

Analysis of 3G implementation in China

Master Thesis

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Resume

China now is facing the transition process from current 2G and 2.5G network to 3G eras. According to Actor Network Theory, it is a dynamic process for standardization process of the steps of cognition of current network, new features of network being imagined, new entrant in the market and the new network formed. During this process, actors interact among each other with their influence in the three realms: innovation system, market place and regulatory regime. Then how will these actors interact with each other in the 3G implementation in China?

The current mobile standards in China, 2G and 2.5G systems introduce the enhanced demand for even better mobile services. With the technical push, features of 3G was formed and now, the possible 3G standards that might be implemented in China are CDMA2000, W-CDMA and TD-SCDMA. With the standards influence from the features of these standards, different migration path might be chosen. Even though the selections of the operators are still unclear, but the selection of standards influences the revenue received, service providing, potential market and also the business model of operators directly. Besides these factors, regulatory regime in China monitors the market and adjusts the competition among actors. By far, all the operators have finished their testing work, and they wait for the licenses from regulatory regime. The delay of licensing and the possible telecom restructuring influence the reaction of actors. Therefore, it is a dynamic process to 3G and the interaction between actors is unavoidable.

Keywords: China, 3G implementation, Actor Network Theory, Standardization Strategy, mobile service market, regulatory regime, marketplace, innovation system.

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Section 1: Introduction

In this paper, I would like to analysis the process of 3G implementation in China. Although there are many papers before discussing 3G relative issues, I still would like to cover this topic from the lens of Actor-Network Theory (ANT). I will use a theoretical framework standardization strategy to examine the socio-tech process through which actors agree on a series of technical specifications in the duration of the 3G implementation in China. I will use ANT to analysis how actors pursue their own interests with different standardization strategies and how they interact among each other in the three realms and three translation moments in the process of 3G implementation in China. Since the first step of the standardization strategy is the perception of the current actor network and the current actors' interests and then the imaged network features, I will give out the current Chinese industry overview and the current actors, their interests and their interaction between each other. And then I will give out the current 2G/2.5G standards and the possible 3G standards' features in China. After these there would be the analysis of actors' reaction to the new upcoming network structure in three different realms. The way I use ANT will be just the same with the way explored in David Tilson and Kalle Lyytinen's paper of ANT study for US wireless mobile industry. With the standardization strategy, the interaction between standards, regulatory regime, market place and innovation system would be given out. And during the analysis, actors in China 3G network and their reactions to the new imaged network features and their standardization strategies will also be introduced. Besides this, different issues from policy, market and technical aspects are involved during the licensing process. The main impetus argument of ANT is its symmetrical point of view between human and non-human actors. In David and Kalle's paper, they view standards as an actor in the network through the application of standardization strategy since it is undeniable that standards have crucial influence on the other actors. The theoretical interaction between standards, regulatory regime, innovation system and marketplace will be shown in the following section.

1.1 Structure of this paper

During the analysis of the dynamic translation process of 3G in China, I conclude the possible related issues into three realms. They are issues generated from technology realm, regulatory and market place just as general division of the tech-economic social. These issues exist in the following realms as I used in this paper: innovation system, market place and regulatory regime. The reason that I divide the industry like this is to make the adoption of ANT more conveniently to build the business model.

In order to give a clear analysis introduction, in the first section of this paper, I will give out the theory part that introduces the main theory I will use in this paper- Actor Network Theory. And I will also explain why I use it and what are the main actors in China mobile service market and their value, target consumers, business partners and activities. In order to state it clearly, I put all the actors in to a map where I show the interaction between them.

In the following section, it is the standards part, where I will give out the brief introduction of 2G, 2.5G and 3G network technical figures and the possible migration path from 2G/2.5G to 3G for China for the standards sub-issues. This is used to fit in the standardization strategy to show the perception of current network features. And with the actors' interests stated in the former section, imaged network features will emerge. In this case, the creation of new standards begins. And in this part, I will include the spectrum issues such as spectrum trading, roaming problem and infrastructure sharing issues.

After this would be the market place part that gives out the introduction of the development of the China's mobile market and operators' restructuring. The relationship between Standards and regulatory regime, innovation system and market place in the translation process of 3G networks is shown during the facts statement. In this chapter, I will first state the current 2G/2.5 services and the revenue of China Mobile and China

Unicom. The basic and new services revenue will be given after that and then the 3G services classification is concluded. The services preference of Chinese consumers will have influence directly on the reaction of the out come of regulatory regime and the input of innovation system. Therefore, in the market place, consumers' interest in 3G services should be taken into consideration. And based on the description of China's mobile service market environment, the 3G potential service market survey is given out by adoption of the speech given by Prof. Xiongjian Liang and Prof. Bin Zhang on the topic of China's 3G market. [1]

Following this would be the regulatory regime realm part. In this section, I will give an introduction of Chinese mobile telecom industry and its radio regulation body, the role of this radio regulation body and its influence in the whole relationship cycle with standards and other two realms: market place and innovation system. In this section, some licensing issues would be covered. And licensing principles by ITU would be presented. And then combined with China case, spectrum allocation policy will be discussed. In addition to that, the new institution economic method is explored to see how institution policy interacts with economic and in this China case would be how the policy from Ministry of Information Industry (MII) influence the 3G standardization process.

1.2 Problem Statement

In the process of 3G implementation in China, how do the actors interact with each other and how do the standards work with the other three realms: innovation system, market place and regulatory regime in the standardization duration? In this paper, I try to search answers to these questions.

1.3 Methodology

Framework:

As is shown in the following figure, during the 3G standardization process, based on ANT, standards have impact on the innovation system, regulatory regime, and market place and in turn, the out come of innovation system and regulatory regime have influence of the creation of the new standards. This relationship cycle would be the main framework of this paper. And besides it, standardization strategies are used.

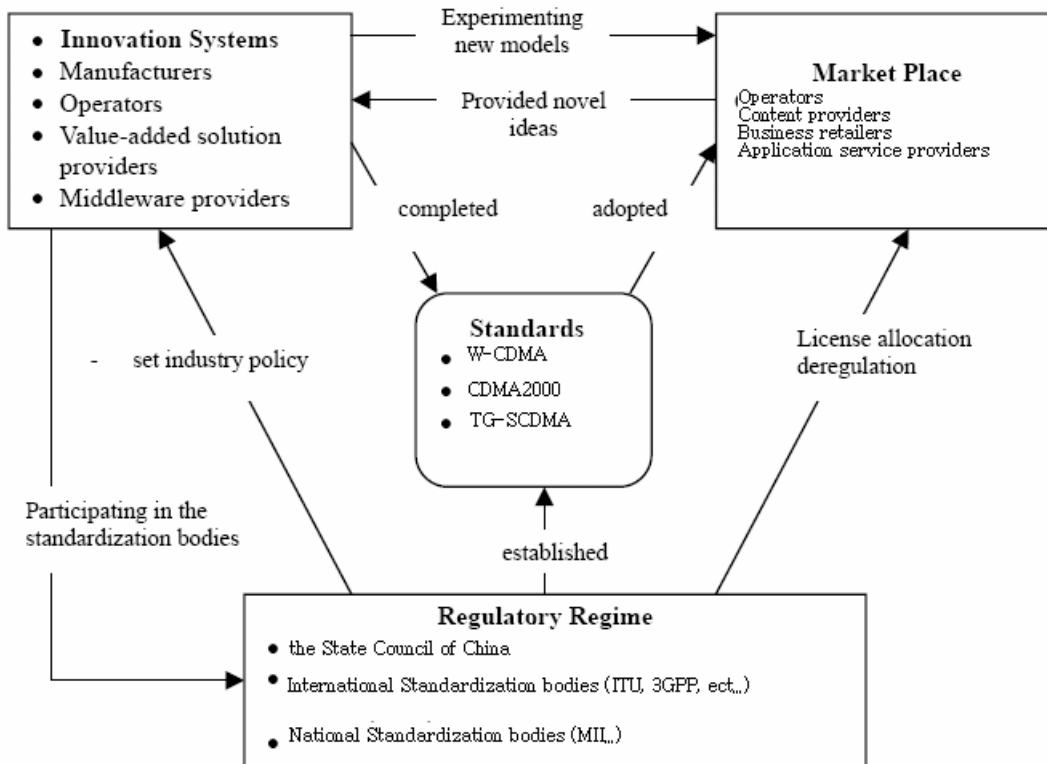


Figure 1: Actor network of 2.5G and 3G era in China

Based on Youngjin Yoo, Kalle Lyytinen, Weatherhead School of Management, Case Western Reserve University, Cleveland, USA, Heedong Yang, College of Management, Ewha Womans University, South Korea: The role of standards in innovation and diffusion of broadband mobile services: The case of South Korea

During the analysis of the interaction between actors in the network, the activities they take could cause a series of issues, these issues can be conclude as follows:

Technical issues (standards features, the migration path form 2G to 3G, imagined 3G network structure)

Market issues (current mobile service environment, revenue from the main local operators, 3G services classification and consumers preference of the 3G services.)

Regulatory Issues (licensing principles, allocation of spectrum, auction, new institution economic approach, structure of China radio regulatory body and the interaction between them)

Theories:

- *Actor Network Theory*
- *Standardization Strategy*
- *New institutional economic approach*

The Actor Network Theory is the main theory that indicates this paper. The main idea of the theory is to view human and non-human as actors that have influence on each other and also impact the transition process to a new actor network. The Standardization Strategy is the chief method that I adopted for analysis. It is the method explored according to Actor Network Theory. It makes the process of transition formulation. And the last theory I adopted is the new institution economic approach. Just as the way of ANT, it narrows down the actors into regulatory regime and the economy. It emphasizes the role of regulatory regime during the transition to 3G network.

1.4 Empirical data

In this paper, the empirical data I use are all from the official website of the MII, the survey of the every month

Theory materials:

In this paper, the theories and principles I will use are mainly based on scholar papers on Actor Network Theory, 3G China case study paper, ITU 3G licensing briefing paper, paper on mobile business model, paper on new institution economic approach, ITU official website, China MII official website and TD-SCDMA forum website.

Empirical data:

The data I used in this paper are from 3G forums, CNII, MII official websites of the survey report for the revenue from China Mobile and China Unicom. And also the definitions of data services are based on the official websites of China Mobile and China Unicom.

Section 2: Actor Network Theory

2.1 Introduction

In this paper I would like to use Actor-Network Theory (ANT) as a theoretical framework to examine the social process of the 3G implementation in China, through which participants reach agreement on some standards, policy issues. This agreement would finally be achieved after a long term of interaction between each other and the interaction would also influence the timing of launching the licenses. Since ANT is mainly about the analysis of dynamic process of agencies, organizations and humans, I would like to use it in this paper. Just as David Tilson and Kalle Lyytinen from Case Western Reserve University used in their paper--*Making Broadband Wireless Services: An Actor-Network Study of the US Wireless Industry Standard Adoption*,[2] they deploy Actor-Network Theory (ANT) as a theoretical lens to examine the socio-technical means through which agreements are reached during standards making and adoption. They examine how actors formulate diverse standardization strategies to pursue their own interests and how they relate to other actors to make that possible in the context of the US mobile wireless industry facing the shift to 3G services. Similar to this, I would like to use ANT to analysis how actors pursue their own interests and how they relate to other in China's mobile wireless industry facing the shift to 3G services.

And as was explored in David Tilson and Kalle Lyytinen's paper, standardization strategy will be used to examine the interaction between actors and the interaction between different realms and the whole process of transitions form the current mobile network to 3G mobile networks. And I will give out a clear introduction of how the potential 3G standards influence the interaction between innovation system, regulatory regime and the market place. Since the main impetus argument of ANT is its symmetrical point of view between human and non-human actors, during the analysis with standardization strategy, the technical standards would be seen as an active actor having its undeniable impact on the other three realms. Just as the theoretical interaction between

standards, regulatory regime, innovation system and marketplace shown in figure1, they have close interaction among each other.

2.2 Actor network of China's mobile service market

Normally, innovation system, market place, regulatory regime can be seen as separate actor networks. Each of them has its own specific components. But they have influence and connections with one another and their own actors also have interaction among each other. Here I would like to give out the brief introduction of the conception and the main functions of innovation system, regulatory regime, and market place in the mobile services network and the relationship between them and standards during theoretical translation process.

2.2.1 Innovation system:

Normally, innovation system is composed by interconnected sites, competencies, ideas and resources that can be used to develop new technology and solutions through a series of research and experimentation activities. According to Y.Yoo, Korea, 2005,[3] innovation system includes the following organizational actors: manufacturer, operators, value-added solution providers and middleware providers. They all work together to help compete the standards. And all these development and innovations activities taken by them should base on the duration of the creation of the standards. The more detailed connection is like this: when the features of the standards introduce a new air or network interface, all the actors would try to negotiate about an agreement on the new capabilities to make use of these interfaces and this agreement would be made officially as some technical specifications. In this case, new interconnection model among actors emerges based on technical projects or experiments. And this process is normally organized through the generation of new featured standards and their corresponding enhanced network.

2.2.2 Market place:

Market place is this kind of actor network which consists of both organizational and human actors, say individual consumers. When it comes to the practical actors, market place contains operators, content providers, service providers, application providers, business retailers and consumers. In market place, mobile services and their underlying technologies are provided. These technologies are defined in the certifications of the featured standards. The services provided in the market place are also to be adopted by the standards and then it provides important ideas through market survey and data to the innovation system, and then this outcome would consummate the technologies that are defined for the standards again. And whenever there is a new model coming out from innovation system, it would be tested in the market place. In market place, standards plays a role of supervision since it would define some technologies that might be chosen for the future use or create some new capabilities. The adoption of these new technologies and services from the innovation system to the market place to a large extent depend on the conception, propensity and individual interests of the actors, both organizational actors like operators while human actor like individual users. Actors in the market place, operators, content and application providers and users are connected with each other and even with the actors in the innovation system, manufacturers, through technologies and the related actor networks built on the standards and related infrastructures. Therefore, we can say that the innovation system tests the out come of their development as new model in the market place and then the feedback of the actors' reaction to the new model would in turn consummate the technologies for the new standards' building. In market place, it is the new services and technologies that would have impact on the consumers' behaviors. And in turn, the consumers' demands of the services are also taken into consideration when the standards are being developed. Innovation system and market place are two separate realms that are related to each other closely.

2.2.3 Regulatory regime

Telecommunications industry was monopoly in China with only one operator China Telecom before 1993. This condition was broken by the establishment of China Mobile in 1994. Right now, the main component of China's regulatory regime, the Ministry of Information Industry has been separated from the operation of China Telecom. And it has the supervision function of the market place and innovation system. For a widely consideration, regulatory regime should be an important actor that consists of industrial, national and international authorities. As we all know international authorities such as ITU (International Telecommunications Union), the United Nations agency for information and communication technologies [4]. It has different scholar groups working for different realms such as radiocommunication, standardizations and development. And it sets the specifications for technical standards for different countries to refer to. For 3G case, ITU has its briefing paper and licensing principles which are also the main references of this paper. As for the national authorities, in China, the radio regulatory body is composed by the State Council of China, the Ministry of Information Industry (MII) and then Department Radio Regulatory and the State Radio Monitoring Center, the two of which are under the supervision of MII. This national radio regulatory body combined with the technical specifications from the international regulatory authorities establishes the possible 3G standards that might be implemented in China and the national radio regulatory body sets the industry policy for the innovation system and the manufacturers in the market place to follow. It launches the licenses and sets the rules for the actors to follow and refer to in market place. And also in turn, the technical support would be given to regulatory regime from the outcome of some technical activities or researches by innovation system. Therefore, regulatory regime has constraint influence on how the actor network would be composed. And the feedback from innovation system and market place would also be taken into consideration during the process of the creation of the technical specifications and the market and policy rules. Changes and activities in regulatory regime have impacts on the other realms in the following ways: the execution of the industry policy would impact on the behavior and the direction of future research and technical activities of innovation system while the licensing policy

and the extent of market liberalization would have influence on the behavior of the actor in the market place. In this process, regulatory interventions and regulatory monitoring by means of pricing and quality play an important role. And for the regulatory intervention, normally they will have the activities such as licensing, frequency allocation, and decisions for specific standards innovations.

In conclusion, all these interaction between these three realms are driven by the development of the new technology and the upgraded consumer demand. This need for new technologies helps the emersion for the new featured technologies and services for standards. The development of the standards has influence on the activities of market place, regulatory regime and innovation system. And in the other hand, the activities of these realms have constraint on the implementation of the new technology. These influence and constraint is shown by the series of activities such as pricing, spectrum allocation, licensing policy and market behavior, which would be given out more detailed in the following chapters.

2.3 Interactions among actors

According to Giovanni Camponovo and Yves Pigneur from *The University of Lausanne, Business Model Analysis Applied to Mobile Business*, successful business models would best present the economic characters underlying this industry. Therefore, in this paper, I would like to use the mobile business model they developed combined with the major organizational actors used in the paper of David Tilson and Kalle Lyytinen from *Case Western Reserve University, Making Broadband Wireless Services: An Actor-Network Study of the US Wireless Industry Standard Adoption*, to give the introduction of the business model of Chinese mobile industry and the actors in it.

Based on the former scholars' research and the specific Chinese mobile industry, I conclude the actors and their interactions as is shown in the figure below:

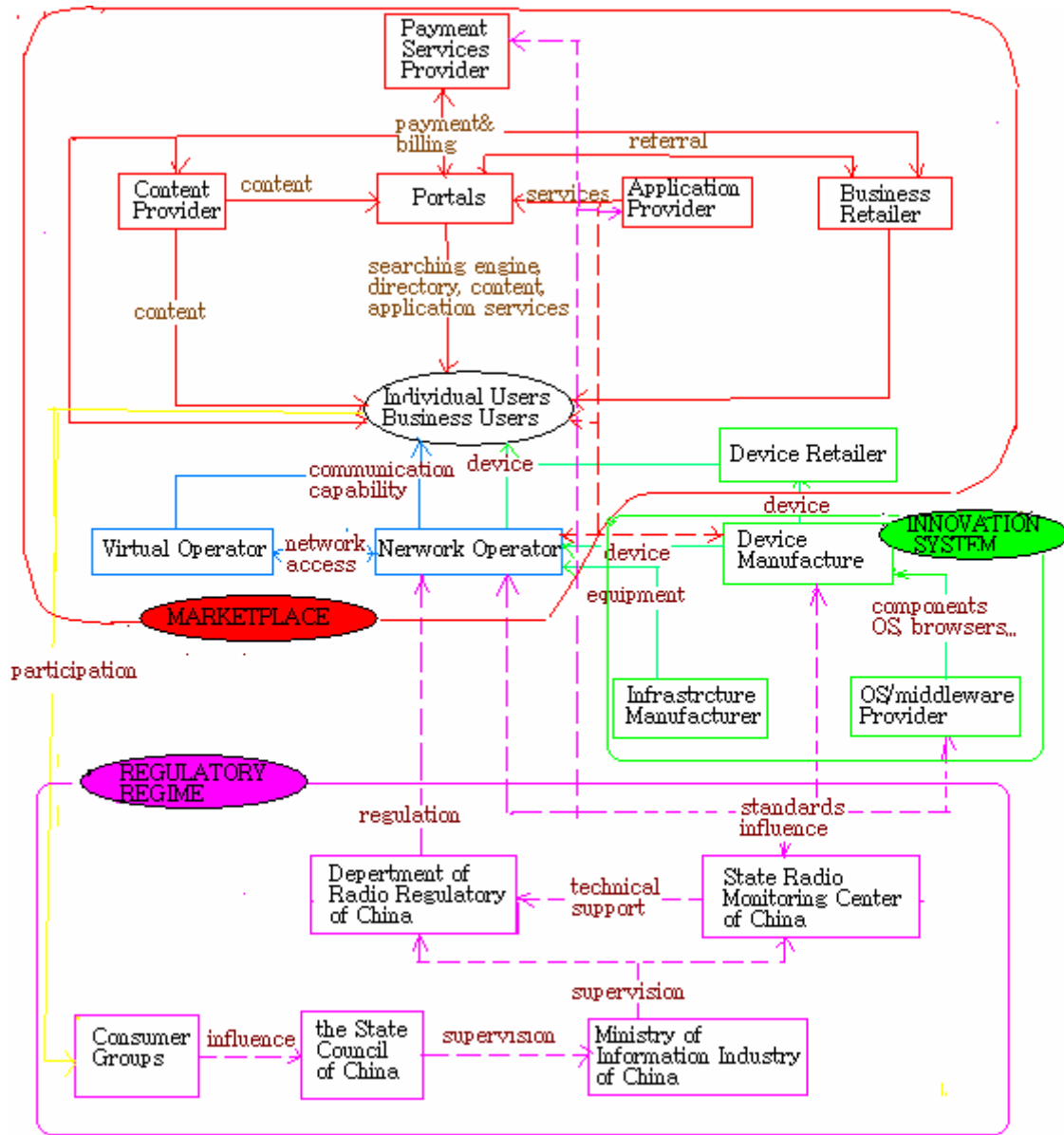


Figure 2: Map of actors in regulatory regime, market place and innovation system in China and the interactions among each other actor.

