



# Memory Size for Map 에 따른 R.R Performance효과

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1. Analysis Object

2. Test환경

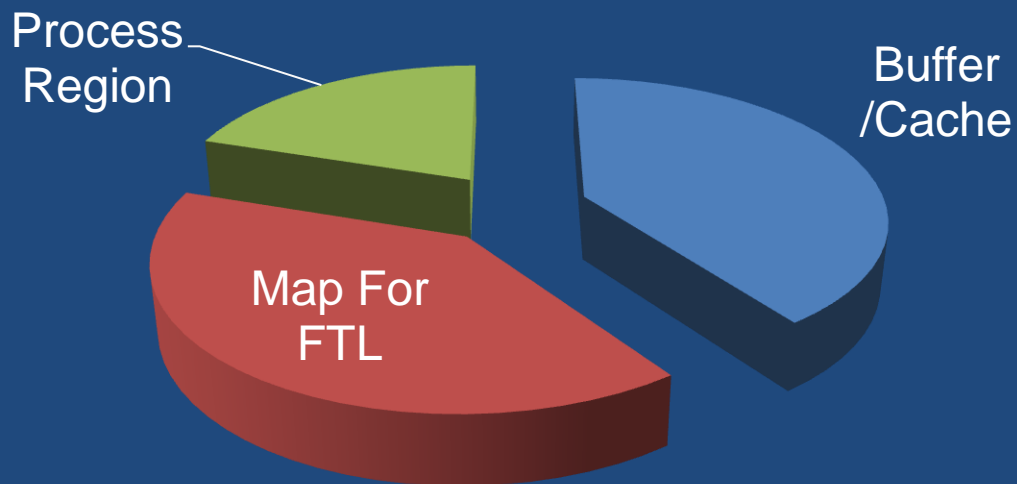
3. Izone-Like에서의 Map Cache/Segment효과

4. Real Workload에서의 Map Cache/Segment효과

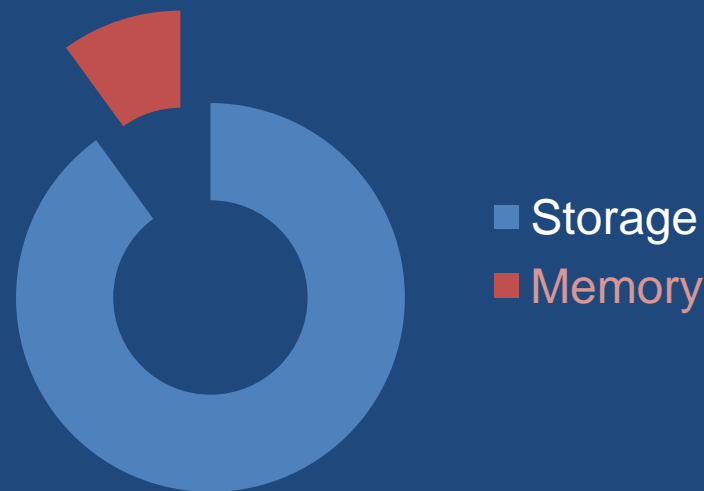
5. Izone-Like과 Real Workload의 특성분석

6. 결과

## Memory(SRAM or DRAM)



## Map Rate



Page Size( Map UNIT ) : 8K

Storage Size	Map Size	Memory Needs?
4G	2M	??
8G	4M	??
16G	8M	??
32G	16M	??

