The Diffusion of the Internet in China

by

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Executive Summary

China and the United States share a new and rapidly expanding border—the Internet. It is a border that neither country fully understands. The possibility for misunderstanding is great because the Internet is not only transforming the relationship between the two countries, it is also transforming the countries themselves. It could be argued that China is going through the greater change. Unlike the past where information was mediated by the State, the mass media, and the work unit, Chinese citizens with Internet connections and a command of English have unprecedented direct and immediate access to information and people around the world. Because of abundance of Chinese language content, Chinese who can only read Chinese still have access to a wealth of information. The Chinese government has imposed its own unique regime on the networks in China that connect to the Internet. Though the United States and China both participate in the Internet, the regimes that they use to govern their networks are very different.

The Internet is diffusing rapidly and extensively throughout China. Five thousand users in 1994 grew to over eight million by the end of 1999. Between January and July of 2000, that number grew from 8.9 million to 16.9 million.[1] Although it is unlikely that the number of users will continue to nearly double every six months, if growth can be sustained at anywhere near half that level – a big "if" – in several years China will have more Internet users than any other country on earth.

China's leaders have chosen to accept and welcome the Internet because they see it as part of the path to becoming competitive in the global economy. Chinese President Jiang Zemin in a March 2000 speech urged Communist Party cadres to embrace the Net. Pointing to the Internet as the site of the Party's next struggle, Jiang urged Party members to keep up with the technology. "Internet technology is going to change the international situation, military combat, production, culture, and economic aspects of our daily life significantly," Jiang reportedly said.[2]

The question facing China is how to insure that the Chinese Communist Party (CCP) and the government stay in control of the Internet even as they use it to pursue the path of economic prosperity. Though the Ministry of Information Industry has continued to strengthen its position as the primary policy maker over the Internet, there are more than 20 Party and government organizations that see the Internet touching on their bureaucratic "turf". In addition, there are interested government bodies at the provincial and local levels with complex relationships to the national Ministries. To further complicate matters, many of these bodies at the national as well as local level have economic interests in ventures directly related to the Internet. Over the past five years, various bodies of the Chinese government have issued many regulations as the government has sought to develop a regime for ordering the Internet.

The State Council decided in 1996 to allow only a few selected Ministries to be Interconnecting Networks with the capability of directly connecting to the global Internet.[3] The Interconnecting Network regime allowed for competition between ISPs while imposing a hierarchical structure on what had the potential of being a more distributed network. The regime had its roots in the struggle between the former Ministry of Electronics Industries (MEI) and the Ministry of Posts and Telecommunications

(MPT) for control over the Internet. Though MEI and MPT were ultimately merged into the Ministry of Information Industry (MII) in 1998, the Interconnecting Network regime survived and evolved. So far, China Telecom, the national telephone company, has used this regime and its control over both the local loop and long distance circuits to maintain its dominant position over Internet infrastructure.

During the late nineties, there was significant discussion both within MII and within other bodies such as the National Peoples Congress and the State Council about the merits of having more competition in the telecom sector. There were some who argued that China would best be served by having a strong China Telecom that could compete with the impending onslaught of foreign competitors. It was also argued that multiple backbones were inefficient. However, under a strategy known as "letting the sons compete," MII and the State Council agreed to give Uninet and ChinaNetcom Interconnecting Network status. It also allowed them to join the State Owned Enterprise JiTong Corporation, operator of the China Golden Bridge Network, in competing with China Telecom in the provision of Voice Over Internet Protocol (VOIP) services.

Under the WTO accession agreement negotiated with the United States, China agreed to open its telecommunications sector to foreign investment. However, MII Minister Wu Jichuan has made it clear that any investment must be in keeping with China's regulatory environment for Internet Service Providers (ISPs) and Internet Content Providers (ICPs). Though the US Trade Representative believes that the provisions regarding international packet switching networks will allow ISPs to bypass the Interconnecting Networks, this is probably not Minister Wu's position. The Interconnecting Network regime and the requirement that all international traffic transit an Interconnecting Network router may be so central to Chinese efforts to control the Internet that the West may not be able to negotiate around it. The Chinese government is setting up a hierarchy where only corporations in which the PRC government has a controlling interest are allowed into the top tier. Under this model foreigners are allowed to invest in these corporations but in a way that the Chinese government maintains the majority stakeholder position. MII points to China Telecom (Hong Kong) as an example of how they would like to see foreigners participate in telecommunications ventures. Unicom had a successful Initial Public Offering (IPO) on NASDAQ in June 2000 and China Netcom may follow in the fall. China Netcom, from the technology it has chosen to the way it rewards its management, has been set up in the hope of making it an ideal "state-owned" vehicle for Wall Street investment.

Foreign investment is introducing a wild card into the Chinese Internet game. On one hand, individuals and even government Ministries are captivated by this opportunity to use the US markets to fund deployment. On the other hand, many Chinese have an ambiguous attitude toward foreign ownership and control of infrastructure organizations dating to well before the days of gunboat diplomacy. American investors will inevitably push the US government to try and "level the playing field" in Chinese telecommunications as quickly as possible. Given the internal and security concerns of the Chinese government, the field will be leveled at best gradually.

[1] China Network Information Center, Semi-Annual Survey Report on Internet Development in China (2000.1 and 2000.7).

[2] Peter Lovelock, "MFC Internet Update – March 13, 2000," *Made for China* available at http://www.madeforchina.com/update.

[3] The term Interconnecting Network" or *hulian wangluo* is used in the 1996 regulations. There is no widespread agreement on how to refer to these Chinese networks that have permission to connect to the global Internet. Sometimes the term is translated "InterLinked Networks". Other times the term backbone networks is used. Others use the term Network Service Provider (NSP) as differentiated from an Internet Service Provider (ISP).

Introduction

China is no stranger to information technology. The technology of writing has been an integral part of the Chinese civilization and the empires that have governed it for millennia. During the Qing dynasty, three copies of every tax receipt were made: one for the taxpayer, one for the magistrate, and one for the Department of Revenues in Beijing.[1] Writing strengthened and supported the hierarchy. The Internet, however, represents a new and untamed information technology. It is possible now to exchange information much more rapidly and in ways that potentially bypass traditional hierarchies, promoting informational flow that breaks down boundaries.

Table 1: China Statistics (1998)[2]	
Population	1.27 billion
Literacy (over 15)	81.5%
GDP	4.42 trillion
GDP per capita	$700
Telephones	105 million
Television	300 million
Administrative	23 provinces, 5 autonomous regions, 4 municipalities.

Informatization

Many Westerners are surprised that the Chinese government has allowed the Internet to develop in China, given Western perceptions of the Communist Party's needs to control the flow of information. Peter Lovelock argues that most foreign observers are missing the mark when they question why the Chinese government is taking the risk in allowing its citizens access to the Internet.[3] He points out that the Internet is an essential component of the Chinese government's efforts to use information technology to decentralize decision-making while continuing to control it centrally—a process known in China as "informatization". The Chinese government has always seen the adoption of the Internet as part of this larger process.

During the heyday of the Soviet Union there was much talk about the potential of information technology to make central planning work. It was hoped that by providing decision-makers with faster and more accurate information, they could better manage the economy. As documented by the University of Arizona's MOSAIC Group, the attempts by the Soviets to actually put this concept into practice failed.[4] The failure was in part due to both the inefficiencies of centralized control, combined with the limitations of the technology. Will the Chinese Communists be able to implement what eluded their Soviet counterparts? By decentralizing decision-making and by taking advantage of the newly available power of distributed computing, can the Chinese central government maintain "control" over the economy without having to manage decisions on a day-to-day, hands-

on basis? Or will companies and local authorities choose to under-invest in automation, so as to not make their operations too transparent to higher authorities?

The Internet is expanding rapidly and extensively. In July of 2000, the China Network Information Center (CNNIC) estimated that there were 16.9 million users of the Internet in China. This was up from 8.9 million in January of 2000. The Internet has been widely adopted in the academic sector and is being rolled out in the public and business sectors as well.

Governing the Internet

In order to understand the dynamics of China's informatization efforts, it is helpful to examine the process by which the Chinese government has sought to manage their portion of the Internet. This process has been complicated by the fact that multiple Ministries have seen the Internet as touching on their domain. To compound the problem, many of these government organizations hope to economically leverage their role in the Internet. Though the Ministry of Information Industry (MII) is the predominant decision-maker, there are many ministries who see the Internet touching on their turf (see Appendix 1)(A glossary of acronyms is found at the end of this manuscript).

The history of Internet governance in China must be seen within the context of the conflict between the Ministry of Posts and Telecommunications (MPT) and the Ministry of Electronics Industries (MEI). While the two Ministries were ultimately merged into MII in 1998, the conflict has left its legacy in the form of the Interconnecting Network regime.

Under this regime, the State Council imposed a hierarchical infrastructure on what was a potentially distributed or non-hierarchical technology. The regime insured that one government organization was responsible for all the organizations that access the Internet through its network, but limited which government organizations could run Interconnecting Networks. Though the MII has, under State Council guidance, issued Interconnecting Network licenses to more and more organizations, it has made sure that all these organizations are under its control. Some in China have called this the "father lets the son compete" strategy. The competition to offer new national backbones with the ability to connect to the global Internet is intense.

MII has been battling with the State Administration for Radio, Film, and Television (SARFT) over whether cable networks can offer Internet services. It is not clear how MII's hierarchical control over the Internet will withstand the pressures of competition and the implementation of the WTO agreements.

Securing the Internet

Security issues play a major role in the Chinese government's attitudes towards the Internet. Chinese authorities have a number of intertwined concerns. The problem of protecting government and commercial networks from hacking, computer crime, and even information warfare is intermixed with a concern that the Internet will threaten state security by enabling dissent and offering a means for organizing resistance.

The Chinese leadership recognizes the potential of the Internet to coordinate dissidence. Up to this point, it has chosen to block a limited number of Web sites dealing with controversial issues including Taiwan, Tibet, and Falun Gong, as well as sites of leading media outlets such as the *New York Times* and the *Washington Post*.[5] The Ministry of Public Security (MPS) prosecuted a number of individuals associated with dissident e-magazines, which have pestered Chinese leaders. The aggressive prosecution of Falun Gong members may, in part, be attributed to Falun Gong's ability to use the Internet to rapidly mobilize.

Although the threat of dissidence may be an issue for some, there is a larger concern on the part of many about how the Internet will contribute to the massive restructuring that China is undergoing. The overarching question becomes will government decision makers, their organizations, their nation, and their culture be winners or losers in the new economy brought about by a globally distributed technology.

Prosperity

A wide range of Chinese government organizations are leading efforts to promote the Internet and electronic commerce. A set of regulations dealing with electronic commerce is presently under consideration and there are major attempts being made to reform the banking infrastructure.

Economic activity is not only driven from the top down, it is also driven from the bottom up. The potential benefit of the Internet to the Chinese is far greater than just the amount of e-commerce transactions. Users are establishing relationships, visiting Web sites, building their own Web sites, and exploring new technologies as they strive to profit from this new universe.

Many new Internet Business Providers (IBPs) have entered the market, providing exchanges, applications, and even business process re-engineering. These IBPs will be a source of innovation and transformation. How top-down initiatives will interact with bottom-up economic development is perhaps one of the most important questions facing China.

Provinces

It is very easy for an outside observer to become fixated on the machinations at the center of government and forget that a significant part of the decision-making regarding the Internet is happening at the provincial and local levels. Different enterprises, cities, and provinces will, in their efforts to expand economically, take different paths in carving out their niches in the global economy. Chinese decision-making takes place in a matrix of vertical (between higher and lower territorial levels) and horizontal (at the same territorial level) ties.[6] One organization will often not be able to issue binding orders to another. Instead, a great deal gets done through consensus building, personal ties, and compromise. China's government is both hierarchical and networked. Distributed technology both threatens the complex interaction of

organizations within the network and offers the promise of making the process of governing more effective.

As part of our study, we examine the dimensions of Internet diffusion for Guangdong and look at some of the factors that may be responsible for making Guangdong one of the most wired provinces in China. Unfortunately, we have not been able to update our study of Internet diffusion in Guangdong which was done in 1998. By the year 2000, the dimensions of Internet diffusion for China as a whole approached the dimensions of Internet diffusion in 1998 in Guangdong.

Importance for US Policy-makers

So far there have been no official talks between the US and PRC governments regarding their shared border in cyberspace.[7] There is no formal legal assistance agreement between the U.S. and China and no extraditions for cybercrimes have taken place.

The one area where there have been extensive negotiations is intellectual property. On security issues, much of the discussion has taken place between experts from academia in both countries. In addition, there have been many informal contacts between Chinese and US officials. Many of these contacts have occurred when Chinese officials have visited their counterparts in the US and when US officials have visited their counterparts in China.

It is essential that US business and political leaders understand the complexity of the balancing act that Chinese society is undergoing in order to avoid destabilization. Internet policy in China moves through a series of expansions and contractions. It is often referred to as "Two Steps Forward, One Step Back." In looking at the history of the Chinese Communist Party, one is aware of the magnitude of some of these contractions. Could the opening provided by the Internet be followed by a wave of repression as happened in the "100 Flowers bloom campaign" or during the Tiananmen Square demonstrations? Probably not, but it is essential for US political and business leaders to understand the delicate balance that has created China's unique Internet regime.

The Global Diffusion of the Internet Framework

The analytic framework used in this study was initially formulated *in The Global Diffusion of the Internet: An Initial Inductive Study*[8], based on a more general analytic framework developed in *The Information Technology Capability of Nations*[9]. Most broadly, the framework consists of *dimensions* and *determinants*. Dimensions are six variables, described below, that capture the state of the Internet within a country at a given point in time. Determinants reflect the factors that led to the observed state and will likely influence future development.

A useful analytic framework should be sufficiently rich that it captures well the multifaceted diversity of countries' experiences with the Internet. At the same time, the

number of variables should be small enough that they can be easily kept in mind. Each of the variables should describe an important, somewhat intuitive, and measurable feature of the presence of the Internet in a country. In a rough sense, the variables should form a complete set in that they collectively cover almost everything that might reasonably be of interest, and each variable should have something to offer to the overall picture that the others do not. Finally, for the framework to be useful, it must be feasible to measure the values of the variables given a modest investment of resources. If the analytic framework is based on variables that cannot be measured in practice, then its effectiveness is compromised.

The six dimensions of Internet Diffusion are shown in Table 2.

Dimension	*Description*
Pervasiveness	Number of users per capita
Geographic Dispersion	Physical dispersion of infrastructure and access; primarily a function of the fraction of first-tier political subdivisions (states, provinces, governorates, etc.) with Internet points of presence (POPs).
Sectoral Absorption	Extent of connectivity in four social sectors: Education, Commercial, Health, and Government.
Connectivity Infrastructure	Capacity of the technical infrastructure; primarily a function of the capacity of domestic and international backbones, and the types of access (e.g. modem vs. high-speed) available to users.
Organizational Infrastructure	Internet services market characteristics; a measure of the richness, robustness, and level of choice of the Internet service provision market.
Sophistication of Use	Integration, transformation, and innovation; a measure of the nature of Internet usage by a leading segment of the user community.

Table 2 Dimensions of the Diffusion of the Internet

The Internet within a particular country at a particular point in time may be assigned one of five levels along each dimension. A dimension/level approach was also employed by the United Nations Economic and Social Commission for Asia and the Pacific in its Technology Atlas Project[10]. Table 3 shows, as an example, the definition of the five levels for one dimension, Pervasiveness.

Level 0	*Non-existent*: The Internet does not exist in a viable form in this country. No computers with international IP connections are located within the country. There may be some Internet users in the country; however, they obtain a connection via an international telephone call to a foreign ISP.
Level 1	*Embryonic*: The ratio of users per capita is on the order of magnitude of less than one in a thousand (less than 0.1%).
Level 2	*Established*: The ratio of Internet users per capita is on the order of magnitude of at least one in a thousand (0.1% or greater).
Level 3	*Common*: The ratio of Internet users per capita is on the order of magnitude of at least one in a hundred (1% or greater).
Level 4	*Pervasive*: The Internet is pervasive. The ratio of Internet users per capita is on the order of magnitude of at least one in 10 (10% or greater).

Table 3 The Pervasiveness of the Internet

Table 3 illustrates distinctive features, common to all dimensions, of the levels. The levels should progress from less to more in an ordered way. Using an order of magnitude difference between levels has a number of advantages. First, it increases the probability that two observers looking at the same country at the same point in time are likely to come up with the same assignments of levels, in spite of the fact that data about the Internet is often rapidly changing, incomplete, and of variable credibility. Second, while the measure is fundamentally quantitative, there is a qualitative aspect to the levels. When a country progresses from one level to another, the change is substantial enough that one is likely to observe a significant change in the impact and use of the Internet on a country.

While the "state" of the Internet at a given point in time within a given country can be captured using the dimensions outlined above, it is perhaps more important to understand the factors that have caused the Internet to evolve to the state it has. Figure 1 shows the collection of top-level factors that most strongly shape the nature and extent of the Internet within a country. Government policies are identified separately as a determinant because of their importance and because government policies usually impact the dimensions only indirectly, by shaping other determinants. The arrows reflect the direction of influence between the independent variables (determinants) and the dependent variables (dimensions) used in this study. This is not to imply that other influences do not exist. For example, government policy makers may formulate policies in part as a reaction to the state of the Internet itself.

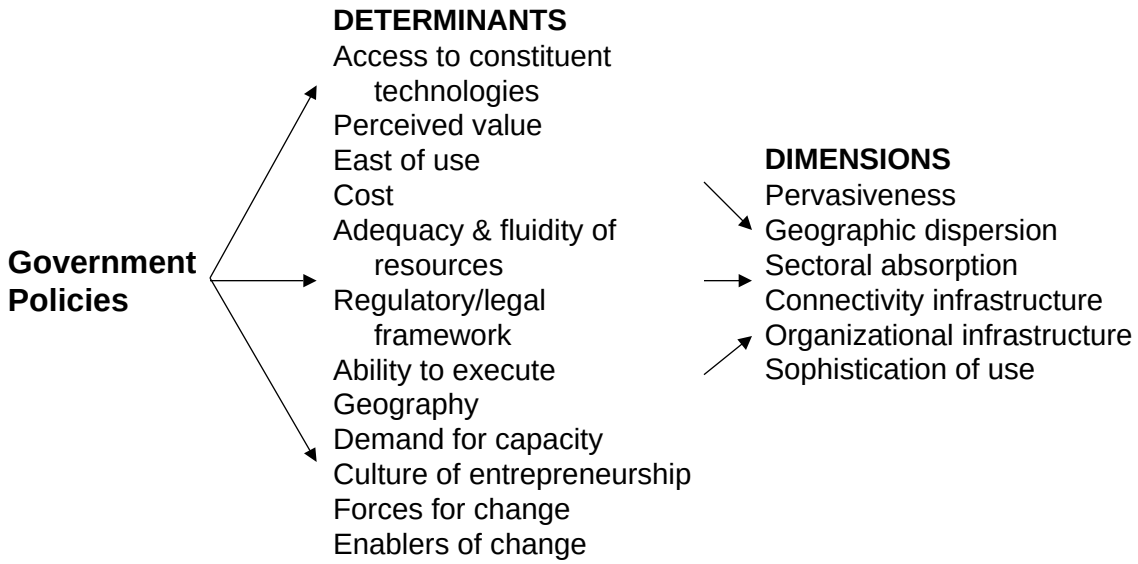


Figure 1 Determinants of Internet Diffusion

Not all determinants have a strong impact on all dimensions. For example, Pervasiveness is primarily a function of access to constituent technologies, perceived value, ease of use, and cost. If any of these factors is highly unfavorable, then individuals will not access the Internet, even if the other three factors are favorable. Identification of the subset of determinants most directly influencing particular dimensions can yield suggestions for policies that can promote (or hinder) development of that dimension. Consequently, Pervasiveness can be improved by:

- Improving access to the constituent technologies (basic telephone service, Internet services, personal computers and modems).
- Enhancing the perceived value of the Internet (often a social phenomenon, but one that may be enhanced by providing desirable content or other incentives for use).
- Making the Internet easier to use, e.g. by increasing local language content or improving literacy rates.
- Reducing the cost of access, e.g. through lower ISP subscription rates, reduced costs to ISPs by the telecommunications services providers, or increasing the average per capita income through overall improvement of the economy.

In summary, the analytic framework employed in the Global Diffusion of the Internet Project captures the state of the Internet within a country in a rich, multifaceted, yet relatively straight-forward way through the use of dimensions. The determinants provide insight into factors shaping the Internet's evolution. Together, the dimensions and determinants provide an analytic tool that is helpful for conducting longitudinal studies and multi-country comparisons, and formulating policy recommendations.

Informatization as a Key to Prosperity and Stability

> *The Chinese government views the diffusion of the Internet within its borders as part of the larger process of informatization. It is hoped that information technology will facilitate the decentralization of decision- making while providing mechanisms for the central government to maintain control over the direction of the economy.*

Ten years before China's first Internet connection, technocrats in academia and government were building support for the idea that information technology in general, and networks in particular, were essential to China's growth. Muller and Tan point to the attention that Alvin Toffler's book, *The Third Wave*, received in China during the mid-eighties.[11] Chinese intellectuals were fascinated with the concept that the world was entering a post-industrial state where value was created through flows of information. Some saw the possibility of China leapfrogging or at least catching up with the West by making investments in information technology. The term "informatization" has been widely used in China to refer to the process. It has been widely assumed that informatization was not only the next wave, but would bring prosperity with it. In fact numerous Chinese government studies have pointed to the robustness of the US economy as evidence that investments in information technology pay off.

China, as part of its commitment to economic growth since the late seventies, has rapidly rolled out the telephony infrastructure needed to support business. In the late eighties and early nineties, China made the development of a national data infrastructure a priority. It was based on the X.25 protocol. Information technology it was believed was essential for economic growth, but it was also believed to provide a way for the central government to manage that growth. As Lovelock has pointed out, many Chinese policymakers believe that information technology will allow the central government to decentralize decision-making to the provinces and the market while continuing to be able to control it centrally.[12] Decisions that in the past had been made through organizational hierarchies could now be made more efficiently through distributed organizations supported by information technology networks.

In 1993, the Chinese central government embarked on a series of Golden Projects to give the central government information on and control over the rapid decentralization of decision-making that was taking place as a result of the move to a market economy. The backbone for the Projects, the Golden Bridge, connected ministries and State-Owned Enterprises (SOEs) through an IP network and provided support for the other Golden Projects. Though the Golden Projects ultimately were dwarfed by the blossoming of the Internet in China, some MII officials today still point back to them.

As the Golden Projects were exploring the impact of networking technologies on government, China's academic community started participating in global networking. The CAnet (China Academic Network), established in 1987, is generally recognized as the first computer network in China. CAnet used an X.25 link to exchange information with the European Research Network. Two other early and entirely independent sources of Internet development were the China Research Network (CRnet) and the Institute for

High-Energy Physics (IHEP). In March 1993, IHEP set up a TCP/IP leased line to the Stanford Linear Accelerator Center that allowed it full access to the Internet.

As global interest in the Internet exploded in 1995 with the development of the World Wide Web, a wide variety of Internet projects began to bubble out of the Chinese academic, government, and commercial communities. Some of the academic networks began to sell “shell accounts” to commercial users and provide e-mail and Usenet connectivity to bulletin board operators. Many of these bulletin board operators were quickly evolving into full-fledged Internet Service Providers (ISP). At the same time, many government organizations created their own proposals to build national computer networks for internal use.

Though there would continue to be debates about the possibility and advisability of building networks in China that were cut off from the global Internet, China’s technocrats had embraced the Internet as an essential component of informatization.

Governing the Internet in China

> *The Chinese government through its Interconnecting Network regime has instituted a hierarchical order on what could be a distributed network of networks. At the top of the hierarchy are certain chosen state owned enterprises. China Telecom, once the monopoly telecommunications provider, now faces co-ordinated competition.*[13]

State Council

In 1995, with the Chinese Internet rapidly expanding in a decentralized manner, China leaders started discussing the Internet in earnest. China's leaders had to choose a range of options running anywhere from cutting China completely off from the Internet to allowing unrestricted growth. The Chinese State Council allowed the growth of the Internet, but imposed hierarchical controls on all the organizations involved with it. On February 1, 1996, the State Council issued Order No. 195, "Interim Regulations on International Interconnection of Computer Information Networks in the PRC," later modified on May 20, 1997.[14]

While China is slowly moving toward a market economy, most of the significant economic decisions are still made by government agencies. The history of the Internet in China must be explained mainly through the role these government ministries played and continue to play. In China, real political power is held by the Standing Committee of the Politburo (SCPB), usually consisting of the top five to seven leaders in China. The Party Politburo often decides strategic directions on political, economic and social issues such as economic reform plans, policies toward foreigners and even hi-tech development plans. It can be assumed that the Politboro was either formally or informally involved in the decision to actively embrace the Internet.

Although the national strategy is made by the Politburo, the tactical decisions and daily operations are left to China's State Council and its ministries. The State Council usually relies on the industrial ministries to formulate and carry out policies that the Council will then rubber stamp. In the event of conflict between ministries, the State Council will arbitrate. As the government decentralizes, individual provincial governments are beginning to have more and more influence over decisions. In the telecommunication field, almost all the provincial governments are seeking to expand their infrastructure. Local provincial telecommunication authorities are aligning with the provincial governments to attract foreign investment capital and technology. In so doing, they often circumvent the directives of the central government regarding foreign investment and architecture.

