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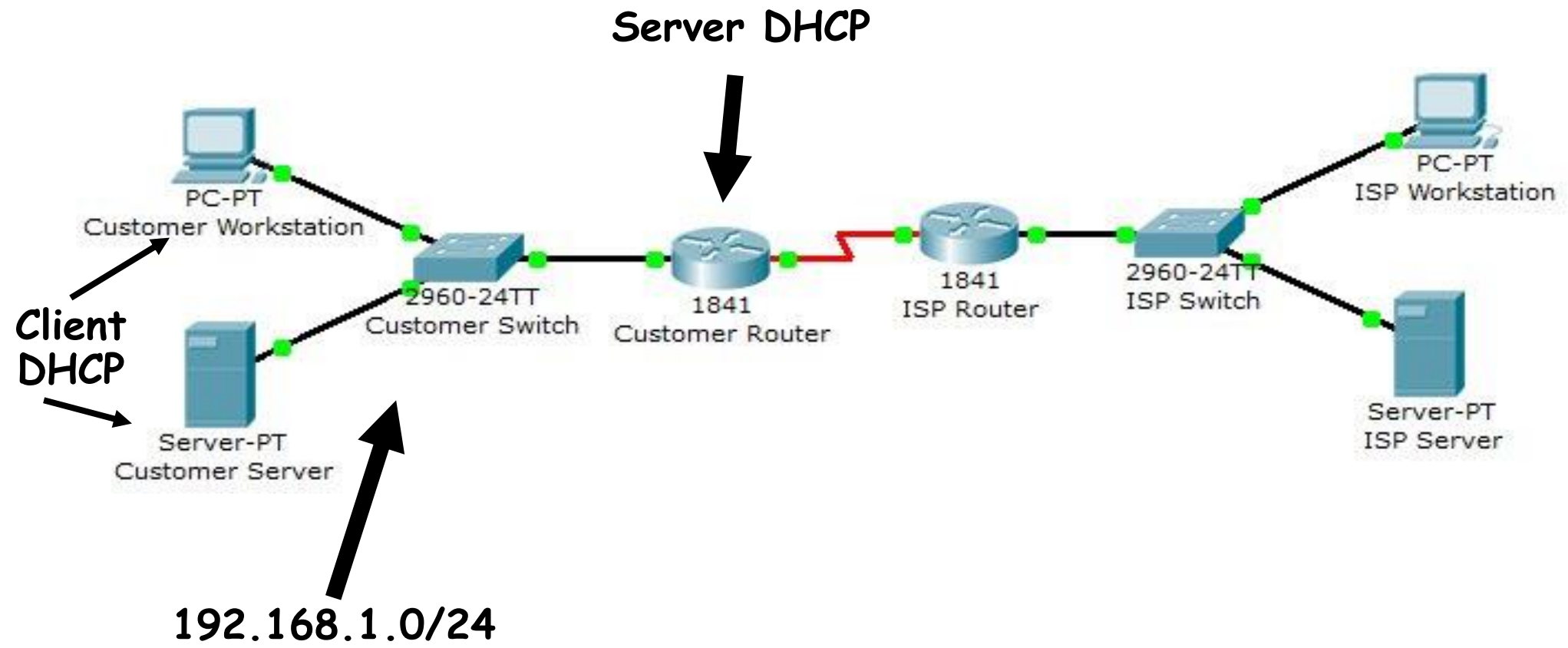
Dynamic Host Configuration Protocol (DHCP)

DHCP protocol

- The DHCP protocol allows to dynamically configure hosts in a LAN.
- Configuration parameters:
  - ✓ IP address and subnet mask
  - ✓ Default gateway
  - ✓ DNS Server

Example


Server DHCP
PC-PT
Customer Workstation
Client
DHCP
Server-PT
Customer Server
2960-24TT
Customer Switch
1841
Customer Router
1841
ISP Router
2960-24TT
ISP Switch
PC-PT
ISP Workstation
Server-PT
ISP Server
192.168.1.0/24

Server DHCP configuration (1/3)

- The command to start DHCP configuration is

```
Router(config)#ip dhcp pool NAME_POOL
```

- NAME_POOL is the name used to identify the DHCP configuration on the router
- The next step is the definition of the address pool to be assigned dynamically:

```
Router(config-dhcp)# network NET_ADDRESS NETMASK
```

- In the case of 10.0.0.0/8 block:

```
Router(config-dhcp)# network 10.0.0.0 255.0.0.0
```

Server DHCP configuration (2/3)

- It could happen that the set of available IP addresses to be assigned dynamically is not exactly the pool
- Motivation: a host (usually a server) requires a static (fixed) IP address
- It is possible to exclude IP address from the pool

```
Router(config)#ip dhcp excluded-address IPADDRESS(ES)
```

- If the initial 49 addresses should be excluded:

```
Router(config)#ip dhcp excluded-address 192.168.1.1
                                        192.168.1.49
```

Server DHCP configuration (3/3)

