BBR Bufferbloat in DASH Video

Santiago Vargas, Rebecca Drucker, Aiswarya Renganathan, Aruna Balasubramanian, Anshul Gandhi
NetSys and PACE Labs

Stony Brook University
Computer Science

Why BBR & Video?

- BBR is a new TCP congestion control algorithm that is used by **40% of all Internet traffic**, including large video providers like YouTube, Facebook, Netflix, etc.
- BBR is designed to estimate link capacity and send just enough to keep the network connection full
- Due to its recent development and adoption, BBR is not as well-studied as other loss-based congestion control algorithms
- This project seeks to understand the impact of BBR on DASH Video QoE under different video player and network settings

KEY TAKEAWAYS

> Under BBR, DASH video **QoE is reduced by 60%** in networks with large router buffers compared to small buffers

> QoE decreases are caused by BBR **bufferbloat** where queuing delays increase RTTs to **>7x** the propagation delay

> Bufferbloat happens under BBR since it **over-estimates** bandwidth by **>3x** and fills router queues

> BBR's over-estimation is a reaction to network burst tolerance

> Using a bandwidth sampling approach in BBR causes video **QoE to improve to near ideal QoE**

Understanding BBR Video QoE

- Since network operators provision their networks with different equipment and configurations, we vary router buffers, RTTs, and burst tolerance
- In Figure 1, we see that networks with larger router buffers experience worse QoE than smaller buffers
- DASH QoE is degraded under these larger buffers, because RTTs grow **>7x** compared to smaller buffers
- These high RTTs are the result of a **bufferbloat** problem that BBR was designed to solve

Figure 1: Video QoE under Varying Buffers

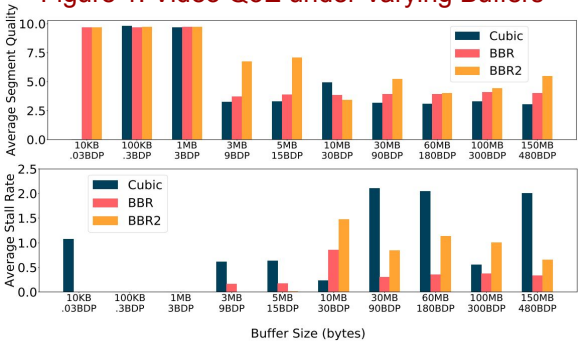


Figure 2: Video QoE under Varying Burst Sizes

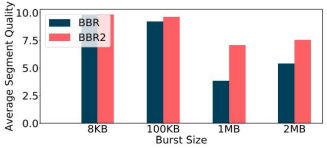
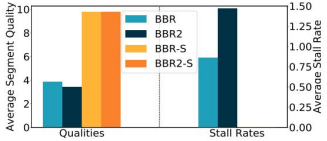


Figure 3: Video QoE under BBR-S



Uncovering BBR Bufferbloat

- TCP traces reveal that BBR's bufferbloat is caused by BBR over-estimating bandwidth by a factor **>3x**, which dictates BBR's sending rate
- Network burst tolerance allows spikes in delivery rates which are captured by BBR's max filter estimation of bandwidth, causing **bandwidth over-estimation**
- Figure 2 confirms that networks with high burst tolerances experience much worse video QoE
- We modify BBR to instead use a bandwidth sampling technique and call this algorithm BBR-S
- Figure 3 shows that under **BBR-S video QoE is near ideal** even under bursty network settings