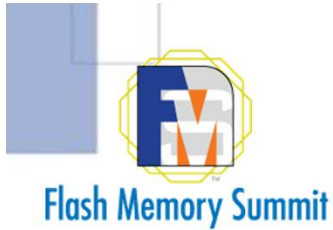


# Unique SSD Configuration to Optimize for a Variety of Embedded Application

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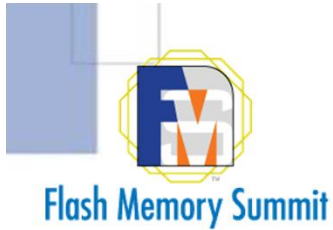
ATP Electronics, Inc.



# Outlines



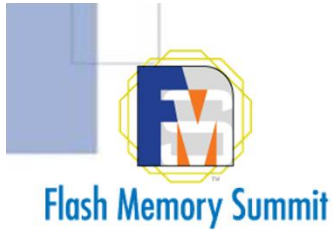
- Overview
- Workload Types
- Applications with Different Workloads
- Random Write/TBW Test Data
- Over-Provisioning Summary
- Flexibility of OP for End-user
- ATP OP Tool Summary



# Overview



- In the embedded application, various workloads can dictate the efficiency of data processing. This affects drive endurance, sustained write performance and performance stability.
- The process of OP is when a certain percentage of an SSD's free space has been reserved to help boost the lifetime, endurance and overall performance of the drive itself.

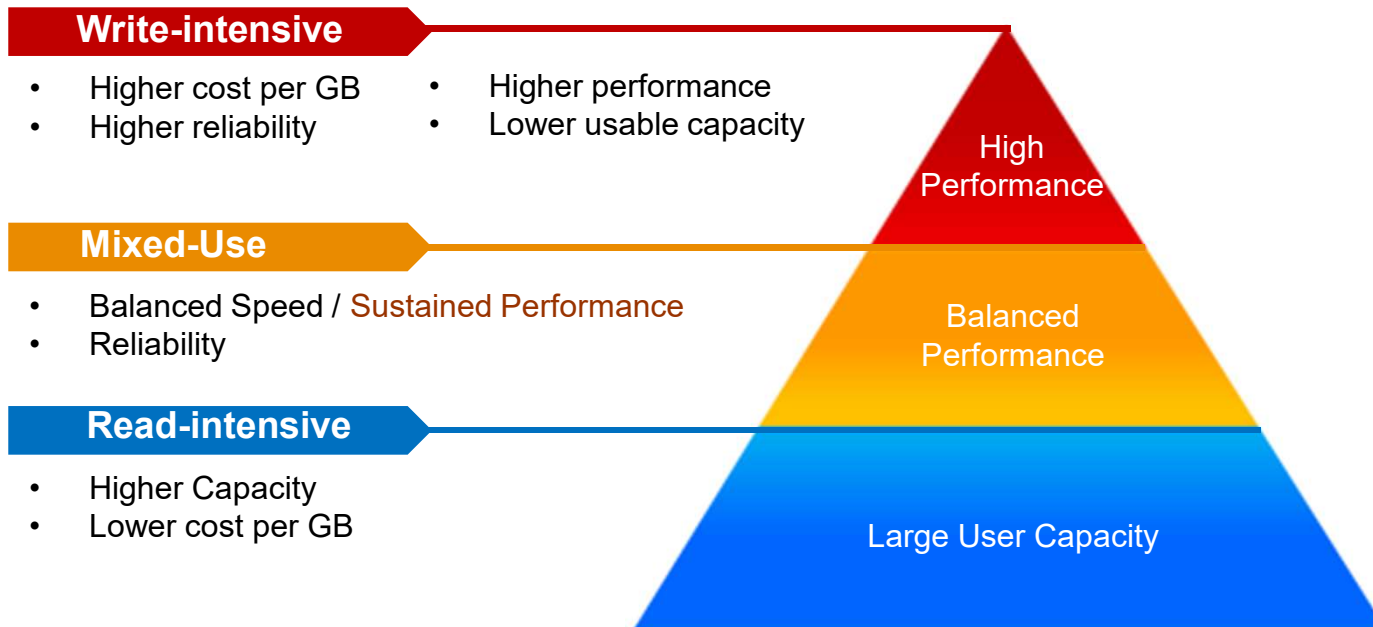


# Overview



- The suitable OP percentage may be truly decided by end users in terms of the balance between cost, performance and endurance.
- With the software tool developed by ATP, the flexibility in OP change enables end users to easily evaluate the proper OP based on various workloads.

