

IOMEGA® STORCENTER™ ix12-300r ADVANCED NETWORK CONFIGURATION GUIDE

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INTRODUCTION

The Iomega® StorCenter™ ix12-300r network storage array offers versatile storage provisioning, advanced protocol capabilities, expandability, and affordability in an easy-to-use product ideal for small businesses, workgroups, and departments. Based on enterprise-class EMC® storage technology, the StorCenter ix12-300r provides quad gigabit Ethernet connections, direct or network attach, easy file sharing, iSCSI block access, multiple RAID configurations for optimized data protection, and storage pools for application flexibility and expandability to match your budget. Business users will appreciate the robust data protection features, such as UPS support; print serving; folder quotas; rsync device-to-device replication; and user replaceable hot swap fans, power supplies, and drives for business continuity and disaster recovery. The easy-to-use interface, Active Directory support, and remote access provide no-hassle management. The StorCenter ix12-300r supports PC, Mac®, Linux®, and UNIX clients and is VMware® certified for NFS and iSCSI and Microsoft Windows Server 2008 R2 (Hyper-V) certified for iSCSI.

A Virtual LAN (VLAN) is a group of hosts with a common set of requirements that communicate as if they were attached to the same broadcast domain regardless of their physical location. A VLAN has the same attributes as a physical LAN, but does not require the hosts to be located on the same network switch. Like routers in LAN configurations, VLANs are created to provide segmentation services to address issues such as scalability, security, and network management.

NIC bonding (also known as NIC teaming, link aggregation, trunking, among others) is a computer networking technology that uses multiple network cables and ports in parallel to increase the link speed beyond the limits of any one single cable or port, and to increase the network redundancy for higher availability.

Standard Ethernet frames contain 1500 bytes of payload, or Maximum Transmission Unit (MTU). Jumbo Frames can normally carry up to 9000 bytes of MTU, although variations exist. By increasing the frame size, the same amount of data can be transferred in fewer frames, therefore reducing hardware and software processing overhead and improving network efficiency.

This white paper discusses the advanced network capabilities available on the StorCenter ix12-300r, including VLAN, NIC bonding, and Jumbo Frame, and how to configure them to fully take advantage of these enterprise-class technologies. The paper includes detailed instructions and procedures to help users plan and configure the StorCenter ix12-300r network settings and the corresponding network infrastructure.



TERMINOLOGY

LAN: Local Area Network.

NIC: Network Interface Card (a.k.a. Network Adapter)

Virtual NIC: Virtual network interface card. In this paper, it refers to a VLAN or bonded NIC device.

NAS: Network Attached Storage. The name given to dedicated data storage technology that can be connected directly to a computer network to provide centralized data access and storage to heterogeneous network clients.

NIC bonding: a computer networking technology that uses multiple network ports/cables in parallel to increase the link speed beyond the limits of any one single port/cable and to increase the redundancy for higher availability. Other similar terms include NIC teaming, link aggregation, Ethernet trunking, etc.

VLAN: Virtual LAN. A Virtual LAN (VLAN) is a group of hosts with a common set of requirements that communicate as if they were attached to the same broadcast domain, regardless of their physical location. A VLAN has the same attributes as a physical LAN, but does not require the hosts to be located on the same network switch.

MTU: Maximum Transmission Unit, sometimes also referred to as payload. This is the size of the largest protocol data unit that a computer networking layer can transmit.

Jumbo Frame: an Ethernet frame that carries more than the standard 1518 bytes of MTU.

IEEE 802.3ad: a NIC bonding protocol referred to by its IEEE workgroup name.

IEEE 802.1Q: also known as VLAN Tagging, is a networking standard written by the IEEE 802.1 workgroup to allow multiple bridged networks to transparently share the same physical network link without leakage of information between networks.

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VLAN CONFIGURATION

VLAN is essentially a Layer 2 (Data Link Layer) construct, while an IP subnet is a Layer 3 (Network Layer) construct. In an environment employing VLAN, a many-to-many relationship can exist between VLANs and IP subnets. It is possible to have multiple subnets on one VLAN or have one subnet spread across multiple VLANs.

