Université Constantine 2
جامعة قسنطينة 2

Network Management

– Course 1 –

Chapter 2: TCP/IP addressing and routing (1/2)

Introduction

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Concerned Students :

Faculty/Institute	Department	Level	Speciality
NTIC	TLSI	License 3	G.L.

Objectives

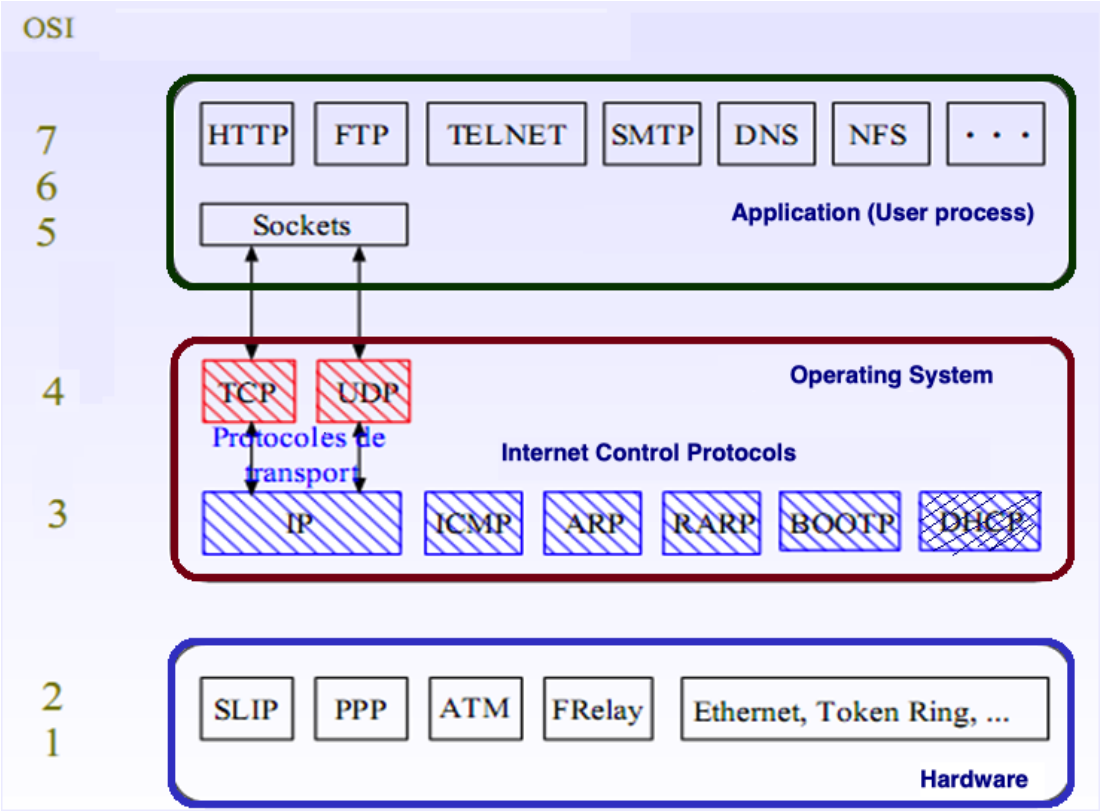
- Presentation of the basic principle of TCP/IP stacking,
- Reminder on IP addressing,
- Reminder of Subneting in IP networks,
- Introduce transport level addressing.

TCP/IP Presentation

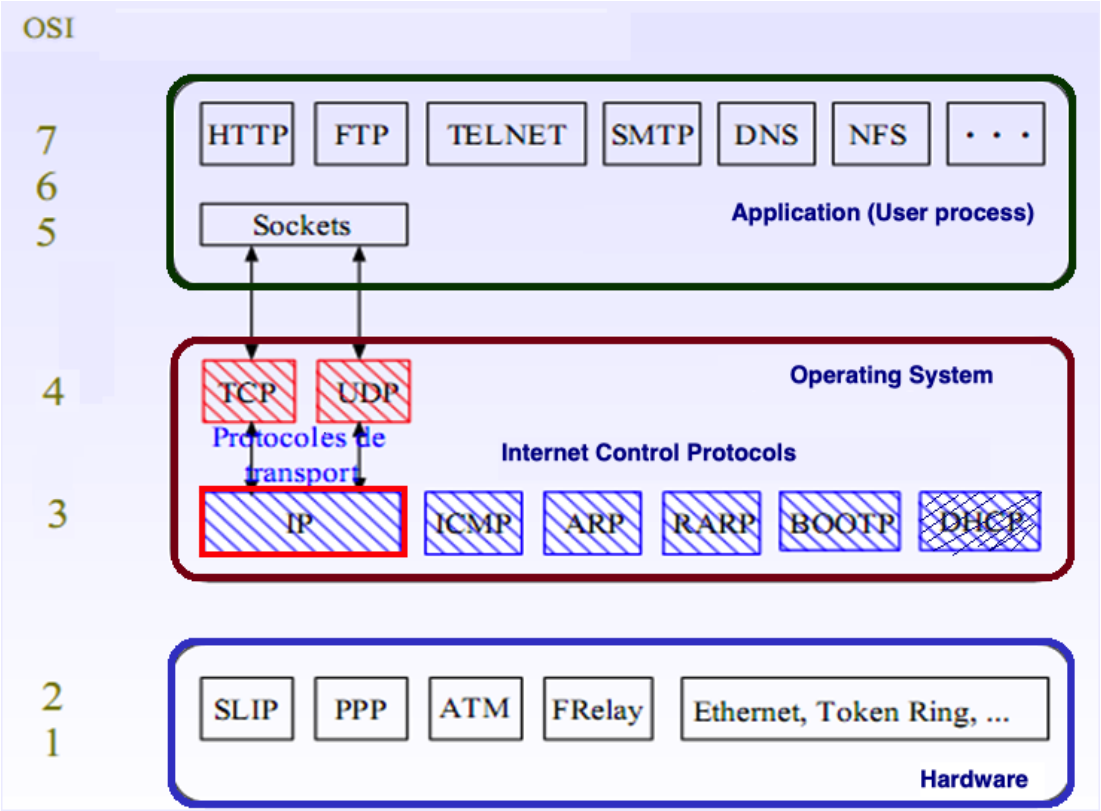
TCP/IP: *Transmission Control Protocol/Internet Protocol*, is:

- Internet protocol.
- Developed in UNIX environment (late 70) by DARPA (Defense Advanced Research Projects Agency).
- A Standard,
- It is the most common on computer systems (Unix/Linux, Windows, Netware...)

