

# MP2 Report - Fall 2014

## **Submitted by:-**

Name:- Kavita Maral Mehta

UnityId:- kmmehta

StudentId:- 200062954

Section:- 001

The readings which I have received after running different configurations on different protocols i.e MSI, MESI, Dragon has been included in the zip folder with names "output\_canneal.04t.debug" and "output\_canneal.04t.longTrace".

And here in this Report I would be describing what I have observed from the results which I have received.

For the whole process I have kept Number of Processors = 4 and this remains fixed for the whole process.

(1.) Now for the first set of Calculations ,

Fixed Parameters:- (i) associativity = 8

(ii) Block Size = 64B

Variable Parameter:- (i) Cach Size = 256Kb, 512Kb, 1Mb, 2Mb.

We will look at the Total Cache rate of each cache for different Protocols.

Cache Size	MSI		MESI		Dragon	
256Kb	Cache0	7.70%	Cache0	7.70%	Cache0	7.70%
	Cache1	8.25	Cache1	8.25%	Cache1	8.24%
	Cache2	7.8%	Cache2	7.8%	Cache2	7.81%
	Cache3	9.94%	Cache3	9.94%	Cache3	9.94%
512Kb	Cache0	7.70%	Cache0	7.70%	Cache0	7.70%
	Cache1	8.25%	Cache1	8.25%	Cache1	8.25%
	Cache2	7.8%	Cache2	7.8%	Cache2	7.8%
	Cache3	9.94%	Cache3	9.94%	Cache3	9.94%
1Mb	Cache0	7.70%	Cache0	7.70%	Cache0	7.70%
	Cache1	8.25%	Cache1	8.25%	Cache1	8.25%
	Cache2	7.8%	Cache2	7.8%	Cache2	7.8%
	Cache3	9.94%	Cache3	9.94%	Cache3	9.94%
2Mb	Cache0	7.70%	Cache0	7.70%	Cache0	7.70%
	Cache1	8.25%	Cache1	8.25%	Cache1	8.25%
	Cache2	7.8%	Cache2	7.8%	Cache2	7.8%
	Cache3	9.94%	Cache3	9.94%	Cache3	9.94%

From the above observation we can clearly see that increasing the cache size and even changing the protocol does not provide us with any change in the total

miss rate. This is happening because basically it matters the most at which block address the processor wants to either read or write. If a same block address is being written or read many times no matter what is the size of the cache it will generate a lot of misses.

(2.) For my second set of calculations:-

Fixed Parameters:- (i) Cache Size = 1Mb

(ii) Block Size = 64B

Variable Parameter:- (i) Associativity = 4-way, 8-way, 16-way

Here also we will look for Total Cache rate for each cache while running different protocols.

Associativity	MSI		MESI		Dragon	
4-way	Cache0	7.70%	Cache0	7.70%	Cache0	7.70%
	Cache1	8.25%	Cache1	8.25%	Cache1	8.25%
	Cache2	7.8%	Cache2	7.8%	Cache2	7.8%
	Cache3	9.94%	Cache3	9.94%	Cache3	9.94%
8-way	Cache0	7.70%	Cache0	7.70%	Cache0	7.70%
	Cache1	8.25%	Cache1	8.25%	Cache1	8.25%
	Cache2	7.8%	Cache2	7.8%	Cache2	7.8%
	Cache3	9.94%	Cache3	9.94%	Cache3	9.94%
16-way	Cache0	7.70%	Cache0	7.70%	Cache0	7.70%
	Cache1	8.25%	Cache1	8.25%	Cache1	8.25%
	Cache2	7.8%	Cache2	7.8%	Cache2	7.8%
	Cache3	9.94%	Cache3	9.94%	Cache3	9.94%

Here we see that even changing the associativity of the cache does not reflect any change in Total miss rate. The reason is similar to the reason giving in the previous observation.

### (3.) Third set of calculations:-

Fixed Parameters:- (i) Cache Size = 1Mb

(ii) Associativity = 8

Variable Parameter:- (i) Block Size = 64B, 128B, 256B

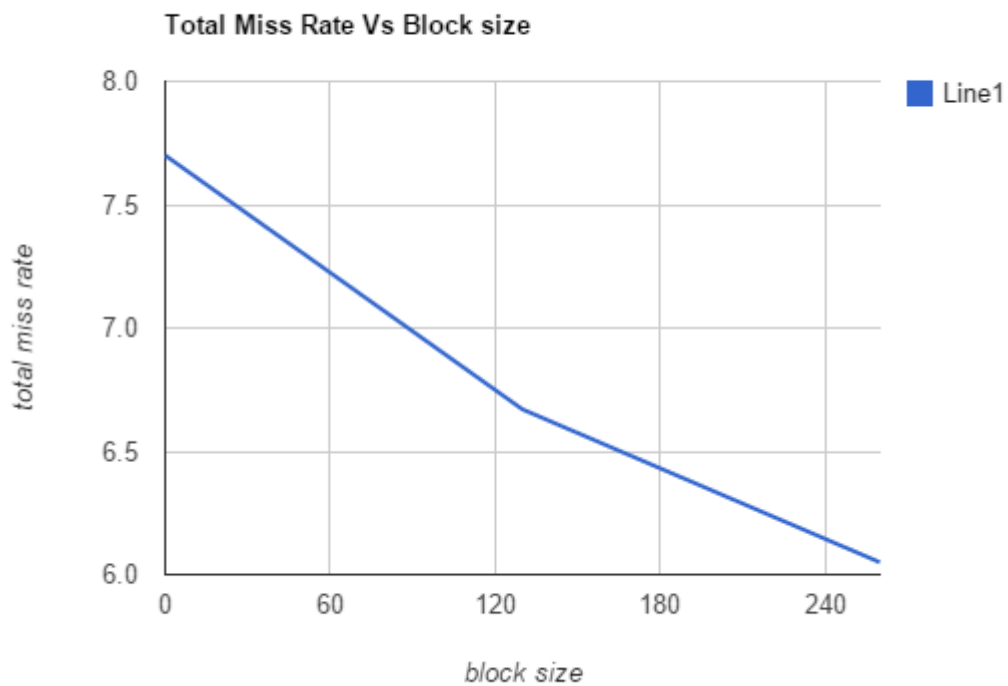
Here also we will look for Total Cache rate for each cache while running different protocols.

Block Size	MSI		MESI		Dragon	
64B	Cache0	7.70%	Cache0	7.70%	Cache0	7.70%
	Cache1	8.25%	Cache1	8.25%	Cache1	8.25%
	Cache2	7.8%	Cache2	7.8%	Cache2	7.8%
	Cache3	9.94%	Cache3	9.94%	Cache3	9.94%
128B	Cache0	6.67%	Cache0	6.67%	Cache0	6.51%
	Cache1	7.19%	Cache1	7.19%	Cache1	7.08%
	Cache2	6.9%	Cache2	6.9%	Cache2	6.75%
	Cache3	8.8%	Cache3	8.8%	Cache3	8.60%
256B	Cache0	6.05%	Cache0	6.05%	Cache0	5.90%
	Cache1	6.65%	Cache1	6.65%	Cache1	6.5%
	Cache2	6.37%	Cache2	6.37%	Cache2	6.23%
	Cache3	8.05%	Cache3	8.05%	Cache3	7.86%

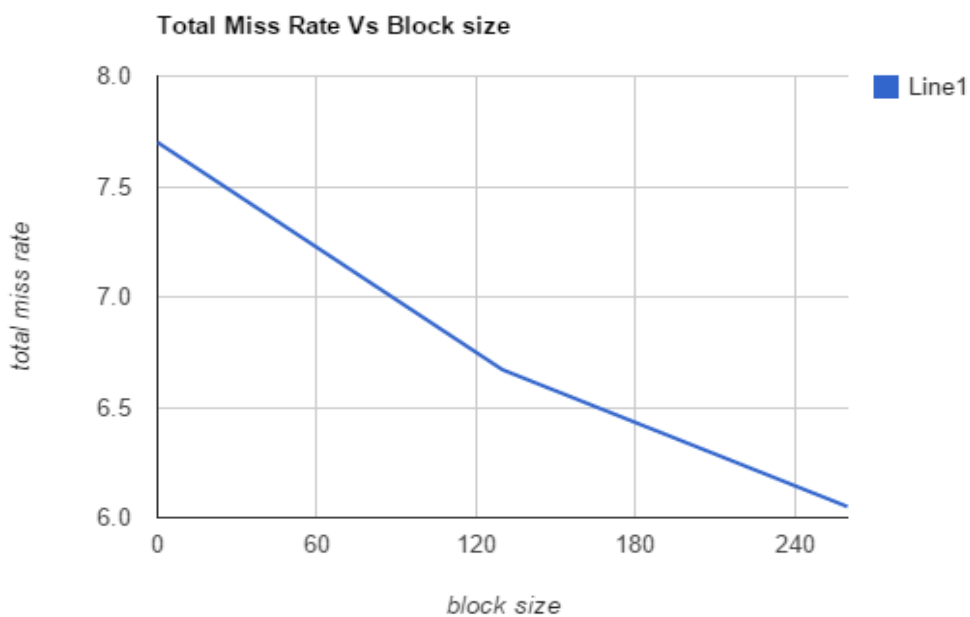
Here we observe that as Block Size is increasing, Cache Misses decrease. The reason behind this is that as the block size increases, there is a good chance for the processor to read and write to other block addresses thereby not invalidating other block address in the other caches and thereby decreasing the miss occurring in that caches.

