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Part 1: Web Services Delivered from the Cloud

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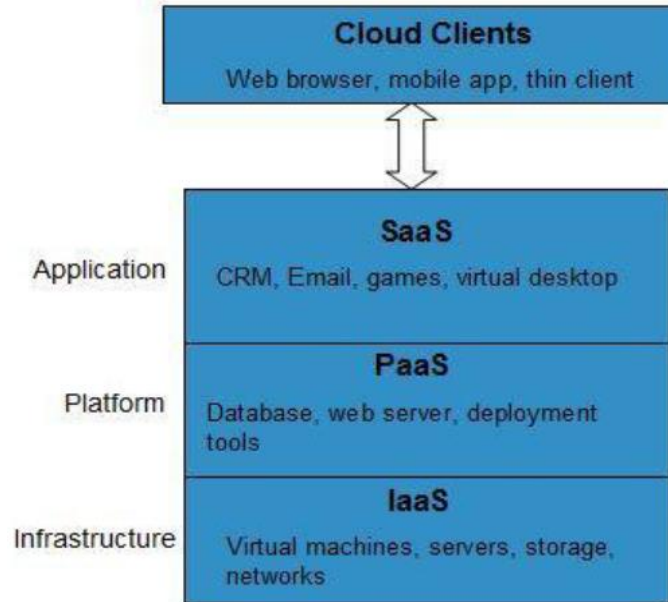
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7. Chapter Summary.

1. Chapter Overview

WEB SERVICES DELIVERED FROM THE CLOUD			
Communication-as-a-Service (CaaS)	Infrastructure-as-a-Service (IaaS)	Monitoring-as-a-Services (MaaS)	Software as a Service (SaaS)

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2. Communication-as-a-Service (CaaS)

- It is an **outsourced enterprise communications solution**.
- Its **vendors/sellers** are responsible for the **management of hardware and software required for delivering**.
- This model began its evolutionary process from within the Telecom (Telco) industry.
- It offers Quality of service (QoS) under a service level agreement (SLA).
- Customers can selectively **deploy communications** features and services throughout their company on a **pay-as-you-go basis** for service(s) used.
- It provides flexibility Capacity, Feature Set, scalability and little to no management oversight from customers.
 - **No Capital Expenses** needed for ongoing maintenance and operations.
- Its providers are usually prepared to handle peak loads, responsible to perform periodic upgrades or replacements of hardware and software to keep the platform updated.

2.1 Advantages of CaaS

a. Remote management

It of infrastructure services by third parties was once unacceptable but now it has changed. This is due to cost savings achieved in using those services.

b. Hosted and Managed Solutions.

ie. Every component in a CaaS solution is managed 24/7 by the CaaS vendor.

- No Facilities and Engineering Costs Incurred and guaranteed Business Continuity.

2.2 Fully Integrated, Enterprise-Class Unified Communications Features		
Chat	Multimedia conferencing	Microsoft Outlook integration
Instant Messaging (IM)	Voice over IP (VoIP) services for Video calling	Unified messaging and mobility
web collaboration	Video Conferencing	a handset
Soft phones (software-based telephones)	local & long-distance voice services	real-time presence and unified messaging
Chat	voice mail E.T.C	

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3. Infrastructure-as-a-Service (IaaS)

3.1 Modern On-Demand Computing.

3.2 Amazon's Elastic Cloud.

3.3 Amazon EC2 Service Characteristics.

3.4 Mosso (Rackspace).

3. Infrastructure-as-a-Service (IaaS)

- a. **It depends heavily** on modern on-demand computing technology and high-speed networking.
- b. It is the delivery of computer infrastructure as a service.
 - (typically a platform virtualization environment).
- c. Customers maintain ownership and management of their application(s) while offloading hosting operations and infrastructure management to the IaaS provider.

