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# **NAT**

## **Network Address Translation**

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# Operating Principle

→ **Outbound packet**

→ **Substitute IP source address with another one**

→ **Inbound packet**

→ **Substitute IP destination address with original one**

# Applications

- **Public access with private addressing**
  - **Public Address Expansion**
- **(Private) Address Overlapping**
- **Privacy**
  - **Address hiding**
- **Policy compliance**

# Public Address Expansion

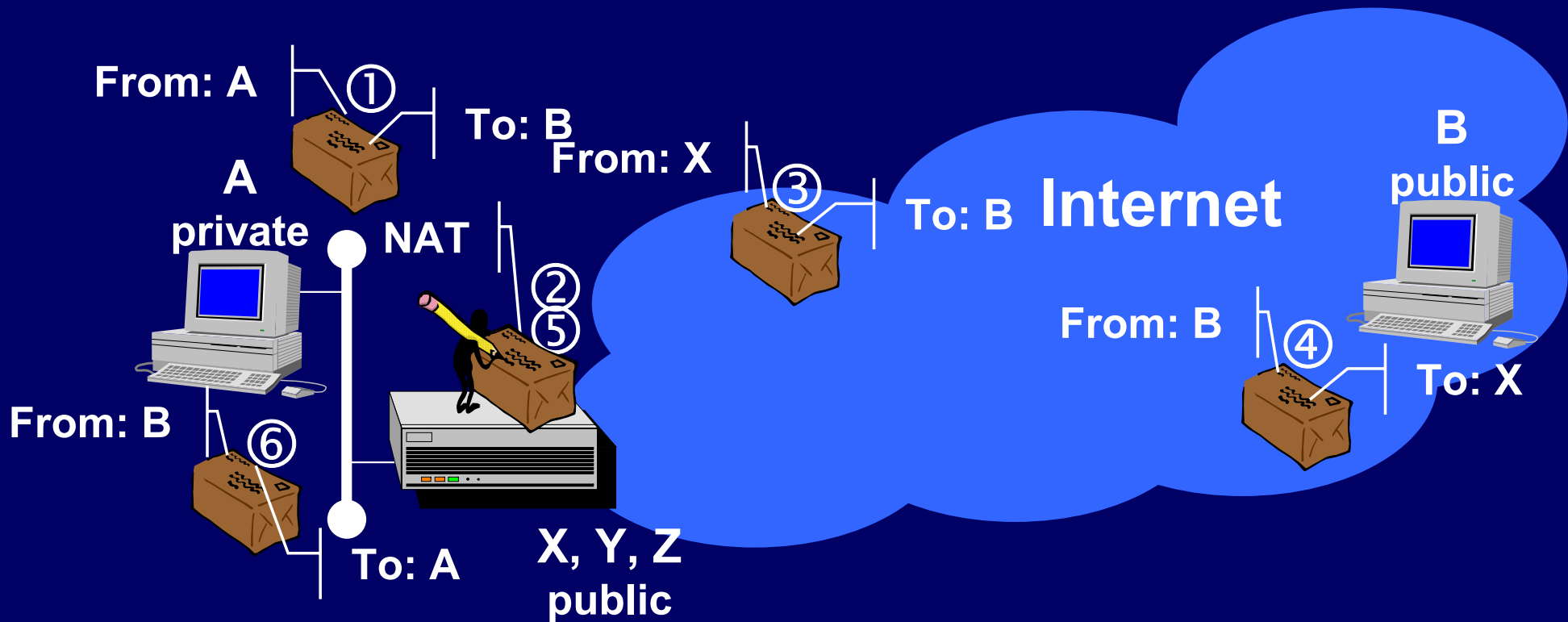
→ Outbound packet

→ Substitute *private* IP source address with *public* one

→ Inbound packet

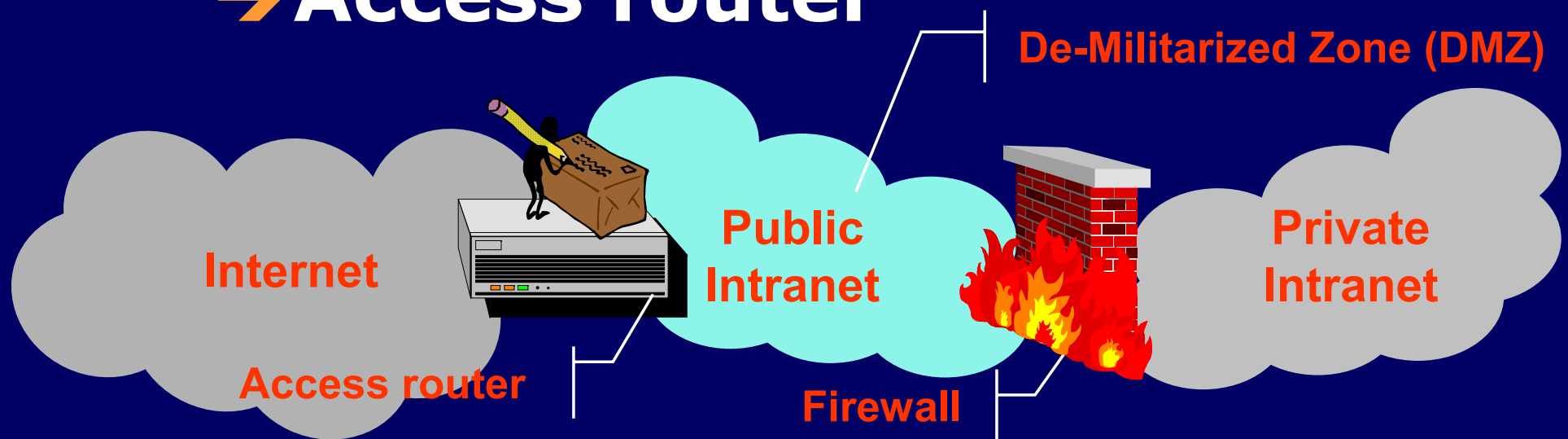
→ Substitute *public* IP destination address with original *private* one

