

Adoption of Fixed-mobile Convergence in the U.S. Telecommunication Industry

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Fixed–mobile convergence (FMC) is a radical innovation for telecommunication companies because it requires them to move into unknown territories that are beyond traditional business lines and underlying technologies. In the meantime, understanding what types of telecommunication companies are better at doing business through the early adoption of FMC has become increasingly important in the converging telecommunication industry. This paper tries to examine several firm characteristics and their influence on the extent of FMC adoption in the US telecommunication industry. The results show that FMC is still in the early stage and that firm scope and size have a significant positive impact on the extent of FMC adoption.

Keywords: fixed–mobile convergence; firm characteristics; adoption; US telecommunication industry

ACM Classifications: C.2.3, C.2.m, K.m.

1. INTRODUCTION

The telecommunication industry is now facing the trend of fixed–mobile convergence (FMC), which is effectively blurring the boundaries between the fixed-line and mobile industries. Although various definitions have been set by many organizations, FMC is commonly understood as the seamless integration of previously separate fixed and mobile services, networks, and commercial practices (Curwen, 2006; Yang *et al*, 2004).

FMC originates from various factors such as technological development, deregulation, competition, and customer demand (Yang *et al*, 2004). Rapid technological innovation makes it possible to overcome the barriers between fixed and mobile networks. Liberalization and deregulation of the

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telecommunication industry has also pushed established telecommunication companies – which once held a monopoly or were controlled by the government – into finding new ways of remaining competitive in a severely changing environment. For many telecommunication companies, FMC is regarded as a good opportunity to increase their market share and improve their profitability by introducing converged networks and services (Joseph *et al*, 2005). In addition, the customers' demand for one-stop shopping for telecommunication services is placing a greater emphasis on FMC. For customers, FMC offers more convenience and benefits because they can enjoy greater flexibility, lower costs, and simplified communication services.

FMC is no longer considered something that is going to happen; rather, it is very much a present reality. For example, TDC (Tele Denmark Communications) has already packaged mobile phone services with their fixed-line services under the brand name “DUET.” BT's “OnePhone” and “Fusion”, SBC's “Connections”, Telstra's “HomeLine Plus”, and KT's “Netspot Swing” are other examples of FMC.

Indeed, FMC can be regarded as a breakthrough or radical innovation because it is linked to high-risk and high-uncertainty projects with the potential to influence the marketplace greatly and bring returns to the firm (O'Connor and McDermott, 2004). FMC is a huge risk for telecommunication companies because it requires them to move into unknown business and technological territories.

In recognizing the significance of FMC, a few previous studies have concentrated mainly on FMC in the context of technological possibilities, regulatory challenges or industry-wide analysis. However, little academic research has investigated FMC at the firm level. In addition, there has been no empirical research focusing on the actual adoption of FMC in the US telecommunication industry. Moreover, there is no research linking the telecommunication-specific firm characteristics and the extent of FMC adoption.

The goal of this paper is to examine the extent to which US telecommunication companies are leveraging FMC to transform their business practices. In addition, by analyzing the relationships between several firms' characteristics and the extent of FMC adoption in the US telecommunication industry, this paper aims to determine what types of companies are better at doing business through early adoption of FMC.

The remaining part of this paper is organized as follows. After reviewing the literature and developing research hypotheses and a research model in Section 2, methodology is introduced in Section 3. Section 4 shows the empirical results for the US telecommunication industry. Finally, Section 5 presents conclusions and implications.

2. RESEARCH HYPOTHESES AND RATIONALE

Innovation theory is relevant to the study of FMC as a radical innovation. Information technology (IT) innovations are adopted as organizational responses to change in internal and external environments, or as preemptive actions to influence the environments (Lee and Xia, 2006).

Tornatzky and Fleischer (2002) categorize the possible antecedents of IT adoption into three areas: firm characteristics, characteristics of the external environment, and characteristics of IT itself. Another categorization is offered by Cordell and Wassum (1999), who divide the primary factors into characteristics of the environment, of the organization itself, and of the individual within the organization. Commonly studied determinants of IT innovation adoption include environmental, organizational and technology factors, as well as innovation characteristics (Lee and Xia, 2006).

