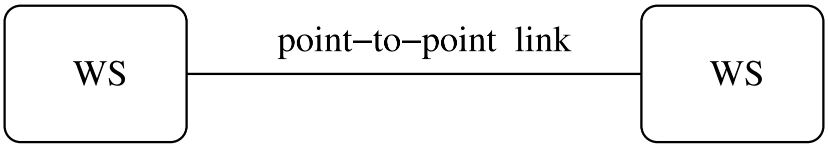
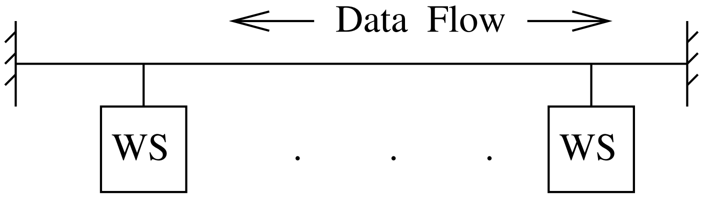
COMMUNICATIONS NETWORKS AND OSI MODEL

I) Types of Networks

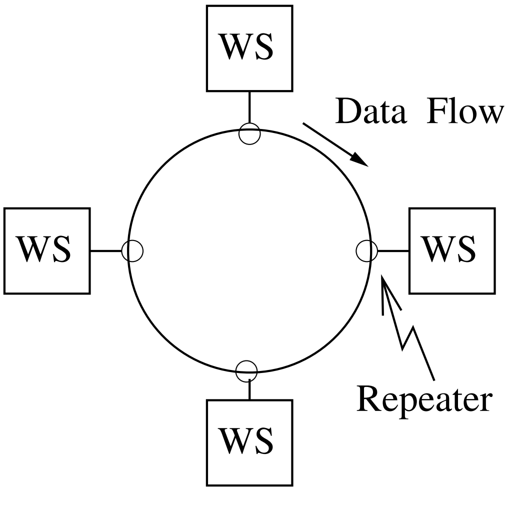
1. Point-to-point connection



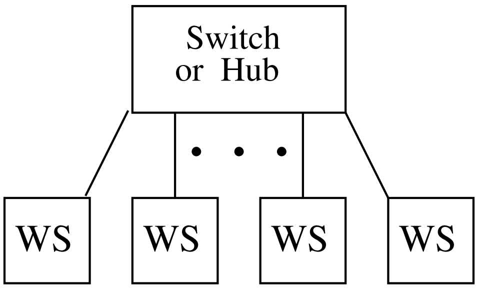
2. Local-Area Networks (LANs)



