Section 1 – Storage

Objective 1.1 – Create and Administer VMFS datastores using advanced techniques.

Knowledge

- Describe how to identify iSCSI, Fibre channel, SATA and NFS configurations using CLI commands and log entries
- Describe the VMFS file system
  - Metadata
  - Multi-access and locking
  - Extents
  - Tree structure and files
  - Applicability to clustered environment
  - Journaling
- Explain the process used to align VMFS partitions
- Explain the use cases for round-robin load balancing

Skills and Abilities

- Perform advanced multi-pathing configuration
  - Configure multi-pathing policy
    - Configure round-robin behavior using command-line tools
  - Manage active and inactive paths
- Verify SAN LUN accessibility
- Configure and use NPIV HBAs
- Manage VMFS file systems using command-line tools
- Configure NFS datastores using command-line tools
- Configure iSCSI hardware and software initiators using command-line tools

Tools

- VI client
- CLI
  - esxcfg-vmhbaecls
  - vdf
  - fdisk
  - vmkfstools
Objective 1.2 – Implement and manage complex data security and replication configurations.

Knowledge
- Describe methods to secure access to virtual disks and related storage devices
  - Distributed Lock Handling
- Identify tools and steps necessary to manage replicated VMFS volumes
  - Resignaturing
  - Snapshot LUNs
- Understand how to configure physical storage adapter properties

Skills and Abilities
- Configure storage network segmentation
  - FC Zoning
  - iSCSI/NFS VLAN
- Configure LUN masking
  - Storage device
  - Host
- Configure iSCSI/NFS security options
- Use esxcfg-advcfg
  - Set Resignaturing and Snapshot LUN options
  - Set ESX Server host-side disk options
- Manage RDMs in a replicated environment
  - Virtual compatibility mode
  - Physical compatibility mode
- Use proc nodes to identify driver configuration and options
- Use esxcfg-module
  - Modify storage adapter settings
  - Identify and load/unload modules
  - Get module status

Tools
- VI client
- CLI
  - esxcfg-advcfg
  - esxcfg-module
Objective 1.3 – Troubleshoot Virtual Infrastructure storage components.

Knowledge
- Identify storage related events and log entries
- Analyze storage events to determine related issues

Skills and Abilities
- Verify storage configuration using CLI, VI client and server log entries
- Troubleshoot storage connection issues using CLI, VI Client and logs
  - Rescan events
  - Failover events
- Interpret log entries for configuration validation and predictive analysis
- Troubleshoot file system errors using logs and CLI

Tools
- VI client
- CLI
  - vm-support script
  - esxcfg-*
  - vmkfstools

Objective 1.4 – Implement and manage Storage VMotion.

Knowledge
- Describe Storage VMotion operation
- Explain implementation process for Storage VMotion
- Identify Storage VMotion use cases
- Understand performance implications for Storage VMotion

Skills and Abilities
- Use Remote CLI to perform Storage VMotion operations
  - Interactive mode
  - Non-interactive mode
- Implement Storage VMotion based on various use cases
  - Migration of all virtual disks to target storage location
  - Migration of virtual disks to independent target storage locations
Tools
- Remote CLI

Section 2 – Networking

Objective 2.1 – Install and configure Virtual Infrastructure networks.

Knowledge
- Differentiate physical and virtual switch characteristics
- Create and modify virtual switches and virtual switch policies
- Enable advanced networking capabilities
  - TCP Segmentation Offload (TSO)
  - Jumbo Frames
  - NetQueue
- Identify and understand the impact of various routing protocols

Skills and Abilities
- Configure service console network using CLI
- Configure VLANs (virtual networks)
- Configure TSO and Jumbo Frames
- Enable Cisco Discovery Protocol
- Use CLI commands to modify virtual network configuration

Tools
- CLI
  - esxcfg-nics
  - esxcfg-vswitch
  - esxcfg-vmknic
- VI client

Objective 2.2 – Install and configure a virtual networking infrastructure to meet set security design requirements.

