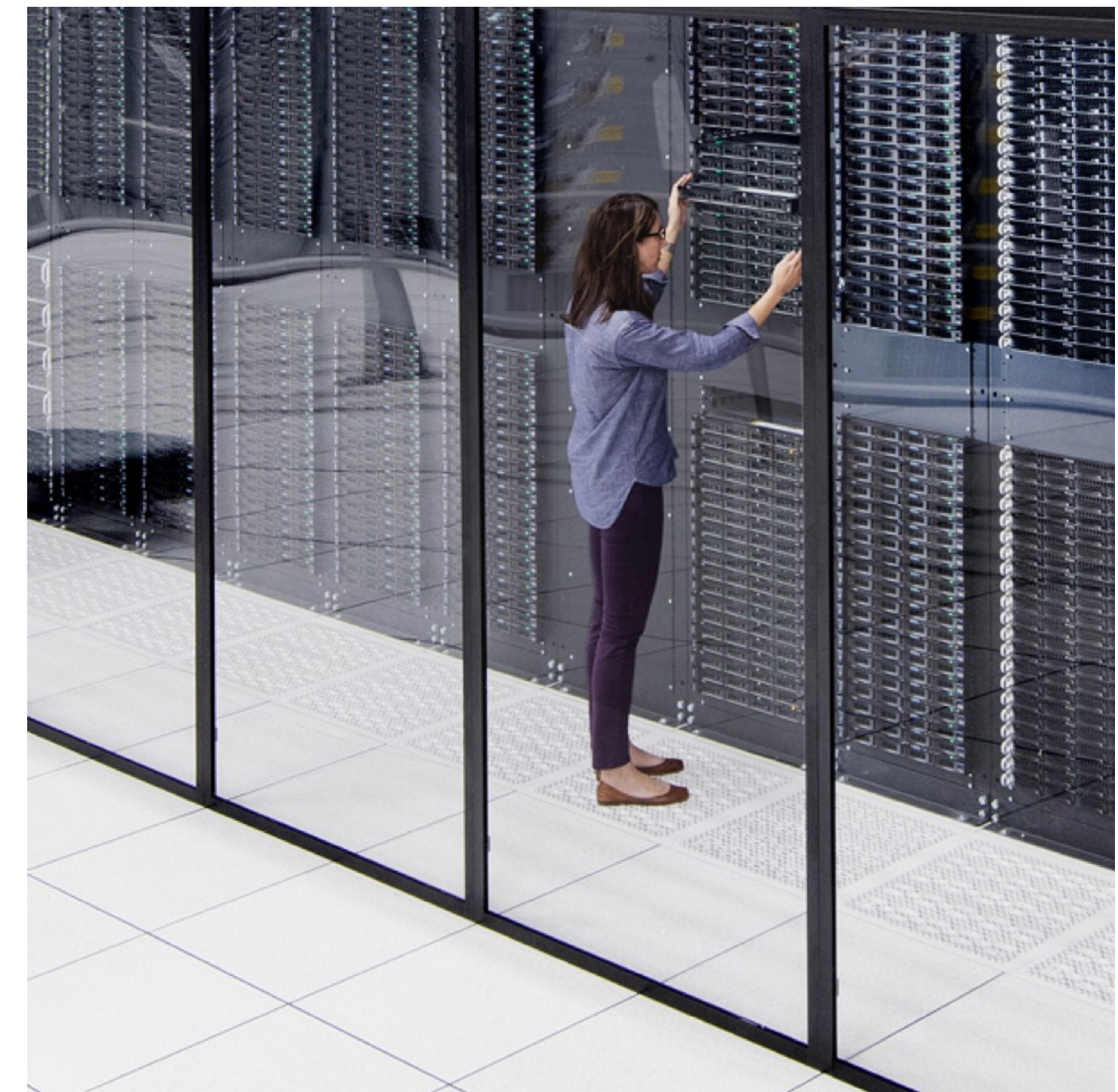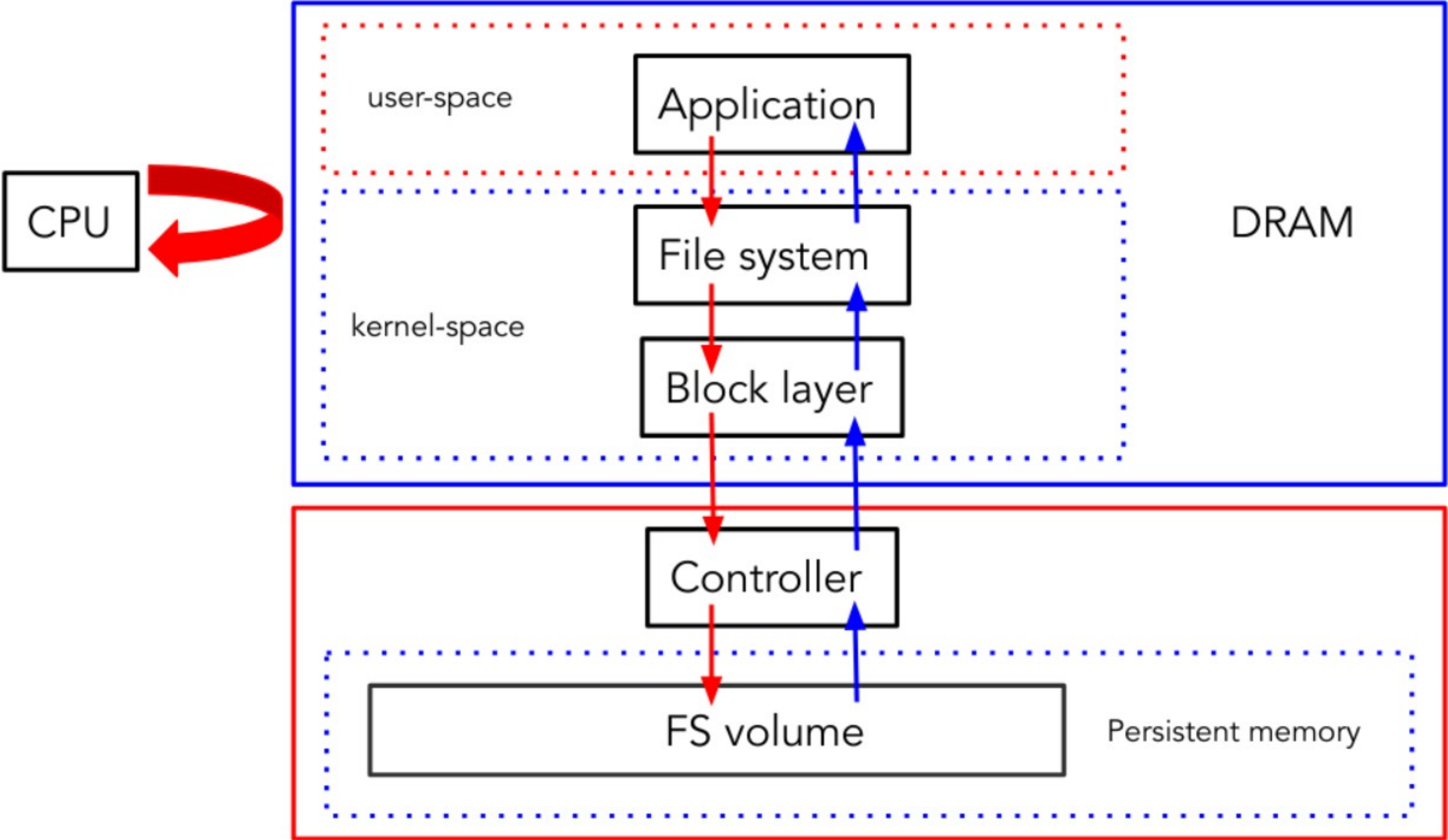