BUS



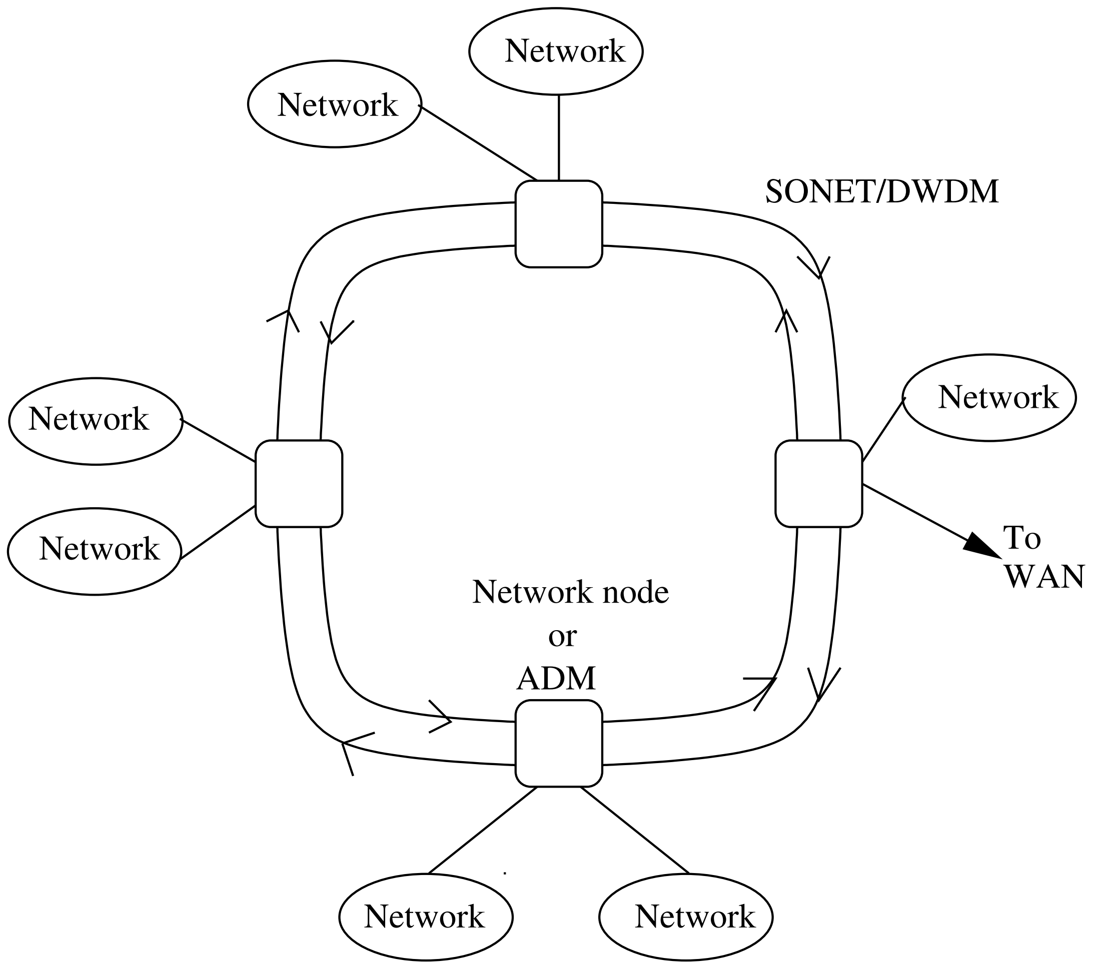
Ring



STAR

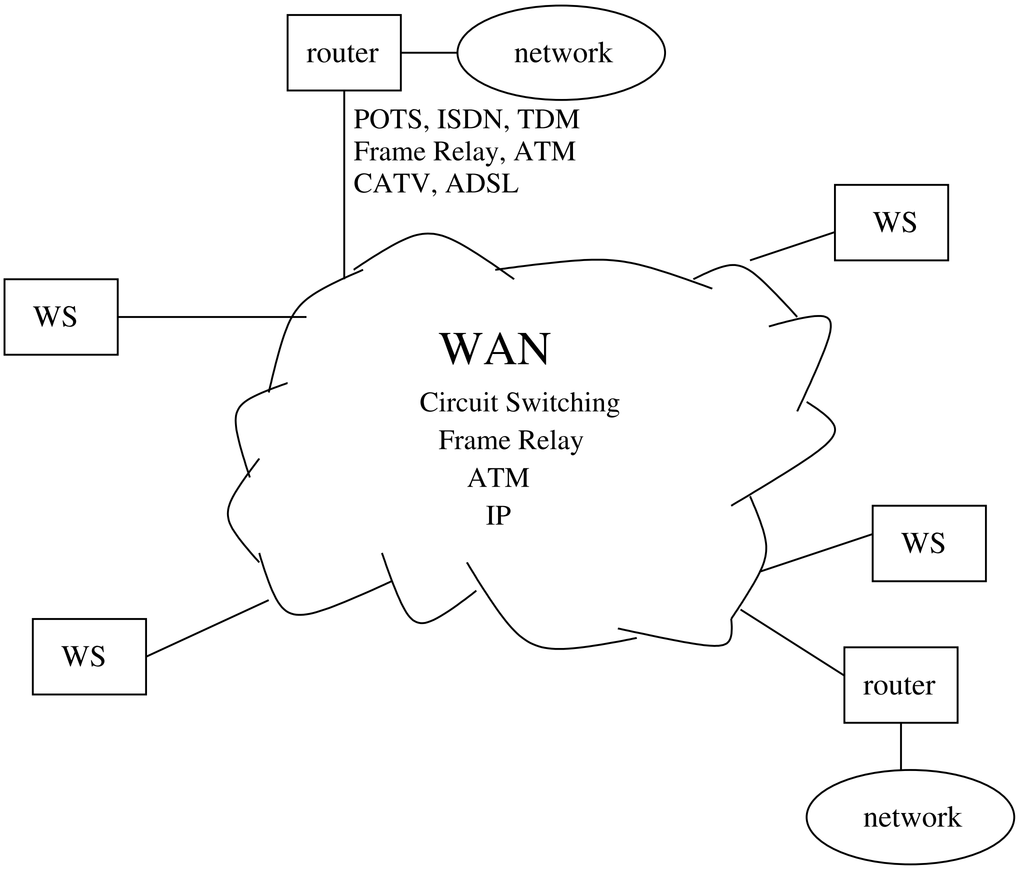
3. Metropolitan Area network (MAN)

- MAN provides connectivity among networks in the metropolitan area.
- Technologies:
  - Dual Queue Dual Bus (DQDB);
  - Fiber Distributed Data Interface (FDDI);
  - Synchronous Optical Network (SONET);
  - Dynamic Packet Transport (DPT) ring.

