THE ACCIDENTAL ACCOMPLISHMENT OF LITTLE SMART: UNDERSTANDING THE EMERGENCE OF A WORKING-CLASS ICT

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INTRODUCTION

Can wireless technology serve low-income communities? A common belief in the policy circle is that, by working closely with engineers and scientists, rational decision-making through democratic processes will produce effective technological applications for development purposes. Others, on the contrary, hold a pessimistic view: policymakers, especially in developing nations, seldom work in democratic institutions; the telecom industry, including the wireless sector, seldom operates in fully competitive markets; more often than not, the interests of the have-nots are ignored and existing inequalities perpetuated because low-income groups tend to be disenfranchised in political processes. This is why aid programs, using wireless technology or not, tend to suffer from low sustainability. But do we have to either take the rational choice viewpoint or be so critical, if not hopeless? Are there any alternative solutions and alternative ways of thinking?

This paper analyzes the emergence of Little Smart (*Xiaolingtong*), a limited-mobility wireless technology in China that allows subscribers to have mobile service at the price of landline. As of July 2005, this working-class ICT is used by 81.3 million Chinese, which would be the world's fourth largest national wireless user population following the number of regular cell phone subscribers in China (270 million), United States (158.7 million), Japan (86.7 million), but more than that in Germany (64.8 million).[1] The strong message sent by the Little Smart phenomenon, as will be analyzed

[1] ITU (2004). The official number of 270 million regular mobile phone users in China does *not* include Little Smart subscription, which is counted in regulatory terms as part of the fixed-line market.

in what follows, is that even in a context where democratic policy frameworks are non-existent, and even though public and private stakeholders do not deliberately serve less wealthy populations, it is still possible for low-cost solutions like Little Smart to materialize, with certain limitations though. The emergence of Little Smart is, in this sense, an accidental accomplishment that defies both the optimistic and pessimistic views aforementioned. In so doing, it poses an intellectual challenge and a rare opportunity for us to understand the formation of alternative wireless technologies being shaped by public policy processes, corporate strategies, and market dynamics.

The analytical task of this paper is to examine the case of Little Smart as a working-class ICT fostered in complex social context and dynamic institutional frameworks, a project initiated in our work on the mobile communication society (Castells, Fernandez-Ardevol, Qiu and Sey, 2004, pp. 140-159). To do so, it is essential to include in the analysis both formal policy transitions at the national level and informal practices at the level of local state. Another indispensable part is played by commercial players including China Telecom and China Netcom, the country's two fixed-line operators, as well as UTStarcom, which brought the technology to China. Little Smart also has its problems in terms of the quality of its current services. Its long-term aspect remains cloudy as a result of the technological design and, more important, the evolving interests of major stakeholders vis-à-vis the wellbeing of low-income user communities.

Understanding this particular case of Little Smart in China would refine conceptions about wireless communication and development by, first, sensitizing us to critical scale relationships as evidenced in localized state-enterprise ties operating in a policy and business environment of transnational convergence. These scale relationships and the processes of re-scaling have been essential to the formation of Little Smart. Second, it shows that the logic of profit maximization, at certain historical conjunctures, can create serendipitous momentum for development-oriented wireless build-up, although how to maintain this momentum, and how to transform it into upward social mobility, remain pending questions.

In the larger context of the developing world, China is of course only one particular country despite its size and growing global influence. Its continuous economic boom, massive urbanization process, and the failure of state-owned enterprises in recent

years are causing an unprecedented surge in the mobility of low-income populations. This socio-economic transition is at the bedrock of a new class that we term the "information have-less" defined as "an informational, and therefore social, economic and political category in the evolving network society" (Cartier, Castells and Qiu, forthcoming). In China, the have-less class includes hundreds of millions of rural-to-urban migrants, laid-off workers, students, pensioners, and other low-income groups organized in translocal networks, using working-class ICTs such as Little Smart, Internet café, SMS, and prepaid telecom services (ibid). The current study, by focusing on one working-class ICT, is therefore not to suggest that Little Smart is *the* solution but to learn from the emergence of this particular technology lessons that bear upon policy options for the entire social class of information have-less. The implications of this study thus go beyond this particular market segment in China to encompass low-income groups with varying degree of marginality in the network society, from the global South to downtown slums in industrialized nations.

In particular, a few questions are pursued in this paper:

1. How did Little Smart emerge and manage to grow so rapidly?
2. What are the formation processes of this low-cost wireless technology at the transnational, national, and local levels? How did major commercial stakeholders – China Telecom, China Netcom, and UTStarcom – interact with national regulators and local state authorities in these processes?
3. How do Little Smart subscribers perceive and evaluate the service? How are they using it? For what purposes? Are they involved in the technology formation processes, if at all?
4. What are the problems in the emergence of Little Smart? Why?

Due to a general lack of research on the social aspects of Little Smart, I draw on three types of data to answer the above questions. First, Chinese-language materials from primary sources were collected and analyzed including news articles, official documents, IT industry reports, company profiles and financial analyses. Second, a series of face-to-face and telephone interviews were conducted with Little Smart subscribers as well as mid-level executives and technicians involved in the R&D and marketing of the

technology.[2] Third, two focus groups were held among Little Smart users in Zhaoqing and Shanghai. Zhaoqing is a small city in South China, where the first commercial Little Smart service was launched in 1998. Shanghai, on the other hand, was the last big city to have Little Smart in 2004.

THE SERVICE AND ITS DIFFUSION

"Little Smart" is only one of many names to refer this particular wireless service, which is delivered mostly via conventional telephone wires, using a combination of specially designed base stations, controllers, and management software as the last-mile solution to transmit voice and data to and from inexpensive handsets. The officially designated name by China's Ministry of Information Industry (MII) is "wireless city phone" (*wuxian shihua*) in order to count the service as part of the fixed-line market in regulatory terms. The most popular term, "Little Smart," is an English translation based on the Chinese brand name, *Xiaolingtong*, which means literally "Little Smart Connection." This brand is created by China Telecom, the traditional landline operator, and now used by both China Telecom and China Netcom, the second fixed-line operator that received half of China Telecom's assets since May 2002.

Because the service began as localized operation in late 1990s, it was named by the local branches of China Telecom differently such as *Shihuatong* (City Phone Connection) in Shenzhen and *Duanzhoutong* (Duanzhou Connection) in Zhaoqing, a city whose ancient name was Duanzhou. Meanwhile, there is an entire array of informal derogatory terms created by subscribers to refer to Little Smart due to its low service quality, at least during the beginning years. These include nicknames such as *Weiwei ko* (Hello-Hello Call, because users are always saying hello-hello), *Shikengtong* (Toilet Connection, to indicate the very low standard of service), and, in the city of Zhaoqing, *Duanzhousai* (Duanzhou Disconnection). Although most of the depreciating names are no longer in use due to the improvement of services in recent years, these multiple names

[2] Interviews with subscribers were conducted in 15 cities and 9 provinces spreading across China's western region (Sichuan Province and Shaanxi Province), northern region (Beijing and Tianjin), central region (Hubei Province), eastern region (Shanghai, Zhejiang Province and Anhui Province), and southern region (Guangdong Province and Hainan Province). Interviews with telecom executives were conducted in Guangzhou (South China), Hangzhou and Shanghai (East China).

of Little Smart, together with those assigned by regulators and telecom operators, reflect the complexity of issues involved in the formation processes of the technology.

