# iSCSI, NAS and IP Storage Configuration for VMware ESX Server

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VMWORLD 2006

# Overview

- What is iSCSI?
- What is NAS?
- Why are iSCSI and NAS interesting?
- How VMware is doing iSCSI
  - Implementation
  - Features
- How VMware is doing NAS
  - NFS Implementation
- IP Storage Network Configuration
  - Network Setup
  - Multi-path Options

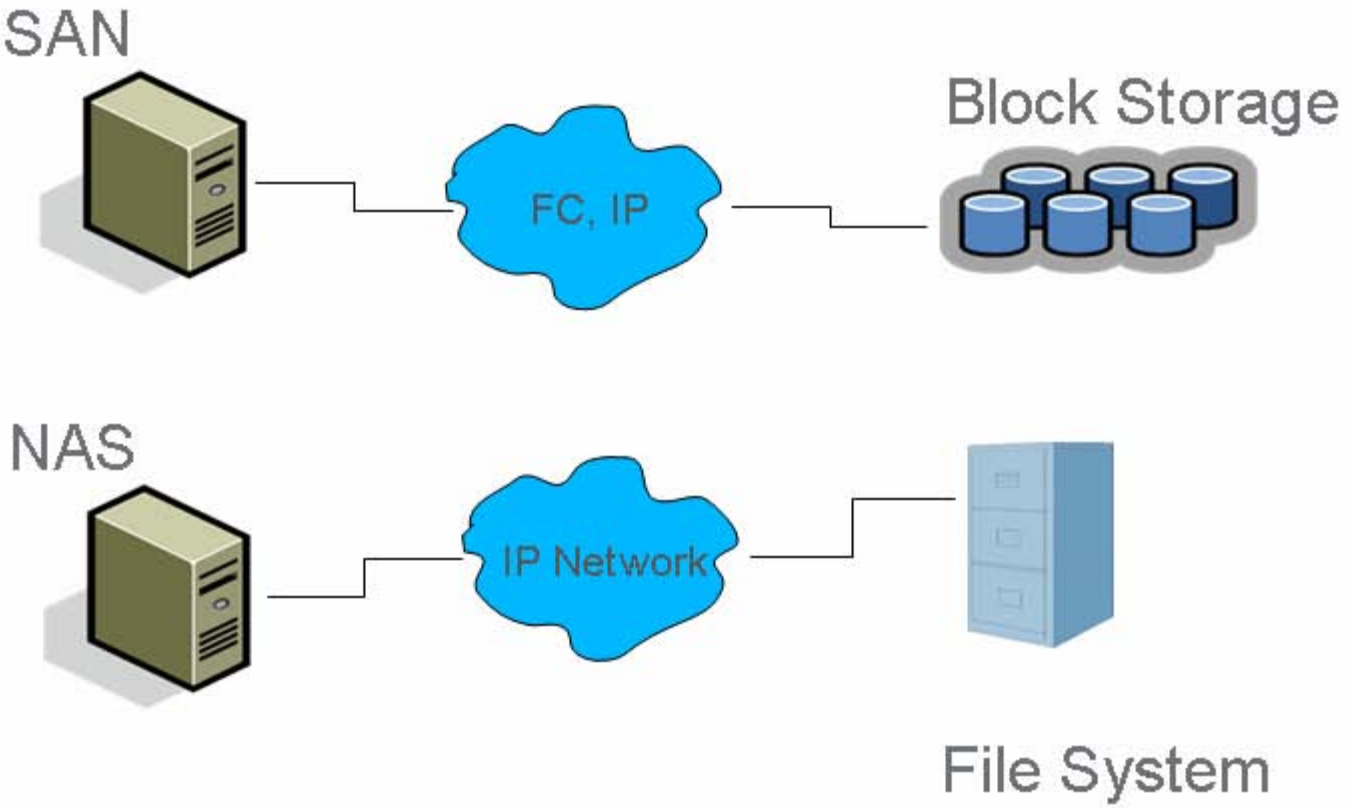
# What is iSCSI?

