Video@Home

Adaptive Wireless Media Streaming in Local Area Networks

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Outline

- Motivation
- Overview of the related work
- Video@Home – an overview of the architecture
- Content-aware deadline-based scheduling (performance enhancing proxy)
- Conclusions and future work

Motivation for Adaptation

- Streaming video has experienced a noticeable growth during the last decade
- Multimedia applications have very strong delay requirements
- Wireless communication systems have to provide a certain level of QoS
- Trade-off between throughput, reliability and delay
- Adaptive systems have to be in place where responses to changing resource availability and application demands are of importance

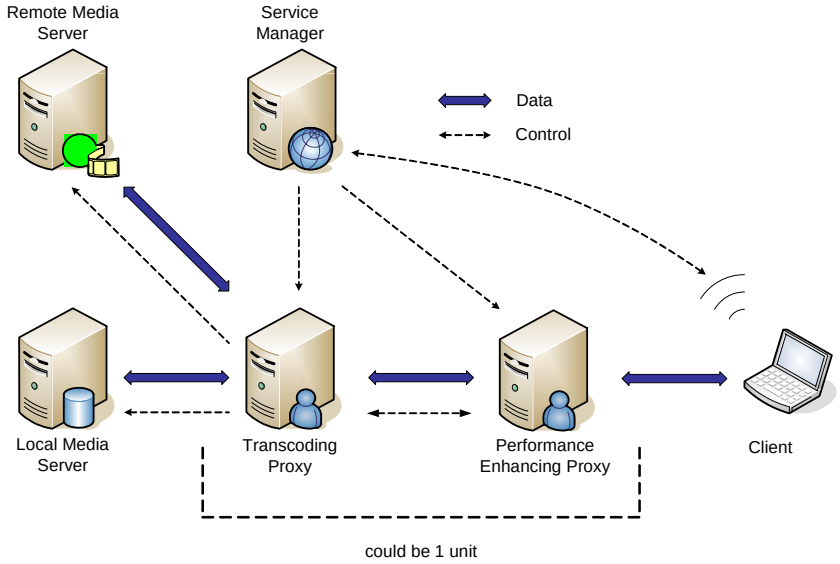
Related Work

- RT Video Streaming over WLAN (A. Majumdar, IEEE Trans. on Circuits and Systems for Video Tech., 2002): FEC and ARQ or HARQ in the application layer
- Real-time Retry Limit Adaptation (M. van der Schaar, IEEE Trans. on MM, 2004): priority queues for layered video, no deadlines considered
- CAR Content-aware Adaptive Retry (M. Lu, ICME 2005): good video data transmission performance, however limitation for 1 flow, no fairness, only deadline extension
- IEEE 802.11 Rate Control Algorithms (Sajal K. Das, PAM 2006): no deadlines considered

Open issues:

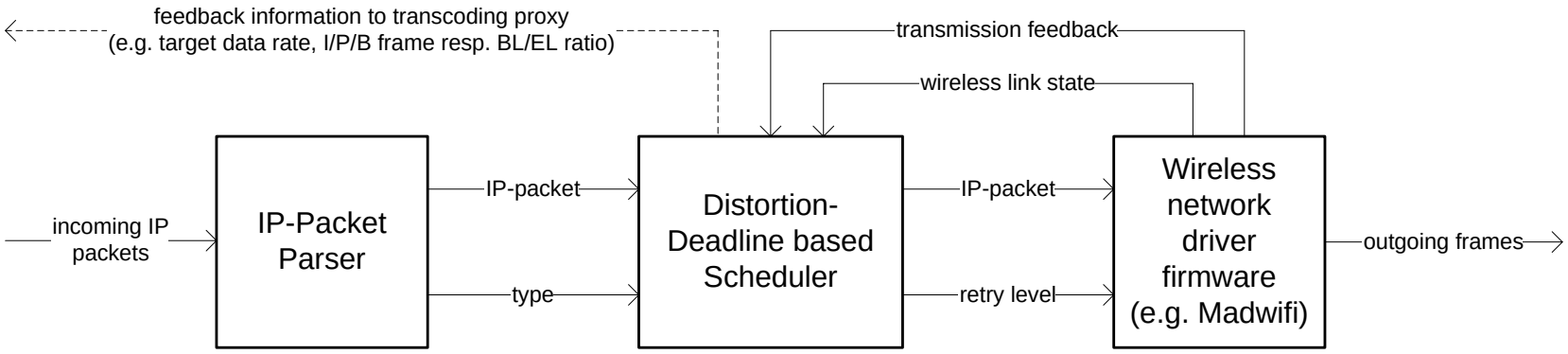
- Joint content and network transmission adaptation
- Multiple flows support
- Audio streams support
- Fairness constraints for non-realtime flows

