White Paper

On

RFID Technology Policy in China

Released by 15 Ministries and Commissions including Ministry of Science and Technology of PRC
June 9th 2006
Foreword

The Radio Frequency Identification (RFID) technology is a type of non-contact automatic identification technology (hereinafter referred to as RFID technology) realized through radio frequency communication. The RFID tag features small volume, great capacity, and long term of service life and repeatable use, and supports fast reading and reading, invisible recognition, mobile recognition, multi-target recognition, positioning and long-term tracking management. RFID technology can be used together with Internet and communication technologies and realize article tracking and information sharing within global scope. The RFID can substantially improve the management and operation efficiency when used in industries of logistics, manufacture and public information service. With constant improvement and upgrading of the relevant technologies, the RFID technology will become an emerging hi-tech industry group as well as new growth point of the national economy. Therefore, the study on RFID technology and development of RFID industry can have far-reaching impact in upgrading the social informationization level, promoting sustainable development of economy, improving quality of people’s life and enhancing public security and national defense security, and thus of strategic and important significance.

The RFID technology has gained rapid development since the 1990s. Developed countries and regions have applied the technology in many fields, and actively promoted the internationalization of the relevant technology and application standard. In recent years, China has initially carried out research and development and industrialization of technology related to RFID, and begun to apply in some areas. However, the applications do not have advantage of scale due to relative weak base, lack of core technology and scattered use.

China is becoming a global manufacture center for its great population and constantly growing economy scale, and therefore RFID technology has its vast market for application. Currently the RFID technology and application develops rapidly but not mature, China should grasp such opportunity and concentrate efforts on research and development of RFID core technology, formulate technology standards in line with the national conditions of China, push forward the construction of self-proprietary public service system and promote the formation of competitive industrial chain so that China can clinch its position in this area.
The development of RFID technology and application is a sophisticated systematic work. It involves many industries and government authorities, influences many areas e.g. society, economy and daily life, and needs overall planning and coordination among governments, enterprises and research and development institutions and realize reasonable resource allocation and mutually complementary advantages to the maximum extent. To this end, the Ministry of Science and Technology works together with the State Development and Reform Commission, Ministry of Commerce, Ministry of Information Industry, Ministry of Communications, General Administration of Customs, Ministry of Railway, Ministry of Public Security, Ministry of Education, Ministry of Construction, Ministry of Agriculture, General Administration of Quality Supervision, Inspection and Quarantine, Standardization Administration of China, State Post Bureau, State Food and Drug Administration and China Association for Standardization and China Federation of Logistics and Purchasing to organize experts of each department in preparing this white paper in about one year. This white paper provides systematic guidance for future development of RFID technology and industry in China over the next few years.

This white paper is divided into five sections, respectively on development status quo and trend of RFID technology, China’s strategy on development of RFID technology, China’s RFID technology and priority application area and promoting industrialization strategy and construction of macro environment.
# Table of Contents

Section 1 Development Status Quo and Trend of RFID Technology 1  
1.1 Development Status Quo of Technology 1  
1.2 Status Quo of Standard 3  
1.3 Development Trend 4  
Section 2 China’s Strategy on Development of RFID Technology 6  
2.1 Overall Development Objective 6  
2.2 Guiding Philosophy and Principle 7  
2.3 Development Approaches and Implementation Process 8  
  2.3.1 Development Approaches 8  
  2.3.2 Implementation Process 8  
Section 3 China’s RFID Technology Development and Priority Application Area 10  
3.1 Key Technology 10  
  3.1.1 General Basis and Forward-looking Technology 10  
  3.1.2 Key Technology on RFID Industrialization 11  
  3.1.3 Key Technology on RFID Application 12  
3.2 Standard and Testing 13  
3.3 Priority Application Area 13  
  3.3.1 Public Security 13  
  3.3.2 Production Management and Control 14  
  3.3.3 Modern Logistics and Supply Chain Management 14  
  3.3.4 Port Import and Export Goods Supervision and Management 14  
  3.3.5 Traffic Management 14  
  3.3.6 Military Use 15  
  3.3.7 Major Work and Activities 15  
Section 4 China’s Efforts in Promoting RFID Industrialization Strategy 16  
4.1 Guiding Philosophy 16  
4.2 Development Approaches 16  
4.3 Implementation Process 17  
Section 5 China’s Construction on Macro Environment for Developing RFID Technology 19
Section 1 Development Status Quo and Trend of RFID Technology

