$$\text{RTT} = \text{number of hops} \times 2 \times (\text{processing delay} + \text{queueing delay} + \text{transmission delay}) + \text{propagation delay}$$

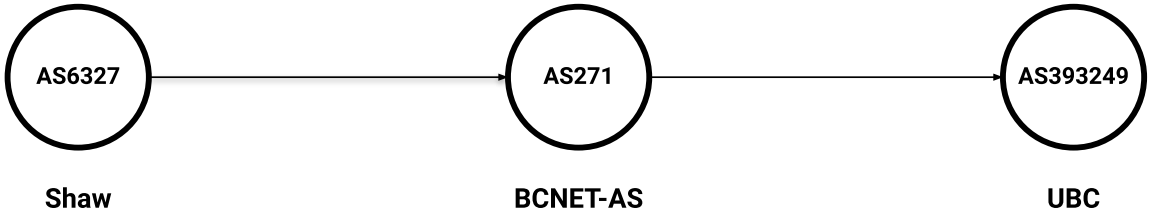
10 gigabits per second = 1.25 gigabytes per second

Assuming transmission delay = 60 / 1280000000 = 4.8e-8 sec = 0.048 microseconds

Assuming processing delay = 10 microseconds

Assuming queueing delay = 10 microseconds

Packet size = 60 bytes



Shaw Bandwidth = 10G

BCNET Bandwidth = 10G

Not publicly available: Estimate = 10G

traceroute to ubc.ca (206.87.224.15), 30 hops max, 60 byte packets

Shaw
1 _gateway (192.168.0.1) 2.468 ms 3.685 ms 3.607 ms
2 70.77.0.1 (70.77.0.1) 16.291 ms 16.214 ms 16.138 ms
3 rc3no-be116-1.cg.shawcable.net (64.59.134.133) 18.349 ms 18.269 ms 18.845 ms
4 24.244.57.181 (24.244.57.181) 18.761 ms 18.681 ms 18.574 ms
5 24.244.57.5 (24.244.57.5) 21.433 ms 21.346 ms 24.537 ms
6 rc3no-be214.cg.shawcable.net (24.244.57.1) 24.872 ms 11.151 ms 15.658 ms
7 rc1st-be11-1.vc.shawcable.net (66.163.72.70) 28.817 ms 27.760 ms 28.167 ms
8 * * *
9 208.98.209.22 (208.98.209.22) 33.613 ms 32.009 ms 32.539 ms

BCNET
10 cr2-100g-bb3928ae1.vncv1.bc.net.bc.net (207.23.253.118) 33.214 ms 32.531 ms 32.213 ms
11 134.87.30.149 (134.87.30.149) 34.497 ms 40.860 ms 41.721 ms

UBC
12 137.82.88.122 (137.82.88.122) 31.382 ms 28.457 ms 29.856 ms
13 a22-a0.net.ubc.ca (137.82.123.113) 29.802 ms * 27.090 ms
14 * * *
15 ubc.ca (206.87.224.15) 30.472 ms 30.618 ms 26.526 ms

Shaw Bandwidth = 10G

RTT - home to Shaw edge = 33 ms

Shaw to BCNET number of hops = 9

$$0.033\text{sec} = 9 \times 2 \times (10^{-5}\text{sec} + 10^{-5}\text{sec} + 4.8 \times 10^{-8}\text{sec}) + \text{propagation delay}$$

$$\text{propagation delay} = 0.03264\,\text{sec} = 32.64\text{ms}$$

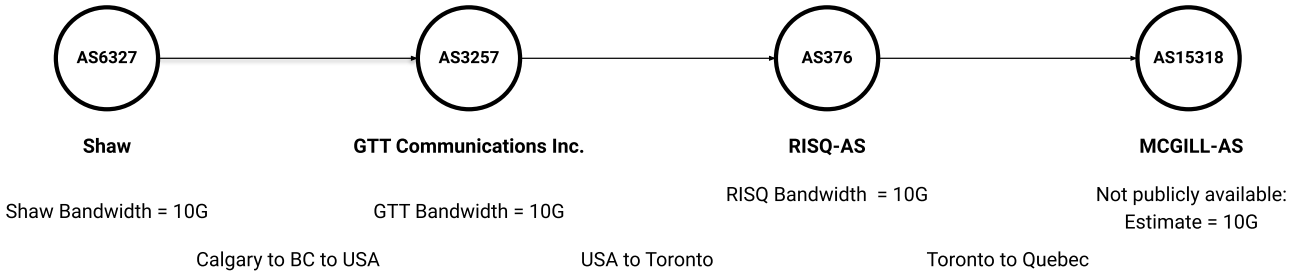
BCNET Bandwidth = 10G

RTT - BCNET start to BCNET edge = 4 ms

Shaw to BCNET number of hops = 2

$$0.004\text{sec} = 2 \times 2 \times (10^{-5}\text{sec} + 10^{-5}\text{sec} + 4.8 \times 10^{-8}\text{sec}) + \text{propagation delay}$$

