Advanced Network Services Teaming

Advanced Network Services (ANS) Teaming, a feature of the Advanced Network Services component, lets you take advantage of multiple adapters in a system by grouping them together. ANS teaming can use features like fault tolerance and load balancing to increase throughput and reliability.

Supported Adapters

Teaming options are supported on Intel® PRO/100, Intel® Gigabit, and Intel® 10GbE adapters. Selected adapters from other manufacturers are also supported.

> **NOTES:**
>
> - Not all team types are available on all operating systems or with all adapters.
>
> - Be sure to use the latest available drivers on all adapters.
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> - If you are using an Intel® 10GbE Server Adapter and an Intel Gigabit adapter in the same machine, the driver for the Gigabit adapter must be updated with the version on the Intel 10GbE CD or respective download package.
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> - If a team is bound to a Hyper-V virtual NIC, you cannot change the Primary or Secondary adapter.
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> - Intel 10GbE Network Adapters may not be teamed with Intel PRO/100 adapters. Devices based on the Intel® 82597EX controller only support AFT, ALB, and SFT team types.
>
> - Hot Plug operations with non-Intel adapters that are part of a team cause system instability. We recommended that you restart the system or reload the team after performing Hot Plug operations with a team that includes a non-Intel adapter.
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> - Some advanced features, including hardware offloading, are automatically disabled when non-Intel adapters are team members to assure a common feature set.
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> - TOE (TCP Offload Engine) enabled devices can not be added to an ANS team and will not appear in the list of available adapters.
>
> - Spanning tree protocol (STP) should be disabled on switch ports connected to teamed adapters in order to prevent data loss when the primary adapter is returned to service (failback). Alternatively, an activation delay may be configured on the adapters to prevent data loss when spanning tree is used. Set the Activation Delay on the advanced tab of team properties.
>
> - Fibre Channel over Ethernet/Data Center Bridging will be automatically disabled when and adapter is added to a team.

ANS Teaming Types

- Adapter Fault Tolerance (AFT) - provides automatic redundancy for a server's network connection. If the primary adapter fails, the secondary adapter takes over. Adapter Fault Tolerance supports two to eight adapters per team. This teaming type works with any hub or switch. All team members must be connected to the same subnet.

- Switch Fault Tolerance (SFT) - provides failover between two adapters connected to separate switches. Switch Fault Tolerance supports two adapters per team. Spanning Tree Protocol (STP) must be enabled on the switch when you create a SFT team. When SFT teams are

created, the Activation Delay is automatically set to 60 seconds. This teaming type works with any switch or hub. All team members must be connected to the same subnet.

- Adaptive Load Balancing (ALB) - provides load balancing of transmit traffic and adapter fault tolerance. In Microsoft* Windows* operating systems, you can also enable or disable receive load balancing (RLB) in ALB teams (by default, RLB is enabled).

- Virtual Machine Load Balancing (VMLB) - provides transmit and receive traffic load balancing across Virtual Machines bound to the team interface, as well as fault tolerance in the event of switch port, cable, or adapter failure.This teaming type works with any switch.

- Static Link Aggregation (SLA) - provides increased transmission and reception throughput in a team of two to eight adapters. This team type replaces the following team types from prior software releases: Fast EtherChannel*/Link Aggregation (FEC) and Gigabit EtherChannel*/Link Aggregation (GEC). This type also includes adapter fault tolerance and load balancing (only routed protocols). This teaming type requires a switch with Intel Link Aggregation, Cisco* FEC or GEC, or IEEE 802.3ad Static Link Aggregation capability.

  All adapters in a Link Aggregation team running in static mode must run at the same speed and must be connected to a Static Link Aggregation capable switch. If the speed capability of adapters in a Static Link Aggregation team are different, the speed of the team is dependent on the lowest common denominator.

- IEEE 802.3ad Dynamic Link Aggregation - creates one or more teams using Dynamic Link Aggregation with mixed-speed adapters. Like the Static Link Aggregation teams, Dynamic 802.3ad teams increase transmission and reception throughput and provide fault tolerance. This teaming type requires a switch that fully supports the IEEE 802.3ad standard.

- Multi-Vendor Teaming (MVT) - adds the capability to include adapters from selected other vendors in a team. If you are using a Windows-based computer, you can team adapters that appear in the Intel PROSet teaming wizard.

⚠ **IMPORTANT**:

- Be sure to use the latest available drivers on all adapters.

- Before creating a team, adding or removing team members, or changing advanced settings of a team member, make sure each team member has been configured similarly. Settings to check include VLANs and QoS Packet Tagging, Jumbo Frames, and the various offloads. These settings are available in Intel PROSet's **Advanced** tab. *Pay particular attention when using different adapter models or adapter versions, as adapter capabilities vary.*

- If team members implement Advanced features differently, failover and team functionality will be affected. To avoid team implementation issues:

  - Create teams that use similar adapter types and models.