Now from the above observations we can infer that in order to reduce the miss rate we should increase block size of the cache.

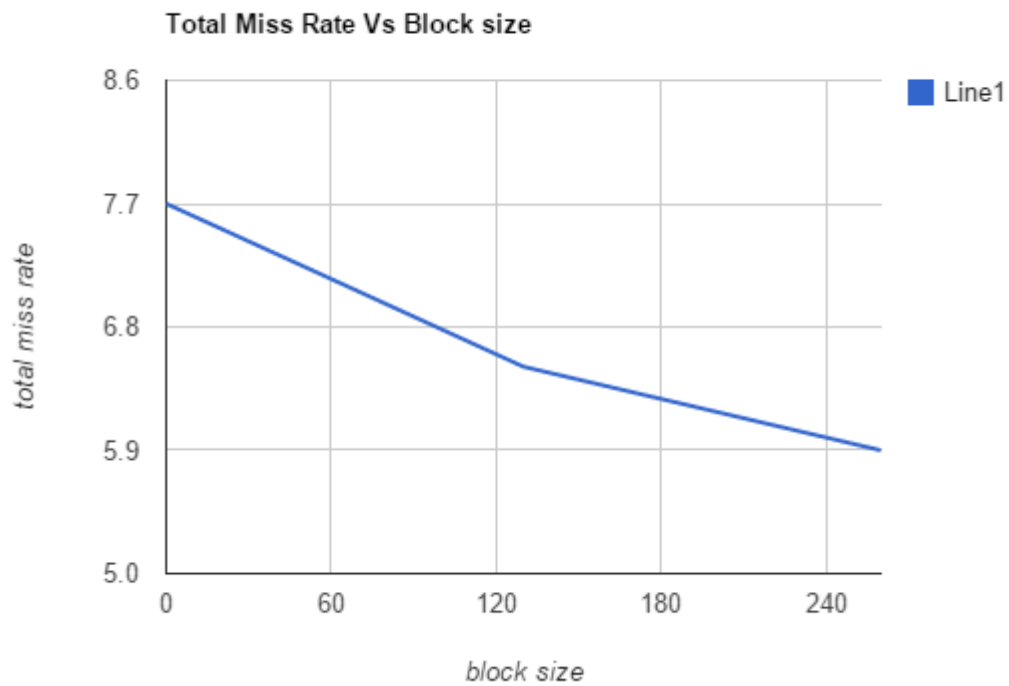
Now let's look at the graph for decreasing miss rate for cach0 for MSI with varying block size values - 64B, 128B, 256B.



Now let's look at the graph for Cach0 for MESI protocol for varying block size - 64B, 128B, 256B.



Now Let's look at the graph for Cache0 for Dragon protocol for varying block size - 64B, 128B, 256B.



Now we will look at the Comparison between MSI, MESI and Dragon protocol for all the 11 parameters mentioned in a tabular form.

(Trace file:- canneal.04t.debug)

(1.) First set of Configuration:-

Fixed Parameters:- (i) associativity = 8

(ii) Block Size = 64B

Variable Parameter:- (i) Cache Size = 256Kb, 512Kb, 1Mb, 2Mb.

Cache Size	MSI	MESI	Dragon	
256Kb	Cache0		Cache0	
	No. of reads	2339	No. of reads	2339
	No. of readmisses	198	No. of readmisses	198
	No. of writes	269	No. of writes	269
	No. of writemisses	3	No. of writemisses	3
	Miss-rate	7.70%	Miss-rate	7.70%
	Writebacks	0	Writebacks	0
	C2C	0	C2C	0
	Memory transactions	215	Memory transactions	201
	Interventions	0	Interventions	43
	Invalidations	34	Invalidations	0
	flushes	0	flushes	0
	Cache1		Cache1	
	No. of reads	2341	No. of reads	2341
	No. of readmisses	210	No. of readmisses	210
	No. of writes	229	No. of writes	229
	No. of writemisses	2	No. of writemisses	2
	Miss-rate	8.25%	Miss-rate	8.25%
	Writebacks	0	Writebacks	0
	C2C	0	C2C	0
	Memory transactions	232	Memory transactions	212
	Interventions	0	Interventions	41
	Invalidations	34	Invalidations	0
	flushes	0	flushes	0
	Cache2		Cache2	
	No. of reads	2396	No. of reads	2396
	No. of readmisses	205	No. of readmisses	205
	No. of writes	253	No. of writes	253
	No. of writemisses	2	No. of writemisses	2
	Miss-rate	7.8%	Miss-rate	7.8%
	Writebacks	0	Writebacks	0
	C2C	0	C2C	0
	Memory transactions	226	Memory transactions	207
	Interventions	0	Interventions	38
	Invalidations	35	Invalidations	0

	flushes	0
	Cache3	
	No. of reads	1969
	No. of readmisses	216
	No. of writes	204
	No. of writemisses	0
	Miss-rate	9.94%
	Writebacks	0
	C2C	0
	Memory transactions	242
	Interventions	0
	Invalidations	32
	flushes	0
		flushes
Cache3		
No. of reads		1969
No. of readmisses		216
No. of writes		204
No. of writemisses		0
Miss-rate		9.94%
Writebacks		0
C2C		121
Memory transactions		95
Interventions		68
Invalidations		32
flushes		0
		flushes
	Cache3	
	No. of reads	1969
	No. of readmisses	216
	No. of writes	204
	No. of writemisses	0
	Miss-rate	9.94%
	Writebacks	0
	C2C	0
	Memory transactions	216
	Interventions	68
	Invalidations	0
	flushes	0
	512Kb	Cache0
No. of reads		2339
No. of readmisses		198
No. of writes		269
No. of writemisses		3
Miss-rate		7.70%
Writebacks		0
C2C		0
Memory transactions		215
Interventions		0
Invalidations		34
flushes		0
Cache1		
No. of reads		2341
No. of readmisses		210
No. of writes		229
No. of writemisses		2
Miss-rate		8.25%
Writebacks		0
C2C		0
Memory transactions		232
Interventions		0
Invalidations		34
flushes		0
Cache2		
No. of reads		2396
No. of readmisses		205
No. of writes		253
No. of writemisses		2
Miss-rate		7.8%
Writebacks		0
C2C		0
Memory transactions		226
Interventions		0
	Cache0	
	No. of reads	2339
	No. of readmisses	198
	No. of writes	269
	No. of writemisses	3
	Miss-rate	7.70%
	Writebacks	0
	C2C	147
	Memory transactions	54
	Interventions	43
	Invalidations	34
	flushes	0
	Cache1	
	No. of reads	2341
	No. of readmisses	210
	No. of writes	229
	No. of writemisses	2
	Miss-rate	8.25%
	Writebacks	0
	C2C	146
	Memory transactions	66
	Interventions	41
	Invalidations	34
	flushes	0
	Cache2	
	No. of reads	2396
	No. of readmisses	205
	No. of writes	253
	No. of writemisses	2
	Miss-rate	7.81%
	Writebacks	0
	C2C	148
	Memory transactions	59
	Interventions	38
	Cache0	
	No. of reads	2339
	No. of readmisses	198
	No. of writes	269
	No. of writemisses	3
	Miss-rate	7.70%
	Writebacks	0
	C2C	0
	Memory transactions	210
	Interventions	43
	Invalidations	0
	flushes	0
	Cache1	
	No. of reads	2341
	No. of readmisses	210
	No. of writes	229
	No. of writemisses	2
	Miss-rate	8.25%
	Writebacks	0
	C2C	0
	Memory transactions	212
	Interventions	41
	Invalidations	0
	flushes	0
	Cache2	
	No. of reads	2396
	No. of readmisses	205
	No. of writes	253
	No. of writemisses	2
	Miss-rate	7.8%
	Writebacks	0
	C2C	0
	Memory transactions	207
	Interventions	38



