

Park, Jieun; Kim, Seongcheol; Nam, Changi

## Conference Paper

# Why has a homegrown technology failed: A case study on WiBro in the Korean telecommunication market

25th European Regional Conference of the International Telecommunications Society (ITS):  
"Disruptive Innovation in the ICT Industries: Challenges for European Policy and Business",  
Brussels, Belgium, 22nd-25th June, 2014

### Provided in Cooperation with:

International Telecommunications Society (ITS)

*Suggested Citation:* Park, Jieun; Kim, Seongcheol; Nam, Changi (2014) : Why has a homegrown technology failed: A case study on WiBro in the Korean telecommunication market, 25th European Regional Conference of the International Telecommunications Society (ITS): "Disruptive Innovation in the ICT Industries: Challenges for European Policy and Business", Brussels, Belgium, 22nd-25th June, 2014, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/101407>

### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

### Terms of use:

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Why Has a Homegrown Technology Failed: A Case Study on WiBro in the Korean Telecommunication Market<sup>1</sup>

Jieun Park<sup>2</sup>, Seongcheol Kim<sup>3</sup>, Changi Nam<sup>4</sup>

## Abstract

This study identifies and analyzes the causes for WiBro's failure in the Korean telecommunications market within the context of the technological systems framework and the actor-network theory. The reverse salients of WiBro were identified according to the activities of the actors from three different domains: technology, government, and business. The findings and implication of this study were obtained through a review of the literature and in-depth interviews with eight key experts. The reverse salients found can be categorized into two types: 'apparent' and 'underlying.' The apparent reverse salients are the lack of investment and inadequate business model of the business actors. The underlying reverse salients are the policies enacted by government actors and are less obvious but heavily influence the creation of the apparent reverse salients and ultimately contribute to the failure of WiBro.

**Keyword:** WiBro (Wireless Broadband), Actor network theory, Reverse salient, Technological systems, Case study

---

<sup>1</sup> This work was supported by the National Research Foundation(NRF) of Korea grant funded by the Korean government(NRF-2013S1A3A2043357). This research was also funded by the MSIP(Ministry of Science, ICT & Future Planning), Korea in the ICT R&D Program 2014.

<sup>2</sup> School of Media and Communication, Korea University, Media Hall, 307, Anam-ro, Seongbuk-gu, Seoul 136-701, Republic of Korea

<sup>3</sup> School of Media and Communication, Korea University, Media Hall, 145, Anam-ro, Seongbuk-gu, Seoul 136-701, Republic of Korea

<sup>4</sup> Department of Business and Technology Management , Korea Advanced Institute of Science And Technology(KAIST), N22, 291 Daehak-ro, Yuseong-gu, Daejeon 305-701, Republic of Korea

## 1. Introduction

Wibro, short for ‘Wireless Broadband,’ is the South Korean version of the mobile WiMAX standard. WiBro was first commercially launched in 2006 with high expectations for success, and the Korean government and major business actors, like Samsung Electronics and Korea Telecom (KT), actively supported and promoted the technology. However, WiBro had disappointing adoption both in the domestic and the international telecommunications market. Even though there was ample evidence indicating WiBro’s failure, the Korean government continued promoting WiBro by restricting the use of the 2.3 GHz and 2.5 GHz bands to WiBro only. However, on October 3<sup>rd</sup>, 2013 the Ministry of Science, ICT, and Future Planning (MSIP) officially announced that mobile carriers were now allowed to select between WiBro and LTE-TDD (*Yonhap News*, 2013). Such a policy decision can indicate that the Korean government admitted the failure of WiBro.

The WiBro case in Korea is worthy of note, as it started with great promise, but turned out to underperform in the market. Thus, it is meaningful to look into the causes for WiBro’s failure. This study aims to identify the factors that have driven WiBro into failure in the Korean telecommunications market and examines them within the context of the actor–network theory and the technological systems framework.

In this paper, Section 2 provides an overview of Wibro, including the development, background, and state of the current WiBro market. In Sections 3 and 4, the theoretical framework and case study methodology of this study are explained. Section 5 presents the results of the in-depth interviews with the key experts and discusses them within the context of the other materials used in this case study. In Section 6, this study will briefly summarize the results and will explain the implications of the findings. Finally, suggestions for future research and the limitations of this study will be discussed at the end.

## 2. WiBro Overview

### 2.1. WiBro Development Background

WiBro, short for ‘Wireless Broadband,’ is Korea’s homegrown portable Internet services technology for the IEEE 802.16e standard (Nam, Kim, & Lee, 2008). It was designed to enable mobile broadband access in Korea, and the Korean government had three motivations to develop such a technology (Kim, 2009; Lim, 2005).

First, Korean telecommunications companies had been paying substantial amounts of money in royalties to licensors, like Qualcomm, for using source technologies for mobile communications (Lim, 2005). For example, Qualcomm held the patent for the core technology used in Code Division Multiple Access (CDMA) devices. It was only natural for Korean companies and the government to feel the necessity of developing and owning a source technology.

Second, 3G International Mobile Telecommunication 2000 (IMT-2000) systems seemed

inadequate in accommodating data traffic, which kept increasing every year, and thus, the market was in need of additional capacity.

Third, Korean actors were seeking another opportunity to be leaders in the wireless communication market after the success in being the first to implement the commercial launch of CDMA in 1998. Developing a homegrown wireless broadband Internet technology seemed a plausible idea (Kim, 2009).

