

# Apacer

## *Advanced Wear Leveling*

*HW Development Dept.  
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# Advanced wear leveling

- A technique applied to extend the service life of SSD. The program/erase cycle of each block in the wear leveling group will be evenly distributed.
- Dynamic data and Static data are both used in the wear leveling process

# Flash block management

- User block 、 System block 、 Spare block

Ex.

Flash total blocks (per chip or group) = 1024 Blocks



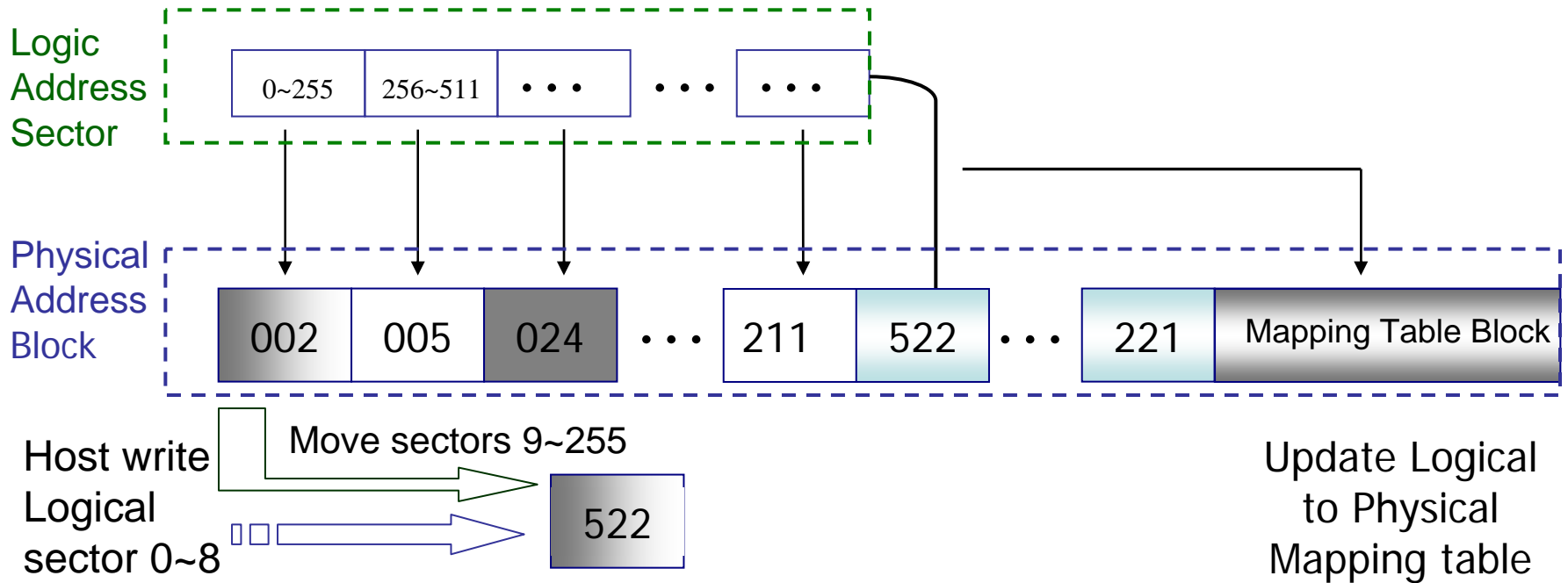
Device capacity =  $977 \times 128 \times 1024 = 128,057,344$  Bytes

