Make Your PostgreSQL 10x Faster on Cloud in Minutes

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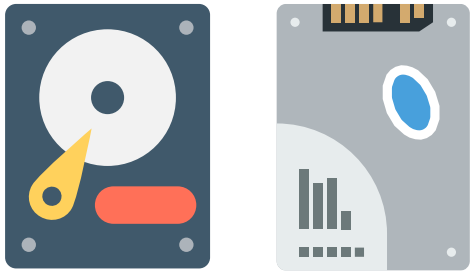
apposha

Physical vs. Cloud Storage

All storages are not created equal



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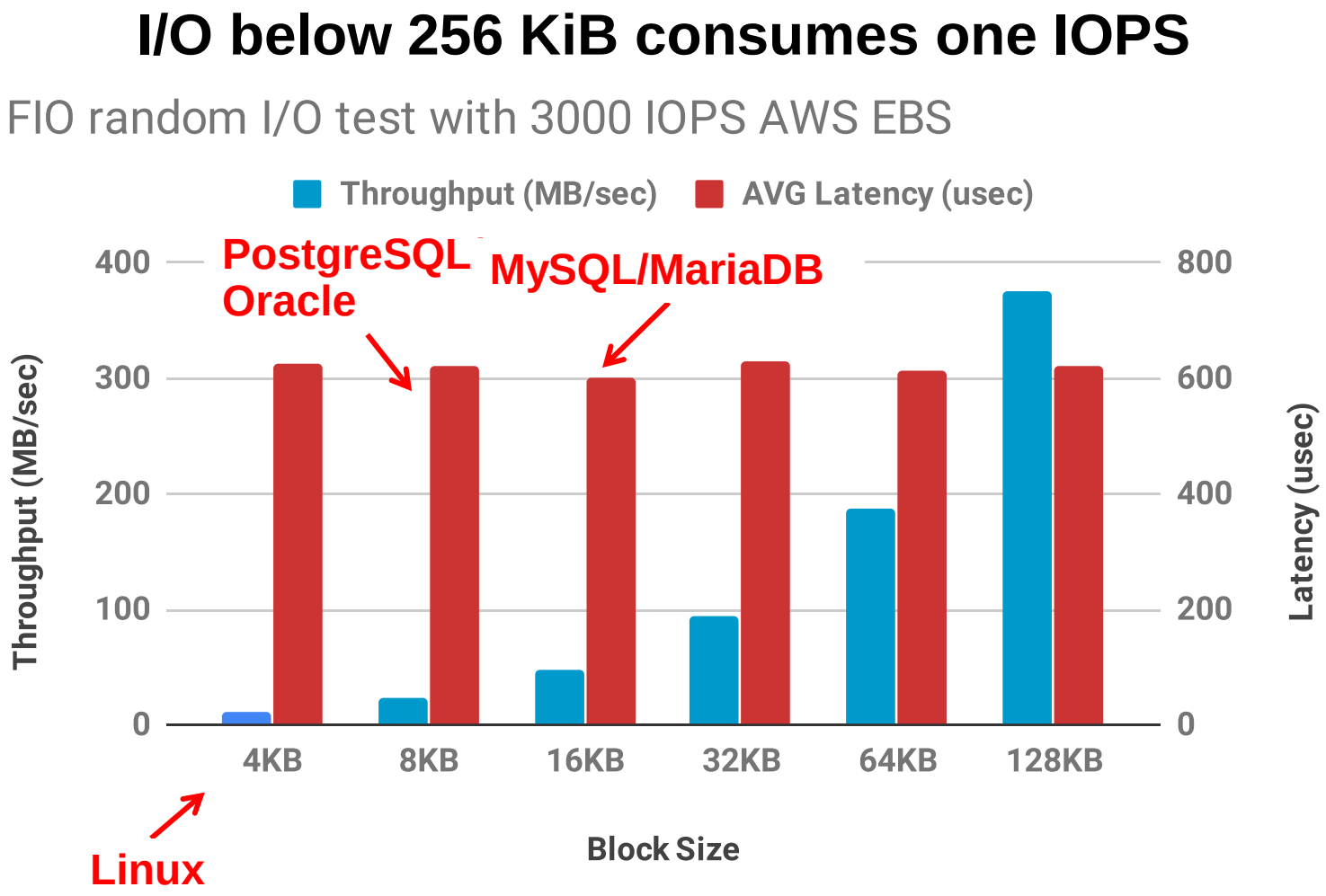
Purchase H/W
HW-controlled

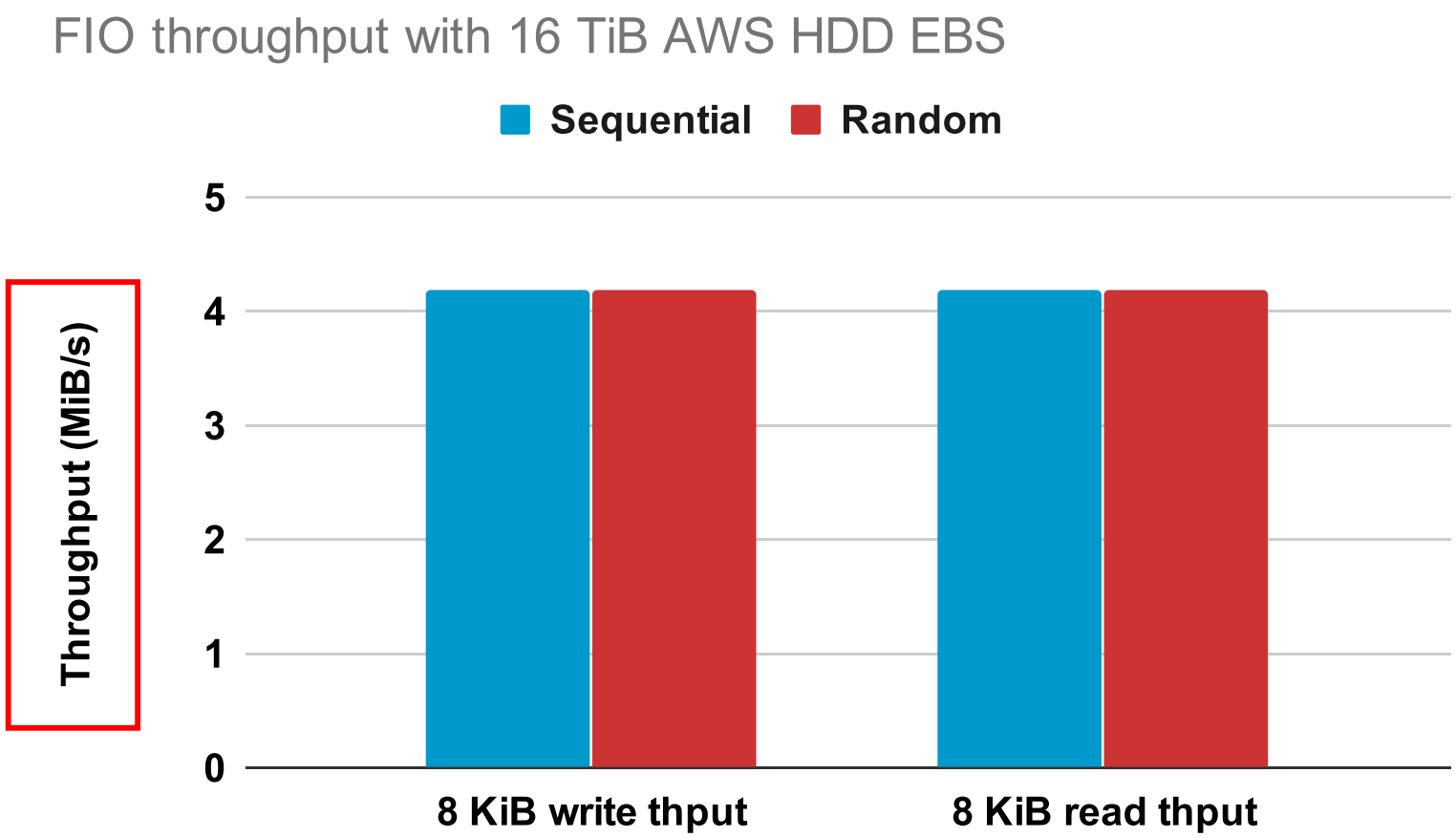
Pay-as-you-go
SW-controlled

Example: AWS SSD Storage



Example: AWS HDD Storage (1)

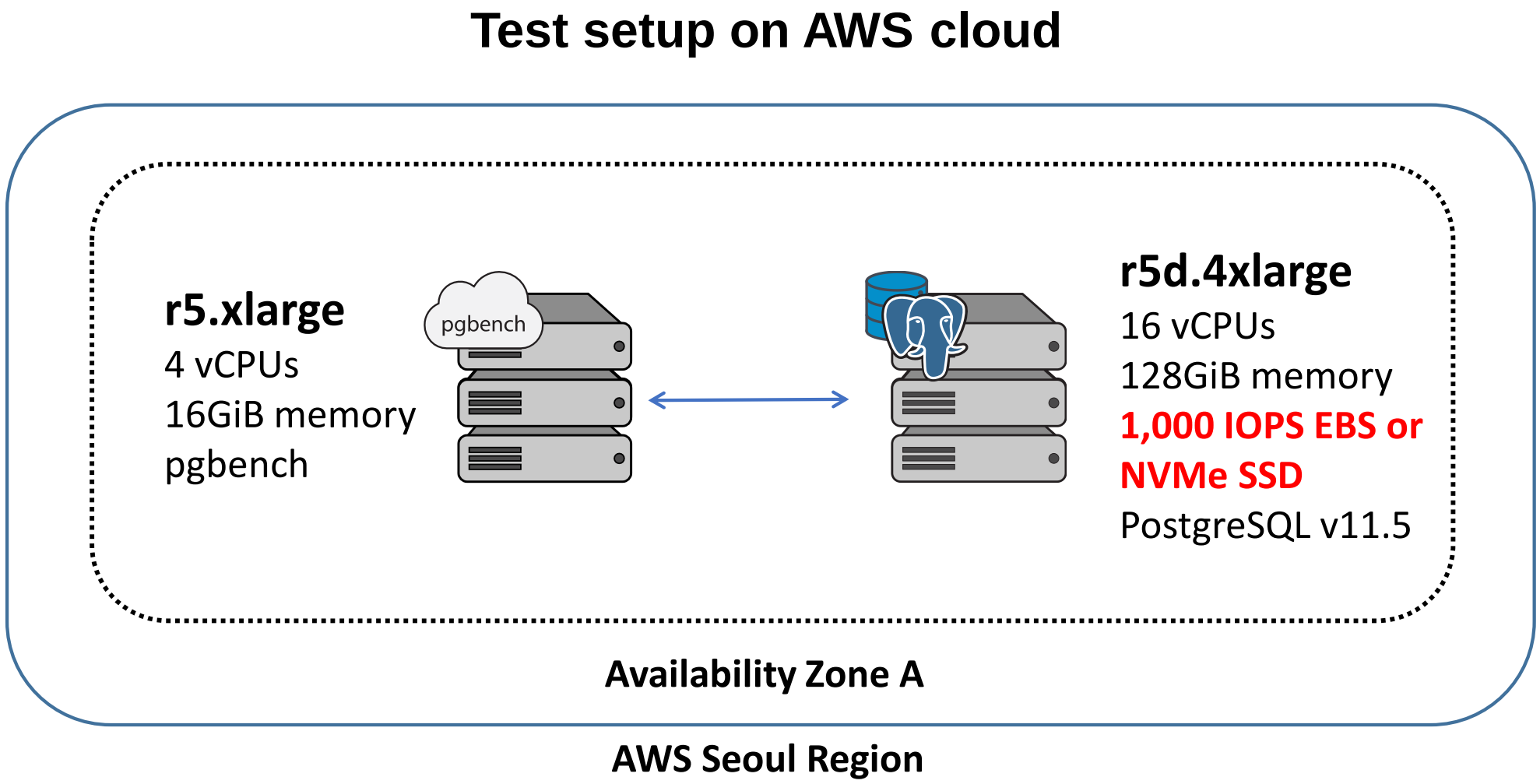
Sequential and random I/O show identical performance



Example: AWS HDD Storage (2)

Sequential and random I/O show identical performance

Illustrative Experiment (1)



PGTune - calculate configuratio

pgtune.leopard.in.ua/#/

앱 Bookmarks test Search KVM Networking -... Block I/O Controlle... VDBench [PATCH] cgroup: li... dtv wiki autoit.ip.ne.kr 1. 리눅스서버의 전...

DB Type what is this?

Online transaction processing systems

Total Memory (RAM) what is this?

128 GB

Number of CPUs what is this?

16

Number of Connections what is this?

500

Data Storage what is this?

