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# Competitive Mode Enhancement for Delay-Based Congestion Control Algorithms
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## Abstract

This document proposes introducing a "Competitive Mode" into delay-based congestion control algorithms to improve their competitiveness and fairness during coexistence scenarios.

## Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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Table of Contents



## 1. Introduction

Congestion control algorithms can be categorized into loss-based and delay-based algorithms based on their congestion detection mechanisms. Loss-based congestion control algorithms typically fill the link buffer until packet loss occurs, then reduce the sending rate. In contrast, delay-based congestion control algorithms proactively reduce the sending rate when queuing delay increases. Representative delay-based congestion control algorithms (e.g., Vegas[Vegas], FAST[FAST], Copa[Copa]) measure RTT or queuing delay, calculate the expected throughput based on delay variations, determine congestion, and adjust the congestion window size.

While delay-based algorithms generally exhibit lower packet loss rates and smaller queuing delays than loss-based algorithms, they fail to fairly share link bandwidth with loss-based algorithms (e.g., Cubic) when both types of traffic coexist.

## 2. Introducing Competitive Mode into Delay-Based Congestion Control Algorithms

### 2.1. Method for Determining Competitive Mode

Determine whether the current flow is in a coexistence/competition phase with Cubic traffic based on the magnitude of queuing delay variation. The COPA provides a method to determine whether it is in competitive mode.

Specifically, upon receiving an ACK, the algorithm calculates the RTT for each flow and maintains a historical minimum RTT value(min_rtt). Based on RTT samples, it records the maximum(max_delay) and minimum(min_delay) RTT values over a 4-RTT window. Competitive Mode is triggered based on the following inequality.

min_delay < min_rtt + 0.1(max_delay - min_rtt) Formula 1

Here, max_delay and min_delay represent the maximum and minimum RTT values within the last 4 RTT intervals, and min_rtt is the historical minimum RTT. The difference between min_delay and min_rtt represents the minimum queuing delay at the bottleneck link during this period, while the difference between max_delay and min_rtt represents the maximum queuing delay. If the inequality is not satisfied, it indicates that the bottleneck link’s queue has not emptied during this period, suggesting likely competition from Cubic-like flows. Consequently, the algorithm enters Competitive Mode. If the inequality holds, the algorithm operates in Default Mode.

### 2.2. Congestion Window Compensation in Competition Mode

When the algorithm determines it is in Competition Mode, it introduces an additional congestion window gain factor to moderately increase the congestion window size.

TBD.

## 3. Examples

### 3.1. Copa with Competitive Mode

TBD.

### 3.2. Vegas with Competitive Mode

TBD.

## 4. IANA Considerations

TBD.

## 5. Security Considerations

TBD.

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## 7. Acknowledgements

TBD.

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