

A Simulation-Based Analysis on the Configuration of Burst Buffers

Tianqi Xu[†], Kento Sato[‡] and Satoshi Matsuoka[†]

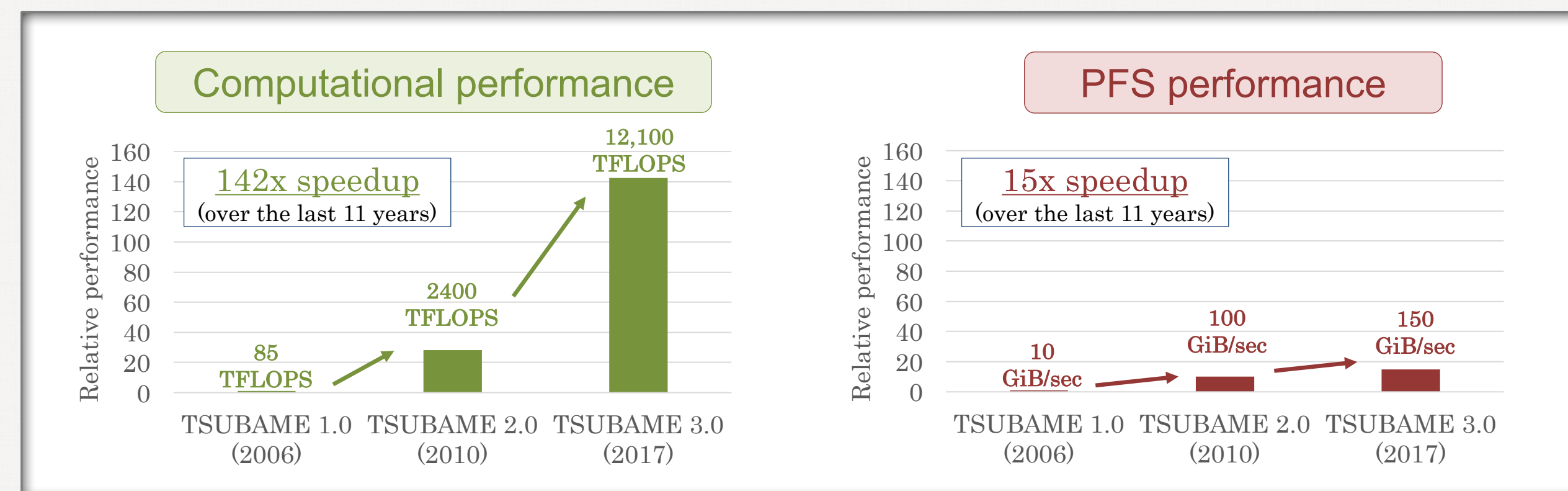
[†] Tokyo Institute of Technology / [‡] Lawrence Livermore National Laboratory