In 2004, the Ministry of Information and Communication (which was dissolved in 2008) announced the ‘IT839’ growth strategy, and WiBro was one of the core services to be nurtured under this project (TTA, 2007; Lim, 2005). Major telecommunications business actors, including Samsung Electronics, KT, SKT, and Hanaro Telecom, and the Korean government granted KRW 38.5 billion (USD 34.6 million) to the Electronics and Telecommunications Research Institute (ETRI) to develop a wireless broadband Internet technology, which was later named as WiBro. The research project commenced in January of 2003 and ended in December of 2005, and then launched commercially the following year.

## 2.2. WiBro Market

The outlook for WiBro in the Korean telecommunications market was positive when it first launched in Korea. In 2007, the Ministry of Information and Communication estimated that the number of WiBro subscriber would be 790 thousand by 2006, 4.9 million by 2009, and 9.2 million by 2011 (Yoon, Kim, & Choi, 2007). However, the adoption of WiBro in the market was quite disappointing.

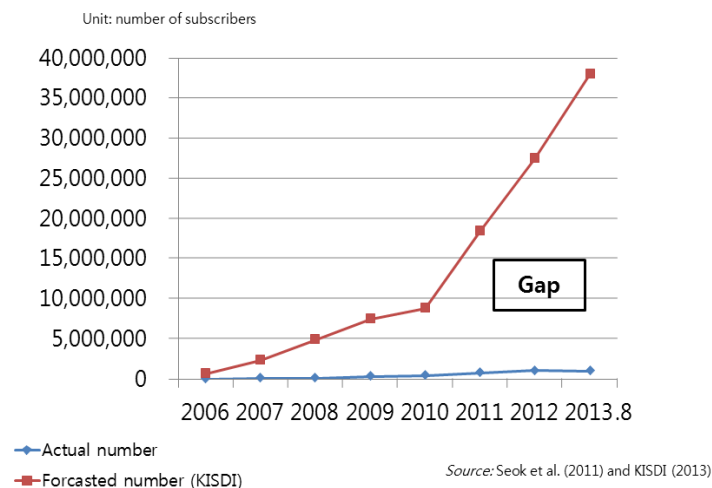


Figure 1. The gap between the WiBro subscriber estimation and actual subscribers in Korea.

Unlike the tardy expansion in the domestic market, WiBro adoption in other countries was quite outstanding for the first couple years. Samsung Electronics was noticeably vigorous in carrying out global business with this technology (Han, 2008). For instance, Sprint Nextel of the US announced its cooperation with Samsung in 2005, which indicates that Samsung

constructed WiBro network facilities for Sprint (*Hankyoreh*, 2005; JoongAng Daily, 2008). As of 2009, companies in about 27 countries had adopted WiBro, and availability would continue to expand to other countries like Italy, Brazil, or Australia (Lim, 2007).

Unfortunately, many of those partners started to drop WiBro business from 2012, replacing it with LTE-TDD. For instance, Sprint announced that it would stop its WiBro service and introduced new LTE-TDD service using the WiBro band (ExTreme Tech, 2013). In a similar manner, Yota, Russia's leading telecommunications company, transformed WiBro service into LTE-TDD in May of 2012 (KCA, 2013; Kim, 2012).

### **3. Theoretical Framework and Research Question**

This study uses the actor–network theory and the technological systems framework to analyze the WiBro case since a number of existing studies have combined these two theoretical constructs into a single tool for analysis (Yoo et al, 2005; Takeishi & Lee, 2005; Lyytinen & Fomin, 2002).

Van De Ven (2005) described innovation and the diffusion of complex technology systems, to be “collective achievements” of diverse actors. Here, the word ‘actors’ refers to any element within the system – human or nonhuman, individual or group, technical or non-technical (Latour, 1987). In the case of wireless broadband services, such as WiBro, examples of such actors would be technology developers, telecom companies, or regulatory bodies, all which influence WiBro in their own way. They are connected and interact with each other, and it is difficult for a network with such actors to move forward as an entire system when a part of those actors fall behind or are “out of phase” with the others (Takeishi & Lee, 2005; Hughes, 1983, 1989). The actor–network theory and technological systems framework emerged as effective theoretical tools that can be used to analyze a complex technology system.

#### **3.1. Actor Network Theory**

The actor–network theory was introduced by sociologists Latour (1987), Callon, and Law (1992). It focuses on the complex, multi-directional interrelationships of components in a system, and it emphasizes the interaction of the actors involved in a large technological system. This perspective sees technology as more than a simple artifact, but rather as dependent on a network that is constituted by humans, organizational entities, and other actors in the system.

The key of this theory lies in the process of ‘translation’ (Callon, 1986; Latour, 1987) where actors attempt to create a forum, consortium, or a central network in which all the participants agree that the network is meaningful and worth building (Bardini, 1997).

Translation consists of problematization, interessement, enrollment, and mobilization. During the problematization phase, a focal actor of the network defines the identities and interests of the other actors and finds an alignment with the focal actor's own interests

(Callon, 1986). Then, in the second phase, *interessement*, the focal actor convinces the other actors to accept the definition of the participants' identities and interests. The last phase, *enrollment*, refers to the moment when another actor decides to accept the interests defined by the focal actor, joining the newly created actor network (Callon, 1986; Tilson, 2008). When the focal actor succeeds in obtaining support from the other actors through enrollment, an obligatory passage point (OPP) is achieved (Callon, 1986). Furthermore, when this actor network is strong and stable, it is also irreversible, i.e., it appears like a black box and is taken for granted.

WiBro is one of the standards for international mobile WiMAX technologies. Standardization can be considered to be a process where technological artifacts are devised (problematization) and aligned with other actors (*interessement* and *enrollment*). For a technology to be a *de facto* standard, it would have had to have become widely and irreversibly used by the actors.

This analyzes the WiBro case in accordance with the explanatory concept of the translation process within an actor network.

