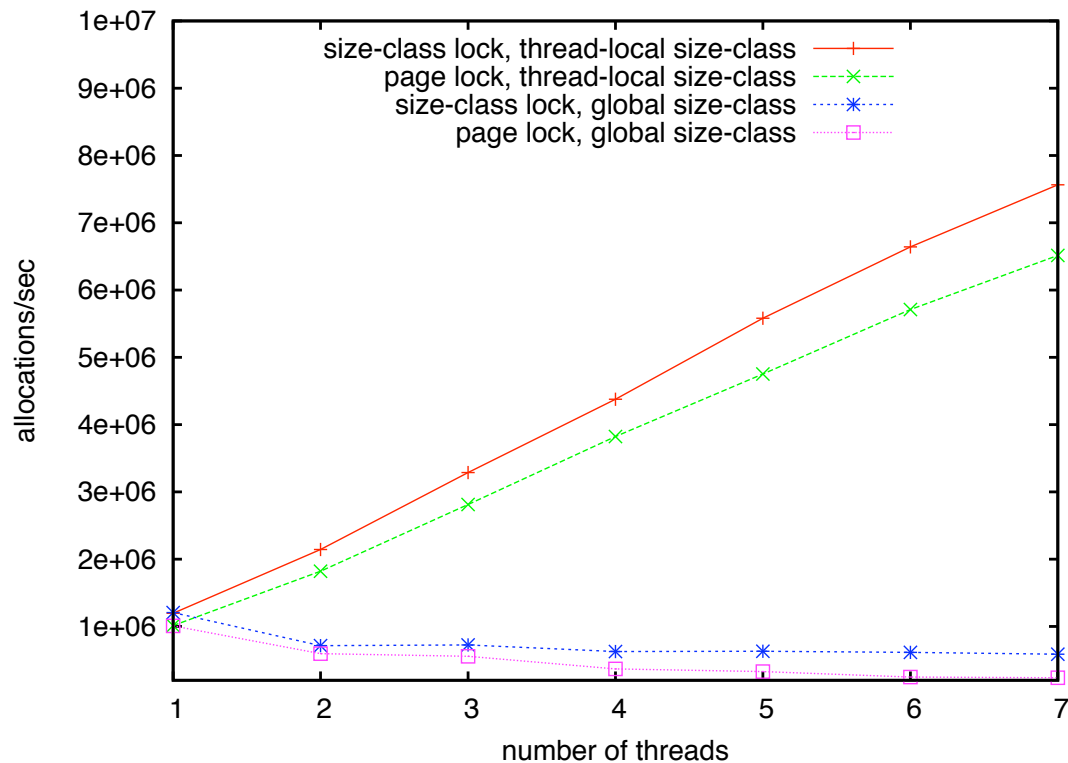
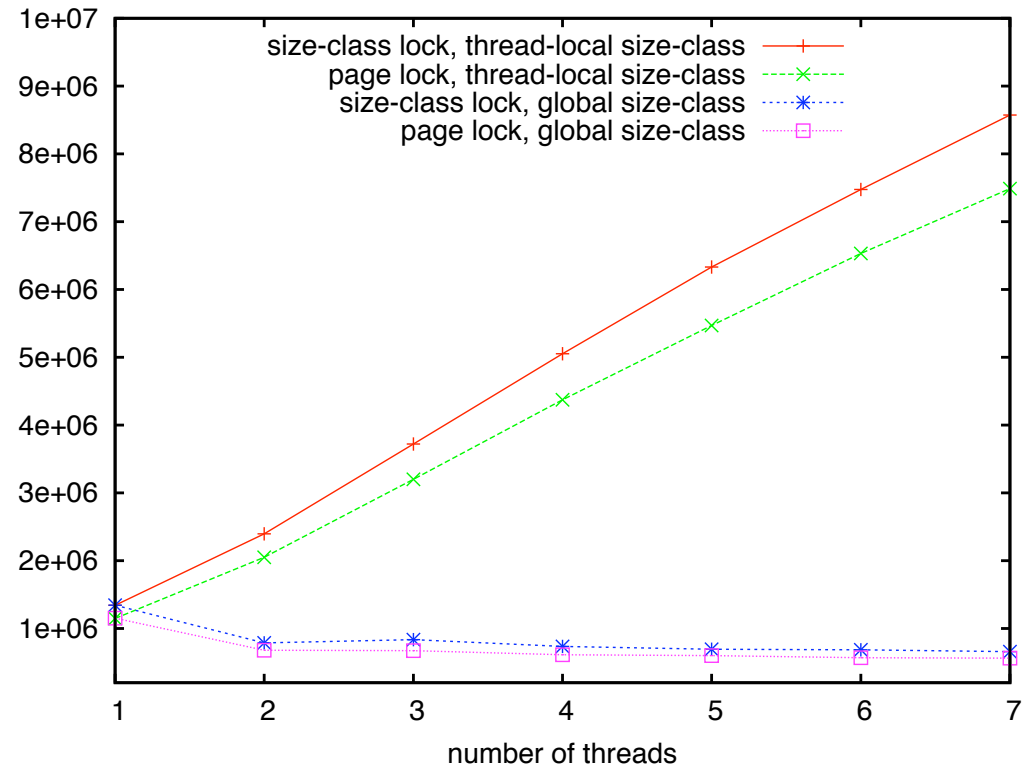


