Distributed operating systems tanenbaum pdf software free trial

The Amoeba Distributed Operating System

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1. INTRODUCTION

Roughly speaking, we can divide the history of modern computing into the following eras:

- 1970s: Timesharing (1 computer with many users)
- 1980s: Personal computing (1 computer per user)
- 1990s: Parallel computing (many computers per user)

Until about 1980, computers were huge, expensive, and located in computer centers. Most organizations had a single large machine.

In the 1980s, prices came down to the point where each user could have his or her own personal computer or workstation. These machines were often networked together, so that users could do remote logins on other people's computers or share files in various (often ad hoc) ways.

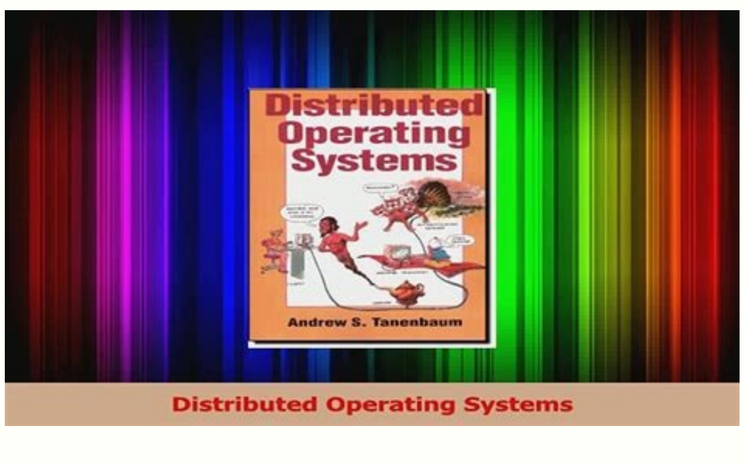
Nowadays some systems have many processors per user, either in the form of a parallel computer or a large collection of CPUs shared by a small user community. Such systems are usually called *parallel* or *distributed computer systems*.

This development raises the question of what kind of software will be needed for these new systems. To answer this question, a group under the direction of Prof. Andrew S. Tanenbaum at the *Vrije Universiteit* (VU) in Amsterdam (The Netherlands) has been doing research since 1980 in the area of distributed computer systems. This research, partly done in cooperation with the *Centrum voor Wiskunde en Informatica* (CWI), has resulted in the development of a new distributed operating system, called *Amoeba*, designed for an environment consisting of a large number of computers.

Amoeba is available for free to universities and other educational institutions and for special commercial prices and conditions to corporate, government, and other users, as described later.

2. WHAT IS AMOEBA?

Amoeba is a general-purpose distributed operating system. It is designed to take a collection of machines and make them act together as a single integrated system. In general, users are not aware of the number and location of the processors that run their commands, nor of the number and location of the file servers that store their files. To the casual user, an Amoeba system looks like a single old-fashioned time-sharing system.



RESEARCH ISSUES IN DISTRIBUTED OPERATING SYSTEMS

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As distributed computing becomes more widespread, both in high-energy physics and in other applications, centralized operating systems will gradually give way to distributed ones. In this paper we discuss some current research on five issues that are central to the design of distributed operating systems: communications primitives, naming and protection, resource management, fault tolerance, and system services. For each of these issues, some principles, examples, and other considerations will be given.

1. INTRODUCTION

As distributed computing becomes more widespread, both in high-energy physics and in other applications, centralized operating systems will gradually give way to distributed ones. Distributed operating systems have many points in common with centralized ones, but they also have many distinctive features of their own. They often differ in the areas of how processes communicate with each other, how resources are named (and protected), how they are managed, how robustness (fault tolerance) is achieved, and how system services are provided to user processes. In the following sections we will survey current research ideas in each of these areas.

2. COMMUNICATION PRIMITIVES

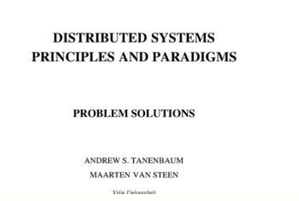
The computers forming a distributed system normally do not share primary memory, so communication via shared memory techniques such as semaphores are generally not applicable. Instead, message passing in one form or another is used. One widely discussed framework for message-passing systems is the ISO OSI reference model, which has seven layers, each performing a well-defined function [Zimmerman 1980]. The seven layers are: physical layer, data-link layer, network layer, transport layer, session layer, presentation layer, and application layer. Using this model it is possible to connect computers with widely different operating systems, character codes, and ways of viewing the world. Unfortunately, the overhead created by all these layers is very substantial. Nearly all the experimental distributed systems discussed in the literature so far have opted for a radically different, and much simpler model, so we will not mention the ISO model further in this paper.

2.1. Message Passing

The model that is favored by researchers in this area is the **client-server model**, in which a client process wanting some service (e.g., reading some data from a file) sends a message to the server and then waits for a reply message. In the most naked form, the system just provides two primitives: SEND and RECEIVE. The SEND primitive specifies the destination and provides a buffer; the RECEIVE primitive tells from whom a message is desired (including "anyone") and provides a buffer where the incoming message is to be stored. No initial setup is required, and no connection is established, hence no teardown is required.

Precisely what semantics these primitives ought to have has been a subject of much controversy among researchers. Two of the fundamental decisions that must be made are unreliable vs. reliable and nonblocking vs. blocking primitives. At one extreme, SEND can put a message out onto the network and wish it good luck. No guarantee of delivery is provided, and no retransmissions are attempted by the system. At the other extreme, the SEND can handle lost messages, retransmissions, and acknowledgements internally, so that when SEND terminates, the program is sure that the message has been received and acknowledged.

The other choice is between nonblocking and blocking primitives. With nonblocking primitives, SEND returns control to the user program as soon as the message has been queued for subsequent


DISTRIBUTED SYSTEMS
PRINCIPLES AND PARADIGMS

PROBLEM SOLUTIONS

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