



Choosing the Best Network Interface Card for Cloud

Mellanox ConnectX[®]-3 Pro EN vs. Intel XL710

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Introduction: How to Choose a Network Interface Card for a Cloud Environment

High performance connectivity is an essential component of cloud computing environments, enabling efficient data transfers and effective hardware utilization while maximizing virtualization and scalability. The difference between a successful deployment and one plagued with poor performance is often a matter of the underlying interconnect technology. The Network Interface Card (NIC) is therefore a crucial piece of the puzzle when building a high-performance cloud. In choosing one NIC over another, there are various factors to consider.

Does the NIC address the needs of your applications and market? It is important to make sure that your NIC has a wide enough range of features that accelerate your application and offload your CPU, providing more room for compute and virtualization.

What is the technology embedded in the NIC, and what advantages does it provide? The available bandwidth, the ability to support heavy virtual workloads and specific application offloads are all important features of the NIC technology. A scalable and high performing NIC will have a wider range of application benefits and a longer life span because it can address the growing needs of your cloud.

Which NIC provides superior performance? Ultimately, a high performance cloud's networking is largely dependent upon a highly performing NIC. Bandwidth, low latency, and application-specific performance are some of the parameters to compare.

Power consumption is another factor. Power consumption is a major expense in today's networks. In a large cloud infrastructure with thousands of servers, power consumption can become a major drain on profitability, so it is important to consider a NIC that can reduce such an expense.

The overall return on investment (ROI) should also be calculated. Cost and performance should be weighed against one another to determine the actual Total Cost of Ownership (TCO).

Comparison: Mellanox ConnectX[®]-3 Pro EN vs. Intel XL710

Given the aforementioned factors in choosing the best NIC for a cloud environment, we compared two of the leading Ethernet NICs in the marketplace to see which addresses these concerns better: Mellanox's ConnectX[®]-3 Pro EN and Intel's XL710.

Technology

When it comes to bandwidth, ConnectX-3 Pro EN offers 10, 40 and 56 Gb/s Ethernet, while the XL710 reaches the 10 and 40 GbE levels. The option of providing 56Gb is important in a cloud to optimize the user experience. Applications that require higher bandwidth will suffer without a 56Gb option. Furthermore, a network that is bounded at 40Gb cannot easily upgrade when the demands require greater bandwidth in the future. The 56Gb option futureproofs the cloud..

Mellanox’s ConnectX family of adapters supports RDMA over Converged Ethernet (RoCE), which enables zero-copy data transfers and reduces CPU overhead tremendously. Moreover, ConnectX-3 Pro EN enables hardware offloading via TCP stateless offloads even for overlay networks such as NVGRE and VXLAN, in order to further free the CPU for other activities. RDMA is not available on the XL710, and hardware offloading for overlay networks is only partially available in transmit operations.

ConnectX-3 Pro EN also includes congestion control features (QCN and ECN), which ensure that the maximum bandwidth can be passed efficiently during congestion events. Again, this is lacking in the XL710.

Finally, for customers seeking the utmost cloud simplicity and peace of mind, the ConnectX family is one piece of Mellanox’s end-to-end suite of interconnect products, including switches, cables, and management software. Mellanox even offers a version of ConnectX-3 Pro EN that uses Virtual Protocol Interconnect® (VPI®), a Mellanox technology that facilitates the conversion of a device from Ethernet to InfiniBand or vice versa. This guarantees that the customer can grow the network based on the latest requirements instead of based on legacy equipment. The XL710, on the other hand, is a standalone offering with little flexibility for current data center integration or for future growth.

Table 1. Technological Features

Infrastructure	Mellanox ConnectX-3 Pro EN	Intel XL710 Controller
Network Ports	10 / 40 / 56GbE Ethernet and VPI options	10 / 40GbE
RDMA	RoCE	No
Latency	7.5us (TCP)	27us (TCP)
Overlay Networks	VXLAN, NVGRE hardware offloads on Transmit and Receive	Only for VXLAN and only on Transmit
Congestion Control	QCN (L2) ECN (L3)	No

Conclusion: From a technological standpoint, ConnectX-3 Pro EN is a full generation ahead of XL710, and it can therefore better address the specific needs of the applications and markets that require high performance interconnect.

Performance

In virtualized environments, overlay networks of inter-VM communication are integral to assuring the scalability and security of the cloud. Such overlay networks can reduce overall throughput unless there are hardware offloads in place to improve utilization of the CPU and enable stateless offloads of the payloads. ConnectX-3 Pro EN enables both VXLAN and NVGRE overlay networks, and provides hardware offloading to ensure near-line-rate throughput. XL710, however, only enables VXLAN in transmit operations and fails to provide sufficient offloading of the CPU. The resultant throughput is at best half that of ConnectX-3 Pro EN.

