Analysis of the quality of video transmission in Wi-Fi networks depending on the algorithm used packet queue management

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Abstract

Wireless information transmission systems exist as much as human civilization itself. Technologies are changing, but the essence of transmission networks remains the same - to organize the interaction of several different elements so that information without wires at a given time comes from one point to another.

Keywords: Information technology, wi-fi, wireless technology, traffic analysis

1 Introduction

Wireless technologies - a subclass of information technology, are used to transfer information between two or more points at a distance, without requiring a wired connection. To transmit information, radio waves can be used, as well as infrared, optical or laser radiation.

There are many wireless technologies most commonly known by marketing names, such as Wi-Fi, WiMAX, Bluetooth. Each technology has certain characteristics that are determined by its scope.

2 General

In this topic, we will unmask the behavior of a Wi-Fi network with video traffic when implementing various queue management algorithms.

- Drop Tail
- Random Early Detection In / Out Coupled (RIO-C)
- Random Early Detection In / Out De-coupled (RIO-D)
- Adaptive Random Early Detection (Adaptive RED)

To achieve this goal we will perform the following tasks:

1. Consider the network requirements from multimedia traffic and the limitations of TCP / IP networks.
2. Simulate Wi-Fi transmission of video and web traffic using the Drop Tail, RIO-C, RIO-D, Adaptive RED packet queuing algorithms running on the router.
3. To analyze the impact of these technologies on the quality of video transmission. Estimate the size of the queue, the total network latency, PSNR (SNR) of the received video.
4. To assess the influence of the parameters of the Adaptive RED algorithm on network delays, as well as the quality of video transmission, based on the PSNR criteria.

Random early detection (RED), also known as random early discard or random early drop is a queuing discipline for a network scheduler suited for congestion avoidance.

In the conventional tail drop algorithm, a router or other network component buffers as many packets as it can, and simply drops the ones it cannot buffer. If buffers are constantly full, the network is congested. Tail drop distributes buffer space unfairly among traffic flows. Tail drop can also lead to TCP global synchronization as all TCP connections "hold back" simultaneously, and then step forward simultaneously. Networks become under-utilized and flooded-alternately, in waves.

RED monitors the average queue size and drops (or marks when used in conjunction with ECN) packets based on statistical probabilities. If the buffer is almost empty, then all incoming packets are accepted. As the queue grows, the probability for dropping an incoming packet grows too. When the buffer is full, the probability has reached 1 and all incoming packets are dropped.

RED is more fair than tail drop, in the sense that it does not possess a bias against bursty traffic that uses only a small portion of the bandwidth. The more a host transmits, the more likely it is that its packets are dropped as the probability of a host's packet being dropped is proportional to the amount of data it has in a queue. Early detection helps avoid TCP global synchronization.

The adaptive RED or active RED (ARED) algorithm infers whether to make RED more or less aggressive based on the observation of the average queue length. If the average queue length oscillates around min threshold then early detection is too aggressive. On the other hand, if the average queue length oscillates around max threshold then early detection is being too conservative. The algorithm changes the probability according to how aggressively it senses it has been discarding traffic.

Random early detection (RRED) algorithm was proposed to improve the TCP throughput against Denial-of-Service (DoS) attacks, particularly Low-rate Denial-of-Service (LDoS) attacks. Experiments have confirmed that the existing RED-like algorithms are notably vulnerable under Low-rate Denial-of-Service (LDoS) attacks due to the oscillating TCP queue size caused by the attacks. RRED algorithm can significantly improve the performance of TCP under Low-rate Denial-of-Service attacks.

3 Conclusions

During the work, issues related to the transmission of video information over a wireless Wi-Fi network were considered, with the introduction of various packet queue control algorithms on the router. Also, factors affecting the quality of video transmission are identified.

References

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