A Framework for a Minkowski Distance Based Multi Metric Quality of Service Monitoring Infrastructure for Mobile Ad Hoc Networks

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Abstract: As a result of the rising popularity and necessity of real-time multimedia applications, Quality of Service (QoS)monitoring needs more attention in wireless networks. Due to infrastructureless and mobile nature of wireless mobilead hoc networks (MANETs), QoS monitoring is a challenging task. This paper extends our previously published workand provides a framework for a robust and a multi-metric QoS monitoring infrastructure (MMQoSMI) for MANETs.Three QoS metrics (delay, jitter, and packet loss) are considered by the proposed QoS monitoring framework. TheMMQoSMI nodes are mainly selected based on individual node stability and available bandwidth for each node.Then, these nodes are implicitly connected using link bandwidth and delay as QoS metrics. For an MMQoSMInode to measure the QoS metrics of its directly connected links, it relies on the Minkowski distance approach.This approach measures the selected QoS metrics and then enters them to the distance assessment system whileconsidering customer's QoS requirements of each multimedia application. As a result, MMQoSMI nodes combinethe selected QoS metrics and produce an output that represents the instantaneous QoS. Every node in the MANETassesses the available QoS and then forwards it to its cluster-head node to be used for network monitoring and otherpurposes.

Index Terms: Ad Hoc Networks, Quality of Service, Virtual Backbone, Minkowski Distance, Monitoring, Euclidean Distance,Node Stability

I. Introduction and Related Work

Different applications have different *Quality of Service* (QoS) requirements that need to be carefully met in orderto fulfill customer's needs [1]. The evolution of wireless mobile networks and real time applications introduces newchallenges in supporting predictable and reliable communication performance. These challenges are a consequenceof the vastly increasing number of current and future multimedia products that find application not only in fixedwireless networks but also in the mobile environment [2].

Wireless *mobile ad hoc networks* (MANETs) have become a rapidly growing field. Applications of MANETsoccur in situations such as emergency search-and-rescue operations, meetings or conventions in which users wish toquickly share information, and data acquisition operations in hostile terrain. In situations like battlefields or majordisaster areas, ad hoc networks need to be deployed immediately without base stations or wired infrastructures.These networks are typically characterized by scarce resources (bandwidth, power, etc.), lack of established backboneinfrastructure, high error rates, and a dynamic topology [3].

QoS can be estimated and specified in terms of several *metrics* that are of prime importance to the applicationunder consideration. Typical QoS metrics are available bandwidth, delay, jitter, tolerable packet loss rate and/ornumber of hops, and path reliability [4]. While gaining more interest, QoS support is yet to become a commonreality and is still an open research territory especially for multimedia applications.

One of the practices that leads to performance degradation in networking, in general, is the practice of broadcastinginformation globally throughout the network. A simple method of

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