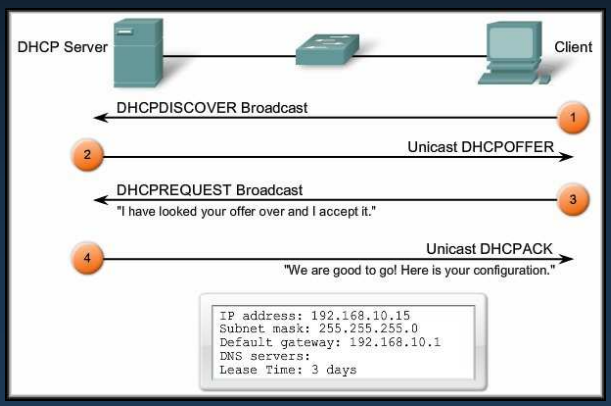
Chapter 7

IP Addressing Services

Part I

IP Addressing Services

Dynamic Host Configuration Protocol (DHCP)



Dynamic Host Configuration Protocol (DHCP)

- Every device that connects to a network needs an IP address.
  - Network administrators assign static IP addresses to routers, servers, and other network devices whose locations (physical and logical) are not likely to change.
  - User computers in an organization often change locations, physically and logically.
    - Desktop clients do not require a static address.
    - A workstation can use any address within a range of addresses.
    - This range is typically within an IP subnet.

Dynamic Host Configuration Protocol (DHCP)

- Administrators typically prefer a network server to offer DHCP services.
  - Scalable.
  - Relatively easy to manage.

- In a small branch or SOHO location, a Cisco router can be configured to provide DHCP services without the need for an expensive dedicated server.

DHCP Operation

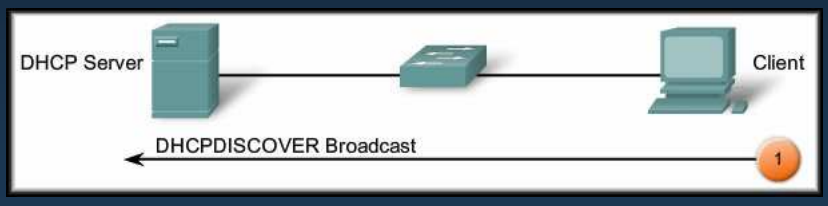
- Address Allocation Methods:
  - Manual:
    - The IP address for the client is pre-allocated by the administrator and DHCP conveys the address to the client.
  - Automatic:
    - DHCP automatically assigns a permanent IP address to a client with no lease period.
  - Dynamic:
    - DHCP assigns, or leases, an IP address to the client for a limited period of time.

DHCP Operation

- Dynamic Allocation:
  - DHCP works in a client/server mode.
    - When the client connects, the server assigns or leases an IP address to the device.
    - The device connects to the network with that leased IP address until the lease period expires.
    - The host must contact the DHCP server periodically to extend the lease.
    - The leasing of addresses assures that addresses that are no longer used are returned to the address pool for use by other devices.

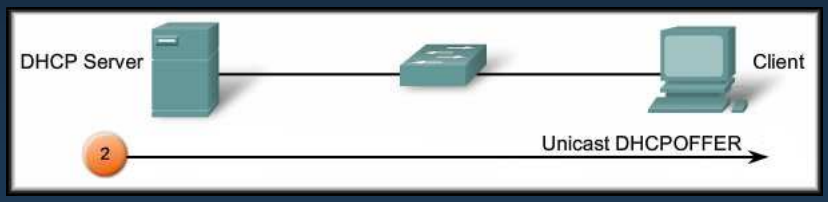
DHCP Operation

- Dynamic Allocation: 4 Step Process.
  - DHCPDISCOVER:
    - The client broadcasts a DHCPDISCOVER message.
    - The DHCPDISCOVER message finds the DHCP server(s) on the network.



DHCP Operation

- Dynamic Allocation: 4 Step Process.
  - DHCPOFFER:
    - The server responds with a DHCPOFFER.
    - The DHCPOFFER message is sent as a unicast and contains an available IP address to lease.

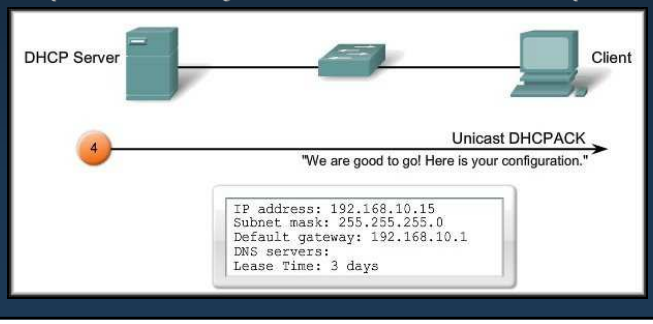


DHCP Operation

- Dynamic Allocation: 4 Step Process.
  - DHCPREQUEST:
    - The client responds with a broadcast of a DHCPREQUEST message.
    - When used for obtaining a lease, it serves as an *acceptance notice to the selected server* and an implicit decline to any other servers.
    - Also used for lease renewal and verification.

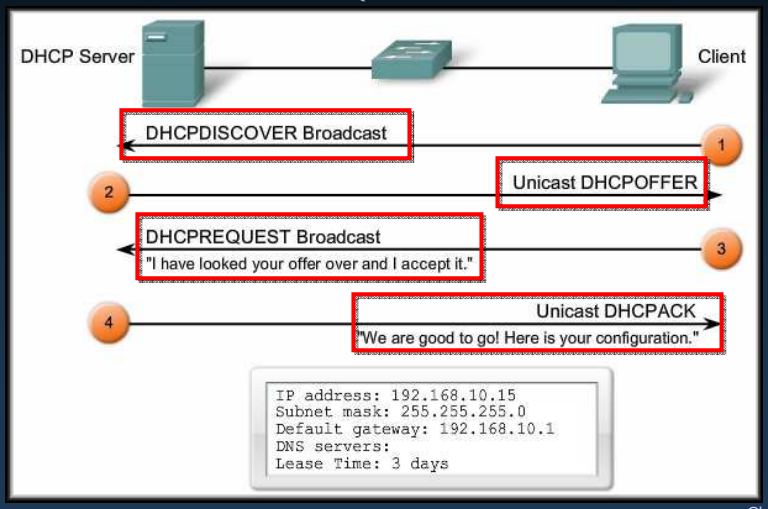
DHCP Operation

- Dynamic Allocation: 4 Step Process.
  - DHCPACK:
    - The server verifies the lease information and responds with a DHCPACK message.
    - The client logs the information and sends an ARP request to verify that the address is unique.



DHCP Operation

- Dynamic Allocation: 4 Step Process.



BOOTP and DHCP

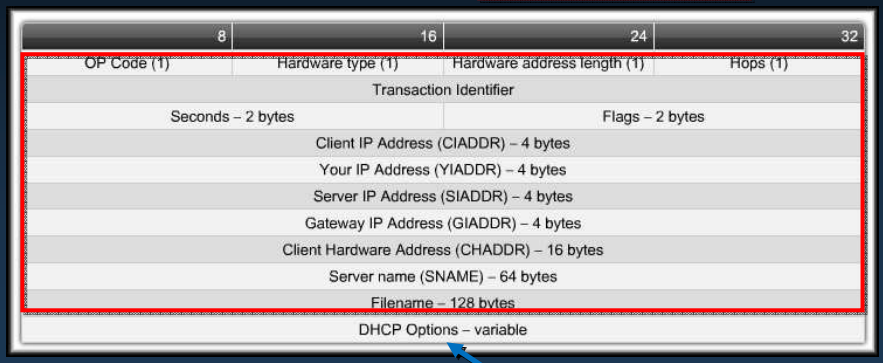
- Bootstrap Protocol (BOOTP):
  - Predecessor of DHCP.
  - A method to download address and boot configurations for diskless workstations.
  - Both DHCP and BOOTP are client/server based and use UDP ports 67 and 68.
  - The main difference is that BOOTP was designed for manual pre-configuration of the host information in a server database.