### Environment

- NAND Simulator / NFC Simulator / Research FTL / Except Interface Overhead

### Test Case

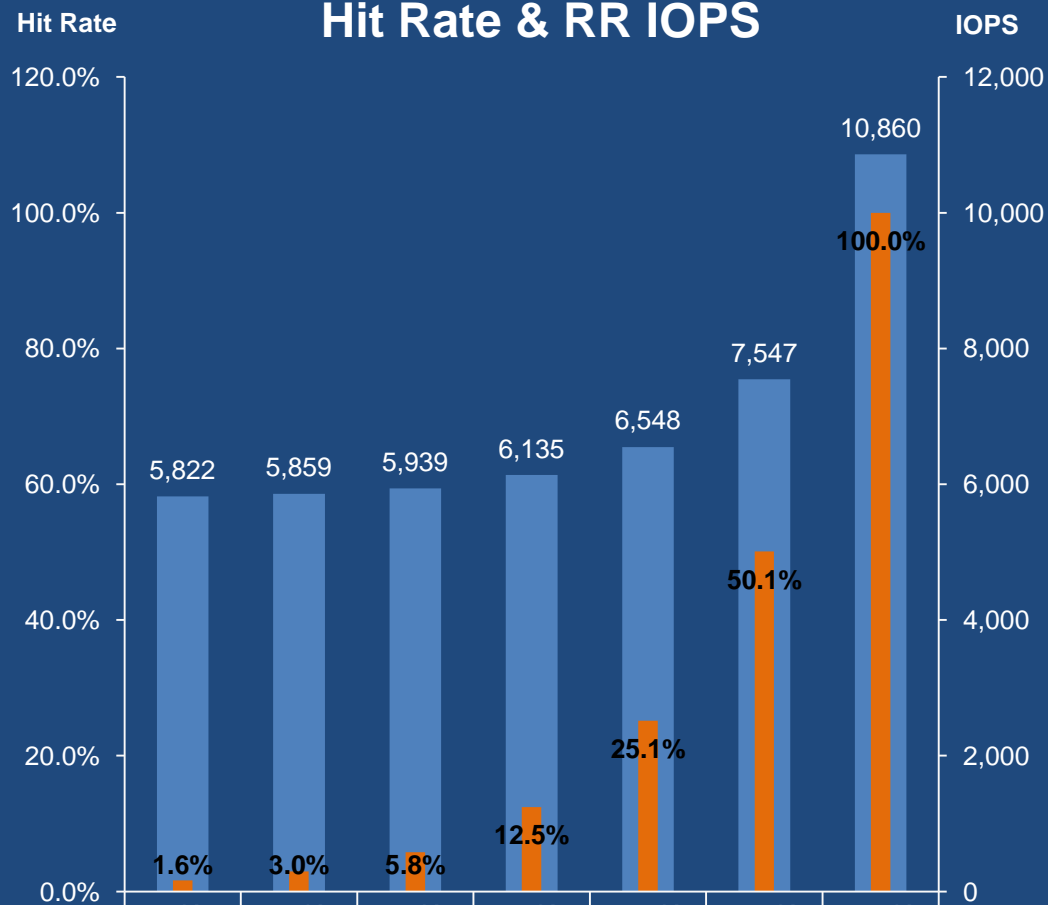
- Iozone과 비슷한 Pattern Workload를 Generation하여 사용.  
[ Random Read 1G영역의 Workload 20000 개 ]
- Real Workload test를 위하여 Android Emulator를 사용.  
[ First Booting Data]
- Aligned Workload와 Misaligned Workload를 사용

# Performance According to Map Cache Size in Iozone-Like

Test Condition : 32GB / address range 1GB / 4K Aligned random read workload 20000 count

