Chapter 7

10 Gigabit Ethernet Connectivity with Microsoft Windows Servers

Contents

Server Connectivity Technology

A server connects to an access switch with multiple network adapter ports. For a typical rack-mountable server, a typical configuration consists of the following ports:

- Integrated lights-out (iLO) management port: Replaces the console and provides the capability to turn the servers on and off
- Dual lights-out management (LOM) port: Connected redundantly to the management network
- Quad-port Gigabit Ethernet adapter: Used for production traffic
- Two single-port host bus adapters (HBAs) or single dual-port HBA: Used for Fibre Channel connectivity

Modern installations consist of servers adopting 10 Gigabit Ethernet adapters with or without the capability to support Fibre Channel over Ethernet (FCoE) as follows:

- iLO
- Dual LOM
- **Dual-port 10 Gigabit Ethernet adapter:** Used for production traffic; may or may not include support for FCoE (unified I/O)
- **(Optional) Two single-port HBAs or single dual-port HBA:** used for Fibre Channel connectivity if the 10 Gigabit Ethernet adapter does not provide FCoE support

Operating Systems Support

Different operating systems handle multiport adapters and multiple network interface cards (NICs) in different ways:

- **Microsoft Windows:** Requires NIC vendors' teaming software (and drivers) to bundle the network adapters together
- **Linux operating systems:** Offer built-in support for bonding (http://linux-ip.net/html/ether-bonding.html); NIC vendors also offer specific drivers tailored for their adapters that may provide better performance than the built-in bonding implementation
- **Virtualized servers:** Handle multiple NICs natively without the need to install any teaming software on the guest OS; virtualized server networking is beyond the scope of this guide

For Microsoft products, if you have Intel adapters, you can deploy Intel PROSet with Advanced Network Services (ANS). For HP products (typically operating on a Broadcom adapter), you can use the HP Network Configuration Utility (NCU):

- **Intel:** Intel adapters can be teamed with ANS (http://www.intel.com/support/network/sb/cs-009747.htm, http://www.intel.com/support/network/adapter/ans/). Teaming configurations can be performed from the Properties tab by clicking on the Configure button or by using the Visual Basic scripts in C:\Program Files\Intel\NCS2\Scripts\.
- **HP:** HP adapters can be teamed with HP NCU (http://bizsupport.austin.hp.com/bc/docs/support/SupportManual/c01415139/c01415139.pdf).

Teaming software from different vendors may be incompatible with each other. For example, if your server deployment consists of built-in Broadcom LOMs and Intel adapters, then you may not be able to use HP NCU or Intel PROSet for all the adapters concurrently.

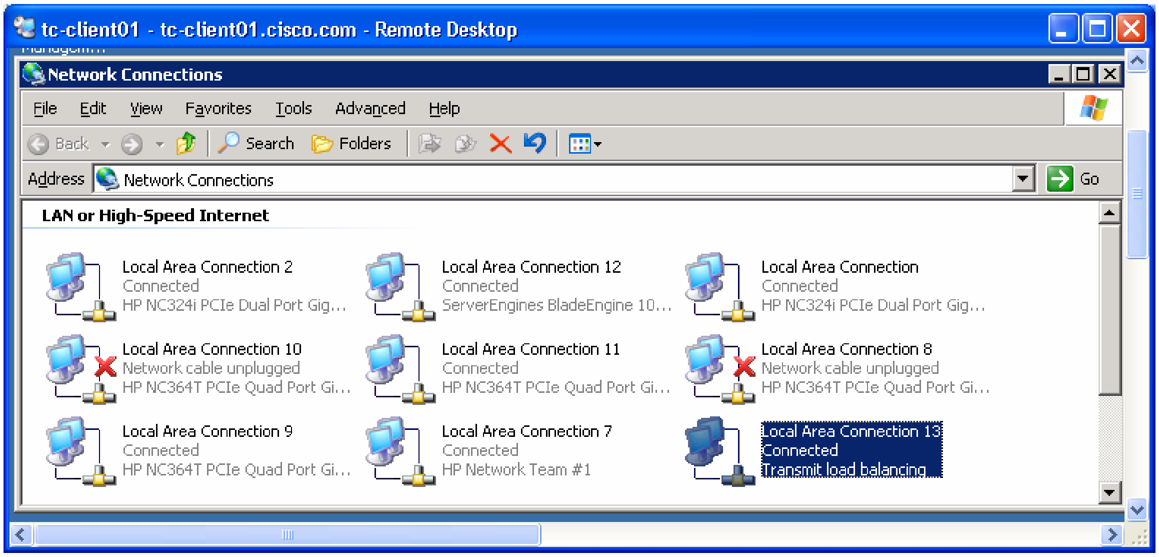
Another important factor to consider when deploying teaming is that sometimes teaming software interferes with Small Computer System Interface over IP (iSCSI) support. In some cases, then, you need to flash network adapters to reset the iSCSI boot configuration and set it to preexecution environment (PXE) boot before you can use the NIC teaming configurations. In the case of Intel controllers, you can use utilities such as the Intel Boot Agent Utility, ibautil, from a bootable CD to flash the adapter: see http://downloadcenter.intel.com/Detail_Desc.aspx?agr=Y&DwnldID=8242.

Typical Teaming and Bonding Capabilities

Network adapters connect to the network in a redundant fashion. This redundancy increases performance and provides high availability. Two main options are available for servers to support redundant connectivity to the network:

- **Routing:** An IP address is assigned to each NIC and a routing protocol is run on the server. This option is not commonly used and is not recommended.
- **NIC teaming:** The network adapter manufacturer provides software that, together with the driver, bundles the NICs and exposes them to the operating system as a single entity. Figure 1 shows an example in which Local Area Connection 9 and Local Area Connection 11 have been teamed and are presented to the OS as a single adapter, which is listed as Local Area Connection 13.

Figure 1. Example of Teaming Configuration



tc-client01 - tc-client01.cisco.com - Remote Desktop

Network Connections

Address: Network Connections

LAN or High-Speed Internet

Local Area Connection 2
Connected
HP NC324i PCIe Dual Port Gig...

Local Area Connection 12
Connected
ServerEngines BladeEngine 10...

Local Area Connection
Connected
HP NC324i PCIe Dual Port Gig...

Local Area Connection 10
Network cable unplugged
HP NC364T PCIe Quad Port Gi...

Local Area Connection 11
Connected
HP NC364T PCIe Quad Port Gi...

Local Area Connection 8
Network cable unplugged
HP NC364T PCIe Quad Port Gi...

Local Area Connection 9
Connected
HP NC364T PCIe Quad Port Gi...

Local Area Connection 7
Connected
HP Network Team #1

Local Area Connection 13
Connected
Transmit load balancing

Typical teaming options include the following:

- **Fault tolerance (adapter):** Only one of the teamed NICs transmits and receives; all remaining NICs are on standby. The user can optionally define the order of preference to set the NIC that becomes primary. In Figure 2, this is option (a).
- **Load balancing ((transmit or adaptive):** Outgoing traffic is load-balanced across all teamed NICs, while the incoming traffic is received only on one NIC. Figure 3 illustrates this type of configuration. Adapter 9 (with a MAC address ending in .07cc) and adapter 11 (with a MAC address ending in .07ce) are teamed, and adapter 9 is preferred for the receive direction of the traffic (which means that Adapter 9 answers Address Resolution Protocol [ARP] requests). The load-balancing method hashes traffic based on the destination IP address. In Figure 2, this is option (b).

