

»»» mobile phones

Cross Layer Protocol Design

Radio Communication III



»»» mobile phones

The layered world of protocols

The ISO OSI model



OSI model

- » The open systems interconnection reference model (OSI model) describes a layered communication protocol design
- » The way terminals communicate with each other is described by protocols
- » Instead of a monolithic protocol approach the OSI model envisions a *layered* protocol approach
- » The number of layers is referred to as *protocol stack*

THE NEED FOR STANDARDS

- » Over the past couple of decades many of the networks that were built used different hardware and software implementations, as a result they were incompatible and it became difficult for networks using different specifications to communicate with each other.
- » To address the problem of networks being incompatible and unable to communicate with each other, the International Organization for Standardization (ISO) researched various network schemes.
- » The ISO recognized there was a need to create a NETWORK MODEL that would help vendors create interoperable network implementations.

ISO - ORGANISATION FOR STANDARDISATION

- » The International Organization for Standardization (ISO) is an International standards organization responsible for a wide range of standards, including many that are relevant to networking.
- » In 1984 in order to aid network interconnection without necessarily requiring complete redesign, the Open Systems Interconnection (OSI) reference model was approved as an international standard for communications architecture.

THE OSI REFERENCE MODEL

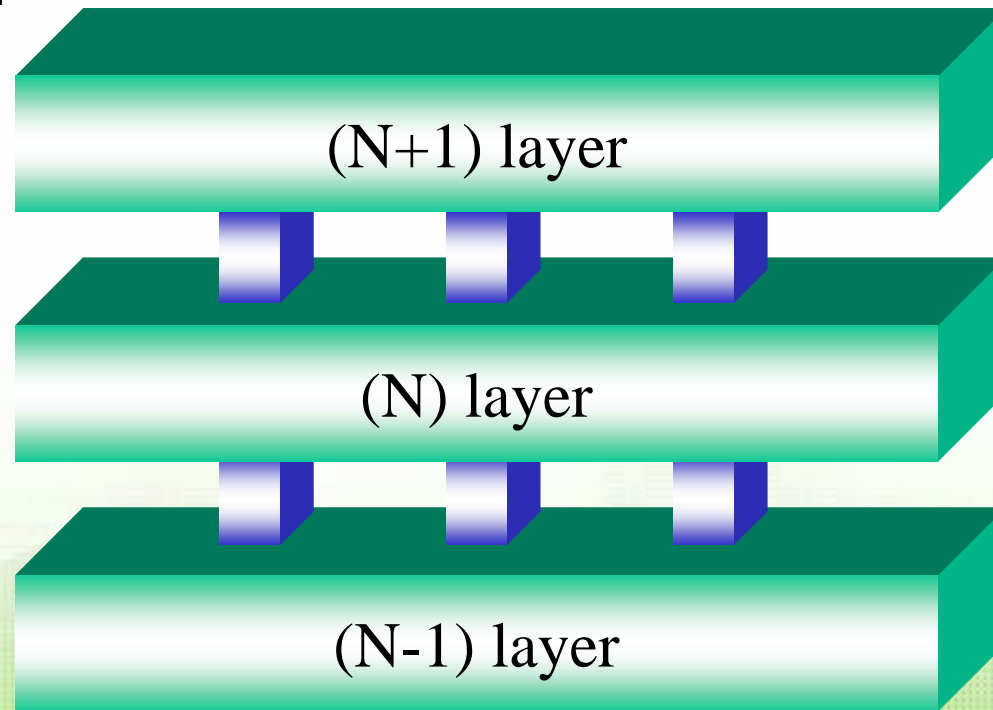
- » The model was developed by the International Organization for Standardization (ISO) in 1984. It is now considered the primary Architectural model for inter-computer communications.
- » The Open Systems Interconnection (OSI) reference model is a descriptive network scheme. It ensures greater compatibility and interoperability between various types of network technologies.
- » The OSI model describes how information or data makes its way from application programmes (such as spreadsheets) through a network medium (such as wire) to another application programme located on another network.
- » The OSI reference model divides the problem of moving information between computers over a network medium into SEVEN smaller and more manageable problems .
- » This separation into smaller more manageable functions is known as layering.

A LAYERED NETWORK MODEL

- » The OSI Reference Model is composed of seven layers, each specifying particular network functions.
- » The process of breaking up the functions or tasks of networking into layers reduces complexity.
- » Each layer provides a service to the layer above it in the protocol specification.
- » Each layer communicates with the same layer's software or hardware on other computers.
- » The lower 4 layers (transport, network, data link and physical — Layers 4, 3, 2, and 1) are concerned with the flow of data from end to end through the network.
- » The upper four layers of the OSI model (application, presentation and session—Layers 7, 6 and 5) are orientated more toward services to the applications.
- » Data is Encapsulated with the necessary protocol information as it moves down the layers before network transit.