1.1 Development Status Quo of Technology

The application of RFID technology can be traced back as early as in the friend or woe target recognitions of aircrafts in the World War II, but has not been widely applied due to reasons of technology and cost. In recent years, with the development of large scale integrated circuit, and network communication and information security technologies, the RFID technology enters its stage of commercialized application. Bearing features of high speed moving object recognition, multi-target recognition and non-contact recognition, the RFID technology exhibits huge potential of development and space of application, and is thus regarded as one of the most promising information technologies.

The RFID technology involves high technology areas of information, manufacture and materials and covers technologies e.g. wireless communication, chip design and manufacture, antenna design and manufacture, tag packaging, system integration and information security. Some of the national and international and transnational companies are expediting and promoting the research and development and application processes of RFID technology. During the past ten years, thousands of patents regarding RFID technology were produced, mainly concentrated in US, European countries and Japan.

The RFID tag can be divided into active, passive and semi-active types on basis of the energy supply method, and low frequency (LF), high frequency (HF), ultra high frequency (UHF) and microwave (MW) types on basis of work frequency. Currently, the RFID application is mainly referred to LF and HF tag products on international basis; the UHF tag has started production of scale and is expected to become the mainstream in the next five years for its advantages of long distance recognition and low cost; the MW tag has been put into use in part of the countries. China has mastered the design technology of HF chip and accordingly successfully realized industrialization of the product, and meanwhile the development of UHF chips has also been completed.
At present, the products of RFID tag antenna mainly include etched/punched antenna normally with Aluminum or copper, while the advantages of printed antenna can become increasingly prominent with development of new conductive printing ink. The RFID tag package is mainly of low temperature inverted keying process, while new tag packaging processes have also emerged e.g. fluidic self assembly and vibratory assembly. The research and development of tag manufacturing equipment and packaging technology featuring low cost and high is underway in China.

The products of RFID reader-writer have many varieties, part of which can realize multi-protocol compatibility. China has introduced series products on RFID reader-writers, among which small capacity read-write modules have reached similar levels as foreign products and large capacity read-write modules and reader-writer system on chip (SoC) is in stage of research and development.

In term of application system integration and data management platform, some international organizations proposed the RFID-based application architecture. Major software manufactures provided services and solutions supporting RFID in their products, and the relevant testing and application promotion work is undergoing. China has reached initial results in terms of RFID application architecture, public service system, middleware, system integration and information integration and testing work. The establishment of national RFID testing center has been listed in China’s science and technology development program.

China has applied the RFID technology in many areas e.g. railway carriage number identification, ID card and ticket management, animal identification, special equipment and hazard materials management, public transport and production process management.
1.2 Status Quo of Standard

The RFID standard system consists mainly of air interface standard, physical properties, reader-writer protocols, coding system, testing specification, application specification, data management and information security standard. Currently, the International Standardization Organization (ISO/IEC) is the major international organization preparing the RFID standards, among which ISO/IEC JTC1 formulates the RFID technology related international standards and other technology committees of ISO prepare part of the standards related to application of RFID application. Other relevant organizations also carry out work on RFID standardization. It is noted that the relevant standards are lack of consistent basis among each other. The International Standardization Organization is actively promoting the inter-working at level of RFID application.

China has laid a certain foundation on standardization research work on RFID technology and application. The research and formulation work on relevant standards has been carried out from many aspects. Application standards e.g. Technical Specification on Integrated Circuit Card Module and Application Technology for Construction Cause IC Card have been prepared and widely used. In term of frequency planning, many tests have been performed. For technical standards, the drafting work on national standards has been substantially completed in accordance with ISO/IEC 15693 serial standards, and the preparation of national standards on basis of ISO/IEC 18000 serial standards has been listed in the national standards preparation plan. In addition, the research work on China’s RFID standard system architecture nears its completion.
1.3 Development Trend

In recent years, the RFID technology has been applied in many social areas, and produced significant influences on improving life quality of people, increasing economic benefits of enterprises, enhancing public security and raising the level of social informationization. According to forecasts, the RFID tag technology will be gradually used in large scale in the next two or three years. By the year 2008, the market demand for RFID tag will have reached 4 billion US dollars in the field of global supply chain.