$$\text{propagation delay} = 0.00396\,\text{sec} = 3.96\text{ms}$$



traceroute to mcgill.ca (132.216.177.160), 30 hops max, 60 byte packets

Shaw
1 _gateway (192.168.0.1) 3.443 ms 3.963 ms 4.640 ms
2 70.77.0.1 (70.77.0.1) 16.630 ms 19.446 ms 20.041 ms
3 rc3no-be116-1.cg.shawcable.net (64.59.134.133) 19.979 ms 20.923 ms 21.400 ms
4 24.244.57.181 (24.244.57.181) 23.232 ms 23.200 ms 25.544 ms
5 24.244.57.5 (24.244.57.5) 26.602 ms 29.196 ms 28.831 ms
6 rc3no-be214.cg.shawcable.net (24.244.57.1) 26.246 ms 12.396 ms 17.000 ms
7 rc3so-be23.cg.shawcable.net (66.163.71.118) 16.971 ms 23.805 ms 23.728 ms
8 rc1wt-be82.wa.shawcable.net (66.163.76.9) 87.709 ms 87.671 ms 87.532 ms

GTT Communications Inc.
9 ae22.cr4-sea2.ip4.gtt.net (209.120.141.209) 87.563 ms 87.542 ms 87.520 ms
10 ae16.cr0-mtl1.ip4.gtt.net (89.149.186.134) 102.922 ms 101.716 ms 102.630 ms
11 ip4.gtt.net (208.116.159.206) 104.697 ms 107.626 ms 106.978 ms

RISQ-AS
12 imtrl-rq-ic-dmtrl-rq.risq.net (192.77.63.70) 94.936 ms 95.455 ms 95.417 ms
13 mcgill-gw.risq.net (132.202.62.90) 94.767 ms 235.857 ms 235.774 ms
14 mcgill-internet-membre1.risq.net (206.167.128.42) 235.735 ms 235.705 ms 235.594 ms
15 * * *
16 * * *
17 * * *

MCGILL-AS
18 www.mcgill.ca (132.216.177.160) 212.800 ms 212.822 ms 235.461 ms

Shaw Bandwidth = 10G

RTT - shaw to GTT = 87 ms

number of hops = 8

$$0.087\text{sec} = 8 \times 2 \times (10^{-5}\text{sec} + 10^{-5}\text{sec} + 4.8 \times 10^{-8}\text{sec}) + \text{propagation delay}$$

$$\text{propagation delay} = 0.08684\,\text{sec} = 86.84\text{ms}$$

GTT Bandwidth = 10G

RTT - GTT to RISQ= 18 ms

number of hops = 3

$$0.018\text{sec} = 3 \times 2 \times (10^{-5}\text{sec} + 10^{-5}\text{sec} + 4.8 \times 10^{-8}\text{sec}) + \text{propagation delay}$$