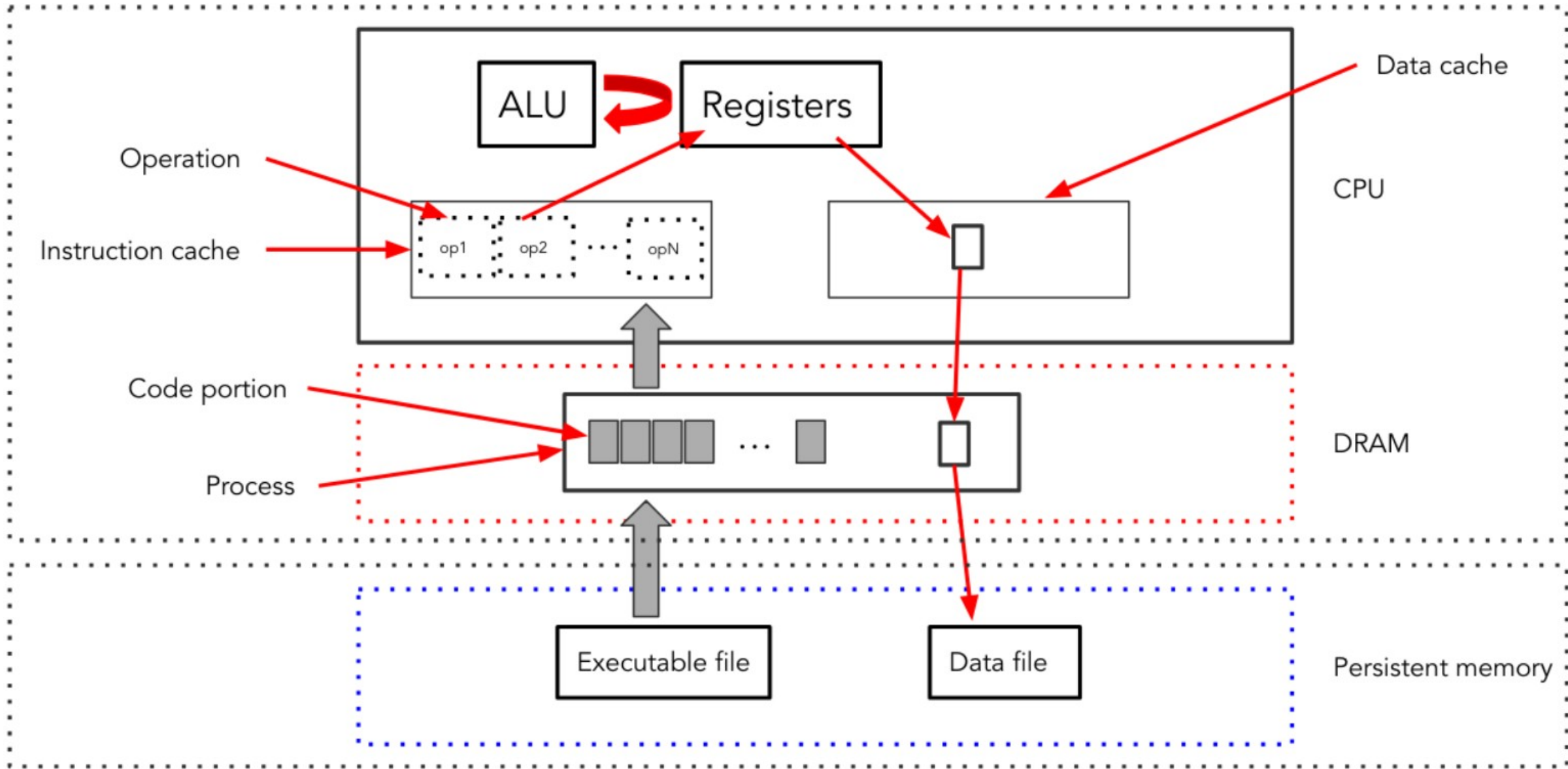# Can file systems survive in