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Executive Summary

The goal of Micro Integration, Inc. is to penetrate the Wireless Local Loop Market in Southeast Asia. As part of this strategy, the firm is currently negotiating a contract with a major Philippine telecommunications company to provide WLL technology and hardware. In order to become a dominant player within the region, MI must also enter other countries beside the Philippines. This choice is governed not only by market conditions, but also by MI's own research and development schedule.

After examining the total number of new lines demanded in a country as well as other qualitative factors, our analysis has revealed that MI should enter the Thai telecommunications market as soon as R & D has been completed. The total number of lines demanded is growing continuously through the end of the time horizon; hence, MI should not wait to attempt to secure a contract to supply that demand. However, it is important to note that Indonesia is also a very lucrative market, only slightly less attractive than Thailand. As a result, MI should be aware of any changes in current trends which may increase the market opportunity within Indonesia, and thus change the optimal choice.

INTRODUCTION

Client and Market Overview

The client company is Micro Integration, Inc., a Silicon-Valley start-up firm specializing in wireless communication technology consulting. MI combines expertise in telecommunication marketing and experience in radio systems design engineering.

The telecommunications industry is undergoing structural changes due to the growing trend toward globalization and deregulation of telecommunication markets. The global demand for local access to telephone networks is proven, although the required capital investment and the time needed to complete full deployment are daunting. The purchase of central office switches and trunking capacity represents perhaps the easiest part of expanding a nation or region's telephone infrastructure. The "last mile" is the most difficult part of the expansion since the telephone service has to come to the subscriber's premises with the minimum cost and maximum reliability, often passing through rugged terrain.

Wireless local loop (WLL) technology offers a solution to provide network access, promising more efficient use of capital and a much faster deployment time than traditional copper lines. WLL installations are projected to be 25% to 50% of the total number of access lines installed in the some areas. Various wireless technologies can provide access to the telephone network, including point-to-point and point-to-multipoint microwave, cellular mobile radio, Personal Communications Systems (PCS) or, equivalently, Personal Communications Networks (PCN), wireless (in-building) PBX, and satellite systems. Wireless local loop service is generally defined as *fixed wireless services intended to provide primary access to the telephone network*. Within this definition, WLL systems may be specifically designed for fixed wireless service or may be a modification or hybrid of mobile cellular/PCS technology.

At this time MI is in the final stages of negotiations for a Wireless Local Loop (WLL) contract with a telecommunications service provider in the Philippines. The contract under negotiation covers the design,

development, manufacturing, site-planning, and installation of the system in Philippines, a country consisting of over 6,000 islands with 70 million inhabitants.

For the past four years Philippines has been expanding its telecommunications infrastructure at dramatic rates. While the metropolitan areas are currently served by 11 telecom service providers and 5 cellular carriers, outside of Metro Manila, teledensities[1] are typically less than one line per 100 people while thousands of small villages have no phone service at all. This is a common condition facing countries in the developing world, and MI's target is to satisfy the demand for telephone lines in both rural and metropolitan areas at the minimum cost to both the telephone service subscribers and providers.

The Southeast Asian telecommunications market, including the Philippines, is presently considered one of the fastest growing in the world. Consequently, not only MI but also other telecommunications' firms from the developed world seek to profit from this expansion. In order to carve out a niche for itself, MI plans to explore business opportunities in countries sharing the same needs; i.e. countries in East Europe, Africa, and near-east Asia, thereby leveraging its knowledge to achieve maximum effectiveness.

WLL Technology Overview

In comparison to the alternative of deploying copper lines, WLL technology offers a number of key advantages including *faster deployment, lower construction costs, lower network maintenance, management, and operating costs, and lower network extension costs.*

WLL System Description

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[1] The concentration of present or potential subscribers within a telephone service area is referred to as *tele-density*. A large metropolitan area would be considered to have a high tele-density, while a sparsely populated rural area would have a low tele-density. In some developing countries, however, a large concentration of population does not necessarily mean high tele-density if only a small fraction of the population can afford the service.

Figure 1 presents a diagram of a typical WLL installation. The existing telecom infrastructure includes the Central Office, the Local Network Switch (PSTN/PBX) and any Satellite, fiber optic, or undersea cable communication systems in place. The WLL system then connects to the PBX or PSTN through a base station (or

Fig1. Typical Wireless Local Loop Installation
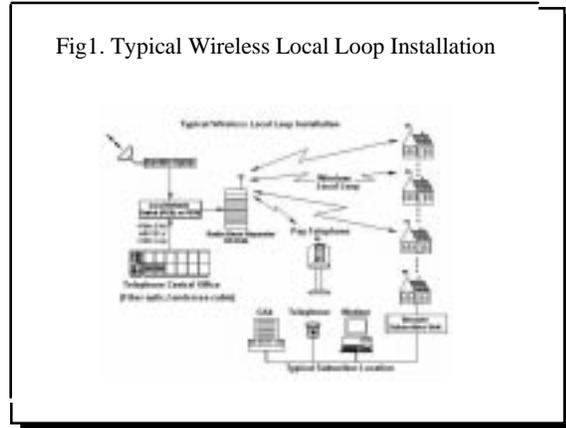
repeater). The WLL system's interface to the telephone network can be supported either by its own switch or through direct connection to the local exchange.

The base stations in a WLL system are deployed as needed to provide the necessary geographic coverage, with each base station connected back to the telephone network, typically either by wire or microwave links. In this sense, a WLL system resembles a mobile cellular system: each base station supports a cell or several sectors of coverage, servicing subscribers within the coverage area and providing the link back to the PSTN.

Subscribers in a WLL system receive phone service through terminals linked by radio to a network of these base stations. The WLL terminals may be handsets that allow the subscriber varying degrees of mobility, they may be integrated desktop phone and radio sets, or they may be single- or multiple-line units that connect to one or more standard telephones. Terminals may be mounted indoors or outdoors, and they may or may not include battery back-up for use during line power outages. The differences in WLL terminal designs reflect the use of different radio technologies in wireless local loop systems and the varying levels of services that can be supported -- from Plain Old Telephone Service (POTS) to advanced broadband services.

PROBLEM FORMULATION

Problem Framing

After interviewing our client we were able to locate MI in the market according to the Porter's Five Forces

model; and in doing so we gained more

insights with regard to their political, strategic,

and tactical concerns. Figure 2 displays a

representation of the WLL industry

competition at the level MI desires to enter and

the surrounding market forces that affect the

rivalry within the industry.

Fig.2 Elements of WLL Industry Structure
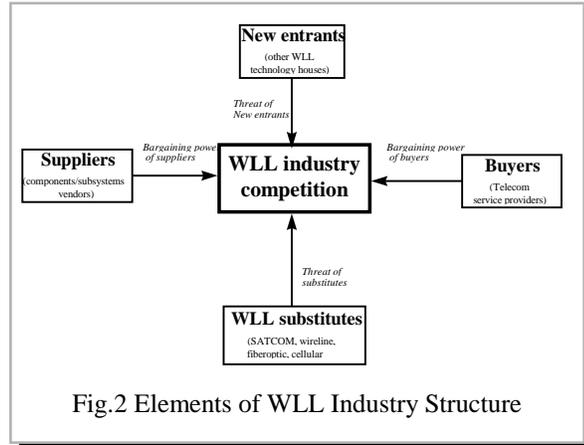
- The *suppliers* in the industry that MI

desires to enter are technology consultants, components vendors and manufacturing operations that provide

OEM products for resale. The forces that govern the relationship with the supplier primarily deal with

procurement negotiations.

- The *buyers* of the WLL industry are the telecom service providers of the different countries; they may

be privately or state-owned. Then the relevant forces between MI and its buyers are the contract

negotiations as they pertain to cost of service, product reliability, maintenance requirements, etc.

- The *WLL substitutes* category groups various alternative technologies such as the wireline service, and

if applicable, SatCom systems and FiberOptic cable installations. The forces that will govern the market

rivalry in this respect are primarily contract negotiations with the substitute technology manufacturers, and

market demand.

- The *New Entrants* category includes companies such as MI that desire to enter the market. The forces

that keep this relationship in balance are accomplished through barriers placed by the various elements of

the market to keep new entrants separate from the established competitors. Examples of such impediments

include government regulations and exclusive contracts.

