Quizzes, Assignments, Discussions, PPT

Assignment 7

Information codewords

D: 11000110111 0

G: 1101 (4 bits)

r: 3 bits (4-1 bits)

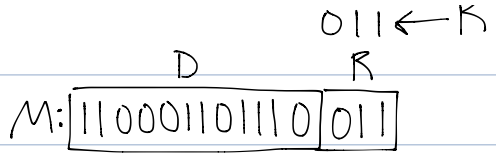
D·2^r: D + r 0 bits OR 11000110111 0|000

division: Match 1001100101 11 (XOR)

1101 | 11000110XXX0000 ← ignore?

must be same

1101
0010
0000
0101
0000
1011
1101
1100
1101
0011
0000
0111
0000
1111
1101
0100
0000
1000
1101
1010
1101
1110
1101



G: 1011 (4 bits)

M: 11011011

D: 11011

R: 3 bits (4-1 bits) = M XOR D + r 0 bits (OR) last r bits of M = 111

parity codes

7x7 even parity

0111:111	0 (6 1's) 1st
0000:011	0 (2 1's) 2nd
0001:111	0 (4 1's)
1010:010	1 (3 1's)
0000:110	0 (2 1's)
0010:011	1 (3 1's)
1111:100	1 (5 1's) 7th
8th 0001:000	1 ↓ 2nd

1st → same

7E:06:1E:A5:0C:27:F9:11

heavy load

effective Layer-2 rate 1 Gbps hubbed LAN 100m 1526 bytes

@100m $\partial_{prop} = \frac{100m}{2 \cdot 10^8 m/s} = 5e^{-7} s$

@1526 bytes & 1Gbps $\partial_{trans} = \frac{1526 \text{ bytes} * 8 \text{ bits/byte}}{1 \cdot 10^9 \text{ bits/s}} = 1.2208e^{-5} s$

$$\text{Efficiency (HeavyLoad)} = \frac{1}{1 + 5\left(\frac{\partial_{prop}}{\partial_{trans}}\right)} = \frac{1}{1 + 5\left(\frac{.05}{1.2208}\right)} = .83$$

Effective Rate = .83 · 1Gbps = 830Mbps

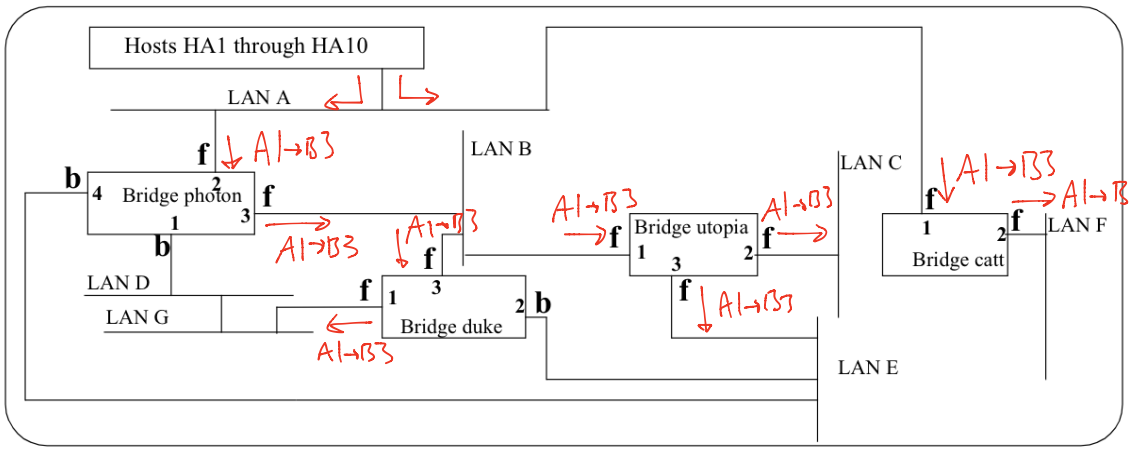
point-to-point vs. hubbed

2 stations, link not shared, no competition, no reduction inefficiency, 1Gbps

many stations, link shared, competition, reduce efficiency, 830 Mbps

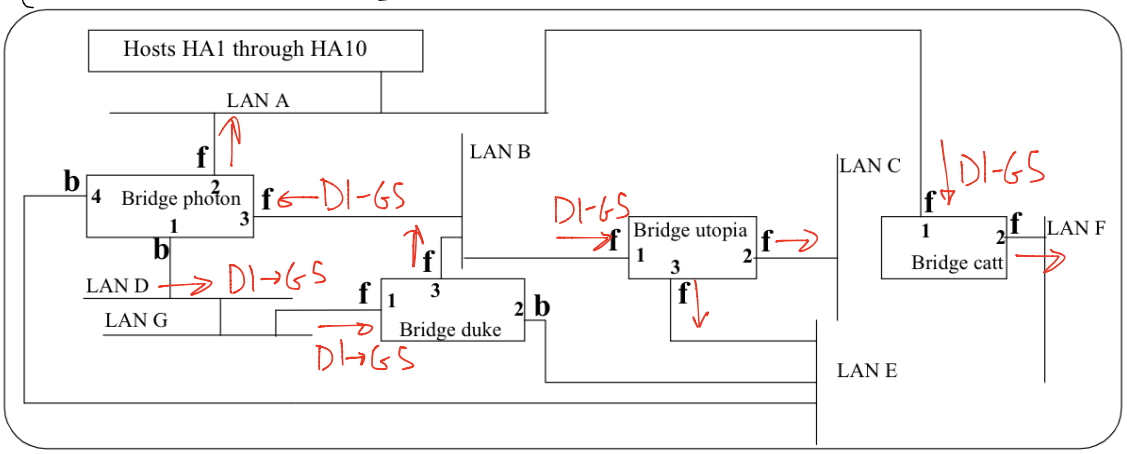
(i) HA1 to HB3 (ii) HD1 to HG5 (iii) HC1 to HA1 (iv) HE1 to HD1