BOOTP	DHCP
Static mappings	Dynamic mappings
Permanent assignment	Lease
Only supports four configuration parameters	Supports over 20 configuration parameters

DHCP Message Format

- The developers of DHCP needed to maintain compatibility with BOOTP.

Same as BOOTP



Added to support functions of DHCP.

Configuring a Cisco Router as a DHCP Server

- 3 Basic Steps:
  - Step 1:
    - Define a range of addresses that DHCP is not to allocate.
    - Usually static addresses reserved for the router interface, switch management IP address, servers, and local network printers.
  - Step 2:
    - Create the DHCP pool of addresses using the **`ip dhcp pool`** command.
  - Step 3:
    - Configure the specific DHCP tasks for the pool.

Configuring a Cisco Router as a DHCP Server

- The DHCP service is **enabled by default** on versions of Cisco IOS that support it.
  - To disable the service:

```
Router(config)#no service dhcp
```

  - To enable the service:

```
Router(config)#service dhcp
```


Configuring a Cisco Router as a DHCP Server

- **Step 1:**
  - Exclude an address or addresses from the pool:

```
Router(config)#ip dhcp excluded-address
                low-address [high-address]
```

    - Exclude an individual address or range of addresses when assigning addresses to clients.
    - Used to reserve addresses that are statically assigned to key hosts, for instance, the interface address on the router.

Configuring a Cisco Router as a DHCP Server

- Step 2:
  - Create the DHCP pool and place the router in DHCP configuration mode.

```
Router(config)#ip dhcp pool [pool-name]

Router(config-dhcp)#
```


Configuring a Cisco Router as a DHCP Server

- Step 3:
  - Configure the specific DHCP tasks.
  - Define the pool of addresses:

```
Router(config-dhcp)#

    network network-number [mask | /prefix]
```

  - The network statement enables DHCP on any router interfaces belonging to that network.
    - The router will act as a DHCP server on that interface.
    - It is also the pool of addresses that the DHCP server will use.

Configuring a Cisco Router as a DHCP Server

- Step 3:
  - Configure the specific DHCP tasks.
  - Assign the default gateway for the DHCP clients:

```
Router(config-dhcp)#

default-router ip-address [ip-address2……]
```

  - Only one is required but up to 8 addresses may be assigned in one command line.

Configuring a Cisco Router as a DHCP Server

- Step 3:
  - Configure the specific DHCP tasks.
  - Assign the DNS Server(s) for the DHCP clients:

```
Router(config-dhcp)#

dns-server  ip-address [ip-address2……]
```

  - Only one is required but up to 8 addresses may be assigned in one command line.

Configuring a Cisco Router as a DHCP Server

- Step 3:
  - Configure the specific DHCP tasks.
  - Assign the WINS Server(s) for the DHCP clients:

```
Router(config-dhcp)#

netbios-name-server ip-address
                    [ip-address2……]
```

    - Only one is required but up to 8 addresses may be assigned in one command line.

Configuring a Cisco Router as a DHCP Server

- Step 3:
  - Configure the specific DHCP tasks.
  - Assign the Domain Name for the DHCP clients:

```
Router(config-dhcp)#

domain-name [domain]
```

Configuring a Cisco Router as a DHCP Server

- Step 3:
  - Configure the specific DHCP tasks.
  - Assign the duration of the lease for the DHCP clients:

```
Router(config-dhcp)#
lease {days [hours] [minutes] | infinite}
```

  - The default lease time is 1 day.

Configuring a Cisco Router as a DHCP Server

- Step 3:
  - Configure the specific DHCP tasks.
  - *FYI* - Other available parameters:

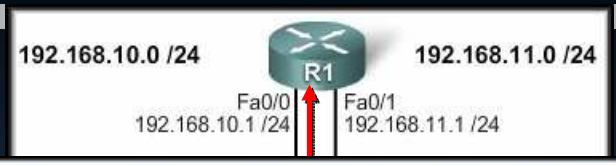
```
Router(config-dhcp)#
netbios-node-type [type]
host address [mask | /prefix]
hardware-address hardware-address-type
   or client-identifier unique-identifier
client-name name
bootfile filename
```

Configuring a Cisco Router as a DHCP Server

- ***FYI***
  - By default, the DHCP server pings a pool address twice before assigning the address to a requesting client.
  - If the ping is unanswered within 500 ms (i.e. times out), the DHCP server *assumes that the address is not in use and assigns the address to the requesting client*.
  - To change the number of ping packets sent and/or the timeout wait value:

```
Router(config)#ip dhcp ping packets number

Router(config)#ip dhcp ping timeout
                                milliseconds
```


Configuring a Cisco Router as a DHCP Server




```
ip dhcp excluded-address 192.168.10.1 192.168.10.9
ip dhcp excluded-address 192.168.10.254
ip dhcp excluded-address 192.168.11.1 192.168.11.9
ip dhcp excluded-address 192.168.11.254

ip dhcp pool LAN-POOL-1

network 192.168.10.0 255.255.255.0
default-router 192.168.10.1
domain-name span.com

ip dhcp pool LAN-POOL-2

network 192.168.11.0 255.255.255.0
default-router 192.168.11.1
domain-name span.com
```

Step 1

Step 2

Step 3

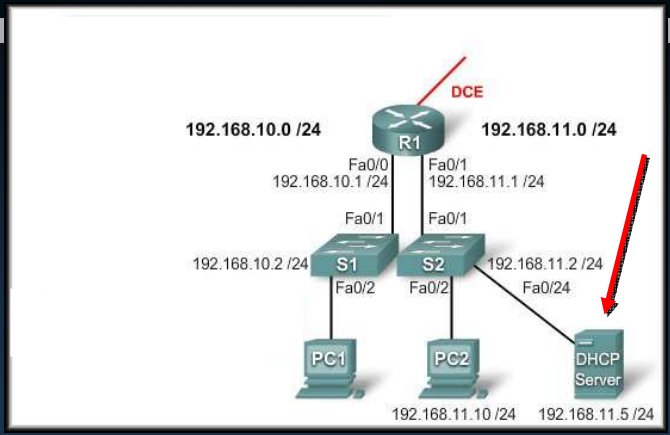
Configuring a Cisco Router as a DHCP Server

- Verifying DHCP:

```
Router#
    show ip dhcp binding
    show ip dhcp server statistics
    show ip dhcp pool
    debug ip dhcp server events
```

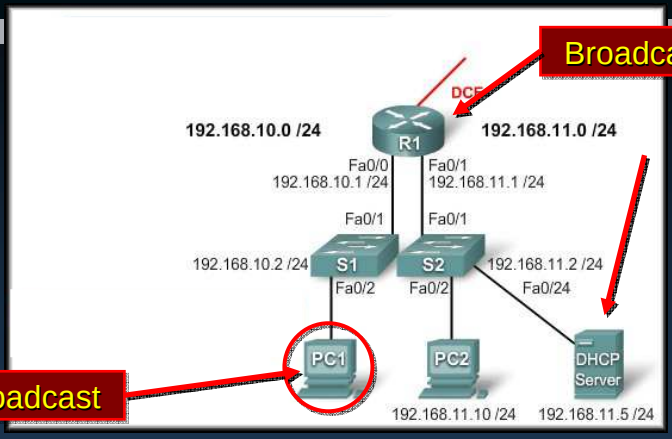
Much more detail in the lab….