Iozone-Like : Iozone의 Random Workload와 비슷한 Pattern의 Workload

## Hit Rate & RR IOPS



### FTL Information :

Map Cache 8KB ~ 512KB

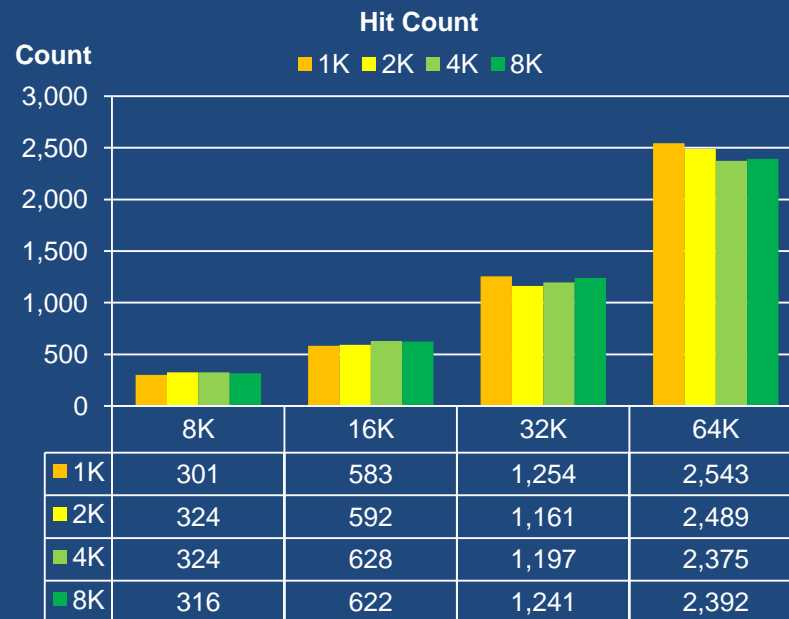
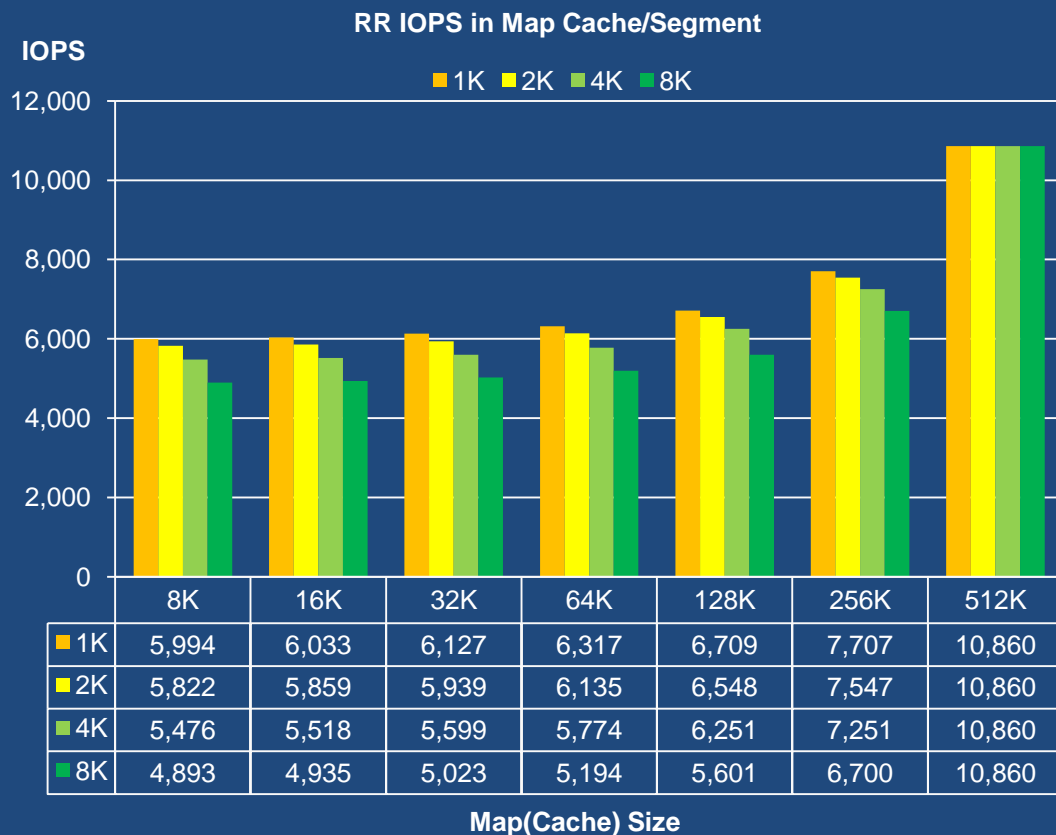
Map Segment Size 2KB

■ READ(IOPS)	5,822	5,859	5,939	6,135	6,548	7,547	10,860
■ hit rate	1.6%	3.0%	5.8%	12.5%	25.1%	50.1%	100.0%

Map Cache Size : Memory Size for Map

# Performance According to Map Segment Size in Izone-Like

Test Condition : 32GB / address range 1GB / 4K Aligned random read workload 20000 count



## Remarks

### Memory for Map of Map

Map Segment	1K	2K	4K	8K
Map of Map Size	60960Byte	30480Byte	15240Byte	7620Byte

## FTL Information :

Map Cache 8KB ~ 512KB

Map Segment Size 1KB ~ 8K

## Test Result :

Map Cache : Hit rate의 증가에도 Performance의 향상은 미미

Segment Size : Performance의 차이는 의미있음.