Based on Giovanni Camponovo and Yves Pigneur from *The University of Lausanne, Business Model Analysis Applied to Mobile Business*

As is shown in the figure above: Chinese mobile industry can also be divided into three groups: marketplace, innovation system and regulatory regime like many other countries. In addition to these three parts, the technical standards should also be taken into

consideration acting as an actor given the fact that the current network structure and 3G standards have influence on the activities of the above actors and the process of the implementation of 3G. The actors have influences among each other. Each single organization can be seemed as an actor and some of them together make up of a sub network. All the specific actors of the three realms and the connection among them are involved in the dynamic process of the implementation of 3G in China.

We can tell from the framework that marketplace consists of payment service provider, content provider, application services provider, portals, users (both individual and corporations) and network operators (mobile network operator and virtual network operator, say WLAN). And innovation system is mainly made up by device manufacturer, OS/middleware provider and infrastructure manufacturer. At last, regulatory regime, which plays a very important supervision role in China, should have the components of consumers groups, the State Council of P.R.China, Ministry of Information Industry of China (MII), and the State Radio monitoring center and the Department of Radio Regulatory, which are under the supervision of MII.

The following part I will give out short information of the main actors' values in the whole network, target customers, core activities, business partners and revenue flows.

2.4 Actors' interests and main activities in the network

In the Chinese innovation system, like many other countries, device manufacturers provide physical mobile devices such as mobile phone, notebook and so on. Their main activities are doing research, development and product design. They buy micro browser and embedded software from application developers and then make their own products out of these devices. They allocate their products through their business channel to device retailers and network operators, which are very important partners for devices manufacturers. Devices manufacturers and operators have very close business partner relationship. They will have some contract to make the 3G handsets pushed to consumers

through the operators. For example, China Mobile would make some 'special menu' for students with some binding handsets and mobile numbers to promote some mobile phones. They might also cooperate with content providers, application providers to help them provide new services that would help the consumers pursuing their devices. The application interoperability is then enabled by different manufacturers agreeing with one standard. Therefore, which standards are to be chosen in 3G mobile market is important for the manufacturers, content providers, and services providers. In the business chain, the main consumers of handset manufacturers are the device retailers, content and application providers and network operators' distribution channels. They gain money from the sale of their product and portal activities, which could be seen in the figure 2 that all the actors in the innovation system connect with content providers and application providers either directly or through the portal. In China, the main devices manufacturers are equipment vendors like ZET, Huawei, Nokia, Eriksson, Siemens, Motorola, phone manufacturers like ZET, Huawei, Sony, Samsung, PDA manufacturers and some wireless card manufacturers.

Another actor in the innovation system would be the infrastructure manufacturers. They provide physical core network infrastructure including air interface, base station, routers and so on. Besides these physical supports, they also provide virtual infrastructure such as network management systems, billing systems, network management systems, application and service platforms and so on. Both the physical and virtual infrastructures have very close business relationship with the billing system, application providers, and content providers in market place and network operators. Besides the physical and virtual infrastructure support, infrastructure manufacturers also provide services such as network design, evolution planning, integration, implementation operation these kinds of infrastructures related services. Network operators need to use their physical network infrastructure to build the network and also need to use the network design services during the process of network building. Content providers and services providers are also their consumers since they need to use the portal they offer in the market place. Therefore, innovation system has close relationship with market place and network operators.

Actually, network operators are related to every realm. As is shown in the former figure that operator I the actors in innovation system and market place.

Then the actual behavior of infrastructure manufacturer with its business partners is like this: equipment sellers buy equipment from the component vendors and application developers. And then they make their own products—equipment and sell them to network operators. Here the collaboration among different equipment vendors is necessary to make sure the network interoperability and their business solutions usable in the whole network. In this case, normally members of standardization groups emerge to enable the adoption of new networks. The network infrastructure manufacturers sometimes are partners with devices manufactures. They gain money from the sale of their products and their business solutions. In China, ZET, Huawei, Ericsson, Nokia, Motorola, Siemens and Lucent are the main infrastructure manufacturers.

Operators are normally divided into fixed-lined and mobile network operators. In the 3G implementation in China, both fixed-line and mobile network operators are involved. This is because that 3G is a new tech and every operator is on the same level. Facing with the large potential 3G market, every one wants to have the license of 3G operation. In China, both Chinese and international operators are active in the preparing for the 3G market.

Although both fixed-line and mobile network operators are involved in the 3G market, the main part would still be the mobile network operator because of its current market share for mobile services industry. Mobile network operators provide physical access to end users to enable the end users communication with each other in their network and other network operators' networks or even with internet in with the technology 3G standards provide. They make the mobility of the end users possible here the standards related technical issues such as infrastructure sharing and spectrum allocation should be taken into consideration. They provide various network-related services such as location

information to the end users and billing services to third parties such as application providers and virtual operators. In order to build a new network, normally operators have to make purchase from infrastructure vendors and make agreements for traffic with other operators and Internet Service Provider (ISPs). This activity makes sure the access other networks for the end users. They play an important role in marketplace and innovation system. Because of this crucial role in mobile business, operators have a large group of business partners. They are content providers, application providers, service providers, virtual operators and portals. These actors also play important role in the translation process for 3G network. A well processed standardization can help not only the development of the standards itself but also increase the revenues of the actors. Revenue sharing agreements might be a good strategy for the related actors' benefit. The main activities of operators are to promote network and to make contract management of customers, handling problem and to provide services and to operate infrastructure such as the planning, deployment, maintenance and management of the network. Operators earn revenues from their subscribers by charging services fees and volume-based fees and from transaction fees by the network services they provided. And also they might get benefits through some portal activities.

The main Chinese local operators in the telecom industry are China Mobile, China Telecom, China Unicom and China Netcom. Besides these, there are also China Railcom and China Satcom. And among them, China Netcom's main revenue is come from the revolution services based on ICT, broadband content and application services. China Unicom's main revenue is based on the GSM and CDMA network infrastructure which provide mobile services. China Telecom's main revenue is from its business services, non-voice services. China Mobile is the largest mobile services network operator in China. It has the largest GSM network infrastructure in China and has the largest mobile individual consumer group. Its services cover both users in cities but also in countries. The value-added services are the main revenue resource. Before the licensing of 3G by the policy makers, different operators have different attitude. The fixed-line operators such as China Telecom and China Netcom, want the license badly while the network operators, say China Mobile and China Unicom have some consideration of the extend

that Chinese consumer could accept the 3G service and its concerning cost and also the network building cost of 3G. Here the influence between the reaction of both operators and consumers is explored very well. And for the international operators, the way they share this 3G market is to collaborate with Chinese operators. By far, the international operators emerged in China are NTTDoCoMo, Verizon, Swisscom, Vodafone and Orange. [5] But they are still waiting for the related policy to be clearer.

The figure below shows the revenue, users' amount and the main services of the four operators in China.

(Hundred Billion)	Revenue (yuan)	Payoff (yuan)	New Subscribers	Total Subscribers	Main Services
China Netcom	406.53	58.58	110.5	1.1507	ICT; broadband content; application services
China Unicom	491.7	37.7	926.6	1.5163	Services enabled by GSM and CDMA networks
China Telecom	869.58	118.16	145	2.24	Business services, non-voice services
China Mobile	1666	379	3,115	3.3237	Basic mobile services and Value-added services

Figure 3: Overview of the main operators in China By Q2,2007

Data from CNII official website [6]

Market place:

Content providers provide relevant data services such as news, music and video services to the end users. They will work with portals in order to get connection with consumers. Otherwise, they might get connection with the users directly through direct distribution. They often work with a number of content aggregators and portals in to spread their products. They get information from press agencies and media companies and then with this content they make their own products. And there would be an agreement with other partners like application providers and network operators to make sure the profitable revenue sharing business model. The main activity of them is to collect information for content and process it and then format, publish and distribute the content they made. Also they need to manage the content they distribute. They normally get money from subscriptions and usage fees from the consumers and agreements revenue sharing with other partners. The well known content provider are press agencies like Xinhua in China, media companies like Shanghai Wenguang, CCTV and then some content aggregators like Yahoo, Sina.com.

Application providers provide middleware and different application related services to actors such as network operators, portals, businesses retailers, device manufacturers and consumers, which is shown in the figure of the actors. Application providers normally collaborate with network operators make sure the access to the essential network services. And also they work with the portal to enable the connection with its users. Device manufacturers are also one of the partners. The cooperation with device manufacturers identifies the compatibility with different devices and the exploitation of their brand. One application providers can also purchase from other application developers without make their own service. Their main activities may include application development, integration, management, infrastructure operation support and consulting services. Their revenue mainly comes from agreements for their services.

Payment agents are always ignored by other researches. Normally payment agents could provide a series of ways for users to pay for their purchase of the services form content providers or application providers. This whole process is cash-free through phones. And then the fees might be concluded into the month bill or a bill from the bank. Besides the services for individuals, they also have payment platform services for business consumers. Their target customers are normally the end users and service providers. Payment agents normally cooperate with banks or credit card companies during the payment process. They get connection with their customers' accounts through these financial institutions. They also have network operators as partners during the billing and collection services process. Besides this, device manufacturers and hardware providers are also their partners. Services providers might provide them the security solutions for the payment process and other service providers might also provide other services that might help the improvement of the payment system. In conclusion, the main activities of payment system are to develop payment platform and the management of the payment, to billing and to collect. They will gain benefit form the subscription and transaction fees.

ISPs stand for the Internet Service Providers. It provides access to Internet. From 2.5G mobile services, ISP becomes actor in the market. This is because of the more and more demand for the integration of mobile phone network and Internet network. In the new business model, ISP become important especially for the 3G services, which is have the features of combination of mobile services with Internet-based services. Normally, ISPs work with infrastructure vendors to get Internet equipment and to build their network. Then like mobile network operator, they would also make agreements with network operator for traffic in order to make the connection with end users. And make sure they could get access on Internet through the portal of mobile network operator. They also work with content providers and application providers to make the services they offered could be more various. Therefore, in conclusion, their main target consumers group would be mobile network operators and end users. With the partners and target consumers, ISPs promote network, manage activities and provide access to Internet. They earn from the subscription of the users and traffic agreements with partners.

That is to say market place have influence on which standards to be chosen since this influence will act upon the novel idea of technical researches of the innovation system given the market demand and reaction and then the out come of the innovation system would help consummate the content of the standards in turn.

Regulation regime:

According to *Giovanni Camponovo, Yves Pigneur, the University of Lausanne, Business Model Analysis Applied to Mobile Business*, regulatory regime is very important in telecommunication industry. As is shown in the framework, regulatory regime consists of government, which in China is the State Council of China, and international regulatory bodies such as ITU, 3GPP and so on and then the national regulatory body, which in China is composed of MII and its sub organizations. Regulatory regime establishes standards. In the 3G case, the ITU sets IMT-2000 for 3G standards and then the MII make the national industry policy according to the international standards. And this industry policy would influence the behavior of innovation system and then the out come of the innovation system would participate in the regulatory regime again. The licensing policy and spectrum allocation policy of the regulatory regime would also supervise the behavior of the actors in the market place. Therefore, it is possible to say that regulation regime interact all the parties in the mobile industry and it sets regulations to monitor the market. It also makes policies to manage the frequency allocation, licensing and to monitor and supervise the market and make sure the healthy competition between actors to enable the healthy development of the whole industry. It gains benefits from the taxes and license fees.

2.5 Standardization strategy

All these above analysis and statement are about the features of actors in Chinese 3G translation process and their interests and interaction among each other. In order to give

more detailed explain of how the process of the translation goes on in each of the realms among all these actors, I will borrow the conception of translation phase in ANT, which is divided into three important moments: problematisation, interessement and enrollment.

There is the description of the three moments and what would the main actor in it do in this moment in the following figure:

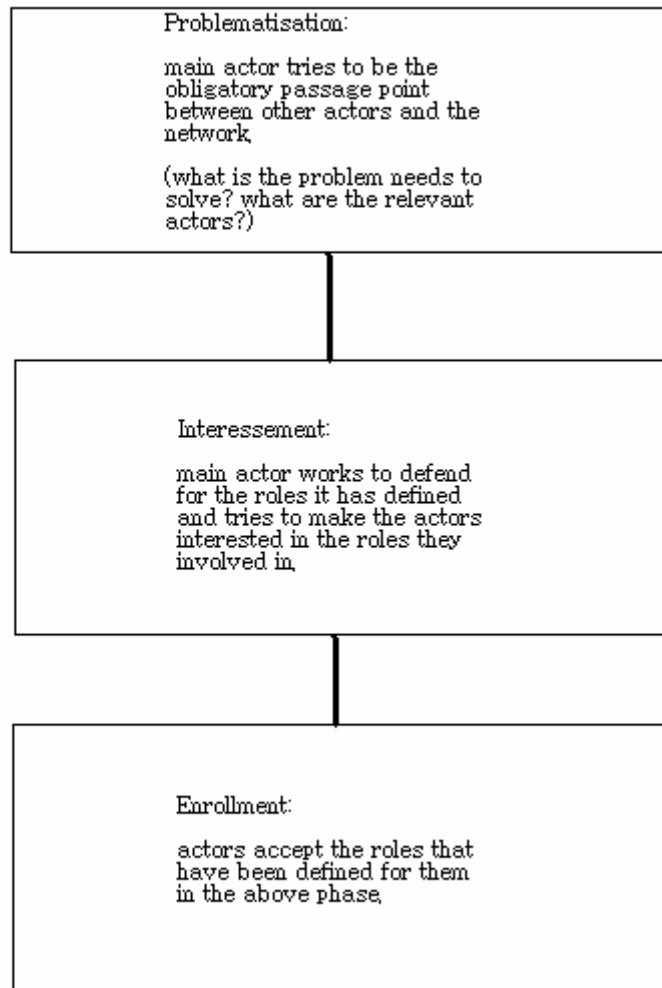


Figure 4: The three steps in the Standardization Strategy

Based on David Tilson, Kalle Lyytinen, *Case Western Reserve University*, Making Broadband Wireless Services: An Actor-Network Study of the US Wireless Industry Standard Adoption.

Problematization:

As is shown in the figure, potential standards would be identified in this stage by the main actor. The first consideration would be about the features of the standards. And this consideration has much connection with the benefits of the main actor that they would get from the implementation of the new standards. Then what other actors should be involved in is another consideration taken by the main actors. In these stages, normally a so called-*standardization strategy* is deployed.

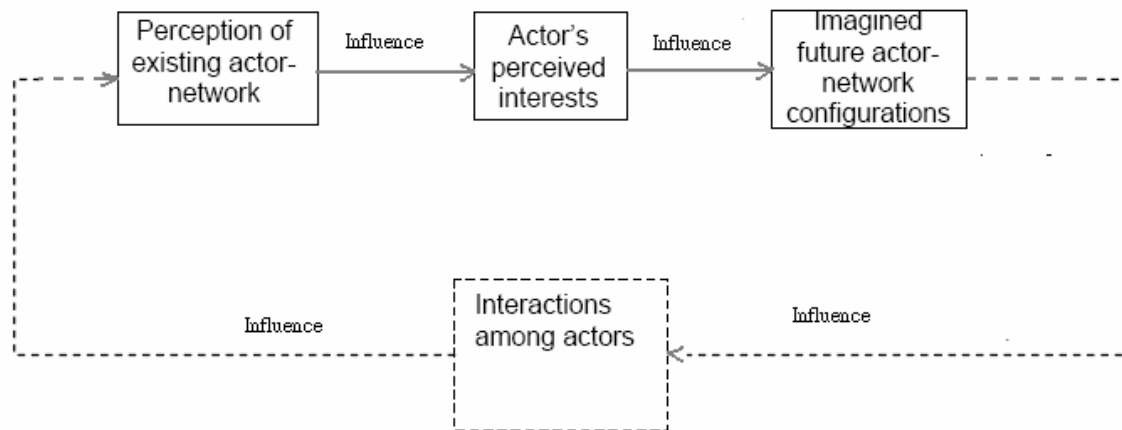


Figure 5: Standardization Strategy

From David Tilson, Kalle Lyytinen, Case Western Reserve University, Making Broadband Wireless Services: An Actor-Network Study of the US Wireless Industry Standard Adoption.

As is shown in the above figure, in this standardization strategy formulation, the perception of current network have influence on the actors' interests, and some of their interests that could not be full filled in the current network would make them to image a new actor-network that have these features. Then a new standard might be proposed and it will have influence on the interaction among actors. This cycle describes best the behavior of main actor in this problematization stage.

Interessement:

In this phase, the main actor tries to make other actors aware of its problematization and it tries to make sure the creation of the standards through some negotiation with other actors. According to Latour (1986) a proposed standard normally moves through time

and space in the environment where all actors might have different reactions upon the creation of the proposed standard. They might modify, deflect, argue or obey it.

Therefore, the diffusion of the standards is based on the needs and interests of all the actors and their interaction to the creation of the new technology in the network.

In the phase of interessement, from the standardization strategy formulation, all the actors try to pursue their interests. Therefore, a conclusion could be drawn that the reaction of all the actors in interessement phase and the main actor in the problematization phase can be seen in the standardization strategy. And then the use of standardization strategy could change the structure of the current network and thus a new network is created and new actors might be enrolled. It is a dynamic cycle from the very beginning stage of problematization to the stage of interessement and even to the coming enrollment stage.

Enrollment:

In the process of the actors interacting with each other to pursue their own interests, various strategies they use would finally result in an agreement. Different interests of different actors should be covered in this agreement, documental technical artifacts. Then when the standard is implemented, the original network is enlarged and more actors would be attracted into the new standard adopted actor-network.

With this detailed analysis method, I will give out main idea of the method to analysis the translation process for 3G implementation.

Research method:

Normally, the first stage of the translation process is the problematization. It is common that the existing actor-network would cause the telecom industry changed. Based on the research method of David Tilson and Kalle Lyytinen in their paper, “with the development of the mobile services, the availability of digital wireless networks capable of supporting data services and the possibility upgrade of the network capacity, the need

to compensate for low growth in voice revenue and the number portability, growth in Internet usage and the challenge from new technologies such as Wi-Fi, Wi-Max and VoIP, mobile services industry might have some changes.”[2] This would cause the new need for the mobile services and new need for enhanced standards. Therefore, there are some potential reasons resulting in the disruption of the existing actor-network. First, technical push makes digital wireless networks available and enables data services and upgraded network capacity. And in the market place, the low revenue of basic voice can not satisfy the operators and government. Besides, demand of consumers and challenge of other mobile technologies also make new need for mobile services and enhanced standards. With these push factors, new actor network should be formed begin with the imagined features.