# Workload Types



# Application with different workload



- MRT Front-end Automatic Gates
  - Massive small data of information transaction.
  - 100% Write workload, small random pattern
  - Demanding write performance requires higher OP (constant card swipes)
  - High TBW is needed for constant transactions due to large amount of passengers



# Application with different workload



- **MRT Back-end System (Central System)**
  - Receive transaction data for database warehousing.
  - Overall Read/Write mixed workload
  - Receiving the data from front-end requires writing to the central system
  - Data matching of previous transactions requires data reading; passengers accessing to the system via cellphone apps requires data reading
  - Mixed workload requires OP optimization



# Application with different workload



- Avionics Infotainment System
  - Write once, Multiple Read
  - Write, large seq. pattern
  - Data streaming for your entertainment
  - Larger user capacity is better (lower OP)
  - Lower cost per GB
  - Industrial grade with good reliability



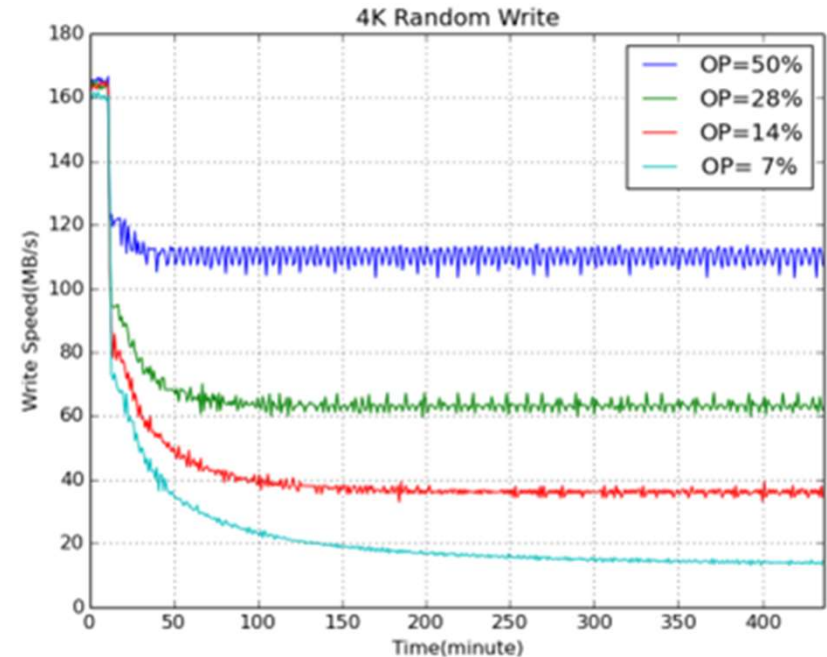


# About Over-Provisioning

- Over-provisioning's (OP) purpose is to reserve additional space of an SSD, which helps manage data traffic and mitigates the write fragmentation, thus leading to enhanced performance and endurance.
- The higher the OP percentage, the lower the WAI; lowering WAI may therefore extend TBW. Higher OP can also improve an SSD's performance.

