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Table-0

Link Delay = 0 ms	
Link Data Rate (Mbps)	Throughput (Mbps)
9	8.16
12	10.88
15	13.6
18	16.32
21	19.12
24	21.76(not included in the screenshot)

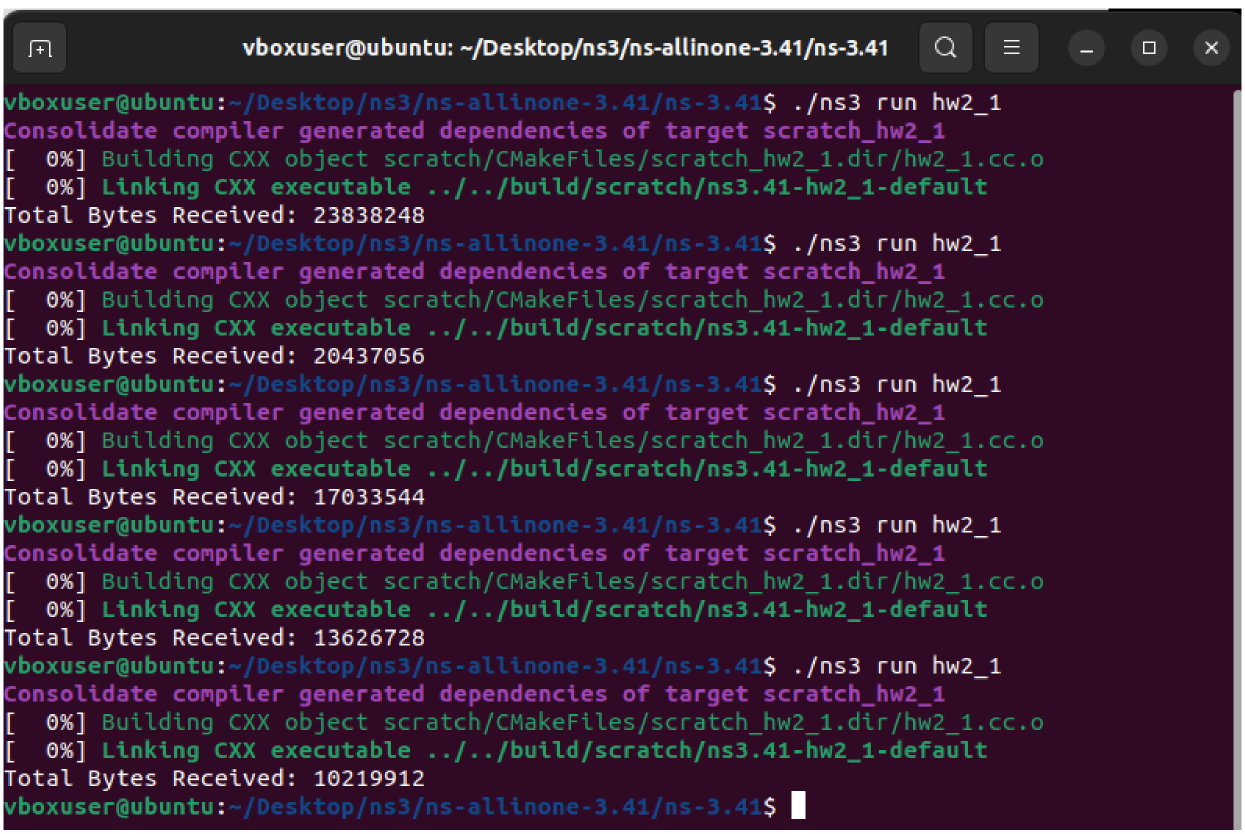
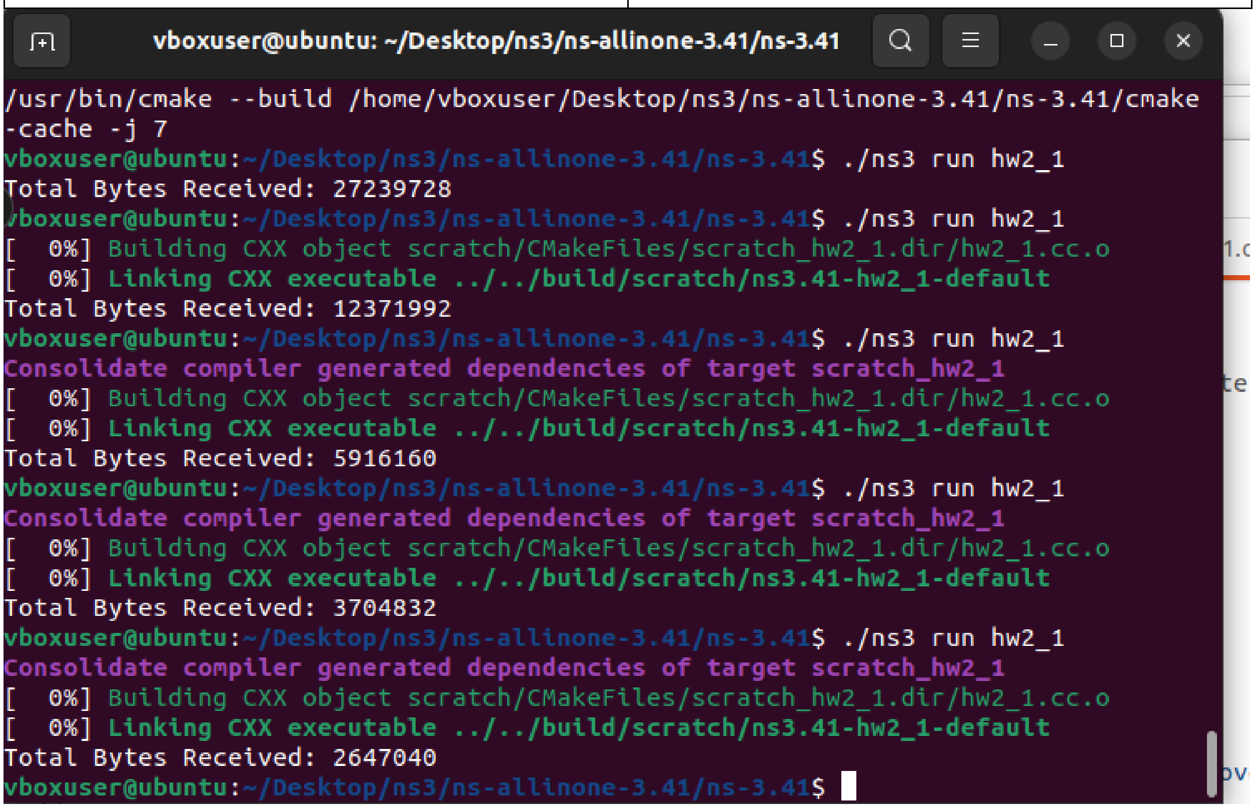