- Finally, in the center of the picture is MI and its competition, including both technology consultants and equipment manufacturers. There is a wide range of equipment manufacturers; included are corporate giants such as Motorola, Ericsson, and Hughes Network Systems as well as relatively smaller companies such as Diva Communications, Phoenix Wireless, Qualcomm, and InterDigital. Regardless of their size WLL equipment manufacturers are continually striving to:

◊ reduce the per-subscriber cost of WLL infrastructure and subscriber equipment;

◊ improve the ease of deployment and the system's network management capabilities;

◊ better suit either or both low- and high-density subscriber environments;

◊ provide advanced services; and,

◊ provide transparency to the wireline network, by providing seamless interface with PSTN
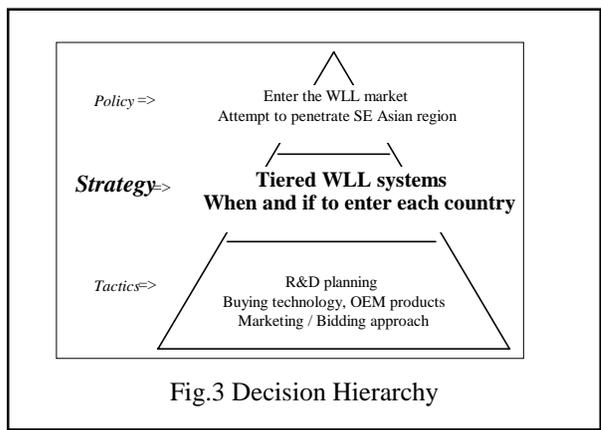
Because of the MI's favorable competitive position, our client has already decided to enter the international WLL market with a current focus on the Southeast Asian region. Consequently, any future analysis will deal exclusively with a strategy outlining how to expand. Figure 3 displays MI's decision hierarchy pyramid. The major decisions facing MI are whether it should enter a specific country, and when to enter it. Once a decision has been made it will be relatively straight-forward to handle the technology development and implementation issues; indeed, some effort has been spent on that problem already during the submission of the Philippines contract. However, such tactical issues are out of the scope of this study.

Policy => Enter the WLL market
Attempt to penetrate SE Asian region

***Strategy*=>** **Tiered WLL systems
When and if to enter each country**

Tactics=> R&D planning
Buying technology, OEM products
Marketing / Bidding approach

Fig.3 Decision Hierarchy

MI's Competitive Advantages

In attempting to narrow the scope of our analysis, we started to identify the specific competitive advantages of the client. Although not directly involved in direct manufacturing of WLL systems, MI can offer a *lower*

overall cost WLL solution. The reason for this savings is that its focus on design and procurement rather than development and manufacturing of its WLL products allows for a system tailored to the needs of its client, *that provides only what the clients wants at the a price for which the client is willing to pay*. Also, the fact that MI would, in partnership with its customers, set up production of its WLL line in the country of the customer, assures customer loyalty and another employment opportunities. This also demonstrates MI's competitive advantage in *product differentiation*: while other competitors offer a pre-manufactured product, MI will release control of the product to the customer, allowing for more flexibility and customization.

MI has limited resources, both financial and otherwise; therefore, it makes sense to concentrate its product offerings in a limited market. In addition, because of its size, it is essential for MI to establish credibility in an unknown territory before undertaking larger expansion; by growing slowly this goal could be more easily accomplished. The company views itself as a technology consultancy, offering primarily superior knowledge and experience. However, because of the large scale availability of turn-key solutions, our preliminary analysis revealed that MI's role should include design, manufacture, and maintenance of all hardware necessary for a WLL system. The installation and maintenance operations were included primarily as enhanced customer services to distinguish MI from other competitors, since many (more established) firms can also offer technical expertise. Starting from low-cost WLL installations and by being able to provide high reliability and customized service in areas neglected by most (service-oriented) firms, MI hopes to be able to dominate the market by growing with the market in which it enters.

Problem Statement

Based upon considerations of the above-mentioned competitive factors, MI decided to expand their WLL business to other countries within Southeast Asia. In order to examine this strategy, MI wanted an evaluation of the market opportunity within a variety of countries in order to determine which were most lucrative. In order to examine prospective markets within Southeast Asia, we decided to analyze the overall Southeast Asian regional telecom market growth, and narrow our focus to the three countries experiencing the strongest growth in the WLL arena (Indonesia, Malaysia, and Thailand), assuming that they will be the primary target markets of our client in the future. The goal of this report, therefore, is to provide

recommendations as to which country to enter and also, given MI's current product development schedule, when would be the best time to enter each country.

Given the above problem, our model used the following assumptions:

- The time Horizon is limited to 4 years (until 2001)

- The geographic scope is limited to the Southeast Asian region, and specifically to the following countries: Philippines, Thailand, Malaysia, Indonesia.

- We are assuming that MI's current negotiations with the Philippines will result to a WLL product contract, and installation will commence in early 1998

- Since MI has limited resources, it can only penetrate one country at any single time.

- We assume no product development schedule anomalies (i.e. lack of engineering expertise, unforeseen governmental regulations, etc.)

Identification of Uncertainties

Because MI would earn revenues directly proportional to the number of Wireless Local Loop lines installed, the major uncertainty is how many WLL lines will be needed within the next four years in each country. We decided to relate WLL line demand to total line demand in a linear fashion. For most countries over our time horizon this will be a safe assumption. However, quantifying the number of lines is not an easy task. Because phone line demand is closely related to a variety of other factors, we identified those other uncertainties which would either directly or indirectly affect line demand. Attempting to quantify those lines demanded for which MI could potentially supply and install is even more important. As a result, economic growth, demographic change, government regulation, regional/political stability, and competition were identified as being the most important predictors of MI's financial success. Together these variables can be used to estimate the potential of a specific market.

However, other uncertainties that might effect the MI's market opportunity also exist. MI must be able to establish itself as a credible and reputable business partner capable of fulfilling demand in a timely manner. Since the firm is very small, a number of problems may arise because of staffing issues, scarcity of resources, or other issues that may prevent successful market penetration.

Another very important uncertainty involves the actual securing of a contract. Although a country may have a large market, MI will not benefit unless it wins the right to supply some of the lines. However, as is frequently the case, contracts are awarded through business and personal contacts; MI may be the best firm, but still not profit from its expertise because of its small size and limited exposure.

Also, MI does not currently possess a completed WLL system. The company expects to be able complete development and begin installing lines in the beginning of 1998, but any delay in that schedule might mean unfulfilled obligations and lost future contracts. To this, the possibility of not being able to find the right product or expertise for a particular customer request should be added. In addition, desire for advanced broadband services may argue against use of wireless local loop technology. Economic benefits associated with technology transfer and local manufacture of the WLL equipment are not necessarily certain. Such considerations involve political and economic issues that are beyond the traditional scope of the network operator and will vary with each procurement and deployment. In the end, we have incorporated most of the uncertainties within our model, but some by their nature and other by client request must remain outside of the purview of this analysis.

Identification of Alternatives

Once the policy of entering the Southeast Asian telecom market as a technology provider was established, the client provides us with clear alternatives that needed to be examined. The alternatives were to enter the Philippines and one or more of the other Southeast Asian countries. The decision to not enter any country is also available, but would be considered only under extreme circumstances. The other choice would be at what point these countries should be entered. It was assumed that the Philippines market would be exploited as much as possible, and that the choice to enter other countries was part of the strategy to become a dominant (profitable) player in the Southeast Asian telecom market.

MODELING

Modeling Methodology

As a first step, we determined exactly what factors about demand were important to MI. After extensive

discussion, we were able to divide telephone line demand into three tiers: low or tier 1, middle or tier 2 and

high or tier 3. A tier breakdown is useful to our client because it allows MI to time its research and

development to ensure that the most appropriate (and lucrative) technology is available when demanded. By

clearly delineating the tier requirements, MI will know exactly how to allocate its limited resources to best

fulfill demand. In addition, any country specific requirements may be easily identified as a feature of a

given tier.

Varying WLL Technology Features Required for Different Markets			
	Low Tier WLL	**Middle Tier WLL**	**High Tier WLL**
Market Environment			
Network Access	No alternatives to WLL technology as the means of network access	Few alternatives to WLL technology as the means of network access	WLL technology is one of several competitive means of network access
Subscriber Tariffs	lack of competition may allow premium tariffs regulatory issues may limit tariffs	lack of competition may allow premium tariffs regulatory issues may limit tariffs	additional services and features may allow premium tariffs competition may limit tariffs
Universal service	Required	Required	Not required
Advanced Exchange Services	Not required	Desirable	Required
Broadband Services (e.g.,ISDN services)	Not required	Not required	Desirable for competitive differentiation
High Capacity	Required	May be required	May be required
Product Feature			
Voice quality	Can be inferior to wireline	Can be inferior to wireline	Must be as good as wireline
Privacy/Security	Not required	May be required	Required
Fax/Data support	Not required	Desirable	Required
Mobility	Not required	Not required	Desirable for competitive differentiation
Technology			
Line Interface	Analog	Analog	Digital
Call service features	basic service (DTMF?)	• Voice encryption • Call waiting	
Data Technology	accommodate <14 Kbps	accommodate <56 Kbps	ISDN compatible
Lines per channel	20	20	TDMA/CDMA compatible
Channels per box	100	100	1000
Radio technology	Analog FM	Digital FM / PSK	microcellular with Smart Antennas
Technology Development	Buy	Buy / Develop	Develop
Availability*	Dec 1997	Sep 1999	Jan 2001

*Assuming R&D efforts commence on September 1997

Given the above uncertainties and limitations of our analysis, we then proceeded to create a modeling

framework in an attempt to answer the question of which country to enter at what time. In determining the

market opportunity within a country, as previously stated we determined one of the most important factors to be the total demand for new telephone lines. Consequently, the first step in the analysis involved the creation of a quantitative forecast model that would predict lines demanded through the end of our time horizon. However, because each country had distinct characteristics that would effect market opportunity, our initial analysis needed to be modified to accurately represent entry conditions. By identifying and weighting the qualitative characteristics that would most effect MI's decision to enter a particular country, the second part of our model served to incorporate both the forecast data as well as other relevant information. The end result is a weighting system that scores both country characteristics and predictions to determine where the largest telecom opportunity exists. The two-part model will assign "desirability" values to each of the countries, allowing for both an ordinal and cardinal comparison.

