RGB: Redfish Green500 Benchmarker (A Green500 Benchmark Tool Using Redfish Technology)

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Background

- **Why a Redfish Green500 Benchmarker is useful:**
  - Data centers consume a huge amount of energy.
  - Tremendous heat.
  - Need to use some cooling facilities.
  - Providing this amount of energy costs a lot.
  - It is important to focus on some special metrics such as **energy efficiency (PPW).**

The Green500 provides a list to encourage cluster stakeholders to make sure that they are aware of the level of energy consumption in their data center, and they will try to reduce that energy.

Using the internal capability of Redfish enabled equipment to get power samples (instead of using an external expensive power meter, or power management solution).

Objective

- To design and develop a Green500 checking tool using Redfish technology (the integration of Redfish and Green500).
- Broaden Redfish usage.
- Provide feedback from HPC community to DMTF and Green500.

Overall, the primary goal of the research is **to enhance the Redfish Standard to make sure it is sufficient to address the requirements of Green500 calculations**, **develop a checking tool software**, **improve the software by running that against a simulation environment** and **finally run it in a real cluster, and get the real results**.

Motivation

1- RGB would benefit Green500 project:

ISSUE: Green500 provides a "manual methodology" using "undefined vendor software" to find the level of energy consumption and performance per watt.

How it is addressed by RGB:
- RGB automates Green500 methodology.
- RGB accomplishes what green500 needs to achieve using Redfish Standard technology, not referring to some generic vendor software.

2-RGB would benefit supercomputer stakeholders:

ISSUE: Green500 procedure is a manual process.

How it is addressed by RGB:
- It makes Green500 calculations easy for clusters.
- It gives them an automatic tool to run "Power Measurement Methodology of Green500".
- Therefore if datacenters have got redfish enabled equipment, there is an open source client Green500 benchmark software.

3- RGB would benefit DMTF:

- RGB calculations is based on Redfish technology.
- This research provides a feedback to DMTF which shows if Redfish API, and DMTF instrumentations provide sufficient data for Green500 calculations.
- RGB satisfies the customers of Redfish enabled equipment. It encourages clusters to use Redfish enabled equipment. Because if all the equipment of a cluster or most of them supports Redfish, using RGB they can automatically run Green500 calculations, and be able to submit for top500 easily.

Overview (RGB Process)

Getting Input → Initialization Step → Measurement Step → Deriving Output → THE GREEN 500

RGB Input:
- A supercomputer with Redfish enabled instrumentations to be submitted to the Green500 list.
- Requested Green500 quality level (1,2, 3).

Step A) Initialization Step

1. Select Granularity method based on the input level.
2. Select Timing method based on the input level.
3. Select Measurement method based on the input level.
4. Select Machine fraction based on the input level.
5. Select Subsystems based on the input level.
6. Select Meter accuracy based on the input level.

Step B) Measurement Step

1. Launch the benchmark.
2. Start recording the measured power samples using Redfish commands.
3. Stop recording the measured power samples based on the selected algorithms in the **initialization step.**
4. Save the performance result.
5. Calculate the unit average power by repeating the above steps based on selected algorithms in the **initialization step.**
6. Derive the output.
7. Repeat the above measurement procedure at least three times and find the average of each output.

RGB Output:

The average of the following values:
- ***GFLOPS Per Watt***
- $\bar{P}(R_{max})$

Conclusion and Future Work

- Current Redfish API interface does not provide sufficient information to apply the quality levels of Green500 precisely yet.

Future Goal:
- Simulate an environment to test RGB against Redfish Telemetry Model which conveys necessary information.

Limitation#	Name	level	comment
1	**Lack of Timestamp**	1, 2, 3	There is no substantial timestamping for reading sensors, therefore the current version of RGB is not completely accurate.
2	**Inadequate sampling rate**	3	The rate of reading Energy consumption is not enough. To achieve the third quality level, it is necessary to be able to read voltage and current sampled at rate of 5 kHz for AC / 120 Hz for DC.

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