

NAT Network Address Translator



New addressing concepts

■ Problems with IPv4

- Shortage of IPv4 addresses
- Allocation of the last IPv4 addresses is forecasted for the year 2005
- Address classes were replaced by usage of CIDR, but this is not sufficient



■ Short term solution

- NAT: Network Address Translator



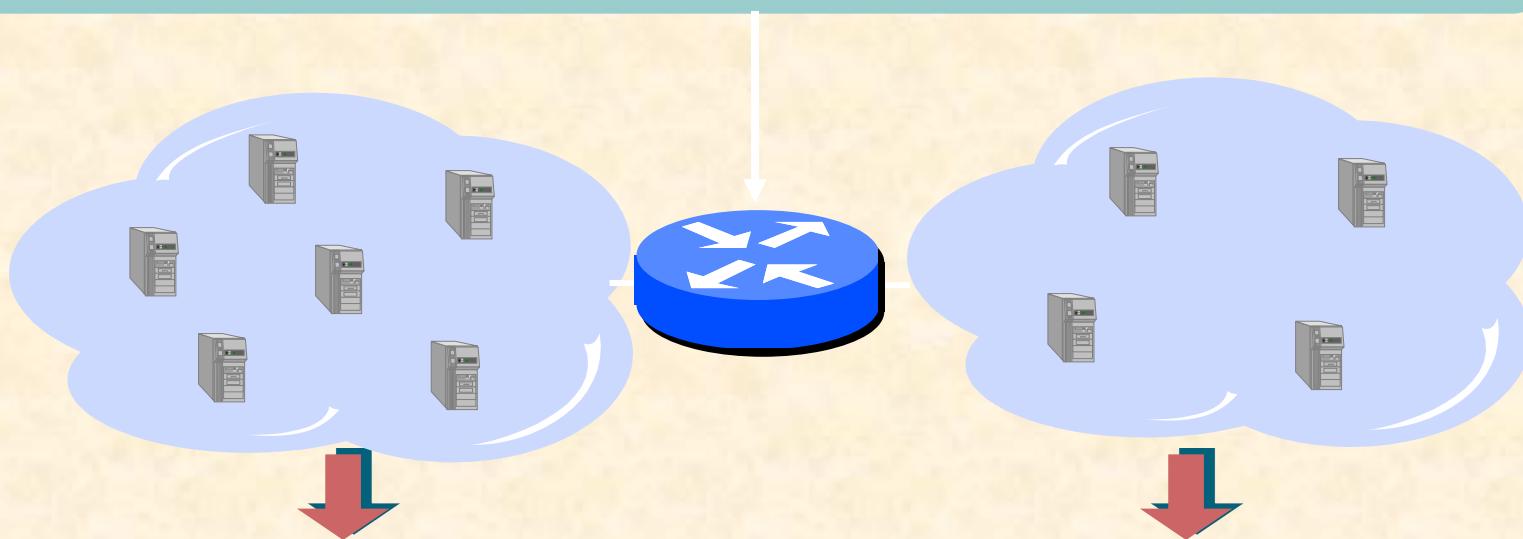
■ Long term solution

- IPv6 = IPng (IP next generation)
- Provides an extended address range

NAT: Network Address Translator

■ NAT

- Translates between local addresses and public ones
- Many private hosts share few global addresses



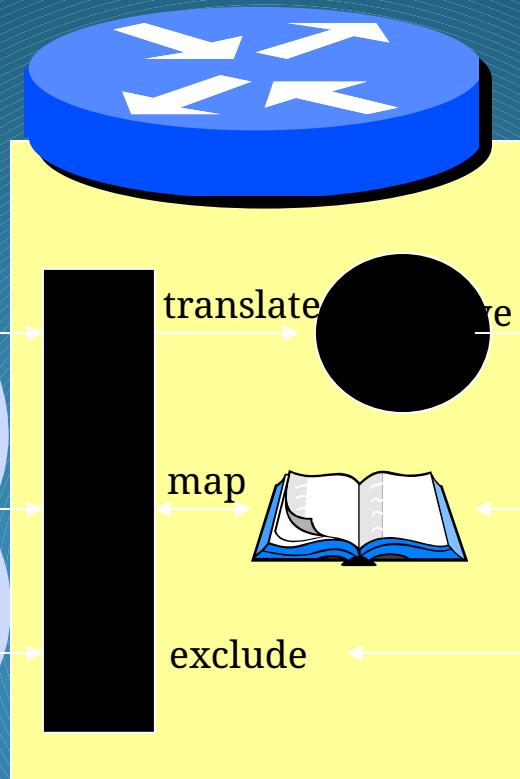
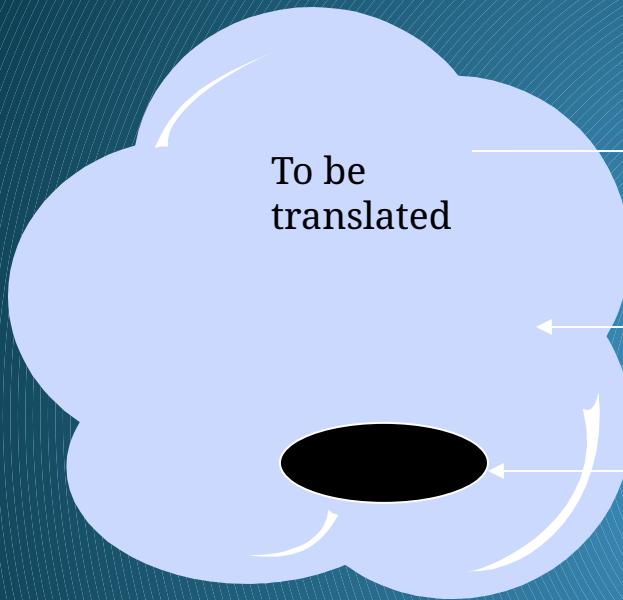
■ Private Network

- Uses private address range (local addresses)
- Local addresses may not be used externally

