

TCP/IP Networks

By Ronald L. Roeber, IETS Coordinator

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TCP/IP

- ◆ TCP/IP refers to an entire family of data communications protocols
- ◆ The name TCP/IP is derived from two protocols in that family:
 - Terminal Control Protocol /
 - Internet Protocol

Today

- ◆ TCP/IP network protocol is included in nearly all commercial operating systems by default.
- ◆ A large proportion of business networks depend on TCP/IP
- ◆ Until recently, this was not the case...

Protocols

- ◆ The forms of ceremony and etiquette used by diplomats and heads of state
- ◆ Rules for interacting
- ◆ Standards of conduct
- ◆ Promote understanding and avoid misunderstanding

10 years ago...

- ◆ IPX (Novell) was the most widely used network protocol
- ◆ Microsoft did not bundle network protocols in their operating system
- ◆ Corporate networks were dominated by SNA
- ◆ Unix networks used UUCP

Why TCP/IP Won

- ◆ Open standard, freely available and developed independent of vendor specific OS and hardware
- ◆ Independence from network hardware
- ◆ Common addressing scheme allows any TCP/IP device to uniquely address another
- ◆ Standard high-level protocols for consistent and widely available services

TCP/IP Architecture

- ◆ The OSI (Open Systems Interface Reference Model) is used as a reference for discussing data communications.
- ◆ Though it is difficult to do so (and perhaps controversial) we will use 4 layers to describe the TCP/IP.

TCP/IP Protocol

- ◆ Application Layer
 - Consists of applications and processes that use the network
- ◆ Host-to-Host Transport Layer
 - Provides end-to-end data delivery services
- ◆ Internet Layer
 - Defines datagram and handles the routing of data
- ◆ Network Access Layer
 - Consists of routines for accessing physical networks

About Data Handling

- ◆ Each layer in the stack adds control information to ensure proper delivery
 - header
- ◆ Each layer treats the data it receives from the layer "above" as data and adds its own header
 - encapsulation

Terms

- ◆ Applications refer to data as a *stream*
- ◆ TCP calls data a *segment*
- ◆ Internet layer sees all data as blocks called *datagrams*
- ◆ Networks refer to transmitted data as *frames*

Application Layer Examples

- ◆ telnet: Network Terminal Protocol
- ◆ ftp: File Transfer Protocol
- ◆ http: Hypertext Transfer Protocol
- ◆ SMTP: Simple Mail Transfer Protocol

Delivering The Goods

- ◆ Addressing
 - IP addresses which uniquely identify every host on the network
- ◆ Routing
 - Gateways deliver data to the correct network
- ◆ Multiplexing
 - Protocol and port numbers deliver data to the correct software process on the destination host

The IP Address

- ◆ IP addresses are usually written as four sets of decimal numbers separated by dots.
 - xxx.xxx.xxx.xxx
 - Each of the four numbers in the range 0-255 (the decimal values for a single byte)
 - Each address includes a *network part* and a *host part*.

Address Classes

- ◆ Class A – first number less than 128
 - First number network and last three for the host
 - 10.122.36.2
 - Network 10
 - Host 122.36.2
- ◆ Class B – first number from 128 to 191
 - First two numbers network and last two for the host
 - 172.122.36.2
 - Network 172.122
 - Host 36.2
- ◆ Class C – first number from 192 to 223
 - First three numbers network and the last one for the host
 - 223.122.36.2
 - Network 223.122.36
 - Host 2
- ◆ Class D – first number from 223 to 239
 - Address used for multicasting
- ◆ Class E – first number greater than 239
 - Reserved

Network Routing

- ◆ Gateways route data between networks
 - If the destination host is on the local network, data is delivered to the destination host
 - If the destination host is on a remote network, the data is forwarded to the local gateway

Routing Table

- ◆ Destination – destination host or network
- ◆ Gateway – gateway to use to reach destination
- ◆ Flags
 - U – route is up and operational
 - H – route to a specific host (not a network)
 - G – route uses a gateway
 - D – route was added due to a Redirect Message
 - Ref – number of times route was referenced
 - Use – number of packets sent via this route
 - Interface – name of the network interface

Names & Addresses

- ◆ Translating names into addresses
 - 129.93.88.93 ianrwww.unl.edu
- ◆ Host table
 - On each machine
- ◆ Domain Name Service (DNS)
 - Host information is automatically disseminated to only those interested

Protocols, Ports & Sockets

- ◆ Multiplexing
 - Once data is delivered to the correct host it must be delivered to the correct user or process
 - Combining many sources of data into a single stream is called *multiplexing*

Demultiplexing

- ◆ Divide arriving data into multiple processes
 - Protocol numbers – identify transport protocols
 - ip 0, icmp 1, tcp 6...
 - Port numbers – identify application to receive data

Port Numbers & Services

- ◆ Host network services are identified by port numbers
 - Below 256 reserved for well known services
 - 80/http
 - 21/ftp
 - 23/telnet
 - 25/smtp
 - Between 256 and 1024 used for Unix-specific services which are no longer Unix specific
 - 443/https
 - 525/timed
 - 532/netnews
 - 531/conference(chat)

Sockets

- ◆ IP address + port number is called a socket
- ◆ Dynamic port numbers are assigned in a system to uniquely identify each user (that is why many people can telnet/http/ftp/smtp into the same computer at the same time)

If only we had time

- ◆ DHCP - Dynamic Host Configuration Protocol
 - how IP addresses are automatically assigned)
- ◆ PPP & SLIP
 - Provides access to network through external (dial-up) connection

In the End

- ◆ TCP/IP: dominant network protocol
 - flexible
 - modular
 - extensible
- ◆ It is open, we can look inside.

Some Resources

TCP/IP Network Administration
By Craig Hunt
ISBN: 1-56592-322-7

Computer Networks and Internet

EXCITE Seminar Web site:

<http://www.ianr.unl.edu/excite/>