History of Conflict between MPT and MEI

Any attempt to understand the history of the Internet in China needs to take into account the competition between the Ministry of Posts and Telecommunications (MPT) and the Ministry of Electronics Industries (MEI). These were the two most powerful ministries in the information industry. The pivotal question was: "who would control

China's information superhighway of which the Internet was just the precursor?"[15] MPT, as the telecommunications monopoly, wanted to maintain control of the fast-growing and lucrative service market. MEI, a manufacturer of information-technology products, was a new player in providing services. Suffering from the onslaught of foreign and domestic competition, MEI was fighting to find a new revenue source in service provision. Traditionally, MPT had been slow and less motivated to respond to the demand for advanced services, delaying deployment of state-of-the-art technologies. By the 1990s, MPT had begun to adjust its strategy. Solid profits and growing demand enabled MPT to continue to upgrade the quality and expand the reach of its network. Up-to-date technologies such as fiber cable and satellite systems were integrated into its backbone networks.

MEI was a national base for research and development (R&D) and manufacturing of electronic components, computers and associated software, digital telecommunications systems and broadcasting equipment. MEI strongly supported deploying advanced technology and introducing competition into the service market in the interest of boosting demand for its products.

MPT's service sector was a regulated monopoly market, giving it protection from both domestic and foreign competition. This resulted in lucrative, guaranteed profits for its service operation. MEI, on the other hand, had to compete with both domestic and foreign players for MPT's business. Foreign equipment was preferred because of its higher quality, reliability and better after-sale service. MPT took advantage of its huge procurement budget to convince foreign suppliers to set up joint ventures with its equipment manufacturers, a key strategy to compete with MEI. MPT's manufacturers replaced MEI, becoming the dominant suppliers of most of China's telecommunications equipment markets. MPT gradually established itself as a solidly organized, cash-rich ministry, giving it the political and economic power to protect its interests while expanding its infrastructure.

MEI fought desperately to change its market position by relying on the solid political power gained through its broad IT technology base, personal ties with many top-level leaders, and its alliance with other ministries. MEI's ties to the leadership included President Jiang Zemin, who was MEI minister in the early 1980s.

As a result of the placement of former MEI executives, serious consideration was assured by China's inner circle of new MEI initiatives. In addition, the current MEI Minister, Mr. Hu Qili, had been a member of the Party Politburo in the late 1980s.

MEI and its allies launched a campaign to enter the basic telecommunications service sector. Led by Mr. Qili, MEI formed a consortium with the Ministry of Railways and the Ministry of Electric Power. By accusing the MPT of inefficiency, as evidenced by huge unmet demand and slow development of new services, MEI's consortium successfully convinced the State Council to introduce competition and liberalization. A second carrier, China Unicom was formed on July 19, 1994. China Unicom provided both local and long-distance services. Although this carrier had a long way to go in order to compete with MPT's national operation, Unicom had opened the door to providing telecommunications services.

The introduction of Unicom should not obscure the fact that China Telecom was by far the dominant telecommunications player and that the MPT was the dominant ministry in telecommunications

State Council's Steering Committee on National Information Infrastructure

The State Council set up a Steering Committee on National Information Infrastructure to coordinate Internet policy. According to the State Council's Notice on April 16, 1996, the Steering Committee was fully responsible for every major issue relevant to informatization in China. Its major responsibilities included:[16]

- Formulation of the policies, regulations and laws;
- Development of strategic plans of China's NII and monitoring the implementation;
- Coordination of the large and cross-ministry projects;
- Coordination of and power over major issues regarding China's Internet;
- Coordination of the technology R&D and developing standards related to China's NII; and
- Performance of other functions assigned by the State Council.

The Steering Committee was chaired by Vice-Premier, Zou Jiahua. The first deputy-chair was MEI's Minister, Mr. Hu Qili. Other deputy-chairs were:

- Wu Jichuan, minister of the MPT
- Liu Qibao, deputy general secretary of the State Council
- Zen Peiyan, deputy commissioner of the State Planning Commission
- Xu Penghang, deputy commissioner of the State Economic and Trade Commission
- Zhu Lilan, deputy commissioner of the State Science and Technology Commission
- Chen Yuan, deputy director of the People's Bank of China

Members of the Steering Committee consisted of high-ranking officers from all the ministries and agencies who had a stake in China's Internet. They were:

- Wei Yu, deputy commissioner of the State Education Commission (SEC)
- Lu Xinkui, deputy minister of the MEI
- Liu Shengzai, deputy minister of foreign trade (MOFTEC)
- He Dongcai, deputy minister of Broadcasting (MBMT)
- Liu Wenjie, deputy director of Customs
- Xiang Huachen, deputy director of Taxation
- Li Bin, deputy director of the State Council's News Office
- Lu Yongxang, deputy director of the Chinese Academy of Science (CAS)
- Li Zhuanshen, assistant minister of the Ministry of Public Security (MPS)
- Li Rui, deputy director of China's Technology Bureau
- Yun Banggen, director of the telecommunications division of the Peoples Liberation Army (PLA).

The Steering Committee and Key Internet-Related Issues

In keeping with the view that the Internet is a value-added service, the government freely chose to allow any domestic organization to run an ISP. Any interested domestic organization or firm could get a license to provide Internet services if they met the minimum requirements. However, by granting a limited number of government organizations the right to run Interconnecting Networks, the State Council kept tight control over international connectivity and established a hierarchy of responsibility.

The most challenging decision for the State Council was choosing who should run the limited number of Interconnecting Networks. As in many other nations, the research and educational community initially developed the Internet in China. The leadership saw the use of the Internet by these communities as enhancing China's future. In addition, research and educational communities tended to limit their services within their own community, therefore not posing a threat to the commercial interests of other ministries. Granting Interconnecting Network status to the education community's CERNET and research community's CSTNet was a logical decision few would debate, although there were some at the time who argued that the two networks should be consolidated into one.

Decisions on the commercial Interconnecting Networks were more complicated. MPT saw the Internet as a natural extension of its telecommunications services. Having been unsuccessful at becoming the only commercial Interconnecting Network, MPT had to settle for being one of two commercial Interconnect Networks. As a powerful player within the Steering Committee, MEI was in the position to have its affiliate be selected by arguing that information technology fell in MEI's domain. MEI was the only organization which launched Internet services after the State Council presented the Interim Regulations.

Other ministries at the time tried to to obtain the right to operate an Interconnecting Network and failed. They fall into two categories. One group had done some regional development of networks for their internal purposes as represented by the Ministry of Railways, the Ministry of Aerospace Industry and the People's Liberation Army (PLA). However, these organizations were turned down apparently because Internet provision is outside their traditional business operations. In the case of the PLA, there were additional concerns about the potential power of the PLA in relation to the ministries if it were to develop a successful national commercial Internet backbone.

The other group of government bodies such as the Ministry of Broadcasting (MBMT) and Xinhua had not been able to obtain Interconnecting Network status. They both lacked the resources to run a national network at that time. Furthermore, these ministries did not have enough political power to influence the decisions of the Steering Committee.

By establishing a hierarchy, the State Council prevented a multitude of government ministries from getting their own global Internet connectivity and becoming major players in their own right.

The Ministry of Information Industry

In March of 1998, the struggle between MPT and MEI ended. The National People's Congress (NPC) made a decision to create a new Ministry of Information

Industry (MII) by merging the MPT, MEI, and parts of MBMT, China Aerospace Industry Corporation (satellite communications), and China Aviation Industry Corporation (air traffic control frequencies).

Wu Jichuan, former Minister of MPT, was appointed as head of the new Ministry. Vice-Ministers and staff were chosen from both MPT and MEI.[17] According to its July 1998 mission statement, the State Council gave MII broad responsibility for planning and overseeing the development of China's electronics, telecommunications, and electronic information industries (see Appendix 3). It is responsible for setting up laws and regulations for each sector and for coordinating the informatization of the country. In regards to the Internet, MII was given specific control over domain names and IP addresses. MII was made responsible for the planning, construction and administration of private networks for the Communist party and other government ministries. The intention was to have one organization ultimately in charge of all networks. The Steering Committee was abolished and its functions absorbed by MII.

ChinaTelecom and the Question of the National Backbone

During 1997 – 1998, there was a great deal of discussion within China over whether multiple government organizations should be allowed to invest in building national physical layer data backbones to compete with China Telecom. Many believed that the government could not afford to invest in redundant architecture on a national scale. Competition should be encouraged at the periphery of the network, but long distance data traffic, it was argued, should utilize China Telecom's network such as its new Frame Relay service. There was a concern that too much competition would undermine China Telecom's ability to compete when foreign companies entered the market. There were others who argued that national security could best be assured if one company, China Telecom, was in control of the backbone. Of course, it was those in China Telecom and their allies in MII who most fervently raised the "security" issue.

Supporters of competition pointed to the example of ChinaGBN, which was affiliated with the old MEI. ChinaGBN uses VSAT for its national backbone but was still required to buy its international circuits through China Telecom. ChinaGBN carved out a niche serving government companies, but also was an alternative option for Internet Service Providers. Although it was difficult to assess the impact of ChinaGBN on China Telecom's ChinaNet service, most observers believed that competition and the threat of it has had its impact on China Telecom's investment, deployment, and service decisions. China Telecom might not have rolled out service as quickly and effectively if there had not been the threat that ChinaGBN would lock in new customers. ChinaGBN was seen as a highly effective tool for controlling China Telecom.

ChinaGBN had planned on developing its own fiber backbone. However, after the merger of MPT and MEI, there was some discussion among policymakers about ChinaGBN utilizing the fiber optic backbone of China Telecom and not building its own.

At the same time there developed an effort both inside and outside of MII, to increase competition in IP backbone services. These efforts picked up momentum and were debated in a number of telecommunications journals and discussed in political and legislative circles.[18] The concept of having competing backbones began to gain more currency in the State Council.

Let the Sons Compete

Unicom

By the spring of 1998, the State Council had approved Unicom, the second telecommunications network, as a national IP backbone with the ability to interconnect with the global Internet backbone.

Up to that point, Unicom had been primarily competing in the mobile telephony market. Its provincial arms attracted US $1.5 billion in foreign capital using the Chinese-Chinese-Foreign (CCF) mechanism. Under this arrangement, a foreign company would invest in a joint venture with a Chinese company with the joint venture then investing in Unicom. The MII ruled in 1998 that these arrangements were illegal, thus cutting off one source of funds for Unicom.

Some thought that with the absorption of MEI into MII, that Unicom was losing its sponsor and its political clout. However, MII reinvigorated Unicom by appointing MII vice-minister Yang Xianzhu to be Unicom's president and MII Director General for Planning Wang Zianzhou to be Unicom's general manager. This changed the power position between China Telecom and China Unicom.

MII authorized Unicom to participate in the Voice Over IP trials and to deploy IP telephony service in over 100 cities. Unicom has built an IP over ATM backbone—Uninet—to support both its Voice Over Internet offering and other IP services such as virtual private networks (VPNs). Unicom is deploying metropolitan fiber rings in over 240 cities that will be used to connect businesses and users directly to Uninet. According to MII, "China Telecom and China Unicom, the two telecom enterprises, will compete with each other according to new market regulations and rules of the game."[19]

Unicom is definitely under MII's control, and as such is a trusted son. In that capacity, it has the privilege of building a national IP network with global connectivity and can also be counted on to help control the volatile Internet. Unicom is also part of the government's strategy for controlling China Telecom. By creating an entity for China Telecom to chase after, many government leaders believe that they will see better, faster, and more efficient service from the former monopoly.

China Netcom

China Netcom (CNC) started out as the IP Network Model Project and was sponsored by the Chinese Academy of Science, the Shanghai government, the Ministry of Railways, and the State Administration of Radio, Film, and Television (SARFT). Each invested 300 million RMB in the project that links 15 cities on the east coast including Beijing, Shanghai, and Guangzhou.

The backbone takes a different technological strategy than used by China Telecom. By running the Internet Protocol directly on fiber (IP/DWDM) it saves the costs associated with running ATM equipment. Though IP/DWDM cannot provide the quality of service (QOS) guarantees associated with ATM, its advocates argue that they can provide enough bandwidth to make QOS less relevant. The 15-city backbone being built by China Netcom will be operating at 40 gigabytes per second.[20]

In the spring of 1999, Netcom received approval from the State Council through the State Development Planning Commission to build the network and connect it to the global Internet.[21] It was also authorized to participate in the Voice Over IP trials.

China Netcom has been set up from its managerial contracts on down to be the ideal "state owned" vehicle for foreign investment. China Netcom has already reported a profitable quarter and is set to go public on Nasdaq during the fall of 2000. China Netcom's board of directors include a number of well connected technocrats including Jiang Miaheng, who in addition to being the President's son is a former czar of the information industry in Shanghai. Jiang Miahang is now in a leadership position in the Chinese Academy of Science.

China Mobile Telecommunication Network

During 1999 China Telecom was divided into mobile and fixed-network companies. China Mobil Telecommunications on May 17, 2000 commenced operation of a backbone network linking Beijing, Shanghai, Guangzhou, Tianjin, Nanjing and Hangzhou capable of supporting IP telephone and Internet services in addition to traffic generated by mobile phones. The backbone supposedly has 465MBbps of international bandwith.

MII and SARFT and the convergence of cable with the Internet

Probably the greatest threat to China Telecom's bottleneck over the local loop comes from the possibility that China's 13,000 cable operators will start offering Internet service through their cable networks and will band together to form a national IP backbone and Interconnecting Network. Though this requires a significant upgrade of the cable infrastructure (perhaps only 10% of it will currently support two way traffic), a number of cities have started trials. There is also a significant conflict between the MII and the State Administration for Radio, Film and Television (SARFT). The State Council in the Fall of 1999 issued a directive that the cable networks could not be used to provide Internet and phone service. Shanghai, a leader in interactive cable, was exempted from the directive. There is much speculation as to how this pronouncement will be interpreted and how convergence will evolve in China. Though there are turf battles between SARFT and MII, there is also a concern on the part of China leaders of the impact of letting cable operators into the Internet before they are fully corporatized. In many cities, the cable operators are still part of the local government. These enterprises must first be spun off as state owned enterprises and consolidated into a state owned corporation under SARFT before they can be allowed into the Internet business. If these cable operators are let into the Internet and phone business before they are separated from the government, some people at MII believe they will never be controlled.[22]

Internet Content Providers

Given the dominance of China Telecom and the freedom offered to consumers by the Internet, many Internet providers have forgone providing connectivity in favor of

becoming a portal site or some other form of Internet Content Provider (ICP). Some of these portals such as Sina.com and Sohu.com have attracted significant foreign capital, thereby allowing them to grow their businesses.

In accepting foreign investment, these companies were choosing to operate in a gray area where the rules are ambiguous. The Chinese government had not spelled out what actually constituted an ICP and whether an ICP was a telecommunications provider. If ICPs were telecommunications providers, then the restrictions on foreign ownership applied.

MII Minister Wu caused a flurry of controversy in September 1999 when he pointed out to a *Financial Times* reporter that: "China's government still needs to strengthen its management over the information content business. So, whether or not it is an ICP or an ISP, it is about value added services. In China, the service area is not open." Asked what level of foreign investment was suitable in the local market, Wu told the *Financial Times*, "The current policy does not allow that. We will correct these irregularities."[23]

Some observers at the time saw Wu's comments as posturing around China's possible World Trade Organization (WTO) accession. Others believed that it reflected Wu's deep distrust of foreign investment. What it did point to was that a significant portion of the Internet business community in China was in a bind. On one hand, the US investment community, in hopes of securing access to China's market, were willing to take significant risks and invest money in these Chinese startups. On the other hand, no one knew what the legal status of the startups were.

Negotiating with the WTO

Telecommunications figured very prominently during the WTO talks of 1999. In the words of Jiang Zemin, "China is a developing country and its social productive forces have yet to be developed, so it can join the WTO only on terms for a developing country."[24] During negotiations, the US government pressed hard for China to open up both basic and value-added telecommunication services. The US was willing to accept "developing country" types of delays in implementing access to basic and value-added services.

In April of 1999, Premier Zhu Rongji came to Washington with a deal that included opening up the telecommunications sector. At that time, there was speculation that Rhongi had outmaneuvered Wu and his allies. There were even rumors at the time that Wu was going to resign. When President Clinton did not accept the offer and US-Chinese relations deteriorated in the wake of the bombing of the Chinese Embassy in Yugoslavia, Wu's position was strengthened and he remained Minister of MII.

Finally, on November 15, 1999, the US and China agreed to China's WTO accession. The US gave up its demand for majority (51%) ownership. The section of the agreement includes the following schedules for foreign equity in telecommunications services.

Value-Added and Paging

Upon accession: 30% -- Beijing, Guangzhou, and Shanghai

1 year:	49% -- Chengdu, Chongging, Dalian, Fuzhou, Hangzhou, Nanjing, Ningbo, Qingdqo, Shenyand, Shenzhen, Xiamen, Xi'an, Taiyun, and Wuhan Incuding Beijing, Guangzhou, and Shanghai.
2 years	50% -- throughout the country

Domestic and International Packet & Circuit Switching

3 years:	25% -- Beijing, Guanghzou, and Shanghai
5 years	35% -- Chengdu, Chongqing, Dalian, Fuzhou, Hangzhou, Nanjing, Ninbo, Qingdao, Shenyand, Shenzhen, Xiamen, Xi'an, Taiyuan, and Wuhan
6 years	49% -- Nationwide

The agreement left it somewhat ambiguous as to which categories ISPs, Interconnecting Networks, ICPs, and Internet Business Providers (IBPs) fell into. China only orally committed that ICPs would fall under the first category and ISPs under the last. US negotiators did not want a separate section on Internet services as they did not want to undermine the position embodied in the WTO telecommunication agreements that Internet service is a value-added service. MII Minister, Wu Jichuan has continued to voice his position that the International Telecommunications Union definitions of basic and value-added services will have to be "perfected".

Minister Wu has made it clear that all companies receiving foreign investment will still have to go through the Chinese government's licensing regime. "The government will strengthen its supervisory function over an opened telecom service industry and provide orderly competition in line with relevant rules."[25] As mentioned earlier, there are different licensing regimes for Interconnecting Networks and for regular ISPs. Interconnecting Networks require the approval of the State Council. ISPs need to be licensed by MII. What is not clear is, whether under the WTO accession agreement, did China commit to dismantling the Interconnecting Network regime and when. The US Trade Representatives office believes that the Chinese did make such a commitment. According to sources in the US Trade Representative's office, the provisions for Domestic and International Packet & Circuit Switching allow anyone to get global Internet connectivity without going through an Interconnecting Network. The big question is whether Minister Wu believes that the Chinese made such a commitment. The US Trade Representative acknowledges that they are going to have to push the Chinese every step of the way in terms of opening up the Internet to foreign investment.

For the Chinese government it is not just a matter of "ownership", it is a matter of control. Any organization in China that angers or threatens the Chinese government could lose its Internet connectivity. Firms that host their servers outside of China run the risk of having their IP addresses blocked by the government. In this new world of technology, having your Internet connectivity completely cut off, may be a death sentence for your business. The Chinese government is determined to have a say over who has a Web site in China and which Web sites are seen in China. Clearly, if ISPs are able to bypass the Interconnecting Network regime, there is a potential that the Chinese government will lose its ability to monitor Internet traffic and block certain websites.

It is rumored that the Chinese did make an oral commitment to a provision that telecommunications services can be provided through satellite transmission. Again, there

is a question as to whether IP traffic will have to run through a government controlled router before it is broadcast over an international satellite link.

Minister Wu announced in February of 2000 that the MII is currently formulating "Regulations for the Management of Foreign Investment in Telecommunication Services" and "Regulations for Internet and Information Security Management."[26] These regulations will provide important new guides on how the Chinese government plans to open up the telecommunications sector to foreign investment while still maintaining order and some degree of control over the Internet.

The US Trade Representative fought very hard for including ICPs under the WTO accession agreement. On one hand, from the Chinese perspective, ICPs as value-added services would not be as important to protect from foreign control as the basic telecommunications sector. On the other hand, the Chinese government had come to realize the power of ICPs as a new form of media. Since media has traditionally been under government ownership, this greatly complicated WTO negotiations. The fact that more than $200 million had already been invested in ICPs by foreign firms made the stakes even higher.

Minister Wu made it clear that firms that had illegally accepted foreign investments, such as Unicom or even ICPs, would have to rectify the situation as a precursor to the implementation of any new deals under the WTO agreement. He also said that China would require foreign investors to seek governmental approval before making any investments in the telecom sector. He believes that such a requirement is in keeping with the WTO agreement and is customary in many countries.

It is clear that the WTO agreement is only a framework, which will have to be negotiated through each step of its implementation. There will inevitably be conflict between MII's vision of "controlling" the telecommunications sectors and the WTO goals of opening it. There are a thousand ways to frustrate an agreement as a Beijing-based lawyer warned: "China will find itself in perpetual litigation in WTO dispute panels."[27]

It is important to emphasize the importance that China's leaders place on developing a legal and regulatory system before fully opening the telecommunications market to foreign investors. They are opening the market in stages starting with paging and some domestic VSAT. China is working out how to how to harness market forces and foreign capital and still ensure that telecommunications are kept in order.

Voice Over IP: Can the bureaucracy keep up with convergence?

Once the Internet was available in China, it did not take long for some individuals to start using Voice Over IP to dramatically cut back the costs of phone service to foreign countries. A number of enterprising individuals even set up shop and allowed customers to use their Internet phone service. Two brothers in Fujian were arrested for running a flourishing Voice Over IP business. However, much to MII's consternation, the Fuzhou Intermediate People's Court issued a decision in January 1999 that found the two brothers had broken no law in operating their own Voice Over IP business.[28]

The MII responded that it was illegal to operate an IP phone company without its approval. Zhang Chunjiang, Director of MII Telecommunications Advisory Bureau announced that the Ministry would crack down harshly on IP phone companies that are

"tantamount to information smuggling by bypassing government supervisors in our country."[29]

During the Spring of 1999, MII worked with China Telecom, Unicom and later China Netcom to roll out a trial of Voice Over IP services. MII managed the selection of equipment and partners to support the rollout. China Telecom, Unicom, and Netcom were all instructed to pick different vendors. In addition, MII required that the different vendors prove that their equipment operated with that of other vendors. In doing so, MII is positioning itself as a major player in the Voice Over IP standards game. At the same time, it has used its position of power to ensure that Voice Over IP gateway products are going to be manufactured in China and rapidly integrated into its networks.

Class One and Class Two: The new telecommunications regulations

Though the State Council was expected to approve the long awaited telecommunications regulations during the summer of 2000, by August of 2000 the regulations had still not been issued. These regulations divide telecommunication services into Class One and Class Two services. Class One services are provided using networks that are owned by the provider. Class Two services are provided by organizations who utilize someone else's network to provide the service.

Internet and multimedia services are designated as Class One services, though information services and other relevant services provided via the Internet are Class Two services.

A major difference between Class One and Class Two licenses is that a Class One licensee must have the State as a controlling shareholder. Organizations holding either license must be legally established and have the capital and staff to offer long term service.

Class Two licenses can be authorized by the local telecommunications office in the area where the service is being offered. The number and business scope of Class One telecom service providers are determined by the State Council's telecom authority. This authority is also responsible for approving and licensing all Class One telecom services. The draft regulations refer to the decision-maker as the "State Council's telecom authority." Though MII is the designated authority, the State Council has given itself the leeway of changing bodies if it needs to.

The draft regulations do not mention whether the Class One license supersedes the need for an Interconnecting network license or whether Internet Service Providers with a Class One license need separate permission to interconnect with the global Internet.

What is important here is that the Chinese government is implementing a hierarchical order on its telecommunications infrastructure. Class Two networks are dependent on Class One networks for physical connectivity. There will be competition between Class One networks, but enterprises running Class One networks must be controlled by the State and must have approval from the State Council's telecommunication authority. It is a hierarchy, but it is a hierarchy with competition built into it. No one enterprise has a chokehold on the hierarchy. MII, as the State Council's telecommunication authority, has responsibility for keep the telecommunication sector orderly.

Securing the Internet

There are a number of different concerns embodied in the Chinese concept of security. There is the deeply held belief that State security requires the Party and the State to control certain information and that government and commercial networks must be protected from hacking, computer crime and foreign espionage. In addition, many governmental bodies are are worried about how the Internet will impact their political and economic power, and want to ensure that organizations associated with them get their share of any economic benefits that come with the Internet.

Encryption

Perhaps the encryption issue best illustrates the interaction of the many different concerns that the Chinese government has over security issues. Encryption is essential to effective electronic commerce. If encryption is to enable international electronic commerce, then encryption used in China must interoperate with software used outside of China. For the past couple of years, China has had rules on the importation of encryption software but most of the rules were confidential. Companies implementing various e-commerce solutions embodying encryption once again were often operating in a gray area where there were no public regulations to protect them. This is not to say they didn't have tacit support from government officials in at least certain ministries.

There has been significant debate between the MII, the Ministry of Public Security (MPS) and the Ministry of State Security (MSS) over what China's official security policy should be. In October of 1999, a State Council directive was published giving power over encryption to the National Commission on Encryption Code Regulations (NECR). The NECR is thought to report to the Ministry of State Security and the State Bureau of Secrecy.

Under the original regulations only NECR-approved encryption products could be used by work units and individuals. This generated a great deal of concern. Many software and communications products including Windows 2000 have encryption embedded in them. It was feared that foreign software and hardware manufacturers would be required to use encryption software developed in China under the guidance of NECR. While MII has been concerned that these regulations could stifle e-commerce in China, the regulations were driven by a number of security issues. Certain encryption schemes could be vulnerable to attack by foreign intelligence operations. Also MSS and MPS may have requirements to break encryption schemes in their effort to keep track of criminal and anti-State behavior.

There is general agreement, however, that the regulations are also an attempt by the MSS to not only expand its bureaucracy and mission, but to help the organizations in China that can develop encryption software and commercially exploit it. Many of these organizations are either owned by the MSS or have ties to it. Though this is not to say that MSS does not have legitimate security concerns, it is important to see how they are

intertwined with both bureaucratic power and economic interests. While the regulations could be interpreted in multiple ways, some observers speculate that they are not aimed at browser software but at cashing in on the lucrative B2B market.

