

Ignify Consulting

ISO/OSI – Reference Model

Author: Ranjit Goray
ranjit@ignify.com

Ignify Consulting
13304 Alondra Blvd #201.
Cerritos CA 90703
www.ignify.com

March 2003



Confidential

Property of Ignify
May not be reproduced or distributed without prior permission

1

Communication Networks

Various Services and flexibility

Network Architectures

- Grouping a set of related function to a layer
- A set of protocols

Advantage of layered architectures

- Simplification
- Flexibility



Confidential

Property of Ignify
May not be reproduced or distributed without prior permission

2

Example of Protocol

Interaction between two peer entities

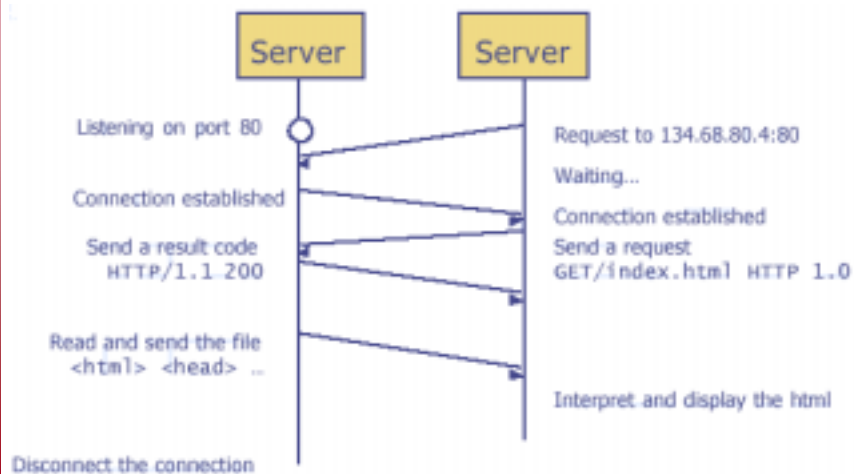
Server/Client

- Server - a process waiting a request
 - ◆ Listening specific port in TCP/IP
 - ◆ Httpd (Apache™), ftpd, telnetd,...
- Client – a process making a request
 - ◆ A request to server address and the port number
 - ◆ Netscape, IE, telnet,...

A connection in a server/client model is a 5-tuple

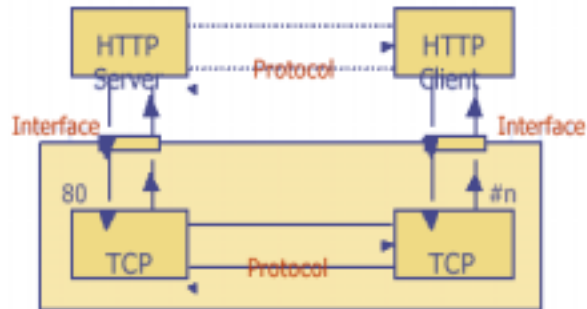
- Protocol type, Source address, Destination address
- Source port number, destination port number

Example of Protocol, http(1)



Example of Protocol, http(2)

Need a connection-oriented service & a reliable underlying layer



Other Examples

DNS (Domain Name System)

- Convert an IP name to an IP address, or vice versa
- Netlab.exe.iupui.edu <-> 134.68.80.4
- UDP/IP – Connectionless

SMTP (Simple Mail Transfer Protocol)

- TCP connection to local SMTP server
- Work as if connectionless for forwarding the message to remote SMTP server

OSI Reference Model

International Organization for Standardization / Open Systems Interconnection (ISO/OSI)

Reference Model, but not a real implementation

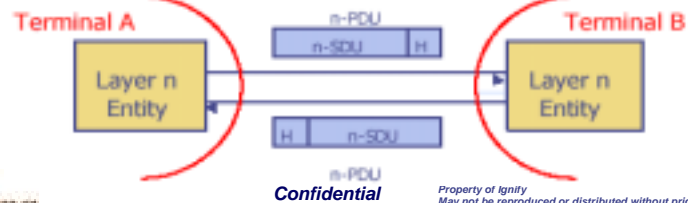
A process on one machine on layer n

- Communicates with a peer process on the other machine
- By exchanging PDU (Protocol Data Unit)

PDU contains a header and a payload called SDU (Service Data Unit)