DHCP Relay



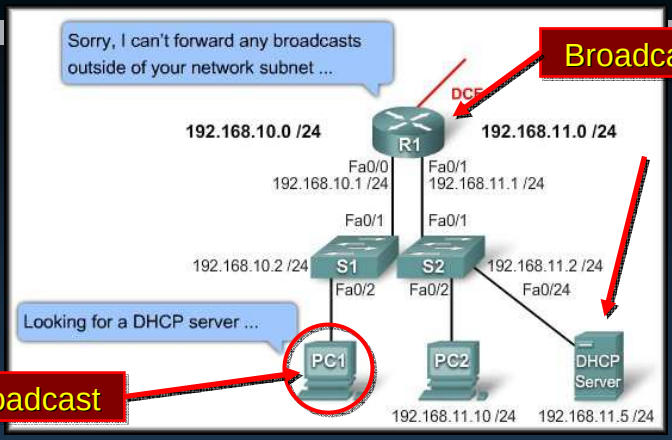
- In a complex hierarchical network, enterprise servers are usually contained in a server farm.
- These servers may provide DHCP, DNS, TFTP, and FTP services for the clients.

DHCP Relay



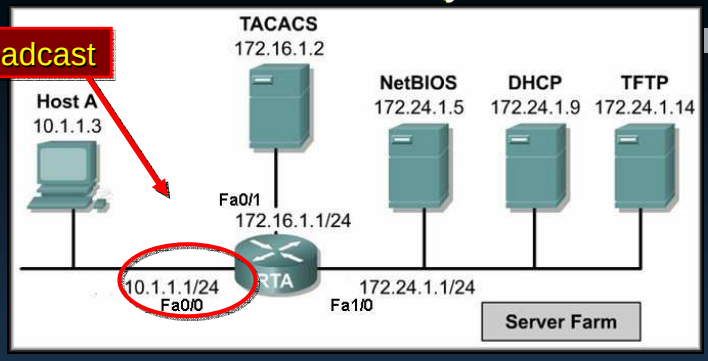
- PC1 either tries to obtain an IP configuration or attempts to renew its address.
- In addition, other network services use broadcasts to find a TFTP server or an authentication server.

DHCP Relay



- The solution is DHCP Relay.
- By configuring a helper address feature on intervening routers and switches the device will forward DHCP broadcasts, and others, to the appropriate server.

DHCP Relay



- To configure RTA Fa0/0 *(the interface that receives the Host A broadcasts)* to relay DHCP broadcasts to the DHCP server, use the following commands:

```
RTA(config)#interface fa0/0
RTA(config-if)#ip helper-address 172.24.1.9
```


DHCP Relay

- DHCP is not the only service that the router can be configured to relay.
- By default, the **`ip helper-address`** command forwards broadcasts for eight UDP services.

Service	Port
Time	37
TACACS	49
DNS	53
BOOTP/DHCP server	67
BOOTP/DHCP client	68
TFTP	69
NetBIOS name service	137
NetBIOS datagram service	138

DHCP Relay

- Default Forwarded UDP Services

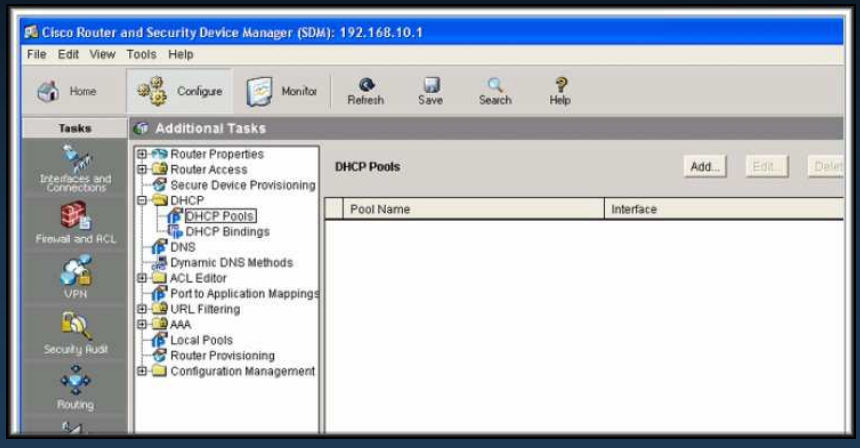
```
Router(config)#interface Fa0/0
Router(config-if)#ip helper-address 172.24.1.9
Router(config-if)#exit

Router(config)#ip forward-protocol udp 161
Router(config)#no ip forward-protocol udp 37
Router(config)#no ip forward-protocol udp 49
Router(config)#no ip forward-protocol udp 53
Router(config)#no ip forward-protocol udp 137
Router(config)#no ip forward-protocol udp 138
```

Add SNMP

- If you wish to stop the forwarding of a service or add another service for forwarding, it can be done using the **`ip forward-protocol`** command.

Configuring a DHCP Server Using SDM

- DHCP can also be configured using the Cisco Router and Security Device manager (SDM).



Troubleshooting DHCP Configuration

- Resolve any IP Address conflicts.

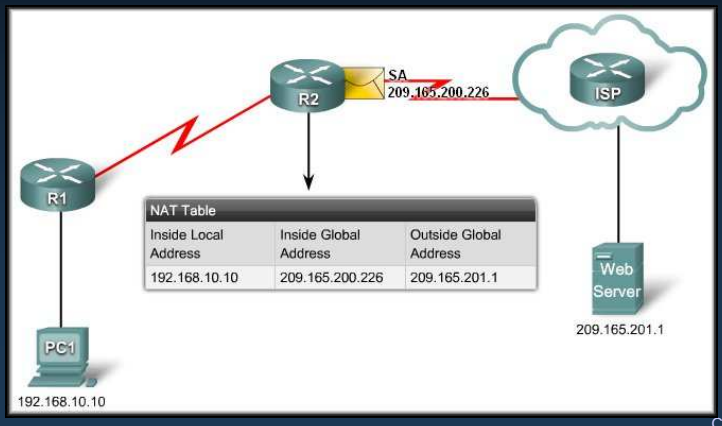
```
show ip address conflicts
```

- Verify physical connectivity.
- Test connectivity by configuring a workstation with a static IP address.
- Verify switch port configuration.
- Do DHCP clients obtain an IP address on the same subnet or VLAN where the DHCP server resides?
  - Verify any DHCP Relay configuration.
- Verify that the router is receiving DHCP requests.

```
debug ip dhcp events   debug ip dhcp server
      debug ip packet detail
```


IP Addressing Services

Scaling Networks With Network Address Translation (NAT)



Scaling Networks With NAT

- All public Internet addresses must be registered with a Regional Internet Registry (RIR).
- Organizations can lease public addresses from an ISP.
- Only the registered holder of a public Internet address can assign that address to a network device.

Public Internet addresses are regulated by five Regional Internet Registries (RIRs):
- ARIN
- RIPE NCC
- APNIC
- LACNIC
- AfriNIC

Scaling Networks With NAT

- Private Internet Addresses:
  - These are reserved private Internet addresses drawn from three blocks.
  - These addresses are for private, internal network use only.
  - RFC 1918 specifies that private addresses are not to be routed over the Internet.

Class	RFC 1918 Internal Address Range	CIDR Prefix
A	10.0.0.0 - 10.255.255.255	10.0.0.0/8
B	172.16.0.0 - 172.31.255.255	172.16.0.0/12
C	192.168.0.0 - 192.168.255.255	192.168.0.0/16

Scaling Networks With NAT

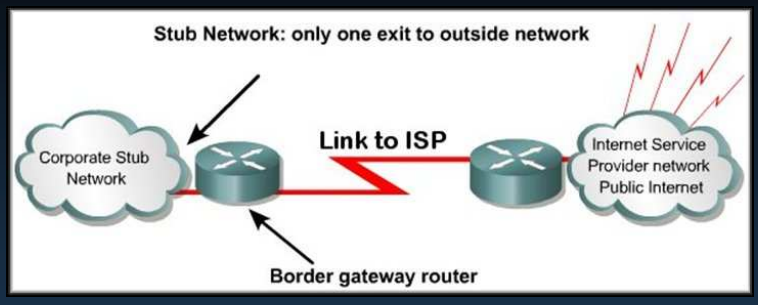
- Private Internet Addresses:
  - Two Issues:
    - You cannot route private addresses over the Internet.
    - There are not enough public addresses to allow organizations to provide one to every one of their hosts.
  - Networks need a mechanism to translate private addresses to public addresses at the edge of their network that works in both directions.
  - Solution – NAT.

