Internet development in China

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Abstract.

This article describes the status of Internet development and application in China. It introduces the Chinese search engines as well as four main domestic networks connected to the Internet and analyses Internet applications in five major fields in China: e-government, e-commerce, distance education, distance medical treatment, and digital library. It also discusses China's Internet management and related issues and problems and provides an overview of Internet development in China.

1. Introduction

Fourteen years ago, Qian Tianbai, a professor of the Chinese Academy of Science (CAS), sent out the first e-mail message from China, lifting the curtain of Internet utilization and development in China. Twelve years later, millions of people in China watched the live broadcast of China's National Military Review via the Internet. Today many well-known domestic Internet service providers and news service agencies have established electronic network stations publishing daily events and programmes of national or international importance. Before many people have realized it, the Internet has now become an essential part of their lives in China.

The development of the Internet in China has undergone two major phases [1]. The first phase spanned from 1987 to 1993. During this phase, the High-Energy Physics Laboratory of CAS and a few scientific research institutes began accessing the Internet and establishing e-mail services between the academy institutes through CHINAPAC.

In 1989, the High-Energy Physics Laboratory of CAS implemented e-mail transmission services; institutions such as Fudan University, Shanghai Jiaotong University, and Tsinghua University became connected to the Internet. In 1994, China Science and Technology Net (CSTNET) became directly connected to the Internet and received 'CN' as the highest-level domain name for China.

The second and present phase started in 1994. During this period of time, China has implemented TCP/IP connections and begun offering full Internet services. It is during this phase that CSTNET, CHINANET, CERNET and CHINAGBN (some of China's most important networks) have been authorized by the national government and founded as owners of independent international channels. These networks have become the nation's first-level Internet service providers who can both build primary networks and communicate with each other.

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2. The largest networks of China

2.1. CSTNET

CSTNET [2, 3] is based on the NCFC network and on the CASnet of the Chinese Academy of Science, and is connected with networks maintained by other Chinese science and technology departments. NCFC is an advanced technology information foundation project sponsored by the World Bank and supported by the National Project Committee, the National Science Committee, the Chinese Academy of Science, the National Natural Science Funds Committee, and the National Education Committee. The project is led by the Chinese Academy of Science and jointly conducted by CAS, Beijing University, and Tsinghua University. The NCFC network consists of two parts. The lower part is composed of the campus nets of CAS, Beijing University, and Tsinghua University. The higher part is the backbone network connecting with other domestic research and educational organizations' campus networks and with the global Internet. CASnet is a countrywide network of CAS, which also consists of two parts, one part being local area networks of sub-academies, the other a wide area network connecting all sub-academies' and graduate schools' local area networks scattered throughout the country. Currently such connections are established via high-speed satellite channels.

2.2. CHINANET

CHINANET [2, 3] is a public network founded in 1995 and managed by China's postal services organizations. It consists of a backbone and connected networks. The backbone connects the net nodes of the country's municipal cities as well as provincial capital cities. Each such connected net node further consists of net nodes within each municipal city or province. Presently, CHINANET covers more than 20 provinces and over 200 cities and is the largest and fastest-growing computer network in China.

2.3. CERNET

In 1994 CERNET [2, 3], funded by the State Project Division and led by the Ministry of Education, started its operations. Generally known as an educational network, its objective is to connect universities, colleges and high schools of China so as to improve the nation's educational and research environment and accelerate educational and research development.

CERNET was developed by Tsinghua University, Beijing University, and 10 other key universities of the nation. It is a three-level network that includes a countrywide backbone, regional networks, and campus networks. The centre of CERNET located in Tsinghua University is responsible for the planning, implementation, operation and management of the network. Regional network centres are located in Beijing, Shanghai, Nanjing, Xi'an, Guangzhou, Wuhan, Chengdu and other places. These regional centres provide connection services for the local campus networks.

2.4. CHINAGBN

CHINAGBN [2, 3] is a national public network of economic information. Its objective is to facilitate decision-making in the field of national macro-economy. Currently, CHINAGBN uses 22M international interface channels, and its internal backbone uses its own satellite communication facilities. The satellite network in the sky and the fibre optic network on the ground enable CHINAGBN to provide countrywide public Internet services.

3. Major Chinese search engines

As Internet services develop and gain popularity in China and resources based on Chinese characters increase, foreign search engines became unfit for the special needs of Chinese users. Scientists and information technology professionals in China have been working hard to develop Chinese search engines, and much success has been achieved. By the end of December 1999, China had already developed 74 different search engines, and the number continues to grow [4]. Table 1 summarizes the major Chinese search engines [5].

With the increase of Chinese information on the Internet, Chinese search engines provide an increasing amount of coverage. Pccms, for example, indexes 1,120,000 World Wide Web sites and 90,000 groups of news articles, and Sohoo indexes 50,000 Chinese web sites. Some cover information not only from mainland China, but also from Taiwan, Hong Kong, Singapore and other regions of the world.

Compared with foreign-language search engines, many early Chinese search engines provided simple query-input methods but were incomplete functionally. Efforts in recent years, however, have brought gradual improvements. Today, several high-quality Chinese

Table 1
The major Chinese search engines

Search engine name	Sample application site
Yeah	www.yeah.net
Pccms	http://pccms.pku.edu.cn:8000/gbindex.htm
Chinaaok	www.chinaaok.com
Sohoo	www.sohoo.com.cn
Richsurf	www.richsurf.com/rich.surf
Tonghua	www.tonghua.com.cn
Beijixing	www.beijixing.com.cn
Netcompass	http://compass.net.edu.cn: 8010

search engines support both basic and advanced queries and provide both conventional and intelligent search functions. In addition, they support both the Chinese simplified character GB code (the official national standard for Chinese character information exchange) and the Chinese BIG5 code (a non-official but commonly followed standard for Chinese character information exchange) and are able to provide complete search results in detail [5]. For example, Pccms, created by Beijing University, supports full-text retrieval as well as news group and FIP retrieval, performs searches both in simple and advanced modes, and provides both a Chinese interface and an English interface. Sohoo's Chinese-flavoured full-text search engine, Search97, provides a user-friendly Chinese interface with special Chinese character handling mechanisms reflecting the Chinese tradition. It provides subject heading browsing, web site searching, and news searching in addition to other functions.

