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To cite this version:

HAL Id: hal-01907003
https://hal.science/hal-01907003
Submitted on 31 Oct 2018

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

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

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)

Experimental Results

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

Conclusions