This emerging of the imagined services features might cause the development of new network operators’ data services. The process goes like this: The increasing popularity of the Internet and technical potential of digital wireless network have the ability to provide new wireless data services. The imagined new features come out. Then some existing wireless industry actors might recognize the opportunity. Then technological interface is put in place and new commercial relationship is made; device and infrastructure manufacturers, middleware vendors in innovation system work with one another to deliver a data service platform. Content providers compete with each other to gain the chance to cooperate with the operator. Operators work together with content providers to bring the new data service to the market. Then in the market place, some consumers accept it. This will then result in the process that some actors enroll by chance and then under the network effect, others join later. And then actors play dependent with each other in the actor-network and then the enrollment stage finish. [2]

Based on the ITU briefing paper and the Actor-Network Study of the US Wireless Industry Standard Adoption, there should be some rationales during the standardization process:

- Minimized cost of infrastructure since it is not seen as a differentiator in the marketplace

- Avoid lock-in to infrastructure and device manufacturers (that is why some agreement should be made for them to enable the interoperation between different manufacturers.)
- Avoid one industry player from controlling of important interface.

This standardization strategy can shape the industry in the image of futures and avoid the industry's transition into unattractive imagined futures.

Transition between industries goes like this: the wireless data services not only provide the transition from exiting network to a new imagined network but also attracted new actors into this wireless data services industry. They are the middleware vendor from the computing industry, the traditional web from the content industry and IT services and also some fixed-line operators such as China Netcom and China Telecom.

Since operators are involved in every realm, here I would like to give out the relationship between operators and infrastructure manufacturer, operator and handset manufacturer, operator and content providers and operator and consumers.

In the market place, operators work with more than one infrastructure manufacturer across its many markets. Operators use competition between manufacturers to identify the best solutions to problems. Operators maintain close, long term relationship with infrastructure manufacturer. In the standardization, operators work with manufacturer to have preferred solutions adopted as standards. Operators use standardization as way of minimizing cost.

In the market place, operators work with several handset manufacturers expecting to specify device requirement. For the standardization, the handset manufacturer is required to provide data capabilities through collaboration with specified middleware providers and they are less standardization desirable.

With the consumers' focus leading to the desire to offer content based services brings the content providers into this industry. The content services are web portals, news, entertainment, information and music and TV broadcast and video program. Content providers compete with one another to get the connection with consumers through the operators. There are standardization wars around the delivery of content. New content providers, actors from computing and networking industries get into this forum.

The focus on the telephony services of consumers lead to similar focus on data services. In the standardization process, consumers are not evolved. And for the corporate consumers, standards based solutions speed up the time to market and they are willing to adopt proprietary solution to gain competitive advantage over other operators.

By far it is the brief analysis of all the actors in different realms in the wireless services industry in China and the actors' reaction to the different stages of the translation process. In the following chapters, I will give out some issues that are involved in market place and regulatory regime. And first, I will give short introduction of the existing network systems and the imagined 3G standards.

Section 3: Transition from 2G/2.5G standards to 3G standards

Standards as technical actors in the actor network are very important and they have influence on the other three realms, market place, innovation system and regulatory regime. Regulatory regime sets specifications of standards for new networks according to the market demand and the trends of international and national industry development. These specifications of standards would be executed by the actors in innovation system and market place. Thus during the execution, standards have impacts on the behavior of the actors in market place and the outcome of market place provides new spark of ideas to the development activities in innovation system and then the out come of innovation system would be tested as new model in market place and thus to get the feedback to consummate the standards, which would also have impacts during the constitution of standards for regulatory regime. This interaction between each other functions dynamically until the transition from current network to new featured network stable. In the transition process, the features of existing network and the imagined network should be the percept by the actors in the industry and with the attraction of new business opportunities, new actors would enroll to make the new actor network established finally. In order to help better understand of the different standards and their features, in this section I will give out the existing 2G/2.5G network structure and their features in China and then introduce the possible 3G technologies and features of 3G services. With the introduction of the networks, I will then give out the possible migration path from current network to 3G network infrastructure in China.

China Telecommunications industry has been experiencing evolutions. The first transition is form the first generation mobile technology, analogue cellular systems, to the second generation, digital cellular systems. In this evolution, sending non-instant

text messaging, SMS is possible, which is proved to be a very successful service that gain lots of consumers and is still very popular right now. After this, with the Internet-based services enabled by the technology so-called GPRS, Chinese mobile market came to the 2.5G times. This 2.5G technology enables people to send Multimedia Messaging Service (MMS) and to get online through the Wireless Application Protocol (WAP). With the wildly spread of the Internet based services, high speed of the data transfer and multi-media services is imagined by the actors and then upcoming evolution, the migration from 2G/2.5G network to the “Third Generation” (3G) systems would occur.

To compare the current with the future 3G network, I would like to give out the existing network features first. Right now China is in its 2G and 2.5G times. The main 2G technologies it uses are GSM and CDMA. By far, China Mobile and China Unicom are the two largest mobile network operators. China Mobile has a GSM network and covers it with the General Packet Radio Service (GPRS). By the beginning of 2007, it has 2.7 hundred million users in China. On the other hand, China Unicom has two networks, GSM and CDMA. By the beginning of 2007, China Unicom has realized the coverage of CDMA network with 1x technology and has gain 34 million users. For the GSM network, China Unicom has 1 hundred million users and plan to cover GPRS step by step. Right now, its GPRS network has been tested commercially in Shanghai and Beijing.

As is shown in the figure of Standardization Strategy, the imagined features of new network are drawn by the cognition of the existing network. Therefore, I will first introduce the exiting network features of standards in China.

3.1 Existing 2G network features

In China, the main 2G technologies are GSM and CDMA, operated by China Mobile and China Unicom. They are both digital systems. 2G technologies were first

developed at the end of the 1980s. Both the control link and the voice signal are digitized in these systems. Compared with the first generation network, 2G systems provide better voice quality and higher data capacity at a lower cost. The most significant advantage of 2G compared with 1G is the possibility of sending short message services (SMS), which is very popular in China.

According to GSM world [7], GSM stands for Global System for Mobile Communications. It is an open, digital cellular technology used to transmit mobile voice and data services. It is different from the first generation analog wireless systems. It uses digital technology and time division multiple access transmission methods. GSM is a circuit-switched system which divides the 200 kHz channel into eight 25 kHz time-slots. Based on the specification of ITU, GSM network may have two main frequency ranges, 900 MHz or 1800 MHz bands and the 850 MHz or 1900 MHz bands. China uses the former one, 900 MHz or 1800 MHz, the same with Europe. In China, China Mobile is the largest mobile operator who owns a GSM network. To take the GSM 900 MHz network in China for an example, the uplink frequency band occupies frequencies from 890 MHz to 915 MHz while the downlink frequency band occupies from 935 MHz to 960MHz. we can see there are 25 MHz bandwidth in each side.

As we can imagine the word ‘cellular’, the whole GSM network has many virtual ‘cellular’ like beehive. Mobile phone user works as a Mobile Station. Mobile stations move among these cellular and inform the cellular they are in by sending request signals. The communication among them is in the charge of Base Station Subsystem and the Network Switching Subsystem of GSM network. The coverage area of each cell varies according to the implementation environment. There are four kinds of cell size divided by antenna height. From large coverage area to small, they are macro cells (antenna above average roof), micro cells (under average roof top level), Picocells (indoors) and umbrella cells (cover shadowed regions/fill in gaps).

In China, GSM is the most popular network and 3G network is largely possible to be built sharing the current network structure. Therefore, it is important to know the network structure of GSM network.

Like GSM networks in other countries, GSM network in China also consists of these parts:

- The Base Station Subsystem (BSS)

According to Privateline Telecommunications Expert,[8] the Base Station Subsystem has two components: the Base Transceiver Station (BTS) and the Base Station Controller (BSC). The Base Transceiver Station works as radio Transceiver that defines the cell and handles the radio-link protocols with the Mobile Station. While the Base Station Controller takes charge of the radio resources for Base Transceiver Station and handles radio-channel setup, frequency hopping and handovers. It connects the Mobile station with Mobile service Switching Center.

- The Network and Switching Subsystem (NSS)

The Network and Switching Subsystem is the core network of GSM network. It executes switching functions and manages the communications between mobile stations and the Public Switched Telephone Network. (PSTN is the world's public circuit-switched telephone networks. In China, it is owned by fixed-line operators, China Netcom and China Telecom.) While as part of the core network, NSS is owned and operated by mobile network operators, China Unicom and China Mobile. NSS also makes it possible for mobile stations to communicate with each other in enhanced network. The functions of NSS works like the process of telephone exchange except for the additional functions for mobility request. The

Network Switching Subsystem usually belongs to the circuit-switched network. It makes the use of traditional GSM services possible such as voice calls and SMS.

In fact, right now, both circuit-switched network and packet-switched data services are used in one network. With the development of 2G network, the Short Messaging Services is enabled compared with the first generation. However, the Internet based services is not accessible while the imagined features have already emerged among the actors. Thus the enhanced GSM network GPRS and its internet based services come out. On the GSM core network, an overlay structure of packet-switched data services shifts the GSM core network into the GPRS core network. GPRS core network, with both packet-switched and circuit-switched technologies can provide enhanced 2.5G services such as Wireless Application Protocol (WAP) and Multimedia Messaging Services (MMS). According to the definition of GPRS core network, it is the optional part allowing packet based Internet connections. It provides mobility management to tract the mobile station and it becomes the major function of a GSM or a UMTS network.

This is the example of network infrastructure sharing within one network. This method too a largest extent saves the cost of building a new network and also makes a good use of the current one. To make the process of transition from 2G/2.5G to 3G smoothly, this method should be adopted.

There is the map of the network structure of GSM.

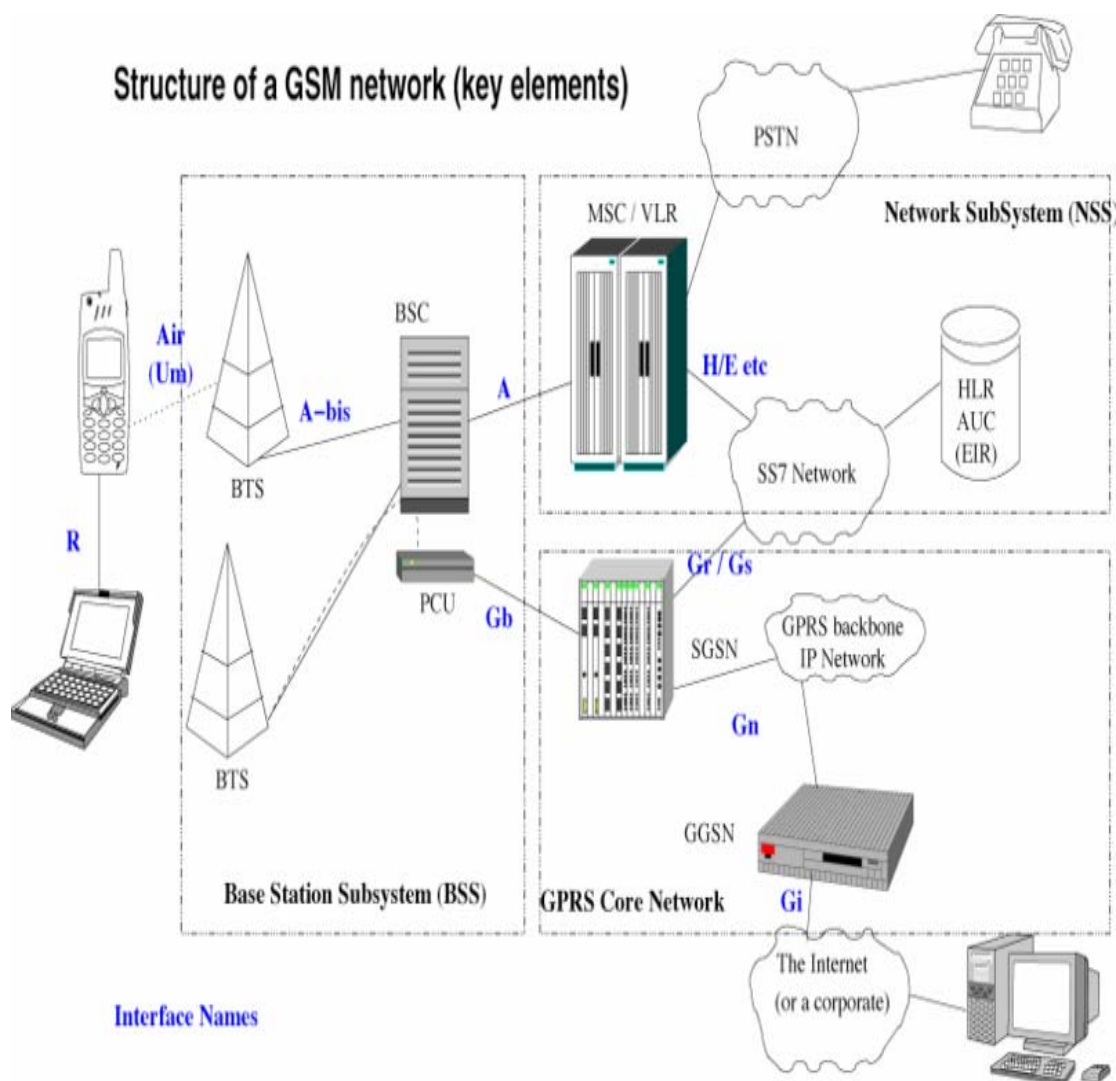


Figure 6: Structure of GSM network

Quoted from [9]

While according to CDMA Development Group,[10] CDMA stands for Code Division Multiple Access, which assigns unique codes to each communication to differentiate it from others in the same spectrum. Therefore, CDMA has the so-called "spread spectrum" technology. This technology allows users to occupy both the same time and the frequency band. CDMA enables people to share the airwaves simultaneously without any alternative technologies. Since the 3G network provides wireless services such as wireless email, web, digital picture taking/sending, GPS

applications, video and audio streaming and TV broadcasting, the capacity for voice and data communications of the infrastructure is important. And this is also the advantage of CDMA for better capacity for voice and data communications than other commercial mobile technologies and also its allowing more subscribers to connect at any given time makes it a common platform for 3G.

The CDMA air interface can be used in both 2G and 3G networks. CDMA/CDMA 1 includes IS-95A and IS-95B. It is the foundation for CDMA2000 and WCDMA. [10]

3.2 From 2G to 2.5G

Based on the current 2G/2.5G network, right now in China, China Mobile has only one network GSM, thus, it enhance the network with the only one path—the overlay of GPRS core network to provide 2.5G services. And for China Unicom, it has both GSM network and CDMA network. For GSM network, it will act the same as China Mobile and have already tested its GPRS network in Shanghai and Beijing. For CDMA, it is the only one operator in China operating this 2G technology. It has already built its CDMA 1x network and gained 100 million users by the beginning of 2007.

Packet-switched GPRS network has the delivery speeds of up to 115kbit/s while circuit-switched GSM data transmission rate is only 9.6kbit/s. The significant advantage of GPRS is that it avoids dialup delays since it can provide permanent connection to the Internet. GPRS makes GSM get compatible with the Internet based services in a more efficient manner.

However, GPRS has its own shortcomings. “GPRS networks take the full channel of eight time-divisioned circuits, running at 14.4kbit/s each to create one packet channel of 115kbit/s. This means that to obtain a 115kbit/s connection, each user would

theoretically be occupying network resources equivalent to eight voice circuits. Therefore, if GPRS services do take off, considerable strain might be placed on the existing systems.”[11]

“Another factor that may slow down the take up of GPRS is the need for subscribers to buy GPRS-enabled handsets. Aside from the cost of these handsets, there have been reports that manufacturers are still grappling with problems of overheating, battery life and software operability of the GPRS handsets, and that their commercial availability on a large scale will be subject to considerable delay.”[11]

Therefore, it is unavoidable that there is the GPRS network after the population of GSM network since the imagined features of the new network have been drawn by the actors. But the answer of whether the WAP services of GPRS can gain as many users as the SMS of GSM or not depends on the willing of the consumers. Therefore, it is very important to test a new model form innovation system into market place before the related products is produced in a large amount. From the market data of [29], WAP services are not as popular as SMS in China. Similar to this, right now the operators and devices manufacturers are testing their interfaces, devices for 3G in some big cities in China. TD-SCDMA is to be tested in Beijing, Shanghai, Shenzhen, Tianjing and other 6 cities this year.

3.3 Imagined 3G features:

However, this little reduced fever for mobile internet can not hold back the innovation of new technologies. With spread of the internet based services, more and more need for higher data transfer rate and multi-media services have come into the features for new standards.

According to ITU briefing paper, the imagined 3G services should include high-speed data, mobile Internet access and entertainment such as games, music and video programs using image, video and sound to mobile users. It provides:

- high data rates at a minimum of 144 kbit/s, for all radio environments and 2 Mbit/s in low-mobility and indoor environments;
- symmetrical and asymmetrical data transmission;
- circuit-switched and packet-switched services, such as Internet Protocol (IP) traffic and real-time video;
- improved voice quality;
- greater capacity and improved spectrum efficiency;
- several simultaneous services to end-users and terminals, for multimedia services;
- seamless incorporation of 2G cellular systems; and
- global roaming between different 3G operational environments; and economies of scale and an open international standard that promises to meet the needs of the mass market

Different from 2G/2.5G network, 3G services have much higher data transmission rate, even over most residential fixed-line networks. Typical 3G asymmetrical multimedia services such as internet browsing and full motion video have more traffic flowing in one direction than the other. It is divided into medium multimedia with 384kbit/s downstream while 64kbit/s upstream data transfer rates and high multimedia with 2mbit/s downstream while 128kbit/s upstream data transfer rates. For its symmetrical multimedia services such as videoconferencing and telemedicine, have user bit rate of 128kbit/s in each direction.

This great improvement in data transfer rate enables the multitasking between mobile phones, hand-held computers, and other multimedia devices. Therefore, high-quality

audio, video and graphics, Internet browsing, e-commerce, e-mail services are provided on 3G phones.

Besides the high data transfer rates 3G system provides, the support of seamless global roaming would be one of the distinct advantages of 3G networks. International roaming through seamless delivery of services over different media such as satellite or fixed-line makes it possible for users to move across borders while using the same number and handset.

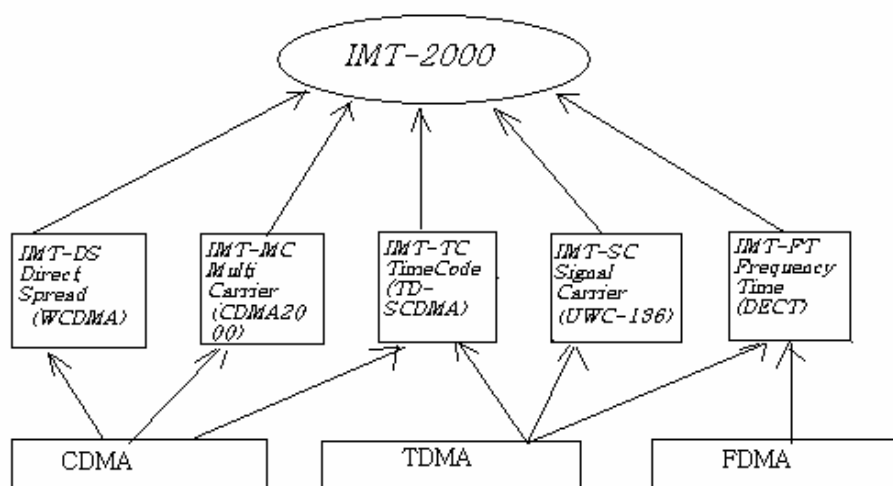
According to ITU briefing paper, the development of the conception of IMT-2000 was built by ITU. After over ten years of hard work under the leadership of the ITU, a historic decision was taken in the year 2000: unanimous approval of the technical specifications for third generation systems under the brand IMT-2000, which is built to realize the fact that for the first time, full interoperability and interworking of mobile systems could be achieved. [12]

IMT-2000 includes five standards: IMT-DS Direct-Sequence/WCDMA, IMT-MC Multi-Carrier/CDMA2000, IMT-TD Time-Division, including TD-CDMA (Time Division Code Division Multiple Access) and TD-SCDMA (Time Division Synchronous Code Division Multiple Access), IMT-SC Single Carrier/UWC-136 and IMT-FT Frequency Time/DECT. In China, WCDMA, CDMA2000 and TD-SCDMA would be the possible 3G access methods.