$$\text{propagation delay} = 0.01768\,\text{sec} = 17.68\text{ms}$$

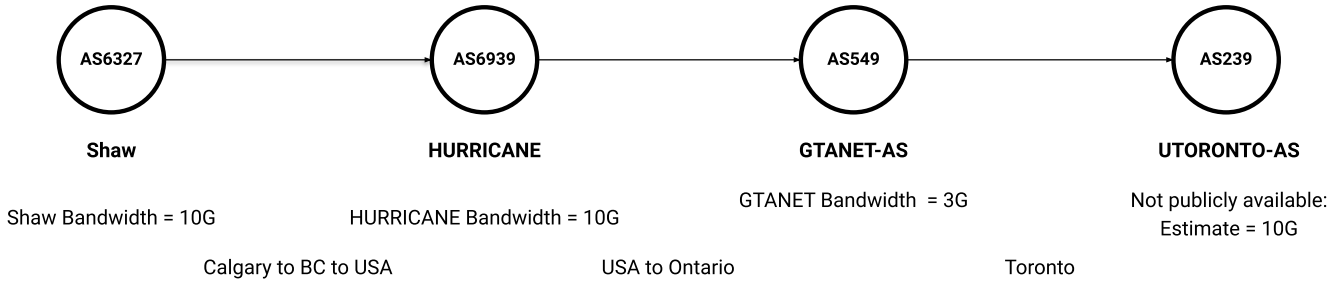
RISQ Bandwidth = 10G

RTT – RISQ to MCGILL = 125 ms

number of hops = 6

$$0.125\text{sec} = 6 \times 2 \times (10^{-5}\text{sec} + 10^{-5}\text{sec} + 4.8 \times 10^{-8}\text{sec}) + \text{propagation delay}$$

$$\text{propagation delay} = 0.12476\,\text{sec} = 124.76\text{ms}$$



traceroute to utoronto.ca (128.100.166.120), 30 hops max, 60 byte packets

Shaw

1 _gateway (192.168.0.1) 2.481 ms 3.503 ms 3.486 ms
2 70.77.0.1 (70.77.0.1) 19.609 ms 21.290 ms 21.874 ms
3 rc3no-be116-1.cg.shawcable.net (64.59.134.133) 21.923 ms 22.209 ms 22.183 ms
4 24.244.57.181 (24.244.57.181) 202.875 ms 203.117 ms 202.977 ms
5 24.244.57.5 (24.244.57.5) 26.460 ms 26.523 ms 26.747 ms
6 rc3no-be214.cg.shawcable.net (24.244.57.1) 23.703 ms 14.311 ms *
7 rc3so-be23.cg.shawcable.net (66.163.71.118) 75.934 ms 75.925 ms 76.103 ms
8 rc1wt-be82.wa.shawcable.net (66.163.76.9) 76.101 ms 76.091 ms 76.092 ms

HURRICANE

9 100ge14-2.core1.sea1.he.net (206.81.80.40) 76.079 ms 76.074 ms 76.069 ms
10 100ge1-2.core1.msp1.he.net (184.104.194.22) 76.064 ms 76.059 ms 76.049 ms
11 100ge13-1.core2.chi1.he.net (184.105.223.177) 76.173 ms 76.379 ms 76.359 ms
12 port-channel4.core3.chi1.he.net (184.104.196.218) 175.233 ms 235.619 ms 235.679 ms
13 port-channel1.core2.tor1.he.net (184.104.196.246) 234.989 ms 234.980 ms 234.948 ms
14 100ge9-1.core1.tor1.he.net (184.104.196.245) 235.084 ms 235.054 ms 234.791 ms
15 gtanet-networking.10gigabitethernet3-1.core1.tor1.he.net (216.66.30.114) 234.778 ms 234.759 ms 234.875 ms

GTANET
16 utoronto2-ut-hub-if-internet.gtanet.ca (205.211.94.134) 234.754 ms 234.735 ms 234.716 ms
17 * * *
18 * * *
19 * * *

UTORONTO
20 128.100.166.120 (128.100.166.120) 235.784 ms 235.697 ms 235.931 ms

Shaw Bandwidth = 10G

RTT – Shaw to HURRICANE = 76 ms

number of hops = 8

$$0.076\text{sec} = 8 \times 2 \times (10^{-5}\text{sec} + 10^{-5}\text{sec} + 4.8 \times 10^{-8}\text{sec}) + \text{propagation delay}$$

$$\text{propagation delay} = 0.07568\,\text{sec} = 75.68\text{ms}$$

HURRICANE Bandwidth = 10G

RTT – HURRICANE to GTANET = 76 ms

number of hops = 7

$$0.159\text{sec} = 8 \times 2 \times (10^{-5}\text{sec} + 10^{-5}\text{sec} + 4.8 \times 10^{-8}\text{sec}) + \text{propagation delay}$$

$$\text{propagation delay} = 0.15872\,\text{sec} = 158.72\text{ms}$$

GTANET Bandwidth = 3G

3 gigabits per second = 0.375 gigabytes per second

Assuming transmission delay = 60 / 375000000 = 1.6e-7 sec = 0.16 microseconds

RTT – GTANET to UTORONTO = 3 ms

number of hops = 4

$$0.003\text{sec} = 4 \times 2 \times (10^{-5}\text{sec} + 10^{-5}\text{sec} + 4.8 \times 10^{-8}\text{sec}) + \text{propagation delay}$$

$$\text{propagation delay} = 0.00284\,\text{sec} = 2.84\text{ ms}$$