Supporting Telemedicine in Hurricane Shelters

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Abstract

In this paper, we propose virtual burst assembly with per-flow queueing to support telemedicine in Hurricane Shelters. Our analysis shows that the proposed scheme can greatly reduce the latency and jitter in telemedicine and bring quality medical care to Hurricane Shelters.

1. Introduction

Hurricanes accompanied with severe winds and heavy rainfalls can destroy properties, cease transportation systems, and even claim invaluable lives. Hurricane shelters are preselected locations which are setup to provide accommodation, food, and other necessities to people in the Hurricane affected areas. Although several post-care measures are deployed, there are severe delays before medical help can reach the needy in time. To counter these delays we propose to support telemedicine in Hurricane Shelters to provide remote medical services by medical experts through communication networks. With the proposed design, delays within the network are reduced such that telemedicine can be supported with minimal human intervention.

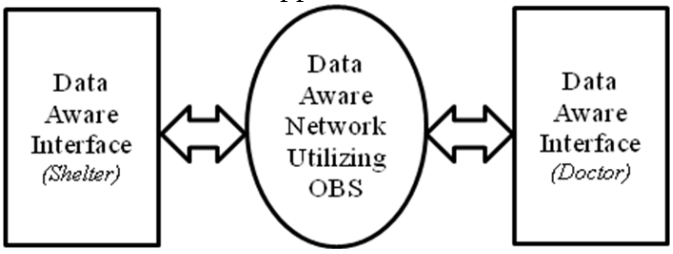

Figure 1 Overview of the setup indicating shelter interface and the doctor's interface

Figure 1 shows the setup in this proposed work. The interface at the Hurricane Shelter includes cameras, microphones, and any other input device to read or monitor the patient's medical condition. The data aware network carries this information, based on priority, class of service or quality of service to the medical personnel. The doctor at the remote site has an interface that displays all relevant data and takes inputs from the doctor to manipulate the interface at the Hurricane Shelter.

2. Methods

Optical Burst Switching (OBS) [1] is considered as a viable solution for the next generation optical switching networks to serve bandwidth demanding applications such as telemedicine. Existing OBS paradigm assembles packets into bursts based on destinations or types of services. For example, packets with the same destination or belonging to the same service class are in the same burst assembly queue during the burst assembly process. If packets from multiple flows get lined up in the same queue, they will be served in a "first-come, first-served" fashion. While it is fine for best effort traffic, it will severely deteriorate the performance

of delay sensitive applications such as telemedicine. Our analysis has shown that latency and jitter performances of normal flows are severely affected by greedy flows under this queuing policy. In this paper, we propose to combine virtual burst assembly (VBA) [2] with per-flow queuing scheduling mechanisms (e.g. *Deficit Round Robin* (DRR), *Stratified Round Robin* (SRR)) so that each flow gets its fair share of bandwidth and bounded latency/jitter.

3. Analysis and Results

We evaluate the per-flow queuing schemes (DRR and SRR based) in comparison with the original scheme on a 14-node, 21-link NSFNET topology using the ns2-OBS simulator. 25 flows were generated from one edge node and destined to another edge node several hops away. One of the 25 flows is a greedy flow which started at time 4 seconds.

The throughput and latency results of Flow 24 and the greedy flow are shown in Figure 2. In traditional burst assembly, once the greedy flow starts, the throughput of flow 24 (as well as other flows) drops as shown in Figure 2 (a). In contrast, Figure 2 (b) and (c) show that the proposed VBA with DRR and VBA with SRR can effectively limit the bandwidth taken by the greedy flow. Since SRR can provide better delay bounds, the latency experienced by VBA with SRR is much less than VBA with DRR, as shown in Figure 2 (d). The same improvement is also observed from the jitter plots in Figure 3. The large jitter encountered in the original scheme in Figure 3 can cause unstable video in telemedicine. The proposed scheme (VBA with DRR or SRR) can considerably reduce jitter with its per-flow queuing.

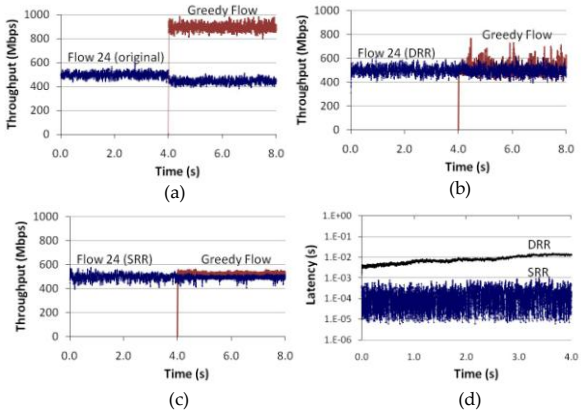

Figure 2: Throughput and latency comparisons.

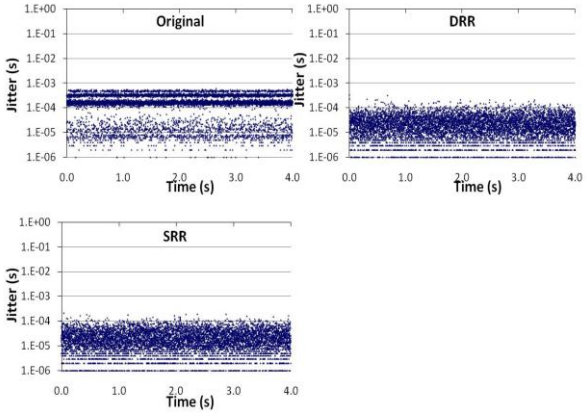

Figure 3: Jitters for normal flow (Flow 24).

4. Conclusions

In this paper, we have proposed virtual burst assembly with per flow queueing to provide throughput and latency guarantees to support delay sensitive applications such as telemedicine. Such an approach can be used to support telemedicine in Hurricane Shelters to bring quality medical care to people in need.

6. Acknowledgement

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7. References

[1] J. S. Turner, "Terabit burst switching," *Journal of High Speed Networks*, vol. 8, no. 1, pp 3-16, 1999.

[2] L. Wang, Y. Chen and M. Thaker, "Virtual Burst Assembly - A Solution to Out-of-Sequence Delivery in Optical Burst Switching Networks," *IEEE GLOBECOM 2008*, pp.1-6, Nov. 2008.