

Artificial Intelligence: Impact on the Connector Industry

Artificial intelligence exploded into public awareness on November 30, 2022, with the release of ChatGPT and its influence has grown exponentially ever since. This transformative technology has already been implemented into a host of applications as well as generated record growth for suppliers like Nvidia, a vendor of critical components. It is very early in the ultimate development of AI, but from what I see, it has the potential to eventually impact nearly every aspect of our life.



AI enabled computers can create unique information, relate vast amounts of data and perform tasks using processes like human intelligence. Utilizing information from an extensive training process, AI computers can analyze data to create new innovative solutions. Imagine a system that reviews the clinical reports of thousands of patients to compare the success of treatment they received and the success of the results to determine the most effective treatment for an individual patient with similar symptoms, age, sex, genetics, and ethnic background. In another example, medical researchers can plug in desired characteristics of an organic material, and AI will search its training database for molecular structures of materials with potential therapeutic effects on the human body. Customized algorithms and training of an AI computer can enable the review of every financial transaction of a particular stock, and the condition of the economy at the time, to identify trends that can strongly predict how that stock will perform in the future. AI is being infused into robots that can learn entirely new tasks simply by watching a human, eliminating costly and time-consuming programming.

AI systems, not only collect and analyze data but can understand the context of a request. In a recent demonstration, a human told an android robot to “clean up this table” which had a collection of plates, cups, and glasses on it. The robot understood the intent of the request and proceeded to gently place each item in a rack, clearing the surface. When asked how the robot felt about completing the task, it said “I think I did a pretty good job”. None of this was programmed. Chatbots are becoming much better at understanding spoken language as well as speaking in natural language. Chat GPT has been trained to understand what makes a story humorous and to create jokes funnier than those written by human professionals. These systems are currently far from perfect but are making significant progress toward artificial general intelligence. The ultimate step will be systems that are self-aware, and self-training at rates far beyond human capabilities, a scary concept.

Thoughts on Connectors

The connector industry will benefit from the AI evolution due to demands for exceptional speed, reduced latency, and energy efficiency. Computer intensive applications have stimulated the growth of a large-scale purpose-built AI infrastructure. High-speed backplane, midplane, and orthogonal connectors as well as I/O connectors will be required, but so will device sockets and high-density / low profile cable to PCB connectors. Pluggable optical transceivers including QSFP-DD, OSFP, and OSFP-XD are being rapidly adopted to provide high-bandwidth interconnection among remote AI clusters. Advanced versions of these transceivers utilizing coherent and linear technology address the demand for transmission ranges in the thousands of kilometers, while still offering reduced power consumption.

Entirely new system architectures such as co-packaged optics and chicklets are being considered. The current trend toward disaggregated systems where key resources including memory, storage, and computation may reside in remote locations will require high-performance low latency optical interconnect. Dispersed computed resources also spread the demand for local power. New developmental interconnects both copper and fiber that provide the necessary density and performance will be required to support the unique demands of AI computing clusters.

The amount of power consumed by current AI computers is increasing at unsustainable rates. A single rack can draw ten thousand watts. Connectors that are designed to minimize resistive loss will be in demand. Current fan driven air cooling will be replaced by liquid cooling. Initially, only select devices including the processor will be cooled by cold-plate technology, but as time goes on more devices will require liquid cooling which may eventually go to full immersion cooling technology. Connectors of all types used in these systems will require modification to be compatible with these cooling techniques.

Communication between racks of high-performance servers, routers, and switches will require the use of high-bandwidth copper and fiber optic cables. AI is seen as a technology that will drive the use of optics inside the data center, inside the box, and closer to the switch. Short intra-rack cables can be satisfied with low cost direct attach passive copper cables, but as distance and bandwidth increase, the use of active copper, active optical, and pure optical cables and transceivers will increase.

Years ago, some equipment manufacturers felt that designing a system using components defined in an industry standard inhibited their ability to innovate. Standards took years to develop and even longer to upgrade. In some cases, manufacturers were willing to specify proprietary components to gain a competitive edge. The result often resulted in higher costs and supply problems. Open standards have become ubiquitous as manufacturers have demanded a minimum of two sources, while many component suppliers have embraced the tooling of products defined by a standard. Samtec has been exceptionally successful in employing this strategy. Tooling a new high-performance connector has become extremely expensive, especially when the available market may be limited. Standards organizations such as Ethernet, CXL, and PCIe have recognized the challenge to remain relevant and have been aggressively upgrading their standards to satisfy demand for increasing performance. The Ethernet Alliance has been particularly aggressive in publishing a roadmap to 1.6 Tb Ethernet. Standards organizations see real opportunities in emerging AI systems.

The Bishop Report – Industry Update

Bottom line, artificial intelligence is becoming a powerful new technology that will spur the entire electronics industry to new levels of performance. Skyquest Technology recently estimated the global value of hardware specifically designed for AI based applications was \$13.3 billion in 2022 and projected to reach \$84.9 billion by 2031. The value of standard hardware will be many times that.

Sustaining the incredible rate of AI advances will require development of advanced interconnects in accelerated design cycles. The proliferation of AI will provide excellent growth opportunities to component manufacturers that are tuned to the needs of the industry and committed to develop new products that support this emerging demand.