MANAGING PERSISTENT MEMORY

Linux Foundation Vault 2016

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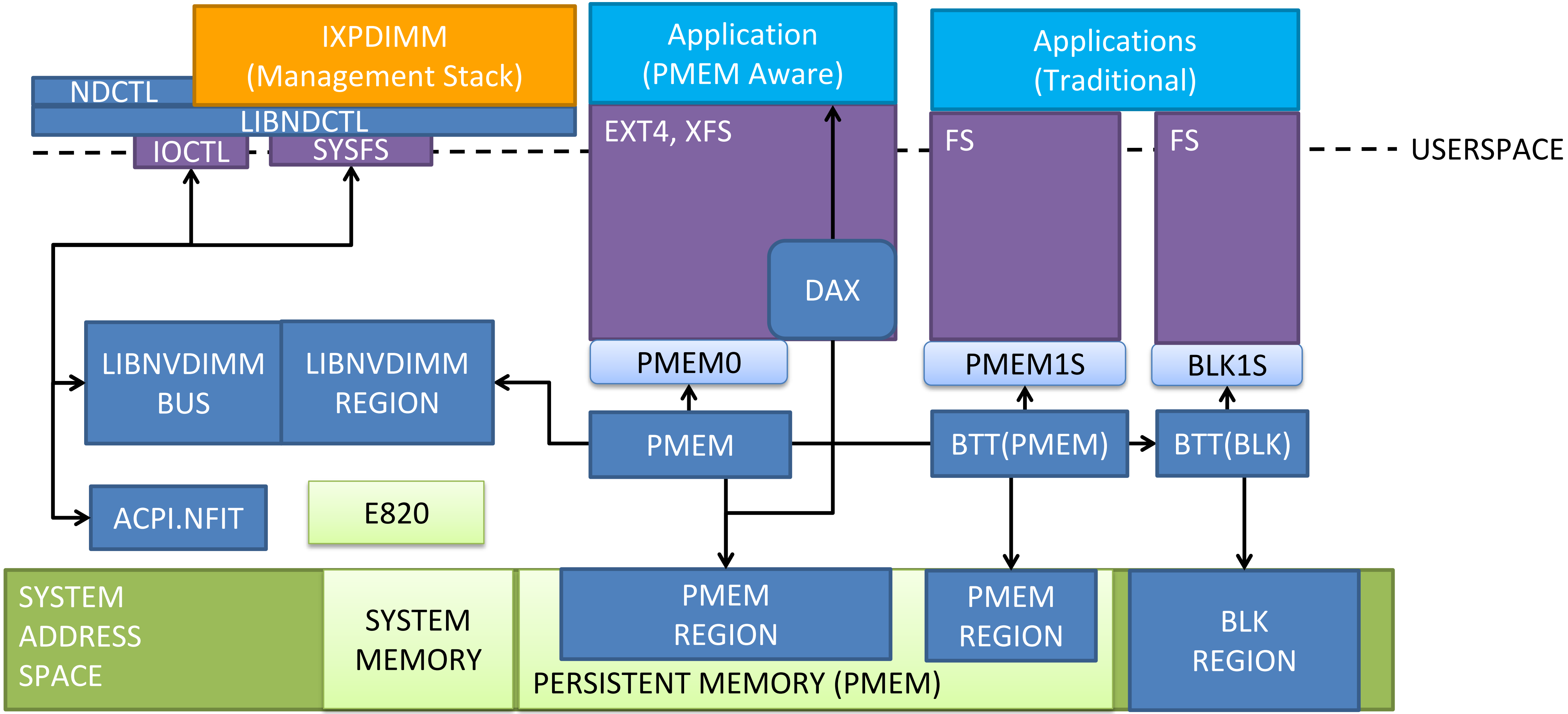
/dev/pmem0

THANK YOU

/dev/ndblk0.0s

Managing Persistent Memory



Namespaces

```
# ndctl list --namespaces --type=pmem
{
  "dev":"namespace6.0",
  "mode":"raw",
  "size":33554432,
  "uuid":"70a6adce-722e-4ab8-b698-35eaea9750b3",
  "blockdev":"pmem6"
