Technische Universität Hamburg

Leibniz Universität Hannover

Morsels: Explicit Virtual Memory Objects

DIMES '23

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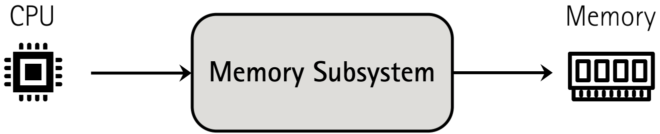
New Challenges for Virtual-Memory Management



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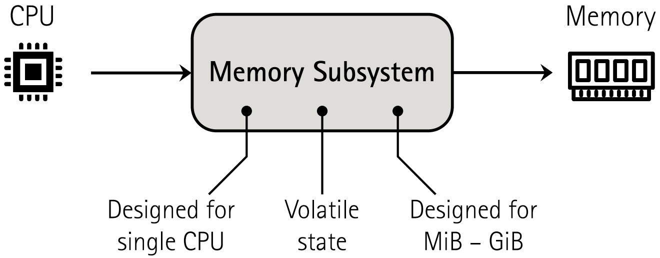

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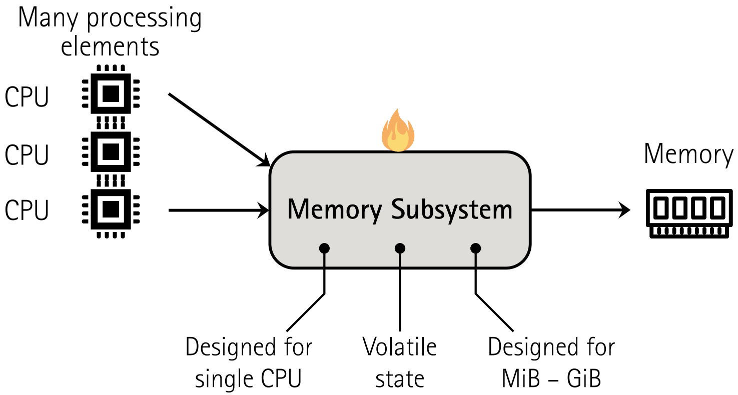

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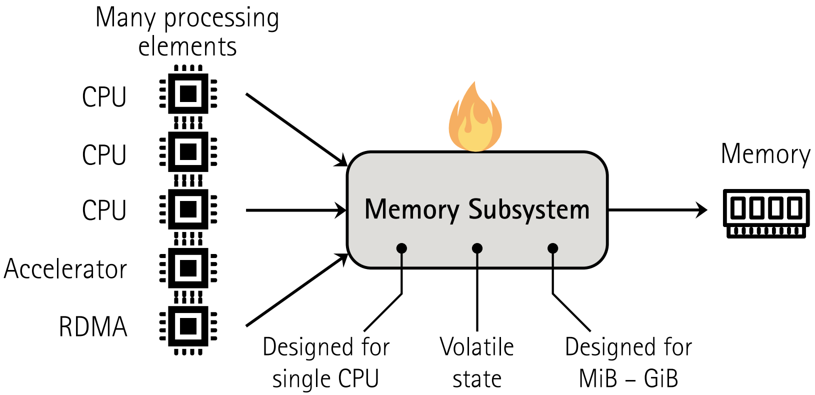

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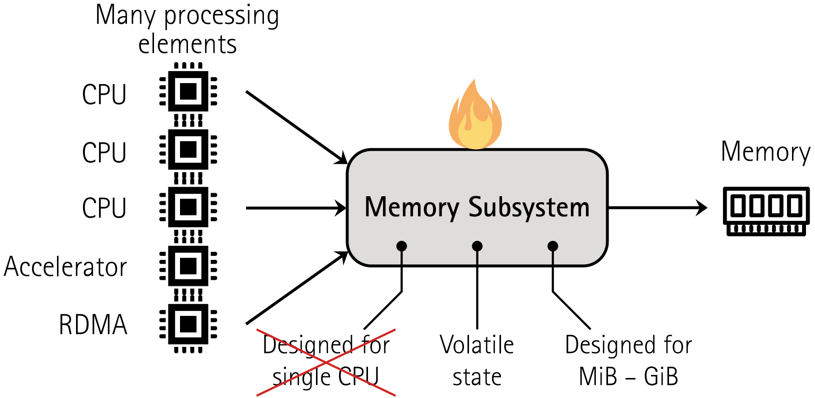

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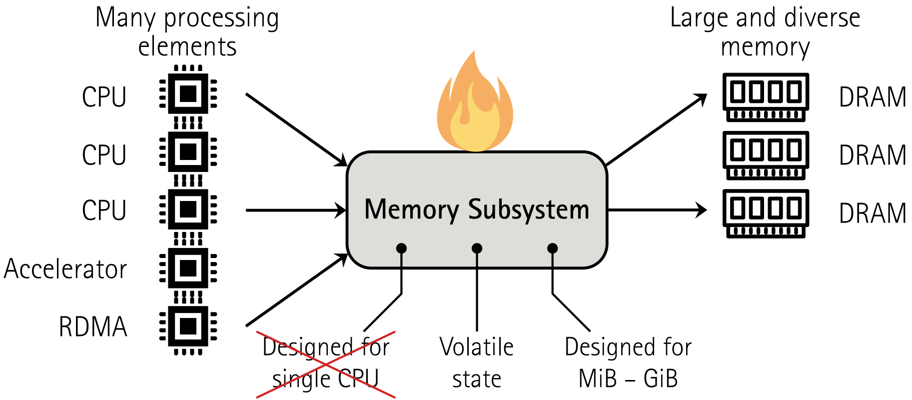

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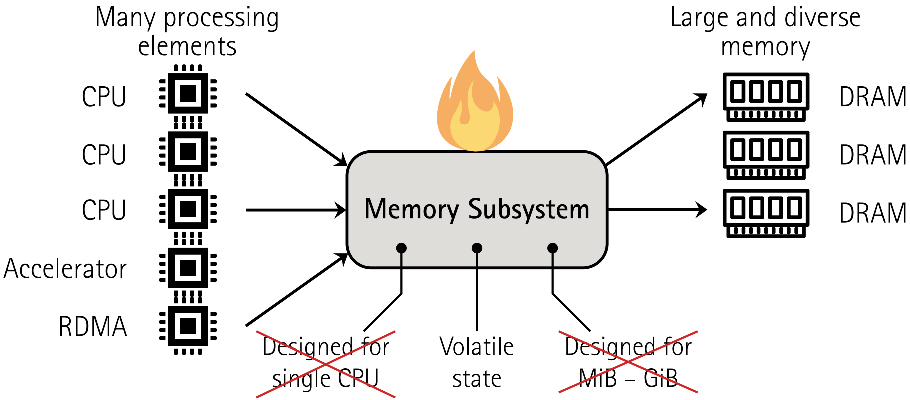

