OrionX.net

The OrionX Constellation™: Data Center
High Performance Interconnect

Assessment and Ranking of Major Vendor Offerings

The increasing importance of extreme-scale systems in high performance computing (HPC), artificial intelligence, cloud computing, and web-scale deployments has led to the emergence of a new market segment: high performance interconnect (HPI).

HPI represents the high-end of the networking equipment market where the highest possible bandwidth and lowest possible latency is a requirement. It is a segment that started with specialized proprietary technologies fueled by supercomputing applications but has blossomed into an indispensable, large, and growing market with the advent of scale-out systems and cloud computing. Switches and host-based adapters that are used to build large-scale clusters and massively parallel processing (MPP) systems characterize the HPI market.

Please see other OrionX Constellation reports for a discussion of the industry's technology evolution, vendor environment, and typical customer evaluation criteria.

Technologies

From a market share perspective, the HPI market is currently led by: InfiniBand and Ethernet, followed by proprietary offerings from HPC vendors such as Cray and SGI, and the newly introduced Omni-Path Architecture (OPA) from Intel.

As a proxy for the HPI market segment, the TOP500 list of the most powerful systems in the world provides a glimpse of market dynamics at the very high-end: over 40% are based on InfiniBand, 44% use Ethernet, and 15% are built with proprietary interconnects. However it is worthwhile to note that only five of the TOP100 systems are Ethernet-based, and the highest is ranked in the 74th position.

Major Vendors

Major vendors in this market include Mellanox, vendors with an exclusive focus on Ethernet such as Cisco, Juniper Networks, HPE, Brocade, et. al., and Cray, SGI, and Intel.

OrionX Evaluation Methodology

In this report, major vendors are compared according to the OrionX Constellation evaluation methodology.

Types of Data

The evaluation process collects and organizes data in six dimensions organized into three major categories:

Excellence

OrionX Constellation™ reports cover 5 Es: industry milestones (Events), historical view of a technology segment (Evolution), main vendors in a market segment (Environment), customer decision criteria (Evaluation), and how vendors in a segment score (Excellence) based on the OrionX methodology, which considers market presence and trends, customer needs and readiness, and product capabilities and roadmap.

1) Market presence and trends: a vendor's presence in the segment and its ability to shape or embrace market trends

2) Customer needs and readiness: a typical customer's current needs and readiness to adopt a particular product

3) Product capabilities and roadmap: a product's existing capabilities and competitive standing as well as its expected enhancements and replacements in the future

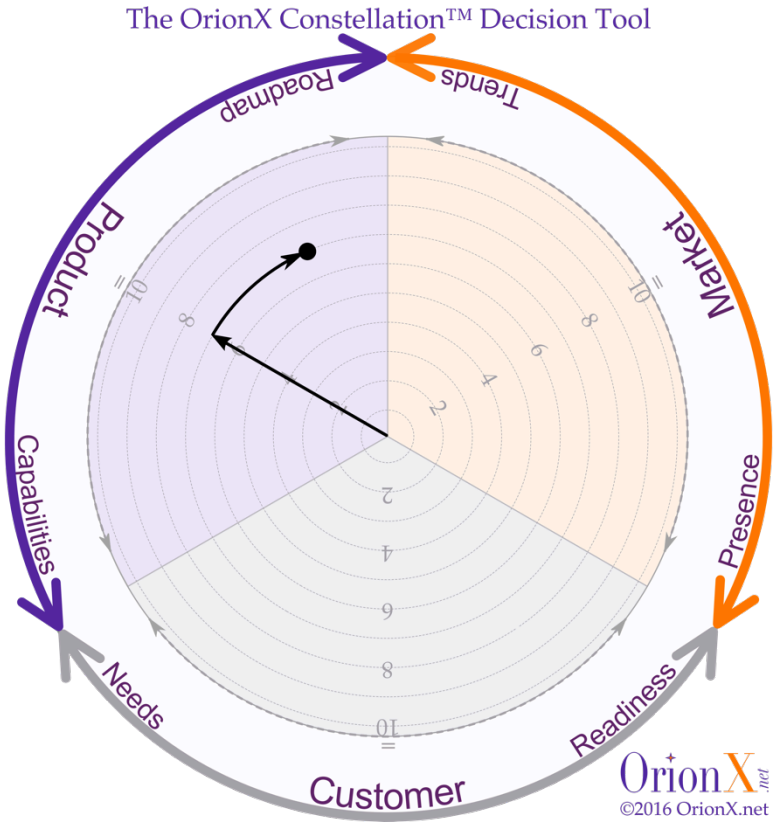
These six parameters attempt to capture the core of technology customers' selection process.