### **3.2. Technological Systems Theory and the Reverse Salient**

Another theoretical framework, which is quite highly relevant to the actor network theory, is the technological systems theory. Hughes (1983, 1987) explains that a technological system is a network that includes a wide range of components like political organizational, legal, technical, and scientific factors. In this technological system perspective, the key success factor for a system to grow is the balanced co-evolution of all the components coexisting in the system (Hughes, 1987; Dedehayir & Makinen, 2008; Bae, Kim, & Lee, working paper). Only when those systemic components co-evolve and maintain evenness, the system can successfully grow. However, if any player within the system is running slower than the others, thus breaking the balance of the system, the system fails to reach the desired growth level (Dedehayir & Makinen, 2008). Hughes labeled such a situation as a state of 'reverse salience' (Hughes, 1983). The reverse salients in a technological system are the retarding components that are not operating at the same speed or level relative to the other components, and thus hamper the progress or development of the system altogether.

WiBro, was once an international wireless broadband standard with a bright prospect, but it turned out to be a disappointment in the market. Given that WiBro was technologically competitive and that it benefitted from unprecedented government support, it is crucial to analyze why it failed to take off and lead the market.

With this in mind, a research question is proposed:

**RQ.** *What are the causes for WiBro's failure, or the reverse salients of the WiBro system in the Korean telecommunications market?*

## **4. Methodology**

This study will take a case study approach to examine the development and failure of the WiBro market in Korea. A case study helps the researcher gain a thorough understanding of a present circumstance or a phenomenon (Yin, 1984; Anderson, Crabtree, Steele, & McDaniel, 2005), and this study method has been widely used for investigation on contemporary events (Kim, 2010; Yoo et al, 2005). The case study approach is a fitting research methodology for the current study because the failure of WiBro is a topic of great interest in Korea, and there is ample empirical evidence to be collected.

Table 1. WiBro interviewees

Number	Group	Organization	Expertise/Major
1	Governmental institution	ETRI	Mobile service policy research
2	Telecom company	SKT	Access/Solution (Member of WiBro team until disintegration)
3	Manufacturer	Samsung Electronics	Business planning
4	University	Korea Advanced Institute of Science and Technology	IT and telecom industry, spectrum management
5			Marketing, Economics
6		Seoul National University of Science & Technology	Mobile, wireless telecommunication
7		Yonsei Univ.	Mobile networks
8		Korea Univ.	Mobile networks

As for data collection, specific materials that can serve as explanatory factors affecting were collected from two major sources: archival material collections and, more importantly, in-depth expert interviews. First, accessible archival materials, such as government publications, white papers from IT consulting firms, industry reports, academic papers, news articles, and any materials related to WiBro were collected and analyzed. Such data can be used to compile factual information and reliable statistical figures relevant to the WiBro industry. This study also conducted in-depth interviews with key experts through face-to-face meetings and telephone and e-mail exchanges. The interviewees are key experts who were directly associated with the development or the operation of WiBro or are professional scholars who are well-acquainted with the Korean telecommunications industry, particularly

with WiBro. We interviewed eight experts between mid-November and mid-December of 2013. The interviewees are a WiBro team manager from SKT, a mobile network expert working at ETRI,, a manager from Samsung Electronics, and five university scholars.

The interviews started with the open-ended question, “What do you see as the most crucial cause for WiBro’s failure?” The talk then continued with follow-up questions. In cases of where there were two or more interviewees in a group, they were encouraged to engage in discussion.

## **5. Case Study: WiBro and its Failure**

We devised interview questions that were based on the findings from the existing literature. After the interview, we organized and compared the findings from the existing literature to the in-depth interviews, and then we provide an overall analysis.

The actors and artifacts in the WiBro network together establish WiBro’s technological system, meaning that when all of these actors and artifacts are in balance and co-evolve, the entire technological system can grow. However, if any of the actors or artifacts in the WiBro network lags behind the others as a reverse salient, the entire system is hindered, meaning that the technology would not succeed in the market. Thus, this study will first identify the actors within the WiBro system and will examine their activities in three domains: government, business, and technology. Then, we attempt to identify the reverse salients of WiBro, where the process of translation in the actor network that is essential for diffusion of the technology breaks down (Bae et al., working paper).

### **5.1. Assessment of Actors in the Technology Domain**

The fundamental purpose of any telecommunications service is to support networking technologies, and it seems fair to argue that WiBro technology itself had comparative advantages over competing technologies in the market.

WiBro technology was superior to competing technologies, like HSDPA and CDMA 1x EV-DO, in terms of data up/download speeds, connection time, and cost efficiency for operators (TTA, 2007; Kim, 2009; Kim et al, 2011). WiBro, which was introduced in both Wave 1 and Wave 2, had an excellent connection time of 0.3 seconds from cellphone to network, whereas HSDPA and CDMA 1x EV-DO take 2.4 and 0.8 seconds, respectively (Lee et al., 2011). WiBro’s data loading speed for both Wave 1 and Wave 2 was also much faster than that of the other two. Furthermore, WiBro technology enables operators to offer both voice and data services in a single IP network (All IP network) and thus reduces the cost burden for establishing and managing separate networks for voice and data (TTA, 2007; Kim, 2009; Kim et al, 2011). In addition, since WiBro was developed and commercialized earlier than LTE was, WiBro was considered to have a time-to-market advantage (Kim, 2009).



