Praneeth Eddu

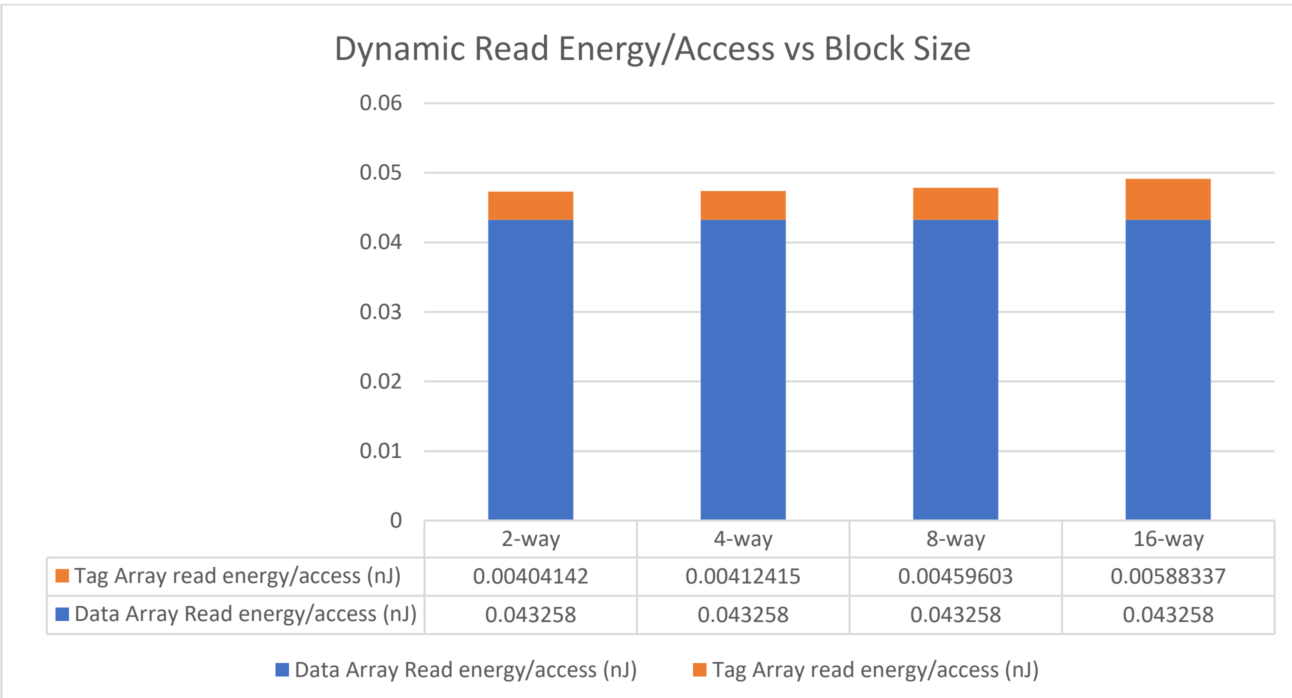
ECE 3056

12/3/18

GTID: 90297078

Assignment 5 – Energy

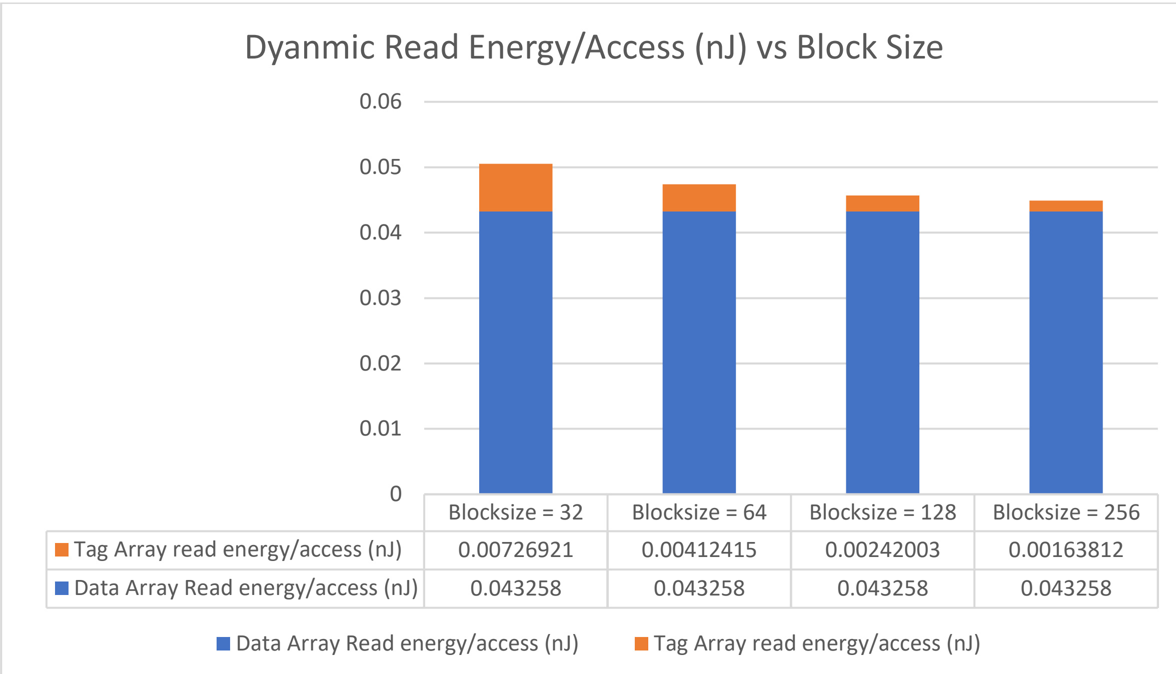
1a.



Analysis:

The dynamic read access time for data array remains the same for all the associativity cases since the cache only retrieves from the data from the data array. However, the set