The protocol most commonly used today in VLAN configuration is IEEE 802.1Q. Other proprietary protocols exist, such as Cisco's Inter-Switch Link (ISL) and 3Com's Virtual LAN Trunk (VLT). To use VLAN on a network interface, the network switch port that the interface is physically connected to must be tagged accordingly. This normally requires the service of a network administrator.

The StorCenter ix12-300r implements IEEE 802.1Q, or VLAN Tagging, to provide the best interoperability. Each of the four physical interfaces can have up to four VLANs tagged in addition to its existing network configuration. Therefore, each network interface can have a maximum of five IP addresses associated with it. There are many benefits of using VLAN in a business environment, these benefits include:

- ▶ **Increased performance:** Grouping users performing similar functions or within individual workgroups into logical networks will help reduce network collision over the switched network and also limit the broadcast traffic. Moreover, the latency added by routers will be reduced since less traffic will need to be routed between the logical networks.
- ▶ **Improved manageability:** VLAN removes dependency on the physical network and topology by creating a logical network to connect physically diverse workgroups within a single broadcast domain. It's easy, flexible, and less costly to modify a logical network in changing environments. Large networks can be managed centrally regardless of physical locations of devices.
- ▶ **Network tuning and simplification of configurations:** Administrators can fine-tune the network infrastructure at a more granular level without disrupting other logical networks. When network issues arise, administrators can quickly isolate the problematic network to identify the root cause. Additionally, software configurations can be standardized and deployed easily across computers and users within the same network.
- ▶ **Enhanced security:** Segmenting users into separate VLANs helps restrict user access to sensitive information at the network layer, providing an extra layer of data security. Traffic between VLANs can be easily controlled using router features such as access lists.

NIC BONDING CONFIGURATION

NIC bonding addresses two problems with Ethernet connections: bandwidth limitations and lack of redundancy. Ethernet bandwidth requirements do not scale linearly; they have historically increased by an order of magnitude each generation (10/100/1000/10000 Mbit/sec Ethernets). When the network bandwidth ceiling is reached, upgrading to the next generation is very expensive. The alternative solution is to combine two or more physical Ethernet links into one logical link for an aggregated bandwidth. In a typical port-cable-port connection, there are three single points of failure whether the connection is between computer and switch or between switches. NIC bonding provides a solution to this problem by eliminating the single points of failure. Failover can happen automatically in the event of a port or cable failure.



NIC bonding can be configured in different modes. Some typical modes include:

- ▶ **NIC failover:** this mode provides adapter fault tolerance through automatic failovers from an active NIC to a standby NIC in the case of switch port, cable, or NIC failure. No switch configuration is required for this mode. It works with any switch or hub.
- ▶ **Adaptive transmit load balancing (TLB):** this mode provides transmit traffic load balancing and fault tolerance in the event of switch port, cable, or NIC failure. Transmit load is balanced across member NICs, but normally only one NIC accepts all receive load. No switch configuration is required for this mode. It works with any switch or hub.
- ▶ **Adaptive load balancing (ALB):** this mode provides both transmit and receive traffic load balancing and fault tolerance. Both transmit and receive loads are balanced across member NICs. No switch configuration is required for this mode. It works with any switch or hub.
- ▶ **Static link aggregation (SLA):** this mode bundles or channels NIC ports together and shows them as a single link. This increases the total bandwidth for the link and provides fault tolerance in the event of a switch port, cable, or NIC failure. All member NICs must be linked to the same switch, and the switch must be configured for SLA before the bond is created. It works with Cisco switches that have channeling mode set to ON, Intel switches capable of link aggregation, and other switches capable of static IEEE 802.3ad.
- ▶ **IEEE 802.3ad dynamic link aggregation:** this mode dynamically bundles or channels NIC ports together and shows them as a single link using the Link Aggregation Control Protocol (LACP). It increases the total bandwidth for the link and provides fault tolerance in the event of switch port, cable, or NIC failure. This mode requires that the switch fully supports the 802.3ad standard and be configured before the bond is created.
- ▶ **Switch failover:** this mode provides fault tolerance across switches. A NIC connected to one switch will automatically failover to a standby NIC connected to a different switch in the event of a switch, switch port, cable, or NIC failure. No switch configuration is required. It works with any switch, but not on hubs.

