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# An OS Service for Transparent Remote Memory Accesses in NoC-Based Lightweight Manycores

Pedro Henrique Penna <sup>1 2</sup>, Matheus Souza <sup>2</sup>, Emmanuel P. Júnior <sup>3</sup>, Bruno Nascimento <sup>3</sup>, Márcio Castro <sup>3</sup>, François Broquedis <sup>4</sup>, Henrique Freitas <sup>2</sup> and Jean-François Méhaut <sup>1</sup>

## Introduction

- **Lightweight Manycores Are Substantially Different**
  - Integrate up to thousands of simple and low-power cores
  - Feature rich, fast and reliable interconnects
  - Present a constrained distributed memory configuration
- **Current Runtime Systems Miss Rich Abstractions**
  - The engineer should implement all by himself
  - A fully-featured OS would make software design easier

## Goals and Contributions

- **Target Challenges That Arise from the Distributed Memory**
  - Data accessing, tiling and migration
  - Address space expansion
  - Secure data sharing
- **Propose the Remote Memory (RMem) Service**
  - New OS facility that provides a shared memory abstraction
- **Introduce Communication Primitives on Top of RMem**
  - Rely on a one-sided programming paradigm
  - Enable applications to share data in a secure fashion
- **Present a Prototype of RMem for the MPPA-256 Processor**
  - Integration with Nanvix (<https://github.com/nanvix>)

