CSMA/CD with Priority based Persistence Assignment

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Index Terms: CSMA/CD, Multiple Access , Persistence, Priority, Urgency

1. ABSTRACT:

Carrier-sense multiple access (**CSMA**) is a media access control (MAC) protocol developed to verify the absence of other traffic/network signals before transmitting on a shared channel, namely an electrical bus or a band of the electromagnetic spectrum.

Variations on basic CSMA include addition of collision-avoidance, collision-detection and collision-resolution techniques.

Carrier-sense multiple access with collision detection (**CSMA/CD**) is a media access control method used in early Ethernet technology , most notably for LAN(local area networking). It uses carrier-sensing to delay transmissions until no other stations are transmitting or the channel is idle. This when used in combination with collision detection then utilizes a transmitting station to recognize collisions by sensing transmissions from other stations while it is transmitting a frame. The station stops transmitting that frame when this collision condition is detected, transmits a jam signal, and then waits for a random time interval before trying to resend the frame.

My solution ,The Persistence Switch Method based on Priority Assignment,aims to resolve the issue of media share and Re-collision by utilizing a Priority Protocol , I call this method the CSMA/CD_PRP.

2. INTRODUCTION:

Multiple access methods have brought about a revolution in the networking fields,enabling the growth of communication and simultaneous communication among users/servers and also laying the brickwork for the wi-fi and ethernet technologies which followed.

Multiple access enlists the use of various protocols,some of which include the Aloha,Slotted-Aloha,Csma,CSMA/CD,etc.

The CSMA/CD or Carrier Sense Multiple Access Colission Detection protocols ensure the reliable transfer of data and resolves collision issues which arise in case of high-traffic channels.In case of a collision, the CSMA/CD protocol notifies the sender via a jamming signal(generated at the time of collision) and utilizes various methods to ensure a reliable transfer.

However this method is now obsolete with the emergence of new and advanced technologies like Ethernet and wireless transmission protocols which have replaced its use in all practical purposes.

3. Research Problems:

Although CSMA/CD provides procedures/protocols for channel/media sharing in case of collision, it poses a problem of resource loss in case of low-traffic.

Therefore it has a problem striking the perfect balance between optimal sharing of resources during high-traffic collision and other low-traffic scenarios.

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My solution includes assignment of different persistence method for transmission of frames depending on the priority assigned to the sending site.

The priority can be assigned on a variety of factors as specified in the section: 'Priority Protocol'.

Based on the priority assigned, the sender will be assigned persistence methods , with 1-persistent being assigned to the one with highest priority and p-persistent method shall be assigned to the one with the lowest.

The Assignment shall be carried out by the router/nodes with the help of inbuilt Algorithm which states the assignment criterias. However the assignment is done only when collision occurs, i.e., no prior assignment before sending is required and frames can be sent as done in CSMA.

This thus helps resolve the issue of low-traffic scenarios.

4. Related Research:

As I looked for shortcomings of the CSMA/CD model, I came across various other solutions for the aforementioned problems . Some of them are listed in this section.

4.1. Code-division multiple access

An example of multiple access is CDMA, where several transmitters can send information simultaneously over a single communication channel. This enables multiple users to share a band of frequencies. To permit this without undue interference between the users, CDMA utilizes spread spectrum technology and a special coding scheme (where each transmitter is assigned a code).

CDMA is a spread-spectrum multiple-access technique which entitles spreading the bandwidth of the data uniformly for the same transmitted power. A spreading code is a pseudo-random code that has a sparse ambiguity function, unlike other narrow pulse codes. In CDMA a locally generated code runs at a much higher rate than the data to be transmitted. By combining bitwise XOR with the faster code,data transmission is carried out.

4.2. Polarization-division multiple access

Polarization-division multiple access (PDMA) is a channel access method used in some cellular networks. In this type , separate antennas with different polarizations each along with separate receivers,allows simultaneous access of regional satellites.