- **Switch-assisted load balancing or static link aggregation:** Cisco also refers to this option as static EtherChannel. In other words, it is a PortChannel configuration with no negotiation protocol. If the upstream Cisco Nexus® switches are configured for virtual PortChannel (vPC), then you can run the server adapter in this mode with links divided between two upstream Cisco Nexus switches. The configuration on the Cisco® switch needs to specify **channel-group <number> mode on**. In Figure 2, this is option (c).
- **IEEE 802.3ad dynamic:** This option uses the traditional EtherChannel configuration accompanied by the negotiation of the bundling configuration through the standard IEEE 802.3ad Link Aggregation Protocol (LACP). If the upstream Cisco Nexus switches are configured for vPC, then you can run the server adapter in this mode with links divided between two upstream Cisco Nexus switches. The configuration on the Cisco switch needs to specify **channel-group <number> mode active**. In Figure 2, this is option (c). In contrast to switch-assisted load balancing, this option provides dynamic negotiation using the IEEE 802.3ad protocol.

Figure 2. Example of Teaming Configuration

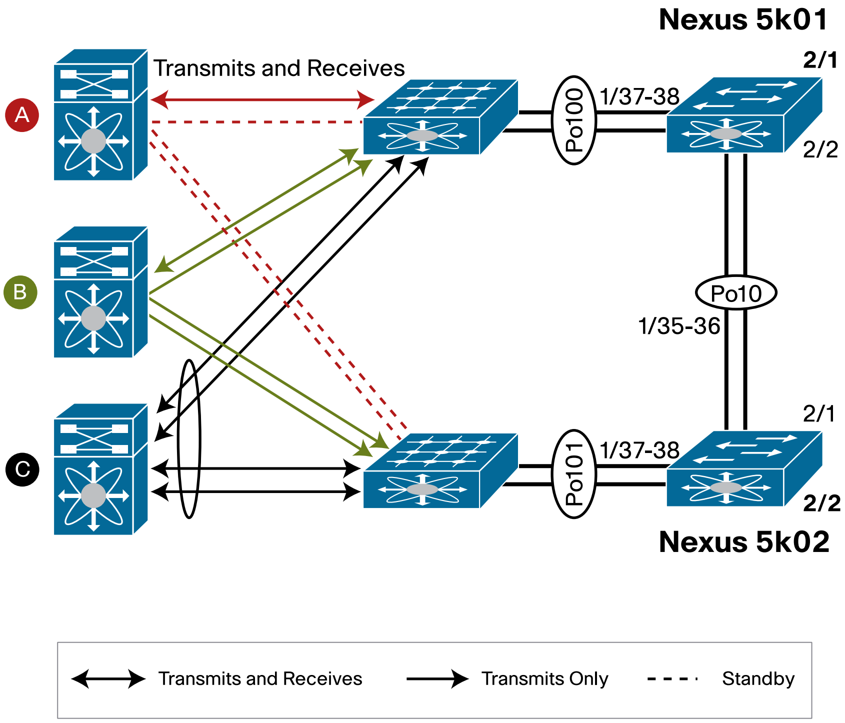
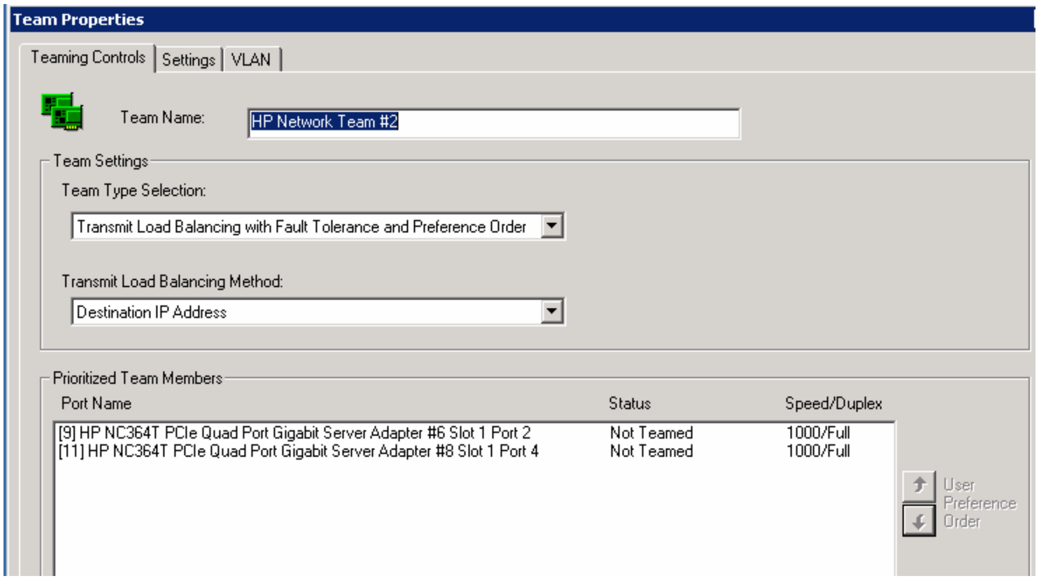


Figure 3. Example of Teaming Configuration



Team Name: HP Network Team #2

Team Type Selection: Transmit Load Balancing with Fault Tolerance and Preference Order

Transmit Load Balancing Method: Destination IP Address

Port Name	Status	Speed/Duplex
[9] HP NC364T PCIe Quad Port Gigabit Server Adapter #6 Slot 1 Port 2	Not Teamed	1000/Full
[11] HP NC364T PCIe Quad Port Gigabit Server Adapter #8 Slot 1 Port 4	Not Teamed	1000/Full

Teaming with PortChannels

Some terminology differs from vendor to vendor. For example, Intel uses the following terminology:

- **Static link aggregation:** In Cisco terminology, this is a static PortChannel (EtherChannel): **channel-group mode on**.
- **Dynamic link aggregation:** In Cisco terminology, this is a dynamic PortChannel (EtherChannel): **channel-group mode active**.

For PortChannels, HP NCU uses this terminology:

- **Switch-assisted load balancing:** In Cisco terminology, this is a static PortChannel (EtherChannel): **channel-group mode on**.
- **IEEE 802.3ad dynamic:** In Cisco terminology, this is a dynamic PortChannel (EtherChannel): **channel-group mode active**.

Additional teaming capabilities include the following:

- **Capability to define VLANs:** Each additional VLAN on an adapter is presented to the OS as an individual local-area connection.
- **Capability to define a VLAN on top of a teamed adapter:** This option enables redundant connectivity from the server to the network and creation of a virtual network adapter on every VLAN.

Transmit Load Balancing

Transmit load balancing (TLB) can be used when the upstream switches do not support vPC. It has the peculiar behavior of using multiple links for sending and only one link for receiving.

