Systems Dynamics Approach to Analyzing Spectrum Management Policies for Mobile Broadband Services in India

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ABSTRACT

Demand for wireless data and Internet services are expected to grow exponentially, in advanced and emerging markets in the near future. While advanced countries have often used centralized planning and coordination methodology to forecast and allocate the associated spectrum blocks to wireless operators for meeting demand, often its ad-hoc in emerging markets dictated by market forces. In this paper, the authors construct a casual model to represent the different variables that affect spectrum management practices and highlight possible paths forward. Using the causal model structure, they hypothesize that emerging countries with their unique market structure and legacy of spectrum management are better suited to create active secondary markets. The authors cite early market indicators in India such as the adoption of national roaming by the wireless broadband operators and the use of multi-SIM handsets by subscribers that tend to support our hypothesis.

Keywords: Economies of Scale, Inefficient Spectrum Allocation, Multi-SIMs, National Roaming, Secondary Spectrum Market, Spectrum Sharing, Spectrum Trading System Dynamics

INTRODUCTION

In a recent research study by Cisco (2010), it has been pointed out that Mobile data traffic will grow at a compound annual growth rate (CAGR) of 92% from 2010 to 2015, reaching 6.3 exabytes per month by 2015. The study also points out that “mobile-only Internet” population will grow 56-fold from 14 million at the end of 2010 to 788 million by the end of 2015. These trends clearly indicate the possible exponential growth in the use of mobile devices to access Internet and other related bandwidth intensive applications and services, especially in emerging markets such as India.

The potential increase in demand for wireless data and Internet services is likely to put stress on the wireless networks and hence the need for better spectrum management. Paucity
of spectrum for commercial mobile services in emerging markets has been highlighted by many researchers (Hazlett, 2006). For example, the formulation of spectrum policy in India began under conditions of very limited availability of spectrum, due to huge spectrum holdings by Defense as indicated in Prasad and Sridhar (2009). There is the obvious trade-off before the policy maker, between the number of operators to be allocated spectrum and spectrum block allocated to each operator. In emerging countries such as India, the decision is made in favor of competition and hence the associated maximal usage of allotted spectrum. Even if many operators are present, the huge population and hence the potential user base for mobile services, is expected to provide each operator with the critical mass required for sustainable operation. The mobile subscriber growth in India as presented in Appendix A and the level of competition as presented in Appendix B illustrate these effects.

However, it is typical in advanced markets the user base is not large enough to warrant many operators. Even in the U.S., there are only four carriers providing cellular mobile services nation-wide. The market share of local and regional carriers in any of the Cellular Market Areas in the US is still insignificant as pointed out in US-DoJ (2011). Hence the policies are always in favor of a limited number of operators with more spectrum blocks for each operator. It is still in the radar of US Federal Communication Commission (FCC) to cap spectrum per operator and limit allocation to certain threshold number of operators (US-GAO, 2011). Hence the policies are always in favor of a limited number of operators with more spectrum blocks for each operator. It is still in the radar of US Federal Communication Commission (FCC) to cap spectrum per operator and limit allocation to certain threshold number of operators (US-GAO, 2011). Given this disparity in spectrum policies and market structure in emerging and advanced markets, it is interesting to analyze the future evolution path for spectrum management in these two extreme scenarios.

Sridhar and Hämmäinen (2011) indicate that the mobile Internet users in India have jumped from 8 million last year to 25 million and that about 49% of Internet users use Mobile only for accessing the Internet. Hence, on the demand side, the large number of mobile subscribers who can potentially access Internet and other broadband services using mobile only increases the demand. This poses stress on appropriate spectrum management. In emerging countries such as India, spectrum management challenges are due to (i) lack of alternative wired access network infrastructure for broadband access; (ii) deeper penetration of mobile phones and hence the associated demand for wireless broadband, and (iii) relatively inadequate allocation of spectrum for mobile services compared to advanced markets.

A critical parameter to note is the mobile cellular tariffs in India which is one of the lowest in the world. Due to intense competition, the operators provide usage based variable pricing plan that cuts across different subscriber segments. The drop in mobile air time charges in India is given in Appendix C. Subscribers have started using multi-Subscriber Identification Module (SIM) phones to take advantage of the various pricing models. However, in advanced markets, users are accustomed to flat rate pricing in wired networks which covers almost 100% of the population and hence most of the mobile operators provide flat rate data plans, though with high enough data download limits. In flat rate scenario, subscribers maximize their usage for the fixed tariff they pay. Hence, in a flat rate pricing model, traffic shaping and capacity management by the operators assume importance.

In this paper we provide a detailed analysis of the issues in spectrum management in India and use system dynamics methodology to illustrate the effect of different factors on spectrum management policies. System dynamics is a commonly used tool to study causal relationships and the resulting endogenous structure amongst variables of interest (Sterman, 2000). It has been widely applied in policy analysis and has also been used in the mobile communications context both for understanding market development (Pagani & Fine, 2008; Jain & Sridhar, 2003) and regulatory policy (Casey & Töyli, 2011). We use System Dynamics methodology to identify the cause and effect relationship amongst variables of interest using a stakeholder (in this case, “regulator and policy maker”) view point. Using the causal model
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