(i) HA1 to HB3



	photon	duke	utopia	catt
A	port 2	port 3	port 1	port 1
B				
C				
D				

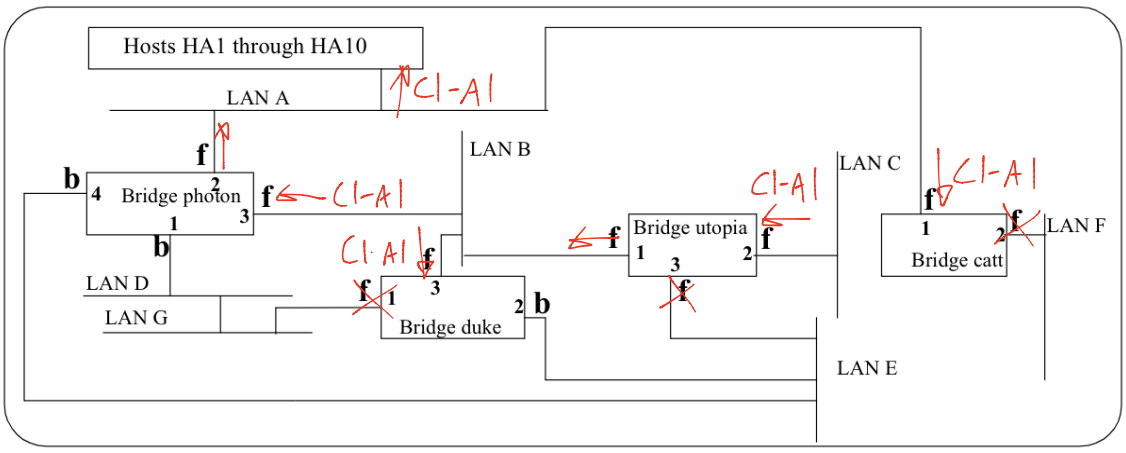
(ii) HD1 to HG5



	photon	duke	utopia	catt
A	port 2	port 3	port 1	port 1
B				
C				
D	port 3	port 1	port 1	port 1

hubs forward frames to all ports (other than receiving port)

(iii) HC1 to HA1

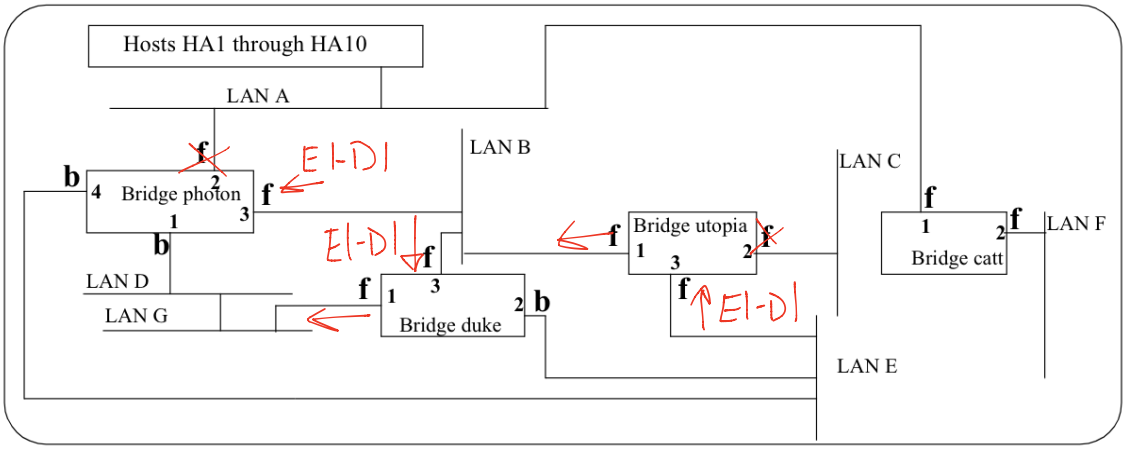


	photon	duke	utopia	catt
A	port 2	port 3	port 1	port 1
B				

iv)

C	port 2	port 3	port 2	port 1
D	port 3	port 1	port 1	port 1

(iv) HE1 to HD1



	photon	duke	utopia	catt
A1	port 2	port 3	port 1	port 1
B				
C1	port 2	port 3	port 2	port 1
D1	port 3	port 1	port 1	port 1
E1	port 3	port 3	port 3	X

Maximum Link Distance

64 bytes 200,000 km/s 100 Mbps

$$d < \frac{L}{2R} = \frac{64\ \text{bytes} \cdot 8\ \text{bits/byte} \cdot 200{,}000\ \text{km/s}}{100\ \text{Mbps} \cdot 2} = 512\ \text{m}$$

↑ Frame = 2 · d_prop · R

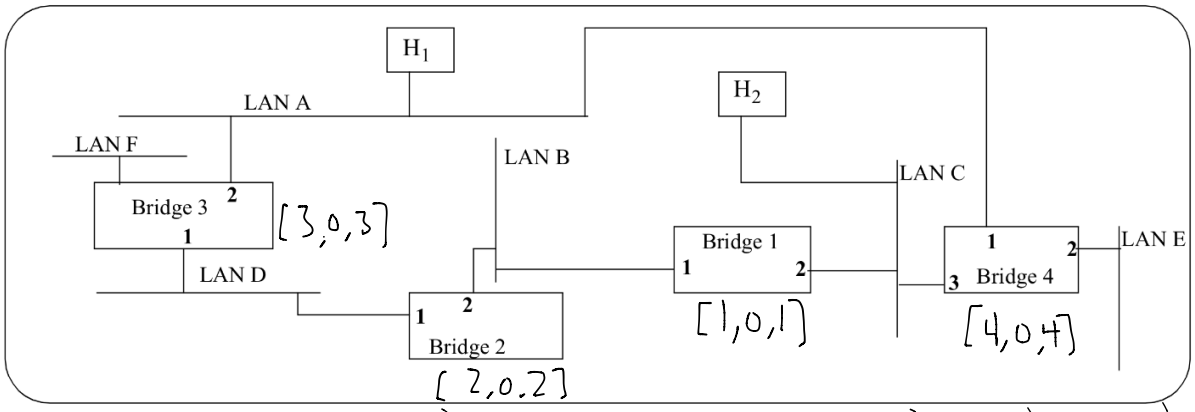
hosts interconnected by hubs in same collision domain