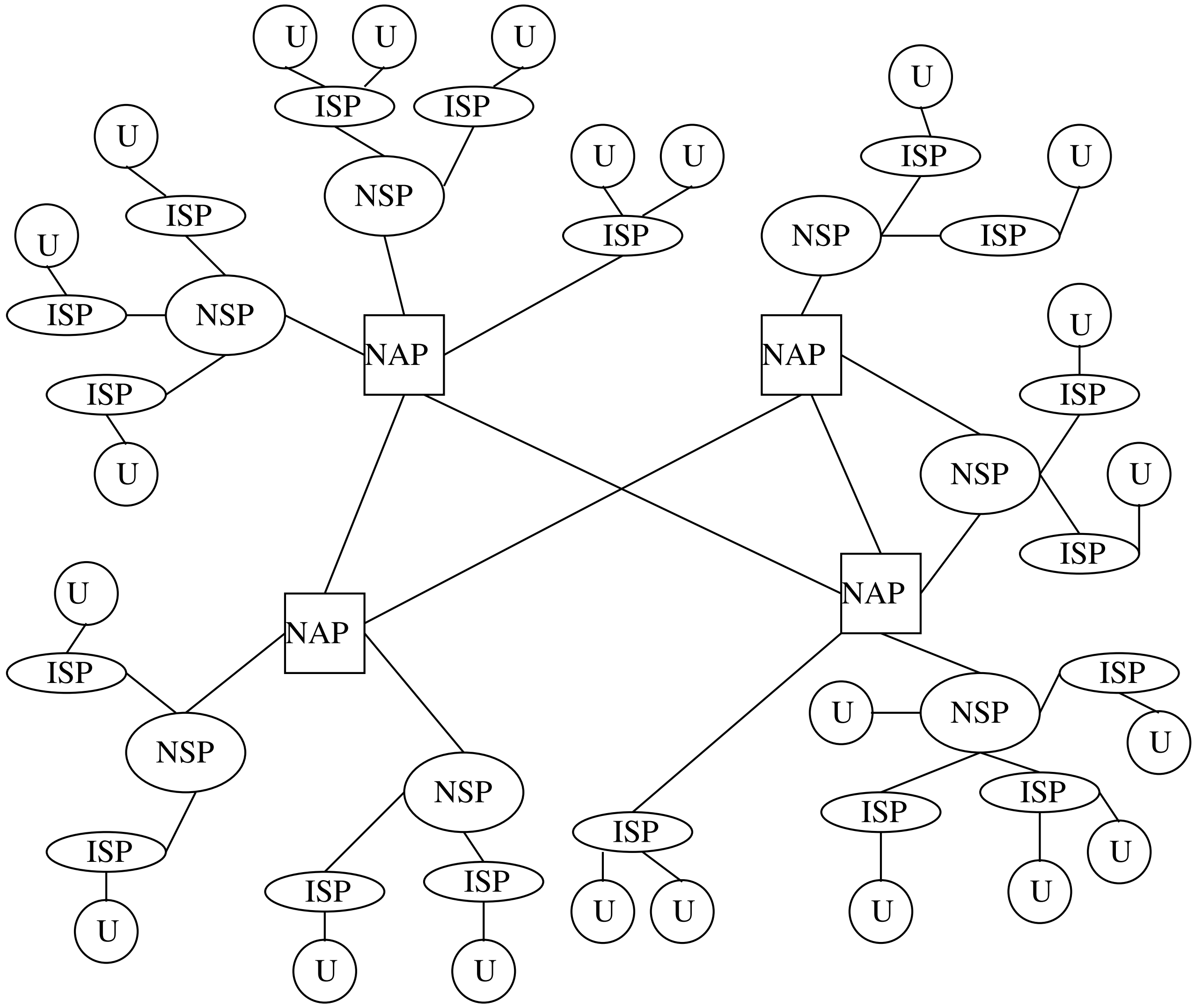


4. <u>Wide-Area Data network (WAN)</u>

- Network service:
  - Dedicated connection: POTS, TDM, ISDN.
  - Switched connection: Frame Relay and ATM.
  - Internet access: CATV and ADSL
- Switching technologies: circuit switching, Frame Relay, ATM, IP.



5. Internet



NAP – Network Access Point

ISP – Internet Service Provider

NSP – Network Service Provider

U – Ender Users

II) Network Architecture

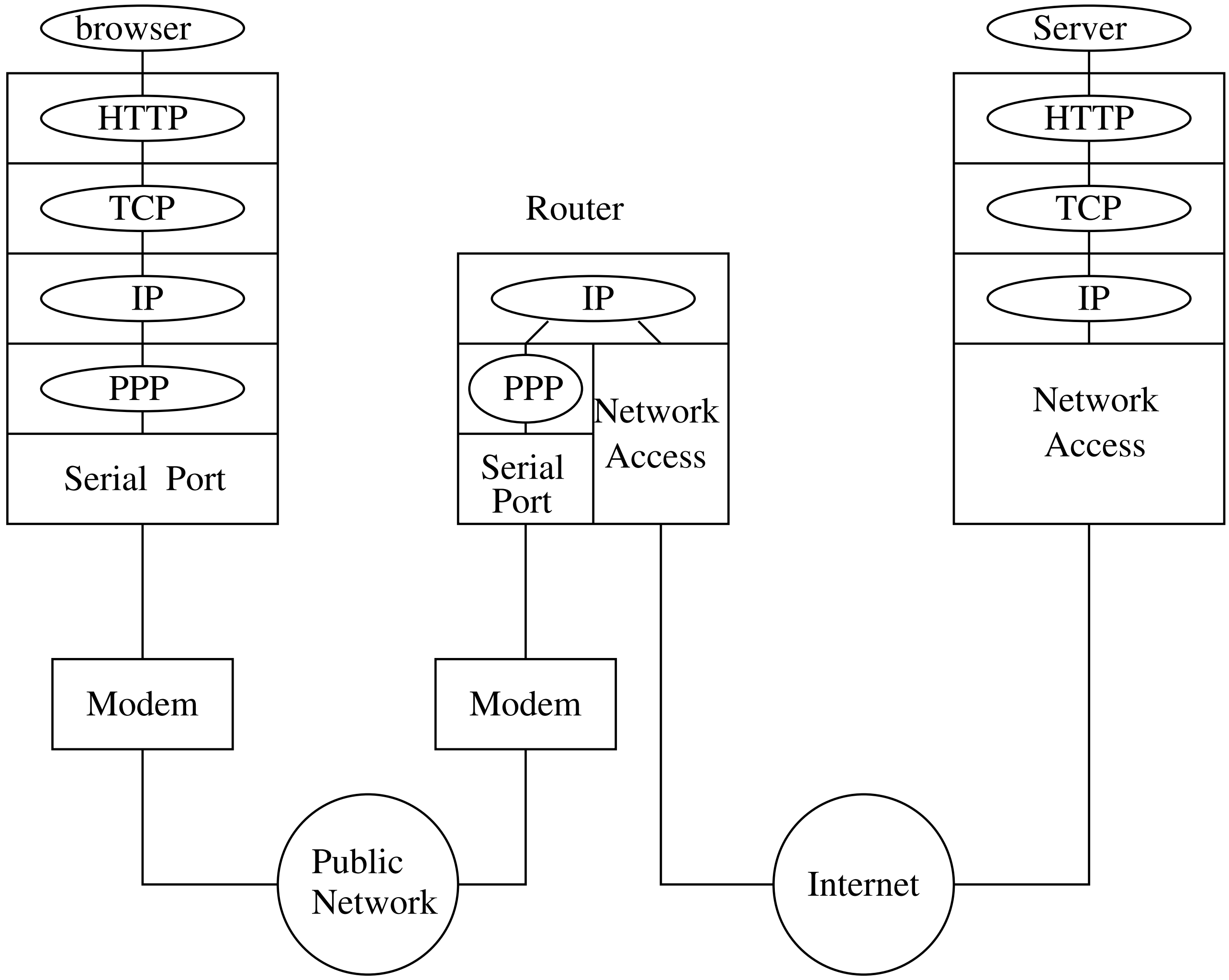
1. Layer Architecture

- To reduce the design complexity.
- Network functions are organized as a series of layers, each one built upon its predecessor.

