# Medium Access Control for High-speed Multimedia LANs

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## 1 Introduction

In recent years, with the rapid advance in the multimedia nature of communications equipment, many types of data can be found mixed within the network. To be able to cope with this multimedia traffic, a lot of research has been done on shared-medium high-speed multimedia LANs, especially on dual counter-rotating ring LANs because of the increase in ring throughput made possible by spatial reuse.

The majority of this dual-ring LAN research have focused on fixed-length slot LANs (hereafter, abbreviated as *slot LANs*). This is because slot LANs are compatible with ATM and B-ISDN technology. In addition, slot-waiting time, a problem in low-speed LANs, can be ignored. However, the authors of this paper think that variable-length packet LANs (hereafter, abbreviated as *packet LANs*) are more suitable for high-speed LANs than slot LANs.

In this paper, we will consider the use of packet LANs in high-speed dual-ring LANs as oppose to the use of slot LANs. In addition, we will introduce the idea of semi-global fairness for dual-ring LANs and propose an algorithm for realizing such a fairness.

## 2 High-speed Packet LANs

### 2.1 Analysis of High-speed Packet LANs

There are 2 main reasons why packet LANs are more suitable for high-speed LANs than slot LANs:

1. For high-speed LANs, the problem of large packets causing delays in the sending of other smaller, real-time packets can be ignored. For example, a packet must wait at least 120 $\mu s$ before a 1500byte packet is transmited in a 100Mbps LAN, whereas it will only have to wait 12 $\mu s$ in a 1Gbps LAN
2. The problem with slot LANs is the overhead involved when fragmenting packets into slots. In addition, it would be necessary to fragment packets into slots, for example, every 0.384 $\mu s$ in a 1Gbps slot LAN. Such problems do not exist in packet LANs

### 2.2 Simulation Comparison Results

There are 2 methods of implementing dual-ring packet LANs – by IB (Insertion Buffer) Rings [1] or by CSMA/RN (Carrier Sensed Multiple Access Ring Network) [2]. We compare these 2 methods to ATM-LANs by means of simulation for data traffic conditions. The simulation result is shown in Fig.1.

| Transmission speed | 1 Gbps |
|---|---|
| Distance between nodes | 1.0km |
| Propagation delay | 5 $\mu s$/km |
| Packet size | 4800 bytes |

Table 1: Simulation conditions

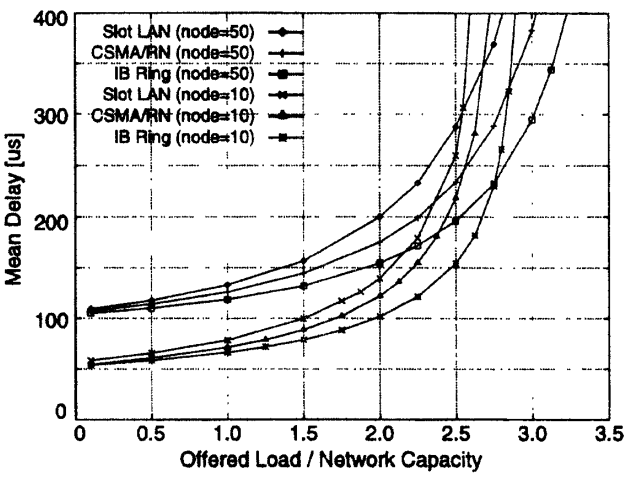


Figure 1: A comparison of slot LANs and packet LANs (nodes=10,50)

From this result, we can say that both types of packet LANs result in a lower mean packet delay than for slot LANs, with IB rings having the best results. This agrees with our analysis in the previous section that packet LANs are more suitable for high-speed LANs than slot LANs.

## 3 Fairness in Dual-ring LANs

Although spatial reuse may increase the throughput for dual-ring LANs, it may cause some nodes not to be able to transmit for a long period of time. However, if nodes are limited to transmitting the same quota of packets as those nodes that it "covers," we can show that fairness is maintained among the nodes. We call this type of fairness as *semi-global fairness*.

### 3.1 FULL algorithm

Here, we propose the FULL algorithm to implement this semi-global fairness. First, each node is allocated a quota of packets (or bytes) which it can transmit within a fairness cycle. The steps for the FULL algorithm is shown in Fig. 2.

