New Prioritization Schemes for QoS Provisioning in 802.11 Wireless Networks

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Outline

- Motivation
- New prioritization schemes
- Implementation of the schemes
- Results
- Conclutions

Motivation

- 802.11e was designed to provide QoS support for WiFi networks.
- It prioritizes based on the service characteristics.
- Although it is a sophisticated framework it fails to handle “user based” QoS needs.
  - In an enterprise environment differentiation of services provided to employees and visitors.
  - In a home environment differentiation between “home users” and neighbors who “borrow” ☺ the service.
  - Differentiation between “golden” members, “silver” members, etc.
- A possible extension is a “content-based” prioritization in the same philosophy as the “content-based” routing

Two new Prioritization Schemes

- Two new prioritization schemes that are based on
  - the identification of the stations that generate the traffic or
  - the content of the packets
- We implemented them using the open source driver *MadWiFi* and commercial Atheros WiFi cards

QoS Provisioning in IEEE 802.11e

- The basic framework includes 4 priority access/class queues, that are used by the services BK, BE, VI and VO.
- Distributed and Point are replaced by new Hybrid Coordination Function.
- Traffic Categories (TCs) are introduced and correspond to the appropriate Access Categories (ACs).
- There is an AC for each service.

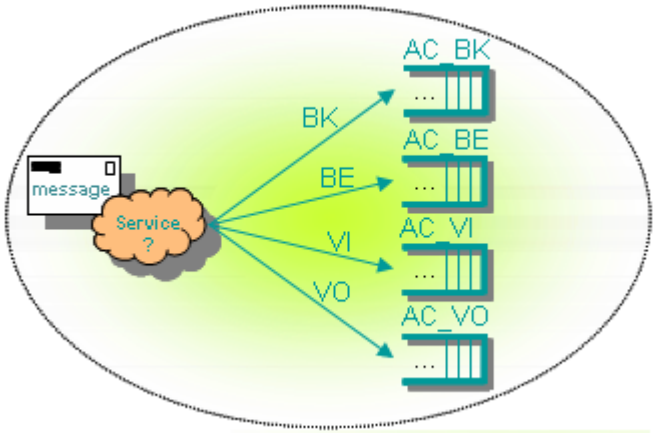
The “User Centric” Scheme

- In IEEE 802.11e, there is no way for the AP to identify different stations and share appropriately the medium.
- Solution: Defining priorities for different groups.
- Once the total demand exceed the available bandwidth, higher priority stations get more bandwidth than low priority ones.

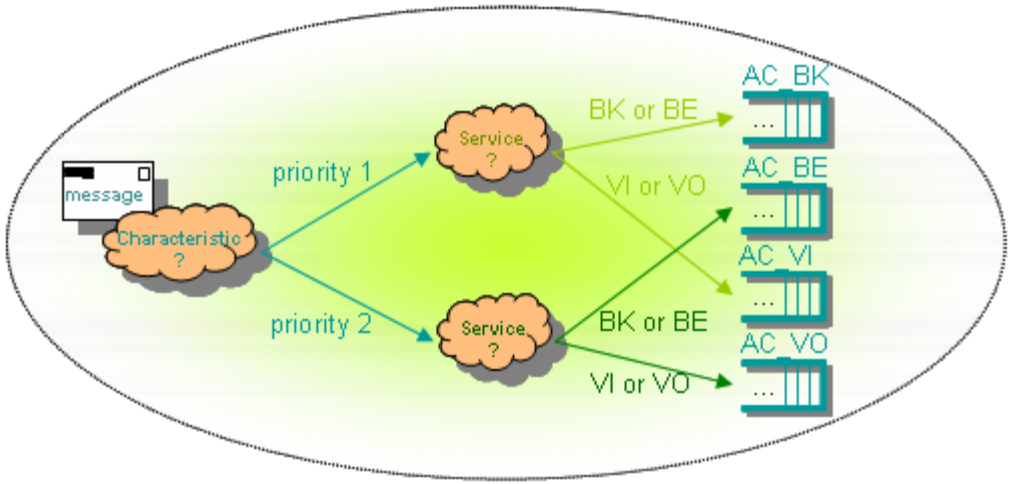
The “User Centric” Scheme (cont)

