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

Presenter:
Elham Hojati

Industry: Mr. Jon Hass, Dell Inc.

Lead faculty: Dr. Alan Sill, TTU
                       Dr. Yong Chen, TTU

Students: Elham Hojati

Background

❑ **Why a Redfish Green500 Benchmarker is useful:**

▪ Data centers consume a huge amount of electrical power.

▪ Tremendous heat.

▪ Need to use some special cooling facilities.

▪ Providing this amount of energy costs a lot.

▪ It is important to focus on some special metrics and benchmark properties 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 simulated environment** and **finally run it in a real world situation and get the real results**.

Motivations

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.

- 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.

How it is addressed by RGB

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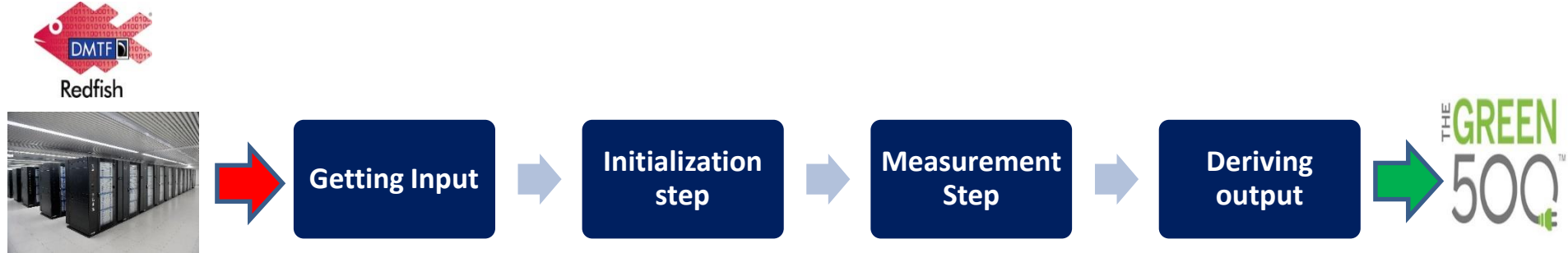
RGB Input:
- A supercomputer with Redfish enabled instrumentations to be submitted to the Green500 list.
- Requested Green500 quality level (1,2, 3)

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 Algorithm 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.

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

Step B) Measurement Step
1. Launch the Linpack benchmark
2. Start recording the measured power samples using Redfish commands.
3. Stop recording the measured power samples based on selected algorithms in the initialization step.
4. Save the Linpack performance.
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 .

Implementation

- RGB: Redfish Green500 Benchmarker
- RGC: Redfish Green500 Checker

Run RGB in Real Environment

Quanah Cluster

- Commissioned in 2017

- Running CentOS 7.3

- Currently consists of

  - 467 Nodes

  - 16,812 Cores (36 cores/node)

  - 87.56 TB Total RAM (192 GB/node)

  - Xeon E5

  - 2695v4 Broadwell Processors

  - Omnipath (100 Gbps) Fabric

- Benchmarked at 485 Teraflops/sec

http://www.depts.ttu.edu/hpcc/about/documents/New_User_Training.pdf

Feedback

❑ Redfish API interface does not provide sufficient information to perform different quality levels of Green500 precisely.

Limitation Number	Name	quality 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. To have precise output, it is necessary to have timestamps for: • PowerConsumedWatts • AverageConsumedWatts
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.
3	**Different URIs for gathering info**		

Future Works

- The current version of RGB is not completely accurate.
- It is necessary to design a more precise tooling that provides more deterministic and higher confidence output.

.

Future Goals:
- Use Redfish telemetry model which conveys necessary information and SSE.
- Practice to get required information from motherboard to the BMC.

