How does a Client SSD Controller Fit the Bill in Hyperscale Applications?

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What can happen in 60 seconds?
2013 vs. 2014

- 127,013,889 emails sent
- 4,190,000 Google search queries
- 461,805 Facebook logins
- 103 hours of video contents uploaded
- 66,200 Amazon sales
- 347,000 tweets sent
- 38,000 photos uploaded
- 136,319,444 emails sent
- 600,000
- 306
- 80,000
- 433,000
- 67,000
Data Volume shapes storage industry, creating more expectations for solid **Solid State Disk**.

**Consumer Applications**

- Support high capacity
- Maximize read/write performance
- Minimize power consumption
- Enhance data protection design

**Hyerscale Applications**

- [ ] Support high capacity
- [ ] Maximize read/write performance
- [ ] Minimize power consumption
- [ ] Enhance data protection design
Now, what are hyperscale applications looking for in SSD?
HIGH PERFORMANCE

Multi-core design is essential.

ERROR CORRECTION DESIGN: RAID ECC RECOVERY

Layer and layer of correction schemes to fight against any errors that may have been caused by NAND flash.

END TO END DATA PROTECTION

Data needs to be protected all the way.

BCH vs. LDPC

ECC capability matters.

HIGH CAPACITY

The greater; the better!

pFAIL CIRCUIT

DESIGN BETTER SSD

Flash Memory Summit

PHISON Knows What You Need
Design to Maximize Performance

Multi-core is essential for delivering a sustaining performance.

- Quad- vs. Octa-core controller implementations
- Each CPU is designed to carry out specific tasks.
- Sustaining performance also includes promising QoS.
- Multi-core design increases complexity of firmware architecture.
Design to Fight Against Power Loss

PFail Design: Data is guaranteed **safe** in any power cycle event.

- During power failure, user data in an external memory must be programmed to NAND in a short period of time.
- The design needs to consider all possible corner cases from hardware and firmware perspectives.
- Characterization of on-board power segments.
Data Reliability: E2E Data Protection

Data is always protected during read/write operations.

- Different parities will be tagged to data during its travelling path.
- Data protection with E2E parity
- RAM protection with RAM parity
- Flash protection with ECC parity
**Data Reliability: Flash ECC Schemes**

Which correction scheme suits better for hyperscale applications?

<table>
<thead>
<tr>
<th>Decoding Algorithm</th>
<th>BCH</th>
<th>LDPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correction Strength</td>
<td>Algebraic</td>
<td>Probability</td>
</tr>
<tr>
<td>Non-Soft Bit Decoding</td>
<td>Guaranteed</td>
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<td>Decoding Difficulty</td>
<td>Difficult</td>
<td>Easy</td>
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<td>Decoding Performance</td>
<td>Sustained</td>
<td>Sustained → Drop</td>
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<tr>
<td>Cost (Gate Count)</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
Additional ECC to Recover Erroneous Data

RAID ECC (SmartECC™) for data reconstruction

• When an uncorrectable ECC occurs, RAID ECC will be responsible to recover error bits based on additional parities (“RAID Parity”) stored previously.
• Recovery scale: Block level vs. Die level
• RAID ECC consumes additional drive capacity in order to achieve different levels of data reconstruction.
Triple Layers of Data Protection

Front-end: End to End Data Protection
Prevent any soft errors caused by bit flips along the travelling path of data.

Core: SmartECC™ Engine
If an uncorrectable error is detected, SmartECC™ is capable of reconstructing the damaged data by using RAID parity.

Back-end: Flash ECC Protection
Error-detect-and-correct performed during read operations.
Design to Maximize SSD Capacity

When it comes to capacity, more means better.

- Higher capacity means more memory components required in a compact board design.
- Flash controller still needs to maintain high performance with maximum capacity.
- High capacity also introduces additional complexity to firmware architecture.
Client Controller + Enterprise Features = Hyperscale
It all comes from a client SSD controller.

But what differentiates entry-level from consumer SSD?

- To record any activity during drive lifetime so that when any fault occurs, it can be analyzed.
- Throttling operation to be implemented for reducing power consumption.
- To fight against data retention of flash by refreshing data at real time or idle state.
- AES and TCG is a common requirement for entry-level SSD.
For more information on Phison SSD, please visit us at Booth #712 & #714.
THANK YOU FOR YOUR TIME & ATTENTION!