These regulations are also the result of the interplay of organizations as they seek to establish how certification of public keys should be accomplished and what organization will ultimately control it. The People's Bank has taken the lead on Certificate Authorities. These Certificate Authorities involve encryption. Because encryption is under the control of the NECR and the MSS, it means that the MSS will have a choke hold on one of the few hierarchies that is being imposed on the Internet.

Foreign companies lobbied heavily against the parts of the regulations that could be interpreted as requiring the use of Chinese-authored encryption in all foreign products including Microsoft Windows, Cisco Routers, and GSM mobile telephones. In a four point circular dated March 2000, the NECR said that only a certain type of highly specialized encryption product, known as a "black box," must be designed in China. "Other things, including wireless telephones, Windows software, browser software and so on are not included in the scope," according to the circular.[30] The circular also confirmed that China will not introduce a "key escrow" system in which encryption keys must be stored by a government-approved third party. "Foreign businesses do not need to be worried about this point."[31]

Some sources have told the *Wall Street Journal* that MII did not receive advance warning of the October 1999 encryption regulations.[32] The controversy that resulted is seen by some as an indication that Chinese leaders need to better coordinate their Internet policies. This incident encouraged the revival of the Leading Group on Informatization. The *Wall Street Journal* speculates that "it is possible that the Ministry of State Security, working with other secretive government and Communist Party groups, issued the regulations to ensure that more high-profile parts of the government will consult with them on Internet security."[33]

The Leading Group on Informatization has been revitalized in the wake of the encryption regulation debacle in an attempt to improve intergovernmental coordination. Vice Premier Wu Bangguo is the group leader and MII Minister Wu is the executive Vice Group leader.

Information Control

The Chinese Communist Party (CCP) has traditionally seen the mass media as its mouthpiece and a tool for communicating with the people. A whole network of control mechanisms have developed over the past half century in both the CCP and the government in an effort to ensure that the media supports the State and Party. Policies regarding control of the media ultimately comes from the Politburo of the CCP. Ding Guangen, the head of the CCP's Publicity (Propaganda) Department, directly oversees the operation of all CCP and government organizations involved in the production and control of the media. Once a policy is made at a regular Politburo meeting, the CCP's Publicity Department issues a document with guidelines on how to handle sensitive issues such as the Tiananmen Square incident or the Falun Gong movement. In recent years, the general guideline states that "stability is the topmost priority".

The CCP's Propaganda Department is connected with a number of organizations in the government. The State Council's Information Office has played a prominent role

in issuing guidelines on the use of the Internet. The Ministry of State Security, in its goal of protecting the nation's security, is closely aligned with the Propaganda Department. The Ministry of Public Security (MPS) and its Bureau of Public Security have been responsible for enforcing the laws about the use of the Internet. Together, these forces of conservatism have struggled against those in the government who have a vested interest in seeing the Internet expand as rapidly as possible.

There are several think tanks that provide information and advice for the CCP and government leaders regarding the control of information issues associated with the Internet. These include the Chinese Academy of Social Science, the Chinese Strategy Research Institute, the Chinese Institute of Contemporary International Relations (CICIR), the Information Institute, and the Institute of International Studies as well as elite universities such as Peking, Tsinghua, and Fudan. The National People's Congress has also taken an active role in discussing the need for laws dealing with media control in general and the Internet in particular.

The national media is a very powerful vested interest in China and it was not unaware of the potential competition from the Internet. Very few guessed how rapidly it would spread and how much money the Western investment community would be willing to throw at China. Few realized how the Internet provided ways of circumventing the normal mechanisms that the Chinese government has put up to prevent foreign ownership and control of telecommunications and media.

The Internet has the advantage of speed, content and accessibility over newspaper, radio, and television. But more importantly, instead of selectively feeding the user information, it allows the user to find the information he or she wants from all over the world. It provides an opportunity to get not just the information that the government wants the user to receive, but information that is truly interesting and potentially valuable. The Internet potentially revolutionizes the whole meaning of the word media. It provides an opportunity to connect with all sorts of other individuals and organizations without the need for the approval of the work unit, State or Party.

In China, portals such as Sohu.com, Sina.com, Netease.com, and a significant number of others began to receive millions of hits as they began to offer search engines, chatrooms and, most importantly, news to the Chinese Internet users. Most of the portals are focused on entertainment and sports. This is content ideally suited for the Web, with its support for color graphics, hyperlinked texts, and rapid updates. The portals were getting some revenue from advertising, but were being fueled by foreign investments and by speculation of Initial Private Offerings (IPOs).

ICP News

In China, all newspaper publications are government owned. In the early days of the Chinese Internet, some sites such as Sina.com included dispatches from foreign agencies, including Agence France-Presse and Reuters.[34] But when the government told its own newspapers that they could not use text directly from foreign organizations, Sina.com stopped doing it as well. Since then, it primarily buys copy from the Chinese press and writes a few of its own dispatches. Even though the Dow Jones Company is a major shareholder in Sohu.com, the site offers only Dow Jones' business and financial

news, not its broader news service. In addition, the portals have been advised by the government not to provide links to foreign news sources.

The portals make sure that everything on their sites are suitable to the Chinese government. They walk a balancing act because news can draw readers to their site, but news has a risk as well.

According to the *People's Daily*, the Ministry of State Security issued a rule at the end of January 2000 stating that all organizations and individuals are forbidden from releasing, discussing or transferring secret state information on Web sites, bulletin boards, chatrooms, and through e-mail. The regulations require companies using the Internet to exchange information, to get a stamp of approval from the government before publishing previously unreleased information on the Web. Web sites were also required to undergo a security check. The regulations ask China's Internet service providers and related organizations to teach their users about secrecy and include secrecy clauses in their user contracts.

The portals have also been told to use only news that has been published in government-owned sources and not to use reporters. Though the use of reporters remains some what of a gray area, most of the portals and Web sites have been complying. So far most of the government-owned news sources have been allowing the portals to republish their material without reimbursement. However as some of the portals begin to cash in through IPOs, the government media want their cut.

Many of the major newspapers have developed their own online editions and *China Daily*, for example, is getting 6 million "hits" per month.[35] The government has committed to investing millions of RMB in the Web sites of the leading traditional media including *People's Daily, Xinhua News Agency, China Daily, China Radio International and the China Internet Information Center*. There have even been rumors that foreigners would be allowed to invest in some of these websites. .

Information has always been seen in China as not only something to be controlled, but as something valuable. Every local and provincial government has an information office that is responsible for the release of government information. These information offices have developed their own "portals" that are tied together by the national CEInet of the State Information Office. These information offices often not only provide information but broker business relationships. Since the early nineties all sorts of government organs have attempted to sell databases or offer subscription services. Now these organs are developing their own portals. Depending on how IPOs are doing on the stock market, some are dreaming about potential IPOs for themselves or for some spinoff. The boundaries between what is government information infrastructure and what is private is very fuzzy in China and will undoubtedly become more so.

During the year 2000, we are seeing a plethora of regulations developing as each Ministry tries to control and cash in on the part of the Internet that is its turf. This includes not only the rules on encryption, the use of reporters and the release of state secrets, but also rules on advertising and the sale of multimedia. Most regulations require some sort of registration with a branch of a particular Ministry. With a new regulation coming out every week as the government puts the Internet in order, it is not clear the degree to which the creation of all these regulations will stifle the development of ICP and Web sites.

What is clear is that individuals will not be allowed to develop successful Web sites in complete autonomy from the State. In fact, personal Web sites were banned in China as of May 1, 2000. A business in China is required to negotiate hundreds of relationships and regulations at the local, provincial and national level. When the US and China get down to hard bargaining over "fairness" issues in the information business, China will be able to point out hundreds of regulations that must be complied with in order to do "information" business in China. This is not to say that the sole reason for these regulations is to set the stage for WTO negotiations. The Central government in the interest of maintaining order must develop a regulatory environment to govern the rapidly emerging private sector.

What is unknown is whether the attempt to regulate "media" will have a detrimental effect on initiatives to mediate business. The reason China is embracing the Internet is the belief that it will yield significant benefits to the economy. As was witnessed in the loosening of the encryption regulations, China's leaders must walk a tightrope between allowing individual Ministries to over-regulate the Internet, and being unable to govern it. The fact that so many Ministries and government-owned enterprises have a stake in this new form of "mediation", makes this policy-making process all the more complex.

Given the complexity of this process, it is not surprising that many of the new Internet regulations are coming out of the State Council's information office as opposed to a particular ministry. During the Spring of 2000, the Internet Information Management Bureau was created under the State Council Information Office to guard against "false information," "misleading information," and "morally destructive" information on the Internet. The Bureau has taken the lead in developing a registration process for ICPs and is circulating regulations that will allow ICPs to hire reporters.

Chatrooms

Chatrooms have been very popular in China and allow individuals to interact and express their opinions. They are an interesting form of mediation as they allow groups of individuals to communicate in virtual space. It is almost impossible to predict what will happen in them. The government does monitor chat sites and most of the portals that run chat sites have a monitor on hand who is prepared to delete any comments that stray too far. There was an immense amount of discussion of the US bombing of the Chinese embassy in Belgrade in 1999. Later in June, the government and the ICPs were very sensitive around the anniversary of the Tiananmen Square incident. In fact, Sohu temporarily closed its chat section.

The chatrooms can cloak a person's identity and things may be said that might not be said in other places. However, the Public Security Bureau, with the help of an ISP, can track down the user and the accessing phone number. Of course, users who participate in chat sessions from Internet Cafes are much more difficult to catch.

Web Site Blocking

China continues to block certain foreign Web sites, including those belonging to the *Washington Post* and *The New York Times*. The sites that are blocked change over time and there are no explicit regulations on what sites might be filtered. The decision to

block is done collectively by the MPS, MII, and the Propaganda Department. Since the blocking takes place on the router of the Interconnecting Network, reports that different networks are blocking different sites are plausible.

It is important to recognize that it is relatively easy to access a blocked site from within China by using a proxy server located outside of China.

Prosecutions

Lin Hai

The Chinese government has begun to enforce its December 1997 regulations that forbid the use of the Internet to "harm national security, disclose state secrets, harm the interests of the State, of society or of a group, the legal rights of citizens, or to take part in criminal activities."[36] During the summer of 1998, the MPS arrested Lin Hai, a thirty year old owner of a Internet job search marketing company. He had been caught providing 30,000 Chinese e-mail addresses to VIP Reference (*Dacankao)*, a U.S.-based Internet democracy magazine.[37] Supposedly, the e-mail addresses were collected for advertising purposes, but were passed on to the magazine when they did not generate as much interest as expected. Though the prosecutor rejected the case for lack of evidence, the MPS continued to hold Lin Hai.[38]

On January 20, 1999, the Shanghai No. 1 Intermediate Court convicted him for "inciting the subversion of state sovereignty". The verdict included a 2-year jail sentence, a US $1,200 fine and the confiscation of "the tool of his crime" – two desktop computers, one laptop, one modem, and a telephone.[39]

There has been speculation that the conviction of Lin Hai is the result of the frustration that government officials feel at their inability to stop the torrent of anti-government propaganda that is coming into the country and into their own e-mail boxes. These foreign-based e-magazines are sent from different e-mail addresses each week and are very difficult to filter. The government did, however, filter e-mail sent from China to the e-mail address of VIP Reference and caught Lin Hai in the process. The two-year sentence, though stiff for selling e-mail addresses, is somewhat lenient given his conviction on the "subversion" charge, which is one of the most serious crimes in China.

Tunnel

The publishers of *Tunnel*, a weekly on-line magazine were also arrested by MPS. *Tunnel* was originally written in China and features dissident writings.[40] The publishers, based in Jiangxi province, had attempted to hide their tracks by sending the newsletter to a server in California where it was electronically distributed back into China. They had electronically published more than 20 editions of the magazine before they were caught.[41] Despite the arrests, *Tunnel* is still being published and sent to subscribers in China.

Falun Gong

The Falun Gong religious movement has used e-mail and the Web to organize and disseminate information. When Falun Gong organized a mass demonstration in Beijing to protest mistreatment, e-mail was used to organize the event. When the government

cracked down on the movement, some Falun Gong supporters continued to use e-mail to report on the government's activities and to organize a clandestine meeting with the press.

The government, as part of its efforts to curtail Falun Gong's efforts, shut down all Web sites with information on Falun Gong and jammed the e-mail accounts of some followers. At least one Falun Gong adherent was directly charged with using e-mail to subvert the government.

According to AP and Wired News, hackers attacked Falun Gong Web sites in the United States from Internet addresses that seemed to trace back to Chinese government offices of the Chinese MPS's Internet Monitoring Bureau.[42]

There is a long tradition in China of meting out harsh punishment as an example to others. The Lin Hai and Falun Gong cases represent warnings about the dangers of using the Internet to mobilize support against the government.

National Security

There are a number of areas where the Chinese government may be concerned about threats to national security from the Internet. National infrastructure could be at risk by hackers or even hostile governments. The Internet could serve as an incubator for dissent, resulting in political forces that might topple the government or splinter the country. A further concern is the possibility that applications could be developed on the Internet that weaken the PRC's control of its currency.

It is important to note that encryption has an impact on all three vulnerabilities. Robust encryption is a requirement for protecting national infrastructure, but it can be used to protect those who want to avoid government scrutiny. Finally, encryption is an essential component of any digital currency and can potentially be utilized to circumvent Chinese currency controls.

National security concerns were also involved in discussions over whether China Telecom should operate one physical national backbone or whether there should be competitive service providers. Since one avenue of PRC control of the Internet is through access to the backbone, the Interconnecting Networks, by being gatekeepers, provide both access for customers and protection for the government. There are many in the government who are distrustful of having China's core telecommunications controlled by foreigners, because it is not clear that foreigners will play a similar role. By keeping China Telecom in a dominant position, the State is assured that it can control and monitor access. Now that JiTong, Unicom, and China Netcom have been given permission to run backbones, they too will be expected to safeguard the national interest.

There is a lot of discussion within China about the potential vulnerabilities of using foreign equipment in their telecommunications infrastructure. There is concern that there may be back doors into equipment that foreign governments, particularly the American government, know about and could potentially exploit to monitor and even disable China's telecommunications infrastructure. Despite these national security concerns, China's network operators prefer the reliability and flexibility of Cisco equipment to any homegrown alternative.

One respected observer notes that there is greater concern about viruses and who controls the money spigot than about national security. "National security" is mostly an

argument made by the people with power in MII and China Telecom in order to scare their somewhat unsophisticated bosses into issuing tough edicts.[43] According to this line of reasoning, few of them care seriously about national security, assuming that it is either a red herring or someone else's problem. The concern about national security has probably heightened over the past couple years, but those who voice security concerns often also have an economic or bureaucratic motive.

It is difficult to say whether the closing of the CCF loophole for foreign funding was due to national security concerns, an effort by China Telecom to protect its monopoly, or a requirement by MOFTEC that had to be met before Unicom could have an IPO. The answer is, of course, that all three are true.

National and organizational interests are also behind efforts to develop Red Flag Unix in competition with Microsoft's Windows 2000. National security concerns are interwoven with attempts to cut costs, develop domestic industry, and build organizational power and influence.

Cultural Security and Preservation

There is wariness among some leaders about integrating the Internet into China. It is feared that massive exposure to Western culture and language will undermine China's culture and language, particularly among its youth. Certain individuals and organizations have espoused building a China Intranet of Chinese content. The "169" Multimedia network is an outgrowth of this idea and provides low cost access to Web sites only in China. Some factions advocate that a China-only Internet service should not only be an option but that it should be the only Internet service available to those outside of government and academia. So far these conservatives have had to be satisfied with the "169" service, which in most provinces even now has an international option.

It can be assumed that one of the reasons that the government has supported the development of the ICP industry is because it is a major producer of Chinese language content.

Computer Crime

Since the beginning of the 1990's, the number of computer crimes has risen dramatically. According to the *People's Daily*, the CCP's official voice, hacker crime in China is increasing at an annual rate of 30%.[44] There were a total of 180 cases of computer crime handled by the police as of 1999.[45] However, according to an official with the Ministry of Public Security (MPS), only 15% of all hacker attempts are accounted for, either because little actual physical harm was done or the victim wanted to minimize damage to their image.[46]

China has a severe shortage of computer security specialists and computer security products.[47] Zhao Zhangsheng, a computer security expert with the Chinese Academy of Social Sciences, has stated that China's information technology is still at "a nascent stage," and that even when firewalls are used, there are many holes left for hackers to enter.[48]

The MPS has engaged in tiger attacks against a variety of banking, government and public networks and found most systems vulnerable to attack.

Foreign hackers have repeatedly attacked China's systems. After assaulting two of China's official Web sites, Bronc Buster, an international hacktivist, sent a public e-mail saying "Your security is a total joke, it would be extremely easy for anyone with the needed resources to totally take down the entire Internet in China. These sites had some of the poorest security I've ever seen for a system run by a powerful world government ... The hacking part took less than two minutes, we spent more time laughing than we did hacking."[49]

As in other parts of the world, there has been a substantial amount of theft involving the Internet. Some of the reports of computer crime in the press include:

- The first computer crime reportedly happened in July 1986 in South China's Shenzhen where a computer thief at a local bank embezzled more than 50,500 RMB (US $6,020) by modifying software programs.[50]

- In 1987, an accountant at a local branch of the China Agriculture Bank in Southwest China's Chengdu was found to have embezzled about 1 million RMB (US $120,000) by forging invoices in the computerized account system.[51]

- In April 1998, a post-secondary graduate hacker stole insider stock information from a Shanghai brokerage house's system to help his friend who had lost money in stocks.[52]

- In late July 1998, the Intranet of a paging service center in Balian in northeastern China was paralyzed for an hour. Later, police found that the system had been modified by a "time bomb" that was planted in the network.[53]

- In January 1999, fifty-one people were arrested on charges of hacking into a Chinese railway's computer system The scheme involved buying cheap tickets and reselling them after breaking into the reservation computer,

upgrading them to more expensive express trains. The scheme involved over 8,000 tickets worth US $54,000.[54]

- The banking sector has had over 21 million RMB (2.5M$) embezzled.[55]

Outlook Weekly, an official journal in the PRC, at the beginning of 1999 published an article warning that "cybercrime in China has reached such a serious level that it has damaged the normal economic order and threatens national security."[56] In calling for legislation to address information security, Zhang Lansheng, a Shanghai deputy to the National People's Congress (NPC), stated that insecurity of information has become the leading problem plaguing e-business in China.[57] Speaking to state and military security departments in 1998, China's President Jiang Zemin stated explicitly that China's current security methods have been too backward to cope with the technology. He also demanded that state and military security departments set up a task force to look at the management of computer information networks.[58]

Legislation and Regulations

In March 1997, the NPC amended the country's criminal code with three articles that included computer hacking and fraud as serious crimes.[59]

> **Article 285**: Whoever violates state regulations and intrudes into computer systems with information concerning state affairs, construction of defense facilities, and sophisticated science and technology is to be sentenced to not more than three years of fixed-term imprisonment.
>
> **Article 286**: Whoever violates state regulations and deletes, alters, adds, and interferes in computer information systems, causing abnormal operations of the systems and grave consequences, is to be sentenced to not more than five years of fixed-term imprisonment or criminal detention; when the consequences are particularly serious, the sentence is to be not less than five years of fixed-term imprisonment.
>
> Whoever violates state regulations and deletes, alters, or adds the data or application programs installed in or processed and transmitted by computer systems, and causes grave consequences, is to be punished according to the preceeding paragraph.
>
> Whoever deliberately creates and propagates computer virus and other programs which sabotage the normal operation of the computer system and cause grave consequences is to be punished according to the first paragraph.
>
> **Article 287**: Whoever uses a computer for financial fraud, theft, corruption, misappropriation of public funds, stealing state secrets or other crimes is to be convicted and punished according to relevant regulations of this law.

On December 30, 1997, the Ministry of Public Security promulgated the "Regulations on the Security and Management of Computer Information Networks and

the Internet."[60] It is quite evident that the Steering Committee on National Information Infrastructure was actively involved in drafting regulations, approved by the State Council on December 11, 1997. The new regulations are a codification of existing practices. They build on the "The Regulations of Safety Protection for Computer Information Systems"[61] and "Notice on Strengthening the Management of Computer Information Network and Internet Registration Information," both of February 1996, and the "Temporary Regulations on Electronic Publishing" of March 1996.

The regulations state that the Internet can not be used to "harm national security, disclose state secrets, harm the interests of the State, of society or of a group, the legal rights of citizens, or to take part in criminal activities."[62] No unit or individual may use the Internet to create, replicate, retrieve, or transmit the following kinds of information:

- Inciting to resist or break the Constitution, or laws, or the implementations of administrative regulations.
- Inciting division of the country, harming national unification.
- Inciting hatred or discrimination among nationalities or harming the unity of the nationalities.
- Making falsehoods or distorting the truth, spreading rumors, destroying the order of society.
- Promoting feudal superstitions, sexually suggestive material, gambling, violence, murder.
- Terrorism or inciting others to criminal activity, openly insulting other people, or distorting the truth to slander people.
- Injuring the reputation of state organs.

By making it illegal to "transmit" any of the above, the ISPs and the Interconnecting Networks are responsible for the activities of their users. How actively they will be forced to monitor their users for illegal activities in order to protect themselves is not clear. On the other hand, Section Seven states that the freedom and privacy of network users is protected by law. Futher, it states that "…no unit or individual may, in violation of these regulations, use the Internet to violate the freedom and privacy of network users."[63]

What is clear is that ISPs and corporations connected to the Internet are expected to work as agents for the MPS. "Units and individuals engaged in Internet business must accept the security supervision, inspection, and guidance of the Public Security organizations. This includes providing to the Public Security organization information required to discover and properly handle incidents involving law violations and criminal activities involving computer information networks."[64] They are also responsible for providing information about violations of the criminal code.

For violations of these regulations, the Public Security organization has the option of providing a warning, confiscating illegal earnings, or assessing a fine of US $625 against individuals and US $1,875 to work units. For more serious offenses computer network access can be closed down for six months, and if necessary Public Security can suggest that the business operating license of the concerned unit be canceled along with its network registration.

The Interconnecting Networks are responsible for the ISPs they support; ISPs are responsible for their customers; and work units are responsible for their workers. The Chinese government has extended its social control mechanisms to the business and connectivity infrastructure of the Internet in a manner that does not threaten the economic benefits it may provide. In fact, the clause requiring the MPS to "protect the legal rights of Internet service providing units and individuals"[65] may be an effort to insure that an ISP can not lose its license and connectivity solely for competitive reasons.

The regulations do not specifically mention information service providers, but do use the catch-all term "Internet business." This provides MPS the authority to supervise all parts of the Internet without explicitly trampling on the domain of other Ministries.

The regulations of December 30, 1997 require connecting units and corporations to "assume responsibility for network security, protection and management and establish a thoroughly secure, protected, and well managed network." They are also required to carry out technical measures for network and information security.[66]

Institutions

The MPS set up the Computer Management and Supervision Office specifically to deal with crimes involving computers. The staff includes people skilled in computer and network administration and investigation. One hundred and fifty computer engineers were hired in Shanghai alone. Over 2000 people have been hired nationwide.

Ultimately, a situation has been set up where the Interconnecting Networks authorize and have responsibility for the networks and businesses that connect to them. Webmasters are required to get permission before they offer a new service or business on the Internet. In addition, Internet service providers are responsible for their customers and are required to make back-up tapes of all SMTP (e-mail) traffic that passes through their network. The ISP is required by the regulation to act as an agent of the MPS and must provide the MPS with any information that the MPS requests including the back-up tapes. Needless to say, these back-up tapes can become a management headache in their own right and some ISPs are known to not be maintaining them.

It is rumored that the MPS has made arrests only rarely because of information found through monitoring e-mail. Rather, the MPS has often discovered illegal activities through other sources, and made public claims that they located the guilty party through e-mail. It is also important to note that people who choose to use Web-based mail services hosted outside of China, such as Hotmail and Yahoo, circumvent the SMTP mail capture procedures and make it difficult for the MPS to access their e-mail accounts. So far, there have been no regulations against the use of Hotmail or Yahoo and many, particularly students, are using these services.

On July 25, 1998, the Chinese government established the China National Information Security Testing, Evaluation and Certification Center (CNISTEC) to conduct testing and evaluation on the quality and performance of security products. CNISTEC maintains close connections with MPS, MII, CAS and over 30 other governmental organizations.[67] In February 1999, the China National Accreditation Council for Product Certification Bodies and the China Quality and Technical Supervision Board certified that CNISTEC had met the criteria in ISO/IEC Guideline 65 as an accredited certification body. The CNISTEC currently certifies 11 categories of products:

- Access Control Products (firewalls, routers, proxy servers/gateways)
- Authentication Products
- Security Auditing Products
- Security Management Products
- Digital Signature Products
- Non-Repudiation Products
- Commercial Encryption Products
- TEMPEST Products
- Information System Security Products
- Information Security Services

In February of 1999, China established the State Information Security Appraisal and Identification Management Committee to coordinate the country's anti-cybercrime campaign. The Committee is under the direct control of the State Council. It is responsible for protecting confidential government and commercial information on the Internet, identifying any illegal net users, and defining the rights and responsibilities of ISP providers and Internet users.[68] Both the MII and the MPS are cooperating on this, though it is unclear whether the actual equipment testing takes place at MII facilities in Beijing or MPS facilities in Tianjin. Though the MSS is believed to be involved on the Management Committee, it also sponsors the National Commission on Encryption Code Regulation (NECR) which was discussed earlier. This commission claims to be the certification authority for regulation of research and development, production, distribution, sale, use and import/export of encryption products and technologies.

Prosperity

It is not clear how rapidly e-commerce will transform China, but it is clear that that the major area of growth is Business to Business (B2B) e-commerce. Business users are using the Internet in bottom-up efforts to communicate with customers and potential customers through e-mail and web pages. At the same time there are a number of top-down government initiatives to interconnect organizations and to provide the legal and financial infrastructure to support e-commerce. The transformation of Chinese business through e-commerce will depend on how these top-down and bottom-up initiatives interact.