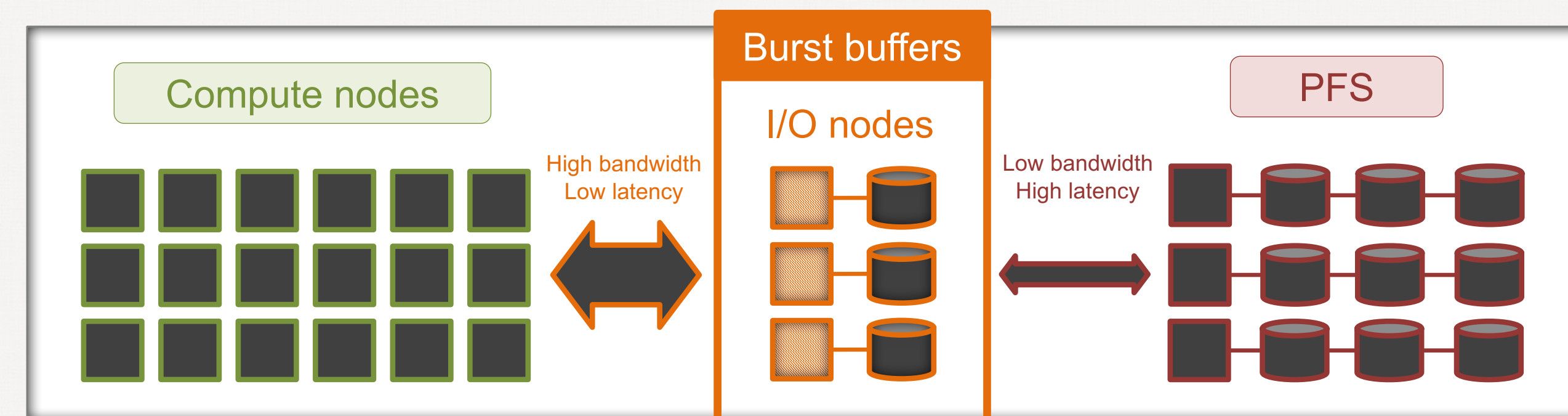
Background

Burst Buffer in HPC

- Computational performance has dramatically increased, but parallel file system (PFS) cannot catch up

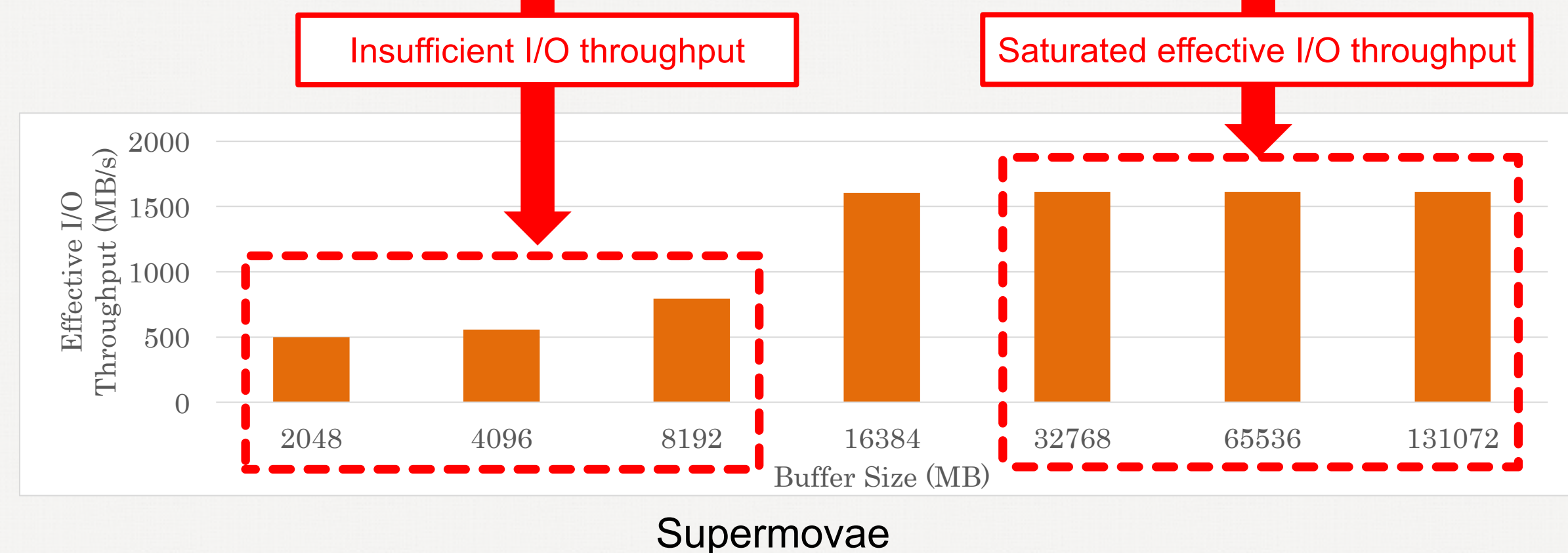


- Burst buffer (BB) systems are designed to alleviate the gap with higher performance but lower capacity



Why do burst buffer configurations matter ?