TCP/IP Protocol Suite



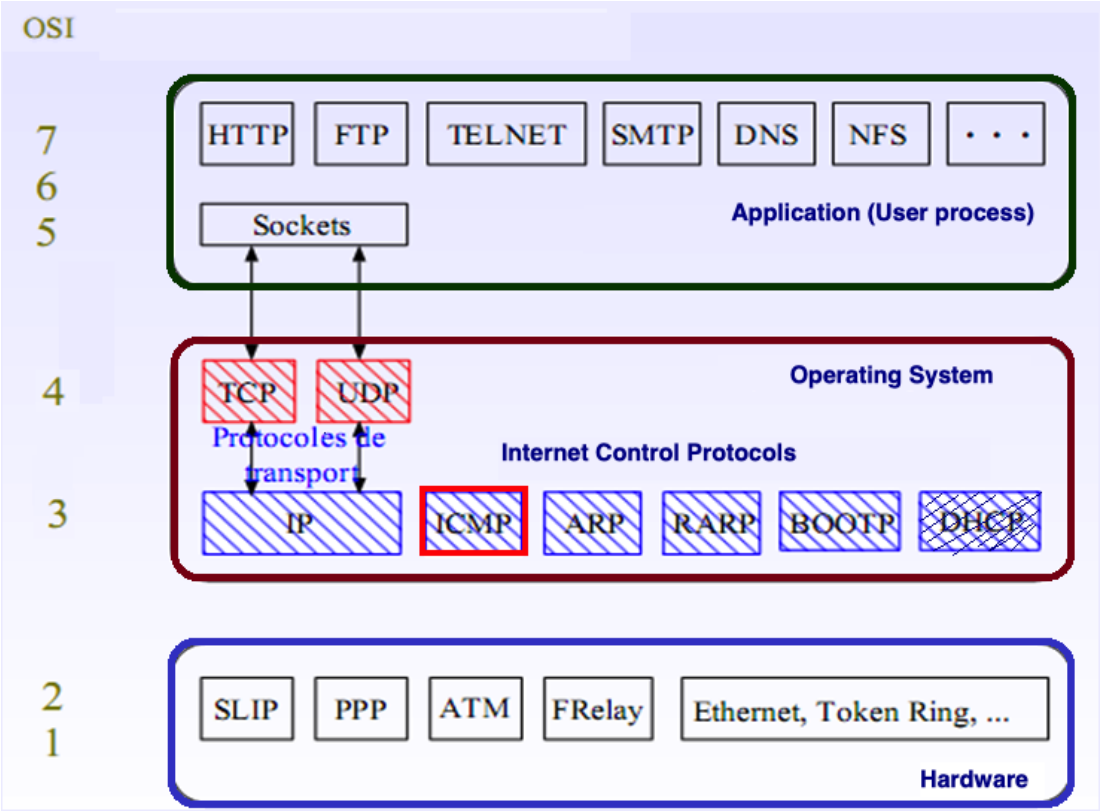
IP (Internet Protocol)



IP (Internet Protocol)

- IP handles packet routing for all other protocols in the TCP/IP family.
- IP works in **connection-less** mode, ie. packets sent by level 3 are routed autonomously, **without** *delivery guarantee* **or** *on the order of arrival.*
- The IP destination address of a packet (32 bits) identifies the *destination* network and the *host* machine connected to this network.

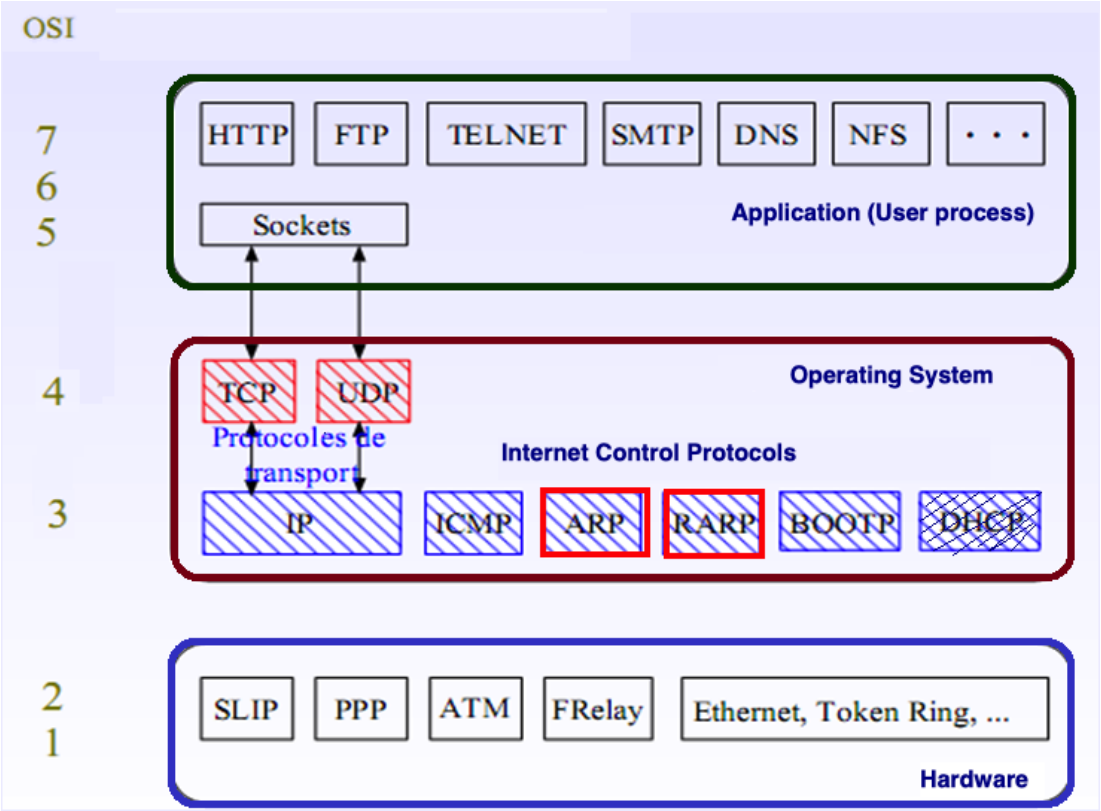
ICMP (Internet Control Message Protocol)