IMT-2000 makes it possible to provide value-added services and applications through one agreed standards brand. The system provides a platform for distributing both fixed and mobile, voice and data, Internet and multimedia services. One of its key purposes is to make sure seamless global roaming, to enable users to move across borders without changing phone number or handset. IMT-2000 also makes it possible

to communicate and deliver data seamlessly over a number of media such as satellite and fixed line. IMT-2000 provides higher transmission rates: 2Mbit/s for users at a low moving speed, and 348kbit/s for users at a higher moving speed such as cars or trains, compared with the 9.6kbit/s and 28.8kbit/s in 2G systems.

IMT-2000 structure



Value-added services and worldwide applications development on the basis of one single standard accommodating five possible radio interfaces based on three technologies.

Information based ITU's IMT-2000 paper:

<http://www.itu.int/osg/spu/imt-2000/technology.html#Cellular%20Standards%20for%20the%20Third%20Generation> cited by 2007/08/20

Figure 7: Structure of the IMT-2000

In order to meet the imagined features of the new network, IMT-2000 should have the following key characteristics:

1. *Flexibility*

For the operators' benefit, in order to save cost, they want to avoid supporting wide range of different interfaces and technologies. IMT-2000 standard provides a highly flexible system as is shown in the above figure. There are five different radio interfaces based on three different access technologies FDMA, TDMA and CDMA. This content ensures different operators with different access technologies or

interfaces could cooperate and participate in the 3G market. Take China Unicom for example, it can use either CDMA1x network or GSM network to shift to 3G network.

2. *Affordability*

This means that 3G systems should have the ability to be affordable, in order to encourage the adoption by their potential consumers and network operators.

3. *Compatibility with existing systems*

IMT-2000 services have to be compatible with existing systems. In China, 2G systems have experiencing a long time and have been active with their large group of users. 2G system, especially GSM standard will continue to exist for some time in the Chinese mobile market. Therefore, 3G system should have compatibility with these 2G systems so as to make sure the effective and seamless migration paths from 2G/2.5G to 3G systems..

4. *Modular Design*

“The vision for IMT-2000 systems is that they must be easily expandable in order to allow for growth in users, coverage areas, and new services, with minimum initial investment” [11]

To give a more clear presentation of the 2G, 2.5G and 3G network services, I conclude them into the following figure:

Technologies	Enabled Applications
2G	<ul style="list-style-type: none"> ● Voice ● Short Message Services ● Digital Text Delivery

2.5G	<ul style="list-style-type: none"> ● Mobile Banking ● Voice mail ● Mobile Internet ● Mobile Radio ● News ● Mobile Advertising ● Mobile Financing
3G	<ul style="list-style-type: none"> ● Video Conference ● Video Phone ● Mobile TV ● GPS ● Digital Catalog Shopping ● Digital Audio ● Remote Medical Care ● Remote Education

Table 1: Applications of the three mobile technologies

Even though we have got the clear imagined 3G network features, there are still some other issues that might influence the standardization process. The different roles and interest of actors in Chinese mobile industry make difficulties in reaching an agreement on a single standard. Different actors might tend to different standards. This phenomenon happened in other 3G pioneer countries, so will in China. Therefore, standards battle will never stop in both the international and national market.

From the above innovation of standards, 3G standard features were first introduced and then specifications about it are given by regulatory regime. This fact fits in the standardization strategy very well.

3.4 The three possible 3G standards in China:

Based on the features that are imagined during the transition process, IMT-2000 specified the 3G standards as follows. Here I would like to cover all the three possible standards in China. They are CDMA2000, WCDMA and TD-SCDMA.

3.4.1 CDMA2000:

As is shown in the figure of the migration path below, CDMA2000 can be achieved through CDMA1x, which is the enhanced network of IS-95. According to UMTS world,[13] CDMA2000 specification was developed by the Third Generation Partnership Project 2 (3GPP2). 3GPP is an international telecommunications standards union by ARIB and TTC in Japan, CWTS in China, TTA in Korea and TTA in North America. CDMA2000 can be developed from CDMA/CDMAone into numbers of networks. It has compatibility with IS-95B. And it is not constrained to only the IMT-2000 band, but also can be the overlay of CDMA2000 1x system. CDMA 1x is the overlay of CDMA system, which supports maximum 115kbps data transmission speeds, and enables to the largest extent 60 active users (per serving antenna sector) to request and receive packets simultaneously. By far, China Unicom has already finished its overall network coverage work of CDMA1x.

The way from CDMA to CDMA1x and then to CDMA2000 is one of the migration paths to 3G.

Based on the CDMA development group, CDMA2000 have the following advantages:

- Increased Voice Capacity
- Higher Data Throughput

- Multicast Services: It provides multimedia content, such as TV broadcasts, MP3 audio files, movies to end-users
- Frequency Band Flexibility (already been deployed in 450, 800, 1700, 1900 and 2100 Mhz bands)
- Serves Multiple Markets (supports both fixed and mobile services)
- Multiple Service Platform(Plam or Pocket PC mobile OS; Java or BREW application platforms; WAP and WiFi or Push-to-talk)
- Increased Battery Life
- Synchronization worldwide of the Base Station for the forward link transmission timing.

CDMA2000 has the advantages of CDMA technologies and also some other enhancements such as advanced control and signaling mechanisms, improved interference management techniques, end-to-end Quality of Service (QoS), and new antenna techniques. These new technologies significantly improve the network capacity of current CDMA1x and also reduce the delivery cost.

3.4.2 W-CDMA:

W-CDMA, short for Wideband Code Division Multiple Accesses, has higher transmission speed and is used widely in Japanese FOMA system and European UMTS system. With the features of wideband spread-spectrum mobile air interface of Code Division Multiple Access (CDMA), W-CDMA can get higher speeds and support more users than time division multiplexing (TDMA) in GSM networks. According to UMTS world,[14] W-CDMA is one of the main technologies for the implementation of 3G systems.

The implementation of W-CDMA has the features of complexity and versatility. This is because of the complexity of each single algorithm and the computational complexity of a receiver. The simulation of Data Link Layer of W-CDMA system is 10 times more compute-intensive than the existing 2G systems' simulation of the same layer. Users in W-CDMA system can communicate at the same time with different data rates. Its frequency band is from 1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz.

Technical features:

- 5MHz Radio channels width.
- 3.84 Mcps Chip rate
- FDD and TDD
- Asynchronous operation.
- Multimode transmission.
- Increased capacity and coverage by multi-user detection and smart antennas.
- Different types of handoff: soft handoff, softer handoff and hard handoff.

3.4.3 TD-SCDMA:

TD-SCDMA, is such a 3G mobile telecommunications standard that was developed by Chinese Academy of Telecommunications Technology (CATT), Datang and Siemens A/G. According to UMTSworld, [15] TD-SCDMA stands for Time Division Synchronous CDMA, approved by ITU in 1999 and the technology is developed by the CATT and Siemens. "TD-SCDMA uses the Time Division Duplex (TDD) mode, which transmits uplink traffic (traffic from the mobile terminal to the base station) and downlink traffic (traffic from the base station to the terminal) in the same frame in different time slots. That means that the uplink and downlink spectrum is assigned flexibly, dependent on the type of information being transmitted. When asymmetrical data like e-mail and internet are transmitted from the base station, more time slots are

used for downlink than for uplink. A symmetrical split in the uplink and downlink takes place with symmetrical services like telephony.”[15]

According to presentation about TD-SCDMA from ITU, it has the following features:[16]

Key features:

- Adoptive allocation of radio resources by Time Division Duplex
- Simultaneous multiple use access by Code Division Multiple Access
- Joint Detection
- Dynamic Channel Allocation
- Smart Antennas
- Combination of 4 Access Techniques: CDMA, TDMA, FDMA and SDMA
- Optimal and adaptive allocation of the radio resources

3.5 Possible migration path from 2G/2.5G to 3G in China

Standards have influence on the market place through their features. The above standards have different compatibility to each other. The features of them decide the migration path from 2G to 3G. To shift from current network to 3G systems, there are many different paths based on different network infrastructures. In China, the main 2G network is GSM owned by China Mobile and China Unicom and then CDMA by China Unicom. By the beginning of 2007, China Mobile have already have the entire covered GPRS network and China Unicom have finished its testing work of CDMA1x network and has been build and enlarging its enhanced GSM network, GPRS system. Then what are the detailed migration paths that might shift from 2G to 3G? I will give the answer to this question in the following figure:

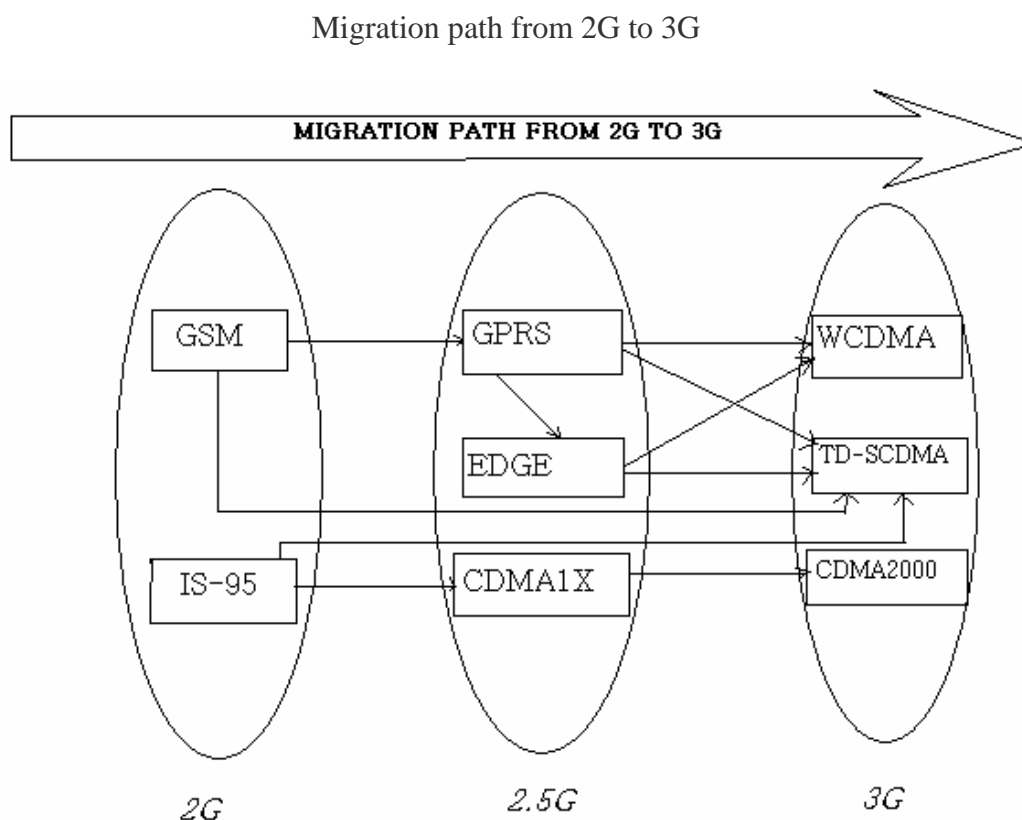


Figure 8: possible migration path from 2G to 3G

Based on 3G mobile policy: the case of China, ITU

In China, the possible 3G standards are WCDMA, TD-SCDMA and CDMA2000. Among the three standards, WCDMA and CDMA2000 are based on GSM/GPRS and IS-95. Therefore, the possible path to 3G is from GSM to WCDMA and IS-95 to CDMA2000. And because the only difference between TD-SCDMA and WCDMA is the access method, another path would be from GSM to TD-SCDMA. At present, China Mobile has GSM and GPRS networks while China Unicom IS-95 and CDMA1x networks. Therefore, from the figure above, we could draw the conclusion that both China Mobile and China Unicom have the possibility to build the TD-SCDMA system since they can migrate to TD-SCDMA either from GSM directly or from GPRS or from CDMA directly. Both of the two can have the WCDMA

system from their GPRS network. From the network effect point of view, China Mobile has more advantages than China Unicom in this path since its GSM network has more users than China Unicom's. However, China Unicom has the absolute advantage if it comes to CDMA2000 since only China Unicom has the network of CDMA1x. But there might be this condition that each operator chooses different standards considering their own network infrastructures and interests. Right now in China, every operator has finished their testing work and even the fixed-line operators since they are on the same level in this new network building. Therefore, we can use adopt a Chinese saying that when everything is ready, the only thing to do is to wait for the licenses. Besides these, the existing network structure, the market share of operators, the users' willing and many other standardization issues all might have influence of the chosen of standards and the migration path to 3G.

Based on the consideration of existing network infrastructure and the cost and potential market in the 3G network, operators also should consider the issues bellows. They might be contained on the specification of the new standards from the regulatory regime but also they are influencing the reaction of operators and their partner actors in this whole network.

3.6 Standards related issues

The features influence the business model of operators, especially for those mobile operators who have already have network infrastructure. Besides this, the innovation brings issues to be considered in to regulatory regime and market place.

3.6.1 Spectrum issues

In order to make the roaming worldwide and to realize the unification of the standards, ITU gives out its allocation spectrum arrange. Based on this, China launched its 3G spectrum shown in the figure below:

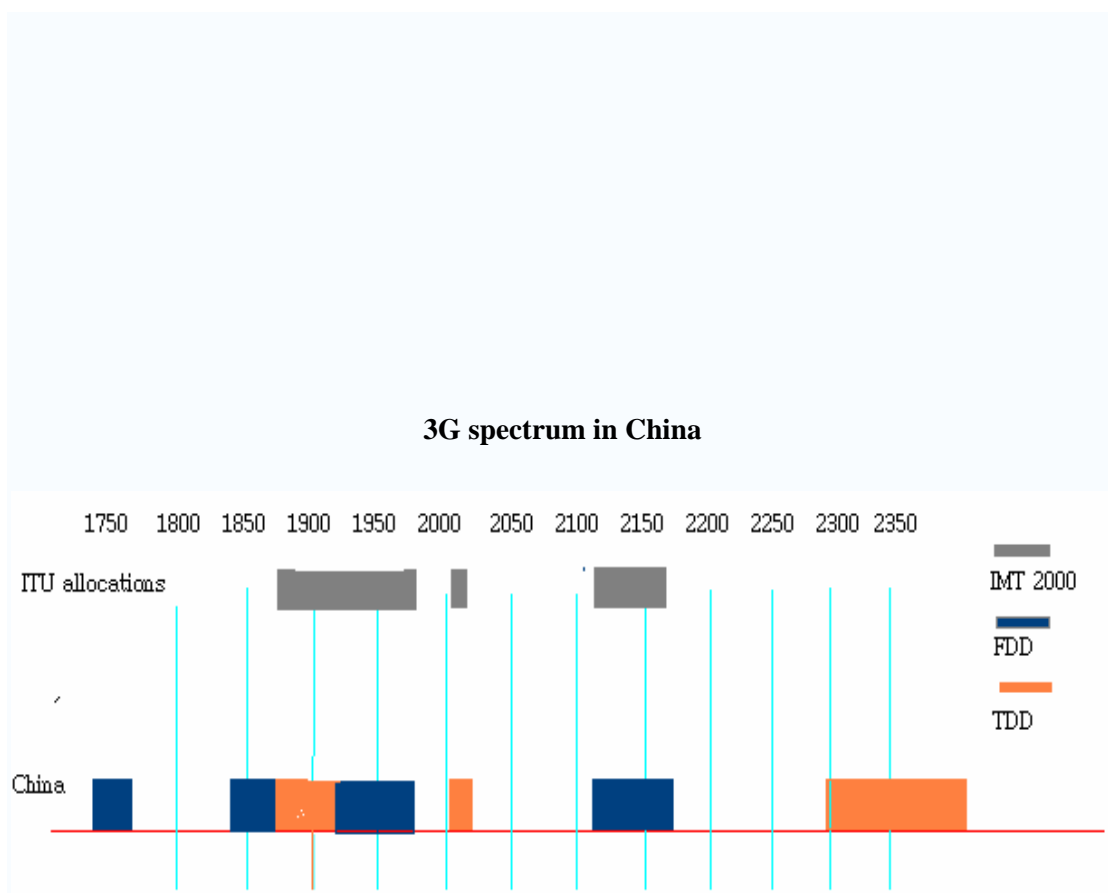


Figure 9: spectrum allocation of China, data source from ITU website

Spectrum planning would be very important at the beginning of the 3G project in China. Xie Feibo from Ministry of Informatin Industry in China (MII) said that one of the most important projects in 2006 was to institute the relative policy about the assignment of 3G spectrum and planning the start of RFID work.

He said that the FDD method, which stands for WCDMA and CDMA2000 technologies, was assigned to 2*90m, and TDD (TD-SCDMA) 155m. This is consistent with the international core frequency band of 3G and 2300-2400m is left for the support of the TD-CDMA. Also there is some for satellite communication with 2* 30m frequency band. As is shown in the figure above, TDD and FDD are the two main modes of division dual. The main allocated frequency band for 3G in China is 2100Mhz and the frequency bandwidth of 60Mhz are divided into four uplink and downlink 15Mhz frequency bandwidth for the four Chinese operators: China Mobile, China Telecom, China Unicom and China Netcom.[17]

3.6.2 Infrastructure sharing

Besides the spectrum allocation and assignment issues, another important issue would be the extent of network infrastructure sharing between different 3G license holders. Why should the network infrastructure be shared? The answer to this question has been given in the ITU's briefing paper for the licensing of 3G. First, sharing existing or new network infrastructure will help promoting economic efficiency. This action will make new entrants able to compete against existing actors in the industry who might have their own network infrastructure and provide 3G or competing wireless services. Before 3G, 2G network in China are only operated by China Mobile and China Unicom. But in the 3G era, China Telecom and China Netcom have been assigned spectrum band. And other actors such as content provider, application provider have been taking part in this market and connect internet-based services with traditional mobile phone services. Sharing infrastructure can also avoid waste of resources, reduce infrastructure building cost. With the China becoming member of WTO, investment burden for foreign telecom companies has been lower. And with the sharing of infrastructure, more business opportunities for both national multinational companies involved in this industry would help the competition in

Chinese mobile market to be healthy and help the Chinese mobile industry grow better.

Besides the infrastructure sharing among different actors, the sharing of current network infrastructure to build new network would also save cost for operators. For the operators' benefits, the implementation of 3G would be a long process with 2G and 3G networks coexistence. In order to migrate from 2G to 3G, the support of 2G network is very important. Because the coverage of current 2G networks is incomparable for 3G in the short future time, 2G should be used as a network infrastructure providing basic voice and data services for the mobile consumers. On the other hand, 3G should use its new services provide high speed multimedia services for the users who need this kind of services.

