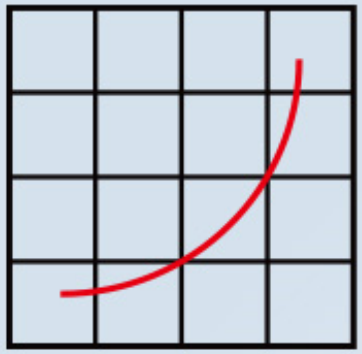

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SERT - An Overview

Klaus-Dieter Lange
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SPECpower Committee Chair

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SPECpower Committee Vice-Chair

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

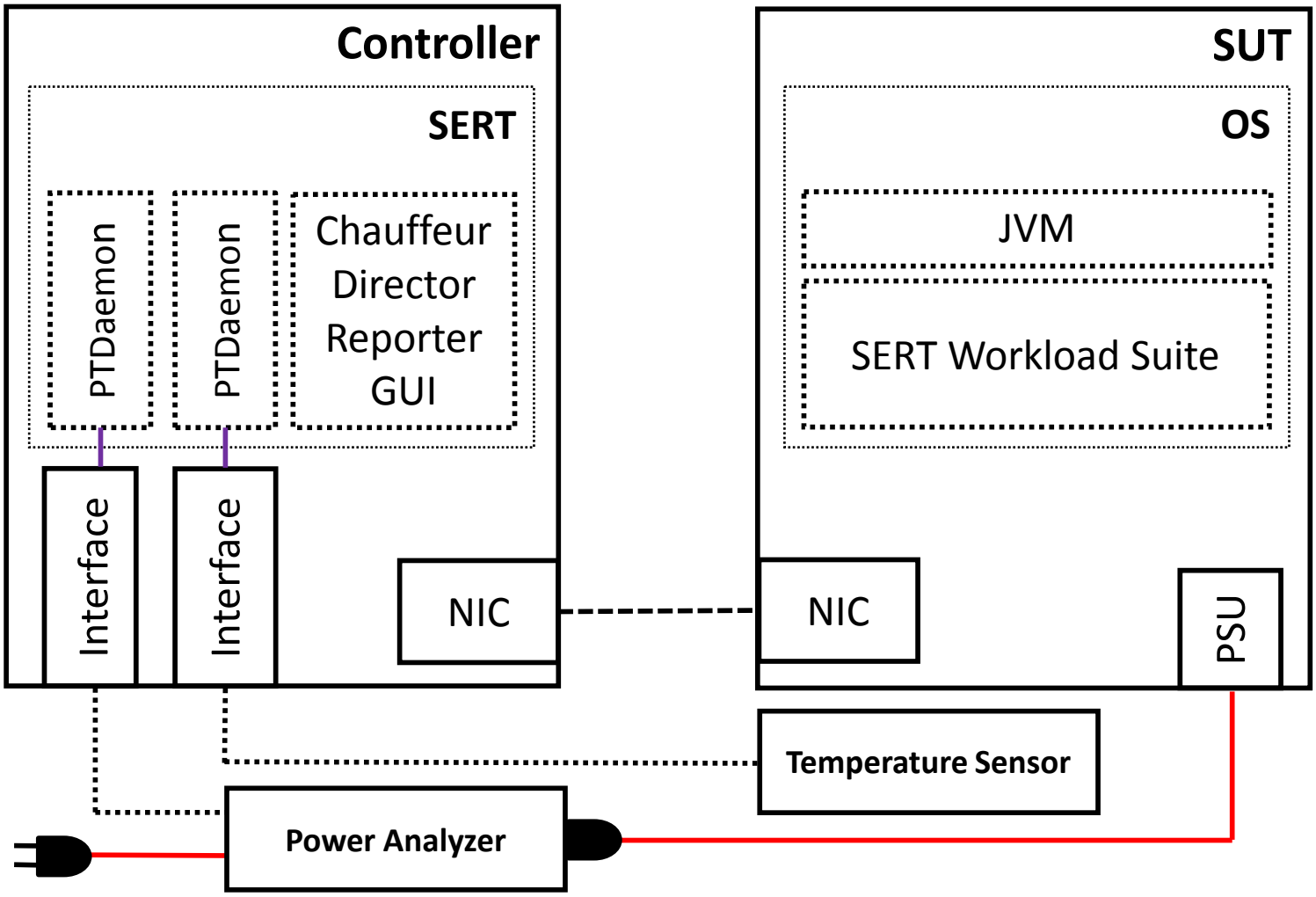
- Automatic discovery of hardware / software described in FDR
- Tests to verify compliance with run rules and to detect results tampering