ICMP (Internet Control Message Protocol)

- **ICMP** is a maintenance protocol used for testing and diagnostics.
- It allows two systems on a *IP* network to share **status and error information**.
- **ICMP** returns several messages depending on the type of problem encountered:
  - *Machine unreachable*,
  - *Timeout*,
  - *Wrong header*...
- **ping** uses the *echo request* and *echo reply* ICMP packets to determine if a given IP system on a network is working.

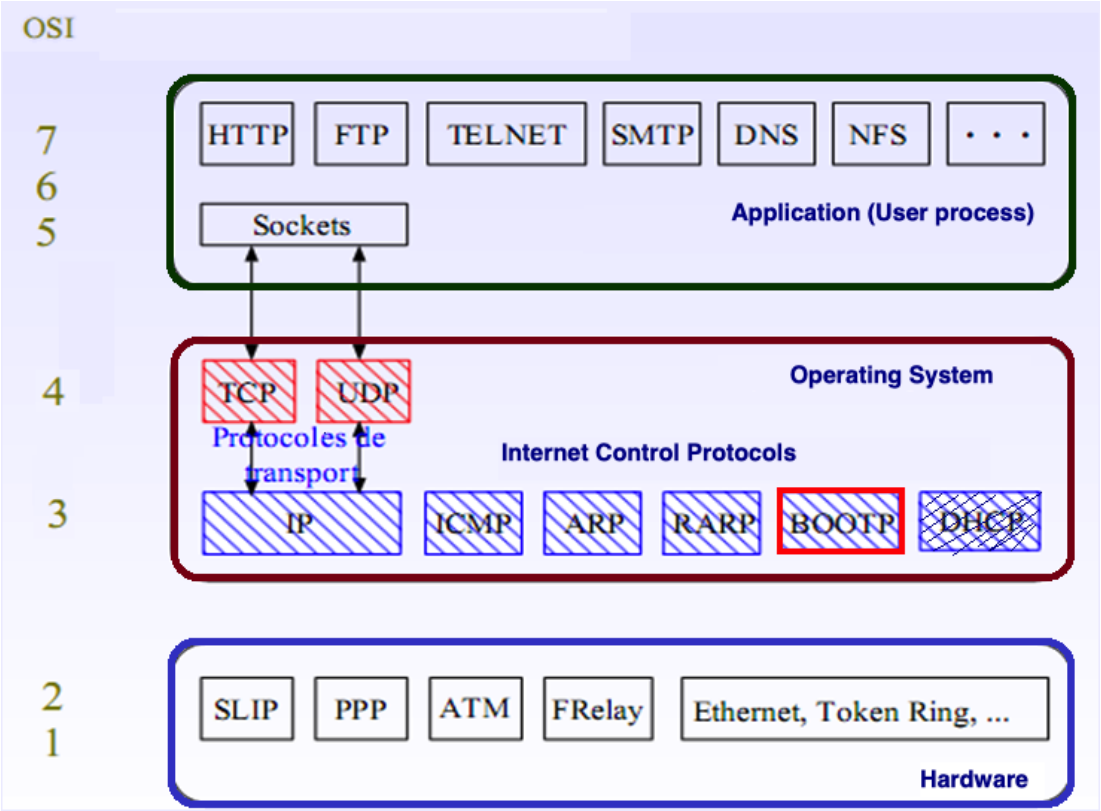
ARP (Address Resolution Protocol)



ARP (Address Resolution Protocol)

- **ARP** is used to determine the physical (or MAC) address of a node from the IP address by performing a broadcast of the type "**who is A.B.C.D?**"
- **ARP** then builds an **addressing table** (ARP Table) in which it stores the collected information.
- Conversely, the **RARP** (*Reverse Address Resolution Protocol)* protocol is responsible for determining the IP address from the physical (or MAC) address.