D → G = 1 collision domain = 512 m

B → A = 2 collision domains = 1024 m

Assignment 8

BPDU = [root ID, root path cost, bridge ID]



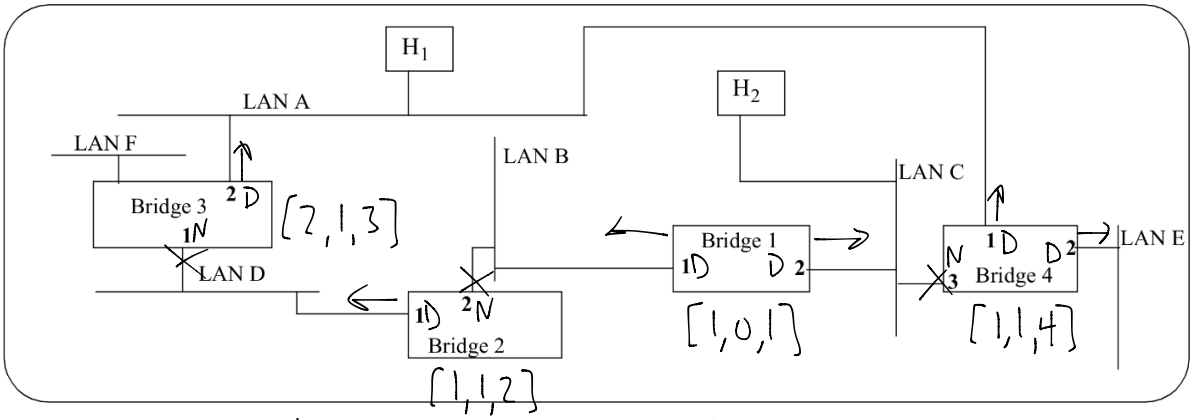
	root	received	new root	designated	not d
1	[1,0,1]	[2,0¹,2] [4,0²,4]	[1,0,1]	[2,0¹,2] [4,0²,4]	
2	[2,0,2]	[1,0²,1] [3,0¹,3]	[1,(2),2]	[3,0¹,3]	[1,0²,1]
3	[3,0,3]	[2,0¹,2] [4,0²,4]	[2,(1),3]	[4,0²,4]	[2,0¹,2]
4	[4,0,4]	[1,0³,1] [3,0¹,3]	[1,(3),4]	[3,0¹,3] (2)	[1,0³,1]

received BPDU < own BPDU = not designated

own BPDU < received BPDU = designated

ordering BPDU: R, C, B

root port = not designated



	1	2	3	4
Root	1	1	2	1
Root Port	—	2	1	3
Root Path Cost	0	1	1	1
New BPDU	[1,0,1]	[1,1,2]	[2,1,3]	[1,1,4]
Designated	1,2	1	2	1,2

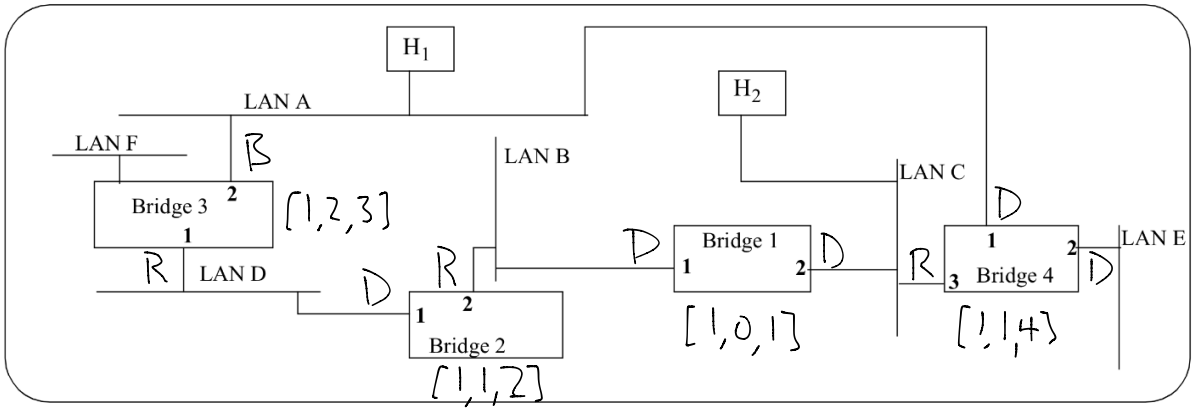
	root	received	new root	designated	not d
1	[1,0,1]	—	[1,0,1]	1,2	—
2	[1,1,2]	[1,0,1]	[1,1,2]	1	—
3	[2,1,3]	[1,1,2] [1,1,4]	[1,2,3]	—	[1,1,4]
4	[1,1,4]	[1,0,1] [2,1,3]	[1,1,4]	[2,1,3] 2	

