IN5020 - Distributed Systems

Topic 1 - Introduction to Distributed Systems

Praveensankar Manimaran

Praveema@ifi.uio.no

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Literatures reading for these exercises

- Lecture slides – course introduction
- Coulouris et al Chapter 1 page 5-6
- Coulouris et al Chapter 1 page 14-26

Question 1 -

Why Transparency is important in Distributed Systems and explain the different types of transparency?

Distribution Transparency – Why?

- Distributed system consists of different resources and processes distributed across multiple computers

- It is essential to hide this distribution to the end users and applications.

- For example, if you watch a movie in netflix, you shouldn't be bothered about the information related to how the server stores the movie, how the server manages failure, etc.

Distribution Transparency - Types

Transparency	Description
Access	Hide differences in data representation and how an object is accessed
Location	Hide where the object is located
Relocation	Hide that an object may be moved to another location while in use
Migration	Hide that an object may move to another location
Replication	Hide that an object is replicated
Concurrency	Hide that an object may be shared by several independent users
Failure	Hide that failure and recovery of an object

Question 2 -

What are the implications of distributed systems?

Implications of distributed systems

1. Concurrency
2. No global clock
3. Independent failure of components
4. Unreliable communication
5. Unsecure communication
6. Expensive communication

Question 3 -

What are the different techniques available to improve the scalability of the system?

Scalability

- For example, an esports championship events such PGL Antwerp, Free Fire World Series are having more than 1 million concurrent viewers. what are the available to techniques to ensure that those systems can handle more number of viewers.

Scalability - techniques

1. Replication
   1. replicate resources (services, data) across the system
   2. Use edge servers near the users to improve the availability (for example, if more people from particular region watches the sport event, then we can place an edge server to ensure that those people can watch the videos without much delay)

2. Distribution (Sharding)
   1. splitting a resource (such as data) into smaller parts, and spreading the parts across the system

Question 4 -

Describe what is meant by Scalable systems

Scalable systems

Scalability denotes the ability of a system to handle an increasing future load

A scalable system: remains effective when there is a significant increase in the amount of resources (data) and number of users

Scalability in three dimensions:

1. **Scalable in size**: Users and resources can easily be added

2. **Geographically scalable**: Users and resources may lie far apart

3. **Administratively scalable**: The system spans many administrative organizations

Question 5 -

Consider the implementation strategies for massively multiplayer online games. In particular, what advantages do you see in adopting a single server approach for representing the state of the multiplayer game? What problems can you identify and how might they be resolved?

Massively Multiplayer Online (MMO) Games

Challenges in MMO games:

- **Fast response times** to preserve the user experience of the game
- **Real-time propagation** of events to the many players
- Maintaining a **consistent view** of the shared world

Advantages of single server: Single copy of states benefits the consistency

Problems in Single server approach: scalability issues

- Single point of failure
- Scalability in size (resources): Let say each online user may needs 10 Mb RAM, 100 kb bandwidth. Calculate the server capacity needed for 100,000 users.
- Scalability in geographic: users in US, Norway, Hongkong may have different latency depending on where the server is located

Thank You