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CS802 (B) Cloud Computing

Subject Notes

Unit – 5 **CO5**

Issues in cloud computing; implementing real time application; QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Cloud Middleware. Mobile Cloud Computing. Inter Cloud issues. A grid of clouds, Sky computing, load balancing, Resource optimization, Resource dynamic reconfiguration, Monitoring in Cloud, Installing cloud platforms and performance evaluation, Features and functions of cloud computing platforms.

ISSUES IN CLOUD COMPUTING

Cloud Computing is Internet-based computing, where shared resources, software, and information are provided to computers and other devices on demand.

These are major issues in Cloud Computing:

1. **Privacy:**
   The user data can be accessed by the host company with or without permission. The service provider may access the data that is on the cloud at any point in time. They could accidentally or deliberately alter or even delete information.
2. **Compliance:**
   There are many regulations in places related data and hosting. To comply with regulations (Federal Information Security Management Act, Health Insurance Portability and Accountability Act) user may have to adopt deployment modes that are expensive.
3. **Security:**
   Cloud-based services involve third-party for storage and security. One can assume that a cloud-based company will protect and secure one's data if one is using their services at a very low or for free, they may share user's information with others. Security presents a real threat to cloud.
4. **Sustainability:**
   This issue refers to minimizing the effect of cloud computing on environment. Citing the server's effects on the environmental effects of cloud computing, in areas where climate favors natural cooling and renewable electricity is readily available, the countries with favorable conditions, such as Finland, Sweden, and Switzerland are trying to attract cloud computing data centers.
5. **Abuse:**
   While providing cloud services, it should be ascertained that the client is not purchasing the services of cloud computing for nefarious purpose. A banking Trojan illegally used the popular Amazon service as a command and control channel that issued software updates and malicious instruction to PCs that were infected by the malware.

IMPLEMENTING REAL TIME APPLICATION

Cloud computing is enabling businesses to take advantage of the latest technologies without having to spend fortunes on costly software, hardware and IT services. Today, many businesses and companies have embraced cloud computing and they are using it in different ways. Here are some of the most common ways through which businesses are applying cloud computing.

- **Communication:**
  Emails are some of the most popular communication methods that businesses and companies use today. This service is evolving at a very fast rate becoming more reliable and faster. Today, most businesses are always email campaigning clients and using emails to store important data about their customers. Through cloud computing, webmail clients can use cloud storage while providing analytics surrounding email data from any location globally. Companies are also using cloud-based SaaS apps to enable access to enterprise information instantly from any location. Ideally, cloud computing has made it easier for companies and businesses to executive internal processes smoothly.
- **Collaboration:**
  Cloud computing has made it easier for employees, clients and businesses to collaborate with ease. Sharing files and documents has been made easier by cloud computing. This has enhanced connections that are easy and less time-consuming. Google Wave for instance enables users to create files then invite other users to edit, collaborate with the files or comment. Collaboration with cloud computing is the same as instant messaging. However, it provides complete, specific tasks that take just hours instead of months to accomplish.
- **Data storage:**
  Businesses are using cloud computing solutions to store crucial data. Data store in a business or home computer can only be accessed when using that device. However, cloud computing enables to store and access data anytime, anywhere and from any device. This storage is also secure because user gets a unique password and username that ensures that only user can access files online as well as encryption of the data. There are several security layers for cloud storage and this makes it extremely difficult for hackers to access the data in the cloud. Virtual office Perhaps, the most popular among all real-time applications of cloud computing is the ability to rent software (i.e. SaaS) rather than use it. For instance, Google Docs can be used to run a virtual office.

QOS ISSUES IN CLOUD

Cloud computing must assure the best service level for users. Services outlined in the service-level agreements must include guarantees on round-the-clock availability, adequate resources, performance, and bandwidth. Any compromise on these guarantees could prove fatal for customers.

The decision to switch to cloud computing should not be based on the hype in the industry. A good understanding of the technology enables the user to make smarter decisions. Knowing all the features will empower the business users to understand and negotiate with the Service Providers in a proactive manner.

- Workload modeling involves the assessment or prediction of the arrival rates of requests and of the demand for resources (e.g., CPU requirements) placed by applications on an infrastructure or platform, and the QoS observed in response to such workloads.
- System modeling aims at evaluating the performance of a cloud system, either at design time or at runtime. Models are used to predict the value of specific QoS metrics such as response time, reliability or availability.

