Network Architecture and Security

ECAM STRASBOURG-EUROPE 2018-2019

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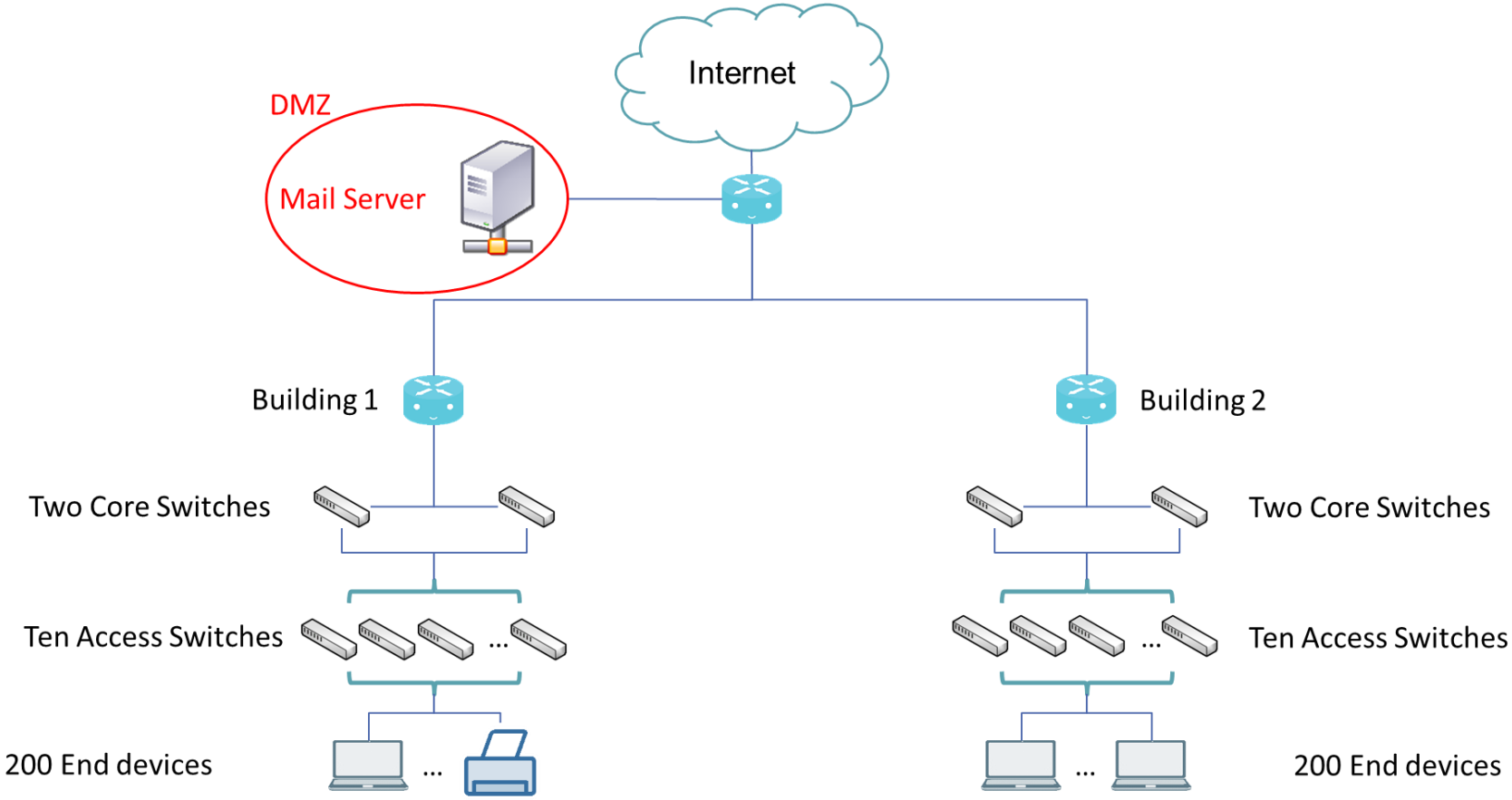
Do you remember ?



IP Addresses and IP Addressing

IPv4 addresses

Numerical label assigned to each device (e.g., computer, printer) participating in a computer network that uses the **Internet Protocol** for communication.

Format : U.V.Z.T where U, V, Z and T are between 0 and 255.

