NCSA-HC

**Cloud Fundamentals**

**Storage Fundamentals**

* **Disk** – uses rapidly rotating disks coated with magnetic material for storing and retrieving digital information.
* **Disk Array** – collection of disks that form a redundant storage system that is controlled by firmware. Has cache memory and advanced functionality such as RAID and virtualization. Increases availability, resiliency, and maintainability.
* **JBOD (Just a bunch of disks)** – collection of disks that are not in a RAID configuration. Disks are presented to a server with no amalgamation, pooling, or structure applied.
* **Intelligent Storage Systems** – capability of fully or partially realizing functions that are usually implemented on host computers. Front end, cache, backend, and physical disks
* Reasons to Invest in Storage:
  + Applications
  + Data Protection
  + Data Availability
  + Data Security
  + Scalability
  + Performance
  + Cost

Storage Technologies

* **DAS (Direct attached Server)** – attached disk without any network in between.
* Can be individual disks, group of disks, attached to disk
* Application sharing and file sharing
* Used mainly for server or group of servers. Most cost-effective solution
* Protocols
  + ATA
  + SATA
  + eSATA
  + SCSI
  + SAS
  + FC
* **NAS (Network Attached Storage) –** appears as a file server with an IP address. Accessed over a network connection.
  + Takes the filer portion which handles file transfers solution. Acts like its own container computer.
  + Cost Effective
  + Utilization rate is high
  + Protocols
    - CIFS
    - NFS
* **SAN (Storage Area Network)** – block based storage system available over the system.
  + Can move large amounts of data.
  + Protocols
    - iSCSI – IP based storage access protocol. iSCSI initiator is a server that initiates iSCSI command. iSCSI targets are storage devices that are iSCSI enabled.
    - FC – HBA (host bus adapter) installed on each server. HBA’s connect the server directly to the storage system in a small environment. Can also be connected with a FC switch. Accelerate backup and restore, improve business continuanace, boost HA, and storage conslidation
    - FCoE – FC protocol with 10 GB Ethernet. Eliminates the need for two different data centers.
* **Storage virtualization** – consists of taking several physical storage devices and joining them to appear as one logical unit to manage.
* **Flash Storage**
  + Memory unit – stores data
  + Access Controller – manages and controls access to the storage space on the memory unit
* **Cloud Computing** – resources used in the cloud.
  + Public Cloud
  + Private Cloud
  + Hybrid Cloud

**Virtualization Fundamentals**

* **Virtualization** – breaks the bond between hardware and applications, allowing customers to realize higher utilization levels of their physical resources.
* **Server virtualization** – server can run multiple applications and OS’s. Greater utilization
  + Benefits: low server spend, decreased OS costs, lower management costs, increased flexibility, higher availability
  + Could have complete failure for 10 systems if data is not backuped.
  + Server sprawl doesn’t remedy storage sprawl
* **Storage virtualization:**
  + RAID 0 strips data across 2-3 disks with no parity for redundancy.
  + RAID 1 mirrors data across 2-3 disks. Fault tolerance
  + RAID 5 uses block level stripping with parity data distributed across all member disks and only needs 1 drive to be present to operate
  + RAID 10 is a strip of mirrors. Multiple raid 1 mirrors and a raid 0 strip is created over these.
  + Snapshots are incremental
  + Benefits:
    - Utilization – flexvault allows better utilization
    - Deduplication – contains a copy of 1 OS across multiple VM’s
    - Multiprotocol in a single storage pool, lower TCO, investment protection, DR more accessible.

