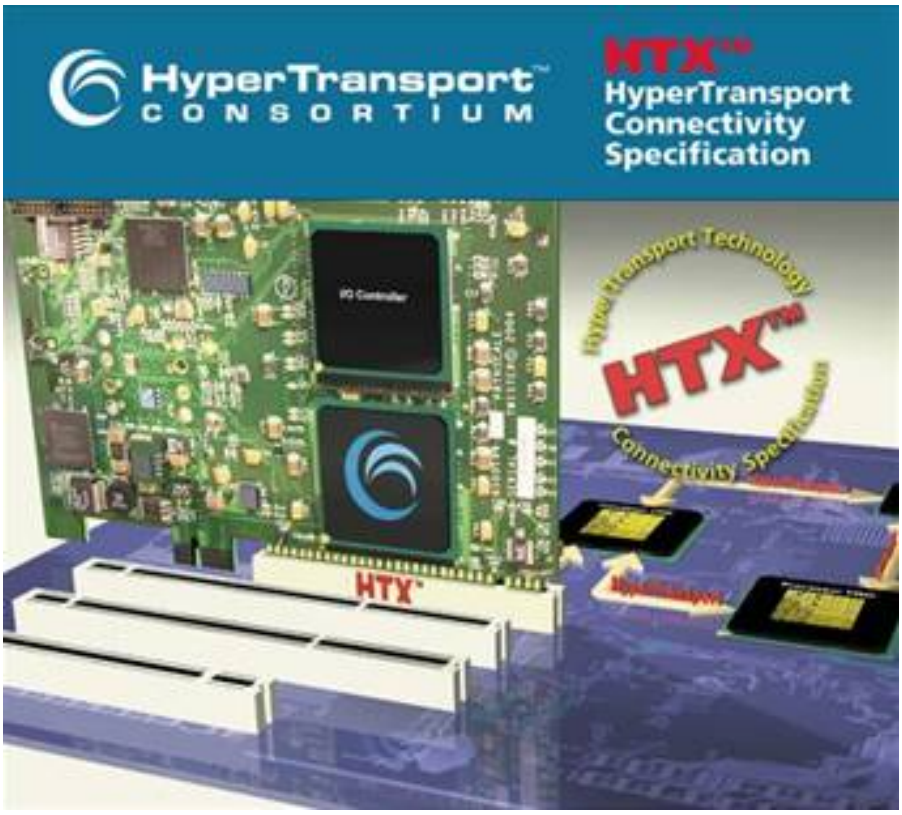
HTX Connectivity Standard

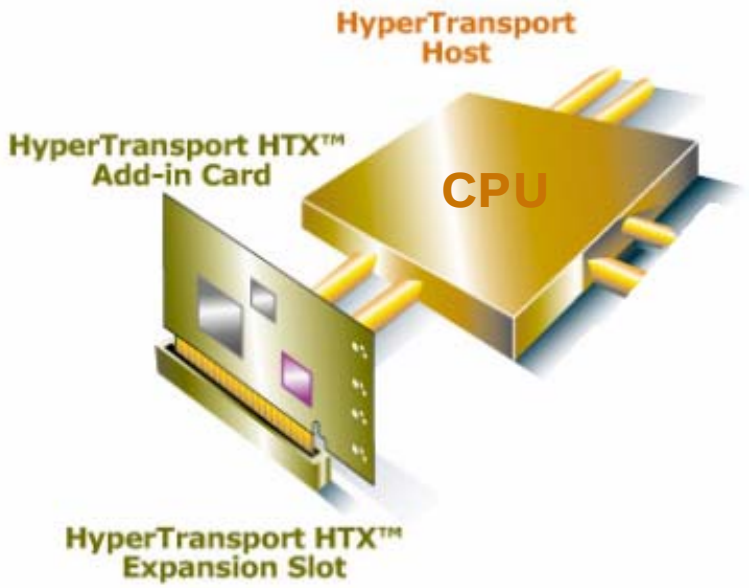
Overview and FAQ



HTX General Profile

What is HTX connectivity?

