ORIGINAL ARTICLE

Routing protocols source of self-similarity on a wireless network

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Abstract In this work, a model of a MANET has been developed, performance of different routing protocols (DSR, GRP and OLSR) have been analyzed in terms of bandwidth utilization, delay, media access delay, packet retransmission, traffic sent and received and self-similar nature of the network traffic is also examined. The results of the analysis showed that OLSR and GRP have better performance on a larger wireless networks than DSR. In additional, routing protocols and increasing the number of network users (mobile stations) does not induce self – similar properties on a wireless network and it is found that, OLSR is the best for large wireless networks.

1. Introduction

This work is directly related to the increasing role played by the wireless network to ensure effective management and successful operation of a variety of organizations that use this type of network. Virtually, every such network is vulnerable to increase in the number of users, volume of the information circulating on the network and traffic load associated with these circumstances deteriorate the network services. All these call for experimental studies of the network properties, not only in the real-time monitoring, but also for a deeper study, in particular, to predict their behaviors. For the same reasons, the task of perfecting the appropriate scientific methods and software for analyzing and modeling of traffic is paramount. Works on this issue have been conducted intensively by many

authors, for instance [1,2]. Nevertheless, many questions are still left unanswered or insufficiently studied or focused on solving relatively narrow applications. Up to date, there are no comprehensive methods of organizing and conducting experimental studies of traffic on network in general. Rather, limited list of statistical methods used in the processing of data on the amount of traffic. Mathematical models of traffic rely heavily on the assumption of stationarity [3]. All these demonstrate the need for further development of research on this subject. Feature of packet switching necessitates the reconsideration of traditional approaches to the analysis and synthesis of traffic using the traditional teletraffic theory and queuing theory. When considering systems of packet found new features of quality of service, have been deprived of the traditional approaches. Different scientists in their works show that, telecommunications traffic for most types of services is self-similar (fractal) in nature [4–6]. Also, in recent studies, a work demonstrates that, local and wide area networks are statistically self – similar and it is observed that, Hurst parameter is the only parameter for evaluating self – similarity on a com-

puter network [7]. Another authors, tested self – similarity on a web traffic in terms of Hurst index (H) and found that, H = 6.8 using least square fitting line and also noticed that, the network variance slowly decayed rather than exponential decay [8], another work, addressed long range dependence and self – similarity in web traffic using popular technique called Hurst parameter technique [9]. A research work was carried out on how to calculate fractal dimension on a complex network, the work revealed that covering a network with a reasonable number of boxes can indicate fractal dimension and self – similarity on a network [10]. Also, there are many studies, both experimental and theoretical researches in this area, but a very small number of works devoted to the study of the self – similar or fractal nature of the traffic on a wireless networks in terms of routing protocols and to date, no systematic studies of the impact of self-similar properties of traffic on the quality of service (QoS) have been addressed. Investigation of this problem is important because self-similar limits traffic transmission or (QoS), this tends to deteriorate QoS compared to what is observed in the following works, for example, in case of Poisson traffic [11,12]. Accounting for self-similar properties of the traffic will more accurately describe and reproduce the traffic, which in turn, will provide the opportunity to obtain indicators QoS, corresponding to the actual characteristics of some networks observed [13]. Therefore, relevant studies of the properties of self-similar traffic and their impact on the performance of QoS in data communication networks and optimization of input parameters of the telecommunication networks will ensure specific QoS

The purposed of this research is, to develop mobile Ad – Hoc network (MANET) model to investigate the properties of self-similarity on a wireless network in terms of routing protocols in order to analyze the quality of their functions or factors affecting the QoS. However, the following objectives can be realized; review and analyze existing approaches and methods for the experimental investigation of traffic in wireless networks, compare the performance of the routing protocols such as dynamic routing protocol (DRP), geometric routing protocol (GRP) and optimized link state routing protocol (OLRP),

observe the effect of self – similarity by changing or increasing the number of the mobile stations (MS) on the MANET model. The remaining part of the work is organized as follows creating the MANET topology, method of evaluating Hurst index, results, discussions and conclusion. However, this paper haven able to developed MANET topology with different number of MSs, selects the best performed protocol and confirms that, routing protocols cannot influence self – similar traffic on a wireless network.

2. Creating the MANET topology model

The MANET model created is a cordless network with 150 mobile stations, data transfer rate of 18Mbps and transmission power of 0.11 W. Each station moves randomly in the range of 10000 sqm. Simulation time for all the protocols was chosen as 1000s. The average speed over network for DSR is about 200 thousand events/s and volume of traffic used for the memory is 160 MB, for GRP is about 210 thousand events/s and 130 MB and for OLSR is about 55 thousand events/s and 960 MB depicted in Fig. 1.

In MANET, the topology is constantly changing due to the movement of the MSs in a space or changes in signal propagation conditions [14,15]. In addition, network is characterized by limited bandwidth and radio visibility zone. The network has an arbitrary structure consisting of mobile stations (and nearby hosts) connected by wireless communication channels, the union forms an arbitrary topology. MSs are free to move in any direction and to be recognized freely, so network topology can charge rapidly and unpredictably. MANET topology is much more redundant connections than the traditional networks [16–18], whereby channel properties including bandwidth and error rate are static in traditional networks.

3. Methods of estimating network self-similarity

The impact of the self-similarity on the network shall be estimated using Hurst index (H) and H, is considered stable if
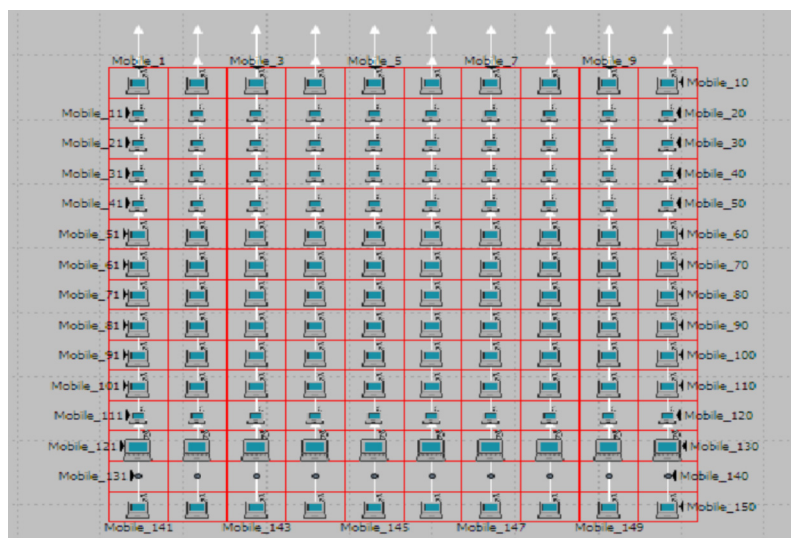

Fig. 1   Model of MANET topology in OPNET environment.