	Invalidations	35
	flushes	0
	Cache3	
	No. of reads	1969
	No. of readmisses	216
	No. of writes	204
	No. of writemisses	0
	Miss-rate	9.94%
	Writebacks	0
	C2C	0
	Memory transactions	242
	Interventions	0
	Invalidations	32
	flushes	0

	Invalidations	35
	flushes	0
	Cache3	
	No. of reads	1969
	No. of readmisses	216
	No. of writes	204
	No. of writemisses	0
	Miss-rate	9.94%
	Writebacks	0
	C2C	121
	Memory transactions	95
	Interventions	68
	Invalidations	32
	flushes	0

	Invalidations	0
	flushes	0
	Cache3	
	No. of reads	1969
	No. of readmisses	216
	No. of writes	204
	No. of writemisses	0
	Miss-rate	9.94%
	Writebacks	0
	C2C	0
	Memory transactions	216
	Interventions	68
	Invalidations	0
	flushes	0

1Mb	Cache0	
No. of reads	2339	
No. of readmisses	198	
No. of writes	269	
No. of writemisses	3	
Miss-rate	7.70%	
Writebacks	0	
C2C	0	
Memory transactions	215	
Interventions	0	
Invalidations	34	
flushes	0	
Cache1		
No. of reads	2341	
No. of readmisses	210	
No. of writes	229	
No. of writemisses	2	
Miss-rate	8.25%	
Writebacks	0	
C2C	0	
Memory transactions	232	
Interventions	0	
Invalidations	34	
flushes	0	
Cache2		
No. of reads	2396	
No. of readmisses	205	
No. of writes	253	
No. of writemisses	2	
Miss-rate	7.8%	
Writebacks	0	
C2C	0	
Memory transactions	226	
1Mb	Cache0	
No. of reads	2339	
No. of readmisses	198	
No. of writes	269	
No. of writemisses	3	
Miss-rate	7.70%	
Writebacks	0	
C2C	147	
Memory transactions	54	
Interventions	43	
Invalidations	34	
flushes	0	
Cache1		
No. of reads	2341	
No. of readmisses	210	
No. of writes	229	
No. of writemisses	2	
Miss-rate	8.25%	
Writebacks	0	
C2C	146	
Memory transactions	66	
Interventions	41	
Invalidations	34	
flushes	0	
Cache2		
No. of reads	2396	
No. of readmisses	205	
No. of writes	253	
No. of writemisses	2	
Miss-rate	7.81%	
Writebacks	0	
C2C	148	
Memory transactions	59	
1Mb	Cache0	
No. of reads	2339	
No. of readmisses	198	
No. of writes	269	
No. of writemisses	3	
Miss-rate	7.70%	
Writebacks	0	
C2C	0	
Memory transactions	210	
Interventions	43	
Invalidations	0	
flushes	0	
Cache1		
No. of reads	2341	
No. of readmisses	210	
No. of writes	229	
No. of writemisses	2	
Miss-rate	8.25%	
Writebacks	0	
C2C	0	
Memory transactions	212	
Interventions	41	
Invalidations	0	
flushes	0	
Cache2		
No. of reads	2396	
No. of readmisses	205	
No. of writes	253	
No. of writemisses	2	
Miss-rate	7.8%	
Writebacks	0	
C2C	0	
Memory transactions	207	

	Interventions		0		Interventions		38		Interventions		38		
	Invalidations		35		Invalidations		35		Invalidations		0		
	flushes		0		flushes		0		flushes		0		
	Cache3				Cache3				Cache3				
	No. of reads		1969		No. of reads		1969		No. of reads		1969		
	No. of readmisses		216		No. of readmisses		216		No. of readmisses		216		
	No. of writes		204		No. of writes		204		No. of writes		204		
	No. of writemisses		0		No. of writemisses		0		No. of writemisses		0		
	Miss-rate		9.94%		Miss-rate		9.94%		Miss-rate		9.94%		
	Writebacks		0		Writebacks		0		Writebacks		0		
	C2C		0		C2C		121		C2C		0		
	Memory transactions		242		Memory transactions		95		Memory transactions		216		
	Interventions		0		Interventions		68		Interventions		68		
	Invalidations		32		Invalidations		32		Invalidations		0		
	flushes		0		flushes		0		flushes		0		
2Mb	Cache0				Cache0				Cache0				
	No. of reads		2339	No. of reads		2339	No. of reads		2339				
	No. of readmisses		198	No. of readmisses		198	No. of readmisses		198				
	No. of writes		269	No. of writes		269	No. of writes		269				
	No. of writemisses		3	No. of writemisses		3	No. of writemisses		3				
	Miss-rate		7.70%	Miss-rate		7.70%	Miss-rate		7.70%				
	Writebacks		0	Writebacks		0	Writebacks		0				
	C2C		0	C2C		147	C2C		0				
	Memory transactions		215	Memory transactions		54	Memory transactions		210				
	Interventions		0	Interventions		43	Interventions		43				
	Invalidations		34	Invalidations		34	Invalidations		0				
	flushes		0	flushes		0	flushes		0				
	Cache1				Cache1				Cache1				
	No. of reads		2341	No. of reads		2341	No. of reads		2341				
	No. of readmisses		210	No. of readmisses		210	No. of readmisses		210				
	No. of writes		229	No. of writes		229	No. of writes		229				
	No. of writemisses		2	No. of writemisses		2	No. of writemisses		2				
	Miss-rate		8.25%	Miss-rate		8.25%	Miss-rate		8.25%				
	Writebacks		0	Writebacks		0	Writebacks		0				
	C2C		0	C2C		146	C2C		0				
	Memory transactions		232	Memory transactions		66	Memory transactions		212				
	Interventions		0	Interventions		41	Interventions		41				
	Invalidations		34	Invalidations		34	Invalidations		0				
	flushes		0	flushes		0	flushes		0				
	Cache2				Cache2				Cache2				
	No. of reads		2396	No. of reads		2396	No. of reads		2396				
	No. of readmisses		205	No. of readmisses		205	No. of readmisses		205				
	No. of writes		253	No. of writes		253	No. of writes		253				
	No. of writemisses		2	No. of writemisses		2	No. of writemisses		2				
	Miss-rate		7.8%	Miss-rate		7.81%	Miss-rate		7.8%				
	Writebacks		0	Writebacks		0	Writebacks		0				
	C2C		0	C2C		148	C2C		0				
	Memory		226	Memory		59	Memory		207				

	transactions		transactions		transactions		transactions	
		Interventions		0		Interventions		38
		Invalidations		35		Invalidations		35
		flushes		0		flushes		0
	Cache3		Cache3		Cache3		Cache3	
	No. of reads		1969		No. of reads		1969	
	No. of readmisses		216		No. of readmisses		216	
	No. of writes		204		No. of writes		204	
	No. of writemisses		0		No. of writemisses		0	
	Miss-rate		9.94%		Miss-rate		9.94%	
	Writebacks		0		Writebacks		0	
	C2C		0		C2C		121	
	Memory transactions		242		Memory transactions		95	
	Interventions		0		Interventions		68	
	Invalidations		32		Invalidations		32	
	flushes		0		flushes		0	

From the above results what I observed was that In MESI protocol there were more number of cache to cache transfers as compared to MSI, which is a good improvement as that help reduce processor every time accessing memory for the value. Secondly I found that increasing the cache size didn't provide any improvement over the miss rate as explained before. All other values are almost same for MSI, MESI and Dragon Protocol. Finally one more thing to be taken into account is that there are 0 number of invalidations in case of Dragon Protocol which is a good thing as it would involve less number of bus transactions.