■ Public Network

- Uses public addresses
- Public addresses are globally unique

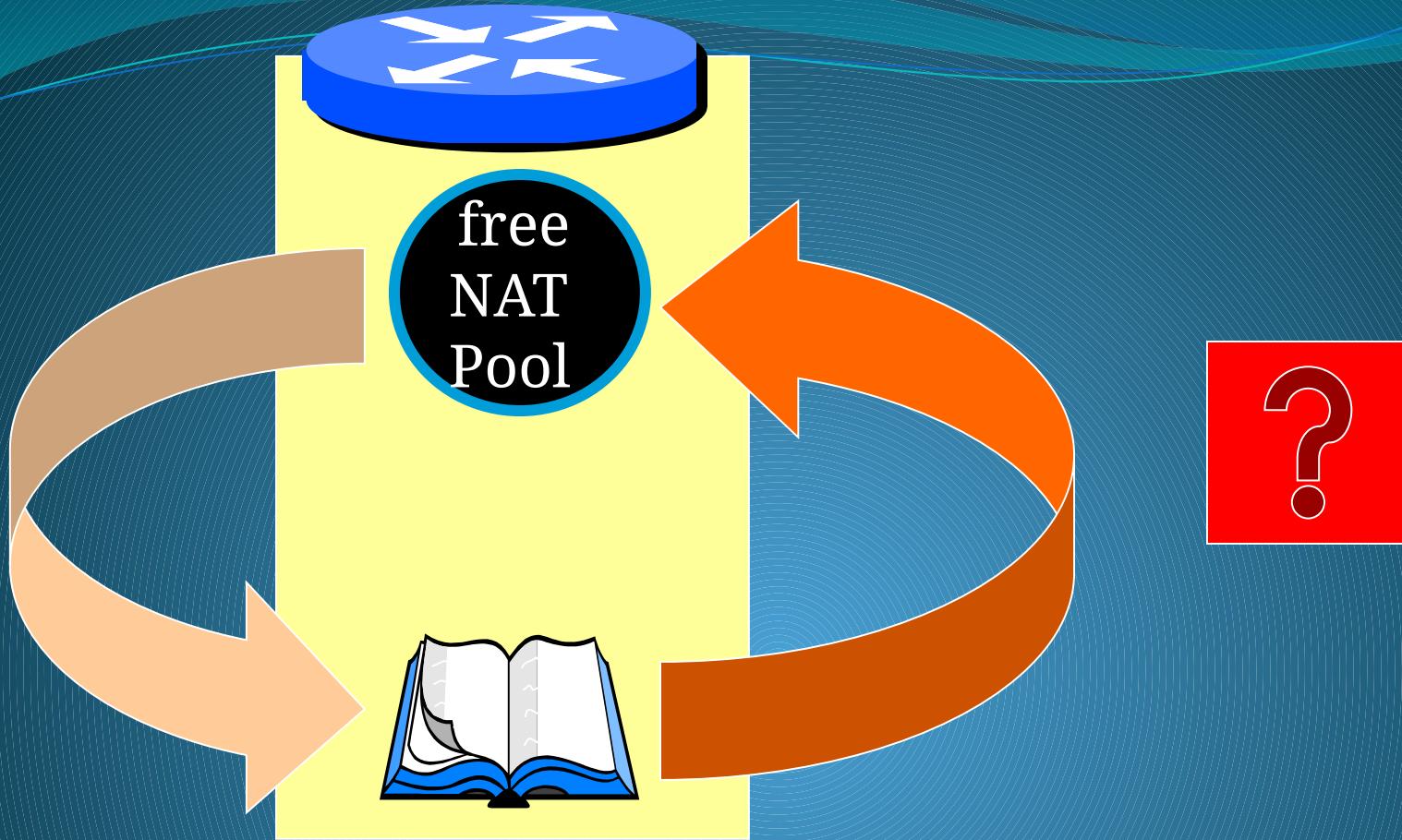
realm with
private addresses



realm with
public addresses



Fig. 5 Translation mechanism (TI1332EU02TI_0003 New Address Concepts, 9)



A timeout value (default 15 min) instructs NAT how long to keep an association in an idle state before returning the external IP address to the free NAT pool.

NAT Addressing Terms

- Inside Local
 - The term “inside” refers to an address used for a host inside an enterprise. It is the actual IP address assigned to a host in the private enterprise network.
- Inside Global
 - NAT uses an inside global address to represent the inside host as the packet is sent through the outside network, typically the Internet.
 - A NAT router changes the source IP address of a packet sent by an inside host from an inside local address to an inside global address as the packet goes from the inside to the outside network.

NAT Addressing Terms

- Outside Global

- The term “outside” refers to an address used for a host outside an enterprise, the Internet.
- An outside global is the actual IP address assigned to a host that resides in the outside network, typically the Internet.

- Outside Local

- NAT uses an outside local address to represent the outside host as the packet is sent through the private enterprise network.
- A NAT router changes a packet’s destination IP address, sent from an outside global address to an inside host, as the packet goes from the outside to the inside network.

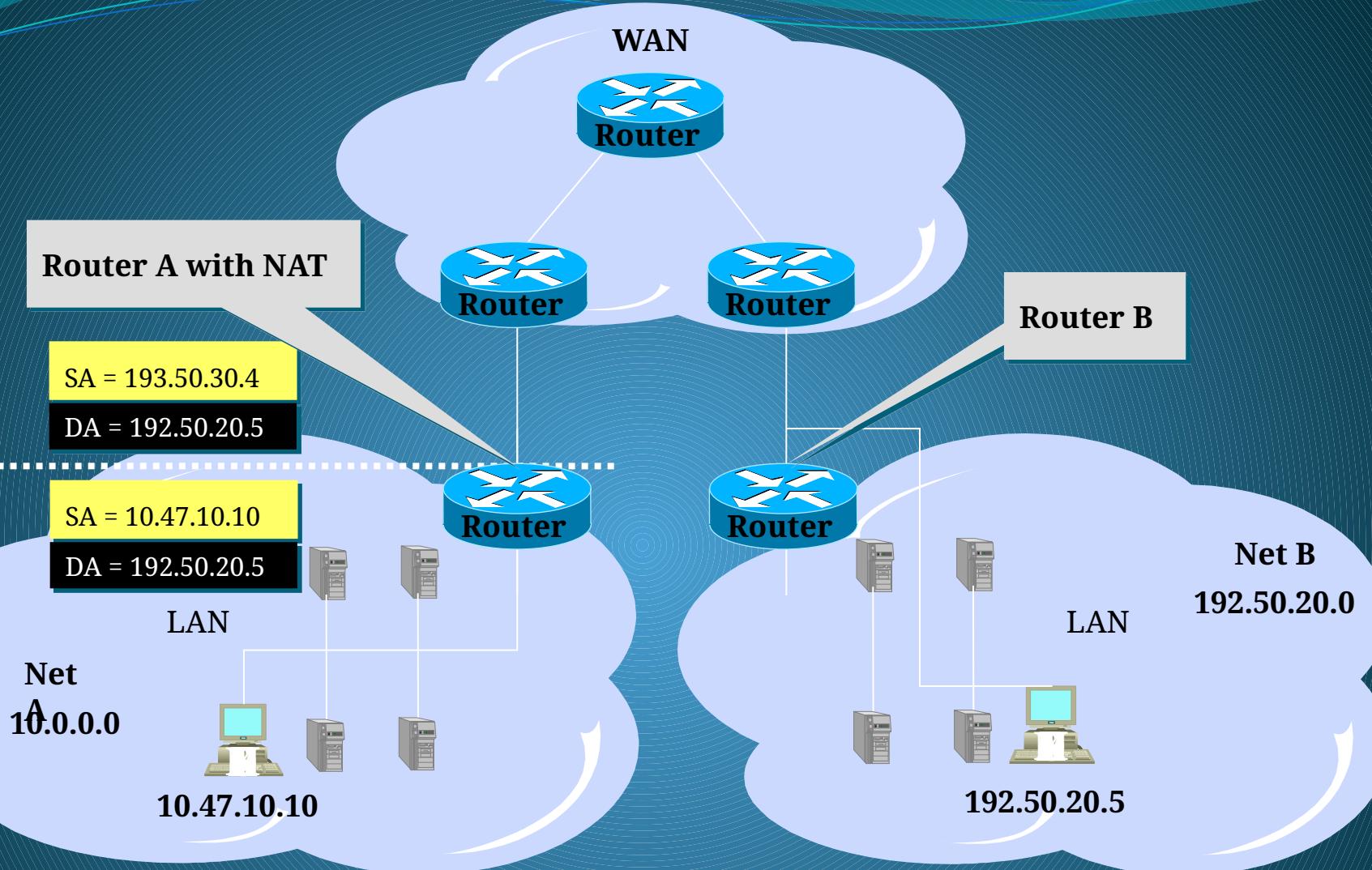


Fig. 7 An example for NAT (TI1332EU02TI_0003 New Address Concepts, 13)