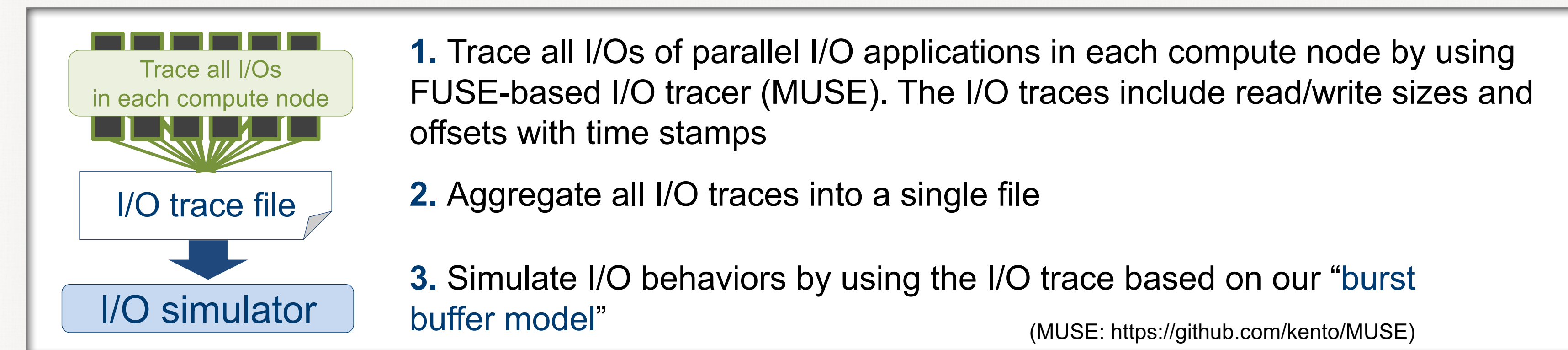
	Small-scale burst buffers	Large-scale burst buffers
Performance	Low bandwidth	High bandwidth
Capacity	Low capacity	High capacity
Cost	Low cost	High cost



To find out the best trade-off between performance, capacity and cost, simulating I/O behaviors of applications in the two-level hierarchical storage is critical

