Overcoming the Digital Divide in Rural Areas: Focusing on the Mobile Divide

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Abstract Although the diffusion of mobile services appears to be occurring much more rapidly than the spread of wired services, there are risks of a new type of digital divide: the mobile divide. The mobile divide, which refers to a specific digital divide that involves the unbalanced diffusion of mobile technologies, must be concretely studied. Thus, this study focuses on the mobile divide with respect to disadvantaged populations. Although various studies suggest that the diffusion of mobile devices may reduce the digital divide, somestudies argue against the positive effect of mobile devices in addressing traditional digital devices. Low and O'Connell (2006) insisted that equity of access to mobile technologies should be considered in the contextof the traditional digital divide; they argued that there may be socio-economic barriers to accessing mobile devices and the mobile Internet that are similar to the socio-economic barriers to accessing stationary computers and the stationary use of the Internet. Focusing on the smartphone divide, this study suggests that emphasizing utilization is an appropriate manner in which to bridge the mobile divide rather than focusing on other factors, such as accessibility and capability, thatprevious studies have used to measure the traditional digital divide.

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1 Introduction

In diverse countries,such as Korea, the digital divide between rural areas and urban areas is an important issue that should be addressed by public and social policies. Wareham et al. (2002) suggested that the digital divide requires the consistent attention of governments and policymakers to address further polarization. Consistent withthese suggestions, the U.S. government has focused on making Internet access as widespread as traditional telephone connections (Wareham et al., 2003). According to previous studies, the digital divide may be related to various social differences,such as race, gender, education, age, work, and economic conditions, and may be reduced by the diffusion of diverse digital devices (Hoffman & Novak, 1998; Gollakota & Doshi, 2011). In this regard, Wareham et al. (2003) demonstrated a substantial increase in Internet access throughout the U.S.; however, policy questions regarding the American digital divide remain, especially thoseregarding socio-economic gaps.

In addition toissues related to the growth of the digital divide, fixed mobile convergence (FMC) and fixed mobile substitution (FMS) services have been rapidlygrowing in the global market. For instance, the number of Korean smartphone users is currently more than 20 million, which is more than 40% of all Korean mobile users and more than 80% of the entire economically active population in Korea. Because the diffusion of mobile services should be

much faster than that of wired services, debates regarding the significance of mobile devices have emerged some scholars warn of a new type of digital divide known as the mobile divide, and other researchers expect the digital divide to decrease as a result of the diffusion of mobile services. Adopting the latter argument, Horrigan (2009) argued that African Americans constitute the most active and fastest-growing segment of mobile Internet users in the U.S., and this shift should be followed by a considerably reduced digital divide between African Americans and white Americans.

This study focuses on the mobile divide with respect to socially disadvantaged populations. Specifically, this study compares rural populations and other socially disadvantaged populations in Korea using the findings of previous studies. Korea is the global leader in broadband network diffusion, and smartphone users have recently exceeded 20 million people (more than 40% of all mobile users in Korea).Thus, Korea provides a useful context for understanding whether the diffusion of mobile phones is effective in reducing the digital divide or whetherthis diffusion signifies a new digital divide, namely, the mobile divide. Section 2 defines the digital divide and explains why the mobile divide should be treated as an important phenomenon within the broader digital divide. Section 3 examines recent studies pertaining to the mobile divide. Section 4 briefly reviewsannual statistics on the digital divide from the National Information Society Agency (NIA) in Korea. The annual report discusses the traditional digitaldivide with respect to the three indices of accessibility, capability, and utilization; this reportalso includes a simple digital divide index for the mobile divide that focuses on the diffusion of smartphones. Section 5 provides a discussion.

