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THE ROLE OF SMS IN MOBILE DATA SERVICE DIFFUSION IN CHINA: A LONGITUDINAL CASE STUDY BASED ON ACTOR-NETWORK THEORY

IT for Underserved Communities

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Abstract

While Japan's I-mode failed to be adopted in other countries and WAP also did not succeed in promoting mobile data services, a rather simple technology of SMS made its way to facilitate the growth of mobile data services in China. In this paper, we conduct a case study based on actor-network theory in order to explain 1) how mobile data services are developed and adopted in China, 2) what is the role of SMS in facilitating the development of mobile data services, and 3) what technological and social factors attribute to the adoption process of mobile data services. Drawing upon actor-network theory (ANT), this paper investigates longitudinally the driving forces fueling the development of data services in the China market. By analyzing the network structures formed by the various actors such as mobile data service providers, government departments, technical artifacts, customers, etc., we can better understand the dynamics of the mobile data service development in China and provide valuable references for the rest of the world.

Keywords: SMS, text messaging, data service, mobile commerce, actor-network theory

Introduction

The advances of wireless communication technology and widespread use of hand-held devices such as cell-phones enable people to communicate with each other anytime, anywhere on the move. Besides voice communication, it is also possible to provide via mobile network short messages, emails, wireless Internet access, and a broad variety of wireless business services. Those services are often broadly termed as mobile data service, which usually refer to non-voice offerings carried on mobile communication technologies such as SMS (Short Message Service), MMS (Multimedia Message Service), WAP (Wireless Application Protocol), etc. (Yan 2003).

I-mode is so far the most famous and successfully adopted mobile data service provided by the largest mobile operator of NTT DoCoMo in Japan. There were more than 45.9 million I-mode subscribers by February 2006 (NTT DoCoMo Official Website). Users can use cell-phones to access I-mode services such as sending and receiving e-mails, playing games, buying tickets, paying bills, and receiving a variety of information services such as news, weather forecasts, and stock quotes. I-mode uses NTT's proprietary packet switched network namely PDC-P for data communication (Palomaki 2006) and cHtml, a compact subset of Html for wireless Internet Web access (Ratliff 2002). The success of I-mode has been ascribed to a careful balance of the right technology, the right strategy, the right content, and the right marketing (MacDonald 2002). The extension and adoption of Japan's I-mode in other countries, however, was not so successful. Some people comment that the success of I-mode is due to cheap messages and games. In contrast, Europeans also prefer SMS but seldom play games (Baldi and Thaug 2002). There is a lack of comprehensive theoretical study on why I-mode succeeded in Japan but failed in other countries.

WAP is another technology designed to facilitate wireless Internet access through mobile devices. By standardizing the Internet access protocol, it was expected to promote the adoption of mobile data services worldwide. Nevertheless, as opposed to the expectations of most proponents, only limited success was achieved since its initial introduction to the European market (Lewis 2000; Wang et al. 2005). Unpleasant user experience, lack of end-to-end

security, inappropriate revenue sharing and pricing policy, and misleading marketing strategy are among the reasons for this result (Palomaki 2006). While both I-mode and WAP could not make mobile data services successful in the countries other than Japan, what will be the right technology and strategy to promote mobile data services in different countries with diversified cultural and social environments?

SMS is a rather simple data communication technology that allows users to send text messages of less than 160 characters over cell-phones. Due to its limited functionality, people did not expect SMS to play a key role in promoting mobile data services. Surprisingly, SMS has been widely spread in Europe and many Asian countries (Celdran 2002; Faulkner and Culwin 2005), and it became an established leader compared to other technical artifacts including MMS and WAP. In China (the typical geographically underserved nation), SMS-related service has alone produced revenue of 30 billion RMB in 2005, 300 times bigger than 5 years ago. There are hundreds of data services being adopted popularly by Chinese customers (Yan 2003), of which many are low-end and historically underserved. It seems that SMS has successfully facilitated the growth of mobile data services in China. We wonder why it is the case and how it happened. Specifically, we want to study 1) how mobile data services are developed and adopted in China, 2) what is the role of SMS in facilitating the development of mobile data services, 3) what technological and social factors (and maybe their interactions) attribute to the development of mobile data services.

While the promotion of mobile data services are often studied from business model (e.g. Anwar 2003; MacDonald 2002) or value chain perspectives (e.g. Rulke 2002), the adoption of mobile data services are usually studied from user perspectives (e.g. Lai 2004; Teo and Pok 2003). However, these studies could not provide a comprehensive explanation for the success and failure of the mobile services experienced in different countries with different technologies. For a complex social-technical phenomenon like adoption of mobile data service, in-depth analysis on multiple actors and their dynamic interactions should be conducted to reveal the mechanics that drive the development of mobile data services (Liang and Wei 2004). Drawing upon actor-network theory (ANT), this paper investigates longitudinally the driving forces fueling the development of data services in the China market. By analyzing the network structures formed by the various actors such as mobile data service providers, government departments, technical artifacts, customers, etc., we can better understand the roadmap of mobile data service development worldwide in general and that of China in particular.

The remainder of this paper is structured as follows. Section 2 provides an overview of the actor network theory including the corresponding terminology. Section 3 introduces the research methodology and data collection procedures. Section 4 explains the detailed development process of actor-network. Section 5 discusses the implications of this research. The last section is about future research directions.

Actor-Network Theory in Information Systems

The development and application of actor-network theory (ANT) was initiated by (Callon 1986) and (Latour 1987) with an attempt to address the increasingly complex socio-technical world (Walsham 1997). ANT treats the social and the technical as inseparable and indeed argues that people and artifacts should be analyzed with the same conceptual apparatus (Walsham 1999).

ANT does not distinguish between or define a priori any kinds of human and nonhuman elements but just calls them *actants* or *actors*. The motivations and actions of groups of actors are often examined (Hanseth et al. 2004) by the pivotal concepts of *translation* and *inscription* (Oh and Lee 2005). The actor-network is configured over time through the *enrollment* of allies (both human and nonhuman) by means of translation (Callon, 1986). That refers to a variety of ways by which actors seek to persuade others and enroll them into an alignment with an existing or prospective network whereby the relationships between actors and the network as a whole become stable and *irreversible* (Yoo et al. 2005). *Inscription* or scripting is related to the notion of standardization and 'making work visible'. Actants in a network thus embed 'scripts' for the future action and behavior in the network (Yoo et al. 2005).

The process of translation usually consists of four steps (Oh and Lee 2005). In one attempt to achieve a translation, the actor may suggest that it shares a 'common' problem with potential allies, a process known as *problematization* (Callon 1986). Then comes *interessement*, where one focal actor convinces the allies with the necessary skills, knowledge or other resources to devise a solution to their 'common' problem (Howcroft et al. 2004) and thus makes itself indispensable (Callon 1986). Then, the original problem is renegotiated or translated, as other actors *enroll* themselves into the network defined by the focal actor and their common interests. In the last stage of translation, the *mobilization* of previously enrolled actants occurs when social investment reaches a point where withdrawal

would be irreversible (Howcroft et al. 2004). Translation is not always successful, as stated by Callon (1986) that each entity enlisted by the problematization could choose to be integrated into the network, or inversely, refuse the translation (Oh and Lee 2005). A holistic ANT terminology can be found in (Akrich and Latour 1992). Interested readers are also encouraged to examine (Howcroft et al. 2004), (Hanseth et al. 2004) and (Tatnall and Gilding 1999) for implementations of ANT in the IS field.