Proposal

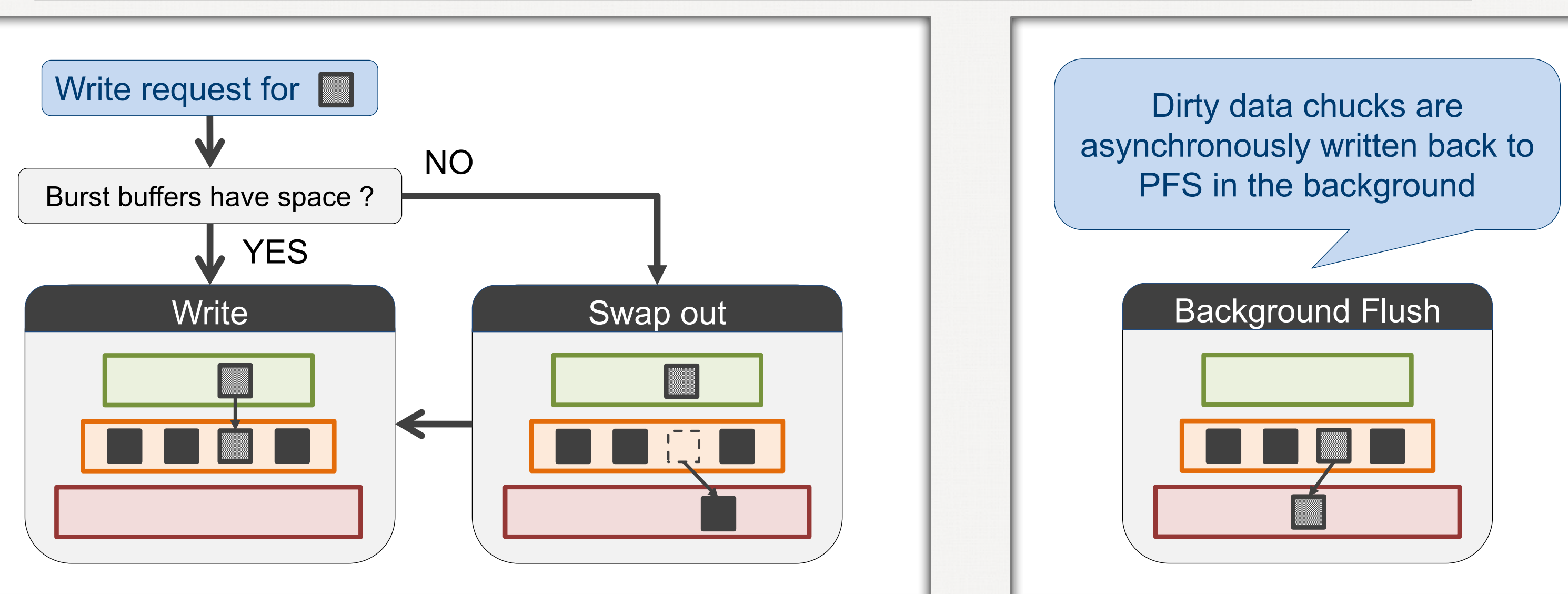
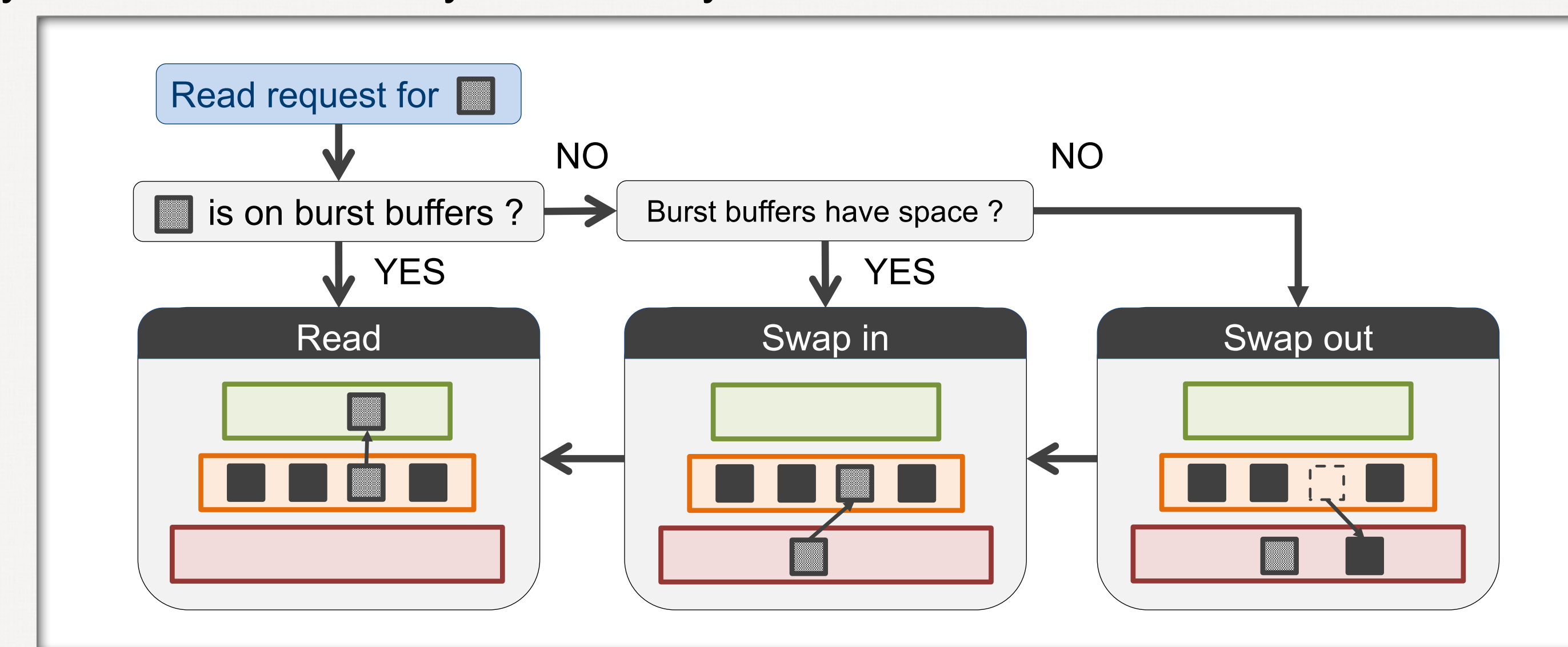
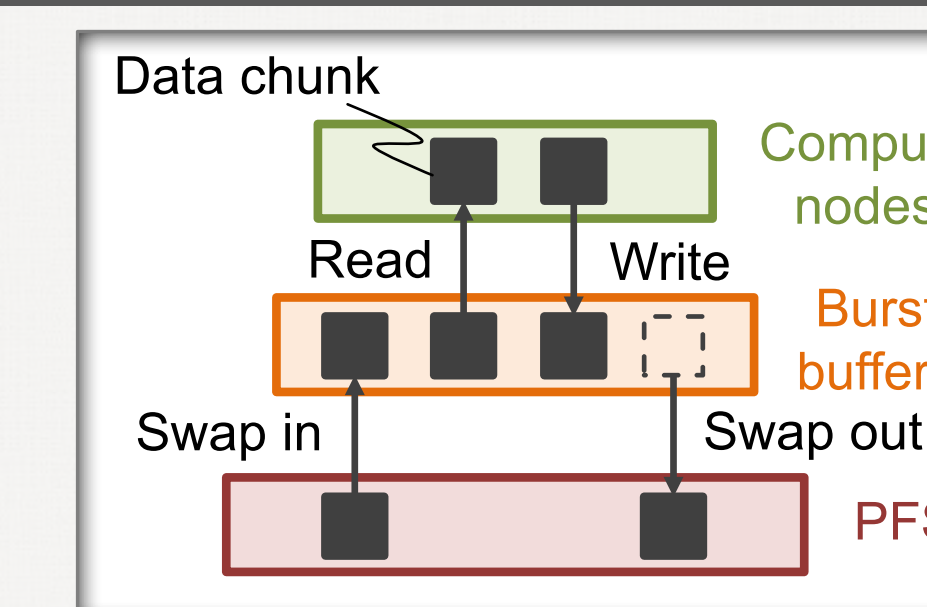
We simulate I/O behaviors of applications under different burst buffer configurations