Layers and Stack

- » One basic rule of the OSI model is that each layer uses the functionality of the layer below and exports functionalities to the next higher layer



Layers and Stack

- » Protocol stack can be implemented in hardware, software or a mixture of both.
- » In actual communication systems (computers, mobile phones, etc) the higher layers are realized in software and the lower layers are in hardware

Motivation for an layered protocol stack

- » Each layer has to fulfill a predefined set of rules or functionalities, this ease the process
 - To test the single layers individually
 - Each layer can be realized by different companies or institutions
 - Experts can realize their own world without knowing lower or higher layers
 - Standardization of smaller parts

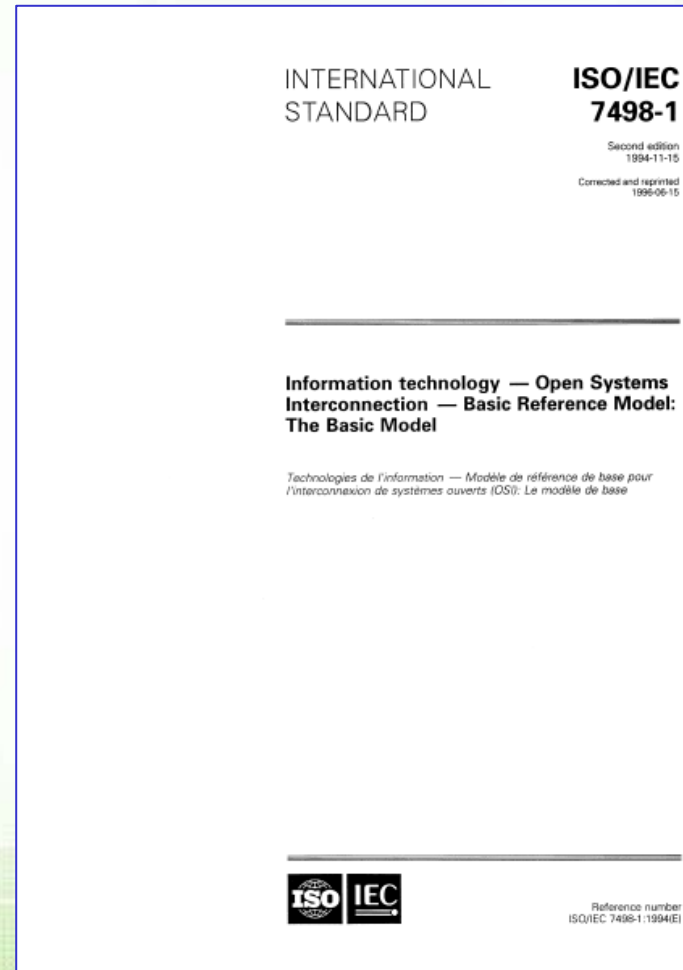
»»» mobile phones

ISO/IEC 7498-1

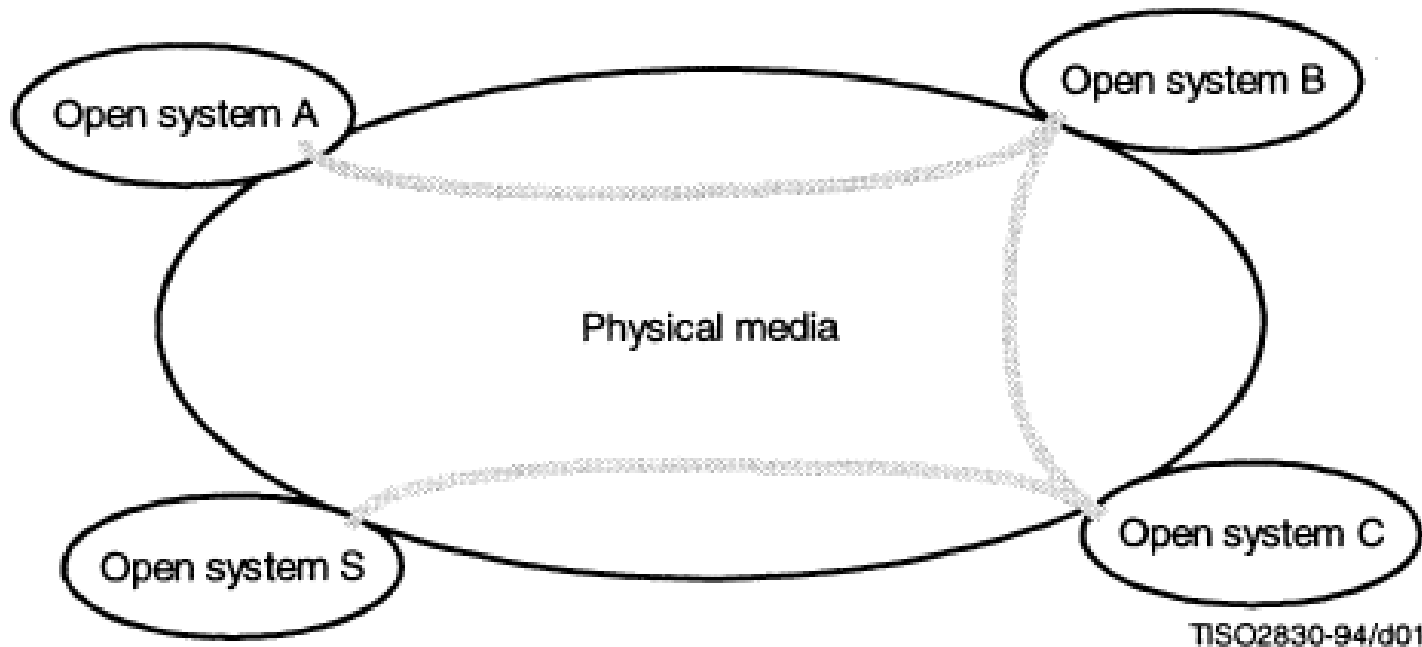


Document

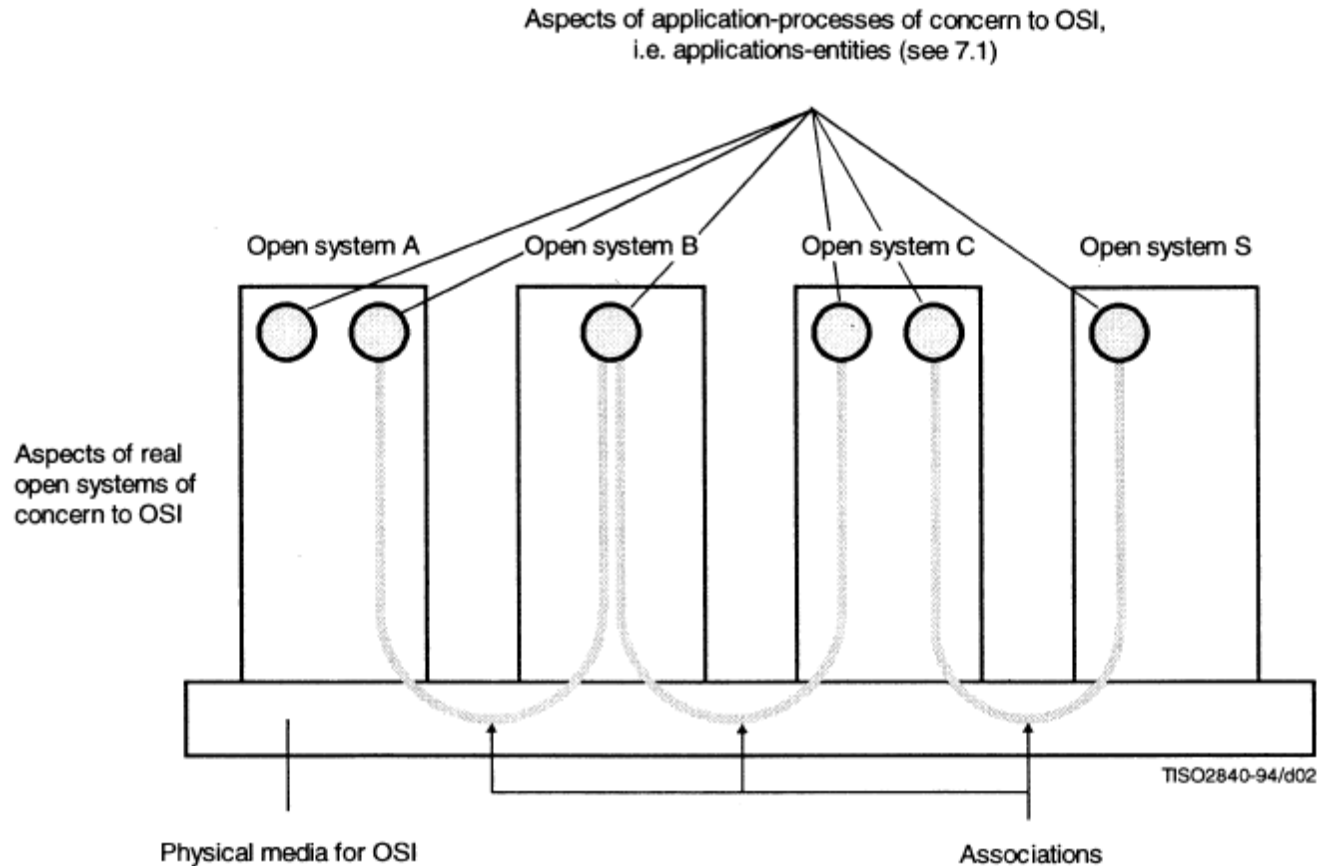
- » Please refer to the document ISO/IEC7498-1
- » Common basis for the coordination of standards development for the purpose of system interconnection



