Mobile Telephony Innovation System: The Case of Indonesian Regulatory Perspective

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Abstract **-** This paper developed a framework of mobile telephony innovation system in Indonesia, consisting of four main actors: operators, policy makers, technology developer and the market. We developed an underpinning perspective focusing on how technology developers and national regulator formed a relationship intermediated by ITU. By taking evidence from Indonesia, the study has shown (1) Indonesia has been merely standard adopter. The absence of Indonesian manufacturing firm in ITU sectoral membership made a limitation on contribution (2) Realizing the unfortunate condition, country has initiated to get opportunity to establish a mobile telephony innovation system by taking advantage from wireless technology evolution. There is an initial effort to provide research incentive on WiMAX technology development.

Keywords*:* Mobile Telephony, Innovation System, Regulatory

1. INTRODUCTION

Many researchers have conducted in depth analysis of telecommunications system of innovation. Several research has been carried out analyzing telecommunications innovation system in Brazil (Szapiro, 2003) (Mani, 2004), Sweden (Lindmark, 2006) and China (Ping Gao, 2007). The significant issue in mobile telephony has attracted many researchers. Studies on mobile telephony innovation, mainly on its standard development and service implementation, were presented (Bekkers, 2002; Scharl, 2005). On the other hand, economic approaches were observed on developing mobile diffusion models (Dekimpe et al., 1998; Gruber and Verboven, 1999). Mobile technology has taken its essential role in new telecommunications era, performed co-evolution with other factors and supported engine of innovation (Fransman, 2002). The main literature in Mobile Telephony sectoral system of innovation was provided in the book by Edquist (Edquist,2004).

The objective of this paper is to construct a framework of mobile telephony system of innovation in Indonesia involving four agents: regulator, technology developers, operators and market. We put special attention to regulatory perspective in relation with technology developer's role in the system.

The paper is divided into 5 (five) sections. The second section explains the general framework of Mobile Telephony Innovation System and regulatory perspective. Third one presents role of technology developers as part of component in constructing Innovation System. Fourth section provides evidence after conducting interviews and analysis based on case study in Indonesia. Lastly, the final section gives conclusions.

2. FRAMEWORK OF ANALYSIS

Started by fundamental works by Freeman (Freeman, 1995), Malerba (Malerba, 2002), Edquist (Edquist, 1997), the system of innovation might be approached mainly through National Innovation Systems and Sectoral System of Innovation. As our study focuses on Indonesia which is a developing country, we use National Innovation System (NIS) approach including sectoral dimension.

In sectoral dimension, a mobile telephony innovation system involves agents: firms and non-firm organizations. Innovation is a collective process and firms are the key actors in sectoral system (Malerba, 2002). Sectors are changing over time and firms interact with non-firm organizations. Therefore, in regard to technology diffusion, we build a model focused on service operators and technology developers as two type of firms; two other agents as non-firm organization, namely: national regulator (government agency) and market. Regulatory institution mainly shapes their interactions, in which ITU behaves as the international body issuing main mobile-telephony-related policies.

Figure 1 shows the framework of mobile telephony innovation system. We defined the overall function of mobile telephony innovation as being to develop, diffuse and to use the innovation in the market. Any regulatory product has final aim to benefit society whereas operators have significant role in executing technology diffusion over market. Should operators execute their business strategy over market, national regulators would have control over operators through regulatory products supporting market competitiveness and to give maximum benefit to market.

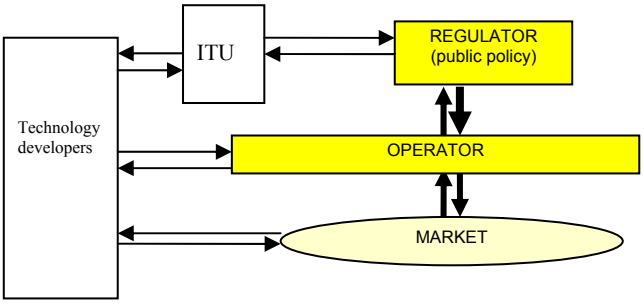

Figure 1. Framework of Mobile Telephony Innovation System

Malerba (2002) mentioned that the elements of a sectoral system are closely connected, it follows that their change over time results in a co-evolutionary process of its various elements. The evolutionary literature has proposed that sectors and technologies differ greatly in terms of knowledge base and learning process related to innovation (Malerba, 2002). Dosi (1994) and Nelson (2002) provide insightful underpinning perspective how evolutionary theory may explain co-evolution among agents in the system.