User block = Logical capacity

Spare block = Free block and bad block pool for wear leveling

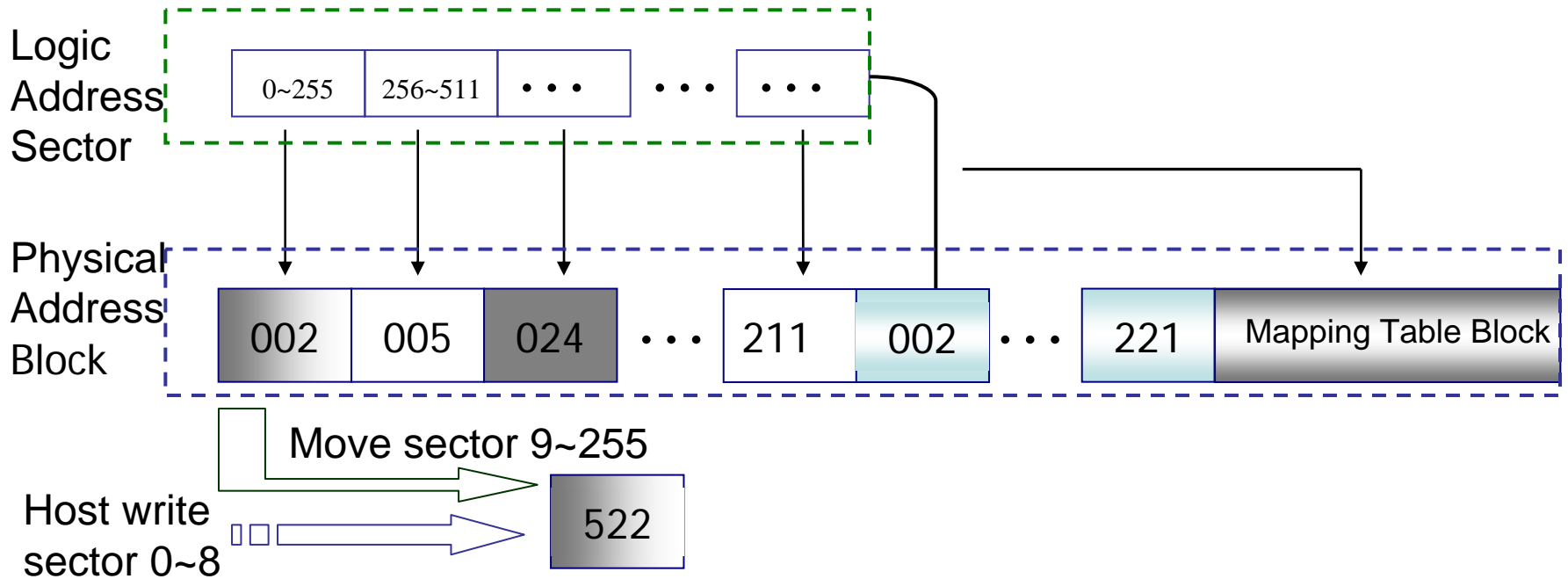
System block = mapping table, record block ..etc

