D2.2 – Chinese Roadmap Survey

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Executive Summary

The purpose of this report is to provide a roadmap on the current progress on ICT research developments in China from the perspective of the Chinese ICT experts and participants. This report explains how current ICT activities are developing in China, how the current ICT projects are being performed and the overall strategy and major planning on ICT research. The research also looked into the current relationship in terms of ICT research between the EU (European Union) and China, which includes the current China-EU cooperation projects, technological direction for potential China-EU cooperation in ICT and the major challenges of China's ICT participation in EU projects.

Secondary research was undertaken to explain the current developments on ICT research in China. Journals, websites, and internal databases were used to provide critical information to the findings. Survey questionnaires were designed to gather Chinese ICT experts views regarding ICT research areas research and collaboration priorities for the next three to eight years in China. The OpenChina-ICT event, organised by BSEAC, also provided feedback through the use of a questionnaire distributed to both Chinese organisations and participants.

The findings demonstrated that ICT developments in China are growing and that there is huge potential for further improvements. Future collaborations, partnerships, new dialogues, and shared information are the key drivers for future ICT developments, particularly with the EU. However, the findings also pointed out that further effort needs to be done to enhance the development of Chinese ICT related research. Financial support, high-level dialogue activities, improved China-EU collaboration, and more information on participating on Chinese research programs have all been recommended by ICT experts and event participants. The noticeable theme outlined in this roadmap survey is that more effort from EU enterprises and institutes must be provided in order to make progress in the advancement of ICT in China.

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Preface

- China provides a highly developed ICT research environment and offers significant opportunities for cooperation in various fields, particularly with the EU. China is already facing some of these challenges at present, which Europe will likely face in the coming years and/or decades. China constitutes an important strategic partner for Europe in facing its future development challenges. Europe has the opportunity to learn from China's efforts in ICT research to prepare for these challenges. The Roadmap report was inspired by China's developments in ICT and Europe's ability to collaborate with China to push forward in the field of ICT related researches.

- OpenChina-ICT (Opening European Chinese Cooperation on ICT Research) is a project supported and underlined by the FP7 Framework Programme, which, established by the EU, aims at enabling both Chinese and European stakeholders, through research on ICT priorities and projects, organising conferences and related activities, to have a better understanding of R&D projects related to ICT in China and the EU, to co-draft the EU-China ICT Cooperation Plan, to analyse in details present and future priority areas for ICT studies in China and the EU. The EU-China ICT Cooperation Plan will be submitted to the European Commission as a reference document for its policy-making. At the same time, it is also destined to be a reference document for related ministries and departments in the Chinese government to design win-win international cooperation projects, henceforth to advance in an effective manner the China-EU cooperation in the research and development of ICT technologies.

- The operation and facilitation part of OpenChina-ICT in China is mainly carried out by CATR, CECO and BSEAC:

  - **CATR** (Chinese Academy of Telecom Research), as the only support institute for the Ministry of Industry and Information Technology (MIIT) in the field of ICT, has for long been dedicated to ICT research, standardization, planning, assessment and quality assurance, with an outstanding record of achievements.

  - **CECO** (China-EU Science & Technology Cooperation and Promotion Office) is a non-profit organization aiming to provide consultation and guidance to Chinese research institutes, universities, enterprises and scholars to participate in the EU Science and Technology Framework Programmes. The organization is supervised by and answerable to Department for International Science and Technology Cooperation at the Ministry of Science and Technology. It is attached to China Science

and Technology Exchange Centre at the Ministry of Science and Technology (MOST).

- **BSEAC** (Beijing Software Enterprise Advisory Centre) is a consultancy firm providing governments both in and outside China, business units and enterprises with a full range of customized services and comprehensive support. It is dedicated to advancing international cooperation in science & technology, energy and manufacturing.

1. General Overview of ICT Research Development in China

Since the establishment of the People's Republic of China in 1949, China has achieved a series of outstanding accomplishments in the field of ICT. The general goal of China's science and technology development in the Twelfth Five-Year Plan (2011-2015) is to achieve fundamental breakthroughs in core ICT technologies and to provide strong support for accelerating the ongoing transformation of its economic development.

1.1 Achievements of ICT Research and Developments in China

1.1.1 Computer and Software

- In the field of Computer and Software, Model 103 conducted open computing performance in 1958; while the success of Model 104 in getting through trial operations indicated that the trial production of China's first large general electronic computer was successful in 1959. In the mid-1960s, China had already produced five types of trial transistorised computers and put them into a small number of productions. This success meant that China's industry of computer had evolved to the second generation.

- In 1983, Model "Galaxy-I", China's first large computer, of which the rate was marked by billions of times per second, came into being. Through continuous endeavour by Chinese scientists, China's research capacity on super computers had been improved significantly. China was the third country of researching on and producing high-performance super computer after the USA and Japan worldwide. The computing rate of LINKPACK exceeded 160 trillion times per second of float computing.

- In the field of software, "Chinese Character Computer - Laser Photo Typesetting System" which made use of the High Magnification Information Compression and High Speed Reduction technology and the High Precision Laser Scan Output technology, was successfully produced on trial. At that time, Laser Chinese Character Photo Type Setting System had been used widely all over the world. From the beginning of the 1980s, applications of microcomputer were promoted rapidly. As a result, the Chinese character information processing technology was spread to a large scale and the functionality of interoperating Chinese character and Western information was realised. In 1983, the input method of "Wangma five strokes" was invented – a major breakthrough on China's way to the digitisation of Chinese characters.

- In 1988, KINGSOFT Company started the development of WPS, which was a kind of Chinese character processing system. This innovation filled the blank of computer character processing in China. The successful development of Chinese Linux Operating system laid an excellent foundation for the promotion and implementation of application software made in China. It is worthwhile to mention that database systems, middleware and enterprise management software "made in China" also developed quickly.

- In fact, China-made products and services of information security also developed quickly. Embedded Operating Systems went into the phase of industrialisation. Consequently, various kinds of embedded application software made a great contribution to the product upgrade of Chinese household electrical appliances, the information industry and the manufacturing sector. China also quickened its pace of exporting software. Laser Photo Type Setting systems were exported to the USA, Japan, Britain and other countries, which took up a 90% share of the global Chinese newspaper industry. A series of office products successfully entered into the markets of Japan, North America and Africa. Management softwares entered into the market of Southeast Asia. Original network games started to enter into overseas markets.

1.1.2 Microelectronics and Integrated Circuits

- In the field of Microelectronics and Integrated Circuits, China developed the first germanium transistor in 1957. China successfully put forward silicon single crystal and gallium arsenide crystal materials in 1959 and 1962 respectively.

- The first integrated circuit (IC) of China's own independent research and development came into being in 1965, only 7 years later than 1959 when American Fairchild Semiconductor Company successfully developed the world's first integrated circuit.

- In 2001, China's first general CPU called "Dragon Chip" was invented by Institute of Computing Technology at Chinese Academy of Sciences. In 2002, China successfully produced a high-performance general CPU called Dragon Chip I.

- In the same year, China Sugon Company put forward the Longteng Server which was completely invented of its own independent research and development. The Longteng Server made use of Dragon Chip I CPU, and the main board was invented together by Sugon Company and Institute of

Computing Technology at Chinese Academy of Sciences, and Sugon LINUX operating system. This Longteng Server was China's first invention out of its own completely independent research and development.

- In 2006, the Dragon Chip processor invented by Chinese Academy of Sciences, and Peking University Zhongzhi-863 CPU System Chip invented by Peking University, together with COMIP system chip invented by Datang Microelectronics Technology Company – all these were identified as remarkable achievements of the 863 Plan on High-level General Chip in the Tenth National "Five-Year Plan".

- As far as the production line is concerned, the size of chip has moved from 3 inches at the beginning of the Reform and Opening-up Period to its current 12 inches. The IC manufacturing craft has reached the level of deep submicron. Actually, advanced manufacturing craft has already achieved 80nm. Packing and testing has also moved from the bottom to the middle and high level.

- The level of IC design had been improved tremendously. For example, the ratio of enterprises with design capability of less than or equal to 0.5 micron is more than 60 per cent. In fact, there are a considerable number of enterprises with design capability of less than 0.18 micron. The design capability of some enterprises can achieve 90nm. As regards equipment, 100nm plasma etching machine and large angle ion implantation machine have already been successfully developed and also used in production lines. With reference to materials, 8 inches and 12 inches silicon single crystal have been developed. And the domestic production and supply ability of silicon wafer and photo resist have been continuously improved.

1.1.3 The Mass Communication Sector

- At the beginning of the 1970s, China successfully invented colour television. In 1973, China initiated colour television broadcasting. At the same time, China successfully produced the sample model of three-line colour television centre equipment on trial.
- At the beginning of 1970, China started comprehensive research on the optical communication technology, ranging from optical raw material, signal component, fibre optical cable, to system equipment. In 1975, China successfully launched its first man-made terrestrial satellite of Chinese own design and manufacture.

- In the same year, China's first analogue 10-metre antenna for satellite

communication Earth station was successfully invented. This success laid an essential foundation for the development of China's satellite communication technology.

- In 2002, IPv4 core router was successfully invented. The research community solved a plethora of difficult technological problems, such as architecture design of core router, large-scale integration complex system of hardware and software, high rate packet routing processing, systematic high-reliability and redundancy of combination of hardware and software, just to name a few. This success was an important milestone of Chinese scientists exploring and developing core technologies of the Internet.

- In 2004, the successful invention of IPv6 core router indicated that China had mastered key technologies of the Internet realisation. In December 2008, China built the largest IPv6 tested network all over the world. CNGI-CERNET 2/6IX, built by Tsinghua University together with 25 other universities, is currently the largest pure IPv6 internet network all over the world. It has been marked as one of the leading examples of network innovations worldwide.

- In 2006, high-level communication systems, such as China 40 Gbps SDH optical communication systems, 80×40Gbps dense WDM systems, large capacity and long distance transmission systems, and fibre to home, were successfully developed. The research of relevant supporting components was also remarkable. It is undeniable that China has now achieved a world-leading level of optical communication technology.

- China has also made great achievements in basic information infrastructure and the level of communication services. China excels in its modern communication service industry and is closely followed by other countries. Moreover, China's electronic communications technology and industry of completely independent research and manufacture have been advanced by leaps and bounds with the advancement of China's communication systems. Actually, there are fundamental breakthroughs in many core technology areas. China's basic system of communication technology and industry has been established. China has exerted an increasingly important influence on the standardisation of international communication.

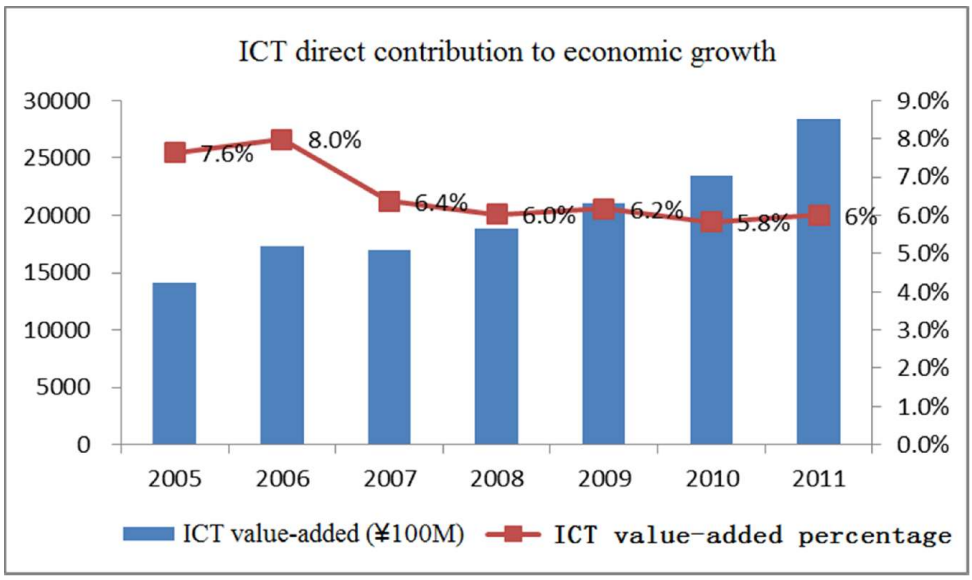
- The comprehensive competitive strength of Chinese leading communication operators is equally remarkable. Communication equipment manufacturers, such as Huawei and ZTE, have been important providers in the international market. As China's first communication standard - out of its own completely

independent research and manufacture - TD-SCDMA has already reached a mature level and continues to develop at a fast pace.

1.2 The ICT Contribution to China's Economic Growth

- As the ICT industry has sustained rapid growth, its direct contribution to GDP has been stable over the past years, albeit only decreasing slightly in recent years. From 2005 to 2011, the scale of the information industry revenue shot up from 4.1 trillion RMB to 10.6 trillion RMB, with an average annual growth of 17 per cent; the information industry rose from 1.4 trillion RMB to 2.8 trillion RMB, at an average annual increase of 12.3 per cent. Slowdown in the growth of the information industry compared to other industries resulted in the direct contribution of the ICT industry to GDP in that period showing a trend of slight decrease. In 2011, the ICT value-added share of GDP was 6 per cent, 1.1 percentage points lower than 7.1 per cent in 2009.

Figure 1: The direct contribution of China's ICT industry to GDP



Source: CATR report

- The ICT industry provides a large number of jobs and creates new employment opportunities. According to the statistics by the Department of Human Resources, by the end of 2010, the total number of employees in the ICT industry reached 14.321 million. Among these employees, the practitioners working in the telecommunications sector were 2.794 million, while 2.725 million employees in the software sector, and 8.803 million in the electronic information product manufacturing sector. The total number

of employees in the whole ICT industry accounted for 1.9 per cent of the total employment and 4.1 per cent of urban employment in China.

- Apart from its direct contribution to GDP, the ICT industry also helps to accelerate economic restructuring and the transformation in economic growth patterns, stimulating the development of relevant industries, making indirect contribution to economic growth, and thus holding a position of strategic significance in China's national economy.

1.3 Overview of China ICT Spending Trends

- ICT Spending means the ICT products and services provided to the residents, governments and enterprises. ICT products include all terminals such as mobile phone, tablets, personal PC, smart TV, IPTV terminals, portable IT products etc. ICT services include telecom service, internet services and other value added services.
- Smart Terminal is becoming the favourite equipment. In 2012, the shipment of Chinese smart terminal is 0.224 billion which exceeds the shipment of PC, and China's shipment of smart mobile phone has became the biggest in the world. Furthermore there were 1.1billion mobile phone users by the end of 2012 and nearly 0.3 billion smart mobile phone users with more than 50 per cent rate of increase, the popular band of which includes iPhone SAMSUNG Nokia HTC and Huawei.
- Wireless is becoming the most popular route by which the people go on the Internet. Along with the smart mobile phone gaining even greater market acceptance, wireless is likewise becoming the most popular way by which the people go on the Internet. There were 0.75 billion mobile Internet users in China by the end of 2012, who go on the Internet by 3G, 4G or WIFI at their convenience. The mobile Internet users like to pay for the traffic fee and the traffic consumption is becoming the new revenue growth point for the Telecom enterprise which is exceeding the voice and message service.
- Mobile Internet Service is popular with the greatest mass of users. By the end of 2012, there were more than 50 App Stores in China and the App download scale of the biggest one - which has more than 0.7million Apps - reached nearly 10 billion, which is also vastly increasing. Many Apps have more than 0.1 billion users, including national app and foreign ones, for example the user of WeChat went beyond 0.3 billion in China at the beginning of 2013.
- In the current age, smart terminal, wireless and mobile Internet service are the users' focus area, and are also the key consumption trends.

1.4 ICT Research Structure and Key Players

1.4.1 State-owned Research and Development Institutes

- The state-owned institutes are an important force of China's ICT research and development, including China Academy of Telecommunication Research (CATR) of the Ministry of Industry and Information Technology (MIIT), and Chinese Academy of Sciences (CAS), among others.

- CATR was established in the mid-1950s. It is a national-level research organisation in the telecom field directly under the leadership of MIIT. CATR owns several national- and ministry-level test centres with advanced test equipment, among which, the RTnet, MTnet and EMC Lab has leading facilities and environments in Asia and worldwide. As China is a member state of the ITU, CATR actively participates in international activities. Many experts from CATR are chairmen and speakers in ITU study and working groups, and play important roles in the fields of 3G, mobile data service, IP and optical communications. They have set up long-term cooperation with leading telecom manufacturers and operators as well as test organisations in the world. CATR has been undertaking the research of national- and ministry-level projects. Since 1994, it has completed more than 2,000 projects, of which more than 80 projects were major ones from the National "863" Plan and the Tenth Five-Year Plan, and more than 20 were from National Major Science and Technology Projects. Under the leadership of the MIIT, CATR has become a national academy that supports governments in industry regulation and represents the national highest-level research on the telecom network technology. It has also become a pioneering metrology/test/certification organisation and a consultancy unit in the industry.

- Founded in 1949, Chinese Academy of Sciences (CAS) is not only the most prestigious academic institution of science and technology, but also a centre for comprehensive research in natural sciences and high-tech, where ICT is one of the main research areas of CAS. It houses a large number of scientists, who are mainly engaged in fundamental research, high-tech research and development, and technological innovations. It is affiliated with more than 100 institutes across the country, more than 400 scientific and technological enterprises, and 3 universities. Among these affiliated institutes, there are 52 national key laboratories. The ICT-related research institutes in CAC including the Institute of Microelectronics, Shanghai Institute of Micro-system and Information Technology, and Shenyang Institute of Automation, to name just a few.

1.4.2 Colleges and Universities

- Similar to other countries, in China, scientific research, including ICT, is to a large extent carried out by colleges and universities. The leading universities in China include Beijing University of Posts and Telecommunications, Tsinghua University, Peking University, Southeast University, Zhejiang University, Shanghai Jiaotong University and many others.

- In cooperation with other research institutes and enterprises, China has combined research and production, formulating a development model that uses theory to solve problems in production practices, and the findings therein to inform the production of market competitive goods. Research and market are closely connected in this model. It can be said that colleges and universities play an important role in the development of ICT.

1.4.3 Enterprises

- The reform in science and technology research has helped to shift the focus of ICT research from the independent research institutes to enterprises. In recent years, a large number of high-tech enterprises in China, with a tremendous speed of development and growth, have become the leading players in ICT research, such as ZTE, Huawei, CETC, Lenovo, and Founder. As a result, a number of household brands of products have come into being. To upgrade China's industrial technology, the Chinese government has taken a series of policy measures to support the construction of R&D centres, exchange with leading international partners, and provide useful reference for domestic enterprises and applications.

  - The ZTE Corporation is a leading global provider of telecommunications equipment and network solutions. ZTE is committed to providing customers all over the world with innovative technologies. The company has established 18 state-of-the-art R&D centres in China, France, and India, and employs over 30,000 research professionals. Ten per cent of the company’s annual revenue is invested in R&D. In addition, ZTE cooperates with its top-tier industry chain partners to build laboratories focused on developing technological breakthroughs. ZTE ranked No.1 among global companies in terms of PCT patent filings in 2011 with 2,826 total applications. Also, the company ranks No. 1 in China in terms of the domestic patent authorisation and application. With 107 subsidiary organisations globally, ZTE wins the trust of global clients through its devotion to innovation, customisation and high-quality services.

- Huawei is a leading company in telecommunication research and manufacturing. Its solutions have been deployed by 45 of the world's top 50 telecom operators. More than 53,000 out of its total 120,000 employees are dedicated to R&D. Through the dedication to customer-centric innovation and strong partnerships, Huawei has established end-to-end advantages in telecom networks, devices and cloud computing. Huawei ranks No. 2 in the world among ICT providers. Its global revenues reached $28 billion in 2010 and it was the second largest Patent Cooperation Treaty applicant with a total filing of 49,040 patents by the end of 2010.

- CETC is the leader of research in electronic and information products, development, production and system integration. It is one of the top 20 state-owned corporations in China. Its research and products field include command and control system, radar, communication system and equipment, electronic optic device, anti-terrorism and security products, electronic materials and components, radio and television equipment, and frequency control devices, among many others.

- With the development and growth in ICT, an increasing number of Internet companies in China have started to become important players in the market. Baidu, as the largest search engine and website in the Chinese language around the world, currently houses several thousand R&D engineers with world-leading technology in search engines. Alibaba is a world-leading e-commerce company for Small and Medium Enterprises (SMEs), assisting millions of buyers and providers to process their on-line transactions – a service that is effectuated through three Internet transaction platforms, namely an international market targeting servicing global import/export businesses, a Chinese one focused on domestic trade and a Japanese one to promote domestic and international sale of Japanese products (this last one being operated together with a partnership company). Tencent is currently one of China's biggest providers of comprehensive Internet service, and is also one of the Internet enterprises with the largest number of users. Tencent sets as its strategic goal to provide users with "one-stop-only service for cyber-life", offering leading network platforms in China such as Internet value-added service, mobile phone top-up service and online advertisement. Through the following platforms - QQ (instant message service), Tencent website (QQ.com), online games, QQ space, wireless portal, soso.com, paipai.com and Tenpay.com - Tencent has created the largest social network community in China, responding creatively to users' demands in communication, information, entertainment and e-commerce.

- In the ICT field in contemporary China, due to problems in finance and market, SMEs have by far not yet become the mainstream leaders of its development. Nevertheless, in several fields and technological directions, certain SMEs have experienced fast growth and development, such as the TD-SCDMA 3G terminal test equipment developed by Beijing Star Point Communications Technology Company has reached the world leading level. Equipment and solutions for accessing optical fibre broadband provided for telecom operators by Beijing GW Technologies Company combine R&D, manufacture and marketing services.

1.5 Uptake of European ICT technology in China

- Since the Chinese government implemented the reform and opened up policy in the end of the seventies, trade and investment between EU and China increased significantly and a close trade relationship has been established. China became the second export partner and the first import resource. According to statistics of DG Trade of EU Commission, the In 2011, the value of export from EU to China reached 188 billion USD, and amount to 8.8% of total exports. The value scale of imports from China to EU reached 405.8 billion USD, with a percentage of 14.3% among the whole volume.

- In the ICT sector, Europe is the second export destination of China's ICT-related products. Based on WTO data, the value of ICT products imported to the EU from China reached USD 128.7 billion, which is 24.9% of the whole import scale in 2011. The following chart shows the trade volume of the ICT sector between EU and China from 2009-2011.

	Import from China to EU	Percentage of the total product	Import from EU to China	Percentage of total China import
2011	1287.3	24.9%	97.2	3.2%
2010	1249.1	24.2%	90.7	3.3%
2009	935.1	21.5%	84.7	4.0%

Figure 1.2 ICT trade between EU and China Unit: 100 million USD

- Communication and telecom enterprises from Europe have invested heavily in China; these enterprises have played an important and positive role in promoting the EU-China cooperation in the field of ICT.

- With the rapid development of China's telecommunications industry,

Ericsson takes China as a global hub of production, technology research and professional services. From 2000, Ericsson increased its investment substantially in China, particularly in four areas including high-tech investment, creation of jobs, exports growth and development of human resources. Today, the Nanjing Ericsson Panda Communication Co., Ltd. has become the largest of Ericsson’s supply hub and supports Ericsson's global supply network with two other fulcrums in America and Europe. Ericsson has the strategic plan to develop a global technology research and development centre in China. Ericsson employs more than 4300 people engaged in R&D and invests more than 1 billion RMB annually in R&D. Ericsson China R&D Academy, established in 2002, has grown to become the world's second largest R&D base of Ericsson.Ericsson has more than 16,000 employees in China. In 2012, China is the third-largest market in the world (after the United States and Japan) ranked by sales revenue, accounting for 6% of the Group's total sales.

- Nokia Siemens Networks has established a complete value chain in China, including TD-LTE R&D, manufacturing, marketing and sales. Nokia Siemens has five global R&D centers, four global manufacturing bases, 14 entities or joint ventures in China. The Chinese apartment of Nokia Siemens Networks reached 12 billion RMB in annual sales, 12.2 billion RMB in annual local purchases, with exports of 8.7 billion RMB and annual tax amount of 20 billion RMB.

- Telecommunication enterprises from Europe have made a lot of investment in China. For example, Telefónica established a strategic alliance with China Unicom and currently holds a 5.01% stake. In July 2004, France Telecom-Orange established its China R&D center in Beijing - the center is dedicated to mobile terminals, mobile Internet services, new video experience services as well as wireless communication network technology and other fields. In 2012, the Orange Beijing R&D center established the Shenzhen branch, which is mainly responsible for the cooperation with Huawei, ZTE and other vendors in the field of innovation in communications products and terminal technology.

2. China's General Strategy and Key Planning in ICT

In China, government departments and agencies, through making and promulgating relevant planning, strategies and policies are able to guide and promote technological R&D, innovation and industrial development in ICT. The planning may come from the State Council or other government departments. For instance, the former issued *The Twelfth Five-Year Plan (2011-2015) for National Economic and Social Development* and *The Twelfth Five-Year Plan for Emerging Strategic Industries*, while the latter, such as the MIIT, issued *The Twelfth Five-Year Plan for the Telecom Industry* and *The Twelfth Five-Year Plan for the Internet*. These plans cover nearly all aspects of the ICT industry, such as the next-generation ICT sectors, including the electronic information manufacturing sector, the software service sector, the telecom sector, the Internet of Things (IoT), cloud computing and the next-generation mobile communication. They have played an important role in guiding and promoting technological innovation and industrial development of ICT in China.

2.1 The National Digitalisation Strategy of the State Council

This Strategy was promulgated by the State Council in 2006, with the aim of enhancing the digitalisation of the economy and society by using ICT.

- Development Goals
  - By 2020, the network availability should be significantly improved, together with the exploitation of information resources and the improvement of the level of information security. China should seize the opportunities for transforming network technology and establishing a world-leading, multi-networks-integrated, and secure information infrastructure. China shall also conceive a scientific outlook on information resources, marking information resources as important as energy and materials, and create conditions for developing knowledge-intensive industries.

- Key Technological or Industrial Directions
  - To advance network integration, in the aim of undertaking the transition towards next-generation networks.
  - To optimise network structures, improve network functionality, and advance the development of a comprehensive basic information platform.
  - To accelerate reform and advance the "convergence of the three networks" from such aspects like service, network and terminal.

