Technologies and Policies for an Evolving
Telecommunications Sector in China

by

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Abstract

This thesis seeks to understand several choices currently facing the Chinese telecommunications sector. It starts with a review of the general macroeconomic trends affecting China, and with a framework for understanding Chinese policy-making through the bureaucratic model. I analyze the players and their stakes in the sector, review the technological and institutional highlights of the telecommunications network, and study the prospects for foreign investment. Finally I look at various mobile technologies as ways of meeting growing demand. Several recommendations for the future of the Chinese telecommunications infrastructure are made.

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Chapter 1

Introduction

1.1 Problem Statement

China's plans to quickly modernize and develop its telecommunications infrastructure have attracted global attention, from foreign investors eager to enter this huge new market, to social scientists who wonder what increased access to communications technology will mean for the world's most populous nation. Despite the government's recognition of the strategic importance of telecommunications and the high growth rate in the sector, China still has one of the least developed telecommunications systems in Asia. With a telephone penetration rate of only 1.46 percent countrywide (1994), compared with more than 50 access lines per 100 people in the United States, and with figures as low as 0.2 lines per 100 people in some provinces, China clearly has a lot of development work ahead. In fact, China has set a target of installing another 50 million phone lines by the year 2000. ("Telecoms", EIU, March 1994) Like other developing countries, however, it is beset by a lack of capital to finance much of its projected development.

Aside from the financial issues, there is also the question of how developing countries such as China should go about restructuring this sector. Is deregulation and competition the best way for these countries to upgrade their telecommunications infrastructures, or should they rely on a monopolistic national telecommunication authority as South Korea, Singapore, and Japan did? Furthermore, should they follow the traditional path of laying down copper phone wires, or should they use wireless networks in lieu of wireline? These questions are common to all of Asia's low income countries including Vietnam, Sri Lanka, Indonesia, Pakistan, and China.
However, China's unique political and economic situation make the telecommunications policy arena very different from that of many other developing countries. China's economy continues to grow at double-digit rates, after being the world's fastest growing economy in the late 80's, yet it is also in transition from being a socialist to a market economy. Moreover, the state retains its political authoritarianism; decisions are not made in the open, and the structure and policy-making process behind telecommunications are not fully understood.

This thesis seeks to elucidate the telecommunications sector organization and policy making process, and then to examine the effects that recent technological and investment trends will have on China's ability to meet its growing telecommunications demand. In particular, I will study the opening up of the market to foreign investment as a policy tool, and the use of several wireless communications systems as technological innovations necessary for China to meet both its growing urban and rural needs. Through these examples I will also show that increased decentralization in China's telecommunications authority has devolved a great deal of control from the central government and made the concept of a single coherent "telecommunications policy" problematic at best.

1.2 Structure and Focus of the Thesis

Foreign study of the People's Republic of China's (PRC) telecommunications sector is relatively new. The World Bank completed its first study of the sector in 1992, and the largest body of research is probably in market studies done by various companies and consulting firms. In these types of analyses, the emphasis is on the identification of investment opportunities, the understanding of policy directives as affects these opportunities, and the prediction of future investment trends.

This study will focus instead on an understanding of the players and interests driving development of the sector, as well as the way in which not only official pronouncements by the Ministry of Posts and Telecommunications, but also global trends towards liberalization and the adoption of specific types of technologies shape the ability of the sector to meet growing demand.

Chapter two starts with an overview of the larger Chinese picture, including key points of economic and enterprise reform, as well as a review of Oksenberg and Lieberthal's model for
understanding policy-making in China. It also provides some background on global trends in telecommunications reform, and addresses the need for telecommunications policies and laws, both in general and particularly in China.

Chapter three moves on with a presentation of the current state of telecommunications development and access to network services in China. I then summarize sector organization and analyze recent developments such as the formation of Lian Tong and Ji Tong.

In Chapter four I study the prospects for foreign investments in Chinese telecoms, examining both the need for such investment, attitudes towards foreign involvement, and how the outcome of the current debate is likely to shape the future of the sector and vice versa. The linkages between decentralization and foreign investment are also addressed. This chapter also discusses the “policy of exceptions” as a framework for understanding the telecommunications sector. Then I draw on the experiences of several other countries in the Asia-Pacific region to understand China’s options.

Chapter five uses the concept of the “policy of exceptions” to investigate some of the key exceptions to MPT regulations – wireless technologies. This chapter will go into some details about the different technological choices facing China in the mobile front, in order to illustrate the interactions between policy and technology adoption, and to evaluate the effects that different wireless systems may have in satisfying demand in different areas of the country. In particular, the idea of “technological leapfrogging” is discussed as a creative solution to China’s growing demand problem.

Chapter six ties together the policy and technology choices faced by the sector with an analysis of the major problems to be addressed in the Chinese telecom sector right now. I then make some recommendations regarding foreign investment and technology adoption usage; summarize, and conclude with suggestions for future study.
Chapter 2

Background

2.1 Telecommunications and Economic Development

A strong positive correlation between general economic development as measured by GNP per capita or other similar aggregate statistics, and development of telecommunications infrastructure is well established. While this sort of evidence provides only general and descriptive insights into the benefits of telecommunications, it is quite useful in achieving a general understanding of trends. Most of the empirical work done is either statistical correlation or regression analysis at a country level; or structural economic analysis which uses input-output analysis to focus on levels of activity in different sectors. For example, Figures 2-1, 2-2, and 2-3 show the density of telephone lines graphed against GDP per capita for low, medium, and high teledensity countries. (Zita, PECC, 1995. Original source: ITU)

Studies using proxies for GDP and telephone density have also had similar results. For example a study by Bebee and Gilling in 1976 graphs a telephone index against a development support index for 29 countries. See Figure 2-4. The “development support index” is developed based on measures such as the proportion of GDP used in fixed capital formation, the literacy rate of the population over fifteen years of age, median number of years of education in the population, per capita daily intake of protein and calories, percentage of population living in urban areas, and the population growth rate. The “telephone index” was constructed from the number of telephones per 100 literate people over age 15 in the population, number of business telephones per 100 nonagricultural person, and the average annual number of telephones per telephone. The results are similar to those found in simple GDP vs. teledensity graphs, but suggest that in higher-income and developed countries,
Figure 2-1: Teledensity and Wealth in Low Teledensity Economies

Figure 2-2: Teledensity and Wealth in Medium Teledensity Economies
More recently, methodology developed by Andrew Hardy has shown that the causality runs in both directions - economic development leads to more investment in telecommunications, but telecommunications also contributes to economic development. (Hudson, 1990)

Why is this so? Access to a means of communication can facilitate the development process by improving efficiency, or ratio of output to cost; effectiveness, or quality of products or services; and equity throughout a society. Unfortunately, if development occurs only among the areas already richer or more developed, then telecommunications can also have the effect of widening the gap between "haves" and "have-nots" rather than bringing more equity.

The benefits of telecommunications can be both direct and indirect. For example, benefits may accrue to both the caller and the person called. As a result, benefits are usually greater than those measured solely from the anticipated revenue of a network. In fact, several studies by the ITU, OECD, World Bank and other development agencies have shown that the benefit - cost ratio of telecommunications usage ranges from 5:1 to more than 100:1, especially in rural areas.
Figure 2-4: Telephone Index as Function of the Development Support Index
Furthermore, investment in the telecommunications sector generally yields high rates of economic return. For example, thirteen telecommunications projects approved for World Bank support yield rates of return ranging from 15 to 30 percent as compared to 10-14 percent, which is used by the Bank as a threshold for acceptable investments in developing countries. (Saunders, Warford, and Wellenius, 1994) Despite these potential benefits, the supply of telecommunications services in developing countries continues to be far below demand. Telephone density in developing countries varies widely from 0.1 lines per 100 people in countries such as Madagascar to 10 lines per 100 in Argentina and Uruguay. (Saunders, Warford, and Wellenius, 1994.) The problem has been both a lack of money and the fact that, until recently, telecommunications was not treated as basic infrastructure such as power grids and roads, and thus was ignored by planners.

This is especially true of Asia. With 3 billion people having access to few more than 30 million phone lines, there is an awareness that the region as a whole needs to undergo a crash program of unprecedented expansion. Reliable and up-to-date communications are as important as ports, roads and railways once were; they are necessary for attracting foreign investment and national growth. Asia is particularly well suited to rapid telecommunications development to go along with its economic expansion because of the relatively low density of existing telephone. This lack of infrastructure may actually make new technology easier to integrate.

In the Chinese case, a rapidly expanding economy acts as both cause and effect of swift telecommunications modernization; as communication becomes easier, there is more incentive for businesses to invest, and as more money comes into the economy, more can be spent on telecommunications. In fact, from 1985-1992 the growth rate of telecommunications has exceeded both that of GNP and trade. (See Table 2-1) In 1991 and 1992 the growth rate of the telecommunications sector exceeded 40%, and it reached 71.6% in the first four months of 1993. In fact, it is believed that the growth rate of the telecommunications industry needs to be higher than that of the economy as a whole because its "social benefit...is much higher than the direct benefit received by the posts and telecommunications authority itself"1. According to one Chinese study of the relationship between investment in posts and telecom and the national economy as a whole, an additional investment of 100 million yuan in the telecom sector would increase national income by 1.38 billion yuan in 10 years, i.e. an

1Zhao and Junjia, April 1994
implicit internal rate of return of 45% (Zhao and Junjia, April 1994.)

2.1.1 Spatial Effects of Telecom Development

The "information gap" does not exist only between industrialized and developing countries, but also within countries themselves. For example, in 1988 the number of urban telephone subscribers in China was more than three times the number of rural users, although more than half of the population lived in rural areas. Money going into China's telecom expansion is going mostly to the more developed, coastal areas. The dualistic nature of telecom development is only one example of the dualism within the country as a whole. According to Singer, the concept of dualism has four main elements: 1) A different set of "superior" and "inferior" conditions which can coexist in a given time and space; 2) a chronic rather than temporary nature; 3) the degree of disparity has a tendency to increase; 4) the relations between "superior" and "inferior" elements are such that the better does not pull up the worse, and may in fact serve to push it down. (Lee, 1991.) On the basis of these characteristics, Lee identifies three levels of dualism in Chinese telecom: rural-urban, core-peripheral, and advanced-rudimentary.

Time-series data indicates that the rural-urban gap in communications in China is indeed "chronic," and has widened over time. In 1965 the rural-urban telephone density ratio was 1:1.6, but it had grown to 1:3.3 by 1988. Similarly, provinces such as Guangdong have long dominated the telecommunications system, and there is some evidence that these regions hurt less developed regions by their ability to attract a limited total amount of investment. In 1988, Shanghai, Beijing, and Guangdong alone received nearly 60% of total capital investment in telecommunications. Because the coastal cities attract investment, people and resources of the remote and north-west regions are more and more drawn to the coast. Lee characterizes this phenomenon as "an exploitative core-peripheral relationship as described by dependence theories." (Lee, 1991.)

Unplanned large scale migration from rural to urban areas is perhaps the greatest concern about the widening technology gaps. Large influxes of unemployed rural laborers have created living and health problems in Guangdong in recent years, slowing down urban development as pressure is put on resources for energy, water, transportation, housing, etc in the city. On the other hand, the communication dualism is only one of many factors leading to migration and in fact, some have argued that a rural telephone program, far from
keeping people happy in their rural locations, would make it easier for people to keep in touch with their home village and family and thus make migrating to cities more attractive. (Saunders, Warford, and Wellenius, 1994.)

Lee also examines the "advanced-rudimentary" dualism in communications, or the co-existence of basic and modern technologies. This is another way of stating China's unique ability to "leapfrog" over many years of telecom development. According to Lee, the simultaneous uses of loudspeakers to transmit radio messages in some villages, and high-tech digital cellular systems in other areas of the country is complementary: "the modern and traditional sectors do not constrain each other's development." (Lee, 1991.) Thus the presence of a dualism here is not necessarily negative. If China can take advantage of the opportunity to leap-frog, rather than forcing each area of the country to go through the same technological progression, then it can succeed in bringing its telecom infrastructure "into the 21st century without ever seeing the 20th."

The difficulty, though, will be in providing rural remote areas with communications. Thus far the Chinese government has provided little incentive to do so despite evidence that the availability of telecommunications can contribute significantly to rural economic activities, and that the benefits of investment may be the greatest in rural and remote areas where distances are greater and telephone penetration lower. (Hudson, 1990.)

Whether rural or urban, the linkages between development of the telecommunications industry and economic development as a whole are quite strong. Furthermore, a broader view of macroeconomic policy, especially policies on investment and enterprise development, helps us understand the options open to a country trying to develop its infrastructure.

2.2 Economic Reform in China

2.2.1 The Backdrop for Change

During the post 1949 period, but before economic reform, China modeled its economy after the Soviet-style centrally planned system. The state owned most industries and exerted central control over economic planning and the financial system. However, the extent to which the economy was centrally planned was never quite as much as in the former Soviet Union. In 1960 there were only about 500 commodities under mandatory planning as compared to 20,000 in the former Soviet Union. (Harrold, 1992.) In practice, most economic
activity was quite decentralized, with local officials capable of implementing, formulating, and planning local economic activity. In addition to providing experience with local control—a characteristic which persists—this regional autonomy also created severe inefficiencies because there was so little flow of goods and services between areas. For example, about seventy-five percent of the grain grown in China was consumed by the families that produced it. (Army Handbook, 1994.) Thus, there was much to be gained from interprovincial trade which could exploit the comparative advantage of different locales.

Within a single city, enterprises ranged from small, collectively owned handicraft units, barely earning subsistence-level incomes for their members, to state-owned factories whose workers received steady wages as well as social benefits. (Army Handbook, 1994.) However, the disparities from region to region are even greater. The large land area of China and the extremely diverse climatic and geographical regions combined with the regional autonomy resulted in various areas of the country having very different levels of technological sophistication, prosperity, and economic activity. The contrast between rural and urban areas was particularly stark, but also developed along the core-periphery axis, with regions such as Beijing becoming wealthier while provinces such as Qinghai and Xinjiang lagged behind.

Also during the post 1949 period, China was transformed from an almost exclusively rural, peasant economy to one in which industry had a 49 percent share in the economy by 1978. By 1991, agriculture accounted for only 26% of GNP, with industry making up most of the rest. Of the share in 1978, 78 percent came from large and medium sized state-owned enterprises, with a much smaller share from local enterprises. These large state enterprises were bureaucratic and overburdened with almost every type of social obligation for workforces which were too large. (Harrold, 1992.) Thus, prior to 1978 there were many socioeconomic pressures pushing towards reform. Furthermore, unlike other socialist economies in transition, China experienced no deep macroeconomic crisis. Reform was gradual and was not accompanied by the usual strong deflationary policies.

2.2.2 The Socialist Market Economy

Since 1978, China's economic system has evolved from centralized state planning to a structure with some market allocation and commercial competition known as "a new system of planned commodity economy of Chinese style." Debates over the relationship between planning and the market were a key feature of China's economic landscape until the Constitution
was amended in March 1993 when “planned economy under public ownership” was changed to “socialist market economy.” Although there is some disagreement about what a socialist market economy is, it is generally agreed that such an economy allows market forces to play a key role in resource allocation while still maintaining “public ownership” (state or collective ownership) and adopting measures to prevent “unfair” income distributions. (Harrold and Lall, 1993.)

These principles are applied by the State Planning Commission, which retains responsibility for planning at the national level. It also articulates five-year economic plans which establish general goals and priorities for capital investment, production, and supply; annual plans which include performance targets for state owned and commercial enterprises; and allocates funding for each year. Part of current reform plan is to shift the implementation of these goals from direct administrative controls to indirect economic tools such as prices, taxes, and interest rates.

The opening up to the outside world encompassed changes in six key areas, namely: 1) enterprise reform 2) financial sector issues, 3) fiscal reform, 4) external reforms, 5) price reform, and 6) social sector reform. (Harrold, 1992) Of greatest importance to the telecommunications sector development were the reforms in enterprises and foreign investment.

2.2.3 Enterprise Reform

Poor performance of many state-owned industries and subsidies to state-owned enterprises has produced a large fiscal burden on the government. To help recoup these losses, reform has tried to make state-owned enterprises independent economic entities, responsible for their own losses and profits. In essence, China’s approach to enterprise reform can be characterized as marketization or corporatization rather than privatization of state-owned enterprises. The two most significant changes came in 1984 when targets were lowered and enterprises were allowed to sell above plan output on markets; and when profit remittances to the central government were changed to a system whereby enterprises paid income taxes and shared profits with their local authorities (Harrold, 1992.) Shifting the aim of state-owned enterprises gradually from meeting output targets to meeting financial targets has reduced many efficiency losses in the economy.

Separation of “dual rights” – protection of the management autonomy of a state owned enterprise while the state retains final ownership – is key to China’s strategy of enterprise
reform. Under the widespread contract responsibility system (CRS), a state-owned enterprise manager is supervised by the relevant line bureau according to a set of performance indicators; unfortunately this system has diluted management autonomy quite a bit. This issue was addressed in July 1992 with the State Council's publication of *The Regulations for Transforming the Operating Mechanisms of the State-Owned Enterprises* which called for the protection through law of the autonomous rights of state-owned enterprises in fourteen key areas. By March 1993, 28 out of 30 provinces and autonomous regions had published their regulations for implementing and enforcing these rights. However, bureaucratic interference still remains an issue for most enterprises, especially in investment, import/export, personnel, and excess levies and taxation by supervisors (Harrold and Lall, 1993).

In addition to enterprise autonomy, another major aspect of the “dual rights” approach is the formation of shareholding companies. A shareholding company is taxed at the standard 33 percent tax rate and must operate under normal tax rules rather than the contract-based tax arrangements typical of CRS. In addition, the manager is responsible to a board of directors rather than government officials, which greatly reduces the scope for government intervention. In 1992, shareholding companies were given a major boost when the System Reform Commission enhanced their legal status with the publication of “Views of Standards for Limited Share Companies” and when 400 additional enterprises were transformed into limited liability and shareholding companies. By the end of 1992, there were a total of 3,700 shareholding companies, but 86 percent of these had issued shares only to staff and workers. While these shareholding companies have done well, they have been limited mostly to state-owned enterprises which already had good performance. Further experimentation and development of a nationwide legal and regulatory framework will be necessary if they are to make a greater impact.

2.2.4 Foreign Investment

The passing of the joint venture law in 1979 and the opening of the first four Special Economic Zones in 1980 marked the beginnings of foreign direct investment (FDI) in China. Although FDI was an important component of Deng Xiaoping's reform process from the start, up until 1986 it was focused exclusively on export-oriented industries. The “22 Articles” of 1986 removed the most serious constraint, China's attempt to force joint ventures to use foreign exchange to achieve self-sufficiency. Further improvements came in 1990 with
the introduction of regulations limiting the scope of administrative intervention in joint venture operations. By the early 1990s China was the largest recipient of foreign direct investment in the developing world. ("The Economy", EIU, February 1, 1995)

According to the Ministry of Foreign Trade and Economic Cooperation (MOFTEC), the total volume of contracted foreign investment between 1979 and 1993 was $221.9 billion across 174,228 projects, of which 81% were committed to the coastal regions and 33.7% to Guangdong alone. Almost 70% of total foreign investment originates from Hong Kong, with Taiwan next at 8.3% (though much of this is routed through Hong Kong), and then the USA with 6.5% of the total. Japan followed, with just 4%. Whereas many investments from Hong Kong and Japan are in labor-intensive processing and assembly operations, Western operations tend to favor more value-added technology.

Gradual liberalization of the foreign trade regime, including reductions in the numbers of commodities subject to import and export quotas or licenses, as well as other reforms have made China a major force in the world market. Nevertheless, there are still many restrictions particularly on imports, and China is under pressure to undertake further reform if it wants to join the World Trade Organization.

Currently the three primary types of enterprises with foreign investments in China are equity joint ventures, contractual joint ventures, and wholly foreign-owned ventures. Equity joint ventures are limited liability companies in which the foreign partner must contribute at least 25 percent of the capital and cannot recover its investment until liquidation or sale of the venture. There is no limitation on the number of partners in the venture, and profits are distributed according to capital contribution.

Under the law governing contractual joint ventures, or cooperative joint ventures, the parties determine the form of operation through negotiation of a contract. Usually they will form a new limited liability company or operate jointly as partners. There are no government stipulations on the duration of the venture, the amount of capital the foreign investor contributes, or on profit distribution.

