The EXTENDED DQRAP (XDQRAP) ALGORITHM

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1 Introduction

This paper presents the algorithm for Extended DQRAP (XDQRAP) as described by Wu and Campbell in [1]. Whereas a CMS (control minislot) in DQRAP carries no information, i.e., the single transmission implies a request to reserve a single slot, XDQRAP utilizes the CMS to carry information describing the number of slots requested. However, in interleaved DQRAP [2] frames from the same segmented packet could enter into different resolution queues to resolve contention. These frames may or may not reach the destination in the correct order. One solution to this problem is to include a sequence number in each frame so that the destination can reconstruct a packet based on the sequence numbers. A better method is to extend DQRAP so that multiple slots are reserved by a single CMS thus ensuring that frames are transmitted in sequence. The immediate access property is maintained for single slot requests but is dropped for multiple slot requests. XDQRAP, as with DQRAP, utilizes the global TQ as described in [2]. A priority scheme in XDQRAP allows a single slot message to preempt a multiple slot message in the midst of transmission.

2 Protocol

2.1 Frame Format. In XDQRAP we increase the size of the CMS to include reservation fields to specify the number of slots requested as shown in Figure 1. The source address field in CMS is for collision detection purpose. All stations, including source and destination stations, upon receiving the feedback from the successful transmission of a CMS, increment their copies of TQ by the number of slots requested in the CMS. In XDQRAP, the priority scheme uses the extra-bit format described by [3]. In this scheme, each CMS uses an extra bit to differentiate whether the request is of high priority. When a high priority packet sends a request into a CMS, it also turns on this bit. A basic implementation of XDQRAP treats single slot requests as high priority and treats the multiple slot requests as normal priority thus the extra priority bit is not necessary. If it is desired to provide priorities to multiple slot requests then the appropriate number of bits must be included

2.2 Protocol. In prioritized DQRAP two transmission queues are maintained by each station [Lin 94], one is normal transmission queue (N_TQ), and the other is high priority transmission queue (H_TQ). With interleaving factor n, each node maintains n resolution queues, RQ_i, i = 1...n, and one single N_TQ and one single H_TQ. In order to differentiate whether the received

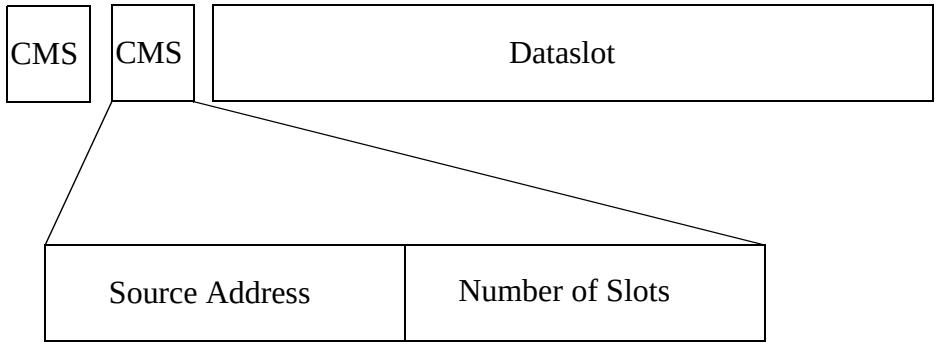

Figure 1 XDQRAP Frame Format

packet is sent when N_TQ and H_TQ are both equal to 0, each node maintains the sum of previous N_TQ and H_TQ, $Prev\_TQ_i$, i = 1...n. Let F_k, k = 1,2,..m, denote feedback from the k_{th} CMS. The values of F_k can be E:empty, S:single, or C:collide. If a station transmitted a request in a CMS, it will enter the N_TQ, H_TQ, or RQ in the order of the CMS numbered from 1 to m. Let N_k, k = 1,2..m, denote number of slots requested from the k_{th} CMS. The XDQRAP protocol is stated as follows:

```
XDQRAP_Protocol()
{
    int i, group;
    N_TQ = 0;
    H_TQ = 0;
    for (i = 1; i <= interleaving_factor; i++) {
        RQ_i = 0;
        Prev_TQ_i = 0;
    }
    group = 1;
    while(TRUE) {
        Detect_CMS_Feedback();
        XDQRAP_QDR(group);
        XDQRAP_RTR(group);
        XDQRAP_DTR(group);
        group = (group % interleaving_factor) + 1;
    }
}
```

```
XDQRAP_QDR(int group)
{
    int k;
    for (n_single = 0, k = 1; k <= m; k++)
        if (F_k == S)
            n_single++;
    for (k = 1; k <= m; k++) {
        if (F_k == S) {
            if (N_k == 1) {     /*  High priroity request  */
                if (Prev_TQ_group == 0 && n_single == 1)
                    /*  Immediate access  for single slot request */
                else
                    H_TQ++;
            }
            else  /*  Normal priority request with pure reservation  */
                N_TQ = N_TQ + N_k;
        }
        else if (F_k == C)
            RQ_group++;
    }
    Prev_TQ_group = N_TQ + H_TQ;
}

XDQRAP_RTR(int group)
{
    if (RQ_group > 0) {
        if (the node has packet on the first entry of RQ_group)
            send request into CMS
    }
    else if (the node has new arrival packet)
        send request into CMS
    }
}

XDQRAP_DTR(int group)
{
    if (H_TQ > 0) {
        if (the node has the packet queued in the first entry of H_TQ)
            send data into DS
        H_TQ--;
    }
```

```
    else if (N_TQ > 0) {
        if (the node has the packet queued in the first entry of N_TQ)
            send data into DS
        N_TQ--;
    }
    else if (RQ_group == 0) {
        if (the node has new arrival packet && the number of slots requested is one)
            send data into DS
    }
    if (RQ_group > 0)
        RQ_group--;
}
```

REFERENCES

[1] Chien-Ting Wu and Graham Campbell, "Extended DQRAP (XDQRAP) - A Cable TV Protocol Functioning as a Distributed Switch" , *Proceedings of 1st International Workshop on Community Networking*, July 1994. Also available as *DQRAP Research Group Report 94-2*.

[2] Chien-Ting Wu and Graham Campbell, "Interleaved DQRAP with Global TQ", *DQRAP Research Group Report 94-4*.

[3] Harn-Jier Lin and Graham Campbell, "PDQRAP - Prioritized Distributed Queueing Random Access Prot o-col" *Proceedings of 19th Conference on Local Area Networks*. Sep 1994, pp 82-91. Also available as *DQRAP Research Group Report 93-2.*