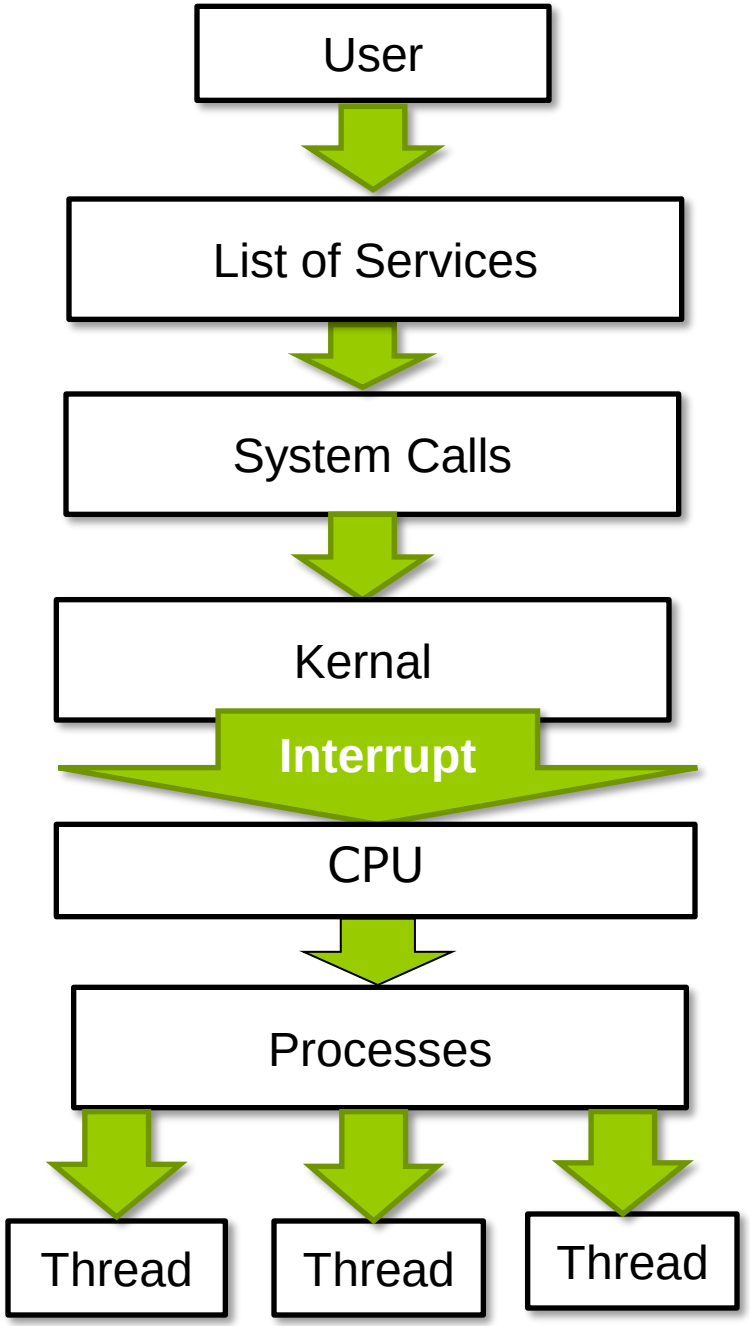
Part 4

The Big Pic of OS



Ports


Optical Audio "Toslink"
USB A 1.0/1.1/2.0
Firewire 4 pin iLink
Firewire 400 1394a
Firewire 800/3200 1394b/c
Ethernet 8P8C common:RJ-45
Modem RJ-11
Apple Desktop Bus - ADB
Mac Serial
PS/2
Future
USB A 3.0
DE-9F
DB-25 Serial/Com Port
DE-9 Serial RS232
e-SATA
Centronics Parallel 36pin
Centronics SCSI 50pin
AT Keyboard
50 pin SCSI 2
Surround sound
stereo/ Headphones
Line In
Mic
Digital Audio RCA plug style
AAUI
Composite Audio/Video
S-Video
Component Video
F-Connector RF/COAX
Parallel Port/SCSI 1/DB-25F
Mac Video/MIDI /gameport/AUI/DA-15
Mini DisplayPort
Mini-DVI
Mini-VGA
Apple Hi-Density Video HDI-45
Apple Display Connector - ADC
LFH60 (dual DVI-D)
DMS59 (dual DVI-D)
HDMI
Micro-DVI
DisplayPort
DVI Video
DE-15/HD-15 VGA/SVGA

I/O Subsystem

- One purpose of OS is to hide peculiarities of hardware devices from the user
- I/O subsystem responsible for
  - Memory management of I/O including **buffering** (storing data temporarily while it is being transferred), **caching** (storing parts of data in faster storage for performance), **spooling** (the overlapping of output of one job with input of other jobs)
  - General device-driver interface
  - Drivers for specific hardware devices