The Ministry of Foreign Economic Relations and Trade (MOFERT) is responsible for approving all three kinds of ventures. Equity joint ventures are usually decided upon in ninety days and contractual joint ventures in forty-five. Wholly foreign-owned ventures are usually only approved if MOFERT believes that the enterprise will benefit the development of China's national economy. Therefore, enterprises using advanced technology and equip-
ment, or those which manufacture products not made in China are favored. (National Trade Data Bank, March 11, 1992)

2.3 Policy Making in China

The policy making process in China is often obscured and incomprehensible to outsiders. Prior to the 1970s, Chinese decision-making was usually portrayed in very static terms, emphasizing the totalitarian nature of the central government, the absence of the rule of law, and the allegedly firm grasp that the state had on all of society. (Lieberthal and Oksenberg, 1988.) However, this approach proved unable to explain the dynamics of the Cultural Revolution and changes that occurred after that. As a result, several new models were advanced. I will examine these models of decision making in China, and adopt one to apply to the case of the telecommunications sector.

2.3.1 Rationality Model

The basic premise of the rationality model is that "policy outcomes are the result of an evaluation of choices by a coherent group with shared perceptions of the values to be maximized in response to a perceived problem. The overarching concern of the group is to advance the national interest." (Lieberthal and Oksenberg, 1988.) Though few policy analysts would apply this in its pure form, the more subtle implications are that Chinese policy outcomes are guided by debate and dialogue over policy issues or problems. Contingent upon this interpretation, however, is the availability of relevant information to decision makers, clearly articulated and known priorities, and sufficient time for policy makers to consciously evaluate their options. Often, these components are missing or superseded by other considerations.

2.3.2 Power Model

Struggles for power among individuals and factions form the basis for the second major model of Chinese policy and politics. According to this analysis, substantive issues are not the key determinant of policy debates and outcomes, but rather "policy is the aggregate response of leaders or factions to problems they perceive, and this response reflects the relative power of the participants, their strategies for advancing their beliefs and political
interests, and their differentiated understanding of the problem at hand.” (Lieberthal and Oksenberg, 1988.)

Lucian Pye employs this sort of framework in *The Dynamics of Chinese Politics* while emphasizing the importance of Chinese culture: the importance of personal relations (*guanxi*), the deep-seated fear of disorder (*luan*), the long history and appeal of patron-client ties which works against large scale organization, and the fact that conflict is not handled well. The need for order and conformity, when placed against the need for personal relations, tends to produce factions that form and break easily. Thus in this approach strategies, motivations, the costs of conflict and cooperation are central to understanding what policies are produced and implemented.

2.3.3 Bureaucratic Structure

Lieberthal and Oksenberg reexamine these two models of the Chinese policy-making process to develop a new approach that incorporates elements of both the “power” and “policy” aspects while emphasizing the bureaucratic struggles and structure which inform policy decisions. This framework addresses the pervasiveness of the bureaucracy, for example, in the incorporation of directives into the budget, and the jurisdiction of implementing directives. “The neglect of the bureaucratic structure frequently leads to dubious assumptions about the policy process...both the policy and power analysts search for logical coherence in policy and assume it to have an underlying, logical consistence. Or, they attribute...discrepancies...to differences among the elite.” (Lieberthal and Oksenberg, 1988.) This thesis will adopt Lieberthal and Oksenberg’s model to understanding the “protracted, disjointed, and incremental” policy process in which not only policy and power, but also the fragmented bureaucratic structure are key variables in determining outcome.

In particular, Lieberthal and Oksenberg stress the fragmented structure of authority within the leadership, the role of consensus building in the policy process, the diffuse nature of this process, and the locus of decision making. This decision making starts with the four tiers of the central government: 1) a core group of about thirty elite leaders who propose policy 2) their staff, leaderships groups and institutes which serves to buffer them from the bureaucracy, 3) commissions and ministries with supra-ministerial status and coordinate activities of line ministries and provinces, and 4) ordinary ministries which implement policy in their particular area. (Lieberthal and Oksenberg, 1988)
As with other areas of government, the telecommunications sector can be understood through an analysis of competing bureaucracies, the lack of a single coherent leader or decision maker, and core leaders who favor different parts of the bureaucracy.

2.4 Trends in Telecommunications Reform

The divestiture of AT&T in 1984, the establishment of a facilities-based duopoly in 1981 followed by privatization of British Telecom and Cable & Wireless in 1984, and the introduction of competition and privatization of NTT in Japan in 1985 marked the beginning of a wave of telecommunications sector reform that has reached around the world in less than a decade. By 1993, major reforms were under way in at least fifteen developing countries, though the extent of reform varies greatly from place to place.

Although each country is unique, the overall result of reform in industrialized countries seems to have been quite positive. Stakeholders have come out ahead, employees have better salaries, and consumers have increased choice. However, the developing countries face unique obstacles and concerns which may require their approach to be different from that of the industrialized nations. Unlike state communication monopolies in the developed world, those in developing countries generally fell short of meeting service requirements. In fact, large unmet demand for connections, call traffic congestion, poor quality and reliability of service, limited territorial coverage, and a user willingness to pay more are all characteristics of telecommunications systems in most developing countries.

Because of these existing problems, large efficiency gains come very easily from improved management, technical innovation, and a separation of the monopolistic operator from the government. However, reform in developing countries also faces unique difficulties: an incomplete telecommunications infrastructure sometimes lacking even the most basic services; scarce human resources to run telecommunications as a commercial operation; limited information; undeveloped local capital markets which make privatization difficult; weak legal, regulatory, and institutional frameworks; and limited access to foreign investors and banks. (Wellenius and Stern, 1994.)
2.4.1 Competition

One of the themes of telecommunications reform has been the introduction of competition. However, *competition* itself can have different meanings according to context. Economically, it implies a situation in which all firms are price takers, though in the business sense it is the presence of some rivalry among firms though some may have more pricing power than others. Because telecommunications has traditionally been a monopoly, pure competition is not something that can be reached at once, if ever. Furthermore, there are two basic ways of introducing competition into a telecommunications market: to accept new entrants without any explicit restrictions, or to admit competitors in limited numbers.

Canada and Australia have adopted this second approach, controlling the rate of entry and restricting the number of newcomers. In the US, long distance markets are free to competition whereas local services are provided by regulated companies that in effect act as monopolists. In Japan, competition has been introduced into both the local and long-distance market with the division into Type I and Type II carriers. Type I carriers are businesses which own telecommunications facilities and require authorization of the MPT; Type II does not. Meanwhile Nippon Telegraph and Telephone Corporation (NTT) still provides both local and long-distance services. Finally, South Korea has adopted a unique approach by announcing plans for a nationwide flat-rate pricing. (See Chapter 4).

There are several reasons for the different approaches to competition adopted by the US and Japan on one side and Australia and Canada on the other. First, the business demands in the US and Japan are larger, the market is larger, and allows more competition. This is true because the demands for telecom services allow firms to enter the market with bullish expectations, diminishing the significance of sunk cost as firms are confident about the ability to sell off their facilities in the future should they need to. Secondly, the US and Japan have had a longer period in which technology of telecommunications and computers have merged, which has given their electronics equipment industry a boost. This in turn feeds the telecom industry. Furthermore in Japan and the US, large business customers are willing to bypass traditional carriers when the prices are competitive. China is similar in this respect with its many specialized networks. (Nambu, 1994)
2.4.2 The World Bank

China has been influenced by these trends towards competition, especially by the World Bank. In a review of Smith and Staples' World Bank Discussion Paper *Telecommunications Sector Reform in Asia: Toward a New Pragmatism*, Jonathan Solomon is somewhat critical of this focus, calling the paper "almost like a vindication for the major Reagan/Thatcher/Nakasone thrust during the 1980s. Its recommendation to manage infrastructure like a business, and not a bureaucracy, to introduce competition wherever feasible...are all in accord with their policies...The monolithic public utility monopolist and the pluralist multiple private vendors of multiple services are two very different models. With the World Bank going decisively one way, where does this leave the ITU..?" (Solomon, 1994) While China has received aid and loans from the World Bank recently for telecommunications infrastructure, it is far from achieving, or striving for, complete deregulation.

2.5 Telecommunications Law

Legislation and regulation are vital to an effective telecommunications systems. Without them, market and regulatory confusion prevails.

China is one of the few countries that does not have a telecommunications law governing its industry. This is not surprising given China's history as a country without clearly legalized property rights or property ownership. Unlike countries of the West as well as newly industrialized and authoritarian countries such as Singapore, China does not have a tradition of following a "rule of law" as we understand it. However, the lack of a telecom law is now probably the most serious obstacle to hindering efficient growth of the industry. Lack of clear guidelines results in market uncertainty and confusion around the issue of interconnection.

As a result, the National People’s Congress (NPC) entrusted the MPT with preparation of a draft of a telecommunications law. This was submitted by the MPT in 1994 to the State Council’s Bureau of Legal Affairs for review and consultation. The draft was then due to be discussed and passed by the National People’s Congress in 1995, but has now been delayed, probably for another two or three years.
2.6 The Need for Regulation

In parallel with these legal reforms, China is trying to introduce effective regulation to improve sector performance. To this end, the National People’s Congress passed an Anti-unfair Competition Act effective December 1, 1993, as well as a set of regulations in September 1993 to liberalize MPT approved, value-added services such as radio paging, 800 MHz trunked mobile service, 450 MHz radio mobile services, domestic VSAT, and other such services under licensing systems. (Xu, 1994)

In general, there are two kinds of regulation: operational and administrative. Operational regulation refers to regulation in which the agency or mechanism that oversees telecommunications policies and prices is an agency of the state, often part of the Ministry of Communications or some similar organ. This group is supposed to represent the interests of both the system users and equipment suppliers. However, because operational regulators are tied to the operation and management of the telecommunications administration, the various interests often become confused.

On the other hand, administrative regulation uses a separate regulator and a separate operating entity. There is a clear distinction between those who make the rules and those who manage the communications system. This prevents policies from being formed because of the special needs of some supplier, and allows an independent assessment of both managerial and social requirements in policy formation. This model, which has been adopted by countries such as the US, is strongly encouraged by the World Bank for developing countries. With the split of the MPT, China is also moving in this direction.

2.6.1 Regulatory Goals

Public regulation usually has several goals: maximizing economic efficiency, protecting customers, promoting various social goals, and standardizing technical operations. When the sector is dominated by a monopoly, there is the danger that the monopolist will price higher and produce less than would a competitive market. In such cases, the regulator can act to promote efficiency in production, technology, and the use of new services. In other cases, the regulator has acted to prevent anti-competitive behavior and oversee the transition from monopoly to competitive market.

Protection of customers should be a primary goal of regulation. Marginal consumers
are in the greatest danger of losing access to fair and reasonable telecommunications service. Furthermore, the government may wish to subsidize service to the poor as part of a government program; it is the job of the regulator to help achieve these goals. Finally, regardless of the degree of centralization, all telephone systems need standard interfaces so that different parts of the network can be used together. This is especially important and difficult in a large country such as China, which uses so many different types of equipment.

2.6.2 Regulatory Functions

The three main regulatory functions are price regulation, technical regulation, and sector structure. According to the World Bank, the primary goals of price regulation are to prevent monopoly abuses, to prevent service cross-subsidies which disadvantage new competition; to prevent cross-subsidies which promote inefficiencies; and to avoid situations in which one group is unfairly favored at the expense of others. (Wellenius, WB Report No. 9413-CHA)

Price regulation is determined either with rate of returns or price caps.

Under rate of return regulation, the operator's prices are set so that it will recover costs as well as provide a rate of return equal to the social cost of capital. Many economists dislike this approach because it guarantees a certain rate of return and thus gives the supplier incentive to keep prices high. On the other hand, price cap regulation starts with determination of the supplier's rate of return. Then a cap is put on the firm's overall prices for a certain period of time. This cap is usually set such that the firm is forced to achieve at least minimum productivity gains over a certain period of time. This method is also preferred because of its simplicity compared to the rate of return method, but it has already run into controversies in the US when dominant firms having monopoly power have abused their price structures.

Another aspect of price regulation which emerges after competition has been introduced is the need for rate rebalancing. Historically, cross subsidization has existed among services because of reasons including external economies associated with communications, income redistribution, economies of scale, and economies of scope (including vertical integration) (Nambu, 1994). As a result, there has traditionally been a large discrepancy between rates and costs, especially between long distance and local service. Once competition is introduced, the margin between rates and costs is reduced and demand for services often increases.
Technical regulation is generally comprised of regulating the use of the radio frequency spectrum, assuring interoperability of all components of the public network, and assuring a minimum level of technical quality and availability to the customers. While the ITU establishes general rules about radio spectrum allocation, it is up to each country to determine who will have access to the spectrum. Furthermore, the regulator should have some mechanism with which to settle interference problems that may arise as more people are given access to the spectrum.

In the US the question of interoperability is handled through the setting of minimum standards for network connections. For example, standards for equipment interfaces, signal requirements, and software protocols are used. It is the obligation of providers of network service such as the MPT to make sure that components connected to the public network meet national standards. In the US these standards are set largely by private industry working with advisory committees under the Federal Communications Commission (FCC).

The third key need for regulation is the need for technical quality control. Without regulatory controls, service standards may be low, especially in situations where there is a lot of unmet demand and pressure to expand service. However, high quality network operation is necessary to maintain efficiency; poor operation results in higher switching and transmission costs as well. Regulation of technical quality should also include some means of adjudicating service quality. In the US, state regulatory commissions periodically review service quality based on both customer complaints and independent regulatory review.

2.6.3 Regulations in other Countries

United States

US communications law reflects the country's legal tradition based heavily on formal laws and administrative processes. Its basis is the Communications Act of 1934, which requires that communications be regulated according to its public good, convenience, and necessity. Not only are operations and regulations completely separate, but federal laws are assured supremacy over state laws, preventing some of the problems that have arisen from the decentralization of China's network.

The FCC is responsible for technical standards, spectrum use, system accounting, pricing
standards and levels, etc. Although the break-up of AT&T and the wave of deregulation of the 1980s significantly reduced FCC's role in pricing and service, it retains some say in the prices that AT&T, still the dominant carrier, can charge, as well as how each of its competitors will have access to long distance and local networks.

The growth of the national network and the need for interoperability has effectively transferred much of the power from the states to the FCC. However each state does have a regulatory commission which controls intrastate long distance and local exchange service and rates.

After deregulation, rate rebalancing occurred very quickly in the US. Long distance rates fell, local rates increased, and an "FCC subscriber line charge" for the local telephone company was added to the cost of each access line as way to make the contribution that long distance service gives to local networks more explicit. (Nambu, 1994). Federal regulators justified this charge by the argument that long distance callers have historically paid per-minute charges for use of the local loop while local callers pay nothing. Thus while the marginal cost of using the local network is very small, the fixed costs of having the network are still quite large and the charge is designed to address this fact.

United Kingdom

The Chinese government reportedly studied both the American and German models of telecommunications structuring, but rejected them because they did not wish to split up its network on a federal basis. Instead, it is now looking into the model adopted by UK and Australia, in which a state monopoly has been replaced by a controlled duopoly in which a second smaller player has functions outside the previous monopoly network and receives a certain amount of revenue up front. ("China: Breaking Up," May 1994)

More specifically, the Telecommunications Act of 1984 provided British Telecom (BT) with a license to provide public telecommunications services. BT is controlled by the Department of Trade and Industry (DTI), and regulated by the Office of Telecommunications (Oftel) within DTI. Oftel also regulates Mercury, the private company authorized to compete with BT. Mercury is not subject to the same level of regulation as BT because it is not viewed as a dominant company. Recently, Oftel and DTI reviewed the status of the "BT/Mercury duopoly" and recommended an increase in competition in the sector. (Wellenius, WB Report No. 9413-CHA)
While the comparisons with MPT/Lian Tong are obvious, we should remember that unlike Mercury, Lian Tong has yet to become a coherent entity or corporation, and that it is comprised of other branches of the government.

Japan

Japan’s telecommunications sector has undergone dramatic changes as competition has been introduced. There are two kinds of carriers: type I and type II both of which are open to competition. Type I carriers, of which there are about 70, can offer basic and enhanced services to the public. Their tariffs are subject to formal approval by the MPT, and they are expected to receive fair returns, in the spirit of the FCC's rate of return regulation. Type II carriers are subject to minimal regulation and more competition. General type II carriers are supposed to provide services to a limited size community, while type II carriers which provide special services are unrestricted. (Wellenius, WB Report No. 9413-CHA)

Unlike the US and UK, Japan has had only minimal price rebalancing since deregulation. Changing local rates has met strong political resistance because the benefits of rebalancing are not seen as equally distributed. Moreover, the MPT intends to protect new entrants into the market by protecting them from price competition. (Nambu, 1994).

2.7 Chinese Regulatory Structure

2.7.1 Pricing Policy

In the PRC, initial telephone charges are quite high compared to the incremental cost of connecting a subscriber to the network. This serves both to finance investments and to ration scarce connections, since many people cannot afford the high prices. In US dollars, initial fees included $17 to be on the waiting list, and $80 - $320 for the connection in cities, and $150-$650 for provincial capitals. (Wellenius, WB Report No. 9413-CHA)

Local telephone charges are very low compared with international standards. National long distance rates are also lower than in other countries, but international rates are about double those of developed countries, and these themselves are very high compared with cost. An initial study by the World Bank in 1988 recommended that local telephone charges be increased an average of 60% and long distance charges decreased by 25%. See Tables 2.2 and 2.3 for current charges.
These tariffs are set on a countrywide basis by the central MPT subject to approval by the State Price Board (SPB). The prices are supposed to assure that the cost of production is covered, but this is difficult because the government still sets the prices for most commodities. Therefore, these prices ultimately reflect the government’s choice rather than economic costs. The MPT has been overall modestly profitable, with an annual rate of return of about 7% in 1988. (Wellenius, WB Report No. 9413-CHA) However, there are very large cross-subsidies in the system both between local and long distance calling and between regions of the country. For instance, in 1989 the ROR ranged from 28% in Beijing to -22% in Tibet. According to the World Bank, the overall tariff rate for the main network in 1989 was about right – the 12% ROR was an accurate reflection of the social cost of capital. However, they estimated that tariffs in Guangdong, Shanghai and Tianjin should have been about 20% lower to make their profits equal to double the actual level in other areas of the country (ie Guizhou, Gansu, Ningxia). (Wellenius, WB Report No. 9413-CHA)

2.7.2 Technical Regulation

The MPT has established a system to set and monitor compliance with technical standards for equipment in the public network. Currently, the DST sets standards while the DOC tests samples of equipment such as telephone sets, Fax machines, and modems, and issues manufacturing licenses. The national network standards that do exist, for example, for numbering, signalling, and transmission, are also set by the DST and enforced by the DGT. (Wellenius, WB Report No. 9413-CHA)

Channel allocation for mobile communications is one example of the MPT’s technical regulation (see chapter 4). Another technical standard that needs to be revised is the numbering plan for mobile communications. The current specifications for TACS (total area coverage system) require a Mobile Identification Number (MIN) for each subscriber. However, the current arrangement is such that there cannot be more than 10 thousand subscribers in an area. Several solutions have been proposed within the MPT. (Zhang Nong, 1994)
Table 2.1: Growth Rates in GNP, Trade, and Telecommunications

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GNP</td>
<td>3,588</td>
<td>4,470</td>
<td>6,558</td>
<td>17,695</td>
<td>19,855</td>
<td>24,000</td>
</tr>
<tr>
<td></td>
<td>25%</td>
<td>47%</td>
<td>170%</td>
<td>12%</td>
<td>21%</td>
<td></td>
</tr>
<tr>
<td>Trade</td>
<td>206</td>
<td>381</td>
<td>696</td>
<td>1,154</td>
<td>1,357</td>
<td>1,656</td>
</tr>
<tr>
<td></td>
<td>85%</td>
<td>83%</td>
<td>66%</td>
<td>18%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Telecommunications</td>
<td>11</td>
<td>13</td>
<td>30</td>
<td>82</td>
<td>204</td>
<td>286</td>
</tr>
<tr>
<td></td>
<td>18%</td>
<td>131%</td>
<td>173%</td>
<td>149%</td>
<td>40%</td>
<td></td>
</tr>
</tbody>
</table>

Note: Units are in 100 million yuan. Percentages are changes from the previous year. Trade is defined as import value + export value. (Zhao and Junjia, April 1994)