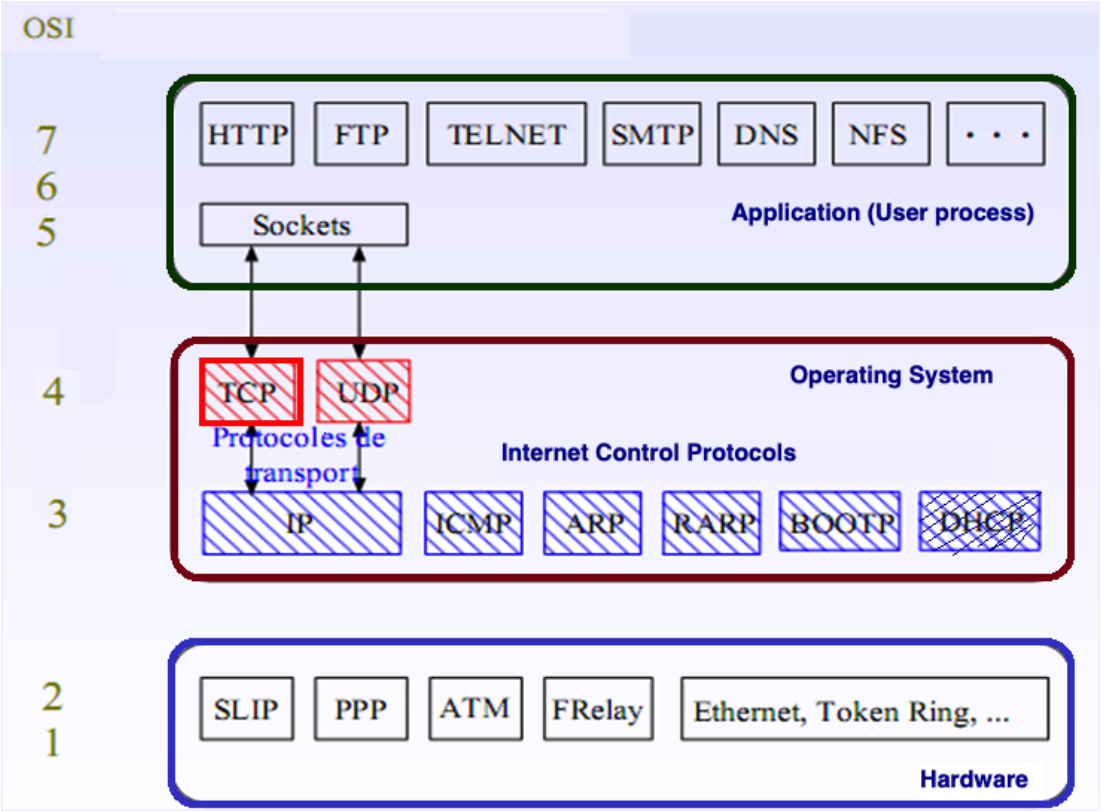
BOOTP: Bootstrap Protocol



BOOTP: Bootstrap Protocol

- **BOOTP** (Bootstrap Protocol) is a bootstrap network protocol,
- Allows a **client machine without hard disk** to discover its own IP address, the configuration server address, and the name of a file to load into memory for execution.
- Booting-up under **BOOTP** is a two-phase operation:
  - Determination of addresses and selection of the boot file (role of BOOTP).
  - Boot file transfer.

TCP (Transmission Control Protocol)



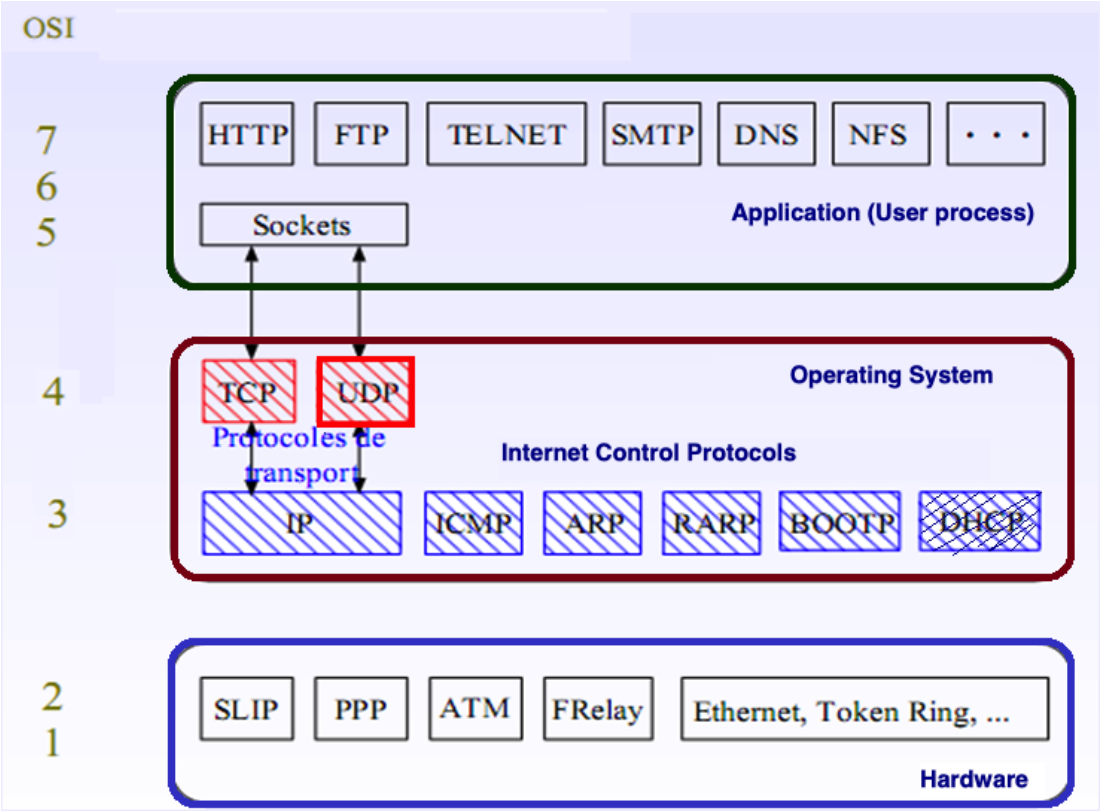
TCP (Transmission Control Protocol)

- **TCP** is responsible for forwarding packets and re-transmitting those corrupted or lost by the network,
- **TCP** works in connection-oriented mode,
- **TCP Header** uses extra bits to perform sequencing of information, for header control and data in the packet.
- On successful delivery, **TCP** requires that the receiver to **acknowledge** receipt of the data (**ACK)**.

++ **TCP** a reliable, session-based protocol for client-server applications and critical services such as email.

— This reliability makes the protocol heavy and slower..