- Transport of SCSI over TCP/IP
  - Internet “standard”
  - IETF 3720, IEFT 3347
- SAN-oriented
  - Comparable to Fibre Channel in many ways
- Non-priveleged Service
  - Port 3260, anyone can be an iSCSI target
- Target Names
  - iqn.date.com.namingauthority:uniquename
  - eui:01234567890ABCDEF
  - Fully qualified:
    - ibox.vmware.com:860//iqn.1998-01.com.vmware.ibox:target1
    - Hostname port iSCSI name target

# What is NAS?

- File systems of TCP/IP
  - NFS, CIFS most common
- Widely used for sharing files
- NFS Internet Standard
  - IETF 1094
- NFS naming conventions
  - nfs.remote.com:/remote/filesystem
- More info on iSCSI:
  - www.ietf.org, www.iscsistorage.com
- More info on NFS:
    - www.ietf.org, en.wikipedia.org/wiki/Network_File_System

# SAN vs. NAS



# Why iSCSI and NAS are Interesting

- Easy access to remote data
- Easy sharing of data
- Inexpensive
  - No additional hardware
    - Use existing NICs
    - Optionally, iSCSI HBAs, TOE for speed-up
  - Use existing hardware
    - Any system can be a NAS, iSCSI server
  - Existing infrastructure
    - Office cabling, routers, switches
    - Administrative expertise
- Use existing network technologies
  - Authentication, encryption, routing, internet ready

# Why NAS is Interesting

- Prolific file-sharing approach
  - Widespread use
  - Easy storage conglomeration
- Use existing file system tools
  - Backups
  - Resource allocation
- Built-in permissions
  - File access consistent, network-wide

# Why iSCSI is Interesting

- Emerging, Large Market
  - 50-100% annual growth
  - About one-third of the SAN market (attach rate)
  - Lots of industy backing: Cisco, EMC, NetApp, Micrsoft
  - Dominant SAN by the end of the decade
- Different approach than NAS
  - Raw block storage, not file system
- Different Approach to SAN
  - Built-in encryption
  - Built-in discovery
  - Long haul
    - No bridging

# How We do iSCSI

- Software only
  - Based on the Cisco reference implementation
  - Uses ESX's vmkernel network stack
  - Discovery, authentication done through service console
- QLogic iSCSI adapters
  - QLA4050C, QLA4052C (QLA4010C experimentally)
  - Looks like any other SCSI adapter
  - Does its own networking
- Takes advantage of existing storage implementation
  - Just appears to be more disks to work with
  - Multipath-capable

# iSCSI Features

- ESX Boot Support
  - Available with QLogic HBAs, only
- Target discovery
  - SendTargets
  - Static discovery (QLogic HBAs only)
  - No SLP or iSNS
- ESX features
  - VMFS3 or RDMs
  - VMOTION
  - Multiple paths
    - SCSI multipath for QLogic HBA
    - NIC teams for SW initiator
- Authentication
  - CHAP, per initiator
  - None

# NAS Support and Features

- Internal implementation
  - Uses ESX vmkernel networking stack
  - NFS version 3 over TCP only (no UDP)
- Internal locking protocol
  - Mandatory, lease-based for ESX hosts,
- ESX features
  - No VMFS3 or RDMs
  - VMOTION
  - Multiple paths through NIC teaming
  - No ESX booting
- Security
  - Standard AUTH_UNIX/AUTH_HOST
    - Hostname, userid, group id for file access

