

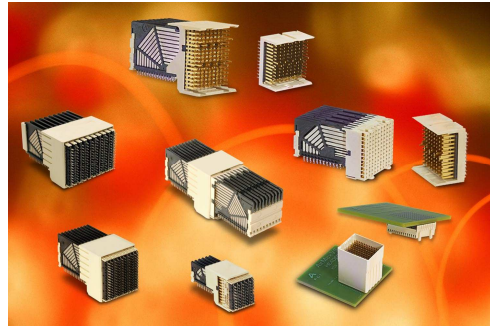


Optimizing Connector Speed and Density in Telecom/Datacom Applications

The selection of electronic interconnects by system designers is becoming increasingly critical during the design of next-generation telecom and datacom equipment platforms. As information content has expanded from voice to also include data and video content, the converged content is being transmitted as digital data. With Internet traffic doubling year-over-year driven by bandwidth demands from uses such as IPTV, audio and video downloads, and online gaming, service providers look to networking equipment to provide more bandwidth capacity either by adding links or boosting data rates on existing links. At the same time, service providers either need to pack more communications equipment in the available floor space in data centers, branch offices and central offices or invest in additional floor space. For server, data storage, router and switch “boxes” to both provide expanded capabilities and shrink in size, electronic connectors need to deliver increased signal density, not just high-speed transmission rates.

The push for increased system bandwidth and higher link data rates has led to continued evolution and innovation in connector design, particularly in the realm of backplane connectors. Now that 10 Gb/s data transmission has been demonstrated for copper backplane links, the connector industry is responding to the challenge to develop more compact, high-speed backplane connector solutions. System designers are requiring further advances in connector technology that will preserve signal integrity at higher data rates while at the same time squeezing more differential signal pairs in a smaller package.

One connector innovation to address these industry needs was the use of edge-coupled contacts in a shield-less connector design, the AirMax VS® system developed by FCI and introduced in 2004. That connector system exhibits excellent signal integrity at data rates up to 12.5 Gb/s while providing a signal density of 64 high-speed serial differential signal pairs per inch of card edge. The inventive design provides additional benefits by reducing routing complexity and by enabling differential pairs, single-ended signals and power to be mixed with the same signal module. Initially developed as a backplane system, the product range has been expanded to also support high-speed coplanar, mezzanine and cable-to-board applications.



Examples of backplane, coplanar, and mezzanine connector configurations demonstrated using AirMax VS® high-speed connectors.

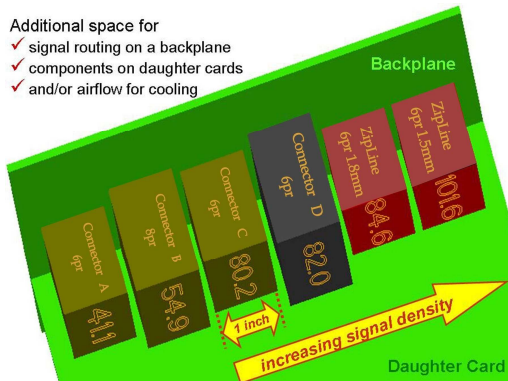
While high-speed serial links on backplanes in today's telecom and datacom equipment typically fall in the range of 2.5 Gb/s to 10 Gb/s, system designers are aiming to achieve 40 Gb/s, and even 100 Gb/s, with future equipment designs. To accomplish these goals, the system designers must balance three interacting components: highly sophisticated integrated chip packages, complex multi-layer backplanes and daughter cards, and backplane connectors. As an alternative to using costly next-generation SERDES (serializing/deserializing) transceivers in the progression to higher data rates, the less-costly next step may be the use of multiple parallel lanes to achieve higher throughput. For example, the initial implementation of a 40 Gb/s link might consist of four high-speed serial lanes with each lane operating at 10 Gb/s.

To help maximize signal density while facilitating this progression, connector companies are being challenged to further increase signal density without compromising connector electrical performance. The new ZipLine™ connector system addresses customer demand for maximum signal density and employs the same edge-coupled contact technology pioneered with the AirMax VS (Virtual Shield) connectors to deliver low insertion loss and crosstalk at data rates up to 12.5 Gb/s. Initial connector configurations deliver 84.6 differential pairs per inch of card edge, and the system offers a migration path to over 100 differential pairs per inch of board length when needed.

