Network Programming

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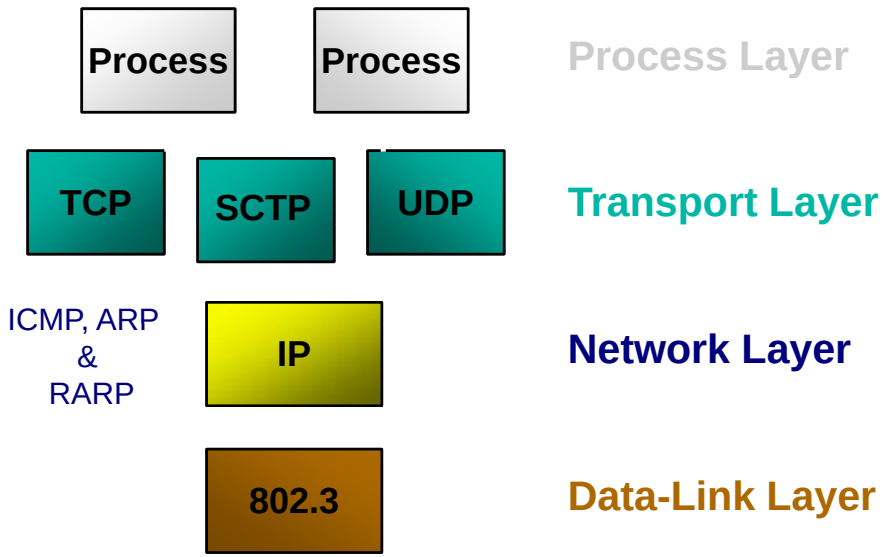
Introduction to Sockets

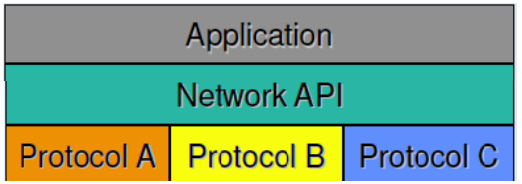
Outline

- Definitions
- Berkeley API
- Socket definition and types

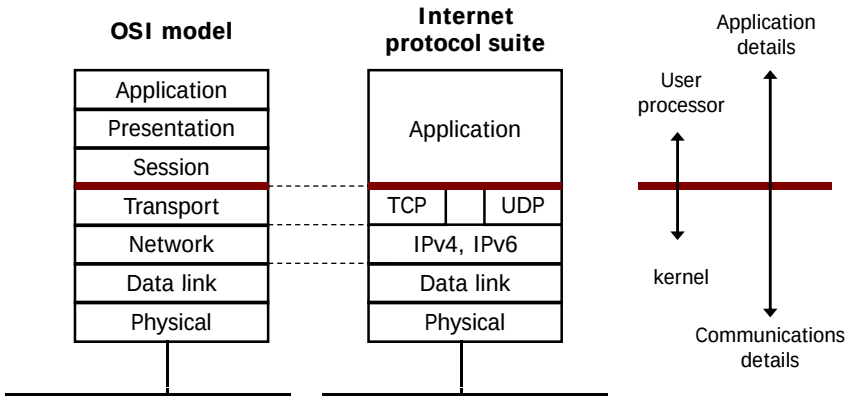


Network API

- API - Application Programming Interface
  - API is a set of functionality/services delivered by a programming system.
  - Also API is a set of declaration, definitions, and procedures followed by programmers to write client-server programs.
- Network API
  - The services (often provided by the operating system) that provide the interface between application and protocol software.