Quantitative Forecasting

As previously stated, the objective of this project is to recommend which country (Thailand, Indonesia, or Malaysia) represents the best market for MI. As a first step in making this recommendation, the future market for telephone lines in each country is examined. If this information were available from a reliable source, the following quantitative analysis would be unnecessary. However, this information is unavailable and so an original forecast must be created.

Step 1 - Telephone Line Demand Forecast

The first step in forecasting telephone line demand is to determine exactly what information is available. After an extensive search, the following information was retrieved and found relevant for each country

- past, present, and future population
- past and current telephone line demand
- past, present, and future GDP estimations
- past and present unsatisfied demand for telephone lines
- teledensity projections for the year 2000

After gathering this information, the past relationship between telephone line demand, GDP, and population was determined through an analysis of historical data. GDP and population were chosen because of their perceived correlation to telephone line demand and the availability of future projections for these factors. In

order to determine the exact relationship among the variables, we identified a target for the projections in the year 2000 based upon (generally considered) reliable information from ITU. After examining linear, exponential, polynomial, and logarithmic functions, multiple linear regression resulted in the closest fit to the ITU projection by a wide margin. The regression also resulted in an extremely high degree of correlation between the factors (high r-squared value) indicating that a relationship did in fact exist. Although there was no way to determine if this relationship was in any way causal, the historical relationship was considered adequate to assume that the same relationship would hold in the future.

Our results indicated matched the ITU projections as follows

Country	ITU teledensity estimate (2000)	Our estimate (2000)
Indonesia	4.93	4.24
Malaysia	31.83	29.78
Thailand	14.08	19.28

Generally, our estimates are greater than those of the ITU. This is to be expected because this model initially predicts estimated demand per 100 population while the ITU estimates actual installed telephones. In the year 2000, each country is expected to have unsatisfied demand which implies that all the telephones actually demanded are not installed.

After forecasting the new demand for telephones lines in each country, we estimated the expected total demand using information on past and present unsatisfied demand. In each year, the total demand for telephone lines is equal to the new demand plus the unsatisfied demand from the previous year. Therefore, it was necessary to project the unsatisfied demand in each year through the year 2000. This was accomplished by calculating and examining historical data on unsatisfied demand as a percentage of total demand. In each country an obvious trend was evident from this data. As the trend was not always linear for each country, we chose to project unsatisfied demand using a method which varied for each country that produced conservative results. (see Appendix A).

Finally, in order to determine the total demand for telephone lines in each country for a specific year, we simply added the estimate of the previous years unsatisfied demand to the projected new demand. The

following graphs summarize our forecasts for each country. For comparison purposes, data from the

Philippines is also included.

Total Number of Lines Demanded
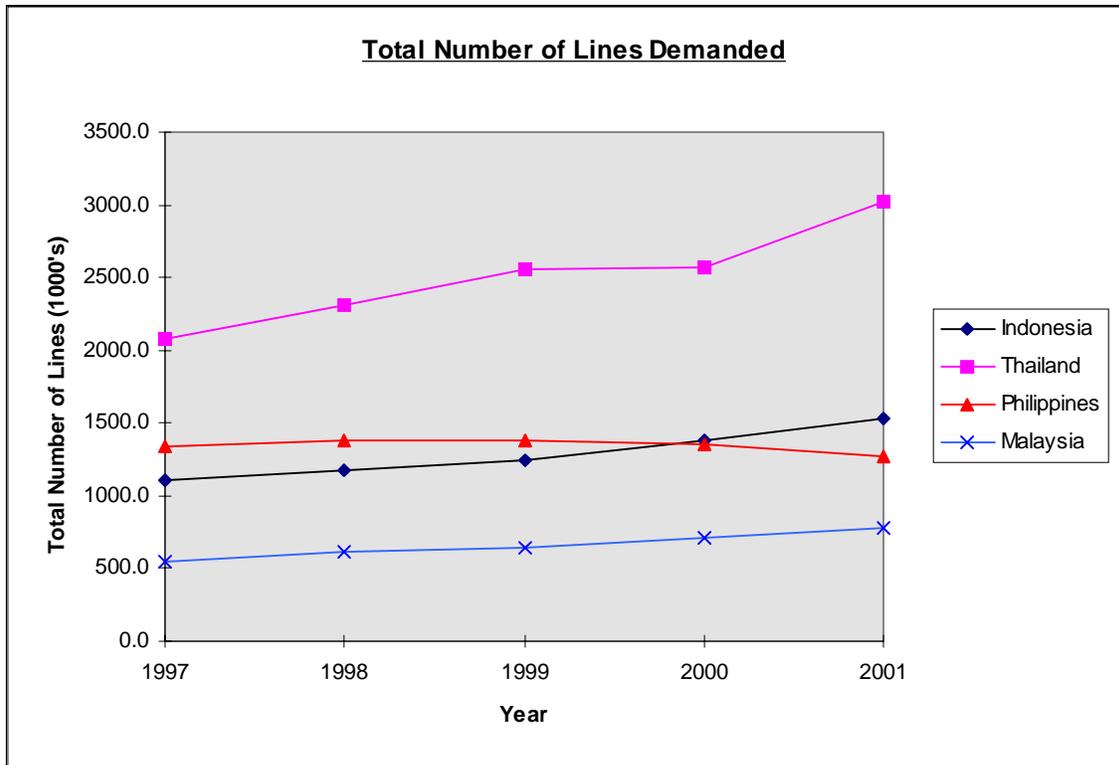
Step 2 - Tier Breakdown of Line Demand

The second step towards recommending a country is to gather additional details about the nature of the

demand for telephone lines. In order to do this, we broke down the total demand in each country into three

types of telephone lines: tier 1, tier 2, and tier 3. This breakdown was done according to MI's R&D

development schedule. Tier 1 lines provide basic telephone service without data transfer capabilities. Tier

2 lines provide some additional feature such as call waiting, but still no data transfer capabilities. Tier 3

lines are full-featured including the ability to transmit digital data.

In the breakdown of the total demand in each country into tiers we make several important assumptions.

We assumed that tier 1 lines are used primarily be rural residents and some rural businesses. Tier 2 lines

are used by urban residents and some businesses. Tier 3 lines are used by more urban businesses that

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require data transfer capabilities. We also assumed that both residents and businesses upgrade to the next higher tier (with 3 still being the highest) according to some transition rate that is closely associated with the rate of growth in internet and facsimile machine usage in each country.

To determine the breakdown of tiers for residential telephones, we initially segmented the population into urban and rural residents. Using data that indicated what percentage of lines were for rural residents, we were able to to project the number of rural residential lines and urban residential lines demanded for a given year. Using the assumptions above, we could then break the demand into tier 1 and tier 2 lines.

Business tier segmentation involves a slightly more complicated model than described above. Using historical data on the sector composition of GDP in each country, we projected the changes in this composition through the year 2001. We assumed that for each industry sector a certain percentage of lines demanded were for tiers 1, 2, and 3. As the sector distribution of GDP evolved, so too would the breakdown of tier demand.

This breakdown gives an idea of the types of lines demanded in each country and further captures the dynamics of the market. The results are displayed in Appendix B and C.

The preceding forecasts of the demand for telephone lines in each country is essential in determining which country to recommend. However, this analysis must be looked at as an estimate and not reality. For example, of the telephone lines in each country many will be cellular which MI cannot support before the end of the project's time horizon. Additionally, the breakdown of the individual markets into tiers is merely an estimate. The use of a qualitative econometric model to address these and other issues allows for a comprehensive analysis.

Qualitative Econometric Analysis

There are several key factors which are not easily quantified that are taken into consideration when making the decision of *which* country Micro Integration should enter first after development in the Philippines.

However, these factors need to be examined as objectively as possible. A weighting system was developed to combine the quantitative forecast information with relevant qualitative information to produce a final recommendation. For each piece of information, ten points were distributed among the three countries - Thailand, Indonesia and Malaysia - according to some basic guidelines. The higher the score in a category for a country, the more this country is preferred as a choice of market entrance. Upon completion of the scores at each category, a separate weighting system to compare and evaluate the importance of each category to the decision maker at Micro Integration also exists (by distributing points among all of the factors).

A preliminary assignment has been made based upon our assessments from data gathering and conversations with Paul Tom at Micro Integration. (See Appendix D) "Exchange Rate Volatility" is set to one point as the base, and other factors are then compared against it. The current assessment is based on all gathered in answering the question of *which country to enter as of now*. As time goes on, development in each country and Micro Integration's preference and focus are expected to change. *The table should serve as a "living" model and be periodically updated and reviewed*. The key factors and the country variations among them are described below.