Among the factors summarized above, this paper focuses on the organizational factors (firm characteristics). Organizational factors that have been noted by scholars in adoption studies include

organizational structure (Ives *et al.*, 1980), size of firm (Damanpour, 1992; Igarria *et al.*, 1997; Kimberly and Evanisco, 1981), firm scope (Dewen *et al.*, 1998; Hitt, 1999; Teece, 1980), industry type (sector) in which a firm involves (Chau and Tam, 1997), and top management support (Lefebvre and Lefebvre, 1992). For example, according to Kim (2002), firm characteristics affecting the extent of adoption of an electronic billing system include industry tenure, firm scope, and firm size.

This literature review helps to justify the main proposition of this paper, which is that FMC adoption is affected by firm characteristics, of which some are strategic variables in the telecommunication industry and others are general firm characteristics.

Industry Type

The US telecommunication industry mainly consists of the two subindustries of fixed-line telecommunication and mobile communication. Each subindustry, based on the different technologies of either fixed-line or mobile network, is under a different regulatory environment and experiences different market dynamics and customer demand (Kim, 2002). Thus, even though the trend of convergence in the telecommunication industry blurs boundaries, there are still some differences in the adoption of FMC between the subindustries of fixed-line and mobile communication.

Hypothesis 1. The extent of FMC adoption differs between fixed-line companies and mobile communication companies.

Tenure Position

There is little evidence that established incumbent companies stimulate innovation (Bauer, 1997). In fact, these companies find it more difficult to innovate because of their structural and cultural inertia, internal politics, complacency, fear of cannibalizing existing products, fear of destroying existing competencies, satisfaction with the status quo, and a general lack of incentive to abandon a certain present for an uncertain future (Markides, 1998).

Tushman and Anderson (1986) and Henderson (1993) show that competency-enhancing or incremental innovations are initiated by existing companies, whereas competency-destroying technical discontinuities are often launched by new firms. According to Thomas (1999), if the innovation is radical and has the potential to cannibalize existing sales, one expects to find new entrants more likely to adopt radical new technologies and products before incumbents. This is referred to as the “replacement effect.”

In the US telecommunication industry, since FMC can be regarded as a type of radical innovation, we would expect that the incumbent telecommunication companies are less likely to adopt FMC.

Hypothesis 2. Tenure position will be negatively related to the extent of FMC adoption.

Firm Scope

Firm scope normally refers to the identity of customer groups served and not served (Kim, 2002). This definition is established by Porter and Millar (1985) and is based on the number and types of market segments served. The definition of a market is partly dependent on the level of aggregation, because many industries actually entail multiple products and a wide range of segments (Gimeno and Woo, 1999; Zahra, 1993).

In the US telecommunication industry, which is characterized by diversification and blurred boundaries, consolidation across the subindustries is considered a leading factor in competitive behaviour (Gimeno and Woo, 1999). After the Telecommunication Act of 1996, telecommunication

companies that had no experience with multiple business lines started to diversify their businesses into other markets and to be more competitive (Kim, 2002). Converged or diversified telecommunication companies may expect economies in achieving FMC. Conceptually, economies of scope arise from two main sources: the spreading of fixed costs over an expanded product mix and the cost complementarities that can arise between different output categories if functional activities are carried out under the umbrella of one firm (Pulley and Humphrey, 1993).

Some researchers have proven that firm scope is a significant adoption facilitator of IT investment (Dewan *et al*, 1998) and e-business (Zhu *et al*, 2002). For the diversified telecommunication companies who have business lines in both the fixed and mobile sectors, the extent of FMC adoption would be greater than in those companies focused on only one sector, that is, fixed or mobile. Accordingly, a firm with a broad scope is hypothesized to be conducive to an early adoption of FMC.