UDP (User Datagram Protocol)



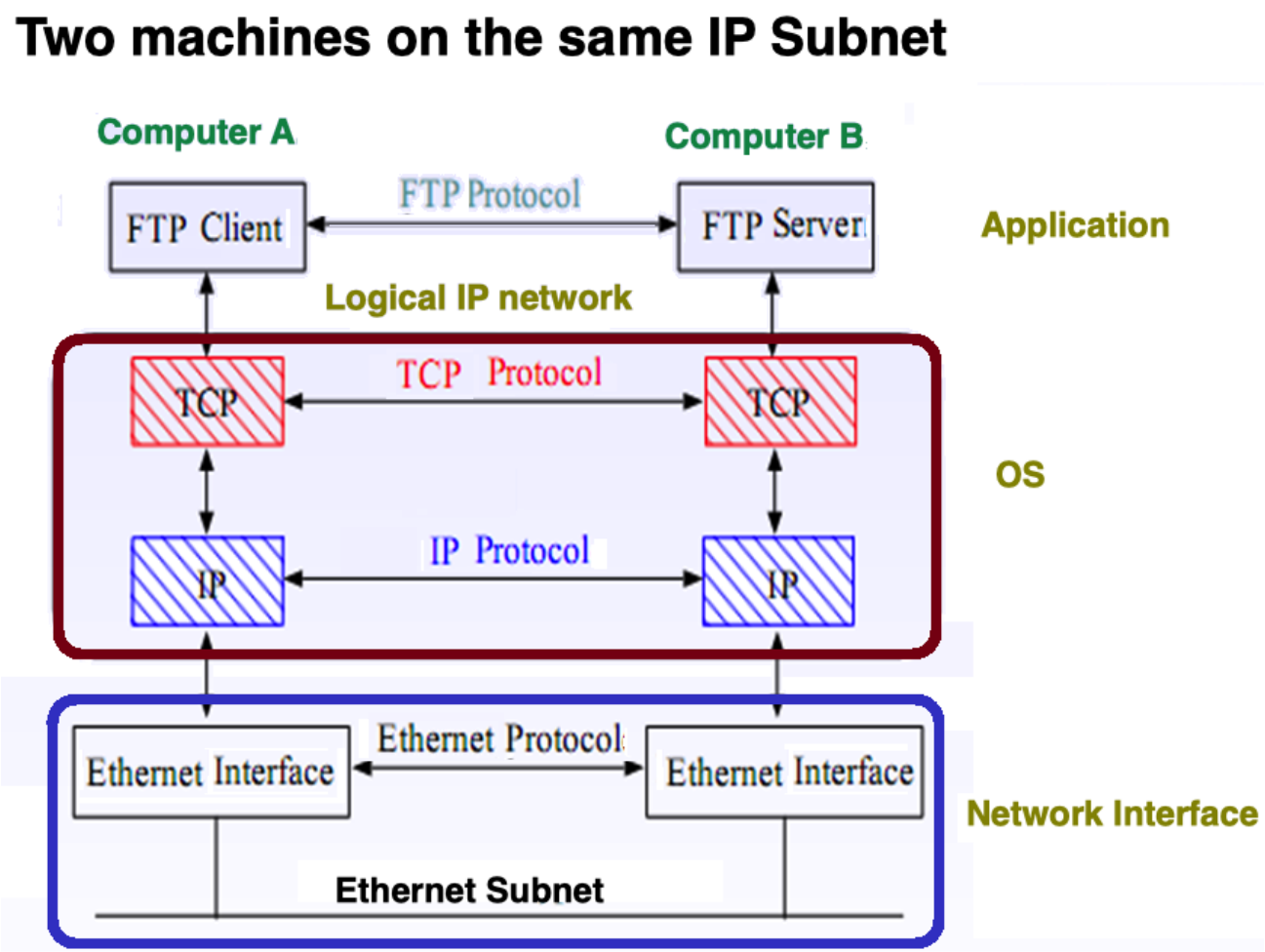
UDP (User Datagram Protocol)

- **UDP** is a TCP add-on that provides a connectionless *datagram* service, it does not guarantee *delivery* or *order* of delivered packets.
- **UDP** allows data to be exchanged over highly reliable networks without using unnecessary network resources or processing time.
- **UDP** also supports sending data in **broadcast mode**.

