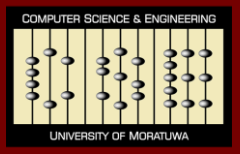


CS2033: Data Communication and Networks

Introduction

Sunimal Rathnayake
Department of Computer Science and Engineering
University of Moratuwa
sunimal [at] cse [.] mrt [.] ac [.] lk

Developed based on original slides by Prof. Gihan Dias and Dr. Sulochana Suriyaarachchi

About me

- Sunimal Rathnayake
- Senior Lecturer at CSE, UOM
- Education
  - BSc Engineering (Hons.) in Computer Science and Engineering, University of Moratuwa (2014)
  - PhD in Computer Science, National University of Singapore (2020)
- Research Interests: cloud computing, parallel computing, HPC, performance engineering
- Web: https://sunimalr.staff.uom.lk/
- Email: sunimal@cse.mrt.ac.lk

Outline

- What is communication
- What is a network
- OSI Model
- CS2032 Scope

Communication

- Sending information from one place to another
- Transmission of signals that will be interpreted as data
- An information could be transmitted electronically between two points over a physical connection medium

Sharing & Communication

Through The Ages

1 Cave Paintings

France, 30,000 BC

Who doesn't love a cave painting? Created to communicate, themes included animals and symbols for early man.

2 Pictograms

China & Egypt, 5000 BC

Pictograms and ideograms represented a concept, object or activity, and led to Egyptian hieroglyphs and Chinese characters.

3 Carrier Pigeons

Greece, 776 BC

OK, pigeons are disease-ridden, but they're great with directions, and rather load bearing, according to the Ancient Greeks.

4 First Postal Service

Persia, 550 BC

Persian King Cyrus the Great created the first Postal Service – which handily doubled as data and tax gathering as well.

5 The Marathon Man

Greece, 530 BC

Ancient Greek Pheidippides ran 150 miles in two days (with no trainers!) to announce the Greek victory over Persia.

6 Heliographs

Rome, 37 AD

Roman Emperor Tiberius sent coded orders daily by heliograph to the mainland from his island, Capri. Alright for some!

7 Paper

China, 105 AD

Tsai Lun of China took the inner bark of a mulberry tree, added water, pounded it a lot – and voila, paper was invented!

8 Town Crier/Bellman

The UK, 1540 AD

What did Town Criers tell the illiterate masses? Royal proclamations, local bylaws and – of course – local business adverts.

9 Daily Newspaper

Germany, 1650 AD

The first daily was the 'Einkommende Zeitung' published in Leipzig, 1650. The first English daily was the daily Courant, 1702.

10 Morse Code

The USA, 1835 AD

American Samuel Morse invents Morse code, a series of on/off clicks, tones or lights. Great (and disastrous) for the navy!

11 Telephone

The USA, 1876 AD

Scottish engineer Alexander Graham Bell patents the electric telephone. No camera or apps, but exciting nonetheless!

12 First Transatlantic Signal

Cornwall to Newfoundland 1902 AD

Italian inventor Guglielmo Marconi transmits the first radio signal to travel the Atlantic Ocean.

13 1st TV Broadcast

Great Britain, 1927 AD

Scottish inventor John Logie Baird transmitted the first television signal. Finally, something to point our sofas towards!

14 ARPANET Launched

The USA, 1969 AD

The Advanced Research Projects Agency Network was the precursor network to what we now know as the global Internet.

15 WWW

USA, 1994 AD

American government releases control of the Internet and the world wide web is born – hello light speed news and online shopping!

16 AIM

USA, 1997 AD

AOL pioneered Internet chat with AIM (AOL Instant Messenger) in 1997. Now we could all safely talk to total strangers!

17 Blogging

USA, 1999 AD

Everyone gets a voice – the launch of Blogger.com and LiveJournal in 1999 led to a blogging explosion across the Internet.

18 Facebook

USA, 2004 AD

Bored Harvard student Mark Zuckerburg created Facebook. Today it has an estimated 850 million users. Like?

19 YouTube

USA, 2005 AD

YouTube broke ground in user-generated content, with users uploading videos across the Internet. Totally viral, right?

