


SPP 2377 Kick-Off '22, TU Dresden

ParPerOS: Parallel Persistency OS

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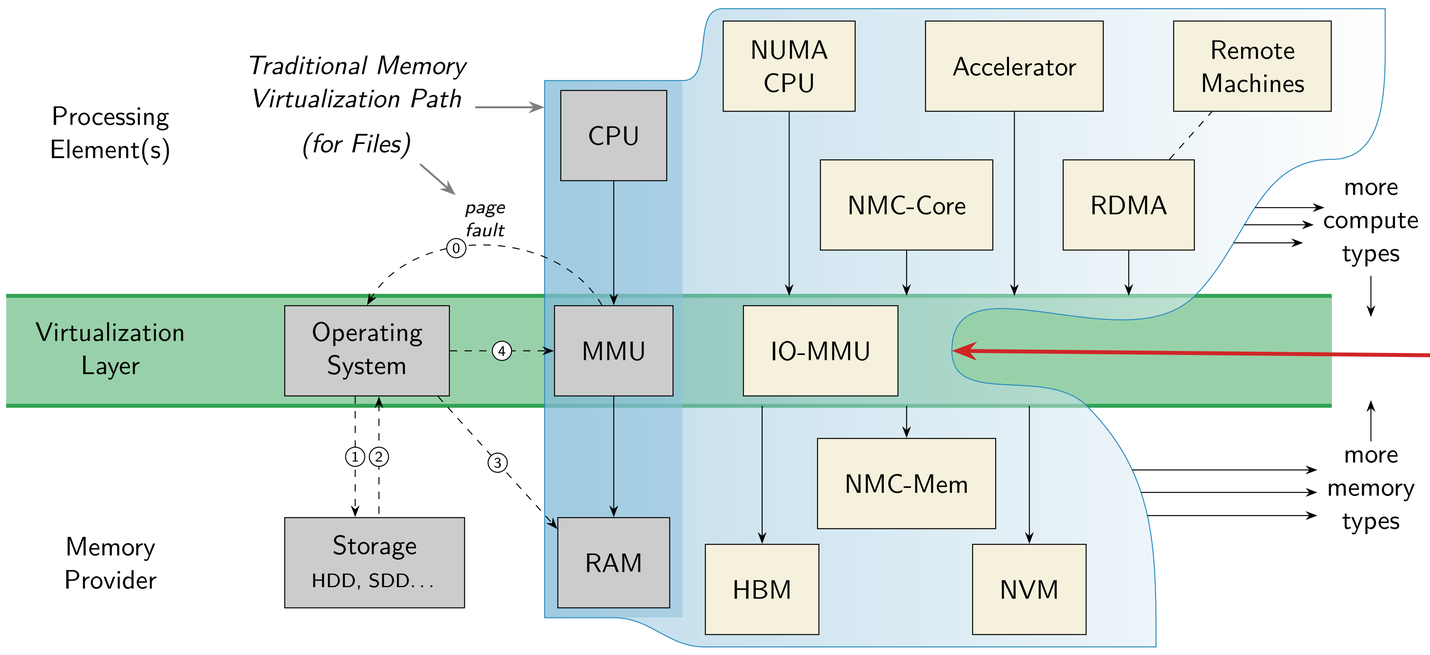


New Memory Challenges

The advent of **new memory technologies**, whether volatile, persistent or distributed, brings with it new challenges. In addition to their **novel properties**, they are also accessed in parallel by a multitude of different **processing elements**.
This necessitates new methods for dealing with **parallelism**, **contention**, and new **persistency requirements**.

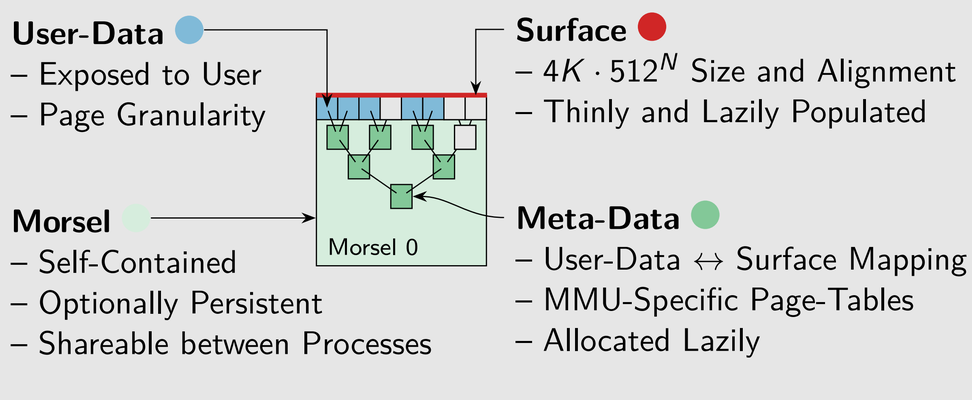
What are efficient abstractions to access and share large amounts of memory?

