface for connection to the LAN at the branch, or a Frame Relay Access Device (FRAD) with the same interfaces.

The transmission of SDLC polls throughout the network must be minimized to maximize efficiency, and it is therefore recommended that each ATM be upgraded with a Token Ring interface card and positioned on the local LAN. The OS/2 server will no longer need to be polled by the host and can remain as the branch's file server. The transmission of 3270 traffic will now be via SNA/LLC2 over a Frame Relay circuit.

LAN traffic is also supported through the connection of the router or the FRAD to the Token Ring hub. The provisioning of a TCP/IP protocol stack will enable the transmission of new applications such as Electronic Mail, client/server and image transfer.

To allow for the local connection of dial-up 3270 devices such as Point Of Sale (POS) terminals, it is recommended that the OS/2 server at each be upgraded to support such a feature, or another machine be purchased as an Asynchronous Terminal Server. POS traffic can then be transmitted through the wide area network to the host for only the cost of a local call to the merchant.

4.2.2.3 Connection to Ratburana

As both SNA (mainframe) and LAN-based applications require transfer through the wide area network, devices such as multiprotocol routers must be used to connect Head Office computing equipment to the rest of the network. The networking equipment must also support connection to the Head Office backbone at both Ratburana and Phaholyothin to provide users on various floors of the new HO with the ability to send information over the WAN.

The types of devices requiring connection to the wide area network include:

1) Front End Processor for communications with the ES9000 mainframe, AS/400 minicomputers, Tandem computer and other computers and applications;

2) LAN hubs supporting both Ethernet and Token Ring for connection to file servers, PC's, SAA gateway, other routers and IBM 3270 LLC2-type devices;

3) LAN or ATM switches which may be deployed at the Head Office to provide a high speed backbone;

4) satellite or VSAT devices; and

5) possibly voice or video codec devices in the future.

The proposed network uses sophisticated and complex access devices which efficiently transport banking applications using fewer and more appropriate network protocols. Specifically the access nodes deployed in each branch will:

a) dynamically prioritize traffic according to business requirements for example mission-critical banking data (SNA) priority 1, back office data (Lotus Notes or TCP/IP) priority 2, and voice priority 3;

b) provide integrated compressed voice channels;

c) guarantee higher bandwidth utilization by about 3 to 10 times;

d) encrypt data to improve security of bank information; and

e) provide automatic dial back via the PSTN in the event of link failure.

Three variations of a network concept were considered:

- traditional routers;
- Frame Relay Access Devices (FRAD);
- IBM Nways Broadband switches with remote concentrators.

These three alternatives are now individually discussed in the sections below.

4.2.2.4 Traditional Routers

Implementing a routed network has become a standard solution when an organization decides to implement a corporate network. The network topology proposed by the consultants could equally be implemented using any popular brand of router. Routed networks, however, require the adoption of a routable protocol such as TCP/IP. All other protocols are then encapsulated inside this protocol.

In general, TFB will remain a host-centric network based on the computer centers. The key issue, therefore, is to select the most efficient protocols to exploit the available bandwidth, transport the necessary protocols, maintain response times and support the

capability to utilize redundant network paths for network resilience. In this scenario, routers add complexity without providing additional functions.

However, to adopt a routed solution will require trade-offs in a number of critical areas as indicated below:

1) **Cost** In preliminary cost analysis, using Cisco 7000 and 2501 routers versus a Frame Relay solution using Hypercom 5000 and 1000 units, the routed solution was more than 20% more expensive in its acquisition cost.

2) **Management Complexity** Routers are inherently complex to configure and manage. For TFB with its logical network topology, such complexity fails to add valued as it arises from providing feature sets which are not relevant to the TFB network.

3) **Poor Voice and Multimedia Capability** For speech to be intelligible, the digitized blocks must arrive at a consistent, predictable rate. This is inconsistent with the intrinsic nature of TCP/IP traffic which is typically in bursts of large blocks. Nor is this consistent with the routing and recovery algorithms in use, and for these reasons, voice traffic is rarely sent through a routed network.

Multimedia has similar, but tighter requirements than voice. The lack of market offerings in this area highlights the difficulties being faced, even when the carrier service is operating a LAN speeds of 10 Mbps or higher.

4) **Legacy SNA Support** The transport of SNA over TCP/IP requires that the SNA data be encapsulated into TCP/IP blocks prior to transmission. These are then subject to much the same problems that beset voice and multimedia on a routed network. The outcome is that inconsistent and unpredictable response times can be experienced by the SNA applications.

Most major vendors are now dropping their proprietary TCP/IP encapsulation of SNA in favor of Data Link Switching (DLSw), which standardizes the process and allows

true routing. When compared to the encapsulation process used by Frame Relay, DLSw is considerably less efficient due to its higher encapsulation process overheads. Empirical evidence reported in industry press benchmarks also indicates that router-based, SNA prioritization is less successful than that employed in Frame Relay in achieving consistent throughput and therefore predicable response times.

5) **Link Efficiency** TCP/IP was designed for environments where bandwidth is inexpensive and plentiful and link efficiency was not a factor in its design and implementation. As such it has high block overheads compounded by bandwidth-consuming routing protocols to maintain routing tables.

For the above reasons, a router-based network is possibly not as suited to the TFB environment as some of the other options.

4.2.2.5 Frame Relay Access Devices

Frame Relay is an internationally standardized protocol which provides link layer packet transfer and switching throughout an enterprise network. Along with ATM, Frame Relay evolved from the Broadband Integrated Services Digital Network (B-ISDN) developments and standards during the 1980's.

Because of its commercial end-user orientation, Frame Relay standards evolved far quicker than those for ATM and today there is a wide range of available equipment on the market at competitive prices and interoperability is not an issue. There are also a number of global value added network service providers (VANs) supporting Frame Relay, allowing standardized access to international sites.

Frame Relay Access Devices (FRADs) provide cost-effective transmission of different data streams in a private or public Frame Relay network. Modern FRADs can support a number of industry standard and legacy protocols, as well as interface to LANs.

To enable the standardization of vendor support of FRADs, the IETF's RFC 1490 is an industry-standard specification which defines a method for transporting multiprotocol traffic over Frame Relay. This enables protocols such as IBM SNA, TCP/IP and Novell's IPX to seamlessly be sent over the same wide area link. The bandwidth for each protocol stream is individually defined and does not impact on the performance of other protocol streams which may also be sent on the same link.

One of the advantages of Frame Relay over many other internodal protocols is that it supports voice applications. Frame Relay has a low protocol overhead and was designed for user rather than carrier speed links and supports variable packet sizing. Many product implementations therefore support voice carriage over Frame Relay with the most recent products offering voice compression to bandwidths in the 8 kbps to 14 kbps range.

Modern FRADs also have comprehensive support for legacy protocols such as SNA, providing local polling facilities, and incorporate data compression and security in the products. FRADs can also route network layer protocols such as TCP/IP, whilst normally being cheaper than dedicated routers. Vendors are currently building Asynchronous Transfer Mode interfaces into their next generation products which will provide a migration path to ATM in the wide area network in the future. Moreover, Frame Relay enables the prioritization of mission critical data such as on-line banking applications over less-critical back office data.

Given that TFB requires a wide area networking product which can support SNA for banking transactions, TCP/IP for back-office applications and voice for PABX networking, FRADs are a viable option for deployment in the wide area network.

4.2.2.6 IBM Nways Broadband Switches

The IBM Nways Broadband switch family of products is IBM's next generation of communications products. The IBM Switched Virtual Networking (SVN) strategy provides a migration path from legacy, host-centric architecture, to a flexible, switched architecture enabling the transportation of voice, data and video in the local and wide area network.

Central to IBM's wide area networking solution is the 2220 Nways family of switches. Not only do they support a multitude of wide area serial interfaces such as E1, E3, HSSI and Frame Relay for the transport of data, but they implement IBM's Network Broadband Services (NBBS) thereby supporting voice and video traffic using either a frame-based or cell-based transport mechanism. Further, they also provide interfaces to LANs and ATM, supporting a switched networking infrastructure throughout an enterprise network if desired. The 2220 comes in number of models, the 500 and 501, the 300 and the soon-to-be-released model 200.

Presently, the Nways 2220 product suite is relatively expensive when compared with high-end router products. For the minor TFB branches the 2217 is a low cost access switch providing both SNA/SDLC, Token Ring and Frame Relay connectivity. This could provide a cost-effective means to connect minor branches to a major branch network consisting of IBM 2220 switches.

Given that TFB has a large investment in IBM equipment, the Nways family of communications products provide a viable solution to its short and long term requirements. However, at this point in time, the IBM Nways suite is quite a bit more expensive than potentially cheaper alternatives such as FRADs.

4.2.2.7 Preferred Solution

The design network team preferred solution for the deployment of WAN Access Nodes is the use of Frame Relay Access Devices (FRADs), because of their efficiencies

in transporting SNA and LAN-based traffic, their ability to integrate and prioritize voice and generally lower cost per port than other products.

FRADs also can seamlessly interface with current and future IBM equipment, which is an important benefit to a heavy IBM user such as the TFB. FRADs also provide interfaces to LANs as well as legacy systems and vendors are now providing a migration path to ATM technology based on FRADs. The products are also much cheaper than comparable router-based or IBM Nways products, which is a further benefit, given the need to purchase a product for every TFB branch.

4.2.3 Leased Line and Satellite Overlay Network

For redundant paths to improve network availability for major bank branch and it support disaster recovery. The design network team design a star network of 64 kbps of leased (for Bangkok area) and satellite links (for upcountry area)64 Kbps links from Phaholyothin to major bank branches or nodes.

4.2.3.1 Leased Line Overlay Network for Bangkok Area

The design network team design 64 Kbps links from Phaholyothin to major bank branches or nodes by use another vendor that use links from Ratburana to major bank branches or nodes. This design help redundant physical paths by other vendor that TOT, TA, Data Net or UIH can support this requirement. Satellite links will not use for Bangkok area because they are very high cost compare with leased line.

4.2.3.2 Satellite Overlay Network for Upcountry Area

From discussions held with TOT, UIH and TT&T, leased lines have poor availability (suffer from frequent outages) and redundant physical paths are generally not available outside Bangkok metropolitan area.

The large geographically distributed TFB network, together with the forecast of a significant increase in bandwidth and the necessity for high circuit availability, suggests

that a **satellite-based VSAT network** for back up and load sharing purposes would be appropriate, subject to telecommunications regulations.

Satellite backup is most appropriate for the major branch nodes in up-country areas. Initially, satellite would be recommended at each major branch node in up-country areas, then as physically diverse transmission paths become available the satellite service could be redeployed to other branches. In this progressive way, reliability and increased availability is propagated further and lower into the TFB network.

The requirements for a satellite based overlay network are:

- at least 64 kbps circuits from Phaholyothin to each major branch node (Star topology);
- support voice communications;
- support data communications with at least SNA and IP protocols;
- cost effective;
- readily scalable.

Samart and Worldsat have confirmed that they have secured "C-band" capacity on ThaiCom from Shinawatra. Separately the consultants have established that both "C-band" and "K_u-band" capacity is available on JCSAT-3, AsiaSat-2, PanAmSat-2 and PanAmSat-4. The selection of appropriate satellite will largely depend on regulatory requirements, but choice will also depend on satellite capacity costs and performance of the Satellite Service Provider in Satellite management.

The selection of frequency band will be a trade off between:

- lower cost C-band equipment (though with time K_u-band equipment will decrease);
- lower cost C-band satellite costs;
- higher cost C-band antennas because they are physically larger;
- better performance of C-band under heavy rain and other environmental conditions;

• higher probability of interference to C-band equipment due to adjacent equipment operating at similar frequencies.