OrionX Constellation Decision Tool

Visualizing six distinct parameters, each with its own axis, in three categories cannot be done with the traditional 2×2 or 3×3 diagrams. Indeed, existing models in the industry do quite a good job of providing simple diagrams that rank vendors in a segment.

To make this visualization possible, OrionX has developed a diagram that divides a circle into three slices, one for each major data category. The overall score in each category is the average of the two sub-categories, represented by the distance from the center. The relative strength of each sub-category determines the placement of the score on the arc sweeping the slice.

The diagram below shows the OrionX Constellation Decision Tool when product roadmap scores 10 and product capabilities scores 4. Their average is 7 while the bias in favor of roadmap is 60% of the way to the right.



Assessment

What follows is the OrionX assessment and opinion for each of the six parameters for Mellanox InfiniBand, Ethernet providers rated together as a single virtual vendor, and Intel OPA. Proprietary offerings are excluded because they are not available as stand-alone solutions and because the information regarding their characteristics and roadmap is not public.

This assessment is a snapshot at a point in time, and while some parameters take some time to change materially, various changes together can significantly impact our overall sentiment.

Our thought process and reasoning is described below followed by a table summarizing our findings and assessment and the OrionX Constellation Decision Tool.

Market Presence

The three vendors under consideration all have excellent presence in the HPI market for different reasons.

Mellanox: 9

In the HPI market, Mellanox has a commanding presence with active engagement with the community, well-respected products, and an aggressive roadmap bolstered by a reputation for effective execution. It is expected to be on all HPI short lists. At the same time, judicious expansion into Ethernet has helped increase the company's total available market and presence in the wider networking area. We also note that some custom interconnects are built using component technologies from Mellanox.

Ethernet vendors: 7

The ubiquity of Ethernet, and the large number of vendors which provide it, loom large in any networking consideration. However, Ethernet's presence in the HPI market is tempered by the lower performance of the technology. Customers tend to select Ethernet only when their specific application workload happens to accommodate the lower performance of Ethernet. As Ethernet performance continues to improve, the range of applications that will find it suitable will also grow. But new and more demanding applications, say, in-memory computing, graph analytics, and real-time streaming applications, are rapidly complementing the range of insatiable HPC applications that will always need the fastest possible interconnects.

Intel: 6

Intel's presence in the HPI market is derived from its acquisition of QLogic's InfiniBand assets and Cray's Aries interconnect business. Its strong leadership in microprocessor technologies strengthens that credibility. However, in the networking interconnect market in general, Intel is a new player with much to prove technically as well as in long-term business commitment, sales, support, community engagement, and standards compliance; though its many formidable strengths and positive early results point to its ability to perform and deliver. The reasonable expectation is to see an active involvement in the HPI market, and a product line that will, at a minimum, carve its place in the market. If so, Intel's market presence in HPI will continue to grow.

Market Trends

The general trend in the HPI market is simple: higher bandwidth, lower latency, ease of use, and active development of high-end features. Currently, customers view a vendor's adoption of Ethernet as its primary product strategy as insufficient commitment to advancing HPI technologies. This will remain the case unless Ethernet's bandwidth and latency can somehow approach or exceed that of alternatives. The three alternatives under consideration have significant resources to advance the state of the art but have different areas of focus:

Mellanox: 9

Mellanox has been the primary vendor in the HPI market having successfully surpassed several other technologies such as SCI, Quadrics, Myricom, and other InfiniBand vendors. It continues to define and embrace key trends in HPI. Its commitment to HPI trends is reflected well in its published roadmap and community engagement.

Ethernet vendors: 7

Ethernet is undoubtedly the overwhelming focus of the overall networking market. Ethernet performance is expected to continue to improve as link-speeds become faster. Some high performance workloads will find it sufficient, but a serious embrace of HPI market trends requires higher performance than Ethernet is likely to offer in the foreseeable future. Some traditional Ethernet providers have, in the past, provided other technologies and may do so again in the future. (For example, Cisco offered InfiniBand following its acquisition of TopSpin in 2005 but that product line was discontinued in 2009 in favor of Cisco's traditional Ethernet switches.)