Top Layer
$\vdots$
N Layer
N−1 Layer
$\vdots$
First Layer

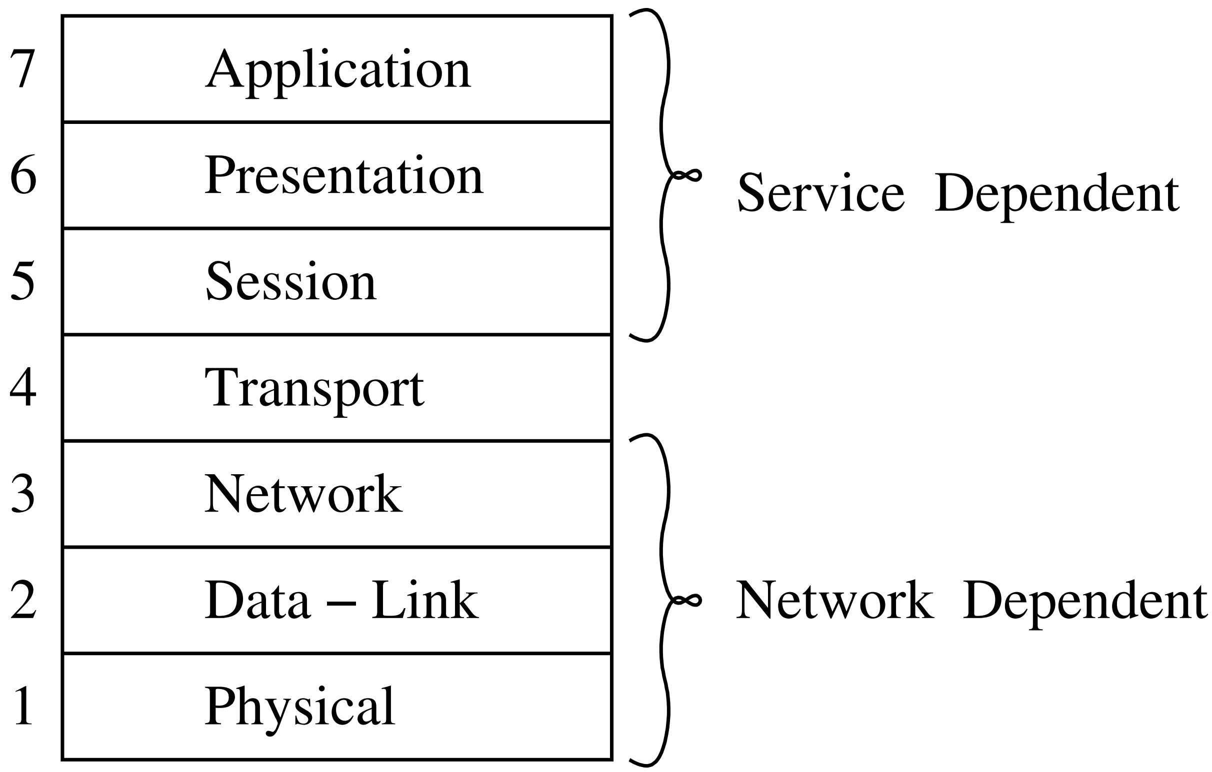
- Only adjacent layers can directly interact with each other.
- Each layer performs a related subset of functions.
  - Lower layers performs more primitive functions.
  - The peer layers cooperate to provide services to the layers on top of them.
- Changes in one layer do not require changes in other layers.
- Each machine in the network implements functions in one or more layers.

• Example: Internet Access



2. OSI (Open System Interconnection) Layer Architecture

- The communications tasks are decomposed into seven layers
- OSI model is the standard network architecture adopted by ISO (International Standard Organization)



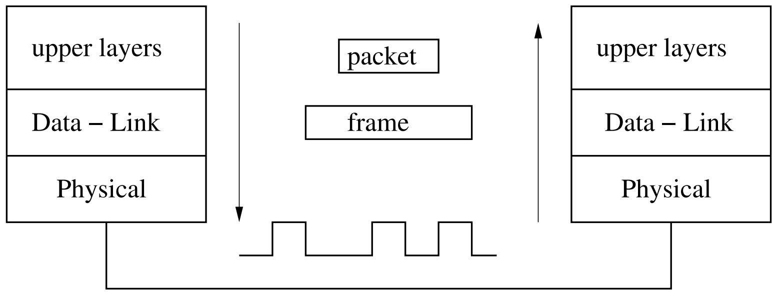
3. Descriptions of layers

(a) Physical layer

- transmission of unstructured bit stream over physical medium
- signal coding, digital modulations

