Shubhangi Dutt
CS-524 A

CS- 524 Introduction to Cloud Computing

Assignment-5

Answer 1

Rack Server - The name rack server refers to the fact that it is housed in a rack, which is a basic metal frame around 19 inches wide. It is measured in units such as 1U, where 1u equals 1.75inches. This structure or rack can be made more complicated by adding factors for efficiency, such as improved power distribution, which need cooling (air or liquid). I/O devices that can be shared across other servers through an I/O switch are another option for add-ons.

Blade Server -The blade server has no other server attachments; it is simply a circuit board containing a processor, memory, and I/O. Because it is compact and can fit inside a rack server if more parts are required, it has an advantage over Rack server. As a result, this is a good option for cloud computing.
The following are the reasons for using these kind of servers:

- It was an attempt to decrease the amount of physical space that servers typically occupied. The Blade server, in particular, takes up less space and hence has a smaller physical footprint.
- Second, because the connections are simpler, there is less cable spaghetti.
- Most significantly, by utilizing them, we get flexibility. This is due to the fact that we may add or delete elements/devices as needed, rather than using a fully loaded server at all times.

Answer 2

In order to connect nodes in a wired LAN or WAN we make use of ethernet. These nodes may be servers of a data center in which case the ethernet works on the following technologies:-
TOR- This is the abbreviated form of top of rack which as the name suggests has a switch at the top of each server in the rack. These switches are connected along the height of the rack and therefore TOR ensures limited cable usage. It is implemented using copper cables.

EOR- This is the abbreviated form of end-of-rack which means the switches are placed at the end of each row of racks thus connecting all servers in a row. Although this ensures a higher level of connectivity it comes with higher costs due to more cable length and the usage of optical fibre cables.

Ethernet technology is particularly significant because it tries to eliminate the requirement for additional transport technologies that are typically necessary for storage and traffic processing.

Answer 3

In order to understand which type of storage is suitable in which scenario we need to understand the basic difference between the three. DAS is Direct-Attached Storage which means it is fixed to the physical device or host machine. This means higher throughput but not good scalability. NAS is Network Attached Storage which is a storage for files on a network. NAS helps central storage of files or objects which enables easier access to data across the network. SAN is Storage Area Network which helps store bytes of data on a network with multiple connections so as to avoid a single point failure in transfer or access of data.
Upon understanding the differences it is clear that DAS cannot be implemented on Cloud Computing because it lacks scalability, availability, remote accessibility while NAS and SAN provide the same.
DAS does have an edge over NAS and SAN as it has high performance,no network delay, within or outside the host and low cost setup which is why it is suitable for keeping local data such as boot image or swap space.

Answer 4

The phy layer keeps in check out-of-band signals, errors, line coding etc. The phy layer is present in both source and receiver SAS architecture in order to perform smooth serial transmission of data. It makes use of 8 bit unique identification and other ways to identify number of pathways in which data is being transmitted.
It is used in transmitter-reciever devices to ease transmission unlike the physical layer which works with physical and electrical characteristics of cables, connectors etc.

Answer 5

There are 4 generic file-related system calls, namely; read, write, open, close.
There is no RPC invocation for the close system call because of the following reasons :-

- It helps in crash detection. This works because the architecture is stateless and thus does not save the state in all locations which therefore helps identify a crash.
- No file modification

An RPC invocation does not take place if a file is stored in a client cache. This is because a remote procedure call isn't required to access the client cache. This results in faster access of data.

Answer 6

There are three types of topologies supported by FC-2M which are as follow:-

- Point-to-point - In this topology a direct or dedicated connection is established between two nodes on a network. It is a simple connection.
- Arbitrated loop- An arbitrated loop topology is a simpler version of fabric topology which has nodes connected in a one-way loop or ring and enables only two nodes to communicate at a time.
- Fabric- The most flexible topology is the fabric topology which has nodes connected by switches. This enables multiple links in different fashions to communicate simultaneously. Multiple physical links means higher throughput and lesser single point failure.

Answer 7

The connection between an Enode and an FCF takes place after a series of events between an Enode and an FCF. It starts with FCFs repeatedly broadcasting advertisements to a multicast address and an Enode selecting a particular FCF, to which it then sends a Discovery Solicitation. Upon recieving this solicitation the FCF node performs entity discovery and sends a discovery advertisement to the Enode which confirms the FCF to be capable. After receiving this advertisement the Enode sets up a virtual link with the FCF for a login request post which ports are established on both ends and a virtual link is setup.

Answer 8

a)
Every node in the network is assigned a unique ISCSI code that is used to identify it worldwide. The distinction is that several nodes can have the same address, while a single iSCSI node can be accessed from multiple addresses. We may use this functionality to establish a communication session between iSCSI nodes using multiple TCP connections. As a result, a higher throughput is achieved.

b)
The following features are essential to SCSI operations

- Congestion-control - Since SCSI connections have multiple sessions it can establish a link using any of the sessions however all data must be transmitted through that link selected. Availability of multiple links provides congestion control
- In-order delivery - Since data must be sent as per R2T PDU, data is sent in order.
- Retransmission of failed packets- Once the link is established data is sent as per the pre-determined cap of data and every session has a three-layer data recovery scheme.

c)
SCTP was not used in SCSI as it was fairly new while TCP had been around for a while. The level of familiarity was a lot higher in TCP at the time of standardization and hence TCP was the immediate choice.

d)
Since authentication of nodes only takes place in the initial stop of the login procedure there is no way to confirm that the communication is in fact happening between the initial nodes at a later point in time which means data transfer is not safe and can be subject to attacks. To prevent this we make use of the IPsec tunnel. This ensures no eavesdropping or active attacks on data.

