COM-onomics

The Economics and Use of COM Express in Embedded Applications

Many embedded applications today require not only significant processing performance, but also increased I/O function in a compact form factor: Enter COM Express. In utilizing the COM method of a module containing all of the components for a host computer (offered as an COTS component) attached to a carrier board (COTS-developed or custom per application), the COM Express form factor is poised to become the de facto architecture for balancing performance, size, I/O and thermals within the embedded computing market.

In physical applications, COM Express can be utilized as a standalone embedded solution or as a processor mezzanine. To see this, we must look closer at the COM Express design standard and how its specifications allow it to be utilized within an application setting.

Function and Design

The standard for a COM Express carrier board is CPU-agnostic. The architecture allows the embedded industry to adopt LVDS interfaces while maintaining legacy support.

The board-to-board connectors in COM Express consist of two rows, in which one row provides pins for PCI Express, LPC Bus, SATA, LVDS LCD Channel, VGA and TV-out, LAN, system and power management, and power and ground interfaces, while the second provides SDVO and legacy IDE and PCI signals with additional PCI Express, LAN, and power and ground signals.

The maximum total I/O support in COM Express becomes:

32 PCI Express lanes (80Gbps aggregate)
x16 PCI Express graphics
2 LVDS Channels
2 Serial DVO Channels
4 SATA-150 links (600MBps aggregate)
3 10/100/1000 Ethernet ports (10G provisions in the future)
8 USB 2.0 ports

COM Express has also been designed to support future generations of PCI Express and SATA interfaces.

The physical dimension requirements of the COM Express CPU modules allows for two different sizes: Basic and Extended, measuring 125mm x 95mm and 155mm x 110mm, respectively. The Extended Form Factor has a larger power budget, doubles memory capacity, utilizes dual-channel RAM configurations, and allows the use of larger processors and chipsets.

The Basic and Extended Form Factors, however, share the same board-to-board connections, signaling definitions, and mechanical assemblies. This means that any carrier board can support either a Basic or an Extended CPU Module.

As can be seen, COM Express is a very flexible architecture that can be used in a diverse range of applications, due to the significant I/O capabilities, CPU-agnostic design, and the ability to interchange host CPU modules. So, how do these capabilities contribute to promote the use of COM Express as either a standalone embedded board or as a processor mezzanine?

COM Express – The Little Board that Could

Standards such as AdvancedTCA are focused on a much defined market segment (Telco and Data) because of three main reasons: First, significant bandwidth processing power. Second, there is no need, in most cases, for significant amounts of I/O within ATCA applications. Third is the fact that, in the applications that utilize AdvancedTCA, size is not a very important issue. It makes sense, in these cases, to utilize a separate processing node, separate switch nodes, and to create expansion via AMC modules. These three points can also be applied to MicroTCA, with lesser implications on necessary size. AdvancedTCA and MicroTCA are high-bandwidth, high-power, low I/O solutions mainly for Telco and Data applications. They suit their market very, very well.

COM Express, however, is more flexible. Any application in any market that requires high bandwidth, high I/O, and small size can utilize COM Express. Industrial Automation, Test & Measurement, Military/Aerospace, Security, Transportation, and Medical markets all require the processing power, I/O capabilities, and small form factor that is present in COM Express.

As a standalone embedded board, the COM Express methodology creates a solution in which there is significant processing and I/O bandwidth in a small physical footprint. Many applications in the aforementioned markets can take advantage of these characteristics by utilizing a standalone embedded board: Interactive kiosks, Self-Checkouts, training simulators, electronic billboards and such can take advantage of the features of COM Express by utilizing a standalone embedded board within their applications.

Within the same markets and applications, designers of embedded systems and applications may also partition COM Express CPU Modules from their own platform base, including specialty I/Os and FPGAs, utilizing COM Express as a processing mezzanine. In doing so, these designers can focus on their application-specific I/O on a custom baseboard, without the need to address high-speed switched fabrics, signal reflections and impedance controls, routing, termination placement, etc.

The COM Express methodology creates an architecture that can satisfy the needs of most (if not all) applications that require a balance of performance and I/O in a compact form factor, and the flexibility of the specification allows for the utilization of COM Express as either a standalone embedded board or as a processing mezzanine within the proprietary building blocks of other applications, allowing designers to focus on their own core engineering competencies.

All of this is well and good, but the real question, at the end of the day, is how will the adoption COM Express affect the overall bottom-line of an organization? What is the total cost of ownership, the product life cycle costs, time-to-market, transitional metrics, etc.?

Ducats and COM Express

First and foremost, COM Express represents a significant reduction in life cycle costs due to the scalability and interoperability of modules. Once a specific carrier board has been implemented to an application, future hardware upgrades can be implemented by simply changing the COM Express Module. This significantly reduces the hardware costs of upgrading, which represent the bulk of expense when a new generation of CPU and RAM technology becomes available.

In hand with the quick implementation of upgraded hardware comes the faster time-to-market for deployment and time-to-revenue after. There is a direct relationship between how fast an organization can deploy and implement hardware upgrades and how quickly said organization can begin to see ROI. With COM Express, the essential plug-and-play architecture of the standard means that next-generation processor and RAM technology can be deployed, implemented, and working much faster than previously, quickly generating a revenue stream. Simply stated, the COM methodology allows an organization to rapidly respond to demand fluctuations, competitive forces, and new technologies by quickly and efficiently modifying existing designs, inexpensively broadening their product portfolios, and plug-and-play implementation of new COM boards.

COM Express represents a safeguard to R&D investments and a lowering of total ownership cost, because it allows designers to separate commodity COM Express modules from their proprietary building blocks. Investments into R&D for specific, value-added application elements will not have to be reengineered for successive technology generations.

It is possible to achieve some of the form-fit-function of COM Express via mini-ITX/nano-ITX motherboards and the like at a lower cost. However, when dealing with these competing form factors, an organization loses significantly more than it gains, mainly in the realm of life cycle availability and revision control. COM Express manufacturers strive to provide at least five years of availability and revision control of their products, allowing critical applications to be provided with the necessary hardware throughout their lifespan.

COM Express improves form-fit-function in specific applications, and helps to reduce design risks by cutting development time and costs, and, at the same time, providing the scalability and flexibility needed over a multi-year life cycle of an embedded application.

Finally, being a PICMG embedded standard, COM Express has no ‘proprietary’ builds. Standards-based COTS products have already been shown to reduce initial investment costs, as well as life cycle maintenance costs, due to the inherent competition among suppliers to produce cost-effective solutions.

As of now, COM Express represents the highest performance available in small form factor modules. The scalability, flexibility, throughput, support for legacy and non-legacy standards, and low cost of ownership make COM Express a very viable choice for a host of embedded applications across many different markets.

By reducing life cycle costs, protecting R&D investments, and reducing time-to-market and time-to-revenue metrics for any organization, COM Express makes a very compelling argument for itself within the embedded industry.