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An Overview of QoS Model in Mobile Ad hoc Network

Mohanapriya. J*
School of Information Technology
VIT University, Vellore, India
mohanapriya.j@vit.ac.in

Magesh. G
School of Information Technology
VIT University, Vellore, India
magesh.g@vit.ac.in

Abstract: The maturity of Wireless transmission and the popularity of portable computing devices have made the dream of communication "anytime and anywhere" possible. With the continuing advance in computing and wireless technologies, Mobile Ad hoc Network (MANET) are expected to become an indispensable part of the computing environment in the near future. As MANET gain popularity they need to support real time and multimedia applications. Such applications have stringent the quality of service requirements such as bandwidth, delay and delay jitter. Due to the design and development of Quality of service (QoS) model make increased research interest. In this paper we present on survey about Features of MANET, MANET applications, the QoS model of the MANET, We also examine Advantages and Disadvantages in MANETs and challenges involved in providing QoS model in an ad hoc network. In particular it proposes a brief survey about IntServ , DiffServ, Special Issues and Difficulties in MANETS in recent trends.

Keywords: Mobile Ad hoc Network (MANET), Quality of service (QOS) model, IntServ, DiffServ.

I. INTRODUCTION

Ad hoc networks are the key concept for the evaluation of wireless networks [1]. Ad hoc networks are typically composed of equal nodes that communicate over wireless links without any central control .Ad hoc networks provide application such as rescue missions in natural disasters, law enforcement operations, commercial and Educational use and sensor networks are just possible commercial examples. Mobile ad hoc network (MANET), sometimes called as mobile mesh network,[2] consist of wireless nodes that communicate with each other by cooperatively sharing a common wireless medium. Each device in a MANET is free to move independently in any direction and will therefore change its link to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is providing each device to continuous maintain the information to properly route traffic. MANETs are useful in many applications because they do not need any infrastructure support. Collaborative computing and communications in smaller areas(building, organization, conferences etc)can be set up using MANETs communications in battle fields and disaster recovery areas are further examples of application environments. (With the evolution of multimedia technology Quality of Service (QoS) in MANET become an area of great interest .Besides the problem that exist for QoS in wire based networks. MANETs imposed new constraints. This is due to the dynamic behavior and the limited of such networks. With the widespread availability of portable computing devices, more and more applications are being designed for mobile use especially for multimedia applications such as streaming audio, games and real-time data such as stock exchange data analysis [3]. This evolution makes QoS in MANETs relevant and important and poses a new challenge to the research community.

The main objective of this paper is to discuss about the features of MANET in the wireless environment and application of MANET. The rest of this paper is to define the QoS model methodology by which certain types of services (e.g. per-flow or per-class) could be provided in the network [4] along with service differentiation [5] where multimedia flows such as voice or video are given priority over best effort flows and in last section we also discuss about the challenges to be faced in MANET.

II. MANET ARCHITECTURE

The figure represents MANET with routers host ,the inner cloud represents MANET interfaces and links form a MANET and the outer cloud represents the classic IP link model.

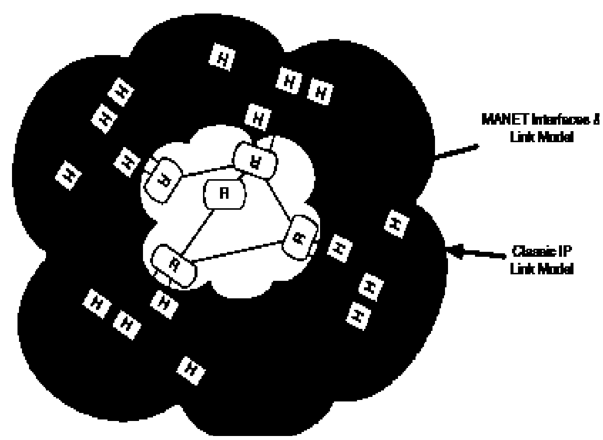

Figure. 1

III. LITERATURE SURVEY & RELATED WORKS

A. *Features of MANET*

B. *Autonomous Terminal*

In MANET the terminal will act both as host and router, so it is named as autonomous terminal. The mobile nodes of ad hoc network can also perform switching functions as a router.

C. *Distributed Operation*

Since for Network operation in MANET the central control has no background Network. Hence the control and the management of the Network is distributed among the terminals. Each node in MANET will communicate among themselves and acts as a relay as needed, to implement functions .eg. Security and routing.

D. Multihop Routing

Based on different link layer attributes and routing protocols,the types of ad hoc routing algorithms can be singlehop and multihop. But multihop is more widely used in MANET than singlehop due to the lost of less functionality and applicability.

E. Dynamic Network Topology

The nodes in MANET will act as a mobile, so the Network topology will not be in a structured formats. MANET should follow the traffic and extension able conditions of the mobile network nodes in network. The mobile nodes dynamically build routing among them selves as they move about, forming their own network on the fly.

F. Fluctuating Link Capacity

Due to high bit-error rates in MANET the wireless connection might be more profound. One end-to-end path can be shared by several sessions. The channel over which the terminals communicate is subject to noise, fading, and interference, and has less bandwidth than a wired network. In some scenarios, the path between any pair of users can traverse multiple wireless links and the link themselves can be heterogeneous.