Protection and Security

- **Protection** – any mechanism for controlling access of processes or users to resources defined by the OS
- **Security** – defense of the system against internal and external attacks
  - Huge range, including denial-of-service, worms, viruses, identity theft, theft of service
- Systems generally first distinguish among users, to determine who can do what
  - User identities (**user IDs**, security IDs) include name and associated number, one per user
  - User ID then associated with all files, processes of that user to determine access control
  - Group identifier (**group ID**) allows set of users to be defined and controls managed, then also associated with each process, file
  - **Privilege escalation** allows user to change to effective ID with more rights

Virtualization

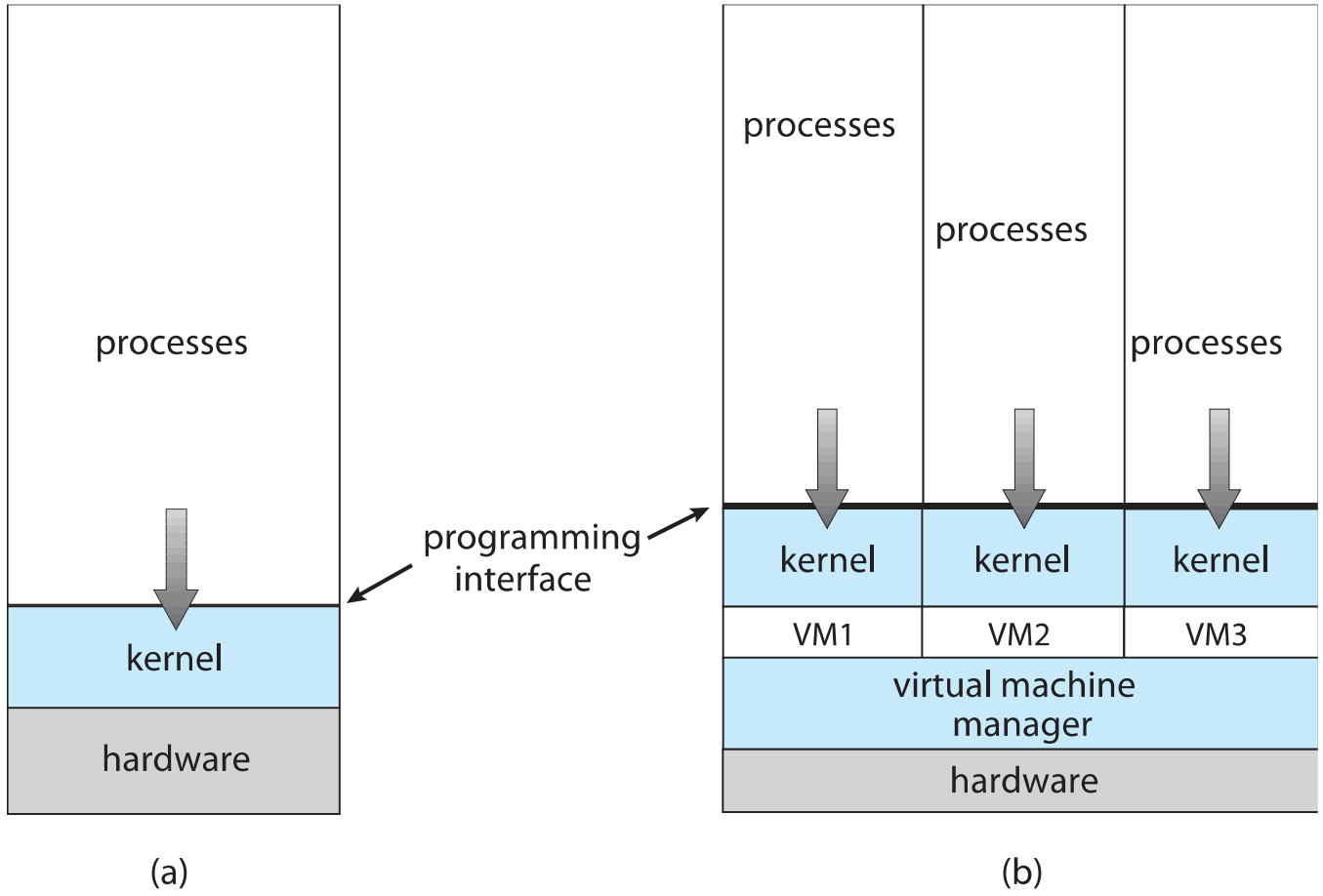
- Allows operating systems to run applications within other OSes
  - Vast and growing industry
- **Emulation** used when source CPU type different from target type (i.e. PowerPC to Intel x86)
  - Generally slowest method
  - When computer language not compiled to native code – **Interpretation**
- **Virtualization** – OS natively compiled for CPU, running **guest** OSes also natively compiled
  - Consider VMware running WinXP guests, each running applications, all on native WinXP **host** OS
  - **VMM** (virtual machine Manager) provides virtualization services

Virtualization (cont.)

