

# CCNA 200-301, Volume 2

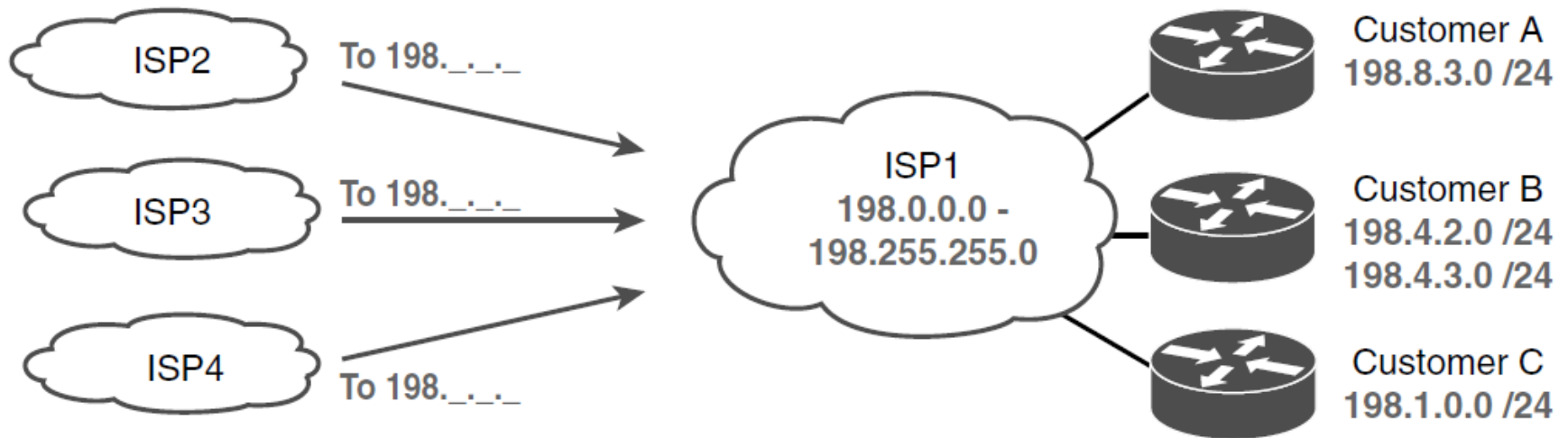
Chapter 10

**Network Address Translation**

# Objectives

- Configure and verify inside source NAT using static and pools

# Typical Use of CIDR



# RFC 1918 Private Address Space

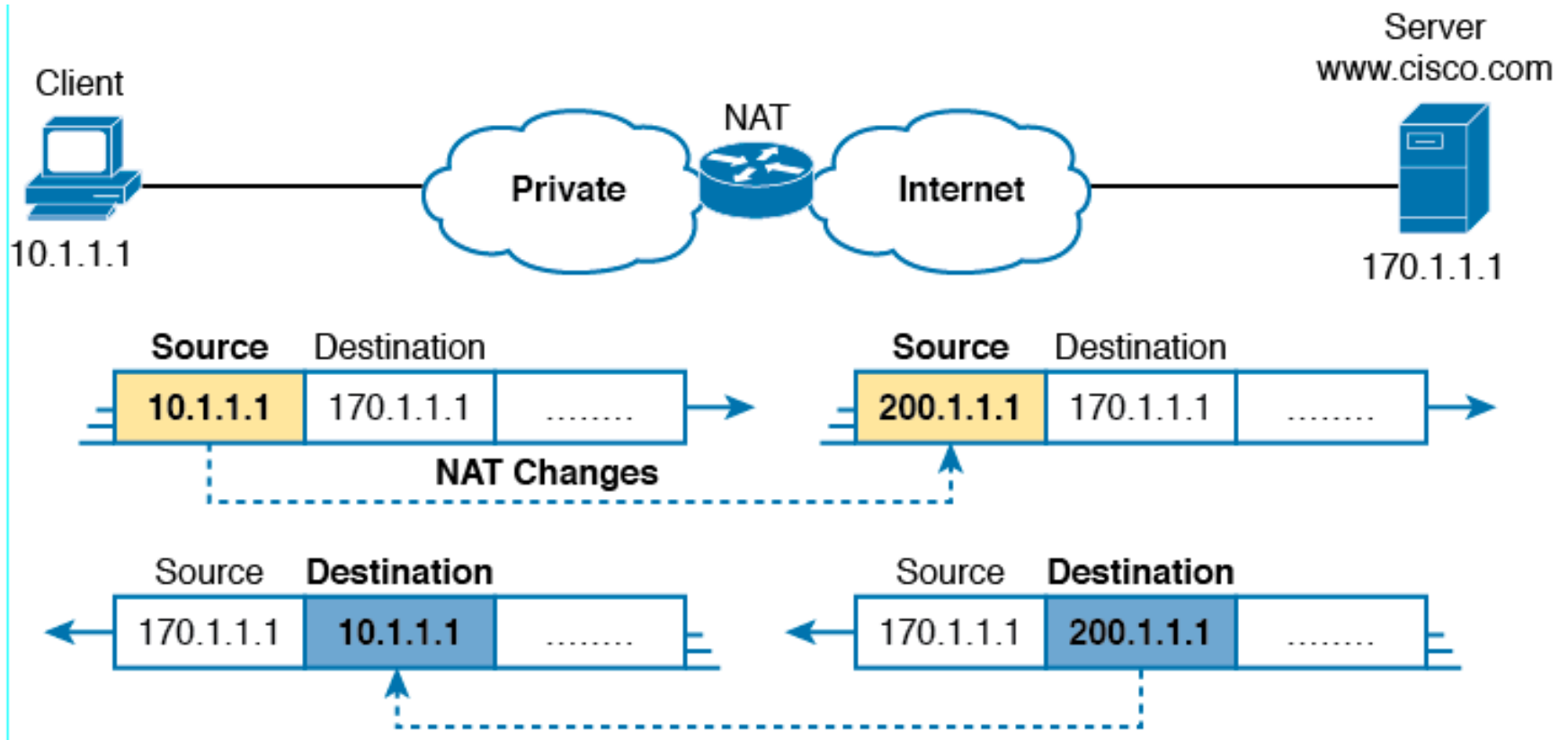
Range of IP Addresses	Network(s)	Class of Networks	Number of Networks
10.0.0.0 to 10.255.255.255	10.0.0.0	A	1
172.16.0.0 to 172.31.255.255	172.16.0.0 – 172.31.0.0	B	16
192.168.0.0 to 192.168.255.255	192.168.0.0 – 192.168.255.0	C	256

