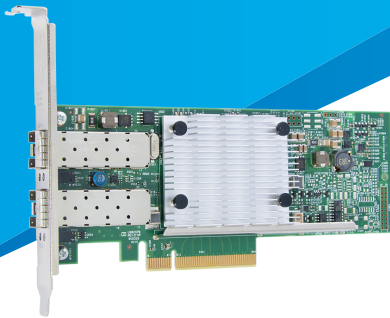


Cavium FastLinQ 10GbE Intelligent Ethernet Adapters vs. Intel 10GbE Adapters



Cavium FastLinQ 3400/8400 adapters provide maximum performance and flexible bandwidth management to optimize virtualized servers and networks

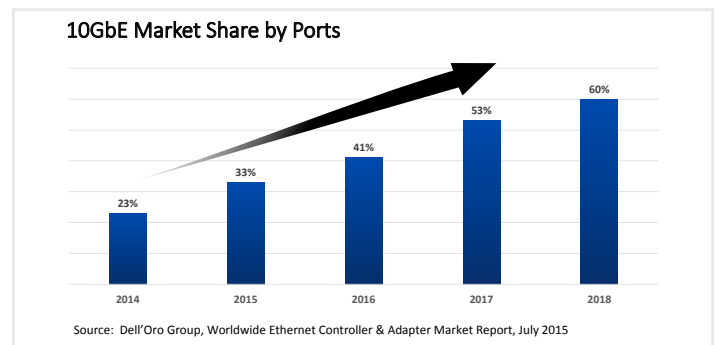
CAVIUM ADVANTAGES

- **Switch-independent NPAR with concurrent SR-IOV** – partition 10GbE links and allocate network bandwidth to deliver QoS for virtual machines and applications
- **Layer 2 network virtualization with stateless offloads** – enterprise tunneling with optimum efficiency
- **PCIe 3.0** – higher throughput and lower latency for server-NIC transfers
- **Common 10GBASE-T PHY with switch manufacturers** – eliminate potential interoperability issues
- **Remote multi-adapter management** – lower OPEX by simplifying adapter management
- **Hardware-based storage offloads** – reduce I/O processing and power consumption in server

EXECUTIVE SUMMARY

The evolution to new and more powerful servers continues and server virtualization is well established as the way to fully utilize CPU resources. As new servers support higher virtualization ratios, I/O capacity has become one of the critical resources and 10 Gigabit Ethernet (10GbE) is the high-performance standard for server connectivity. This is especially the case for data centers that are moving to private clouds.

As shown below, the Dell'Oro Group shows evidence of this trend by forecasting 10GbE will comprise more than 60% of Ethernet port shipments by 2018.

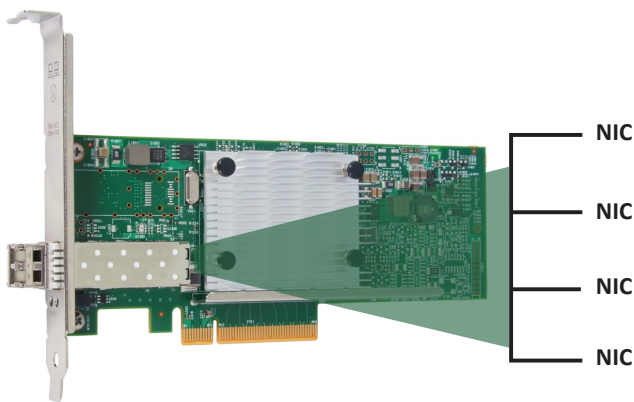


In addition to increased bandwidth, 10GbE adapters can provide many key features that affect both server and network performance. This includes the capability to optimize I/O for applications and meet quality of service (QoS) requirements for applications that are running in virtual machines (VMs).

Cavium™ FastLinQ® high-performance intelligent Ethernet adapters are ideally suited for virtualized and cloud data centers. This competitive brief highlights important benefits for Cavium FastLinQ 3400 10GbE adapters and FastLinQ 8400 10GbE converged network adapters (CNAs) when compared to Intel® 10GbE adapters.