Table 2. WiBro and other competing 3G technologies in comparison

	WiBro (Wave 1)	WiBro (Wave 2)	HSDPA	CDMA 1x EV-DO
Standard	IEEE 802.16e	IEEE 802.16e	3GPP	3GPP2
Voice & Data	Both simultaneously	Both simultaneously	Separate (only voice)	Separate (only voice)
Data loading speed	Download 19.97Mbps / Upload 5.04Mbps	Download 37.44Mbps / Upload 10.08Mbps	Download 13.97Mbps / Upload 2.0Mbps	Download 2.4Mbps / Upload 153kbps
Connection time	0.3 sec.	0.3 sec.	2.4 sec.	0.8 sec.

Source: TTA (2007)

For a standard network technology in a market to maintain its advantage, investments must be made and it should be continuously upgraded by the operators. However, this was not the case for WiBro (Han, 2008). Also, Interviewee #1 (ETRI) commented that WiBro's market status could have been different from the present if the inclusion of Voice over Internet Protocol (VoIP) was allowed in WiBro by the government much earlier, specifically before KT merged with its mobile subsidiary, KTF, in 2010. As a result, it started to fall behind competing technologies, like LTE in the 4G market. This indicates how technological factors alone do not determine the results of a system but are rather influenced by other factors including the decision making of government or business actors.

To summarize, the overall result of literature review and of the expert interviews on WiBro case corroborate the fact that WiBro technology was objectively competitive enough in the early phase of its introduction to the market, and thus that was not the core reverse salient factor of WiBro. Then, we need to pay more attention to activities in the government and business domains to find the core reverse salient of WiBro.

## 5.2. Assessment of Actors in the Government Domain

Admittedly, the Korean government strived to bring WiBro to success. All the interviewed experts and collected literature agreed that the government at least in the beginning had placed much effort. Despite the efforts, however, some of the government's activities were found harshly criticized. Interestingly, the results from the literature review and the in-depth interview showed there were quite different assessments of the government's activities.

According to the analysis from the literature review, the reverse salient factors in the government realm were the government's belated permit of VoIP over WiBro and granting WiBro business licenses to operators that already had alternative network technology. First, the analytical reports and news articles indicated that WiBro's status in the market could have been different from the present if the VoIP function was included in the early phase of the market, specifically before KT merged with its mobile subsidiary KTF in 2010 (Yoon et al,

2007). Moreover, granting business licenses for WiBro to operators that were equipped with alternative network technology was discussed to be one of the fundamental problems. That is, they had another option: SKT focused more on HSDPA instead of WiBro and KT had KTF (Lee et al, 2011; Paik et al, 2010).

Nevertheless, the result from some of the interview was notably different. Interviewees #2 (SKT) and #7 (Yonsei Univ.) argued that the belated approval of VoIP was not a result of the government’s decision but rather of the immature technology which was technologically insufficient for VoIP support. Concerning the second problem of selecting SKT and KT for WiBro, the interviewees argued that the government’s choice of KT and SKT, which were the financially stable companies, must have been rationally correct.

Table 3. Reverse salients of the WiBro system in the government domain identified from the literature and in-depth interview

	Literature (Papers, Reports, etc.)	In-depth Interviews
Reverse salient in government domain	◦Belated permit on VoIP functionality	◦Ineffective WiBro promotion strategy in global stages
	◦Granting business license for WiBro to the operators that have alternative technology	◦Unsuccessful management on WiBro consortium in related actors

Interviews with the key experts provided two additional reverse salient factors in the government domain. The first point argued by Interviewee #2 (SKT) concerned the Korean government’s WiBro promotion strategies on the global stage. The Korean government emphasized the aspect of ‘developed by Korea’ or ‘homegrown,’ and that was not attractive to global network operators and device manufacturers. The most important point for a network technology standard for business players is whether it is going to be the *de facto* international standard that can create economies of scale and network effects. Thus, regardless of how technologically superior and high quality it actually is, WiBro as “Korea’s proud technology” did not successfully appeal to the global market.

The second point argued in the interview was that the Korean government failed to maintain the consortium of the actors in the WiBro network (Interviewee #8). The government had formed a consortium with KT, SKT, Hanaro Telecom, Samsung Electronics, and other participants, but in the course of the project two major members, Samsung Electronics and KT, announced their withdrawal from the group. The reason for such an action has not been publicly discussed, but, in the words of interviewees, the core issue was the unsatisfactory royalty system that was set up for the technology. In order to ameliorate the

situation, the Ministry of Information and Communication, at that time under Minister Chin Dae-je, actively persuaded KT and Samsung Electronics to rejoin. From the perspective of the government, this project and the consortium would mean little without these two key companies. Subsequently, the actions the government undertook to persuade the two were viewed as unfair in the eyes of other consortium members. It negatively impacted the trust that had been built up with the other members, and their commitment to the consortium faltered, ultimately driving them out of the WiBro consortium.

The actor–network theory and its ‘translation’ process can explain this issue. The WiBro system, as a big technological system, was constituted by diverse actors in the network. The system needs to undergo translation in order to be successfully diffuse into the market.

In the case of WiBro, the government was a ‘focal actor’ of the WiBro network. The purpose for the development and success of WiBro was to create greater job opportunities and, ultimately, to create wealth for Korea on a national level. Such a result is in the interest of Korean government and also of other actors, including device manufacturers and telecom companies (problematization). Then, the government, or the focal actor, succeeded in inviting a major manufacturer (Samsung Electronics), mobile operators (KT and SKT), and other technology ventures to share a goal for those common interests (interessement)

WiBro’s actor network seems to have reached the interessement phase, but failed to pass enrollment and the next stages where other actors decide to join the network and start to feel ‘black-boxed’ within WiBro, accepting it as something irreversible. Rather, the actors exited the group since they concluded that WiBro would not bring the expected results to them. In the end, WiBro did not succeed in diffusing into the market.

