Comparing Ethernet and RapidIO

By Tom Roberts

Systems designers evaluating communications fabrics for new systems can see two attractive options in Ethernet and Serial RapidIO. Technology enthusiasts may promote one over the other, but an even-handed comparison shows that both have areas of relative advantage. The designer's challenge is to evaluate these advantages in light of specific system requirements and choose the best option. Ethernet and RapidIO can co-exist within a system, so sometimes the best option may be to use them both, each focused on functions they perform best.

A first step is to compare and contrast the two technologies. While their capabilities overlap in some areas, they were developed to solve different problems and their underlying architectures differ in many respects.

Ethernet was originally conceived of as a way for multiple computers to communicate over a shared coaxial cable. As technology evolved the physical layer became point-to-point and practically supportable bandwidths increased to the current level of 10 Gbps. Ethernet has become the unchallenged communications interconnect for Wide Area Networks because it is highly flexible, supporting essentially unlimited numbers of endpoints.

Flexibility versus processing overhead

However, for historical reasons each endpoint is assumed to have a processor that is both available and capable of running software which implements the Ethernet protocol stack. This software stack gives Ethernet its flexibility but the processing overhead it generates needs to be considered. For Wide Area Networks (WAN) and Local Area Networks (LAN), the processing overhead can be compensated for by using large communications packets. For other applications, such as control plane transactions between boards within a chassis, the packet sizes are small and Ethernet's software overhead reduces performance efficiency.

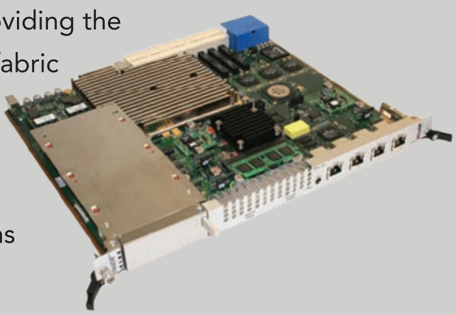
The reliability of Ethernet communications depends on choices made in filling out the software stack. The widely used TCP protocol provides end-to-end connection reliability but adds to the software stack overhead. UDP can be used when that overhead is too high and it is acceptable to drop packets for congestion control or because of errors.

RapidIO was designed for embedded applications, supporting chip-to-chip and board-to-board communications. The focus of RapidIO is on delivering communications with high bandwidth, low latency, determinism, and limited software dependence. Most of the RapidIO protocol is implemented in the hardware of its endpoints, simplifying software support and reducing software overhead. RapidIO bandwidths range from 667 Mbps to 30 Gbps. As with Ethernet, 10 Gbps implementations are now widely used.

Strong Quality of Service (QoS) characteristics are also part of RapidIO. For example, to support deterministic latency between two end points, RapidIO can transport traffic in fixed units. This gives the system the ability to interleave important traffic at fixed intervals, even if larger, less important streams have already been launched. Multicast support provided by RapidIO is another critical area for reducing latency in such applications as wireless base-band and video devices. Minimum guaranteed bandwidth is yet another RapidIO QoS feature.

In evaluating the application fit of Ethernet, the flexibility of its software stack clearly stands out. Its ubiquitous presence in the WAN marketplace means there is a wide array of supporting components: switches; end points; software stacks. And, if a system needs to communicate with or across a WAN, Ethernet will do it seamlessly.

RapidIO offers clear application advantages when requirements include low latency, determinism, guaranteed delivery, or guaranteed minimum bandwidth. For example, RapidIO is a good fit for a system requiring high bandwidth, low latency, and deterministic communications between multiple processing elements inside a chassis.



Mercury Computer Systems' Ensemble BSW-101 AdvancedTCA RapidIO/Gigabit Ethernet Switch Blade, part of the Ensemble AdvancedTCA Application Platform, is an AdvancedTCA fabric and base switch blade providing the non-blocking 4x Serial RapidIO fabric interface for AdvancedTCA systems with up to 16 slots. It also supports 23 channels of Gigabit Ethernet communications via a Gigabit Ethernet switch.

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