Network API



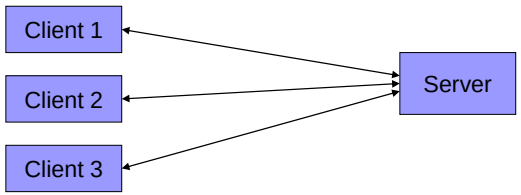
Network API wish list

- Generic Programming Interface.
  - Support multiple communication protocol suites (families).
  - Address (endpoint) representation independence.
  - Provide special services for Client and Server
- Support for message oriented and connection oriented communication.
- Work with existing I/O services
- Operating System independence
- Presentation layer services

TCP/IP

- TCP/IP does not include an API definition.
- There are a variety of APIs for use with TCP/IP:
  - Sockets by Berkeley
  - XTI (X/Open Transport Interface) by AT&T
  - Winsock - Windows Sockets API by Microsoft
  - MacTCP / Open Transport by Apple

Client-Server Model



- One side of communication is client, and the other side is server
- Server waits for a client request to arrive
- Server processes the client request and sends the response back to the client
- Iterative or concurrent

Functions needed:

- Specify local and remote communication endpoints
- Initiate a connection
- Wait for incoming connection
- Send and receive data
- Terminate a connection gracefully
- Error handling

Berkeley Sockets

- A socket is an abstract representation of a communication endpoint.
- Generic:
  - support for multiple protocol families.
  - address representation independence
- Sockets (obviously) have special needs:
  - establishing a connection
  - specifying communication endpoint addresses
- Sockets work with Unix I/O services just like files, pipes & FIFOs

Sockets API

API is Application Programming Interface

•Sockets API defines interface between application and transport layer

➢two processes communicate by sending data into socket, reading data out of socket

•Socket interface gives a file system like abstraction to the capabilities of the network

•Each transport protocol offers a set of services

➢The socket API provides the abstraction to access these services

•The API defines function calls to create, close, read and write to/from a socket

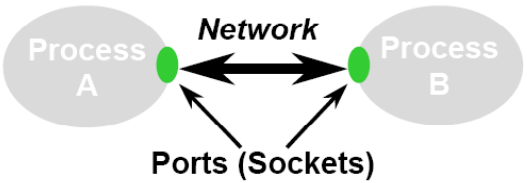
Sockets Abstraction

The *socket* is the basic abstraction for network communication in the socket API

➢Defines an endpoint of communication for a process

➢Operating system maintains information about the socket and its connection

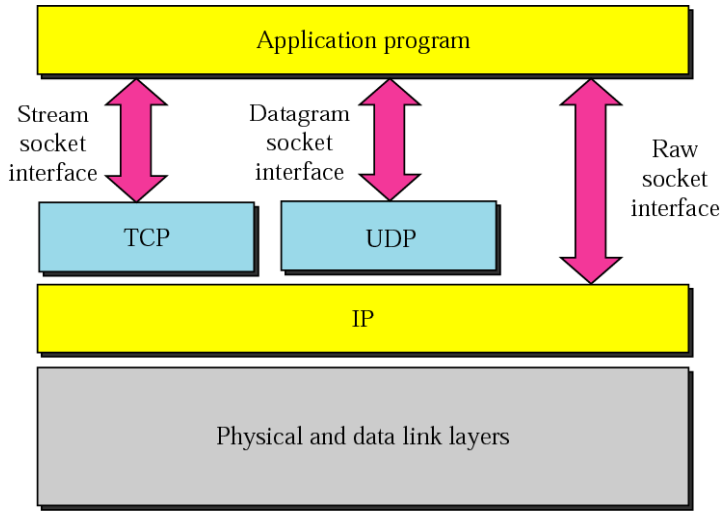
➢Application references the socket for sends, receives, etc



Elements of a Socket

- Each socket can be uniquely identified by
  - Source IP address
  - Source port number
  - Destination IP address
  - Destination port number
  - An end-to-end protocol (TCP or UDP)

Types of Sockets



Stream Sockets

- Also known as connection-oriented socket
- Use TCP
- Provide reliable, connected networking service
- Error free; no out-of-order packets
- Applications: telnet, ssh, http
- TCP uses a pair of stream sockets to connect one application program to another across the Internet.

Datagram Sockets

- Also known as connectionless socket
- Use UDP
- Provide unreliable, best-effort networking service
- Packets may be lost; may arrive out of order
- Applications: streaming audio/video
- UDP uses a pair of datagram sockets to connect one application program to another across the Internet.

Raw Sockets

- Some protocols as ICMP or OSPF that directly use the services of IP use neither stream sockets nor datagram sockets.

- Raw sockets are designed for these types of applications.