- Header – control information
- Payload – do not care

Layer n protocol – A set of rules governing the behavior of layer n



Ignify Consulting

Confidential

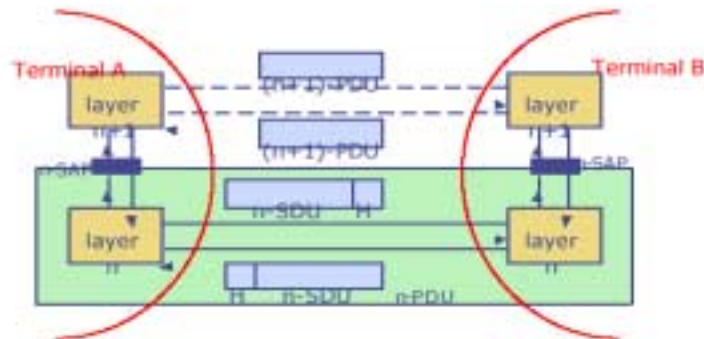
Property of Ignify
May not be reproduced or distributed without prior permission

7

Interface and Service

Communication between two peer processes is not physical

The layer n+1 uses the services provided by layer n through layer n interface, called SAP (Service Access Point)



Ignify Consulting

Confidential

Property of Ignify
May not be reproduced or distributed without prior permission

8

Segmentation and Reassembly

Maximum PDU size of Ethernet is 1500 bytes

How can we send information larger than the maximum thru Ethernet?

Segmentation

- The layer n in a terminal can segment its payload into small pieces

Reassembly

- The layer n in the other terminal put together the small



ISO/OSI Reference Model

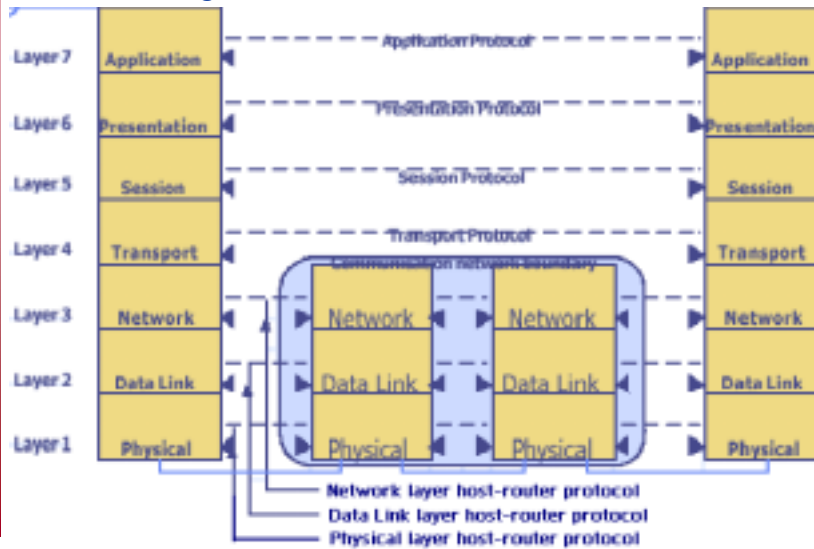
International Standard Organization / Open Systems
Interconnection

7 Layers

Principles

- A layer should be created where a different level of abstraction is needed.
- Each layer should perform a well defined function.
- The function of each layer should be chosen with an eye toward defining internationally standardized protocols.
- The layer boundaries should be chosen to minimize the information flow across the interfaces
- The number of layers should be large enough so that distinct function need not be thrown together in the same layer out of necessity.
- The number of layers should be small enough that the architecture does not become unwieldy.

OSI 7 Layer Reference Model



The Physical Layer

Deal with the transfer of **raw bits** over communication channel

Electrical Aspects

- Voltage Level
- Signal duration

Mechanical Aspects

- Socket type
- Number of pins

Examples

- Twisted copper wire – telephone wire
- Coaxial cable
- Radio – cellular phone , 802.11
- Optical fiber

The Data Link Layer

Deal with transfer of frames

Framing Information

- Boundary of the frame
 - ◆ Attaching special bit patterns to the beginning and end of the frame
- Control and address information
- Check bit for recovering from transmission errors
 - ◆ Acknowledge frames
 - ◆ Handled with damaged, lost, and duplicate frames
- Flow controls
 - ◆ Prevent a fast transmitter from drowning a slow receiver in data

Broadcast networks

- Control access to the shared channel
- LAN
 - ◆ Sub-Layer: Medium Access Control layer (MAC)
 - ◆ One-to-One communication over broadcast medium

Examples

- HDLC – High – Level Data Link Control
- PPP – Point-to-Point Protocol
- SONET – Synchronous Optical Network



Confidential

Property of Ignify
May not be reproduced or distributed without prior permission

13

The Network Layer

Transfer of data (packet) over networks

Routing

- Select a path from the source to the destination thru many intermediate network components as switches and routers.
- Static routing vs. dynamic routing
- Deal with congestion – temporary traffic surges in a network components forming bottlenecks
- Differentiation of packet types
- Heterogeneous network
 - Different address scheme
 - Maximum Transfer unit (MTU)
- Political Routing
 - ◆ Inter-office emails between Microsoft branches shouldn't pass thru Netscape's routers.