In the future nine years, RFID technology will continue its momentum of rapid development. New progress will be made in areas of electronic tag, reader-writer, system integration software, public service system and standardization. With constant progress of key technology, the RFID products can have more varieties, and the value-added service will be applied and derived in wider areas.

The RFID chip design and manufacture technology will develop in trend of lower power consumptions of chip, further distance of action, higher speed and reliability in reading and writing and reduced costs. The chip technology will be closely combined with the overall solution of application system.

The RFID tag packaging technology will be combined with printing, paper-making and packaging technologies. The low cost tag antenna and low cost packaging technology supported with conductive printing ink will promote the large scale production of RFID tags, and become one of the key factors determining the industrial development speed in a certain future time.

The RFID reader-writer design and manufacture develops in trend of multifunction, multi-interface and multi-pattern of reader-writers, and in direction of modularized, small, portable and built-in. Meanwhile, the multi-reader-writer coordination and network construction technology will also become one of the trend in future development.
The RFID technology is used to construct an omnipresent network environment in combination with automatic recognition technology e.g. bar code and biological recognition, and information technology e.g. Internet, communication and sensing network. The massive RFID information processing, transmission and security constitute new challenges to the RFID system integration and application technology. The RFID system integration software will develop in built-in, intelligent and regroup-able direction, and bring the organization, management and use of RFID information resource into greater width and depth through constructing RFID public service system.
Section 2 China’s Strategy on Development of RFID Technology

Faced with huge market demand and fierce international competition, China has to implement effective technology development strategy to speed up independent innovation and clinch its position in the future international competition. China shall drive the development of technology and products with self-owned intellectual property rights guided by application, facilitate the formation of China’s self-owned RFID industrial chain and realize the overall development and improvement of RFID technology; establish the independent innovation system with enterprise as the main part and make breakthrough in RFID key technology; participate in international standardization work, propose and establish China’s RFID technology standard system, and give priority to the coding system, data management and exchange system and frequency allocation in China; promote the founding of technology and industry alliance, and realize the rapid and healthy growth of technology and industry in line with the overall situation of international cooperation and international competition.

2.1 Overall Development Objective

The overall objectives for China’s development of RFID technology are as follows: Make breakthrough in a series of general key technology, industrialized key technology and applied key technology on RFID through technological breakthrough, foster a talent contingent adaptable to the technology research and industrial development, establish China’s independent innovation system on RFID technology, obtain the self-owned intellectual property rights on core technology; implement the pre-competition alliance strategy on basis of independently researched and developed technology, form into industrial chain for combination, corporation and command of self-proprietary technology through organizing enterprise innovation group e.g. industrial alliance and industrial base, and realize the objective that the self-researched and developed products account for major share of the market; promote the extensive application of RFID technology in the industry through implementation of demonstration project and innovation application modes, gradually form into public application in large scale and radiating relevant fields; form into China’s standard system on RFID through studying and preparing relevant national standards.
2.2 Guiding Philosophy and Principle

The guiding philosophy on China’s developing RFID technology is as follows: establish the independent development mode with enterprises as the mainstay and supported by government authorities, industry, school, research institutes and users proceeding from the national conditions; make breakthrough in RFID key technology guided by demonstration of use, and promote the forming of RFID technology innovation system and industrial chain; research and prepare China’s RFID standard system through method of independent preparation of standards and with reference to international standards.

In light of the said guiding philosophy, China needs to follow the following principles during the course of developing RFID technology:

1. Principle of Independent innovation

Make independent innovation on RFID technology, and strive to achieve the international advanced level or international leading level in several core areas on technology.

2. Principle of Industrialization

Establish the mainstay status of the enterprises in development of RFID technology with market demand as orientation; enterprises should strengthen communication and cooperate more closely between each other to form into an integral and internationally competitive industrial chain.

3. Principle of Openness
Closely follow up the edge of technology development, stress on borrowing advanced technology of other countries, strengthen international communication, stick to mutual complementation of advantages and push forward the win-win cooperation.

