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TCP and UDP QoS Characteristics on Multiple Mobile Wireless LAN

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Abstract

The improvement of Quality of Service (QoS) in mobile wireless LANs is a challenging task as it has a different characteristic. This paper aims to present an explanation about protocols used on the multiple mobile wireless LANs, making a comparison between the results of previous experiments and propose a new protocol to improve results in QoS Characteristics on Multiple Mobile Wireless LANs (m-WLAN).

Keywords: m-WLAN, QoS, Access Point, Interferences, Throughput

Introduction

The development of technological industries and development in the science of wireless communication enable mobile users to connect via the Internet anywhere. Wireless devices have become very popular because of their small size and easy to carry and no need a wire to connect the Internet. In addition, the Mobile routers that are defined as movable access points connected to the Internet can accommodate more than one mobile device. A system that contains a mobile router and associated devices called a mobile WLAN (m-WLAN).

m-WLAN and different wireless technologies use IEEE802.11 standard that can be integrated at the network layer and use the Medium Access Control (MAC) protocol to provide data link layer, provide addressing, channel access control, and allows the terminals to be connected with access point in network that contains multiple access.

The QoS can be measured by several ways like bandwidth, delay, throughput, reliability and cost. QoS policies for wired networks are not directly applicable to wireless networks as the fundamental characteristics of the underlying link layers differ significantly and some layers of the IP stack are also affected [1].

There are many problems have an influence on the data transfer among Access Points (APs) in multi-hop networks and in handovers due to interference signals, obstruction by objects, and reflection. For many years, researchers interested in reducing the error rate resulting from APs in multi-hop networks and in handovers. When deals with fixed APs the solutions like power control are effective. However, because mobile APs and associated terminals are often move, so it is difficult to control the power for mobile APs, and therefore, an investigation is needed for m-WLANs. Authors [2] has already investigated the capacity characteristics of m-WLANs by theoretical analysis and simulation when multiple m-WLANs come close together.

In this study we will investigate on flow level throughput characteristics by using Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) in the case of multiple m-WLANs that share a single Carrier Sense Multiple Access / Collision Avoidance (CSMA/CA) domain, making a comparison between the results of previous experiments and proposing a new protocol to improve results in QoS Characteristics on Multiple m-WLANs.

Literature review

The main idea behind designing the internet that all the hosts are static and every host have a unique IP address that identifies its point to the network, otherwise in the wireless mobile network where a node change its point. The IP/network layer provides a solution to this problem [3].

There are many types of wireless network such as Personal Area Network (PAN), Wireless Local Area Network (WLAN) and cellular wireless networks [4]. 802.11 is a standards for WLAN technology, 802.11 uses a CSMA/CA-MAC protocol to access the wireless medium; where a sender take a permission from receiver to transmit data [5].

The description of user behavior in wireless network has been a subject in last years. Therefore, there are many examples allowing the network designer to design setting some network parameters such as the number of APs and users. Furthermore, these models are designed to take the characteristics of existing wireless networks and it is not clear if these models are representative wireless networks deployments in future [6].

There are numerous researches to support QoS in wireless networks. Furthermore, there are many protocols used to enable QoS routing via multi-paths using a link state mechanism to reduce protocol overhead [7]. There's protocols aim to satisfy bandwidth of flows between source and destination by using multiple paths, and collects link-state information from sender to receiver in order to construct a partial topology at the receiver, which chooses multiple paths from the source to itself that can satisfy the bandwidth requirement collectively[8]. Other related work on QoS in wireless mobile networks in [9, and 10].

The TCP and UDP are transport protocols most commonly used today [11] which are used between two hosts on the Internet to provide connection between them that would be static and not mobile. To merge TCP or UDP into the wireless environment it raises a number of issues, such as packet loss in wireless environment and congestion [12].

However, it is necessary to know the flow level quality such as TCP/UDP throughputs and losses, to design controls for various applications.

This paper focuses on improvement QoS characteristics in the TCP and UDP levels when multiple m-WLANs closeness to each other.

