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# COM EXPRESS VERSUS ETX

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# COM EXPRESS BRINGS STANDARDIZATION TO COM INDUSTRY

The PICMG COM Express standard, ratified in July 2005, brought the first open standard for computer-on-modules to the embedded industry. Prior to this ratification, the proprietary definition of ETX was the computer-on-module preferred choice. The PICMG COM Express standard is quickly being adopted by the embedded industry with its forward looking combination of scalability and new technology. Today, the computer-on-module choice for new OEM designs is COM Express.

## THE NEED FOR A TRUE STANDARD

In order to understand the value of the COM Express standard, it is necessary to understand how the ETX specification evolved. The ETX specification was initially formulated by a single company, outside of a recognized standards body. It, lacked open participation that industry standards organizations promote. Third party ownership is necessary for standards to evolve as advances in technology occur. The ETX specification was based on the current technology of the time, but what is now considered legacy technology. Many of the legacy technologies are moving into the end of the product life cycle and may be disappearing altogether as well as they do not scale to the full potential of modern CPUs, GPUs and high-speed memory.

The COM Express specification, was formulated with broad industry participation within the PICMG (PCI Industry Computer Manufacturing Group), a third party open industry standards organization. COM Express is an open standard that offers equal participation by any company and has controlled processes for updates and changes. Release 1.0 of the specification was ratified in July 2005 by the PICMG.

COM Express reflects the requirements of a wide spectrum of embedded applications due to the participation of many leading companies across the embedded industry. The participants represented the medical, industrial automation, test & measurement, network security, network communications and defense & aerospace industries.

The COM Express specification is based on the latest I/O technology, and can scale to realize the full potential of today's CPUs, such as the Intel Core 2 Duo processors, GPUs, and high-speed memory. Because the COM Express specification allows legacy and new I/O technologies to coexist in the same design, it provides a safe migration path from legacy to new technology.

## A CHANGING TECHNOLOGY FIELD

While CPU and GPU data processing speeds continue to show no signs of slowing, the ISA bus, PCI bus, AGP, ATAPI, serial and parallel port interfaces have all reached their limits. As the CPUs, GPUs and memory performance outpace the legacy I/O interfaces, overall system performance cannot be optimized and the cost/performance ratio declines. Adding additional CPU, GPU and memory bandwidth at the performance problem only increases cost without improving performance.

In response to this I/O performance bottleneck, the PC industry created the PCI Express, Serial ATA (SATA) and Serial Attached SCSI (SAS) specifications. These high-speed, low pin-count, low-voltage, serial differential links are capable of data transfer speeds several orders of magnitude higher than those achieved by the legacy I/O interfaces. The new I/O technology has led to rapid displacement of PCI by PCI Express, AGP by PCI Express Graphics, IDE by SATA and SCSI by SAS. At the same time the legacy parallel (LPT) and serial (COM) port have been entirely replaced by USB and the PS/2 port function has also migrated to the USB standard..

## ETX – LEGACY TECHNOLOGY ADOPTION SLOWS

ETX 2.0 was built on legacy ISA, PCI, IDE and 100Base-T Ethernet technology. These legacy interfaces do not support today's high-performance CPUs, GPUs and memory. Trying to cover the performance gap by using faster CPUs, GPUS, and memory doesn't work, as the legacy I/O causes CPU idle cycles, limitations in graphics performance and memory wait states. ETX lacks an AGP interface for an external high-performance GPU, which also limits the flexibility for OEMs to built systems tuned accurately to the requirements of the underlying application.

ETX cannot scale to applications which benefit from a multi-processor architecture and are memory-hungry. The ETX footprint at 95mm x 114mm is too restrictive to accommodate such requirements. Finally, ETX is not capable of supporting 1Gigabit Ethernet or higher, primarily because it lacks the definition of pins necessary for the signaling in Gigabit Ethernet.

These limitations mean that OEMs cannot leverage their investments in ETX to evolve their future products to more cost-effective and higher performance technologies

and components. As a result, companies are searching for a new computer-on-module product that can take their products to the next generation.

Note: XTX is a recent effort by a group of companies to provide ETX with a second life by replacing the ISA bus signals on the ETX connectors with PCI Express signals. This approach is very limited as the number of PCI Express links is limited to 4 only, with no support for x16 PCI Express Graphics links for external high-performance GPUs, and no support for on-board Gigabit Ethernet. The ETX and XTX specified connectors do not support second generation PCI Express and SATA signaling speeds. XTX lacks support within open industry standards bodies providing OEMs with no leverage of their investments in XTX.