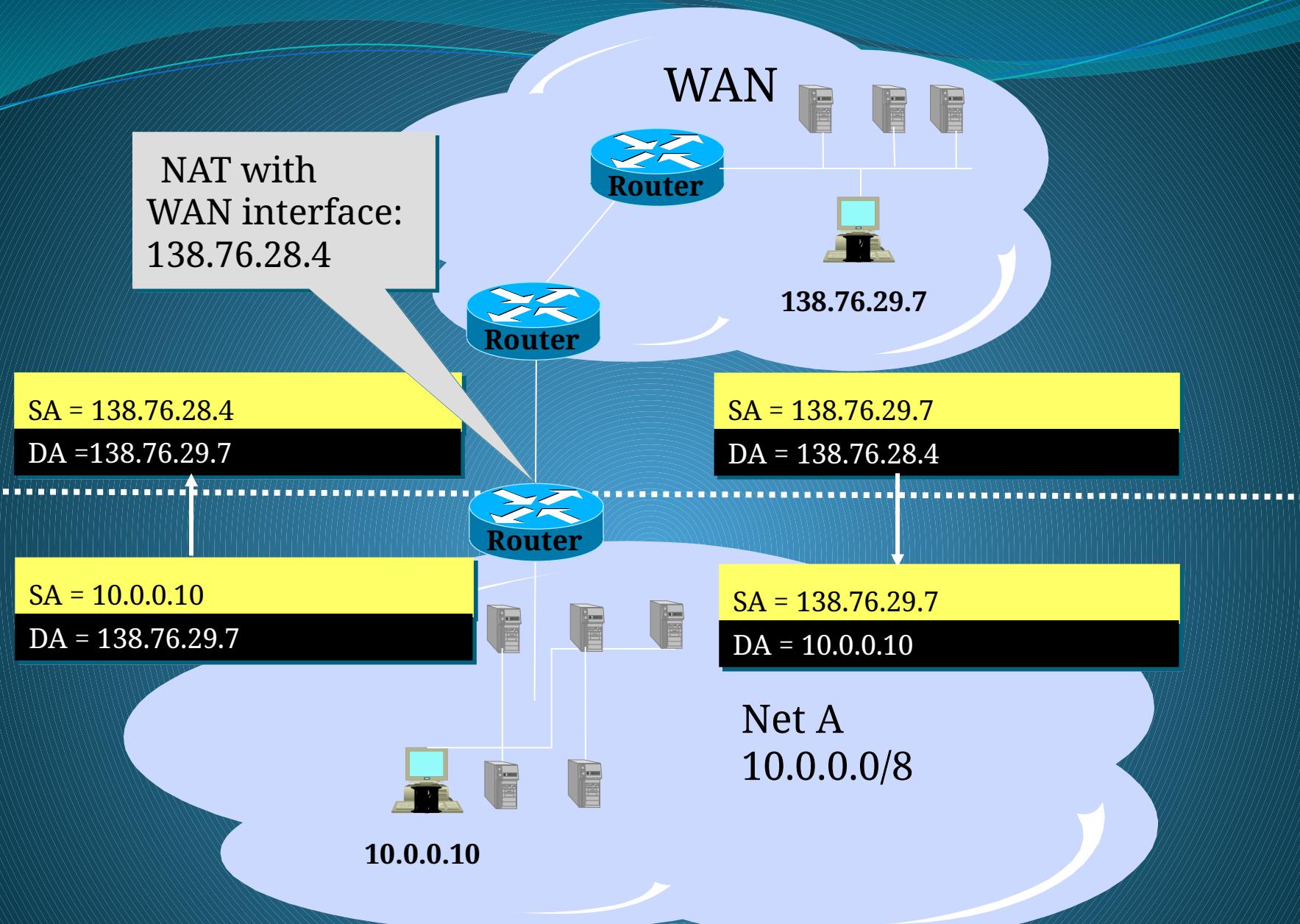


Fig. 11 An example for NAPT (TI1332EU02TL_0003 New Address Concepts, 21)

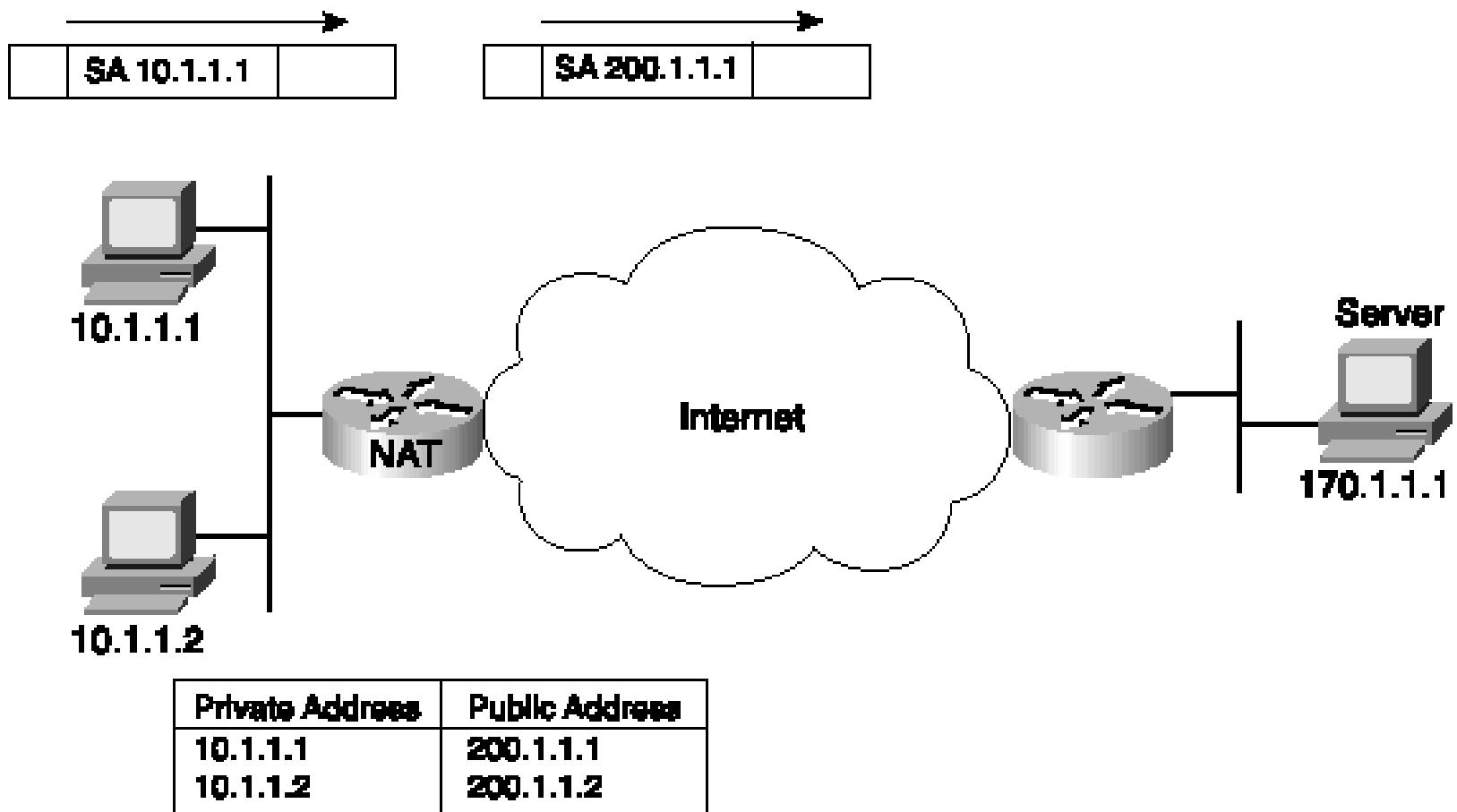
Types Of NAT

- There are different types of NAT that can be used, which are
 - Static NAT
 - Dynamic NAT
 - Overloading NAT with PAT (NAPT)

Static NAT

- With static NAT, the NAT router simply configures a one-to-one mapping between the private address and the registered address that is used on its behalf.

Static NAT



Dynamic NAT

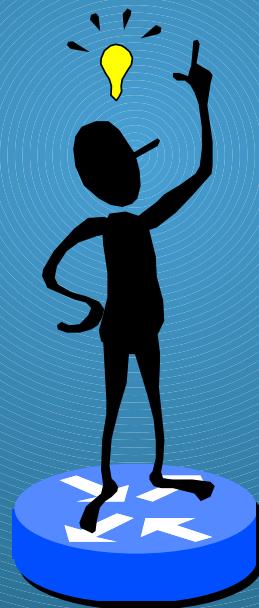
- Like static NAT, the NAT router creates a one-to-one mapping between an inside local and inside global address and changes the IP addresses in packets as they exit and enter the inside network.
- However, the mapping of an inside local address to an inside global address happens dynamically.

Dynamic NAT

- Dynamic NAT sets up a pool of possible inside global addresses and defines criteria for the set of inside local IP addresses whose traffic should be translated with NAT.
- The dynamic entry in the NAT table stays in there as long as traffic flows occasionally.
- If a new packet arrives, and it needs a NAT entry, but all the pooled IP addresses are in use, the router simply discards the packet.