Table 2.2: Domestic Phone Charges

<table>
<thead>
<tr>
<th>Distance (km)</th>
<th>Price</th>
<th>Distance (km)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 25</td>
<td>0.10</td>
<td>400-600</td>
<td>0.70</td>
</tr>
<tr>
<td>25-50</td>
<td>0.20</td>
<td>600-800</td>
<td>0.80</td>
</tr>
<tr>
<td>50-100</td>
<td>0.30</td>
<td>800-1000</td>
<td>0.90</td>
</tr>
<tr>
<td>100-150</td>
<td>0.40</td>
<td>1,000-1500</td>
<td>1.00</td>
</tr>
<tr>
<td>150-200</td>
<td>0.50</td>
<td>1500-2000</td>
<td>1.10</td>
</tr>
<tr>
<td>200-400</td>
<td>0.60</td>
<td>Over 2000</td>
<td>1.20</td>
</tr>
</tbody>
</table>

(China Telecom Newsletter, January 1995)
Prices are per minute and in Chinese yuan (US$1 = Y8.44)
Table 2.3: International Rates

<table>
<thead>
<tr>
<th>From</th>
<th>MPT China</th>
<th>Hong Kong Telecom</th>
<th>CTM (Macau)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>3.14</td>
<td>0.93</td>
<td>2.25</td>
</tr>
<tr>
<td>China</td>
<td>–</td>
<td>0.31</td>
<td>0.43</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>0.50</td>
<td>–</td>
<td>0.39</td>
</tr>
<tr>
<td>Japan</td>
<td>2.19</td>
<td>1.02</td>
<td>1.50</td>
</tr>
<tr>
<td>Macau</td>
<td>0.50</td>
<td>0.27</td>
<td>–</td>
</tr>
<tr>
<td>Singapore</td>
<td>2.95</td>
<td>0.89</td>
<td>1.50</td>
</tr>
<tr>
<td>South Korea</td>
<td>2.19</td>
<td>1.02</td>
<td>1.88</td>
</tr>
<tr>
<td>Taiwan</td>
<td>2.05</td>
<td>1.02</td>
<td>1.50</td>
</tr>
<tr>
<td>Brazil</td>
<td>4.71</td>
<td>2.04</td>
<td>2.25</td>
</tr>
<tr>
<td>France</td>
<td>3.54</td>
<td>1.62</td>
<td>2.25</td>
</tr>
<tr>
<td>India</td>
<td>3.54</td>
<td>1.55</td>
<td>2.25</td>
</tr>
<tr>
<td>UK</td>
<td>3.54</td>
<td>1.14</td>
<td>2.25</td>
</tr>
<tr>
<td>USA</td>
<td>3.14</td>
<td>1.11</td>
<td>2.25</td>
</tr>
</tbody>
</table>

(China Telecom Newsletter, January 1995)

Prices are per minute and in Chinese yuan (US$1 = Y8.44)
Chapter 3

China’s Telecommunications System

3.1 Network Topology

According to Xu Shanyan, director of the MPT’s General Office, the total number of exchange lines in service in China at the end of 1993 was 30.48 million, making it one of the ten largest networks worldwide. (Hayes, October 1994) Around 72% of the public telephone network has been digitized, along with 98.6% of the long distance digital exchange network. It is expected that by 1996, there will be 19 long distance fiber optic lines, and the entire country’s long distance telephone network will be automated. By the year 2000 there is an expected increase of 84 million switching systems and 1.5 million long distance lines. Despite these developments, however, there are more than one million homes waiting for telephones, with an average waiting period of six months. Long distance lines are scarce, connection rates are low, and more than half of the country’s villages and small towns do not have any phones at all. (Cai, 1994)

Domestic long distance channels have been growing rapidly, at 16% annually over the past decade. However, as of 1994, only 55% of the long distance traffic is controlled by automatic switches, and only half is transmitted through microwave, modern cable (including fiber optic), and satellite transmission networks. The remainder still goes through overhead, open-wire lines. (Bien, 1994)

In many rural areas, the local network is not connected to the long-distance network.
Instead, only one or two phones in the nearest town or county post office are linked. The wait for use of such phones is usually many hours long and in 1988, the MPT estimated that about half of long distance calls did not go through.

The national network combines the use of both manual and automatic switching in four hierarchical levels. The basic skeleton for the national network is formed by six interprovincial centers – Beijing, Shanghai, Wuhan, Shenyuan, Xian, and Chengdu – where several provinces of a major region interconnect. Beijing also has direct circuits to all the provincial capitals. These centers, along with auxiliary centers in Tianjin, Nanjing, Lanzhou, and Chongqing form a mesh, in which one site is able to communicate directly with any other site. Below the top layer, networks generally form star configurations, in which traffic goes through a central hub. The second level, located at provincial capitals, handles connections for intraprovince communications. The third layer of the network has nodes in the large cities which connect circuits between counties, and the fourth level at county (zian) centers connect circuits within a district and tend to be located with the seats of county government. A call from one county center to another part of the country might thus be routed through seven different circuits at different levels. (Liang and Zhu, 1994)

3.1.1 Measures of Telephone Density

One of the greatest difficulties in studying the Chinese telecommunications system is understanding the meaning of various statistics. Not only do numbers from different sources often conflict, but China often has a different way of calculating various measures. Most importantly, the actual number of handsets, or telephones, is not usually reported in world statistical data because there may be many actual phones per line. Instead, the World Bank and other international agencies report telephone penetration or telephone density as meaning the number of access lines per 100 population. By contrast, China reports telephone density as the number of physical telephone handsets per 100 people, a number which is typically about 40% higher.

In general access lines are the number of lines which run from the local exchange office to households. This number, which is less than the number of actual telephones, is generally larger than the number of exchange lines, which measures the ability to connect to other lines within the local area of one switch. This is again greater than the number of trunk lines, which connect between switches. Toll trunk lines are long distance lines between
switches (for example, between cities) whereas exchange trunk lines are local lines between switches. The term "main line" seems to be used alternately for "trunk" and "exchange".

Furthermore, the reported switching capacity in China is much lower than the number of installed lines because of underground installation problems and chronic funding shortages. For example in 1988 only 68% of urban and 57% of rural exchange capacities were connected to subscribers. (Bien, 1994) In 1990 there were 7.8 million working lines with 10-12 million lines of installed capacity. (Wright, 1995.) At the end of 1995 there were a projected 50 million exchange lines installed but only 23 million working. This has occurred because, of the components necessary for a functional line, switching equipment is the cheapest, after which is the cost of long distance lines. The access pairs for the local loop from the local switch to households is significantly more expensive. Thus China has bought and installed a lot of switching equipment as it has looked ahead to modernization, but most of this capacity remains unconnected because of lack of money. Furthermore, in many rural areas cables are damaged or not functional.

Another confusing aspect of these statistics is that the MPT tends to divide its statistics into "urban" and "rural" regions. However, in many provinces "urban" statistics count only the capital of the region with "rural" encompassing not only the truly sparsely populated and remote areas, but also small towns and small industrial centers. As a result, rural-urban disparities in service access and quality may be even greater than they appear. (Wright, 1995)

### 3.1.2 Targets for 2000

By the year 2000, the government plans to more than double the number of telephone sets in the country to 78 million, to reach a telephone density of 5-8%. Targets have also been set that double exchange capacity and toll trunk lines to 100 million and 1.4 million, respectively. (MPT, 1993) To achieve these goals, the MPT will have to purchase over $10 billion worth of switches and transmission equipment in 1995 and around $52 billion in infrastructure between 1996 and 2000. (Zita, January 1995)
3.2 Sector Organization

From the 1950s to the 1970s, China’s state-owned telecommunications system was semi-military, highly centralized, and seen basically as a tool for administrative needs. When the country started to reform economically, however, lack of funds at the state level devolved authority for developing the telecom sector to the local level. The State Council issued directive number 165 in 1979 which stipulated that in posts and telecommunications, the government administration and business management should be separated. This was followed by a “six-point instruction” from the State Council in 1984 which stipulated, among other things, that responsibilities in the telecom industry should be shared among different administrative levels, ministerial administration should be coordinated with regional authorities, and the construction of infrastructure should mobilize resources from all concerned. (Lu, April 1994) Throughout all of this, telecommunications at the national level was basically synonymous with the MPT.

3.2.1 Ministry of Posts & Telecommunications

The Ministry of Posts & Telecommunications is the traditional leader of the Chinese telecommunications sector. In addition to being China’s only public long distance carrier until very recently, the MPT also formulates and oversees implementation of telecom policies, laws, plans, and reform programs; acts as the regulatory agency; acts as a liaison between China’s central bureaucracy and the 31 semi-autonomous provincial carriers, and manages a large part of China’s telecom equipment manufacturing industries. (Bien and Pham, 1994) The Department of Communications (DOC) of the MPT approves the construction of dedicated networks and implements communications technology laws and policies established by the Department of Policy and Laws (DPL). The Department of Science and Technology (DST) coordinates standards setting as well as running the MPT’s training institute for telecommunications technology. Finally, the MPT’s responsibilities also include participating in international telecommunications organizations such as the ITU; coordinating the dedicated networks of various state organs; and directly operating and managing various telecommunications and postal services. (See Figure 3-1 for an organizational chart of the MPT.)

Including its reporting entities, the MPT has fifteen headquarters and around 1,200,000
employees, 49% of whom work in the telecommunications branches. It has a reputation for being one of the most conservative ministries of the government. In addition to the MPT, a number of other central authorities also have some control over certain telecommunications sector matters. These include the

- State Planning Commissions (SPC) - Responsible for China’s general planning and economic policy, establishes targets such as those required by the telecommunications industries. The SPC approves the MPT’s five year plans. These approvals are necessary for access to “mandatory commodities.”

- State Science and Technology Commission (SSTC) - Oversees the work of civilian research institutes subordinate to several ministries and coordinates the science policy with state’s planning and budgeting operations.

- National Defense, Science, Technology, and Industry Commission - Activities include development of communications satellite and many military applications.

- State Pricing Board (SPB) - Approves or disapproves prices recommended by MPT and other ministries.

- Ministry of Finance (MOF) - Regulates national fiscal policies, reviews MPT’s financial planning and performance.

- Ministry of Foreign Economic Relations and Trade - Sets policy and coordinates access to foreign credit.

- National Administrative Bureau of State-Owned Property (NABSOP) - Establishes state policy to promote efficient use of state-owned products.


- Ministry of Television and Broadcasting (MTB) - Performs radio and television broadcasting services including using transmission links provided by the MPT (Wellenius, World Bank Report No. 9413-CHA, 1992)

- All of these organs are subordinate to the State Council, the executive organ of the National People’s Congress (NPC). See Figure 3-2.

MPT’s position as the single entity responsible for all telecommunications services has lead to a great deal of inefficiency as different parts of the bureaucracy often interfere with each other. Hence MPT has recognized the need for establishing “an institutional structure that clearly defines separate and distinct roles for policy-making, regulation, and management” (Melody, 1991). Functional separation should not only improve policy making and regulations, but also allow service enterprises to operate more efficiently. The Ministry finally split itself nominally into two parts in 1994. The MPT is now the national regulator,
analogous to the FCC in the United States, while the Directorate General of Telecommunications (DGT) became the dominant carrier responsible for long distance, international, and national data networks. For now however, the division is in name only. MPT is still synonymous with the national monopoly. (Zita, 1995.)

It has also been recognized that postal and telecommunications services should eventually have completely separate ownership and management, as they do in countries such as the USA, Canada, India, Brazil, Japan, and many others. Whereas the labor productivity and technological intensity of telecommunications is likely to improve rapidly, postal services will remain very labor intensive and have less scope for efficiency improvements. Separation of posts and telecommunications has, in fact, begun with the recent creation of the Directorate General of Posts (DGP) which is analogous to the DGT and serves local, national, and international mail. However, postal services continues to be cross-subsidized by profits from telephone network services. Further separation will probably occur only when there is enough additional traffic to overcome the costs of fragmenting the organization into smaller parts.

Directly under the MPT in the telecommunications hierarchy are thirty provincial Posts and Telecommunications Administrations (PTAs) which function as the medium managerial level and oversee operations in the twenty-one provinces, five autonomous regions, and four special municipalities (Beijing, Shanghai, Tianjin, and Guangzhou). At the third level, each of some 350 municipal/city Posts and Telecommunications Enterprises (P&T's) provide local service in nearby urban and rural areas, and coordinate development and operation of the long distance networks among subordinate P&T's. Thirty of these are located in the provincial capitals, but these are distinct from the PTAs. Finally there are about 2,150 county level P&Ts which provide local service in the county capitals and extensions to the county rural areas. Local governments have some say in P&T activities within their borders. This control was expanded by the State Council in 1990 when the county level P&T's were made responsible for township and village telephones, but with administration vested in the county government. (Liang and Zhu, 1994.) Local operators are generally more aligned with the municipal government than with the MPT, and regional development constraints or goals are not always in agreement with plans promulgated from Beijing.
3.3 Other National Telecommunications Entities

3.3.1 Private Networks

Private networks, also known as “dedicated networks” have been an important part of the national communications infrastructure since 1977. As various large users realized that the MPT would be unable to provide the needed networks, they went to the State Council and received approval for setting up their own networks. Among the operators of specialized national networks are the Ministry of Railways, Ministry of Water and Power, Ministry of Electronics, Ministry of Water and Power, Bank of China, New China News Agency, and the Peoples Liberation Army. Although accurate information about the number of local lines in service in these dedicated networks is not available, a rough estimate is about 10% of the public main network.(Wellenius, World Bank, Report No. 9413-CHA)

The lack of coordination between the public and private networks has resulted in many cases of repetitive construction of networks, signal interference, and technological incompatibility. (Lu, 1994.) This pattern is indicative of China’s centrally planned economy which gave local leaders an incentive to devote resources to “empire building” in order to maintain their power base, but which resulted in many needlessly duplicated projects.

To counter this tendency, the State Council issued Directive number 54 in 1990 to enforce coordination between public and private networks.(Lu, 1994) Since then, some of these private networks have been used not only for the specialized needs of the owners, but also to overcome constraints from shortages in the public networks. For example, the Ministry of Railways (MOR) system, which is the largest dedicated network with 250,000 lines connected to automatic exchanges in 750 places and remote telephones in 2000 additional locales, is now partly interconnected with the MPT’s public network. Local calls can be made between MPT and MOR subscribers, and in places with no MPT service at all, MOR provides occasional public service by relaying messages to the next MPT exchange. MOR has also connected main suppliers such as the power company to its telephone exchanges, to facilitate maintenance. Other dedicated networks now have similar interconnections with the public system.(Lu, 1994.)

Dedicated networks which connect a ministry or national commission to large-scale industrial enterprises are usually two or three-tiered star-shaped networks, whereas other mixed type networks use a mesh between centers of higher order and a star configuration
from centers to lower-order stations. Because these networks are generally smaller than public networks, and because the ministries or other groups which own them generally are able to make large investments, digitalization and other new technologies will penetrate faster than in the public networks. For example, China National Petroleum & Chemical Company expects to have a satellite-based, interactive voice, data, and fax network covering 2000 sites by 1997. (Liang and Zhu, 1994) Currently the ministries operate voice as well as data networks including transmissions systems of fiber optic cables, microwave systems, and VSATs (very small aperture terminal satellites).

3.3.2 National Alternative Service Providers

The inadequacy of the telecommunications sector was highlighted first by Li Peng's Electronics Leading Group, or ELG of 1985-1988, followed by the Science and Technology Commission and State Planning Commission. This attention, together with reforms the state enterprise, fiscal, and monetary structure of the 1990s, gave urgency to the need for a more developed telecommunications sector. Partly out of these concerns came the MPT's agreement in late 1993 to give up its monopoly position as the sole legal operator of public interprovincial voice and data networks. Thus began the liberalization of the basic service market in telecommunications, which was marked by the arrival of two new public entrants, Ji Tong and Lian Tong, into the market. The MPT fought hard to retain its monopoly status but was ultimately unable to prevail against the combination of political pressure and unmet demand for services. Pressure for this move came largely from other ministries hoping to open up their own private networks to the public. Liberalization was eventually achieved not only because of the power of these ministries but also because of the political clout of supporters of the new companies, including Vice Premier Zou Jiahua and Vice Premier Zhu Rongji. ("Competition...", Pyramid Research, April 1994)

3.3.3 Ji Tong

Ji Tong Communications Corporation was founded in May 1993 and given final approval by the State Council in September of that year. With twenty-six different shareholders, it is China's largest communications equity consortium. It is officially owned by the Ministry of Electronics Industry (MEI), and the president, Lu Shouqun has close ties to Communist Party Secretary Jiang Zemin and was formerly second-in-command at the MEI. The MEI
holds the controlling stakes in Ji Tong through state-owned enterprises such as the 54th Research Institute of the MEI and China Electronic Systems Engineering Corporation. Other investors include Nanjing Wireless Factory, Beijing Municipal Electronic Office, China Great Wall Industries, and the Bank of China. ("Competition...", Pyramid Research, April 1994)

Ji Tong's stated mission from the government was to develop a nationwide information infrastructure through its role as equipment supplier and possible owner of the “Three Golden Projects.” The largest of the three, Golden Bridge (Jin Qiao) is to be a national economic information network which includes the construction of a satellite-based ISDN backbone connected to various private networks. In addition to its use for financial and macroeconomic information by stock exchanges and financial institutions, the central government in Beijing will use it to assist in macroeconomic planning and monitoring. Golden Customs (Jin Guan) is the second project, planned as a national foreign trade and customs-related information network that would exchange data by email and/or an EDI (Electronic Data Interchange) network. Finally Golden Card (Jin Ka) is to help China reduce its reliance on a cash economy, which has contributed to inflation, by forming a nationwide network supporting ATMs, credit cards, and debit cards. There have been indications that this network would ultimately be owned by the financial institutions though Ji Tong will construct and manage the project. ("Competition...", Pyramid Research, April 1994)

Many foreign firms have viewed deals with Ji Tong as a way of getting their foot in the door to future investment opportunities. (See section 4.3 for a description of some of these investments.) Although holding equity in network operators is still banned, foreign companies have been making more limited partnership deals in equipment manufacturing and the like.

3.3.4 Lian Tong

Perhaps even more significant than Ji Tong was the formation of China United Telecommunications Corporation, or Lian Tong, China's second long distance voice operator. Though formed at the same time as Ji Tong, it was granted final approval by the State Council in December 1993, and was not inaugurated as a state corporation until July 1994.

The existence of Lian Tong is a reflection of the powerful interests that the potential value of telecommunications services have attracted. The Ministry of Electronics Industries
(MEI), Ministry of Railways (MOR), and the Ministry of Electric Power (MEP) conceived of and largely control Lian Tong, with MEI as the primary catalyst behind the venture. Each of the MEI, MOR, and MEP have 100 million RMB of equity in Lian Tong. Other owners (with 80 million RMB of equity each) include China International Trust & Investment Corporation, China Resources Holding, China Everbright International, Huaneng Group (a subsidiary of the Ministry of Power), several subsidiaries of the Ministry of Foreign Trade & Economic Cooperation (MOFTEC), and around ten others, with more shareholders expected in the future. ("China: Lian Tong, EIU, Aug. 8, 1994) The People's Liberation Army (PLA) was originally interested in joining the consortium as well but later declined official involvement.

The close ties between MEI and the current core leaders has enabled Lian Tong to withstand strong opposition from the MPT. (Zita, Jan. 1995.) Not only does Lian Tong have the backing of the State Council, but also of China's president Jiang Zemin, Vice Premier Zou Jiahua, and Li Tieying, formerly the minister of the MEI, and now the leader of the powerful enterprise reform commission charged with restructuring state enterprises.