IPv4 addresses

Examples :

- 127.0.0.1
- 192.168.1.1

But how can I identify the network and the machine ?

Network Mask

A **network mask** is a mask that allows us to **identify the network and the host**.

Example : 192.168.1.1 with the mask 255.255.255.0

So the network part is 192.168.1.0 and the host is 0.0.0.1

A tiny exercice

a) Give the binary value for address mask : 255.255.0.0

b) Give the binary value for IP address : 192.168.128.4

A tiny exercice

a) Give the binary value for address mask : 255.255.0.0

11111111.11111111.00000000.00000000

b) Give the binary value for IP address : 192.168.128.4

11000000.10101000.10000000.00000100

IPv4 Classful Addressing

Class	Leading bits in address (binary)	Range of first byte (decimal)	Network ID format	Host ID format	Number of networks	Number of addresses per network
A	0	0–127	a	b.c.d	$2^7 = 128$	$2^{24} = 16777216$
B	10	128–191	a.b	c.d	$2^{14} = 16384$	$2^{16} = 65536$
C	110	192–223	a.b.c	d	$2^{21} = 2097152$	$2^8 = 256$

Another tiny exercice

a) Give the IPv4 address class of
   1. 206.104.103.2
   2. 102.253.2.4
   3. 145.45.129.169

b) How many addresses do the networks containing these IP address have ?
   1. 192.168.128.4
   2. 10.152.30.6
   3. 172.4.2.9

IPv4 addresses used in Private Networks

IP address range	number of addresses	classful description	Subnet mask	host id size	mask bits
10.0.0.0 - 10.255.255.255	16,777,216	single class A network	10.0.0.0/255.0.0.0	24 bits	8 bits
172.16.0.0 - 172.31.255.255	1,048,576	16 contiguous class B network	172.16.0.0/255.240.0.0	20 bits	12 bits
192.168.0.0 - 192.168.255.255	65,536	256 contiguous class C network	192.168.0.0/255.255.0.0	16 bits	16 bits

Another tiny exercice again

You have to size the network for ECAM Strasbourg-Europe:

a) Will you use a public or private network? Why?

b) Which network class will you choose?

c) Give a possible network address, together with the network mask.

Limits of Classful Routing

Address loss:

- A B-Class network is required, having 65535 possible hosts… for only about 540 hosts!

The rapid growth of internet leads to exhaustion…

- Very often, a C-Class was not sufficient and there were only 2^{16} (= 65536) B-Class addresses…

Classless Inter Domain Routing

Classless Inter-Domain Routing (CIDR ˈsaɪdər,) is a method for **allocating IP addresses and IP routing**.

CIDR was introduced in 1993 **to replace the previous addressing architecture** of classful network design in the Internet.

Its aims were **to save IP addresses** and **to facilitate routing**.

CIDR notation *: IP Adress '/' decimal number*

Example : 192.168.1.1 with the mask 255.255.255.0 becomes 192.168.1.1 / 24

A tiny exercice… what else ?

For the following address 91.198.174.2/19:

a) Give the binary value and the decimal value of the address mask

b) Give the network address in binary and decimal

c) Give the host address in binary and decimal

A tiny exercice… what else ?

For the following address 91.198.174.2/19 (01011011.11000110.10101110.00000010):

a) Give the binary value and the decimal value of the address mask

11111111.11111111.11100000.00000000 for 255.255.224.0

b) Give the network address in binary and decimal

01011011.11000110.10100000.000000000 for 91.198.160.0

c) Give the host address in binary and decimal

00000000.00000000.00001110.00000010 for 0.0.14.2

IPv6 addresses

Resolve the IPv4 exhaustion issue and can **support myriads of devices of the Internet of Things**.

They have **128 bits** which are represented in 8 groups of 16 bits each separated by colons and written with four hexadecimal digits.