2 Literature Review

2.1 The Digital Divide and the Adoption of Mobile Technology

Kang (2009) explained that the government and public organizations as well asthe private sector and/or civil society can work to achieve an inclusive and people-oriented information society to reducethe digital divide among diverse social sectors. Kang cited a report from the World Summit on Information Society (WSIS) to identifyseveral digital divides. According to the report, the external digital divide describes divisions across different countries and regions, including differences between developed and developing countries in contrast, the internal digital divide refers to divisions between low - and high-income populations, rural and urban areas, males and females, younger and elderly groups, literate and illiterate people, able and not-able people, and those affected by particular events in the most developed regions/countries. Indeed, this list doesnot includeall of the internal digital divides among different social groups. Moreover, the internal digital divide may be related to the current global economic crisis, as this crisis could prevent socially disadvantaged groups from overcoming any pre-existing internal digital divides. This study concentrates on the internal digital divide rather than the external digital divide.

Several studies have shown that information technologies, such as mobile technologies, have been diffused more rapidly than other types of information technologies and that the digital divide (or digital gap) has been reduced over the past decade. For example, DoshiandGollakota (2009) explained that mobile phone technology has diffused rapidly according to the number of subscribers and penetration rates in rural areas. Interestingly, these authors suggested that Internet usage increased more in urban areas and in the developed world than in rural areas and that the diffusion rates of each information technology may differ. The authors also suggested that the diffusion of an innovation should be discussed in terms of both the supplyand demandsides, although most prior studies have focused on supply-side factors. For instance, these authorsexaminedhow users perceive innovation and the ease of use for new technologies. Martin andAbbot (2010) analyzed the diffusion of mobile phones in Uganda and argued that the diffusion of mobile phones into rural areas represents impressive changes in the past decade. Although digitally disadvantaged populations, such as farmers, agricultural processors, marketers, and other people in rural areas,are located at a significant distancefrom any telephone service, these populations have recently become familiar with mobile services (Martin & Abbot, 2010).

Horrigan (2009) reported that the high level of mobile device activity helps to offset lower levels of access to more traditional digital tools, including desktop computers, laptops, and home broadband connections. This finding suggests that mobile services and technologies can effectively assist in bridgingthe digital divide. Horrigan also reported that the digital divide is reduced by half when mobile devices are included, although white Americans are approximately 50% more likely than African Americans to use computers. In this regard, mobile services and technologies can reduce the digital divide for disadvantaged or vulnerable groups, including people in rural areas. Horrigan also explained that a majority of Americans have

used at least one mobile device. This finding suggests that digitally disadvantaged groups can access the Internet using mobile devices to the same degree as non-disadvantaged groups, even if the former groups cannot use traditional, stationary network devices.

The individual adoption of innovative technology may be related to the characteristics of anindividual, his/her organizational and social relationships, communication methods and technology characteristics, such as a device's key features, level of complexity, and other factors (Rogers, 2003; Nam and Barnett, 2010). In addition, a variety of academic studies have shown that the adoption of innovative devices does not immediately result in the replacement of older devices; rather, replacement occurs over the long term (Bass, 1969; Wang &Lan, 2007).

The Bass model is one of the most well-known research models that are used to explain how innovative technology is diffused (Bass, 1969; Bass et al., 1994; Nam & Barnett, 2010). This model suggests that the adoption of a new technology is related to two factors; first, diffusion depends on the number of previous adopters second, the existence of previous adopters, such as early adopters, positively affects diffusion. The Bass model explains that the adoption of innovation is affected by social and individual relationships. Rhee and Kim (2004) also suggested that the compatibility of a new service medium with current services or media may affect adoption. This suggestion implies thatinnovative services should replace or support current technologies to draw additional adopters into an innovative service or medium. The diffusion of mobile devices, including smartphones, would substitute for traditional devices in a stationary Internet environment. Moreover, previous studies have suggested that the digital divide can be reduced as the diffusion of mobile devices increases. According to Kang (2009), the trends in Internet use and mobile phone use are similar and may be adequately described by an exponential or logistic curve (Fig.1). In this regard, the adoption of a mobile device can be understood in conjunction with the adoption of other devices, especially devices in traditional, stationary network environments, as a bridge that reduces the current digital divide.

