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
Provides iSCSI, FCoE, Virtualization, and Flexible Port Partitioning

Key Features

- Low Cost, Low Power, 10 Gigabit Ethernet (10GbE) Performance for the Entire Datacenter
- Standard Cat6a Cabling with RJ45 Connectors
- Backward Compatible 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 32 virtual ports
- Unified Networking Delivering LAN, iSCSI, and FCoE in One Low Cost CNA
- Industry First Dual-Port 10GBASE-T Adapter with Single-Chip Solution with Integrated MAC + PHY
- Reliable and proven 10 Gigabit Ethernet technology from Intel Corporation

10 Gigabit for the Broad Market

The Intel® Ethernet Converged Network Adapter 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 Ethernet 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 (10 GbE) on the latest server platforms.

10GBASE-T Simplifies the Transition to 10 GbE

The X540 family of products works with existing networks today. It works with legacy Gigabit Ethernet (GbE) switches and CAT6a cabling. Install the X540 adapter into a server and the auto-negotiation between 1 GbE and 10 GbE provides the necessary backwards compatibility that most customers require for a smooth transition and easy migration to 10 GbE. When time and budget allows, 10GBASE-T switches can be added any time to experience the full benefits of 10 GbE.

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 10 GbE and you can deploy it anywhere in your data center. 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 X540-T2 is the lowest cost way to deploy 10 GbE in your data center today. The X540-T2 uses low cost, CAT6 and CAT6a cabling. Chances are this cabling already exists in the data center.

A way for Intel to reduce cost and power is to integrate components into a single-chip solution. Of course, integration is what Intel does best. With the new X540 Controller, the MAC controller and the PHY are integrated into a 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. When cabling is accounted for, 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 data center. The wait for a low cost 10 GbE copper solution to broadly deploy 10 GbE to all corners of the data center is over. The new X540, dual-port adapter provides bandwidth-intensive applications with highly affordable 10GbE network performance and cost-effective RJ-45 connectivity for distances up to 100 meters.

Exciting New Data Center Usage Models

More than simply a 10x increase in performance, with 10 GbE there are exciting new usage models that are now possible, including Unified Networking (iSCSI, FCoE and LAN), Virtualization (VMDq and 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 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 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 10 GbE bandwidth across multiple processes, ensuring a QoS by giving each assigned process equal bandwidth. Network administrators may also rate-limit each of these services to control how much of the 10 GbE 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 all of these traffic types in one adapter at no additional cost and 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 original principles that made us successful in Ethernet:

- **Open Architecture** integrates networking with the server, enabling IT managers to reduce complexity and overhead while enabling a flexible and scalable data center network.
- **Intelligent Offloads** lower cost and power while delivering the application performance that customers expect.
- **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 X540 is the easiest, most reliable, and most cost-effective way of connecting servers to iSCSI SANs.

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 with iSCSI, now customers can easily connect to an FCoE network with Intel 10 GbE 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 enables 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 using standard 10 GbE Ethernet adapters.

This approach enables 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 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 10 GbE and unified networking helps organizations overcome connectivity challenges and simplify the data center infrastructure. 10 GbE 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.

Companion Products

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

- Intel® Ethernet Server Adapter X520 Series
  - –10 GbE SFP+ PCIe v2.0 (5 GT/s) performance
  - –Copper or fiber-optic network connectivity; up to four ports per card
- Intel® Xeon® Processors
- Intel® Server Boards