The Chinese Communist Party (CCP) has undoubtedly taken significant risks in allowing the Internet. But it is a tough call as to whether China has seen the promised payback in terms of national prosperity. Chinese policy-makers often point to research, such as the Cisco-University of Texas study of the information economy, to show how America is reaping substantial economic gains from the Internet.[69] No such similar studies have been done in China. However, MII estimated that China's e-commerce Web sites had combined revenues of RMB 200 million (US $24.2 million), more than double that of 1998.[70] Other sources have reported estimates of $40 million for both Business to Business (B2B) and Business to Consumer (B2C) revenues for 1999.[71] Estimates for on-line shopping for 2000 range as high as RMB 800 million (US $96.7 million) and clearing over US $1 billion by 2002.[72] There are currently more than 600 on-line stores in China with more being added regularly.[73]

If we take the University of Texas methodology, the Chinese e-economy should be measured as a combination of the revenues from telecommunications infrastructure, combined with software, hardware and integration revenue, with B2B and B2C revenues. It is not clear whether on-line sales represent a contribution to the e-economy as a whole (has increased demand) or is simply a different way of buying something. Given the urgency of creating new jobs, it is essential to Chinese policy-makers that the Internet not only increase the efficiency of buying, but that it increase demand as well. Though B2C gets a great deal of attention, it is B2B electronic commerce that is expected to finance the Internet infrastructure and the national economy. If the Internet allows Chinese businesses to increase their exports while increasing the amount of value they provide, the Internet could have a phenomenal effect on the country. If Chinese manufacturers and exporters invest in information technology and Internet connectivity this will not only spur the growth of export industries, but will have ramifications throughout domestic industries as well. As domestic industries become more IT efficient, they will be able to compete with the foreign firms that are gradually entering the Chinese market under the WTO process.

B2B e-commerce is key to the vibrancy and success of the Internet in China. However, it is important to point out the barriers to e-commerce. Chinese are used to doing business on the basis of personal relationships. Given the complexities of working

under the State, individuals have had to depend on *guanxi* (connections) to get things done. In addition, neither the legal nor the physical infrastructures have existed nationwide to support settlements, delivery, and materials acquisition. Many of the "trusted" systems that businesses in the West have come to depend on, are only now being developed. Information technology definitely has a role in the development of settlement systems between banks, but there is also the need for a legal and contract infrastructure. Much debate about e-commerce in China hinges on the concept of "trust". In China, once people have developed a personal relationship there is a much greater capacity for trust. It is not clear to many Chinese whether you can buy something from someone you don't know and be sure that you are getting what you want. It is not surprising that cash-on-delivery is the preferential way of paying for goods purchased over the Web.

Chinese are highly conscious of the social relationships and networks in which they participate. It remains to be seen whether Internet technologies will strengthen and extend these social networks or whether the social networks will be a barrier to the absorption of information technology. Information has traditionally been shared within the context of social networks, hierarchical or otherwise. The information sharing and organizing made possible by distributed information technology creates a certain degree of discomfort on the part of those at both the top and even more so at the middle of hierarchies. In the words of Thomas Lam, the general manager for enterprise operations at Cisco China, "In China, the tendency is to protect information – everything is confidential -- but with the Internet it's just the opposite, you've got to share information to do your job." [74]

In China, labor is cheap. There is a lot less incentive to standardize and automate business processes than in the West, especially when the automation tools such as Enterprise Resource Planning (ERP) are inordinately expensive. One of the reasons that Electronic Document Interchange (EDI) has been so slow to diffuse in China is that many organizations were not sufficiently automated to gain efficiency from it.

It is important to point out that rudimentary forms of e-commerce have diffused very rapidly in China. Many businesses are using e-mail to conduct business. Even if the organizations do not have a dedicated connection to the Internet, they are able to place "brochureware" on a Web intermediary site and participate in Web brokerages. Many Chinese manufacturers are finding customers on the newly emerging B2B exchanges. Virtual China reported that 200 to 400 of the buyers and sellers on Chemconnect.com are from China.[75] During the year 2000, the number and the capabilities of B2B exchanges are exploding. It is possible that many Chinese manufacturers will be able to participate on the exchanges with a PC, a Web browser, and a modem. Once they receive the order they may be able to work it manually. This combination of automation and manual methods is known in the West as a "Betty" switch and may serve many Chinese manufacturers quite well.

Fewer Chinese manufacturers have been able to electronically integrate into the supply chains of Western manufacturers. It can be assumed that there are enormous competitive advantages to having this capability, but there are also the significant costs of automating one's business practices. A few researchers have noted a hidden risk that may be impeding full-scale automation. Due to the complexity and intricacy of dealing with multiple Ministries at the local, provincial and national level, many companies may

find it convenient not to have a completely transparent log of all transactions. This is a highly sensitive issue where it is very difficult to do research, yet it may be one of the most important challenges that the Chinese government needs to address if it wants its industry to be fully competitive on the global level.

There are significant differences in the adoption of information technology between state-owned enterprises (SOEs) and private enterprises. SOEs are much more likely to invest in information technology. The situation, however, has developed where many SOE's have multiple information systems that do not talk to each other. The government has announced plans to link the Ministries and SOE's, but it is not clear what level of data integration will be achievable.

The private or "cooperative" companies, in contrast, are much less likely to invest in costly information technology. However, they are keenly aware of all the hype about e-commerce and many are looking at ways to both develop solutions based on standards and freely available software. Given the rate at which open standards technologies such as XML are developing, it is anticipated that some of the most innovative work in inter-enterprise information systems will come out of Chinese private manufacturers who are linking to the supply chains or B2B exchanges of the global giants.

The adoption of B2B e-commerce in China both at an individual firm and at a national level depends on the interaction of top down (governmental) and bottom up (market) forces mediated by the interaction between Western and Chinese culture (see Figure 2). It may come as no surprise that some of the most innovative companies in e-commerce are led by Chinese who have been educated and been in the work force in the West and who then have returned to China. These leaders participate in two cultures and help to bridge them. Many have returned to China, because of the tremendous opportunity in connecting China to the global electronic economy. Many of these Western-educated Chinese have started as electronic middlemen. It is likely, however, the real leadership will come from manufacturers who have directly connected their firms both to Western consumers and manufacturers.

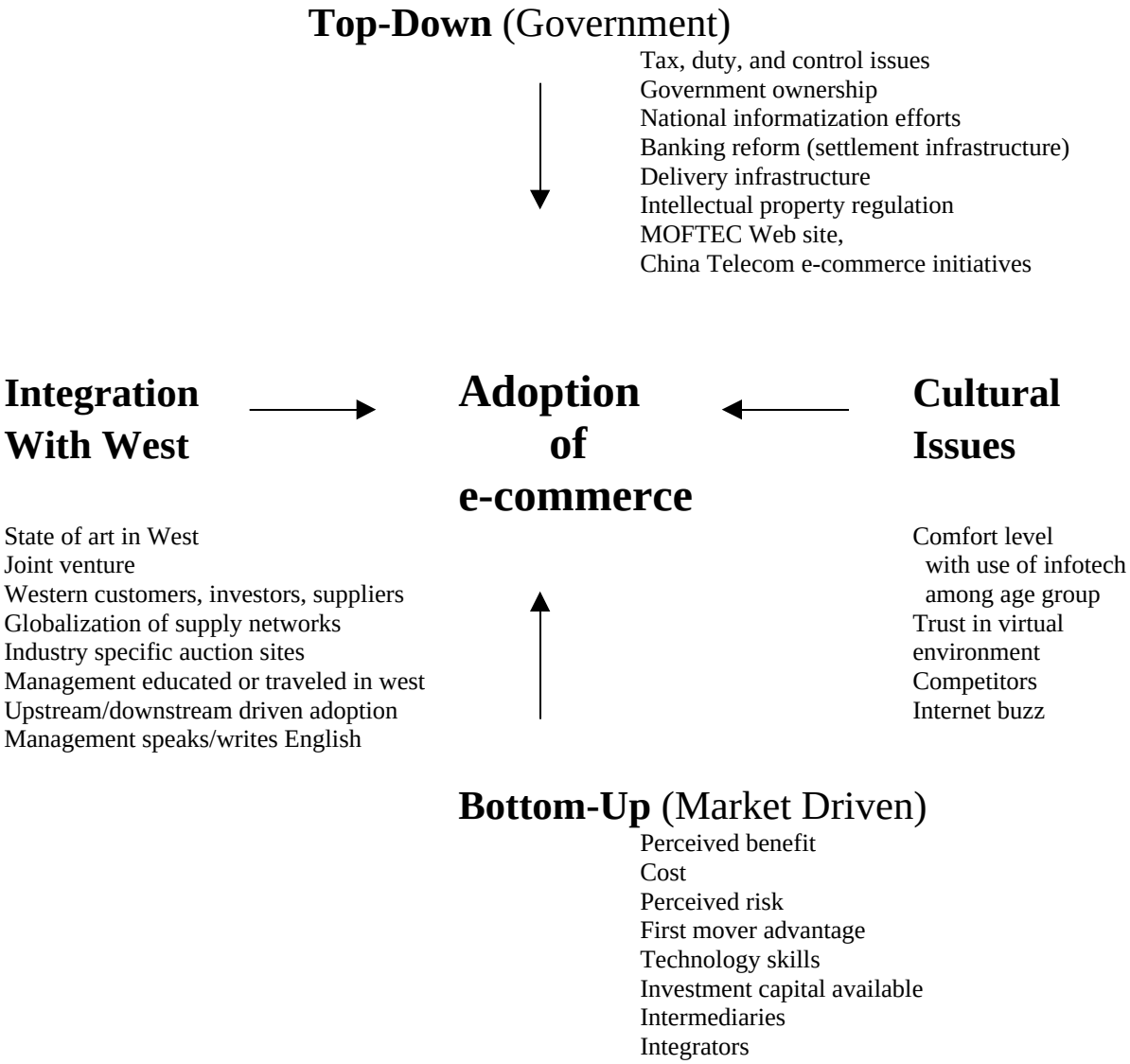


Figure 2: Factors Affecting Adoption of E-commerce in China

Dimensions of Internet Diffusion in China

> *By 1996 the Internet in China was definitely moving beyond the introductory stages of Internet diffusion. The educational sector was leading the way. By 1999, the public sector had begun rapidly integrating the Internet through the government on-line project. Businesses have access to Internet connectivity, but most have yet to transform their business processes to take advantage of it.*

In order to analyze China's Internet diffusion, this study takes advantage of the framework developed by the Global Diffusion of the Internet Project.[76] This framework allows us to organize the wealth of data about Internet diffusion in a way that makes it possible to conduct cross country and longitudnal comparisons. Under this framework, the Internet in any particular country can be analyzed according to six dimensions:

1. Pervasiveness
2. Geographic Dispersion
3. Organizational Infrastructure
4. Connectivity Infrastructure
5. Sectoral Dispersion
6. Sophistication of Use

Pervasiveness

By July 2000, there were 16.9 million Internet users according to China Internet Network Information Center (see Figure 3).[77] The number of Internet users has been more than doubling every year with the users growing by more than 400% last year.

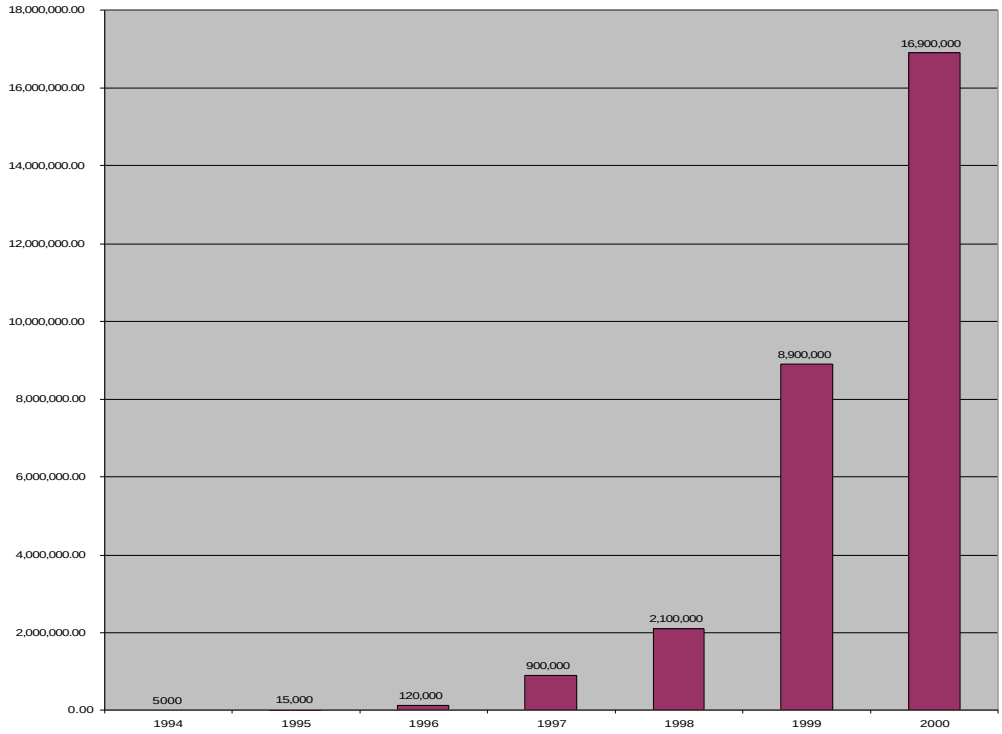


Figure 3: Internet Users in China

With China's population at 1.24 billion, 14 people per thousand have Internet access. In the year 2000 China moves to a Level 3 (**Established**) for Pervasiveness.

Table 4 Internet Pervasiveness in China	
Level 0	*Non-existent*: The Internet does not exist in a viable form in this country. No computers with international IP connections are located within the country. There may be some Internet users in the country; however, they obtain a connection via an international telephone call to a foreign ISP.
Level 1	*Embryonic*: The ratio of users per capita is on the order of magnitude of less than one in a thousand (less than 0.1%).
Level 2	*Nascent:* The ratio of Internet users per capita is on the order of magnitude of at least one in a thousand (0.1% or greater).
Level 3	Established: The ratio of Internet users per capita is on the order of magnitude of at least one in a hundred (1% or greater).
Level 4	*Common*: The ratio of Internet users per capita is on the order of magnitude of at least 1 in 10 (10% or greater).

CNNIC estimates that 2.58 million Internet users are connected through leased lines and the remainder connect using dial-in accounts.[78] There is a significant amount of account sharing among users. It is estimated that every account is shared by an average of eight people.

CNNIC estimates that 76% of users are between 18 and 30. Most have a Bachelors or Associate degree.[79]

Geographic Dispersion

Table 5 summarizes the characteristics of the Interconnecting Networks. By early 1996, ChinaNet had established access nodes in all of the provincial capitals. During 1997 and 1998, the provincial Post and Telecommunication Administrations (PTA) extended the Internet to other cities in the provinces. More than 360 cities have access to ChinaNet.

Table 5. Interconnecting Networks			
Interconnecting Networks	Routers	Networks/Cities Supported	Backbones
ChinaNet	Cisco	230 Cities	E-1 DDN, Frame Relay, higher speed circuits between network operation centers
ChinaGBN	Cisco	100 Networks/30 provincial nodes	E-1 VSAT from PanAmSat moving to ATM
Uninet	Cisco	149 nodes/ 129 cities; 250 cities by end of 2000	622 Mbps ATM, OC-3 to provinces
China Netcom	Cisco	Mainly eastern provinces;; 17 cities	IP/DWDM OC-48

China Mobile	?	100,000 dial-up users around country; 200,000 card users; 100 special-line customers; 450,000 e-mail users	IP
CERNET	Nortel/ Cisco	700 Universities; connect all universities by 2000.	OC-3/ OC-48
CSTNet	Cisco	200 Research Networks	E-1 DDN, Frame Relay, VSAT from Asia II

The Golden Bridge Network (ChinaGBN), which relies on the JiTong's national VSAT (very small aperture terminal) satellite communications backbone, provides Internet access in 24 cities at rates between 64 Kbps and E-1 (2.048 Mbps) using a PanAmSat space segment. ChinaGBN is also building a fiber network in the Eastern portion of the country. The China Netcom backbone also connects primarily major cities in the eastern provinces. Unicom's Uninet is providing Voice Over IP in over 129 cities.

The Ministry of Education's academic network, CERNET, is currently providing access to about 700 universities around the country. Based primarily on Cisco technology, CERNET upgraded its Cisco equipment in the fall of 1998 to support Layer 3 switching and Voice Over IP.[80] CAS's CSTNet has also interconnected several hundred research institutes which are distributed around China using 10 VSAT connections to the Asia II satellite as well as leased lines from China Telecom.

China has been at a Level 3 for Geographic Dispersion under the Global Diffusion of the Internet framework since 1997 (see Table 6). As the provincial arms of China Telecom build out their networks, and if they choose to provide access to the "163" and "169" networks at distance insensitive costs, China will deserve to be considered for a Level 4 ranking. However, in many rural areas, access to a dedicated connection to the Internet is still an impossibility, given the limitations in DDN deployment.

Table 6: Ranking Geographical Dispersion for China's Internet	
Level 0	*Non-existent*. The Internet does not exist in a viable form in this country. No computers with international IP connections are located within the country.
Level 1	*Single location*: Internet points-of-presence are confined to one major population center.
Level 2	*Moderately dispersed*: Internet points-of-presence are located in multiple first-tier political subdivisions of the country.
Level 3	*Highly dispersed*: Internet points-of-presence are located in at least 50% of the first-tier political subdivisions of the country.
Level 4	*Nationwide*: Internet points-of-presence are located in essentially all first-tier political sub-divisions of the country. Rural access is publicly and commonly available.

Sectoral Absorption

There are currently 180,000 enterprises registered under the *.com.cn* domain that is set aside for businesses. Although the majority of registered domains are in the .com sector, it is not true yet that the majority of businesses in China have domain names. The State Economic and Trade Commission estimates that half of China's 1500 medium to large state-owned businesses are utilizing the Internet for business. Many, however, are still using dial-in accounts and having others host their Web pages. The percentage of smaller firms that have leased lines or servers is even less.[81] Even so, by 2000 we

estimate that at least 10% of all business with over 100 people have a server or a server hosted remotely. As a result we upgrade the commercial sectoral ranking from **Minimal** to **Medium**.

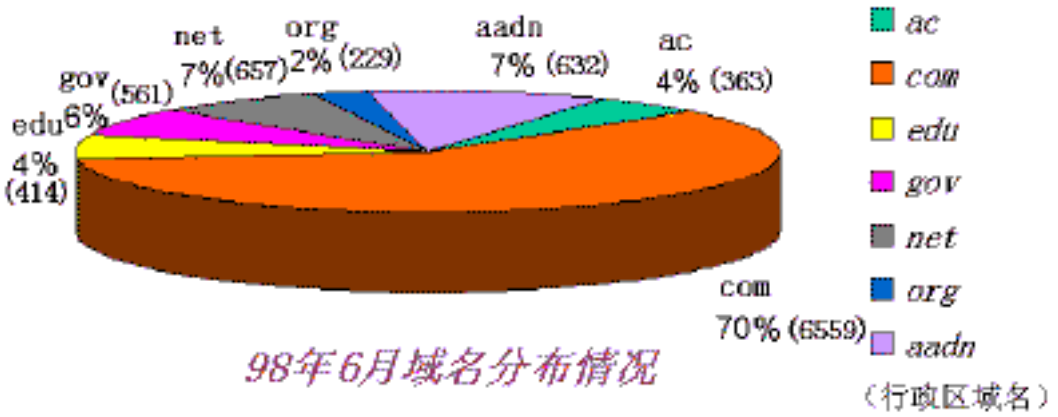


Figure 4. Distribution of Second-level Domains Under the *.cn* TLD, 6/98[82]

The academic sector, where 700 of a total of 1000 universities have leased line connectivity, has the highest penetration of all of China's sectors. Only a few primary and secondary schools have leased line connectivity, though some have dial-in accounts. Given the incredible strength of CERNET, under our framework, we rate the Academic sector at the **Medium** level.

Government agencies were initially slow to develop a Web presence. MII now has a Web site that explains their restructuring and CNNIC has an informative Web site. In addition, various government ministries and a few provincial and local governments have been involved in the development of sites oriented towards tourism and economic development. In 1999, the government embarked on a massive "government on-line" project. Through this project many ministries developed Web pages and the government can now be ranked at the **Medium** level for sectoral absorption.

Though there have been implementations of telemedicine and some hospitals have leased-line connectivity, the health sector is still at the **Minimal** level.

Table 7: Ranking Sectoral Absorption for the Internet in China

Sector	Minimal	Medium	Great Majority
Academic	>0-10% have leased-line Internet connectivity	10-90% have leased-line Internet connectivity	>90% have leased-line Internet connectivity
Commercial	>0-10% have Internet servers	10-90% have Internet servers	>90% have Internet servers
Health	>0-10% have leased-line Internet connectivity	10-90% have leased-line Internet connectivity	>90% have leased-line Internet connectivity
Public	>0-10% have Internet servers	10-90% have Internet servers	>90% have Internet servers

Table 8: Ranking Sectoral Absorption		
Sectoral point total	Absorption dimension rating	*Non-existent*
0	Level 0	*Rare*
1-3	Level 1	*Moderate*
4-6	Level 2	*Common*
7-9	Level 3	*Widely used*
10- 12	Level 4	

Under the Global Diffusion of the Internet framework, we assign sectors with a **Minimal** rating 1 point, sectors with a **Medium** rating 2 points, and a **Great Majority** rating 3 points. Under this system, China has a total of 7 points which moves it up to a Level 3 (**Common**) for Sectoral Absorption.

Connectivity Infrastructure

Backbone Infrastructure

China's data communication infrastructure is built using over 820,000 kilometers of fiber optic cable of which 150,000 km is used in nationwide trunk cables. All the trunk lines now use either 622Mbps or 2.4 Gbps synchronous digital hierarchy (SDH) technology, with potential capacity expansion available by adding wavelength-division multiplexing (WDM) technology. Eight 2.5 Gbps interprovincial trunks run north – south and eight run east – west. Provincial backbones are being installed. The fiber optic cable is supplemented with microwave and satellite. This infrastructure is primarily controlled by China Telecom though some other ministries such as Railways and the People's Liberation Army have substantial fiber in the ground.

On this fiber, China Telecom has developed its Digital Data Network (DDN) service using time division multiplexing (TDM). The DDN network is capable of supporting E-1 (2Mbs) speeds. There is also the X.25 network ChinaPAC that is still used to access the Internet in certain provinces and China Frame Relay which provides 45Mbps service to 21 provincial capitals. An ISDN network has also been deployed but has not met with much success. These networks are being replaced with an asynchronous transfer mode (ATM) network that is being deployed at the national level and in some of the more prosperous provinces. Though the ChinaNet service was originally built with E1 lines, China Telecom is upgrading the lines to 155 Mbs as part of the migration to ATM.

ISPs and Interconnecting Networks primarily use the ChinaDDN and China Frame Relay to provide direct circuits to their customers, to connect with upstream providers and to build their own internal backbones. China Telecom has not provided dark fiber to any other organization.

China Netcom is building its own high speed IP over DWDM infrastructure that can potentially offer gigabytes of backbone IP connectivity to major cities in the eastern

provinces. Unicom is building an ATM network linking 129 cities that can potentially offer 155 Mbps of backbone speed. The backbone of the Unicom network runs at 622 Mbps.

Thus, even though the core China Telecom network supports 155 Mbps and only to major provincial capitals, the aggregated bandwidth of the country is or will soon exceed 200 Mbps. China's backbone infrastructure is thus at the **Broad** level.

Exchanges

By June of 1997, the four Interconnecting Networks in China had interconnected using bilateral peering and upgraded their interconnections to E-1 speeds. In 1997, the Steering Committee on National Information Infrastructure announced its plan to set up three Internet exchanges in Beijing, Shanghai, and Guangzhou to facilitate interconnection between the four national Interconnecting Networks. The plan stalled due to not only technical, financial and coordination difficulties, but due to the restructuring of MII.

In March of 2000, it was announced that China Telecom, ChinaGBN, CERNET, CSTNet, Uninet China Mobile, China Great Wall Network (CGWNet) and China Netcom would exchange traffic over a broadband network. Another network affiliated with MOFTEC, the China International Electronic Transaction Network (CIETNET) has also been authorized to connect.

Because most of the sought-after Web servers in China are on China Telecom's network, any competing Interconnecting Networks that want to provide customers and ISPs with an alternative to China Telecom must find a cheap way of routing traffic to China Telecom without sacrificing quality. More importantly, networks such as China Netcom that are offering customers gigabyte speeds, route their traffic to websites on China Netcom at least OC-3 speeds. The development of a Chinese Network Access Point (NAP) is a significant step in the development of competitive market for backbone services.

Though CERNET had proposed running the NAP itself, it was ultimately decided that China Telecom would physically run it at their facilities. The NAP, however, is governed by a committee made up of representatives from each of the networks. The committee reports to MII.

ChinaNet has given each network a dark fiber connection to the NAP from each network's operation center. Each network operates a router at the NAP. The routers connect to the dual homed Gigabyte switches at OC-3, but the NAP is designed to be upgraded to much higher speeds if necessary. Currently, each of the networks exchange traffic on a bilateral peering basis.

MII has intentions of opening up 8 NAPs around the country starting with Shanghai and Guangzhou. How these two NAPs will interface with the existing exchanges being run by local authorities is not clear.

Access Methods

Most users (6,660,000 according to CNNIC) access the network through dial-in modems at speeds up to 56Kbs. There are trials of fiber to the building, DHL, cable access and other high speed access methods, but none of these have been fully implemented. Most leased lines support 64Kbs data rates, though some ISPs and large businesses have implemented speeds up to E1 (2 Mbps).

