

**Connectivity and Mobility:**  
**Two Dimensions in Tapping the Opportunities for Mobile Business**

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**Summary**

Mobile business, noticed as a constructive alternative for e-commerce and e-business, has been diversely defined and conceptualized. This study develops a comprehensive framework for the sake of clearing such a havoc of conceptual deluge. The framework for the comprehensive understanding of e-business (including m-business) consists of two dimensions: connectivity and mobility. These two dimensions represent to overcome the constraints of time and place in business transactions, respectively. Various cases for each combination of these two components are explained for clear understanding of this framework. By this framework, we can understand the value that Location-Based Service (LBS) brings anew to e-business services.

**Keywords:** mobile business, mobility, connectivity, ubiquitous computing, location-based service (LBS)

## **Introduction**

As electronic commerce and the information technology (IT) were recognized as two facets of the “digital economy” in a report of U.S. Department of Commerce (1999), the Web-based systems have been changing the way of business transactions. Recently, the prosperous mobile and wireless technologies also add momentum to this digital evolution of business transactions, and help to set the turf for mobile businesses.

In this study, the concept of mobile business is comprehensively reviewed in terms of ‘connectivity’ and ‘mobility.’ Supposing that ‘time’ and ‘place’ are two major constraints to overcome in realizing the genuine mobile business, the solutions for time and place are related to connectivity and mobility, respectively. Connectivity has steadily attracted substantial attention in electronic commerce, whereas mobility has not in relative terms. As a core technical solution for the sake of mobility, this study investigates the role and value of Location-Based Service (LBS) from this framework. For the sake of developing a comprehensive framework for e-business that includes mobile business (m-business), diverse definitions and conceptualizations of e-business and m-business are introduced and discussed in evolution to our framework. Also, to demonstrate that our framework has practical applicability, we review the relevant cases for each combination of two dimensions in our framework.

This paper consists of five sections after introduction. The first section discusses the generic definition of mobile business. This discussion guides us to a comprehensive framework on e-business and m-business. The second section introduces our framework. For the sake of clear understanding of this framework, the relevant cases are reviewed in the next section. The attractiveness and value of LBS are discussed from this framework in the subsequent section. Lastly, the discussion and conclusion follow.

## **Mobile Business**

Mobile business has been called by numerous names such as mobile commerce, m-commerce, or m-business. It is also considered as pervasive computing (Turban et al., 2002). The pervasive computing, as the next generation of personal computing, is expected to play a major role in e-business especially in the consumer space and in industries like automotive and transportation (Burkhardt et al., 2002). Burkhardt et al. (2002) suggest the key success factors for mobile business as follows:

- Attractive offerings for the mobile user community
- Easily usable and reliably accessible infrastructure by all parties involved in the business processes
- Security through identification, authentication, privacy, and no repudiation
- Trusted environment
- Payment system covering from small changes (a couple of cents) to high-valued transactions
- Business models for e-business operations

Generally, mobile business is understood as any electronic commerce and Internet business done in a wireless environment. However, diverse definitions of mobile business include the electronic commerce conducted on mobile phones (Kehoe, 2000); and any transactions with monetary value that is conducted via mobile telecommunication network (Durlacher, 2000). Kalakota et al. (2002) explain mobile business as the combination of three components: Internet, Wireless, and e-business. From the similar point of view, Evans (2002) contents that business process, e-business,

and wireless communication constitute the mobile business.

The characteristics of mobile business can be divided into the primary and secondary tiers (Kim et al., 2002). The primary characteristics include reachability, ubiquity, convenience, and security. Reachability means that the user can be contacted anywhere, anytime, and he/she can choose to limit his/her reachability to particular persons or times. Ubiquity means the access to an application independent of the location. Convenience does matter as mobile devices are always at hand. The secondary characteristics include localization (using location-based services), instant connectivity, and personalization.

This typology of mobile business characteristics includes both the technical aspect of the generic e-business (convenience and security) and the marketing aspect (personalization). Therefore, by putting these diverse characteristics together, mobile business can be defined as “the e-business reinforced with mobility” and understood as an extended business model embedding the traditional definition of e-business.