SSD storage

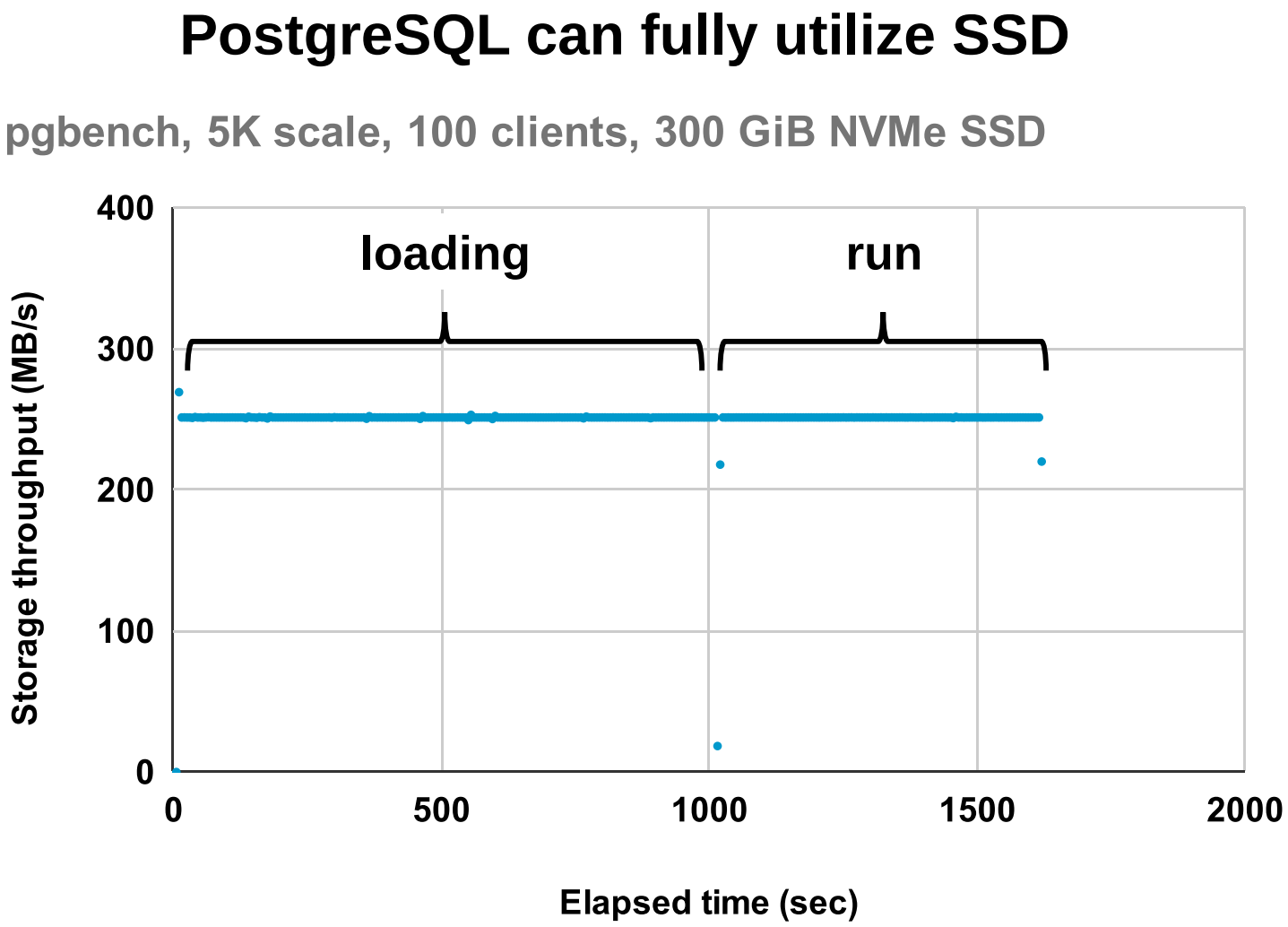
Generate

```
# this tool not being optimal
# for very high memory systems

# DB Version: 11
# OS Type: linux
# DB Type: oltp
# Total Memory (RAM): 128 GB
# CPUs num: 16
# Connections num: 500
# Data Storage: ssd

max_connections = 500
shared_buffers = 32GB
effective_cache_size = 96GB
maintenance_work_mem = 2GB
checkpoint_completion_target = 0.9
wal_buffers = 16MB
default_statistics_target = 100
random_page_cost = 1.1
effective_io_concurrency = 200
work_mem = 8388kB
min_wal_size = 2GB
max_wal_size = 4GB
max_worker_processes = 16
max_parallel_workers_per_gather = 8
max_parallel_workers = 16
```

Illustrative Experiment (2)

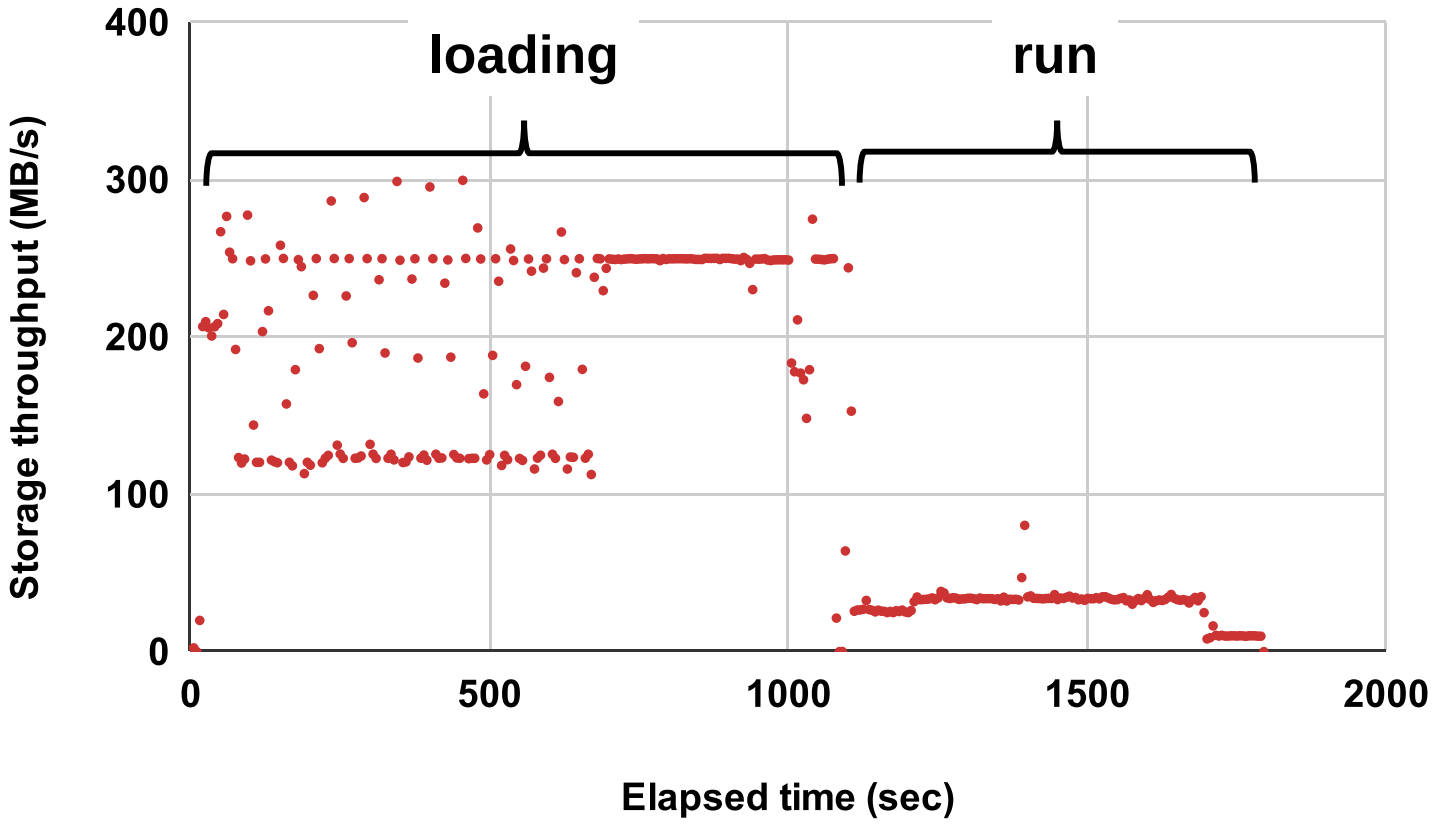


13,000 TPS

Illustrative Experiment (3)

PostgreSQL cannot fully utilize cloud storage

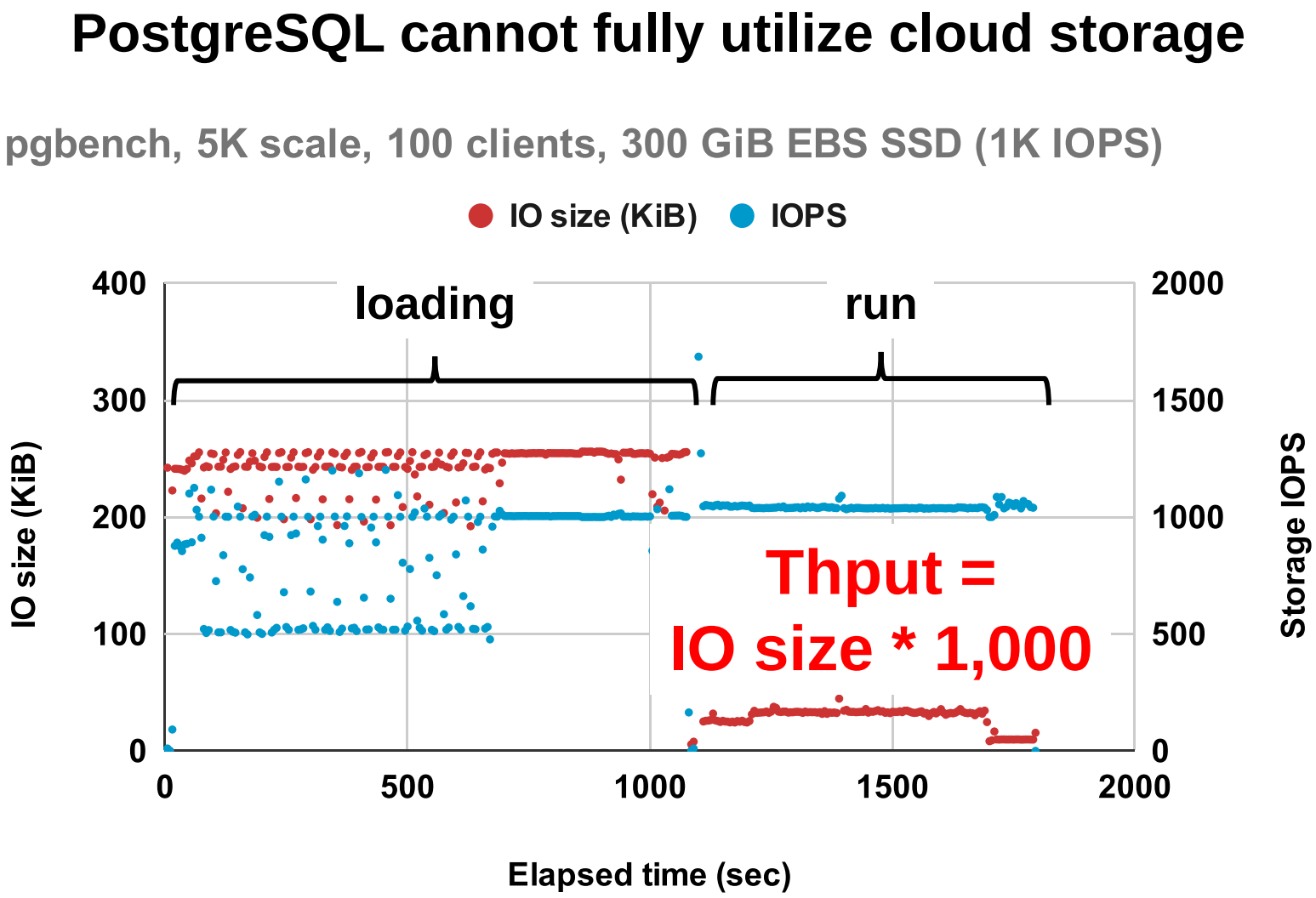
pgbench, 5K scale, 100 clients, 300 GiB EBS SSD (1K IOPS)



