

## Patent Application Behavior of China own 3G Standard: An Example of TD-SCDMA

Dan Tian<sup>1</sup> and Yongqin Feng<sup>2</sup>

<sup>1</sup> *School of Management Science and Engineering,  
Dongbei University of Finance & Economics  
Dalian 116025, China*

<sup>2</sup> *Defective Product Administrative Center,  
General Administration of Quality Supervision, Inspection and Quarantine  
<sup>1</sup> tiandan@dufe.edu.cn, <sup>2</sup> fengyq@dpac.gov.cn*

### **Abstract**

*The TD-SCDMA is a Chinese 3G mobile phone standard, which has proven technological maturity and commercial viability. In this paper, a patent map is generated by Patent Information Analyze System(PIAS) of Chinese State Intellectual Property Office, and which are researched that the characteristics of the patent application behavior of standard developers in China. The research shows that patent applications of their own technology by standard developers provide technological basis for the establishment of standards. The leading enterprises of technical standard proposals are the core in the correlation relationship of standard developers and play key roles in the standards establishment. The patents of standard developers are the foundation in the early stage, and also decide in the standards future evolution.*

**Keywords:** TD-SCDMA, Technical standards, Patent map

### **1. Introduction**

In recent years, when standard associations develop technical standards, they use patents increasingly to speed up the process of standard [1]. The integration between technical patent and standards is profoundly changing the industrial competition regulations. Based on patents, the technical standards guide the direction of industrial development further, buck for excess profits and become a sharp competitive edge of developed countries and leaders. Technical standards have been a significant tool of market competitions, which mean a great deal of pressure for developing countries on low-end industry. TD-SCDMA (Time Division-Synchronous Code Division Multiple Access) is the first international standard of wireless communication introduced by China and gained international recognition. It owns independent intellectual property rights and provides samples for relevant researches. With the key point of this, this paper studies these patent application behaviors of standard developers, summarizes and abstracts experience, and provides urgent manage support for the development of independent standards technology.

### **2. Literatures**

According to the definition of International Standardization Organization (ISO), technical standard is a paper of set of paper with mandatory and guiding function. It contains detailed technical requirements and paper about technology solutions, aimed at making some revelent introductions or services fulfill certain security standards or market access demands[2].

According to who and how to set it, the technical standard could be divided into De Jure Standard and De Facto Standard. De Jure Standard is set by governments or standards associations and is the consultation result of members from relevant organizations. While De Facto Standard is set by enterprises. It is developed and established its dominant status by market during the competition [3]. Henderson found that there are two methods to help enterprises benefit from the standards. First, controlling the technical standards or details and winning with uniqueness. Second, developing and producing related products, winning with necessary resources [4].

Including patents has an important effect on the foundation and industrialization of technical standards. Lemley says that the patents included in the technical standards have the effect of "Hold Up" and cause issues of patent royalty accumulation. It could make the royalty step-down gradually to impact the influence [5]. Rysman finds that when standards associations are setting standards, they use new patents more and more and accelerate the subsequent standardization process. Iversen says that due to the time of setting technology standards is too long, and the technology is continuously developing, the jet lag of patent applications and standards established will hinder the procession of standard building. Bekkers finds that, because of their dominance in the standards development, leading companies use expected patent application, further increase the number of technology patents related to standards and then increase its cost [7]. Feldman points out that those companies holding standard reference patents forbid others to use the patents. It will weak the standard to be used widely and spread rapid in the market [8].

Chinese scholars have done a lot of exploratory studies on how to use the patent creation technology standard for the late-development countries and enterprises. Zhou Deng says that it is difficult for a single enterprise to grasp all the resources that are used to form a technical standard. He believes that the forming process of standard need firms to form an alliance of patents. Liya Ge points out that the strategy of technical standards strategy for outdated technology enterprises mainly includes three types: according market cooperation to expand the application in the current market, cooperative innovation through technology alliance formation and getting the first mover advantage by getting into blank emerging markets firstly. Xin Chen thinks that when the enterprises of our country take the patent pool as a carrier of technology standards implementation, they should also actively establish related technology research and development alliance, accumulate patent bargaining chip through cooperative innovation [11]. Jian Wang and Zheng Liang point out that during the process of making technical standards in China, we should make full use technology resources of international advanced enterprises, while not only make it by our own. Shengce Ren and Guoliang Xuan argue that during the process of making technical standards, new entrants could break through the barriers and entry by patent acquisition or other measures. They could catch up by subsequent investment and innovation.