# Wear-leveling simple algorithm



Partial data
  empty data
  full data
  Spare block

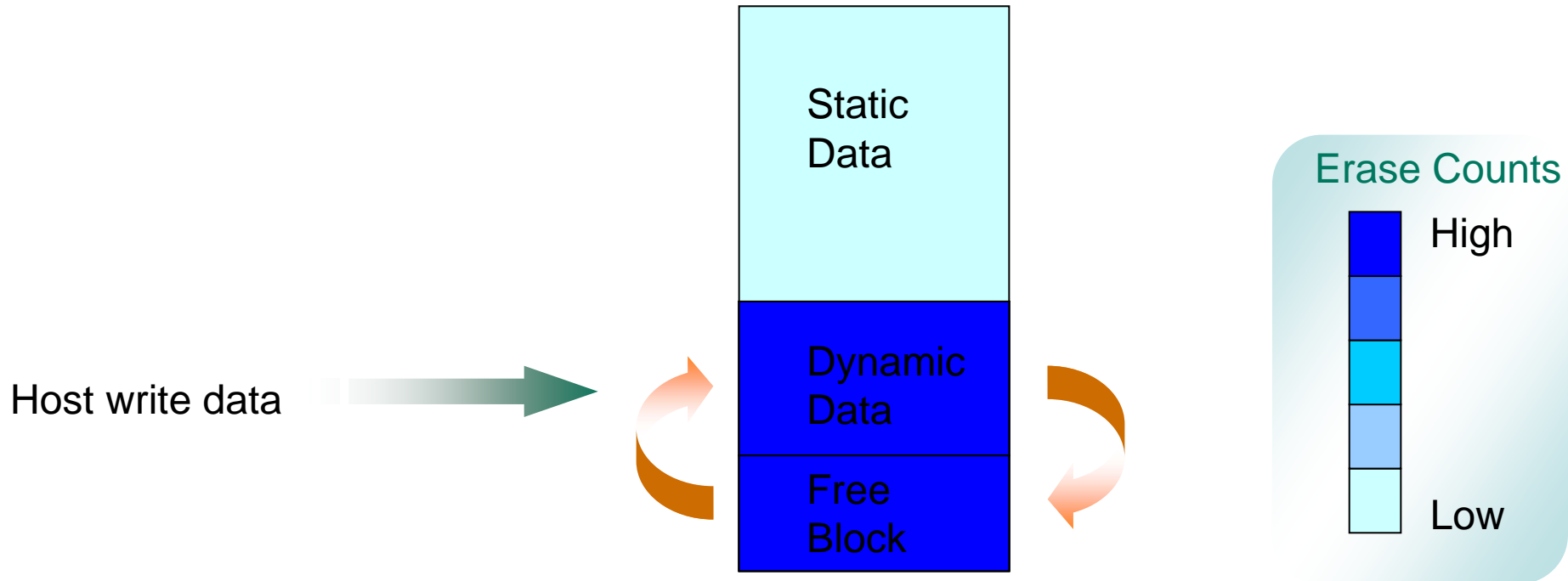
# Wear-leveling simple algorithm



Partial data
  empty data
  full data