(2.) Second set of Configuration:-

Fixed Parameters:- (i) Cache Size = 1Mb

(ii) Block Size = 64B

Variable Parameter:- (i) Associativity = 4-way, 8-way, 16-way

Associativity	MSI	MESI	Dragon
4-way	Cache0	Cache0	Cache0
	No. of reads	No. of reads	No. of reads
	2339	2339	2339
	No. of readmisses	No. of readmisses	No. of readmisses
	198	198	198
	No. of writes	No. of writes	No. of writes
	269	269	269
	No. of writemisses	No. of writemisses	No. of writemisses
	3	3	3
	Miss-rate	Miss-rate	Miss-rate
	7.70%	7.70%	7.70%
	Writebacks	Writebacks	Writebacks
	0	0	0
	C2C	C2C	C2C
	0	147	0
	Memory transactions	Memory transactions	Memory transactions
	215	54	201
	Interventions	Interventions	Interventions
	0	43	43
	Invalidations	Invalidations	Invalidations
	34	34	0
	flushes	flushes	flushes
	0	0	0
	Cache1	Cache1	Cache1
	No. of reads	No. of reads	No. of reads
	2341	2341	2341
	No. of readmisses	No. of readmisses	No. of readmisses
	210	210	210
	No. of writes	No. of writes	No. of writes
	229	229	229
	No. of writemisses	No. of writemisses	No. of writemisses
	2	2	2
	Miss-rate	Miss-rate	Miss-rate
	8.25%	8.25%	8.25%
	Writebacks	Writebacks	Writebacks
	0	0	0
	C2C	C2C	C2C
	0	146	0
	Memory transactions	Memory transactions	Memory transactions
	232	66	212
	Interventions	Interventions	Interventions
	0	41	41
	Invalidations	Invalidations	Invalidations
	34	34	0
	flushes	flushes	flushes
	0	0	0
	Cache2	Cache2	Cache2
	No. of reads	No. of reads	No. of reads
	2396	2396	2396
	No. of readmisses	No. of readmisses	No. of readmisses
	205	205	205
	No. of writes	No. of writes	No. of writes
	253	253	253
	No. of writemisses	No. of writemisses	No. of writemisses
	2	2	2
	Miss-rate	Miss-rate	Miss-rate
	7.8%	7.8%	7.8%
	Writebacks	Writebacks	Writebacks
	0	0	0
	C2C	C2C	C2C
	0	148	0
	Memory transactions	Memory transactions	Memory transactions
	226	59	207
	Interventions	Interventions	Interventions
	0	38	38
	Invalidations	Invalidations	Invalidations
	35	35	0
	flushes	flushes	flushes
	0	0	0
	Cache3	Cache3	Cache3
	No. of reads	No. of reads	No. of reads
	1969	1969	1969
	No. of readmisses	No. of readmisses	No. of readmisses
	216	216	216
	No. of writes	No. of writes	No. of writes
	204	204	204
	No. of	No. of	No. of
	0	0	0