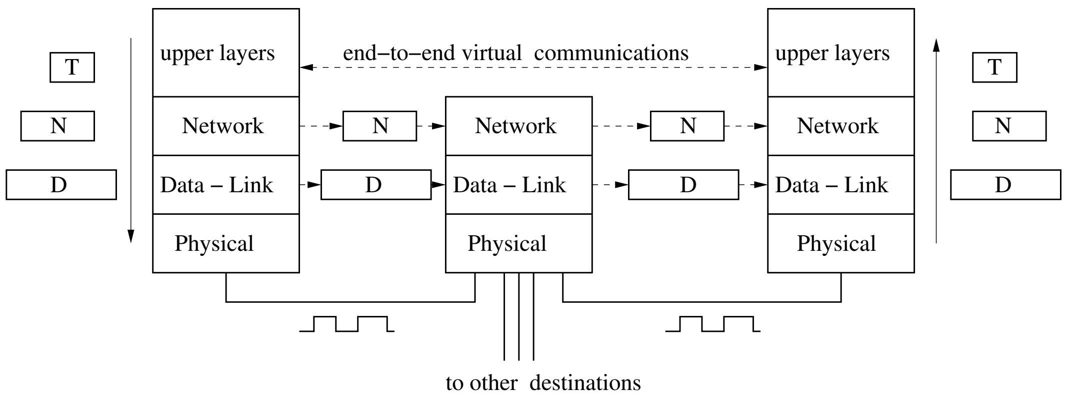
(b) Data-Link layer

- framing
- error and flow controls



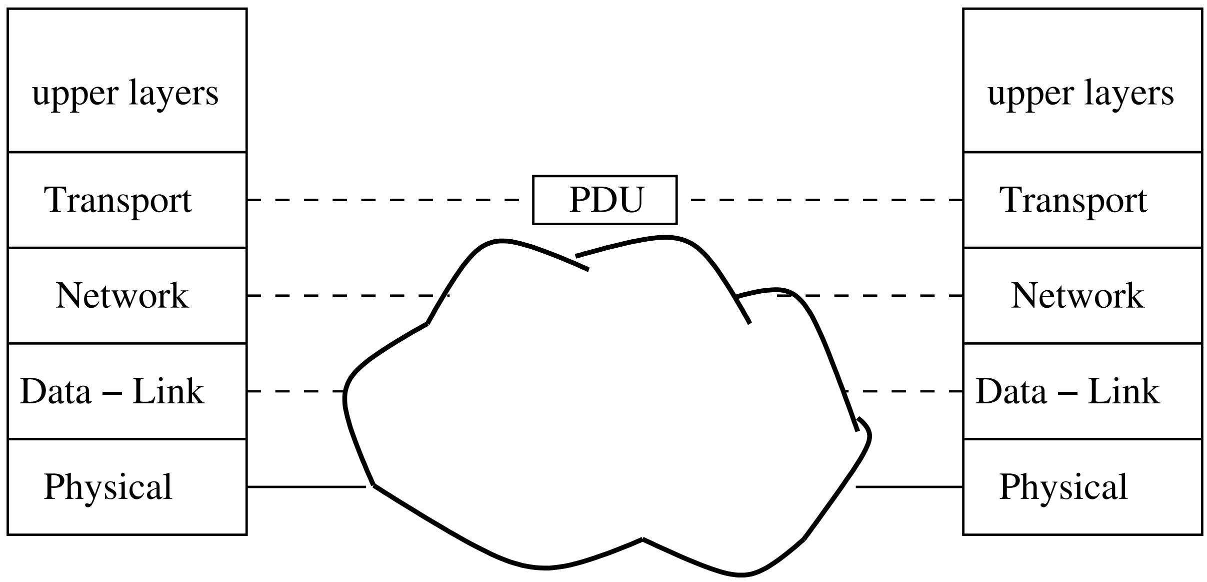
(c) Network layer

- Data forwarding and routing
- provides transparent transfer of data between two end hosts



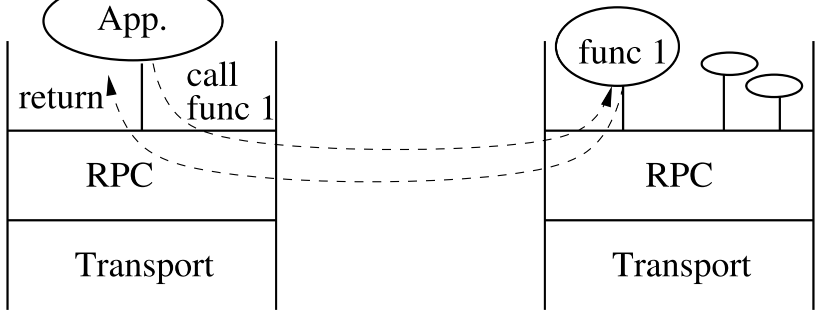
(d) Transport layer

- first end-to-end layer
- provides reliable, transparent transfer of data between two end hosts
- shields the underlying network from the upper layers



(e) Session layer

- Provides additional services over the transport layer
- Popular session-layer feature: Remote Procedure Call (RPC)

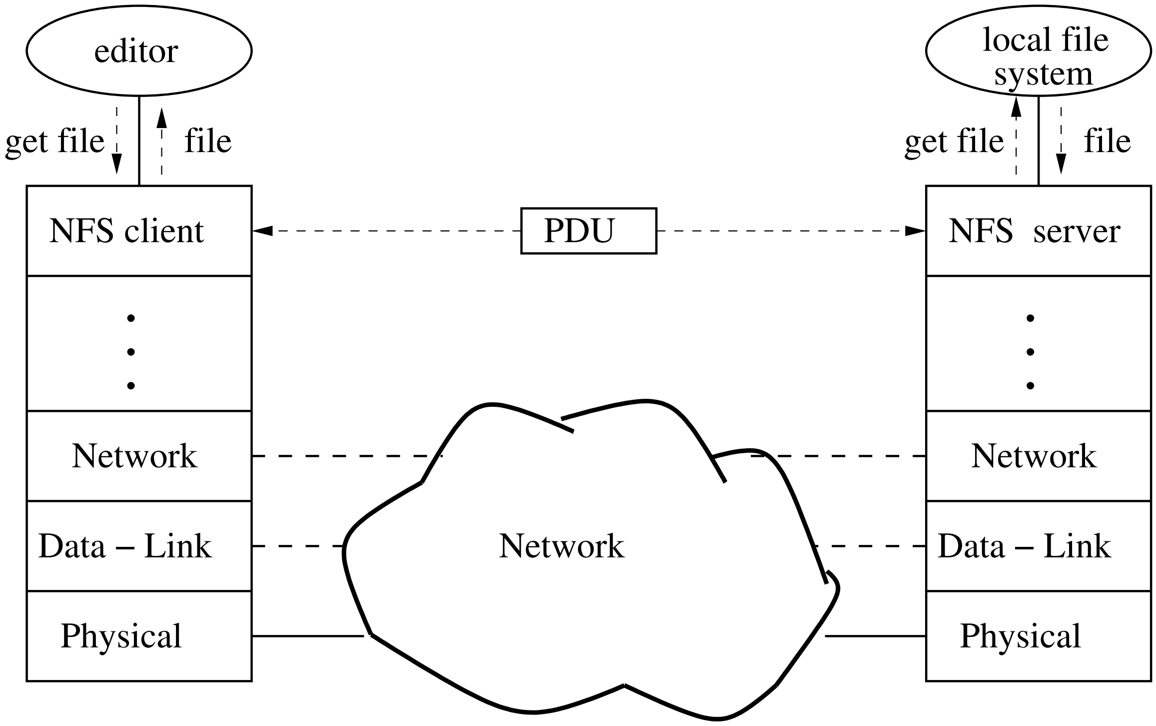


(f) Presentation layer

- concerns with the representation of data
- data conversion between network and host data representation formats
- encryption and data compression