Sometimes people believe infrastructure sharing among network operators conflicts with the common knowledge that network providers have the nature to compete with each other through their network infrastructure. Is it possible that network providers could cooperate with each other peaceful? Will it have the negative effect to the whole industry development? ITU briefing paper has given the answers. "It is said that it depends on the type of infrastructure being shared and the terms and conditions, including the time period for which infrastructure sharing to be made available. Most network operators currently share site facilities in order to co-locate network equipment. This is increasingly common for fixed networks where ducts and exchanges are being used to house competitor's equipment or cabling. For mobile operators, site and tower sharing has been commonplace for several years and has generally been considered to have promoted new entrant ability to compete against incumbent operators who already have the facilities available, usually having occupied the best available sites. Such site and facility sharing has also prevented wasteful facility duplication and from an environmental perspective has had a positive impact."[11]

Given the current market situation in Chinese mobile market, which still has voice phone and SMS services as the most popular mobile services, 2G and 3G services will co-exist for a considerable period. Chinese consumers haven't seemed to be so interested in the multimedia entertainment services and higher speed internet-based services through mobile phone. Therefore, market demand in Chinese 3G market is not large similar with other countries. But with the penetration of 3G services increasing, the trend of implementation of 3G in China would not be held back. Thus 2G and 3G network would co-exist for some time. Therefore, operators might then have been thinking of re-farming their 2G spectrum in order to make their network more efficient. However, in order to follow the original purpose of 3G standards, realizing the international roaming, governments will take action to avoid this kind of reaction taking place. The reason to avoid the re-farming spectrum of 2G is given more detailed explanation in the ITU briefing paper. "Re-farming of second generation spectrum and upgrades of GSM standards means the re-designation of spectrum in a specified band for a different technology from that for which it was originally licensed. Re-farming of second generation spectrum would mean changing the use of some or the entire spectrum at 900 and 1800 MHz from GSM/PCN technology to UMTS technology." [11] Thus, the international roaming would have large problem to realize.

3.6.3 Roaming between Networks

Given the infrastructure sharing issue and the co-existence of 2G and 3G networks, 3G handsets have to roam between GSM, GPRS or CDMA, CDMA1x and 3G networks in China. And even the users have to roam between different 3G networks: W-CDMA, CDMA2000 and TD-SCDMA. For devices manufacturers, they want to make their product have the technologies that could make their users roam between different networks smoothly. Therefore, in China, these years, two modes and three

modes mobile phone are popular in the market. With these two mode and three modes phone, people don't have to worry about they can not use their CDMA phones in GSM network. That is the reason why in the imagined features of IMT-2000, flexibility and affordability are two characters of 3G network. They make the roaming between different networks possible. This is very different in pure 2G network. 3G system provides the possibilities for actors to get on the international mobile market stage.

Besides international roaming, national roaming is also a key requirement for the successful transition to 3G network in China. Compared with China Mobile and China Unicom, China Telecom and China Netcom would be the new entrants in 3G systems. Network roaming makes it easier for them to operate over the existing mobile operator's 2G networks and makes the competition between fixed-line operators and mobile network operators more equally in Chinese 3G system. However, since by far, China hasn't launched the licenses, the more detailed infrastructure sharing and network roaming could not be forecasted.

Above all, the fast development of the technologies inside the mobile services industry and the updated imagined features of new networks enable the capable of supporting data services and the network capacity. New entrants get involved in the transition process to a new 3G network. In this process, standards battle never stops. There are competition both inside and outside the industry from technologies such as Wi-Fi and Wi-Max. There are different ways of migration to 3G networks. Given the current Chinese mobile market situation, 2G and 3G network would co-exist for some time. The spectrum related issues and network roaming come out with it. Regulatory regime regulates the market operation and it makes a series of specifications based on the participation of the outcome of the innovation system and the innovation ideas form the market place to supervise the behavior of actors in both the innovation system and the market place. With the development and research activities,

innovation system tests their model in the market to get feedback to compete the creation of the standards. This is a dynamic process and all the actors are involved.

Section 4: Market place environment for 3G in China

In the market place, network operator acts as an important role that cooperates with many actors in both the market place and the innovation system. Regulatory regime sets policies about the spectrum allocation, infrastructure sharing and launch license for operators based on their interests. And the network chosen of the three standards would directly influence the market strategies of manufacturers and ISPs. Therefore, in the following part, I will introduce the Chinese mobile industry market place.

4.1 Introduction of Chinese telecom industry policy

Based on to the speech given by the undersecretary of the Ministry of Information Industry in China Qinjian Lou on the fifth Chinese Telecom Industry Development and Policy Meeting, the role of regulatory regime is to set regulations in order to monitor the market place. And also combined with the relationship between the three realms, the innovation system made up of device manufacturers, infrastructure manufacturers and mobile OS providers or middleware providers can test their new business model in the market place. Actors' reaction in the market place has impact on the activities of both regulatory regime and innovation system. Regulators will help the transition progress from current 2G/2.5G to 3G more smoothly.

Operators play an important role in the market place. By far in China, the operators are on their way of transition from the traditional telecom services to the value-added telecom services. In the new operator-driven business environment, the development of the services afforded by operators will directly influence the product of handset manufactory and software development. And because of the various radio, mobile, and fixed network access methods, the competition now takes place between different

networks. Therefore, in order to meet the needs of consumer, telecom services, which would be the advantage of 3G, should be improved. The implementation of 3G will help improve the competition situation of national telecom market.

In order to break the limitation of current telecom industry structure, policy makers gave out a so called “eleven-five” programming. In this programming, there are some general developing plans on national telecom industry. In the programming, it is planned that before 2010, the focus would be on the growth of value-added service, mobile telecom and broadband network. And the focus would also be on the innovation of new technology and services, the development of mobile multimedia technologies based on the 3G mobile services, and the consummation of industry value chain.

Until now, there still is no clear knowledge about which standard would be used in the 3G time of China, and no real licensing policy. But the test of TD-SCDMA has been almost finished, and the licensing policy is supposed to be carried out in the end of 2007.

Based on the main idea of industry policy, the main job of all the actors in the market place will focus on the services of mobile market in the year 2007. But according to the “eleven-five” programming, how to really carry out the implementation of 3G covers standards, spectrum, licensing and regulatory issues. All these issues are related to each other during the process of analysis, which would be given out more details in the following chapters.

4.2 Development of China's mobile industry

China's telecommunications industry has been experiencing great progresses in both infrastructure development and services provision since 1979. The following fact all together resulted in the rapid growth of China's telecom industry. According to Larry D.Qiu 2005 in his paper, he presents "On the demand side, fast economic growth and the resulting improvement in people's living standards constitutes a strong and sustained demand for telecom services. On the supply side, reform and restructuring of the local telecom sector provide incentives for local telecom companies to expand and improve their businesses. In addition, favorable government policies on taxes, interest rates and capital investments have encouraged the expansion of local telecom services." [18] The first local operator on the Chinese telecom market, China Telecom under the supervision of former MII, MPT (Ministry of Post and Telecommunications in China) was playing the role of monopoly in China's telecom services market before mid 1990s. At that time, Chinese government had huge pressure with the low economic benefit from the market and the complaint of the poor quality but high cost of the telecom services from the Chinese consumers. Given these situations, Chinese government decided to break up the former MII in order to end the monopoly status in the telecom market. With the development of mobile services, demand for higher qualities of telecom services came out in the market. With this demand for new featured services, Chinese government had to introduce competition to the market. Some other ministries participating in the telecom market support for the break up of MPT's monopoly so as to get access to the telecom market easier. Finally, given the domestic pressures from the users, other ministries from market place and the economic concern and the willing to get accession to the WTO, Chinese government began its serious reforms of the telecom industry in the mid 1990s. Larry D.Qiu writes "The reforms were to introduce competition to the market for two purposes. First, the domestic industry needed to provide better and more telecom services to Chinese

customers. Second, local service providers needed to improve their competitiveness against foreign rivals for when China would open its domestic market to the world. Several small steps were taken starting in 1994, but the major breakthrough did not come out until 1998.”[18]

4.2.1 Monopoly and Introducing Competition in the early time

Before 1993, there was only one telecom service provider in China, China Telecom. The operation of China Telecom belonged to the former of the Ministry of Information Industry of China, the Ministry of Post and Telecommunications, MPT at that time. MPT not only had the operation function of China Telecom but also acted as the regulatory regime for Chinese telecommunications industry. Therefore, with the special support of MPT, China Telecom played the role of monopoly operator in Chinese mobile service market until 1993. In 1993, the first value-added network (VAN) operator Jitong Communications Company Limited (Beijing) was built. The emerging of Jitong broke the phenomenon of only one operator in market place. And it was busy with activities on communications researches and product development. It provided mobile phone services and value-added services. Despite of these efforts it made, Jitong was still not the competitor that could have threat to China Telecom. This was because of the small business size and limited business scope of Jitong and the strong back up of MPT of China Telecom. It was the emerging of China Unicom in 1994 that actually broke the monopoly status of China Telecom. China Unicom was built by some other telecom related ministries in China in order to introduce competition to the industry so as to improve the service quality and production efficiency in the market place. At that time, services price was determined by MPT and individual operators had no rights to bargain on it. Therefore they could not compete on price. Although China Unicom had been introduced into the market, it could not get access to the backbone infrastructure. This problem brought a difficult time to China Unicom in its early years of development. And also although China

Unicom obtained operating rights to develop its fixed line traditional telecom services in provinces like Tianjin, Chongqing and Chengdu, it was still difficult for China Unicom to open a large market in the first year. This was because that the existing local post and telecom operators had long term business partnership with China Telecom and they were not willing to change the business model and partner to cooperate with China Unicom. Therefore, it is not difficult to imagine that there was no entry for China Unicom to access MPT's local network. And also China Unicom had limited business channels for financing and gaining investments as a new entrant in the market with less support of MPT compared with China Telecom. Even though with these difficulties, China Unicom did a good job in its mobile services. The competition between China Telecom and China Unicom resulted in the development of the Chinese telecommunications industry. It forced China Telecom to adopt more advanced technologies in order to keep its market dominant position. For example, before the entry to mobile market of China Unicom, China Telecom was using Total Access Communication System (TACS). It is an analog system that doesn't have the ability to provide better voice quality, send use short message services or even provide value added services. However, with the development of the global telecom technology, the advanced digital Global System for Mobile (GSM) came into China in 1991. Given the fact that China Unicom took the GSM network to provide better services, China Telecom upgraded its system too so as to keep its consumers through network effect and compete with China Unicom better.

4.2.2 Reforming Regulatory Structure

Even though China Unicom brought threat to China Telecom with its mobile services, the dominant position of China Telecom never changed. This was to a large extent related to the nature of MPT and its support for China Telecom. MPT had a dual function in the Chinese Telecommunications industry. It not only acted as the

regulatory regime in China to set specifications and monitor the market but also provided telecom services through its operation on the arms of China Telecom at the same time. It was this feature of MPT and its relationship with China Telecom that resulted in the monopoly situation in the Chinese mobile market. In order to separate this dual role of MPT and to encourage healthy competition in the market so as to promote the industry development, China Telecom was reformed in 1994. The purpose of this movement was to separate China Telecom from MPT. In this case, MPT could focus on its regulation function. However, the absolute separation from MPT was impossible for China Telecom. This was because that MPT was China Telecom's largest shareholder and it still controlled the most financing and planning activities of China Telecom. But the operation function belonged to China Telecom itself. China Telecom's revenue had to be handed in to the MPT and China Telecom could keep 0.5% itself. Therefore, it is clear that China Telecom still had a close connection with MPT. With the support of MPT, the competition between China Unicom and China Telecom was so unfair.

Things changed again in 1998. Given the low economic benefit from the less competitive market, the Chinese government carried out a reform in order to minimize the influence of government on the operation of telecom operators. This reform can be viewed as a milestone in the history of the development of the Chinese mobile market. There are reasons resulting in the restructuring of China's telecommunications regulatory framework. First, with the unfair competition between China Unicom and China Telecom, China Unicom required the complete separation of China Telecom from MPT. And besides the concern of China Unicom, the government realized the potential harm of the monopoly situation to the national telecom industry. In the monopoly market, competition is minimized and then the development of mobile services and technologies is slowed down and also the revenue of the telecom industry is limited. This is not good for the national economy. Besides this, with the development of new telecom technologies and the popularization of mobile phones in both national and international environments,

Chinese consumers required better improved mobile services. Thus, in 1998, the Ministry of Information Industry (MII) was built as a regulatory body of telecom services, taking the place of MPT in the market. Actually, the new formed MII was the combination of the former MPT, Ministry of Electronic Industries in China , Network Division of the Ministry of Broadcasting, Film and Television in China , and some other regulatory institutions. The MII is in charge of the national telecommunications and information technologies through its regulatory function. The biggest difference between MII and the MPT is that MII does not intervene in the operation process of the local operators. It is only in charge of monitoring China's information industry. However, China Telecom still enjoyed some favorable policies. The same as the former MPT, MII sets prices for the mobile services provided in the market. However, after long time of lag, competition in the mobile market was still limited and the service quality remained poor compared with other developed countries.

For the whole national telecommunications, the development of China's telecommunications was asymmetry. In some rural areas telecommunications system was underdeveloped and even in some mountainous region traditional telephone services was not available. And even now, there are still 10% of villages in China having no access to traditional telephone services. In order to change this situation, some rural communities set up their own systems to provide their own mini size local telecom services. "It is worth pointing out that in many rural areas, it is more economical and flexible to utilize wireless telecommunications through mobile telecommunications and satellite communications. The wireless telecommunications have the advantage of low construction costs, fast in construction phase and low maintenance expenditures. The coverage density of the electricity grid is much higher than that of the telecommunications network. It is desirable to utilize the available electricity grid to develop telecommunications service. And the CAT (Community Antenna Television) network has been developed in many rural regions. This would be another economical means for telecommunications." [18]

4.2.3 Restructuring Local Operators

In 1999, China Telecom was divided into several state-owned enterprises (SOEs) by different types of telecom services. These services can be concluded as fixed line telephone, mobile phone, paging and satellite telecommunications services. With the breakup of China Telecom, the monopoly was broken up. The name China Telecom now refers to the successor who keeps the original company's main business--the fixed line telephone business. China Mobile Communications Corporation (China Mobile for short) is also generated from the original company who take charge of the mobile phone business. The satellite segment belongs to the company China Satellite. In 2000, China Network Communications Corporation (China Netcom) and China Railway Telecommunications Corporation (China Railcom) got licenses to provide basic fixed line services rather than mobile services. After the initial breakup of China Telecom, the current phase of the local operators is formed. There are fixed-line operators: China Telecom, China Netcom and China Railcom and mobile operators: China Mobile and China Unicom. In the traditional fixed line telephone service market, China Telecom still has its monopoly power. Others have to pay for the network access fees to China Telecom. In 2001, China Telecom was divided again into northern and southern parts. And then the northern part of China Telecom and Jitong was combined to form the later China Netcom. Then in this condition China Network Communications Group Corporation (China Netcom Group) was built. The southern part of the former China Telecom keeps its name of China Telecommunications Group Corporation, which is the current China Telecom. By the restructuring of the telecommunications operators, the monopoly phenomenon is completely broken and there are six companies now dominating the domestic telecom market right now.[18]

4.3 Mobile services market environment for 3G in China

4.3.1 Market share of China's mobile service market

As is stated above, China right now has six local operators. They are China Telecom, China Unicom, China Mobile, China Netcom, China Railcom (China Tietong) and China Satcom, which was also separated from the past China Telecom. The main operators in mobile service market are China Mobile and China Unicom. And the main fixed-line operators are China Telecom and China Netcom.

Based on the presentation given by Prof. Xiongjian Liang and Prof. Bin Zhang from Beijing University of Posts and Telecommunications,[1] by June 2005, China Mobile has been gaining as many as 232 million subscribers and China Unicom has been gaining 120 million, 89.61 million of which was from its GSM network and 30.92 million from its CDMA network. At the same time the total subscribers in the mobile service market of fixed-line operators were 79.75 million, shared by China Netcom and China Telecom. And most of the subscribers of these fixed-line operators in the mobile market were attracted from mobile operators.

By June, 2005, of all the subscribers of the mobile operators in the mobile service market, 35% belongs to China Unicom while 65% are using China Mobile's services. This market share can be shown in the following figure:

Market share of the mobile operators in China's mobile service market

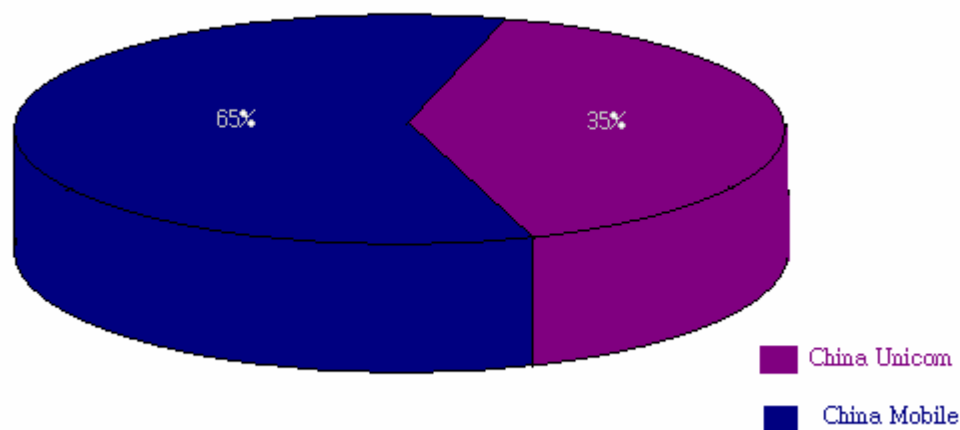


Figure 10: Market share of subscribers of mobile operators by 2005

Based on the presentation of China's 3G market of Prof. Xiaojian Liang and Prof. Bin Zhang from Beijing

University of Posts and Telecommunications

From this figure we can see that in the mobile service market, China Mobile still keeps the dominate position and owns the largest number of mobile subscribers in China. By 2005, China Mobile and China Unicom share the mobile services market. But in the future 3G market, this model might be broken with the entry of other operators and the possible restructuring of the current telecommunications market structure in China.

The features of 3G services enable the fact that internet and mobile network will work together to provide 3G services. Therefore, in order to provide the new imagined 3G services and to realize a business model for 3G, not only the mobile operators but also the fixed line operators will participate in the mobile service market. Actually, before 3G, with the 2.5G service, some fixed-line operators have already get into this market

and been attracting subscribers. The following figure shown the market share of all the operators involved:

Market share in China's mobile service market

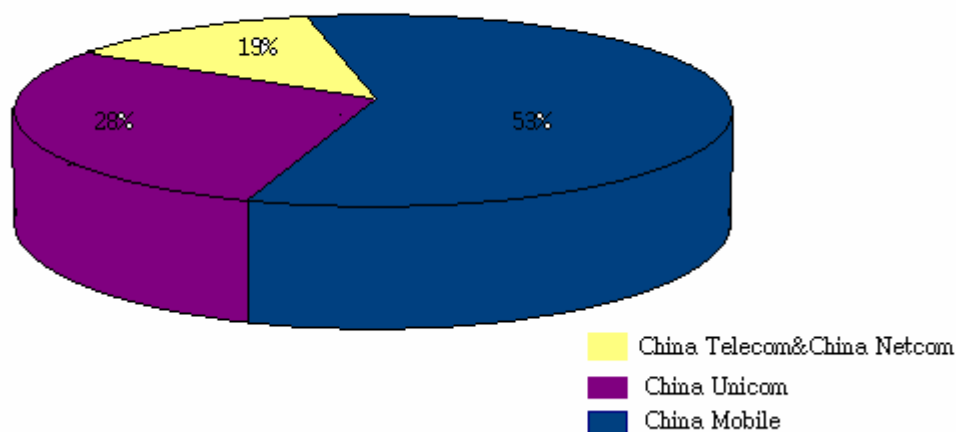


Figure 11: Market share of all local operators in the mobile service market in China by 2005

Based on the presentation about China's 3G market of Prof. Xiaojian Liang and Prof. Bin Zhang from Beijing

University of Posts and Telecommunications

From this figure we can tell that in the mobile service market, not only the mobile operators but also the fixed-line operators participate in it. This is because of the new mobile internet technologies that make it necessary to attract both fixed and mobile operators in the market. And from the share shown in the figure, China Telecom and China Netcom took 19% of market share, China Unicom 28% and China Mobile 53%. From this data we can tell that fixed-line operators have found their positions in the market. For 3G services, China telecom and China Netcom will also act in the market. And they even have the advantage of building their network without thinking of network effect issues compared to mobile operators.

