Hot Band Workloads and High End HP Storage Products

Chuck Paridon, HPES Master Storage Performance Architect

SNIA Emerald™ Training

SNIA Emerald Power Efficiency Measurement Specification, for use in EPA ENERGY STAR®

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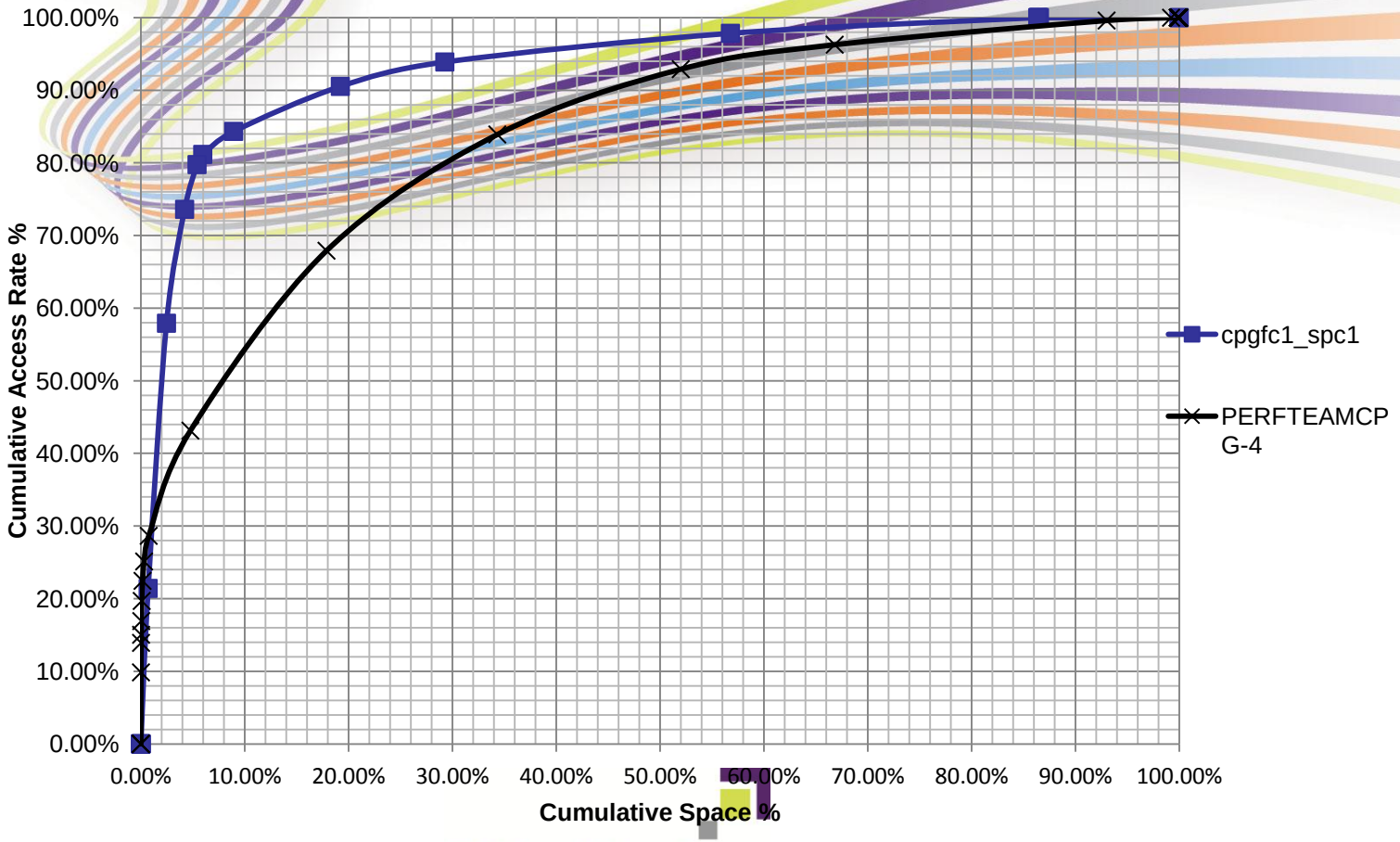
SNIA Green TWG Cache Friendly Performance Comparison Chart
Tiered Storage Speedup on 3PAR Storage Products