In considering suitable satellite access technologies, the consultants evaluated the appropriateness of:

• Time Division Multiple Access (TDMA) as currently used by TFB for some 35 remote branches and ATM's;

• Single Channel Per Carrier (SCPC) as currently used by TFB to three large remote branches;

• Demand Assigned Multiple Access (DAMA);

The relative merits and demerits of each is shown below in Table 4.1

Table 4.1. Suitability of Satellite Access Technologies.

Satellite Access Technology	Advantages	Disadvantages
TDMA	Efficient for large numbers of VSAT's using delay insensitive data applications. Ideal for star based networks. VSAT terminals relatively inexpensive.	Unsuitable for voice and pure SNA and IP protocol data (because encapsulation or conversion to X.25 required). Bandwidth restricted to usually less than 64 kbps. Unsuitable for mesh networks due to double hop via satellite. Hub is relatively expensive.

Table 4.2. Suitability of Satellite Access Technologies (continued).

Satellite Access Technology	Advantages	Disadvantages
SCPC	Ideally suited to star networks with some mesh connectivity. Efficient for both voice and data. Bandwidth available from 2.4kbps to 8Mbps. Hub is least expensive because satellite and network control and management is not required.	Inefficient utilization of satellite resources, therefore tariff is higher. Hub costs increase as the number of VSAT's increase.
DAMA	Most efficient for star or full mesh voice and data networks, utilizing less space segment resources.	Less efficient where only one time zone is covered. Hub is relatively expensive. Bandwidth restricted to 64kbps. Call set-up time unsuitable for interactive data applications

The Network design team believe that the most suitable satellite access technique is SCPC because:

• the majority of TFB network traffic is real time interactive data between remote branches and TFB's head office, as is voice communications (certainly initially) i.e. a "star" network topology;

• SCPC modems tend to be more flexible in bandwidth and feature capability, making capacity and network changes far simpler and more easily customized. For example most SCPC modems can offer user selectable data rates from 9.6kbps to 8Mbps and the range of modulation schemes (BPSK, QPSK) and Forward Error Correction techniques (rates 1/2, 3/4, 7/8) can reduce operating costs or improve network performance;

• in conjunction with intelligent bandwidth management devices (such as Frame Relay Access Devices), prioritization of voice and data as they vary over time and at different branches can be accommodated.

To obtain the maximum benefit from a satellite based overlay network the Network design team recommend that a satellite earth station hub be established at the Disaster Recovery site of Phaholyothin with SCPC circuits to each of the 50 or so major branches in up-country areas equipped with VSAT's. This architecture offers:

• voice, data and image;

• route diversity;

• scalable bandwidth (from 64kbps, up to a maximum of 2Mbps);

• high circuit availability > 99.5%;

• rapid deployment anywhere in Thailand.

4.2.4 Ratburana to Phaholyothin Link

The establishment of a high-speed broadband link between Ratburana and Phaholyothin is is essential to:

a) ensure seamless operation of both offices;

b) improve the rate of recovery of the bank's operation in the event of a catastrophic disaster of either site;

c) reduce the amount of data and information lost during major equipment failure;

d) support network diversity and availability by acting as a hub for a satellite based overlay network;

e) obtain significant cost savings compared to leasing broadband capacity.

Whilst it is difficult to determine accurately the bandwidth requirements between these two major sites, the total bandwidth required will be the sum of:

- real time host to host connections via high speed channel extenders;
- Link data WAN for data from branches;
- voice traffic;
- LAN traffic host & file server access and information transfer via electronic mail;
- videoconferencing;

The maximum recommended speed for the channel extenders to achieve real time duplication is 34-50 Mbps.

The maximum recommended speed for WAN traffic is 4-6 Mbps

The voice traffic between the two offices can estimated from each channel use 64 Kbps and maximum use is 60 channel. So maximum recommended speed for voice is 4 Mbps.

The LAN connection between Ratburana and Phaholyothin are estimated that operates at maximum speed is 4-8 Mbps.

Two major videoconferencing studios are operating at maximum speed 768 Kbps, then the total estimated bandwidth requirements to support videoconferencing is 768 Kbps.

The upper limit, combined estimated bandwidth required between Ratburana and Phaholyothin is then 69 Mbps but those traffic are not use the same time. These mean use only 2*34Mbps are the suitable for demand. This capacity can be provided either by:

- leasing broadband fiber optical cable capacity from TOT , CAT, TA or UIH; or

• digital point to point microwave link.

All leased line vendors have confirmed that broadband capacity can be provided via fiber optical cable and price for leased line are lower than use microwave link very much and may be problem about the obstructing building. So we design use high speed leased line link between Ratburana to Phaholyothin by use 2 vendor to support each link for prevent the problem totally fail.

4.2.5 High Speed ATM Switch at Both Ratburana and Phaholyothin

Ratburana to Phaholyothin Link 2*34 Mbps, that design in section 4.2.5 must use some equipment to link together and must support application channel extenders, link data WAN, voice traffic, LAN traffic and videoconferencing.

The network design team uses ATM switch to connect all these application together because it can share bandwidth that voice or videoconferencing use for each time. It is not stay if we are not using them. For the future we can share LAN traffic at the same manner.

4.2.6 The Managed Bandwidth Enterprise Network

The new Enterprise Network proposed by the network design teams therefore entails:

• TFB leasing 64-256 kbps(up to traffic) land lines from Ratburana to each major branch in Bangkok and up country as they become available;

• Leasing 64-256 kbps(up to traffic) land lines from Phaholyothin to each major branch in Bangkok

• installing a satellite based network of SCPC circuits between a satellite earth station hub at Phaholyothin and VSAT's at each major branch ;

• Leasing 34Mbps fiber line 2 link from 2 vendor between Ratburana and Phaholyothin for WAN, LAN, voice and host-to-host connectivity;

• TFB leasing 64 Kbps (for Bangkok area) and 9.6-19.2 kbps (for upcountry area) land lines between major branches (Node) and small or remote branches;

• installing Frame Relay Access devices at each branch. At Ratburana the FRAD will interface the host to each of the WAN leased land lines , at Phaholyothin the FRAD will interface to the disaster recovery host and each of the WAN satellite circuits including the microwave link. Each major branch will interconnect their file server, ATM, asynchronous POS server, PABX to their FRAD, with one WAN connection via land line to Ratburana and one WAN connection to Phaholyothin via land line or satellite. Each small or remote branch will interconnect their server and ATM to their FRAD and one WAN connection to the nearest major branch.

• Installing ATM Switch at Ratburana and Phaholyothin. ATM Switch will interface FRAD, PABX, videoconferencing and high speed leased line 34Mbps

• implementing a Network Management and Configuration Management System.

The two overlaying star network of interconnecting leased land lines and satellite circuits (or leased land lines from other vendor) from two diverse sites in conjunction with the FRADs will:

• provide load sharing between the two 64 kbps links, providing 128 kbps capacity under ideal conditions to major branches

• in the event of failure of either link, enable traffic to be carried and prioritized over the operational bearer;

• will improve performance of each remote branch through prioritization of traffic and use of more appropriate protocol;

• enable each major branch to be capable of prioritizing SNA, IP and voice traffic, and as a picture of the network performance is built up from the NMS, fine tune individual

branch performance to suit local banking practices, customer requirements and reducing voice costs as appropriate;

• during periods of lower than peak utilization of bandwidth allocated to a particular traffic type (say SNA), allow other traffic (say voice or IP) to burst over their allocated bandwidths up to the maximum available, in this way the total bandwidth is always utilized by the traffic which requires it (but under heavy load, SNA would always be given highest priority).

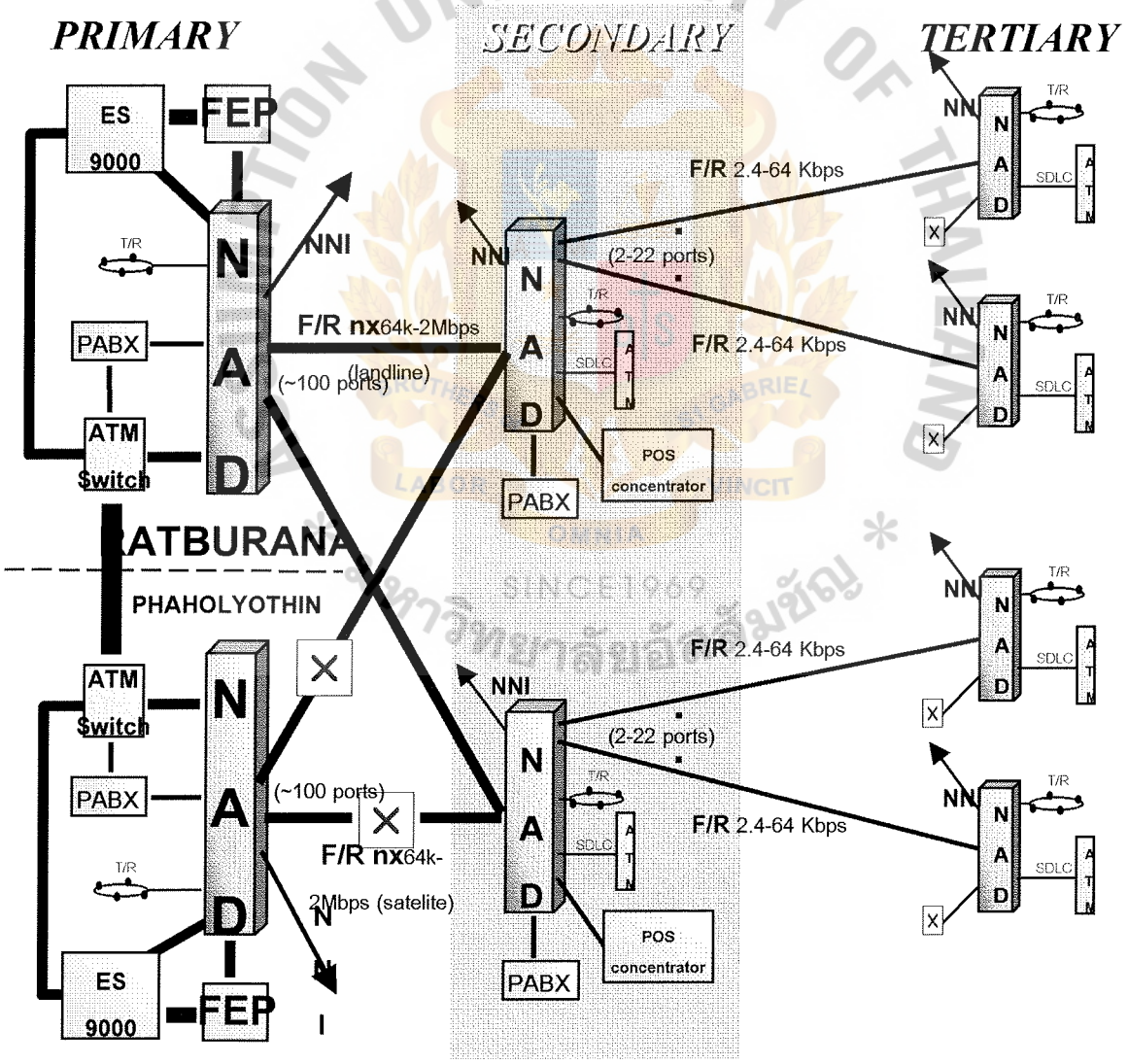

Figure 4.3. Diagram of New TFB Network.