IaaS components		
Computer hardware (typically set up as a grid for massive horizontal scalability)	Computer network	Internet connectivity
Platform virtualization environment for running client-specified virtual machines	Service-level agreements	Utility computing billing

Benefits of using outsourced service include:

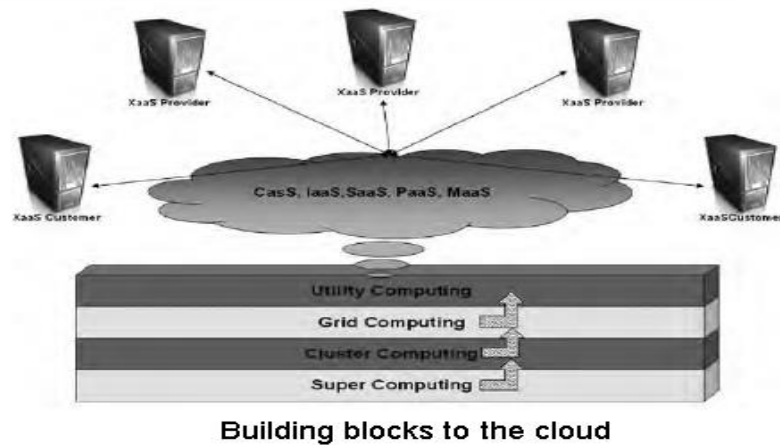
- a. **Ready access to a preconfigured environment** that is generally ITIL-based (**The Information Technology Infrastructure Library [ITIL]** is a customized framework of best practices designed to promote quality computing services in the IT sector.)
- b. Use of the latest technology for infrastructure equipment
- c. Secured, “sand-boxed” (protected and insulated) computing platforms that are usually security monitored for breaches.
- d. **Reduced risk** by having off-site resources maintained by third parties.
- e. Ability to manage service-demand peaks and valleys.
- f. **Lower costs** that allow expensing service costs instead of making capital investments
- h. **Reduced time**, cost, and complexity in adding new features or capabilities.

3.1 Modern On-Demand Computing

- a. The **on-demand model evolved** to overcome the challenge of being able **to meet fluctuating resource demands efficiently**.
- b. Maintaining sufficient resources to meet peak requirements can be costly.
 - Example is Amazon's Elastic Compute Cloud (Amazon EC2).
- c. It is **designed to make web-scale computing easier for developers**.

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2.3.1 Modern On-Demand Computing



3.2 Amazon's Elastic Cloud

Advantages:

- Its web service interface **allows customers to obtain and configure capacity with minimal effort.**
- It provides users with **complete control of their (leased)** computing resources and lets them run on a proven computing environment.
- It reduces the time required to obtain and boot new server instances to minutes, allowing customers to quickly scale capacity as their computing demands dictate.
- It changes the economics of computing by **allowing clients to pay only for capacity** they actually use.
- It provides developers applications and isolates themselves from common failure scenarios.

Using Amazon EC2 to Run Instances

To use Amazon EC2, clients need's to create an Amazon Machine Image (AMI) contains the

Amazon Machine Image (AMI) contains		
Applications	Libraries	Data
Associated configuration settings used in the virtual computing Environment.		

Associated configuration settings used in the virtual computing environment.

Amazon Machine Image (AMI)	
1. Standard.	2. High-CPU instances.

- For example, if all that is needed is a basic Linux server, clients can choose one of the standard Linux distributions AMIs.

3.3 Amazon EC2 Service Characteristics

Characteristics		
Dynamic Scalability	Full Control of Instances	Configuration Flexibility

Integration with Other Amazon Web Services

[Wisdom Materials](#)

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Integration with Other Amazon Web Services	Amazon Web Services
A web services interface that allows users to store and retrieve any amount of data.	Amazon S3
Web service for running queries on structured data stored with the Amazon Simple Storage Service (Amazon S3) in real time.	Amazon Simple DB
A reliable, scalable, hosted queue for storing messages as they pass between computers	Amazon Simple Queue Service (Amazon SQS)
Web service for content delivery.	Amazon Cloud Front

3.3 Amazon EC2 Service Characteristics

Characteristics	Explanation Or Example
It offers persistent storage for Amazon EC2 instances.	Amazon Elastic Block Store (EBS)
Support for Use in Geographically Disparate Locations	– Assigns 5 Elastic IP addresses per account – Each EIP can be assigned to a single instance. – It replaces the normal dynamic IP address used by that instance – An EIP maps to an external IP address used to direct the to and from traffic.
Elastic IP Addressing	

3.4 Mosso (Rackspace)

- It is a competitor of Amazon's EC2 service is a web application hosting service and cloud platform provider.
- It has been **designed to run an application with very little or no modifications.**
Ie No time is spent coding custom APIs
- Mosso's Cloud Files provide **unlimited storage** for content and a content delivery network (CDN) a scalable, dynamic storage platform.