# Three Important Functions that Extend the Life of IPv4

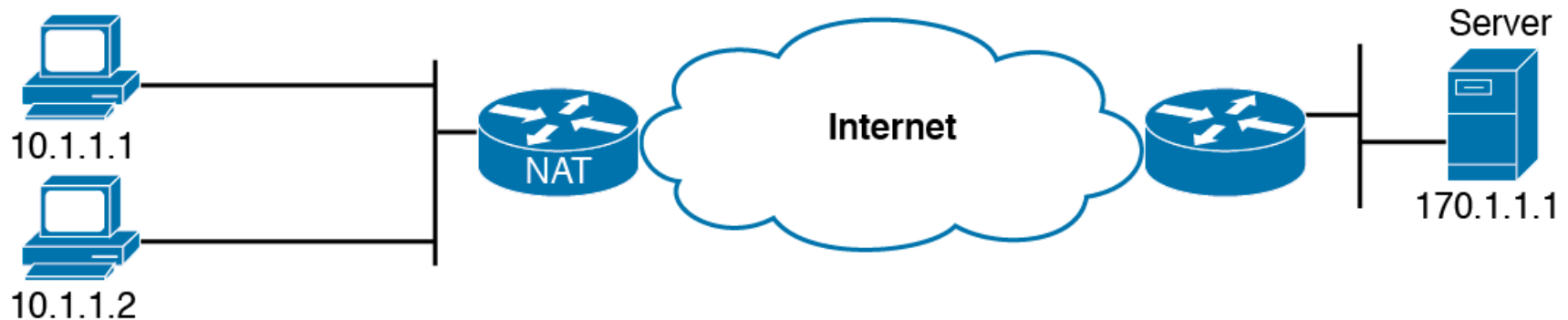
Feature	RFC(s)	Main Benefits
CIDR*	4632	Assign more-specific public Ipv4 address blocks to companies than Class A, B, and C networks. Aggregate routes to public IPv4 addresses based on worldwide address allocation plan.
NAT*	3022	Enable approximately 65,000 TCP/UDP sessions to be supported by a single public IPv4 address.
Private networks	1918	Enable the use of NAT for enterprise Internet connections, with private addresses used inside the enterprise.