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```
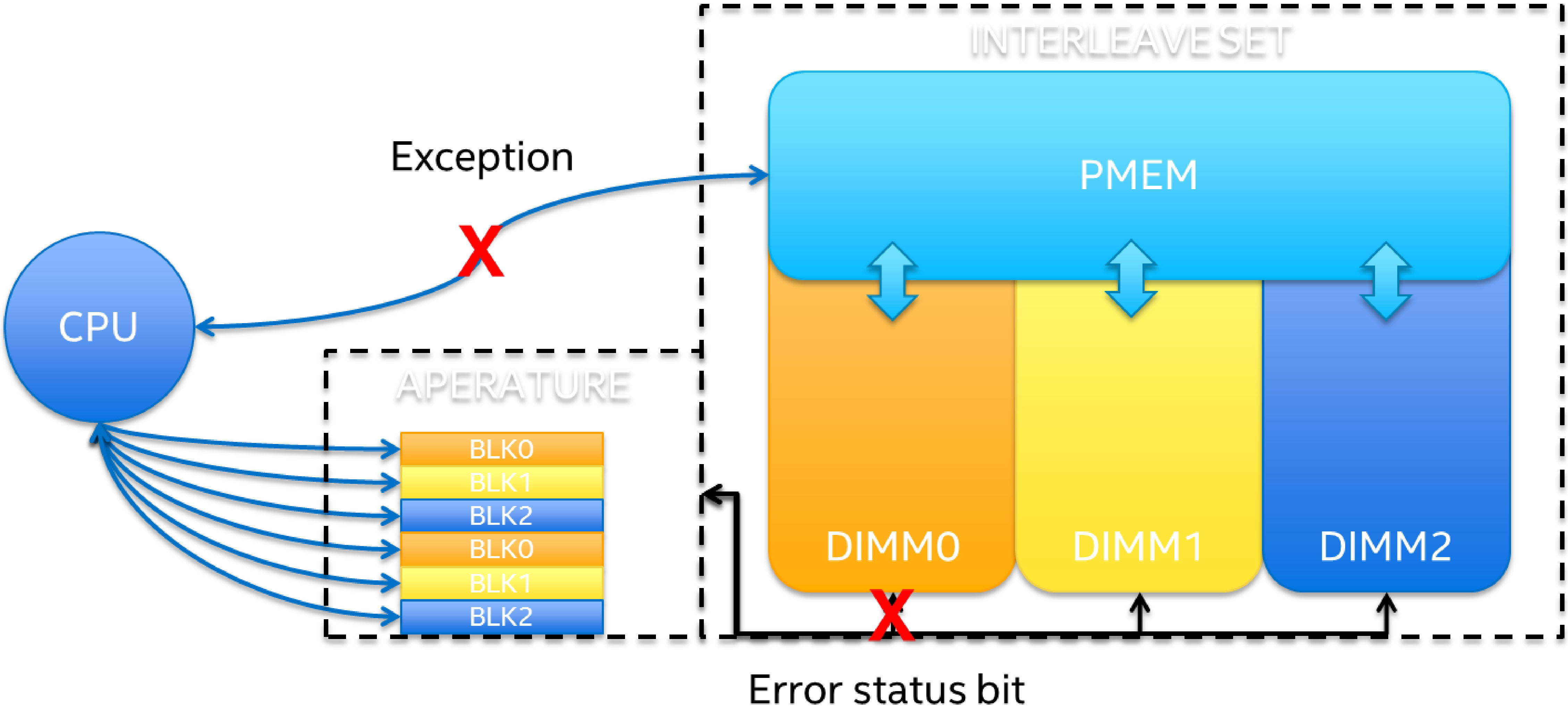

“Namespace”: Persistent memory capacity accessed through a PMEM or BLK disk device

Namespaces

```
# ndctl list --namespaces --type=blk
{
  "dev":"namespace0.0",
  "mode":"sector",
  "uuid":"5ce6c34a-88b0-469a-86f5-ea8f462a68ca",
  "sector_size":4096,
  "blockdev":"ndblk0.0s"
}
```

Why BLK?