Usability

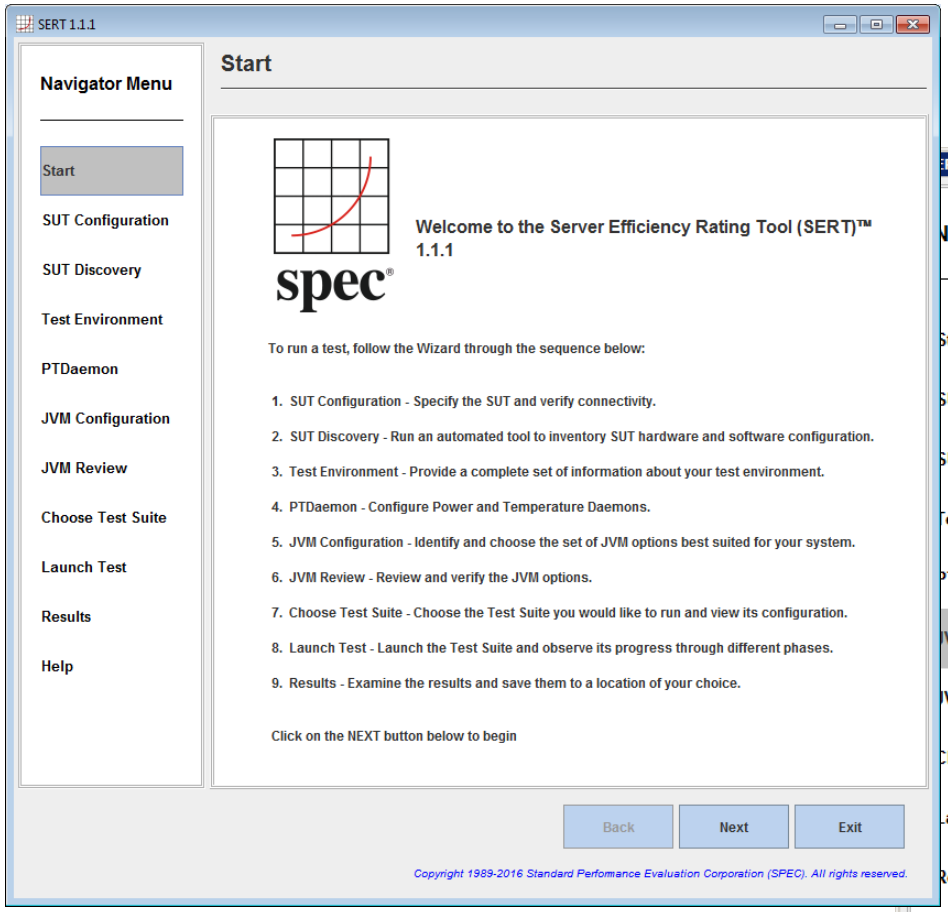
- Economical / easy to use, with minimal equipment / skill requirements
- Active update and support processes in place