- Investigate the impact of different buffer sizes
- Estimate I/O performance of applications in different buffer sizes

Burst buffer model

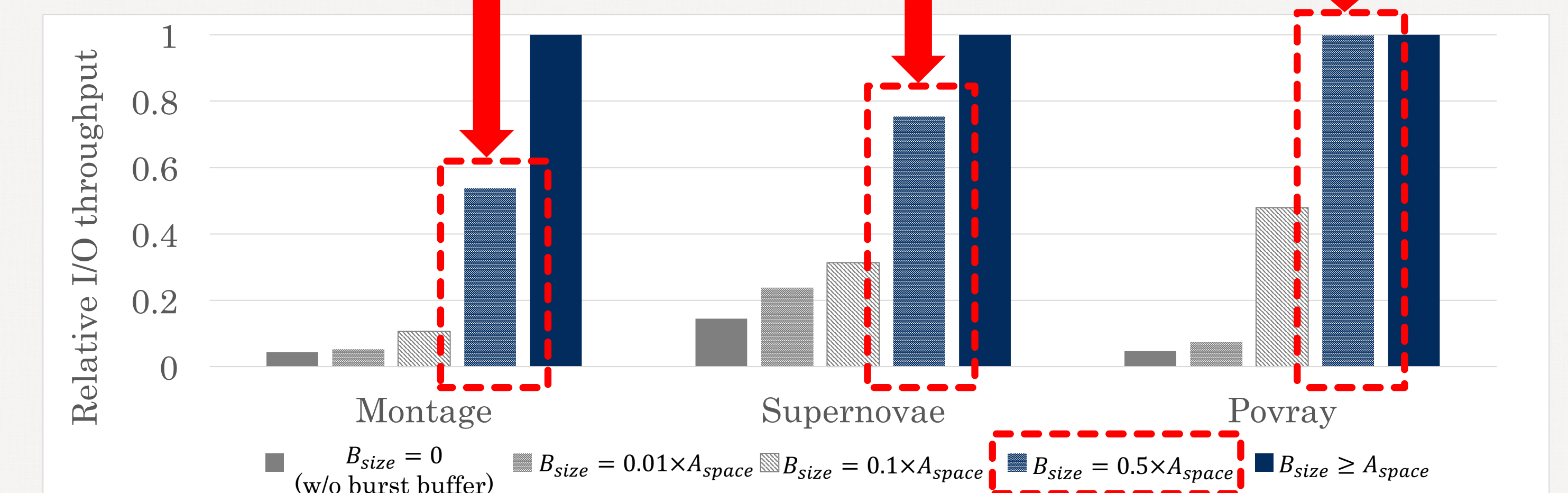
- Files are divided into "data chunks"
- Data chunks are moved between burst buffers and PFS (i.e., swap-in/out) based on a swap algorithm (LRU in this evaluation)
- Dirty data chunks are asynchronously flushed