- To provide the Internet access, default router (192.168.1.1) and DNS server (192.168.1.10) must be configured

```
Router(config-dhcp)# default-router 192.168.1.1
```

```
Router(config-dhcp)# dns-server 192.168.1.10
```

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Network Address Translation

(NAT)

Public and private IP addresses

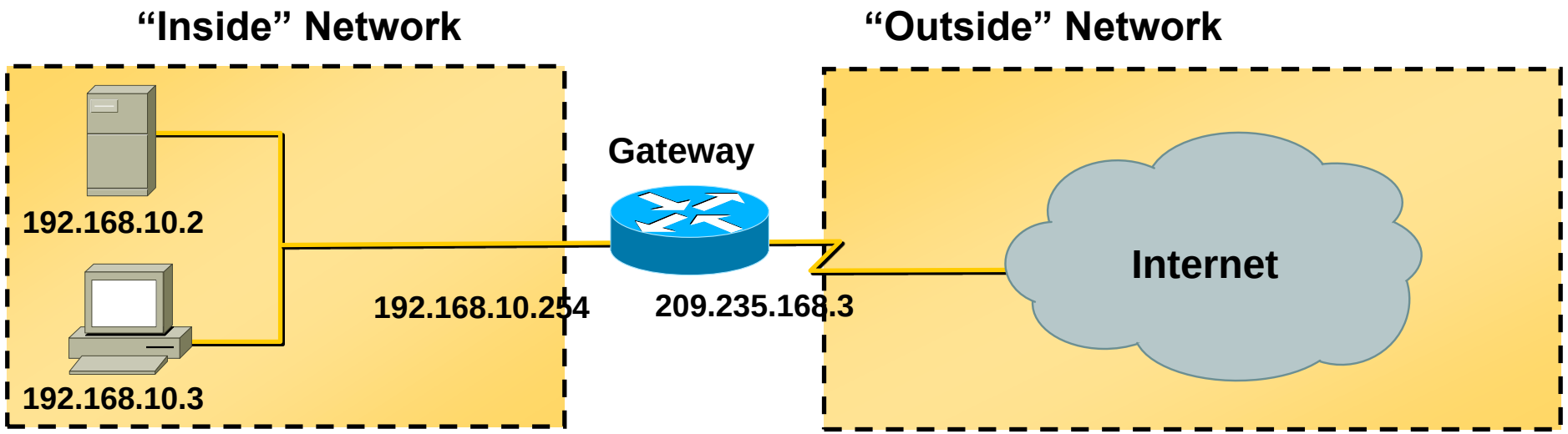
- Problem: IP addresses are not enough to assign a unique IP address to each network host/device

Address Class	Number of Network Numbers Reserved	Network Addresses
A	1	10.0.0.0
B	16	172.16.0.0 - 172.31.0.0
C	256	192.168.0.0 - 192.168.255.0

NAT (1/4)

- **Advantages**
  - No need to request public IP addresses for all the devices
  - Reduction of public IP addresses
  - Security improvement: real devices IP addresses hidden
- **Drawbacks:**
  - Extra-load for access routers
  - Breaking of the layers separation rule

NAT (2/4)


“Inside” Network
“Outside” Network
Gateway
192.168.10.2
192.168.10.3
192.168.10.254
209.235.168.3
Internet

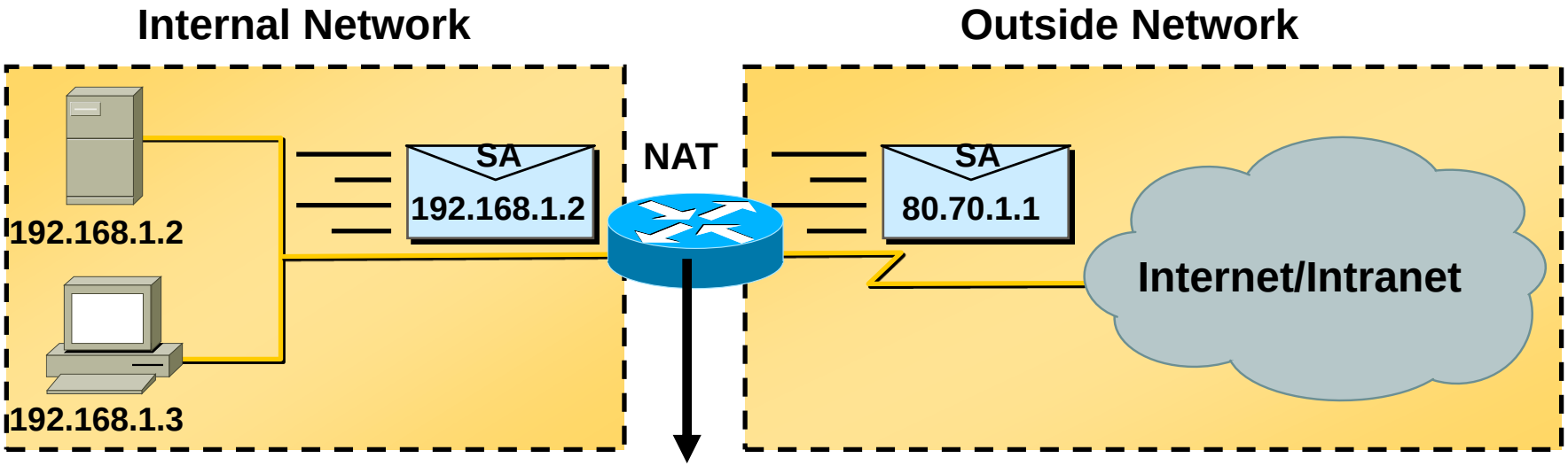
NAT (3/4)

