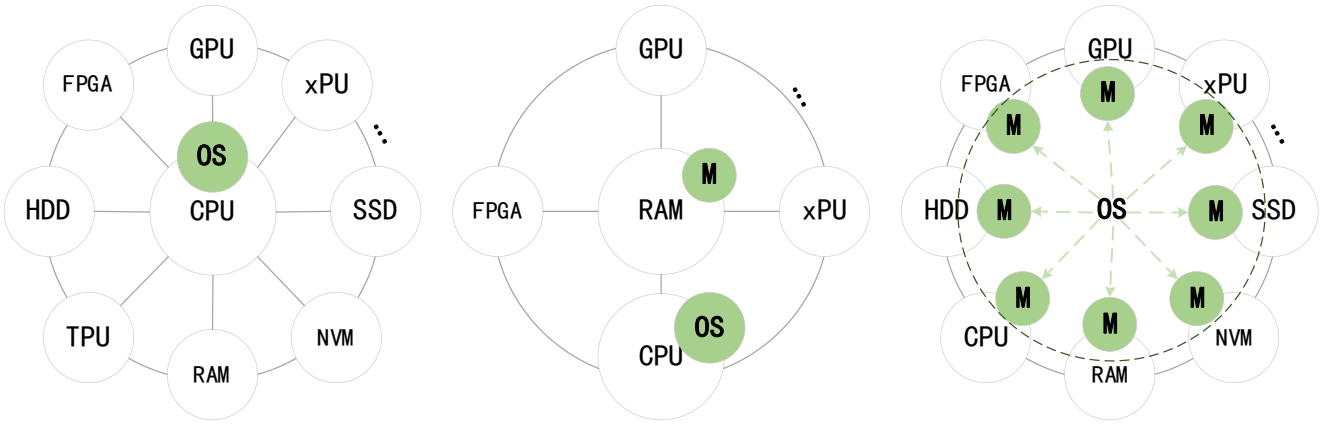
Physically Resource Disaggregated Datacenter: Technique Routes, Design, and Open Issues

Haiqiao WU, Chen ZHANG, Yuming XIAO, Tao HUANG, Yunjie LIU

Frontiers of Computer Science, DOI: 10.1007/s11704-025-41118-5

Problems & Technique routes

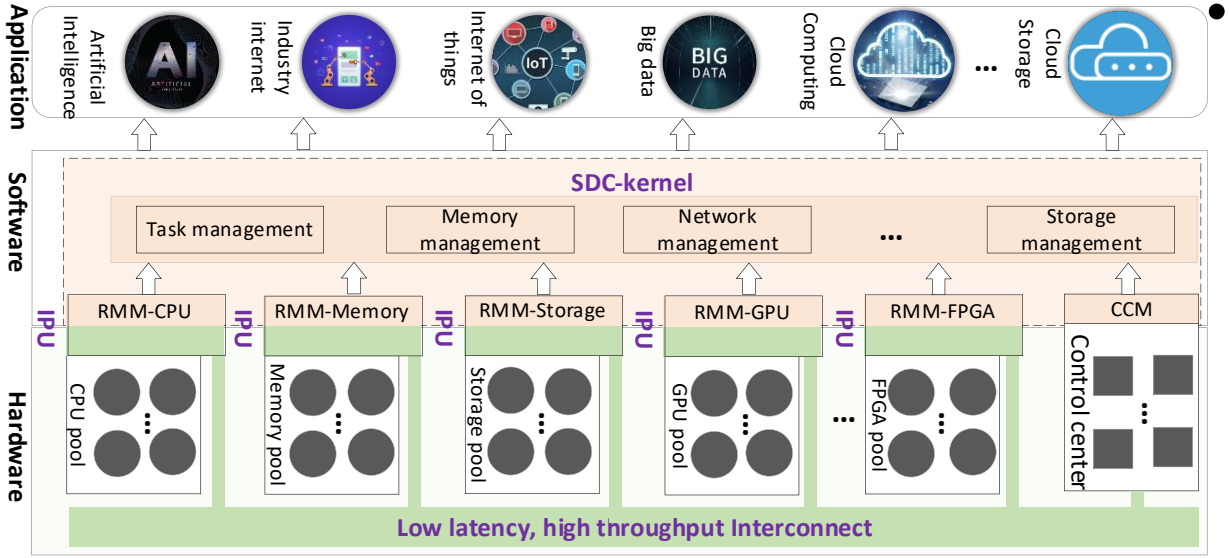
- Problems of traditional server-based datacenters:
  - Low resource utilization.
  - Low scalability and flexibility.
  - Low fault tolerance granularity.
- Technique routes: Physically disaggregating resources is a promising direction to tackle the problems, which can be categorized into three technique routes, including CPU-centric, Memory-centric, and Resource decentralization.



Technique routes for PRD-DC: a) all management and usage logic of storage and computing resources run on the CPU, and other disaggregated resources are used by accessing remote resources; b) migrates the memory management functions in traditional OS to the memory side; c) decouples the traditional OS completely and runs the decoupled management functions of different resources on the corresponding resource side.

Our proposal & Open Issues

- Our proposal:
  - All kinds of storage/computing units are connected to the low-latency and high-throughput network through IPU (I/O Processing Unit), and managed by SDC-kernel. The units under an IPU form a physical resource pool;
  - IPU is responsible for the access and drive of the connected resources, and the interaction between resource pool;
  - SDC-kernel splits the traditional kernel into independent modules, including Resource Management Modules (RMM) and Control Center Module(CCM), and runs these modules in the corresponding IPUs and the control center.



The overview of the proposed Serverless Datacenter

- Open Issues:
  - Compatibility for applications
  - Reliability and security
  - Power supply and energy-saving
  - Heterogeneity supporting