PAT

Port Address Translator



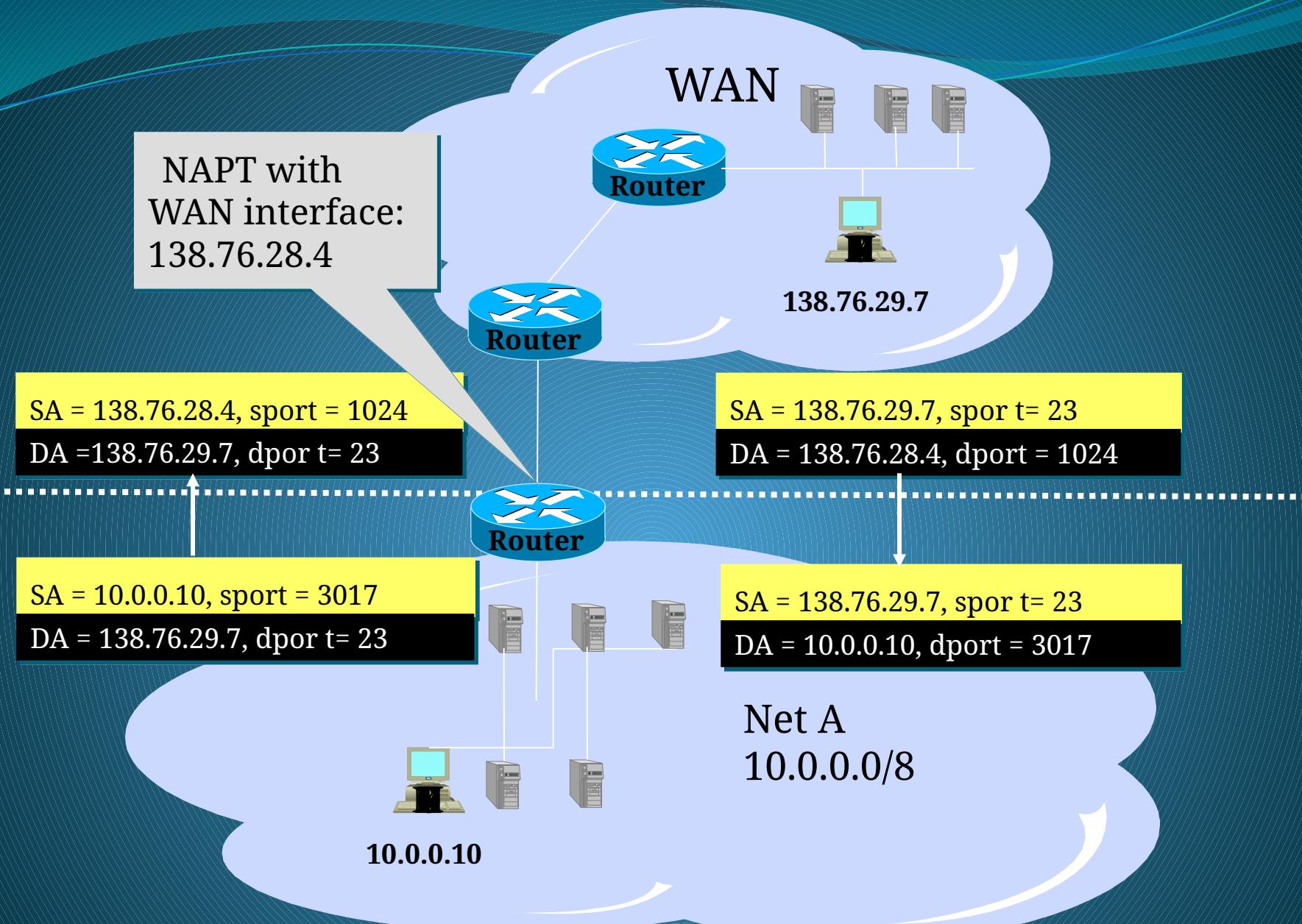
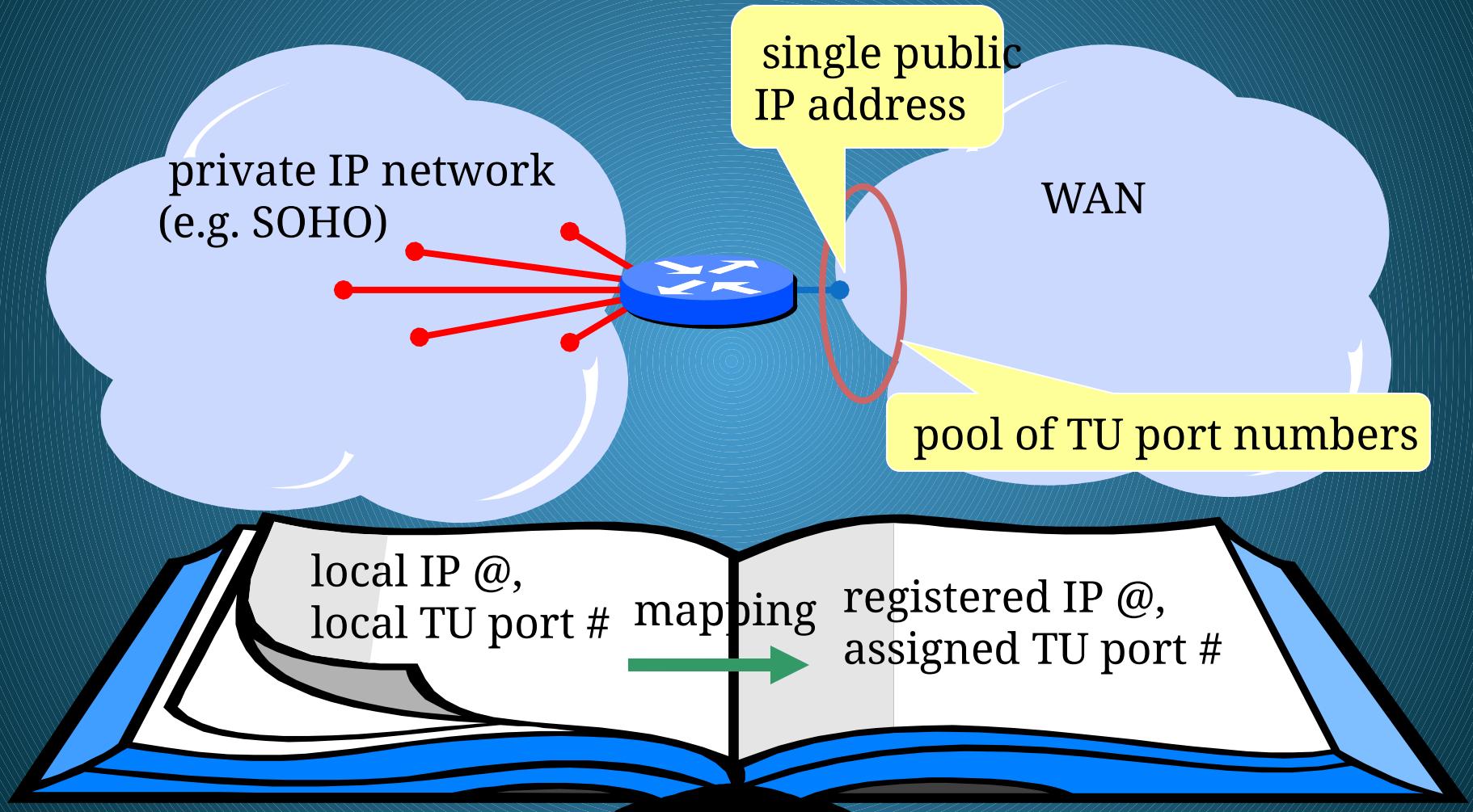


Fig. 11 An example for NAPT (TI1332EU02TL_0003 New Address Concepts, 21)