Knowledge
- Understand network segmentation benefits and best practices
  - Isolation of Service Console traffic
  - Isolation of VMkernel traffic
• Define common network security risks and explain their impact to a virtual network infrastructure
• Describe and configure virtual switch security policies

Skills and Abilities
• Configure VLANs
• Set virtual networking security attributes
  o Forged Transmits
  o Promiscuous Mode
  o MAC Address Changes
  o VLAN configuration
• Configure switch notification

Tools
• CLI
  o esxcfg-vswitch
  o esxcfg-vswif
  o esxcfg-vmknic
• VI client

Objective 2.3 – Administer advanced VMkernel networking configurations.

Knowledge
• Define configuration options for VMkernel ports
  o Peer DNS
  o MTU
  o TSO
• Understand VMkernel routing
• Troubleshoot VMkernel configuration issues

Skills and Abilities
• Add and remove VMkernel ports
• Enable/Disable VMkernel ports
• Configure the VMkernel routing table
Tools

- CLI
  - esxcfg-vmknic
  - esxcfg-route
- VI client

Objective 2.4 – Manage Failover and Failure Detection

Knowledge

- Describe how to map port groups to physical NICs
- Understand failover order for physical NICs and attached port groups
- Explain options for detecting link failures
- Troubleshoot failover operations

Skills and Abilities

- Use CLI commands to manage uplinks
- Configure failover order
  - Active Adapters
  - Standby Adapters
  - Unused Adapters
  - NIC promotion
- Configure beacon probing
- Configure reverse teaming
- Set advanced network failover options
  - Failover detection
  - Failback
  - Link state tracking

Tools

- CLI
  - esxcfg-vswitch
- VI Client
Objective 2.5 – Administer advanced Service Console networking configurations.

Knowledge
- Define configuration options for VMkernel ports
  - Peer DNS
  - MTU
  - TSO
- Understand VMkernel routing
- Troubleshoot VMkernel configuration issues

Skills and Abilities
- Inspect Service Console network configuration
- Enable/Disable vswif interface
- Configure advanced service console networking
  - Redundant HA heartbeat
  - Packet tracing
  - CHAP authentication for iSCSI
- Configure hostname resolution
  - /etc/hosts
  - /etc/nsswitch.conf
  - /etc/resolv.conf
- Monitor traffic over a Virtual Switch
  - Bandwidth
  - Dropped packets
- Identify and resolve network issues using network monitoring tools
  - tcpdump
  - Snoop

Tools
- CLI
  - esxcfg-vswif
  - dig
  - netstat
  - route
  - nslookup
  - hostname
  - vmknic
  - esxcfg-route
- VI client
Objective 2.6 – Manage Service Console firewall configurations.

Knowledge
- Understand firewall rules
- Explain the use of services in a firewall configuration
- Identify which ports must be open in a virtual infrastructure firewall configuration

Skills and Abilities
- Configure ESX Server firewall settings
- Open and close ports
- Monitor firewall logs

Tools
- CLI
  - esxcfg-firewall
- VI client

Objective 2.7 – Administer complex iSCSI configurations.

Knowledge
- Understand how iSCSI is used with the VMkernel
- Identify iSCSI features and limitations
- Design an iSCSI solution

Skills and Abilities
- Configure the ESX Server iSCSI software initiator
- Open the related firewall ports for iSCSI
- Manage iSCSI initiator settings
  - Discovery
  - CHAP authentication

Tools
- CLI
  - esxcfg-swiscsi
  - vmkiscsi-tool
  - esxcfg-rescan
  - esxcfg-firewall
- VI client
Section 3 – DRS Clusters and Performance Monitoring

Objective 3.1 – Create and administer complex DRS clusters.