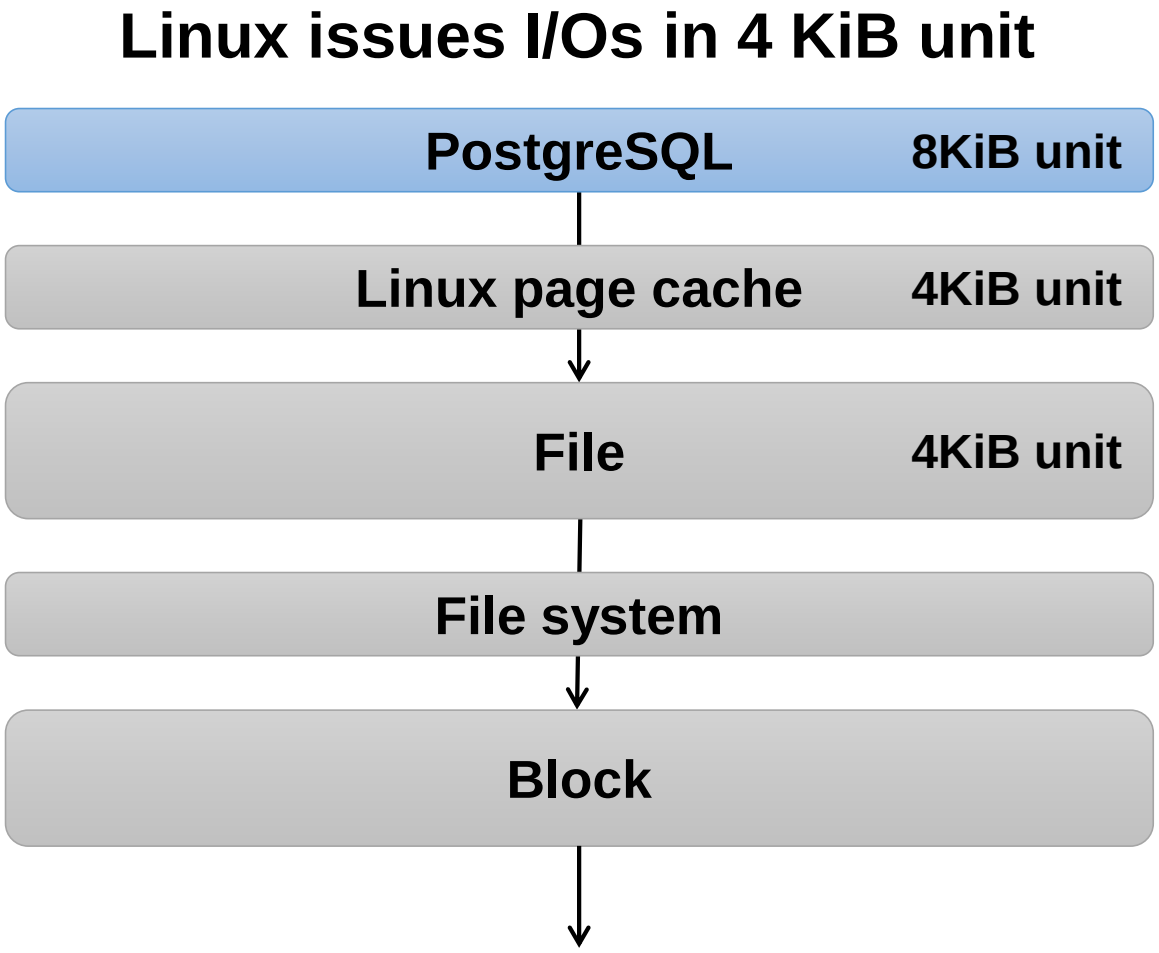
13,000 TPS

1,000 TPS

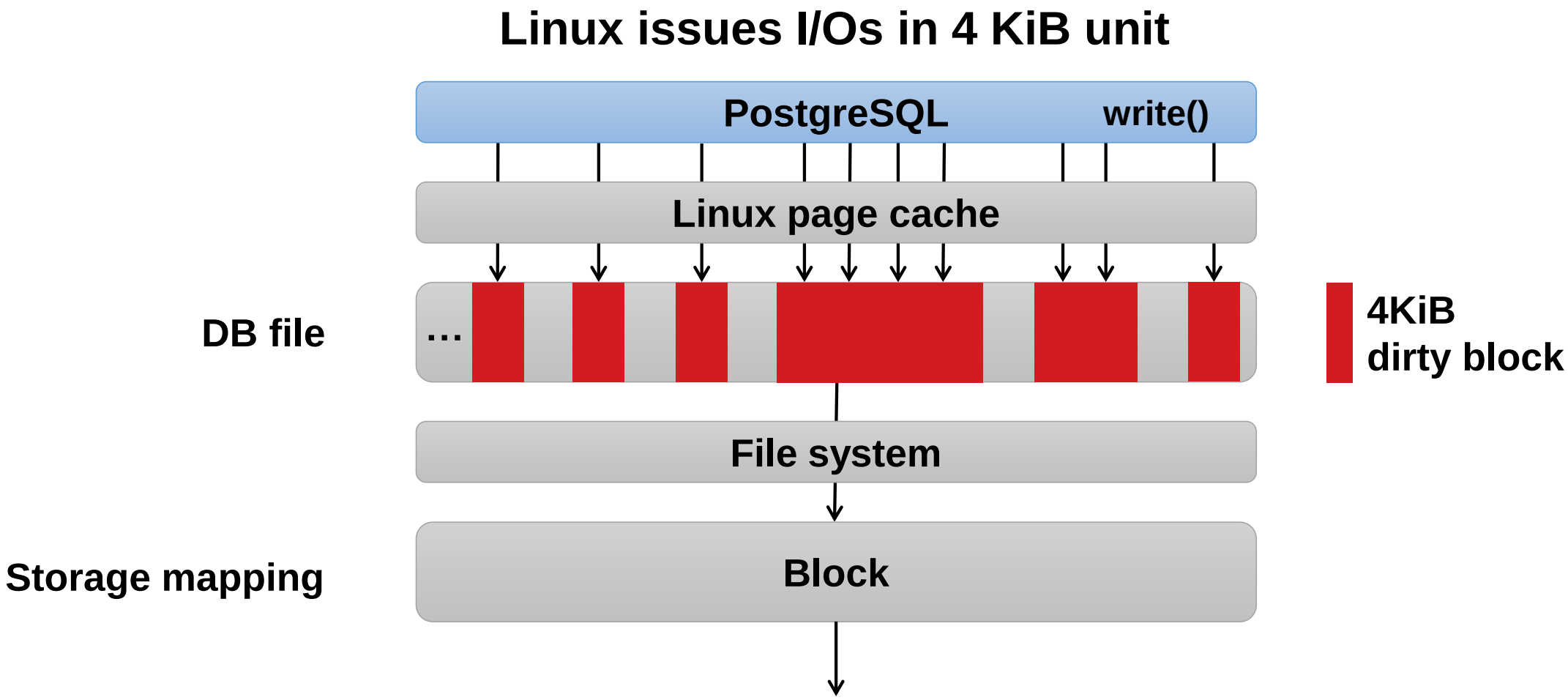
Illustrative Experiment (4)



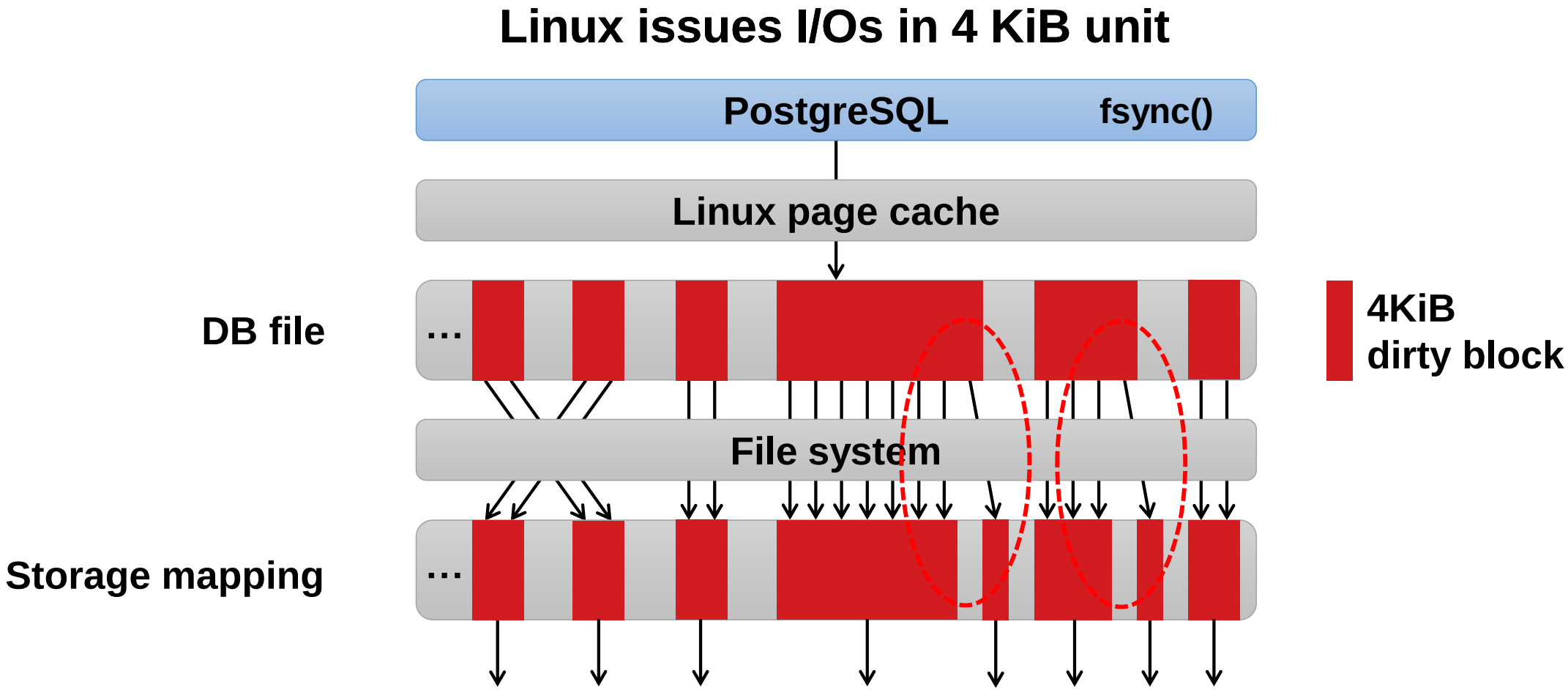
What's the Problem? (1)



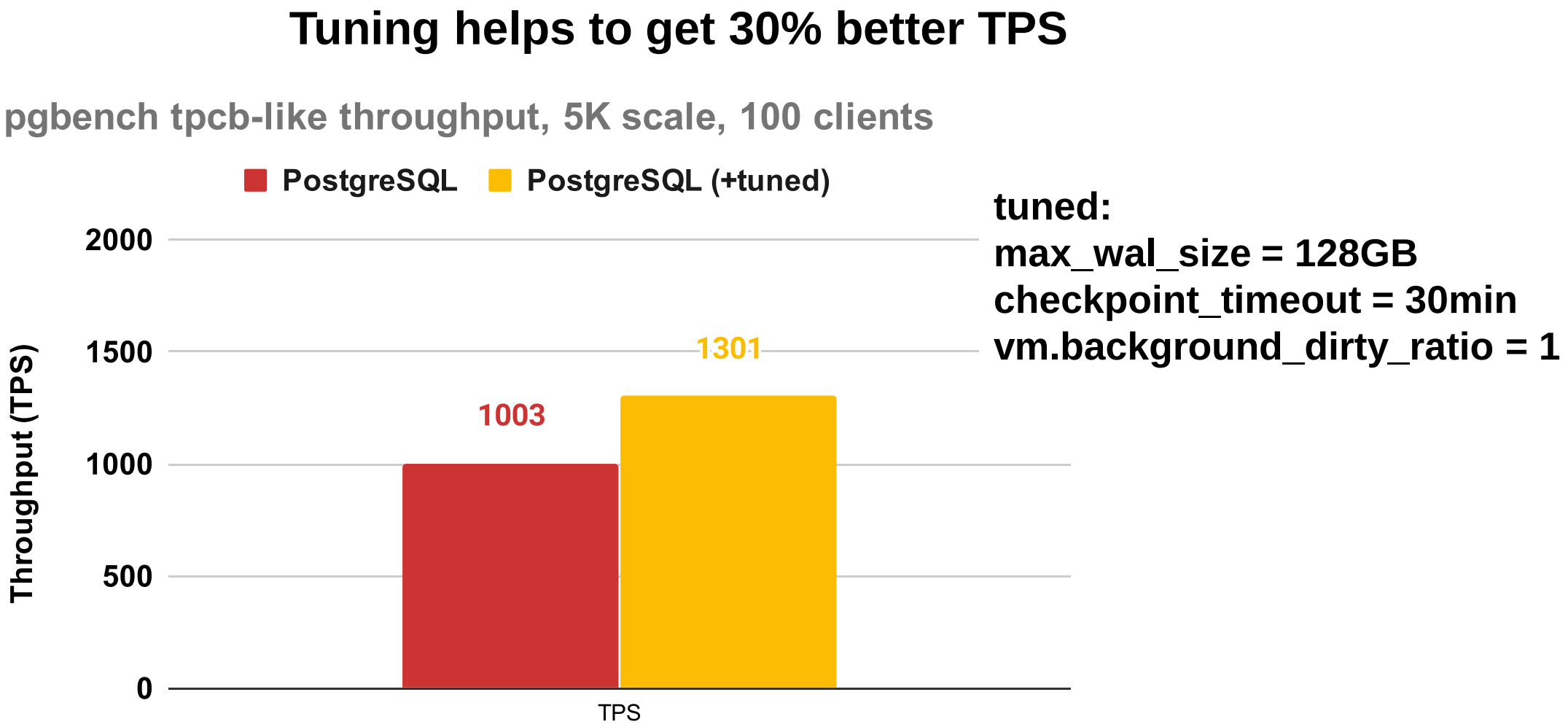
What's the Problem? (2)



What's the Problem? (3)



