Telecommunications Policy ■ (■■■■) ■■■–■■■

Contents lists available at ScienceDirect

Telecommunications Policy

URL: www.elsevier.com/locate/telpol

Competition effect of a new mobile technology on an incumbent technology: An Indian case study

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ARTICLE INFO

Keywords:
Mobile technology
Diffusion
Competition
GSM
CDMA
India

ABSTRACT

Changes in mobile technology have radically altered people's lives by improving their ability to communicate. New mobile technologies in the market offer enhanced voice capability, high-speed data service, and expanded service coverage. In India, the spread of second-generation mobile technologies—global system for mobile (GSM) and code division multiple access (CDMA)—has led to a dramatic rise in teledensity, from approximately 1% in 1985 to 76.86% in 2011. This presents an interesting opportunity to study the competitive effects of the two technologies. In this paper, we analyze the effect of a new technology (CDMA) on an existing technology's (GSM) diffusion process and vice versa using an epidemic diffusion model that incorporates the competition effect. The results showed that the diffusion of CDMA was faster than that of GSM in India and CDMA diffusion had a positive effect on GSM. Further, despite competition, GSM continues to remain the dominant mobile technology in India. These findings offer useful insights into the diffusion process of mobile telephony in countries with multiple technology standards. They can potentially guide the design of diffusion strategies for future generations of mobile technology.

1. Introduction

Advancements in mobile technology have radically changed people's lives. Each new generation of mobile technology is characterized by improvements such as enhanced voice capability, high-speed data service, better spectrum management, and wider coverage (Table 1). These technological enhancements have not only widened the mobile market but also contributed to making newer mobile applications feasible and affordable, thus enabling faster diffusion of mobile telephony.

A significant development in the evolution of mobile technology is the change in the mode of signal transmission (analog vs. digital) from the first generation to the next. Another equally important change pertains to the access mechanism used. The spectrum is divided into frequency bands, referred to as channels, which are allocated to different users. On the basis of allocation, three different access mechanisms can be identified: frequency division multiple access (FDMA), time division multiple access (TDMA), and code division multiple access (CDMA) (Gruber, 2005). Digital (i.e. 2G) mobile technology has been introduced globally under different technological variants that can be divided into two major standards: GSM and CDMA. Of the two, GSM is more popular and still enjoys more than 80% of the market share worldwide. Most of the

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http://dx.doi.org/10.1016/j.telpol.2016.01.001
0308-5961/

Please cite this article as: Gupta, R., & Jain, K. Competition effect of a new mobile technology on an incumbent technology: An Indian case study. *Telecommunications Policy* (2016), http://dx.doi.org/10.1016/j.telpol.2016.01.001

Table 1
Generations of mobile technology.

Characteristics	First generation (1G)	Second generation (2G)	Third generation (3G)	Fourth generation (4G)
Signal	Analog	Digital	Digital	Digital
Switching	Circuit switched	Circuit switched	Packet and circuit switched	Packet switched
End application	Basic voice telephony	Voice plus basic data applications	Data and multimedia applications	All IP-based
Speed	Low capacity	Low data speed	Medium data rates	More advanced multimedia applications
Standards	Advanced mobile phone service (AMPS)	Code division multiple access (CDMA), personal digital communications (PDC), global system for mobile communications (GSM)	Wideband CDMA, CDMA 2000, time division synchronous CDMA (TD-SCDMA)	Orthogonal frequency-division multiplexing (OFDM), multi-carrier CDMA
Coverage	Limited local and regional coverage	Global coverage	Global coverage	Global coverage

European Union countries have adopted GSM, while other countries including India, US, Canada, Japan and China have a competitive environment, where more than one standard vie for consumer attention (Gandal, Salant & Waverman, 2003; Casey & Töyli, 2012). Some of the countries such as Japan and Korea have not adopted GSM as a national standard. The Korean government pushed the decision to adopt CDMA standard in Korea whereas Japan had its own Personal Digital Cellular (PDC) standard (based on TDMA) and CDMA (Jho, 2007; Funk, 2009).

Telecommunication is one of the fastest growing sectors in India. While various factors are responsible for this growth (Gupta & Jain, 2012), competitive technologies have significantly contributed to expanding the market. Since the launch of CDMA in 2002, the Indian mobile market has witnessed stiff competition between GSM, which continues to enjoy popularity among the users, and CDMA, which is fast gaining ground owing to the collaborative efforts of CDMA operators, device manufacturers, and technology facilitators. Although the competition between GSM and CDMA has resulted in benefits for end users, its effects on the overall diffusion of mobile telephony in India have not been closely examined.

Majority of the empirical studies on mobile telephony diffusion have typically focused on a single technology (Botelho & Pinto, 2004; Chaddha & Chitgopekar, 1971; Gamboa & Otero 2009; Michalakelis, Varoutas, & Sphicopoulos, 2008; Singh, 2008). The interactions between new and existing technologies within a technological generation (i.e., intragenerational technology competition) have scarcely been explored. In the same vein, the impact of existing technologies on the survival and diffusion process of a new technology or vice versa has not been adequately discussed in academic literature. The capital intensive nature of mobile technology involving heavy investment puts the financial stakes of mobile service providers and policy stakes of the government at risk. Therefore an investigation into the effect of a new technology on an incumbent technology is necessary to determine their survival pattern. This paper explores how each mobile technology, GSM and CDMA, influences the other's diffusion process in an attempt to clarify the diffusion process of mobile telephony as a whole in India. We use an epidemic diffusion model, which incorporates the competition effect, to investigate the interaction effects of GSM and CDMA. The findings will assist all the stakeholders in reducing their risk and enable them to correct their further course of action. They can also be used by policymakers to frame guidelines that facilitate the rapid diffusion of mobile telephony, as well other allied technologies throughout the country.

This rest of the paper is organized as follows. Section 2 presents an overview of mobile telephony in India. In Section 3, the relevant literature is reviewed. Section 4 discusses the research methodology and the diffusion models adopted in the study. The analysis and findings are presented in Section 5. Sections 6 and 7 present the discussion and policy implications respectively followed by conclusions in Section 8.

2. Overview of mobile telephony in India

Digital mobile telephony with GSM technology was introduced in India in 1995. Since then a number of technological and policy reforms have fueled the rapid growth of the telecom sector. The National Telecom Policy of 1994 was an important milestone in the evolution of Indian mobile services as it allowed private players to enter the wireline and mobile sector. Today, the Indian mobile sector has three types of players: public sector companies (BSNL and MTNL), private Indian companies (Reliance Communications, Tata Teleservices), and companies with foreign investments (Vodafone, Bharti Tele-Ventures, Escotel, Idea Cellular, BPL Mobile, and Spice Communications). Of these, the prominent GSM technology operators are Airtel, Vodafone, and Idea Cellular. Reliance Communications and Tata Indicom are the two major CDMA technology operators. In fact, India is the second largest CDMA market in the world. The 42% drop (Fig. 1) in CDMA tariffs within one and a half years of its launch made the service more affordable to the masses (International Telecommunication Union, 2006).

At the end of financial year 2010–2011, India had a total of 811.59 million subscribers, of which 698.37 million (86.05%) were GSM subscribers and 113.22 million (13.95%) were CDMA subscribers (Telecom Regulatory Authority of India, 2011). The ratio of GSM to CDMA subscribers is shown in Fig. 2. Over the years, technological and policy reforms have transformed

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