Knowledge

- Demonstrate the use or resource pools and child pools with DRS clusters
- Understand how to monitor DRS cluster performance and resource utilization within the cluster
- Explain best practices for DRS cluster design
- Understand performance considerations for DRS clusters

Skills and Abilities

- Deploy complex resource pools
  - Utilize best practice guidelines
  - Configure expandable reservations where applicable
- Deploy a complex DRS cluster
  - Ensure optimal use of Maintenance Mode
  - Configure appropriate threshold settings
- Implement Distributed Power Management within a DRS cluster
- Monitor DRS clusters
  - Cluster performance
  - Resource utilization
  - Troubleshooting

Tools

- VI client

Objective 3.2 – Demonstrate advanced performance analysis techniques.

Knowledge

- Demonstrate the use of various performance tools
- Understand configuration options for performance data collection
  - line graphs vs. stacked graphs
  - real-time vs. historical metrics
  - statistics collection levels
- Use performance information to troubleshoot and resolve:
  - CPU Utilization issues
  - Memory utilization issues
  - Disk utilization issues
Skills and Abilities

- Use esxtop to monitor the health of the ESX Server
- Use vm-support to capture performance snapshots of the ESX Server
- Use guest OS performance analysis tools to determine performance characteristics within the virtual machine
- Generate reports and collate data from VirtualCenter
  - Alarms
  - Resource utilization
  - Performance
  - Topology Maps
- Diagnose resource utilization issues
  - CPU ready time/wait time
  - Memory ballooned/swapped
  - Disk queue depth/locking
  - Network dropped packets/

Tools

- CLI
  - esxtop
  - vm-support
- VI Client
  - Performance graphs
  - VirtualCenter management server configuration

Section 4 – Business Continuity and Data Protection

Objective 4.1 – Configure Virtual Machine Clustering.

Knowledge

- Explain the different methods of clustering virtual machines
  - Cluster in a box
  - Cluster across boxes
  - Physical to Virtual clustering (N+1 clusters)
- Describe how shared storage is configured with clustering
- Understand HBA configuration options
Skills and Abilities

- Configure bus sharing options
  - Physical
  - Virtual
- Configure Raw Device Mappings (RDMs)
  - Pass-through
  - Non pass-through
- Configure HBA options
  - Queue depth
  - Device/LUN Reset
  - Timeout value

Tools

- CLI
  - esxcfg-advcfg
  - esxcfg-module
- VI client

Objective 4.2 – Configure advanced HA deployments

Knowledge

- Describe guidelines for restart priority and isolation response.
- Explain how to customize a typical HA deployment
- Understand HA communication (heartbeat)
- Detail impact of DRS affinity rules on an HA cluster
- Describe troubleshooting techniques
- Explain best practices for HA deployment

Skills and Abilities

- Configure restart priority and isolation response
  - Cluster-wide setting
  - Individual VM override settings
- Configure advanced HA options
  - Failure detection time
  - Redundant isolation address settings
  - Default failover host
- Configure physical switch settings to support HA
- Troubleshoot HA deployments
  - Failover capacity
Objective 4.3 – Configure and Administer VMware Consolidated Backup (VCB)

Knowledge
- Explain VCB capabilities, limitations and best practices
- Describe how snapshots are created
- Understand differences between file-level and full VM backups
- Detail what files are part of a full VM backup
- Explain how to integrate VCB with
  - Third-party backup software
  - Multipathing software
  - VirtualCenter
  - VMFS Storage
- Explain VMware Converter based restores
- Describe common VCB log files

Skills and Abilities
- Verify sizing of VCB holding tanks based on full VM backup requirements
- Perform integration tests
  - VCB to VirtualCenter
  - VCB to Third-party backup software
  - VCB to VMFS Storage
- Analyze VCB logs to verify functionality
- Use VCB command line tools to verify and troubleshoot VCB deployments
- Review multipathing configuration
- Run performance tests to determine optimal VCB deployment
- Configure a VCB backup role into VirtualCenter