associativity breaks up the tag array into n data paths which in turn increases the number of gates introduced in the architecture. This causes an increase in the transistor switching which leads to an increased the dynamic energy. Hence, the dynamic read energy/access increases as the associativity increases.

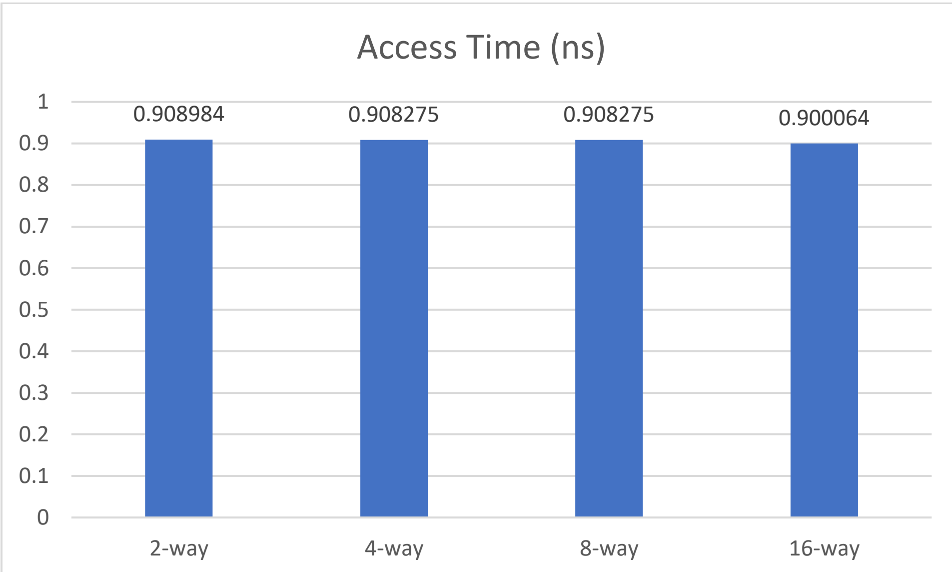
1c.



