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DATA LINK LAYER IMPLEMENTATION OF RPR PROTOCOL

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Abstract--**The explosion in end user demand for bandwidth and optimal usage of network resources, there is an imperative call for a topology that addresses the issues posed by the ever changing complexity of network management. Integrating the intelligent features of IP network, economical feature of Ethernet, and high bandwidth utilization and availability of optical fiber ring network, RPR (Resilient Packet Ring) is an ideal networking solution for Metropolitan Area network (MAN). RPR makes it possible for a carrier to provide carrier-class services in a MAN at a low cost, offering network reliability of SDH level but at a much lower transmission cost. RPR is different from traditional MAC with its most appealing feature of carrier-class reliability, spatial reuse, fairness, bandwidth reallocation and resilience. This project describes implementation, characteristics and basic applications of RPR.Transmission and reception of RPR frames in real time and maintaining the data integrity is discussed, simulated in VHDL (Hardware Description Language) and implemented inML506board.**

I. INTRODUCTION

Wireless Sensor Networks comprises of small sensor nodes communicating The Resilient Packet Ring (RPR, IEEE 802.17) is the latest development in a series of ring based network protocols standardized by IEEE [6]. Rings are in general built using several point-to-point connections.

When the connections between the stations are made using dual rings, rings allow for resilience (a frame can reach its destination even in the presence of a link failure). RPR utilize the simplicity of ring networks and use the bandwidth of the dual-ring as efficiently as possible for high-speed data transmission in MAN and in WAN. RPR features include distribution of bandwidth fairly to all active stations while providing fast auto restoration. RPR implements a Medium Access Control (MAC) protocol, for access to the shared ring communication medium, which has a client interface similar to that of Ethernet's.

II. RPR PACKET PRIORITY

The RPR implement a three level, class based, traffic priority scheme. The class based scheme is to let class A be a low latency, low jitter class, class B be a class with predictable latency and jitter, and finally class C be a best effort transport class. The RPR ring does not discard frames to resolve congestion. Hence when a frame has been added onto the ring, even if it is a class C frame, it will eventually arrive at its destination.Class A traffic is divided into classes A0 and A1, and class B traffic is divided into class B-CIR (Committed Information Rate) and B-EIR (Excess Information Rate). The two traffic classes C and B-EIR are called Fairness Eligible (FE).

The bandwidth around the ring is pre-allocated in two ways. The first is called "reserved" and can only be used by class A0 traffic, and is equally reserved all around the ringlet. If stations are not using their pre-allocated A0 bandwidth, this bandwidth is wasted. The other pre-allocated bandwidth is called "reclaimable". A station that has class A1 or B-CIR Traffic to send, pre-allocates "reclaimable" bandwidth for these types of traffic. If not in use, such bandwidth can be used by FE traffic. In addition, any bandwidth not pre-allocated is also used to send FE traffic.

III. TRANSIT QUEUE

Most of the existing solutions for the local minimum problem use perimeter routing technique (PRT). The minimum transit queue size is the maximum transfer unit that a station itself may add (because this is the maximum buffer size needed by the frames in transit while the station adds a new frame).Some flexibility for scheduling of frames from the add- and transit-path can be obtained by increasing the size of the transit queue. A station may add a frame even if the transit queue is not completely empty. Also a larger queue may store lower priority transit frames while the station is adding high priority frames. The transit queue could have been specified as a priority queue, where frames with the highest priority are dequeued first. This was considered too complex. Thus stations have two transit queues. The high priority transit frames (class A) are queued in the Primary Transit Queue (PTQ), while the low priority transit frames (class B and C) are queued in the Secondary Transit Queue (STQ).

Forwarding from the PTQ has priority over the STQ and most types of add traffic. Regarding priority between add traffic and the STQ, as the STQ fills up, it will have increasingly higher priority (this is not a linear function, but based on thresholds). Since class A frames have priority over all other traffic, a class

A frame traveling in the ring will usually experience not much more than the propagation delay and some occasional transit delays waiting for outgoing packets to completely leave the station (RPR does not support pre-emption of packets).When in transit, both class B and C frames are stored in the STQ, hence, once added to the ring, they experience delay values within the same range.