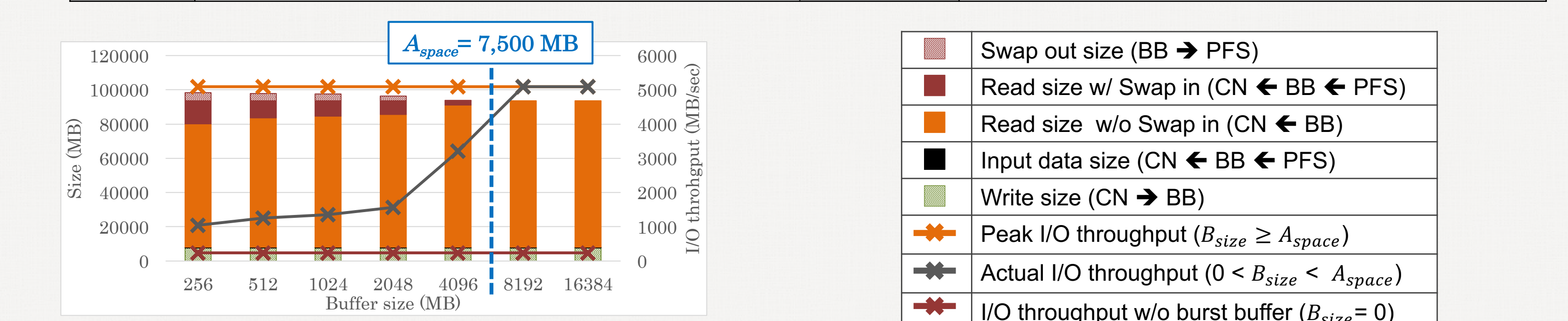
Simulation Results

Simulating environment		Simulating applications			
System	Reedbush (@ University of Tokyo)	Applications	Input Size (MB)	Access Space (A_{space}) (MB)	Total I/O (MB)
Burst buffer	DDN IME 14K x6 (Capacity: 209TB) Latency: 20 us, Bandwidth 436.2 GB/s	Montage	1,200	7,500	27,000
PFS	Lustre DDN SFA 14KE x3 (5.04 PB) Latency 500 us, Bandwidth 145.2 GB/s	Supernovae	6,600	23,000	55,000
		Povray	14	25	760

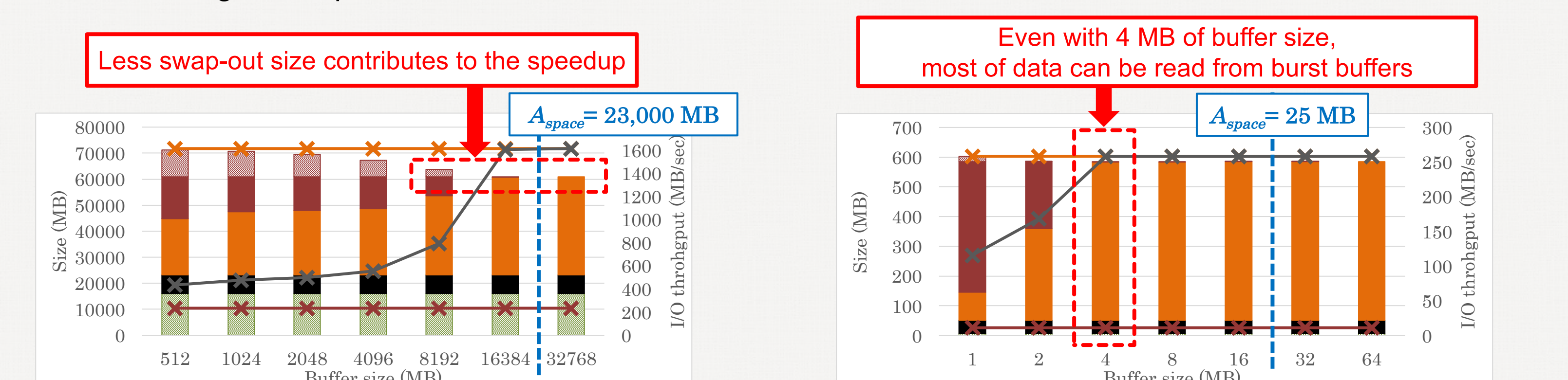
Applications can still achieve comparable I/O performance to its peak I/O performance even with half size of A_{space} of burst buffers