4. Principle of Cooperation

Strengthen communication and coordination with government authorities; attach importance to cooperation among enterprises, institutions of higher learning and scientific research units, strengthen cooperation and coordination of links in industrial chain, encourage each other and seek joint efforts in promoting technological progress.

2.3 Development Approaches and Implementation Process

2.3.1 Development Approaches

China will form its independent innovation system and integral industrial chain on RFID technology through general and forward-looking technology research, industrialized key technology breakthrough, research and development of application key technology, research on standard and development strategy and service system construction. In addition, it will make breakthrough in industrialized key technologies e.g. chip design and manufacture, antenna design and manufacture, packaging technology equipment, reader-writer design and manufacture and electronic tag integration guided by typical application demonstrations and through independent innovation, and in addition, develop middleware and system integration technology through integration innovation, build the public information service system and testing environment, and establish the technical standard system inter-working with international standards.

2.3.2 Implementation Process

The RFID technology shall be implemented by steps and stages as follows:

Stage I-Nurture period (2006~2008): Follow up the research and development of up-to-date general technology, research and develop RFID technology with self-owned intellectual property rights in combination with application in key industries, and formulate the relevant technical standards and application standards in accordance with the state RFID standard system architecture and carry out the application demonstration projects.

Stage II-Growth Period (2007~2012): Make breakthrough in applied and industrialized key technology, expedite preparation of relevant technology standards and industrial application standards, basically form into China’s system on RFID system and explore the application areas.

Stage III-Mature Period: Form into technology system up to the international leading level at that time, and realize the extensive application of RFID technology and combination with other technologies.
Section 3 China’s RFID Technology Development and Priority Application Area

China should plan the RFID technology development and application as a whole and implement by steps, focus on general foundation and forward-looking technology research, give priority to development of industrialized key technology and applied key technology, establish RFID standard system and promote application in key industries.

3.1 Key Technology

Carry out research and breakthrough in RFID industrialized key technology and applied key technology, and gradually establish the technology innovation and service supporting system in line with the RFID industrial development and application in China.

3.1.1 General Basis and Forward-looking Technology

Carry out research on general technology and forward-looking technology at international leading level and with great potential of development, including research on ultra-low power consumption circuit; security algorithm applicable to tag chip and its realization technology; research and development on the core module of ultra-high frequency (UHF) reader-writer; research on ultra-high frequency and microwave frequency RFID tag antenna based on different application objects; research on key technology for tag packaging equipment; research on integration and combination of RFID and other technologies; research on technologies related to RFID system testing and authentication; research on IPv6 network technology-based RFID information service system.
3.1.2 Key Technology on RFID Industrialization

The key technologies on RFID industrialization include the chip design and manufacture, antenna design and manufacture, electronic tag packaging technology and equipment, RFID tag integration, reader-writer design and manufacture technology.

(1) Chip Design and Manufacture

Develop design and manufacture technology for low cost and low power consumption chips, new storage technology suitable for realization of tag chip, anti-collision algorithm and circuit realization technology, chip security technology, tag chip and sensor integration technology.

(2) Antenna Design and Manufacture

Carry out research on tag antenna matching technology, RFID tag antenna structure optimization technology in light of different application objects, multi-tag antenna optimized distribution technology, on-chip antenna technology and reader-writer intelligent beam scanning antenna array technology, and develop RFID tag antenna design emulation software with self-owned intellectual property rights.

(3) RFID Tag Packaging Technology and Equipment

Carry out research and development low temperature and hot pressing packaging technology, precise mechanism design optimization, multi-physical quantity inspection and control, high speed high precision movement control, equipment failure self diagnosis and repair and on-line testing technology.

(4) RFID Tag Integration

Carry out research and development on the matching technology among the chip, the antenna and the adhered special material medium, consistency, anti-jamming and security and reliability technology for tags.
(5) Reader-writer design
Carry out research and development on multi-reader-writer anti-collision technology, anti-jamming technology, low cost small size reader-writer integration technology, ultra-high frequency reader-writer module development and reader-writer security authentication technology.

