COMPETITIVE BRIEF

August 2014

Choosing the Best Network Interface Card

Mellanox ConnectX®-3 Pro EN vs. Intel X520

Introduction: How to Choose a Network Interface Card

High performance connectivity is required by everyone these days, whether in enterprise data centers, cloud computing environments, or Web 2.0 installations. 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 data center. In choosing one NIC over another, there are various factors to consider.

Does the NIC address the needs of your application 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 both bare metal and 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 changing needs of a data center.

Which NIC provides superior performance? Ultimately, a high performaning data center's networking is largely dependent upon a highly performing NIC. Raw 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 the data center today. In a large data center with hundreds or 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 X520

Given the aforementioned factors in choosing the best NIC, 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 X520.

Technology

When it comes to bandwidth, ConnectX-3 Pro EN offers 10, 40 and 56 Gb/s Ethernet, while the X520 only reaches the 10 GbE level. This constitutes a significant difference in capability. Furthermore, because the ConnectX-3 Pro EN uses a PCIe Generation 3.0 bus, it can handle as many as 8 GT/s (Giga-transfers per second), compared to only 5 GT/s with the X520's PCIe Gen 2.0 bus.

Mellanox's ConnectX family of adapters also 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. Neither RoCE nor hardware offloading for overlay networks is available in the X520.

ConnectX-3 Pro EN also includes congestion control features (QCN), which ensure that the maximum bandwidth can be passed efficiently during congestion events. Again, this is lacking in the X520.

Finally, for customers seeking the ultimate in data center simplicity and peace of mind, the ConnectX family is but 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 proprietary 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 X520, 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 X520 82599 Controller
Network Ports	10 / 40 / 56GbE Ethernet and VPI options	1 / 10GbE
Host Interface	PCIe 3.0 x8 8GT/s	PCIe 2.0 x8 5GT/s
Power Consumption (IC on 10GbE Board)	3.8W	6.5W
RDMA	RoCE	No
Latency	0.8us (RDMA) 6us (TCP)	12us (TCP)
Overlay Networks	VXLAN, NVGRE hardware offloads	No
Congestion Control	QCN (L2)	No

Conclusion: From a technological standpoint, ConnectX-3 Pro EN is at least one generation ahead of X520, and it can therefore better address the specific needs of the applications and markets that require high performance interconnect.

Performance

Naturally, with higher bandwidth and a more advanced bus comes higher throughput. ConnectX-3 Pro EN reaches a maximum throughput of 38 Gb/s, while X520 can only achieve 9.5 Gb/s.

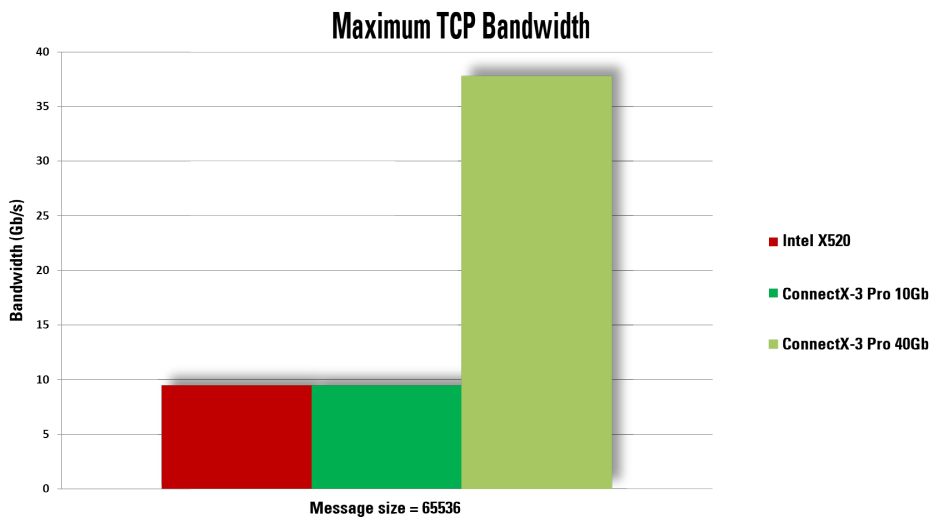

Figure 1. *Maximum bandwidth*

But even comparing only at 10GbE speed, ConnectX-3 Pro EN provides better results than the Intel X520 by way of low latency. ConnectX-3 Pro EN shows 2X better latency results than X520, even before incorporating RoCE. With RoCE support, ConnectX-3's latency numbers are 15 times better than the X520's.