\*CIDR and NAT may be better known for their original RFCs (1518, 1519 for CIDR; 1631 for NAT)

# NAT IPv4 Address Swapping: Private Addressing



# Static NAT Showing Inside Local and Global Addresses



SA = 10.1.1.1 →

SA = 200.1.1.1 →

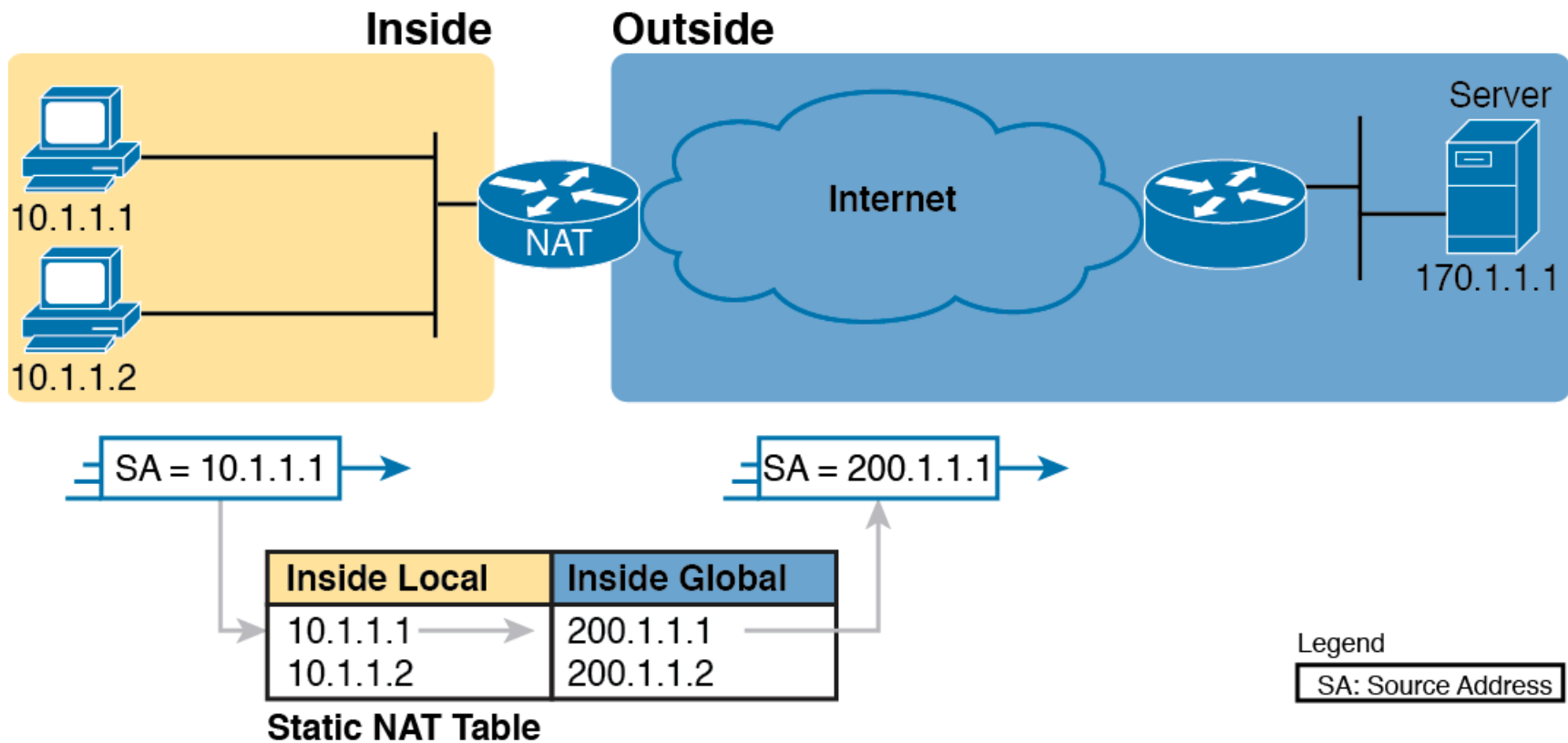
Private Address	Public Address
10.1.1.1 →	200.1.1.1 →
10.1.1.2	200.1.1.2