- To develop multiple forms of broadband access and push forward consistently the availability of Internet applications.
- To promote the development of various forms of digital television broadcast (e.g. cable, Earth and satellite) and effectuate the transition from analogue to digital television broadcast.
- To apply such network functionality for technological expansion as photoelectric sensor and radio frequency identification, develop and improve comprehensive information infrastructure and effectuate in a stable manner the transition towards the next-generation networks.
- To break through such bottlenecks in the development of infrastructure industries as integrated circuit, software, key electronic devices and components, and key craft equipment. To place emphasis on such key ICT areas as mobile communication, digital television, the next-generation network, and radio frequency identification.

2.2 The ICT Development Strategy by NDRC

2.2.1 The 12th Five-Year Plan for National Economic and Social Development

In March 2011, "The Twelfth Five-Year Plan for National Economic and Social Development of the PRC" (referred to as "The Twelfth Five-Year Plan" hereinafter) was published, with NDRC as the main drafter. The Twelfth Five-Year Plan is the most important economic and social development plan in China, which includes various aspects of economic and social development and its purpose is to promote economic and social development in the next five years. For ICT, this plan includes promoting the high-tech service industry and strategic emerging industries and building the next-generation information infrastructure.

- Development Goals

  - To accelerate the construction of the next-generation national information infrastructure that is broadband-based, integrated, secure and ubiquitous, promote an in-depth integration of digitalisation and industrialisation, and advance the digitalisation of various social and economic fields.

- Key Technological or Industrial Directions

  - The new-generation ICT industry places its emphasis on developing the new-generation mobile communication, the next-generation Internet, the convergence of three networks, the IoT, cloud computing, new display, high-end software, high-end server and information service.
  - To plan and lay out in its entirety the construction of such facilities as the new-generation mobile communication network, the

next-generation Internet, digital television broadcast network, and satellite communication, so as to build ultra-high speed, large-capacity and highly intelligent national trunk transmission networks.

- To guide the construction of broadband wireless cities, promote urban accessibility of optical fibres, accelerate the construction of broadband networks in rural areas, and improve in an all-round manner the availability of broadband and access bandwidth.
- To further R&D in IoT key technologies and demonstration applications in key areas. To enhance the construction of service platform for cloud computing. With dual access to both broadcasting & TV and telecommunication services as the focal point, to build a complete legal system of regulations and standards, achieve the convergence of the three networks of telecommunication, broadcasting & TV, and the Internet, and promote network interconnectivity, interoperability and service integration.

2.2.2 The 12th Five-Year Plan for Strategic Emerging Industries

In May 2012, "The Twelfth Five-Year Plan for Strategic Emerging Industries" was published by the State Council, and NDRC was the main drafter. It further clarifies the development of key emerging industries in the next five years, where the new-generation IT industry is regarded as the one of the seven emerging industries.

- Development Goals

  - By 2020, the following industries should become the pillar industries for national economy in China, including: energy saving and environmental protection, the new-generation ICT, bio industry, and high-end equipment manufacturing. Efforts should also be made to enable the following industries to become leading ones in national economy, namely new energy, new material and new-energy automobile.

- Key Technological or Industrial Directions

  - The seven strategic emerging industries refer respectively to energy saving and environmental protection, the new-generation ICT, bio industry, high-end equipment manufacturing, new energy, new materials and new-energy automobile.

  - The new-generation ICT mainly includes information network infrastructure, the next-generation mobile communication, the next-generation core equipment of the Internet, high-intelligence terminal, the convergence of three networks, IoT, cloud computing,

integrated circuit, new display, and high-end software & server. There is a need to further accelerate the construction of the next-generation information networks, and to achieve such breakthroughs in the new-generation ICT as ultrahigh-speed optical fibre and wireless communication, advanced semi-conductor and new display.

2.2.3 The Decision on Accelerating the Training and Development of Strategic Emerging Industries

In October 2010, the draft of "The Twelfth Five-Year Plan for National Economic and Social Development" (The "Twelfth Five-Year Plan") identified the targets and directions for ICT development in China.

- Development Goals

  - By 2020, the added value of strategic emerging industries should take up as high as 15 per cent in GDP, with an enhanced capacity to absorb labour and create employment. Such industries like energy saving and environment protection, the new-generation ICT, bio industry, and high-end equipment manufacturing, should become the pillar industries of the national economy.

- Key Technological or Industrial Directions

  - The New-generation ICT. To accelerate constructing the next-generation national information infrastructure that is broadband-based, integrated, secure and ubiquitous; promote the R&D and industrialisation of the new-generation mobile communication, the next-generation Internet core equipment and intelligent terminals; accelerate promoting the convergence of three networks, and push forward the R&D and demonstration application of IoT and cloud computing. Efforts should be made to develop such core basic industries like integrated circuit, new display, high-end software, and high-end servers.
  - To enhance such information service capacities like software service and network value-added service, and accelerate upgrading key infrastructure to the intelligent level. Great efforts should also be made to develop digital virtual technology and promote the development of cultural and creative industries.

  - Vigorously Promote International Science and Technology Cooperation and Exchange. To enable various cooperation mechanisms to play their role, so as to advance international science and technology cooperation and exchange at multiple levels, through multiple channels and in multiple ways. To encourage international enterprises and research

organisations to establish their R&D centres in China, and support qualified foreign investment enterprises to apply for national research projects with domestic enterprises and research organisations. To support Chinese enterprises and research organisations to carry out global outsourcing of R&D service, carry out R&D and establish research organisations in other countries, and apply for patent internationally. To encourage Chinese enterprises and research organisations to participate in the making of international standards, and incentivise international investment enterprises to participate in Chinese technological projects for demonstration application, so as to jointly formulate international standards.

2.2.4 The 2020 Long-Term Planning Outline for the Information Industry and Technology Development

In March 2011, "The Twelfth Five-Year Plan for National Economic and Social Development" was officially promulgated by NDRC.

- Development Goals
  - By 2020, to establish a relatively complete system of science and technology innovation. On the basis of major breakthroughs in the 11th Five-Year Plan, China should strive for an overall breakthrough and development by leaps and bounds in ICT, the ownership of a large number of core technology of proprietary intellectual property rights (IPRs) in major ICT fields, a basic self-supply of key products, and being ranked among advanced nations in ICT.

- Key Technological or Industrial Directions
  - To join efforts together to achieve breakthroughs in key projects like integrated circuits, software and new equipment and components, strive for breakthroughs by stages, master a range of key technologies, own a series of core patents and standards, and enhance in an all-round manner the support for the development of the information industry.
  - According to the general trends in digitalisation, networking and intelligence, promote constructing Digital China and major applications in information infrastructure and exploitation of information resources (e.g. broadband communication network, digital television network, and the next-generation Internet), advance the convergence of three networks, and achieve breakthroughs in core technology and major products in such fields as digitalised audio-visual, the new-generation mobile communication, and high-performance computer and network

facilities.

In agreement with the development trend, strategic requirements and general idea of development in ICT, efforts should be made to develop core technologies in the following 15 areas in the next 5 to 15 years: the technology of integrated circuit, software technology, new components technology, electronic material technology, network communication technology, computing technology, storage technology, digital audio-visual technology, network and information security technology, photo-electronic technology, display technology, measuring instrument technology, electronic equipment manufacturing technology, ICT application, and GPS/telemeter/remote control/remote sensing.

2.2.5The State Council Decision on Encouraging the ICT expense

In August 2013, the State Council of China released Several Guidance on Encouraging the ICT Spending and Enlarging the Domestic Need. In this Guidance, Chinese government takes ICT as an important engine of expanding the domestic need, cultivate new economic growth, transforming the economic development. In this document, it requires the related stakeholders: to accelerate the upgrading of ICT infrastructure, to improve the supply capacity of ICT products, to cultivate the ICT spending need; to improve the ICT level of public service, to emphasize the spending environment and improve the policies.

2.2.6 Broadband China Strategy

In August 2013, the State Council of China published Notice of the State Council on the Issuance of the “Broadband China” Strategy and Implementation scheme (Guo Fa [2013] No. 31). The strategy is the action plan for broadband in the future. Broadband China Strategy positioned broadband as the strategic public infrastructure in the national economic and social development, as water, power and road. This is a big breakthrough for ICT policies. It means from now on, broadband construction is not only the tasks of the telecom operators, the local governments will include broadband into the economic and social development plan, and provide better conditions and policy supports for broadband development.

- Broadband China Strategy raises the mid-term and long-term targets:
  - By 2015, to initially form the next generation national information infrastructure adapting to the economic and social development needs. To basically achieve FTTB and FTTH in urban areas and broadband access in rural villages, a rate of 50% for fixed-line broadband household penetration, 32.5% for the third generation of mobile communications

and its Long Term Evolution (3G/LTE) penetration, 95% for broadband penetration in administrative villages (wired or wireless access method,), and broadband coverage on the whole for schools, libraries, hospitals and other public interest institutions. The broadband access for urban and rural households will reach 20 megabits per second (Mbps) and 4Mbps, and some developed cities will reach 100Mbps.

- By 2020, the gap between China and developed countries on the level of broadband network infrastructure development will be narrowed, and Chinese people will fully enjoy economic growth, service facilities and development opportunities brought by broadband. China will have a complete coverage of urban and rural areas with broadband networks, a rate of 70% for fixed-line broadband household penetration, 85% for 3G/LTE penetration, and over 98% for broadband coverage in administrative villages. The broadband access for urban and rural households will reach 50Mbps and 12Mbps respectively, and that for part of households in developed cities will reach 1 gigabit per second (Gbps).

2.3 The MIIT ICT Development Strategy and Planning

2.3.1 The 12th Five-Year Plan for Industrial Technology Innovation

This Plan, published by the MIIT in 2011, aims to promote the development of ICT, which focuses on the technological research of the electronic information industry, software and information technology services and IT.

- Development Goals

  - By 2015, technological innovation in major ICT industries should achieve key breakthroughs, helping China to master a range of core and key technologies with proprietary IPR. The technological level in certain industries should rank among the top around the world.

- Key Technological or Industrial Directions

  - The Electronic Information Manufacturing Industry: the emphasis is to develop the following: thin, light-weight, portable, low power and touch technologies for industrial design of computer products, main board manufacturing, and industrial control computer architecture; air traffic control technology; key technology of digital terrestrial television, digital audio-visual coding technology, blue-ray high-definition technology, digital copyright management technology, digital content protection technology, home gateway technology, home electronic appliances

interconnection technology, and unified multi-service certification platform technology; high-end universal chip technology, 12-inch advanced craft and manufacturing line technology and 8-inch/6-inch feature technology, such advanced packaging and testing technologies as BGA, CSP, MCM, WLP, 3D and TSV, micro-electromechanical system (MEMS) technology, advanced EDA tools, and key technologies of LED epitaxial growth and chip manufacture; new chip components based on SMT technology, new components based on MEMS technology, and integrated passive components based on LTCC technology; such new display technologies as TFT-LCD, PDP, OLED, electronic paper, 3D display, and laser display; such key technologies for major electronic equipment as key equipment for integrated circuit, key equipment for new panel display, single crystal device with the grade of semi-conductor, equipment for manufacturing new components, equipment for the production line and post-packaging for high-brightness LED chips, equipment for manufacturing new components and surface mounting equipment; technology of new solar power battery and high-quality, low-cost polycrystalline silicon, green battery technology of lithium-ion, and such advanced electronic materials technology as high-efficiency, high-brightness LEDG components technology, electronic-grade polycrystalline silicon, and 8- to 12-inch silicon epitaxial films; mobile communication technology of wireless broadband, core technology of new mobile communication terminal, full-wave optical fibre technology, satellite mobile communication system antenna technology, the Ka- and V-frequency satellite communication technology, integrated system on SOC chip, RFID technology, new sensory technology, and technologies to prevent electromagnetic radiation and information leak.

- For the Software and Information Technology Service Industry, the emphasis is to develop the following: unstructured database technology, multimedia database technology, real-time database technology, middleware technology, embedded software technology, information security software technology, and intelligent human-computer interaction technology, Chinese information processing technology, geographic information processing technology, distributed computing technology, parallel computing technology , virtualisation technology, networked large-scale software development and verification technology, IP multimedia Subsystem (IMS) technology, IPTV middleware technology, new password technology, authentication and identification technology (biometric identification technology), identification, prevention and filtering & quarantine technology of adverse information, software as service technology, technology for treating key support tools for ICT service, game and animation software technology, virtual reality technology and green IT support software

technology.

- For the Telecom Industry, the emphasis is to develop the following: the IMT-Advanced technology, wireless city technology based on TD-SCDMA/TD-LTE, System Architecture Evolution (SAE) technology, optical transmission network (OTN) technology, packet transfer network (PTN) technology, space borne processing and exchange technology; IPV4 and IPV6 transition and integration technology, Internet service Mashup technology, 3D Internet technology, QoS control technology, FMC fixed network mobile interconnection technology, IoT security and reliability technology, Internet control and tracing mechanism and core technology, and IDM technology.

2.3.2 The 12th Five-Year Plan for Electronic Information Manufacturing

This Plan aims to promote the development of the electronic information Industry, which focuses on the research of integrated circuit, component of new panel display and sensor smart terminal operating system, chip, server and NGI. This Plan contains three sub-plans: *The Twelfth Five-Year Plan on Basic Electronic Materials and Key Components*, *The Twelfth Five-Year Plan on Electronic Equipment*, and *The Twelfth Five-Year Plan on Digital Television and Digital Home*.

- Development Goals

  - During the Twelfth Five-Year Plan period, the annual increase rate for sales revenue of the above-scale electronic information manufacturing industry should be kept at around 10 per cent, exceeding 10 trillion RMB in 2015; the annual increase of industrial added value should exceed 12 per cent; the annual increase in sales revenue of strategic emerging industries in the electronic information manufacturing industry should be 25 per cent.

  - For the top 100 enterprises, the percentage of R&D investment in sales revenue should exceed 5 per cent; the total number of patents in the ICT field should reach around 1.3 million; there should be breakthroughs in core technologies in fields such as integrated circuit, new display components, key components, key electronic materials and electronic equipment. Integrated circuit products should supply 30 per cent of the demand in China's domestic market, while the scale production technology in the chip manufacturing industry should reach the 12-inch and 32/28nm level of craft; the rate of self-supply of the panel of flat-panel television should exceed 80 per cent; China should also establish a complete TD-LTE industrial system.

- Key Technological or Industrial Directions

  - With the whole-machine demand as the orientation, to strive for developing high-performance integrated circuit products; to accelerate developing new matching and support capacity; with such propriety technologies as the new-generation mobile communication, the next-generation Internet, IoT, and cloud computing, to advance upgrading computer, mobile communication equipment and audio-visual products; to promote an integrated development of military and civil applications, and accelerate the development and transformation of electronic information technology to be used by both military and civil applications.

  - With the following seven fields as the strategic emerging industries, namely the new-generation network communication system equipment and intelligent terminal, high-performance integrated circuit, new display, cloud computing, IoT, digital home, and key electronic components and materials, use key engineering applications as the driver to accelerate the industrialisation of innovative products and establish a complete industrial chain on its basis.

  - To implement with great efforts the strategy of "Walking Out of China" and through such measures as policy support, credit assurance, and improvement of customs clearance service, to encourage qualified backbone enterprises to establish branches overseas, expand marketing channels, set up R&D centres and carry out multi-layered cooperation with international science and technology enterprises and R&D organisations.

2.3.3 The 12th Five-Year Plan for the Internet of Things (IoT)

This Plan was promulgated by MIIT in November, 2011, aiming to promote the development of the Internet of Things (IoT), which focuses on the research of information perception technology, information transfer technology, information processing technology and information security technology.

- Development Goals

  - By 2015, China aims to accomplish certain achievements in the following fields: R&D and industrialisation of core technologies, research and making of key standards, establishment and improvement of industrial chain, and demonstration and promotion of major applications, for purpose of formulating in a preliminary manner an IoT

development framework that is driven by innovation, pulled by applications, based on coordinated development, and secure and manageable.

- The capacity of technological innovation should be significantly enhanced. China should achieve breakthroughs in a range of IoT core technologies, achieving over 500 major research findings in technological fields such as sensing, transmission, processing and application; research and make over 200 national and industrial standards; promote establishing a series of exemplary enterprises, key labs and engineering centres as the carriers of innovation, so as to lay foundation for continuous innovation capacity.

- To complete constructing an industrial system in a preliminary manner. To form a relatively complete IoT industrial chain, nurture and develop 10 industrial cluster zones and over 100 backbone enterprises.

■ Key Technological or Industrial Directions

- To Improve the Sensing Technology. To support with emphasis the R&D of ultra-high frequency and microwave RFID tags, intelligent sensors, and embedded software, sustain research and manufacture of such key equipment as position sensing technology and MEMS-based sensors, and push forward the research on 2D decoding chip.

- To Advance Breakthroughs in the Transmission Technology. To support with emphasis the R&D of new short distance wireless communication technology and sensor nodes that are applicable to IoT, sustain the networking and management techniques of sensor networks of self-perception, self-configuring, self-repairing and self-management, and drive the development of networking technology for fixed, mobile, wired and wireless multi-layered IoT network.

- To Enhance the Research on the Processing Technology. To support with emphasis the research on such technologies applicable to IoT as mass information storage and processing, data mining, and intelligent analysis of image and video, sustain the development of database, system software and middleware, and push forward the research on such basic software as hardware-software user interface.

- To Consolidate the Base of Generic technology. To support with emphasis the manufacturing of core chips and sensor micromation that support IoT and the research of IoT information security, to sustain the development of high-performance micro-power and energy access, and

identification & addressing that can be used on sensor nodes, and to push forward the research on such technologies as spectrum and interferometric analysis.

2.3.4 The 12th Five-Year Plan for the Internet Industry

This Plan was promulgated by the MIIT in 2012, aiming to promote the development of the Internet Industry, which focuses on the research of software, technology, smart terminal operating system, chip, server and NGI.

- Development Goals

  - To improve the availability of Internet application services. The number of netizens will exceed 800 million, with an availability rate of more than 57 per cent, and over 200 million netizens in rural areas.

  - A Significant Improvement in Accessibility. The access ports of fixed broadband Internet will exceed 370 million, with bandwidth access capacity in urban homes reaching or exceeding 20Mbps and enabling simultaneous use by at least 2 high-definition TVs and high-speed web-surfing; the bandwidth access capacity in rural homes will reach or exceed 4Mbps, and enable simultaneous use by at least 1 standard-definition TV and 1 high-speed web-surfing. The goal of fibre to 200 million homes should be accomplished.

  - To Upgrade and Optimise Network Facilities. The total bandwidth of backbone networks should increase tenfold as much as that in the 11th Five-Year Plan, reaching 300Tbps and the quality of network connectivity should reach a world-leading level. The international Internet outlet bandwidth shall increase fivefold, reaching 6.5Tbps, with 100 overseas POP points for backbone networks. Backbone network will in a full manner support IPv6, where major commercial websites, educational websites and government websites will support IPv6. The spatial arrangement of IDC will be further optimised, with technological upgrade. The PUE value of upgraded IDC should aim for lower than 2, while the PUE value of newly established cloud computing data centres should aim for lower than 1.5. High-speed and reliable CDN will cover the whole nation.

- Key Technological or Industrial Directions

  - To breakthrough in key technologies for Internet applications such as intelligent search, the new-generation web browser, and multi-media, to accelerate the R&D and promotion of Internet application basic

platform and intelligent terminal operating system, to speed up coordination and R&D of mobile intelligent terminal operating system, and to push forward breakthroughs in such fields as operating system, middleware, mobile browser, application service, core chips and intelligent terminal.

- To push forward the commercialisation of cloud computing service. To deploy and develop demonstration projects for the commercial application of cloud computing, guide and support enterprises to open up their own resources and service management capacity (such as computing storage), construct public cloud computing service platform, promote innovation in both service and business model of cloud computing, and promote the commercialisation of public clouds.

2.3.5 The 12th Five-Year Plan for the Communication Industry

This Plan was promulgated by MIIT in May, 2012, aiming to accelerate constructing the next-generation national information infrastructure that is broadband-based, integrated, secure and ubiquitous, push forward the development of the communication industry, improve in a full manner the level of digitalisation, and promote the transformation ongoing in economic development. This Plan includes 3 sub-plans: *The Twelfth Five-Year Plan for Broadband Network Infrastructure*, *The Twelfth Five-Year Plan for International Communication*, *The Twelfth Five-Year Plan for Telecommunications Network Numbers and Internet Domain Names and IP Address Resources.*

■ Development Goals

- Towards the end of the Twelfth Five-Year Plan, through implementing the strategy of “Broadband China”, to establish in a preliminary manner the next-generation national information infrastructure that is broadband-based, integrated, secure and ubiquitous, and to achieve in a preliminary manner the goal of “fibre to apartments and homes in urban areas, broadband to towns and villages in rural areas, and universal benefit of information service for all the people”.

- Expectedly towards the end of the Twelfth Five-Year Plan, optical fibre access network will cover commercial buildings and newly-built apartment quarters; the rate of fibre to home in urban newly-built residence buildings should reach or exceed 60 per cent; the Internet access bandwidth capacity should basically reach 20Mbps and 4Mbps respectively for urban and rural areas; in certain developed cities, the access bandwidth capacity should reach 100 Mbps, hence availing a significant increase in bandwidth actually available to users. 3G

networks should fundamentally cover urban and rural areas, and hot points for wireless broadband data service should be continuously covered, and LTE will be commercialised. The establishment of ultra-high speed, large-capacity, and highly intelligent trunk transmission network should be completed. The next-generation Internet will be fully deployed for commercial use. Backbone network and the system of the top 1,000 commercial websites of domestic traffic should support IPv6. The total outlet bandwidth for international service should reach 8Tbps.

- Key Technological or Industrial Directions

  - Optical Fibre Broadband: to accelerate pushing forward the broadband upgrade of information networks. With optical fibre broadband as the key point, to drive the demonstration of optical fibre networks, accelerate upgrading information networks to broadband, and improve the availability and accessibility of broadband networks in both urban and rural areas.
  - Mobile Communication: to plan in entirety the coordinated development of 2G/3G/WLAN/LTE, accelerate constructing 3G networks, expand network coverage, optimise network structure, improve network quality and achieve the commercialisation of LTE. - To strengthen the optimal allocation of spectrum resources, and accelerate deploying the research and industrialisation of LTE-enhanced core technologies. - To promote in a proactive and orderly way the construction of broadband wireless city. - To develop with great efforts the mobile Internet, construct a service innovation system of high-speed network, service platform and intelligent terminals, strive for breakthroughs in such core technologies as mobile intelligent terminal operating system platform, and improve capacity for autonomous development.
  - The Next-generation Internet: to optimise domestic structure and infrastructure layout of the Internet, and improve the quality of interconnectivity. To proactively push forward commercial network deployment of IPv6. To accelerate upgrading backbone network, metropolitan area network, IDC and support systems to IPv6.
  - Cloud Computing: to plan in entirety the infrastructure layout of cloud computing, and encourage enterprises to integrate resources, and share and co-build infrastructure for cloud computing. To actively promote the commercialisation of cloud computing services, and push forward the formation of a public service system of cloud computing.
  - The Mobile Internet: to break through such core links as mobile intelligent terminal and application platform, and to establish a value-chain eco-system of infrastructure, application platform and

intelligent terminal.

- E-Commerce: To actively develop the third party e-commerce platform and to support the integration and upgrade of such related systems as online trade and credit payment. To support demonstration of innovation and application of mobile e-commerce, and to improve the industrial chain of mobile e-commerce.
- The convergence of three networks: to increase application resources development, business innovation and market promotion; to develop with great efforts such services related to the convergence of three networks as IPTV, mobile TV, Internet video and Internet broadband access, and to drive the development of enterprises in both the upper and lower stream of the industrial chain; to improve the technological innovation system of the convergence of three networks; to enhance the making of national and industrial standards for the convergence of three networks; to improve the standardisation system of the convergence of three networks; to increase efforts for science & technology breakthroughs, accelerate the research and industrialisation of generic technology, core technologies and basic technologies for the convergence of three networks, and strengthen integrated innovation in core products and application services.
- IoT: the key point is to catch up with the world-leading technological fields, to carry out major technological breakthroughs and integrated innovation in application, to breakthrough with focused efforts on core technologies such as sensor networks, and to establish a relatively complete IoT technological system.

2.4 Key Technological Directions for Future ICT Fields to be supported with emphasis by China

Through an overview and analysis of government plans, major projects, planning, strategies and policies related to ICT, it can be seen that in the next three to eight years, the ICT fields to receive emphatic guidance and support from the government mainly include: the next-generation Internet, broadband mobile communication, the mobile Internet, the convergence of three networks, IoT, cloud computing, network and information security, integrated circuit, electronic components, computer and software.

2.4.1 The Next-Generation Internet

- Research and industrialisation should be carried out in emerging networked basic software such as a mobile intelligent terminal operating system, a networked operating system platform, and intelligent mass information resources centre management system. To support the research and

industrialisation of core application software and information technology support software for emerging Internet industries.

- To support the industrial development of high-end server and core network equipment. To carry out R&D on high-concurrency, high-throughput, high-reliability, and highly fault-tolerant high-end servers, and high-processing capacity, low-cost, and low-power super server; and on such core network equipment as low-power high-end router, large-capacity integrated backbone core routers, and virtualised, programmable routers. To strengthen the capacity to design and manufacture core chips and to carry out R&D on such core components as low-power high-end router chip, high-speed access equipment chip and intelligent terminal chip that supports the next-generation network.

2.4.2 IoT

- Sensing Technology. To support with emphasis the R&D on ultra-high-frequency and microwave RFID tags, intelligent sensors, embedded software, to support the research and manufacture of such key equipment as position sensing technology and MEMS-based sensors, and to drive the research on 2D decoding chips.

- Transmission Technology. To support with emphasis the R&D on the IoT-applicable new short-distance wireless communication technology and sensor nodes, sustain the networking and management techniques of sensor networks of self-perception, self-configuring, self-repairing and self-management, and drive the development of networking technology for fixed, mobile, wired and wireless multi-layered IoT network.

