Project 3 - Part 1

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1. Checking connectivity test between hosts by sending 10 ping messages:

```
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 h3 h4 h5 h6 h7 h8
*** Adding switches:
s1 s2 s3 s4 s5 s6
*** Adding links:
(h1, s1) (h2, s2) (h3, s3) (h4, s4) (h5, s4) (h6, s5) (h7, s6) (h8, s6) (10.00Mbit 1ms delay
loss) (15.00Mbit 2ms delay 2% loss) (s1, s3) (20.00Mbit 4ms delay 1% loss) (20.00Mbit 4ms de
1% loss) (s3, s5) (40.00Mbit 10ms delay 2% loss) (40.00Mbit 10ms delay 2% loss) (s5, s6)
*** Configuring hosts
h1 h2 h3 h4 h5 h6 h7 h8
Starting the network
*** Starting controller
*** Starting 6 switches
s1 (10.00Mbit 1ms delay 3% loss) (15.00Mbit 2ms delay 2% loss) s2 (10.00Mbit 1ms delay 3% lo
Mbit 4ms delay 1% loss) s4 (20.00Mbit 4ms delay 1% loss) s5 (20.00Mbit 4ms delay 1% loss) (4
Dumping host connections
h1 h1-eth0:s1-eth1
h2 h2-eth0:s2-eth2
h3 h3-eth0:s3-eth2
h4 h4-eth0:s4-eth2
h5 h5-eth0:s4-eth3
h6 h6-eth0:s5-eth3
h7 h7-eth0:s6-eth3
h8 h8-eth0:s6-eth2
```

```
Testing network connectivity
h1 ->
h2 is reachable
h3 is reachable
h4 is reachable
h5 is reachable
h6 is reachable
h7 is reachable
h8 is reachable
*** Results: 8% dropped (6/70 lost)

h2 ->
h1 is reachable
h3 is reachable
h4 is reachable
h5 is reachable
h6 is reachable
h7 is reachable
h8 is reachable
*** Results: 5% dropped (8/140 lost)

h3 ->
h1 is reachable
h2 is reachable
h4 is reachable
h5 is reachable
h6 is reachable
h7 is reachable
h8 is reachable
*** Results: 8% dropped (17/210 lost)

h4 ->
h1 is reachable
h2 is reachable
h3 is reachable
h5 is reachable
h6 is reachable
h7 is reachable
h8 is reachable
*** Results: 7% dropped (22/280 lost)
```

```
h5 ->
h1 is reachable
h2 is reachable
h3 is reachable
h4 is reachable
h6 is reachable
h7 is reachable
h8 is reachable
*** Results: 8% dropped (29/350 lost)

h6 ->
h1 is reachable
h2 is reachable
h3 is reachable
h4 is reachable
h5 is reachable
h7 is reachable
h8 is reachable
*** Results: 7% dropped (31/420 lost)

h7 ->
h1 is reachable
h2 is reachable
h3 is reachable
h4 is reachable
h5 is reachable
h6 is reachable
h8 is reachable
*** Results: 8% dropped (42/490 lost)

h8 ->
h1 is reachable
h2 is reachable
h3 is reachable
h4 is reachable
h5 is reachable
h6 is reachable
h7 is reachable
*** Results: 8% dropped (48/560 lost)
```

2. TCP bandwidth between each pair of hosts:

```
TCP Performance rate
*** Iperf: testing TCP bandwidth between h1 and h2
*** Results: ['8.82 Mbits/sec', '8.84 Mbits/sec']
*** Iperf: testing TCP bandwidth between h1 and h3
*** Results: ['12.0 Mbits/sec', '12.0 Mbits/sec']
*** Iperf: testing TCP bandwidth between h1 and h4
*** Results: ['3.56 Mbits/sec', '3.55 Mbits/sec']
*** Iperf: testing TCP bandwidth between h1 and h5
*** Results: ['3.43 Mbits/sec', '3.44 Mbits/sec']
*** Iperf: testing TCP bandwidth between h1 and h6
*** Results: ['4.27 Mbits/sec', '4.30 Mbits/sec']
*** Iperf: testing TCP bandwidth between h1 and h7
*** Results: ['1.62 Mbits/sec', '1.66 Mbits/sec']
*** Iperf: testing TCP bandwidth between h1 and h8
*** Results: ['1.16 Mbits/sec', '1.16 Mbits/sec']
*** Iperf: testing TCP bandwidth between h2 and h3
*** Results: ['4.39 Mbits/sec', '4.40 Mbits/sec']
*** Iperf: testing TCP bandwidth between h2 and h4
*** Results: ['10.6 Mbits/sec', '10.6 Mbits/sec']
*** Iperf: testing TCP bandwidth between h2 and h5
*** Results: ['10.7 Mbits/sec', '10.7 Mbits/sec']
*** Iperf: testing TCP bandwidth between h2 and h6
*** Results: ['2.27 Mbits/sec', '2.27 Mbits/sec']
*** Iperf: testing TCP bandwidth between h2 and h7
*** Results: ['786 Kbits/sec', '805 Kbits/sec']
*** Iperf: testing TCP bandwidth between h2 and h8
*** Results: ['518 Kbits/sec', '543 Kbits/sec']
```