This behavior can be seen in the MAC address table of the two switches to which a server configured in this manner is connected. As you can see, the server uses two different MAC addresses for sending traffic, and the ARP table of the router learns only one of the two MAC addresses:

```
tc-nexus7k01-vdc2# show ip arp vlan 60

IP ARP Table
Total number of entries: 3
```

```
Address          Age       MAC Address     Interface
10.60.0.10       00:00:59  001f.290d.07cc  Vlan60

tc-nexus5k01# show mac address-table int eth1/12
Legend:
        * - primary entry, G - Gateway MAC, (R) - Routed MAC
        age - seconds since last seen,+ - primary entry using vPC Peer-Link
   VLAN     MAC Address      Type      age     Secure  NTFY   Ports
---------+-----------------+--------+---------+------+------+----------------
* 60       001f.290d.07cc    dynamic   0        False  False Eth1/12

tc-nexus5k02-vdc2# show mac address-table int eth1/12
Legend:
        * - primary entry, G - Gateway MAC, (R) - Routed MAC
        age - seconds since last seen,+ - primary entry using vPC Peer-Link
   VLAN     MAC Address      Type      age     Secure  NTFY   Ports
---------+-----------------+--------+---------+------+------+----------------
* 60       001f.290d.07ce    dynamic   0        False  False Eth1/12
```

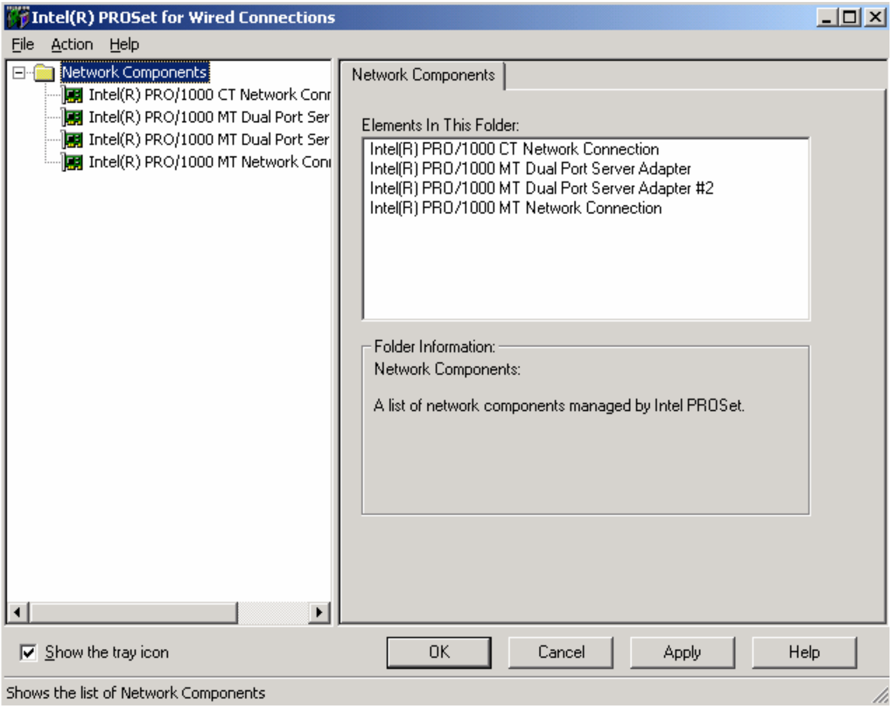
Typical Teaming Configuration Steps

This section shows a sample configuration for NIC teaming.

Creating a PortChannel Team

Follow these configuration steps:

1. Open the teaming software (in this case, Intel PROSet) to see the available Intel adapters. In this screenshot you can see that the server has four adapters of which an Intel Dual Port Gigabit Ethernet server adapter: Intel PRO/1000MT Dual Port Server Adapter.


Intel(R) PROSet for Wired Connections
File
Action
Help
Network Components
Intel(R) PRO/1000 CT Network Conr
Intel(R) PRO/1000 MT Dual Port Ser
Intel(R) PRO/1000 MT Dual Port Ser
Intel(R) PRO/1000 MT Network Conr
Network Components
☑ Show the tray icon
OK
Cancel
Apply
Help

Elements In This Folder:

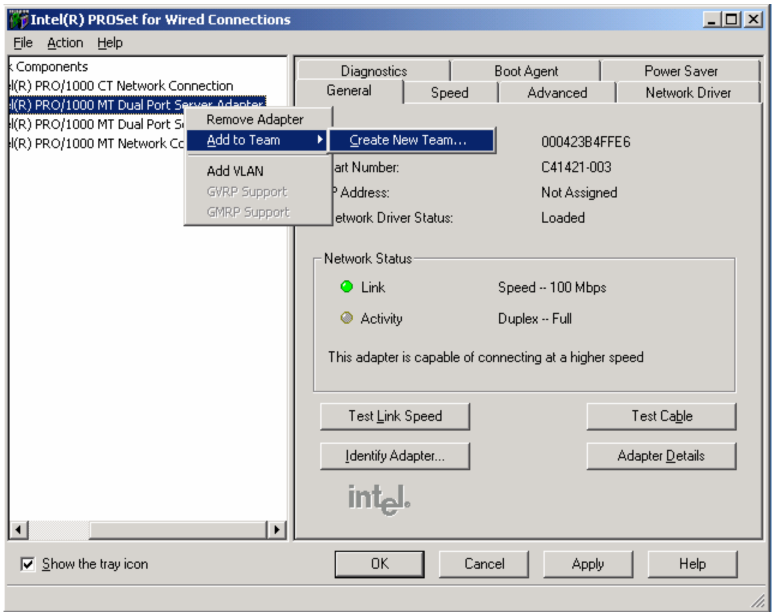
Intel(R) PRO/1000 CT Network Connection
Intel(R) PRO/1000 MT Dual Port Server Adapter
Intel(R) PRO/1000 MT Dual Port Server Adapter #2
Intel(R) PRO/1000 MT Network Connection

Folder Information:
Network Components:

A list of network components managed by Intel PROSet.

Shows the list of Network Components

2. On the **Network Components** tab, select the adapter you want to use and click **OK**. In the left configuration pane, click the adapter you want to use to create the team. To create a new team, choose **Add to Team > Create New Team**. Click **OK**. A new team is created.