20 Twitter

USA, 2006 AD

What can you really say in 140 characters? A lot, according to Twitter's 350m+ users – it's a micro-blogging masterclass.

moo.com

Types of Communication

- Video, Text, Voice, Data, Multimedia
- Direction of Information Flow
  - One-way
  - Interactive – Non real time
  - Interactive – Real time
- Number of parties involved
  - Two-party
  - Multi-party

Network

- A system that connects devices for communication:
  - PSTN: Public Switched Telephone Network
  - LAN: Local Area Networks
  - Television Network
  - Vehicular Networks
  - Internet

Components of a Network

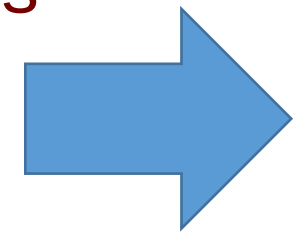
- Terminals for Access

- Equipment for Switching

- Media for Transmission

Challenge

- Different architecture
- Different languages
- Different data formats
- Different communication rates



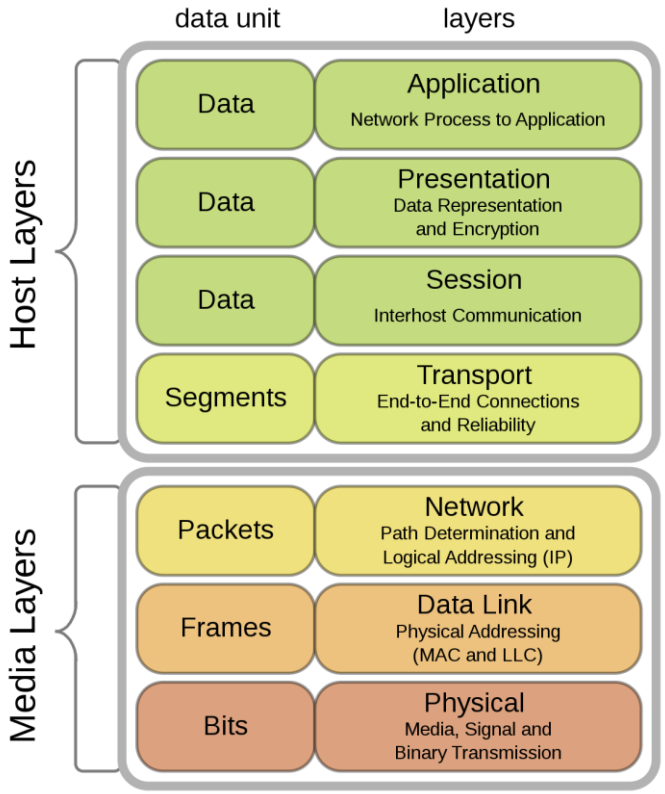
- Modularization
- Layering
- Standardization

Layered Architecture

- Separate functional layers
- Transparent Implementation
  - Flexible to modify
  - Independent design and testing
- Eg: OSI reference model, TCP/IP model

OSI Model

- Open System Interconnect (OSI)
  - Communication regardless of underlying architecture
- 7 Layers
  - Layer – well defined function
  - Boundaries – minimum information flow across



Source: Wikipedia

Physical Layer

- Purpose
  - Accept a raw string of bits and deliver it across a link
- Functions
  - Encoding and signaling
  - Data transmission and reception
  - Topology and physical network design
- Hardware Specifications – operations of cables, connectors, wireless radio transceivers, network interface cards and other hardware devices

Data Link Layer

- Purpose
  - Provide error free transmission across a single link
- Functions
  - Data framing
  - Error Detection and handling
  - Flow Control
  - Addressing – hardware level

Network Layer

- Purpose
  - Deliver packets (datagrams) from sender to the receiver (host-to-host) across a communications network
  - Shield higher layers from the details of how packets got to their destination

- Functions
  - Logical Addressing - Which machine to send the packet to
  - Routing - How to get there
  - Datagram encapsulation
  - Congestion Control - Lot of packets in the network core
  - Quality of Service -Guarantee levels of service