4.3. Hardware and Topology Configuration

4.3.1 Technical Specification for Frame Relay Access Equipment

4.3.1.1 Overview

In preparing their response, tenders should address their design to the following key objectives for TFB's new enterprise network:

- The concurrent transport of SNA and LAN-based traffic;
- Sessions can be routed to their destination through multiple intermediate nodes;
- Bandwidth can be scaled for end end-point node or intermediate link;
- Support a migration path to emerging technologies such as ATM;
- Permit the prioritization of discrete data traffic streams;
- Provide mechanisms to ensure that SNA response times are. and remain predictable;
- Common management interface;
- Maximize online availability.

The broad design is based on two primary sites, Ratburana and Phaholyothin, each terminating links from some ninety secondary sites (major branches) which in turn each act as a concentration point for an average of six tertiary sites (smaller branches). The intermodal protocol shall be Frame Relay supporting SNA and TCP/IP based devices. The following table indicates features which are considered either mandatory or highly desirable in all equipment tendered in this separable portion. Tenders are to indicate their compliance to each requirement. Where compliance is indicated it will be taken to cover all equipment for the primary, secondary and tertiary sites unless specifically qualified by the Tendered.

4.3.1.2 Requirements for Tertiary Site Nodes

The tertiary sites consist of approximately 500 TFB branches located throughout Thailand. Each site is supported by an OS/2 Server Token Ring environment and may

Tertiary, sites connect to their secondary site via leased circuits operating typically in the range 2400bps to 19200bps. In the event of link failure the tertiary site shall automatically establish a dial up circuit to Phaholyothin.

Tenders may offer a solution which is integral to the OS 2 server providing that it meets the requirements below.

Table 4.3. The Tertiary Node Requirements.

	Tertiary Site Feature	Requirement
1	Token Ring Interface l6Mbps	One-Two
2	SDLC Serial V.24 Port 2400bps - 19,200bps	One-Two for ATM
3	Frame Relay WAN Feeder interface 2400bps-64kbps (V.24,V.35)	One
4	Automatic dial backup	Required
5	NNI interface	Optional if public VAN becomes available
6	Integral DSU	Optional

4.3.1.3 Requirements for Secondary Sites

The secondary sites consist of approximately 90 TFB major branches located throughout Thailand. The branch processing configuration is similar to the tertiary sites. Each site is supported by an OS/2 Server Token Ring environment and may also have one or more on site or remote Automatic Teller Machines connected via low speed SDLC interface.

Currently POS devices dial into Hypercom Network Access Controllers located at a central site in Bangkok. As part of the network redevelopment, TFB wish to provide a regional concentration point for dial or leased line POS devices. Accordingly Tenderers are invited to offer suitable equipment either integral to the Secondary node or standalone with appropriate interfaces to the node.

Secondary sites connect to the Ratburana Primary Site via terrestrial leased circuits operating initially at 64kbps but possibly up to 2Mbps in the future as this bandwidth becomes available throughout Thailand. Additionally, the node will have a 64kbps land line digital link (Bangkok area) or satellite link (upcountry area) to the Phaholyothin primary node to improved link availability and provide an alternate diverse path. This link will also support non essential services, or overflow under peak conditions.

TFB also intends carrying a limited number of voice traffic circuits between the primary and secondary sites. Tenders are requested to detail their preferred solutions for voice over Frame Relay including options, performance trade-offs. and costs to implement same. A range of interfaces (2W, 4W E&M, El) may be required according to the existing branch PABX capability.

Table 4.4. The Secondary Node Requirements.

	Secondary Site Feature	Requirement
1	Token Ring Interface l6Mbps	One-Two
2	SDLC Serial V.24 Port 2400 - 19,200bps	One or more for ATMs
3	UNI ports for downstream tertiary nodes at speeds from 2.4 Kbps to 64Kbps	2 to 16 site dependant
4	Frame Relay WAN Feeder interfaces 2400 -64,000 bps (V.35)	Two (indicate if higher speeds available)
5	NNI interface	Required if public VAN becomes available
6	Frame Relay Pass Through	Required
7	Automatic Dial Backup for downstream(PSSTN)	Required
8	Async Port	Required
9	Integral DSU	Optional
10	Voice circuit interfaces	Desirable, see Primary site PABX notes

4.3.1.4 Requirements for Primary Sites

a) Private WAN interfaces

The two primary sites are the main computer center at Ratburana and the Disaster Recovery Site at Phaholyothin.

Ratburana will terminate all terrestrial leased lines, operating initially at 64kbps, but possibly up to 2Mbps, from the ninety (90) secondary sites. Ratburana will be connected to the Phaholyothin Node via ATM Switch .

Secondary sites also will have a 64kbps land line digital link (Bangkok area) or satellite link (upcountry area) to the Phaholyothin primary node for improved link availability, alternate route and disaster recovery access.

In normal operation, it is expected that the bulk of the traffic will have Ratburana as its origin or destination. Very little traffic will terminate locally at the Phaholyothin primary node. Should Ratburana become unavailable for processing or communications access then processing will be transferred to Phaholyothin and network access adjusted as required.

b) Public WAN interfaces

Should a public domestic Frame Relay network become available in the future in Thailand, TFB requires the ability to interconnect its private network at the primary and secondary sites. The Tendered shall provide:

- a description of the options available in the products tendered;
- an assessment a of the impact of implementing the required products on the then existing configuration;
- expected costs.

TFB also may require interfaces between its network and one or more international Value Added Networks for service delivery to its offshore branches and key international financial institutions. The Tendered shall provide:

- a description of the options available in the products tendered;
- an assessment of the impact of implementing the required products on the then existing configuration

- a list of those countries in which the products tendered are currently available;
- expected costs.

c) ATM Interface Requirements

The primary site backbone is planned to be ATM based using workgroup ATM switches interconnected to a central ATM switch.

Servers will be attached to this central ATM switch which will need to be accessible by users located in secondary and tertiary sites over the Frame Relay network.

Tenderers shall provide:

- compliance statements for the equipment proposed to the Frame Relay Forum/ATM Interworking Implementation Agreements;
- the method by which the ATM interface is to be implemented;
- an outline of their ATM implementation experience;
- three reference sites where the vendor has implemented similar interfaces.

d) IBM Host Systems Access

It is proposed to directly interface the Frame Relay switches at Ratburana and Phaholyothin to the IBM ES9000 Mainframes. Currently, TFB operates IBM3745s with one 3746-900 running NCP Release 7.1. TFB are not committed to implementing IBM 3746-950s. The Tenderer shall provide

- alternative and their recommendation for interfacing to the IBM host environment;
- a description any IBM (or other third party) hardware or software needed to implement the interface;
- expected costs.

e) Voice Integration

TFB also int ends carrying a number of voice traffic circuits between the primary and secondary sites. The primary sites operate Meridian SL-1 digital and ISDN capable PABXs and the secondary sites operate Fujitsu ISDN capable PABXs.

Tenderers are requested to detail their preferred solutions for voice over Frame Relay including options, performance trade-offs, and costs for implementation. Interfacing is expected to be via 2W or 4W E&M trunks according to the existing branch voice service implementation.

Table 4.5. Each Primary Node Configuration.

Primary Site Feature	Requirement
Frame Relay channelized WAN 2Mbps link interface (G.703) (receive traffic from secondary to primary site)	7 circuits
Frame Relay WAN V.35 link interface	57 ports
HDLC port (receive traffic from upcountry secondary site POS concentrator)	equal all of HDLC ports from secondary sites
Voice 2Mbps circuit interface for node to PABX at primary site (G.703)	174 channels
Automatic PSTN dial backup POOL for downstream branch (V.34)	35 channels include modems
Automatic ISDN dial backup for downstream node	1 PRI circuit or 30 BRI channels (prefer PRI)
ATM OC-3 interface for ATM Switch for Paholyothin-Ratburana connectivity	1 port
Host connectivity via FEP 256Kbps (V.35)	20 ports

Table 4.6. Each Primary Node Configuration (continued).

Primary Site Feature	Requirement
Host connectivity via FEP 2Mbps (V.35)	8 ports
Frame Relay Pass Through	Required
Provide via traffic load balancing from secondary sites	Required
NNI interface	Required if public frame relay network becomes available

4.3.2 Technical Specification for ATM Switch Equipment

The two primary sites are frame relay primary node and main computer at Ratburana and Phaholyothin. ATM Switch will terminate frame relay primary node, operating at34Mbps or more. This site will also be the originating point for voice circuits via 2 PRI-ISDN interface to the main PABX Meridian-1 from Nortel at both sites. Video Conference at both Ratburana and Phaholyothin will interconnect to ATM Switch bye use proprietary HDLC protocol. Channel Extender between Ratburana-Phaholyothin that use for real time host to host connections or remote copy will use HSSI interface.

Dual link 34 Mbps between Ratburana and Phaholyothin will connect to ATM Switch.

Table 4.7. Each ATM Switch Configuration.

	ATM Switch Site Feature	Requirement
1	WAN E3 link circuit connect between Ratburana-Phaholyothin (G.703)	3 circuits
2	PABX TIE TRUNK between Ratburana-Phaholyothin (ISDN PRI)	120 channels (4 PRI circuits)
3	ATM OC-3 interface for Primary Node Frame Relay Phaholyothin-Ratburana connectivity	2 channels
4	VDO conference between Ratburana-Phaholyothin (proprietary HDLC protocol)	1 port
5	Router or ATM Workgroup interfaces	Optional

4.4 Topology Configuration

4.4.1 Criteria for Bangkok Area

Table 4.8. Criteria for Design Link in Bangkok Area.

Node	Reason
1. ATM and EDC outside Branches	
ATM should be leased line connect to Secondary Node Speed 9.6 Kbps Backup use dial backup to Primary main node	all model of ATM can use speed maximum at 9.6 Kbps
EDC should be leased line connect to Secondary Node Speed 19.2 Kbps Backup use dial backup to Primary node	all model of EDC can use speed maximum at 19.2 Kbps

Table 4.9. Criteria for Design Link in Bangkok Area (continued).

Node	Reason
2. Tertiary Site Nodes	
for sub branches or branches grade B that have transaction not more than 1,500 transaction/day and terminal lower than 25 terminal/branch	Price for digital leased line for 64Kbps and 19.2Kbps are nearly same and in Bangkok it is easy to find leased circuit 64Kbps
use digital leased line 64 Kbps connect to Secondary node	
Backup use dial backup or ISDN to Primary Node	Many area in Bangkok can not find ISDN for backup
3. Secondary Sites	
define by branches grade A that have transaction more than 1,500 transaction/day and terminal more than 25 terminal/branch or branches that have Region Center or International Trade Center	Define from high transaction and high priority that should not fail
Each Node must support Tertiary Nodes are not more than 9 branches and ATM or EDC out site branch not more than 12	Fix branches to access node because if node fail will effect branches not much and easy to backup
Use digital leased line N*64 Kbps(n up to traffics) connect to Primary node both Ratburana and Phaholyothin (different vendor) for share load, backup and disaster	
Backup use dial backup or ISDN to Primary Node	Many area in Bangkok can not find ISDN for backup

4.4.2 Criteria for Upcountry Area

Table 4.10. Criteria for Design Link in Upcountry Area.

