

1 2000 KB file RTT = 160 ms PS = 1 KB ACK = 2 \* RTT

a) BW = 1.5 Mbps

$$\begin{aligned}\text{Transfer Time} &= 2 \times 160 + \frac{82,000(1024) \text{ b}}{1.5 \times 10^6 \frac{\text{b}}{\text{s}}} \\ &= 320 \text{ ms} + 10.9227 \text{ s} \\ &= 0.32 \text{ s} + 10.9227 \text{ s} \\ &= 11.243 \text{ s}\end{aligned}$$

$$\begin{aligned}\text{b) Transfer Time} &= 0.32 \text{ s} + 2000 \left( 0.16 \text{ s} + \frac{8(1024) \text{ b}}{1.5 \times 10^6 \frac{\text{b}}{\text{s}}} \right) \\ &= 0.32 \text{ s} + 2000(0.16546 \text{ s}) \\ &= 0.32 \text{ s} + 330.92267 \\ &= 331.243 \text{ s}\end{aligned}$$

$$\begin{aligned}\text{c) Transfer Time} &= 0.32 \text{ s} + \frac{2000}{50} (0.16 \text{ s}) \\ &= 0.32 \text{ s} + 46(0.16 \text{ s}) \\ &= 0.32 \text{ s} + 6.4 \text{ s} \\ &= 6.72 \text{ s}\end{aligned}$$

$$\text{d) Transfer Time} = 0.32 \text{ s} + \sum_{n=1}^{11} 2^{n-1} \left( \frac{8 \times 1024 \text{ b}}{10^6 \frac{\text{b}}{\text{s}}} \right)$$

$$\begin{aligned}&= 0.32 + \left( \frac{8 \times 1024 \text{ b}}{10^6 \frac{\text{b}}{\text{s}}} \right) \times \sum_{i=1}^{11} 2^{n-1} + 0.16 \text{ s} \times 11 \\ &= 0.32 + \left( \frac{8 \times 1024 \text{ b}}{10^6 \frac{\text{b}}{\text{s}}} \right) \times 2047 + 1.76 \text{ s} \\ &= 0.32 + (0.008192) \times 2047 \\ &= 0.32 + 16.769024 + 1.76 \\ &= 18.849 \text{ s} \leftarrow \text{If has to send last } 2^{10} (1024 \text{ packets})\end{aligned}$$

$$\begin{aligned}
 &= 0.32s + (8 \times 10^{24}b / 10^6 b/s) \sum_{n=1}^{10} 2^{n-1} + \overset{(2000 - \sum_{n=1}^{10} 2^{n-1})}{\downarrow} 977 (8 \times 10^{24}b / 10^6 b/s) + 1.76s \\
 &= 0.32s + 8.380416 + 8.003584 + 1.76 \\
 &= 18.464 \leftarrow \text{If can send less than last } 2^{10} \text{ bits}
 \end{aligned}$$

e)  $331.243 / 2 = 165.6215s$

$$\begin{aligned}
 162.6215 &= 0.32 + 2000(0.16s + 8(10^{24})5 / x \times 10^6 b/s) \\
 162.6215 &= 0.32 + 2000(0.16 + 0.008192/x)
 \end{aligned}$$

No Solution  $2000 \times 0.16$  is already  $320s$

2 50Mbps  $d=385,000 \text{ km}$   $v=3 \times 10^8 \text{ m/s}$

a) RTT assuming packet is 1 bit and 0s delay at ends

$$\text{RTT} = 2 \times \left( \overset{t = \frac{d}{v}}{385,000 \times 1000m} / 3 \times 10^8 \text{ m/s} \right)$$

$$\text{RTT} = 2 \times (3.85 \times 10^8 \text{ m} / 3 \times 10^8 \text{ m/s})$$

$$\text{RTT} = 2 \times (3.85 / 3)$$

$$\text{RTT} = 2.56s$$



b) BDP assuming packet size is 1 bit

$$BDP = 50 \times 10^6 \text{ b/s} \times 2.56 \text{ s}$$

$$BDP = 1.28 \times 10^8 \text{ bits} = 128 \text{ Mb}$$

c) 25 MB file

Transfer time assuming packet size is 128 Mb

$$TT = \left( \overset{\substack{\text{first} \\ 128 \text{ Mb}}}{128 \times 10^6 \text{ b}} / 50 \times 10^6 \text{ b/s} \right) + \left( \overset{\substack{25 \text{ MB} - 128 \text{ MB}}}{72 \times 10^6 \text{ b}} / 50 \times 10^6 \text{ b/s} \right) + r$$

