

# École Pour l'Informatique et les Techniques Avancées – EPITA

BSc L1 – 18 May 2024

Course: Introduction to Computer Networks

# Introduction to Computer Networks

Date & Time	No.	Topics	Duration (hours)
Fri 19/04/24 – 10:00–13:00	1	Primer, Network protocols, types, topology, architecture	3
Fri 26/04/24 – 10:00–13:00	2	Network models, TCP/IP model, Packet switching	3
Sat 27/04/24 – 10:00–13:00	3	Physical Layer (Function, Signals, Modulation, Multiplexing, Transmission media & Hardware, Optical networks)	3
Sat 27/04/24 – 14:00–17:00	4	Data Link Layer (Function, Framing, Protocols, Flow control, Access control, Error correction, Hardware)	3
Fri 03/05/24 – 14:30–17:30	5	Network Layer (Function, IP addressing and subnets)	3
Sat 04/05/24 – 10:00–13:00	6	Network Layer (Routing algorithms and protocols), Internet Control Message Protocol	3
Tue 14/05/24 – 16:30–19:30	7	Network Layer (IGP & EGP), Autonomous System, Border Gateway Protocol	3
Wed 15/05/24 – 14:30–17:30	8	Transport Layer (Function, Flow and congestion controls, Protocols)	3
Thu 16/05/24 – 11:15–13:15	9	Cross-layer process: Access Control Lists	2

# Introduction to Computer Networks

Date & Time	No.	Topics	Duration (hours)
Fri 17/05/24 – 14:00–17:00	10	Application Layer (DNS, SMTP)	3
Sat 18/05/24 – 14:00–17:00	11	Cross-layer process: Network Address Translation	3
Fri 24/05/24 – 10:00–13:00	12	Review / Open-session	3
<i>Total</i>			<i>35</i>
Fri 31/05/24 – 14:30–15:30		EXAM	1

## GRADING criteria :

- Class participation comprising **attendance & reactivity**): 10%
- **Exercises** (practical work): 40%
- Final evaluation (**Quiz & Exercises**): 50%

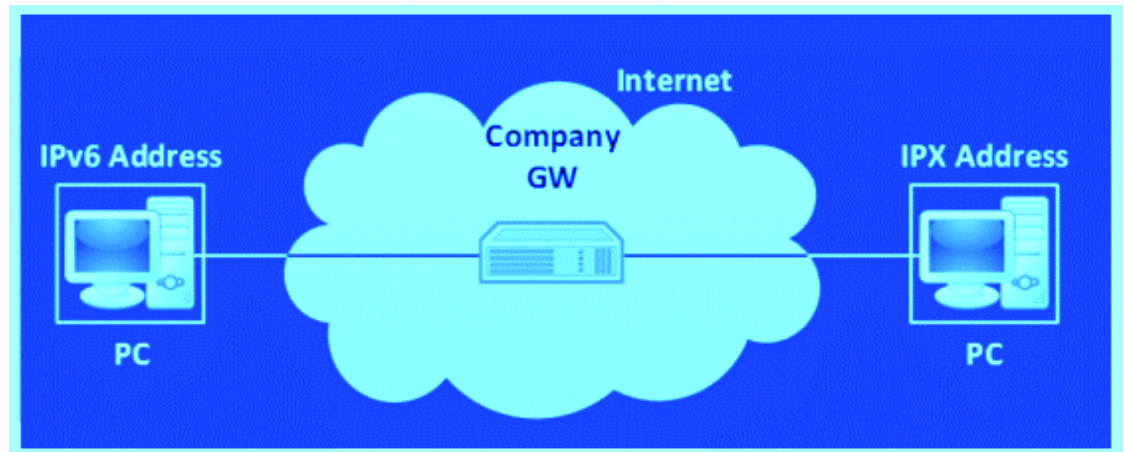
**i** Check policies in the course outline

# Lecture 1 1 Outline

- ▶ **Network Address Translation (NAT)**
  - Types
  - One-to-Many NAT
  - **Class exercise 17**
- ▶ Run-down
  - Open session