INTERLEAVE SET
Exception
PMEM
CPU
APERATURE
BLK0
BLK1
BLK2
BLK0
BLK1
BLK2
DIMM0
DIMM1
DIMM2
Error status bit

CONFIGURATION FOR APPLICATIONS

Namespace Modes

RAW

SECTOR

MEMORY

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- Byte-addressable
- Limited DAX

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- Configurable sector size.
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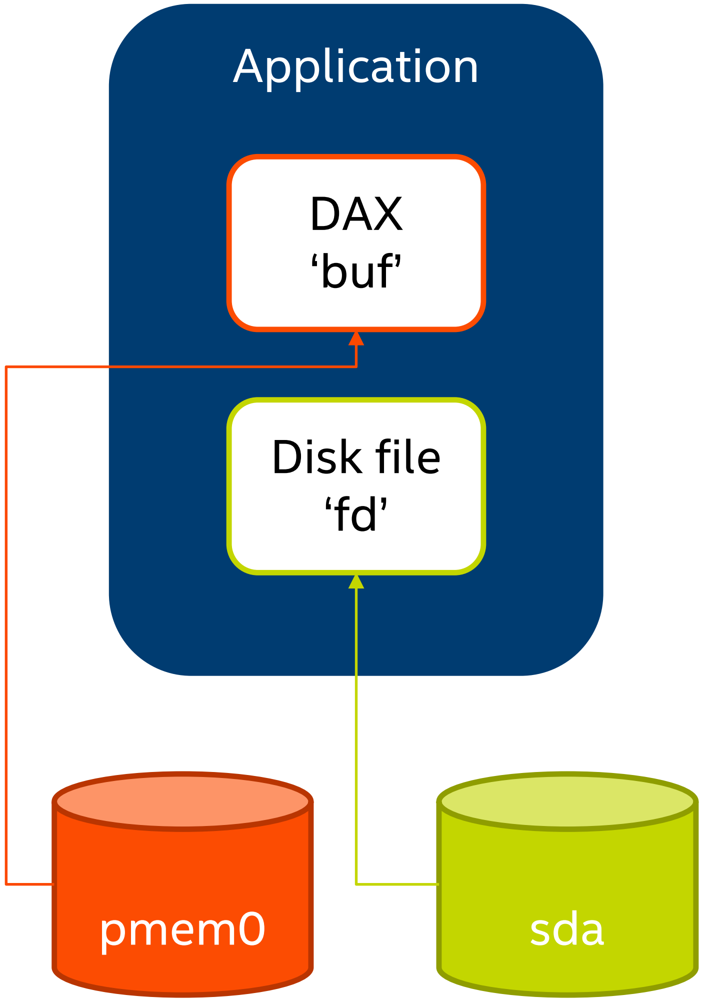
MEMORY

- Enables full DAX (DMA/RDMA/Direct-I/O)
- Only applicable to PMEM namespaces

“Memory” Mode DAX: Direct I/O



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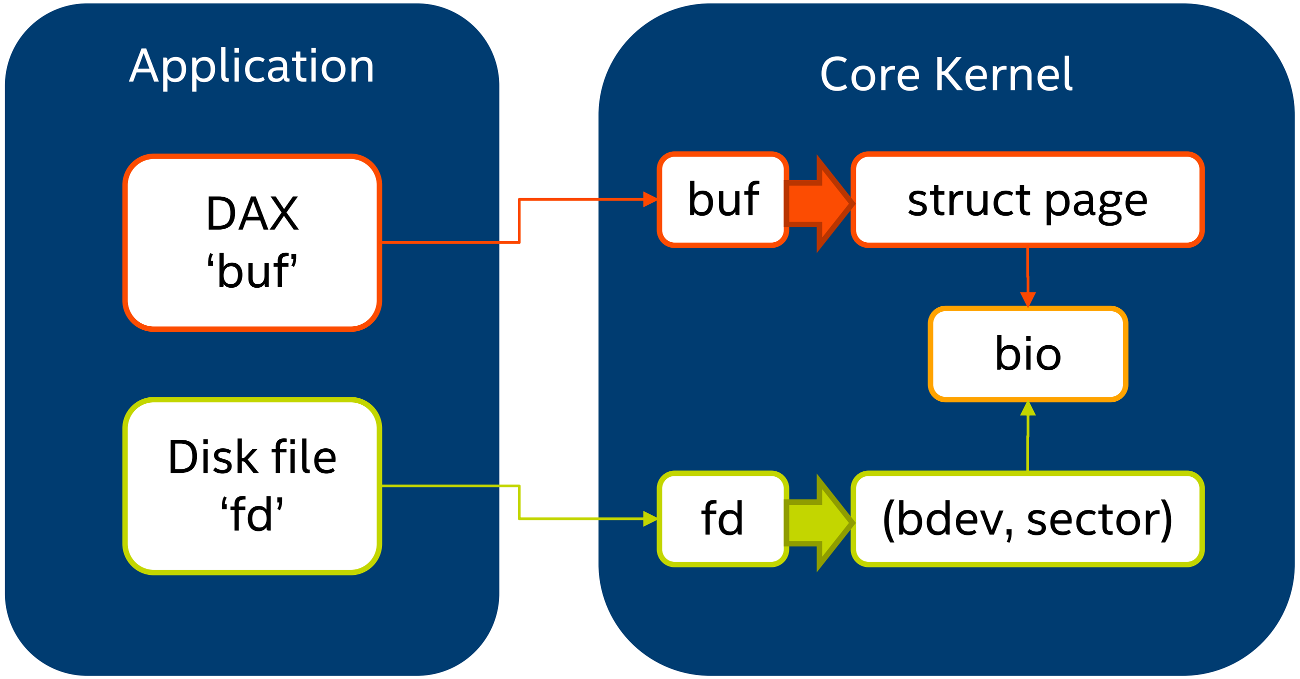