Node	Reason
1. ATM and EDC outside Branches - ATM should be leased line connect to Secondary Node Speed 9.6 Kbps - Backup use dial backup to Secondary Node	all model of ATM can use speed maximum at 9.6 Kbps
- EDC should be leased line connect to Secondary Node Speed 19.2 Kbps - Backup use dial backup to Secondary Node	all model of EDC can use speed maximum at 19.2 Kbps
2. Tertiary Site Nodes 2.1 Low speed link For sub branches or branches that have transaction not more than 1,000 transaction/day and terminal lower than 20 terminal/branch use analog leased line 19.2-28.8Kbps connect to Secondary node (use old leased line that use old network) Backup use dial backup to Secondary Node	Transaction are low, low speed can support application at branches, in rural area it can not easy to fine digital link Only dial backup (speed 19.2-28.8Kbps) is enough for small branches. Backup to Secondary node because price for dial to primary node is high.

Table 4.11. Criteria for Design Link in Upcountry Area (continued).

Node	Reason
2.2 High speed link	
for branches that have transaction higher than 1,000 transaction/day and terminal higher than 20 terminal/branch or branches that have Region Center or International Trade Center that stay in same area (province)of branches that more priority	Transactions are high, but it is priority low than Secondary node.
use digital leased line 64Kbps connect to Secondary	
Backup use dial backup or ISDN to Secondary Node	Many area in upcountry can not find ISDN for backup
3. Secondary Sites	
Define by branches grade A that have transaction more than 1,500 transaction/day and terminal more than 25 terminal/branch or branches that have Region Center or International Trade Center and must highest priority in that province.	Define from high transaction and high priority that should not fail
Each Node must support Tertiary Nodes in same province or near province are not more than 20 branches and ATM or EDC out site branch not more than 20	Fix branches to access node because if node fail will effect branches not much and easy to backup, define only branches in near province because leased line between province are higher than in the same province.
Use digital leased line N*64 Kbps(n up to traffics) connect to Primary node at Ratburana and Satellite VSAT SCPC at Phaholyothin for share load, backup and disaster	
Backup use dial backup or ISDN to Primary Node	Many area in upcountry can not find ISDN for backup

4.5 Cost/ Benefit Analysis

4.5.1 Overview

This section outlines the Network design teams estimates of the costs of Network Implement by use Frame Relay Access Devices. And the costs of hardware by use the three alternative network designs proposed, they being the Frame Relay Access Devices, using traditional routers and the IBM Nways Switched Virtual Network.

4.5.2 Cost Estimates

First table shows Network costs using Frame Relay Access Devices.

Table 4.12. Enterprise Network Costs Using Frame Relay Access Devices.

Summary Costs (including 10% contingency)	Total (Baht 000's)	Hardware (F/R)	
		Up speed link	HW (F/R)
Ratburana&Phaholyothin			
Capital	25,870	300	25,570
Recurrent	19,618	18,000	1,618
Major Branches			
Capital	117,085	7,000	110,085
Recurrent	67,769	60,000	7,769
Remote Branches			
Capital	99,545	7,000	92,545
Recurrent	66,403	60,000	6,403
Grand Total Enterprise Network			
Capital	242,500	14,300	228,200
Recurrent	153,790	138,000	15,790

Second table shows Hardware costs using three way Frame Relay Access Devices, traditional routers and the IBM Nways Switched Virtual Network.

Table 4.13. Hardware of Network Costs Comparison for Different Access Devices.

Summary Costs (including 10% contingency)	Costs of Hardware		
	FRAD	Routers	IBM Nways
Ratburana/Phaholyothin			
Capital	12,785	17,153	11,878
Recurrent	809	1,107	748
Capital	12,785	17,153	11,878
Recurrent	809	1,107	748
Major Branches			
Capital	110,085	144,892	330,300
Recurrent	7,769	10,300	23,784
Remote Branches			
Capital	92,545	69,913	109,519
Recurrent	6,403	4,834	7,579
Grand Total Enterprise Network			
Capital	228,200	249,111	463,575
Recurrent	15,790	17,348	32,859

4.5.3 Actual Cost

Following table shows actual costs of implement network for Thai Farmers Bank

Table 4.14. Actual Cost of Implementation of Thai Farmers Bank Network.

Year	Actual (Mbaht)		
	Capital Cost	Recurrent Cost	Total
1997 Start	0.5	0.0	0.5
1998 BKK	218.0	40.0	258.0
1999 Upcountry	81.6	80.0	161.6
Total	300.1	120.0	420.1
2000 Tuning	0.0	110.0	110.0

4.5.4 Benefit Analysis

From section 4.5.2, Thai Farmers Bank estimates cost to implement this project by dividing 2 parts. Part I capital cost are 242,500,000 baht and Part II recurrent cost are 153,790,000 baht. This section will contain the benefit analysis. From the objective of network implementation of Thai Farmers Bank, we can conclude the benefits as follows:

a) The reliability of services will be dramatically increased to 99.5% (from lower than 95%)

By designing the network to redundant root, automatic backup, NMS will monitor and alarm a warning before the problem occur.

b) Grater bandwidth will be available to support new services and improve response time for existing services;

By increasing speed main links from 9.6-19.2 Kbps to 64 Kbps (3 to 6 times). It makes faster response time and makes available bandwidth for other application.

c) Banking traffic, corporate traffic and integrated voice can be dynamic priorities to ensure maximum performance is available and when required to TFB's customers, banking processes, and achieve significant reduction in voice costs.

By using protocol frame relay this can support LAN, voice, image or video application that Thai Farmers Bank will use it in future.

d) Comprehensively manageable to ensure that key performance indicator relating to network performance, its availability, service reliability, network response etc. can be routine and network costs controlled.

By using NMS to help manage network easily, can use data from NMS to monitor and tune the traffic of networks.

Therefore, we can estimate cost of benefit as follow:

- From reliability of services we can increase reliability from 95% to 99.5%. It can estimate if the bank can not operate 1 hour/branch that loses money at 10,000 baht. So Thai Farmers Bank has 500 branches and operating hours in one year are estimated at 6Hr/day * 5 days/week * 52 week/years = 1560 hour So if we can improve network availability 4.5% (99.5-95), we can save money from loss of opportunity estimated at 1560 hours * 500 branches * 10,000 baht * 4.5% = 351,000,000 baht/year
- From higher bandwidth that can support new applications for example

Lotus Note used for e-mail, workflow (loan approve, tracking loan) or other applications this help Thai Farmers Bank easily to manage information and it will has opportunity to compete with other banks. These benefits are intangible costs but we estimate opportunity for new application costs at 100,000,000 baht/year

Fast response time, higher bandwidth will make fast response time for all applications for example Teller transaction, ATM or EDC this help support more transaction. We will estimate fast response time (more than one time) will make support transaction up

to 30%, each transaction are cost 3 baht, each branch have transaction average 1,000 transaction/day, ATM have transaction average 300 transaction/day. EDC have all transaction 20,000 transaction/day.

So we can estimate benefit cost of fast response time are

Branches 1000 tr/br * 3 bath/tr * 30% * 500 br * 5 day/week * 52 week/year = 117,000,000 bath/year

ATM 300 tr/br * 3 bath/tr * 30% * 800 ATM * 7 day/week * 52 week/year = 78,624,000 bath/year

EDC 30,000 tr * 3 bath/tr * 30% * 7 day/week * 52 week/year = 9,828,000 bath/year So fast response time will generate benefits costs at 205,452,000 bath/year

•From banking traffic that can support voice traffic, It reduces cost of long distance calls and makes easy communication between branches to head office or branches to branches. We can estimate the benefit cost of voice network . Voice network will implement 15 secondary node and 4 extension/node. Estimate each extension use 1 hour/day and each extension use 12 baht/min (cost of long distance vary from 3-18 baht/min)

So banking traffic will generate benefit cost at

15 site * 4 ext/site * 12 baht/min * 60 min/day * 5 day/week * 52 week/year = 11,232,000 baht/year

4.5.5 Comparing Costs and Benefits

From section 4.5.3 actual costs and section 4.5.4 benefits cost, we can compare costs and benefits by using payback analysis to show the payback period of network implement.

Table 4.15. Payback Analysis, Showing a Payback Period of Three Years.

Year	Capital MBaht	Recurrent MBaht	Total MBaht	Cumulative costs MBaht	Benefits MBaht	Cumulative Benefits MBaht	Note
1997	0.5	0.0	0.5	0.5	0.0	0.0	Start Imp.
1998	218.0	40.0	258.0	258.5	50.0	50.0	BKK area
1999	81.6	80.0	161.6	420.1	300.0	350.0	Upcountry
2000	0.0	110.0	110.0	530.1	300.0	650.0	Tuning
2001	0.0	110.0	110.0	640.1	667.6	1,317.6	Finish

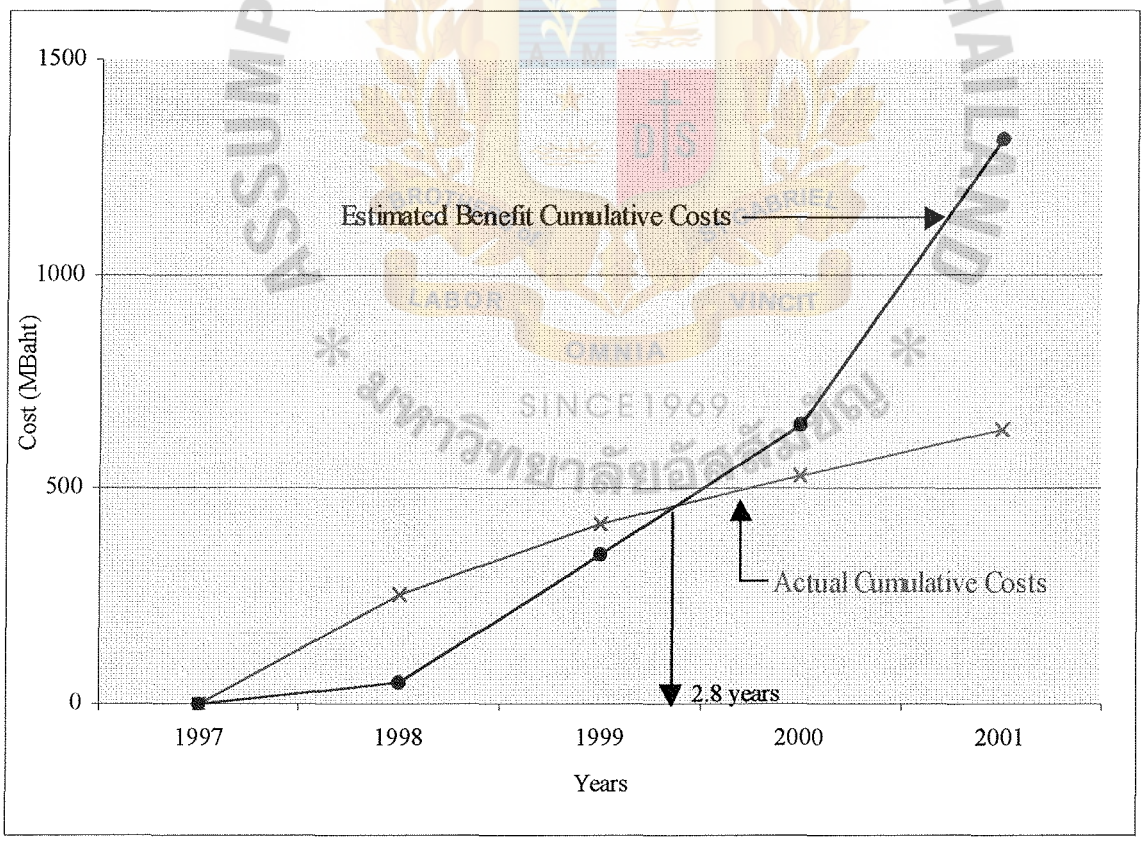

Figure 4.4. Payback Analysis Graph.