Billing



Confidential

Property of Ignify
May not be reproduced or distributed without prior permission

14

The Transport Layer

Responsible for end-to-end transfer of message

Segmentation and reassembly

Error-free transfer

- Error detection and recovery
- Sequencing
- Flow Control

Establishing and releasing connections

- Multiple connections for high Throughputs
- Multiplexing a connection across many session layers for reducing the cost

Type of Services

- Connection-oriented services – error free point-to-point channel
- Connectionless services – no guarantee on the correct delivery of the message

Example

- Unix Socket Interface

The Session Layer

Enhance a reliable transfer service

Control how data is exchanged

- Manage dialog control
 - ◆ Full duplex
 - ◆ Half duplex

Examples

- Log in to a remote system
- Transfer a file between two machine
- Token Management
 - ◆ Both side do not attempt the same operation at the same time
- Synchronization
 - ◆ Two-hour file transfer with one hour mean time crashes
 - ◆ The whole transfer would start over again
 - ◆ Insert checkpoints into the data stream
 - ◆ After a crash, continue after the last checkpoint

The Presentation Layer

- Concern with syntax and semantic of information
- Overcome the difference in data representation
- Resolve machine dependencies
- Character code
 - ASCII, EBCDIC, Unicode, ...
- Big endian or little endian

32-bit word like an integers



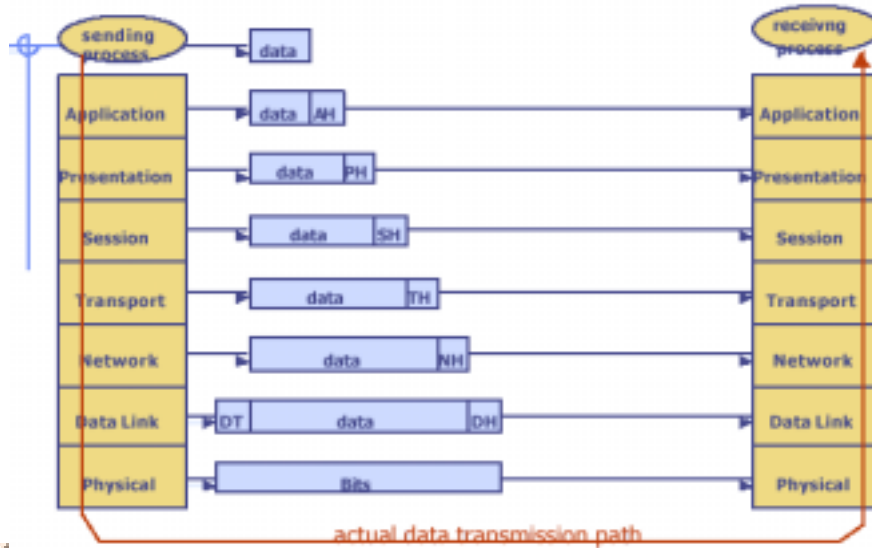
The POWER Processor can be configured as either big endian or little endian

The Application Layer

To provide network services
Example

- HTTP – web browsing application
- FTP – File transfer between two different systems
 - ◆ Different file name convention
 - ◆ Different ways of representing text lines
- SMTP – Electronic mail
- Virtual terminals – vt100, TN 3270, xterm

Data Transmission in OSI Model



TCP/IP Architecture

History

- Successor of ARPANET (defense Advanced Research Agency)

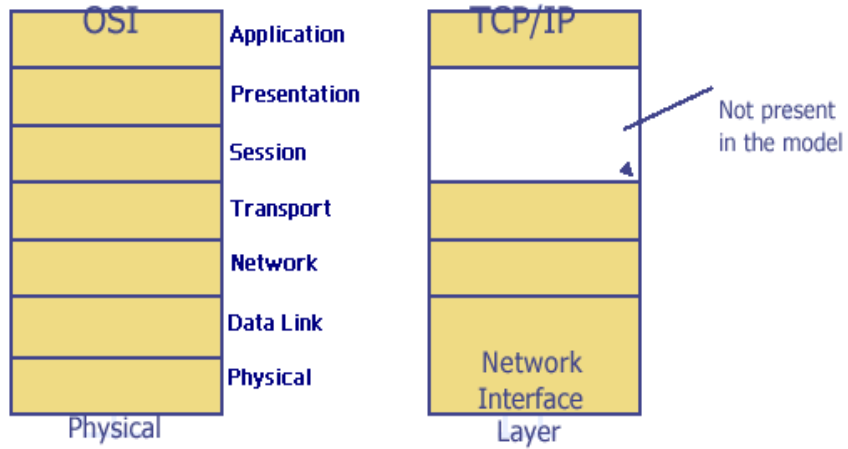
Principles

- Robustness
 - ◆ If failures occur in the network, the packets are routed around the failure point
 - ◆ Multiple paths and globally unique address
- Flexibility – No Data Link Layer or Physical Layer defined
- Packet switching networks
- Best-effort connectionless in the Network Layer
 - ◆ “I will do my best to transfer your data, though I cannot guarantee their delivery and quality”
 - ◆ IP packets are exchanged between routers without a connection setup.
- Two services in the Transport Layer
 - ◆ TCP – reliable connection-oriented transfer
 - ◆ UDP – unreliable connectionless transfer

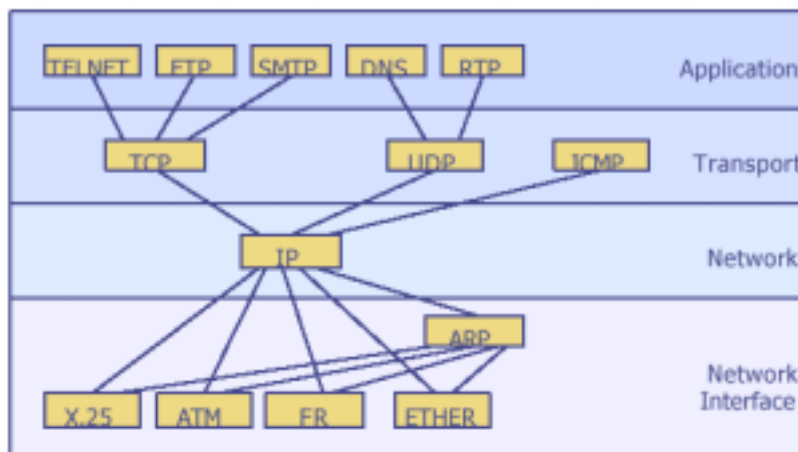
Applications

- Remote login, e-mail, file transfer, network management

OSI Model vs. TCP/IP



Protocols and Networks in TCP/IP



TCP/IP Protocol

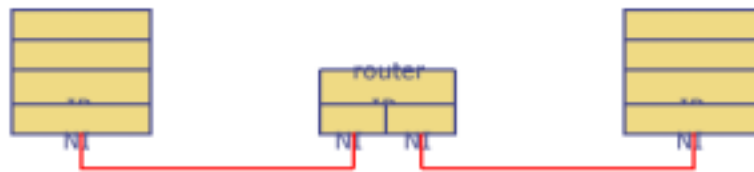
Each host (NIC) is assigned by a globally unique IP address (32-bit)

- IP address = network address + host address
- A net mask is used to calculate them

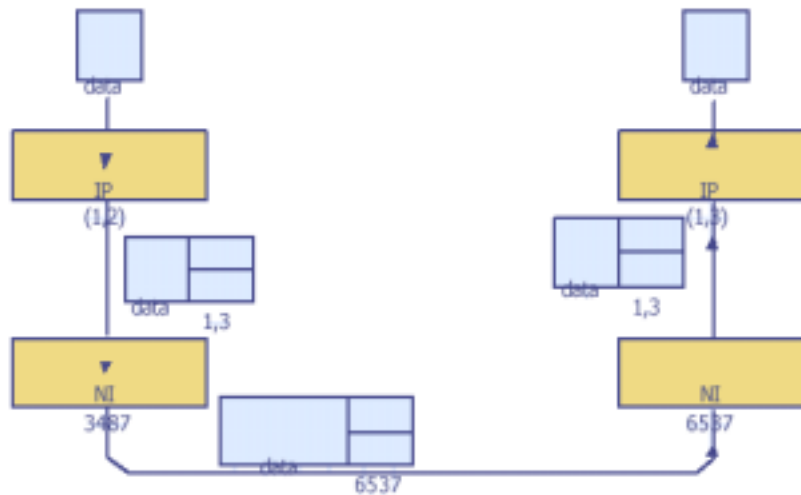
Each host (NIC) is also assigned by a machine address, or a physical address