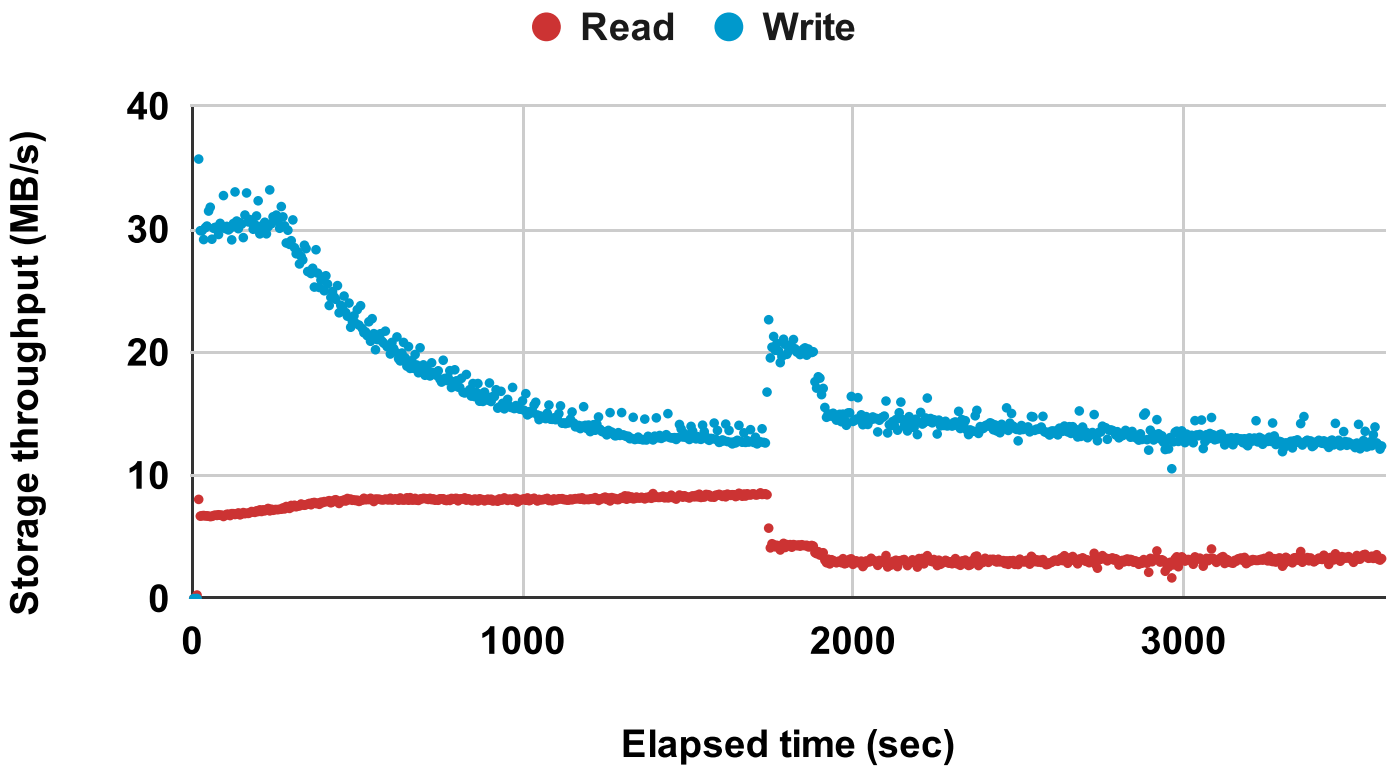
Tuning PostgreSQL (1)



Tuning PostgreSQL (2)

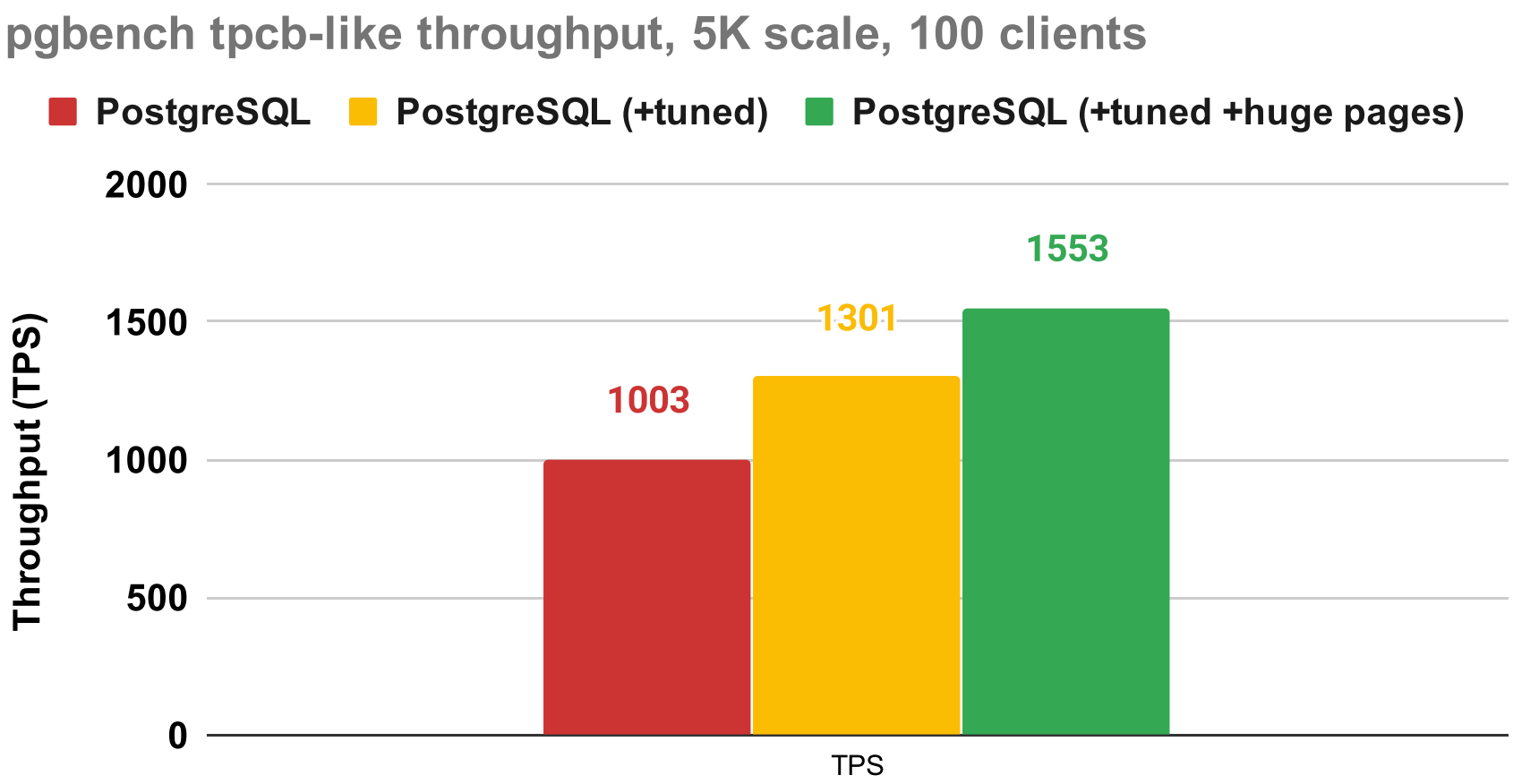
Be aware of cache space contention inside OS

PostgreSQL (+tuned) storage throughput during pgbench run



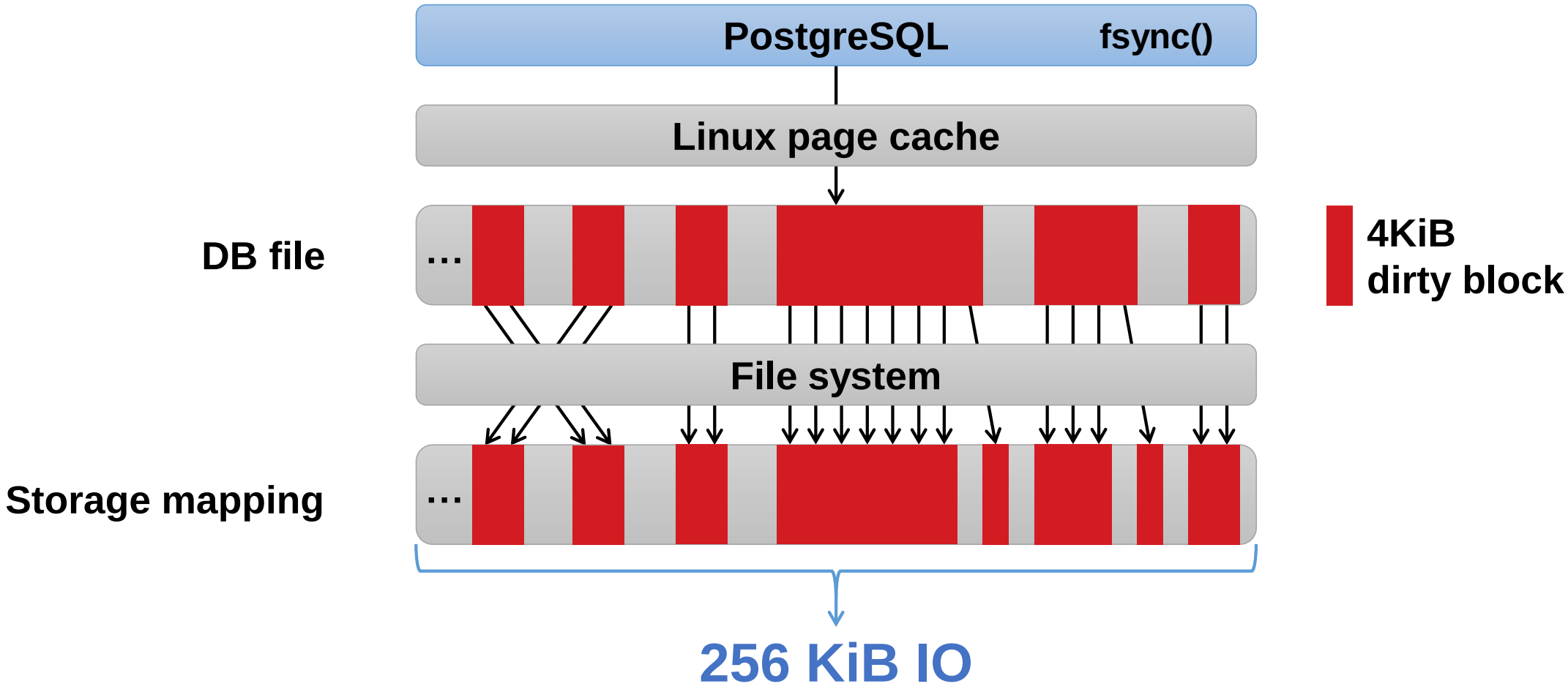
Tuning PostgreSQL (3)

Using huge pages additionally improves 20%



Possible Solution for AWS EBS SSD

What if we can issue 1 IO instead of 8?



Cloud Storage Diversity

Each cloud has different policy for its storage

	IOPS	Thput	Note
ebs-gp2	3/GiB	250	Burstable
ebs-io1	$67/1K/M	500	
ebs-st1	500	40/TiB	Burstable
ebs-sc1	250	12/TiB	Burstable

Google Cloud

	IOPS	Thput	Note
pd-ssd	30/GiB	0.48/GiB	
pd-ssd-16kb	30/GiB	0.48/GiB	16 KiB
pd-std	1.5/GiB	0.12/GiB	
pd-std-16kb	1.5/GiB	0.12/GiB	16 KiB

	IOPS	Thput	Note
ultra	$49/1K/M	$1/MB/M	
pre-ssd	20,000	900	Burstable
std-ssd	6,000	750	Pay # IOs
std-hdd	2,000	500	Pay # IOs

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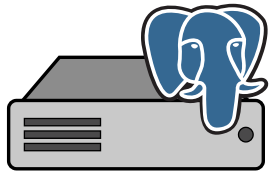
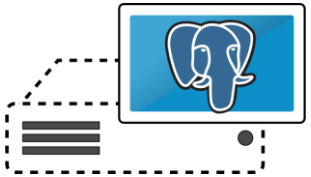
AppOS Extension

AppOS is a file engine built for diverse types of storage

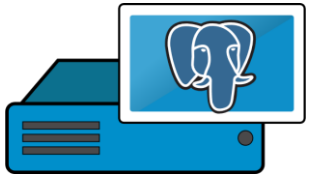
Bare metal



Virtual machine



Container



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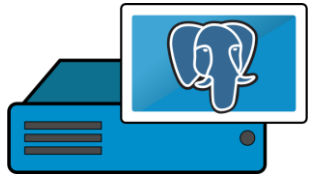
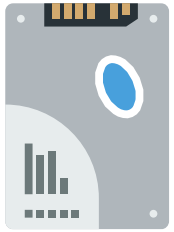