Intel(R) PROSet for Wired Connections

File Action Help

- Components
- l(R) PRO/1000 CT Network Connection
- l(R) PRO/1000 MT Dual Port Server Adapter
- l(R) PRO/1000 MT Dual Port Se
- l(R) PRO/1000 MT Network Cc

Remove Adapter
Add to Team ▸ Create New Team...
Add VLAN
GVRP Support
GMRP Support

Diagnostics | Boot Agent | Power Saver | General | Speed | Advanced | Network Driver

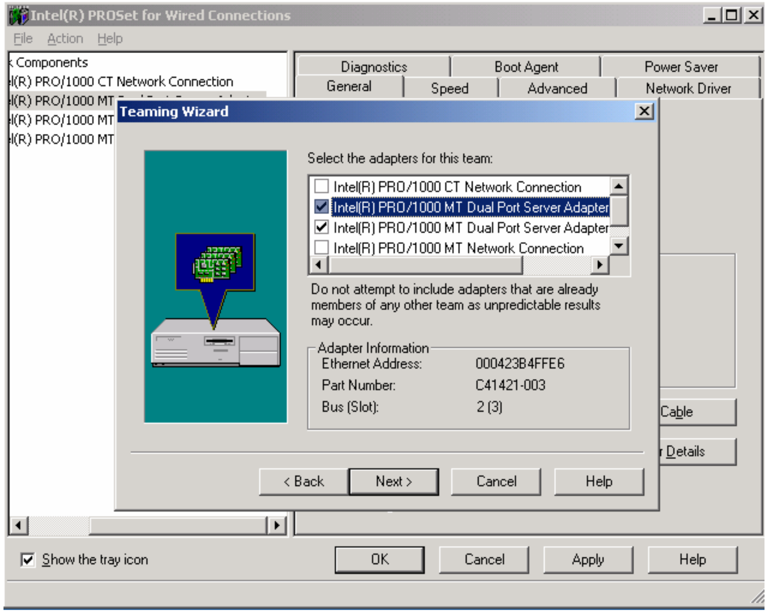
000423B4FFE6
art Number: C41421-003
P Address: Not Assigned
etwork Driver Status: Loaded

Network Status
● Link Speed -- 100 Mbps
● Activity Duplex -- Full
This adapter is capable of connecting at a higher speed

Test Link Speed | Test Cable | Identify Adapter... | Adapter Details

☑ Show the tray icon | OK | Cancel | Apply | Help

3. Select all the adapters that you want to be part of the same team. Click **Next**.



Intel(R) PROSet for Wired Connections

Teaming Wizard

Select the adapters for this team:

☐ Intel(R) PRO/1000 CT Network Connection
☑ Intel(R) PRO/1000 MT Dual Port Server Adapter
☑ Intel(R) PRO/1000 MT Dual Port Server Adapter
☐ Intel(R) PRO/1000 MT Network Connection

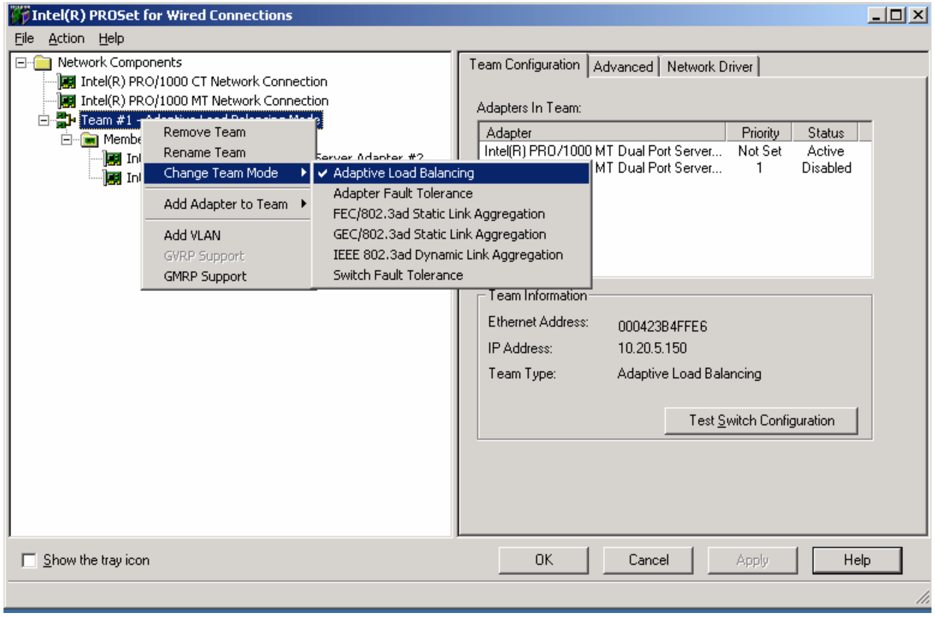
Do not attempt to include adapters that are already members of any other team as unpredictable results may occur.

Adapter Information
Ethernet Address: 000423B4FFE6
Part Number: C41421-003
Bus (Slot): 2 (3)

< Back | Next > | Cancel | Help

☑ Show the tray icon | OK | Cancel | Apply | Help

4. In the left configuration pane, click the team you are creating and choose **Change Team Mode** and the load-balancing method you want to use.


Intel(R) PROSet for Wired Connections
File Action Help
Network Components
Intel(R) PRO/1000 CT Network Connection
Intel(R) PRO/1000 MT Network Connection
Team #1 - Adaptive Load Balancing Mode
Membe
Int
Int
Server Adapter #2
Remove Team
Rename Team
Change Team Mode
Add Adapter to Team
Add VLAN
GVRP Support
GMRP Support
✓ Adaptive Load Balancing
Adapter Fault Tolerance
FEC/802.3ad Static Link Aggregation
GEC/802.3ad Static Link Aggregation
IEEE 802.3ad Dynamic Link Aggregation
Switch Fault Tolerance
Team Configuration
Advanced
Network Driver
Test Switch Configuration
□ Show the tray icon
OK
Cancel
Apply
Help

Adapters In Team:

Adapter	Priority	Status
Intel(R) PRO/1000 MT Dual Port Server...	Not Set	Active
MT Dual Port Server...	1	Disabled

