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TELEPHONE TRAFFIC ANALYSIS BASED ON SCALE-FREE USER NETWORK AND SCALE-FREE LOAD DISTRIBUTION

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Abstract. In this paper we analyze the traffic of telephone systems. Unlike classical traffic analysis where users are assumed to be connected uniformly, our proposed method employs a scale-free network to model the connectivity of telephone users. Furthermore, the probabilities for different users to make calls are different. This inequality is expressed by a scale-free traffic load distribution. We show that network traffic is greatly influenced by the user behavior, and that call blocking probability is generally higher in the case of a scale-free user network. It is also shown that the carried traffic intensity is practically limited not only by the network capacity but also by the scale-free properties of the user behavior.

Keywords. Traffic analysis, telephone network, user network, scale-free network, call blocking.

AMS (MOS) subject classification: 90B18, 90B20, 91D30

1 Introduction

Models for traffic analysis have been derived by fitting the existing traffic data under particular sets of conditions [4]. Since the underlying mechanisms of the complex network behavior are unknown or simply not taken into account in the modeling process, such models fall short of a clear connection with the actual physical processes that are responsible for the behavior observed in the traffic data.

Recent study of small-world and scale-free properties of so-called *complex networks* has motivated research in the modeling of practical networks based upon certain specific network topologies that possess properties closely resembling those of realistic physical networks [3, 8]. In general terms, a *complex network* may be characterized by a large number of nodes and a set of complex relationships between them [5, 7]. From the viewpoint of complex networks, the user network underlying any communication network exhibits scale-free properties [3]. Up to now, complex network behavior in telephone systems has been rarely considered. Aiello *et al.* [1] studied the scale-free