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# SERT - An Overview

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# Overview



SERT is a tool created by SPECpower committee

- In collaboration with Industry Partners
- Built on existing SPEC methods and expertise

Evaluates different components of a server

- Using three workloads that consist of multiple worklets
- Each worklet stresses different areas within a workload, and exhibit different efficiency behaviors
- Workloads run sequentially at varied load levels
- Each worklet within a workload contribute equally to the Workload Efficiency Score

Targeting worldwide server efficiency programs

# Server Efficiency Rating Tool

# Capabilities



## Relevance



- Energy assessment across a wide spectrum of server configurations
- Configuration updates to stay current with latest platforms (off-cycle release)

## Reproducibility



- Predefined set of Java run time parameters ensure tight run to run variations
- Extensive Full Disclosure Report (FDR) description

## Fairness



- Portable across Architectures, OSes, Platforms
- Developed by industry consortium

## Verifiability



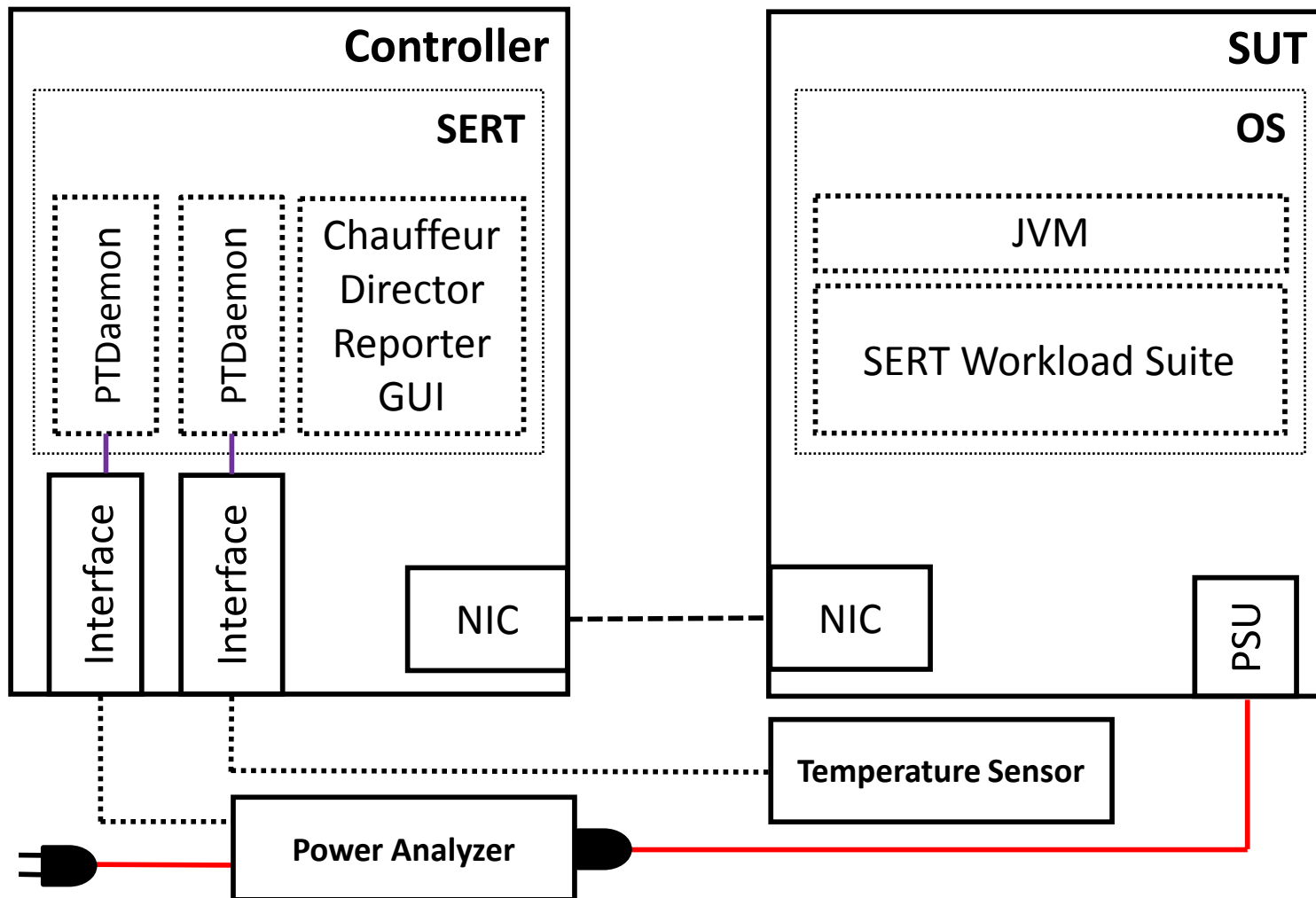
- Automatic discovery of hardware / software described in FDR
- Tests to verify compliance with run rules and to detect results tampering

