P14:

1. delaytotal = delayqueuing + delaytransmission

=IL/(R(1-I))+L/R

=L/R\*(1/(1-I))

=L/(R-La)

1. If L/R =x

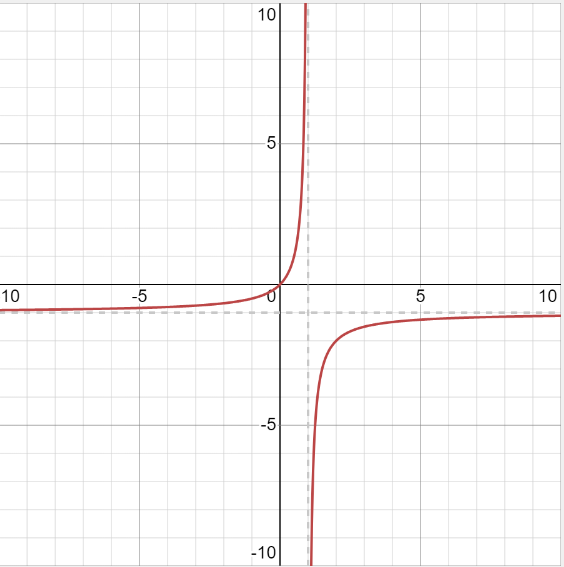
delaytotal=L/(R-La)

=1/(R/L-a)

=1/(1/x-a)

=x/(1-ax)

Graph:



P18:

Using <https://www.ip2location.com/free/traceroute> to trace route from 50.97.82.1 to [69.120.159.83](javascript:;)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Hop | IP Address | Hostname | Location | Time |  |
| 1 | 50.97.82.1 | fcr03a.dal05.v797.uk2group.com | |  | | --- | | United States of America, Texas, Dallas | | 0.653 ms | 0.653 |
| 2 | 173.192.118.144 | ae13.dar02.dal05.networklayer.com | |  | | --- | | United States of America, Texas, Dallas | | 2.294 ms | 2.294 |
| 3 | 173.192.18.214 | d6.12.c0ad.ip4.static.sl-reverse.com | |  | | --- | | United States of America, Texas, Dallas | | 1.597 ms | 1.597 |
| 4 | 50.97.17.56 | ae5.cbs02.eq01.dal03.networklayer.com | |  | | --- | | United States of America, Texas, Dallas | | 2.391 ms | 2.391 |
| 6 | 169.45.18.5 | ae2.cbs01.eq01.chi01.networklayer.com | |  | | --- | | United States of America, Illinois, Chicago | | 23.414 ms | 23.414 |
| 7 | 50.97.17.49 | ae0.cbs02.tl01.nyc01.networklayer.com | |  | | --- | | United States of America, New York, New York City | | 43.921 ms | 43.921 |
| 8 | 50.97.17.45 | ae9.bbr02.tl01.nyc01.networklayer.com | |  | | --- | | United States of America, New York, New York City | | 44.988 ms | 44.988 |
| 9 | 65.19.113.154 | 451be09a.cst.lightpath.net | |  | | --- | | United States of America, New York, Bethpage | | 43.982 ms | 43.982 |
| 12 | 67.83.243.3 | 67.83.243.3 | |  | | --- | | United States of America, New York, Hicksville | | 53.246 ms | 53.246 |
|  |  |  |  |  | 216.486 |
| 1 | 50.97.82.1 | fcr03a.dal05.v797.uk2group.com | |  | | --- | | United States of America, Texas, Dallas | | 0.516 ms | 0.516 |
| 2 | 173.192.118.142 | ae13.dar01.dal05.networklayer.com | |  | | --- | | United States of America, Texas, Dallas | | 0.473 ms | 0.473 |
| 3 | 173.192.18.214 | d6.12.c0ad.ip4.static.sl-reverse.com | |  | | --- | | United States of America, Texas, Dallas | | 3.556 ms | 3.556 |
| 8 | 50.97.17.45 | ae9.bbr02.tl01.nyc01.networklayer.com | |  | | --- | | United States of America, New York, New York City | | 45.110 ms | 45.11 |
| 9 | 65.19.113.154 | 451be09a.cst.lightpath.net | |  | | --- | | United States of America, New York, Bethpage | | 43.530 ms | 43.53 |
| 12 | 67.83.243.5 | rtr4-ge1-16.mhe.prnynj.cv.net | |  | | --- | | United States of America, New Jersey, Jersey City | | 50.245 ms | 50.245 |
|  |  |  |  |  | 143.43 |
| 1 | 50.97.82.1 | fcr03a.dal05.v797.uk2group.com | |  | | --- | | United States of America, Texas, Dallas | | 0.609 ms | 0.609 |
| 2 | 173.192.118.142 | ae13.dar01.dal05.networklayer.com | |  | | --- | | United States of America, Texas, Dallas | | 0.462 ms | 0.462 |
| 3 | 173.192.18.214 | d6.12.c0ad.ip4.static.sl-reverse.com | |  | | --- | | United States of America, Texas, Dallas | | 3.168 ms | 3.168 |
| 4 | 50.97.17.56 | ae5.cbs02.eq01.dal03.networklayer.com | |  | | --- | | United States of America, Texas, Dallas | | 2.528 ms | 2.528 |
| 5 | 169.45.18.73 | ae8.cbs02.dr01.dal04.networklayer.com | |  | | --- | | United States of America, Texas, Dallas | | 2.820 ms | 2.82 |
| 8 | 50.97.17.45 | ae9.bbr02.tl01.nyc01.networklayer.com | |  | | --- | | United States of America, New York, New York City | | 43.633 ms | 43.633 |
| 9 | 65.19.113.154 | 451be09a.cst.lightpath.net | |  | | --- | | United States of America, New York, Bethpage | | 43.849 ms | 43.849 |
| 12 | 67.83.243.1 | rtr3-ge1-17.mhe.prnynj.cv.net | |  | | --- | | United States of America, New Jersey, Jersey City | | 47.800 ms | 47.8 |
|  |  |  |  |  | 144.869 |