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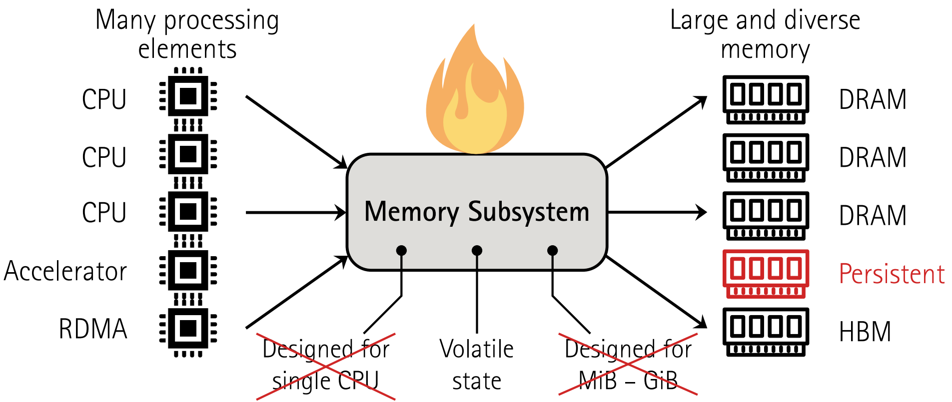

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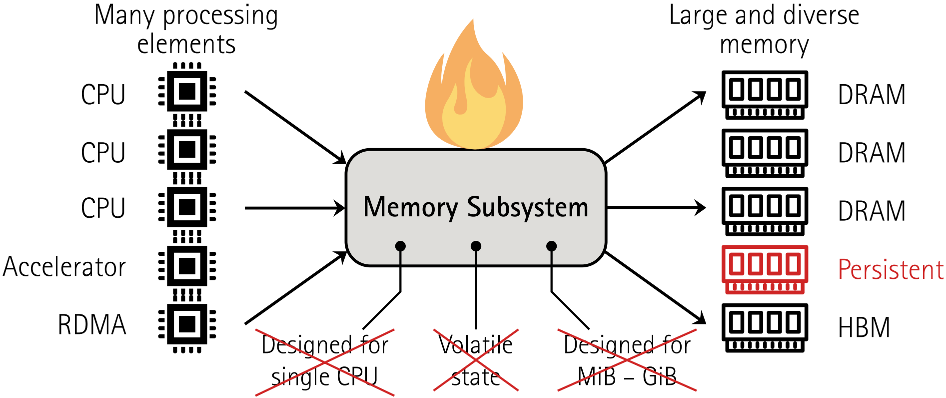

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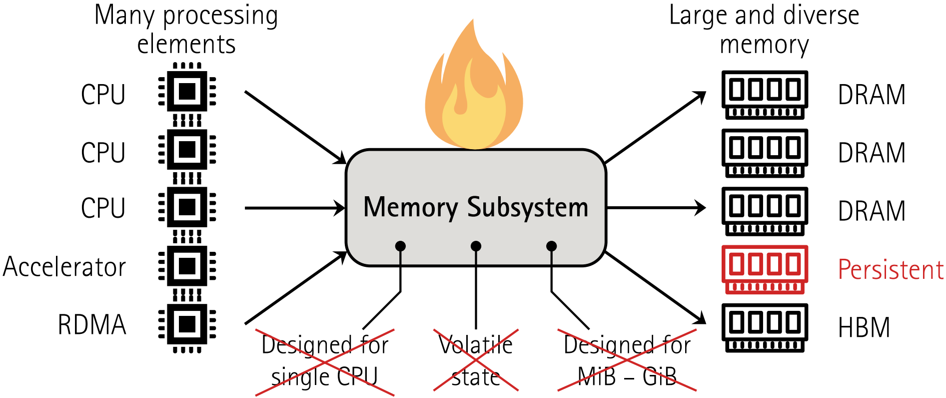

What are efficient OS abstractions for large memory objects?

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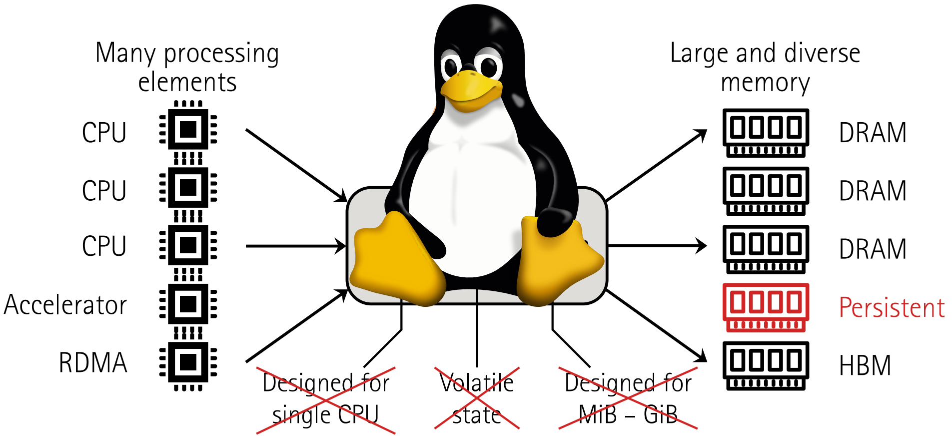

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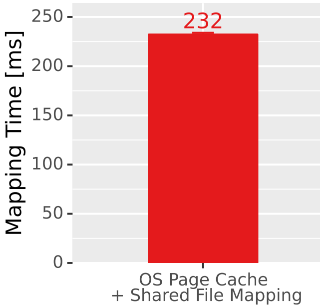

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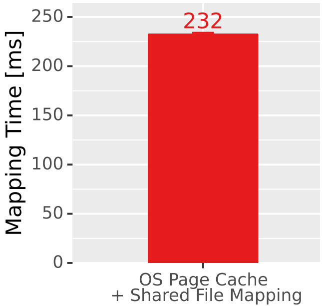

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Our solution: Morsels

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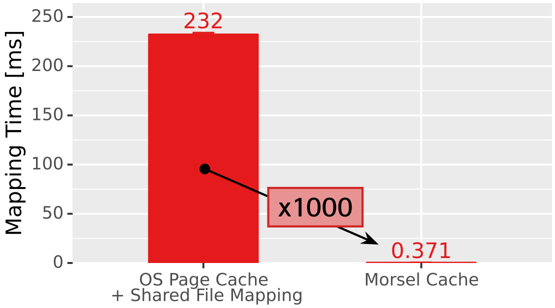
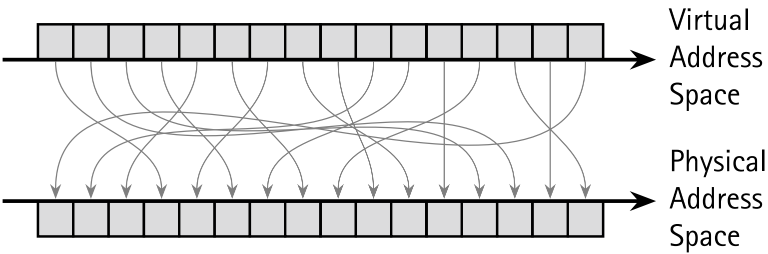


Memory Objects – Morsel Concept



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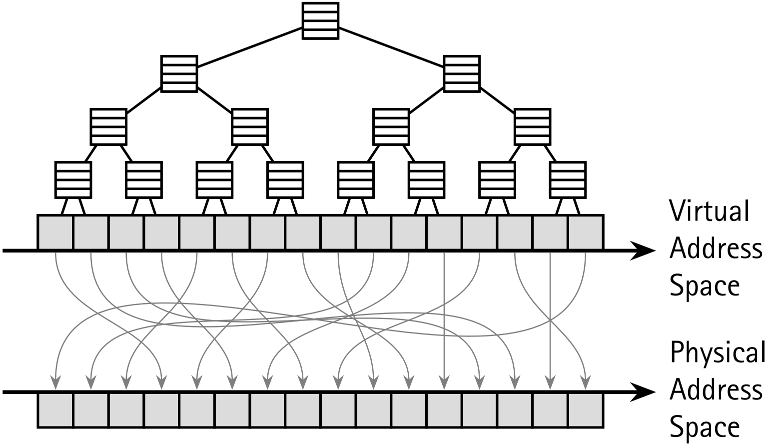

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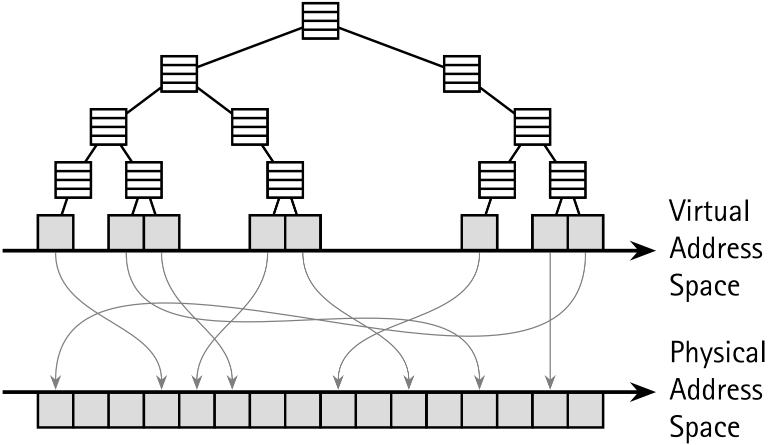

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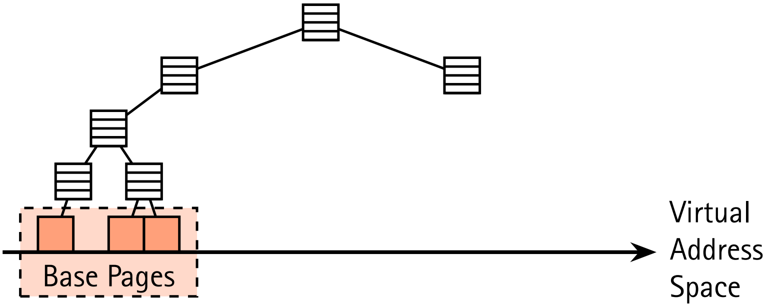

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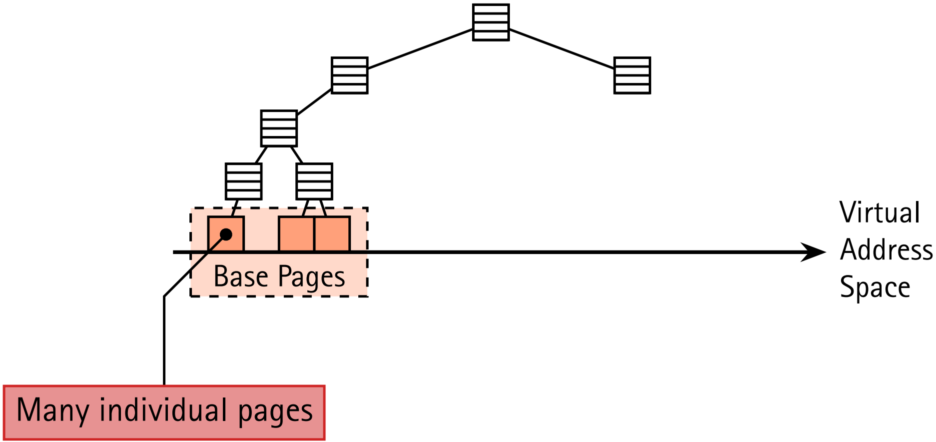

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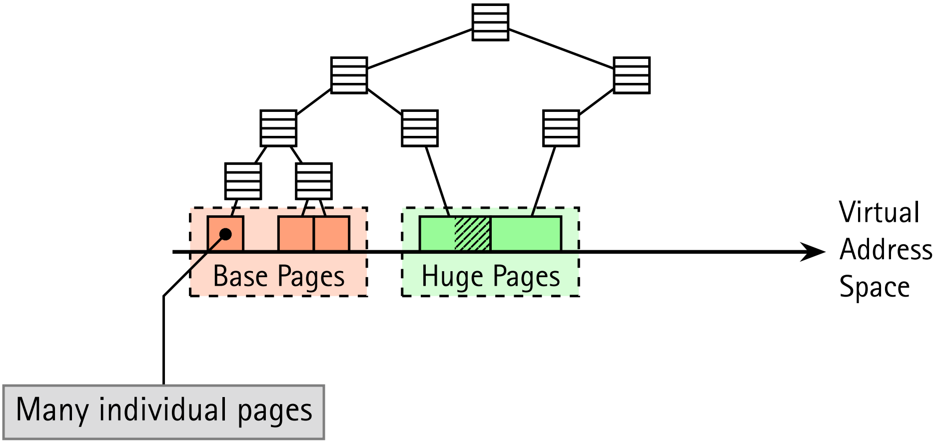

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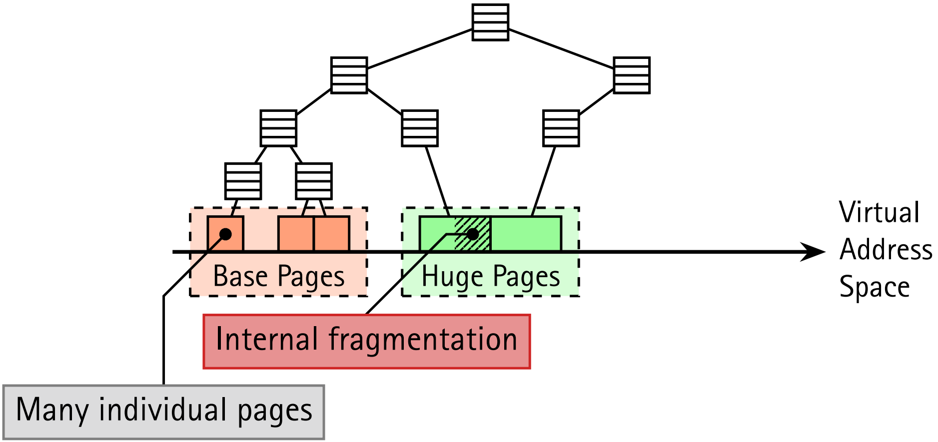

