



Lightfleet Emerges from Stealth with Broadcast Optical Interconnect

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March 8, 2007

SERVICE NAME

» Enterprise Servers

Summary

Start-up Lightfleet, Inc. has come out of stealth mode to reveal its unique all-to-all optical interconnect. The company's "Corowave" technology is described as a "simultaneous, all-to-all, continuous broadcast optical interconnect." Lightfleet's goal is to eliminate the unwieldy mess of point-to-point cables that form the interconnect of very large highly parallel systems. Its solution substitutes a set of optical transmitters and receivers that connect through "free space" – that is, through the air and not guided by fibre optic cables. In addition to simplifying installations, replacing large numbers of point-to-point connections with optical broadcast also brings a significant savings in power.

Lasers, Lenses, and Mirrors: How Corowave Works

Although broadcast offers the additional feature of one-to-many communication, a broadcast network also supports one-to-one links through the use of address headers. The Corowave design employs multiple transmitters and multiple receivers in order to transmit multiple messages simultaneously. Individual nodes can "pay attention" to just the messages sent to them. In essence, the broadcast technology can be used to create an ever-changing mesh of virtual point-to-point links.

Yes, Corowave employs lasers for their strong light output and ease of data modulation. But the lasers' narrow beams need to be spread out through diffusing lenses to reach all receivers. Of course, a fundamental principle of light is that two beams can cross through each other without interference. The trick is to carefully align the receivers, using focusing lenses, so that each picks up the signal from just one of the transmitters. Lightfleet's technologists leveraged their backgrounds in optical design to devise the package of spreading lenses and focusing lenses that permits multiple, simultaneous transmissions.

The initial Corowave implementation employs 32 transmitters and corresponding receivers to create a 32x32 interconnect. To achieve a more compact package, the diffused light beams are reflected off a mirror to the optical receivers. The enclosure contains air, not a vacuum. The optical interconnect assembly will be enclosed, but beam interruption by dust particles is not a worry, since the receivers' focusing lenses gather light from a broad swath. Besides, a temporary obscuring of any light beam can be as easily protected by ECC as intermittent electrical noise is corrected in electrical signal cables.

Advantages of Broadcast Optical Interconnects over Electrical

From what Lightfleet has shown Ideas International (IDEAS), we have no doubt that it can create a “simultaneous, all-to-all, continuous broadcast optical interconnect.” The question becomes: “What are the advantages over traditional electrical interconnects?”

When complex problems are split across large numbers of compute nodes, the challenge arises as to how to interconnect the nodes to achieve the required node-to-node communication. For some problems, the nodes primarily communicate with nearest neighbors and can be interconnected via straightforward mesh or torus topologies. Lightfleet’s all-to-all technology can support nearest neighbor communication patterns, but that does not start to take advantage of its capabilities.

Other applications need low-latency access to any node, and cannot tolerate the delays of multiple hops across a network. To provide direct point-to-point connections, the number of cables grows exponentially with the number of nodes. Multistage switches offer an alternative, but increase communication latency. To eliminate cables while maintaining uniform low latency, Lightfleet’s lasers and opto-receivers employ lenses so that each sending laser broadcasts to all receivers simultaneously.

The cable reduction and uniform low latency of the Lightfleet interconnect provide an attractive solution for those applications requiring access across all nodes, and not primarily their nearest neighbors. But where Lightfleet’s technology will really shine is for applications that exploit its simultaneous, all-to-all broadcast capability.

Somewhat of a “chicken and egg” dilemma, not many applications currently employ broadcast communication because there are not many computing platforms offering all-to-all broadcast. However, the potential performance gains may well spur those with particularly difficult problems to recode their algorithms.

Pattern recognition and data correlation appear to be particularly well suited for all-to-all broadcast communication. Applications span the range from facial/speech recognition/identification, financial fraud detection, biological/pharmaceutical research, climate modeling, etc.

In fact, it was Japan’s Earth Simulator climate modeling system that sparked the Lightfleet team’s development efforts. In June 2002, that 640-node system surprised the supercomputing community by leaping to the top of the TOP500 list. The Earth Simulator’s interconnect requires 83,200 cables totaling 2,400 km in length. Looking to address the problem of massive interconnect with a far simpler solution, a group of technologists tapped on their optical networking experience to found Lightfleet in May 2003.

The IDEAS Bottom Line

As mentioned above, for its initial implementation, Lightfleet plans a 32x32 interconnect, which would allow 32 nodes containing dual-core Intel processors to fully communicate with each other. Targeted to ship to early adopters in the

summer of 2007, this first system will allow users to confirm the benefits of all-to-all broadcast technology. Other interconnect configurations could be released depending on customer needs.

Although a multinode Intel server will be its initial product, Lightfleet describes itself as an interconnect developer, not a server vendor. The company stresses that its Corowave technology could also be incorporated into storage products and communication systems, embedded into medical imaging systems, or integrated into specialized government processing systems.

IDEAS believes Corowave offers a unique interconnect approach that could assist in solving difficult computing problems. As Lightfleet attains success, we plan to track its progress.

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