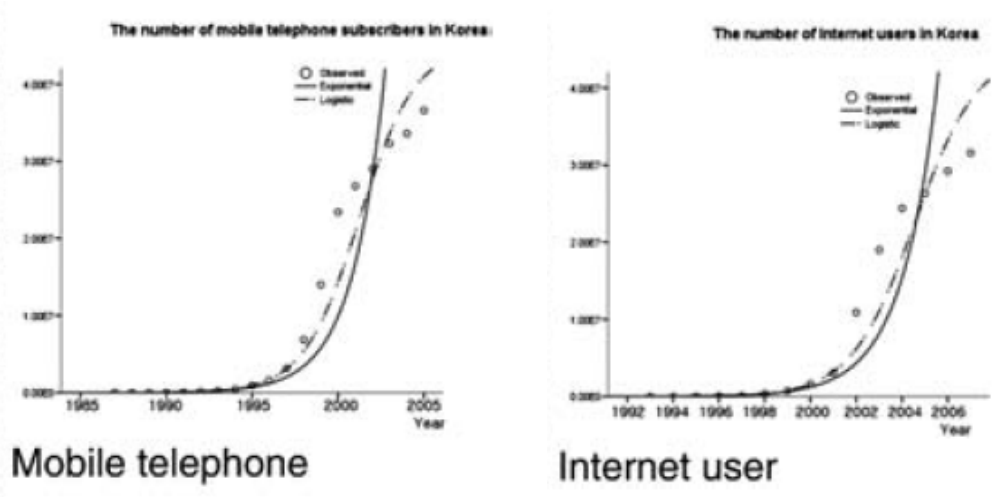

Fig. 1 Comparing Trends in Mobile Telephone Subscribers and Internet Users (Kang, 2009)

2.2 Bridging the Digital Divide

According to previous studies, the diffusion of mobile devices may serve to reduce the digital divide. In this section, we review the method with whichthe traditional digital divide has been measured to understand how to measure the mobile digital divide.

An implementation index for the digital divide (IDD) is used to account for an individual's accessibility to the Internet, the capacity to use computers and the Internet, and actual utilization. Among these three indices, the accessibility and capacity indices are not considered to represent the main indicators of the digital divide in Korea because of the country's well-distributed broadband network and well-educated population (Kang, 2009). The most important factor for obtaining meaningful results among those three indices isthe usage of computers, as Korean governmental organizations commonly weigh utilization (i.e., computer use) prior to the other two factors to determine IDD, with accessibility weighted by 0.3, capacity weighted

by 0.2, and utilization weighted by 0.5. Table 1 shows stationary Internet usage and population statistics. Current Internet usage may be at a mature stage and thus may imply that the digital divide is consistently decreasing over time. The gap index and the level index are calculated using the following equations (Kang, 2009).

$$\begin{aligned}\text{IDD(Index for Digital Divide)} &= 0.3 \times Accessibility + 0.2 \times Capacity \\ &+ 0.6 \times (0.6 \times Frequency\ of\ Use + 0.4 \times Usefulness) \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (1)\end{aligned}$$

$$\text{Level Index} = \left(\frac{\text{IDD for the Disadvantaged Group Concerned}}{\text{IDD for the General Population}}\right) \times 100 \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (2)$$

$$\text{Gap Index} = \left(1 - \frac{\text{IDD for the Disadvantaged Group Concerned}}{\text{IDD for the General Population}}\right) \times 100 \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (3)$$

Table 1 Internet Usage and Population Statistics (www.internetworldstats.com/asia/kr.htm)

AR	Users	Population	% Pop.	Usage Source
2000	19,040,000	48,066,900	39.6 %	ITU
2005	31,600,000	49,929,293	63.3 %	KRNIC
2006	34,120,000	51,300,989	66.5 %	MIC
2008	34,820,000	49,232,844	70.7 %	NIDA
2009	37,475,800	48,508,972	70.7 %	NIDA
2010	39,440,000	48,636,068	81.1 %	ITU