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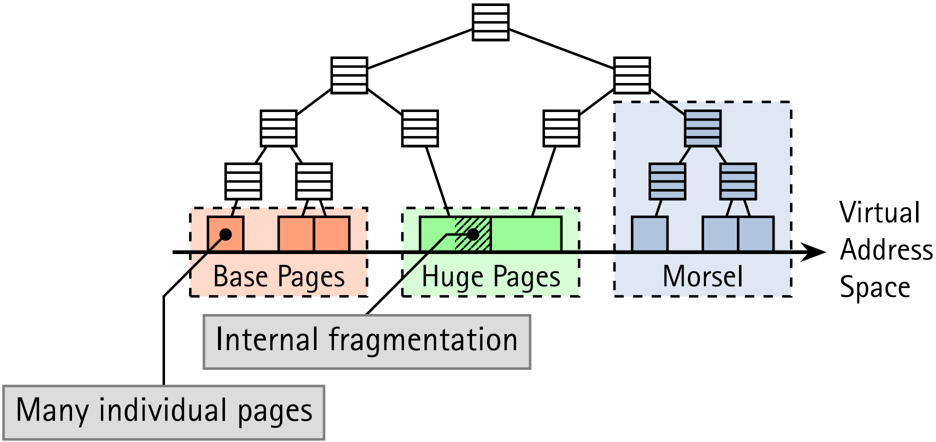

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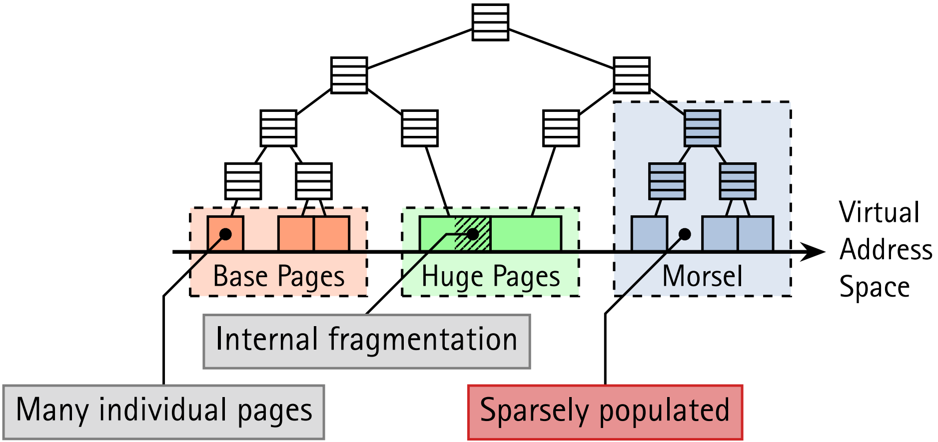

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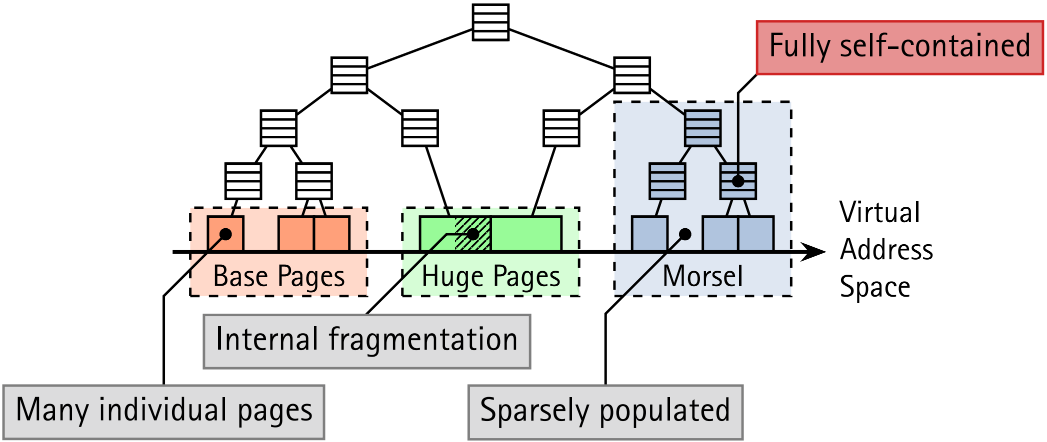

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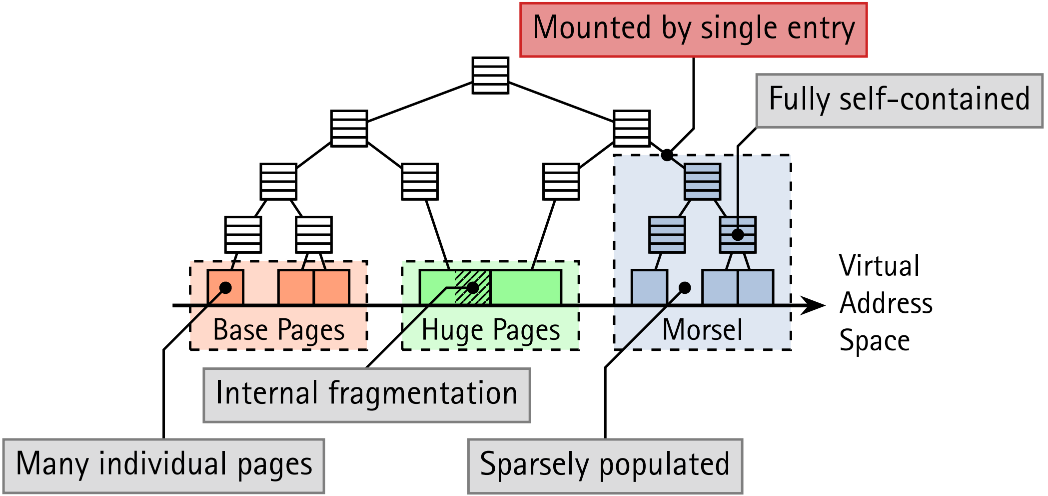