Mosso Cloud Servers

- Servers with **advanced, high-availability architectures + online backup service.**
- Cloud sites are capable of running Windows or Linux applications across banks of servers numbering in the hundreds.

4. Monitoring-as-a-Service (MaaS)

- 4.1 Protection against Internal and External Threats
- 4.2 Delivering Business Value
- 4.3 Real-Time Log Monitoring Enables Compliance

Monitoring-as-a-Service (MaaS)

- It is **providing security** as a service from **cyber threats.**
- It is crucial in **securing and maintaining the confidentiality, integrity, and availability** of IT assets.

Traditional In-House security measures

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- a. require time and resources which constraints or limits security operations and their effectiveness
- b. requires **constant vigilance** over the security infrastructure and critical information assets.
- c. requires advanced technology, skilled security experts, and scalable processes which never come cheap.

MaaS

- a. Offers real-time, **24/7 monitoring** and nearly immediate incident response across a security infrastructure.
- b. connects the customer **infrastructure to Security Operation Centers (SOCs)**.

4.1 Protection against Internal and External Threats

Maas provide services		
Early Detection	Platform, Control, and Services Monitoring	Intelligent Log Centralization and Analysis
Vulnerabilities Detection and Management	Continuous System Patching/Upgrade and Fortification	Intervention, Forensics, and Help Desk Services.

4.2 Delivering Business Value (Cost incurred in providing Maas)

- a. Delivering business value means costs incurred in the maintaining the Maas.
- b. In-House capability is not as attractive as outsourcing the service to a provider.

Costs associated with MaaS

- 1. Service fees for security event monitoring for all firewalls and intrusion detection devices, servers, and routers;
- 2. Internal account maintenance and administration costs;
- 3. Preplanning and development costs.
- 4. **In-House capability means**
 - a. Staff attrition.
 - b. Scheduling.
 - c. Around the clock operations, etc.

4.3 Real-Time Log Monitoring Enables Compliance

MaaS help customers comply with industry regulations by automating the collection and reporting of specific events of interest, such as log-in failures to ensure the integrity of confidential data

5. Platform-as-a-Service (PaaS)

5.1 The Traditional On-Premises Model 5.2 the New Cloud Model

5.3 Key Characteristics of PaaS

Platform-as-a-Service (PaaS)

- a. **Outsourced hardware environments or platforms** are available as Paas and we will look at Mosso (Rackspace) and examine key characteristics of their PaaS implementation.
- b. Provides platforms for building and running custom web-based application. It is an outgrowth of the SaaS.

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- c. It supports the complete life cycle of building and delivering web applications and services entirely available from the Internet, all with no software downloads or installation for developers, IT managers, or end users.
- d. Best Example is an Online IDE or Framework provided by a software solutions company to its developers for creating web based applications
- e. It allow users to focus on innovation

5.1 The Traditional On-Premises Model

- a. **Each solution required** a specific set of hardware, an operating system, a database, often a middleware package, email and web servers, etc with
 - **A team of developers** to navigate complex programming development platforms
 - **A team of network, database, and system management experts** was needed to keep everything up and running
 - required **specialized data centers** and enormous amounts of electricity to operate them
 - required use of fail-over sites.

5.2 The New Cloud Model

- a. PaaS offers a faster, more cost-effective model for application development and delivery.
 - Companies such as Amazon.com, eBay, Google, iTunes, and YouTube all use PaaS.
 - deliver new capabilities to new markets via the web browsers.
- b. It offers workflow facilities for

application design	application development	testing, deployment
hosting		

- c. Also offers application services such as

virtual offices	team collaboration	database integration
Security	scalability	Storage
Persistence	state management	dashboard instrumentation, etc

5.3 Key Characteristics of PaaS

- a. Offers services **to develop, test, deploy, host, and manage applications.**
- b. Concurrency management, scalability, fail-over and security.
- c. Web-based development based on standards such as HTML and JavaScript
- d. Support to create combinations of web services (called mashups) using Simple Object Access Protocol (SOAP)
- e. Ability to form and share code with ad-hoc, predefined, or distributed teams greatly enhances the productivity

6 Software-as-a-Services (SaaS)

6.1 SaaS Implementation Issues 6.2 Key Characteristics of SaaS 6.3 Benefits of the SaaS Model.

The Traditional model	The Cloud model
Software-as-a-Product	Software-as-a-Service(SaaS)
ie. Purchased and installed on personal computers.	ie. Applications are hosted by a vendor or service provider and made available to customers over a network.
	SaaS is supported by <ul style="list-style-type: none">– web services and service-oriented architecture (SOA)

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	<ul style="list-style-type: none">– Huge bandwidth availability– powerful microprocessors– inexpensive data storage devices
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Software-as-a-Services (SaaS)

SaaS variants or types	
hosted application management model	software on demand model
Vendor hosts commercially available software	Vendor hosts s/w created specifically for SaaS distribution.