### **5.3. Assessment of Actors in the Business Domain**

In terms of the activities of actors in the business domain, the reverse salient factors identified in the literature and in-depth interviews were similar. There was a greater diversity and larger number of reverse salient components for business domain, relative to the technology and government domains.

The first and the core cause of the failure indicated by the interviewees was the lack of demand for a wireless broadband Internet service (Kim et al, 2011; Koh, 2010; Yeo et al, 2008). The demand for mobile wireless data service was showing a slow growth rate, and the voice service was still the key mobile functionality when WiBro service started. Interviewee #2 (SKT) said that there were not many people who wanted to use mobile internet services over a USB modem. According to Interviewee #1 (ETRI) and #2 (SKT), demand for mobile internet from the end-users was scarce before the introduction of the iPhone in Korea. Likewise, there was lack of demand for WiBro’s wireless broadband services and thus, WiBro, with such low national service coverage and low quality of service, was unlikely to succeed.

Second, the service price for WiBro was thought to be too high (*MediaToday*, 2007; *Financial News*, 2008; Koh, 2010; Kim et al, 2011). Research on wireless broadband Internet service users (Yeo et al, 2008) reported that people resisted WiBro service because they felt

that WiBro service was too expensive to use. Considering that the service coverage of WiBro was very limited, with the most basic data plan of KT WiBro service providing KRW10,000 for 500MB plus KRW50 for 1 MB of additional data, the prices was evaluated to be too much of a burden (*Financial News*, 2008; *MoneyToday*, 2007).

Table 4. Reverse salients of the WiBro system in the business domain identified from the literature and in-depth interviews

	Literatures (Papers, Reports, etc.)	In-depth Interviews
Reverse salients in business realm	<ul style="list-style-type: none"> <li>◦ Lack of demand</li> <li>◦ Expensive service plan</li> <li>◦ Uncertain business model of telecom companies</li> <li>◦ Insufficient investment on facilities</li> <li>◦ Limited device types</li> <li>◦ Lack of contents</li> </ul>	<ul style="list-style-type: none"> <li>◦ Lack of demand</li> <li>◦ Expensive service plan</li> <li>◦ Uncertain business model of telecom companies</li> <li>◦ Insufficient investment on facilities</li> <li>◦ Limited device types</li> <li>◦ Lack of contents</li> </ul>

Beyond a high service price, the most critical problem for WiBro service was the lack of a business model and of investment in facilities (KISDI, 2013; Kim et al, 2011; Koh, 2010; Kim, 2009; Yoon et al., 2007). Telecom companies failed to introduce data plans that could maximize the strengths of WiBro. Telecom companies, particularly SKT, had concerns over possible cannibalization that could be caused by the service expansion and diversification of WiBro. For instance, if WiBro started to implement voice functionality and provided more attractive services, users of the alternative technology (like HSDPA-based services) were likely to use the current service much less. For such a reason, network operators admittedly did not put their best efforts into WiBro. For instance, the construction and update of WiBro facilities happened at a very slow pace, and the WiBro business model was very weak and simple. When first introduced, WiBro's service coverage was only limited to Seoul and certain designated 'hot zones' in five major metropolitan cities. Currently, about 83 cities and most of the major highways or subway lines are covered, but even now, there still exist frequent shadow regions. (*The Kukmin Daily*, 2013).

Regarding the weak business model, Interviewee #2 (SKT) explained that the rapid increase in subscribers between 2008 and 2010 is mostly credited by a promotional campaign offered by KT and SKT where a WiBro USB modem was bundled with a free netbook. This indicated that the apparent growth of WiBro was not based on a firm, sustainable business model but on a temporary campaign. Only a small portion of SKT WiBro subscribers actually used the WiBro device after they gained the free notebook. Seeing that between 15–30% of

WiBro subscribers on average between 2008 and 2010 cancelled their subscription to WiBro service, WiBro as a service was apparently unattractive, and there was no stable business model for WiBro.

Furthermore, the lack of device diversity and contents available for WiBro were also critical reverse salients in the WiBro's system (*MoneyToday*, 2013; KISDI, 2013; Kim et al, 2011; Lee et al, 2011; Paik et al, 2010). WiBro manufacturers and mobile carriers started the service through a USB modem, dongle-type device, or in a laptop form. A mobile phone was introduced much later. For this reason, WiBro was unable to take the lead in the mobile data market. Also, the interviewees frequently mentioned the lack of contents in the beginning phase of WiBro market to also be a reverse salient of WiBro.

#### 5.4. Overall Analysis and Implications

Diverse actors and artifacts compose of the the WiBro actor network. Hughes' technological systems theory states that a system of a new technology evolves when all the involved actors are in balance and interact accordingly, but this was not the case of WiBro. Consequently, this study attempted to find the components that retarded the growth of WiBro by analyzing the technology, government, and business domains of the activities.

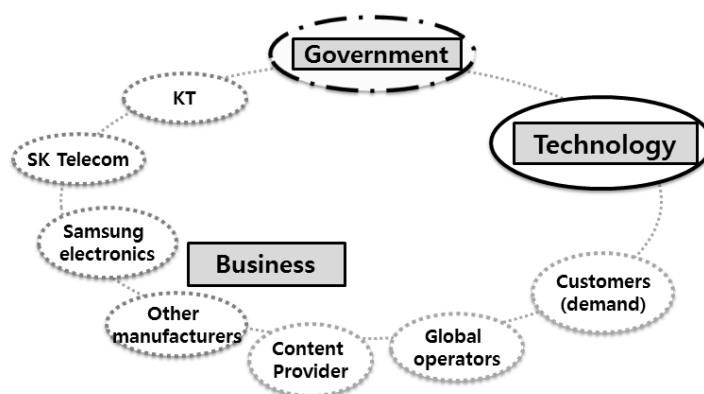


Figure 2. Weakened actor network of WiBro due to reverse salients, particularly in the business domain

Figure 3 illustrates the reverse salients of WiBro in accordance with the results of this study. According to the results from the literature review and the interviews, the technology was evaluated as a 'salient' factor, meaning that it was competitive in the market. The government, however, greatly interrupted the growth of WiBro. Also, critical reverse salient factors were found in the activities of actors in the business domain. Thus, as the dotted network circle in Figure 2 shows, the network of actors was weakened, and thus the WiBro technological system was not able to advance.