**Static NAT Table**

Legend

SA: Source Address

# Static NAT Terminology

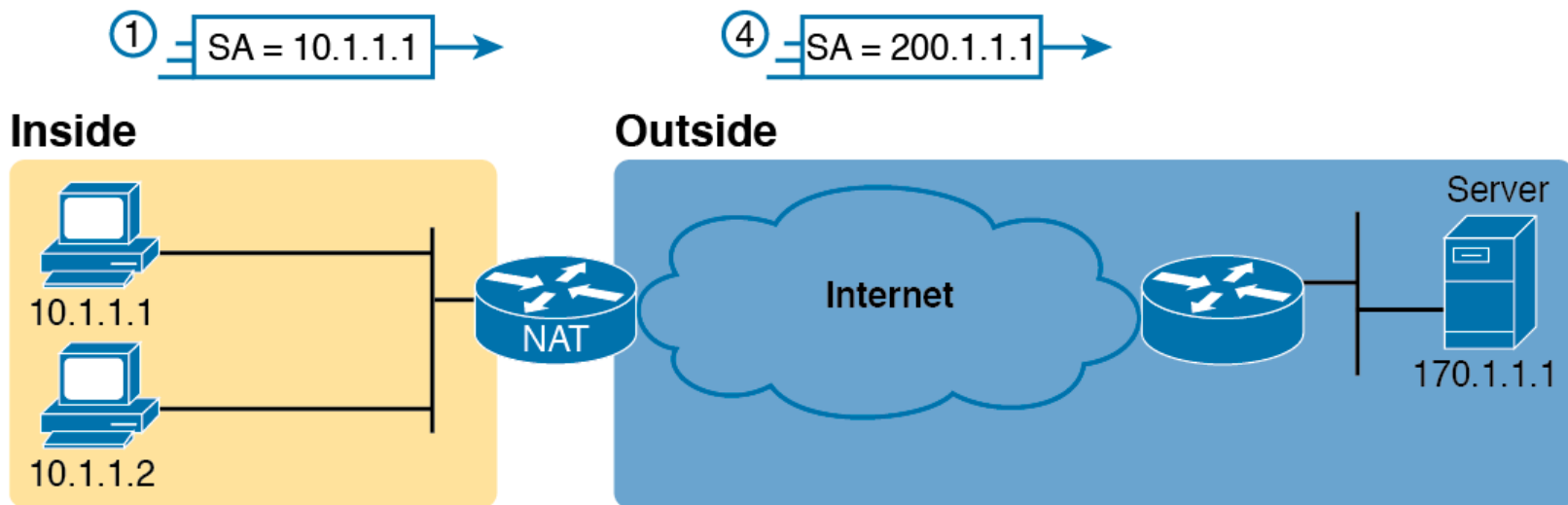




# NAT Addressing Terms

Term	Values in Figures	Meaning
Inside local	10.1.1.1	<p><b>Inside:</b> Refers to the permanent location of the host, from the enterprise's perspective: it is inside the enterprise.</p> <p><b>Local:</b> Means not global; that is, local. It is the address used for that host while the packet flows in the local enterprise rather than the global Internet.</p> <p><b>Alternative:</b> Think of it as inside private, because this address is typically a private address.</p>
Inside global	200.1.1.1	<p><b>Inside:</b> Refers to the permanent location of the host, from the enterprise's perspective.</p> <p><b>Global:</b> Means global as in the global Internet. It is the address used for that host while the packet flows in the Internet.</p> <p><b>Alternative:</b> Think of it as inside public, because the address is typically a public IPv4 address.</p>
Outside global	170.1.1.1	<p>With source NAT, the one address used by the host that resides outside the enterprise, which NAT does not change, so there is no need for a contrasting term.</p> <p><b>Alternative:</b> Think of it as outside public, because the address is typically a public IPv4 address.</p>
Outside local	—	<p>This term is not used with source NAT. With destination NAT, the address would represent a host that resides outside the enterprise, but the address used to represent that host as packets pass through the local enterprise.</p>