International Circuits

Only the nine authorized Interconnecting Networks can presently connect to the global Internet and then only through China Telecom's gateways. In 1997, the Chinese prices for the higher end international half-circuits were more than double the cost of the United States-to-China half-circuits (see Table 9). China Telecom's expensive rates for international half-circuits discourage competitors such as ChinaGBN and slow Internet expansion.

Table 9. Monthly International Circuit Prices (in US $)[83]

Bandwidth	64 Kbps	128 Kbps	256 Kbps	1 Mbps	2 Mbps
China half-circuit	$6,585	$10,600	$18,000	$49,000	$73,000
Foreign half-circuit	$6,585	$8,300	$9,900	$18,000	$22,000

As of January 2000, ChinaNet had the most international IP connectivity (see Table 10 a & b).

Table 10a: International IP Bandwidth (1/2000)

Interconnecting Network	**Bandwidth**
ChinaNet:	487 Mbps
ChinaGBN	67 Mbps
CSTNet	22 Mbps
Uninet	20 Mbps
CERNET	8 Mbps

Table 10b: International Bandwith between 1998 –12/2000[84]

Year	1998	1999	2000/6	12/2000
Capacity of International Connection	241 Mbs	351 Mbs	700 Mbs	1.5 Gbps

China Netcom is establishing 2 OC-3 international links during the summer of 2000. Though each of the Interconnecting Networks has significantly increased its bandwidth, ChinaNet has increased its overall share of the bandwidth.

Table 11: Ranking Connectivity Infrastructure for China's Internet

		Domestic backbone	**International Links**	**Internet Exchanges**	**Access Methods**
Level 0	*Non-existent*	None	None	None	None
Level 1	*Thin*	≤ 2 Mbps	<= 128 Kbps	None	Modem
Level 2	*Expanded*	>2 -- 200 Mbps	>128 Mbps -- 45 Mbps	1	Modem 64 Kbps DDN lines

Level 3	*Broad*	>200 Mbps -- 100 Gbps	>45 Mbps -- 10 Gbps	More than 1; Bilateral or Open	Modem > 64 Kbps leased lines
Level 4	*Extensive*	> 100 Gbps	> 10 Gbps	Many; Both Bilateral and Open	< 90% modem > 64 Kbps leased lines

China has the backbone and international connectivity profile of a Level 3 (**Broad**) country, but the exchange and access infrastructures are still immature. Again, we use a rating of Level 2.5 to connote this in-between status (see Table 11).

Western observers often note the poor responsiveness of the Chinese Internet. It is fine for sending e-mail using the SMTP protocol, but there are often delays associated with downloading Web pages. These delays can make it painful to visit sites with multiple links or to engage in Web surfing. Although some networks such as Sparkice have reasonably good response times, other networks are so slow as to make it very frustrating to utilize the Web. Additionally, most Chinese pay for Internet service on a per-hour basis plus local phone charges. This makes them reluctant to use the Web even though they will send and receive e-mail every day. The issues of speed and pricing create real barriers to the use of the Web.

Organizational Infrastructure

China's Internet networks are divided into two categories: Interconnecting Networks and Access Networks. The term "Interconnecting Networks" comes from a literal translation of the Chinese characters *Hulian*, which stand for "interconnecting". These computer networks are directly linked to the global Internet through international leased lines. As discussed earlier, only eight licenses have been granted by the State Council: one each to the academic and research networks—CERNet and CSTNet—and six to the commercial networks—ChinaNet, ChinaGBN, Uninet, China Netcom, China Mobile, and CIETNET.

Interconnecting Networks are required to lease the Chinese leg of their international lines from either China Telecom or Unicom. Lines on the foreign leg are often leased from multinational carriers, including AT&T, Global One, and Teleglobe.

ChinaNet and the Multimedia Network

China Telecom is the dominant provider of Internet service in China. In many provinces, more than 90% of all commercial users access the Internet through it. Most ISPs in China also route traffic over ChinaNet. China Telecom has also deployed the Public Multimedia Network, known by its access code as "169." This network offers a less expensive service which limits access to only Chinese web sites. The Multimedia Network has been very successful and rivals ChinaNet in terms of the number of subscribers. China Telecom is building a national ATM network to support it. In fact, many predict that the Multimedia Network and ChinaNet will merge, and there have been signs of this in certain provinces.

ChinaNet is managed and operated by the Data Communication Bureau of China Telecom. China Telecom has been technically separated from the Ministry of Information Industry (MII), but the two are connected through both formal and informal ties. At the city and provincial level, the Post and Telecommunications Administrations (PTA) are part of the local government, as well as arms of China Telecom.

Golden Bridge Network

With its roots in the conflict between the old Ministry of Electronic Industries (MEI) and the Ministry of Posts and Telecommunications (MPT), JiTong's Golden Bridge Network has continued to compete with China Telecom in terms of providing connectivity to government, SOEs, business organizations and ISPs. By 1999, it had over 100,000 dial-up users. During the early days, ChinaGBN gained a reputation for reliability and even in 1999, though it had less international bandwidth than China Telecom, it claimed to provide better international response times due to a lower number of subscribers per bandwidth.

Local Internet Service Providers

There were more than 500 ISPs in China by the end of 1999. Approximately 100 of the ISPs, including the Beijing Telecommunications Administration, are part of China Telecom. Many of these ISPs have already invested millions of dollars in their networks. China Telecom has been able to recoup some of its costs through the telecom access charges that dial-up users must pay in addition to their Internet access fees.

Many other ISPs are either wholly or partially owned by the PTAs including Capital Online in Beijing, Guangzhou Vision and Shanghai Online. Many ISPs depend on personal relationships with the PTA to establish connectivity and to minimize charges. There are over 200 ISPs who have varying degrees of independence from China Telecom. Many of them, like ISPs elsewhere, are diversifying into developing and hosting content as well as providing system integration services. Any Chinese corporation, after meeting certain safety, legal, technological, and financial requirements, can be licensed as an ISP. Any ISP has to be licensed by MII and gain global access through one of the Interconnecting Networks. They are not permitted to directly connect with a foreign ISP.

ISPs have had to pay traffic sensitive charges to China Telecom for their connections to the Internet and yet are forced by the market to compete with China Telecom ISPs in terms of price. In addition, they do not receive the local access charges that China Telecom recoups. Most ISPs have had significant financial difficulties and many have come and gone since 1995.

It is important to note that in some major cities China Telecom is evolving into more of a wholesaler.

CERNET and CSTNET

Started in 1993, the China Education and Research Network (CERNET) developed a massive network connecting over 700 universities throughout the country to the global Internet. Hundreds of thousands of people use the network each day and there are more than 3 million subscribers, primarily students. The plan is for CERNET to

connect not only all universities in China, but high schools, middle schools, and primary schools as well. CERNET operates under the authority of the Ministry of Education. The CERNET National Network Center is headquartered in Beijing Tsinghua University.

On a smaller scale, China Science and Technology Network (CSTNet) has connected research institutes that are associated with the Chinese Academy of Science. CSTNet merged a number of networks that had arisen in the research community between 1987 and 1996.

Both CERNET and CSTNet are considered Interconnecting Networks under State Council Order #195 and both have a regulatory role of monitoring the networks they connect. Both must go through the China Telecom gateway to interconnect with global Internet providers. Neither is allowed to offer commercial service. CERNET has developed a policy that charges for all international traffic and claims that this policy has been successful in recouping revenue and reducing demand on their international circuits.

Organizational Infrastructure Ranking

Prior to 1999, China was ranked at a Level 2 (**Controlled**) in terms of Organizational Infrastructure Ranking under the Global Diffusion of the Internet framework (see Table 12). This is because of the immense power of China Telecom in terms of its power of its ISPs, the strength of its national backbone, and its control of the international gateways. However, in 1999, it could be argued that the new competition from Unicom and China Netcom introduce a degree of competition that justifies evaluating Organizational Infrastructure at the Level 3 (**Competitive**) level. There has also been a significant amount of competition in the Internet Content Provider (ICP) industry as companies have jostled to become the major portal in the country in the hope of attracting both advertising revenue and foreign investment. Once again, a Level 2.5 is appropriate for Organizational Infrastructure given both the rapid evolution that the ISP and ICP industries are undergoing and the power that China Telecom still wields in the Internet market.

Table 12: Ranking Organizational Infrastructure of the Chinese Internet

Level 0	*None*: The Internet is not present in this country.
Level 1	*Single*: A single ISP has a monopoly in the Internet service provision market. This ISP is generally owned or significantly controlled by the government.
Level 2	*Controlled*: There are only a few ISPs and the market is closely controlled through high barriers to entry. All ISPs connect to the international Internet through a monopoly telecommunications service provider. The provision of domestic infrastructure is also a monopoly.
Level 3	*Competitive*: The Internet market is competitive, there are many ISPs and low barriers to market entry. The provision of international links is a monopoly, but the provision of domestic infrastructure is open to competition, or vice versa.
Level 4	*Robust*: There is a rich service provision infrastructure. There are many ISPs and low barriers to market entry. International links and domestic infrastructure are open to competition. There are collaborative organizations and arrangements such as public exchanges, industry associations, and emergency response teams.

Sophistication of Use

Applications such as e-mail and Web access are being utilized to substitute for telephone calls and mail. The Chinese are behind many Western countries in terms of implementing electronic commerce. Chinese organizations often lag behind the West in terms of business process standardization and this has limited the automation of those business processes.

Chinese businesses have been quick to be listed on Web intermediaries such as Chinamarket.com, MeetChina.com, and Alibaba. Some firms have become active on global B2B exchanges such as Chemconnect.com. These activities, however, do not require significant re-engineering of business processes. In can be assumed that within five years, many Chinese firms will participate in interorganizational information systems. Not only will these firms be able to bid and take orders electronically, but they will be able to integrate into supply management chains and automatically provide data on production and logistics. It is not clear what factors will determine if and when Chinese firms invest in the business standardization and automation required for them to truly leverage the power of the Internet.

There has been much public discussion about the merits of transforming China into a knowledge-based economy. The government has embarked on a number of "Golden" projects aimed at transforming parts of the economy. The Golden Card project, for example, involves the deployment of smart cards for electronic currency. At the same time, a few China Telecom-affiliated ISPs are starting pilots providing stock market purchasing, electronic banking, and other services over the Web. It is unclear how and whether the "Golden" projects and the innovations associated with the Internet are going to come together.

ICPs, fueled by foreign capital and a heavily competitive atmosphere, have been rapidly innovating in the attempt to create value. As a result, Chinese individuals are being exposed to a wide variety of services including free e-mail, matchmaking, chat rooms, auctions, and e-commerce services. As a result, even though most organizations are still at a Level 2 (**Conventional)**, there are many individuals who are moving into Level 3 (**Transforming**) (see Table 13).

Under the belief that there will not be enough Ipv4 addresses to meet China's projected needs, CERNET has taken a leadership role in implementing IP v. 6. Not only has CERNET implemented Ipv.6 in its backbone but it has developed IP v. 6 network managment tools, implemented video applications on IP v. 6, and created its own search engine for Web pages on IP v. 6. CERNET has also recently signed an agreement with Nokia to jointly conduct IP v. 6 research. CERNET has taken a world leadership role in developing the next generation Internet and the argument could be made that it is at the **Innovating** stage for sophistication of use.

China thus shows signs of being at the **Conventional, Transforming and Innovating** stages. Because most organizations are only entering the Transforming stage and often through third party intermediaries, we believe it is appropriate to rank China at a Level 2.5 for sophistication of use.

Table 13: Ranking China's Sophistication of Use of the Internet		
Level	***Individual Use***	***Organizational Use***
Level 0 *None*	No use of the Internet	No use of the Internet
Level 1 *Minimal*	E-mail communication or Web browsing is an infrequent and novel experience.	E-mail is available, but is not used as an alternative to traditional inter-personal communications (memos, telephone, and meetings). Web sites consist of a very small number of static pages reflecting a "minimalist brochure."
Level 2 *Conventional*	E-mail may be a preferred means of communicating with people in an individual's circle of acquaintances. Web surfing is a regular activity. Some individuals maintain Web sites to post personal interest information. Individuals may listen to broadcast programming on the Web rather than on the radio or television. On-line Chat is an advanced form of Level 2, or possibly a Level 3, depending on whether it is primarily entertainment or results in changes in the individual's social network.	E-mail is widely used for both official and unofficial communication. Listservs or their equivalent are used to disseminate information or solicit feedback. Web sites are largely static, but are extensive and provide customers with in-depth information about products and services, utilization of those services, comparative information, etc. The content is more than just advertisement.
Level 3 *Transforming*	On-line communities proliferate around shared interests. These communities bring together people who otherwise would not have contact with each other. Interaction between members of such communities is substantive and often interactive. Examples include on-line Bridge clubs, use of ICQ to create communities, Individuals' Web-cams.	One strong indicator of business process re-engineering is that a significant number (over 5%) of Web sites, both government and business, are interactive. Web sites are dynamic, becoming an alternative distribution channel. On-line ordering is possible. Customer service functions expand to permit customers to conduct transactions that formerly involved employees. International companies use the Internet as a substitute for business trips, enabling round-the-clock collaborative product development. E-Commerce has taken hold.
Level 4 *Innovating*	Highly sophisticated forms of technology supporting inter-personal interaction and access to content are not only used by, but developed for, a demanding customer base.	The fundamental structure of organizations and their external relations with other organizations is altered. Companies pioneer new uses of the Internet, such as IP Telephony, data mining of Web customers' "click-histories".

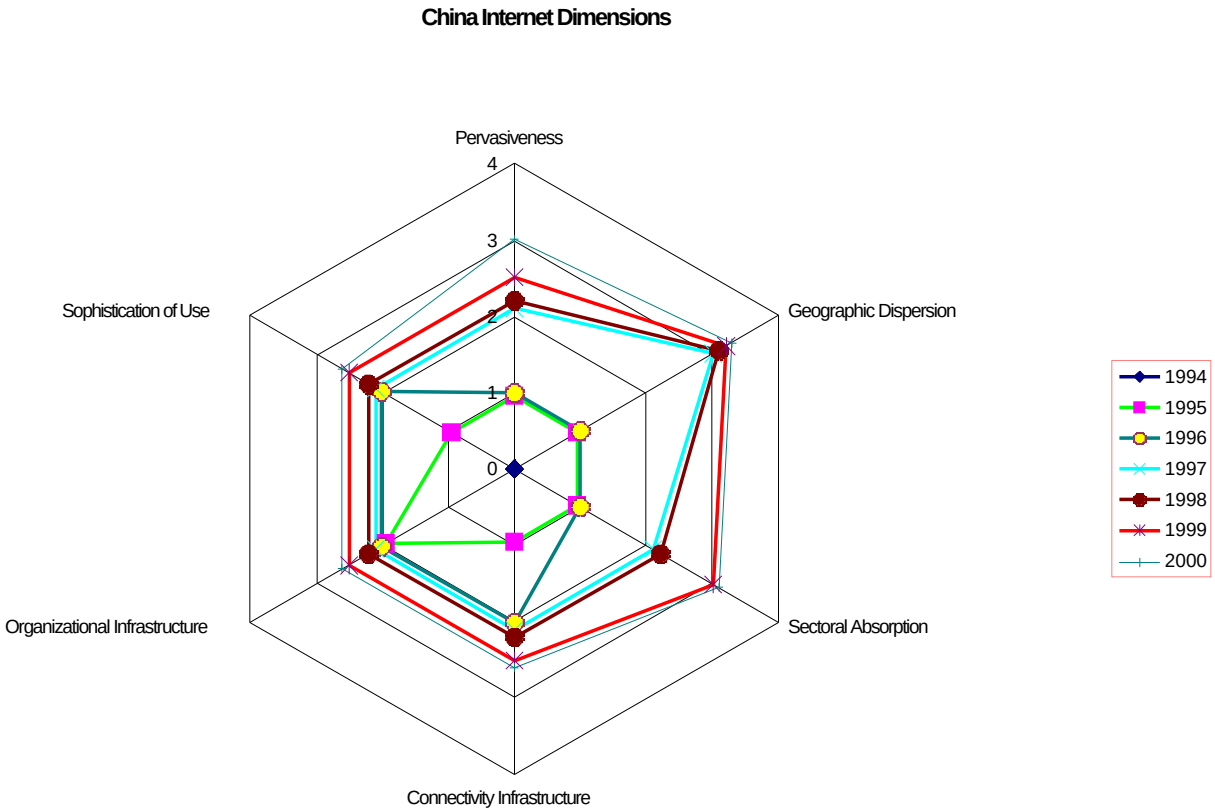
Summary

The six dimension ratings for China, which stayed fairly constant in 1998 and 1999, expand in 2000. These ratings are summarized in Table 14 and depicted in Figure 5.

Dimension	Level	Explanation
Pervasiveness	(3) *Established*	Having reached one user per hundred inhabitants, the user community has expanded from networking technicians to students, government (including the military), large business, and the broader public.
Geographic Dispersion	(3) *Highly Dispersed*	Internet access is available in all first-tier administrative sub-divisions.
Sectoral Absorption	(3) *Widely Used*	The Internet has taken root in the academic and government sectors.
Connectivity Infrastructure	(2.5)	China, by increasing ChinaNet's backbone capacity and international links, is still approaching Level 3. There are limits on availability of service greater than E-1 and access is still primarily by modems.
Organizational Infrastructure	(2.5) *Controlled ->Competitive*	There is healthy competition among ISPs in major cities, but only four commercial networks can interconnect with the global Internet. The WTO accession agreements promise more competition.
Sophistication of Use	(2.5) *Conventional-Transforming*	The Internet is used to enhance current processes, such as messaging, without fundamentally changing those processes. Individuals led by ICPs are transforming. IBPs are transforming business processes

Table 14 Internet Dimensions for China

Figure 5: Dimensions of Internet Diffusion in China



Provincial Case Study: The Internet in Guangdong Province

Guandong province rivals the cities of Beijing and Shanghai and is more than three to five years ahead of the rest of the country in terms of Internet diffusion. The province's proximity to Hong Kong, the central government's Open Door Policy, and the resulting economic boom have all contributed to the rapid rate of Internet diffusion.

In studying the Internet in China, it is essential to remember that much of the deployment of Internet infrastructure is driven by decisions at the provincial and local level. Thus, the instantiation of the Internet in each province takes on different characteristics depending on political, economic, and cultural factors at the provincial and local level. In the coming years, we expect to see substantial differences in how individual provinces and cities integrate themselves into the global electronic economy. Though a study of Internet diffusion in each province is certainly warranted, it is beyond the scope of this report.

Instead, we explore the dimensions of Internet diffusion in Guangdong, China's most economically advanced province. For anyone interested in the Internet in China, it is important to get a handle on the relationship between organizations at the national, provincial and local level which are involved in the Internet.

Figure 6: Map of Guangdong

Guangdong province, with Fujian to the east, and Hong Kong to the south is the largest province in southern China. It occupies 170,760 square kilometers and has 20 cities, 77 counties, and 41 city districts. It was set up in 1370 AD with Guangzhou as its capital. Its population is about 71.4 million, the fifth most populous province in China. It has the highest number of Internet users of all the provinces.[85]

The Central Government, through its Open Door policy, has given Guangdong a significant degree of economic autonomy. As a result, three cities from Guangdong,

Shenzhen, Zhuhai and Shantou, were designed as special economic zones. In 1988, the central government allowed Guangdong to experiment with economic reforms throughout the province allowing it to develop into an export-oriented economy. Guangdong is regarded as China's frontier to the outside world. Many Hong Kong businesses have shifted manufacturing to Guangdong cities like Shenzhen.

The Gross Domestic Product (GDP) grew by 30% from 609.7 billion RMB (US $74.35 billion) in 1996 to RMB 793.7 (US $96.79 billion) in 1997. The economy was growing very quickly in 1996 and 1997. Exports grew 20% from US $59.346 million in 1996 to US $75.724 million in 1997. However, with the Asian crisis, exports only increased by 4% between 1997 and 1998.[86] While this slowdown was a source of anxiety among policymakers and businessmen, the doubling of this rate of increase in exports to 8% in 1999 eased many fears.

Table 15: Statistical Data on Guangdong in 1998[87]

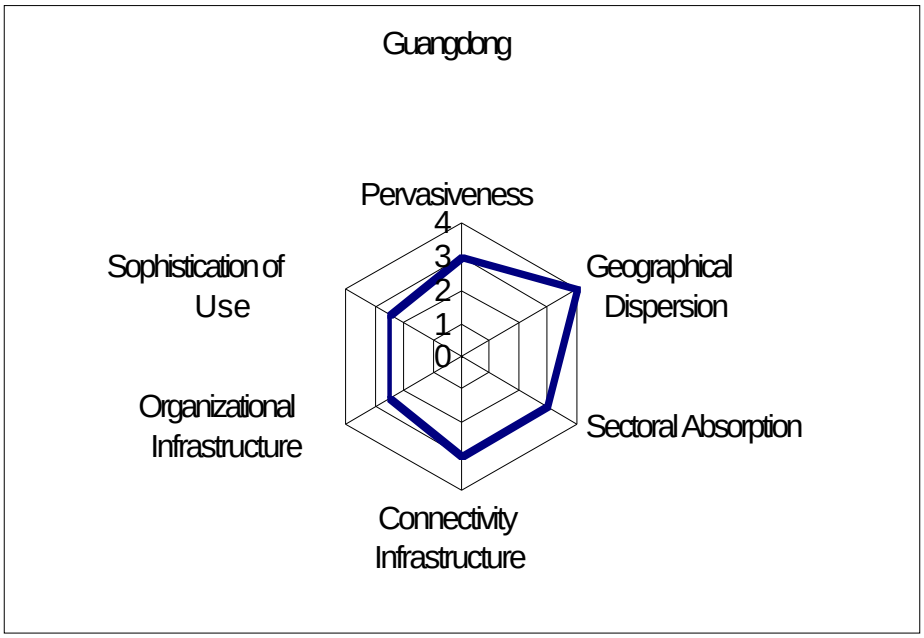
Population	71.43 million
Internet Users	800,000
Internet Users per 100	1.12
Telephones per 100	21.11
Micro-computer Production	748,200
GDP	RMB 793.723 billion, US $ 95,86 billion
Export	US $ 75.724 billion
Import	US $ 54.279 billion
College Students	185,000 regular and 146,400 adult ed.
Graduate Students	8043
Literacy (age 6 and over)	82%

Since 1994, Guangdong has rapidly embraced the Internet. The provincial arm of China Telecom built one of the first provincial backbones and the Guangdong Information Center put up a significant amount of government information on the Web.

Internet Dimensions of Guangdong

Table 16: Internet Dimensions for Guangdong in 1998		
Dimension	**Level**	**Explanation**
Pervasiveness	(3) Established	1.11 users for every 100 people
Geographic Dispersion	(4) Provincewide	"163" and "169" networks available in 23 cities. There is no distance charge from rural areas.
Organizational Infrastructure	(2.5) Controlled - Competitive	China Telecom is the primary provider of Internet access and controls international circuits. There are many Internet content providers some of whom provide access. Golden Bridge network and CERNET provide commercial and educational access.
Connectivity Infrastructure	(3)	ATM backbone is being constructed. Supports Frame Relay and IP. There is an Internet Exchange and connectivity to Hong Kong and the world.
Sectoral Absoption	(3) Common	Internet leased line connectivity is available in most universities but not secondary schools. State Information Office runs Web site that provides access to information from various sections of the government.
Sophistication of Use	(2.5) Conventional	Internet is primarily being used as a substitute for voice and fax. E-mail is very popular. There is some top-down efforts to change business processes such as the Golden Projects. Business intermediaries driving change

Figure 7: Kiveat Diagram of Internet Dimensions for Guangdong in 1998



Pervasiveness

The Guangdong Steering Committee of NII estimates that there were 800,000 users in Guangdong in 1998. [88] Using the Steering Committees numbers means that Guangdong's Internet users-per-capita is 1.11 for every 100 users.

It is important to keep in mind that counting users in China is difficult because many Chinese Internet users share the same subscription. Table 17 shows the rapid growth in subscriptions to China Telecom's ChinaNET "163" Network and Multimedia "169" Network. Under the standard agreement, users who access the "169" Network have access to all Web sites in China, but do not have access to Web sites outside of China. However, they do have global e-mail access.

Table 17: China Telecom Internet Dial-up Subscribers in Guangdong[89]

Year	Network	Subscriptions
1997	"163" Network	46,000
1997	"169" Network	43,000
1998	"163" Network	130,000
1998	"169" Network	160,000
1999 (March)	"163" Network	190,000
1999 (March)	"169" Network	210,000

Geographic Dispersion

The Guangdong Internet is highly dispersed. As in other provinces in China, Guangdong's Internet access is connected through the four major networks. They include ChinaNET, CERNET, ChinaGBN, and CSTNet. However, unlike many other provinces in which Internet points-of-presence are confined to only the provincial capital, Guangdong's Internet points-of-presence are now located in most of the major cities in the province.

The nodes of the major networks span the entire the province. ChinaGBN provides Internet access in Guangzhou as GBNet-GZ. CERNET has located its Southern China Regional Network Centers in Guangzhou, provides Internet access to the major universities in Guangdong and nearby provinces, and operates Guangdong Education and Research Network (GDERNET), an organization that serves all the education and research community in Guangdong province.[90] ChinaNET has expanded its provincial nodes from Guangzhou and Shenzhen to cities throughout the province. Currently the "163" Network and "169" Network are available in 23 cities in Guangdong. However, the phone tariffs are set up so that users accessing the Internet through the "163" Network and "169" Network do not have to pay distance-sensitive prices. As a result, Internet access costs the same throughout the province.