Class	RFC 1918 Internal Address Range	CIDR Prefix
A	10.0.0.0 - 10.255.255.255	10.0.0.0/8
B	172.16.0.0 - 172.31.255.255	172.16.0.0/12
C	192.168.0.0 - 192.168.255.255	192.168.0.0/16

What is NAT?

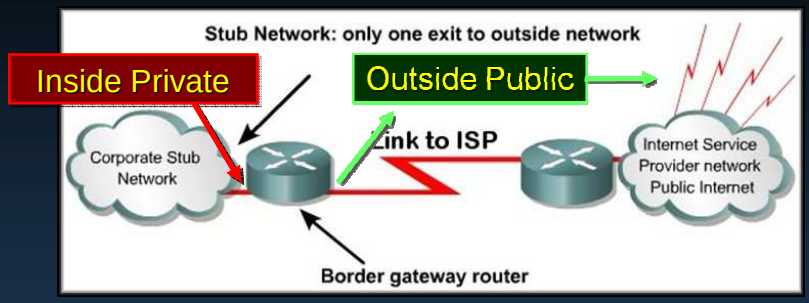
- The DHCP server assigns IP dynamic addresses to devices inside the network.
- NAT-enabled routers retain one or many valid Internet IP addresses outside of the network.
- When the client sends packets out of the network, NAT translates the internal IP address of the client to an external address.
- *To outside users, all traffic coming to and going from the network has the same IP address or is from the same pool of addresses.*

What is NAT?



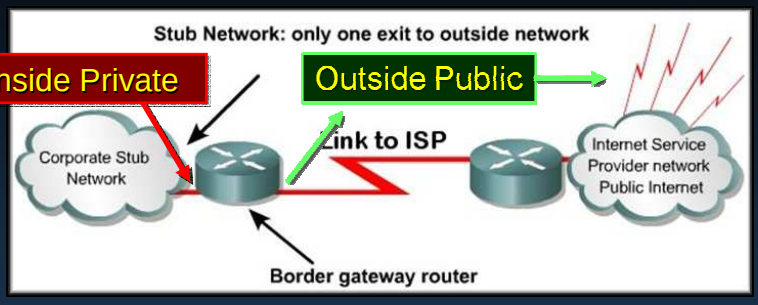
- A NAT enabled device typically operates at the border of a **stub network**.
- A **stub network** is a network that has a **single connection** to its neighbor network.

What is NAT?



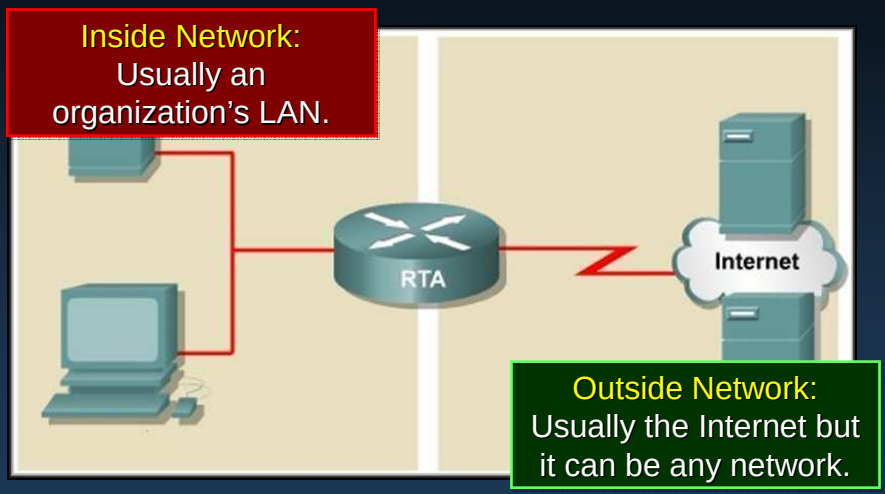
- When a host on the **inside** network wants to access a host on the **outside** network, the packet is sent to the border gateway router.
- The border gateway router performs the NAT process, translating the **inside private** address to an **outside public** address.

What is NAT?



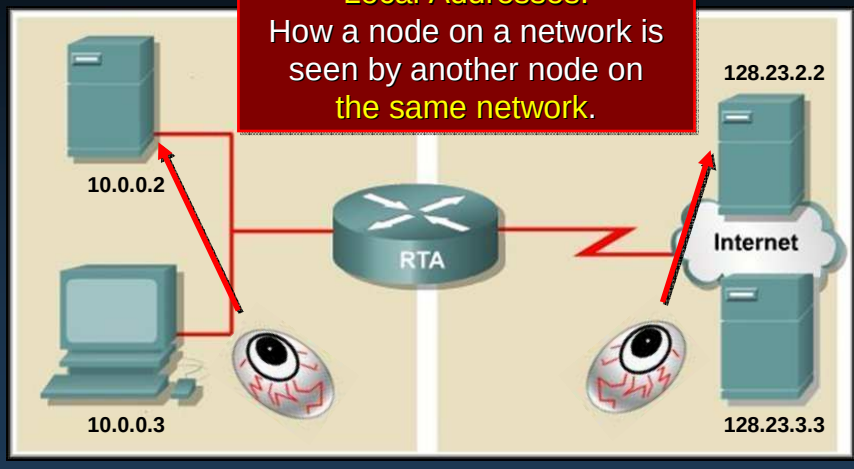
- The translation process uses an internal translation table.
- The contents of the table will vary depending on the type of network translation being implemented.
- We will be looking at the use of static NAT, dynamic NAT and Port Address Translation (PAT).

NAT Terminology



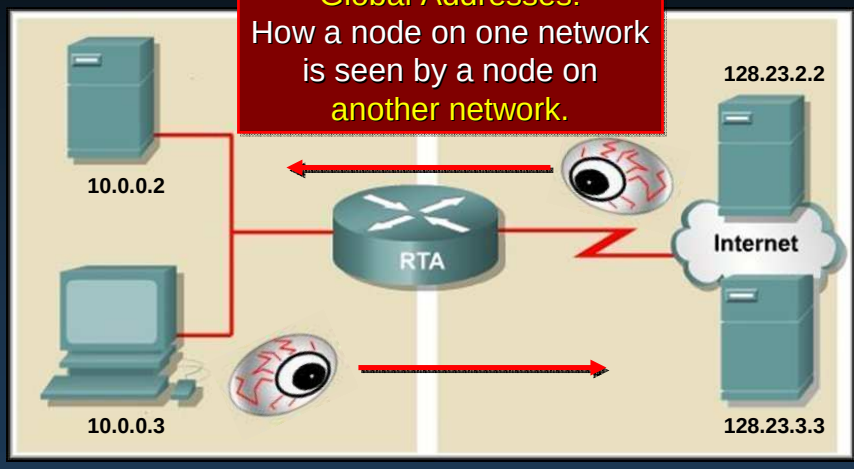
NAT Terminology

Local Addresses:
How a node on a network is seen by another node on the same network.