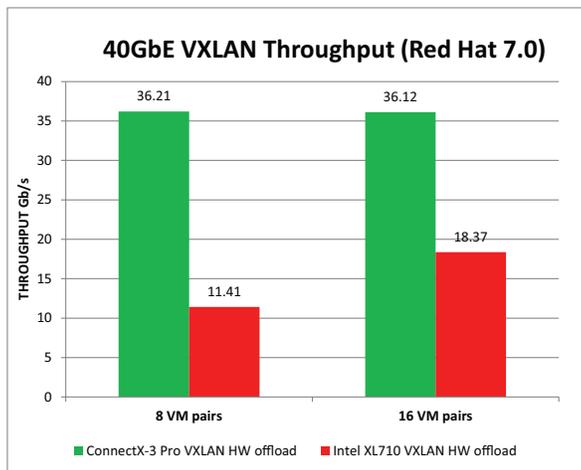


Figure 1. VXLAN maximum bandwidth

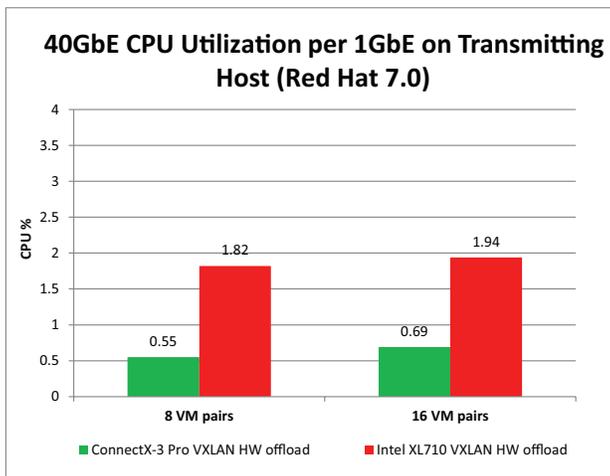
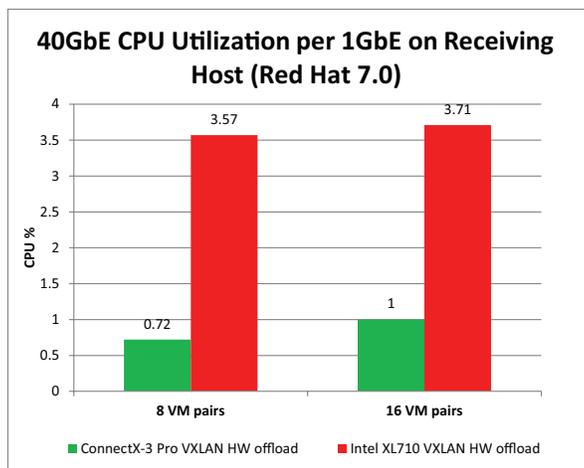


Figure 2. CPU utilization per 1Gb/s with VXLAN hardware offloading

Furthermore, in a cloud that connects virtual machines from around the globe, response time is critical. ConnectX-3 Pro EN offers its high throughput at much lower latency than XL710, further increasing the gap between the performance of the two NICs.

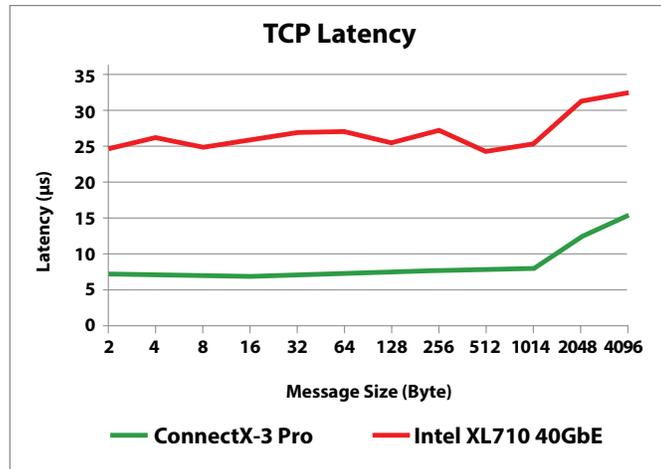


Figure 3. TCP latency

Conclusion: ConnectX-3 Pro EN offers a significant performance advantage over Intel’s XL710, and it offers additional features that provide an even greater performance boost. Cloud environments that use overlay network protocols will receive much higher bandwidth per server with ConnectX-3 Pro EN. Reducing CPU utilization that is wasted on data transfer also enables a much better ratio of VMs per server to the cloud with Mellanox ConnectX-3 Pro EN versus the competition.