Currently Lian Tong's role in competing with MPT's can best be described as "competitive coordination." The terms of reference as stipulated by the State Council dictate that Lian Tong should use the MOR and MEP's redundant network capacity to provide voice, data, radio, and cellular services to the public, concentrating primarily in areas where these services do not exist or where those provided by the MPT are inadequate. This is not the full-fledged competitive network that some have described it as, but it has certainly laid the groundwork for competition, especially in value-added service provision. Lian Tong is expected to move quickly beyond being a network using redundant capacity as it aims for the lucrative long distance routes between large cities and coastal provinces. It will aim at both the business and residential markets. According to Chief Engineer Tang Qi of Lian Tong's Guangzhou branch, "if we offer a better service than the MPT, we'll get customers." ("China Unicom.." 1995) In fact, Lian Tong chairman Zhao Weichen announced at the launching ceremony their goal of capturing 10% of China's long distance telecommunications market, one third of mobile services business, and offering international services by the end of the decade. ("China: Lian Tong, EIU, Aug. 8, 1994) There has been some interconnection agreement reached between the MPT and Lian Tong, though the details are unclear. ("China Unicom.." 1995)
Other goals set out by Zhang Shukui, Lian Tong’s president and former governor of Guizhou Province include upgrading existing networks of the MOR and MEP to supply services to the public, for example upgrading and building four backbone optical fiber cables along the MOR’s rail tracks; building satellite networks and PCNs (personal communication networks); joining Ji Tong in building the “Three Golden Projects”; and establishing a national cellular mobile communications network with roaming capability between seven or eight major cities (though recently a new mobile company has been established directly under the control of the MEI rather than Lian Tong). (Xu, July 1994) With such ambitious targets, Lian Tong has been actively seeking foreign partners for funding. Thus far it has signed Memorandum of Understandings (MOUs) and actual agreements with companies such as USA’s Bell South, Pacific Link of Hong Kong, and Excellent Group of Malaysia. (Xu, July 1994) Close international attention will focus on Lian Tong’s role in the opening up of the telecommunications sector to foreign companies.

One such MOU was signed between Lian Tong and GTE in January 15, 1995, for the two companies to enter into a long-term strategic alliance including joint research and development; and a joint-venture company to be headquartered in Beijing. This office would assist Lian Tong with technological and management support for projects in China and abroad. GTE was due to open an office in Beijing in March, and other projects were yet to be determined at the time. Among those present at the signing of the MOU were Lian Tong Deputy General Manager Guo Guan Min, GTE chairman Michael T. Masin; as well as director of the SETC (State Economy and Trade Commission) Wang Zhongyu, Minister Hu Qili of the MEI, Minister Shi Dazheng of the MOP, Minister Han Xubin of the MOR, and vice-premier Zou Jiahua, and the US’s Henry Kissinger. (China Telecom, January 1995.)

The dynamics between Lian Tong and the MPT are at the core of the changing nature of the telecommunications sector. The MPT remains conservative and unwilling to give up its monopoly. Meanwhile the MEI has more money, is more efficient, and has been gaining more support from the State Council in its telecoms operations. Although the MPT retains a final say in policy issues, it is members of the MEI, not the MPT, who are working with the US Department of Commerce’s Information Technology Subgroup on issues of telecommunications technology transfer. The importance of the core group of powerful leaders such as Jiang Zemin and Zhou Jiahua in their support for Lian Tong and
its backers; as well as the role of the various ministries of the bureaucracy in determining the future of the sector is quite evident.

Thus it is also worth remembering that Lian Tong as it currently exists is not a very coherent single entity, having arisen from a coalition of powerful ministries each wanting to get its foot in the door of a lucrative new business. It is not clear how these and new stakeholders will pool their resources and work together. Relationships between Lian Tong and local entrepreneurs, and between Lian Tong and foreign investors have yet to be clearly defined. Lian Tong’s future investments are likely to be guided by past experience rather than corporate policy or telecommunications law.

3.3.5 The People’s Liberation Army

The People’s Liberation Army is another player to watch as the telecommunications sector undergoes reform. The PLA has recognized that secure and robust communications are central to modern warfare. It is also concerned that service quality on the public networks which it now uses for nonstrategic communications will deteriorate as traffic volume grows rapidly. Thus although the PLA rejected the possibility of taking an equity position in Lian Tong, the PLA has its own commercial ambitions in telecommunications and may still take a role in Lian Tong at some point in the future.

Indeed the PLA already commands a favorable position in many aspects of telecommunications development in the name of national security. It enjoys vast rights-of-way holdings and wide operational latitude in every major municipality. Similarly because the State Radio Regulation Commission (SRRC) is under the joint jurisdiction of the State Council and the Central Military Commission, the PLA has preference in radio spectrum allocation. Thus far the PLA has launched Yuan Wang, a major paging operation in Beijing, as well as playing an important role in Hua Mei\(^1\) in Guangzhou. (Zita, Jan. 95)

3.4 Service Access and Quality

National telephone density in China has grown from 0.05% in 1949 to 0.13% in 1957, to 0.75% in 1990. The 1994 penetration rate of 2.2%, corresponding to 1.46 lines per 100, (Zita, 1994, MPT 1993) indicates the recent rapid growth of telephone access, but

\(^1\)See Section 4.4 for more information about Hua Mei.
the system is nowhere near meeting the pent-up demand. It is still among the lowest for large developing countries and lags far behind the newly industrialized and developed countries, where telephone (line) density is around 40%. For less developed countries, the World Bank considers a 10% penetration rate as a good target. (Wright) Service quality and access is especially difficult in rural and remote regions, though the situation has improved tremendously since 1952 when only 84 cooperative farms in the entire country had telephones. (Noam, 1994)

Telephone line density varies greatly among provinces. For example in 1992 when the nationwide average density was 1.03 telephone lines per 100 people, Henan had a density of 0.4, the autonomous regions an average of 0.9, and Shanghai, 5.9 per 100. (World Bank, Report No. 13548-CHA, 1993) Furthermore, the gap between rural and urban, and core vs peripheral areas seems to be growing. This year, with an overall phone penetration rate of 2.2% the urban penetration rate was 9 percent, and in very large cities and coastal regions, as high as 20%.(Cai, 1994) (See Table 3.2 for teledensities in selected coastal cities.)

In addition, China has much fewer pay phones than other developing countries. In 1990, there were 46,000 payphones in China's urban areas, or two payphones per 10,000 urban residents. According the World Bank, average for developing countries is five to one hundred per 10,000 urban residents. (Bien, 1994)

3.4.1 Service Indicators

The high demand for phone access has encouraged the use of many PBXs (private branch exchanges) for offices and local loops, further increasing congestion and decreasing call-of-completion rates. This contributes to the large difference between the number of telephones per 100 population and the number of lines per 100. In 1991 although only about 6% of urban lines in service were used as trunks for PBXs, they supported approximately 47% of connected telephones, a higher proportion than in any other country. (World Bank, Report No. 13548-CHA, 1993).

Telephone service is particularly congested and almost unusable at peak business hours in many places. The average call completion rate is about 58% for local calls and 31% for domestic long distance (see Table 3.1). Call completion requires availability of a dialtone when one picks up the phone; the presence of a free line for each of the connections from the local loop to trunk lines back to the local loop; and someone to pick up the phone. A
A rough guess for industrialized countries is 70% (Wright), although in places such as the US where it is possible to measure the rate without counting the times when the receiving party does not pick up the phone, call completion rates for local area calls are greater than 98% (Wright). Experience in other countries suggests that these low rates are due primarily to the shortage of lines. Call completion rates for domestic long distance calls vary among the provinces, with Shanghai having one of the lowest rates in 1992 at 42%. This is probably a reflection of call volume. These rates have improved in most of the country in the past few years as the number of long distance circuits have increased by an average of 39% a year since 1989.

The reported average of 5.3 faults per 100 lines per month in China is considerably better than in many other developing countries. For example, in 1992 India reported 19 faults per 100 lines. Technological advancements have significantly improved performance. The average duration of faults in switching and inter-office facilities shortened from 4.7 hours in 1988 to 0.2 in 1992 with the introduction of fiber optic digital inter-exchange facilities and digital stored program control. (World Bank, Report No. 13548-CHA, 1993)

As with other aspects of telecommunications, the reliability of the system varies widely among provinces, from an average of 0.03 faults per 100 lines per month in Jiangsu in 1992, to 21 in Shanxi. In addition to technological variations, the disparity can also be attributed to differences in maintenance levels, availability of test equipment, reporting and recording procedures, etc. (World Bank, Report No. 13548-CHA, 1993).

### 3.4.2 Unmet Demand

The number of outstanding registered applicants for telephone service in urban areas grew from 0.5 million outstanding in 1988 to 1.6 million in 1992, or 17% of total lines in service. In Shanghai, outstanding registered demand was as high as 71.5% of lines in service. Not only are the numbers growing, but outstanding applicants are not a completely accurate reflection of unmet demands since a large number potential customers do not even bother putting themselves on the waiting lists. Furthermore, demand registration is restricted by installation fees. While the high fees are useful for financing investments in telecommunications and in rationing the scarce supply, they obscure the full magnitude of service demand.
Table 3.1: Quality of Telephone Service

<table>
<thead>
<tr>
<th>Region</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<td></td>
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<tr>
<td>Beijing</td>
<td>1.75</td>
<td>30.00</td>
<td>70.00</td>
<td>0.10</td>
<td>48.51</td>
<td>30.19</td>
</tr>
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<td>Shanghai</td>
<td>7.53</td>
<td>89.00</td>
<td>11.00</td>
<td>0.01</td>
<td>42.40</td>
<td>28.55</td>
</tr>
<tr>
<td>Tianjin</td>
<td>5.05</td>
<td>98.00</td>
<td>2.00</td>
<td>0.05</td>
<td>–</td>
<td>27.50</td>
</tr>
<tr>
<td>Average:</td>
<td>4.78</td>
<td>72.33</td>
<td>27.67</td>
<td>0.05</td>
<td>45.36</td>
<td>28.75</td>
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<td>3.00</td>
<td>0.15</td>
<td>54.92</td>
<td>40.78</td>
</tr>
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<td>99.00</td>
<td>1.00</td>
<td>0.04</td>
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<td>34.22</td>
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<td>0.12</td>
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<td>30.05</td>
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<td>0.56</td>
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<td>0.05</td>
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<tr>
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<td>57.82</td>
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<td>Average:</td>
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<td>0.28</td>
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<td>30.86</td>
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<td>0.22</td>
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</tbody>
</table>

(1) Average fault reports per 100 working lines  
(2) Percentage of faults from trunk cables and subscriber lines  
(3) Percentage of faults from switching and interface facilities  
(4) Average duration of faults before cleared (hours)  
(5) Completion rate of local calls (effective calls as percentage of total calls dialed)  
(6) Completion rate of domestic long distance calls  

Table 3.2: Teledensity in Coastal Cities and Special Economic Zones

<table>
<thead>
<tr>
<th>City</th>
<th>Teledensity (%)</th>
<th>New Installations as of Sept. 1994</th>
<th>Main Line per 100 people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dalian</td>
<td>12.70</td>
<td>54757</td>
<td>8.20</td>
</tr>
<tr>
<td>Tianjin</td>
<td>15.60</td>
<td>145021</td>
<td>7.46</td>
</tr>
<tr>
<td>Qingdao</td>
<td>16.83</td>
<td>35328</td>
<td>11.09</td>
</tr>
<tr>
<td>Shanghai</td>
<td>15.50</td>
<td>325673</td>
<td>12.10</td>
</tr>
<tr>
<td>Ningbao</td>
<td>19.00</td>
<td>16889</td>
<td>7.81</td>
</tr>
<tr>
<td>Fuzhou</td>
<td>25.15</td>
<td>44722</td>
<td>14.21</td>
</tr>
<tr>
<td>Guangzhou</td>
<td>25.05</td>
<td>168271</td>
<td>17.16</td>
</tr>
<tr>
<td>Zhanjiang</td>
<td>16.80</td>
<td>16821</td>
<td>7.31</td>
</tr>
<tr>
<td>Shenzhen</td>
<td>82.24</td>
<td>75463</td>
<td>45.08</td>
</tr>
<tr>
<td>Zhuhai</td>
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<td>35589</td>
<td>28.85</td>
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<td>Haikou</td>
<td>36.13</td>
<td>31183</td>
<td>26.68</td>
</tr>
<tr>
<td>Chongqing</td>
<td>7.25</td>
<td>43213</td>
<td>4.46</td>
</tr>
</tbody>
</table>

(China Telecom Newsletter, November 1994)
Figure 3-1: MPT Organizational Structure

(Xu, 1994)
Figure 3.2: Telecommunications Responsibilities of Government Bodies

(Xu, 1994)
Chapter 4

Foreign Investment

4.1 Need for Foreign Investment

While progress on the development of the telecommunications network during the 1990s has been rapid, it pales in comparison to government targets for the year 2000 and beyond. According to Xu Shanyan, director of the MPT's General Office, the government plans to achieve a 23.7% annual increase in traffic volume between now and the end of the century, with 100 million exchange lines to be installed. The target for the year 2000 has been quoted as a density of anything from 5-8 exchange lines per 100 people, with 40 out of 100 in urban areas. According to Xu, "...every household will be expected to have access to one telephone. The waiting time for telephone installation will not be longer than one month...In rural areas telephone connections will be made available to every individual village." (Asian Communications, Oct 1994)

These forecasts have attracted the attention of the world's telecommunications industry, from major switching equipment manufacturers, to smaller companies looking for export companies, to other companies hoping to enter the service sector.

Estimates of the capital investments needed to install even a basic network ranges from Salomon Brother's recent figure of $100 billion (Weiss and Wong, 1994) to other more modest estimates of US $53 billion. To secure this much funding between now and the year 2000, China will clearly need to tap into as many sources of funding as possible. Multilateral development agencies such as the World Bank and the Asian Development Bank are good sources of funding, but are able to lend only when international competitive bidding is used to procure equipment. That is, these agencies can only issue loans when the banks'
particular lending requirements are met. (Hayes, Asian Communications, 1994)

World Bank

The World Bank is currently involved in a loan for one such project. It will include lending money for investments between 1993-1997 which will add infrastructure as well as help develop conditions for increasing competition and private participation. The long distance investment program became part of China’s 8th Five Year Plan, and the local telephone expansion program would include investments in the 8th Five Year plan and 9th Five Year Plan (1996-2000).

The 8th Five Year Plan provides for the installation of 50,000 km of additional fiber optic cable in the long-distance network, for a total of 53,000 km. Bank financing includes two of the fiber optic projects scheduled, or 21% of the scheduled expansion. In particular, it would be a segment of long distance interprovincial network in the north from Beijing to Lanzhou, and one in the south from Fuzhou/Hangzhou to Chengdu. (World Bank Report No. 13548-CHA) The 8th Five year Plan also calls for the number of local switching lines to increase from 12 million to almost 34 million. In Heilongjiang, Liaoning, and Jiangsu, the three provinces which are the primary beneficiaries of the loan, the Bank would finance about 14.4% of the expansion program of 6,392,800 lines. The Bank would also invest in approximately 1.6% of total projected construction program expenditures while ancillary network expenditures and rural additions would be funded through local financing. (World Bank Report No. 13548-CHA)

The total project cost is estimated at US$623 million, with the proposed Bank loan of US$250.0 million financing 40.1% of the total cost and 84.8% of the foreign exchange costs; a grant of US$1.3 million from the Swedish BITS grant financing 2%; and the remaining cost of US$371.7 million covered by the MPT. Project costs were estimated based on costs from competitive bidding for similar projects in China. The costs would also finance consultants to help the MPT develop an appropriate accounting system, train P&T accountants; finance a study on tariff adjustment; and finance overseas training of MPT staff. Loans through the Bank generally have certain restrictions; for example, the equipment in the Bank financed components is specified in detail.

In addition to an investment component, the project includes a reform component which requires the MPT to implement sector reform in collaboration with the PTAs of Jiangsu and
Liaoning. It would also require accounting reform, rationalization of tariffs, and encouraging development of a legal and regulatory framework.

In addition to the World Bank, the Asian Development Bank (ADB) is also lending to China for the installation of optical fiber cables. The ADB approved a loan of $100 million in 1993 for multiplexing transmission equipment and optical fiber cables in two routes linking Beijing to Wuhan, Guangzhou, Taiyuan and Xian. More than 400 million people live in the targeted region. Of the total cost, US$175 million, ADB is covering 57% of the total and all of the foreign-exchange component. ("ADB Approves...," Sept. 6, 1993.) The MPT will oversee the work and contribute US$30 million, with other sources covering the rest.

Aside from international lending agencies, suppliers' credit, government export credits, and private finance will form the rest of the borrowing requirements. The question of private finance thus leads to the issue of how open the sector will be to foreign operators, as discussed later.

4.2 Foreign Switching Manufacturers

The Chinese telecom industry has been marked by a sharp shift in financing patterns in the past five years. Throughout the 1980s, foreign concessionary loans through bilateral aid programs from Europe, Canada, and Japan were a significant source of funding. However, these have tapered off since 1989. Thus MPT's annual foreign borrowing rose from $14.6 million in 1986 to $66 million in 1989, then dropped sharply to $39 million in 1990. (Gorham and Chadran, March 1993) Bilateral funding agencies in countries including Germany, Sweden, Canada, France, Norway, and Australia are all expected to scale back their funding, both because of the global recession and because of US pressure to avoid using concessionary funds for commercially viable projects.

This measure was reinforced in 1993 when the OECD's (Organization for Economic Cooperation and Development) Helsinki Package restricted the export grants for commercially viable projects. In addition, Vice Premier Zou Rongji tightened controls on domestic financing in mid-1993 as part of a package for cooling the overheated economy. These developments have made financing much more difficult to obtain, leading the MPT and local PTAs to make different decisions about competition in the switching market. What was once an attempt to rationalize the market through preferential treatment for certain
suppliers has become a highly competitive free for all. (Rehak, August 1994)

The digital switching market has traditionally been dominated by Alcatel, Siemens, and NEC, but these suppliers now face growing challenges from AT&T and Northern Telecom. In 1994, both AT&T and Northern Telecom announced major agreements with the MPT and SPC for locally manufacturing digital exchanges. (Rehak and Wong, March 1995) Furthermore, Swedish vendor LM Ericsson had started constructing a switch manufacturing facility even before it announced its intention to join the market, and Fujitsu is rumored to be entering the local supplier market. (See Figure 4-1), players in the switching market.

Local production is a priority for switching vendors, not only because of the difficulty in obtaining soft-loan financing, but also because of restrictions on the Chinese side. For example, in a six month period in 1994, the foreign loan cap was $720 million. In addition, local joint ventures often run into difficulty financially because the MPT and local PTAs have only limited funds of their own for equipment purchasing, and foreign government-backed soft loans are technically not an option under some regulations. However, some suppliers are still negotiating to use them for joint venture sales. (Rehak and Wong, March 1995)

While the heightened competition in the market has been good for the MPT as well as local PTAs in terms of lower prices, subcommercial interest rates, and other special concessions, the MPT has lost sight of its original goal of rationalizing the public switching system by limiting the number of switching models in the network. Interconnection issues are imminent, and will continue to be a serious problem as more of the country gets linked together. Currently there is no structure or regulation guiding the number of manufacturers and the types of equipment they install.

4.3 Ji Tong

The formation of Ji Tong was an important step towards liberalization of the telecom sector and brought with it many opportunities for foreign companies to enter into the Chinese market. Many companies have struck deals with Ji Tong in the hopes that they will eventually lead to more direct participation in network operation in the future.

The first such deal was signed between Hong Kong paging operator Pacific Link (PacLink) and Ji Tong in September 1993. According to PacLink officials, this joint venture
was formed primarily to provide Ji Tong with contacts and to help their management become experienced at negotiating contracts and dealing with foreign suppliers. In return, PacLink hopes to be in an advantageous position to operate mobile networks in China when such an opportunity arises. (Pyramid Research Asia, April, 1994)

Another highly publicized joint venture known as Beijing Ji Tong-Bell South Communications & Information Engineering Co., Ltd., was signed between Ji Tong and Bell South International (BSI) in January 1994. BSI was committed to investing $11.8 million in June 1994, with an expected total of $30 million covering the entire project which includes network planning, design, and engineering services for Ji Tong. Given the size of this investment, it seems clear that BSI expects to be involved in even more substantial operating or applications projects later on. However, officials were quick to point out that BSI's current role as technical advisor is in compliance with existing restrictions on foreign companies.