ANT has been gaining attention from the information systems research community as a powerful tool to “overcome the current poor understanding of the information technology artifact” (Hanseth et al. 2004). Holmstrom and Stalder (2001) analyzed the introduction process of electronic cash in Sweden and concluded that the cash card failed because interests of some actors were not inscribed into the network. Therefore, a multi-purpose network is a prerequisite to keep all actors from drifting out of the socio-technical system. Faraj et al. (2004) investigated the Web browser development history using three processes of inscribing, translating, and framing. They investigated how actors interact with each other in the race of acquiring users for their own browser of Navigator and Internet Explorer. Since then, ANT has been applied in various IS contexts for numerous problems (Adams and Berg 2004; Allen 2004; Atkinson 2002; Atkinson and Stergioulas 2004; Frohmann 1995; Klischewski 2001; Linde et al. 2003; Mahring et al. 2004).

Among the studies to date, two are worth mentioning in that they deal with ANT of nation-wide technology diffusion as this paper. Yoo et al. (2005) explored the role of standards in shaping the mobile infrastructure in South Korea by actor-network theory and concluded that successful deployment of broadband mobile services involved the mobilization of the broad and complex socio-technical networks including technological, institutional, political and financial resources. Gao (2005) analyzed the mechanism of China’s strategy formulation for the telecommunications market transformation through actor-network theory. Overall four stages of transformation were identified, in which actors try to inscribe their interest in the national strategy within the dynamic socio-technological context. Gao (2005) also extended the actor-network theory by adding a contextual analysis ingredient.

Research Methodology

To study the diffusion of mobile data services, we need to investigate technological, political, social factors, as well as the interactions between them, in order to understand the adoption process. Therefore, ANT is selected over other research methodologies in this paper.

Carrying out a longitudinal case study on the mobile data service in China requires capturing main events and activities in the mobile industry, identifying key stakeholders in different historical stages, and exploring their dynamic interest alignment process (Gao 2005). To do that, many years’ of data pertaining to various stakeholders and technology artifacts are required. Moreover, the adoption process of socio-technical systems as in this paper often involves participants in a variety of organizations and different industries. This makes the data collection task considerably tough for research methodologies of survey questionnaires, interviews and field experiments due to their limited coverage. Keeping this in mind, and considering that the proliferation of SMS is far behind the emergence of electronic commerce and well explored by online media, we select Internet news portals as the main source for data collection.

The features of online news match our research objectives because: Firstly, news media often report significant events in a timely manner. Internet portals further expedite the report process by publishing real time news online (Dimmick et al. 2004). Secondly, since most of the Internet portals in China form alliance with many official newspapers, online sources have little chance to miss critical news events (Ahlers 2006), especially when the data of many portals are used for cross check purposes. Thirdly, although the authors of this paper didn’t conduct interviews in person, many official interviews conducted by journalists of official newspapers are available online and can be used as references. The real names of the interviewees and reporters are all made publicly available to mass audiences. This is a strong argument for the truthfulness of those reports. Certainly, viewpoints of particular reports will not be taken directly as basis for our analysis.

To build and verify the ANT model, we collected news data from the three most well known Internet portals: Sina.com, Sohu.com and Netease.com. Sina.com was selected as the main data source for its fame as the number one online news portal in China and broad coverage of news events. The other two Web sites are used for confirmation and complement purposes. To ease the process of relevant news sifting, the intra-site search engine of Sina.com (namely, iAsk.com) and the most popular independent search engine in China, namely Baidu.com, are employed.

The time interval selected for study is from 1997 to January 2006 – a nine-year period that covered the main evolution history of China mobile data services. At first, the two authors (both proficient in English and Chinese) thoroughly read the latest news reports of Sina.com during a one month period, identifying the formats and subjects of news that are of interest to our research theme. The resulted news subjects then grouped into technology, content provider / service provider, consumer and regulator. This is also in line with the theoretical framework to be introduced in the next section. The formats of news reports are classified into survey, interview, viewpoint and event report. Then, many key words that may appear on the titles of relevant news reports are identified. These key words include Service Provider, Short Message Services (SMS), Text Messaging, Mobile Phone, Wireless Internet, Wireless Commerce, Mobile Commerce, etc. Subsequently, the search engines introduced above are employed and a total of 5758 news reports originating from various media sources were gathered. Independent search engine of Baidu.com was also used in this step to retrieve missing event reports due to news censoring policy in China. A filtering procedure is used to manually screen out irrelevant or less useful reports and removing duplicates. By browsing their titles for relevancy check, about 70% of the 5758 reports were excluded immediately (This is a common practice when we browse a list of searching results from a searching engine). Another 20% percent of reports were carefully eliminated through reading the full text for further relevance screening (many news reports were short so did not take too much time to go through the full text). Finally, 574 news reports were selected that are relevant to our research. There were also minor errors and data inconsistency from different sources. We verified the data when it was possible by searching Web sites of official authorities such as Ministry of Information Industry (MII), China Mobile, China Unicom, Consumer Associations, and so on. We also used cross checking techniques (i.e., among reports originated from different news papers) to amend the discrepancy of data until the authors are convinced that the data is reliable for later theoretical analysis. At the end, the selected 574 reports were sorted in longitudinal order for easy analysis. The key events identified from the news reports are summarized in the Appendix I, which shows a clear picture of mobile data service history in China. The number of news reports on different subjects and formats are sketched in Table 1.

Table 1. News Report Statistics by Formats and Subjects

Subjects \ Formats	Survey	Interview	Viewpoint	Event Report	Subtotal
Technology	3	1	19	29	52
Content Provider/Service Provider	44	10	63	241	358
Consumer	56	2	32	14	104
Regulator	6	3	8	43	60
Subtotal	109	16	122	327	574

Development Stages of Value-Added Data Services

Key Players of the Mobile Communication Industry in China

The original Actor Network Theory does not provide guidelines on how to identify actors and analyze the interactions among them. The applications of ANT under different context therefore often adopt quite different styles of description. In this paper, we create a framework that identifies four main actor groups, each of which can further be decomposed into specific actors with particular characteristics. The four groups of actors identified include *SMS and related technologies, data service and content providers, consumers, and regulators* (see Figure 1).

SMS and related technologies refer to technology artifacts associated with SMS such as SMS payment platform, SMS gateway, SMS-based enterprise applications (detailed later) and many others. Those technologies were developed at different times throughout the history and each played a distinct role in different ANT stages.

Data service providers refer to the group of corporations that make the mobile data services possible through business operations or supplying mobile communication hardware/software. Typical members in this group include terminal manufacturers, mobile infrastructure providers and mobile carriers which provide mobile handsets, mobile network equipment and network operation management, respectively. As one of the pillar industries supporting the economics of the whole country, mobile communications are tightly controlled by the central government. Only two of the six mobile network operators, China Mobile and China Unicom, are authorized to run mobile communication businesses. This made the role of carriers unique: they sometimes function like regulators. For instance, when illegal activities of some content providers are observed, carriers have the authority to stop their services. China Mobile is the largest mobile carrier in China with the asset capitals, annual revenue and subscriber number almost three times to its only rival China Unicom. For general information of mobile industry in China, interested readers may refer to (Loo 2004) for more details.