Table-1

Link Data Rate = 24 Mbps	
Link Delay (ms)	Throughput (Mbps)
0	21.76
50	9.92
100	4.72
150	2.96
200	2.08



Q0-

The effect of the link delay on throughput is more significant

Q1-

It's the same, because the filesizeb in hw2_0 had the same size as what was printed in hw2_1

```
int fileSizeB = 27239728; // File size in Bytes
```

Theory

Q0-

To prove Shannon-Hartly Capacity theorem we need to define received signal as sum of signal power and noise power as in the below formula:

$$Received\ signal \ = Signal\ power\ (S)\ +\ Noise\ Power\ (N)$$

$$\sqrt{}(Received\ signal) = \sqrt{(S+N)}$$

Then we need to find the number of data information levels that can be separated without errors as :

$$m = \sqrt{(S+N)}/\sqrt{(N)}$$

$$m\ = \sqrt{1+S/N}$$

then digital information will be :

$$I\ \ = log_2\, m$$

$$I\ = log_2\sqrt{1+S/N}$$

$$= \frac{1}{2}\, log_2\, (1+S/N\,)$$

If the channel transmits k pulses per second then the channel capacity is:

$$C\ = I * k$$

$$C\ = k/2\ * log_2\ (1+S/N\,)$$

According to Nyquist theorem k = 2B, then the capacity is :

$$C\ = B * log_2\ (1+S/N\,)$$

To demonstrate the validity of Shannon's equation, let's consider a simple example. Imagine we have a communication channel with a bandwidth of 10 kHz (10,000 Hz), a signal power of 1 mW (milliwatt), and a noise power of 0.1 mW.Using the Shannon Capacity Formula:

$C = 10{,}000 \times \log_2(1 + 0.0010.0001)$

$C = 10{,}000 \times \log_2(1 + 10)$

$C = 10{,}000 \times \log_2(11)$

$C \approx 10{,}000 \times 3.4594$

$C \approx 34{,}594$

This means that in this scenario, the maximum achievable data rate over the channel is approximately 34,594 bits per second, given the specified bandwidth, signal power, and noise power. This demonstrates the application and validity of the Shannon Capacity Formula.

Q1-The Sampling Theorem states that a continuous signal can be perfectly reconstructed from its samples if the sampling frequency f_s is greater than twice the maximum frequency component of the signal f_{max} . This is expressed as:

f_s > 2 times f_{max}

On the other hand, the Bandpass Sampling Theorem applies to band-limited signals. It states that a band-limited signal can be perfectly reconstructed from its samples if the sampling frequency f_s is greater than twice the bandwidth of the signal B . This is expressed as:

f_s > 2 times B

While the Sampling Theorem applies to any signal, the Bandpass Sampling Theorem specifically addresses signals that have a limited frequency range.