- Applications of QoS models often appear in relation to decision-making problems in system management. Techniques to determine optimized decisions range from simple heuristics to nonlinear programming and meta-heuristics.

DEPENDABILITY

Dependability is one of the highly crucial issues in cloud computing environments given the serious impact of failures on user experience. Cloud computing is a complex system based on virtualization and large scalability, which makes it a frequent place for failure. In order to fight against failures in a cloud, administrator assure dependability differently from the common way where the focus of fault management is on the Infrastructure as a Service and on the cloud provider side only.

DATA MIGRATION

Data migration is referred to as the process of transferring data from one location to another new and improved system or location. It effectively selects, prepares and transforms data to permanently transfer it from one system storage to another. With the focus of enterprises increasing on optimization and technological advancements, they are availing database migration services to move from their on-premises infrastructure to cloud-based storage and applications.

Types of data migration

- **Cloud Migration:** It is the process of moving data, applications and all important business elements from on premise data center to the cloud, or from one cloud to another.
- **Application Migration:** Involves transfer of application programs to a modern environment. It may move an entire application system from on premise IT center to the cloud or between clouds.
- **Storage Migration:** It is the process of moving data to a modern system from outdated arrays. It enhances the performance while offering cost-effective scaling.

STREAMING IN CLOUD

Streaming data is data that is generated continuously by thousands of data sources, which typically send in the data records simultaneously, and in small sizes (order of Kilobytes). Streaming data includes a wide variety of data such as log files generated by customers using mobile or web applications, ecommerce purchases, in-game player activity, information from social networks, financial trading floors, or geospatial services, and telemetry from connected devices or instrumentation in data centers.

This data needs to be processed sequentially and incrementally on a record-by-record basis or over sliding time windows, and used for a wide variety of analytics including correlations, aggregations, filtering, and sampling. Information derived from such analysis gives companies visibility into many aspects of their business and customer activity such as - service usage (for metering/billing), server activity, website clicks, and geo-location of devices, people, and physical goods and enables them to respond promptly to emerging situations.

Examples of streaming data

- Sensors in transportation vehicles, industrial equipment, and farm machinery send data to a streaming application. The application monitors performance, detects any potential defects in advance, and places a spare part order automatically preventing equipment down time.
- A financial institution tracks changes in the stock market in real time, computes value-at-risk, and automatically rebalances portfolios based on stock price movements.

- A real-estate website tracks a subset of data from consumers' mobile devices and makes real-time property recommendations of properties to visit based on their geo-location.
- An online gaming company collects streaming data about player-game interactions, and feeds the data into its gaming platform. It then analyzes the data in real-time, offers incentives and dynamic experiences to engage its players.

CLOUD MIDDLEWARE

Software that connects computers and devices to other applications. It can also be referred to as the slash or connecting point in client/server. Another way to define middleware is to say that it is software that acts as a liaison between applications and networks. The term is often used in the context of cloud computing, such as public or private cloud.

Middleware definition is to say that it acts as an intermediary. It is often used to support complicated and distributed applications. It can be a web server, application server, content management system, or other tool that supports application development and delivery. It can also be a software application that connects two or more applications so that data can be shared between them.

Types of Middleware

- **Message Oriented Middleware:** Message oriented middleware is a concept that involves the passing of data between applications using a communication channel that carries self-contained units of information (messages). In a MOM-based communication environment, messages are usually sent and received asynchronously.
- **Object Middleware:** Object-based middleware is runtime software that enables objects (components) to work cooperatively with a container program or another object, even if the software is distributed across multiple computers.
- **Remote Procedure Call (RPC) Middleware:** Remote procedure call (RPC) is a protocol that one program can use to request a service from a program located in another computer on a network without having to understand the network's details. A procedure call is also sometimes known as a function call or a subroutine call.
- **Database Middleware:** It connects two applications together so data and databases can be easily passed between the "pipe". Using middleware allows users to perform such requests as submitting forms on a web browser or allowing the web server to return dynamic web pages based on a user's profile.

MOBILE CLOUD COMPUTING

Mobile Cloud Computing which is defined as a combination of mobile computing, cloud computing, and wireless network that come up together purpose such as rich computational resources to mobile users, network operators, as well as to cloud computing providers. Mobile Cloud Computing is meant to make it possible for rich mobile applications to be executed on a different number of mobile devices. In this technology, data processing, and data storage happen outside of mobile devices. Mobile Cloud Computing applications leverage this IT architecture to generate the following advantages:

1. Extended battery life.
2. Improvement in data storage capacity and processing power.
3. Improved synchronization of data due to "store in one place, accessible from anywhere" platform theme.
4. Improved reliability and scalability.
5. Ease of integration.