We signify that the co-evolution among agents in mobile telephony system is present along wireless evolution path. Relationship between international technology developer and national regulator are inter-mediated by ITU. ITU bridging national regulator and technology developers (global industry), whereas ITU recommendation product are affecting both sides in mutual relation on standard and spectrum radio regulation. In case of 3G, ITU received various proposals from industry, resulting two dominant standards: WCDMA and CDMA2000. Then once it becomes official ITU standard, state members have to adopt and regulate the frequency band allocation and implement the designated standards.

Technology developers also carry out relationship with operators, concerning network technology penetration; and with market concerning handset technology. Through such interaction, a telecommunications specialist firms could shape operator and market's dependency. On the other hand, regarding its market size and demand, operator and market might give impact to the firm's strategies. For instance, as reported by Juniper Research, the Indian sub continent region accounted for the majority (23%) of low-cost handset sales, due to efforts by operators to meet low-income users' needs (Cellular-news, 2009).

In the connection between regulator, operators and market, there is a socio-technology pattern of diffusion. The co-evolution between operator and regulators are mainly about standardization and frequency allocation. Government authority on those two issues will give significant impacts to operator's strategy. The choice of 3G mobile telephony standard may also be determined by firms through public consultancy. On the other hand, to perform swift market diffusion, operators establish co-evolution strategies adapted with a market and country's specific condition. Chena (2007) argued that mobile camera feature in handset had opened new market possibility boosting higher market share in Japan. Japanese handset vendors had close R&D relationship with service providers. The diffusion of 3G in Japan from the operator's side mainly determined by handset, price and backward compatibility services (Jonsson and Miyazaki 2004). Should operators develop its competences, they are characterized by path dependency and learning process through cumulative process which may eventually lead to fruitful outcomes (Miyazaki, 1994).

3. ROLE OF TECHNOLOGY DEVELOPERS

The evolution of mobile telephony technology began with first generation, continued by 2G and 3G (officially called IMT-2000 standards). Each generation performs incremental innovation from previous one with certain technical characteristics. Technologies were developed by specialist firms and scientific bodies, and then introduced to ITU to be adopted as international standards. As per September 2008, there were 3.8 billions mobile telephony subscribers worldwide, on which 80.42 % have adopted GSM standard. Two dominant 3G standards exist, that is WCDMA present in 49 countries with about 240 millions users and CDMA2000 with over 112 millions users. Both standards are very competitive, showing that Asia-Pacific region added the most subscribers, while Europe, the Middle East and Africa grew the fastest (ITU, 2007a).

We signify technology developer's role in National Innovation System for its indirect relation with national regulator. As ITU sector member, technology developer firms could shape mobile telephony standards by submitting their proposals. Primarily, telecommunications specialist firms carry out the role of technology development. By assessing USA Patent database, we examined number of CDMA and 3G issued patents assigned by leading telecommunications specialist firms, as shown in Table 1. Besides industrial firms who are the ITU sector members, role of technology developers could be performed through contribution to scientific journals. A country may take an active role in mobile telephony research and shape the perspective of technology development both through academia and industry. We conducted short bibiliometric analysis to examine country contribution on the research of CDMA. Table 2 lists top-three countries which are contribute to CDMA and 3G scientific papers in Engineering Village database.

Table 1. Number of patent submitted (Patent Analysis USA Patent Database per 25 July 2009)

Telecommunications Firms	Number of Patents (based on words on abstract)	
	"CDMA"	"3G"
Nokia	120	6
Ericsson	142	5
Samsung	230	1

Table 2. Number of contribution on CDMA scientific papers (Engineering Village database per 25 July 2009)

Country	Number of Papers (measured by Topic, Abstract, title)	
	"CDMA"	"3G"
USA	4,139	742
China	2,311	594
South Korea	1,647	206
Japan	1,574	216

Based on Table 2 we observe the involvement of four countries on CDMA and 3G technology development by contributing scientific papers. Each of the country has actively submitted 3G technical standards to ITU-T. The facts showed the connection between number of scientific papers and its activity in ITU's standards submission. China has its national standard TD-SCDMA, while Japan and the US contribute to two most adopted standards WCDMA and CDMA2000. In 2007, ITU has included South Korea's WiBro technology in the international 3G standard. As seen in Table 2, South Korea's Samsung also has the most contribution in CDMA patent submission. The fact implied South Korea's active role in developing mobile telephony technology to support its national innovation system. It is common in developed country that a foster approach to support development of domestic technology to strengthen national innovation.

