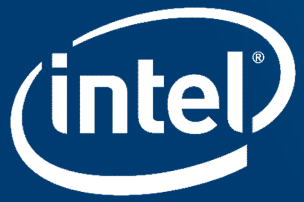

SPDK BLOBSTORE

Ben Walker
Data Center Group
Intel Corporation

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AGENDA

- INTRODUCTION
- USE CASES
- DESIGN
- BENCHMARKS

INTRODUCTION

LOTS OF APPLICATIONS WANT TO USE SPDK...

BUT THEY AREN'T DESIGNED TO DIRECTLY USE THE BLOCK DEVICE

WHAT DOES A FILESYSTEM DO?

PARTITIONS

PERMISSIONS

CACHING

RAID

SNAPSHOTS

ACCESS TIMES

BYTE GRANULARITY

SPARSE ALLOCATION

DIRECTORIES

TRIM

CHECKSUMS

I/O SCHEDULING

WHAT CAN SPDK DO TO HELP?

LET'S BUILD SOME NEW COMPONENTS!

USE CASES

WHAT SORT OF APPLICATION BENEFITS FROM SPDK?

Lots of I/O

Latency Sensitive

- SAN? Database? Cache?

We picked two use cases:

- RocksDB
- Dynamic Block Allocation

ROCKSDB

- Log-structured merge tree
- Written in C++, Open Source
- Pluggable storage backend
- Broadly adopted
- Recommends XFS

Makes minimal use of XFS

- Directory structure
- I/O pattern
- Minimal caching needs

NO OTHER FILE SYSTEM FEATURES REQUIRED!

DESIGN

GLOSSARY OF TERMS

- File: Array of bytes
  - Mutable, Resizable
  - String name
- Object: Array Of bytes
  - Immutable, replaceable
  - String name
- Page – 4 KiB

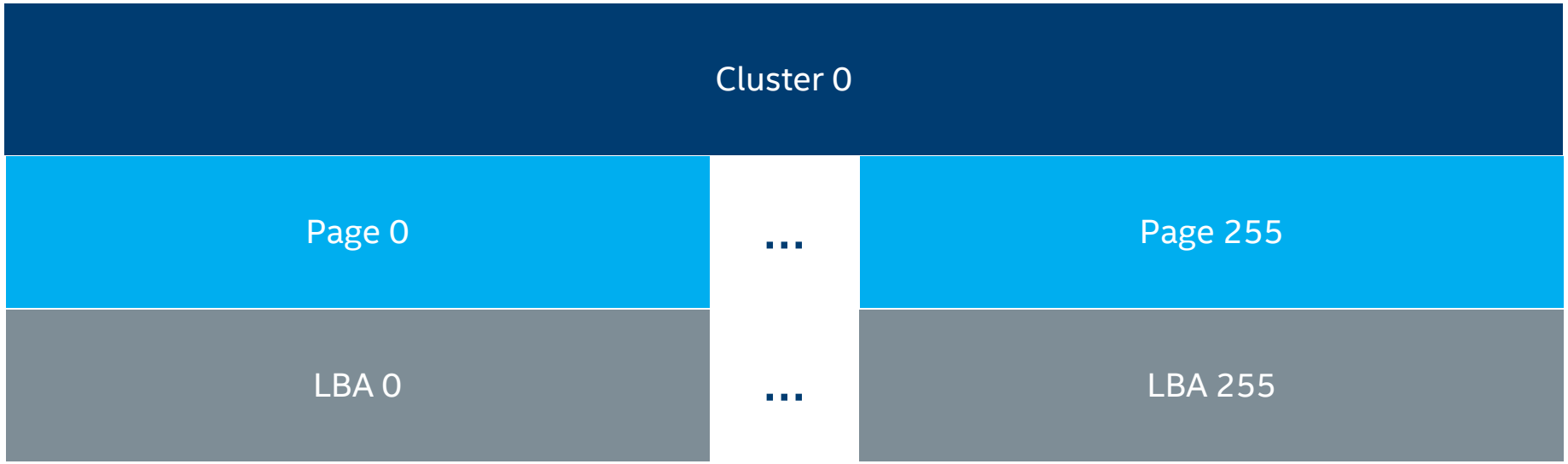
DESIGN GOALS

- Simple and efficient
- Design for fast storage media
- Support file & object-like semantics