- HTX is an innovative, HyperTransport-based, slot-type, direct-connect interface between high-performance subsystems and system CPU that:
  - ✓ Offers the highest performance of any slot-type interconnects
  - ✓ Delivers a collection of technical and business values unachievable with comparable interconnect technologies
  - ✓ Empowers a new generation of more integrated, lower cost, function-optimized high-performance systems and peripherals
  - ✓ Opens the door to innovative high-performance market opportunities to system and subsystem manufacturers, leading to product differentiation and market leadership



In what form is HTX connectivity defined?

- In the form of a standardized specifications

HTX Specification

HTX3 Specification

(click on the icons above to open document)

What does the HTX specification define?

- Electrical features, mechanical features, routing rules, system design options and signal integrity guidelines of an HyperTransport-based motherboard slot connector for board-level peripheral subsystems and a companion riser card

What type of connector does HTX specify?

- HTX specifies the use of a 1x and 16x industry-standard PCI Express-type connector that carries HyperTransport-specific signals

Why is HTX called a "standard"?

- Because the HTX specification has been developed, approved and released to the industry by the HyperTransport Consortium as an HyperTransport Consortium standard

Who has the rights to adopt and market the HTX standard?

- Any legitimate HyperTransport Consortium member company

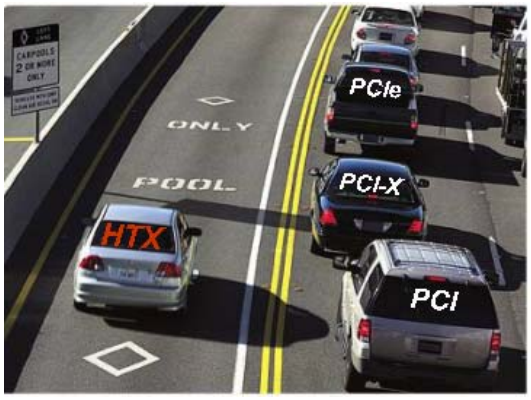
Which companies may become HyperTransport Consortium members?

- Any company may become a member of the HyperTransport Consortium by entering into a Consortium Membership Agreement and by paying a minimal yearly membership fee.
- No product royalties are charged to member companies
- More information about the HyperTransport Consortium and how to become a Consortium member is available here

HTX Market Positioning

When is HTX needed or otherwise?

- HTX can be compared to a car-pool lane:
  - ✓ When traffic demand is high – i.e. in compute-intensive applications – it is the fastest way to destination – i.e. lowest latency to compute results. In some cases, the only way to reach it in due time



  - ✓ When traffic is low – i.e. in normal compute applications – its time-saving potential is minimal when compared to any fast lane – i.e. a PCI Express interface could prove adequate for the intended purpose

What advantages does HTX offer compared to generic peripheral interconnect standards?

- HTX delivers the collective architectural and operational values of the HyperTransport's technology and ecosystem, plus:
  - ✓ It is the only standardized method to directly-connect high-performance subsystems to the system CPU without the performance penalty and cost burden of intermediate control logic or interface logic, typical of other interconnect standards
  - ✓ It delivers the industry's lowest operational latency and highest bandwidth between subsystem and CPU
  - ✓ It allows implementation in 4-layer motherboards and add-in cards using conventional PCB materials and technology
  - ✓ It is the most cost-effective way to deliver best subsystem performance
  - ✓ It provides the performance edge required for best product differentiation and market competitiveness

What are the HTX target markets?

- HTX primarily targets compute-intensive market sectors, e.g. data centers, high performance computing (HPC), media processing, scientific, military, medical

What subsystem functions are best suited to leverage the HTX performance edge?

- Data and algorithm acceleration
- High-performance server clustering
- Network security monitoring
- Real-time data analysis and routing
- Encryption/decryption
- Media encoding/decoding
- Real world animation
- Advanced 3D imaging – e.g. industrial, scientific, medical
- Storage management
- Other next-generation compute-intensive co-processing functions

What system products can best benefit from HTX-class peripherals?

- Servers
- Blade systems
- Scientific workstations
- Embedded platforms (networking, medical, military, etc.)
- Gaming platforms

Should the industry expect HTX products to be marketed through retail and distribution channels?

