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Systems Software Research Group

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Towards Operating System Support for Heterogeneous-ISA Platforms

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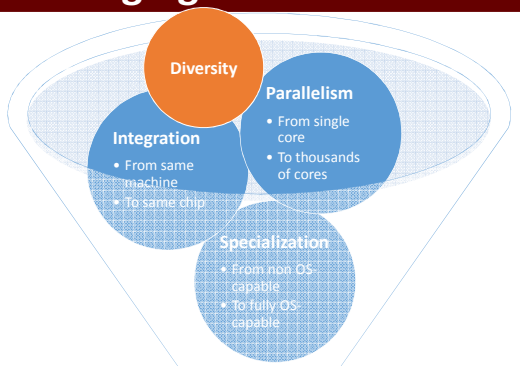
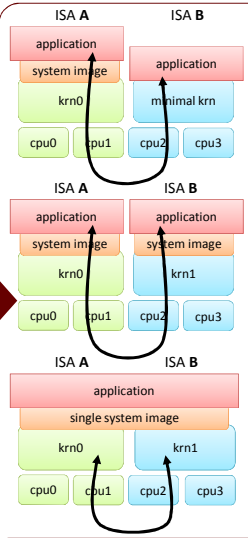
Supported by

Emerging Hardware Trends



Fully **OS-capable Het-ISA** platforms

How to Run Applications?

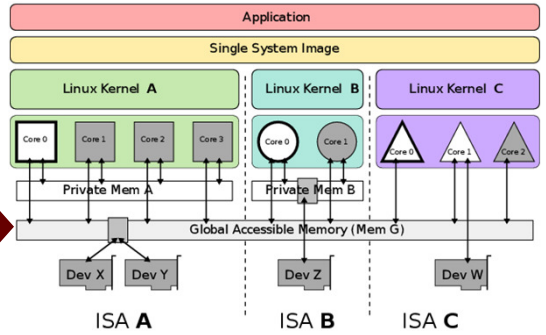


- **Asymmetric kernel OS**
- Explicit communication in the application with a minimal kernel (e.g. NIX)

- **Traditional Approach**
- Explicit communication in the application (e.g. MPI, OpenCL)

- **Multiple kernel OS**
- Kernels communicate instead of the application (e.g. DVSM)

The Popcorn OS Way

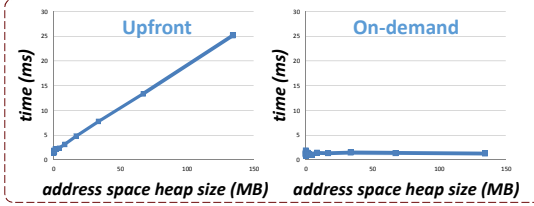


- Extends **traditional SMP OS concepts**
  - to support **heterogeneous-ISA** platforms
  - to **improve programmability**
- **Single OS**, multiple kernels
  - Each kernel instance may run on a **different ISA**
  - Kernels **communicate** by message-passing
  - A **global OS state** is maintained amongst kernels
- **Hiding hardware diversity** from apps
  - Applications run **transparently** across and amongst kernels

- **Peer** kernels
- **Resource sharing** amongst kernels
- Kernels **share system load**
- Adopt **Linux kernel**
  - To distinguish from previous approaches
  - To take advantage of the mature software ecosystem

- Kernels must **coexist** on the same hardware
- Kernels must be able to **interact** with **any hardware resource**
- Kernels **communicate** and **coordinate**
- Inter-kernel **thread and process migration**
- **Single system image**

Required Features



Linux Prototype

Boot Process
- Primary and Secondary kernels
- Kexec to boot a kernel
- Processor core system wide id

Shared Memory Handling
- Private and shared memory
- Each kernel has an initial allocation of private memory

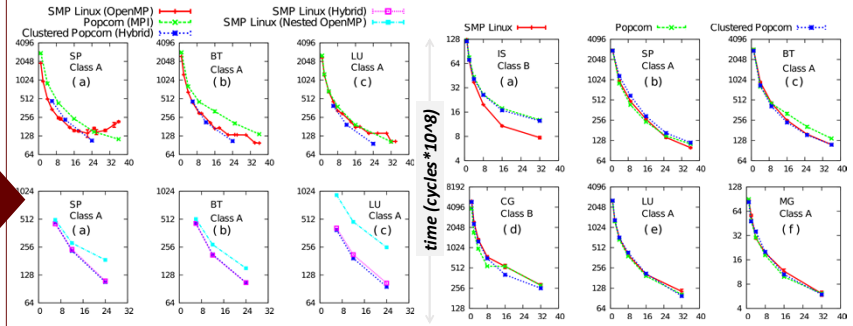
Device Drivers
- Resource masking
- Proxy drivers
- Time-shareable devices

Kernel to Kernel Communication
- Message passing
- Kernel level
- Pluggable

(User) Task Migration
- Process and thread migration
- Migration service
- Upfront and on-demand task state object migration

Software Network Switch
- Each kernel has an IP address
- Single IP overlay
- Operates on shared memory

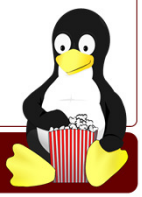
Homogeneous-ISA **Experimental Evaluation**



Compute-bound NPB MPI/NEMESIS

Conclusions

An SMP OS kernel can be used as the base of a **multiple kernel OS** for emerging **OS-capable heterogeneous-ISA** platforms



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