AppOS extension



aws

Google Cloud

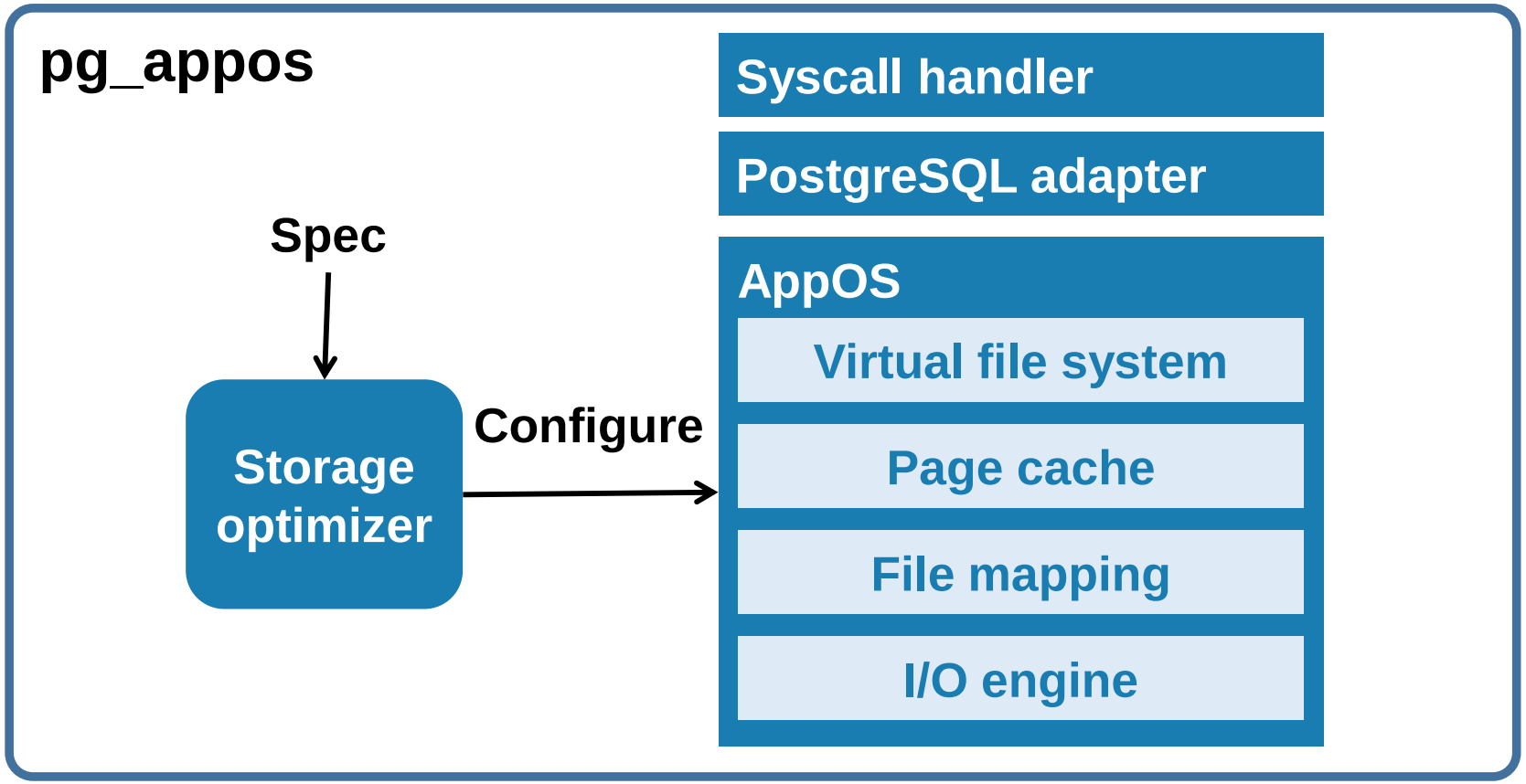
Microsoft Azure

AppOS Design Goals

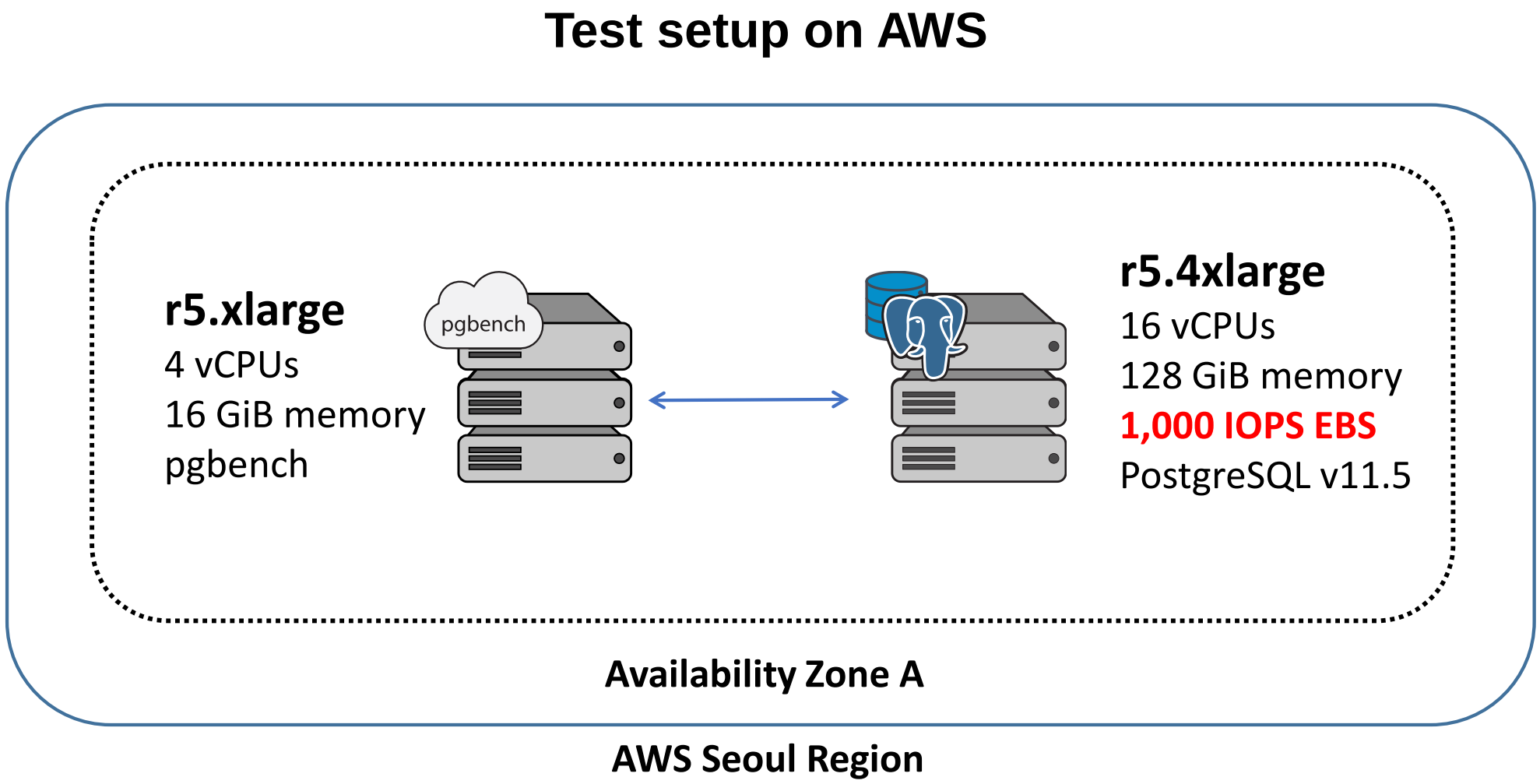
- ☑ **No PostgreSQL code changes**
- ☑ **PostgreSQL-aware I/O processing**
- ☑ **Storage-aware I/O processing**

AppOS Architecture

AppOS extension is a collection of libraries

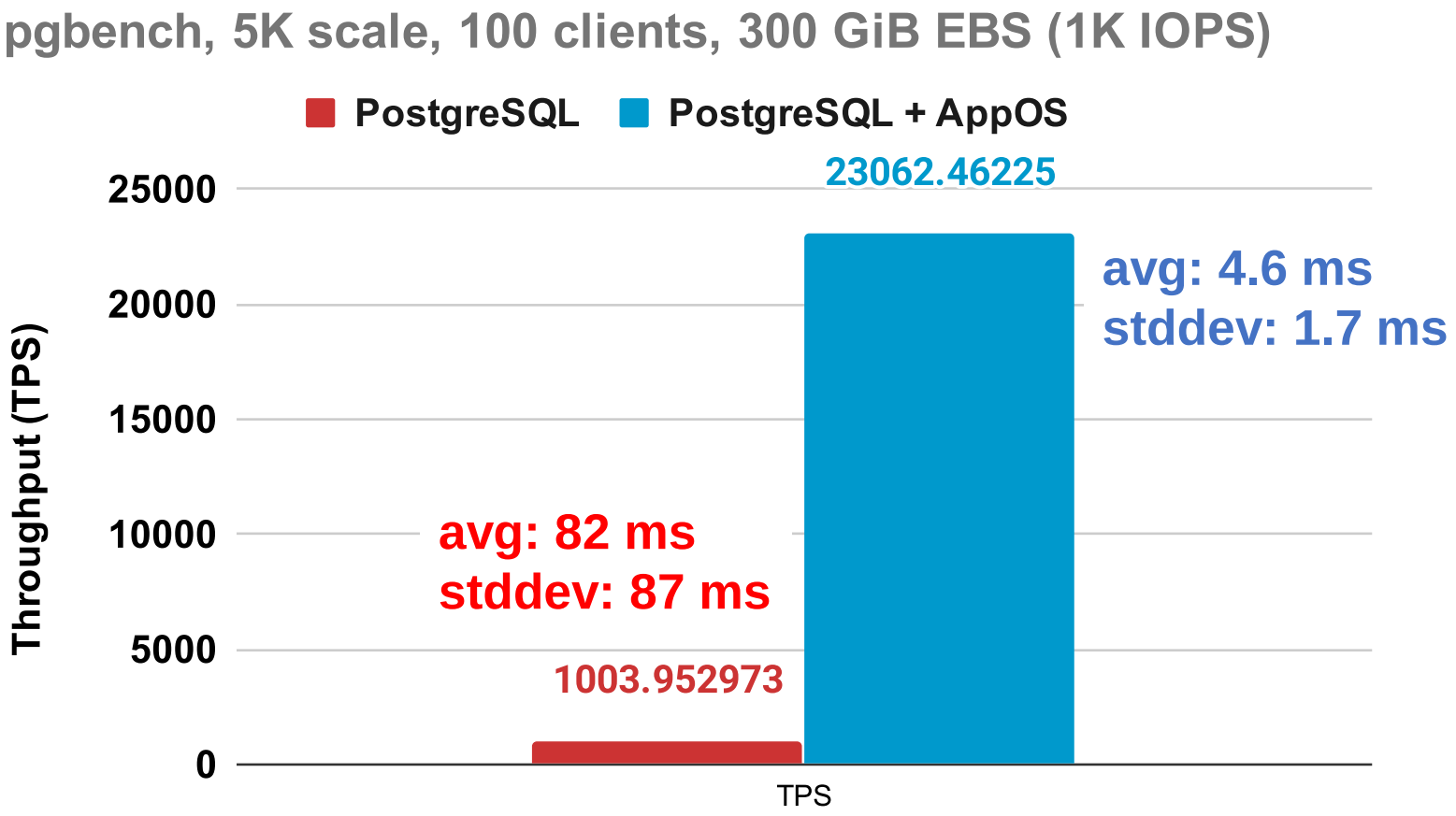


Performance on AWS Storage (1)



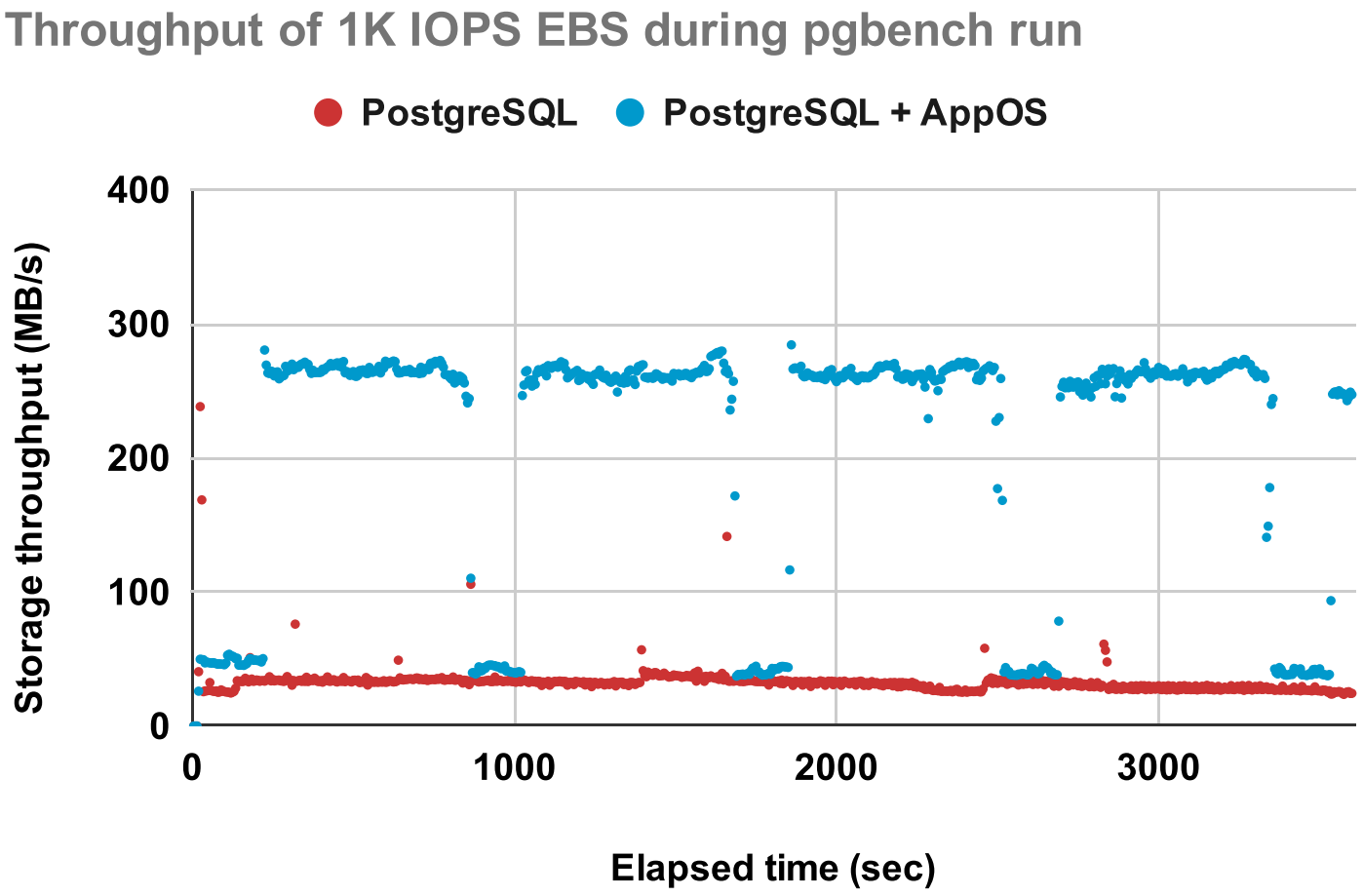
Performance on AWS Storage (2)