First / Second / Third-Tier Systems Forecasts

- First Tier provides basic analog voice services. Second Tier incorporates call-waiting, forwarding, and possibility of voice encryption. Third-Tier has data transmission capabilities and is ISDN backwards compatible.
- In evaluating among first, second and third tier systems, Micro Integration's development in the Philippines must be considered. Currently, Micro Integration has planned to build and operate first tier services in rural areas. First tier system is also the system that can be setup in the shortest time. Strategically, it is wise to establish interpersonal trust, and business relationships with other countries while the Philippines system is close to fully operational. Since we are answering the question *when* to enter another country after Philippines, the first systems available to "demo" are the first tier systems. When this

factor is considered along with the fact that many rural areas that exist in all three countries, the forecasted demand for the first tier systems will play a slightly more important role than that for second and third tiers.

- Given current conditions in mainline demand, regulations and backlog, Thailand again has an edge in its demand for the next five years over Indonesia and Malaysia despite its high cellular penetration rate. With close to 50% of current demand in backlog, most of the requested service are first tier basic voice services. Not many other local technologies have been implemented. Therefore, by stepping into Thailand as soon as trust and connection are established, the only limit to profitability is the company's ability to drive down unit cost, as well as its capacity and resources.

Competitions in the Telecommunications Market / Opportunities in WLL Technology Entry & Other Technologies

- These three factors are interrelated but somewhat different in consideration. To weigh these factors for each country, a few sub-factors are considered:

◊ Current and future in general telecommunications investments, WLL, and other technologies.

◊ Current competition conditions in the telecommunications market in general, conditions for WLL, and other technologies.

◊ Projection of main lines, cellular and data services subscriptions in the next 4-5 years.

- From World Telecommunication Development Report 96/97, it was clear that all three countries have opened up the industry to private investors, with Indonesia being a larger, more developed and competitive market.

- From the 1995 total investment, Thailand is far behind its two neighbors, at US$384.5M compared to US$1.65 and US$1.25 billions in Indonesia and Malaysia. Thailand is one of the fastest growing fixed line networks in the world but with lines being added very quickly, prices falling and service improving, more and more people that were initially reluctant to sign up for service are now doing so. As a result, the waiting list has grown about 10% since 1990. All of this points to Thailand as a source of large opportunity in telecommunications in general and, given the urgent needs, especially for WLL technology which is faster and cheaper to install.

- In Asia, WLL is projected to account for up to one-third of all new telephone lines - 80M lines over the next decade. With cellular services becoming more popular in Indonesia, WLL, even though a different technology, will face tough competition. On the other hand, WLL can be of significant benefit to Thailand's plan in zeroing the backlog. Both growth in mainlines and total investments in Malaysia are not expected to surpass either of the other two countries.

- With respect to the fast increases in demand for telecommunications service, there are certainly opportunities for other technology than WLL and copper wirelines in Southeast Asia. Since cellular service is already highly demanded in Indonesia, cellular phones are likely to gain even more market share than now. In Thailand, approximately 30% of new lines are cellular which is much higher than the rate in Indonesia and Malaysia. Growth in the Malaysian telecommunications market, however, is overall very slow, Malaysia is not very attractive to the entry of other technologies.

Economic Stability

- Under this category, we evaluate each country's economic growth, private sector investment, GDP, inflation rate, and government's commitment to expanding and building the technology infrastructure. This category may reflect the country's willingness and capability of reinvesting its resources back to its own infrastructure.

- Indonesia will continue with high growth, ensuing infrastructure needs, and the removal of restrictions on foreign investment. The accelerated growth, especially in intermediate capital and consumer goods give rise to inflation and the doubling of the national account deficit. Overall it is fairly stable, without much uncertainty in political stability.

- Thailand is likely to have slower economic growth in the years ahead, currently around 6.5% GDP growth, as it negotiates the difficult transition from labor-intensive manufacturing to more sophisticated, higher-tech industries.

- The Malaysian government's Second Industrial Master Plan, is particularly encouraging development in information technology and allowing for heavy inflows of foreign funds. They are committed to poverty alleviation. The general consensus is that the ambitious government plan leads to an overall more confident outlook.

Political Stability

- We consider the current political and social affairs as well as foreign relations. As a start up technology consultant and provider, Micro Integration must establish itself in a stable and open country in order to gain trust and loyalty from business and residential customers.

- Thailand and Malaysia are both somewhat unpredictable in future government policies and leadership direction. Thailand has much corruption in elections and disagreements with various parties; potential constitutional reforms are pending. Malaysia while shifting from a commodity-based economy to manufacturing, is speaking publicly of the prospects for a reunification with Singapore. From the technology perspective, the impact may be a positive one, but the immediate effects could create instability in telecom market.

- Indonesia is without many obstacles, as President Suharto is almost sure to be re-elected. However, at his old age, concerns shift to the question of whom he will choose as his vice-president. Underlying political tensions will always be exist - widening socioeconomic disparities and lack of meaningful political reform.

Government Regulation / Deregulation

- From multiple sources, Thai government's Build-Transfer-Operate(BTO) policy has allowed many concessions in both mainline and cellular lines development. While the two telecommunication operators are state-owned, the BTO allows private partners to construct the network and transfer ownership to the public partners upon completion. The private partners then operate the network for the duration of the concession period. This has allowed significant injection of private capital. They have already approved many projects in satellites, mobile communications, data services, as well as fiber optics nationally and internationally. However, it does not necessarily reflect the true dynamics of competitions, as critics charge that the opening of the market was driven by politics because of corporate relationships with politicians.

- Since Malaysia expects that much of its investment in infrastructure will be provided by the private sector, privatization of the infrastructure sector has progressed rapidly since the mid-1980s. In this view, telecommunication has been gradually privatized and foreign investments as well as joint ventures have been encouraged and partially subsidized.

- Although the Indonesian government broke the monopoly of the two state-owned phone companies in 1989 for non-basic services, it left untouched the governments underlying control of the basic telecoms service. Nonetheless, due to Indonesia's positive attitude toward foreign participation and the wavering of government policies, business climate in the telecommunications market is considered as being favorable.

Geographic Similarities with Respect to Philippines

- By comparing similarities in geographical settings, Micro Integration can assess how much adjustment and changes they have to make in their Philippines Low/Mid/High-Tier systems in order for them to be implemented in each of the countries.

- In our comparison, Indonesia, although much larger, is most similar to the Philippines and also has many underdeveloped islands. Malaysia and Thailand, on the other hand, are both quite different in geographic topology.

Exchange Rate Volatility

- Since Micro Integration's R&D labs are expected to be based in the U.S. The stability and variability of exchange rate is a concern of the company. The less volatile the exchange rate is, the more viable it is for Micro Integration in terms of investment. Based on Bank of America World Information Services Country Data Forecast, all three countries are similar in exchange rate volatility, with Indonesia slightly more stable and consistent.

Below is a table indicating the actual weighting and scoring for each factor and country:

	Weights	Indonesia	Malaysia	Thailand
Forecast First Tier	6	2.5	1.5	6
Forecast Second Tier	5	3	1.5	5.5
Forecast Third Tier	5	3.5	1.5	5
Opportunities for WLL Technology Entry	5	3.5	4	2.5
Competition in Telecom Market	4	4	3	3
Economic Stability	4	3.5	4.5	2
Opportunities for Other Technology Entries	4	3.5	2.5	4
Political Stability	4	5	3	2
Government Regulation	3	5	3.5	3.5
Geographic Similarities w.r.t. Philippines	2	5	2.5	2.5
Exchange Rate Volatility	1	4	3	3
WEIGHTS TOTAL		160.5	114.5	163.5

From the above table, Thailand seems to contain the most attractive telecommunications market after including all factors related to market opportunity. The scoring system and weights would need to be changed only slightly before Indonesia, the second best choice, could displace Thailand as the country in which to enter first. In all cases, it seems that Malaysia is far behind both other countries, and thus is excluded from further analysis.

INITIAL RESULTS

Which?

According to the modeling methodology above, MI should enter Thailand first.

When?

In determining when MI should enter a specific country, we initially decided to examine the growth in telephone lines demanded and determine a point at which MI's research and development schedule would coincide with an increase in growth for the most attractive country. For example, we would examine the number of tier 1 lines demand in each country once MI had a product available. Similarly, tier 2 demand would be examined when it was also available. In determining this correlated demand schedule, it became clear that growth occurred continually for all countries. At points throughout our time horizon, growth in lines demanded held constant for each country relative to each other (except for the Philippines, which was excluded because MI had already decided to enter the country). By examining the graph below, we see that as tier 1, 2 or 3 become available Thailand will always be the country with the highest potential market.