  Spare block

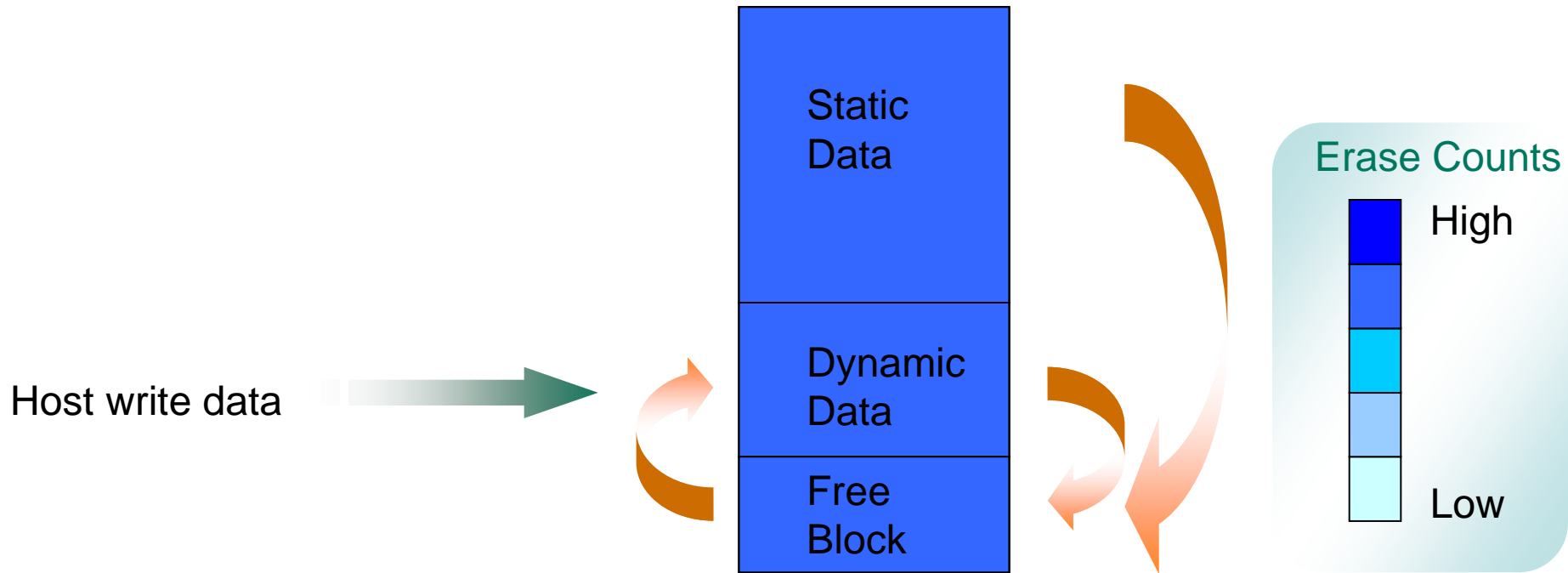
# Wear leveling

## Dynamic wear leveling



# Advanced wear leveling

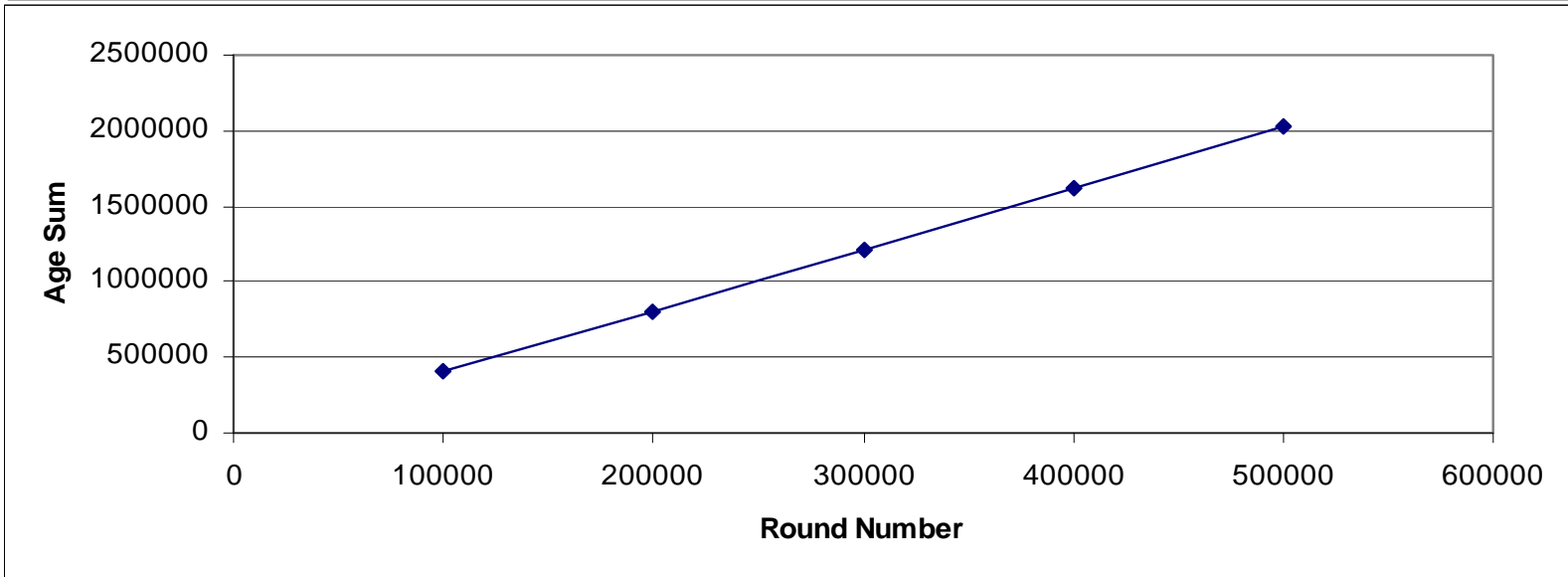
Advanced wear leveling (Dynamic + Static)



