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Rugged 10 GbE closes technology gap for military

By John Wemekamp

The military was once perceived as a very conservative adopter of new technology, even though it was the dominant force behind investment in microelectronics. This was because the military cycle from development to deployment was so long that commercial markets could exploit the technology more rapidly. When the funding finally ended, development was already driven by the commercial, consumer, and telecommunications markets, where the massive development costs get recovered in volume sales in time to feed the cycle again. But the success of COTS rugged embedded computer vendors and the development of new platform standards have placed the military back in the forefront of influence and deployment of commercial technologies, such as Ethernet and IPv6, in parallel with their other non-rugged market users.

10 GbE is still in its infancy in any market segment, with standards being developed as it is introduced into new application areas. The most common physical standard is known as XAUI (Roman *ten* Attached Unit Interface), which uses a 16-pin connector for interconnection over a few meters. For longer distances XAUI can be converted to fiber, and a number of standards exist for this. But these optical standards are more difficult to implement and have not received wide acceptance for critical embedded computing applications such as blade servers, routers, switches, and multiple computing clusters. This prompted the development of a serialized four-lane 10 GbE backplane standard, signaling at 3.125 GHz, referred to as 10GBASE-KX4.

Evolving backplane requirements

Parallel backplane buses are being displaced from embedded computing applications, particularly where multiple computing elements are involved. High-performance processor devices and hence, SBCs or server blades, now incorporate two or more integrated GbE ports. In a multicompute environment, these ports are connected to each other via switches to create a control/management plane which, in some cases, also serves as a data plane. Since Ethernet is a preferred medium for subsystem-to-subsystem connection, as well as a platform backbone, using common IP standards within and between subsystems simplifies development and integration of an overall platform's application. No other type of network technology offers this all-around capability: board to board, subsystem to subsystem, access to common applications and databases, the use of Network Attached Storage (NAS), plus connection to external networks such as the evolving Global Information Grid (GIG).

The availability of embeddable Ethernet switches has made it easier to integrate subsystems in racks for rugged applications, such as new-generation ground vehicles, that require the most efficient use of weight, space, and cooling. New embedded switches are being introduced with both GbE and 10 GbE ports. SBCs or blades are normally connected to the switch via its GbE ports. Switch-to-switch and external paths are connected using the extra performance of 10 GbE to avoid potential bottlenecks at switches. However, where additional bandwidth is required, individual 10 GbE links can be added to SBCs and blades by means of PMC/XMC mezzanines giving additional high-performance point-to-point or networked ports. Until recently, backplane technology has limited the connectivity of 10 GbE to front panels of SBCs, PMC/XMC mezzanines, and switches, making the implementation of truly rugged systems difficult to achieve with any level of standardization among vendors.

The rapid adoption by COTS vendors and systems integrators of the VPX (VITA 46) standard is creating a freedom of topology for rugged embedded computing applications, enabling the use of both GbE (1000BASE-T) and 10 GbE (10BASE-KX4, VITA 46.7) across the backplane and the incorporation of dedicated switch slots within a rack (VITA 46.20). The 6U VPX6-684 FireBlade II Ethernet switch from Curtiss-Wright Controls Embedded Computing (CWCEC) is shown in Figure 1.

Figure 1

In addition to 10 GbE, the introduction of IPv6 is an important part of the DoD's future strategy. Although IPv6 provides enhanced security features, it cannot provide the unbreakable levels of protection needed in the information war zone. One approach to improving security is to add PMC/XMC mezzanines to critical SBCs and switches providing payload encryption for GbE ports using Advanced Encryption Standard (AES) and its forebear, Triple Data Encryption Standard (3DES), for high levels of classification.

The military and its supporting COTS vendors actively participate in technology development such as VPX, as well as proposing and supporting Request for Comments (RFCs) applicable to new military requirements through the Internet Engineering Task Force (IETF). This renewed focus by the DoD and other government agencies on Ethernet and IPv6 is key to their future enterprise-wide and operational strategy, closing the deployable technology gap with other leading markets.

To learn more, e-mail John at john.wemekamp@curtisswright.com.