# Public Address Expansion

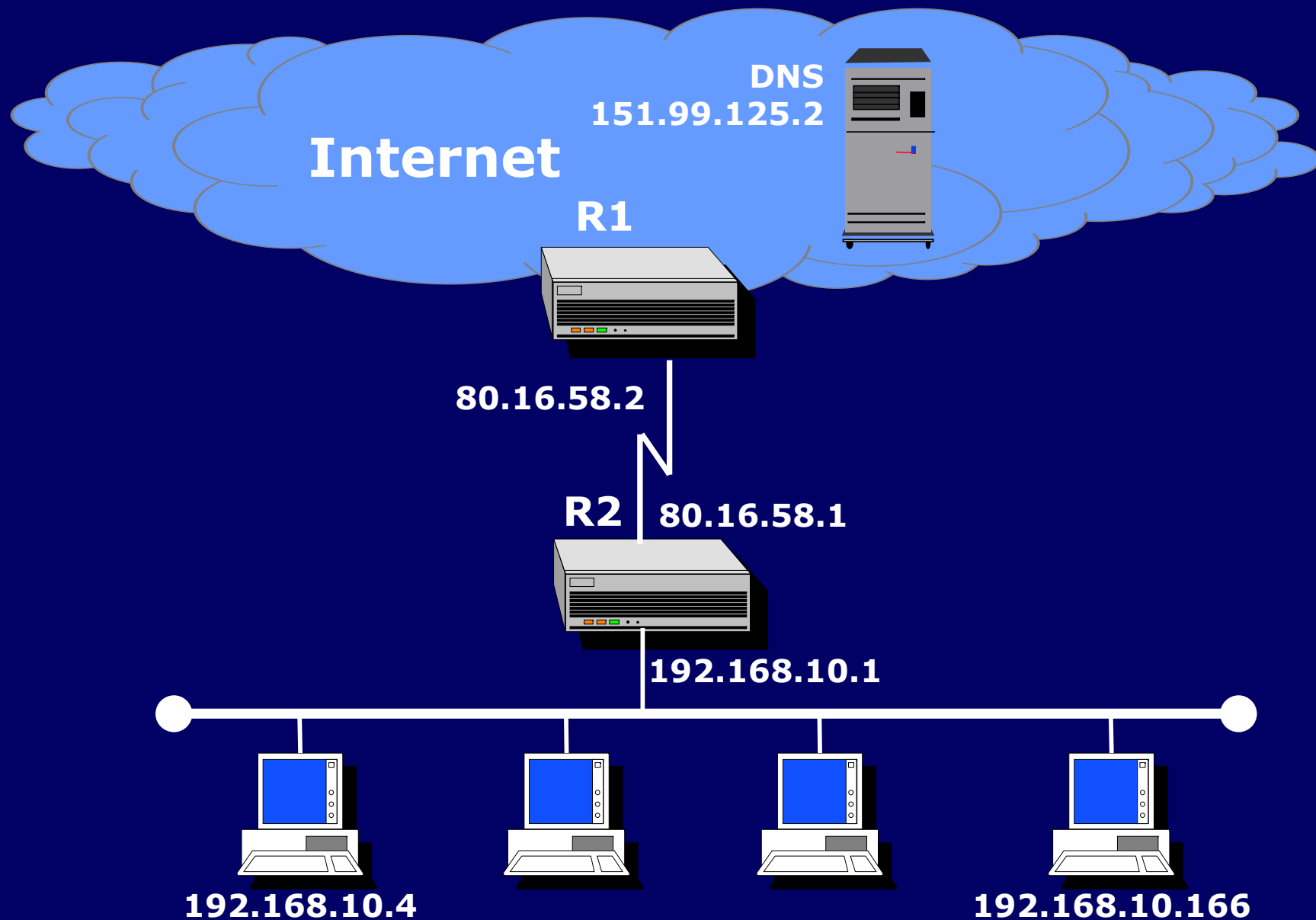


# Public Address Expansion

- One IP address dynamically shared by many hosts
- At the edge between enterprise intranet and the Internet
  - Firewall
  - Access router



# Case Study





# Sample R2 Configuration

```
interface Ethernet0
  ip address 192.168.10.1 255.255.255.0
  ip nat inside
  !
interface serial0
  ip address 80.16.58.1 255.255.255.252
  ip nat outside
  !
ip nat inside source list 1 interface
  serial0 overload
access-list 1 permit 192.168.10.0 0.0.0.255
  !
ip route 0.0.0.0 0.0.0.0 80.16.58.2
  !
```

# R2 Translation Table

## Visualizzazione della tabella delle traduzioni

```
router#sho ip nat translation
```

Pro	Inside global	Inside local	Outside local	Outside global
tcp	80.16.58.1:1056	192.168.10.4:1056	213.212.128.8:80	213.212.128.8:80
tcp	80.16.58.1:1027	192.168.10.166:1027	195.31.235.39:21	195.31.235.39:21
tcp	80.16.58.1:1028	192.168.10.166:1028	195.31.235.39:20	195.31.235.39:20
tcp	80.16.58.1:1098	192.168.10.4:1098	195.31.235.39:21	195.31.235.39:21
tcp	80.16.58.1:1099	192.168.10.4:1099	195.31.235.39:20	195.31.235.39:20
udp	80.16.58.1:137	192.168.10.166:137	151.99.125.2:53	151.99.125.2:53
tcp	80.16.58.1:1058	192.168.10.4:1058	212.110.36.130:80	212.110.36.130:80
tcp	80.16.58.1:1059	192.168.10.4:1059	212.110.36.130:80	212.110.36.130:80
tcp	80.16.58.1:1060	192.168.10.4:1060	212.110.36.130:80	212.110.36.130:80
udp	80.16.58.1:137	192.168.10.4:137	151.99.125.2:53	151.99.125.2:53