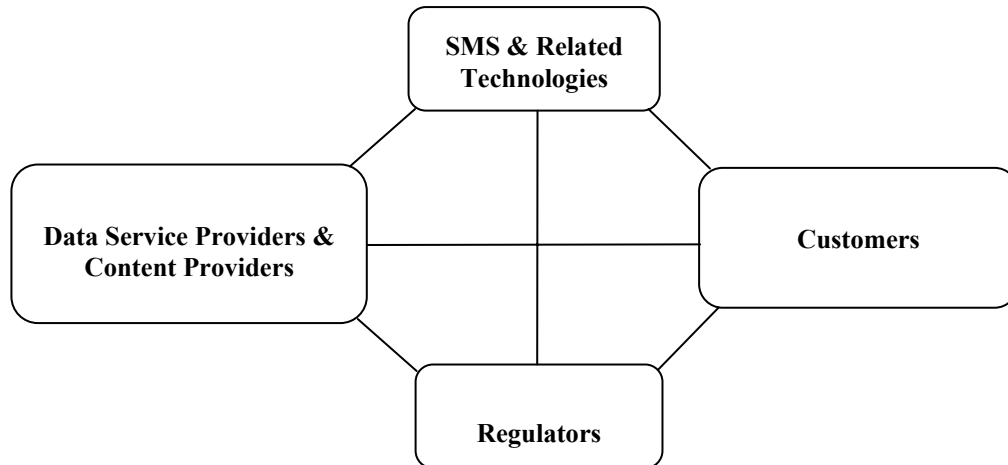


Figure 1. Key Actor Groups in the China Mobile Data Service Market

Content providers in the data service group refer to the agencies that participate and make profits by creating, structuring, and delivering information contents to cell-phone subscribers. Please note that content providers include not only content or service suppliers who provide healthy services, but also those illegal individuals and organizations who take advantage of mobile data services to make unlawful profits.

The general term of *regulators* refer to organizations that enact policies to participants in the mobile data service market. Ministry of Information Industry (MII), Ministry of Public Security, Ministry of Broadcasting & TV, mobile industry unions and other government departments are typical regulators in the data service market. Of all those regulators, MII seems to be most influential as the delegate of central government. Mobile carriers, as was discussed in prior paragraphs, sometimes also play the role of regulators due to their unique position in the mobile commerce value chain.

Customers refer to individuals and corporations that adopt mobile communication technology and subscribe to the data services. Cell-phone subscribers are typical and important customers especially in the early stages of the data service diffusion. While sharing similar characteristics of mobile subscribers worldwide, China mobile subscribers are prone to be more price-sensitive. Many organizations such as companies and certain public service organizations are also customers of mobile data services. They adopt mobile data services in order to improve the efficiency and effectiveness of their business operations.

Sketch of the SMS-enabled Data Service History

Careful examination of the evolution history of China mobile data services results in four stages of actor networks as summarized in Table 2.

The first stage *Person to Person (P2P) SMS communications* began in 1997, when the first SMS was sent within China Mobile's network. The second stage *SMS information services* started in November 2001, when mobile carriers determined to share their SMS platform with independent content providers. While the rich information

services promoted the SMS mass adoption, many illegal groups were also attracted and enrolled into the network. Consequently, the third stage of *SMS service regulation* started when the MII issued one regulation document in May 2004. Then, the fourth stage *SMS enterprise applications* commenced with the Mobile Domain Name Information Center (MobNIC) established in January 2005. Widespread adoption of SMS-based enterprise applications are the key characteristics of this ongoing actor network stage.

Please note that although we narrate the evolution history of data services by separating them into stages, the border of any two successive stages are not clear cut but somewhat fuzzy (refer to Appendix I). In the following subsections, the evolution of the four stage actor networks will be discussed in more detail.

Table 2. Four ANT Stages of China’s Mobile Data Service Enabled by SMS

Stage \ Step	Step One: Problematization	Step Two: Interessement	Step Three: Enrolment	Step Four: Mobilization	Inscriptions
Stage I: Person to Person SMS Communication (1997 - Nov.,2000)	Mobile carriers proposed SMS as new way for mobile communication.	Carriers employed favorable pricing policy to promote SMS adoption.	Customers adopted SMS and enrolled into the actor network.	Customers felt comfortable using SMS; Carriers reap profits from SMS.	SMS protocol
Stage II: SMS Information Services (Nov., 2000 - May, 2004)	Internet portals need SMS to sell information content; Carriers lack information content to attract more subscribers.	Carriers shared the charging platform and invested in SMS gateway updating project.	Internet portals adopted SMS as a new channel to sell information content and enrolled into the network.	By providing rich information to customers, carriers and portals were rewarded with great profits.	SMS gateway, SMS charging platform
Stage III: SMS Regulation (May, 2004 - Jan., 2005)	Flourish of unhealthy and garbage SMS fueled the ever increasing customer complaints.	Carriers updated SMS management platform and invited more regulators.	Some of the illegal groups were driven out of the market (counter-enrollment).	The interests of established actors were ensured as the results of the regulations.	SMS management platform, SMS law specifications
State IV: SMS Enterprise Applications (Jan., 2005 -)	The enterprise SMS market was under-explored but with great business potential.	Carriers proposed SMS Domain Name and Real Name Subscription (RNS) and promoted the SMS enterprise adoption.	Mobile ASPs and enterprises found their interests being inscribed by SMS and enrolled into the actor network.	Enterprises accepted SMS-based solutions provided by carriers and mobile ASPs.	MobNIC, RNS, SMS enterprise application software.

Four Data Service Stages

Stage One: Person to Person SMS Communication (1997 – Nov. 10, 2000)

Voice service was the only source of revenue for mobile carriers before the launch of SMS in China, which happened in 1997 when the first text message was sent within the network of China Mobile’s Tianjing branch.

Some technology features of SMS proved to be helpful in accelerating its mass adoption. Due to its simplicity, SMS modules are available on most if not all cell-phones as opposed to that of MMS or WAP (Novak and Svensson 2001). The protocol adopted by SMS is universal and therefore easy for implementation in all mobile networks. Because SMS consumes limited bandwidth attached to voice channel, carriers can adopt low price strategy to acquire new customers. The SMS senders are charged for 0.1RMB for each message, a price that is much lower than making phone calls (0.4RMB/min). Moreover, carriers offer a favorable one-way charge policy and waive the roaming charges for customers. Thus, besides mobile voice service, SMS became a favorable alternative for personal mobile communication.

Therefore, in the first step of *problematization* in ANT, mobile carrier as the focal actor sought to be indispensable by suggesting SMS as a solution to communication problems of potential actors (in this case, consumers). The favorable marketing strategies from carriers, together with the unique technology features of text messaging services, met the communication requirements of consumers. Thus, the problematization efforts made by carriers were acknowledged and the obligatory passage point was successfully surpassed.

Then, in the following step of translation, *interessement*, mobile carriers attempted to stabilize the identity of SMS subscribers. By doing this, carriers further confirmed the validity of the problematization step. So the network proceeds to *enrolment*, where consumers accepted the interests defined by the focal actor of carriers.

In the last step of translation, *mobilization*, carriers attempt to keep other actors from leaving the network. When more consumers were acquired into the market, people feel comfortable being connected with their colleagues and friends via SMS. Therefore, carriers succeeded in retaining them through the process of mobilization. However, the types of SMS services, as were mainly produced by mobile carriers, were far from rich in stage one. Accordingly, the total number of SMS messages sent was only 1 billion per year. The three groups of actors and their interactions in stage one are depicted in Figure 2.