Scalability of Allocation Throughput

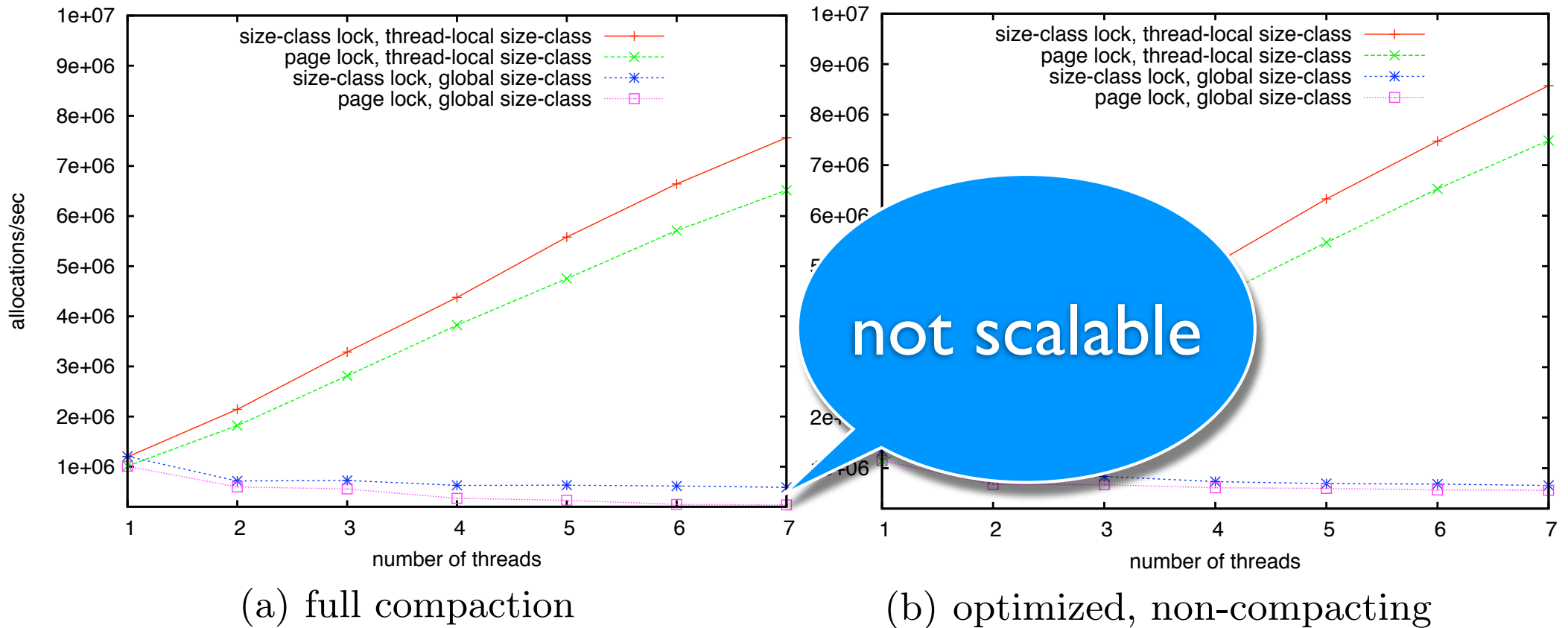


(a) full compaction



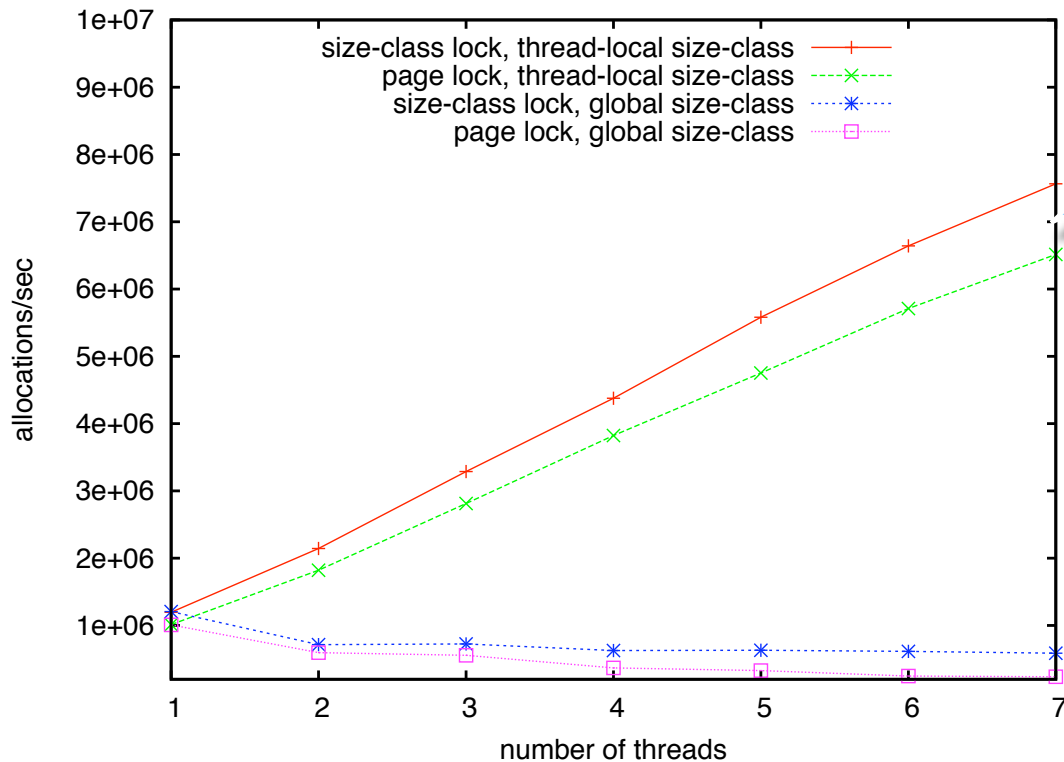
(b) optimized, non-compacting

Scalability of Allocation Throughput

