

CCNA 200-301 v1.1

MODULE 4 — IP Services

Complete Hands-on Training Labs

Topology • Sequential Device Configuration • Verification Output • Troubleshooting

NETWORK GUIDE ACADEMY

Instructor / Student Lab Guide

Scope: CCNA v1.1 Module 4 — IP Services objectives 4.1 through 4.10. The labs intentionally use one configuration path per device and then move forward to verification and troubleshooting

Module 4 lab map

Lab	Topic	Primary skill
4.1	NAT/PAT	Static NAT, dynamic pool NAT and PAT/overload
4.2	NTP	Server/master and client synchronization
4.3	DHCP and DNS roles	Address assignment and name resolution workflow
4.4	SNMP	Polling, MIB/OID concepts and traps
4.5	Syslog	Central logging, facilities and severity levels
4.6	DHCP client and relay	ip address dhcp and ip helper-address
4.7	QoS PHB	Classification, marking, queuing, policing and shaping
4.8	SSH	Secure remote CLI access
4.9	TFTP/FTP	Configuration backup and transfer
4.10	SPAN/RSPAN/ERSPAN	Supplemental operational traffic mirroring lab

How to use this workbook

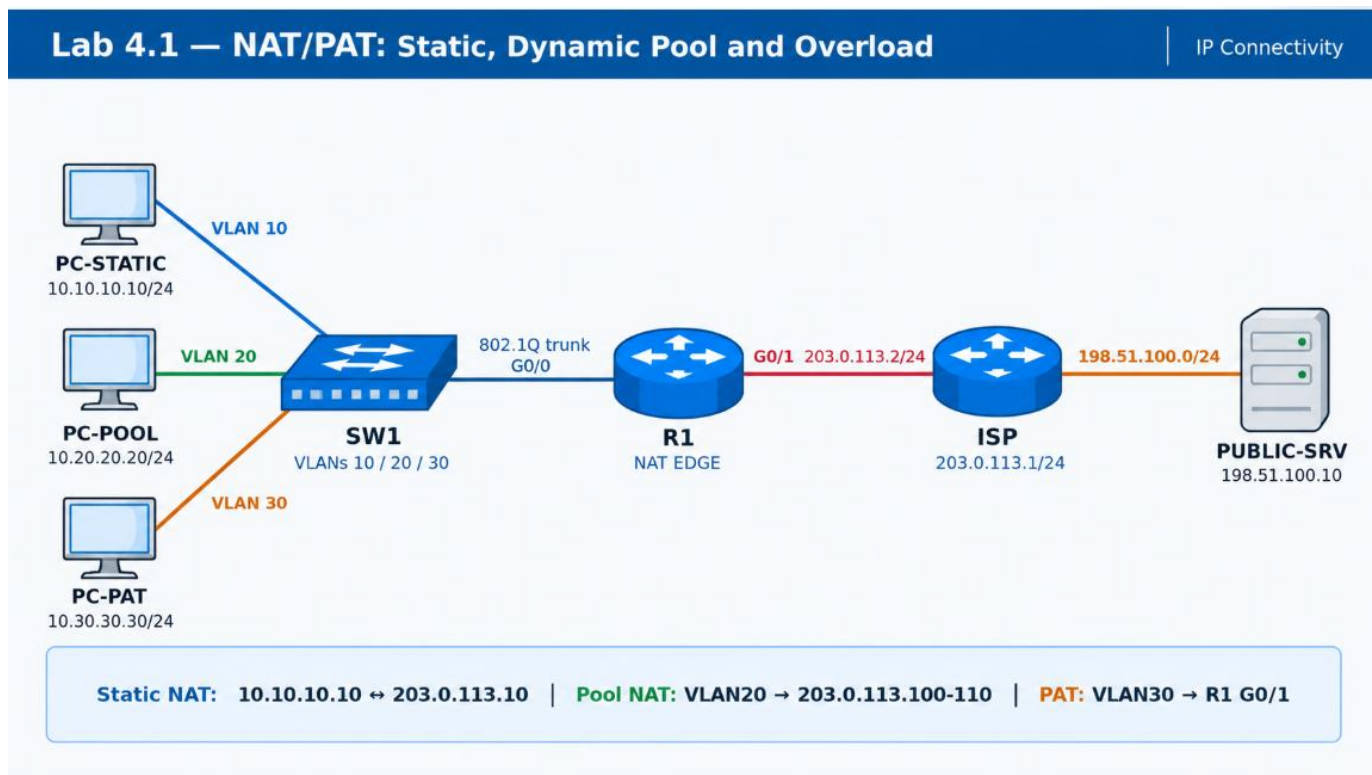
1. Build the topology exactly as shown and apply the addressing plan.
2. Configure devices in the order presented. Do not skip directly to later devices.
3. Run each verification command immediately after its related configuration.
4. Compare your output with the sample output and read the “What to verify” bullets.
5. Run the end-to-end test, then perform the controlled fault/recovery exercise where provided.