if all same root ID, don't change root bridge

if not root or designated = BLOCK

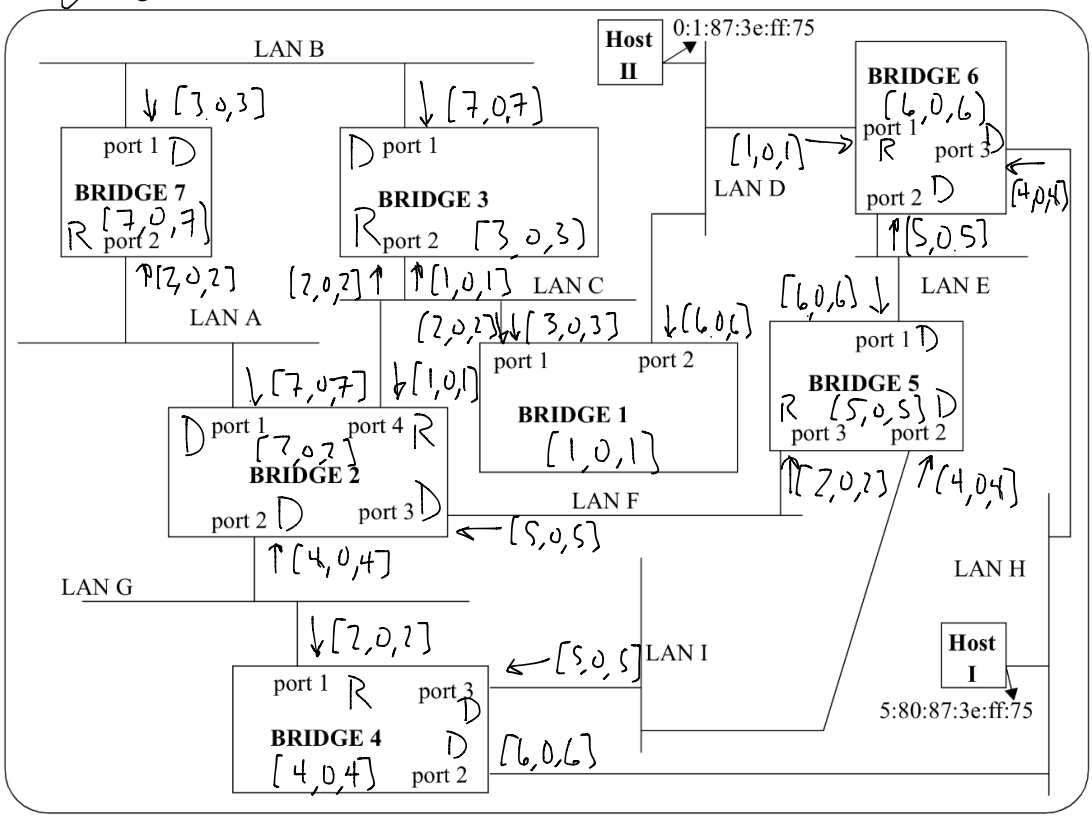
	1	2	3	4
Root	1	1	1	1
Root Port	—	2	1	3
Root Path Cost	0	1	2	1
New BPDU	[1,0,1]	[1,1,2]	[1,2,3]	[1,1,4]

Designated	1,2	1	—	1,2
Blocked	—	—	2	—

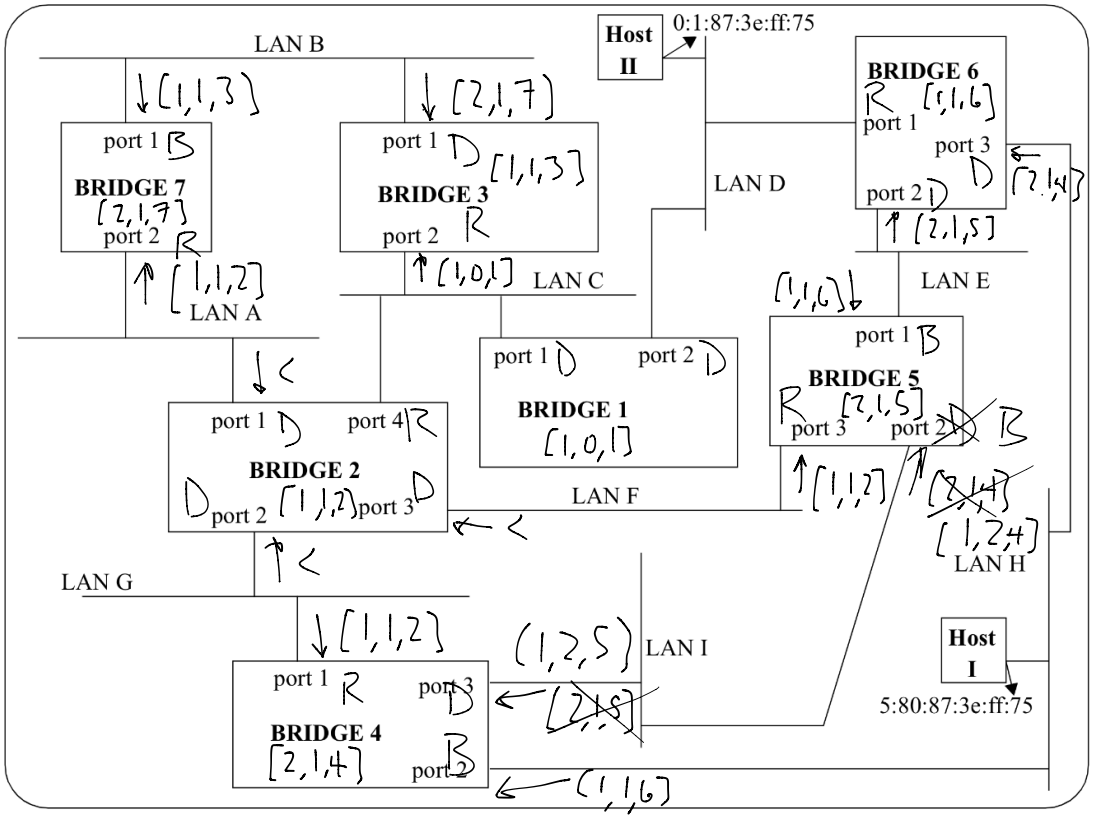


BPDU pt 2

t = 0



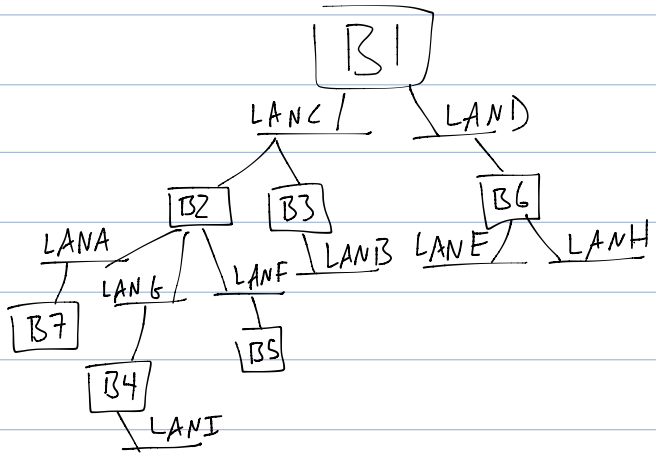
	1	2	3	4	5	6	7
t=1	[1,0,1]	[1,1,2]	[1,1,3]	[2,1,4]	[2,1,5]	[1,1,6]	[2,1,7]