# Advanced wear leveling

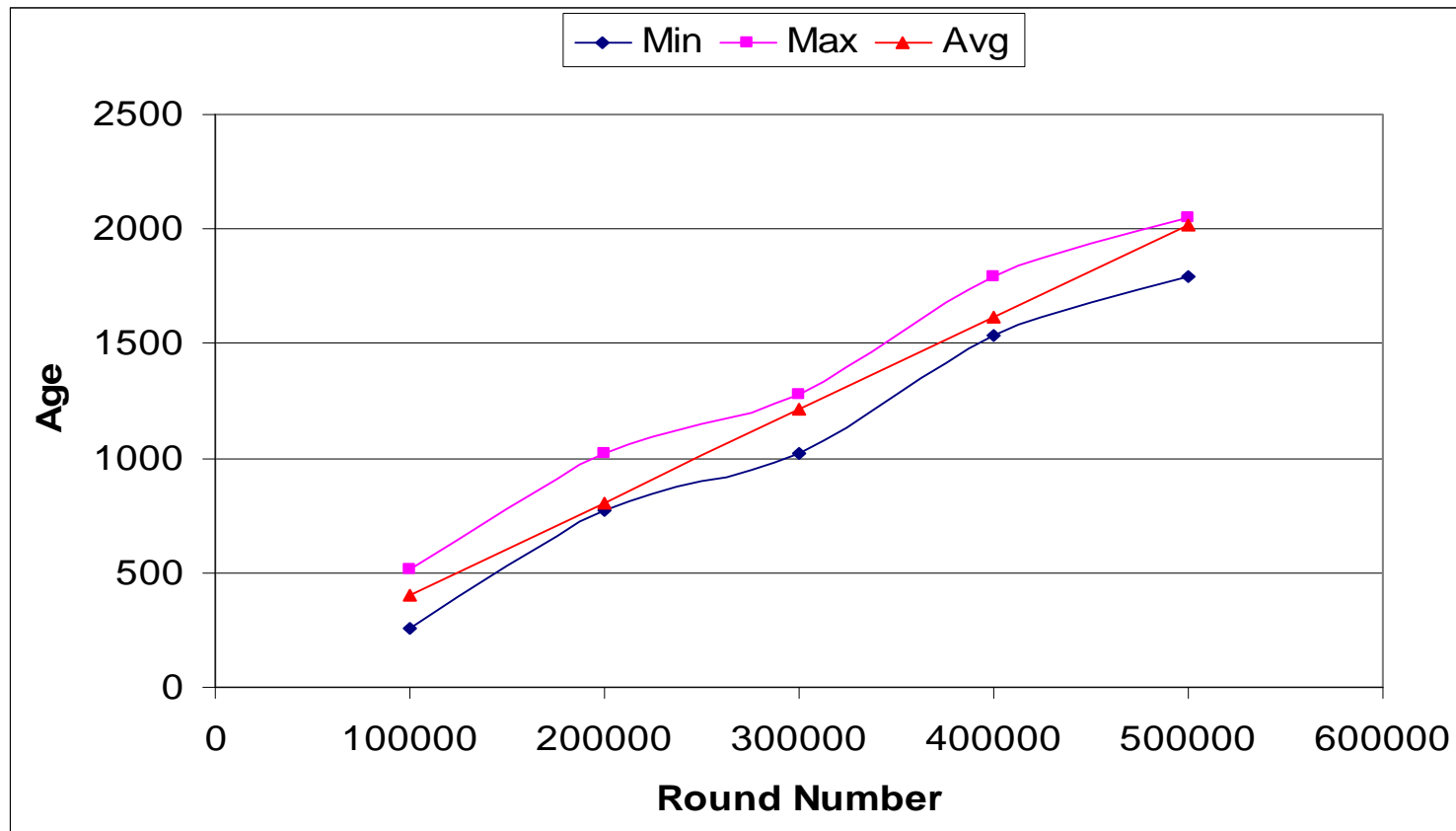
- Test 1GB; After 500K cycle on the first 1MB

Round (Cycle)	Min. Block P/E	Max. Block P/E	Avg. Block P/E	Total P/E (Sum.)
100K	256	512	403	404,682
200K	768	1024	806	809,343
300K	1024	1280	1210	1,214,033
400K	1536	1792	1613	1,618,690
500K	1792	2948	2017	2,023,378



