A Demonstration of Video over a User Centric Prioritization Scheme for Wireless LANs

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***Abstract*—Due to the unreliable nature of the wireless medium, provisioning of the Quality of Service (QoS) in wireless LANs is by far more complicated than in wired networks. In this demo we show the efficiency of a new QoS support scheme that is based on an user centric approach. The new mechanism takes under consideration the identification of the station that generates the traffic additionally to the traffic itself. Therefore, it uses a second prioritization level on the top of the one that is implemented in IEEE 802.11e. It first defines groups of stations based on their MAC addresses and it assigns different priorities to different groups. Under this classification, stations are served based on the prioritization of the group they belong. Among stations with same priority, traffic is scheduled based on the priorities given by 802.11e. The new scheme is implemented using open source drivers and 802.11g WiFi cards. In the demo, a video clip is streamed from a server to a client with high priority under heavy traffic load. The underlying wireless transport alternates between the classic IEEE 802.11e and the new prioritization scheme. The new scheme delivers a smooth and jitter-free user experience, while the video playout over IEEE 802.11e experiences noticeable jitter and frequent distortions. The demo clearly demonstrates the performance superiority of the new implemented scheme, as compared to the legacy IEEE 802.11e.**

I. The New Prioritization Scheme for QoS

As the number of wireless networks increases, there is a tremendous need for management of the wireless bandwidth. Due to the nature of the wireless medium, the number of wireless users that are connected simultaneously to an AP can vary by a lot. Considering that all the users share the same bandwidth, it is hard to define a clear notion of the quality of service guarantees in a wireless environment. A representative example of this difficulty is that the bandwidth that is assigned to a particular wireless station can be the whole available (if the station is the only active user associated with an AP) or can be 20 times less (if 19 more users are active in the cell).

In such an unpredictable environment where people that are connected to an AP come and go dynamically, there are users that should prevent their bandwidth no matter what the number of stations in the network is. In this demo, we present a new prioritization scheme that schedules packets in the network based first on the identification of the station that generates the traffic and then on the traffic itself. In this scheme we use a two levels prioritization scheme [1]. We define groups of stations based on their MAC addresses and we assign different priorities for each of them. Among stations that have the same priority, traffic is scheduled based on the priorities given by 802.11e. Using such a scheme the wireless network can guarantee different QoS characteristics to different groups of users, based on their characteristics and their needs.

Under the new scheme, the MAC transmission process in the downlink of the AP has modified as follows: Every packet is pushed on an appropriate QoS queue depending on the intending receiver (and its priority) and then on the service that generates this packet. The AP maintains information about the associated stations (their MAC address) and their assigned priority in a table called *Priority Table*. Based on this table the AP schedules packets of different stations accordingly.

II. Implementation of the New Prioritization Scheme

The implementation of the prioritization scheme in this demo is based upon *MadWiFi* [2], which is an open source IEEE 802.11a/b/g Linux driver for the *Atheros* chipset. We choose this combination of driver/chipset because it allows building prioritization schemes by offering a multi queue framework based on the IEEE 802.11e standard.

In order to implement the new scheme, we built the new functionality using the 802.11e framework and we built the two level prioritization scheme. In the first level, the priority is assigned based on the stations ID (MAC address), while in the second level it is based on the traffic characteristics. By extending the basic structure VAP [3] of the driver that keeps all the necessary information related to the AP (including information about the associated stations) we implemented the functionality of the Priority Table.

III. Demonstration of Video over the New Prioritization Scheme

A. Demo Configuration

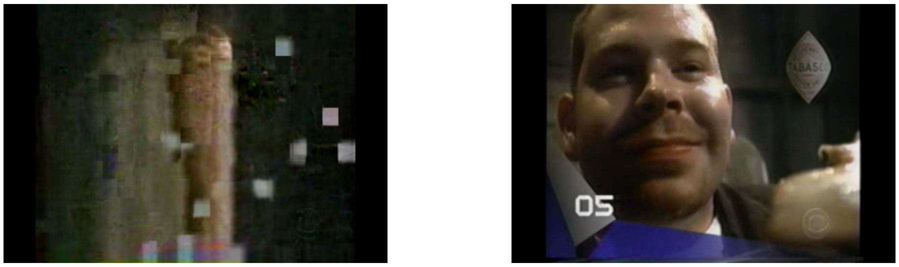
The demo consists of 4 laptops, whose basic configurations are outlined in Table I.