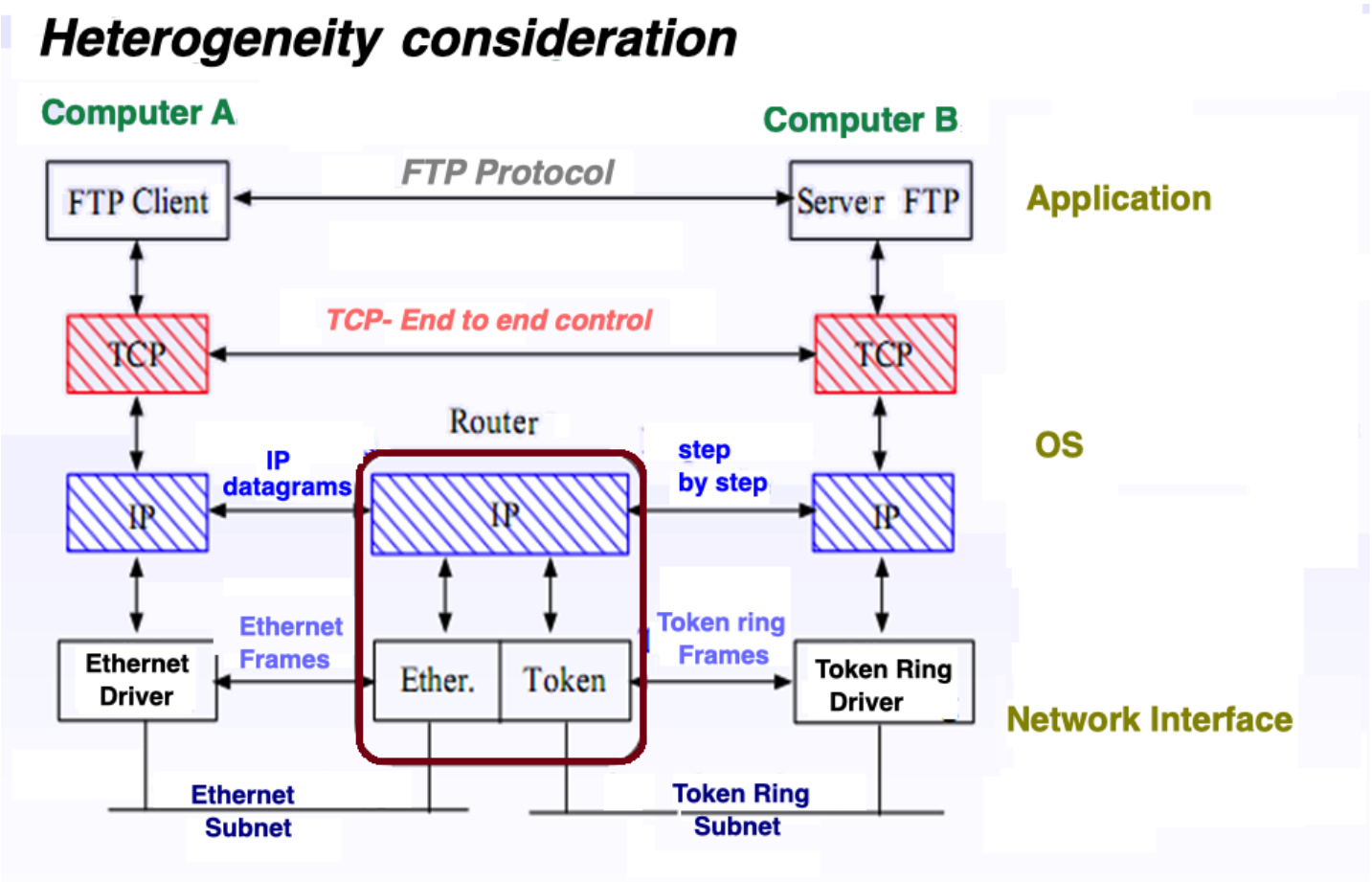
Usage examples:

- File Downloads,
- Video-Conferences.

Homogeneous vs heterogeneous stacking



Homogeneous vs heterogeneous stacking



client/server Model

- **TCP/IP** network applications work according to the **client/server** model.
- On the server machine a server process (**daemon**) handles client requests.
- Client and server communicate by exchanging messages that contain requests and responses.
- *Application Example:*

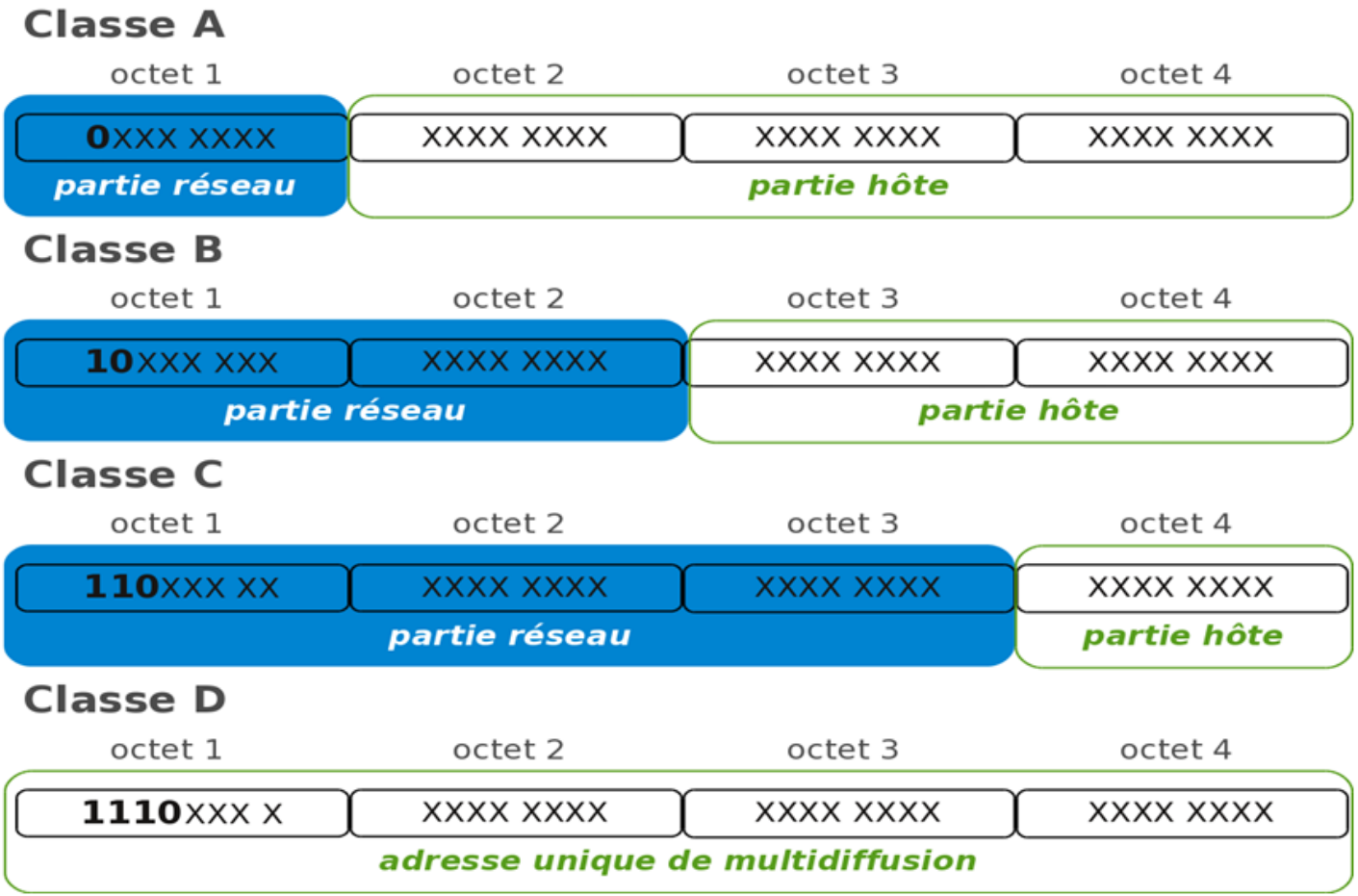
  browser and web server

IP Addressing: Reminder

A **IPv4** address is composed of 4 Bytes.

