Web Hosting

- Hosting websites refers to placing websites on web servers to bring them into access by people over internet. Web servers play a significant role in web hosting services as they form the key elements. Following are few functions performed by web servers in hosting:
Role of Web Servers in Web Hosting

• Stores and secures website data: In web hosting services, a web server stores all website data and secures it from unauthorized users when it is properly configured.

Provides web database access: A web server’s responsibility is to provide access to websites that are hosted. Web hosting service providers own some web servers that are used in variable ways to provide different web hosting services, such as backend database servers.

Serve the end user requests: Web servers accept requests from different users connected over the internet and serve them accordingly.
Shared Web Hosting

- With shared hosting, multiple websites are hosted on the same physical server.
Shared Web Hosting

• **Advantages**
  – Shared web hosting is popular among small business owners as it is the cheapest of all paid web hosting services.
  – The web host provides technical assistance to the website owners in the form of system administration.

• **Disadvantages**
  – The major disadvantage with shared hosting is limited resources as multiple websites share the same server.
  – A single website overusing the resources can affect all the websites hosted on that particular server. This may result in slow loading of web pages and repeated downtime.
Virtual Private Server (VPS) Hosting

- With VPS hosting, multiple clients share the same server; however, unlike in shared-hosting, the main server is split into smaller virtual servers.
Virtual Private Server (VPS) hosting

• Advantages
  – VPS hosting is cost-effective and is suitable for small and medium-sized businesses.
  – You will have more control over your server (compared to shared hosting) - you can use specialty functions like running scripts for your website, including new programs into your system, etc.

• Disadvantages
  – Though it is actually a separate server, there are multiple sites hosted on the same physical server.
  – If one of the websites consumes a lot of CPU or RAM resources, it can impact the entire server and therefore your virtual server too.
Dedicated hosting

• With dedicated web hosting, one server operates for a single client exclusively. As the whole server is used for a single user, it'll provide bandwidth and a memory large enough to accommodate large amounts of traffic.

• **Advantages**
  – Dedicated web hosting is good for websites having large traffic like e-commerce sites. Such sites require large storage space, bandwidth and secure servers.

• **Disadvantages**
  – It's expensive.
  – You need to have the requisite skills and competence in technology (monitoring, upgrading and constructing) so that you can fix technical issues when they come up.
  – The web host may not provide these services without charging an additional fee.
Co-located Web Hosting

• In co-located web hosting, the servers are housed at designated locations, for which resources like housing, electricity, uninterrupted Internet connection, and security have to be provided.

• The responsibility of backing up, storing data, and the server software all rest with the website owner.

• Therefore, you need to have money, adequate competence and expertise in the area, otherwise it's likely not worth it.
Co-located Web Hosting

• **Advantages**
  – Co-located web hosting is suitable for businesses looking for large bandwidth, large storage space and for those who can manage hosting issues independently.
  – you have full control over recourses and adopted policies

• **Disadvantages**
  – Involves heavy costs – paying rent, equipment, etc.
  – It is not affordable for most small businesses.
Cloud Hosting Service

• Cloud hosting involves hosting by a series of network servers that transfer your data through them simultaneously.

• Multiple servers work together but seems like one server.

• Advantages
  – There is almost no limit for the data storage.
  – The resources for cloud hosting are shared across multiple servers.
  – This ensures uptime even if one of the physical servers fails.
Cloud Hosting Service

- **Disadvantages**
  - **Flexibility Options**: Sometimes, cloud hosting providers don’t offer the same flexibility options as regular hosting providers do.
  - Some vendors deliberately attempt to "lock-in" customers by using proprietary software/hardware, so that it is impossible or very expensive to switch to another cloud vendor.

- **Security**
  - Although cloud service providers implement the best security standards, storing data and important files on external service providers always opens up risks.
  - Using cloud-powered technologies means you need to provide your service provider with access to important business data.
Cloud hosting service

• Disadvantages
  – **Limited Control:** Since the cloud infrastructure is entirely owned, managed and monitored by the service provider, it transfers minimal control over to the customer.
Web Application Deployment

- Basics of client / server architecture
- More clients => more load => more resources to handle it
- Qualities of a well architected application:
  - Availability
  - Reliability
  - Maintainability
- To manifest these qualities, you need a strategy for expanding compute resources quickly as need arises
  - Scale up
  - Scale out
Scaling up

• You typically choose to scale up when any single request demands more memory and processing power to complete, and

• the bottleneck / latency in the system is the intensive number of software objects created in the computer’s memory or the intensive algorithms and business logic that is performed.

• In this case, the key to completing each incoming request more efficiently is to provide each incoming request with more processing power.
Scaling Out

• Conversely, you typically scale out when any single request requires less memory and processing power to complete, but

• the real \textit{bottleneck / latency is in network communication, disk access, etc.}

• In this case, the key to completing each request more efficiently is to run it in parallel to other requests as each wait on external components to complete -- again, waiting on disk access, network access, etc.
System Upgrade

• To manifest these qualities, you need a strategy for expanding compute resources quickly as need arises:
  – Scale up
  – Scale out
  – It’s common to do both

• Scale out is made possible through a load balancer

Load balancing refers to efficiently distributing incoming network traffic across a group of backend servers, also known as a server farm or server pool.
Achieving Redundancy – Failover

• Importance of redundancy, takes different forms at various parts in the system.
  – Failover is the operational process of switching between primary and secondary systems or system components (a server, processor, network, or database) in the event of downtime.
  – Such downtime could be caused by either scheduled maintenance, or unpredicted system or component failure.
Achieving Redundancy - Clustered Web Servers

• A clustered web server is a technique used within web hosting to distribute the load across multiple machines or 'nodes'.

• The aim of this technique is to remove single points of failure and increase website availability and uptime.
Achieving Redundancy - Geo-Redundancy

• Geo-Redundant hosting allows your Websites to be hosted on multiple locations at the same time.

• If one server is affected by hardware failure, a power outage or even a natural disaster, its function can be taken over by a server in another location thereby guaranteeing the most reliable Web hosting possible.

• In disaster recovery, geo-replication provides additional redundancy in case a data centre fails or there is some other event that makes the continuation of normal functions impossible.
Different Types of Web Hosting

- Virtual Server
- Dedicated Server
- Co-Located
- Shared Server
- Cloud
Achieving Redundancy - Virtualization

- Virtualization is a broad term (virtual memory, storage, network, etc)
  - The focus here is on platform virtualization
- Virtualization basically allows one computer to do the job of multiple computers, by sharing the resources of a single hardware across multiple environments

‘Non-virtualized’ system
A single OS controls all hardware platform resources

Virtualized system
It makes it possible to run multiple Virtual Containers on a single physical platform
Virtualization

- Separates the physical hardware from the operating system.
- Allows multiple virtual machines, with heterogeneous operation systems to run in isolation, side-by-side on the same physical machine.
- Each virtual machine has its own set of virtual hardware (e.g. RAM, CPU, NIC, etc.) upon which an operating system and applications are loaded.
Benefits of Virtualization

• **Partitioning**
  
  – Multiple applications and operating systems can be supported within a single physical system
  
  – Servers can be consolidated into virtual machines on either a scale-up or scale-out architecture
  
  – Computing resources are treated as a uniform pool to be allocated to virtual machines in a controlled manner
Benefits of Virtualization

• Isolation
  – Virtual machines are completely isolated from the host machine and other virtual machines. If a virtual machine crashes, all others are unaffected
  – Data does not leak across virtual machines and applications can only communicate over configured network connections
Benefits of Virtualization

- **Encapsulation**
  - Complete virtual machine environment is saved as a single file; easy to back up, move and copy
  - Standardized virtualized hardware is presented to the application – guaranteeing compatibility
Benefits of Virtualization

• **High hardware utilization**

  – with running several operating systems (applications) in separated virtualized environments
  
  – Each application runs in its own operating system
  
  – Each operating system does not know it is sharing the underlying hardware with others
Benefits of Virtualization

• **Cheaper implementation**
  – Furthermore, having fewer physical server saves you money on power bills, maintenance fees and datacentre office space and fees.

• **Speedy Installations**
  – Virtual devices allow fast installations of new server applications or router and switch software services, because you no longer have to purchase equipment that can take days or weeks to get it ordered, delivered and set up.
  – Instead, you simply configure a new virtual machine, router. This process generally consists of simply copying an image, thereby significantly reducing setup times.
Benefits of Virtualization

• No vendor lock-in
  – One of the nice things about virtualization is the abstraction between software and hardware. This means you don't have to be tied down to one particular vendor.
  – the virtual machines don't really care what hardware they run on, so you're not tied down to a single vendor, type of server (within reason of course), or even platform.
Benefits of Virtualization

• Easier migration to cloud

  – With a move to virtual machines, you are that much closer to enjoying a full-blown cloud environment. You may even reach the point where you can deploy VMs to and from your data center to create a powerful cloud-based infrastructure.
Virtualization and Hypervisor

• What is Hypervisor?

– A hypervisor is a program that would enable you to host several different virtual machines on a single hardware.

– Each one of these virtual machines or operating systems you have will be able to run its own programs, as it will appear that the system has the host hardware's processor, memory and resources.

– In reality, however, it is actually the hypervisor that is allocating those resources to the virtual machines.

– In effect, a hypervisor allows you to have several virtual machines all working optimally on a single piece of computer hardware.
What is a hypervisor?

- A hypervisor or virtual machine monitor (VMM) is a piece of computer software, firmware or hardware that creates and runs virtual machines.

- A computer on which a hypervisor runs one or more virtual machines is called a **host machine**, and each virtual machine is called a **guest machine**.

- The hypervisor presents the guest operating systems with a virtual operating platform and manages the execution of the guest operating systems.

- Multiple instances of a variety of operating systems may share the virtualized hardware resources:
  - for example, Linux, Windows, and OS X instances can all run on a single physical x86 machine.
How does it work?

- The servers would need to execute the hypervisor.
- The hypervisor, in turn, loads the client operating systems of the virtual machines.
- The hypervisor allocates the correct CPU resources, memory, bandwidth and disk storage space for each virtual machine.
- A virtual machine can create requests to the hypervisor through a variety of methods, including API calls.
- There are two types of hypervisors:
  1. Bare metal or native hypervisors and
  2. Embedded or hosted hypervisors
Types of hypervisors

• Bare metal, native or type I hypervisors
  – This is when the hypervisors are run on the host's hardware to control it as well as manage the virtual machines on it.
  – If you are currently using Microsoft Hyper-V hypervisor, VMware ESX/ESXi, Oracle VM Server for x86, KVM, or Citrix XenServer, then this is the type of hypervisor with which you are working.

• Embedded, hosted or type II hypervisors
  – These hypervisors are run as a software using an operating system such as Windows, Linux or FreeBSD.
  – This is what the Virtage hypervisor, VirtualBox and VMWare Workstation are classified as.
Bare metal hypervisors vs. Hosted hypervisors

- Bare metal hypervisors are faster and more efficient as they do not need to go through the operating system and other layers that usually make hosted hypervisors slower.

- Type I hypervisors are also more secure than type II hypervisors.

- Hosted hypervisors, on the other hand, are much easier to set up than bare metal hypervisors because you have an OS to work with.

- These are also compatible with a broad range of hardware.
Lightweight Virtualization - Container

- VMs are based on a hardware level virtualization – basically they are virtualizing hardware resources.

- But container virtualization is done at the operating system level, rather than the hardware level.
What makes containers different?

• Just like VMs, containers have their own private processing space, can execute commands and have private network interfaces and IP addresses, but they use only a fraction of the resources VMs demand.

• Independent of hypervisors, containers include all the necessary libraries and configurations required to run specific applications, which makes them extremely lightweight compared to VMs and require far less administration than VMs do.

• Simplicity: Containers’ ease of use allow you to build and test portable applications in very short spaces of time. You can easily package an application on your local machine and transfer it to any private or public cloud platform seamlessly.
Question

• Which of the following is a significant disadvantage of containers?
  – Time to deploy
  – Resource consumption
  – Security
  – Inefficiency

• In which scenario can you host the most instances on a server?
  – Using only VMs
  – Using containers in VMs
  – Using only containers
  – Using VMs in containers
Question

• What is a major disadvantage of VMs vs. containers?
  – Security
  – Vendor lock-in
  – Boot time
  – Limited management tools

• Which of the following statements about a container is true?
  – It can run different OSes on the same physical server
  – It can run many applications on a small number of servers
  – It's inherently isolated from other instances
  – It requires a hypervisor to function
The choice between VMs and containers

• Do you need a full platform that can house multiple services? Go with a virtual machine.

• Do you need a single service that can be clustered and deployed at scale? Go with a container.

• **Docker** is an open-source system of software containers.
  – It allows developers to package all of the things that are needed to run a program inside the container itself.
  – The host, runtime, code, operating system, tools, libraries, and other components are all inside an isolated environment.
  – Everything is self-contained, so programmers will not have to worry about what flavor of Linux is being used.
Virtualization and Cloud Computing

- In virtualization software manipulates hardware, while cloud computing refers to a service that results from that manipulation.

- Virtualization is a foundational element of cloud computing and helps deliver on the value of cloud computing.

- Cloud computing is the delivery of shared computing resources, software or data — as a service and on-demand through the Internet.
Cloud Computing – Main features

• **On-Demand Self-Service** – Users can unilaterally provision computing capabilities.

• **Broad Network Access** – Users can access multiple resources and devices over network.

• **Resource Pooling** – Users can create extra resources without being concern about physical hardware provision.

• **Rapid Elasticity** – Users can add and reduce capacity through software.

• **Measured Service** – Users can see who is using what and how much.
Microsoft Azure

• What is Microsoft Azure?
  – An open and flexible cloud platform that enables you to quickly build, deploy, and manage solutions across a global network of Microsoft-managed datacenters.
  – Microsoft Azure allows you to perform virtually any compute or data storage operation by provisioning and scaling the necessary resources on demand on a pay-as-you-go basis.
Opportunities for Cloud Deployment (Azure)

- Near instant provisioning to meet load
- Scale **back down** when load subsides
- Auto-scaling
- Load balancing is baked in
- Leveraging existing investments in virtualization
- Hybrid approach doesn’t require long term commitment or investment.
Azure Benefits

• Scaling, redundancy, failover, etc.
• New architectural options
• Something for everyone – small and large organizations
Tradeoffs

• Devote manpower to building competency in low-level pursuits where you have complete control OR on higher level business problems?

• Take on expense of building out a data center for a temporary spike in load OR spend time and money elsewhere?
  
  – Do I provision enough servers to handle future demand (we cannot predict)?
  
  – Do I provision enough servers to handle today’s demand (risking the fact that we may experience load we cannot handle)?
Recap

• In client / server architected systems there’s usually a variable demand

• In the past, handling spikes in demand required preparing ahead of time – building out a large server farm (just in case)

• Microsoft Azure allows for immediate provisioning and de-provisioning – pay only for what you use

• Microsoft has invested in redundancy, failover, caching, storage, machine learning, authorization, etc. and you can leverage it inexpensively