```
*** Results: ['505 Kbits/sec', '505 Kbits/sec']
*** Iperf: testing TCP bandwidth between h3 and h4
*** Results: ['1.96 Mbits/sec', '1.96 Mbits/sec']
*** Iperf: testing TCP bandwidth between h3 and h5
*** Results: ['1.90 Mbits/sec', '1.90 Mbits/sec']
*** Iperf: testing TCP bandwidth between h3 and h6
*** Results: ['10.3 Mbits/sec', '10.3 Mbits/sec']
*** Iperf: testing TCP bandwidth between h3 and h7
*** Results: ['1.91 Mbits/sec', '2.03 Mbits/sec']
*** Iperf: testing TCP bandwidth between h3 and h8
*** Results: ['1.97 Mbits/sec', '1.90 Mbits/sec']
*** Iperf: testing TCP bandwidth between h4 and h5
waiting for iperf to start up...*** Results: ['1.06 Gbits/sec', '1.06 Gbits/sec']
*** Iperf: testing TCP bandwidth between h4 and h6
*** Results: ['1.11 Mbits/sec', '1.13 Mbits/sec']
*** Iperf: testing TCP bandwidth between h4 and h7
*** Results: ['622 Kbits/sec', '636 Kbits/sec']
*** Iperf: testing TCP bandwidth between h4 and h8
*** Results: ['692 Kbits/sec', '711 Kbits/sec']
*** Iperf: testing TCP bandwidth between h5 and h6
*** Results: ['1.13 Mbits/sec', '1.15 Mbits/sec']
*** Iperf: testing TCP bandwidth between h5 and h7
*** Results: ['810 Kbits/sec', '293 Kbits/sec']
*** Iperf: testing TCP bandwidth between h5 and h8
*** Results: ['538 Kbits/sec', '577 Kbits/sec']
*** Iperf: testing TCP bandwidth between h6 and h7
*** Results: ['2.66 Mbits/sec', '2.66 Mbits/sec']
*** Iperf: testing TCP bandwidth between h6 and h8
*** Results: ['3.35 Mbits/sec', '3.36 Mbits/sec']
*** Iperf: testing TCP bandwidth between h7 and h8
waiting for iperf to start up...*** Results: ['1.04 Gbits/sec', '1.04 Gbits/sec']
```

3. Using ping to determine the UDP loss rate between every pair of hosts (ignoring
15 Mbps bandwidth)

```
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 h3 h4 h5 h6 h7 h8
*** Adding switches:
s1 s2 s3 s4 s5 s6
*** Adding links:
(h1, s1) (h2, s2) (h3, s3) (h4, s4) (h5, s4) (h6, s5) (h7, s6) (h8, s6) (10.00Mbit 1ms delay
loss) (15.00Mbit 2ms delay 2% loss) (s1, s3) (20.00Mbit 4ms delay 1% loss) (20.00Mbit 4ms de
1% loss) (s3, s5) (40.00Mbit 10ms delay 2% loss) (40.00Mbit 10ms delay 2% loss) (s5, s6)
*** Configuring hosts
h1 h2 h3 h4 h5 h6 h7 h8
Starting the network
*** Starting controller
*** Starting 6 switches
s1 (10.00Mbit 1ms delay 3% loss) (15.00Mbit 2ms delay 2% loss) s2 (10.00Mbit 1ms delay 3% lo
Mbit 4ms delay 1% loss) s4 (20.00Mbit 4ms delay 1% loss) s5 (20.00Mbit 4ms delay 1% loss) (4
Dumping host connections
h1 h1-eth0:s1-eth1
h2 h2-eth0:s2-eth2
h3 h3-eth0:s3-eth2
h4 h4-eth0:s4-eth2
h5 h5-eth0:s4-eth3
h6 h6-eth0:s5-eth3
h7 h7-eth0:s6-eth3
h8 h8-eth0:s6-eth2
```

```
h1 ->
h2
h3
h4
h5
h6
h7
h8
*** Results: 10% dropped (7/70 lost)

h2 ->
h1
h3
h4
h5
h6
h7
h8
*** Results: 10% dropped (14/140 lost)

h3 ->
h1
h2
h4
h5
h6
h7
h8
*** Results: 8% dropped (18/210 lost)

h4 ->
h1
h2
h3
h5
h6
h7
h8
*** Results: 10% dropped (29/280 lost)

h5 ->
h1
h2
h3
h4
h6
h7
h8
*** Results: 10% dropped (37/350 lost)
```

```
h6 ->
h1
h2
h3
h4
h5
h7
h8
*** Results: 9% dropped (40/420 lost)

h7 ->
h1
h2
h3
h4
h5
h6
h8
*** Results: 9% dropped (47/490 lost)

h8 ->
h1
h2
h3
h4
h5
h6
h7
*** Results: 10% dropped (56/560 lost)

*** Stopping 8 hosts
h1 h2 h3 h4 h5 h6 h7 h8
*** Stopping 6 switches
s1 ....s2 ....s3 ....s4 ....s5 ....s6 ....