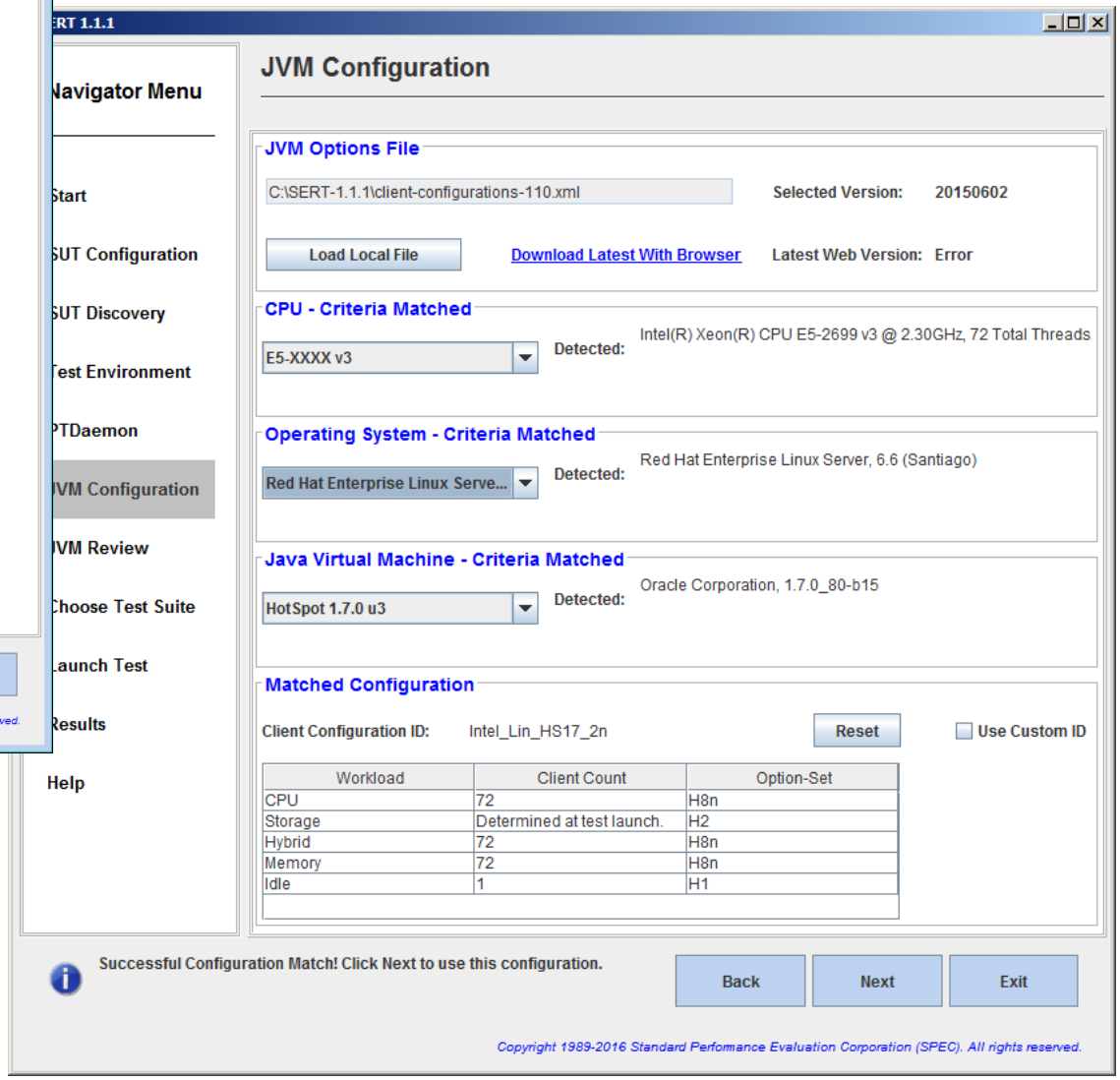
Server Efficiency Rating Tool

Block Diagram



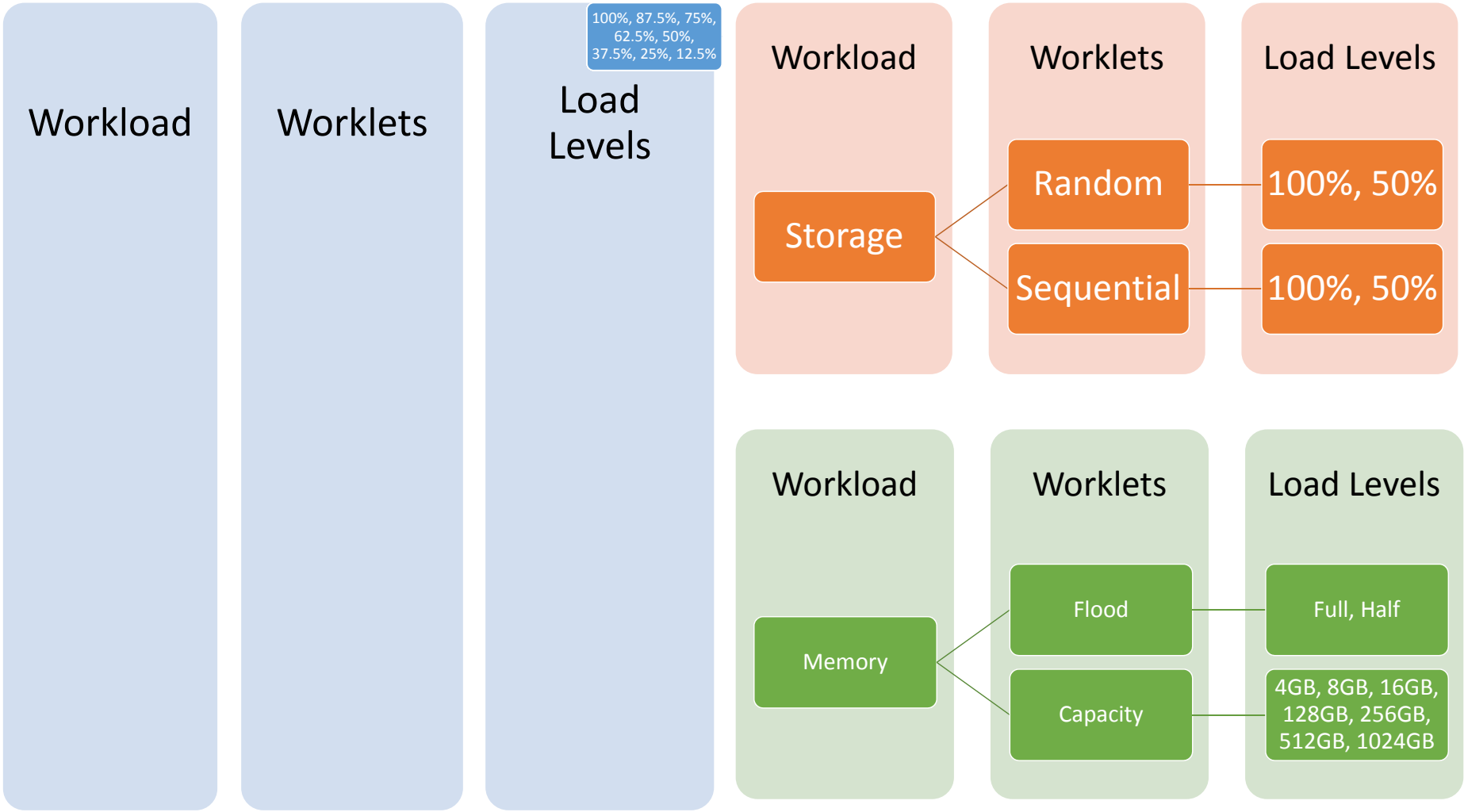