## COM EXPRESS – ADOPT AN INDUSTRY STANDARD WITH A FUTURE

The COM Express specification was carefully written to provide longevity and to address the technology needs of a wide range of embedded applications and industries. Performance scalability is built into the specification with support for future speed upgrades of PCI Express, SATA, SAS and Ethernet interfaces. The specification expands performance scalability via larger footprints that enable SMP as well as dual channel and large memory configurations.

The I/O specifications of COM Express are impressive, with support for up to 32 PCI Express links. These can be configured in any combination of x1, x2, x4, x8, x16 and x32 links. Support for x16 links means that high-speed external GPU solutions can be used. The large degree of flexibility and number of links supported give OEMs the ability to configure high-performance I/O and application-specific accelerators on the carrier board.

To gain an appreciation of the bandwidth available with PCI Express, consider that an x16 PCI Express link can sustain a peak transfer rate of 80Gbps in full-duplex mode, far higher than possible via 8x AGP. Since the COM Express mezzanine connectors are specified to support in excess of 6GHz signaling frequencies, the specification supports 2nd generation PCI Express, which doubles the fundamental transmission speed from 2.5Gbps to 5Gbps. This means that an x16 link can support an astonishing 160Gbps bandwidth.

The COM Express specification supports up to four SATA or SAS links and up to three 1Gigabit Ethernet interfaces. The mezzanine connector supports future speed grades for these interfaces, including 10Gbit Ethernet for the network interfaces. The COM Express specification is relevant well beyond the next decade and provides OEMs with unparalleled leverage of investment in COM Express technology.

The low voltage, serial differential nature of PCI Express, SATA and SAS provides more robust signal integrity and requires less pins that the legacy I/O technology. This makes the PCB design of carrier boards less complex, and results in a more reliable and compact design. These new interfaces provide an optimal balance between CPU and I/O throughput, resulting in higher overall system throughput.

The COM Express specification eliminates the problems surrounding legacy interfaces, and looks ahead to the future by specifying support for the next generation PCI Express, SATA and SAS. The specification recognizes the continued need for the PCI bus and ATAPI interface, as they may evolve slower towards the new interfaces for certain applications. The specification accommodates the legacy PCI bus and ATAPI interface with options to replace the PCI bus with PCI Express lanes and the ATAPI interface with Gigabit Ethernet ports. Table 1 shows which legacy and non-legacy signal interface combinations are possible over the mezzanine connectors.

| CONNECTOR PIN-OUT TYPE | PCI | PCI EXPRESS LANES | ATAPI | 1 GIGABIT ETHERNET |
|---|---|---|---|---|
| 1 | No | 6 | No | 1 |
| 2 | Yes | 22 | Yes | 1 |
| 3 | Yes | 22 | No | 3 |
| 4 | No | 32 | Yes | 1 |
| 5 | No | 32 | No | 3 |

*Table 1: Combinations of legacy and non-legacy interfaces defined for the COM Express mezzanine connectors.*

## COM EXPRESS – A STANDARD WITH BUILT-IN SCALABILITY

The COM Express specification is defined to provide maximum scalability across a wide spectrum of embedded applications and industries. This is achieved by flexible I/O specifications, and by the footprints defined.. COM Express specifies two footprints – Basic and Extended. The Basic footprint is very compact at 125mmx95mm and focuses on compact, high-performance, low power systems. These systems typically do not contain more than one single or multi-core CPU. The Extended footprint is slightly larger at 155mmx110mm and can accommodate multiple single or multi-core CPUs and larger memory configurations. The Extended footprint can cater to the requirements of larger systems, which prioritize performance over power dissipation and size. Figure 1 illustrates the scalability between the Basic and Extended modules. Systems can be designed taking this scalability into consideration from the onset.. Processor options for ETX are limited by its single 95 x 114mm form factor. too small to support high performance processor configurations.

The scalability of the COM Express standard across applications is a draw to the embedded industry. A carrier board can be designed to accept both Basic and Extended modules, so that a wide range of performance points can be addressed within the same product category or product line. Similarly, a carrier board design can be modified and re-used across different product categories, such as a bench-top, portable and handheld product.

An example of this scalability can be found in diagnostic imaging for medical purposes. A very high-end diagnostic imaging system can be build as a floor-installed piece of equipment, using one or more COM Express modules.. A bench-top version at a different performance point can be build, reusing much of the same hardware and software design and COM Express modules. OEMs can offer upgrades in performance points by swapping low to mid-range modules with a performance packed Extended module.