Exam alignment: Cisco CCNA 200-301 v1.1 lists IP Services objectives 4.1 through 4.9. Lab 4.10 is included as an operations-focused supplemental lab for traffic analysis and troubleshooting.

Lab 4.1 — NAT/PAT: Static, Dynamic Pool and Overload

Configure three distinct inside source translation methods on one edge router so each method can be verified independently without overlapping source subnets.

Lab topology



Addressing / device plan

Device / Interface	IP address	Gateway / next hop	Purpose
PC-STATIC	10.10.10.10/24	10.10.10.1	Static NAT host
PC-POOL	10.20.20.20/24	10.20.20.1	Dynamic pool source
PC-PAT	10.30.30.30/24	10.30.30.1	PAT source
R1 G0/1	203.0.113.2/24	203.0.113.1	NAT outside
ISP G0/0	203.0.113.1/24	—	Toward R1
ISP G0/1	198.51.100.1/24	—	Public server LAN
PUBLIC-SRV	198.51.100.10/24	198.51.100.1	Internet test server

Lab objectives

- Configure VLANs 10/20/30 and an 802.1Q router-on-a-stick inside interface.
- Configure static NAT for one server/host, dynamic pool NAT for VLAN 20 and PAT for VLAN 30.
- Verify translation type, inside local/global values, hit counters and end-to-end reachability.

Step 1 — Configure SW1

```
enable
configure terminal
hostname SW1
!
vlan 10
 name STATIC_NAT
vlan 20
 name DYNAMIC_POOL
vlan 30
 name PAT_USERS
!
interface GigabitEthernet0/1
 description TRUNK_TO_R1
 switchport mode trunk
 switchport trunk allowed vlan 10,20,30
 no shutdown
!
interface GigabitEthernet0/2
 description PC_STATIC
 switchport mode access
 switchport access vlan 10
 spanning-tree portfast
!
interface GigabitEthernet0/3
 description PC_POOL
 switchport mode access
 switchport access vlan 20
 spanning-tree portfast
!
interface GigabitEthernet0/4
 description PC_PAT
 switchport mode access
 switchport access vlan 30
 spanning-tree portfast
end
write memory
```

SW1 verification

```
SW1# show interfaces trunk
Port      Mode Encapsulation Status Native vlan
Gi0/1     on  802.1q      trunking  1

Port      Vlans allowed on trunk
Gi0/1     10,20,30

SW1# show vlan brief
10 STATIC_NAT active Gi0/2
20 DYNAMIC_POOL active Gi0/3
30 PAT_USERS active Gi0/4
```

What to verify

- Gi0/1 is trunking and carries VLANs 10, 20 and 30.
- Each PC access port is in the intended VLAN.

Step 2 — Configure R1 NAT edge

```

enable
configure terminal
hostname R1
!
interface GigabitEthernet0/0
no shutdown
!
interface GigabitEthernet0/0.10
encapsulation dot1Q 10
ip address 10.10.10.1 255.255.255.0
ip nat inside
!
interface GigabitEthernet0/0.20
encapsulation dot1Q 20
ip address 10.20.20.1 255.255.255.0
ip nat inside
!
interface GigabitEthernet0/0.30
encapsulation dot1Q 30
ip address 10.30.30.1 255.255.255.0
ip nat inside
!
interface GigabitEthernet0/1
description TO_ISP
ip address 203.0.113.2 255.255.255.0
ip nat outside
no shutdown
!
ip route 0.0.0.0 0.0.0.0 203.0.113.1
!
! Static one-to-one translation
ip nat inside source static 10.10.10.10 203.0.113.10
!
! Dynamic pool translation for VLAN 20
ip access-list standard NAT-POOL-SOURCES
permit 10.20.20.0 0.0.0.255
ip nat pool PUBLIC-POOL 203.0.113.100 203.0.113.110 netmask 255.255.255.0
ip nat inside source list NAT-POOL-SOURCES pool PUBLIC-POOL
!
! PAT/overload for VLAN 30
ip access-list standard PAT-SOURCES
permit 10.30.30.0 0.0.0.255
ip nat inside source list PAT-SOURCES interface GigabitEthernet0/1 overload
end
write memory

```

R1 verification before traffic

```

R1# show ip interface brief | include GigabitEthernet0/0|GigabitEthernet0/1
GigabitEthernet0/0      unassigned    YES unset  up   up
GigabitEthernet0/0.10  10.10.10.1    YES manual up   up
GigabitEthernet0/0.20  10.20.20.1    YES manual up   up
GigabitEthernet0/0.30  10.30.30.1    YES manual up   up
GigabitEthernet0/1     203.0.113.2   YES manual up   up

R1# show ip nat translations
Pro Inside global      Inside local    Outside local    Outside global
--- 203.0.113.10        10.10.10.10     ---             ---

```

What to verify

- Inside subinterfaces are up/up and marked as NAT inside in the running configuration.
- The static mapping exists immediately, before any user traffic.
- Dynamic pool and PAT entries appear only after matching traffic is generated.