# Dynamic NAT



**NAT Table Before First Packet**

Inside Local	Inside Global

**Criteria for NAT:**

10.1.1.\_\_\_\_

②

**NAT Table After First Packet**

Inside Local	Inside Global
10.1.1.1	200.1.1.1

③

**NAT Pool:**

200.1.1.1  
200.1.1.2  
200.1.1.3  
200.1.1.4  
200.1.1.5

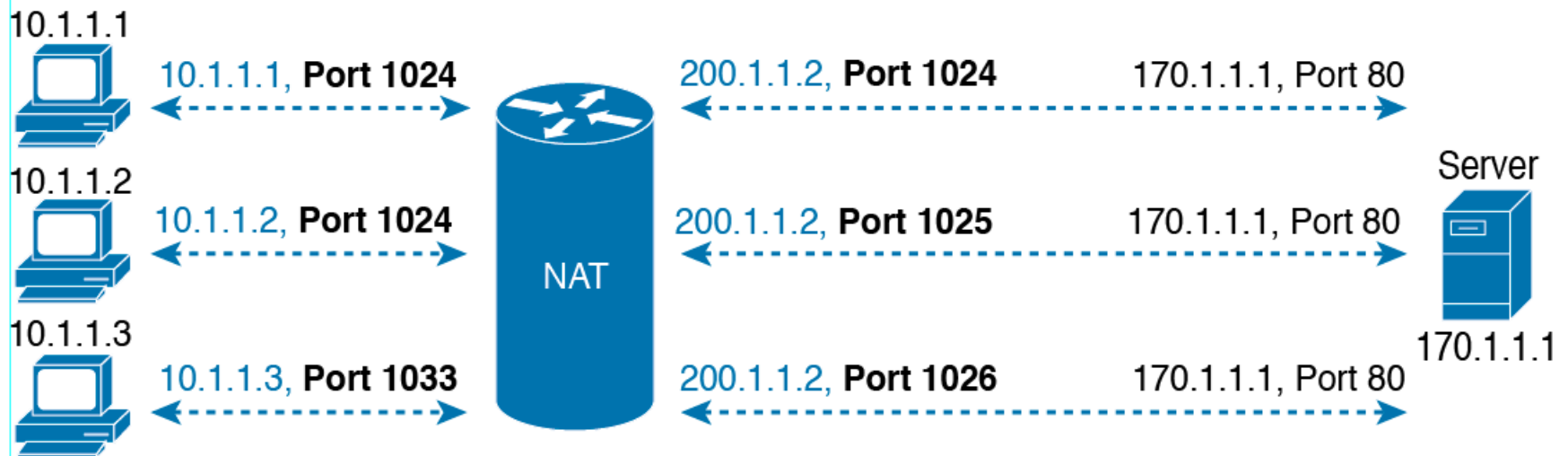
# Three TCP Connections from Three PCs



# Three TCP Connections from One PC



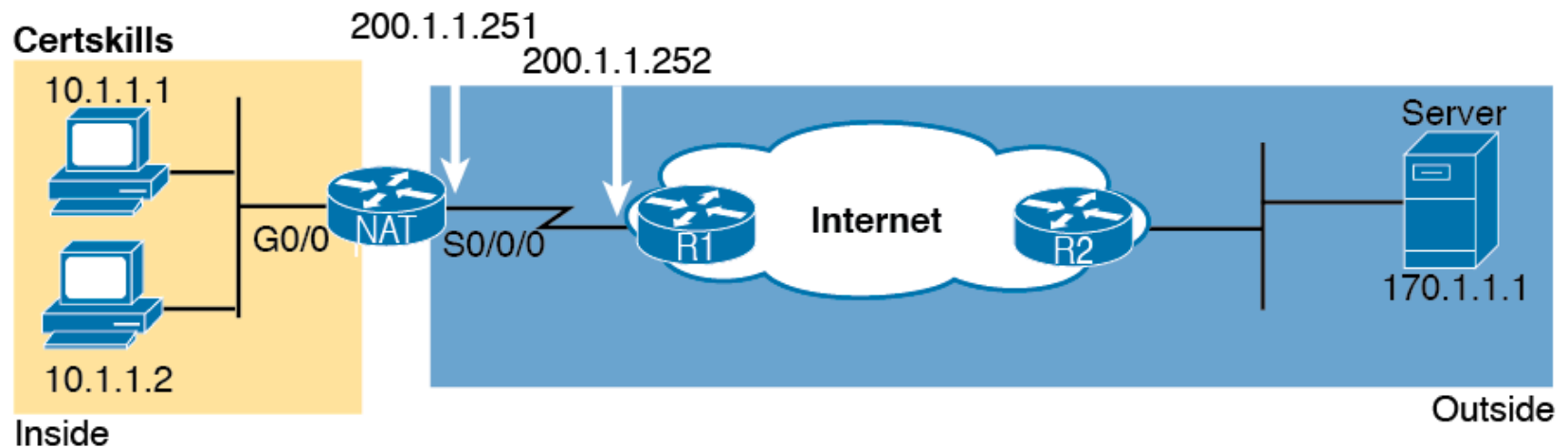
# NAT Overload (PAT)



