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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, Mário 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)

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

Experimental Results

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

Conclusions