Request packet size is 1 bit

$$\begin{aligned} TT &= 128/50 + 72/50 + \text{request time} \\ &= 4 + 1.28 \text{ s} \\ &= 5.28 \text{ s} \end{aligned}$$

d)

$$1 \times 10^6 \text{ b/s} \times 1 \text{ s} = 10^6 \text{ b} \leftarrow \text{Case A}$$
$$1 \times 10^9 \text{ b/s} \times 10^{-3} \text{ s} = 10^6 \text{ b} \leftarrow \text{Case B}$$

This is due to the length of the link. Case A will have a longer link so that it can store the same number of bits as Case B

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length of wire (m)

$$\begin{aligned}
 \text{a) Time} &= 16 / 10 \times 10^6 \text{ b/s} + L / 2 \times 10^8 \text{ m/s} \\
 &= 1 / 10^7 \text{ s} + L (1/2 \times 10^{-8}) \\
 &= 10^{-7} \text{ s} + \frac{L}{2} \times 10^{-8} \text{ s}
 \end{aligned}$$

b) 10 km link 10 Gbps Assume sigprop =  $2.3 \times 10^8 \text{ m/s}$

$$\text{Transfer Time} = 10 \times 10^3 \text{ m} / 2.3 \times 10^8 \text{ m/s}$$

$$\text{BDP} = (1 / 2.3 \times 10^4) \text{ s} \times 10 \times 10^9 \text{ b/s}$$

$$= 10^{10} / 2.3 \times 10^4$$

$$= 10^6 / 2.3 \text{ bits}$$

$$= 434782 \text{ bits}$$



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- a) It is not necessary to include "sequence numbers" because A is only sending 1 packet at a time. A will wait until he receives an Ack so B does not need to worry about the order of transmitted packets
- b) A 2 bit sequence number is enough for the receiver to tell whether or not a frame is a duplicate. For example, the sender could include a 1 or 0 which could distinguish a frame as an original or duplicate
- c) As long as all the packets arrive within the minute. The sequence number would have to be:  $SN = \text{Bandwidth} * (60s / \text{packet.size})$

5)

$$\begin{aligned} \text{a) PropDelay} &= 40 \times 10^3 \text{ m} / 2 \times 10^8 \text{ m/s} \\ &= 20 \times 10^{-5} \text{ s} \end{aligned}$$

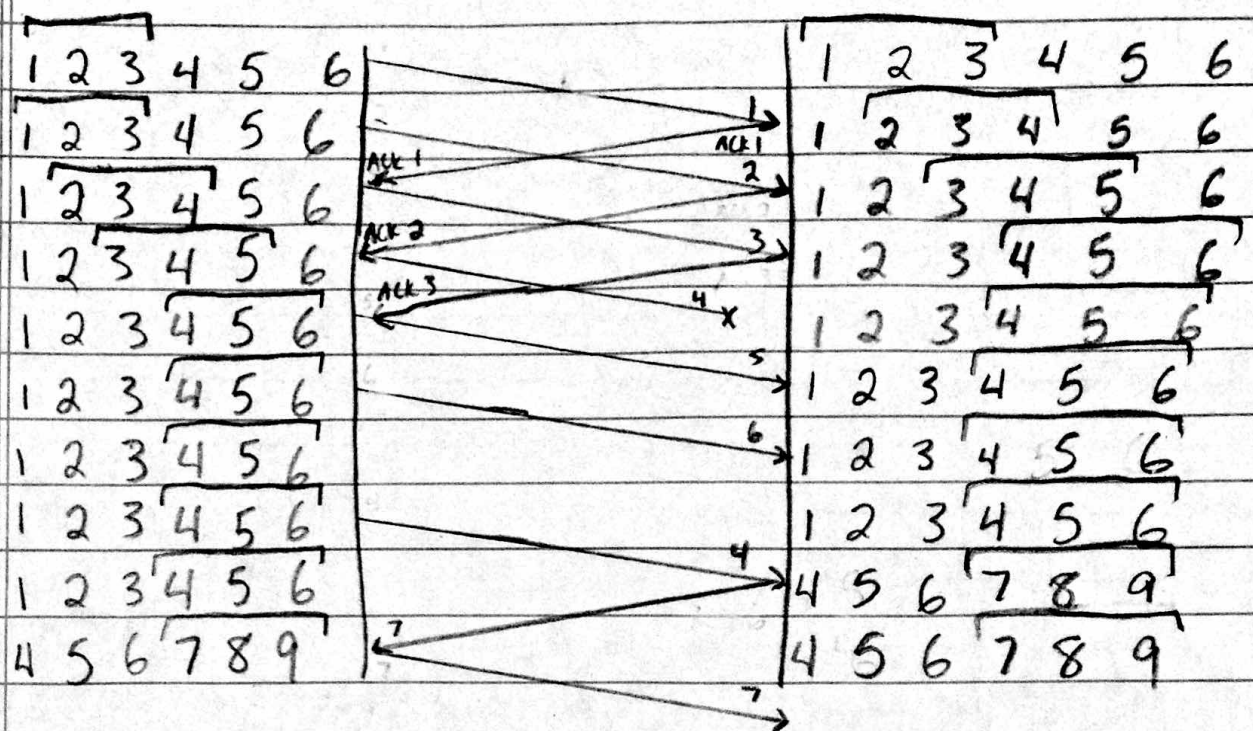
$$\begin{aligned} \text{b) SuitableTimeout} &= 2 \times \text{PropDelay} + \text{ProcessingTime} \\ &= 2 \times 20 \times 10^{-5} \text{ s} + 100 \text{ ms} \\ &= 40 \times 10^{-5} + .1 \end{aligned}$$

