Merits and Methods of I/O Traced-Based Performance Benchmarking of Client SSDs

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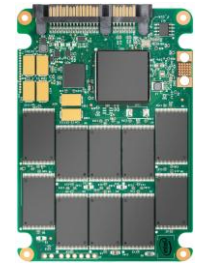
Presentation Outline

- Position Statement

- Performance Measurement Score Card

- Propose Method of I/O Trace-Based Client SSD Testing

- Example Application of I/O Trace-Based Testing

- Summary

Position Statement

- **SSDs Are the Marvel of PC Storage**
  - Ultrabook™, notebook, tablets

- **Hard Disk Drives are NOT the Same as Solid-State Drives**
  - Should NOT be Tested the Same

- **Correctly Test SSDs with I/O Traces and Methodologies**
 - HDD benchmarks do not show SSD Goodness.

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Performance Measurement Score Card

| Measurement Method	Pro's	Con's
Pure Synthetic: Algorithmic I/O Sequence	1. Point or Instance Analysis	1. Artificial; Not real life 2. Does not test the SSD as it is used 3. Overall Results are inconclusive
Application Based: Custom Script Calling of Real Applications to some time attribute	1. Emulation is closer to real usage involving real user applications	1. Script or software coding is needed. 2. Purchase of Applications is Expensive 3. More Non-Storage Performance Variables Introduced Via the Hardware 4. Emulation of Idle times is inaccurate 5. Ambiguous Figure of Merit
I/O Trace: Record User I/O Sequence and then Replay	1. Real Life Workload 2. Tests True SSD Performance 3. Accurate 4. No need to purchase new applications 5. Versatility	1. Limited Tracing Software Offerings 2. Existing Software Offerings Have. Limited Playback Capabilities

I/O Trace-Based SSD Testing is The Way to Go!

Example Application of I/O Trace Based Testing

- **Focused & Reproducible Real Life Workload Methods to Optimize SSDs**
  - Power Profiles