However, the main actors among all the operators are still the mobile operators which are China Mobile and China Unicom. This fact is also reflected in the data shown in the figure. To present the main two operators in China more detailed, I will give the main characteristics of China Mobile and China Unicom in the following table, which was concluded in the presentation about China's 3G market by Prof. Xiaojian Liang and Prof. Bin Zhang from Beijing University of Posts and Telecommunications.

Overall features of China Mobile and China Unicom

Characteristics	China Mobile	China Unicom
Services	Mobile only	Mobile and fixed-line
Network	GSM GPRS	GSM CDMA (CDMA1x)
Market experience	Old actor in market Well-experienced	New entrant
Advantage	largest GSM network	largest CDMA network world
Market scale	More than 60%	Less than 40%
Governmental supervision	Comparatively strict	Comparatively loose
Pricing	No preference policy	Have preference policy
Brand conception	Easily cognized	Comparatively low cognized

Table 2: The overall introduction of China's main mobile operators

Based on the presentation about China's 3G market of Prof. Xiaojian Liang and Prof. Bin Zhang from Beijing

University of Posts and Telecommunications

The above is the main features of China Mobile and China Unicom. From the table above we can tell that China Mobile is the experienced operator while China Unicom is the new entrant, which part of the reason for the fact that the market share of China Mobile is over 60% while that of China Unicom is under 40% and China Mobile has the dominant position. And another reason for that would be the more close connection with the government of China Mobile. But the feature that China mobile only has mobile service while China Unicom has all kinds will bring China Unicom more benefit. China Mobile has the largest GSM network in the world while China Unicom has the largest CDMA network in the world. This indicates that the two operators might choose different transition path to 3G given the current network advantage of them.

4.3.2 Revenue of main operators

The revenue of China Mobile and China Unicom from the year 2001 to the year 2005/06 is shown in the figure below:

Revenue of China Mobile and China Unicom

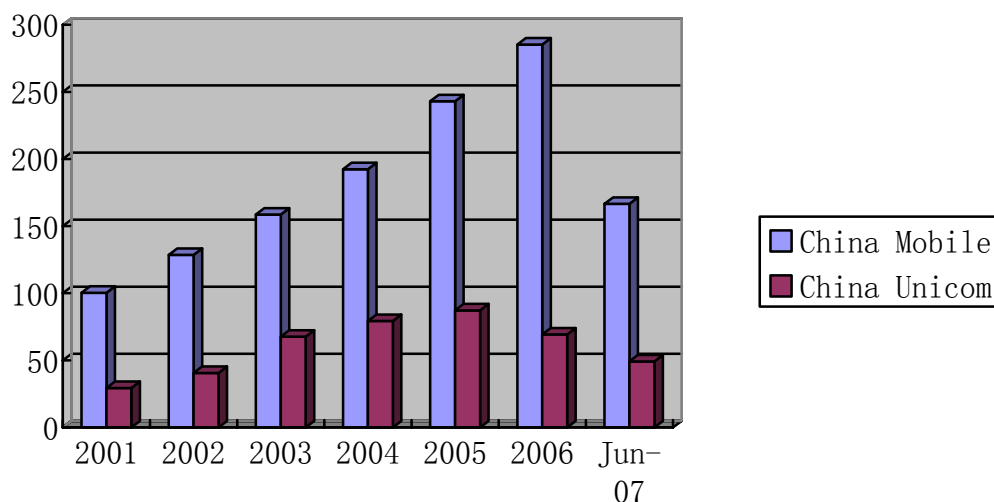


Figure12: Revenue of China Mobile and China Unicom

Data from Study of China's 3G market by Prof. Xiongjian Liang, Prof. Bin Zhang and MII website

From the figure we can see that China Mobile has much higher revenue than China Unicom. But the gap is reducing year by year. In 2001, the operating revenue of China Mobile was 100.33 billion yuan and that of China Unicom was 29.39 billion yuan. In 2002, they grew to 128.56 billion and 40.58 billion. In 2003, they became 158.6 billion and 67.56 billion while in 2004 they were 192.36 billion and 79.31 billion. And in 2005, they were 243 billion and 87.23 billion. In 2006, they became 285.3 billion and 69.3 billion. By the first half of 2007, China Mobile has the operating revenue of 166.58 billion and China Unicom has 49.17 billion.

From the operating revenue we can tell the pure profit. But to measure the benefit of operators, we should also take ARPU into consideration. Then what is ARPU? ARPU stands for Average Revenue Per User in mobile industry.

The following figure gives out the ARPU of China Unicom and China Mobile

ARPU of China Unicom and China Mobile

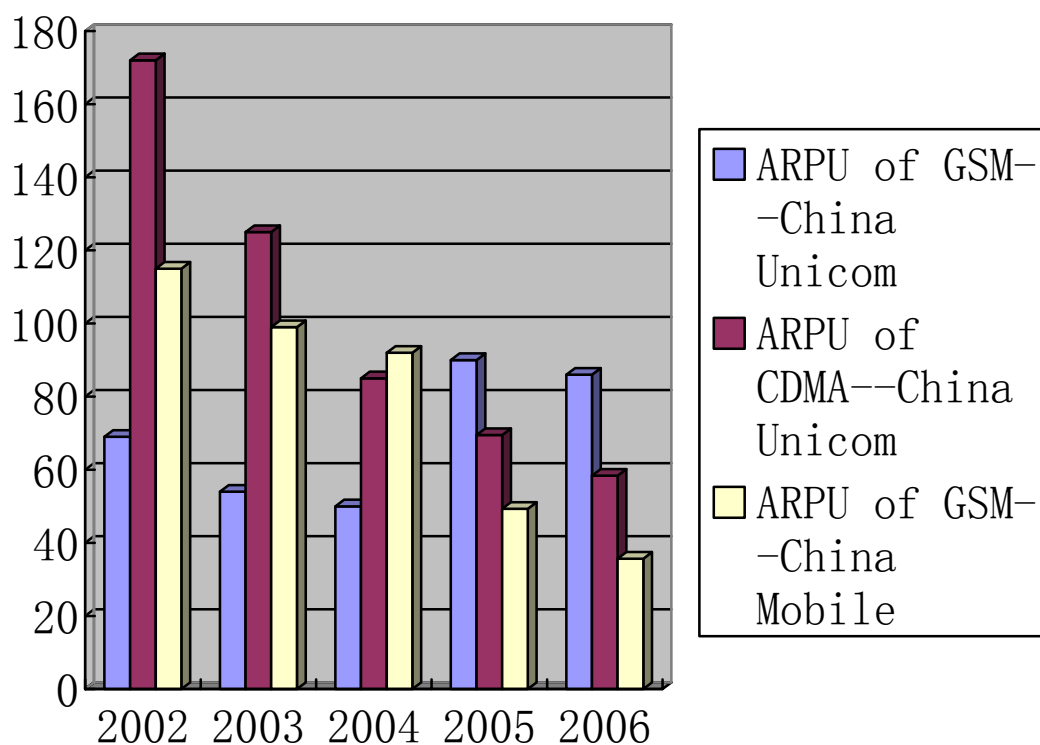


Figure 13: ARPU of China Mobile and China Unicom from 2002 to 2006

Data from Study of China's 3G market by Prof. Xiongjian Liang, Prof. Bin Zhang and MII website

From this figure we can conclude that before the year 2003, the ARPU of China Unicom's CDMA network was the highest and then it went down evidently year by year. The second place would be the ARPU of China Mobile which became the first place after 2003. And the last one is the ARPU of China Unicom's GSM network. The fact that the ARPU queue changed before and after 2003 was because the ARPU reducing rate of China Unicom is faster than China Mobile. In 2005, the ARPU of China Mobile was 90 yuan while that of China Unicom was 49.3 yuan of GSM network and 65.9 yuan of CDMA network. [19] In 2006, the ARPU of China Mobile reduced to 86 yuan while that of China Unicom was 58.38 yuan of CDMA network and 35.67 of GSM network. From these data we can see that both China Mobile and

China Unicom, the ARPU of them is reducing year by year. And as for China Unicom, even though it has both CDMA and GSM networks, its new services are mainly based on the CDMA network.[20]

With the development of telecom technologies, except for the traditional mobile services, Value-Added Services (VAS) are also popular, such as push-to-talk service, call management service, location sensitive billing service, mobile data services and so on. [21]

4.3.3 Services of China Mobile and China Unicom

In China's mobile market, China Mobile and China Unicom provide the following services and technologies. Based on the presentation of *Prof. Xiongjian Liang and Prof. Bin Zhang*, the brand service of China Mobile and China Unicom is shown in the following figure. [22]

Operators	China Mobile	China Unicom
Service Brand	Monternet (Mobile Internet) Enable its partners to get access to network system, accounting, WAP and SMS platform	U-Max Newly launched service brand of China Unicom in July, 2003

SMS Short Message Service	SMS Short Message Service	Uni-SMS Brand of SMS provided by China Unicom
MMS Multimedia Message Service	MMS Multimedia Message Service	U-Mail “mobile multimedia Email service introduced by China Unicom”[23]
WAP Wireless Application Protocol	WAP Wireless Application Protocol	U-Info “A wireless access service China Unicom provides to its CDMA subscribers. With mobile handset supporting WAP1.2 or above browser, the user can access the Internet by pressing a single button”[23]
JAVA	Application Box Service brand by China Mobile for Java usage on mobile phone	U-Magic “You can use the pre-installed U-Magic applications in a U-Magic CDMA mobile phone or download various U-Magic applications onto your mobile handset to experience the excitement of U-Magic”[23]
IVR “Interactive voice response. allows a computer to detect voice and touch tones using a normal	Voice Magazine E-magazine with music and other interactive voice applications	Music Street “The original zone of the amusement sound. It integrates all the amusement audio service of China Unicom. The services include 10155 Pop Music on Demand, 10158 Short Message listening and 10159 Personal Pop

phone call”[25]		Music”[23]
<p>CRBT</p> <p>“One kind of value-added service. Short for Color Ring Back Tone service. enable audience to download performance”[24]</p>	<p>Mring</p> <p>CRBT service of China Mobile under the sub brand M-zone</p>	<p>Cring</p> <p>Brand name of CRBT service of China Unicom</p>
<p>Flow Media Tech for instant watching audio and video on mobile phones</p>	<p>Mobile Video</p> <p>Video distributed through mobile device</p>	<p>U-Web</p> <p>“The mobile stream media technique is to compress the video and audio data and then put the compressed data into the web service. The mobile terminal subscriber can watch the video, while the rest data is downloading at the same time, without waiting for all the data to be downloaded”[23]</p>

<p>GPS Global Positioning System</p>	<p>LBS Location Based Service of China Mobile</p>	<p>U-Map “U-Map is a highly accurate global positioning service China Unicom offers to the public on its CDMA 1X network with the help of cutting-edge U-Map technology. The positioning error can be as small as 5-50 meter in outdoor environment. U-Map service is available both indoor and outdoor”[23]</p>
<p>Broadband</p>		<p>U-Net “CDMA 1X wireless access card is a kind of mobile Internet access equipment designed for China Unicom's "U-Net" service. You can insert this card into the PCMCIA interface of your notebook or handheld terminal equipment, and access the Internet via Unicom's CDMA 1X wireless network. You may also connect your CDMA 1X mobile handset to notebook or other terminals to enjoy U-Net service.”[23]</p>

Table 3: Services provided by China Mobile and China Unicom

China Mobile and China Unicom have been developing the value-added services greatly and the revenue from value-added service has become the significant part of the whole mobile services revenues.

The following figure shows the total service revenue and value-added service revenue of China Mobile

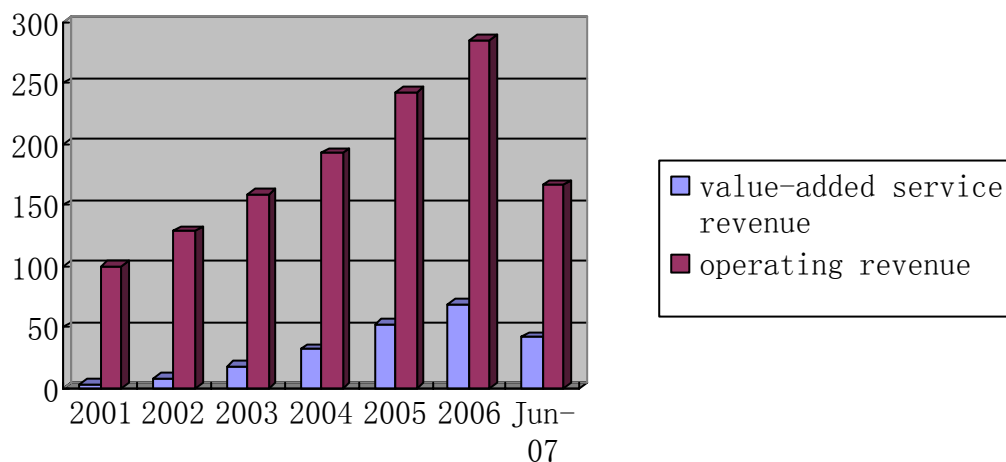


Figure 14: Value-added service revenue and operating revenue of China Mobile

Data from Study of China's 3G market by Prof. Xiongjian Liang, Prof. Bin Zhang and MII website

From this figure we can see the value-added service has been growing rapidly. By 2006, the value-added service revenue of China Mobile reached 69.31 billion yuan, increased by 38% compared with the same time 2005. SMS, WAP, and CRBT are the main revenue resource. The value-added service revenue has taken up to 25% of the total revenue in the telecom industry by the end of 2006. [26]

4.3.4 Operators' restructuring

From the current operators' structure, the services development and the revenue of the main actors in the last few years and their more and more subscribers, we can say that China has a large mobile service market. Even through the ARPU of China Mobile and China Unicom have been reducing in the last few years, but the number of total operating revenue is increasing. From those facts above, I would like to conclude that China's mobile market has been growing rapidly. Then further question might also come out that whether this market is suitable for 3G network?

In order to implement 3G smoothly, the consideration of economic environment is very important. Then what kind of economic environment is stable for 3G development? According to [1], the answer is that only when the potential market is large, the growing of national economy is steady and informatization is viewed as the key driver of national development, then this is a good economic environment for the implementation of 3G.[1] In Chinese mobile market, the growing of national economy is steady and the informatization is also viewed as the key driver of national development. The Chinese market is large but the potential market need for 3G services is not clear.

According to actor network theory, actors have influence on each other during the transition process of 3G network. Operators as important actors have driven the development of the whole industry. To fit in the standardization strategy, after the cognition of the new network features, more actors would get involved to form a new network. Therefore, with fixed-line operators getting involved, there would be the restructuring of the current operator. But the possible restructuring of these operators also brings uncertainty into the market.

There are four possible reforming schemes given by *Prof. Xiongjian Liang, Prof. Bin Zhang, Beijing University of Posts and Telecommunications* in the Study of China's 3G market:

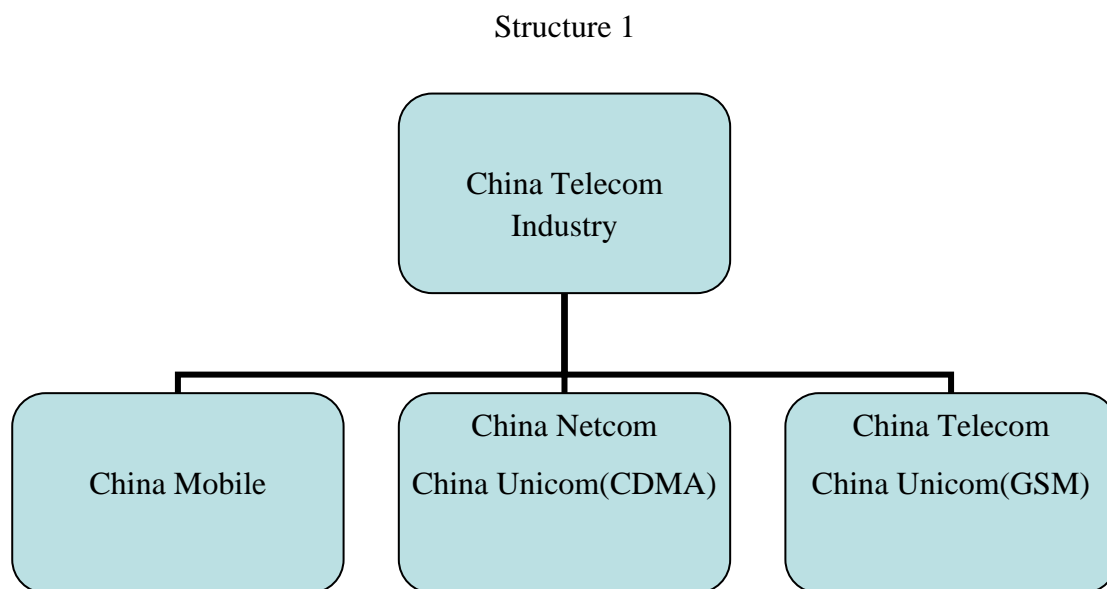


Figure 15: Possible structure I of China local operators

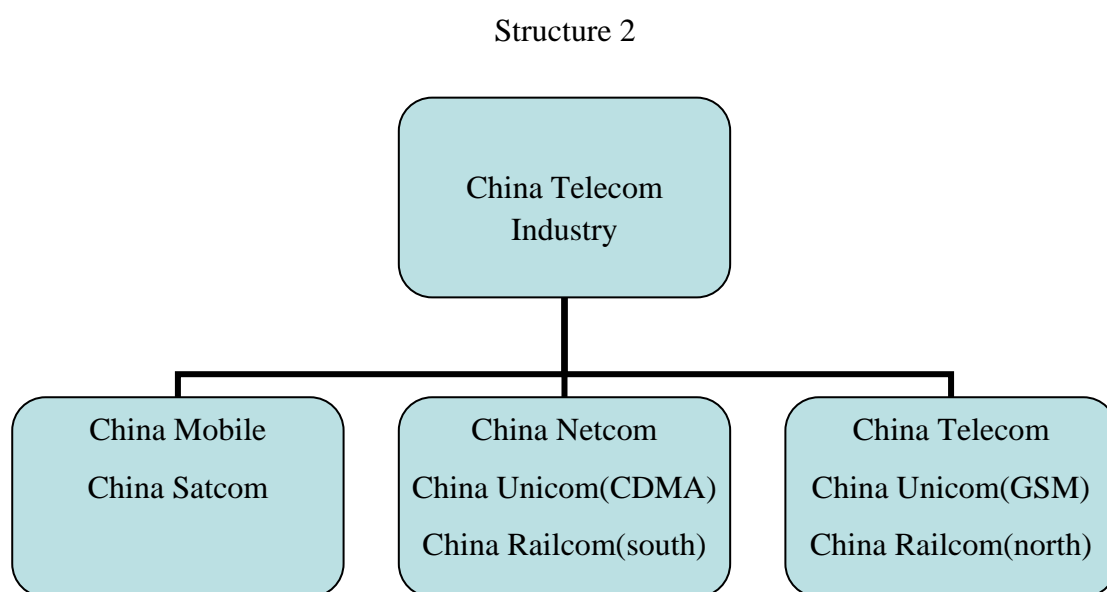


Figure 16: Possible structure II of China local operators

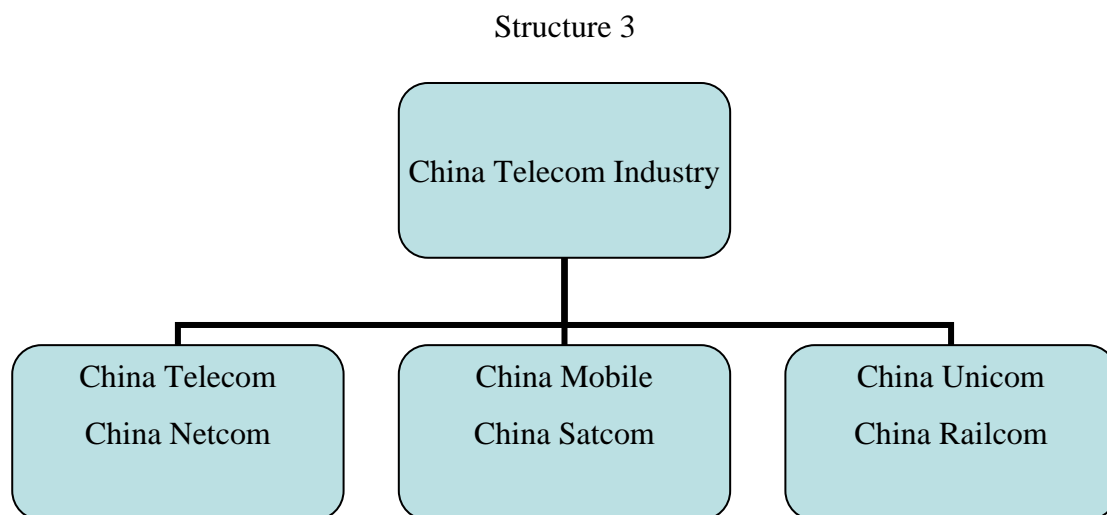


Figure 17: Possible structure III of China local operators

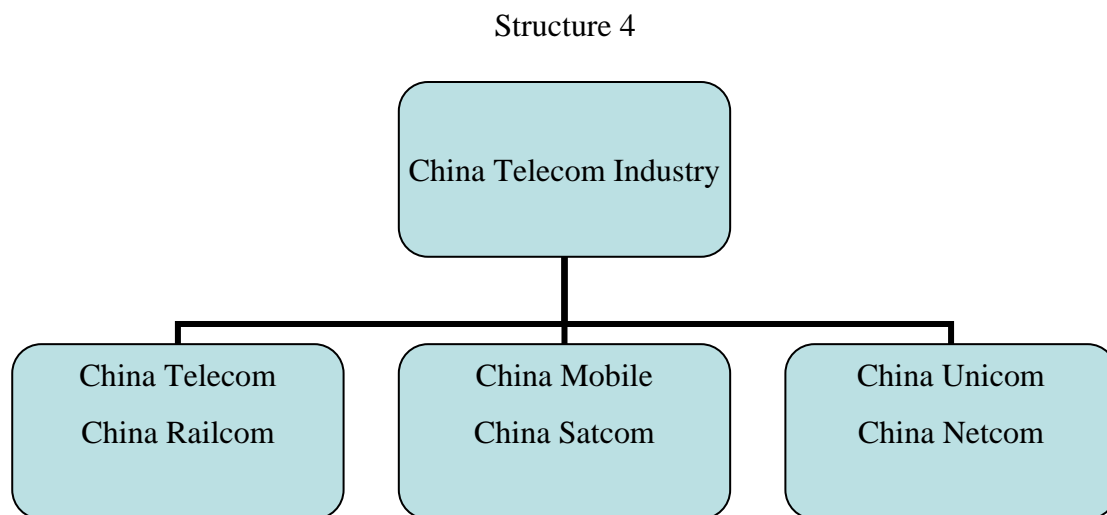


Figure 18: Possible structure IV of China local operators

With the uncertain reforming issue, the licensing of 3G has been delayed for a long time. People might ask what the 3G policy in China is.

4.3.5 Selection of 3G standards

Besides the uncertainty the possible restructuring of operators, regulator regime also have influence on the implementation of 3G in China through its industry policy and other related regulations.

Based on regulatory regime, there are three period of the development in the industry. The first period is before 2001,Oct. At that time China follow the principle: follow actively, test first, foster market and sustain development. [1] After this , comes the second era, from 2001,Oct to the end of 2003. In this period, the attitude of China government is to test with large scale and illustrate with the fact. Finally, the last period is from 2004 up to now. The government now leads the market actively and promotes industrialization. Based on the ANT theory, regulator regime has influence on the market place through these industry policies. Besides the influence of regulatory regime, standards also have impact on the market. Since standards battle never stop, master the superiority of the three standards is crucial for operators to select a proper standard.

The superiority of WCDMA would be its owning more subscribers and developing faster. The value chain of WCDMA is more open and its size and supplying environment is better.

The superiority of CDMA2000 is that it can transit from 2G/2.5G to 3G smoothly with a more mature value chain. China Unicom has a large scale of CDMA1x.

The superiority of TD-SCDMA is its low patent expense and it can promote China's domestic industry and technology.

There are three 3G standards waiting for being launched to four operators: China Mobile, China Unicom, China Telecom and China Netcom. In order to avoid waste, the regulatory regime should try to keep a balance between operators when it is to launch the license.

There is the guess in the market place that TD-SCDMA might first come to China Telecom. And the test job of TD-SCDMA network has finished. It is proved that TD-SCDMA can be applied to 3G independently. In fact, 3G application is very profitable for manufacturers, operators and users. The cost of 3G phone service is only half of 2G while the cost of 3G handset is 120% of 2G phones.

China mobile tend to select WCDMA. This is because that WCDMA is based on the GSM network, which is the only one 2G network of China Mobile. From GSM, WCDMA could transit smoothly. And for the international market, most operators in the worldwide have selected WCDMA as their standard. If China Mobile also choose WCDMA, then the network roaming is easier for users of China Mobile. As the largest mobile operator in China, China Mobile has finished the transition to soft switching network and private IP network by the end of Nov, 2004. By Feb, 2004, China Mobile has already have been cooperating with five handset manufacturers, including Motorola. They produced mobile phones with the symbol of 'X-Zone' in May 2004.

China Unicom has both the GSM and CDMA networks. It might select WCDMA and CDMA2000 according to the possible migration path from 2G to 3G I mentioned before. It has already finished the network building job of CDMA1x on its original CDMA network. This makes China Unicom to be the largest 2.75G network in the world. It has a China Unicom—Huasheng Ltd, which is designed to be the terminal manufacturer.

Besides this, both China Mobile and China Unicom have the possibility to build the TD-SCDMA to encourage the national technology.

China Telecom has no clear target which standard to choose. It emphasizes both WCDMA and CDMA2000. But because of its close connection with the government, it is the most possible for China Telecom to choose TD-SCDMA to build the 3G network as a domestic industry. China Netcom also have no reference of the three standards since as fixed-line operator, either standard is the same for it. However, China Railcom tends to select TD-SCDMA.

Devices manufacturers in the market place

Based on *Prof. Xiongjian Liang, Prof. Bin Zhang, Beijing University of Posts and Telecommunications* in their paper: Study of China's 3G market, manufacturers in the innovation system are also important actors in the market place. The main manufacturers in China might have the following reactions to the new business opportunities brought by 3G:

- Datang is working on the R&D of TD-SCDMA
- Datang is the main patent holder of TD-SCDMA technology and the dominator of the TD-SCDMA industry with China's government's support.
- Up to June 2005, Huawei had achieved 11WCDMA contracts and got 5% of the WCDMA essential patent. In Feb 2005, Huawei issued WCDMA distributed station first in the world.
- Huawei put energy into chip, system, terminal and service application, with the goal of becoming a comprehensive 3G supplier

- ZET is the only Chinese equipment company listed in the “100 global peak IT companies in 2005” by Times and it has ascended into the first group of CDMA2000 companies.

4.3.6 Consumers' preference of 3G services

Besides the manufacturers and operators, another actor in the market place is the consumers. The consumption preference of China's mobile subscribers is relative to the following aspects: Voice as dominant, herd consumption behavior, different consumption levels, population of mobile consumption, large amount of potential subscribers, brand difference, different price for different consumer segment and the taste of young people who are the main users of data services.

This is the survey and analysis on consumption preference of China's 3G subscribers:

	Beijing	Shanghai	Shenzhen	Wuhan	Chengdu	Kunming	Total
Video phone	65.59%	69.66%	47.89%	60.14%	68.06%	74.16%	64.74%
Real-time LBS	51.61%	70.79%	32.38%	36.23%	25%	66.29%	44.71%
Ambience information	37.63%	56.18%	8.45%	26.09%	10.42%	48.31%	29.65%
Video-conference	59.14%	61.80%	30.99%	45.65%	28.47%	59.55%	46.31%
Mobile	41.93%	24.73%	49.30%	44.93%	43.06%	44.94%	41.67%

E-business	%			%			%
Blue	18.82	12.36%	23.69%	36.32	17.36%	16.85%	21.63
Touch	%			%			%
Mobile TV	38.71	30.34%	57.75%	54.35	44.44%	31.46%	43.43
	%			%			%

Table 4: market survey consumption preference of 3G by subscribers

From Prof. Xiongjian Liang, Prof. Bin Zhang, *Beijing University of Posts and Telecommunications: Study of China's 3G market*

From this table we could see that the video phone is still the most popular one in most countries except for Shanghai. In Shanghai, real-time LBS service is the most preferred. And after the video phone, users in most countries choose video conference. But users in Shenzhen choose the mobile TV as the most favored one. Thus, the tastes of users vary from city to city. Price and services qualities and also the consumer segment might influence the services preference of consumers.

4.3.7 Classification of 3G services

Based on the current mobile services in the market and technologies in the market, 3G services should be classified as follows:

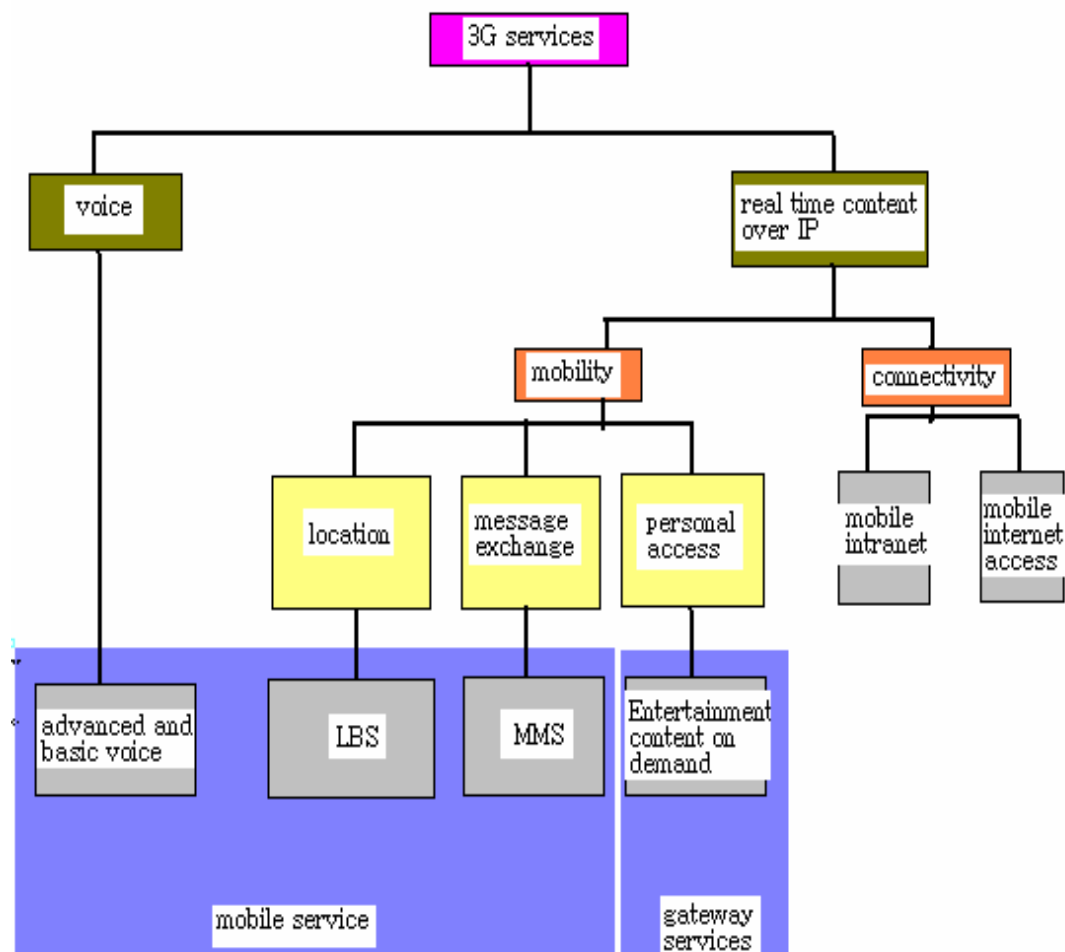


Figure 19: Map of 3G services

Based on Prof. Xiongjian Liang, Prof. Bin Zhang, Beijing University of Posts and Telecommunications: Study of China's 3G market

From this we can see that 3G services can be divided into voice service and real time content services over IP. This real time service can be also divided into mobility and connectivity use. For connectivity, there are mobile intranet and extranet and mobile internet access. For mobility, there are location, message exchange among people and personal access to 3G network. The first one refers to LBS, second refers to MMS and

the last one refers to entertainment content. For the voice services, there are basic and advanced voice services.

Upgraded demands and newly developed technologies drawn the applications of services. The 3G services are divided into communications via SMS and Email; Internet based information such as News, weather, sports, finance and time tables; financial activities services such as stock quotes and trading; personal organizer; office services to get access to office internal network; e-commerce such as electronic wallets, tickets and gambling; Advertising functions and entertainment function like games, video, music and mobile TV.

In Conclusion, four major 3G services in the market should be content download, media on demand, LBS and Mobile video.

Section 5: Regulatory regime for mobile market in China

Besides the innovation system, market place, and standards are related to each other, regulatory regime also plays an important role in the transition process of 3G in China. Regulatory regimes establish the standards and supervise the behavior of the actors in the market place and set licensing, spectrum allocation, spectrum management and auction policies. The out come of the innovation system also participate in the creation of the standards. In some countries, consumer group are also part of the regulatory regime which influence the policy made by the regulatory body for the industry. In this section, I will adopt the institution economic method to give out the importance of regulatory regime and their roles in this transition process to 3G network.

5.1 Institution economic method:

According to Institution economic perspective, “institutions are the ‘rules of the game’, consisting of both the formal legal rules and the informal social norms that govern individual behavior and structure social interactions (institutional frameworks). Organizations, by contrast, are those groups of people and the governance arrangements they create to coordinate their team action against other teams performing also as organizations. Firms, Universities, clubs, medical associations, unions, etc. are some examples.” [27] In telecommunications industry, the specifications of the technologies and the policies set by the regulatory regime are the ‘rules of the game’ while the regulatory regime is the organization mentioned above.

In the institution economic method, scholars claim that government plays an important role in market economies. To adopt this point of view into the Chinese telecom industry, it is the regulatory regime that plays this important role. To be more

specific, it is the Ministry of Information Industry in China and the Council of China together play this role in the industry.

According to John Groenewegen and Marianne Van Der Steen in their paper, the evolutionary policy maker, they say “in mainstream economics, governments have a role to play in market economies because markets fail. Natural monopolies, collective goods and externalities are the three basic reasons of market failures. When efficient markets exist, individual actors can take care of the coordination of transactions themselves through market contracts. Departing from the adage, ‘in the beginning there were markets,’ it is argued that individuals with clear and well-protected property rights will negotiate with each other about exchanging rights until a Pareto efficient situation is realized. In this way, externalities will be internalized unless the market on which contracts have to be concluded, do not exist, or when the information is so imperfect or asymmetric that the transaction costs of contracts are too high. New institutionalisms like Oliver Williamson and Douglass North would argue that in those cases, markets also fail and government has a role to play in creating a clear and stable environment of property rights, competition policy and the like. Moreover, government should create markets when these do not emerge and design transparent information structures. Government is in a special position to do so because it has privileges to create institutions like markets, to create or change the legal rules of the game (taxes, regulations) and to enforce behavior of private actors. New institutionalisms would add that government should only correct the market failures when the benefits are higher than the cost of government failures due to principal agent problems.”[27] I agree with the point of view held by Oliver Williamson and Douglass North. It is the same case in the telecom industry. Regulatory regime only corrects the market. It is in a special position and it has privileges to create or change policies. It helps the competition between different actors. It adjusts the market share of the operators by the assignment of spectrum and it controls the timing of the transition process by the launch of licenses.

“In institutional evolutionary economics, government, like other agents, is part of an ongoing process. Economic processes are interrelated with technological, cultural and institutional processes. Such an approach provides insights into path dependencies and irreversibility. In such an evolutionary world, government cannot and should not ‘simply’ correct the failures of the market, but should play a role that facilitates guides and sometimes directs the process into socially desirable directions.”[27] Then how to direct the process? Oliver Williamson and Douglass North give two methods: “one is to offer only options, the other one is to direct technological development. If a government could do the thing above then it can be aware of the limitations of other actors and also itself. Even if some other actors lock the process into undesirable paths of development, it can also learn the possibilities of the necessity to explore and to create opportunities.” [27]. As for the telecommunications industry, regulatory regime directs the evolutionary process by the launching of licenses, directing technological development through its policies.

5.2 China’s regulatory regime

According to this method, I would like to give out the detailed Chinese regulatory regime structure and its significant influence during the process of the implementation of 3G system.

The structure of China Radio Regulatory Body:

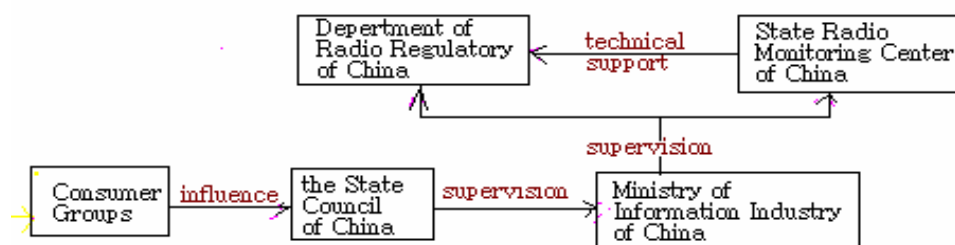


Figure 20: Structure of China’s Regulatory Body for telecom industry

Here in the China Regulatory Body, the main actors would be the State council of China and MII. The Department of Radio Regulatory of China and the State Radio Monitoring Center of China is under the charge of MII. The State Radio Monitoring Center gives technical support to Department of Radio Regulatory.

The major responsibilities of MII are as follows: [28]

1. "To study and formulate the government's development strategies, guidelines, policies and overall plans of the information industry with a view to invigorating the manufacturing industry of electronic and IT products, the communications and the software industry as well as promoting the informatization process of the national economy and the social service.
2. To stipulate laws and regulations of the manufacturing industry of electronic and IT products, the communications industry and the software industry, issue administrative rules and be responsible for the administrative enforcement of laws and the supervision of the enforcement of laws.
3. To make overall plans for the development of national public communications networks (including local and long distance telecommunications networks), radio and TV broadcasting networks and dedicated networks of other sectors and exercise sector management.
4. To establish technical policies, systems and standards for the manufacturing industry of electronic and IT products, the communications industry and the software industry; to establish technical systems and standards for radio broadcasting and TV transmission networks; to exercise control over the network access verification of telecommunications network equipment and the network access of telecommunications terminal equipment; and to provide guidance to quality supervision and control of electronic and IT products.