BLOBSTORE BASICS

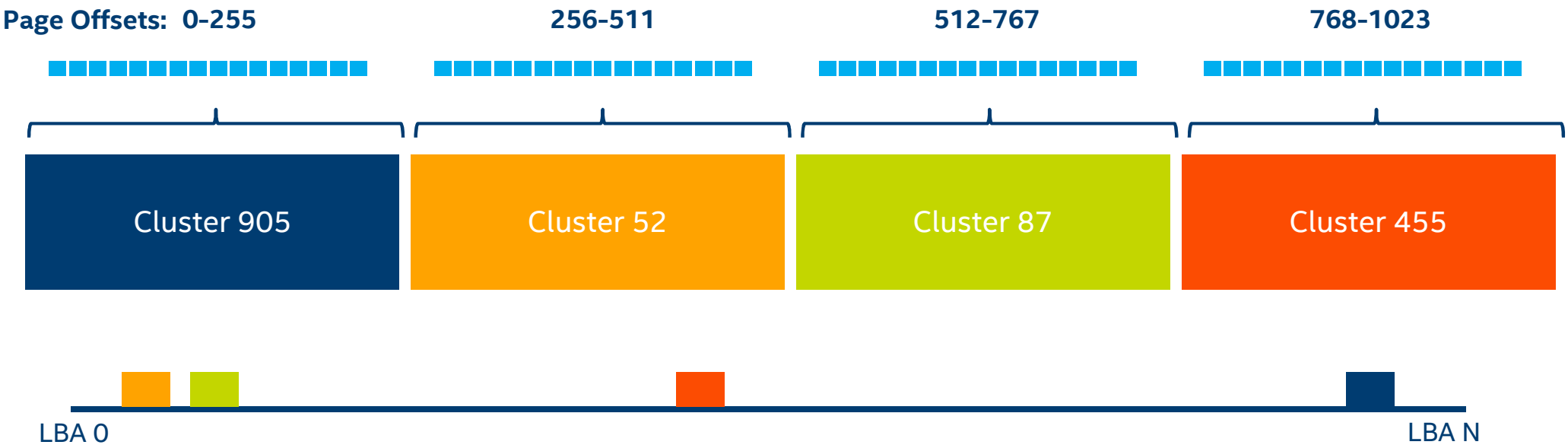
- The user interacts with chunks of data called blobs
  - Array of pages
  - Mutable, resizable
  - ID
- Asynchronous
  - No blocking, queueing, or waiting
- Fully parallel operations
  - No locks in I/O path

BLOBSTORE SPACE ALLOCATION



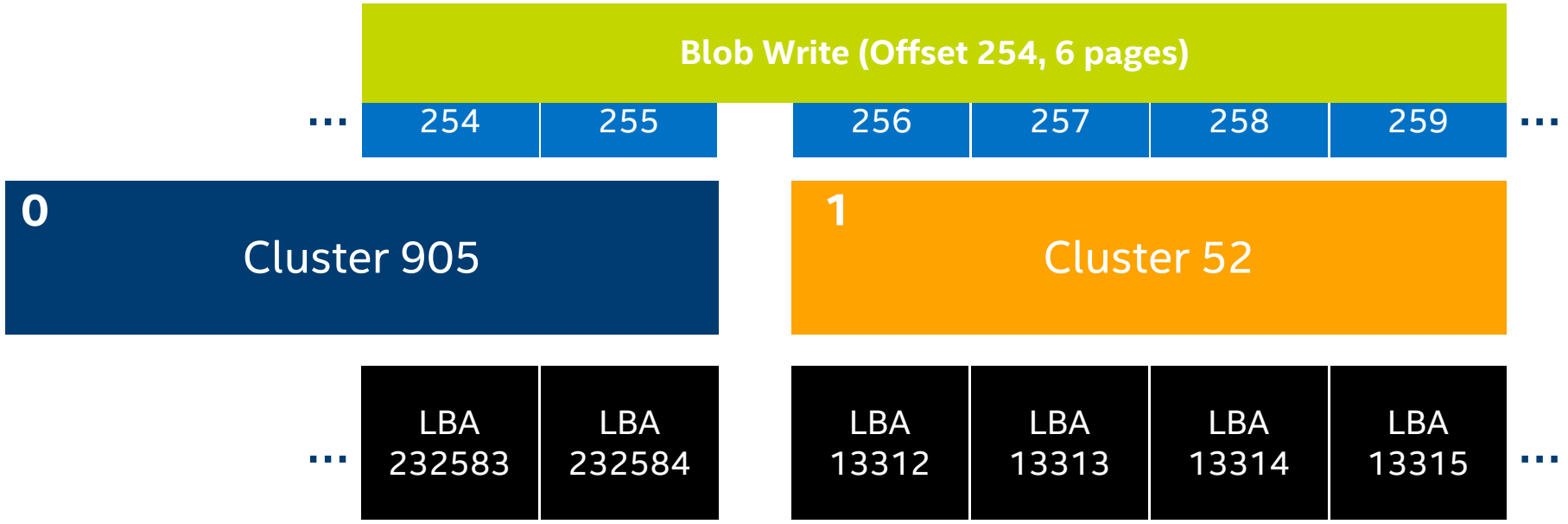
BLOBSTORE DESIGN

Blob: **array of pages** implemented as an ordered **list of clusters**:



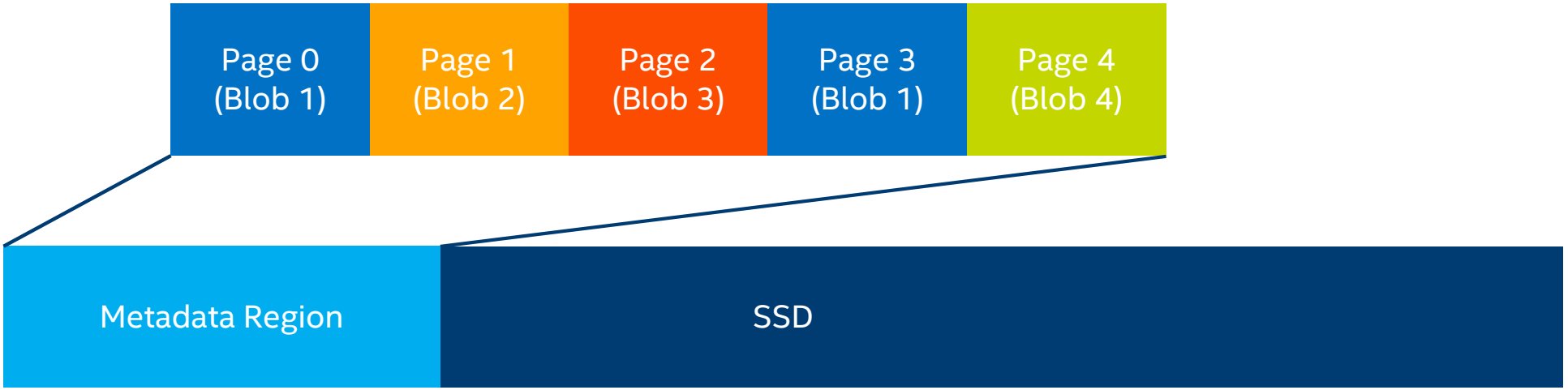
BLOBSTORE SAMPLE I/O

Blobs are read/written by specifying a relative **page offset** and a **page count**



BLOBSTORE METADATA

- Metadata is stored in **pages** in a reserved region
- Metadata pages are **not shared** between blobs
- A blob may have multiple pages of metadata



BLOBSTORE API

- **open, close, read, write, sync, resize**
- Asynchronous, callback-driven
- Read/write in units of pages, space allocation in clusters

