

Storage Networking Foundations Certification Workshop

Duration: 2 Days

Type: Lecture

Course Description / Overview / Expected Outcome

A group of students was asked recently to define a "SAN." Some replies included "storage area networks," "server area networks," "system area networks" and the instructor's favorite, "The latest thing to sell!" SAN is all of these things and more. This course takes a top-down approach in examining the information flow requirements levied on a Storage Network and how various technologies meet those requirements. It identifies why organizations are moving toward NAS and SAN. It provides a comprehensive technical examination of Fibre channel, SCSI and IP protocols, along with the role they play in a Storage Network. It compares SAN technologies with network technologies including ESCON, Gigabit Ethernet, ATM, and other LAN and WAN physical transports. The course examines the practical problems faced in the heterogeneous world where the "any to any" connectivity provided by SANs can present more problems than it solves. It identifies the techniques used to overcome these problems through the use of volume management, storage resource security and persistent binding. The course identifies the components and products that make up a NAS or SAN, examines the design and performance aspects of a SAN, and finally explores where Storage Networks are headed over the next few years.

Course Objectives

- **Identify** what Storage Networking is and how it relates to storage
- **Understand** SAN, NAS & DAS choices and the benefits of each
- **Examine** Storage and Storage Networking solutions
- **Examine** Storage and Storage Networking technologies similarities and differences
- **Clarify** and explain the language of Storage Networking: Terminology
- **Learn** what Storage Networking solutions and technologies can and cannot do in the practical realities of implementation.
- **Examine** a top-down approach to information flow requirements levied on a storage network and how various storage network technologies meet those requirements.
- **Compare** Storage Networking technologies with Data Networking technologies and identify opportunities for infrastructure consolidation.
- **Examine** approaches to the practical problems faced in homogeneous and heterogeneous world where the "any to any" connectivity provided by SANs can present just as many problems as it solves.
- **Examine** the Storage Solutions including virtualization, data sharing, high availability and information lifecycle management.

- **Explore** the many topologies and the underlying technologies and protocols that can be used in storage networks including Point-to-Point, Arbitrated Loop and Switched Fabric topologies. Explore the trade offs in cost/benefit where these topologies can be applied today.
- **Demystify** the controversy surrounding Storage Networking's protocol wars between Fibre Channel and IP-based storage and finally understand the differences between them and the vendor products.
- **Examine** the underlying protocols that allow Storage Networking to exist including Fibre Channel, iSCSI, TCP/IP, Gigabit Ethernet and others
- **Explore** the Fibre Channel technology and understand the underlying concepts behind a Fibre Channel SAN
- **Explore** the technologies behind IP SANS and resolve the differences between IPFC, iFCP, FCIP, and iSCSI.
- **Examine** Remote Direct Memory Access RDMA and Infiniband technology and understand the movement to system bus replacement and remote direct memory access technologies.
- **Understand** the protocols that allow NAS systems to provide benefits including NFS, CIFS, HTTP, DAFS, VI, and NDMP
- **Examine** the current and future trends in Storage Networking technologies and protocols and the developments that are occurring to improve the benefits that can be achieved.

Who Should Attend

- This course is designed for individuals who want to earn their SNIA Certified Professional (SCP) through passing the SNIA Storage Networking Network Foundations Exam S10-100.
- This course is targeted towards anyone who designs, implements, manages, specifies or selects Storage Networking technologies.
- This includes IS/IT technical staff and managers, product developers, systems integrators, systems engineers and technical marketing personnel.
- Anyone who wants to understand more about storage networking solutions and technologies
- This course is designed to provide technical and management IT staff a short but comprehensive understanding of Storage Networking.
- Product and project teams that are involved with applications, systems, storage and end users will benefit from this course.
- Developers, integrators, engineers, administrators, managers, marketing personnel and others with a need for an understanding of Storage Networking will find this course extremely informative.
- Anyone involved in storage or data communications networking will understand the similarities and differences between these environments and will be in position to take on the challenges introduced by Storage Networking.

Prerequisites

An understanding of current computer interfaces or networks is desirable, although not absolutely necessary.

What's exciting about it, why it's important, where it's going...