In addition to browsing and retrieval, many Chinese search engines provide other services. For example, Pccms offers email services providing search results to those who send search requests to the search engine via email. Search engines such as '263' enable users to receive information packages sent out through mailing lists upon subscription to such mailing lists. Some search engines offer online translation, online news searches, and even web page creation services [6].

Although Chinese search engines have achieved much, there are still unresolved problems. First,

Chinese search engines are generally moderate in quality, and the majority are not very cost effective. Second, the exchange between GB and BIG5 codes is rather difficult. Third, the update speeds of the engines are relatively slow compared to foreign search engines.

4. Distribution of Chinese domain names on the Internet

With Internet development continuing to progress in China, the number of registered domain names in the country is growing fast. According to the January 2001 report of China's Network Information Centre (CNNIC), the total number of registered domain names under the country code of 'CN' reached 122,099 by the end of year 2000. Table 2 summarizes the distribution of these domain names as of 31 December 2000 [7].

Table 3 summarizes the registered Chinese domain names for each province, autonomous administrative region and municipal city [7]. With a 36.9% dominance, Beijing leads all other regions within China. The most developed regions, Beijing, Guangdong and Shanghai account for 60.2% of all registered domain names under the area name of 'CN'. Most of the developed regions seem to be in eastern or southern China, and most of the Chinese domain names seem to be registered in these regions. This distribution reflects the relationship between Internet development and economic development.

National and provincial government leaders have not only realized the importance of Internet development, but have also established relevant development plans. In 1999 most government departments became connected to the Internet and established their own web sites. This year also marked the beginning of massive enterprise connections to the Internet. The Chinese government had hoped to have 1,000,000 enterprises connected to the Internet in 1999 and double that figure in the following three years. The connection of enterprises to the Internet would undoubtedly promote the further development of Internet applications in China.

Table 2
Distribution of registered domain names under area name of 'CN'

Category	AADN	AC	COM	EDU	GOV	NET	ORG	Total
Number of names	3567	682	96,221	1127	4615	13,291	2596	122,099
Percentage	2.9%	0.6%	78.8%	0.9%	3.8%	10.9%	2.1%	100%

Table 3
Registered 'CN' domain names by regions

Region	Beijing	Shanghai	Tianjin	Chongqing	Hebei	Shanxi	Neimeng
Number	44,605	11,141	2004	1140	2099	768	556
Percentage	36.9%	9.2%	1.7%	0.9%	1.7%	0.6%	0.5%
Region	Liaoning	Jilin	Heilongjiang	Jiangsu	Zhejiang	Anhui	Fujian
Number	3718	762	1156	5471	4862	1051	2983
Percentage	3.1%	0.6%	1.0%	4.5%	4.0%	0.9%	2.5%
Region	Jiangxi	Shandong	Henan	Hubei	Hunan	Guandong	Guangxi
Number	447	4740	1919	2093	1138	17043	835
Percentage	0.4%	3.9%	1.6%	1.7%	0.9%	14.1%	0.7%
Region	Hainan	Sichuan	Guizhou	Yunnan	Xizang	Shanxi	Gansu
Number	1270	2165	371	1689	143	1563	401
Percentage	1.1%	1.8%	0.3%	1.4%	0.1%	1.3%	0.3%
Region	Qinghai	Ningxia	Xinjiang	Hongkong	Macau	Taiwan	
Number	86	299	1044	1404	0	6	
Percentage	0.1%	0.3%	0.9%	1.2%	0	0.01%	

5. The 10 best web sites

With the availability of increased numbers of web sites, the public now enjoys access to a richer abundance and larger variety of public information, including science and technology information, government information, economic and commercial information, medical information and entertainment information. In its 2000 report, CNNIC identified China's 10 best web sites as summarized in Table 4 [8]. The selection was based on the number of user hits each web site received. It was believed that the user access frequency of a web site would be ultimately determined by the coverage depth, information quality and the service scope of the site.

Table 4
The 10 best web sites in China

Ranking	Web site URL
1	www.sina.com.cn
2	www.163.com (www.netease.com, www.yeah.net, www.nease.net)
3	www.sohu.com (www.sohu.com.cn, www.sohoo.com.cn)
4	www.163.net
5	www.263.net (www.263.net.cn)
6	www.china.com
7	www.21cn.com
8	www.east.net.cn (or www.east.com.cn, www.east.cn.net)
9	www.online.sh.cn
10	www.cpcw.com

6. Internet users in China

According to the survey of CNNIC, the total number of Internet users in Mainland China reached 22,500,000 by the end of 2000, of which 69.6% were male and 30.4% were female; 62.9% were single, and 37.1% were married. Tables 5–9 show the distributions of these users according to age, location, education level, vocation and monthly personal income, respectively [7].

An examination of the data reveals several interesting findings:

- The ratio of male to female Internet users in Mainland China is greater than 2 to 1. The males seem to be more inclined to access the Internet than the females.
- There are far more single users than married users. Generally, younger people tend to be more inclined to access the Internet than older people. The 18–24-year-old group makes up the largest age segment of Internet users.
- The users seem to be located mostly in well-developed provinces or regions of the country; fewer users seem to be from the less-developed western China. It is generally expensive for communities or organizations to provide necessary network facilities; therefore, there are fewer such facilities in less-developed regions than in well-developed regions.
- According to Table 9, the higher a person's income, the less likelihood there is that this person would access the Internet. One possible explanation would be that, the higher a person's monthly income, the greater the possibility that the individual is

Table 5
User distribution based on age

Age	<18	18–24	25–30	31–35	36–40	41–50	51–60	>60
Percentage	14.9%	41.2%	18.8%	8.9%	7.1%	5.7%	2.1%	1.3%