data-centric world?
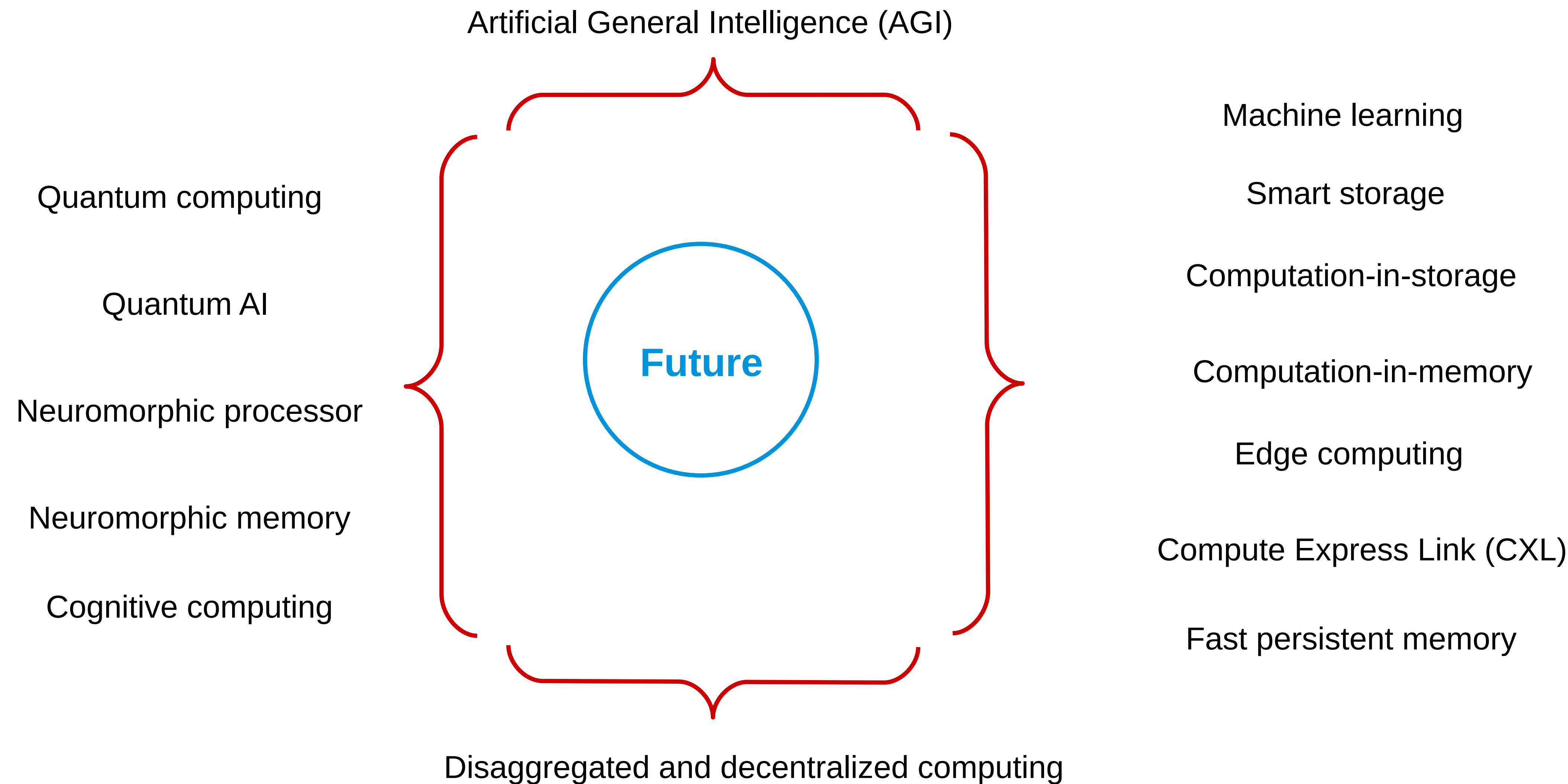
Viacheslav Dubeyko