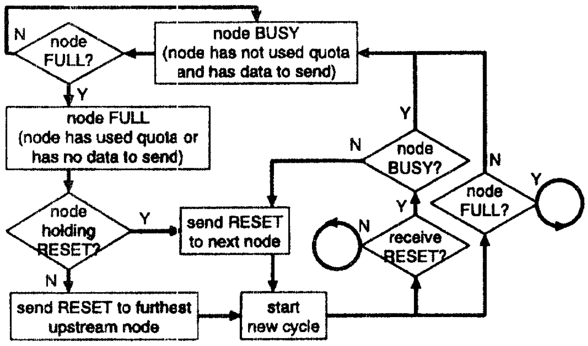


Figure 2: FULL algorithm flow chart

### 3.2 Simulation Results

Here, we compare the FULL algorithm with another fairness algorithm called the ***global SAT algorithm*** [3] by means of simulation. The simulation conditions are the same as shown in Table 1. Each node is given a quota of 1 packet each.

The simulation result for data traffic conditions is shown in Fig.3. From the result, we can say that the FULL algorithm achieves a lower mean packet delay than the SAT algorithm. This difference increases with an increase in the number of nodes, showing that the FULL algorithm is less sensitive to an increase in the number of nodes.

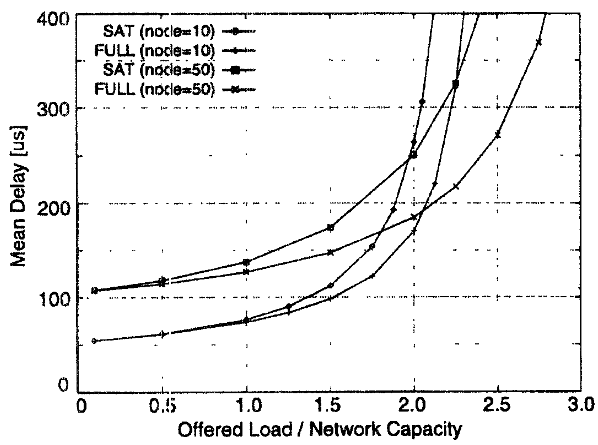


Figure 3: Simulation results for data traffic conditions (nodes=10,50 ; LAN=CSMA/RN)

For video traffic conditions, each node sends a MPEG2 video (mean rate = 5.1 Mbps, peak rate = 16.6 Mbps, multiplied by 4) to 5 randomly chosen nodes, changing destination after completing each transmission. The cumulative distribution graph of the time taken for each video packet to reach its destination is shown in Fig.4. Again, more packets reach their destination under less time when using the FULL algorithm.

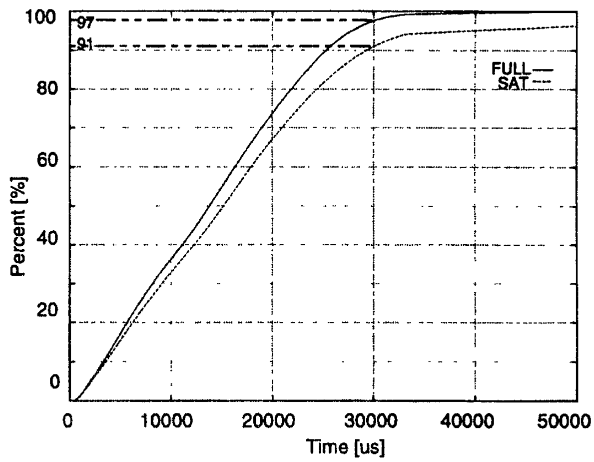


Figure 4: Simulation results for video traffic conditions (nodes=50 ; LAN=CSMA/RN)

## 4 Conclusion

In this paper, we consider the use of packet LANs and slot LANs for high-speed LANs. We do analysis to show that packet LANs is applicable for such high-speed LANs, as well as do simulation to show that packet LANs achieves a smaller mean packet delay than slot LANs for normal data traffic conditions. This supports our idea that packet LANs are more suitable for high-speed LANs.

In addition, we introduce the concept of semi-global fairness and propose the FULL algorithm to implement it. By simulation for both data traffic conditions and video traffic conditions, we show that our algorithm shows significant improvements in mean packet delay over the SAT algorithm.

## References

[1] W.Bux, M.Schlatter, "An approximate Method for the Performance Analysis of Buffer Insertion Ring", *IEEE Trans. Commun.*, Vol. COM-31, pp. 50-55, Jan 1983

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