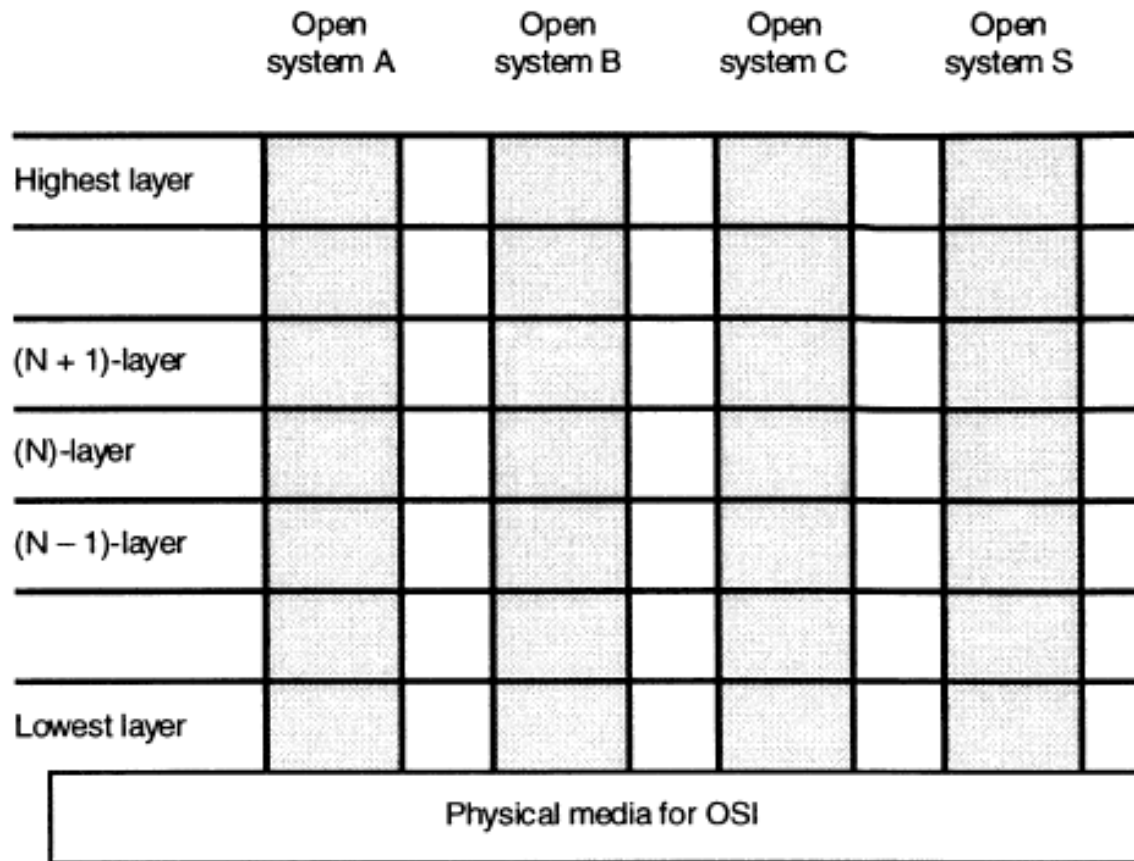
Open system interconnection



Principles of layering



Layered Model



TISO2850-94/d03



Figure 4 – (N + 1)-entities in the (N + 1)-layer communicate through the (N)-layer

