



Industrial/Embedded Networking and I/O Bridge Solutions in Smart World

Smart home, smart office, smart factory, smart city, smart transportation, etc., people can access Internet anytime, anywhere in the smart world, ASIX Electronics Corp. provides easy-to-design, cost-efficient industrial/embedded networking and I/O bridge controllers solutions for industrial automation and smart embedded devices applications.

Entering Smart World - Embedded Systems and Industrial Computers

Thanks to the popularity of smartphones, tablets and 4G/5G mobile networks, people can access Internet anytime, anywhere in the smart world. There are many smart embedded devices in our lives, such as smart TVs, smart speakers, smart home appliances, smart meters, set-top-boxes, multi-function printers, projectors, etc. These smart embedded devices are usually developed based on embedded systems with many benefits such as small in size, low-cost, power-efficient, etc.

In response to the huge impact of the COVID-19 pneumonia epidemic, global manufacturing industries have introduced new smart manufacturing ecosystems in succession to improve factory manufacturing efficiency and production quality. This trend has brought strong industrial computer market demands to global industrial equipment manufacturers. The industrial computers require to support multiple serial ports for communicating with traditional manufacturing machines via RS-232, RS-422 or RS-485 serial interfaces, and support real-time industrial Ethernet interfaces such as EtherCAT, PROFINET, EtherNet/IP, etc., in order to support deterministic and real-time communication between smart manufacturing machines and smart manufacturing ecosystems.

The Great Leap Forward in Computer Bus Technology

As computer technology changes continue to speed up, the computer bus technologies are also changing with each passing day. Since 1981, IBM PC introduced 8-bit ISA bus technology, with maximum throughput 8 MB/s and 98-pin pinout connector. The 32-bit PCI bus technology was introduced by PCI Special Interest Group in 1992, with maximum throughput 132 MB/s and 124-pin pinout connector. The computer bus technology was evolved to a new generation high-speed serial computer expansion bus standard – PCI Express 1.0 (officially abbreviated as PCIe or PCI-E) until 2013, which has simpler communication interface (with only 36 pins for X1 lane width slot, and 164 pins for X16 lane width slot) and higher data transfer throughput (500MB/s for bidirectional X1 lane width, and 8GB/s for bidirectional X16 lane width). Under the latest PCI Express 5.0 standard, the maximum throughput of bidirectional X16 lane width has been increased to 63GB/s. Compared to the traditional PCI interface, the PCIe peripheral products can support higher data transfer throughput under low pin count slot

interface. That is why new computers don't support built-in PCI slots any more now. The great leap forward in computer bus technology has become a powerful cornerstone of various computer peripheral technology innovations.

Portable computers, such as laptop/notebook/ultrabook/etc., emphasize portability, lightness, thinness, and power efficiency. Therefore, portable computers have been developed different computer expansion bus technologies. The 16-bit PCMCIA 1.0 card standard was introduced by PCMCIA Association in 1991, and then continuously evolved to 32-bit Cardbus and Express Card expansion slot technologies. These traditional expansion slot technologies can meet the basic peripheral expansion needs of portable computers. Following the innovation of expansion slot technology, a new generation USB 2.0 standard was introduced in 2000, which supports a very simple communication interface (just need 4 pins) and maximum throughput 480 Mbps. This is a significant innovation for portable computers to become thinner, lighter and more powerful. In fact, the PCMCIA/Cardbus/Express Card products had been replaced with the USB products for a long time. The latest USB 4.0 standard was introduced in 2019 and supports maximum throughput 40 Gbps by using the latest USB Type-C connector (with 24 pins). The USB (Universal Serial Bus) technology supports many convenient functions such as low pin count, hot-swap, plug & play, high-current quick charging, etc. It has been widely used in various computer peripherals, laptops, smart phones, tablets, handheld devices, smart network devices, etc. The USB technology has become one of the most important computer peripheral expansion bus technologies in the smart world now.