Hypothesis 3. Firm scope will be positively related to the extent of FMC adoption.

Firm Size

Firm size has been consistently recognized as an adoption facilitator (Damanpour, 1992). Size is generally held to be positively related to adoption of innovation (Chen *et al*, 2006; Frambach and Schillewaer, 2002; Kimberly and Evanisco, 1981). Most frequently, this relationship is attributed to economies of scale, which enhance the feasibility of adoption (Baldrige and Burnham, 1971). For example, as small companies are characterized by severe constraints on financial resources, a lack of in-house information system expertise, and a short-range management perspective (Thong, 1999), they face substantially more barriers in the adoption of innovations and are less likely to adopt innovations than large businesses (Kim, 2002). According to Kimberly and Evanisco (Kimberly and Evanisco 1981), size and adoption behaviour may be positively related because increasing size creates a “critical mass”, which justifies the acquisition of particular innovations.

From this perspective, it can be argued that increasing firm size facilitates adoption behaviour. Therefore, we can expect that the larger firms are more likely to adopt FMC because it often requires significant facility investments such as telecommunication networks and equipment.

Hypothesis 4. Firm size will be positively related to the extent of FMC adoption.

The proposed research model for this study is presented in Figure 1.

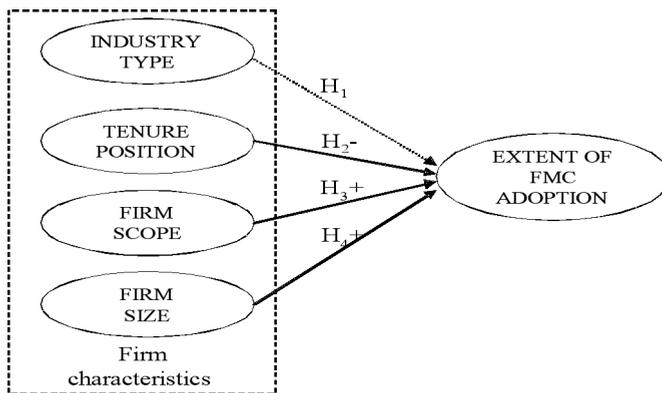


Figure 1: Research model

3. METHODOLOGY

Operational Measures

Operational measures for the research variables are specifically developed if there are no appropriate instruments presented in previous studies. In particular, the dependent variable is set as the extent of FMC adoption because adopting and offering FMC services is a matter of degree. FMC generally follows five stages: (1) no FMC service offerings; (2) FMC in VAS (Value Added Services) such as voice messaging, fax messaging, and instant messaging; (3) packaged FMC services, which are integrated bundles of local telephone, long distance, DSL, Wi-Fi, and mobile communications services; (4) more advanced bundled FMC services with more convenience and lower price; and (5) ultimate FMC services, which offer seamless communication by single subscription, through one device, regardless of the type of access network. Thus, the dependent variable is measured by using a five-point scale from one to five. For example, the “BellSouth Answer” service, which bundles all fixed-line (long distance, high-speed internet, and direct TV) and mobile services with a price discount, is classed as stage four and coded as 4. Other examples of FMC services coded as 4 include Verizon’s “Freedom”, Cincinnati Bell’s “Talk.Text.Surf”, and SBC’s “Quadruple pack.”

INDUSTRY TYPE is an industry-specific dummy variable categorized into: (1) companies whose main business is fixed-line telecommunication services and (0) companies whose main business is mobile communication services.

TENURE POSITION is a dummy variable coded as 1 if the firm is an incumbent player and 0 otherwise (in other words, a new entrant). In the fixed-line telecommunication subindustry, an incumbent is defined as an ILEC (Incumbent Local Exchange Carrier) that has to file to the FCC (Federal Communication Commission). The CLECs (Competitive Local Exchange Carriers) are regarded as new entrants in the fixed-line subindustry. In the mobile communication subindustry, cellular operators are defined as the incumbents. The PCS (Personal Communication Service) providers that entered the mobile communication market later, through spectrum auctions, are regarded as new entrants that compete with existing cellular operators.