*** Stopping 1 controllers
c0
*** Done
```

The output of iperf for UDP is shown below, but we cannot find the loss rate by this method, so we used PING to find the packet loss rate as shown above.

```
UDP Performance
*** Iperf: testing UDP bandwidth between h1 and h2
*** Results: ['15m', '9.63 Mbits/sec', '9.63 Mbits/sec']
*** Iperf: testing UDP bandwidth between h1 and h3
*** Results: ['15m', '14.5 Mbits/sec', '14.5 Mbits/sec']
*** Iperf: testing UDP bandwidth between h1 and h4
*** Results: ['15m', '9.58 Mbits/sec', '9.58 Mbits/sec']
*** Iperf: testing UDP bandwidth between h1 and h5
*** Results: ['15m', '9.59 Mbits/sec', '9.59 Mbits/sec']
*** Iperf: testing UDP bandwidth between h1 and h6
*** Results: ['15m', '14.1 Mbits/sec', '14.1 Mbits/sec']
*** Iperf: testing UDP bandwidth between h1 and h7
*** Results: ['15m', '14.0 Mbits/sec', '14.0 Mbits/sec']
*** Iperf: testing UDP bandwidth between h1 and h8
*** Results: ['15m', '14.1 Mbits/sec', '14.1 Mbits/sec']
*** Iperf: testing UDP bandwidth between h2 and h3
*** Results: ['15m', '9.48 Mbits/sec', '9.48 Mbits/sec']
*** Iperf: testing UDP bandwidth between h2 and h4
*** Results: ['15m', '14.9 Mbits/sec', '14.9 Mbits/sec']
*** Iperf: testing UDP bandwidth between h2 and h5
*** Results: ['15m', '14.9 Mbits/sec', '14.9 Mbits/sec']
*** Iperf: testing UDP bandwidth between h2 and h6
*** Results: ['15m', '9.38 Mbits/sec', '9.38 Mbits/sec']
*** Iperf: testing UDP bandwidth between h2 and h7
*** Results: ['15m', '9.20 Mbits/sec', '9.20 Mbits/sec']
*** Iperf: testing UDP bandwidth between h2 and h8
*** Results: ['15m', '9.19 Mbits/sec', '9.19 Mbits/sec']
*** Iperf: testing UDP bandwidth between h3 and h4
*** Results: ['15m', '9.64 Mbits/sec', '9.64 Mbits/sec']
*** Iperf: testing UDP bandwidth between h3 and h5
*** Results: ['15m', '9.56 Mbits/sec', '9.56 Mbits/sec']
*** Iperf: testing UDP bandwidth between h3 and h6
*** Results: ['15m', '14.9 Mbits/sec', '14.9 Mbits/sec']
*** Iperf: testing UDP bandwidth between h3 and h7
*** Results: ['15m', '14.7 Mbits/sec', '14.7 Mbits/sec']
```

```
*** Iperf: testing UDP bandwidth between h3 and h8
*** Results: ['15m', '14.7 Mbits/sec', '14.7 Mbits/sec']
*** Iperf: testing UDP bandwidth between h4 and h5
*** Results: ['15m', '15.0 Mbits/sec', '15.0 Mbits/sec']
*** Iperf: testing UDP bandwidth between h4 and h6
*** Results: ['15m', '9.39 Mbits/sec', '9.39 Mbits/sec']
*** Iperf: testing UDP bandwidth between h4 and h7
*** Results: ['15m', '9.21 Mbits/sec', '9.21 Mbits/sec']
*** Iperf: testing UDP bandwidth between h4 and h8
*** Results: ['15m', '9.13 Mbits/sec', '9.13 Mbits/sec']
*** Iperf: testing UDP bandwidth between h5 and h6
*** Results: ['15m', '9.39 Mbits/sec', '9.39 Mbits/sec']
*** Iperf: testing UDP bandwidth between h5 and h7
*** Results: ['15m', '9.23 Mbits/sec', '9.23 Mbits/sec']
*** Iperf: testing UDP bandwidth between h5 and h8
*** Results: ['15m', '9.19 Mbits/sec', '9.19 Mbits/sec']
*** Iperf: testing UDP bandwidth between h6 and h7
*** Results: ['15m', '14.8 Mbits/sec', '14.8 Mbits/sec']
*** Iperf: testing UDP bandwidth between h6 and h8
*** Results: ['15m', '14.8 Mbits/sec', '14.8 Mbits/sec']
*** Iperf: testing UDP bandwidth between h7 and h8
*** Results: ['15m', '15.0 Mbits/sec', '15.0 Mbits/sec']
```