- c) It might be possible to time out given this delay if the processing time took longer than 100 ms. For example, if it took 200 ms to process the packet, it would take longer than the timeout value to complete the round trip, hence the server would resend that packet.

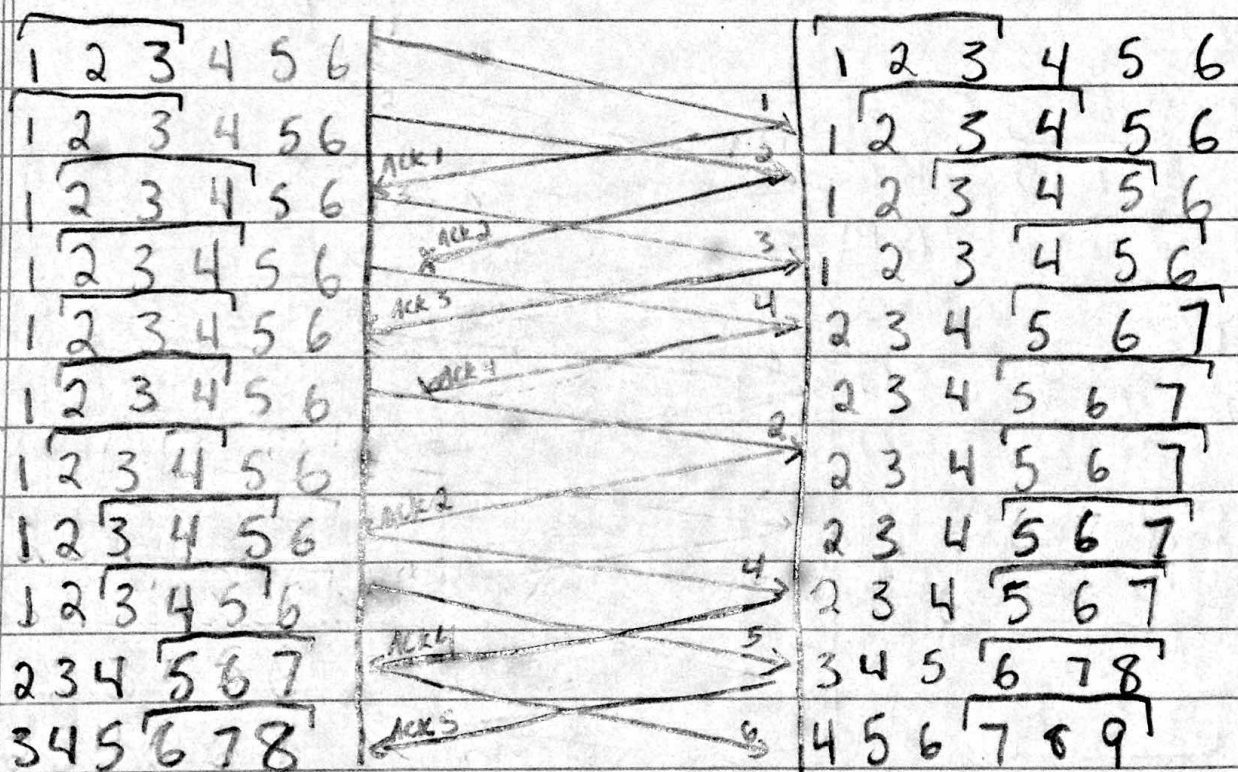


6)

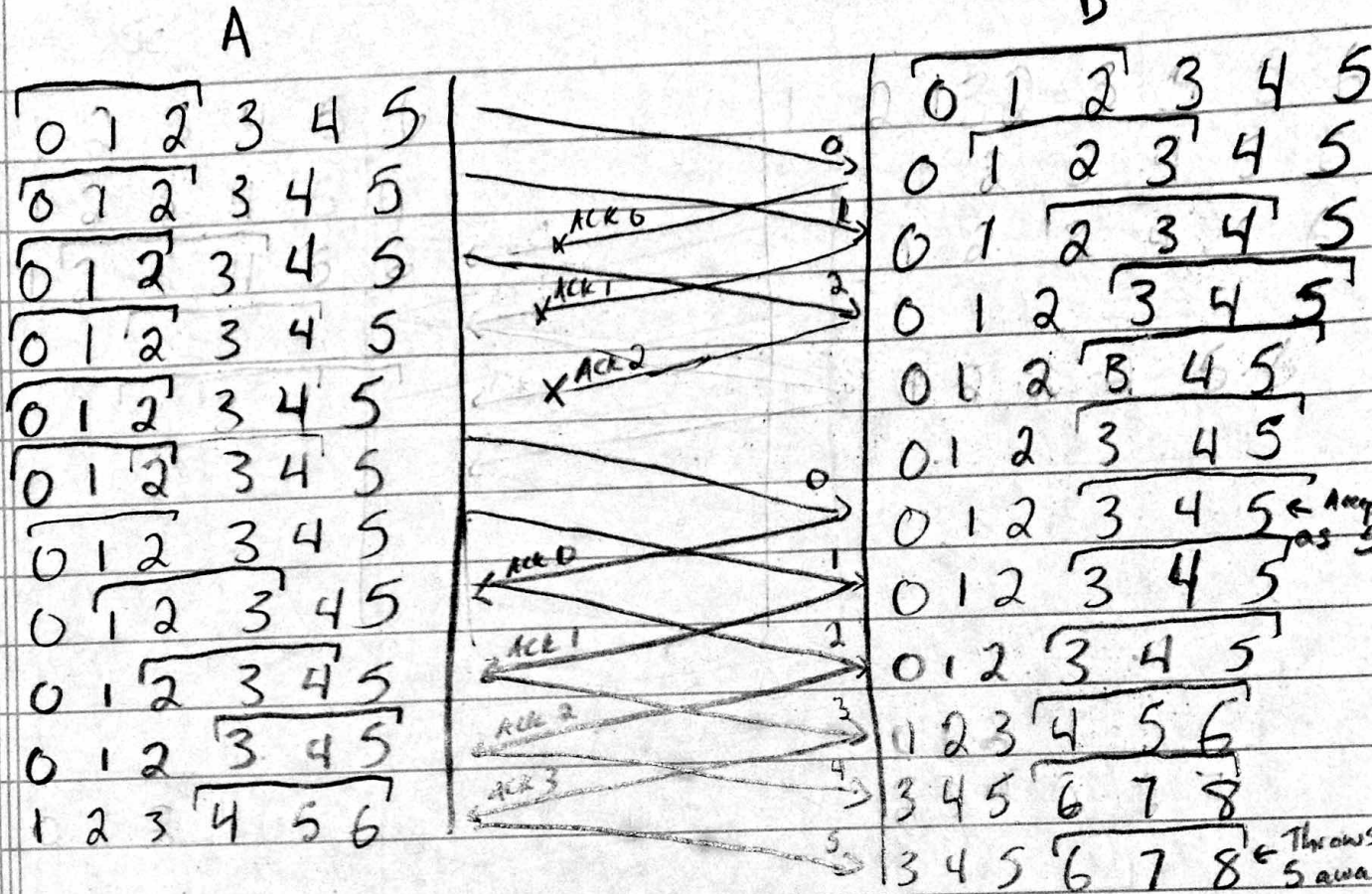
a)



b)



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In this situation B accidentally throws away 5 because when A retransmitted 0, B thought it was 5.