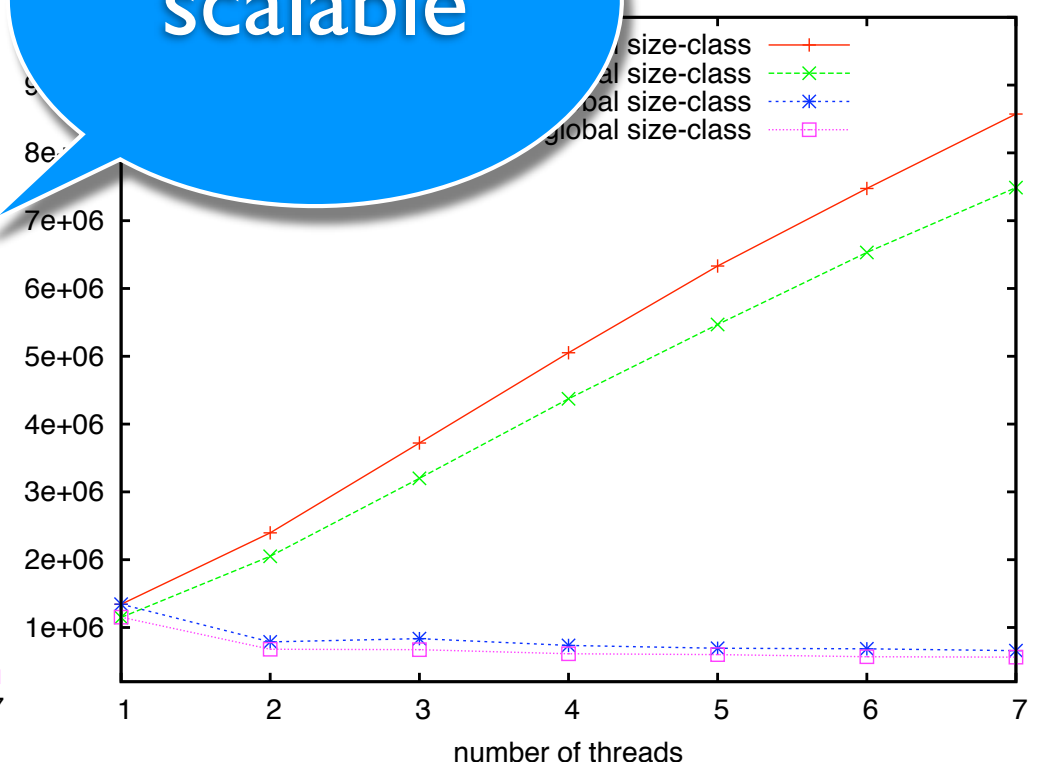


Scalability of Allocation Throughput

scalable



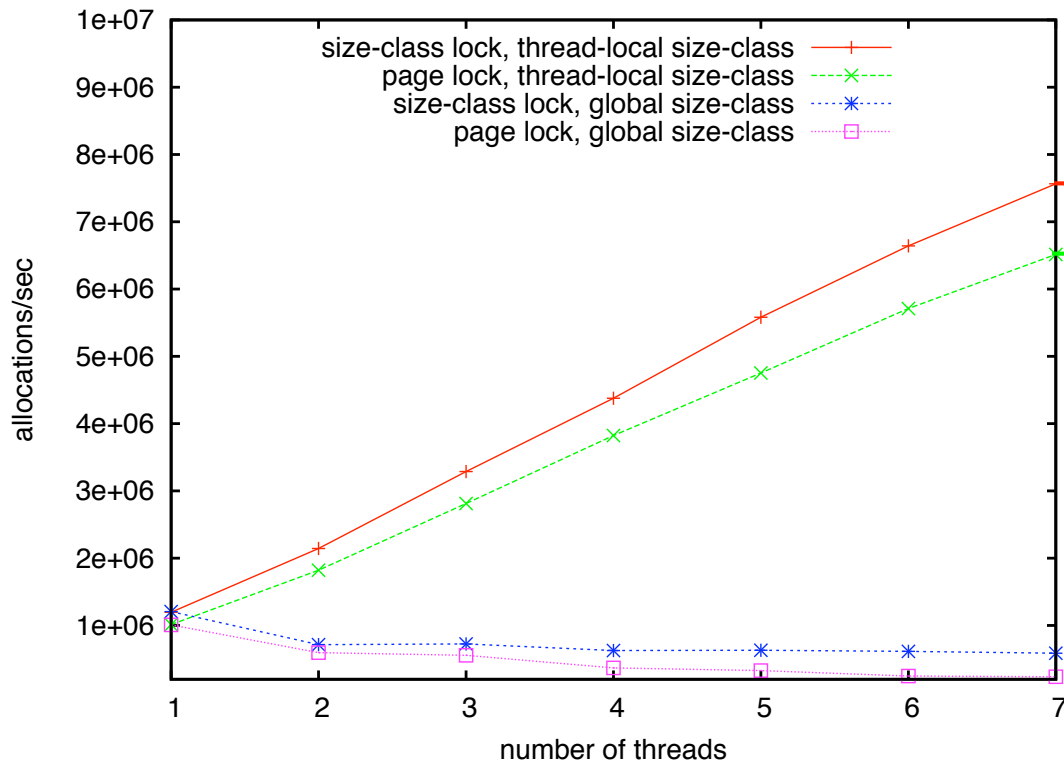
(a) full compaction



(b) optimized, non-compacting

Scalability of Allocation Throughput

no