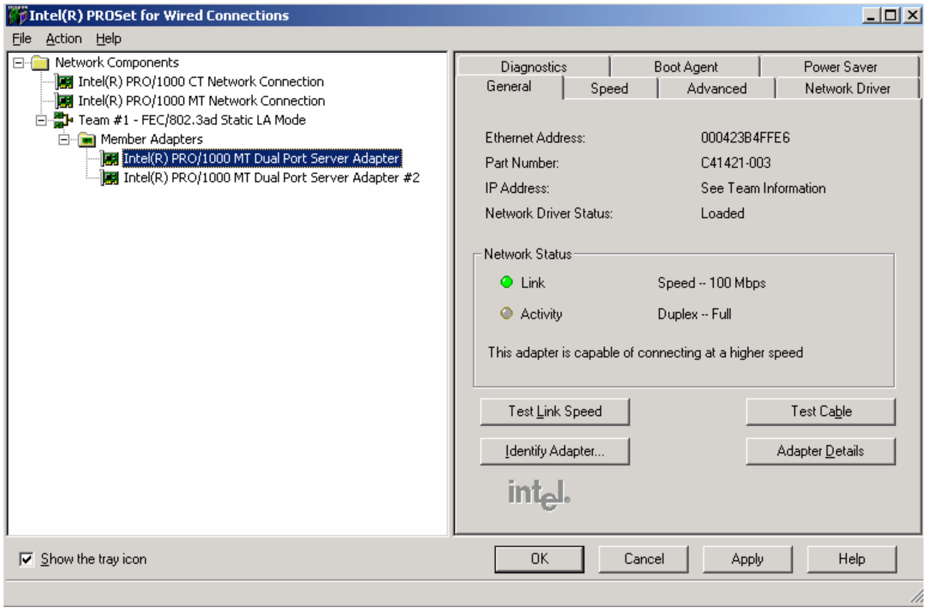
Team Information

Ethernet Address: 000423B4FFE6

IP Address: 10.20.5.150

Team Type: Adaptive Load Balancing

5. Click **OK**. The two adapters are teamed to form an IEEE 802.3ad EtherChannel.


Intel(R) PROSet for Wired Connections
File Action Help
Network Components
Intel(R) PRO/1000 CT Network Connection
Intel(R) PRO/1000 MT Network Connection
Team #1 - FEC/802.3ad Static LA Mode
Member Adapters
Intel(R) PRO/1000 MT Dual Port Server Adapter
Intel(R) PRO/1000 MT Dual Port Server Adapter #2
Diagnostics
Boot Agent
Power Saver
General
Speed
Advanced
Network Driver
Test Link Speed
Test Cable
Identify Adapter...
Adapter Details
intel.
☑ Show the tray icon
OK
Cancel
Apply
Help

Ethernet Address: 000423B4FFE6

Part Number: C41421-003

IP Address: See Team Information

Network Driver Status: Loaded

Network Status

● Link Speed -- 100 Mbps

● Activity Duplex -- Full

This adapter is capable of connecting at a higher speed

The switch configuration to support the PortChannel requires definition of a **channel-group** under the switch port. After a port belongs to a channel group, all configurations for the port (spanning tree, switch-port mode, etc.) are performed under **interface port-channel**, and they cannot be configured under the **interface etha/b** mode.

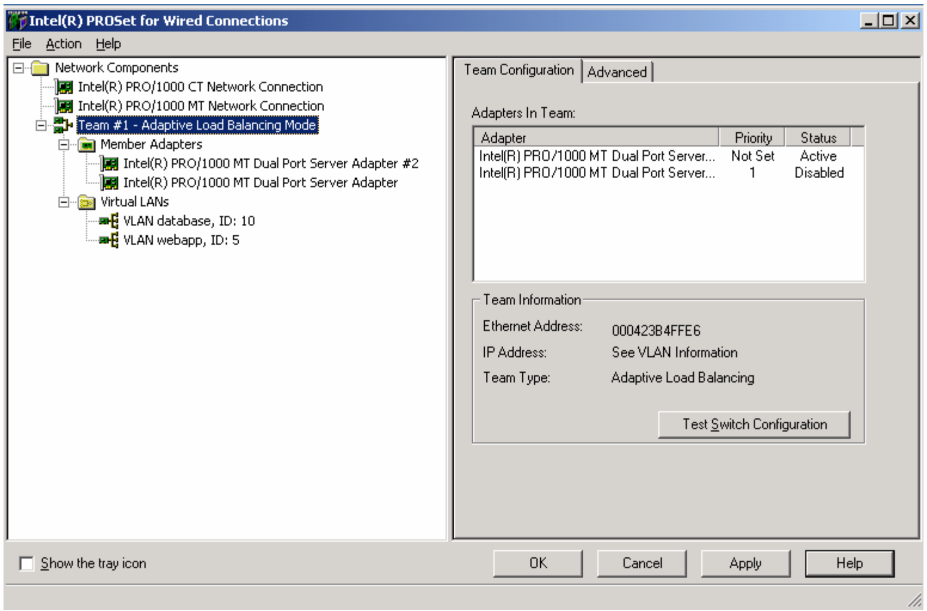
If the PortChannel is spread across two Cisco Nexus 5000 or 7000 Series Switches, the configuration of the PortChannel looks as follows:

```
interface port-channel60
  switchport
  switchport mode access
  switchport access vlan 60
  vpc 60
```

Assigning VLANs

After bonding the adapters, you can partition the teamed adapters with VLANs as shown in Figure 4.

Figure 4. VLAN Assignment


Intel(R) PROSet for Wired Connections
File
Action
Help
Network Components
Intel(R) PRO/1000 CT Network Connection
Intel(R) PRO/1000 MT Network Connection
Team #1 - Adaptive Load Balancing Mode
Member Adapters
Intel(R) PRO/1000 MT Dual Port Server Adapter #2
Intel(R) PRO/1000 MT Dual Port Server Adapter
Virtual LANs
VLAN database, ID: 10
VLAN webapp, ID: 5
Team Configuration
Advanced
Test Switch Configuration
Show the tray icon
OK
Cancel
Apply
Help

Adapters In Team:

Adapter	Priority	Status
Intel(R) PRO/1000 MT Dual Port Server...	Not Set	Active
Intel(R) PRO/1000 MT Dual Port Server...	1	Disabled

Team Information

Ethernet Address: 000423B4FFE6
IP Address: See VLAN Information
Team Type: Adaptive Load Balancing

With this configuration, the upstream switch port needs to be configured as a trunk port, allowing the VLANs that are configured on the teamed adapter.

If more than one VLAN is defined on a given team of adapters, the teaming software creates a new adapter for the newly defined VLAN.

If the PortChannel team is spread across two Cisco Nexus 5000 or 7000 Series Switches, then the configuration of the PortChannel looks as follows:

```
interface port-channel60
  switchport
  switchport mode trunk
  switchport access vlan 60
  switchport trunk allowed vlan 50,60
  vpc 60
  spanning-tree port type edge trunk
```

Tuning Servers with 10 Gigabit Ethernet Adapters

The main steps you need to follow to make sure that the 10 Gigabit Ethernet–connected server is configured properly and takes advantage of the available bandwidth are listed here in order of priority:

- Verify that the adapter is installed in a proper PCI Express (PCIe) bus with a speed greater than or equal to 8X.
- Make sure that the traffic generation and reception is distributed across all the available cores by selecting the appropriate receive-side scaling (RSS) configuration. For example, if you have four cores, then you should configure four RSS queues.
- Make sure that large segment offload and TCP checksum offloading are enabled, and if the option exists, make sure that selective acknowledgement in hardware is enabled.
- Make sure that all options—large segment offload, TCP offload, RSS, TCP scaling, etc.—are enabled in the same way in the operating system (in Microsoft Windows Server 2008, you can check this configuration by using the command **netsh int tcp show global**).

Failure to do follow these steps may result in reduced performance and greater CPU utilization than is needed.

PCIe Connectivity

10 Gigabit Ethernet adapters need to be installed in the correct PCIe slot to avoid an unnecessary bottleneck in the system. The minimum requirement to achieve 10-Gbps throughput in one direction is to install the card in a PCIe 8X slot.

Table 1 presents the bandwidth in each direction with increasing PCIe lanes.