- It is defined as an extension of the existing 802.11e framework.
- New prioritization level based on the identity of the stations.
  - *Before*: Every packet was pushed to the appropriate queue, based on the service that generated the packet.
  - *Now*: AP checks if the receiver of the packet requires higher priority, then the service that the packet belongs to, and later classifies the packet.

The “User Centric” Scheme (cont)



classic, one level



new, two levels

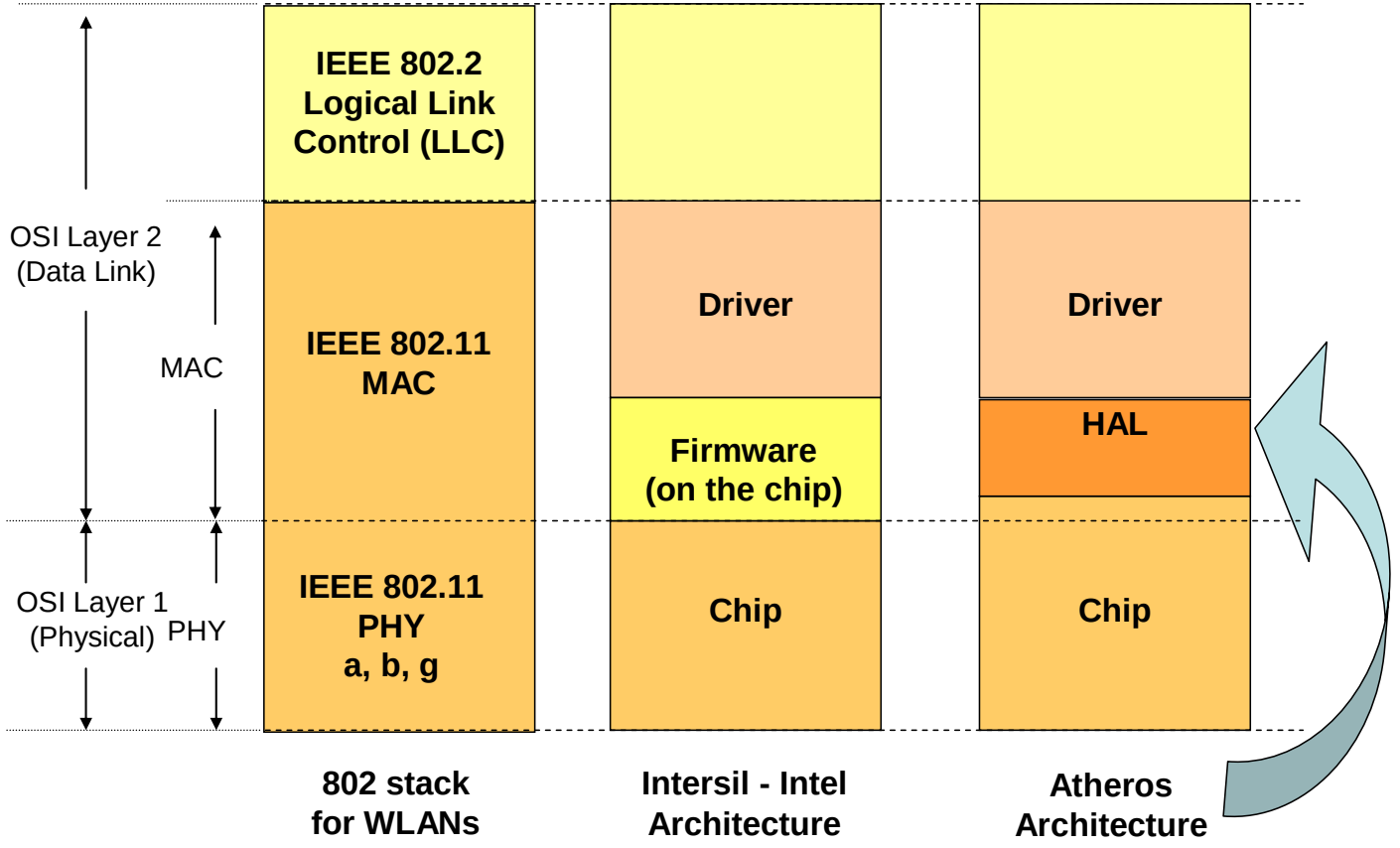
The “Content-based” Scheme

- Similar to the previous scheme.
- Instead of prioritizing based on the id of the station we consider the contend of the payload of the packet.
  - Examination of particular criteria that we apply in the payload (e.g. examination of the values of particular attributes in the payload, currently examination of the existence of particular words or phrases in the payload).