In technical terms, Little Smart is known as the Personal Access System (PAS) developed by UTStarcom on the basis of Japan's Personal Handy-phone System (PHS) (Liu, 2004). It is a variant of the Wireless Local Loop (WLL) technology as "a micro-cellular system that provides connectivity between the end user and the local switching center where traditionally, copper wires had been used to connect these locations" (Frost & Sullivan, 2003, p. 3). The WLL solutions also include the Digital Enhanced Cordless Telephony (DECT) system in Europe and its modified version, corDECT, in India (O'Neill, 2003), neither of which have been able to achieve similar growth result as in the case of Little Smart.

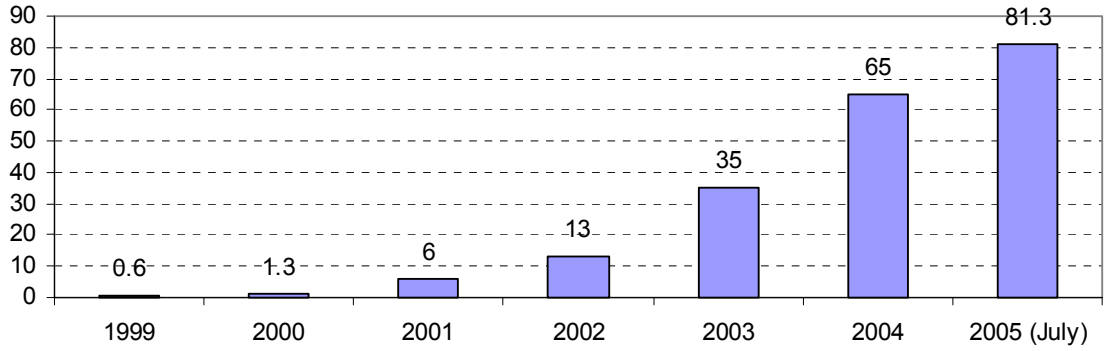
Little Smart is categorized as a "limited mobility service" due to several reasons. First, subscribers cannot roam beyond city limits because most handsets do not have a SIM card and the spatial range of coverage for each Little Smart base station is limited to a couple hundred meters in radius as opposed to ordinary cellular base station that can cover areas kilometers or tens of kilometers away (Tan, Chen and Liu, 2005). Second, Little Smart signal is usually less reliable and less clear, especially in moving vehicles, as compared to the quality of GSM and CDMA systems. As a result, a widely observed pattern in both small and large cities is that, users often carry two handsets: a Little Smart phone for not-so-important calls and a regular mobile phone for important ones, for example, with supervisors or clients. Third, the services of Little Smart tend to be limited. Subscribers in most cities could not send or receive SMS on their Little Smart phones until 2004. Although advertisements claim Little Smart allows for low-cost international calls, one focus group participant in Shanghai complained that he was never able to use this function. Finally, because Little Smart handset makers try to lower the production cost and therefore the price of their products, certain basic functions of mobile handsets, such as the silent and vibration modes, are not provided in certain low-end models, thus making the user experience significantly inferior to that of regular cell phones.[3]

Despite all the drawbacks, the diffusion of Little Smart has been exponential, increasing from 0.6 million in 1999 to 81.3 million in July 2005 (Figure 1). The average

[3] Interviews with users in Shanghai.

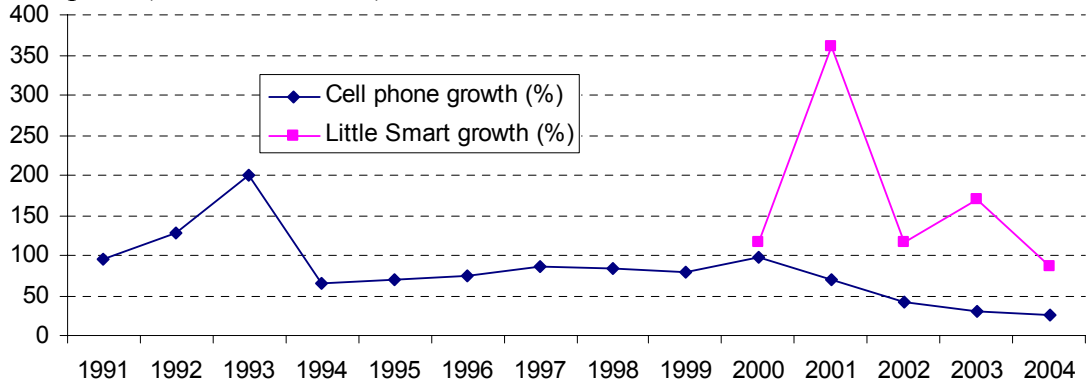
annual growth rate is 179.96 percent, representing a faster speed of diffusion ever achieved in China's regular mobile phone market including GSM and CDMA (Figure 2). As a result, while it took seven years (1993-2000) for regular mobile phone subscription to increase from one million to fifty million, it only took Little Smart five years (1999-2004) to leap through this process.

Figure 1. The growth of Little Smart subscribers in China, 1999-2005 (million)



Sources: *MII Annual Statistical Reports*, 1999-2004; *MII Monthly Statistical Report*, July 2005.

Figure 2. Annual growth rates of Little Smart subscription and regular mobile subscription (GSM and CDMS) in China, 1990-2004



Compilation based on *MII Annual Statistical Reports*, 1990-2004.

Price is the key factor that drives the phenomenal expansion of Little Smart. Because the service belongs to fixed-line business in regulatory terms, Little Smart subscribers only need to pay when they call or send messages to others, whereas for regular mobile phone the two-way charging scheme is applied. The operational cost is thus effectively halved. In some cities, Little Smart users can pay a monthly flat rate of about US$ 8 for unlimited airtime while GSM or CDMA users need to pay more than US$ 12 for 200 to 270 minutes airtime per month (Liu, 2004; Tan, et al, 2005). Little

Smart handset is also much cheaper. As opposed to ordinary mobile handsets costing from $100 to about $850, the price range of Little Smart phones goes from less than $50 to about $170 at maximum (ibid). All my interviewees and focus group participants who started to use the service since 2002 paid less than $100 for the handset. During promotional periods, several of them paid less than $30 to get the phone, while some others got handsets for a nominal fee of $0.12, or even totally free, after signing a one-year contract and pre-pay certain amounts of airtime expenses for the coming year (about $60 in Shanghai and $36 in Zhaoqing). Little Smart users in Wuhan (central China), Shanghai and Hangzhou (east China) also reported that they used prepaid IP services on top of Little Smart to bring the cost of domestic long-distance calls down to less than one cent, which is even less expensive than local calls on the landline.