Inside Local	Inside Global
10.1.1.1: 1024	200.1.1.2: 1024
10.1.1.2: 1024	200.1.1.2: 1025
10.1.1.3: 1033	200.1.1.2: 1026

Dynamic NAT Table, With Overloading

# Sample Network for NAT Examples, with Public Class C 200.1.1.0/24



Static NAT Configuration

Inside Local	Inside Global
10.1.1.1	200.1.1.1
10.1.1.2	200.1.1.2

# Static NAT Configuration

```
NAT# show running-config
```

```
!
```

```
! Lines omitted for brevity
```

```
!
```

```
interface GigabitEthernet0/0
```

```
ip address 10.1.1.3 255.255.255.0
```

```
ip nat inside
```

```
!
```

```
interface Serial0/0/0
```

```
ip address 200.1.1.251 255.255.255.0
```

```
ip nat outside
```

```
!
```

```
ip nat inside source static 10.1.1.2 200.1.1.2
```

```
ip nat inside source static 10.1.1.1 200.1.1.1
```

```
NAT# show ip nat translations
```

Pro	Inside global	Inside local	Outside local	Outside global
-----	---------------	--------------	---------------	----------------

# Static NAT Configuration (continued)

```
--- 200.1.1.1      10.1.1.1      ---  
--- 200.1.1.2      10.1.1.2      ---
```

```
NAT# show ip nat statistics
```

```
Total active translations: 2 (2 static, 0 dynamic; 0 extended)
```

```
Outside interfaces:
```

```
Serial0/0/0
```

```
Inside interfaces:
```

```
GigabitEthernet0/0
```

```
Hits: 100 Misses: 0
```

```
Expired translations: 0
```

```
Dynamic mappings:
```



# Dynamic NAT Configuration

```
NAT# show running-config
!
! Lines omitted for brevity
!
interface GigabitEthernet0/0
 ip address 10.1.1.3 255.255.255.0
 ip nat inside
!
interface Serial0/0/0
 ip address 200.1.1.251 255.255.255.0
 ip nat outside
!
ip nat pool fred 200.1.1.1 200.1.1.2 netmask 255.255.255.252
ip nat inside source list 1 pool fred
!
access-list 1 permit 10.1.1.2
access-list 1 permit 10.1.1.1
```

# Dynamic NAT Verifications Before Generating Traffic

```
! The next command lists one empty line because no entries have been dynamically
! created yet.
NAT# show ip nat translations

NAT# show ip nat statistics
Total active translations: 0 (0 static, 0 dynamic; 0 extended)
Peak translations: 8, occurred 00:02:44 ago
Outside interfaces:
  Serial0/0/0
Inside interfaces:
  GigabitEthernet0/0
Hits: 0 Misses: 0
CEF Translated packets: 0, CEF Punted packets: 0
Expired translations: 0
Dynamic mappings:
-- Inside Source
[id 1] access-list 1 pool fred refcount 0
  pool fred: netmask 255.255.255.252
    start 200.1.1.1 end 200.1.1.2
    type generic, total addresses 2, allocated 0 (0%), misses 0

Total doors: 0
Appl doors: 0
Normal doors: 0
Queued Packets: 0
```

# Dynamic NAT Verifications After Generating Traffic

```
NAT# show ip nat translations
```

Pro	Inside global	Inside local	Outside local	Outside global
---	200.1.1.1	10.1.1.1	---	---

```
NAT# show ip nat statistics
```

```
Total active translations: 1 (0 static, 1 dynamic; 0 extended)
```

```
Peak translations: 11, occurred 00:04:32 ago
```

```
Outside interfaces:
```

```
Serial0/0/0
```

```
Inside interfaces:
```

```
GigabitEthernet0/0
```

```
Hits: 69 Misses: 1
```

```
Expired translations: 0
```

```
Dynamic mappings:
```

```
-- Inside Source
```

```
access-list 1 pool fred refcount 1
```

```
[eml fred: netmask 255.255.255.252
```

```
start 200.1.1.1 end 200.1.1.2
```

```
type generic, total addresses 2, allocated 1 (50%), misses 0
```

