Product Brief

Intel® Ethernet Converged Network Adapter X540-T2

Network Connectivity

Intel® Ethernet Converged Network Adapter X540-T2

10GBASE-T Converged Network Adapter simplifies migration to 10GbE and provides iSCSI, FCoE, virtualization, and flexible port partitioning

Key Features

- Low cost, low power, 10 Gigabit Ethernet (10GbE) performance for the entire data center

- Standard Cat 6A cabling with familiar RJ-45 connectors

- Backward compatibility with existing 1000BASE-T networks simplifies the transition to 10GbE

- Flexible I/O virtualization for port partitioning and quality of service (QoS) of up to 64 virtual ports

- Unified Networking delivering LAN, iSCSI, and FCoE in one low-cost CNA

- Industry-first 10GBASE-T adapter with single chip solution with integrated MAC + PHY

- Reliable and proven 10 Gigabit Ethernet technology from Intel

10 Gigabit for the Broad Market

The Intel® Ethernet Converged Network Adapter (CNA) X540-T2 is the latest innovation in Intel's leadership to drive 10 Gigabit Ethernet into the broader server market. This adapter hosts Intel's latest silicon, the Intel® Ethernet Controller X540, which is used by many OEMs as a single chip solution for LAN on Motherboard (LOM) to deliver 10 Gigabit Ethernet (10GbE) on the latest server platforms.

10GBASE-T Simplifies the Transition to 10GbE

The X540 family of products works with existing networks today. It works with legacy Gigabit Ethernet (GbE) switches and Cat 6A cabling. Install the X540 adapter into a server and the auto-negotiation between 1GbE and 10GbE provides the necessary backwards compatibility that most customers require for a smooth transition and easy migration to 10GbE. When time and budget allows, 10GBASE-T switches can be added any time to experience the full benefits of 10GbE.

10GBASE-T uses the copper twisted-pair cables that are very familiar to IT professionals today. It is everything you know and love about 1000BASE-T. The knowledge, training and investment in BASE-T are preserved. 10GBASE-T is the easiest and most versatile 10GbE and you can deploy it anywhere in your datacenter. Its flexible reach from 1 meter to 100 meters supports the latest network architectures including Top of Rack (ToR), Middle of Row (MoR), and End of Row (EoR).

10G Performance at Low Cost and Low Power

The new Intel Ethernet Converged Network Adapter (CNA) X540-T2 is the lowest cost way to deploy 10GbE in your data center today. The X540-T2 uses low cost, Cat 6 and Cat 6A cabling. Chances are this cabling already exists in the data center.

A way for Intel to reduce cost and power is to integrate multiple components into a single chip solution. Of course, integration is what Intel does best. With Intel's new Controller X540, Intel has integrated the MAC controller and the PHY into one single chip solution.

So why is integration important? First, integration translates to lower power. A single chip solution simply uses less power than two separate components. This means no more active heat sink and reduces the per-port power consumption. Second, integration also means lower cost per port. Manufacturing a single part costs less than two. Cost efficiencies realized from a single part mean 10GBASE-T is the lowest cost media to deploy.

With lower cost and power, 10GBASE-T is ready for broad deployment. 10GBASE-T is an option for every rack and tower server in the datacenter. The wait for a low-cost 10GbE copper solution to broadly deploy 10GbE to all corners of the data center is over. The new X540 dual port adapter provides bandwidth-intensive applications highly affordable 10 Gigabit Ethernet (10GbE) network performance with cost-effective RJ-45 connectivity for distances up to 100 meters.

Exciting New Datacenter Use Models

More than simply a 10x increase in performance, with 10GbE there are exciting new use models that are now possible including Unified Networking (iSCSI, FCoE & LAN), Virtualization (VMDq & SR-IOV), and now Flexible Port Partitioning (FPP).

Flexible I/O Virtualization

Virtualization changes the way server resources are deployed and managed by running multiple applications and operating systems independently on a single server.

