Research Paper Readings for Part B

PStream: Priority-Based Stream Scheduling

Abstract

- QUIC - Quick UDP Internet Connection.
- QUIC uses streams to solve the head-of-line blocking
- MPQUIC schedulers are stream aware.
- MPTCP schedulers are not stream aware.
- resource preferences of the streams are highly related to the content the stream provides.
- Scheduling without recognition of the stream feature can aggravate inter-stream blocking when sharing paths.
- This paper proposes an alogrithm PStream - priority based online stream scheduling mechanism.

PriorityBucket: MPQUIC scheduler to XLR8 first rendering

Abstract

- first visual feedback - first rendering of the web page is important for satisfying users
- if we prioritize the streams that are critical to rendering in MPQUIC then we can reduce first rendeiring time.
- This paper proposes the prioriybucket algorithm for this purpose and this reduces rendering time and page load time by 34% and 35%.

Introduction

Definitions and web page crirtical path

- Page load time - the time it takes for a page to fully load in a browser after a user clicks a link or makes a request.
- However, a web browser may begin rendering a web page before all resources have been fetched. The purpose is to give visual feedback to users and to make the page interactive as soon as possible.
- The period from a blank page to its first visual feedback is called the first rendering time [3], which is also a critical metric in the page loading process.
- The first rendering time is decided by the critical rendering path, which is a series of steps that web browsers need to perform before they start rendering web pages.
- They need to prepapre DOM tree, CSSDOM tree, etc. Then combine them to render the page.
- HTML, CSS an javascript are the memeber of critical rendering path, other pages are not required for critical rendering.

HTTP/2 priortization

- HTTP /2 performs prioritization on HTTP requests and this can be represented as dependency tree.
- Dependency tree nodes represent the streams.
- Each stream is assigned with priority value which indicates the proportion of resources assigned to it.
- The dependency relationship defines the transmission order of the streams.
- A stream that depends on another stream should not be allocated the resources until the dependent stream has finished transmission.
- This improves the performance.
- This paper has used the GO implementation of the project.

Related Work

basic prototype [6]

- The prototype of MPQUIC [6] disregards stream priority and packs a packet using a round-robin mechanism that cycles through the streams.

- The protype uses Lowest RTT First schdeuler for scheduling.
- However HTTP/2 was not included in the prototype.
- Other path characterstics such as bandwidth are also considered when facing the parh herteroginity.

SA-ECF [10]

- this uses HTTP/2 prioritization and makes pacjet scheduling decisions for both RTT and congestion window
- Select two paths with lowest RTT and select the better one amongst them.
- Decision is based on the completion time estimate of stream.
- This is to ensure that transmission does not delayed over the slower path.
- Estimation uses the remaining bytes between the streams and hence different streams compete each other for the fast path in a greedy fashion causing burst transmission on the fast path.

Mogensen et al. [11]

- data scheduled redundantly over the multiple paths for real time vehicular communication in LTE networks.

[12] research paper ref

- assumes dependancy tree of web page is known in advance at server side
- uses this info to optimize the transmission order of all the streams.
- not practical approach.

[13] research paper ref

- considers both stream size and priortiy features in scheduling.
- to optimize the completion time of time critical streams it schedules a stream to a single path (i think this is done to maintain the priority and it uses the fastest path)
- this sacrifise the benefits of multipath.

Priority Bucket Design

- This scheduler uses HTTP /2 prioritization to get the priority of the stream.
- and later it applies priority bucket to send the packets.

Overview

- establish the connection
- after connection establishment each arrival of the stream triggers the scheduler.
- scheduler allocates stream to path with calculated amount of data.
- once allocation completes, transmission will be executed.
- proccess ends when all streams finish transmitting and no stream arrives.

Structure

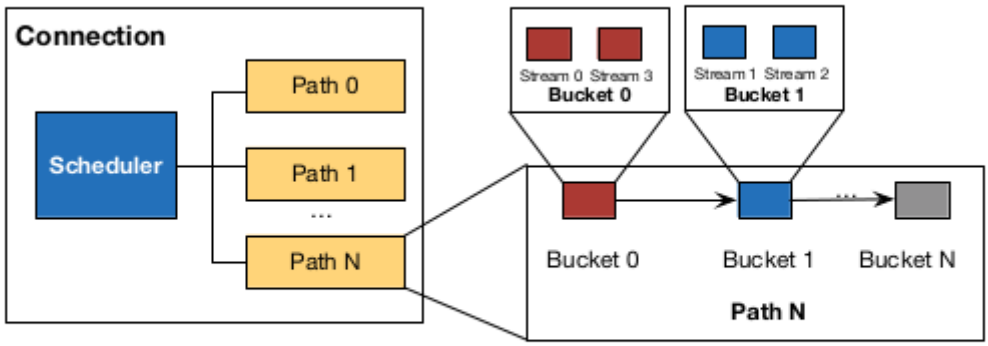

Figure 1: A structure of PriorityBucket design.

- MPQUIC connection is established by crypto handshake with connection id
- within a connection there can be multiple paths
- path may have zero or more streams.
- Global scheduler allocates path to streams based on the proposed scheduling policy.

Stream and Bucket

- stream
  - lighweight bi-directional byte stream abstraction with unique id
  - they can be opened closed or cancelled without tearing down the entire connection.
  - can be scheduled on one or more paths for calculated portion of data
- To prioritize the critical streams on a path we distinguish streams with different priority buckets.
- Streams of equal priority value are divided into the same bucket.(as shown in fig)
- Inside the same bucket transmission follows FCFS.
- Bucket with low priortiy depends on most recent pending stream in higher priority bucket.
- low priority bucket transmissions can be preempted by the critical or higher priority bucket transmission.

Scheduler

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