Source: HP Blue line is the SPC-1 workload IO density data. Black is Hot Band. The steeper the curve and the sharper the knee, the more Tiered Storage can enhance the IO rate. SPC speedup ~50% Hot Band ~30%
So total speedup due to both cache and tiering ~ 100 + (40 *0.3) = 112%

Hot Band IO Patterns

- The Hot Band workload is comprised of several different IO streams, some of which contain hot spots, or regions of more intense IO demand.
- This results in varying degrees of logical block address re-referencing in certain regions of the overall IO space that can be either contained with the cache of an array, or can be placed on storage devices that deliver a higher IO rate.

Hot Band IO Patterns

Hot Band IO Profile

IO Profile	% of workload	Read/Write Percentage	IO Size (KiB)	Access Pattern	Usable Address Range
Write Stream 1	5	0/100	See Table 12	Sequential	0-100%
Write Stream 2	5	0/100	See Table 12	Sequential	0-100%
Write Stream 3	5	0/100	See Table 12	Sequential	0-100%
Read Stream 1	5	100/0	See Table 12	Sequential	0-100%
Read Stream 2	5	100/0	See Table 12	Sequential	0-100%
Read Stream 3	5	100/0	See Table 12	Sequential	0-100%
Read Stream 4	5	100/0	See Table 12	Sequential	0-100%
Read Stream 5	5	100/0	See Table 12	Sequential	0-100%
Uniform Random	6	50/50	See Table 12	Random	0-100%
Hot Band 1	28	70/30	See Table 12	Random	10 -18%
Hot Band 2	14	70/30	See Table 12	Random	32-40 %
Hot Band 3	7	70/30	See Table 12	Random	55-63 %
Hot Band 4	5	70/30	See Table 12	Random	80-88 %

Hot Bands concentrate 54% of the IO in 32% of the space

Hot Band IO Patterns

- The Hot Band workload when run on High End Storage demonstrates the power/performance advantage of two product features
  - Array Based Cache
  - Storage Tiering
- Although the initial goal was solely cache focused, there is also a benefit of implementing faster tiers in the product such as HP P9500 Smart Tiering

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SNIA Green TWG Cache Friendly Performance Comparison Chart Cache and Tiering Speedup on HP P9500 Storage Product

	Hot IOPS	Hot RT	Rnd IOPS	Rnd RT	C/WS ratio	Cache Hit Ratio Hot Band vs Rnd
Small Array	4,330	32.8 ms	4,[illegible]0	[illegible]3.4 ms	<<	N/A
Large Array Cache Assist only	39,900	8.97 ms	18,410	22.[illegible] m	[illegible]%	60%/24%
Large Array (Tiered)	42,870	5.77 ms	N/A	N/A	~3%	60%/24%

Example

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SNIA Green TWG Tiered Storage w/Hot Bands Analysis and Tier Configuration Process

- The Workload Analysis Process Consists of Two Steps

1. Create a single pool large enough to hold the desired working set
2. Run the Hot Band workload on that pool and use the analysis tools to produce a report guiding the composition of the tier(s)

- The tier construction process involves 2 decision points.