PhD, Linux kernel developer
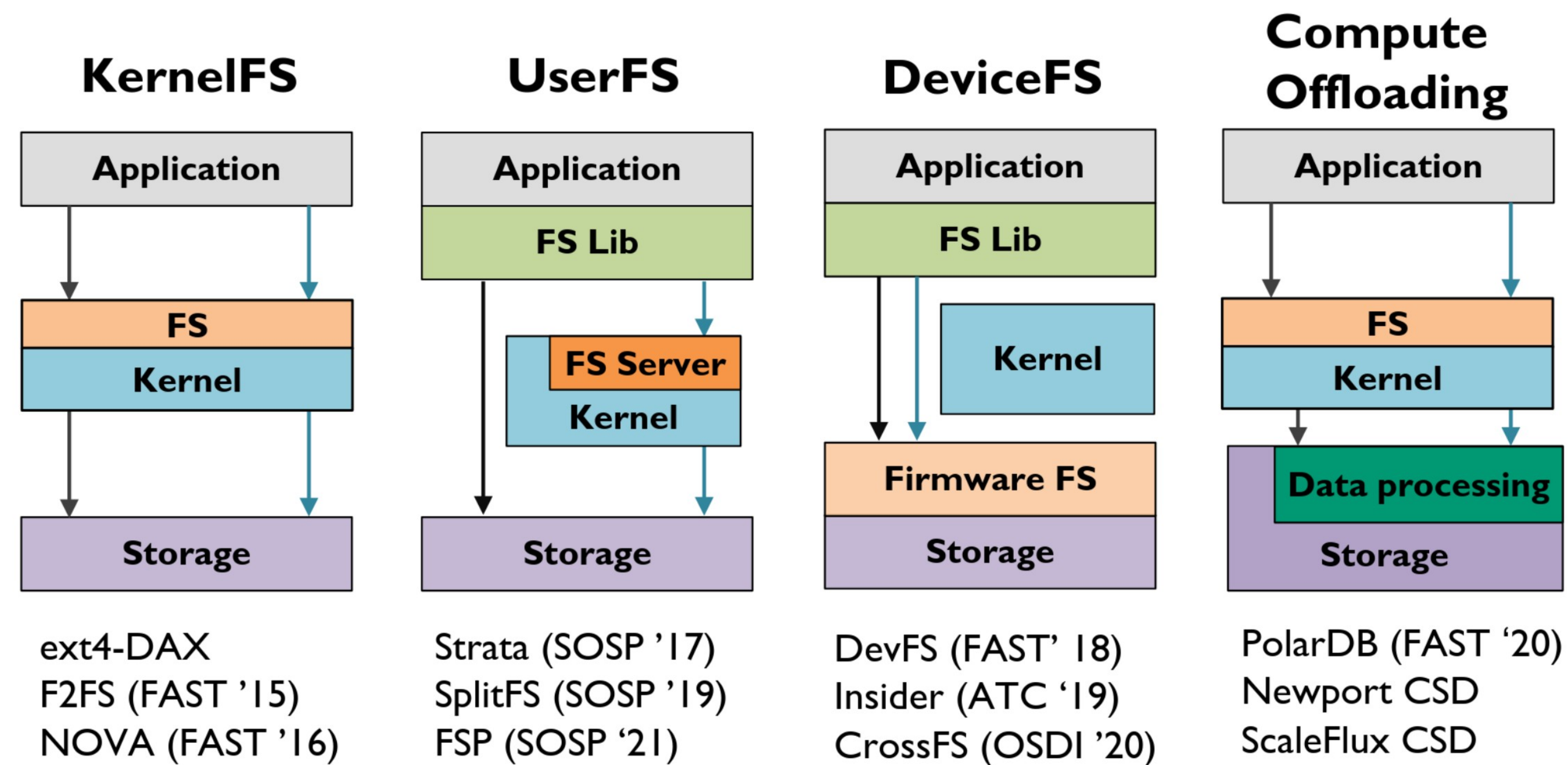**IBM**

