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**MODE OF STUDY: REGULAR**

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**Question One**

**You are selected by St. Paul’s University, to go and represent them in a symposium on Distributed systems. Discuss in detail, the impact of the various design and system features of distributed system that you will talk about. In your answer, include the drawbacks of these choices.**

**(15 Marks)**

Distributed system is a collection of independent computers at networked locations such that they communicate and interact only through message passing that is viewers as a single coherent system by its users. Also it can be defined as a network that consists of autonomous computers that are connected using a distribution middle ware, which helps in sharing different resources and capabilities to provide users with a single and integrated coherent network.

**Distributed system features**

The following are main features of distributed systems

1. **Openness.** This feature ensures that a distributed system provides a standard rule following some protocols defining syntax and semantics of that service.
2. **Resource sharing.** This a feature that allows a distributed system to share and access remote resources.
3. **Concurrency.** A distributed system should allow programs that share resources to execute concurrently that is at the same time.
4. **Scalability.** A distributed system should be scalable with respect to size, geography, and administration.
5. **Fault Tolerance.** Nodes in a distributed system fail therefore there is need for a hardware and software redundancy and recovery.
6. **Transparency.** This is the ability to hide the fact that the processes and the resources of the distributed systems are physically distributed across multiple computers and makes users to realize that it’s a single coherent system.

The impact of the various designs and system features of a distributed systems.

1. The client-server distributed system design.

In this distributed system design, clients contact the server-which is a high end workstation for data, then it formats it and display it to the end-user which is the client. The client can also make a change from the client-side and commit it back to the server to make it permanent. Under this distributed system design any node can act as a client and server at the same time.

In this system design, the clients requests a resource and the server provides that resource. A server may serve multiple clients at the same time while a client is in contact with only one server that is only one client can only be in contact with one server but servers can handle requests of more than one clients.

Both the client and server usually communicate via a computer network but sometimes they may also reside in the same network.

The impact of client-server distributed system design.

* Improved data sharing. Client server system design has improved data sharing by making sure that data is retained by usual business and corporation processes and also manipulated on the server computer which makes it available for designated users that is clients which have an authority to access it.
* All the required data and information is stored in a single platform that is the server, thus it’s easy and less costly to secure and provide an authorization mechanism to ensure the data integrity.
* In this distributed system design, the server computer need not be located physically close to the clients. It’s always in a remote geographical location and the clients can communicate with it with ease as if they are on same location.
* Client- server distributed system design makes it is easy to replace, upgrade or relocate the nodes in the model because all the nodes are independent and request data only from the server.
* All the nodes in this distributed system design may not be built on similar platforms yet they can easily facilitate the transfer of data. For example the server can be running on a different operating system from the client.

**2. The peer to peer distributed system design**

The peer to peer distributed system design contains nodes that have equal participants in data and resource sharing. All the data processing tasks, data sharing, and resource sharing functions are equally divided between all the nodes. In this system design, responsibilities are uniformly distributed among machines in the system, known as peers also any node in this peer to peer system design can act as client or server at any given time.

The impact of peer to peer distributed system design.

* Each node in this system design is “Self-sufficient” that is it manages itself so the distributed system implementation is quite easy to set up and also to maintain.
* In client server distributed system design, server node handles all requests from the client nodes but this approach is not required in peer to peer computing this cutting the cost of the servers.
* Scalability in this distributed system is easy to implement because it’s easy to add new and more nodes and also users thus increasing rapidly the data and sharing capacity of the system.
* Node dependability is none because no any node in the peer to peer distributed system design model depends on other for functioning.
* No single point of failures.

3. Other distributed system designs are:

* Three-tier

In this distributed system design, the information about the client is stored in a middle tier rather than on the client to simplify application deployment and its mostly common for web based applications

* n-tier

The n-tier distributed system design architecture, is generally used when an application or server needs to forward additional enterprise services on the network or on the distributed system.

