

## ***SNIA Storage Network Foundations (S10-101) Exam Description & Preparation Guide***

The SNIA Storage Network Foundations (S10-101) exam will certify that the successful candidate has knowledge of general storage networking concepts, components and basic ability to work on a storage network implementation team.

### ***Test Parameters***

- ✓ The delivery channel for this test will be the Thomson Prometric testing centers worldwide.
- ✓ The exam format will be multiple-choice with multiple-responses where appropriate and noted.
- ✓ The maximum testing time allowed for the exam is 90 minutes and 15 additional minutes for a survey that precedes the actual exam.
- ✓ Reference materials or other tools will not be allowed nor made available to the client at the testing center.
- ✓ The exam language is currently English.

### ***Prerequisite Exam***

- ✓ None

### ***Passing Score: 70%***

### ***Number of Exam Items: 73***

### ***Requirements (Experience and Training)***

- ❖ Experience in IT and/or storage networking operations
- ❖ Advanced computer skills and knowledge in at least one operating system
- ❖ An understanding of the overall storage networking concepts
- ❖ Ability to explain and recognize key storage networking components and technologies
- ❖ A familiarity with storage networking products and solutions
- ❖ A familiarity with standard configuration tools
- ❖ Ability to describe storage network backup, recovery, and business continuance
- ❖ Technical skills as a team member to implement storage network solutions

## **SNIA Storage Network Foundations Exam - Topics to Study**

*Please note there will NOT be exam items corresponding to EVERY topic. However, the exam items will be drawn from this blueprint and study material. If numbers are skipped or appear missing, this is intentional. We are only showing information relevant to this exam.*

### **1. Explain and recognize basic Storage Networking Technology Components and Concepts (40%)**

- 1.1 Describe Networking Concepts vs. Storage Concepts
  - ✓ Define protocols and infrastructures commonly used for DAS, SAN, NAS architectures
  - ✓ Differentiate session vs connection vs link
  - ✓ Differentiate names vs addresses
  - ✓ Differentiate payload integrity and error recovery approaches
  - ✓ Define full duplex vs half duplex
- 1.2 Review Networking Concepts
  - ✓ Define the difference between the function of a router vs switch
  - ✓ Describe the technical advantages of SAN over DAS (e.g., consolidation, scalability, reliability, serviceability)
  - ✓ Describe flow control (credit-based vs retrospective)
  - ✓ Define bit rate vs bandwidth vs throughput
  - ✓ Describe the functional differences of infrastructure components (e.g. storage router, bridge, gateway, director, switch)
  - ✓ Define data structures (e.g., message, segment, packet, frame)
  - ✓ Define segmentation and fragmentation
- 1.3 Define the differences in disk technologies
  - ✓ Define fragmentation/defragmentation (symptoms, sequential/random, value)
  - ✓ Determine the differences between ATA and SCSI upper layer protocols
  - ✓ Identify the differences among ATA/SATA, SCSI, iSCSI, FC, Infiniband, SAS
  - ✓ Define protocols and infrastructures commonly used
  - ✓ Identify industry-based connectors
  - ✓ Identify symbology of industry-standard connectors
  - ✓ Describe the use of printers and scanners as Storage devices
  - ✓ Describe half duplex and full duplex transport protocols
- 1.4 Describe features of Disk Controllers (cache, protection)
- 1.5 Compare and contrast the electrical and mechanical differences in entry-level, mid-range and enterprise disk drives
- 1.6 Compare and contrast how the disk technologies of Fibre Channel, ATA, SATA, SCSI, and SAS operate
  - ✓ Describe differences between serial and parallel approaches (e.g. connectivity, distances, and configurations)
    - Define serial approaches (SATA, SAS, FC, Ethernet)
- 1.7 Define RAID technology (e.g., levels)
  - ✓ Describe technical characteristics of host-based RAID vs non-host based RAID
  - ✓ Describe RAID levels commonly used for data protection and trade-offs relative to performance (e.g., common RAID levels)
- 1.8 Describe SCSI technology
  - ✓ Define the structure of SCSI standards
    - Describe SCSI-3 architecture model
  - ✓ Identify SCSI I\_T\_L\_Q Nexus addressing concepts
  - ✓ Define SCSI command protocol
  - ✓ Describe QUEUEing concepts