# Example of Reuse of a Dynamic Inside Global IP Address

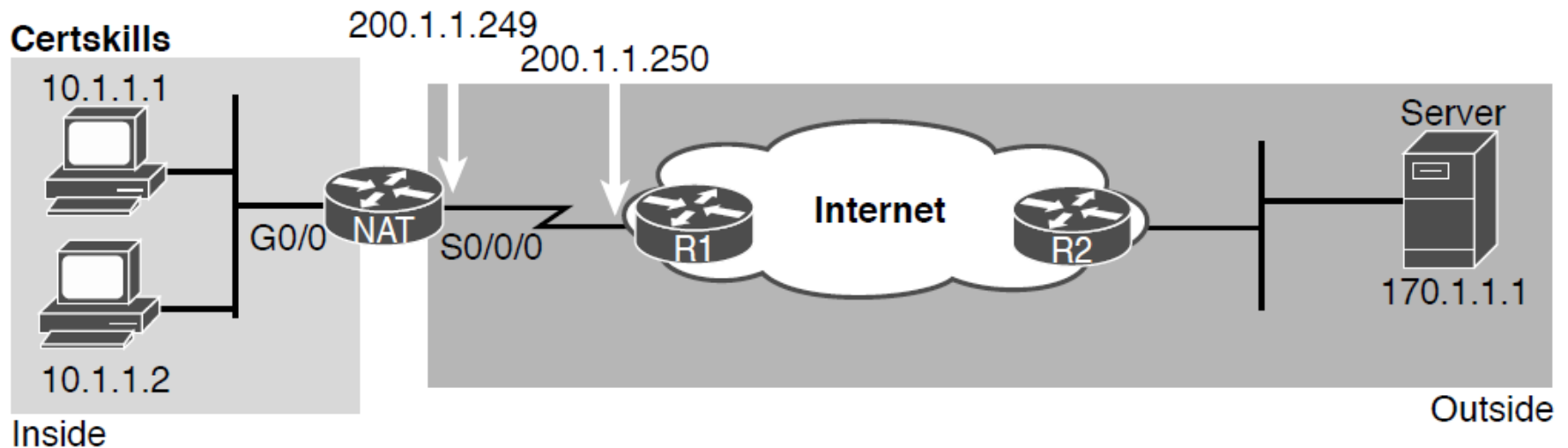
```
! Host 10.1.1.1 currently uses inside global 200.1.1.1
NAT# show ip nat translations
Pro Inside global      Inside local      Outside local      Outside global
--- 200.1.1.1          10.1.1.1          ---                ---
NAT# clear ip nat translation *

!
! telnet from 10.1.1.2 to 170.1.1.1 happened next; not shown
!
! Now host 10.1.1.2 uses inside global 200.1.1.1

NAT# show ip nat translations
Pro Inside global      Inside local      Outside local      Outside global
--- 200.1.1.1          10.1.1.2          ---                ---
!
! Telnet from 10.1.1.1 to 170.1.1.1 happened next; not shown
!
NAT# debug ip nat
IP NAT debugging is on

Oct 20 19:23:03.263: NAT*: s=10.1.1.1->200.1.1.2, d=170.1.1.1 [348]
Oct 20 19:23:03.267: NAT*: s=170.1.1.1, d=200.1.1.2->10.1.1.1 [348]
Oct 20 19:23:03.464: NAT*: s=10.1.1.1->200.1.1.2, d=170.1.1.1 [349]
Oct 20 19:23:03.568: NAT*: s=170.1.1.1, d=200.1.1.2->10.1.1.1 [349]
```

# NAT Overload and PAT



NAT Table (Overload)

Inside Local	Inside Global
10.1.1.1: 49712	200.1.1.249: 49712
10.1.1.2: 49713	200.1.1.249: 49713
10.1.1.2: 49913	200.1.1.249: 49913

# NAT Overload Configuration

```
NAT# show running-config
!
! Lines Omitted for Brevity
!
interface GigabitEthernet0/0
  ip address 10.1.1.3 255.255.255.0
  ip nat inside
!
interface Serial0/0/0
  ip address 200.1.1.249 255.255.255.252
  ip nat outside
!
ip nat inside source list 1 interface Serial0/0/0 overload
!
access-list 1 permit 10.1.1.2
access-list 1 permit 10.1.1.1
!
```