2.3 Debates regarding the Mobile Divide

Although the studies that were reviewed above suggest that mobile devices may reduce the digital divide, some studies question this positive effect onthe traditional digital device. Low and O'Connell (2006) argued that equal access to mobile technologies should be considered in the same manner as the traditional digital divide; this argument implies that there may be socio-economic barriers to accessing mobile devices and mobile Internet similar to the barriers to stationary computers and stationary Internet access. This suggestion appears to conflict with the studies that were described in the previous sections, which argue that mobile diffusion may effectively diminish the traditional digital divide. For instance, elderly people who were not raised using mobile devices might refuse to adopt mobile devices, whereasyounger people may be comfortable with mobile technologies. In Korea, 39.3% of the entire rural population was elderly in 2005, and this percentage is expected to increase to approximately 63% in 2020 (Hankyoreh, 2005). This expectation indirectly suggests that the mobile divide between urban areas and rural areas will increasein the absence of new initiatives and innovations that aim to increase the affordability of mobile phones and provide aid for disadvantaged social segments. Hence, the mobile divide will increase social disparities. Indeed, mobile technologies are increasing the divisions between those who can afford access to mobile devices and those who cannot afford such access.For instance, those who can afford access to mobile devices will find more business opportunities to trade, whereas those who cannot afford access will have fewer opportunities (ID21 insights, 2007). In the current and future markets, those with mobile and convergence technologies will be able to access more diverse opportunities in new markets thus, rural areas will require policies and initiatives to diminish the mobile divide. BotzerandYerushalmy (2007) cited Low and O'Connell (2006) and Naismith et al. (2004) and argued that mobile devices also offer opportunities for users to gain access to learning experiences that placethem in a realistic learn-

ing context; as such, these devices provide opportunities for users to enhance their knowledge.

In recent years, there have been diverse debates regarding smart devices, such as smartphones and tablet PCs; in contrast with traditional mobile devices, these smart devices provide both traditional voice calling and additional functions, such as mobile Internet, financial services, and word processing. Thus, the mobile divide is more complex now than ever before. That is, evenif the mobile divide can be reduced in terms of mobile service subscribers, a mobile divide may emerge in terms of the efficient usage of mobile services. For instance, people in rural areas may have disadvantages in learning how to use smart devices for their business transactions. Karlson et al. (2010) demonstrated that usinga PC (computer) was significantly less frustrating than usinga smartphone. Their study shows that the adoption ofsmartphones in rural areas to increase work efficiency may be more difficult than in urban areas thus, smartphones may create another typeof mobile divide.

3 Reviewing the Mobile Divide in Korea

As suggested above, the diffusion of mobile devices may reduce the traditional digital divide, but a mobile divide may emerge as a result of the uneven diffusion of mobile devices.

The mobile divide can be measured simply by counting the number of mobile subscribers or by calculating the sales of mobile devices; this divide can also be evaluated with the sophisticated and complex indices that have been used to analyze the traditional digital divide, including accessibility, capacity, and utilization indices. To determine which approach is appropriate for measuring the mobile divide, this section reviews the annual report that was published in March 2011 by the National Information Society Agency (NIA), which analyzed the digital divide.

3.1 The Traditional Digital Divide

The traditional digital divide in Korea was measured based on accessibility, capability, and utilization (i.e., computer use); according to these measurements, there have been remarkable improvements in the digital divide (NIA, 2011). However, when these indices are considered individually, rural areas clearly show the least improvements as compared with all other disadvantaged groups. These statistical results suggest that existing public and private policies and initiatives that target rural people in an endeavor to bridge the digital divide should be re-considered. These statistical results also show that the most important factor in reducing the digital divide in rural areas is utilization, which includes frequency of use and usefulness and is absolutely lower than for the other groups. For instance, the accessibility index for rural areas is relatively high at approximately 90%, but the index for frequency of use is only approximately 40%. In this regard, public and private initiatives and policies should focus on enhancing user experiences with PC and Internet technologies. Such initiatives should consider adopting information technologies to help production and sales activitiesin rural areas rather simply focusing on infrastructure or basic education.