### 1.9 Explain iSCSI

- ✓ Define iSCSI in its relation to the protocol stack
- ✓ Compare and contrast iSCSI and NAS (i.e., block level vs file level)
- ✓ Identify concepts of gateways to existing SAN infrastructures
- ✓ Define Ethernet oversubscription
- ✓ Define FCIP and long distance fabric links

### 1.10 Describe HBA/NIC technology

- ✓ Explain partial toe, full toe, non-toe for iSCSI
  - Differentiate between using non-dedicated non-TOE iSCSI initiator vs. a non-dedicated full-TOE initiator
- ✓ Describe the impact of single-ported and multi-ported HBAs on performance and availability
- ✓ Describe the impact of software/firmware/drivers on HBA performance/interoperability/availability

### 1.11 Describe Fibre Channel (FC) SAN

- ✓ Define characteristics of Fibre Channel that make it appropriate for SAN implementation (e.g., distances, topologies, media types, fabric, services)
- ✓ Define the distance and speeds available in FC SAN (e.g., distance, 1/2/4/10 Gb speed)
- ✓ Describe topologies and the connectivity implied (e.g., point-to-point, arbitrated loop, switched fabric)
- ✓ Describe FC protocol layers
- ✓ Describe FC classes of service
- ✓ Describe FC addressing
- ✓ Define the function of Fabric services in Fibre Channel (e.g., name service, directory, security, zoning, time)
- ✓ Describe Fabric enabled technologies (e.g authentication, file sharing, replication, extension, FAIS, security)
- ✓ Identify fabric extension technologies (e.g., FCIP, iFCP, WAN, CWDM, DWDM)

### 1.12 Describe Array Technology/Virtualization

- ✓ Define array as a collection of disks with controller(s)
- ✓ Define Storage Virtualization (e.g., abstraction, transparency, taxonomy)
- ✓ Identify technical advantages and disadvantages of Virtualization (both application and physical levels)
- ✓ Define Storage Virtualization Taxonomy elements (i.e., Block, Disk, Tape, File System, File/Record)
- ✓ Describe LUN Mapping (UNIX vs Linux vs MS Windows)

### 1.13 Define SAS technology

- ✓ Define common SAS link speeds
- ✓ Describe SAS narrow vs wide ports
- ✓ List the SAS protocols (SMP, SSP, STP)
- ✓ Define a SAS expander
- ✓ Describe SAS support for SATA devices (e.g., connectors, STP)

### 1.14 Define SATA technology

- ✓ Define a SATA port multiplier
- ✓ Define SATA link speeds and distances

### 1.15 Describe NAS concepts (e.g., filing, components, O/S)

- ✓ Identify technical advantages and disadvantages of NAS technology
- ✓ Define NAS OS characteristics
- ✓ Define NAS Gateway or NAS Head approaches
- ✓ Identify NAS backup and recovery risks

- 1.16 Describe the SNIA Shared Storage Model
  - ✓ Identify the layers and components of each layer
  - ✓ Describe block aggregation

## **2. Perform Storage Networking Administration (10%)**

- 2.1 Identify HBA configuration parameters
- 2.2 Define troubleshooting methodologies and tools
  - ✓ Isolate faults and conditions (e.g., volumes of disks not visible, multipathing not functional, disk corruption)
- 2.3 Identify the distance limitations between long-wave and short-wave Fibre
- 2.4 Create/modify zone sets
  - ✓ Describe best practices for zoning
- 2.5 Identify the possible zoning conflicts that could cause fabric segmentation
- 2.6 Identify tradeoffs in costs, scalability, and redundancy
  - ✓ Identify implications and decision points
- 2.7 Create storage layouts using partitioning, protected data, security as criteria
  - ✓ Identify the use of partitioning, protected data, security
- 2.8 Define and compare uses of connectivity protocols

