

# System Administration

## Week 05, Segment 2

### Networking I: IPv4 Basics & CIDR Subnetting

**Department of Computer Science  
Stevens Institute of Technology**

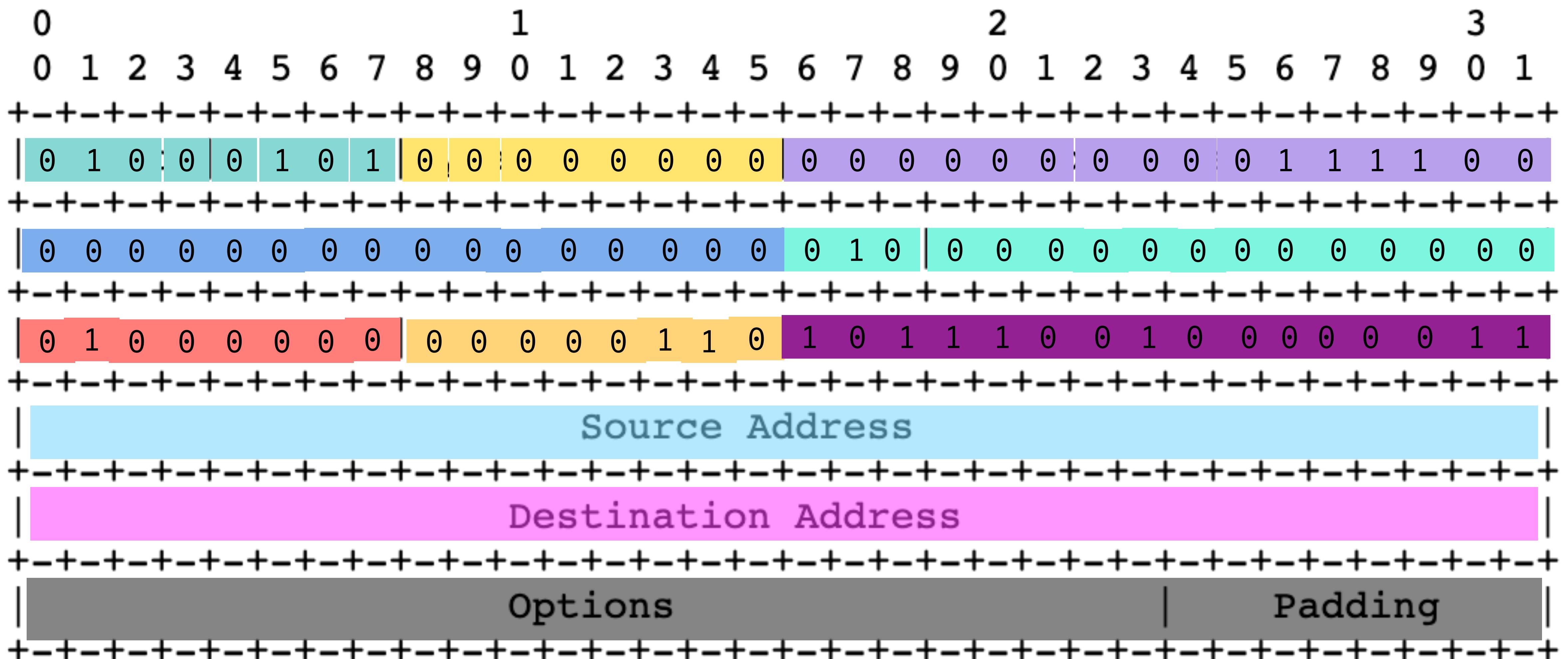
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<https://stevens.netmeister.org/615/>

## Terminal – 80x24

0x0000:	001b	2173	595a	e076	6372	3900	0800	4500	..!sYZ.vcr9...E.
0x0010:	003c	0000	4000	4006	b903	a654	0763	9bf6	.<..@.@....T.c..
0x0020:	380b	fc57	0050	8a66	07d0	0000	0000	a002	8..W.P.f.....
0x0030:	8000	b76b	0000	0204	05b4	0103	0303	0402	...k.....
0x0040:	080a	0000	0001	0000	0000				.....



Terminal – 80x24

0x0000:	001b	2173	595a	e076	6372	3900	0800	4500	..!sYZ.vcr9..E.
0x0010:	003c	0000	4000	4006	b903	a654	0763	9bf6	.<..@.@...T.c..
0x0020:	380b	fc57	0050	8a66	07d0	0000	0000	a002	8..W.P.f.....
0x0030:	8000	b76b	0000	0204	05b4	0103	0303	0402	...k.....
0x0040:	080a	0000	0001	0000	0000				

## IPv4 Basics

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**IPv4 addresses are 32-bit numbers**



1 0 0 1 1 0 1 1 1 1 1 0 1 1 0 0 1 1 1 0 0 0 0 0 0 0 1 0 1 1

## IPv4 Basics

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1 0 0 1 1 0 1 1 1 1 1 0 1 1 0 0 0 1 1 1 0 0 0 0 0 0 0 1 0 1 1

**Each IPv4 address consists of four octets.**

## IPv4 Basics

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1 0 0 1 1 0 1 1 . 1 1 1 0 1 1 0 . 0 0 1 1 1 0 0 0 . 0 0 0 0 1 0 1 1  
155 . 246 . 56 . 11