TABLE I: Basic Configuration of Mobile Stations

Model	HP 530 Notebook PC
CPU /Memory	Intel Celeron M 1.60 Ghz / 512 MB
Operating system	Fedora Core 8, kernel ver 2.6.16
802.11 NIC	NL-5354CB+ Aries2(f), PCMCIA
802.11 Chipset	Atheros AR5004+

One of the laptops is used as an Access Point (AP) and the other three as associated stations. One of the stations is a low priority station ($station1$). The second one is a high priority station ($station2$) and the third one generates voice traffic into the network and it does not actively participate in the demo.

Two sections of video transmission are considered in the described testbed. Two VLC [4] servers are placed at the AP and constantly stream different commercial video clips to stations 1 and 2. The destination stations run a VLC media



(a) Legacy 802.11e (b) new Prioritization Scheme

Fig. 1: Video Quality Comparison: A Snapshot.

player to play their video. Additionally to the traffic generated by the two video streams, an $iperf$ [5] video stream runs periodically from $station3$ to the AP, in order to increase the traffic load of the network. We alternate on-the-fly the MAC protocol in the network between 802.11e and then new prioritization scheme. We observe the changes in video quality at station 1 and 2 for the different MAC protocols. Figure 2 depicts the demo setup.

B. Demo Description

The demo consists of three sequential phases, as outline in Table II. Once all three phases are completed the cycle starts from the beginning.

TABLE II: Three Phases in the Demonstration

Phase 1	IEEE 802.11e is active in the network. There is no additional traffic except for the two video streams. The quality of the video is acceptable at both stations.
Phase 2	IEEE 802.11e is active in the network. Additional voice traffic is generated by $station3$. The quality of the video becomes bad at both stations due to the heavy traffic in the network and the high priority that voice traffic has.
Phase 3	The *new prioritization scheme* is active in the network. The quality of the video at $station2$ (high priority station) upgrades appreciably, although the heavy traffic in the network. $Station1$ keeps having bad video quality.

As described in Table II, in phase 1 both the stations enjoy good video quality under legacy 802.11e, since the network is not congested. However, in phase 2, $station3$ participates in the network and generates heavy voice traffic (using a special flag in $iperf$). Since voice has higher priority than video, voice traffic kills the video traffic and therefore the video quality is poor in both stations. Noticeable freeze and distortion occur

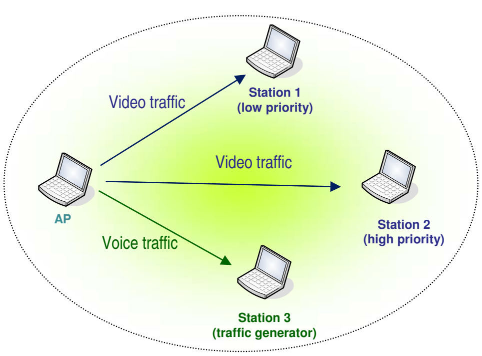


Fig. 2: The Demo setup.

frequently. Once the MAC protocol switches from 802.11e to the new prioritization scheme, the AP gives priority to $station2$ (high priority station) over any other station in the network. Therefore, the video of $station2$ in phase 3 is smooth and has very good quality. Figure 1(a) and 1(b) provide a snapshot of the video taken at $station2$, the first when 802.11e is active and the second one when the new scheme is active. The comparison of these two figures is typical and reveals the substantial improvement in the video quality that the new scheme can deliver.

C. A Graphical User Interface: PriorityGUI

To facilitate experiment configuration and simplify user participation, a graphical user interface (GUI) called *PriorityGUI* has also been developed. Based on Java SDK 1.4 for Linux, PriorityGUI communicates directly with the driver of 802.11, and obtain the corresponding state information and parameters such as the MAC address of every station that qualifies for high priority. The PriorityGUI displays the content of Priority Table. Using the GUI we can also dynamically change the Priority Table in the driver by removing or adding MAC addresses. A snapshot of the window of PriorityGUI is depicted in Fig. 3.

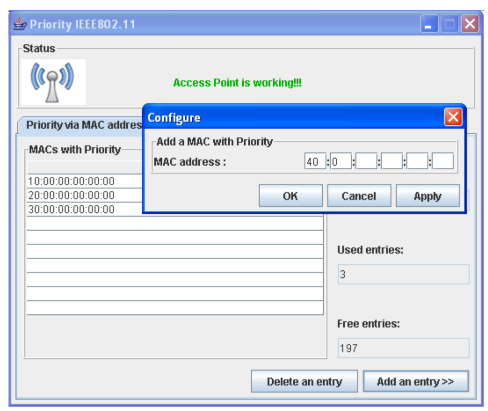


Fig. 3: The Priority GUI.

References

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