3.1.3 Key Technology on RFID Application
Carry out research and breakthrough in RFID applied key technology e.g. RFID application architecture, RFID system integration and middleware, RFID public service system, RFID testing technology and specifications, and form into supporting service system for RFID technology development in China.

(1) RFID Application Architecture
Carry out research on interface technology and service functions on various software and hardware in the RFID application system, coordinate relationship between parts in the system and provide the supplier and user with guidance on system integration.

(2) RFID System Integration and Data Management
Carry out research and development on technology for integration between RFID and wireless communication, sensing network, information security and industrial control, technology on RFID application system middleware, and organization, storage, management, exchange, distribution, data management and trans-platform computation technology on massive RFID information resources.

(3) RFID Public Service System
Establish self-proprietary infrastructure service system supporting social application of RFID in China, provide certification, registration, coding management, multi-code system mapping, code analysis, retrieval and tracking services, and guarantee validity and security of the system.

(4) RFID Testing Technology and Specification
Carry out research and development on testing technology and specification for consistency of physical properties and performances between RFID tag and relevant products, testing technology and specification for consistency of air interface between tag and reader-writer, comprehensive testing technology and specification for system solutions.

3.2 Standard and Testing

Carry out research and preparation of air interface in conformance with radio frequency management policy and regulations in China; carry out research and preparation of coding and code application rules, product and application standards; prepare the testing specification; carry out research on inter-working between standards; establish public service system standards with self-proprietary intellectual property rights and scientific and equitable testing standard system.

3.3 Priority Application Area

Encourage and support the priority application of RFID technology in areas of public security, production management and control, modern logistics and supply chain management, traffic management, military use, major work and activities, and provide experiences in large scale use of RFID technology.

3.3.1 Public Security

China is in urgent need of strengthening management on application of RFID technology to improve people’s life quality and construct harmonious society, specifically including medical and health, food safety, hazardous articles management, anti-forgery security, coal mine safety, electronic license, animal identification (involving public hygiene and safety) and door access management.
3.3.2 Production Management and Control

RFID is applied in raw material supply, production plan management, and production process control and lean manufacture for enterprises to improve the informationization level of manufacture industry in China and drive the industrialization through informationization, and can promote improvement in production efficiency and management efficiency. The specific areas to be applied include automobile manufacture, home appliance production and textile and clothing.

3.3.3 Modern Logistics and Supply Chain Management

The application of RFID technology in circulation link of articles can realize article tracking and information sharing, and has thoroughly changed the traditional supply chain management mode, substantially improved the enterprise operation efficiency. The specific application areas include warehousing management, logistics distribution, retail management, container transportation and postal service.

3.3.4 Port Import and Export Goods Supervision and Management

The law enforcement authority of each port cooperates in applying RFID technology in supervising customs clearance for imported and exported goods at ports within the state, to realize tracking and positioning supervision on imported and exported goods, strengthen the supervision level on customs clearance and improve the efficiency on customs clearance.

3.3.5 Traffic Management

The RFID technology has the feature recognizing fast-moving objects, which can be used for rapid and effective positioning and accounting and thus facilitate management and control on vehicles. Specific application areas include public transport tickets, non-stop billing, vehicle management and management of railway locomotives, vehicles and relevant facilities.
3.3.6 Military Use

The military use is one of the major directions for RFID technology, as military logistics support urgently needs realization of visible management. The specific application areas include the military materials and equipment management, precise and accurate identification of transport units and fast positioning and active searching.

3.3.7 Major Work and Activities

When integrated with other relevant technologies, RFID can construct comprehensive service system combining functions of rapid recognition, data collection and information transmission. The RFID technology can be used for comprehensive management on major activities such as large scale sports meet and exhibition, specifically including ticket management, vehicle management and facility management.
Section 4 China’s Efforts in Promoting RFID Industrialization Strategy

4.1 Guiding Philosophy

During the process of RFID technology development and industrialization, overall consideration shall be given to key links e.g. key technology breakthrough, market promotion and standard research. Attention shall be paid to equally between unit technology and system, industrial input and market fostering, enterprise operation and government promotion, technology innovation and standard formulation, independent research and development and international cooperation, to realize the independent, healthy and sustainable development of RFID industry in China.