The Intel Ethernet Converged Network Adapter X540-T2 includes Intel® Virtualization Technology for Connectivity (Intel® VT-c) to deliver I/O virtualization and Quality of Service (QoS) features designed directly into the X540 controller on the adapter. Intel® I/O virtualization advances network connectivity models used in today's servers to more efficient models by providing Flexible Port Partitioning (FPP), multiple Rx/Tx queues, and on-controller QoS functionality that can be used in both virtual and non-virtual server deployments.

Flexible Port Partitioning (FPP)

By taking advantage of the PCI-SIG SR-IOV specification, Intel Ethernet products enable Flexible Port Partitioning (FPP). With FPP, virtual controllers can be used by the Linux* host directly and/or assigned to virtual machines. FPP allows you to use the functionality of SR-IOV to assign up to 63 processes per port to virtual functions in Linux. This enables an administrator to partition their 10GbE bandwidth across multiple processes ensuring a quality of service (QoS) giving each assigned process equal bandwidth. Network administrators may also rate limit each of these services to control how much of the 10GbE pipe is available to each process.

Unified Networking

Unified Networking solutions on the new Intel Ethernet Converged Network Adapter X540-T2 let you combine the traffic of multiple data center networks like LAN and SAN onto a single efficient network fabric. You now have the choice of NFS, iSCSI, or Fibre Channel over Ethernet (FCoE) to carry both network and storage traffic at speeds of up to 10 GB. The X540-T2 adapter combines support for these traffic types in one adapter at no additional cost or with no additional licensing fees for the adapter.

Intel's Unified Networking solutions are enabled through a combination of standard Intel Ethernet products along with trusted network protocols integrated in the operating systems. Thus, Unified Networking is available on every server either through LAN-on-Motherboard (LOM) implementation or via an add-in Network Interface Card (NIC).

Intel has delivered high quality Ethernet products for over 30 years and our Unified Networking solutions are built on the same founding principles that made us successful in Ethernet.

1. Open Architecture integrates networking with the server allowing IT managers to reduce complexity and overhead while enabling a flexible and scalable datacenter network.

2. Intelligent offloads lower cost and power while delivering the application performance that customers expect.

3. Proven Ethernet Unified Networking is built on trusted Intel® Ethernet Technology enabling customers to deploy FCoE or iSCSI while maintaining the quality of their traditional Ethernet networks.

iSCSI Simplifies SAN Connectivity

iSCSI uses Ethernet to carry storage traffic, extending the familiarity and simplicity of Ethernet to storage networking, without the need for SAN-specific adapters or switches. Intel Ethernet CNA X540 is the easiest, most reliable, and most cost-effective way of connecting servers to iSCSI SANs.

Intel Ethernet server adapters include hardware-based iSCSI acceleration features that do not require offloading to a proprietary TCP/IP stack. iSCSI acceleration uses large send offload, Receive Side Coalescing and transmit send offloads to help reduce latency and lower CPU utilization. To improve efficiency, MSI-X, Receive-side Scaling and Intel® Ethernet Flow Director scale I/O processing across multiple CPU cores. Direct memory access (DMA), direct cache access (DCA) and header splitting improve network data processing efficiency, and data center bridging (DCB) supports multiple traffic classes that can be prioritized for iSCSI traffic.

Open FCoE Consolidates LANs and Legacy SANs

Intel's Open FCoE solution enables Intel Ethernet 10 Gigabit Server products (LOM or NICs) to support Fibre Channel payload encapsulated in Ethernet frames. There is no upgrade charge for Open FCoE on the adapter. Just as iSCSI, now customers can easily connect to an FCoE network with Intel 10GbE solutions.

For the first time, Open FCoE is now supported on 10GBASE-T. As 10GBASE-T switches come to market enabled with FCoE support, the X540 is ready when you're ready. This allows you to use cost-effective 10GBASE-T for all your converged networking needs. The Open FCoE architecture uses a combination of FCoE

initiators in Microsoft Windows* and Linux* operating systems and in the VMware ESXi* hypervisor to deliver high-performance FCoE solutions over standard 10GbE Ethernet adapters.