- The IP addresses of the local network (192.168.10.X) are not "visible" from outside.
- The router (Gateway) has two network interfaces, one on the local (inside) network and one on the public (outside) network.
- The router is connected to the Internet Service Provider (ISP), that will assign the public IP address to the outside interface

NAT (4/4)

- The router must implement NAT (Network Address Translator - RFC 1631)
- The NAT idea id to modify (translate) the IP addresses (and other header fields) of outgoing and incoming packets.
- Two main types of NAT operations exists:
  - Static NAT: one-to-one translation;
  - Dynamic NAT: N-to-one translation.

Static NAT



NAT Table

Inside Local IP Address	Inside Global IP Address
192.168.1.2	80.70.1.1
192.168.1.3	80.70.1.2

The translation is performed also for the incoming packets (acting on the IP destination address field)

Dynamic NAT

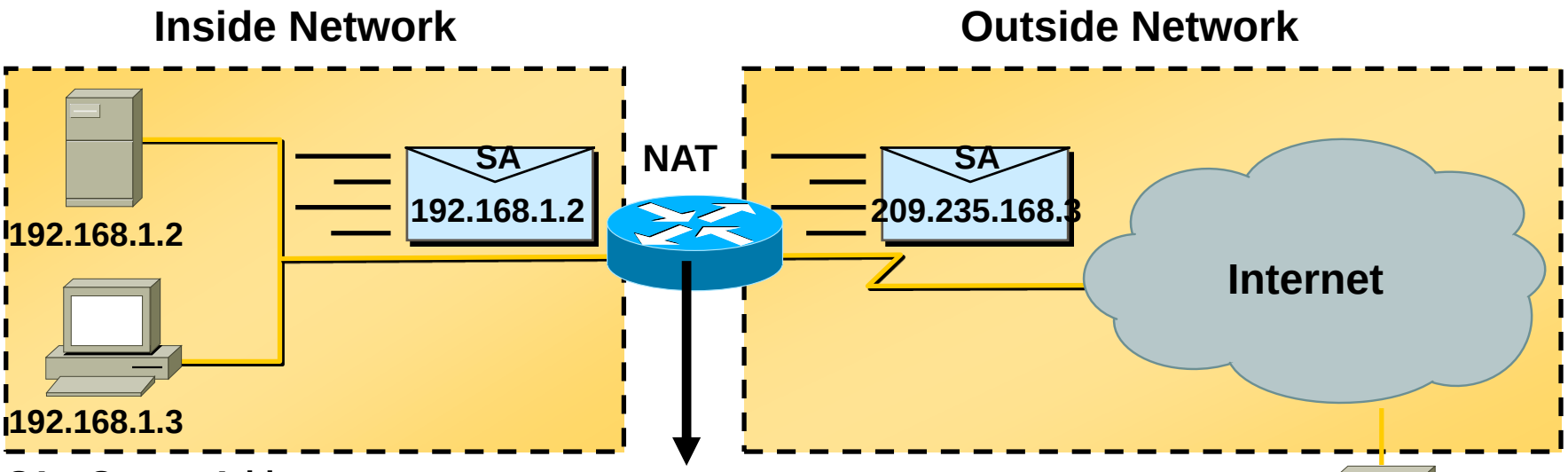


Tabella NAT

Inside Local IP Address & port	Inside Global IP Address & port
192.168.1.2:1024	209.235.168.3:55001
192.168.1.3:1723	209.235.168.3:55002

151.100.37.12:80

SERVER HTTP

NAT Configuration

- The first step in NAT configuration is the setting of inside (local) and outside (global) interfaces

```
Router(config-if)#ip nat inside
```

```
Router(config-if)#ip nat outside
```

Static NAT configuration

- One-to-one translation among a private and a public IP address.
- Used for servers.
- Translation rule:

```
Router(config)# ip nat inside source static
        private_address public_address
```

Dynamic NAT configuration (1/2)

- The number of available public IP addresses is lower than the number of hosts (private IP addresses) requiring Internet access
- Private IP addresses definition:

```
Router(config)# access-list access-list-number
permit source_address wildcard
```

- Pool of public IP addresses:

```
Router(config)# ip nat pool name start-ip end-ip
netmask netmask
```

- Translation rule

```
Router(config)# ip nat inside source list acl-
number pool name
```

Dynamic NAT configuration (2/2)

- It is also possible to use a single public IP address for all the LAN hosts: the public IP address of the router
- In this case the pool of public IP addresses is not required
- Translation rule:

```
Router(config)# ip nat inside source list acl-number interface interface overload
```