NAT Terminology

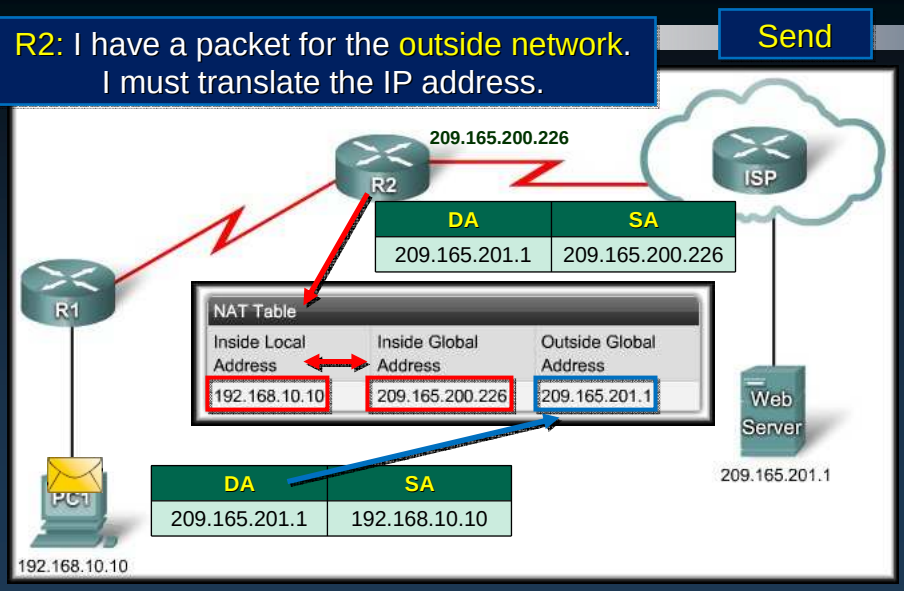
Global Addresses:
How a node on one network is seen by a node on another network.



NAT Terminology

- Inside Local Address:
  - An RFC 1918 address assigned to a host on an inside network.
- Inside Global Address:
  - A valid public address that the host on the inside network is assigned as it exits the router.
- Outside Global Address:
  - A reachable IP address assigned to a host on the Internet.
- *Outside Local Address:*
  - A local address assigned to a host on an outside network.
  - *(Use beyond the scope of this course).*

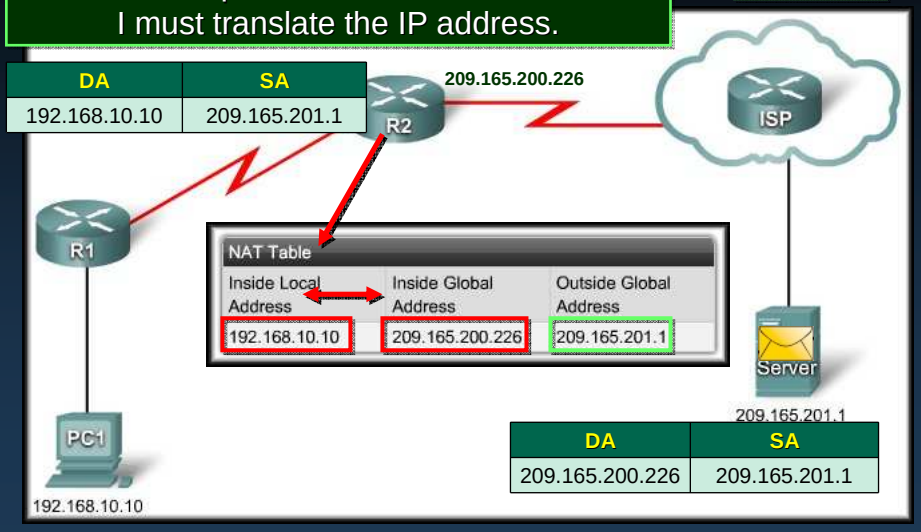
How Does NAT Work?



How Does NAT Work?

R2: I have a packet for the inside network. I must translate the IP address.

Receive



Dynamic Mapping and Static Mapping

- Dynamic Mapping:
  - Mapping of local addresses dynamically to a pool of global addresses.
  - The hosts able to use NAT is limited by the number of addresses in the range.
  - If you have allocated 6 public addresses for NAT, any 6 users can use NAT simultaneously.
    - The NAT device dynamically assigns an address when a request is received. When a session ends, the address is returned to the pool for another user.

NAT Table	
Inside Local	Inside Global
10.0.0.1	179.9.8.81
10.0.0.2	
10.0.0.3	
10.0.0.4	
10.0.0.5	
10.0.0.6	
10.0.0.7	
10.0.0.8	179.9.8.86

Dynamic Mapping and Static Mapping

- Static Mapping:
  - One to one mapping of local and global addresses.
  - The hosts able to use NAT is limited by the static assignment in the table.

NAT Table	
Inside Local	Inside Global
10.0.0.1	179.9.8.81
10.0.0.2	179.9.8.82
10.0.0.3	179.9.8.83
10.0.0.4	179.9.8.84
10.0.0.5	179.9.8.85
10.0.0.6	179.9.8.86

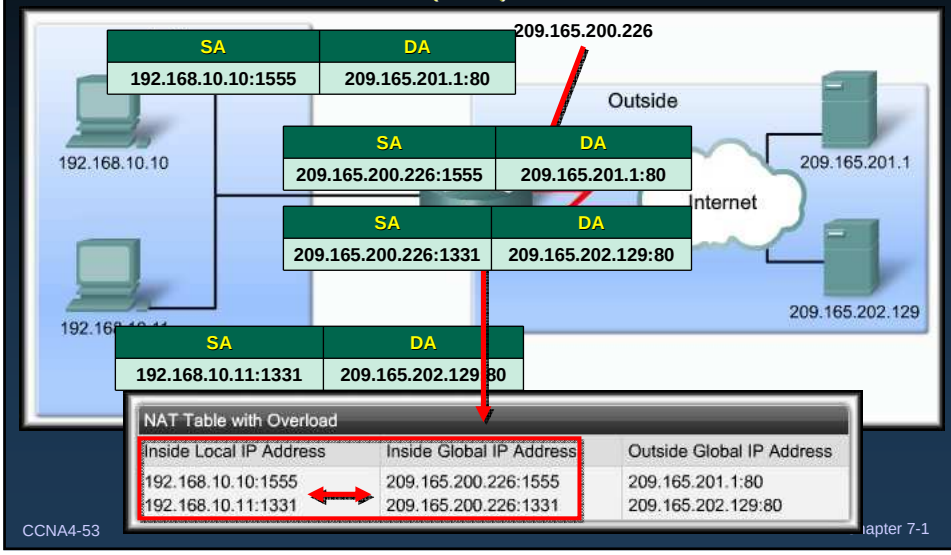
  - If you have allocated 6 public addresses for NAT, only these 6 users can use NAT.
    - No other network users will have access unless you allocate another global address and add it to the table.

NAT Overload

- Port Address Translation (PAT):
  - Allows you to use a single Public IP address and assign it up to 65,536 inside hosts (4,000 is more realistic).
  - Modifies the TCP/UDP source port to track inside host addresses.
  - Tracks and translates:
    - Source IP Address.
    - Destination IP Address.
    - TCP/UDP Source Port Number.
  - These uniquely identify each connection for each stream of traffic.