Transport Layer

- Purpose
  - Provide end-to-end delivery from one host to the other
- Functions
  - Connection establishment, management and termination
  - Multiplexing and demultiplexing
  - Error detection and correction
  - Flow Control
  - Quality of Service

Session Layer

- Purpose
  - Provide a means of controlling the dialog between two end-users (applications)
- Functions
  - Dialog Control (full vs half duplex)
  - Token Management
  - Synchronization
  - Recovery Management
- Not often implemented in real systems

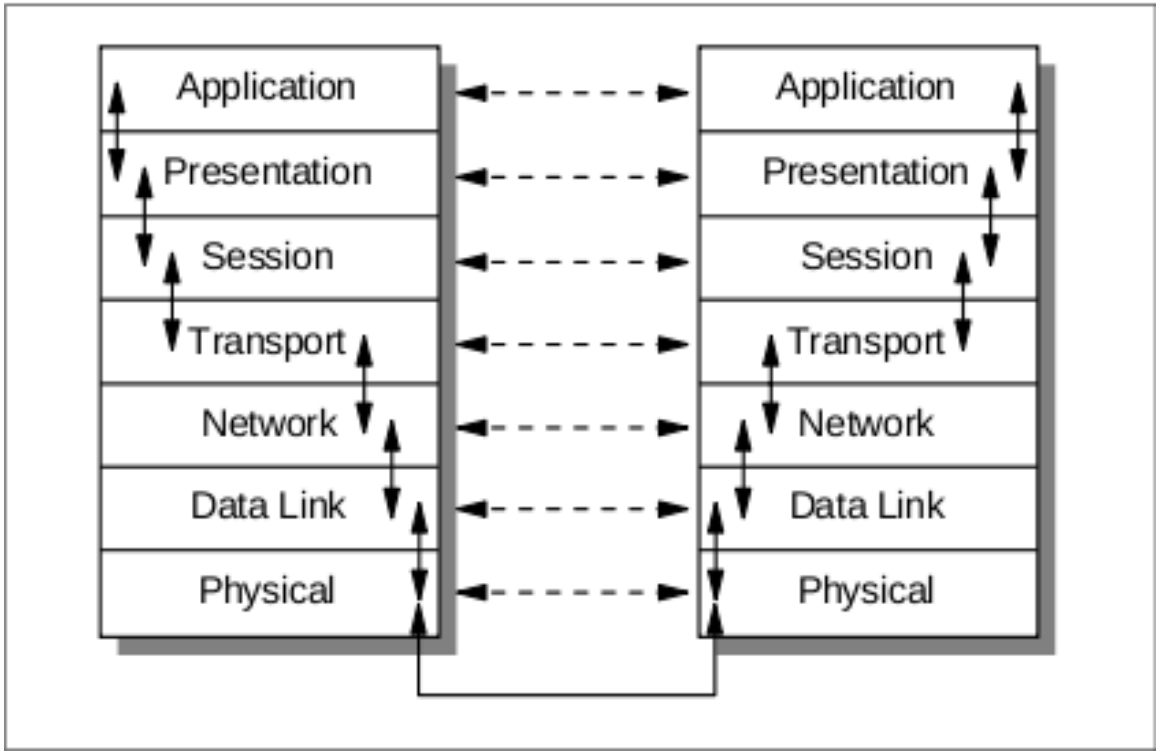
Presentation Layer

- Purpose
  - Formatting data for transmission
- Functions
  - Translation
  - Compression
  - Encryption
- In practice not implemented in a separate layer but included elsewhere – e.g. in the applications

Application Layer

- Purpose
  - Provide network-based applications to users
- File transfer, Electronic Mail, World Wide Web, Virtual Terminal, Instant Messaging, Directory Services, Remote file systems
- Some widely used applications are standardized

Communication in OSI Model



http://www.supportsages.com/blog/wp-content/uploads/2010/09/Osi_layer.png

CS2033 Scope

- Physical Layer in depth
- Touches Data Link Layer
- Introduces briefly Network layer and Application layer