- Processing Technology. To support with emphasis the research on technologies applicable to IoT such as mass information storage and processing, data mining, and intelligent analysis of image and video, sustain the development of database, system software and middleware, and push forward the research on such basic software as hardware-software user interface.

- Generic technology. To support with emphasis the manufacture of core chips and sensor micromation that support IoT and the research of IoT information security, to sustain the development of high-performance micro-power and energy access, and identification & addressing that can be used on sensor nodes, and to push forward the research on technologies such as spectrum and interferometric analysis.

2.4.3 Network and Communication Technology

- Around services such as broadband multimedia, the new-generation mobile communication, digital content application, rural communication, intelligent information processing and intelligent communication, to develop with emphasis such products as the next-generation network, the new-generation mobile communication equipment, broadband wireless access/digital integrated equipment, home gateway, intelligent terminal, intelligent information processing and ubiquitous communication network equipment, broadband multimedia network equipment and digital content products.

- Key Technologies
  - High-Performance Multi-Service Bearer Network Technology
  - Broadband Wireless and Mobile Communication Technology
  - Business Control and Media Processing Technology
  - Broadband Multimedia Network Technology
  - Optical Communication Technology
  - Home Network Technology
  - Intelligent Terminal Technology
  - Intelligent Information Processing and Ubiquitous Communication Network Technology
  - Digital Content and Application Development Technology

2.4.4 Computer Technology

- The key is to develop products related to high-performance computing, grid computing, MPU-oriented computer system architecture, embedded computing and high trustworthy computing; and products related to pervasive computing, information printing output and intelligent computing. At the same time, China shall carry out prospective research into such non-typical computing technologies as quantum computing, optical computing, and bio-computing.

- Key Technologies：
  - High-performance computing and high-performance server technology
  - Grid computing technology
  - Computer system architecture technology
  - Embedded computing technology
  - High trustworthy computing technology and pervasive computing technology
  - Human-machine interface technology and information print output technology

- Intelligent computing technology
- Quantum, optical and DNA computing technologies

2.4.5 Network and Information Security Technology

- The key is to develop products related to security processing chip and System on Chip (SoC), security operating system, secure database, information hiding, identification, security isolation, information content security, intrusion detection, network disaster recovery, and virus protection and prevention

- Key Technologies：
  - Password technology
  - Security processing chip technology
  - Electronic identification, confirmation of responsibility and authorisation management technology
  - Computing environment and terminal security processing technology
  - Network and communication boundary security technology
  - Emergency response and disaster recovery technology
  - Information security assessment and assurance technology

2.4.6 Integrated Circuit Technology

- The Key is to develop core chips such as universal, new-structure CPU, DSP, D/A, A/D converter, storage and programmable components; in combination with the global developmental trend of the SoC technology, the key is to develop SoC chip products that may have a significant impact upon the future development of whole machine; concerning the SoC development applied to computer, network and communication, and digital audio-visual, to deploy with emphasis the R&D of a range of key IP core products and EDA products.

- Key Technologies：
  - SoC design technology
  - Nanometre components and 90nm, 65nm and 45nm large-scale production and craft technology
  - Technologies on microwave, millimetre wave, power device and module
  - MEMS technology
  - New, high-density integrated circuit encapsulation and testing technology

2.4.7 Software Technology

- The priority is to develop trustworthy network computing platform;

accelerate developing embedded software, Chinese information processing, software for managing digital media and content, and software service; enhance the construction of software repository system

- Key Technologies：
  - Database technology
  - Trustworthy network computing platform
  - Chinese information processing and intelligent human-machine interaction
  - Digital media and content management
  - Embedded software
  - Software service technology

2.4.8 New Components Technology

- In order to satisfy the requirements of computer, network and communication, digitalised home appliances, automobile electronics, environmentally-friendly equipment and upgrading traditional industries, the key is to develop the following products: chip electronic components, electromechanical components, printed circuit board, sensitive components and sensors, frequency devices, new green battery, optical cable, new micro motor, electro-acoustic devices, power semiconductor devices, power electronic devices and vacuum electronic devices.

- Key Technologies

  - Model 1005 chip electronic components technology
  - Chip composite network and passive integrated components technology
  - USB connector, IEEE 1394 connector and IC card connector technology
  - SAW devices and bulk acoustic wave devices technology
  - High-definition CRT technology
  - Multi-layered, software-based, integrated, and environmentally-friendly printed circuit board technology
  - High transfer rate multimode fibre technology
  - High reliability automotive electronic sensor technology and 42-volt automotive electronic sensor technology
  - High sound quality automobile audio speaker technology
  - High-end automobile cable technology
  - Electric power steering system with servo motor technology
  - Warming, voltage-controlled and oven controlled crystal oscillator technology
  - High-resolution environmentally-friendly, security-monitoring, and sensor technology

- New energy-saving transformer technology and micro motor technology
- High-precision industrial control sensor technology
- New green battery technology
- Power semiconductor device technology
- Power electronics device technology

2.4.9 Display Technology

- The Key is to develop such display components as LED, plasma, organic light emitting and projection.

- Key technologies：
  - LED display technology
  - Plasma display technology
  - Organic light-emitting display technology
  - Projection display technology
  - Such display technologies as high-definition CRT, TDEL, large-size FED, and laser.

2.4.10 Electronic Equipment Manufacturing Technology

- The key is to develop semiconductor and integrated circuit core equipment, emerging electronic components core equipment, new display components core equipment, and core equipment for installing and connecting electronic whole machine.

- Key Technologies：
  - Technology for manufacturing semiconductor and integrated circuit equipment (including the technologies for manufacturing silicon, compounds, and wide band gap semiconductor equipment)
  - Technology for manufacturing emerging electronic components equipment (including equipment with new electronic components, green battery, high-end printed board and LTCC)
  - Technology for manufacturing equipment with new display components
  - Technology for manufacturing surface mounting equipment
  - Technology for manufacturing environmentally-friendly, energy-efficient electronic equipment

2.5 Overview of regulations in the China Information society

- There are four different kind of Regulatory Authorities and Regulation Systems of China Information society, including RA of Information Content,

RA of Radio Telecom and Internet and RA of Cybercrime.

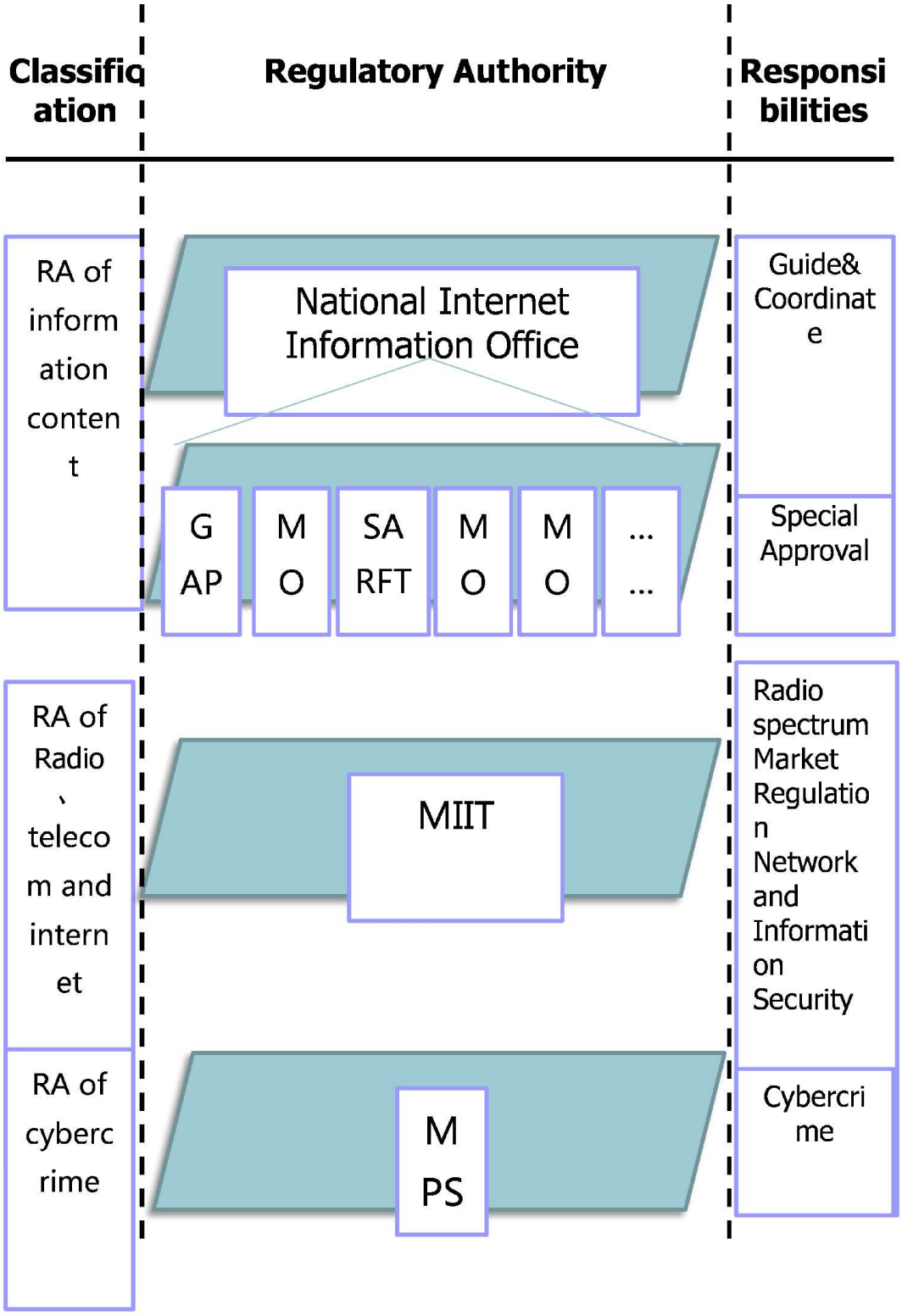


Figure 1.2: Information Society Regulation System of China

- The Regulation of Information Content is becoming more important.RA of Information Content includes more than ten Authorities, the National Internet Information Office is the highest Information Content Regulation Authority, which guides and coordinates the regulation between different Authorities. The other major Authorities regulate the market access of Internet service providers before they sell products or service (like Medicine, Movie, News, Education and so on) on the Internet by special appreciation. In the future, the regulation of information content would become more important along with the increase of the influence of the Internet on the traditional media and other area. In particular, the content transmitted through Internet with the use of mobile phones will become the main object of regulation.

- The deregulation of market access of Radio, Telecom and Internet would become possible. There is only one authority regulating Radio, Telecom and Internet in China, being MIIT. The responsibility of MIIT includes the allocation of Radio spectrum and wireless spectrum, the market access of telecom and Internet service. Along with the merger between the radio, television and telecom and the reduction of the networks' monopoly, the market access of the radio, telecom and Internet would become more and more deregulated. The support of implementation opinions and guidance in private capital among the telecommunications industry, published by MIIT in June 2012,define and clarify eight key area in which the private capital can invest, including access service\CPN\Web hosting\Value-added telecom service\ Base station computer room\Communication tower and other infrastructure construction, operation and maintenance.

- The regulation of Network and Information Security will be strengthened. The Chinese government pays close attention to the Network and Information Security. NPC published recently the Decision on strengthening the network and information protection at the beginning of 2013, in order to guide and promote the Network and Information Security legislation. 'The Decision' involves Network Identity, User Privacy, Information Content and so on. The regulation object includes telecom and Internet service users and providers. While the Internet user scale gets bigger and bigger, the regulation of networks and information security would be strengthened in the future.

- The regulation of Cybercrime will be further reinforced. Cybercrime is a big threat in the World; many countries including USA, UK, Japan, Korea and EU have increased regulation by developing strategies, legislation and so on. China also faces this threat and the MPS is constantly improving technical

means to warn, find and defeat cybercrime.

3 National ICT Research Programmes

3.1 Policy Makers

In China, the State Council is the highest national executive branch, responsible for planning and developing national industries and related work at the level of the overall national development. As far as the ICT field is concerned, the State Council aims - from a macro-level -at guiding the development and planning ICT-related industries. Departments specifically responsible for ICT-related R&D and industrialisation include the National Development and Reform Committee (NDRC), the Ministry of Science and Technology (MOST), and the Ministry of Industry and Information Technology (MIIT). Furthermore, the National Science Foundation Committee (NSFC) also provides funding for some basic ICT research projects.

3.1.1 NDRC

- NDRC has recommended key priority areas, including accurate agricultural, industrial intelligent production, transport and logistics, power grids, and financial, health, and public administration. The main function of NDRC is to formulate and implement economic and social development strategies, mid- and long-term planning and annual plans, and to formulate high-tech industries strategies, planning and major policies. In addition, NDRC is also responsible for project investment, including central government investment and investment in the key construction projects.

- Among NDRC, it is mainly up to both the Department for Development and Planning and Department for High-Tech Industry to be responsible for ICT-related development planning.
  - Department for Development and Planning: to research and suggest work programmes to edit and compile mid- to long-term planning for national economic and social development (referred to “mid-to-long-term planning” hereinafter), and to be responsible for the preliminary work in editing mid-to-long-term planning; to research and analyse major issues in socio-economic development, predict developmental trends, measure planning indices, and suggest a basic framework for national economic and social development.
  - Department for High-Tech Industry: to connect and balance the developmental planning, plans and industrial policies for such key industries as information, bio, aero-space, new material, new energy, ocean, and high-tech service sector, to monitor and analyse the operation of key industries, to research and coordinate key issues in development, to research and promote institutional reform in related

fields, and to nurture the formation of emerging industries in national economy.

3.1.2 MOST

- MOST is responsible for formulating science and technology development plans and policies, national key basic research programmes, high-tech R&D programmes and technological support programmes. It is also responsible for the co-ordination of basic research and frontier technological research, the major commonweal technology, key technologies, and generic technology research. It is to draw up and implement the State Key Laboratory of Science and Technology Base Project, and draw up national major scientific and engineering construction plans. In addition, MOST is also responsible for making policies on external scientific and technological cooperation and exchange, and for bilateral and multilateral cooperation and exchanges in science and technology, both intergovernmental and with international organisations.

- Among MOST, it is mainly up to both the Department for Development and Planning and Department for High-Tech Development and Industrialisation to be responsible for ICT-related development and planning.
  - Department for Development and Planning: to organise and draft planning and annual plans for the science and technology development, give recommendations on allocating financial resources for science and technology plans and coordinate the implementation of planning and plans; together with other stakeholders to give recommendations on planning the construction of national scientific and technological basic condition platform and key innovation bases; to promote regional science and technology development; to draft regulations for information secrecy; to be responsible for managing science and technology assessment and statistics.
  - Department for High-Tech Development and Industrialisation: to draft planning and policies for the high-tech development and industrialisation in related fields; to organise and implement a high-tech research development plan, science and technology support plan, and policy guidance science and technology plan in related fields; to guide constructing national high-tech industrial development zones; to promote the construction of technological service systems related to high-tech industrialisation; and to draft policies to promote market development for technologies.

3.1.3 MIIT

- MIIT is responsible for formulation and implementation of information

industry planning, policies and standards, and organisation and implementation of national mega-projects of science and technology.

- Among MIIT, it is mainly up to the Department of Planning and Department of Science and Technology to be responsible for ICT-related development and planning.
  - Department of Planning is responsible for organising and drafting development strategies and plans for industry, the telecom industry and digitalisation.
  - Department of Science and Technology is responsible for organising and drafting high-tech plans, policies and standards concerned with bio-pharmacy, new materials, aerospace, and the information industry. It drafts industrial technological regulations and standards, so as to guide industrial quality assurance. It organises the implementation of basic work of industrial technologies, significant demonstration engineering projects for industrialisation, and related state mega-projects on science and technology, so as to advance the combination of innovation with production, research and teaching.

- The MIIT offers detailed information on all the relevant ICT facets. The information is available on the MIIT website in Chinese. The website includes information concerning general ICT information, government regulations and policies, information on potential projects and areas of interest, news and events, and includes platforms for public participation. The MIIT site provides an easy-to-access forum for ICT industry involvement and the information available provides transparency in activities, as well as current and anticipated events. The remaining obstacle is the ability for foreign non-Chinese readers/speakers to access the information, as there is no link to an English version of the website. This is one of the barriers that affects collaborative engagement and must be overcome to open communication channels.

3.1.4 NSFC

- NSFC's main function is to promote the national technological system innovation and transform the appropriate funding mechanism for scientific research. NSFC funds nearly 100,000 basic research projects every year, and, among them, ICT is the main area.

- The NSFC has progressively established its funding system with a focus on three main categories: Research Program, Talent-Training Program, and Research Environment Program.
  - Research Program aims to achieve an improved level of basic research by means of developing balanced and coordinated disciplines with

emphasis on key areas, facilitating interdisciplinary research, and stimulating original innovation.

- Talent-Training program is targeted at fostering top talents and innovative research teams, creating a talent pool for basic research, thereby enhancing China's S&T competitiveness in the future.
- Infrastructure Construction has been improved with the Special Funds for Basic Research Instruments, International Cooperation and Exchange Public Understanding of Science, etc.

3.1.5 The division of Labour among the Different Ministries and Departments

- In the ICT R&D field, national programmes mainly include: the 863 Plan, the 973 Plan, State Mega-Projects of Science and Technology, and Natural Science Foundation Projects, all aimed at pushing forward the research and industrialisation of key ICT technologies in China.

  - The 973 Plan is administered by MOST; its purpose is to solve key scientific issues in terms of national strategic demands, and frontier scientific issues that will play an important role in advancing human knowledge of the World. It is also aiming to improve China's capacity for autonomous innovation in basic research, provide scientific base for sustainable economic and social development in China, and provide sources of innovation for the emergence of future high-tech.
  - The 863 Plan is administered by both MOST and the Department of General Armament. In the key technological areas that concern China's long-term development and national security, this Plan sets the goal of improving China's capacity of autonomous innovation and, as the key point, the research and development of frontier technologies. It will plan the deployment of integrated application and demonstration of high-tech industrialisation in entirety and will enable high-tech to play its role of guiding future development in a full manner.
  - The State Mega-Projects of Science and Technology is co-administered by MOST with NDRC and the Ministry of Finance. This Programme is mainly about aspects such as the development of high-tech industry, to promote upgrading traditional industries, to solve bottleneck issues for national economic development, to improve public health, and to ensure homeland security. It strives for breakthroughs and will make efforts to achieve science and technology development – this particular improvement shall drive an overall development of national productive force by leaps and bounds, so as to fill in the blanks in national strategies.
  - The National Natural Science Foundation is administered by the National Natural Science Foundation Committee. This Foundation aims mainly at setting significant scientific frontiers, the requirements of

major state strategies, to respond to future challenges, and to deploy a series of basic, strategic and prospective areas for priority development.

3.2 The 973 Plan

3.2.1 Overview of the 973 Plan

- The National Key Basic Research Development Plan (the 973 Plan) is a development plan on basic research that has clear national goals. It has an overall impact and serves as a driving force for China's development and progress in science and technology. It aims at solving key scientific issues in national strategic demands and frontier scientific issues that will play an important role in advancing human knowledge of the World. It is also dedicated to improve China's capacity for autonomous innovation in basic research, provide a scientific base for sustainable economic and social development in China, and provide sources of innovation for the emergence of future high-tech.

- The implementation of the 973 Plan helps to achieve the deployment of basic research oriented towards national demands, establish a system to fund basic research that has a double engine of both free exploration and orientation towards national demands, and complete the framework of basic research. The 973 Plan includes four main aspects:
  - To carry out multidisciplinary, comprehensive research and provide theoretical justification and scientific foundation for solving problems which are tightly connected with significant scientific issues among the national economic and social development and the development of science and technology *per se,* as agriculture, energy, information, resources & environment, and population & health.
  - To deploy related, significant and highly-exploratory frontier basic research;
  - To cultivate and recruit talents with high scientific calibre and innovation capacity for development in the 21st century;
  - To construct with emphasis a series of high-quality scientific research bases able to take state key scientific tasks, and to form several trans-disciplinary research centres for comprehensive scientific research.

3.2.2 Key Research Directions in the 973 Plan

The 973 Plan includes eight fields: agriculture, energy, information, resources & environment, population & health, material, comprehensive overlaps and significant scientific frontiers. The three fields out of these eight closely connected with ICT, namely information, trans-disciplinary and significant

scientific frontiers will be introduced in details below.

The Information Field

The Development Goals of basic research in the information field is to combine China's national circumstances and developmental status quo with the international developmental trends of ICT, and to carry out systematic, in-depth research with emphasis in the following aspects: information obtaining, processing, transmission, storage, recovery, security and utilisation; basic components of information system, information processing environment, scientific computing, artificial intelligence, and control theory, for purpose of laying a solid theoretical and scientific foundation for the development of the information industry in China by leaps and bounds. The key research directions include:

- Basic research on micro-nano integrated circuits, optoelectronic devices and integrated micro- systems
- Basic research on information processing environment and scientific computing
- Basic research on the next-generation ubiquitous and controllable information network;
- Basic research on information obtaining
- Basic research on high trustworthy and highly-efficient software
- Basic research on intelligent information processing and harmonious human-machine interaction;
- Basic research on mass information processing, storage and application;
- Basic research on quantum communication;
- Basic research on information security

2）The Field of Trans-disciplinary Research

The 973 Plan sets up the field of trans-disciplinary research to encourage and strengthen the integration of different disciplines. Through key deployment in strategic and trans-disciplinary issues, and through the convergence and integration of various disciplinary fields, it aims to cultivate a greater number of innovation research products, recruit inter- and trans-disciplinary research talents with innovation awareness and capacity, to incubate several high-quality, trans-disciplinary research bases for comprehensive research, and to strengthen China's overall capacity in autonomous innovation and finding solution to key issues. The field of trans-disciplinary research will emphatically aim to solve comprehensive, significant scientific issues facing national economic and social development; trans-disciplinary, comprehensive significant scientific issues; and significant scientific issues of trans-disciplinary concerns among natural science,

engineering & technological science, and humanities, arts and social sciences.

Key research directions include:

- Scientific base manufactured under extreme environmental conditions；
- Such scientific issues as related to eco-environment, transportation & logistics, and social security during urbanisation
- Cross-disciplinary research of mathematics with other fields；
- Complex system, disaster formation and prediction control；
- Basic research related to spatial exploration and Earth observation；
- Fundamental scientific issues in significant equipment and key engineering projects；
- Innovation in scientific experiment and observation methodology, technique and equipment.
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3）The Field of Scientific Frontiers

The 973 Plan sets up the field of significant scientific frontier, making important deployment around significant scientific frontier issues, so as to encourage and support original research, nurture a greater number of original research findings, endeavour to form Chinese advantage areas in global scientific frontiers, and strengthen China's capacity of original innovation. The key deployment in the field of significant scientific frontier includes：

- Frontier research that has significant impact on and serves as a driving force for scientific development；
- Frontier cross-disciplinary research integrates with other related disciplines, with a possibility of forming new disciplinary growth points；
- Frontier research to demonstrate in a full manner Chinese advantage and characteristics and to benefit a rapid improvement in the international status of China's basic science.

3.2.3 The Working Mechanism of the 973 Plan

1）Administrative Institutions and Functions

The 973 Plan is administered by MOST, and implemented together with the National Natural Science Foundation Committee and other related government departments. MOST has established an expert advisory group, to offer consultation, advice, supervision and assessment of such aspects as the development strategy and policy for state key basic research planning,

and significant policy issues related to project establishment, assessment and organised implementation during the 973 Plan, so as to assure the scientific and democratic quality of establishing and managing projects in the 973 Plan; MOST establishes respective expert advisory groups for related fields, to be responsible for tracking and understanding the implementation of projects, in the purpose of ensuring the smooth implementation of projects

2）The Selection of Projects in the 973 Plan

Projects in the 973 Plan should consider the requirements in China's economic, social and scientific development, carry out a unified plan, and organise the implementation per annum. The period for research project is in general 5 years. Projects in the 973 Plan are granted in accordance with the working method of expert peer review and merit-based support and with the principle of "by demands, by priority and by excellence", and that of "transparency, fairness and justice", with an emphasis on combining national demands with significant scientific issues. The requirements of the principle are：

- Basic research to solve significant and key issues facing China's long-term development, with a consideration of significant demands during China's social, economic and scientific & technological development；
- Basic research targeting significant scientific frontier issues, so as to embody cross-disciplinary research and comprehensive study and to explore basic laws of science；
- Basic research with Chinese advantages and characteristics, with an embodiment of Chinese features of nature, geography and humanistic resources and with the ability to occupy an important position in international scientific frontier.

3）Project Management during the 973 Plan

- For projects in the 973 Plan, the accountability mechanism is a project expert group led by a chief scientist who is responsible for the overall implementation of the project. Research units offering support to projects are responsible for overseeing daily routines and providing necessary conditions for the implementation of projects

- Projects in the 973 Plan are managed by the mechanism of research by thematic topics. A scientific outlay management model is put into place, where there is an overall budget, process control and total cost accounting for each and every topic research in project and upon this basis, budget

management is organically combined with cost-keeping and accounting. The approval of a project application is based on both the selection of projects by expert peer review and an examination of budget according to tasks in project. While expert peer review ensures the scientific and feasible quality of research in projects, budget preparation, reporting and examination are also strengthened. A Budget Review Committee for the 973 Plan has been set up by MOST and the Ministry of Finance. Enhancement review measures such as budget assessment by an intermediary organisation, review by the Budget Committee and public accountability through media release, are adopted, so as to ensure that funds are scientifically and rationally arranged, thus making the approval of projects and the administration of their implementation in the 973 Plan more scientific and standardised.

- Projects in the 973 Plan have a management model of "2+3", namely that two years after the implementation of a project, there will be a mid-term assessment, with key evaluation on the "working status" and "research prospective" of the project. With a consideration of the overall objective of the project, the research plan for the following three years will be adjusted and determined in accordance with the principle of "focused objectives, give priority to what is important, slim team, and supporting the excellent". Moreover, according to the mid-term assessment, efforts will be made to strengthen the support to those key topics with a prospect of breakthroughs and according to the actual needs of the topic, so as to ensure "key research receiving key support".