G. Light-Weight Terminals

The MANET nodes are mobile devices with less CPU processing capability, small memory size and low power storage. The mobile devices need optimized algorithms and computing and communicating functions.

IV. APPLICATIONS OF MANET

A. Tactical Network

The invention of Unmanned Aerial System (UAS) over the last decade is one of the most significant drivers for the increased deployment of MANETs in the Warfield .MANET solutions are needed in defense communications environment for reliability, security and scalability. Tactical network applications of MANETs also includes for automated battlefields, where in form of autonomous robots and autonomous ground vehicles, to check for hostile battlegrounds and land mines. The enabling technologies on the radio side for Mantes are likely to have a high impact that includes software defined radios (SDR), cognitive radios (CR), and smart antenna techniques such as multiple input multiple output (MIMO).

B. Commercial Sector

Adhoc can be used in emergency operations for disaster relief efforts. e.g. in fire, flood, earthquake, and emergency rescue operations must take place where infrastructure is relayed from one rescue team member to another over a small handheld ad hoc network. Other commercial scenarios include ship-to-ship ad hoc mobile communication, law enforcement etc.

C. Smart sensor Network

A wireless ad hoc sensor network consists of a number of sensors spread across a geographical area. Each sensor has wireless communication capability and some level of intelligence for signal processing and networking of the data. Some examples are establishing communication for tactical network, measurement of the air pollution etc. There are two ways to classify smart sensor networks, namely whether the nodes are individually addressable and whether data in the network is aggregated [3].

D. MANET P2P Networking

MANET and P2P shares common features such as the lack of a central infrastructure, a highly dynamic network topology and the need for self-organization. For deployment on top of MANETs for the following reasons due to overlay traffic on the Internet and Flooding over the network. It can be overcome by using limited Bandwidth in MANETs, so that the conventional DHT Maintenance can be prohibitely heavy-weight and overwhelm the network.

E. Virtual Class Room

The recent contribution towards teaching and learning process is the establishment of virtual Class Room (VCR) .The VCR can be immediately constructed and their networks can be dynamically any where within a mile at any time. With the help of the MANET Virtual Class Room can support urgent and timely learning activity, which improves the learning attributes. for example the teacher may interact with the students located around one mile distance by using MANET in Virtual Class Room environment.

V. QUALITY OF SERVICE (QoS) IN MANETs

As QoS is usually defined as a set of service requirements that needs to be met by the network while transporting a packet stream from a source to its destination. The following performance parameters are commonly used to measure and request to QoS

Delay: The link elapsed between sending and receiving of the packet that travels from a source to destination.

Delay Variations (Jitter): The variation in the delay of the packets sent from the source towards the destination.

Bandwidth: The maximum data transfer rate that can be sustained between user end points.

Packet loss rate: The ratio of dropped packets to the total number of packets.

A. QOS MODELS

They are two main QoS Models [6] that have been standardized by the IETF (Internet Engineering Task Force), namely Integrated Service (IntServ) and Differential Service (DiffServ). The following sections describe these two QoS models

B. IntServ and MANETs

The idea behind IntServ [7] is adopted from a virtual circuit connection mechanism,i.e., telephony world and B-ISDN.IntServ allows sources to communicate their QOS requirements to routers and destinations on the data path by means of a signaling protocol such as RSVP[8] and dRSVP(for specifying a range of QOS requirements)[9]. Routers apply corresponding resource management schemes, e.g., Class Based Queueing (CBQ) to support the QoS specifications of the connection. Based on these mechanisms, IntServ provides quantitative QoS for every flow.

IntServ/RSVP model is not suitable for MANETs due to the resource limitations in MANETs. The Advantages and DisAdvantages of the IntServ approach for MANETs are enumerated as follows.

C. *Scalability*

IntServ provides per-flow granularity, so the amount of state information increases proportionally with the number of flows. This results in a huge storage and processing overhead on routers, which is the well-known scalability problem of IntServ. The scalability problem is less likely to occur in current MANETs considering the small number of flows, the limited size of the network and the bandwidth of the wireless link. On the other hand, as fast radios and efficient low bandwidth compression technology develop rapidly, the emergence of high speed and large size MANETs with plenty of applications is foreseeable. Then, the pure IntServ approach for MANETs will inevitably meet the scalability problem as in high speed fixed networks today.

D. *Signaling*

Signaling protocols generally contain three phases: connection establishment, connection tear-down and connection maintenance. Corson [10] predicts that a larger percentage of link capacity will be allocated to control overhead in a network with smaller and time-varying aggregate network capacity. For MANETs with dynamic topology and link capacities, the overheads of connection maintenance usually outweigh the initial cost of establishing the connection. Therefore, RSVP-like signaling is not practical in MANETs.

E. *Router Mechanisms*

IntServ imposes high requirement on routers. All routers must have the four basic components: RSVP, admission control routine, classifier, and packet scheduler. Consequently, the processing overheads of routers are high which is undesirable in power-constrained MANETs.