compaction
is better by a
constant



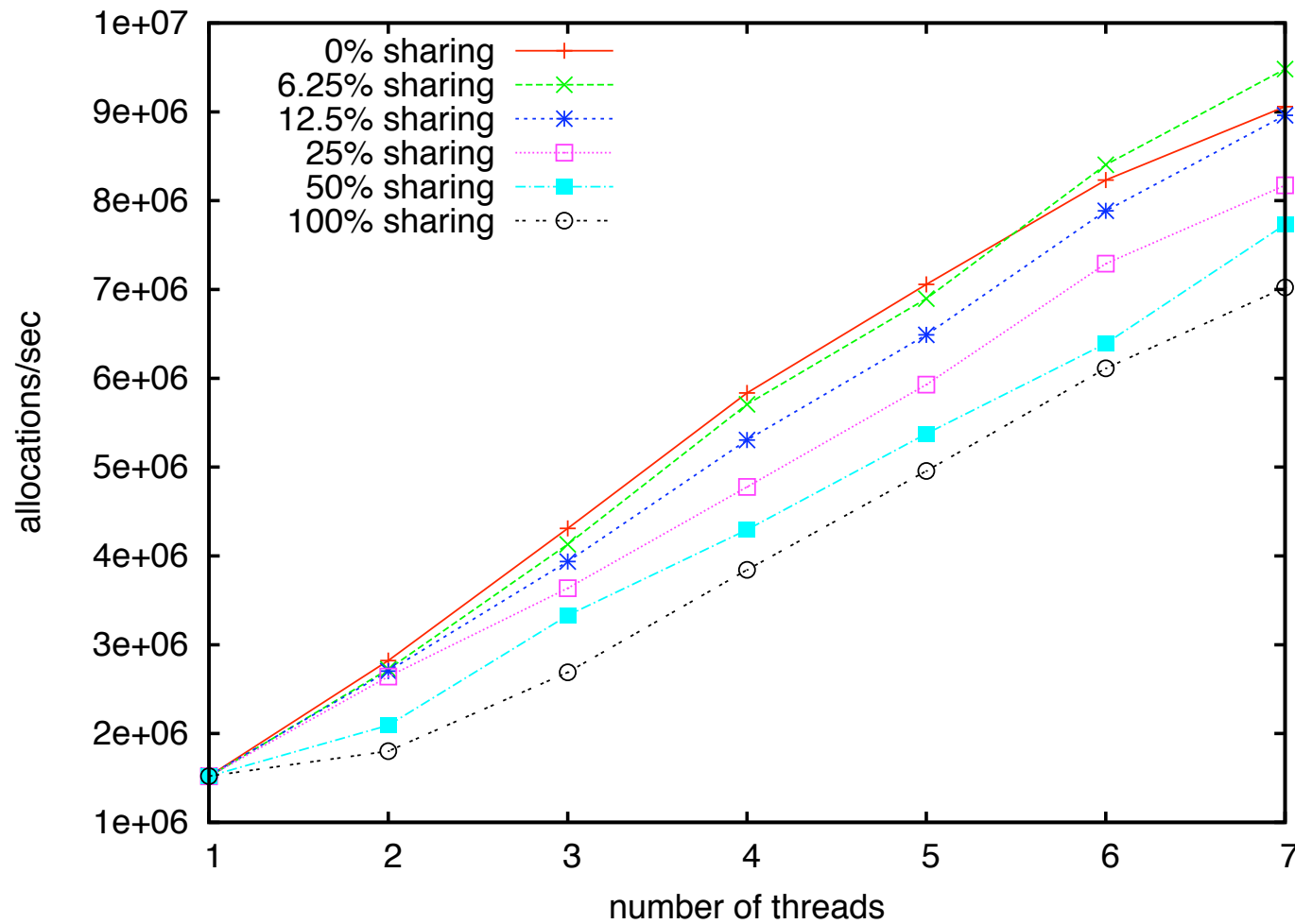
(a) full compaction



(b) optimized, non-compacting

- **global** size-class locks do not scale
- **full** compaction only requires constant factor

