Latency Sensitive Data Communications for Emergency Responses at Hurricane Command Centers

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Abstract

In this paper, we propose a real-time virtual burst assembly scheme for latency sensitive data communications for emergency responses at Hurricane Command Centers. The analysis shows that the proposed scheme can greatly reduce the latency and jitter experienced by real-time traffic and greatly enhanced the emergency response capabilities of hurricane command centers.

1. Introduction

Hurricanes bring oppressive natural conditions which severely damage property, ruin city infrastructure, putting lives at risk. A sophisticated but efficient telecommunication network connecting hurricane command centers, hospitals, and emergency relief authorities would be very critical in handling the situations by providing the infrastructure for emergency communication and monitoring. Most of these applications are very sensitive to latency and jitter (variation of latency). To accommodate these vital applications, we propose real-time virtual burst assembly (RT-VBA) for emergency responses at Hurricane Command Center in dealing with latency sensitive data communications.

2. Methods

Reconfigurable Asymmetric Optical Burst Switching (RA-OBS) [1] has been proposed as a cost effective way to scale the network capacity using existing network infrastructures. In RA-OBS, the *Optical Burst Switching* (OBS) [2] mode is the primary switching method to handle dynamic traffic. In the OBS mode, packets are assembled into bursts based on destinations or types of services. For example, packets with the same destination are physically attached to the burst being assembled during the burst assembly process. Unfortunately, latency sensitive packets suffer from the burst assembly latency inherent to burst assembly, as well as the transmission latency caused by the transmission of non-real-time packets. This can severely affect the latency sensitive data communications at Hurricane Command Centers.

In this paper, we propose *Real-Time Virtual Burst Assembly* (RT-VBA) which allows for greatly improved latency performance of real-time data. This is achieved using the concept of virtual bursts [3], which serve as templates for optical bursts, whose contents may be changed at any point before the actual transmission of data. In the proposed RT-VBA, bursts are assembled from the real-time and non-real-time queues. Priority is given to the queue that is associated with real-time traffic. For example, packets associated with live video conferencing among hurricane command centers are given much higher priority than packets associated with file transfers. The transmission of real-time packets

could be instant if there is an ongoing burst in transmission. This dramatically reduces the effect of burst assembly time on latency.

3. Analysis and Results

A hardware testbed was used to evaluate the performance of the proposed RT-VBA using real variable bit rates video streams, with a TI DaVinci video development board providing real-time encoding of the video. The network testbed consists of a set of FPGA boards implementing the ingress routers, Ethernet switches and an optical switch. Figure 1 (a) shows the *probability density function* (pdf) and *cumulative distribution function* (cdf) of video packet latency with RT-VBA, while Figure 1 (b) shows the performance of the same video traffic without RT-VBA. From the cdf curve in Figure 1 (a), over 80% of the video traffic has a latency under 3 ms, while that number is less than 60% for the original setup

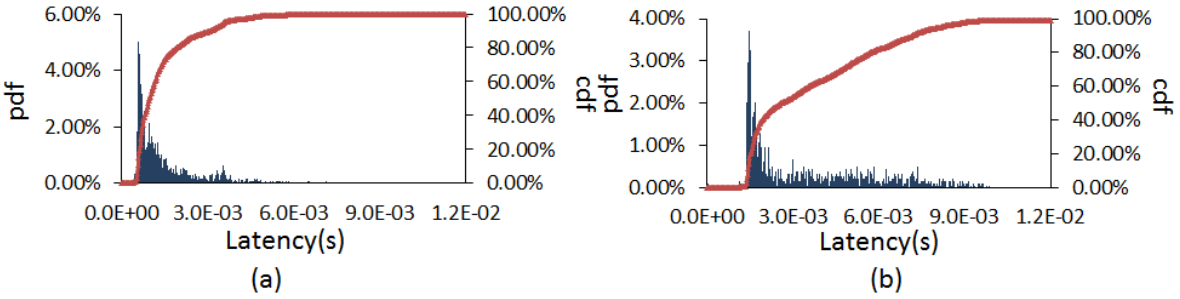

Fig. 1. Video Packet Latency Distribution (a) Proposed RT-VBA Scheme; (b) Original Scheme

represented by Figure 1 (b). The steeper cdf curve in Figure 1 (a) also means that the jitter of the video stream is significantly reduced by the proposed RT-VBA scheme.

4. Conclusions

In this paper, we have proposed real-time virtual burst assembly to provide latency sensitive data communications for emergency responses at hurricane command centers. The analysis has shown that latency and jitter performance of the proposed scheme is greatly improved for real-time traffic. Such an approach can greatly enhance the emergency response capabilities at hurricane command centers.

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7. References

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