SWITCH-INDEPENDENT NIC PARTITIONING

Switch-independent network interface card (NIC) partitioning (NPAR) is a hardware-based method for partitioning a 10GbE port into four PCI Express (PCIe) physical functions (PFs), or 8 PFs for dual-port Cavium FastLinQ 3400/8400 adapters. Each PCIe PF looks like a unique physical port to the host and bandwidth can be allocated to each one individually. A typical application would assign bandwidth for live VM migration using VMotion with a VMware® deployment. Bandwidth can also be assigned to individual VMs with high I/O requirements.



Cavium FastLinQ 3400/8400 adapters enable switch-independent NIC partitioning that is operating system (OS) agnostic. Many tier-1 server OEMs have also adopted Cavium's NPAR technology and added their own differentiation to create OEM-specific versions of NPAR that are tightly integrated with server management applications. This is a powerful endorsement of the value-added benefit that Cavium NPAR provides.

NPAR is configured for Cavium FastLinQ 3400/8400 adapters during power-on initialization with support for minimum and maximum bandwidth settings per PF. Minimum settings insure that a PF will always get at least a baseline amount of bandwidth while maximum settings can be as high as 100% to ensure full bandwidth utilization.

The Cavium implementation of NIC partitioning can also be used concurrently with single root I/O virtualization (SR-IOV). This unique capability can reduce the number of adapter ports needed to support failover and load balancing on a virtualized host that is using SR-IOV.

In comparison, Intel 10GbE adapters support Flexible Port Partitioning (FPP), which is a non-standard extension of SR-IOV. FPP has many limitations, including the requirement to use SR-IOV, which may not apply to many deployments. FPP cannot be used with a bare-metal OS and is only supported on servers running Linux. Although port partitioning is typically used with virtualized servers, FPP cannot be used with VMware ESXi, Windows Hyper-V, Linux KVM, or Xen. Cavium FastLinQ 3400/8400 NPAR capabilities are supported with all these hypervisors.

As a final point of comparison, FPP has rate-limiting bandwidth allocation only. This implementation lacks the flexibility and optimization that is possible with min/max settings that are used with Cavium FastLinQ 3400/8400 adapters.

LAYER 2 NETWORK VIRTUALIZATION/TUNNELING WITH STATELESS OFFLOADS

The scale of large enterprise and cloud-based, multitenant deployments has pushed the limitations of traditional virtual LANs (VLANs), which are restricted to 4096 network IDs. The solution has been the development of network virtualization/tunneling that can support up to 16 million IDs. These technologies include Virtual Extensible LAN (VXLAN), Network Virtualization using Generic Routing Encapsulation (NVGRE), Generic Routing Encapsulation (GRE), and Generic Network Virtualization Encapsulation (GENEVE).

Cavium FastLinQ 3400/8400 adapters fully support VXLAN, NVGRE, and GRE with stateless offloads when tunneling is enabled. These adapters are also provisioned to support the OS-agnostic GENEVE standard as it is adopted in 2016.

In contrast, Intel X520, X540, and X550 adapters only support VXLAN with stateless offloads. The Intel X710 adapter adds support for NVGRE and GRE.

PCI EXPRESS 3.0

PCIe 3.0 is the latest update to the high-speed serial computer expansion bus standard and has capacity for almost twice the bandwidth as PCIe 2.0. Cavium FastLinQ 3400/8400 adapters fully support PCIe 3.0. Intel X520 and X540 adapters only support PCIe 2.0.

COMMON 10GBASE-T PHY WITH SWITCH MANUFACTURERS

The physical layer (PHY) standard defines the interface that an adapter uses for physical access to a networking medium. The initial implementations of 10GbE adapters used SFP+ connectivity for both optic and direct attach copper (DAC) cabling. The Cavium FastLinQ QLE3442-RJ is a next-generation, dual-port 10GbE adapter that leverages the IEEE 10GBASE-T standard to provide connectivity to Cat 6/6a twisted pair cables. Unlike 10G SFP solutions that do not support 1G to 10G auto-negotiation, 10GBASE-T solutions allow for backwards compatibility to 1GBASE-T networks while providing a path for eventual switch upgrades to 10GbE.

