Introduction

Motivation
- Strong market indicators of a demand for mobile video.
- Increasingly powerful and efficient handsets. Higher data rates provided by faster, more sophisticated infrastructures.
- UMTS/HSDPA has a higher global market penetration than any other mobile communications technology.

Goal
- To improve video quality in UMTS/HSDPA networks through the use of Active Queue Management to reduce the number of high priority video frame packets dropped due to network congestion.

Why is this of interest?
- Main research focus has been on HSDPA scheduling mechanisms; little has been done to optimize buffer management.
- Buffer management research has focused on the MAC-hs layer.
- Some buffer management research in the Radio Link Control (RLC) layer but focus was on loss due to packet expiration.

Video Encoding

- MPEG encoding produces an MPEG group of pictures containing I (most important), P and B (least important) frames.
- Less important frames depend on higher priority frames.
- Removing an I frame effects all the P and B frames that rely on it and drastically reduces video quality.
- Frame type can be used as a priority mechanism for Active Queue Management.

Active Queue Management

Three AQM schemes were evaluated:
- Drop-Tail - default implementation in RLC layer.
- Differentiated Services - drops packets for a particular frame type with a probability calculated from the average queue length and a set of min. and max. thresholds for each frame type.
- Priority Drop Tail - attempts to hold on to all high priority frames and preferentially only drop low priority frames.

Results - Quality of Service

- When examined on a frame-by-frame basis, better quality is obtained for some frames using the Differentiated Services scheme and even better results are seen with the Priority Drop Tail scheme.
- QoS measurements were obtained using the Peak-Signal-to-Noise ratio (PSNR), Mean Opinion Score (MOS), end-to-end delay and packet loss.
- Better PSNR and MOS results obtained for Priority Drop Tail scheme.
- No high priority frames were dropped using Priority Drop Tail scheme.
- Priority Drop Tail scheme resulted in a better average end-to-end delay than other schemes.

Future Areas Of Investigation

AQM based on Data Packet sets
- Video frames are made up of many data packets. If many data packets for a frame are dropped the video decoder may not be able to decode the video frame. Therefore sending partial sets of data packets may waste bandwidth and precious resources.

HSDPA Scheduling based on Traffic Type and Buffer Capacity
- Use traffic type and/or buffer load to increase the probability of scheduling a user.

Dynamic Buffer Allocation
- Allocate under utilised buffer space to overloaded buffers.