Step 3 — Configure ISP

```
enable
configure terminal
hostname ISP
interface GigabitEthernet0/0
description TO_R1
ip address 203.0.113.1 255.255.255.0
no shutdown
interface GigabitEthernet0/1
description PUBLIC_SERVER_LAN
ip address 198.51.100.1 255.255.255.0
no shutdown
end
write memory
```

Step 4 — Configure end devices

Device	IP / mask	Default gateway
PC-STATIC	10.10.10.10 /24	10.10.10.1
PC-POOL	10.20.20.20 /24	10.20.20.1
PC-PAT	10.30.30.30 /24	10.30.30.1
PUBLIC-SRV	198.51.100.10 /24	198.51.100.1

Step 5 — Generate traffic and verify translations

```
PC-STATIC> ping 198.51.100.10
Success rate is 100 percent

PC-POOL> ping 198.51.100.10
Success rate is 100 percent

PC-PAT> ping 198.51.100.10
Success rate is 100 percent

R1# show ip nat translations
Pro Inside global    Inside local    Outside local    Outside global
icmp 203.0.113.10:12  10.10.10.10:12  198.51.100.10:12 198.51.100.10:12
icmp 203.0.113.100:7  10.20.20.20:7   198.51.100.10:7   198.51.100.10:7
icmp 203.0.113.2:31   10.30.30.30:31  198.51.100.10:31  198.51.100.10:31
--- 203.0.113.10      10.10.10.10     ---              ---

R1# show ip nat statistics
Total active translations: 4 (1 static, 3 dynamic; 3 extended)
Outside interfaces:
  GigabitEthernet0/1
Inside interfaces:
  GigabitEthernet0/0.10, GigabitEthernet0/0.20, GigabitEthernet0/0.30
Hits: 27 Misses: 0
```

What to verify

- PC-STATIC uses inside global 203.0.113.10.
- PC-POOL receives an address from 203.0.113.100-110.
- PC-PAT shares 203.0.113.2 and is distinguished by a translated identifier/port.
- NAT hit counters increase when traffic crosses the router.

Controlled test — clear dynamic translations only

```
R1# clear ip nat translation *
R1# show ip nat translations
Pro Inside global    Inside local    Outside local    Outside global
--- 203.0.113.10      10.10.10.10     ---             ---
```