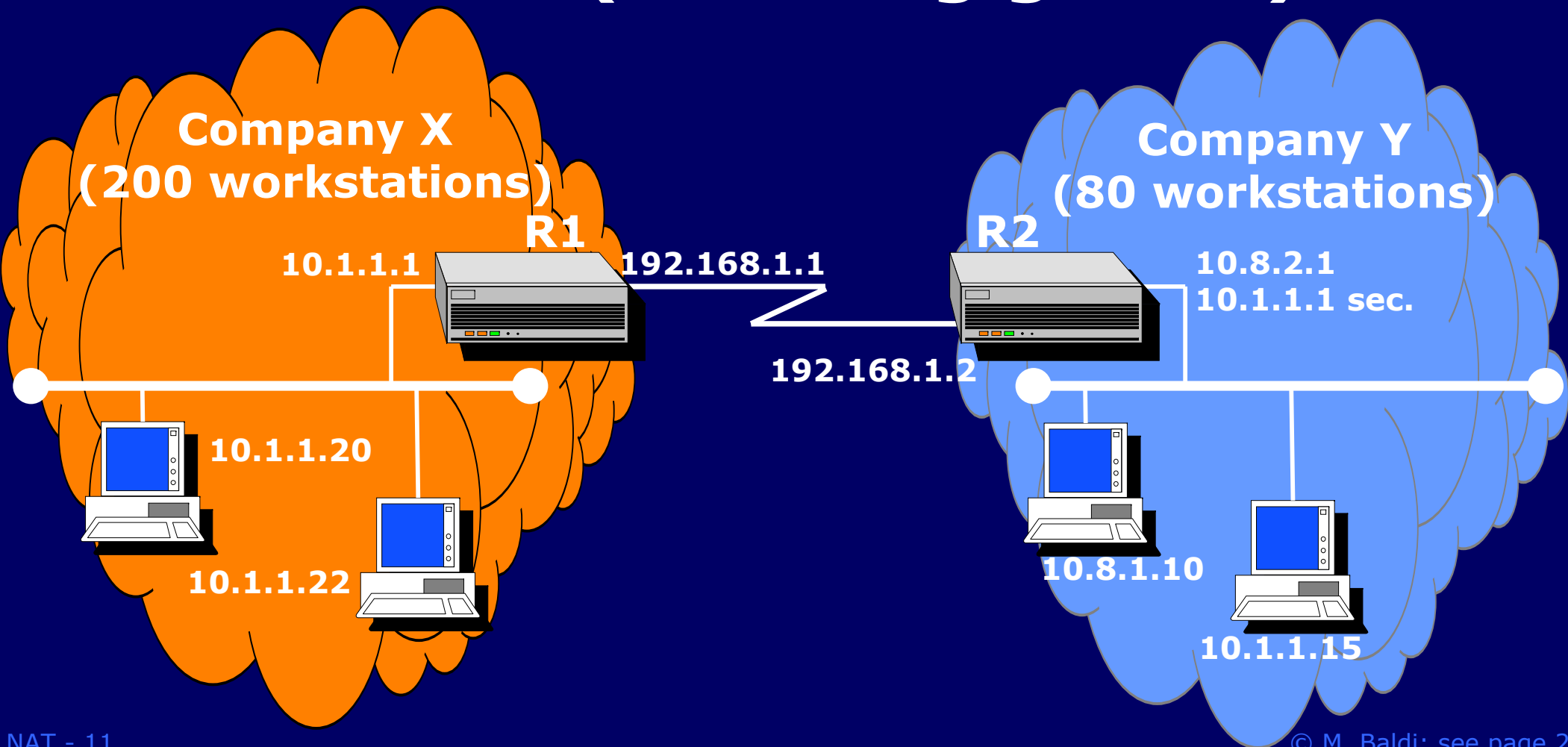
3 pagine HTTP aperte dal client 192.168.10.4  
verso il server 212.110.36.130

Indirizzo pubblico di traduzione

Risoluzione nomi indirizzi tramite DNS pubblico

# Private Address Overlapping

- Merging and acquisition
- Extranets (including guests)