4. EVIDENCE FROM INDONESIA

We carried out a preliminary analysis of the condition of Indonesian industrial firms. We complete the evidence based on in-depth interviews with a commissioner of Indonesian telecommunications regulatory body and managements of two leading mobile operators.

In the group of non-oil and gas, Indonesian electronic manufacture sit as fifth largest after palm oil, iron, textile and rubber industries, contributing 6.3% of total export values. However, most of electronic industry produces consumer products therefore, telecommunications equipments depends heavily on import[1]. It signified fact that Indonesia has a weak mobile telephony manufacturing industry. In addition, the absence of Indonesian manufacturing firm in ITU sectoral membership made a limitation on contribution[2]. As indicated in Figure 1, technology developers have indirect relationship with national regulator, whereas technology developers might give influence through ITU standard submission.

Taking into account scientific academic contribution on national innovation capacity, we conducted a bibliometric analysis by using Enginerring Village database (Compendex). By measuring words "wireless" on publication's abstract and Indonesia as author affiliation; it showed only 28 records. Compared with Malaysia's 578 records in academic publication for the past 40 years[3]. Indonesia's most active contribution was attained in 2007 with 10 publications, while Malaysia reached 137 papers. The situation reflects Indonesia's weak international contribution in the wireless system of innovation.

However, there is a chance for Indonesia to make mobile telephony as an opportunity to catch up technologically by acquiring innovation in emergence wireless technology. In addition, involvement in global research network becomes more significant in defining future wireless standard as more coordination among regulator around the world also required (Santhi, 2003). Following wireless evolution, the future mobile telephony has not been clearly defined, then the opportunity for actively involve in research is widely open. There would be a chance to perform technological leap by understanding trends and standard development along wireless evolution path.

By measuring the number of patent application, one can assume what sort of technology will emerge in the near future and indicate potency of technology diffusion in international market. Our preliminary literature study leads to primary technologies to be considered, that is CDMA and OFDM[4]. The CDMA was important technology being basis of major 3G standards while OFDM is primary innovation used in recent wireless technology, particularly on WiMAX development. Data was taken from USA Patent Database updated until end of January 2009. Figure 3

[1] In 2003, Indonesia's reception apparatus for wireless (including radio telephony, radiobroadcasting and telegraphy) import value was 331 millions USD while in 2008, it exceeded to be 1,588 millions USD (BPS, 2009).

[2] As per July 2009, Indonesia has three ITU sector members, *Telkom, Indosat* and *ACeS*, that all of them are network operators

[3] Malaysia's GDP per capita is USD 6,540 while Indonesia is USD 3,900

[4] OFDM (Orthogonal Frequency Division Multiplexing) a modulation technique popularly used in wideband communications. The primary advantage of OFDM is its ability to cope with severe channel conditions

shows number of worldwide patent submission (granted and under review) of two wireless core technologies (CDMA and OFDM) from 2001 to 2008.

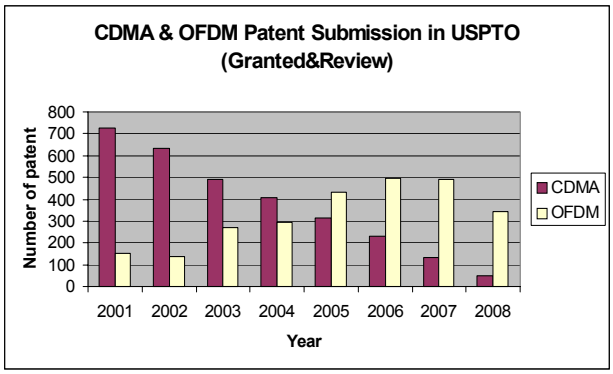

Figure 3. Patent analysis of CDMA and OFDM technology (source : USA Patent Database)