- **Class A** (16 M hosts):
  X.0.0.0. (from 1.0.0.0 to 126.0.0.0) with a mask of 255.0.0.0.
- **Class B** (64K hosts):
  X.Y.0.0 (from 128.0.0.0 to 191.0.0.0) with a mask of 255.255.0.0.
- **Class C** (254 hosts):
  X.Y.Z.0 (from 192.0.0.0 to 223.0.0.0) with a mask of 255.255.255.0.
- **Class D**:
  X.Y.Z.W (from 224.0.0.0 to 239.0.0.0) with a mask of 255.255.255.255 (Multicast).
- **Class E**:
  X.Y.Z.W (from 240.0.0.0 to 255.0.0.0) not used!!!.....

IP Addressing: Reminder



Private IP addresses

The following addresses can be **freely** used to set up a **private network**, there are:

- Class A: **10.0.0.1** to **10.255.255.254** / 255.0.0.0
- Class B: **172.16.0.1** to **172.31.255.254** / 255.240.0.0
- Class C: **192.168.0.1** to 1**92.168.255.254** / 255.255.0.0

IP Subneting

The advantages of segmenting a network into subnets (**subneting**) are:

- **Reduce clutter** (distributing nodes reduces overall clutter).
- **Compute time savings** (broadcasting).
- **Isolation of a network** (limitation of the impact of failures on a network).
- **Security hardening**.
- **Optimization of the space reserved for an IP address** (especially the case of classes A or B).

Classless Inter-Domain Routing (CIDR)

- **CIDR** developed in 1993,
- Splitting the address space into blocks of variable size (**Variable-Length Subnet Mask, VLSM**),
- More efficient use of address space,

Example 1 (symmetric VLSM case):
Network: *200.100.100.0* with mask: 255.255.255.**224**
from where:

- $224 = \mathbf{111}00000 \Rightarrow$ 3 bits of the 4^{th} byte of the address for the subnet *N*
- 5 bits remaining for host.
- The number of subnets is: $2^3 = 8$.
- In *CIDR* notation, this network is denoted by:

200.100.100.0/27

Making a subnet mask

Example 2:
Having the network *34.0.0.0*, and we want to use the **first two** bits of the **second byte** to designate subnets.

The mask to apply will then be:

11111111.11000000.00000000.00000000

i.e. **255.192.0.0**

Making a subnet mask

4 cases of figures are possible for the result of the subneting of an *IP* address of the **34.0.0.0** network. If the first **2** bits of the 2^{th} byte are:

- **00**, result is **34.0.0.0**
- **01**, result is **34.64.0.0**
- **10**, result is **34.128.0.0**
- **11**, the result is **34.192.0.0**

Example: Applying the mask 255.192.0.0 to the address **34.108.123.12**

gives the Network address:

34.64.0.0/10

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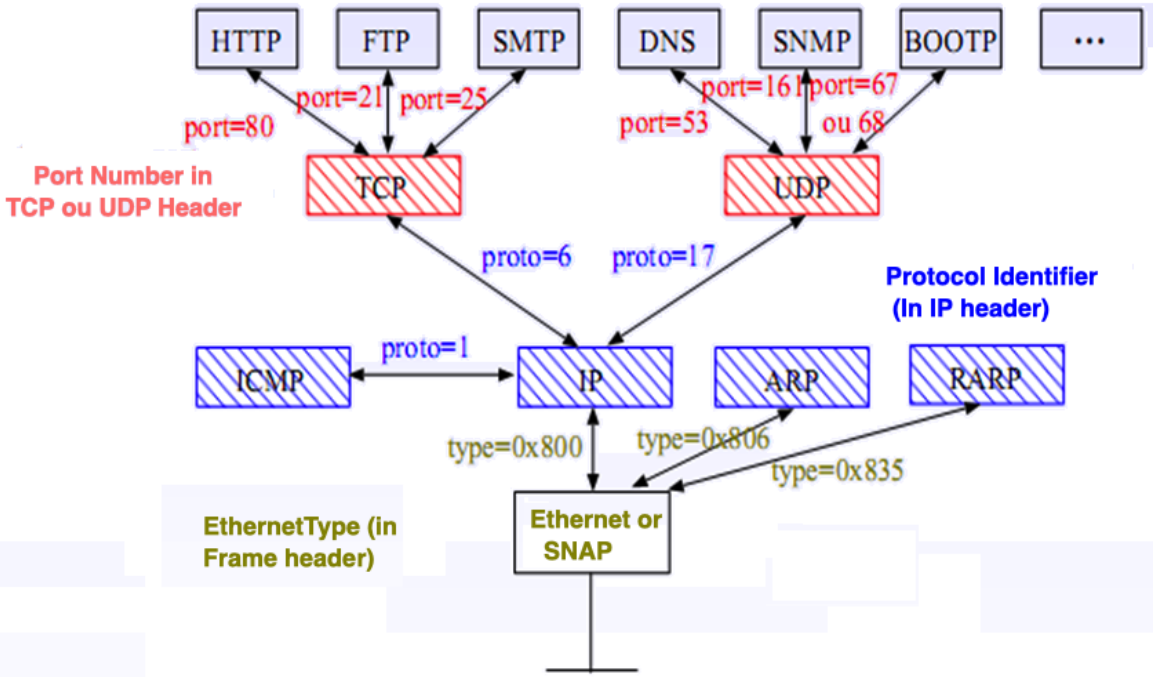
Addressing applications: ports

- A **transport address** is used to identify the remote reciever (**remote application**) by reserving an output **port** number **TCP** or **UDP** and sending an IP packet to the server machine.
- Address is a quintuple:

  (proto, src, src-port , dest, dest-port).
- The corresponding **server** application listens to calls on this port (e.g the httpd daemon processes http requests).
- The request is received by the IP driver, routed to TCP or UDP then to the requested port.