Table 6
User distribution based on geographical location

Region	Beijing	Shanghai	Tianjin	Chongqing	Hebei	Shanxi	Neimeng
Percentage	12.4%	9.0%	2.5%	2.0%	2.5%	1.3%	1.2%
Region	Liaoning	Jilin	Heilongjiang	Jiangsu	Zhejiang	Anhui	Fujian
Percentage	4.7%	2.4%	2.5%	5.4%	6.6%	2.4%	3.6%
Region	Jiangxi	Shandong	Henan	Hubei	Hunan	Guangdong	Guangxi
Percentage	2.1%	5.3%	2.3%	3.5%	4.0%	9.7%	2.0%
Region	Hainan	Sichuan	Guizhou	Yunnan	Xizang	Shanxi	Gansu
Percentage	0.3%	5.0%	0.8%	1.5%	0.0%	1.5%	1.1%
Region	Qinghai	Ningxia	Xinjiang				
Percentage	0.3%	0.5%	1.5%				

Table 7
User distribution based on education level

Education level	Lower than high school	High school	Junior college	Undergraduate	Master's	Doctorate
Percentage	6.4%	23.5%	29.0%	38.8%	1.9%	0.4%

Table 8
User distribution based on vocation

Vocation	Percentage	Vocation	Percentage
Computer/Information Technology	11.9%	Postal/communication	3.1%
Commerce/trades	11.2%	Business management/revenue Services	2.4%
Research/education	10.8%	Information services	2.3%
Government	8.6%	News media/advertising	1.7%
Social services	8.3%	Cultural/entertainment/sports	1.5%
Finance/insurance/realty	6.7%	Agriculture (farming, fishing, etc.)	1.5%
Manufacturing	6.5%	Law enforcement	1.3%
Transportation	4.1%	Mining	0.8%
Utility	4.1%	Other	10.0%
Construction	3.6%		

engaged in business activities other than accessing the Internet.

• Considering the vast population of China and the relatively very small portion of its people that receive a college education, it is overwhelmingly clear that education level has a positive impact on a person's likelihood of accessing the Internet.

Those with a graduate education constitute only a very small proportion of Internet users. This is probably due to the fact that only a very small proportion of college graduates are selected to receive a master's education, and likewise a very small proportion of master's degree holders are selected to receive a doctorate-level education in China.

Table 9
User distribution based on personal monthly income (unit: Chinese Yuan, ¥)

Monthly income	Percentage	Monthly income	Percentage
No Income	16.4%	3001–4000	2.9%
1–500	15.3%	4001–5000	1.8%
501–1000	25.9%	5001–6000	1.6%
1001–1500	15.8%	6001–10,000	0.5%
1501–2000	7.5%	>10,000	0.6%
2001–2500	4.1%	Uncertain	4.1%
2501–3000	3.5%		

7. Five major areas of Internet application in China

As the number of Internet users increases rapidly in China, the Internet is becoming an increasingly important part of people's work and studies, ushering the country into a new Internet era. Out of the many areas of Internet application in China, electronic government, electronic commerce, distance education, distance medical treatment and digital library are emerging as the five main areas.

7.1. Electronic government

Owning over 3000 databases, Chinese governments at all levels are by far the largest owner of information resources in the country. To take full advantage of the government information resources, the Government Online Project was started on 22 January 1999 [9]. As part of this project, all government departments build their own web sites and provide online management and service functions.

As pioneer organizations of the project, 66 ministries and commissions of the country signed contracts with the China Telecom Corporation, and over 20 provincial government departments rated the project as their key task in 1999. The country's Telecommunications Department gave high priority to this project and offered large discounts to participants in the project. Many software and hardware manufacturers, ISP/ICP organizations and press units also supported the project by supplying equipment and services free of charge or at discounted prices. As a result, the project achieved remarkable progress in a relatively short amount of time. By January 2000, the country's central government and its related national departments had founded 52 web sites. These government web sites attempted to explore new fields of applications such as electronic commerce, electronic databases, electronic documents, electronic duty affairs, electronic collection services, electronic bidding, electronic welfare services, electronic postal services, and electronic identification services. Table 10 lists a sample of government organizations together with a sample of services they offer via the Internet [10].

Table 10
Sample government organizations with sample Internet applications

Organization	Sample Internet applications	Web site URL
Demos Bank	Electronic payment	www.pbc.gov.cn
Customs Headquarters	Foreign-exchange verification, customs tax return services, online foreign exchange	www.customs.gov.cn
Labour Bureau	Enterprise database services	www.molss.gov.cn
National Tourist Bureau	Electronic reservation services	www.cnta.cn
Ministry of Education	Distance education	www.moe.edu.cn
Sanitation Ministry	Online medical services	www.moh.gov.cn
Revenue Bureau	Audit services, electronic declaration services	http://docsvr.mof.gov.cn
Foreign Trade Ministry	Entrance quota licensing	www.moftec.gov.cn
National Technical Supervision Bureau	Anti-faking services	www.ciq.gov.cn
Irrigation Works Ministry	Flood-prevention information publication	www.mwr.gov.cn
Earthquake Bureau	Earthquake-response supervision and damage-control services	http://210.72.96.1
News Release Office	Electronic publication and release	www.bb.ah.cn
Labour Ministry	Employment information collection and publication	www.mop.gov.cn
Others	Electronic signature, stock management, etc.	www.csrc.gov.cn

7.2. Electronic commerce

The rise in electronic commerce in China occurred one or two years after it occurred in Western countries. It was in 1997–1998 when electronic commerce first became a popular topic in China. Subsequently the Chinese government conducted a series of important projects such as the Golden Bridge project, the Golden Card project, and the Golden Gate project.

The Golden Bridge project aimed to establish a public economic information network based on satellite technologies to interconnect heterogeneous private networks of multiple departments and sectors. Apart from providing Internet access, it allowed email, electronic data interchange, online database services, and applications services. The Golden Card project aimed to create a countrywide banking and credit card system that would enable people to conduct credit transactions instead of traditional cash transactions and to make electronic deposits to, and withdrawals from, their bank accounts. Known also as the Golden Customs project, the Golden Gate project aimed to connect foreign trade companies with banks and with China's customs and tax offices so as to automate customs checking procedures, eliminate cash transactions, and achieve paperless trading [11]. Collectively, these projects promoted the construction of the Chinese information infrastructure and accelerated the digitization of commercial banks and the development of electronic data interchange (EDI).