This approach allows IT managers to simplify the data center and standardize on a single adapter for LAN and SAN connectivity. The Intel Ethernet Converged Network Adapter X540-T2 is designed to fully offload the FCoE data path to deliver full-featured converged network adapter (CNA) functionality without compromising on power efficiency and interoperability.

Data Center Bridging (DCB) Delivers Lossless Ethernet

Conventional Ethernet does not guarantee successful data delivery, which is not acceptable for SAN traffic. Ethernet enhancements such as Data Center Bridging (DCB) overcome that limitation with technologies that guarantee lossless delivery, congestion notification, priority-based flow control, and priority groups.

Intel is driving Data Center Bridging (DCB), a new collection of standards-based end-to-end networking technologies that make Ethernet the unified fabric for multiple types of traffic in the data center.

The combination of 10GbE and unified networking helps organizations overcome connectivity challenges and simplify the data center infrastructure. 10GbE provides a simple, well-understood fabric for virtualized data centers, one that helps reduce cost and complexity as the number of virtual machines continues to grow.

Software Tools and Management

Intel Ethernet server and converged network adapters support Dell's Lifecycle Controller. The Lifecycle Controller is coupled with the Dell DRAC service processor to provide embedded system management. The Lifecycle Controller enables both local and remote access to manage initial setup and configuration of the BIOS settings on the platform, setup and configuration of Intel Ethernet adapters, update of all the platform firmware, and the deployment of the operating systems.

Intel® Advanced Network Services (Intel® ANS) include new teaming technologies and techniques such as Virtual Machine Load-Balancing (VMLB) for Hyper-V environments. Intel ANS also provides a variety of teaming configurations for up to eight ports, and support for teaming mixed vendors' server adapters. Intel ANS includes support for 802.1Q VLANs, making Intel ANS one of the most capable and comprehensive tools for supporting server adapter teaming.

Additionally, Intel® PROSet for Windows* Device Manager (DMIX) and PROsetCL extends driver functionality to provide additional reliability and Quality of Service features and configuration.

Companion Products

Consider these Intel® products in your server and network planning:

- Intel® Ethernet Server Adapter X520 Series for 10GbE SFP+ PCIe v2.0 (5 GT/s) performance
- Copper or fiber-optic network connectivity, up to four ports per card
- Solutions for PCI Express, PCI-X,* and PCI interfaces
- Intel® Xeon® Processors
- Intel® Server Boards

General	
Features	Benefits
Intel® Ethernet Converged Network Adapter X540-T2	▪ Industry's first integrated MAC+PHY reducing cost and power
Low-profile	▪ Enables higher bandwidth and throughput from standard and low-profile PCIe slots and servers
Load balancing on multiple CPUs	▪ Increases performance on multi-processor systems by efficiently balancing network loads across CPU cores when used with Receive-Side Scaling from Microsoft* or Scalable I/O on Linux*
iSCSI remote boot support	▪ Provides centralized Storage Area Network (SAN) management at a lower cost than competing iSCSI solutions
Intelligent offload for iSCSI and FCoE	▪ Hardware offload delivers application performance while the software initiator provides platform scalability and OS integration. Software initiator provides platform scalability and OS integration.
Support for most Network Operating Systems (NOS)	▪ Enables widespread deployment
RoHS-compliant, lead-free technology	▪ Complies with the European Union directive 2002/95/EC to reduce the use of hazardous materials
Lifecycle Controller	▪ Local and remote access to BIOS setup and configuration on the platform and adapter

