Suitability of IP Telephony in the Public Switched Telephone Network (PSTN): A Case Study

Hak Ju Kim, University of Houston – Clear Lake, USA

ABSTRACT

This article seeks to develop a richer understanding of the suitability of IP telephony in the Public Switched Telephone Network (PSTN) with an actual local exchange carrier (LEC)’s case and network simulation. We also performed a simple real options analysis to evaluate a telecommunications network. The underlying network and associated data were derived from our studies of an actual LEC. The preliminary result shows that an IP telephony network would save about 73% of the total link capacity of a circuit switched network and it could also carry some integrated services traffic at low incremental cost. The value of the IP telephony network was shown as positive under real options and as negative using net present value (NPV). We measured deferrable and irreversible value as well as the uncertainty value of an IP telephony network. Through this experiment, we can get inference that IP has potential for a voice carriage.

Keywords: IP telephony; real options; strategic decision-making; valuation

INTRODUCTION

Real options have been popular in academics (Amram & Kulatilaka, 1999; Brealey & Myers, 2002; Dixit & Pindyck, 1994; Graham & Harvey, 2002; Kauffman & Li, 2005), by recognizing its fundamental importance as a strategic decision-making tool. However, they do not feel the effect on how it leads to reframe the way they approach to solve a certain problem and to build in much more flexibility into their problems in practice.

The current telecommunications industry can be characterized as dynamic, aggressive, and uncertain (Antonelli, 1997; Bourreau & Dogan, 2001; Grover & Vaswani, 2000; Uri, 2000). This is particularly true for Internet-based businesses, due in large part to the ongoing development of IP-based technologies and declining costs (Leida, 1998; McKnight & Bailey, 1997; Odlyzko, 1998). Extrapolating from the growth of the Internet, some industry observers (Bos & Leroy 2001; Traupman, O’Connell, Minnis, Jadoul, & Huterer, 1999; Venken, Vleeschauwer, & Vriendt, 2001) expect that the primary network of the future will be IP-based. Included in this framework is voice...
traffic, which has been emerging as an Internet application in recent years.

The phenomenon of IP telephony (IPT) is interesting from many perspectives. Several previous studies (Marlatt, 1998; McKnight & Leida, 1998; Mier, 1998; Pospischil, 1998; Selsius Systems, 1998; Weiss & Hwang, 1998; Wong, 1999) have shown that the transmission and switching costs of this technology are lower than circuit switching, leading to speculation that IP technology will eventually replace circuit switching technology in the PSTN. The decision to undertake such a technological transition will surely be complex and multidimensional.

IPT is becoming an alternative to the telephone technology used by traditional telephone networks that have not changed substantially for decades. However where IPT can be a substitute for traditional telephony, it has a variety of challenges such as technical hurdles (Stone, 2003), pricing dilemma (Wieland, 2006), and policy environments (FCC, 2004). IPT also has many uncertainties, such as reduction in current growth rate, devaluing equipment and service by the short IP technology transition cycle, a fiercely competitive landscape of technology substitutes and innovations, and uncertain service demands by subscribers. Various policy issues are unresolved: the possibility of universal service obligation, access charge requirements, and treatment as a traditional telephone company. Enormous uncertainties create the opportunity to make decisions as states of nature are revealed. The uncertainties associated with IPT suggest the real options approach would be useful. For example, when should an Internet company try to enter the IPT market? If it enters now, it may obtain a larger market share that it would not get by entering later, but it may lose money because of too small a total market. If it waits a few years, it will know if market growth will be high or low, but it has missed out on several years of sales and will probably obtain a reduced market share due to late entry. Under these types of uncertainties, IPT is ripe for a real options approach.

In this article, we will frame this problem based on the real options approach as a decision of capital investment under uncertainty. The goals of this article are two fold: (1) to demonstrate the application of the real options approach to telecommunications networks, and (2) to develop a richer understanding of the suitability of IP technology in the PSTN. In this article, we will apply a simple real options approach (i.e., Black-Scholes option model) to support this strategic investment decision, and a computer simulation (i.e., COMNET III) to determine the initial capital investment requirements. The underlying network and associated data are derived from our studies of an actual local exchange carrier (LEC).

Our model dimensioned the networks to carry the LEC’s voice traffic. We then added integrated services traffic until the point where the delays of the network become acceptable (in the IP case). Traffic differentiation (prioritization) was applied for the voice traffic to support the toll-quality service. We expect that this article will be useful to network planners in network companies.

The preliminary result of our study shows that IP telephony network would save about 73% of the total link capacity of a circuit switched network and it could also carry some integrated services traffic at low incremental cost. The value of the IP telephony network was shown as positive under real options and as negative using NPV. We measured deferrable and irreversible value as well as uncertainty value of IPT network. Through this experiment, we can get inference that IP has potential for voice carriage.

The next section introduces the real options approach including concepts, factors, variables, indicators, application tools, and applying procedure. We then carry out network modeling and simulation. And then we assess IPT using the real options approach, especially Black-Scholes option pricing model.
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