PAT with e.g. a single public IP address



NAT&PAT

Network Address Translation & Port Address Translation



New addressing concepts

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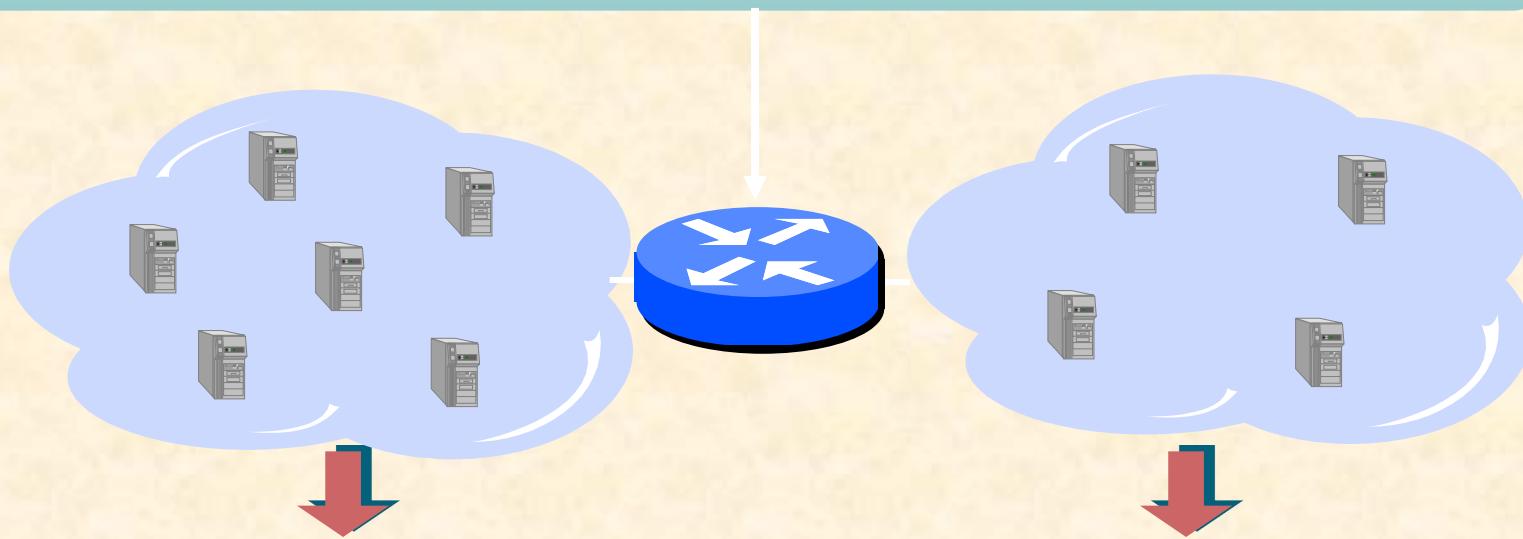
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NAT

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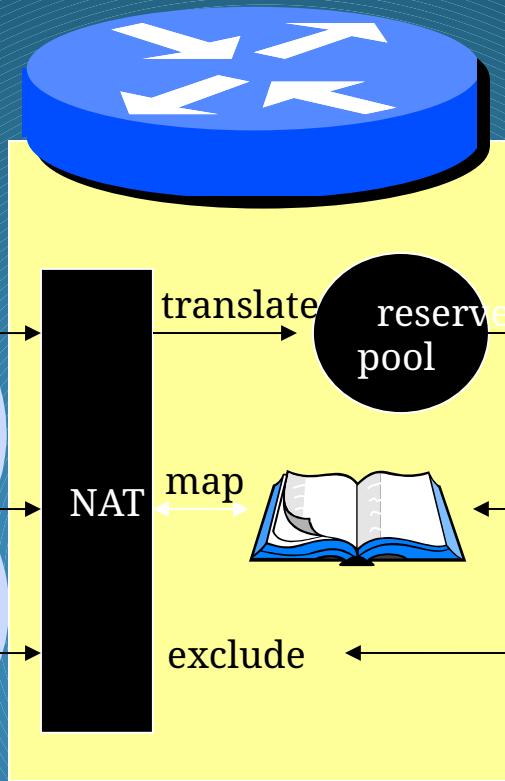
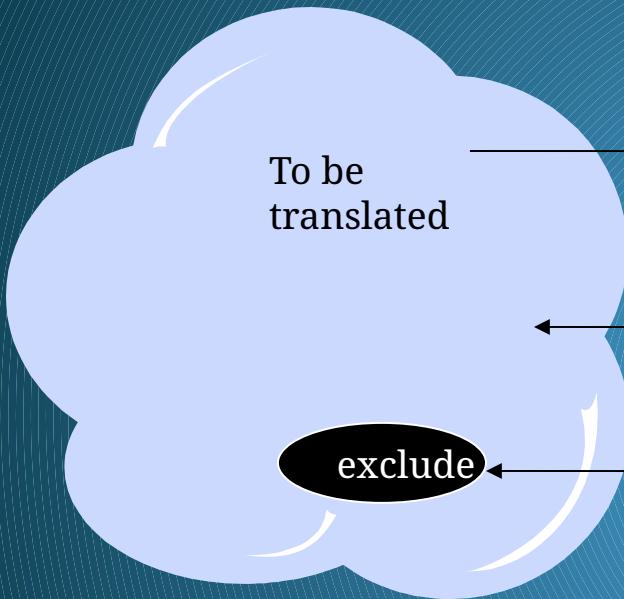
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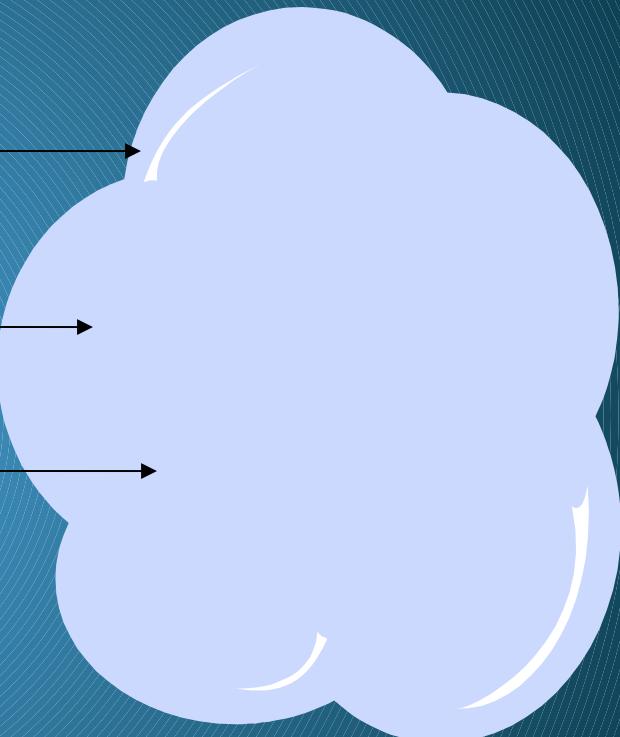
Public Network