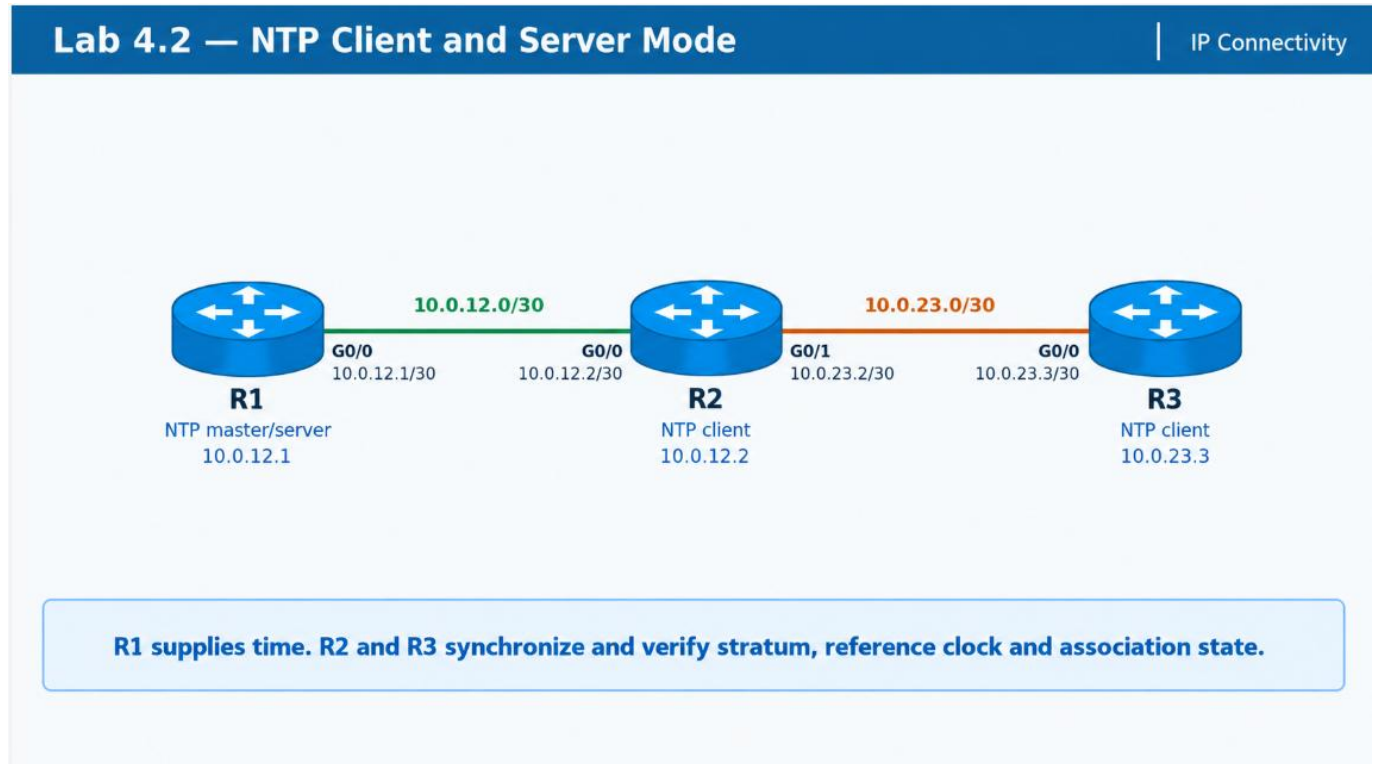
What to verify

- Dynamic pool and PAT entries disappear.
- The configured static translation remains.

Lab 4.2 — NTP Client and Server Mode

Configure one router as an authoritative lab-time source and synchronize two downstream routers to it.

Lab topology



Addressing / device plan

Device / Interface	IP address	Connected to	Role
R1 G0/0	10.0.12.1/30	R2 G0/0	NTP master/server
R2 G0/0	10.0.12.2/30	R1 G0/0	Client
R2 G0/1	10.0.23.2/30	R3 G0/0	Transit
R3 G0/0	10.0.23.3/30	R2 G0/1	Client

Lab objectives

- Configure R1 as NTP master/server.
- Configure R2 and R3 as NTP clients.
- Verify stratum, reference clock, synchronized state and peer selection.

Step 1 — Configure R1 NTP server

```

enable
configure terminal
hostname R1
clock timezone IST 5 30
interface GigabitEthernet0/0
 ip address 10.0.12.1 255.255.255.252
 no shutdown
 ntp master 3
end
write memory
    
```

R1 verification

```
R1# show ntp status
Clock is synchronized, stratum 3, reference is 127.127.1.1
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz
```

```
R1# show clock detail
22:15:31.442 IST Tue Oct 20 2026
Time source is NTP
```

What to verify

- R1 reports synchronized state.
- R1 advertises the configured lab stratum.
- The router is ready to answer NTP requests.

Step 2 — Configure R2

```
enable
configure terminal
hostname R2
clock timezone IST 5 30
interface GigabitEthernet0/0
 ip address 10.0.12.2 255.255.255.252
 no shutdown
interface GigabitEthernet0/1
 ip address 10.0.23.2 255.255.255.252
 no shutdown
ntp server 10.0.12.1 prefer
end
write memory
```

R2 verification

```
R2# show ntp associations
address      ref clock    st  when  poll reach delay offset disp
*~10.0.12.1  127.127.1.1   3   34   64  377  1.12  -0.48  1.05
* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
```

```
R2# show ntp status
Clock is synchronized, stratum 4, reference is 10.0.12.1
```

What to verify

- The asterisk identifies the selected system peer.
- Reach 377 indicates successful recent NTP exchanges.
- R2 is one stratum higher than R1.

Step 3 — Configure R3

```
enable
configure terminal
hostname R3
clock timezone IST 5 30
interface GigabitEthernet0/0
 ip address 10.0.23.3 255.255.255.252
 no shutdown
 ip route 10.0.12.0 255.255.255.252 10.0.23.2
 ntp server 10.0.12.1
end
write memory
```

R3 verification

```
R3# show ntp associations
address      ref clock    st  when  poll reach delay offset disp
*~10.0.12.1   127.127.1.1   3   21    64  377  2.08  0.31  0.84

R3# show ntp status
Clock is synchronized, stratum 4, reference is 10.0.12.1
```

What to verify

- R3 has IP reachability to the NTP server.
- R3 is synchronized to 10.0.12.1 and shows a valid reach value.

Controlled failure — remove reachability to the time source

```
R3(config)# interface GigabitEthernet0/0
R3(config-if)# shutdown

R3# show ntp status
Clock is unsynchronized, stratum 16, no reference clock
```

What to verify

- After NTP times out, the client eventually becomes unsynchronized.
- Restore the interface with no shutdown and confirm synchronization returns.