



# Hot Band Workloads and High End HP Storage Products

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## SNIA Emerald™ Training

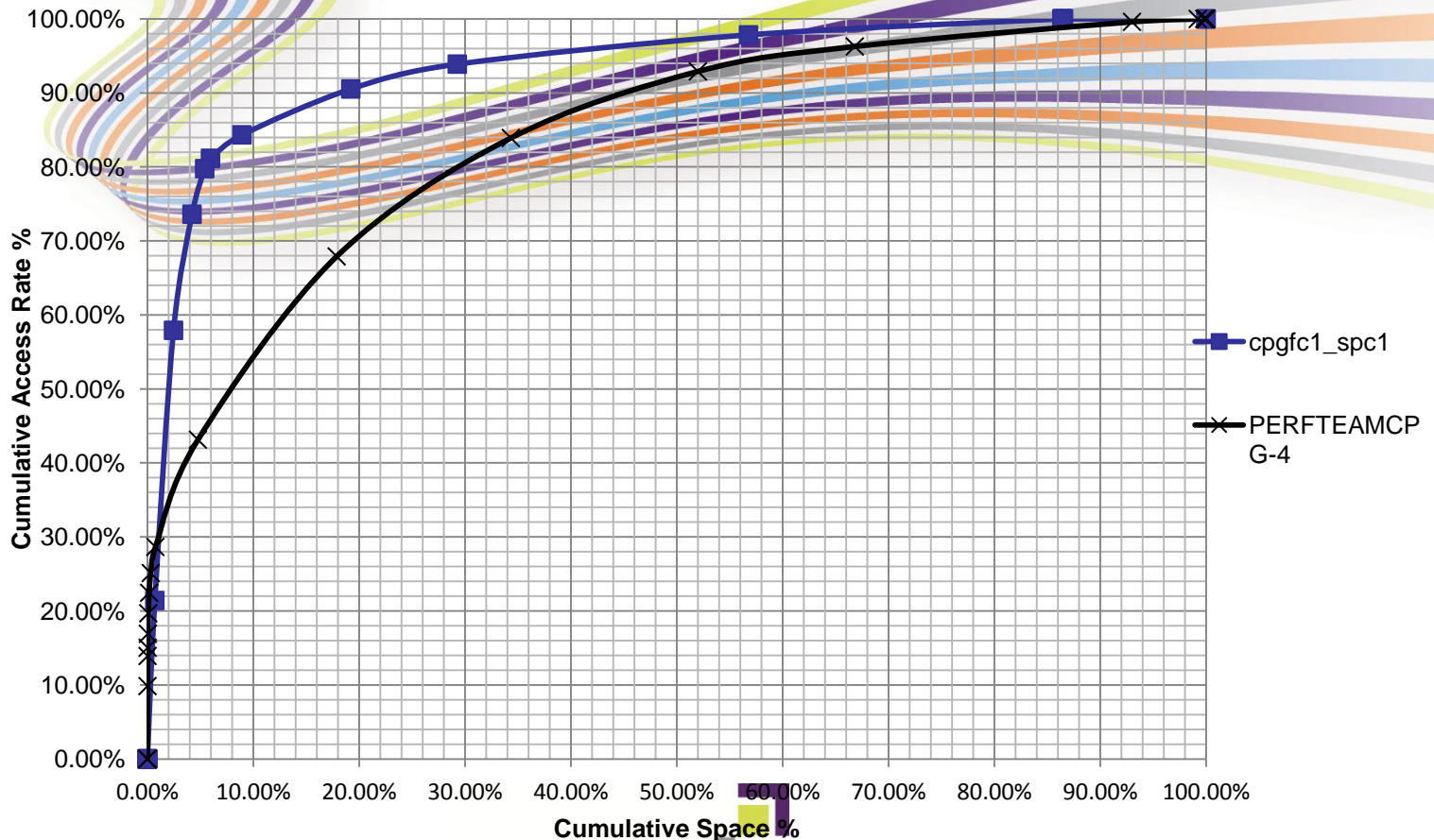
*SNIA Emerald Power Efficiency Measurement Specification, for use in EPA ENERGY STAR®*

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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  
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# 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