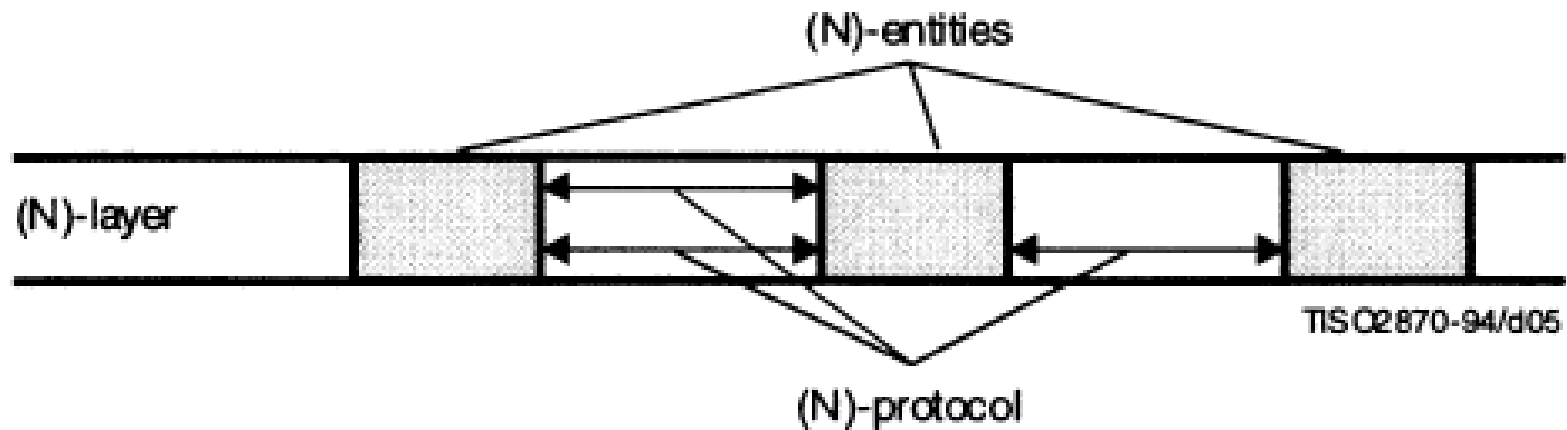


Figure 5 – (N)-protocols between (N)-entities

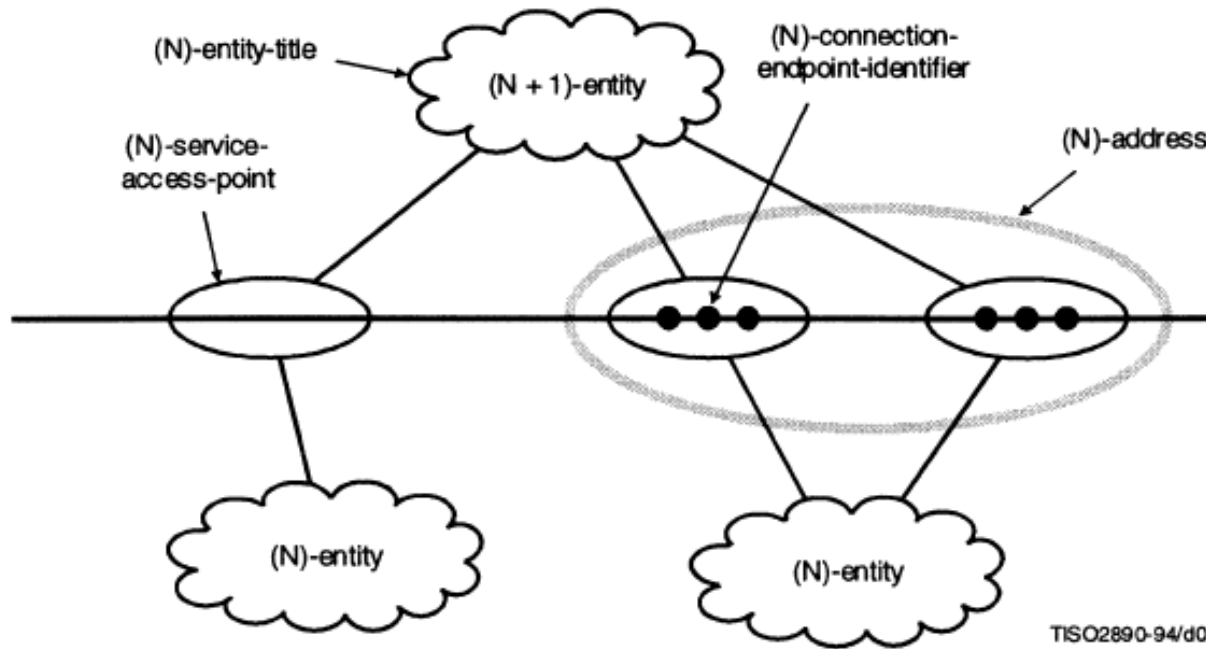
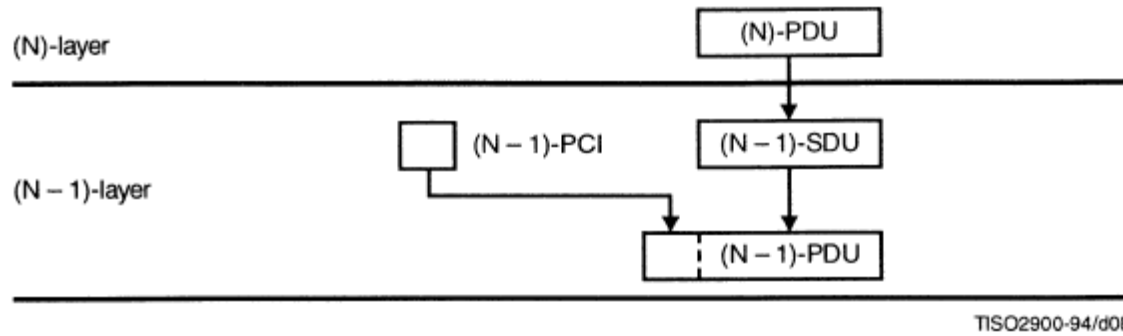
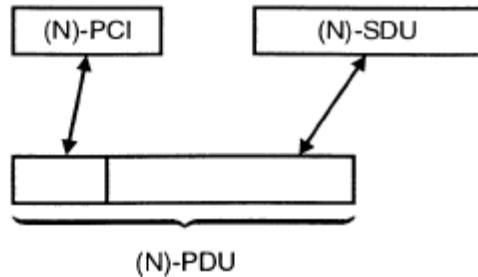