## **Mobile Business Framework**

### **Connectivity and Mobility**

In realizing the genuine operations of mobile business, “time” and “place” are two major constraints to overcome. Overcoming the “time” constraint means that various kinds of commercial transactions and business processes performed within the temporal limits in the past can be conducted at any time. Overcoming the “place” constraint means that these activities can be conducted anywhere, regardless of the spatial limitation. The “time” constraint is related to the concept of “connectivity” that allows

continuous activities via connected network through night and day, or weekdays and holidays. The “space” constraint is related to “mobility” that frees the present location of computer users from being stuck to the fixed devices at certain sites. Figure 1 demonstrates the mobile business framework consisted of those two dimensions.

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### **Characteristics by Quadrants**

Quadrant 1 can be understood as the area of the traditional commerce. Quad 2 means the area of current electronic commerce and e-business attaching importance to the connectivity of network. The difference between Quad 3 and Quad 4 is whether connectivity is continuously guaranteed while mobility is guaranteed.

### **Meaning of Connectivity**

There used to be temporal and spatial limitations in the traditional commercial transactions and the operations of business such as the business hours of commercial banks, department stores, and so on. It is connectivity that makes these barriers lifted and allows users to conduct transactions and business at any time (Quad 2).

Connectivity is the major drive that brings in the current electronic commerce and e-business. However, it cannot be said that the spatial limits were completely removed because the location of information devices connected to network is relatively fixed. That is, because users should move in person to the devices already attached to computer network, “mobility” is not yet guaranteed. The business models that improved connectivity (but not necessarily the mobility) are as follows:

- **Telemedicine:** Both medical service providers and recipients can meet online, undergo medical examination, or exchange medical information via network. However, patients should move to the place where network devices and telemedicine equipments are installed so that there is little chance to cope with emergency. If mobility is established to this service, its service quality will be substantially improved.
- **Online shopping:** Users can shop whenever they want due to the secured connectivity in terms of time dimension. Most business models of current e-commerce (especially, B2C) come under this category.

### **Meaning of Mobility**

Mobility helps overcome the spatial limitation that connectivity alone cannot handle. It includes the meaning of “portability.” Unlike Quad 2 (only connectivity is guaranteed) where users should access to the devices, Quadrants 3 and 4 (mobility is secured) allow both the device and users to move around together. The concept of mobility helps understand the change of computing environment from the device-centered to the human-centered. The human-oriented computing environment is well represented by ubiquitous computing that uses all devices in the surrounding circumstances as computing tools. In this section, mobility with limited connectivity and with continuous connectivity is further explained.

### ***Mobility with discontinuous connectivity (Quad 3)***

In this category, users utilize the applications and data already imbedded in mobile devices without being connected to the Internet continuously. For example, the change

of data can be captured on move, but is reflected to the business or information system via sync function. In this system, other users cannot access to the real-time data, not overcoming the “temporal” limitation. The examples of this e-business category are as follows:

- **Transportation information management of logistics companies:** The data made during delivery services is processed at stated intervals (batch-mode) after working hours, rather than in real time.
- **Market survey:** Despite the on-site data collection of surveyors and interviewers with mobile devices, data analysis is conducted afterwards rather than by real-time processing.
- **Mobile office:** Mobile devices without being attached to network are used for reference queries during sales activities. Sales data are stored in the devices on the move, but will be input to the enterprise information system afterwards by sync operation.
- **PIMS (Personal Information Management System):** Most PDAs or electronic organizers are used off-line with the separate data processing and sync functions with servers.

#### ***Mobility with continuous connectivity (Quad 4)***

In this case, the freedom of the data mobility is achieved in addition to the device and service mobility. RF (radio frequency), IR (infrared radiation), and Bluetooth are the possible wireless technologies that help to secure such comprehensive mobility. By such technologies, real-time Internet connection is secured, and users can enjoy various information services like e-mails and Web search continuously with free mobility. The

wireless computing environment gives the users freedom of mobility, and therefore is valued over and above the wired communications (Bergeron, 2001). Therefore, the mobility with continuous connectivity (Quad 4) can be regarded as the genuine mobile business. The e-business cases under this category include the followings:

- **Mobile marketing:** By consolidating location information of customers, marketing personnel can make the best use of the mobility technology.
- **Telematics:** Location-based services including GPS are the main technical elements for helping navigation and drive.
- **Telemetry:** Telemetry is the wireless transmission and reception of data for remote monitoring of environment conditions or equipment parameters. Connectivity by wireless, not wired, is gradually emphasized in every application of monitoring.