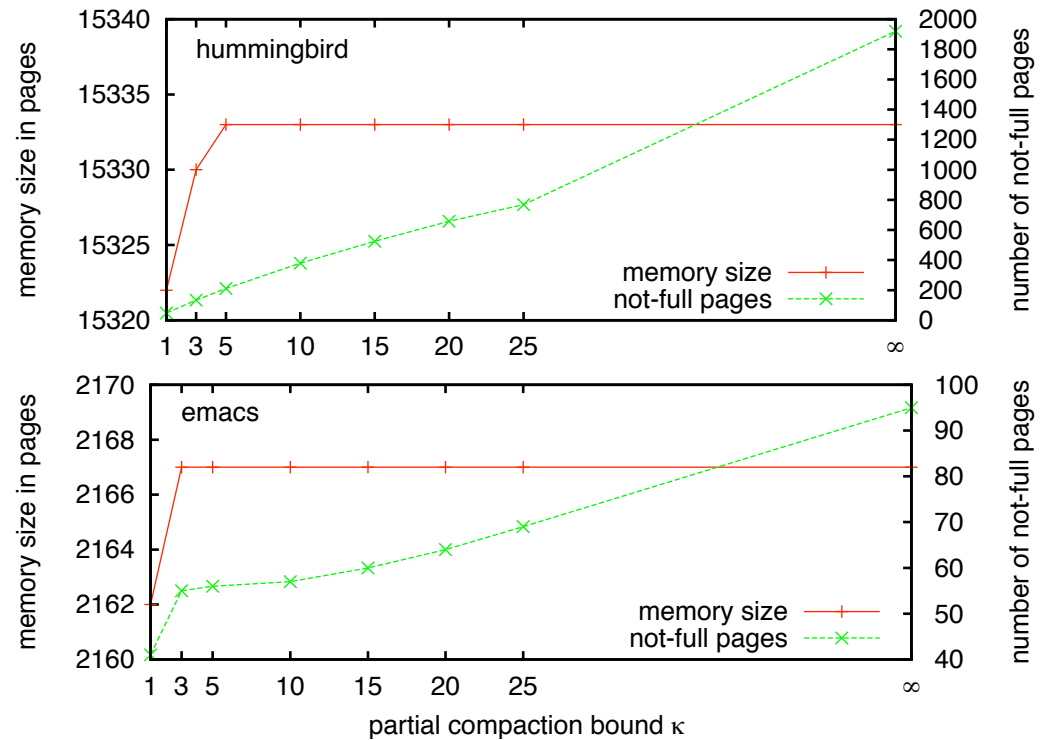
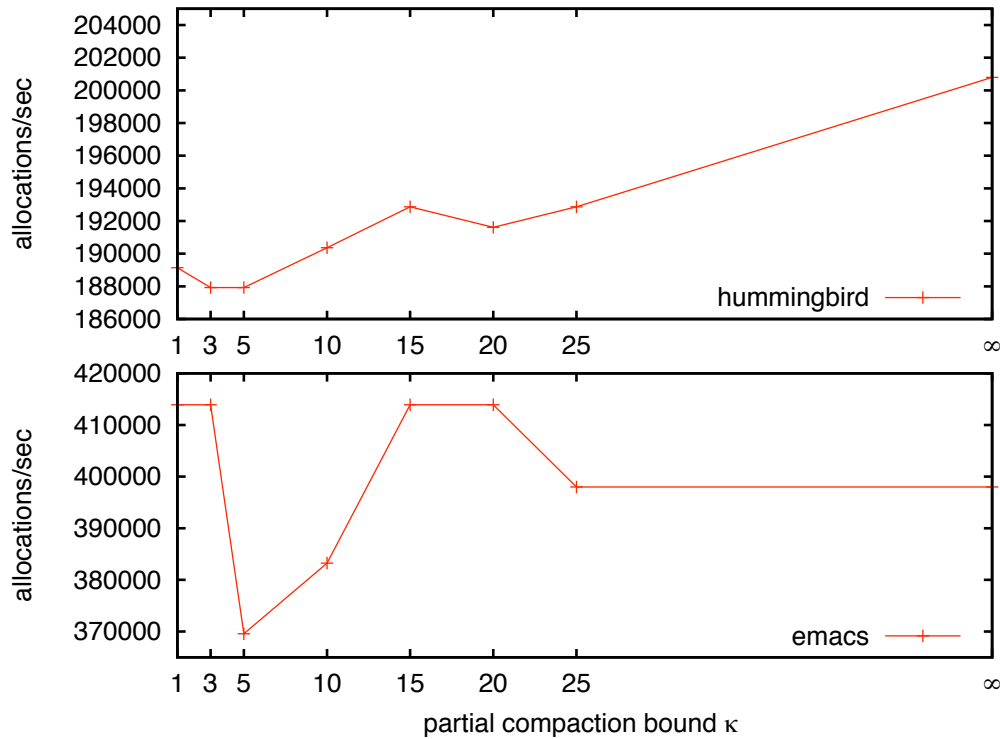
Scalability of Allocation Throughput



(c) opt., non-comp. with sharing

- level of **sharing** determines scalability

Real Application Performance



- **less** compaction **may** result in **better** allocation throughput
- size-class fragmentation **increases** with **less** compaction but total memory consumption **may not**

TLSF vs. opt., non-comp. CF Performance

	memory (in MB)				
	TLSF	CF (16B blocks)		CF (32B blocks)	
	memory size	memory size	size-class fragmentation	memory size	size-class fragmentation
Emacs	25.7	34.6	0.46	34.5	0.38
Hummingbird	203.7	245.3	8.3	245.9	11.4

	malloc (in clock ticks)				free (in clock ticks)			
	TLSF		CF		TLSF		CF	
	avg time	max time	avg time	max time	avg time	max time	avg time	max time
Emacs	228	93359	260	81662	153	71159	279	74798
Hummingbird	411	109079	529	98820	500	69192	574	79914

TLSF vs. opt., non-comp. CF Performance

only 1.3%
of the 35% more
memory

	memory				
	TLSF		CF (16B blocks)		
	memory size	memory size	size-class fragmentation	size-class fragmentation	size-class fragmentation
Emacs	25.7	34.6	0.46	34.5	0.38
Hummingbird	203.7	245.3	8.3	245.9	11.4

	malloc (in clock ticks)				free (in clock ticks)			
	TLSF		CF		TLSF		CF	
	avg time	max time	avg time	max time	avg time	max time	avg time	max time
Emacs	228	93359	260	81662	153	71159	279	74798
Hummingbird	411	109079	529	98820	500	69192	574	79914