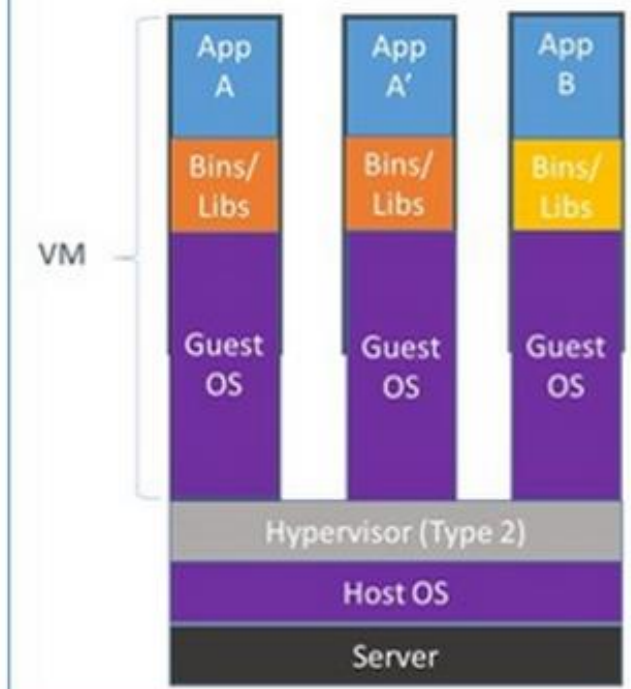
- Use cases involve laptops and desktops running multiple OSes for exploration or compatibility
  - Apple laptop running Mac OS X host, Windows as a guest
  - Developing apps for multiple OSes without having multiple systems
  - QA testing applications without having multiple systems
  - Executing and managing compute environments within data centers
- VMM can run natively, in which case they are also the host
  - There is no general purpose host then (VMware ESX and Citrix XenServer)

Explaining Virtual Machines

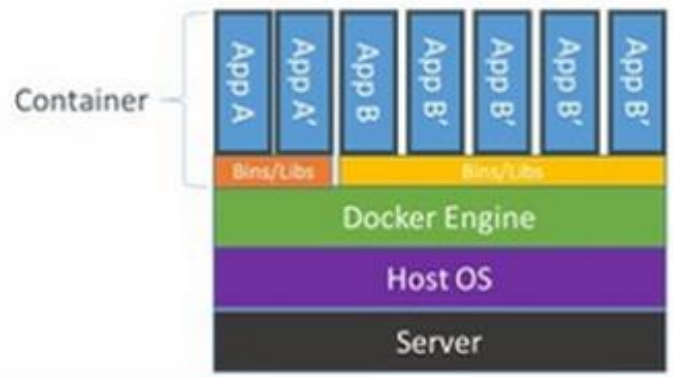
Computing Environments - Virtualization



Containers vs. VMs



Containers are isolated, but share OS and, where appropriate, bins/libraries



- Containers let you freeze and restart an exact copy of a system that you plan to deploy, including the operating system and configuration files. This makes debugging easy and testing a snap, and it even changes the way that deploys and rollbacks happen in IT operations.

- Container packages are not only complete, but they are also small and efficient enough to download and run in seconds. Cluster managers provide the load balancing and scale to ensure uptime even during a rollout.

Docker

- The first and still most popular container technology, Docker's open-source containerization engine works with most of the products that follow, as well as many open-source tools.