PostgreSQL processes 23x more transactions with AppOS



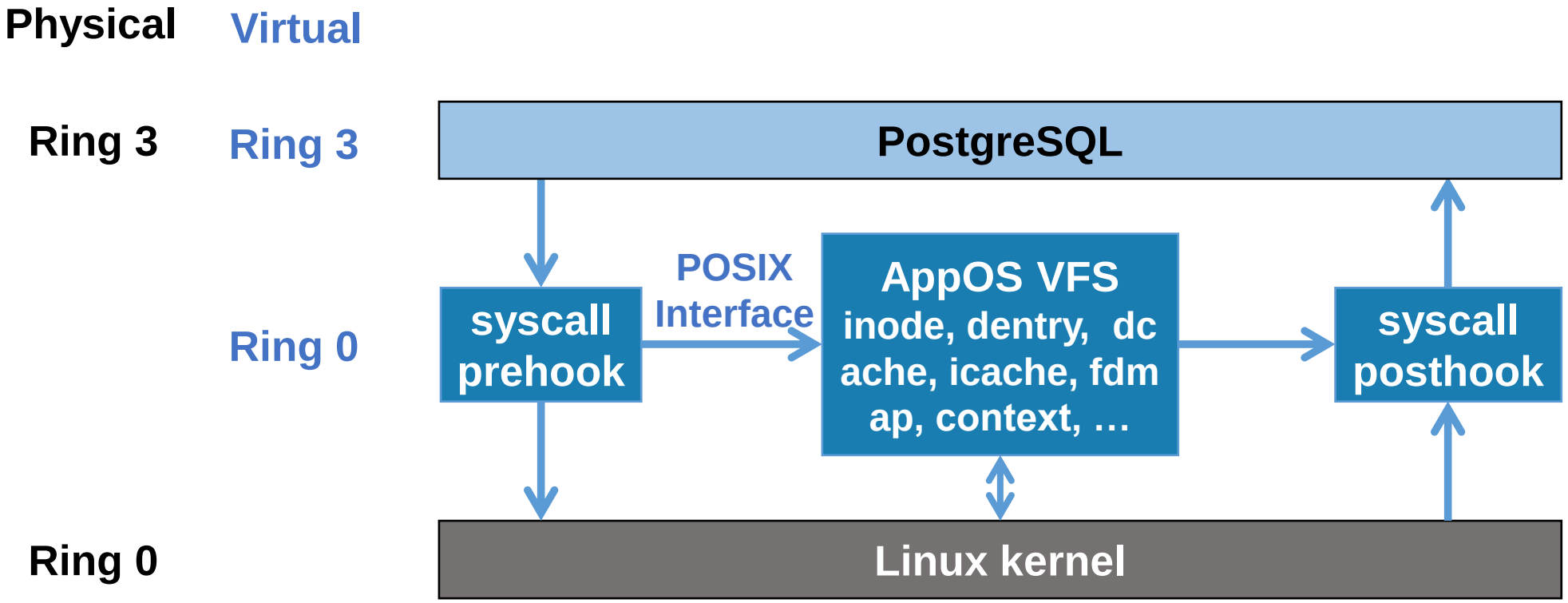
Performance on AWS Storage (3)

AppOS makes PostgreSQL to fully utilize storage bandwidth



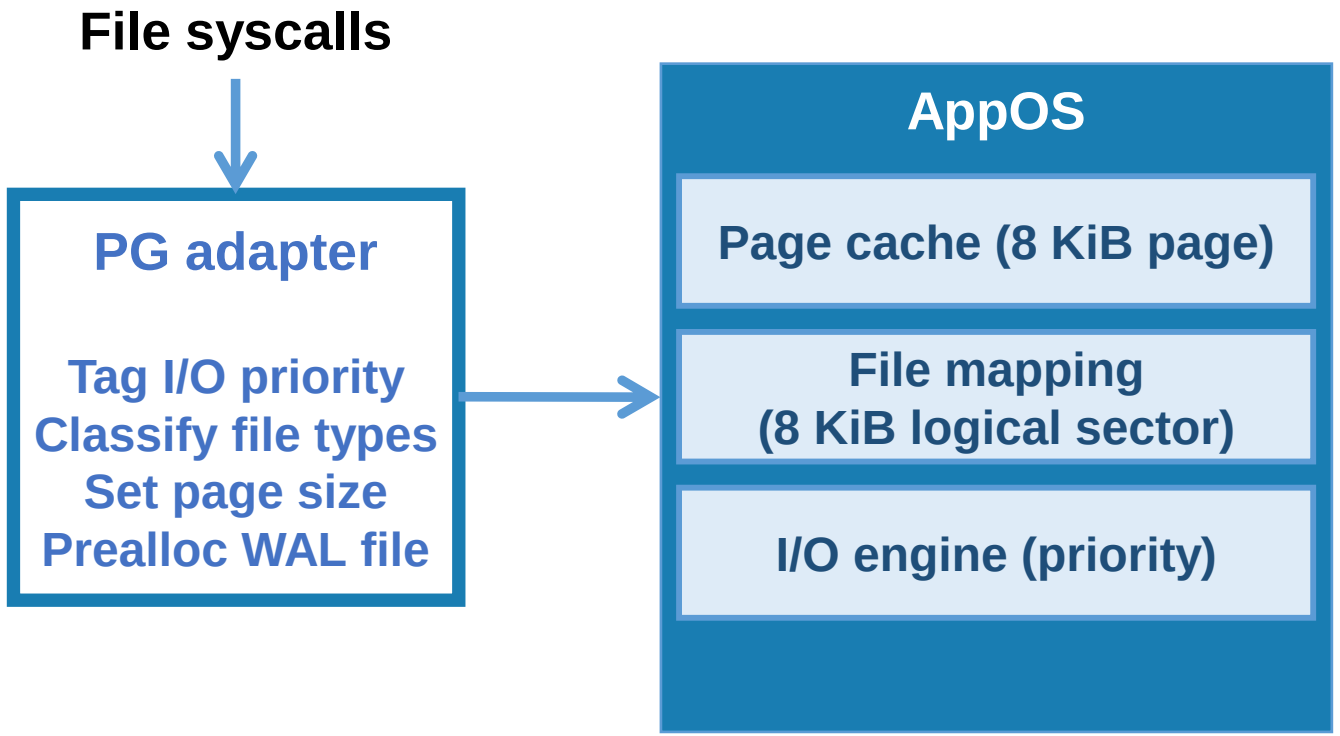
AppOS Internals (1)

AppOS does not require code changes



AppOS Internals (2)

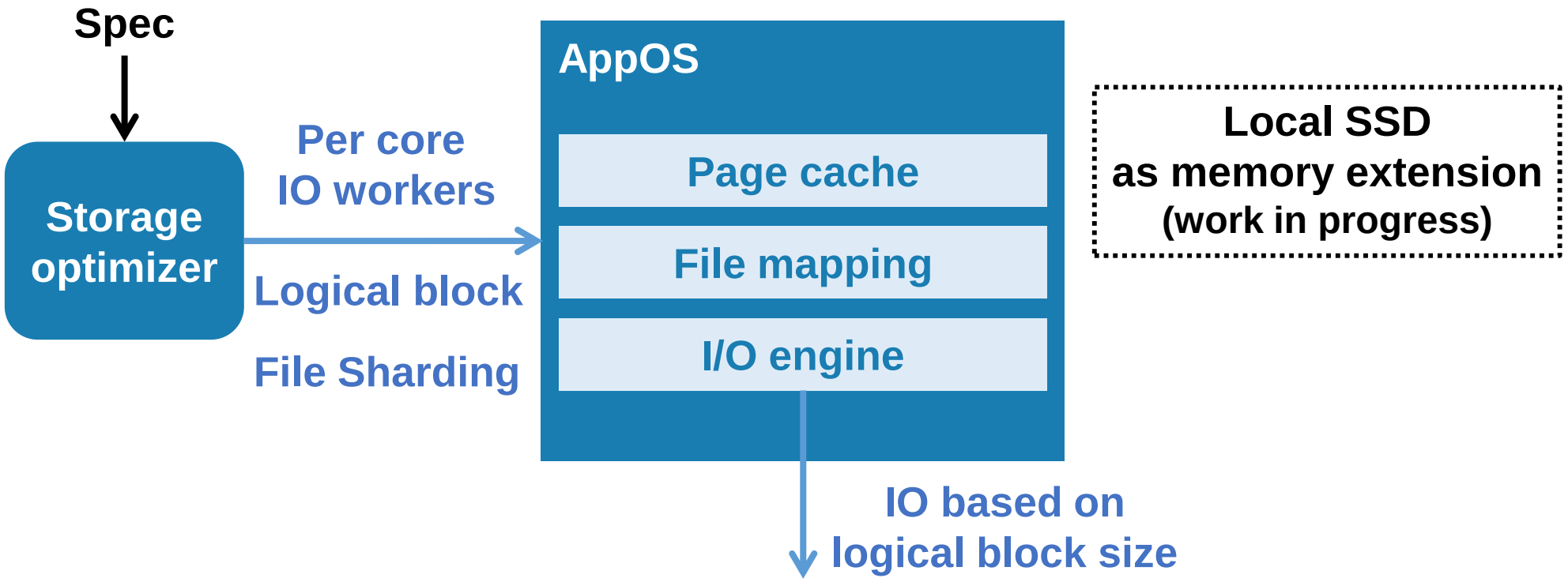
AppOS provides PostgreSQL-aware I/O processing



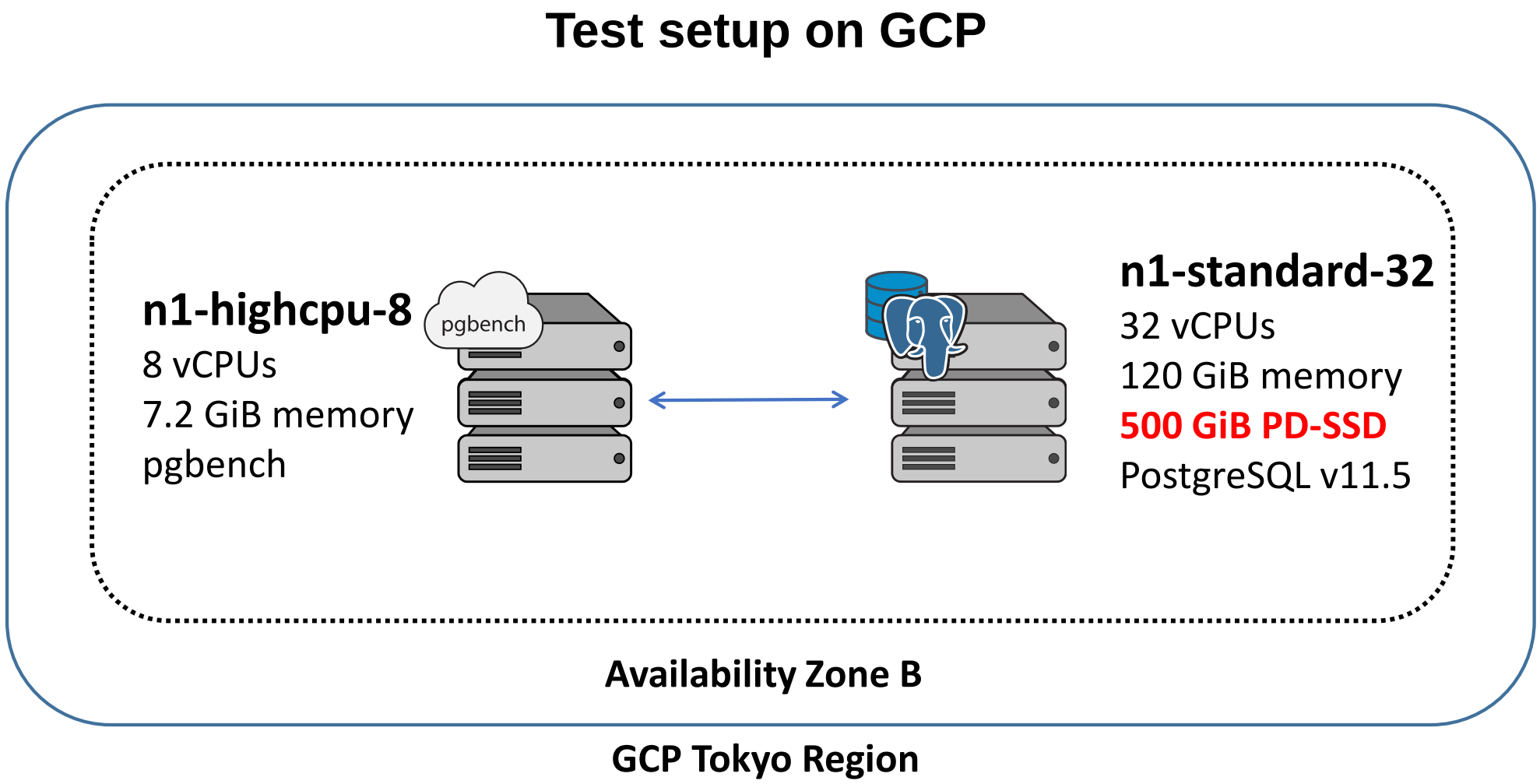
Logical sector size = atomic unit

AppOS Internals (3)