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Equipment designers need for increased connector density extend beyond the linear density along the edge of the daughter card. As the number of processors, memory and other integrated circuits in a system continue to increase, more heat is generated and that heat needs to exit the system.

Designers are looking to minimize the overall connector profile, in particular the height and the width facing the direction of airflow, to minimize the obstruction to airflow. The additional board “real estate” also frees space to allow the placement of additional components on a daughter card. The transition from the rack-mount server form factor to the denser blade form factor in the data center is one example of an industry trend driving the need for more compact connector volumes to accompany greater signal density. A comparison of connector volume and linear signal density for high-performance backplane connector products that support 6 or 8 differential signal pairs per column highlights the efficiencies in space utilization available to today’s system designers.



Connector volumes and signal densities (differential pairs/inch) for high-performance backplane connector systems.

With more multi-core processors and more memory in systems, additional power also needs to be delivered to the daughter cards in a chassis. This need can be addressed either by integrating higher-power contacts in signal connector module or with the addition of separate high-power connector modules to the card edge. As an example, the ZipLine range includes options that incorporate a special 6-contact power wafer, with combined capacity to deliver up to 36A when a single wafer is included in a 6-pair (6 differential pairs per column) module. Higher power delivery requirements can be addressed by adding more power wafers, but the current-carrying capacity needs to be de-rated accordingly.

High-performance signaling requirements are not restricted to the backplane interface. Similar requirements are also seen for mezzanine board-stacking connectors. One example application is to employ optional mezzanine cards to add high-speed communications functionality or memory and storage capacity to a server blade that also connects to a backplane or midplane. A second application need is found in network access products that employ backplane-less designs.

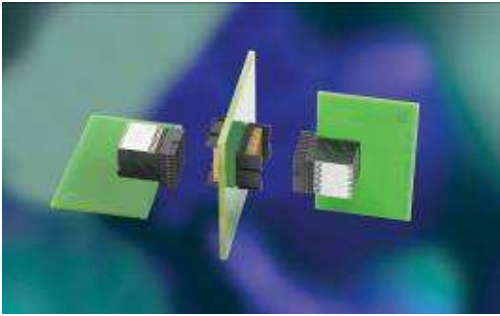
In those access products, high-speed mezzanine connectors are used for direct connections between stacked daughter cards. There is no backplane.



GIG-Array® high-speed, high-density mezzanine connectors for 40mm stack height featuring BGA termination.

Manufacturers have found BGA termination to be an effective technique to reliably attach high-density, array-type mezzanine connectors to carrier boards, optimize trace routing, and support high-speed differential signaling at data rates up to 10 Gb/s. An additional challenge to suppliers of mezzanine connectors is the variety of stack heights needed to provide adequate clearance for other board-mounted components or to facilitate airflow. Where board-to-board spacing in the range of 4mm to 14mm was once sufficient to support a wide range of end-use applications, the larger heat sinks and more-demanding thermal management considerations in newer systems have led to the development of mezzanine connectors for stack heights as high as 40mm.

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Example of orthogonal midplane application using high-performance, high-density ZipLine™ connector system.

Another trend in seen in communications equipment is the adoption of orthogonal midplane architecture to accomplish direct, efficient connections between multiple line cards and a common switch or communications card.

When implementing this architecture, vertical daughter cards on one side of a midplane are connected to horizontal add-in cards on the opposite side of the midplane. The backplane headers are designed to be installed back-to-back while oriented at 90 degrees to each other. The headers' signal pins through shared vias in the midplane, providing a direct, high-speed connection while eliminating traces on the midplane. Orthogonal midplane interconnects can support differential signaling at up to 20 Gb/s. System architects may now customize and assign their highest-speed connections to the orthogonal pins while routing other signals and power to standard backplane contacts.

Today, there is a flexible, scalable connector technology available in a very compact package that can provide a stable platform for the next 3-5 years. It supports high-speed serial data transmission at up to 12.5 Gb/s with a signal density in excess of 100 signal pairs per linear inch. For the foreseeable future, telecom and datacom equipment designers will continue to demand faster data links with high signal density. The market needs a flexible connector platform that combines high performance with the highest density to support current and future product developments.