- In view of the high-end markets that HTX products serve, HTX-based solutions require professional installation and configuration. Therefore, unlike PCI-class products, they are sold and supported by Original Equipment Manufacturers (OEMs) and/or by Value Added Resellers (VARs)
- Unlike PCI-class products, HTX does not cater to the end-user market and therefore HTX products are not usually sold through distribution or retail channels

Does HTX replace generic peripheral interconnect standards?

- HTX does not replace any of the general-purpose, end-user type peripheral interconnect standards like PCI-X or PCI Express
- HTX complements PCI-class peripheral I/O interconnects in high-performance products

How many HTX connectors per system should there be?

- There can be as many HTX connector slots as there are CPU-native HyperTransport links available in the system
- One or two HTX connector per system/motherboard is considered adequate for current HTX designs

HTX Business Values

What business values does HTX offer to system/motherboard manufacturers?

- The opportunity to:
  - ✓ Tap the performance potential of HTX at the negligible BOM cost of the HTX connector, which takes full advantage of the economy of scale and multi-sourcing of PCI Express-type connectors
  - ✓ Develop universal motherboard platforms for multiple target markets – i.e. the addition of an HTX connector makes the hosting motherboard equally suitable for conventional as well as high-performance computing markets
  - ✓ Leverage universal motherboard platforms toward minimizing the system manufacturer's product inventory, stocking and product support costs, as well as maximizing the product life span
  - ✓ Extend pre-sale product configurability and personalization
  - ✓ Deliver high performance upgradeability to the end-user
  - ✓ Be best-in-class players in the commoditization trend that has been sweeping the high performance computing market

What business values does HTX offer to subsystem manufacturers?

- The opportunity to:
  - ✓ Deliver state-of-the-art subsystem products with low latency capability unachievable with other interconnect technologies
  - ✓ Deliver add-on subsystem that perform at the same peak level of fully integrated system solutions
  - ✓ Extend own market capture by enabling the migration of compute intensive functions from early generation closed box solutions to off-the-shelf platforms – e.g. the porting of network security and net protocol analysis engines from dedicated network security appliances to data-center servers
  - ✓ Extend product use to multiple system platforms
  - ✓ Capture market applications previously served only by fully integrated solutions

What business values does HTX offer to both system and subsystem manufacturers?

- The ability to:
  - ✓ Participate to higher-end, higher margin markets
  - ✓ Gain an edge on competition

More information on HTX business values can be found in the white paper "HTX Connectivity – The Future of High Performance Computing".

HTX compared to PCI Express

Does HTX deliver better performance than PCI Express?

- Yes, significantly better performance in the form of much lower operational latency and in most cases higher bandwidth for the following reasons:
  - ✓ HTX uses HyperTransport's clock forwarding scheme, which delivers 25% better latency performance than the 8b/10b clock/data recovery serializer/de-serializer scheme used by PCI Express. The net result purely in terms of net bandwidth is that HTX supports up to 20.8 GB/s of bandwidth with a 2.6 GHz clock (HTX3 specification) vs. 16.0 GB/s of PCI Express Gen 2 with a 5.0 GHz clock. Therefore, HTX delivers 30% better throughput with a proportionally less critical clock rate – i.e. less radiated and inducted noise, better signal integrity
  - ✓ HTX is a processor-native interconnect – PCI Express is not. Therefore, HTX is relieved of the additional 55% average latency penalty introduced by intermediate PCI Express control and multiplexing logic
  - ✓ Also, HTX makes use of HyperTransport's lean packet protocol, which further reduces per-packet overhead latency by up to 100% in respect to PCI Express
  - ✓ Finally, HTX makes use of HyperTransport's Priority Request Interleaving™ for no-wait peripheral processing – i.e. control packets (typically read requests) not penalized by low priority ones and yielding an additional average latency reduction of 20nS on average per transaction, where applicable.
  - ✓ In real life applications, just by taking into account the bandwidth, chipset overhead and protocol latency advantages – i.e. without taking into account the Priority Request Interleaving latency reduction - HTX takes 0.78 mS to 7.8 Sec less than PCI Express to transfer 100K to 1B packets of 4-data byte each respectively and 1.16 Sec to 3.23 Hours less than PCI Express to transfer 100K to 1B packets of 512-data byte each respectively. In general, one must consider that complex, compute-intensive tasks require many multiples of the above scenarios.