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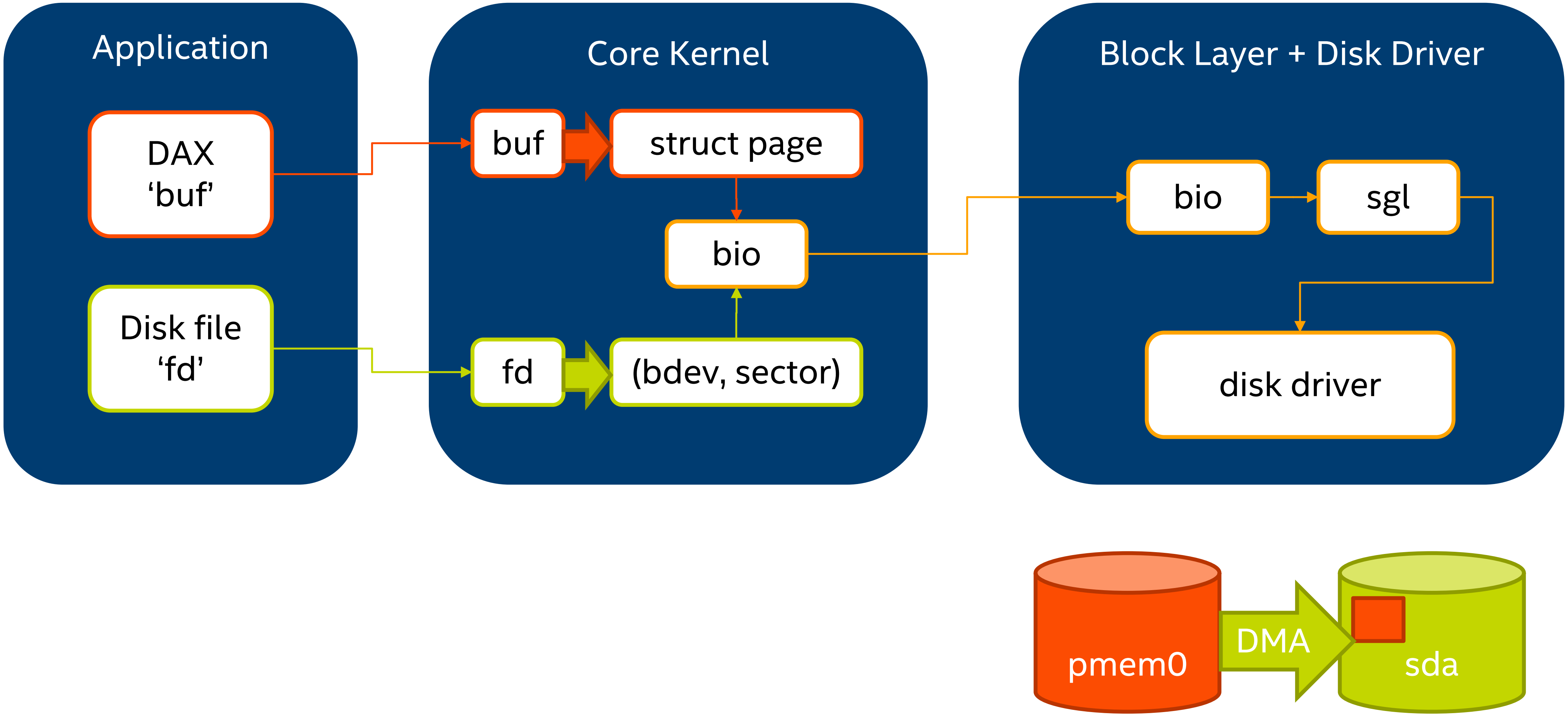

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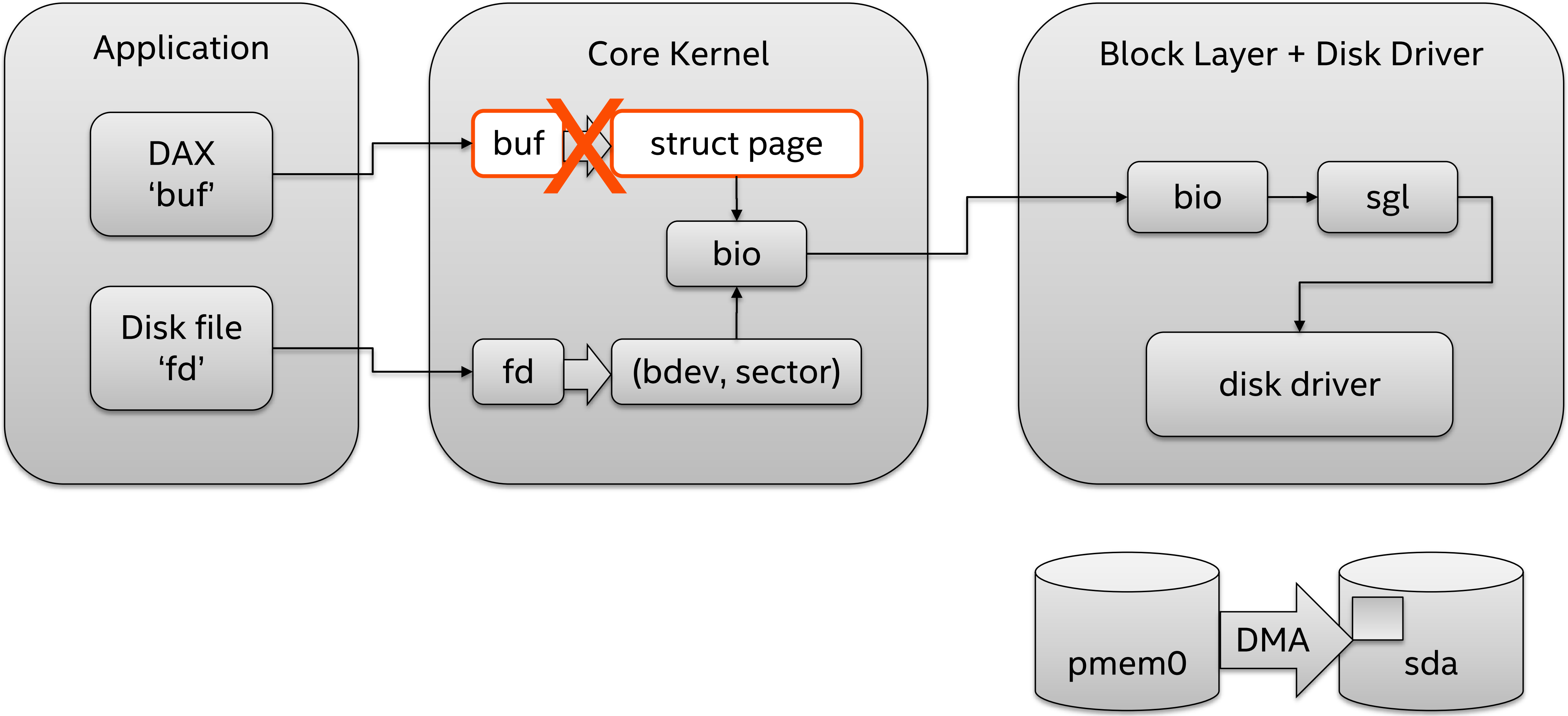

“Memory” Mode DAX: Considerations

- struct page array is 64-bytes per 4K page (16GB per 1TB)

```
# ndctl create-namespace --reconfig=namespace9.0 --mode=memory --map=dev --force
```