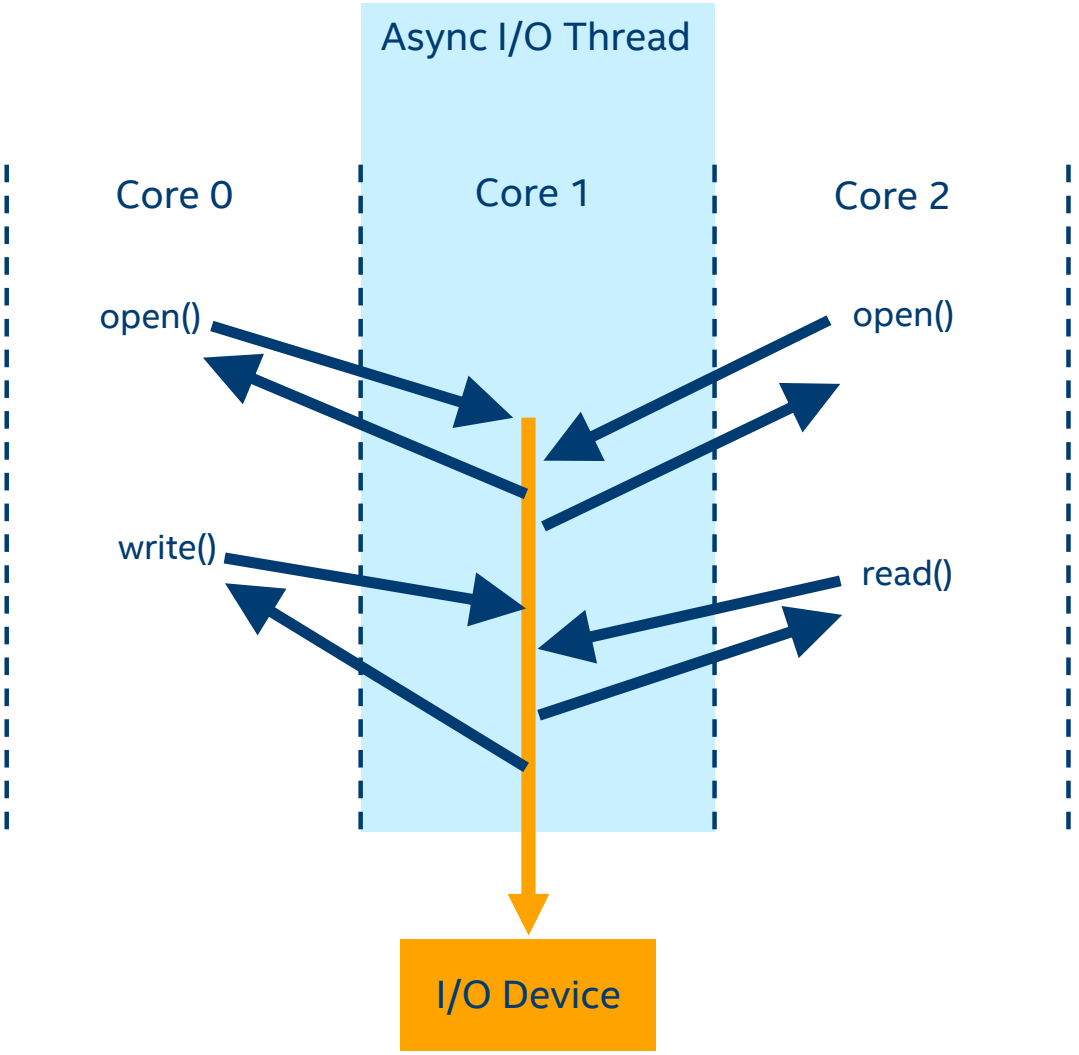
- Data is **direct**
- Metadata is **cached**
- Minimal support for xattrs

INDEPENDENT OF BLOBFS

BLOBFS DESIGN