Other ventures that have been formed with Ji Tong include Champion Technology of Hong Kong which has a $1.5 million deal to manufacture and sell trunking radio, cellular radio, and paging systems; Hughes Network Systems which has been selected to provide VSATs for the first trial phase of the Golden Bridge Project; and US supplier InterDigital Communications Cooperation which will sell CDMA equipment for a mobile network in Beijing. Foreign equipment suppliers will have the predominant role to play as Ji Tong builds its planned networks, though other opportunities are opening up as well. IBM is reportedly discussing a research and development joint venture with Ji Tong which would probably conduct research and provide advice on data transmission network hardware. (Pyramid Research Asia, April 1994)

4.4 The Service Market and Recent Developments

While China has been welcoming foreign suppliers for the telecommunications infrastructure, it has very firmly stuck to its "3 No's" policy of refusing any foreign participation in the ownership, management, or operation of telecommunications services networks. Rooted in concerns about national security and pride, the ban on foreign involvement in the service sector is nevertheless weakening as foreign operators begin to test the limits of direct participation. These changes are coming at a time when MPT's authority as the single state-owned monopoly has been modified by the formation of Lian Tong and Ji Tong and
by its own split into the DGT as dominant carrier and MPT as regulator. As the sector is reformed, however, no comprehensive regulatory regime has been able to clearly define the new role of the MPT. A telecommunications law governing the industry was originally supposed to be complete in 1995 but is now projected to be another couple of years in the coming. Instead a confusing and ambiguous "policy of exceptions" has allowed "inconsistent and fitful approval of new carriers and competitive service providers backed by political constituencies outside of the MPT." (Zita, Jan 1995)

As a result, much international attention has been focused on attempts by various companies to participate in the service market, especially Hong Kong investors trying to break into radio paging and cellular radio projects. Many foreign analysts and investors believe that China cannot meet the target of 100 million PSTN lines by the year 2000 without direct foreign investment; according to this view, adoption of the global privatization model is China's only rational choice. Nevertheless, the MPT has responded on several occasions with stern pronouncements that foreign ownership and operation of telecommunications services is not permitted.

For example, in May 1993 there was a press announcement about a joint venture between SCM Brooks Telecommunications and a Chinese company, Galaxy New Technology Company to build and operate a modern telecommunications network in Guangzhou. When the Guangzhou electronic equipment company was called, however, one manager claimed that the company had an engineering department by the name of Galaxy Company Ltd which had met with but did not reach an agreement with SCM Brooks. Another manager declared that there was no such entity as Galaxy Company Ltd. According to a telegraphic report prepared at the American Consulate in Guangzhou, the Consulate had contacted the Guangzhou Post and Telecommunications Bureau for clarification on the matter and were told that such a joint venture was impossible. They were referred to a press announcement from the MPT three days following the news about the Sino-US Joint Venture. According to this MPT announcement of May 10, 1993:

Mr. Xu Shanyian, a spokesperson for China's Ministry of Post and Telecommunications reiterated: "In China, it is not permitted for foreigners, including Hong Kong, Macau, and Taiwan entities, to participate in the joint management of postal or telecommunications operations, and the policy prohibiting foreign capital from being directly invested in these operations has not changed. All those who have violated the above principles should immediately rectify their mistakes and stop the execution of any contracts that have already been signed or are now being implemented.
At the same time, Xu emphasized that telecommunications in China is under rapid development, and to keep up the pace, China "will keep on carrying out the open policy and import more foreign capital, equipment, and technology.(National Trade Data Banks, July 20, 1993)

Such incidents reflect the growing debate within China between advocates of liberalization and the MPT which is afraid of losing its monopoly. This debate came to a head again towards the end of 1993 when Shanghai's reformist mayor Huang Ju suggested in New York that foreign companies might be allowed to play a greater role in the city's telecom development.(Business China, EIU, July 25, 1994)

Once the Pacific Rim's leading financial center, Shanghai has the potential to be in this position again. In order to do so however, it must quickly modernize its telecommunications sector. Unfortunately, both a shortage of funds to pay for its telecommunications expansion program and the central government's policy of retaining full control over network operations have prevented the many foreign firms keen on investing from entering this area.

Writing in a Chinese telecommunications journal, deputy director of Shanghai's PTA, Cheng Xiyuan, listed a wide range of sources of investment capital such as loans, collective investment groups, leasing of facilities, adjusting tariff rates, and shared stock. While he did not specifically mention foreign involvement, the article did suggest that Shanghai at least was waiting for the central government to relax its controls on telecommunications operation.(Business China, July 25, 1994) Meanwhile, mayor Huang Ju reportedly told leading Western telecom operators that he favored a "pilot" project in Shanghai under which foreign operators would invest in building and operating a new network.(Financial Times, February 25, 1994)

While the MPT again quickly denied that foreigners would be allowed either as equity partners or to fill a management role in networks operations, recent reorganization of the sector suggests that the likelihood of such changes is increasing. Professor Li Yining of the National People's Congress noted that while China was "not ready for a change of policy," when market conditions "matured" there would be "no reason why foreign businesses cannot take part in the operations of telecommunications networks in China." He also listed three necessary developments for this change to occur: local industry strengthening to the point where it is no longer dependent on preferential government treatment, technical improvements to an internationally competitive level, and changes in service charges and
revenue sharing. According to Li, "as these problems are essentially technical in nature, it seems highly likely that they can be resolved in the future." (Financial Times, February 25, 1994)

The formation of Lian Tong is especially important in assessing changes in the telecom sector. According to Vice Premier Zou Jiahua in a statement in China Daily, he hoped Lian Tong would be allowed to make "bold experiments in cooperating with foreign partners and introducing foreign funds" to meet its investment requirements. (Business China, EIU, August 8, 1994)

If Lian Tong is successful, which seems likely given the backing it has from the State Council, foreign firms will be waiting eagerly to make deals on some form of operations in the network in addition to the manufacturing ventures already underway. Once this happens, Shanghai could use its special status of being directly under the administration of the central government to bypass administrative layers including the MPT and appeal directly to the State Council for special powers to encourage its development. This is only one of many ways in which the entrance of Lian Tong into the telecom picture changes foreign perspective on the continuing ban on network operations.

In addition, the general manager of Lian Tong’s Guangzhou branch, Luo Zhiyong, recently invited foreign investors to form a construction joint venture with the Guangzhou South China Telecommunications Investment Corporation, a shareholder of Lian Tong’s Guangzhou branch. After this step, the network could be rented to the Guangzhou branch and the foreign partner given a certain portion of profit guaranteed by the corporation. This new approach would again allow foreign contractors limited entry into China’s telecommunications network. According to Mr. Luo, "The ratio of profit returns will be discussed in each project, but after certain period of time, the network should be solely owned by the corporation through a transfer of property rights." (South China Morning Post, February 15, 1995)

Further evidence of both the ambiguity and confusion over the foreign investment question comes from other "exceptions" which have been granted thus far. The first was a venture named Corporate Access launched by Richard Li Tzar-kai’s Pacific Century Group. The first foreign venture to run and install communication links in China, it is based in Singapore and is restricted to carrying data within a company. For example it would be used by a company with offices in both Hong Kong and China, or in other locations "where
business opportunities are around, but there is a shortage of quality telephone lines.” The
deal was struck between Corporate Access and one of the three mainland carriers, but Li
would not reveal whether it was MPT, Ji Tong, or Lian Tong. Furthermore, Li commented
concerning the ban, “It is specifically sanctioned by the State Council that such a service is
allowed.” (South China Morning Post, November 11, 1994)

Another example is the recent joint venture between the China American Telecommu-
nications Company (Hua Mei) and SCM Brooks Telecommunications in Guangzhou, to
develop a new broadband ISDN network approved for high-speed data traffic and video.
With 50% foreign ownership by SCM Brooks, it is clearly a violation of a literal interpre-
tation of MPT’s rules. In this case, however, not only will the network be China’s first
ATM-based network, but the PLA organization COSTIND, Commission of Science and
Technology in the Industry of National Defense, is the lead Chinese partner of the project
— making it politically very difficult for MPT to object. (Zita, Jan. 1995) Hence, another
exception.

The most recent wrinkle in this debate came in February of 1995 when the State Council
decided to revise its policy on the information industry, entrusting Vice Premier Zou Jiahua
with the task of steering the course of change and developing the national information in-
dustry. Among the proposed changes were developing new incentives for foreign investment
in the domestic electronic and information infrastructure.

The major policy changes were then articulated by the State Planning Commission.
According to its Commissioner, Mr. Chen Jinghua, more extensive and effective coopera-
tion with foreign companies is necessary to ensure China’s growth into the next century.
Specifically:

* Increase the ratio of information industry output to the GNP and the industry’s labor
  force, while restructuring the industry;

* Further expand information infrastructure, and accord telecom development greater
  priority over other industry sectors, in order to expedite the building of information
  superhighway;

* Speed up the development of electronic industry with the focus on micro-electronic
  industry, which will be made a pillar industry in the national economy;

* Strengthen the development of information service and market;
• Encourage local governments and state-owned enterprise groups to develop information industry, in addition to increasing investment through the introduction of competition mechanism;

• Expedite the process of the formulation and passage of the information/communications law;

• Encourage foreign companies to invest in information infrastructure and other related industries, encourage sino-foreign cooperation in developing information technologies and speed up the process of the China's tap and integration into the international economic information networks;

• Strengthen the work of training professional and skilled personnel.

This again suggests that important players to watch are Lian Tong and the local PTTs because foreign investment in the services sector, should it happen, will begin here rather than in the MPT. While MPT is unlikely to give up its official policy, decentralization has allowed these other actors to take advantage of eager foreign investors. Furthermore because there are so many foreign companies trying to enter the market, the PTTs have found it easy to play the entities off one another, which is another reason that very few of the deals have come into public light thus far.

Because both the local PTTs and the MPT do have this advantage of playing off foreign competitors, it is quite unlikely that the service market will be opened in the immediate future. However, the “policy of exceptions” pattern suggests that there will continue to be innovative ways through which investors can step into the market without actually violating a literal interpretation of MPTs official policy. For example in the case of Hua Mei, the assets are leased to the Guangzhou telecommunications bureau. Models such as this in which foreign entities are guaranteed a specified rate of return without owning the venture directly, will become more and more widespread. (Zita, Jan, 1995)

Another popular variation is the build-operate-transfer (BOT) or build-transfer-operate (BTO) arrangements. According to one analyst, “If you believe that China is going to develop its economy then you have to believe that foreign investment will be allowed into the telecommunications sector. Build, Operate, and Transfer; Build, Transfer, and Operate and other similar type schemes are all possible as funding and provide a sufficient equity
return for the investor. So would be licensing to telecommunications systems under a revenue sharing arrangement. These schemes will ensure equity-like returns without having to have a foreign operator.” (Asian Communications, Oct. 1994) Thus far these have been much more popular with local PTTs than with the MPT, though in October 1994 the MPT agreed to two BOT-type agreements with Hong Kong Telecom. The first is a GSM network in Beijing, and the second the installation and management of 13 inter-provincial fiber networks though it has not been disclosed whether the final deal will be a lease or BOT.(Asian Communications, Oct. 1994)

4.5 Interviews

Four representatives from American companies investing in the Chinese telecommunications sector were interviewed. Three were from large companies, and one from a smaller investment firm; none wished to be identified. Each company, of course, hopes that China will relax its ban on ownership, operation, and management of services. On the other hand, none of the people with whom I spoke were able or willing to comment on when they thought such a move might come. “It is very difficult to predict what the Chinese government will do, or when they will do it,” was the official word, though one person also mentioned China’s desire to enter the GATT and World Trade Organization which would force a loosening of many present restrictions, possibly including that one.

According to two interviewees from telecommunications companies, there are many rumors of “revenue sharing deals” being struck between foreign companies and local PTTs. While none of these deals have been confirmed by the Chinese, there is little doubt that a lot of activity is going on at the local level. Furthermore, each foreign company seems to believe that some other companies probably have deals that in effect bypass the ban on services; but no firms are willing to admit to such deals. This point was emphasized by all the interviewees.

When business is done, deals are made, foreign companies work with both central headquarters and at the local level, but it is the local level which is drawing more attention. When they could get away with it, some local PTTs have purchased switches without informing Beijing. The most successful make these purchases with their own money, later making excuses to apply exceptions to the rules which are supposed to control their pur-
chases.

Another point that was stressed by several people was the present state of chaos in terms of both policy and technical equipment. All wished for a more cohesive law or policy guide from the Chinese end, though none saw this as a reason as yet to stop trying to work in the market.

4.6 Experiences from Other Countries: The Asia-Pacific Region

4.6.1 South Korea

Korea had a long history as an occupied country until the Potsdam Conference after World War II, when it was divided into South and North Korea. Since then, South Korea has had one of the most remarkable growth stories in the Pacific. Along with its economic success has come progressive policies and success in telecommunications. With a telephone penetration rate of 35 per 100 people as of 1991, South Korea has one of the highest telephone densities in Asia. (Wellenius and Stern, 1994)

Most telecommunications infrastructure which had been installed by the Japanese was destroyed by the end of the Korean War. After that, no major investments were made until the first five-year economic plan in 1962. During the 1970s the level of unsatisfied demand started to rise, so that by the late 1970s, telecommunications in Korea suffered problems typical of developing countries, including inefficient allocation of financial resources and a backlog of unfilled orders. Waiting time for telephones was often more than a year, and a black market for telephones developed. At the end of the 1970s, the government started redirecting its industrial focus from heavy industry to electronics, including telecommunications. In 1978, the government started making major investment in telecommunications with the launching of a national automatic telephone switching network supporting subscriber demands for voice and data services. These investments were financed mainly through price increases and foreign borrowing.

At the time, foreign currency needed to purchase foreign switching and transmission facilities were in short supply. This, together with the poor harvests, shrinking demand for exports, and the second oil crisis, lead the government to accumulate debt at a very rapid pace as it underwent economic restructuring. Despite these difficulties, Korea continued to
expand telecommunications facilities unlike most developing countries where it was given a very low priority around that time. (Choo and Kang, 1994)

Internal financing was also an issue at the time. The government was concerned that increasing rates would increase the consumer price index. Nevertheless, it decided that users should pay for network expansion, so local rates were more than doubled.

Prior to 1983, the basic law governing the industry was the Telecommunications Act of 1961, which was based on heavy government regulation of equipment, service offerings, rates, and conditions. Major changes came between 1982 and 1983 with the enactment of a new set of laws including the Telecommunications Basic Law, the Public Telecommunications Business Law, the law on the Establishment of the Korean Telecommunications Authority (KTA), and the passing of the Basic Telecommunications Act and Public Telecommunications Business Act. The acts moved the sector towards privatization and tried to separate business operation from policy formulation. The laws provided that all telecommunications businesses were carried out by common carriers designated by the Ministry of Communications (MOC) which would also coordinate the businesses. They also established the KTA as a completely government-owned public corporation, which was given the management and operation responsibilities previously held by the MOC. At the same time, DACOM (Data Communications Corporation of Korea) was established as a private company given the status of common carrier for the purpose of providing new services such as email, videotex, etc. (Sung 1994)

Restrictions on the network began to be relaxed in 1985 and continued until 1991 when virtually anyone was allowed to share lease lines with no service restrictions. The telecommunications laws were revised again in July 1989 and July 1991. The first revision made the registration system for value added networks (VANs) theoretically less stringent. The second law came out of a larger effort by the Korea Information Society Development Institute (KISDI) to restructure the sector. It drew a distinction between various service categories: General Service Providers (basic telephony and data), Special Service Providers (cellular, paging, other wireless); and Value Added Service Providers (data networks, email, etc). Value added service providers were required to meet a registration requirement which is also expected to be further liberalized with time. At the same time, a regulatory framework was established which authorized new service providers, encouraging competition in the sector. (Bruce, Robert R., and Jeffry P. Cunard, "Restructuring the Telecommunications
Sector in Asia: An Overview of Approaches and Options,” in Wellenius and Stern, 1994) Also in 1990, KTA was renamed Korea Telecom and converted to a joint-stock company which the government plans to privatize. These plans, which have been delayed partly because of the downturn in the Korean stock market, would bar any single shareholder from owning more than 10 percent of Korean Telecom.(Bruce and Cunard)

Several factors motivated these changes towards liberalization at this time; namely, pressure from major telecom users within the country and trade pressure from partners, especially the US, for a more liberal and open telecommunications regime. The major members of the Computer and Communications Promotion Association (CCPA) were instrumental in these matters. Among them are STM and Samsung Data Systems (SDS), which are joint ventures of Lucky Goldstar with Electronic Data Systems (EDS) and Samsung with IBM, respectively.(Sung, 1994) Businesses such as Reuters, the Associated Press, and Citicorp also urged increased market access.

Like other countries in Asia, Korea has been very reluctant to remove restrictions on foreign ownership of domestic telecoms. This includes ownership of Korea Telecom’s shares, and of providers of value added services. Korean resistance stemmed largely from the fear that technology from the US and Japan would be advanced enough to freeze out most Korean firms.(Choo and Kang, 1994) This may especially be of concern because Korea has predominantly adopted American equipment and standards, and feels the need to develop its own new services.(Sung, 1994) In 1987 the US started Market Access Fact Finding (MAFF) talks with Korea concerning telecommunications. These resulted in an indirect request in 1988 by the US for an opening of Korean markets. In 1989, in accordance with the US Congress’s Omnibus Trade Act of 1988, the US Trade Representative designated the European Community and Korea as priority countries for negotiation.(Sung, 1994) Nevertheless, until the beginning of 1994, foreign investors could hold no more than 50 percent of the shares of a Korean provider of value added services though this restriction was lifted as a result of trade pressure. The restriction still stands for General Service Providers however.

Significant foreign investment is expected in mobile services, as Korea is aggressively introducing competition to this market. Several of the U.S. regional operating companies are pursuing opportunities in Korea, though no foreign entity is allowed to own more than one third of the voting stock of such a provider. Moreover, Korean Telecom and DACOM
(Data Communications Corporation of Korea) which has provided all data communications services for many years, have been excluded from the mobile services market. This is part of a concerted attempt now to diversify the sector. In this vein, individual companies have been barred from owning more than one-third of a Special Service Provider’s voting stock, and in October 1989, Korea Mobile Telecommunications Corporation (KMTC) sold 35 percent of its shares to its employees in the general public. (Bruce and Cunard)

Universal Service

Universal service was a stated goal of the Telecommunications Basic Law until the 1991 amendment rescinded this portion. However, universal service in South Korea is considered almost complete in terms of telephone penetration. (Kim and Ro, 1993) Though there is no precise definition, universal service is usually taken to mean that no preferential or discriminatory treatment is given to customers because of either place of residence or income level; and that customers must be given access to telecommunications services at reasonable rates. This concept can be traced back to the Communications Act of 1934 in the United States, which then became the basis for similar acts in many other countries including Korea. In the US, there is no assumption that “universal” means “uniform” but for Japan, the concept does generally imply that rates are uniform for subscribers across the country. This is also the case for South Korea. Universal service is still a primary objective of the MOC, now defined in terms of information rather than just telephones, but most other players in the sector now are leaning heavily towards an emphasis on liberalization and competition rather than on access. The tension between the two approaches has yet to be resolved.

One economic argument that has been used against universal service is on efficiency grounds. Economists view universal service as a means to internalize a network externality since subscribers who join the network benefit not only themselves but the other subscribers as well. However, according to this argument once the network expands to the point where it is now, marginal external benefits and hence the need to promote the goal diminish. Furthermore, cross-subsidization has been criticized heavily for inefficiencies; and proponents of deregulation have pointed out that telephone access demand is inelastic with respect to changes in local call rates. Kim and Ro, however, disagree, stating that “this type of analysis and conclusion depends on the estimation method and the data used. Recently, Cain
and Macdonald reported that the elasticities may be higher than previously estimated, and that they increased in the 1980s. (Kim and Ro, 1993)

It seems likely that the Korean sector will continue on its path of liberalization and deregulation, now emphasizing efficiency over its old equity approach. Nevertheless, the National Telecommunications and Information Administration's (NTIA) 1988 report enlarged the previously accepted goal to include other services such as fax, data transmission, long-distance service, and mobile telephone service. (Kim and Ro, 1993)

**Relevance to China**

If China is to successfully modernize its telecommunications sector, it should of course examine the successes and lessons to be drawn from other countries, especially those in Asia. What made them successful, and can China try to do the same?

The major restructuring of Korea's telecom sector has been important to its continued growth. Furthermore, the fact that there has been a telecom law in place, and the absence of the kind of regulatory confusion found in China has been conducive to industry development. As with the other “Four Tigers” – Taiwan, Hong Kong, and Singapore – Korea's vibrant economy has played an important role in the development of the telecom sector. An economy that has been able to generate substantial resources for basic infrastructure development has allowed Korea to focus now on new services.

Aside from the difference in the economies, the sociopolitical background of China and Korea are also quite different. Unlike Korea which has had a long history of foreign occupation and contact, China has a history of isolation. Korea's wariness of foreign investment in telecommunications services has probably arisen more out of concerns about Japanese and American technologies taking over the market, and less out of the simple dislike of foreign entities that has characterized Chinese attitudes towards foreign investors in the past. More importantly, despite the restrictions on foreign investment, Korea received a lot of foreign funding for its telecommunications development. Finally, it is more difficult to attract foreign loans in today's world economy than it was in the post-war environment in which South Korea rapidly developing.