This paper indicate that the existing research is mainly focused on the influence the technology patent make on technical standards and the way for the creation of technical standards based on the technology patent. Their main research objects are the technical patents. This provides a certain theoretical support for the study of patent behavior of technical standard founder. However it is still very weak on the patent behavior of patent holders, who are also technical standard founders. Meanwhile previous researches are lack of the research sample and data. The research for the technical patent in technology standard mainly used case study method and game model, which are lack of empirical study.

### 3. Research Design

#### 3.1. Research Method

Patent is the most abundant content and continuously updated public technology information resources in the world. While huge amounts of data make traditional statistical analysis methods fall down. Blanchard reported that with the continuous development of the software programming, a large number of patent map tools appear and quickly spread to information retrieval, information intelligence, technology monitoring and so on[14]. Patent map is a kind of patent analysis and visualization tools. By gathering high-dimensional massive patent data, it reveals the complex relationships among items intuitively and vividly, displays a technology panorama and distribution pattern [15].

According to mining and analyzing the technical, economic and legal information from patent literatures, patent map reflect the huge amounts of information containing in the patent data in the form of charts, which has directive function similar to maps. Patent Information Analyse System(PIAS) is developed by Intellectual Property Publishing House of State Intellectual Property Bureau. It is a patent map analysis software used to do patent retrieval and qualitative and quantitative analysis research on patent information analysis the elements. PIAS could do qualitative and quantitative analysis research on patent strategy elements, such as development trend, the applicants' conditions and patent protection areas, by secondary processing of patent information. PIAS has many advantages in the Chinese patents data mining and patent citation analysis and provides tool support to the research on patent application behavior of TD-SCDMA technology standard founders.

#### 3.2. Sample Selection

In view of the research objectives, research sample selection need to meet the following requirements. First the sample should have experienced the technical scheme selection process, standards setting process and standards implementation process. It could track and collect the complete information during technical standards creating process. Second the sample will be able to obtain accurate and reliable information. TD-SCDMA is formulated by the wireless communication standard research group of China. It has experienced the whole process of standards' evolution, collected a large number of statistical data and documents and meets the requirements of the research sample selection.

**Table 1. Evolution of TD-SCDMA Standard**

<b>TIME</b>	<b>stage</b>	<b>content</b>
1995.11-2001.3	standards setting process	Setting standards and getting international organization approval
2001.4-2005.3	standards industrialization process	technical scheme research and development and product development
2005.4-	standards implementation process	Building trial network in ultinational form or area and making it commercial

According to its characteristics, the evolution of TD-SCDMA could devide into three stages, setting, industrialization and implementation. From November 1995 to March 2001, it is standards setting process. In this time, its core is setting standards and gaining recognition of the international organization for standardization. From April 2001 to March 2005, it is

standards industrialization process, whose core is technical scheme research and development and product development. After March 2005, it is standards implementation process, during which trial networks are built in multinational form or area and become commercial.

### 3.3. Data Source and Data Cleaning

TD-SCDMA is formulated by the wireless communication standard research group of China. The sample data come from a public database retrieval. For TD-SCDMA, Code Division Multiple Access (CDMA) is basic technology, while Time Division Duplex(TDD) and Smart antenna technology is key technology. Using smart antenna under the combination of TDD and CDMA, is the biggest technological features of DT-SCDMA standard and also the key for Td-SCDMA to become the independent standard of our country and to gain international recognition. Therefore this paper take Code Division Multiple Access, CDMA, Time Division Duplex, TDD and smart antenna as patent retrieval search keywords.

After determined search keywords, we take Code Division Multiple Access, CDMA, Time Division Duplex, TDD and smart antenna as index words in PLAS V3.0, download patent data from state intellectual property office center source sites in PLAS data basic. It is a total 3571 patents. Considering TD-SCDMA is mainly formulated by our country and it will first apply for a patent in China, we search the Chinese patent only. Because CAMA and TDD are short for Code Division Multiple Access and Time Division Duplex, the result could have patent overlap. We remove these overlapping patents and get 3492 patent as the final sample.