Many commercial networks have been constructed and put to use. The Chinese Civil Aviation Ticket-Ordering System has been in use for 12 years. In 1997 the system sold over 55.6 million tickets for ¥20 billion (¥100 = 8.2661 UK Pound Sterling; ¥100 = 12.0818 US Dollars [12]). By June 1997, China had issued 50,560,000 various credit cards and over 60 million non-bank IC reservation cards. Other successful national e-commerce systems include the Chinese Commodity Trade System authorized by the National Economy Trade Committee and the Chinese Commodity Order System [13].

Regionally Shanghai, Beijing, Guangzhou and Xi'an have taken the lead in e-commerce development. By the end of 1997, the total length of fibre optic cable in Shanghai reached 8824 km. Over the years, Shanghai has developed five major enablers to accelerate e-commerce activities in Shanghai: the Shanghai Information Exchange Web, the Shanghai Community Service Web, the Shanghai International Economy Trade EDI Web, the Shanghai GBnet and Gathering System, and the Shanghai Social Security Web. Three of these enablers are most prominent: the Shanghai Community Service Web connects with local services and offers a wide variety of services to the public; the Shanghai International Economy Trade EDI Web unites three sub-centres, the Shanghai Customs, the Harbour Navigation, and the Foreign Economy Trade, provides a means for non-paper trade, and improves the opportunities for Shanghai enterprises to participate in international trade activities; the Shanghai Social Security Web provides insurance services of various kinds.

China has done much in recent years to further e-commerce development in the country. However, the level of e-commerce activities in the country as a whole is still relatively low. One major problem lies in its payment methods. Credit cards are not yet a prevalent means of payment in China. Although debit cards are used, they are not the preferred choice; the majority still prefer cash transactions [14].

To fully recognize the benefits of electronic commerce, China not only needs to solve the various problems common to all countries, but also needs to resolve those problems unique to China, including its inconvenient payment system, relatively poor quality of computer information networks, low dissemination rate of enterprise information, and incomplete information policy.

7.3. Distance education

As the coverage of domestic multimedia networks continues to expand, universities and technical schools in China, as subsequent beneficiaries of the information highway, have entred a new era of distance education. By late 1999, Tsinghua University in Beijing had successfully implemented a distance education programme in Nanhai City of Guandong Province, thousands of kilometres away from Beijing, marking the beginning of this new era. For the first time, 118 students in Nanhai attended Tsinghua University's live classes via the Internet.

Subsequently, another distance-education network, Quantongda-101, was constructed in Qingdao City, Shandong Province. This network paved the road to Beijing 101 High School for students of Qingdao City, not only enabling students in Qingdao to participate in the enrichment activities of a nationally recognized school in Beijing, but also providing an economic and effective means for parents and students in Qingdao to receive counselling and tutoring from teachers in Beijing.

Academic institutions such as Nankai University have taken a very active part in utilizing the Internet to

offer distance education. Employing a high-speed broad-band campus network, Nankai University has striven to become an important information centre of education and scientific research. Its campus network consists of a backbone network, branch networks, and the Tianjin Education and Scientific Research Network. The goal is to have all university resources accessible via the Internet and to have undergraduate degrees available through the Web. Four systems help to achieve this goal: the teaching application system, the scientific research information system, the official business system, and the campus information services system. These systems manage eight categories of information resources: teaching, scientific research, books and data, management, educational administration, foreign cooperation and communication, school industry, and campus services in general.

Distance education in China also includes programme offerings from outside the country. For example, it was reported recently that 12 doctors at Ha'erbin Industry University took some of their elective courses from Syracuse University in the US and from other foreign universities. As distance education gains in popularity, more students in China seem to be interested in attending the 'Internet schools' where they are able to take classes from foreign institutions.

Another trend of distance education in China seems to be ISP/ICP organizations' offering of online education programmes via the Internet. For example, the China Communal Multimedia Communication Network now provides a series of interactive Internet education programmes such as pre-school, grade school, college and adult education programmes as well as special skill-training programmes. Students of these programmes can receive lectures, take exams and obtain records and degrees online. Table 11 lists the web sites for the main representatives of these Internet education programmes.

7.4. Distant medical treatment

With distance medical treatment, the digital images of medical diagnoses are transmitted to pertinent experts or departments via wide-band channels; after the experts have analysed the images, their feedback is transferred back to the patient's doctor. Such a process makes it easier for doctors at different locations to conduct joint consultation and provide joint diagnoses, resulting in more accurate and more timely medical decisions. China has made some progress in this area of Internet application in recent years [15].

At the end of May 1998 China's first domestic information network system of medical treatment and sani-

Table 11
Main web sites of Chinese Internet education programmes

Internet-education programmes	Web site URL
The Distance-Education Information Network of China	http://yuanjiao.tongtu.net/
The Distance-Education School of Zhejiang University	www.zjuyc.com/
The Family of Distance Educators	www.online-edu.org/
The Distance-Education Center of Shanghai Jiaotong University	www.dlc.sjtu.edu.cn/
The Hope Web School	www.hoho.edu.cn/
The Network Doctor	www.webschool.com.cn/
101 Distance-Education Network	www.chinaedu.com/
8211 Distance-Education Network	www.8211.com/
The Continuing Education School of Tsinghua University	http://166.111.18.8/yuanch.htm
The Distance-Education School of Ha'erbin Industry University	www.hagongda.com/

tation, Jinwei Medical Treatment, began to operate in 20 major hospitals in 15 cities. The Jinwei Health Care card of medical information, a component of the system, was first issued at the same time. The strength of this network system lies in its support for long-distance medical consultations. It facilitates distance diagnosis of difficult illnesses across the network, providing patients with access to the most advanced techniques and services available in China or in foreign countries.