Example : 2001:0db8:0000:85a3:0000:0000:ac1f:8001

which could also be written 2001:0db8:0000:85a3::ac1f:8001

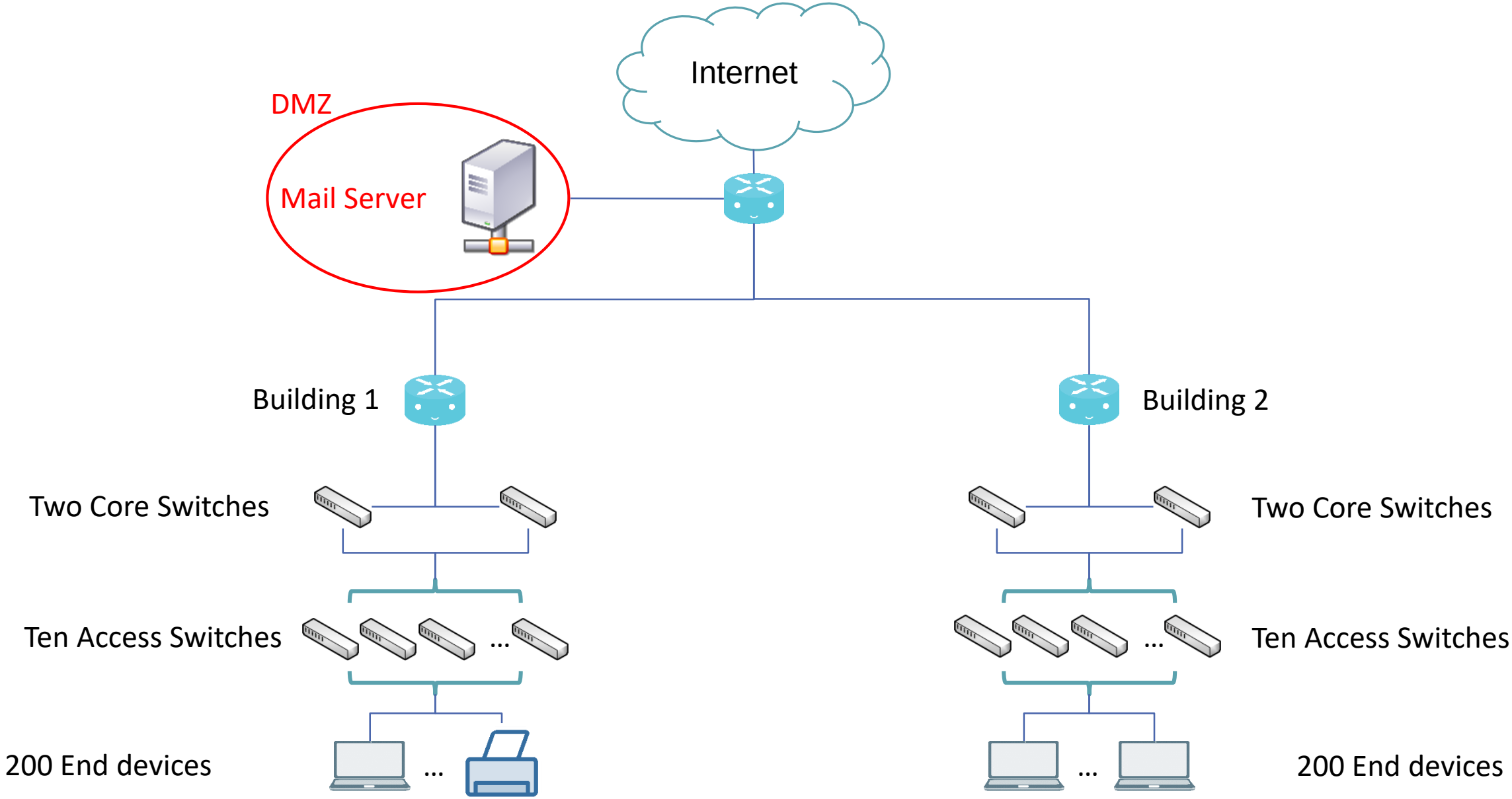
Any questions ?

Exercice

Design a local network with a mail server and two buildings having 200 end devices (PCs, printers, etc.) each.

Constraints are:

- The mail server is set in a DMZ (demilitarized zone)
- Three routers having each 4 ports are used: 1 between the enterprise network and the Internet, and one at each building.
- Each building is equipped with two core switches for redundancy and 10 access switches
- Switches all have 24 ports.


Internet
DMZ
Mail Server
Building 1
Building 2
Two Core Switches
Two Core Switches
Ten Access Switches
Ten Access Switches
200 End devices
200 End devices

Exercice

1) How many devices do you need to serve?

