Ans1.

Calculation for the average queuing delay:

Assuming the transmission and propagation delays are constant in each sample for respective data size as the distance traveled and data packet size is the same.
Assuming that the processing delay is negligible.
Assuming that the packet that took the least time has 0 queuing delay.

Least time taken by 500 bytes packet = 2.4ms => transmission + propagation delay
Least time taken by 1000 bytes packet = 2.8ms => transmission + propagation delay

Average Queuing delay of 500 bytes packet = (10 - 2.4) + (2.8 - 2.4) + (2.4 - 2.4) + (4 - 2.4) + (5.5 - 2.4) / 5

= 2.54ms

Average Queuing delay of 1000 bytes packet = (11 - 2.8) + (10 - 2.8) + (2.8 - 2.8) + (3 - 2.8) + (5.5 - 2.8) / 5

= 3.66ms

Calculation for the transmission and propagation delays experienced by a packet of size 600 bytes:

Assuming propagation delay is constant for 500, and 1000 bytes packet as scale and distance remains constant for same path.

From previous equations:

Propagation + Transmission Delay for 500 bytes = 2.4
Propagation + Transmission Delay for 1000 bytes = 2.8

Eq1. P + 500/R = 2.4
Eq2. P + 1000/R = 2.8
where P -> Propagation delay
R -> Transmission rate

We also know that,

Average queuing delay for 500bytes packet = 2.54
Average queuing delay for 1000bytes packet = 3.66

Eq.3 500 * a/R = 2.54
Eq.4 1000 * a/R = 3.66
where a -> incoming packets per second
R -> transmission rate

Solving Eq 1, 2, 3 and 4:

R = 1250bytes / ms
a = 2.8 packets / ms

Propagation delay = 2

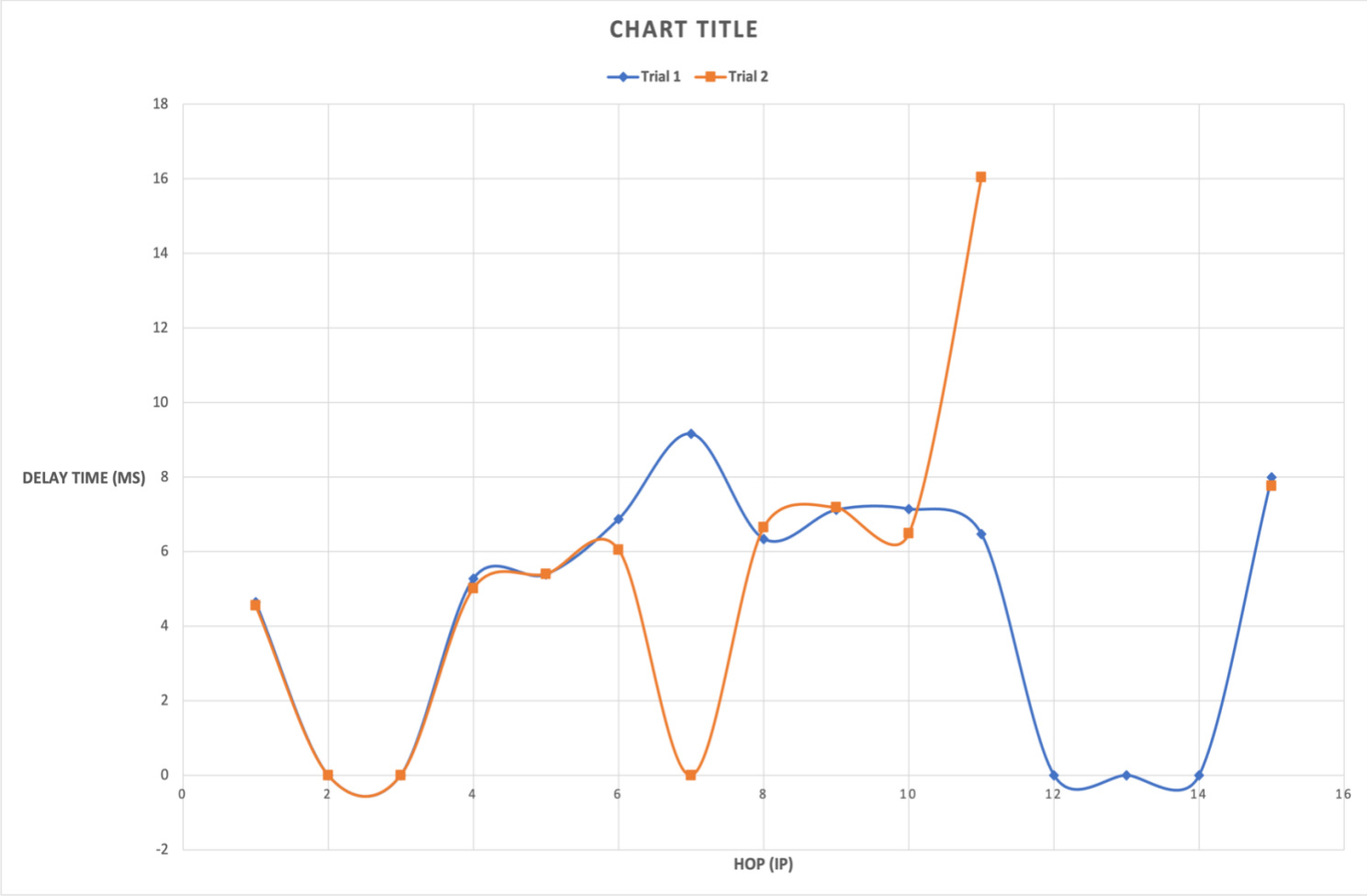
Hence, Propagation + Transmission Delay for 600 bytes = 2 + 600/R = 2.48 ms

Ans 2 – a

Data for IP address and average delay at the corresponding hops:

IP	**Delay**	**IP1**	**Delay1**
(192.168.86.1)	4.644	(192.168.86.1)	4.553
*	0	*	0
*	0	*	0
(192.119.18.214)	5.26766667	(192.119.18.214)	5.0175
(149.112.13.16)	5.384	(149.112.13.16)	5.40033333
(140.197.253.23)	6.866	(140.197.253.23)	6.05166667
(140.197.253.139)	9.158	*	0
(199.104.93.22)	6.33933333	(199.104.93.22)	6.64966667
(199.104.93.33)	7.11566667	(199.104.93.33)	7.18566667
(155.99.130.67) / (155.99.130.65)	7.142	(155.99.130.65) / (155.99.130.67) / (155.99.130.65)	6.489
(155.99.130.101) / (155.99.130.103)	6.47	(155.99.130.103) / (155.99.130.107) / (155.99.130.101)	16.041
*	0	*	
*	0	*	
*	0	*	
(155.98.186.21)	7.9915	(155.98.186.21)	7.76033333

Plot for the above data:



Ans 2 - b

Queuing delay
Low priority to traceroute traffic at certain IP addresses

Ans 3.

Average round trip queueing delay = Average Delay - Minimum Delay
= 128.135 - 122.577
= 5.558 ms