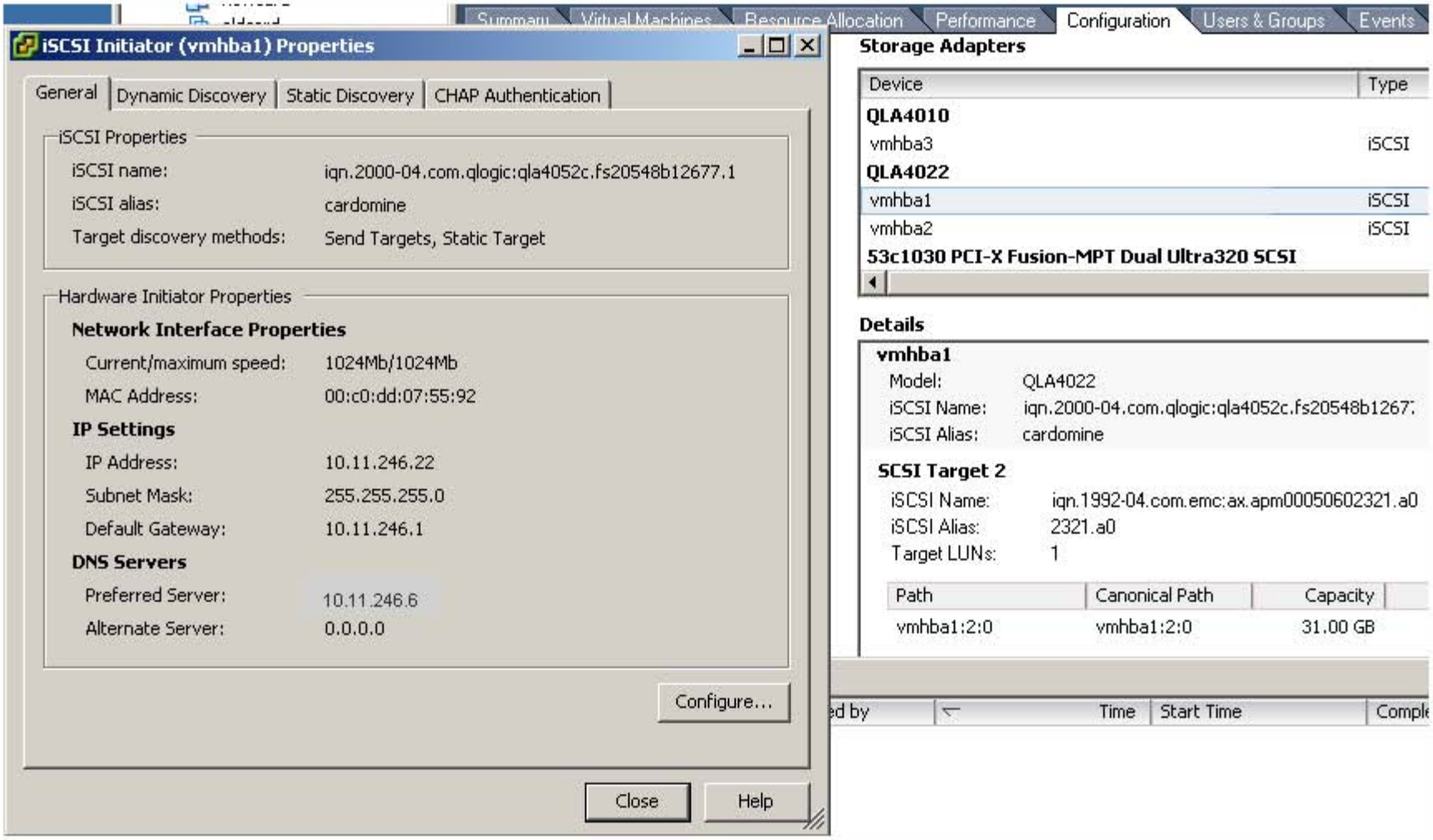
# OK, Where's Our Storage?

- iSCSI
  - EMC AX100i, CXx00i Series (and Dell rebadging)
  - EMC Celerra NS, NSX, CNS
  - NetApp FAS 2xx, 9xx, 3020 filers
  - EqualLogic PS Series
- NFS
  - RedHat Linux 3 u5 NFS server
  - Fedora Core 4 NFS server
  - NetApp FAS 2xx, 9xx, 3000, 6000 filers
  - EMC Celerra NS, NSX, CNS