Kubernetes

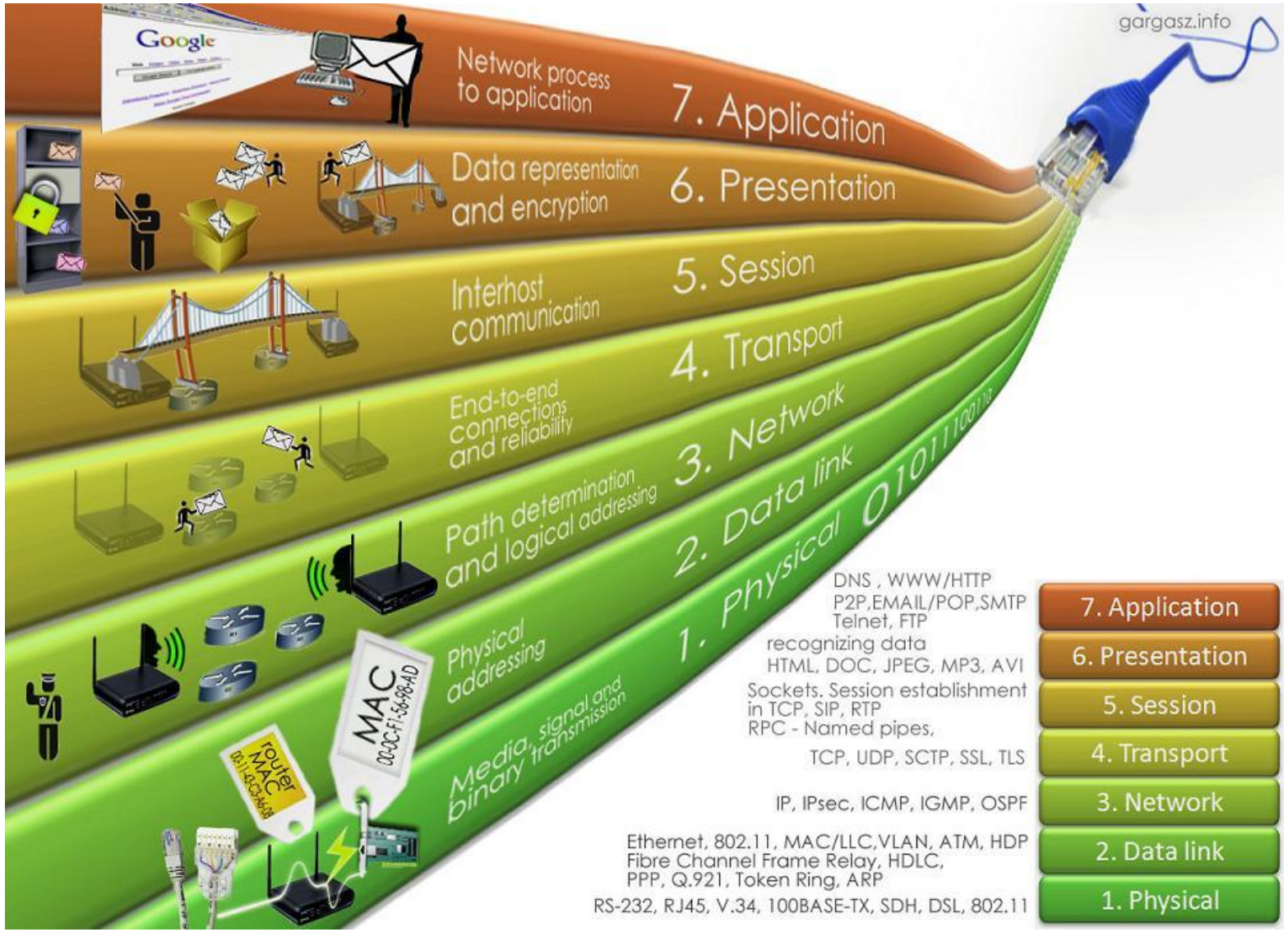
- While there is no standard for cluster management, the Kubernetes open-source cluster manager, originally developed by Google, is far and away the most popular. Supported by Amazon's AWS, Google's Cloud Engine (GCE) and Microsoft's Azure Container service, Kubernetes is relatively portable, which helps prevent vendor lock-in.

Distributed Systems

- Distributed computiing
  - Collection of separate, possibly heterogeneous, systems networked together
    - **Network** is a communications path, **TCP/IP** most common
      - **Local Area Network** (**LAN**)
      - **Wide Area Network** (**WAN**)
      - **Metropolitan Area Network** (**MAN**)
      - **Personal Area Network** (**PAN**)
  - **Network Operating System** provides features between systems across network
    - Communication scheme allows systems to exchange messages
    - Illusion of a single system