  - Reload the team after adding an adapter or changing any Advanced features. One way to reload the team is to select a new preferred primary adapter. Although there will be a temporary loss of network connectivity as the team reconfigures, the team will maintain its network addressing schema.

📝 *NOTES*:

- Hot Plug operations for an adapter that is part of a team are only available in Windows Server 2003, Windows Server 2008, and Windows Server 2008 R2.

- The FEC (Fast EtherChannel) and GEC (Gigabit EtherChannel) team types have been

renamed to Static Link Aggregation.

- For SLA teams, all team members must be connected to the same switch. For AFT, ALB, and RLB teams, all team members must belong to the same subnet. The members of an SFT team must be connected to a different switch.

- Teaming only one adapter port is possible, but provides no benefit.

Primary and Secondary Adapters

If the primary adapter fails, another adapter will take over its duties. If you are using more than two adapters, and you want a specific adapter to take over if the primary fails, you must specify a secondary adapter.

There are two types of primary and secondary adapters:

- **Default primary adapter:** If you do not specify a preferred primary adapter, the software will choose an adapter of the highest capability (model and speed) to act as the default primary. If a failover occurs, another adapter becomes the primary. The adapter will, however, rejoin the team as a non-primary.

- **Preferred Primary/Secondary adapters:** You can specify a preferred adapter in Intel PROSet. Under normal conditions, the Primary adapter handles all non-TCP/IP traffic. The Secondary adapter will receive fallback traffic if the primary fails. If the Preferred Primary adapter fails, but is later restored to an active status, control is automatically switched back to the Preferred Primary adapter.

To specify a preferred primary or secondary adapter

1. From Device Manager, open the properties of a team.

2. Click the **Settings** tab.

3. Click the **Modify Team** button.

4. Select the adapter you want to be the primary adapter and click the **Set Primary** button.

The adapter's preferred setting appears in the Priority column.

Failover and Failback

When a link fails, either because of port or cable failure, team types that provide fault tolerance will continue to send and receive traffic. Failover is the initial transfer of traffic from the failed link to a good link. Failback occurs when the original adapter regains link. You can use the Activation Delay setting (located on the Advanced tab of the team's properties in Device Manager) to specify a how long the failover adapter waits before becoming active. If you don't want your team to failback when the original adapter gets link back, you can set the Allow Failback setting to disabled (located on the Advanced tab of the team's properties in Device Manager).

Adapter Fault Tolerance

Adapter Fault Tolerance (AFT) provides the safety of an additional backup link between the server and switch. In the case of switch port, cable, or adapter failure, network connectivity is maintained.

Adapter Fault Tolerance is implemented with a primary adapter and one or more backup, or secondary adapters. During normal operation, the backup adapters are in standby. If the link to the primary adapter fails, the link to the secondary adapter automatically takes over. For more information, see Primary and Secondary Adapters.

To use Adapter Fault Tolerance all adapters must be connected to the same subnet.

Switch Fault Tolerance

Switch Fault Tolerance (SFT) teaming allows you to connect each of two teamed adapters to a separate switch.

Switch Fault Tolerance can detect failures when they occur:

- on either teamed adapter

- on either cable connecting the teamed adapter to its switch

- on switch ports connected to the adapters, if link is lost

In SFT teams, one adapter is the primary adapter and one adapter is the secondary adapter. During normal operation, the secondary adapter is in standby. In standby, the adapter is inactive and waiting for failover to occur. It does not transmit or receive other network traffic. If the primary adapter loses connectivity, the secondary adapter automatically takes over.

In SFT teams, each adapter in the team can operate at a different speed than the other.

Adaptive Load Balancing

Adaptive Load Balancing (ALB) uses software to balance routable traffic among a team of two to eight adapters or LOMs (the team must include at least one server adapter) connected to the same subnet. The software analyzes the send and transmit loading on each adapter and balances the rate across the adapters based on destination address. Adapter teams configured for ALB also provide the benefits of fault tolerance.

NOTES:

- ALB does not load balance non-routed protocols such as NetBEUI and some IPX* traffic.

- You can create an ALB team with mixed speed adapters. The load is balanced according to the lowest common denominator of adapter capabilities and the bandwidth of the channel.

- On Windows systems, Receive Load Balancing is enabled by default.

- Receive Load Balancing is not supported on Microsoft Hyper-V*.

Virtual Machine Load Balancing

Virtual Machine Load Balancing (VMLB) provides transmit and receive traffic load balancing across Virtual Machines bound to the team interface, as well as fault tolerance in the event of switch port, cable, or adapter failure.

The driver analyzes the transmit and receive load on each member adapter and balances the traffic across member adapters. In a VMLB team, each Virtual Machine is associated with one team member for its TX and RX traffic.

If only one virtual NIC is bound to the team, or if Hyper-V is removed, then the VMLB team will act like an AFT team.

NOTES:

- VMLB does not load balance non-routed protocols such as NetBEUI and some IPX* traffic.

- VMLB supports from two to eight adapter ports per team.