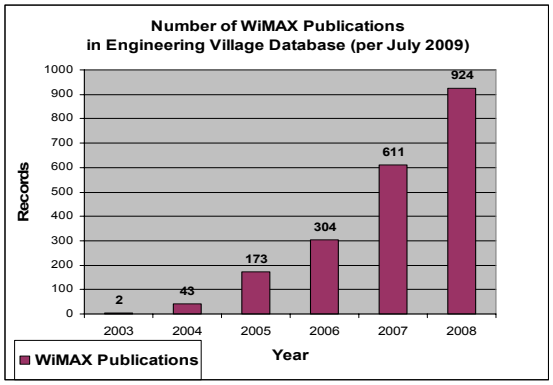

Figure 4. Number of publication in WiMAX technology worldwide (source : Engineering Village Database)

By measuring keywords "CDMA" and "OFDM" in the abstract of patent submission, we could understand how both technology influence wireless evolution path. Figure 3 reflects how CDMA innovation has reached its mature stage, indicated by negative growth since CDMA technology has been applied extensively in 2G and 3G standards. On the other hand, OFDM technology is building its process innovation represented by significant annual growth. Further technical analysis will lead to OFDM-based technology namely WiMAX. To support our perspective, we carried out brief bibliometric analysis based on Engineering Village database. Figure 4 showed that global research in WiMAX has been conducted extensively along the last decade. In 2003, Engineering Village database recorded 2 publications, but in 2008 it reached 924 records. Thus, national regulator might realize that future wireless evolution will be about WiMAX technology; therefore regulator could anticipate and develop innovation capacity to acquire such technology.

Realizing WiMAX as an emerging technology, Indonesia has wider opportunity on innovation development and establishment of a national system. Our study indicated Indonesia's government effort to catch up technological lag through R&D incentives. In addition to growth of Internet users, Indonesian regulator sees a commercial prospect to fabricate WiMAX-related equipment, from antenna, transmitter and terminal. Therefore, considering the market opportunity, it is so much significant to establish WiMAX's local industry[5].

In 2007, Indonesian regulator started a national incentive program on the development of WiMAX technology. It funded USD 3.4 million involving Indonesian universities and national research institutes (DGPT, 2007). It was expected through such R&D fund that Indonesia could set up a national WiMAX system and develop national industry with maximum local content. Our interview revealed a regulator's confidence that national standard development can established since WiMAX technology could meet broadband access demand[6]. Yet, Indonesian leading mobile operators are determining its response to the emergence of WiMAX mainly based on its profitability and business perspective[7].

The program enabled significant achievement that in May 2008, an Indonesian national firm launched first local's WiMAX microchip designed by Indonesian scientists. In 2008, the government standardized Indonesian WiMAX system consisting of subscriber's station, base transmitter station and antenna. Setting up the service commercialization, regulator licensed 8 operators who won spectrum auction in August 2009. Completing effort to establish NIS, regulator made it compulsory for operators to provide subscriber's station and base transmitter, with infrastructure having 30% and 40% local content consecutively. It is further expected that such obligation could initiate cooperation between operators and national industry.

[5] In 2004-2005, Indonesia spent 4 billions USD for telecommunications infrastructure, but only 0.1 – 0.7 % was local product fabrication.

[6] Interview with Heru Sutadi, commissioner of Indonesian Telecommunications Regulatory Bureau

[7] In March 2009, our interview with Yoseph Garo, VP Business Incubation of Telkomsel (1st Indonesian leading mobile operator) showed a company reluctance to join WiMAX industry, since the operator will focus on 3G evolution towards LTE. On the other hand, interview with Guntur Siboro, Marketing Director of Indosat (2nd largest operator) revealed an interest and the company had successfully obtained WiMAX license in August 2009.

5. CONCLUSIONS

As Freeman and Malerba (Sharif, 2006) pointed out each country may have its National Innovation System regardless its limitation and weakness. Despite the absence of proper mobile telephony innovation system, it is necessary to point out that Indonesian regulator has started trying to change country's status not as a merely technology (and standard) adopter. At present, there is a changing regulatory perspective by regarding mobile telephony as an opportunity to establish country's innovation capacity.

Indonesia has made mobile telephony as opportunity to establish National Innovation System by acquiring innovation in mobile's emergence technology. Since WiMAX is an emerging technology, Indonesia has wider opportunity on innovation development and establishment of a national system.

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