The guiding philosophy on China’s developing RFID industry is as follows: establish the independent development mode with enterprises as the mainstay and supported by government authorities, construct the industrial alliance, form into RFID industrial chain acquiring self-owned intellectual property rights; give play to group advantages and create national brands with international competitiveness through construction of industrial base; carry out international exchange and cooperation and improve the overall level of RFID industry in China.

4.2 Development Approaches

Enhance the capability in design and development and manufacture of products and meet the market demand on basis of independent innovation and technology research and development; strengthen policy support, and create favorable development environment; build industrial base, expedite formation of industry chain and upgrade the market competitiveness of national products and industry.

1. Nurture the market, guided by application and through application demonstration and popularization in typical industries, expedite realizing industrialization of key technology research and development results of RFID and form into development of scale.
2. The technology progress facilitates industry upgrading and improves competitiveness. Realize the design of RFID products developing from general type to specialized type, constantly perfect the production equipment for products from preliminary level to advanced level, improve the consistency and final product rate of products, and expedite upgrading the overall level of the RFID industry chain.

3. Actively create favorable development improvement, strengthen policy support, and stick to the technology development path combining independent innovation, integration innovation and introduced innovation, and make efforts in cultivating the capabilities in independent design, development and manufacture.

4. Further perfect the industrial policy, actively introduce new financing channels and modes, build RFID industrial base, realize the convergence of technology and industry and promote the formation and development of RFID industry chain.

5. Establish the product certificate system, popularize with priority on the core technology products with self-owned intellectual property rights, create sound order of market and promote sustainable and healthy development of RFID industry.

6. Strengthen public service system building e.g. testing platform for RFID technology products and upgrade the “hatching” conversion capabilities for technology research and development results.

7. Lay stress on RFID product standardization work, and formulate serial standards adaptable to the industry development in China.

4.3 Implementation Process

The RFID industry development shall be planned in an overall manner and implemented by steps and stages in combination with market development progress:
Stage I-Nurture period (2006~2008): Make breakthrough in industrialization of core technology research and development and formulation of standards, and preliminarily form into RFID industry chain and sound environment for industry development through demonstrated application in key industries.

Stage II-Growth Period (2007~2012): Expand scope of RFID application, and form into capacity of scale production, establish public service system, facilitate forming the market of scale and promote sustainable development of RFID industry.

Stage III-Mature Period: Integrate industry chain, adapt to development of the new generation of technology, radiate to multiple application areas and improve RFID application efficiency and benefits.
Section 5 China’s Construction on Macro Environment for Developing RFID Technology

1. Formulate the RFID industry planning and relevant policies in line with actual conditions in China, incorporate the RFID industry in key development areas of the state; create favorable environment for technology and industry development, encourage enterprises to invest and produce in RFID area, promote forming of RFID industry base and support the application of RFID technology in industries, Give supports to RFID manufacture, base construction and application through various Approaches including policy, laws and regulations, economy and administration.

2. Set up trans-industry RFID technology and industry development and coordination institutions, and facilitate RFID development at level of state. Establish the coordination mechanism involving ministries and commissions, and promote the combination and sustainable development of RFID technology, industry and application through various organization type including combined actions.

3. Continuously carry out the research on China’s RFID development strategy, standard system framework and key standards. Encourage institutions of higher learning, scientific research units and enterprises to develop technological products with self-owned intellectual property rights, participate in formulation of domestic and international RFID technology standards and industry application standards, and form into the standard system capable of supporting industry development and application.

4. Create favorable investment environment, encourage enterprises to invest and produce in RFID area, facilitate construction of RFID industry base, and support enterprises in using RFID technology and products. Provide necessary supports and preferences to construction and use of RFID manufacture and base through various forms and Approaches e.g. policy, laws and regulations, economy and administration.

5. Support establishment of open-type foundation platform for technology research and development, establish the public service platform supporting RFID technology application, establish the RFID technology testing environment and certification management mechanism and quality assurance system.
6. Construct the training system for RFID technology, foster various professionals through multiple education modes and form into perfect mechanism for training professional talents.

7. Strengthen guidance on publicity and public opinions on RFID technology and industry development, and create favorable social environment. Encourage carrying out international technology exchange activities on RFID and strengthen cooperation with international enterprises.