## Usability



- Economical / easy to use, with minimal equipment / skill requirements
- Active update and support processes in place

# Server Efficiency Rating Tool Block Diagram



# Server Efficiency Rating Tool GUI




SERT 1.1.1

**Navigator Menu**

- Start
- SUT Configuration
- SUT Discovery
- Test Environment
- PTDaemon
- JVM Configuration
- JVM Review
- Choose Test Suite
- Launch Test
- Results
- Help

**Start**



Welcome to the Server Efficiency Rating Tool (SERT)<sup>™</sup>  
1.1.1

To run a test, follow the Wizard through the sequence below:

1. SUT Configuration - Specify the SUT and verify connectivity.
2. SUT Discovery - Run an automated tool to inventory SUT hardware and software configuration.
3. Test Environment - Provide a complete set of information about your test environment.
4. PTDaemon - Configure Power and Temperature Daemons.
5. JVM Configuration - Identify and choose the set of JVM options best suited for your system.
6. JVM Review - Review and verify the JVM options.
7. Choose Test Suite - Choose the Test Suite you would like to run and view its configuration.
8. Launch Test - Launch the Test Suite and observe its progress through different phases.
9. Results - Examine the results and save them to a location of your choice.

Click on the NEXT button below to begin

Back Next Exit

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SERT 1.1.1

**Navigator Menu**

- Start
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**JVM Configuration**

**JVM Options File**

C:\SERT-1.1.1\client-configurations-110.xml Selected Version: 20150602

Load Local File Download Latest With Browser Latest Web Version: Error

**CPU - Criteria Matched**

E5-XXXX v3 Detected: Intel(R) Xeon(R) CPU E5-2699 v3 @ 2.30GHz, 72 Total Threads

**Operating System - Criteria Matched**

Red Hat Enterprise Linux Serve... Detected: Red Hat Enterprise Linux Server, 6.6 (Santiago)