# NAT (Network Address Translation)

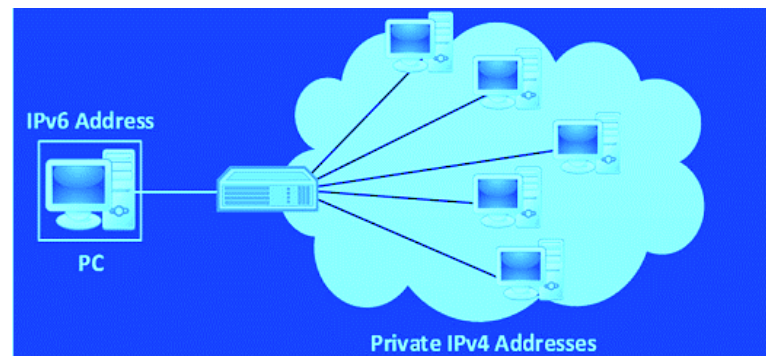
- ▶ A built-in component of most Routers
- ▶ NAT main Types:
  - **One-to-One NAT (a.k.a Basic or Static NAT):**
    - Enables interconnection of two incompatibly addressed (e.g., IPv4 to IPv6 & vice versa) or different assigned IP networks
    - Follows RFC 2663



# NAT (cont.)

## ▶ NAT main Types:

- **One-to-Many NAT (A.k.a. IP Masquerading / Overload):**
  - IP address space (with many private IP addresses) hidden behind a single public IP address
  - Uses Port Address Translation (PAT): Inside Local and Inside Global PAT table (each local device is mapped with the public IP address using a unique port number)



# One-to-Many NAT

## ▶ Pro's:

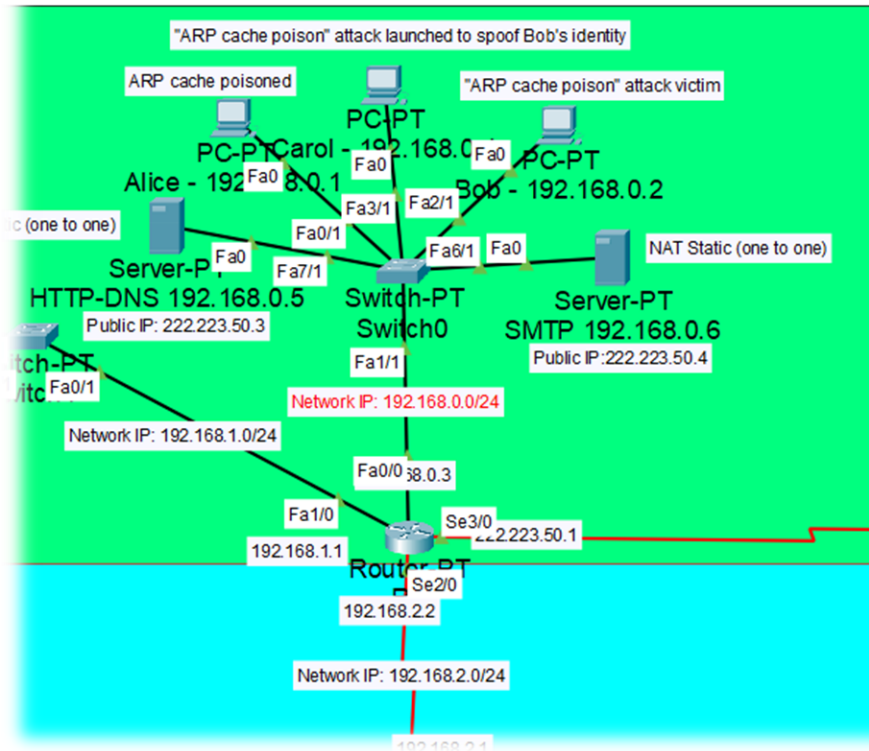
- Provides enhanced security
- Facilitate the process of saving public IPv4 addresses
  - Partial solution for the IPv4 address space exhaustion problem
  - ...

## ▶ Con's

- Creates overhead/latency
- Difficult to manage with protocols that detect changes in headers (e.g., IPSec, ...)
- ...