# NAT Overload Configuration (continued)

```
NAT# show ip nat translations
```

Pro	Inside global	Inside local	Outside local	Outside global
tcp	200.1.1.249:49712	10.1.1.1:49712	170.1.1.1:23	170.1.1.1:23
tcp	200.1.1.249:49713	10.1.1.2:49713	170.1.1.1:23	170.1.1.1:23
tcp	200.1.1.249:49913	10.1.1.2:49913	170.1.1.1:23	170.1.1.1:23

```
NAT# show ip nat statistics
```

```
Total active translations: 3 (0 static, 3 dynamic; 3 extended)
```

```
Peak translations: 12, occurred 00:01:11 ago
```

```
Outside interfaces:
```

```
    Serial0/0/0
```

```
Inside interfaces:
```

```
    GigabitEthernet0/0
```

```
Hits: 103 Misses: 3
```

```
Expired translations: 0
```

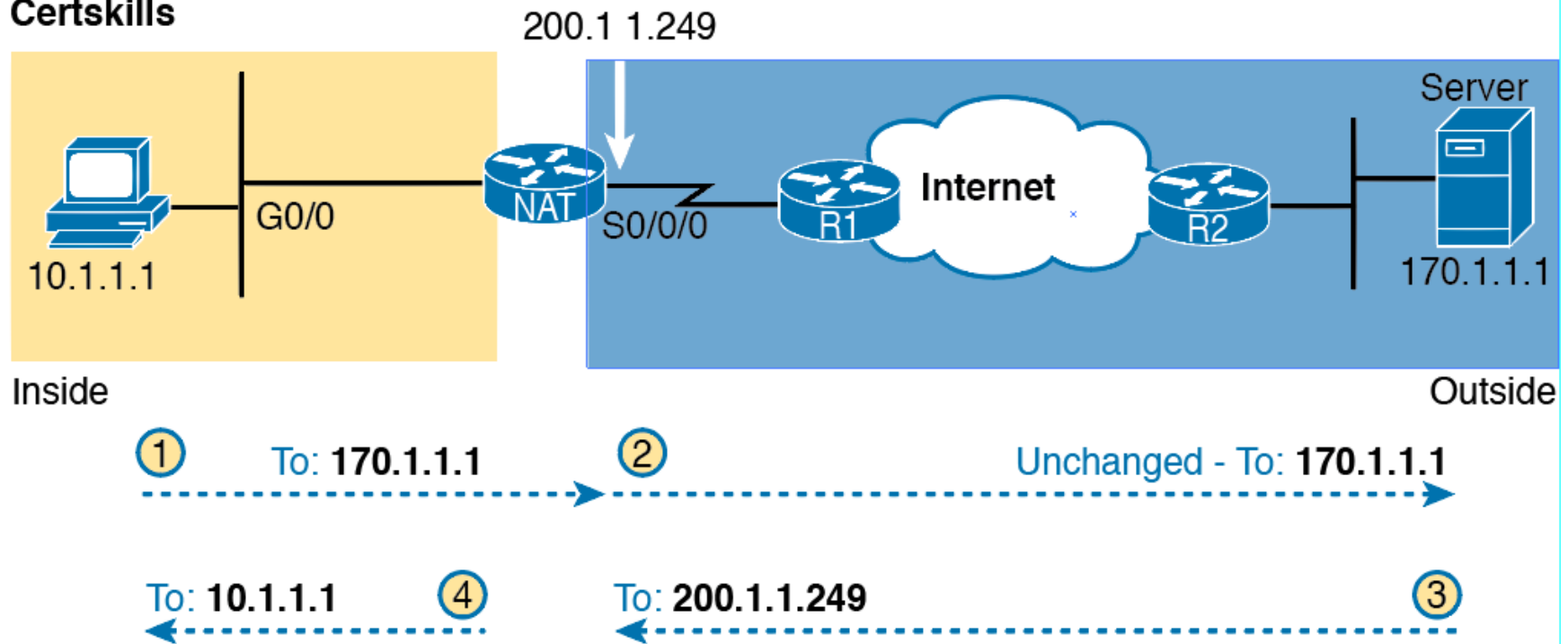
```
Dynamic mappings:
```

```
-- Inside Source
```

```
access-list 1 interface Serial0/0/0 refcount 3
```

# Destination Address Changes on Outside to Inside (Only) with Source NAT

Certskills





# NAT Troubleshooting

- Reversed inside and outside
- Static NAT
- Dynamic NAT (ACL)
- Dynamic NAT (pool)
- PAT
- ACL
- User traffic required
- IPv4 routing