- Meaningful in one network by router
- Ethernet uses 6-octet (48 bit)
- ATM uses 16-octet

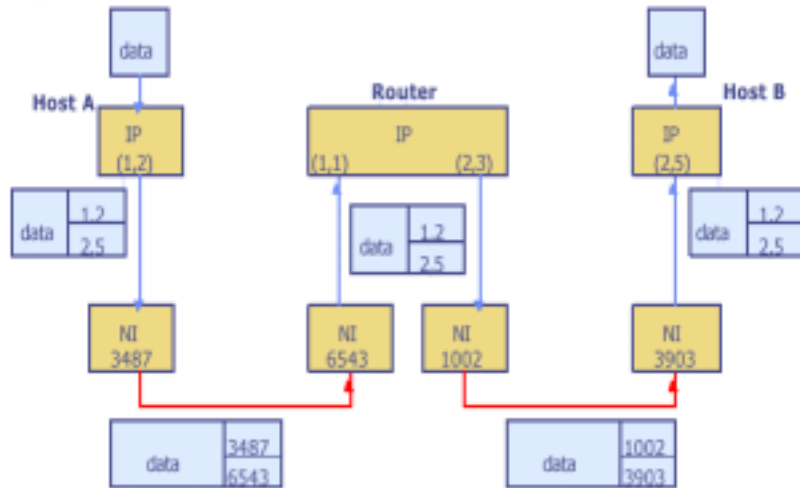
Router – consists of two or more network interfaces



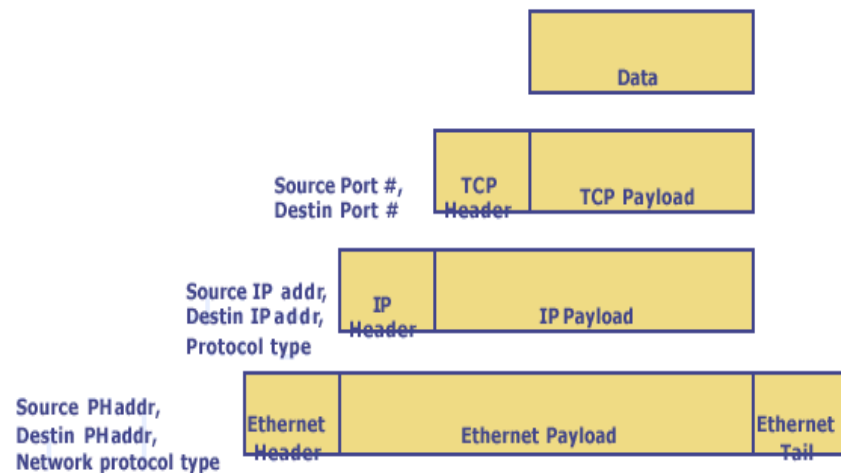
TCP/IP in a Network



TCP/IP thru a Router



TCP/IP in a System



Server in TCP/IP

A process waiting a packet on a specific port number

Duplicate a connection after establishing

Connection ?

- 5 tuple – (PT, SA, SP, DA, DP)
 - ◆ Protocol type, source address, source port, destin address, destin port
 - A server waits on (pt, sa, sp, any-DA, any-DP)
 - Upon a request from the client, any-DA and any-DP are filled with specific value
- Server Port Number 0 to 1023 are reserved to well known services.

Protocol	Reserved Port#	Comments
FTP	21	File Transfer
telnet	23	Remote login
SMTP	25	E-mail
DNS	53	Domain name system
HTTP	80	World Wide Web

OSI vs. TCP Reference Models

OSI introduced concept of services, interface, protocols. These were force-fitted with TCP later → it is not easy to replace protocols in TCP.

In OSI, reference model was done before protocols.

In TCP, protocols were done before the model

OSI: Standardize first, build later

TCP: Build first, standardize later

OSI took too long to standardize. TCP/IP was already in wide use by the time.

OSI became too complex.

TCP/IP is not general. Ad hoc.

Los Angeles Office

- 13304 Alondra Blvd #201, Cerritos CA 90703
- Email: sales@Ignify.com
- Tel: 562-404-8089

India Office

- 7 Madhuban, North Main Road, Koregaon Park, Pune
- Tel: +91-20-612-0778
- Email: India@Ignify.com

San Francisco Bay Area

- 4800 Great America Pkwy, Suite 310, Santa Clara, CA 95054
- Tel: 408-480-3289

Global Website: <http://www.Ignify.com>