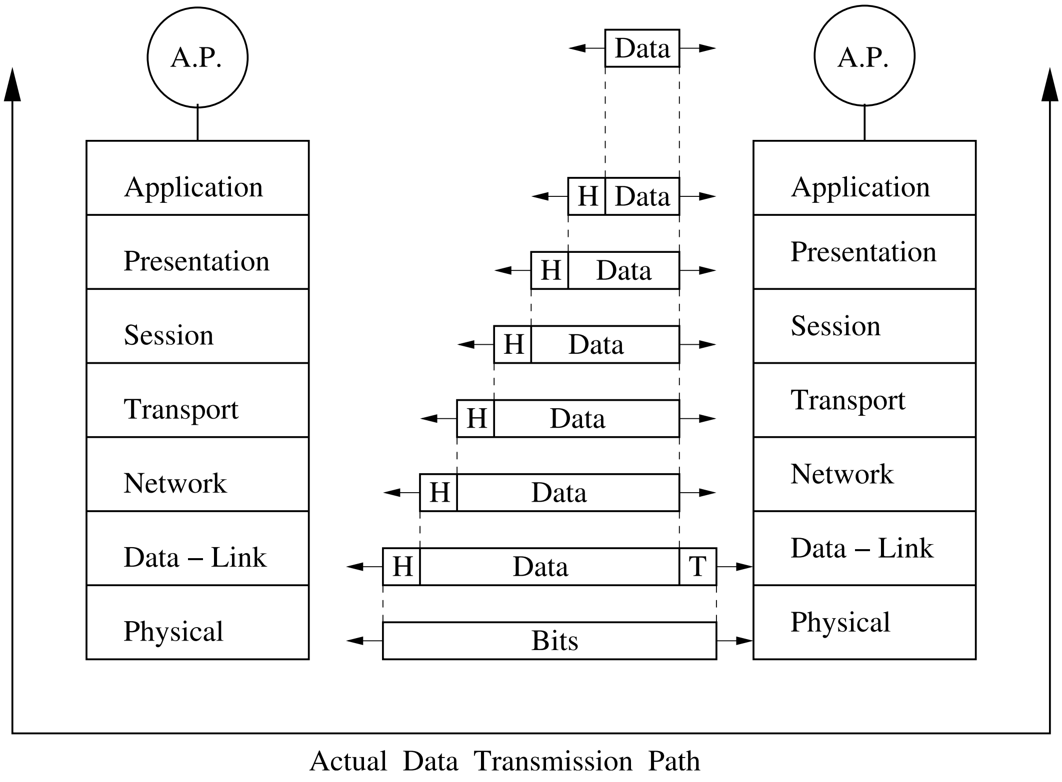
(g) Application layer

- provides application services to the network users.
- File Transfer Protocol (FTP), email, Network File System(NFS), HyperText Transfer Protocol (HTTP).



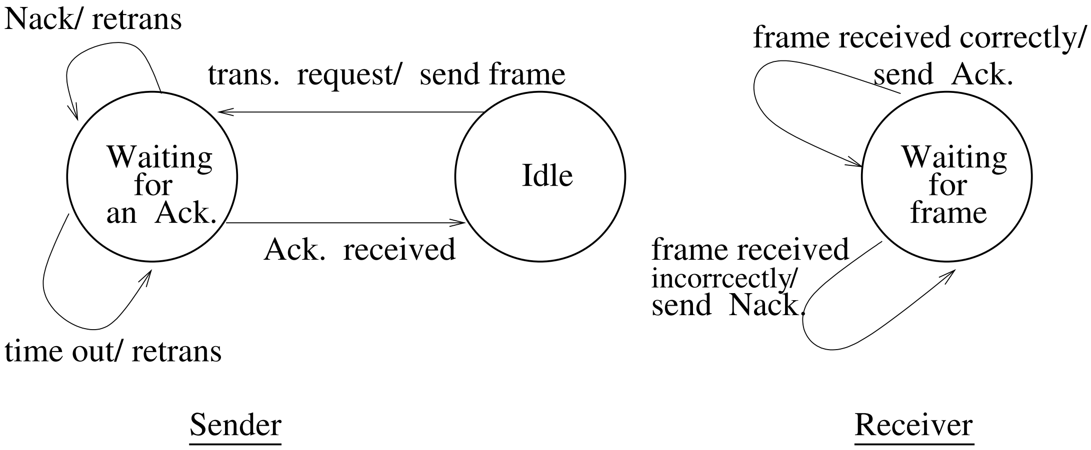
4. Virtual Communications and Protocols

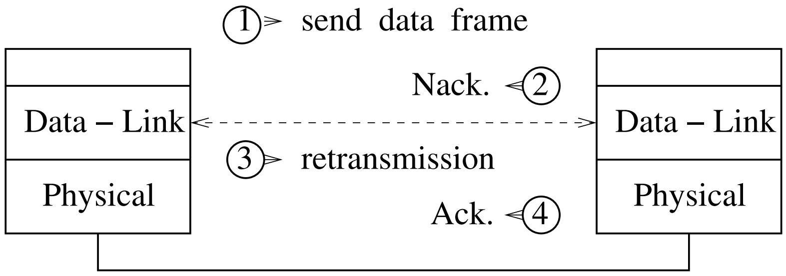
- In order to perform communication functions of a given layer, the peer layer entities in that layer must cooperate by exchanging protocol data units (PDUs).
- Except for the physical layer, there is only a virtual communication between any two peer layer entities.
- The actual communication is performed by passing information between adjacent layers in the same machine.



- The header of the N-PDU contains information to allow peer layer entities to execute the protocol properly.
- Protocol is a set of rules governing the ways in which peer layer entities exchange and respond to PDUs.

- Example: Stop-and-wait protocol
  - the protocol can be specified by a finite state machine.



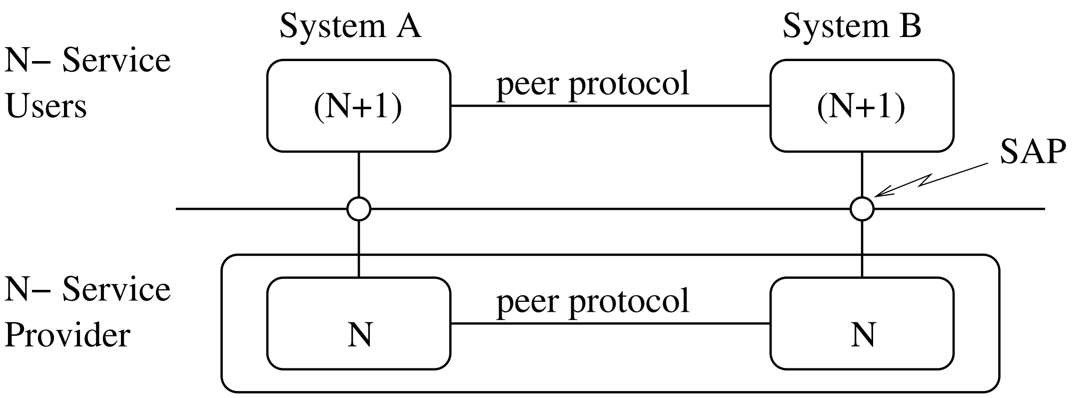


- The format of the N-PDU must follow the specification of the N-layer protocol.
  - example: data frame format of kermit protocol

soh	len	seq	type	data	bcc	cr

5. Interface between layers

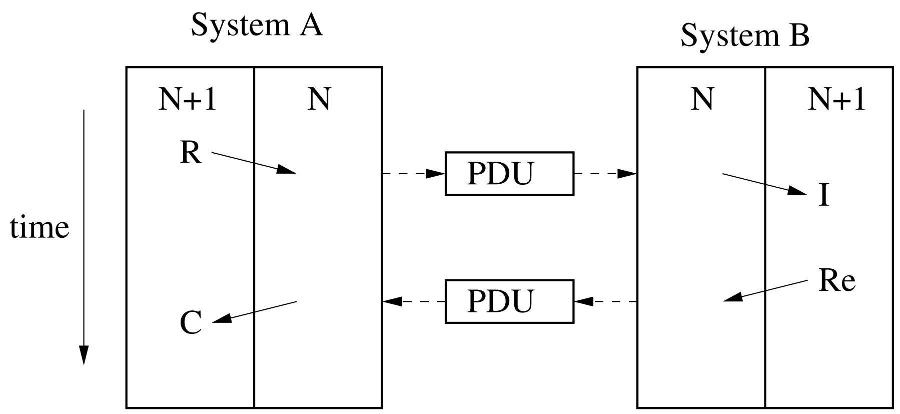
- The N-layer entities are the service providers of the (N+1)-layer entities.



- Two basic services: connection-oriented and connectionless.
- Interactions between service user and its service provider are managed by passing messages called primitives between layers through the Service Access Point (SAP).
- A primitive initiates an action or advises of the result of an action. Each primitive may contain parameters to convey control information needed to perform its functions.
- Four basic primitive types: request, indication, response, and confirm.

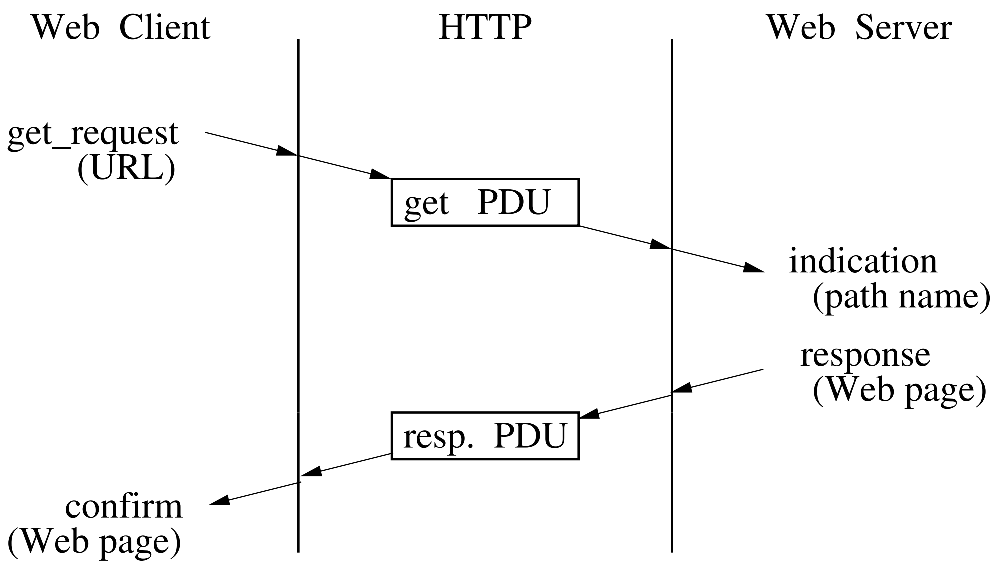
6. Primitive and protocol

- A request primitive initiates PDU exchange between peer layer entities.



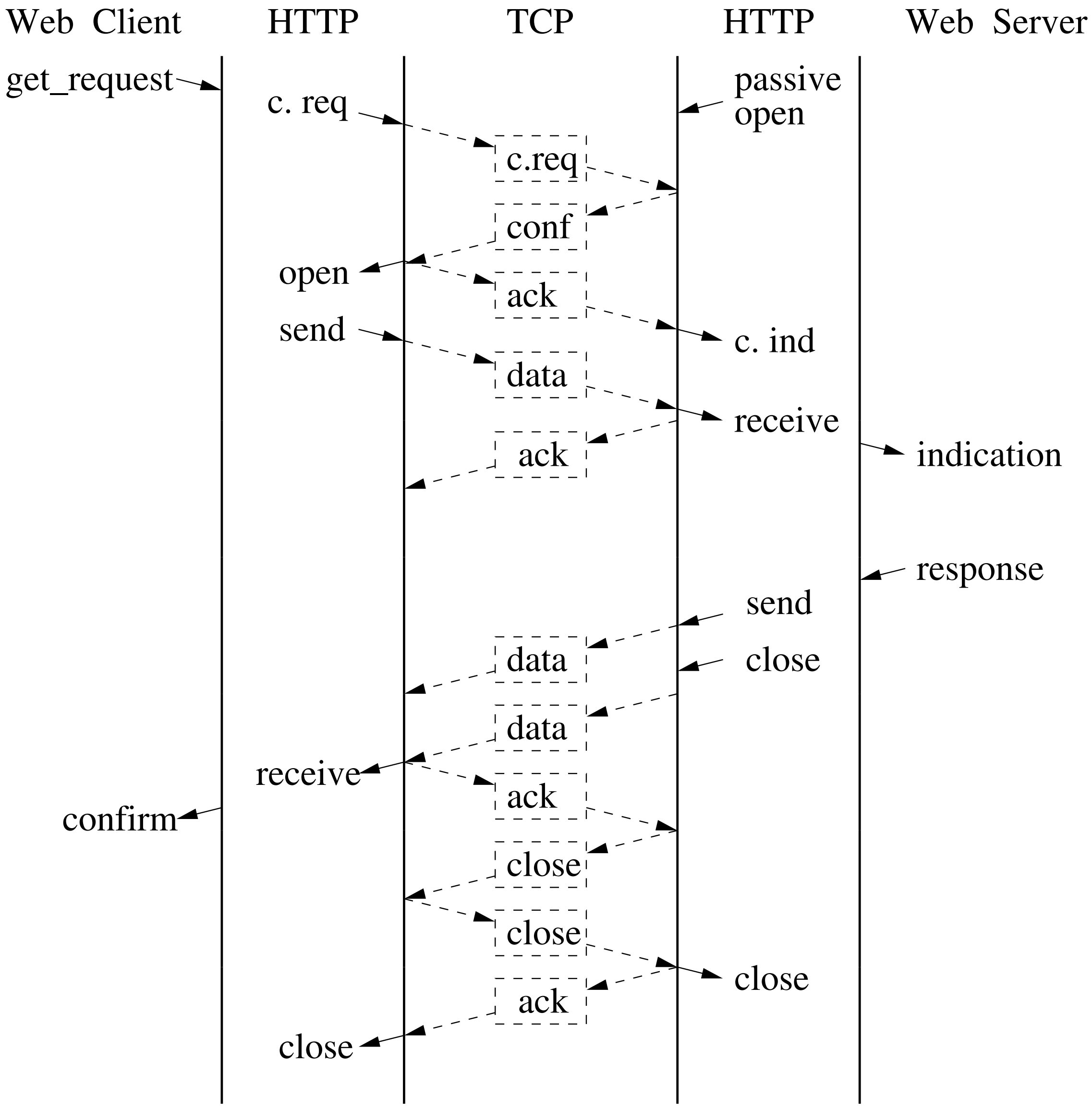
R = request; I = indication; Re = response; C = confirm .