An RPR station may, however, have one transit queue only (the PTQ). In order for class A traffic to move quickly around the ring, the transit queues in all single transit queue stations should then be almost empty. This is achieved by letting transit traffic have priority over all add traffic, and by requiring all class A traffic to be reserved (class A0). Hence there will always be room for class A traffic and class B and C traffic are competing for the remaining bandwidth, just like in the two transit queue stations.

Latency is measured from the time a packet is ready to enter the ring (i.e. first in the ingress queue), until it arrives at the receiver. Class A traffic keeps its low delay even when the ring is congested. Class B traffic still have low jitter under high load, while Class C traffic experiences some very high delays.

IV. RESILIENCE

As soon as a station recognizes that one of its link or a neighbour station has failed, it sends out topology messages. When a station receives such a message telling that the ring is broken, it starts to send frames in the only viable direction to the receiver. This behavior, which is mandatory in RPR, is called steering.

The IEEE 802 family of networks has a default packet mode called “strict” in RPR. This means that packets should arrive in the same order as they are sent. To achieve this after a link or station failure, all stations stop adding packets and discard all transit frames until their new topology image is stable and consistent. Only then will stations start to steer packets onto the ring. Even on a 2000 km ring, it will take a maximum of 50 ms for this algorithm to converge, that is from the failure is observed by one station, until all stations have consistent topology databases and can steer new frames.RPR optionally defines a packet mode/attribute called relaxed, meaning that it is tolerable that these packets arrive out of order. Such packets may be steered immediately after the failure has been detected and before the database is consistent. Relaxed frames will not be discarded from the transit queues either.

When a station detects that a link or its adjacent neighbour has failed, the station may optionally wrap the ring at the break point (called “wrapping”) and immediately send frames back in the other direction (on the other ringlet) instead of discarding them. Frames not marked as wrap eligible (via the we frame field) are always discarded at a wrap point.

V. RPR FRAME

Following is a short summary of the functionalities of RPR frame fields:-

OH: 8 Bytes: Preamble for Ethernet PHYs, Length & Type for GFP.

DA: 6 bytes: IEEE 802 address.

SA: 6 bytes: IEEE 802 address.

TYPE: 2 Bytes: Standard IANA indication of layer 3/2.5 protocol carried in Payload.

TTL: 1 Bytes: Ring TTL value, decremented at every transit node.

CoS: 3 bits: Indicates Class of Service used for payload for QoS.

EXT: 1 bit: Indicates extensions to basic header (TBD).

Client-ID: 20 bits: Identifies receiving client.

HEC: 2 Bytes: Header Error Checksum.

PAYLOAD: Data to be transmitted.

CRC: 4 Bytes: Standard Ethernet CRC.

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VI. RESULTS AND DISCUSSIONS

I SIMULATION OF CRC GENERATION FOR DATA

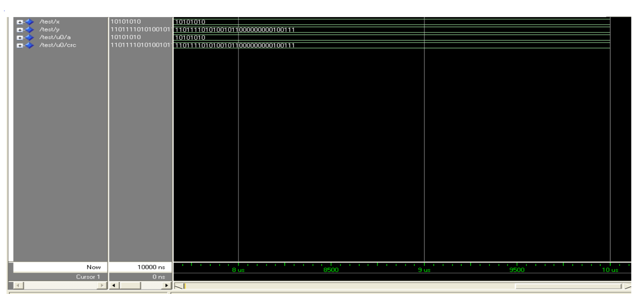

Fig 1. CRC Generation for data simulation

The figure 1 shows the simulation output of crc generation for data.
The data is transmitted to CRC Generator and the 32-bit CRC is generated for the data.

II SIMULATION OF CRC GENERATION FOR HEADER:

Fig 2. CRC Generation for header simulation

The figure 2 shows the simulation output of crc generation for header.
The header is transmitted to CRC Generator and the 16-bit CRC is generated for the header.