To analyze the issue in a more detailed manner, this study argues that the reverse salients of WiBro appear to be of two types: 'apparent reverse salients' and 'underlying reverse

salients’.

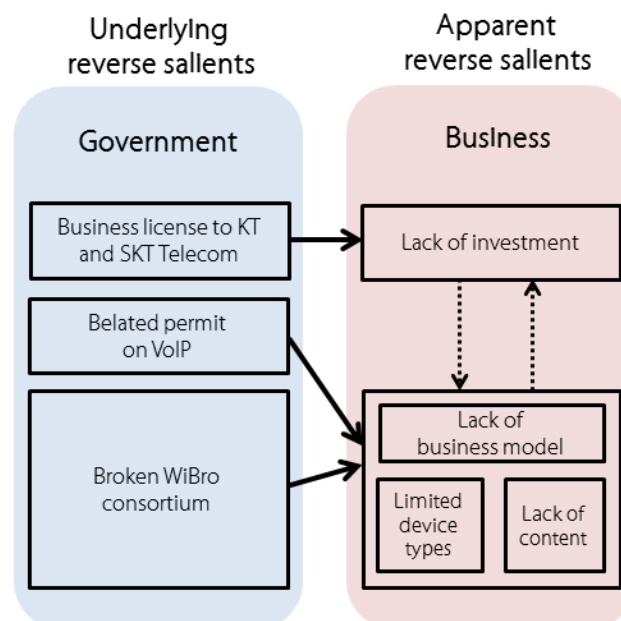


Figure 3. Reverse salients of WiBro on two levels

The apparent reverse salients of WiBro refer to the activities of the actors on the business level, including the lack of investment and the lack of a business model. These reverse salients are apparent and more easily identifiable. However, we believe that the activities in the government domain heavily contributed to the emergence of such problems in the business domain. Government’s failure to maintain the consortium indicates a failure in creating cooperation and interdependency among the business actors. In such circumstances where network operators, manufacturers, and content providers are not working together, it is very unlikely to develop a diverse and successful business model for the WiBro service. Thus, this paper labels such reverse salients, which are located underneath the key problems identified on surface, as underlying reverse salients.

Furthermore, the analysis of the interviews and other materials revealed that economies of scale and network effects are the most important factors that can define success in a healthy telecommunications ecosystem. WiBro is a good example of a failure. WiBro fell into the vicious circle of a dying service in the market. To illustrate, network operators both in domestic and even in the global markets did not choose WiBro standard because it was not widely adopted by other operators. This causes WiBro’s participation in the global telecommunications market to become smaller, and thus operators are less motivated to upgrade technology or to invest in WiBro facilities. Device manufacturers and content providers are also less motivated to continue their business in WiBro. Consumers also start losing interest since there are only a few types of WiBro devices available, few content to

enjoy, and comparatively disappointing coverage. A decrease in consumer demand will directly contribute to operators' shrinking revenue from the WiBro business.

## **6. Conclusion**

When the International Telecommunication Union (ITU) selected WiBro as the sixth global standard for 3G telecommunications, the Korean government and the stakeholders fell immediately into a festive mood. Newspapers and researches spoke of the promising future for WiBro, but unfortunately the reality was harshly different.

This study looked into why WiBro failed in the Korean telecommunications market despite the government's unprecedented active support and the positive outlook on the technology at the beginning. Hughes' framework of technological systems (1983, 1987) was utilized in this study to identify and analyze the causes behind WiBro's poor performance, and the actor-network theory was used to state how all actors in the WiBro network affect and is affected by each other. The factors that contributed to the failure of WiBro were regarded as reverse salients in the WiBro network, and this study tried to identify and analyze them according to three different domains: technology, government, and business.

This study draws the conclusion that the apparent reverse salients in the business realm and the underlying reverse salients in the government realm played an essential role in the failure of WiBro. The business actors' lack of investment on facilities and lack of business model for WiBro seem to be the apparent core reverse salient of WiBro system. However, underneath them, the activities of the government greatly influenced the creation of reverse salients in the business realm. The government granting WiBro business licenses to the existing telecom companies who had other technologies in competition with WiBro made the telecom companies less motivated to invest in WiBro. Also the belated VoIP license and, most importantly, the fragmented consortium of the actors led by the government contributed to the lack of diversity in services and successful business model for WiBro.

This study thoroughly reviews and analyzes WiBro within an academic framework. There have been numerous analytical reports, news articles, and research on WiBro from diverse angles, but there has been no study that investigates the failure of WiBro in the market under theoretical constructs, mainly the technological systems framework and the actor-network theory.

WiBro's failure in the market leaves another question concerning what the Korean government and the business actors of WiBro should do next. In the current market situation, where LTE is dominant, and, in particular, LTE-TDD is rising as a leading technology, the Korean government should focus on negotiating with LTE source technology owners over the royalty payments for using the technology. Delaying to adopt leading technologies will not help Korean manufacturers or telecom companies.