4）International Cooperation

The 973 Plan will further strengthen international cooperation and academic exchange. According to the Science and Technology Cooperation Agreement between the PRC and the EU, research projects in the 973 Plan are open for application from the European side as arranged by MOST, where EU scientists can file joint applications with their Chinese partners for research projects in the 973 Plan. The majority of projects in the 973 Plan established, at various degrees, extensive and in-depth exchange and cooperation with other countries.

3.3 The 863 Plan

3.3.1 Overview

- In November 1986, China started "the Plan for High-Tech Research and Development" (referred to "the 863 Plan" for short hereinafter), aimed at the global frontier of high-tech development. The principle for this plan is "to do what is meant to do". In significant high-tech fields concerning national long-term development and homeland security, this plan aims at

improving China's capacity on autonomous innovation, sets the research and development of frontier technology as the focal points, plans in entirety the deployment of integrated application and demonstration industrialisation of high-tech, and enables high-tech to play in a full manner its role of guiding future development.

- After more than two decades of implementation, the 863 Plan has laid a solid foundation for the incubation, development and industrialisation of high-tech in China. During the period from 1986 to 2005, China has invested 33 billion RMB in total into the 863 Plan; over 150,000 research fellows carried out research projects through the Plan; and this Plan financed the participation of over 500 research organisations, more than 300 colleges and universities and nearly 1,000 enterprises. According to incomplete statistics, in the past two decades, under the sponsorship of this Plan, more than 120,000 papers were published, with over 8,000 patents both inside and outside China, and over 1,800 national and industrial standards were made therein. This plan, through an emphasis on consistent autonomous innovation, has achieved a large number of innovative research findings that have reached or approximated the world-leading level, especially in such aspects as the high-performance computer, the third-generation mobile communication, high-speed information network, deep-sea robot and industrial robot, aerospace and Earth observation systems, oceanographic observation and exploration, the new-generation nuclear reactor, super hybrid rice, insect-resistant cotton, and genetic engineering. It has paid particular attention to high-tech integrated innovation and incubating strategic emerging industries, where a series of products with proprietary IPR have been successfully developed, thus forming the growth points in China's high-tech industry in the following fields: bio-engineering and pharmacy, communication equipment, high-performance computer, Chinese information processing platform, artificial lens, and photoelectronic materials and components. At the same time, to answer the demands of the modernisation of national defence, it has also scored achievements in developing China's new means of strategic deterrence and new-concept staple equipment. Up to now, the 863 Plan has already become the symbol for China's science and technology development, especially high-tech research and development. More importantly, such achievements as scored in the 863 Plan have played an important role in improving China's capacity on autonomous innovation, enhancing China's comprehensive strength and strengthening national self-confidence.

3.3.2 Key Research Directions in the 863 Plan

- The 863 Plan includes ten research fields, namely information technology, bio- and pharmaceutical technology, new material technology, advanced

manufacturing technology, advanced energy technology, resources environment technology, oceanic technology, modern agricultural technology, modern transportation technology, and Earth observation and positioning technology. These ten high-tech fields are regarded as the focal points of development, with in its arrangement several thematic projects and significant projects. In the following, we will briefly survey the ICT-related key projects in these ten fields:

State Key ICT Projects in the 863 Plan in 2012

- During the Twelfth Five-Year Plan, the ICT field in the National 863 Plan sets the principle of "network-based, computing-centred, application-oriented, and security-ensured" as its guiding guideline. It seeks fundamental breakthroughs in ICT frontier areas, so as to master core technologies for ICT development, strengthen integrated innovation and application module innovation, extend the depth and width of ICT application, and support the development of the new-generation ICT. The focal points are the following five thematic directions: advanced computing, network and communication, virtual reality and digital media, information security, and microelectronics and photoelectronics. The significant project is high-performance computer, while the four key topics are cloud computing, broadband, network and information security. All these together form the general framework.

- In 2012, the 863 ICT Field, on the basis of the initiation of certain key topics in 2011, will be focused on the deployment of four themes of advanced computing, network and communication, virtual reality and digital media, and microelectronics and photoelectronics, with the following as their main content:

  - The Theme of Advanced Computing. The key is to support the development of such key technologies and systems as networked trustworthy software, the programming and operating environment for polycaryon/multicaryon processor, mass Web data analysis and management, and large-scale Chinese semantic information processing.
  - The Theme of Network and Communication. The key is to support the R&D on such core technologies and demonstration systems as new large-capacity all-optical switching network, and end-to-end green network.
  - The Theme of Virtual Reality and Digital Media Technology. The key is to support the R&D of such core technologies and application systems as 3D content, brain-machine collaborative audio-visual information processing, the new-generation digital television, real-scene perception, and multi-mode, large-scale true 3D display.
  - The Theme of Microelectronics Technology. The key is to support the

R&D on such core technologies as digital-analogue mixed-signal programmable SoC chip, the new storage control device and components, and on-chip high-speed optical interconnection components and chips.

The Field of Advanced Manufacture Technology

- The Project of "the Core Technology of Cloud Manufacturing Service Platform". This Project underlines China's transition from a manufacturing mode of production to a service-oriented mode of development. It aims to utilise fully the opportunities created by the development of emerging technologies such as cloud computing, the Internet, the IoT and knowledge service, and to achieve breakthroughs in such core technologies as virtualisation of manufacturing resources, transforming manufacturing capacity into service, and customisation of manufacturing processes. It will, through autonomous R&D, develop a cloud manufacturing platform that is service-oriented, supporting on-demand use of manufacturing resources, and dynamically coordinating manufacturing capacities.

- The Project of WIA-Based Wireless Measurement and Control Technology, Equipment and System. This Project carries out R&D on wireless measurement and control technology, equipment and system that is based on WIA (Wireless network for Industrial Automation), so as to promote the development of industrial energy saving and emission reduction, together with its related industries.

The Field of Advanced Energy and Technology Field

- The Project of the Core Technology of Intelligent Grid. This Project sets up 21 topics to cover the six directions of large-scale centralised access and intermittent energy grid technology, high-density distributed power grid technology, grid technology to support the development of electric vehicles, large-capacity energy storage systems, intelligent distribution and electricity-use technology, and large grid of intelligent scheduling and smart transmission technology.

The Field of Modern Agricultural Technology

- The Research Topic of "New Technology and Equipment to Identify Characteristic Properties and Qualities of Food", in accordance with current issues of food safety, uses such modern analysis technologies as video chip, genetic bar codes, electronic noses, and biological mass spectrometry, to carry out technology R&D and application in the following three areas: the research on new technology of biological identification of true characteristic

properties of food, the research on the technology of biomimetic recognition of the sensory quality of food, and the research of equipment for biological and biomimetic identification of safety in food qualities and properties. It aims to construct a technological system to modernise the analysis of characteristic properties and sensory quality of agricultural and processed products and food in China, for purpose of changing the current situation of a lack of standard, or the existence of confusing indices to identify the authenticity, species, and origin, and evaluating the quality of agricultural and processed products and food in China.

The Field of Modern Transportation Technology

- The Research Topic of "the Core Technology of Smart Vehicle-Road Synergy". This Project aims at the increasingly serious traffic problems in China, with its key research on the core technology of smart vehicle-road synergy system, so as to establish vehicle-road synergy technology system and framework and to advance a technological transformation in China's road safety from passive prevention to active intervention and prevention.

3.3.3 The Working Mechanism of the 863 Plan

1）Administrative Institutions and Functions

- The 863 Plan is administered by MOST and the Department of General Armament, the main responsibilities include:
  - Making a plan on development strategies, targets and strategic tasks;
  - Determining technological fields and task-setting therein；
  - Organising the 863 Plan Expert Committee and Field Expert Groups；
  - Establishing optional project library, reviewing suggestions for project applications to be approved, and approving project applications
  - Making annual plans and budgets；
  - Supervising and reviewing the implementation of the plan, and coordinating and solving significant issues during the implementation of the plan.

Sources of Funding

- The 863 Plan receives a special fund from the Central Exchequer, so as to strengthen the monitoring and review of expenditure with independent accounting and earmarking of planned outlay.

The Management of Themes

- In every field a few themes are set up to be focused on the R&D of frontier

technologies. The Field Office organises research, so as to give recommendations on theme-setting, the objectives of every theme and major tasks in the field – recommendations to be comprehensively reviewed by the Liaison Office and finally to be approved by the Organic Department of Implementation.

- Under every theme a series of topics are set up and beneath these topics, in principle, no more sub-topics will be set up. These topics are selected through transparent and fair competition, through the following main procedures:
  - Publicly announcing the guideline for applying for research topics;
  - To be reviewed by peer expert through correspondence;
  - To be reviewed by peer expert meetings;
  - To be approved by the Field Office.

The Application Procedure of Projects

- For the 863 Plan, the application for all projects and topics is online, through the website of "National Science and Technology Plan Projects Application Centre". The main procedure includes the following four steps: an understanding of application information, the registration of application organisation, the writing-up of application proposals, and application organisation reviewing the proposals.

Applicant Qualifications

- There is a Legal Person Responsibility System in the 863 Plan, meaning that it is legal persons that are responsible for research topics and tasks. Research topics are applied for by legal persons, where a natural person is appointed as the principal in charge of applying for every topic. For each and every project/topic, there can be only one applicant organisation (or the leading applicant institution) and one principal. The basic qualifications that an applicant organisation should meet are: enterprises, business units, scientific research organisations and higher education institutions with independent legal personality that have been registered in mainland China for more than one year, with relatively strong capability of and conditions for scientific research, and with standardised operation and administration.

3.4 State Mega-Projects

3.4.1 Overview

- "The National Mid-and Long-Term Programme of Action for the Development of Science and Technology (2006-2020)" identifies a range of

priority topics in key fields. It is further focused around national goals on such aspects as the development of high-tech industry, economic restructuring and industrial upgrade, solving the bottlenecks in national economic development, improving public health and ensuring homeland security – aspects where it strives for breakthroughs, endeavours to achieve science and technology development – this particular improvement shall drive an overall development of national productive force by leaps and bounds, so as to fill in the blanks in national strategies. There is a mechanism of mega-projects, of which the implementation of each project will be initiated on the basis of sound proof and in accordance with demands for national development and the maturity of implementation conditions. At the same time, according to national strategic demands and changes in development situations, China will carry out dynamic adjustment of mega-projects, to be implemented step-by-step. As for those mega-projects targeting strategic products, enterprises should be enabled to play an active role in developing and investing in research. The research and development of strategic equipment should be set up as the entry point for technological innovation in enterprises, so as to utilise market mechanisms in a more efficient way to allocate scientific and technological resources, where state investment, serving as a guide in nature, should be used mainly for achieving breakthroughs in core technologies.

- Mega-projects aim to achieve national goals and complete key strategic products, key generic technology and significant engineering within certain limited period of time through breakthroughs in core technologies and resources integration. They are henceforth the top priority in China's science and technology development. This Programme of Action outlines 16 mega-projects that cover such compelling significant issues as the strategic industrial fields of information and biology, energy, resources & environment, and public health, as well as technology to be used for both military and civil purposes and technology for national defence. These 16 mega-projects are: core electronic devices, high-end general chips and basic software, large-scale integrated circuit manufacturing technology with the complete set of craft technology, the next-generation broadband wireless mobile communications, high-end CNC machine tools and basic manufacturing technology, large-scale oil and gas fields and coal-bed methane development, large-scale advanced pressurised water reactor and high temperature gas cooled reactor nuclear power plants, water pollution control and treatment, innovation of key new drugs, the prevention of major infectious diseases such as AIDS and viral hepatitis, large aircraft, high-resolution Earth observation system, and manned spacecraft and Moon exploration engineering.

3.4.2 Key Research Directions

- This Programme of Action outlines 16 mega-projects that cover such compelling significant issues as the strategic industrial fields of information and biology, energy, resources & environment, and public health, as well as technology to be used for both military and civil purposes and technology for national defence. Of these projects, those closely connected with ICT are mainly the following: core electronic devices, high-end general chips and basic software, large-scale integrated circuit manufacturing technology with the complete set of craft technology, and the next-generation broadband wireless mobile communications.

The Mega-project of Core Electronic Devices, High-End General Chips and Basic Software Products

- MOST is the principal unit of the leading group of this mega-project, while MIIT is the liaison and organisation unit of this project, responsible for implementing the project. The implementation proposal of this project, after being reviewed by Expert Committee, has been reviewed and passed by the Executive Meeting of the State Council and now entered into the stage of formal implementation.

- This mega-project has its main target to catch up with the rapid development in international technology and industry in the fields of chip, software and electronic devices. Through continuous innovation, it aims to achieve breakthroughs in a series of core technologies, and research and develop a series of strategic core products. Through the implementation of this project, by 2020, China shall have basically established an internationally competitive system of high-tech R&D and innovation in such fields as high-end universal chips, basic software and core electronic devices. This will enable China to play an important role in global ICT and its industrial development; furthermore, the environment for innovation and development of information technology in China will be optimised with great magnitude, with a pool of internationalised and high-calibre talents. The system of autonomous innovation will be relatively complete, thus contributing in no insignificant way to China's entry into the rank of innovation nations.

- As regards to funding input, on the basis of the funding on mega-projects from the Central Government, China actively encourages and adopts effective measures to promote the establishment of diversified, multi-channel funding mechanism, where the input from local governments, enterprises, financial organisations and private capital is actively guided and promoted. At the same time, China will strengthen the monitoring of the use

of outlay and expenditure, so as to ensure the smooth implementation of this project.

- During the Twelfth Five-Year Plan, this project sets as its focal point those strategic basic products that can satisfy significant demands in the development of China's information industry. It aims to achieve breakthroughs in the core technology of high-end universal chips and basic software and to carry out R&D on autonomous, manageable and China-made CPU, operating system and software platform, new mobile intelligent terminal, high-performance embedded central processing unit, and SoC and networked software, for purpose of industrialisation and application in large quantity, and a basic establishment of the system of ensuring proprietary core electronic devices and products.

The mega-project of Large-Scale Integrated Circuit Manufacturing Equipment and the Whole Set of Craft Technology

- This project is one of the 16 mega-projects aimed at developing core equipment to manufacture integrated circuits, so as to master the whole set of advanced craft technology and related new material technology with proprietary IPRs, to break-through the current situation of China having to rely upon imports for manufacturing equipment and technology for high-end integrated circuit, and to serve as a driving force for technological upgrade and restructuring in related industries.

- The key content and targets for implementation during the Twelfth Five-Year Plan are as follows: the key is to achieve break-through in the 45-22nm core manufacturing equipment, to develop 32-22nm complementary metal oxide semiconductor (CMOS) craft technology and 90-65 special technology, and to carry out prospective research on 22-14nm technology, so as to establish a industrial chain of manufacturing 65-45nm equipment, materials, technology-matching capacity and integrated circuit, hence further reducing China's gap with the world-leading level. The equipment and materials should take up respectively 10 per cent and 20 per cent of Chinese domestic market. They will also explore markets overseas.

The mega-project of the Next-generation Broadband Mobile Communications Network

- The next-generation broadband wireless mobile communications network represents the main development direction for ICT - for this reason to implement this project will significantly improve China's comprehensive competitiveness and innovation capacity in wireless mobile communications

and drive China's mobile communications technology and industry to move towards the world-leading level.

- The key content and targets for implementation during the Twelfth Five-Year Plan are as follows: with the future evolution of TD-SCDMA as the mainline, to complete the R&D and industrialisation of TD-LTE, to carry out research on LTE-advanced and post-4G core technologies, and to improve China's status in the making of international standards. Efforts should be made to accelerate breakthroughs in core technologies such as mobile Internet, broadband group system, and the new-generation wireless LAN and IoT, to promote their industrial application, innovation in operating service and IPR creation, and to enhance the core competitiveness of the industry.

3.4.3 The Operating Mechanism of Mega-Projects

1）The Administration and Working Mechanism of Mega-Projects:

- MOST, together with NDRC and the Ministry of Finance, establishes a working mechanism for all the three parties involved, to research on solving significant issues during the organisation and implementation of mega-projects, each according to its own responsibility, and to jointly push forward the organisation, implementation, and administration of mega-projects.

- MOST is responsible for coordinating the connection between mega-projects and plans for science and technology: it takes the lead in organising research and makes science and technology policies related to the implementation of mega-projects; it collects all information related to mega-projects and issues uniform requirements for information collection; it reports to National Science and Technology Education Leading Group and the State Council on annual work plan and implementation of projects; and furthermore, it keeps a record of adjustments related to the implementation scheme or plan of mega-projects. It is also in charge of routine organisation, coordination, liaison and communication for mega-projects.

- NDRC takes the lead in organising to research and make industrial policies related to the organisation and implementation of mega-projects, as well as coordinating the connection between mega-projects and national key engineering projects.

- The Ministry of Finance is responsible for researching and making financial policies related to mega-projects. It issues requirements for making budgets for mega-projects, and reviews and approves an annual budget for

mega-projects. It is in charge of supervising the expenditure and outlay of the funds for mega-projects and making budget adjustment during the implementation of these projects.

2）The Organisation of Projects and Terms for Application

- The Mega-Project of Core Electronic Devices, High-End General Chips and Basic Software Products.
  - MOST is the principal unit of the leading group of this Project, while MIIT is the liaison and organisation unit of this Project, responsible for implementing the Project.
  - The basic qualifications that an applicant organisation for this project should meet are: enterprises with independent legal personality (the registered capital no less than the applied amount of funding from the Central Exchequer), business units, scientific research organisations and higher education institutions with independent legal personality that have been operating in mainland China. For the Project there is a Legal Person Responsibility System.

- The Mega-Project of Large-Scale Integrated Circuit Manufacturing Equipment and the Whole Set of Craft Technology
  - This project is organised by the Office for Administering the Implementation of Mega-project and the Project Application Guideline is published on the websites of MOST, Beijing Municipal Commission of Economy and Information Technology, and the Science and Technology Commission of Shanghai Municipal Government. The terms for application include two aspects; one being an enterprise with a majority of shares owned by Chinese partners that are registered in mainland China and with a registered capital no less than 10 per cent of the applied amount of funding from the Central Exchequer; while the other is scientific research organisations and higher education institutions with independent legal personality.

- The Mega-Project of the Next-generation Broadband Mobile Communications Network
  - For topics in this project, there is a Legal Person Responsibility System, where the legal person entity is responsible for applying for and implementing research topics therein. The applicant units should be enterprises, business units, scientific research organisations and higher education institutions with independent legal personality that have been registered in mainland China for more than one year, with relatively strong capability of and conditions for scientific research, and with standardised operation and administration. The leading applicant unit should review the qualification of its partner unit(s) prior to filing

for joint application. Also, during the joint application, the total number of applicant units (including the leading unit and its partner units) should not exceed five. The leading applicant unit should hold main responsibility for tasks in the applied topics, as well as administer the internal organisation and implementation of the topics. As for corporations and companies, if specific work is carried out by its subsidiary company, then the subsidiary company should be the applicant unit for convenience of using and administering funding resources.

3) International Cooperation

- The Office for Administering the Implementation of mega-projects is in charge of the international cooperation for mega-projects. The responsible unit, prior to carrying out significant international cooperation should seek approval and review by the office for administering the implementation first and to be approved by the leading unit of the project.

3.5 The Natural Science Foundation

3.5. 1 Overview

- The establishment of the National Natural Science Foundation Committee was approved by the State Council on February 14, 1986. It insists on basic research, and has gradually developed and established a funding framework consisting of three series, namely research projects, talent projects, environment and conditions projects. In the past two decades, the Natural Science Foundation has made significant contributions to advancing China's development in natural science basic research, pushing forward basic disciplinary construct, and identifying and recruiting excellent science and technology talents.

- The Natural Science Foundation insists on funding the following types of projects: general projects, youth science foundation projects, regional science foundation projects, key projects, key research plan projects, national excellent youth science foundation projects, the foundation for research cooperation with international, Hong Kong or Macau scholars projects, national basic science talent recruitment foundation projects, significant international (regional) research cooperation projects, joint foundation projects, special fund for basic research in scientific instruments projects, and Mathematic Tianyuan Youth Foundation projects.

- The Foundation has several thousand ICT-related projects per year, mainly administered by the Department of Information Science of the Foundation.

In 2011, the Department of Information Science at NSFC received 17,262 project applications, with 8,587 applications for general projects – an increase of 18.60 per cent from 2010. It funded 1,611 projects, with a total amount of funding at 955 million RMB and at an average funding intensity of 592,800 RMB per project (while 330,800 RMB per project in 2010). The average funding rate is 18.76 per cent (while 19.75 per cent in 2010). Parts of the projects involve such cross-disciplinary research as information and mathematics, and information and health. Expectedly, in 2012, the average funding intensity will be 800,000 RMB per project and the period of funding.

3.5.2 Key Research Directions in the Natural Science Foundation

- The ICT-related research fields and directions in the Natural Science Foundation mainly include the ten key areas under the jurisdiction of the Department of Information Science; one area each in the Department of Mathematical Science, the Department of Earth Science and the Department of Engineering and Material Sciences; and three areas for priority development in the Department of Cross-Disciplinary Science.

Ten Areas in the Department of Information Science

- The ten areas under the jurisdiction of the Department of Information Science are as follows: new information material and devices, nanometre integrated circuit, sensor network and bionic perception base, future wireless communications theory and technology, low-power I-level supercomputing and new computing system, networked computing, software technology base, network data mining and understanding, information space security, and complex system and complex network theory

Areas in Other Departments

- Department of Mathematical Science
  - In the Basic Physics Field of Quantum Information and Future Information Devices as under the jurisdiction of the Department of Mathematical Science have the following research directions related to ICT: the physical issues of morphological conversion and measurement of quantum information, and quantum information processing and solid quantum computing based on particular physical systems.

- Department of Earth Science
  - In the Field of New Ways and New Technology for Earth Observation and Information Obtaining as under the jurisdiction of the Department of Earth Science, the ICT-related research directions are: theory and

technology for collecting and applying basic information of the Earth system, and applied theory of the assimilation, integration and sharing of observation data.

- Department of Engineering and Material Sciences
  - In the Basics of Intelligent Grid as under the jurisdiction of the Department of Engineering and Material Sciences, the ICT-related research directions are: the theory and technology of multi-information integration and self-healing in intelligent grid, electricity information and secure control and it supporting technological theory and method, and theory and method for achieving the interaction mechanism in intelligent grid.

Department of Cross-Disciplinary Science

- The ICT fields for priority development in the Department of Cross-Disciplinary Science mainly include: large-scale high-performance scientific computing, reform in organisation and management with service innovation under networked information technology, and network base for spatial information. All these research directions are related to ICT.

3.5.3 Major Programmes

- The NSFC funds several initiatives focused on the three main areas (mentioned previously) to promote greater developments in Sciences. It has 13 listed Programmes for 2012, which encompass a range of areas of interest.

Examples of major programs run by the NSFC in 2012:

- General Program
  - The General Program supports scientists to conduct basic research on freely selected topics within the funding scope of NSFC for innovative research and to promote a balanced, coordinated and sustained development of all disciplines.

- Key Program
  - The Key Program supports researchers to conduct in-depth, systematic and innovative research in directions with sound research basis or where new growth points of research disciplines emerge, so as to promote disciplinary development and breakthroughs in important areas or scientific frontiers.

- Major Research Plan

- The Major Research Plan focuses on key basic scientific issues with strategic importance to the nation and major frontier areas and gives high priority identified on the basis of the capability and advantages of the country. Research Plan is designed to be a project cluster, which contains a number of projects with relatively identical objectives for innovative research resources integrity in order to explore the possible break-through in the identified areas.

- International (Regional) Cooperation and Exchange
  - International Cooperation and Exchange initiative aims to encourage researchers to conduct extensive and intensive international cooperation and exchange with top scientists and research institutions around the world, to promote substantial joint research activities for more researches focusing on frontier areas in the world, to stimulate Chinese Scientists to participate and initiate bilateral/multilateral scientific collaborations for making full use of international research resources, and to enhance the capability of China's science community in coordinating regional and global scientific cooperation, so as to impel strategic cooperation and strengthen the influence of China's basic research globally.

- Talent Training in Basic Science
  - Talent Training in Basic Science encourages good combination of basic research and education, strengthening research training of undergraduate students, improving practical ability and research interests and creative thinking of students, so as to develop high quality talents for scientific research.

- Other Programmes include:
  - Fund for less Developed Regions
  - Young Scientists Fund
  - Excellent Young Scientists Fund
  - Science Fund for Creative Research Groups
  - Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao
  - Programs of Joint Funds
  - Special Funds
  - National Science Fund for Distinguished Young Scholars.

3.5.4 The Operating Mechanism of the Natural Science Foundation

1）Administering Institutions and Functions

- The National Natural Science Foundation Committee, the administering body in the State Council, is responsible for administering the National Natural Science Foundation, and supervising the implementation of funded projects. The science and technology administration agency in the State Council is responsible for the macro-management, and entire planning and coordination of the work of the National Natural Science Foundation, in accordance with the law. The finance department in the State Council is, in accordance with the law, administering and supervising the budget and accounting of National Natural Science Foundation. Auditing offices supervise, in accordance with the law, the use and management of funds in the Foundation.

2）Sources of Funding for the National Natural Science Foundation

- The National Natural Science Foundation is mainly funded by the Central Exchequer. At the same time, the state encourages individuals, legal persons or other organisations to contribute to the Foundation. The Central Exchequer lists the funding for the Foundation in its budget.

Qualifications for Applying for Funds from the Foundation

- Applicants for funds from the Foundations will need to meet the following two requirements: first, with experience in basic research topics or other related basic research; two, with senior professional and technical positions (titles) or a doctoral degree, or recommendations from two scientists or technicians with senior professional and technical positions (titles) from the same research field.

International Cooperation

- As scientific and technological issues in the information field have discernible cross-disciplinary features, the Department of Information Science at NSFC pays special attention to cross-disciplinary research in mathematics, chemistry, bioscience, pharmacy, material, Earth science and management, encouraging experts to carry out substantial international cooperation and offering a preferential policy of “all being equal, preference to be given to” project applications with a background of international cooperation, so as to encourage and promote Chinese scientists and their international counterparts to make the best of their advantages to solve jointly international frontier science and technology issues. The international cooperation projects at NSFC are mainly significant international (regional) cooperation research projects and international (regional) cooperation and exchange projects. In 2010, 63 significant international (regional) cooperation research projects received funding from NSFC, with a total

amount of funding as much as 126.8 million RMB, and at an average funding figure of 2.01 million RMB per project. In 2011, the average funding figure is generally 3 million RMB per project, and the funding period is five years.

