Assignment 3

When the Raspberry Pi is first powered on and booting, the power consumption rises from around 2.50W to a state that the power fluctuates between 3.00W to 5.00W approximately during booting.

It finally reaches a steady state of 4.64W of power consumption.

The Ethernet interface having the IP address 192.168.10.1 has name enx0c37965f8a25.

Network Activity

1. By capturing the packets sent, it can be counted and approximated that 10 packets are transmitted over around 20 seconds.

Therefore, the approximated frequency of messaging is 0.5 events/sec or 30 events/min.

2. Sending packets using tcpdump leads to an increase in the power consumption of the Raspberry Pi, which reaches a peak of 5.36W and then returns to the steady state of 4.64W.

For ping from the Raspberry Pi to the lab machine, the power increases to a range fluctuating around 5.00W.

For ping from the lab machine to the Raspberry Pi , the power increases to a range fluctuating around 5.00W, which is similar to the previous scenario. Yet a few high values above 5.50W was observed, suggesting that it is more expensive for the Raspberry Pi to receive.

This might be due to the need to decode the protocol at the receiving end.

3. For the iperf tests, when setting the local machine as the server and the Raspberry Pi as the client, it was observed that the power increased to around 5.60W, with a few peak values above 6.00W.

When setting the Raspberry Pi as the server and the local machine as the client, it was observed that the power increased to around 5.60W, with a few peak values above 6.00W, which is similar to the previous scenario.

On the Raspberry Pi, it is shown that the “rx-usecs” is 57.

After changing “rx-usecs” to 0, for the iperf experiments, it was observed that the power increased to around 5.60W similarly, but fluctuated much less than the previous setting.

CPU Activity

By stressing the CPU, it was observed that the power consumption increased to around 6.10W. The Raspberry Pi consumes more power under stressing CPU than previous scenarios focusing on network activity.

Theoretical Experiments

1.Select the Netherlands as an example.

The carbon intensity, CI, is 205g/kWh = 0.205kg/kWh.

Assuming the Raspberry Pi runs for three hours.
The energy consumption, EC, is 4.6W * 3h = 13.8Wh = 0.0138kWh

CF = 0.205 * 0.0138 = 0.002829 kg

2. For an average of 45B of Raspberry Pi,
total EC = 5 * 365 * 24h * 4.6W * 45 * 10^9 = 9.07 * 10^12 kWh
total CF = 9.07 * 10^12 * 0.205 = 1.86 * 10^12 kg

This is a significant number.

This is not a fair estimate, as not all regions have this same carbon intensity, and not all devices have the same power consumption as the Raspberry Pi.

Link to repo:
https://github.com/Y-J-Xue/CWM-ProgNets