### **Cases of Mobile Business by Quadrants**

Figure 2 discusses several real cases of mobile business according to the framework introduced above.

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#### **Quad 1 (low connectivity/low mobility)**

This area denotes the traditional commerce that never recognized the importance of connectivity and mobility in transactions with customers.

#### **Quad 2 (high connectivity/low mobility)**

This area represents well the characteristics of current e-commerce and e-business, so



that various services are available through mobile business these days. However, this is not the perfect mobile business in terms of mobility because users should move to the devices connected to networks.

Though the current mobile ads are based on the secured connectivity to mobile communication network, mobility is not well secured because most of the advertisement contents are not based on the movement or location information of users. By sending advertisements relevant for the current location of users, mobile ad services can evolve to Quad 4, which must be more attractive and valuable to customers.

### *Telemedicine*

This system was introduced by government and civil organizations to provide high-quality medical services to the residents in farming and fishing villages.

Telemedicine systems in Korea mainly connect large-scale general hospitals to small ones in rural areas via remote teleconference, medical video, and image systems to make doctors have a talk with patients and check them over.

Telemedicine system in Korea was originated in 1994 when that Kyungpook National University Hospital and Uljin County Medical Center were connected through PSTN (Public Switched Telephone Network). The medical center transferred X-ray images by a modem-installed computer, and then doctors at the university hospital interpreted them and returned the results.

Mobility may seem to be secured because patients need not go to the hospital and can get medical services at any place they want. However, true mobility is not realized because patients should move to the devices connected to the system. By enhancing mobility of the involved people such as doctors and patients in addition to the

connectivity (already realized as above), this system can be evolved to Quad 4. By such enhancement, the system can support the emergency medical services that need immediate treatment on the spot by the close monitoring of location information.

### ***C-mode (Japan)***

Twenty-one C-mode vending machines were jointly developed by three Japanese companies, NTT Docomo, Coca-Cola Japan, and Itochu, and were installed in Tokyo, Japan at the end of 2001. These Coca-Cola vending machines have a small-sized LCD monitor showing video clips (for movie trailers), keypad, sensor, printer, and speaker as well as coin slot. Consumers press the keypad buttons, apply their own i-mode devices to the sensor, and select a bottle. They don't use real coins during this transaction. They can enjoy a movie preview or print a map of nearby restaurants.

The contents of C-mode vending machines are stored on DVDs, and updated by beverage companies on a daily basis. This is a typical case where the existing electronic commerce has been extended to the mobile environment. However, true mobility is not secured because the location of devices is fixed so that customers should move to the devices in person.

### ***Mobile campus***

Paichai University located in Daejeon, Korea provides the information of university through mobile phones and PDAs connected to the Internet. The university established a mobile system on the campus based on the wireless LAN infrastructure in 2001 under the slogan of "Mobile Paichai." The system provides various information services such as course registration, record inquiry, academic affairs, bulletin boards, issue of

certificates, search of library information, job information, and board and lodging. Universities like Yeungnam, Honam, KAIST, and Sunmoon have introduced and used on-campus wireless phone services affiliated with KTF (the second largest mobile carrier in Korea). In this service, the campuses are connected to each other through both wired and wireless networks. University authorities send SMS messages including academic schedule and notices to faculty and students. This service may seem to be located in Quad 4. However, it can be classified into Quad 2 because mobility is secured in the limited area of campus.

### **Quad 3 (low connectivity/high mobility)**

This area emphasizes mobility with limited connectivity. Connectivity is not secured during user's movement, but is secured afterwards by separate equipments or processes. E-book that users store in mobile devices during particular time and read on the move is a good example.

### ***Mobile games***

Mobile games are categorized into two types: streaming and download. While the streaming type makes users enjoy games online, the downloading games require to download the contents and to play the games afterwards. Therefore, the streaming type is classified into Quad 4; whereas the downloading type is in Quad 3.

In the downloading type, telecommunication operators make revenue according to the elapse of downloading time, whereas the game companies collect regular fees. Users can enjoy games with low phone charges because they pay only for downloading. Game developers and service providers can secure a profit source more reliably due to the

fixed charge system.