## 4. Patent Map and Analysis

### 4.1. Time Characteristics of Patent Application Related to TD-SCDMA

During the evolution of TD-SCDMA, the number of patent application related to TD-SCDMA rise along with the advancement of standards establishment process (Figure 1). These characteristics show that patent application has come out before TD-SCDMA. After the setting process of TD-SCDMA, the number begins to rise up quickly. During the industrialization process, it continues to rise, but the speed of the rise dramatically. When TD-SCDMA is come to effect, the number of patent application began to fall after sharply peaked in 2007.

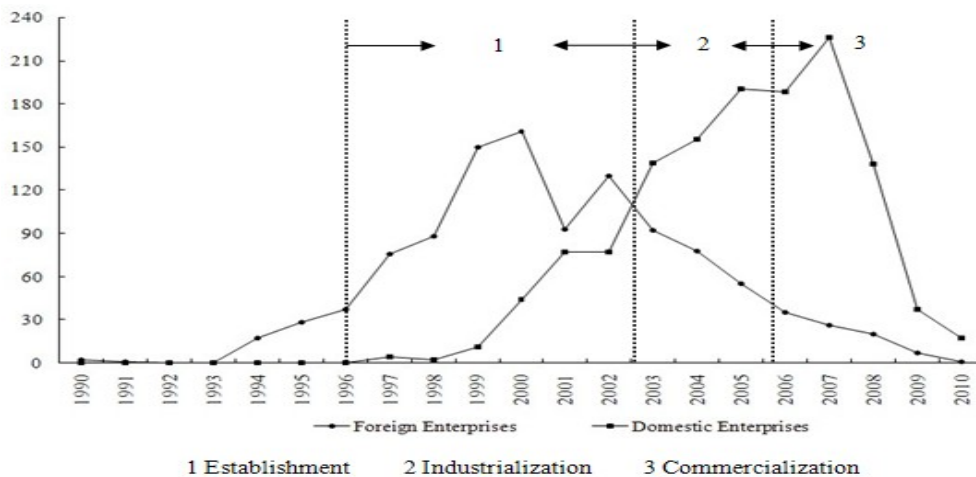


Figure 1. Trend in Patent Application Related to TD-SCDMA Standard

#### 4.2. Patentees Characteristics of TD-SCDMA

According to the patentee distribution ranging from TD-SCDMA standard, 3492 patent belong to more than 60 enterprises, of which, the top 20 enterprises' patent number account for 68.79% of the total number of patents, they are mainly the patentee to TD-SCDMA standard, have the typical representative, and have become the focus of subsequent analysis (see Figure 2). In these enterprises, they include ZTE, Huawei, Datang, Kaiming, Xinwei communication and other domestic enterprises and universities, also include Samsung, Qualcomm, InterDigital and NEC and other foreign enterprises. Among them, the number of patents in Huawei and ZTE are respectively 672 and 303, are way ahead in other patent.