Goal: New Abstractions for Memory Management

- Unified, efficient, optionally crash-consistent
- Sharable across processes and hardware devices
- Focus on large (heterogeneous) memory objects

Morsels

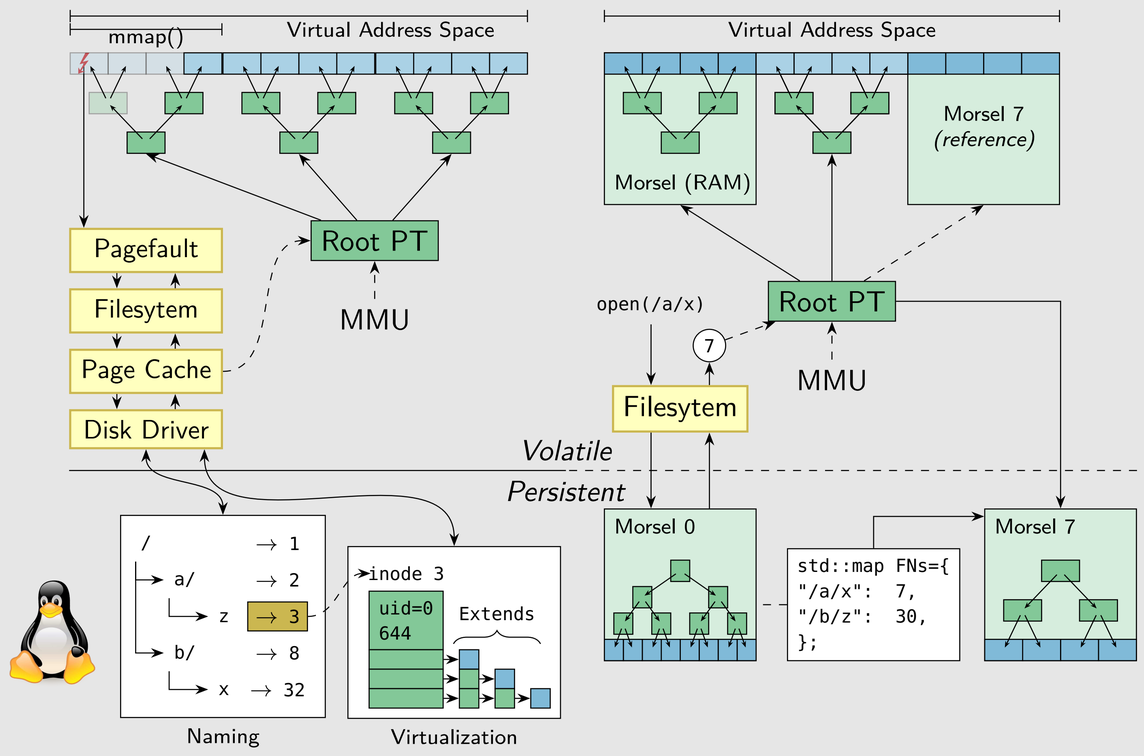
Morsels are minimal self-contained **address space abstractions** that form the core of our new unified memory management. They consist of a small **page table tree** and can easily be mounted into an existing address space.



Features

- Exokernel-style approach: Close to MMU hardware
- Scalable for large amounts of memory and many processing elements
- Lock-free and crash-consistent

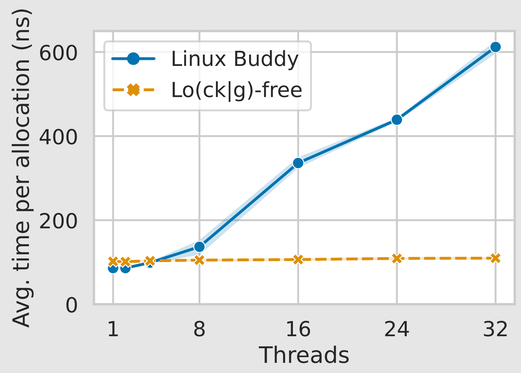
Morsels in the Address Space



Project: Lo(ck|g)-Free Allocator

Morsels need a **page allocator** for the hardware-specific page sizes (4K, 2M).