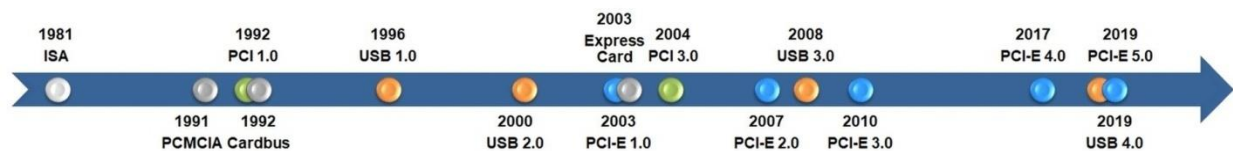


Figure-1. A History of Computer Bus Technology Innovation

Industrial/Embedded Network and I/O Bridge Controllers

No matter desktop computers, portable computers, industrial computers, or ubiquitous smart network devices around life, they all need to support either wired or wireless network connection in order to support network access or remote control/monitor functionalities. Compared to wireless network connection, the wired network connection can provide more stable and faster network communication capabilities. Therefore, the main network interfaces for desktop computers, industrial computers and smart network devices in fixed locations are still used wired Ethernet connections.

ASIX Electronics Corporation is a leading IC design company for Industrial/Embedded networking and I/O connectivity solutions. ASIX introduced the first PCMCIA to fast Ethernet controller solution in 1998. With the development of computer bus technology, ASIX continues to introduce new Non-PCI/SPI embedded Ethernet controllers for embedded systems, Super-Speed USB Ethernet controllers for

desktop/portable computers, and the latest industrial Ethernet controllers for industrial computers. ASIX Industrial Ethernet solutions include EtherCAT slave controllers and TSN Gigabit Ethernet PCIe NIC card. Except the industrial/embedded Ethernet controller solutions, ASIX also offers PCIe/USB to serial/parallel bridge controllers and RS-232/RS-485 UART transceivers solutions to meet the multiple serial ports requirements for industrial computers. These industrial/embedded network and I/O bridge controller solutions are suitable for computer peripherals, smart home, smart office, smart factory, industrial automation, and Industrial Internet of Things (IIoT), etc. applications.