Industry leading top of rack (ToR) switches use Broadcom® 10GBASE-T PHYs, the same PHY that is part of Cavium FastLinQ QLE3442-RJ adapters. Utilizing the same PHY implementation for both ends of the adapter/switch connection insures optimum compatibility and performance. The Intel X540 and X550 10GBASE-T adapters use a non-Broadcom PHY with a minimal share of the ToR switch market.

REMOTE MULTI-ADAPTER MANAGEMENT

It is well known that ongoing operating expense (OPEX) can be a much greater cost factor than the original capital expense (CAPEX). With that in mind, data center and network managers want the option to remotely manage adapters from a centralized management console. This helps to reduce OPEX and is also critical to insure network consistency.

As a starting point, Cavium FastLinQ 3400/8400 adapters are fully supported with baseline OS network management utilities. That capability is greatly enhanced with the powerful Cavium QConvergeConsole® graphical user interface (GUI) management tool that enables administration off all Cavium adapters throughout the data center from a single console locally or remotely on Linux and Windows. Additionally, there is the Cavium Control Suite (QCS) command line interface (CLI) scriptable tool for setup/status both locally or remotely on Linux and Windows. There is also a fully integrated Cavium QConvergeConsole (QCC) vCenter™ Plug-in module that is ideal for VMware deployments.

Intel adapters can only be managed with baseline OS utilities. There is no option for remote multi-adapter management.

HARDWARE-BASED STORAGE OFFLOADS

The 10X increase in bandwidth provided by 10GbE networks can also be used to support protocols for storage area networks (SANs). iSCSI and Fibre Channel over Ethernet (FCoE) are the predominant storage protocols for Ethernet and both hardware and software based initiator solutions are available in the market.

Cavium is the industry leader for SAN connectivity and Cavium FastLinQ 8400 CNAs optimize server utilization with full hardware offload for iSCSI and FCoE protocols. By comparison, Intel 10GbE adapters require iSCSI and FCoE software initiators that squander critical CPU resources for storage I/O.

CONCLUSION

As summarized in the Table 1 below, Cavium FastLinQ 3400/8400 adapters deliver key benefits that insure maximum value with 10GbE deployments.

LEARN MORE

The following white papers have additional information on key benefits that are provided with Cavium FastLinQ 3400/8400 adapters:

- [SR-IOV Improves Server Virtualization Performance](#)
- [NIC Partitioning and Data Center Bridging](#)
- [Concurrent NIC Partitioning and SR-IOV](#)

ABOUT CAVIUM

Cavium, Inc. (NASDAQ: CAVM), offers a broad portfolio of infrastructure solutions for compute, security, storage, switching, connectivity and baseband processing. Cavium's highly integrated multi-core SoC products deliver software compatible solutions across low to high performance points enabling secure and intelligent functionality in Enterprise, Data Center and Service Provider Equipment. Cavium processors and solutions are supported by an extensive ecosystem of operating systems, tools, application stacks, hardware reference designs and other products. Cavium is headquartered in San Jose, CA with design centers in California, Massachusetts, India, Israel, China and Taiwan.

Table 1. Cavium Advantages

Feature	Cavium 3400	Cavium 8400	Intel X520	Intel X540	Intel X550	Intel X710
Switch-Independent NIC Partitioning	✓	✓	✗	✗	✗	✗
Layer 2 Network Virtualization/Tunneling Offloads for NVGRE and GRE	✓	✓	✗	✗	✗	✓
PCIe Gen 3.0	✓	✓	✗	✗	✓	✓
Common 10GBASE-T PHY with Switch Manufacturers	✓	N/A	N/A	✗	✗	N/A
Remote Multi-adapter Management	✓	✓	✗	✗	✗	✗
Hardware-based Storage Offloads	✗	✓	✗	✗	✗	✗



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