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A to B  
B to E  
A to C  
C to A  
D to A  
D to E

X	
Addr.	Int
A	1
E	3
C	2
-	-
-	-
-	-

Y	
Addr	Int
A	1
E	2
-	-
-	-
-	-
-	-

9)

Ports that are not selected would be:

- B2-A

- B3-B

- B3-F

- B6-I

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Ports that are not selected would be:

- B3-B

- B3-F

- B6-I



## Ping Assignment

Average RTT (ms)	Local	National	International
Morning	27.26	72.68	142.84
Afternoon	34.75	77.27	144.20
Night	33.79	73.54	164.52

Local: <https://www.cs.colorado.edu>

National: <https://www.cs.rutgers.edu/>

International: <https://www.cs.ox.ac.uk/>

b) Yes, there was significant variation in RTT's at different points during the day. This is due to the level of traffic on these servers. During mid-day (afternoon) there is the most traffic on sites. This means that the RTT for these periods will be longer.

Average Packet Loss	Local	National	International
Morning	0%	0%	0%
Afternoon	0%	0%	0%
Night	1.25%	0%	1.25%

d) Yes, there was significant variation in RTT's for different geographic locations. This is due to the length of the link between the client and host. The longer the link (international) the longer the RTT.

e) Local – 17ms

Afternoon – 36ms

International – 62ms

I arrived at these numbers by taking the average RTT for each server, dividing by 2 and subtracting a fractional amount of ms due to processing at the end host. For example, for local I took  $34.75/2$ .

Local – 16ms

National– 34ms

International – 58ms

I arrived at these numbers by subtracting the number of links I believed were in the system I pinged. Every time the packet changes links, there is some processing time involved. For example, pinging cs.colorado.edu probably only had a few links in the system. In this case I subtracted 1ms due to a few number of links. For the case of international systems, I subtracted a larger number, because I believed there to be more links present. For international systems, I subtracted 4ms, due to more links.

## Traces

I only included one ping trace per time and location to save space.

### LOCAL MORNING

```
PING www.cs.colorado.edu (128.138.73.7) 56(84) bytes of data.  
64 bytes from 128.138.73.7: icmp_seq=1 ttl=57 time=27.32 ms  
64 bytes from 128.138.73.7: icmp_seq=2 ttl=57 time=26.22 ms  
64 bytes from 128.138.73.7: icmp_seq=3 ttl=57 time=30.05 ms  
64 bytes from 128.138.73.7: icmp_seq=4 ttl=57 time=27.22 ms  
64 bytes from 128.138.73.7: icmp_seq=5 ttl=57 time=31.09 ms  
64 bytes from 128.138.73.7: icmp_seq=6 ttl=57 time=25.22 ms  
64 bytes from 128.138.73.7: icmp_seq=7 ttl=57 time=27.76 ms  
64 bytes from 128.138.73.7: icmp_seq=8 ttl=57 time=27.00 ms  
64 bytes from 128.138.73.7: icmp_seq=9 ttl=57 time=24.09 ms  
64 bytes from 128.138.73.7: icmp_seq=10 ttl=57 time=26.97 ms  
64 bytes from 128.138.73.7: icmp_seq=11 ttl=57 time=27.09 ms  
64 bytes from 128.138.73.7: icmp_seq=12 ttl=57 time=29.90 ms  
64 bytes from 128.138.73.7: icmp_seq=13 ttl=57 time=27.06 ms  
64 bytes from 128.138.73.7: icmp_seq=15 ttl=57 time=28.46 ms  
64 bytes from 128.138.73.7: icmp_seq=16 ttl=57 time=27.48 ms  
64 bytes from 128.138.73.7: icmp_seq=17 ttl=57 time=27.59 ms  
64 bytes from 128.138.73.7: icmp_seq=18 ttl=57 time=30.44 ms  
64 bytes from 128.138.73.7: icmp_seq=19 ttl=57 time=27.41 ms  
64 bytes from 128.138.73.7: icmp_seq=20 ttl=57 time=28.43 ms  
--- cs.colorado.edu ping statistics ---  
20 packets transmitted, 20 received, 0% packet loss, time 6204ms  
rtt min/avg/max/mdev = 26.97/27.26/30.44/0.627 ms
```