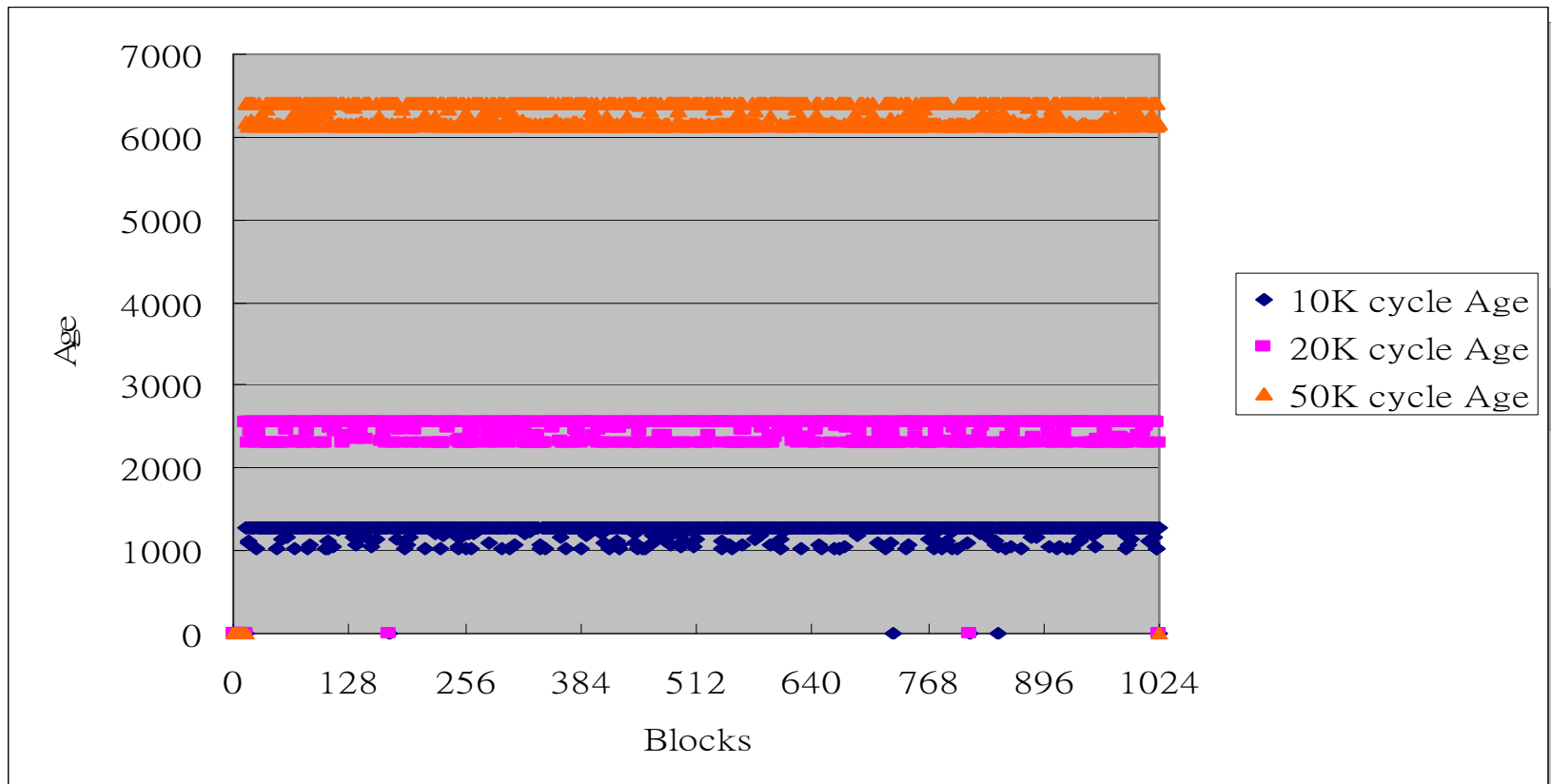
# Advanced wear leveling

- Test 1GB; After 500K cycle on the first 1MB



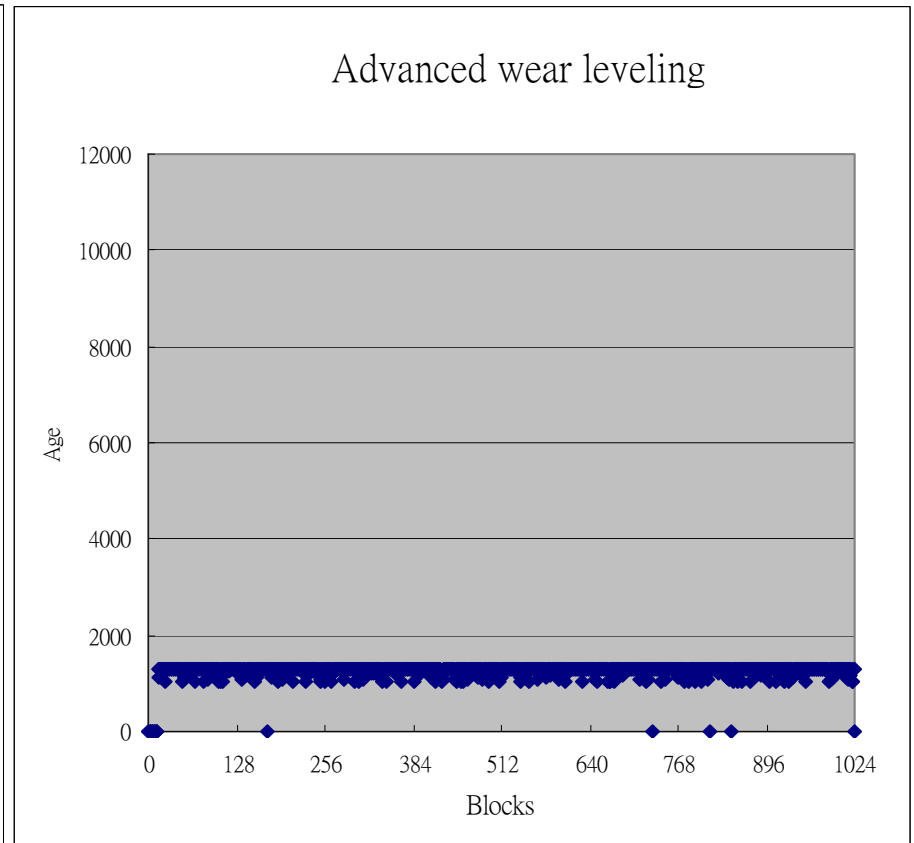
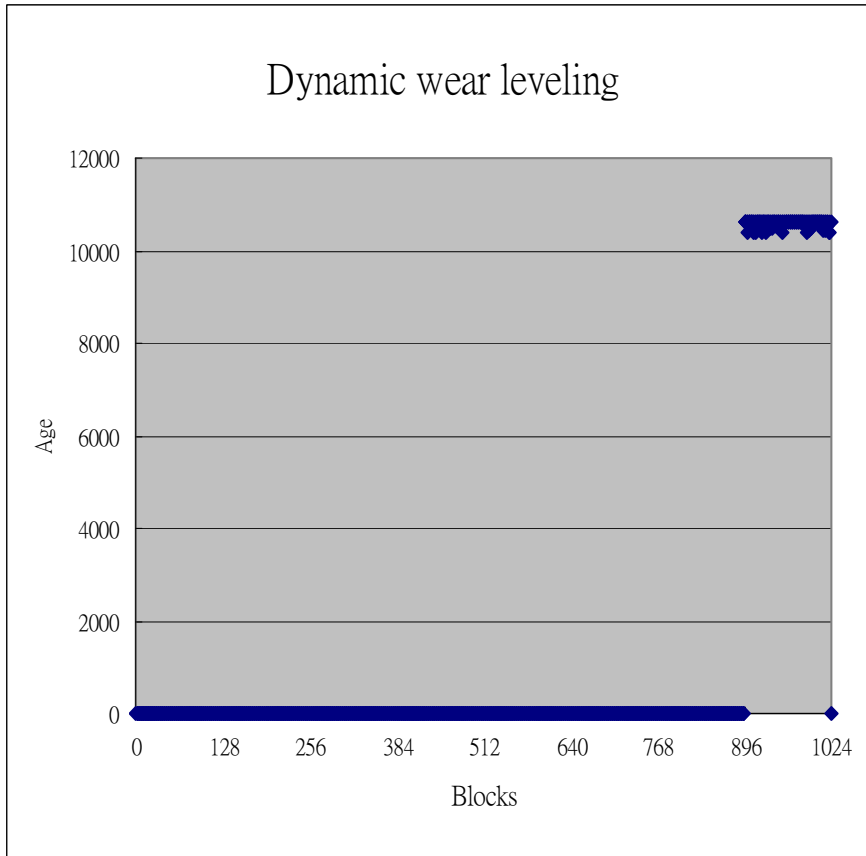
# Advanced wear leveling test

Round (Cycle)	Min. Block P/E	Max. Block P/E	Avg. Block P/E	Max. Diff. Range	Total P/E (Sum.)
10K	1027	1283	1250	256	1,262,600
20K	2306	2562	2503	256	2,528,964
50K	6144	6400	6254	256	6,316,793



# Advanced vs. Dynamic wear leveling

Burn-in 10K cycle – 10% dynamic data , 90% static data





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