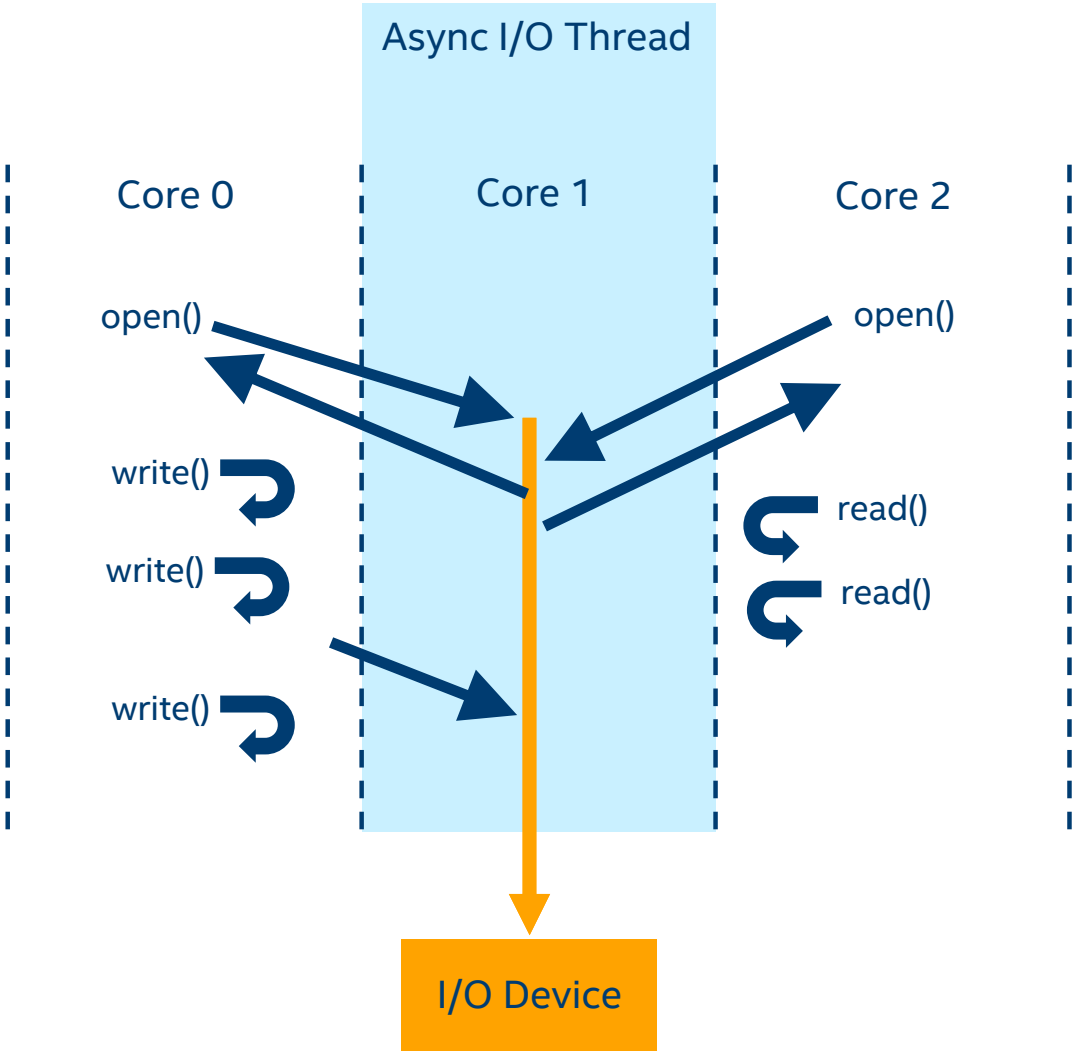
- Layered on Blobstore
- User interacts with **files**
- Data can be **cached**
- **Synchronous API***

