Performance Evaluation of Ad Hoc Networking Protocol with QoS (Quality of Service)

1. INTRODUCTION

1.1. PREFACE

Ad Hoc mobile networking is the uncharted frontier of contemporary networking technology and also known to be current active research area. A wireless Ad hoc network consists of wireless nodes communicating without the need for a centralized administration. A collection of autonomous nodes or terminals that communicate with each other by forming a multi-hop radio network and maintaining connectivity in a decentralized manner is called an ad hoc network. There is no static infrastructure for the network, such as a server or a base station. Ad hoc wireless networks are self-creating, self-organizing, and self-administering.

They come into being solely by interactions among their constituent wireless mobile nodes, and only such interactions are used to provide the necessary control and administration functions supporting such networks. In essence, Ad Hoc networking is all about providing connectivity between mobile nodes, which have no supporting connections to the fixed networking infrastructure. By far the biggest problem in current Ad Hoc networking research is that of routing in a situation, where the topology of the network is changing continuously. The idea of such networking is to support robust and efficient operation in mobile wireless networks by incorporating routing functionality into mobile nodes. A user can move anytime in an ad hoc scenario and, as a result, such a network needs to have routing protocols which can adopt dynamically changing topology. To accomplish this, a number of ad hoc routing protocols have been proposed and implemented. Routing models can also be divided in three types namely “Proactive”, “Reactive” and “Hybrid”, which include Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV) and ad hoc on-demand distance vector (AODV) routing. The Ad hoc On Demand Distance Vector (AODV) protocol, proposed by Perkins, is one of the Reactive Routing Protocol, which blends elements of the DSR and DSDV protocols, using the DSR reactive route discovery and maintenance models, in combination with the sequence number and periodic update features of the DSDV protocol.

In an Ad Hoc mobile network, every node in the network carries its own router with it, and all nodes cooperate in carrying traffic. The whole philosophy of the Ad Hoc...
networking model is a radical departure from the highly structured and frequently hierarchical models employed for both local area and wide area networking, currently in use. In fixed infrastructure network the topology of the network is unchanging, or changes at a very slow rate. So the mechanisms for name mapping, route discovery, and route maintenance can be very lethargic in their response times. Indeed, manual reconfiguration of the routing topology is commonly employed.

1.2. ISSUES IN AD HOC ROUTING

The technological challenges of Ad Hoc routing are very much non-trivial! The first "package" of problems derived from the continuously varying topology, and potential throughput, of the Ad Hoc network. Network throughput will vary for two reasons. The first, and obvious reason, is that the larger the number of hops your traffic has to travel across to get to where it is going, the greater the routing delays you incur, which cumulatively add up to increase the latency of your link, and thus potential throughput, for a finite buffer size in participating nodes. Since the network topology is continuously changing, frequently in an unpredictable manner, the number of hops between you and your destination node will also vary. The second reason why network throughput will vary is a consequence of Shannon's information theory, since for a constant power output and receiver sensitivity, as distance increases between two wireless nodes, the signal/noise ratio declines and thus achievable link bit rate drops. Therefore, as the signal weakens, the range of potentially available services declines, or the bit error rate increases. This variation of throughput with time is usually referred to as "fading", as much as this term is used and abused in various niches of communications theory.

At this time very few protocols for MAC layer connections exist which can adaptively adjust their throughput to accommodate variations in link performance. We are seeing the first steps with the IEEE 802.11 wireless Ethernet, where link quality degradation forces a reduction in link bit rate. We have yet to see a genuinely robust protocol which dynamically rubber bands the bit rate through the channel to achieve a desired balance of speed and bit error rate. In wireless networking, where power and bandwidth come at a big premium. By far the biggest problem in current Ad Hoc networking research is that of routing in a situation where the topology of the network is changing continuously, somewhere within the network.
Static networks mostly use either Distance Vector (DV) or Link State (LS) routing algorithms, neither of which are spectacularly well suited to highly dynamic topologies. In a highly dynamic wireless network, such protocols run into a number of difficulties:

- Topologies may be highly redundant, with some nodes being in the situation of being able to connect to a very large number of neighbours, while others see very few neighbours.
- Bandwidth is scarce and cannot be wasted.
- Battery power on portable equipment is a finite resource which cannot be wasted.
- High rates of topology change require high update rates.

From a perspective view, the routing problem really decomposes into two problems. One is that of "route discovery", the other is that of "route maintenance" whereby the validity of discovered routing information is maintained.

1.3. AODV AND QoS-AODV

The Ad hoc On Demand Distance Vector (AODV) protocol is proposed by Perkins. It blends elements of the DSR and DSDV protocols, using the DSR reactive route discovery and maintenance models, in combination with the sequence number and periodic update features of the DSDV protocol. The thesis focuses on enhancement in performance of normal AODV protocol by improving the QoS. The various QoS parameters can be stated as bandwidth, cost, end-to-end delay, delay variation (jitter), throughput, probability of packet loss, battery charge, processing power etc. Research is going on towards Performance Improvement by emphasizing any of these parameters. This thesis considers the Bandwidth parameters so as to improve QoS. Various Performance metrics are to be studied for Performance evaluation of QoS-enabled AODV protocol.