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Strategic Technology Options in the Wireless Industry:
A Case Study for US Wireless Carriers

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ABSTRACT

The major U.S. wireless operators already have announced their plans for the evolution of their networks towards 3G, but some uncertainties remain, such as emergence of new technologies (WiMAX and WLAN) and the consolidation among operators (AT&T Mobile and Sprint Nextel). The article discusses a real option based model for technology decisionsand applies it to the U.S. wireless industry as a case study. We also discuss what decisions must be made, what the outcomes are, and how the options model is validated. The preliminary results show that the evolution of wireless network technologies between generations (inter-generations migration scenario) is desirable (a positive net option value), but not desirable (a negative net option value) within generations (intra-generation migration scenario), in the U.S.

Keywords: 3G; Technology Migration; Real Options; Wireless Networks

INTRODUCTION

In the late 1990s, AT&T Wireless and Cingular Wireless each faced a critical decision. The TDMA technology that they chose earlier that decade was approaching obsolescence; the data communications features that were beginning to be demanded by the marketplace had not been developed for this technology platform, nor would they be by equipment manufacturers. Thus, to remain competitive in the marketplace, these mobile service providers had to switch to a CDMA or GSM-based platform. This transition meant replacing all of their base station and switching hardware as well as customer handsets in an orderly fashion. Although both carriers ultimately chose GSM (and ultimately merged to become today's AT&T Mobile), the decision process has received little attention in the literature despite the enormous business and financial risks involved. This article uses this decision and the information available at the time, to propose a real option based model for technology decisions.

Recently the real options approach (ROA) has emerged in the strategic management field

(Dixit & Pindyck, 1994 & 1995; Benaroch & Kauffman, 1998; Amram & Kulatilaka, 1999; Kim & Sanders, 2002). The ROA provides a structure linking of strategic planning and financial analysis tools to evaluate potential opportunities and uncertainty (Dixit & Pindyck, 1994). The ROA is appealing to firms because of its distinctive ability to capture managers' flexibility (Trigeorgis, 1996) in adapting their future actions in response to evolving markets or technological conditions. For example, when managers evaluate new projects, they may face several choices beyond simply accepting or rejecting the investment. Other choices include delaying decisions until the market conditions are more favorable, or deciding to start small and expanding later if the results are good.

The network industry is perhaps particularly sensitive to these issues, because firms in this industry require large, up-front capital investment before revenues can be earned, the ROA works best under high uncertainty with large investment costs, so the network industry fits the ROA methodology well (Alleman & Noam, 1999). With the demands for various services in their markets, network operators are challenged by the rapid development of technologies (Lawless & Anderson, 1996; Balachandra & Friar, 2004) as well as the existing network migration dilemma (Podhradsky, 2004; Akhtar et al., 2005). Since the complete replacement of existing networks is not practical, a firm's preferred approach is to create more flexibility (Langlois & Robertson, 1992; Sanchez, 1999; McDysan et al., 2000; Schilling, 2000) in networks that allow for the customization of services for users and the easy upgrading of their networks when better components, with competitive advantages, come along.

The U.S. wireless industry is a good laboratory for a study like this, since multiple technologies exist and the industry was undergoing a major transition from second generation (*2G*) to the third generation (*3G*) during the study period and is currently moving toward fourth generation (4G) technologies. So, each service provider had to choose a particular network transition strategy, indicating when, how, and at what pace to introduce new technologies. The chosen strategy determined the firm's focus and sometimes required the coexistence of new and existing network technologies.

The goal of this study is to develop a theoretical framework for wireless operators to support their strategic decisions when considering technology choices as they move to the next generation network technology. Our study does not give an absolute value for the choice of technology, but provides some inferences by attempting to quantify the value of the technology migration strategy as a basic element of strategic decision-making. As a result, this study intends to raise core issues concerning the transition towards *3G*.

U.S. Wireless Market

By early 2007, the U.S. wireless market (Budde, 2007; CTIA, 2006; FCC, 2006) was dominated by AT&T Mobility, Verizon Wireless and Sprint Nextel, together accounting for more than 70% market share. T-Mobile, Alltel and U.S. Cellular make up the next tier, accounting for about 20%. In 3G networks, Verizon Wireless and Sprint Nextel used cdma2000 technology, while AT&T Mobility and T-Mobile offered WCDMA technology. Recently, Sprint Nextel began deploying a WiMAX network, preparing for the next round of competition, in 4G technologies (Polivka, 2007).

Figure 1 (world) and Figure 2 (U.S.) plot the number of subscribers in each wireless technology from 1992 to 2006. Based on the number of subscribers in generation, the chart clearly shows the dramatic growth of GSM in the world wireless industry (Figure 1), while CDMA dominates the U.S. wireless industry. Unlike GSM's dominant position in world wireless market, CDMA has experienced high growth and is the lead technology in the U.S. wireless market. TDMA also has a significant market share, but will eventually be obsolete as providers upgrade to more advanced technologies, such as GSM, GPRS, EDGE, and WCDMA. Analog was completely phased