* Asynchronous API possible



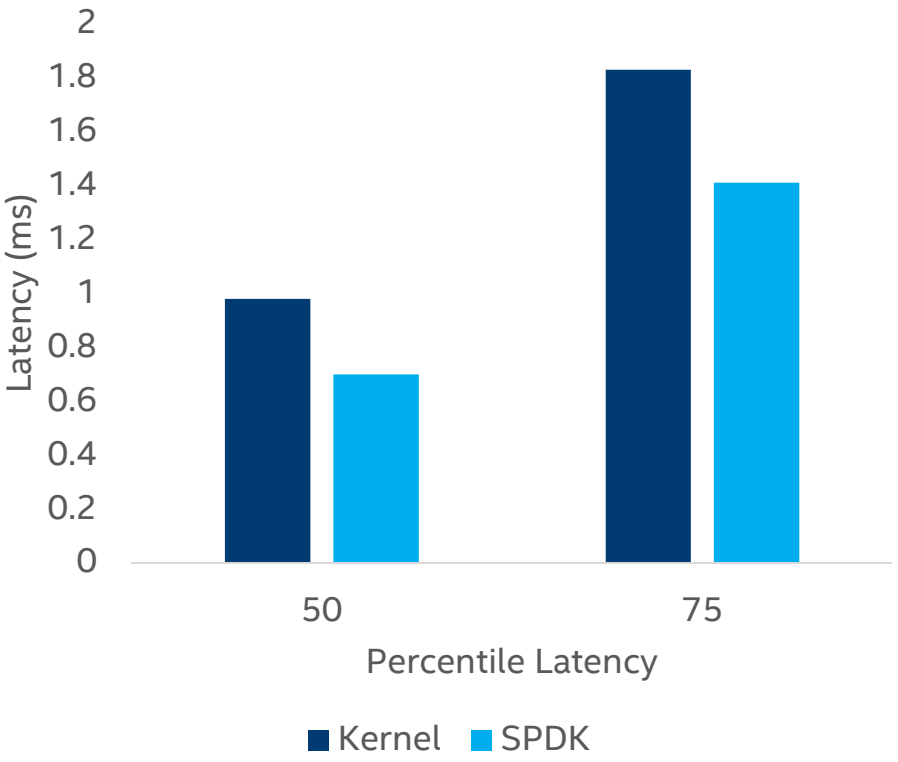
BLOBFS CACHING

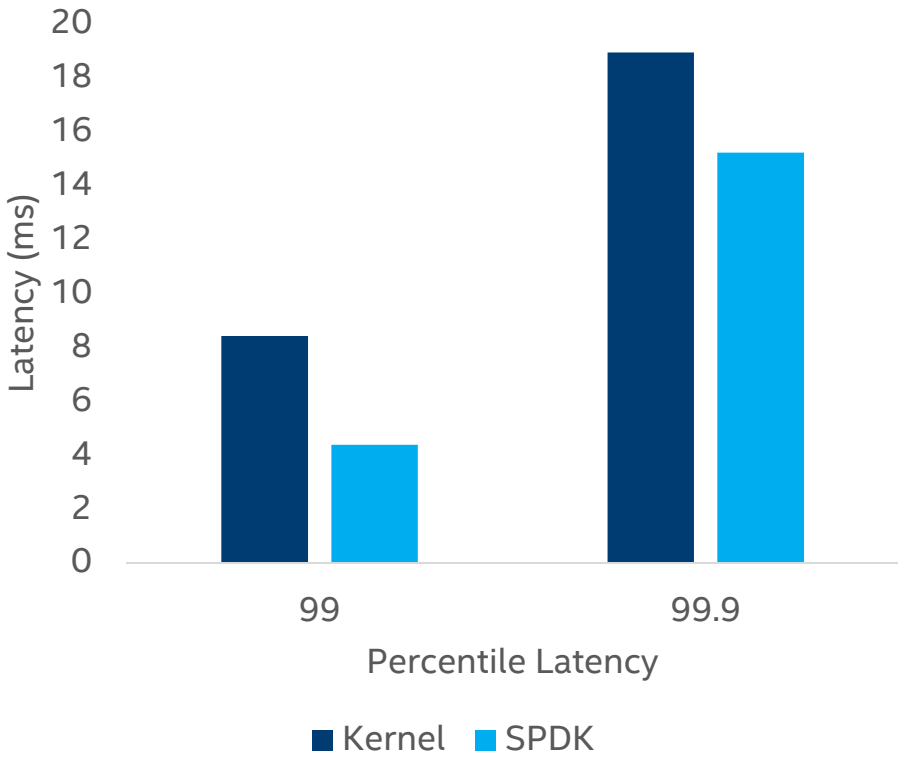
- Not a general purpose page cache
  - Read ahead
  - Sequential write buffering
  - All other access bypasses cache