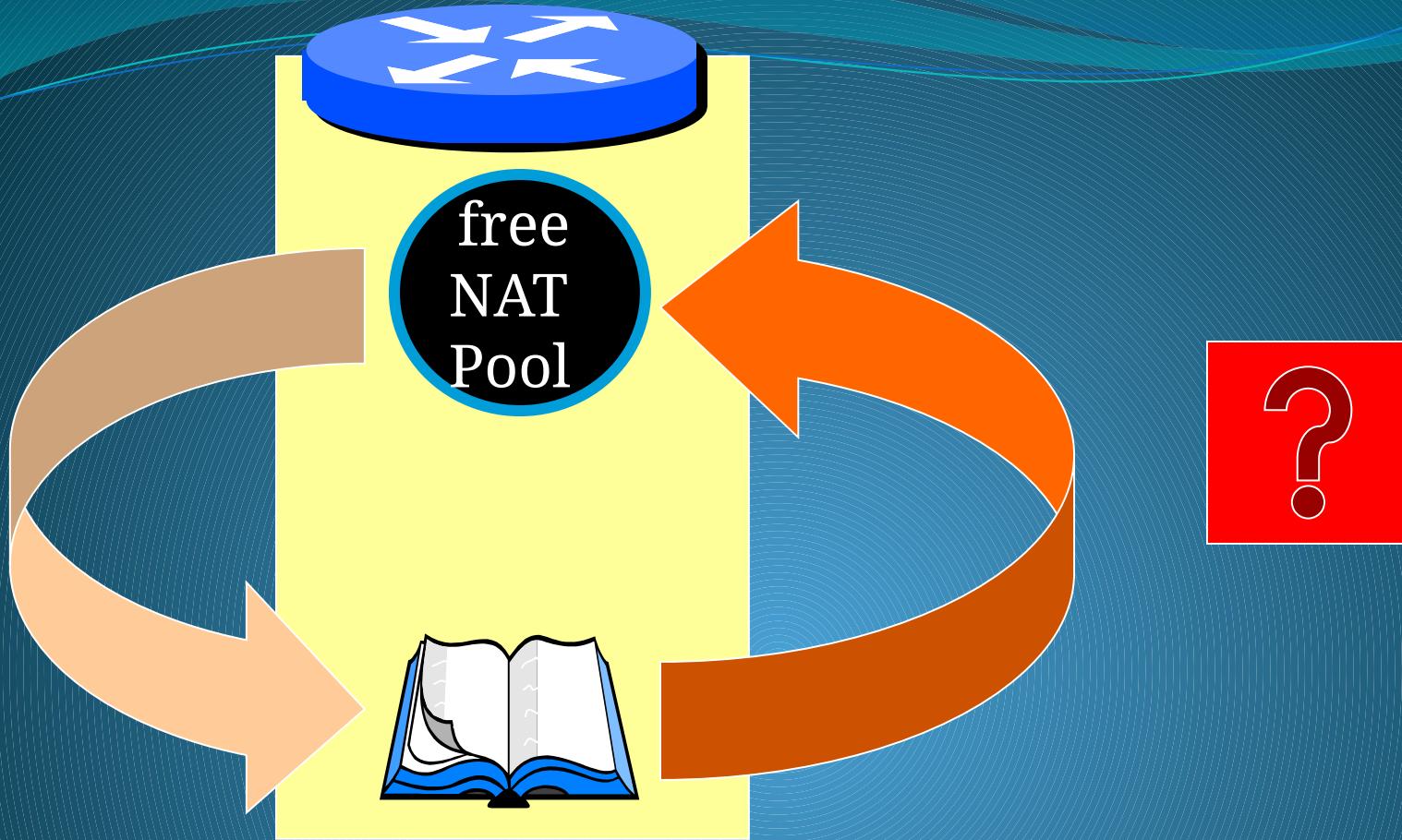
- Uses public addresses
- Public addresses are globally unique

private addresses



public addresses





A timeout value (default 15 min) instructs NAT how long to keep an association in an idle state before returning the external IP address to the free NAT pool.

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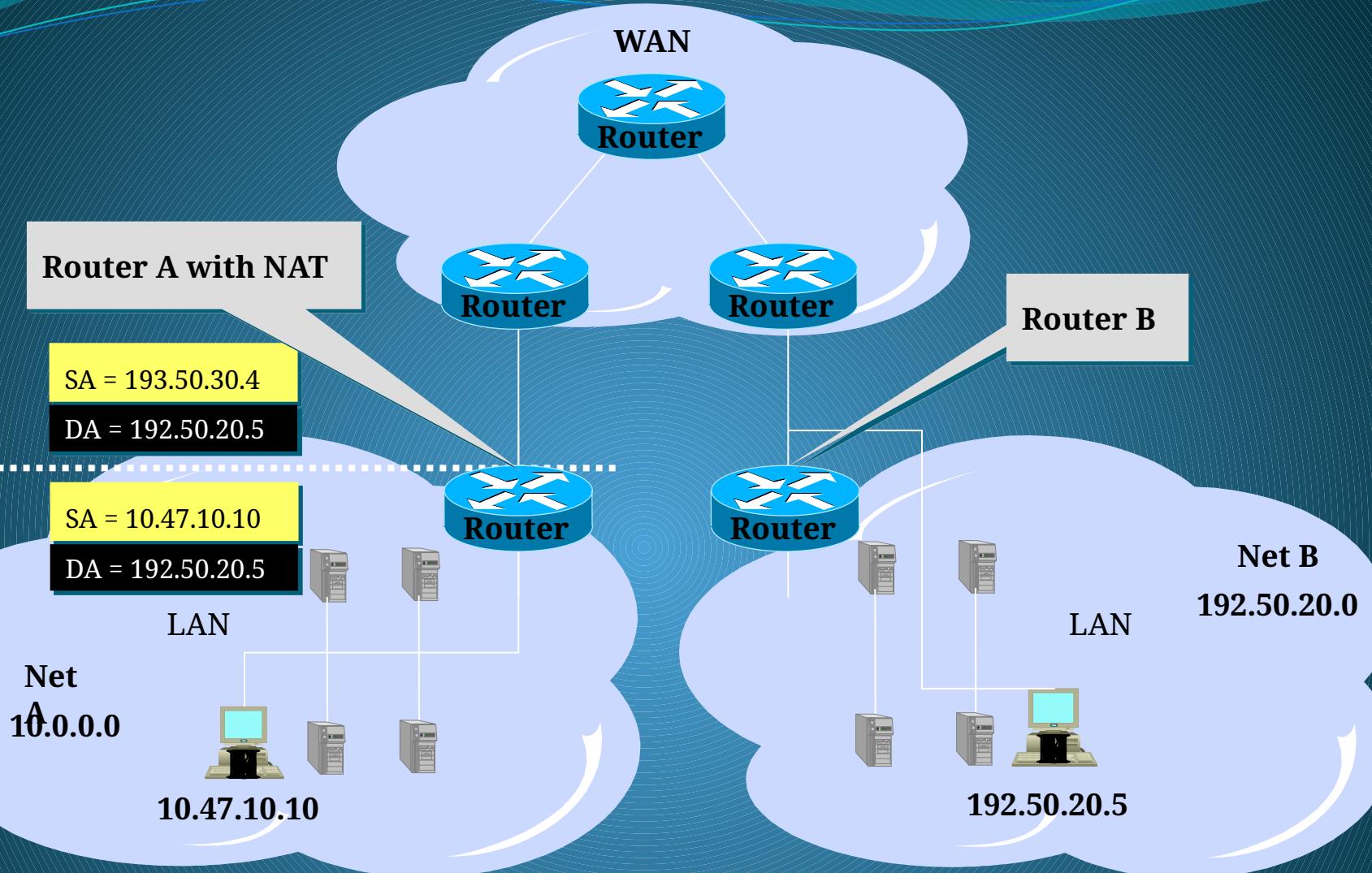


Fig. 7 An example for NAT (TI1332EU02TI_0003 New Address Concepts, 13)

