ICE 4071: Industrial Internet of Things (IIoT)

Lecture 5 & 6: Network Services and Reference Models

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Network Services

Layer N   - Provides services to layer N+1

               - Uses the services of layer N-1

               - Service Provider

                    Fast, Expensive

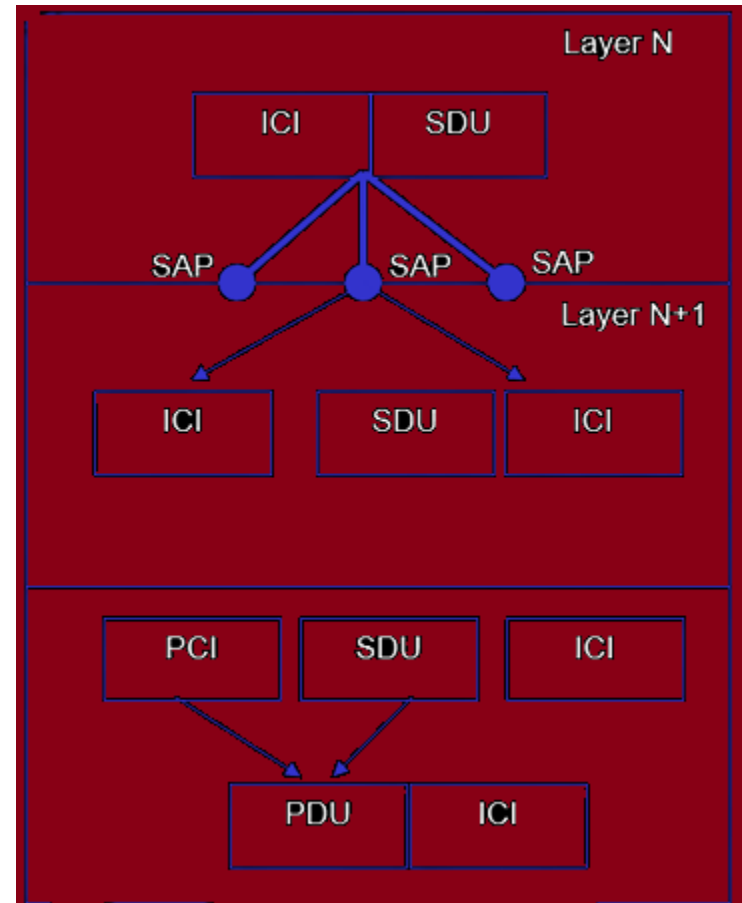   Slow, cheap

Layer N+1 - Service user

IDU   – Interface Data Unit

SDU – Service Data Unit

ICI   – Interface Control Information

SAP – Service Access Point

PDU – Protocol Data Unit
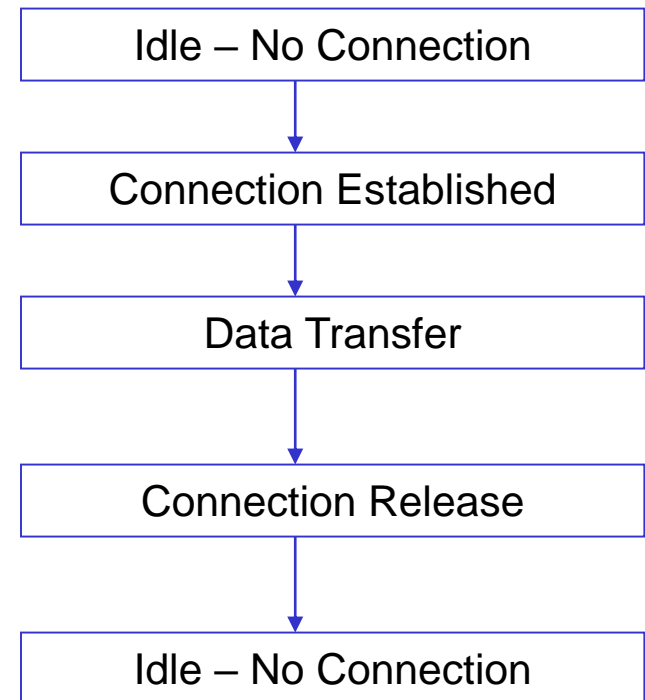
PCI   – Protocol Control Information

Network Services

Types of Services:

    i.   Connection oriented service

    ii.   Connection Less service

Connection Oriented Service

(Virtual Circuit Service):

- Similar to a telephone system

- Service user has to

    Establish a connection

    Transmit data

    Terminate connection

| Idle – No Connection |
| :---: |
| ↓ |
| Connection Established |
| ↓ |
| Data Transfer |
| ↓ |
| Connection Release |
| ↓ |
| Idle – No Connection |

Network Services

- Good care is taken for user data
- Flow control, error checking, error recovery is performed
- Used in WAN's.