**Flash Fundamentals**

* **SSD Basics**
  + SSD provide higher performance than HDD
    - Measuring endurance is different
    - Flash accelerates I/O
      * Server
      * Hybrid
      * All Flash array (Flash appliances) contains controllers and DRAM
      * Traditional arrays
    - Flash Devices
      * USB Drives
      * SD Cards
      * PCIe Cards (Perferral Component Interface)
      * SSD
    - Components
      * DRAM memory
      * Flash controller – manages data placement and access, transfers data to DRAM
      * Flash memory chips
* NAND - Container that stores a charge
  + Surrounds a permeable barrier to hold the charge
  + NAND is NVMEM
    - Data is maintained across power cycles
    - Barrier remains closed until power is supplied to open it
    - Barrier requires power to release its charge
    - NAND used to use SLC (Single-Layer cell) and then MLC (multilayer cell) and then TLC (Triple-layer cell)
    - 2D NAND
      * Shrinking planar cell holds less charge
      * Fewer electrons
      * Fewer program/erase (P/E) cycles
      * Small loss
    - 3D NAND
      * Use larger cells
      * More differentiation between bit states
      * Less interference
      * Better P/E cycles, better endurance
      * Increased scalability
      * Benefits
        + Endurance
        + Density
        + Power
        + Performance
* SSD Endurance
  + SLC
  + eMLC (enterprise) – slower programming speeds but high P/E
  + cMLC (consumer) – high programming speeds but low P/E
  + P/E cycles (Program/Erase) – finite lifetime. Bit errors occur when charged can be recognized.
  + DWPD (Drive writes per day) – Evaluation = TBD + DWPD.
    - P/E cycle rating
    - Expected lifetime of the drive
    - Average write amplification
    - Percentage of overprovisioned capacity
  + Warranty
  + Workload
  + Voltage – improves i/o but wears on it.
  + Write amplification – aggregate measure of PE cycles. Caused by rewrite activity to a used block. Reduces endurance
    - Voltage can’t be added incrementally to a cell. All the voltage must be taken out before a new value can be put in.
    - NAND flash must be erased before a rewrite
      * Erase block are much larger than write block
      * Rewriting a block forces a rewrite of the full erase block
    - FTL (Flash Translation Layer) part of the controller
      * FTL can move the on-disk data location as needed
      * Abstraction layer between host address and on-disk data
      * Logs overwrite as they occur.
        + New data is written to a new location
        + Dirty data is marked for deletion
        + Erased blocks are logged as dirty blocks as well
      * Attempts to use all NAND erase blocks equally which is known as wear leveling
      * Write amplification is reduced by deferring the P/E cycle.
      * Garbage collection
        + Dirty blocks accumulate
        + FTL can reclaim fragmented space
        + Increases free space on your SSD
        + Runs transparently in the background
        + Has potential for latency
        + Some systems with internal write-back cache in the controller maintain low latency.
        + Needs swap space to operate efficiently.
        + Overprovisioning (OP) is a dedicated capacity that can’t be accessed.
  + MSW(Multi-stream Write) – data management feature
    - Enables greater control and efficiency for data placement
    - Reduces overprovisioning requirements
    - Enables multiple data streams to be grouped or segregated
    - Enables writes to be tagged so the FTL can work better.
  + TBW (Total Bytes Written)
    - Provides data around the life of the SSD compared to it’s P/E. Compares data relative to the warranty agreement.
  + Storage disk show – shows current usage life of the SSD.

**Data Network Fundamentals**

* Data Network is data over distance
* Data Storage is data over time.
* DAS (Direct-Attached Storage) – Application, File System, and Storage are all connected together. Like an external hard drive.
* NAS (Network-Attached Storage) – Device is attached to the network but appears on the network. Accessed by other machines.
  + Looked at by one device connected through the network. Appears as a file server
  + File access
  + Management simplified
* SAN (Storage Area Network) – Storage appears to the network as another drive.
  + On it’s own network. Mounted as a disk drive
  + Dedicated to storage
  + Block access and stored as data blocks
  + Performance High, configuration flexible.
* SAS (Serial Attached Scusi)
  + Network is created via aerial cables.
  + Can’t be longer than 8 meters and has limited range. Inexpensive
* FC (Fibre Channel)
  + SAN environment to signal to the FC
  + Reliable, Scalable, Flexible
  + Can be used with most cable types
  + FC-P2P (point-to-point)
    - Host server connected to the storage appliance
  + FC-AL (arbitrated loop)
    - All devices are in a loop
    - More connects
    - Failures can cause a break in the loop
  + FC-SW (Switched Fabric) single or dual
    - Interconnected via switches
    - Each host either connected to a single or dual
  + Zoning
    - Group of fibre channel ports
    - Only located in one or multiple zones.
    - Hard is defined by a switch
    - Soft cables can be moved without reconfiguring.
  + Block storage
    - Handles data in chucks
    - Provides greater flexiblity
  + File storage
    - Handles data in terms of files.
    - Easier to deploy
  + HA – data available at all times
    - Redundancy
    - 99% or 99.99%
  + HPC – exceptionally large system
    - Small configuration changes produce large benefits
    - Performance is measured in FLOPS (Floating point operations per second)

**Intro into NetApp products**

* ONTAP 9 – runs on traditional FAS and AFF with some converged systems/3rd party/near cloud
  + Consolidates data management
  + Reduces costs of flash with inline storage efficiencies
  + Increases performance up to 60% with flash optimizations
  + Shrink storage footprints with 15 TB.
* ONTAP Select – Software defined that is run on-premise on commodity server hardware
  + Deployed in a DC or remote office
  + Uses a flexible capacity-based license
  + Capitalizes on SDS
  + Data protection
* ONTAP Cloud – run in the cloud on AWS/Azure. (E, EF, and SolidFire uses other software
  + Quick deployment for DevOps
  + Enables easy data movement between onpremises.
* OnCommand Management Protfolio
  + System Manager
    - Included with ONTAP software.
    - Works with all FAS systems and flex software
  + Unified Manager/Performanced Manager
    - Provides storage health
  + OnCommand Workflow Automation (OnCommand WFA)
    - automated operations
  + API Services
  + OnCommand Insight
    - Single interface with multivendor environments
* SnapCenter Software
  + Unified solution for data protection. Powered by SnapCenter Server
  + Plug-ins replace Snapmanager and Snapdrive
  + Includes a plugin creator
  + Benefits
    - Centralized UI
    - Increases performance and reduces testings
    - RBAC
    - Offers load balancing
  + Snapshot – low impact. POT
  + SnapVault – Disk to disk backup with RPO < 1 hour and incremental transfers.
  + SnapMirror – Regional Dataprotection with asynchronous and fail back
  + Metro Cluster – array base clustering
  + SnapLock – retain data to maintain data compliance.