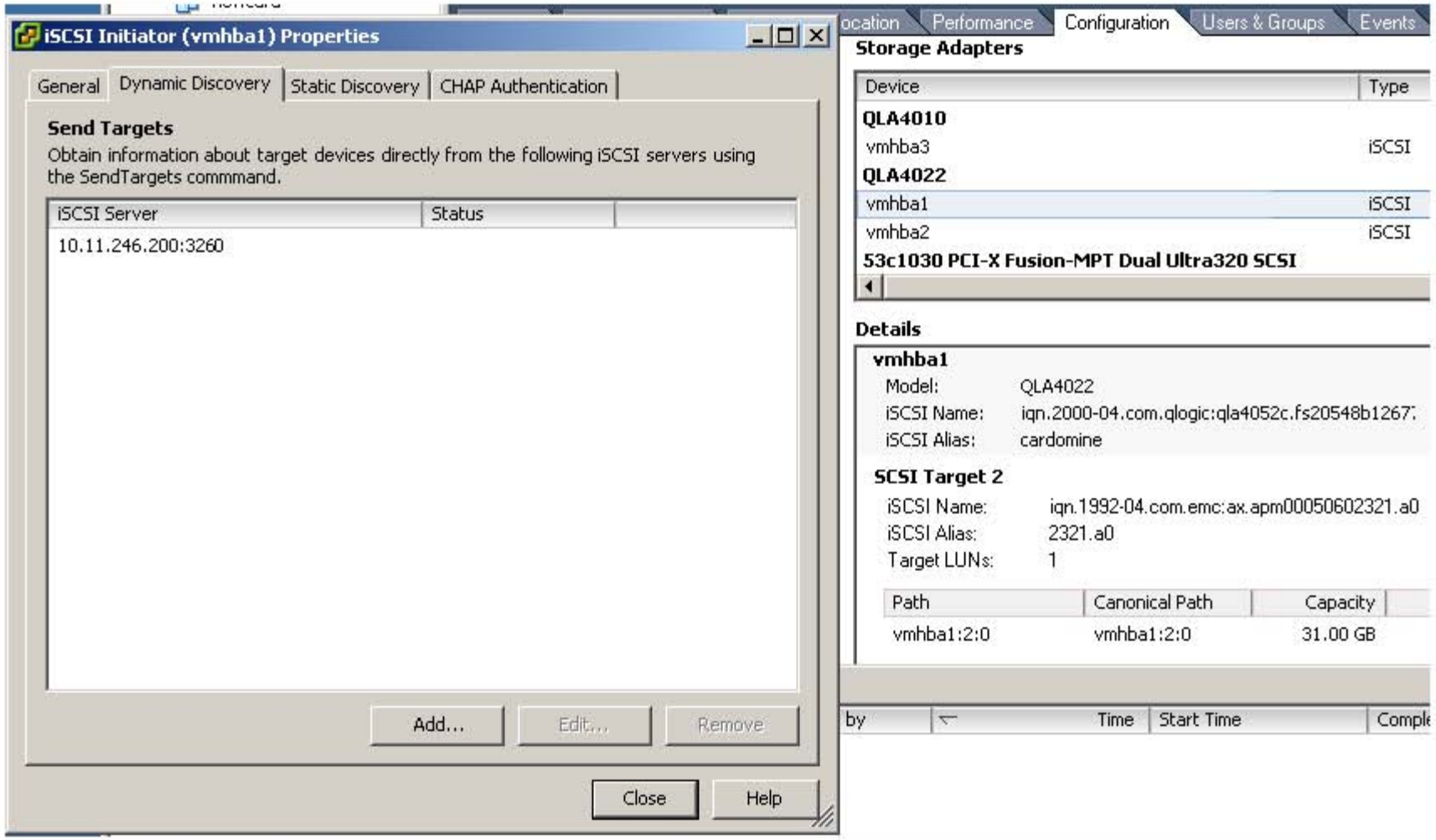
# iSCSI Configuration

- Administration
  - Configured through Virtual Center UI
    - QLogic cards configured completely through Storage configuration
    - SW Initiator takes a few more steps
      - Network setup through Networking config
      - Discovery, Authentication through Storage Configuration
  - Common configuration for all initiators
  - No vendor-specific tools needed
  - SNIA-based IMA library implementation
    - Standard
    - Third-party vendors can use interface for iSCSI management
      - Expandable “plug-in” approach to management