**Java Virtual Machine - Criteria Matched**

HotSpot 1.7.0 u3 Detected: Oracle Corporation, 1.7.0\_80-b15

**Matched Configuration**

Client Configuration ID: Intel\_Lin\_HS17\_2n Reset  Use Custom ID

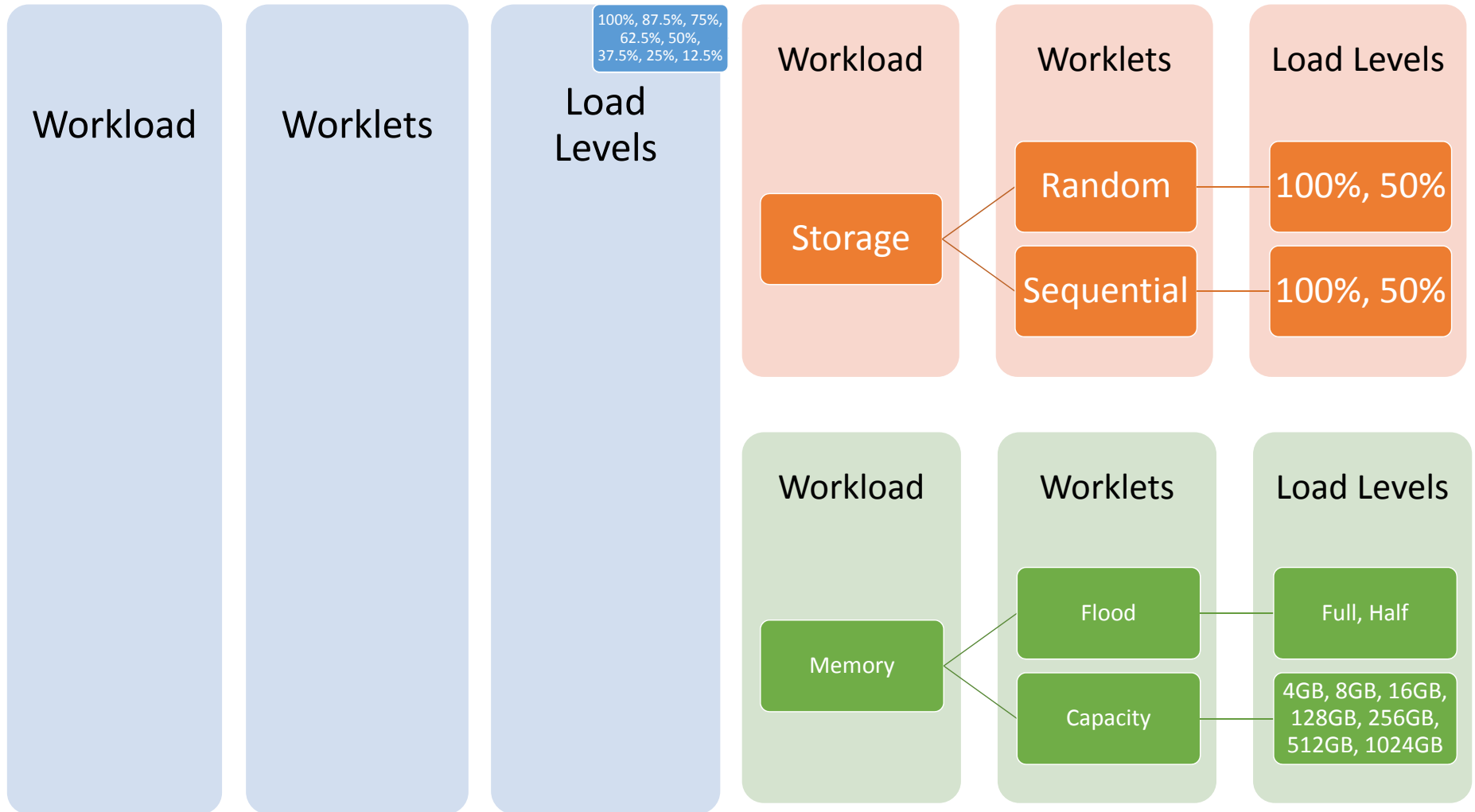
Workload	Client Count	Option-Set
CPU	72	H8n
Storage	Determined at test launch.	H2
Hybrid	72	H8n
Memory	72	H8n
Idle	1	H1

Successful Configuration Match! Click Next to use this configuration.

Back Next Exit

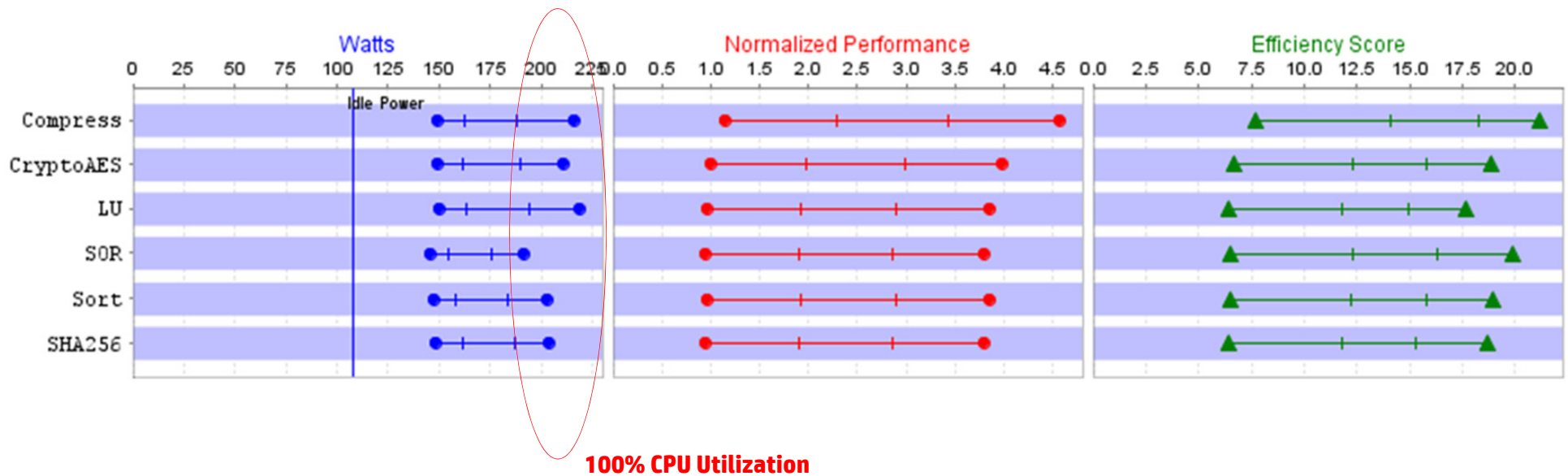
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# SPEC SERT Workloads