	<table><tr><td>writemisses</td><td></td></tr><tr><td>Miss-rate</td><td>9.94%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>242</td></tr><tr><td>Interventions</td><td>0</td></tr><tr><td>Invalidations</td><td>32</td></tr><tr><td>flushes</td><td>0</td></tr></table>	writemisses		Miss-rate	9.94%	Writebacks	0	C2C	0	Memory transactions	242	Interventions	0	Invalidations	32	flushes	0	<table><tr><td>writemisses</td><td></td></tr><tr><td>Miss-rate</td><td>9.94%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>121</td></tr><tr><td>Memory transactions</td><td>95</td></tr><tr><td>Interventions</td><td>68</td></tr><tr><td>Invalidations</td><td>32</td></tr><tr><td>flushes</td><td>0</td></tr></table>	writemisses		Miss-rate	9.94%	Writebacks	0	C2C	121	Memory transactions	95	Interventions	68	Invalidations	32	flushes	0	<table><tr><td>writemisses</td><td></td></tr><tr><td>Miss-rate</td><td>9.94%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>216</td></tr><tr><td>Interventions</td><td>68</td></tr><tr><td>Invalidations</td><td>0</td></tr><tr><td>flushes</td><td>0</td></tr></table>	writemisses		Miss-rate	9.94%	Writebacks	0	C2C	0	Memory transactions	216	Interventions	68	Invalidations	0	flushes	0																																																																																																																																																																																																
writemisses																																																																																																																																																																																																																																																			
Miss-rate	9.94%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	0																																																																																																																																																																																																																																																		
Memory transactions	242																																																																																																																																																																																																																																																		
Interventions	0																																																																																																																																																																																																																																																		
Invalidations	32																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
writemisses																																																																																																																																																																																																																																																			
Miss-rate	9.94%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	121																																																																																																																																																																																																																																																		
Memory transactions	95																																																																																																																																																																																																																																																		
Interventions	68																																																																																																																																																																																																																																																		
Invalidations	32																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
writemisses																																																																																																																																																																																																																																																			
Miss-rate	9.94%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	0																																																																																																																																																																																																																																																		
Memory transactions	216																																																																																																																																																																																																																																																		
Interventions	68																																																																																																																																																																																																																																																		
Invalidations	0																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
8-way	<table><tr><td colspan="2">Cache0</td></tr><tr><td>No. of reads</td><td>2339</td></tr><tr><td>No. of readmisses</td><td>198</td></tr><tr><td>No. of writes</td><td>269</td></tr><tr><td>No. of writemisses</td><td>3</td></tr><tr><td>Miss-rate</td><td>7.70%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>215</td></tr><tr><td>Interventions</td><td>0</td></tr><tr><td>Invalidations</td><td>34</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache1</td></tr><tr><td>No. of reads</td><td>2341</td></tr><tr><td>No. of readmisses</td><td>210</td></tr><tr><td>No. of writes</td><td>229</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>8.25%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>232</td></tr><tr><td>Interventions</td><td>0</td></tr><tr><td>Invalidations</td><td>34</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache2</td></tr><tr><td>No. of reads</td><td>2396</td></tr><tr><td>No. of readmisses</td><td>205</td></tr><tr><td>No. of writes</td><td>253</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>7.8%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>226</td></tr><tr><td>Interventions</td><td>0</td></tr><tr><td>Invalidations</td><td>35</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache3</td></tr><tr><td>No. of reads</td><td>1969</td></tr><tr><td>No. of readmisses</td><td>216</td></tr><tr><td>No. of writes</td><td>204</td></tr></table>	Cache0		No. of reads	2339	No. of readmisses	198	No. of writes	269	No. of writemisses	3	Miss-rate	7.70%	Writebacks	0	C2C	0	Memory transactions	215	Interventions	0	Invalidations	34	flushes	0	Cache1		No. of reads	2341	No. of readmisses	210	No. of writes	229	No. of writemisses	2	Miss-rate	8.25%	Writebacks	0	C2C	0	Memory transactions	232	Interventions	0	Invalidations	34	flushes	0	Cache2		No. of reads	2396	No. of readmisses	205	No. of writes	253	No. of writemisses	2	Miss-rate	7.8%	Writebacks	0	C2C	0	Memory transactions	226	Interventions	0	Invalidations	35	flushes	0	Cache3		No. of reads	1969	No. of readmisses	216	No. of writes	204	<table><tr><td colspan="2">Cache0</td></tr><tr><td>No. of reads</td><td>2339</td></tr><tr><td>No. of readmisses</td><td>198</td></tr><tr><td>No. of writes</td><td>269</td></tr><tr><td>No. of writemisses</td><td>3</td></tr><tr><td>Miss-rate</td><td>7.70%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>147</td></tr><tr><td>Memory transactions</td><td>54</td></tr><tr><td>Interventions</td><td>43</td></tr><tr><td>Invalidations</td><td>34</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache1</td></tr><tr><td>No. of reads</td><td>2341</td></tr><tr><td>No. of readmisses</td><td>210</td></tr><tr><td>No. of writes</td><td>229</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>8.25%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>146</td></tr><tr><td>Memory transactions</td><td>66</td></tr><tr><td>Interventions</td><td>41</td></tr><tr><td>Invalidations</td><td>34</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache2</td></tr><tr><td>No. of reads</td><td>2396</td></tr><tr><td>No. of readmisses</td><td>205</td></tr><tr><td>No. of writes</td><td>253</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>7.81%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>148</td></tr><tr><td>Memory transactions</td><td>59</td></tr><tr><td>Interventions</td><td>38</td></tr><tr><td>Invalidations</td><td>35</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache3</td></tr><tr><td>No. of reads</td><td>1969</td></tr><tr><td>No. of readmisses</td><td>216</td></tr><tr><td>No. of writes</td><td>204</td></tr></table>	Cache0		No. of reads	2339	No. of readmisses	198	No. of writes	269	No. of writemisses	3	Miss-rate	7.70%	Writebacks	0	C2C	147	Memory transactions	54	Interventions	43	Invalidations	34	flushes	0	Cache1		No. of reads	2341	No. of readmisses	210	No. of writes	229	No. of writemisses	2	Miss-rate	8.25%	Writebacks	0	C2C	146	Memory transactions	66	Interventions	41	Invalidations	34	flushes	0	Cache2		No. of reads	2396	No. of readmisses	205	No. of writes	253	No. of writemisses	2	Miss-rate	7.81%	Writebacks	0	C2C	148	Memory transactions	59	Interventions	38	Invalidations	35	flushes	0	Cache3		No. of reads	1969	No. of readmisses	216	No. of writes	204	<table><tr><td colspan="2">Cache0</td></tr><tr><td>No. of reads</td><td>2339</td></tr><tr><td>No. of readmisses</td><td>198</td></tr><tr><td>No. of writes</td><td>269</td></tr><tr><td>No. of writemisses</td><td>3</td></tr><tr><td>Miss-rate</td><td>7.70%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>210</td></tr><tr><td>Interventions</td><td>43</td></tr><tr><td>Invalidations</td><td>0</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache1</td></tr><tr><td>No. of reads</td><td>2341</td></tr><tr><td>No. of readmisses</td><td>210</td></tr><tr><td>No. of writes</td><td>229</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>8.25%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>212</td></tr><tr><td>Interventions</td><td>41</td></tr><tr><td>Invalidations</td><td>0</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache2</td></tr><tr><td>No. of reads</td><td>2396</td></tr><tr><td>No. of readmisses</td><td>205</td></tr><tr><td>No. of writes</td><td>253</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>7.8%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>207</td></tr><tr><td>Interventions</td><td>38</td></tr><tr><td>Invalidations</td><td>0</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache3</td></tr><tr><td>No. of reads</td><td>1969</td></tr><tr><td>No. of readmisses</td><td>216</td></tr><tr><td>No. of writes</td><td>204</td></tr></table>	Cache0		No. of reads	2339	No. of readmisses	198	No. of writes	269	No. of writemisses	3	Miss-rate	7.70%	Writebacks	0	C2C	0	Memory transactions	210	Interventions	43	Invalidations	0	flushes	0	Cache1		No. of reads	2341	No. of readmisses	210	No. of writes	229	No. of writemisses	2	Miss-rate	8.25%	Writebacks	0	C2C	0	Memory transactions	212	Interventions	41	Invalidations	0	flushes	0	Cache2		No. of reads	2396	No. of readmisses	205	No. of writes	253	No. of writemisses	2	Miss-rate	7.8%	Writebacks	0	C2C	0	Memory transactions	207	Interventions	38	Invalidations	0	flushes	0	Cache3		No. of reads	1969	No. of readmisses	216	No. of writes	204
Cache0																																																																																																																																																																																																																																																			
No. of reads	2339																																																																																																																																																																																																																																																		
No. of readmisses	198																																																																																																																																																																																																																																																		
No. of writes	269																																																																																																																																																																																																																																																		
No. of writemisses	3																																																																																																																																																																																																																																																		
Miss-rate	7.70%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	0																																																																																																																																																																																																																																																		
Memory transactions	215																																																																																																																																																																																																																																																		
Interventions	0																																																																																																																																																																																																																																																		
Invalidations	34																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
Cache1																																																																																																																																																																																																																																																			
No. of reads	2341																																																																																																																																																																																																																																																		
No. of readmisses	210																																																																																																																																																																																																																																																		
No. of writes	229																																																																																																																																																																																																																																																		
No. of writemisses	2																																																																																																																																																																																																																																																		
Miss-rate	8.25%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	0																																																																																																																																																																																																																																																		
Memory transactions	232																																																																																																																																																																																																																																																		
Interventions	0																																																																																																																																																																																																																																																		
Invalidations	34																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
Cache2																																																																																																																																																																																																																																																			
No. of reads	2396																																																																																																																																																																																																																																																		
No. of readmisses	205																																																																																																																																																																																																																																																		
No. of writes	253																																																																																																																																																																																																																																																		
No. of writemisses	2																																																																																																																																																																																																																																																		
Miss-rate	7.8%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	0																																																																																																																																																																																																																																																		
Memory transactions	226																																																																																																																																																																																																																																																		