How could Little Smart have such a price advantage? Besides the special regulatory arrangement of one-way charging, the PAS technology has a few features to reduce infrastructure cost as it was initially designed to cover small areas such as a building or residential complex. First, it uses switches for fixed-line network and "requires no modification to the central switching office, nor does it require investing in mobile switching hardware (Frost & Sullivan, 2003, p. 7). Second, it is scalable to fit areas of different user density, which varies greatly within and around Chinese cities.[4] Third, it is relatively easy to set up. Fixed-line operators only need to add the base stations, some controllers, and management software on top of their existing landline system (Tan et al, 2005). It therefore only takes three to four months to deploy Little Smart in a large city of 10 to 12 million potential users (Frost & Sullivan, 2003, p. 5).

From the perspective of subscribers, although low cost remains the main reason for adoption, members of both focus groups in Shanghai and Zhaoqing reported another of their considerations being the health risk caused by mobile phone radio wave emission. They believed that Little Smart has much lower emission than both GSM and CDMA, which resulted partly from commercial promotions launched by service providers. The belief is reinforced by the fact that the battery of Little Smart phones usually lasts longer, which is a major advantage for users. A focus group participant in Shanghai, for instance, revealed that she only need to charge her Little Smart handset once or twice every week,

[4] Interview with UTStarcom executives in Hangzhou.

whereas regular mobile phone often needs to be charged every day. These handsets, most of which are now made in China, usually have a sleek outlook that is hardly distinguishable from ordinary mobile handsets. And they tend to have a lighter weight.

Most importantly, the reliability and service quality of Little Smart systems have improved significantly in recent years, especially in smaller cities. In Zhaoqing, local China Telecom executives boasted that their Little Smart works well on moving vehicles. One interviewee in the eastern city of Ningbo is a widowed pensioner living by himself. Without a landline at home, Little Smart was his only telephone set. He chose to do so because the service was reliable enough for him to conduct all his life activities through Little Smart, including arranging gatherings with families and friends and using the inexpensive phone as his lifeline. Not all cities have such a high level of service reliability though, especially in major metropolitan centers like Beijing and Shanghai, which are late adopters due to China's peculiar telecom policy and localized market conditions at the turn of the century.

Finally, working-class Chinese consumers like Little Smart because "limited mobility" is a feature that reflects their daily life patterns. As stated in the China Telecom case study of UTStarcom:

> Despite its geographical size, China tends to have an extremely localized culture in the sense that the majority of work and social activities for citizens revolve around one's immediate environment. According to a recent survey from the China Post, 80 percent of the population spends 80 percent of their time within the city limits, suggesting that the lion's share of demand for mobility solutions will generally remain local. This made the PAS solution all the more attractive for Chinese citizens.[5]

Indeed, factory workers in a new industrial zone, pensioners in an old residential community, students in a university, shopkeepers in a local store, all of these people need to move around but not to places far flung, at least not on frequent basis. The roaming capacity beyond city limits may be essential to business travelers but not to these groups, who had seldom been taken as the target market for wireless services up to this point. But

[5] China Telecom case study, UTStarcom, p. 3.

their daily life patterns need to be reflected in the design of the technology just as we treat any other user groups.

THE CO-EVOLUTION OF POLICY AND MARKET

A few key transformations have been under way in China's telecom industry, setting the stage for the emergence of Little Smart and other working-class ICTs. The most fundamental transition is the reform of the country's telecom sector from a single state monopoly to limited competition among four players including two fixed-line operators (China Telecom and China Netcom) and two mobile operators (China Mobile and China Unicom), all of which remain state-owned but are now listed on the stock market. The real change here, when it comes to providing connectivity to low-income communities, is not deregulation or liberalization, let alone democratization, but the fading away of the universal service commitment held by the old socialist state and the re-shaping of the state-owned telecom firms in the principle of profit maximization. Not to be denied in this process is a notable, albeit limited, degree of opening-up that allows for more competition within the domestic market and more international participation including not only global telecom giants (Zhao and Schiller, 2002) but also emerging players like UTStarcom.

While the policy framework for China's telecom industry has been in flux, a more important transformation is the overall modernization of the national economy that leads to growing geographical and social mobility of all classes, including the information have-less. A new set of market dynamics thus emerged given the country's continuous economic boom on the one hand and the tremendous informational demands of the have-less class (Cartier, et al, forthcoming). Being uprooted from rural villages, state-owned factories, and other traditional institutions, these populations need to adapt to the fast changing society. They are in search of employment and education opportunities, social support and networking resources, among other daily informational needs, which collectively create a new market for working-class ICTs. It is within this structure of market differentiation and the growing consumption power of the have-less that low-end services like Little Smart become highly popular. This is not a process of simple linear causation though because the market is conditioned by policy arrangements. Since

policymaking also takes place in response to market dynamics, what can be seen is a co-evolving structure that includes both telecom policy frameworks and market conditions, interacting with each other at different levels of operation, as observed in the rise of Little Smart.

A lot has been written on the reform of China's telecom policy and telecom market since early 1990s (e.g., Lee, 1997; Mueller and Tan, 1997; Xu and Pitt, 2002; Guan, 2003). It is only necessary to recount the most essential developments to show the shifting emphasis from universal service to average revenue per user (ARPU), which is a decade-long process of transformation, for which the Little Smart case serves as a peculiar example. In 1993, China Telecom, the only state monopoly since the funding of the People's Republic, started to be separated from the then Ministry of Post and Telecommunications (MPT). The MPT was merged with the Ministry of Electronic Industry (MEI) to form the MII in 1997. Soon afterwards, in 1998, China Telecom was stripped of its mobile communication division, which became China Mobile, by far the largest wireless provider in the country. This was followed by the transferring of half of China Telecom's assets into the ownership of China Netcom in 2002, thus creating two equally sized fixed-line companies.

While the reshuffling was going on, the fixed-line business came under tremendous pressure to increase profit, measured here by ARPU, because both China Telecom and China Netcom started to be listed on domestic and global stock markets including New York Stock Exchange. Yet the fixed-line market was increasing slowly with very little, if any, ARPU increases. On the contrary, sales for mobile phones and services grew in leaps and bounces with its total subscriber population increasing from 43 million in 1999 to 207 million in 2002 and the emergence of a series of value-added services such as SMS, ring tone downloads, and GPRS, all helping to boost ARPU in the wireless sector (Xu, 2004). Sharp contrast between the lucrative wireless market and unimpressive growth in the fixed-line sector created the major incentive for China Telecom, and China Netcom starting from 2002, to offer limited mobility services.

But the emergence of Little Smart resulted as much from the market situation as from the policy environment including both formal policymaking at the national level and more practical, and sometimes informal, processes of policy implication at the local

levels (Jiang, 2003; Liu, 2004). On this dimension it is essential to acknowledge that multiple policy rationales have been interwoven to produce the complex and uneven development of Little Smart; and that these rationales do not have to be consistent with each other at all for they emerged from particular policy contexts, local or national. Indeed, the most critical factor in this process is the capacity for fixed-line service providers to operate at multiple scales, taking advantage of long-existing center-periphery tensions in the political system and the scalability of the technology.

Table 1. The co-evolution of policy and market concerning Little Smart

1996	China Telecom started to consider using limited mobility service as the last-mile solution to provide connectivity in mountainous areas.
December 1997	The first Little Smart trial site went into service in Yuhang, Zhejiang Province.
December 1998	The first commercial Little Smart service was launched in Zhaoqing, Guangdong Province, marking the formal beginning in small cities.
1999	Little Smart entered two bigger cities, Kunming and Xi'an, both of which are provincial capitals.
October 1999	MII issued an emergent order forbidding the development of new Little Smart projects in all provinces and cities.
May 2000	MII asked all existing Little Smart projects to be suspended for evaluation.
June 2000	MII issued "the Announcement for the Standardization of Construction and Management Processes for PHS Wireless City Phone" specifying that Little Smart is a "low-speed wireless access service within small areas."
November 2000	MII ordered China Telecom to raise the monthly fee and airtime price for Little Smart.
February 2001	MII issued a new order specifying the price scheme for Little Smart while commanding Little Smart "not to be launched in big cities in the short term."
May 2002	China Telecom was split into two. China Netcom received half of China Telecom's assets, including those for Little Smart operations.
March 2003	Little Smart service began in Beijing.
April 2003	Little Smart service began in Guangzhou.
May 2004	Little Smart service began in Shanghai.

Table 1 summarizes the trajectory of policy change with regard to Little Smart at the national and local levels of operation. Underpinning this series of events are three crucial processes, the first being the lingering of China's socialist commitment to

universal service, at least in the initial years of 1996-1999, which is nonetheless an indispensable element in the formation of Little Smart. During this period, China Telecom, as the monopoly player then, started to experiment with this low-cost solution in order to increase telephone penetration in mountainous areas (Liu, 2004, pp. 3-4). There was, at the time, no pressure to pursue higher ARPU. Neither was there much recognition for the size and importance of the potential market for working-class ICTs. The main reason was because China Telecom attempted to use the wireless "last-mile" solution to reduce infrastructure and operational cost in mountainous regions so that telephone penetration can grow faster. This happened to meet the needs of some local governments because, most critically, annual telephone growth is among the major criteria for evaluating local state performance. Hence, in cities where the relationship was particularly strong between local officials and the long-time state monopoly, China Telecom, the two sides would want to work together to foster the limited wireless solution regardless of discouraging or even prohibitive national policy.

Important is to note that Yuhang and Zhaoqing, where Little Smart was first launched, are not just any small cities. They are located not far from the central metropolis of Shanghai and Guangzhou in the country's two wealthiest regions, the Yangtze River Delta and the Pearl River Delta, respectively. Such a location ensures relatively easy access and control by China Telecom in processes of constructing, maintaining, and modifying the technology. The local governments here also control more resources compared to most other small cities while enjoying relatively more latitude in policy implementation processes. Moreover, because the two deltas sustain China's most open and lively regional economies, the potential market demand for Little Smart is easier to detect compared to the majority inland small cities.

The second undercurrent in the historical trajectory was that Little Smart encountered very strong resistance at the national level, which is testified by MII's repetitive request to suspend the service or raise Little Smart prices during 1999-2000. Both China Mobile and China Unicom, the country's only two mobile operators, campaigned vehemently against Little Smart for fear of cut-throat competition in the low-end market. At the same time, central decision-makers in Beijing hesitated in showing any support for Little Smart because the technology was believed to be "outdated"; there

was no formal international standard for PHS and PAS; and the spectrum used by Little Smart reportedly overlaps with 3G applications (Jiang, 2003; Bao, 2004). What the national regulators did at this time was to issue the ordinances, to appease the mobile operators at least for a while, whereas the MII did not really stop all Little Smart projects, whose number continued to rise throughout China (Kuo, 2003). Such a loose way of implementation was taken as a *de facto* green light in local state practices. And when the Febrary 2001 MII ordinance came out, ruling that Little Smart could not enter big cities, this was already a sign of recognizing Little Smart businesses in small cities.

The third process, which is a joint consequence of the first two processes, is the spatial pattern of Little Smart diffusion known in China's telecom industry as "countryside surrounding cities (*nongcun baowei chengshi*)," a phrase originally coined for Mao's military strategy during the communist revolution. To be precise, Little Smart started in small cities, rather than the rural countryside. But this metaphor vividly reflects that the service was first available in the more "peripheral" places before entering large urban centers like Beijing and Shanghai. Moreover, the development, especially in its early periods in small cities like Zhaoqing, was marginally legal, sometimes completely underground, subverting the official policy regime for wireless services, like the operation of Mao's guerrilla war.[6]

"Countryside surrounding cities" is of course not a deliberate choice by China Telecom or UTStarcom. Were they given the chance to choose, Little Smart would have entered Beijing and Shanghai much earlier. The real causes begin with the decision of China Telecom and the former MPT to import PAS in 1996 under the promise that it would help enhance teledensity in the mountainous areas, first in small cities like Zhaoqing (Liu, 2004). It was due to this decision that Little Smart initiated in the relatively peripheral places, but not too far away from the big cities. Meanwhile, equally important is that there was considerably less resistance in small cities, where China Mobile and China Unicom had barely entered, not to mention built working relationships with the local state, in the late 1990s. National decision-makers were also more likely to tolerate the situation as temporary experiments in third-tier cities, where teledensity was

[6] Participants in the Zhaoqing focus group all recalled the period in 1999 and 2000 when they all heard the Little Smart service in their city would be stopped. Two of them reported that they delayed their plan to adopt the technology precisely because of this "rumor".

low anyway. Thus Zhaoqing and Yuhang became the first small cities for such "localized" experiments. In 1999, Kunming and Xi'an were the first two provincial capitals to adopt Little Smart, both of which located in inland western China (Jiang, 2003). At this time, according to Duncan Clark at BDA China, the process of legalizing Little Smart has gone "from a policy of 'grow quietly, but grow' to one of almost no regulation at all." "After service launched in Beijing, MII's new ministrer, Wang Xuedong, pronounced that Little Smart appears to be the people's choice, and the ministry line now is, 'We will neither support nor hinder'" (Kuo, 2003). In May 2004, following those in Beijing and Guangzhou, Shanghai residents finally started to receive Little Smart services. Hence the triumph of the "countryside surrounding cities" strategy, unplanned, accidental, and *ad hoc* as it is, within the context of multi-scale co-evolution between policy processes and market dynamics.

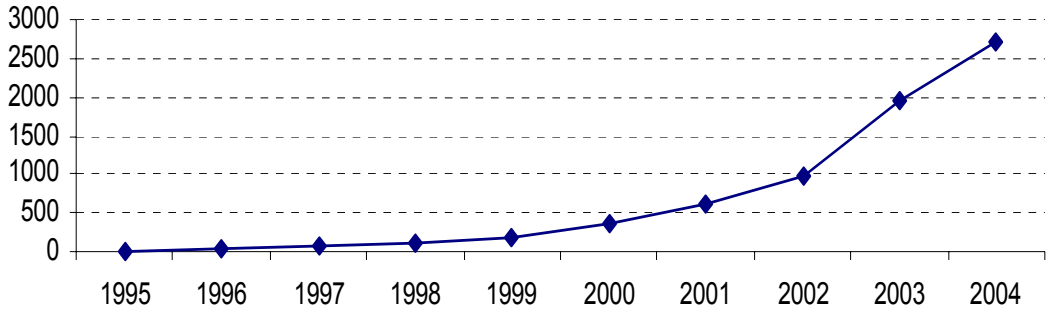
THE TRANSNATIONAL OPERATIONS OF UTSTARCOM

In addition to its national and sub-national dimensions, the rise of Little Smart also involves major transnational operations as represented by UTStarcom, a company founded by returning overseas Chinese students in the United States, which played a central role in the formative process of this particular low-cost access solution. There are, of course, other transnational dynamics going on such as the reform of China Telecom both before and after it went public on NYSE, or MII's changing policy priorities, which were at least in part shaped by the transnational discourse emphasizing competition in the telecom sector. However, UTStarcom is remarkably different from China Telecom and MII as a transnational player in and of itself, as shown by its history, management team, and corporate positioning.

UTStarcom also represents a third force that is crucial to the co-evolution of policy and market other than telecom operators and government policymakers, i.e. the equipment providers. With the rapid diffusion of Little Smart, a number of players in China's telecom industry such as ZTE, Huawei, and 25 mobile phone manufacturers have all entered this market (ibid), producing everything from base stations to controllers, from network management software to more than 100 models of Little Smart handsets (Liu, 2004). There is therefore an entire production chain for the Little Smart business, which

carries considerable political clout that influences policymaking and implementation. Meanwhile, with the multiplication of equipment providers, the market share of UTStarcom has declined to 65-70 percent, although it remains the dominant supplier in this market (ibid).

Figure 3. The growth of UTStarcom as indicated by annual net sales revenue (million USD)



Compilation based on UTStarcom company statements available at www.utstarcom.com

Table 2. A Timeline for the development of UTStarcom (1991-2004)

1991	Two groups of overseas Chinese students separately founded Unitech in California and Starcom in New Jersey.
October 6, 1995	Unitech and Starcom were merged to form UTStarcom.
October 19, 1995	Softbank agreed to provide US$30 million of venture capital to UTStarcom.
1996	UTStarcom (China) was established.
March 3, 2000	UTStarcom completed initial public offering on Nasdaq. Its stock price rose 278 percent on the first day.
May 2001	UTStarcom's PAS system was launched in Taiwan by Fitel.
October 2001	UTStarcom opened its Japan branch office.
November 2001	700-U, the first PAS handset designed by UTStarcom was launched in China.
March 2002	UTStarcom became the main broadband equipment provider for Yahoo! BB in Japan.
March 2002	UTStarcom invested $50 million established its R&D center in India.
March 2003	UTStarcom purchased part of the assets of Commworks, a unit of 3COM, for $100 million.
March 2004	UTStarcom launched its first dual-mode PAS/GSM handset.

In retrospect, the development of UTStarcom looks like a textbook example for successful telecom start-ups with its annual revenue growing from about US$10 million in 1995 to $ 2704 million in 2004 as illustrated in Figure 3. Although Table 2 shows that

the company invests in other businesses like broadband Internet access and it has ambitions in such markets as Japan, Taiwan, India, and the United States, its development trajectory matches closely with the expansion of Little Smart in mainland China with most impressive growth between 2000 and 2003 and a slow-down of growth rate since 2004 (see Figures 1 and 2). UTStarcom's reliance on Little Smart as the main source of income came as no surprise. Considering the overall difficulties in the global telecom market since the Internet bubble burst at the turn of the century and the gradual decline of increase rate in China's regular mobile phone market, the tremendous commercial opportunity offered by Little Smart is definitively exceptional.

Yet how could UTStarcom grab this opportunity and become the main Little Smart equipment provider whereas others did not? What is unique about this company? The answer lies in UTStarcom's transnational operation, especially in connection with Japan and the US. Returning overseas Chinese students, as the spearhead of transnational "brain circulation" (Saxenian, 2002), have been very active in China's telecom industry. But UTStarcom stands out from other companies founded by returning students because, while most companies of this kind only have certain kind of connections in the US, UTStarcom enjoys support from players in both the US and Japan, especially Masayoshi Son's Softbank in the latter case.

UTStarcom has been a transnational enterprise since its beginning. Although most of its revenues come from mainland China, its global headquarters is located in Alameda, California. The company enjoys support from eight R&D centers around the world including three in the United States (New Jersey, California, and Chicago), four in China (Shenzhen, Hangzhou, Hefei, and Beijing), and one in India. It has 30 branch offices not only in China and the US but also in Japan, Germany, India, Australia, Israel, and Vietnam. Until April 2003, UTStarcom had close to 4200 employees, including about 700 in the US and 3400 in China.[7]

The senior management team of UTStarcom consists of four Chinese core decision-makers – Hung Liang Lu, Ying Wu, Bill Huang, and Johnny Chou – all of whom were former overseas Chinese students in the United States. The remaining six members of the management team are of American and European decent including

[7] See www.utstar.com

mostly managers from high-tech companies in the United States such as Lucent, 3M, Cisco, as well as a formal official from the US Commerce Department during the first Bush Administration.[8]

Within this team, the most unique character is probably Hung Liang Lu, the Chairman and CEO of UTStarcom. Born in Taiwan, Mr. Lu moved to Japan at age six, and went to UC Berkeley to study civil engineering, where he started to gain experience as an entrepreneur. He founded Unitech in 1991 before the merge with Ying Wu's Starcom to form UTStarcom in 1995. In addition, Lu has critical Japanese connections in addition to his many experiences in northern California. Since the Berkeley years, he has been a close friend and business partner of Masayoshi Son, Japan's leading IT investor, who regards Lu as his "blood brother" (Global Entrepreneur, 2004). Not coincidentally, Son's Softbank provided the first major venture capital of US$30 million for UTStarcom in 1995 (ibid), although the total sales revenue of the company was only $10 million this year. Without Lu's connection with Son, it would have been difficult for UTStarcom to raise such an amount of venture capital from Softbank.

The Japan connection also proves vital when UTStarcom started to import PHS equipment and handsets from Japan while making modifications on the existing Japanese technology to create the PAS system. Notably the company did not have its own model of Little Smart handset until late 2001 and it was only since then had UTStarcom invested more heavily in adapting the technology to the spatial characteristics of the local markets, for example, by making more powerful base stations that suit Chinese cities with much lower population density than in Japanese cities.[9] Given the unstable policy environment at the time, the reliance on Japan for R&D and technology imports was crucial because it not only reduced the risks facing UTStarcom at the time but also helped fostering the company's leadership role in this unique market.

It is obvious that UTStarcom draws heavily from its US operation given the company's history, R&D centers, and branch offices in the US. But there are two particular aspects that need more emphasis, one of which being the listing on Nasdaq. When UTStarcom completed its IPO on Nasdaq on March 3, 2000, its stock price soared

[8] For discussions on other key members of the management team, see Castells, et al (2004, pp. 147-148).
[9] Interview with UTStarcom executives in Hangzhou.

278 percent on the first day. The continual progressing of UTStrcom's performance on Nasdaq was parallel to the growth of Little Smart in China, where subscription increased by 362 percent during 2000-2001. Strong signals were thus sent to the company's management team that it should capitalize on the Little Smart business and invest more in the R&D of PAS. On the other hand, when UTStarcom expanded at a later stage into other markets such as Taiwan and Vietnam, it always uses the corporate identity as an American company in order to gain more trust from international business partners.[10]

It was the combination of these various transnational factors – in terms of technology transfer, venture capital and stock market investment, and corporate identity – that makes UTStarcom a central player in the Little Smart phenomenon. The above analysis thus shows that the leadership role of UTStarcom in the limited mobility market should not be taken for granted. It is rather a product of the particular China-US and China-Japan connections aforementioned. Indeed, when the MPT opened bid for low-cost access network solution in 1996, there were 13 companies with different technologies in the competition. At the end, PAS/Little Smart was selected, allowing UTStarcom to seize this most valuable opportunity, thanks to China's telecom reform as well as the company's global networks extending across the Pacific Ocean, allowing it to muster tremendous support from R&D centers, stock markets, and venture capitalists in both Japan and the US.

A PREMATURE DECLINE?

The remarkable success of Little Smart in China being presented and analyzed as above, however, should not be taken as a claim that limited mobility service is the answer for low-income communities worldwide; or that it will continue to prosper even in the Chinese market. Rather, the essence of the case analysis shows that the rise of Little Smart owes to a host of institutional and historical factors operating on transnational, national, and local levels, whose unplanned overlapping, interaction, and co-evolution helped create a conducive situation that happened to meet the need of the information have-less. The pending question is, how long can this accidental achievement last? To

[10] Interview with UTStarcom executives in Hangzhou.

what extent is the success of Little Smart a "shooting star (*liuxing*)", as proclaimed by some analysts (Jiang, 2003)? These are not unnecessary worries since the fixed-line operators and Little Smart equipment providers have painfully realized that this particular market segment, despite its growing size, has been suffering from "drastic decline in ARPU" since 2004 (IT Management World, 2004, p. 17). A national taskforce was therefore established to "save" Little Smart on December 13, 2004 (ibid), reflecting an unusual sense of crisis that stands at odd with the rapid growth of this working-class ICT.

In a comparative light, similar limited mobility services like Japan's PHS and India's corDECT had never taken off as the Little Smart, not because the technologies were not good enough or the two countries did not have enough telecom talents. Market demand in these two countries, especially India, has been considerable. But in Japan, the PHS was regulated as a low-end mobile phone rather than an extension of the fixed-line.[11] The target consumer group is mostly school children, who turned out to be not much attracted to PHS despite the lower cost because this group is more fashion sensitive than price sensitive, and PHS is usually regarded as mobile phone for "dummies." The interaction of regulatory policy and market dynamic in this case failed to produce conducive conditions, and hence the failure of PHS to foster its own market.

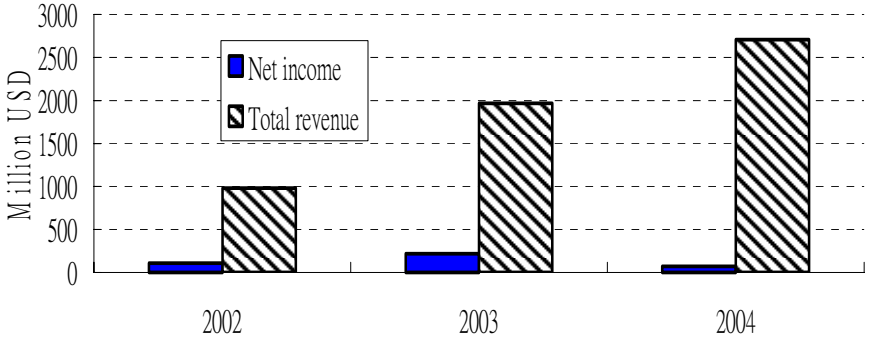
The case of India illustrates another possible scenario, where the attraction of corDECT has been widely acknowledged as the "poor man's mobile phone" (O'Neill, 2003), whose total subscription increased from about 100,000 in September 2001 (ibid) to 7.55 million in March 2004 (DoT, 2003-2004). This impressive, but still slower speed of growth as compared to Little Smart was achieved under the condition that India's telecom authorities were much more supportive of this limited mobility service than their Chinese counterparts. While the MII was trying to curb Little Smart growth, the Indian Department of Telecommunications (DoT) issued its guidelines endorsing corDECT in 2001 with an explicit goal in enhancing universal service (McDowell and Lee, 2003). But the institutional framework for telecom policymaking is less centralized in India than in China. Subsequently, the Indian GSM/CDMA operators were able to launch a legal challenge against the right of fixed-line operators to provide limited mobility service

[11] See Ma and Liu (2004) for more detailed comparison between the market development of Japan's PHS and China's Little Smart.

(O'Neill, 2003), something China Mobile and China Unicom were unable to do. Given the lower average income in India, the market demand was also smaller. Thus, given the combination of less favorable policy and market conditions, corDECT systems in India usually cover small places, such as the residence of business, rather than entire cities as in China (McDowell and Lee, 2003, p. 376).

This paper cannot provide more systematic international comparison due to space limits. Meanwhile, it is more important to critically examine the growth of Little Smart in China to see how the historical and institutional settings, while creating rare opportunities, also have serious latent problems. The slowing down of subscription growth as shown in Figures 1 and 2 is but one indicator for the beginning of the end. Like any technology, the diffusion curve will plateau. But this is more than a "normal" situation because the total number of Little Smart subscribers, being 81.3 million as of July 2005, is still a fraction of the information have-less. Not to count the bulk of laid-off workers, pensioners, and students, the population of rural-to-urban migrants alone is estimated to be at least around 100 million (Solinger, 1990). As will be shown, this slowing-down is not a simple process of technological diffusion reaching saturation but indeed a result of co-evolving policy and market conditions since 2004.

Figure 4. The declining profitability of UTStarcom, 2002-2004



Compilation based on annual reports available at www.utstar.com.

A second, and more serious, alarm sign is UTStarcom's drastically decreasing profitability. The ratio of the company's net income versus total sales revenue was about 11 percent in both 2002 and 2003. But it was only 2.69 percent in 2004 with the slowing down of Little Smart growth. As a result, the company announced for the first time a plan to reduce staffing by 17 percent by firing 1400 employees worldwide (Moritz, 2005).