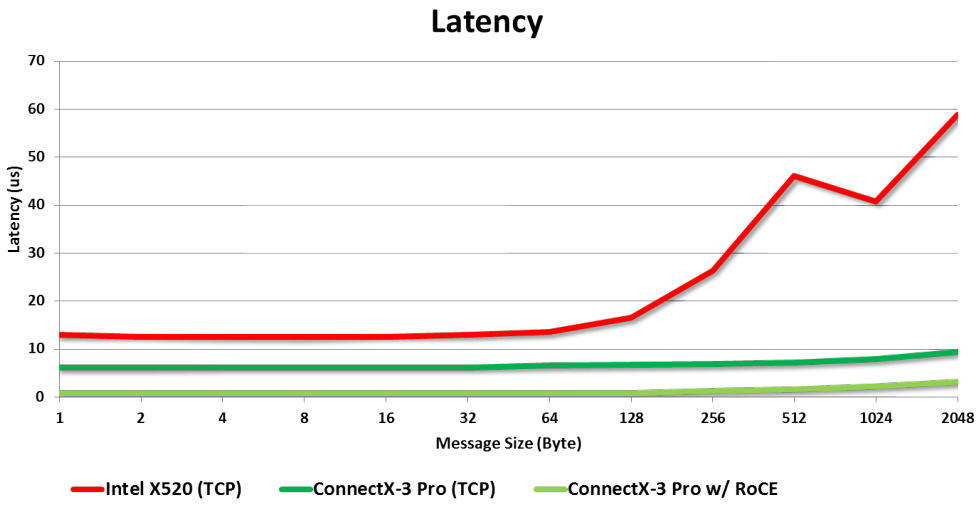

Figure 2. *Latency on 10GbE cards, with and without RDMA*

Acceleration for the Cloud

When overlay networks (NVGRE and VXLAN) are in use, there is added value in enabling hardware offloading for these protocols to improve utilization of the CPU. ConnectX-3 Pro EN supports this feature, but X520 does not.