Total Number of New Lines Demanded Correlated with MI's Product Availability
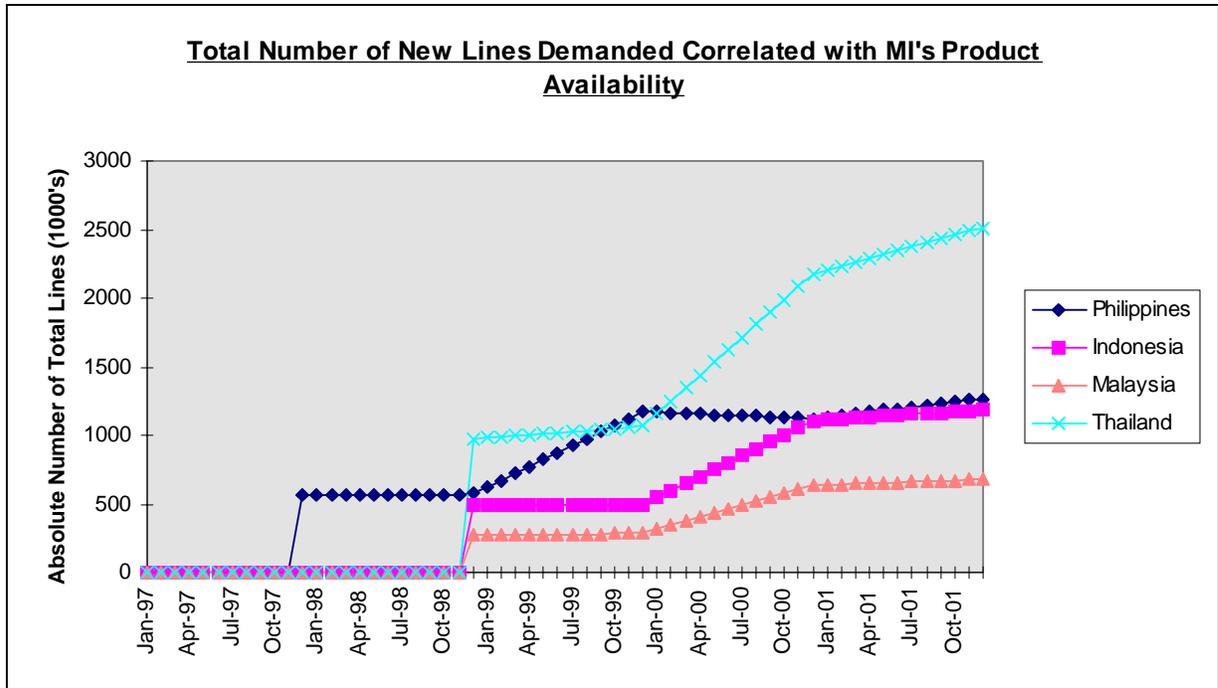
As a result, our analysis suggested the idea that MI should enter the country deemed most attractive as soon as products become available, specifically Thailand. Waiting does nothing except allow other competitors to satisfy market demands and gain status as an established player. In addition, once a country has been entered, switching to another market required relatively more resources and time. Hence, it makes no sense to try to enter the Indonesian market without first fully satisfying that of Thailand.

SCENARIOS

The above analysis assumed that current trends would continue and that no unexpected changes would take place. However, through the use of scenarios, we can identify possible developments that would alter the decision to enter Thailand.

Increased Internet Demand

• Because internet expansion is caused mostly by business demand and Indonesia has a higher proportion of business telephone users than Thailand, the Indonesian market will become more attractive as relatively more internet lines will be required.

Increased Cellular Demand

- Approximately 30% of all new lines demanded in Thailand are cellular; hence, if demand were to increase, the country's growth would expand because it is already nearing a saturation point. However, since the Indonesian cellular penetration level is much lower, future growth would necessarily mean a relatively larger market in Indonesia.

Loss of Confidence by the Business Community

- Because about 65% of the lines demanded in Thailand are for residential users, any decline in the business sector would hurt Indonesia (50% residential lines) relatively more. Consequently, Thailand's market would be relatively more advantageous should this even occur.

MI Development Schedule Delayed

- Because Thailand's teledensity is predicted to reach 20 lines per 100 (as compared to Indonesia's 4.5 per 100), any delay by MI would mean a lost opportunity. Most developed countries have teledensities of about 40 per 100, and Thailand's growth is predicted to slow as saturation sets in. However, because Indonesia's demand is no where near satisfied, any delays will result in relatively less lost sales.

Based upon the above, in three out of four scenarios Indonesia's market opportunity will increase relative to that of Thailand. In making a final choice, changes in market conditions must be kept in mind.

DISCUSSION

Thailand v. Indonesia

According to both our quantitative and qualitative model, Thailand seems to be the country in which to enter first. Growth in lines demanded is very high and even when tempered by qualitative factors, Thailand still comes out on top. However, the time horizon may alter the optimal choice. In our short time frame that ends in 2001, Thailand's growth is phenomenal with lines per 100 doubling to more than 20. Considering that most developed countries have 40 to 50 lines per 100, the future growth prospects for Thailand seem

limited. Our analysis would predict a substantial drop-off in growth in demand, as the country reaches a saturation point. The case for Indonesia is quite different. While lines demanded do not grow nearly as fast as that of Thailand, once the qualitative factors are added into the analysis, Indonesia is a close second. Within out time horizon, lines per 100 jumps to about 4.5. This figure is nowhere near a saturation point. Our prediction would be that the growth rate in Indonesia will either stay constant or increase in the future, while that for Thailand will begin to decrease as the saturation point is approached. As a result, we can still recommend Thailand over Indonesia if MI is able to enter the market quickly. Otherwise, if MI's timetable slips and expected entrance into a country is after 2001, the firm should look closely at entering Indonesia. Finally, it is important to remember that Indonesia can still be entered as soon as possible and still be very lucrative (though possible not as advantageous as Thailand).

FURTHER ANALYSIS

As soon as Micro Integration knows more about the costs and revenues related to its entry in the Philippines market, a thorough analysis of the decision options available should be performed. Such an analysis could be done using the theory of real options. Thus, Micro Integration would know whether it would be more profitable to delay certain investments or whether it should expand its facilities so that they would be able to enter several countries at a time. Additionally, MI has to determine in detail the (long-term) value of follow-up contracts in the Philippines vs. delaying the entry of another country and thus running the risk of getting less market share in this country.

RECOMMENDATIONS

Based upon MI's research and development schedule, the first step in penetrating the Southeast Asian telecom market is to firmly establish itself as a dominant and reliable player within the Philippines. Then as tier 1, 2, and 3 technologies become available, MI should begin to expand into other countries. According to our forecast and MI's schedule, when tier 1 becomes available for use in other countries, Thailand's market will be the most lucrative in which to enter. When tier 2 is developed, Thailand also shows the greatest market opportunity. In addition, since MI would have already entered the Thai market with tier 1

lines, it should be relatively easier to gain an additional contracts (because of business contacts and technical familiarity with the country). The same also holds for tier 3. Consequently, once one country is chosen, the best course of action is to continue to expansion until demand subsides.

Based upon MI's experience, to obtain a contract takes approximately one year. Because tier 1 lines will be ready in approximately that time also, the initial marketing efforts within Thailand should take place immediately to ensure that the entry window is not missed. Since a contract is the most important variable in determining success, if MI is able to secure an order within another country (earlier than that of Thailand), it should by all means enter that market for tier 1 lines. However, in the future as Thailand's demand dwarfs that of other countries, continued expansion in the first country must be compared with the as yet untapped potential in Thailand.

LESSONS

As the telecommunications industry becomes deregulated throughout the world, it is no longer a simple technology marketplace. New players, different perspectives, different goals have turned this industry into a whole new competitive information game that is without an end. Particularly in Southeast Asia, we have seen tremendous growth and needs for just the basic communication services. These dormant markets in the developing countries are awakening as giants for domestic and foreign investment. Technology and services will continue to boom into the next century. But because of much instabilities in the political and economic policies, and the underdeveloped telecommunications infrastructure, it is hardly visible where these developing countries will lead us. We may follow how Hong Kong and Singapore have matured through the last few decades, but as other businesses enter the Southeast Asia, growth can multiply beyond expectations. We have had a very comprehensive understanding of the telecommunications market and technologies in the Southeast Asia.

The key uncertainties described in earlier sections were essentially the primary obstacles that we and Micro Integration have. Because Micro Integration is still a start-up company, in the process of negotiating WLL development contracts, the focus of the company and our studies seemed to be continuously changing -

from first interested in being a service provider to being a technology consultant to now a technology provider in Philippines but with more ambitious and determined goals of penetrating the rest of Southeast Asia. As a result, as the contract negotiation progresses, it was a challenge for us to aim at these moving targets with any analytical tools. It has been known that business is done very differently in Asia than in the West. Most opportunities which lead to success are often created through corporate, personal, or political relationships. There is always a saying that, "In Asia, it is often difficult to make a decent living, yet one can get rich really fast. In the West, on the contrary, one can easily find a decent job, but it is hard to get rich at all…"

Appendix A: Forecasting Approaches and Methods Used

It is well known that accurate forecasting is an extremely difficult task. This is why we spent a long time discussing the applicability of well-known forecasting methods to our problem. As a matter of fact, developing countries do not necessarily publish reliable statistics; the situation is even worse for the inaccessible rural areas. In the following paragraph, we will present some of the methods we looked into and why we chose the forecasting method we eventually used.

Before we go into detail, we should clearly state, that central to almost all forecasting methods is the assumption that the future will resemble the past (at least in some way).