I/O Features for Multi-core Processor Servers

MSI-X support	• DMA Engine: enhances data acceleration across the platform (network, chipset, processor), lowering CPU usage • Direct Cache Access (DCA): enables the adapter to pre-fetch the data from memory, avoiding cache misses and improving application response time
Low latency	• Based on the sensitivity of the incoming data, the adapter can bypass the automatic moderation of time intervals between the interrupts
Header Splits and Replication in Receive	• Helps the driver focus on the relevant part of the packet without the need to parse it
Multiple Queues: 16 queues per port	• Network packet handling without waiting or buffer overflow providing efficient packet prioritization
Tx/Rx IP, SCTP, TCP, and UDP checksum offloading (IPv4, IPv6) capabilities	• Lower processor usage • Checksum and segmentation capability extended to new standard packet type
Tx TCP segmentation offload (IPv4, IPv6)	• Increased throughput and lower processor usage • Compatible with large-send offload feature (in Microsoft Windows* Server operating systems)
IPsec Offload	• Offloads IPsec capability onto the adapter instead of the software to significantly improve throughput and CPU usage (for Windows* 7, Windows* 2008 Server R2, Windows* 2008 Server, and Vista*)
MACSec	• IEEE spec: 802.1ae • Layer 2 data protection with encryption/authentication ability between devices (e.g, routers, switches) • MACSec is designed into the network adapter hardware. These adapters are prepared to provide • MACSec functionality when the ecosystem is ready to support this new technology
Compatible with x8 and x16 standard and low-profile PCI Express* slots	• Allows each PCI Express* slot port to operate without interfering or competing with the other
Receive and Transmit Side Scaling for Windows environment and Scalable I/O for Linux* environments (IPv4, IPv6, TCP/ UDP)	• Enables the direction of the interrupts to the processor cores in order to improve the CPU utilization rate
RJ-45 connections over Cat 6A cabling	• Ensures compatibility with cable lengths up to 100 meters
Intel® PROSet Utility for Microsoft Windows* Device Manager	• Provides point-and-click power over individual adapters, advanced adapter features, connection teaming, and Virtual Local Area Network (VLAN) configuration
Intel backing	• Backed by an Intel limited lifetime warranty, 90-day money-back guarantee (U.S. and Canada), and worldwide support

Virtualization Features

Virtual Machine Device queues (VMDq)[1]	• Offloads the data-sorting functionality from the Hypervisor to the network silicon, improving data throughput and CPU usage • Provides QoS feature on the Tx data by providing round-robin servicing and preventing head-of-line blocking • Sorting based on MAC addresses and VLAN tags
Next-Generation VMDq (64 queues per port)	• Enhanced QoS feature by providing weighted round-robin servicing for the Tx data • Provides loopback functionality, where data transfer between the virtual machines within the same physical server need not go out to the wire and come back in, improving throughput and CPU usage • Supports replication of multicast and broadcast data
PC-SIG SR-IOV Implementation (64 virtual functions per port)	• Provides an implementation of the PCI-SIG standard for I/O Virtualization. The physical configuration of each port is divided into multiple virtual ports. Each virtual port is assigned to an individual virtual machine directly by bypassing the virtual switch in the Hypervisor, resulting in near-native performance • Integrated with Intel® VTI for Directed I/O (VT-d) to provide data protection between virtual machines by assigning separate physical addresses in the memory to each virtual machine
IPv6 Offloading	• Checksum and segmentation capability extended to the new standard packet type
Flexible Port Partitioning: 64 Virtual Functions per port	• Virtual Functions (VFs) appear as Ethernet Controllers in Linux OSes that can be assigned to VMs, Kernel processes or teamed using the Linux* Bonding Drivers
Advanced Packet Filtering	• 24 exact-matched addresses (unicast or multicast) • 4096-bit hash filter for unicast and multicast frames • Lower processor usage • Promiscuous (unicast and multicast) transfer mode support • Optional filtering of invalid frames
VLAN support with VLAN tag insertion, stripping and packet filtering for up to 4096 VLAN tags	• Ability to create multiple VLAN segments

Specifications

General

Intel® Ethernet Converged Network Adapter X540-T2	430-4439-LP 430-4440-FH
Connector	RJ-45 Copper
Cabling	Cat 6A

Network Management

Wired for Management (WfM) baseline v2.0 enabled for servers

DMI 2.0 support, Windows Management Instrumentation (WMI) and SNMP

Remote Installation Services (RIS)

PXE 2.0 enabled through boot Read-Only Memory (ROM)

Specifications (continued)