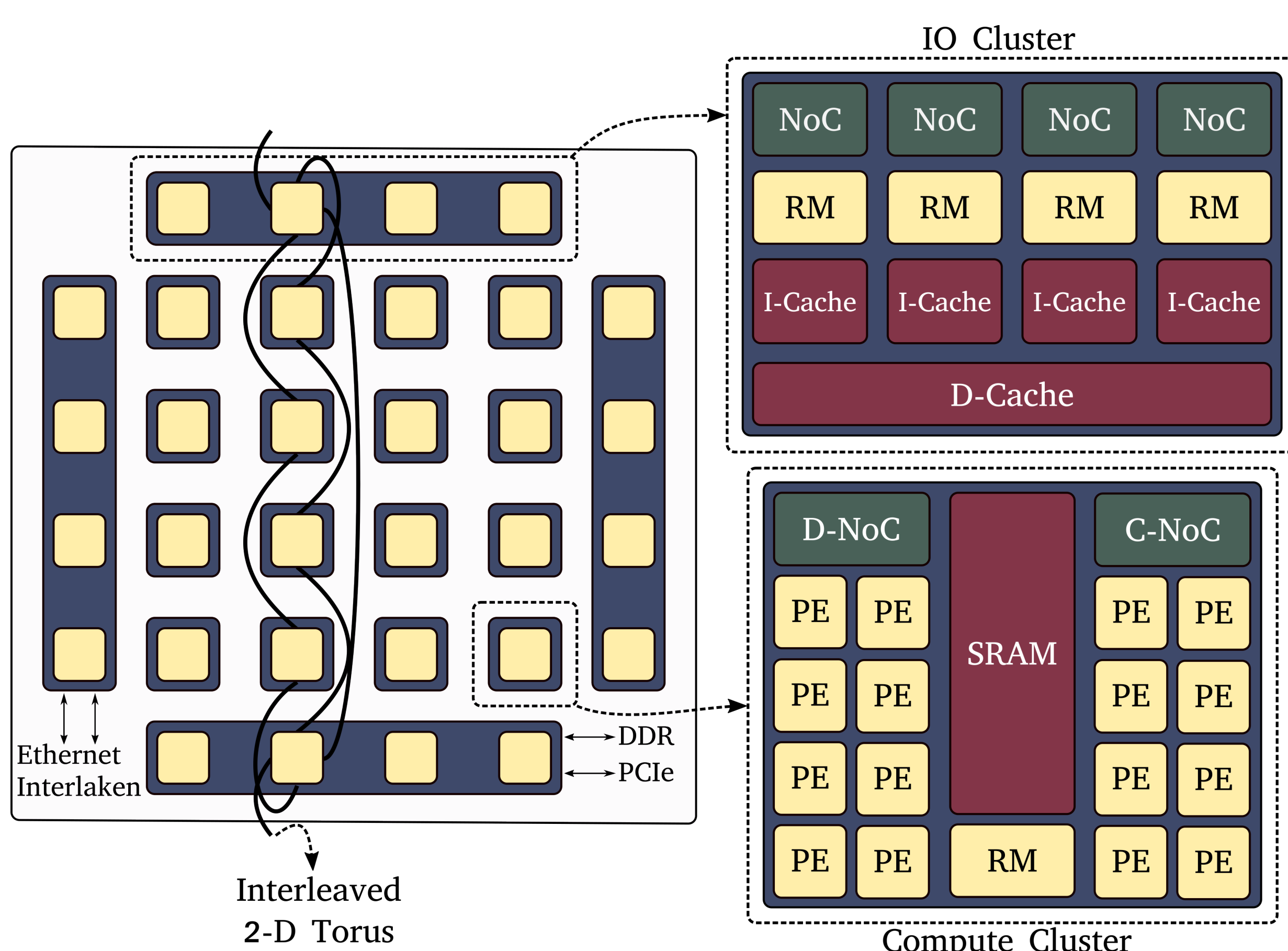


Figure 1: Architectural overview of MPPA-256.

## The RMem Service

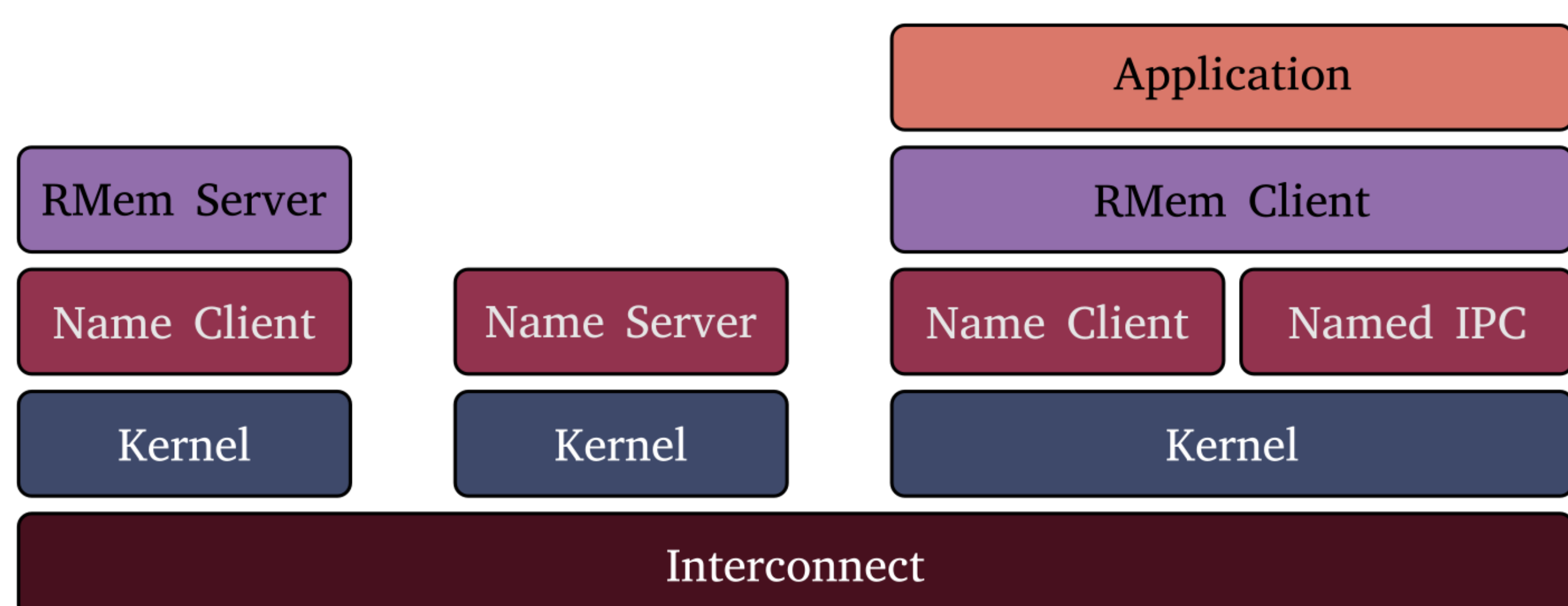


Figure 2: RMem Service architectural overview.