What's the point of file system?

Future technologies and technological trends

Artificial General Intelligence (AGI)

Machine learning

Smart storage

Computation-in-storage

Computation-in-memory

Edge computing

Compute Express Link (CXL)

Fast persistent memory

Quantum computing

Quantum AI

Neuromorphic processor

Neuromorphic memory

Cognitive computing

Future

Disaggregated and decentralized computing

Why file systems introduce overhead?

KernelFS

Application

FS

Kernel

Storage

ext4-DAX
F2FS (FAST '15)
NOVA (FAST '16)

UserFS

Application

FS Lib

FS Server

Kernel

Storage

Strata (SOSP '17)
SplitFS (SOSP '19)
FSP (SOSP '21)

DeviceFS

Application

FS Lib

Kernel

Firmware FS

Storage

DevFS (FAST' 18)
Insider (ATC '19)
CrossFS (OSDI '20)

Compute Offloading

Application

FS

Kernel

Data processing

Storage

PolarDB (FAST '20)
Newport CSD
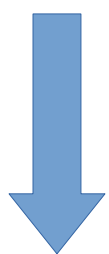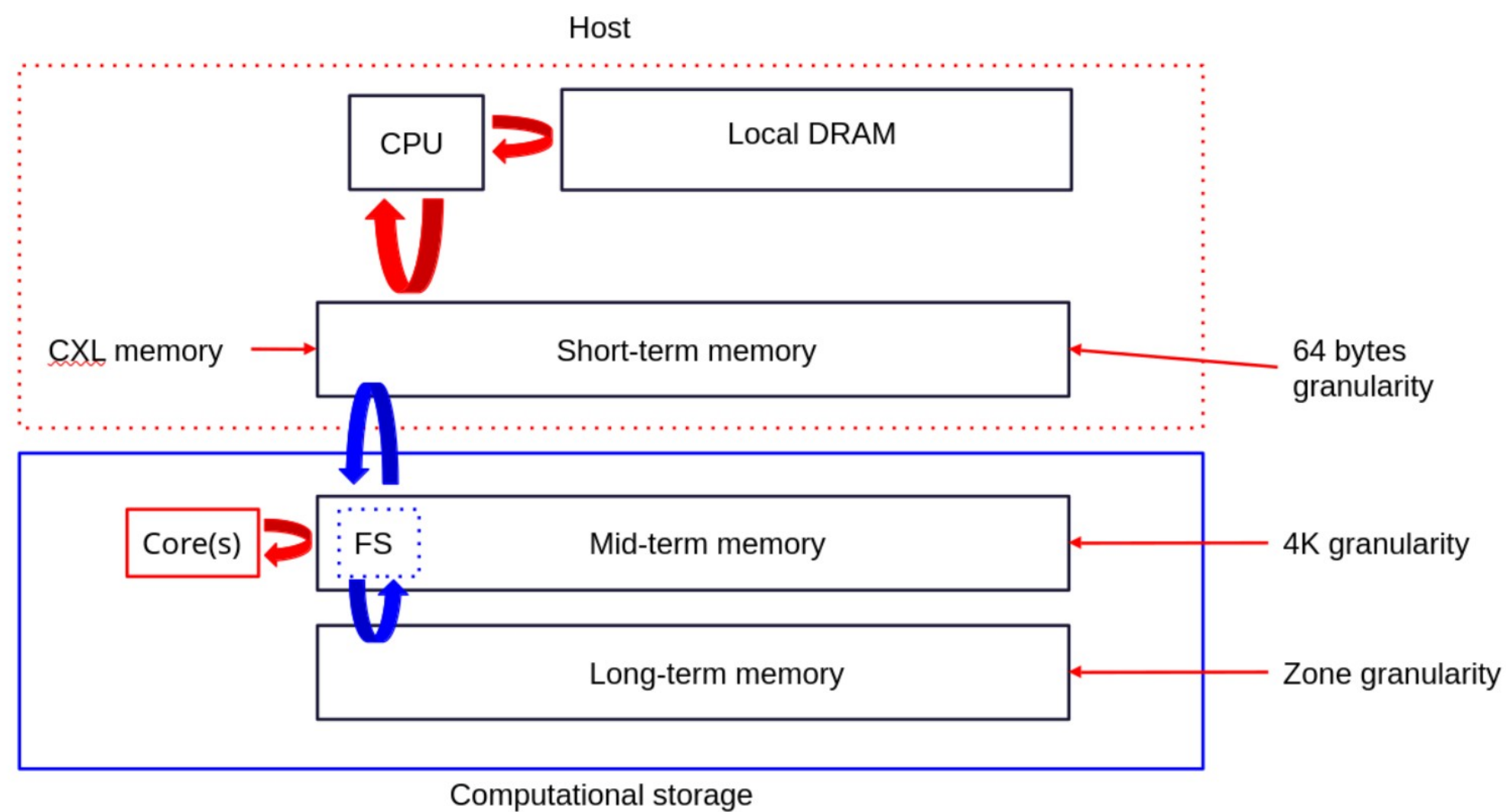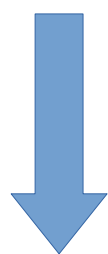ScaleFlux CSD