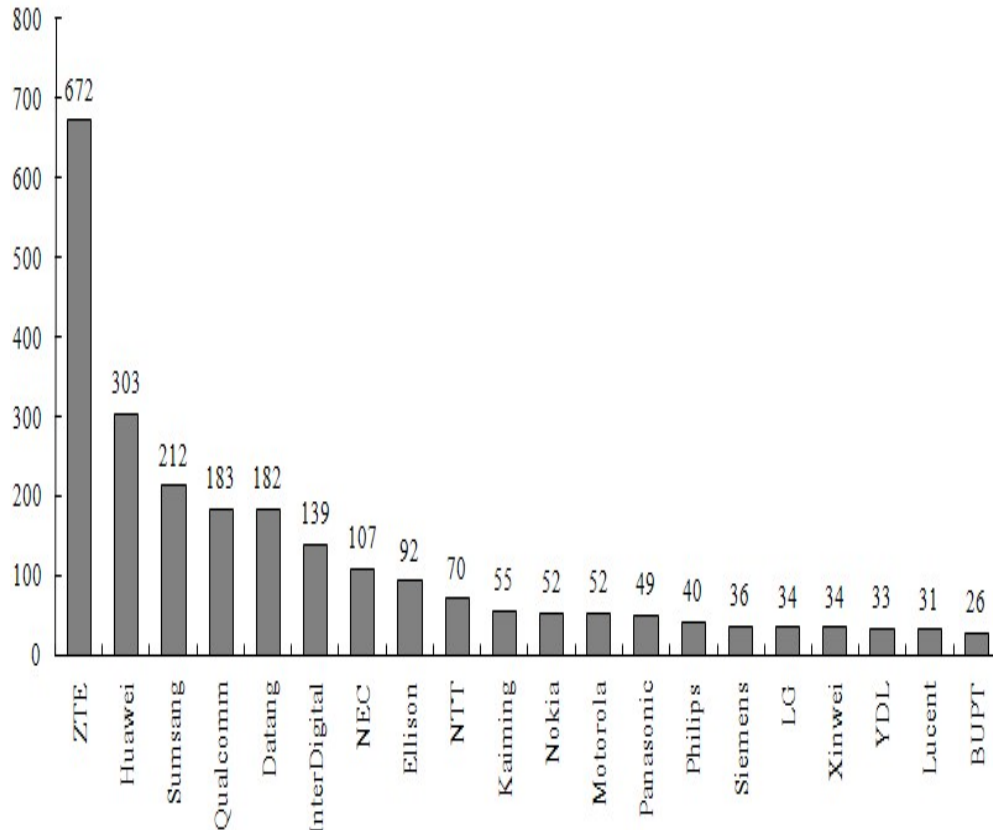
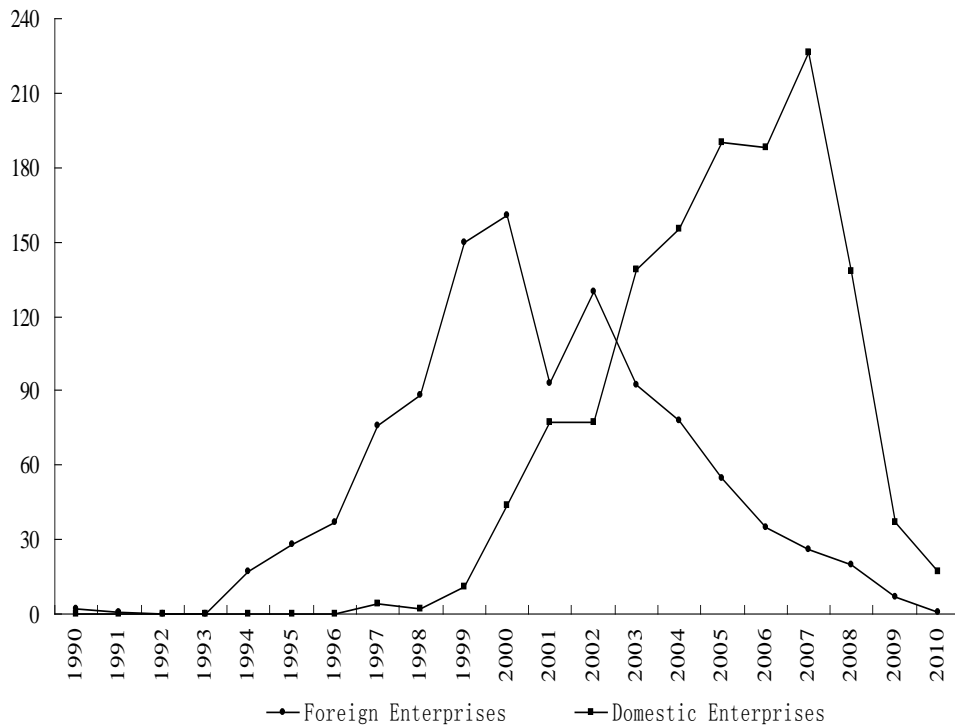


Figure 2. Main Assignees Related to TD-SCDMA Standard

In order to analyze the evolution of main patent quantity change in different stages held in standard, in each year the number of patent applications major patentee in Chinese and foreign enterprises are added up, we draw the picture of the two patent application trend. As shown in Figure 3.7, foreign enterprise have filed TD-SCDMA for patent application in early stage, and in the stage of development they reached for the peak, then decreased gradually. Domestic enterprises for TD-SCDMA related patent application started later than foreign enterprises, but from the standard-setting stage they began to increase steadily, and in the final stage of industrialization they has run over the foreign enterprises, and reached the peak after the implementation of standards for nearly three years, then began to fall. From the patent number, the number of domestic enterprises to apply for patent is much higher than that of foreign enterprises, in the evolution of TD-SCDMA standards in which they have played an important role.