BENCHMARKS

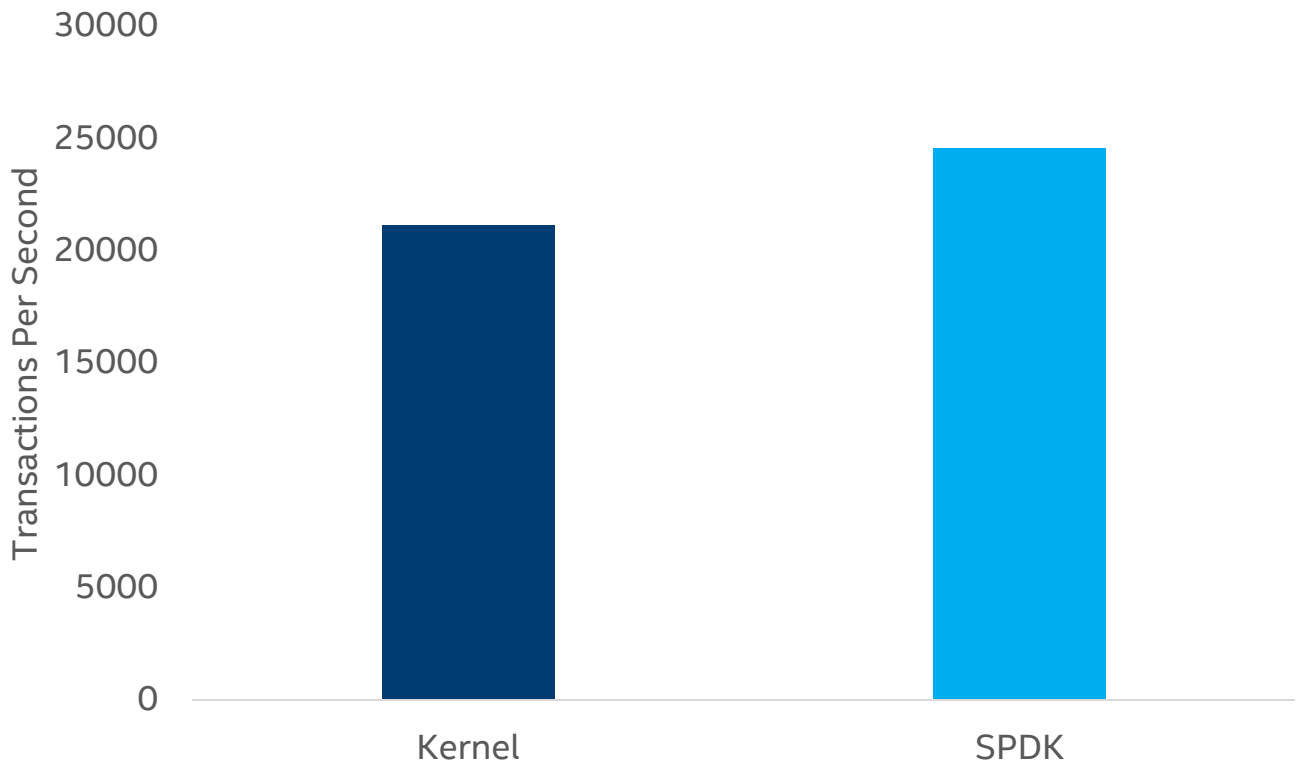
BENCHMARK: DB_BENCH READ/WRITE LATENCY





System Configuration: 2x Intel® Xeon® E5-2699v3, Intel® Speed Step enabled, Intel® Turbo Boost Technology enabled, 8x 8GB DDR4 2133 MT/s, 1 DIMM per channel, Fedora* Linux 25, Linux kernel 4.10.8, Intel® P3700 NVMe SSD (800GB), FW 8DV101H0, SPDK 17.03, DPDK 17.02, RocksDB 5.1.2

BENCHMARK: DB_BENCH READ/WRITE THROUGHPUT



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NEXT STEPS

NEXT STEPS

- Major API clarifications
- More & better benchmarking
- Use blobstore as a dynamic partitioner (bdev)
- BlobFS caching strategy is RocksDB-centric
- Asynchronous BlobFS API
- Sparse allocation of blobs
- More open source application integration?