## **3. Manage Storage Networks (10%)**

- 3.1 Describe storage management components
  - ✓ Define capacity, configuration, LDM, Storage Network Managers, Device Managers
  - ✓ Define Reporting, Analysis, Monitoring, SRM, Error Statistic Analysis
- 3.2 Determine port assignments
- 3.3 Define and compare Storage Device Management to Storage Network Management
  - ✓ Discriminate between the components, characteristics and functions
- 3.4 Describe Configuration Management Elements
  - ✓ Define Host (HBA, Device, File System), Fabric (zones, zone sets, ISLs, LSAN/VSAN) IP Storage (Network, LSAN/VLAN), Storage (Disk, Array, Tape, Other)
  - ✓ Open Systems Storage Management (Path Managers, HBA, File System, Cache, LUNs, Zoning, Masking/Mapping)
  - ✓ Define Virtual HBA (e.g., iSCSI, VN\_PORT)
  - ✓ Define Virtual OS technology concepts (e.g., virtualized host)
- 3.5 Describe requirements or modifications needed to implement SMI-S based storage management
  - ✓ Define the "client" and the "provider" in the SMI-S process model
- 3.9 Apply Data Management Concepts
  - ✓ Define Data Management Concepts (e.g. Backup Recovery, Information Life Cycle, tiered data usage model)
  - ✓ Compare backup techniques (e.g., Network, LAN-free, Snapshot, Application Server-free, Server-free, NDMP, backup to disk, replication, CDP)
  - ✓ Differentiate among backup methodologies as they relate to Scalability, Manageability, Performance and common pitfalls (e.g., shoe shining, time consistent databases)
  - ✓ Identify how policy-based management can be a technical advantage
  - ✓ Describe the use of replication technology to migrate data for specific application changes
  - ✓ Identify risks associated with Virtualization techniques (e.g., CoW Snapshot dependence on the source consistency)

- 3.10 Describe Change Management Process (ITIL) (Applied Fibre Channel Protocol)
- 3.15 Identify common blocking problems to fabric merges (e.g., duplicate domains, zone conflicts, incompatible switch setting)
- 3.18 Identify ISL technical advantages and disadvantages over-subscription
- 3.19 Identify the distance limitations between long-wave and shortwave Fibre

#### **4. Perform Storage Networking Backup and Recovery (13%)**

- 4.1 Define Backup and Recovery Technologies (e.g., tape, tape components, D2D, D2D2Tape, Optical, 3PC)
- 4.2 Describe the differences between virtual tape libraries (VTL) and disk to disk (D2D)
- 4.3 Compare backup approaches (i.e., differential vs. incremental, SNAPshot, Backup vs Disaster Recovery
  - ✓ Describe performance and compression/compaction of the different approaches
- 4.4 Identify steps to restore data from backup
  - ✓ Describe a restore from cumulative differential, perpetual differential and full back-up
- 4.5 Identify methods in using high availability and disaster recovery in a SAN infrastructure
- 4.6 Identify the role of infrastructure resolution in backup recovery and disaster
- 4.7 Describe the different back-up and restore configurations
  - ✓ Describe the technical advantages and disadvantages of each configuration (i.e., performance)
  - ✓ Identify external requirements that are uniquely satisfied by serverless backup or third-party copy
- 4.8 Analyze potential backup problems (e.g., open file, out of space, virus scanner)
- 4.9 Identify steps to track error logs within the operating system for backup and recovery messages
  - ✓ Locate error messages, etc.
- 4.10 Determine components that must be in place to do a back-up and operational recovery of a database
- 4.11 Define Data Security
  - ✓ Authentication
  - ✓ Key Management
  - ✓ Encryption
  - ✓ Data Destruction
- 4.13 Describe the purpose of securing fabric

#### **5. Implement Storage Networks (12%)**

- 5.1 Differentiate SAS/SATA implementation parameters
  - ✓ Identify the configuration characteristics of SAS/SATA
  - ✓ Identify compatibility characteristics of SAS/SATA
  - ✓ Identify the performance (capacity, speed, etc.) characteristics of SAS/SATA
- 5.2 Define the differences between PCI-X and PCI-e
- 5.4 Identify the RAID levels and implementation (e.g., hardware, software, host-based)
  - ✓ Describe technical benefits and limitations of the different RAID levels
- 5.5 Differentiate Fibre Channel (FC) implementation parameters
  - ✓ Identify industry-known port names

5.7 Using Switch Technology

- ✓ Identify Core/Edge, Cascaded and Mesh designs
- ✓ Identify the causes of a zone merge failure
- ✓ Define hard zones, soft zones, overlapping zones, port zoning, WW name zoning
- ✓ Identify the subscription rate for a sample fabric (e.g., ISL oversubscription)
- ✓ Identify concepts of fan-in and fan-out ratios
- ✓ Define the dual independent fabric concepts and technical benefits (e.g., process for keeping them independent)
- ✓ Define multipathing (e.g., NIC teaming vs. MPxIO/MPIO)

