An OS Service for Transparent Remote Memory Accesses in NoC-Based Lightweight Manycores
Pedro Henrique Penna, Matheus Souza, Emmanuel Podestá Júnior, Bruno Nascimento, Márcio Castro, François Broquedis, Henrique Freitas, Jean-François Méhaut

To cite this version:

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

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
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

Figure 1: Architectural overview of MPPA-256.

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

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

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

¹Université Grenoble Alpes (UGA), Grenoble, France
²Pontifícia Universidade Católica de Minas Gerais (PUC Minas), Brazil
³Universidade Federal de Santa Catarina (UFSC), Brazil
⁴Institut National Polytechnique de Grenoble (Grenoble INP), France