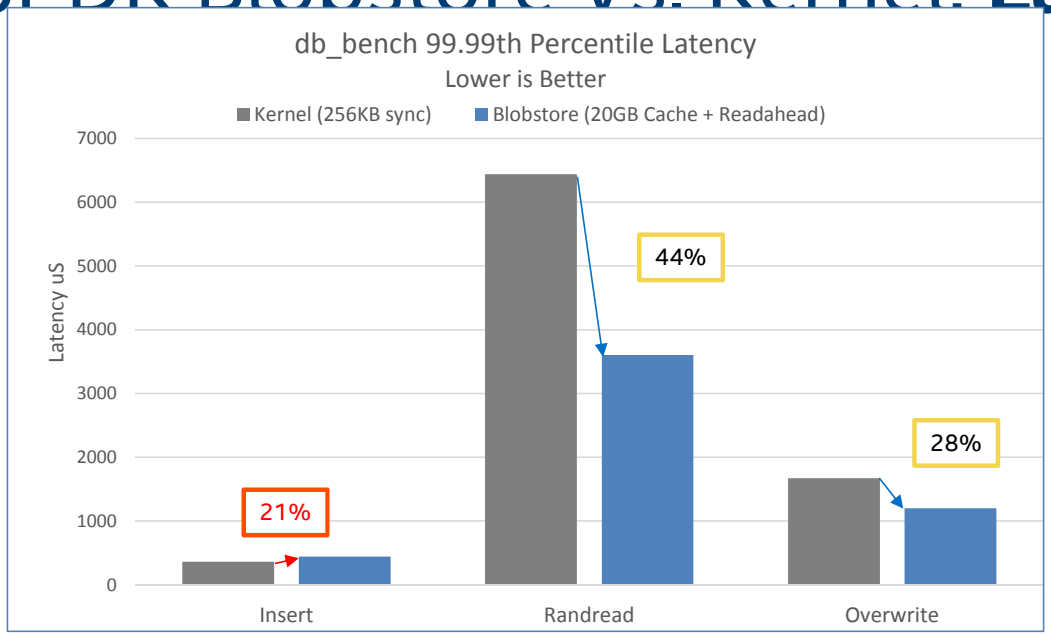
EFFICIENCY

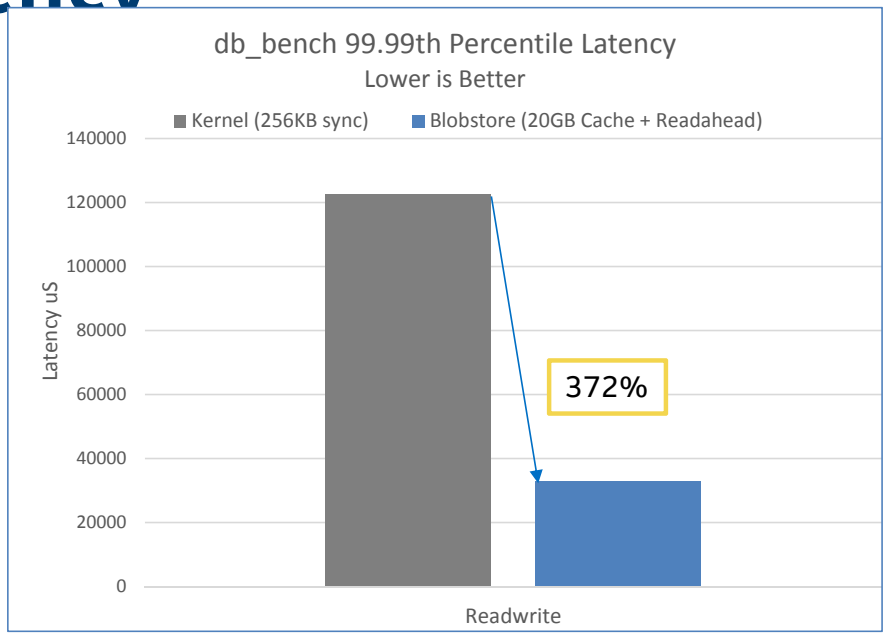
SIMPLICITY

FLEXIBILITY


intel®
experience
what's inside™

SPDK Blobstore Vs. Kernel: **Latency**





SPDK Blobstore reduces tail latency by 3.7X

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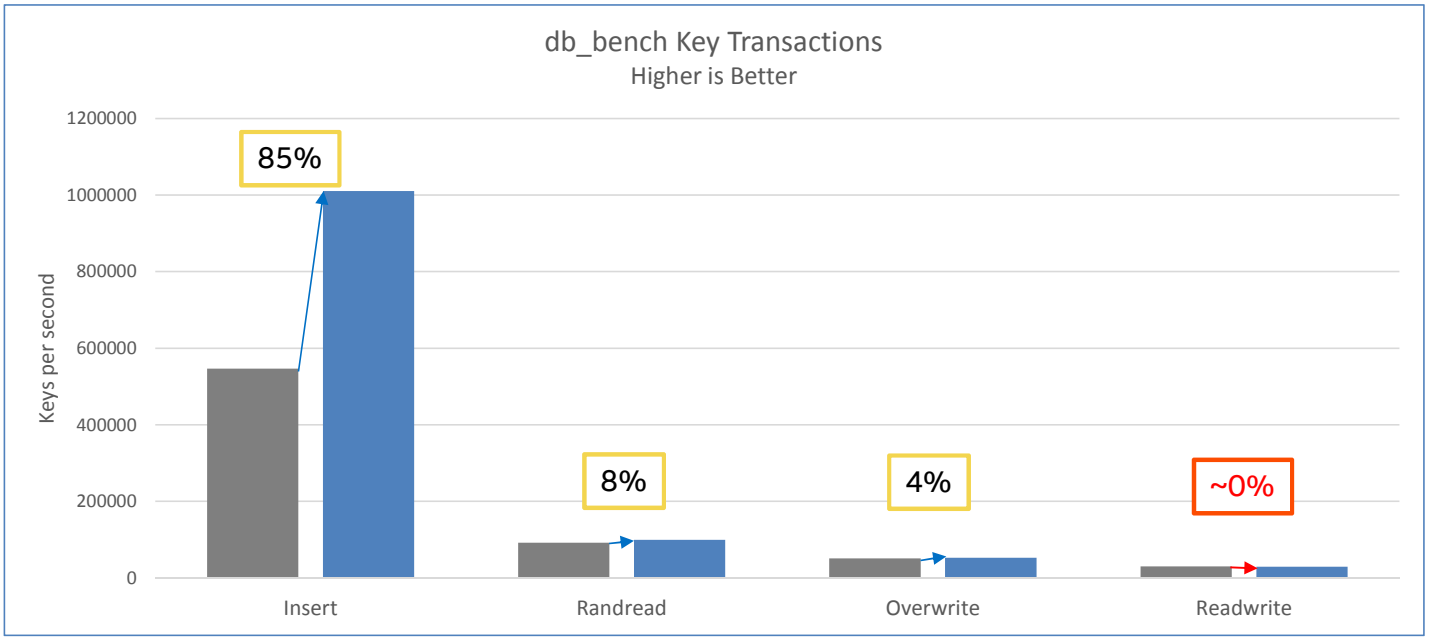
SPDK Blobstore Vs. Kernel: **Transactions Per Second**



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