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ON THE FRACTAL NATURE OF INTERNET

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Rezumat. *Lucrarea analizează două căi de a demonstra natura fractală a internetului. În primul rând, prezintă autosimilaritatea traficului pe Internet şi propune un model fractal pentru acesta. În al doilea rând, propune un model independent de scară a topologiei Internet-ului. În continuare, autorii demonstrează că structura fractală a topologiei influenţează comportarea fractală a traficului pe Internet. Această afirmaţie este susţinută prin câteva rezultate experimentale.*

Abstract. *The paper analyses two ways to demonstrate the fractal nature of Internet. First, it presents the self-similarity of the Internet traffic and proposes a fractal model of this traffic. Secondly, it proposes a scale-free model of the Internet topology. Furthermore, the authors demonstrate that the fractal structure of the topology influences the fractal behaviour of the Internet traffic. This assertion is sustained by some experimental results.*

Keywords: fractal, self-similarity, traffic model, free-scale networks

1. Introduction

Traffic flowing through the telecommunication networks in the pre-internet age was predominantly ‘voice’. The number of calls arriving at a station, namely the counting process, approximated a Poisson or renewal process. In either case arrivals were memory less in the Poisson case, or memory less at renewal points, and interarrival intervals were exponentially distributed. The Poisson arrival model and exponentially distributed holding time model allowed analytically and computationally simple Markov chains to be used for much of the telephone traffic modeling. An M/M/1/K chain can be used to accurately model a single server finite queue system with exponential service and Poisson arrivals yielding closed form solutions for queue length distribution, waiting time distribution, blocking probability etc.

Internet traffic, which behave very differently from such simple Markovian models. Traffic measurements made at the Local Area Networks (LAN) and Wide Area Networks (WAN) suggest that traffic exhibits variability (traditionally called ‘burstiness’) over multiple time scales [1]. The second order properties of the counting process of the observed traffic displayed behavior that is associated with self-similarity, multi-fractals and/or long range dependence (LRD). This indicates that there is a certain level of dependence in the arrival process.

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