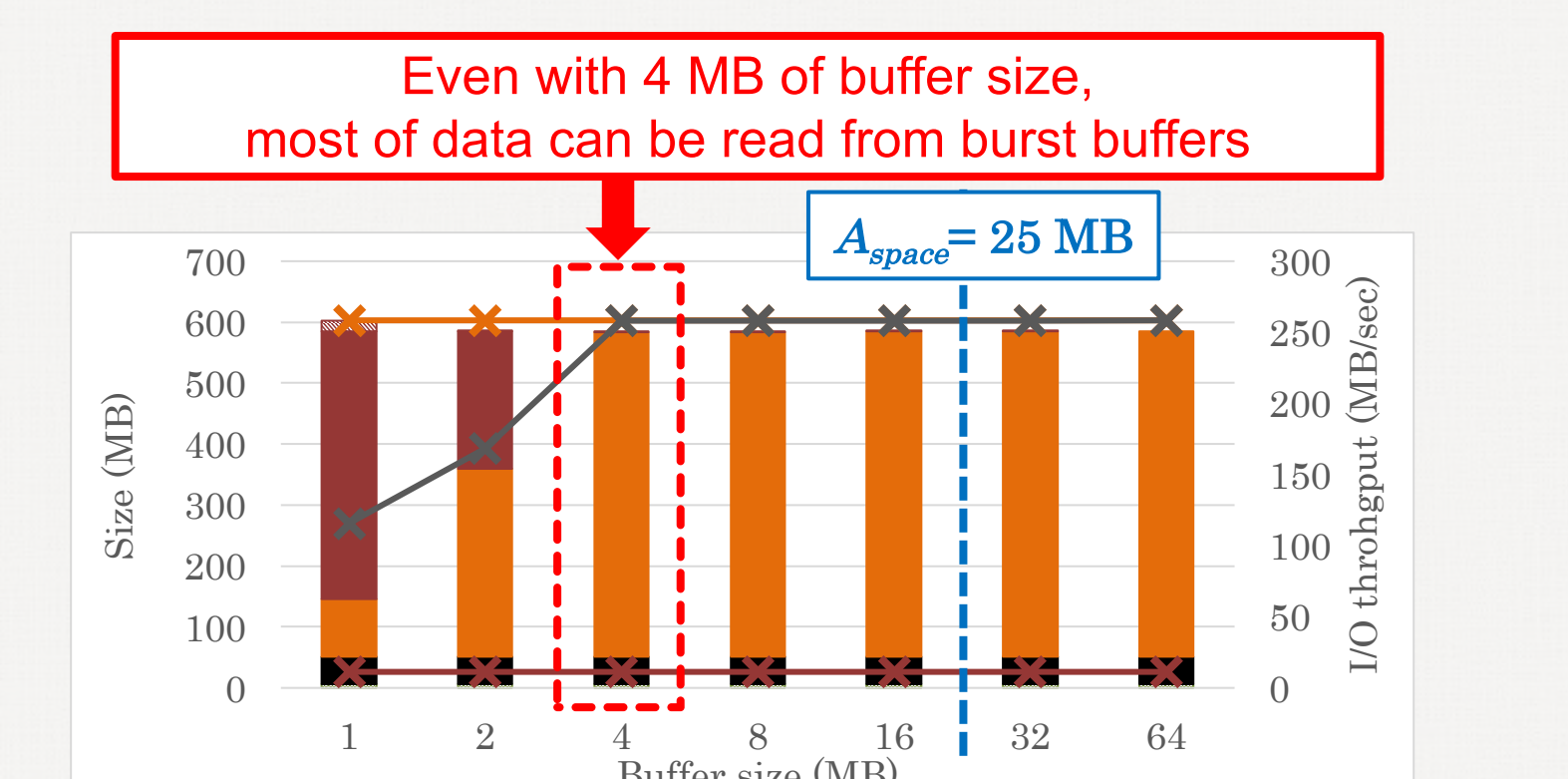
B_{size}	Size of Burst buffers	A_{space}	Total I/O space that an applications access (i.e., Required storage space to run an application)
------------	-----------------------	-------------	--------------------------------------------------------------------------------------------------



Montage: I/O operation break-down



Supernovae: I/O operation break-down



Povray: I/O operation break-down

Conclusion

- We investigate the performance under different buffer sizes
- Burst buffer configurations have huge impact to the performance
- We can still achieve the peak I/O performance with less than half of required storage space to run