Flash Memory Summit

Methods to Improve System Lifecycles and Improve Sustainability

Presenter: Larry Freymuth, Senior Manager System Validation and Test, Viking Enterprise Solutions

Overview

- What is the issue
- What are the key contributing factors
- What are the trade offs
- What are possible solutions
- Path forward

What is the Issue

- Users need extended life cycles and improved overall sustainability
- Cost of acquisition of flash-based systems is typically very high
  - Extending the product life decreases the refresh cycles and optimizing overall IT budget spending
  - Overall environmental impact is reduced with fewer equipment turns
- Component replacement results in un-planned downtime and degraded performance cycles (rebuilds, non-HA operation)
- Greater desire to reduce the overall environmental impact
  - Energy, waste, refresh cycles, etc.

Key Contributing Factors

- High performance systems dictate higher power and cooling requirements
  - Higher power results in higher system temperatures
  - Higher system temperatures can decrease overall reliability and lifecycle
  - Higher system temperatures require increased energy to be used for cooling
  - Higher system temperatures generate more heat for the data center to evacuate
  - Hot air management contributes to warming of external environment
  - Traditional DC cooling topologies consume energy to evacuate heat (chillers, blowers, etc.)
  - Performance needs push systems outside of their “Sweet Spot” for power and thermal operation

Key Contributing Factors (2)

- Higher enclosure temperatures can reduce component life
  - More frequent replacement of components during the product lifecycle
  - Flash device replacements happen more often
  - More strain on PSU and fan components due to operating at higher temps
- Free air DC and higher ambient temps can degrade product lifecycle
  - Higher DC ambient reduces overall DC TCO
  - Higher DC temperatures can accelerate device failures and degrade reliability
  - “Opposing Trends” exist

Key Contributing Factors (3)

- SSD power management not typically fully utilized
  - Modern SSDs allow performance throttling versus power consumption
  - Typical systems have more SSD BW than system can take advantage of
  - Not all SSDs need to be powered on at all times
  - Efficient balance of SSD power and overall performance often not achieved/implemented
  - The above factors result in additional power and cooling being utilized for un-realized performance availability.

What are the Trade Offs

- Power versus Performance
- Operating temp versus product lifecycle
- Performance versus temperature
- DC ambient temperature versus product lifecycle
- Improved sustainability requires an overall improvement in the balancing of Performance, Power, Packaging and Cooling

Possible Solutions

- Implement optimized solution to minimize power required versus performance of overall solution
  - Run devices in lower power states
  - Limit/cycle online devices
  - Limit installed/online host add in cards (AICs)
  - Optimize fan speed for power and reliability
  - Optimize thermal management solution
  - Move to rack level cooling solutions which are historically more efficient
  - Overall reduction in density of the solution (fewer devices, AICs, etc.)

Possible Solutions (2)

- Optimize thermal solution
  - Advanced cooling solutions such as cold plates and phase-change heat sinks
  - Liquid cooled heat sinks for CPUs and memory where possible
  - Chassis level liquid cooling for all components
  - Rack level cooling solutions (liquid cooling, large rack-mount fans/blowers, immersion cooling)
  - Lower DC ambient temperature, conflicts with desire for free air data centers

Possible Solutions (3)

- Smaller, parallel systems to reduce the overall load per system
- Lower performance requirements for individual system
- Combine parallel, lower performance systems to achieve overall system level performance in a less dense overall solution
- The solution lies in improvements to the Performance, Power, Packaging and Cooling trade offs of complex systems

Path Forward

- Improvements in cooling solutions must be implemented
  - DC temps will likely only get higher (Free Air DC and Optimized DC TCO)
  - Liquid, immersion and cold plate solutions
  - Cooling paradigm must change, we must reduce the energy spent on cooling
- System performance must be optimized to include power and cooling parameters, not just throughput
  - Optimize for “sweet spot” operation to minimize power and thermal to extend life
- More dis-aggregated and parallel computing

Thank You