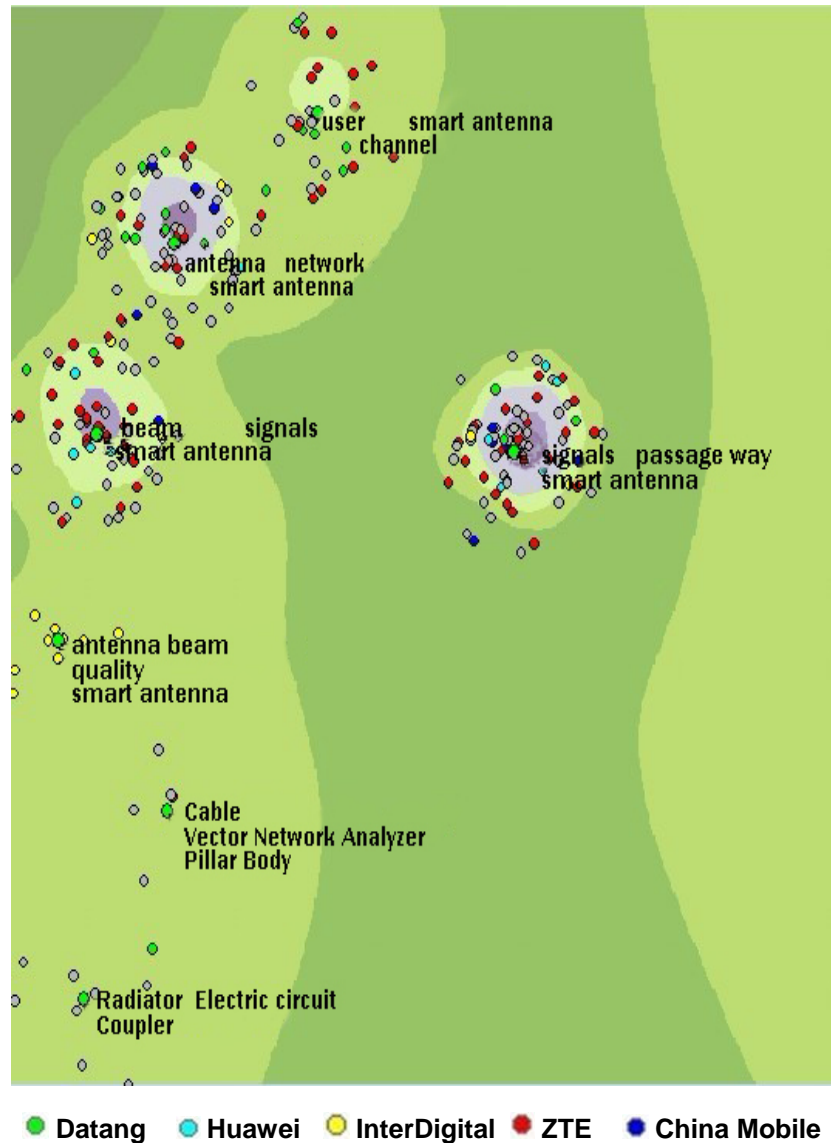


**Figure 3. Patent Applications of Chinese and Foreign Enterprises in the Evolution of TD-SCDMA Standard**

#### 4.3. Technical Field Characteristics of TD-SCDMA

The TD-SCDMA standard is the technology with independent intellectual property rights standards developed by China, the patents are concerned mainly from China. Therefore, we use the PIAS system for Chinese patent analysis of patent map drawing. Because in PIAS analysis, patent number must be under 1000, therefore, the key technology based on TD-SCDMA standard mainly involved, the patent data samples are divided into three categories; wherein, the field of smart antenna technology includes 296 patent; technology in the field of time division duplex includes 657 patent, the other are for the technical field CDMA patent. Because the TD-SCDMA standard technology innovation is mainly focused on the technology of smart antenna and a time division duplex, therefore in the process of analysis we focus on the technology of smart antenna and a time division duplex related patent distribution.