- The Department of Information Science encourages international research fields such as mobile network and application, space-sky-Earth network and information processing, network information processing and application, visionary-hearing information perception computing, the theory and technology of virtual reality and trustworthy software, the theory, technology and typical application of advanced control, the theory and technology of micro-/photo-electronic integration, the scientific application of e-Health, green communications network, high-performance computing for significant demands, the visualisation of complex industrial processes and human-machine interaction evolution, and CPS.

3.6 Summary

- The implementation of the abovementioned plans and projects enables the government to change its role from administrative commands to indirect supervision in aspects such as key areas of scientific research and competitive rules, hence nurturing, recruiting and putting together a pool of high-tech talents, as well as establishing a series of world-class high-tech research and development bases.

- In the implementation and concretisation of projects, there is a need to span across departmental and regional boundaries, to concentrate the most advantageous resources nationwide through competitive means, and to improve the efficiency to use funding resources in the context of the market economy. Various projects and plans have made significant achievements in exploring mechanisms of industrialisation, thereby providing beneficial experiences for China's reform in the institutional arrangement for science and technology research.

- These projects have, to a large extent, promoted the development of the ICT technology and industry, advancing in different aspects the R&D and industrialisation of core ICT technologies in China, and having played a role in leading the focal points and directions of research in the ICT field in China.

- The future key research directions in the ICT Field in China mainly include: core electronic devices, high-end universal chips, the technology to manufacture equipment for large-scale integrated circuits, photoelectronic components and integrated micro-system technology, basic software products, sensor network and biomimetic sensing technology, IoT technology, Smart City, the next-generation Internet, the fourth-generation

mobile broadband technology, information security technology, the next-generation digital television technology, cloud computing and large-scale data centre technology, photo-network technology, and 3D content processing technology.

4. EU-China Cooperation in ICT Research

EU-China ICT cooperation began in the 1980s. EU information and communication has been the biggest investment in S&T cooperation for years in China. ICT cooperation mechanism has constantly improved and there is a lot of room for China and EU to develop its ICT infrastructure because of the demand. Since the mid 1980s, the most important cooperation between EU and China has been carried out through EU's Framework Programme (FP): FP5 and FP6. Successful cooperation had achieved substantial progress in various researching fields. This attributes to EU's resolution of adding international cooperation to its Framework Programme in developing prioritized technologies including ICT, energy and life science etc. Under FP5 and FP6, the cooperation between China and EU are mainly non-ICT researches, for example: in FP6, China's contribution mainly focuses on priorities such as: information society technologies (105 participants), research for policy support (36 participants), food quality and safety (22 participants). It was only until the FP7 (2007-2013) that ICT has truly become the most important field of EU-China cooperation. Through ICT collaboration, Europe will be able to support the sustainable development of its regions and ensure the economic and social safety and security of its citizens. In exchange, Chinese ICT research can benefit from integration into the European research environment. Scientists from both sides will be able to easily research pressing issues for mutual benefit.

4.1 Bilateral Programmes between EU and China

Science, technology and innovation form an important part of the EU-China relationship.

Science and innovation are now high on the European and Chinese agendas, in the EU 2020 strategy and the 12th Five-Year Plan respectively, offering many opportunities to work together even more. The EU and China agreed at their 14th Summit in February 2012, to broaden their exchange in science and technology towards innovation. The recent establishment of an EU-China 'High-Level People-to-people Dialogue' is also expected to foster more connections between students and young-people, as well as European scientists for the longer term.

International cooperation with China will remain a priority in the EU's 'Horizon 2020' (2014 to 2020) Programme for Research and Innovation. Moreover, with the majority of European research funding being at the Member State level, the breadth of the bilateral engagement with China is evident in research collaborations, joint laboratories, innovation activities, as well as scientific exchanges in key priority areas. And there is scope in the coming years to do more in a more coordinated and unified way as Europe for China to achieve a

greater scale and impact.

Bilateral cooperation in ICT field from MOST:

- The total numbers of bilateral cooperation projects from MOST is 73.
- The amount of funding is 158.22 million RMB from 2006 to now.

There is also an interesting evidence of trilateral co-operation with China: Spain and Denmark have established a relationship in energy and Germany and Finland have a successful mechanism for trilateral projects in basic research.

There are many synergies in the priorities for co-operation with China. Of the collaborative research areas in the EU's 7th Framework Programme (FP7), most of the priorities are also the subject of co-operation at bilateral level. The table shows the priorities indicated by Member States, although these areas may also be those in which bottom-up collaboration is also intensive. Three Member States have indicated they have a national strategy for S&T with China (Denmark, France and Sweden).

Indicated priority areas of co-operation:

	Energy	Environment	Health	ICT	Food, Biotech Agriculture	Materials	Space	Social Sciences	Transport
BE					■		■		
CR		■			■	■			
DK	■	■	■	■	■	■			
DE	■	■	■	■	■	■	■	■	■
EE			■			■		■	
EL	■	■	■		■				■
ES	■	■	■	■	■	■			■
FR	■	■	■	■	■	■	■	■	■
IT	■	■	■		■	■	■	■	■
LT	■	■		■					
HU		■	■		■	■			
NL	■		■		■			■	
A	■	■	■	■	■	■			■
PL	■				■			■	
SI	■	■	■	■	■			■	
FI	■	■	■	■	■	■		■	
SE	■	■	■	■	■	■	■	■	■
UK	■	■	■	■	■	■	■	■	■
EC	■	■	■	■	■	■	■	■	■
Total	15	15	15	11	17	13	7	11	9

Joint committees take place on a regular basis to define priorities, usually every two years. There are also a number of agreements or activities carried out with other Chinese S&T governmental ministries or agencies, including the National Science Foundation of China (NSFC), the Chinese Academy of Sciences (CAS), the Chinese Academy of Agricultural Sciences (CAAS) and also the Ministry of Education (MoE). While much collaboration is through national level institutions, many scientific activities are also carried out between research organizations in a more decentralized way.

Innovation co-operation takes different forms between European countries and China. There are some recent examples of formal dialogues on innovation at the ministry-level (MOST) such as Germany and the UK, and there are other Member States who have undertaken cooperation in this area through cooperation in science parks (Belgium, France), mutual learning, conferences (Sweden), or project-level actions (EC). In total, 11 MS, including Denmark, Spain, Italy, Lithuania, Netherlands, Finland, and the UK indicate innovation activities for Chinese cooperation.

4.2 Chinese Participation in EU ICT research

4.2 .1 “FP7”

Chinese participation in EU ICT research is mainly included in FP7 (the Seventh Framework Program for Research and Technological Development). FP7 is the EU's main instrument for funding research in Europe and it will run from 2007-2013. Establishing on the achievements of its predecessor, FP7 is designed as a main contribution to the re-launched Lisbon strategy. The program has a total budget of over € 50 billion. This represents a substantial increase compared with the previous Framework Program FP6 (41% at 2004 prices, 63% at current prices), a reflection of the high priority of research in Europe. FP7 is structured into 4 programmes namely Cooperation (with budget of € 32 billion), Idea (with budget of € 7.4 billion), People (with budget of € 4.7 billion) and Capacities (with budget of € 4.2 billion) and plus a fifth specific programme on nuclear research (with budget of € 2.7 billion). The grants will (for the most part) be invested in researchers all over Europe and beyond, in order to co-finance research, technological development and demonstration projects. Grants are determined on the basis of calls for proposals and a peer review process, which are highly competitive. The EU Member States have earmarked a total of € 9.1 billion for funding ICT over the duration of FP7, making it the largest research theme in the cooperation programme. The core technology and application areas of ICT R&D are addressed and a sustained effort is required until the end of the Framework.

4.2.2 Chinese participation of FP7 ICT research projects

- China has been an active participant in the FP7 program, with a particular focus on the ICT sector. Statistics from MIS, the European Commission's internal management tool, show that the first FP7 ICT call received 1840 applications in total, of which 50 involved at least one Chinese partner. Of these, 12 proposals were retained, demonstrating a success rate for China within the first FP7 ICT call of 24%.

- There are 178 projects out of 15 research themes involving China, which cover all the 10 thematic priorities of FP7 – Health, Food, agriculture and Bio-technology, Information and Communication Technologies, Nanosciences and Nanotechnologies, Materials and New Production Technologies, Energy, Environment (including climate change), Transport (including aeronautics), Socio-Economic Sciences and the Humanities, Security and Space.

- Of all the 178 projects, there are 35[1] ICT research projects ranking first in project numbers as shown in Figure 2.

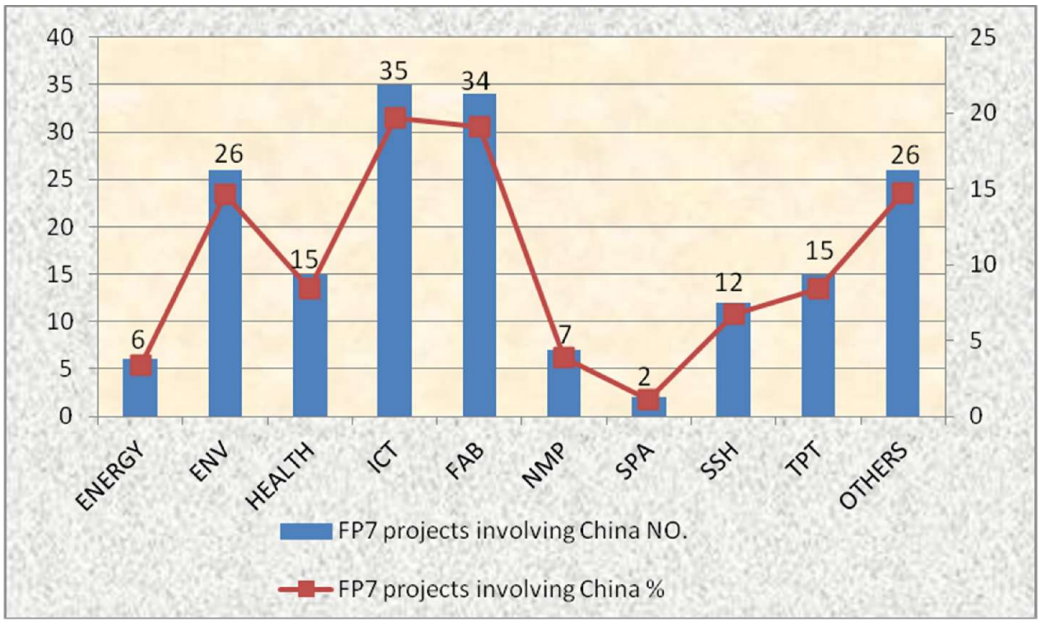


Figure 2: FP7 projects involving China

- Most of the Chinese participants are universities, colleges and state research

[1]Counted up to FP7-ICT Call 8.

institutes; SMEs play a rather unimportant role.

- Chinese ICT players in sectors including manufacturing, automotive, medical equipment, etc. are able to benefit from the cooperation and communication with European counterparts. Meanwhile, China's ICT industry and SMEs are further linked with the European market.

4.2.3 "OpenChina-ICT"

OpenChina-ICT is one of the 35 ICT projects; the duration dates are from January 2012 to December 2013. The OpenChina-ICT project, supported by the European Commission through its FP7 research-funding program, aims at significantly contributing to the facilitation of ICT related research cooperation between Europe and China.

The consortium is coordinated by Fraunhofer (Germany) and includes Sigma Orionis, Fraunhofer IFF, BSEAC (China), CATR (China) and CECO/CSTEC (China).

OpenChina-ICT directly addresses the research level and gives ICT research stakeholders' concrete tools to initiate international collaborative ventures. Achieving this overall objective is supported through drafting a concrete EU-China ICT Cooperation Plan, which will detail current and emerging priorities for international cooperation and advise not only the European Commission, as the main addressee, but also the Chinese government on how to design effective and mutually beneficial international research cooperation program. The development of this EU-China ICT Cooperation Plan will be accompanied by the coordination of regular meetings between Chinese and European officials.

Among expected project outcomes until the end of 2013:

- Conduct country specific surveys on ICT research environment, to identify current and emerging research topics and priorities
- Interview experts to identify current and emerging research topics and priorities as well as the main research actors in Europe and China
- Organize one major dialogue conference in Beijing and three workshops (two Chinese and one European)
- Develop and maintain a portal website and promotional material so as to communicate the project's goals, objectives and results to stakeholders
- Establishment of a broad knowledge base with respect to European and Chinese ICT research environments.

4.2.4 "OpenChina-ICT" Dialogue Conference - November 2012

In mid-November 2012, the OpenChina-ICT Dialogue Conference was held as a forum bringing together leading individuals and institutions, both public and private, in the field of ICT. With over 240 registered participants, including representatives from over 100 Chinese and 12 European organizations, the OpenChina-ICT Dialogue Conference proved to be a successful platform for matchmaking and opened channels for EU participation in the Chinese ICT industry.

The two-day event was specifically designed to provide a stage for information dissemination by leading experts in both the EU and China ICT industry and to provide both formal and informal networking opportunities to facilitate dialogue between participants. As a result of conference-intermission networking and B2B matchmaking sessions, Chinese and EU individuals were able to discuss potential partnerships and build cooperative relationships. Of participants that took part in both days of the Dialogue Conference and were surveyed, 90% of survey respondents felt the event in itself and in particular, the B2B matchmaking session, were both strong successes, demonstrative of the enthusiasm behind such an initiative.

Over 40 Chinese organizations met with EU organizations during the B2B matchmaking session. Over 70 meetings took place, resulting in the signing of 46 Memorandums of Understanding (MOU's), signifying the intention of opening dialogue between the EU and China, subsequently developing the ICT sector with more information made available.

The reviews and general enthusiasm during the Conference suggest the eagerness of both Chinese and EU companies and/or firms to collaborate on the development of the ICT industry. The OpenChina-ICT Dialogue Conference is the foundation upon which these relations will continue to grow and encourage more intricate cooperation with clarity on how the EU can enter and prosper alongside China's ICT industry.

The event featured presentations from key individuals in the ICT industry on their perspective on the ICT industry in respect to their areas of expertise. The group of speakers includes industry experts such as Mr. Jijun Xing of the *China Science and Technology Exchange Center (CSTEC) and Ministry of Science and Technology (MOST)*, Ms. Yingjie Fan of the *National Natural Science Foundation of China (NSFC)*, and Morten Moller from the *European Commission and Head of Unit of F3*.

4.2.5 Further Information on the OpenChina-ICT project

The OpenChina-ICT Dialogue Conference further encouraged the development of relations between the EU and China with particular information shared on the importance and the methods for EU participation in China's ICT industry. Information on the Conference, proceedings and post-event and further information regarding contacts and affiliates can be found on the OpenChina-ICT website (www.openchina-ict.eu).

Information on the OpenChina-ICT project and related information is available in both English and Chinese. In order to bridge the gap between EU and China, the OpenChina-ICT initiative seeks to help ameliorate the barriers that prevent collaboration by disseminating information through various outlets of communication in both languages. The main website contains information on the project in general and has links to affiliates and further information on the ICT industry in both EU and China.

4.3 European Participation in Chinese Research Programmes

- Chinese research programmes are mainly from national research institutes with Universities acting as the key players. Some mainstream national research programs like the 863 and 973 plan integrate the talents and resources from the best research institutes and universities. The 973 plan is now open for international cooperation.

- In general, China's programs of international cooperation including EU participation are:
  - Key international cooperation projects supported by Chinese Academy of Sciences (CAS)
  - International Partnership Program for Creative Research Teams supported by CAS and State Administration of Foreign Experts Affairs (SAFEA)
  - Overseas Young Scholar Research Fund supported by NSFC
  - Einstein China Professor Program supported by CAS
  - Fellowship for young international scientists supported by CAS
  - Visiting professorship for senior international scientists supported by CAS
  - Research Fellowship for International Young Researchers supported by CAS

- China has a comprehensive international cooperation in the ICT field; its partners include U.S, Japan, Germany, Serbia and so forth. The cooperation field ranges from digital government to computer science, from 3G network,

technology development to open source code and outsourcing information service. The Ministry of Science and Technology has launched 12 government-funded mega-projects. Four of these are related to ICT: namely core electronic components; high-end generic chips and basic software; extra large scale integrated circuit manufacturing and technique; and new-generation broadband wireless mobile telecommunications.

- However, the EU-China ICT research cooperation mainly occurs under FP7. China plays an important role in the EU's FP7 ICT research projects while the EU supports China's prioritized ICT research themes, including:

  - Key international cooperation projects supported by Chinese Academy of Sciences (CAS)
  - Nanotechnology
  - Information Processing, Information Systems – IT security
  - Embedded Systems & Real-time Systems
  - Microelectronics & Integrated Circuits
  - Mobile & Wireless Communication Technologies
  - Distributed Systems

- Private enterprises are also open to cooperation in the ICT field. For example, the top ten electronic and information companies like Huawei (with Siemens), ZTE (with Portugal Telecom, France Telecom), Lenovo (with US) are all involved in international cooperation. All of which can become very promising partners for the EU in ICT R&D.

4.3.1 Dialogues

The cooperation mechanism played a significant role in the European participation in Chinese Research Programmes. Dialogues and expert groups are main cooperation mechanisms that proved to be feasible and fruitful.

The dialogue enables both Europe and China to pursue their own concerns. In 2009, The European Commission Directorate General of Information (DG INFSO, now called DG CONNECT) and the Ministry of Science and Technology (MOST) established EU-China ICT dialogue mechanism. After the first meeting in 2009, the Directorate General Communication Networks, Content and Technology(DG CONNECT, ex-DG INFSO) is presently involved in two on-going dialogues:

- The Dialogue on ICT Research with the Ministry of Science and Technology (MOST) whose second dialogue took place in Brussels, Belgium in March 2011. This dialogue focused, in particular, on the reciprocity between China's access to EU's FP R&D programs and EU's access to China's 863 and 973 R&D programs. During this dialogue, the

main ICT areas of common interest for EU-China cooperation were discussed.

- The third Dialogue on Information Technology, Telecommunications and Informatisation with the Chinese Ministry for Industry and Information Technology (MIIT) took place in Chengdu, China November 2011. The main outcomes of this dialogue were a common agreement to continue developing the existing EU-China collaboration - in particular technological areas notably Internet of Things and a joint commitment to more rapidly adopt Ipv6 and to continue exchanging experiences on developing a regulatory system for electronic communications and Internet security.

China–EU ICT Research Dialogues

Main partners: MOST & DG CONNECT，Vice-Minister-DG level, with focus on:

- Strategies for cooperation
- Review of implementation of earlier activities
- Development/promotion of ICT R&D projects

First meeting: July 2009, Beijing

- Review of participation in respective programs
- Future Internet/IoT/IPv6
- High-performance computing
- Research networks connectivity
- 4G

Second meeting: March 21 2011, Brussels
Third Meeting: November 2011, Chengdu

4.3.2 Expert group

The EU-China Expert Group that the European Commission and Chinese Ministries (MIIT/MOST) have created aims to provide inputs to their ongoing dialogue for promoting cooperation in ICT between China and Europe. In this way, international cooperation between the two regions will serve the interests of both sides, while supporting Europe as a place for excellence in international research. The cooperative mechanism will take a series of pragmatic and incremental actions to enhance direct dialogues among stakeholders including policy makers and researchers from both the EU and China.

In carrying out an efficient dialogue mechanism, DG INFSO and MOST jointly established EU-China expert group in the fields of Future Internet, IPv6 and Internet of things. The groups are coordinated by CATR, which is responsible for organizing cooperation in these fields between EU-China.

- **Expert group on future internet/IPv6**

  In 2010, DG INFSO and CATR established the "EU-China expert group of future internet/IPv6''. On the 10th of July 2010, a round table and a work meeting of expert group were held in Beijing and Brussels - in the meetings they set up the cooperating plan on Future Internet/IPv6 and established contact between the two parties.

  The Chinese members headed by Jiang Lintao are mainly from Tsinghua University, Beijing University of Posts and Telecommunications and BII Group; the EU contact person of the expert group is Jacques Babot, the head person is Philippe Cousin.

  The cooperation mainly focuses on:

  - Establishment of internet innovative platform and testing environment
  - Co-experiment of PTDN
  - Co-research on virtual technology, cloud computing and Ubiquitous Network
  - Co-research on the social impact of internet
  - Co-research on the issues of IPv6 commercialization, especially the IPv4/IPv6 coexistence and transition betweenIPv4 and IPv6
  - Co-research of global deployment of IPv6 resources (joint statement has been made by EU and China on promoting and speeding up the commercial deployment of IPv6)

  Main activities of the expert group after its establishment:

  - September to October 2010, Chinese members attended EU's ICT 2010 conference in Brussels and held the EU-China workshops on cooperation of IPv6/Future Internet and the EU-China expert workshop on IPv6/Future Internet. The cooperation encompassed Future Internet, IPv6 and social impact of Internet, specifically the cooperation covered such aspects as: virtual technology, cloud computing, ubiquitous network, PTDN, IPv6 extensive commercial deployment, IPv6 training (mainly by BII and Beijing University of Posts and Telecommunication), co-research of DNS server deployment. In the meetings, plans had been made and testing platforms designated. In dealing with the Internet's social impact, an expert group had been established for contacting and cooperating with the EU's PARADISO project. CATR had also taken part

in Internet research projects, report writing and event communication.

- In December 2010, Chinese members were invited to attend the EU's "Future Internet Week" and made an introduction of China's requirement of IPv6, the status quo of IPv6 and future development plan.
- In February 2011, taking the opportunity of the Myfire Workshop, the EU expert group on Future Internet/IPv6 held a meeting on the group's working plan. It included issues of IPv6 and Future Internet, specifically, the issues in the process of IPv6 commercialization, IPv4 and IPv6 coexistence and transition, co-research of IPv6 recourse deployment around the globe, construction of future internet innovative platforms and testing environment, co-testing of PTDN, co-research of virtual technology and cloud computing, social impact analysis of internet.
- EU-China IPv6 and Future Internet expert mail list had been made for attracting more experts from both countries to join the research. The mailing list had been supportive for collecting more extensive cooperative themes.

Future plans:

- In the field of IPv6
  - Expert group will hold technological workshops with regard to the IPv4 and IPv6 coexistence and transition in the process of IPv6 commercialization
  - The experts from the two parties will finish a research report on global IPv6 deployment in cooperation with each other
- In the field of Future Internet
  - China will access the Future Internet innovative platform and the testing environment by joining the EU Future Internet Research and Experimentation (FIRE)
  - Based on the Future Internet innovative platform and the testing environment, the two parties will carry out co-experiment on PTDN
  - The expert group will organize technical workshops on cloud computing. The themes will mainly focus on EU-China status quo and requirement of cloud computing, technical standard and development strategy
  - Co-research on the social impact of Internet

- **EU-China IoT Advisory Group**

The EU-China IoT Advisory Group was established in February 2011. Its first

meeting was held at the end of the month. The Chinese members are headed by Mr. Yu Xiaohui(Chief Engineer from CATR), the liaison personnel is Miss Kang Yanrong (from CATR). The Chinese expert members are mainly from national research institutes and enterprises including CATR, China Mobile, China Unicom, and ZTE. The EU members are headed by Mr. Philippe Cousin; the members are mainly IoT project members under FP7. Most of them come from University of Surrey in Britain.

The cooperation mainly includes:

- Enhancing the IoT cooperation and communication in its strategic perspective
- Co-research on the general frame work of IoT
- Developing testing sites in cities with IoT
- Establishing mutual control mechanism between EU-China pilot cities of Smart City and establishing an open testing bed
- Joint promotion of ISO's IoT standardization
- Cooperation of international IoT management and IoT policy (safety and privacy)

Main activities of the advisory group after its establishment:

- Active promotion of EU-China IoT cooperation; 4 meetings have been held both in China and EU under the promotion of the Advisory Group
- Establishment of an information exchange mechanism; issued a sample template of writings and document for more efficient EU-China IoT R&D and communication; ensured regular communications between the two parties on EU-China IoT R&D and application; carried out irregular communications on IoT research findings.
- EU offered to China certain reference materials including *a compilation of IoT research findings under FP7,Internet of Things：global technology and social application trend, preliminary structure of EU IoT as reference model*
- English translation of the *white paper of Internet of Things* issued by CATR has been offered to the EU partner.

Future plans:

- On IoT technology R&D
  - Develop new field of cooperation according to the previous cooperation suggestions, IoT strategy, general framework, application site, standardization, international management and

safety/privacy policy

- On general architecture of IoT
  - Based on discussion, the EU-China IoT Advisory Group and he IoT-A expert reached agreement on IoT Architecture and reference model
- In consideration of a rather weak IoT test and R&D, China had suggested new fields of cooperation:
  - To establish a joint owned IoT laboratory and interconnected EU-China laboratories.
  - Co-research of IoT testing technology, protocol uniformity, IoT equipment certification and testing scheme.

■ **EU-China Green Smart City Expert Group**

According to the resolution of the third China–EU ICT Research Dialogue meeting, the two parties will establish Smart City cooperation mechanism, i.e. EU-China Green Smart City expert group.

Common interests:

- To resolve the problems in the process of urbanization by extensive and in-depth ICT application
- To improve urban efficiency and public services
- To support economic development and improve people's quality of life
- To establish a working plan
- To select pilot cities in EU and China for smart city cooperation
- To summarize typical EU-China smart city construction methods and models in order to provide examples for other cities
- To create more opportunities in the industry of smart city and further promoting EU-China cooperation

After the dialogue meeting in 2011, MIIT and EU representatives had reached agreement on establishing the EU-China Green Smart City expert group.

Institutional settings of the group:

- Steering Committee of EU-China smart city cooperation
- Technical Expert Group
- Secretariat

Currently the candidates that fit the above positions have been listed, and the secretariat has started working by regular meetings twice a week for the

promotion of smart city cooperation. The criteria of pilot cities in the EU and China had been set and the selecting work is about to start. 5-6 cities will be selected from each side, the cooperation will be focused on general structure, energy saving and environmental protection, green urban construction, urban management and service, and intelligent transportation.