Switching a message

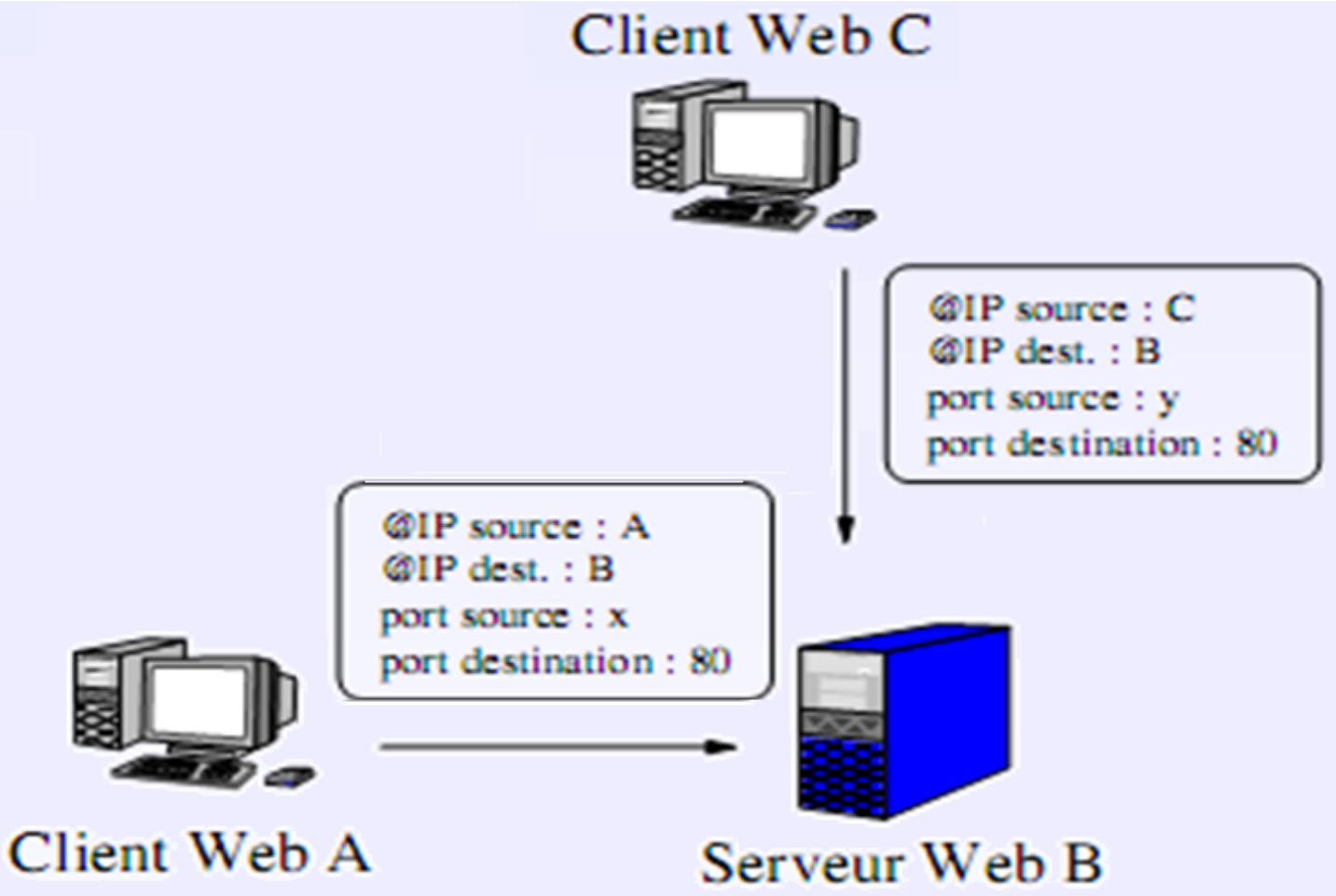


Port examples

Service Port Number:

- 21 : FTP
- 23 : Telnet
- 25 : SMTP
- 53 : DNS
- 80 : HTTP
- 110 : POP3
- 119 : NNTP

Example:


Client Web C
@IP source : C
@IP dest. : B
port source : y
port destination : 80
@IP source : A
@IP dest. : B
port source : x
port destination : 80
Client Web A
Serveur Web B

Conclusion

- The mission of this course was to recall the basic notions of the protocols participating in the TCP/IP stack and the role of each of them in a network communication.
- A callback is dedicated to IP addressing and splitting a network IP address into multiple subnets.

References

- CCNA Exploration 4.0 /**Routing Protocols and Concepts**/Instructor Handbook,
- Configuration, implementation and administration of Internet and Intranet servers under Linux.
- **Basics of Linux system administration**. Sébastien Namèche (sebastiennameche.fr)
- **Linux network administration**. Source: http://en.wikibooks.org/w/index.php?oldid=171613 Contributors: Michael Witrant, Tavernier.

Some useful links

Link 1 :

- https://dept-info.labri.fr/ guermouc/AR/cours/cours1.pdf

Link 2 :

- http://technet.microsoft.com/fr-fr/library

Link 3 :

- http://www.linux-france.org/prj/edu/archinet/systeme