- It provides a one-of-a-kind tutorial with an industry subject matter expert who has real-world experience and superior presentation skills
- It provides a vendor-neutral view of storage networking with a focus leveraging your investment in network infrastructure, existing and future storage and server assets
- It separates the myth from reality of the various storage networking solutions and technologies
- It explains the technical differences between Fibre Channel and IP Storage and when to use these technologies
- It puts you in position to understand what storage networks can and cannot do for you
- It will make you more knowledgeable in dealing with the plethora of vendors of storage networking products and services
- It takes a "network" view of storage networks yet identifies how storage networks differ fundamentally from other data networks like the Internet
- It takes complex storage networking topics and breaks them down in a simple, easy-to-understand way

Course Topics

Storage Network Introduction & Concepts

- Network Vs. Storage
- DAS, NAS, SAN, CAS
- Server to Storage: Information Flow Requirements
- What is a Physical Transport Network?
- Storage Network Physical Transport Choices
- Beware of Semantics

Basic Storage Network Technology

- SNIA Shared Storage Model
- Identify standards organizations

Storage Networking Myths: Hype versus Reality.

Storage Networking Environment

Storage Technologies

- Disk & Tape Technology
- SCSI

Storage Network Topologies and Applications

Storage Networking Physical Transport Technologies:

- Fibre Channel
- IP Storage
 - OSI & The Internet Protocol Suite

- ISCSI, iFCP, FCIP, iSNS
- Infiniband
- RDMA

Storage Networking Products and Components

Storage Area Network SAN and Network Attached Storage NAS

Storage Networking SAN Solutions:

- Virtualization
- Storage Management
- Data Management, Backup & Recovery
- Continuity Management & High Availability
- Storage Networking Security

System Internal Network Advances

Storage Network Design Introduction

Storage Network Certification Program

Storage Networking Futures

Course Summary

Detailed Course Outline

Module 1: Storage Network Introduction & Concepts

- Network Vs. Storage
- DAS, NAS, SAN, CAS
- The Requirements of Networking
- Local Area Networks
- Wide Area Networks
- A Simple Internetwork
- Why Internetwork?
- Server to Storage: Information Flow Requirements
- What is a Physical Transport Network?
- Storage Network Physical Transport Choices
- Network Components
- Beware of Semantics
- Fundamental Concepts
- What is OSI?
- OSI Data Structures
- IPS Encapsulation
- What is Fibre Channel?
- Network Architecture Information Focus
- Network Architecture Roles
- Application Services Layer
- Transport Layer
- Transport Addressing Ports
- Internet Layer
- Names & Addresses

- Hierarchical, Routable Addressing
- Why subnet and segment?
- IP Next Generation IPng (IPV6)
- FC Address Comparison – 1 Gram
- IP Address Comparison – 1 Gram
- IP Address Comparison
- Address Assignment
- Name Service

Module 2: Storage Network Foundations

- Who is the SNIA Certified Professional?
- Foundations Topics
- Foundations Exam Topics

Module 3: Basic Storage Network Technology

- Describe storage performance and data protection strategies including RAID, caching, and connectivity technology
- Differentiate between DAS, SAN, NAS, CAS and IP Storage environments
- Describe the SNIA Shared Storage Model
- Identify standards organizations
- Wires & Protocols
- Blocks Vs. Files
- SAN to SAN over WAN
- CAS - Content Addressable Storage
- Content Addressable Storage

Module 4: Storage Networking Myths – Hype versus Reality

- San Myths
- Myth: SAN is a Technology or Product
- Myth: SAN is Fibre Channel and a Fabric Switch
- Myth: SAN is a new concept
- Myth: SANs solve all (most) distributed storage problems
- Myth: SANs are simple to implement
- Myth: Today's technologies are SAN-Ready
- Myth: Server-less backup is key to efficient SAN backup
- Myth: SANs are, or will be heterogeneous
- Myth: SANs will replace LANs
- Myth: LANs will replace SANs

Module 5: Storage Networking Environment

- Storage
- Laws of Computing
- I/O Directions

- Constant Server Growth
- Constant Storage Growth
- Practical Direct Connectivity Limits – Storage Adapters
- Practical Limits on Direct Connectivity – Server Adapters
- IT Challenges
- Enterprise Issues & Concerns
- Distributed Resource Issues
- SAN Benefits
- SAN Performance vs. Distance
- The Path to Data
- Direct Attached Storage
- Channel Attached Storage
- Shared Channel Attached Storage
- External RAID Controller
- Storage Network Environment End
- Shared Storage Model & Standards
- Standards

Module 6: Storage Technologies

- Disk Technology
- SCSI Devices
- SCSI
- RAID and JBOD
- SCSI Anatomy
- Virtual SCSI Cables on SCSI Bus
- Virtual SCSI Cables Fibre Channel
- Shared Storage Model & Standards
- Disk & Tape

