Chapter 7

P2P Streaming over MANET and VANET

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ABSTRACT

Mobile Ad Hoc Networks (MANETs) and Vehicular Ad Hoc Networks (VANETs) as mobile wireless networks are challenging environments as there is no centralized packet routing mechanism. Packet delivery is normally multi-hop and may encounter out-of-range intermediate network nodes on the routing path. There may be problems of energy consumption in MANETs and of constrained routing paths in VANETs. Consequently, introducing real-time video streaming into these environments is problematic. Peer-to-peer (P2P) streaming from multiple sources is a way of strengthening video streaming in these circumstances. In this chapter, P2P streaming is combined with various video error resilience mechanisms that mostly take advantage of the multiple paths available in such networks. As video streams are sensitive to errors the impact of wireless channel errors should be assessed and, for VANETs, realistic mobility models should be modeled, especially in urban settings. The chapter looks in detail at how video source coding can assist in the protection of video streams, in that respect comparing various forms of multiple description coding.

INTRODUCTION

The ever increasing growth of wireless technologies together with the benefits of employing such flexible systems has made them likely to be used for real-time multimedia communication. Wireless networks allow users to communicate anywhere, anytime, and on-the-fly. Mobile Ad hoc Networks (MANETs) are a type of pervasive network that truly support pervasive computing. Future advances in pervasive computing rely on advancements in mobile communication, which includes both infrastructure-based wireless networks and non infrastructure-based MANETs. The traditional infrastructure-based communication model is not adequate for today’s user requirements. In
many situations, communication between mobile hosts cannot rely on any fixed infrastructure. The cost and delay associated with installation of infrastructure-based communication model may not be acceptable in dynamic environments such as disaster scenes, battlefield, and inter-vehicular communications. MANETs are an effective solution in these scenarios.

In most emergency scenarios, whether they are man-made or natural disasters, it is essential that rescue personal can communicate with each other when they are moving around the disaster area. However, the disaster itself may well have removed the communication networks within the vicinity. Usually in the case of a natural disaster the communication infrastructure is destroyed. Therefore, in such conditions there is need for a communication network that does not depend on any infrastructure. Various technologies present themselves such as satellite, IEEE 802.16 (WiMAX), and wireless mesh networks, all of which can employ IP routing. A MANET is such a network that does not require any pre-existing fixed network, allowing rescue teams to communicate whether they are on foot equipped with handheld devices or travelling on vehicles, when the network is usually known as VANET (Vehicular Ad Hoc Network) or Car-to-Car network. Real-time video transport over an ad hoc network is a challenging task, owing to the dynamic topology, the absence of an established infrastructure for centralized administration and the limited processing and power capabilities of mobile terminals.

Much research has been carried out to provide solutions to sharing information in the form of data or images. However, very little effort has been put into examining communication of video over a MANET or a VANET. Real-time video can better describe the current conditions or give a clearer picture of the disaster area than textural data or just images. The motivation of this Chapter is to assess robust Peer-to-Peer (P2P) video streaming over these infrastructureless networks. P2P streaming and MANETs have turned out to be two of the most active research areas for pervasive computing. P2P systems offer the means to realize decentralized networks, which can be used to share resources over the internet. On the other hand, a MANET is a spontaneous network made of mobile nodes connected wirelessly but without relying on a specific infrastructure network. These areas were developed independently of each other with the result that there is insufficient verification of whether the P2P distribution paradigm and specifically P2P real-time video streaming would work on MANETs. Along with that, there are still several issues to be addressed if MANET is to be employed for highly demanding, real-time multimedia applications. More specifically, more robust solutions are required to ensure that the delay, jitter (variation of delay) and packet loss requirement of real-time multimedia applications can be satisfied for communication over unreliable, time-varying ad hoc network. Fortunately, multimedia applications can tolerate a certain level of packet loss depending on the application, error concealment strategy at the receiver side, and compression scheme adopted.

Thus, to achieve acceptable wireless ad hoc video communication in general, and wireless video in particular, a number of key requirements need to be addressed. Firstly, there should be a solution for easy adaptability to wireless bandwidth fluctuations due to channel interference, dynamic topology and cross (competing) traffic. Secondly, it is necessary to provide robustness to partial data losses due to high packet error rates. Thirdly, energy issues are becoming important – particularly how to avoid mobile devices remaining awake for longer periods than is necessary in order to act as streaming sources. Fourthly, the problem of proving security on mobile devices with limited computational resources will require lightweight security solutions. Finally there should be support for multiple sources with multiple paths to cope with nodes leaving the network or suffering adverse channel conditions. However, this Chapter is primarily concerned with video streaming issues and cannot pretend to cover all these requirements.
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