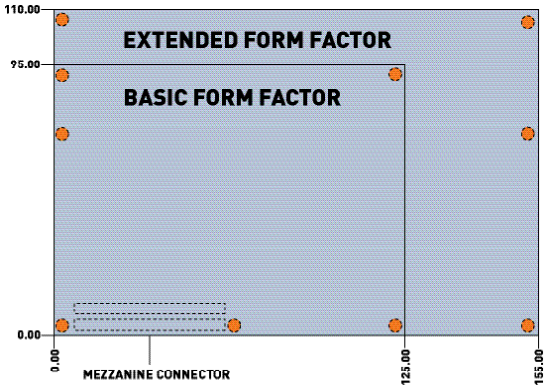


*Figure 1. Compatibility between Basic and Extended modules*

## COM EXPRESS AND ETX SIDE-BY-SIDE

Table 2 provides a complete overview of the benefits of COM Express over ETX.

| FEATURE | COM EXPRESS | ETX 2.0 |
|---|---|---|
| PCI Express | Yes, up to 32 links, configurable as any combination of x1, x2, x4, x8, x16 or x32 links. | None. Specifications that seek extensions of ETX, such as XTX, offer very limited link configurations. |
| SATA | Yes, up to 4 links. | None. |
| SAS | Yes, up to 4 links. | None. |
| 1Gigabit Ethernet | Yes, up to 3 ports. | None. Only one 10/100Base-T Port. |
| Support for higher future speeds of PCI Express, SATA, SAS and gigabit ethernet | Yes. The mezzanine connector was specified with this specifically in mind and can perform in excess of 6GHz signaling speeds. 1Gigabit Ethernet can be expanded to 10Gigabit Ethernet. | No. Specifications that seek extensions of ETC, such as XTX, use connectors that cannot support higher future speeds. |
| USB 2.0 support | Yes. Up to 8 ports. this facilitates migration of LPT, COM port and PS/2 I/O without additional carrier board cost. | Yes, but limited to only 2 ports. this is not enough to facilitate migration of LPT, COM Port and PS/2 I/O without additional carrier board cost. |
| High-performance external graphics | Yes. Through a x16 PCI Express graphics link. | No. Specifications that seek extensions of ETX, such as XTX, do not support x16 PCI Express Graphics. |
| Modern digital display interfaces | Yes. Through dual DVO and dual LVDs links and through an x16 PCI Express Graphics link, which can be connected to high-performance DVI-i, UDI or HDMI transmitters. | Limited, through single LVDs interface. |
| Simultaneous multiple display support | Yes. Through dual DVO and dual LVDs links, and through support of multiple external gpus over the 32 PCI Express links. | No. Limited to one. |
| SMP support | Yes. The extended module footprint was specifically specified to support multiple CPU configurations. | No. Limited to single CPU configurations due to small module footprint. |
| Balanced architecture | Yes. The large I/O bandwidth of PCI Express, SATA, SAS and Gigabit Ethernet matches high-performance CPU, GPU and memory bandwidth. | No. Slow and legacy I/O prohibits taking full advantage of modern high performance CPUs, GPUs and memory. |
| Applicability to wide spectrum of embedded applications and industries | Yes. The combination of choice of footprint and I/O configurations provides oems with a single platform, no matter what the underlying application is. | No. The combination of limited footprint and legacy I/O severely limits applicability to a narrow range of applications. specifications that seek extensions of ETX, such as XTX, suffer similar restrictions. |
| Performance scalability | Yes. Support for SMP CPU and dual channel, large memory configurations. | Limited. no support for SMP CPU and dual channel, large memory configurations. |
| Resilience to obsolescence | Yes. Built on PCI Express, SATA, SAS and Gigabit Ethernet, with support for future generation speed upgrades built into a single platform. | No. Built on ISA, PCI, IDE and 100Base-T Ethernet legacy. specifications that seek extensions of etx, such as XTX, are too limited to provide real longevity. |
| Maintained by open standards organization | Yes. The specification originated within the picmg and is maintained by the PICMG. | No. ETX was originally formulated by a single company and is maintained by an ad hoc group of companies. |

## CONCLUSION

The PICMG COM Express standard is well positioned for today and tomorrow's price/performance and technology demands. The specification contains the flexibility to support technology for years, including flexible I/O configurations, large numbers of PCI Express links, SATA, SAS and 1 to10Gigabit Ethernet. COM Express is the computer-on-module standard that OEMs can count on to preserve their product development investments into the future. COM Express provides OEMs with a standard platform that can scale from handheld to floor-installed equipment and performances.

ETX has had a successful run in the computer-on-module market, but is not able to support the capabilities of today's high speed serial I/O, processors and chipsets. The quickly disappearing legacy interfaces will require additional components on board and expensive legacy system components, increasing the OEM product cost. When considering a new computer-on module design, COM Express is the logical choice for OEMs to maximize their financial and technology investment.

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