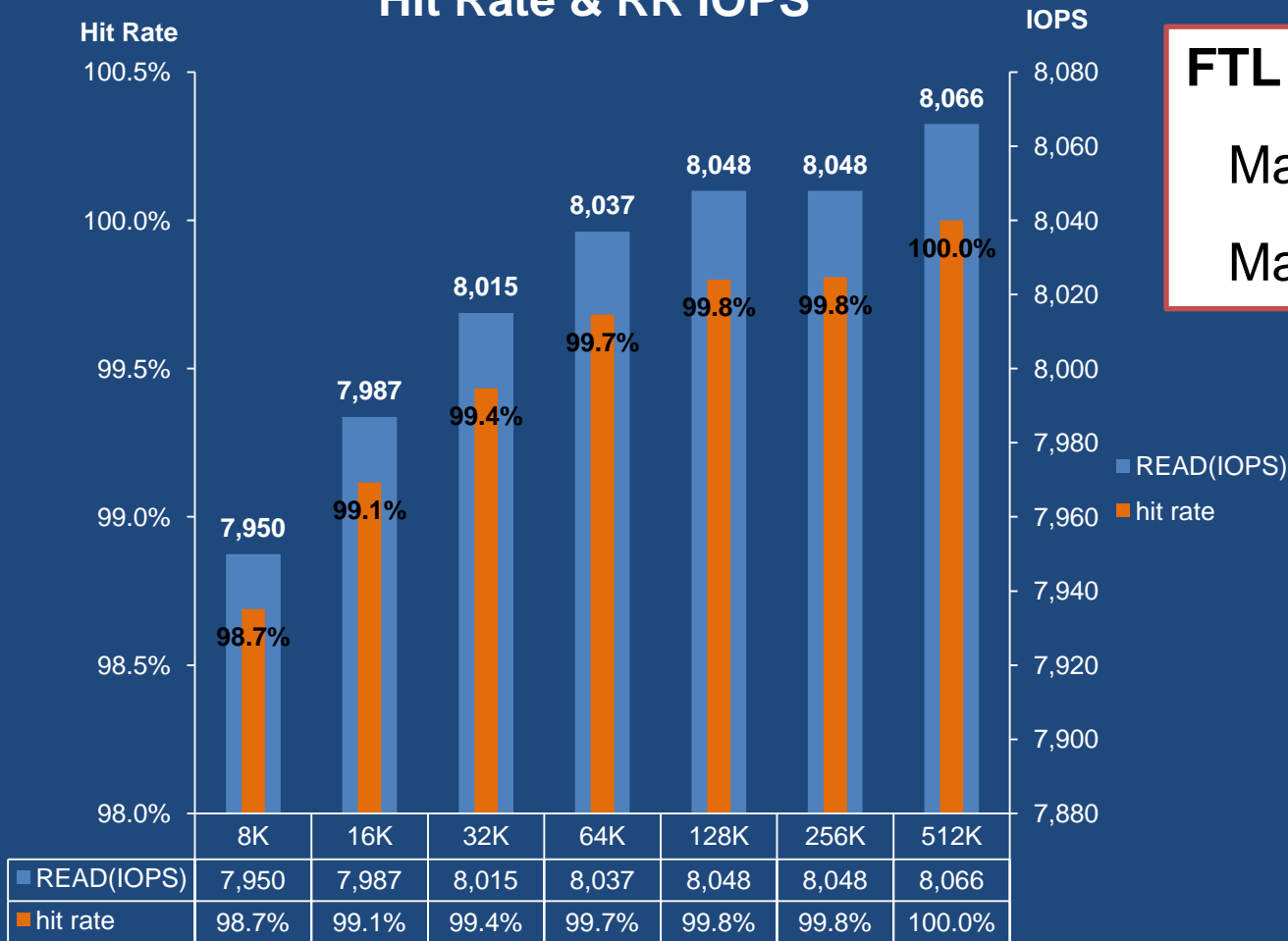
**Reason :** Hit Rate가 아니라 전송Data의 Size가 Performance에 차이를 유발

# Performance According to Map Cache Size in Real Workload ( Android Workload )

Test Condition : 32GB / address range 1GB( Image Size ) / Android First Boot Workload( Read : 14481 Write : 5199 )