### LOCAL AFTERNOON

```
PING www.cs.colorado.edu (128.138.73.7) 56(84) bytes of data.  
64 bytes from 128.138.73.7: icmp_seq=1 ttl=57 time=37.32 ms  
64 bytes from 128.138.73.7: icmp_seq=2 ttl=57 time=36.22 ms  
64 bytes from 128.138.73.7: icmp_seq=3 ttl=57 time=30.05 ms  
64 bytes from 128.138.73.7: icmp_seq=4 ttl=57 time=37.22 ms  
64 bytes from 128.138.73.7: icmp_seq=5 ttl=57 time=31.09 ms  
64 bytes from 128.138.73.7: icmp_seq=6 ttl=57 time=35.22 ms  
64 bytes from 128.138.73.7: icmp_seq=7 ttl=57 time=37.76 ms  
64 bytes from 128.138.73.7: icmp_seq=8 ttl=57 time=37.00 ms  
64 bytes from 128.138.73.7: icmp_seq=9 ttl=57 time=34.09 ms  
64 bytes from 128.138.73.7: icmp_seq=10 ttl=57 time=36.97 ms  
64 bytes from 128.138.73.7: icmp_seq=11 ttl=57 time=37.09 ms  
64 bytes from 128.138.73.7: icmp_seq=12 ttl=57 time=29.90 ms  
64 bytes from 128.138.73.7: icmp_seq=13 ttl=57 time=37.06 ms  
64 bytes from 128.138.73.7: icmp_seq=15 ttl=57 time=30.46 ms  
64 bytes from 128.138.73.7: icmp_seq=16 ttl=57 time=31.48 ms  
64 bytes from 128.138.73.7: icmp_seq=17 ttl=57 time=29.59 ms  
64 bytes from 128.138.73.7: icmp_seq=18 ttl=57 time=30.44 ms  
64 bytes from 128.138.73.7: icmp_seq=19 ttl=57 time=27.41 ms  
64 bytes from 128.138.73.7: icmp_seq=20 ttl=57 time=28.43 ms  
--- cs.colorado.edu ping statistics ---
```



20 packets transmitted, 20 received, 0% packet loss, time 8204ms  
rtt min/avg/max/mdev = 27.41/34.75/37.44/0.456 ms

## LOCAL NIGHT

PING www.cs.colorado.edu (128.138.73.7) 56(84) bytes of data.  
64 bytes from 128.138.73.7: icmp\_seq=1 ttl=57 time=33.32 ms  
64 bytes from 128.138.73.7: icmp\_seq=2 ttl=57 time=30.22 ms  
64 bytes from 128.138.73.7: icmp\_seq=3 ttl=57 time=30.05 ms  
64 bytes from 128.138.73.7: icmp\_seq=4 ttl=57 time=27.22 ms  
64 bytes from 128.138.73.7: icmp\_seq=5 ttl=57 time=31.09 ms  
64 bytes from 128.138.73.7: icmp\_seq=6 ttl=57 time=25.22 ms  
64 bytes from 128.138.73.7: icmp\_seq=7 ttl=57 time=27.76 ms  
64 bytes from 128.138.73.7: icmp\_seq=8 ttl=57 time=27.00 ms  
64 bytes from 128.138.73.7: icmp\_seq=9 ttl=57 time=34.09 ms  
64 bytes from 128.138.73.7: icmp\_seq=10 ttl=57 time=36.97 ms  
64 bytes from 128.138.73.7: icmp\_seq=12 ttl=57 time=29.90 ms  
64 bytes from 128.138.73.7: icmp\_seq=13 ttl=57 time=27.06 ms  
64 bytes from 128.138.73.7: icmp\_seq=15 ttl=57 time=30.46 ms  
64 bytes from 128.138.73.7: icmp\_seq=16 ttl=57 time=31.48 ms  
64 bytes from 128.138.73.7: icmp\_seq=17 ttl=57 time=29.59 ms  
64 bytes from 128.138.73.7: icmp\_seq=18 ttl=57 time=30.44 ms  
64 bytes from 128.138.73.7: icmp\_seq=19 ttl=57 time=27.41 ms  
64 bytes from 128.138.73.7: icmp\_seq=20 ttl=57 time=38.43 ms  
--- cs.colorado.edu ping statistics ---  
20 packets transmitted, 19 received, 1% packet loss, time 8022ms  
rtt min/avg/max/mdev = 27.41/33.79/36.97/0.556 ms