Interventions	0																																																																																																																																																																																																																																																		
Invalidations	35																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
Cache3																																																																																																																																																																																																																																																			
No. of reads	1969																																																																																																																																																																																																																																																		
No. of readmisses	216																																																																																																																																																																																																																																																		
No. of writes	204																																																																																																																																																																																																																																																		
Cache0																																																																																																																																																																																																																																																			
No. of reads	2339																																																																																																																																																																																																																																																		
No. of readmisses	198																																																																																																																																																																																																																																																		
No. of writes	269																																																																																																																																																																																																																																																		
No. of writemisses	3																																																																																																																																																																																																																																																		
Miss-rate	7.70%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	147																																																																																																																																																																																																																																																		
Memory transactions	54																																																																																																																																																																																																																																																		
Interventions	43																																																																																																																																																																																																																																																		
Invalidations	34																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
Cache1																																																																																																																																																																																																																																																			
No. of reads	2341																																																																																																																																																																																																																																																		
No. of readmisses	210																																																																																																																																																																																																																																																		
No. of writes	229																																																																																																																																																																																																																																																		
No. of writemisses	2																																																																																																																																																																																																																																																		
Miss-rate	8.25%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	146																																																																																																																																																																																																																																																		
Memory transactions	66																																																																																																																																																																																																																																																		
Interventions	41																																																																																																																																																																																																																																																		
Invalidations	34																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
Cache2																																																																																																																																																																																																																																																			
No. of reads	2396																																																																																																																																																																																																																																																		
No. of readmisses	205																																																																																																																																																																																																																																																		
No. of writes	253																																																																																																																																																																																																																																																		
No. of writemisses	2																																																																																																																																																																																																																																																		
Miss-rate	7.81%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	148																																																																																																																																																																																																																																																		
Memory transactions	59																																																																																																																																																																																																																																																		
Interventions	38																																																																																																																																																																																																																																																		
Invalidations	35																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
Cache3																																																																																																																																																																																																																																																			
No. of reads	1969																																																																																																																																																																																																																																																		
No. of readmisses	216																																																																																																																																																																																																																																																		
No. of writes	204																																																																																																																																																																																																																																																		
Cache0																																																																																																																																																																																																																																																			
No. of reads	2339																																																																																																																																																																																																																																																		
No. of readmisses	198																																																																																																																																																																																																																																																		
No. of writes	269																																																																																																																																																																																																																																																		
No. of writemisses	3																																																																																																																																																																																																																																																		
Miss-rate	7.70%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	0																																																																																																																																																																																																																																																		
Memory transactions	210																																																																																																																																																																																																																																																		
Interventions	43																																																																																																																																																																																																																																																		
Invalidations	0																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
Cache1																																																																																																																																																																																																																																																			
No. of reads	2341																																																																																																																																																																																																																																																		
No. of readmisses	210																																																																																																																																																																																																																																																		
No. of writes	229																																																																																																																																																																																																																																																		
No. of writemisses	2																																																																																																																																																																																																																																																		
Miss-rate	8.25%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	0																																																																																																																																																																																																																																																		
Memory transactions	212																																																																																																																																																																																																																																																		
Interventions	41																																																																																																																																																																																																																																																		
Invalidations	0																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
Cache2																																																																																																																																																																																																																																																			
No. of reads	2396																																																																																																																																																																																																																																																		
No. of readmisses	205																																																																																																																																																																																																																																																		
No. of writes	253																																																																																																																																																																																																																																																		
No. of writemisses	2																																																																																																																																																																																																																																																		
Miss-rate	7.8%																																																																																																																																																																																																																																																		
Writebacks	0																																																																																																																																																																																																																																																		
C2C	0																																																																																																																																																																																																																																																		
Memory transactions	207																																																																																																																																																																																																																																																		
Interventions	38																																																																																																																																																																																																																																																		
Invalidations	0																																																																																																																																																																																																																																																		
flushes	0																																																																																																																																																																																																																																																		
Cache3																																																																																																																																																																																																																																																			
No. of reads	1969																																																																																																																																																																																																																																																		
No. of readmisses	216																																																																																																																																																																																																																																																		
No. of writes	204																																																																																																																																																																																																																																																		