Table 2 Changes in the Digital Divide in Korea (Data Source : NIA, 2011; ITSTAT, 2011)

Category	2005		2006		2007		2008		2009		2010	
	Gap Index	Level Index	Gap Index	Level Index	Gap Index	Level Index	Gap Index	Level Index	Gap Index	Level Index	Gap Index	Level Index
People with Disabilities	34.8	65.2	26.1	73.9	24	76	21.2	78.8	19.7	80.3	18.7	81.3
Low-Income People	35.8	64.2	27	73	24.5	75.5	21.9	78.1	20.5	79.5	19.5	80.5
Rural People	58.3	41.7	50.2	49.8	45.4	54.6	42.1	57.9	39.7	60.3	38.2	61.8
Elderly People	50.7	49.3	41.6	58.4	37.4	62.6	35.8	64.2	34.1	65.9	32.5	67.5

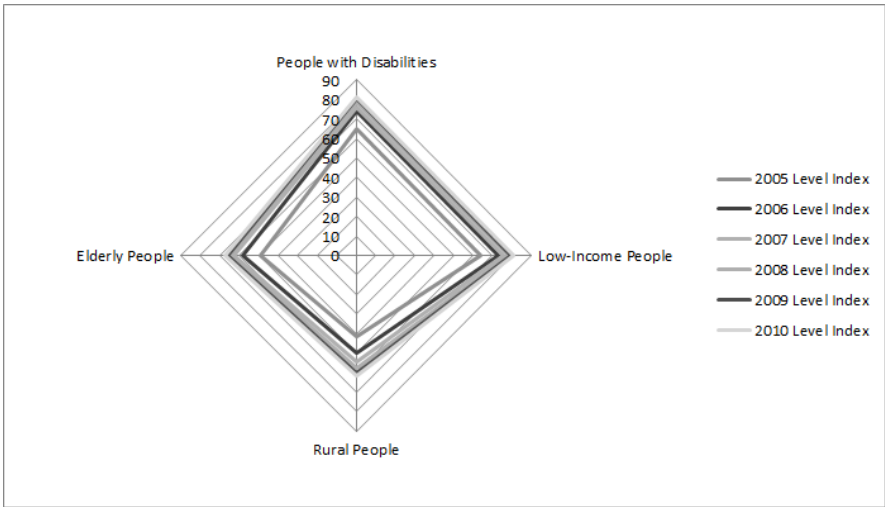

Fig. 2 Changes in the Digital Divide in Korea (Data Source : NIA, 2011; ITSTAT, 2011)

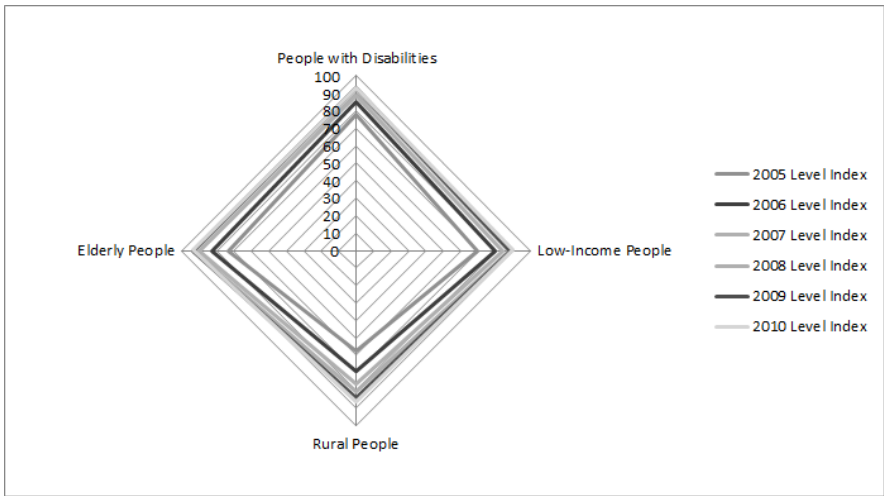

Fig. 3 Changes in the Digital Divide in Korea regarding Accessibility (Data Source : NIA, 2011; ITSTAT, 2011)

