

Standards and the OSI Model

Introduction To Networking

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Communication Standards

- People need to follow standards when talking, eating, crossing the road
- Back in the early days of home computing there was a lack of standards e.g. Commodore, Sinclair, Atari, BBC all INCOMPATIBLE computers
- Shops has to stock different versions of hardware / software for different computers
- There was little to no interchangeability
- The same happened in the 1980s with video tape when some people bought VHS others Betamax
- The same happened again in 2000s with Blu-Ray and HD-DVD
- In each case eventually a standard won out in the marketplace.

Adherence to Standards

- So long as manufacturers follow the same standard
 - Customers can mix and match various products.
 - A PC from DELL with a printer from EPSON
 - Customers these days expect standard to be in place
 - Gives the customer the freedom to choose
 - Creates competition among suppliers - this should produce better and cheaper products.

Communication Standards and Protocols

What is a standard?

- A standard is a framework of specifications that has been...
 - Approved by a recognized standards organization ('de jure' standard)
 - Is accepted as a 'de facto' standard by the industry
 - Published as an open standard

De Jure Standards

- 'De jure' (meaning 'from the law') standards are ratified by an international body
 - E.g. International Standards Organisation (ISO),
 - CCITT
 - IEEE
- Ethernet is an example of a 'de jure' standard
- 'De jure' standards are generally given an identification number for precise reference
 - E.g. 802.3 Ethernet

De Facto Standards

- De facto (meaning 'from the fact') standards become standards because everybody decides they are a good idea
 - QWERTY keyboard layout
 - Postscript language for printers
 - Microsoft Word document format
 - Adobe PDF document format

Networking Standards

- International Standards Organisation (ISO) In the late 1970s, produced the architectural framework for networking called the Open Systems Interconnect (OSI) reference model.
(www.iso.ch)
- International Telecommunications Union (ITU) Particularly important in the WAN world (DSL etc.)
(www.itu.org)
- European Telecommunications Standard Institute (ETSI) Involved with European ISDN standards.
(www.etsi.org)

Network Standards

- Institute of Electrical and Electronic Engineers (IEEE) Important in the definition of LAN standards. E.g. IEEE 802.3 and IEEE 802.11

(www.ieee.org)

- Internet Architecture Board (IAB), Request for Comments (RFC) & Internet Engineering Task Force Set the technical direction of TCP/IP and standardisation of relevant protocols.

(www.iab.net)

Open Standards

- Here are the key fundamental principles behind Open Standards and what this can mean to you:
 - **Availability**
Open Standards are available for all to read and implement.
 - **No Royalties**
Open Standards are free for all to implement, with no royalty or fee
 - One of the most important open standards is the 'Open Systems Interconnection' references model or OSI for short
 - The OSI model produced by the ISO (International Systems Organization)

OSI Model

- The Open Systems Interconnection model (OSI) was created by the International Systems Organization (ISO)
- As a model, it is used to help us understand how protocols and networking components could be made to work together
 - It is non-commercial
 - It is not a tangible product but a conceptual model
 - It allows us to analyse network protocols, compare how they work , and also help troubleshoot when problems arise

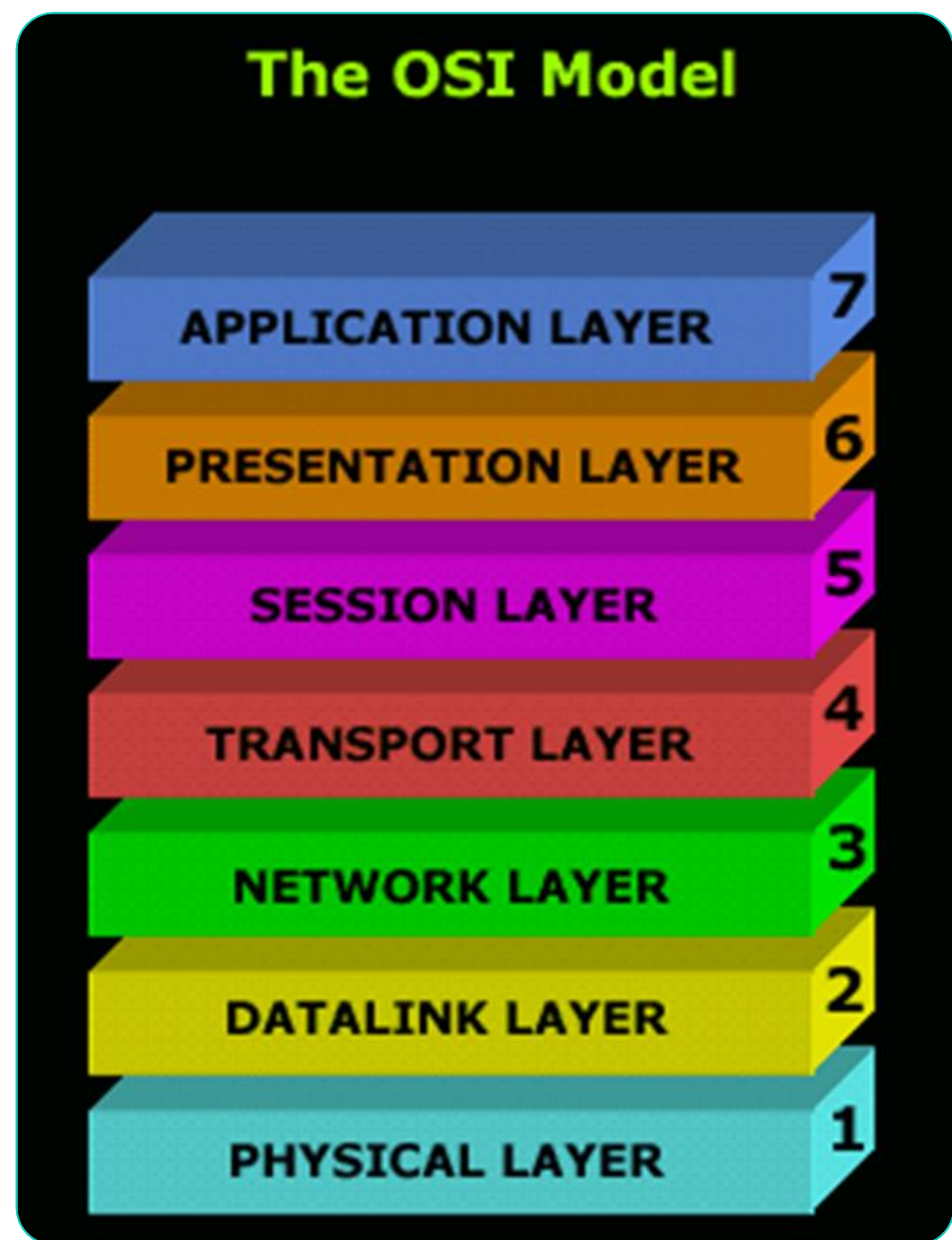
Protocols

- A set of rules and regulations that control the communications between two network devices
- In networking you don't normally use a single protocol, but a suite of protocols
 - For example; TCP/IP a family of protocols not just one
- We use TCP/IP for Internet communication

Internet Communications

- Communication between devices over the Internet is highly involved
- The standards organisation have decided to divide the communication process in sections, or small parts to make the design and troubleshooting of networks more manageable
- These sections are called 'layers'
- Each layer is responsible for a group of related specifications, functions and activities
- The OSI model is divided into 7 layers
- That is why is some times called, the 7 layer model

The OSI Model



OSI Model Mnemonics

- Please Do Not Touch Steve's Pet Alligator
 - All People Seem to Need Data Processing
 - A Penguin Said that Nobody Drinks Pepsi
 - Please Do Not Throw Sausage Pizza Away
 - Please Do Not Tell Salespeople Anything
 - Please Do Not Teach Stupid People Acronyms
 - All Presidents Say They've Never Done Pot
- ... in case you find it hard to remember

OSI Layers - Quick Summary

Application

Responsible for determining when access to the network is required.

Presentation

Ensures data is received in a useable format. Data encryption is done here.

Session

Establishing & maintaining connections. Responsible for ports and ensures queires for services.

Transport

Breaks data into frames & assigns sequence numbers. Also checks for errors in data received. UDP and SPX are protocols that work on this layer.

Network

How systems on different network segments find each other. Source-Destination addresses. Subnets, Path determination exist at this layer. IP & IPX protocols used here.

Datalink

Frames exist here. This layer handles flow control. Specifies topology and provides hardware addressing - MAC.

Physical

Transmission of the raw bit stream. Electrical signalling and hardware interface.