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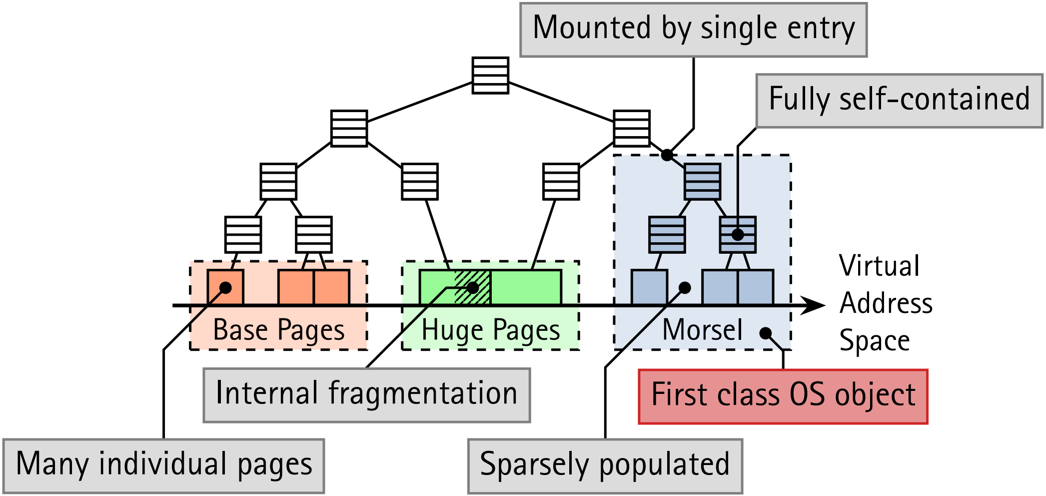

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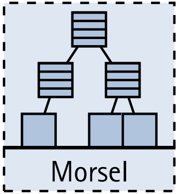

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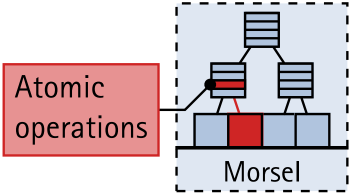

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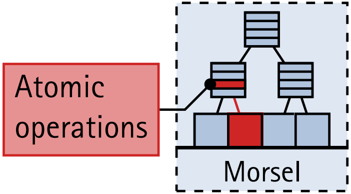

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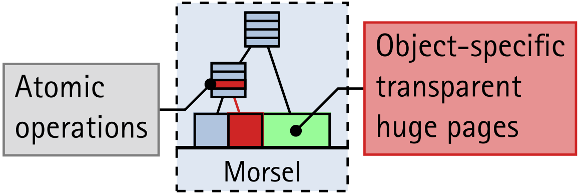

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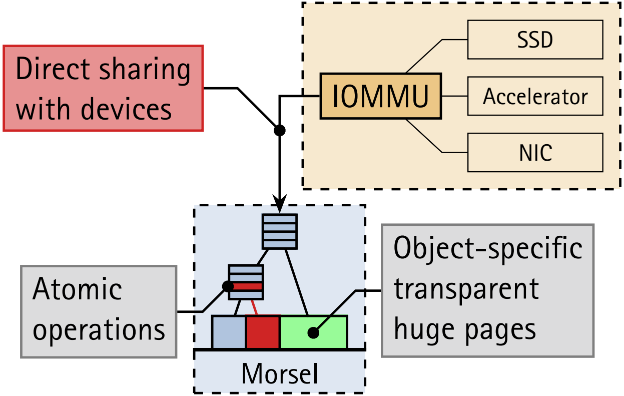
- Sharing with devices
  - Reduce management overhead for DMA



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Evaluation: Prototypic implementation in Linux

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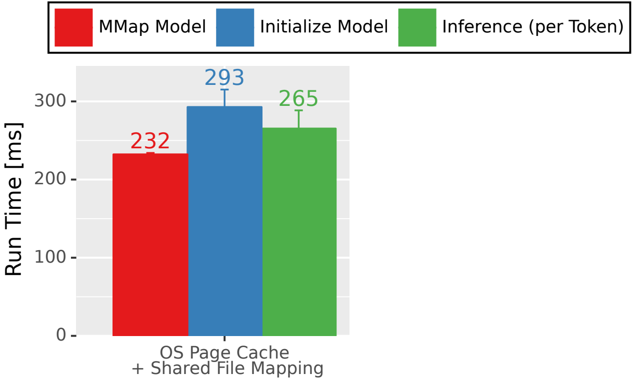

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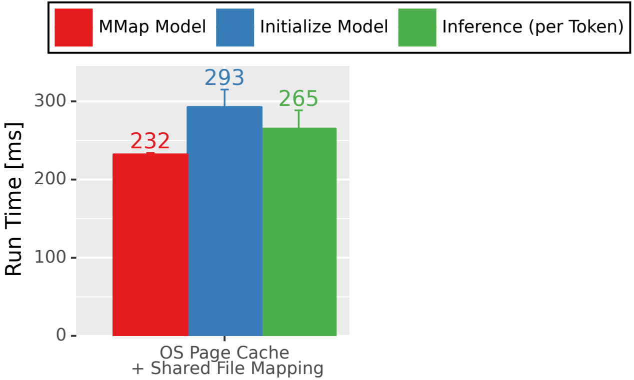

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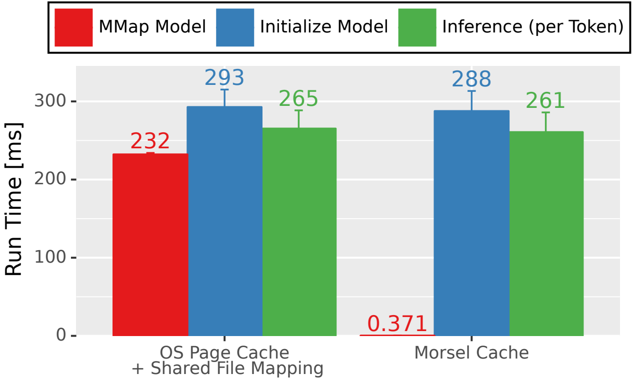

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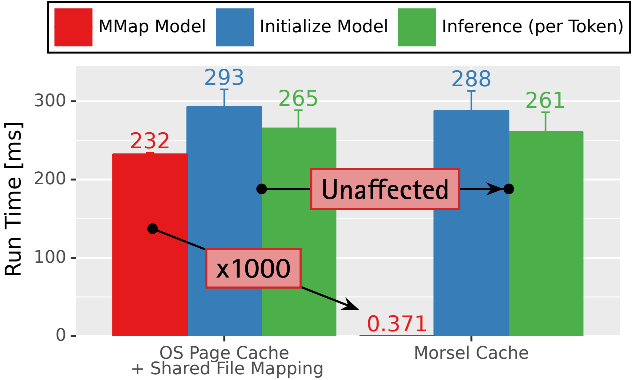