FIRM SCOPE is the principal independent variable capturing the impact of firms conducting multiple activities. This is a dummy variable represented as 1 if the company is diversified and 0 otherwise (meaning the company focuses only on its original business—fixed-line or mobile communication).

FIRM SIZE is defined as the number of subscribers who receive bills from the company.

Sampling and Data Collection

A stratified sampling design was used to represent the US telecommunication industry better because it can be stratified by two basic subindustries (fixed-line carriers and mobile communication service providers) and can occupy two tenure positions (industry incumbent or new entrant). A randomized list was developed for each of the four stratified subsets by using various FCC and industry sources.

To confirm the progress of FMC adoption, data collection was conducted in October 2003 and again in October 2006. Though the concept of FMC was first introduced in late 90’s, FMC has become a real service in the market in 2003. Thus we decided to examine the extent of FMC adoption at that point of time. In addition, since the adoption of FMC in 2003 was found to be in the very early stage, we decided to collect data again in 2006 to make a comparative study.

The first data collection in October 2003 proceeded in two stages. The first stage was to identify the websites of selected companies to obtain company information. Web directories, such as

“Xroad” and “JAYDE”, and “Wireless Week” were used to obtain the homepage addresses of each selected company. This study identified 43 companies that operated under their own brand, maintained their homepages, and revealed key data such as the number of subscribers. Companies identified as maintaining their homepages in the first stage proceeded to the second stage of data collection. The second stage consisted of a comprehensive analysis of each website of the selected companies. We visited the websites of the selected companies and evaluated the real extent of FMC adoption, in particular the extent of FMC service offerings. The firm scope and size data were mainly gained from the websites, and FCC industry statistics data were also analyzed in order to look at the tenure positions of the companies in the fixed-line or mobile communication industry. In addition, a number of journal articles, white papers and newspapers were used to support and verify the collected data.

The second stage of data collection with the previous sample was conducted in October 2006. However, three companies, Focal Communications, NewSouth Communications and AT&T Wireless Services, were excluded from the second data collection process because they had been acquired by other companies. Thus, the second sample contains only 40 companies (see the company lists in Appendix 1 and 2). The firm scope and size data were collected again for the study in October 2006.

4. EMPIRICAL RESULTS

Overall Adoption of FMC

According to Table 1, almost half of selected US telecommunication companies now offer some form of FMC service. However, on average, the extent of FMC adoption is still low (1.9 on a five-point scale), although average FMC adoption is slightly improved from that of October 2003 (1.72 on a five-point scale). As shown in Table 1, there is no telecommunication company that offers ultimate FMC services. At October 2003, there were only three telecommunication companies that provided Stage 4 FMC services. They were Bell South, Qwest and Verizon, and these are all ILECs in the fixed-line subindustry. At October 2006, two more ILECs (SBC and Cincinnati Bell) and one mobile incumbent company (Nextel Communications) are listed at Stage 4. This result implies that most US telecommunication companies are still in the early stage of FMC adoption and are doing little to offer FMC services to the customer even though they recognize its importance.

Comparing the results of October 2003 with those of October 2006, seven of the 40 companies are identified as advancing their FMC adoption stages. A pair-wise t-test was conducted to check the difference in the extent of FMC adoption at October 2003 and October 2006, and the results verify that there is a significant difference at the 99% level.

There was no significant difference between the subindustries of fixed-line and mobile communication in both studies (regarding Hypothesis 1). According to an analysis of variance (ANOVA), FMC is not widely adopted in the US telecommunication industry regardless of the type of subindustry (see Table 2). The regression result also confirms that industry type is not a significant predictor of the extent of FMC adoption. Actually, the recent trends of convergence and cross-competition, which eliminate the traditional boundaries of the major subindustries, may lead US telecommunication companies in a similar direction for FMC adoption (Kim, 2002).