Each corresponding ground station antenna and its counterpart in the satellite needs to be polarized in the same way . This can be accomplished by provision of each participant ground station with an antenna that has dual polarization. The frequency band allocated to each antenna beam can be identical because the uplink signals are orthogonal in polarization. This technique enables reuse of frequency.

4.3. Token ring

Token Ring local area network (LAN) technology is a communications protocol for local area networks. It makes use of special three-byte frame called a 'token' that is propagated around a logical topology/ring of servers and workstations. This token passing is a channel access method focuses on fair access to all stations, and eliminates the collisions of contention-based access methods .

Token ring method is one of the early models of CSMA/CA , ensuring low-complexity division of channel access,in recent times however it has been surpassed by the new and upcoming protocols.

5. CSMA/CD_PRP

The technique I propose in this section is the persistence switch method based on priority assignment which only activates when a conflict arises, In all other scenarios we shall be using the regular CSMA techniques.

This method thus focuses on maintaining the balance and sharing of resources in an appropriate manner based on the scenarios. Thereby getting rid of two of the worst problems faced in CSMA/CD, namely:

i. Resource wastage in low traffic scenarios.

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ii. Improper distribution of networking resources while transmitting data.

The technique revolves around the assignment of different Persistence methods based on the proposed 'Priority Protocol'.

In case of a conflict of priority, it shall be resolved by utilizing a 'Time-slotted Queue'.

The various persistence methods involved are as follows:

5.1. 1-P Persistence Method:

With confirmation of an idle channel , it sends its frame immediately with probability 1.

5.2. Non-Persistent Method:

When the channel is idle it sends its frame immediately. However if the line is busy it waits a random amount of time before checking the channel again.

5.3. P-persistent Method:

It is used in case of slotted channels, it senses the channel, if it is idle it transmits with a probability p. It then waits for the next slot with a probability q=1-p. If the channel is found busy it considers that collision has taken place and undertakes backoff procedures. Otherwise it goes to p probability transmission.

5.4. O-Persistent Method:

In this method a transmission order is assigned to each node by a supervisory node. Once the medium goes idle, the nodes wait for their timed slot in accordance to their assigned transmission order.

The first assigned node finishes immediately and so on with the remaining orders.

6. Priority Protocol:

This protocol undertakes the assignment of priority(and correspondingly the persistence techniques) to the sender frames/data. It is to be noted however that this protocol is **only utilized when a conflict occurs.**

Priority assignment is done in the following manner:

1.Priority by size:If in a scenario it is required to transfer large amounts of data between devices,the sender with larger/more data will be given higher priority.

2. Priority by urgency: The sender can notify certain data as 'urgent' which will then be given highest priority in case of a conflict.

3.Priority of time: When focusing on faster transmission between several devices, the senders will smaller data are given higher priority.

6.1. Distribution of persistence techniques based on priority assignment:

The persistence techniques are assigned as follows:

i. The one with highest priority uses 1-P persistence as it is optimal for urgent transmissions.
ii. The one with lowest priority is assigned P-persistent method of transmission.
iii. All other intermediate priority assignments utilize the Non-Persistent Method of transmission, thereby focusing on quick delivery and low re-conflict.
iv. In case of conflict of priority assignments, the Sender data are inserted in a queue and thereby follow O-Persistent method depending on their position in the queue.

The protocol thus ensures proper distribution of network resources and maintains a proper balance between low-traffic and high-traffic cases of data transmission by not pre-assigning channel resources to the Senders/Clients.

