Optical Networks with Resilient Packet Rings

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Introduction

A Metropolitan Area Network (MAN) is a large network of computers which spans a large campus or a city. MAN interfaces the end users with the Wide Area Network. It supports all kinds of services, namely, voice, image, video and data based services. These services are classified as real-time, near real-time, best effort services from the traffic engineering perspective.

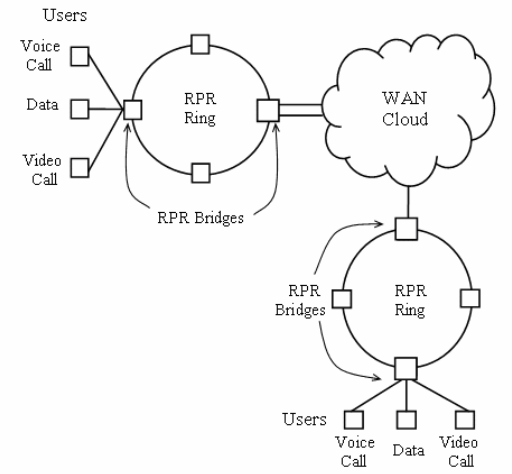

Figure 1: Schematic of an RPR enabled network.

RPR Technology

The IEEE 802.17 Resilient packet Ring (RPR) standard aims at high data rates for Metropolitan Area Networks (MANs). The objective is to achieve high utilization, Quality of Service (QoS) for high priority traffic classes, fairness for low priority traffic classes, spatial reuse and 50 ms protection simultaneously. The inherent capacity of RPR to accommodate data traffic over and above voice traffic makes it, an attractive technology. RPR is an alternative to legacy networks like Synchronous Digital Hierarchy (SDH)/ Synchronous Optical NETwork (SONET) which are based on Time Division Multiplexing (TDM) technology.

RPR is basically a dual ring, packet based technology with a provision for prioritized service, shown schematically in Figure 1. This feature of prioritized service, make possible the support for real-time service. Ironically, if a voice connection uses this real-time service, the quality would still be inferior to the one provided by the carrier networks like Plesiochronous Digital Hierarchy (PDH) and SDH/ SONET. Hence, it is imperative to enable TDM services in RPR network, by implementing, ``TDM over RPR".

TDM over RPR

The problem of realizing a TDM pipe through RPR requires two aspects to be implemented: (a) QoS in the RPR cloud and (b) Timing and synchronization at the receiver end. Here, we present the results pertaining to the later part only.

Live voice was transmitted through the Farsync E1 card (which created E1 frame) and was received by RPR node (implemented in Xilinx ML506 evaluation board. Since, the Xilinx ML506 Evaluation Board doesn't have E1 interface, a HDB3 to NRZ transcoder was implemented). The E1 TDM frames are converted into RPR frame on board and assigned the A0 class. The RPR frames carrying E1 frames are interfaced with the GTP so that the payload is carried across to the RPR bridge/network on the other-side and again converted back to E1 frames to interface with the E1 card of the destination PC. In the destination RPR bridge the timing and synchronization algorithms were developed and tested.

Receiver synchronization: The objective here is to (a) recover the TDM clock from the remote upstream TDM node, used at the transmitter, and (b) emulate the same TDM line further downstream. This is equivalent to controlling the rate at which frames are sent from RPR to E1 line converting module in the receiving RPR node to the destination PC. The inter-arrival interval estimates are obtained from the inter-frame intervals, using the *moving averager* of window size of 80 frames.

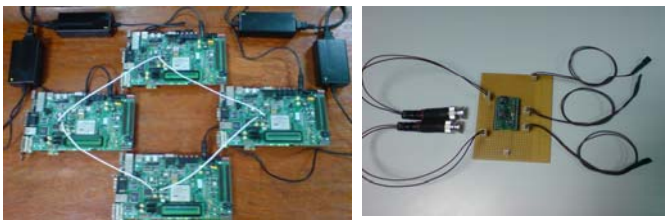

Figure 2: A 4 node RPR ring implemented using Xilinx ML506 Board (left). Fabricated PCB with HDB3-NRZ Transcoder chip showing connecting cables (right).

Results

To see how the moving averaging algorithm responds to abrupt change in the input rate, we set R1 = 250 units till t = 300 ms changes to R2 drops to 60 units abruptly (See Fig 2). Future work is to implement the synchronization algorithm corresponding to higher order estimators and test it out in the more stringent real world applications.

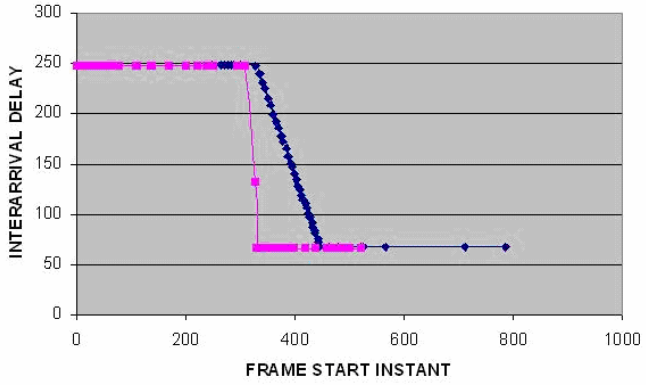

Figure 3: Inter-arrival intervals versus time (both in terms of clock intervals). Blue (estimated or output inter-arrivals) and pink (actual inter-arrival intervals).

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