F. *DiffServ and MANETs*

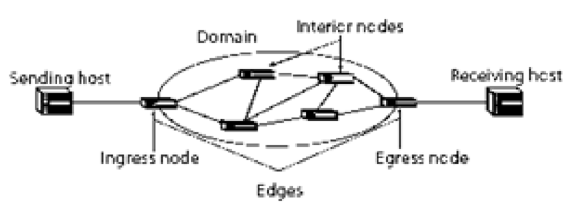

Figure 2: DiffServ domain

Differential Service (DiffServ) [11,12] model avoids the problem of scalability by defining a small number of per hop behaviors(PHBs) at the boundary routers and associating a different diffServ code point(DSCP) in the IP header of packets belonging to each class of PHBs. The interior routers along the forwarding path use DSCP to differentiate between different QoS classes on per-hop basis. Thus, DiffServ is scalable but it does not guarantee services on end-to-end basis. DiffServ provides qualitative QoS for aggregate flows. In DiffServ, we can identify three different service classes: expedited forwarding, assured forwarding, and best-effort. Diffserv may be a possible solution to the MANET QoS model, because it is light weighted in interior routers. The Advantages and Disadvantages of the DiffServ approach for MANETs are enumerated as follows.

G. *Node Functionality*

DiffServ is designed to overcome the difficulty in implementing and deploying IntServ and RSVP in the Internet backbone. The size of MANETs is not comparable with that of the backbone, but the functionalities of nodes in MANETs are analogous with those of routers in the Internet backbone. As a router, a node routes packets for other nodes as what the backbone routers do in the Internet. Hence, a MANET is similar to a backbone network in the sense of the functionalities of nodes. Intuitively, this similarity implies a potential usage of the DiffServ approach in MANETs.

Timescale DiffServ is aimed to provide service differentiation among traffic aggregates to customers over a long timescale. In MANETs, mobility and link capacity reach some steady state over a long timescale despite the instantaneous changes in topology and bandwidth conditions. It is difficult to provide short timescale QoS by trying to keeping up with the time-varying conditions but it should be possible to provide QoS on a long timescale for MANETs as DiffServ does for the Internet.

Interior nodes DiffServ is lightweight in interior nodes as it does away with per-flow states and signaling at every hop. In MANETs, keeping the protocol lightweight in interior nodes is important since putting too heavy load on a temporary forwarding node which is moving is unwise.

Services: Premium Service is supposed to provide low loss, low latency, low jitter and end-to-end assured bandwidth service like a virtual least line. Such a virtual least line is hard to maintain due to the dynamics of MANETs. On the other hand, Assured Service (AS) [13] is aimed to provide guaranteed, or at least, expected throughput for applications and it is easy to implement. AS is attractive when throughput is chosen as an important QoS parameter for MANETs. In addition, AS is more qualitative-oriented than quantitative-oriented[14] and it is not easy, if not impossible to provide much quantitative QoS in MANETs with the physical constraints. Therefore, AS has a potential usagein MANETs.

With all the promising aspects of MANETs with Differv, it is still not straightforward to adopt the DiffServ approach in MANETs since DiffServ is designed for fixed and relatively high speed networks. It is also desirable to incorporate suitable QoS features provided bv IntServ into MANETs.

VI. MANET CHALLENGES

A. *Internetworking*

Internetworking between internet and MANET (mainly IP based) is highly expected in addition to the communication with in ad hoc network. The routing protocols which is existing for communication is a challenge for the mobility management.

B. *Routing*

In the MANET environment there is not fixed infrastructure due to the changing of network topology. The issue of routing packets between any pairs of nodes becomes a challenging task.In MANET mostly the routing is based on reactive instead of proactive .multicast routing is another challenge because there is no static environment in the multicast tree due to the random movement of node with in the network.The communication between two nodes contain multiple hops rather than single hop,which is more complex in case of routing.

C. *Security and Reliability*

In addition to the common features of wireless connection, an ad hoc network has its particular security problems due to e.g. nasty neighbour relaying packets. The feature of distributed operation requires different schemes of authentication and key management. Further, wireless link characteristics introduce also reliability problems, because of the limited wireless transmission range, the broadcast nature of the wireless medium (e.g. hidden terminal problem), mobility-induced packet losses, and data transmission errors.

D. Power Consumption

For most of the light-weight mobile terminals, the communication-related functions should be optimized for lean power consumption. Conservation of power and power-aware routing must be taken into consideration.

VII. CONCLUSION

In this paper, we provide a brief overview on the Features of MANET, various application of MANET. QoS in MANETs is a new but rapidly growing area of interest. This great research and market interest is firstly because of the rising popularity and necessity of multimedia application and secondly because of the potential commercial usage of MANETs. we also presented an overview of the two best known IP QoS models such as Integrated Services and Differentiated Services. We argue that QoS support in MANET is fundamentally different from traditional networks because of its particular behaviors. we also point out the issues and challenges of MANETs. Thus QoS support in MANETs has become an unavoidable task. In this report we have tried to give a brief introduction to QoS issues and challenges in networks.

VIII. ACKNOWLEDGEMENT

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