Smart antenna adopts SDMA Technology (SCDMA) uses the signal transmission in the direction of the difference to distinguish the signal of the same frequency or time slot in the same code channel to maximize the use of limited resources [18]. According to smart antenna patent map (see Figure 4), topics involved in smart antenna technology include user channel, signal channel, smart antenna network areas, wherein, Datang, Huawei, ZTE, InterDigital, China mobile company's patents dominate; the technical field of the signal and channel of the smart antenna technology are dominated by Datang Huawei, ZTE, China Mobile, InterDigital; ZTE and Datang is dominant in the user channel field; Tang, resurgence and China Mobile patents were predominant in smart antenna network field; ZTE and Datang, Huawei are in the field of beamforming technology, indicating that Chinese enterprises have become the dominant force in smart antenna patent application.



**Figure 4. Patent Map of Smart Antenna**

Time division duplex (TDD) refers to the use of the same carrier frequency in the uplink and downlink transmission. According to the time division duplex patent map (see Figure 5), time division duplex related to technical field mainly includes signal transmission, random access channel and suppress inter-cell interference and other 7 areas. Among them, Datang, Huawei, ZTE, Samsung and InterDigital company are applying for a patent in key technologies in the field of TDD. From the distribution in the patent map of these companies, ZTE has occupied the dominant position in the signal transmission and terminal access, channel and other fields; Datang's patents are mainly concentrated in the time division duplex mode and channel; Huawei's patents distributed in the field of the user terminal and cell search; and Datang, ZTE and Huawei control most patent key technology areas, the number of patents and technical areas covered are far more than that of the Samsung and InterDigital, showing that Chinese enterprises have mastered the main patent in TDD technology.