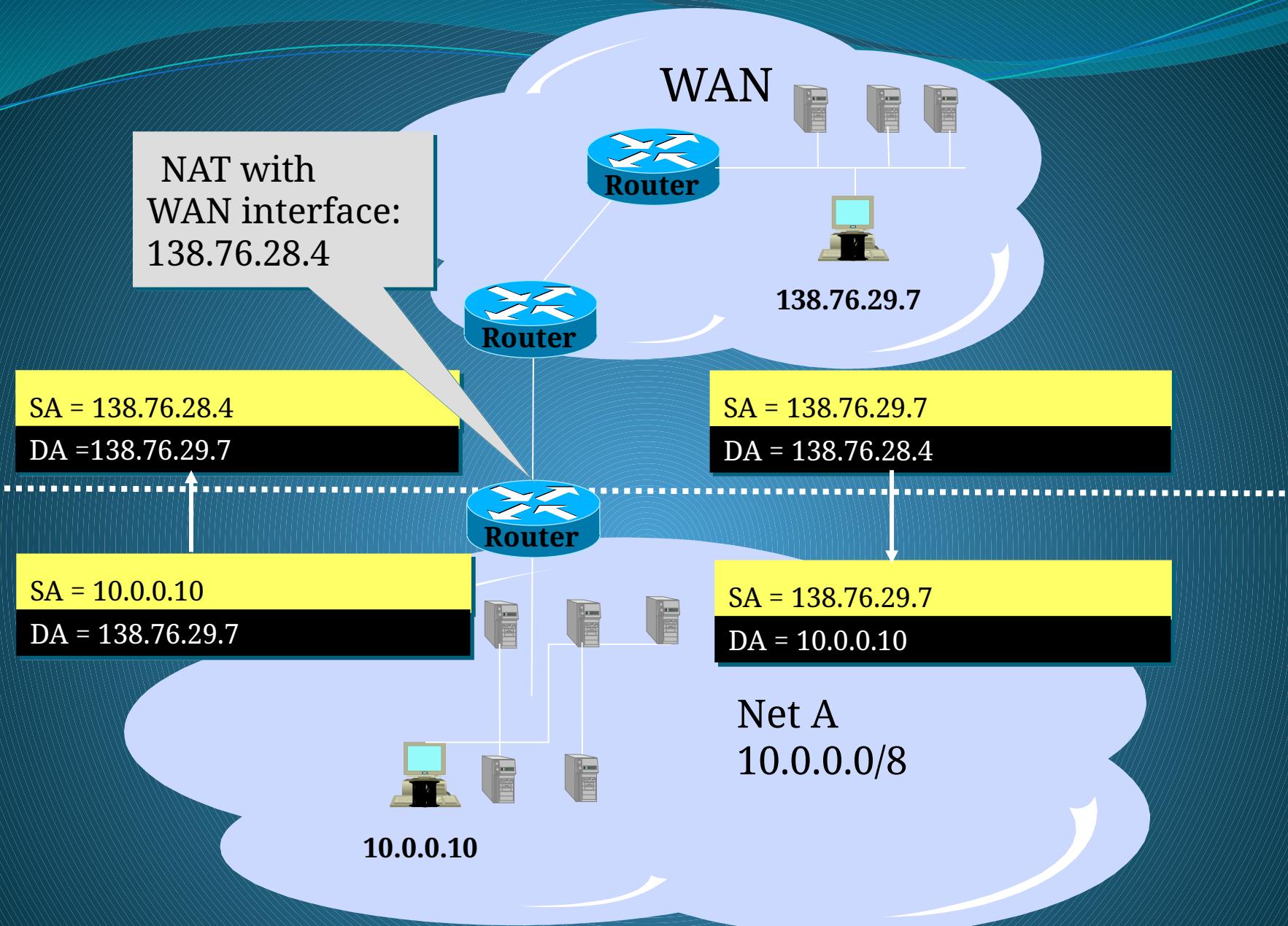


Fig. 11 An example for NAPT (TI1332EU02TL_0003 New Address Concepts, 21)

Types Of NAT

- There are different types of NAT that can be used, which are
 - Static NAT
 - Dynamic NAT
 - Overloading NAT with PAT (NAT Over PAT)

Static NAT

- With static NAT, the NAT router simply configures a one-to-one mapping between the private address and the registered address that is used on its behalf.

Static NAT

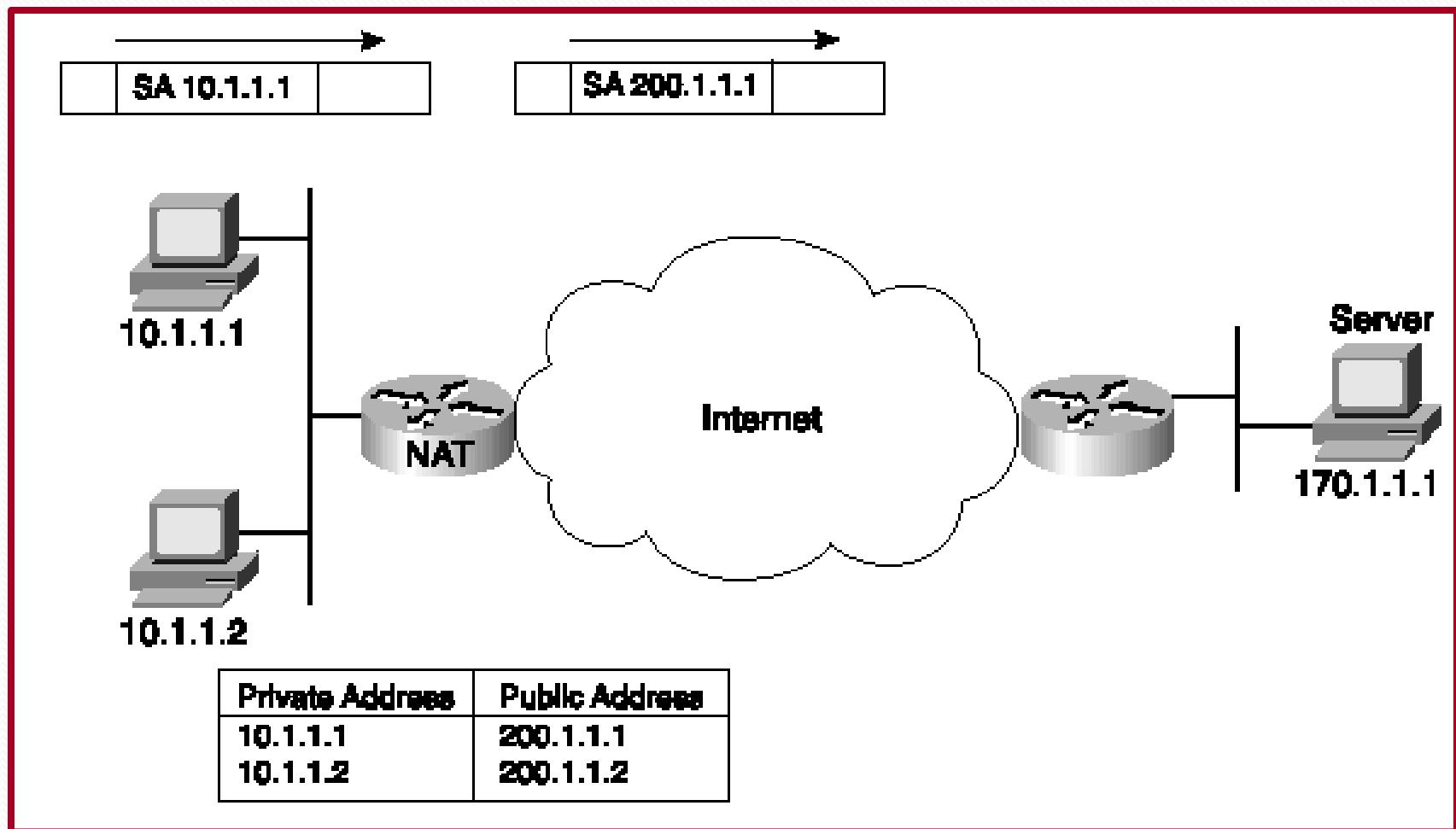


Fig. 2 Address shortage and possible solutions (TI1332EU02TI_0003 New Address Concepts, 5)

Static NAT Configuration

- To form NAT table

```
Router(config)#IP Nat inside source static [inside local  
source IP address] [inside global source IP address]
```

- Assign NAT to an Interface

```
Router(config)#Interface [Serial x/y]  
Router(config-if)#IP NAT [Inside]
```

- See Example

Dynamic NAT

- Like static NAT, the NAT router creates a one-to-one mapping between an inside local and inside global address and changes the IP addresses in packets as they exit and enter the inside network.
- However, the mapping of an inside local address to an inside global address happens dynamically.

Dynamic NAT

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- The dynamic entry in the NAT table stays in there as long as traffic flows occasionally.
- If a new packet arrives, and it needs a NAT entry, but all the pooled IP addresses are in use, the router simply discards the packet.