1. Average =(216.486+143.43+144.869)/3=168.261 ms

Standard deviation=((216.486-168.261)^2+(143.43-168.261)^2+(144.869-168.261)^2)/3^(1/2)=34.104

1. The three numbers of router are 12,12,12

The path didn’t change.

1. According to the excel, the biggest delay always happens in **United States of America, New York, Bethpage**
2. The intra-continent are always faster than the inter-continent

P19

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| http://traceroute.sdv.fr/index.php?v6=0&host=69.120.159.83 | | |  |  |  |
| to 69.120.159.83 (new jersey) |  |  |  |  |  |
|  | Hop | Hostname | IP Adress | Time |  |
|  | 1 | wblindix.sdv.fr | 212.95.66.126 | 0.154 ms |  |
|  | 2 | border-gateway2.sdv.fr | 212.95.69.227 | 0.786 ms |  |
|  | 3 | th2-10g-0003.sdv.fr | 212.95.64.54 | 6.699 ms |  |
|  | 4 | equinix-paris.mpr1.cdg12.fr.above.net | 195.42.144.13 | 6.402 ms |  |
|  | 5 | ae27.cs1.cdg12.fr.eth.zayo.com | 64.125.29.6 | 78.435 ms |  |
|  | 8 | ae22.ter1.ewr1.us.zip.zayo.com | 64.125.29.161 | 78.3 ms |  |
|  | 9 | 128.177.75.115.IPYX-249626-910-ZYO.zip.zayo.com | 128.177.75.115 | 78.635 ms |  |
|  | 10 | 64.15.1.11 | 64.15.1.11 | 80.292 ms |  |
|  | 11 | 64.15.6.17 | 64.15.6.17 | 80.18 ms |  |
|  | 12 | rtr4-ge1-16.mhe.prnynj.cv.net | 67.83.243.5 | 88.576 ms |  |
|  | 13 | 67.59.240.151 | 67.59.240.151 | 82.078 ms |  |
|  |  |  |  |  |  |
| https://www.as30781.net/nettools/traceroute/ | | |  |  |  |
| to 69.120.159.83 (new jersey) |  |  |  |  |  |
|  | **Hops** | **AS** | **IP** | **hostname** | **time** |
|  | #1 | JAGUAR-AS (AS30781) | [85.31.192.253](https://www.as30781.net/nettools/ping/85.31.192.253) | be3-200.hr01-corp.mar02.jaguar-network.net | 0.855 ms |
|  | #2 | \* | \* | \* | \* |
|  | #3 | JAGUAR-AS (AS30781) | [78.153.231.2](https://www.as30781.net/nettools/ping/78.153.231.2) | be4.cr02.mar02.jaguar-network.net | 20.995 ms |
|  | #4 | JAGUAR-AS (AS30781) | [78.153.231.116](https://www.as30781.net/nettools/ping/78.153.231.116) | he0-0-0-6.cr01.par01.jaguar-network.net | 20.88 ms |
|  | #5 | JAGUAR-AS (AS30781) | [78.153.231.43](https://www.as30781.net/nettools/ping/78.153.231.43) | be10.cr02.par01.jaguar-network.net | 20.686 ms |
|  | #6 | JAGUAR-AS (AS30781) | [85.31.194.115](https://www.as30781.net/nettools/ping/85.31.194.115) | be10.cr02.par02.jaguar-network.net | 21.451 ms |