ndctl/libndctl < IXPDIMM

ndctl/libndctl: low level generic primitives

IXPDIMM: Coherent / comprehensive management stack

INTEL IXPDIMM SOFTWARE

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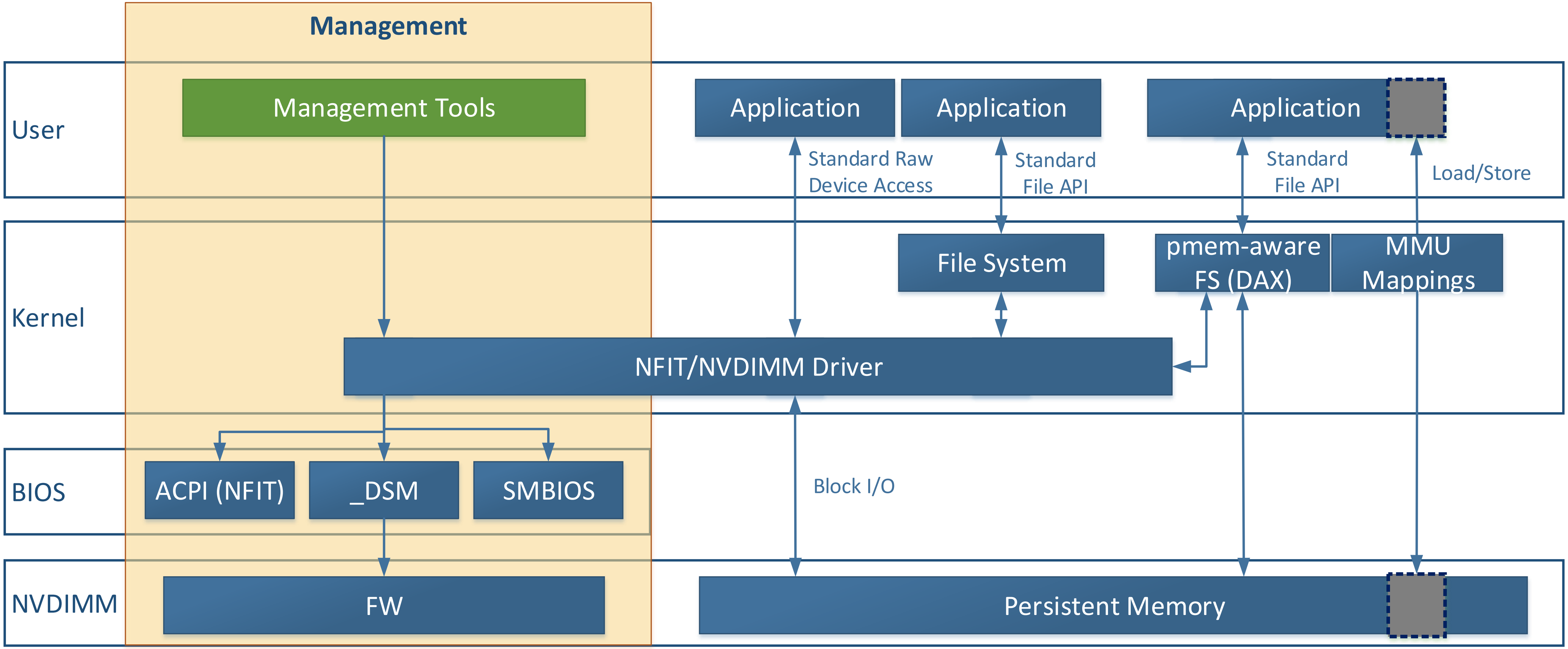
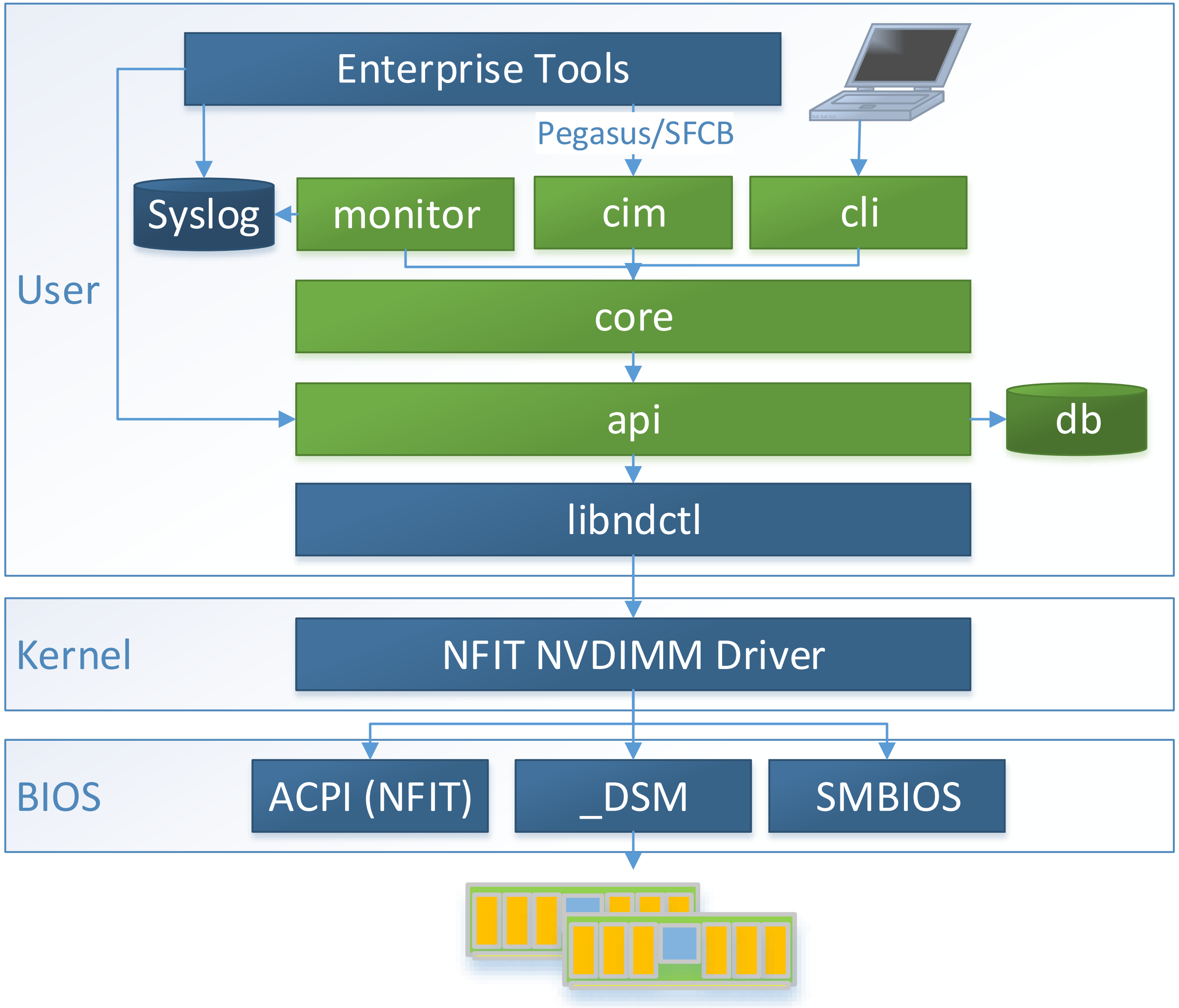