Dynamic NAT Configuration

- Specify inside addresses to be translated

```
Router(config)#IP Nat inside source list [standard Access  
List number] pool [NAT Pool Name]
```

- Specify NAT pool

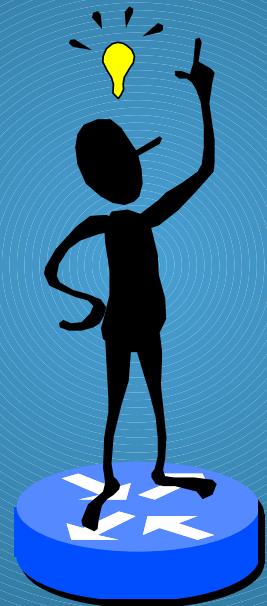
```
Router(config)#IP Nat pool [NAT Pool Name] [First inside  
global address] [Last inside global address] netmask  
[subnet mask]
```

- Assign NAT to an Interface

```
Router(config)#Interface [Serial x/y]  
Router(config-if)#IP NAT [Inside]
```

- See Example

PAT Port Address Translator



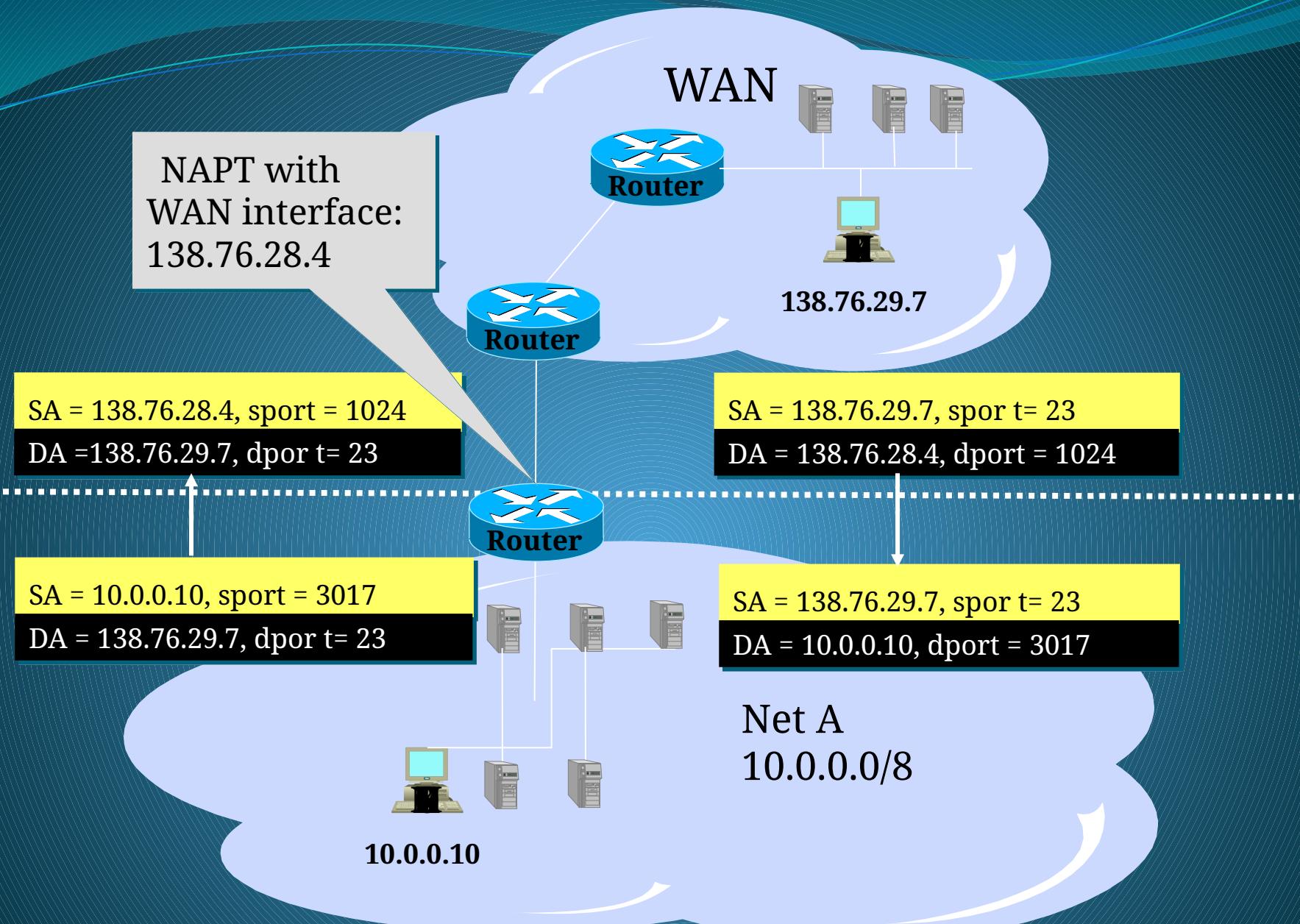


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PAT with e.g. a single public IP address

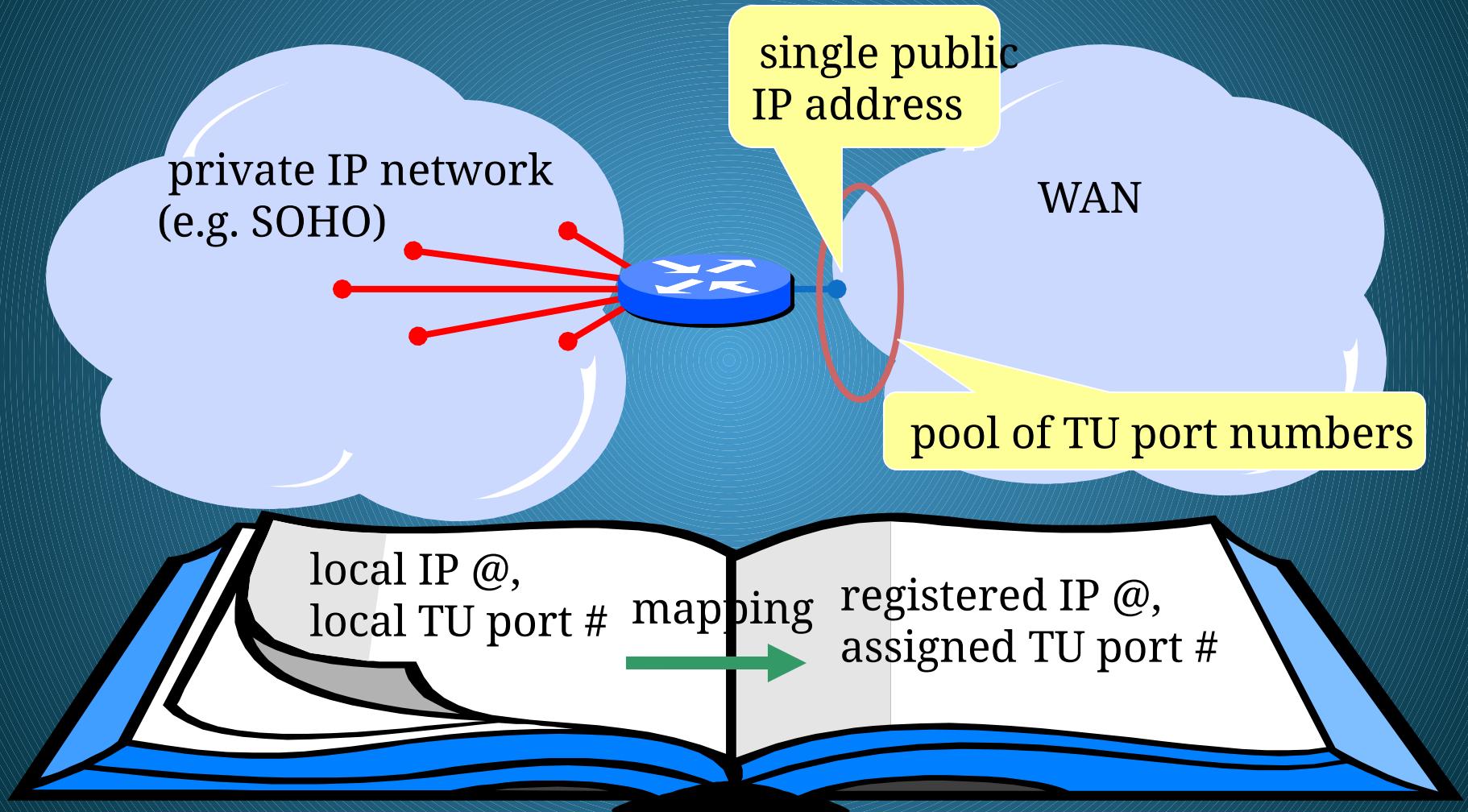


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PAT Configuration

- Specify inside addresses to be translated

```
Router(config)#IP Nat inside source list [standard Access  
List number] pool [NAT Pool Name] overload
```

- Specify PAT pool

```
Router(config)#IP Nat pool [NAT Pool Name] [First inside  
global address] [Last inside global address] netmask  
[subnet mask]
```

- Assign PAT to an Interface

```
Router(config)#Interface [Serial x/y]  
Router(config-if)#IP NAT [Inside]
```

- See Example