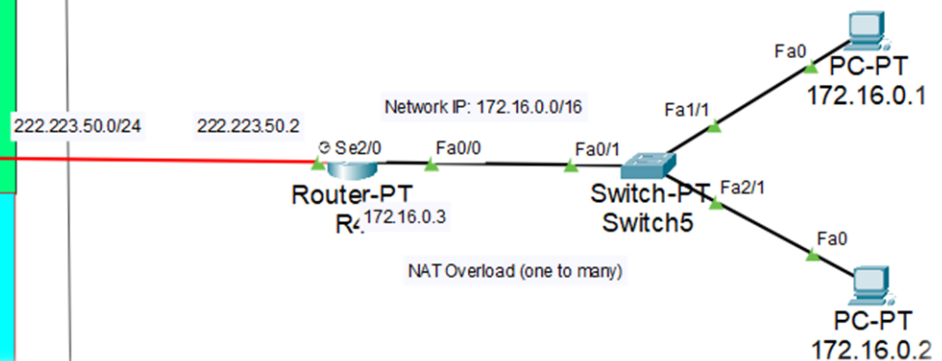
# Exercise 17: Practical work (1 / 2)

AS100



Inside Local: Fa0/0  
 Inside Global: Se3/2  
 Outside Local: Fa0/0  
 Outside Global: Se2/0

AS200



Inside Local: Fa0/0  
 Inside Global: Se2/2  
 Outside Local: Fa0/0  
 Outside Global: Se3/0



# Exercise 17: Practical work (2/2)

## ► Using your last cisco packet tracer file:

### 1. Apply NAT overload in AS200 for NID: 172.16.0.0

```
R# (config-if)#ip nat inside //interface: inside local e.g., Fa0/0
```

```
R# (config-if)#ip nat outside //interface: inside global e.g., Se6/0
```

```
R# (config)# access-list NUM permit IP_OR_Net-ID Wild_Card
```

//Using access list to designate inside local IP address (or 'Interesting traffic ') to be used for dynamic translation for NAT

```
R# (config)# ip NAT inside source list NUM interface INT_Num overload
```

//NATing using the access list for 'local inside' devices with the IP address of 'outside local' interface IP

### 2. Apply NAT Static on HTTP and Mail server on AS100, and restrict these services for AS 200 only

```
R# (config-if)#ip nat inside //interface: inside local e.g., Fa0/0
```

```
R# (config-if)#ip nat outside //interface: inside global e.g., Se6/0
```

```
R# (config)# ip NAT inside source static Private_IP_Address Public_IP_Address
```

```
R# Show ip nat translations
```



**Static NAT:** We can initiate translation from both inside to outside and vice versa. That is not desired in Dynamic NAT and Overload (PAT)

*Verify from outside networks using PING or TRACERT/TRACEROUTE.*

*Save cisco packet tracer file with your 'First\_Last-name\_Ex-6-17'*

**Deadline: See 'Teams' Assignment section**

# Lecture 1 1 Outline

- ▶ Network Address Translation (NAT)
  - Types
  - One-to-Many NAT
  - Class exercise 17
- ▶ **Run-down**
  - **Open session**

# Open session

- ▶ Practice discussed topics on Network Simulation Program
- ▶ Questions?

# Lecture 11 ends here

- ▶ Course Slides: Go to MS Teams:  
'Introduction to Computer Networks – Spring 2024 | BSc'  
-> Files section
- ▶ Send your questions by email:  
mohammad-salman.nadeem@epita.fr  
OR via direct message using MS Teams
- ▶ Thank You!

# Course references

- ▶ Internet Engineering Task Force, [www.ietf.org](http://www.ietf.org)
- ▶ Wikipedia, [www.wikipedia.org](http://www.wikipedia.org)
- ▶ IPv6.com, <http://ipv6.com>
- ▶ Cisco, Resolve IP Fragmentation, MTU, MSS, and PMTUD Issues with GRE and IPSEC, <http://www.cisco.com/c/en/us/support/docs/ip/generic-routing-encapsulationgre/25885-pmtud-ipfrag.html> [Accessed June 1, 2015]
- ▶ Microsoft technet, IPv6, IPv6 Technical Reference [https://technet.microsoft.com/enus/library/cc738109\(v=ws.10\).aspx](https://technet.microsoft.com/enus/library/cc738109(v=ws.10).aspx) [Accessed June 1, 2015]
- ▶ Networking For Dummies, John Wiley & Sons, 8<sup>th</sup> Ed.
- ▶ William Stallings, Data and Computer Communications, 10<sup>th</sup> Ed.
- ▶ W. Stallings, Data and Computer Communications, 10th Ed.
- ▶ L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 5th Ed., Morgan Kaufmann
- ▶ J. Postel, "Internet Protocol DARPA Internet Program Protocol Specification," IETF RFC 791, Sep. 1981