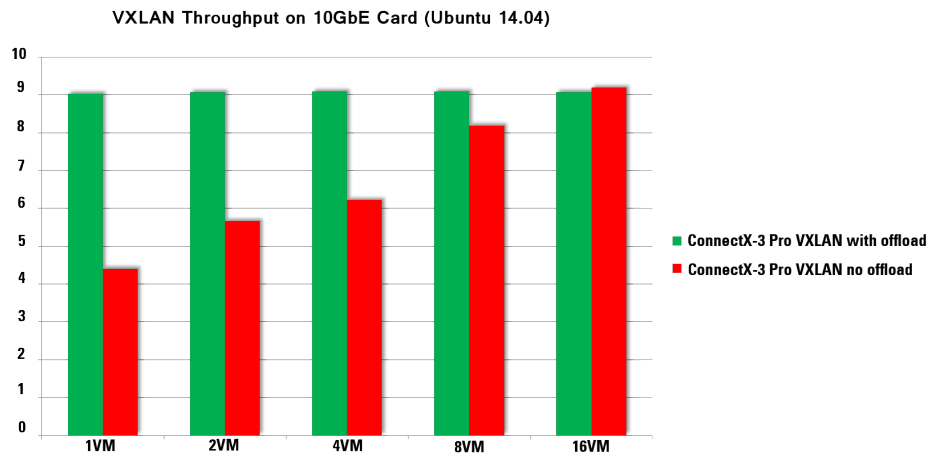

Figure 3. *10GbE throughput of VXLAN traffic*

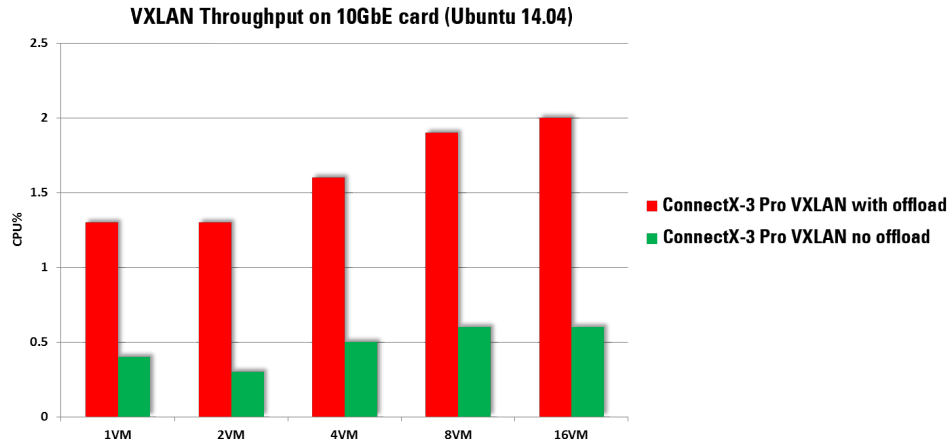

Figure 4. *CPU Utilization per 1Gb/s with and without NVGRE hardware offloading*

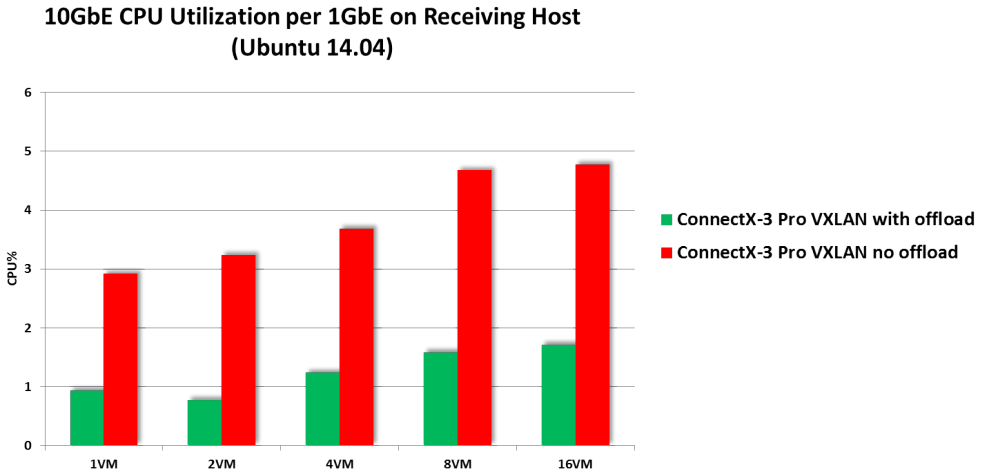

Figure 5. *CPU Utilization per 1Gb/s with and without VXLAN hardware offloading*

Conclusion: ConnectX-3 Pro EN offers a significant performance advantage over Intel's X520, and it offers additional features that provide an even greater performance boost. Cloud and other environments that prefer to use overlay network protocols such as VXLAN and NVGRE will receive much higher bandwidth per server. Offloading the CPU also enables a much better ratio of VMs per server to the cloud administrator with Mellanox ConnectX-3 Pro EN versus the competition.

Power Consumption

Not only does ConnectX-3 Pro EN offer higher performance, but it provides it while also consuming less power than the competition.

Table 2. *Power features*

	Mellanox ConnectX-3 Pro Dual-Port SFP+	Mellanox ConnectX-3 Pro Single-Port QSFP	Intel X520 Dual-Port SFP+
Speed	20	40	20
Ports	2	1	2
PCIe	x8 Gen3	x8 Gen3	x8 Gen2
Power Consumption[1]	3.74W	5.32W	4.5W
Power per 1Gb (W/Gb)	0.187	0.133	0.225

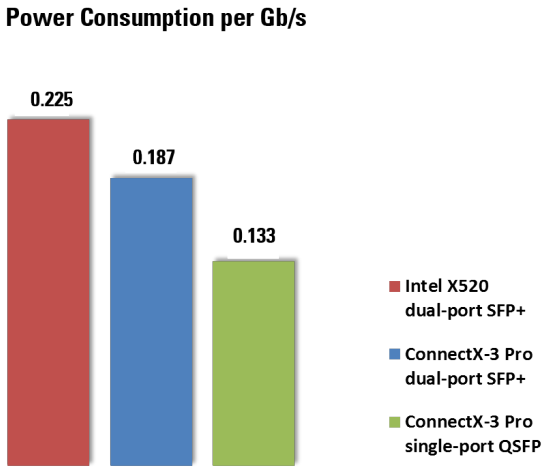

Figure 6. *Watts per 1Gb/s of supported speed*

Conclusion: When power savings are multiplied across hundreds or thousands of NICs, ConnectX-3 Pro EN becomes the clear choice thanks to its more efficient consumption for similar (or even greater) bandwidth.

Return on Investment

We have already shown ConnectX-3 Pro EN's superiority over X520 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.

[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.

According to the US Energy Information Administration, the average retail price for industrial consumers in April 2014 was 6.75 cents per Kilowatthour. 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, 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.

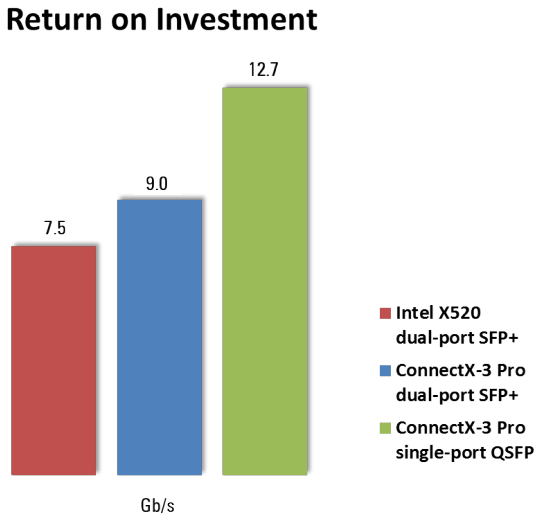

Figure 7. *Throughput per dollar of power consumption*

ConnectX-3 Pro EN has a clear advantage in terms of throughput per dollar.

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 at least a generation ahead in bandwidth, 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 X520 on all counts and for all the main use cases. Whether for HPC, cloud, Web 2.0, storage, or data center, 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.

Mellanox TECHNOLOGIES
350 Oakmead Parkway, Suite 100, Sunnyvale, CA 94085
Tel: 408-970-3400 • Fax: 408-970-3403
www.mellanox.com

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