SHB Express edge-card computing systems merge past, present, and future technologies

By Brad Trent

Some system architectures require option cards in form factors that are not adaptable to the commercial marketplace. The main advantage of designing an SHB Express (PICMG 1.3) system is the ability to take advantage of the huge population of inexpensive, commercially available, off-the-shelf PCI, PCI-X, and now PCI Express option cards. In other words, we let the laws of supply and demand work for us in a PICMG 1.3 system architecture. New PCI Express System Host Boards (SHBs) and PICMG 1.3 backplanes enable the system designer to support multiple option cards with different bus architectures. This allows the designer to take advantage of the plethora of inexpensive PCI/PCI-X option cards as well as the new PCI Express cards. Read on to see precisely how the latest SHB Express developments, including the models in the SHB Express Product Guide *that follows, make this all happen.*

System host boards

SHB Express system host cards are designed to the PICMG 1.3 industry standard. The standard defines 20 PCI Express lanes or links between an SHB and a PICMG 1.3 backplane. A board designer configures the available PCI Express links in a wide variety of combinations based on the SHB's chipset and the slot support requirements of the backplanes.

PICMG 1.3 SHBs and backplanes fall into two broad categories: Graphics class and server class. A graphics-class SHB can have one x16 and either one x4 or four x1 PCI Express links to the backplane. A typical server-class SHB may have a combination of x8 and x4 links routed to the backplane. Graphics-class SHBs and backplanes should always be paired together. Likewise, server-class SHBs should always be used with server-class backplanes. Doing this allows you to take full advantage of all available option card slots on the PICMG 1.3 backplane. The PICMG 1.3 specification is written to prevent any unforeseen board damage caused by mixing the two classes of backplanes and SHBs. If a server-class SHB is used with a graphics-class backplane or vice versa, the possibility exists that one or more of the backplane's option card slots might be nonfunctional. Mismatching the SHB and backplane could result in not having enough PCI Express links available to connect all of the option card slots to the system host board.

Multicore processors are finding many applications in SHB Express systems. Multicore processors are processors that have separate execution cores on a single processor die. The most common multicore processors available today have either two or four independent execution cores. These additional execution cores greatly improve overall system performance. These new processor designs are also far more thermally efficient than their predecessors. New PICMG 1.3 system host boards are now available with one and in some cases two dual-core processors. The benchmarks on some of these new SHBs with two thermally efficient, dual-core processors provide outstanding system performance. Figure 1 shows some typical benchmark test results that compare single- and dual-core SHB performance.

SHB Express backplanes

Today's PICMG 1.3 backplanes support a wide variety of option card slot configurations and form factors. These backplane variations are available in both the server-class and graphics-class categories as well as 14-slot, 20-slot, and new shoebox form factors. When choosing any type of passive backplane ensure that the supported option card slots adhere to the applicable PCI, PCI-X, or PCI Express electrical interface specification. For example, many inexpensive passive backplanes routinely violate the capacitive loading limits of the PCI bus by allowing the system host board to directly drive more PCI slots than allowed by the electrical specification. This situation may result in erratic option card operations, particularly in environments with high ambient electrical noise or fluctuating electrical power.

As stated earlier, one of the unique attributes of SHB Express systems is the capability to support a wide variety of system architectures including older ISA cards. It's been years since a new ISA card has been designed, but a fair