Server Efficiency Rating Tool
GUI



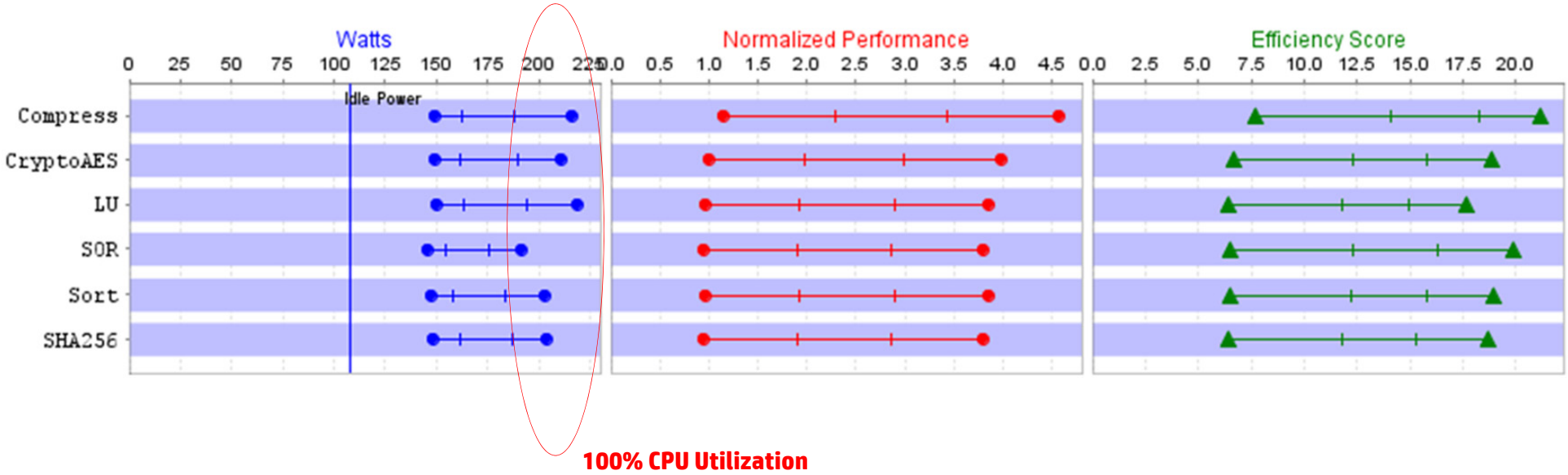


Server Efficiency Rating Tool