- You can create an VMLB team with mixed speed adapters. The load is balanced

according to the lowest common denominator of adapter capabilities and the bandwidth of the channel.

Static Link Aggregation

Static Link Aggregation (SLA) is a performance technology developed by Cisco to increase throughput between switches. This team type works with:

- Cisco EtherChannel-capable switches with channeling mode set to 'ON'

- Intel switches capable of Link Aggregation

- Other switches capable of static 802.3ad

The transmission speed will never exceed the adapter base speed to any single address (per specification). Teams can contain two to eight adapters, but must match the capability of the switch. Adapter teams configured for Static Link Aggregation also provide the benefits of fault tolerance and load balancing.

NOTES:

- The FEC (Fast EtherChannel) and GEC (Gigabit EtherChannel) team types have been renamed to Static Link Aggregation.

IEEE 802.3ad Dynamic Link Aggregation

802.3ad is an adopted IEEE standard. Teams can contain two to eight adapters, and you can have a maximum of two IEEE 802.3ad dynamic teams per server. You must use 802.3ad switches (in dynamic mode, aggregation can go across switches). Adapter teams configured for IEEE 802.3ad also provide the benefits of fault tolerance and load balancing. Under 802.3ad, all protocols can be load balanced.

Dynamic mode supports multiple aggregators. Aggregators are formed by port speed connected to a switch. For example, a team can contain adapters running at 1 Gbps and 10 Gbps, but two aggregators will be formed, one for each speed. Also, if a team contains 1 Gbps ports connected to one switch, and a combination of 1Gbps and 10Gbps ports connected to a second switch, three aggregators would be formed. One containing all the ports connected to the first switch, one containing the 1Gbps ports connected to the second switch, and the third containing the 10Gbps ports connected to the second switch.

NOTES:

- Once you choose an aggregator, it remains in force until all adapters in that aggregator lose link.

- In some switches, copper and fiber adapters cannot belong to the same aggregator in an IEEE 802.3ad configuration. If there are copper and fiber adapters installed in a system, the switch might configure the copper adapters in one aggregator and the fiber-based adapters in another. If you experience this behavior, for best performance you should use either copper *or* fiber-based adapters in a system.

- If multiple switches are used, all team members connected to the same switch must operate at the same speed.

Before you begin

- Verify that the switch fully supports the IEEE 802.3ad standard.

- Check your switch documentation for port dependencies. Some switches require pairing to start

on a primary port.

- Check your speed and duplex settings to ensure the adapter and switch are running at full duplex, either forced or set to auto-negotiate. Both the adapter and the switch must have the same speed and duplex configuration. The full duplex requirement is part of the IEEE 802.3ad specification: http://standards.ieee.org/.
  If needed, change your speed or duplex setting *before* you link the adapter to the switch. Although you can change speed and duplex settings after the team is created, Intel recommends you disconnect the cables until settings are in effect. In some cases, switches or servers might not appropriately recognize modified speed or duplex settings if settings are changed when there is an active link to the network.

- If you are configuring a VLAN, check your switch documentation for VLAN compatibility notes. Not all switches support simultaneous dynamic 802.3ad teams and VLANs. If you choose to set up VLANs, configure teaming and VLAN settings on the adapter *before* you link the adapter to the switch. Setting up VLANs after the switch has created an active aggregator affects VLAN functionality.

Multi-Vendor Teaming

MVT allows teaming with a combination of Intel and non-Intel adapters. This feature is currently available under Windows Server 2003, Windows Server 2008, and Windows Server 2008 R2).

If you are using a Windows-based computer, adapters that appear in the Intel PROSet teaming wizard can be included in a team.

MVT Design Considerations

- In order to activate MVT, you must have at least one Intel adapter or integrated connection in the team, which must be designated as the primary adapter.

- A multi-vendor team can be created for any team type.

- All members in a MVT must operate on a common feature set (lowest common denominator).

- For MVT teams, manually verify that the frame setting for the non-Intel adapter is the same as the frame settings for the Intel adapters.

- If a non-Intel adapter is added to a team, its RSS settings must match the Intel adapters in the team.

Setting Up Adapter Teaming in Microsoft* Windows*

Before you can set up ANS teaming in Microsoft Windows, you must install Intel® PROSet software. For more information, select Intel PROSet in the Table of Contents (left pane) of this window.

NOTES:

- ANS Teaming is compatible with Microsoft Network Load Balancing (NLB/WLBS) running on Microsoft Windows Server* 2003, Microsoft Windows Server 2008, and Microsoft Windows Server 2008 R2, when in multicast mode only. To use Microsoft Network Load Balancing in an Adaptive Load Balancing (ALB) team type, Receive load balance must be disabled.

- If Intel® Active Management Technology is enabled on an adapter, you will not be able to add it to a team. When you create or modify a team, the adapter will not be displayed in the list of available adapters. The adapter will not have a Teaming tab on its Device Manager property sheet.

- Teaming only one adapter port is possible, but provides no benefit.

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