Connectivity Infrastructure

The Connectivity Infrastructure of Guangdong is rapidly evolving. The ChinaPAC X.25 network which can be used to access the Internet has points-of-presence (POPs) in over 21 cities in the province. Guangdong Data Communication Bureau has signed a contract with Newbridge Networks Corp to supply networking equipment for the

expansion and upgrade of the province's digital data network (DDN). This upgrade will provide integrated service management of MainStreetXpress 46020 Network Managers across multiple administrations operating in urban networks in cities throughout Guangdong province.[91]

The DDN supports Frame Relay access from 12 cities in the province. Frame Relay access is currently available at speeds up to E-1 (2 MBps). The ATM protocol is used in the backbone of the network to support Frame Relay and Internet Protocol (IP) services. The China Public Multimedia Network, "169" Network, has connected to Guangzhou with large-capacity ATM. According to the GDCB, their next generation network will be based on running the IP protocol on top of the ATM protocol.[92] They are currently testing equipment from six different vendors for this next generation of network. China Telecom is also rolling out a CDPD service that provides wireless data communications. It is currently conducting an IP telephony trial service.[93]

The Guangdong Wireline TV Corp has significant potential for providing high-speed access to the home. As of 1999, only a few hundred cable modems have been installed as part of this trial.[94]

China Telecom is also planning on being able to install ADSL by the year 2000. Currently, however, there are legal problems engendered by the potential of ADSL to support video on demand—the domain of the TV company.[95]

Organization Infrastructure

The Guangdong Data Communications Bureau (GDCB), part of the Guangdong Telecom Bureau, supports 90% of all commercial users in Guangdong. The Guangdong Telecom Bureau is the provincial body of China Telecom. Internet access is sold through the city telecom offices such as Guangzhou Telecom.

Table 18: China Telecom

Scope	Body	Web Address
National	China Telecom	http://chinatelecom.cninfo.net
Provincial	Guangdong Telecom	http;//www.gdcb.gd.cn
City	Gungzhou Telecom	http://gztelecom.com.cn

Besides China Telecom, there are many ISPs in Guangdong (see Table 19). Most of the ISPs have built portal sites with links to sites of interest and very powerful Chinese Web site search engines.

Table 19: Major ISPs and Content Providers in Guangdong

Feihua Telecom	http://www.fhnet.cn.net/feihua
Guangzhou Netease Computer System Ltd.	http://www.nease.net
Karsing Online	http://www.kol.com.cn
Great Trend Internet Services	http://szwd.net.cn
Shenzhen Newsnet	http://newsnet.szppt.net.cn

The city branches of China Telecom have also built portal sites. Guangzhou Telecom, for instance, runs gznet.com. GDCB was a pioneer in developing the 21cn.com portal site of the "169" multimedia network. This site is one of many city and provincial sites that can be accessed through the cninfo.net domain.

Sectoral Absorption

The public sector has an extensive Web presence. This presence has been developed by the information offices of the province and each city. GDNet, run by the Guangdong Information Center, has extensive statistics on economic indicators at the provincial and national level.[96] It has global news, market prices, commerce regulations, stock quotes from the Shenzen exchange, and health care statistics. GDNet also plays a matchmaker function by providing requests for quotes from around the world. Though the information provided is extensive, it rarely links to separate Web sites of the various branches of the government which gathered the information. This is probably due to the fact that most of the branches of the provincial government do not yet have their own departmental Web sites. There is a separate Guangdong government domain that provides information on the various provincial decision-making bodies. This site is maintained by the Guangdong Information Center. The city information offices also have their own Web sites that provide information on the city and its government. Both the provincial and city sites are part of the China Economic Information Network (CEInet) that is operated by the State Information Office. The city, provincial, and national sites all point to one another, a reflection of the fact that they are all loosely organized brances of CEInet.

Table 20: Information Offices

Network	Body	Web address
China Economic Information Network (CEInet)	State Information Office	http://www.cei.gov.cn
Guangdong Information Network	Guangdong Information Center	http://www.cei.gov.cn http://www.gdic.gd.gov.cn/xxzx_e.htm
Guangzhou Information Network	Guangzhou Information Office	http://www.203.207.178.12

Guangdong's **common** sectoral absorption is explained in Table 21.

Table 21: Sectoral Absorption in Guangdong

Academic	2	Most universities in Guangdong have Internet access provided by CERNET
Commercial	2	10-90% of business with more than 100 employees have Internet servers
Health	1	Less than 10% of hospital and clinics have leased-line Internet connectivity
Public	2	10-90% of government entities have Internet servers

Is has yet to be seen whether the development and availability of a videoconferencing network based on an high-speed ATM exchange will have a significant impact on either the commercial or health sectors. The regional communications and network systems integrator, Datacraft Asia, will design and build a high-performance distance videoconferencing network in Guangdong. Hongkong Telecom, China Telecom and the Guangdong PTA have joined networks to sponsor the

first cross-border ATM-based telemedicine trial, linking several hospitals and universities between Guangdong and Hong Kong.[97]

Sophistication of Use

Guangdong has not broken out beyond the conventional level. For the time being, sending e-mail, reading the newspaper, and accessing "169" Multimedia Network are three of the major reasons why Guangdong people are online. Regarding online newspaper readership, the Web site of South China Daily group in Guangdong Province was visited by more than 400,000 people in June of 1998. Business to Business e-commerce is being talked about, but few companies have implemented it or have re-designed their business processes to take advantage of it. Only a few companies have implemented EDI, mainly in conjunction with the Golden Gate project. Many more are using electronic intermediaries. The GDCB is promoting digital signatures to support e-commerce.

Unique Factors influencing Guandong's Internet Difussion

The dimensions of Internet diffusion in Guangdong are created through the interaction of governmental (top-down) policies with the dynamism that has been created by economic opportunity.

China Telecom

China Telecom is committed to building a nationwide Internet Protocol (IP) backbone and rolling out both the "163" ChinaNET and the "169" Multimedia Network. Though China Telecom continues to lose money on its IP services, it makes it up in the per minute local telephone charges for accessing the networks.[98] China Telecom, as a matter of both national and organizational interest, is plowing the huge cash flow generated by Internet services back into the network.

China Telecom's provincial arm, the GDCB, is taking the initiative in rolling out a provincial ATM backbone and developing new value added services such as IP-telephone and electronic commerce. In the interests of providing the tools to support e-commerce, the GDCB developed its own certificate authority for authenticating servers well ahead of the development of national policy. In the case of the certificate authority, the People's Bank has put a hold on its rollout by the GDCB.

Steering Committee on the National Information Infrastructure

The provincial government has a Steering Committee on the National Information Infrastructure that sets policy for the province on information technology and the Internet. The Steering Committee is appointed by local government and is associated with the Guangdong Province Information Center.[99] The Center was established in 1997 as a "co-department institution" under the Guangdong government, being controlled by the planning commission. The Center's 108 employees work with over 700 others from other cities and counties in Guangdong. The Center has a broad mandate to be responsible for the organization and direction of the informatization of the economy. It gathers a wide range of macroeconomic indicators and makes them available through the CEInet site GD Information Network that was discussed earlier.

The Steering Committee contracts with the Center to implement various projects. The Center is responsible for building the networks for the provincial government and the Communist Party, and supporting their office automation. In this role, there has been some tension with China Telecom over the extent of resources China Telecom should provide to the government. The Center has also been responsible for the development of databases for a wide range of organizations including the Shenzhen Union Exchange and the GD Highways Company. The Center runs the GDIX, an Internet Exchange that connects the research, provincial government and educational networks with ChinaNet. Presently, the GDIX is testing a connection to HKIX, the Internet exchange in Hong Kong.

As mentioned earlier, the Center's GD Information Network has a great deal of information drawn from many sectors of the government and the economy. It is an open question as to how individuals and businesses in Guangdong are utilizing this rich data environment. Another interesting question is why the GD Information network is much richer than the information services provided by Fujian and other provinces. The

influence of Hong Kong and the sophistication of Internet use in Guangdong can be seen in the quality of the GD Information Network.

According to Xu Zhi Biao, now the Director of the office of the Guangdong Steering Committee of NII, the government's strategy for promoting the informatization of the province involves these steps:

- Putting government information on line
- Reforming laws and regulations to support e-commerce
- Encouraging vendors to do business with the government electronically[100]

The Steering Committee has embarked on a project promoting enterprises to go on-line which starts with getting an e-mail account and progresses to getting a Web page. The Steering Committee is also concerned about providing an infrastructure that will support the spread of the Internet and informatization.

Open Door Policy

Though the provincial government has easily adopted information technology, Guangdong's rapid absorption of the Internet relative to the other provinces can be primarily attributed to its economic growth as a result of the Open Door Policy. In 1979, the State Council gave Guangdong permission to implement special economic policies. As a result, three cities from Guangdong, Shenzhen, Zhuhai and Shantou were designated as special economic zones. In 1988, the central government allowed Guangdong to experiment with economic reform province-wide. Guangdong has developed into an export-oriented economy and is regarded as China's frontier to the outside world. The relative prosperity of the province has allowed people to purchase Internet services. In addition, the Internet represents a significant opportunity for time and cost savings for those individuals and companies involved in international trade and, through the Web, opens up access to highly valuable information.

Migration

Guangdong's open door policy and the resulting economic boom have attracted entrepreneurial and technical talent from throughout China. Guangdong and its private companies are often the destination for the cream of China's youth that fail to land positions in Beijing and Shanghai. Many of these migrants have an aptitude for technology and have been early adopters of the Internet. In addition to attracting risk takers from throughout China, Cantonese culture has traditionally been commerce friendly and has been a fertile ground for entreprenurial Internet companies.

Over 20 million people have emigrated out of Guangdong to Hong Kong and other countries. These overseas Chinese still have connections and influence with their family and friends who remained in Guangdong. E-mail is being extensively used to support those connections.

High-tech Multinational Companies

Multi-national companies have been attracted to Guangdong as a gateway for both manufacturing and selling in China. The Institute for the Future recognizes Shenzen as a key node in the Global Silicon Network. As part of doing business with these high-tech multinational firms, Guandong's businesses are exposed to the latest in information

technology and are sometimes required to implement it as part of the their trading agreements. Multi-national companies also see Guangdong as a major market for their technologies and a gateway into the rest of China. For example:

- Cisco Systems and Lucent Technologies are upgrading Guangdong's telecommuications infrastructure .
- Intel is making special chips that allow Guangdong users to share the same online subscription.
- Compaq is building the E-commerce Technology Center in Guangzhou.
- Microsoft is making Chinese software and implementing Web TV in Guangdong.

Relationship between Hong Kong and Guangdong

Guangdong's attractiveness to Hong Kong as a base for manufacturing operations could create one of the most symbiotic partnerships in Asia. This interconnection is happening across most sectors of Guangdong society.

The main push for connectivity between Guangdong and Hong Kong is to expand research capabilities. Universities can share electronic libraries or expand joint research programs to better understand their objective. For instance, a joint program with Chinese Academy of Sciences and the Chinese University of Hong Kong is conducting a Joint Laboratory for GeoInformation Science. The technology plays a key part in sharing and promoting geographical information. Some of the participating cities include Beijing, Shanghai, Taipei, Kao-Hsiung, Tianjin, Chongqing, Guangzhou, Shenzhen and the Hong Kong Special Administrative Region.[101] The Joint Universities Computer Center Limited HARNET connects the eight main universities of Hong Kong to other international institutions, primarily in China.[102]

The government is strongly pushing information technology. Plans such as Digital 21 have included goals for connectivity to the Mainland from Hong Kong. The first to be implemented is the trial dedicated circuit between the Guangdong Internet Exchange run by the Guangdong Information Office and HKIX.

Guangdong companies must have e-mail if they want to continue doing business with Hong Kong. It is an open question as to how quickly Hong Kong businesses will build inter-enterprise resource planning systems that use information technology to distribute decision making across the virtual enterprise.

Surprisingly, the health sector is keeping up with technology. Through the help of strong Telecom giants like Hong Kong Telecom, China Telecom, and Guangdong Posts and Telecommunications, the health sector has explored new applications and telemedicine trials across ATM technology.

Determinants of Internet Diffusion in China

> *Internet diffusion has been driven by the desire of the Chinese to connect with each other and the outside world. The prices of PCs and Internet access have kept a damper on diffusion but have not stifled it. Competing and state owned enterprises are continuing to deploy national infrastructure. The education community has played a leading role in getting students and their associates on the Internet.*

While the Global Diffusion of the Internet framework gives us a representation of the status of the Internet at any given time or over a time series, a profile of the contributing factors is useful. The Global Diffusion of the Internet project has developed a set of factors that seem to be important in most of the countries the Project has studied. Of course, there are important differences as well as commonalties between countries in terms of how a particular factor shows up in a particular country and thus how it influences Internet diffusion. "Understanding these factors not only has explanatory utility, but also can indicate the principle mechanisms, factors, and policies that may be applied to promote (or hinder) the Internet's development."[103] It can be assumed that the Internet and e-commerce is instantiating in different cultures and countries differently. By understanding some of the determining factors, policy-makers may be able to influence not only the rate of Internet and e-commerce diffusion, but also how the Internet is absorbed into the culture and the economy.

For a foreign businessman involved in either investing in the Chinese Internet or using it to trade, it is important to have a handle on how rapidly individuals and organizations will have access to the Internet. Of equal importance are factors that will determine both the rate of Internet and e-commerce diffusion and the form they take.

In this section, we will examine a number of key factors that have emerged as particularly strong determinants of the extent and nature of growth of the Internet within China. 22 shows the relationships of the determinants to the dimensions. In the following section, we apply the determinants to each of the dimensions of Internet diffusion in China, predicting the potential for each dimension.

Determinants	Pervasiveness	Geographic Dispersion	Sectoral Absorption	Connectivity Infrastructure	Organizational Infrastructure	Sophistication of Use
TECHNOLOGY ITSELF						
Perceived Value	X	X	X	X	X	X
Ease of Use of the Internet	X		X			X
Cost of Internet Access	X		X		X	
INTER-RELATIONSHIPS WITHIN TECHNOLOGY CLUSTER						
Access to Constituent Technologies	X	X	X	X	X	X
Demand for Capacity, Multiplicity of ISPs, Services Provided				X		
EXTERNAL/SURROUNDING FORCES						
Geography		X				
Adequacy & Fluidity of Resources	X	X	X	X	X	X
Ability to Execute		X		X		
Culture of Entrepreneurship					X	X
Regulatory/Legal Framework	X	X	X	X	X	X
Forces for Change	X	X	X	X	X	X
Facilitators of Change			X			X

Table 22: Relation of Dimensions to Determinants

Access to the Internet

Access to the Internet requires hardware and software and a way of connecting with an Internet point of presence, usually an ISP.

Individual Access to the Internet

Though China has rapidly increased its telephone density, particularly in the cities, there are still many rural areas where most families do not have access to a phone line. While it is a government priority to establish at least one phone in every village, a commitment has not been made to make Internet access available in every village.

Most Chinese use a PC to access the Internet. The number of PCs in the country has often been hypothesized as a limiting factor on the number of Internet subscribers. In 1997, IDC estimated that there were under 10 million PCs in China. In 2000, this number has doubled to 20 million PCs.[104]

There are multiple efforts underway to develop the TV as the access device to the Internet as well as to build Internet functionality into DVD recorders. There are also efforts to build an under US $500 PC for low cost Internet access. Most of these efforts require the use of a telephone line to access the Internet. Many realize the potential of the widely deployed cable network to support Internet access.

There is also speculation about the popularity of Wireless Access Protocol (WAP) enabled mobile phones as an access method to the Internet. Even though most mobile phones in use today do not support the protocol, many ICPs have made commitments to supporting it.

Internet cafes have been very popular in China. They provide a relatively painless and low-cost method of accessing the Internet as they provide both the PC and the access line. The recent CNNIC study indicated that 11% of users surveyed accessed the Internet from these cafes. Thirty seven percent of users accessed the Internet from either work or school, with 50% accessing the Internet from home.[105]

ISP Access to the Internet backbone

ISPs not associated with China Telecom have often had a difficult time getting connectivity from it under terms where they could compete directly with its own subsidiaries. Often in the provinces, ISPs and even Internet Cafes needed to have a personal relationship with someone in the PTA in order to get connectivity. With the development of first JiTong, then Uninet and now China Netcom as backbone providers, ISPs' options for international connectivity have increased. It is not clear whether ISPs who use non China Telcom backbone connectivity can provide good access to China Telecom routes for their customers. The development of an exchange point with broadband capabilities should make it much easier for customers of the new Interconnecting Networks to get to websites on China Telecom.

Cost of Internet Access

The cost of ISP access for individuals has been steadily dropping. However, the telephone access charges — where China Telecom makes its profit — have not been dropping (see Figure 8).

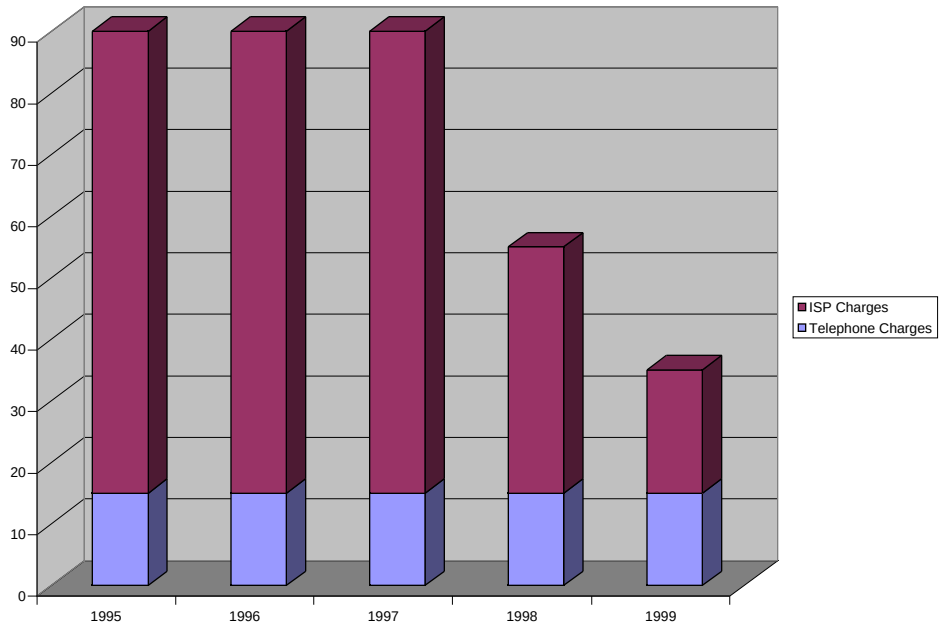


Figure 8: Monthly Online Costs in China for 40 Hours per Month (US $)[106]

Chinese almost universally complain that the price of Internet connectivity is too high. There was a lot of public pressure on China Telecom to lower the Internet access rates in 1998 and again in 1999. Because of the telephone access charges, Chinese users still pay more than US $15 per month more for full Internet access than do Americans. In addition, their average wages are significantly less.

As a result of these price pressures, many Chinese end up mostly using applications such as e-mail which do not require them to stay on-line for long. In addition, by choosing such lower cost options as the "169" Multimedia network, which only provides access to Web sites in China and global e-mail connectivity, they can also reduce their online charges.

For people without a PC, buying one remains a major financial commitments, not taken lightly given the average wage in China, even in industrialized cities. Many of the early adopters of the Internet were in fact families who purchased both a PC and Internet access so that their son or daughter could learn and correspond with US colleges. Families have often been willing to pool their income in the interests of the next generation.

ISP Costs for Accessing the Backbone

When China Telecom reduced its prices for online access, it did not at first reduce the charges that ISPs have to pay for backbone access. Most ISPs have agreed to contracts where they are forced to pay for traffic in addition to the charge for bandwidth. As a result, between 1996 and 1999 non-China Telecom ISPs have struggled under the pressures of competing with China Telecom, while having to buy backbone services from them. With the maturation of China Telecom and the advent of Unicom and China Netcom, it is expected that a whole new generation of ISPs will develop.

It is important to realize that these ISPs are still dependent on China Telecom for their Digital Data Network (DDN) circuits both to their backbone provider and to their customers if they offer dedicated circuits. Though the rates for DDN circuits are not exorbitant, they are often difficult to procure without the right connections with China Telecom. Futher, ISPs cannot use satellite connections to get global connectivity. They must get it through an Interconnecting Network.

It is also important to restate that the Interconnecting Networks must pay China Telecom for the Chinese leg (also known as the gateway) of any international circuit. Though prices have come down, China Telecom is still charging twice that of what US carriers charge for their leg of an international circuit. These gateway charges are reflected in what the new Interconnecting Networks must charge for access.

Ease of Use

The development of a Chinese Internet means that millions of Chinese are able to visit Web sites in the Chinese language. Though at first English was predominantly used in e-mail, now most e-mail traffic in China is in Mandarin. There are a number of different systems for entering Chinese characters through a keyboard. Some involve the use of the romanized script pinyin. Others depend on the use of the numeric keyboard to select strokes. A number of systems allow the user to select the Chinese character.

Companies such as IBM and Intel have invested millions of dollars in the development of voice input systems. The development of touch screens allow the user to draw the character directly on them. No one method has come to predominate.

For individuals with no English training, the use of romanized characters in Uniform Resource Locators (URLs) for accessing Web pages can be a difficulty. The IETF is currently considering an extension of the Domain Name System that will allow the development of Mandarin-based URLs.

Millions of Chinese are now learning English in elementary school. As a result, the number of Chinese who can take advantage of English Web sites and Internet applications is growing dramatically. No matter how much Chinese content there is, the Internet, for the foreseeable future, will have more value to those comfortable with English.

Perceived Value of the Internet

As mentioned earlier, one of the greatest values of having Internet service was that it allowed young people to access universities outside of China and correspond with them via e-mail. In addition, e-mail popularity as a way of communicating has grown as the number of friends, colleagues, and family with e-mail connectivity expands. Many university students had grown familiar with "chat" applications on their university bulletin boards. As national chat rooms developed, both at ISPs and at ICPs such as Sina.com and Sohu.com, they have proved immensely popular

News is a major interest to many Chinese. ICPs have carved out niches by offering news and sports information in a flashy form. Major newspapers now also support online editions and chat rooms. There is very little information on the Chinese Web that is not available through print media. While there is a real hunger for "valuable" news, news that provides insights into the functioning of State organizations is often guarded as state secrets. At the same time, private organizations tend not to disclose too much information publicly. As the government regulates ICPs and allows them to engage in reporting, ICPs will have the challenge of coming up with valuable information for their viewers that does not threaten the government.

Clearly, for people who can read English and know how to navigate the Web, there is a wealth of information available through the Internet. As noted earlier, only a few Web sites have been blocked.

Since 1996, Internet use itself has become highly fashionable particularly among young people. Having an ISP account or even an e-mail account is a symbol of status. What people get from the Internet may be less important than participating in this latest "craze" that has such global scope. Internet adoption is a group phenomenon in addition to being something that the individual chooses. Like cell phones and pagers, the Internet is becoming a "must have" device.

ICPs are continually trying to offer new services in their efforts to carve out market share. These services include on-line banking, stock trading, job listings, auctions, and electronic retail. Many of these services are copied from successes in the West. It is still an open question as to how successful many of these services will be and whether they are drawing new people to the Internet. As mentioned earlier, there are some significant cultural and logistical barriers to using the Internet to purchase goods and services. It remains to be seen how long it will take for a significant B2C

infrastructure to develop in China and whether the presence of it will drive Internet diffusion by increasing the perceived value of Internet access.

It is also unclear how valuable Internet access would be to those outside the intelligentsia. There have been some stories of rose farmers in Guangdong profiting from getting pricing on flower markets over the Internet. However, most intellectuals seem to doubt that villagers or even workers will ever have any use for the Internet. This is strikingly different from India where there are many "tales" of PCs that have been made available to peasants along with an interpreter and have made a significant impact.[107] Given that a majority of Chinese are peasants, Western dreams of 1.2 billion Chinese on the Internet will have to wait for the Internet to develop value as a tool for peasants.

Perceived Value by Organizational Users

Chinese companies are abuzz with the hype surrounding the Internet and e-commerce although few have significantly redesigned their business processes to take advantage of the Internet. Many in management are using dial-up Internet accounts to access e-mail. Many companies have listed themselves on Web sites such as the government run ChinaMarket.com or the privately run MeetChina. Some have developed Web pages, often hosted by someone else. More than a few Chinese companies are active players on the new B2B sites such as ChemConnect that have developed in the past few years. Far fewer companies have a dedicated IP connection to the Internet or their own Web server.

Management is willing to use the Internet to exploit business opportunities, but avoids making long-term commitments that either require restructuring or significant recurrent costs. It is not clear how the Chinese business world, where business and information flow through personal relationships, is going to meld with the automated global economy. It can be assumed that within ten years most Chinese manufacturers still in business will be so integrated into the Internet that software agents will be able to get quotes, submit orders, and get detailed production and logistics information automatically over the Web. What is not clear is the path between today and the future.

Most Chinese businessmen know that the Internet is the future. But many have yet to standardize their business practices. There is a significant difference with regard to automation between State Owned Enterprises (SOEs) and private companies which are primarily family based. The SOEs often have invested in software, due in part to top-down government initiatives including the need for information to manage these large corporations. On the other hand, the SOEs often have multiple software packages—inventory, accounting, tax, and customer management—that do not necessarily talk together. Very few have implemented Enterprise Resource Planning (ERP) applications. Even fewer are ready to implement the next generation inter-Enterprise Resource Planning applications (iERP) that will allow multiple organizations to coordinate production. On the other hand, the far more nimble private companies are more cautious of their capital investments and many have yet to standardize their business practices which is a precursor to any automation.

Certain SOEs will attempt to integrate into the supply chains of their global customers. It is also expected that some of the most dynamic private companies, especially those led by management that has either gone to school or worked in the West,

will take the risk of integrating their enterprises into inter-organizational systems over the Internet. It is these companies that will become truly "Internet" companies and they will gain significant value because of that integration. The real question is how quickly will the leading companies in China catch up with state-of-the-art Western and Japanese supply chain management implementations. Once one Chinese company has demonstrated a competitive advantage through electronic integration, many companies will follow.