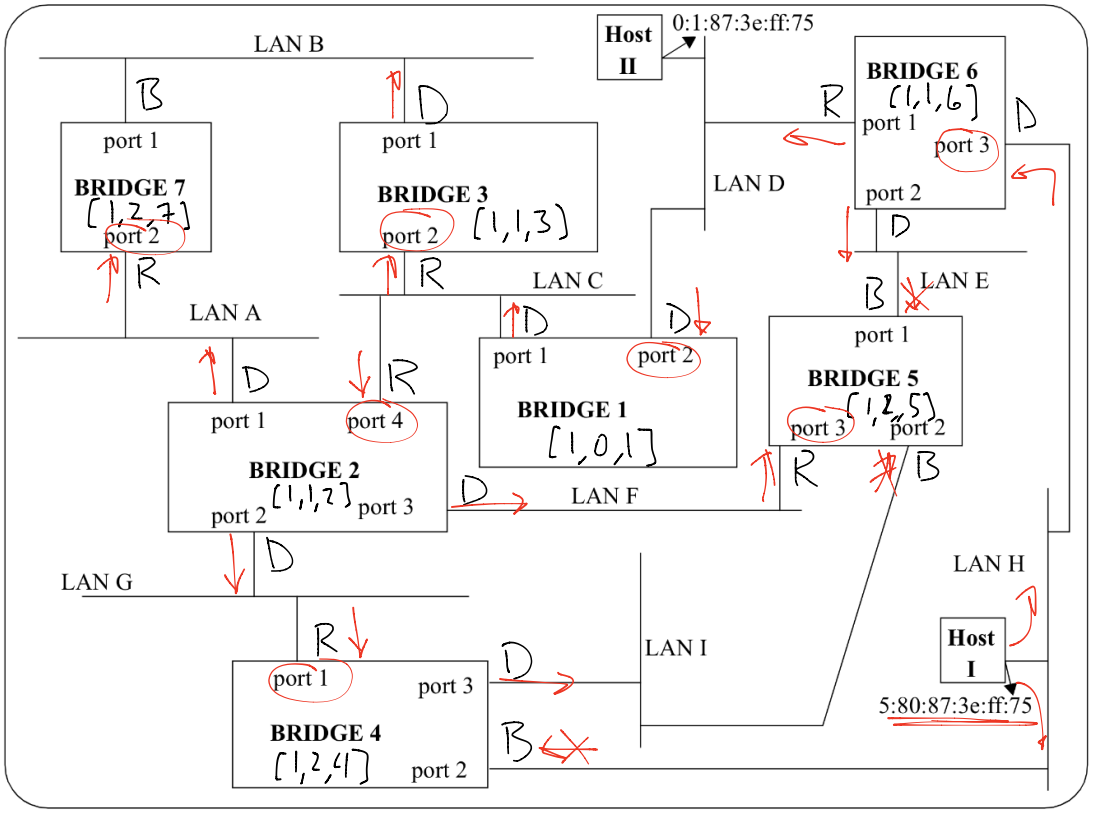
	1	2	3	4	5	6	7
t=2	[1,0,1]	[1,1,2]	[1,1,3]	[1,2,4]	[1,2,5]	[1,1,6]	[1,2,7]

	Root Port	Root Path Cost	Designated Ports	Ports in Forwarding	Ports in Blocked
Bridge 1	-	0	1,2	1,2	—
Bridge 2	4	1	1,2,3	1,2,3,4	—
Bridge 3	2	1	1	1,2	—
Bridge 4	1	2	3	1,3	2
Bridge 5	3	2	—	3	1,2
Bridge 6	1	1	2,3	1,2,3	-
Bridge 7	2	2	-	2	1