Intel: 8

Intel's OPA technology clearly embraces many HPI market trends. Intel has a sharp focus on achieving high performance with its new interconnect offerings and its actions appear quite aligned with expected customer requirements. However, it must demonstrate that its CPU-centric approach for network protocols and parallel application constructs (vs performing these tasks in the network itself) are aligned with customers' requirement to achieve maximum bandwidth and minimum latency.

Customer Readiness

Mellanox: 8

As the de-facto standard vendor of HPI equipment, customer readiness to adopt Mellanox technologies is quite high. Its products are tried and tested, enjoy a healthy ecosystem, a large body of existing work and experienced staff, and can interoperate with other equipment, across many servers, libraries, storage systems, etc. For customers who have never implemented InfiniBand systems, the learning curve is relatively smooth but non-zero.

Ethernet vendors: 9

Ethernet networking is ubiquitous and adopting it is likely as easy as it can get. However, using Ethernet in, say, a large HPC cluster, has its own challenges in terms of system configuration, topology, and serviceability. And moving among Ethernet providers requires some changes in operations and skillset.

Intel: 6

Intel's OPA offering is promising but it is simply too new in the market to have amassed the necessary history of implementation in a wide variety of use cases. As a new technology with very small early customer base, it requires a high degree of customer willingness to try something new and manage any unforeseen challenges.

Customer Needs

Mellanox: 9

HPI customers need high performance, low latency, easy of use, and interoperability from a vendor that enjoys significant market presence, aggressively pursues new advances, and has built a reputation for execution. Mellanox presents such a case to customers.

Ethernet: 6

While customers' traditional networking needs are fully met with a very comprehensive portfolio of Ethernet products and services globally, in the HPI market, those products fall short of the need for the highest performance and lowest latency.

Intel: 7

Intel's OPA offerings are aligned with customer needs for an interconnect that goes beyond Ethernet. However, as a new product, it will take some time to build and establish extensive sales and support, available skill set, and well-understood behavior in various use cases. In addition, OPA is proprietary, which makes it unavailable for non-Intel technologies such as IBM POWER or ARM microprocessor based systems.

Product Capabilities

Mellanox: 9

Mellanox has a well-established reputation as providing a comprehensive product portfolio with leading specifications. Some of the attributes that support a near perfect score for Mellanox include: the highest performing standards-based interconnect on the market at any given time for a number of years; provision for InfiniBand as well as Ethernet processing in the same switch; the availability of switches with the number of ports that match system architects' varying requirements for scalability, over-subscription, density, and price/performance; high degree of familiarity among high-end customers; and the relative ease of identifying technical expertise.

Ethernet: 7

The plethora of Ethernet products and services means any functionality and variation is available. However, Ethernet has been and is expected to remain a lower performing technology than the other HPI technologies. Because this segment is essentially defined by the need for performance, this one aspect reduces the score for Ethernet.

Intel: 7

Intel's OPA product portfolio is an impressive debut by a company whose technical and business strengths give it significant credibility. Early reported performance benchmarks have been limited in scope and, as is reasonable in early stages, under controlled environments.

Fundamentally, Intel's OPA simply requires time to canvass the spectrum of applications and use-cases and to show where it can shine. At the same time, Intel's architectural choices appear focused on packet processing, offloading of network and application protocol processing to server CPUs and possibly accelerators. These choices entail a trade-off vs. a universally superior approach, and will determine the applications and use-cases that favor them.

Product Roadmap

Mellanox: 10

Mellanox scores a perfect 10 when it comes to product roadmap. The company has demonstrated repeatedly its willingness to share and its ability to execute and deliver on ambitious product roadmaps. This has engendered a high degree of confidence among customers to reliably plan future deployments with reasonably accurate expectations of product performance and behavior.

Ethernet: 6

Ethernet is the major engine that drives networking technologies across the board. It is also not as rigorously concerned with the highest possible bandwidth and the lowest possible latency as required by the HPI market. These opposing factors make it, simultaneously, a reliable driver that will reliably underperform other HPI technologies.