Android Workload : Linux Workload in Android Emulator

## Hit Rate & RR IOPS



### FTL Information :

Map Cache 8KB ~ 512KB

Map Segment Size 2KB

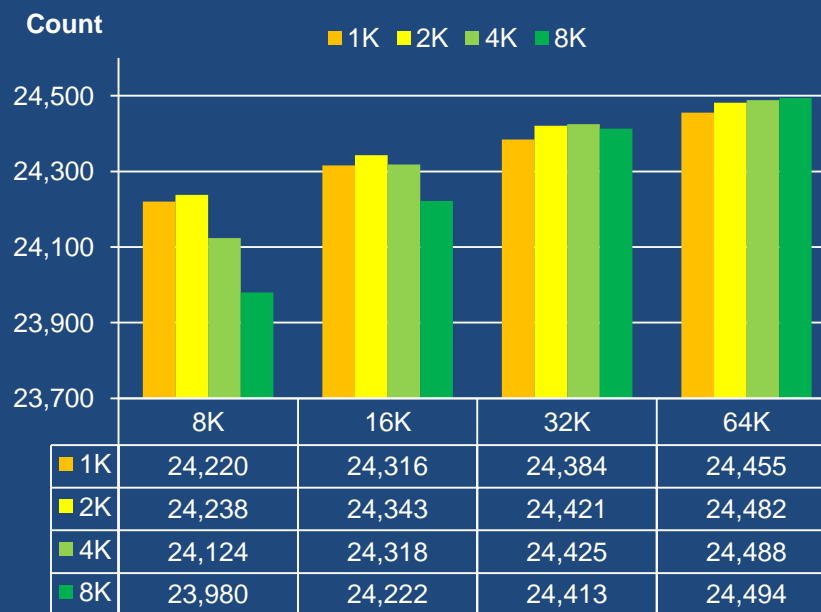
Map Cache Size : Memory Size for Map

# Performance According to Map Segment Size in Real Workload ( Android Workload )

RR IOPS in Map Cache/Segment