Explain QoS Characteristics at distance of multiple m-WLANs

To describe the QoS characteristics of m-WLAN, previous researchers categorized the characteristics into three state states; State-1, State-2 and State-3 have different QoS characteristics and different implications of interferences. As shown in Fig.1, m-WLAN-1 and m-WLAN-2 are independent, and each m-WLAN system has a mobile router that is denoted as AP, and wireless terminals and a receiver terminal are connected to the AP. Mobile routers behave as APs and use the same channel. Each wireless terminal sends an uplink flow of TCP or UDP toward the receiver terminal through the AP. Fig.1 clarify three distance cases between two m-WLANs in the three states. An m-WLAN distance, *d*, is defined as a distance between APs. In the models, AP and connected terminals in the same m-WLAN are placed close enough with each other to use the whole capacity of bandwidth if the m-WLAN has no interferences. The Dashed lines indicate virtual areas of carrier sense domains.

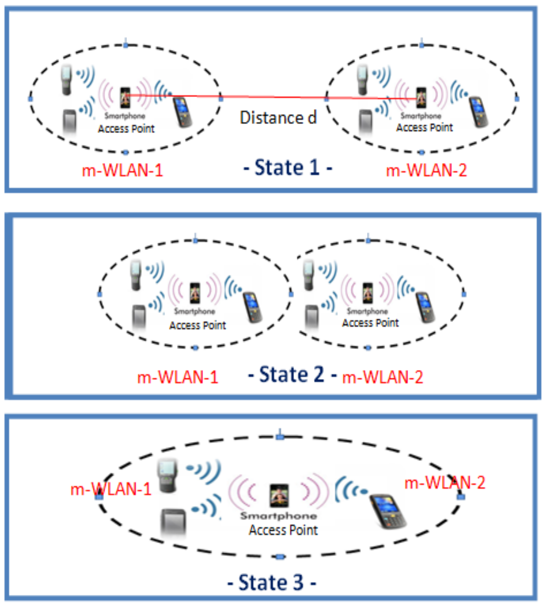

Fig. 1: Three States Model

In State-1, an m-WLAN does not suffer from other m-WLANs because the m-WLAN distance d is large enough to receive interference from other m-WLANs, even the radio signals reach from other devices will be weak to cause bit errors.

In State-2, the m-WLANs became close and the distance short, so the radio signals affect each other by bit errors and carrier busy. Thus, each terminal must wait to send data, and they also cause a bit error. Therefore, the throughput of the TCP and UDP decreases by carrier busy, retransmission and back-off, because the distance has became short and the interference signal becomes large.

In State-3: An m-WLAN completely includes other m-WLANs in its CSMA/CA domain. In this state, multiple m-WLANs that use the same channel share a CSMA/CA domain. For this reason, all of the terminals and APs of all of the m-WLANs share a single CSMA/CA channel.

The state can be various in different places and in various system configurations. Moreover, not only the distance d determine the state, but also time and other factors that change the interference like obstruction by objects, and conditions contribute to device performance characteristics.

Comparison between the previous results of TCP and UDP QoS Characteristics on m-WLANs experiments

To know the values of flow level throughput, previous researchers made the experiments with real machines [13] consisting of two m-WLANs, that means two APs and several terminals as in Fig.1.

Throughput of each flow in the three states was determined according to the distance *d* between the m-WLANs. Two asymmetric models in terms of the number of terminals and a symmetric model were examined for TCP and UDP Throughputs as follows. Considering a real situation, smart phones were used as portable wireless terminals.

Model A was a symmetric, the number of terminals in m-wlan1 equals the number of terminals in m-wlan2, and both used TCP protocol, in state 1 when the distance d was 24 m or more, each m-WLAN had 20 Mbps in each total throughput. In model B was asymmetric and the number of terminals in m-wlan1 less than the number of terminals in m-wlan2, and used TCP protocol, each m-WLAN had 20 Mbps too. In model C which was similar model B but used UDP protocol, the total throughput was a little higher than that in Model-A and Model-B because UDP yields fewer overhead, since it has unidirectional flow and had no ACK/retransmit traffic.

In state 2 the throughput was lowered as the two m-WLANs were brought to 2 m. The UDP and TCP show different characteristics. At distance less than 2 m the two m-WLANs completely shared one

CSMA/CA domain and showed 20 Mbps in total throughput of the two m-WLANs.

In model B, the throughput of m-WLAN-1 per flow was 5.6 Mbps, while that of m-WLAN-2 was 0.6Mbps. Therefore, total throughput of m-WLAN-1 and m-WLAN-2 were 11.2Mbps and 4.8Mbps, respectively. This means the total throughput is unfair between m-WLANs [13].

Proposed System

High conflict rates in multihop mobile wireless networks constitute an issue that has to be resolved in order to achieve throughput quality in such mobile networking environments [14].