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

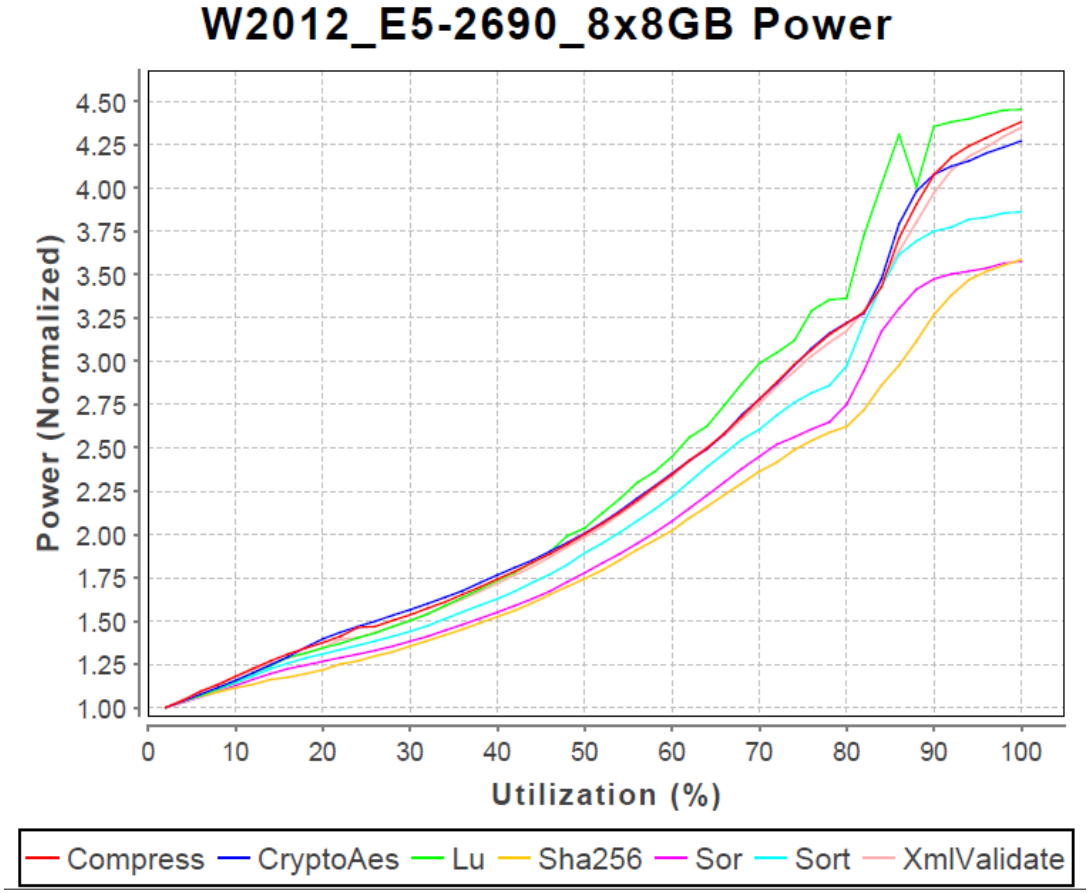
- Resulting in level playing field for different architectures

