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Title: Evaluation of PI Controller queue management algorithm using ns-3

Motivation: Congestion in Networks is a very important and serious problem. To maintain the stability of the network, people have been working on congestion control algorithms. The Queue Management Method deployed inside the routers is an important factor in the congestion control study. Active Queue Management (AQM) has been proposed to maintain the queue for avoiding the congestion inside the network. In this project, we plan to study different requirements of the network and evaluate PI controller's effectiveness to provide high resource utilization, identifying and restricting disproportionate bandwidth usage. PI Controller is a well-known AQM technique which is being revisited by the research community. Based on modern day requirements, we intend to evaluate the effectiveness of PI controller AQM so that it can resolve the congestion control problem.

Problem Definition: Memory price has been decreasing since last decade. Due to this, routers are having large sized buffers. Thess large sizes buffers lead to high queuing delays. This problem is known as the Bufferbloat problem. It is the undesirable latency coming from router as it is buffering excessive data. Internet performance gets affected due to the Bufferbloat problem. AQM algorithm works as a solution to the Bufferbloat problem. AQM algorithms provide the solution to control the queuing delay by controlling the queue occupancy to the desired target.

Literature Survey: In the network, routers play an active role in the resources allocation just to effectively control and prevent congestion. This is known as AQM technique. The concept is that an Active Queue Management Algorithm inside a router may intelligently drop or mark some packets or keep some packets before the queue overflows. There are various methods that have proposed different sets of algorithms in AQM. Among various AQM algorithms, Random Early Detection (RED) is the most widely used technique. RED has been proven to effectively tackle both the problem of bias against huge bursty sources and also the global synchronization problem where each sender no longer needs to reduce their transmission rate to reduce the congestion. Due to its high popularity among the

researchers, RED technique has been used by many of the router vendors in their products to control the congestion.

Flow Random Early Drop (FRED) is another AQM algorithm which is a modified version of RED that uses per active flow for creating different dropping decisions in the different sets of connections with various bandwidth. FRED (Flow Random algorithm keeps track of those flows that have the packets inside the buffer queue where the cost of FRED is proportional to the buffer size and at the same time it is independent of total number of flows considering idle flows and the short-lived. It can also able to achieve the benefits of per flow queuing with very minimum difficulty.

BLUE is another different kind of Active Queue Management scheme to operate congestion control from the losses of packets and introduce the link utilization much better way than any other algorithm. It maintains the single probability which is P(m) basically to drop or mark the packets. If the buffer queue is continuously dropping or rejecting the packets because of the buffer overflow, BLUE algorithm then increase its P(m) to maintain the rate at which it sends dropping packets notification. If the buffer becomes empty or if the link stays idle for long time, BLUE technique reduces its marking probability. This is effectively allowed by the BLUE algorithm to learn the proper rate that needs to send back the congestion notification.

After studying all the above algorithm ,we come to the conclusion that to solve current congestion we have to modify the old PI Controller queue management algorithm so that we can better performance than current AQM schemes.

Plan of Work: There is ns-3 source code already available for PI controller but it is outdated and needs an upgrade. Previously, the network traffic was completely different from the today's internet traffic. Previously live stream was not very common whereas now a days it is everywhere especially due to COVID-19 it increases drastically. So we have to update the old PI Controller algorithm to according to latest internet traffic. Even if we try to use the old algorithm in ns-3 for network traffic management then the output won't produce a better result.

After it is revised to latest algorithm which can fit into ns-3, we have to perform certain kinds of validation. The validation should be done whether after we shift to latest the ns-3, to ensure that we did not break the algorithm logic. We have to prove that our algorithm is working properly as expected. Old source code will go through several modifications and adding up new feature to become to beat the modern network traffic. After completing the implementation part of the source code, we have to perform some kind of evaluation. So our first basic evaluation will be conducted using some congestion control topology which are very popular to conduct such evaluations.

At the last stage of our project, we intend to perform a thorough analysis of the PI controller algorithm by using an AQM Evaluation Suite. After the detailed analysis of our algorithm we can align with latest ns-3 module for research and development purpose.

References:

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