  - If they are valid, the packet gets higher priority.
- It can be implemented using two levels of priorities, similarly to the “User Centric” Scheme.

Implementation of the Schemes

- Linux open source MadWifi driver for commercial WiFi cards with Atheros chipsets.
- Most MAC functionality is implemented in the driver.
- The way packets are handled in the transmission process and how they are pushed into the 4 queues is controlled by the driver.

Implementation of the Schemes



Introducing 2 levels of prioritization

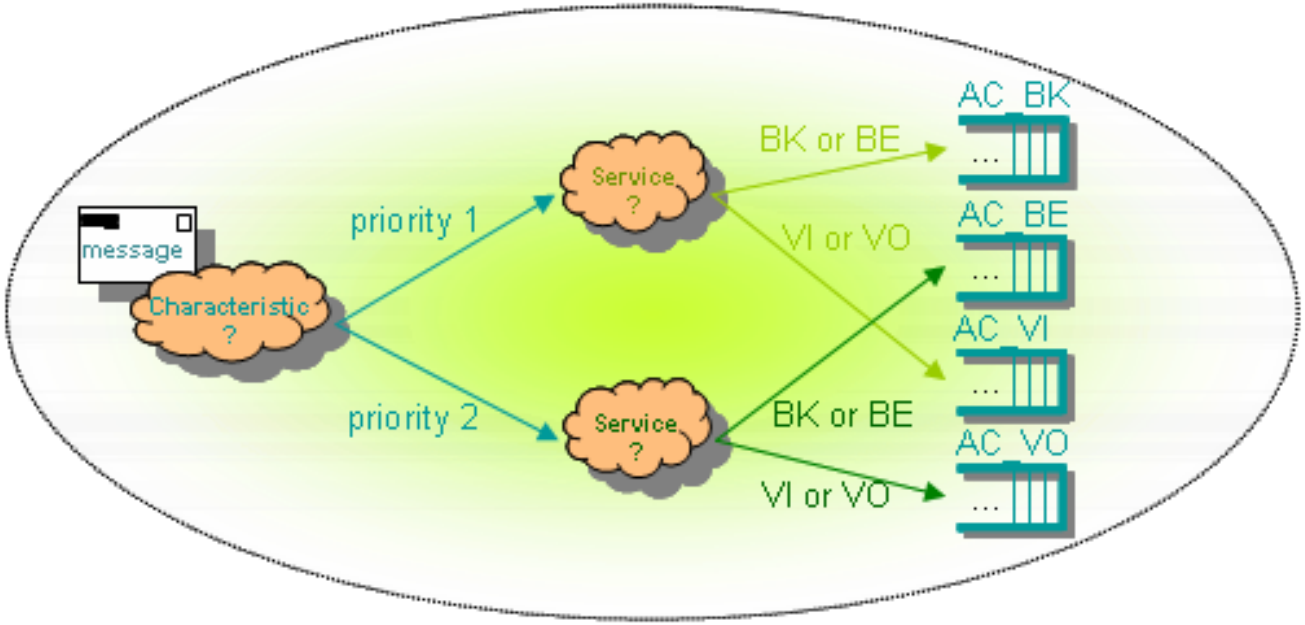
- Definition of two priority groups.
- Modification of AP functionality of MadWifi and definition of two tables we call *Identity* and *Content Priority Table.*
  - *Identity Priority Table* maintains info about the MAC address of all associated stations and their priority.
  - *Content Priority Table* maintains info about the criteria for packets with high priority.