Characteristics of Mobile Cloud Computing Application

1. **Cloud infrastructure:** Cloud infrastructure is a specific form of information architecture that is used to store data.
2. **Data cache:** The data can be locally cached.
3. **User Accommodation:** Scope of accommodating different user requirements in cloud app development is available in mobile Cloud Computing.
4. **Easy Access:** It is easily accessed from desktop or mobile devices alike.
5. **Cloud Apps:** facilitate to provide access to a whole new range of services.

INTER CLOUD ISSUES

Inter cloud or 'cloud of clouds' is a term refer to a theoretical model for cloud computing services based on the idea of combining many different individual clouds into one seamless mass in terms of on-demand operations.

- **Security issues**: Cloud-based services involve third-party for storage and security. Can one assume that a cloud-based company will protect and secure one's data if one is using their services at a very low or for free? They may share user's information with others. Security presents a real threat to cloud.
- **Lack of resources/expertise:** As the usage of cloud technologies is increasing, tools to manage it are getting sophisticated, finding experts on top of this in cloud computing is becoming a bottleneck to many organizations. Many companies are adopting automated cloud management technologies but it's always better to train individuals to satisfy the need of time.
- **Performance:** Cloud Computing is on-demand compute service and supports multitenancy, thus performance should not suffer over the acquisition of new users. The CSP should maintain enough resources to serve all the users and any ad-hoc requests.
- **Building a private cloud:** Building a private cloud is very difficult as it involves many tasks such as grabbing an IP address cloud software layer, setting up a virtual local area network (VLAN), load balancing, and firewall rule-setting for the IP address, loading the correct version of RHEL, server software patch, arranging nightly backup queue.

A GRID OF CLOUDS

Grid computing is a group of networked computers which work together as a virtual supercomputer to perform large tasks, such as analyzing huge sets of data or weather modeling. They use computers which are part of the grid only when idle and operators can perform tasks unrelated to the grid at any time.

1) **Computational Grid:** A computational grid is a loose network of computers linked to perform grid computing. In a computational grid, a large computational task is divided up among individual machines, which run calculations in parallel and then return results to the original computer.

2) **Data Grid:** A data grid is an architecture or set of services that gives individuals or groups of users the ability to access, modify and transfer extremely large amounts of geographically distributed data for research purposes.

3) **Collaborative Grid:** In grid computing, resources are used in collaborative pattern, and also in grid computing, the users do not pay for use. ... In cloud computing, resources are used in centralized pattern. While in grid computing, resources are used in collaborative pattern.

Grid Characteristics

- **Large scale:** A grid must be able to deal with a number of resources ranging from just a few to millions. This raises the very serious problem of avoiding potential performance degradation as the grid size increases.

- **Geographical distribution:** Grid's resources may be located at distant places.
- **Heterogeneity:** A grid hosts both software and hardware resources that can be very varied ranging from data, files, software components or programs to sensors, scientific instruments, display devices, personal digital organizers, computers, super-computers and networks.
- **Resource sharing:** Resources in a grid belong to many different organizations that allow other organizations (i.e. users) to access them. Nonlocal resources can thus be used by applications, promoting efficiency and reducing costs.
- **Multiple administrations:** Each organization may establish different security and administrative policies under which their owned resources can be accessed and used. As a result, the already challenging network security problem is complicated even more with the need of taking into account all different policies.

SKY COMPUTING

Sky Computing is an emerging computing model where resources from multiple clouds providers are leveraged to create large scale distributed infrastructures.