After the establishment of the expert group and the selection of pilot city, the two parties will hold a kick-off meeting for smart city cooperation. The kick-off meeting is currently under preparation.

4.4 Barriers for Chinese Partners to participate in European Research Programmes

4.4.1 Introduction to the Survey

- Obvious obstacles exist for the cooperation between China and the EU, due to differences in history, culture and level of economic development. So is the case for the cooperation in the ICT field between China and the EU. And the barriers for cooperation in the ICT field between China and the EU come from two sources, one being the barriers for the European side to participate in Chinese research programmes, while the other is for their Chinese counterparts to participate in European research programmes.

- CATR - as one of the Chinese partners of the OpenChina-ICT project – has conducted this survey among chosen ICT experts through e-mail questionnaires, mainly in order to clarify the cooperation obstacles in the ICT field for China and the EU, and, in particular, the barriers for the Chinese side to participate in European research programmes.

- For this survey, more than 80 ICT experts received the questionnaire, of which 58 gave feedback. These experts come from scientific research institutes, universities, telecom operators, equipment manufacture and Internet enterprises. Of all the experts with feedback, all have experiences of collaboration with European researchers or entities, and some even being or have been participating in collaborative projects with Europe; approximately one third have been actively participating in activities of international standards organizations including 3GPP, ITU and IETF, and have therefore also experiences of collaboration with researchers from non-European countries/regions such as Korea, Japan and the US; and their feedback is of high value for CATR to identify and analyse the cooperation obstacles in the ICT field for Chinese partners.

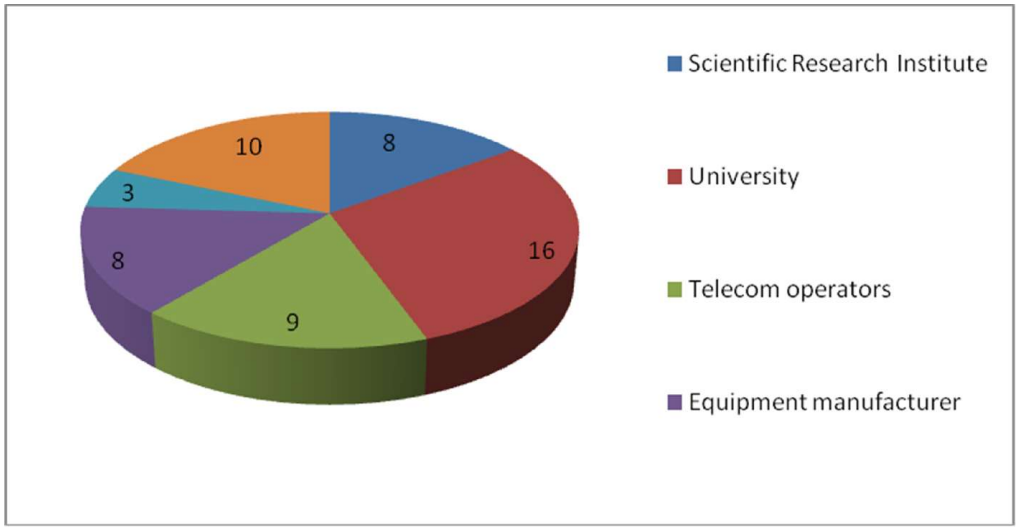


Figure 3: Potential Barriers for the Cooperation between China and the EU

4.4.2 Design of the Questionnaires

- This questionnaire contains the issues related to potential obstacles for the ICT cooperation between China and the EU such as government policy for cooperation, different cultures between China and the EU, information channels for the Chinese partner to get related information, sources of funding, technologies of mutual interest, and so forth.

- For this questionnaire, policy issues point to the cooperation environment between China and the EU, which contains the political environment, economic situation, human rights policy, environmental policy and the trade agreements between China and the EU. Cultural issues point to the cultural aspects between China and the EU, such as different ways of thinking, communication manners, and language barriers. Information Channels issues point to channels for both Chinese and European partners to get the related information on ICT research programmes. In general, these ICT research related information is mainly published by government websites. And cooperation partners or friends are another way to get such information. Funding issues point to the resource of funding for ICT programmes. Government special project funds are the main resource of funding for this cooperation ICT programmes, while corporate or personal self-financing is a good supplement.

- In the questionnaire, every question has five options. And as for these options, according to the degree of importance for each, a number from 1 to 5 is attached to the related option and each number corresponds to one degree of importance. Therefore, upon receiving our questionnaires, the

selected ICT experts could make choices from 1 to 5 for every option of the related question according to their knowledge and experience in the ICT field.

- The corresponding relationship between the degree of importance for every option and the number from 1 to 5 is as follows:
  - 5: Extremely important
  - 4: More important
  - 3: Generally important
  - 2: Less important
  - 1: Totally unimportant

4.4.3 Feedback Analysis of the Questionnaire

- In this questionnaire, the first question is about the barriers for the Chinese side to participate in European research programmes. The potential barriers for Chinese to participate in European research programmes in this questionnaire contain: 1) policy; 2) culture; 3) information channel; 4) funding; and 5) technology. After receiving feedback of the chosen experts in the ICT field, the results are summed up and Figure 4 shows the perception of the potential barriers for participating in European programmes. The higher the number, the more important the option. From Figure 5 we can see that, compared to the culture, information channel and technology issues, policy environment for the cooperation between China and the EU and funding resources are the focuses of experts' concerns.

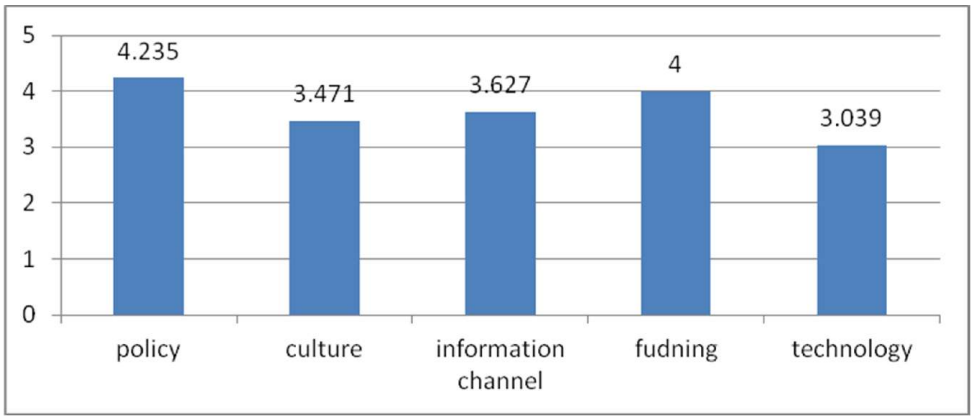


Figure 4: Potential Barriers for Cooperation between China and the EU

- The second question is about the investigation of cooperation-related policies between China and Europe. The cooperation-related policies contain human rights policy, environmental policy, trade agreements, and economic cooperation activities. The results can be seen in the following figure. From

Figure 5 we can see that, as for the policy environment for the cooperation between China and the EU, the trade agreements between China and the EU have been the focus concern of chosen experts in the ICT field.

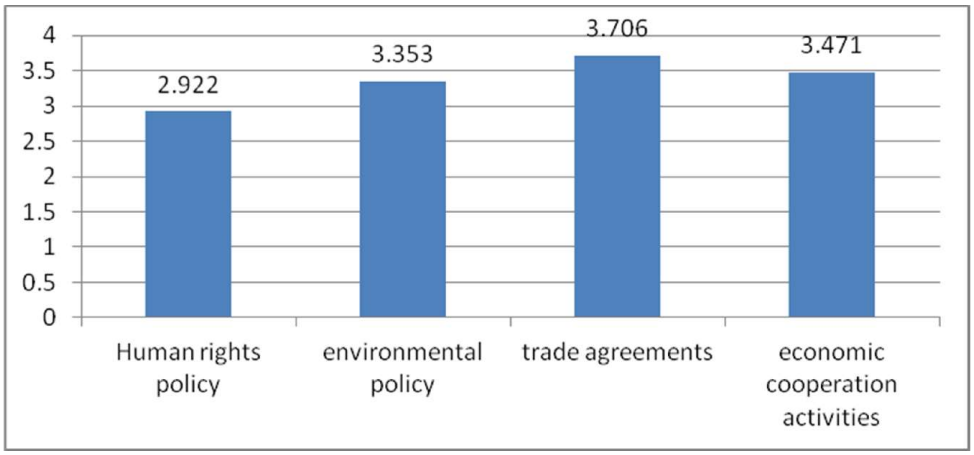


Figure 5: Policy environment

- The third question is about cultural differences between China and Europe. The potential cultural barriers may contain different ways of thinking, communication manners, and language barriers. The results are summed up in Figure 6, from which we can see that the ways of thinking and communication manners are the two kinds of cultural barriers for the cooperation between China and the EU.

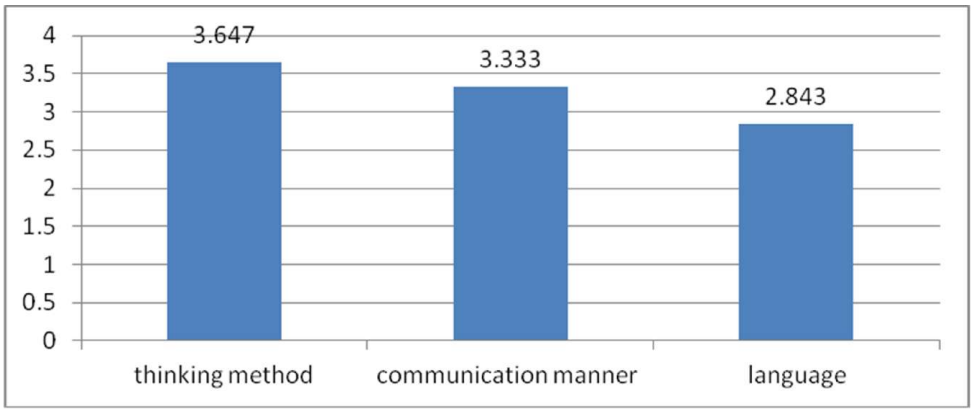


Figure 6: Culture environment

- The fourth question is about information channels for cooperation in the ICT field between China and Europe. The information channels include the website of the Chinese government, the website of the EU government, cooperation projects, and friends and project partners. The results are summed up in the following figure. From Figure 7, we can see that

cooperation projects are the most important information channel for Chinese to participate in European programmes.

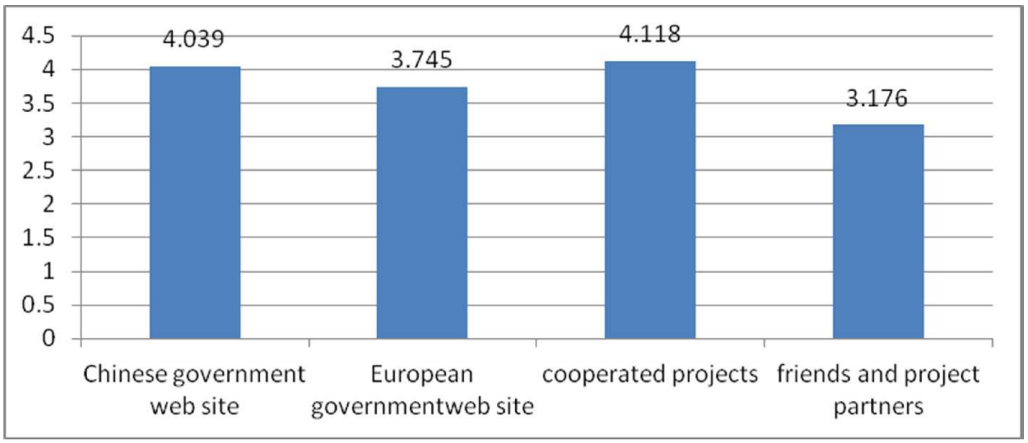


Figure 7: Information channels for the cooperation between China and the EU

- The fifth question is about funding resources used to support the cooperation in the ICT field between China and Europe. Potential funding resources are government special project funds and corporate or personal self-financing. The results are summed up in the following figure. From Figure 8, we can see that government special project funds are the dominant sources of support for cooperation projects between China and the EU.

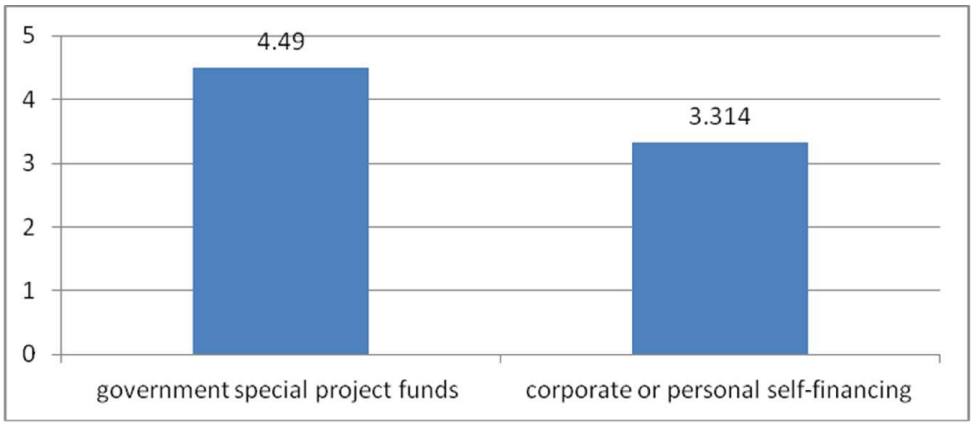
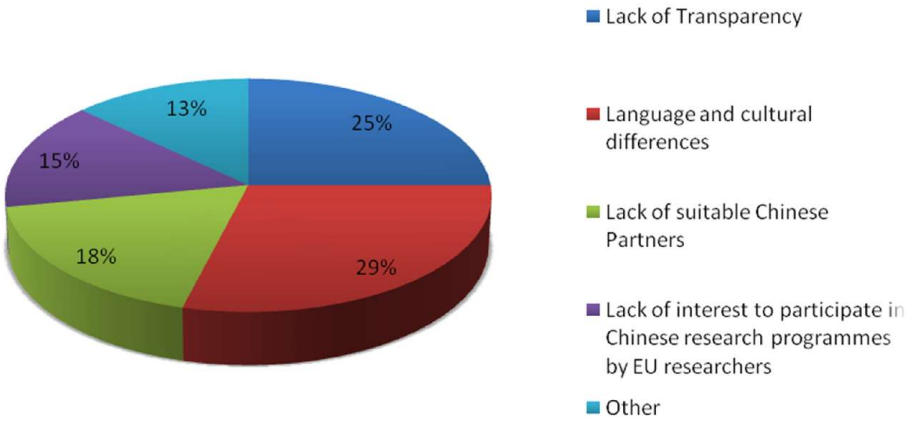


Figure 8: Funding sources to support projects

4.5 Barriers for EU Partners to Participate in Chinese Research Programmes

According to the FP7 ChinaAccess4EU project, in terms of the major barriers encountered by EU researchers for participation in Chinese programmes, it is language and cultural differences (29%), as well as lack of transparency of Chinese programmes (25%) that culminate in the two main obstacles. Other barriers include lack of suitable Chinese partners, and lack of interest to participate in Chinese research programmes by EU researchers (see the graph below):



However, the situation is getting better in recent years with more and more Chinese researchers' improving their language skills and obtaining an overseas education or work background.

Several Chinese major research programmes under MOST and NSFC provide researchers from the EU the possibility of participating in Chinese research projects, such as 863 Programme, 973 Programme and programmes funded by National Natural Science Foundation of China (NSFC). In 2009, it was reported that French scientist Vincent Deubel participated in a research project entitled "Negative regulation of virus-triggered IFN-ß signaling pathway by alternative splicing of TBK1". Vincent Deubel is acting as Director General of Institut Pasteur of Shanghai, Chinese Academy of Sciences in partnership with Shanghai municipality. This project was supported by the 973 Programme and NSFC.

In the present moment, it should be noted that there are still barriers on both sides: European companies come up against barriers to investment, difficult

government procurement procedures, subsidies, intellectual property rights, and complain of a lack of a level playing field. Chinese companies, meanwhile, complain that they face discrimination, as well as linguistic, cultural and legal barriers in the EU.

It is well known that the Chinese Government is relatively non-transparent when compared to many other political institutions and organizations, but is becoming more open over time in response to evolving international expectations. There are no objective standards used to measure transparency, but compared to its own past practice the Chinese Government has increased the amount and frequency of information it releases to the public, expanded social competition over ideas, and relaxed its controls over information.

The larger countries in Europe (especially Germany) seem to be particularly active in collaborating with China. For example, Germany regards China as an important future trading partner and uses many different approaches to stimulate cooperation. Some are aiming to improve the cooperation on a scientific level; others are intending to establish long-term cooperation between German SMEs and Chinese companies through joint R&D projects.

In the area of competition, China has adopted new regulations similar to those in the EU, which will help upgrade the level of dialogue between the authorities in the two regions.

4.6 ICT Technological Priorities of China-EU Collaboration

With policy guidance and funding support from the Chinese government, Chinese research units have been actively participating in the research and development in the ICT area, and seeking for opportunities for international collaboration to improve the level of ICT research and innovation.

In order to gather technological views on future EU-China collaboration priorities in the ICT area and find out future ICT research emphases in China, the survey was carried out among ICT experts in China, who are as the same as in the survey of barriers described above in 4.4.
The selected research units for this survey included universities, research institutes, telecom service providers, ICT equipment vendors and Internet application enterprises. As many as 58 experts from various ICT research fields were surveyed and gave feedback. The results can demonstrate the trends of emphasised research fields, from which we can draw some tentative suggestions

for collaboration.

4.6.1 Survey Methodology

- The survey was done by sending questionnaire to various Chinese ICT experts through email. The questionnaire was designed to gather the views of research and collaboration priorities of important ICT research areas between China and EU for the next three to eight years, including the next-generation Internet, optical communication, wireless communication, the Internet of things, cloud computing, network and information security, terminal, smart city, and the convergence of three networks.

- For each research area, the specific technologies of main directions in research and collaboration areas with priority were also asked so as to get a comprehensive idea of future collaboration emphases for Chinese partners. Experts could also point out the research fields or technologies not covered in the questionnaire.

- For each question, 5 options were given to identify the level of research priority for China-EU collaboration. The level of importance corresponds to the number in options from 1 to 5:

  - 5: Extremely important
  - 4: Very important
  - 3: Relatively important
  - 2: Less important
  - 1: Totally unimportant.

- In the results, for each option, an average number was calculated based on all the numbers collected.

4.6.2 Analysis of Survey Results

- The survey received 58 responses from 27 research units including experts from the government, research institutes, universities, telecom carriers, telecom equipment vendors and Internet enterprises in China. The distribution of the surveyed experts is shown in Figure 9.

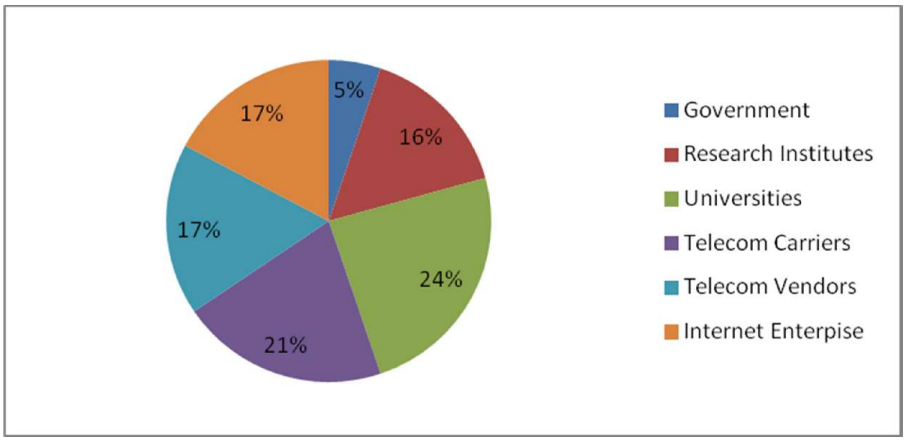


Figure 9: Distribution of surveyed research units

- The result of identified priorities of ICT research areas of collaboration is shown in Figure 10: Priorities of Research Areas of Collaboration10. The vertical axis shows the average priority level calculated on the basis of all feedbacks. This shows the general view of emphasised research areas in the next three to eight years. From the results, it can be seen that all the surveyed areas are above the level of "relatively important", but the level of importance varies across the board.

- We can classify the research areas into three tiers according to their identified priority level of collaboration. The first-tier research areas, which are identified as very important to extremely important, include the next-generation Internet, network and information security, broadband mobile communication and cloud computing. The second tier areas that are identified as very important are smart terminals, optical communication and the Internet of things. The third tier areas identified as relatively important to very important include smart city and the convergence of three networks.

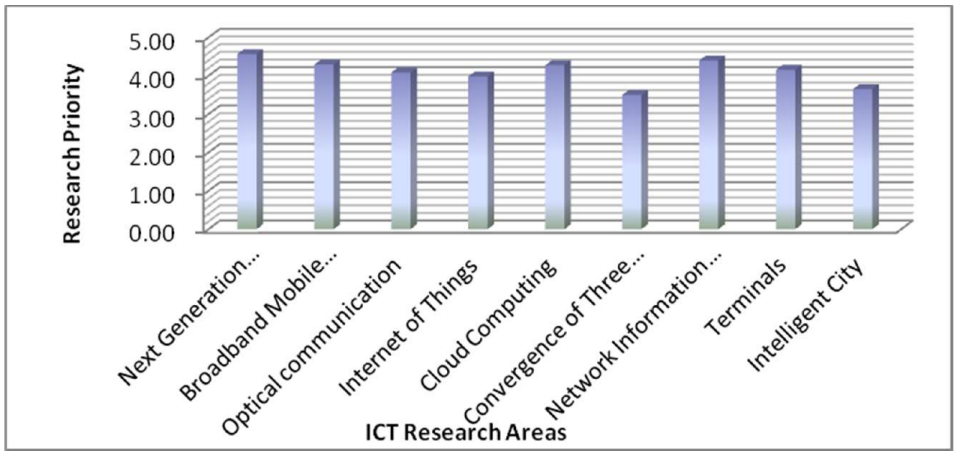


Figure 10: Priorities of Research Areas of Collaboration

- The next-generation Internet
  - The key technologies in the next-generation Internet area include next-generation Internet protocol architecture, routing and addressing, network virtualisation, security, control and management, ubiquitous synergy technologies. **Fehler! Verweisquelle konnte nicht gefunden werden.**1 gives the identified research priority level of these technologies. We can see that security, control and management, routing and addressing, network virtualisation and protocol architecture are the most important research focus identified by the experts.

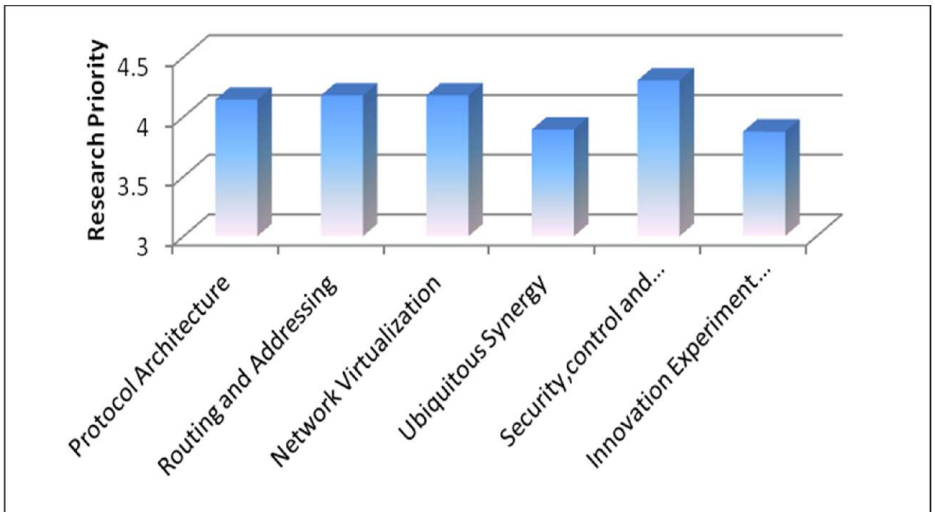


Figure 11: Research priorities in the next-generation Internet area

- Network and Information Security
  - The network and information security area includes a plethora of key technologies as shown in Figure 12: Research priorities in the network and information security area2. The research emphases identified by experts include information identification and control, important information system protection, encryption technology, mobile intelligent terminal security, network identification management and security of the Internet of things.

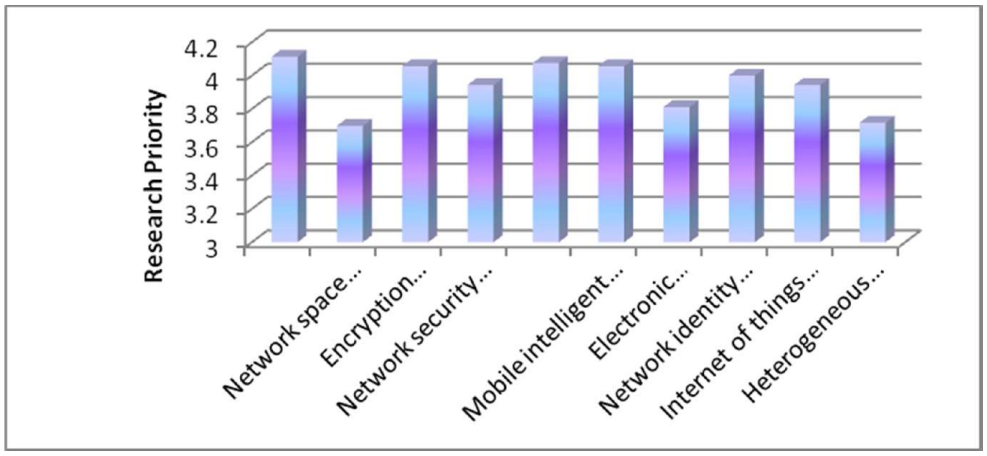


Figure 12: Research priorities in the network and information security area

- Broadband Mobile Communication

  - Figure 13: Research priorities in the broadband mobile communication area3 shows the survey results of the broadband mobile communication area. From the results, we can see that the most important technology identified is the new-generation mobile communication technology (i.e., LTE and LTE-advance). Other research items include service and customer oriented network architecture, hot point and indoor microcell technologies, distributed antenna, heterogeneous network coordination and convergence, self-optimised technology and cognitive radio.