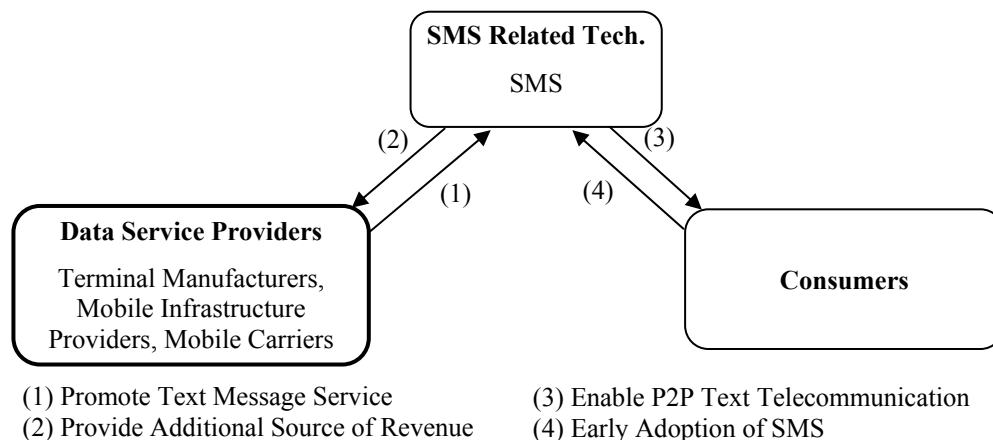


Figure 2. Stage I: Person to Person SMS Communication

Stage Two: SMS information services (Nov., 2000 - May, 2004)

By the end of 2000, mobile voice services, as was always the key source of revenue, had slowed down. The ARPU (Average Revenue Per User) of voice service kept dropping, revealing the increasing percentage of low-end customers. To further realize the business potential of mobile communication markets, carriers began exploring value-added data services. In stage one, carriers themselves played the role of content provider, which requires the expertise in information creation, integration and distribution – a task that is obviously not their core competency. However, without rich information content and attractive value-added service, it is difficult to invite the participation of more consumers.

Around the year 2000, the Dot.Com bubbles collapsed because e-commerce companies failed to leverage their rich information contents and novel services into revenues. Consumers, although they enjoyed the Internet services, were reluctant to pay for the services that were free from the very beginning of e-commerce era (Yuan and Zhang 2003). In developing countries like China, lack of online payment mechanics and under-developed logistic systems are other factors that attribute to the dilemma of the e-commerce (Martinsons 2002). Internet portals need new channels to sell their rich information contents and services. Mobile carriers, with their own business problems in mind, thus offered SMS to Internet portals as a potential profitable business choice. It seems that the alliance of carriers and portals can solve both of their problems. Therefore, carriers were successful in making themselves indispensable in the first ANT step of *problematization*.

The economic scale of mobile carriers is far larger than that of the Internet portals in China. While data services account for a small percentage of carriers' revenue (usually less than 20%), they are lucrative enough to support the survival of most Internet portals. Thus, the proposal of cooperating with SMS by carriers was pleasantly accepted by portals. This is a process of successful *interessment*. Most prestigious Internet portals, including Netease.com, Sohu.com, China.com, etc., reacted positively toward the offering and participated actively in the marketing campaigns initiated around the year 2000. Beside Internet portals, other content providers such as public service departments, newspapers, TVs, and radio broadcastings were also attracted by SMS's business potentials.

For mobile carriers, their successful collaboration with content providers relies on the construction of some network infrastructures, among which, charging platform and SMS gateway are of great importance. Carriers need the SMS charging platform to manage their business relationship with content providers. On November 10, 2000, a historical moment for China mobile data services, China Mobile launched the mobile portal Monternet and shared with content providers its charging platform. According to the policy of China Mobile, content providers can keep 85% of the SMS-related revenues. In August 2001, China Unicom also launched its mobile portal Uni-Info and thus provided another choice for the content providers. SMS gateway is the IT artifact for establishing connections between carriers' wireless network and portals' fixed line network. Mobile carriers invested heavily on the SMS gateway updating project. Based on the above efforts, carriers were well prepared for inviting content providers' participation. Thus, the third step of ANT evolution, *enrolment*, went smoothly. Most Internet portals reacted positively toward the alliance proposal. In January 2003, the largest Internet portal Sina.com, once the lagging behind content provider, purchased Guangzhou MemeStar Corp. (XunLong in Chinese) and thus became the largest content provider at that time. In another business purchasing case, China.com acquired SMS service provider Keen Billion with 30 million dollars.

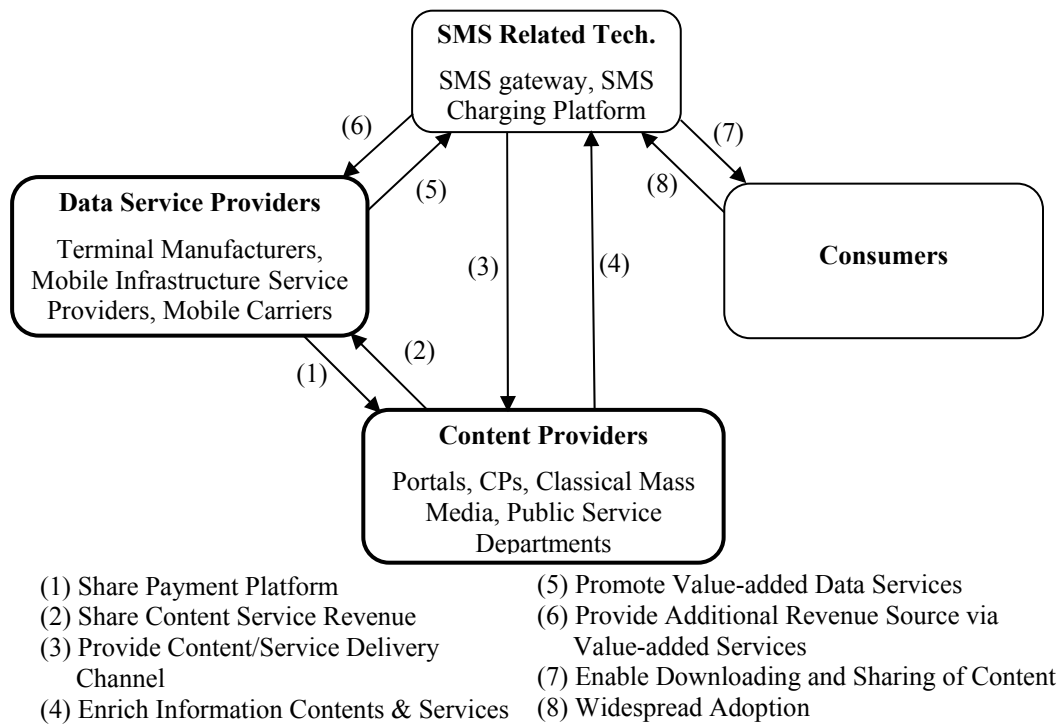


Figure 3. Stage II: SMS information services

Mobile carriers and content providers reaped considerable revenue in the years following their initial investment on SMS. According to one survey carried out in November 2001, 70% of cell-phone subscribers used SMS in their everyday life. In 2001, a total of 18.9 billions SMS messages were sent in China. In the following years of 2002 and 2003, this number soared to 90 billion and 137.1 billion respectively (MII Official Website). Mobile carriers harvested at least 10% of the market revenue, a very huge number considering the huge SMS volume. For Internet portals, SMS became their key source of revenue.

Fueled by SMS, Netease.com became the first Internet portal making profit in August 2002, followed by three then-largest Internet portals Sina.com, Sohu.com, and TOM.com. One newspaper commentator has even asserted that Internet portals in China run into the gold mineral of SMS in the Dot.Com winter. Therefore, in the last step of actor network evolution, *mobilization*, the collaboration between carriers and portals was established. The interactions among actors in the second stage are depicted in Figure 3.