5. To be responsible for nationwide distribution and management of such public communications resources as radio frequencies, satellite orbit positions, communications network numbers, domain names and addresses; to be responsible for the examination and approval of the establishment of radio stations as well as detection and supervision of the use of radio frequencies; and to regulate radio frequencies and help settle radio interference related matters according to laws and maintain radio wave order in the air.

6. To exercise supervision and control over telecommunications and information service market, implement licensing for operation as necessary, exercise supervision over service quality, ensure fair competition and universal service and safeguard the interest of both the state and users; and to establish arrangements for network interconnection, interoperation and accounting, and supervise their implementation.

7. To formulate tariff policies for communications and information service, set tariff standards for basic postal and telecommunications services and supervise their implementation.

8. To organize the planning, construction and management of dedicated government communications networks; to manage the supervision and dispatch center of the national communications networks and international communications gateways; to deploy and coordinate dedicated government communications, emergency and disaster relief related communications and mission-critical communications; and to ensure security for communications of the government.

9. To provide guidance and foster the growth of the information industry in compliance with the industrial and technological development policies, by giving directions to the adjustment of its industrial structure, product mix and enterprise structure, as well as the reorganization of state-owned enterprises and the

establishment of enterprise groups; and to rationally allocate resources and prevent duplicated construction.

10. To facilitate R&D in the manufacturing industry of electronic and IT products, the communications industry and the software industry, organize projects to tackle major technical problems and promote the digestion, absorption and improvement of the imported technologies with a view to applying R& D results to production; and to offer support to national industries.

11. To study and formulate development plans for the informatization of the national economy and help project owners and initiators in promoting the key informatization projects; to direct, coordinate and organize the development and utilization of information resources; and to give guidance to the popularization of electronic and information technologies and education on informatization.

12. To organize and give guidance to the consolidation of financial data, the submission of profits, the allocation of funds and clearing of postal and telecommunications enterprises, coordinate operational relations between postal enterprises and telecommunications enterprises, mobilize funds for subsidies for universal service and for posts, and take charge of personnel matters concerning the Ministry and units directly under the Ministry.

13. To present China in relevant international organizations and when signing inter-governmental agreements, organize foreign economic and technical cooperation and exchanges, and handle matters concerned with other countries.

14. To study communications and information policies concerning the Hong Kong Special Administrative Region (SAR), Macao (SAR) and Taiwan and deal with related issues.

15. To be Responsible for the publication of sector statistic and information.

16. To handle other matters entrusted by the State Council.”[28]

In the former section, I mentioned that at the early time of Chinese telecom industry, there was only one operator, China Telecom, which is owned by the former MII, MPT. Thus, MII have both the operation function and the regulatory function. Even though in order to separate these two functions, the operation of China Telecom do not belongs to MII, whenever it comes to the regulatory related theme, the ownership of the operators would always be hot topic.

5.3 Regulatory related issues

5.3.1 Ownership of operators:

In China, the four operators are state-owned but they have their own rights of operation without the intervention of MII. But they have to act under the rules of the game given by MII. “Competition without privatization has been a path adopted by the Chinese government within the constraints of its traditional centrally-planned economic system and Marxist ideological origins. State ownership of major telecom operators lends ambiguity to the status of the central government, which is caught between the interests of two rival coalitions of interests. On the one hand, the government would like to achieve the benefits of competition by incorporating deregulatory mechanisms in the telecommunications sector. On the other hand, it has limited ambition to invest in the construction of extra networks.”[29]

Foreign investment in telecommunications operation from multinational network operators or multinational companies was banned before China being member of

WTO. This fact helped China avoid foreign operation but also made problems for China to finance. Therefore, Chinese government set up branch companies of China Mobile and China Unicom in Hong Kong, namely China Mobile (HK) and China Unicom (HK). 70% shares of this branch are held by the government. “Subsequently, this branch re-invests or takes over the mobile networks in China while the operation is left to the hands of local Chinese operators. In this manner, the mobile company obtains sufficient funds and, at the same time, the operation is fully controlled by Chinese operators. The absence of pressure from foreign operators in the Chinese market enables the Chinese regulator to formulate the Chinese version of policy without the necessity to follow the approach that has been widely adopted by other countries. However, this situation is due to change when China’s becomes a member of the WTO.”[29] With the agreement of member of WTO, China has to lower down its door obstacle for foreign investment.

5.3.2 Codifying Regulation [30]

By far, China still has not any Telecommunications Art. The draft out work of the first Telecommunications Act of China was finished. This would help operators in China compete with each other in a relative fair environment. And it can also provide the business opportunities for foreign investment and protect the users’ benefit. In the August of 2006, the draft was sent to National People’s Congress, where it would be certificated and revised by the Council of China and Ministry of Information Industry of China. It is expected that the Telecommunications Art would come out as soon as possible. As we all know, a game without clear rules is deregulation for telecommunications industry especially when evolution takes place.

5.3.3 Status of the Regulator

The main component of Chinese regulatory regime should be the Ministry of Information Industry. The establishment of the Ministry of Information Industry

means status of the regulator in China now is independent. It is separated from the government. Although the stance of the regulator could not avoid the nature of state ownership, the separation of operational function from that of regulation would provide more business opportunities for both the local actors but also the actors worldwide. Right now, MII has no more operational connection with operators, which is a good fact to multinational telecom companies. But even though China has provide business opportunities to foreign investment, local operators still have favorable policy. Therefore, it is a good idea for foreign investment to cooperate with local operators.

5.3.4 International policies and the role of international agencies

When it comes to regulatory regime, it include both national regulatory regime and international regime an also the council of China. As we all know, ITU is such kind of international regulatory regime who set licensing related principles and internationally co-coordinated policies for telecommunications operators all over the world. There are the regulatory principles attached to the February 1997 WTO agreement: “Where a license is required, the following will be made publicly available: all the licensing criteria and the period of time normally required to reach a decision concerning an application for a license; and the terms and conditions of individual licenses. The reasons for the denial of a license will be made known to the applicant on request.” The first international policy was the European Commission’s April 1997 Directive on Licensing in order to simplify and harmonize licensing within the European Community. It supported for harmonization within minimum license conditions. While when it comes to allocating scarce spectrum resources, this directive on licensing left it to individual member countries to determine.

Besides this, in order to coordinate the introduction of 3G system, Europe Community

released another document in the same year. In July 2000, the EC proposed an indication of regulatory framework for telecommunications services. This movement makes the international policies more consistent. Before licensing, in order to make sure the consistency of licensing method, national authorities are needed to consult each other.

The European Commission also proposed a decision on a regulatory framework for radio spectrum policy, which provides a policy platform within EU countries to address all kinds of issues related to the use of radio spectrum. This decision covers the content related to harmonize the allocation, assignment and conditions of use of radio spectrum.

The original purpose of 3G network is to realize the global interoperability and inter-working. But with more and more operators getting involved, the arrangement has been proved to be difficult. Network roaming right now relies on the agreements among individual operators. There are difficulties to realize international harmonization of different technology proposals. In Europe, the European Telecommunications Standards Institute (ETSI) takes responsibility to progress the standardization process in Europe. Another international organization is the Third Generation Global Partnership (3GPP), which was formed in 1998. Its main task is to facilitate standardized transitions to 3G mobile for countries all over the world.

In order to realize the global interconnection and a wider international community, harmonized policies should not only limit within the 15 states of EU. International cooperation not only looks for immediate solutions for 3G services but also helps define future licensing principles. These licensing principles are been adopted in China whenever licensing issues comes.

With the introduction of the main international regulatory organizations and their main purpose for technologies development, in the following part I will give out the

specific principles and specifications mentioned in the ITU briefing paper for 3G. it is said in that paper, clear and stable licensing conditions and policy parameters are very important to potential bidders, the network operators, China Mobile, China Unicom, China Telecom and China Netcom, before the beginning of licensing process. However, there is no clear Telecommunications Act by far and the industry environment is very unclear. Therefore, it is difficult to give out clear analysis. I can only give out the theoretical issues mentioned in the ITU briefing paper. They are:

- number of licenses to be awarded
- the conditions, if any, to be attached to the licenses
- the method by which licenses will be allocated to prospective operators of 3G services
- Clear terms for payment of monies tendered at auction.
- Having such information available is necessary in enabling potential bidders of 3G licenses to determine the value of a license and to develop viable business plans. [11]

5.3.5 Number of licenses to be awarded

“The number of licenses to be awarded is an element of competition policy and can critically determine the success or failure of the 3G regulatory framework and of 3G service provision in general.”[11] In China, there are four licenses to four local operators.

5.3.6 Frequency allocation

ITU has allocated frequency bands 1885-2025MHz and 2110-2200MHz for the use of IMT-2000. Countries choose the spectrum within these bands with the consideration that the chosen spectrum is available for them to apply 3G network. Different countries have different choices. The same frequency band

might be available in one state while not available in the other countries. But whatever they choose, they are within the ITU allocation. In this way, it makes it easier to roam among networks. The ITU's World Radio Communications is the international body that is in charge of radio spectrum allocation. The World Radio Communications Conference (WRC) is held every two to three years by ITU. In the meeting a global framework was established for the use of radio spectrum. Global coordination can also encourage services to be better with the competing signals and transmissions. In the World Radio Conference 1992 (WRC1992), 2 GHz frequency for IMT-2000 on a global basis was identified. But later it is proved that this frequency was not sufficient, especially to the countries 2GHz is not available, such as the States with the 2 GHz frequency as military use. Therefore, in Istanbul in May-June 2000 allocated additional spectrum for 3G services: the three bands was identified for use of 3G services. They are below 1GHz, 1.7GHz, and 2.5GHz. Most 2G systems right now are available for the 1GHz and 1.7GHz and the 2.5GHz is made for the consideration that extra spectrum with the growing number of mobile users, rapid growth of mobile data services, mobile e-commerce, wireless internet access and mobile video-based services, and the need to secure common spectrum worldwide for global roaming.

5.3.7 Commercialization of radio spectrum

The radio spectrum is an indispensable natural resource in telecommunications industry. Countries have been using approaches to make the radio spectrum commercialized. In China, there is Radio Spectrum Regulation of the People's Republic of China detecting the allocation and commercialization process of the radio spectrum. This Radio Spectrum Regulation was published in 1993, and it supports for the principle that the users should pay for occupying spectrum.

At present in China's mobile market, the two local operators both China Mobile and China Unicom do not have to pay for the allocated spectrum. It is the subscribers that have to pay a so-called 'spectrum occupation fee' every year. And then the operators gather the fees from subscribers to hand in to the Radio Regulatory Department of the Ministry of Information Industry. The RRD of MII is formerly named as State Radio Regulatory Committee. At the year of 2003, the spectrum occupation fee was 50 Yuan per subscriber. With the increased number of the subscribers, total spectrum occupational fee will grow rapidly. To take the year 2000 as an example; the spectrum occupation fee reached a total of 4,263 million Yuan with a total of 85.26 million mobile subscribers by the end of the year.[29]

With the experience of the spectrum auction fever resulted by the licensing of 3G mobile in Europe, Germany and UK gained 47.5 billion dollars and 33 billion dollars from the license fee. This data have been attracting governments in other countries try to follow the same approach. However, there was a negative reaction from the stock market. The reaction has led to a decline of auction fees in these later-mover countries. In China, auction for 3G licenses was included as one of the possible approaches of allocating radio spectrum. Even through with this fact, calls for a spectrum auction are not as popular as they are in other countries, especially in Europe. In my opinion, Chinese government might take the method of assignment for the licenses in order to regulate the market in line. Just as minister Wu Ji Chuan of the Minister of Information Industry of China said during an interview with the Financial Times in September 2000, the method for calling for 3G licenses, auction, used in Europe is not applicable in the Chinese. In China, the supervision function of regulatory regime is traditional. Auction method has been used for allocating phone numbers in some place in China in order to get a number with better meaning, say 8, 6, or 9. This auction approach has not reached the regulator's level. The allowance for using the auction method mentioned in the regulation has not changed too much of this phenomena. The implementation of 3G in China has been a disputed topic in China.

Government does not want to see bubble economic generated by the implementation of 3G after the experiences from other countries. Therefore, with the laggard development of Chinese telecommunications industry compared with other countries and the incomplete telecommunications regulation, regulatory regime in China is very careful of the licensing and they are waiting for the best time to launch. That is why the licensing of 3G has been delayed for such a long time. And also minister Wu have the consideration that it will take a long time to get the license fee back for operators. But the potential market demand for 3G is not encouraging. [33]

And also in China, by far, the two largest local operators, China Mobile and China Unicom are still state major owned, even in the branches of them in Hong Kong. This ownership of the operators presents another disincentive for taking the auctioning approach. Although MII right now have make the operation and regulation separately, the ownership of operators in China still makes the difference from China and the countries where operations of the operators are completely separated from government. In China, the benefit of an auction activity is not as attractive as other countries since the license fee in an auction will be transferred to the state government. [29]

Minister Wu also said that operators' paying for the spectrum should be deigned to meet the specific situation of China. This principle has been involved in the Telecommunications Regulation of 2000: "Telecom operators should pay for telecom resource charges for their occupation and use of telecom resources"[32]. With this principle, the possible waste of recourses is avoided. For example, the principle prevents the operators from occupying resources without using them. By commercializing allocated spectrum, supply and demand sides in the market place can be adjusted, and market resource can be allocated more effectively. [29]

It seems to be conflict that I mentioned before it is the individual subscribers who pay for the spectrum occupation fee rather than the operators. But actually, it is not. It is the current case when it is still 2G and 2.5G are in China. In this case, operators have no pressure to improve their spectrum efficiency. But this might cause waste when the subscribers are not as many as it is supposed to be. But the principle for 3G licensing avoids this waste by commercializing the allocated radio spectrum in real terms. And in this sense, the paying party becomes the operators in 3G are rather than the subscribers.

“According to a senior director of the Radio Regulatory Department of the Ministry of Information Industry, the proposed new method will mean that the regulator defines the price of the spectrum by benchmarking the price of relevant economies and then allocating the spectrum to operators according to this defined rate. Although this might be influenced by subjective factors, it can prevent over-speculation of the spectrum price” [29]

The Ministry of Information Industry of China launched an additional spectrum band of 3.5GHz range in 2001. This spectrum range will be used for wireless local loop services. Even though the price for this spectrum is unclear, MII gave indications of the basic capability of bidders and their spectrum usage schemes. [29]

Since the development of 3G is not only significant for Chinese operators but also for the Chinese telecommunications manufacturing industry, the choice of 3G standards are also very important. TD-SCDMA marked the technical development of Chinese telecommunication industry. Therefore, it has large opportunities to be carried out and the test work of TD-SCDMA network has also been finished. Standards battle would continue. Given the advantages of the three standards and specific Chinese mobile

market, more than one standard compete with each other is the most possible stage for Chinese 3G market.

5.3.8 Cost Sharing

Even though this has not happened in China, I would like to mention it as it might be taken into consideration in the near future. Based on the ways of licensing, there are auction and allocation. If the China regulatory regime would like to take the first licensing method, cost sharing then will become a topical issue. It occurs when as the auction price is higher than one operator can afford, they might share the cost. We say that infrastructure sharing avoids waste and promote the competition among actors. But cost sharing is not. When two or more operators sharing the cost for the license, the economic interest will draw them together and the result of which might be the restriction to healthy competition in the market. Therefore, cost sharing is different from infrastructure sharing. For cost sharing, operators build and own network components together while for infrastructure sharing one operator should pay to use another operator's infrastructure.

It is easier to imagine that the two operators building a network together. Instead of compete against each other, they may joint together to compete against other operators. There is also other worry about that if the cost sharing be a common phenomena, the regulator might thinking of change the launched terms of the licenses. If the regulator really takes action about this, then it might cause actors disconcerting in the actor network.

In China, we could not see the ways of launching the licenses. And it is difficult to forecast the reaction of MII and operators. But the experience of other countries can be adopted. RegTP, the telecommunications regulator of German allows its 3G

operators to share only certain parts of their network infrastructure, such as towers and antennae. And the backbone of the network and base stations should be built by the operators themselves. And only when the break down of the operator has no effect on others, sharing is permitted in the situation that malfunctions happens. Even though there are some restrictions on cost sharing, the sharing of physical items such as towers and antennae can save around 20%-40% of deployment costs, which is still a considerable saving. [31]

In other countries of Europe, take Netherlands for example, the cost sharing is not allowed where the cost sharing could be seen as a way of occupying the pragmatic middle ground. But in Sweden, even closer cooperation than German is allowed.

From the above we can that different countries have different policies about cost sharing. In China, there is no one agreed standards about 3G. There is still no research on cost sharing problem from the operation to management in 3G network. [32]

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5.3.9 Implementation of regulatory policy

Besides the above license conditions related issues, the implementation of regulatory rules should also be taken into consideration.

The first consideration of the successful implementation of regulatory policy would be the development of appropriate pricing principles. These principles can be used to solve the problems and interest conflict during the pricing process of 3G roaming services. Roaming between networks is also important for operators to resale their network capacity to others. It is different from the cost sharing and infrastructure sharing mentioned before. Cost sharing and infrastructure sharing involve physical connection of networks. Here the pricing principles are used for the roaming form one network to another. Purchase activity is involved. The buyer will have to combine the

purchased network functionality with its own network functionality to deliver 3G services.

As is given in the ITU briefing paper for 3G, “one approach used widely for the wholesale pricing of resale services involves establishing a price based on retail prices less avoidable costs.”[11] This method can be adopted in the China’s 3G market. Whenever operators want to quit the market, they can adopt this method to resale their network. A good pricing regime can help avoiding resource waste in the market. The detailed principles of the approach are given as follows: “when a 3G operator acquires the roaming service, it does not incur any of the costs of the retail functions associated with the supply of the service. This is achieved by subtracting, from the retail price of a mobile call, the ‘avoidable cost’ the network owner would avoid in the long run if it ceased supplying mobile services in the retail market. In implementing the retail-minus pricing approach, it would be necessary to determine an appropriate basis for both the retail starting price and the costs that should be deducted from it.”[11]

It is difficult to determine the appropriate retail price because in practice there must be various prices for 3G services in the market. These prices are relative with the monthly fee for the operators which can be different for different operators and the data services used by the consumers, which vary according to the amount of the service. “One method to overcome this problem is to establish the retail price with reference to the average revenue from providing to all customers those services that would be available to a competitor as part of the roaming package. This will include revenues from connections, rentals and calls. Retail revenues for the services provided under a roaming agreement would, in practice, be calculated separately for different services and for peak and off-peak periods.”[11]

Section 6: Conclusion

With the above presentation of transition process to 3G network and related issues in China based on the Actor Network Theory, I can conclude that the standardization process of the implementation of 3G in China is a dynamic duration. It follows the rules stated in the standardization strategy. Based on the possible 3G standards, migration paths are formed for operators. Given the consumer preference, operating revenue, infrastructure sharing and so, operators select one standard with the license. And in 3G network, new actors will be involved with the new services attraction. It makes the restructure of the existing actor network. Within the network, actors cooperate and compete with each other under the monitor of MII and follow the related regulations. Even though the auction policy is still unclear in China, actors in the network have been getting ready for the reception of the license for 3G. By June, 2007, MII has announced that the three standards will coexist in China's 3G market, which makes it easier for China to be consistent with international market. Both international and national manufacturers have been active producing related products. Operators and device manufactures have been finishing several thousand testing work on devices, interface and so on. The enlarged testing work of TD-SCDMA has begun in Beijing, Shanghai, Tianjing, Shenzhen and other 6 cities.

For further think that according to the fact that authorities declares that 3G network should available during the Olympic Games in Beijing, the trend of implementation of 3G in China is undeniable. Based on the analysis above, I might think about whether it can be as popular as GSM network in China? Whether it can gain vast benefit to operators?

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