Main points of the implementation

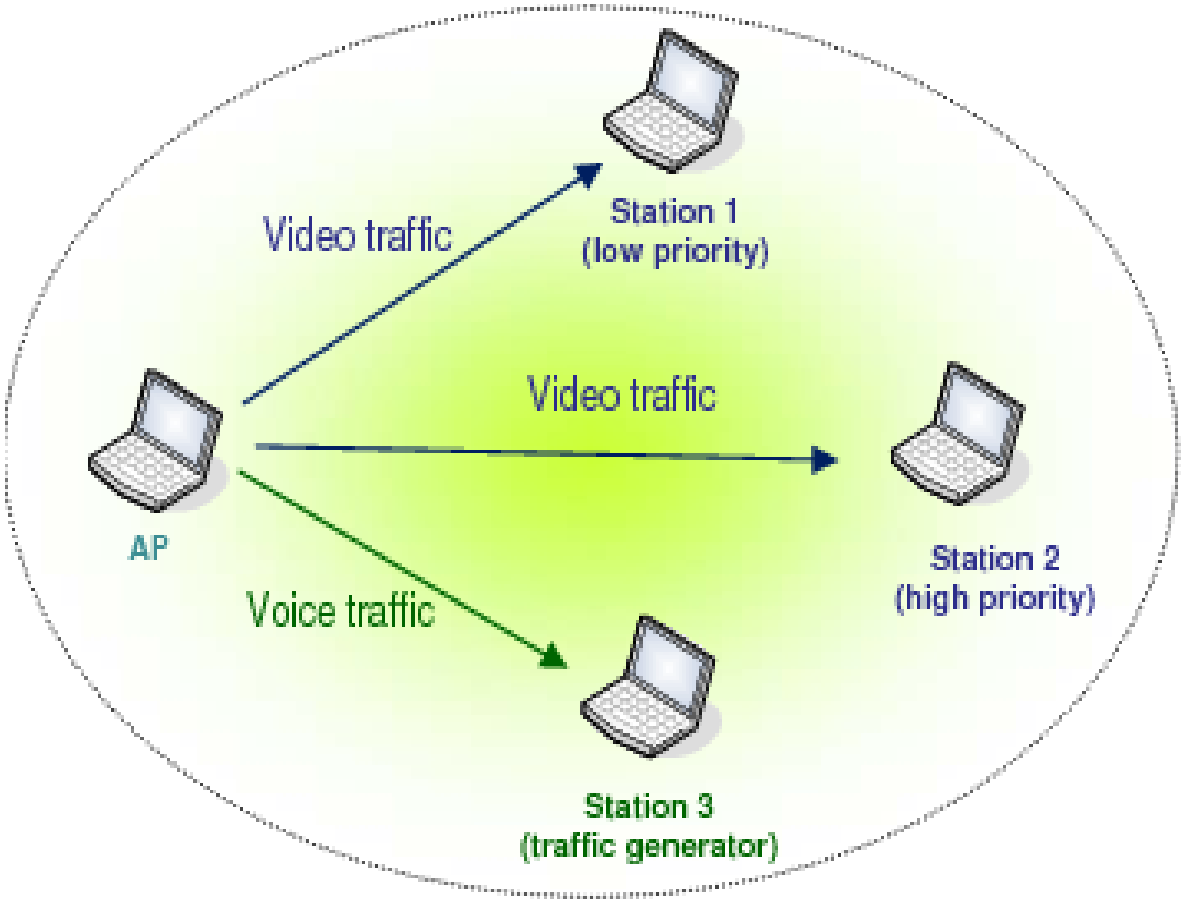
- *Development of the Priority tables* using the structure Virtual Access Point (VAP).
- *Assignment of priority* to each station or criterion by developing a Graphical User Interface (GUI)
- *Definition of high and low priorities as 1 and 2*.
- Priority 1 to queues BK and VI, priority 2 to queues BE and VO.

