

Study Guides on Computer Networks and Distributed Systems

Distributed Systems Models

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Motivation

In these lectures we study the most important abstractions and interfaces used in Distributed Systems (DS), specifically, we study the different ways of modeling DS and an introduction to physical clocks and synchronization. The challenge of this chapter is to grasp the concept and the usefulness of each of them:

- The **physical models** serve to identify the kinds of underlying computer systems used in the construction of DS. Of particular interest is the concept of Mobile Computing.
- The **architectural models** correspond to the concept of **architecture** that we studied extensively in CN. You may find that juggling the different perspectives explained in this section on architectural models is difficult, thus, I encourage you to work out your own outlines, those that will emerge from your study, particularly by skimming other sections of the textbook if necessary. You may want to consider the recommendation that **Cal Newport** gives in his book *How to become a straight-A student*:

“The most effective way to imprint a concept is to first review it and then try to explain it, unaided, in your own words. If you can close your eyes and articulate an argument from scratch, or stare at a blank sheet of paper and reproduce a solution without a mistake, then you have fully imprinted the concept”

All in all, get practice into discussing the importance and the differences between the different architectural concepts:

- The Elements (entities, paradigms, roles and the physical infrastructures)
Entity in this section is to be understood as any of the multiple forms that a computer program or system of programs might take: objects, components and web services
 - The Patterns (tiered architectures)
 - The technologies (middleware solutions)
- The **fundamental models** constitute a deep, mathematical reflection on the fundamental limitations of DS, those derived from the laws of physics. In this section, two variants of the interaction model are explained, the characteristics of the failure model and the security model. Regarding the interaction model (interactions among processes) you already know what a network protocol is and the main measures of network performance, regarding the failures you already studied error detection and correction codes and the -Internet- best effort model, last, security is an essential aspect of DS in the present. Here we will introduce the concept of computer clock and clock synchronization.

- A pragmatic comprehension of the **concept of time in DS** results essential, we will work the textbook sections 14.1 through 14.3 which are devoted to physical clocks and synchronization.

Questionnaire

1. Which Communication Paradigm do you think that **Socket programming** belongs to? (Consult slides 9 through 13 in the presentation ASD-2 on Architectural Models: <http://paloalto.unileon.es/asd/Lec/ASD-Ch2-Part1.pdf>)
 - Interprocess communication
 - Remote invocation
 - Indirect communication
2. Does Java offer some form of RPC or remote invocation? Tell its name and provide a brief description of your own.
3. What is the most cited architectural style in the field of Distributed Systems?
4. Can a server in a C/S DS act as a client to another server? Describe a concrete, real situation where these chained servers are present.
5. Briefly comment on the applicability of TCP and UDP transports in the construction of Distributed Systems that follow the Client/Server and the Peer-to-peer architectures?
6. ¿Es posible implementar una aplicación C/S usando sockets UDP?
7. Explain the most important placement strategies used in the DS of today.
8. Why is crucial that placement be implemented properly in a DS?
9. In a three-tier architecture an application is decomposed into how many blocks?
10. The aspects resulting from the former question are assigned to how many physical servers?
11. In a three-tier architecture, what is the database responsibility?
12. Today's web software offers the possibility that a client requests the update of even a small part of a web page? Explain the concepts and technologies involved.
13. What is the main drawback of the thin-client architecture?
14. What is the *reflection* pattern in distributed systems?
15. Can you explain what the *end-to-end* argument is in networking and distributed systems? Do you think that TCP represents the essential idea in that argument?

16. Distributed systems are composed of multiple *interacting processes*, in this context, what is a distributed algorithm?
17. What is the essential difference between asynchronous and synchronous DS?
18. What is the goal of Lamport's logical time?
19. The Network Time Protocol (NTP) can be used to synchronize computer clocks. Explain why, even with this service, no guaranteed bound is given for the difference between two clocks.
20. What failures does TCP protect from?
21. What is a Byzantine failure in a DS?
22. What is a secure channel in DS security? Tell an example protocol that sets up a secure channel before proceeding to data exchange in web protocols?
23. Tell an example of an element of a Distributed System that belongs to the Physical Model.
24. What DS transparencies apply to Mobile Computing?
25. What are the entities communicating in a Distributed System?
26. Which Communication Paradigm do you think that Socket programming belongs to?
 - Interprocess communication
 - Remote invocation
 - Indirect communication
27. Does Java offer some form of RPC or remote invocation? Tell its name and provide a brief description of your own.
28. What is the most cited architectural style in the field of Distributed Systems?
29. Can a server in a C/S DS act as a client to another server? Describe a concrete, real situation where these chained servers are present.
30. Discuss the applicability of TCP and UDP transports in the construction of Distributed Systems that follow the Client/Server and the Peer-to-peer architectures?
31. What aspects of the computers and networks limit most the performance of a C/S system?
32. Same as question 8, but, applied to the Peer-to-peer architecture.
33. What DS transparencies apply to a Web Load Balancer like that in the pdf slide titled "Placement/Replicating servers: Load Balancers"?
34. Explain the functions of an Http Proxy.

35. Work the questions that appear in the slide titled “3-tier physical servers”
36. Propose a solution to make the DTT frequency band allocation problem transparent so that the user change is avoided.
37. Exercises from the textbook by Dollimore-Kindberg-Coulouris-Blair:
 - 14.1 Additionally, discuss the procedure for updating the clocks to the daylight savings time.
 - 14.2
 - 14.4
 - 14.5
38. Are you successfully solving the exercises included in the Lab Practicals?