Recently, an international medical network of China based in Tongji Hospital, and connected with the Cancer Hospital of the Chinese Medicine College, also commenced operations in Hubei Province.

As a result of recent Internet application developments, many web sites have been constructed dealing with Chinese traditional herbal medicines. Table 12 lists the main representatives of these web sites.

7.5. Digital library

In 1995, China's National Library began research into digital libraries. Subsequently, several reports were submitted to the country's Culture Department and the

Table 12
Main web sites on Chinese traditional medicines

Sponsoring organization/web site content	Web site URL
The National Herbal Medicine Administration	www.medicinechina.com/gbpages
The National Evaluation Committee of Herbal Medicine Breed Protection	www.zybh.com.cn
Taiwan Herbal Medicine Committee	www.ccmp.gov.tw
Chinese Herbal Medicine Academy	www.tcm.imicams.ac.cn/nyjy.html
Beijing Herbal Medicine University	www.bujcmp.edu.cn
Eye Hospital of Chinese Herbal Medicine Academy	www.nease.net/~tanghz/tcm/pmain.htm
China National Herbal Medicinal Center for Liver	www.tcm.imicams.ac.cn/liver.htm
The Basic Information Database for Herbal Medicine	www.fruits.cnc.ac.cn:1542/medicine.html
The Valid Ingredient Database for Herbal Medicine	www.159.226.2.20:1-205/cgi-bin/proc/zcy
China Herbal Nostrum Database	www.159.226.2.20:1524/cgi-bin/qiancgi/lz33
China Herbal Medicine Books Retrieval of the National Herbal Medicine Administration	www.tcm.imiciams.ac.cn.97wxjs.html
China Herbal Medicine Dictionary	www.cnc.ynu.edu.cn/wlxx/yd.index.htm
Chine Herbal Medicine Atlas	www.inchina.net/yyws/zhongcao/zhongcao.html
The Herbal Medicine Database of Plants	www.sdb.ac.cn/specialdb/zy09.html

National Project Committee. In 1998 an experimental digital library was created and various techniques and issues explored, including:

- techniques supporting data resource construction, such as SGML adaptation;
- metadata query systems;
- object data storage and query system supporting heterogeneous data resources;
- high-speed library network system;
- cooperative construction of resource bases;
- search and retrieval of object databases belonging to and located in different provinces via common networks [16].

Based on these reports and experiments, the Chinese Digital Library Project was initiated in July 1998. The underlying guidelines of this project are:

1. Large scale and high quality – the project should build a large-scale and high-quality Chinese resource base across a broad-band IP network. The project should support the development of national innovation systems and provide nationwide and even worldwide services through national communications networks, and its technological quality must be comparable with international standards.

2. Collaboration and cooperation – the project must employ unified standards and, through collaboration and cooperation, establish a resource-sharing mechanism so as to avoid unnecessary duplication.

3. Content – the project should combine independent development efforts with imported technologies and build a distributed, extensible and independently owned Chinese digital library system that combines related resources into a large-scale knowledge network so as to better serve the needs of a knowledge-based economy.

4. Technology characteristics – the finished system should have the traits of a virtual network and should be able to access and process complex data resources and store vast volumes of data. The system should have high compatibility and scalability and should be able to process complex and intelligent searches.

5. Technical specifications – the project will employ international mainstream technologies such as the Standard General Mark-up Language/Extensible Mark-up Language (SGML/XML) and distributed object-oriented software development technologies. It should follow international standards and industry criteria of electronic information disposal and exchange.

6. Organization and management – the project will utilize item contract management and will be led by the Chinese Digital Library Project Construction Conference, which was formed by China's Culture Department in March 2000, consisting of 21 related departments including the Central Propaganda Department's Publishing Office and the National Project Committee's Social Development Department. The Chinese Digital Library Project's Construction Management Centre will oversee the specification, organization, execution and management of the project [17].

On 5 April 1999 the Chinese Digital Library Project Construction Conference ceremoniously held its first meeting at the National Library, signifying the official start of the project after the long preparation [18].

8. Internet management in China

8.1. The management model

Different countries have different models of Internet development and application management. China adopts the principle of planning as a whole, implementing according to standards, and managing based on classes.

In order to effectively manage international connections of domestic computer information networks and to facilitate a healthy development environment, the State Department drafted and issued a guide, Temporary Regulations on the Management of International Computer Information Networks in China, in February 1996 [19]. The guide formally defines terms such as international connection, the Internet, and entering network. The guide also systematically sets out the Chinese model of Internet organization and management.

To more effectively manage the Internet environment in China, China formed a Leading Group of Economic Information. The Leading Group coordinates Internet management efforts, and studies and resolves important issues related to international connections. The Group defines rights and obligations of Internet service providers and users, and examines and supervises international networks.

China's four major networks, CHINANET, CHINAGBN, CERNET and CSTNET, are managed by China's Electric Department, Electronic Industry Department, National Education Council and the Chinese Academy of Sciences, respectively. Any new public network to be founded must first be approved by the State Department. Each computer information network to be connected directly with the Internet must use international interface channels provided by China's Telecommunications Department National Public Telegraphy Network.

Internet connection providers must receive permission from the Internet management organizations in order to provide connection services. As part of the permission application, Internet connection providers must provide information on the quality of their computer information networks, their appliance extensions, and their host computer addresses. They must meet four basic conditions: the enterprise is founded legally, their technical and management personnel possess adequate knowledge of their computer information network and equipment, they have a rights and security supervision system, and they have in place proper technology protection measures. They must also meet some other criteria in accordance with the regulations of the State Department.

Individual users who wish to connect their computers or computer information networks to the Internet must sign an agreement with the Internet connection providers before such a connection can be provided. All international connection providers including international interface channel providers must work with the network management centres in strengthening their own network management according to the national regulations, including providing adequate security measures and proper employee and user training.

The organization and management of CERNET as depicted in Fig. 1 provides an illustration of the Internet management model in China [20, 21].

The chief leader and decision-making institution of CERNET is the Education Ministry's CERNET Leading Group, which consists of national education leaders. Immediately under the Leading Group are two other groups, the CERNET Administration Committee and the CERNET Expert Committee, each being responsible for certain important aspects of the decision-making process as well as overall planning.