Sl.No	Service	Example
1	Reliable Message stream	Sequence of pages
2	Reliable Byte Stream	Remote login
3	Unreliable Connection	Digitized voice and video (Delays due to acknowledge makes if unreliable)

Network Services

Connection Less Service (Data Gram Service):

- Similar to postal system

- Each Packet is routed independently

- Connection establishment and release

- No acknowledgement

- No flow control

- No error control

- QoS is obtained by the acknowledgement of receiver

- LANs normally use due to

  Small area coverage, Private Owning

Idle – No Connection
↓
Data Transfer
↓
Idle – No Connection
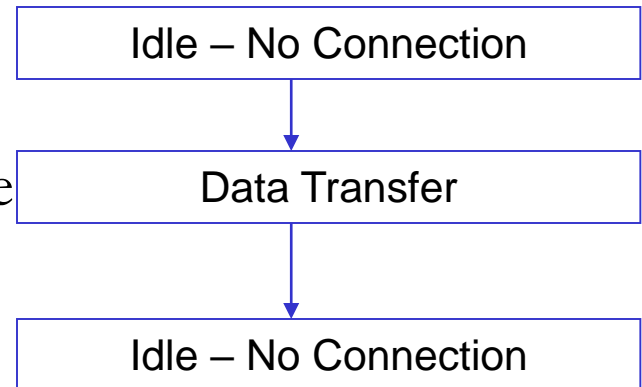
Network Services

Relation between service and protocol:

Service:

• Set of operations that a layer provides to the layer above it.

• It does not say anything about how these operations are implemented.

Protocol:

• Set of rules governing the format and meaning of messages exchanged by peer entities

• Entities use protocols to implement their services.

The primitives are invoked to and from the layer or service provider through identifiers called SAPs.

Network Reference Models

1. ISO – OSI Reference model

   ISO – International Standards Organization.

   OSI – Open System Interconnection.

2. TCP / IP Reference Model:

   TCP – Transmission Control Protocol, IP – Internet Protocol.

OSI REFERENCE MODEL:

Principles:

1. Each layer has to perform well defined function.

2. Layers will be created considering its upper and lower layers only.

ISO-OSI Reference Models

3. Any change with in the layer should not affect others.

4. Layer is created where there is need for handling data.

5. Functions of each layer and corresponding interface are chosen to define standardized protocols.

6. Number of interactions at layer boundary is minimal.

7. The number of layers should be in such a way that the processing overhead should not be treated as burden.
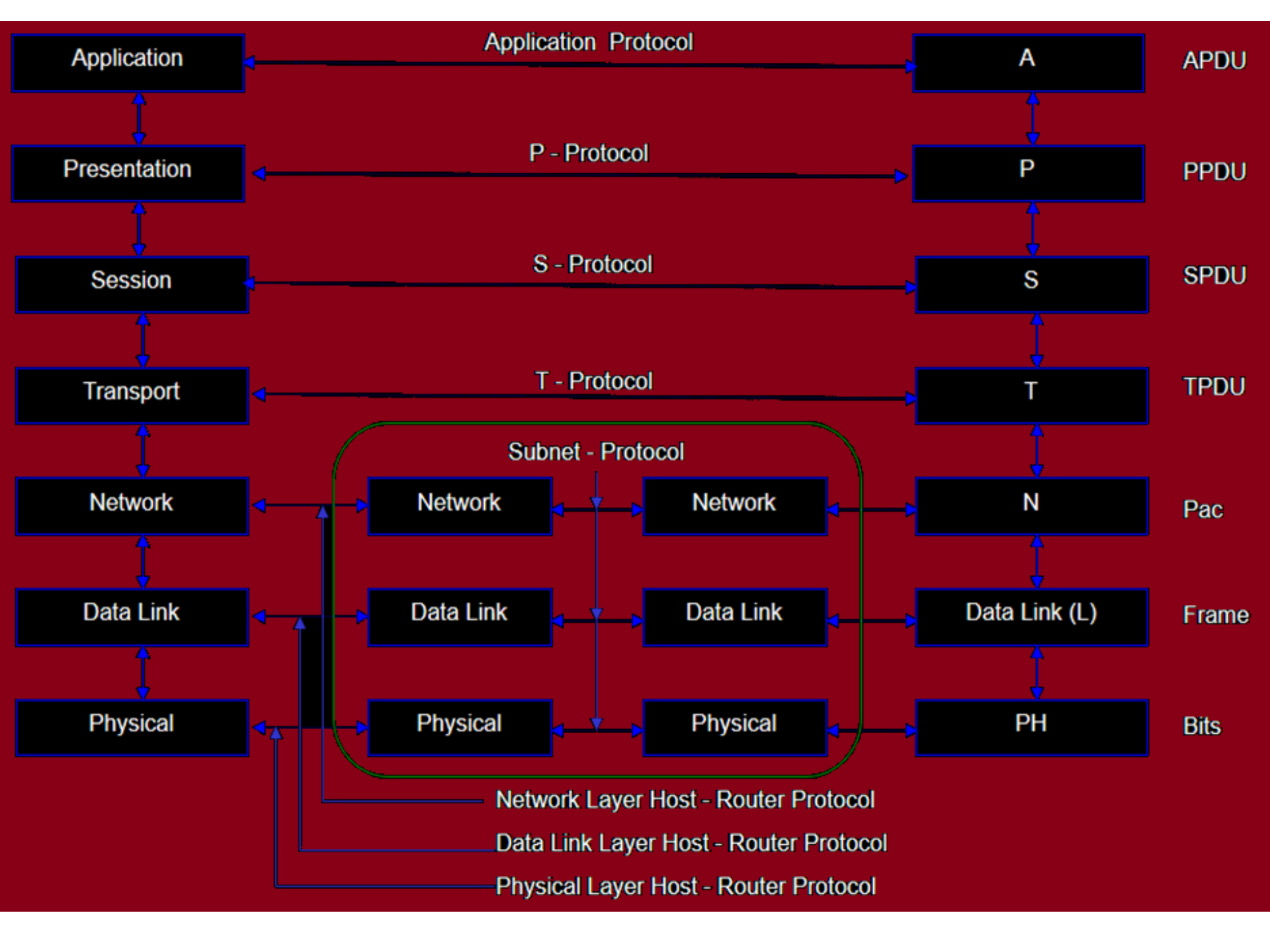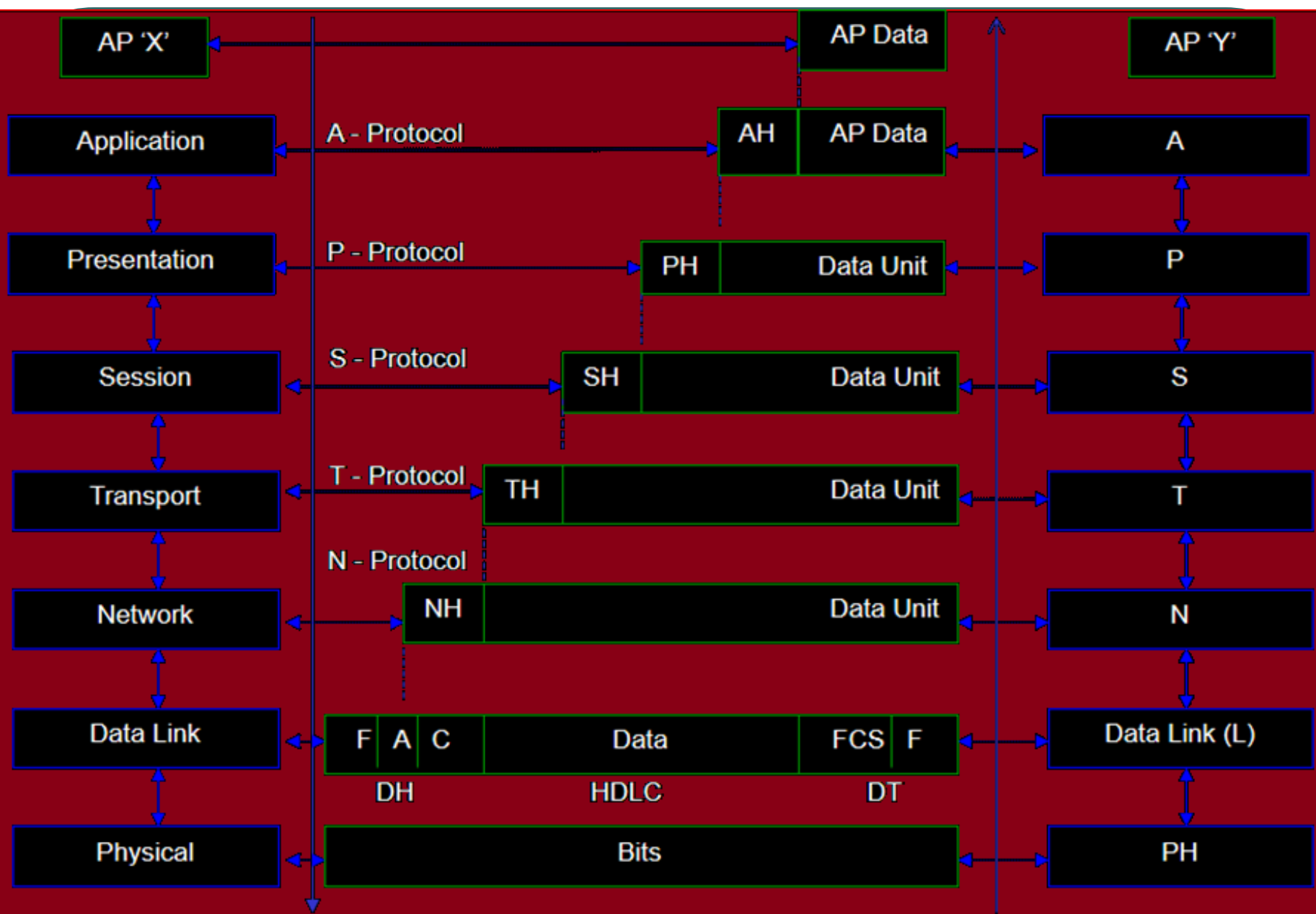
ISO-OSI Reference Models