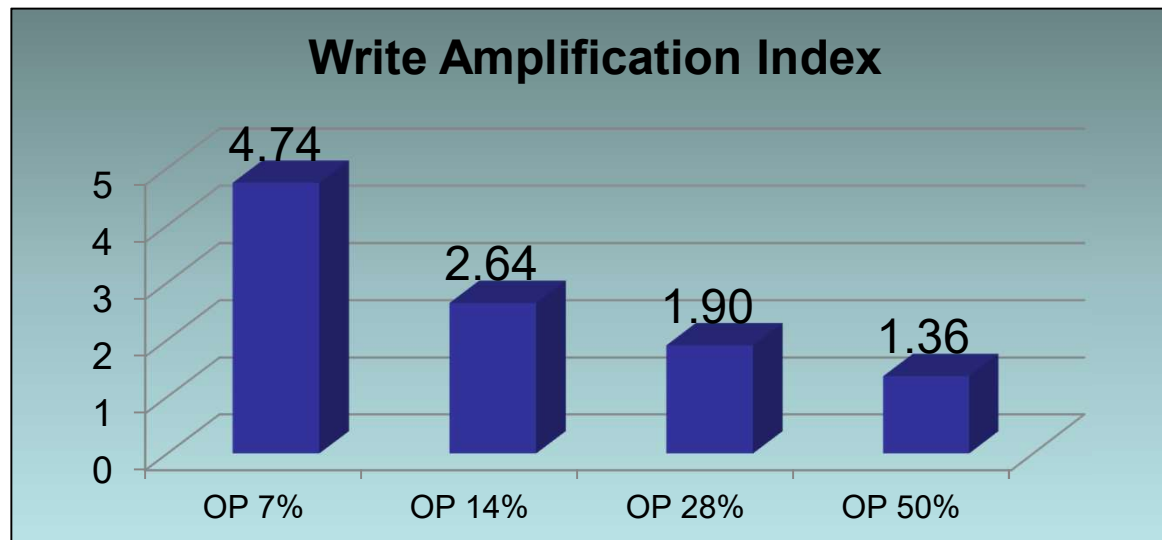
# 4K Random Write Test Data

- For demonstration of random write performance.
  - mSATA 1228GB MLC
  - OP setting: 7% / 14% / 28% / 50%
  - 7% OP shows around 91% drop in write speed after long period testing.
  - 50% OP shows around 33% drop.
  - Higher OP may lead to better and consistent performance, compared to lower OP.



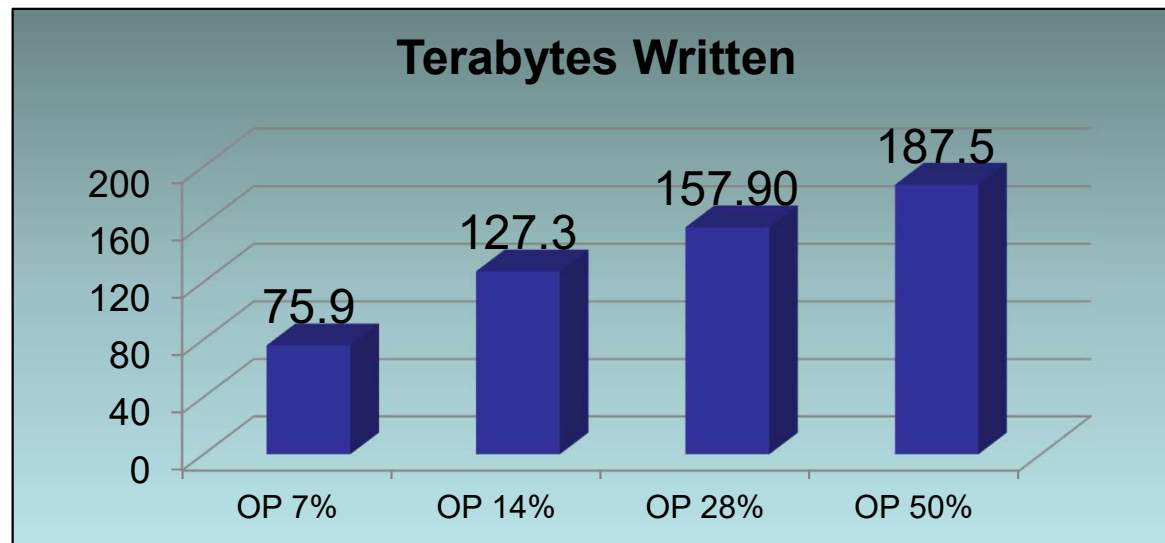
# WAI Test Data

- This performance differences can best reflect on WAI.
  - mSATA 128GB MLC
  - JEDEC219A random workloads
  - Higher OP helps reduce WAI and improves performance.



# TBW Test Data

- The TBW is based on WAI with JEDEC219A workloads
  - Higher TBW means higher endurance and longer product life.