The StorCenter ix12-300r supports three modes: NIC failover, adaptive load balancing (ALB), and IEEE 802.3ad link aggregation. To use the 802.3ad mode, the switch(es) that the ix12-300d device is connected to must also support 802.3ad protocol. Configuration of a switch normally requires the service of a network administrator. The other two modes do not require any switch-level configuration and are therefore much simpler to implement.

JUMBO FRAME CONFIGURATION

A standard Ethernet frame size is 1518 bytes, containing 1500 bytes of payload (MTU). Each frame requires that the network hardware and software process it. So if the frame size is increased, the same amount of data can be transferred with fewer frames, thus reducing CPU utilization and increasing network throughput due to reduction of network overhead. An Ethernet frame with more than 1500 bytes of payload is called a Jumbo Frame. Conventionally Jumbo Frames can carry up to 9000 bytes of payload.

Most Gigabit Ethernet switches and Gigabit NICs support Jumbo Frames, but all Fast Ethernet switches and Fast Ethernet NICs do not support Jumbo Frames. Normally IP networks require that all hosts in a subnet have an identical MTU. Therefore, when using Jumbo Frames, the best practice is to enable Jumbo Frames on all network interfaces connected to the same subnet. To reduce interoperability issues, NICs capable of Jumbo Frames require explicit configuration to enable Jumbo Frame.

The StorCenter ix12-300r supports Jumbo Frames of sizes 4000 and 9000 bytes. Jumbo Frame can be configured on individual interfaces and bonded interfaces.

OTHER I/O HIGH AVAILABILITY OPTIONS

All services on the StorCenter ix12-300r can take advantage of the advanced network capabilities described in this paper to improve performance, security, and high availability. Additionally, the iSCSI service can leverage the Multipath I/O (MPIO) solution at the application layer to achieve enhanced high availability and improved I/O performance.

The StorCenter ix12-300r network storage array is a certified iSCSI hardware-based RAID storage array with MPIO support for Windows Server 2003, Windows Server 2008, and Windows Server 2008 R2. Additionally, the StorCenter ix12-300r server is certified iSCSI storage with MPIO support for the VMware vSphere 4 virtualization platform.

To improve performance and data availability at the data path level, a hardware-based network solution or a software-based MPIO solution or a combination of both can be deployed. The network solution requires that both the storage device and server have at least two NICs that can be bonded together. The MPIO solution provides redundant logic data paths – iSCSI sessions – from an iSCSI initiator to an iSCSI target. For details about how to use MPIO with a Windows server or an ESX 4.0 server, refer to white papers *Using Microsoft MPIO with Iomega StorCenter for iSCSI High Availability* and *Using Iomega StorCenter ix4-200d NAS Server with VMware vSphere 4*, respectively.

CONFIGURATION PROCEDURE

As illustrated collectively in the procedures below, when using all these advanced network capabilities together the following limitations apply on the StorCenter ix12-300r:

- ▶ VLAN can be configured on individual physical NICs, but cannot be configured on bonded NICs. Each NIC can have up to four VLANs.
- ▶ NIC bonding can add individual physical NICs that do not have VLAN configured and do not participate in another bond.
- ▶ Jumbo Frame can be used on individual physical NICs and bonded NICs but cannot be used on VLAN virtual NICs.

To configure the advanced network settings:

1. Go to **Settings > Network Services > Network Settings**.

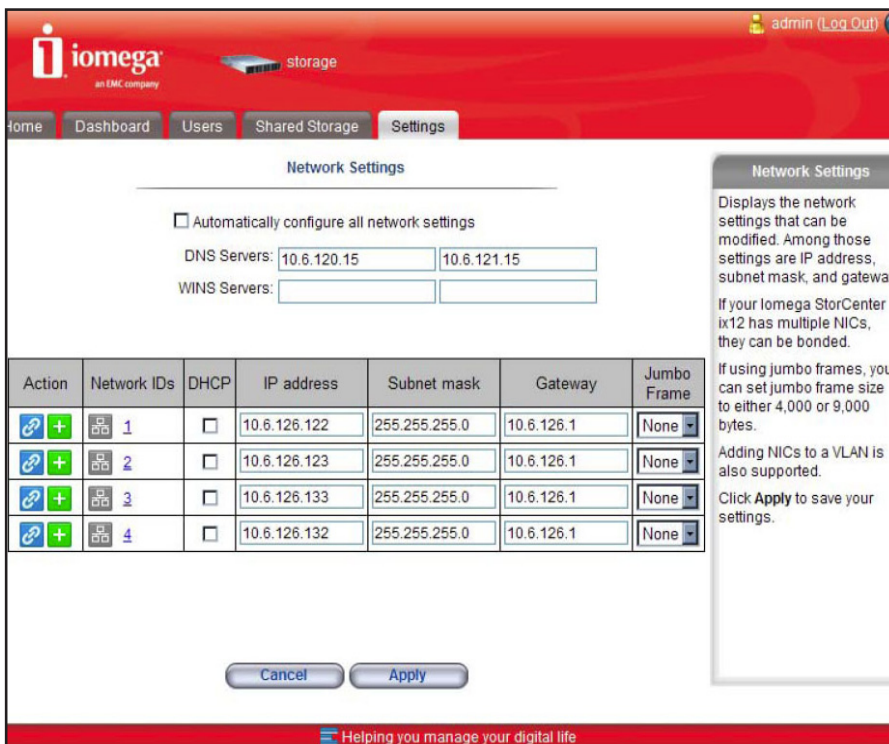


Figure 1 Network settings

- Click the **+** button next to an interface to add a VLAN for the interface and enter the network settings for the VLAN. The existing network configuration of the interface does not need to be removed.

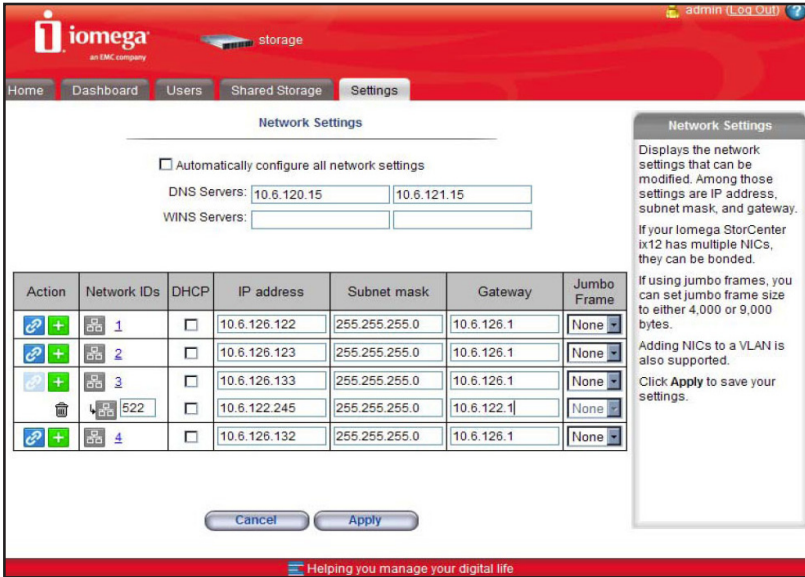


Figure 2 Add a VLAN

- Repeat step 2 to add more VLANs to the interface. The corresponding switch port must be tagged accordingly with the VLAN IDs. After this step, the NIC has five different working IP addresses assigned to it.