Module 7: Storage Network Topologies and Applications

- Bus
- Loop
- Fabric
- Hybrid

Module 8: Fibre Channel

- Fibre Channel SAN
- SAN Fibre Channel Introduction
- High Speed Data Communications
- Traditional Channels
- Traditional Networks
- Fibre Channel Begins
- Fibre Channel Benefits

- SAN Technology Comparisons
- Fibre Channel Standards
- Fibre Channel Organizations
- OSI & Fibre Channel
- Storage Networking Topologies
- SAN Interfaces
- IDE Bus
- SCSI Bus
- Current SCSI Topologies
- ESCON
- SAN Ports
- SAN Virtual Circuits
- Dynamic Virtual Circuits – Any to Any!
- Dynamic Virtual Circuits – Any to Any?
- Fibre Channel Node
- Nodes
- Example Fibre Channel Network
- San Adaptors
- Fibre Channel Node Port
- SAN Ports
- Node Port (N_Port/NL_Port)
- Fibre Channel Port Types
- Fibre Channel Link
- Fibre Channel Links
- SAN Fibre Channel Topology
- Port Types: N-Port
- Port Types: F-Port
- Port Types: NL-Port
- Fibre Channel Hub
- Port Types: FL-Port
- Port Types: E-Port
- Trunking
- Port Type: G-Port, GL-Port
- Device Ports
- Switch Ports
- World Wide (Port & Node) Names
- Fibre Channel Addressing
- Sessions - Login
- Topologies: Point-to-Point
- Topologies: Arbitrated Loop
- Arbitrated Loop Performance Factors
- Arbitrated Loop Performance Factors
- Redundant Loops
- Performance: Server/Storage Port Ratios

- Performance Improvement?
- Cascaded Hubs: One Loop
- Extended Distance
- Topologies: Fabric
- Fabric Performance Factors
- Fabric Switch
- Fabric Switch Services
- Multiplexing Traffic
- Multicasting Traffic
- Fabric Switched - Mesh
- Fabric Switched – Cross Connect
- Fabric Performance: Server/Storage Port Ratios
- Performance Improvement?
- Fabric: Single Switch/Director
- Fabric: Multiple Switches
- Loop vs. Fabric
- Hybrid: Loop and Switch
- Loop and Switch
- Loop Switch: High Performance?
- Loop Switch: High Performance?
- SAN Topology Benefits
- SAN Performance
- SAN Performance
- Fibre Channel Addressing
- Fibre Channel Class of Service
- The Fibre Channel Network
- Fibre Channel Node
- Serial Data Transmission
- Multiple Media Options
- Storage Networking Components
- FC-0 Physical Interface
- Fibre Channel Campus Wiring
- Physical Layer Media and Connectors
- Gigabit Interface Connector (GBIC)
- Small Form Factor Pluggable (SFP)
- Media Interface Adapter (MIA)
- Gigabit Link Module (GLM)
- Variants
- Optical Cable
- Modal Dispersion
- Light Source
- Speed Negotiation
- Hubs
- Fibre Channel Hubs

- Hubs
- Loop Switch
- Loop Switch
- Fabric Switch/Director
- Director Switch Characteristics
- Bridge/Gateway
- FC Upper Layer Protocol Mapping
- Channel Protocols via Fibre Channel (FC-4)
- Network Protocols via Fibre Channel (FC-4)
- Mapping SCSI and IP over Fibre Channel
- SCSI over Fibre Channel
- SCSI-3 and FCP Functions
- Information Unit Transfers
FCP Write and Read Operations
- SCSI “Addressing”
- IP over Fibre Channel
- IP Routing and The ARP
- ARP Processing
- IP over Fibre Channel
- SAN Economics

Module 9: IP Storage

- IP Storage
- OSI & The Internet Protocol Suite
- Storage Networking Protocols
- Fibre Channel & IPS
- Fibre Channel Vs Gigabit Ethernet
- IP Storage
- IPS is Gathering Momentum
- IP Storage Standards Efforts
- IP Storage Applications
- Fibre Channel over TCP (FCIP)
- Internet Fibre Channel Protocol (iFCP)
- How iFCP Works?
- iSCSI Definition
- iSCSI Definition
- iSCSI Encapsulation
- Direct-Attached Storage
- Storage Area Network – SAN
- TCP iSCSI Sessions
- iSCSI Login
- iSCSI Login Sequence
- iSCSI - a Layered Model
- Ordering & Numbering