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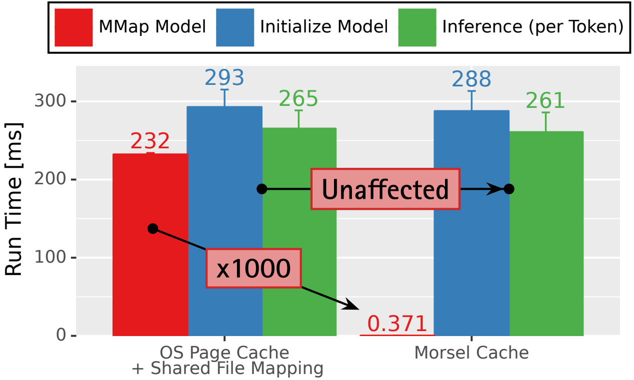
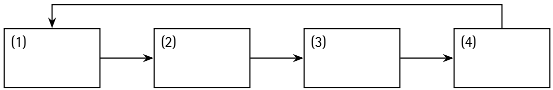


Result: 45% reduced startup time

Case Study 2: Processing Pipeline

Unix Domain Socket: Passing File Descriptors



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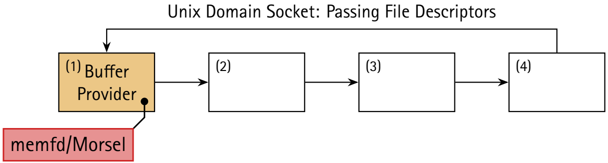
- Comparing Morsels with memfd



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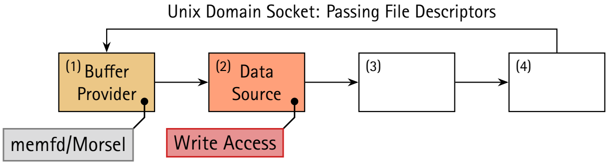

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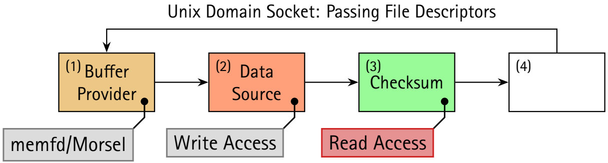

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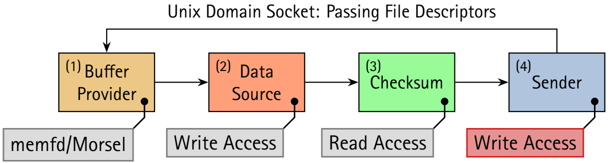

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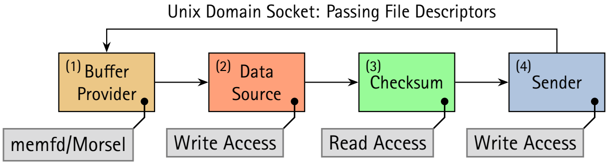

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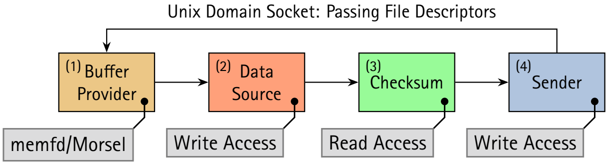

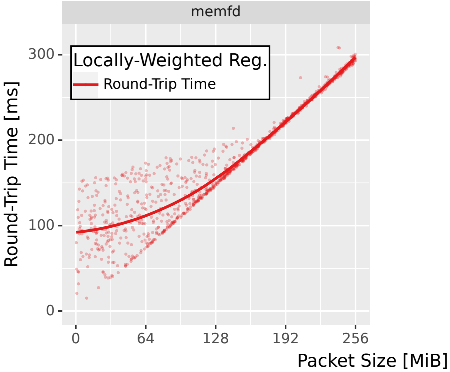

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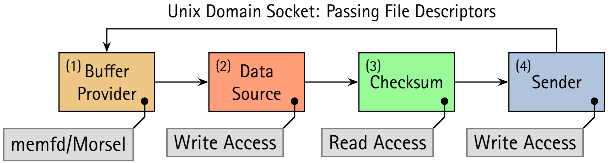

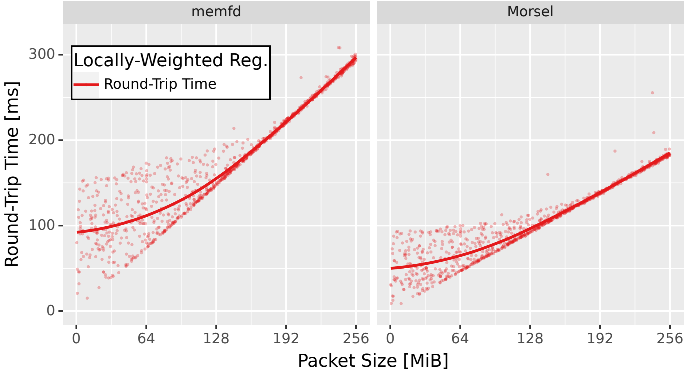

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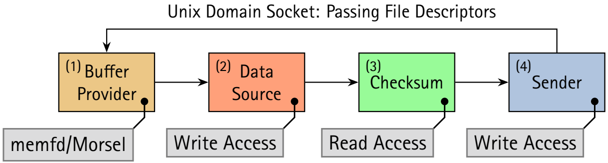

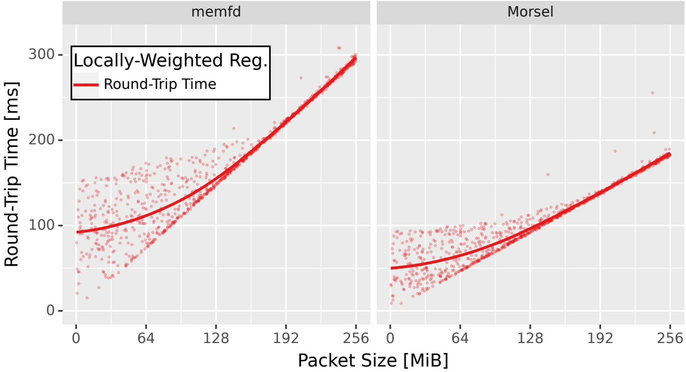

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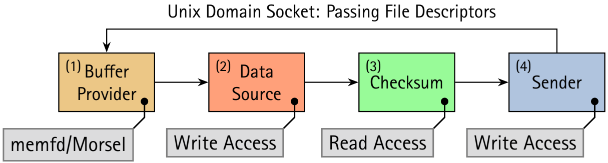

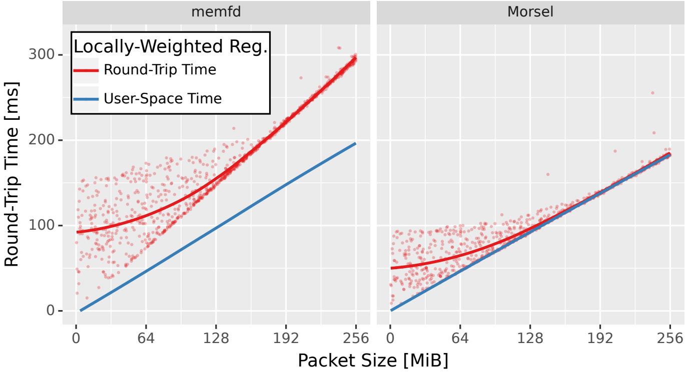

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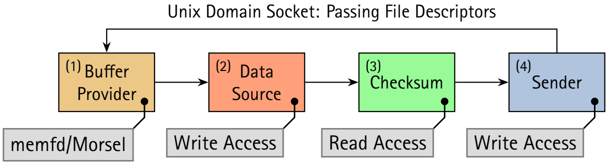