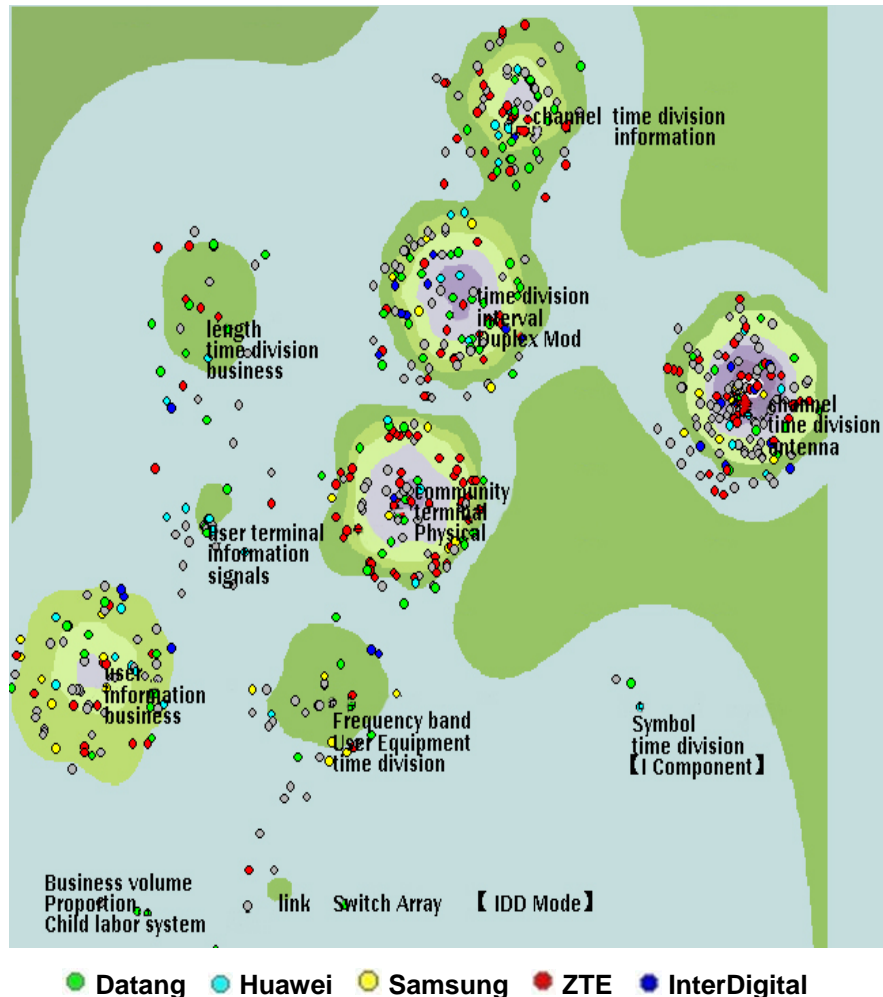


Figure 5. Patent Map of Time-division Duplex

## 5. Conclusion

According to the analysis of patents' characteristics of the time of the application, in the process of the creation of the technical standards, technical standards and patent technology is becoming the trend of convergence. From patent application time trend of TD-SCDMA standards, patent application runs through the whole process of technical standard evolution, and the number of patents was increasing with the advancement of technology standard, patent in technical standards evolution is first increasing gradually, reaching a peak and then decreasing gradually trend. On the one hand, the number of patents is increasing to promote the process of the standard established, suggesting that the patent application has promoted creation of technical standards; on the other hand, when the technology standard establishment has entered a new stage, the number of patent applications will appear in a rising trend, which indicates that the established technical standards are promoting the relevant patent application activities. In a word, the evolution of technology standard is continuous interaction between the process of patent application and technical standards.

According to analysis of the characteristic of the patentee, the patent application is an important means for enterprises to participate in the establishment of standards, Patent



promote the Patent Alliance behavior standards between the founders. The patentee characteristics reflect the control on standards related to technical standards Founder Technology, from the evolution of TD-SCDMA standards in each stage's changes of the patent right holders of patent number, there was a positive correlation between the number of patent and the patent right which people play a role in the creation of standards. Although in the early stage of TD-SCDMA standard, Qualcomm, InterDigital and other foreign companies use their advantage in the field of 3G technology to gain a large number of patents in China, but with Chinese independent innovation ability enhanced, TD-SCDMA standard patent applications continue to increase, and eventually counted more than foreign enterprises, therefore enhance the formulation of TD-SCDMA standard from the number of patent. For the enterprises which have weak foundation in technology innovation resources, it is difficult to apply for a patent on themselves. At this time, the patent can be gotten in patent purchasing or other measures to break through the barriers, and by virtue of the follow-up investment and innovation to realize the completion. TD-SCDMA standards patent map displays that, every technology patent applications have different emphases, the single enterprise is very difficult to master all patent implement standard, forming alliance in standards establishment is a rational choice for enterprises. For example, the TD-SCDMA standard in the process of creation, there was a TD-SCDMA alliance established by ZTE, Datang Telecom, Soutec, HOLLEY, Lenovo, Huawei, China Electronics, China Putian. Alliance members distributed in different links of the industrial chain, and they can have their own technological advantages in different areas, being conducive to the continuous development of cooperation innovation, and promote the rapid industrialization of technical standards.

According to analysis of characteristics of patent application technical field, patent application has made the technical foundation for the technical standards establishment. In the high-tech industry, technology standard has become the highest form of patent technology. Creation of technical standards is supported by advanced technology, advanced technology is usually involved in the establishment of technology standards, and advanced technology is the technical foundation of standard. Related patents of TD-SCDMA standard with the spectrum utilization, frequency, and flexibility of business support have unique advantages in TD-SCDMA standard. Grindley study shows that, technical ability is the deciding factor of whether enterprises have led technical standards [19]. The relevant technology standard patent holders of patents is covering the core technology relating to the technical standards, showing that the patentee has the technical strength to bear the establishment of standards, patent applications and laid a good technical foundation for the development of technical standard technical proposal.