Implementation of the schemes

Two levels of priority definition



Setup for Experiments



Experiment Phases

- Phase 1: *IEEE 802.11e is active*. The quality of the video is acceptable at both stations.
- Phase 2: *Additional voice traffic is generated by station 3*. The quality is bad at both stations
- Phase 3: *The new prioritization scheme is active*. The quality at station 2 (high priority station) remain good while the quality of station 1 (low quality station) is low, due to the additional voice traffic.

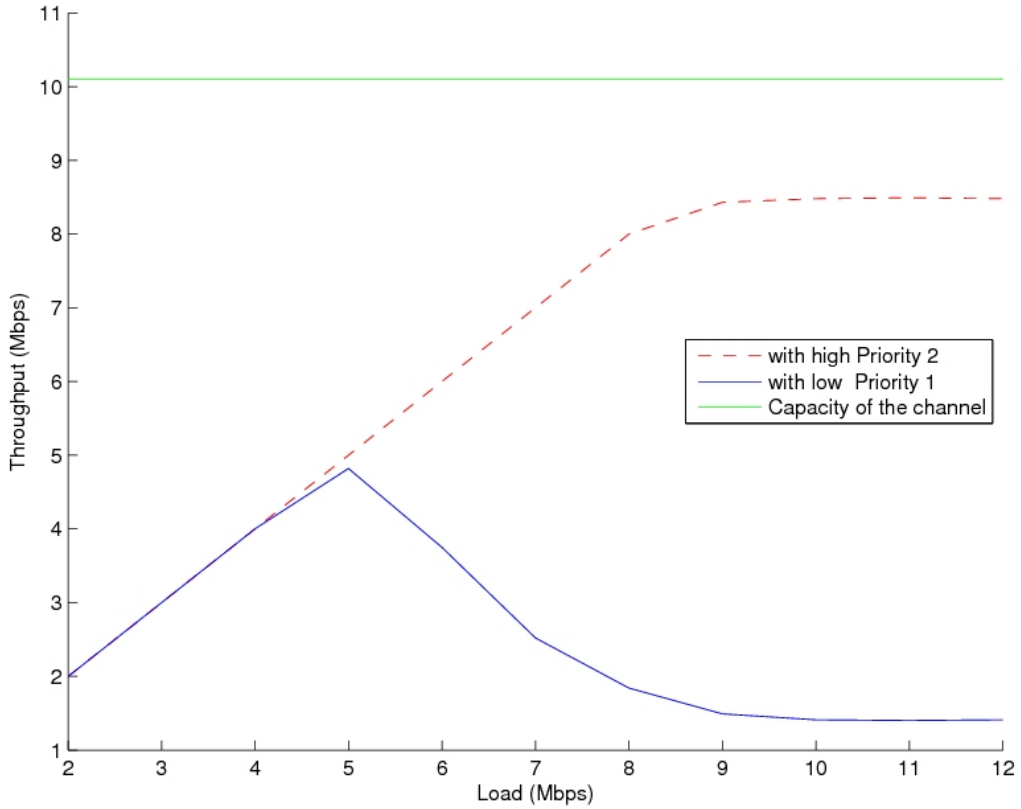
Results

The new prioritization scheme

Low priority station

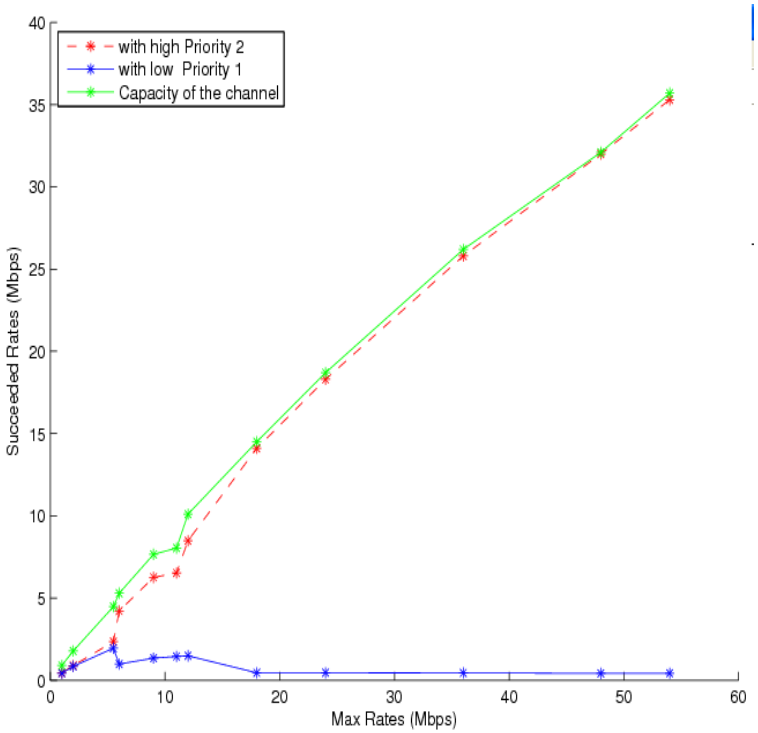
High priority station

Further Results - Throughput