5.8 Using HBA technology

5.9 Implementing Virtualization

- ✓ Describe the technical advantage of LUN masking over zoning
- ✓ Describe the technical advantages of using both LUN masking & zoning concurrently
- ✓ Describe how VSAN/LSAN is implemented

5.11 Recognize the concept of virtualized host technology

5.12 Implementing NAS

- ✓ Share, use, mount resources
- ✓ Differentiate between NFS and CIFS (i.e., stateful/stateless)
- ✓ NDMP

5.13 Describe requirements or modifications needed to implement SMI-S based storage management

**6. Monitor Storage Networking Performance (not on this exam)**

**7. Assess a Customer's Storage Network (not on this exam)**

**8. Plan and Design a Storage Network (not on this exam)**

**9. Provide Storage Networking Business Continuance (15%)**

9.1 Define Continuous Data Protection

- ✓ Define Consolidation and Capacity Utilization
- ✓ Define technical Administrative benefits
- ✓ Define clustering and Failover
- ✓ Define Data Protection (RAID)
- ✓ Define high availability (host, fabric, and storage)

9.2 Identify or modify business case for implementation of Continuity Management

- ✓ Define levels of Disaster Recovery
- ✓ Define tiered storage
- ✓ Define compliance
- ✓ Define security (e.g. encrypt, authenticate)

9.3 Describe archiving/nearline

- ✓ Define Content Addressable Storage (CAS) (e.g., hand offs)

## **Reference List**

*Automated Network Storage Fundamentals*  
EMC, 2003

*BCFP in a Nutshell*  
Syngress

*Blueprints for High Availability*  
Marcus and Stern

*Building SANs with Brocade*  
Chris Beauchamp, Josh Judd, and Benjamin Kuo, Syngress 2001

*Building SANs with Brocade Fabric Switches – How to Design, Implement, and Maintain Storage Area Networks (SANs) with Brocade Fabric Switches*  
Chris Beauchamp, Josh Judd, and Benjamin Kuo

*Building Storage Networks and Building Storage Networks 2<sup>nd</sup> Edition*  
Marc Farley, Osborne McGraw Hill

*Cisco Storage Networking Architecture Poster*  
Cisco Press

*Clearing the Confusion: A Primer on Internet Protocol Storage Networks*  
David Dale, John Hufferd, and Ahmad Zamer, SNIA

*Connectathon 2001 NDMP Overview*  
Jim Ward, Connectathon 2001

*Designing High Speed Interconnect Circuit – Advanced Signal Integrity Methods for Engineers*  
Dennis Miller, Intel Press

*Designing Storage Area Networks 2<sup>nd</sup> Edition*  
Tom Clark, Edison Wesley 2003

*Designing Storage Area Networks – A Practical Reference for Implementing Fibre Channel and IP SANs*  
Tom Clark

*Disaster Recovery Planning – Preparing for the Unthinkable*  
Jon William Toigo

*Ethernet: The Definitive Guide*  
Charles E. Spurgeon

*FCIA Fibre Channel Fundamentals, 2003*

*Fibre Channel - A Comprehensive Introduction*  
Robert W. Kembel, NLA 2000

*Fibre Channel Arbitrated Loop*  
Robert W. Kembel

*Fibre Channel Connection to the Future*  
Fibre Channel Association FCA

*Fibre Channel for Mass Storage*  
Ralph H. Thornburgh

*Fibre Channel for SANs*  
Alan F. Benner

*Fibre Channel – Gigabit Communications and I/O for Computer Networks*  
Alan F. Benner

*Fibre Channel Switched Fabric*  
Robert W. Kembel

*Fibre Channel Volume 1: The Basics*  
Gary R. Stephens & Jan V. Dedek

*FireWire System Architecture Second Edition IEEE 1394a*  
MindShare, Inc. Don Anderson

*Gigabit Ethernet for Metro Area Networks*  
Paul Begell

*Gigabit Ethernet Networking*  
David G. Cunningham, Ph.D. and William G. Lane, Ph. D.