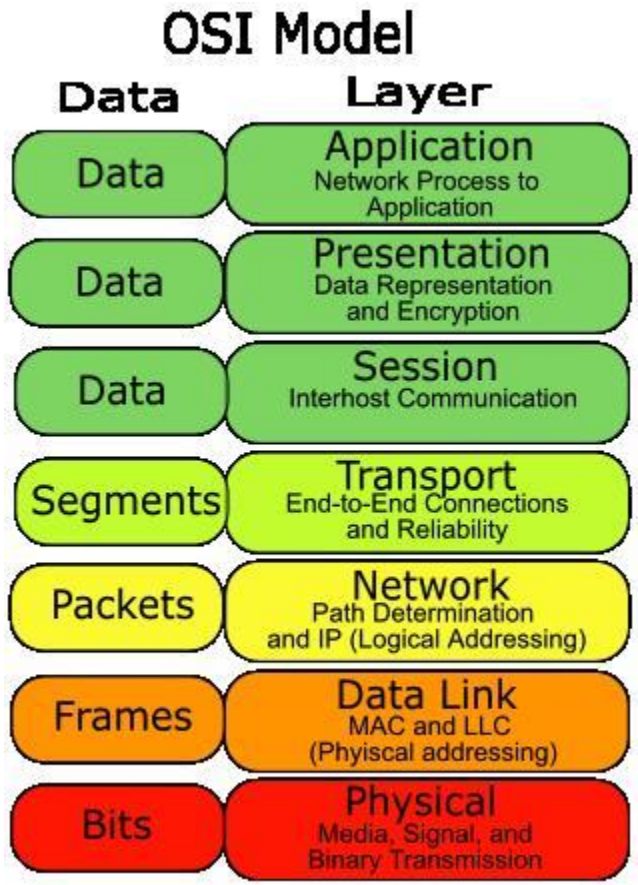
OSI Model

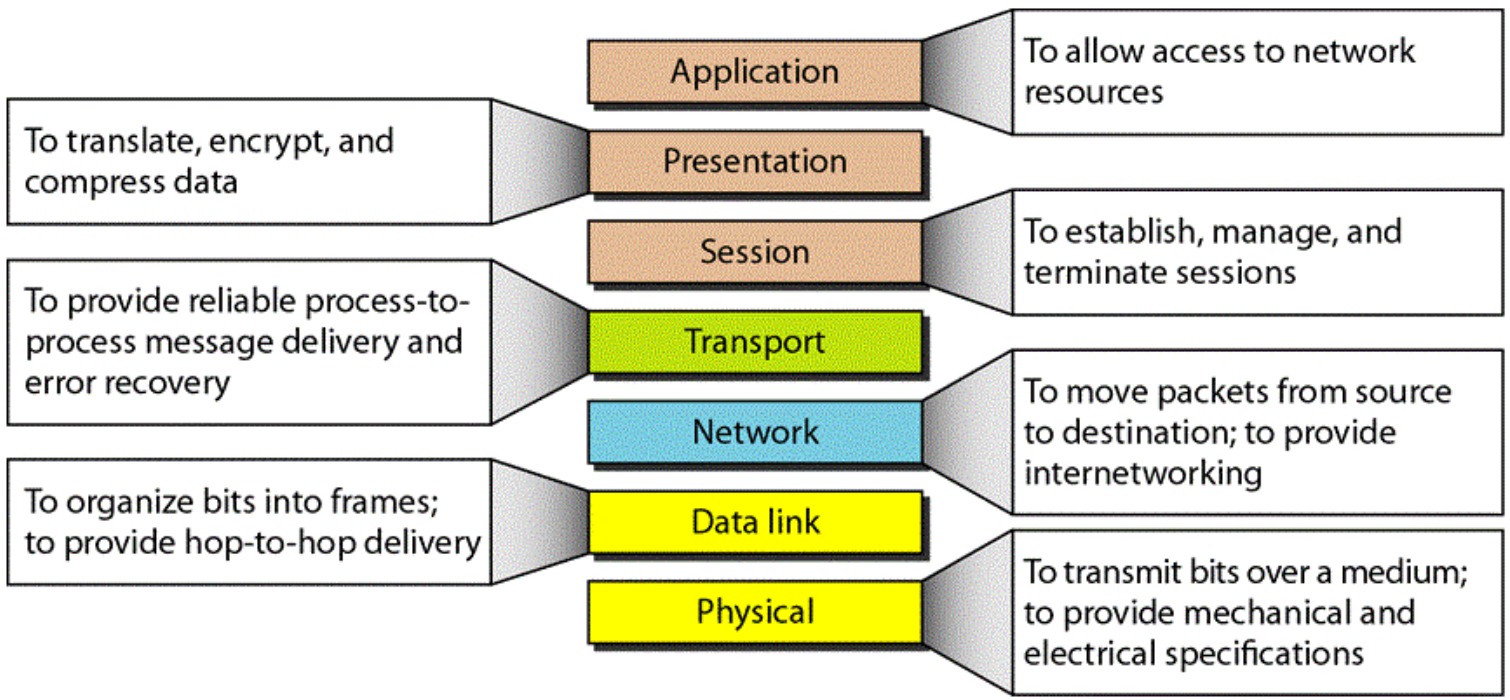
The OSI Model



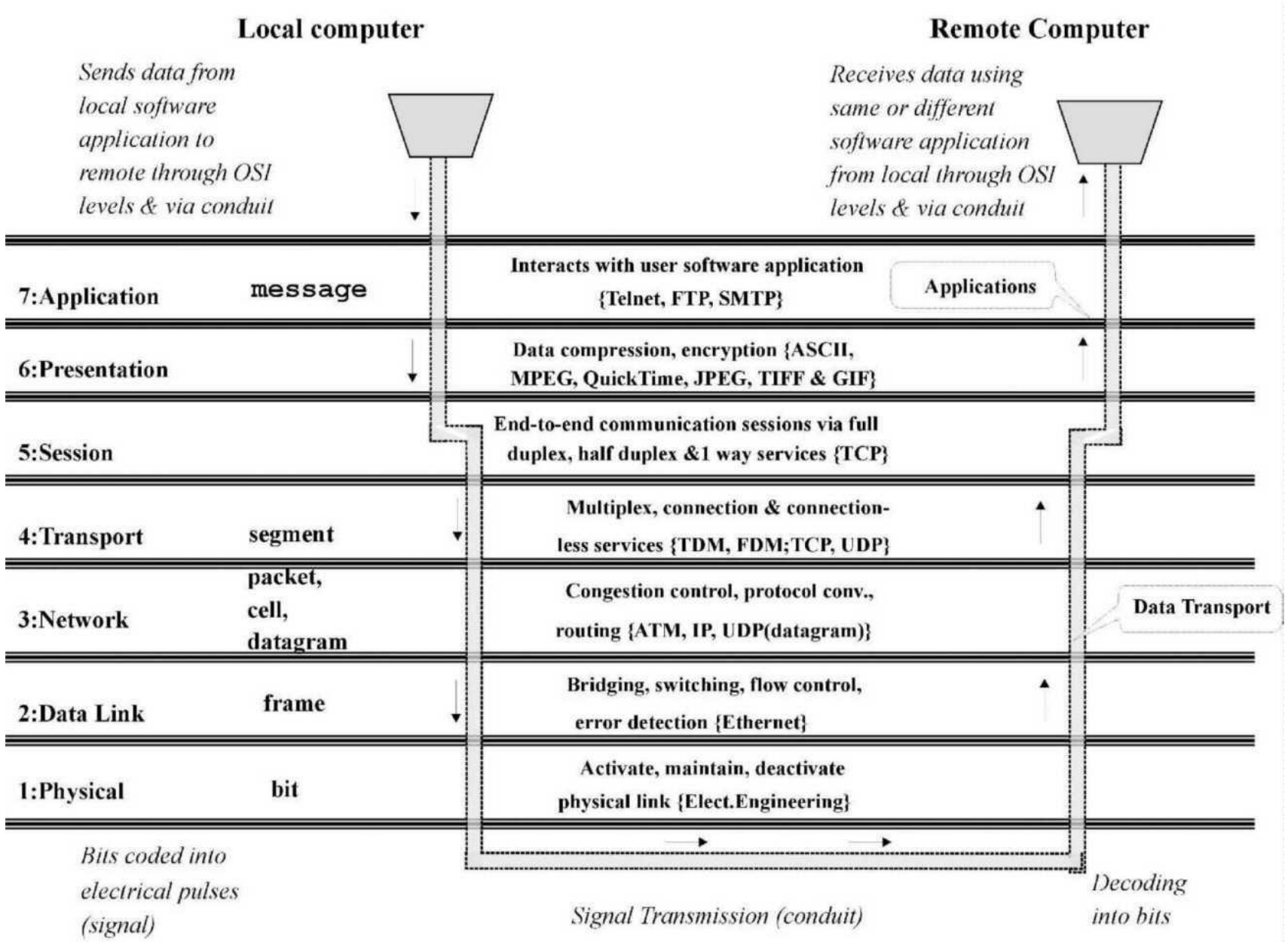
- All People Seem To Need Data Processing

The OSI Model


OSI Model
Data
Layer
Data
Application
Network Process to Application
Data
Presentation
Data Representation and Encryption
Data
Session
Interhost Communication
Segments
Transport
End-to-End Connections and Reliability
Packets
Network
Path Determination and IP (Logical Addressing)
Frames
Data Link
MAC and LLC (Phyiscal addressing)
Bits
Physical
Media, Signal, and Binary Transmission


Application
To allow access to network resources
To translate, encrypt, and compress data
Presentation
Session
To establish, manage, and terminate sessions
To provide reliable process-to-process message delivery and error recovery
Transport
Network
To move packets from source to destination; to provide internetworking
To organize bits into frames; to provide hop-to-hop delivery
Data link
Physical
To transmit bits over a medium; to provide mechanical and electrical specifications

Group	#	Layer Name	Common Protocols and Technologies	Common Network Components Associated with this Layer
Upper Layers	7	Application	DNS, NFS, DHCP, SNMP, FTP, TFTP, SMTP, POP3, IMAP, HTTP, Telnet	Network aware applications, Email, Web Browsers and Servers, File Transfer, Name Resolution
	6	Presentation	SSL, Shells and Redirectors, MIME	
	5	Session	NetBIOS, Application Program Interfaces, Remote Procedure Calls	
Lower Layers	4	Transport	TCP and UDP	Video and Voice streaming mechanisms firewall filtering lists
	3	Network	IPv4, IPv6, IP NAT	IP Addressing, Routing
