Networking in Operating Systems

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OS and Networking

In OS texts, networking is almost always an advanced topic, or covered with respect to a network file system or under the heading of “distributed systems”

But how an OS implements a network stack is an almost perfect illustration of many of the topics we’ve covered so far
Networks: A Good Illustration of OS Concepts

User management aspects
System calls to read/write important network state and content
Virtual concepts like interfaces
Sockets as communication endpoints (cf. file descriptors)
Interfacing with hardware, interrupt handling
Concurrency
Roles of the OS in Supporting Network Communications

Device drivers (manage network devices)
Sockets (data structure to maintain comm. endpoints)
Service some types of layer 2 and 3 protocols
Provide a firewall (e.g., netfilter)
Implement forwarding (provide a gateway or router)
What is a Network?

“...nothing more than a collection of machines who have agreed to speak the same language; the network exists at their pleasure and only as a set of distributed state among their OS network stacks: the data structures and functions that make up the part of the kernel responsible for creating, delivering, and receiving packets.”
Network Utilities in an OS

Who am I?

What state am I in?

How do I locate others?

How do I send information to others?
Network Utilities in an OS

Who am I? ifconfig

What state am I in? netstat

How do I locate others? arp, route, ping, traceroute

How do I send information to others? nc
Network-related system calls

strace --e trace=network

socket / bind / listen / accept

send / recv / sendto / recvfrom

read / write

select / poll
recv

/**
* Receive a datagram from a socket.*/

asmlinkage long sys_recv(int fd, void __user *ubuf,
    size_t size, unsigned flags)
{
    return sys_recvfrom(fd, ubuf, size, flags, NULL,
        NULL);
}

http://lxr.cpsc.ucalgary.ca/lxr/#linux+v2.6.32/net/socket.c#L1765
Demos

Messaging with netcat

ICMP handling of

TIMESTAMP http://lxr.cpsc.ucalgary.ca/lxr/
#linux+v2.6.32/net/ipv4/icmp.c#L846

ECHO_REQUEST http://lxr.cpsc.ucalgary.ca/lxr/
#linux/net/ipv4/icmp.c#L809