The question is which companies are going to take the lead and how rapidly will they do so. It may very well take two to four years for significant progress to be made in e-commerce in China and then only at a few companies. However, at a certain point, perhaps in a matter of a year or two, most successful firms will have jumped on the bandwagon. Integration and software firms at the leading edge of e-commerce in China may have to wait a couple years before they can reap the dividends of their evangelizing work. Integration and software firms face a risk that when e-commerce catches on in China it will be implemented with shareware, open standards such as XML, and skills that are basic commodities. In order to capture margin, integration firms will have to convince Chinese manufacturers to make significant investments in state of the art implementations today. What is not clear is what these implementations will look like in the Chinese context. These implementations need to be integrated into the global economy while minimizing the political and cultural obstacles to electronic integration.

Perceived Value by Government Entities

The government perceives the Internet as critical for economic progress. Leaders at MII point to studies of the impact of the Internet on the US economy as proof that the Internet will yield such dividends for China. There has been little public acknowledgment of the challenges that China faces in reaping the same dividends as the US has from the Internet. Millions of Internet users may represent significant revenue to China Telecom and may allow Chinese ICPs to attract millions of dollars in investment capital, but it is not clear that this will have an appreciable impact in terms of transforming the economy. Even if e-commerce develops in China, it is hard to know if it will actually increase GNP or simply mean that people buy over the Internet instead of through stores.

President Jang Zamin in his March 2000 speech on the Internet Economy affirmed the economic possibility of the Internet and the need for safeguards. In addition to allowing the deployment of an Internet infrastructure, the government is taking steps to put in place the security, delivery, and settlement infrastructure needed for e-commerce.

The government is also driving the interconnection of 520 key state-owned large and medium-sized enterprises with the Ministry of Finance, the State Administration of Taxation, the State Economic and Trade Commission, the Ministry of Foreign Trade and Economic Cooperation (MOFTEC) and the State Bureau of Internal Trade. It is not clear that the government fully understands the challenges of electronically integrating organizations and whether they are planning on just implementing TCP/IP connectivity or whether they are committed to investing in inter-organizational information systems. As is all too often the case, they may be dreaming of the latter, while budgeting for the former.

The government has made a major commitment to the "government on-line" project and is busy putting up Web sites for many government agencies. It remains to be seen how transparent and interactive these Web sites will be and whether they will contain "valuable" information and links. There is a potential that these sites will develop beyond "brochureware", but that is not clear . The governing process in China is immensely complex. The "government on-line" project is a first step in the long process of re-engineering government to take advantage of information technology. It is likely that the most significant things will take place beyond the public eye through technologies such as e-mail. Nevertheless, the "government on-line" project is one of the most visible efforts at informatization in China. As such it should be closely watched.

Adequacy and Fluidity of Resources

As the BDA study of the Internet in China notes, few organizations which were granted interprovincial ISP licenses have been able to capitalize on them and many are not even renewing their licenses.[108] This was due in part because they were prevented from getting foreign investment, and they were also hampered by their dependence on China Telecom, the DCB, and the PTAs for both their global interconnectivity, their dial-up lines, and their leased lines. Resources to compete with China Telecom were simply not available.

It could be expected that the lack of competition would result in poor performance by the dominant carrier, China Telecom. However, it has been able to meet a significant amount of demand for Internet service because it was able to mobilize the financial, informational, human, technological, and material resources needed to build both a national backbone and to deploy ISPs.

One of the things that makes China stand out from many other developing countries, is the fact that once it made a commitment to deploying the Internet it did so rapidly around the country. CERNET received significant financial support from the State Education Commission. China Telecom funded the development of a national backbone; provinces funded provincial backbones; and PTAs developed ISP infrastructure. Much of the development of the national and provincial backbones was subcontracted out to Sprint and AsiaInfo. Thus China Telecom used its finances to outsource the human resources it needed to rapidly and widely deploy the Internet. China Telecom's telephone business was throwing off enough money to support the rapid deployment of this new data service. Though the Internet service often did not pay for itself, the telephone access charges that the PTAs received more than made up for the difference.

Vendors such as Cisco, 3Com, Sun, and Nortel were willing and able to provide the latest technology for routing and switching the Internet. It is important to note that except for the field of encryption, there have been few restrictions by the US government regarding the export of Internet technology to China. Because the funds were available, the technology was readily available. China Telecom has often staged technical and price competitions between as many as six vendors in an effort to get the best technology at the best price. In addition, the standards on which the Internet developed are primarily open

and readily available, enabling the rapid development of Internet technologies by Chinese manufacturers.

More than US $1 billion has poured into the ICPs from foreign sources and have helped finance their business development and expansion. This capital has allowed them to attract the human and technical resources they need to implement the services that have been evolving so rapidly in the West.

How quickly the ISPs and software providers will be able to marshal the resources necessary to transform China's business processes and integrate them into the emerging global electronic market is open to question. Clearly a great deal of initiative will come from the State sector. The State has access to tremendous resources for contributing to the re-engineering of China's economy, but faces significant obstacles in terms of bureaucratic infighting and resistance. Whether the State will end up cutting off private sector access to critical resources for e-commerce or taking too many "pounds of flesh", as has happened in the ISP business, is open to question.

Legal and Regulatory Framework

As detailed earlier in our section on the history of government policy regarding the Internet, governmental decision-making has been evolving over the past five years. Many orders have been promulgated by many different government bodies. Private companies have often operated in a gray area where their survival depended on cultivating good relationships with various ministries as well as the provincial and local government. ISPs have generally had a difficult time competing with the ISPs aligned with China Telecom. Private ICPs, which have had even less formal regulation, flourished thanks to foreign and domestic investment and are now languishing as the investment mood has soured.

MII has promised a new Telecommunications Law for a number of years. If this law in fact comes out it may open up the telecommunication sector to more competition and pave the way for the convergence of voice, data, and TV. It is possible that this new law will enshrine the "Interconnecting Network" hierarchy and preserve it in the face of the opening represented by the WTO accession agreement.

New regulations in China don't necessarily mean that there will be more competition. Often the rules represent an attempt by a ministry to assert itself in the constant bargaining going on between ministries to gain financial benefit and bureaucratic power from the fabled Internet.

As is the case with the 1999 encryption regulations, often businesses will choose to selectively respond to a new regulation. Thus even as regulations proliferate, the gray area only expands.

Ability to Execute

Once China chose to officially adopt the Internet, both China Telecom and CERNET deployed massive national backbones rapidly. For a developing country, China implemented its national Internet strategy very quickly. Some people attribute this

ability to the organizational strength of China Telecom. Distributed networking technology may be a good fit for a decentralized organization like China Telecom that is distributed between the national, provincial, and local levels.

ICPs have also deployed rapidly. It remains to be seen whether the country as a whole as well as its manufacturers, software providers, and ICPs can overcome the barriers to electronic commerce and can integrate China into the electronic global economy. Because this involves changing organizational processes and many different government bodies, it will be difficult. Since it is a priority of the government at the highest levels, China may in fact succeed.

The Chinese government has moved beyond just the ability to implement infrastructure. The MII is highly aware of the standards that determine the success and failures of electronic manufacturers and is becoming highly sophisticated in attempts to leverage China's purchasing power to build the capability and capacity of domestic industry. This is perhaps best exemplified by the negotiations of MII and the Interconnecting Networks with Voice Over IP vendors. MII aggressively pushed for the integration of competing Voice Over IP products, staged the competition so that each Interconnecting Network chose a different MII approved vendor, and insured that Chinese manufacturers would, over time, be the predominant manufacturer of Voice Over IP gateways. The success of China's Voice Over IP implementation should not be judged solely on the size of the infrastructure that has been so rapidly deployed, but to what extent the deployment has spurred the growth of China's electronic industry.

It remains to be seen whether government driven efforts such as Red Flag Linux fail or whether China will be able to execute at a level that makes it a powerhouse in the information technology world.

Geography

China has most of the factors that would limit geographical dispersion: large landmass, widely distributed population centers, and rough or hostile terrain. The fact that the Internet had been rolled out to all of the provinces and autonomous regions including Tibet by 1996-1997 is a testament to the commitment of the Chinese government to making sure that all provinces had access to this revolutionary technology.

Demand for Capacity and Connectivity

A major determinant of Internet is the demand for capacity and connectivity. The rapid expansion of international bandwidth from a few megabytes in 1997 to over 559 Mbps by January 2000 has been driven by demand. Many of the provincial ATM backbones are probably being built in anticipation of future traffic.

It is very important to note that the experience of accessing Web sites in China has traditionally been very different from what users in the US expect. Response times for a Web page download for certain users, even on LANs, could range upwards of five minutes. During 1998, certain ISPs such as Sparkice were able to provide download times that were comparable to what Western users expect. Other ISPs have continued to have long delays. Some of this delay can be attributed to poorly designed and overloaded

infrastructure, but some of the delay is most likely attributable to scarce international bandwidth.

It is very difficult to calculate how much international IP bandwidth China should have given its population because such calculations depend on how much traffic stays within country, what applications are used, and how often they are used.

Chinese users on networks such as CERNET and the "169" network face financial incentives not to spend much time surfing the international World Wide Web, if they do at all. By creating financial incentives not to surf international sites, China Telecom and the other Interconnecting Networks have limited the demand for scarce and expensive international bandwidth.

Multiplicity of ISPs and Services Provided

China has over several hundred ISPs. The exact number depends on how you count them. Historically most of the independent ISPs have not been able to compete with China Telecom and its affiliated ISPs. Efforts to build national information infrastructure have failed, in part, because the competitors to China Telecom are dependent on it for global connectivity, local loops, and long haul circuits. It remains to be seen whether Uninet and China Netcom will be able to build viable businesses and whether they will support the growth of viable ISPs. Cable networks, by solving the last mile problem, are probably the most potent potential competitors to China Telecom's affiliated ISPs.

In addition to the traditional services associated with IP connectivity, including Web browsing and e-mail, a rich assortment of services have developed primarily around ICPs in their attempt to become portal sites. During 1999 there was an explosion of Internet Business Providers (IBPs) who offered matchmaking, electronic auctions, and a wide variety of business services, many of them copied from successful sites in the West. The availability and the promise of foreign capital has spurred the proliferation of both ICPs and IBPs and has attracted a significant number of foreign-educated Chinese to return to China to make their fortune.

Though it is not easy to assess how the ICP and IBP infrastructure in China compares with other developing countries, it is safe to state that the infrastructure created by China's competing ICPs is richer than in many other countries with comparable per capita GDPs. These ICPs have certainly contributed to the "buzz" about the Internet in China and have most definitely attracted users to the Internet.

One of the more interesting questions is whether the IBPs will find ways of adding value by circumventing some of the barriers to commerce in China including settlements, logistics, taxes, and lack of trust. The government, through banking reform, development of a certificate authority, and the simplifying of the tax regime can help to put in place a whole new service infrastructure. It is also possible that new services will be created by ICPs that will make B2B and B2C commerce easier.

The deployment of Voice Over IP has helped drive the deployment of three more national IP backbones (Uninet, China Mobile and China Netcom). Now that the price of circuit switched international calls have been lowered to that of international Voice Over IP calls, it is not clear whether Voice Over IP is going to drive the connectivity infrastructure forward.

Culture of Entrepreneurship

Chinese culture, as evidenced by the explosion of commerce in Hong Kong and Taiwan, has a strong element of entrepreneurship in it. It could be more adequately described as family entrepreneurship, not individual, and it has begun to thrive in China. The question is how do family entrepreneurships get started in a communist culture. Many of the founders of family-owned corporations have political or even family ties to the ruling elite. Many in the Communist Party have choosen to "jump into the sea", an expression in China that means letting go of the lifeline of support of the work unit in order to join a joint venture or even start one's own company. But many who have "jumped into the sea" have done this with their connections to the government intact.

Many of the SOEs and even Ministries have engaged in a form of entrepreneurship of their own where they spin off or support companies that fall under their influence. The presence of these companies makes policymaking all the more complex. There have been many efforts to start ISPs and ICPs by government bodies.

There is clearly a strong culture of entrepreneurship emerging. It has been led by returning Western-educated Chinese such as Edward Zeng of Sparkice, Edward Tian of AsiaInfo, and Charles Zhang of Sohu.com. The ability of these leaders to attract foreign capital, build substantial businesses, and in the case of Edward Tian, go public on the NASDAQ exchange, has thousands of others returning from the West. It has also prompted many ambitious Chinese to forego careers in government and academia, in favor of starting Internet Cafes, ISPs, ICPs, and IBPs. It is not clear whether these young entrepreneurs will have the backing from their families, the government bureaucracy, or Western corporations and venture capitalists that is needed in order to survive in the fast-paced world of the Internet. Since March of 2000, there has been significant belt-tightening on the part of both foreign and domestic sources of capital. Venture capitalists are no longer interested in the number of page views a dot.com has, but in its path to profitability.

Forces for change

The biggest driver of the Internet is the desire of the Chinese community to connect—to connect with their friends, family, potential mates, chat buddies, and Western universities. There is also a desire to connect with not only Western culture, but to be part of a global phenomenon. Because the standard of living even in Chinese cities is so low compared to the US, the Chinese will often spend significantly more of their income on Internet connectivity (PC, ISP connection, Internet Cafe fees) than do Westerners. It is not clear whether the elasticity of their demand curve is significantly different than Westerners. If one assumes that the cost of e-mail and Web access in China drops to zero, driven by the demand to get eyeballs, as has practically happened in Europe, what will the effect be on diffusion rates in China? Network benefits associated with the Internet when combined with the "hype" around being connected to it, will insure that the number of users connected to the Internet will continue to double each year. The question is when will the rate of expansion start to slow as it has in the US?

Enablers of Change

The Chinese government is by far the greatest enabler of change primarily through its investments in the educational community, CERNET and its management of China Telecom.

CERNET, by giving over 3 million students and professors access to the Internet, has made a significant contribution far beyond the educational community. These students have convinced their parents and friends to use the Internet—if only convincing them to go to an Internet cafe—so that they can communicate more cheaply with them. In addition, the universities have trained students on how to use information technology and the Internet to transform organizations. Clearly, as the students enter the job market they are going to make a difference in the companies they work for, differences that are essential if China is to take advantage of e-commerce.

China Telecom in many provinces directly supports up to 95% of the commercial users and often provides Internet connectivity to most of the other ISPs. It is not clear how quickly China Unicom, China Netcom, and the cable networks are going to provide real competition to China Telecom in terms of national backbone services. Even more important, it is not clear when ISPs will be able to use satellites to bypass China Telecom's gateway and buy their global Internet connectivity on the global market. The threat of competition, both real and imagined is driving both China Telecom's deployment, and is probably partially responsible for the drop in the cost of Internet access over the past couple years.

Prospects for the Internet in China

Assuming that there is no major political crisis, the Internet will continue to diffuse in China at a moderate rate. China's "co-ordinated competition" and the lack of legal and regulatory transparency will leave its mark on the pattern and rate of diffusion. However, Chinese institutions have demonstrated an ability to execute in terms of deploying Internet infrastructure. If Chinese businesses can take advantage of the Internet to compete in the global economy, the infrastructure will be built.

We can now integrate the discussion of the Dimensions and the Determinants of the Internet. The results reveal some of the trends for the Internet in China, and suggest measures or changes that might be most effective in promoting the growth of the Internet.

Determinants of Pervasiveness

Table 23 illustrates the determinants of Pervasiveness.

Table 23: Pervasiveness: Level 3 (Established)		
Determinant	*State of Determinant*	*Impact on Pervasiveness*
Access to Internet	Internet access is available in all provinces and in most major cities. Availability depends on telephone infrastructure and access charges. The price of PCs is dropping rapidly although is still very high for the majority of Chinese families. Internet Cafes abound. Potential of Wireless Access Protocol (WAP) to enable many new users in the coming years.	**Fair** and rapidly improving.
Perceived Value of the Internet	The Internet has become fashionable in social and economic circles. Companies and governments are talking about the benefit it could bring. The Communist Party and the Government have significant concerns about the Internet's impact on their ability to control the society. This has served to strengthen China Telecom's dominance of ISPs.	**Fair** and improving
Ease of Use of the Internet	Chinese are able to use multiple methods for inputing characters, none of them ideal . E-mail is often sent using Mandarin. URLs are in English. Mandarin domain names being deployed.	**Good** and improving
Cost of Internet Access	100% decrease in user fees per year for the past two years. Telephone access charges have remained steady. Backbone connectivity charges for ISPs are generally usage sensitive and remains high.	**Good** and improving
Forces for Change	China Telecom by its dominance of ISPs has both driven the diffusion of the Internet and has squelched effective competition. JiTong, Unicom, and China Netcom may provide a heightened level of competition.	**Good** and improving
Enablers of Change	Chinese are very social, and have embraced technologies that enhance social interaction and knowledge acquisition. It is not clear how quickly Chinese companies will interact electronically with Western organizations and among themselves.	**Good** and improving

What we can see from Table 23 is that China is still in the process of moving past the 1 Internet user per 100 benchmark. With approximately 16.9 million users, it has

more than some countries and by next year it will have many more. However, the reality is that the majority of its population is rural based and many of them have rudimentary reading skills and no access to computers or the Internet. A fair number of the Chinese intellectuals have found a way to access the Internet though family, a friend or an Internet cafe.

There is a great deal that could be done to increase pervasiveness including providing low cost bandwidth to Internet cafes and allowing the active proliferation of them. Internet Cafes not only provide access, they provide information on using the Internet and on what sources of information to access. The development of low-cost wireless web access may, over time, bring millions more to the Internet in China.

Determinants of Geographic Dispersion

Table 24: Geographic Disperson 3 (Highly Dispersed)		
Determinant	*State of the Determinant*	*Impact on Geographic Dispersion*
Access to Internet	China Telecom's Internet backbone has reached every province. The provincial IP backbones access most major cities or are available via DDN or X.25. Telephone infrastructure is being deployed to every village. Most universities have access to CERNET.	**Good** and improving
Perceived Value of Expanded Geographic Scope	The Chinese government is unsure on how quickly to distribute Internet access to the county and village level. First is a question of cost, second of benefit and third of control.	**Good** and improving
Adequacy & Fluidity of Resources	China Telecom has been willing to invest in an Internet infrastructure by subsidizing it with telecom revenues. Foreign investors have invested heavily in ICPs and if China acceeds to the WTO, will most likely invest in ISPs and backbone providers. Until recently there was not the resources available to build national backbones and compete with China Telcom.	**Fair** and improving
Regulatory/legal Framework	The absence of a Telecommunications Law, the Interconnecting Network restrictions, and the lack of transparency in regulatory activities has stifled the development of competing national backbone providers. The difficulties that private ISPs have faced have also limited geographic dispersion. On the other hand, China Telecom, a government entity, has been responsible for most of the geographical diffusion.	Fair and improviing
Ability to Execute	China Telecom has been enormously successful for a bureaucracy in terms of its rollout of the Internet. CERNET has also implemented a highly professional network operation.	**Good** and improving
Geography	China is a vast country with mountainous terrain. China's deployment of a national fiber optic backbone is evidence of its commitment to connect the whole country	Not changing
Forces for Change	China's WTO accession with its potential of opening up the telecommunications services to investment and legitimating foreign investment in ISPs, ICPs, and IBPs could greatly increase competition in the Internet sphere. It could potentially undermine China Telecom which to this point has	**Good** and improving

	been the greatest driver of the Internet.	

Despite limited competition in terms of backbone networks, China has done remarkably well at geographic dispersion and has done so rather rapidly. Even though China did not officially embrace the Internet until 1995-1996, multiple national backbones were in place by 1996. The fact that the provincial Data Telecommunication Bureaus in each province are responsible for building their provincial networks has meant that provinces have had a role in provincial dispersion of the Internet.

Determinants of Sectoral Absorption

Table 25: Sectoral Absorption: Level 3 (Widely Used)

Determinant	State of the Determinant	Impact on Sectoral Absorption
Access to Internet	Dial-up access can be obtained in most major cities. The availability of leased lines (DDN) is still a limiting factor as is cost of leased lines. CERNET provides access to most Universities. Unicom and China Netcom may increase availability of high bandwith lines.	**Good** and rapidly improving
Perceived Value of the Internet	The perceived value to Universities is high. Business are investing in dial-up accounts, but are slower to invest in leased line connectivity.	**Fair** and improving
Ease of Use of the Internet	While use the Internet is relatively simple, integrating an organization into the Internet is not. Many ISPs, IBPs, and ICPs now offer Web host and design services, lowering barriers to entry	**Fair** and improving
Adequacy & Fluidity of resources	ISPs have had difficulty getting the financing to build national backbones and to compete with China Telecom. Uninet and China Netcom may be changing that. Organizations lack human resources to integrate enterprise systems into the Internet.	**Fair** and improving
Legal and Regulatory Framework	The country lacks a legal and regulatory framework that will facilitate competition and lower the cost of organizational connectivity. A good deal of work needs to be done to establish the proper legal framework for electronic commerce: the development of a national settlement system; the development of a digital signature system; and the adoption of tax and accounting laws to properly handle electronic transactions and to not penalize organizations that automate transactions.	**Fair** and slowly improving
Forces for Change	CERNET has driven adoption in the academic sector and contributed to increasing the human resources available for organizational transformation. The "Government Online" project is bringing many government organizations on to the Web at the national, provincial, and government levels. What impact the "Government Online" project will have on absorption in the business sector is not clear	**Good** and improving
Enablers of Change	University and public sectors are most open to change, and have the financial and human resources necessary to carry it out. Business sector has embraced dial-up access. SOEs are embracing leased line access and are being followed by the private sector.	**Good** and improving

Sectoral Absorption is highest in the university portion of the academic sector. During 1999 – 2000 under the "Government Online" project, government organizations established leased line connectivity, e-mail systems, and developed Web pages. The business community initially started by using dial-up accounts for e-mail and by placing "brochureware" on Web-intermediary sites. Starting with the SOEs, organizations are connecting their intranets to the Internet through leased lines, mainly at 64Kbs. Business organizations are starting to operate their own Web sites and slowly moving into electronic commerce. In the health field, there have been numerous experiments with Telemedicine, particularly in the military arena, but lack of resources and bandwidth has hindered wide spread deployment in the civilian medical sector.

Determinants of Connectivity Infrastructure

Table 26: Connectivity Infrastructure (2.5) Expanded, approaching Broad		
Determinant	*State of Determinant*	*Impact on Connectivity Infrastructure*
Perceived Value of Extensive Connectivity	China Telecom has built an extensive national backbone and its provincial arms are building major provincial backbones. China Netcom, ChinaGBN, Uninet, and China Mobil Telecommunications are also building major national backbones to compete. MII policy-makers repeatedly warned against resource duplication.	**Fair** and improving
Cost of Connectivity	The cost of global Internet connectivity has decreased throughout the world. More and more is being offered at lower prices. Many believe that China Telecom's bottlenecks on the gateway and local loop have kept prices higher than they would be in a competitive market	**Fair** and improving
Adequacy & Fluidity of Resources	Chinese government has chosen to invest heavily in CERNET and China Telecom Internet infrastructure. Foreign investors seem eager to invest in both the ICP and ISP markets because of the size of the Chinese market. If the ban on foreign investment on telecommunications is relaxed there should be funds available to support substantial competition to China Telecom.	**Fair,** could improve rapidly
Legal and Regulatory Framework	The Legal and Regulatory framework has not protected builders of national backbones. Those that survived, such as ChinaGBN had the backing of the powerful MEI. Both Uninet and ChinaNetcom are "sons" of the government and have powerful backers in high places. If they succeed, second tier ISPs will have a chance. China is not the right place to run a national ISP without the right connections.	**Fair** and changing but not clear how rapidly.
Ability to Execute	China Telecom demonstrated its ability with the help of Asia Info to execute when it built the national backbone in 1996. CERNET also demonstrated remarkable ability. In Voice over the Internet, China has also moved rapidly and decisively and the government has taken advantage of competition to increase its power with foreign companies.	**Good** for a former monopoly
Demand for Capacity	International bandwidth has always been a constrained resource for China, but China Telecom has been rapidly expanding international bandwidth. Some of the provinces are building high capacity backbones in anticipation of demand for video and high bandwidth services.	**Good** and improving
Multiplicity of ISPs	Though there are many ISPs, those not part of local PTAs have had a distinct competitive disadvantage. This could change if the ChinaNetcom, Uninet, and a national cable network become vigorous competitors. It is not clear how many more Interconnecting Networks the government will allow.	**Fair**, could improve rapidly.
Services Provided	Leased lines of 64 Kbps have been available from DDN, but are not plentiful in some areas of the country. Provision of high-speed/low cost Internet access services (e.g. cable modems and xDSL) are in trial stages.	**Fair** and improving
Forces for Change	China Telecom at the national, provincial, and local levels	**Good**

	is pushing the deployment of China's connectivity infrastructure. The potential competition of Uninet, ChinaGBN, and China Netcom is undoubtedly driving it forward as is its organizational desire to be the telecommunications service provider for the country	

Much of China's Connectivity Infrastructure has been driven internally by China Telecom in response to consumer demand and in anticipation of the requirement by business organizations for more value-added services and higher bandwidth. It is assumed that the revitalization of ChinaGBN and the emergence of Uninet and China Netcom will only serve to heighten China Telecom's investment in connectivity infrastructure. At the same time, each of these competing networks, by building its own infrastructure, is making a significant contribution to overall national connectivity. Though some planners at MII talk about the danger of duplication of resources, the reality is that the market will most likely prove a better allocator of Internet resources than can be done by the China Telecom bureaucracy. The question is how quickly can competition be brought to China's connectivity infrastructure without significant legal and regulatory reform. In the meantime, it seems that MII is committed to having multiple competing Interconnecting Networks and is able to use its power to ensure that this happens.

The emergence of a national network access point or exchange is essential for allowing the other Interconnecting Networks to compete with China Telecom. With broadband connectivity between their networks, the competing ISPs can route traffic directly to China Telecom rather than routing it through expensive international links.