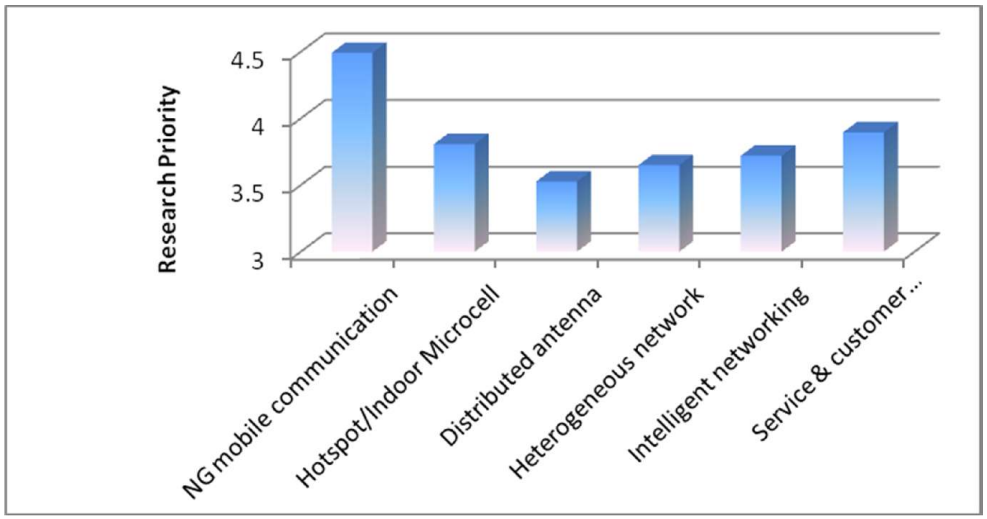


Figure 13: Research priorities in the broadband mobile communication area

- Cloud Computing

  - The key technologies in the cloud computing research area include cloud server system, cloud storage system, cloud operating system, cloud data centre energy saving and networking technologies, cloud security, and testing and evaluation. As shown in Figure 14: Research priorities in the cloud computing area4, the research areas of the highest priority level include cloud security, cloud operating systems, and data centre technologies.

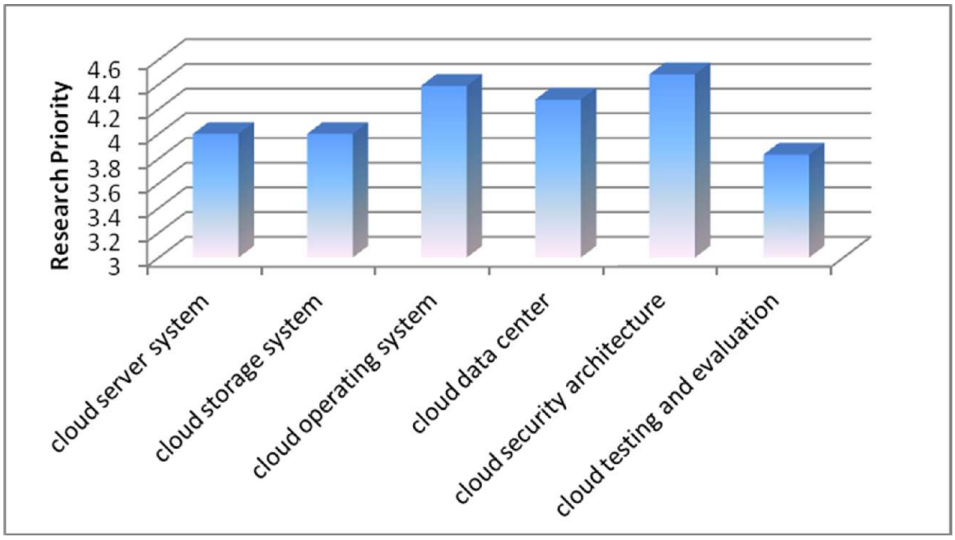


Figure 14: Research priorities in the cloud computing area

- Smart Terminals

  - As shown in5, the top-ranked research focuses for smart terminals are chip technology, terminal operating system and human machine interaction technology of smart phones and smart TVs. Other research focuses include new human terminal interaction, application services, and new materials.

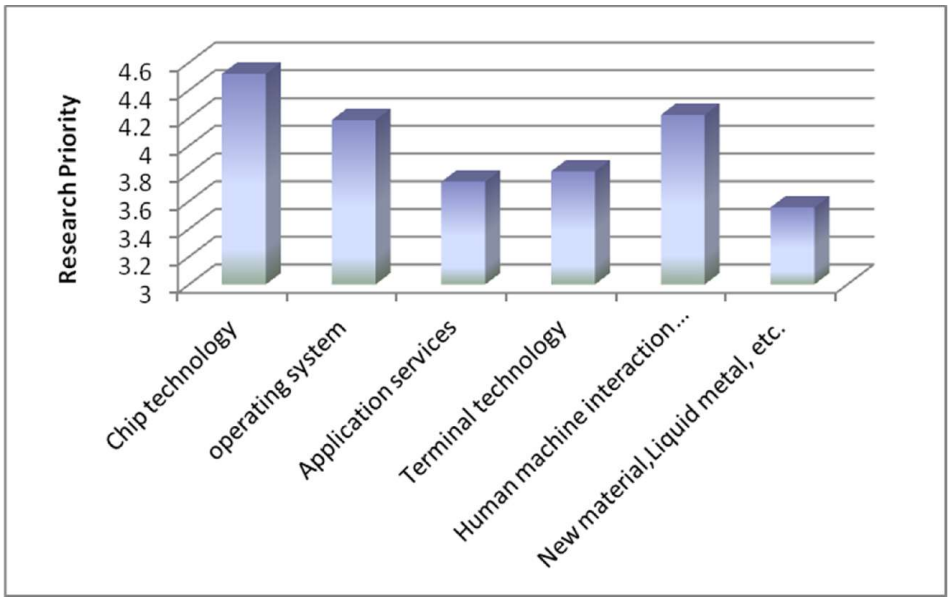


Figure 15: Research priorities in the Smart Terminal area

- Optical Communication

  - Figure 16: Research priorities in the optical communication area6 shows the results of research priority in the optical communication area. According to the survey feedback, the most important technologies identified in the optical communication area include ultra-high speed optical transmission technology, ultra-large capacity optical switching and networking, data centre optical interconnection technologies and next-generation PON.

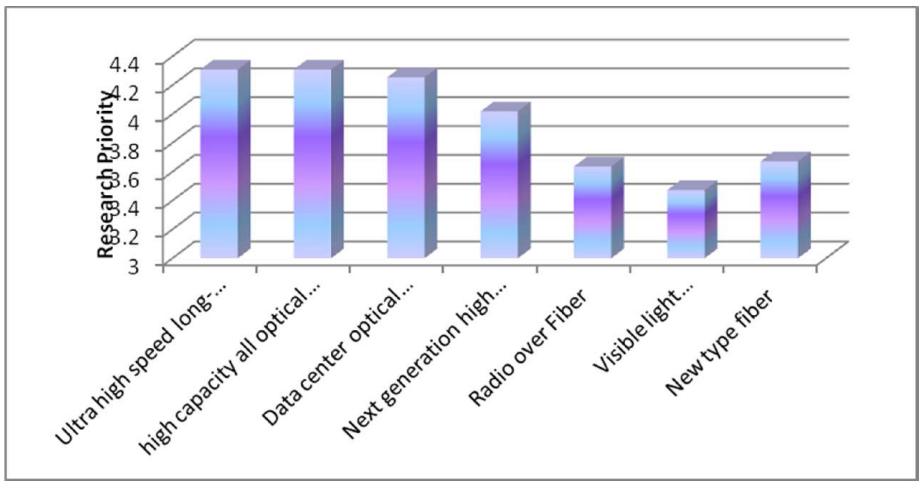


Figure 16: Research priorities in the optical communication area

- The Internet of Things

- As shown in 7, the key technologies identified by the experts in this area include M2M communications and application platform technologies, lightweight IPv6, integrated intelligent sensor technologies, ultra high frequency and microwave RFID and short distance wireless communication, with a descending priority, as a result of the survey.

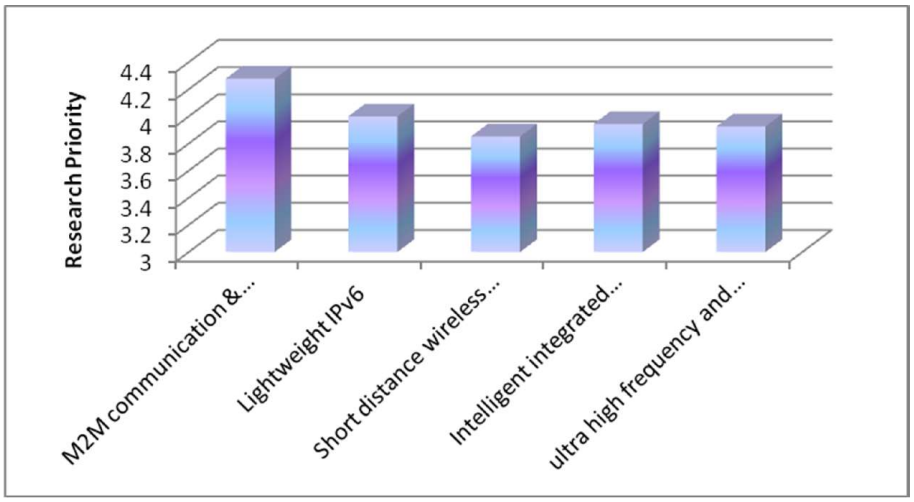


Figure 17: Research priorities in the Internet of Things area

- Smart city

  - 8 shows the survey results of research priority in the smart city area. We can see that this area contains high performance data processing for city management and operation, human-centric smart city public service support technology, multi-mode data system interconnection technology, multilevel intelligent decision-making of city information, and city multi-source intensive dynamic operating data presentation, with their descending priority, according to views from the experts.

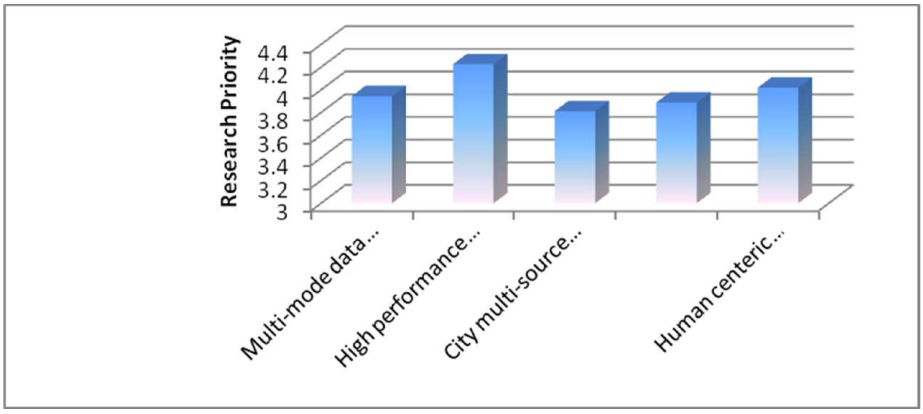


Figure 18: Research priorities in the smart city area

- The Convergence of Three Networks

- The convergence of three networks area covers the key technologies to support the convergence of the telecom network, the Internet, and the broadcast and television network. Figure 19: Research priorities in the convergence of three networks area19 shows the survey results of research priority in this area. The technologies of highest priority include intelligent video terminal, new-generation web technology, and new type human machine interaction technology. Other technologies include new display technology, content encoding, multi-screen interaction, and broadcast memory.

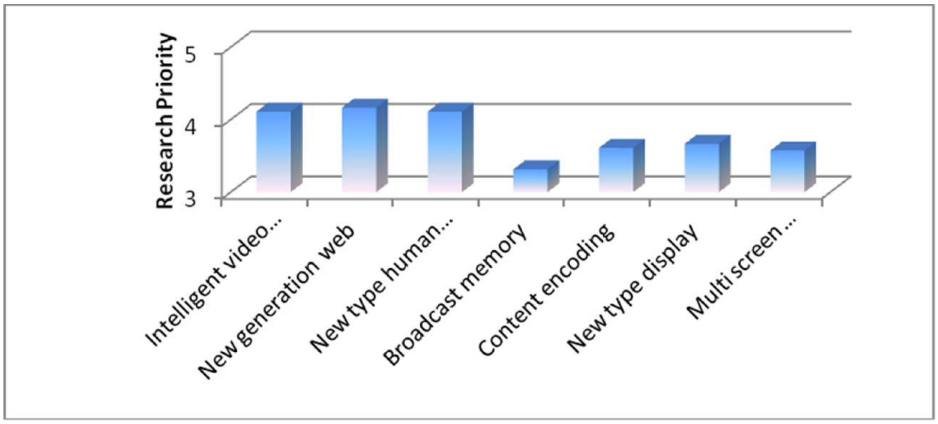


Figure 19: Research priorities in the convergence of three networks area

4.6.3 China-EU ICT Collaboration Priorities from the Perspective of China

Based on the key findings of above analyses from government policies and technological views from Chinese research units, we select top seven research areas from Tier 1 and Tier 2 as the ICT research areas of high priorities of China-EU collaboration. While the research areas of Tier 3, smart city and the convergence of three networks, are of less priority according to the survey and are not proposed for collaboration. Moreover, the topic of the convergence of three networks is a specific concept for China, which is not only an issue of technology but also of policy, and is thus cancelled from the collaboration list. The seven priority ICT research areas of China-EU collaboration are listed and described as follows:

- Broadband Mobile Communication

  - Broadband mobile communication is one of the strongest research and industrial areas in China. The main focus in this area is new-generation broadband mobile communication. TD-SCDMA is among the three international standards of 3G, and TD-LTE is now one of the four options of 4G standards. China has input considerable efforts into TD-LTE

research and industrialisation, and holds a plethora of proprietary IPRs in this area. TD-LTE has the potentials to become one of the most competitive 4G technologies around the world.

- The next-generation Internet

  - China has already started research on the next-generation Internet. With the support of National Innovation Projects, China has already built the largest IPv6 network (CNGI-China Next-generation Internet) in the world, and conducted large-scale network experiments and application demonstration. China has achieved certain breakthroughs in IPv6 migration technology, next-generation trusted Internet architecture, and addressing based on real IPv6 source address, with positive results in international standardisation and routing products manufacturing. In the next few years, China will conduct real network experiments and deployments. With the development of new applications such as the mobile Internet, the Internet of Things and cloud computing, more research emphases should be put into this area to enable high scalability, virtualisation, security and energy efficiency.

- Network and Information Security

  - As the fast development area of ICT, network and information security is becoming increasingly important. The key technologies to be strengthened in this area include encryption technology, information identification and control, important information system protection, mobile intelligent terminal security, network identification management and security of the Internet of things, and security test and evaluation.

- Cloud Computing

  - Cloud computing will bring revolutionary changes that will sweep across the ICT industry. China is at the primary stage in the cloud computing service market, and possessing certain strengths in cloud technology research, cloud computing server and storage device manufacturing. The “National Mid-and-Long-Term Science and Technology Plan” and “The Twelfth Development Plan of the ICT industry” have listed cloud computing as one of the important areas for research and development in China. Cloud computing research in China focuses on cloud operating systems, cloud computing security, data centre networking, data centre energy saving technology, and cloud computing testing and evaluation.

- The Internet of Things

  - China, as well as other countries, is at the primary stage in this area. With government support, China has already laid a good foundation in technology, industry and application in this area. The National Sensor Network Innovation Area had been built in Wuxi City, and significant progress has been made in the standardisation of sensor network interface, identification, security and network architecture. Applications in grid, transportation, medical processing, and environmental protection, have been underway. However, as a new technology and network architecture, more research needs to be done, including sensing, transmitting, processing and manufacturing technologies.

- Optical communication

  - Optical communication is regarded as one of the most promising technologies for future communication networks. With the rapid growth of the Internet, many countries have announced their national broadband plans. China is now developing its own Broadband China Strategy, and optical communication technology is one of the most important areas to be strengthened. The National 973 and 863 Plans have input considerable efforts to develop optical communication technologies in China. Equipment vendors, such as Huawei and ZTE, are becoming top manufacturers in the global optical communication equipment market. The hot spots of research in this area include ultra-high speed transmission, large capacity optical switching, NG-PON, and data centre optical interconnection.

- Smart Terminal

  - In China，the smart terminal market, including smart phone and smart TV, is experiencing fast development. By enhancing research input, establishing industry alliances and regulating standards, China has achieved significant breakthroughs in TD-SCDMA terminal technology and smart TV technology. However, there is still a long way to go in many areas, including smart terminal operating systems, radio chip design and manufacturing. Furthermore, Chinese research institutes and vendors are making efforts to research on next-generation display, human and machine interaction, and new web technology based on HTML4.

5. Conclusions and Suggestions

5.1 Summary of the Development of ICT in China

5.1.1 Summary of ICT R&D in China

- Since the establishment of the People's Republic of China in 1949, China has achieved a series of outstanding accomplishments in the field of ICT. This report has demonstrated the technical advances China has made for over 60 years, such as the Model 103 conducted open computing performance in 1958, which led to model "Galaxy-I" being China's first large computer with its rate marked by billions of times per second in 1983. China's first general CPU called "Dragon Chip" was invented in 2001 and then successfully put into production in 2002.

- Recently –as of the past decade (particular from 2006) - China began to produce state-of-the-art technology, where high-level communication systems, such as China 40 Gbps SDH optical communication systems, 80×40Gbps dense WDM system, large capacity and long distance transmission systems, and fibre to home, were successfully developed. In 2008, CNGI-CERNET 2/6IX, built by Tsinghua University together with other 25 universities, is currently the largest pure IPv6 Internet network all over the world, which demonstrates that the level of China's information basic infrastructure and communication services has reached the world-leading level.

- In China, the ICT industry is still as strong and has sustained rapid growth, where its direct contribution to GDP is stable and only decreased slightly in recent years. From 2005 to 2011, the scale of the information industry revenue went up from 4.1 trillion RMB to 10.6 trillion RMB, with an average annual growth of 17%; the information industry rose from 1.4 trillion RMB to 2.8 trillion RMB, at an average annual increase of 12.3 %.This means China can continue to progress and push the boundaries of ICT innovations.

- China's research system mainly consists of colleges and universities, state research and development institutes and enterprises. State-owned research and development institutes play an important role in Chinese ICT research and development, including China Academy of Telecommunication Research (CATR) of the Ministry of Industry and Information Technology (MIIT), and Chinese Academy of Sciences (CAS).

- Like many other countries, in many fields of scientific research in China, including ICT, research work is carried out by colleges and universities. Beijing University of Posts and Telecommunications, Tsinghua University, Peking University, Southeast University, Zhejiang University, and Shanghai Jiaotong University, among many other prestigious universities, have been actively involved in ICT research.

- With China's reform in science and technology research, the focal point of research for China's ICT development has strategically shifted from research institutes to enterprises. In recent years, a large number of high-tech enterprises in China have experienced rapid development and growth, of them some having developed into world-class enterprises in the field, such as ZTE and Huawei.

- ICT R&D in China appears to be as strong and committed over 60 years. Advanced technological progress has been continuous, the ICT industry remains prosperous, and now enterprises, as well as research institutes, want to get in on ICT R&D in China. Evidence of rapid growth and development in China demonstrates potential future prospects and continuous successes in the field of ICT R&D.

5.1.2 Summary of ICT Research Plans in China

- The Chinese government, in the long-term, has provided a lot of attention to scientific and technological development. Through setting up various kinds of science and technology development plans at the national level, such as the 863 Plan, the 973 Plan, NSFC, and measures for implementing concrete projects, the Government has changed its role from administrative commands to indirect supervision in aspects such as key areas of scientific research and competitive rules, hence nurturing, recruiting and putting together a pool of high-tech talents, as well as establishing a series of world-class high-tech research and development bases.

- In the implementation and concretisation of projects, there appears to be a need to span across departmental and regional boundaries, to give attention to the most advantageous resources nationwide through competitive means, and to improve the efficiency to use funding resources in the context of the market economy. Various projects and plans have made significant achievements in exploring mechanisms of industrialisation, thereby providing beneficial experiences for China's reform in the institutional arrangement for scientific and technological research. These projects have, to a great extent, promoted the development of the ICT technology and

industry, advancing in different aspects the R&D and industrialisation of core ICT technologies in China, and having played a role in leading the focal points and directions of research in the ICT field in China.

- The future key research directions in the ICT Field in China mainly include: core electronic devices, high-end universal chips, the technology to manufacture equipment for large-scale integrated circuits, photoelectronic components and integrated micro-system technology, basic software products, sensor network and biomimetic sensing technology, IoT technology, Smart City, the next-generation Internet, the fourth-generation mobile broadband technology, information security technology, the next-generation digital television technology, cloud computing and large-scale data-centre technology, photo-network technology, and 3D content processing technology.

5.1.3 China's General Strategy and Significant Plans on ICT

- In China, government departments make and publish relevant plans, strategies, and policies to guide and promote the technology R&D, innovation, and industrial development in the ICT field. These plans include not only those promulgated by the State Council, such as *The Programme of Action for the Twelfth Five-Year Plan (2011-2015) for National Economic and Social Development*, and *the Twelfth Five-Year Plan for Strategic Emerging Industries*, but also those promulgated by other government departments, such as *The Twelfth Five-Year Plan on the Communications Industry*, and *The Twelfth Five-Year Plan on the Internet* promulgated by the MIIT.

- The general strategy and significant plans are concerned with nearly every aspect of ICT, including electronic information manufacturing industry, software service industry, the communications industry and new-generation information technology industries such as IoT, cloud computing and the new-generation mobile communications. They have played a very important role in guiding and advancing technological innovation and industrial development of ICT in China.

- Through an overview and analysis of government plans, major projects, planning, strategies and policies related to ICT, there is evidence to suggest that in the next three to eight years, the ICT fields will receive emphatic guidance and support from the government, which will mainly include: the next-generation Internet, broadband mobile communication, the mobile Internet, the convergence of three networks, IoT, cloud computing, network and information security, integrated circuit, electronic components, and

computer and software.

5.1.4 Summary of Existing China-EU Cooperation in ICT

- The increasing Chinese cooperation with the EU in ICT projects and research indicates that China's emphasis focuses mainly on new progression in the ICT industry. The priorities on ICT development embodies China's ambition on becoming one of the world's most powerful countries in ICT field, a field that is both important for the well-being of its own people and the people around the globe. Through EU-China cooperation in ICT research, Europe has the opportunity to learn from China's efforts in ICT research and is able to ensure the economic and social safety and security of its citizens. Chinese ICT research can benefit from integration into the European research environment.

- The mainstream EU-ICT program is called the FP7. China has been an active participant in the FP7 program, with a big focus on the ICT sector. As per the FP7 data collected in September 2009 by DG RTD Department D - International Cooperation, China has been the second largest "third country" participant in terms of proposal numbers, on the basis of proposals involving at least one Chinese partner. Chinese participants have been involved in 900 proposals across the thematic areas, ranking second to the Russian participants, who submitted 1182 proposals. OpenChina-ICT is one of the 35 ICT projects; aiming to significantly contribute to the facilitation of ICT related research cooperation between Europe and China. Most of the Chinese participants are universities, colleges and state research institutes. SMEs play a rather minor role.

- The mainstream Chinese research programs highlighted are the 863 Program and 973 Program. The 863 Program, created in 1986, is the ongoing national research program in China. The detailed research priorities and funding scale are updated according to the 5-year-plan. The 973 Program, created in 1997, is the ongoing program for key basic research initiated by the State Sciences and Education Steering Group. The funding is allocated annually by the Ministry of Finance. The Science and Technology Cooperation Agreement between China and the European Commission, which was signed in 1998 and renewed in 2004. Accordingly, European scientists and researchers are invited to join the National High Technology Research and Development Program (Chinese 863 Program) and the National Key Basic Research Program (Chinese 973 Program) - the Ministry of Science and Technology of China supports cooperation. However, due to the lack of detailed guidelines and implementation instructions, European partners can rarely attend

Chinese national programs. Only one proposal has been confirmed in 863 Program, this is known as FP863, which is selected from Call 4 of FP7 ICT Theme.

- Dialogues and expert groups are main cooperation mechanisms that approved feasible and productive ICT research and cooperation and played a significant role in the process of EU's participation in Chinese ICT research projects.

  - The European Commission Department of General Information Society (DG INFSO) and the Ministry of Science and Technology (MOST) established the EU China ICT dialogue mechanism in 2009, focusing on strategies for cooperation, review of implementation of earlier activities and development of ICT R&D projects. Since the first meeting in July 2009 in Beijing, DG CONNECT (ex-DG INFSO) is currently involved in two ongoing dialogues on ICT Research with MOST and the dialogue on Information Technology, Telecommunications and Information with MIIT.

  - The EU-China Expert Group created by European Commission and Chinese Ministries (MIIT/MOST) aims to provide inputs to their ongoing dialogue for promoting cooperation on ICT between China and Europe. DG CONNECT and MOST jointly established the EU-China expert groups in the fields of Future Internet/IPv6, Internet of Things and Smart City. This cooperative mechanism will take a series of pragmatic and incremental actions to enhance direct dialogue among stakeholders, including policy makers and researchers from both the EU and China.

- Currently, there are three alternative suggestions on the mode for future EU participation in Chinese research projects. Firstly, basic research cooperation opportunities in the Chinese mainstream project, the 973 Plan and more potential partnerships in 863 Plan - which has already offered an opportunity in the FP863 project. Secondly, initiate cooperation through new research partners in China, such as big private enterprises and outstanding SMEs. Thirdly, give full play to the EU's advantages in the cooperation through ICT research priorities in the coming years and form an integral part for China's ICT development by bringing substantial results and long-lasting achievements for both sides.