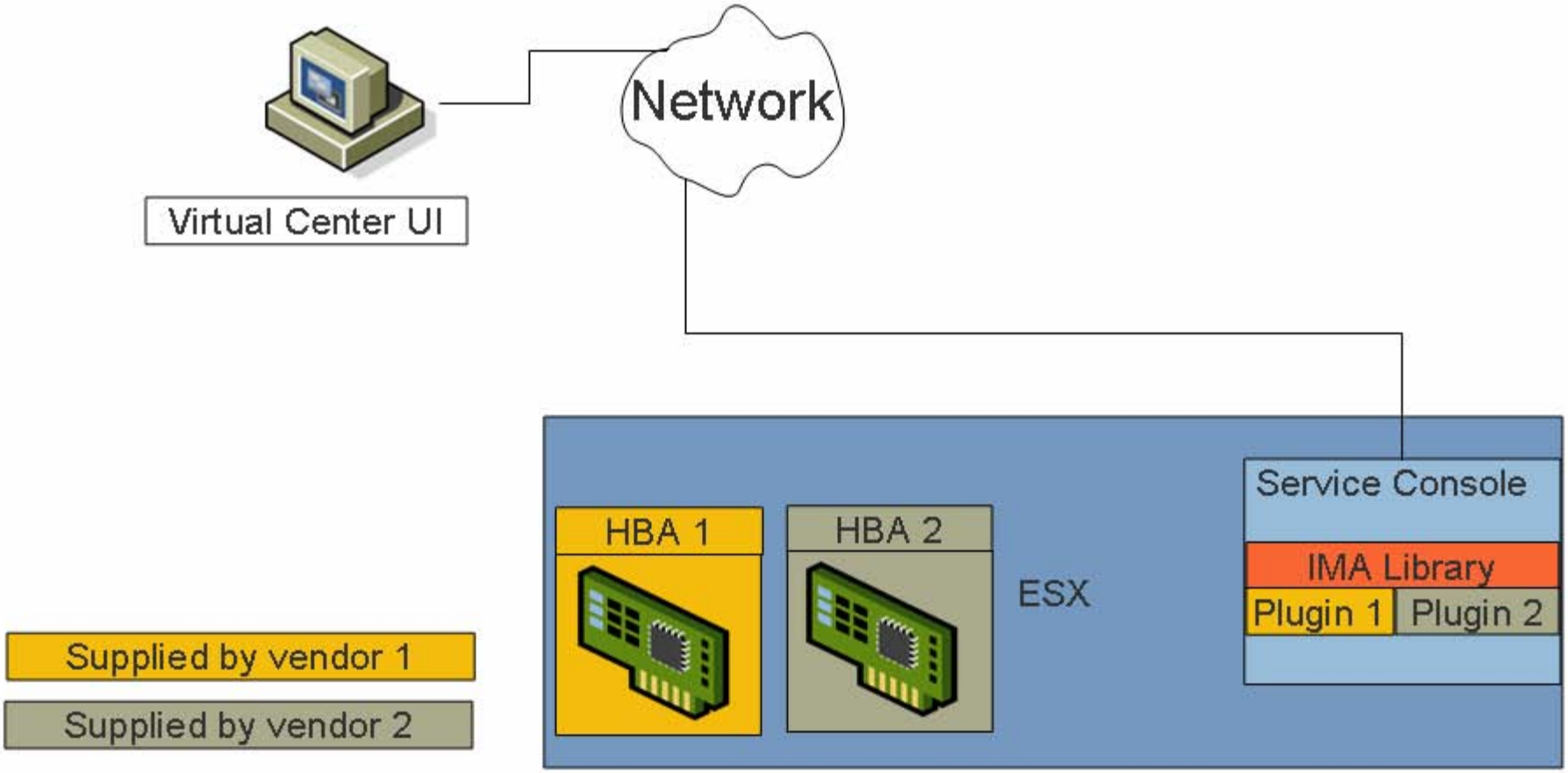
# iSCSI Configuration



# iSCSI Configuration



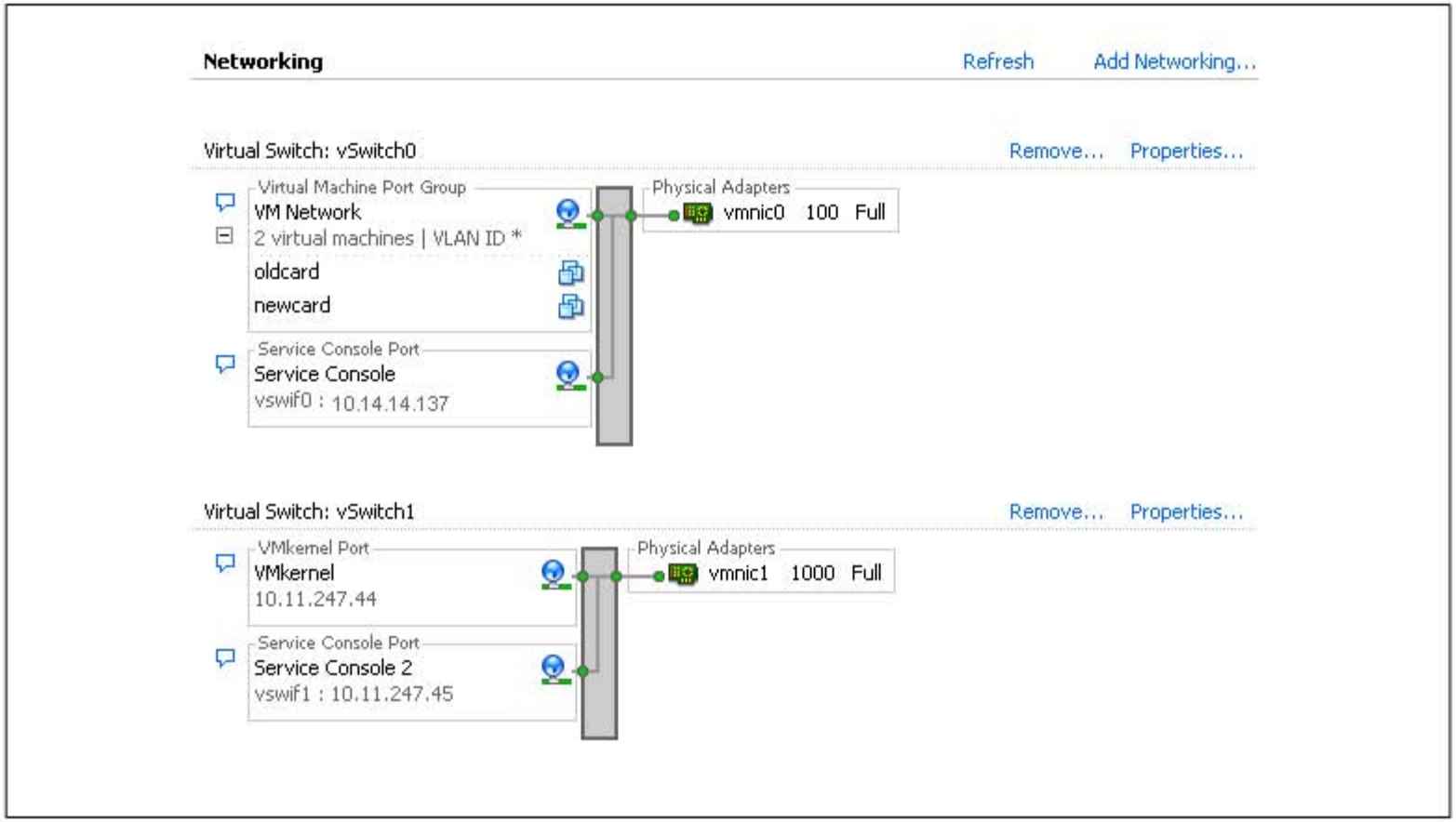
# IMA Plugin Overview



# NFS Configuration

- Configured with Virtual Center UI
  - IP Storage Port configured
  - Storage is selected like any other disk or volume
  - Datastores used like VMFS2 or VMFS3 volume

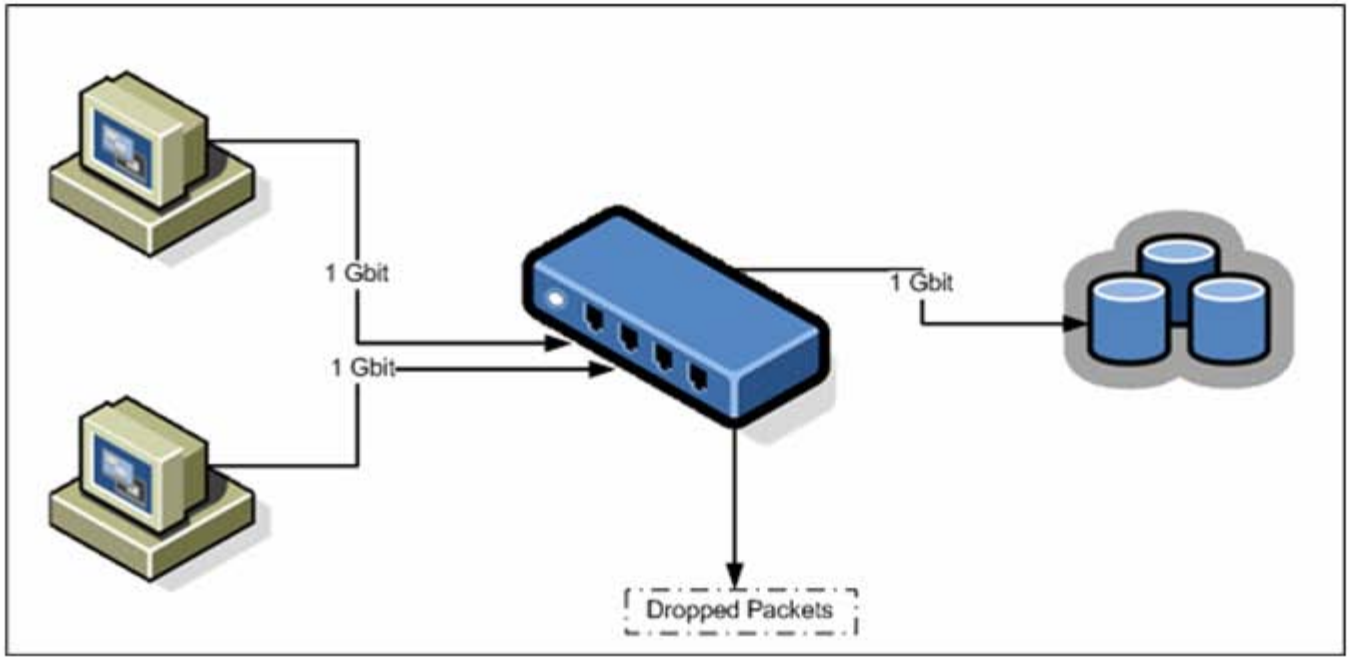
# NFS Configuration



# IP Storage Network Configuration

- Gig-Ethernet equipment, only
- Separate networks
  - Security
  - Separate traffic
    - VLANs still share traffic
    - Separate physical networks for heavy IP-based storage
- Dropped network packets
  - Dropped because network is shared
  - Monitoring network errors
  - Retransmission can be very slow
- Multiple paths for data integrity
  - iSCSI multi-path configurations
  - TCP/IP multi-path configuration

# Network Oversubscription




2 Gigabits of traffic don't fit on a 1 Gigabit link

# Monitoring Dropped Packets

- Available from some storage arrays
- Available from many managed switches
  - > Both directions, more useful