This research is not without limitations. Although this study used multiple sources to extract evidence, including various documents and in-depth interviews, there are

methodological limitations. This study could have been stronger in terms of reliability and generalizability if interviews with more key experts were conducted. However, we should confess that approaching managers at KT, SKT, and Samsung Electronics in charge of WiBro was a challenging job as some of them rejected the interview due to the sensitivity of the issue for their company. Interviewing key government officers who were directly involved in the WiBro project was also challenging because only little information on them was available. Thus, we instead depended on the opinions of scholars who were indirectly related as, for instance, advisors to the WiBro project.

Further research after this can be explored in four ways. First, this study addresses WiBro, or mobile WiMAX, only in the context of the Korean market. A comparative analysis with other major mobile WiMAX markets will be meaningful. For instance, the mobile WiMAX service from Clearwire in the US, which is the world's top WiMAX operator, or UQ in Japan, the second top WiMAX operator, can be analyzed with respect to the success of their service in their respective markets.

In addition, this study can be further strengthened with quantitative data. For instance, in Paik et al. (2010) looked into the WiBro case, and in a similar way we can conduct additional surveys of people who have industry experience or are familiar with this area of study in order to complement the qualitative data from this study.

We can also investigate the user factors that affect the adoption and discontinuation of WiBro service.

Finally, we can also investigate LTE, the current market leading technology, under the same theoretical framework, and we can analyze the factors that made this a success, as opposed to WiBro.



## References

- Anderson, R., Crabtree, B., Steele, D., & McDaniel, R., Jr. (2005). Case study research: the view from complexity science. *Qualitative Health Research, 15*, 669-685.
- Bardini, T. (1997). Bridging the gulfs: from hypertext to cyberspace. Department of Communication, University of Montreal, Available at:  
<http://www.ascusc.org/jcmc/vol3/issue2/bardini.html#Footnote1>
- Bae, G., Kim, S., & Lee, H. (working paper). Regulation as reverse salient in the development of the Korean IPTV Industry.
- Dedehayir, D., & Makinen, S. J. (2008). Dynamics of reverse salience as technological performance gap: An empirical study of the personal computer technology system. *Journal of Technology Management & Innovation, 3(3)*, 55-66.
- Gompa, N. (2013.7.23). Sprint turns on LTE TDD, allowing it to compete with AT&T and Verizon's coverage and performance. 『ExTreme Tech』, Retrieved from  
<http://www.extremetech.com/extreme/162029-sprint-turns-on-lte-tdd-allowing-it-to-compete-with-att-and-verizons-coverage-and-performance>
- Han, J. (2008). *The Competitiveness of WiBro: Requires the Changes of Service Providers*. (Masters dissertation). Korea University, Seoul, Republic of Korea.
- Hughes, T. F. (1976). The science-technology interaction: The case of high-voltage power transmission systems. *Technology and Culture, 174*, 646-662.
- Hughes, T. P. (1983). *Networks of Power: Electrification in Western Society, 1880-1930*. USA: The Johns Hopkins University Press.
- Hughes, T. F. (1987). The evolution of large technological systems. In: Bijker, W.E. Hughes, T, Pincn, T. (Eds.), *The Social Construction of Technological Systems*. The MIT Press, Cambridge, 51-82.
- Jeon, Y. (2008). *An empirical study on the perception of critical success factors of WiBro service*. (Masters dissertation). Kang-nam University, Kyunggi, Republic of Korea.
- Jeong, S. (2008.12.3). WiBro... widely known but low subscription level. *Financial News*, Retrieved from  
[http://www.fnnews.com/view?ra=Sent0901m\\_View&corp=fnnews&arcid=0921501936&cDateYear=2008&cDateMonth=12&cDateDay=03](http://www.fnnews.com/view?ra=Sent0901m_View&corp=fnnews&arcid=0921501936&cDateYear=2008&cDateMonth=12&cDateDay=03)
- Jung, H. (2008.5.14). Korea's WiBro technology heading to America. JoongAng Daily, Retrieved from [http://article.joins.com/news/article/article.asp?total\\_id=3145740&cloc=KCA](http://article.joins.com/news/article/article.asp?total_id=3145740&cloc=KCA)
- KCA (2013. 1) A newly rising 4G standard LTE TDD led by China...The background and the current situation of the global spread. *Trend and Prospect, 58*, 43-56.
- Kim, C., Kim, S., & Hyung, T. (2011). *A Study on the Promotion Policy of WiBro Services in Korea Mobile Market*. KISDI
- Kim, D., Park, J., Kim, S., & Kim, S. (working paper). The fourth mobile network operator's adoption of LTE-TDD and its effect on user welfare.
- Kim, J. (2013.10.3). Lessons from WiBro... which became the headache of Korea's