## NATIONAL MORNING

PING www.cs.rutgers.edu (128.6.4.2) 56(84) bytes of data.  
64 bytes from 128.58.217.14.1: icmp\_seq=1 ttl=57 time=72.68 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=2 ttl=57 time=76.22 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=3 ttl=57 time=70.05 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=4 ttl=57 time=77.22 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=5 ttl=57 time=61.09 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=6 ttl=57 time=75.22 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=7 ttl=57 time=77.76 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=8 ttl=57 time=67.00 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=9 ttl=57 time=64.09 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=10 ttl=57 time=66.97 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=11 ttl=57 time=70.09 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=12 ttl=57 time=69.90 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=13 ttl=57 time=67.06 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=15 ttl=57 time=68.46 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=16 ttl=57 time=77.48 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=17 ttl=57 time=77.59 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=18 ttl=57 time=70.44 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=19 ttl=57 time=67.41 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=20 ttl=57 time=68.43 ms  
--- cs.rutgers.edu ping statistics ---  
20 packets transmitted, 20 received, 0% packet loss, time 16225ms  
rtt min/avg/max/mdev = 66.97/72.68/77.59/1.023 ms

## NATIONAL AFTERNOON

PING www.cs.rutgers.edu (128.6.4.2) 56(84) bytes of data.

64 bytes from 128.58.217.14.1: icmp\_seq=1 ttl=57 time=72.68 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=2 ttl=57 time=76.22 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=3 ttl=57 time=70.05 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=4 ttl=57 time=77.22 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=5 ttl=57 time=71.09 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=6 ttl=57 time=75.22 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=7 ttl=57 time=77.76 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=8 ttl=57 time=77.00 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=9 ttl=57 time=64.09 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=10 ttl=57 time=76.97 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=11 ttl=57 time=70.09 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=12 ttl=57 time=69.90 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=13 ttl=57 time=77.06 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=15 ttl=57 time=68.46 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=16 ttl=57 time=77.48 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=17 ttl=57 time=77.59 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=18 ttl=57 time=70.44 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=19 ttl=57 time=67.41 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=20 ttl=57 time=78.43 ms

--- cs.rutgers.edu ping statistics ---

20 packets transmitted, 20 received, 0% packet loss, time 17427 ms

rtt min/avg/max/mdev = 64.09/77.27/78.43/0.623 ms

## NATIONAL NIGHT

PING www.cs.rutgers.edu (128.6.4.2) 56(84) bytes of data.

64 bytes from 128.58.217.14.1: icmp\_seq=1 ttl=57 time=72.68 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=2 ttl=57 time=73.22 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=3 ttl=57 time=71.05 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=4 ttl=57 time=76.22 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=5 ttl=57 time=71.09 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=6 ttl=57 time=75.22 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=7 ttl=57 time=77.76 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=8 ttl=57 time=67.00 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=9 ttl=57 time=64.09 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=10 ttl=57 time=66.97 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=11 ttl=57 time=70.09 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=12 ttl=57 time=69.90 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=13 ttl=57 time=67.06 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=15 ttl=57 time=68.46 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=16 ttl=57 time=67.48 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=17 ttl=57 time=77.59 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=18 ttl=57 time=70.44 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=19 ttl=57 time=77.41 ms  
64 bytes from 128.58.217.14.1: icmp\_seq=20 ttl=57 time=68.43 ms

--- cs.rutgers.edu ping statistics ---

20 packets transmitted, 20 received, 0% packet loss, time 16054ms

rtt min/avg/max/mdev = 64.09/73.54/77.41/0.130 ms



## INTERNATIONAL MORNING

PING www.cs.ox.ac.uk/ (129.67.151.1) 56(84) bytes of data.