The interference problem among the most important problems that have to be solved for ad hoc networks QoS capable and to be efficient, and widely applicable.

We will propose two options to solve the interference problem. First, we propose the evolvable interference management (EIM) approach for MAC in m-WLANs. We present different suitable techniques for EIM, enabling it to produce a series of EIM protocols to optimize the QoS characteristic and environment of m-WLAN.

EIM employs several techniques as "components" or "tools" to resolve different problems or to achieve certain advantages. These techniques include interference control techniques such as sensitive CSMA-based interference avoidance techniques.

The proposed EIM approach is that it is not a MAC, routing, QoS, security protocol optimized for present or a given future time frame, but it is a framework that can generate MAC, routing, QoS, or security protocols optimized for future advanced technologies such as multi carrier CDMA, new application environments such as sensor networks, and so on.

However, to utilize the radio resources and power of m-WLAN networking, a new MAC protocol of IEEE 802.11/11e is needed. We propose powerful EIM techniques for tackling the QoS problems, power control, and interference.

An EIM scheme called GAP as proposed in [16] based on several EIM techniques, which can serve as an example explain how such techniques may work together.

To control and reduce lower-power transmissions, in a multichannel environment we can reduce the range of power levels that are allowed to be used for each channel. We refer to this strategy as the differentiated multichannel scheme [17].

In this scheme, by CTS messages medium/low-power transmissions are guaranteed to be protected. Moreover, this scheme does not rely on high-power CTS messages or interference engineering, considering reducing the control overhead. As a result, better link quality can be supported for such medium/low-power transmissions. Interference engineering may also be used to enable CSMA-based transmissions of smaller data packets.

In the detached dialogues approach (DDA), the reserved data packet is postponed by a postponed access space (PAS)[18], [19], [20] after the associated interference /sensing-based signaling. In other words, nodes capable can have access to the channel in advance and reserve in the future as timed reservation [18]. Moreover, all the control messages and the related data packet can be separated from each other.

When the DDA technology is mature, this approach may become a desirable to avoid some difficult problems or efficiently supports other mechanisms. It may also become a good tool, for example, for quantity or providing QoS guarantees in a distributed manner. More details and performance evaluation results can be found in [19].

In Routing-based techniques, such as selective table-driven routing [21], radius-oriented ad hoc routing (ROAR) [22], embedded routing [23], as well as other appropriate routing techniques, it can be used to avoid links with low quality or suffer from the interference problems or high collision rates. This strategy is similar to the link-oriented prohibition-based patching approach. However, this technique can be applied on m-WLAN to avoid the interference problems.

Second, we will propose an ad hoc routing protocol that is built up on the bandwidth of links. And use the data rate and bandwidth interchangeably. To increase the probability of successful transmission two wireless APs may choose different transmission rates in order, depending on the channel conditions. Because the standard 802.11b wireless LAN can support 11, 5.5, 2 and 1 Mbps bandwidth rate, while an 802.11a wireless LAN can support up to 8 different rates[15].

In the bandwidth m-WLAN routing protocol, a node chooses its nearest neighbor based on the link bandwidth. Assume that a node Ni has two neighbors Nj and Nk, the link from Ni to Nj has a transmission rate of 11 Mbps and the link from Ni to Nk has a transmission rate of 5.5 Mbps, then the m-WLAN routing protocol will select node Nj as the neighboring node since it corresponds to a higher bandwidth.

Note that it is now that a route from a source to a destination is not the least hop count route as is generally the case in m-WLAN routing; APs are now high bandwidth routes. High bandwidth routes may not necessarily be least mobile wireless count APs.

Conclusions

Multiple m-WLANs that use the same channel suffer from interference with each other. Three state models explain flow level throughput used the distance between the m-WLANs. The characteristics depend on the radio signal interferences and device implementations. In multiple m-WLANs, TCP and UDP showed different characteristics because of congestion control and retransmission nature in TCP. An unfairness problem occurs between m-WLANs in the case of having various numbers of terminals when the m-WLANs share a single channel capacity with CSMA/CA.

A fundamental source of problems for many important requirements, including QoS, fairness and energy efficiency, is interference, complicated by their inherent mobility characteristics. By mitigating or resolving the interference problems in mobile networks, we can achieve reduced collision rate, fairness and better quality, and increased throughput.

By using advanced techniques for interference management, more objectives can be achieved. For example, energy consumption can be reduced and connectivity and coverage can be increased due to smaller interference achieved, and maximum transmission rate can be further increased.

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