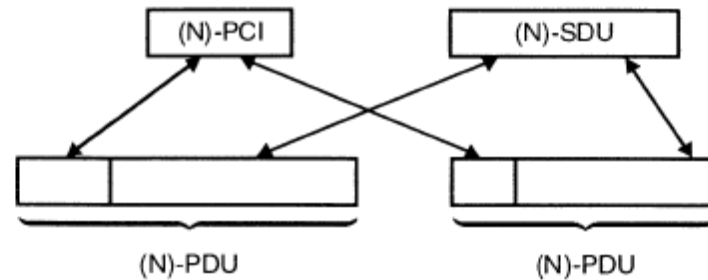
Figure 7 – Entities, service-access-points and identifiers



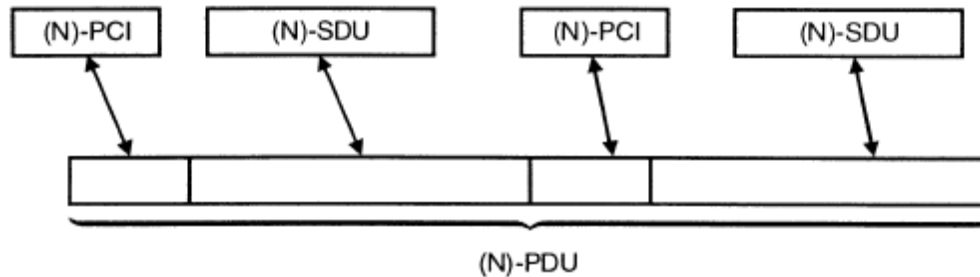
PCI Protocol-control-information
PDU Protocol-data-unit
SDU Service-data-unit



