Characterization and Benchmarking Methodology for Power in Networking Devices

draft-cprjgf-bmwg-powerbench-01

Carlos Pignataro (NC State University)
Romain Jacob (ETH Zürich)
Giuseppe Fioccola (Huawei)
Qin Wu (Huawei)

IETF119 BMWG meeting

Background

- Energy efficiency is becoming increasingly important in the operation of network infrastructure.
- The benchmarking methodology defined here will help operators to get a more accurate idea of the power drawn by their network and will also help vendors to test the energy efficiency of their devices.
- Benchmarking can be understood to serve two related but different objectives:
  - Assessing ``which system performs best'' over a set of well defined scenarios.
  - Measuring the contribution of sub-systems to the overall system’s performance (also known as ``micro-benchmark'').
- The benchmarking methodology outlined in this draft focuses on the first objective. Specifically, it aims to compare the energy efficiency for individual devices.

Terminology

- The **total weighted capacity of the interfaces** (T) is the weighted sum of all interface throughputs.

  T = B1*T1 +...+ Bi*Ti +...+ Bm*Tm

- The **total weighted power** (P) is the weighted sum of all power calculated for different traffic loads

  P = B1*P1 +...+ Bi*Pi +...+ Bm*Pm

  - **Bi** is the weighted multiplier for different traffic levels (note that B1+...+Bj+...+Bm = 1)
  - **m** is the number of traffic load levels (if it is considered 100%, 30%, 0%; m = 3)
  - **Ti** is the total capacity of the interfaces for a fixed configuration model and traffic load (the sum of the interface bandwidths)
  - **Pi** is the Power of the equipment in each traffic load level (e.g. 100%, 30%, 0%)

- **Energy Efficiency Ratio** (EER) is defined as the throughput forwarded by 1 watt and it is introduced in ETSI ES 203 136.

  EER = T/P

  A higher EER corresponds to a better the energy efficiency

Energy Consumption Benchmarking

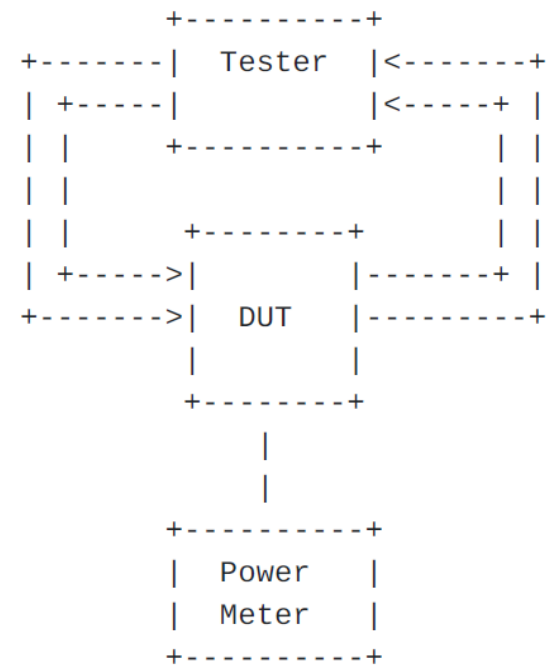
- The maximum power drawn by a device does not accurately reflect the power under a normal workload.
- Therefore, it is important to formulate a consistent benchmarking method for network devices and consider the workload variation (e.g.,30%)and test conditions (e.g., temperature).

- A new metric ‘energy efficiency ratio’ is introduced and is defined as the total weighted capacity of the interfaces divided by the total weighted power
  - In this way it is possible to calculate the energy efficiency by giving a weight to the different traffic load levels.
  - The choice of the weight multipliers and traffic loads is related to the type of device, location of the device for example:

	Traffic load level percentage of maximum load			Weight factor		
Equipment type	high	medium	Low	B_1	B_2	B_3
Core equipment	100 %	30 %	0 %	0,1	0,8	0,1
Edge/access	100 %	10 %	0 %	0,1	0,8	0,1

Test Methodology

- The Device Under Test (DUT) is connected to a Tester and a Power Meter



- It is worth mentioning that the DUT also dissipates significant heat. That means that part of the power is used for actual work while the rest is dissipated as heat.
  - The Power Meter only measures the internal energy consumption of the device.

Traffic and Device Characterization

- The traffic load supported by a device affects its energy consumption. Therefore, different traffic loads must be included.

- The traffic load must specify traffic type, packet sizes mixtures and percentage of overall traffic for each traffic type, as all may affect the energy consumption of network devices.

- The interface types (e.g.,optical interface) and the kind of connector/transceiver (e.g.,fiber optical transceiver module)used must be specified.

- It is also necessary to indicate the number of ports used per linecard as well as the aggregate bandwidth that each linecard can accommodate.

Benchmarking Tests

Initial benchmarking tests defined in the document:

- Throughput
- Base Power drawn by the network device
- Power drawn by the device with Traffic Load
- Energy Efficiency Ratio

The Reporting Format is also specified in the document

Discussion Summary

- E-impact IAB interim meeting Discussion(Feb 15~16)
  - Thanks Toerless Eckert, Marisol Palmero, Alex Clemm, Suresh Krishnan, Jari Arrko for the feedback
    - Consider what is running on the device and which features are enabled besides selected throughput as weighted value (Marisol)
    - work with other type of equipment (Toerless)
    - Is there any standard XML format to inject state for different devices (Toerless)
    - Hackathon Project on power benchmarking (Jari Arrko)
    - Position this draft as standard or not? (Suresh)
    - Consider how long it take for transition among different traffic load level? (Alex)
- Mailing list Discussion
  - Thanks Luis MIGUEL CONTRERAS MURILLO for input
    - Consider more realistic scenario besides what is documented in ETSI Spec
      - Taken Ti as the total *installed* capacity of all interfaces could not be representative of a real deployment scenario

Next Steps

- Comments and Suggestions are welcome

Thank you