What can be observed in the meantime is that UTStarcom has been diverting its efforts from Little Smart to other more profitable markets, especially broadband connection, under the pressure of profit maximization, a lot of which comes from the stock market. Internet access solution was in fact the main area of investment for UTStarcom before 1998, and now with Hung Lu's Japan connection, they have also become the main supplier for Japan's Yahoo! BB, providing core networking, softswitch, and ADSL solutions as well as broadband equipment (Global Entrepreneur, 2004). Of course, diversification is a common strategy from a corporate point of view, which however does not necessarily be congruent with the interests of working-class consumers. Without a conducive policy environment in the long run, despite the remaining market potentials in the Little Smart business, it is unrealistic to ask UTStarcom, or any company, to be fully committed to a working-class ICT.

While UTStarcom transfers resources out of the Little Smart business, both domestic and foreign players are entering the low-cost wireless market, creating a new set of dynamics. First, in response to the challenge posed by Little Smart, ordinary mobile phones are becoming much less expensive than before, as exemplified by the Motorola C115 mobile phone, selling less than US$ 50 per piece in August 2005.[12] Mobile service providers have also significantly lowered subscription price, offering competitive packages such as "M-zone" to suit the needs of students, for example. Due to persisting center-peripheral tension, in some places, it is reported that the local China Unicom branches had already started to use the one-way charging scheme, which technically violated formal national regulation for the mobile market. These localities, again, tend to be usually smaller cities, thus strangely echoing the informal process of "countryside surrounding cities" as in the early stage of Little Smart development.

Underlying the above competitive moves against Little Smart launched by the ordinary mobile phone sector is the key factor of low price. Because Little Smart handsets and service packages are inexpensive, the cost is also quite low for one to shift from Little Smart to low-end GSM service. Thus the same factor that contributed to the competitive advantage of Little Smart at the early stage of its diffusion can also become a disadvantage when Little Smart is facing assaults launched by the regular mobile phone

[12] See http://tech.sina.com.cn/mobile/n/2005-08-31/1208708087.shtml

industry. The disadvantage is reinforced by the general perception that GSM services are much better and more reliable than Little Smart, especially large cities like Beijing and Shanghai.[13]

A third threat to the sustainability of Little Smart has to do with China's plan for 3G wireless services. A commonly held view in the policy circle is that the MII will hand out 3G licenses soon and the fixed-line operators will join mobile operators to hold two 3G licenses. For instance, China Telecom will join hands with China Mobile, and China Netcom with China Unicom, in sharing responsibilities and benefits to develop 3G (Buckman, 2005). As a result, both fixed-line operators, especially their branches in major metropolitan areas, are holding off investments in Little Smart with the anticipation for large-scale development in the 3G market. Meanwhile, there is also the argument that Little Smart is using part of the core frequencies designed for 3G deployment as mentioned earlier. Although others, some UTStarcom executives maintained that they could make Little Smart compatible with 3G,[14] one can easily foresee the scenario that, when the 3G licenses are issued, no matter Little Smart will lose its frequency allocation or not, most of the investment by service and equipment providers will be shifted to this new area of growth. And the stock market will respond even more quickly, exerting pressure on the remaining Little Smart business.

Finally, I understand the rise of Little Smart as an accidental achievement because it was through a serendipitous process that the fixed-line operators and equipment providers developed their interests in this working-class ICT. In this process there was little deliberate planning for long-term engagement and, consequently, there is little stable structure to maintain the conducive factors at different scales with regard to policymaking, local implementation, and market dynamics. To put it another way, the informational needs of the have-less are recognized in a *post hoc* manner for commercial exploitation. They are not acknowledged in order for the telecom players to serve working-class consumers, enhancing universal service and promoting upward social mobility. There is therefore little institutionalization, especially at the national level, for the mechanisms to protect long-term sustainability of this working-class ICT. When there

[13] Interviews with Little Smart subscribers in Beijing and focus group discussion among subscribers in Shanghai.
[14] Interview with UTStarcom executive in Hangzhou.

are such mechanisms, they tend to be in small cities where the market dominance of Little Smart has already been established. For example, in Zhoushan, Zhejiang Province, of East China, local residents can receive a reward of US$ 122 for reporting a blind spot in the city where there is no Little Smart signal.[15] But such a level of commitment to provide high-quality services is the exception rather than the rule while considering local fixed-line operators throughout the nation. It is also very rare that the service providers would want to encourage user participation in the technology shaping process at all. Most importantly, this kind of localized mechanism is not backed up by any structural guarantee at the national level, where the ultimate policymaking power resides. This means the more benevolent local service providers can abandon their existing strategy in favor of the working class at any time, as long as they choose to do so.

The migration of interests has begun within the Little Smart industry, moving away from the original goal of capturing the low-end market, while targeting more affluent consumer groups, or even worse, forcing current Little Smart subscribers to spend more. UTStarcom, for example, has been pushing a range of value-added products based on Little Smart such as its mobile Internet solution called "MiMi C-Mode" (Xu, 2004). SMS, ring tone, and handset wallpaper are among the other value-added services now being promoted by various local fixed-line providers (Xu and Xu, 2004) following the same marketing routine used by GSM and CDMA operators that targets the middle class. But the problem here is not whether technically Little Smart can be used for all the non-voice activities but whether current users need these services. The unequivocal answer emerging from my interviews and focus groups is no – most of the Little Smart subscribers do not need these value-added services except for SMS. From the perspective of these users, it would be far more helpful if the investment can be spent on the improvement of signal reception, on simple voice communication, rather than the advanced data services that no one will use.

CONCLUDING REMARKS

[15] Focus group discussion in Shanghai.

This paper begins with the question: can wireless technology serve low-income communities? It shall end, given the above analysis of Little Smart in China, with a general recognition that the optimistic belief in rational choice is, for the most part, an obvious error, and so is the overly pessimistic view. The capacity for wireless technology to serve low-income communities is an attribute rather than an absolute. It is not a simple positive sign; nor is it just a negative one. Instead, this attribute is conditioned by (a) the institutional settings of specific telecom regulatory systems, including both the formal rules and informal practices, (b) market dynamics produced by the informational needs and consumption patterns of the information have-less, shaped in part by the mobility patterns in their everyday life, and (c) the co-evolution of policy arrangements and market dynamics with the main commercial players such as China Telecom and UTStarcom being at the center stage.

The process and result of conditioning are historically specific. In the case of Little Smart, it was first initiated as an attempt to promote universal service in mid- and late-1990s, and then transformed into a major source of profit by fixed-line operators and equipment providers during 2000-2003. The same pursuit for higher ARPU, in a different period since 2004, can also become a disincentive that hampers the further development of this working-class ICT.

Equally important is the spatial dimension of the technology, which shows that, above all, wireless mobility can be localized; and that localized mobility can suit the daily life patterns of the information have-less very well. Moreover, the rise of the Little Smart involves a complex scaling process from the transnational to the national, and then to the local, back and forth. We have only begun to explore the scale relationships. Yet the most crucial operational scale in this case is the local state, mostly city governments, who has the ultimate implementation power, as shown in the nationwide pattern of "countryside surrounding cities."