Time series analysis

A time series is a set of observations on a variable, such as demand for telephones, arranged in relation to time. Eventually, we used a specific method of determining the underlying trend of a series: Regression Analysis. The regression is calculated using time as the independent variable against the variable to be forecast (e.g. telephone demand) as the dependent variable. The equation for the linear relationship (we used) is

$$Y_t = a + b * t$$
where
Y_t is the variable at time t (in our case GDP per capita in a given year)
a is a constant
b is the slope of the trend line (i.e. the average absolute increment per year)

The forecast for year $t + n$ is then given by

$$Y_{t+n} = a + b * (t + n)$$

Growth curves

Growth curves are commonly used for long-term forecasting, i.e., in excess of ten years ahead. There is a variety of different growth curves such as Modified Exponential Curves, Logistics Curves, and Gompertz Curves. Although growth curves are generally preferable to other methods over such periods of time, they

have the major drawback that they can only be used in telecommunications demand forecasting for countries already highly penetrated (see International Telecommunication Union, "Methods used in long-term forecasting of domestic telecommunications demand and required resources (overall and by main sector)"). Since our forecast should not go beyond the year 2001 and since the countries we examined are all but highly penetrated, we decided not to use one of the various growth curve models to forecast telecommunications demand.

Econometric models

Econometric modeling is a technique designed to incorporate quantitative relationships between the variables of interest and other variables. In our case, this technique permitted the expression of demand for phone lines as a function of GDP, population above poverty, GDP distribution per industry sector, and their respective growth factors.

We first determined a set of variables which we considered influence demand for phone lines among the data available. Then we formulated a linear function defining the quantitative relationship between the demand for phone lines and the factors.

$$Y_t = a + b_1 * X_{1t} + K + b_n * X_{nt} + e_t$$

where

Y_t the demand for phone lines in year t

X_{it} the variables that are considered influencing demand for phone lines in year t

a, b_i constants

e_t an error term

Finally, we used different regression methods to adjust the coefficients b_i in the linear model such that the overall equation would fit best (using least square deviation). However, our model was far off the numbers predicted by World Telecommunications Development Report 1996/97 for the year 2000. Assuming that the forecast of this report was based on more and better data, we did not stick to our econometric model for the forecast of phone line demand in Southeast Asia.

Judgmental methods

This method is based on experience or in our case on collected information. No systematic analysis is made.

We eventually used this method to adjust the results found through time series analysis and to account for

less objective factors such as government regulations, political stability and suitability for WLL technology.

Telephone Line Demand Forecast Model

Backlog data
(1992-95)

Teledensity data
(1992-95)

Real GDP Data
(1992-95)

Population Data
(1992-95)

Total Line
Demand

Linear Regression

TotalFuture Line
Demand
(1997-2001)

Backlog Data
(1992-95)

Forecasting

Unsatisfied Future
Line Demand
(1997-2001)

Population Growth Forecasts
(1997-2001)

Real GDP Forecast Forecasts
(1997-2001)

Teledensity projections
Model Accuracy Check

Unsatisfied Line Demand Forecast
(to be categorized)

Telephone Line Demand Forecast Model

Industry Sector
Data (1992-97)

Industry sector
summary

Curve Fitting

Business Line
Tiered Demand
(1997-2001)

Unsatisfied Line Demand Forecast
(to be categorized)

Upwards
Transition Rate

Tier #1, #2, #3
Definitions / Asumptions

Tier #1, #2, #3
Residential line
demand model

Unsatisfied Tiered
Line Demand
(1997-2001)

Residential Line
Data (1990-95)
for Thailand/Philippines

Rural /Urban
Residential
Line Demand Ratio
for SE Asia

Residential Line
Tiered Demand
(1997-2001)

Overview of the Forecasting Methods We Used

| To Estimate:	Indonesia	Malaysia	Philippines	Thailand
Backlog % per Year	Exponential Regression	Exponential Regression	Power Regression	Exponential Regression
Total Demand # of Phone Lines	Linear Regression	Linear Regression	Linear Regression	Linear Regression
Sector Distribution:				
Agriculture	Linear Regression	Linear Regression	Linear Regression	Exponential Regression
Industry	Power Regression	Power Regression	Linear Regression	Linear Regression
Service	Linear Regression	Linear Regression	Linear Regression	Linear Regression

Appendix B: Numerical Results of Forecast

Total Number of Lines

Indonesia
(all units in 1000's)

	1997	1998	1999	2000	2001
Total Unsatisfied Demanded Lines	1101.7	1177.5	1240.6	1385.0	1537.4
Total Tier 1	486.3	492.5	496.0	533.6	575.1
industry	236.2	213.8	190.8	180.3	169.5
residential	250.0	278.7	305.2	353.3	405.6
Total Tier 2	475.1	506.7	525.2	570.8	611.8
industry	172.1	194.3	207.7	228.8	245.6
residential	303.0	312.4	317.5	342.0	366.2
Total Tier 3	140.3	178.3	219.4	280.6	350.5
industry	140.3	178.3	219.4	280.6	350.5
residential	0.0	0.0	0.0	0.0	0.0
Summation	**1101.7**	**1177.5**	**1240.6**	**1385.0**	**1537.4**
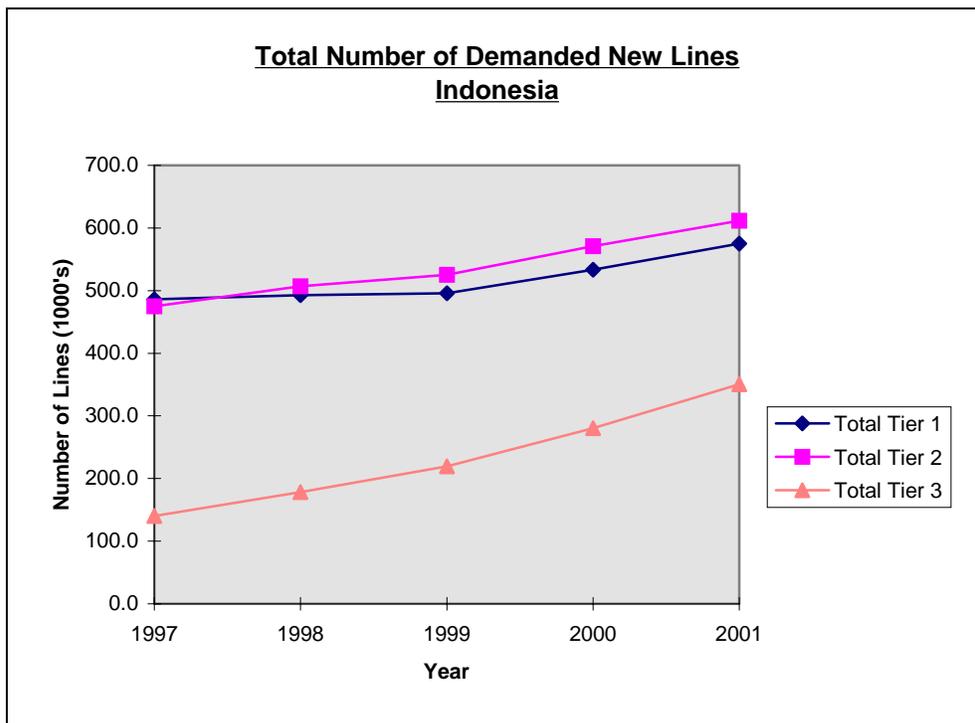
Total Number of Lines

Malaysia
(all units in 1000's)

	1997	1998	1999	2000	2001
Total Unsatisfied Demanded Lines	548.8	613.2	646.3	717.7	775.8
Total Tier 1	245.4	271.6	285.0	316.4	343.1
industry	66.1	62.6	56.0	52.7	48.3
residential	179.4	209.0	229.0	263.7	294.8
Total Tier 2	264.1	289.8	297.8	320.7	334.9
industry	46.7	55.4	59.6	65.5	68.7
residential	217.4	234.4	238.2	255.2	266.1
Total Tier 3	39.3	51.8	63.5	80.6	97.8
industry	39.3	51.8	63.5	80.6	97.8
residential	0.0	0.0	0.0	0.0	0.0
Summation	**548.8**	**613.2**	**646.3**	**717.7**	**775.8**