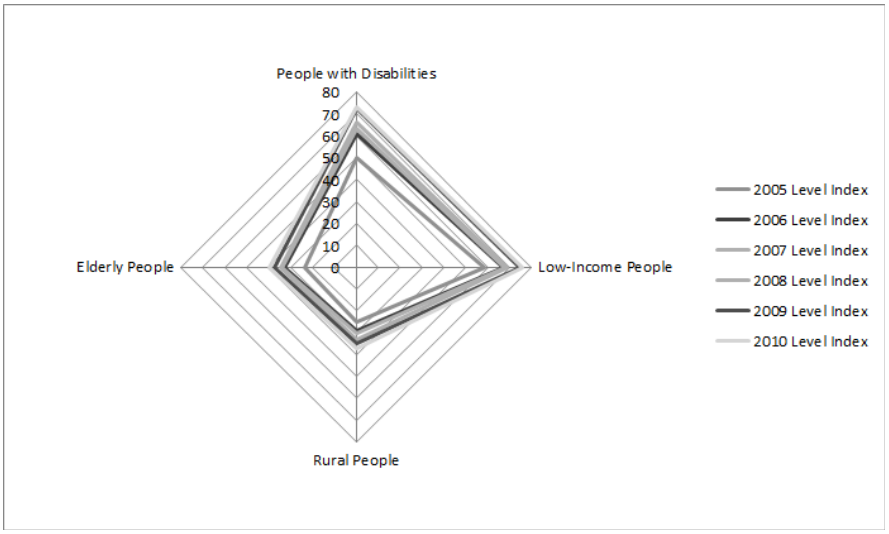

Fig. 4 Changes in the Digital Divide in Korea regarding Capability (Data Source : NIA, 2011; ITSTAT, 2011)

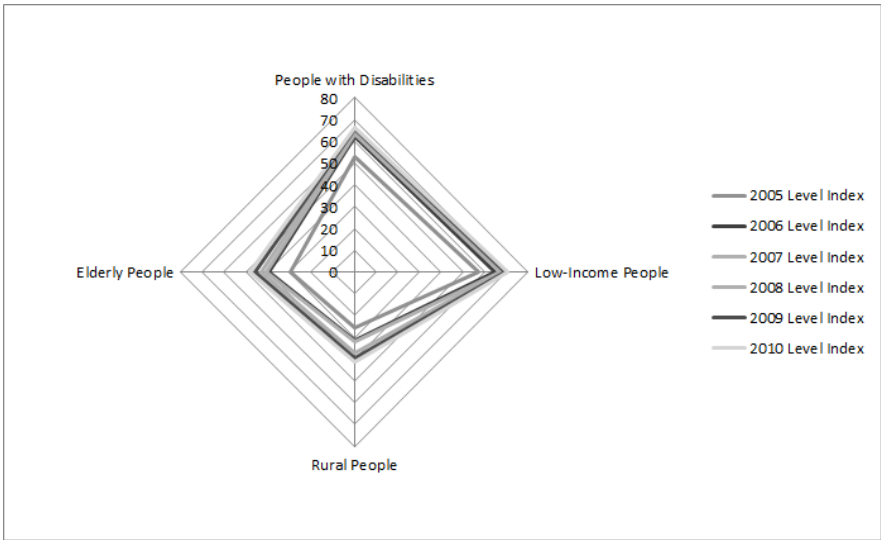

Fig. 5 Changes in the Digital Divide in Korea regarding Frequency of Use (Data Source : NIA, 2011; ITSTAT, 2011)

Table 6 Changes in the Digital Divide in Korea regarding Usefulness (Data Source : NIA, 2011; ITSTAT, 2011)

Category	2005		2006		2007		2008		2009		2010	
	Gap Index	Level Index	Gap Index	Level Index	Gap Index	Level Index	Gap Index	Level Index	Gap Index	Level Index	Gap Index	Level Index
People with Disabilities	41.4	58.6	32.2	67.8	31.9	68.1	29.5	70.5	27.6	72.4	26	74
Low-Income People	38.6	61.4	30.7	69.3	30	70	27.4	72.6	27.1	72.9	25.9	74.1
Rural People	68	32	61.9	38.1	57.6	42.4	55.6	44.4	54.2	45.8	53.4	46.6
Elderly People	66.4	33.6	58.3	41.7	55.6	44.4	54.3	45.7	52.3	47.7	50	50