TLSF vs. opt., non-comp. CF Performance

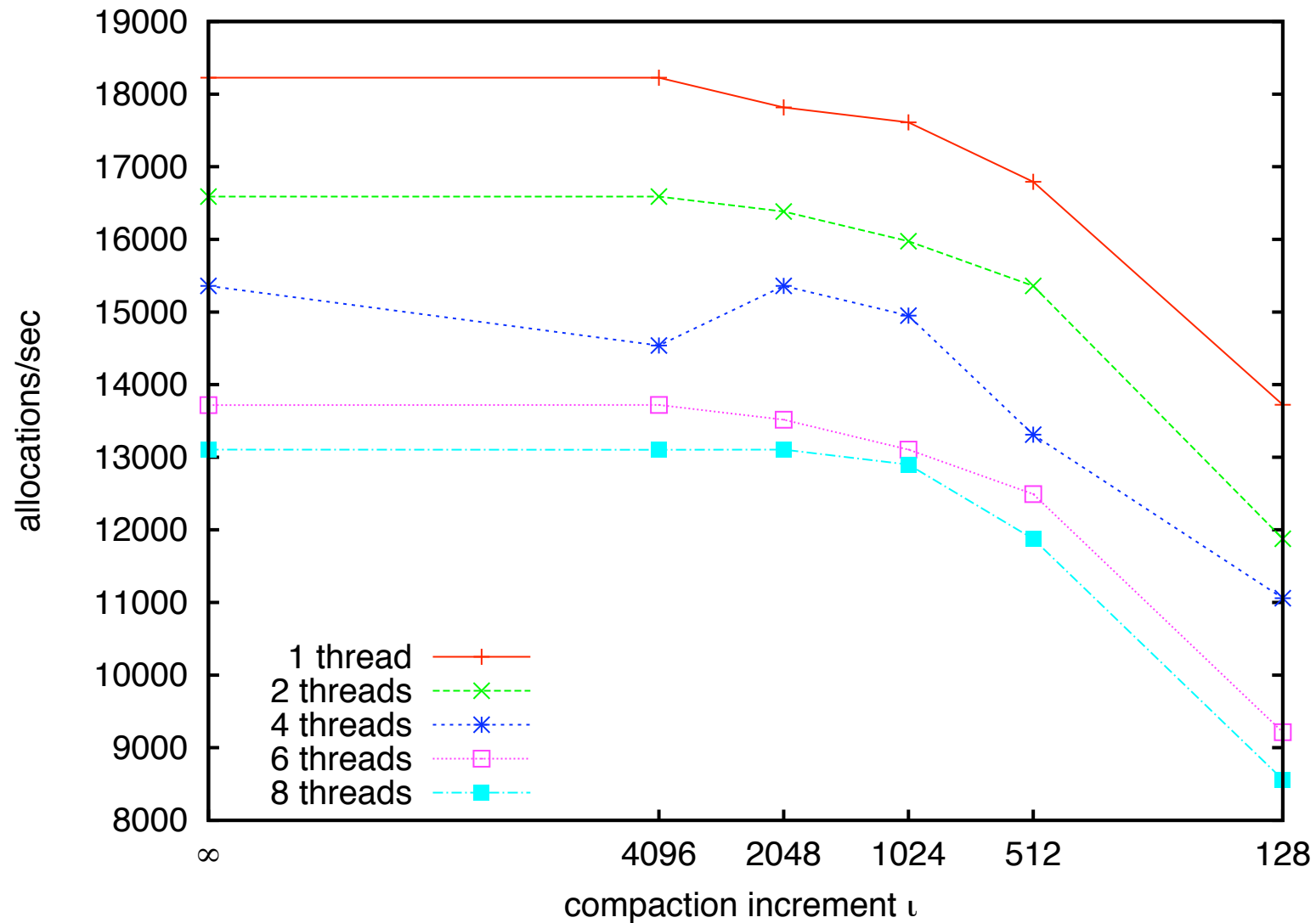
	memory (in MB)				
	TLSF	CF (16B blocks)		CF (32B blocks)	
	memory size	memory size	size-class fragmentation	memory size	size-class fragmentation
Emacs	25.7	34.6	0.46	34.5	0.38
Hummingbird	203.7	245.3	8.3	245.9	11.4

	malloc (in clock ticks)							
	TLSF		CF		CF		CF	
	avg time	max time	avg time	max time	avg time	max time	avg time	max time
Emacs	228	93359	260	81662	153	71159	279	74798
Hummingbird	411	109079	529	98820	500	69192	574	79914