	2	Data Link	Ethernet Family, WLAN, Wi-Fi, ATM, PPP	Network Interface cards and Drivers, Network Switching, WAN connectivity
	1	Physical	Electrical Signaling, Light Wave Patterns, Radio Wave Patterns	Physical Medium (copper twisted pair, fiber optic cable, wireless transmitters), Hubs and Repeaters


Local computer
Remote Computer
Sends data from local software application to remote through OSI levels & via conduit
Receives data using same or different software application from local through OSI levels & via conduit
7:Application
message
Interacts with user software application {Telnet, FTP, SMTP}
Applications
6:Presentation
Data compression, encryption {ASCII, MPEG, QuickTime, JPEG, TIFF & GIF}
5:Session
End-to-end communication sessions via full duplex, half duplex &1 way services {TCP}
4:Transport
segment
Multiplex, connection & connection-less services {TDM, FDM;TCP, UDP}
3:Network
packet, cell, datagram
Congestion control, protocol conv., routing {ATM, IP, UDP(datagram)}
Data Transport
2:Data Link
frame
Bridging, switching, flow control, error detection {Ethernet}
1:Physical
bit
Activate, maintain, deactivate physical link {Elect.Engineering}
Bits coded into electrical pulses (signal)
Signal Transmission (conduit)
Decoding into bits

Application Layer

Example of Application layer protocol: **HTTP**

Software

Web browser

Collect and display content

APIs

Request content

Return content in required format

HTTP

Application layer

Presentation Layer

- Example protocol: Secure Sockets Layer (**SSL**)

Software

Application layer

Presentation layer

Web browser

APIs

HTTP, etc.

