Analyzing Sun Networks

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Carl Malamud

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Preface

Sun Microsystems has based their entire business on the concept of open systems. The original Sun workstation was built out of off-the-shelf parts. Using standard components to build state-of-the-art workstations and software is a policy that continues to this day.

This philosophy extends into networks. Sun networks are built on the industry standard TCP/IP protocols, the same protocols used for the international Internet network. This book shows how TCP/IP networks can be used to build heterogeneous, fast, and big networks.

TCP/IP is only the beginning for a network. Also explained are the Network File System, RPC, and all the other protocols that are part of the Open Networking Community (ONC) family. Because of the widespread acceptance of ONC—over one million computers on every major operating system—this book is about much more than just Sun networks; it is a book about any computers that use TCP/IP and NFS.

In addition to the industry standards, also included are network management, security, interoperability, and other topics that are vital to managing networks. We will see how OSI and SNA are built into the network and how this heterogenous computing environment is managed.

Building viable network architectures is the theme of this book. Throughout the text, case studies from Sun's own network and other leading sites are used. One of the pleasures in writing this book has been working with technology that exists and is being used all over the world.

This is the last volume of a three-volume series on *Analyzing Networks.* For information on OSI-based networks, the reader is directed to *Analyzing DECnet/OSI Phase V.* For information on proprietary networks, the reader is directed to *Analyzing Novell Networks.* For information on heterogeneous networks that are operational today, turn the page.

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Dianne Littwin of Van Nostrand Reinhold has been the editor for all three volumes in this series. I'd like to express my sincere thanks to her for all her hard work and incredible patience. She deserves a vacation.

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CHAPTER 1

Introduction

CHAPTER 1

Introduction

Overview

For some, the network is the equivalent to a freeway. It's there, you have to use it, so you learn one or two exits and shuttle back and forth to work every day. For more inquisitive types, the freeway is just the backbone with a wide variety of different exits, each providing different services.

For this inquisitive reader, this book is intended to provide a road map. We assume the reader has some interest in knowing how a network based on the Transmission Control Protocol and the Internet Protocol (TCP/IP) operates.

TCP/IP is much broader than just Sun workstations, so the title of this book is a bit of a misnomer. The first portion of the book applies to any computer which supports TCP/IP, which is any computer still operating that doesn't use vacuum tubes.

We will see how TCP/IP can be used to integrate a variety of networks together into a coherent whole. Each network may be composed of a variety of different links—FDDI, Ethernet, X.25, ISDN, for example. These different data links are examined in more detail in Chapter 2. (The reader may also consult the the glossary for quick explanations of acronyms.) Chapter 3 then shows how TCP and IP (and several other protocols) are built on top of the subnetworks, integrating them into internetworks.

Built on top of TCP/IP are a variety of services that were originally developed by Sun Microsystems; they are grouped together under the official name of Open Network Computing (ONC) or the unofficial moniker of the Network File System (NFS), a protocol that allows a file system on a remote computer to appear as a local drive. NFS opens the door for a wide variety of distributed computing, including the diskless workstation.

ONC is much more than NFS, however. It includes a remote procedure call protocol on which several other services are built. The Network Information Service (NIS) is a name service; there is a lock manager and many

other support services. Other applications, such as SunNet Manager or 3270 color screen emulation also use this ONC infrastructure.

ONC is the subject of much of this book. Chapters 5 and 7 discuss the RPC and XDR protocols, Chapter 6 describes NFS. Other ONC applications are also discussed: the Automounter in Chapter 11; the License Server and lock manager in Chapter 12.

Describing ONC and the TCP/IP protocols still doesn't really qualify this as a book on "Sun" networks. Although Sun developed NFS, a liberal licensing policy has seen it migrate to every major operating system.

This book is thus really about building heterogeneous networks with a slant on Sun workstations. Most of the technology described, however, has applicability to a wide selection of operating systems and hardware platforms.

The emphasis is on understanding how this heterogeneous network, of which the Sun is one type of server or workstation, works. A wide variety of topics are examined, organized in a way that attempts to make some sense out of the wide range of options that are available. The choice of topics is, of course, arbitrary. Not every issue is covered, and we have not attempted to deal with any issues in a definitive fashion. Points to sources for further reading are provided for people who want to implement software, tune systems, or do any of the other hands-on tasks of managing a network.