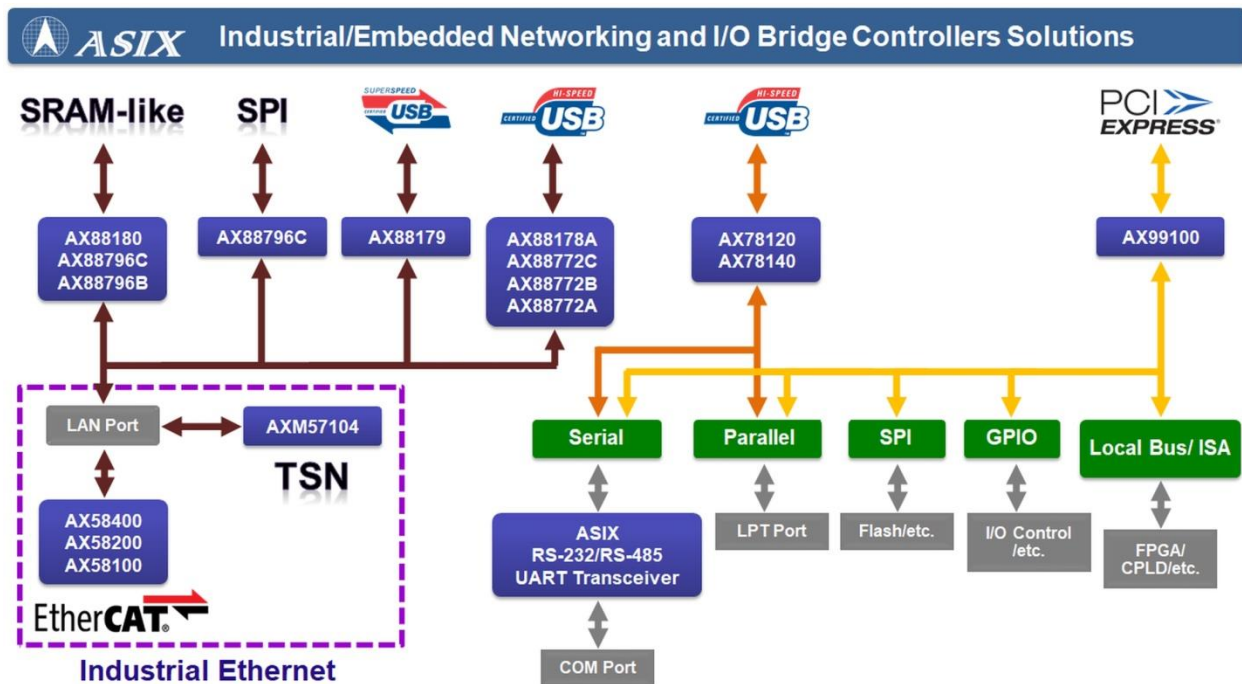


Figure-2. ASIX Industrial/Embedded Products Selection Guideline

PCIe/USB to Serial/Parallel I/O Bridge Controllers

Following the evolution of computer bus technology, the motherboards of new desktop/portable computers don't support built-in serial port (COM) and parallel port (LPT) any more. In this case, if users still need to connect traditional serial/parallel devices such as printer, UART debug console of embedded systems, etc., they can easily support an extra serial/parallel port by installing a PCIe/USB to serial/parallel adapter onto these computers. For industrial computers, designers can also easily support multiple serial ports by connecting PCIe/USB to multiple serial ports solutions via PCIe or USB interfaces of industrial computers.

ASIX offers two interface I/O bridge controller solutions, one is AX99100 PCIe to Multi I/O (4S, 2S+1P, 2S+SPI, Local Bus) bridge controller solution, another one is AX781x0 family USB 2.0 to Multi I/O (4S, 2S+1P) bridge controller solution. The AX99100 PCIe bridge controller supports PCIe to multiple serial/parallel (4 Serials, 2 Serials + 1 Parallel), and also supports PCIe to SPI, GPIO, Local Bus (ISA), etc. I/O interfaces bridge functionalities for PCIe data acquisition and communication cards, PCIe video

capture cards, etc. applications. The AX781x0 family USB 2.0 to Multi I/O bridge controller solution includes two USB bridge controllers, one is AX78140 for USB 2.0 to multiple serial/parallel (4 Serials, 2 Serials + 1 Parallel) applications; another one is AX78120 for USB 2.0 to multiple serial (2 Serials, 1 Serial) applications. Except the PCIe/USB to Multi I/O bridge controllers, ASIX also offers the RS-232/RS-485 UART transceiver solutions, which can be implemented with ASIX PCIe/USB to serial bridge controllers together.

Time Sensitive Network (TSN)

For ideal Industry 4.0 smart manufacturing ecosystems, the smart factory cloud server should be able to collect and analyze all ecosystem information, such as engineering design sub-system, factory manufacturing sub-system, stocks and supply chain sub-system, etc. so manufacturers can maintain the engineering design, factory manufacturing, stocks and supply chains, etc. resources based the real customer demands more efficiently. To reach these requirements, manufacturers need converge the non-real-time IT (Information Technology) networks and real-time OT (Operation Technology) networks into a single network. It is hard for the traditional industrial Ethernet solutions, but the new generation industrial Ethernet, Time Sensitive Networking (TSN) technology can easily converge the IT and OT networks with real-time, deterministic, security communications.

AXM57104 is a cost-efficient Quad Port TSN Gigabit Ethernet PCIe NIC Card solution, which supports enhanced TSN functions included the timing and synchronization compliant to IEEE 802.1AS-Rev/AS and IEEE 1588V2, the Forwarding and Queuing of Time Sensitive Streams (FQTSS): Specifies Credit-Based Shaper (CBS) compliant to IEEE 802.1Qav, the Time-Aware Shaper (TAS) compliant to IEEE 802.1Qbv, and the Per-Stream Filtering and Policing (PSFP) compliant to IEEE 802.1Qci. AXM57104 also supports 32 synchronous I/O pins, one Pulse Per Second (PPS) output and FPGA hard-core field upgradable via In Application Programming (IAP) for TSN standards evolution. To enable TSN functions on existing industrial computers, ASIX AXM57104 Quad Port TSN Gigabit Ethernet PCIe NIC Card solution provides an easy way to evaluate TSN functionalities on industrial Linux platforms.