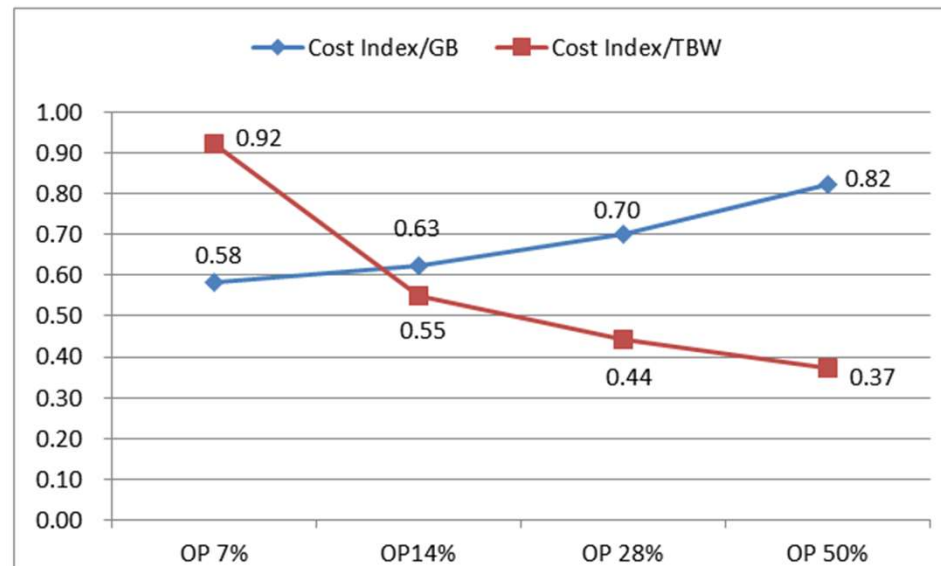
# Over-Provisioning Summary

- The effects of OP configurations on drive performance and endurance is therefore summarized as below.

Comparison Items	Lower OP	Higher OP
Drive Performance	Lower Random Write	Higher Random Write
Sustained performance over time	Worse/Less Steady	Better/Steady
Drive Endurance	Lower	Higher

# Cost Index per GB vs TBW

- Cost optimization through flexible OP adjustment in terms of user capacity and endurance
  - mSATA 128GB MLC
  - For the balance of user capacity and endurance, the OP 14% is an option.






# Flexibility of OP for End User

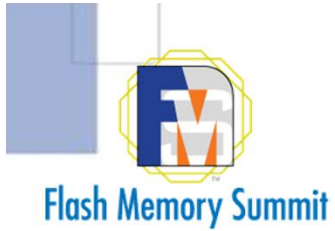


- During qualification phase of a certain drive at end users, the actual usage of workloads may have not been established. Through various testing, one specific OP may turn out to be not suitable for mission critical applications.
- Therefore, end user may request ATP to provide software set with various OP%, such as 14%, 28% and 50%, so that end user can change freely between different set OP percentages.
- Performance, WAI and TBW can be characterized by end users under different workloads to decide which OP can better suit their requirements.
- the optimization process of write amplification index (WAI) and terabytes written (TBW) is made possible efficiently during qualification phase or via in-field performance.

# Flexibility of OP for End User

	MRT Front-end Automatic Gates	OP 50%
	MRT Back-end System (Central System)	OP 14%
	Avionics Infotainment System	OP 7%





# ATP OP Tool Summary



- Environment Requirement
  - Linux platform 32bit (Ubuntu or Fedora)
  - SATA Cable
  - LinuxTool
  - OP Setting Package
  - DUT

# ATP OP Tool Summary



- Operation Steps Summary
  - Enter to Linux System
  - Connect DUT
  - Execute Update.sh to find the DUT

```
atp@atp-UB16042:~/project/update_tool/LinuxTool_general_20170619$ sudo ./update.sh
[sudo] password for atp:

(1) ATP Velocity MV
(2) ATP IG SATA III
(3) Quit

Which one is your TARGET device? █
```

- Select the Target DUI

```
(1) ATP Velocity MV
(2) ATP IG SATA III
(3) Quit

Which one is your TARGET device? 1
Your TARGET device is ATP Velocity MV
```

# ATP OP Tool Summary



- Operation Steps Summary
  - Select Target OP Adjustment Package

```
Which one is your TARGET device? 1
Your TARGET device is ATP Velocity MV

(1) FW_128G_L06B_A1111_OP_28%
(2) FW_128G_L06B_A1111_OP_7%
(3) FW_512G_L95B_B2222_OP_28%
(4) FW_512G_L95B_B2222_OP_7%
(5) FW_512G_L95B_E3333_OP_28%
(6) FW_512G_L95B_E3333_OP_7%
(7) Quit

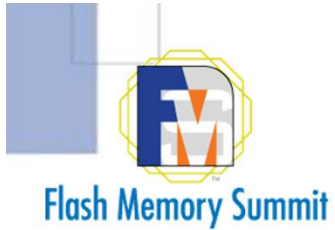
Which one is your TARGET device? 3
```

# ATP OP Tool Summary



- Operation Steps Summary
  - OP Setting then starts. When the process is finished with OP adjustment, it will show "PASS"

```
----- Card Information -----  
Serial Number: 99026170621512000971  
Revision: B2222  
Model Number: ATP Velocity MV 512GB  
-----  
  
Linux Tool Version: Q0627A  
  
*****  
Total Process finished,the result is Pass  
*****
```



# Thank you



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