More information and reference performance values can be found in the following document: "HTX – PCI Express Compared – How and Why HTX Proves Best Choice for Compute-Intensive Applications".

Is HTX meant to be a substitute for PCI Express as a peripheral interface?

- Not at all
- PCI Express is a general purpose peripheral interconnect that excels in supporting a broad spectrum of general purpose peripheral functions by carrying extensive product configuration and peripheral resource allocation functionality that are beyond the scope of HyperTransport and HTX
- HTX complements PCI Express, PCI-X, PCI or any other general purpose interface slot-type peripheral interface by delivering the extra performance and low latency capability that is required in compute-intensive applications and that PCI-class interconnect cannot deliver
- The combination of HTX slots with PCI-class slots offers system manufacturers and end-user alike the most flexible and powerful product configurability available to date for state-of-the-art compute platforms

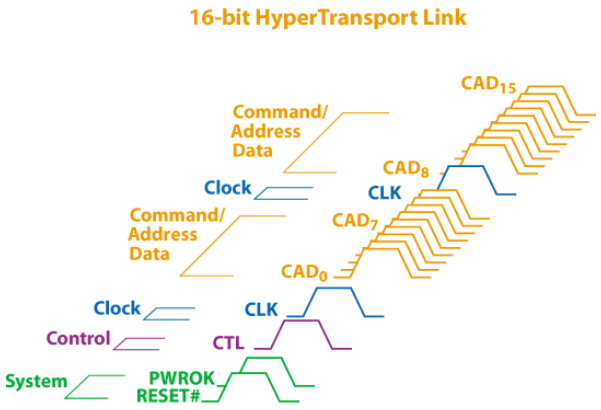
HTX Electrical and Operational Profile

What is the range of specified HTX clock rates?

- 200 MHz through 2.6 GHz in 200 MHz steps

What is the width of the HTX interface?

- 16-bit – i.e. per individual HyperTransport link
- Peripheral manufacturers may use 8-bit wide links if they so choose



What bandwidth is HTX capable of?

- 20.8 GB/s aggregate, with two unidirectional, 16-bit, double data rate (DDR) HyperTransport links working at 2.6 GHz clock

Why is the HTX clock speed limited to 2.6 GHz while the current HyperTransport 3.1 specifications supports up to 3.2 GHz clock speeds?

- Slot connector implementations of high clock rate interconnects bring into play signal integrity and routing considerations due to the longer overall distance that signals must travel to/from CPU, slot connector and HTX add-on board processor/control logic compared to typical chip-to-chip implementations. Therefore, it has been HyperTransport Consortium's practice to give the industry proper time to

gain design expertise with the latest HT clock rates before the same are extended to slot connector applications. Just as importantly, the 2.6 GHz max clock rate capability of the HTX3 specification offers performance capability to spare for any kind of current and next generation HTX subsystem applications.

Can HTX clock speed go beyond 2.6 GHz?

- Yes. The HTX connector itself – i.e. PCI Express-type connector - is certified at 5.0 GHz clock operation and beyond. Furthermore, if trace length and signal skew are minimized there are no electrical reasons for the HTX clock speed to be limited to 2.6 GHz. To have higher HTX clock speeds standardized by the HyperTransport Consortium, all it takes is for such a proposal – backed by adequate validation – to be born and proposed to the Consortium by any Contributor or Promoter member – i.e. member companies that have participation rights to the Consortium's Technical Working Group (TWG) body and its decision-making process. Specifically, the HyperTransport Consortium cannot on its own be the initiator of any HyperTransport technology enhancements. In fact, the Consortium's role is to evaluate, modify/improve and eventually adopt, standardize, administer and license Contributor/Promoter member proposals in a typically parliamentary fashion. The HyperTransport Consortium and its TWG team are open to and welcome any kind of HTX enhancement proposals from Contributor- and Promoter-level members

What is the electrical power capability of the HTX connector?

