CSC411: Advanced Networks

Addressing: CIDR and NAT

Note: **This class lecture will be recorded!**
If you do not consent to this recording, please do not ask questions via your video, audio or public chat; send your question to the instructor using the private chat.

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IP Addresses – Problem

▸ What is the big problem with the use of classes of IP addresses?

CIDR

- Classless Inter-Domain Routing
  - Supernetting
- Entire technology
  - IP addresses
  - Routing

CIDR Addresses

▶ Prefix – arbitrary length

▶ Slash notation
  ◦ a.b.c.d / x
  ◦ x – number of leading bits in prefix

▶ 192.168.5.24 / 26

CIDR Address Example

▸ 2048 contiguous address
▸ Starting at 128.211.168.0

	Dotted Decimal	32-bit Binary Equivalent
Lowest	128.211.168.0	10000000 11010011 10101000 00000000
Highest	128.211.175.255	10000000 11010011 10101111 11111111

CIDR Example #2

- ISP has address block available
  - 128.211.0.0 / 16
- Two customers
  - One needs 12 IP addresses
  - One needs 9 IP addresses
- What two prefixes would be assigned to these two customers?
- Binary representation for each prefix?
- Any ambiguity?

Possible CIDR Prefixes

CIDR Notation	Dotted Decimal	CIDR Notation	Dotted Decimal
/1	128.0.0.0	/17	255.255.128.0
/2	192.0.0.0	/18	255.255.192.0
/3	224.0.0.0	/19	255.255.224.0
/4	240.0.0.0	/20	255.255.240.0
/5	248.0.0.0	/21	255.255.248.0
/6	252.0.0.0	/22	255.255.252.0
/7	254.0.0.0	/23	255.255.254.0
/8	255.0.0.0	/24	255.255.255.0
/9	255.128.0.0	/25	255.255.255.128
/10	255.192.0.0	/26	255.255.255.192
/11	255.224.0.0	/27	255.255.255.224
/12	255.240.0.0	/28	255.255.255.240
/13	255.248.0.0	/29	255.255.255.248
/14	255.252.0.0	/30	255.255.255.252
/15	255.254.0.0	/31	255.255.255.254
/16	255.255.0.0	/32	255.255.255.255

Classless Routing

▸ Classful routing scheme

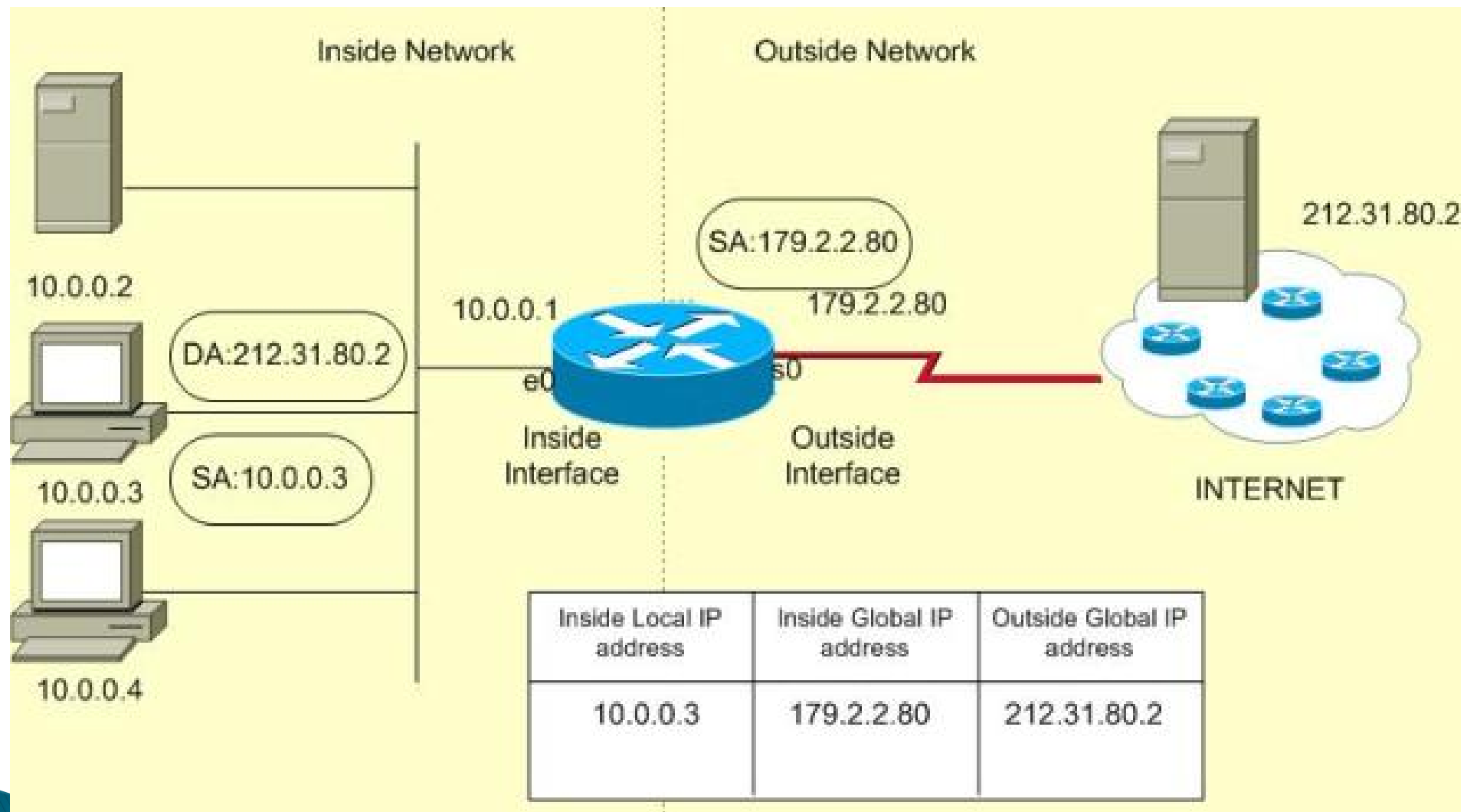▸ Inefficient for classless routing

▸ Requires new algorithms

CIDR Problem

- IP subnet with prefix
  ◦ 129.17.129.96 / 27
- Range of IP address assigned to this subnet?