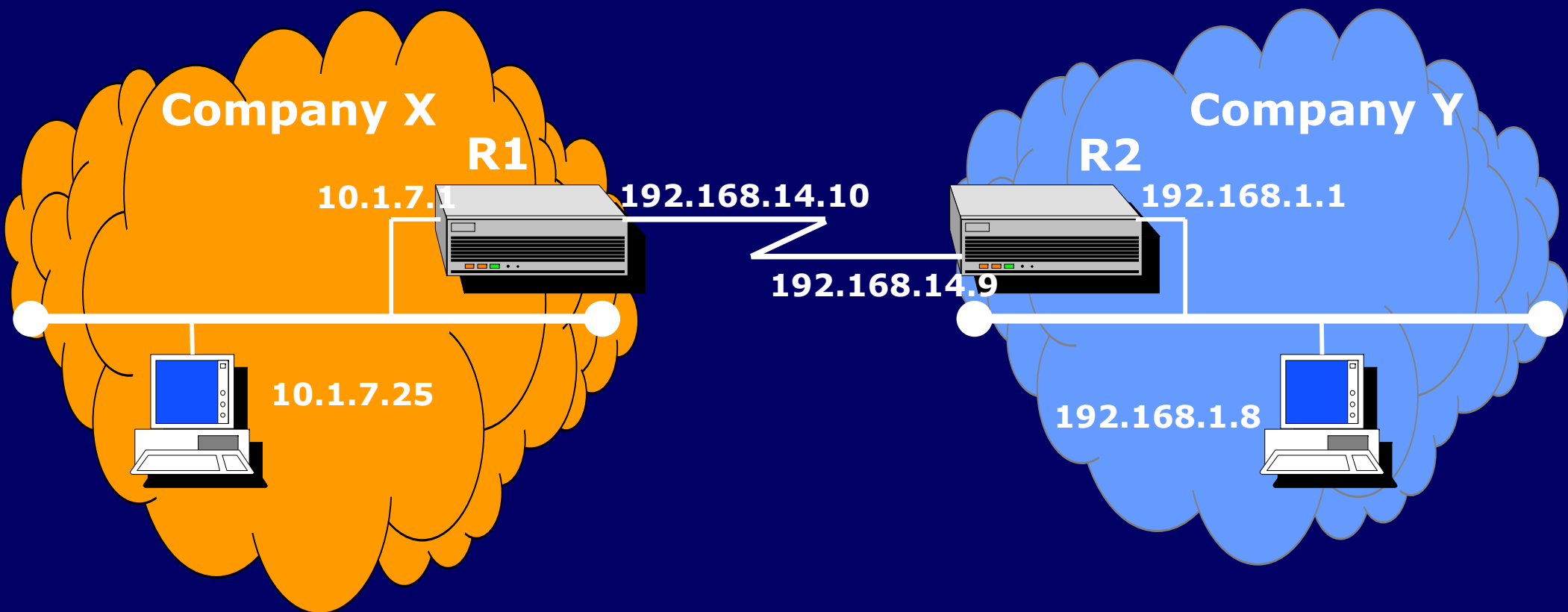
# Sample Configuration: R1

```
ip nat inside source static 10.1.1.20 10.10.1.20
ip nat inside source static 10.1.1.22 10.10.1.22
!
interface serial 0
ip address 192.168.1.1 255.255.255.252
ip nat outside
!
interface ethernet 0
ip address 10.1.1.1 255.255.255.0
ip nat inside
!
ip route 10.8.1.10 255.255.255.255 192.168.1.2
```

# Sample Configuration: R2

```
interface serial 0
ip address 192.168.1.2 255.255.255.252
!
interface ethernet 0
ip address 10.1.8.1 255.255.255.0
ip address 10.1.1.1 255.255.255.0 sec
!
ip route 10.10.1.20 255.255.255.255 192.168.1.1
ip route 10.10.1.22 255.255.255.255 192.168.1.1
!
```

# Address Hiding or Adjustment



# Policy Compliance: why?

- **Routing Optimization**
- **Security/filtering**
- **Management**

```

!
ip nat inside source static 10.1.7.25 192.168.244.45
!
interface Ethernet0
  ip address 10.1.7.1 255.255.255.252
  ip nat inside
!
!
interface Serial0
  ip address 192.168.14.10 255.255.255.252
  ip nat outside
!
!
ip route 192.168.1.8 255.255.255.255 192.168.14.9
!

```



Traduzione da indirizzo inside a nuovo indirizzo

Definizione dell'interfaccia  
inside

Definizione dell'interfaccia  
outside

### Visualizzazione della tabella delle traduzioni

```

*****
**
router#sho ip nat translation
Pro Inside global tradotto Inside local Outside local Outside
global
--- 192.168.244.45          10.1.7.25          ---          ---


```

Indirizzo  
reale

Indirizzo  
tradotto



```
!  
interface Ethernet0  
  ip address 192.168.1.1 255.255.255.0  
!  
interface Serial0  
  ip address 192.168.14.9 255.255.255.252  
!  
ip route . . . .  
ip route 192.168.244.45 255.255.255.255 192.168.14.10  
!
```



**Route esclusiva verso  
l'indirizzo IP presunto  
(prefisso di rete a 30 bit)**

# PAT: Port Address Translation

- AKA NAT overload
- Multiple (private) addresses mapped onto the same (public) address
- Source port is mapped onto random unique port
- It does not work when a specific port is needed
  - IPSec (IP Security), DNS, etc.

# NAT and IPSec

## → Authentication Header (AH)

- IP addresses are part of AH checksum calculation

- Received packets are discarded

## → Encapsulation Security Payload (ESP)

- Ports might be hidden

- No address expansion

# NAT and IPsec

## → Tunnel mode

→ Probably NAT is not needed

→ Translation of tunnel endpoint address is critical

# References

- **K. Egevang, P. Francis, "The IP Network Address Translator (NAT)," RFC 1631, May 1994**