Detect and indicate format

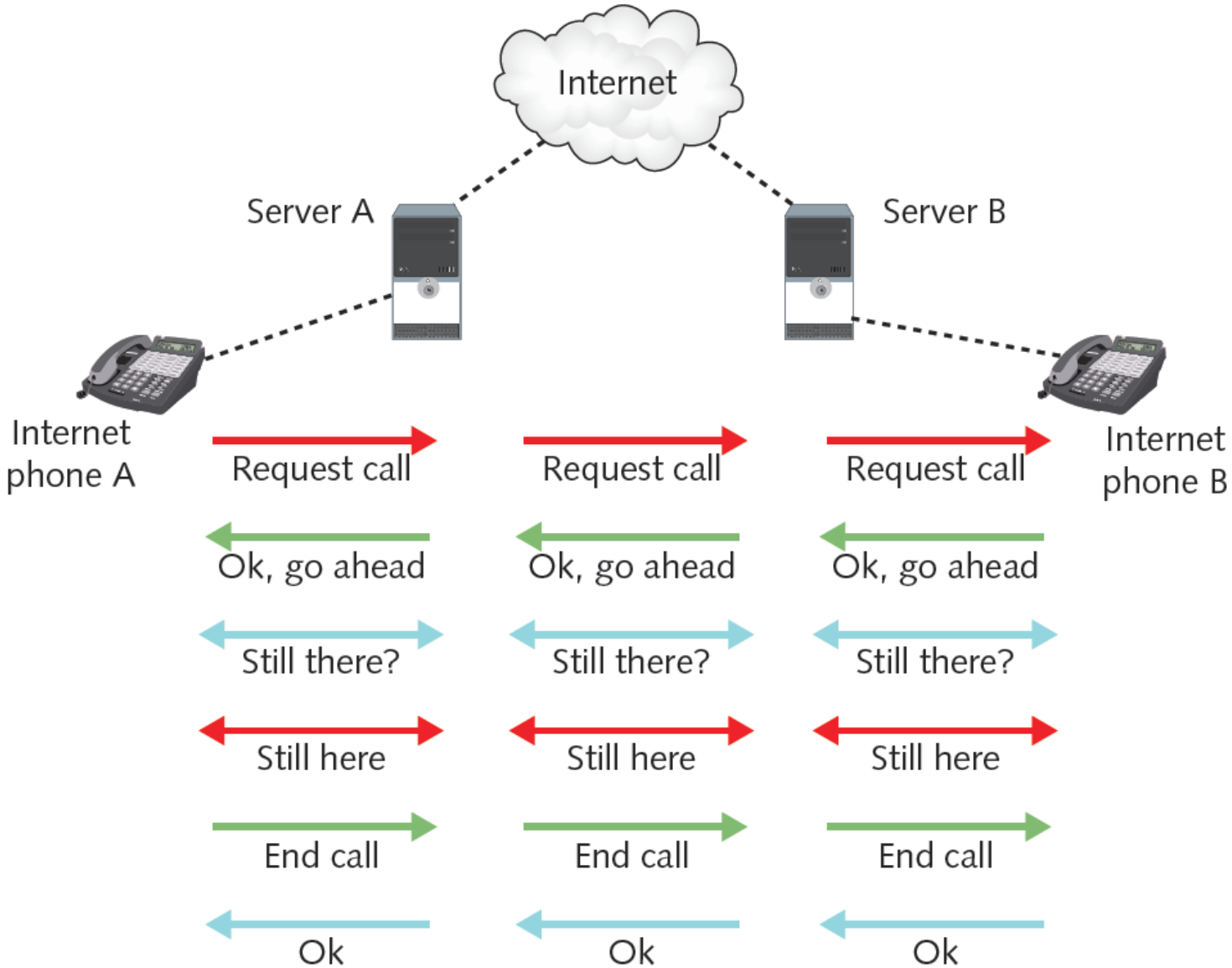
SSL, TLS, etc.

Decrypt data

Encrypt data

Session Layer

- Establishing and keeping alive communications link
- Keeping communications secure
- Synchronizing dialogue between two nodes
- Identify session participants


Internet
Server A
Server B
Internet phone A
Internet phone B
Request call
Request call
Request call
Ok, go ahead
Ok, go ahead
Ok, go ahead
Still there?
Still there?
Still there?
Still here
Still here
Still here
End call
End call
End call
Ok
Ok
Ok

Transport Layer

TCP

- Accept data from Session layer
- Manage end-to-end data delivery
- Handle flow control
- Examples
  - Checksum
  - Segmentation
  - MTU (maximum transmission unit)