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

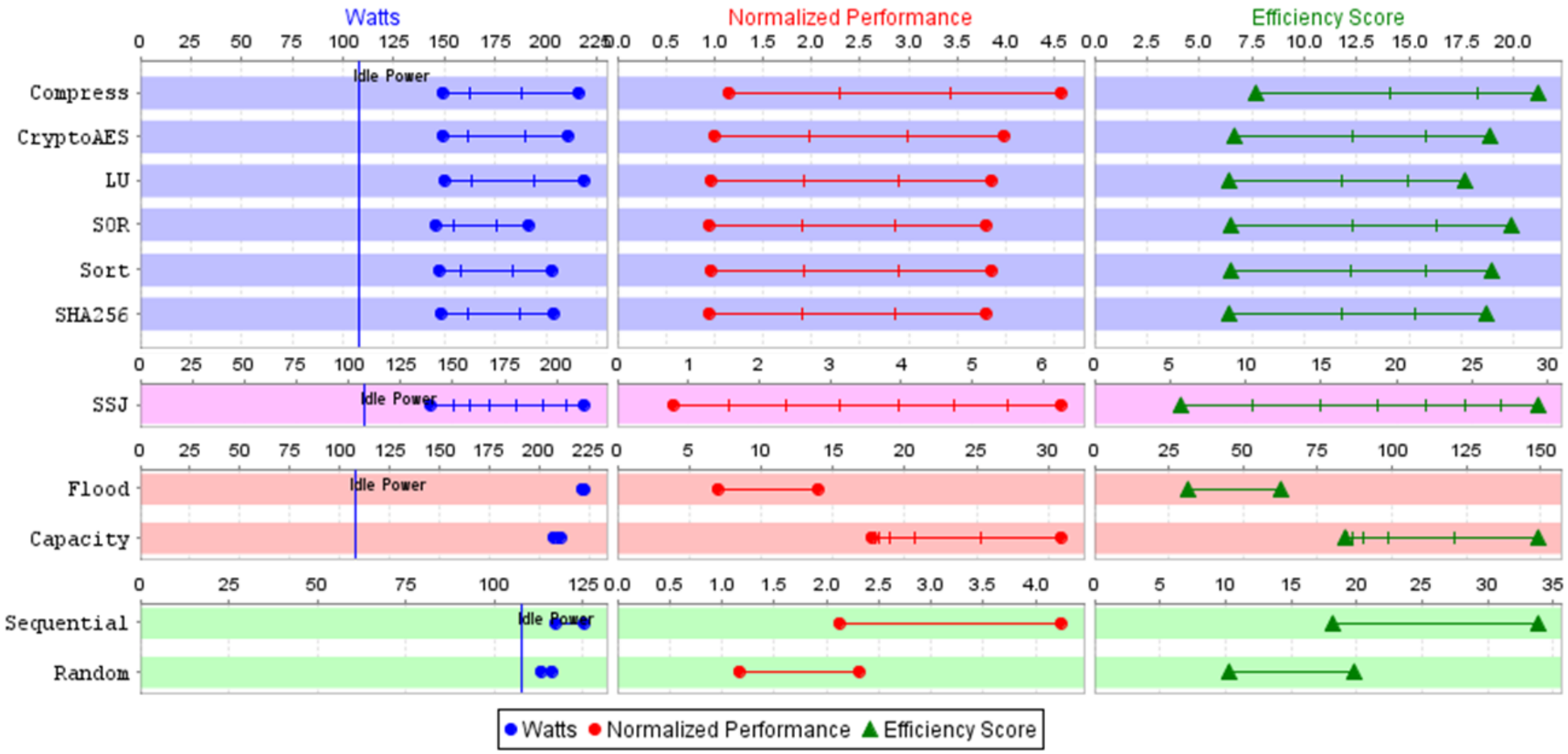
Worklod score not susceptible to any one worklet