# Why multiple worklets? 1/2



Worklets stress different components of the SUT

Resulting in varying efficiency scores

Change in one functional area by a given vendor will not impact overall workload result

Resulting in level playing field for different architectures

# Why multiple worklets? 2/2

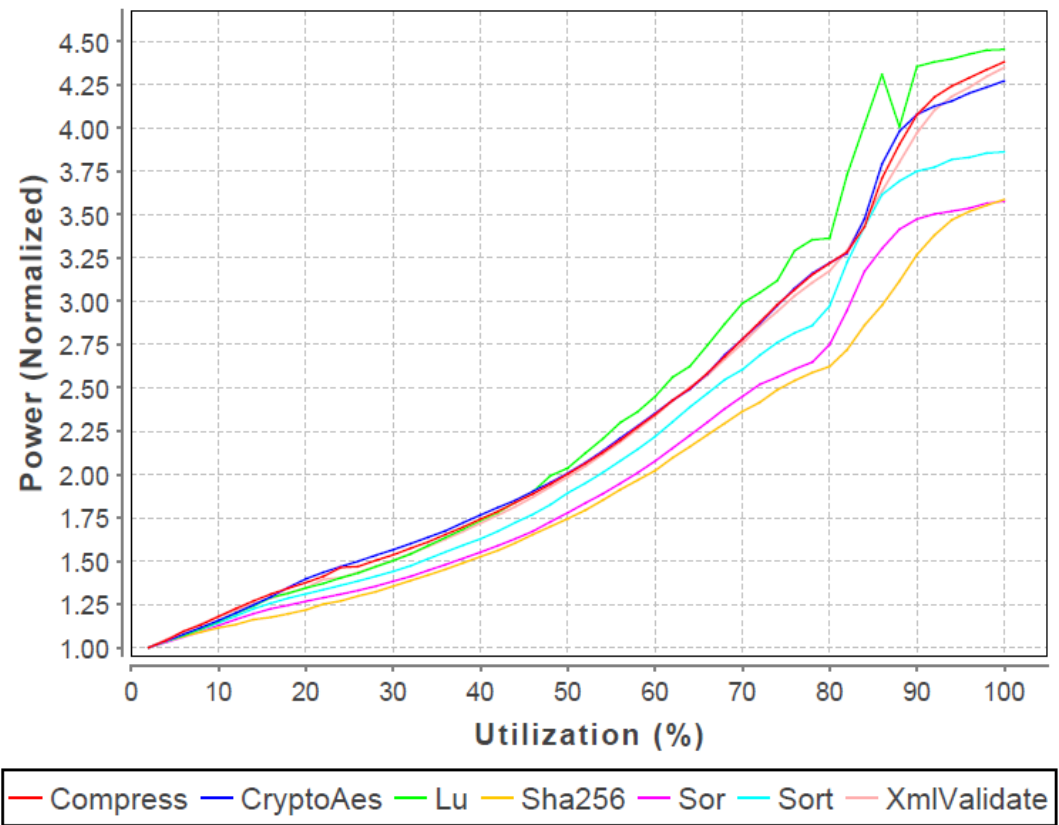


Each worklet exhibits different system behavior over the course of the worklet run