In the situation where technical standards and patent technology is increasingly closer to each other in the context of technical standards, the mastering of founder of patents in the standard establishment plays an important role in the development. According to analysis of patent application, patent technology in the field of characteristic time right, the standard will be held in founder's hand as technology patented, laying the foundation for the creation of participation in standards. Leading standards related to technical proposal is in the core position in the standard founder, and has played a key role in technical standards; Along with the increase in technical standards, connection of technology standard between the founders is perplexing, and is increasingly profound impact on the evolution of technology standard.

## **Acknowledgment**

This work is supported by National Natural Science Foundation of China (71002094, 71102090).

## References

- [1] M. Rysman and T. Simcoe, "Patents and the Performance of Voluntary Standard Setting Organizations", *Management Science*, vol. 54, (2008), pp. 1920-1934.
- [2] ISO. What Are Standards?[EB/OL]. <http://www.iso.org/iso/en/aboutiso/introduction/index.html>, (2010) October 8.
- [3] "Ministry of Science Technology and Innovation. Definition of open standards", National IT and Telecom Agency, vol. 6, (2004), pp. 1-4.
- [4] R. Henderson, "Teaching materials of technology strategy course", Sloan of MIT, (2000).
- [5] D. Lichtman and M. A. Lemley, "Rethinking patent law's presumption of validity", *Stanford Law Review*, vol. 60, no. 45, (2007).
- [6] E. J. Iversen, "Patenting and voluntary standards: tensions between the domains of proprietary assets and "public goods", *The innovation of network technologies, Science Studies*, vol. 14, no. 2, (2001), pp. 66-82.
- [7] R. Bekkers and J. West, "Managing patents in standardization: Lessons from ETSI'S handling of UMTS", 5th International Conference on Standardization and Innovation in Information Technology, (2007).
- [8] R. P. Feldman, M. L. Rees and B. Townshend, "The effect of industry standard setting on patent licensing and enforcement", *Communications Magazine, IEEE*, vol. 38, no. 7, (2000), pp. 112-116.
- [9] D. Zhou, "A literature review on external technology standards", *Science Research Management*, vol. 32, no. 3, (2011), pp. 67-76.
- [10] G. Ya-li, "Strategic Study on Establishing Strategy of Technology Standard", *China Industrial Economics*, vol. 6, (2003), pp. 91-96.
- [11] C. Xin, "The successful practice of patent pool operation on the technological standard by foreign enterprises and its enlightenment", *Science Research Management*, vol. 28, no. 4, (2007), pp. 23-29.
- [12] J. Wang and Z. Liang, "WAPI standard setting in the global governance of science & technology", *Studies in Science of Science*, vol. 26, no. 1, (2008), pp. 85-89.
- [13] R. Sheng-ce and X. Guo-liang, "Corporation patent strategy in technical standard: A case analysis", *Science Research Management*, vol. 28, no. 1, (2007), pp. 53-59.
- [14] A. Blanchar, "Understanding and Customizing Stopword Lists for Enhanced Patent Mapping", *World Patent Information*, vol. 29, (2007), pp. 308-316.
- [15] L. Porter and W. Cunningham, "Tech Mining: Exploiting New Technologies for Competitive Advantage", New York: John Wiley & Sons, (2005).
- [16] Z. Xian, G. Li Dan, T. Chuan and X. Guo Hua, "Research and Application of the Patent Map", *Journal of Information*, vol. 11, (2007), pp. 22-25.
- [17] W. Lei and D. Ni, "Patent Evaluation From the Perspective of The Smart Antenna of TD-SCDMA", *Communications World*, vol. 9, (2009), pp. 18-23.
- [18] B. Xue, B. Yan, Z. Xu and X. Rui, "System Construction and Key Technology of TD SCDMA", *Modern Electronic Technique*, vol. 14, (2003), pp. 11-14.
- [19] P. Grindley, "Standards, strategy and policy: Cases and stories", Oxford University Press, USA, (1995).

## Authors



**Dan Tian** received her PhD in Management (2008) from Dalian University of Technology. Now she is an assistant professor of management science at school of Management Science and Engineering, Dongbei University of Finance and Economics. Her current research interests include different aspects of technology management.



**Yonqin Feng** received her PhD in Management (2012) from Dalian University of Technology. Now she is an engineer of Defective Product Administrative Center, General Administration of Quality Supervision, Inspection and Quarantine. Her current research interests include different aspects of technology standards.