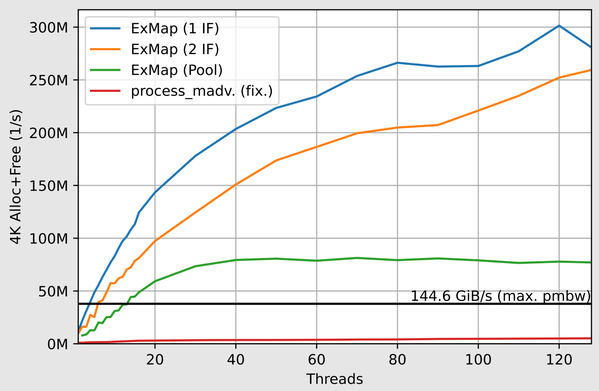
- Lock-free → recoverable from persistent memory
- Log-free → reduce write wearing
- Cache-friendly on DRAM and eADR
- Low memory overhead
- Exceptionally fast for frequent parallel allocations



Project: ExMap (accepted for SIGMOD'23)

DBMS Co-Design: Combine advantages of **MMIO** with **explicit** control

- Explicit alloc/free/read/write on a reserved memory pool
- Batched operations
- `pread/iouring` proxy
- Up to 300M 4K Allocs/s
- 6 GiB/s random read with 4 threads

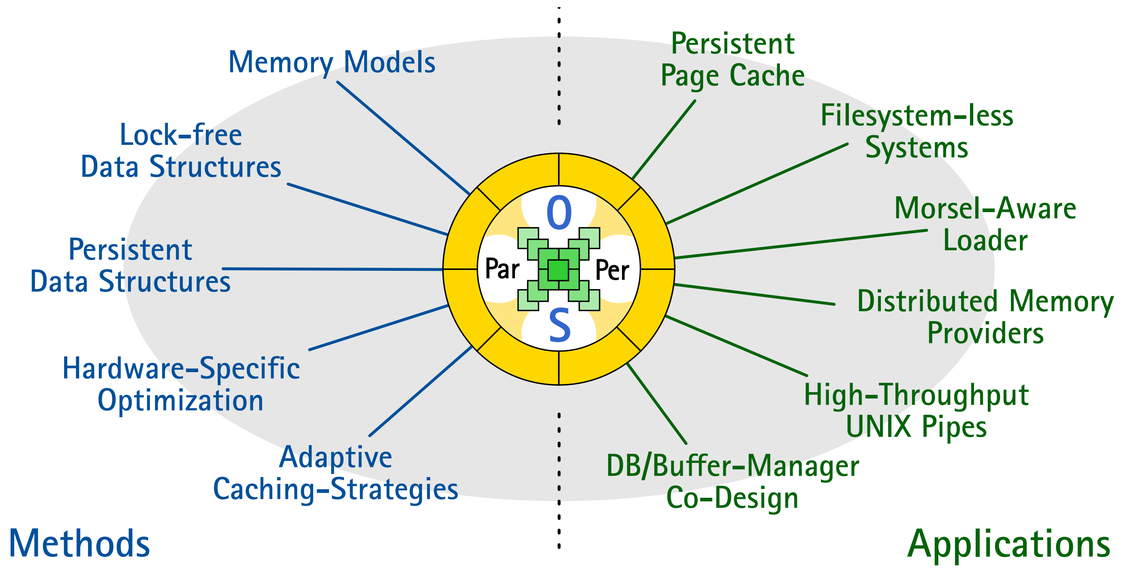


Available at: `https://github.com/tuhhosg/exmap`

Placement within the SPP

Areas: Operating Systems, Algorithms/Data Structures
Goals: Performance, Dependability, Simplification
Domain: PC/Server
Approach: Disruptive

ParPerOS is a fundamental OS project, which allows for broad collaboration:



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