Provides a comprehensive view of the SUT

Workload score not susceptible to any one worklet

W2012\_E5-2690\_8x8GB Power

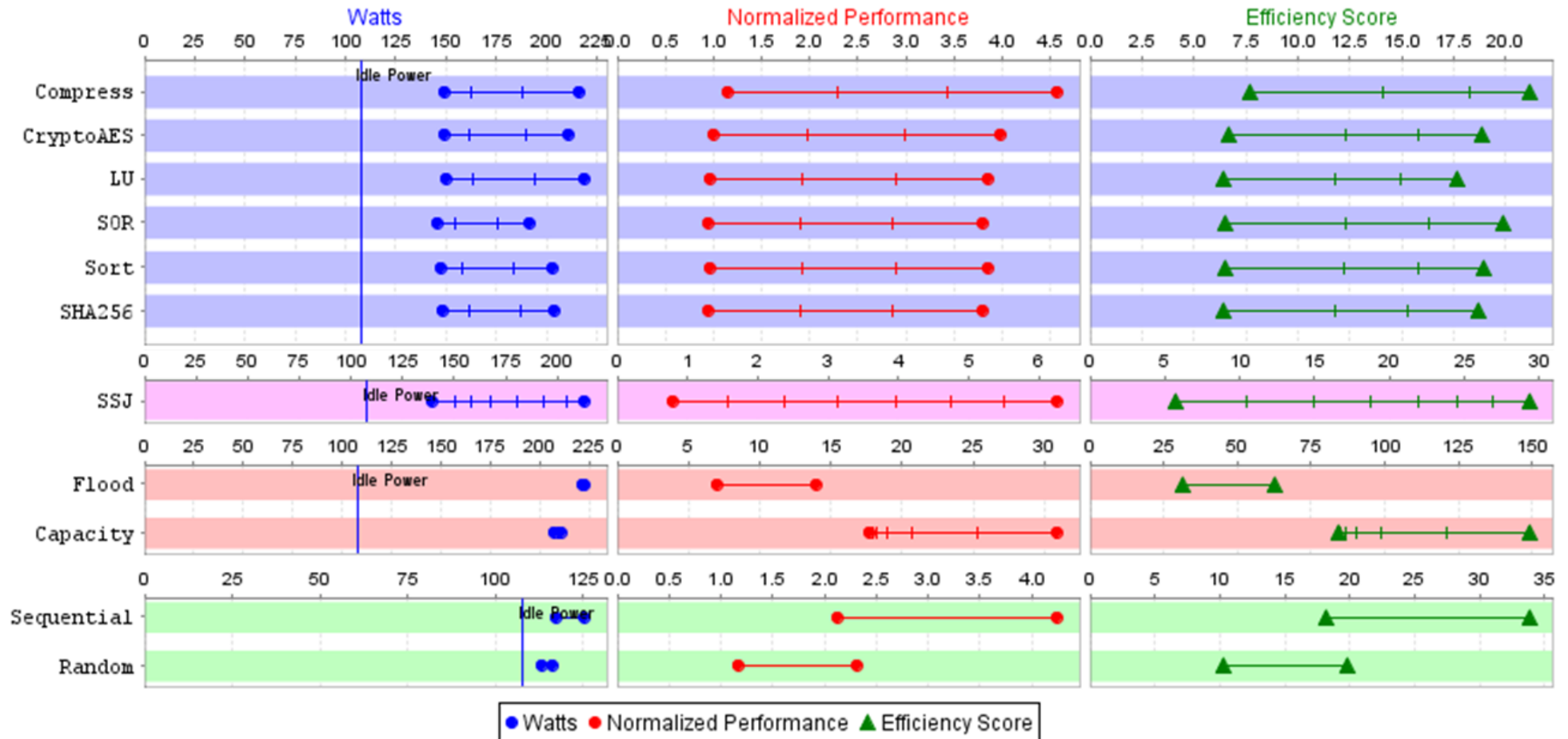


Source: "Analysis of the Influences on Server Power Consumption and Energy Efficiency for CPU-Intensive Workloads" von Kistowksi, Block, Beckett, Lange, Arnold, and Kounev. ICPE'15 Proceedings of the 6th ACM/SPEC International Conference on Performance Engineering



# Server Efficiency Rating Tool

## Worklet Results





**Efficiency = Performance / Power Consumption**

**Each worklet produces an efficiency score**

- Efficiency scores represents the performance and power consumption at multiple target load levels.