The overlapping of historical and spatial conditioning means that large cities like Beijing and Shanghai still lags behind smaller cities in terms of their local Little Smart service quality. This creates a major drawback because big metropolis is the center of urbanization developments, where the have-less populations are concentrated to serve an increasingly transnational economy. But in some of these places where market demand is

the highest, the actual quality of service is the lowest, creating one of the most troubling problems regarding this working-class ICT.

Sustainability is probably still the most formidable challenge. Based on the combination of conducive factors at the transnational, national and local levels, the success story of Little Smart is essentially a serendipitous match between state and enterprise interests on the one hand and a long-ignored market demand on the other. Remembering that China's pager subscription, the world's largest in the late 1990s, dropped from 48.8 million in 2000 to 2.4 million in July 2005,[16] who can promise that the Little Smart will not become a disposed technology in a few years?

May 17, 2005, was World Telecom Day and the theme designated by ITU was "creating an equitable information society: time for action."[17] Ironically, the action taken by China Telecom and China Unicom on the very same day was a new measure to "upgrade" Little Smart handsets so that they would be able to support roaming and value-added services like regular mobile phones (Shen, 2005). Moreover, the service providers will "gradually stop the usage of all previous versions of Little Smart phones" "after a period of transition" (ibid). Controversial as it is, this plan is a key move by the commercial players trying to "save" Little Smart from its quickly declining ARPU (IT Management World, 2004). Whether the strategy will work or not is a question for the future. At this point of time, the real issue that matters is the possibility of intentionally maintaining the accidental achievement of this working-class ICT. It's an urgent question for not only the 81.3 million subscribers, who have already adopted the technology in China, but also other members of the information have-less worldwide.

[16] *MII Annual Statistical Report 2000* and *MII Monthly Statistical Report, July 2005*.
[17] See http://www.itu.int/newsroom/wtd/2005/

REFERENCES:

Bao, Dongzhi (2004). "Xiaolingtong zhilu haineng zouduoyuan? (How far can Little Smart go down the road?)" *Xinxi wangluo* (Information networks). No. 11. pp. 22-31.

Buckman, Rebecca (2005). "China Unicom revamp appears increasingly likely," *Asian Wall Street Journal.* March 29, 2005.

Cartier, Cartier, Castells, Manuel, and Qiu, Jack L. (forthcoming). "The information have-less: Inequality, mobility and translocal networks in Chinese cities." Special issue on digitization and development, *Studies in Comparative International Development.*

China Telecom case study, UTStarcom, Available: http://www.utstar.com/Solutions/Document_Library/Customer_Case_Studies/docs/UTSI_CS_ChinaTelecom.pdf (accessed May 16, 2005).

Department of Telecommunication (DoT), (2003-2004). *Annual Report*, Ministry of Communications & Information Technology, Government of India, New Delhi.

Frost & Sullivan (2003). *The 'PAS' Phenomenon: Revolutionizing Local Wireless Telephony.* Frost & Sullivan White Papers. February 2003.

Global Entrepreneur (2004). "UTStarcom mengzhidui (The dream team of UTStarcom)," April 2004, Issue 97. Available: http://tech.163.com/2004w04/12515/2004w04_1081329420216.html (accessed May 18, 2005).

Guan, Scott Y. (2003). *China's telecommunications reforms: From monopoly towards competition.* Nova Science Publishers.

IT Management World (IT jingli shijie) (2004). "Zhengjiu xiaolingtong de chanye lianmeng (An industry union formed to save Little Smart)," December 20, 2004, p. 17.

ITU (2004). *ITU Internet Reports 2004: The Portable Internet*. Geneva: the International Telecommunications Union.

Jiang, Yu (2003). "PHS de shashangli youduoda? 'Liuxing' xiaolingtong (How lethal is PHS? Little Smart the 'shooting star'," *Zhongguo IT shichang qingbao zhongxin (China IT Market Information Center)*. June 18.

Lee, Paul S.-N. (ed) (1997). *Telecommunications and development in China.* Cresskill, NJ: Hampton Press.

Liu, Hui (2004). *Zhongguo xiaolingtong shichang dongtai yanjiu (Research on market dynamics of Little Smart in China)*, TeleInfo Institute, China Academy of Telecommunications Research of MII, March 2004.

Ma, Siyu, and Liu, Hui (2004). "Zhongri xiaolingtong de fazhan yu jingying celue fenxi (Deployment and operation comparison between PHS in Japan and Little-Smart)." *Tongxin shijie (Communications World)*, April 19. Available: www.wx800.com/msg/2004/04/29/d43572.php (accessed on May 18, 2005).

McDowell, Stephen D. and Lee, Jenghoon. (2003) "India's experiments in mobile licensing," T*elecommunications Politcy, 27*: 371-382.

Ministry of Information Industry (MII), *Annual statistical reports, 1990-2004.* Available at www.mii.gov.cn.

Ministry of Information Industry (MII), *Monthly statistical reports, 2005.* Available at www.mii.gov.cn.

Moritz, Scott (2005). "UTStrcom slashing staff," *The street.* May 5. Available: www.thestreet.com/tech/scottmoritz/10222073.html (accessed on May 8, 2005).

Mueller, Milton, and Tan, Zixiang (1997). *China in the information age.* Westport, CT: Praeger.

O'Neill, Peter D. (2003) "The 'poor man's mobile telephone': Access versus possession to control the information gap in India," *Contemporary South Asia, 12:* 85-102.

Saxenian, AnnaLee (2002). "Brian circulation," *The Brookings Review, 20*(1): 28-31.

Shen, Juan (2005). "Jikafenli xiaolingtong wuyue tuichu, jika yiti jiang zhubu taotai (Separate-card Little Smart available in May, integral-card models will gradually disappear)," *Diyi caijing ribao (First Financial Daily)*. March 21, 2005.

Solinger, Dorothy (1999). *Contesting citizenship in urban China: migrants, the state, and the logic of the market.* Berkeley: University of California Press.

Tan, Zixiang, Chen, Shiang, and Liu, Xiaozhong (2005). Adoption of limited mobility services: "Little-Smart" in China as a case. Paper presented at the Hong Kong Mobility Roundtable, June 2-5, 2005.

Xu, Yan, and Pitt, Douglas C. (2002). *Chinese telecommunications policy.* Artech House Publishers.

Xu, Yongmin (2004). "Xiaolingtong MiMi muzhi xinxi yewu (Little Smart MiMi thumb information service)," *Zhongguo shuju tongxin (China Data Communications)*, June, pp. 19-24.

Xu, Fuxin, and Xu, Yongmin (2004). “Xiaolingtong duanxiaoxi yewu (Little Smart short messaging service),” *Zhongguo shuju tongxin (China Data Communications)*, March, pp. 11-16.

Zhao, Yuezhi, and Schiller, Dan (2002). “Dances with wolves? China’s integration with digital capitalism,” *Info, 3*(2): 137-151.