The game companies are transforming popular wired games to the mobile due to easy inducement and saving money and time in planning new games. Users can also have some advantages that they play stored games on their mobile devices without connecting to their PCs.

### ***Mobile coupon***

Customers experience some inconvenience in collecting, using, and storing off-line coupons. Manufacturers also have difficulty in measuring costs and benefits, in responding to market situation quickly, and in conducting joint promotions. Distributors and marketers have inconveniences in issuing coupons and collecting customer data. Mobile coupons can help solve these problems. Users can use coupons anytime and anywhere to buy products at a reasonable price after they download the digital coupons into their mobile devices at a certain time. Manufacturers can run the efficient coupon policies, respond quickly to market changes through market analysis, and conduct systematic marketing activities based on the analysis of purchasing patterns. In addition, distributors and marketers can issue their own coupons easily.

A typical example of mobile coupon is Coupak of SK Telecom. The number of Coupak subscribers is about 400,000 as of July 2002. About 1,000 shops including department stores, discount stores, supermarkets, and fast-food restaurants registered to this service network. There are four types of coupons available in this service network: Ad coupons (e.g., movie preview), bookstore coupons, mobile card offered by Chohung Bank, and mileage coupons in which OK Cashbag points are accumulated.

For the better customer satisfaction, however, connectivity regarding mobile coupons

needs to be enhanced because it facilitates easy issue and usage of coupons.

Connectivity can also improve marketing and advertising activities because it enables the instant analysis of transaction data in real time.

### ***Mobile office***

For the sake of agile decision-making, connecting headquarters and fields is necessary.

One of the possible solutions to this business architecture is the organization of mobile office environment that makes field workers access to IT resources in headquarters, share diverse data and information, and perform collaboration online.

Personal portable devices like PDAs, smartphones, and webpads are equipped with various operating systems and functions. These products support both wired and wireless communication by connecting to mobile telephone network and wireless LAN. So, sales reps who keep on moving from one place to another, and field workers whose working office is remote from headquarters can get access to the main computer systems anytime and anywhere.

Such mobile office has been productive especially in home delivery, foods and beverages, meter reading, and after-sales services in Korea. Back-end systems such as groupware, SCM, CRM (SFA), and ERP will be soon integrated into mobile environment for the continuous accessibility to IT resources inside organizations.

Eventually, mobile computing business should be extended and integrated to the whole business activities, and run in real time (Lee, 2002).

Yuyu Industry has introduced the sales field management system using PDAs. The pharmaceutical company has improved the efficiency of sales reps in bill collecting, ordering, inventory management, and retrieving transaction ledgers. Operating a sales

support system with Samsung's Nexio (wireless PDA), Kumho Life Insurance has applied the mobile system to customer management, product design, and on-the-field works of life planners. These cases are classified into Quad 3 because information is processed in batch or sync processing, not in real time.

#### **Quad 4 (high connectivity/high mobility)**

This is securing mobility with continuous connectivity. This area can be also called as "ubiquitous area."

#### ***Telematics***

Telematics provides various personalized mobile services regarding location information, safety, entertainment, productivity, finance, shopping, and so on to drivers by wireless communication and GPS (Global Positioning System) technologies.

Telematics services can be categorized into three types (Kim, 2001): 1) traffic information, navigation, and operations, 2) safety, protection, diagnosis, and fallacy handling, and 3) entertainment, personalized service, and communication service.

The leading groups of telematics in Korean market are telecommunications operators (SKT, KT, and LGT), car manufacturers, and device manufacturers. Telecomm operators run atop because they have the communication network, contents, and related service infrastructure. Daewoo began the first telematics service in Korea named DreamNet service similar to GM's OnStar in December 2001. The device manufacturers such as Nextech, Autonet, Mobis, and MobileCom offer the services of AV (Audio-Video) type, and TeleStar provides the safety type service.

This service is the typical mobile business integrating high connectivity and high

mobility because drivers can access to Internet services in the car during constant move.

### ***Mobile payment***

M-payments are defined as payments carried out via the mobile phone (Krueger, 2001).

From the technological aspect, this new payment system is classified into two categories: card-based system (such as smart cards) and non-card-based system via wireless network (Kim et al., 2002).