Video@Home: System Architecture



- Robust Adaptive Service for Multimedia Streaming
- Stream adaptation and channel adaptation
- On demand transcoding according to bandwidth constraints and client device needs in the Transcoding Proxy
- The Performance Enhancing Proxy (PEP) copes with the wireless channel issues

Performance Enhancing Proxy



- Parsing of incoming IP-packets, content recognition
- Scheduling of incoming packets according to the deadline and type
- Feedback information to the Transcoding Proxy

Deadline-Distortion based Scheduling

Deadline estimation

- For real-time flows:

$$d_i = B_i - t_i^{WLS} + T - \Delta a_{i,i-1}$$

d_i: deadline for packet I
B_i: buffer size at the receiver for the flow belonging to the packet i
T : period of the flow (e.g. 40 ms for a 25 fps video stream)
$\Delta a_{i,i-1}$: interarrival time of packets i and i-1
t^{WLS} i: transportation time for the wireless part of the data path for packet i (can be estimated analytically with a certain probability)

- For TCP flows:

$$d_i = a_i + RTO_i - t_i^{WLN} - t_i^{WLS}$$

RTO_i: retransmission timeout for packet i

Deadline-Distortion based Scheduling

Significance function

- Packet's "value" becomes higher when the deadline is near
- Packets with higher distortion values are more valuable
- Packets are worthless after their deadline

$$S_i(t) = D_i \cdot \ln\left(1 - \frac{t - T - a_{i-1} + t_i^{WLS}}{B_i}\right)$$

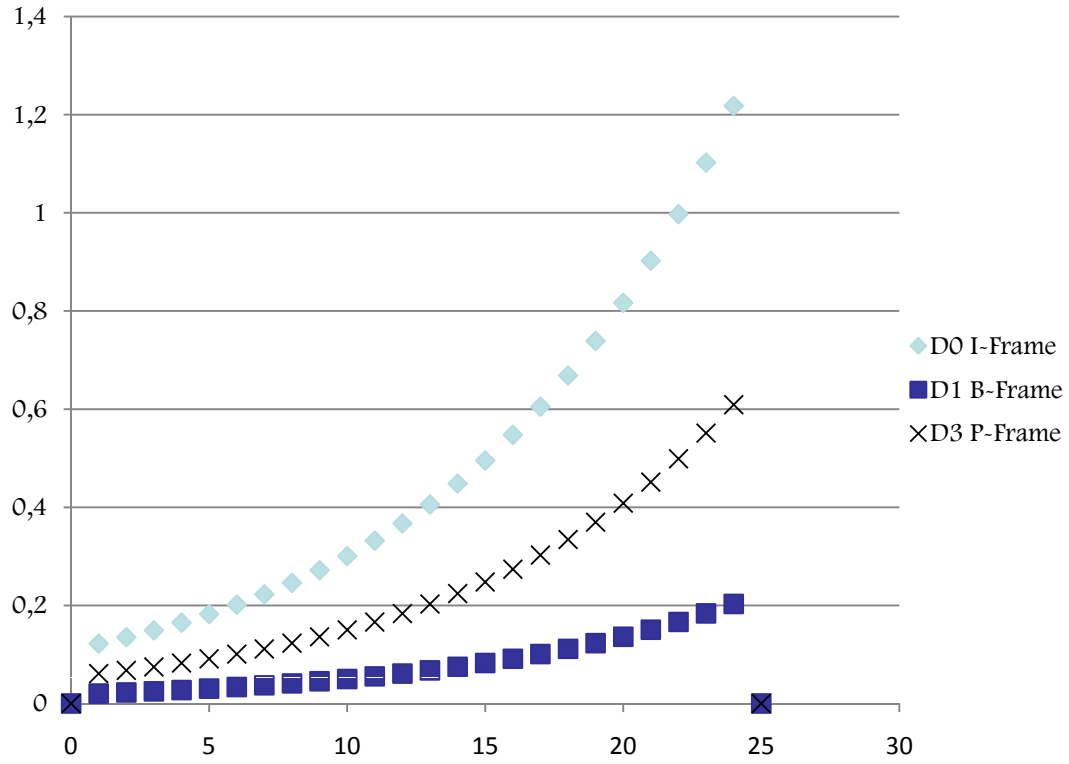
D_i: distortion value of packet i (can be roughly estimated as number of packets / frames based on packet i)

S_i (t) is defined on the interval $[\, d_i - B_i \,,\, d_i \,]$

The scheduling is performed according to the first derivation of the S function.

Deadline-Distortion based Scheduling

Example of the significance function for different frame types



Project Status and Future Work

- Implementation of a Transcoding Proxy for adaptive data rate control ✓
- Implementation of a RTP packet parser ✓
- Implementation of the proposed scheduling mechanism based on Madwifi
- Evaluation and fine tuning of the parameters
- Interconnection between PEP and Transcoding Proxy

Deadline-Distortion based Scheduling

- Example of the S function for two flows