o



Host I → Host II ALL LANS (A-I) 9



Host II → Host I

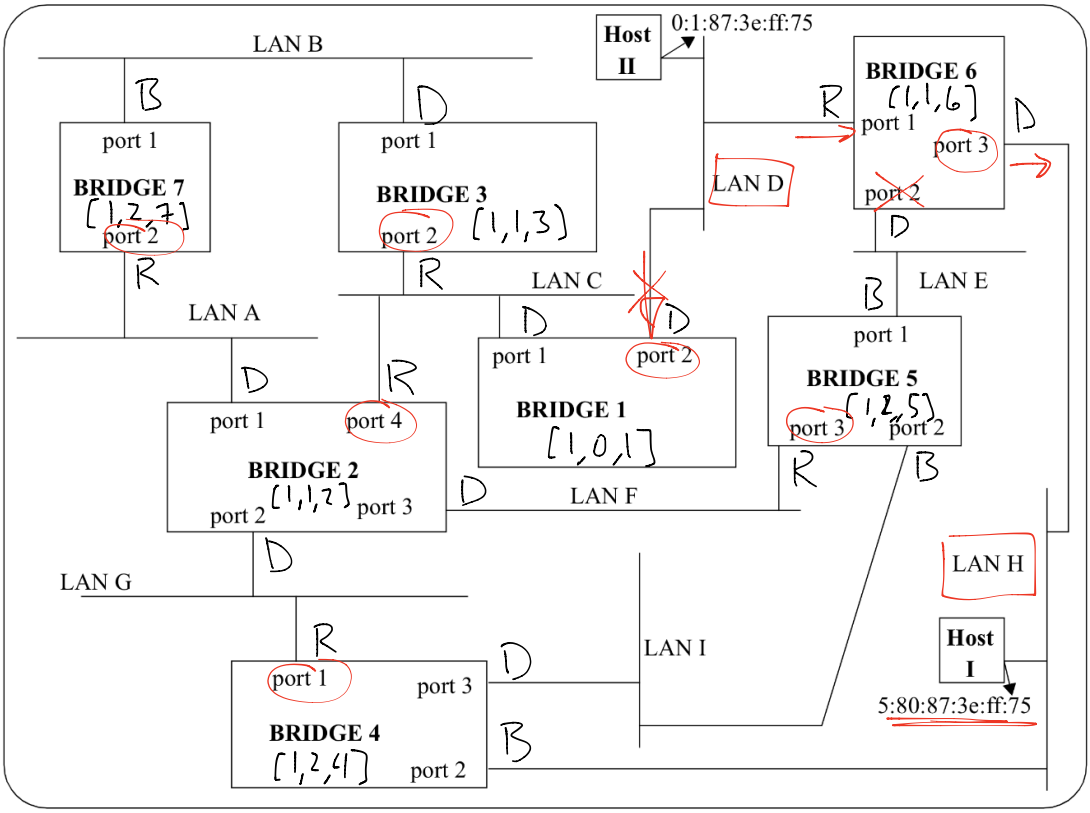

LAN B
Host II
0:1:87:3e:ff:75
BRIDGE 6
[1,1,6]
port 1
port 3
port 2
LAN D
port 1
BRIDGE 7
[1,2,7]
port 2
port 1
BRIDGE 3
port 2
[1,1,3]
LAN C
LAN E
LAN A
port 1
BRIDGE 5
[1,2,5]
port 3
port 2
port 1
port 2
BRIDGE 1
[1,0,1]
port 1
port 4
BRIDGE 2
port 2
[1,1,2]
port 3
LAN F
LAN G
LAN H
LAN I
Host I
5:80:87:3e:ff:75
port 1
port 3
BRIDGE 4
[1,2,4]
port 2

Table 1 IP Routing table at IP router R1

Lower limit of address range	Subnet mask	Flags	Gateway - Next hop	Interface
189.90.43.0	/24	G=0	-	189.90.43.2
189.90.43.2	/32	G=0	-	189.90.43.2
193.41.50.128	/26	G=0	-	193.41.50.129
193.41.50.129	/32	G=0	-	193.41.50.129
198.80.94.0	/24	G=1	189.90.43.1	189.90.43.2
198.80.94.90	/32	G=1	189.90.43.3	189.90.43.2
158.67.9.0	/24	G=0	-	158.67.9.1
158.67.9.1	/32	G=0	-	158.67.9.1
0.0.0.0.	/0	G=1	189.90.43.3	189.90.43.2

Table 2 IP Routing table at IP router R2

Lower limit of address range	Subnet mask	Flags	Gateway - Next hop	Interface
193.41.50.128	/26	G=0	-	193.41.50.131
193.41.50.131	/32	G=0	-	193.41.50.131
143.56.78.0	/24	G=0	-	143.56.78.1
143.56.78.1	/32	G=0	-	143.56.78.1
198.80.94.90	/32	G=0	-	143.56.78.1
189.90.43.0	/24	G=0	-	189.90.43.3
189.90.43.3	/32	G=0	-	189.90.43.3

Table 3 IP Routing table at IP router R3

Lower limit of address range	Subnet mask	Flags	Gateway - Next hop	Interface
198.80.94.0	/24	G=0	-	198.80.94.1
198.80.94.1	/32	G=0	-	198.80.94.1
167.18.19.0	/24	G=0	-	167.18.19.1
167.18.19.1	/32	G=0	-	167.18.19.1
198.80.94.90	/32	G=1	189.90.43.3	189.90.43.1

Table 3 IP Routing table at IP router R3

Lower limit of address range	Subnet mask	Flags	Gateway - Next hop	Interface
189.90.43.0	/24	G=0	-	189.90.43.1
189.90.43.1	/32	G=0	-	189.90.43.1
0.0.0.0	/0	G=1	189.90.43.3	189.90.43.1

Table 4 IP Routing table at Host H1

Lower limit of address range	Subnet mask	Flags	Gateway - Next hop	Interface
158.67.9.0	/24	G=0	-	158.67.9.17
158.67.9.17	/32	G=0	-	127.0.0.1
0.0.0.0	/0	G=1	158.67.9.1	158.67.9.17

Table 5 IP Routing table at Host H2

Row number	Lower limit of address range	Subnet mask	Flags	Gateway - Next hop	Interface
1	198.80.94.0	/24	G=0	-	198.80.94.80
2	198.80.94.80	/32	G=0	-	127.0.0.1
3	198.80.94.90	/32	G=1	198.80.94.1	198.80.94.80
4	0.0.0.0	/0	G=1	198.80.94.1	198.80.94.80

Listed below are the MAC addresses for various Ethernet interfaces:

IP address of interface	MAC address of interface
158.67.9.1	1:a:b0:c1:4d:3e R1
189.90.43.3	3:4:5:6:7:89
189.90.43.2	1a:2b:3c:4d:5e:6f R3 dst
189.90.43.1	1a:2a:3a:4a:5a:6a R1 src
198.80.94.80	8a:9b:7c:6d:5e:4f DST
198.80.94.1	11:22:33:44:55:66 SRC
158.67.9.17	12:9:00:5e:1e:3f H1

