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To cite this version:

HAL Id: hal-01907003
https://hal.archives-ouvertes.fr/hal-01907003
Submitted on 31 Oct 2018

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

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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)

The RMem Service

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

![Figure 1: Architectural overview of MPPA-256.](image1)

![Figure 2: RMem Service architectural overview.](image2)

![Figure 3: Breakdown of remote reads by 2 peers.](image3)

Experimental Results

![Figure 4: Experimental results for synthetic kernel.](image4)

Conclusions

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