Among the things that Korea "did right," were giving high priority to the telecommunications sector starting in the 1970s, and switching economic focus from heavy industry to electronics and telecommunications at the time when it was experiencing a backlog of
unfilled orders – exactly the problem China is facing today. China has now started along this direction too, putting emphasis on light industries and especially telecommunications, but the long lag time between now and when Korea started suggests that problems will not disappear at once.

One major step in the development of the Korea telecommunications sector was the decision to raise service charges, which raised enough capital to continue expanding the network. China, however, is expected to have more difficulty supporting such a price increase given its larger population at a lower income level. While some customers will certainly be willing to pay more for local service, these are more likely to be customers in urban areas who already have access to phone service. On the other hand, detailed willingness to pay studies have not been carried out for customer preferences throughout China, so that such measures cannot be completely ruled out.

The longstanding presence of an official telecommunications law in Korea is also in stark contrast to the Chinese situation. These laws are explicit and clear, and because of the culture, and of the history of law, it is much easier for both domestic and foreign investors to understand the rules.

Another difference between the Korean and Chinese approaches to the telecommunications sector has been the universal service concept. Whereas Korea's MOC has had this as a stated goal for a long period of time, it is not an explicit goal of the Chinese system. This is due more to practical concerns than any ideological differences; China simply is not at the stage where it can guarantee the installation of so many telephone lines. However, the equity argument is often used in the debate over liberalization as a reason for keeping the monopoly status of the MPT. The view that in competitive systems, the economically weak are often disadvantaged, certainly has some validity; and if telecommunications is to be considered a basic need like housing and food, it is necessary to bear these considerations in mind. However, the fact is that China's MPT has not been able thus far to meet the country's requirements and furthermore has not offered any new approaches dealing with the problems of funding and unmet demand.

The sheer magnitude of China's development goals is also different from the Korean situation. Although South Korea also developed its infrastructure very quickly, the difference between installing 2 million additional exchange lines to raise the penetration rate from 3.4% to 8.4%, in the Korean case, (Kim, Eun-Ju, March 1993) to installing an extra
50 million to raise penetration from 3% to 6%, in the Chinese case, (Business China, May 1994) is significant. China needs to install as many lines each year as are in one of the United States' seven Regional Operating Companies to meet its targets.

Because of the differences in the size of the problem and the sociopolitical environment in South Korea and China, experiences from South Korea cannot be directly transferred to China. Some of the solutions such as raising the basic user fee are not practical for the Chinese economic situation. Furthermore, while Korea had a very isolationist stance for foreign investment until very recently, it had a more liberal domestic policy than China. In addition, South Korea has for political reasons had a lot of financial support from countries such as the United States, which China has not been privy to. The largest question facing China's development will be adequate funding, which in today's world economy will only come from foreign investors. South Korea's traditional goal of universal access seems to have been an important factor in achieving a high density rate; this is a concept that China could develop for itself as part of a more coherent framework for the telecommunications sector. Finally, the South Korean experience again suggests the need for a clearer legal and regulatory framework.

4.6.2 Taiwan

Taiwan's telephone penetration rate is also relatively high, with estimates ranging from 33 (Wellenius and Stern, 1994) to 41 lines per 100 population (Chintay Shih and Yeo Lin, 1994). Taiwan's remarkable post-World War II economic growth has generated enough revenue to invest heavily in infrastructure. In 1976 the government implemented a six-year Telecommunication Development Plan which focused on increasing telephone density and modernizing the sector to allow direct dial for both domestic and international calls. During the 1980s rapidly growing international trade created a huge demand for information service, prompting the government to designate both the information and telecommunication sectors as strategic industries. This resulted in continued investment; for the years 1991-1996, for example, the government called for the installation of 12 million lines of digital local switching equipment by the end or 1996; 100 percent digitalization of toll switching lines by 1994; construction of 23,000 kilometers of fiber-optic network; and development of ISDN capabilities in the national network (Wellenius and Stern, 1994).

The telecommunications sector was traditionally governed as a monopoly by the Min-
istry of Communications, which was divided into the directorate general of post (DGP) and the directorate general of telecommunications (DGT) as soon as the MOC moved to Taipei in 1949. The DGT has monopolized the networks and telecommunications business, as well as drafting and executing regulations for equipment manufacturing and service provision. Early structure of the sector arose not only out of the assumed natural monopoly conditions but also because of national security concerns after World War II. Fear of invasion, and the strategic importance of telecommunications lead naturally to a system where the government maintained tight control of telecommunications.

Since then, liberalization of the sector has followed the same sequence as it did in the US, UK, and Japan, with first the CPE (customer premises equipment, such as subscriber telephone sets) market, then VAN (value added network) services, and finally common carriers being open to competition. In fact, Taiwan’s Council for Economic Planning and Development commissioned a study in 1987 to analyze the causes and effects of reforms in the US, UK, and Japan. The study found that primary forces behind reform were also ones that existed in Taiwan, namely, the need for convenient and reasonably priced information by businesses as well as the need to achieve universal service (Chintay Shih and Yeo Lin, 1994).

Development plans in the earlier years of the DGT emphasized the installation of local telephones as a way to ease the burden of long waiting lists. Between 1965-1980 telephone density grew annually at a rate of 18-21%. As the user base grew larger, it slowed to 7.5 percent (Tseng and Mao, 1994). During the 1980s the primary goal was to make the transition from analog to digital switching systems; and plans have been formulated for establishing ISDN in Taipei, Taichung, and Kaoshiung by the year 2000. As of 1990, about two-thirds of households had telephones, with a total switching capacity of 7.84 million lines – 20 percent digital, 24 percent electronic, and 56 percent crossbar – though all are expected to be digital by 2000.

In addition to designating telecommunications as a strategic industry, the Taiwanese government has promoted development of the sector by offering various financing facilities, technological support, R&D incentive programs and assistance in product development. The Bank of Communications plays an important role in helping many entrepreneurs during the startup of small telecommunications and information companies, but it is legally restricted to only 25% of any company’s equity. The Development Fund of the Executive Yuan
was formed in 1973 to provide financial support to domestic industry and also plays an important role in the sector.

Like Korea and China, Taiwan’s sector is very limited in terms of foreign investment. It has long been monopolized by the Directorate General of Telecommunications (DGT) and a joint venture between the DGT and three foreign firms known as the Big Three. In 1973 ventures were established with GTE (now owned by Siemens) creating GTE Taicom System Ltd., and with ITT Telecommunications (an ITT subsidiary now part of Alcatel) forming ITT Taisel (Taiwan International Standard Electronic Ltd.) In 1984 these were joined by a venture with AT&T to form AT&T Taiwan Telecommunication Co. (Business Taiwan, Reuters, March 1, 1993; Tseng and Mao, 1994) With their market power, financial strength, and technological advances, the Big Three form a formidable barrier to market entry.

There has been a Telecommunications Law drafted and in place in the MOC/DGT since 1915. The current Telecommunications Law includes a ban on foreign investment in telecommunications services. However, the Ministry of Transportation and Communication have proposed lifting the ban and permitting foreign investment in small-scale satellite communications, mobile phone services, and paging services, as well as domestic value-added networks, long-distance and international services. However, involvement would be restricted to joint ventures with foreign capital accounting for one-third or less of the total. In addition the chairmen, general managers, and at least half of the boards of directors and supervisors should be Taiwanese nationals. ("Taiwan..") Business Taiwan, March 24, 1995)

Taiwan has an obvious interest in maintaining control over telecommunications as a strategic sector, not the least because of its national security concerns. Nevertheless, the sector is starting to open up to foreign investors, in order to fulfill the government’s commitments after it joins the World Trade Organization, as well as in recognition of the many opportunities for development this represents. Though China has not had the same amount of money available for its investment in the telecom sector that Taiwan has had, it can more quickly take advantage of foreign investment.

Relevance to China

Unlike China, both Korea and Taiwan developed their telecommunications infrastructure while the country was under some threat of invasion. This was a major factor in having
a government-run monopolistic leader in the telecom sector. Furthermore, Taiwan and Korea are significantly smaller than China, and have both experienced remarkable economic growth. It is not clear then, that China would be better off by developing along the exact same paths. China, it seems, does not have the same national security concerns that Korea and Taiwan did at the time of rapid development, and thus would not be forced into having a monopolistic operator/regulator. On the other hand, Taiwan and Korea’s “universal service” as a stated goal helped tremendously in reaching the current relatively high telephone density. China has no such policy, and may want to consider working towards such a goal.

Furthermore, Taiwan and Korea were both able to do without foreign investors partly because they had a lot of financial support from the governments of countries such as the US, again for political reasons. China not only needs significantly more money to develop its much larger base, but it also does not have the same post-World War II money coming; making it necessary to find other sources of funding. Currently, foreign investors are probably the best, most available and most effective, option. Finally, Korea and Taiwan both have a long history of telecommunications law which has made the sector easier to understand and work in. This is something that China must work on quickly.

4.7 Foreign Entrants in the Chinese Market

4.7.1 AT&T

In February 1993, AT&T signed a comprehensive Memorandum of Understanding (MOU) with China’s State Planning Commission. A four page document, the agreement establishes a “long-term comprehensive partnership” between AT&T and the PRC and a commitment to “business opportunities which they could pursue jointly.” (Warwick, 1993) This agreement supplanted China’s Directive 56 moratorium of 1989 which declared that no new foreign switch producers would be allowed to enter China. There were no specific terms and conditions agreed to at the time, though ten areas of potential joint business activity were identified: 5ESS switch manufacturing, VLSI manufacturing, network management expertise, R&D with Bell Labs, optical transmission manufacturing, wireless manufacturing, customer premises equipment manufacturing, training, systems integration, and network service offerings. Many of these areas also include technology transfer, joint R&D, and
training for Chinese nationals. China's obligations are to organize the relevant ministries – the MPT and MEI are expected to be most active – and agencies which will then identify the appropriate Chinese partners for cooperation with AT&T. To respond to the requirements of the MOU, AT&T created the China Business Unit, called AT&T China, in which it hopes to employ mainly Chinese nationals. (Warwick, 1993)

Thus far, confirmed joint ventures between AT&T and China are (“China Industry Overview..” EIU, May 2, 1994)

- AT&T of Beijing Fiber Optic Cable. This joint venture was formed in October 1992 with three Chinese firms, including one firm affiliated with the MPT, to manufacture optical fiber cable.

- AT&T of Shanghai. This venture was formed in 1989 to make, sell, and service digital transmission equipment. AT&T holds a 50% stake, 28% is held by Shanghai Optical Fiber Communications Corporation, and 22% by Shanghai Telecommunications Equipment Factory.

- AT&T of China. This venture is with Shanghai Telecommunications Equipment Factory for manufacturing subscriber-loop carrier systems.

- AT&T Shanghai Fiber Optic Cable. A joint venture with three Chinese firms to produce 200,000 kilometers of cable. AT&T holds 56% of the venture.

One of peculiar problems currently being faced by AT&T is its representative office status, which precludes it from directly hiring its own local staff. Instead, it is generally allocated Chinese workers by the local administrations, who can switch workers to jobs in other joint ventures with little or no warning. This has lead to a series of delays. Moreover, China has been pressing AT&T into providing the latest sub-micron integrated circuit production technology in a proposal for a facility at Wuxi in Jiangsu province. (“China supplier's eye-view..” EIU, May 2, 1994)

4.7.2 Other Foreign Companies

Siemens of Germany has four planned telecom joint ventures with China. These are the Beijing International Switching Systems Corporation of which it has a 40% stake; Shanghai Mobile Communications, to supply GSM mobile phones in Shenzhen and Shanghai; Siemens Business Communications Systems in which it has a 51% stake; and Guangzhou Nanfang Transmission, set up with Guangzhou Nanfang Photoelectrical Telecommunications Equipment Factory. (“China Industry Overview,” EIU, May 2, 1994)
Swedish company LM Ericsson has a long history of manufacturing in China, and in fact China is their fifth largest market. Their largest venture to date is Nanjing Ericsson Communications, China's first mobile communications joint venture which went into service towards the end of 1993. ("China Industry Overview")

Both LM Ericsson and Canada's Northern Telecom have expressed uncertainties over various aspects of Chinese commercial law such as the restrictions on establishing wholly-owned subsidiaries. These companies, as well as AT&T and others, are hoping that Chinese commercial legislation will permit companies to have umbrella organizations which control and coordinate subsidiary enterprises around the country. ("China Supplier's Eye-View," EIU, May 2, 1994)

Japanese company Fujitsu established a joint venture with Jiangsu province in November of 1993 to produce PBX exchanges. Starting in 1995, it is expected to produce one million circuits a year. Furthermore, Fujitsu has a licensing deal with Shanghai to manufacture 500,000 public network switches which are brought to Japan and then resold to China. Finally, Fujitsu formed a US$9 million venture with Nanjing Telecommunications Works to install and maintain optical telecommunications equipment. ("China Industry Overview")

Motorola is investing US$120 million in its plants to make semiconductors, mobile phones, and pagers in Tianjin, where it expects to employ 5,000 workers by 1996. It is a large player in China, with a turnover of US$1.4 billion in China in 1993. ("China Industry Overview")

Other companies which have started operating joint ventures include Alcatel, Hong Kong's Champion Technology, and Japan's NEC.

4.7.3 US Concerns

The success of US based companies in this market will be subject to the political relationship between the US and China. In particular, companies such as AT&T and Motorola will be concerned with COCOM controls and China's Most Favored Nation status. The Coordinating Committee for Multilateral Export Controls, or COCOM, was established by NATO members (except Iceland, but also including Japan and Australia) in 1949 to control products which members would collectively embargo to potential Communist adversaries. Since the end of the Cold War, access has improved a great deal, though some of the old conservatism persists, especially in dealings with China. Traditional guidelines
are the upper limits of permitted technology for commercial sale, though member countries are free to put their own lower "threshold" on their exports. Thus companies must follow certain export control guidelines in their relations with China. These are restrictions were to have wound down by mid 1994, however, and no longer present an obstacle to technology transfer.

In addition, Most Favored Nation (MFN) is a bilateral arrangement between the US and China in which both countries agree to reduce or eliminate trade barriers and tariffs on trade between them. American companies are nervous about the possibility of thus revoking MFN, which could then significantly undermine the competitive advantage of their products. Of course in terms of telecommunications development, it is to the advantage of both China and these companies that MFN stay in place, though other issues such as human rights which are beyond the scope of this thesis do provide some good reasons for possibly revoking it.
Figure 4-1: Digital Switching Landscape

(Pyramid Research, August 1994)
Chapter 5

Wireless Communications

Wireless communication technologies are China's answer to technological leapfrogging. They have the greatest potential in mountainous and sparsely populated regions for which laying down traditional copper cables is prohibitively expensive. Wireless communications will definitely be part of the solution to China's telecom infrastructure development.

The wireless technologies found in China are comparable to those used in the developed world. Moreover, it is in this sector that the most innovative foreign financing and investment deals are being made. Although both domestic and foreign efforts have thus far been concentrated in the more prosperous coastal cities and special economic zones, newer investors are starting to focus inland.

I will examine three types of wireless communications: cellular radio systems, paging networks, and satellites, and analyze the role that foreign investments have and will play in their development and adoption in different regions of the country. Finally I will examine some creative solutions that may be important for more rapid development of the telecommunications network.

5.1 Adopting Information Technologies

Countries such as China in the Pacific Rim may be able to enter the "information society" more quickly and efficiently than those in other regions because they are not hampered by as many previous investments in outdated technology. To take advantage of this opportunity, however, new communications technologies should be carefully chosen. New technologies should be cost effective and practical, but also compatible with the needs, resources, and
technical skills available. Furthermore it is important to ask what effect technology transfer will have on the relationship between developed and developing country. Developed countries may assist developing countries by transferring technologies, but they may also reinforce their own economic power or dominance by transferring only second-rate technologies.

In China's case, the primary needs are for quick diffusion of technologies that can reach many people. Cost is an important consideration, as is more technical training for rural telecom workers. Foreign investors are willing to transfer the latest technologies to China as part of their businesses, but their transactions are constrained by government rules of both the foreign countries and Chinese. These restrictions are largely political.

5.2 Comparisons between Wireless and Wireline

In addition to being much more costly, wireline systems require a longer construction period and more maintenance than wireless networks. Furthermore, radio systems are generally much less susceptible to external environmental factors such as natural disasters. On the other hand, ISDN services are currently unavailable by wireless systems although voice, facsimile, and data communications are comparable. Therefore, for developing countries mostly interested in increasing basic phone service access, this is not an important restriction. Radio frequencies are, however, limited. This poses a definite problem once a certain level of development has been reached and demand moves beyond capacity.

Perhaps the most relevant issue for countries such as China, though, is cost. The "Study Committee for the Utilization of Radio Systems to Consolidate Telecommunications" undertook a study on cost comparison between wireless and wireline communications systems which was first presented to the APEC Working Group on Telecommunications in Hong Kong in March 1994. While the study was not directly about China, their conclusions are instructive.

This study chose to look at three separate cases, comparing traditional wireline networks to cellular networks in a large city model, a middle-city model, and a widespread small-scale rural area model. The model assumed only digital cellular telephones, and found the highest cost savings in the rural area model, which was basically a 500 subscriber network scattered around 2300km\(^2\). It found that the cost per subscriber was around one third that of the wireline network; and if the cost of mobile switching was not included (since one mobile
switching center can support more than the rural-area networks), the cost per subscriber fell to nearly one-sixth. (Saga, Aug. 1994) The large-city model found the cost of wireline to be about twice as much as for the wireless system. For the middle-city model, however (15,000 subscriber network spread over 60km²), wireless was found to actually cost more unless the mobile switching units were not included. (Saga, Aug. 1994)

While it is not clear that the assumptions are completely valid for Chinese cities, it is interesting to note that the present technology diffusion trend from large cities to mid-sized cities to small cities to rural areas may not be the wisest. Instead, attention should be given to remote and rural areas in terms of wireless telephony.¹

Because of the high initial costs of cellular networks, most networks thus far tend to have small capacities and high subscription rates, with the number of subscribers usually limited to 500-1000 stations. (Zheng, 1991) Also because of limitations in network capacity and investment, networks in the initial period are mostly structured on the basis of large radio coverage areas of omnidirectional operation.

In China, cellular operators pay on average $1,000 - $3000 per customer as compared with the $2,000-$5000 that P&T's typically pay for each conventional phone line. Because of the initial fee (on average $3600- $4,500) as well as monthly subscription fees ($27), cellular services generate a revenue for the local P&T. Connection charges are much lower for standard service, ranging from $80-$600. (1993 averages. Gorham and Chadran, 1993) Hence, cellular services are more profitable and cheaper to the supplier, but also thus far less accessible to poorer users.

### 5.3 Mobile Communications Technologies

#### 5.3.1 China’s Cellular Network

While the MPT in Beijing is working to develop the wireline infrastructure in China, the provincial P&Ts have taken the lead in promoting wireless communications. MPT maintains control over radio frequencies used by the telecom providers, but the local P&Ts enjoy a great deal of freedom in planning, financing, implementing and operating the mobile networks. Since November 1987 when Ericsson’s TACS (Total Area Coverage System) 900 MHz mobile telephone systems were first installed in Guangzhou, the number of mobile

¹I was not able to find this report to find out what all of the assumptions of their model were.
cellular telephones has been growing at an annual rate of over 220 percent. By the end of 1994 China had as many as 1.5 million mobile cellular telephone subscribers, a third of whom are in Guangdong province. (China Telecom Newsletter, January 1995) Also among the top six provinces in terms of number of subscribers are Liaoning, Fujian, Zhejiang, Jiangsu, and Hunan. (Du, Feb 1995)

The adoption of mobile phone services has followed patterns of economic growth, with Beijing, Tianjin, Tangshan, the Yangtze Delta and the Pearl River Delta adopting the technologies first. ("Fast Movers," May 1993) Provincial authorities continue to maintain control over the operation of these networks, but have turned to foreign companies for supplying phones, base stations, cellular switching technology, and technical expertise.