V. PROJECT IMPLEMENTATION

5.1 Network Implement Plan

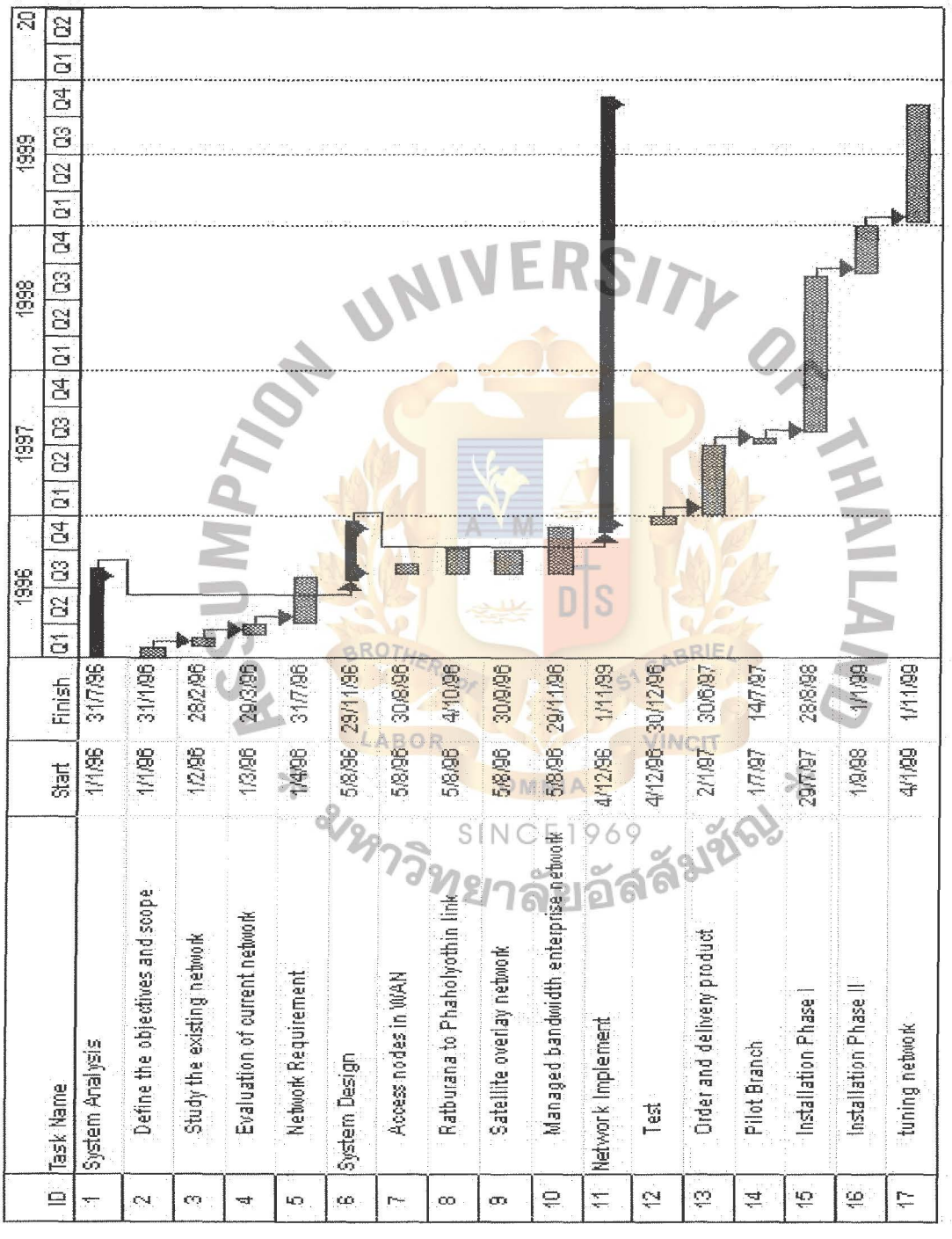

Figure 5.1. Project Plan.

5.2 Select Hardware Vendor

This section will discuss about how to select hardware product and vendor.

5.2.1 Criteria for Vendor Selection

Product

- Product must have authorized distributor in Thailand
- Product must support requirement of Thai Farmers Bank
- Product must support token ring for Tertiary site and Secondary site

Vendor in Thailand

- Vendor must be authorized distributor of product.
- Vendor must have experience in data communication.
- Vendor must have potential to do this project.

5.2.2 Vendors in Thailand

Table 5.1. Vendors that Sent Draft Proposals to Thai Farmers Bank.

No.	Vendor	Product
1	United Communication System(UCS)	Cascade, Motorola
2	United Communication Industry (UCOM)	Cascade, Hypercom
3	World Information Technology (WIT)	Cascade, Memotec
4	Sahaviriya OA. (SVOA)	Cascade, Hypercom
5	T.N.	Stratacom, Hypercom
6	Loxley	Nortel, Hypercom
7	OGA Telecom	Ascom Timeplex, Memotec
8	Siemens	Cascade, Motorola
9	Datapro Computer	IBM

After sending draft proposals to Thai Farmers Bank, the Network design team used criteria as follows to cut some vendors out.

- Implementation Plan
- Technical Staff
- Organization Chart
- Project Administration
- Asset Control System
- Configuration Management
- Price

Table 5.2. The Reasons Selected Vendors to Go to More Detail.

No.	Vendor	Result	Reason
1	Siemens	Pass	Configuration meets requirement, Technical staffs have experience.
2	SVOA	Pass	Configuration meets requirement, Staffs have experience.
3	UCS	No	Network design are not suitable for Thai Farmers Bank
4	UCOM	No	Price very high 324.6 million baht, Technical staff use foreigners there will be problems about support
5	WIT	No	Technical staff do not have experience for product
6	T.N.	No	Configuration do not meet requirement
7	Loxley	No	Technical staff do not have experience for product, Price high 270.6 million baht
8	Datapro	No	Configuration dose not meet requirement

Network design teams selected only 2 vendors to send detail proposal to Thai Farmers Bank again.

After selecting Siemens and Sahaviriya OA, they sent detail proposals, Thai Farmers Bank allowed the 2 vendors setup in house tests to compare results of testing before making decisions.

5.2.3 Result of In-house Testing between Two Vendors

This section will show results of in house testing between two vendors Siemens and Sahaviriya OA. By setting up frame relay switch connect to FEP, router, PABX (Meridian I) and EDC frame relay access to simulate primary node link to frame relay access device by digital modem 64 Kbps or analog modem 19.2Kbps to simulate secondary and tertiary node. Frame relay access device will connect to Token ring branches office, ATM, EDC and PABX (Fujitsu).

Application test (to check all applications that banks use can in testing)

- Teller banking Application (SNA)
- ATM (SDLC)
- Lotus Notes (TCP/IP)
- Voice
- Home banking & Fax
- EDC (HDLC), POS
- Async (file transfer)

Functional Test (to check function of operation network)

- Back up (ISDN, PSTN, port recovery)
- Noise
- Hot Swap
- CIR

•Priority

Result of testing will be shown in the following table.

Table 5.3. Comparison of Results of In-house Testing.

Application	Siemens	Sahaviriya OA
Teller Banking Application	Pass	Pass
Visual Banker	Pass	Pass
Signature Verification	Pass	Pass
ATM	Pass	Pass
Home Banking Application	Not pass	Pass
Voice Application	Pass	Pass
Lotus Notes Application	Pass	Pass
Functional test	Pass	Pass
Technical team to support problem	Fair and can solve problem in short time	Poor and take time to solve problem

5.2.4 Comparison of Configuration, Technique and Price between two Vendors

Table 5.4. Comparison of Advantages of Configuration of Each Vendor.

Siemens	Sahaviriya OA
1. High throughput (no bottleneck) because the primary site is connected between frame relay switch to FEP	1. Can support token ring more than 2 ring/node because uses Hypercom equipment at tertiary node.
2. Not complicated because it is not necessary to use frame relay access at primary site.	2. Support local polling between FEP-FRAD.
3. Easy to dial backup and low cost because dial backup uses switch connect to switch	3. Equipment at tertiary node can hot swap.

Table 5.5. Comparison of Disadvantages of Configuration of Each Vendor.

Siemens	Sahaviriya OA
1. Can support token ring only 2 ring/node because use Motorola equipment at tertiary node.	1. May have problems of throughput because at primary site connect between Hypercom to FEP that Hypercom have low efficiency than Cascade.
2. Equipment at tertiary node can not use hot swapping.	2. Hard to dial backup and high cost because dial backup use FRAD connect to FRAD
	3. Complicated because it is necessary to use frame relay access at primary site, like the tertiary site.

Table 5.6. Comparison Cost and Equipment of Each Vendor.

Detail	Sahaviriya OA	Siemens
Primary site	40,303,000	39,805,000
Secondary		
Bangkok	28,699,000	39,759,000
Upcountry	48,078,000	44,883,000
Tertiary		
Bangkok area	18,022,000	13,709,000
Upcountry	33,205,000	23,098,000
Fall back switch 280 unit	3,360,000	6,440,000
NMS	8,039,000	6,431,000
Project Management		
- Phase I	9,022,000	14,500,000
- Phase II	6,860,000	4,000,000
Maintenance Service after Warranty	10%	10%

Table 5.7. Comparison Cost and Equipment of Each Vendor (continued).

Detail	Sahaviriya OA	Siemens
Model		
Frame Relay Device		
- SW. - Primary	Cascade 9000	Cascade 9000
- Secondary	Cascade 6000	Cascade 6000
- FRAD - Primary	Hypercom 5000	Motorola 6560
- Secondary	Hypercom 5000	Motorola 6560
- Tertiary	Hypercom 3000	Motorola 6520
NMS Device		
- for SW.	Sun 710e 256MB	Sun 710ne 256MB
- for FRAD	HP Model 715 128MB	HP Model 715/64 256MB
Frame Relay Device		
- FRAD (basic unit /UNIT) (1T/R,1SDLC,1Backup,1Trunk)	123,440	76,900
- Cascade 9000 (/UNIT)	660,660	575,000
- Cascade 6000 (/UNIT)	384,990	335,000

5.2.5 Design Select Vendor

From section 5.2.3 and 5.2.4, the network design team design chose the Siemens vendor to install hardware and manage this project because

- Network design and configuration meets requirements of Thai Farmers Bank.
- Technical staffs know the product well.
- In house testing passed all applications.
- Price is low compared with other vendors.

5.3 Select Media Vendor

This section will describe how to design and select media vendor both in Bangkok area and Upcountry area.

5.3.1 Media Vendor in Bangkok Area

In Bangkok area, the network design team design network from section 4.3.1 by using digital link n*64 Kbps connected between secondary node to primary node site both Ratburana and Phaholyothin (different vendor). Digital link 64 Kbps connected between secondary node to tertiary node and link 9.6 or 19.2Kbps connected between secondary node to ATM or EDC. Network design team found media vendor that can support requirement of Thai Farmers Bank. There are 5 vendor (TA, UIH, Datanet, CAT, and TOT) that can support this requirement. Thai Farmers Bank sent requirements and invited the vendor to send information back to Bank and this is compared in Table 5.4

Table 5.8. Comparison of Features of Each Media Vendor.

Information	TA	UIH	Datanet	CAT
1. Number of links that can support	More than 70% some place will install equipment to support	About 90%	About 30%	Less than 20%
2. Period of installation	1 month (If available)	2 month (If available)	3 week (If available)	4-8 month
3. Price (64Kbps)				
3.1 Pledge of lease	2 month	1 month	10,000 baht	1 month
3.2 Install	8,000 baht	10,000 baht	20,000 baht	10,000 baht

Table 5.9. Comparison of Features of Each Media Vendor (continued).