- iSCSI Numbering
- iSCSI Tasks & Tags
- iSCSI Messages
- iSCSI Boot
- Discovery & Configuration
- Error Handling & Recovery
- iSCSI in Order Delivery
- IPsec Modes
- iSCSI Security Solutions
- Security Basics
- IPsec. Security for iSCSI
- TCP/IP Stack Potential Offloads
- TCP Overhead
- TCP Overhead - Example
- TCP/IP Offload Solution for NICs
- Efficient TOE I/F
- Flavors of iSCSI & TOE Adapters
- Overview of iSCSI Stack
- Detailed Overview of iSCSI Layer
- iSCSI HBA Model
- iSCSI NIC Model
- Summary

Module 10: Infiniband & RDMA

Module 11: Storage Networking Products and Components

- Media
- HBAs and SAs
- GBIC
- Hub
- Loop Switch
- Fabric Switch
- Director
- Gateway

Module 12: Network Attached Storage NAS

- NAS as NAFS
- NAS Properties, Architectures & Topologies
- NAS Appliances & NAS Device NASD
- NAS Strengths & Weaknesses
- NAS Filing & File Systems
 - Network File Services NFS
 - Server Message Block SMB & Common Internet File Services CIFS
 - Hypertext Transfer Protocol HTTP

- Direct Access Files Systems DAFS
- NAS Distributed Storage & NAS Clusters
- NAS Configuration
- NAS Application I/O Characteristics & Low and High Latency NAS
- NAS Cache and NVRAM
- NAS Homogeneous & Heterogeneous Data Sharing
- NAS versus SAN, NAS & SAN
- NAS Heads & Gateways
- File and Object Storage
- NAS Security
- NAS Backup & Recovery
- Network Data Management Protocol NDMP

Module 13: Virtualization

- Managing Space
- Distributed Systems
- Server Centralized Data
- Distributed Servers Intranet Accessibility
- Server Consolidation
- Where are we now?
- Logical Devices
- Storage Consolidation – Enterprise Storage
- SAN Storage Consolidation
- Dynamic Storage Allocation
- SANs – Improved Device Utilization
- SAN Remote Mirroring
- Virtual Tape
- Virtual Tape
- Consolidated Virtual Tape
- SAN Data Sharing
- Data Files
- Incompatibilities Galore
- Multiple Systems
- File System Incompatibilities
- Incompatibilities
- Homogeneous Data Sharing Problems
- Device Sharing Problems
- Sharing Solutions
- SAN Partitioning
- Data Replication
- Actual Data Sharing
- SAN File System
- Client Based DFS
- SAN File Systems

- SAN Connectivity
- SAN Zoning
- SAN Hard Zoning
- Topology Based Zoning
- Access Map Operating System or HBA
- Device Zoning – LUN Level

Module 14: Storage Management

- Storage Management
- SAN Device Management
- SAN Enterprise Management
- SAN Support and Maintenance
- Configurations

Module 15: Data Management, Backup & Recovery

- LAN-Based Backup
- LAN-Free Backup
- Server-Less Backup
- Backup Summary
- Snapshot Types
- SAN Data Management
- SAN Applications

Module 16: Continuity Management & High Availability

- SAN High Availability
- Redundant Servers
- High Availability Department Servers
- High Availability Access
- High Availability SAN
- Automatic Fail over?
- Persistent Binding – Path Consistency

Module 17: Storage Networking Security

Module 18: System Internal Network Advances

- System Internal Network Advances
- System Internal Network Advances
- Server I/O PCI Bus
- Infiniband Architecture IBA
- Infiniband Positioning
- DAFS File and Database Applications
- Direct Access File System DAFS
- File Access Methods - DAFS

Module 19: Storage Network Design Introduction

- Storage Network Business and Technical Goals
- Storage Network Characterizing the Existing Infrastructure
- Storage Network Logical Design
- Storage Network Physical Design
- Storage Network Optimization and Tuning

Module 20: Storage Network Certification Program

- Certification Introduction Objectives
- A Different Kind of Certification Program
- SNIA Storage Networking Certification Program
- Certification 'Food Chain'
- SNIA Certification
- Certification Program Structure
- Concepts Domain
- Standards Domain
- Solutions Domain
- Product Domain
- Certified Skill Sets
- Who is the SNIA Certified Professional?
- Who is the FC-SAN Practitioner?
- Who is the FC-SAN Specialist?
- Preparing for Certification
- Registering for the Exams
- What to do on Exam Day?
- SNIA FC-SAN Certification Exams

Module 21: Storage Networking Futures

- Applications
- Systems
- Bandwidth