Tools
- CLI
  - vcbVmName
  - vcbSnapshot
o vcbMouter
o vcbExport
o mountvm
o vcbRestore
o vcbUtil

• VI client
• VMware Converter

Section 5 – Operational Maintenance

Objective 5.1 – VMware Update Manager

Knowledge
• Describe Update Manager capabilities
• Explain VUM architecture and components
• Describe DRS-enabled remediation

Skills and Abilities
• Install and Configure Update Manager
  o VUM Server
  o VUM Agents
  o VUM Download Server
  o VI Client plug-in
• Perform Update Manager tasks
  o Establish baselines
    ▪ Fixed
    ▪ Dynamic
  o Manage and attach baselines
  o Schedule and perform scans
  o Interpret scan status and compliancy
  o Schedule and perform remediation
  o Rollback
• Troubleshoot remediation failures

Tools
• VI client
• CLI
  o vmware-umds

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Section 6 – Logging

Objective 6.1 – Configure VirtualCenter log behavior

Knowledge
- Identify location of VirtualCenter related log files
- Describe options for customizing VirtualCenter log behavior
- Describe options for customizing VI Client log behavior
- Explain default log file characteristics
- Understand log file collection methods

Skills and Abilities
- Modify VirtualCenter Server log configuration
- Modify VirtualCenter Agent log configuration
- Export VirtualCenter logs

Tools
- VI client
- CLI

Objective 6.2 – Configure Service Console log behavior

Knowledge
- Describe Service Console log consolidation
- Identify location of Service Console related log files
- Describe options for customizing Service Console log behavior
- Explain default log file characteristics
- Understand log file collection methods
- Define additional third-party log files located on the Service Console

Skills and Abilities
- Configure Service Console log file rotation
- Modify VC Server log configuration
- Modify VC Agent log configuration
- Export VC logs
Tools

- CLI
  - syslogd
  - logger

Section 7 – ESX Server Security

Objective 7.1 – Configure secure remote access.

Knowledge

- Explain how to prevent remote root login
- Describe the process to allow selected users remote access capabilities
- Understand authentication process and options
- Describe SSH implementation
- Understand how user access is tracked and logged
- Explain the use of TCP wrappers to restrict access from specific hosts/addresses

Skills and Abilities

- Enable/Disable root SSH login
- Modify the default settings to allow both incoming and outgoing SSH traffic
- Create ESX Server user accounts and assign group memberships
  - Command Line
  - VI client
- Configure SSH
  - AllowUsers/DenyUsers
  - Banner
- Define VI Client roles and user and group assignments
- Use Service Console commands to track user access
- Use esxcfg-auth to modify authentication settings
  - Preferred authentication method
  - Login attempts
  - Password aging
- Configure TCP wrappers
  - hosts.allowhosts.deny
Objective 7.2 – Delegate administrative privileges

Knowledge

• Explain how to restrict access to administrative functions
• Describe the process to restrict access to specific administrative commands
• Understand how attempts to use administrative functions can be logged

Skills and Abilities

• Switch from a standard user account to root
• Enable the use of the wheel group
• Configure sudo
  • Users/Groups
  • Hosts
  • Commands
  • Aliases

Section 8 – Rapid Provisioning

Objective 8.1 – ESX Server Scripted Installation

Knowledge

• Explain the usage of the Scripted Installation wizard
• Describe the various methods of automated deployment
  o CD Rom
  o HTTP/FTP
  o NFS
• Define the directives contained in the installation script

Skills and Abilities
• Set up hardware and various connections
  o Boot from SAN
  o Layout of local drives in various raid configurations
• Create an install script and verify the following sections
  o Command
  o %packages
  o %pre
  o %post
  o %vmlicense_text
• Configure Service Console components of an ESX server
  o Network Time Protocol (NTP)
  o DNS
  o SNMP
• Install supported third party agents according to the design plan

Tools
• VI client
• CLI