Analysis of a Stream Size Biased Medim Access Control Protocol

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ABSTRACT

This paper looks to improve the overall network efficiency by using a MAC protocol that biases towards Streams of shorter sizes by basing the initial back off of the packet transmission off the current frame number being sent instead of a system declared minimum initial value. This approach should improve the average time to transmit data from all nodes on the network.

1. INTRODUCTION

Connecting to the internet has never been easier than it is in today's world. The ability to join a Wireless network is as simple as a few clicks of a mouse or taps on a phone, and suddenly the world is at your finger tips. The ability for people to connect from around the world is increasing at an ever expanding rate with wireless access being introduced to the most remote places. With this sudden surge in increased accessability and user interaction comes the question of is the current connection the best we have or can we improve?

Current MAC protocols operate with the assumption that all data being sent should be equal regardless of the type of data or the sender [2, 6]. Under this protocol, packets from a computer using a video service such as Netflix or youTube have equal priotity as a computer sending out an email. While this works well when you are attempting to balance out all users so no user is above another, with a large number of users it can begin to slow the average time to complete sending a stream of data. Though not the best protocol available, it is also not the worst available, but it also has the posibility of improvement. As it stands now, most research in unfair MAC protocols have resolved around one of two types, malicious behavior, behaving with the intent to disrupt other users, [3] or selfish behavior, behaving to improve your own performace [5]

This paper is an attempt at creating a solution to the average time to complete a stream by changing how the MAC sublayer chooses the random back-off delay before sending a packet from a number between 0 and a set minimum, to 0 and the current Frame number in a stream. This has a natural preference for streams of a smaller size as theire back-off ceiling doesn't reach as high as the larger streams.

2. BACKGROUND

So far, very little work has been done on the optimization of unfair Medium Access Protocols; most work has been done on solving the unfair MAC problem while reducing collisions. For wireless networks, a principle problem is the hidden terminal problem. In a wired network, it is possible to sense when another node is being sent, and a collision will occur [1]. In a wireless network, however, this cannot be done, resulting in the need for an alternative method of handling collisions [4]. Thus, wireless MAC protocols like Slotted-Aloha were created. In the Slotted Aloha Protocol, a node can only be sent at the beginning of a time slot [2]. This ensures that one node can finish sending before another one is sent, reducing the number of collisions. Under a network with a light load, this approach has a low chance of collision. However, collisions can still occur if two nodes are sent in the same timeslot. Under heavy loads, the probability that a node will be sent in the same timeslot as another node will increase. Most research into this problem is based on reducing collisions while keeping the distribution of sent nodes fair. An improvement on the Slotted Aloha Protocol is the Frameless ALOHA protocol, which uses a random access scheme to decide which nodes should be sent in which spot [8]. Another attempt at improving the Slotted-ALOHA protocol is the Generalized Slotted ALOHA protocol, in which nodes are sent according to their probability of being transmitted successfully. However, an issue with this protocol is that if every node is attempting to maximize its own transmission rate, then the network can jam. [7]. The Multiple Access with Collision Avoidance for Wireless (MACAW) protocol is one attempt at improving on the Slotted-Aloha Protocol and solving the hidden terminal and unfair MAC problems. MACAW introduces per stream fairness, in which every stream sent on the network is treated equally. This contrasts our proposal in that we will attempt to create an optimal MAC protocol by prioritizing certain streams, thus creating an unfair MAC protocol that optimizes the network.

Most research done on unfair MAC protocols has been conducted on how to detect and prevent unfair behavior from a node on the network. Some has focused on merely detecting and blocking the misbehaving node, while others have suggested implementing a punishment of sorts on the misbehaving nodes. Ways that nodes can misbehave in order to increase their own performance is to refuse to forward packets in order to save energy, or to select a smaller backoff in order to increase throughput for their own traffic. These misbehaving nodes can seriously degrade the network throughput for other, well-behaved nodes. [5].

A similar task to creating an unfair MAC protocol that everyone follows is detecting when a single user, or a small group of users, is being unfair and the process of handling them. A few approaches to remediate unfair behavior have been to exclude the misbehaving node from routing operations, encourage nodes to cooperate by penalizing misbehavior, or to incentivise good behavior by paying nodes for cooperating. Another protocol detects unfair behavior by having a sender transmit an RTS (Request to Send) after waiting for a randomly selected number of slots in the range [0; CW].After the initial transmission between hosts, the recieving host sends with their acknowledgement: a random value that the sender then uses as the back off counter for each subsequent transmittion during the stream. [5] With this protocol, if a recieving node recieves a packet before the appropriate number of frames has passed, then the sending host is not obeying the Protocol and can then be handled accordingly.

Our purpose, however, is to prove that implementing an unfair protocol where network traffic is sent according to a certain priority will actually improve throughput for all nodes in the network. The proposed protocol will ideally also maintain its increased performance even when all nodes on the network are not operating under the same protocol.

3. REFERENCES

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