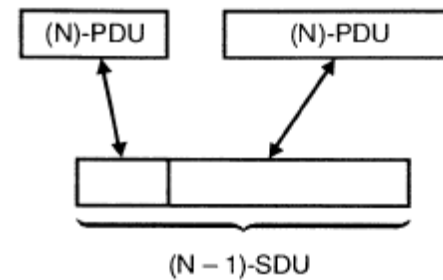
a) Neither segmenting nor blocking



b) Segmenting/Reassembling



c) Blocking/Deblocking



d) Concatenation/Separation

TISO2910-94/d09

SDU Service-data-unit
 PCI Protocol-control-information
 PDU Protocol-data-unit

Seven Layer

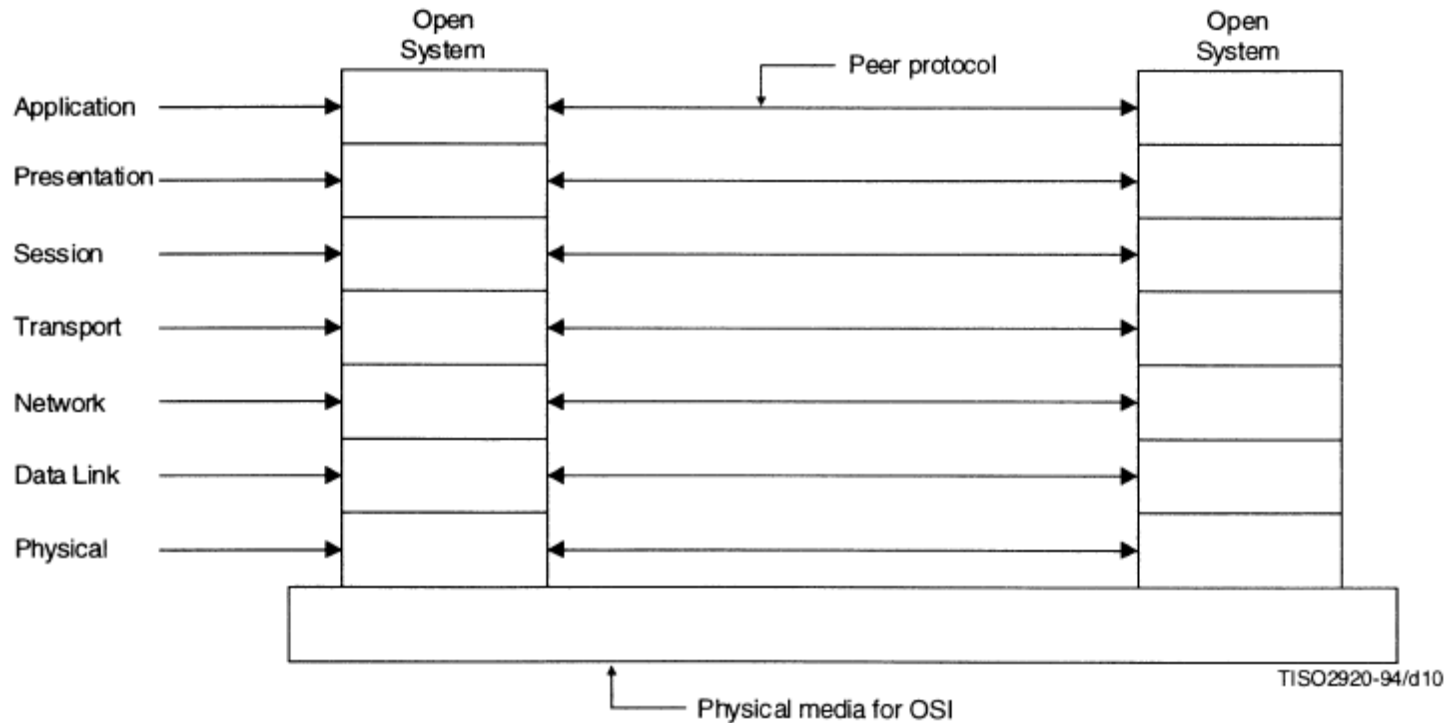


Figure 11 – Seven layer reference model and peer protocols

Relaying

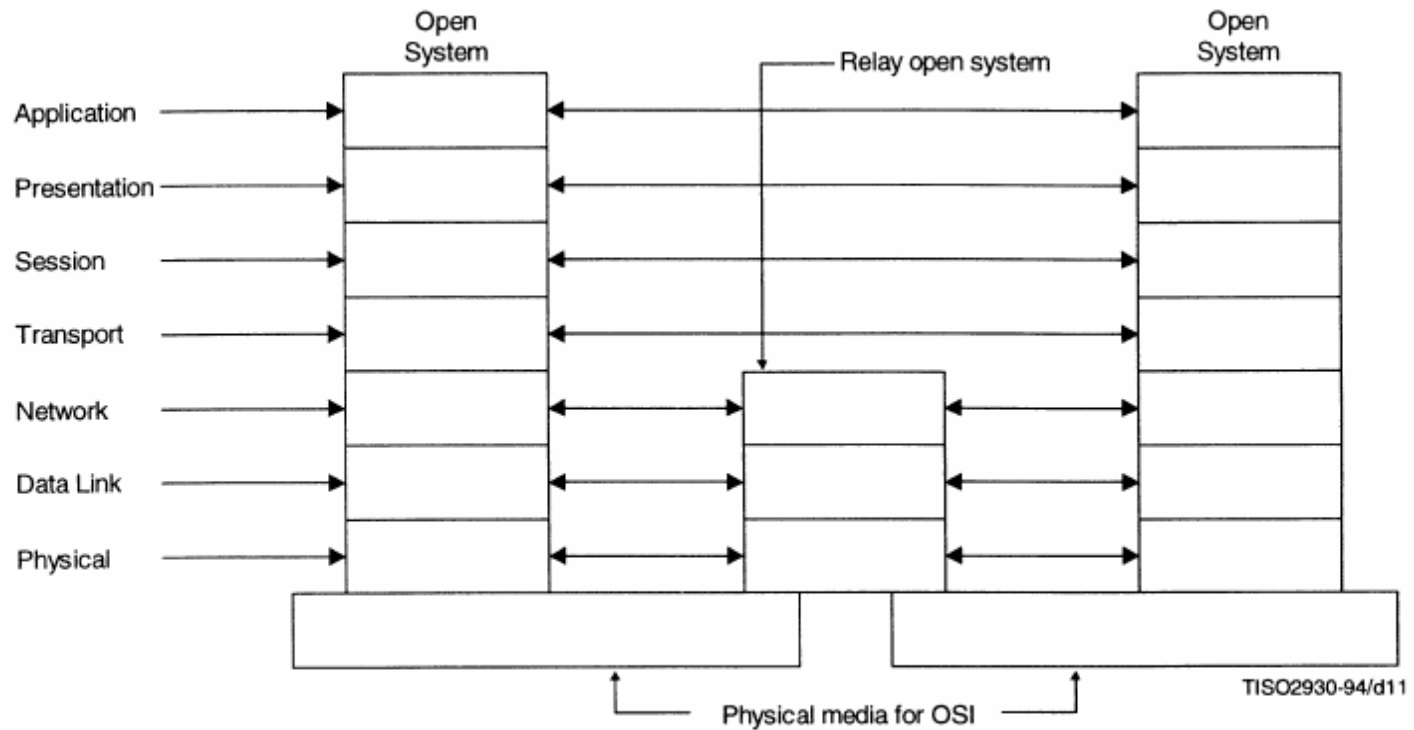


Figure 12 – Communication involving relay open systems

LAYER 7: APPLICATION

- » The application layer is the OSI layer that is closest to the user.
- » It provides network services to the user's applications.
- » It differs from the other layers in that it does not provide services to any other OSI layer, but rather, only to applications outside the OSI model.
- » Examples of such applications are spreadsheet programs, word processing programs, and bank terminal programs.
- » The application layer establishes the availability of intended communication partners, synchronizes and establishes agreement on procedures for error recovery and control of data integrity.

LAYER 6: PRESENTATION

- » The presentation layer ensures that the information that the application layer of one system sends out is readable by the application layer of another system.
- » If necessary, the presentation layer translates between multiple data formats by using a common format.
- » Provides encryption and compression of data.
- » Examples :- JPEG, MPEG, ASCII, HTML.

LAYER 5: SESSION

- » The session layer defines how to start, control and end conversations (called sessions) between applications.
- » This includes the control and management of multiple bi-directional messages using dialogue control.
- » It also synchronizes dialogue between two hosts' presentation layers and manages their data exchange.
- » The session layer offers provisions for efficient data transfer.

» Examples :- SQL, ASP (AppleTalk Session Protocol).

LAYER 4: TRANSPORT

- » The transport layer regulates information flow to ensure end-to-end connectivity between host applications reliably and accurately.
- » The transport layer segments data from the sending host's system and reassembles the data into a data stream on the receiving host's system.
- » The boundary between the transport layer and the session layer can be thought of as the boundary between application protocols and data-flow protocols. Whereas the application, presentation, and session layers are concerned with application issues, the lower four layers are concerned with data transport issues.
- » Layer 4 protocols include TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).

LAYER 3: NETWORK