Answer 9

Since SCSI connections have multiple sessions it can establish a link using any of the sessions however certain connections must be left unused for task management and the ones used should be well co-ordinated and in sync which requires monitoring. This raises the level of complexity we hoped to resolve. Therefore we make use of connection allegiance in which any connection can be used to send the data but once data transmission begins on that connection no other connection can be used for the same. This is done by the initiator issuing a command on the connection to initiate transmission.

Session management is done by login procedure which helps add a connection to a session or create a new session entirely.

Answer 10

Granular access control is a necessity in cloud computing and is achieved by combining concepts of credentials and capability in access control. These concepts define the following:-
Capability- It describes the access permissions for tasks that can be performed by the user such as read, write, create, and delete.
Credential- It is a cryptographically encrypted structure that cannot be tampered with. It ensures

each capability is secure with a common key. This key looks like the following
capability key = HMAC (secret key, capability || object storage identifier)
An example of the proof derived from the capability key is how we use the capability key in combination with the amount of data to be transferred along with a security method.

Now as per the capability defined, the capping of I/O data and the key, data is securely transferred. This ensures that the data is tamper-proof, and verifiable however it does not make sure that the capability is safe against unauthorized use. There is no way to identify a channel between client and storage, or the target device using the credential which therefore can cause a data breach. Hence we cannot use credential as proof for access control.

Answer 11

Approaches to block-level virtualization differ based on where the virtualization is done. It is of three types which are explained as follows:-
Host - The host level virtualization is controlled by volume manager which is a part of the OS. The volume manager is in charge of controlling how the native storage should be translated into blocks of memory that can be used by applications, dynamically. If an application requires huge memory space it provides a larger block of memory however if less memory is required it shrinks the memory space to fit the requirement. This is highly efficient for single host however in a multihost system where memory is shared this cannot be used because different hosts would require different allocation of memories.

Storage device - Storage device based virtualization is managed by controller of storage systems which is usually in close proximity to the host. This gives an improved performance however does not work across remote hosts.

Network - The network level virtualization is controlled by a function in switch. This isn't particularly visible to the host machine unless the protocols aren't followed. These protocols include FC, FCoe, iSCSI. It is further divided into inbound and outbound and is better useful for cloud computing techniques. This is because it can handle traffic differently(in-band and out-band approaches for different types of traffic) and improve performance. This creates transparency and flexibility.

Advantages to in-band approach:-

- Centrally controlled- In-band approach is centrally controlled which aides in monitoring storage metadata like snapshots and migration. Snapshots store important data of virtual memory like AMI in AWS.

- This snapshot feature can help revert to last stable state.

Disadvantage of in-band approach:-

- Here virtualization function is in controla nd application traffic. Since it is centrally controlled it can be a source of bottle neck if traffic increases drastically.
- The snapshot feature can create other hosts to be unstable.

Advantages of Out-band approach :-

- Here virtualization function is only in control traffic and not in application traffic which means no bottle neck. Therefore results in improved performance.

Disdvantages of Out-band approach :-

- The user needs to distinguish between application and control traffic.
- In order to distinguish the traffic an adapter is installed which requires a consistent cache, thus more effort.

Answer 12

The differences between NOR nad NAND flash solid state drives are as follows :-
NOR -

- It is based on Nor gate.
- Fast and addressed to a given byte
- Storage density limited

NAND-

- It is based on NAND gate
- Addresses only in units greater than byte
- Storage density huge therefore more widely used.

Answer 13

1. Delete is done on block basis which is of fixed size, 16,32 64 bytes howerver write is done on page basis which may or may not have a fixed size.
2. A user can only perform write-erase cycles a limited number of times after which the memory cells erase.

3. To perform the write operation,any existing data (if any) needs to be erased first. This therefore results in write operations taking more time than read operations.

Answer 14

A memcached server makes use of key value pairs in order to retrieve data which helps in situations where taska are heavier such as running queries through a database. For example a query can be cached in the memcache server and it will prevent re-querying thus saving memory heavy tasks.
As the size of the data increases it cannot be stored on a single server therefore multiple servers are used whose DRAM is clubbed together. Memcached servers even if connected, are not centrally controlled or monitored. This means a memcached server cannot select which data to retrieve from which server, this is done by the user based on the key.
This process is based on s = H(k) mod n where n should always be a constant for it to work.

As the number of server may change constantly the value returned from this function changes and can be inconsistent therefore another approach is used. We first map the range of the function from max to min clockwise. Each server is assigned a value on a point of the circle. In order to select a server to fetch a key a user needs to select the server with a value greater than H(k). This is known as Consistent Hashing in Memcached Servers.
Consistent Hashing also has certain conditions for servers entering or leaving the pool which are as follows:-

- Any key that is allocated to a server should be reallocated to its neighbours when the server leaves the pool
- Any server that joins the pool must take on keys from it's neighbouring servers.

The result is that instead of impacting the entirety of servers in case of updation of number of servers, only neighbours of the server are impacted.

Resources

https://blog.purestorage.com/purely-informational/san-vs-nas-vs-das-whats-the-difference/
https://www.snia.org/sites/default/education/tutorials/2007/spring/networking/SAS-Overview.pdf
https://en.wikipedia.org/wiki/Arbitrated_loop
https://en.wikipedia.org/wiki/Switched_fabric