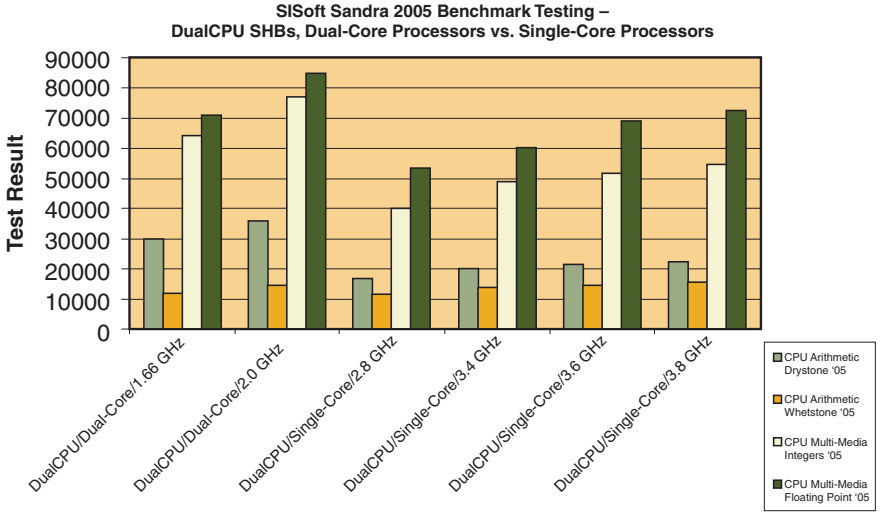

Figure 1

number of special purpose ISA cards are still being produced. In many cases it is cost prohibitive to design out these older option cards. SHB Express offers a solution that supports older cards as well as new PCI Express cards. The option cards are installed in an SHB Express backplane and controlled by a state of the art PICMG 1.3 SHB. The net result is a system that offers high-speed SHB-to-backplane communications via PCI Express without having to discard the proven and cost-effective option cards of the past. This results in improved data throughput due to the higher bandwidth and increased speed offered by PCI Express while leading to a significant reduction in overall development expense and long-term system support costs. The key to making this all happen is PCI Express-to-PCI-X and PCI-to-ISA bridge technology. Bridge technology on a PICMG 1.3 backplane is cost effective, robust, and reliable with minimal data latency delays. This key technology allows SHB Express systems to cover all your past, present, and future system requirements with PCI Express SHBs and passive backplanes. The block diagram in Figure 2 illustrates how PICMG 1.3 systems can support ISA, PCI/PCI-X, and PCI Express option cards

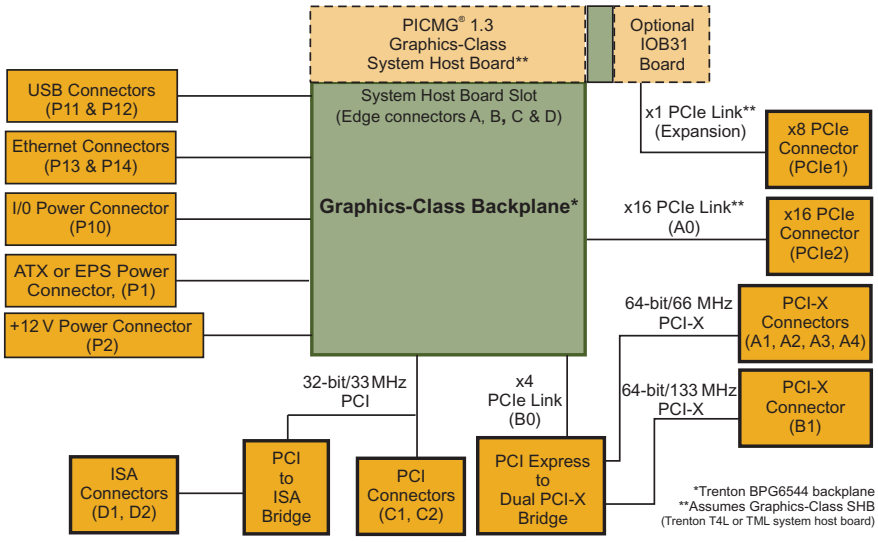

Figure 2

The PICMG 1.3 specification provides enough power pins on edge connector C of the SHB to eliminate the need for auxiliary power connectors. This new feature improves Mean Time to Repair (MTTR) by having the +12 V AUX connector on a backplane instead of the SHB. Figure 3 illustrates the variety of PICMG 1.3 backplanes currently available.