- **Name Service:** provides name resolution protocol
- **Named IPC:** mailbox (1:N) and portal (M:N)

`memread(void *local, off_t remote, size_t size)`

1. Parse the remote address
2. Resolve location of target RMem server
3. Send read request to the server through a mailbox
4. Enable remote portal reads from the RMem server
5. Receive data from the RMem server via a portal

`memwrite(void *local, off_t remote, size_t size)`

1. Parse the remote address
2. Resolve location of the target RMem server
3. Send write request to the server through a mailbox
4. Send data to the RMem server via a portal

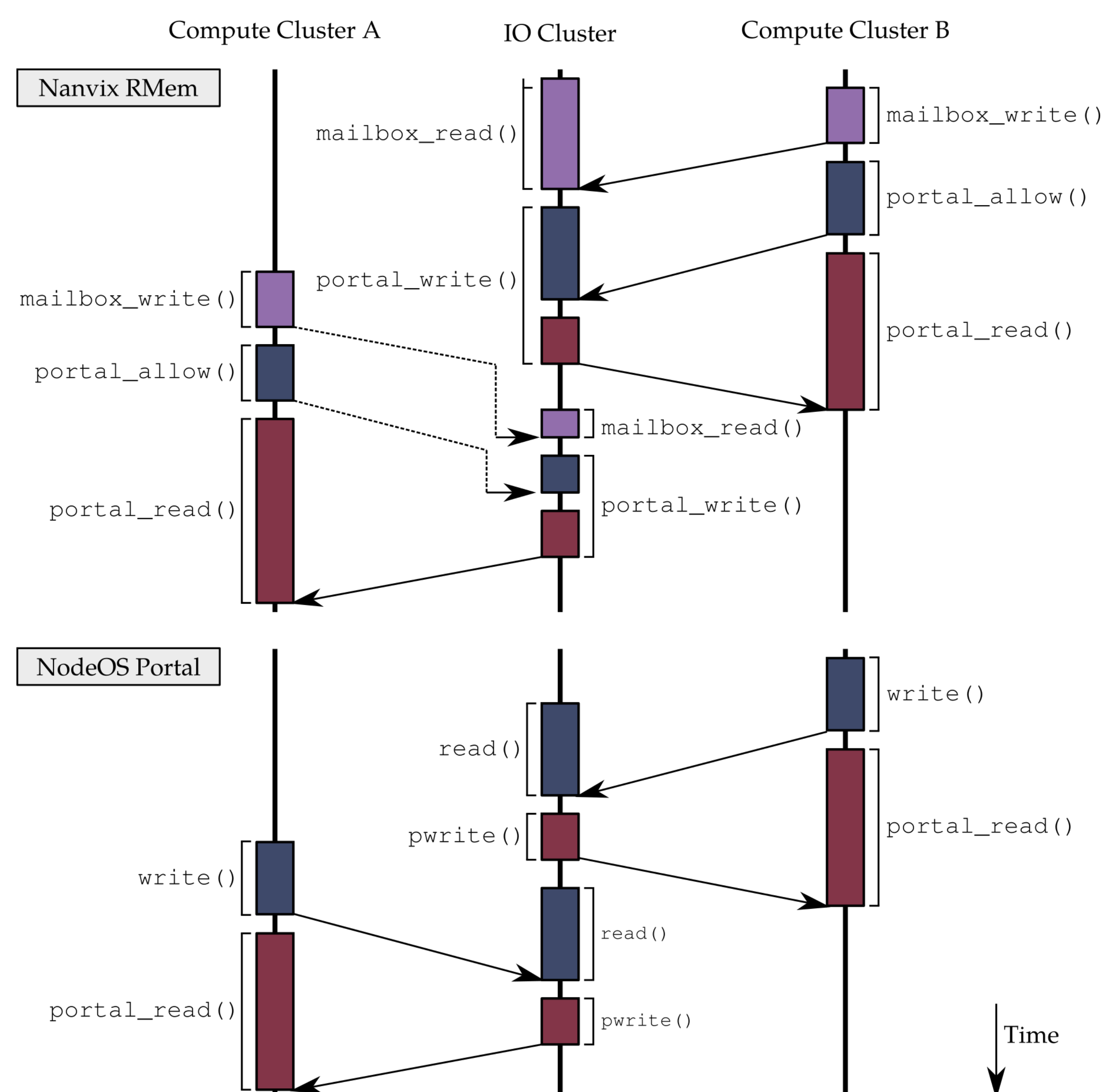


Figure 3: Breakdown of remote reads by 2 peers.

## Experimental Results

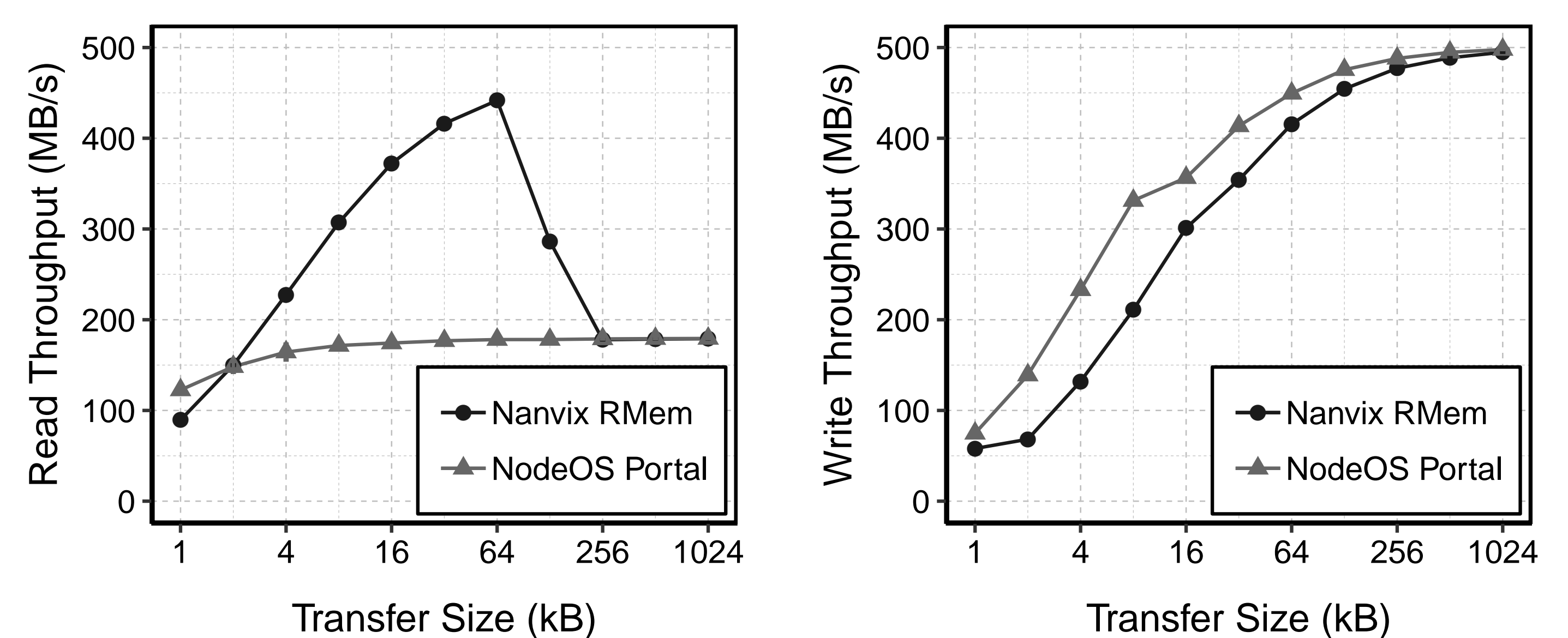


Figure 4: Experimental results for synthetic kernel.

## Conclusions

- RMem Service and NodeOS have similar write performance
- Read protocol maximizes concurrency
- Results encourage a native implementation of our service

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