Between these two technical alternatives, mobile carriers prefer to adopt the contactless recognition systems or have the IC (integrated circuit) chips inside mobile devices instead of smart card. The new system uses the local wireless communication such as infrared, radio frequency, and Bluetooth in off-line shops. The existing mobile payment systems are also effective in off-line shops, but should go through the wireless Internet even in near distance for every process.

Mobility is secured in mobile payment because users don't need to move to the place where specific readers or PCs connected to network are installed.

### ***Mobile government***

Mobile government is an integrated mobile system that handles transparently, quickly, and efficiently diverse public affairs among administrative organizations, citizens, and businesses. In other words, officers of public institutions perform "digital public administration" so that administrative and civil affairs are processed via wireless network and mobile devices like PDAs, and that citizens and businesses receive the civil affairs service via wireless network while they don't visit government offices.

Mobile solutions have been introduced in many places of U.S. government. California

has a mobile fire defense system that offers building structure charts and ground plans by wireless. The instant response system like this helps minimize the victims and property damages. Kentucky provides wireless messaging service to its government employees. Virginia offers information about the enacting process of bills in the House and allows tracking the outcome of elections. Utah provides the schedules of buses and subways, condition of road surface, and weather information to athletes, staff, and tourists to prevent damages from fickle weather in the 2002 Salt Lake City Winter Olympics.

Applications in the mobile government are similar to those in the private sector, but their objective is on public welfare not on profitability. Its evolution has chased for both connectivity of mobile devices (*anytime*) and mobility of users (*anywhere*).

### ***Mobile securities***

As the competition in online stock market has become intense, diversification and differentiation of on-line services have been necessary. Therefore, the functions of personal devices of PDAs and mobile phones have been modified and upgraded appropriately for stock trading. Mobility should not be a constraint in cyber-trading as risks of stock trading have substantially increased due to day trading and frequent price fluctuations. The connectivity had been already achieved on wireline Internet in such services as cyberstock, online stock, and home trading.

### **Ubiquitous Computing and LBS**

From the mobile business cases introduced above, we could find that mobility and connectivity complemented each other when the other was already secured. For



example, mobile phone SMS advertisement, which is based on connectivity, is being evolved to use the location information of consumers or devices they are carrying.

Adding mobility onto connectivity expands the scope of information availability that users have enjoyed in a restricted area by network devices at the fixed location.

Meanwhile, when connectivity is imported to the mobile devices that are not directly related to information transactions (like automobiles), more information about users becomes available, including clickstream data and location information. Unconsciously, users send such information to systems that can be used for more effective online business.

With the advent of advanced analytic techniques like data mining, clickstream analysis advanced its territory into Web visitor's navigation and visiting behaviors. Location information has been relatively less utilized, while it is very useful for customer relationship. By using the location information, the new opportunities exist for the following business activities (Varshney, 2001):

- **Advertising and marketing:** New marketing and advertisement based on users' location information can be conducted in addition to the current Internet marketing based on information devices connected to network.
- **Telemedicine:** It can be evolved to the level of instant and rapid medical services based on patients' location information. By this upgrade, patients can take medical services online without going to hospitals.
- **Telematics:** The substance of this service is based on the location information of users.

This progressive evolution of business models can be understood from the perspective

of ubiquitous computing. Location-based service (LBS) can help realize ubiquitous business environment for the following reasons (Oh, 2002):

- It enables a new mode of mobile business called L-Commerce (location commerce).
- It is a critical driver for mobile service operators to create and develop new mobile services.
- It is a core technology for the growth of telematics market.

Ubiquitous computing combines both connectivity and mobility in e-business, and LBS is the core technology that helps realize it.

### **Conclusive Remarks**

In this study, a comprehensive framework for m-business is suggested with two dimensions of 'connectivity' and 'mobility.' This framework has four quadrants: traditional commercial transactions and business, connectivity-based current e-commerce and e-business, high mobility with limited connectivity, and ubiquitous area emphasizing mobility with continuous connectivity. Moreover, it helps to understand real mobile business cases relevant for each quadrant. The concept of mobility is related to 'place,' because it frees the present location of computer users so that they do not need to be stuck to the fixed devices. 'Time,' the other major constraint against the genuine operations of mobile business, is related to connectivity that allows continuous activities by real-time connection to the network. LBS is suggested as a major technical driver that can promote the evolution of existing e-commerce and e-business into ubiquitous computing environment. Ubiquitous business can be implanted into various business models by utilizing users' location information. Though

pervasive computing is often used interchangeably with ubiquitous computing, the level of mobility is higher in the latter than in the former in a strict sense. That is, as pervasive computing can be defined as the state in which users do not need to recognize the existence of computers by seamless embedment into their environment, ubiquitous computing is a new dimension with higher mobility added onto it (Lyytinen and You, 2002). However, 'pervasive' can be considered as a process (spreading everywhere) and 'ubiquitous' as a result (existing everywhere), so that they are not necessarily separate ones.