SOFTWARE'S SUITED FOR SAAS MODEL		
Accounting	Customer relationship management	email software
Human resources	IT security	IT service management
Video conferencing	Web analytics	Web content management

6.1 SaaS Implementation Issues

SaaS implementation Involves	
Software components	Applications frameworks

Using these reduces the time to market for a product cost of converting a traditional on-premises product into a SaaS product

6.1 SaaS Implementation Issues

1. SaaS Architectural Maturity Level 1—Ad-Hoc/Custom.

- no maturity at all
- unique, customized version of the hosted application
- requires the least development effort
- reduces operating costs

2. SaaS Architectural Maturity Level 2—Configurability.

- Greater program flexibility through configuration
- many customers can use separate instances of the same application
- allows a vendor to meet the varying needs of each customer
- ease of maintenance to the vendor

3. SaaS Architectural Maturity Level 3—Multitenant Efficiency.

- adds multi-tenancy
- a single program instance that has the capability to serve all of the vendor's customers
- enables more
- efficient use of server resources

4. SaaS Architectural Maturity Level 4—Scalable.

- adds scalability
- It is capable of supporting a load-balanced farm of identical application instances running on a variable number of servers
- System capacity can be dynamically changed
- no need for further alteration of application software architecture

6.2 Key Characteristics of SaaS

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- a. SaaS apps are priced based on the number of users that can have access to the service.
- b. Additional fees for the use of help desk services, extra bandwidth, and storage.
- c. Revenue streams to the vendor are usually lower initially than traditional software license fees.

Key Characteristics of SaaS

- a. Network-based management and access to commercially available software from central locations
- b. Application delivery from a one-to-many model (single-instance, multitenant architecture),
- c. Centralized enhancement and patch updating that obviates any need for downloading and installing by a user.

6.3 Benefits of the SaaS Model

- a. Application deployment cycles inside companies can take years, consume massive resources, and yield unsatisfactory results.
- b. SaaS model can lead to improved efficiency, lower risk, and a generous return on investment.
- c. SaaS ensures that all locations of a corporate company are using the correct application version. Hence format of the data being recorded and conveyed is consistent, compatible, and accurate
- d. can reduce administration and management costs
- e. helps to increase the availability of applications to global locations
- f. ensures that all application transactions are logged for compliance purposes
- g. Streamlined administration
- h. Automated update and patch management services
- i. Data compatibility across the enterprise (all users have the same version of software)
- j. Facilitated, enterprise-wide collaboration
- k. Global accessibility

7. Chapter Summary

- Examined the various types of web services delivered from the cloud
- Most common and **successful** example of cloud computing is SaaS
- Offerings have been made available to consumers and small businesses as well as mid-sized and large enterprises.

Part 2: Building Cloud Networks

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- 2 The Evolution from the MSP Model to Cloud Computing and Software-as-a-Service
 - 2.1 From Single-Purpose Architectures to Multipurpose Architectures
 - 2.2 Data Center Virtualization
- 3 The Cloud Data Center
- 4. Collaboration
 - 4.1 Why Collaboration?
- 5 Service-Oriented Architectures as a Step Toward Cloud Computing
- 6 Basic Approaches to a Data Center-Based SOA

6.1 Planning for Capacity	6.2 Planning for Availability	6.3 Planning for SOA Security
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- 7 The Role of Open Source Software in Data Centers
- 8 Where Open Source Software Is Used

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8.1 Web Presence.	8.2 Database Tier.	8.3 Application Tier.	8.4 Systems and Network Management Tier.
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9 Chapter summary.