**Workload Efficiency Scores**

- The geometric mean of all worklet efficiency scores within a workload.
- Hybris SSJ is included in the CPU workload

<u>Summary</u>			
Workload Efficiency Score			<u>Idle Watts</u>
<u>CPU</u>	<u>Storage</u>	<u>Memory</u>	
103.0	26.3	165.7	68.6

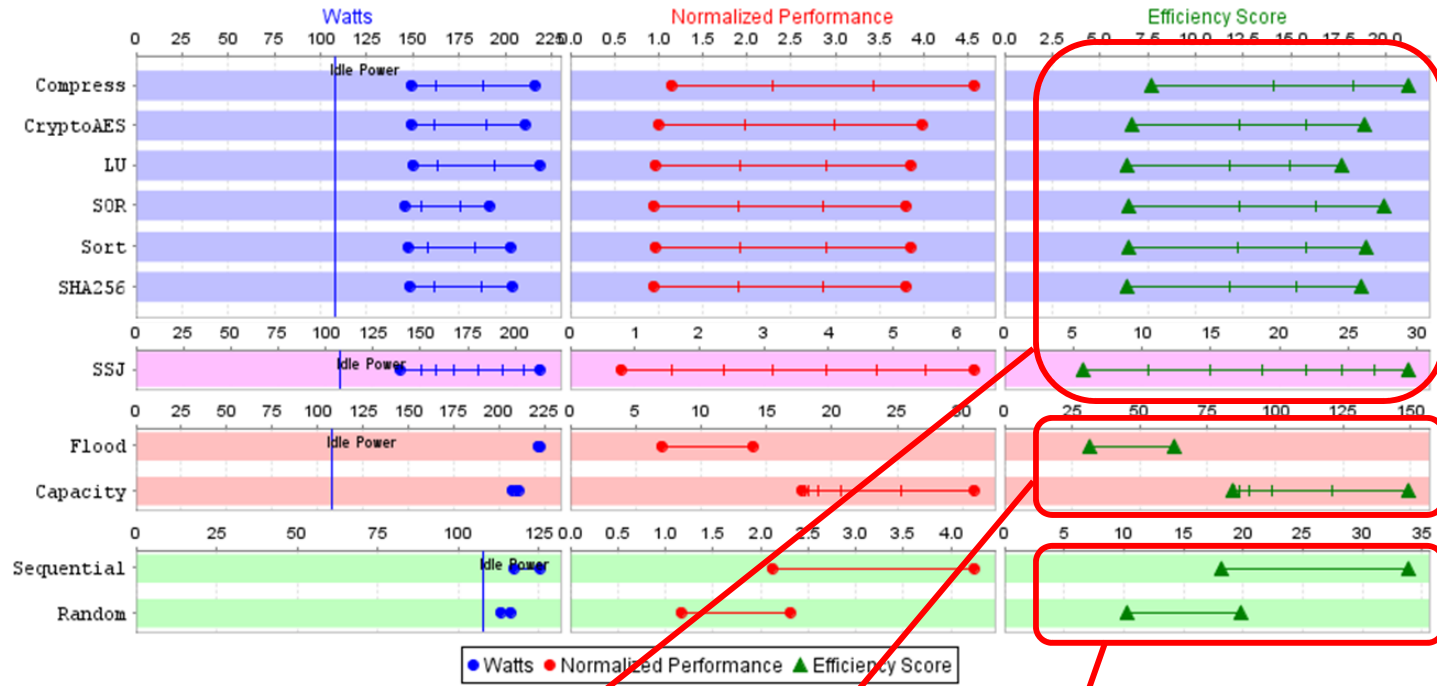
**What about Idle?**

- Not a measure of energy efficiency - Displayed for informational purposes only
  - Highly efficient systems can also consume high power at idle
- Efficiency at utilizations as low as 12.5% is included in the SERT efficiency scores

# Workload Efficiency Scores 2/2



Geometric Mean



Summary			
Workload Efficiency Score			Idle Watts
CPU	Storage	Memory	
103.0	26.3	165.7	68.6