- Example: HTTP service

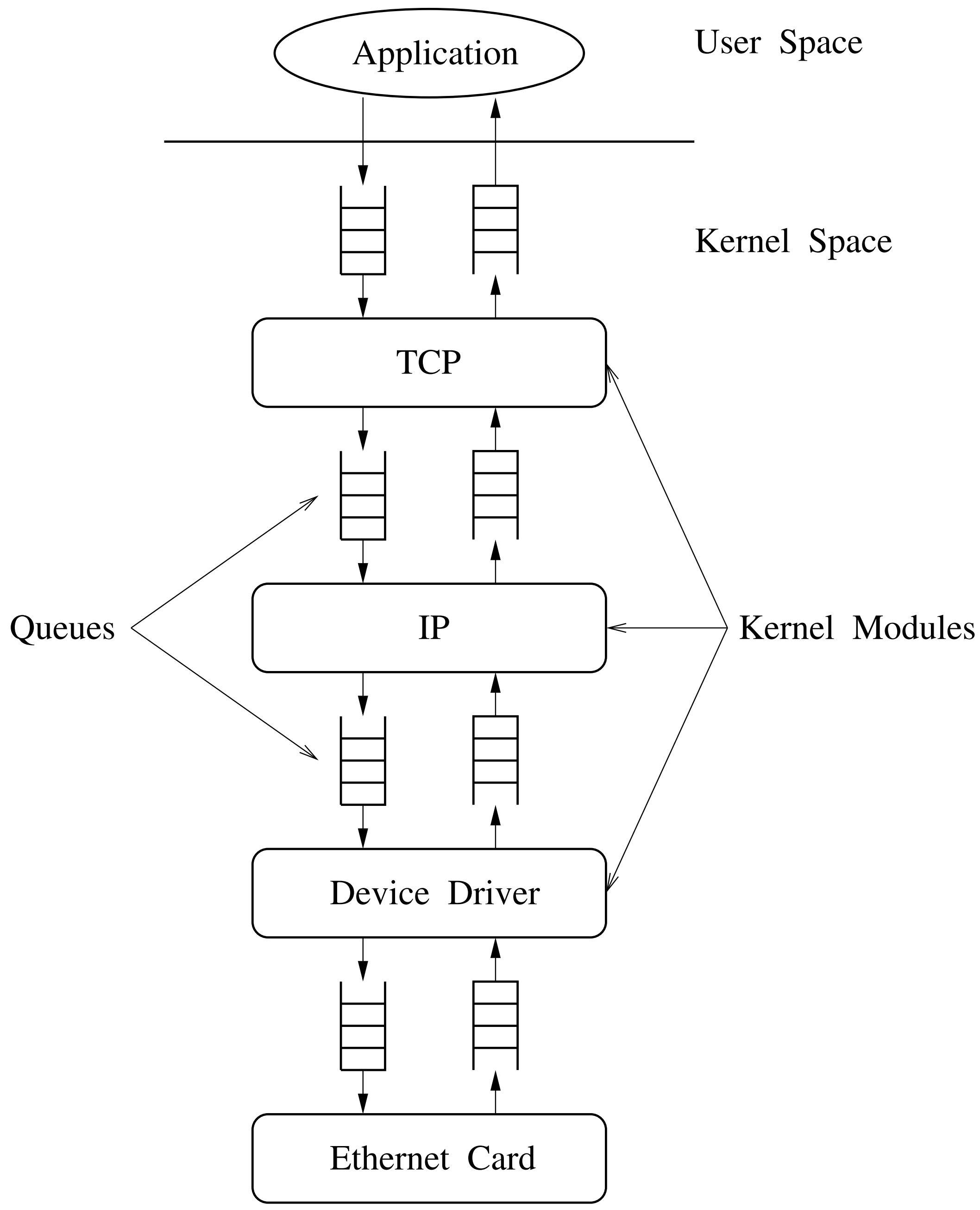


URL == protocol://domain_name/path_name

- Example: TCP service



7. Implementation



8. TCP/IP Suite

OSI	TCP/IP suite
Applications	Applications
Presentation	
Session	
Transport	TCP/UDP
Network	IP
Data-Link	Network Access
Physical	

- IP (Internet Protocol) - internetwork routing.
- TCP (Transmission Control Protocol) - Connection-oriented transport protocol.
- UDP (User Datagram Protocol) - connectionless transport protocol.
- Network Access - Network dependent.
- Applications - EMAIL, FTP, NFS, HTTP.