'Layer 8'

- 'Layer 8' does not exist; It is NOT part of the OSI model
- 'Layer 8' is the topic of popular jokes and memes
- It is jokingly used to refer to the users of a system
- E.g. Problem Exists Between Keyboard and Chair (PEBCAK)
 - It's a layer 8 problem!

The Physical Layer

- The lowest layer of the OSI Model is concerned with electrically or optically transmitting raw unstructured data bits over the network
- From the physical layer of the sending device to the physical layer of the receiving device.
- It can include specifications such as voltage, pin layout, cabling, radio frequency etc.
- At the physical layer, one might find 'physical' resources such as hubs, cables, repeaters, network adapters or modems

Data Encoding Methods

- Addressed by the physical layer
 - Manchester Encoding (Thin Ethernet / 10 base - ancient!)
 - 4B/5B / MLT-3
 - 8B/10B encoding
- This is how the data 0s and 1s is translated into pulses of 1s and 0s, electrical waveforms.
- Examples of technologies that uses physical layer specifications:
 - Ethernet (IEEE 802.3)
 - Token Ring (IEEE 802.5) (very old fashioned)
 - IEEE 802.11b/h/g (Wireless)

The Data Link Layer

- At the data link layer, directly connected nodes are used to perform node-to-node data transfer where data is packaged into frames.
- The data link layer also corrects errors that may have occurred at the physical layer.
- The data link layer encompasses two sub-layers of its own.
 - The first, media access control (MAC), provides flow control and multiplexing for device transmissions over a network.
 - The second, the logical link control (LLC), provides flow and error control over the physical medium as well as identifies line protocols

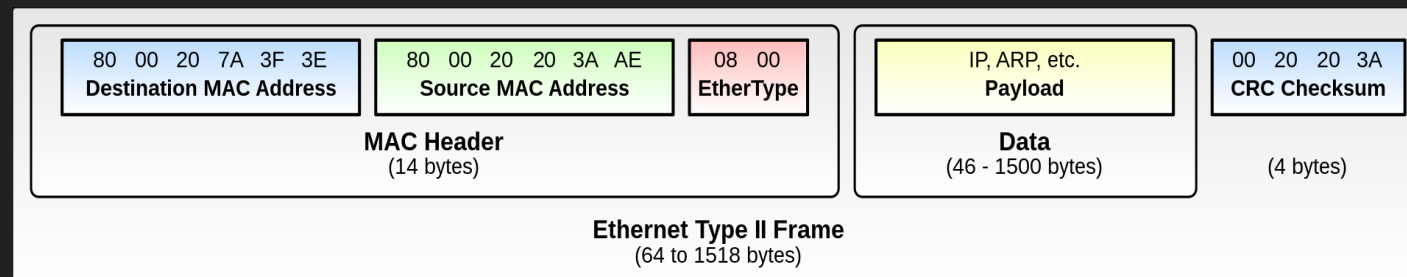
The Data Link Layer

What Data Link Layer Components do:

- Media Access Control (MAC) and Logical Link Control (LLC)
- Addresses network devices (MAC Address)
- Places data in a Data Frame
- Gives the data bits to the NIC card
- Controls the Network Interface Card's (NIC) Access to the Media (MAC)
- Detects transmission errors on a single link (LLC)
- Deals with CSMA/CD and other access methods

Framing

- Places data in a Data Frame (packet)
- Header
- MAC Addresses
- Frame Length
- Data – this may contain user data and information used by upper layer protocols
- Error Check



The most common Ethernet Frame format, type II

Error Detection

- Cyclic Redundancy Check (CRC)
- Unique number calculated before the data is send
- Added to data frame
 - Recalculated upon arrival
 - Same before and after - Frame OK
 - Different - Frame is bad, discarded

The Network Layer

- The network layer is responsible for receiving frames from the data link layer, and delivering them to their intended destinations
- Based upon the **IP addresses** contained inside the frame.
- The network layer finds the destination by using logical addresses
 - E.g. **IP** (Internet Protocol).
- At this layer routers are a crucial component used to route information where it needs to go between networks

The Network Layer

- An important issue addressed by this layer is **routing**
- Provides network-wide addressing and mechanism to move packets between multiple networks
- Move of packets between different networks – routing
- At this layer the information will be put into packets
- At this layer the logical address is used, that is the IP address