Stage Three: SMS Service Regulations (May, 2004 – Jan, 2005)

The enrollment of content providers in the prior stage of actor network promoted the widespread adoption of SMS services. But the huge business value of SMS also attracted many illegal groups, which refer to personals and organizations that make profits from SMS at the expenses of consumer interests. Criminals use SMS for bank card frauds; hackers propagate viruses and harass SMS subscribers; some unlawful content providers try to overcharge customers. Worse still, mobile carriers can't afford to monitor all SMS transactions due to the huge number of them. The worst is that no unified mechanism is available for consumers to cancel unwanted SMS services. One survey carried out by China Consumer Association in 2004 revealed that SMS abuse has become the number one reason for consumer complaints. According to the Institute of Telecommunication, the junk SMS market has alone reached several billion RMB in 2005.

While consumers are the direct victims of unlawful SMS, lawful content providers have also suffered from illegal SMS cases. Customers became skeptical toward SMS-related services. Mobile carriers were thus also impaired of

their company image and SMS business. Therefore, in the first step of *problematization*, established actors were facing a great challenge of market regulations. Mobile carriers, as for their focal roles in the network, made themselves indispensable by setting out and solving the market regulation problems.

To monitor the SMS transactions, carriers invested heavily on the SMS charging and management platforms. In December 2005, China Mobile launched the Mobile Information Services Center (MISC) and began authenticating the identity of users and content providers, as well as tracking and monitoring specific services. But, social problems such as SMS fraud and pornographic SMS were out of the management scope for mobile carriers. The participation of government departments including MII, Ministry of Public Security, and Ministry of National Broadcasting & TV are greatly needed. As those government departments have the responsibilities to address social problems mentioned above, mobile carriers were successful in *interesting* government departments for participation.

In the third step of *enrollment*, many government departments were attracted into the actor network as the natural result of prior interestment stage. In May 2004, MII issued the “Notification on Issues about SMS Regulation” (short for “Notification” later on) (MII Official Website), in which many policies were announced to prohibit the illegal behavior of content providers. According to this Notification, SMS service subscription is invalid without confirmation received from customers. A unified number of “0000” was announced for unconditional unsubscribing of any SMS service. In September 2004, Ministry of Public Security published detailed definitions on SMS fraud and corresponding punishments (MPS Official Website): people who send harassing SMS will be imprisoned for at least 5 days; those who send more than 200 pornographic short messages will be put into jail for at most 3 years. Ministry of National Broadcasting & TV also participated in the SMS regulations. In September 2004, it announced to prohibit the illegal SMS lottery activities – one of the key reasons for consumer complaints. Carriers themselves also participated in the market regulations. In August 2004, the SMS services of China.com and other 21 content providers were stopped temporarily by China Mobile because those content providers were suspected of being involved in inappropriate charging and promotional activities. In September 2004, Sina.com, Tencent.com and other 25 content providers were also ceased temporarily of their data services by China Mobile. The reasons for such punishments can be broadly categorized into: 1) propagation of unhealthy short message and 2) suspicion of compulsory SMS subscription.

This series of regulations had negative impact on the business of illegal groups, as well as Internet portals. In July 2004, Netease.com announced lower revenue expectations as feedbacks to the “Notification” mentioned above. In the following days, the stock quotes of China portals Netease.com, Sina.com and Sohu.com dropped by 11.8%, 10.2% and 5.4%, respectively. According to the financial reports in the 2nd quarter of 2004, the net income from value-added services decreased by 37.1%, 18% and 16% for Netease.com, Sina.com and Sohu.com, respectively. Consequently, Internet portals were forced to self-regulate their services to meet the requirements of the carriers. In September 2004, Sina.com, Sohu.com and Netease.com established the “Trust & Self-discipline Alliance” and invited the participations of more content providers. Members of the alliance are required to check each other’s information content to make sure they abide by the specifications of the “Notification”. By the end of 2004, 23 more content providers joined this alliance. However, illegal groups cannot be driven out of the market in short term since the lucrative business is very inviting to illegal activities not only in the mobile telecommunication market but any other business in general. Since the regulations of government departments will not be stopped in the near future, the actor network was developed into the last step of *mobilization*. Please refer to Figure 4 for interactions among actors in the third stage actor network.

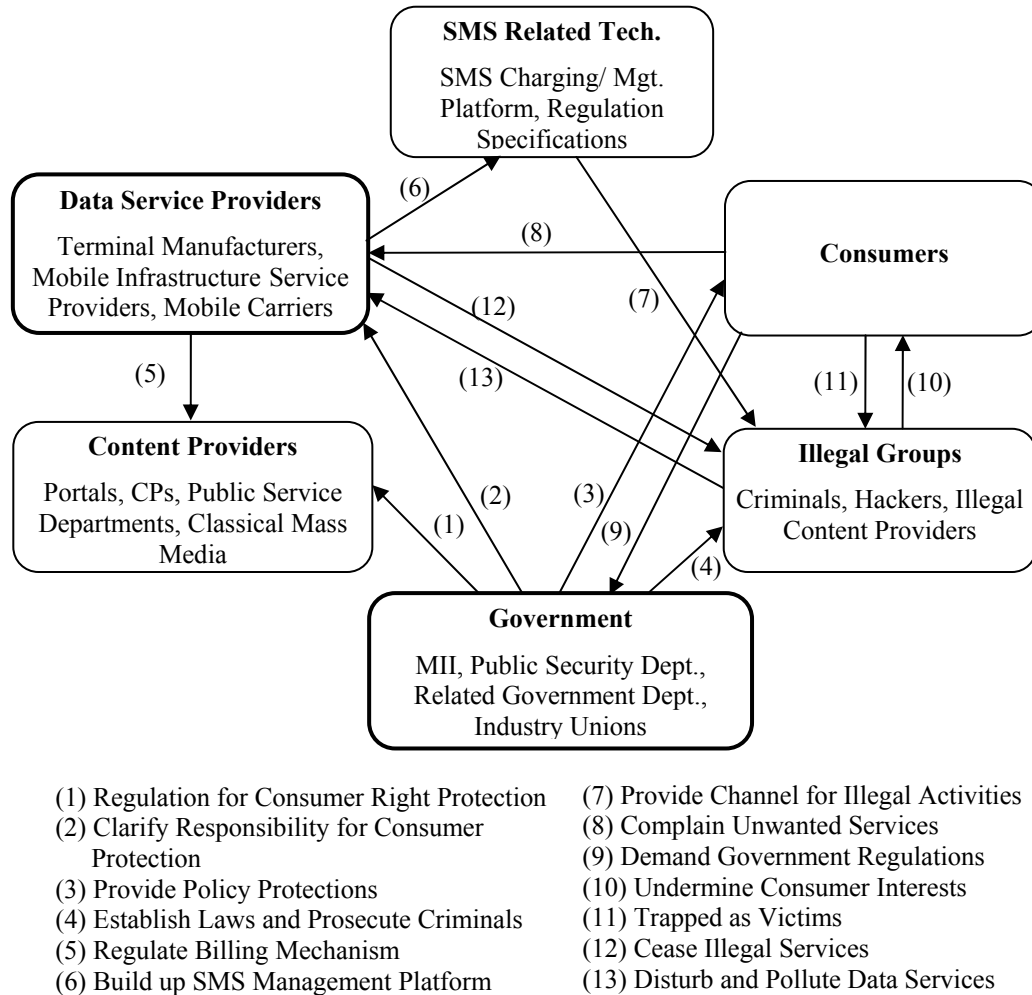


Figure 4. Stage III: SMS Market Regulations

Stage Four: Enterprise SMS applications (Jan, 2005 - present)

While regulators in prior stages succeeded in driving some illegal groups out of the market, carriers began facing new problems of saturated personal SMS service markets. Fortunately, the enterprise SMS market was less explored: the percent of enterprise short messages account for only about 5% of the volume by the end of 2004. But without any unified service locating mechanism in the mobile commerce domain, customers cannot enjoy mobile business services without knowing their service numbers (Yuan and Zhang 2003). Another barrier is related to the authentication of SMS business services. Without registration and authentication procedures, it is difficult for consumers to build trust and for government departments to trace suspects of unlawful SMS. Therefore, in the first process of *problematization*, carriers made themselves indispensable by acting as potential problem solvers of the above-mentioned marketing difficulties.