**Each IPv4 address consists of four octets.**

## IPv4 Basics

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1 0 0 1 1 0 1 1 . 1 1 1 0 1 1 0 . 0 0 1 1 1 0 0 0 . 0 0 0 0 1 0 1 1

155

246

56

11

9B

F6

38

OB

**Each IPv4 address consists of four octets.**

## IPv4 Basics

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1 0 0 1 1 0 1 1 1 1 1 0 1 1 0      0 0 1 1 0 0 0 0 0 0 0 0 1 0 1 1

**IPv4 addresses are divided into a *network part* and a *host part*.**

**Hosts on the same network (*broadcast domain*) can talk to each other without the help of a router.**

## IPv4 Basics

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1 0 0 1 1 0 1 1 1 1 0 1 1 0                    0 0 1 1 0 0 0 0 0 0 0 0 0 1 0 1 1

**There are three different *classes* of IPv4 networks.**

## IPv4 Basics

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1 0 0 1 1 0 1 1 1 1 0 1 1 0 0 0 1 1 0 0 0 0 0 0 0 0 0 1 0 1 1

**There are three different *classes* of IPv4 networks.**

Well, five, really.

# IPv4 Basics

Class	Leading bits	Size of network number bit field	Size of rest bit field	Number of networks	Addresses per network	Start address	End address
Class A	0	8	24	128 ( $2^7$ )	16,777,216 ( $2^{24}$ )	0.0.0	127.255.255.255
Class B	10	16	16	16,384 ( $2^{14}$ )	65,536 ( $2^{16}$ )	128.0.0.0	191.255.255.255
Class C	110	24	8	2,097,152 ( $2^{21}$ )	256 ( $2^8$ )	192.0.0.0	223.255.255.255
Class D (multicast)	1110	not defined	not defined	not defined	not defined	224.0.0.0	239.255.255.255
Class E (reserved)	1111	not defined	not defined	not defined	not defined	240.0.0.0	255.255.255.255

## IPv4 Basics

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10011011	11110110	00111000	00001011
11111111	11111111	00000000	00000000

A *netmask* splits the IPv4 address into  
*network* and *host* parts.

## IPv4 Basics

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10011011	11110110	00111000	00001011
11111111	11111111	11111111	00000000
255	.	255	.
		255	.
			0

A *netmask* splits the IPv4 address into  
*network* and *host* parts.

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## IPv4 Basics

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10011011	11110110	00111000	00001011
11111111	11111111	11111111	11000000
255	.	255	.
		255	.
			192

The *netmask* need not end on a quad boundary,  
however.

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## IPv4 Basics

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10011011	11110110	00111000	00001011
11111111	11111111	11111100	00000000
255	.	255	.
		252	.
			0

The *netmask* need not end on a quad boundary,  
however.

/22



Broadcast: 155.246.56.223  
Hosts/Net: 30

10011011.11110110.00111000.110 11111  
Class B

## 2. Requested size: 64 hosts

Netmask: 255.255.255.128 = 25 1111111.1111111.1111111.1 0000000  
Network: 155.246.56.0/25 10011011.11110110.00111000.0 0000000  
HostMin: 155.246.56.1 10011011.11110110.00111000.0 0000001  
HostMax: 155.246.56.126 10011011.11110110.00111000.0 1111110  
Broadcast: 155.246.56.127 10011011.11110110.00111000.0 1111111  
Hosts/Net: 126 Class B

## 3. Requested size: 48 hosts

Netmask: 255.255.255.192 = 26 1111111.1111111.1111111.11 000000  
Network: 155.246.56.128/26 10011011.11110110.00111000.10 000000  
HostMin: 155.246.56.129 10011011.11110110.00111000.10 000001  
HostMax: 155.246.56.190 10011011.11110110.00111000.10 111110  
Broadcast: 155.246.56.191 10011011.11110110.00111000.10 111111  
Hosts/Net: 62 Class B

Needed size: 224 addresses.

Used network: 155.246.56.0/24

Unused:

155.246.56.224/27

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## CIDR Cheat Sheet

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A.B.C.D / N

- N = bits describing network portion of address      155.246.11.56/27
- M = 32 - N = bits in host portion of address      N = 27
- $2^M$  = number of addresses on this subnet      M = 32 - 27 = 5
- $2^M - 2$  = number of possible hosts       $2^5 = 32$
- first address on subnet = network address       $2^5 - 2 = 30$
- last address on subnet = broadcast address      Network: 155.246.11.32/27
- Broadcast: 155.246.11.63
- Netmask: 255.255.255.224

## Summary

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- Classful networking largely for historical context, although see  
[https://en.wikipedia.org/wiki/List\\_of\\_assigned\\_8\\_IPv4\\_address\\_blocks](https://en.wikipedia.org/wiki/List_of_assigned_8_IPv4_address_blocks)
- Classless Inter-Domain Routing (CIDR) introduces the concept of a *subnet* and a *netmask*

*Coming up:* IPv6, where things are... different. But not all things.

## Links

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- IPv4 Address Representation

[https://en.wikipedia.org/wiki/IPv4#Address\\_representations](https://en.wikipedia.org/wiki/IPv4#Address_representations)

- Classful network

[https://en.wikipedia.org/wiki/Classful\\_network](https://en.wikipedia.org/wiki/Classful_network)

- Classless Inter-Domain Routing:

[https://en.wikipedia.org/wiki/Classless\\_Inter-Domain\\_Routing](https://en.wikipedia.org/wiki/Classless_Inter-Domain_Routing)