A fairly detailed overview does help, however, even if you will have to go chasing after some manual when a problem occurs. If you understand what pieces are involved, you have a valuable sense of perspective on the details listed in a reference manual or protocol specification. Throughout the book, illustrations bring concepts to life: network configurations, network analyzer screen dumps, lists of system calls, or reference tables. One reader termed this information "raw data," which this author has chosen to interpret in the good sense of the term: concrete examples that illustrate theory.

This raw data is presented to the reader because it gives an understanding of the capabilities of a given protocol or module. Looking at dumps from a network analyzer is useful for debugging error situations, but it is also useful as a learning tool to see how a packet is constructed. Knowing what system calls are available, or what management information is kept by a module, is equally instructive. Of course, all this raw data is supplemented by a healthy dose of commentary. A book of all pictures would be nice, but the picture book of network analysis will have to wait for another time.

The Sun Wide-Area Network (SWAN) is used throughout this book as a case study. In addition to the case study material from Sun, material from the San Diego Supercomputer Center, NASA-Ames, and the Internet is in-

Courtesy of Sun Microsystems

PID	TT	STAT	TIME	COMMAND
0	?	D	0:00	swapper
1	?	IW	0:00	/sbin/init -s
2	?	D	0:00	pagedaemon
55	?	S	1:02	portmap
58	?	IW	0:00	ypbind
60	?	IW	0:00	keyserv
68	?	S	18:51	in.routed
71	?	I	0:00	(biod)
72	?	I	0:00	(biod)
73	?	I	0:00	(biod)
74	?	I	0:00	(biod)
84	?	IW	0:01	syslogd
92	?	IW	0:02	/usr/lib/sendmail -bd -q1h
96	?	IW	0:00	rpc.statd
98	?	IW	0:00	rpc.lockd
105	?	S	0:00	automount
112	?	S	10:46	update
115	?	IW	0:00	cron
120	?	IW	0:16	inetd
123	?	IW	0:00	/usr/lib/lpd
253	?	IW	0:00	rpc.rquotad
383	co	S	0:04	-csh (csh)
519	co	R	0:00	ps -ax

1-1 Processes on a Typical Workstation

cluded. Supplementing the case studies are a series of screen dumps taken from a Network General Sniffer Analyzer. This device is a modified PC that can be attached to token ring, Ethernet, ARCnet, and other networks to filter and capture data.

This captured data can then be analyzed. The Sniffer Analyzer is used because the information that is captured is displayed in a format that, given the technical material, is remarkably close to clear English.

For some readers, this book will provide all they need, a conceptual overview of how networking works in an environment with TCP/IP, NFS, or other protocols. Most readers, however, will probably have some contact with a Sun workstation or a TCP/IP network, or they wouldn't be reading this book. For those readers, this book is a supplement to the raw data of manuals, functional specifications, hardware diagrams, and all the other data that accompanies the computer. One nice thing about Sun is that much of this data is no longer shipped as large walls of documentation but is available electronically.

This book provides the overview. If the reader is a user of the network, the overview might help understand what is happening when a remote file system is mounted with NFS or why the license server is not letting you proceed with your application. Others will be interested in writing applications for use on the network. It is important to understand what tools are available so that an appropriate choice can be made. Using existing services, such as using NIS to register the location of a database server, means that the programmer doesn't have to reinvent the wheel.

Users and software developers are two classes that may find this information useful, but there is also one more class: the people who have to buy, install, and manage networks. For this class of readers, some material may be rudimentary compared to their current level of expertise. An engineer who designs FDDI chips is not going to learn anything about FDDI (or Ethernet) from reading this book but might learn something about message systems.

This is a bootstrap attempt: significantly more than a marketing white paper or the trade press but certainly less than all the primary resource documents. Hoping that human nature holds, the author is counting on the fact that a 1-inch thick book will be a more attractive target than the dozen or so linear feet that make up a decent set of source documents.

In Figure 1-1, the reader will see the first of many screen dumps. This dump is from a Sun workstation and is a listing of currently active processes on the computer. Eleven different proceses in that listing are discussed in this book. An interesting test for the reader (and consequently of the author) is to see if, upon completion of the text, he or she can identify which processes are involved in a real network and what the processes do.

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