SMS Domain Name is one technological solution to the SMS service discovery mechanics. This technology was first proposed by ViVend Network Corporation in March 2004 but less noticed until stage four. Using this technology, cell-phone subscribers can locate any registered mobile services by simply sending a short message. For example, if a consumer wants to know the price of a Volkswagen automobile, such as Jetta, she or he can send "Volkswagen Jetta" to the SMS domain name query center, which will then search through its databases for the registered service number of Volkswagen and, if found, forward it to the consumer. Consumer can then contact the customer service center of Volkswagen for more information or service. From the technical point of view, SMS Domain Name functioned as URLs in the WWW world. Mobile carriers made great efforts in promoting SMS

Domain Name technology. As the results of such efforts, in January 2005, SMS Domain Name Information Center (short for MobNIC) was established by China Mobile, China Unicom, and China Mobile Communication Union (MobNIC Official Website). According to one report in March 2005, China Mobile and China Unicom were optimistic on the future of MobNIC and hope to develop 1 million enterprise users in the coming 3 years (MobNIC Official Website).

For customer authentication, carriers invite the publication of Real Name Subscription policy (hereafter named RNS). In China's mobile communication market, prepaid cell-phone subscribers do not need to register detailed personal information in order to be qualified. The lack of user profiles is thus among the reasons why illegal cases are so difficult to trace. RNS means that for both individuals and organizations, they must provide real identity profiles to be registered as authorized users. The issue of RNS policy was encouraged by carriers and supported by related government departments. It was predicted that MII will issue one important document of "SMS Service Management Regulation" sometime in 2006 with the main focus on RNS.

The successful establishment of MobNIC, together with the pre-announcement of RNS regulation, encouraged the participation of mobile application service providers (mobile ASP) and enterprises. The potential of SMS enterprise applications provides both incumbent software providers and entrants with new market opportunities. From the side of enterprises, their workforces can be more supported with mobile technology and as a result, smoother work flow and better customer services are possible. Besides, enterprises can benefit more from their software investment. Due to the low set up cost (usually only several hundred RMB), the ROI (Return Of Investment) of enterprise SMS platform is reported to be more than 1000, a figure that is incomparable to that of its fixed line counterparts. Consequently, mobile carriers were successful in persuading the participation of new actors including mobile ASP and enterprises. This is a process known as *interesement* in ANT.

In the third step of actor network, *enrollment*, mobile ASP was enrolled into the actor network. In fact, mobile ASP appeared in markets since the second stage of the actor network. But it was not until the establishment of MobNIC that they began to harvest from their foreseeing investment. China-SMS.com is such a case in point. Incumbent ERP providers (e.g. UFIDA, the number one domestic ERP provider in China) began integrating mobile modules into their software packages. Many mobile enterprise solutions were gradually put into the market, which includes SMS OA (Office Automation), SMS CRM (Customer Relationship Management), SMS SCM (Supply Chain Management), corporation group SMS solutions, SMS portal solutions and SMS public service solutions. Carriers and government departments also made efforts in encouraging SMS enterprise implementation. In August 2005, MII and National Development & Reformation Bureau announced a policy to promote the implementation of enterprise SMS applications in small and middle enterprises. As the results of such promotional efforts, many pioneer enterprises were enrolled into the actor network.

The last step of actor network, *mobilization*, had not started when this paper was prepared. The fourth stage actor network is under the developing process. But with the witnessed successful implementation of SMS-based applications in many enterprises, the future of enterprise SMS market is bright. Companies, especially those that do not have enough budget to implement large software packages, may find the SMS-based application not only cost-effective but also helpful in aiding their mobile workforces. Thus, we can expect the mobilization process to approach in the near future. The interactions among actors in this stage can be found in Figure 5.

Discussion

The evolution of mobile data service in China was scrutinized via the lens of ANT model in previous sections. The ability of SMS in promoting mobile data services was quite obvious. In this section, we will discuss some issues about SMS in a broader context of mobile data services, followed by the discussion on theoretical contributions of this research.