Information	TA	UIH	Datanet	CAT
3.3 Leased/month	3,000-9,000	8,000	6,500-11,200	8,000
3.4 Leased equipment	no	no	6,000/month	10,000/month
4. NMS	At TFB only monitor connect or not	At TFB monitor connect, power on, other	At Datanet	At CAT
5. Quality of service	Good	good	fair	Fair or poor
6. Backup Main Link	Use alternate path	Use alternate path	No	No

5.3.2 Selected Media Vendor in Bangkok Area

5.3.2.1 Selected Media Vendor for Primary Node to Secondary Node

From the information of media vendor in section 5.3.1, use to select only TA and UIH to support link from primary node to secondary node.

•Did not select CAT because CAT can support only small area and takes long time to install (4-8 month).

•Did not select Datanet because Datanet can support only 50% of area and price for leased line of 64 Kbps is higher than other vendors.

•Selected TA as support link from secondary node to primary node at Ratburana because TA has complete backup root for Ratburana site.

•Selected UIH as support link from secondary node to primary node at Phaholyothin because Thai Farmers Bank will use different vendors to support links for backup if some vendors have problems of linkage, another vendor can support.

5.3.2.2 Select Media Vendor for Secondary Node to Tertiary Node or ATM or EDC

•Did not select CAT because CAT can support only a small area and takes long time to install (4-8 month).

•Selected Datanet for some nodes that Datanet can support, and nodes for which rent of lease line is lower than 6,500 baht.

•Selected TA for 21 nodes which those areas TA can support, use all TA link in that secondary node for easy maintenance. Used TA and UIH alternates in the close area for if node TA or UIH fails Thai Farmers Bank will have some nodes, which can operate in the closed area.

•Select UIH for 24 node that those area UIH can support (UIH can support more area than TA), use all UIH link in that secondary node for easy maintenance. Use TA and UIH alternately in the close areas for if node TA or UIH fail Thai Farmers Bank will have some nodes which can operate in the close area

5.3.3 Media Vendor in Upcountry Area

In Upcountry area, the network design team design network from section 4.3.2 by using digital lease line link n*64 Kbps connect between secondary node to primary node sites at Ratburana and uses Satellite VSAT SCPC at Phaholyothin for share load, backup and disaster. Digital links 64 Kbps or 19.2Kbps connected between secondary node to tertiary node and link 9.6 or 19.2Kbps connected between secondary node to ATM or EDC. Network design team found media vendor that can support requirement of Thai Farmers Bank. There are 3 vendors (UIH, CAT, and TOT) for digital leased line to support primary node to secondary node. 3 vendor (World Sat, Samart and

Compunet) for Satellite VSAT SCPC to support primary node to secondary node. And 4 vendor (UIH, CAT, TOT and TT&T) to support that can support secondary node to tertiary node or ATM, EDC.

5.3.4 Selection of Media Vendor in Upcountry Area

Because of only 3-4 vendors that have service link, so Thai Farmers Bank surveyed information by asking each vendor and used this information to make decision.

5.3.4.1 Selection of Media Vendor for Primary Node to Secondary Node

- Did not select CAT, TOT for digital leased line because they take long time to install (1-2 years), can not support NMS at Thai Farmers Bank to monitor link and quality of service is poorer than UIH.
- Selected UIH for support digital leased line because UIH installed link only 3-6 month, support NMS to TFB and qualities of service are good.
- Selected World Sat and doesn't select Samart, Compunet for Satellite VSAT SCPC because price of World Sat is lower than other vendors, time to install is less or same and quality of service is good.

5.3.4.2 Selection of Media Vendor for Secondary node to Tertiary node or ATM or EDC

Because Thai Farmers Bank has many old analog links between Secondary node to Tertiary node or ATM or EDC from TOT that can support requirement. So Thai Farmers Bank used old analog links from TOT (90%) except for some links that must use new link or digital link will use UIH, TT&T or TOT up to availability of each vendor.

5.4 Result of Project

5.4.1 Point of Implementation

This section will show numbers of points of service that were implemented in Phase I and Phase II

Table 5.10. Point of Implement in Phase I and Phase II.

Point of Service	Phase I	Phase II	Total
Branches	380	153	533
ATM out site branches	210	0	210
EDC	77	13	90
LCR&Notes for Regional Center	29	18	47
International Trade Center	15	1	16
Asset Center	8	6	14

5.4.2 Actual Cost of Implement

Table 5.11. Actual Cost of Implementation in Phase I and Phase II.

Phase I	Capital	218,542,762
	Recurrent	40,000,000
Phase II	Capital	81,573,255
	Recurrent	40,000,000
Total		380,116,017

Table 5.12. Actual Assets Cost of Implement in Phase I and Phase II.

Capital	Phase I	Phase II
UPS& Generator	15,731,232	4,560,000
PABX	2,335,700	3,370,500
Test Tools (Protocol Analyzer)	12,067,000	-
WAN (FRAD)	156,161,758	62,394,030
LAN (Fast Ethernet)	12,148,187	3,409,356
Other (MAU)	6,467,786	2,522,184
Total	204,911,663	76,256,070

5.4.3 Actual Benefit of Project

This section will show the actual benefit of project that Thai Farmers Bank surveyed and measured from users before and after implementation.

•Reduce response time of transaction

This table will show response time reduced 50% of old time. This information is used by measures from all branches in Bangkok area and finding the average.

Table 5.13. Response Time Compared between before Imp. and after Implement.

Transaction	Existing Network (sec)	After Implement (sec)
Balance inquiry	6	2
Inquiry report from RMDS and OCS	11	6
Inquiry signature from same branches	6	3
Inquiry signature from other branches	30	6

•Improved availability of network from lower than 95% to 99.6%.

•Problem of network reduced from 10-20 branches/day to 3-5 branches/day

•Averages down time of network reduced from 6 hour to 4.5 hour.

This information is measured by network help desk recording all network problems and find availability, problem/days and averages down time of each month.

•Support new application for examples Lotus Notes, Loan Approval.

Now Thai Farmers Bank implements a new application for example Lotus Notes (e-mail and workflow) to regional centers more than 45 sites without problem and plans to implement to all branches in 2000.

• Support computer disaster recovery center at Phaholyothin.

Old network is not designed to support computer disaster recovery center. After implementing Thai Farmers Bank test computer disaster recovery center by switch computer to run at Phaholyothin and switch network, They can increase computer disaster recovery center in 1 hour.

•Reduce long distance call.

In 1998, implemented voice 11 secondary node and can save long distance calls by about 2,940,000 baht.

5.5 Tuning Network

After implementing network, the network design teams assigned implementing vendor (product vendor) to monitor and fine tune network to best efficiency. Tuning network is in process and will finish all the end of 1999.

5.5.1 Tuning Network Phase I

These sections have some information that was received from tuning network part I as follows. Tuning network phase I were not finished this will have traffic by use NavisCore Database (tool from vendor) to keep information and analysis.

Scope

Increased Perform an optimization design of the existing Thai Farmers Bank Frame Relay Ascend-based backbone network to improve current response time and support new applications

- Interactive (SNA and IP based)
- Internal TFB Voice Traffic
- CIR of SNA, IP, and Voice Circuits

Objectives

- Optimize CIR, Bc,Be parameters for all PVCs
- Determine bandwidth requirements for backbone network
- Perform failure analysis of single-link failure, switches, and TA and UC trunks for all models
- Analyze estimated backbone costs between three network models

Design requirement

- Provide network design options to support current traffic load
- All satellite-based links will be used for IP-based traffic during normal operation and as backup links for leased lines in the event of failure
- Improve response time for existing applications

Design assumptions

- All branch locations have Frame Relay services
- Branches have different traffic requirements and number of PVCs
- Primary and Secondary Data Center have two B-STDX 9000 switches in each location connecting via two E3 ATM links
- Hub Sites each has one STDX-6000 switch connects to both Data Center via various link speeds (I.e. 64, 128 Kbps)

•The Hub Site has dial backup using analog lines (9.6 Kbps)

Dial Backup links are not included in the backbone links design

•Loopback PVCs are not included in the modeling data

•Circuit priority assigned for all PVC as follows:

1 - SNA

2 - Voice

3 – IP

Observations

•Many primary backbone circuits are extremely over utilized

•Secondary backbone circuits are mostly under utilized

•Site load is not proportional to the backbone bandwidth

•Inconsistency in setting K-factor value for trunks

•The most severe impact of link failures are due to trunks with no backup link

•The dial backup (9.6 Kbps) cannot back up the single-link trunks

•222 PVCs will fail if all UC links are down

•46 PVCs will fail if all TA links are down

•224 PVCs will fail if all Up Country UC links are down

5.5.2 Tuning Network at Chiangmai

From section 5.5.1, Thai Farmers Bank uses some information for the tuning test at secondary node (Chiangmai). The network design teams keep traffic link between secondary node (Chiangmai) to primary node Ratburana (leased line UIH 64Kbps) and Phaholyothin (satellite link 64Kbps) before tuning, analysis and test tuning as follow.

5.5.2.1 Network Traffic before Tuning

From information in Figure 5.1-link utilization of leased line (red) and link utilization of satellite (brown), Figure 5.2.CPU utilization of Cascade 6000(node

equipment) at Chiangmai and Figure 5.3.Traffic load of each application divided by DLCI (17,18 = SNA, 21 = IP, 23 = EDC, 26 = ATM, 32 = Voice)

•Link utilization of leased line is high average 95-100%

•Link utilization of satellite is low average 37-40%

•CPU utilization of Cascade 6000(node equipment) at Chiangmai is high, the average is 45% and the maximum is 74%.

•Parameter CIR, BC and BE set is higher than real traffic load and set all applications at same value.

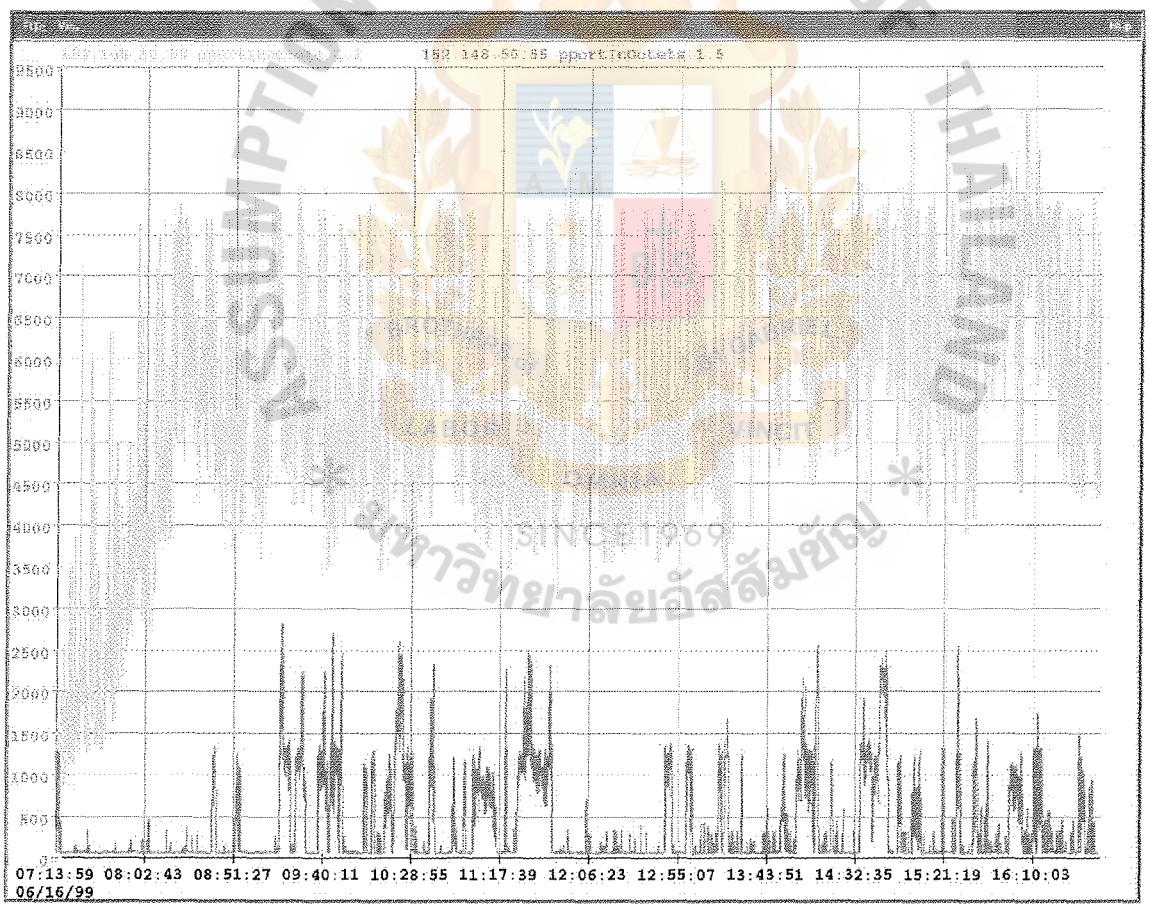

Figure 5.2. Link Utilization of Leased Line (red) and Satellite (brown) before Tuning.