Regression Results

To test the research hypotheses on the relationships between several firm characteristics and the extent of FMC adoption, this study used ordinary least square regression analysis. The dependent variable in the regression is the extent of FMC adoption, and the independent variables in the

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		<i>Extent of FMC adoption</i>					<i>Total (%)</i>	<i>Mean</i>	<i>S.D.</i>
		<i>Stage 1</i>	<i>Stage 2</i>	<i>Stage 3</i>	<i>Stage 4</i>	<i>Stage 5</i>			
October 2003	Fixed	18	7	1	3	0	29 (67.44)	1.62	0.97
	Mobile	4	7	3	0	0	14 (32.56)	1.93	0.73
October 2006	Fixed	16	6	0	5	0	27 (67.5)	1.78	0.90
	Mobile	2	8	2	1	0	13 (32.5)	2.17	0.80
Total (%)	October 2003	22 (51.1)	14 (32.6)	4 (9.4)	3 (6.9)	0 (0)	43 (100)	1.72	0.90
	October 2006	18 (45.0)	14 (35.0)	2 (5.0)	6 (15.0)	0 (0)	40 (100)	1.9	1.05

Table 1: Simple descriptive statistics

		<i>Sum of squares</i>	<i>Df</i>	<i>Mean square</i>	<i>F</i>	<i>Significance</i>
October 2003	Between groups	0.895	1	0.895	1.087	0.303
	Within groups	33.756	41	0.823		
	Total	34.651	42			
October 2006	Between groups	1.241	1	1.241	0.775	0.298
	Within groups	42.359	38	1.115		
	Total	43.600	39			

Table 2: Summary of ANOVA

regression represent factors hypothesized to influence the dependent variable. These explanatory variables include industry type, tenure position, firm scope, and firm size.

There is no evidence of significant multicollinearity among the research variables when the Pearson correlation matrix and Variance Inflation Factors (VIF) were examined. Although the correlation between firm size and firm scope is relatively high, it does not exceed the limit for multicollinearity that is generally accepted in business studies (see Table 3). In addition, according to Table 3, the maximum VIF of independent variables is 4.99. Since all VIF scores are much smaller than 10, we assume that multicollinearity is not a problem (Neter *et al*, 1990).

The regression results serve as the primary tool for testing the four hypotheses. Two regression results for the October 2003 data and the October 2006 data are illustrated in Table 4. In the regression models, the percentages of the variable explained (R^2) are 56.8% and 47.1%, respectively, implying statistically significant ($P < 0.05$) and satisfactory models. Although R^2 for the October 2006 study is lower than that for October 2003, the results of the two studies are almost the same.

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<i>October 2003</i>		<i>VIF</i>	<i>Correlation</i>				
			<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
1	Extent of FMC adoption		1.00				
2	Industry type	1.98	-0.161	1.00			
3	Tenure position	2.80	0.333*	-0.150	1.00		
4	Firm scope	4.99	0.600**	0.025	0.309*	1.00	
5	Firm size (‘000s subscribers)	2.99	0.667**	0.005	0.312*	0.509*	1.00

<i>October 2006</i>		<i>VIF</i>	<i>Correlation</i>				
			<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
1	Extent of FMC adoption		1.00				
2	Industry type	2.01	-0.169	1.00			
3	Tenure position	3.04	0.347*	-0.091	1.00		
4	Firm scope	4.91	0.533**	0.105	0.263	1.00	
5	Firm size (‘000s subscribers)	2.79	0.583**	-0.085	0.273	0.477*	1.00

* Correlation is significant at the 0.01 level; ** Correlation is significant at the 0.05 level

Table 3: Correlation matrix and VIF

	<i>Dependent variable: Extent of FMC Adoption</i>	
	<i>October 2003</i>	<i>October 2006</i>
Industry type	-0.164	-0.549
Tenure position	0.054	0.143
Firm scope	0.345**	0.336*
Firm size	0.475**	0.370*
Number of companies	43	40
<i>R</i> ²	0.568*	0.471*

Note: Entries are standardized beta from a regression analysis.