Number of Lanes	Bandwidth Per Direction for PCIe 1.0	Bandwidth Per Direction for PCIe 2.0
1	250 MB/s, 2Gbps	500 MB/s, 4Gbps
2	500 MB/s, 4 Gbps	1GB/s, 8 Gbps
4	1GB/s, 8Gbps	2GBB/s, 16Gbps
8	2GB/s, 16 Gbps	4GB/s, 32 Gbps
12	3GB/s, 24 Gbps	6GB/s, 24 Gbps
16	4GB/s, 32 Gbps	8GB/s, 64 Gbps
32	8GB/s, 64 Gbps	16GB/s, 128 Gbps

Offloads

The network adapters offer a number of features to optimize the performance:

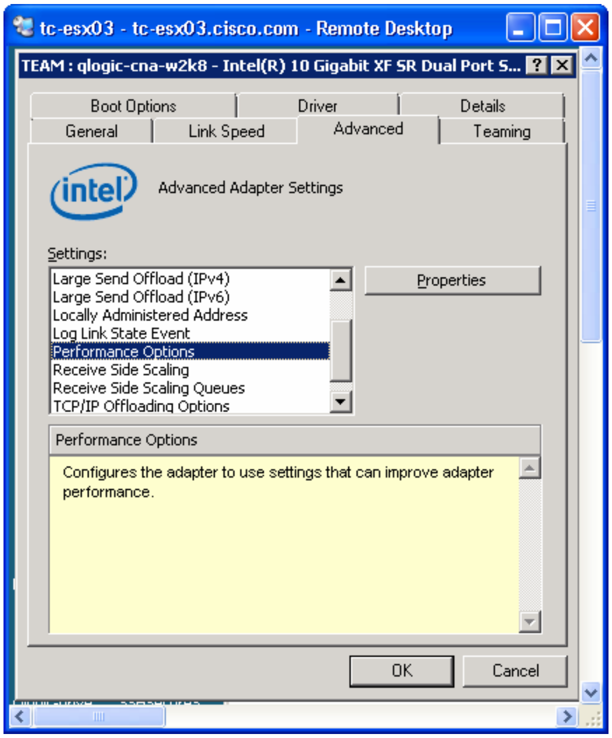
- **TCP checksum offload:** The TCP checksum offload option enables the network adapter to compute the TCP checksum on transmit and receive operations, which saves the CPU from having to compute the checksum. The performance benefits of checksum offload vary by packet size. Small packets have little or no savings with this option, while large packets have larger savings. Savings for a maximum transmission unit (MTU) of 1500 bytes are typically about 5 percent reduction in CPU utilization, and for an MTU of 9000 bytes (jumbo frames), the savings is approximately a 15 percent reduction in CPU utilization.
- **RSS queues (disabled, 2, 4, and 8):** RSS facilitates distribution of traffic to the available cores in the system by separating the traffic into multiple queues (as many as the number of cores with which you want to process network traffic). Microsoft Windows also implements RSS for software-switched traffic. This number should be configured to match the number of cores available.

- **Large send offload:** When this option is enabled, the operating system can pass large message sizes to the network adapter, and the network adapter will slice them up based on the maximum segment size (MSS), which relieves the CPU from the task of TCP segmentation. The TCP large send offload option allows the TCP layer to build a TCP message of up to 64 KB and send it in one call down the stack through IP and the Ethernet device driver.

In a Microsoft Windows system, these options can be activated or deactivated by using the driver configuration. On the **Control Panel**, choose **Network Connections > Local Area Connection**, select your connection, and then choose **Properties > Configure > Advanced**.

Figure 5 shows the options available on a converged network adapter (CNA) based on an Intel chip set for 10 Gigabit Ethernet.

Figure 5. CNA Options for 10 Gigabit Ethernet



tc-esx03 - tc-esx03.cisco.com - Remote Desktop

TEAM : qlogic-cna-w2k8 - Intel(R) 10 Gigabit XF SR Dual Port S...

Advanced Adapter Settings

Settings:

Large Send Offload (IPv4)
Large Send Offload (IPv6)
Locally Administered Address
Log Link State Event
Performance Options
Receive Side Scaling
Receive Side Scaling Queues
TCP/IP Offloading Options

Performance Options

Configures the adapter to use settings that can improve adapter performance.

The use of TCP offload in concert with RSS improves the achievable server performance significantly. For example, assume that you have the following setup:

- **host1:** Four-core server (two dual-core Intel Xeon 5140 processors, 2.33 GHz each, and 4 MB of Layer 2 cache), 8 GB of RAM, running Microsoft Windows Server 2008

  Without RSS, the maximum receive performance that you can get with such a setup ranges is approximately 2.3 Gbps with one of the cores completely utilized and the remaining cores unutilized.

  By using the four cores, you can then expect to achieve close to 9 Gbps worth of traffic, even with no TCP offload capabilities.

OS Tuning

To take advantage of 10 Gigabit Ethernet networking you need to configure the OS properly. Using Microsoft Windows, configuration requires the Microsoft Windows Server Scalable Networking Pack, which relies on a technology that Microsoft Windows refers to as the TCP chimney. If the TCP chimney is not enabled in the OS, and if TCP offload is enabled on the network adapter, then you will not achieve the maximum possible performance.

For more information about TCP chimney and RSS, refer to the following publications:

- **Microsoft Windows Server 2003:** http://support.microsoft.com/kb/912222
- **Microsoft Windows Server 2008:** http://support.microsoft.com/kb/951037

The Microsoft Windows Server Scalable Network Pack controls these parameters (as well as others):

- **TCP Chimney Offload:** This parameter is enabled in the registry editor as **EnableTCPChimney = 1**. If TCP chimney is not enabled, and if the full TCP stack is offloaded in the network adapter card, then TCP traffic has an oscillating behavior. If TCP chimney is enabled and the network adapter card has TCP offload disabled, then TCP traffic is dropped.
- **RSS:** This parameter allows distribution of the traffic to the cores that are present in the system. For example, with four cores, you should configure the driver for four queues, and you should configure **EnableRSS = 1** in the registry editor. If RSS is not enabled, Microsoft Windows by default uses only one core for TCP/IP processing.
- **NetDMA:** This parameter is controlled in the registry by the setting called **EnableTCPA = 1**. This feature allows direct memory access between the adapter and the CPU.

Some of these settings can be configured using the command-line interface (CLI) instead of the registry editor, providing the advantage of not requiring a reboot (the **netsh** CLI shows all the configurations available):

- Microsoft Windows Server 2003: **netsh int ip set chimney ENABLED**
- Microsoft Windows Server 2008: **netsh int tcp set global chimney=enabled**

To verify that TCP chimney and hardware offloads are working, enter the command **netstat –t**. Connections listed as **OFFLOADED** are TCP offloaded by the NIC, and connections listed **INHOST** are handled by the CPU.

Receive Mode Compared to Transmit Mode

Operating systems in general offer less performance in receive mode (traffic received by the server) than in transmit mode (traffic sent by the server), so in typical performance tests with two machines with identical hardware, the sender can easily overwhelm the receiver, causing it to drop frames. To make sure that the sender and receiver do not throttle the performance because of the drops, you should make sure that selective acknowledgement (SACK) is enabled in the adapter and the operating system.

When you are operating with TCP offload disabled, the TCP/IP stack in Microsoft Windows automatically implements SACK.

When you are operating with TCP offload enabled and the TCP/IP stack is implemented in hardware on the network adapter card, you may need to verify that SACK is enabled at the network adapter layer.