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

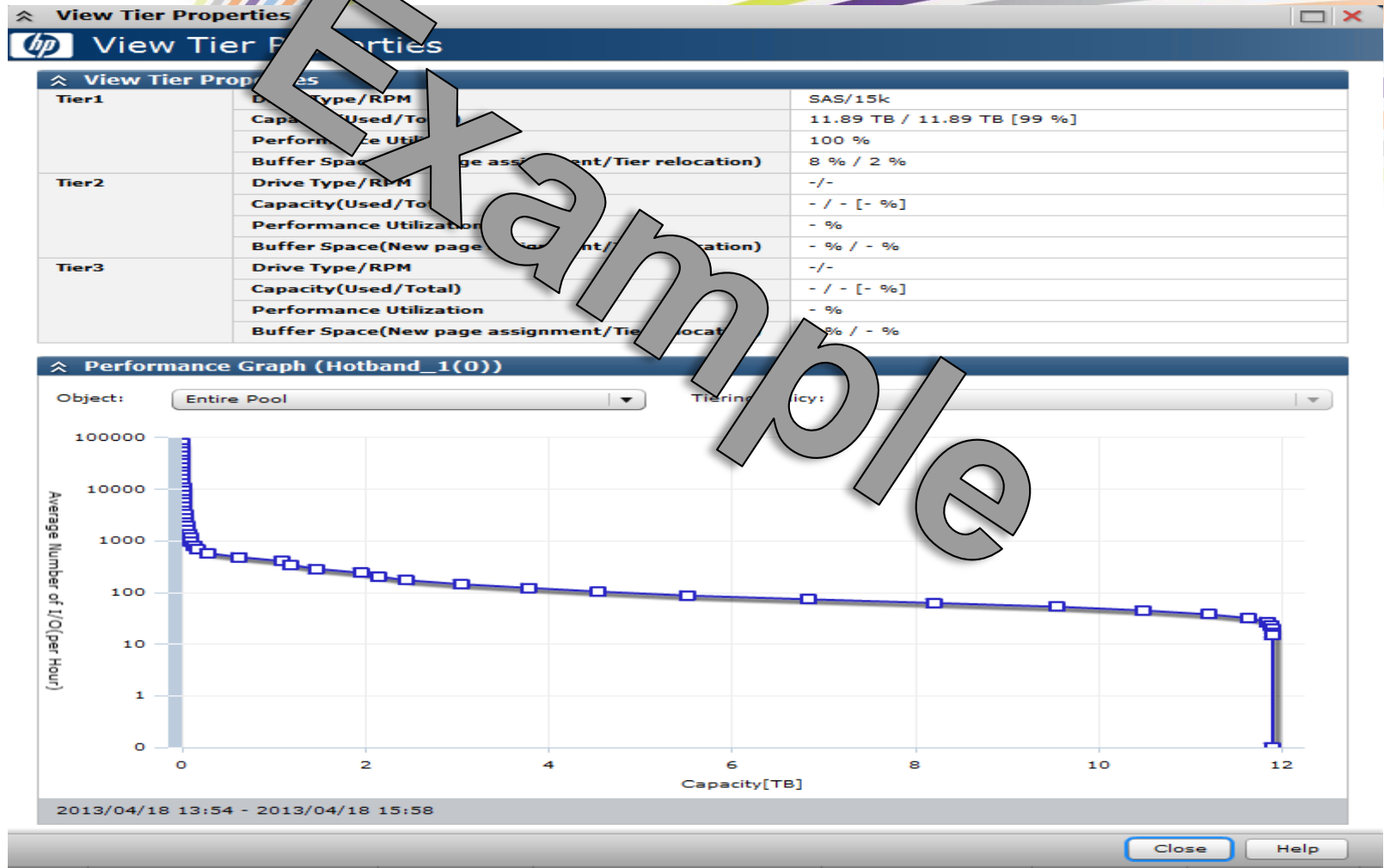
	Hot IOPS	Hot RT	Rnd IOPS	Rnd RT	C/WS ratio	Cache Hit Ratio Hot Band vs Rnd
Small Array	4,330	32.8 ms	4,110	33.4 ms	<<	N/A
Large Array Cache Assist only	39,900	8.97 ms	18,410	22.57 ms	~3%	60%/24%
Large Array (Tiered)	42,870	5.77 ms	N/A	N/A	~3%	60%/24%

