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MODELING THE COMPLEX TOPOLOGY OF THE INTERNET

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Abstract. In this paper, a Multi-local World (MLW) model is proposed to describe the Internet structure based on some statistical analysis on the Internet. Compared to the BA and the Extended BA (EBA) models, this MLW model has better statistical performances in fitting to the real Internet data.

Keywords. Internet topology, Waxman model, BA model, EBA model, MLW model

1 Introduction

Recently, there has been increasing attention on the problem of modeling the Internet topology. It has been shown that the Internet protocols and algorithms, and even virus propagation, depend heavily on the Internet topology [1-3]. As a result, modelling the Internet topology is literally indispensable for the design of effective algorithms and protocols, and for the control of virus propagation through the Internet. In the past, with little information about the Internet topology, it was typically assumed that the Internet is a random network, particularly at its very early stage of development. For instance, in the well-studied Waxman model [4], the probability with which two nodes u and v are connected is $P(u,v) = \alpha \exp(-d/\beta L)$, where $0 < \alpha, \beta \leq 1$ are parameters, d is the Euclidean distance from u to v, and L is the maximum distance between two nodes over the entire network. In this model, the degree distribution of nodes follows Poisson distribution. On the other hand, the Transit-Stub model [5] was proposed in order to capture the hierarchical structural feature of the Internet, in which there are three levels corresponding to transit domains, stub domains, and Local Area Networks (LANs) attached to stub domains, respectively. In this model, a stub domain routes the traffic only if its source and destination are within that domain while a transit domain can also route the traffic whose source and destination are not inside that domain.

For the Waxman and Transit-Stub models, the network size is fixed. Ironically, the actual Internet is an open system that grows by continuous additions of new nodes and new links. Also, to increase the reliability of services, the newly added Internet Services Providers (ISPs) may be prone to connect