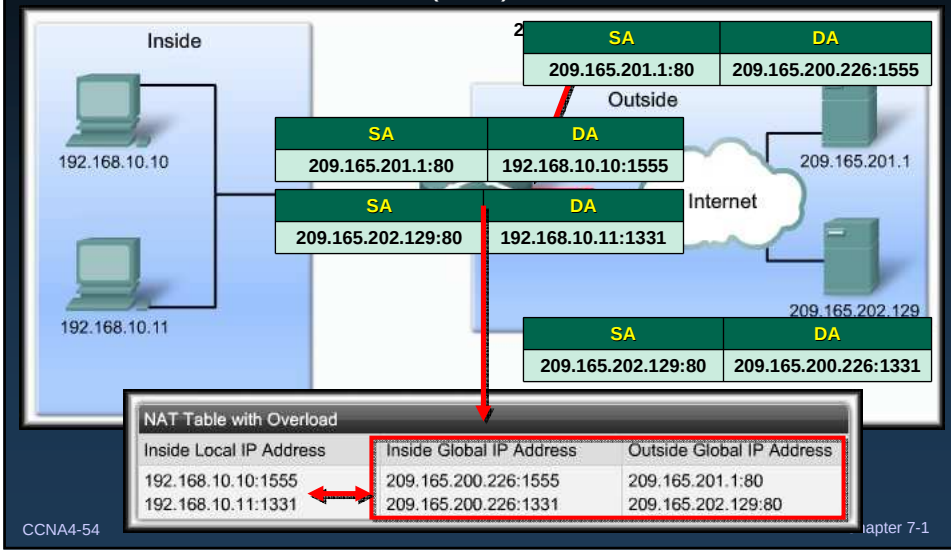
NAT Overload

- Port Address Translation (PAT):



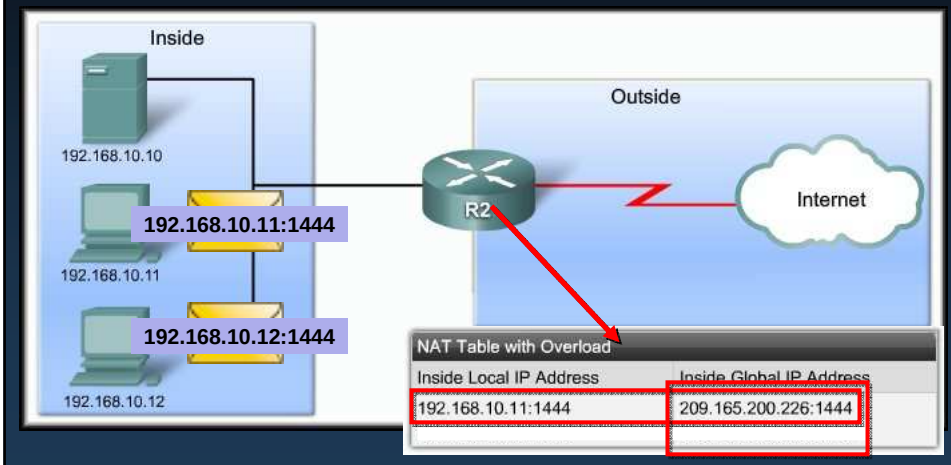
NAT Overload

- Port Address Translation (PAT):



NAT Overload

- Port Address Translation (PAT): *NEXT AVAILABLE PORT*



Benefits and Drawbacks

- NAT Benefits:
  - Conserves the legally registered addressing scheme.
  - Increases the flexibility of connections to the public network.
  - Provides consistency for internal network addressing schemes.
  - Provides network security.

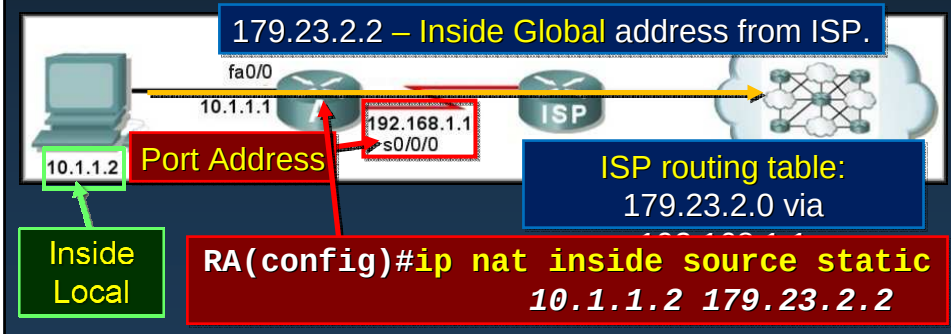
Benefits and Drawbacks

- NAT Drawbacks:
  - Performance is degraded.
  - End-to-end functionality is degraded.
  - End-to-end trace is lost.
  - Tunneling is more complicated.
  - Initiating TCP connections can be disrupted.
    - TCP initiated from the outside or stateless protocols using UDP.
  - Network architectures may have to be rebuilt.

Configuring Static NAT

- Step 1:
  - Specify static translation between an inside local and inside global address.

```
ip nat inside source static
            local-ip global-ip
```



Configuring Static NAT

- Step 2:
  - Mark the router interfaces as an inside interface or an outside interface.

```
RA(config)#interface fa0/0
RA(config-if)#ip address 10.1.1.1 255.255.255.0
RA(config-if)#ip nat inside
```

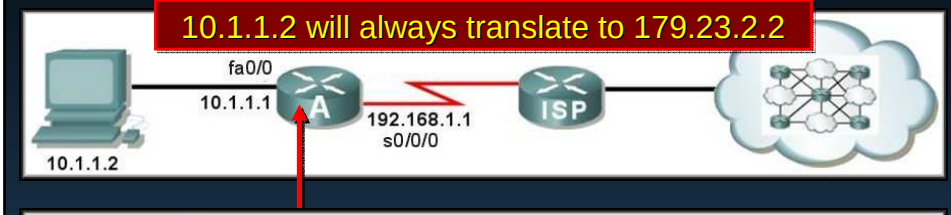
ISP routing table:
179.23.2.0 via

```
RA(config)#interface s0/0/0
RA(config-if)#ip address 192.168.1.1 255.255.255.0
RA(config-if)#ip nat outside
```


Configuring Static NAT

- Summary:

10.1.1.2 will always translate to 179.23.2.2




```
RA(config)#ip nat inside source static 10.1.1.2 179.23.2.2

RA(config)#interface fa0/0
RA(config-if)#ip address 10.1.1.1 255.255.255.0
RA(config-if)#ip nat inside

RA(config)#interface s0/0/0
RA(config-if)#ip address 192.168.1.1 255.255.255.0
RA(config-if)#ip nat outside
```

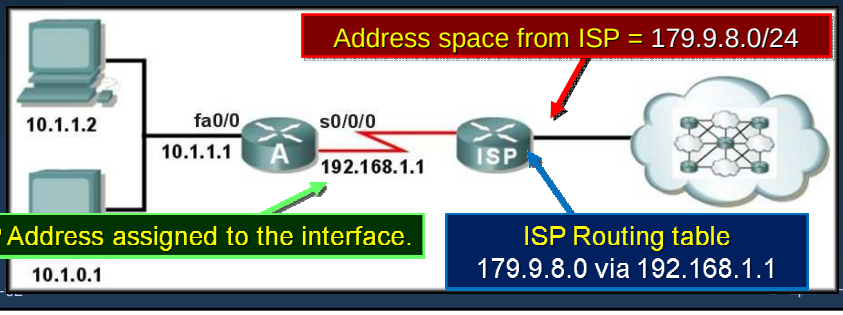
Configuring Dynamic NAT

1. Define a *named address pool* of outside addresses to be used for translation.
2. Define an *access list* to specify those inside addresses that are eligible for translation.
3. *Specify dynamic translation* between the inside addresses allowed by the access list and the pool of outside addresses.
4. *Mark the interfaces* as inside or outside.