- Seven layer standard.

- Service provided:

    1. Provide peer to peer logical services with layer physical implementation

    2. Provides standard for communication between system

    3. Defines point of interconnection for the exchange of information between systems.

- The functions are partitioned into a vertical set of layers.

- Each layer provides service to the next higher layer and conceals the details of how the offered services are implemented.

Note: OSI model is not a network architecture.

It is a reference model telling what each layer should do.

It does not specify the exact services and protocols for each layer.

Layer	Protocol	PDU
Application	Application Protocol → A	APDU
Presentation	P - Protocol → P	PPDU
Session	S - Protocol → S	SPDU
Transport	T - Protocol → T	TPDU
Network	Subnet - Protocol — Network — Network → N	Pac
Data Link	Data Link — Data Link → Data Link (L)	Frame
Physical	Physical — Physical → PH	Bits

Network Layer Host - Router Protocol

Data Link Layer Host - Router Protocol

Physical Layer Host - Router Protocol

OSI Reference Model — Data Encapsulation

Layer (AP 'X')	Protocol	Data Unit	Layer (AP 'Y')
AP 'X'		AP Data	AP 'Y'
Application	A - Protocol	AH | AP Data	A
Presentation	P - Protocol	PH | Data Unit	P
Session	S - Protocol	SH | Data Unit	S
Transport	T - Protocol	TH | Data Unit	T
Network	N - Protocol	NH | Data Unit	N
Data Link		F | A | C | Data | FCS | F	Data Link (L)
		DH | HDLC | DT	
Physical		Bits	PH

F – Flag, A – Address, C – Control, FCS – Frame Check Sequence

ISO-OSI Reference Models

APPLICATION LAYER

Provides access to OSI environment for users and also provides distributed information services

PRESENTATION LAYER

Provides independence to application processes from differences in data representation (syntax)

SESSION LAYER

Provides the control structure for communication between application; establishes manages and terminates sessions between cooperating applications.

TRANSPORT LAYER

Provides reliable, transparent transfer of data between end points; provides end to end recovery and flow control.

ISO-OSI Reference Models

NETWORK LAYER

Provides upper layers with independence from the data transmission and switching technologies used to connect systems; responsible for establishing, maintaining and terminating connections.

DATA LINK LAYER

Provides for the reliable transfer of information across the physical link; sends frames with necessary synchronization, error control and flow control

PHYSICAL LAYER

Concerned with transmission of unstructured bit steam over physical media; deals with the mechanical, electrical, functional and procedural characteristics to access the physical medium.

TCP/IP Reference Models

7. APPLICATION
6. PRESENTATION
5. SESSION
4. TRANSPORT
3. NETWORK
2. DATA LINK
1. PHYSICAL

4. APPLICATION LAYER
3. TRANSPORT LAYER
2. NETWORK LAYER (INTERNET LAYER)
1. HOST TO NETWORK

TCP/IP Reference Models

Application Layer:

It contains all the higher level protocols such as TELNET, FTP, SMTP (Simple mail transfer protocol), remote – login. These interact with TCP in the transport layer.

Other protocols like DNS (Domain Name Service), SNMP (Simple Network Management Protocol), HTTP (Hyper Text Transfer Protocol) interacts with UDP (User Datagram Protocol) of the transport layer.

The interaction between the user and the computer network is initiated by 'commands' and these commands invoke appropriate protocols in the application layer.