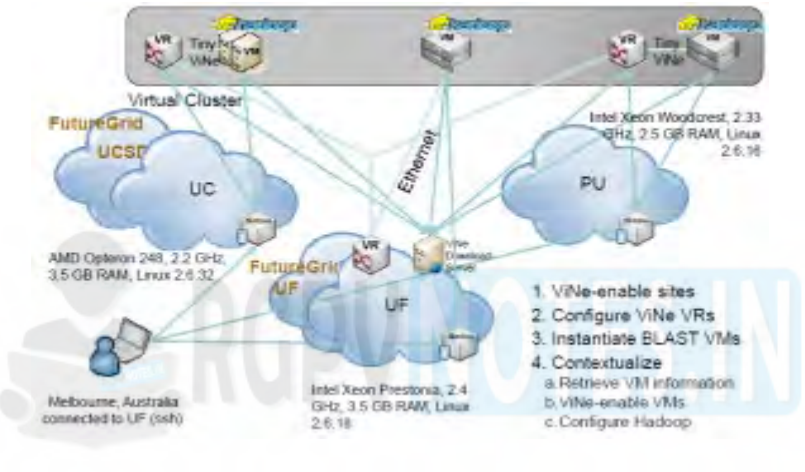

Figure 5.1 Sky Computing

- Sky computing allows users to control resources on their own. So trust relationships within sky computing are the same as those within a traditional non distributed site, simplifying how remote resources interact.
- It is dynamically scalable as resources are distributed over several cloud.
- Sky computing deploy a single appliance with a specific provider, users yrely on basic security and contextualization measures this provider – specific networking & security context.
- To connects the client to a trusted networking domain and configures explicit trust & relationships between them so that client securely takes ownership of customized infrastructure for an agreed time period.
- Seasonal e-commerce web server, event based alert systems.

LOAD BALANCING

Cloud Load balancing is the process of distributing workloads and computing resources across one or more servers. This kind of distribution ensures maximum throughput in minimum response time. The workload is segregated among two or more servers, hard drives, network interfaces or other computing resources, enabling better resource utilization and system response time. Thus, for a high traffic website, effective use of cloud load balancing can ensure business continuity.

The common objectives of using load balancers are:

- To maintain system firmness.
- To improve system performance.

- To protect against system failures.

The advantages of Cloud Load Balancing

- **High Performing applications:** Cloud load balancing techniques, unlike their traditional on premise counterparts, are less expensive and simple to implement. Enterprises can make their client applications work faster and deliver better performances, that too at potentially lower costs.
- **Increased scalability:** Cloud balancing takes help of cloud's scalability and agility to maintain website traffic. By using efficient load balancers, can easily match up the increased user traffic and distribute it among various servers or network devices.
- **Ability to handle sudden traffic spikes:** A normally running University site can completely go down during any result declaration. This is because too many requests can arrive at the same time. If they are using cloud load balancers, they do not need to worry about such traffic surges. No matter how large the request is, it can be wisely distributed among different servers for generating maximum results in less response time.

RESOURCE OPTIMIZATION AND RESOURCE DYNAMIC RECONFIGURATION

Cloud optimization is the process of correctly selecting and assigning the right resources to a workload or application. When workload performance, compliance, and cost are correctly and continually balanced against the best-fit infrastructure in real time, efficiency is achieved.

A cloud configuration system provides the ability to dynamically reconfigure a set of computing resources to define a cloud into multiple separate logical cloud instances. The system includes a reconfiguration tool that reads an existing system and network configuration from a configuration store, allows the user to change the configuration into multiple logical systems, performs some syntactical checks, and stores the new configuration into the configuration store.

MONITORING IN CLOUD

Cloud monitoring is the process of evaluating, monitoring, and managing cloud-based services, applications, and infrastructure. Companies utilize various application monitoring tools to monitor cloud-based applications. Here's a look at how it works and best practices for success.

Types of cloud monitoring

- **Database monitoring:** Cloud applications rely on databases, this technique reviews processes, queries, availability, and consumption of cloud database resources. This technique can also track queries and data integrity, monitoring connections to show real-time usage data. For security purposes, access requests can be tracked as well.
- **Website monitoring:** A website is a set of files that is stored locally, which, in turn, sends those files to other computers over a network. This monitoring technique tracks processes, traffic, availability, and resource utilization of cloud-hosted sites.
- **Virtual machine monitoring:** This technique is a simulation of a computer within a computer; that is, virtualization infrastructure and virtual machines. It's usually scaled out in IaaS as a virtual server that hosts several virtual desktops.

Benefits of Cloud Monitoring

- Scaling for increased activity is seamless and works in organizations of any size.
- Dedicated tools (and hardware) are maintained by the host.

- Tools are used across several types of devices, including desktop computers, tablets, and phones, so organization can monitor apps from any location.
- Installation is simple because infrastructure and configurations are already in place.
- System doesn't suffer interruptions when local problems emerge, because resources are not part of organization's servers and workstations.
- Subscription-based solutions can keep user costs low.