The second layer is the CERNET National Network Centre located in Tsinghua University. This centre is in charge of the national backbone network, the international connections, the enrolment services of public sources, and the building of related information resources. It supplies the entire network with high-quality computer services and is also responsible for skills training and for the development of regional network centres.

The CERNET Regional Network Centres, the main nodes of the network, make up the third layer. They are
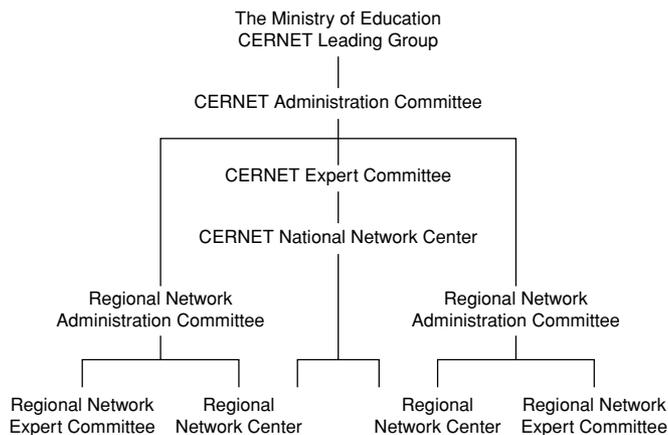
Fig. 1. Illustration of Internet organization and management model in China.

located in eight cities and in 10 leading institutes of the country. These centres are responsible for the local network operations in their respective regions, serving as bridges among different regions. Table 13 shows the distribution of these regional network centres and their coverage areas [22].

8.2. The plan and the law

China pays great attention to the development of the nation's information industry. This is evident in its Tenth Five-Year Plan, in which the following emphases were made:

1. China will further the construction of the NII, complete the transfer network based on DWDM, develop the country's broad-band high-speed IP-based Internet, deploy various information resources, and improve the level of communication services.

2. China will further the application of information technologies in each of the nation's economic industries, reconstruct and promote traditional industries, accelerate the development of information activities in national economic and social services, actively and securely promote e-commerce and the information infrastructures of enterprises and city organizations, and implement important national projects in the information area.

To facilitate healthy development of the Internet and other information technologies in the past 10 years, the Chinese government and its related departments have issued various laws and regulations, including:

1. *The Ordinance of Computer Software Protection in the People's Republic of China* [23]. Issued by the State Department on June 4,1991, this ordinance specifies software user rights and obligations, facilitates software application development, and sets forth legal relationship between software developers/providers and software users. It marks important progress made by China on the protection of intellectual properties.

2. *Management of Computer Information Network International Interface Channels* [24]. These regulations were issued by the Ministry of Post and Telecommunications on April 9, 1996 for the purpose of regulating the passageway channels permitted and specifying the application procedures.

3. *Management of International Connections of Chinese Public Computer Networks* [25]. These rules were issued by the Ministry of Post and Telecommunications on 9 April 1996. The rules regulate individual users' access to ChinaNet and specify the rules to be followed.

4. *Temporary Policy on the Management of Chinese Internet Domain Names* [26]. Published by the National Informationalization Lead Group on 30 May 1997, this policy regulates the architecture of Chinese Internet domain names, the naming principle of domain names, and procedures for domain name applications.

5. *Security Management Rules on Computer Information Networks Connecting with the Internet* [27]. These regulations were published by the National Public Security Ministry on 30 December 1997. These regulations specify information security rules, guard against Internet crime, and ensure an orderly Internet development environment.

Table 13
Distribution of CERNET Regional Network Centres

Region	Location (coverage areas)
North China	T'singhua University (Beijing)
	Beijing University (Beijing, Tianjin, Hebei)
	Beijing Post University (Beijing, Shanxi, Neimenggu)
Northwest China	Xi'an Transportation University (Shanxi, Gansu, Ningxia, Qinghai, Xinjiang)
Southwest China	The Electric and Scientific University (Sichuan, Chongqing, Guizhou, Yunnan, Xizang)
South China	The South China Technology University (Guangdong, Guangxi, Hainan)
Central China	The Central China Technology University (Hubei, Hunan, Henan)
East China (North)	The East China University (Jiangsu, Anhui, Shandong)
East China (South)	Shanghai Transportation University (Shanghai, Zhejiang, Jiangxi, Fujian)
Northeast China	The Northeast University (Liaoning, Jilin, Heilongjiang)

6. *Detailed Rules on Internet Domain Name Registration* [28]. In China, domain name registration is managed by the China Network Information Centre. This publication specifies domain-name management policies including the procedures of third-level domain name application and addition.

7. *Other regulations.* In addition to the ordinances and regulations listed above, other regulations, such as the Temporary Rules on the Management of International Connections of Computer Information Networks published by the State Department on 23 January 1993 [29], and the Temporary Detailed Rules on the Implementation of Computer Information Networks Connecting to the Internet issued by the State Department Informationalization Lead Group on 13 February 1998 [30], also provide certain management references.

8.3. The Internet copyright problem and China's relevant policies

As Internet resources can be easily downloaded and transmitted through the network, the protection of intellectual properties on the Internet becomes an urgent and important issue. However, the digitization of Internet resources adds complexity to the formation of effective protective measures.

The digitization issue. Only by being converted to binary codes of 0s and 1s, can information be identified and transmitted on the Internet. Therefore evaluating the nature of such digitization becomes an important issue when deciding on the legal protection of information resources on the network.

Some people believe digitization should be governed by the copyright law; others feel that it is a code deduction process similar to translation. Regardless, translation embodies the translator's subjective understanding of the original work as well as the choosing and organizing of the translator's own wording; therefore, translation is a reproduction process based on the original work involving a certain component of creativity. Simple digitization does not involve such a reproduction process or creative component, thus negating the second viewpoint above [31].

The 52nd article in China's Copyright Law prescribes, 'copying in this law refers to making one or more duplications of production via press, reprography, facsimile, records, and kinescope, etc.' This traditional definition of copying is inadequate for handling information downloading or decoding through the newly emerging computer technologies.