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



Workload Efficiency Scores 1/2

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

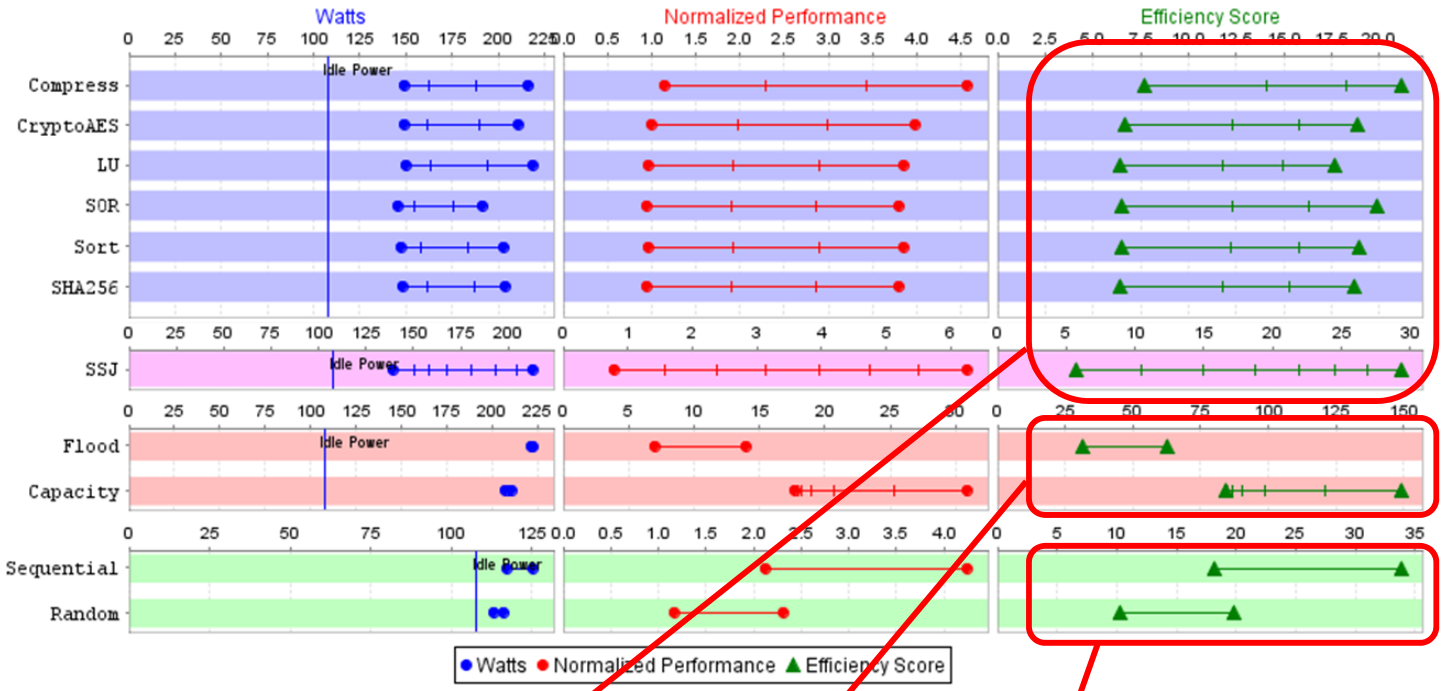
Summary			
Workload Efficiency Score			Idle Watts
CPU	Storage	Memory	
103.0	26.3	165.7	68.6

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

Server Efficiency Rating Tool

SPEC SERT Metric Definition

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

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

$Wght_{CPU}$ is the weight assigned to the CPU workload efficiency value = **65%**

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

$Wght_{Memory}$ is the weight assigned to the Memory workload efficiency value = **30%**

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

$Wght_{Storage}$ 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

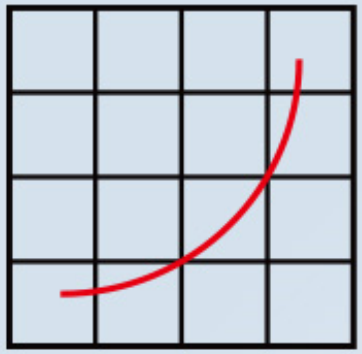
Defined by regulatory program e.g., 1, 2, 4-socket server

Threshold

Defined within a server category

Configuration power/performance modifier

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



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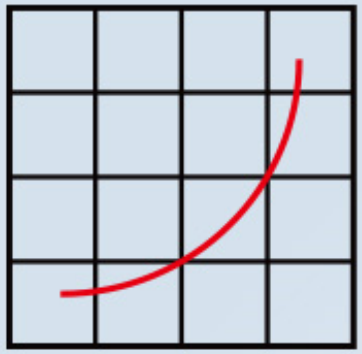
Q&A



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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