- » Defines end-to-end delivery of packets.
- » Defines logical addressing so that any endpoint can be identified.
- » Defines how routing works and how routes are learned so that the packets can be delivered.
- » The network layer also defines how to fragment a packet into smaller packets to accommodate different media.
- » Routers operate at Layer 3.
- » Examples : IP, IPX, AppleTalk.

LAYER 2: DATA LINK

- » The data link layer provides access to the networking media and physical transmission across the media and this enables the data to locate its intended destination on a network.
- » The data link layer provides reliable transit of data across a physical link by using the Media Access Control (MAC) addresses.
- » The data link layer uses the MAC address to define a hardware or data link address in order for multiple stations to share the same medium and still uniquely identify each other.
- » Concerned with network topology, network access, error notification, ordered delivery of frames, and flow control.
- » Examples : Ethernet, Frame Relay, FDDI.

LAYER 1: PHYSICAL

- » The physical layer deals with the physical characteristics of the transmission medium.
- » It defines the electrical, mechanical, procedural, and functional specifications for activating, maintaining, and deactivating the physical link between end systems.
- » Such characteristics as voltage levels, timing of voltage changes, physical data rates, maximum transmission distances, physical connectors, and other similar attributes are defined by physical layer specifications.
- » Examples : EIA/TIA-232, RJ45, NRZ.

SUMMARY

- » There was no standard for networks in the early days and as a result it was difficult for networks to communicate with each other.
- » The International Organisation for Standardisation (ISO) recognised this. and researched various network schemes, and in 1984 introduced the Open Systems Interconnection (OSI) reference model.
- » The OSI reference model has standards which ensure vendors greater compatibility and interoperability between various types of network technologies.
- » The OSI reference model organizes network functions into seven numbered layers.
- » Each layer provides a service to the layer above it in the protocol specification and communicates with the same layer's software or hardware on other computers.
- » Layers 1-4 are concerned with the flow of data from end to end through the network and Layers 5-7 are concerned with services to the applications.

Question for Self Testing!

- » What was the reason for introducing open systems?
- » What is the main advantage of layered protocol design?
- » What is the main disadvantage of layered protocol design?