Jian Zhang, Yujie Ren, and Sudarsun Kannan, "FusionFS: Fusing I/O Operations using CISCOps in Firmware File Systems", 20th USENIX Conference on File and Storage Technologies (FAST 22)
https://www.usenix.org/system/files/fast22_slides_zhang-jian.pdf
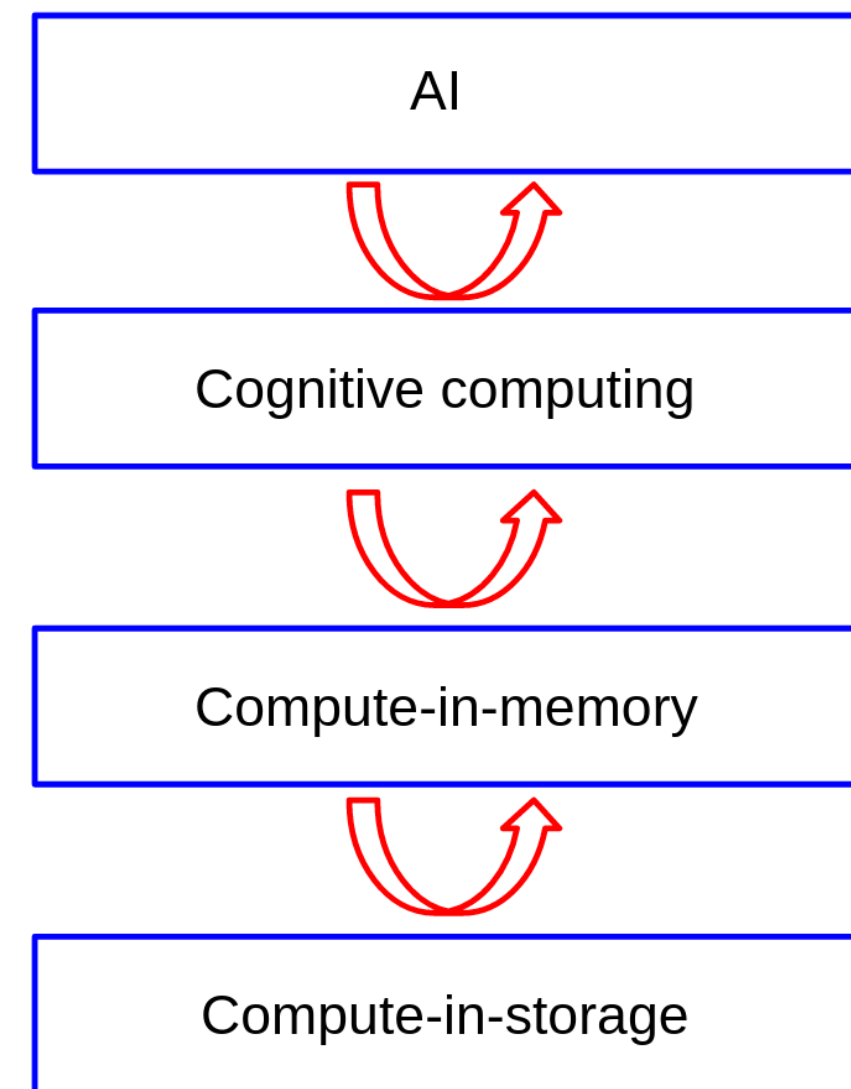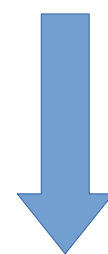
4

Will we need file systems in the future?