III SIMULATION OF DATA INTEGRITY

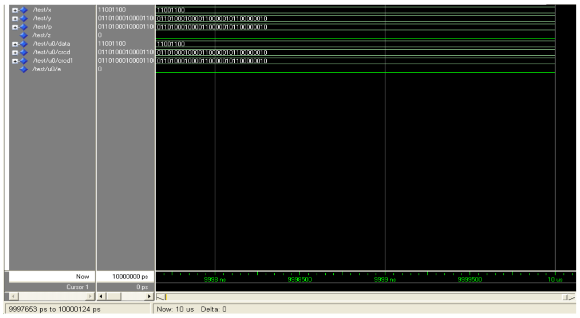

Fig 3. Data Integrity simulation

The figure 3 shows the simulation output of data integrity.
The data is transmitted to CRC Generator and the 32-bit CRC is generated for the data. The 32-bit CRC is also
fetched to the CRC Generator.
In the above case as the crc calculated and crc received is same so
Error flag i.e. 'e'='0'.Thus it can be inferred that data is not corrupted during transmission

IV SIMULATION OF NODE 2

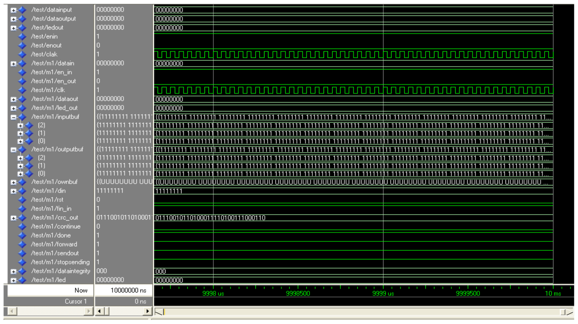

Fig 4. Node 2 simulation

The figure 4 shows the simulation output of node 2.The RPR frames is
first stored in the input buffer of node 2.As node 2 act as an transit node,
the frame it received is buffered into output buffer so that it can be transmitted to next node.
The own buffer of node 2 is empty as no frame
is addressed to node 2.

V SIMULATION OF NODE 3

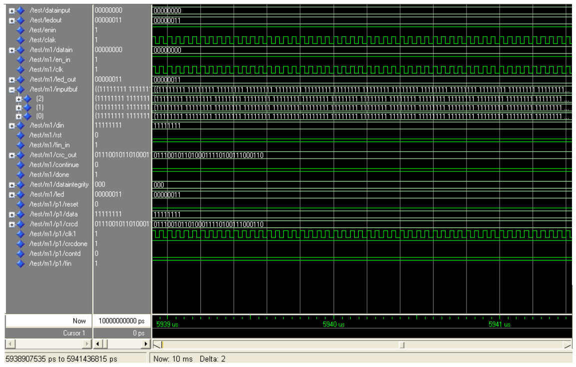

Fig 5. Node 3 simulation

The figure 5 shows the simulation output of node 3.The RPR frames is stored in the input buffer of node 3.
'led_out' is '00000011' indicates that 3 frames are received by the node 3.

VII. CONCLUSION

In this paper, Resilient Packet Ring (RPR) is a new evolving standard for constructing packet-based scalable ring architecture for use by the bandwidth-hungry applications expected to proliferate into metropolitan area networks. The technology couples the efficiency and simplicity of packet-based Ethernet with the strong protection capabilities of the TDM-based SDH/SONET rings. The main advantages over

SDH/SONET rings are the cost-effectiveness and the bandwidth efficiency. The advantages of RPR over Gigabit Ethernet (GigE) are the fairness and 50 msec recovery time in case of link failure, which are not well-defined for GigE.Another important feature of RPR is spatial reuse, which causes bandwidth to be used efficiently on the ring in case the traffic profile allows the reuse. Thus Resilient Packet Ring (RPR) has emerged as a key technology and a recent standard in delivering transport convergence.

Protocol in terms of Packet Delivery Ratio, Average end-to end delay and Normalized Routing Load. From the comparison it is concluded that overall performance of ant based algorithm is better than EHC in terms of throughput. Our proposed algorithm can control the overhead generated by ants, while achieving faster end-to-end delay and improved packet delivery ratio. The future work could be to investigate different methods to further limit the traffic or load and compare the ant based algorithm for other proactive and reactive routing protocols.

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