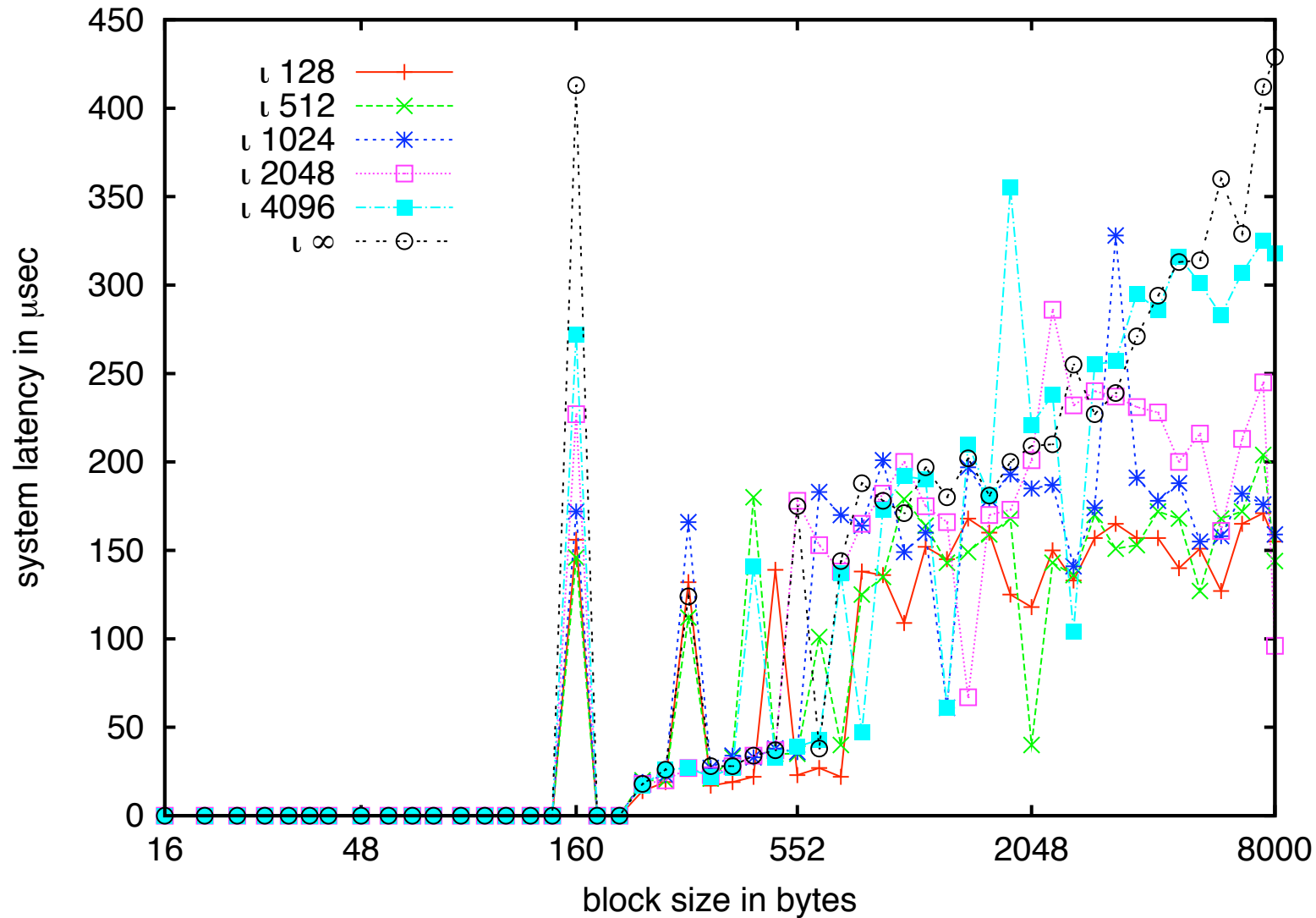
sometimes even better than TLSF

- fragmentation through partitioning **dominates** CF memory consumption
- opt., non-comp. CF only slightly slower than TLSF

Allocation Throughput with Decreasing Compaction Increment



System Latency with 8 Threads and Increasing Block Size



Transient Size-Class Fragmentation with Decreasing Compaction Increment