A current national plan to connect major cities by fiber optic trunk lines also proposes the linking of remote regions by cellular networks. While fiber optics will be installed along the Beijing-Shanghai-Guangzhou, Harbin-Beijing-Haikou, Beijing-Xian-Chengdu, Beijing-Lanzhou-Urumuqi, and Shanghai-Chengdu lines, contracts for cellular interconnections are being awarded to or under negotiation with overseas companies. Motorola, for instance, is currently installing a cellular network in Tibet. (Weiss and Wong, 1994)

The National Radio Management Commission, together with the MPT, have reserved the 900 MHz frequency for urban cellular applications, 450MHz for dedicated networks and some remote areas, and the 150MHz band for all paging networks. Furthermore, the coastal public networks operate at 900 MHz TACS. (Gorham and Chadran, "Communicating") However, these standards are not always observed, and some areas have adopted different standards.

Thus far Ericsson and Motorola have been the main players in this market. Ericsson has a cellular equipment joint venture with the Nanjing Radio Factory, which is affiliated with the MMEI (Ministry of Machinery and Electronics Industry) and in 1993 claimed to have installed roughly 60 percent of China's total cellular capacity. Motorola, on the other hand, began working in 1991 with the MPT's Hangzhou Telecommunications Equipment Factor to produce cellular handsets, base systems, and switching equipment.

Both of these providers have concentrated on analog technology, with the European TACs and American AMPs. In fact, the adoption of these two incompatible standards delayed the introduction of a roaming system. China is likely to continue operating on multiple standards and frequencies for some time, as vendors may find themselves locked into
certain markets for the next 5-10 years because entry into markets with different standards is very difficult. (Gorham and Chadran, “Communicating..”) However, bandwidth and service quality considerations are prompting a move towards digital cellular networks using either CDMA or GSM transmission standards.

5.3.2 Cellular Radio Telephony

Cellular mobile phone service usually uses a 50 MHz band within the 800-900 MHz radio band to create 832 two way radio channels. The frequency band from 824 to 849 MHz is used to receive signals from the mobile units, and the band from 869 to 894 MHz to transmit the signals. The channels can be reused within the same geographic area, increasing the number of customers which can be served. This is accomplished by using a number of low-power radio transmitters each of which services a smaller cell, typically with a radius of six to twelve miles. Each cell area has a base station with radio transceivers and a certain number of radio channels. The low power of the transmitters allow the same channel to be used again in another (non-adjacent) part of the region; cell configuration is chosen to minimize interference caused by reuse of the channel. If congestion appears on the system, cells can be further split into smaller cells by using even lower powered transmitters.

Because mobility is a key feature of this service, it is necessary to track users as they move from cell to cell. Cells are organized into clusters which are repeated over the geographic area. (See Figure 5-1) (Noll, 1991) Base stations in the cells are connected by fixed links to dedicated telephone exchanges called mobile switching centers (MSCs) which interface with the public switched telephone network, carry out call accounting, and manage roaming between cells.

When a user does move from one cell to another, the process of changing the channel used to transmit to and receive from the base stations is known as a handoff. The system continually monitors the strength of the signal from the mobile unit so that when it falls below a certain threshold the call is transferred to a channel in the next cell. This process should be transparent to the user, though if there are no free channels in the new cell, the call could be cut off.

Roaming, or the capability to use cellular phones outside the home service area, is accomplished through agreements between service providers in the different locations. Roaming customers are billed through their home service provider rather than getting separate bills.
Cells are organized into clusters, with most cellular systems using seven cells per cluster. The radio channels are allocated across the seven cells. The clusters are then repeated over and over again to cover the whole geographic area served by the system. Since cells using the same channels are separated from each other, and also since the radio power is low, interference is less likely. Although the cells are depicted as hexagons, their actual shape is quite irregular and depends on the terrain and radio propagation.

Figure 5-1: Cellular Telephony

from each. In the US, Canada, and Europe, the IS-41A standard, which includes automatic intersystem roaming and call delivery, has been adopted to create a seamless network. (Velasquez, April 1994)

Roaming is possible in China with the new network activated on January 1, 1995. The world's largest TACs 900 Mhz cellular mobile roaming network, it covers fifteen provinces and municipalities using Ericsson systems and 21 provinces and municipalities using Motorola systems. (China Telecom Newsletter, Jan. 1995)(see map 5-3)

5.3.3 Chinese Mobile Standards

In 1992 the MPT released frequency allocation standards for mobile communications as follows (Zhang Nong, 1994):

Up Link: 890MHz-915 MHz, in which
905 MHz - 915 MHz, digital

Down Link 935Mz- 960 Mhz, in which
935 MHz - 950 MHz, analog
950 MHz - 960 MHz, digital
5.3.4 Digital Mobile Service

Choosing a Digital Technology

Demand for cellular mobile phone service has grown at such an fast rate that many localities are shortening their base station radii and are continually searching for ways to more efficiently utilize radio spectrum. For instance whereas most cells are macrocells with a coverage radius of 20 km, or up to 40 km for hill-top stations, radio coverage in Guangdong has gone as low as a 1km radius. Microcells are also coming to several other cities such as Shenzhen. (Zhang Nong, 1994) Such problems have naturally lead to the consideration of ways to deal with future traffic growth.

One possible way of increasing the number of channels is to use non-formal channel allocation. Rather than dividing the channels evenly into groups, this scheme would allocate the groups unevenly based on amount of traffic; with groups of less channels reserved for light traffic areas in between macro cells and micro-cells. However, having both macro- and micro-cells in the same system may add confusion to a chaotic system; and the attainable increase in number of channels is not that great. (Zhang Nong, 1994)

A better option for providing increasing system capacity is the adoption of digital mobile systems. Because the choice of a communications systems can have a definite impact on a country’s social and political environment; and because it is more difficult to change technologies once one has been adopted, especially in a country as large as China, there has been a lot of heated debate about which digital standard China should adopt. (CTC Forum, 4/94) The ITU (International Telecommunications Union) recommended a choice among: D-AMPS (TDMA) used in North America; GSM in Europe; PDC in Japan; and N-CDMA (narrow-band CDMA) used also in North America.

Time Division Multiplexing

In time division multiple access (TDMA), pulses from different sources are interleaved into designated time slots of the same transmission channel. TDMA keeps the same framework and design as today’s analog cellular network but provides three times the capacity. Both the US and European standards are a TDMA specification; and it is considered a tested and proven technology.
GSM

Originally named after the Group Speciale Mobile, GSM was designed to provide pan-European roaming so that subscribers could use their equipment anywhere in Europe. The structure of the fixed network in GSM is similar to that of analog cellular radio, but GSM has improved capacity, frequency hopping, more efficient use of the spectrum, and better digital speech quality. The transmit frequency of GSM’s base station is 935-960 MHz, frequency of the mobile station is 890-915 MHz, the duplex separation is 45 MHz and carrier separation is 200 Khz. Its multi-access mode is created a mixture of FDMA (frequency division multiple access) and TDMA (time division multiple access). (Zhang Nanruo, 1994) A typical GSM system is shown in Figure 5-2. (Datapro) Transmission and reception times in GSM are separated by a time shift of three slots rather than working simultaneously. (Trivett, Feb. 1993)

Allocation of the frequencies designated for use by the digital cellular system is required for a license to operate GSM. In some countries however, these frequency bands have been divided to accommodate more than one operator. In general, GSM adopting countries have
been those whose analog systems are already too congested; those which have space on analog but are rolling out GSM to meet particular MOU requirements; and those which currently have enough analog bandwidth but will run out in the future. (Trivett, Feb. 1993)

In China, the primary impetus for change is recognized inadequacies of the TDMA TACS system adopted in the late 1980s. In particular, network capacity is limited by low usage of the radio frequency spectrum; problems in making the transition to future ISDN; and the lack of standardization in analog mobile systems which would facilitate automatic international roaming.

China is now one of the world's fastest growing cellular phone markets and provides the greatest potential for GSM outside of Europe. GSM is operating under a trial basis in Guangdong in a system supplied by Northern Telecom to the Guangdong Mobile Communications Corporation (GMCC) under an October 1993 contract. (Pyramid Research, April 1994) GMCC, which is affiliated with the Guangdong P&T and is the largest mobile network operator in China, is moving at a rapid pace towards digital cellular, with NT, Ericsson, Alcatel, and AT&T all supplying it with GSM equipment. This network will provide services to Huizhou, Hudong, Huiyang, Dayabay, and Bouluo. (Trivett, “GSM” 1994) Siemens also cut over a trial GSM network in the Shenzhen Special Economic Zone in April 1994 (Pyramid Research, April 1994) The first commercial GSM system in China was launched in Jiaxing, near Shanghai, the infrastructure for which was provided by Alcatel. (Trivett, “GSM” 1994)

CDMA

CDMA (code division multiple access) is an application of spectrum spreading modulation technology in a multi-access system. The voice signal is transmitted in bursts at low power over a wider bandwidth while the receiver listens for a specific code sequence to find the intended signal. Its forward signal uses the band 869-894 MHz and the backward signal uses 824-849 MHz. Unlike in time or frequency division multiplexing, the spectrum can be reused without interference because other signals appear to be random noise. The bandwidth of the transmit signal is relatively wide and not relevant to the bandwidth of the message signal. The phone receiver listens only to those signals whose first bits have the specific code sequence that it is programmed to select, thus giving CDMA much greater noise immunity and better quality or reception over other signal transmission technologies. CMDA allows
for a better frequency reuse over short distances, which is particularly appealing when there is a lack of radio spectrum available. It is a very useful technique for accommodating more users in an area with high population density to use the same frequencies without interfering with each other. A comparison of spectral performances is as shown (Zhang Nanruo, 1994):

<table>
<thead>
<tr>
<th></th>
<th>TACs</th>
<th>GSM</th>
<th>CDMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel frequency bandwidth</td>
<td>25KHz</td>
<td>200 KHz</td>
<td>1.25 MHz</td>
</tr>
<tr>
<td>Voice channel number</td>
<td>200</td>
<td>200</td>
<td>240</td>
</tr>
<tr>
<td>Times of frequency reuse</td>
<td>7</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Channels per base station</td>
<td>28</td>
<td>50</td>
<td>240</td>
</tr>
<tr>
<td>Subscribers per base station</td>
<td>1010</td>
<td>2015</td>
<td>11295</td>
</tr>
</tbody>
</table>

Both Ji Tong and Shenzhen Telephone Company have selected US company InterDigital Communications Corporation’s Broadband-Code Division Multiple Access (B-CDMA). Ji Tong is using it to operate a high-speed wireless network in Beijing with a total capacity of 15,000 - 18,000 subscribers for each of 17 base stations. Full wireless service is due to start in 1995-96 and the network is slated to be fully operational by 1997. The Shenzhen system should have a capacity of 100,000 subscribers, with the base stations delivered through its Hong Kong partner Tele-Art Ltd in the 1995-1997 time frame. (Pyramid Research, April 1994)

5.3.5 CDMA vs GSM

Whereas GSM is already commercial in several places and can realize roaming, CDMA is still in its experimental stage. On the other hand, there seems to be support from within the MPT to adopt CDMA rather than GSM. Some of the reasons given are questionable: “GSM harms people’s health, because its radiation power of pulse peak is large,” (Huang San Rong, 1994) but on the other hand CDMA has a capacity as many as five times that capable with a GSM system, which is important given China’s quickly growing demand. CDMA also has the advantage of a soft handover (the several hundred millisecond interruption during a handoff characteristic of GSM does not occur). In general, CDMA looks more promising,
in theory at least, than GSM as a way of meeting China's specific mobile communications needs. However, GSM made an earlier headway into the market and seems to be entrenching itself in the sector.

5.3.6 Heilongjiang Province

As with other parts of China, waiting lists for telephone installation in Heilongjiang province are very long as the Heilongjiang Posts & Telecommunications Administration continues to be unable to meet local demand. In Harbin, registration fees were already US$464 in July 1994, with the time between registration and actual installation more than six months. To encourage demand for cellular services as a substitute for wireline, the HPTA cut its registration fees in 1994 from US$1,161 to US$581, with some areas of lower demand charging fees as low as US$290. Monthly fees went from US$17.42 to US$5.81, and airtime fees were down to US$0.05 per minute. These prices are significantly lower than those charged in the more economically prosperous coastal provinces where the different market supports connection fees of US$2,323 to US$3,484. ("Heilongjiang..", Pyramid Research, July 1994) These cuts were possible primarily because Heilongjiang has yet to experience the explosive growth in economy and prices that has been experienced by the coastal regions. However, the HPTA is also hoping that the low cost will greatly stimulate demand for cellular services to make up for any difference.

HPTA's first cellular network was installed in Harbin in 1991. By 1994 the Motorola 900 MHz AMPS system covered 13 cities and 68 counties. Also by 1994, total province-wide numbers were 30,000 subscribers, or half of total capacity. A second "B" system, a small TACS LM Ericsson-provided network, was introduced in June 1994 has taken care of Harbin's excess cellular demand. Currently there are 7000 subscribers but the HPTA is reportedly negotiating a major expansion to 200,000 subscribers by the end of 1995. ("Heilongjiang..", Pyramid Research, July 1994) With both Motorola and Ericsson networks, Heilongjiang is able to take advantage of the recently activated national roaming network.

5.3.7 Guangdong Province

The country's leader in telecom development, Guangdong's mobile phone use currently accounts for about 35% of the country's total. The number of cellular phone holders has grown at an average annual rate of 166.2% per year over the past seven years. The older
analog network which covers almost all cities and towns in the province reach more than 517,000 customers, while the new digital mobile service that was completed in October, 1994 is aimed to reach 450,000 users covering the Pearl River region from the east to the west of Guangdong, mail roads, and part of the mountainous regions. According to Lu Errui, director of Guangdong's Mobile Communications Bureau, “we are actively cooperating with foreign telecom giants to expand this service.” (Li, Feb. 1995.)

5.4 “Wireless Loop”

One promising development for rural and remote communities is known as the “wireless loop.” This is basically a cellular system, but without advanced features or full capacity. Thus the switch portion is significantly reduced, saving both investment costs and installation time. Because the wireless loop can support 24- and 30-channel telecommunication formats, it can exist alongside existing telephone networks. More importantly, however, it has the potential to extend phone service access to many individuals who currently do not have it.

Small wireless loop systems generally have a subscriber base of 300-5000 customers, within a radius of about 40 kilometers from the base station coverage area. Since deployment costs are not distance-dependent, costs per channel is usually between US$300 - US$1000 per subscriber (Favre, April 1994), as compared to US$2000 - US $5000 for landline systems and US$1000 - $3000 for conventional cellular systems.(Gorham and Chadran, 1993) Unlike landline systems which take a minimum of 1-2 years to install, wireless loop providers can provide service within a few months. Service is easily extended and investment thus less risky.

Currently a few remote locations in China, as well as in the Marshall Islands and Russia, are using wireless loop, according to Shue Kwan, Wireless Subscriber System product manager, AT&T Network Systems. (Favre, April 1994) In addition, India is currently conducting field trials of both CDMA and CT2 wireless local loop technologies in Delhi, Bombay, Calcutta, Hyderabad and Madurai. Motorola and other prospective service providers are awaiting the results of these trials as they propose joint ventures. For example, Motorola together with Usha Martin Industries hopes to set up a rural network in the tea garden areas of West Bengal. Cost estimates in this region are $500 per subscriber compared with
$500 in urban areas for wired loops and $1500-$2000 in rural areas. (Pyramid Research Asia, Sept. 1994)

In China, this technology has far greater potential than it has currently reached, largely because emphasis prior to now has been on densely populated coastal regions. As attention shifts to the Chinese interior, we should be seeing more need for wireless loops.

5.5 Paging Networks

Paging has long been successful in China, not only because of the long wait lists for telephone installation, but also because the main alternative, cellular telephones, cost anywhere from US $1,150 to $1,750 (10,000 - 15,000 yuan) to purchase and register, more than ten times the cost of a pager. As a result, paging networks have also taken off in China, with an expansion from around 430,000 subscribers in 200 cities in 1990, to over one million subscribers in 400 cities in 1991, to over 5.61 million by the end of 1993. (Bien and Pham, 1994)

This technology was given an extra boost when the market was officially opened in late 1993 to organizations not affiliated with the MPT. Though this helped fuel growth, paging networks had in fact already long been leased to the public by private (non-PTT) operators through informal channels. (Pyramid Research, Aug. 1994) According to some sources, however, private operators are still granted licenses only for "special purpose" rather than commercial use, though excess capacity from these networks can be sold to the general public. (Pyramid Research, Aug. 1994)

As with other communication technologies, foreign companies are prohibited from participating the operation of paging networks. However, this is perhaps the most "exceptional" of technologies, or the one where it is the easiest to stretch the literal interpretations of this policy. For instance, there seem to be many Hong Kong companies participating in network operation through joint ventures and "consultancy" arrangements. In fact, Beijing's Capital News Communications paging network lists a Hong Kong joint venture as an operating partner, despite the MPT's policy.

5.5.1 Competition in Beijing

With a telephone waiting list of more than 50,000, Beijing has been a natural place for paging networks to take off. Although the price of a pager still limits customers to mainly
work units, or "danwei" rather than individuals, there are already more paging subscribers (800,000) than main lines in the city.

Approximately 30% of Beijing's paging subscribers use the Beijing Telecommunications Administration's (BTA) networks. The first organization to operate a paging network in China, the BTA has a significant cost advantage over its private competitors since it does not have to pay licensing or network interconnection fees. Roaming has been implemented with other PTA networks in Beijing, Tianjin, and Tanggu. While some of their networks are operated solely by the BTA, others are operated in partnership with the military or other organizations.

Despite its early start, the BTA is now being overwhelmed by the number of alternatives springing up. Most such non-BTA network operators are quite small and serve only several hundred subscribers; they include the Ministry of Railways, State Planning Commission, Air Force, Chinese Communist Party School, Chinese Navy, Beijing City Power Supply Bureau, National Tourism Ministry, and several Beijing district governments. (Pyramid Research, August 1994) Some of the companies share frequencies to help defray the US $23,250 (200,000 yuan) frequency usage fee charged by the BTA. The monthly leasing fee for a trunk line also increased from US $19 in 1993 to US $349 in 1994, though there are reports that some companies favored by the BTA still pay lower fees.

Among the most prominent non-BTA paging operators in Beijing currently are HuaXun Corporation, CATCH Corporation, and GuoAn Communications Company. The largest, HuaXun, operated around 30 networks in the area by August 1994, and had enough capacity to support more than 100,000 additional subscribers. The president of HuaXun was former director of the frequency-distributing Beijing Wireless Management Committee, giving the company political clout and eventually, the largest slice of non-MPT paging frequency in Beijing. It's 1993 revenues alone were nearly US $3.5 million. In addition to paging, HuaXun is also building a mobile communications network for the State Council and Beijing City Government, and manages a 800 MHz mobile system in the city.

Like HuaXun, CATCH has not been limited to network operation. In addition to running twelve paging networks in Beijing, CATCH is an investor in Lian Tong and signed up an agreement to set up Lian Tong's Beijing office, as well as operating 450MHz and 800 MHz trunked mobile networks around China. It's alliance with Lian Tong will likely help it break into the cellular network area; and its support from the Beijing Municipal Government has
allowed CATCH to connect paging networks in Beijing to the Shanghai stock exchange. (Pyramid Research, August 1994)

Finally, the GuoAn Communications Company, subsidiary of China International Trust and Investment Corporation (CITIC), runs four Beijing paging networks: Zhong Xin, RuiXin, HuaYing, and FengYun. The latter two are both operating at about 50% capacity and are interconnected to the national network.

5.5.2 Heilongjiang

Paging has become very popular in Heilongjiang province as a “virtual phone service” for the same reasons as it has in other parts of China — long wait times for fixed line installation, and very high prices of cellular phones. In addition to basic paging, the Heilongjiang Posts & Telecommunications Administration (HPTA) plans to start offering value-added services such as voice-mail.

The growth of the paging market here has been similar to, though on a smaller scale than in Beijing. When the MPT officially opened paging services operation to non-MPT organizations in late 1993, the HPTA's (Heilongjiang Posts & Telecommunications) monopoly was ended. However, it retains a great deal of clout as the provincial PTAs were allowed to retain final approval over which organizations are allowed to operate the networks. Foreign operators are, of course, still banned. Growth of privately-operated networks has been so fast that some of the 30 available frequencies in the allotted 100 MHz band are already shared by more than one operator. Many observers feel that some of the smaller networks will not survive as competition grows.

Interconnection is an important goal. Currently existing paging networks cover virtually the entire province, but many systems are antiquated and cannot be interconnected. HPTA signed a contract with American supplier Glenayre to replace some of these systems with new internetworked paging systems in fourteen cities. Privately-operated paging networks are also allowed to interconnect with HPTA networks.