Our framework suggested in this study can be improved in regards to the following issues. First, this model can be expanded to three dimensions including the characteristics of business partners. For example, the distinction of individual customers and internal business processes (e.g., B2B vs. B2C) can be considered in improving our framework.

Also, more careful attention should be paid to the technical characteristics of mobile devices and wireless network. The technical features of devices and network have a power to forge and renovate new types of mobile business. Especially, additional research should be conducted to the influential factors for mobile technology acceptance and diffusion.

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Figure 1. Mobile Business Framework

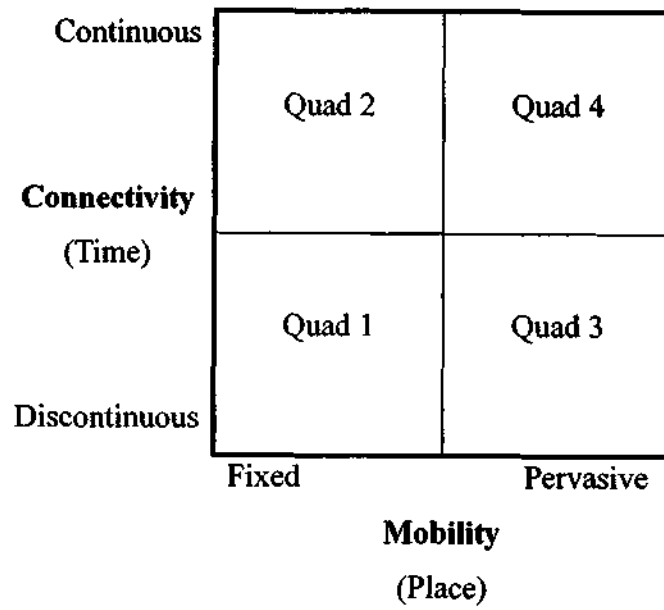


Figure 2. Cases of Mobile Business by Quadrants

Continuous	<p style="text-align: center;"><b>Quad 2</b></p> <ul style="list-style-type: none"> <li>• Mobile ad: 12 Snap (Britain), Flytxt (Britain), SK Telecom, LG Telecom, KTF, mediatude (Britain and Sweden), SkyGo (USA)</li> <li>• Telemedicine: Seoul National University Hospital, Incheon Jungang Gil Hospital, Yonsei University Severance Hospital, Aju University Hospital</li> <li>• C-mode: Joint development by NTT Docomo, Coca-Cola Japan, and Itochu</li> <li>• Mobile campus: Paichai University, Yeungnam University, Honam University</li> </ul>	<p style="text-align: center;"><b>Quad 4</b></p> <ul style="list-style-type: none"> <li>• Mobile payment: Moneta of SK Telecom, Infrared Mobile Payment System of LG Telecom</li> <li>• Telematics: OnStar of GM, TeleStar Co., Carmani of Nestech</li> <li>• Mobile securities: MTS of Sejong Securities, Kyobo, Dongyang, Shinhan, Hanhwa Securities</li> <li>• Mobile government: USA Federal and State Governments</li> <li>• Mobile office: Nate SFA of SK Telecom, Mobile Works of LG Telecom</li> </ul>
Connectivity (Time)	<p><b>Quad 1</b></p>	<p style="text-align: center;"><b>Quad 3</b></p> <ul style="list-style-type: none"> <li>• Mobile games: PocketSpace, Toysoft, NCSOFT, Com2us</li> <li>• Mobile coupon: SK Telecom</li> <li>• Mobile office: Yuyu Industry (medicine), Delivery/Logistics companies, Kumho Life, LG Electronics, Sempio Foods</li> </ul>
Discontinuous		Fixed
<p><b>Mobility (Place)</b></p>		