YES

Host

| File system driver |

Read logical block — Write/Update logical block

| FPGA |

| Log 1 | ... | Log N |

Persistent memory

Storage device

Maybe

Host

| CPU | | Local DRAM |

CXL memory → | Short-term memory | ← 64 bytes granularity

| Core(s) | | FS | Mid-term memory | ← 4K granularity

| Long-term memory | ← Zone granularity

Computational storage

NO

| AI |

| Cognitive computing |

| Compute-in-memory |

| Compute-in-storage |
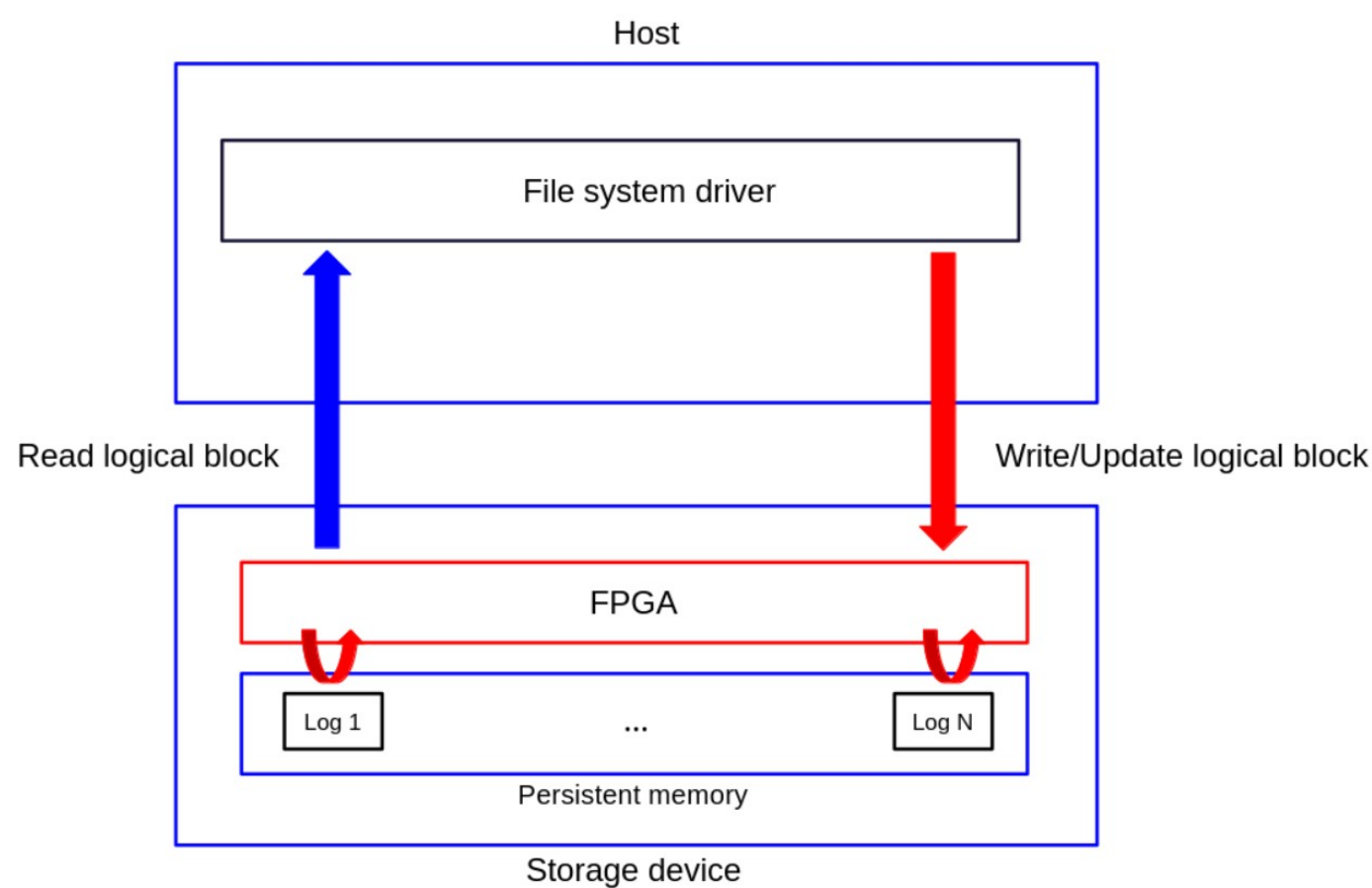
Can file system technologies satisfy the future technologies' needs?