The drawbacks of the above distributed system designs

* If all clients in this distributed system design simultaneously accesses or requests data from the node acting as the server, it gets overloaded, thus becoming slow which in turn affects the performance of the entire distributed system at that instance.
* If the node acting as a server fails for any reason, none of client requests are fulfilled, thus leading to a failure of the system.
* Security is a big challenge in this distributed system designs especially when it’s implemented in a public network, because it’s vulnerable to a DOS – denial of service attack, which compromises and cripples the entire system.
* Fault tolerant is always tough and difficult when the distributed system model is based on unreliable nodes.
* Protocol incompatibilities also may lead to co-ordination and resource sharing difficulties thus compromising the performance of this distributed systems
* The initial cost of setting and maintaining a distributed system is very high and requires a well-established corporation to run and maintain this systems.
* There is no central point of control of the entire distributed.

**Question Two**

**Martin is debating with Judy on the advantages of Distributed Systems over Centralized Systems. They agree that security is a major issue on these systems, discuss broadly on security features, and how they can provide security to distributed systems.**

**(15 Marks)**

Security is a major issue on distributed systems and also centralized systems, any security breach on any of these systems can cripple or compromise the integrity of these systems, so the following are security features that can be implemented on either centralized or distributed system in order to enhance and improve security.

**1. Securing data transmission channels.**

Protection of communication and data transmissions between client and servers in a distributed systems is based on securing the channel between the communicating parties thus making the node transmitting and node receiving data. This process protects against interception of data by a third party who might tap or eaves drop into the distributed systems network.

Also protocols for mutual authentication and data integrity are required to protect and defend the network from counterfeits and attackers.

**2. Authentication**

This a securing feature which can be implemented in a distributed system which verifies whether a user, client, server or any component in the distributed system network are authentic. The following are authentication methods based on a session key.

* **Authentication based on shared keys.**

Shared keys depends on a cryptographic algorithms which have a mathematical basis which produces one way functions which effectively produces a public and a private key which can be used to ensure authentication without compromising security.

* **Authentication using a key distribution center.**

In this authentication technique, a Key Distribution Center collaborates with every other host for a secret key but any pair of hosts does not require to have shared key.

* **Authentication using public key encryption**

This type of authentication implements the use of public key cryptography to authenticate nodes in a distributed systems.

**3. Message confidentiality and integrity**

In addition to authentication, a secure transmission channel must guarantee confidentiality and integrity.

Message integrity means that messages must be protected against hidden manipulation. Confidentiality ensures that messages cannot be intercepted and read by eavesdroppers. Confidentiality is achieved through encryption message. Cryptography can be performed through shared secret key with recipient or using the public key of the recipient. If this security feature is implemented in a distributed system, it will help in reduction in chances of data transmission breaches thus enhancing the security of a distributed system.

**4. Use of digital signatures**

A digital signature is an electronic counterpart of a handwritten signature or printed seal that offers a better security than conventional signatures. This technique when implemented in a distributed system, it ensures that data integrity is enhanced.

**5. Use of session keys**

These are used during the creation of a secure channel, after completion of the authentication phase, the parties usually associated with a unique session key for confidentiality**.**

**6. Access control**

In distributed systems, when a client and server create a secure channel, the client can issue demands to be performed by the server and such demands can be implemented only if they have sufficient access rights for the call. This technique reduces chances of unauthorized access.

**7. Encryptions**

In distributed systems, when data is being transmitted from one node to another encryption techniques can be implemented, this encryption techniques jumbles the data being send over a distributed system network thus making it unreadable and meaningless to a third-party.

**8. Firewalls**

These are special kind of reference monitor devices or software which disconnects any part of a distributed system from the outside world thus providing a secure connectivity and prevention of unauthorized programs from accessing the distributed system.

**9. Sandbox**

This is a technique of executing a downloaded or a malicious program that its instructions are fully controlled. It forbids any execution of foreign code which might compromise the security of target distributed system.

**10. Access rights revocation**

This a technique of isolating an infected node in the distributed system by revoking its access rights to data and other resources in the distributed system network, it reduces chances of malware or virus infection all over the network.

**11. Honey Pots**

This is a security mechanism implemented in a distributed system network so to deflect, detect and counteract attempts at of unauthorized data and resource access.