5.2 Summary of Questionnaire Survey Results

5.2.1 Main Barriers in China's Participation in the EU Projects

- In this project, so as to have a clear understanding of various problems and barriers for Chinese units to participate in the EU projects, CATR has completed a survey provided by expert recipients in the field of ICT through email questionnaires. This questionnaire has identified five major potential cooperation barriers; including policy, culture, information channels, funding, and technological points of mutual interest. Through collating of the feedback and statistical data from experts, it is found that experts have identified three major barriers in their participation in the EU projects - namely policy, funding and information channels.

- Feedback provided by the experts from the questionnaire survey has shown that policy has been regarded as the biggest barrier for the Chinese side to participate in the EU projects. These policies between China and the EU involve multiple aspects, such as human rights policy, environmental protection policy, bilateral/multilateral trade policies, and the policy for China-EU economic cooperation. Whether the China-EU cooperation in ICT can be carried out smoothly is closely related to policy changes between the two sides. If China and the EU can reach agreement in macro-policies, then a harmonious, stable environment for political and economic cooperation for both sides can be created. This would then pave the way for smooth and favourable China-EU cooperation and exchange in many aspects of ICT. Conversely, where no consensus is built between the two sides in terms of macro-policies on politics and economy - thus resulting in discord in the general environment for political and economic cooperation - then the Chinese side will be concerned with the issues of durability and depth of the China-EU cooperation. It will create concerns in regard to the China-EU cooperation *per se*, which may, in the end, negatively impact the possibility of a fruitful and positive outcome of the China-EU cooperation and exchange.

- Apart from such concerns as with the macro-policies for political and economic cooperation between the two sides, experts surveyed in our questionnaires have suggested that the second biggest barrier is the issue of project funding, which is, indeed, the important premise and basis for the implementation of projects. Without sufficient funding support, it can be difficult for projects to be executed smoothly, let alone with productive results. Project funding can come from two channels, one being state project plans or special funds from which the funding for projects can be applied,

while the other is funding raised by research organisations or enterprises on their own. Of these, the source of funding for ICT-related projects in China mainly comes from state special funds or project funds.

- The information channels related to the China-EU cooperation in ICT is equally one of the focal points concerning surveyed experts. It has been suggested that failures to cooperate are due neither to the lack of willingness, nor to the limited amount of funding available – it has been simply because of the inability to obtain related information. For this very reason, information channels do play an indispensable role in the China-EU cooperation in ICT. Smooth communication through unimpeded channels is an important antecedent condition favourable for the China-EU cooperation. At the moment, the main channels for the Chinese side to obtain information on the China-EU cooperation are through governmental websites on both sides.

5.2.2 Potential Technologies for Cooperation in the ICT Field

- Based on the key findings of above analyses from Chinese government policy and technological views from Chinese research units, we conclude that the ICT research areas of high priorities of China-EU collaboration are as follows:

  - Broadband Mobile Communication
  - The Next-generation Internet
  - Network and information Security
  - Cloud Computing
  - The Internet of Things
  - Optical communication
  - Smart Terminal

5.3 Recommendations

5.3.1 Key Technological Directions for Priority China-EU Cooperation in ICT

- In summary, in a combined consideration of such ICT-related key technological directions as in the 863 Plan, the 973 Plan and NSFC research plans, China's general strategy on ICT and key technological directions involved in various key plans, and questionnaires on every technological direction of ICT in this Plan, it can be seen that in the next five to eight years, the key technological directions for priority development in ICT of China-EU Collaboration will be as follows:

- Broadband Mobile Communication
- The Next-generation Internet
- Network and information Security
- Cloud Computing
- The Internet of Things
- Optical communication
- Smart Terminal

- The China-EU cooperation in ICT can give priority to the considerations of the abovementioned key technological directions for the next five to eight years.

5.3.2 Recommendations on next course of action regarding issues raised

- From the respondents and participants who submitted their questionnaires and attended the OpenChina-ICT Dialogue Conference in November 2012, five key issues and recommendations have been constructed to provide guidelines on how to create greater advancements for Chinese and EU relations concerning ICT:

1. **Financial support** – it has been suggested that more financial support should be made available to enable EU participants to come to China and attend Chinese ICT research related conference events. As highlighted from the participants in the questionnaire, it is considered very important that governments should provide more funding to enable more European audiences to attend ICT related research conferences. The Chinese government provides a great source of funding for European enterprises and institutes wishing to come to China. The best way for European enterprises and institutes to apply is through the Foreign Expert Bureau.

2. **Government Relations** –Enterprises and institutes have expressed their concerns on the potential barriers that may prevent them to collaborate with Chinese regarding ICT, in particular, policy, information channels, and culture. To tackle these problems, EU needs to spend more time with Chinese government departments to get more information on barrier concerns. Government departments are the ideal officials to talk to because Chinese government officials want EU enterprises and institutes to come to China but not all information on these matters is open to the public. It must be stressed however that EU enterprises and institutes should not expect speedy responses or changes to be made regarding information and requests provided. It is not easy for China to translate Chinese into English as they still find the English language to be an issue. It would be advisable, if

possible, to have Chinese representative in your respective institute or enterprise to speed the flow of communication from China to the EU. Organizations such as the NSFC, who were present at the OpenChina-ICT Dialogue Conference, do already have members that can effectively communicate in English and therefore should be the ones to consider for EU-China dialogue. Therefore, although it is time consuming and complex, Chinese government officials are the best source of information regarding barrier concerns.

3. **High Level Dialogue**–The OpenChina-ICT project demonstrated the potential for stronger relationships between Chinese-EU enterprises and institutions in Beijing China. In particular, the matchmaking sessions produced 46 Memorandum of Understandings for continued collaboration, marking a major accomplishment at this event. However, other than the OpenChina-ICT project, there has been little evidence to suggest much has been done to enhance high-level dialogues between China and EU. The guest speakers of OpenChina-ICT Dialogue Conference have emphasised the need for more dialogue for future business relationships between China and EU enterprises and institutes. There appears to be a need for a designed process that enables Chinese and European enterprises and institutes to come together and create potential dialogues between them. The process must enable them to constantly be updated on the latest developments on ICT in China and enable them to develop contacts and relationships in their relative ICT fields. One process to consider is B2B social networking (this will be discussed in detail on the 4th recommendation below).

4. **More information regarding the participation in projects**– Many of the participants have emphasised the importance of using information channels concerning future ICT projects, particularly cooperative projects, China & EU government websites, and friends & partners projects. The concern regarding information on ICT program participation in China has been limited. There is evidence to suggest this as on MOST, MIIT, NSFC websites; they give in-depth information about their programs but not much on how to participate. Therefore, information channels need to provide more exposure on programs and events. The following are communication channels that can be used to further enhance the visibility of Chinese ICT program projects:

    - **Social networks**– B2B social networking sites such as LinkedIn, Yammer, and Weibo are ideal web portals to promote ICT related projects to friends and partners and can provide potential future

dialogues as highlighted in the 3rd recommendation above. Interested Chinese and European recipients can use the portals to combine the networking sites to generate greater impact to exposure, make ICT related program content more accessible, and contain ICT enterprise and institute contact information to begin China-EU dialogues.

- **SEO**– SEO (Search Engine Optimization) is a process that improves the visibility of a website by intentionally designing the web portal and search engine page (i.e. Google) so the user can easily identify the site through search engines results using key words (i.e. 'China ICT programs', 'ICT related research', etc.). Government websites have been highlighted as a very important information channel to be used to provide ICT related research. With the approval of Chinese and European governments, they can use their web portals to promote events and ICT related research opportunities. Also, companies and institutes can use the SEO process on their websites and integrate and affiliate with the government websites to make the exposure and communication on ICT related research opportunities even stronger.

- **Public Relations**– ICT related research projects can be exposed by using public relations; a process that enables organizations to manage the flow of information provided by them to the public. Public relations will not only allow the public to understand what is going on in regard to ICT projects in China, but can also persuade them to get involved. Conferences (OpenChina-ICT), the press -European newspapers, and employee communications (European Commission) - are all forms of public relations that should be used to create an information hub to the public.

- **Integration of information channels**– The communication channels provided above, when combined, will create a more effective outcome in terms of information provided, program awareness, and willingness for EU and Chinese enterprises and institutes to become more involved in ICT related programs and research.

5. **Improve EU-China collaboration**– Respondents of the questionnaire have expressed concern on the limited information regarding program participation. It was already recommended that more information channel should be used to expose the programs; however the information is out there for European participants to receive and participate, they need to make more effort. For example, although MIIT, MOST, and NSFC have

provided limited information on their websites regarding program participation, they were available, in person, at the OpenChina-ICT Dialogue Conference, for both presentations and dialogues. Also, Horizon 2020, a new event to improve EU-China collaboration, is in progress. Therefore, the key focus to improve EU-China collaboration is that European companies and institutes need to dedicate time to understand and make more effort to find collaboration and program leads regarding ICT.

5.3.3 Recommendations on how EU partners participate in China's ICT program

- Regularly browse related websites, like MOST, MIIT, NDRC's official websites, the latest project information will be published there.

- When determined that wish to participate in a project, It is advised that contact the Chinese co-operate partner at the first time. Generally, the government-funded ICT project have limit to the number of participants.

- According to the project type, EU participants need to determine their role in the project through discussion with the Chinese partner. The EU participants could be a project partner, or act as a provider of project's procurement of service.

- EU participants could apply some projects with Chinese partners directly, such as MOST's international cooperation projects. However, in the majority of the current government-funded project, EU participants could only be the service provider.

- As to EU participants, it is very important to choose a reliable Chinese partner to establish long-term stable cooperative relationship. Chinese partners have the advantages of language and information sources, they could share project information quickly，assist EU partners to communicate with the relevant regulatory agencies, promote the progress of cooperation.

5.3.4 Closing statement on conclusions and recommendations for advancement in ICT in China

It is evident from this report's findings that key areas of development are hindered due to the several differences, including differences in business practice, culture, and governmental policies. This report further shows that despite these differences, there is willingness from both sides to develop collaborative efforts, and to cooperate in future ventures, but these efforts have to be intensified and stressed under the proper channels.

The most appropriate way to disseminate information between EU countries and China is to have information available in the countries respective language for domestic distribution, but more importantly, in well-composed English for international circulation. Although information may be available on a certain website or information packet, it cannot be expected for Chinese enterprises, especially the Chinese government, to quickly adapt and translate text into English that is freely open to the international communities, as it must maintain its domestic interests first. However, organizations such as the NSFC do already have members that can effectively communicate in English. At the OpenChina-ICT Dialogue Conference, Ms. Fan represented the NSFC and gave her presentation in English, indicative of the ability to communicate universally and of the NSFC's accessibility when it comes to matters of foreign cooperation. Additionally, as an alternative, the EU can open itself up by offering to integrate or sub-contract leading individuals in the field to participate on portions of Chinese projects. Organizations such as CATR have take such steps forward by employing staff members born in EU nations that speak English at a high-level and can act as liaison between the two parties. There must be more effort placed to push for integration amongst the nations.

There has to be a more practical approach from the EU when addressing China's "openness." Pushing forth projects such as the FP programme have been successful, but the EU must take a more pragmatic approach with high-tech programmes such as the 863 Plan. Disseminating information on such high-tech initiatives can prove to be, first and foremost, difficult to communicate, but also contain delicate information that must be carefully distributed to ensure proper maintenance and progression.

A key aspect to any of this progression is attaining funding and channeling it to the proper areas. Rather than having funds spent on a project with a decided date of expiration, there must be efforts to improve and build upon the funding schemes that are already in place. For example, there must be more thorough methods to initiate and follow-up on programs such as the FP programmes. After the FP programme expires in 2013, there are no measures in place to continue to build from it. Further advancements are contingent upon improvement after the implementation process, and build off the progress, rather than see it falter after its expiration date. In this way, more complex projects and programmes will arise with appropriate funding mechanisms.

Most importantly, there must be more face-to-face and on-site visits by EU representatives to China to show interest and to expand mediums for dissemination in all participating nations by means of B2B events, conferences, etc. The OpenChina-ICT Dialogue Conference and the OpenChina-ICT project in general offer a forum for bringing interests together and readying resources to participants to communicate effectively. Initiatives such as OpenChina-ICT must be increasingly encouraged with shared enthusiasm from both sides.

China has a plethora of outlets open to sharing information, but it must be accessed in an appropriate manner. As time progresses, policies and regulation will continue to change, and both the EU and China must adapt alongside these changes to breach the barriers between the two sides. By continuing to disseminate information via the web and professional social networking sites, and maintaining dialogue through events such as OpenChina-ICT Dialogue Conference, there is the possibility of creating symbiotic relationships by gaining foresight into these policy changes. Dialogue Conferences like OpenChina-ICTlay the foundation for schemes such as *Horizon 2020* and programs onward and must be actively encouraged.

Breaching the cultural, political, and business realm of China must be done in progressive fashion, where networks are incrementally built overtime. Barriers must be breached collaboratively by developing relationships during organized forums, and through information dissemination from information made available online and in information documents. Above all, there must be a push for greater efforts on both parties' side to open these mediums for cooperation.

Much has been made of China's reluctance to "open" its information channels. However, there is confidence from representatives of Chinese enterprises that the information is available, but must be obtained through proper access. The theory behind proper access may be broad, but it begins with a willingness to cooperate and work to understand diverse interests and language.

Annex I. Questionnaire of Barriers for China-EU Collaboration in ICT Area

Questions	**Priority** **5:Extremly important** **4:Important** **3: relatively important** **2: Not very Important** **1: Not important at all**
1. What are the main barriers of collaboration between China and Europe in ICT area?	Score according to the priority.
Policy（Macro political and economic environment of China-EU collaboration）	
Culture(Culture background of China-EU collaboration)	
Information Channel （ Various channels to aquire information of China-EU collaboration）	
Funding（Funding support of China-EU collaboration）	
Technical issues(The lack of common technical interests of China-EU collaboration)	
Others	
2. What are the main policy barriers of collaboration in ICT area?	Score according to the priority.
Human rights policy between China and EU	
Environmental protection policy between China and EU	
Trade agreement policy between China and EU	
Economical collaboration between China and EU	
Others	
3. What are the main cultural barriers of collaboration in ICT area?	Score according to the priority.
Different way of thinking between China and EU	
Different way of communication between China and EU	
Language barrier	
Others	
4. What are the main information channels of collaboration in ICT area?	Score according to the priority.
The Chinese government websites released project information	

The Europe government websites released project information	
The information channel built through previous collaboration.	
The information acquired through friends or acquaintance	
Others	
5. What are the main forms of funding between China and EU collaboration in ICT area?	Score according to the priority.
Government projects funding	
Enterprise or Personal funding	
Others	
6. Other barriers in addition to the above listed.	Score according to the priority.

Annex II. Questionnaire of ICT Technological Priorities between China-EU Collaboration

Questions	Explanation	Priority 5:Extremlyimportant, 4:Important 3: relatively important 2: Not very Important 1: Not important at all
1. What are the main area of ICT R&D for the next 3~8 years?		Score according to the priority.
The next generation Internet.		
Broadband mobile communication		
Optical communication		
Internet of Things		
Cloud computing		
Three network convergence		
Network and information security		
Terminals		
Intelligent city		
Others		
2. The main directions in next generation Internet area for the next 3~8 years.		Score according to the priority.
Protocol system research	Open and unified network operation interface and protocol, next generation Internet architecture.	
Addressing and routing technology	Separation of name and address, separation of identity and location, scalable routing, high efficient on-demand routing and forwarding technology.	
Network virtualization	Programmable router architecture and functional layer partitioning, flexible	

	and efficient data packet processing, resource virtualization and isolation technologies.	
Ubiquitous coordination technology	Heterogeneous network access, resource recognition and coordination mechanism, heterogeneous service acquiring.	
Security, control and management technology	Next generation network control and management technology based on autonomy network architecture.	
Innovation experimental platform building	The next generation Internet experimental platform design method, virtual network technology, innovative network architecture management.	
Others		
3. The main directions in broadband mobile communication area for the next 3~8 years.		Score according to the priority.
New generation mobile communication.	LTE/LTE-Advanced, air interface peak speed beyond 100Mbps/1Gbps	
Hot spot/Indoor micro cell technology	Based on Macro networks, deploy micro cells for hot spot and indoor environment to improve system capacity, including interference coordination, network self configuration technology and novel network architecture, etc.	
Distributed Antenna	Deploy antenna to distributed environment to improve system performance.	

Heterogeneous network technology	Coordination and convergence of various access technologies such as macro cell, micro cell, home cell, WLAN, including interference coordination, mobility control and service bypass, etc.	
Intelligent networking technology	Including Self- optimization technology, cognitive radio technology, energy saving communication, etc.	
Service and customer oriented network architecture	Service type and customer application centric, realize multi-service categorized optimization and convergent management.	
Others		
4. The main directions in optical communication area for the next 3~8 years		Score according to the priority.
Ultra high speed optical transmission technology	400Gb/s，1Tb/s ultra high speed transmission technologies, including OFDM, Nyquist WDM、coherent WDM, relative algorithms and performance evaluation, etc.	
Ultra large capacity optical switching and networking technology	All optical switching with the capacity of Pb/s or above, relative networking technologies such as protection and intelligent control, etc.	
Data center optical interconnection	Optical interconnection interface technology, high capacity optical switching technology for large scale data center interconnection.	
Next generation high speed PON technology	WDM-PON、OFDM-PON with 40Gb/s beyond,	

	including upstream and downstream wavelength reuse, colourless ONU, high speed coherent receive, etc.	
ROF	Millimeter wave optical radio system，including 包 Millimeter wave generation and modulation, optical domain frequency up and down conversion, multiplexing and de-multiplexing, transmission loss compensation.	
Visible light communications	Wireless optical communication based on white light LED, including high performance modulation and demodulation, high sensitivity optical signal receiving, channel multiplexing, convergence with power line communication, etc.	
Novel types of fibbers	Multi-core fiver, multi-mode fibber for ultra high capacity transmission, Optical fibber precast slab.	
Others		
5. The main directions in Internet of things area for the next 3~8 years		Score according to the priority.
M2M communication and application platform techniques	M2M cellular wireless enhancement techniques, M2M application common platform techniques, M2M terminal and gateway techniques, M2M equipment identifying techniques	

Lightweight IPv6 technology	IPv6 technology for lossy and low power networks, including IPv6 adapting technology, routing technology, application technology	
Short range wireless communication technology	Wireless communication technology for less than 10 meters, including WPAN and WBAN	
Intelligent and integrated sensor technology	MEMS force sensor, the micro infrared gas sensor, integrated magnetic sensor electronics, high-end CMOS image sensor chip solder seal type temperature sensor	
UHF and microwave RFID technology	UHF and microwave RFID chip technology, antenna technology, packaging technology, middleware technology	
Others		
6. The main directions in cloud computing area for the next 3~8 years.		Score according to the priority.
Cloud Server System Technology	Low cost, high efficient Complicating cloud server system.	
Cloud Storage System Technology	Multiple data access methods, data security and protection methods, node load balancing, reliability, etc.	
Cloud Operating System Technology	Large scale resource management and dispatch, large scale data management and processing technology.	
Cloud Computing Data Center Technology	Data center energy saving technology, data center	

	networking technology	
Cloud Computing Security Architecture	Multi-tenant technology, virtualization technology, distributed storage, terminal security.	
Cloud Computing Testing and Evaluation Technology	Testing and evaluation method of cloud computing core software, hardware device and application service, testing and evaluation tools, testing environment and platform.	
Others		
7. The main directions in three network convergence for the next 3~8 years.		Score according to the priority.
Key technology for Smart TV	The chip technology, system structure, function, operation system of Smart TV.	
The next generation of web technology	html5, RTCweb technology and the cross-screen application among the computer, smart phone and smart TV.	
The new type of human-computer interaction	Intelligent control technology including voice control, motion recognition, touch control, multi-screen interactive, etc.	
The new broadcasting technology	HbbTV technology and application.	
New display technology	OLED,3D.	
Multi-screen interactive technology	The control architecture of multi-screen service in order to achieve real-time switching and streaming adaptation.	

Others		
8.The main directions in network and information security area for the next 3~8 years.		Score according to the priority.
Information identifying control technology	Including large-capacity (> 40Gbps) wire-speed deep business recognition technology, audio and video services online recognition control technology.	
Network spatial information against technology		
Cryptographic technology	Online encrypted data control, the new cryptographic technology, large-scale distributed key management technology.	
Network security event monitoring and early warning technology		
Important information system protection technology	Including industrial control system security risk evaluation technology, important information systems security emergency.	
Mobile intelligent terminal security	Such as the mobile intelligent terminal and application software vulnerabilities mining and security risk detection technology based on the non-open source system.	
Anti-phishing of the electronic document technology research and development		
Network identity management technology	Including as trusted Network identification and authentication services infrastructure, network ID cards.	

Internet of Things safety technology	Identity authentication management of the Internet of Things, Internet of Things privacy information protection, network security risk protection.	
Heterogeneous wireless mobile safety technology	Heterogeneous wireless user authentication, user data protection technology.	
Others		
9. The main directions in terminal area for the next 3~8 years.		Score according to the priority.
chipset technology	cpu performance; dual cores or more; processing power; more close to the PC CPU	
OS technology	multi-task; wildly used and low cost; no feature phones in market	
Applications	more apps with high quality	
Terminal technology	touch-screen and smart OS wildly used; new ways of interaction integrated into terminal	
Human-Computer Interaction Techniques	Eyes capture; projection and interaction; Motion Sensing; voice interaction	
Structure and Material	new material; Liquid metal	
Others		
10. The main directions in smart city area for the next 3~8 years.		Score according to the priority.
City multi-modal data systems interconnect techniques	Urban systems networking, convergence, intelligent retrieval, virtual storage, security and synergies	
Urban operation and management oriented high-performance data analysis techniques	City large-scale and high-performance run-time data processing and analysis, intelligent search and identify, multimode	

	precise positioning behaviour recognition	
Urban multi-source intensive dynamic run data presentation techniques	Urban dynamic operating data and real urban scene natural, realistic integration of modelling, simulation and rendering technology	
Multi-level intelligent decision-making technologies for urban information	Urban mass distributed data and diverse isomerisation decision model online two-way coupling technology, city information intelligent analysis and auxiliary decision support technology	
People-centered smart city common service techniques	smart city public services aggregation technology, real-time analysis of the personal information and preferences discovery technology, people-centered service customization and integration technology, based on personal preferences and context service recommendation technology	
Others		
11. Other important ICT area in addition to the above listed.		Score according to the priority.

Annex III. List of Surveyed Experts

Type of the Surveyed Institute	Name of the surveyed Institute	Name of the Experts	Title
Research Institutes	Research Institute of Telecom Planning	Wang Aihua	Chief Engineer
	Research Institute of Telecom Planning	Xu Zhiyuan	Vice director
	China Academy of Telecom Research	Jiang lintao	Director of Science and Technology Committee
	Research Institute of Telecom Standards	Xu Heyuan	Chief Engineer
	Research Institute of Telecom Standards	Zhang Xueli	Director of Internet of Things Department
	Research Institute of Telecom Standards	Zhang Haiyi	Director of transport and access network
	Research Institute of Telecom Standards	Wang Zhiqin	Director
	Guangdong Radio Identification Common Technology Support Center	Peng Wen	
	National Broadband Network and Application Technology Research Center	Chu Lingwei	
Unviersities	Beijing University of Posts and Telecommunications	Cheng Shiduan	Professor
	Beijing University of Posts and Telecommunications	Wang Hongbo	Associate Professor
	Beijing University of Posts and Telecommunications	Liao Qing	Professor
	University of Electronic Science and technology	Wang Wenyong	Professor

	Tsinghua University	Xu Mingwei	Associate Professor
	Zhejiang Gongshang University	Wang Weiming	Professor
	Beijing University of Aeronautics and Astronautics	Li Chao	Professor
	Beijing University of Aeronautics and Astronautics	Qian Depei	Professor
	Beijing University	Xu anshi	Professor
	Beijing University of Posts and Telecommunications	Hu Zheng	Professor
	Huazhong University of Science and Technology	Liu Deming	Professor
	Suzhou University	Shen Gangxiang	Professor
	Shanghai Jiao Tong University	Hu Weisheng	Professor
	Tsinghua University	Zheng Xiaoping	Professor
Network Operators	Research Academy of China Telecom	Tang Xiongyan	Vice director
	Zhongxun Design and Research Academy of China Unicom	Wang Guangquan	Vice director
	China Unicom	Jia Xueqin	
	Research Academy of China Telecom	Jing Ruiquan	Expert
	China Unicom	Li Hui	
	China Telecom	Deng Jiajia	
	China Mobile	Liu Tao	
	China Telecom	Zhao yong	
	Research Academy of China Mobile	Li Han	vice director of core network department
	China Telecom	Tan Guoquan	
	Research Academy of China Telecom	Zhang Chengliang	Vice Chief Engineer
	Research Academy of the State Grid	Wang Dongshan	
Manufactures	Huawei Technology	Jing Mingjing	Senior Marketing Manager
	ZTE	Ma Jin	

	ZTE	Chen Hui	
	ZTE	Dong Zhenjiang	
	Fiberhome	Zhang Jijun	
	Fiberhome	Mao Qian	
	ZTE	Yuan Fei	
	Huawei Technology	Hua Qingya	Research Department
	Huawei Technology	Xu Xiaoxing	
	Huawei Technology	Gaojianhua	Research Department
Government	The national development and Reform Commission high technology industry department	Jiang Wei	
	Beijing Information Resource Management Center	Wang Wei	Vice director of information resource department
	The development of Communication department ,Ministry of industry and Information Technology	Zang Lei	
Internet Enterprises	Hillstone	Wang Bo	
	Hillstone	Xie Yinhui	
	Hillstone	Wang Quan	
	ChinaCache	Liu Zheng	
	ChinaCache	Wang Liang	
	ChinaCache	Li Xin	
	ChinaCache	Kang XiangRong	
	ChinaCache	Li ming	
	Beijing Internet Institute	Liu Dong	
	China interactive media industry alliance	Bao Ran	

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