

Days 7, 8: IPv4

CCNA 200-301 Study Guide: IPv4 and Core Router Configuration

1.0 Introduction

This guide covers Layer 3 fundamentals, IPv4 addressing, and core router configuration. These topics align with the Network Fundamentals (20%) and IP Connectivity (25%) domains of the CCNA 200-301 exam.

2.0 Layer 3 Fundamentals: The Role of the Router

The Network Layer (Layer 3) provides logical addressing and path determination across different network segments.

Key Characteristics of a Router

- Path Selection: Uses a Routing Table to determine the most efficient path for packets.
- Broadcast Domain Boundary: Routers do not forward broadcasts by default. Each interface is a separate broadcast domain.
- Interface Default State: Unlike switches, Cisco router interfaces are administratively down by default. They require the no shutdown command to function.

3.0 Deconstructing the IPv4 Address

An IPv4 address is a 32-bit logical identifier represented in Dotted Decimal Notation (e.g., 192.168.1.1).

3.1 Structure

- Network Portion: Identifies the specific subnet.
- Host Portion: Identifies the specific device on that subnet.

3.2 Binary Foundations

The octet (8 bits) serves as the fundamental building block of IPv4 addressing. Each bit position within an octet corresponds to a specific power of 2 (2^n), decreasing from left to right.

Positional Values Table

Bit Position	7	6	5	4	3	2	1	0
Power of 2	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Decimal Value	128	64	32	16	8	4	2	1

TL;DR: An octet represents values from 0 to 255. To calculate a decimal value, sum the decimal weights of every bit set to "1".

Examples:

- 192 in binary: 11000000 ($128 + 64$)
- 255 in binary: 11111111 (All bits on)

4.0 IPv4 Address Classification (Classful System)

While modern networks use CIDR (Classless), understanding the original classes is essential for the exam.

Class	Range (1st Octet)	Default Mask	Hosts per Network	Use Case
A	1 - 126	255.0.0.0 (/8)	16,777,214	Very Large Networks
B	128 - 191	255.255.0.0 (/16)	65,534	Medium/Large Networks
C	192 - 223	255.255.255.0 (/24)	254	Small Networks
D	224 - 239	N/A	N/A	Multicast
E	240 - 255	N/A	N/A	Experimental

5.0 Private vs. Public Addressing (RFC 1918)

Private addresses are used internally and are not routable on the public internet.

5.1 RFC 1918 Private Ranges

- Class A: 10.0.0.0 - 10.255.255.255
- Class B: 172.16.0.0 - 172.31.255.255
- Class C: 192.168.0.0 - 192.168.255.255

5.2 Special Reserved Ranges

- Loopback: 127.0.0.1 (Tests the local TCP/IP stack).
- APIPA: 169.254.0.0/16 (Self-assigned when DHCP fails).

6.0 Essential Network Calculations

6.1 Reserved Addresses in a Subnet

1. Network Address: The first address (all host bits are 0). Identifies the subnet.

2. Broadcast Address: The last address (all host bits are 1). Used to communicate with all hosts on the subnet.

6.2 Calculating Usable Hosts

To find the number of usable host IPs:

$$2^h - 2$$

(Where h is the number of host bits. The -2 accounts for the Network and Broadcast addresses.)

7.0 Core Cisco IOS Router Configuration

7.1 Basic Configuration Workflow

```
Router> enable # Enter Privileged EXEC mode

Router# configure terminal # Enter Global Configuration mode

Router(config)# interface GigabitEthernet0/0/0 # Enter Interface mode

Router(config-if)# ip address 192.168.1.1 255.255.255.0 # Assign IP/Mask

Router(config-if)# description Link to LAN-SWITCH-01 # Optional Label

Router(config-if)# no shutdown # Enable the interface

Router(config-if)# end # Exit to Privileged EXEC

Router# copy running-config startup-config # Save to NVRAM
```

7.2 CLI Shortcuts

- do: Execute EXEC commands from config modes (e.g., do show ip int brief).
- no: Negates a command (e.g., no shutdown to enable, no ip address to remove).

8.0 Verification and Troubleshooting

Command	Purpose
show ip interface brief	Concise summary of IP, status (Up/Down), and Protocol.
show interfaces	Detailed stats, error counters (CRC, Collisions), and Layer 1/2 health.
show running-config	View the current active config in RAM.
ping	Tests end-to-end Layer 3 connectivity.

9.0 Key Takeaways for the Exam

- Binary: You must be able to convert between decimal and binary quickly.
- Default Off: Always remember no shutdown for routers.
- Volatile Memory: Configurations in RAM are lost on reboot; always copy run start.
- Subnetting: Never assign the Network or Broadcast addresses to a host.

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