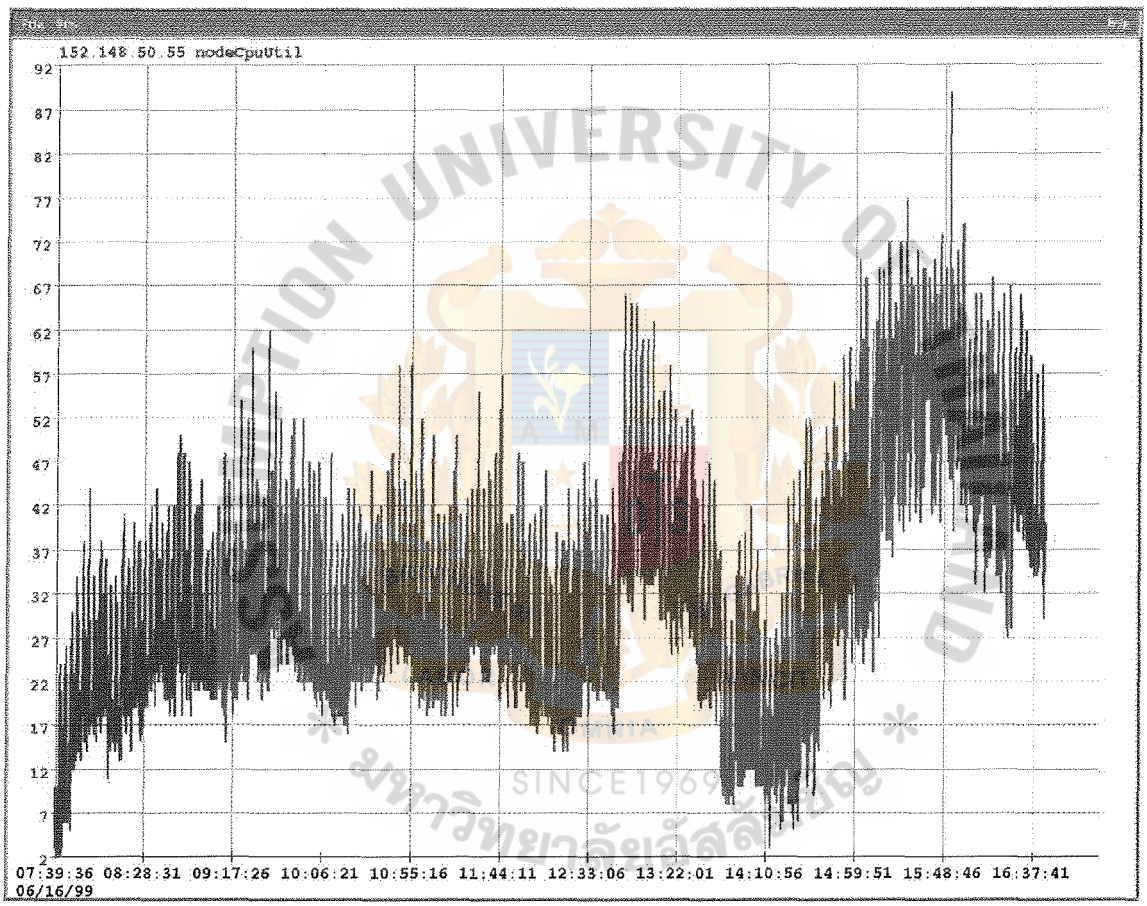

Figure 5.3. CPU Utilization of Cascade 6000(node equipment) at Chiangmai.

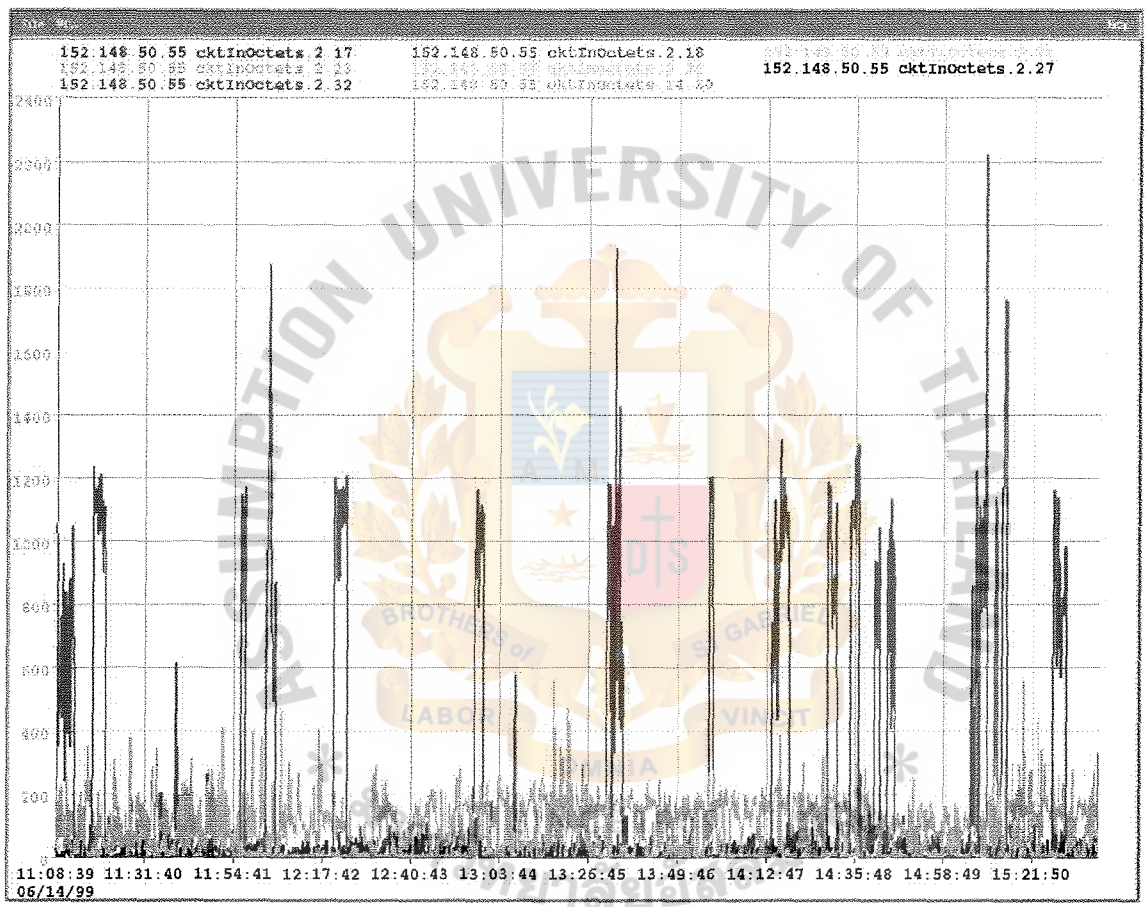

Figure 5.4. Traffic Load of Each Application Divide by DLCI.

5.5.2.2 Set parameter for Tuning Network at Chiangmai

From information 5.5.2.1, The network design team tuned networks by:

- Defining application IP and LCR that access host at Phaholyothin to use satellite link to reduce traffic load of leased line.
- Change value CIR, BC, and BE to be suitable for each application

Table 5.14. New Value CIR, BC, and BE for Suitable for Each Application.

Application	CIR	BC	BE
SNA small branches	4	4	8
SNA branches	8	8	16
ATM out site branches	3	3	6
EDC	4	4	8
Swift	8	8	16
TC	16	16	32
AS/400	3	3	6
IP	16	16	32
Voice	24	24	0
CIP	2	2	4
NMS	2	2	4

5.5.2.3 Result of Tuning Network

After Thai Farmers Bank changed parameter and monitor traffic once more, the result of traffic will be shown in Figure 5.4. Link utilization of leased line (red) and link utilization of satellite (purple) after tuning, Figure 5.5.CPU utilization of Cascade 6000

(node equipment) at Chiangmai after tuning and Figure 5.6.Traffic load of each application divided by DLCI after tuning (17,18 = SNA, 21 = IP, 23 = EDC, 26 = ATM, 32 = Voice)

We can summarize these as follows:

•Link utilization of leased line reduces from 95-100% to 65-87% from set IP and LCR to use satellite link.

•CPU utilization of Cascade 6000(node equipment) at Chiangmai is lower from average 45% and maximum 74% to average 21% and maximum 76%.

•For set parameter CIR/BC/BE can not see different so Thai Farmers Bank will continue tuning.