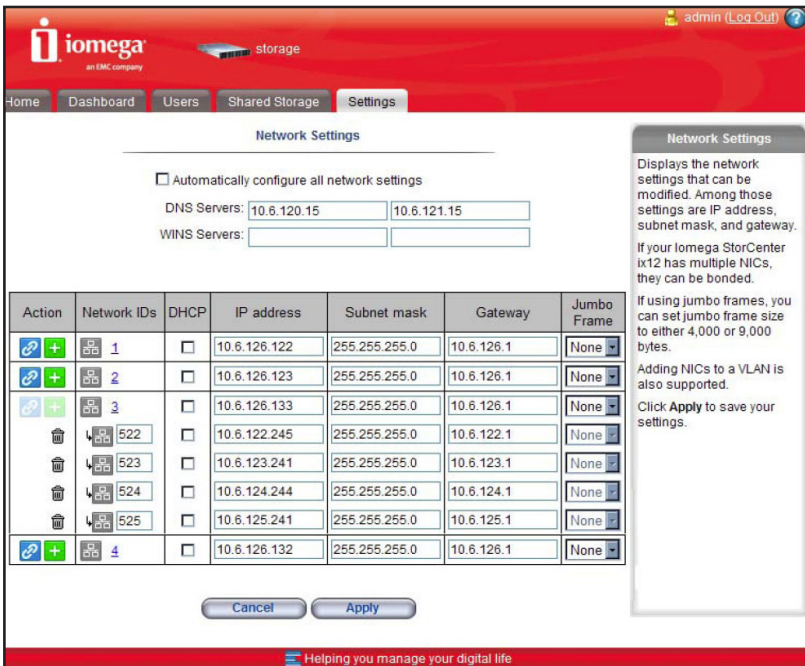



Figure 3 Create up to four VLANs per interface.



- Click the  button next to an interface to create a bonded device. In this example, interface 4 is used as the primary device, and interface 2 is added to the bond.

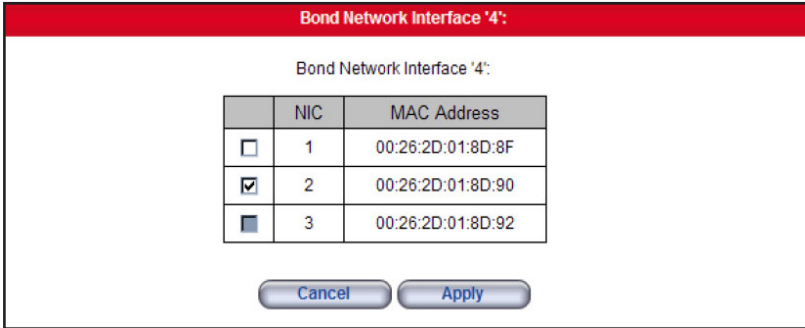


Figure 4 Create a bonded network interface

- Click **Apply** to create the bonded device.

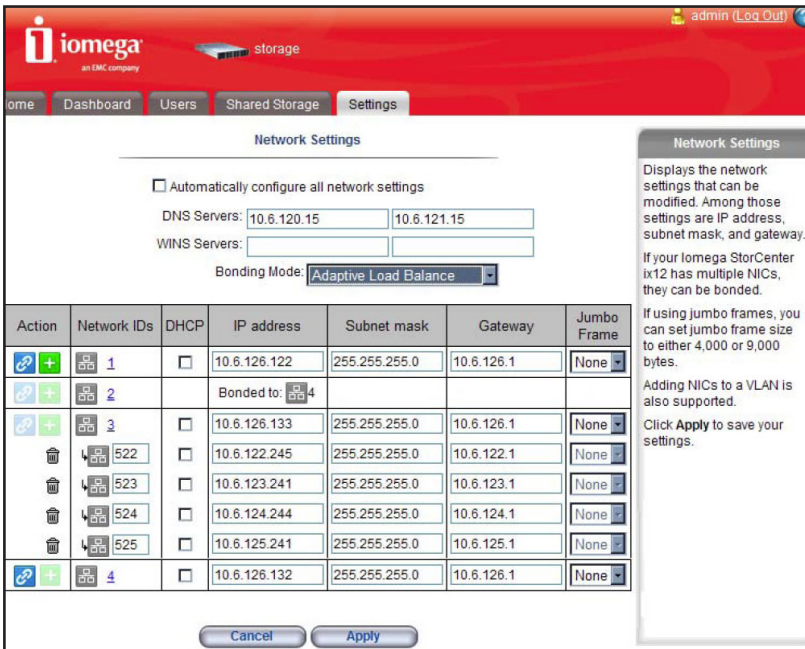


Figure 5 Bonded network interface

- Click the **Bonding Mode** dropdown menu to select the mode to be used. This is a global setting, and all the bonded devices on the StorCenter ix12-300r will use the same mode.