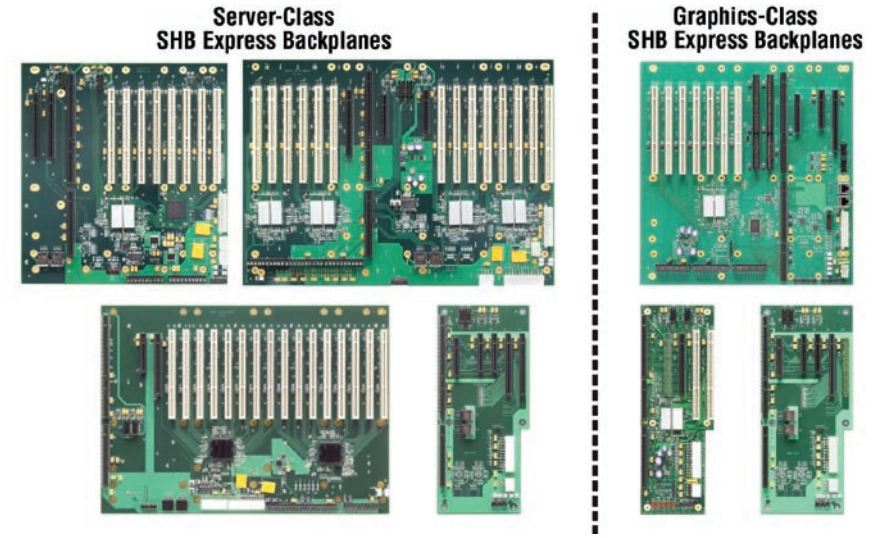

Figure 3

SHB Express chassis

If there is such a thing as a *typical* SHB Express/PICMG 1.3 chassis it's one that fits in a 19-inch rack (Figure 4). The chassis height is usually 4U, but this is not always the case. The chassis height may be greater than 4U depending on the chassis cooling system type, removable media, and hard drive placements. The SHB could have a low-profile passive cooling solution and a *butterfly* backplane that allows the SHB to be mounted horizontally rather than vertically. The result is an overall chassis height of 2U or less. New shoebox PICMG 1.3 backplanes accommodate smaller, wall-mount chassis designs. Here is a partial

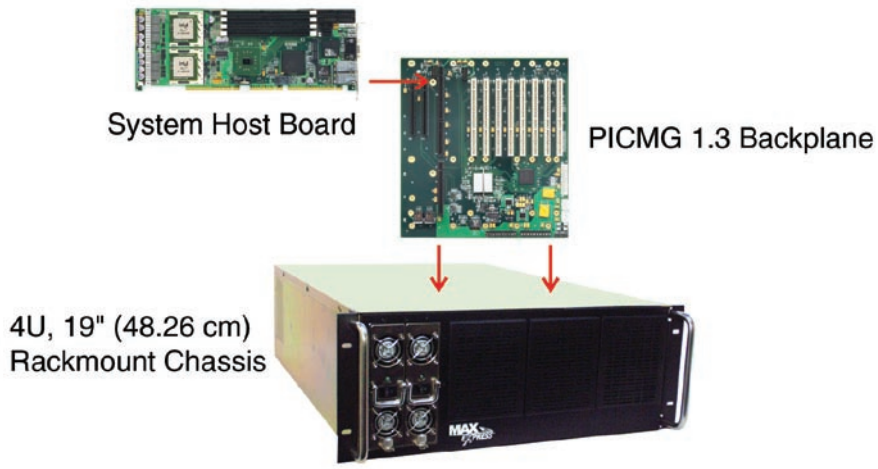

Figure 4

list of key chassis attributes to be considered regardless of the chassis type or vendor:

- Chassis certifications (NEBS, SAIC, Belcore, CE, and Medical Systems [UL544])
- Military requirements/ Certifications (airborne, shipboard, MIL-SPECs)
- Ruggedized requirements and environmental extremes (such as temperature, shock, vibration)
- Fault tolerant
- Airflow/cooling and power delivery requirements

Conclusion

The SHB Express specification was ratified in Q2 of 2005 with an explosion of PICMG 1.3 SHBs and backplanes available from a number of vendors. These boards are being deployed in a wide variety of chassis and in numerous applications to solve a number of bandwidth-related performance issues for system designers. The really nice thing about SHB Express is the ability to support the latest PCI Express board technology, legacy PCI, and even ISA boards. System designers can take advantage of the flexibility built into the specification and supported by a variety of vendors to gain an elegant method for incorporating both leading-edge and legacy technologies in the same design.

The flexibility inherent in the SHB Express specification allows cost-effective migration to PCI Express technology. In other words, unlike other new specifications, SHB Express does not require that the systems designer throw out all previous designs and start over. When developing the SHB Express specification, the PICMG 1.3 Technical Subcommittee took technology advancements such as PCI Express Gen 1 and Gen 2 and advanced switching into consideration.

As a result, SHB Express supports both current and future iterations of PCI Express technology, including advanced switching. SHB Express products support past, present, and future slot board technologies while enabling a seamless and cost-effective transition to PCI Express and advanced switching.

***Brad Trent** is director of engineering for Trenton Technology and served as the technical editor on the PICMG 1.3 Technical Subcommittee. Brad has held various engineering positions in the embedded computing, industrial automation, computer workstation, and process system control industries. Brad holds a BS in Nuclear Engineering from The Georgia Institute of Technology in Atlanta.*

To learn more, contact Brad at:

Trenton Technology
2350 Centennial Drive
Gainesville, GA 30504
Tel: 770-287-3100
Fax: 770-287-3150
E-mail: btrent@trentontechnology.com
Website: www.trentontechnology.com