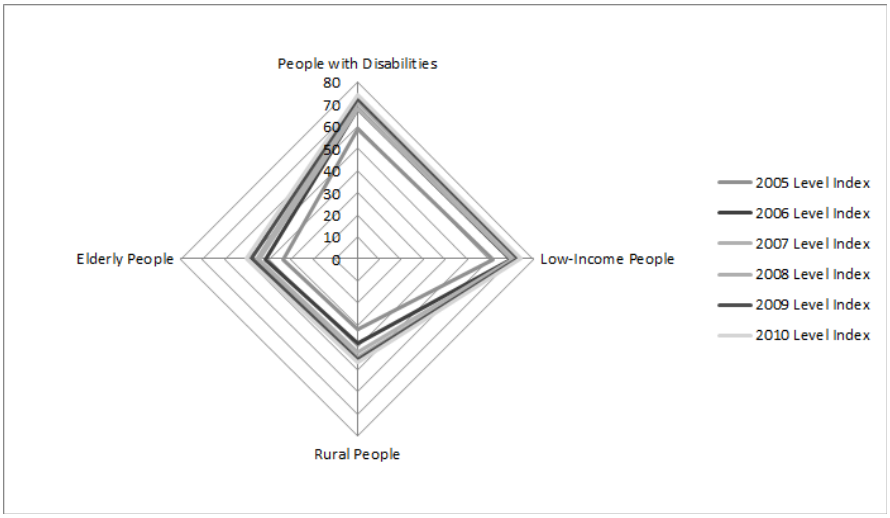

Fig. 6 Changes in the Digital Divide in Korea regarding Usefulness (Data Source : NIA, 2011; ITSTAT, 2011)

3.2 The Mobile Divide in Rural Areas

Because the number of mobile subscribers in Korea exceeds the entire population of Korea, a simple comparison of the number of subscribers in each socially disadvantaged group may not be sufficient to obtain an index of the mobile divide. In addition, technologically simpler mobile phones with restricted functions) provide restricted mobile Internet thus, some subscribers may be unable to effectively use the mobile Internet. In this regard, the mobile divide should be analyzed by examining the diffusion of smartphones as reported by the NIA. Fig. 7 illustrates the use of smartphones by different demographic groups in Korea. The smartphone divide in rural areas is the greatestamong all socially disadvantaged groups; for example, "the percentage of smartphone users in rural areas is approximately one-half of the percentage of low-income smartphone users. Fig. 7 shows that the smartphone divide follows the traditional digital divide most closely with respect to utilization.

Table 7 The Smartphone Divide in Korea (Data Source : NIA, 2011; ITSTAT, 2011)

Category	2010	
	Percentage of Smartphone Users	Level Index
People with Disabilities	1.6%	10.3%
Low-Income People	1.9%	12.2%
Rural People	1.0%	6.4%
Elderly People	1.0%	6.4%
Entire Korean Population	15.6%	-

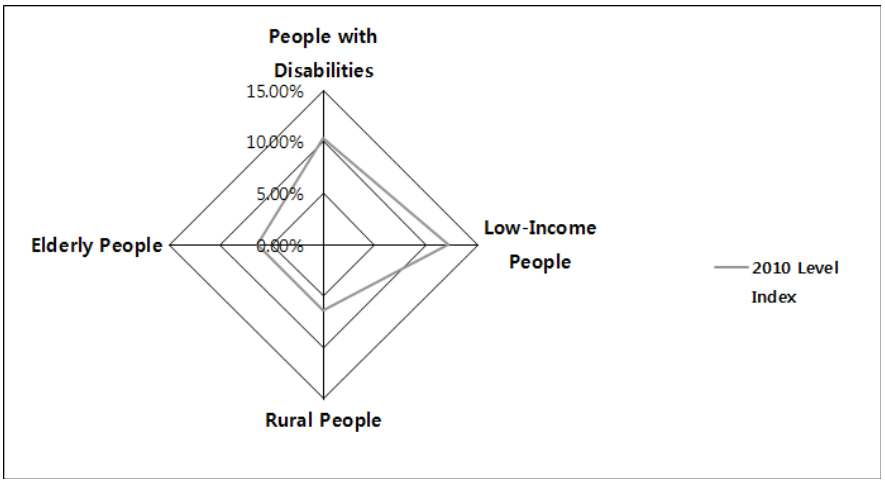

Fig. 7 The Smartphone Divide in Korea (Source : NIA, 2011)