AppOS provides storage-aware I/O processing

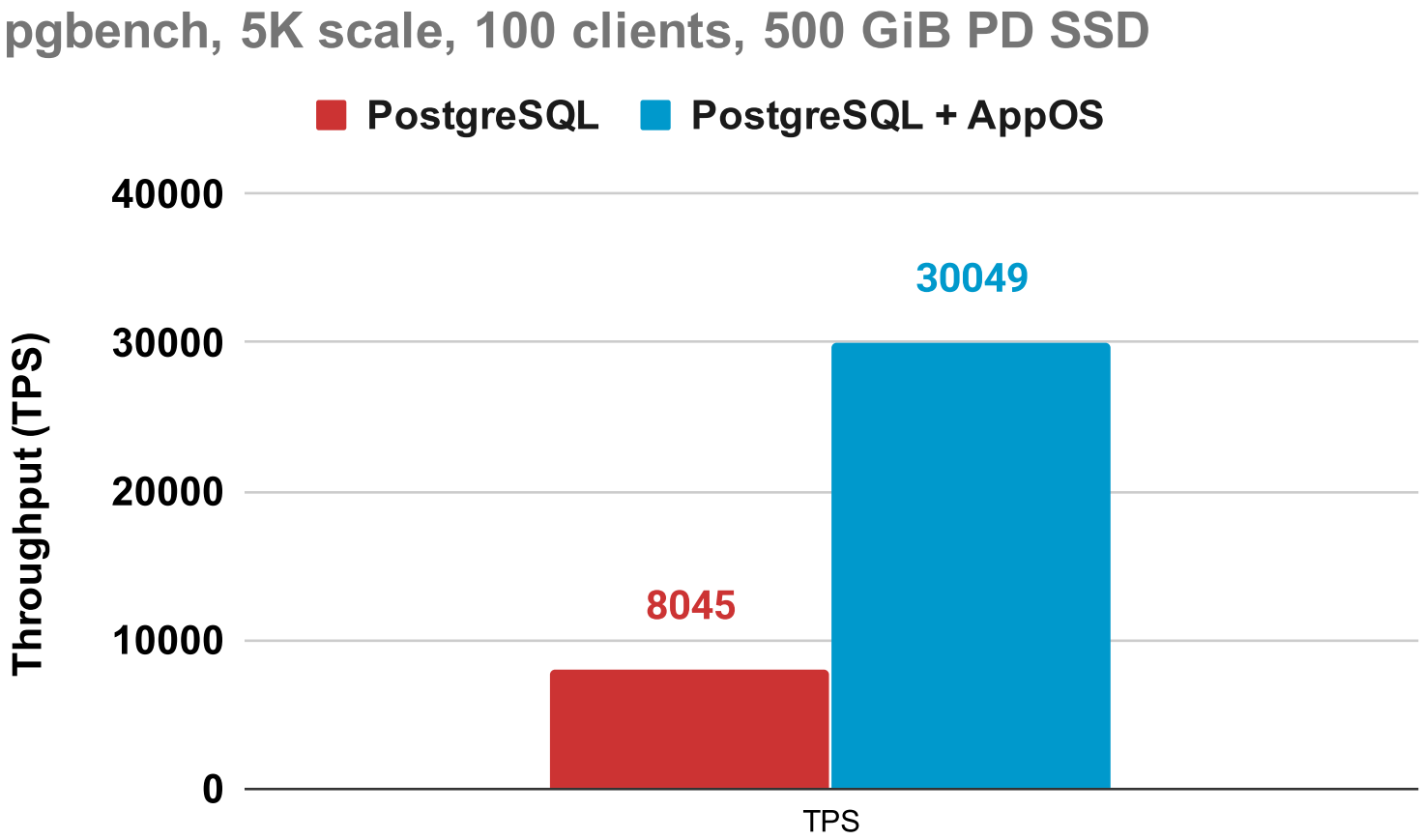


Performance on GCP Storage (1)



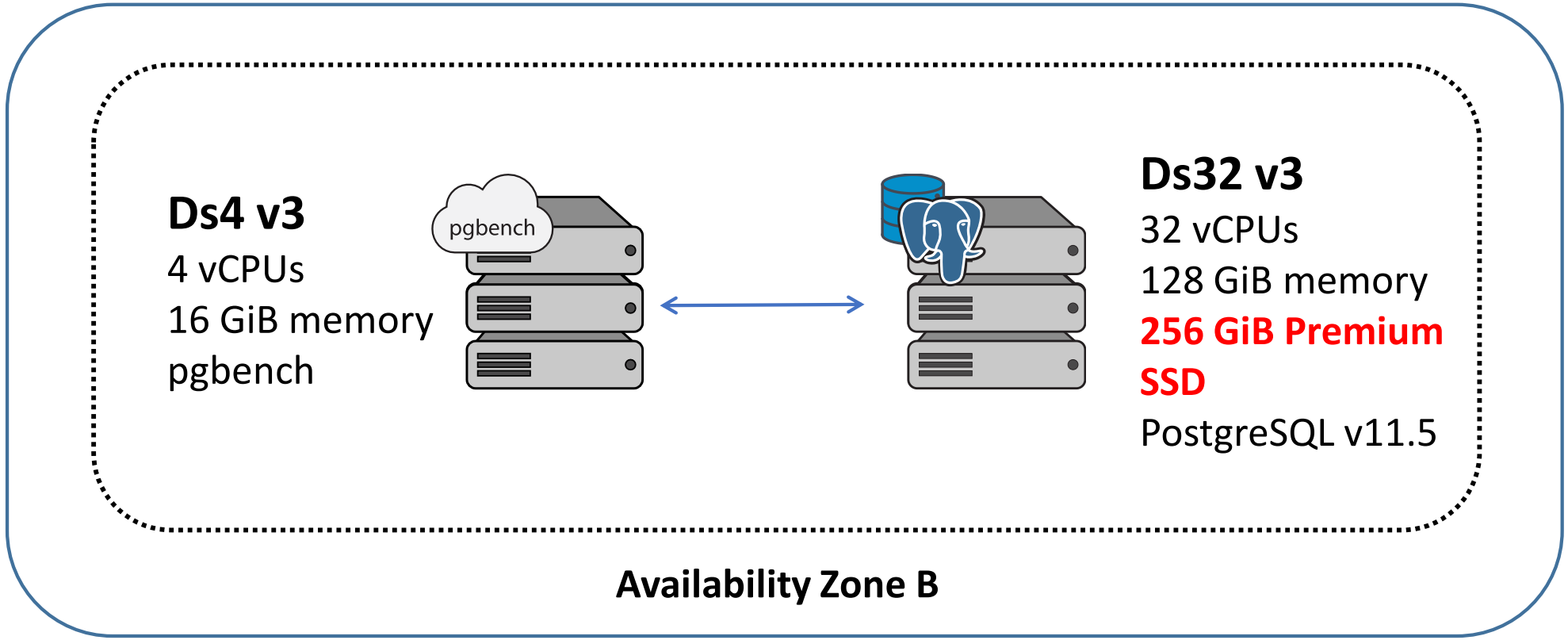
Performance on GCP Storage (2)

PostgreSQL processes 3.7 more transactions with AppOS



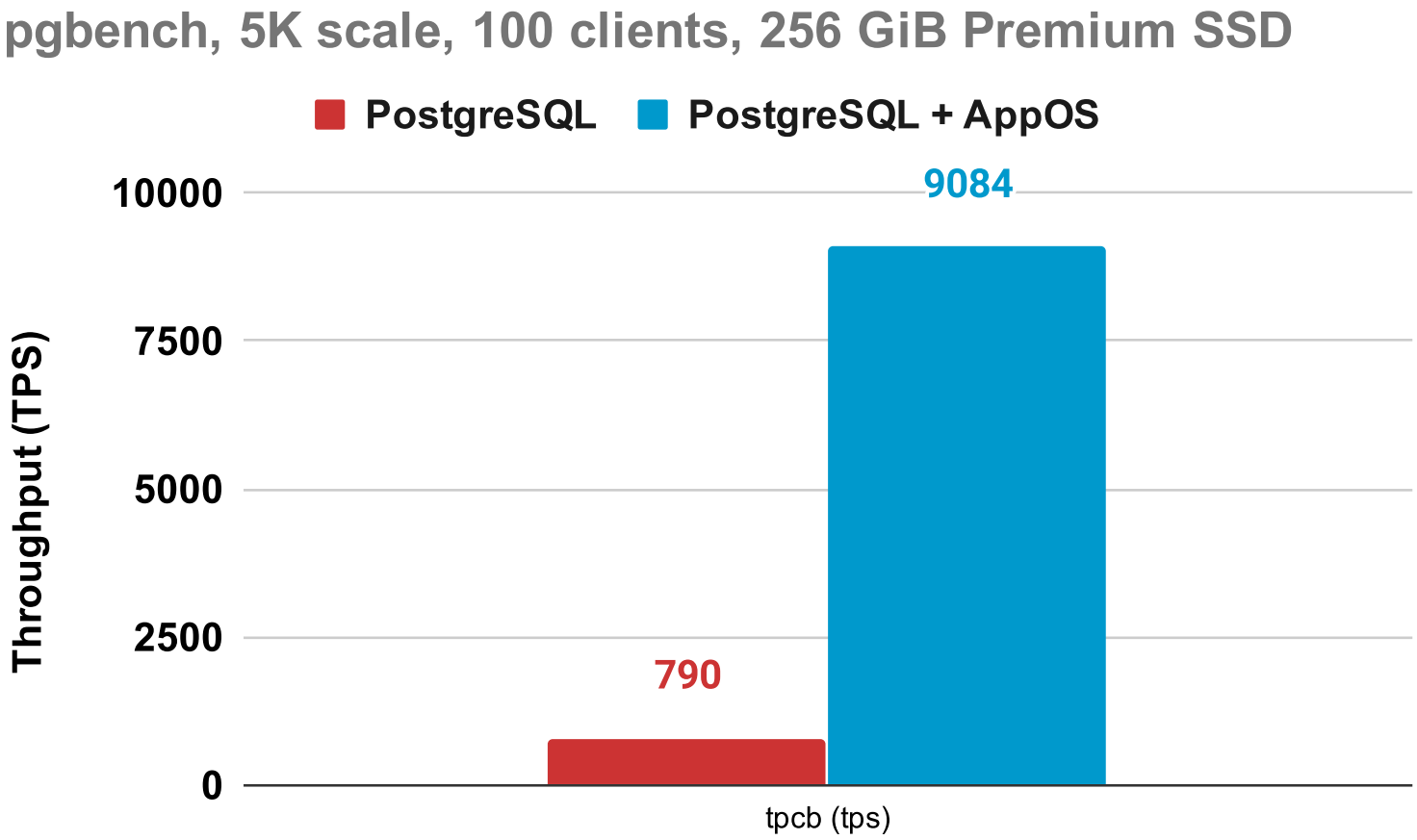
Performance on Azure Storage (1)

