

Chapter 30

An Optimal Fuzzy Load Balanced Adaptive Gateway Discovery for Ubiquitous Internet Access in MANET

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ABSTRACT

A mobile ad hoc network (MANET) is an autonomous collection of independent nodes cooperating together to form an infrastructure less network spontaneously. For increasing usability of MANET domain which finds application in natural disaster such as earthquake, floods etc. it is also desired to be connected with Internet through Internet gateways. Therefore, an efficient gateway discovery mechanism is required for MANET-Internet integration. Existing schemes use one or multiple parameters for optimal selection of gateway which causes a particular gateway to be selected many times which results in higher delay latency and packet drops due to prevailing congestion at a particular gateway. To avoid this situation, the authors have utilized the potential of fuzzy logic to ascertain the decision of load balancing at the Internet gateway. Besides this, their scheme also incorporates an effective adaptive gateway discovery mechanism. Consequently, enhanced performance is achieved as compared to existing state-of-the-art related schemes. The proposed approach is evaluated by simulation and analytical validation.

1. INTRODUCTION

Mobile ad hoc network is a multi-hop wireless network without any existing infrastructure with limited communication range as stated by (Murthy & Manoj, 2004). To increase the usability of the network domain, Internet connectivity is desired. However, integration between Mobile ad hoc network and Internet is a challenging issue due to their architectural difference and communication protocol used.

DOI: 10.4018/978-1-5225-1908-9.ch030

Therefore, an efficient gateway discovery (Rosenschon, 2007; Park et al., 2007; Attia et al., 2015) is needed so that robust and flexible connectivity of Internet is provided to the mobile nodes organized in an ad hoc fashion. Assumption of stationary multiple gateways are considered for providing Internet connectivity to MANET (Belding-Royer & Perkins, 2002). These gateways broadcast their own prefix information to the MANET which allows them to move freely within their radio communication range. When there is a scenario of multiple gateways if any of the gateways fail or overloaded.

Duplicate address detection (DAD), address auto configuration and session management issues are to be addressed when there is a handover from one gateway to another. To enhance the throughput of MANET (Perkins & Belding-Royer, 2003) while connecting to the ubiquitous Internet, load balancing of gateway is necessary. The overloaded gateway causes congestion which results in packet drop, depletion of energy at the gateway which severely affects throughput. The existing schemes of load balancing focused on three types of mechanism in first case load balancing is associated with gateway discovery process and initiated by gateway itself that strategy are termed as proactive gateway load balancing. In second case, load balancing is associated with gateway selection process and initiated by mobile node itself that strategy are termed as Reactive gateway load balancing. In third case, when the load balancing is associated with gateway discovery and selection process that strategy are termed as hybrid gateway load balancing.

1.1. Contributions

The specific contribution of the paper focuses on following aspects:

- A fuzzy based optimal selection of Internet gateway integrated with load balancing strategy on the basis of relevant metrics like traffic load of gateway, Link changes (Yuste et al., 2010) and Accumulated Interface Queue Load per Hop count is designed. Contrary to this, if the selection is made on a conventional metrics without taken care-off Internet gateway load balancing scheme then it may cause a bottleneck and uneven distribution of traffic which may result in performance degradation;
- Besides, adaptive gateway discovery approach is also incorporated to ensure dynamicity to our proposed approach reflecting real-life situations like in natural disaster recovery situations, military battle fields where efficient MANET-Internet connectivity is essential to provide seamless communication of information from affected sites to data centres;
- Moreover, comprehensive evaluation of our proposed approach with respect to varying active source nodes and mobility situations are presented and analyzed.

1.2. Organization of the Paper

The rest of the paper is organized as follows: Section 2 describes related work about MANET-Internet integration and various gateway discovery schemes. Section 3 presents our proposed gateway discovery scheme/approach. Section 4 remarks the analytical validation of our proposed approach. Section 5 reflects our performance evaluation. Finally, in Section 6 we conclude the paper with directions of future work.

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