Tuning Example

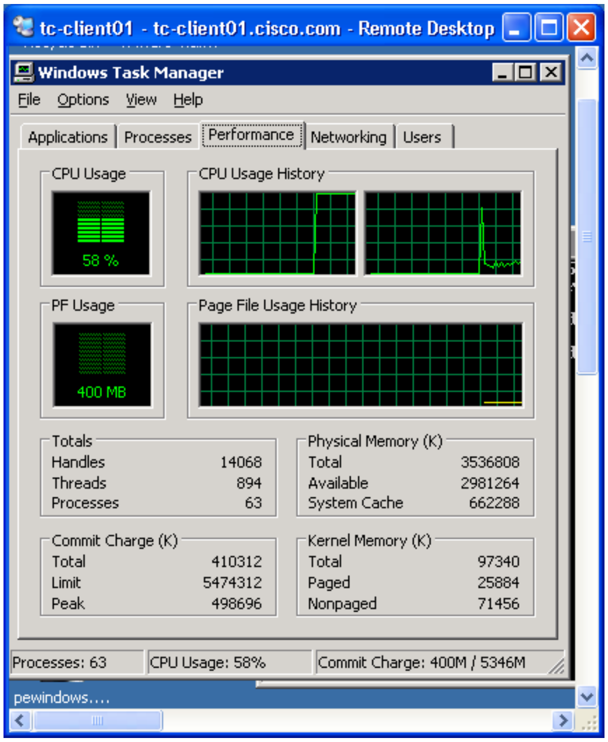
Assume that you have a setup with a sender and receiver as follows:

- **host1:** Four-core machine, 8 GB of RAM, running Microsoft Windows Server 2008
- **host2:** Two-core machine, 4 GB of RAM, running Microsoft Windows Server 2003

You have checked that the network adapters are plugged into an 8X slot, and you have enabled all the parameters on the driver as recommended in this chapter, but you reach a maximum performance of only approximately 4 Gbps.

You check Windows Task Manager on host2 during the test. It shows that one of the two cores is used, but the second core is not (Figure 6).

Figure 6. Windows Task Manager



Totals
Handles 14068
Threads 894
Processes 63

Physical Memory (K)
Total 3536808
Available 2981264
System Cache 662288

Commit Charge (K)
Total 410312
Limit 5474312
Peak 498696

Kernel Memory (K)
Total 97340
Paged 25884
Nonpaged 71456

Processes: 63 | CPU Usage: 58% | Commit Charge: 400M / 5346M

This result seems to indicate that the OS is not operating according to the RSS configuration.

You may want to check the following registry entries (Microsoft Windows Server 2003):

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters
```

Alternatively, enter the following command (Microsoft Windows Server 2008):

```
netsh int tcp show global
```

Figure 7 shows the content of the registry on host2. As expected, neither RSS nor TCP chimney is enabled, which explains why the servers are not able to fully utilize the 10 Gigabit Ethernet adapters.

Conversely, on host1 (which is running Microsoft Windows Server 2008), the **netsh** command shows the following output, indicating that RSS is enabled, but not TCP chimney offload:

```
C:\>netsh int tcp show global
Querying active state...

TCP Global Parameters
----------------------------------------------
Receive-Side Scaling State          : enabled
Chimney Offload State               : disabled
Receive Window Auto-Tuning Level    : normal
Add-On Congestion Control Provider  : ctcp
ECN Capability                      : disabled
RFC 1323 Timestamps                 : disabled
```

In Microsoft Windows Server 2003, you can then enable TCP chimney with this command:

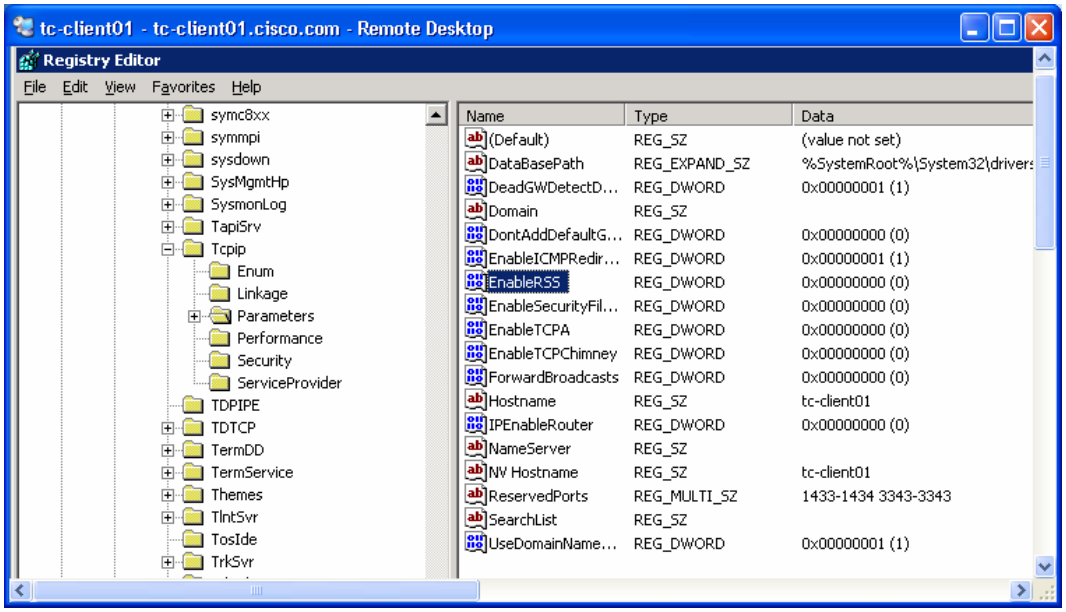
```
netsh int ip set chimney ENABLED
```

You can enable RSS by editing the registry and setting **EnableRSS** to 1.

In Microsoft Windows Server 2008, you can enable TCP chimney and RSS with these commands:

```
netsh int tcp set global chimney=enabled
netsh int tcp set global rss=enabled
```

Figure 7. Registry for host2

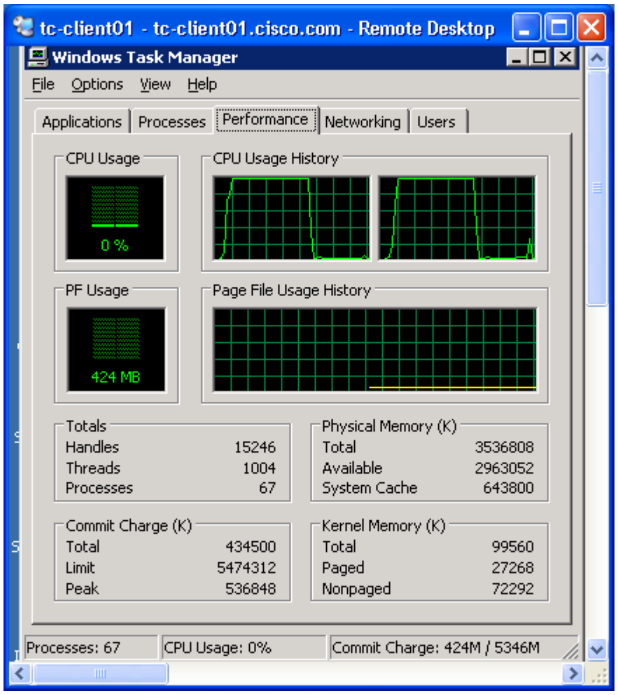


Name	Type	Data
(Default)	REG_SZ	(value not set)
DataBasePath	REG_EXPAND_SZ	%SystemRoot%\System32\drivers
DeadGWDetectD…	REG_DWORD	0x00000001 (1)
Domain	REG_SZ	
DontAddDefaultG…	REG_DWORD	0x00000000 (0)
EnableICMPRedir…	REG_DWORD	0x00000001 (1)
EnableRSS	REG_DWORD	0x00000000 (0)
EnableSecurityFil…	REG_DWORD	0x00000000 (0)
EnableTCPA	REG_DWORD	0x00000000 (0)
EnableTCPChimney	REG_DWORD	0x00000000 (0)
ForwardBroadcasts	REG_DWORD	0x00000000 (0)
Hostname	REG_SZ	tc-client01
IPEnableRouter	REG_DWORD	0x00000000 (0)
NameServer	REG_SZ	
NV Hostname	REG_SZ	tc-client01
ReservedPorts	REG_MULTI_SZ	1433-1434 3343-3343
SearchList	REG_SZ	
UseDomainName…	REG_DWORD	0x00000001 (1)

If the test still shows that only one core is engaged, then the network adapter needs to be configured for RSS.

After proper configuration, when you rerun the tests, you should see both cores now engaged in receive processing (Figure 8).

Figure 8. Windows Task Manager Showing Correct Configuration



Totals
Handles 15246
Threads 1004
Processes 67

Physical Memory (K)
Total 3536808
Available 2963052
System Cache 643800

Commit Charge (K)
Total 434500
Limit 5474312
Peak 536848

Kernel Memory (K)
Total 99560
Paged 27268
Nonpaged 72292

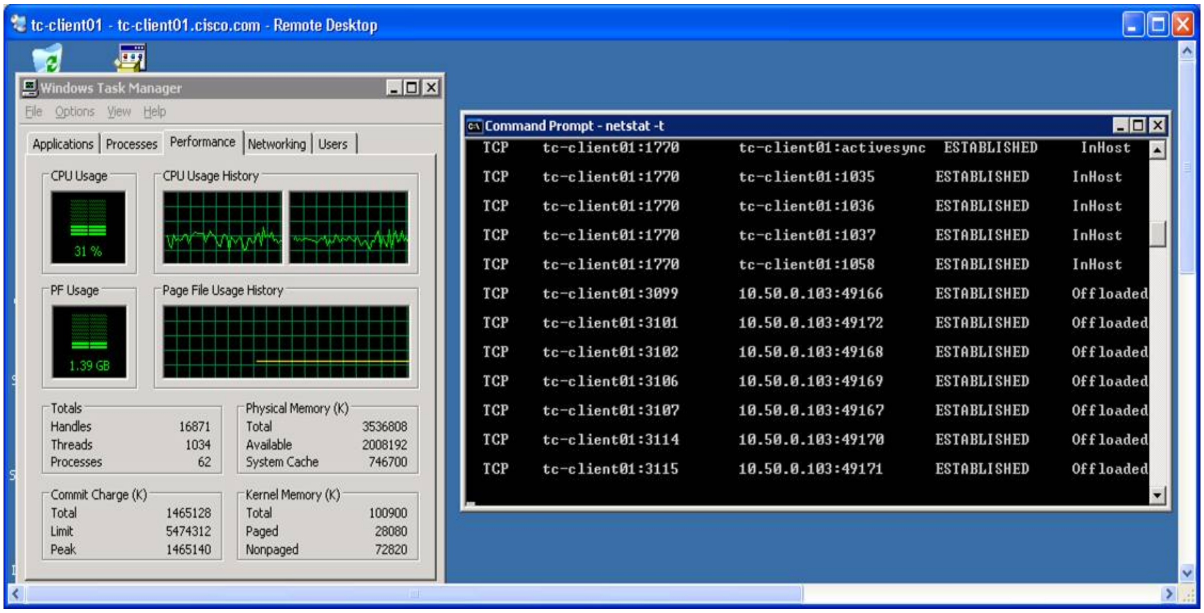
Processes: 67 | CPU Usage: 0% | Commit Charge: 424M / 5346M

To check whether the connections are offloaded, enter this command:

```
netstat –t
```

If the connections display the Offloaded tag, they are effectively being accelerated through the combination of TCP chimney and the network adapter card. Moreover, the CPU use will likely be within a reasonable percentage of that shown in Figure 9.

Figure 9. Windows Task Manager Showing Connection Details


tc-client01 - tc-client01.cisco.com - Remote Desktop
Windows Task Manager
File Options View Help
Applications Processes Performance Networking Users
CPU Usage
CPU Usage History
PF Usage
Page File Usage History
Command Prompt - netstat -t

CPU Usage: 31 %

PF Usage: 1.39 GB

Totals		Physical Memory (K)	
Handles	16871	Total	3536808
Threads	1034	Available	2008192
Processes	62	System Cache	746700

Commit Charge (K)		Kernel Memory (K)	
Total	1465128	Total	100900
Limit	5474312	Paged	28080
Peak	1465140	Nonpaged	72820

```
  TCP    tc-client01:1770       tc-client01:activesync  ESTABLISHED     InHost
  TCP    tc-client01:1770       tc-client01:1035       ESTABLISHED     InHost
  TCP    tc-client01:1770       tc-client01:1036       ESTABLISHED     InHost
  TCP    tc-client01:1770       tc-client01:1037       ESTABLISHED     InHost
  TCP    tc-client01:1770       tc-client01:1058       ESTABLISHED     InHost
  TCP    tc-client01:3099       10.50.0.103:49166      ESTABLISHED     Offloaded
  TCP    tc-client01:3101       10.50.0.103:49172      ESTABLISHED     Offloaded
  TCP    tc-client01:3102       10.50.0.103:49168      ESTABLISHED     Offloaded
  TCP    tc-client01:3106       10.50.0.103:49169      ESTABLISHED     Offloaded
  TCP    tc-client01:3107       10.50.0.103:49167      ESTABLISHED     Offloaded
  TCP    tc-client01:3114       10.50.0.103:49170      ESTABLISHED     Offloaded
  TCP    tc-client01:3115       10.50.0.103:49171      ESTABLISHED     Offloaded
```

If connections are not being offloaded, one of the following problems is likely occurring:

- There may be a mismatch between the NIC firmware and the driver (in which case, a flashing of the network adapter may be required). iSCSI boot configurations also may interfere with the offload capabilities.
- The NIC teaming driver may be interfering with the acceleration features (check the network adapter vendor for more information).
- In some circumstances, RSS may interfere with the offload features.
- For Microsoft Windows, the firewall feature may interfere with the offload features, so you may have to disable the firewall service completely from the Administrator Service GUI.

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