INSTALLING CLOUD PLATFORMSAND PERFORMANCE EVALUATION

There are three major players in the public cloud platforms arena - Amazon Web Services (AWS), Microsoft's Azure, and Google Cloud Platform. The top cloud computing companies are addressing a large and growing market.

Performance analysis is a complex process, but the goal is very simple: to identify the root cause of a problem. Toward this end, proceed in an orderly, step-by-step manner to home in on the fault domain containing the root cause. Since this chapter is specifically about virtualization and cloud computing and also discuss how those two domains affect this process. But first let's examine the high-level flow of a root-cause analysis.

So begin with a typical problem, slow application response time, then in step-by-step fashion, will narrow down the possibilities:

- Decide whether the problem affects the entire application, or just a particular transaction or transaction type. If the latter, then our first step is to isolate the transaction type that slows down. This will define the context for further investigation.
- Identify the problematic tier or tiers. The problem might lie between two tiers (i.e., due to network latency).
- To isolate the problem further, check whether the environment itself has a negative impact, such as CPU exhaustion, memory constraints. This would include anything that is external to the application itself; for instance garbage-collection suspensions.
- Finally, isolate the problem to a specific component, method, or service call within the application. From this point, can determine if the root cause is algorithmic, CPU-centric, a result of excessive VM suspensions, or caused by external bottlenecks, such as I/O, network, or locks (synchronization).

FEATURES OF CLOUD COMPUTING PLATFORMS

- **Resources Pooling:** It means that the Cloud provider pulled the computing resources to provide services to multiple customers with the help of a multi-tenant model. There are different physical and virtual resources assigned and reassigned which depends on the demand of the customer.
- **On-Demand Self-Service:** It is one of the important and valuable features of Cloud Computing as the user can continuously monitor the server uptime, capabilities, and allotted network storage. With this feature, the user can also monitor the computing capabilities.
- **Easy Maintenance:** The servers are easily maintained and the downtime is very low and even in some cases, there is no downtime. Cloud Computing comes up with an update every time by gradually making it better.
- **Large Network Access:** The user can access the data of the cloud or upload the data to the cloud from anywhere just with the help of a device and an internet connection. These capabilities are available all over the network and accessed with the help of internet.
- **Availability:** The capabilities of the Cloud can be modified as per the use and can be extended a lot. It analyzes the storage usage and allows the user to buy extra cloud storage if needed for a very small amount.

FUNCTIONS OF CLOUD COMPUTING PLATFORMS

Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet). The name comes from the use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams. Cloud computing entrusts remote services with a user's data, software and computation.

As technology develops there is a need for companies and businesses to figure out how to use cloud computing for business improvements. This means boosting output while keeping costs down. For the smart business, cloud computing provides a unique critical success factor that if harnessed properly could allow a business to operate more cost effectively than the competition. Like most technologies, cloud computing streamlines operations, reduces their cost and reduces strain on resources like power while at the same time providing higher security.

- **Infrastructure-as-a-Service (IaaS):** Infrastructure-as-a-Service (IaaS) delivers fundamental compute, network, and storage resources to consumer's on-demand, over the internet, and on a pay-as-you-go basis. Using an existing infrastructure on a pay-per-use scheme seems to be an obvious choice for companies saving on the cost of investing to acquire, manage, and maintain an IT infrastructure.
- **Platform-as-a-Service (PaaS):** Platform-as-a-Service (PaaS) provides customers a complete platform—hardware, software, and infrastructure—for developing, running, and managing applications without the cost, complexity, and inflexibility of building and maintaining that platform on-premises. Organizations may turn to PaaS for the same reasons they look to IaaS, while also seeking to increase the speed of development on a ready-to-use platform to deploy applications.
- **Big data analytics:** One of the aspects offered by leveraging cloud computing is the ability to use big data analytics to tap into vast quantities of both structured and unstructured data to harness the benefit of extracting business value.
- **Cloud storage:** Cloud offers the possibility of storing files and accessing, storing, and retrieving them from any web-enabled interface. The web services interfaces are usually simple. At any time and place, have high availability, speed, scalability, and security for the environment.
- **Data backup:** Backing up data has always been a complex and time-consuming operation. This included maintaining a set of tapes or drives, manually collecting them, and dispatching them to a backup facility with all the inherent problems that might happen in between the originating and the backup site. This way of ensuring a backup is performed is not immune to problems (such as running out of backup media), and there is also the time it takes to load the backup devices for a restore operation, which takes time and is prone to malfunctions and human errors.

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