Analysis:

Increase in block size decreases the tag bits that are needed to be compared for hits/misses. Hence, this decreases the transistor switching and decreases the dynamic energy. Hence the Dynamic Read energy/access decreases as the block size increases.

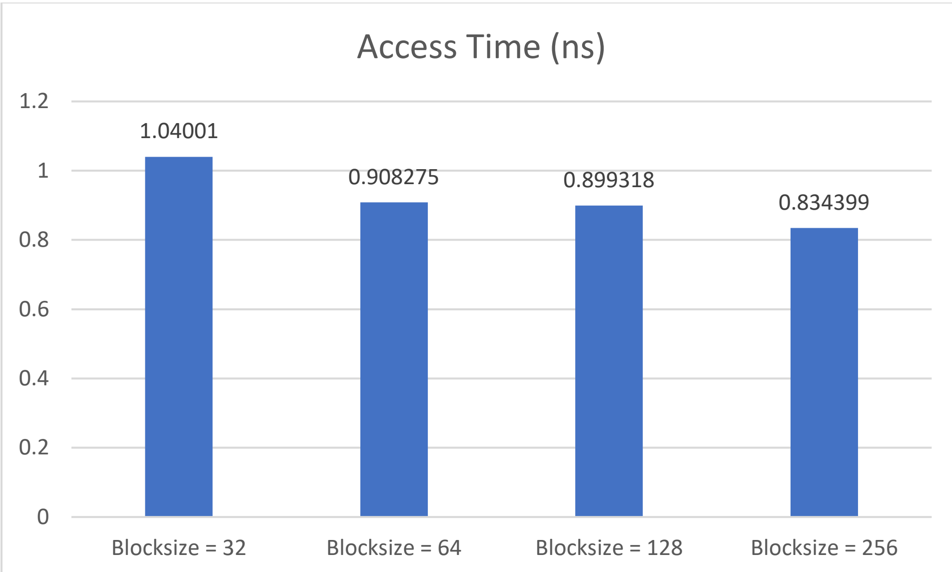
2a.



Analysis:

As mentioned in part 1a. the dynamic power increases as the associativity increases due to higher transistor switching. Theoretically, lower delays are caused by dynamic higher energy. Hence, the access time decreases as the associativity increases. Also, the number of tags bits needed to be compared are reduced with higher associativity which can also cause the reduction in access time.

2b.



Analysis:

As mentioned in part 1c. the increase in block size reduces the tag bits required to be compared which leads to reduced amounts of transistor switching. The lower the transistor switching, the lower the delay. Hence, the access time decreases as the block size increases.

3. The best cache configuration for 256 KB cache that fits closely within 1 mm^2 area and has the minimum energy-delay product is:

Block Size = 8192 Bytes, Associativity = 2 (chosen from all configurations possible)

From the problems 1 and 2, the lower the associativity, the lower combined dynamic read energy/ access has been dispersed. Consecutively, higher block size leads to lower access time. Hence, to satisfy the minimum energy-delay product, the lowest possible associativity (n = 2) and highest possible block size (8192 bytes) have been picked that also meets the area requirements of 1 mm^2.

Associativity	Block Size	Total Dynamic Read Energy/Access (nJ)	Access time (ns)	EDP (ns.nJ)
16	512	0.045835	0.793941	0.0363918
8	512	0.0447239	0.792601	0.0354482
4	512	0.0442472	0.831038	0.0367711
2	512	0.0441766	0.831747	0.0367437
16	1024	0.0455891	0.771621	0.0351775
8	2048	0.0443658	0.761703	0.0337935
4	4096	0.0438368	0758979	0.0332712
2	8192	0.0435655	0.751103	**0.0327221**

All the above test cases met the area requirements of 1 mm^2. After running multiple test cases, EDP for block size of 8192 bytes and n = 2 associativity gave the best results as expected (EDP = **0.0327221** ns.nJ).