Adapter Order Code

Single unit: X540T2

Intel® Ethernet Converged Network Adapter X540-T2

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	▪ Centralized Storage Area Network (SAN) management at a lower cost than competing solutions
Support for most Network Operating Systems (NOS)	▪ Enables widespread deployment
RoHS compliant, lead-free technology	▪ Compliant with the European Union directive (July 2006) to reduce hazardous materials
I/O Features for Multi-core Processor Servers	
MSI-X support	▪ Minimizes the overhead of interrupts ▪ Allows load balancing of interrupt handling between different cores/CPUs
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	▪ Packet handling without waiting/buffer overflow provides 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 to adapter instead of software to significantly improve through- put and CPU usage (for Windows* 7, Windows* 2008 Server R2, Windows* 2008 Server, and Vista*)
Compatible with x8 and x16 standard and low-profile PCI Express* slots	▪ Enables each PCI Express* slot port to operate without interfering or competing with other ports
Receive/Transmit Side Scaling for Windows* and Scalable I/O for Linux* (IPv4, IPv6, TCP/ UDP)	▪ Enables direction of the interrupts to the processor cores in order to improve the CPU usage rate
RJ-45 connections over category-6a cabling	▪ Ensures compatibility with cable lengths up to 100 meters
Intel® PROSet 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)	▪ Offloads data-sorting from the Hypervisor to silicon, improving data throughput and CPU usage ▪ QoS feature for 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, data transfer between the virtual machines within the same physical server don't go out to the wire and back in, improving throughput and CPU usage ▪ Supports replication of multicast and broadcast data
PC-SIG SR-IOV Implementation (64 virtual functions per port)	▪ Implementation of 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 by-passing the virtual switch in the Hypervisor, resulting in near-native performance ▪ Iintegrated with Intel® Virtualization Technology (Intel® VT) for Directed I/O (Intel® VT-d) to pro-vide data protection between virtual ma- chines 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
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	
Product code	X540T2
Connector	RJ-45 Copper
Cabling	See listing below
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 compliant	
Cabling Distances:	
10GBASE-T	▪ 100 m on Cat-6a ▪ 55 m on Cat-6
1000BASE-T	100 m on Cat-5e, Cat-6 or Cat-6a
100BASE-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 frame

10 Gb/s Power (PCIe Edge)

Speed	Watts (typical)
10 Gbps	13.4
1 Gbps	8.2
100 Mbps	5.9

Intel Backing

Limited lifetime warranty

90-day, money-back guarantee

(U.S. and Canada)

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)
Network Operating Systems (NOS) Software Support
Windows* 7 (IA32 and X64)
Windows Server* 2008 (x64 and IPF)
Windows Server* 2008 Core (x64 and IPF)
Windows Server* 2008 R2 (x64 and IPF)
Windows Server 2008 R2 Core (x64 and IPF)
Linux* SLES 11 SP1
Microsoft Windows Server 2003*
Microsoft Vista*
SUSE* SLES 10* or later, Professional 9.2 or later
Microsoft Windows Virtual Server* 2005*
Red Hat Enterprise* 4* or later
FreeBSD* 5.x or later VMware* ESX *3.x support
Fedora*
EFI* 1.1

Advanced Software Features
Teaming support
Adapter Fault Tolerance (AFT)
Switch Fault Tolerance (SFT)
Adaptive Load Balancing (ALB)
Virtual Machine Load Balancing (VMLB)
IEEE 802.3ad (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: Multiple Independent Queues
Interrupt moderation
IPv6 offloading

Hardware Features	
Data rate(s) supported per port	100 Mbps, 1 Gbps, 10 Gbps
Bus Type	PCI Express 2.0 (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

Network-Ready Servers

Top PC and server manufacturers offer Intel® adapters in their new products. Specify or ask for Intel® Network Connections with your next PC, server, or mobile PC purchase. For a list of preferred suppliers, visit us at:

www.intel.com/buy/networking/ adapters.htm

Customer Support

Intel® Customer Support Services offers a broad selection of programs including phone support and warranty service. For more information, contact us at

support.intel.com/support/go/network/ adapter/home.htm

(Service and availability may vary by country.)

For Product Information

To speak to a customer service representative regarding Intel products, please call 1-800-538-3373 (U.S. and Canada) or visit

support.intel.com/support/go/network/contact.htm

for the telephone number in your area. For additional product information on Intel Networking Connectivity products, visit:

www.intel.com/go/ethernet

To see the full line of Intel Network Adapters for PCI Express*, visit **www.intel.com/go/ethernet**

[1] Lead and other materials banned in RoHS Directive are either (1) below all applicable substance thresholds the EU or (2) an approved/pending exemption applies. Lead has not been intentionally added, but lead may still exist as an impurity below 1000 ppm, or an approved RoHS exemption applies.

[2] Intel® VMDq requires operating system support.

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