SSE streaming mechanism
Redfish telemetry model

Swordfish Datacenter Emulator

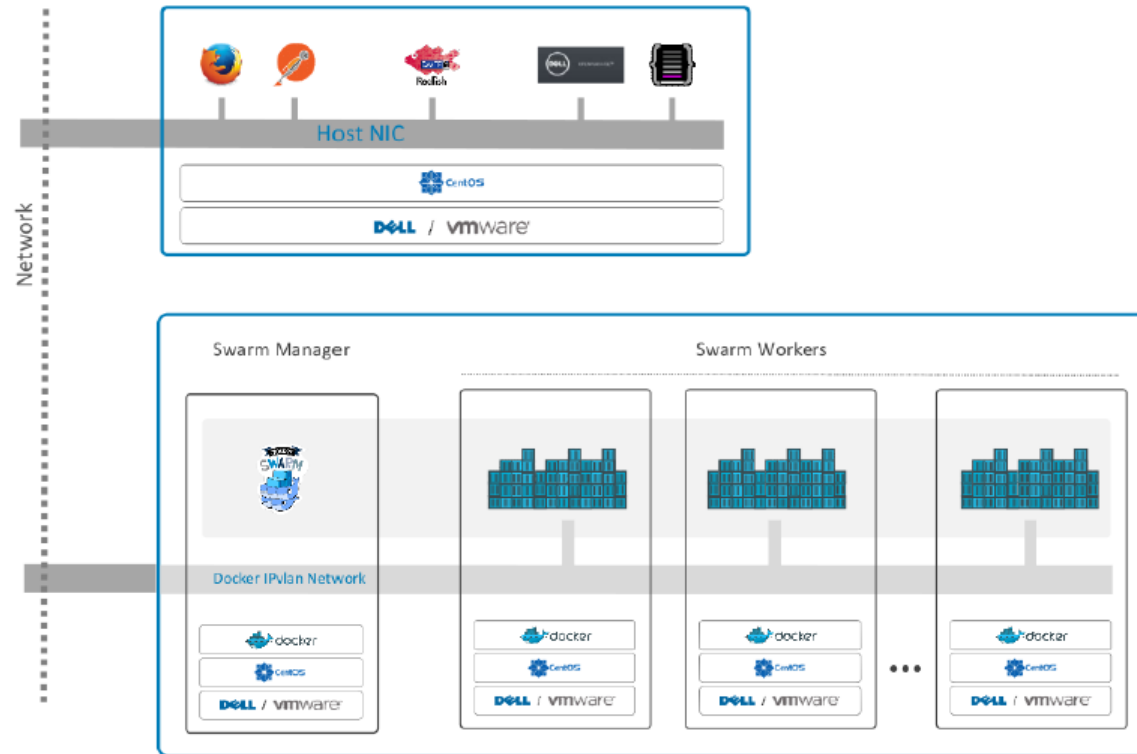|	
Industry:	Ms. Richelle Ahlvers
	Mr. Don Deel
	Mr. Jon Hass
Lead faculty:	Dr. Alan Sill, TTU
	Dr. Yong Chen, TTU
Students:	Elham Hojati

Why Docker

Docker is an open source platform for:
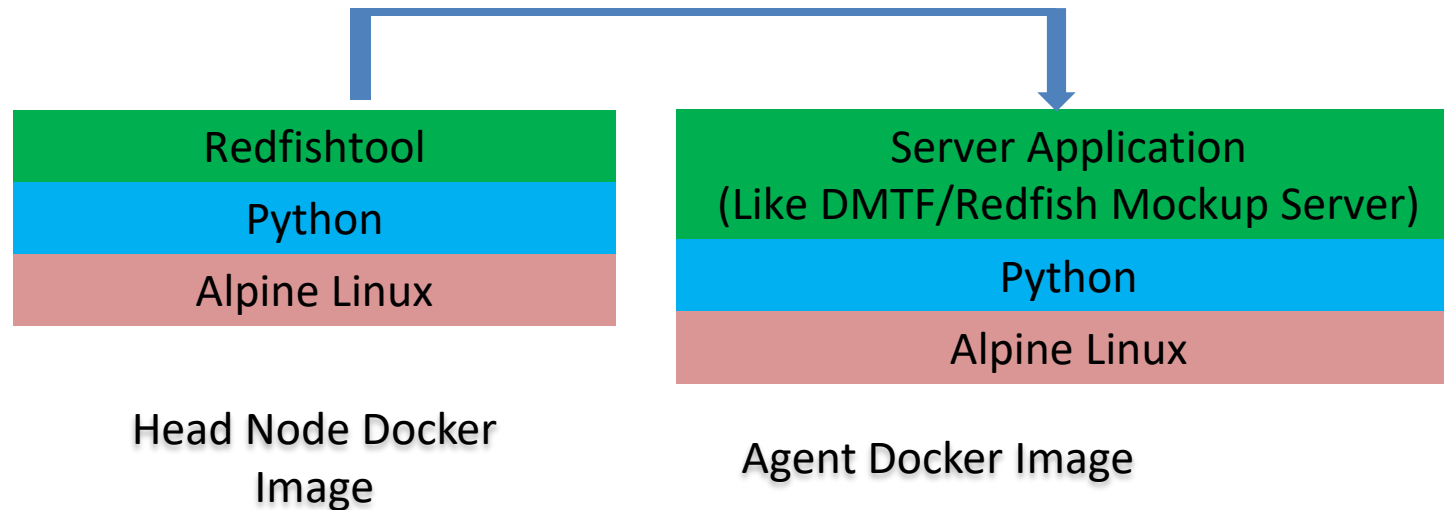- Develop
- Ship
- run apps

Benefits:
- simplicity
- speed
- portability
- density

Data Center Simulator

Ali Nosrati, On Simulating Data Centers with Redfish™-enabled equipment

DATA CENTER SIMULATOR (CURRENT VERSION)

| Redfishtool |
| Python |
| Alpine Linux |

Head Node Docker Image

| Server Application (Like DMTF/Redfish Mockup Server) |
| Python |
| Alpine Linux |

Agent Docker Image

DATA CENTER EMULATOR (NEW VERSION)

Example: