

Days 13, 14, 15: IPv4 Subnetting

CCNA 200-301 Study Guide: Network Fundamentals & IPv4 Subnetting

1.0 Understanding the CCNA 200-301 Exam Landscape

The Cisco Certified Network Associate (CCNA) certification is the industry benchmark for associate-level networking. Mastery of these domains is the first step toward a successful networking career.

Exam Blueprint at a Glance

Attribute	Details
Exam Code	200-301 v1.1
Duration	120 Minutes
Passing Score	Variable (scaled)

Core Knowledge Domains

- Network Fundamentals (20%)
- Network Access (20%)
- IP Connectivity (25%) — The largest and most critical domain.
- IP Services (10%)
- Security Fundamentals (15%)
- Automation and Programmability (10%)

2.0 IPv4 Addressing: The Foundation

An IPv4 address is a 32-bit logical identifier. It is presented in Dotted Decimal Notation (e.g., 192.168.1.1), where 32 bits are divided into four 8-bit octets.

Legacy Classful Addressing

Before CIDR, IP addresses were assigned in rigid blocks. While largely obsolete, these boundaries still inform default behaviors in Cisco IOS.

Class	First Octet Range	Default Mask	Max Usable Hosts	Original Purpose
A	1 - 126	255.0.0.0 (/8)	\$16,777,214\$	Global Organizations
B	128 - 191	255.255.0.0 (/16)	\$65,534\$	Mid-to-Large Networks
C	192 - 223	255.255.255.0 (/24)	\$254\$	Small Local Networks

3.0 CIDR: Modern IP Allocation

Classless Inter-Domain Routing (CIDR) replaced the rigid classful system in 1993. It allows for Variable-Length Subnet Masking (VLSM), enabling administrators to ignore class boundaries and use any prefix length (e.g., /25, /29).

Benefits of CIDR:

- Efficiency: Allocates only the space needed.
- Aggregation: Allows multiple routes to be summarized into one.
- Conservation: Slows the exhaustion of the limited IPv4 address space.

4.0 Mastering Subnetting Mechanics

Key Terminology

- Network Portion: Identified by binary 1s in the mask; defines the "neighborhood."
- Host Portion: Identified by binary 0s in the mask; defines the specific "house."
- Borrowed Bits (S): Bits taken from the host portion to create subnets.

Core Formulas

1. Total Subnets: 2^S
2. Usable Hosts per Subnet: $2^H - 2$

Critical Exam Tip: Always subtract 2 . Every subnet reserves the Network Address (all host bits 0) and the Broadcast Address (all host bits 1).

The Block Size (The "Magic Number")

The Block Size is the decimal value of the last bit "borrowed" in the mask.

- Metaphor: Think of block size as the standard spacing for street addresses. If the block size is 64 , the "streets" (subnets) start at $.0$, $.64$, $.128$, and $.192$.

5.0 Practical Application Scenarios

5.1 Scenario: Meet Host Requirements

Given: $192.168.1.0/24$. Need: 4 subnets with ~ 45 hosts each.

- Subnets: $2^S \geq 4 \rightarrow S=2$.
- Hosts: Remaining host bits $H = 8 - 2 = 6$.
- Calculation: $2^6 - 2 = 62$ usable hosts (Requirement met).
- New Prefix: $/24 + 2 = /26$.
- Block Size: 64 (from the $/26$ mask bit value).

Resulting Subnets:

1. 192.168.1.0/26
2. 192.168.1.64/26
3. 192.168.1.128/26
4. 192.168.1.192/26

5.2 Scenario: Skill Check

Problem: Find the Subnet ID for host 192.168.5.57/27.

1. Block Size: 2^7 means the increment is 2^5 ($256 - 224 = 32$).
2. Subnet Ranges: 0, 32, 64, 96 \dots
3. Find the Fit: 57 falls between 32 and 64.
4. Answer: Subnet ID is 192.168.5.32/27.

6.0 Special-Use Prefix Lengths

Prefix	Usage	Notes
/30	Traditional P2P Link	Provides 2 usable addresses ($2^2 - 2$).
/31	Modern P2P Link	2 usable addresses; no separate net/broadcast (RFC 3021).
/32	Host Route / Loopback	Identifies exactly one IP address.

7.0 VLSM: Maximum Efficiency

The "Golden Rule" of Variable-Length Subnet Masking (VLSM): Always allocate address blocks starting from the largest host requirement and proceed to the smallest.

Example Allocation (192.168.1.0/24):

1. LAN A (110 hosts): Needs 2^7 . Assigned: 192.168.1.0/25 (Range: .0 - .127).
2. LAN B (45 hosts): Needs 2^6 . Assigned: 192.168.1.128/26 (Range: .128 - .191).
3. LAN C (29 hosts): Needs 2^7 . Assigned: 192.168.1.192/27 (Range: .192 - .223).
4. WAN Link (2 hosts): Needs 2^3 . Assigned: 192.168.1.240/30 (Range: .240 - .243).

8.0 Rapid Reference Cheat Sheet

Prefix	Mask (Last Octet)	Block Size	Usable Hosts
/24	.0	\$256\$	\$254\$
/25	.128	\$128\$	\$126\$
/26	.192	\$64\$	\$62\$
/27	.224	\$32\$	\$30\$
/28	.240	\$16\$	\$14\$
/29	.248	\$8\$	\$6\$
/30	.252	\$4\$	\$2\$
/31	.254	\$2\$	\$2\$
/32	.255	\$1\$	\$1\$

Revision #1

Created 2026-03-14 19:21:31 UTC by Tony Utter

Updated 2026-03-14 19:21:45 UTC by Tony Utter