Configuring Dynamic NAT

- Step 1:
  - Define a *named address pool* of outside addresses to be used for translation.

```
ip nat pool name start-ip end-ip
      (netmask netmask |
            prefix-length prefix-length)
```



Configuring Dynamic NAT

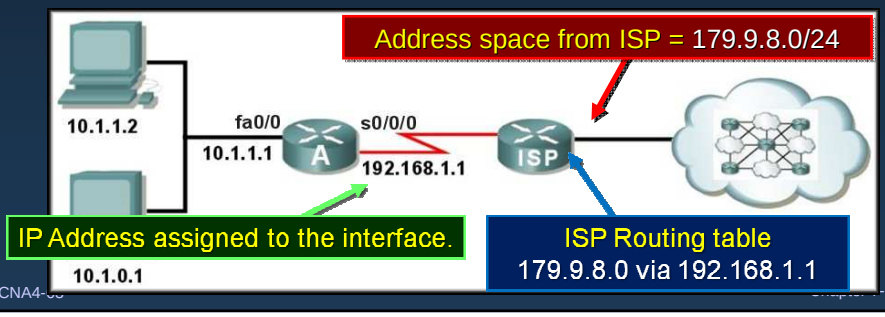
- Step 1:
  - Define a *named address pool* of outside addresses to be used for translation.

```
ip nat pool NAT-POOL1 179.9.8.80 179.9.8.85
            netmask 255.255.255.0
```

Range

Name

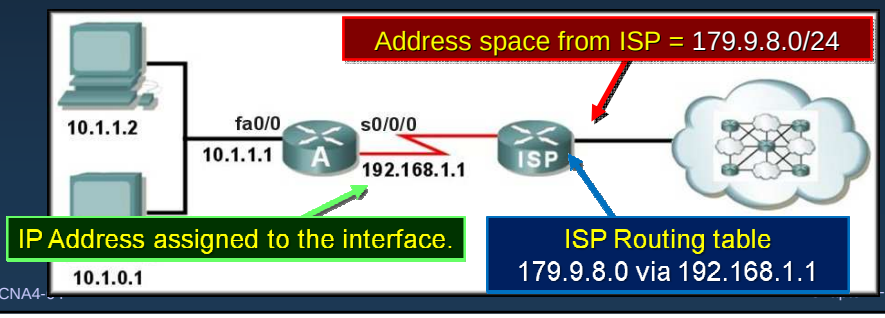
Mask



Configuring Dynamic NAT

- Step 2:
  - Define an *access list* to specify those inside addresses that are eligible for translation.

```
access-list access-list-number
            permit source [source wildcard]
```

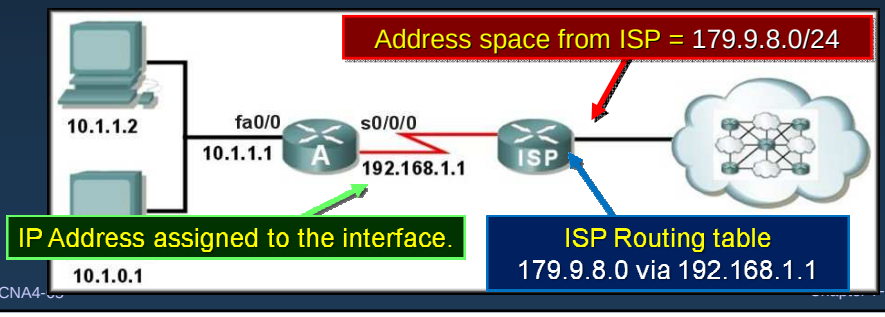


Configuring Dynamic NAT

- Step 2:
  - Define an *access list* to specify those inside addresses that are eligible for translation.

```
access-list 1 permit 10.1.0.0 0.0.255.255
```

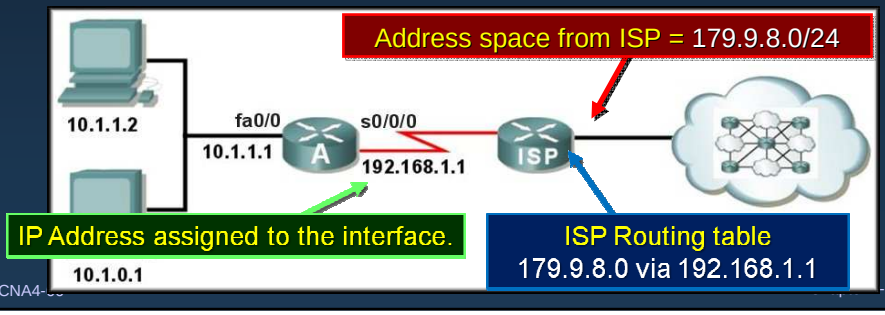
Allows ALL inside network addresses to be translated.



Configuring Dynamic NAT

- Step 2:
  - *Specify dynamic translation* between the inside addresses allowed by the access list and the pool of outside addresses.

```
ip nat inside source list access-list-number
                     pool pool-name
```



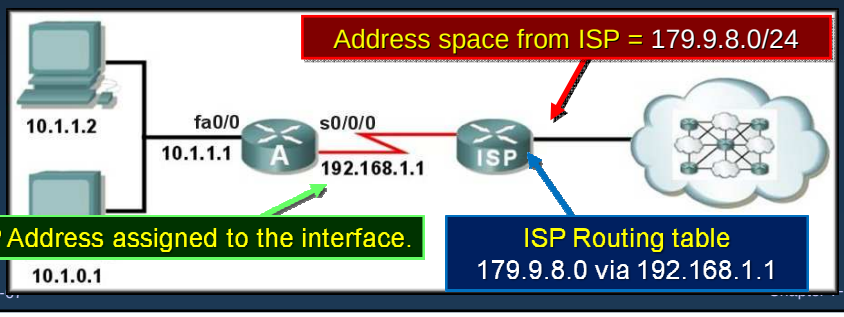
Configuring Dynamic NAT

- Step 3:
  - *Specify dynamic translation* between the inside addresses allowed by the access list and the pool of outside addresses.

From Step 1

```
ip nat inside source list 1 pool NAT-POOL1
```

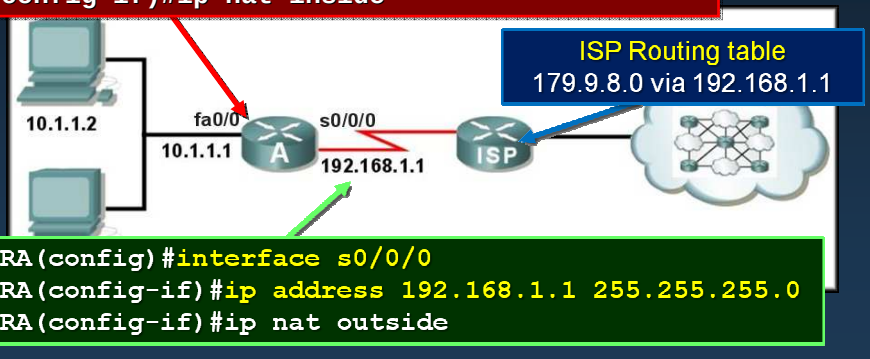
From Step 2



Configuring Dynamic NAT

- Step 4:
  - *Mark the interfaces* as inside or outside.