|  | #7 | JAGUAR-AS (AS30781) | [78.153.231.210](https://www.as30781.net/nettools/ping/78.153.231.210) | te0-0-2-0.er01.lon01.jaguar-network.net | 20.998 ms |
|  | #8 | ASN-TELSTRA-GLOBAL (AS4637) | [195.66.224.76](https://www.as30781.net/nettools/ping/195.66.224.76) | ae15.mpr1.lhr15.uk.above.net | 20.43 ms |
|  | #9 | \* | \* | \* | \* |
|  | #10 | \* | \* | \* | \* |
|  | #11 | \* | \* | \* | \* |
|  | #12 | AS33321 | [128.177.75.115](https://www.as30781.net/nettools/ping/128.177.75.115) | 128.177.75.115.IPYX-249626-910-ZYO.zip.zayo.com | 87.138 ms |
|  | #13 | \* | \* | \* | \* |
|  | #14 | \* | \* | \* | \* |
|  | #15 | AS6128 | [67.83.243.1](https://www.as30781.net/nettools/ping/67.83.243.1) | rtr3-ge1-17.mhe.prnynj.cv.net | 90.88 ms |
|  | #16 | \* | \* | \* | \* |
|  | #17 | \* | \* | \* | \* |
|  | #18 | \* | \* | \* | \* |
|  | #19 | \* | \* | \* | \* |
|  | #20 | \* | \* | \* | \* |
|  | #21 | \* | \* | \* | \* |
|  | #22 | \* | \* | \* | \* |
|  | #23 | \* | \* | \* | \* |
|  | #24 | \* | \* | \* | \* |
|  | #25 | \* | \* | \* | \* |
|  | #26 | \* | \* | \* | \* |
|  | #27 | \* | \* | \* | \* |
|  | #28 | \* | \* | \* | \* |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| http://traceroute.sdv.fr/index.php?v6=0&host=69.120.159.83 | | |  |  |  |
| **to 54.93.127.0 germany** |  |  |  |  |  |
|  | 1 | wblindix.sdv.fr | 212.95.66.126 | 0.088 ms |  |
|  | 2 | border-gateway2.sdv.fr | 212.95.69.227 | 0.831 ms |  |
|  | 3 | bgw1-po10.sdv.fr | 212.95.64.57 | 0.81 ms |  |
|  | 4 | te0-5-1-0.rcr21.sxb01.atlas.cogentco.com | 149.12.208.1 | 1.035 ms |  |
|  | 5 | be3548.ccr42.fra03.atlas.cogentco.com | 154.54.59.133 | 3.723 ms |  |
|  | 6 | anchnet.demarc.cogentco.com | 149.14.159.162 | 3.982 ms |  |

:

1. There is one router same in the two experiment, the IP address of router is 128.177.75.115. The transatlantic link is the same.
2. The same router 128.177.75.115 shows in the traceroute too.
3. These two cities are very different. The beginning is same and changes after.

P20:

M = min {Rs, Rc, R/M}

P25:

1. R\*dprog=20000km \* 0.08 =1.6\*10^5 bits
2. According to a, the bandwidth-delay product is 1.6\*10^5 bits
3. The maximum amount of bits is equal to bandwidth-delay product
4. Length/bit=2.5\*10^8/(2\*10^6)=125 meter/bit

So the length is 125 meters and its longer than football field

1. Width= S/R