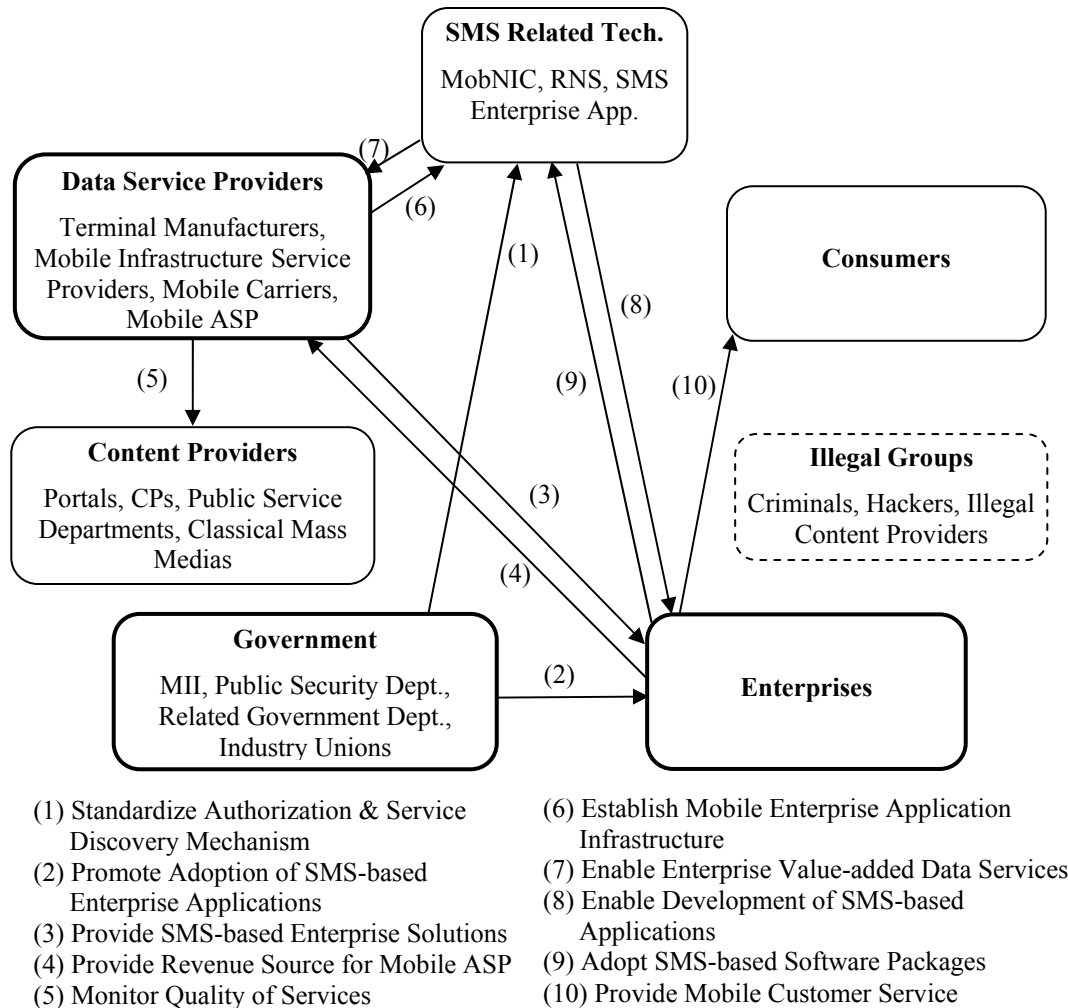


Figure 5. Stage IV: SMS Enterprise Applications

Evolution of Value-added Mobile Data Services

The incompatible mobile technology makes mobile commerce more regional than universal. This situation is very different from the Internet-based electronic commerce in which only one set of unified protocols exist (Yuan and Zhang 2003). Therefore, it is not strange to find that the diffusion process of mobile data services to be quite different in different regions. As for mobile data services, many technology enablers exist, which include SMS, MMS, WAP and others. As was observed, which technology would be adopted first is related to market environment, culture and also mobile infrastructure foundations. It cannot be determined by the technology alone. The first technology adopted may not be the most advanced one (Yan 2003). In China, what took off first was SMS, not MMS or WAP.

On one side, more attention should be paid to SMS as a potential enabling technology of mobile data service. As was observed in the case of China, the SMS volume increased with astounding speed in the past six years and attracted huge amounts of subscribers as well as enterprises. While some people simply ascribe this phenomenon to the technology features and price sensitive customers in China, the well-balanced interests among multiple actors in each stage of actor networks may better explain the great success achieved by SMS. The implication is that SMS

may also be enabling technology for data service in other developing countries, especially those with similar technological, cultural and social environments to China.

On the other side, the role of SMS may be eventually replaced by more advanced technologies in the future. Other data service enabling technologies, such as MMS and WAP, have advanced features such as multimedia, inherent Internet resource locating mechanism and hyper-link, which make them more appropriate in carrying richer and powerful Internet-based data services (Novak and Svensson 2001). Therefore, in the further stages of actor networks, those technologies may come to play as the key roles in promoting data services. Data from China Mobile revealed that WAP revenue increased by 120% in 2005 compared to that in 2004. MMS revenue also increased 77.5% in August 2005 compared with that in January 2005. The reasons for this outcome are multifold. Take WAP for example, the favorable charging policy of mobile carriers and their close collaboration with content providers, abundant handsets with unified WAP version on the market, together with the ever increasing number of free WAP sites can explain at least partially the soaring WAP business. First, the volume charge for WAP services have reduced to 20RMB/month although subscribers are confined to certain WAP sites as compared to all WAP and Internet Web sites for the former charging policy of 200RMB/month. Second, carriers also collaborated with popular Newspapers on WAP service of phone-paper. Such multimedia services, together with incumbent services such as ringtone, music, pictures, have attracted the participation of more users. Third, multimedia handsets were updated to WAP2.0 to make them compatible. At last, the number of free WAP sites has soared to 51000, which attracted huge amount of WAP subscribers and contributed to remarkable percents (about 89%) of China Mobile's WAP volume. The efforts above will continually fuel the country wide diffusion of WAP services in the years to come.

Despite the fast adoption of MMS and WAP witnessed recently, it is less likely for SMS to be replaced by other technologies in short term. SMS, with its country wide adoption and 30 billion (RMB) market size, will dominate the market in the next few years. At the end of 2005, the market size of MMS and WAP is totally 4 billion (RMB) – a minor number compared to SMS. Moreover, the penetration rate of mobile phone in China was only 30% by the end of March 2006. But all new handset users are potential SMS subscribers as explained in the first stage of data services in previous section. Therefore, it will take some time for MMS and WAP to catch up. Although other data service enabling technologies may eventually realize their potentials in the long run, such thing will not happen in the immediate future.

Theoretical Contribution of this Research

ANT is an evolutionary theory. It continuously revises and integrates new ingredients into it (Walsham 1997). In this study, some interesting observations were identified, which will contribute to the theory. The first phenomenon observed is the process of interestment. In the original theory of ANT, the enrollment of new actors is often due to the invitation of established or focal actors. In this research, we found that the interestment process may be motivated by the network as a whole, instead of one particular actor. Such phenomenon was less frequently reported in the literature. Illegal groups are such actors being enrolled. They are attracted into the actor network as the results of lucrative business practice but not welcomed by any established members. Then, regulators (especially government departments) also participated because interests of whole networks were damaged. One possible explanation may involve analysis on environmental reasons (Gao 2005). We may also argue that there are many potential or latent actors, who will participate in the actor network when their interests can be ensured if enrolling into the network. Such enrollment may not be the result of invitation by established actors.

Secondly, the reverse process of interestment was identified in this research and can be named as counter-interestment. For example, law specifications and industry regulations were put forward in the third stage of network to exclude illegal groups out of the market. The objectives of such inscriptions obviously do not intend to interest certain actors. On the contrary, they mean to drive illegal groups out of the actor network to protect the interests of most incumbent actors. Such process of counter-interestment is seldom identified in the literature but obviously it is fundamental to the theory itself. As the results of such counter-interestment, actors can leave, not enroll into the network. The inscription of certain standards (in our case, law specifications and some technology artifacts) will then form barriers that protect interests of the actor network. This point is also related to the next problem to be discussed.

As the results of the counter-interestment, *counter-enrollment* process can be observed as in our third stage of ANT, in which government departments and mobile carriers were successful in excluding most of the illegal groups

out of the network. Since the interests of illegal groups were not inscribed into the network, it is possible for those actors to disappear in the future. Therefore, based on this observation, we argue that ANT theory can be improved by integrating more terms to demonstrate that actors can be driven out, as well as enrolled into the network. Based on the new terms such as counter-interessement and counter-enrollment as proposed in this paper, the power of ANT in explaining complex social and political phenomena may be greatly strengthened.

Limitations of this Research

ANT, due to its power in explaining complex socio-technical phenomena, forms the basis of this work. However, researchers should be aware of some limitations of ANT, which often invite debates of critics and proponents. ANT pays little attention to wider social structures which influence the micro structure (Reed 1995, Walsham 1997). Proponents said that macro-structure of society is made of the same stuff as the micro-structure (Latour 1991). Macro-actors are just micro-actors “seated on black boxes” (Callon and Latour 1981). The symmetric treatment for humans and nonhumans in ANT may be problematic (Pels 1995, Walsham 1997). But proponents of ANT assert that this treatment does not imply an acceptance of the extreme position of symmetry, but rather be a valuable analytical device (Law 1991). While acknowledging its power of description, critics blame ANT for lack of explanation ability (Collions and Yearly 1992, Howcroft et al. 2004). In response to this critique, Callon (1991) stated that explanations can be offered by networks that increase their convergence and irreversibility and that the descriptions can turn into “explanations and even predictions”. The controversy above should not discourage the use of ANT in IS field, but it suggests some cautions for researchers who are considering using this theory.