1. Which technology to deploy
2. The capacities of the tier(s)

- The following slides illustrate an example of these activities

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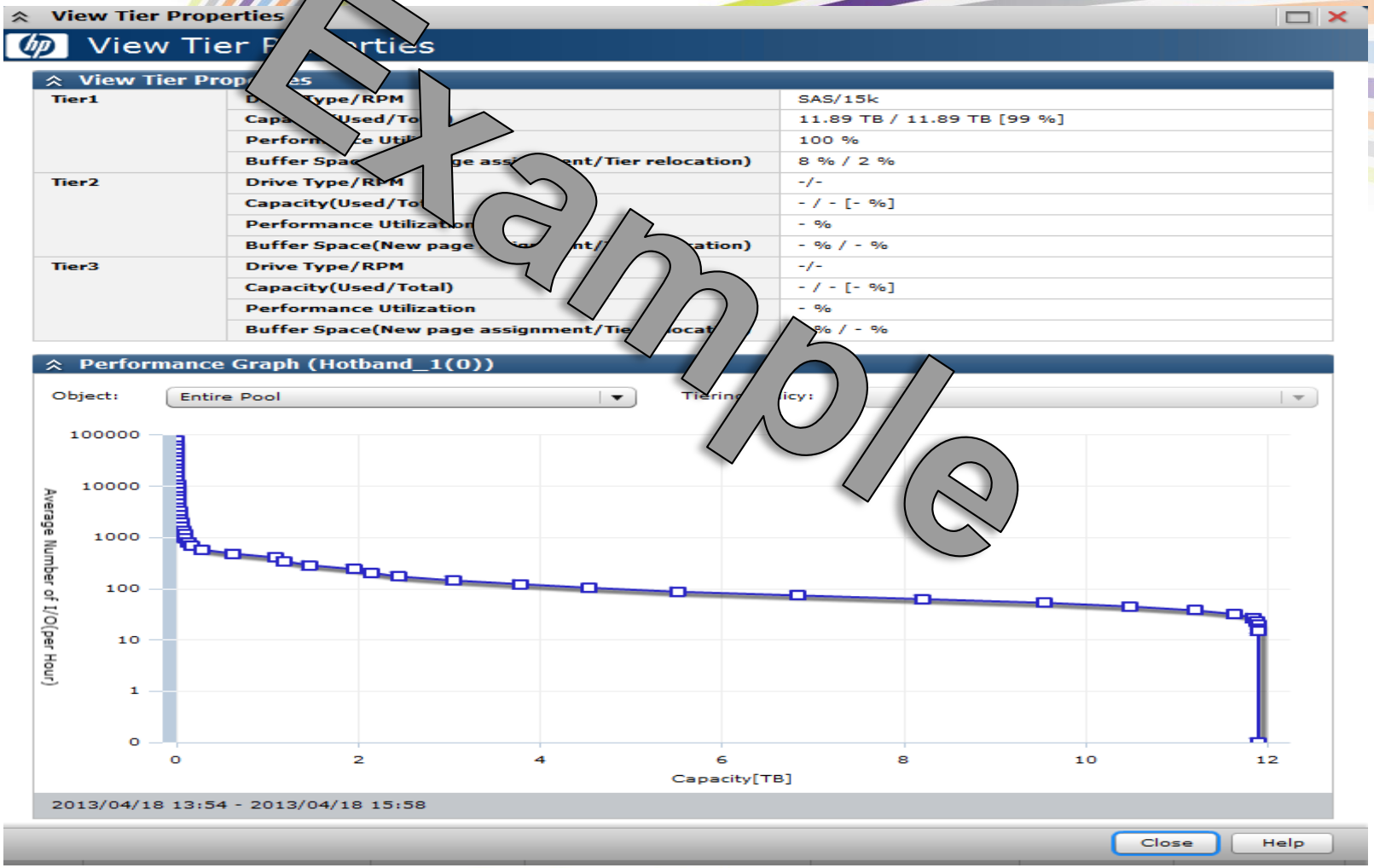
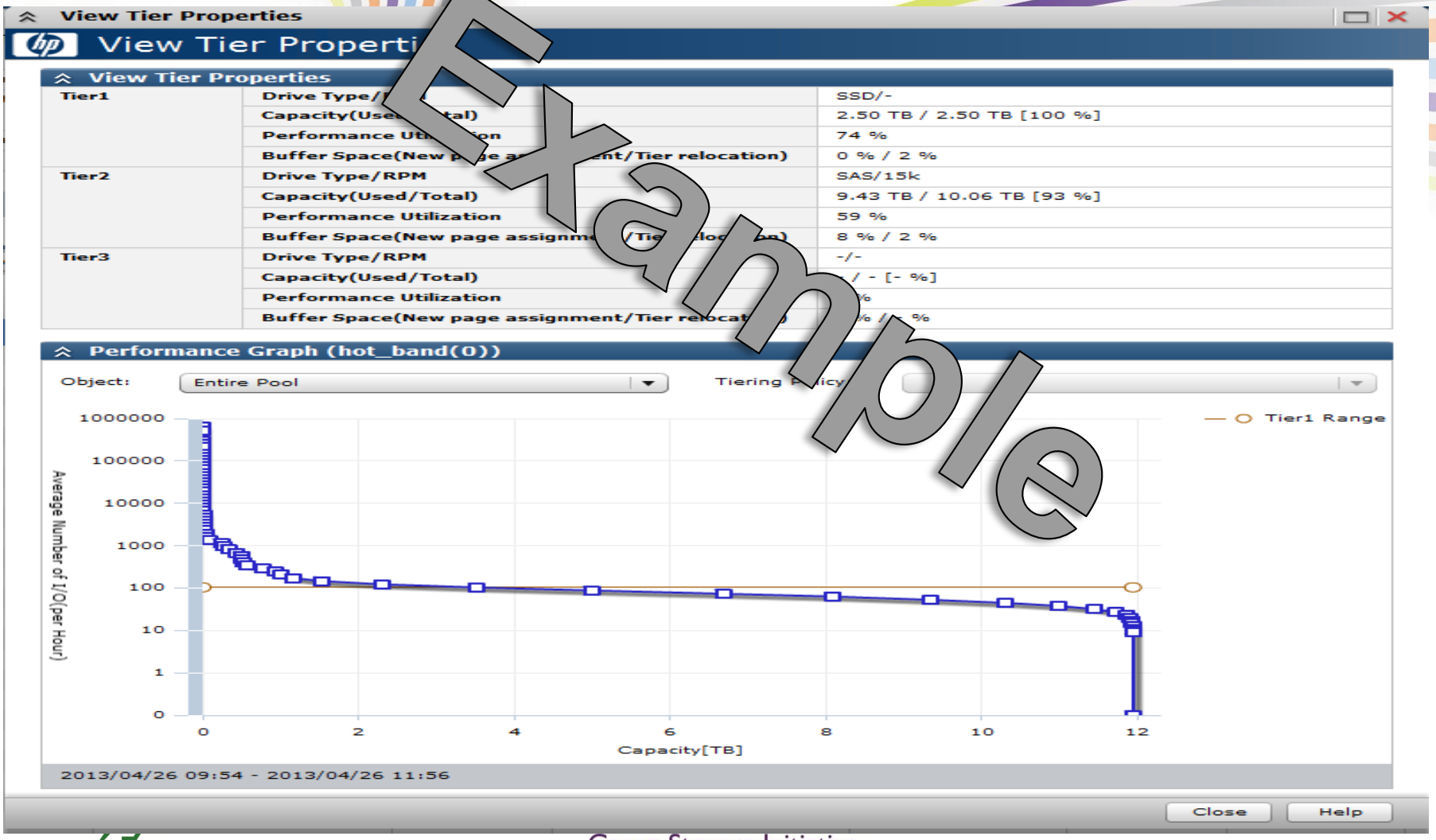
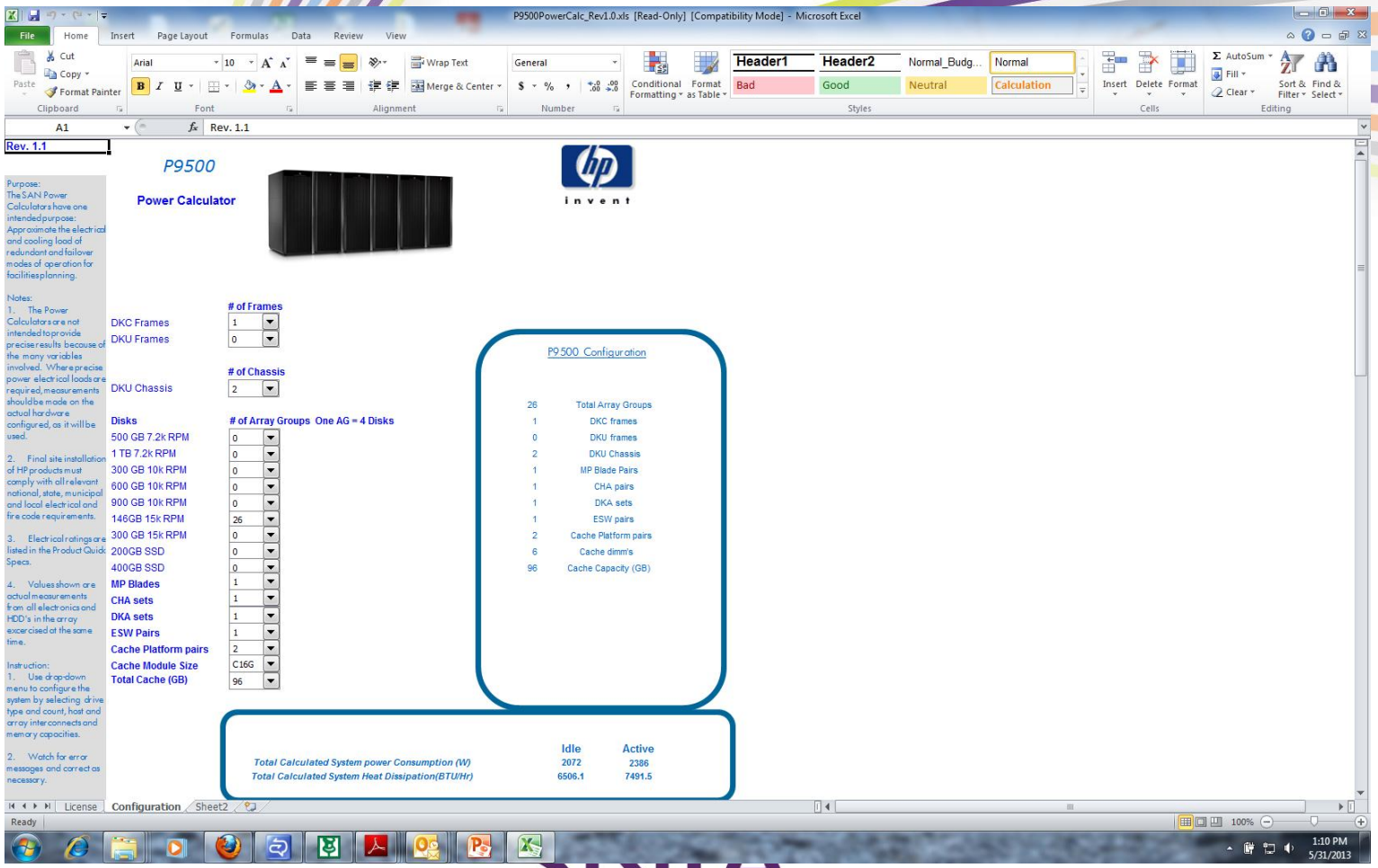
SNIA Green TWG Tiered Storage w/Hot Bands
Initial Tier Property Analysis



SNIA Green TWG Tiered Storage w/Hot Bands Final Tier Property Analysis



The HP P9500 Power Calculator



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SNIA Green TWG Tiered Storage w/Hot Bands Primary Metric Comparison

Configuration	Tier Type	Power Consumption (Idle Watts)	IOPS	IOPS/Watt
Large Array (Initial)	15k RPM	7,491 Watts	18,410	2.457
Large Array (Cache Assist)	15k RPM	7,491 Watts	39,900	5.326
Large Array (Tiered)	15k + SSD	7,283 Watts	42870	5.886

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SNIA Green TWG Hot Band Workload Conclusions and Observations

- The Hot Band workload is amenable to performance optimization by both storage subsystem cache and the proper deployment of tiered storage.
- As a result of high cache hit rates (~60%) the overall performance contribution of tiered storage is limited.
- In addition to the increase in IOPS (132%), there is also a corresponding decrease in power consumption from the substitution of SSDs in the configuration
- The net effect of these two parameter changes is a 140% improvement in the SNIA primary active metric (IOPS/Watt) of