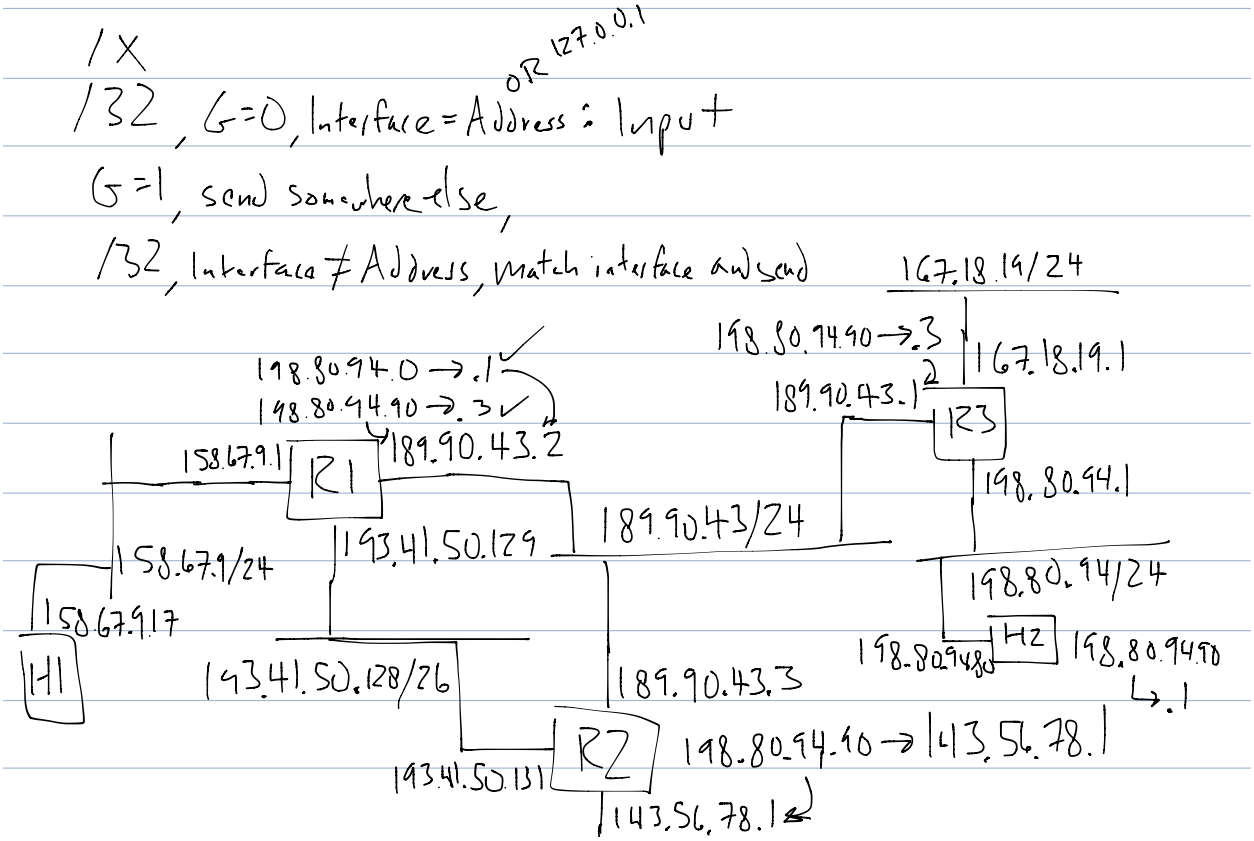
H2 / 198.80.94.90
rows?

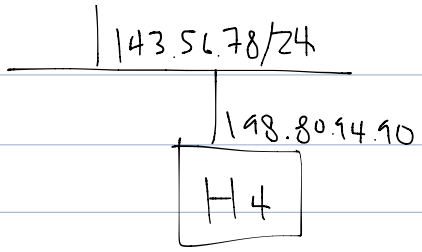
H1 / 198.80.94.90
158.67.9.1

H1 → H2 158.67.9.17 → 198.80.94.80

LAN	Dest IP	Src IP	Dest MAC	Src MAC
H1→R1	198.80.94.80	158.67.9.17	1:a:b0:c1:4d:3e	12:9:00:5e:1e:3f
R1→R3	198.80.94.80	158.67.9.17	1a:2a:3a:4a:5a:6a	1a:2b:3c:4d:5e:6f
R3→H2	198.80.94.80	158.67.9.17	8a:96:7c:6d:5e:4f	11:22:33:44:55:66

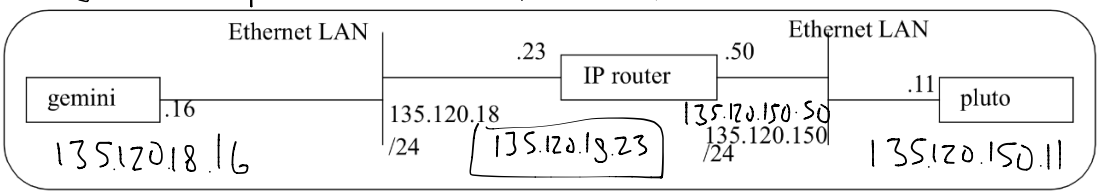
/X
/32, G=0, Interface = Address : Input
or 127.0.0.1
G=1, send somewhere else,
/32, Interface ≠ Address, match interface and send





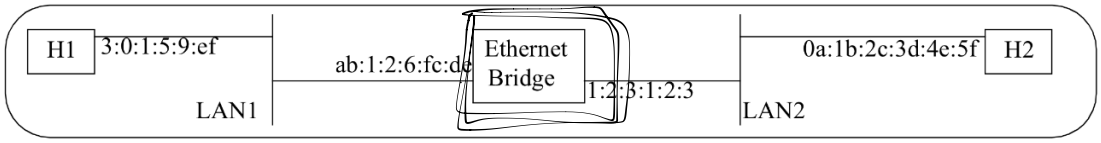
ports in forwarding state = B - 1 + L

gemini → pluto ARP req if empty



135.120.18.23

H1 → H2



	DST	SRC
LAN1	0a:1b:2c:3d:4e:5f	3:0:1:5:9:ef
LAN2	0a:1b:2c:3d:4e:5f	3:0:1:5:9:ef

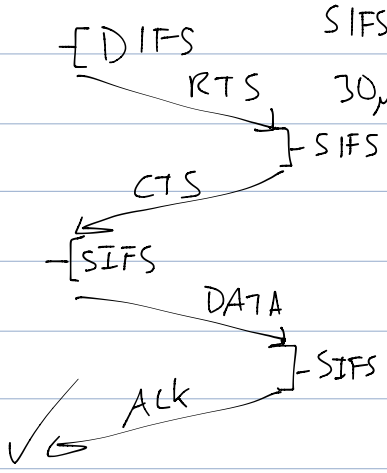
Ethernet bridge vs. IP router

packet forwarding done on dest MAC in ethernet header

Assignment 9

RTS frames, CTS frames, DATA

header + CRC = 34



SIFS + DIFS + RTS + CTS + DATA + ACK

$30\mu s + 50\mu s + \frac{20\,bytes}{11Mbps} + \frac{14\,bytes}{11Mbps} + \frac{1034\,bytes}{11Mbps} + \frac{14\,bytes}{11Mbps} = 867\mu s$