It must be pointed out that there are elements both with MII and within the government as a whole that believe that unlimited international connectivity is not necessarily a good thing and that China would be much better off if it could keep most of its users and organizations on the Multimedia "169" network and build China's Intranet. This nationalistic concern is aligned with China Telecom's desire to limit demand on its expensive international bandwidth. On the other hand, some users on the Internet want access to international sites and are willing to pay more for that access. Thus we see the emergence of schemes where users on the "169" network have a choice of paying more to view international Web sites. Again, it is important to note that even the users of the domestic only Intranet have the option of sending e-mail to anyone in the world. CERNET has also implemented a policy where users who access international sites are billed for them.

Thus, China has been able to implement and charge for a differentiation in service that reflects the difference in price between global connectivity and China connectivity. Such a differentiation is probably essential if China moves to offering high bandwidth connectivity such as cable modems and xDSL. ISPs simply can not afford to allow large number of users to download high bandwidth applications, such as movies, from the West without charging them a special fee.

Determinants of Organizational Infrastructure

Table 27: Organizational Infrastructure: Level 2.5 (Controlled-Competitive)		
Determinant	*State of the Determinant*	*Impact on Organizational Infrastructure*
Access to Internet Backbone	The terms and conditions under which ISPs have had to agree to access the Internet has often undermined their competitiveness. The emergence of new Interconnecting Networks may be changing this	**Fair** and improving
Perceived Value of Complex Organizational Infrastructure	There are some in MII who have doubted competition and even today there is concern about duplication of resources. There is also a concern whether China Telecom will prosper if faced with foreign-backed competition.	**Fair** and getting better
Cost of Internet Access	Internet access fees are high for ISPs which must compete with China Telecom-linked ISPs for customers. China Telecom fees for actual traffic make turning a profit difficult.	**Fair** and getting better
Adequacy & Fluidity of Resources	Limits on foreign investment for ISPs have greatly limited competition. This could change	**Fair** and could get better quickly
Legal and Regulatory Framework	The legal and regulatory framework has allowed the proliferation of ISPs. The requirement that only Interconnecting Networks can have global Internet access has reduced competition. In response to WTO accession agreement, MII is promising to come out with a Telecommunications Law	**Fair** and might get better.
Forces for Change	The force for change has partly been coming from the US and Europe, who have pushed for the opening up of the telecommunications sector to foreign investment and competition. There has also been an effort on the part of many both within MII and without to increase competition in IP backbone services.	**Fair** and getting stronger.
Enablers of Change	The environment has been highly conducive for the development of ICPs. How big an effect they will have on the overall industry remains to be seen especially as investment capital tightens up.	**Fair** with possibility of change

China is entering a critical stage in its development of a robust organizational infrastructure. The entrance of Uninet and ChinaNetcom, when combined with ChinaGBN, represent a significant potential for competition in the Interconnecting Network business. These companies still face China Telecom's of the local loop. One potential alternative is cable networks. So far MII has prevented widespread use of the cable networks to provide "last mile" connectivity to home and business that bypasses China Telecom. In preparation of foreign investment into the telecom sector, MII has promised to implement a regulatory infrastructure for ISPs and to govern foreign ownership. It is not clear whether MII will attempt to undermine competition or enhance it. China's organizational infrastructure may get stuck at Level 2.5 between the

controlled and competitive level or it may make a significant breakthrough to the competitive level within the next two or three years.

Determinants of Sophistication of Use

Table 28: Sophistication of Use: Level 2.5 (Conventional-Transforming)		
Determinant	*State of Determinant*	*Impact on Sophistication of Use*
Access to Internet Backbone	The Internet is available on a dial-up basis in most major cities. Organizational connectivity is available. Ministries and many SOE's have limited dedicated access to the Internet backbone. Private enterprises are slower to connect.	**Fair** and improving
Perceived Value	Though there is much hype about the potential of e-commerce, the number of organizations who know how to re-engineer themselves to take advantage of the Internet is small. The value of implementation is still less than the risk.	**Fair** and improving
Ease of Use	Many Chinese organizations face major challenges in standardizing and automating business processes to take advantage of the Internet.	**Fair** and improving
Adequacy and Fluidity of Resources	Foreign investment is chasing IBPs and other intermediaries. It is not clear whether the resources are there to transform organizational processes within a firm. There is also a shortage of people with the skills at automating organizations.	**Fair** and improving
Legal and Regulatory Framework	There has been little legal support for automating transactions. A digital signature regime still needs to be developed as does a legal and regulatory regime. Settlement infrastructure needs to be both developed and needs legal and regulatory support.	**Poor** and will improve, question is how quickly.
Culture of Entrepreneurship	Entrepreneurship is alive but struggling in the ICP and now IBP communities. There is also a strong entrepreneurial culture among family owned manufacturers. It is not clear though how quickly these family-owned companies and under what circumstances these companies will invest heavily in IT. SOE's have less culture of entrepreneurship, but tend to invest more heavily in IT.	**Fair** but will change dramatically during next five years.
Forces for Change	Companies that are the first to integrate electronically into global supply chains will have a major competitive advantage over those that can't. The pursuit of profits will drive certain key firms to take major risks and invest in advanced enterprise and inter-enterprise IT. Once these companies are successful everyone else will jump on the bandwagon. Over the last couple years, the technical elite in China has begun to take the lead in developing next generation protocols such as IP v. 6 and Voice Over IP. This bodes well for the Chinese electronics industries.	**Fair** and will take a couple years to build momentum.
Enablers of Change	One of the enabling factors is the "demonstration effect." As the number of organizations and individuals demonstrating a particular level of sophistication grows, the amount of "follow the leader" grows as well. At present, the demonstration effect primarily causes companies to have Web brochureware on a Web intermediary and to have an e-mail address. In the future, this will involve more sophisticated levels of IT integration. Often firms may imitate what a leader is doing without fully	**Good**

	understanding the processes involved.	

At an individual level, the Chinese are integrating the Internet into their lives in ways that go far beyond being just a substitution for written and telephone communications. The strength of the ICPs has encouraged people to use the Internet to seek partners, participate in auctions, and to extend their social circles. Chinese organizations, on the other hand, have been slower to integrate information technology and the Internet in ways that transform business processes. China does not have as strong a tradition as the West of standardizing and automating business practices. Depending on personal relationships to facilitate business is not only part of the culture but it is essential for negotiating the complexities of operating under a highly heterogeneous and complex country. As more and more functions become routinized such as logistics, it is possible to automate transactions to a higher and higher degree. One of the dangers of automating transactions is that it makes them more transparent to the myriad number of State organizations at the national, provincial, and local level that might have an interest in the enterprise. Thus there is a risk that an enterprise that automates all its transactions may be placed in a more vulnerable position. Having access to all the transactions in an enterprise does not necessarily empower management. Few Chinese manufacturers have invested in comprehensive ERP systems from companies like SAP and People Soft. These solutions are seen as both too expensive and running the risk of not providing the flexibility required to operate in the Chinese environment. For Chinese family-owned enterprises, to invest in inter-enterprise resource planning applications, the cost must go down, the potential gains must go up, and somehow the government must lessen the risks involved in having all transactions transparent to relevant authorities.

Educational institutions such as Tsinghua are taking the lead in terms of developing expertise and experience with ERP systems. Tsinghua is also taking a leadership role in the development of the next generation Internet.

Government Policy and the Determinants of Internet Diffusion

The most important determinant, government policy, belongs in a category by iteslf. These policies overlay all other determinants, affecting both their nature and their effectiveness, based upon a government's ability to exercise coercive power and to use it to coordinate society. The following table illustrates some of the ways in which the PRC government has influenced the determinants discussed in the previous table. The table can be used to suggest ways in which the government can impact the development of the Internet in China. Each of these measures can be classified according to whether it is likely to be a high impact or a low impact measure. High impact measures are those that are likely to have a strong and relatively quick impact on one or more of the Internet dimensions. Each measure can also be classified according to whether it is easy or difficult to implement.

Table 29: Selected Internet-Enhancing Options for Government Policy Makers

Determinant	*Measures taken by government*	*Measures that might be taken by government*	*Impact/Difficulty*
Access	Investment in ChinaNet	Allow significant foreign	High/Moderate-Difficult

	and CERNET. Approval of ChinaGBN, Uninet and China Netcom	investment in Telecoms. Abolish Interconnecting Network Regime. Allow cable companies to offer Internet service.	
Perceived Value	"Government online", allowing ICP industry to flourish. Government trying to "control" media and flow of information	Promoting policies to increase flow of information (including allowing reporting by ICPs). Removing disincentives for transparent transactions. Foreign investment in ICPs.	High/Difficult
Ease of Use of the Internet	Encouraging Chinese content. Promoting ICP, IBPs, and Internet Cafes	Provide Internet facilitators for villages with low cost access.	Moderate/Moderate
Cost of Internet Access	Reduction of tariffs	Further reduction of charges for international circuits. More competition among Interconnecting Networks and for local loops	High/Easy to lower price of circuits, much more difficult to implement competition for local loop
Adequacy & Fluidity of Resources	Allocated significant resources for CERNET and ChinaNet. Turned blind eye to foreign investments in ICPs.	Allow foreign investment in telecoms	High/Under WTO 50% foreign ownership is proposed, higher percentage ownership is difficult.
Regulatory/Legal Framework	It is legal to operate an ISP or Internet Cafe as long as connectivity comes from an Interconnecting Networks	Provisions that ensure more competition between Interconnecting Networks. Rules for foreign investment in Telecom	High/Difficult
Ability to Execute	Government responsible for the success of ChinaNet and CERNET. Much decision-making is decentralized.	Allow enlarged role for private sector.	Moderate/Moderate
Demand for capacity	Allowed users access to Internet	Create conditions for expansion of business use	Moderate/Moderate
Multiplicity of ISPs.	Allowed ISPs but China Telecom had upper hand	Allow foreign investment; abolish Interconnecting Network regime; open up local loop to competition	High/Moderate-Difficult
Services provided	Creation of multiple IP backbones; controlled release of Voice over the Internet.	Decontrol of Voice over the Internet and Video over the Internet.	Moderate/Moderate
Culture of Entrepreneurship	Turned blind eye to foreign investment in ICPs. Is gradually allowing integrators and ICPs to go public on foreign exchanges.	Ensure a predictable regulatory environment for enterprises to grow and prosper.	High/Moderate
Forces for change	Cultivation of champions in business and industry who can lead informatization of society.	Ensure a predictable regulatory environment that does not penalize firms on the cutting edge of Internet implementation.	High/Difficult
Enablers of change		Continue to fund academic and research community	High/ Moderate

		which provides leadership for informatization process also educates next generation	

Conclusions

Over the next five years, China will be wrestling with the balance between Central Government control over the Internet and the value of competition and decision making decentralization. One of the biggest challenges that the Central Government has faced in making Internet policy is the number of different agencies that have a stake or an interest in the Internet. Without one decision-maker it is more difficult to come to a consistent set of policies that can be externalized as rules or laws.

Because of the opening established through the WTO accession negotiations, China must now come up with a regulatory environment that harnesses the power of foreign investment while ensuring that the government is still in substantial control of its communication infrastructure. Having the state-owned China Telecom in control of most ISPs, the gateway, and the circuits that the other Interconnecting Networks use, was one way of maintaining control. The whole Interconnecting Network regime was another way to ensure not only that MII stayed in control of the private ISPs and ICPs but also that it stayed in control of Internet ventures of other government organizations. Too much intergovernmental rivalry could make it difficult to coordinate government Internet policy.

The Internet is quickly becoming too valuable to China and to individual ministries to have it cut off, but how quickly it will transform Chinese society is still an open question. How well are the top-down government informatization processes going to work? What can be done to get the agile private manufacturers to invest in automating their transactions with the West? Clearly, the more competitive the ISP, ICP, and IBP markets are, the more likely they are to develop solutions that can both lower the cost and increase the benefit of connectivity.

It must be pointed out that China has done fairly well by China Telecom. For a national bureaucracy, China Telecom has been extremely effective and fast in deploying a national backbone and ISPs in most major cities. As a decentralized organization, it has been able to effectively implement a decentralized technology. How well it is going to do in the ICP and IBP markets is open to question. China has clearly benefited from the significant amount of competition in the ICP market, a market that China Telecom plays in but does not dominate. It could be argued that a strong China Telecom is necessary for China to make the necessary investments in national infrastructure. This is especially true if foreign investment is ruled unacceptable. With China Netcom and Uninet joining ChinaGBN as alternative Interconnecting Networks, China has made a choice for competition if only for competition between the chosen "sons" of the government.

What is unclear is how quickly MII and the State Council will allow other networks such as the cable networks to become Interconnecting Networks. As mentioned earlier, the US Trade Representative believes that the PRC has committed to opening up global Internet connectivity through the WTO accession document by agreeing to 35% foreign ownership in international packet switching. What regulatory regime these firms operate under remains to be seen. Will it be one in which any firm can enter, or will it only be only "state-owned" firms specially chosen by either the State Council or MII? There is a significant potential for conflict between the United States and China based on the Chinese government's belief that it must maintain "control" over telecommunications and the media. US companies will almost inevitably lobby the US

government to pressure the Chinese to give US companies more control over their investments and more ability to compete against State-owned efforts such as China Telecom. The US Trade Representative knows that the WTO process will have to be aggressively negotiated every step of the way. The question remains how far can the US push before causing a backlash on the part of conservative elements in the Chinese Communist Party.

As long as there is no major organized resistance to the State, conservative elements in the Communist Party will probably allow the expansion of the Internet. The State will find one way or another to ensure conformity on the part of both individuals and organizations. Even in the face of the potential avalanche of foreign investment, the State will find ways to stay in control even if it means using the threat of force. The real challenge the Communist Party faces is how to open up the Internet to competition while ensuring that irresponsible state-owned enterprises don't squander government resources on ill-advised Internet ventures.

The Chinese Communist Party and the State are taking a calculated risk in providing citizens with ready access to the Internet. They are doing so because they believe it will pay significant economic dividends and will allow China to keep up with the world. Over the course of its five-year history, the Chinese Internet has only begun to produce these dividends. Most observers, including the government believe that it is B2B electronic commerce that has the potential to make a significant impact on the Chinese economy. There are significant cultural and legal barriers to full-scale integration of Chinese businesses into the global electronic economy. However, the potential for profits and the threat of competition is an incredibly powerful force that will drive transformation of China's manufacturing sector. There are significant opportunities for those firms that can figure out how to lower the risks and costs involved in standardizing and automating business transactions. What is not clear is how long it will take for leaders to emerge and for the general economy to follow. China is a significant number of years behind the United States in terms of the integration of information technology. Can China jump into the mainstream of e-commerce within two to three years or will it take longer?

If e-commerce is going to rapidly transform the Chinese manufacturing sector, the question must be asked whether it will support wise long-term decisions. Globalization and information technology may only exacerbate the problems associated with negative externalities including cultural and environmental degradation.[109] It remains to be seen whether the Chinese will be able to create a knowledge economy that not only supplements its manufacturing sector but which serves as a funnel to channel the industrial economy in a way that is in harmony with the environment. This is the ultimate challenge for the Internet in China.

There are some in the West, including some US politicians, who believe that the ultimate consequence of the Internet will be to undermine the Chinese Communist Party. It is believed that once individuals have the communication power of the Internet they will inevitably use it to resist an authoritarian government. This attitude makes assumptions about what is really important for the Chinese and ignores the weight of cultural tradition. The 22 year old in a Chinese Internet cafe today is more interested in learning something new and increasing his social and economic well being than he is in

criticizing the status quo. In this respect, his goals are aligned with the goals of the government.

If we reject technological determinism, it can be assumed that Chinese society will harness the power of distributed computing in ways that are different from the West. With the Interconnecting Network regime we have seen the willingness of Chinese to develop their own institutions for maintaining the delicate balance between control and competition.

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Appendix 1: Key Government Bodies involved in Internet

Key Policy Bodies		
Name	Historical Mission	Interest in Internet
The Chinese Academy of Sciences (CAS)	Scientific research policy-maker and host of hundreds of research institutes	Technology transfer; Internet-oriented research and development
Chinese Academy of Social Sciences (CASS)	Provide government decision makers with information and analysis.	Research regarding social impact of Internet; Electronic Commerce
Internet Information Management Bureau	New body under State Council Information Office	Ensure that ICPs conform to government content guide[1]lines.
Propaganda Department Of Communist Party	Makes sure that media is under the control of the Party	Especially concerned with the influence of Western information and the role of the Internet as media.
State Council	Highest organ of State executive and administrative power	Ensure that Internet and the Ministries that are involved with it are serving the interest of the State.
State Council Information Office	Close ties to Propaganda Department	Oversees much of Internet content policy
State Economic and Trade Commission (SETC)	Policy decisions regarding infrastructure and relationships with foreign firms	Foreign investment in China's Internet Infrastructure
State Planning Commission (SPC)	Controls China's economic resources	Funds for infrastructure; pricing of Internet services. Some of this responsibility is being shifted to MII.
Ministry of Culture	Controls the distribution of cultural products	Music and Movies sold on the Internet
Ministry of Education	Policy-maker and administrator for China's education system	Internet support for university and secondary education
Ministry of Information Industry	Combination of Ministry of Posts and Telecommunications and Ministry of Electronic Industries	Information Technology Decision-Maker and Regulator
Ministry of Public Security (MPS)	Police of Chinese society	Ensure Internet is not used to leak state secrets, conduct political subversion, or spread pornography or violence
Ministry of Science and Technology (MST)	Policy-making and financing of China's research and development	R&D for Internet
Ministry of State Security	Protect State Security	Encryption. Ability to decode traffic on the Web and prevent foreign services from doing so.
People's Bank of China	Loans to Chinese firms	Control of electronic currency and certificate authority
People's Liberation Army	State Security; also has ties to many	Security issues; has wanted to

	manufacturing interests	expand into Internet provision
State Administration of News and Publication	Formely part of Propaganda Dept. Gives permission for official publication	Traditional press moving to Internet
State Administration of Radio, Film, and Television (SARFT)	Manage cable networks	Internet access through cable
State Press and Publishing Bureau	Regulates publishing industry	Regulate the selling of books over the Internet
State Administration of Industry and Commerce	Register businesses	Register B2C e-commerce sites. Grants advertising licenses
State (National) Information Office	Disseminate information about government to the public	Internet as a tool for disseminating information.
Xinhua News Agency	Monopoly news producer	Leverage and protect monopoly on news
Provincial and Municipal Bodies	Moving away from Central government in pursuit of their own economic development	Develop Internet infrastructure. Attract investment through Internet

Appendix 2: Key Regulations

1. MPT's decision to open up computer information services and e-mail to non- MPT entities (MPT Order #675) (Sept. 1993).

2. MPT's notification concerning issues pertinent to examination, approval and management of organizations engaging in Telecommunications industry (Oct. 1993).

3. Security regulations for Computer Industry Security (Order No. 147) that authorize the Ministry of Public Security (MPS) to be in charge (1994).

4. MPT's rules on the management of open market telecommunications (Nov. 1995).

5. MPT's rules on examination, approval and management of telecommunication terminal equipment (Nov 1995).

6. MPS's requirement for users to register with the MPS (MPS #7) (Jan. 1996).

7. The State Council's decision to allow interconnection but only through Interconnecting Networks (Order 195) (Feb. 1996).

8. MPT regulation specifying terms and connection methods of international Internet connections (MPT #492/403) (Apr. 1996).

9. Steering Committee on National Information Infrastructure set up on April 16, 1996 (Order 195).

10. MPT's provisional rules on Interconnection between Special Networks and Public Networks (July 1996).

11. MPT's public notice concerning issues on management of content of telecommunication information service (Aug. 1996).

12. MPT's measures on the management of China public multimedia communication (Sept. 1997).

13. MPT outlines ISP licensing procedures (MPT #36) (Dec 96).

14. The State Council Order #218 – Amends #195, designates 3 categories of computer networks related to the Internet. (May 1997)

15. MPT's Requirements for ICP licensing for multimedia 'operators' and 'providers'. (MPT #28) (Nov. 1997).

16. MPS releases regulations for use of the Internet (MPS #7) (Dec. 1997).

17. MII attempts to assert MII responsibility over Internet regulation (MII #573)(Sept. 1998).

18. State Council issues regulations on the use of encryption and puts National Commission on Encryption Code Regulations (NCECR) under the Ministry of State Security (MSS) in charge (State Council Directive 273) (Oct. 1999).

19. State Council's State Information Office issues regulations regarding the release of state secrets through the Internet. The Bureau for the Protection of State Secrets in charge (Jan. 2000).

Appendix 3: MII Mission Statement

MII's Mission (08/98)[1]
1. Research and formulate the development strategy, policy, and overall planning of China's Information industry; revitalize the manufacturing industry of electronic information products, the telecommunications industry, and the software industry; promote the informatization and China's economy and social services.
2. Formulate laws, regulations and directives regarding the manufacturing industry of electronic information products, the telecommunications industry, and the software industry; responsible for the administrative implementation and monitoring of those laws, regulations and directives.
3. In charge of the overall planning of all networks including China's public telecommunications networks (local and long-distance networks), Radio and TV broadcasting networks (wire and wireless TV networks), military networks and all private networks owned by others; responsible for overall sector administration.
4. Coordinate and publish technology policies, technology architectures and technology standards for the electronic information products industry, the telecommunications industry, and the software industry; publish technology architectures and standards for the radio and TV transmission networks; responsible for the approval of telecommunications networking equipment and terminals; provide guidance on quality monitoring and administration for electronic information products.
5. Responsible for the allocation and administration of China's public telecommunications resources including frequency spectrums, satellite slots, network IDs, domain names, and IP addresses; In charge of the construction approval, tracking and monitoring of all the radio stations including coordinating radio administration, signal interference, and signal control.
6. Monitor and administrate, based on laws, the telecom and information service market; implement the necessary operation licensing system; monitor service quality; insure open competition and universal services; safeguard national interests and consumer interests; formulate the interconnection rules and settlement methods among various networks and monitor the implementation.
7. Formulate policies on rates of telecom and information services; determine pricing standards on basic posts and telecom services and monitor the implementation.
8. Responsible for the planning, construction and administration of private networks for Communist party and governments; manage and administrate national telecom network monitoring and controlling center and international gateways; coordinate the operation of special telecom services for communist party and governments, disaster emergency telecom services and other important telecom services; protect the national telecom security and information safety.
9. According to the industry policy and technology development policy, guide and nurture the development of information industry; guide the adjustment of the structure of industry, products, and corporations; guide the re-organization of state-owned enterprises and the formulation of holding groups; reasonably allocate resources and prevent duplication of projects.
10. Advance the R&D of the manufacturing industry of electronic information products, the telecommunications industry, and the software industry; coordinate and implement the major R&D projects and the digestion, absorption and improvement of imported technologies; promote the commercialization of R&D outcomes; nurture and promote indigenous industry.
11. In charge of the military electronic industry; formulate development strategy, policy and planning for the military electronic industry; cooperate in planning with the military and the Commission for Defense Science, Technology and Industry; implement the plan.
12. Formulate development planning for the informatization and national economy; promote China's key

informatization projects; guide, coordinate and organize the development and applications of information resources; guide the broad adoption of electronic information technology and promote the education of informatization.
13. Organize and guide the financial submission, internal redistribution and settlement of major post and telecom enterprises; coordinate the operation between post and telecom services; implement the subsidization of universal services on post and telecom sectors; implement the human resource authority on its staff in MII and top managers in affiliated organizations.
14. Represent China in international organizations and sign bilateral agreements; coordinate economic and technical cooperation and exchanges with foreign countries; handle all the relevant foreign affairs.
15. Study telecom and information policies regarding the Special Administrative Region of Hong Kong, and Macao and Taiwan; handle relevant issues.
16. Publish the statistics and other information regarding information industry.
17. Responsible for other authorities assigned by the State Council.
According to the State Council, the National Bureau of Post Services is under the auspices of the MII.

Glossary

ADSL	Asynchronous Digital Subscriber Loop
ATM	Asynchronous Transfer Mode
B2B	Business to Business E-commerce
B2C	Business to Consumer E-commerce
CAS	Chinese Academy of Science
CASS	Chinese Academy of Social Science
CATV	Cable television
CCF	Chinese-Chinese-Foreign investment method
CCP	Chinese Communist Party
CEInet	China Economic Information Network
CERNET	Chinese Education and Research Network
ChinaGBN	China Golden Bridge Network
CNC	China Netcom
CNISTEC	China National Information Security Testing, Evaluation and Certification Center
CSTNet	China Science and Technology Network
DDN	Digital Data Network
DWDM	Dense Wave Division Multiplexing
EDI	Electronic Document Interchange
ERP	Enterprise Resource Planning
GDCB	Guangdong Data Communication Bureau
GDERNET	Guangdong Education and Research Network
IBP	Internet Business Provider
ICP	Internet Content Provider
ISP	Internet Service Provider
IP	Internet Protocol
IPO	Initial Public Offering
MEI	Ministry of Electronic Industries
MPT	Ministry of Posts and Telecommunications
MBMT	Ministry of Broadcasting
MII	Ministry of Information Industry
MOFTEC	Ministry of Foreign Trade
MPS	Ministry of Public Security
MSS	Ministry of State Security
MST	Ministry of Science and Technology
NAP	Network Access Point
NECR	National Commission on Encryption Code Regulations
NPC	National People's Congress
PLA	People's Liberation Army
POP	Point of Presence
PTA	Post and Telecommunications Administration
QOS	Quality of Service
SARFT	State Administration for Radio, Film and Television
SCPB	Standing Committee of the Politboro
SDH	Synchronous Digital Hierarchy
SEC	State Education Commission
SETC	State Economic and Trade Commission
SPC	State Planning Commission
SOE	State Owned Enterprises
TDM	Time Division Multiplexing
URL	Uniform Resource Locator
VSAT	Very Small Aperture Terminal
WDM	Wavelength Division Multiplexing

WAP	Wireless Access Protocol
WTO	World Trade Organization