**FAS Systems**

* FAS2600 – Small enterprises, midsize businesses
* FAS8200 – Enterprise workloads
* FAS9000 – Business-critical workloads
* FAS support SAS, SATA, SSD, and NSE (Netapp Storage Encyrption) with HA

**All FLASH FAS**

* AFF8000 – Entry Level
* AFFA200
* AFF8040 – Midrange
* AFFA300
* AFF8080/AFF8080EX – High End
* AFFA700s
* AFFA700

**Unified Storage Architecture**

* Nondisruptive operations
* Seemless scalability
* Proven efficiency

**E Series**

* E2800 – small/medium workgroups
  + 12 disks
  + 24 disks
  + 60 disks
* E5700 – DC, HP environments
  + 24 disks
  + 60 disks
* EF570
  + 24 disks
* DE212C
  + 2U, 12 disks
* DE224C
  + 2U, 24 disks
* DE460C
  + 4U, 60 disks
  + System shelves contain controllers
  + Disk shelves contain input/output modules (IOM’s)
    - IOM monitor disk shelves and give a way to cascade disk shelves
* SANtricity System Manager
  + Administer E-Series or EF series
  + Maximizes storage use and promotes uninterrupted data availability
  + Highly configurable to optimize performance
  + Keeps data always available, protected, and secure

**SolidFire Systems**

* EF-Series
  + Standalone applications
  + Streamlined architecture optimized for low-latency workloads
* All Flash FAS
  + Performance plus robust data management optimized for shared general IT
  + General-purpose virtual infrastructure
* SolidFire
  + Seamless scaling, service-oriented flash storage for next-gen DC
  + Cloud infrastructure, on-premises or off-premises
  + Scale out to 100 nodes and PB of data
  + Compatible with existing customer hardware
  + QOS and system automation. HA/inline data reduction technologies
  + Add new nodes to expand
* Active IQ
  + Holistic system monitoring
  + Enable customers to prevent storage issues
  + Simplifies data management

**Converged Infrastructure Solutions**

* FlexPod
  + Combine a UCS and Nexus Switches + NetApp storage
  + Supports any cloud strategy
  + Supported by NetApp/Ciscio support desk
  + Accelerates DC transformation
  + FlexPod Express – remote office or branch office
  + FlexPod Datacenter – enterprise applications/Vdi
  + FlexPod Select – Big Data and Analytics
  + FlexPod SF – Next gen DC

**NetApp HCI**

* HCI (Hyper Converged Infrastructure) – relies on software to integrate compute, server, storage, virtualization, and virtualized internal networking
  + Conveniently and neatly encapsulated
  + Data Fabric Ready. Easy to scale/Guaranteed Performance/Automated Infrastructure
  + SolidFire is the pick for HCI.
    - Integrated Data Services
    - Data Fabric Services
    - Third-Party Services

**FlexArray Storage Virtualization Software**

* Enables E-Series or third-party vendor storage arrayed to be used for ONTAP aggregates
* Can be purchased and activated any time on FAS8000
* Works with FAS disk and storage arrays
* Support multiple array vendors
* Benefits
  + Converts silos into Unified

**Near-Cloud and Cloud Solutions**

* ONTAP Cloud
  + Manage elastic workloads
  + Enable customers to control and govern data in the cloud
  + OnCommand Insight
  + OnCommand Cloud Manager
  + Multiprotocol support, snapshot, provisioning, deduplication, etc
* NPS (NetApp Private Storage)
  + Manage elastic workloads
  + Can connect to multiple clouds
  + Retain control
  + Hybrid approach
* AltaVault
  + Low cost backup workloads
  + Caches backups locally vaults to public or private cloud
  + Perserve investments in existing infrastructure
* StorageGRID Webscale
  + Active archival workloads that are accessed regularly
  + Manages massive unstructured datasets
  + Spans geographic distributed locations
  + Manages data based on cost, security, etc
  + Encryption with secure multisite dispersion
* Cloud Sync
  + SaaS enables seamless secure data sync
  + Moves and syncs data between on-premise or with S3
* NetApp Cloud Control for Office 365
  + Manages data for Office 365
  + Simplified backups and advanced granular recovery

**NetApp Business Consulting and Professional Services**

* NetApp Business Consulting
  + Define strategic direction to drive innovation and evolve business
  + Supply data-drive insights and identify opportunities
  + Accelerate digitial transformation
* Professional Services
  + Smooth deployment and transition with end-to-end expertise
  + Business expectations
* End-to-End Services
  + Plan/Strategy-Design
  + Build/Deploy – Transition
  + Run/Operate - Optimize