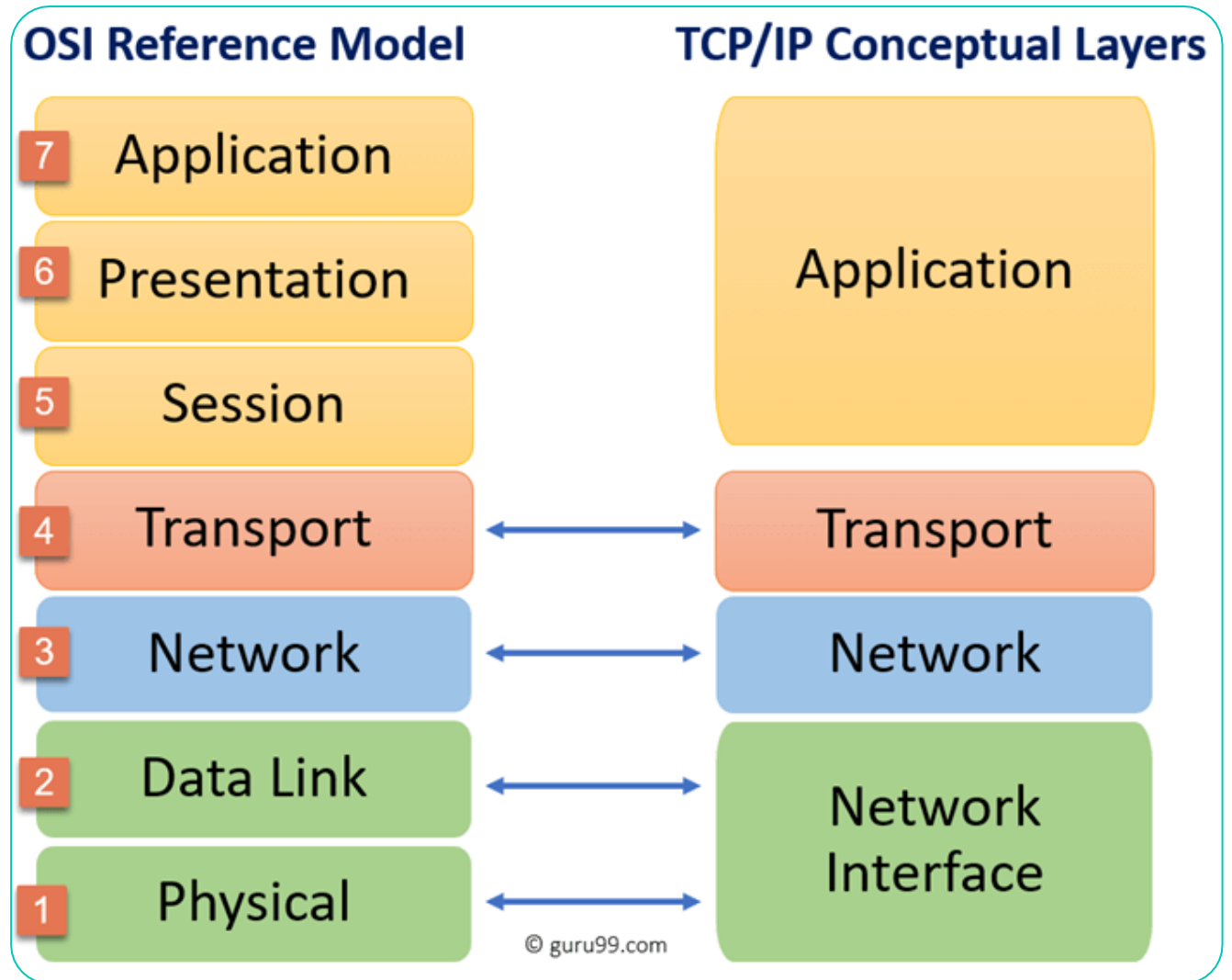
The Transport Layer

- The transport layer manages the delivery and error checking of data packets.
- It regulates the size, sequencing, and ultimately the transfer of data between systems and hosts.
- One of the most common examples of the transport layer is TCP or the Transmission Control Protocol

TCP / IP Conceptual Layers

- The OSI Model is generic and not designed to represent specific protocol(s)
- It does not map perfectly to the TCP/IP protocol stack
- E.g. The Presentation layer, and Session Layer are not present
- Therefore there is also the 'TCP/IP Model' which more closely resembles how all modern networks operate

The TCP/IP Model





Any Questions?