	<table><tr><td>No. of writemisses</td><td>0</td></tr><tr><td>Miss-rate</td><td>9.94%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>242</td></tr><tr><td>Interventions</td><td>0</td></tr><tr><td>Invalidations</td><td>32</td></tr><tr><td>flushes</td><td>0</td></tr></table>	No. of writemisses	0	Miss-rate	9.94%	Writebacks	0	C2C	0	Memory transactions	242	Interventions	0	Invalidations	32	flushes	0	<table><tr><td>No. of writemisses</td><td>0</td></tr><tr><td>Miss-rate</td><td>9.94%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>121</td></tr><tr><td>Memory transactions</td><td>95</td></tr><tr><td>Interventions</td><td>68</td></tr><tr><td>Invalidations</td><td>32</td></tr><tr><td>flushes</td><td>0</td></tr></table>	No. of writemisses	0	Miss-rate	9.94%	Writebacks	0	C2C	121	Memory transactions	95	Interventions	68	Invalidations	32	flushes	0	<table><tr><td>No. of writemisses</td><td>0</td></tr><tr><td>Miss-rate</td><td>9.94%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>216</td></tr><tr><td>Interventions</td><td>68</td></tr><tr><td>Invalidations</td><td>0</td></tr><tr><td>flushes</td><td>0</td></tr></table>	No. of writemisses	0	Miss-rate	9.94%	Writebacks	0	C2C	0	Memory transactions	216	Interventions	68	Invalidations	0	flushes	0																																																																																																																																																																																										
No. of writemisses	0																																																																																																																																																																																																																																												
Miss-rate	9.94%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	0																																																																																																																																																																																																																																												
Memory transactions	242																																																																																																																																																																																																																																												
Interventions	0																																																																																																																																																																																																																																												
Invalidations	32																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
No. of writemisses	0																																																																																																																																																																																																																																												
Miss-rate	9.94%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	121																																																																																																																																																																																																																																												
Memory transactions	95																																																																																																																																																																																																																																												
Interventions	68																																																																																																																																																																																																																																												
Invalidations	32																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
No. of writemisses	0																																																																																																																																																																																																																																												
Miss-rate	9.94%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	0																																																																																																																																																																																																																																												
Memory transactions	216																																																																																																																																																																																																																																												
Interventions	68																																																																																																																																																																																																																																												
Invalidations	0																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
16-way	<table><tr><td colspan="2">Cache0</td></tr><tr><td>No. of reads</td><td>2339</td></tr><tr><td>No. of readmisses</td><td>198</td></tr><tr><td>No. of writes</td><td>269</td></tr><tr><td>No. of writemisses</td><td>3</td></tr><tr><td>Miss-rate</td><td>7.70%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>215</td></tr><tr><td>Interventions</td><td>0</td></tr><tr><td>Invalidations</td><td>34</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache1</td></tr><tr><td>No. of reads</td><td>2341</td></tr><tr><td>No. of readmisses</td><td>210</td></tr><tr><td>No. of writes</td><td>229</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>8.25%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>232</td></tr><tr><td>Interventions</td><td>0</td></tr><tr><td>Invalidations</td><td>34</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache2</td></tr><tr><td>No. of reads</td><td>2396</td></tr><tr><td>No. of readmisses</td><td>205</td></tr><tr><td>No. of writes</td><td>253</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>7.8%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>226</td></tr><tr><td>Interventions</td><td>0</td></tr><tr><td>Invalidations</td><td>35</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache3</td></tr><tr><td>No. of reads</td><td>1969</td></tr><tr><td>No. of readmisses</td><td>216</td></tr></table>	Cache0		No. of reads	2339	No. of readmisses	198	No. of writes	269	No. of writemisses	3	Miss-rate	7.70%	Writebacks	0	C2C	0	Memory transactions	215	Interventions	0	Invalidations	34	flushes	0	Cache1		No. of reads	2341	No. of readmisses	210	No. of writes	229	No. of writemisses	2	Miss-rate	8.25%	Writebacks	0	C2C	0	Memory transactions	232	Interventions	0	Invalidations	34	flushes	0	Cache2		No. of reads	2396	No. of readmisses	205	No. of writes	253	No. of writemisses	2	Miss-rate	7.8%	Writebacks	0	C2C	0	Memory transactions	226	Interventions	0	Invalidations	35	flushes	0	Cache3		No. of reads	1969	No. of readmisses	216	<table><tr><td colspan="2">Cache0</td></tr><tr><td>No. of reads</td><td>2339</td></tr><tr><td>No. of readmisses</td><td>198</td></tr><tr><td>No. of writes</td><td>269</td></tr><tr><td>No. of writemisses</td><td>3</td></tr><tr><td>Miss-rate</td><td>7.70%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>147</td></tr><tr><td>Memory transactions</td><td>54</td></tr><tr><td>Interventions</td><td>43</td></tr><tr><td>Invalidations</td><td>34</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache1</td></tr><tr><td>No. of reads</td><td>2341</td></tr><tr><td>No. of readmisses</td><td>210</td></tr><tr><td>No. of writes</td><td>229</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>8.25%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>146</td></tr><tr><td>Memory transactions</td><td>66</td></tr><tr><td>Interventions</td><td>41</td></tr><tr><td>Invalidations</td><td>34</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache2</td></tr><tr><td>No. of reads</td><td>2396</td></tr><tr><td>No. of readmisses</td><td>205</td></tr><tr><td>No. of writes</td><td>253</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>7.81%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>148</td></tr><tr><td>Memory transactions</td><td>59</td></tr><tr><td>Interventions</td><td>38</td></tr><tr><td>Invalidations</td><td>35</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache3</td></tr><tr><td>No. of reads</td><td>1969</td></tr><tr><td>No. of readmisses</td><td>216</td></tr></table>	Cache0		No. of reads	2339	No. of readmisses	198	No. of writes	269	No. of writemisses	3	Miss-rate	7.70%	Writebacks	0	C2C	147	Memory transactions	54	Interventions	43	Invalidations	34	flushes	0	Cache1		No. of reads	2341	No. of readmisses	210	No. of writes	229	No. of writemisses	2	Miss-rate	8.25%	Writebacks	0	C2C	146	Memory transactions	66	Interventions	41	Invalidations	34	flushes	0	Cache2		No. of reads	2396	No. of readmisses	205	No. of writes	253	No. of writemisses	2	Miss-rate	7.81%	Writebacks	0	C2C	148	Memory transactions	59	Interventions	38	Invalidations	35	flushes	0	Cache3		No. of reads	1969	No. of readmisses	216	<table><tr><td colspan="2">Cache0</td></tr><tr><td>No. of reads</td><td>2339</td></tr><tr><td>No. of readmisses</td><td>198</td></tr><tr><td>No. of writes</td><td>269</td></tr><tr><td>No. of writemisses</td><td>3</td></tr><tr><td>Miss-rate</td><td>7.70%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>210</td></tr><tr><td>Interventions</td><td>43</td></tr><tr><td>Invalidations</td><td>0</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache1</td></tr><tr><td>No. of reads</td><td>2341</td></tr><tr><td>No. of readmisses</td><td>210</td></tr><tr><td>No. of writes</td><td>229</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>8.25%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>212</td></tr><tr><td>Interventions</td><td>41</td></tr><tr><td>Invalidations</td><td>0</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache2</td></tr><tr><td>No. of reads</td><td>2396</td></tr><tr><td>No. of readmisses</td><td>205</td></tr><tr><td>No. of writes</td><td>253</td></tr><tr><td>No. of writemisses</td><td>2</td></tr><tr><td>Miss-rate</td><td>7.8%</td></tr><tr><td>Writebacks</td><td>0</td></tr><tr><td>C2C</td><td>0</td></tr><tr><td>Memory transactions</td><td>207</td></tr><tr><td>Interventions</td><td>38</td></tr><tr><td>Invalidations</td><td>0</td></tr><tr><td>flushes</td><td>0</td></tr><tr><td colspan="2">Cache3</td></tr><tr><td>No. of reads</td><td>1969</td></tr><tr><td>No. of readmisses</td><td>216</td></tr></table>	Cache0		No. of reads	2339	No. of readmisses	198	No. of writes	269	No. of writemisses	3	Miss-rate	7.70%	Writebacks	0	C2C	0	Memory transactions	210	Interventions	43	Invalidations	0	flushes	0	Cache1		No. of reads	2341	No. of readmisses	210	No. of writes	229	No. of writemisses	2	Miss-rate	8.25%	Writebacks	0	C2C	0	Memory transactions	212	Interventions	41	Invalidations	0	flushes	0	Cache2		No. of reads	2396	No. of readmisses	205	No. of writes	253	No. of writemisses	2	Miss-rate	7.8%	Writebacks	0	C2C	0	Memory transactions	207	Interventions	38	Invalidations	0	flushes	0	Cache3		No. of reads	1969	No. of readmisses	216
Cache0																																																																																																																																																																																																																																													
No. of reads	2339																																																																																																																																																																																																																																												
No. of readmisses	198																																																																																																																																																																																																																																												
No. of writes	269																																																																																																																																																																																																																																												
No. of writemisses	3																																																																																																																																																																																																																																												
Miss-rate	7.70%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	0																																																																																																																																																																																																																																												
Memory transactions	215																																																																																																																																																																																																																																												
Interventions	0																																																																																																																																																																																																																																												
Invalidations	34																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
Cache1																																																																																																																																																																																																																																													
No. of reads	2341																																																																																																																																																																																																																																												
No. of readmisses	210																																																																																																																																																																																																																																												
No. of writes	229																																																																																																																																																																																																																																												
No. of writemisses	2																																																																																																																																																																																																																																												
Miss-rate	8.25%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	0																																																																																																																																																																																																																																												
Memory transactions	232																																																																																																																																																																																																																																												
Interventions	0																																																																																																																																																																																																																																												
Invalidations	34																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
Cache2																																																																																																																																																																																																																																													
No. of reads	2396																																																																																																																																																																																																																																												
No. of readmisses	205																																																																																																																																																																																																																																												
No. of writes	253																																																																																																																																																																																																																																												
No. of writemisses	2																																																																																																																																																																																																																																												
Miss-rate	7.8%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	0																																																																																																																																																																																																																																												
Memory transactions	226																																																																																																																																																																																																																																												
Interventions	0																																																																																																																																																																																																																																												
Invalidations	35																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
Cache3																																																																																																																																																																																																																																													
No. of reads	1969																																																																																																																																																																																																																																												
No. of readmisses	216																																																																																																																																																																																																																																												
Cache0																																																																																																																																																																																																																																													
No. of reads	2339																																																																																																																																																																																																																																												
No. of readmisses	198																																																																																																																																																																																																																																												
No. of writes	269																																																																																																																																																																																																																																												
No. of writemisses	3																																																																																																																																																																																																																																												
Miss-rate	7.70%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	147																																																																																																																																																																																																																																												
Memory transactions	54																																																																																																																																																																																																																																												
Interventions	43																																																																																																																																																																																																																																												
Invalidations	34																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
Cache1																																																																																																																																																																																																																																													
No. of reads	2341																																																																																																																																																																																																																																												
No. of readmisses	210																																																																																																																																																																																																																																												
No. of writes	229																																																																																																																																																																																																																																												
No. of writemisses	2																																																																																																																																																																																																																																												
Miss-rate	8.25%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	146																																																																																																																																																																																																																																												
Memory transactions	66																																																																																																																																																																																																																																												
Interventions	41																																																																																																																																																																																																																																												
Invalidations	34																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
Cache2																																																																																																																																																																																																																																													
No. of reads	2396																																																																																																																																																																																																																																												
No. of readmisses	205																																																																																																																																																																																																																																												
No. of writes	253																																																																																																																																																																																																																																												
No. of writemisses	2																																																																																																																																																																																																																																												
Miss-rate	7.81%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	148																																																																																																																																																																																																																																												
Memory transactions	59																																																																																																																																																																																																																																												
Interventions	38																																																																																																																																																																																																																																												
Invalidations	35																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
Cache3																																																																																																																																																																																																																																													
No. of reads	1969																																																																																																																																																																																																																																												
No. of readmisses	216																																																																																																																																																																																																																																												
Cache0																																																																																																																																																																																																																																													
No. of reads	2339																																																																																																																																																																																																																																												
No. of readmisses	198																																																																																																																																																																																																																																												
No. of writes	269																																																																																																																																																																																																																																												
No. of writemisses	3																																																																																																																																																																																																																																												
Miss-rate	7.70%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	0																																																																																																																																																																																																																																												
Memory transactions	210																																																																																																																																																																																																																																												
Interventions	43																																																																																																																																																																																																																																												
Invalidations	0																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
Cache1																																																																																																																																																																																																																																													
No. of reads	2341																																																																																																																																																																																																																																												
No. of readmisses	210																																																																																																																																																																																																																																												
No. of writes	229																																																																																																																																																																																																																																												
No. of writemisses	2																																																																																																																																																																																																																																												
Miss-rate	8.25%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	0																																																																																																																																																																																																																																												
Memory transactions	212																																																																																																																																																																																																																																												
Interventions	41																																																																																																																																																																																																																																												
Invalidations	0																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
Cache2																																																																																																																																																																																																																																													
No. of reads	2396																																																																																																																																																																																																																																												
No. of readmisses	205																																																																																																																																																																																																																																												
No. of writes	253																																																																																																																																																																																																																																												
No. of writemisses	2																																																																																																																																																																																																																																												
Miss-rate	7.8%																																																																																																																																																																																																																																												
Writebacks	0																																																																																																																																																																																																																																												
C2C	0																																																																																																																																																																																																																																												
Memory transactions	207																																																																																																																																																																																																																																												
Interventions	38																																																																																																																																																																																																																																												
Invalidations	0																																																																																																																																																																																																																																												
flushes	0																																																																																																																																																																																																																																												
Cache3																																																																																																																																																																																																																																													
No. of reads	1969																																																																																																																																																																																																																																												
No. of readmisses	216																																																																																																																																																																																																																																												