4 Discussion

4.1 Conclusions& Implications

Numerous academic studies have suggested that the diffusion of mobile devices and services, including the smartphones,can assist in bridgingthe digital divide. However, otherscholars have arguedthat the uneven diffusion of mobile devices across diverse social groups may result in another digital divide: the mobile divide. To address this divergence, this study reviews statistical data from the NIA's annual research report.

This study argues that the smartphone divide should be measured differently from the traditional digital divide. Indeed, the NIA's annual report shows a smartphone divide only with respect to the diffusion rate which is close to the accessibility index. However, this divide may need to be measured in terms of additional factors. Accessibility,

which is used to measure the traditional digital divide, may be a relatively meaningless factor for measuring the smartphone divide. The total number of mobile subscribers in Korea exceeds 50 million people (KCC, 2011), and smartphone users exceed 20 million people (KCC, 2011). Korean telecommunication companies have already built 3G service infrastructure to ensure fullnational coverage, and 4G services are being launched in 2011.

TheKorea Communication Commission (KCC) reports that more than half of all Internet users are currently using smart devices, such as smartphones, to access the mobile Internet (KCC, 2011). This reportsuggests that socially disadvantaged groups, especially people in rural areas, require policies aimed at ensuring that they can efficiently use smartphones at reasonable device prices and tariffs.As shows in Fig. 7, the diffusion rate of smartphones in rural areas is under 5% - absolutely low amount − comparing to the entire diffusion of smartphones. And the shape of Fig. 7 is close to that of the digital divide in utilization. This result may explain that the diffusion of smartphone should be considered in terms of utilization. When rural people gain opportunities to use smartphones, accessibility issues might be already solvedand utilization issues should be concerned.So improvements in utilization (including frequency of use and usefulness) should be focused. When one develops an index to measure the mobile divide index, utilization should be considered the most appropriate and meaningful factor with which to measure − and bridge − the smartphone divide; other indices for the traditional digital divide (i.e., accessibility and capability) are less useful.

To identify appropriate public policies for rural people who wishto use smartphones and to reduce the smartphone divide, this study proposes that the public sectors should implement special tariff policies. Without a sufficient number of smartphone users, educating rural people on the use of smartphones may not bridge the mobile divide. We suggest that MVNO (Mobile Virtual Network Operator) services should be considered to encourage rural people to use smartphones. MVNO can provide relatively cheaper monthly tariffsalthoughMVNO services are less popular than would be expected in Korea until now. A special MVNO strategy to support rural areas may be a worthwhile alternative because a significant portion ofthe rural population consists of elderly and low-income people.

Additionally, the smartphone divide should be addressed in terms of both mobile voice calling and mobile Internet use. As discussed in this study, the traditional digital divide and the smartphone divide in Korea appearto be similar, although the divide scales differ. In this regard, we expect that the smartphone divide can be addressed with alternative devices, such as WiBro- or WiFi-compatible tablet PCs and multimedia players which can be used with cheaper tariffs.

4.2 Limitation and Suggestions

This study aimed to review and compare previous studies pertaining to the mobile divide and found that few studies have examined the use of smartphones. In addition, the emergence of a smartphone divide (as a special type of mobile divide) is in an early stage thus, we were unable to review methods for measuring and reducing the smartphone divide. As such, this study compares the smartphone divide to the traditional digital divide to evaluate whether the smartphone divide can be measured and whether it can be decreased using the methods that are used for the traditional digital divide.

Future research should examine how to develop special tariffs for smartphones and how to supply the smartphone devices that are needed by rural people.

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