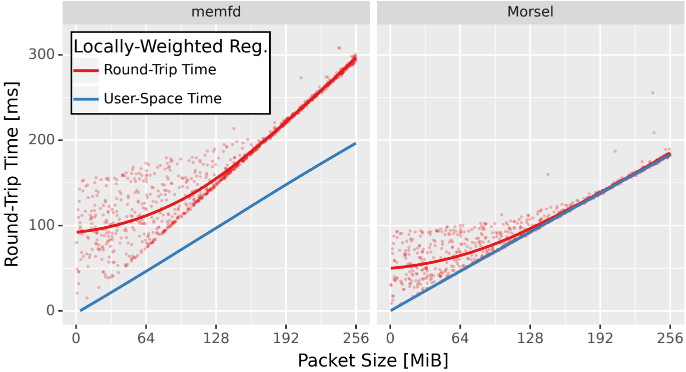

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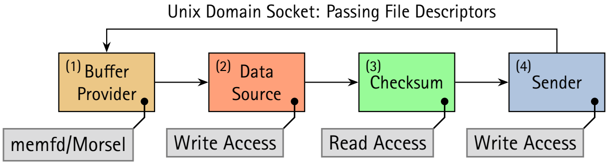
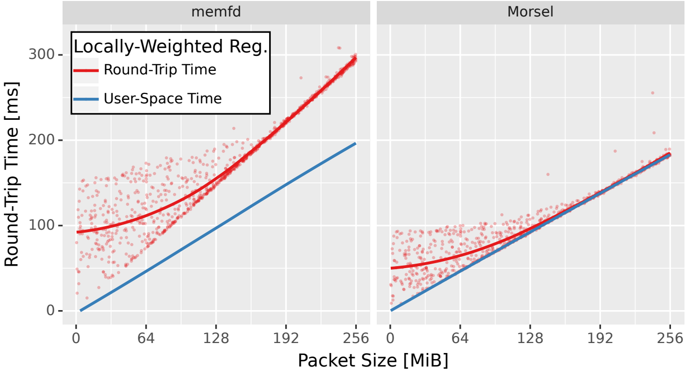
Conclusion: Morsels enable efficient handling of virtual memory!





Morsels: Highly efficient handling of large memory objects

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  - Many individual entities (pages)
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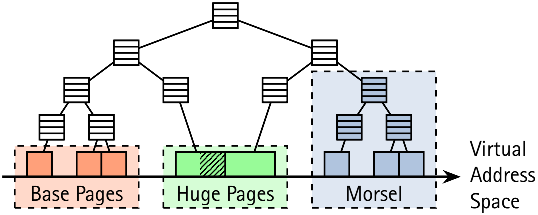
  - No persistent state



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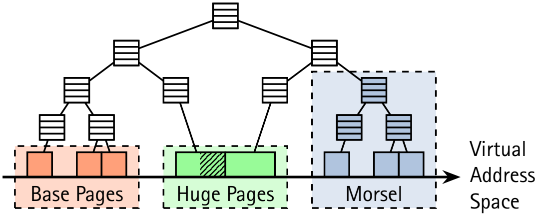

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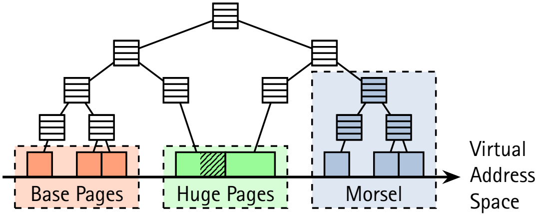
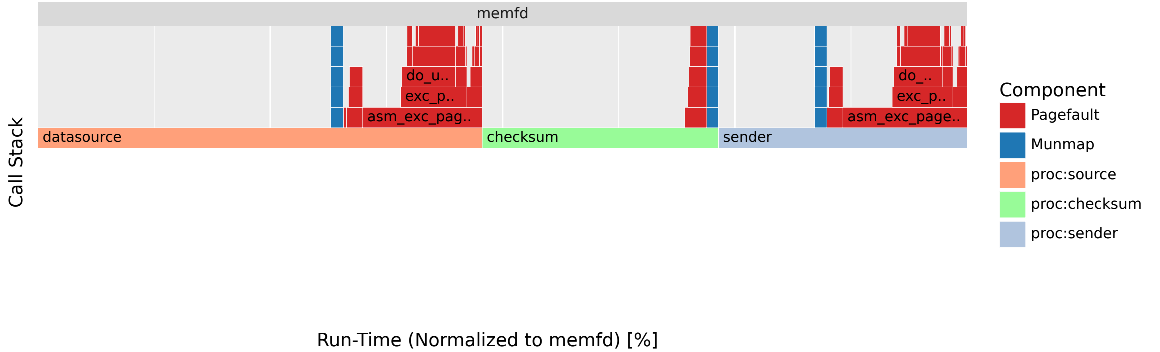
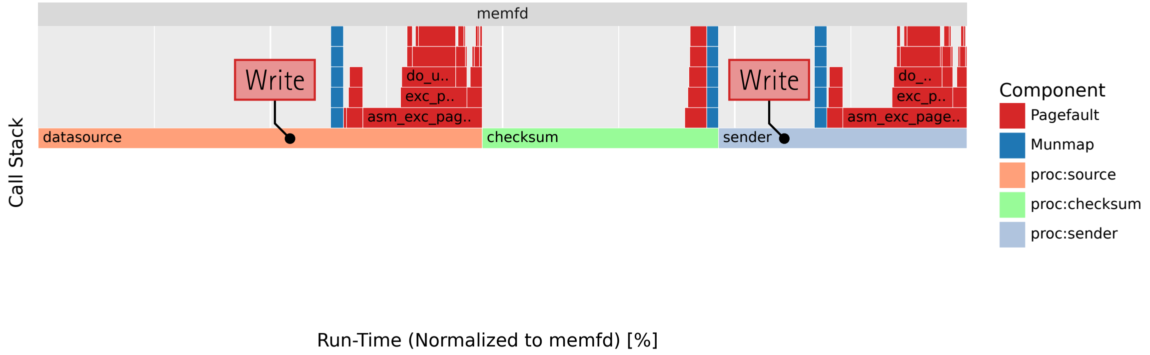
- Results
  - Constant mapping time (x1000 faster for 7 GiB)
  - 39% reduced RTT for shown pipeline