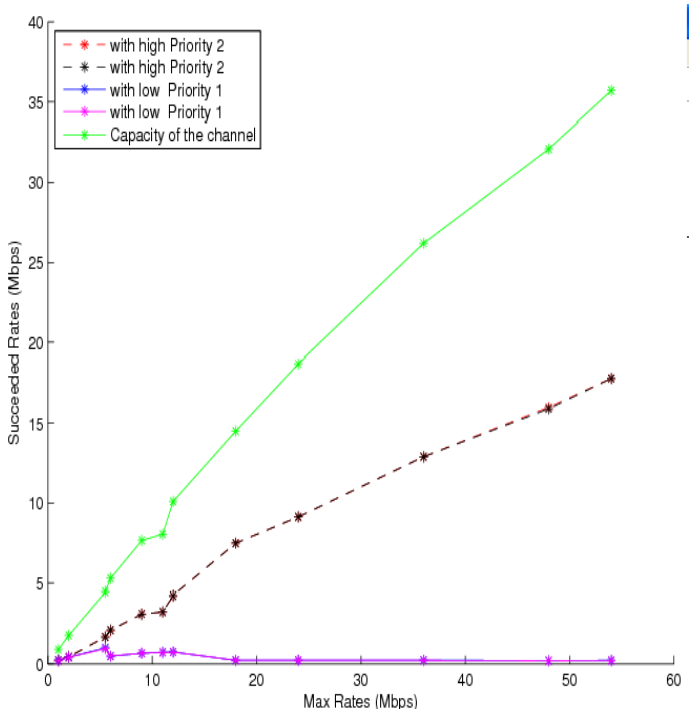


Two stations: One with low priority and one with high
Load increase (using iperf)
Max rate: 12mbps

Further Results - Succeeded Rates



Two stations: One with low priority and one with high



Four stations: Two with low priority and two with high

Heavy load for different max rates

Conclusions

- Network is managed in a more efficient way by adding more sophisticated ways of prioritizing stations (user based, content based)

Future work

- Extension of the implementation to incorporate the prioritization scheme on the uplink traffic
- Content based prioritization will support more advanced classification mechanisms (more advanced queries).

Thank you!!

Questions?

Implementation of the schemes