Transport Protocols for Optical Burst Switched Networks – Moving Beyond Lightpaths

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Long distance gigabit networks are routinely used to transfer terabyte files using a variety of high performance transport protocols. Several recent bulk transfer experiments have demonstrated throughputs in excess of 90% of NIC transfer rates. Some experiments have used end-to-end "lightpaths" – provisioned, dedicated, point-to-point optical circuits.

Dedicated lightpaths have a number of advantages – most are protocol agnostic, many can be implemented as relatively inexpensive overlays in carrier networks, and some can be provisioned by users [1]. However, lightpaths have several technological limitations: ***(i)*** scalability – lightpaths are point to point, and users have a few tens of wavelengths (at most) available to them even in DWDM networks; ***(ii)*** efficiency – lightpaths reserve but rarely use all of the bandwidth available to them. Most lightpath architectures cannot share wavelengths.

Emerging optical burst switched (OBS) networks address both of these limitations. OBS networks share wavelengths by interleaving data bursts from multiple sources. OBS networks support ultra fast wavelength switching, and a number of familiar networking constructs (lightpaths, tunnels, short bursts containing a few contiguous packets, *etc*.). Traffic sharing a wavelength channel can be shaped to control or contain aggressive protocols, and can be finely tuned to achieve requisite levels of performance and efficiency. Wavelengths can be provisioned in a few microseconds, and held for milliseconds to days.

OBS networks can also be implemented as relatively inexpensive overlays. An experimental overlay is deployed in the ATD*net* all-optical testbed in metropolitan Washington DC. It uses unmodified commercial photonic switches and a simple control protocol to provision and manage bursts [2].

This paper focuses on issues related to **transport protocols** in OBS networks; *viz*.:

1. An experimental modification of the ANSI standard Scheduled Transfer (ST) transport protocol for the ATD*net* testbed [3].

2. Performance issues related to existing production and experimental transport protocols operating in OBS networks. *E.g.,* OBS networks do not buffer data in the core, so some features of protocols designed for lossy electronic links are superfluous.

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3. Design issues for new transport protocols operating in OBS networks [4]. *E.g.,* OBS pinned routes guarantee ordered delivery of payloads, so a sequenced delivery service is not required of the transport protocol.

4. Architectural issues that are unique to OBS, and their impact on transport protocols operating in OBS networks. The burst assembler/scheduler and the transport layer can work in concert to provide a number of useful services; *e.g.,* hardware-assisted rate and flow control, shaping, deterministic delay and jitter bounds.

5. Design issues for new transport protocols operating in an OBS-inspired LAN testbed.

6. Design, performance, architectural, and operational issues for transport protocols operating in computing grids having OBS components.

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