1 Chapter Overview

- We describe **what it takes to build a cloud network**.
- Learn how and why companies build these highly automated private cloud networks providing resources that can be **managed from a single point**.
- Discuss the significant reliance of cloud computing architectures on server and storage virtualization as a layer between applications and distributed computing resources.
- Learn the basics of how flexible cloud computing networks such as those modeled after public providers such as Google and Amazon are built, and how they interconnect with corporate IT private clouds designed as service-oriented architectures (SOAs).
- We provide an overview of **how SOA is used as an intermediary step for cloud computing** and the basic approach to SOA as it applies to data center design.
- We then describe the role and **use of open source software in data centers**.
- Understanding of how the engine of cloud computing will drive the future of infrastructure and operations design.

2 The Evolution from the MSP Model to Cloud Computing and Software-as-a-Service

2.1 From Single-Purpose Architectures to Multipurpose Architectures

2.2 Data Center Virtualization

2. The Evolution from the MSP Model to Cloud Computing and Software-as-a-Service

Managed service provider (MSP)

- It is a company that **remotely manages a customer's IT infrastructure or end-user systems**, typically on a proactive ((of a person or action) creating or controlling a situation rather than just responding to it after it has happened.) basis and under a subscription model.

With MSPs part of the IT infrastructure and related services is managed by the Customer and part by the MSP.

E.g.: Virus scanning for Email

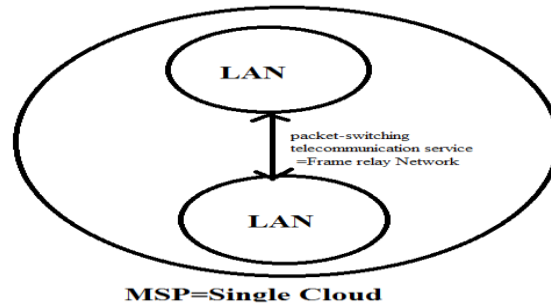
- Frame relay is a packet-switching telecommunication service designed for cost-efficient data transmission for intermittent traffic between local area networks (LANs) and between endpoints in wide area networks (WANs). The first iteration of cloud computing can probably be traced back to the days of frame relay networks.

- Organizations with frame relay were essentially **singular clouds that were interconnected to other frame relay-connected organizations using a carrier/provider to transport data communications between the two entities**. These providers were the MSPs.

- Organizations relied on the I-1.0 infrastructure's routers and switches along the way to connect the dots between the clouds.

Frame Relay Networks (LAN \leftrightarrow LAN and between end points in WAN's) --- \rightarrow Singular Cloud
Singular Cloud<----- \rightarrow Singular Cloud which connected by organization called as MSP's.

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2.1 From Single-Purpose Architectures to Multipurpose Architectures

a. Initially MSPs, the providers would actually go onto customer sites and perform their services on customer owned premises.

b. Then MSPs specialized in implementation of infrastructure and quickly figured out ways to build out data centers and sell those capabilities off in small chunks commonly known as **monthly recurring services. (I.e. scheduled to be performed periodically.)**

MSPs Services			
Remote network	Remote desktop	Security monitoring	Incident response
Patch management	Remote data backup	Technical support for customers	

2.2 Data Center Virtualization

Data center

A large group of networked computer servers (physical or virtual) typically used by organizations for the remote storage, processing, or distribution of large amounts of data.

virtualization refers to the act of creating a virtual (rather than actual) version of something, including virtual computer hardware platforms, operating systems, storage devices, and computer network resources.

a. By allowing the infrastructure to be virtualized and shared across many customers, the business model has changed to provide remotely managed services at lower costs.

b. Cloud computing has been viewed as a broad array of Internet Protocol (IP) services (generally using an application called a Web browser as the main interface) in order to allow users to obtain a specific set of functional capabilities on a “pay for use” basis.

c. Previously, obtaining such services required tremendous hardware/software investments and professional skills that were required in hosting environments.

3. The Cloud Data Center

a. Unlike the MSP or hosting model, the cloud can offer customers the flexibility to specify the exact amount of computing power, data, or applications they need to satisfy their business requirements.

b. Customers connect to the cloud **without installing software or buying specific hardware.**

c. A big reason for their desire to use the cloud is the availability of collaborative services. (IT enabled services are interrelated hence can be called as collaborated services.)