** Statistically significant at P<0.01.

* Statistically significant at P<0.05.

Table 4: Regression results

Regarding Hypothesis 2, the coefficient of the explanatory variable is positive and not significant in both studies. Thus, Hypothesis 2 is not accepted. This result suggests that the extent of FMC adoption is not related to the tenure position of each company in the US telecommunication industry. The trend of convergence may push not only new entrants but also established incumbent companies to consider FMC as a way to redefine their businesses and gain competitive advantage. This result may conflict with prior ones indicating that incumbents are content with past successes, focus on current products or current customers, and are highly unwilling to cannibalize current assets and products to build future market (Bauer, 1997; Tellis, 2006).

As expected by the predictions of Hypothesis 3, the coefficient of the dummy variable for a firm's scope (FIRM SCOPE) differs significantly from zero ($P < 0.01$ at October 2003 and $P < 0.05$ at October 2006). This means that diversification beyond traditional lines of business is positively related to the extent of FMC adoption. This result supports Hypothesis 3 and suggests that diversified telecommunication companies have a higher extent of FMC adoption. In other words, telecommunication companies that have their own subsidiary in the fixed-line or mobile market are more likely to offer a FMC service.

Not surprisingly, firm size is the most significant predictor (regarding Hypothesis 4). The coefficients of the variable FIRM SIZE are 0.475 for October 2003 and 0.370 for October 2006, which are statistically significant at the 0.01 and 0.05 levels, respectively. This result indicates that the extent of FMC adoption is positively correlated with the number of subscribers. Thus, as expected, the extent of FMC adoption is higher when the company has more subscribers. This result is consistent with previous findings in the literature that claim that larger businesses have more resources to facilitate new innovation adoption.

One interesting point is that the statistical strictness of firm scope and firm size at October 2006 is lower than that at October 2003. This implies that the less diversified and relative small telecommunication companies may start to seek FMC opportunities and that FMC is becoming what is colloquially referred to as a "no brainer", that is, a strategy that simply has to be chosen because the alternatives are completely unacceptable (Curwen, 2006).

5. CONCLUSIONS AND IMPLICATIONS

With regard to the goals of this study, it was found that only a small number of US telecommunication companies have adopted advanced forms of FMC, regardless of subindustry type and tenure position, although average adoption of FMC has slightly increased from October 2003 to October 2006. FMC is still in the early stage in the US telecommunication industry, and few telecommunication companies seem willing to rush into the FMC services before the technology is proven and the market is ready. In addition, two firm characteristics – firm scope and size – were found to be significant when predicting the extent of FMC adoption.

The results of this study have a few implications for telecommunication scholars. First, it is necessary to study the antecedents and consequences of FMC efforts in a telecommunication industry that is still slow to adopt this radical innovation. Second, firm scope and size could be important firm characteristics in explaining the strategic behaviours in the telecommunication markets. Third, a new telecommunication policy should be created to balance market power between large diversified telecommunication companies and small focused telecommunication companies, because the former seems more active than the latter in adopting FMC.

This study should also be of interest to managers in the telecommunication industry. To begin with, the first movers, which are normally large diversified companies, may need to think about how to make their customers subscribe to FMC services. They need to solve some significant technical challenges and leverage FMC in order to facilitate whole organizational transformation. Second, the late movers, normally small and focused companies, are required to recognize the potential of FMC and catch up to their competitors. To make up for their limited scope and size and to increase the extent of FMC adoption, these firms may need to pursue methods such as strategic alliances with fixed-line or mobile communication companies, merger and acquisition (M&A), and so on. Finally, since the overall FMC adoption is still low, managers need to pay attention to the FMC drivers again such as customer needs, technological capabilities and regulatory change.

This study contributes to the literature on the telecommunication industry and FMC by

examining the extent of FMC adoption in the US telecommunication industry. In particular, this study provides a firm-level analysis of FMC by collecting data twice in 2003 and 2006.