Hit Count



**FTL Information :**

Map Cache 8KB ~ 512KB

Map Segment Size 1KB ~ 8K

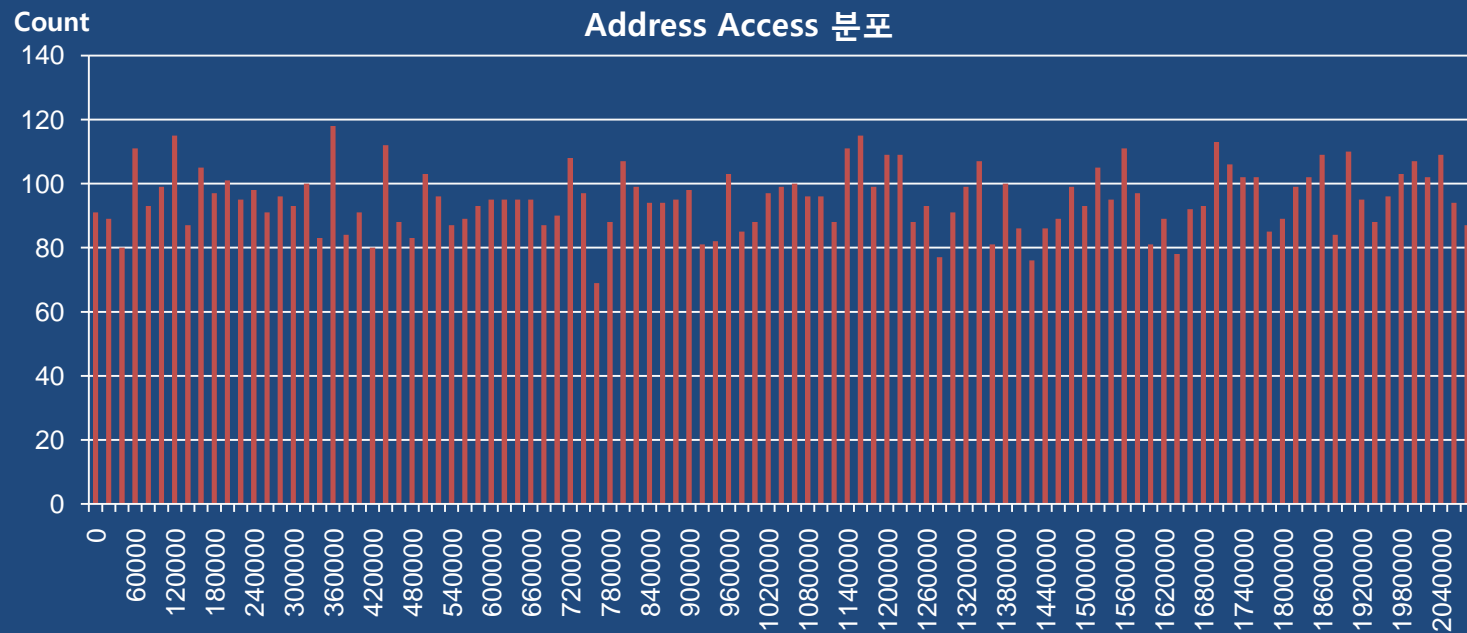
**Test Result :**

Effect of Segment Size & Map Cache Size is small

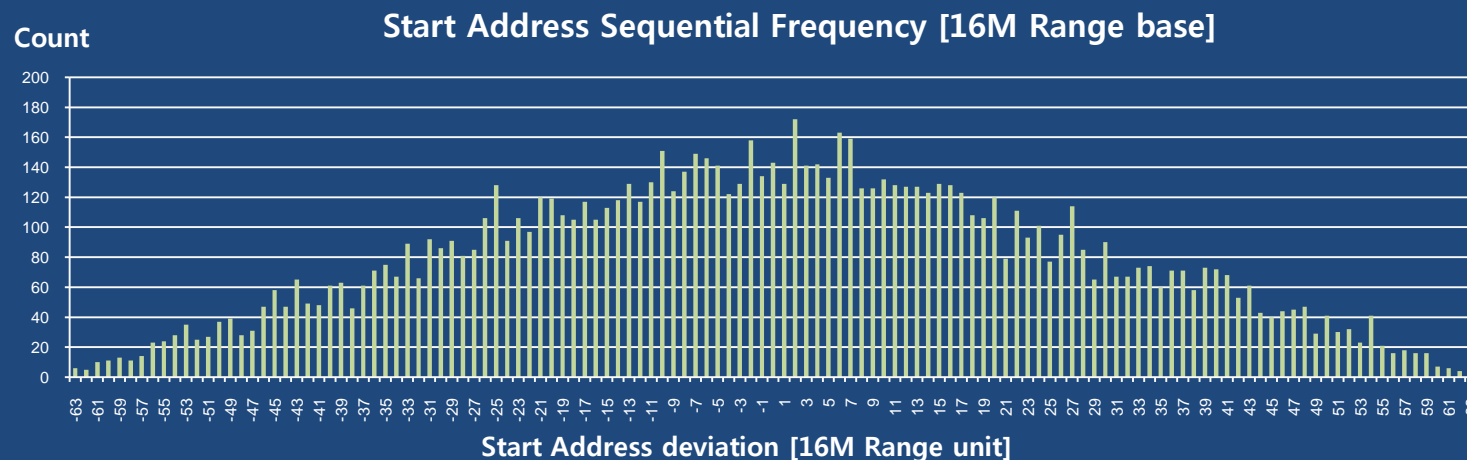
**Reason :** Workload Locality is too high.