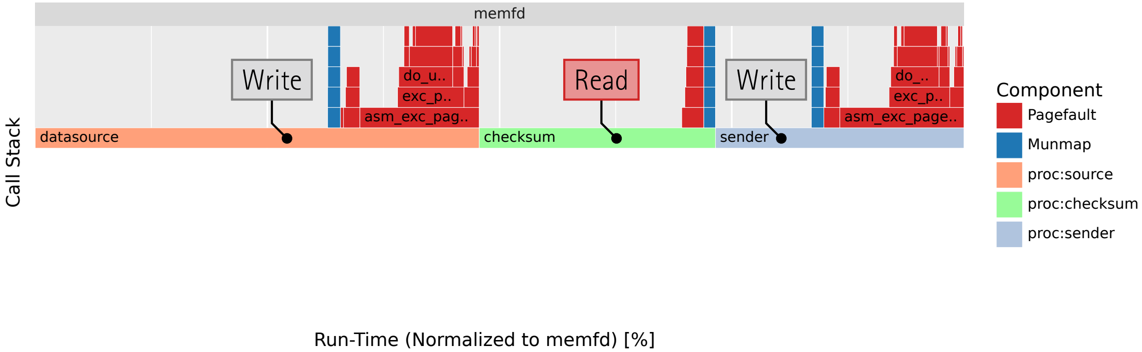
Case Study 2: Processing Pipeline



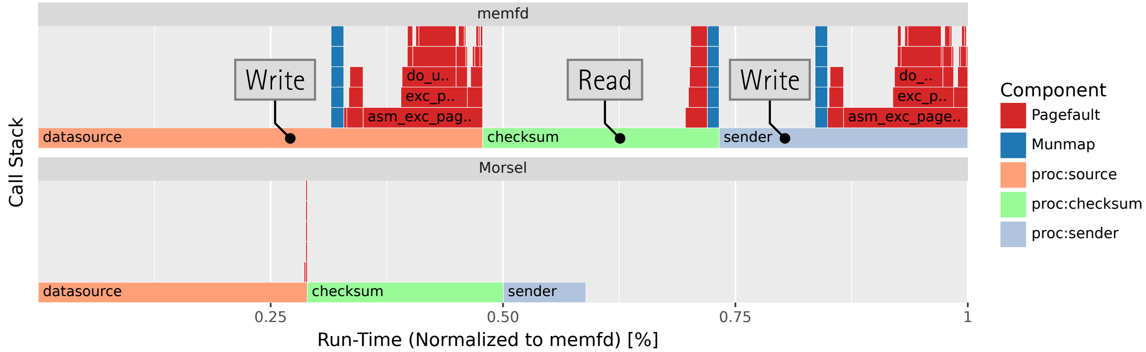
Case Study 2: Processing Pipeline



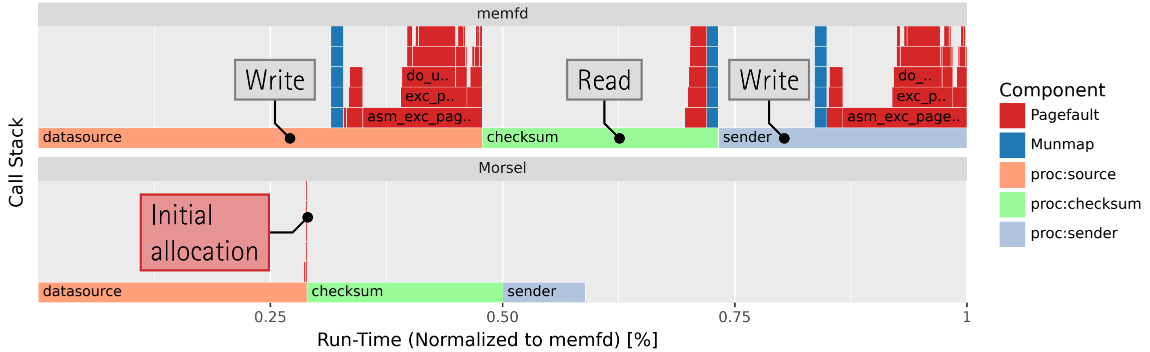
Case Study 2: Processing Pipeline



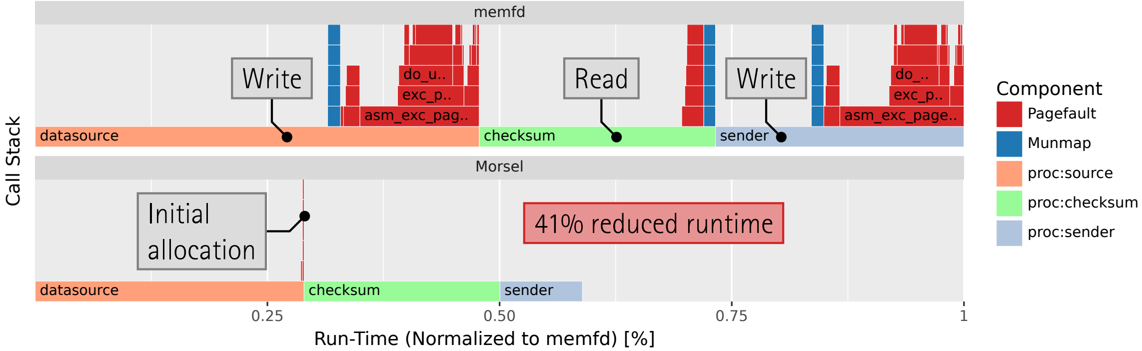
Case Study 2: Processing Pipeline



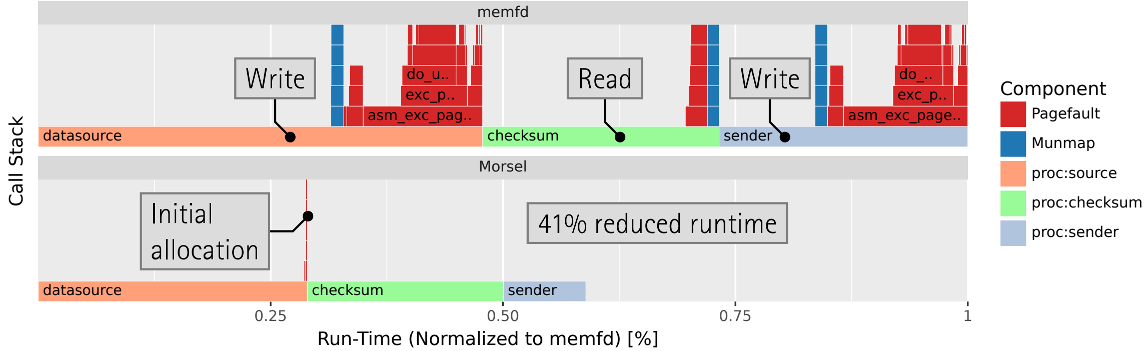
Case Study 2: Processing Pipeline



Case Study 2: Processing Pipeline



Case Study 2: Processing Pipeline



Conclusion: Morsels enable efficient handling of virtual memory!