However, this study is not without its limitations. First, because it measures the extent of FMC adoption in terms of the development stages of FMC service offerings, it may not cover accurately the entire characteristics of FMC. Second, the sample size is so small that we cannot use more appropriate statistical methods. Third, our data collection method is a purely descriptive and subjective technique and may not be the optimal method for this study.

A useful area of further research would be to expand this study by adding the US cable TV operators or non-US telecommunication companies, or by examining the extent of convergence between telecommunication and non-telecommunication businesses. Firm performance, including customer acquisition, market share, and sales, in relation to the results of FMC adoption, may be examined to justify investment in this radical innovation. Finally, a customer-side study or a related policy analysis will be necessary to understand better the adoption of FMC in the US telecommunication industry.

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APPENDIX TABLE 1: THE US FIXED-LINE CARRIERS IN THE SAMPLE

	<i>Incumbents (ILECs)</i>		<i>New entrants (CLECs)</i>
	(1) BellSouth (www.bellsouth.com)	(1)	Cbeyond Communications (www.cbeyond.net)
	(2) Qwest (www.qwest.com)	(2)	Comcast Business Communications (www.comcast.com)
	(3) Verizon (www22.verizon.com)	(3)	Conversent Communications Long Distance (www.convergentnet.com)
	(4) Alltel (www.alltel.com)	(4)	Focal communications* (www.focal.com)
	(5) Cincinnati Bell (www.cinbelltel.com)	(5)	Birch Telecom (www.birch.com)
	(6) Citizens (www.frontieronline.com)	(6)	Logix Communications (www.logixcom.com)
Fixed-line carriers	(7) Iowa Telecom (www.iowatelecom.com)	(7)	NewSouth Communications * (www.newsouth.com)
	(8) Sprint (www.sprint.com)	(8)	Ntelos Network (www.ntelos.com)
	(9) Valor (www.valortelecom.com)	(9)	Nuvox Communication (www.nuvox.com)
	(10) SBC (www.sbc.com)	(10)	Talk America (www.talkamerica.com)
	(11) CenturyTel (www.centurytel.com)	(11)	Tex-Link Communications (www.texlink.com)
	(12) Broadwing (www.broadwing.com)	(12)	Time Warner Telecom (www.xo.com)
	(13) SureWest Telephone (www.surewest.com)	(13)	XO Communications (www.broadwing.com)
	(14) Puerto Rico Telephone Co. (www.telefonicapr.com)	(14)	Xspedius (www.xspedius.com)
		(15)	Z-TEL Communications (www.z-tel.com)

* Excluded from 2006 sample because these companies were merged with other companies

APPENDIX TABLE 2: THE US MOBILE COMMUNICATION PROVIDERS IN THE SAMPLE

	<i>Incumbents (Cellular)</i>	<i>New competitive entrants (PCS)</i>
	(1) AT&T Wireless Services * (www.attws.com)	(1) Leap Wireless International (www.leapwireless.com)
	(2) Centennial Cellular (www.centennialcom.com)	(2) NTELOS (www.ntelos.net)
	(3) Cingular Wireless (www.cingular.com)	(3) Sprint PCS (www.sprintpcs.com)
	(4) Dobson Cellular Systems (www.dobsoncellular.com)	(4) T-Mobile (www.t-mobile.com)
Mobile providers	(5) Nextel Communications (www.nextel.com)	(5) Triton PCS (www.suncom.com)
	(6) Rural Cellular (www.rccwireless.com)	
	(7) US Cellular (www.uscc.com)	
	(8) Verizon Wireless (www.verizonwireless.com)	
	(9) Western Wireless (www.wwireless.com)	

* Excluded from 2006 sample because these companies were merged with other companies.

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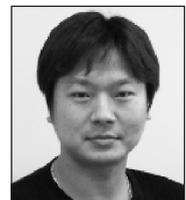
Seongcheol Kim



Changi Nam



Hyun-Kyung Jung



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