# Analysis Workload ( I ozone-Like )

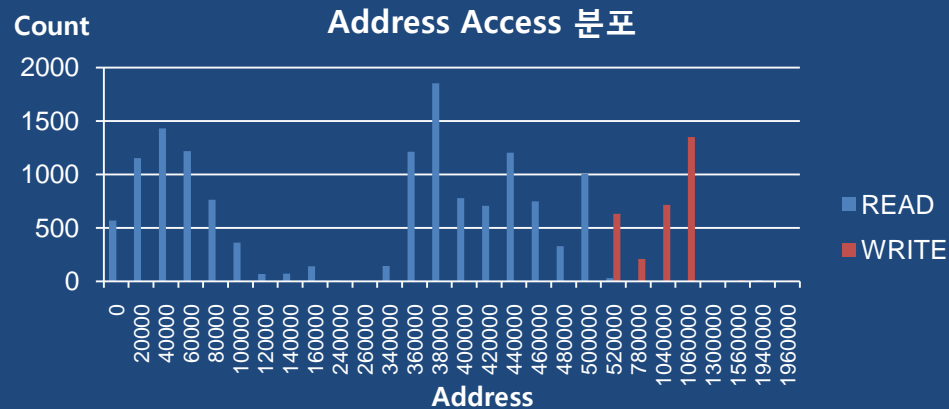


- 4K Random Workload ( Static Size )
- Address Range별로 80 ~ 120 개의 균일한 Workload Count

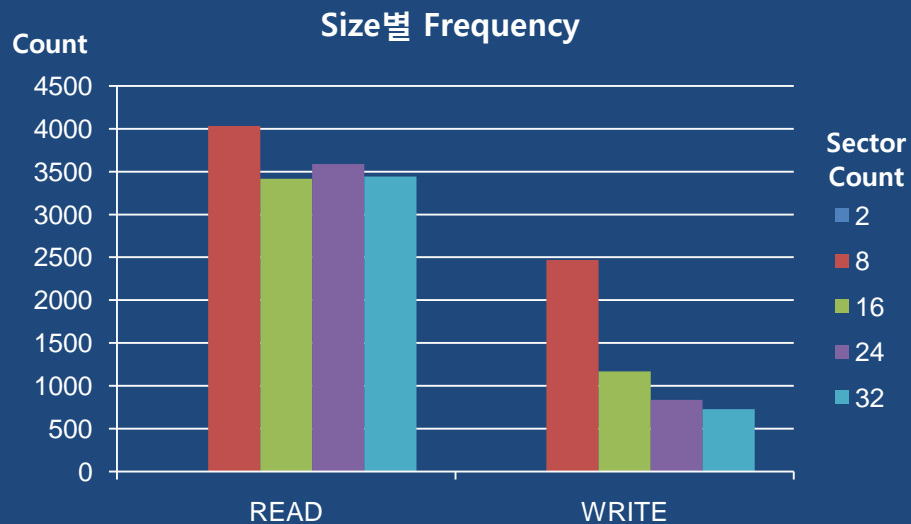


- Workload의 Start Address의 deviation이 큼

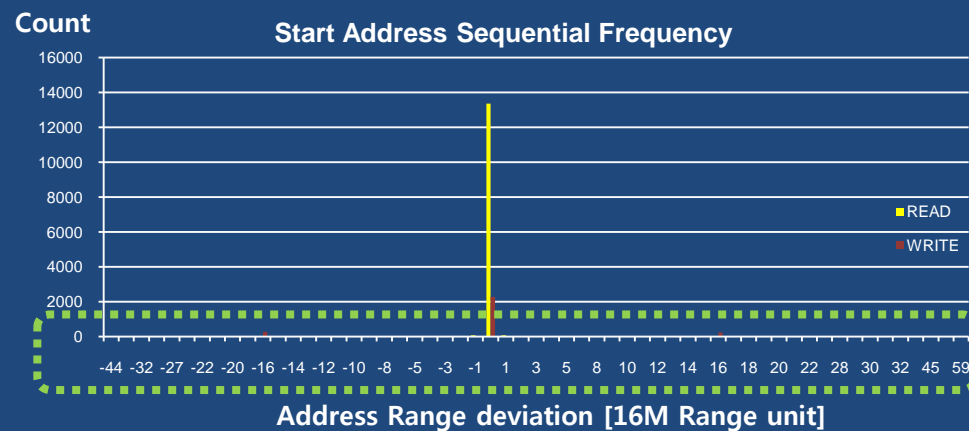
# Analysis Workload ( Android First Boot )