$7.869e^{-4}\,s$ ~~$786.9\mu s$~~

$$\frac{1000\,bytes \times 8\,bits/byte}{delay = 867\mu s} = \frac{9228187.919\,bps}{11Mbps} = .8389$$

OR

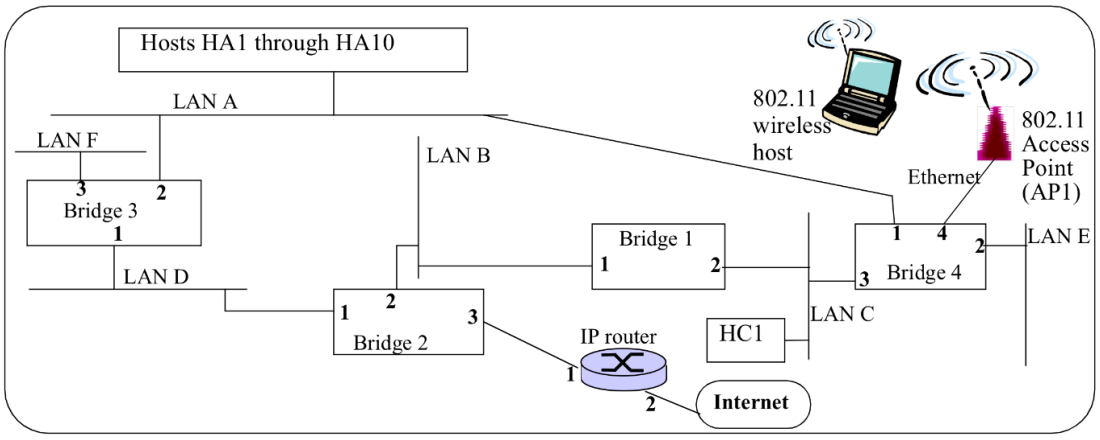
84%

slot times = X

probability = $\frac{1}{1+X}$

$$Mean = \frac{\sum_{i=0}^{X} i}{1+X} = Y \text{ slot times OR } \frac{X}{2} \text{ slot times} * SlotTime$$

additional = ignore DIFS, because always DIFS



HAI → HCI

tables empty, reach all LANS, accesspoint receive, send to wireless host?

NO

HCI: Ethernet MAC = not associated with Wireless link ∴ don't forward

wireless → internet

Address 1: AP's MAC address

Address 2: host's MAC address

Address 3: MAC of dest within AP network / MAC IProuter 1

wireless → HAS

A1: AP MAC

A2: Host MAC

A3: HAS MAC

host → router OR within subnet?

Longest Prefix Match in IP forwarding table lookup

if G=1 → router

if G=0 → Subnet

wireless → [AP → Bridge 4] → ... → Internet

Source?

MAC of wireless host

wireless DHCP, router = default / wireless host vs. router port!?

same subnet mask, same IP address

bridges store wireless host MAC ✓

AP2, bridge 4, port 5 / wireless host AP1 → AP2, before vs. after view

before new frame sent: wrong port (4)

after new frame sent: right port (5)

area coverage:

$\frac{\text{large band}}{\text{required band}} = \frac{20\text{MHz}}{20\text{kHz}} = 1000$ channels − channels for control $= 980$

reuse factor = 4 $\quad \frac{96}{4} = 24$ usage per channel

calls = 96

$MAX = 980 * 24 = 23{,}520$

GSM 200kHz/channel, 8 calls/channel

cell-phone provides

212 in 434, 202 calls 212?

from 202 → 212 switching center → 434 switching center

used to route from home to visiting

mobile station roaming #

single entry for all #'s with 1 area code?

Yes → indirect routing

Hidden terminals CSMA/CA 802.11

RTS collisions ✓

Without

No RTS collisions ✓

Hidden:

No collisions of Data Frame

CTS by AP after successful RTS

Status of other = NAV; Medium busy / Network Allocation Vector / duration field

ACK by AP after data transmit

Hold on to frames to send in Queue

Assignment 10

$n = p \times q$

$z = (p-1) \times (q-1)$

$e = e < n$ & e no common factors z

$d = ed - 1 \% z = 0$

$Key_u = (e, n)$

$key_r = (d, n)$

encrypt $= m^e \bmod(n)$

decrypt $= c^d \bmod(n)$

$p = 5$ $q = 11$ $e = 3 \rightarrow$ $d = 27$

$n = 55$ $z = 40$

hoos = 8 15 15 19

x^e = 512 3375 3375 6859

mod n = 17 20 2039 ✓

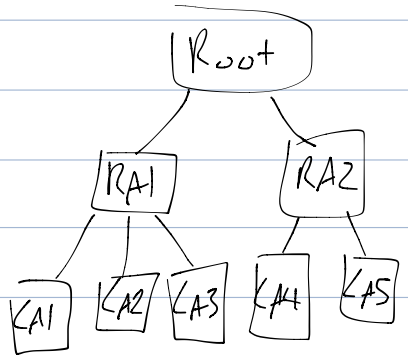
DIFFIE-HELLMAN

n, g, x, y

n = 23 g = 5 x = 3 y = 7

symmetric key = $(g^x \bmod n)^y \bmod n$

10 → 14



Bob → CA5

which used to generate sig w/ Bob's certificate?

CA5 private key

Alice gets Bob's cert, how many more hops?

2, CA5 → RA2 (already has Root)

firewall = first one to pass → do action

only encrypt datagrams between/in internet

tunneling if across internet

TCP across internet, all datagrams have protocol 50 use ESP

ESP +.1 → ESP Auth

ESP header & SPI = security operations and algorithms

SAs are between specific IP instances (routers)