A study of the spreading scheme for viral marketing based on a complex network model

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ABSTRACT

Buzzword-based viral marketing, known also as digital word-of-mouth marketing, is a marketing mode attached to some carriers on the Internet, which can rapidly copy marketing information at a low cost. Viral marketing actually uses a pre-existing social network where, however, the scale of the pre-existing network is believed to be so large and so random, so that its theoretical analysis is intractable and unmanageable. There are very few reports in the literature on how to design a spreading scheme for viral marketing on real social networks according to the traditional marketing theory or the relatively new network marketing theory. Complex network theory provides a new model for the study of large-scale complex systems, using the latest developments of graph theory and computing techniques. From this perspective, the present paper extends the complex network theory and modeling into the research of general viral marketing and develops a specific spreading scheme for viral marking and an approach to design the scheme based on a real complex network on the QQ instant messaging system. This approach is shown to be rather universal and can be further extended to the design of various spreading schemes for viral marketing based on different instant messaging systems.

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1. Introduction

Viral marketing, known also as word-of-mouth marketing, refers to a marketing mode attached to some carriers on the Internet, which can rapidly copy marketing information at a low cost [1–4]. Different from the traditional marketing methods, for example by advertisement, viral marketing spreads the marketing information through word-of-mouth among the users, which turns out to be more trustful for many consumers. Noticeably, viral marking is different from the traditional word-of-mouth marketing, and it carries some advantages over the traditional method for it is launched via web-based communication platforms such as BBS, Web Blogs, instant messaging systems, and so on [5,6]. The main reasons are multifold. First, the information can be easily stored in computers and the web; therefore digital word-of-mouth marketing information exists everywhere on the Internet and for a long time. Second, most people can take part in the word-of-mouth marketing process in their leisure time, so by nature it is a non-synchronous spreading mode of advertisement. Third, the anonymity feature enormously reduces the limitation induced by personal identities thereby making mutual communications on the web much easier than face-to-face in real life. Last but not least, digital word-of-mouth marketing through the Internet can spread more widely and much faster at a significantly lower cost as compared to most if not all traditional methods [7].

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Instant messaging system provides a tool for the involved users to identify on-line consumers and to communicate with others synchronously. Such communication based on the system is actually even more convenient than BBS and Blogs. In fact, instant messaging systems have become one of the most favorable means for word-of-mouth marketing, which has boosted a rapid development of viral marketing today.

The earliest instant messaging system, ICQ, was originated from Israel in 1996. Afterwards, it became more and more popular worldwide. The number of users of various instant messaging systems in China had reached 154 million in 2007, with QQ being the most popular platform [8].

In retrospect, the first one who wrote about viral marketing on the Internet was media critic Douglas Rushkoff, in his 1994 book Media Virus [9]. The term *viral marketing* was suggested by Jeffrey Rayport, a faculty member at Harvard Business School, in his 1996 article "The Virus of Marketing" [10]. The term afterwards was popularized by Tim Draper and Steve Jurvetson of the venture capital firm Draper Fisher Jurvetson, in 1997 [11]; they described Hotmail's email practice of appending advertisements in outgoing mails from the web users.

In real practice, the precursor of viral marketing company named Windows Live Hotmail, known as MSN Hotmail or simply Hotmail, is a free web-based email service operated by Microsoft. It is a marketing mode that every message contains a Hotmail advertisement. It grew to having 12 million accounts in its first year 1996 alone, and had more than 270 million users worldwide as of 2008 [12]. At present, PepsiCo, Tupperware Corporation and Microsoft etc. have chosen viral marketing as their main marketing mode. One may expect that more and more companies will focus their attention on this effective marketing mode, therefore it is important and even necessary to further understand and analyze viral marketing and its mechanism in a general setting, which motivates the research presented in this paper.

In the literature, there are some studies of viral marketing reported, but they are mainly referred to some concepts related to the viral marketing mode, the extent to which these might influence the success of viral marketing, some basic steps to implement the viral marketing, and so on. On the other hand, most of the existing research works were devoted to simple qualitative analysis. And there are very few references that focus on the design of spreading schemes for viral marketing, although the importance of the design steps has already been noticed recently.

Because the viral marketing campaigns were actually performed over some pre-existing and large-scale social networks, and the existing analysis methods are not powerful enough for carrying out detailed research over large-scale networks, we resort to the new complex network theory, particularly its data-based modeling and simulation methods. As it turned out, the new approach is quite effective for analyzing the difficult viral marketing scheme designs as compared to the conventional methods.

Motivated by the above observations, in this paper we bring complex network theory and modeling into the viral marketing research and propose a specific spreading scheme for viral marketing. This scheme, taking into account the numbers and locations of the initiators under different average rates of activated users, uses the instant messaging system QQ as a platform to carry out a detailed study of viral marketing over real user-group social networks. It is found that the proposed QQ-based spreading scheme for viral marketing is very effective over social networks, and that the method is rather universal which can be further extended to the viral marketing using other instant messaging systems as well.

2. Literature review

2.1. Complex networks

The seminal research works of Watts and Strogatz in 1998 [13] and of Barabási and Albert in 1999 [14] have spurred a great deal of interest in studying real-world problems with complex network models. Scientists have known that networks in the real world, such as various social networks, WWW and the Internet, can be modeled by neither completely random nor completely regular network models, and that they should be and can be modeled by more general complex network models which may have some very different statistical features [13–16]. Although the concept of complex network emerged a few years later than the model of viral marketing, basic theories and many real-world applications of the complex network theory have seen very rapid developments in recent years. As a few relevant examples, the complex network theory and modeling have already been applied to analyzing the industrial competitive relationship, building a two-level complex network model of the inter-firm competitive relationship in industry and the inter-firm rivalry that this relationship determines, and modeling bank services channels and telecommunication VIP service schemes [17,18].

A complex network is composed of a set of nodes joined together with edges representing the relationship between the nodes. Complex network models have some unusual features such as large-scale characteristics, interactional relationships, and complexity and dependence on high-computing capabilities. When studying a complex network model, one not only analyzes its node-degree distribution, weighted-edge distribution, average shortest path length, and average clustering coefficient (in order to identify its graphic features), but also studies its topology index (in order to indicate every node's significance in the network), network dynamic properties, and spreading traffic over the network, etc.

From the perspective of statistics, the classification of complex networks contains two important types of models: small-world networks and the scale-free networks [13,14]. The node-degrees of a small-world network follow an exponential distribution, meanwhile it has a short average path length with a high average clustering coefficient. The node-degrees of a scale-free network follow a power-law distribution with a prominent "robust yet fragile" property known as the "Achilles' heel" phenomenon [15], which means that such a network is robust against random attacks but at the same time it is fragile to intentional attacks on its highly-connected nodes.