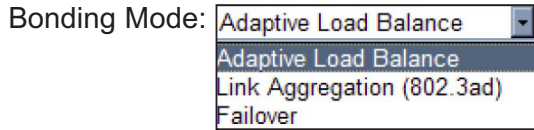


Figure 6 Choose bonding mode

- Click the **Jumbo Frame** dropdown menu next to the interface that needs to use Jumbo Frames to set a frame size.

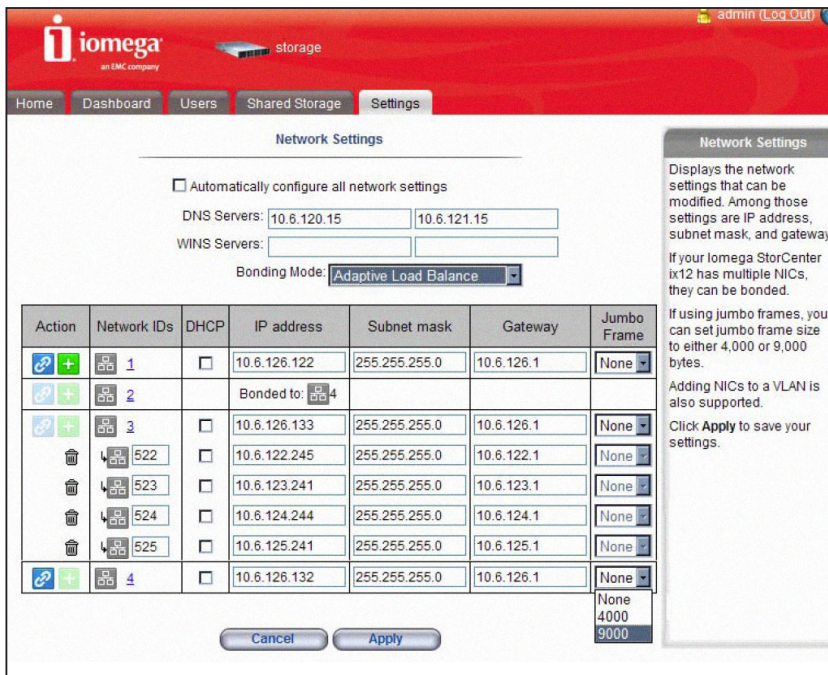


Figure 7 Set Jumbo Frame

- Click **Apply** to finish the configurations. The StorCenter ix12-300r device will need to be restarted for the configurations to take effect.

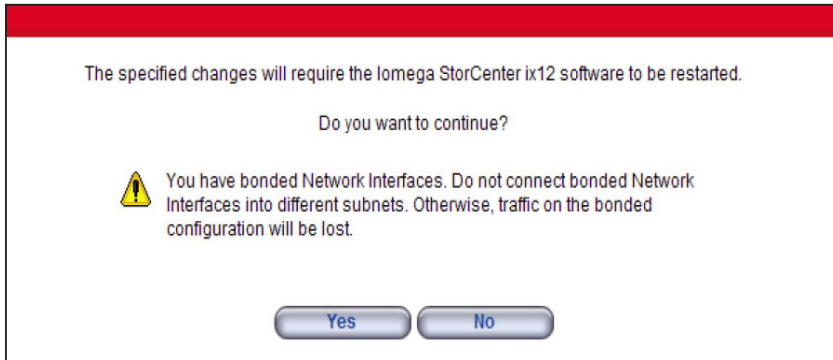


Figure 8 Restart the device to make configurations effective

CONCLUSION

The Iomega StorCenter ix12-300r network storage array is a high-performance, easy-to-use, and highly reliable storage device, specifically designed to meet the storage challenges that small- and medium-sized businesses face daily. The device has four Gigabit Ethernet ports that can be bonded together to provide hardware level network load balancing and fault tolerance. Additionally, the StorCenter ix12-300r supports standard IEEE 802.1Q VLAN tagging to help increase network performance, improve manageability, and enhance network security. The StorCenter ix12-300r also supports Jumbo Frames for better application performance. All these advanced network capabilities enable the StorCenter ix12-300r to be a great solution for demanding business environments.



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