	No. of writes	204		No. of writes	204		No. of writes	204	
	No. of writemisses	0		No. of writemisses	0		No. of writemisses	0	
	Miss-rate	9.94%		Miss-rate	9.94%		Miss-rate	9.94%	
	Writebacks	0		Writebacks	0		Writebacks	0	
	C2C	0		C2C	121		C2C	0	
	Memory transactions	242		Memory transactions	95		Memory transactions	216	
	Interventions	0		Interventions	68		Interventions	68	
	Invalidations	32		Invalidations	32		Invalidations	0	
	flushes	0		flushes	0		flushes	0	

From the above results I found that by increasing the cache associativity we didn't find much improvement as the miss rate is same as it was for lower associativity. I found similar inference as the previous configuration that cache to cache transfer is greater in case of MESI than MSI and number of invalidations is 0 in case of Dragon.

(3.) Third set of Configuration:-

Fixed Parameters:- (i) Cache Size = 1Mb

(ii) Associativity = 8

Variable Parameter:- (i) Block Size = 64B, 128B, 256B

Block size	MSI	MESI	Dragon	
64B	Cache0		Cache0	
	No. of reads	2339	No. of reads	2339
	No. of readmisses	198	No. of readmisses	198
	No. of writes	269	No. of writes	269
	No. of writemisses	3	No. of writemisses	3
	Miss-rate	7.70%	Miss-rate	7.70%
	Writebacks	0	Writebacks	0
	C2C	0	C2C	0
	Memory transactions	215	Memory transactions	201
	Interventions	0	Interventions	43
	Invalidations	34	Invalidations	0
	flushes	0	flushes	0
	Cache1		Cache1	
	No. of reads	2341	No. of reads	2341
	No. of readmisses	210	No. of readmisses	210
	No. of writes	229	No. of writes	229
	No. of writemisses	2	No. of writemisses	2
	Miss-rate	8.25%	Miss-rate	8.25%
	Writebacks	0	Writebacks	0
	C2C	0	C2C	0
	Memory transactions	232	Memory transactions	66
	Interventions	0	Interventions	41
	Invalidations	34	Invalidations	34
	flushes	0	flushes	0
	Cache2		Cache2	
	No. of reads	2396	No. of reads	2396
	No. of readmisses	205	No. of readmisses	205
	No. of writes	253	No. of writes	253
	No. of writemisses	2	No. of writemisses	2
	Miss-rate	7.8%	Miss-rate	7.8%
	Writebacks	0	Writebacks	0
	C2C	0	C2C	148
	Memory transactions	226	Memory transactions	59
	Interventions	0	Interventions	38
	Invalidations	35	Invalidations	35
	flushes	0	flushes	0
	Cache3		Cache3	
	No. of reads	1969	No. of reads	1969
	No. of readmisses	216	No. of readmisses	216



128B	No. of writes		204	No. of writes		204	No. of writes		204			
	No. of writemisses		0	No. of writemisses		0	No. of writemisses		0			
	Miss-rate		9.94%	Miss-rate		9.94%	Miss-rate		9.94%			
	Writebacks		0	Writebacks		0	Writebacks		0			
	C2C		0	C2C		121	C2C		0			
	Memory transactions		242	Memory transactions		95	Memory transactions		216			
	Interventions		0	Interventions		68	Interventions		68			
	Invalidations		32	Invalidations		32	Invalidations		0			
	flushes		0	flushes		0	flushes		0			
	Cache0				Cache0				Cache0			
	No. of reads		2339	No. of reads		2339	No. of reads		2339			
	No. of readmisses		171	No. of readmisses		171	No. of readmisses		167			
	No. of writes		269	No. of writes		269	No. of writes		269			
	No. of writemisses		3	No. of writemisses		3	No. of writemisses		3			
	Miss-rate		6.67%	Miss-rate		6.67%	Miss-rate		6.51%			
	Writebacks		1	Writebacks		0	Writebacks		0			
	C2C		0	C2C		129	C2C		0			
	Memory transactions		189	Memory transactions		46	Memory transactions		170			
	Interventions		1	Interventions		38	Interventions		37			
	Invalidations		34	Invalidations		34	Invalidations		0			
	flushes		1	flushes		0	flushes		0			
	Cache1				Cache1				Cache1			
	No. of reads		2341	No. of reads		2341	No. of reads		2341			
	No. of readmisses		184	No. of readmisses		184	No. of readmisses		181			
	No. of writes		229	No. of writes		229	No. of writes		229			
	No. of writemisses		1	No. of writemisses		1	No. of writemisses		1			
	Miss-rate		7.19%	Miss-rate		7.19%	Miss-rate		7.08%			
	Writebacks		2	Writebacks		0	Writebacks		0			
	C2C		0	C2C		126	C2C		0			
	Memory transactions		206	Memory transactions		61	Memory transactions		182			
	Interventions		2	Interventions		39	Interventions		37			
	Invalidations		35	Invalidations		35	Invalidations		0			
	flushes		2	flushes		2	flushes		0			
	Cache2				Cache2				Cache2			
	No. of reads		2396	No. of reads		2396	No. of reads		2396			
	No. of readmisses		181	No. of readmisses		181	No. of readmisses		177			
	No. of writes		253	No. of writes		253	No. of writes		253			
	No. of writemisses		2	No. of writemisses		2	No. of writemisses		2			
	Miss-rate		6.90%	Miss-rate		6.90%	Miss-rate		6.75%			
	Writebacks		1	Writebacks		0	Writebacks		0			
	C2C		0	C2C		129	C2C		0			
	Memory transactions		202	Memory transactions		55	Memory transactions		179			
	Interventions		1	Interventions		35	Interventions		34			
	Invalidations		36	Invalidations		36	Invalidations		0			
	flushes		1	flushes		1	flushes		0			
	Cache3				Cache3				Cache3			
	No. of reads		1969	No. of reads		1969	No. of reads		1969			
	No. of		191	No. of		191	No. of		187			

	readmisses		readmisses		readmisses	
	No. of writes	204	No. of writes	204	No. of writes	204
	No. of writemisses	0	No. of writemisses	0	No. of writemisses	0
	Miss-rate	8.78%	Miss-rate	8.78%	Miss-rate	8.60%
	Writebacks	1	Writebacks	0	Writebacks	0
	C2C	0	C2C	111	C2C	0
	Memory transactions	217	Memory transactions	81	Memory transactions	187
	Interventions	1	Interventions	55	Interventions	54
	Invalidations	33	Invalidations	33	Invalidations	0
	flushes	1	flushes	1	flushes	0
256B	Cache0		Cache0		Cache0	
	No. of reads	2339	No. of reads	2339	No. of reads	2339
	No. of readmisses	155	No. of readmisses	155	No. of readmisses	151
	No. of writes	269	No. of writes	269	No. of writes	269
	No. of writemisses	3	No. of writemisses	3	No. of writemisses	3
	Miss-rate	6.05%	Miss-rate	6.05%	Miss-rate	5.90%
	Writebacks	1	Writebacks	0	Writebacks	0
	C2C	0	C2C	118	C2C	0
	Memory transactions	173	Memory transactions	41	Memory transactions	154
	Interventions	1	Interventions	34	Interventions	33
	Invalidations	34	Invalidations	34	Invalidations	0
	flushes	1	flushes	1	flushes	0
	Cache1		Cache1		Cache1	
	No. of reads	2341	No. of reads	2341	No. of reads	2341
	No. of readmisses	170	No. of readmisses	170	No. of readmisses	167
	No. of writes	229	No. of writes	229	No. of writes	229
	No. of writemisses	1	No. of writemisses	1	No. of writemisses	1
	Miss-rate	6.65%	Miss-rate	6.65%	Miss-rate	6.53%
	Writebacks	2	Writebacks	0	Writebacks	0
	C2C	0	C2C	116	C2C	0
	Memory transactions	192	Memory transactions	57	Memory transactions	168
	Interventions	2	Interventions	36	Interventions	34
	Invalidations	35	Invalidations	35	Invalidations	0
	flushes	0	flushes	2	flushes	0
	Cache2		Cache2		Cache2	
	No. of reads	2396	No. of reads	2396	No. of reads	2396
	No. of readmisses	167	No. of readmisses	167	No. of readmisses	163
	No. of writes	253	No. of writes	253	No. of writes	253
	No. of writemisses	2	No. of writemisses	2	No. of writemisses	2
	Miss-rate	6.37%	Miss-rate	6.37%	Miss-rate	6.22%
	Writebacks	1	Writebacks	0	Writebacks	0
	C2C	0	C2C	119	C2C	0
	Memory transactions	187	Memory transactions	51	Memory transactions	165
	Interventions	1	Interventions	33	Interventions	32
	Invalidations	36	Invalidations	36	Invalidations	0
	flushes	1	flushes	1	flushes	0
	Cache3		Cache3		Cache3	
	No. of reads	1969	No. of reads	1969	No. of reads	1969

	No. of readmisses	175		No. of readmisses	175		No. of readmisses	171
	No. of writes	204		No. of writes	204		No. of writes	204
	No. of writemisses	0		No. of writemisses	0		No. of writemisses	0
	Miss-rate	8.05%		Miss-rate	8.05%		Miss-rate	7.86%
	Writebacks	1		Writebacks	0		Writebacks	0
	C2C	0		C2C	103		C2C	0
	Memory transactions	201		Memory transactions	73		Memory transactions	171
	Interventions	1		Interventions	49		Interventions	48
	Invalidations	33		Invalidations	33		Invalidations	0
	flushes	1		flushes	1		flushes	0

From the above results I could clearly say that if one wants to decrease the miss rate you will have to increase Cache Block size. The reason is simple as more bytes are put into a cache block upon increasing the cache block size. Another thing that I observed was that as Cache block size increased, number of invalidations also increased in MSI and MESI. The reason is very simple as we bring more bytes into a cache block which may be shared by other processors which thereby increases the number of invalidations during a write.