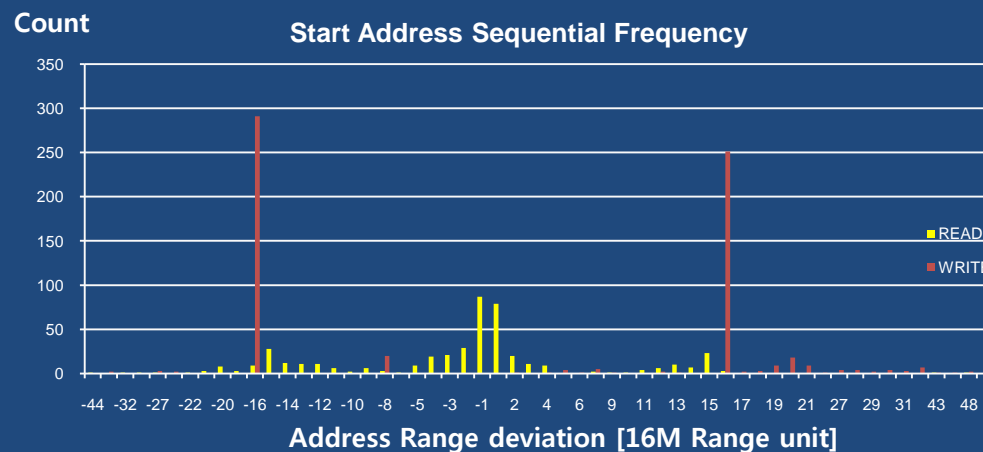
Read/Write  
Locality is very high



Various Workload Size



Zoom In



Start Address sequence is very high

# 결론 : Map Cache/Segment Size변화에 따른 R.R Performance변화

## Iozone-Like

Test Condition : 32GB / address range 1GB / 4K Aligned random read workload 20000 count

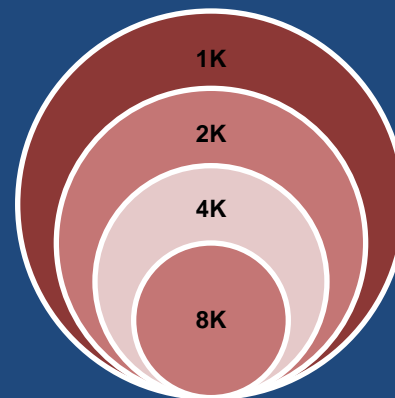
### 8K map Segment

Cache Size	8K	16K	32K	64K	128K	256K	512K
READ(IOPS)	4,893	4,935	5,023	5,194	5,601	6,700	10,860
hit rate	1.6%	3.1%	6.2%	12.0%	24.2%	49.9%	100.0%
8K대비 성능	100.0%	100.9%	102.7%	106.2%	114.5%	136.9%	221.9%
메모리 비율	1.6%	3.1%	6.3%	12.5%	25.0%	50.0%	100.0%

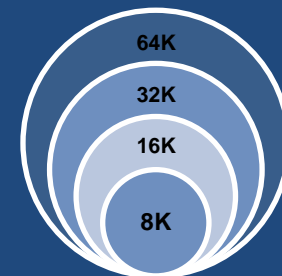
### 8K map Size

Segment Size	1K	2K	4K	8K
READ(IOPS)	5,994	5,822	5,476	4,893
hit count	301	324	324	316
8K대비 성능	122.5%	119.0%	111.9%	100.0%

Map Segment Size 효과



Map Cache Size 효과



## Real Workload( Android Workload )

Test Condition : 32GB / Android 4.0.3 booting workload(android emulator)

Partition(system : 256MB, data : 704MB, cache : 64MB) Total : 1GB

### 8K map Segment

Cache Size	8K	16K	32K	64K	128K	256K	512K
READ(IOPS)	7,778	7,895	7,991	8,032	8,055	8,057	8,066
hit rate	97.6%	98.6%	99.4%	99.7%	99.9%	99.9%	100.0%
8K대비 성능	100.0%	101.5%	102.7%	103.3%	103.6%	103.6%	103.7%
메모리 비율	1.6%	3.1%	6.3%	12.5%	25.0%	50.0%	100.0%

### 8K map Size

Seg Size	1K	2K	4K	8K
READ(IOPS)	7,951	7,950	7,889	7,778
hit count	24,220	24,238	24,124	23,980
8K대비 성능	102.2%	102.2%	101.4%	100.0%

- 높은 Locality 및 Address 연속성으로 인한 Map Cache / Map Segment 효과가 없음.

## RESULT

- Android Workload will move to Iozone-Like. But don't become Like Iozone-Like.
- Use small map segment size for more efficiency in several environment