2. Distributed System Architectures

2.1. The Client/Server model assigns roles to the processes which are communicating with each other.

a) Sketch out the connections and roles between 3 clients and 2 servers $S_1$ and $S_2$, whereby the server $S_1$ uses the services of server $S_2$ under a "subcontract" relationship.

b) Consider a chain of servers $S_i$ (with $i = 1 \ldots n$) where $S_i$ uses the server $S_{i+1}$ under subcontract relationship. What are the main problems with this organization with respect to the response time observed by a client sending a request to $S_1$ with an increasing number of servers?

2.2. A peer in a Peer-to-Peer system offers services. A second peer would like to use these services.

a) Sketch out the message exchange involved in the search for and use of services in a centralized, a pure, and a hybrid P2P architecture.

b) Discuss the advantages and disadvantages of centralized and decentralized architectures based on the three variants in terms of communication overhead, scalability, fault tolerance, and development effort.

2.3. For complex distributed systems, multi-tier architectures are predominately used.

a) How many and which tiers would you propose for an online trading platform which enables customers to shop via the WWW? Sketch out your solution!

b) Assign the following system functions to an architecture tier:
   - The functions of a shopping basket
   - Input forms for the editing of customer data by the customer
   - Discount calculation
   - Preparation of the contents of the shopping basket for presentation to the user
   - Checking of access rights
   - Saving of customer data

c) Discuss the terms horizontal and vertical distribution and assign multi-tier architectures to one of the two approaches.

2.4. Imagine an e-commerce system for a company of Amazon scale. Warehouses are spread across the globe and contain millions of products. Discuss architectural solutions for a store management system that ensure scalability, availability and acceptable performance/response times for clients with focus on partitioning and replication strategies. Discuss pros and cons of your solution.

2.5. Imagine you are a consultant working for a startup company that intends to sell an innovative product via an e-commerce platform. What advice would you give to the company according to the decision either to provide the e-commerce system on premise or to deploy it in a cloud infrastructure? Discuss the consequences of the advised decision.