Adapter Product Features

Intel® PROSet Utility for easy configuration and management	
Intel® Lead-free technology	
Plug and play specification support	Standard
Includes a full-height bracket	
RoHS	
CABLING DISTANCE	
10GBASE-T	100m on Cat 6A 55 m on Cat 6
1000BASE-T	100 m on Cat 5e, Cat 6 or Cat 6A
100MBASE-T	100 m on Cat 5e, Cat 6 or Cat 6A
Receive-side scaling	
VMDq	Optimizes the processing of VM data traffic to improve CPU utilization and bandwidth
Advanced packet filtering (per port)	• 16 exact-matched packets (unicast or multicast) • 4096-bit hash filter for multicast frames • Promiscuous (unicast and multicast) • Optional filtering of invalid frames

Advanced Software Features

Adapter Fault Tolerance (AFT)
Switch Fault Tolerance (SFT)
Adaptive Load Balancing (ALB)
Teaming support
IEEE 802.3ad5 (link aggregation control protocol)
PCIe Hot Plug/Active Peripheral
Component Interconnect (PCI)
IEEE 802.1Q VLANs
IEEE 802.3 2005 flow control support
Tx/Rx IP, TCP, & UDP checksum offloading (IPv4, IPv6) capabilities (Transmission control protocol (TCP), User Datagram Protocol (UDP), Internet Protocol (IP))
IEEE 802.1p
TCP segmentation/large send offload
MSI -X supports Multiple Independent Queues
Interrupt moderation
IPv6 offloading

Technical Features

Data rate(s) supported per port	1 Gigabit and 10 Gigabit
Bus type	PCI Express 2.1 (5.0 GT/s)
Bus width	x8 lane PCI Express, operable in x8 and x16 slots
Bus speed (x8, encoded rate)	20 Gbps uni-directional; 40 Gbps bi-directional
Interrupt levels	INTA, MSI, MSI-X
Hardware certifications	FCC B, UL, CE, VCCI, BSMI, CTICK, KCC
Controller-processor	Intel® Ethernet Controller X540

Operating System/Architecture Support

OPERATING SYSTEM	IA32	X64	IPF[2]
Windows* XP Professional SP3		•	
Windows* XP Professional SP3	•		
Windows Vista* SP2	•	•	
Windows 7* SP1	•	•	
Windows Server* 2003 SP2	•	•	•
Windows Server 2008 SP2	•	•	•
Windows Server 2008 SP2 Core	•	•	
Windows Server 2008 SP2 (w/Hyper-V role)		•	
Hyper-V Server 2008 SP2 (stand-alone version)		•[3]	
Windows Server 2008 R2 SP1		•	•
Windows Server 2008 R2 SP1 Core		•	
Windows Server 2008 R2 SP1 (w/Hyper-V role)		•	
Hyper-V Server 2008 R2 SP1 (stand-alone version)		•[3]	
Linux* Stable Kernel version 2.6	•	•	
Linux RHEL 5.5	•	•	
Linux RHEL 6.0	•	•	
Linux SLES 10 SP3	•	•	
Linux SLES 11 SP1	•	•	•
FreeBSD* 8.0	•	•	
DOS* NDIS 2	•		
DOS ODI	•		
EFI* 1.1			•
uEFI* 2.1		•	•
VMware* ESX 4.03[4]		•	
VMware ESX 4.13[4]		•	
VMware ESXi 5.0[4]		•	
Xen4[5]		•	

10 Gb/s Power (PCIe edge)

CABLE LENGTH (M)	SPEED	WATTS (TYPICAL)
2	10Gbps	13.4
30	1 Gbps	8.2
80	100 Mbps	5.9

1-VMDq requires a virtualization operating system that supports VMDq
2-Itanium™ Product Family
3-Minimal Validation
4-VMware ESXi drivers are available at the VMware website
5-SR-IOV validation only

To see the full line of Intel Server Adapters*, visit www.intel.com/go/ethernet, www.IntelEthernet-Dell.com or contact your Dell sales representative.

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