- telecommunication industry in 7 years. *The Kukmin Daily*, Retrieved from <http://news.kukinews.com/article/view.asp?page=1&gCode=eco&arcid=0007616595&code=11151100>
- Kim, K. (2005.9.15). WiBro of Samsung Electronics goes to America. *Hankyoreh*, Retrieved from <http://www.hani.co.kr/kisa/section-003001000/2005/09/003001000200509151323195.html>
- Kim, M., Jee, K., & Park, J. (2006). Demand forecasting and market position for fixed-mobile convergence focused on WiBro. *Telecommunications Review*, 16(1), 25-34.
- Kim, S. (2010). A Study on the ways for saving DMB services. *Information and Society*, 17, 33-56.
- Kim, S. (2012). Prospect ad future policy direction of WiBro market. *International Telecommunications Policy Review*, 24(23), 72-81.
- Kim, Y. (2009). Current market and the future of WiBro business. *National Assembly Research Service*, 52.
- Koh, J. (2010.6). A growth prospect of WiBro in competition with LTE in Korean telecommunication market. *Issue Analysis*, Korea Development Bank.
- Korea Information Society Development Institute. (2013.9.13). Policy direction on WiBro. Retrieved from [http://www.kisdi.re.kr/kisdi/common/download?type=D&file=GPK\\_EVENTLOG\\_WORK%7C28624%7C1](http://www.kisdi.re.kr/kisdi/common/download?type=D&file=GPK_EVENTLOG_WORK%7C28624%7C1)
- Kwon, H. (2013.10.3). MSIP allows ‘WiBro à LTE TDD’ transformation. *Yonhap News*, Retrieved from <http://news.naver.com/main/read.nhn?mode=LSD&mid=sec&sid1=100&oid=001&aid=0006514787>
- Kwon, M. (2012, 9.5). To keep or to abolish? The question of WiBro. *IT DongA*, Retrieved from <http://it.donga.com/10817/>
- Latour, B. (1987). *Science in Action*. Cambridge: Harvard University Press.
- Law, J. & Callon, M. (1992). The life and death of an aircraft: a network analysis of technical change. In Bijker, W. E. & Law, J. (eds). *Shaping Technology/Building Society*. MIT Press.
- Lee, J. (2007.10.24). [Service Review] After using KT WiBro service. *MediaToday*, Retrieved from <http://www.mediatoday.co.kr/news/articleView.html?idxno=61750>
- Lee, Y., Jung, J., Park, S., & Kim, S. (2011). A Study on Policies for the Activation of WiBro Market. *Korean System Dynamics Review*, 12(2), 37-67.
- Lim, I. (2007, 10). WiBro industry and the current market. *IT-SoC Magazine*, 14, 36-40.
- Lim, N. (2005). Wibro service and its prospect. *Electronics Information Center*.
- Lyytinen, K. & Fomin, V. (2002). Achieving high momentum in the evolution of wireless infrastructure: the battle over the 1G solutions. *Telecommunications Policy*, 26(3-4), 149-170.
- Nam, C., Kim, S., & Lee, H. (2008). The role of WiBro: Filling the gaps in mobile broadband

- technologies. *Technological Forecasting & Social Change*, 75(3), 438-448.
- Oh, S. (2007). Status quo of WiBro and the future prospect. *Weekly Technology Trend Report*, 1288, 12-28.
- Park, J. (2008). Characteristics of Wibro subscribers and market strategy in fixed and mobile convergence. *Electronics and Telecommunications Trend Analysis*, 23(2), 80-90. Electronics and Telecommunications Research Institute (ETRI), April.
- Paik, J., Kim, M., & Park, J. (2010). A Study on the Causes of WiBro's Poor Performance and the Factors in 4G Global Market Success. *Samsung SDS Journal of IT Services*, 7(1), 36-49.
- Lee, K. & Kim, J. (2013. 8). Is the fourth mobile carrier in Korean telecommunication market such a remote idea? ROA Consulting executive summary.
- Seok, W. H., Lee, K. S., & Song, Y. K. (2011). Current Status and Prospect of WiBro Market. *Electronics and Telecommunications Trends*, 26(4), 165-174.
- Shields, W. M. (2007). *Theory and practice in the study of technological systems*. (Doctoral dissertation). Virginia Polytechnic Institute.
- Shin, D. H. (2007). Socio-technical analysis of IPTV: a case study of Korean IPTV. *info*, 9(1), 66-79.
- Sung, Y. (2013.9.12). WiBro that was once a golden egg became nobody's egg. *MoneyToday*, Retrieved from <http://www.mt.co.kr/view/mtview.php?type=1&no=2013091211534428252&outlink=1>
- Takeishi, A. & Lee, K. (2005). Mobile music business in Japan and Korea. *Journal of Strategic Information Systems*, 14(3), 291-306.
- Telecommunications Technology Association (2007). *IT standardization White Paper*.
- Tilson, D. (2008). *The interrelationships between technical standards and industry structures: actor-network based case studies of the mobile wireless and television industries in the US and the UK*. (Doctoral dissertation). Case Western Reserve University.
- Van De Ven, A. (2005). Running in packs to develop knowledge-intensive technologies. *MIS Quarterly*, 29(2), 368-378.
- Woo, S. (2012.2.12). So many complains about smartphone price and data plan. *Hankooki*. Retrieved from <http://economy.hankooki.com/lpage/it/201302/e20130212170108117700.htm>
- Yang, H., Lee, C., & Hwang, S. (2010). A Study on the strategy to activate the mobile augmented reality market through a business model analysis. *Internet and Information Security*, 1(1), 5-27.
- Yeo, J., Jang, B., Park, M., Yeom, Y., Jeon, S., & Kim, J. (2008). *A Study on revitalization strategy of broadband wireless internet service*. KISDI Policy Research 08-40.
- Yin, R. (1984). *Case study research: design and methods*. Beverly Hills, Calif.: Sage Publications.
- Yonhap News (2013.8.30). Present condition of frequency band among three mobile telecommunication companies. Retrieved from

<http://news.naver.com/main/read.nhn?mode=LSD&mid=sec&sid1=105&oid=001&aid=0006457753>

Yoo, Y., Lyytinen, K., & Yang, H. (2005). The role of standards in innovation and diffusion of broadband mobile services: The case of South Korea. *Journal of Strategic Information Systems*, 14(3), 323-353.

Yoon, I., Kim, N., & Choi, S. (2007). Global WiBro Market Outlook & Feasibility Study for Overseas Projects. *Industrial Research Series*, 14.

Yoon, M. (2007.3.30). KT WiBro first introduces 'Campus data plan'. *MoneyToday*, Retrieved from <http://www.mt.co.kr/view/mtview.php?type=1&no=2007033011441978623&outlink=1>