QoS Routing for Multimedia Communication over Wireless Mobile Ad Hoc Networks:
A Survey

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ABSTRACT

A lot of intensive research has been carried out in the direction of providing multimedia communication over wireless mobile ad hoc network (MANET). In MANET, various QoS problems exist such as inefficient routing, handling node mobility, power conservation, limited processing capabilities of network devices, high error rates. Wireless routing introduces new challenges as applying basic routing algorithms directly on MANET could lead to large power consumption, interference, and load-balancing problems. Many routing algorithms have been proposed as extensions to the basic routing algorithms to enhance their performance in MANETs. This paper summarizes existing solutions on QoS routing and resource reservation mechanisms in order to provide multimedia communication over MANET. It also considers the limitations of existing QoS models with regard to satisfying QoS in serving multimedia over MANET. The newest QoS architectures give much better results in providing QoS support. However, more refinements must be proposed in order to enhance further their performance in MANETs.

KEYWORDS

MANET, Mobile Ad Hoc Networks, Multimedia Communication, QoS Frameworks, QoS Routing, Resource Reservation

INTRODUCTION

Delivering multimedia data over wireless MANETs has its own application domain, and also has its own challenges (Loo et al., 2012). Wireless MANET is a prominent solution in diverse emergency situations that require rescue operations, when disasters have destroyed the network infrastructure. There is no need to deploy any infrastructure to make MANET nodes to communicate with each other. The IEEE 802.11 wireless LAN can be implemented without any infrastructure or central controller (Crow et al., 1997). In ad hoc mode, all nodes participate in both data processing and routing task. The network also relies on the multi-hop type of routing for their data transmission. The concept of wireless MANET can give a new bloom to the multimedia industry because in MANETs we can provide the same without deploying any additional infrastructure. So, such networks can work in collaboration rendering services either without paying anything or paying a tiny share of revenue charged. In addition, we can define Quality of Service (QoS) models that will be used to provide the desired QoS efficiently (Nyambo et al., 2014). Existing high-speed networking and effective compression techniques utilize available bandwidth to serve a large number of connections, resulting in various multimedia applications. Basically, three types of multimedia services have been developed: accessing stored data, accessing live data, and accessing interactive data.

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The diverse nature of networked multimedia applications causes various problems because each application has its own requirements (Rao et al., 2002). An application might demand better quality data and can tolerate some acceptable amount of delay, while another application may be more sensitive to delay by compromising the quality of data. Every data flow of packets from a source to a destination in the network needs certain and prerequisite resources in order desired QoS to each individual flow to be provided. Obviously, the transfer of continuous media data (e.g. video and audio) need much more bandwidth than the transfer of discrete media (i.e. text or images–i.e. lightweight data). Also, a decision must be made in order to allocate proper bandwidth to each flow available in the network. For example, Vaidya et al. (2005) have proposed a distributed fair scheduling scheme that ensures that all packets will get a proper bandwidth of the wireless channel.

Multimedia applications can be categorized as per their delay requirements (Rao et al., 2002). Non real-time applications (e.g. image transfer) have no delay requirements, while real-time applications have delay requirements, and can be classified into hard real-time and soft real-time applications. Hard real-time application has very strict delay requirements and failure in satisfying them might result in hazardous side effect. It includes various applications like nuclear-reactor control system, missile control system etc. Soft real-time application has some delay requirements, but that are somewhat less strict than hard real-time application, where failure in satisfying the delay requirements would not result in any hazardous side effects. Examples of soft real-time applications are video-conferencing and video on demand. There is also an extra categorization. Non-interactive applications (e.g. video-on-demand) do not need any type of feedback from the receiver in order to continue application function. There is only the requirement of handling one-way traffic. On the contrary, interactive applications (e.g. gaming and video streaming) require some kind of feedback or commands from the receiver, so that application can proceed further. An interactive application requires two-way traffic, each of which is very much delay sensitive. In interactive applications, one single path may lead to network congestion ultimately affecting the overall network throughput and especially QoS (Rao et al., 2002).

In audio/video transfer, user may either download it or may allow for streaming. Audio/video streaming is preferable as it eliminates the end-to-end delay for user. However, streaming is more difficult to handle than simply downloading the contents, and the QoS may differ with the change of application raising to more difficult challenges. Different types of standards and techniques to successfully transmit multimedia over networks constitute the basic issues related to multimedia transmission. These research issues cannot be ignored, as they can also occur in wireless multi-hop networks. In addition, the wireless medium is very often influenced by the physical obstacles like noise, shadowing, interference and multi-path fading. During the transmission of text/images, these problems are insignificant, but for the audio/video transfer, these should be addressed properly. Actually, audio/video transfer demand better control over the end-to-end delay and minimum jitter (i.e. variation in delay). Moreover, if video or audio is live, these requirements are much more delay sensitive and should be handled strictly. Depending upon the type of access i.e. whether it is a point-to-point or multicast or even broadcast, the issues vary. For point-to-point communication, the network can provide better bandwidth to both end-points. However, in multicasting mode multiple nodes compete for the same wireless channel, resulting in interference. Broadcasting makes it worst, where every node is trying to get access to medium, which finally increases the interference levels of signal. The IEEE 802.11 uses distributed coordination function (DCF) as the basic medium access control (MAC) protocol or optionally it uses point coordination function (PCF). DCF makes use of the carrier sense multiple access with collision avoidance (CSMA/CA) scheme as a mechanism to deal with collision, and it increases the medium access delay in proportion to the load on the network (Wu et al., 2002). PCF uses a polling technique that aims towards providing the contention-free services.

Providing multimedia services over wireless MANET has many challenges:

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