5.5.3 Champion Technology

Claiming more than 60% of the Chinese language pager market, Champion Technology is an interesting success story in the pager market. Unlike larger firms such as Motorola or Matsushita which tend to sell large volumes of low profit margin equipment, Champion sells
its products along with software, training, and technical assistance. As a result, Champion can gain margins as high as 50% from service fees. This is useful also to the customer who wants the technical support. ("Champion," Jan. 1994)

Champion's success has been due largely to the entrepreneurial efforts of its founder and chairman, Paul Kan. Kan has used his Chinese ethnicity to develop political connections, including Wan Li, veteran Communist Party leader and supporter of Deng Xiaoping. In fact, Wan recently invited Kan to suggest ways to liberalize China's telecommunications industry. ("Champion," Jan. 1994) In addition, Kan reportedly has strong links to both the PLA and public security organs which have a hand in radio frequency spectrum allocation. The liberalization of China's telecom market certainly has not done away with the need for guan xi in getting things accomplished.

Despite these strong ties, Champion ran into some controversy recently when news reports suggested that it had become the first foreign owner and operator of paging networks in China. Champion executives insisted that it is their partners, the local government organizations, that actually operate the networks. ("Champion," Jan. 1994)

5.5.4 Future prospects

Demand for pagers is expected to keep rising in the near future. However, as paging frequency bands become clogged by small networks, larger networks may buy them up, or their allocated frequencies may be returned to local PTAs. Motorola and other manufacturers basically hope that Chinese incomes continue to rise and that paging prices will drop enough for the boom to continue. Interconnection problems will also become more important in the future. There may be a few opportunities soon for indirect investment in paging networks through joint venture or private companies, but for equipment manufacturing will remain the predominant channel through which foreign companies can become involved. ("Liberalization..." Pyramid Research, August 1994)

5.6 Satellites

5.6.1 Satellite Technology

Satellite communication systems are comprised of the space segment, the signal element, and the ground segment. A signal is transmitted from the ground to the satellite where it
is received, amplified, converted, and retransmitted by transponders to one or more earth stations. A typical satellite transponder offers 36 MHz of bandwidth at frequencies from 4GHz to 6GHz. A typical communications satellite carries 12 or 24 transponders for a total bandwidth of 432 MHz or 864 MHz. All satellite circuits now operate in one of two frequency bands: the C-band, with uplinks in the 6 GHz range and downlinks in the 4 GHz range, and the Ku-band with uplinks in the 14 GHz range and downlinks in the 12 GHz range. (Anderson, 1994)

As satellite technology has progressed, earth stations have become smaller and smaller, greatly reducing costs. Earth stations have both transmit and receive capabilities, including access to the satellite and ground environment, multiplexing, modulation, amplification, signal processing, and frequency conversion. There are basically four major types of earth stations available in the fixed services satellite band: complex high-capacity type earth stations, midcapacity satellite earth stations, VSATs (very small aperture terminals, often 4-5 m in diameter), and receive-only earth stations. VSAT networks often consist of one master earth stations (MES) and up to a thousand VSAT terminals sharing the same MES. The VSATs can communicate with each other through the MES in a star network, requiring a double satellite hop. This gives the VSAT network an economic advantage over a terrestrial network with links between each location. In addition, VSATs are easier to install and maintain than high-capacity types. (Anderson, 1994)

5.6.2 Satellites and Development

Satellites have dramatically reduced the costs of providing both two-way basic communications and broadcasting services to small and scattered communities. They are most often used to transmit national radio and television networks; but two-way services are also readily available. Despite the great promise that these services have towards development, however, the benefits of satellite technology for telecommunications has often gone largely unrealized.

Cost is the largest obstacle. Even though it is far less expensive to use satellites to reach remote areas than to lay down copper wire, the initial capital investment of over $200 million for the satellite, launch, insurance, and master control station is prohibitive. The total price is even higher when the necessary earth stations are considered. At present, China and India are the only developing countries capable of building their own communications satellites.
rather than relying on foreign suppliers, though they too relied on foreign-built satellites (Intelsat for China) for their first systems.

Another problem is the limited life span (ten years) for most satellites, and the "last mile" work that must be done to make full use of them. For example, local telephone facilities have to be installed or upgraded so that links to the earth station are reliable in order for satellites to be effective. Finally, satellites are most often used for broadcasting, but it should be remembered that for isolated groups of people, two-way communications is an even greater need.

5.6.3 China’s use of satellites

Despite these difficulties, China has made great progress with satellite technology. In fact, it has been estimated that the use of satellite technology in China for both one- and two-way communications has saved China 10-20 years in "economic take-off." (Hong, Junhao, 1995) The era of satellite communications began for China in 1972 with the visits of former US president Richard Nixon and Prime Minister Tanaka of Japan. Since then, both international and domestic use has grown rapidly. (Yan, Zhigang, Jin, 1993)

Satellites used by China are in the Clarke Orbit above the Indian and Pacific Oceans and are owned by one of three organizations: the International Telecommunications Satellite Organization (INTELSAT), the MPT, and a regionally-based company, Asia Satellite Telecommunications Co. (Asiasat). Earth stations for international service are Standard-A (STD-A) type, with antennae diameters of 20m, 30m, and 32m while domestic service stations are 6m, 13m, and 16m. There are now five STD-A earth stations, three in Beijing and two in Shanghai. The satellites accessed by Beijing are at IOR60°E (60 degrees east longitude in the Indian Ocean Region), IOR63°E and POR174°E (Pacific Ocean Region). More than 5000 toll trunk lines operate over INTELSAT satellites, with direct access to 48 regions and countries and transit access to over 180. (Shen, 1993)

Thus far all of China’s domestic communications satellite have used the C-band. This includes five developed by the Chinese Academy of Space Technology as well as six transponders leased from Asiasat and five leased from INTELSAT. Most of the trunks use FDMA and SCPC (single channel per carrier), though TDMA has been field trialed as well. The MPT plans to use an intermediate data rate digital satellite transmission system for the domestic public network with digital circuit multiplication equipment (DCME) to increase
the number of telephone circuits by factors of four to eight. (Yan, Zhigang, and Jin, 1993). Developing satellites to use the Ku band as well will help create conditions for broader usage.

The fastest growing use of satellites, however, is of VSATs, also known as micro earths stations. VSATs are attractive in that the service provider can guarantee fixed costs, they are flexible in capacity, each to configure (adding and changing sites), and have high network quality. VSAT operators generally control costs by either owning the network or obtaining long term leases rather than paying telephone company charges. In this way, one-way point to multipoint networks save about 50 percent over landline costs whereas two-way interactive networks have savings of about 30 percent. (Hudson, 1990)

In China most VSAT networks are star configured, with the hub located in a political or economic center – either a capital city, provincial center, or near the headquarters of some ministries or large companies. Because there is no direct link between two small stations, there is a large time delay in communications between two such places. For voice communications, the calling party would be able to hear the response of the called party only after almost a second. Some small stations such as Hughes’ TES VSAT system now have direct circuits between two small stations, but these are constrained by the size of the small station antenna and transponder power of the satellite. (Gong Bin, 1994) Switching over to mesh configurations would alleviate the problem somewhat.

The number of VSATs currently installed and working in public and private networks exceeds 10,000. (Shimi, 1994) The 1993 State Council directive that officially opened VSAT operation to non-MPT organizations has spurred on this growth, which will soon lead China into being Asia’s largest market for VSAT networks. Now, non-MPT organizations such as China Investments and Trust Corporation (CITIC), Guangzhou Satellite, Guangzhou Tesonics, and Shanghai State either build large networks or purchase high-capacity hubs to sell to secondary users. (Pyramid Research, Oct. 1994) Although MPT and other agencies have gone out of their way to stress cooperation with foreign companies, the terms of relationship are constrained and foreign ownership or operation will not be allowed in the near future.

There is, however, still no firm policy about whether domestic VSAT services might be able to use foreign satellites to carry signals. According to Mr. Zhang Renqi of the State Planning Commissions, China does not have sufficient satellite capacity yet, but “at the
moment, we do not have specific regulations, but in a long term perspective, we advocate the use of Chinese satellites.” (China Telecom Update, CSIS, 1994)

The issue of foreign ownership and operation is particularly sticky and undefined in the area of international satellites. Mr. Liu Cai, director of the Department of Law and Policy (DPL) of MPT stated at a conference that foreign investment in satellite systems such as Apstar is consistent with the ban on foreign service providers because “Apstar and Intelsat are considered international satellites; they cannot serve the country without permission from the government, but capacity can be leased from them if China needs it,” suggesting that the “fixed lease” option is the “exception” foreign service providers should look towards for entering the satellite market. When asked about leasing on negotiated terms, Liu stated, “clever people can do that without breaking the law,” implying that the terms of such a lease should not be linked the results of the operation of the system. (China Telecom Update, CSIS, 1994) Finally, asked in this context about how China defines “operation,” Liu answered that profit-sharing, and “those who get paid based on their share in a property are considered to be participating in a joint operation.” Like radio communications, satellites offer a much more flexible “in” to the telecom sector. (Li, Feb. 1995.)

5.6.4 Private Networks

Private, or special-use VSAT networks are owned primarily by government ministries, but also by financial institutions, news gathering agencies, and other such groups. Among the ministries which operate VSATs are the Ministry of Petroleum and Gas (MPG), and the Ministries of Aerospace Industries, Coal, Mining, and Water Resources. The PLA reportedly operates a VSAT in a remote province as well. (Pyramid Research, October 1994) Furthermore, VSI's V-net system and Israel's GILAT have both been imported by CHINASAT for providing data communications to banks, news agencies, civil aviation administrations, as well as securities and future markets including Shenzhen Securities, Shanghai Cereals, and Beijing Commodities. (Shimi, 1994)

The largest VSAT network in China is, however, operated by the People's Bank of China, which has VSATs located in cities within each of China's provinces. It is currently issuing a tender for major network expansion. Among the bidders are Hughes, IBM, and a consortium of AT&T, China Tongda Network Systems, and China Software Technology Service Co. (Pyramid Research, October 1994)
The formation of Lian Tong and Ji Tong will probably lead the MOR and MPI to connect their networks in the future. If other VSAT operators decide to interconnect their networks as well, the resulting networks may be able to offer long distance service throughout China.

Hughes is the definitive market leader in the VSAT area, with more than 2000 VSATs in more than thirty networks. It has moved further into the market with a joint venture in May 1993 to produce its Telephony Earth Station (TES) and Personal Earth Station (PES) models. It owns a 51% stake while other partners including the MPT’s First Research Institute share the rest. Thus far foreign suppliers such as Hughes, AT&T Tridom, NEC, and GTE have supplied only to private or special-use networks.

5.6.5 VSATs in the public network

Perhaps the most interesting use of VSATs is to substitute or complement wireline systems in the more remote or mountainous regions. For example, in 1992 the Posts & Telecommunications Administration of Tibet started linking locales to the PSTN (public switched telephone network) using Hughes TES (Telephony Earth Station), a model used for voice traffic. By early 1994, 38 of Tibet’s counties had TES, which supported 500 communications lines and allowed access to domestic and international direct dialing services for the first time. (Pyramid Research, Sept 1994) The mesh network of VSATs uses digital SCPC (single channel per carrier), at 2600 Hz and a transmission speed of 32 Kbps. (Yu, 1992)

Similarly, the “5 Provinces” VSAT project provides voice connections to the PSTN via 700 voice channels in Yunnan, Guangxi, Inner Mongolia, Guizhou, and Qinghai. This 38-VSAT network is being financed and operated by the PTAs of these five more underdeveloped regions. Hughes is also supplying TES VSATs for this network.

In China’s economically stagnant northwestern provinces of Shanxi, Gansu, Ningxia, Qinghai, and Xinjiang, the introduction of satellite telecommunications has made possible economic cooperation between the provinces and foreign countries. Tibet also recently opened its first stock trading center which is linked by satellite to China’s two stock exchanges in Shanghai and Shenzhen.(Hong, 1995)
Figure 5-3: National Mobile Cellular Roaming

(China Telecom Newsletter, January 1995)
Chapter 6

Conclusions

6.1 Limitations

The general opacity of policy-making in China makes a study such as this both difficult and necessary. According to Milton Mueller, “In China’s social system, it is very difficult for critical analysis of policy options and industry models to seep into public discourse, particularly when foreigners are involved.” (Mueller, 1994) Underlying my thesis has been the understanding that policy cannot simply be reduced to technology, and that economic, political, social and other forces also shape policy decisions in what appears to be a technological question or effort.

Unfortunately, in China official publications for foreigners are carefully restricted to describing what technologies have been deployed, what the targets are, and how they are being met. Moreover, foreign companies who do find their “in” to the country have an interest in maintaining their advantage and are obviously reluctant to part with information or experiences in their work. This is especially true of telecommunications because of its sensitive nature to the Chinese government, and because of the newness of foreign involvement. Thus, this thesis has been limited more than anything else by the kinds of information I could find and the kinds of questions I was able to ask.

6.2 Summary

Policy-making in the Chinese telecommunications sector can best be understood as the outcome of continually shifting relationships among various bureaucracies: the MPT and
the MEI; the PLA and the various ministries; the MPT, local governments, and local P&Ts, the MPT and the State Council. Each of the organizations has a definite stake in the telecommunications sector. The MPT is struggling to maintain control over its traditional monopoly, the State Council wants to modernize the country as quickly as possible, and the local P&T enterprises are eager to exercise their recently gained autonomy in network planning and financing. Hence, policy decisions are attributable neither exclusively to power struggles among individuals or factions; nor exclusively to rational evaluation of the best interests of the country. Of course, the power of the top leaders is evident. Vice Premier Zou Jiahua, for example, has had considerable influence in getting Lian Tong off the ground. Finally, the telecommunications sector is no exception to the need for guan xi to get things done in China.

According to the Lieberthal and Oksenberg bureaucratic model for understanding Chinese policy, the fact that semi-autonomous bureaucracies are pursuing competing agendas which the top leaders then try to satisfy can often lead to inconsistencies in a single policy statement. This is apparent in Chinese policy towards deregulation and liberalization, and in particular towards foreign investment in telecommunications services.

On the one hand, general macroeconomic reforms have started introducing competition to state enterprises. This trend, together with a worldwide shift towards deregulation and competition in the telecommunications sector has started to erode the MPT’s traditional monopoly. On the other hand, MPT like all monopolists does not wish to give up its control. Similarly, China has long rejected with suspicion any intrusion of sovereignty such as is construed by foreign equity or managerial involvement in the country’s networks, and the State Council continues to reiterate the “3 No’s” policy on ownership, management, and operations. But foreign companies are looking for investment opportunities, and their money is needed. The confusing pattern of reforms emerging in the telecommunications sector tries to accommodate a number of such conflicting interests.

Rather than replacing or redefining the traditional mandate of the MPT, separation of the MPT into regulator and operator and the formation of Lian Tong and Ji Tong have contributed to confusion. Moreover, no comprehensive regulatory and interconnection guidelines have been set; private investment in the service sector has been tested by many foreign investors and the rules are bent frequently for one exception or another. While these trends make sense when we understand these conflicting interests’ at play, the results are
not ideal for the telecommunications industry as a whole.

Mobile communications have seen by far the largest growth in demand, and the most flexibility in bending foreign investment rules in the past few years. Analog and digital cellular communications, VSATs, and the paging market have provided foreign investors with many opportunities to get their foot in the door. While the investments have occurred largely in coastal regions, the greatest promise for these wireless technologies is in the remote and sparsely populated regions.

6.3 Institutional Weaknesses and Recommendations

Overall, the sense of the telecommunications infrastructure in China from both within and outside the country is that the sector is still fraught with a lot of uncertainty. On the bright side, the scale of plans for telecommunications expansion in the next ten or twenty years is so large that if China can “get it right,” past inefficiencies and problems in the telecommunications sector will be largely irrelevant. To make this happen, there are several pressing issues for Chinese policymakers to consider.

Establishing a telecommunications law should be the top priority. Investors, particularly foreign investors, feel uncertain about the business environment. This may have the effect of slowing down development. In addition, clearer regulations could improve efficiency in the system and protect consumers. The basic telecommunications law and regulations together should address the issues of basic goals, service quality and access, sector structure, pricing structure, foreign and domestic investment, and certain technical issues such as digital standards, roaming, and interconnection protocols including pricing,

China is presented with tremendous opportunities to leapfrog over very expensive copper wire technology in remote and mountainous regions, and go directly to wireless and satellite use. However, since the primary emphasis in development has been on coastal areas and large cities rather than rural regions, China has not given itself the chance to take advantage of these technologies to their fullest potential. This is partly because universal service is not a stated target of the MPT, and development in the large and prosperous regions is not only more attractive to foreign business, but also has a smaller marginal cost and is a more visible and thus politically attractive goal.

However it is believed that allowing the gap between rural and urban, and core and
periphery regions to become too large will be detrimental to the goal of economic develop-
ment in the long run. Instead, the government should consider providing some incentives
both for domestic and foreign investors to bring communications technologies to rural and
remote regions. In particular, more attention should be paid to the use of the local loop;
and to the use of satellites for two way communications in addition to broadcasting.

Unlike South Korea and Taiwan which developed their telecommunications systems with
much more foreign aid, China currently does not have the financial resources to pay for its
proposed expansion. As a result the MPT and Lian Tong have faintly hinted that there
will be room for much more foreign investors in the future. Although these investors have
thus far waited patiently for what they view as an inevitable shift away from the ban on
operations, management, and ownership in services, they are unlikely to wait around fore-
ever. Already deals are being struck between these same operators and telecommunications
entities in other Asian countries such as Vietnam. The current “policy of exceptions” has
been good for playing potential investors off one another, but this advantage will not last
forever. China should take care that its policies do not continue to breed distrust. If the
goal of telecommunications development is more clearly articulated is “modernization as
fast as possible”, then foreign participation in services should be allowed. On the other
hand, if other social goals are to take priority to development as fast as possible, more
attention to rural and remote regions is warranted.

China has been largely following the global trend approved of by organizations such
as the World Bank, towards greater liberalization and restructuring of the telecom sector.
Sector liberalization seems inevitable now that the MPT has been split and Lian Tong and
Ji Tong formed. This is appropriate given the present need for resources that the MPT does
not have; however the MPT needs to be stronger about adopting a legal and regulatory
framework right away. However, China’s current approach fails to take advantage of new
technologies and economies of scale. A move towards a market guided sector actually
requires more, rather than less, institutional structure than currently exists.

The use of mobile communications is to be encouraged, especially now in inland and
remote regions. For the coastal and more prosperous cities where demand is quickly out-
stripping the supply of radio frequency spectrum, a switch over to a digital system is the
most viable option. Of the standards available, CDMA appears most suitable for dealing
with China’s biggest problem—need for capacity. However, GSM has made a bigger dent
in the market, and is thought of as a more proven technology. Ideally, CDMA could move into all of the markets so that everyone ran on the same standard. As this is unlikely to happen, telecommunications officials need to work on specific rules for the integration of the two systems in the country.

Use of satellites for public voice networks is often overlooked in favor of digital communication. However, two-way communications is considered a much greater need than one-way broadcasting for people living in remote regions. Designing mesh-shaped rather than star configuration network could help make the systems more usable by reducing delay. In general, more should be done to promote the kind of development happening with the public satellite link in Tibet.

6.4 Future Study

There are still many unknowns about the Chinese telecommunications sector.

One interesting issue which has been studied very little is the spatial implications of telecommunications development. In particular, a detailed study involving fieldwork to determine whether urban-rural disparities in access to telecommunications promotes migration, and how it is needed. A better understanding of the rural-urban gap and how it both affected by disparities in access to telecommunications technology would help the Chinese government make more informed policy choices about where and how to invest.

A close examination of China’s basic telecommunications law is needed once it has been completed. This law should be analyzed especially for its ability to clarify current confusion for foreign and domestic investors. In addition, it will be interesting to see how rights are defined and allocated by this law.

Also needed is a plan to deal with the problems of interoperability with which China is imminently faced. Proposing feasible and specific nationwide standards for switching equipment and for mobile communications would be invaluable for the sector. This research would be quite difficult for someone other than a Chinese national to carry out, however, because the necessary data is difficult if not impossible for others to attain.

A more comprehensive cross-country comparison of the “universal service” concept would be instructive in China’s dilemma of how to meet its growing demand, and whether it should try to do so all at once.
Finally, while there are already many consulting companies carrying out market studies on different aspects of the Chinese telecommunications sector, the opportunity and need still exists for many other such analyses.
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