Network communication and copyright, publishing right and transmission right.

1. *Copyright* – a serious complexity introduced by network communications lies in the temporary copies on computers, copyrighted resources temporarily saved in computer memory, but not on physical media, which exists extensively in network communications.

In China's Copyright Law, copyright refers to 'long copy' such as print, photocopy, record and kinescope. As specified in Paragraph 5 of Article 3 of the Computer Software Protection Ordinance issued in June 1991, 'copy' means duplicating software to physical media. While the official definition of 'copy' is confined to physical media (or long copy), computer software belongs to the domain of 'data production', somewhat more appropriate to be classified as 'temporary copy' [32]. Yet neither the Copyright Law nor the ordinance covers 'temporary copy'. Therefore, a new ordinance is needed to regulate network communications.

2. *Publishing right* – as specified in Paragraph 5 of Article 5 of China's Copyright Law, 'publish' refers to providing numbers of copies of production by means of selling and lending to satisfy reasonable public requirements. Since the Copyright Law does not include 'temporary copy', 'copies of production' here only refers to the copying of physical material [33]. Thus a new regulation is also needed to govern network publishing.

3. *Transmission right* – China's Copyright Law and its related ordinances provide guidelines regarding transmission rights. Paragraph 5 of Article 10 of the Copyright Law regulates a copyright author's rights of acting, play-back, exhibition, film production, TV and kinescope. Paragraph 1 of Article 42 prescribes broadcasting organizations' rights of play-back. The Copyright Law does not prescribe the transmitting rights of actors and makers of records and kinescope [34], but Article 12 of The Regulations on the Implementation of International Copyright Treaty states that the makers of foreign films, videos and kinescope work can accredit others performing their production. Thus foreign makers enjoy the rights of transmitting work to the public extensively, regardless of the work species and communication means. This article surely includes the means of network transmission, which results in better protection for foreign makers than domestic makers [35].

Since China's Copyright Law could not fully handle the constantly changing network environment, China has enacted Management of Computer Information Network International Interface Channels [24] and

Management of International Connections of Chinese Public Computer Networks [25]. Since China has joined a series of international copyright protection agreements according to Article 142 of the General Rule of Civil Law and according to The Regulation on Implementing International Copyright Pack, articles in China's Copyright Law that conflict with international law have been modified.

Domain names. Domain names are individual or organizational entities' official representations on the Internet; therefore, their governance and protection are very important. On 30 May 1999 the Information Work Lead Group of China's State Department issued the Temporary Management Measures on Chinese Internet Domain Names [36]. Among other rules, these measures clearly specified that:

1. The State Department's Information Office and its standing body, the Chinese National Network Information Centre (CNNIC), are the managing organizations of the Chinese domain name system.

2. CNNIC manages China's first-level domain name of 'CN' and two categories of second-level domain names: special domain names and district domain names. It evaluates and appoints other management groups to manage the third- and lower-level domain names.

3. The applicant for a domain name must apply according to legal proceedings and be responsible for the domain name obtained. The evaluation and approval processes are on a first-come-first-served basis.

4. The domain name management departments are not responsible for any conflicts that may arise between domain names and legal entity names such as company names and brand names.

5. Domain name owners may modify or cancel their domain names but cannot sell them.

6. Owners of domain names not containing 'CN' as their first-level domain name should establish a record with CNNIC [37].

Information resources on the Internet are subject to many forms of threats, including hacking and computer viruses. On the one hand, the open architecture of the Internet makes it difficult for legislatures to keep up with the rapid developments of network technologies. On the other hand, resource security on the Internet depends on the development of more advanced information technologies. As in many other countries, information security technologies employed in China today mainly comprise encryption techniques, firewalls, authentication procedures, and anti-virus programmes.

8.4. Charge mechanism

The charge mechanisms have been one of the most sensitive issues in China's Internet utilization. According to the statistics of China's Network Information Centre [38], 47% of Chinese Internet end-users thought the fee for Internet access was too high. High cost seemed to be the main obstacle to China's Internet applications development. As a result, the Ministry of Information Industry issued a charge policy on 5 February 1999, Notification of Mail and Tele-communications Fee Adjustment [39], which dictated lower Internet access fees:

1. The network utilization fee is computed in two ways depending on monthly utilization time. The charge rate is ¥4 per hour for the first 60 hours and ¥8 per additional hour. The call fee depends on the connection time. There are three different charge brackets: one for connection time of less than 15 hours, one for connection time of 15–80 hours, and one for connection time of more than 80 hours. While standard charge rates apply to the first and third brackets, a 50% discount is applied to the second bracket.

2. ISDN users can choose one of two charge systems, the traffic system or the monthly system. The fee for the traffic system is ¥6.00/Mb regardless of the actual usage. For the monthly system the fees are classified into seven categories according to line usage. Table 14 shows the charge details [39].

3. The rental charge of half of the international circuits (2Mb/s) used by Internet organizations is reduced from ¥431,600 to ¥320,000 per month.

4. The charge for group exchange users is reduced from ¥600 to ¥50, and the charge for Internet services provided by telecom business windows is reduced from ¥0.80/min to ¥0.30/min.

9. An analysis of remaining problems

Despite the great progress that China has made in Internet development and applications, there are still some difficult problems to be resolved.

9.1. Slow Internet speed

It was estimated that between December 1996 and mid-February 1997 alone, the size of the World Wide Web doubled from 1 trillion to 2 trillion bytes of data [40]. While the amount of information on the Internet rapidly increases, the Internet communications speed in China remains relatively slow.