*Gigabit Networks – Standards and Schemes for Next-Generation Networking*  
Paul Izzo

*High Performance TCP/IP Networking – Concepts, Issues, and Solutions*  
Mahbub Hassan, Raj Jain

*IETF IP Storage RFCs*  
IPS Working Group, IETF 2003

*Introduction to Storage Area Network, SAN*  
Ravi Kumar Khattar, Mark S. Murphey, Giulio John Tarella, Kjell E. Nystrom

*Inside Windows Storage – Server Storage Technologies for Windows 2000, Windows 2003, and Beyond*  
Dilip C. Naik

*IP SANs– A Guide to iSCSI, iFCP, and FCIP Protocols for Storage Area Networks*  
Tom Clark

*IP Storage Networking: Straight to the Core*  
Gary Orenstein, Addison Wesley 2003



*SNIA Storage Network Foundations Exam Description*  
© SNIA 2007  
*iSCSI - The Universal Storage Connection*  
John L. Hufferd, Addison-Wesley 2003

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*Making SCSI Work – A Practical Guide*  
The Paralan Staff

*Melding NAS and SAN*  
InSight, Aberdeen Group 2001

*Multiprotocol Routing for SANs*  
Josh Judd, Infinity Publishing

*Network Storage Terms & Acronyms*  
Storage Networking Industry Association SNIA

*PC2001 PC Design Guide*  
Co-Authored by Microsoft and Intel, Intel Press and Microsoft Press  
<http://download.microsoft.com/download/win2000pro/PCG/1.0/NT5/EN-US/pc2001v10.exe>

*PCI-X System Architecture*  
MindShare, Inc. Tom Shanley

*P Storage Networking – Straight to the Core*  
Gary Orenstein

*Practical Storage Area Networking*  
Daniel Pollack

*Principle of SAN Design*  
Josh Judd, Infinity Publishing

*Resilient Storage Networks*  
Elsevier, ISBN 1555583113  
<http://www.storageio.com/>

*Resilient Storage Networks – Designing Flexible Scalable Data Infrastructures*  
Greg Schulz

*SAS Storage Architecture – Serial Attached SCSI*  
MindShare, Inc. Mike Jackson

*SCSI Trade Association Organization*  
<http://www.scsita.org/>

*Securing Storage: A Practical Guide to SAN and NAS Security*  
Himanshu Dwivedi

*Serial Attached SCSI: Beyond the Basics SAS*  
Knowledge Tek Author: Hugh Curley

*Server Design Guide (SDG version 3.0)*

Co-Authored by Microsoft and Intel, Intel Press and Microsoft Press

[http://download.microsoft.com/download/1/6/1/161ba512-40e2-4cc9-843a-923143f3456c/hdg\\_3.doc](http://download.microsoft.com/download/1/6/1/161ba512-40e2-4cc9-843a-923143f3456c/hdg_3.doc)

*Small Computer System Interface – An In-Depth Exploration Of*  
David Deming

*SMI ANSI Standard Document INCITS-2004*  
SNIA SMF, SNIA 2004

*SNIA Technical Dictionary*  
SNIA Education Committee

*Storage Area Networks – Designing and Implementing a Mass Storage System*  
Ralph H. Thornburgh and Barry J. Schoenborn

*Storage Area Network Essentials*  
Richard Barker and Paul Massiglia, Wiley 2002

*Storage Area Network Essentials – A Complete Guide to Understanding and Implementing SANs*  
Richard Barker and Paul Massiglia

*Storage Areas Networks for Dummies*  
Christopher Poelker and Alex Nikitin

*Storage Networks*  
Daniel Worden

*Storage Network Management – SNIA Technical Tutorial*  
Roger Cummings

*Storage Network Performance Analysis*  
Huseyin Simitci

*Storage Network Security – SNIA Technical Tutorial*  
Roger Cummings and Hugo Fruehauf

*Storage Security*  
John Chirillo and Scott Blaul, Wiley 2003

*Storage Security – Protecting SANs, NAS, and DAS*  
John Chirillo and Scott Blaul

*Storage Virtualization – SNIA Technical Tutorial*  
Frank Bunn, Nik Simpson, Robert Peglar and Gene Nagle

*Storage Virtualization Technologies for Simplifying Data Storage and Management*  
Tom Clark

*Successfully Implementing and Scaling SANs in the Enterprise - A Planning Guide for Storage Networking Professionals*

<http://www.searchstorage.com/>

*T11.org, T10.org, T13.org*

*The Book of SCSI – A Guide for Adventurers*  
Peter M. Ridge