Power Consumption

ConnectX-3 EN’s performance advantage in virtualized environments is clear, but it might not be as impressive if it achieves such an advantage at the cost of significantly higher power consumption. That is not the case, as Intel’s advertised max power numbers for XL710 are only marginally better than those of ConnectX-3 EN’s.

Moreover, when power is considered as a function of performance, the advantage swings dramatically in favor of ConnectX-3 Pro EN. The following table demonstrates that advantage, expressed as the number of Watts of power consumed per 1Gb of VXLAN traffic:

Table 2. Power consumption

	Mellanox ConnectX-3 Pro	Intel XL710
Max Power ¹ 1x40GbE	6.10 W	5.92 W
Throughput with VXLAN	36.21 Gb	18.37 Gb
W per 1GbE of VXLAN	0.16 W/GbE	0.32 W/GbE

ConnectX-3 Pro EN consumes 50% less power for the same bandwidth compared to XL710. To transfer the same amount of data with XL710 would require multiple ports, thereby using a lot more power.

Conclusion: XL710 has a slight advantage in maximum power consumption, but given the vast difference in performance, this advantage is essentially meaningless. The more important calculation is power as a function of performance, and ConnectX-3 Pro EN is far ahead on this count.

¹ Data is collected from Intel and Mellanox specifications and datasheets. Power consumption is based only on the adapter. It does not include cooling, installation, and other tangential factors.

Return on Investment

We have already shown ConnectX-3 Pro EN’s superiority over XL710 in bandwidth and latency, but performance alone is not enough to consider. It is also worthwhile to compare the two cards with regard to how much performance they provide per dollar.

According to the US Energy Information Administration, the average retail price for industrial consumers in April 2014 was 6.75 cents per Kilowatt-hour. By extrapolating the average power consumption numbers over the course of a year and multiplying by this average retail price, it is possible to see the ongoing cost of each adapter card. However, much more important than the cost is the return on investment (ROI). The NIC that provides the highest performance for your money is the card that provides the most value.

ConnectX-3 Pro EN offers nearly twice as much throughput per dollar than XL710.

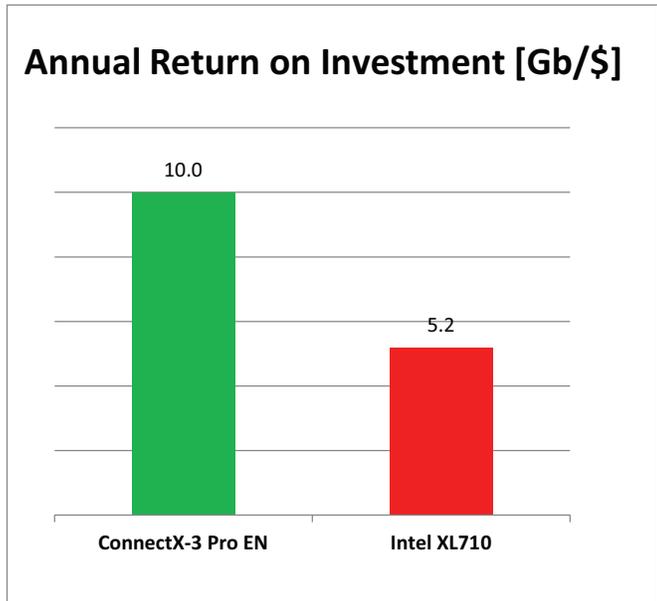


Figure 4. Return on Investment (Gb/\$)

In fact, by choosing the Mellanox card over the Intel one, you not only receive vastly superior performance and save on power consumption; you also receive even greater savings in the long-run. Because ConnectX-3 Pro EN is already a generation ahead of XL710 technologically, it is already future-proofed; when the demands of the data center or cloud increase, there is no need to upgrade the interconnect.

Conclusion: ConnectX-3 Pro EN is not only the better NIC on performance; it is also the better investment financially.

Bottom Line

Mellanox ConnectX-3 Pro EN is a better NIC than Intel’s XL710 on all counts and for all the main use cases. When choosing a NIC for virtualized environments, ConnectX-3 Pro EN is the leading choice to ensure successful high-performance deployments. When comparing on technology, performance, power consumption, and return on investment, ConnectX-3 Pro EN is the clear leader across the board.



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