Test setup on Azure

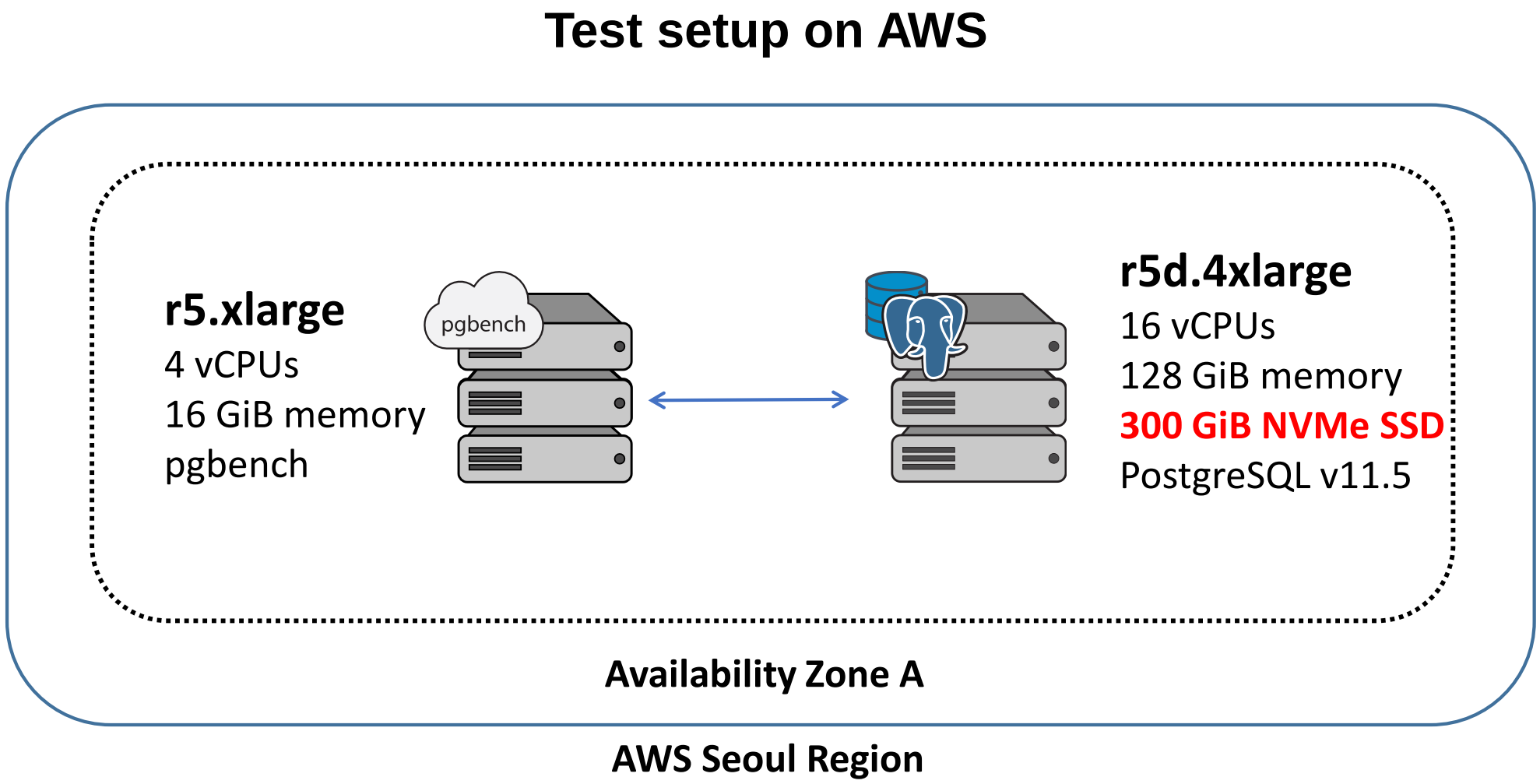


Performance on Azure Storage (2)

PostgreSQL processes 11.5x more transactions with AppOS

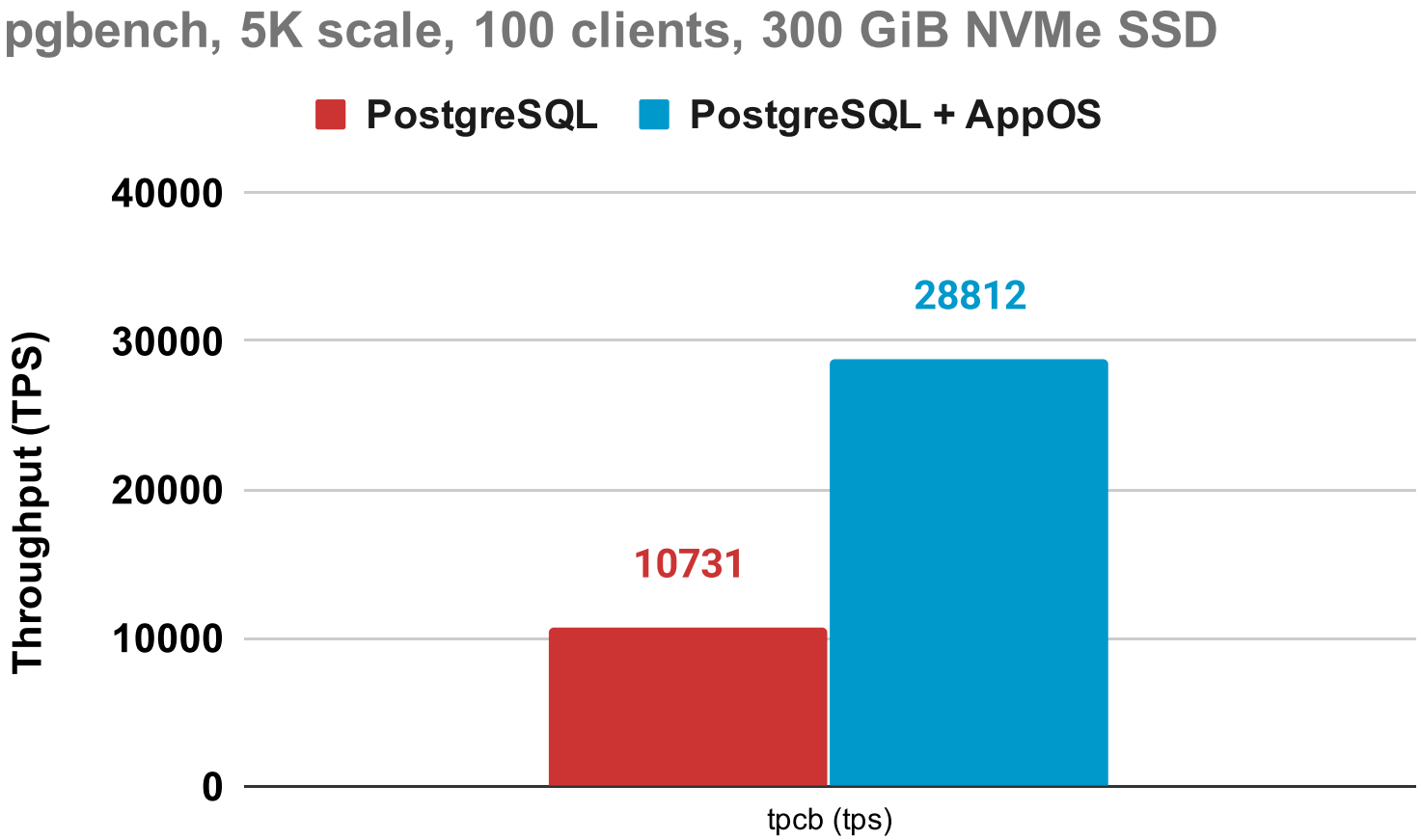


Performance on SSD (1)



Performance on SSD (2)

PostgreSQL processes 2.7x more transactions with AppOS

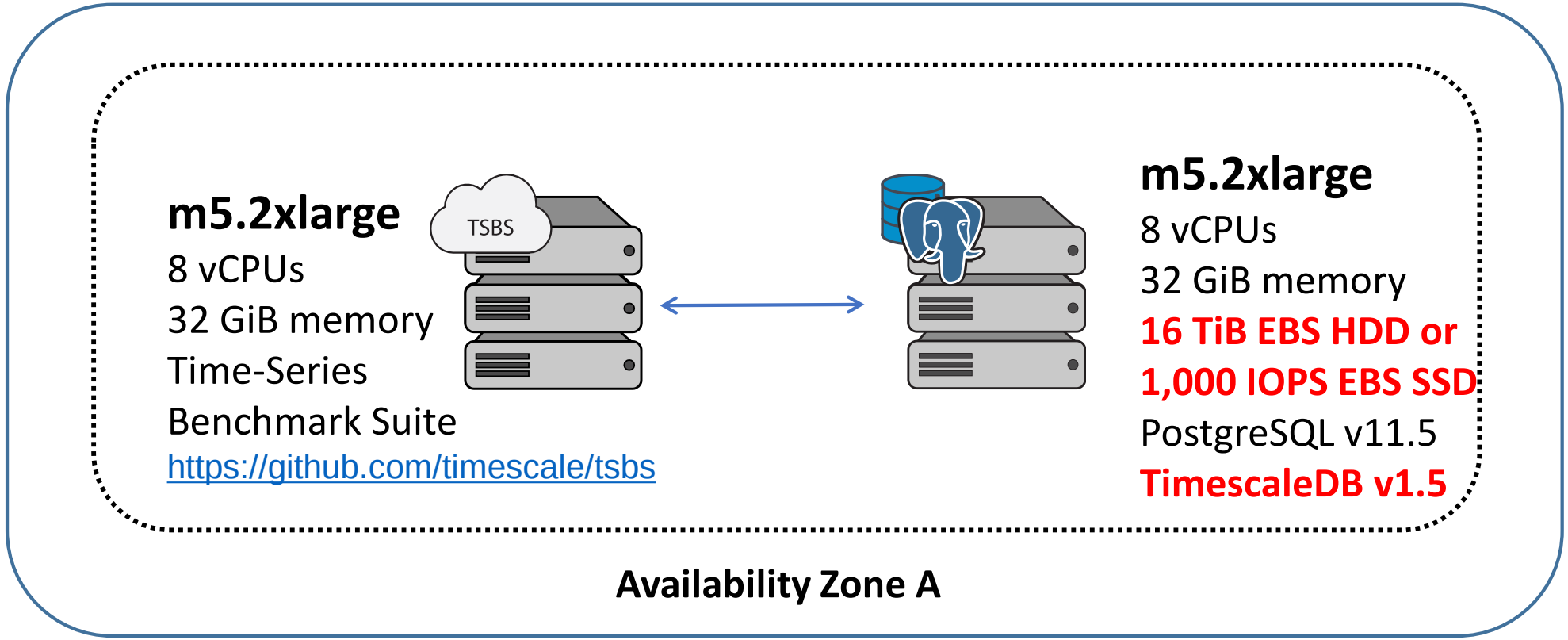


Extensibility

AppOS can seamlessly work with PostgreSQL-derived DBs

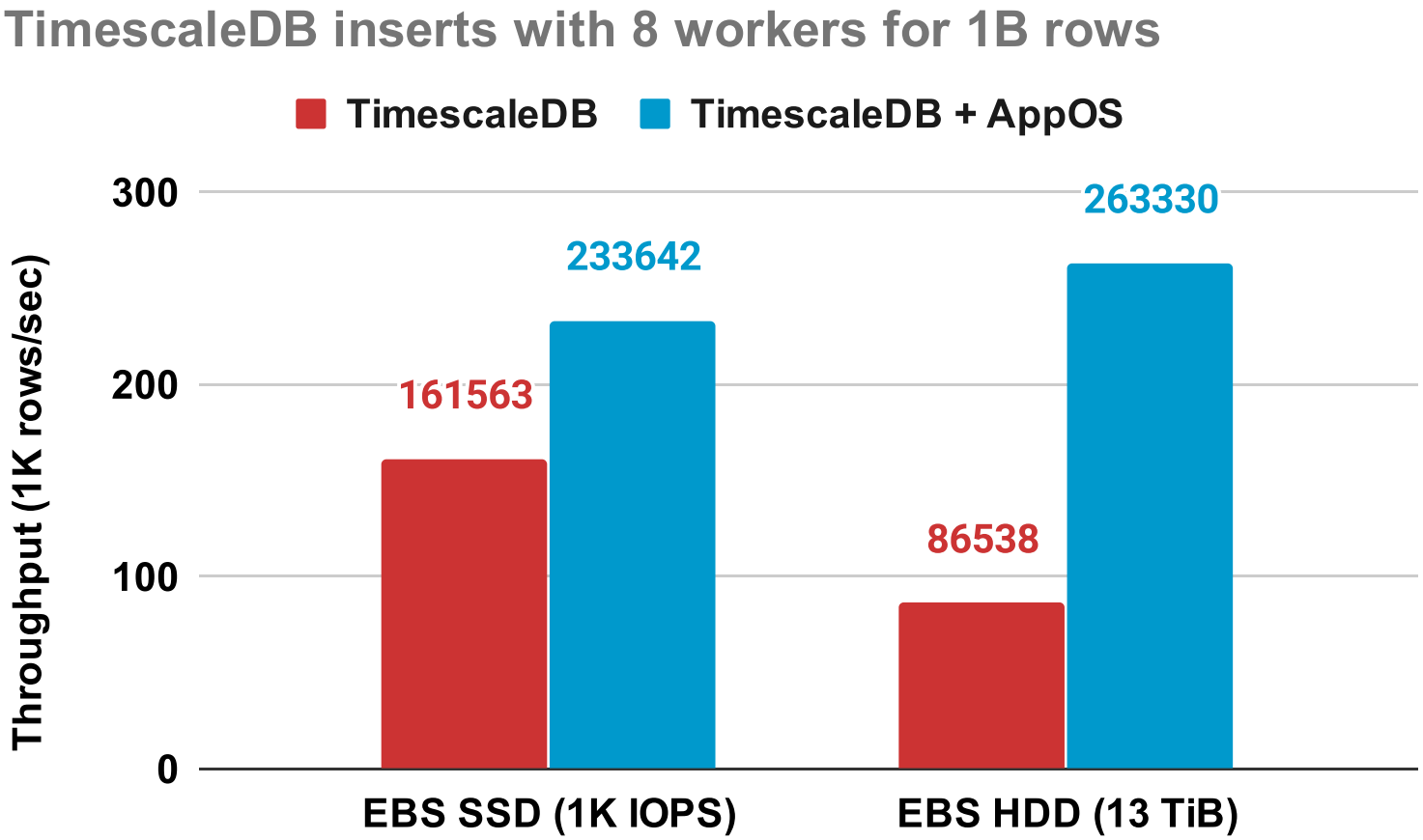
TimescaleDB Performance (1)

Test setup on AWS



TimescaleDB Performance (2)

AppOS improves TimescaleDB inserts by 50%~3x



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shawn@apposha.io