ANT is used in this paper to examine from holistic perspective the driving forces behind the development of mobile data services in China. Other theories may be appropriate to mobile data service studies with dissimilar objectives and from different perspectives. Such theories include (but not limited to) Value Chain Analysis, Technology Adoption Model (TAM), Diffusion of Innovation (DOI) and Network Externalities (Rohlf's 1974). Basically, those theoretical models each support researches from some social, technological, psychological or economical perspective. In contrast, ANT emphasizes examination from holistic perspectives.

In this paper, online News is used to reconstruct the evolution history of mobile data service in China. However, firsthand data sources, especially those generated from interviews and surveys, can be used as additional support to our arguments. For example, specifically designed questionnaires can be distributed to relative individuals to further verify our view on the main stages about mobile data services. The viewpoints and experiences of government leaders, entrepreneurs, mobile subscribers and managers of related corporations will enrich the insight of this study.

Conclusion

In this study, the evolution history of China mobile data service was analyzed from the viewpoint of ANT. Four stages of actor networks were identified according to the data collected from online sources. In each stage of the actor network, we discussed in sequence the motivations behind the problematization process of focal actors, the reasons why certain new actors can be interested in participating in the network, the process of enrolling new actors, as well as the causes contributed to the mobilization results of the prior process. Through those processes of ANT, more aligned interests can be assured by inscribing certain technology standards (such as SMS gateway, MISC, etc) or regulation specifications into the network. The analysis above explained why SMS, the seemingly inferior technology as criticized by some pioneers, not the other more advanced technologies such as MMS or WAP succeeded in promoting mobile data services in China. It can then provide a good reference for practitioners aiming at promoting mobile data services in other regions especially in developing countries. The ANT theory and analysis method utilized in this paper can also be applied to probe into mobile data service in countries with different cultural or economical foundations. The discussion on new terms of counter-interessement and counter-enrollment may also enrich the vocabulary of ANT, besides reinforcing the explanation power of this theory on complex social and political phenomena.

The research may be further extended along several directions. One promising research direction is applying ANT on other technology artifacts to explain the success of I-mode in Japan and the early failure of WAP in Europe. Then, a more comprehensive view can be formed about how various technologies compete on attracting customers and interact with each other. The application of ANT on analyzing particular industries that are active in utilizing mobile technologies is also of great interest. As the results of such research, we may understand how to promote the

adoption of mobile data service within organizations. As future work, we also suggest the application of ANT for analyzing mobile data service adoption on other parts of the world, such as Europe and North America that follow different roadmap of mobile commerce (Zhang and Prybutok 2005). Further, based on those case studies, comparative analysis may also be possible. The results of this research can thus provide an overall picture of the mobile data service worldwide and result in a more comprehensive understanding on what kind of strategies should be adopted in different countries with dissimilar cultural and economical settings (Blom et al. 2005).

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Appendix I: Key Events on Mobile Data Services in China

Stage I (1997 – Nov., 2000)

- 1997 SMS was launched in China Mobile's network (Tianjing Branch).
- Mar., 2000 China Mobile launched the WAP service.
- Aug., 2000 China Mobile collaborated with Sina.com, Sohu.com, 168wap and Linktone on the first SMS subscription service – "Olympics Flash News".

Stage II (Nov., 2000 – May, 2004)

- Nov., 2000 China Mobile launched Monternet and opened the mobile data service market to independent content providers.
- Aug., 2001 Uni-Info service was launched by China Unicom.
- May, 2002 China Mobile and China Unicom achieved full interconnection of their SMS.
- Jun., 2002 SMS became the main revenue source of Sohu.com according to the interview of its CEO, Chaoyang Zhang.
- Jul., 2002 The province branches (including Shanghai, Guangdong, Beijing, etc.) of China Mobile started investing in the SMS gateway updating projects.
- Aug., 2002 Fueled by SMS, Netease.com announced to turnover and reap profits.
- Aug., 2002 The first SMS fraud case was cracked in Jilin Province.
- Oct., 2002 China Mobile launched the MMS service.
- Dec., 2002 China Unicom launched its MMS service via WAP.
- Jan., 2003 Sina.com purchased Guangzhou MemeStar Corp. (XunLong in Chinese) and became the largest content provider by then.
- Aug., 2003 China.com acquired the Keen Billion by 30 million dollars.
- Aug., 2003 China Mobile ceased billing service to content providers of SMS alliances.

Nov., 2003 SMS subscriber number of TOM.COM reached 20 million.

Stage III (May 2004 – Jan., 2005)

- May, 2004 MII issued the “Notification on Issues about SMS Regulation”, in which many policies were announced to prevent the illegal behavior of the content providers.
- Mar., 2004 SMS domain name was proposed by ViVend Networks Ltd.
- Jul., 2004 China Portals encountered crisis in the Nasdaq stock market. The stock prices of China Portals fall sharply: Netease.com -11.8%, Sina.com -10.2%, Sohu.com -5.4%.
- Aug., 2004 The net income from SMS and relevant services decreased sharply for portals: Netease.com -37.1%, Sina.com -18%, Sohu.com -16%.
- Aug., 2004 An enterprise SMS platform was devised by China Net Corp. (WanWang in Chinese).
- Sep., 2004 Sohu.com’s MMS service was ceased. Part of the MMS services of Sina.com was also ceased.
- Sep., 2004 Ministry of Public Security participated in the regulation by announcing detailed explanations on SMS fraud and immoral behavior.
- Sep., 2004 The National Broadcasting & TV Ministry prohibited the unlawful SMS lottery activities.
- Sep., 2004 Sina.com, Sohu.com and Netease.com announced the establishment of a “Trust & Self-discipline Alliance” and invite more content providers to join.
- Dec., 2004 23 more content providers joined the “Alliance”.
- 2004 According to a survey carried out by China Consumer Union, SMS was the No.1 reason of customer complaints.

State IV (Jan., 2005 – present)

- Jan., 2005 SMS Domain Name Information Center (short for MobNic) was established by China Mobile, China Unicom and China Mobile Communication Union.
- May, 2005 The “Enterprise Mobile Commerce Conference” was held; SMS marketing and “Real Name Subscription” was discussed by delegates from the mobile industry.
- Jun., 2005 China-SMS.com (one pioneer SMS solution provider) released cross-network SMS enterprise solutions into the market.
- Aug., 2005 MMS revenue increased by 77.5% compared with that in Jan. 2005 for China Mobile.
- Sep., 2005 UFIDA (the largest ERP provider in China) integrated SMS packages into its solutions.
- Oct., 2005 China Unicom stopped the service of more than 100 content providers, followed by a plan that regularly re-examines the services of content providers every 3 months.
- Oct., 2005 China Mobile proposed three new revenue sharing models (85:15, 70:30 and 50:50, respectively) from which each content provider must choose.
- Mar.–Oct., 2005 More enterprise SMS solutions are put into market, which include SMS CRM system, SMS SCM system, corporation group SMS solutions, SMS OA, etc.
- Nov., 2005 One unified number 50120 was announced to provide SMS domain name query service.
- Nov., 2005 The WAP revenue increased by 120% compared to that in 2004 for China Mobile.
- Nov., 2005 JAVA and BREW services increased by 34.7% and 47.2% in the 4th quarter of the 2005 for mobile carriers in China.
- Dec., 2005 “SMS Service Management Regulation” was predicted to be issued according to the officer of MII. One main focus of this regulation is the promotion of “Real Name Subscription”.
- Dec., 2005 MII and National Development & Reformation Bureau announced to promote the implementation of SMS solutions to Small and Middle Enterprises.