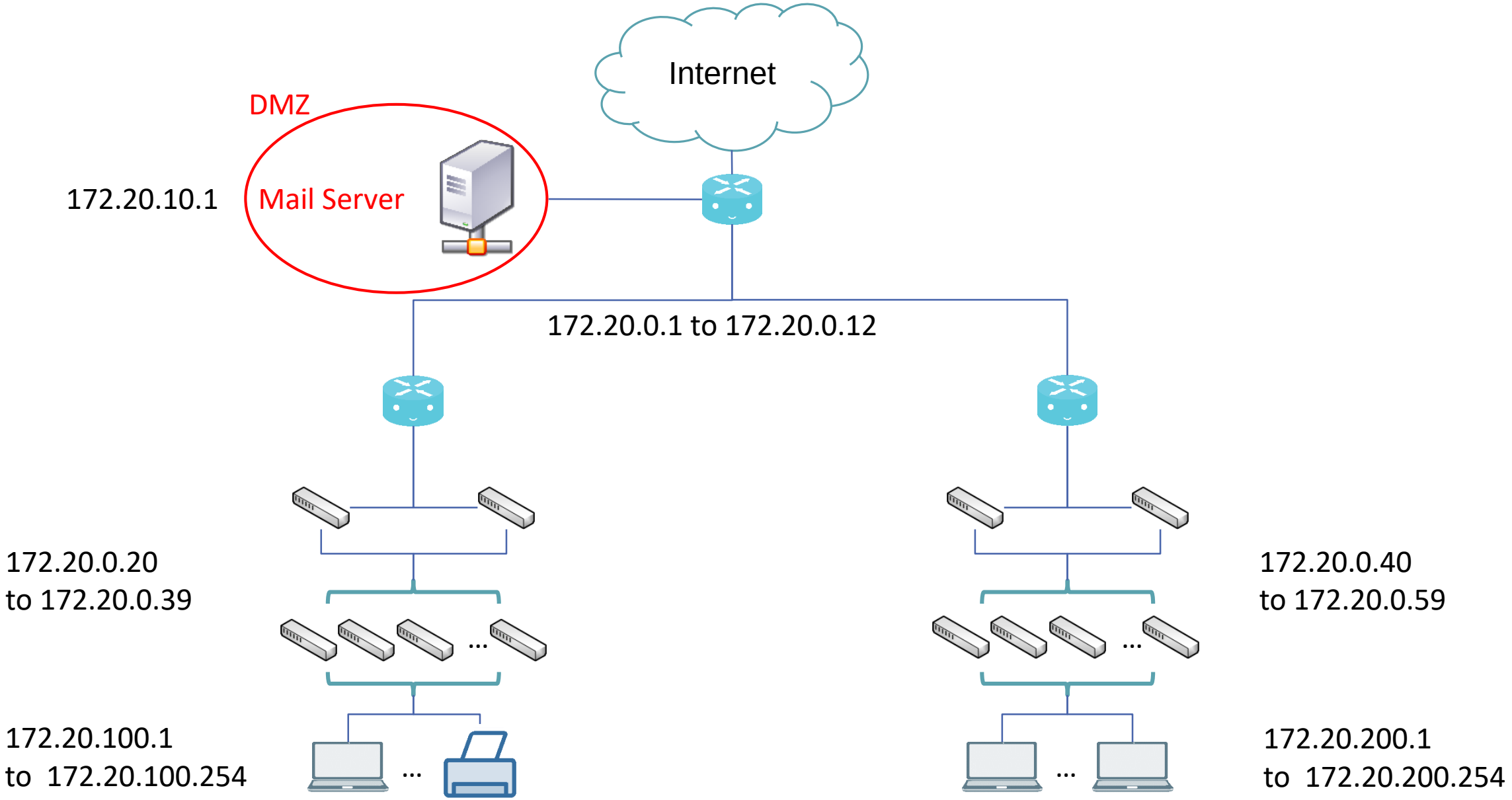
2) Which address class should be used for this network?

3) Select a matching private address range for network internal addressing.

Exercice

4) Allocate addresses for the devices: internal router ports, servers, manageable switches, PCs.

5) Draw resulting network.


Internet
DMZ
172.20.10.1
Mail Server
172.20.0.1 to 172.20.0.12
172.20.0.20
to 172.20.0.39
172.20.0.40
to 172.20.0.59
172.20.100.1
to 172.20.100.254
172.20.200.1
to 172.20.200.254