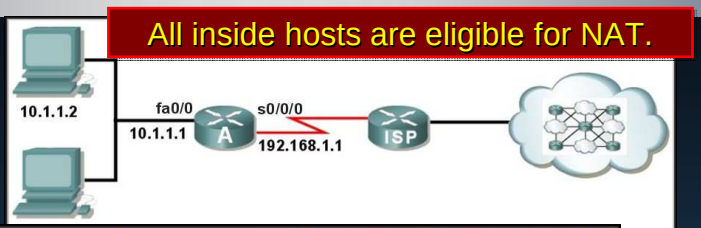
```
RA(config)#interface fa0/0
RA(config-if)#ip address 10.1.1.1 255.255.255.0
RA(config-if)#ip nat inside
```




```
RA(config)#interface s0/0/0
RA(config-if)#ip address 192.168.1.1 255.255.255.0
RA(config-if)#ip nat outside
```

Configuring Dynamic NAT

- Summary:




```
RA(config)#ip nat pool NAT-POOL1 179.9.8.80 179.9.8.85
                                 netmask 255.255.255.0

RA(config)#access-list 1 permit 10.1.0.0 0.0.0.255

RA(config)#ip nat inside source list 1 pool NAT-POOL1

RA(config)#interface fa0/0
RA(config-if)#ip address 10.1.1.1 255.255.255.0
RA(config-if)#ip nat inside

RA(config)#interface s0/0/0
RA(config-if)#ip address 192.168.1.1 255.255.255.0
RA(config-if)#ip nat outside
```


Configuring NAT Overload (PAT)

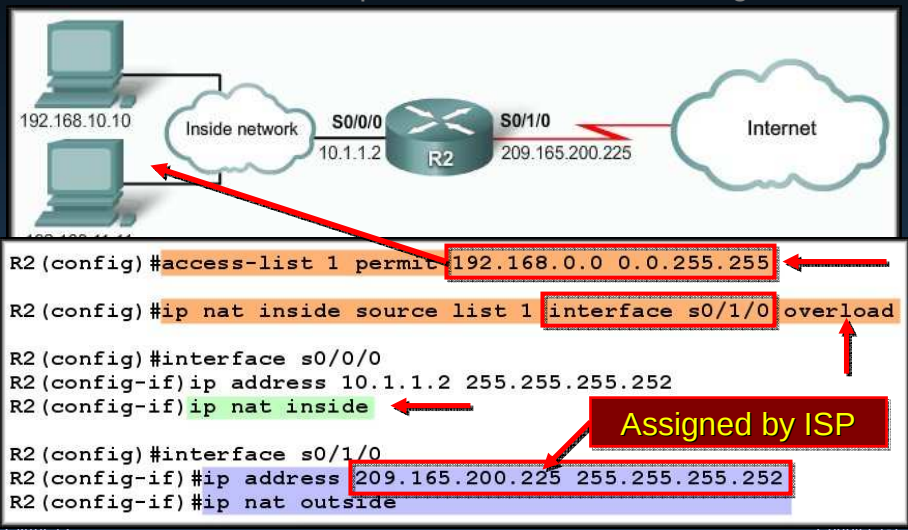
- There are two possible ways to configure overloading.
  - It depends on how the ISP allocates public IP addresses.
    - The ISP allocates one public IP address to the organization.
    - The ISP allocates more than one public IP address.
    - In either case, the configuration will include the **overload** keyword.
      - This keyword specifies to the router that Port Address Translation (PAT) is to be used.

Configuring NAT Overload (PAT)

- The ISP allocates one public IP address to the organization.
  1. Assign the IP address received from the ISP as the IP address of the outside interface.
  2. Define a standard access list permitting those addresses to be translated.
  3. Establish dynamic translation specifying the access list and the actual interface instead of a pool of addresses and include the **overload** keyword.
  4. Identify the inside and outside interfaces.

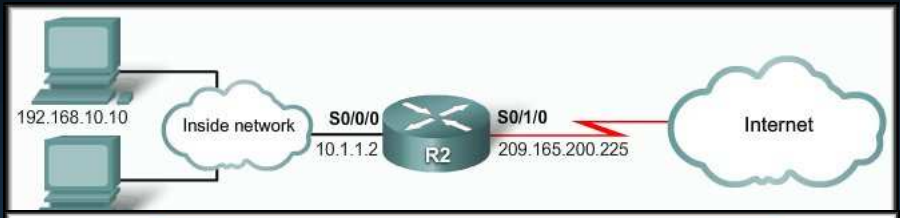
Configuring NAT Overload (PAT)

- The ISP allocates one public IP address to the organization.



Configuring NAT Overload (PAT)

- The ISP allocates more than one public IP address.




```
R2(config)#access-list 1 permit 192.168.0.0 0.0.255.255

R2(config)#ip nat pool NAT-POOL2 209.165.200.226 209.165.200.240

R2(config)#ip nat inside source list 1 pool NAT-POOL2 overload

R2(config)#interface s0/0/0
R2(config-if)ip address 10.1.1.2 255.255.255.252
R2(config-if)ip nat inside

R2(config)#interface s0/1/0
R2(config-if)#ip address 209.165.200.225 255.255.255.252
R2(config-if)#ip nat outside
```

Verifying NAT and NAT Overload

- **show ip nat translations**

```
R2#show ip nat translations
Pro Inside global          Inside local          Outside local         Outside global
tcp 209.165.200.225:16642  192.168.10.10:16642   209.165.200.254:80    209.165.200.254:80
tcp 209.165.200.225:62452  192.168.11.10:62452   209.165.200.254:80    209.165.200.254:80

R2#show ip nat translations verbose
Pro Inside global          Inside local          Outside local         Outside global
tcp 209.165.200.225:16642  192.168.10.10:16642   209.165.200.254:80    209.165.200.254:80
    create 00:01:45, use 00:01:43 timeout:86400000, left 23:58:16, Map-Id(In): 1,
    flags:
extended, use_count: 0, entry-id: 4, lc_entries: 0
tcp 209.165.200.225:62452  192.168.11.10:62452   209.165.200.254:80    209.165.200.254:80
    create 00:00:37, use 00:00:35 timeout:86400000, left 23:59:24, Map-Id(In): 1,
    flags:
extended, use_count: 0, entry-id: 5, lc_entries: 0
R2#
```

Verifying NAT and NAT Overload

- **show ip nat statistics**

```
R2#show ip nat translations
Pro Inside global          Inside local       Outside local      Outside global
icmp 209.165.200.225:3     192.168.10.10:3    209.165.200.254:3  209.165.200.254:3
tcp  209.165.200.225:11679 192.168.10.10:11679 209.165.200.254:80 209.165.200.254:80
icmp 209.165.200.225:0     192.168.11.10:0    209.165.200.254:0  209.165.200.254:0
tcp  209.165.200.225:14462 192.168.11.10:14462 209.165.200.254:80 209.165.200.254:80

R2#show ip nat statistics
Total active translations: 3 (0 static, 3 dynamic; 3 extended)
Outside interfaces:
  Serial0/1/0
Inside interfaces:
  Serial0/0/0, Serial0/0/1
Hits: 173  Misses: 9
CEF Translated packets: 182, CEF Punted packets: 0
Expired translations: 6
Dynamic mappings:
-- Inside Source
[Id: 1] access-list 1 interface Serial0/1/0 refcount 3
Queued Packets: 0
R2#
```


Verifying NAT and NAT Overload

- **clear ip nat translation**

Command	Description
clear ip nat translation *	Clears all dynamic address translation entries from the NAT translation table
clear ip nat translation inside *global-ip local-ip* [**outside** *local-ip global-ip*]	Clears a simple dynamic translation entry containing an inside translation or both inside and outside translation
clear ip nat translation *protocol* **inside** *global-ip global-port local-ip local-port* [**outside** *local-ip local-port global-ip global-port*]	Clears an extended dynamic translation entry

Troubleshooting NAT and NAT Overload

- **show ip nat translations**
- **clear ip nat translation**
- **debug ip nat**

```
R2# debug ip nat
IP NAT debugging is on
R2#
*Oct  6 19:55:31.579: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14434]
*Oct  6 19:55:31.595: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6334]
*Oct  6 19:55:31.611: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14435]
*Oct  6 19:55:31.619: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14436]
*Oct  6 19:55:31.627: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14437]
*Oct  6 19:55:31.631: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6335]
*Oct  6 19:55:31.643: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6336]
*Oct  6 19:55:31.647: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14438]
*Oct  6 19:55:31.651: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6337]
*Oct  6 19:55:31.655: NAT*: s=192.168.10.10->209.165.200.225, d=209.165.200.254 [14439]
*Oct  6 19:55:31.659: NAT*: s=209.165.200.254, d=209.165.200.225->192.168.10.10 [6338]

<Output omitted>
```