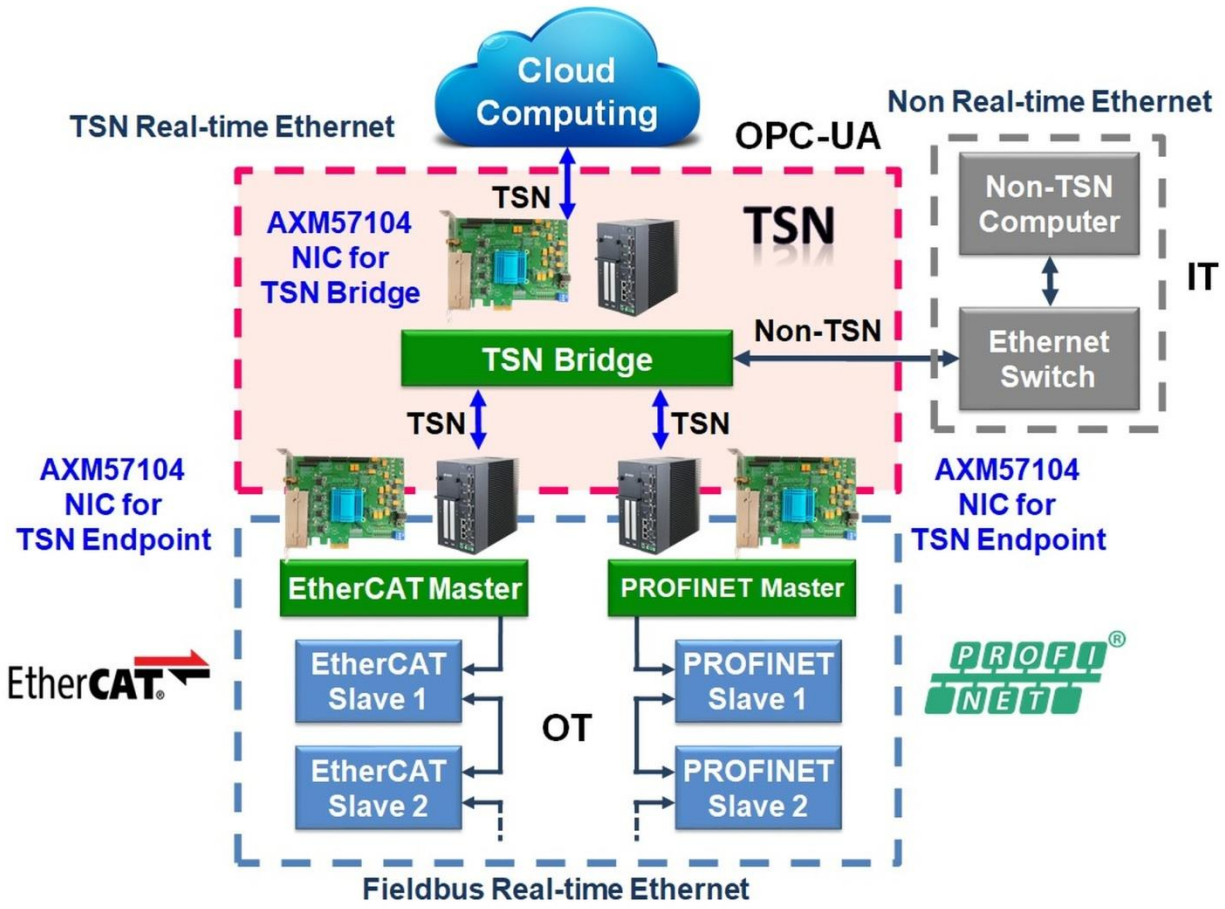


Figure-3. ASIX AXM57104 Quad Port TSN Gigabit Ethernet PCIe NIC Card Solution