Total Number of Demanded New Lines
Malaysia
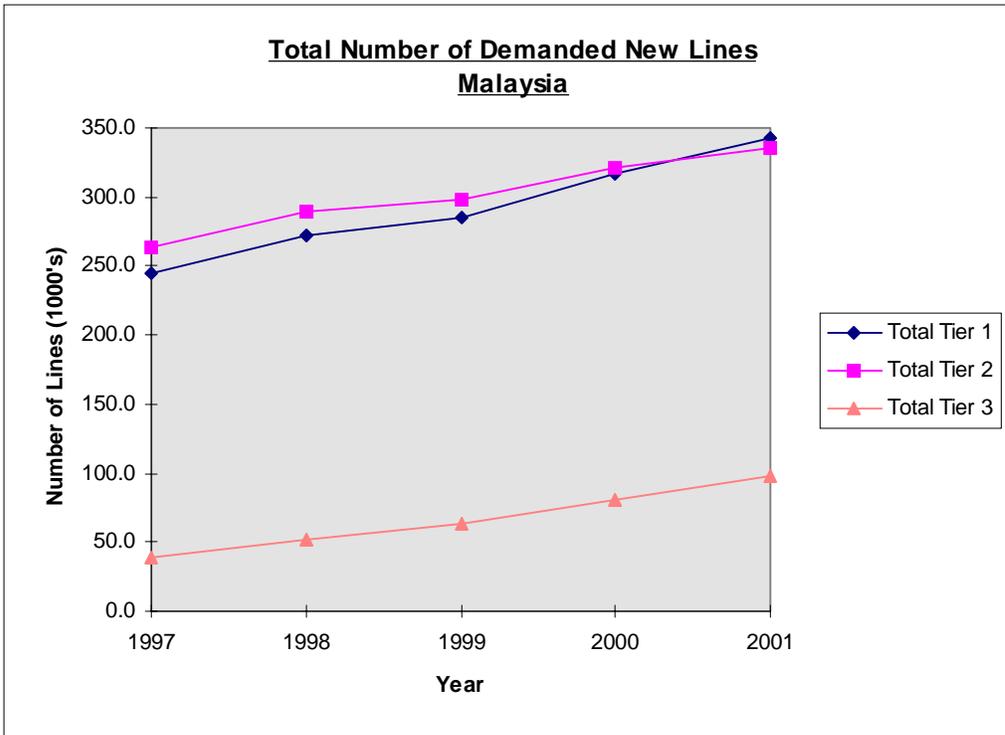
Total Number of Lines

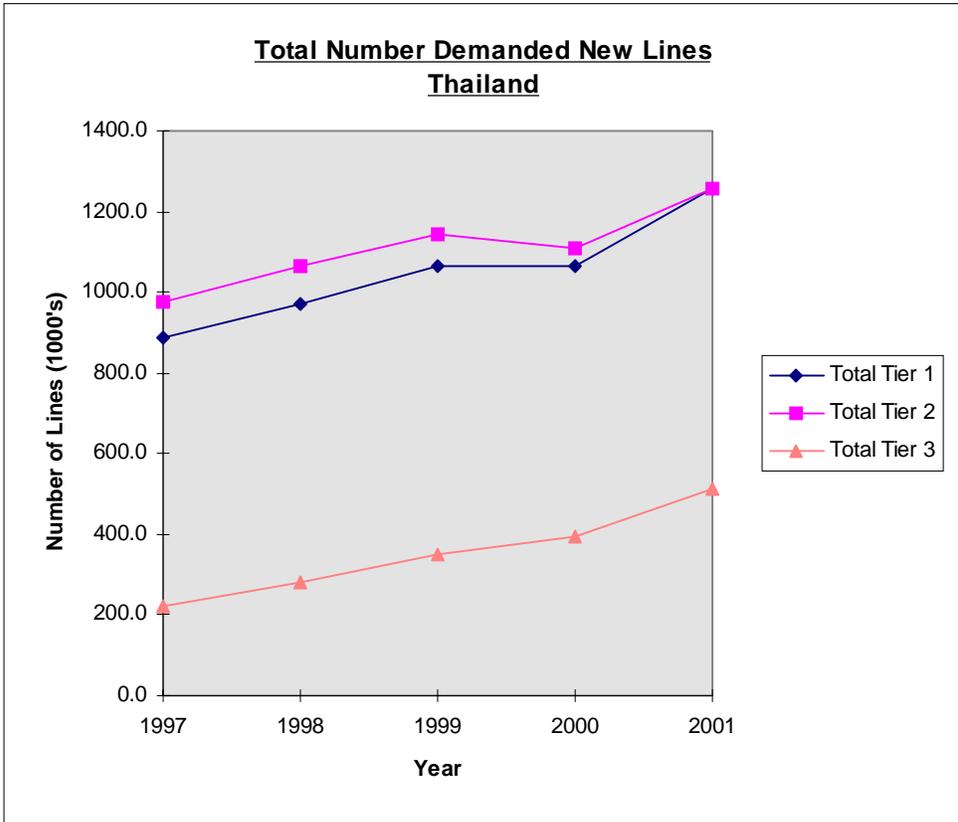| *Philippines* (all units in 1000's)	1997	1998	1999	2000	2001
Total Unsatisfied Demanded Lines	1339.1	1387.0	1387.1	1355.9	1266.3
Total Tier 1	563.5	572.6	565.2	548.4	510.7
industry	176.1	154.1	130.1	107.5	84.8
residential	387.4	418.5	435.1	441.0	425.9
Total Tier 2	614.4	623.9	607.0	573.8	515.9
industry	144.8	154.7	154.4	147.0	131.4
residential	469.6	469.2	452.6	426.8	384.5
Total Tier 3	161.2	190.6	214.8	233.6	239.7
industry	161.2	190.6	214.8	233.6	239.7
residential	0.0	0.0	0.0	0.0	0.0
Summation	**1339.1**	**1387.0**	**1387.1**	**1355.9**	**1266.3**
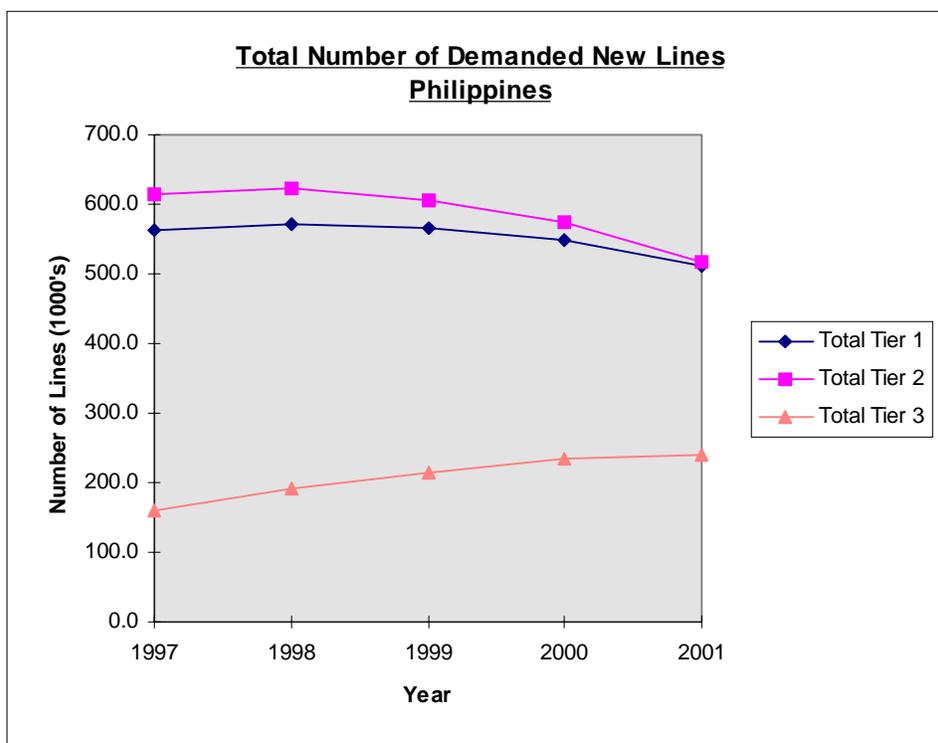
Total Number of Lines

Thailand
(all units in 1000's)

	1997	1998	1999	2000	2001
Total Unsatisfied Demanded Lines	2084.4	2314.3	2561.7	2573.0	3026.5
Total Tier 1	886.6	970.8	1065.8	1066.9	1255.7
industry	255.9	240.5	225.5	191.8	191.2
residential	630.7	730.2	840.3	875.1	1064.5
Total Tier 2	977.6	1062.6	1143.5	1110.7	1258.3
industry	213.2	243.9	269.3	263.7	297.2
residential	764.4	818.7	874.2	847.0	961.1
Total Tier 3	220.2	280.9	352.4	395.4	512.5
industry	220.2	280.9	352.4	395.4	512.5
residential	0.0	0.0	0.0	0.0	0.0
Summation	**2084.4**	**2314.3**	**2561.7**	**2573.0**	**3026.5**

**Total Number Demanded New Lines
Thailand**

Appendix C: Country Comparison by Tiers

Total Number of Tier 1 Lines Demanded

Total Number of Tier 2 Lines Demanded

Total Number of Tier 3 Lines Demanded

- Indonesia
- Thailand
- Philippines
- Malaysia

Number of Lines (1000's)