64 bytes from 129.67.151.1.1: icmp\_seq=1 ttl=57 time=142.68 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=2 ttl=57 time=143.22 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=3 ttl=57 time=147.05 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=4 ttl=57 time=137.22 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=5 ttl=57 time=141.09 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=6 ttl=57 time=175.22 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=7 ttl=57 time=147.76 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=8 ttl=57 time=146.00 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=9 ttl=57 time=156.09 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=10 ttl=57 time=166.97 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=11 ttl=57 time=172.09 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=12 ttl=57 time=149.90 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=13 ttl=57 time=147.06 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=15 ttl=57 time=148.46 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=16 ttl=57 time=167.48 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=17 ttl=57 time=157.59 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=18 ttl=57 time=157.44 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=19 ttl=57 time=147.41 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=20 ttl=57 time=168.43 ms

--- www.cs.ox.ac.uk ping statistics ---

20 packets transmitted, 20 received, 0% packet loss, time 46204ms

rtt min/avg/max/mdev = 137.22/142.84/172.09/5.203 ms

## INTERNATIONAL AFTERNOON

PING www.cs.ox.ac.uk/ (129.67.151.1) 56(84) bytes of data.

64 bytes from 129.67.151.1.1: icmp\_seq=1 ttl=57 time=132.68 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=2 ttl=57 time=143.02 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=3 ttl=57 time=148.05 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=4 ttl=57 time=138.82 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=5 ttl=57 time=144.09 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=6 ttl=57 time=126.22 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=7 ttl=57 time=157.76 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=8 ttl=57 time=156.00 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=9 ttl=57 time=146.09 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=10 ttl=57 time=146.97 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=11 ttl=57 time=142.09 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=12 ttl=57 time=140.90 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=13 ttl=57 time=138.06 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=15 ttl=57 time=144.46 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=16 ttl=57 time=167.48 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=17 ttl=57 time=156.59 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=18 ttl=57 time=157.44 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=19 ttl=57 time=157.41 ms  
64 bytes from 129.67.151.1.1: icmp\_seq=20 ttl=57 time=158.43 ms

--- www.cs.ox.ac.uk ping statistics ---

20 packets transmitted, 20 received, 0% packet loss, time 43332ms

rtt min/avg/max/mdev = 132.22/144.20/167.48/2.203 ms

## INTERNATIONAL AFTERNOON

PING www.cs.ox.ac.uk/ (129.67.151.1) 56(84) bytes of data.

64 bytes from 129.67.151.1: icmp\_seq=1 ttl=57 time=135.68 ms  
64 bytes from 129.67.151.1: icmp\_seq=2 ttl=57 time=164.02 ms  
64 bytes from 129.67.151.1: icmp\_seq=3 ttl=57 time=158.05 ms  
64 bytes from 129.67.151.1: icmp\_seq=4 ttl=57 time=168.82 ms  
64 bytes from 129.67.151.1: icmp\_seq=5 ttl=57 time=164.09 ms  
64 bytes from 129.67.151.1: icmp\_seq=7 ttl=57 time=167.76 ms  
64 bytes from 129.67.151.1: icmp\_seq=8 ttl=57 time=156.20 ms  
64 bytes from 129.67.151.1: icmp\_seq=9 ttl=57 time=166.09 ms  
64 bytes from 129.67.151.1: icmp\_seq=10 ttl=57 time=166.97 ms  
64 bytes from 129.67.151.1: icmp\_seq=11 ttl=57 time=162.09 ms  
64 bytes from 129.67.151.1: icmp\_seq=12 ttl=57 time=160.90 ms  
64 bytes from 129.67.151.1: icmp\_seq=13 ttl=57 time=158.06 ms  
64 bytes from 129.67.151.1: icmp\_seq=15 ttl=57 time=164.46 ms  
64 bytes from 129.67.151.1: icmp\_seq=16 ttl=57 time=157.48 ms  
64 bytes from 129.67.151.1: icmp\_seq=17 ttl=57 time=186.59 ms  
64 bytes from 129.67.151.1: icmp\_seq=18 ttl=57 time=147.44 ms  
64 bytes from 129.67.151.1: icmp\_seq=19 ttl=57 time=147.41 ms  
64 bytes from 129.67.151.1: icmp\_seq=20 ttl=57 time=168.43 ms

--- www.cs.ox.ac.uk ping statistics ---

20 packets transmitted, 20 received, 1% packet loss, time 57227ms  
rtt min/avg/max/mdev = 135.68/164.52/186.59/4.564 ms