4. Collaboration=Interaction

- Collaboration was by corporate styles in which **people tended to be working together in the same place.**

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- Then came the “head office/branch office” model emerged as companies grew in size.
 - Now the workforce has become increasingly distributed. Hence **Tools such as voice mail and email have tried to close the gap by facilitating communications in real and non-real time.**
 - The workspace has a wide variety of tools and systems that people need to do their jobs.
 - It is the range of devices from mobile phones to IP phones, laptop computers, and even job specific tools such as inventory scanners or process controllers. People need to connect, communicate, and **collaborate to ensure that everyone can be included in decision making.**
 - While IBM, Microsoft, and Apple were making computing power available to all, it wasn't until the emergence of the IP network that people could connect easily from one machine and person to another.
 - **This network gave rise to both the Internet and to IP telephony.**
 - **IP telephony gave rise to unified communications and the ability to blend together many forms of communications including text, video, and voice.**
 - Collaboration is the **platform for business**
 - Customers must focus on
 - develop a corporate culture.
 - Business processes need to be adapted and modified.
 - Customers need to leverage technologies.
- If collaboration is the platform for business, the network is the platform for collaboration.
- Network provides unified collaboration through.
 - IP telephony.
 - Video that adds context to communications
 - **Web 2.0 applications that deliver an open model to unify communications.**

4.1 Why Collaboration?

- a. The demand for a greatly reduced innovation cycle has also driven the need for industry-wide initiatives and multiparty global collaboration.
- b. The key business imperatives to focus on Customer Intimacy
- c. communicate with them frequently in order to better understand their challenges, goals, and needs**
 - Extending Your Reach to Support Customers Anywhere and at Any Time
- d. Enabling customers to voice their questions, concerns, opinions, and ideas via simple web 2.0 tools such as Wikis or blogs gives them a voice and contributes tremendous feedback, ideas, and information to your business.

Save to Invest

- a. Organizations are doing many things to cut costs to free up money to invest in the future through the use of collaborative technologies such as tele presence, unified communications, and IP-connected real estate.
Example: Mobility costs can be controlled by routing mobile long-distance calls over the Enterprise IP network.
- b. Real estate, energy, and utility expenses can be cut by enabling remote and connected work force through IP-connected real estate solutions.
- c. SOA-based infrastructures were created to enable people to collaborate more effectively.**
- d. SOA is the way IT systems are presented to the user.**
- e. SOA has become an intermediate step in the evolution to cloud computing.**

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5. Service-Oriented Architectures as a Step Toward

a. **SOA delivers web services from applications to other programs, whereas the cloud is about delivering software services to end users and running code.**

An SOA involves policies, principles, and framework that illustrate how network services can be leveraged by enterprise applications to achieve desired business outcomes. An SOA solution consists of a linked set of business services that realize an end-to-end business process.

b. SOA has brought governance and end-to-end architectural approach to cloud computing.

c. SOA provides evolutionary step to cloud **computing by creating the necessary interfaces from the IT infrastructure to the cloud outside the enterprise.**

d. **Cloud computing essentially becomes an extension of SOA.**

6. Basic Approach to a Data Center-Based SOA

a. **SOA** is a collection of services which **communicate with each other** using standard protocols, which allows for broad interoperability, have an interface, and are message-oriented.

b. New services can be added or created without affecting existing services.

c. The first service-oriented architectures are considered to be the Distributed Component Object Model (DCOM) or Object Request Brokers (ORBs), which were based on the Common Object Requesting Broker Architecture (CORBA) specification.

Benefits of SOA	
1. Free-standing, independent components.	2. Combined by loose coupling.
3. Message (XML)-based instead of API-based	4. Physical location, etc., not important.

6.1 Planning for Capacity

Vendor is a person or company offering something for sale, especially a trader in the street. Set up an initial infrastructure and establish a baseline of capacity which is based on known capacity requirements and vendor recommendations for software and hardware.

6.2 Planning for Availability

a. It includes performing a **business impact analysis (BIA)** and **developing and implementing a written availability plan.**

b. **BIA provides the necessary information for a administrator to fully understand and protect systems.** Then a written availability plan is created.

c. Management should be included in the process of developing availability structure, objectives, roles, and responsibilities to support the development of a successful plan.

6.3 Planning for SOA Security

Three main areas of concern are widely accepted as part of the SOA security arena.

a. **Message-level security** provides the ability to **ensure that security requirements are met in an SOA environment**

b. **Security-as-a-Service** provides the **ability to implement security requirements for services.**

c. **Declarative and policy-based security** provides the ability to implement security requirements.