Year
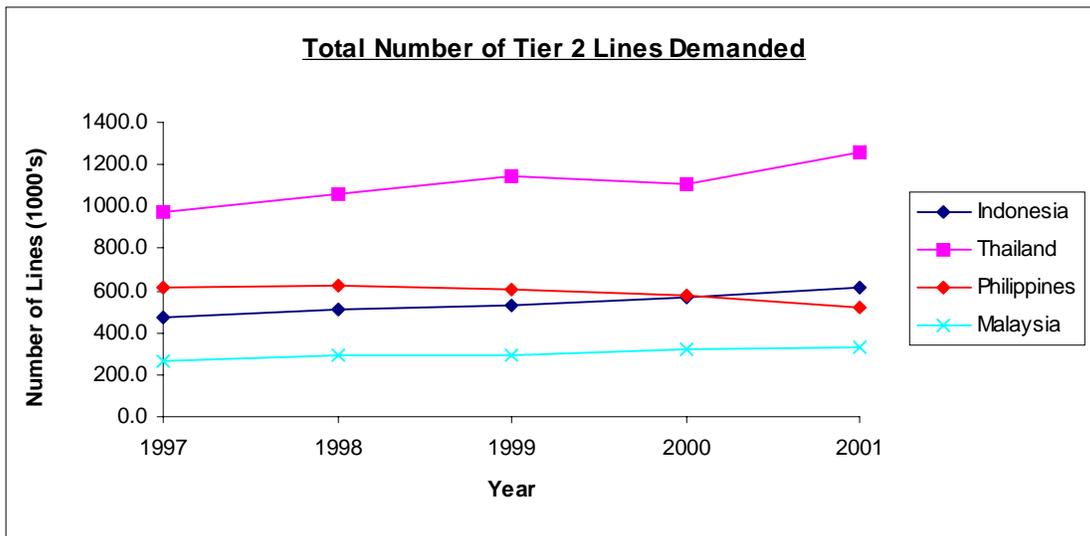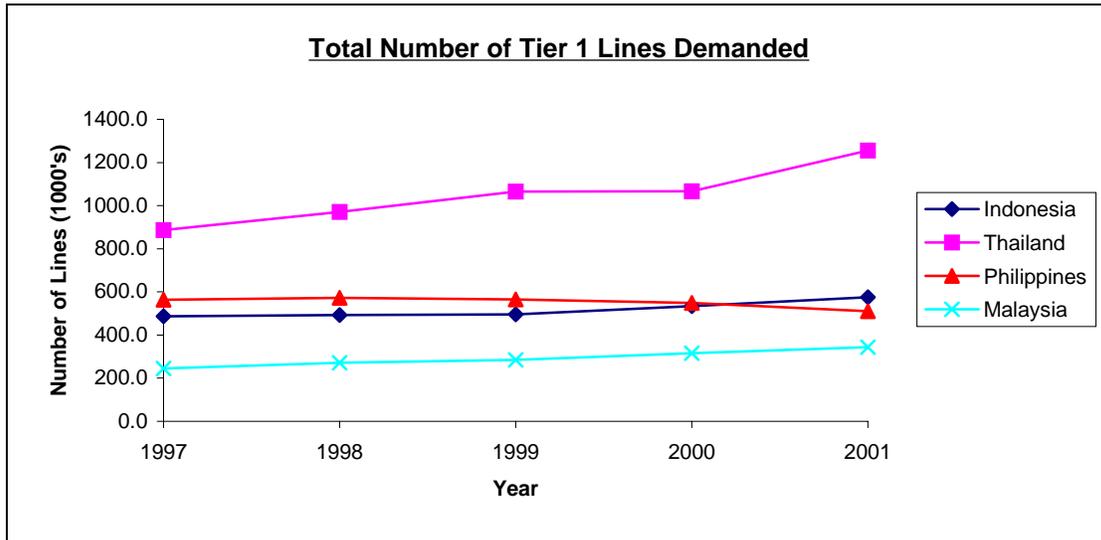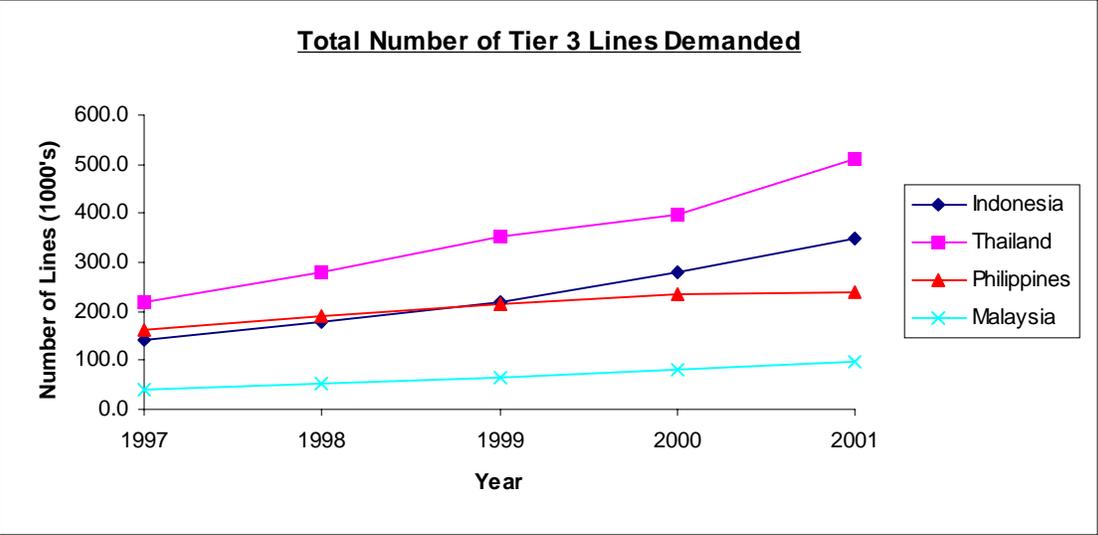
Appendix D:

Basic Indicators

	Population		GDP		Main telephone lines	
	Total (M)	Density (per km2)	Total (B.US$)	Per Capita (US$)	Total (k)	per 100 inhabitants
	1995	1995	1994	1994	1995	
Philippines	67.54	225	64.1	968	1409.6	2.09
Thailand	59.4	116	143.2	2439	3482	5.86
Indonesia	194.75	101	174.6	920	3290.9	1.69
Malaysia	20.13	60	70.6	3622	3332.4	16.56

Waiting List

(CAGR = Compound Annual Growth Rate)

	(k)	(k)	CAGR(%)	Total Demand (k)	Satisfied Demand (%)	Waiting Time (years)
	1990	1995	1990-95	1995	1995	1995
Philippines	567.3	900.2	9.7	2309.8	61	3.6
Thailand	992.5	1083.5	1.8	4565.5	76.3	1.9
Indonesia	388.9	117.5	-32.9	3408.3	96.6	0.2
Malaysia	81.8	122	10.5	3454.4	96.5	0.3

Local Telephone Network

	Main telephone lines				Faults per 100 mainlines per year
	Capacity Used (%) 1995	Automatic (%) 1995	Digital (%) 1995	Residential (%) 1995	1995
Philippines	84.5	100	70	64	131.6
Thailand	79.1	100	86.9	67.8	45
Indonesia	68.2	100	93	50.2	32
Malaysia	60.7	100	95	72.3	60

Tele-accessibility

	Households	Residential main lines			Payphones	
		Total (k)	per 100 households	Mainlines per 100 inhabitants	Total (k)	per 1000 inhabitants
	(k) 1995	1995	1995	1995	1995	1995
Philippines	13400	902.2	6.7	2.09	8	0.12
Thailand	12800	2360.8	18.4	5.86	49.36	0.83
Indonesia	44500	936.3	2.2	1.69	108.26	0.56
Malaysia	4000	2409.4	60.2	16.56	99.22	4.93

Telephone Tariffs

	Residential		Business			
	Connection (US$) 1995	Monthly subscription (US$) 1995	Connection (US$) 1995	Monthly Subscription (US$) 1995	Local call (US$) 1995	Subscription as a % of GDP per capita 1994
Philippines	13	10.1	16	23.1	N/A	11.7
Thailand	133	4	133	4	0.12	2
Indonesia	311	9.1	400	13.8	0.05	12.4
Malaysia	19	7.6	19	13.3	0.05	2.5

Cellular Subscribers

	Cellular Mobile Subscribers					% of total telephone subscribers 1995
	(k) 1990	(k) 1995	CAGR (%) 1990-95	Per 100 Inhabitants 1995	% Digital 1995	
Philippines	9.7	492.7	119.3	0.73	N/A	25.9
Thailand	63.2	1087.5	76.6	1.83	3.5	23.8
Indonesia	18.1	218.6	64.6	0.11	57.2	6.2
Malaysia	86.6	872.8	58.7	4.34	N/A	20.8

Network Growth 94-95

	New Phone Lines Added		New Mobile Subscribers added		New Internet Hosts Added	
	Total (k)	CAGR (%)	Total (k)	CAGR (%)	Total (k)	CAGR (%)
Philippines	300	27	292.3	145.9	1.4	430.2
Thailand	731.2	26.6	444.5	69.1	2.3	134.7
Indonesia	828	33.6	140.6	180.2	2.2	1228.2
Malaysia	468.7	16.4	301.1	52.7	2.6	161.1

Projections

	Main Telephone Lines				Estimated Investment (1996-2000) (M	
	Total (k) 1995	Total (k) 2000	per 100 inhabitants 1995	per 100 inhabitants 2000	Total	Per Year
Philippines	1410	3257	2.09	4.23	2772	554
Thailand	3482	9154	5.86	14.08	8508	1702
Indonesia	3291	10157	1.69	4.93	10299	2060
Malaysia	3332	7003	16.56	31.83	5506	1101

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