# SPEC SERT Metric Definition



$$Eff_{server} = EXP((Wght_{CPU} * \ln(Eff_{CPU}) + Wght_{Memory} * \ln(Eff_{Memory}) + Wght_{Storage} * \ln(Eff_{Storage})))$$

$$Eff_{CPU} = Geomean(Eff_{Compress}, Eff_{LU}, Eff_{SOR}, Eff_{Crypto}, Eff_{Sort}, Eff_{SHA256}, Eff_{Hybrid SSJ})$$

Wght<sub>CPU</sub> is the weight assigned to the CPU workload efficiency value = **65%**

$$Eff_{Memory} = Geomean(Eff_{Flood3}, Eff_{Capacity3})$$

Wght<sub>Memory</sub> is the weight assigned to the Memory workload efficiency value = **30%**

$$Eff_{Storage} = Geomean(Eff_{Sequential}, Eff_{Random})$$

Wght<sub>Storage</sub> is the weight assigned to the Storage workload efficiency value = **5%**

# Specific Weights for SERT Metric



Weights for SERT metric are derived using reference Workload.

Approach:

- Instrument / measure SERT workload power and resource consumption.
- Instrument / measure reference workload power and resource use.
- Derive Weights
  - Weights show how closely reference workload matches the properties of each of the SERT workloads
  - Weights derived using Barycentric Interpolation

Benefit of weights:

- Avoid scalability issues of reference workloads
- Easily extensible for multiple scenarios
- SERT worklets show potential additional bottlenecks or issues

# Server Efficiency Rating Tool

## Single SERT Metric



### **One set of SERT measurements that can be use worldwide**

Significantly reduces repeated testing per regulatory program, reducing distractions from energy efficiency improvements

Can be applied to multiple regulatory programs e.g., “Pass/Fail” or “A-F Level”

SERT can produce government agency customized result reports

### **Server Categories**

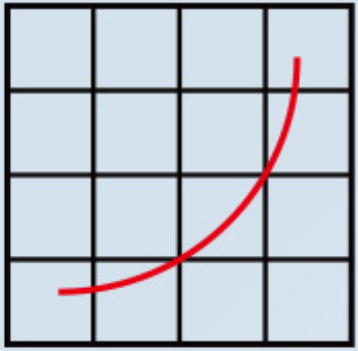
Defined by regulatory program e.g., 1, 2, 4-socket server

### **Threshold**

Defined within a server category

### **Configuration power/performance modifier**

Ability to substitute (e.g. redundant power supplies)

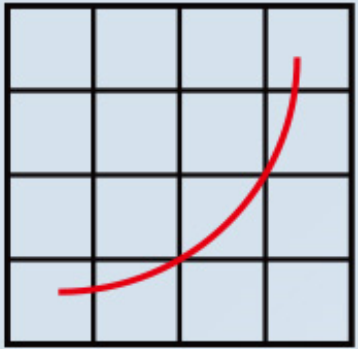


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**Q&A**





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# Thank you!

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# Related Publications



## **Variations in CPU Power Consumption**

ICPE'16: Proceedings of the 7th ACM/SPEC on International Conference on Performance Engineering

## **Energy Efficiency of Hierarchical Server Load Distribution Strategies**

MASCOTS'15: Proceedings of the 2015 IEEE 23rd International Symposium on Modeling, Analysis, and Simulation of Computer and Telecommunication Systems

## **Analysis of the Influences on Server Power Consumption and Energy Efficiency for CPU-Intensive Workloads**

ICPE'15 Proceedings of the 6th ACM/SPEC International Conference on Performance Engineering

## **Server Efficiency Rating Tool (SERT) 1.0.2: An Overview.**

ICPE'14 Proceedings of the 5th ACM/SPEC International Conference on Performance Engineering

## **Further Implementation Aspects Of The SERT Tool (Server Efficiency Rating Tool)**

ICPE'13 Proceedings of the 4th ACM/SPEC International Conference on Performance Engineering

## **The Implementation Of The SERT (Server Efficiency Rating Tool)**

ICPE'12 Proceedings of the 3rd ACM/SPEC International Conference on Performance Engineering

## **The Design And Development Of The Server Efficiency Rating Tool**

ICPE'11 Proceedings of the 2nd ACM/SPEC International Conference on Performance Engineering

## **Server Efficiency - Metrics for Computer Servers and Storage**

ASHRAE Datacom Series – Book 12 - <http://www.techstreet.com/ashrae/products/1894771>