7. The Role of Open Source Software in Data Centers

a. It describes a general type of software license that makes **source code available to the public without significant copyright restrictions.**

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b. Open source distributions such as Red Hat, OpenSuSE, and BSD, coupled with open source applications such as Apache, MySQL and scores of others have long been used to power databases, web, email, and file servers.

8. Where Open Source Software Is Used

8.1. Web Presence or Web site

It is a collection of Web files on a particular subject that includes a beginning file called a home page. For example, most companies, organizations, or individuals that have Web sites have a single address that they give you.

- Web presence is being accessible on the WWW.
- The number of pages or sites an entity owns.
- Include web sites, social network profiles and search engine ranking, traffic, popularity& links.
- Includes Apache, the zend framework, and jetty.

Apache

A robust and commercial-grade implementation of the HTTP protocol Available to everyone free of charge. The term Apache server is derived from a play on the words a patchy server. Apache is truly a cloud-based and cloud-owned tool.

Jetty

- Open source, standards-based, full-featured web server implemented entirely in **java**.
- It is capable across platforms, free for commercial use and distribution.
- Configuration is accomplished by either an api or xml configuration file and highly scalable.
- Jetty ensures performance degrades gracefully under stress, providing a higher quality of service. Jetty can handle large user loads and long-lived sessions easily.

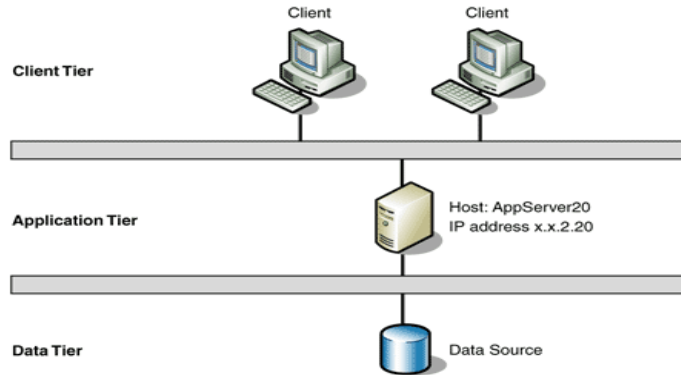
Zend Framework

- Open source, object-oriented web application framework for the hypertext preprocessor language PHP, ease of use and rapid application development features with the simplicity
- ZF support MVC that can be used to establish basic structure for ZF applications.
- Provides support many of the commercial and open source database systems, including MYSQL, ORACLE, IBM DB2, MICROSOFT SQL SERVER, POSTGRESQL, SQLITE, and INFORMIX DYNAMIC SERVER.
- Provides email composition and delivery features, and supports retrieval of email via MBOX, MAILDIR, POP3, and IMAP4.
- It has caching subsystem with many types of back-end architectures (e.g. memory/file systems).

8.2 Database Tier

- A database relies on software known as a database management system (DBMS) to organize, store, and retrieve data. The **model used in relational database model**.
- Other models (**hierarchical model and the network model**) use a more explicit representation of relationships, but they are not commonly used in cloud environments.

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MySQL

- a. world's most popular open source database and used by many of the world's largest companies, including Yahoo!, Alcatel-Lucent, Google, Nokia, YouTube, and Zappos.com.
- b. runs on more than 20 platforms, including Linux, Windows, OS/X, HP-UX, AIX, and Netware.
- b. MySQL database used in LAMP architecture (Linux/Apache/MySQL/PHP-Python-Perl).
- c. It is the king of the database server packages because it is proven, reliable, scalable, and free.
- d. Spatial data, Web Services, and native XML support are yet to be overcome.

PostgreSQL

- a. It earned it a strong reputation for reliability, data integrity, and correctness.
- b. It is highly scalable in both magnitudes of data it can manage and in the number of concurrent users it can accommodate.
- c. It considered being the most secure out-of-the box configuration available for a database.

8.3. Application Tier

Zope	Struts	Plone
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8.4 Systems and Network Management Tier

Performance Monitoring and Management Applications

1. openQRM	2. Zenoss	3. Load Balancing
4. Linux Virtual Server Load Balancer	5. DNS-Based Load Balancing Clusters	6. Dispatcher-Based Load Balancing Clusters
7. Virtualization Applications	8. The Direct Routing Request Dispatching Technique	