- Up to the maximum of 63 Watts, split between 12 Volts and 3.3 Volts sources
- The HTX connector carries the same power specifications of a conventional PCI Express connector, with the addition of VLDT (1.2 Volts, 1 Amp for HTX specification and 1.2 Volts, 2 Amp for HTX3 specification)

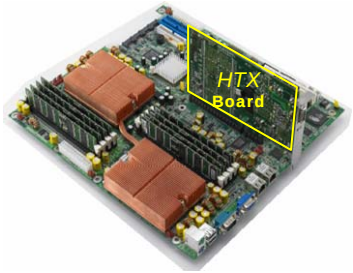
Mechanical Profile

Would the use of the same mechanical connector for HTX and PCI Express within the same system create possibilities of product misplacement?

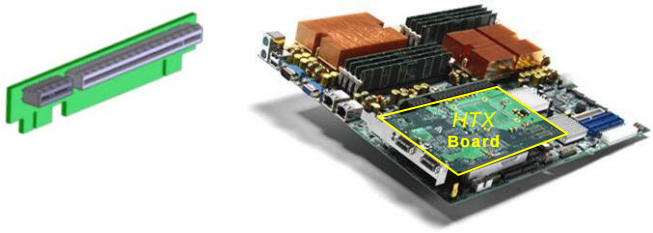
- In accordance with the HTX specification, HTX connectors are to be reverse-installed (rotated 180 degree) in respect to conventional PCI Express connectors, thereby preventing any possibility of HTX or PCIe boards misplacement

What are the installation options for HTX connectors?

- HTX connectors can be installed:
  - Directly on the system motherboard – i.e. alongside conventional PCI-class connectors - for vertically mounted HTX boards in 3U or greater server chassis



- On a HTX specification-defined riser card – i.e. allowing the use of a horizontally-installed, full-sized HTX board in a 1U rack-type chassis

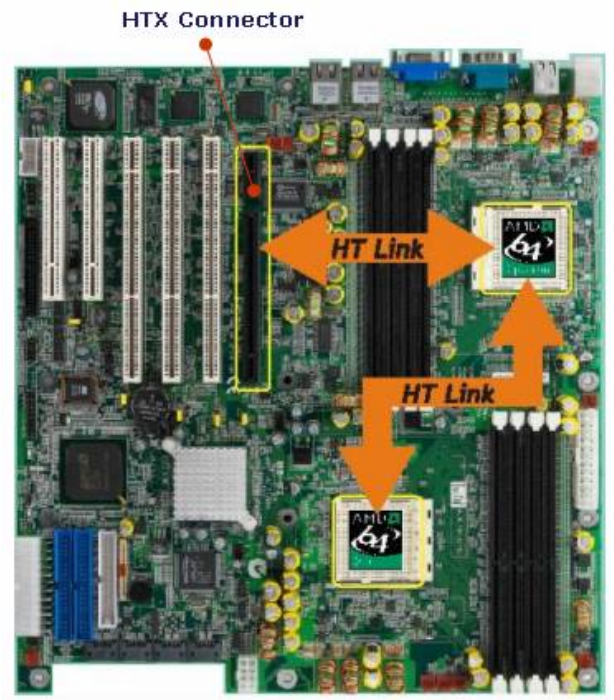


- On a proprietary riser card defined by the system manufacturer

- By using different versions of riser cards – i.e. each supporting a different type of slot interconnect standard (HTX, PCI Express, PCI-X, etc.), system manufacturers can use a single motherboard design to deliver easily configurable, cost-optimized, application-specific system configurations
- Installation options can extend to any variation that system manufacturers see fit for their own market

Is there a recommended location for the HTX connector?

- For a standard EATX motherboard design, the HTX specification recommends slot 6 for the following reasons:
  - ✓ It is the most easily routable location
  - ✓ It has the shortest and most direct path for HyperTransport signals
  - ✓ It can host HTX boards with the same full-size form factor as PCI in a 1U system chassis (by means of a riser card)



- System manufacturers may choose locations other than slot 6 for the HTX connector that they may deem more suitable for specific market targets and applications, provided that proper routing and signal integrity guidelines are complied with

Does the HTX specification define peripheral board dimensions?

- Yes
- Low profile HTX cards are supported, provided that the proper mechanical integrity, support and retention are maintained
- The HTX specification supports peripheral boards that are mechanically compatible with the PCI standard and that fit in conventional chassis designs

HTX Products

Are there system, subsystem and reference design products using the HTX standard?

- Yes. Please visit the HyperTransport Consortium's HTX Products page for the latest information on such products