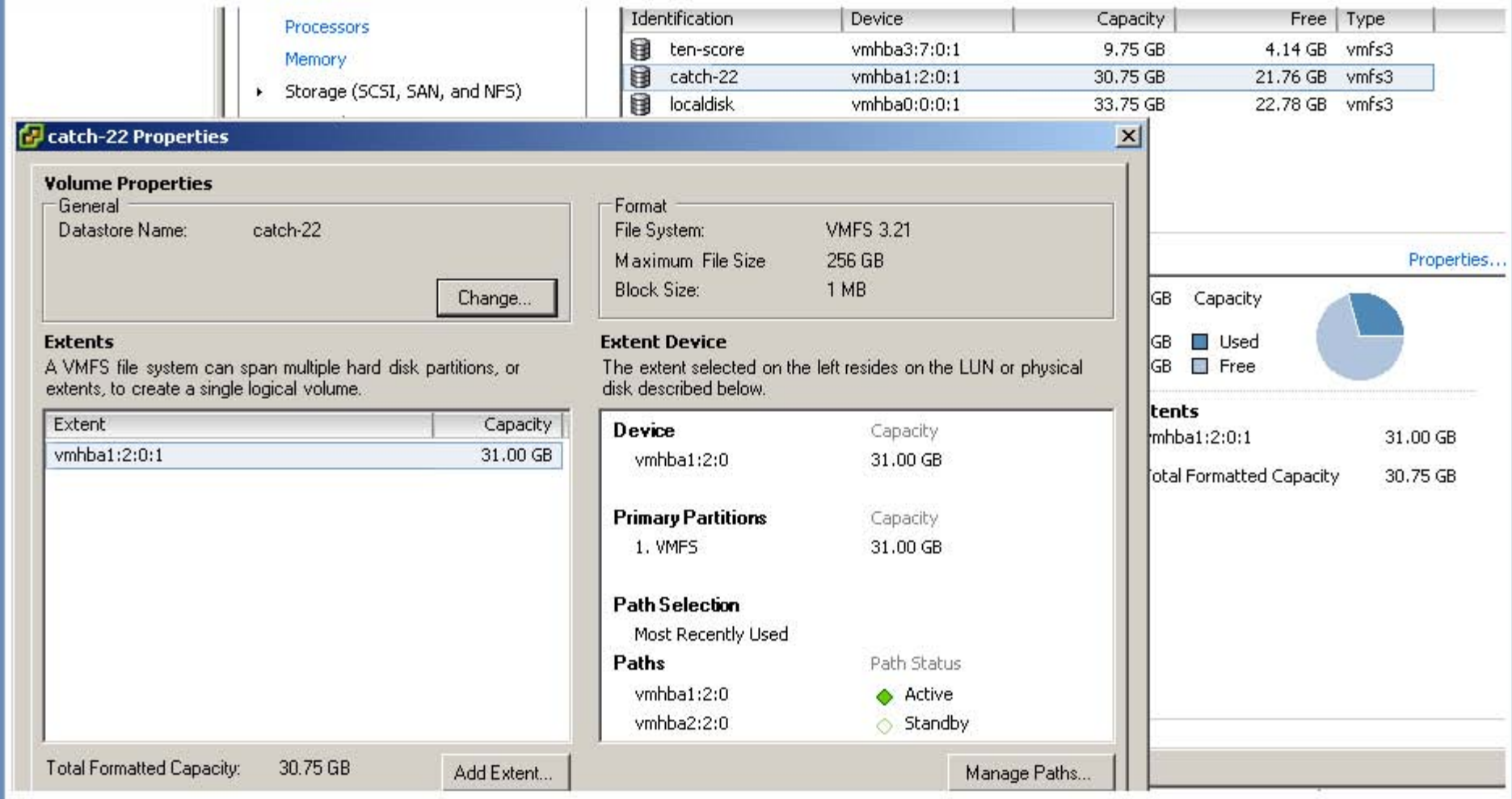
```
*: interface is up
IHQ: pkts in input hold queue       IQD: pkts dropped from input queue
OHQ: pkts in output hold queue      OQD: pkts dropped from output queue
RXBS: rx rate (bits/sec)            RXPS: rx rate (pkts/sec)
TXBS: tx rate (bits/sec)            TXPS: tx rate (pkts/sec)
TRTL: throttle count

  Interface                IHQ    IQD   OHQ    OQD  RXBS RXPS  TXBS TXPS
  TRTL
-----------------------------------------------------------------
* GigabitEthernet0/1        3   9922     0      0 476303000  62273
  477840000  63677    0
```

# Storage Multipathing with iSCSI

- ESX maintains path info
- Storage LUNs uniquely identified
- SW iSCSI initiator
  - Same storage LUN seen multiple times
    - LUN accessed through alternate target for failure
- Multiple iSCSI HBAs
  - Same as SW initiator
  - Both HBAs see storage
    - Switch to other HBA for target failure