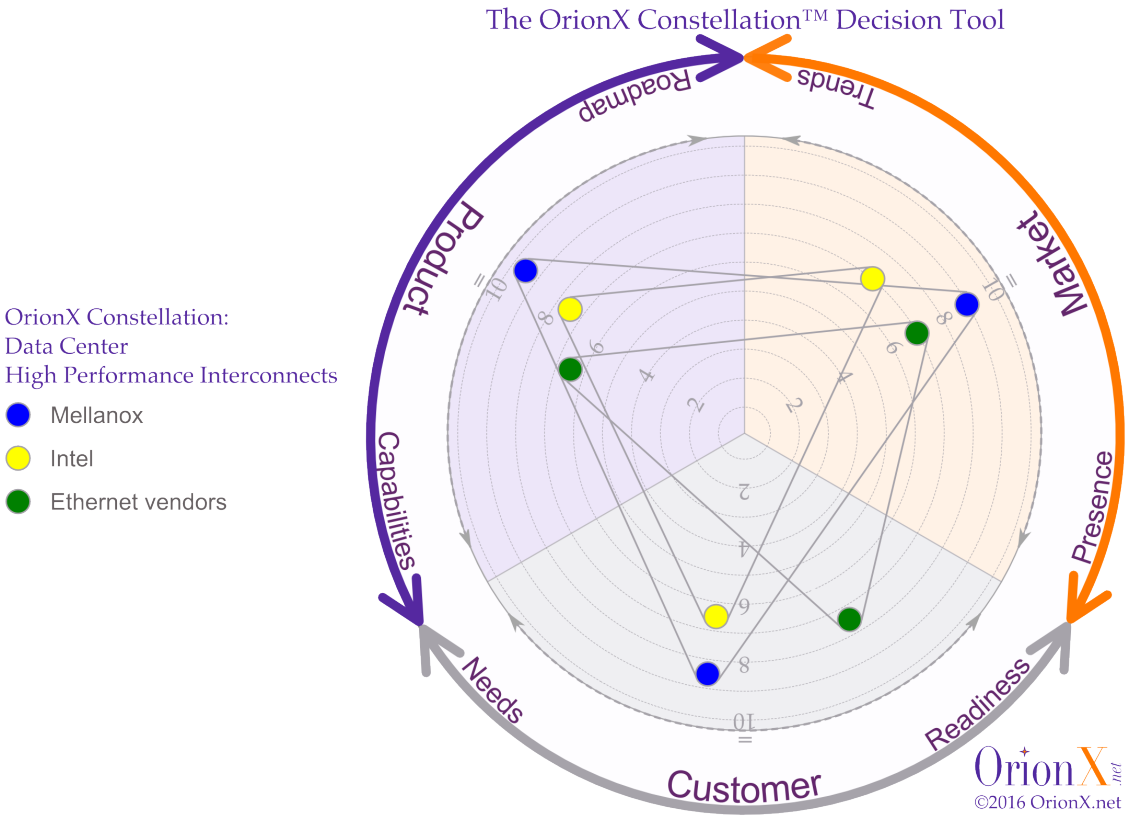
Intel: 8

Intel's roadmap meets expectations but is unproven. As time goes by, the company's willingness to share and its ability to execute its HPI roadmap will further improve an already impressive score.

Overall Scores

The table below and the associated OrionX Constellation Decision Tool diagram summarize our assessment and perspective on major HPI vendor choices. As described above, all Ethernet vendors have been combined into a single virtual vendor. While individual Ethernet vendors may very well have differentiated capabilities and plans for the HPI market, the choice of Ethernet as their core technology overrides most such differences.

Vendor	Market			Customer			Product		
	Presence	Trends	Overall	Readiness	Needs	Overall	Capabilities	Roadmap	Overall
Mellanox	9	9	9	8	9	8.5	9	10	9.5
Ethernet vendors	7	7	7	9	6	7.5	7	6	6.5
Intel	6	8	7	6	7	6.5	7	8	7.5



As the diagram indicates, Mellanox InfiniBand is the clear leader in all parameters, suitable for all customer situations and projecting a strong future. Intel is next, scoring lower in each category and with relative strengths in current product capabilities and its embrace of HPI market trends. Ethernet vendors are a close third, bolstered by ease of adoption.

However, this is a snapshot in time in a dynamic market. Specific customer situations can produce a different picture and while some parameters take time to change materially, various changes together can significantly impact our overall sentiment. Please contact OrionX.net for our latest perspective on the HPI market.

This is the fourth paper in a four-part series examining the HPI market.
Please visit OrionX.net/research for additional information and related reports.