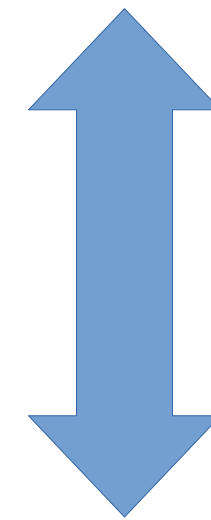Quantum computing

Neuromorphic computing

Machine learning

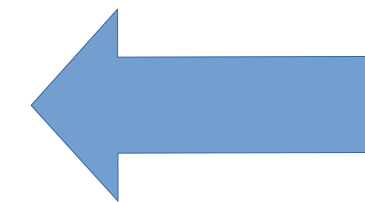Artificial General Intelligence

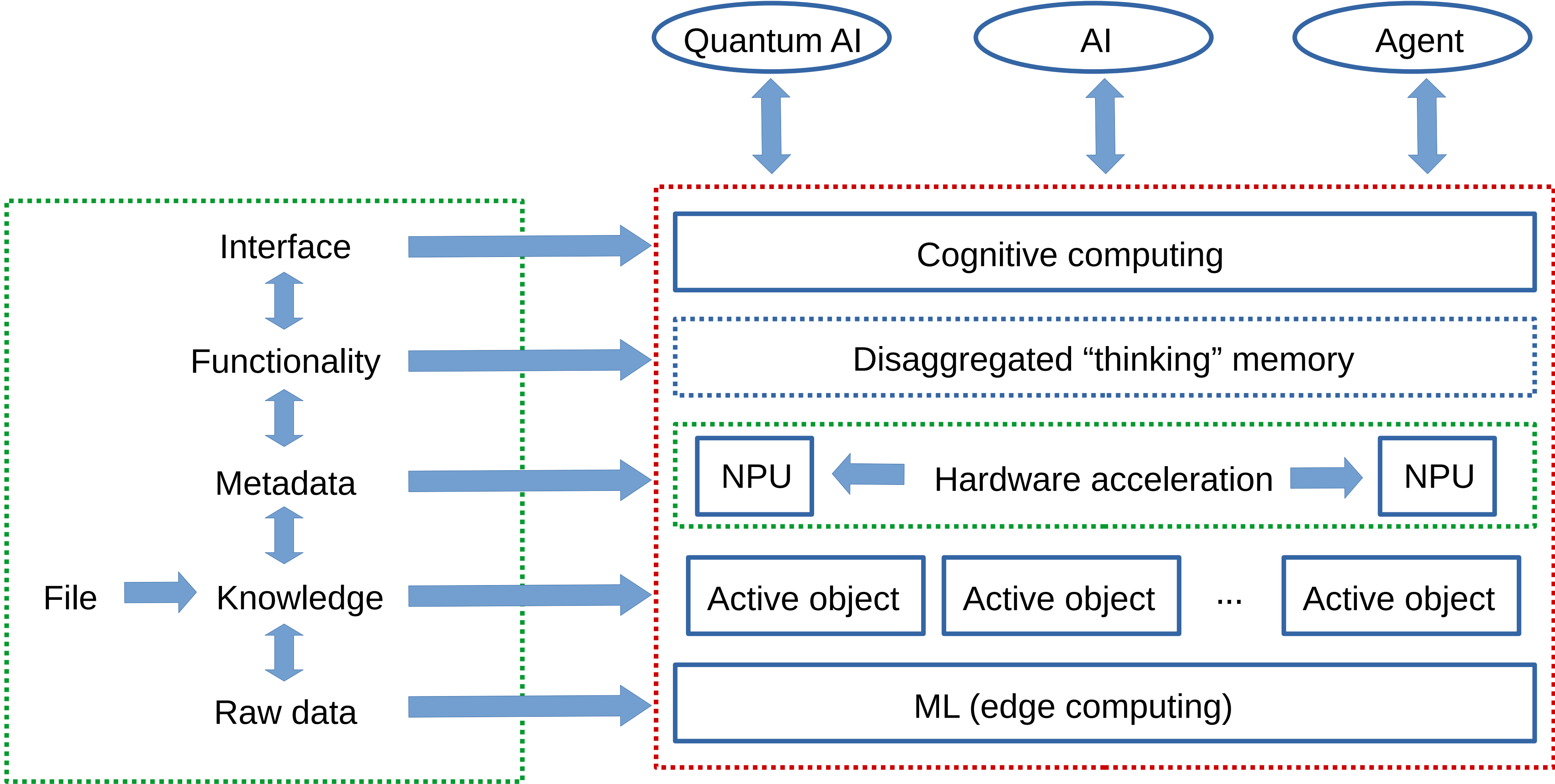Cognitive computing

Disaggregated + edge computing

NO!

Why?

File system:
- storage device
- OS subsystem
- file
- process
- namespace
- permissions
- POSIX
- programming model

Future of file systems

Questions?