Table 14
Adjusted Internet access charge rates for public computers

	One-time charges	Network utilization fees	Communication fees	Other fees
Dial-up access[a]	¥100/account	¥4/hour for the first 60 hours and ¥8/additional hour (usage time less than 1 hour will be treated as 1 hour)	Discounted local calling fees + telephone network charge	1. Monthly storage fee: free 1st 1 Mb; ¥0.20/per additional kb
Group exchange access	¥100 /account	¥50/month	Communication fees + standard group exchange charge	2. Telecom business windows, services charge: ¥0.3/min
ISDN access	¥100/account	Traffic system: ¥6/Mb Monthly system: ¥6000/month (rate≤19.2 kb/s); ¥14,000/month (19.2≤rate 64 kb/s); ¥24,000/month (64≤rate 128 kb/s); ¥38,000/month (128≤rate 256 kb/s); ¥61,000/month (256≤rate 512 kb/s); ¥96,000/month (512 kb/s≤rate 1 Mb/s); ¥150,000/month (1≤rate 2 Mb/s)	Communication fees + half of DDN standard charge	

[a]Note: a 50% discount applies to dial-up access network utilization and communication fees on holidays as well as on late nights between 23:00 p.m. and 8:00 a.m.

For the most part, Internet communications speed in China has been around 1 Kb/s, which is far from meeting users' needs. It has been determined that the problem lies in insufficient channel bandwidth of the country's domestic backbone networks and international outlets. The channel bandwidth of most backbone networks across the domestic Internet is only around 2 Mb/s, and many of the large networks of the country operate only on 100 Mb/s capacities.

To resolve the problem, the government must increase investment to accelerate the construction of greater channel bandwidths. On the other hand, it is also important that major networks of the country employ more advanced technologies and make more rational choices concerning traffic flow distribution and route coordination.

9.2. High usage costs

The monthly usage cost for an average domestic end-user is approximately ¥400–800, and the cost can be four to eight times higher for users who access internationally. The cost-to-income ratio in China is about 100 times higher than North America since the average personal income in China is about one-twentieth of that in North America. If both income and Internet speed are taken into consideration, the relative cost difference can be as large as 4032 times. Table 15 shows a comparison of relative costs between China and America [41].

Clearly, the threshold for an average Chinese user to enter the Internet is too high, which severely constrains the availability of the Internet in China. To improve the situation, related government departments should establish policies allowing and introducing the mechanism of competition into the country's Internet services industry.

Table 15
Internet usage cost comparisons between China and America

	China	America
Average income	1 Unit	20 Units
Monthly usage cost	¥600	¥100
Internet speed	1 K	33.6 K
Cost relative to income	6 * 20 = 120 Units	1 Unit
Cost relative to Internet speed	6 * 33.6 = 201 Units	1 Unit
Cost relative to income and to Internet speed	6 * 20 * 33.6 = 4032 Units	1 Unit

9.3. Poor information quality

Although the number of web sites has dramatically increased in recent years, the overall quality of these web sites is far from being sufficient to meet the users' expectations. Many of these sites are single-subject sites, many provide only textual information, and some are only a skeleton of frames. Information in general can be described as: too much general information, too little specific information; too much static information, too little dynamic information; too much second-hand information, too little first-hand information.

As an improvement, China should provide Internet access to its many large libraries and public databases, thereby enriching the information content on its domestic Internet. China could also invest in building up a few major 'backbone' web sites, through these more current and useful information could be provided.

9.4. Ineffective management mechanism

Currently, the four major networks in China, CHINANET, CHINAGBN, CERNET and CSTNET, are separately owned and managed by different ministries or commissions. While each develops its own applications using state funds, there seems to be little coordination among them. Consequently, there is a duplication of development effort and the equal division of the limited state resources seems to limit their individual development capabilities. In addition, regulations and rules made by different managing organizations seem to be difficult for the users to follow. Sometimes Internet firms adopt a wait-and-see attitude to some of the new regulations [42].

A more effective management mechanism would be a single management hierarchy. While different organizations could continue to own their networks, national policies should be made by one centralized administrative body such as the nation's Ministry of Information Industries. This centralized administrative body should also be responsible for coordinating the use of the state IT funds nationwide.

9.5. Incomplete policies

Although the Internet provides great convenience and power, it also provides much scope for inappropriate practices. While the current policies and regulations provide specific rules for dealing with many such practices, they leave certain blind spots. Occasionally lawsuits arise because of copyright and property right violations on the Internet, yet the investigation and prosecution of such violations are difficult or ineffective due to a lack of specific investigation procedures and prosecution standards. Similarly the current policies and regulations also seem to be ineffective in resolving disputes involving violations of individual privacy rights on the Internet. In addition, the dividing line that separates lawful investigation of potential Internet crimes and violations of individual privacy rights does not seem to have been clearly defined.

To effectively provide and protect a healthy Internet development and utilization environment, China must update its relevant policies and regulations.

9.6. Unbalanced information flow

Currently, about 95% of the information on China's domestic Internet is from outside China and only 5% is native. Information from local organizations is negligible. Such unbalanced information flows tend to overload the country's international outlets seriously and generate frequent and severe Internet congestion. Given the size of China, a more balanced flow distribution would be 30% from overseas, 50% from within China but not from local organizations, and 20% from local organizations. To achieve such an ideal state, China must improve the quality of its domestic web sites and the quality of the information these web sites provide.

10. Conclusion

Compared with Western countries, China made a late start in Internet development. Yet in a relatively short

amount of time it has accomplished much. Since 1997, CNNIC has been conducting annual surveys of Internet development progress in China. The survey results have revealed a remarkably high speed at which China's Internet development progresses. In the past three years, the number of Internet users has increased from 620,000 to 22,500,000. Likewise, the number of computers connected to the Internet, the number of registered domain names, and the number of web sites created have each increased tens of times. Such speed has far exceeded that of European and American countries.

Despite the rapid growth, China's Internet development faces many problems and challenges, some of which are common to many countries such as limited network capacity and insecure networks. Other problems seem to be more unique to China, such as distributed Internet management and the relatively low average education level of its citizens. China must join other countries in continuous technology research to overcome the problems common to all and take effective measures and remove domestic obstacles that hinder healthy Internet development in the country.

Although the number of Internet users in China has reached 22,500,000, it is still only 1.73% of the nation's population size of nearly 1,300,000,000. There is much China needs to do to establish true information societies in China. The potential for further Internet application development in China remains huge.

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