NAT

- Network Address Translation
- Private or nonroutable addresses

Block	Addresses	Description
10.0.0.0 / 8	10.0.0.0 – 10.255.255.255	Class A private block or "24–bit block"
172.16.0.0 / 12	127.16.0.0 – 172.31.255.255	16 contiguous Class B blocks or "20–bit block"
192.168.0.0 / 16	192.168.0.0 – 192.168.255.255	256 contiguous Class C blocks or "16–bit block"

Inside Network

Outside Network

SA:179.2.2.80

179.2.2.80

212.31.80.2

10.0.0.2

DA:212.31.80.2

10.0.0.1

10.0.0.3

SA:10.0.0.3

e0

Inside
Interface

s0

Outside
Interface

INTERNET

10.0.0.4

Inside Local IP address	Inside Global IP address	Outside Global IP address
10.0.0.3	179.2.2.80	212.31.80.2

NAT Translation Table

- Basic NAT translation table entries
  - IP address of originating host on internal network
  - IP address of a host on Internet
- Initialization
  - Manual
  - Outgoing datagrams ***
  - Incoming name lookups

Translation Table Example

Direction	Field	Old Value	New Value
out	IP Source	10.0.0.1	128.10.24.6
in	IP Destination	128.10.24.6	10.0.0.1

Multi-address NAT

- Previous discussion → many-to-1 translation
  - Not enough routable IP addresses
  - Restrict incoming traffic

- 1-1 translation
  - Each internal IP address associated with unique external (routable) IP address
  - Why this type???

Problems with NAT

Internal IP	External IP
192.168.12.15	64.233.169.103
192.168.65.134	187.67.14.189

▸ What is the problem with NAT?

Internal IP	External IP
192.168.12.15	64.233.169.103
192.168.65.134	187.67.14.189
192.168.82.91	64.233.169.103

NAPT

- Network Address Port Translation
- Most common
- Additional field in translation table
  - NAT port
  - Also contains source & destination port numbers
    - Why is this necessary?
- Transport-layer

Index	Protocol	Local IP	Local Port	Pseudo IP	Pseudo Port	Peer IP	Peer Port
1	TCP	192.168.2.88	3645	60.49.63.157	55001	84.74.65.229	8080
2	TCP	192.168.2.88	3710	60.49.63.157	55002	84.74.65.229	8080
3	TCP	192.168.2.88	3819	60.49.63.157	55003	84.74.65.229	8080
4	TCP	192.168.2.88	4111	60.49.63.157	55006	84.74.65.229	8080
5	TCP	192.168.2.106	1472	60.49.63.157	55017	221.130.193.25	8080
6	TCP	192.168.2.88	1644	60.49.63.157	55019	84.74.65.229	8080
7	TCP	192.168.2.88	3534	60.49.63.157	55028	218.208.229.174	8080
8	TCP	192.168.2.88	3672	60.49.63.157	55030	218.208.229.174	8080
9	TCP	192.168.2.88	4866	60.49.63.157	55036	84.74.65.229	8080
10	TCP	192.168.2.88	1331	60.49.63.157	55037	84.74.65.229	8080
11	TCP	192.168.2.88	4893	60.49.63.157	4893	97.82.155.198	6881
12	TCP	192.168.2.88	4929	60.49.63.157	4929	68.148.20.210	28932
13	TCP	192.168.2.105	3102	60.49.63.157	3102	208.71.113.218	80
14	TCP	192.168.2.88	4398	60.49.63.157	4398	85.50.77.7	14706

NAT: network address translation

NAT translation table	
WAN side addr	LAN side addr
138.76.29.7, 5001	10.0.0.1, 3345
......	......

2: NAT router changes datagram source addr from 10.0.0.1, 3345 to 138.76.29.7, 5001, updates table

1: host 10.0.0.1 sends datagram to 128.119.40.186, 80

S: 10.0.0.1, 3345
D: 128.119.40.186, 80

1

10.0.0.1

S: 138.76.29.7, 5001
D: 128.119.40.186, 80

2

10.0.0.4

10.0.0.2

138.76.29.7

S: 128.119.40.186, 80
D: 10.0.0.1, 3345

4
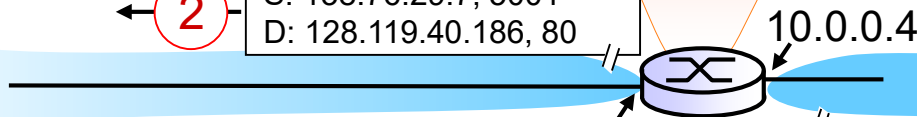
S: 128.119.40.186, 80
D: 138.76.29.7, 5001

3

10.0.0.3

3: reply arrives dest. address: 138.76.29.7, 5001

4: NAT router changes datagram dest addr from 138.76.29.7, 5001 to 10.0.0.1, 3345