Example

# 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

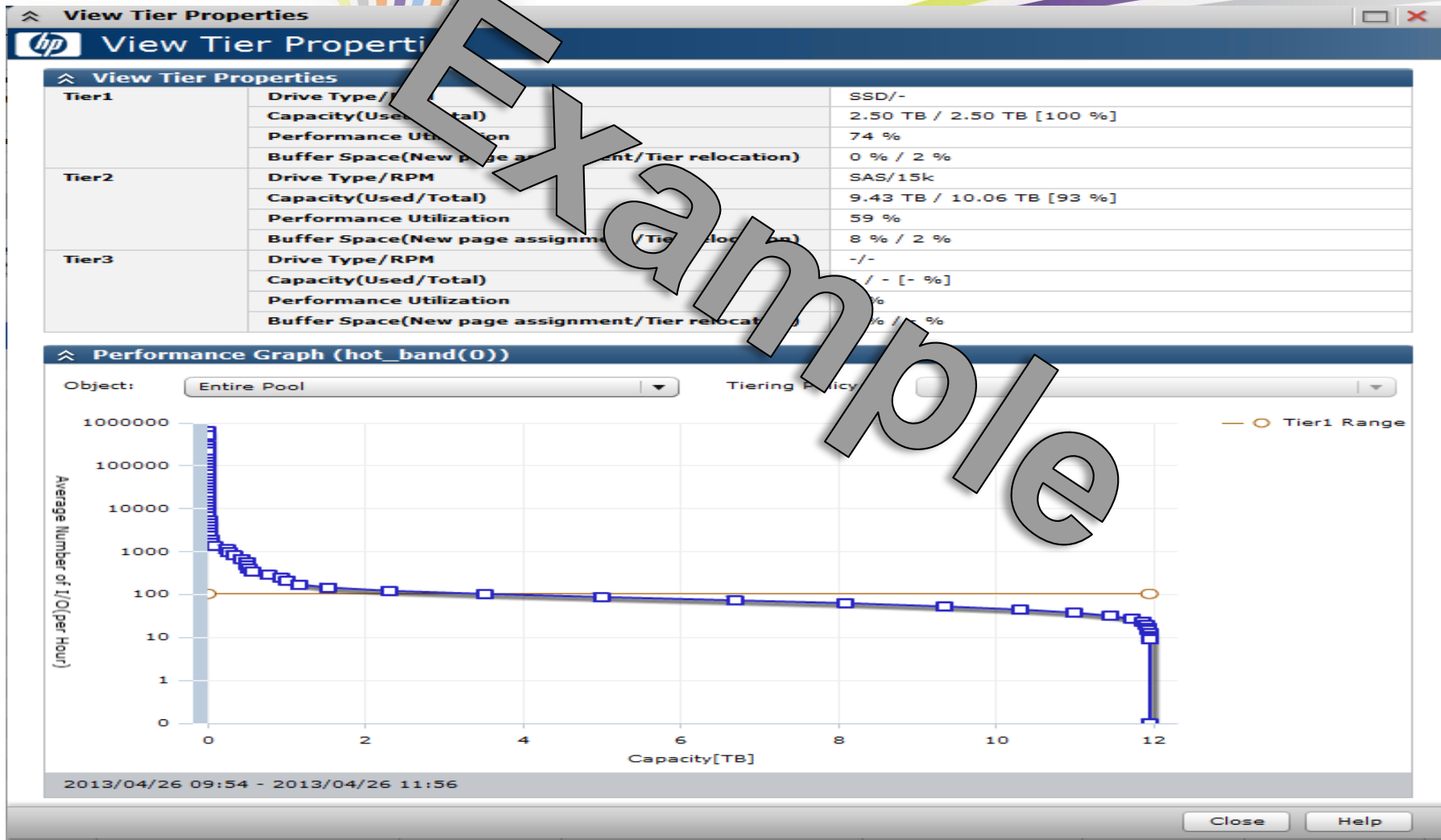
# SNIA Green TWG Tiered Storage w/Hot Bands Initial Tier Property Analysis



Example



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



Example

# The HP P9500 Power Calculator

**Rev. 1.1**

**P9500 Power Calculator**

**Purpose:**  
The SAN Power Calculators have one intended purpose: Approximate the electrical and cooling load of redundant and failover modes of operation for facilities planning.

**Notes:**

- The Power Calculators are not intended to provide precise results because of the many variables involved. Where precise power electrical loads are required, measurements should be made on the actual hardware configured, as it will be used.
- Final site installation of HP products must comply with all relevant national, state, municipal and local electrical and fire code requirements.
- Electrical ratings are listed in the Product Quick Specs.
- Values shown are actual measurements from all electronics and HDD's in the array exercised at the same time.

**Instruction:**

- Use dropdown menu to configure the system by selecting drive type and count, host and array interconnects and memory capacities.
- Watch for error messages and correct as necessary.

**Configuration Options:**

- # of Frames:** DKC Frames (1), DKU Frames (0)
- # of Chassis:** DKU Chassis (2)
- Disks:** 500 GB 7.2k RPM (0), 1 TB 7.2k RPM (0), 300 GB 10k RPM (0), 600 GB 10k RPM (0), 900 GB 10k RPM (0), 146GB 15k RPM (26), 300 GB 15k RPM (0), 200GB SSD (0), 400GB SSD (0)
- MP Blades:** MP Blade Pairs (1)
- CHA sets:** CHA sets (1)
- DKA sets:** DKA sets (1)
- ESW Pairs:** ESW Pairs (1)
- Cache Platform pairs:** Cache Platform pairs (2)
- Cache Module Size:** C16G (1)
- Total Cache (GB):** Total Cache (GB) (96)

**P9500 Configuration**

26	Total Array Groups
1	DKC frames
0	DKU frames
2	DKU Chassis
1	MP Blade Pairs
1	CHA pairs
1	DKA sets
1	ESW pairs
2	Cache Platform pairs
6	Cache dimm's
96	Cache Capacity (GB)

**Summary:**

	Idle	Active
Total Calculated System power Consumption (W)	2072	2386
Total Calculated System Heat Dissipation(BTU/HR)	6506.1	7491.5

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

Example

Configuration	Tier Type	Power Consumption (Watts)	IOPS	IOPS/Watt
Large Array (Initial)	15k RPM	7,491 Watt	18,410	2.457
Large Array (Cache Assist)	15k RPM	7,491 Watts	39,600	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

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