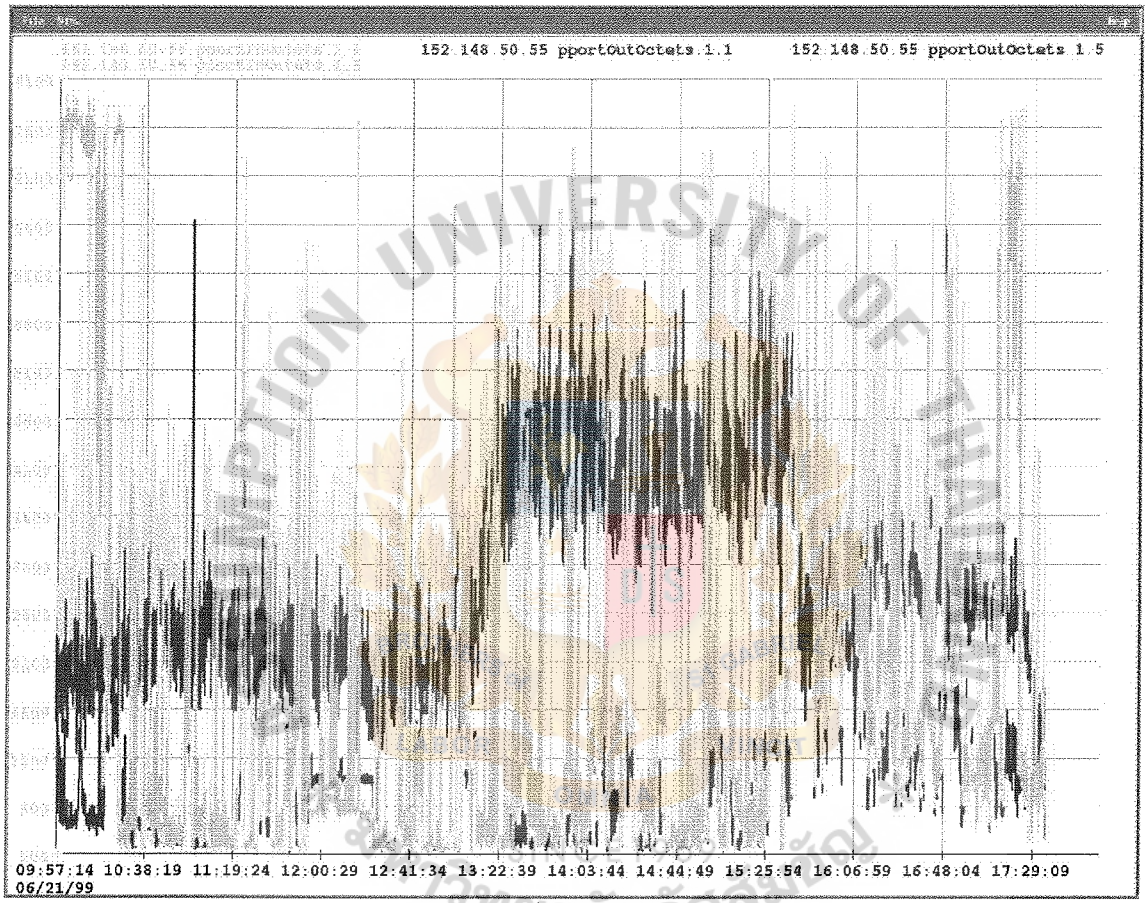

Figure 5.5. Link Utilization of Leased Line (red) and Satellite (brown) after Tuning.

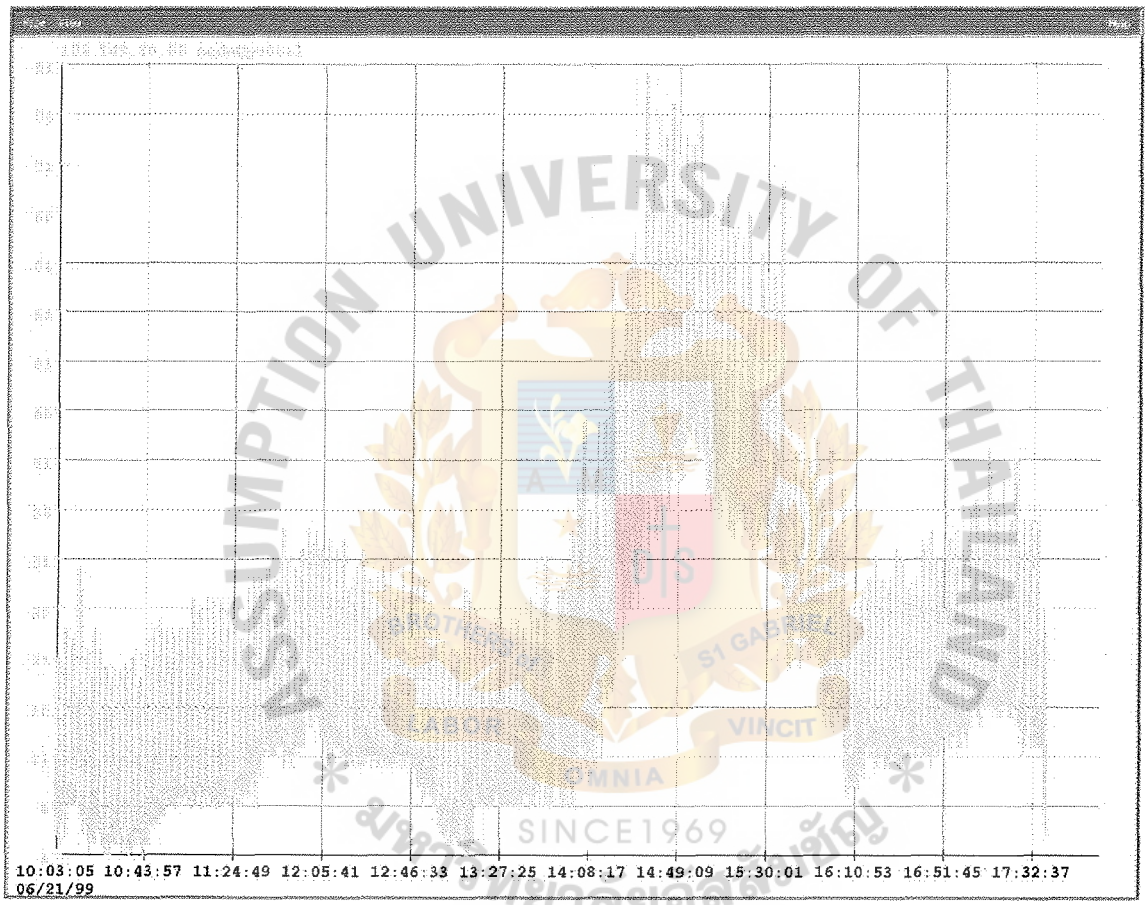

Figure 5.6. CPU Utilization of Cascade 6000(node) at Chiangmai after Tuning.

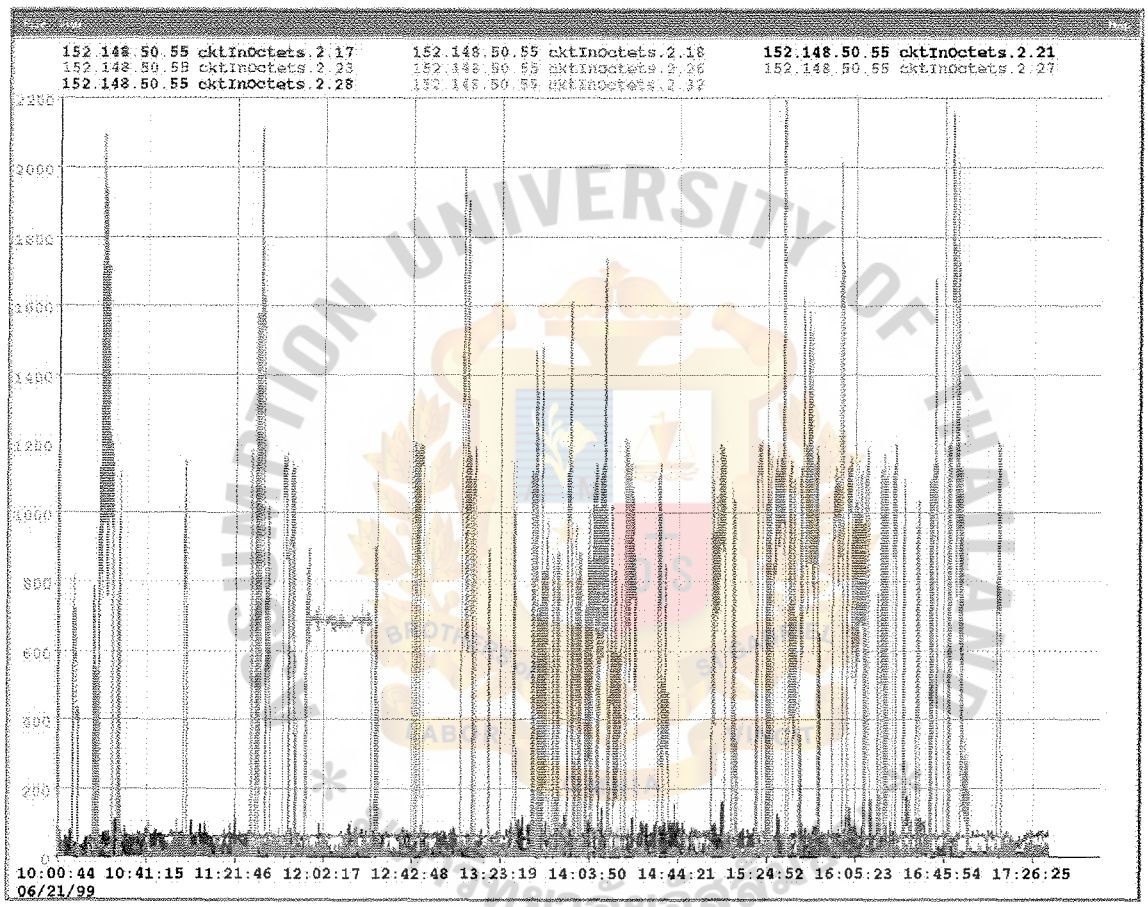

Figure 5.7. Traffic Load of Each Application Divide by DLCI after Tuning.

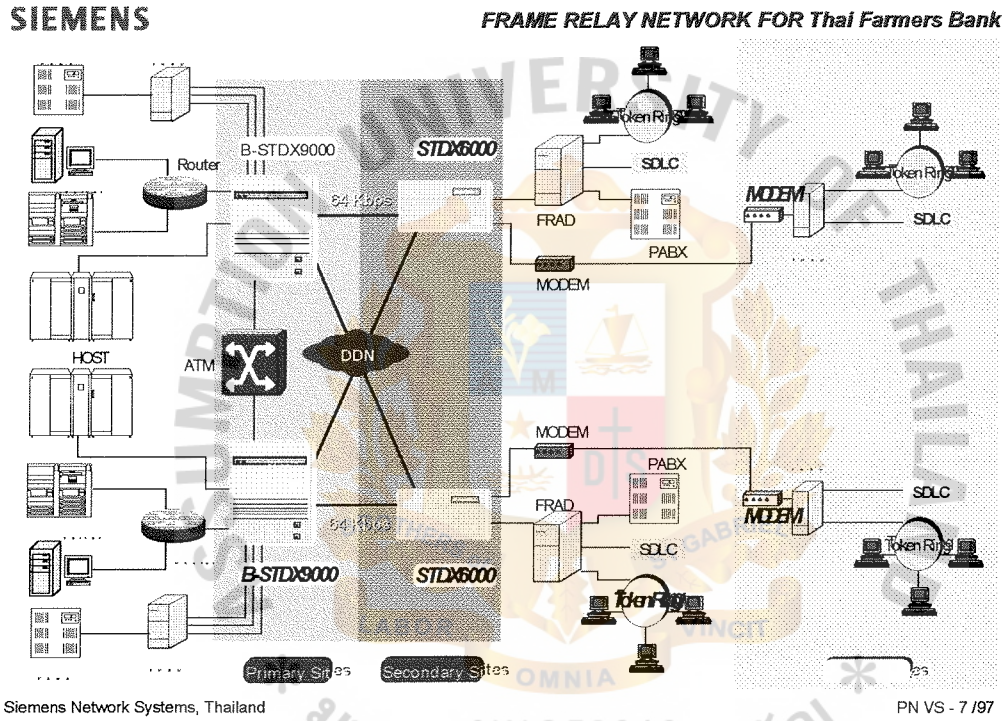

Figure A.1. Network Configuration of Siemens.

BIBLIOGRAPHY

1. James A.Senn, Analysis &Design of information Systems, McGraw – Hill, Inc., 1989.

2. Kenneth E. Kendall & Julie E. Kendall, System Analysis AND Design. Prentice Hall,Inc., 1988.

3. John A. Lehman, System Design in the Fourth Generation, John Wiley & Sons, Inc., 1989.