# Storage Multipath with iSCSI



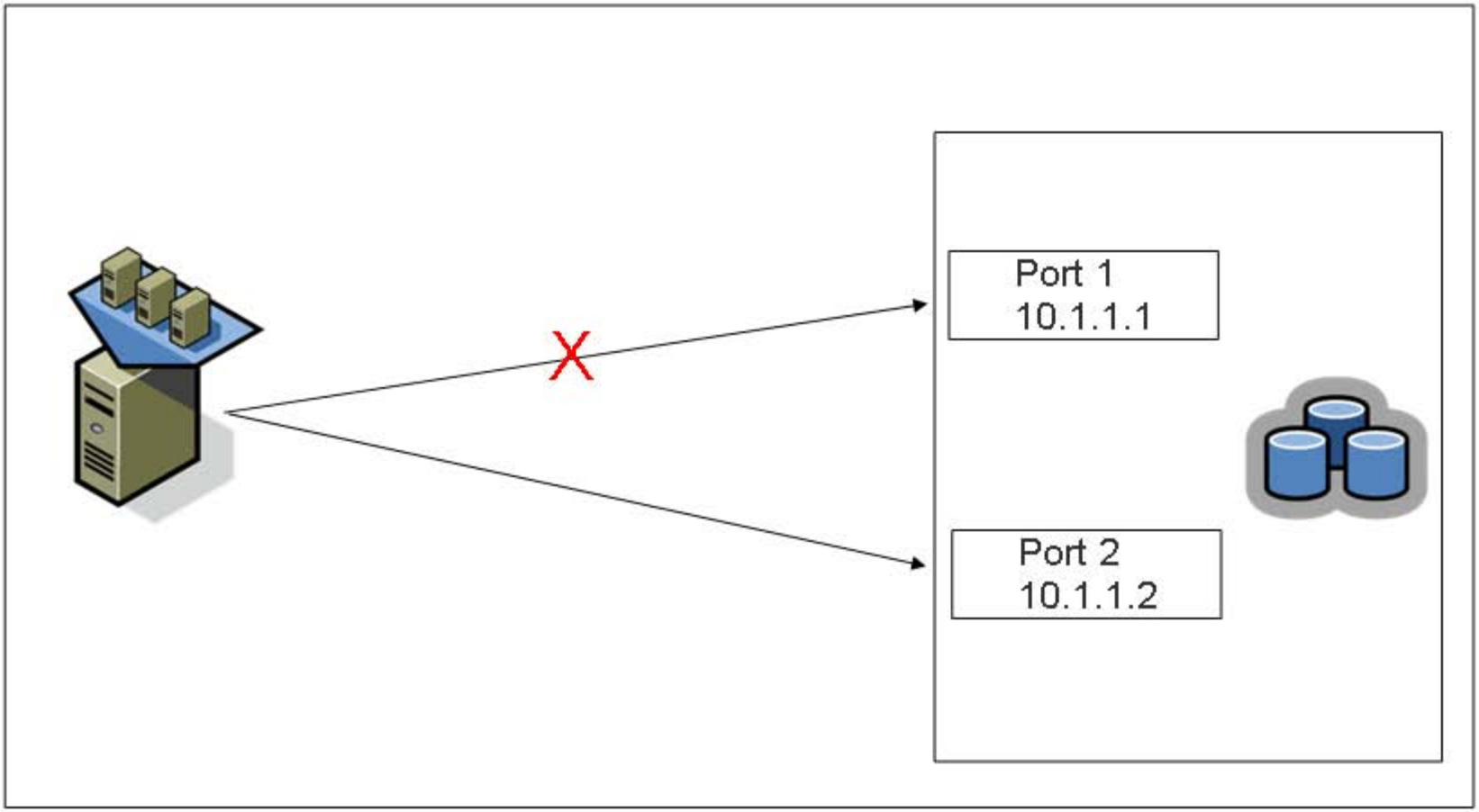
# Network Multipath with NIC Teaming

- Useful for SW iSCSI or NFS
  - > Not for HW iSCSI
- Multiple NICs for ESX vswitch
  - > Failover for loss of link
  - > Rudimentary load balancing
    - Configuration-dependent
- Storage multipathing not involved

# Network Multipathing with iSCSI Login Redirection

- No configuration needed in ESX
- Both HW iSCSI and SW iSCSI
- Requires support from storage
- Storage array maintains path info
  - No info in storage multipathing or ESX network config
- iSCSI sessions are redirected to appropriate port
  - Happens on-the-fly for load balancing

# Network Multipathing with iSCSI Login Redirection



# iSCSI and NAS Rock!

- Questions?

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