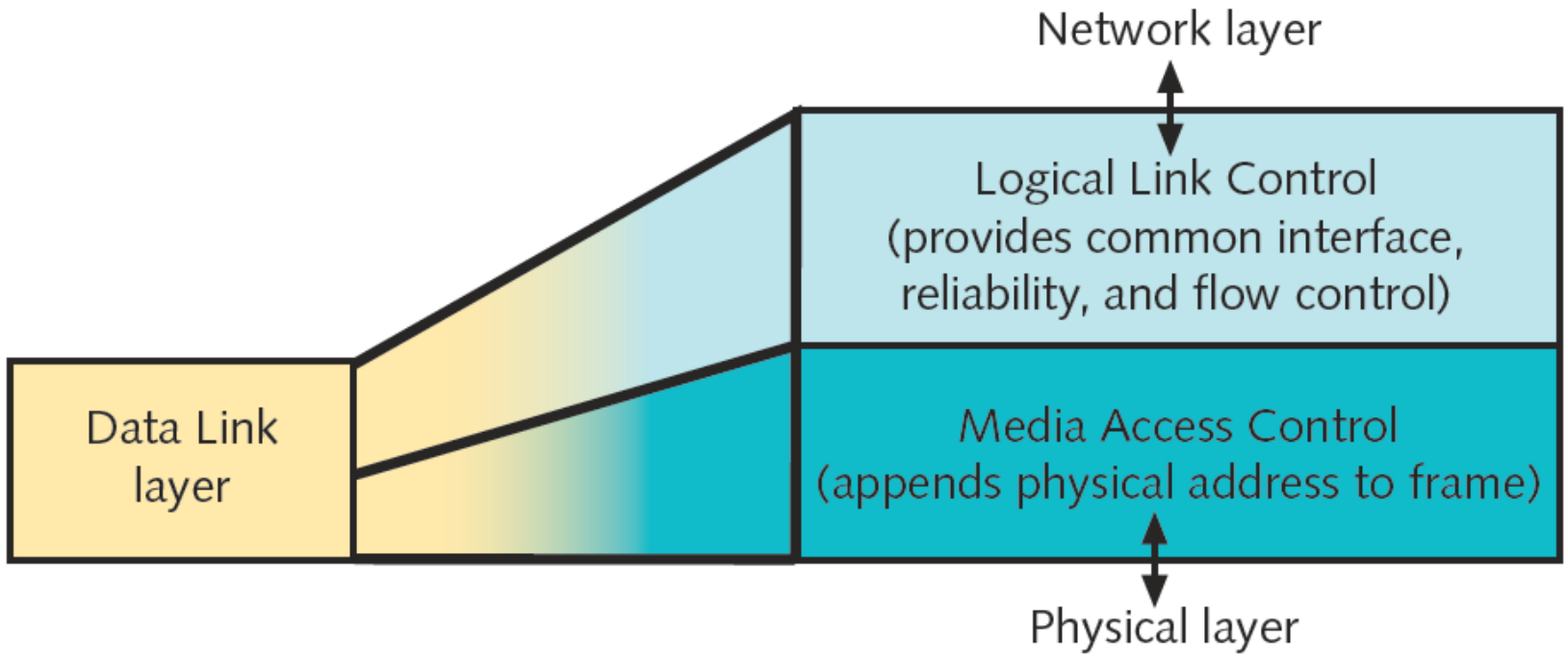
Network Layer

- Routers /Switches
- IP

Data Link Layer

Two Data Link layer sublayers

1. LLC (Logical Link Control) sublayer (Error checking methods: CRC (cyclic redundancy check)
2. MAC (Media Access Control) sublayer : NIC


Network layer
Logical Link Control
(provides common interface,
reliability, and flow control)
Data Link
layer
Media Access Control
(appends physical address to frame)
Physical layer


D-Link
WIRELESS
DWA-525
WIRELESS N 150 DESKTOP PCI ADAPTER
802.11 b/g/n Wireless PCI Adapter
REV-A1
H06881334
B8
P/N: BWA525NA.....A1
H/W Ver.:A1 F/W Ver.: 1.00
S/N: PVF919C000003
Complies With
IDA Standards
DB 100549
MAC ID: 1CAFF700867C
MAC address

Physical Layer

- Copper transmission medium

  Signals issued as voltage

- Fiber-optic cable transmission medium

  Signals issued as light pulses

- Wireless transmission medium

  Signals issued as electromagnetic waves

Functions of the OSI layers

OSI model layer	Function
Application (Layer 7)	Provides interface between software applications and a network for interpreting applications' requests and requirements
Presentation (Layer 6)	Allows hosts and applications to use a common language; performs data formatting, encryption, and compression
Session (Layer 5)	Establishes, maintains, and terminates user connections
Transport (Layer 4)	Ensures accurate delivery of data through flow control, segmentation and reassembly, error correction, and acknowledgment
Network (Layer 3)	Establishes network connections; translates network addresses into their physical counterparts and determines routing
Data Link (Layer 2)	Packages data in frames appropriate to network transmission method
Physical (Layer 1)	Manages signaling to and from physical network connections