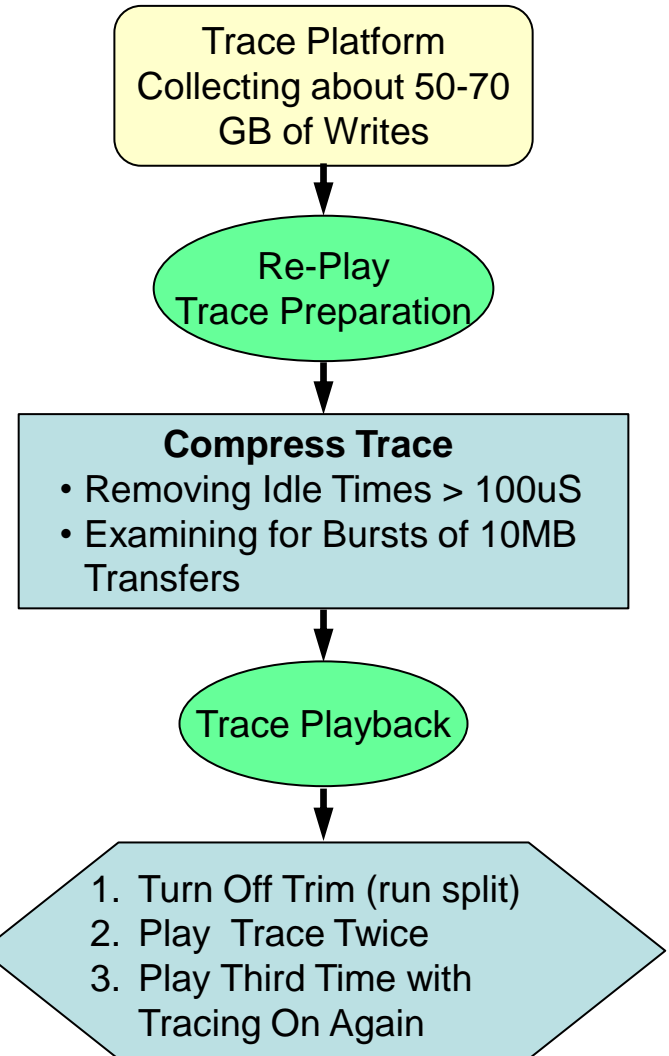SSD Power Profile From I/O Trace Stimulus
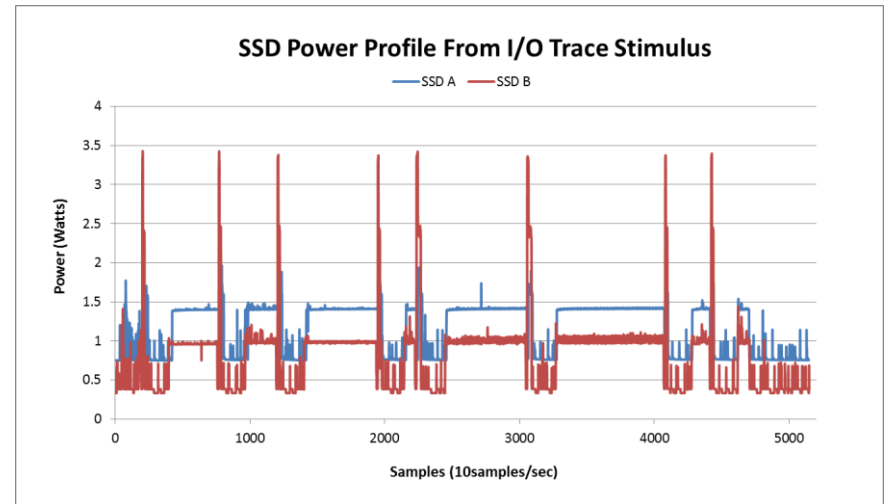
- **Understand True SSD MB/s Performance Over an Elapsed, Busy, and Serviced Time Interval**
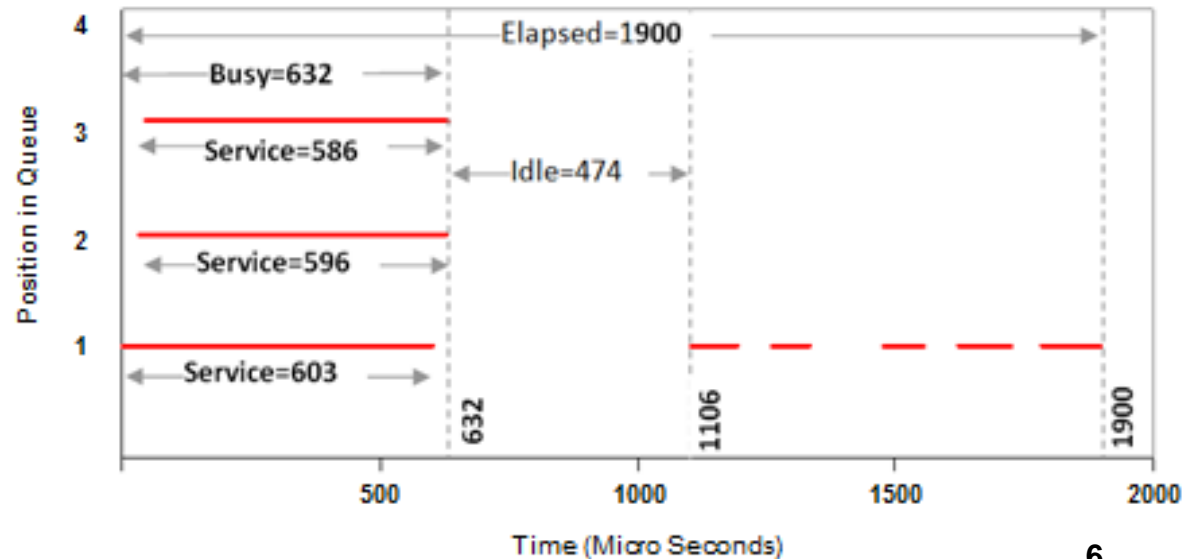
Proposed Method of Trace-Based Testing of SSDs

- **I/O Trace Tests SSD As Designed**
- **Intel is Developing I/O Trace-Based Test Methodology**
  1) Drive Prep
  2) Trace Collection
  3) Trace Playback Preparation
  4) Trace Playback
  5) Analyzing Results
- **Performance Comparison**
  - Equivalent Trace Results in MB/s
  - Develop a New Figure of Merit Metric

I/O Trace-Based Performance Testing Does Justice to SSDs

Trace Platform Collecting about 50-70 GB of Writes

↓

Re-Play Trace Preparation

↓

Compress Trace
- Removing Idle Times > 100uS
- Examining for Bursts of 10MB Transfers

↓

Trace Playback

↓

1. Turn Off Trim (run split)
2. Play Trace Twice
3. Play Third Time with Tracing On Again

← Analyze Results

Summary

- Artificial Synthetic Testing of Client SSDs Provides Inconclusive Benchmark Results

- I/O Trace-Based Testing Does Justice to SSDs
  - Real Life Workload
  - Accurate
  - Easy and Economical
  - Versatile

> **I/O Trace-Based Testing of Client SSDs is The Only Way to Go!**

Back Up

HDD vs. SSD Test Paradigm Shift

Moving Mechanical Parts
Magnetic Storage Medium
- Read Modified Writes

Slow Random/Sequential R/W
Not Rugged
High Power

No Moving Parts
NVM NAND Flash Storage Medium
- Program Pages & Erase Blocks

Fast Random/Sequential R/W
Rugged
Low Power

Why Test them the Same?