Improving Online Game Performance over IEEE 802.11n Networks

Hsiang-Ho Lin, Chih-Yu Wang, Hung-Yu Wei*
Department of Electrical Engineering, National Taiwan University
Problem

- Under heavy background traffic, online game packets will encounter high queuing delay, jitter and even dropped in the bottleneck AP.
- Using ns2 simulator, we apply IEEE 802.11n to WLAN to investigate the efficiency of these mechanisms in improving online game performance.
Introduction

Aggregation (AG)

- MPDU delimiter
- MPDU
- padding
- PHY Header
- MPDU subframe
- ....
- MPDU subframe

A-MPDU
Introduction

Transmission Opportunity (TXOP)

Packet Data

ACK

Packet Data

ACK

Packet Data

ACK

TXOP limit
Introduction

Block ACK (BA)

Diagram showing the structure of Block ACK (BA) with PHY Header, MPDU 1, MPDU 2, MPDU 3, MPDU 4, and ACK fields.
Introduction

Reverse Direction (RD)

- Packet Data
- ACK
- RD Data
- ACK
- Packet Data
- ACK

TXOP limit
## Simulation Settings

<table>
<thead>
<tr>
<th>Traffic model</th>
<th>Uplink Packet interval</th>
<th>Uplink Packet size</th>
<th>Downlink Packet interval</th>
<th>Downlink Packet size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Game</td>
<td>50 ms</td>
<td>42 Bytes</td>
<td>60 ms</td>
<td>87 Bytes</td>
</tr>
</tbody>
</table>

- **AP**: AG, TXOP
- **Game Clients**: BA, RD
- **Other wireless nodes**: BA

<table>
<thead>
<tr>
<th>Traffic</th>
<th>Uplink Load</th>
<th>Downlink Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td>2 Mbps</td>
<td>variable</td>
</tr>
</tbody>
</table>

Predicting the perceived quality of a first person shooter: the Quake IV
Aggregation and Block ACK
- Queuing congestion in AP is relieved by aggregating background traffic
- Block ACK overcomes the drawback of Aggregation
- Short Aggregation waiting time is suitable
- Aggregation is not for long-interval online game traffic

TXOP and Reverse Direction
- TXOP can also alleviate queueing congestion significantly
- In AP’s TXOP limit period online game clients cannot access channel
- Reverse Direction allows online game clients to send out uplink packets

Comparison
- Generally TXOP with RD outperforms aggregation with block ACK
- Since downlink game packets hardly get aggregated, the transmissions between these packets still consist of channel contention overheads.
- Applying TXOP, these packets can be transmitted sequentially in the same TXOP period in which no contention is between the transmissions
- TXOP yields shorter downlink delay and improves network fairness
Conclusion

- Both AG and TXOP can alleviate queueing congestion in the bottleneck AP.
- BA and RD can overcome the drawback of AG and TXOP respectively.
- TXOP is capable of improving network fairness by reducing relative downlink delay.