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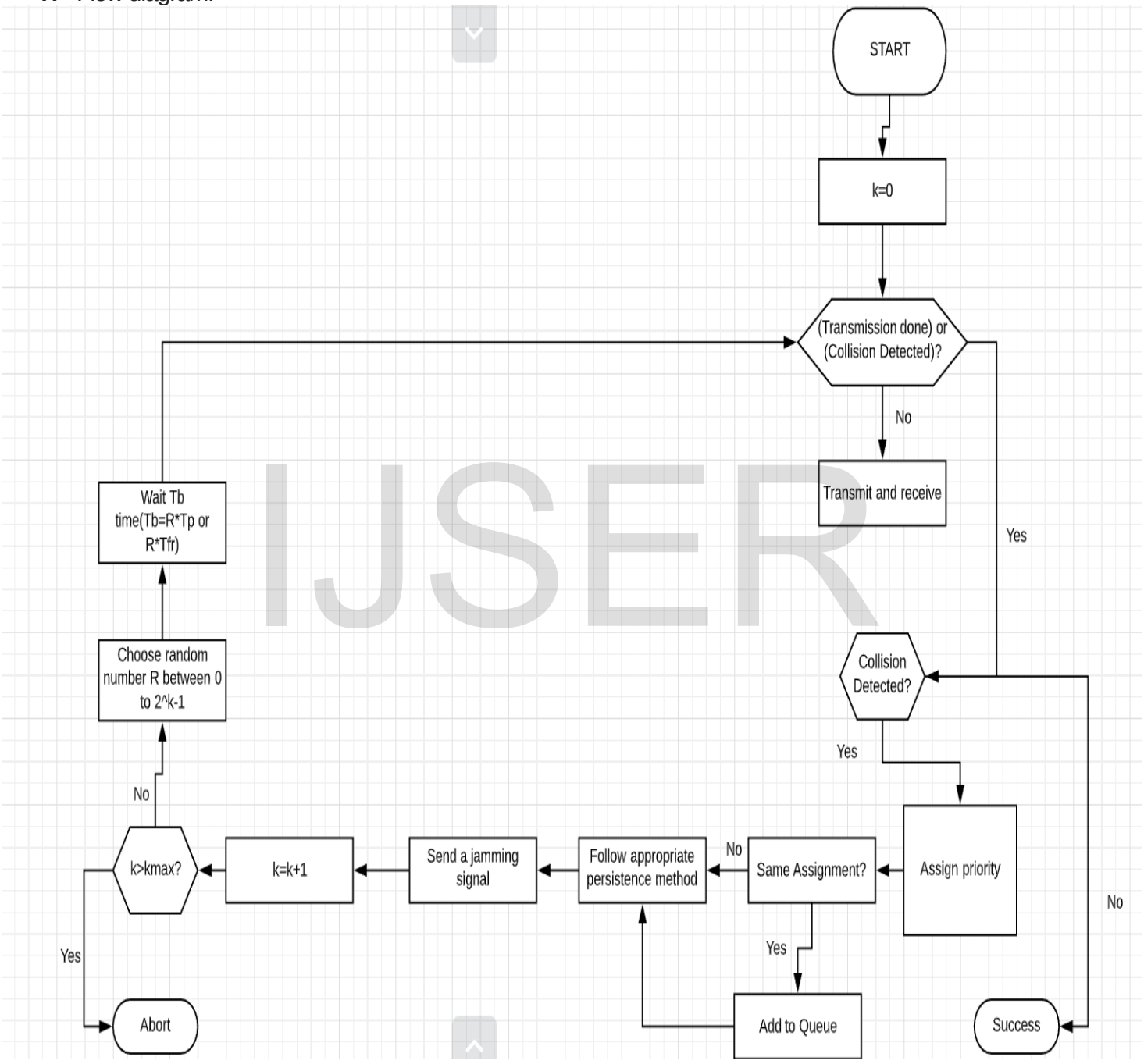
7. Flow diagram:



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8. Possible Drawbacks:

The following are the possible drawbacks to the proposed CSMA/CD_PRP method:

i. Added Complexity due to implementation of different persistent methods and execution of priority assignment protocol.

ii. Added time to propagation delay as a result of computation of priority .

iii. Introduction of Queue further adds to code complexity.

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