Persistent Memory



Components

- Basic Management
  - End-user provisioning and management via CLI
- Enabling
  - SFCB/Pegasus CIM provider for remote access and 3rd party integration
  - C library for programmatic access and abstraction
- Monitoring
  - Daemon for health monitoring

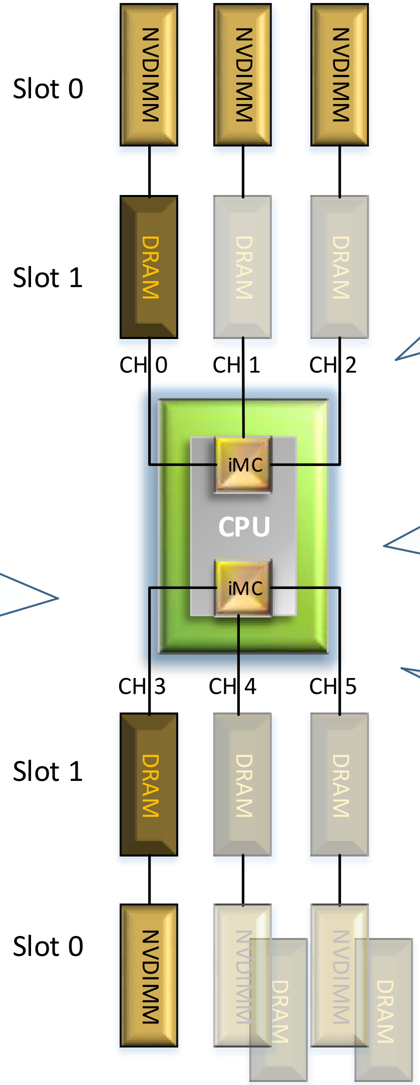


NVDIMM Management

Discovery:
DRAM + NVDIMM topology, identifying information, capabilities

Memory Configuration:
Volatile and persistent partitions, interleave settings

Namespaces:
Create/delete/inventory namespaces



Sensors & Settings:
Thermal, wear, spare, power, errors

Performance:
Bytes read/written, host and block read/writes

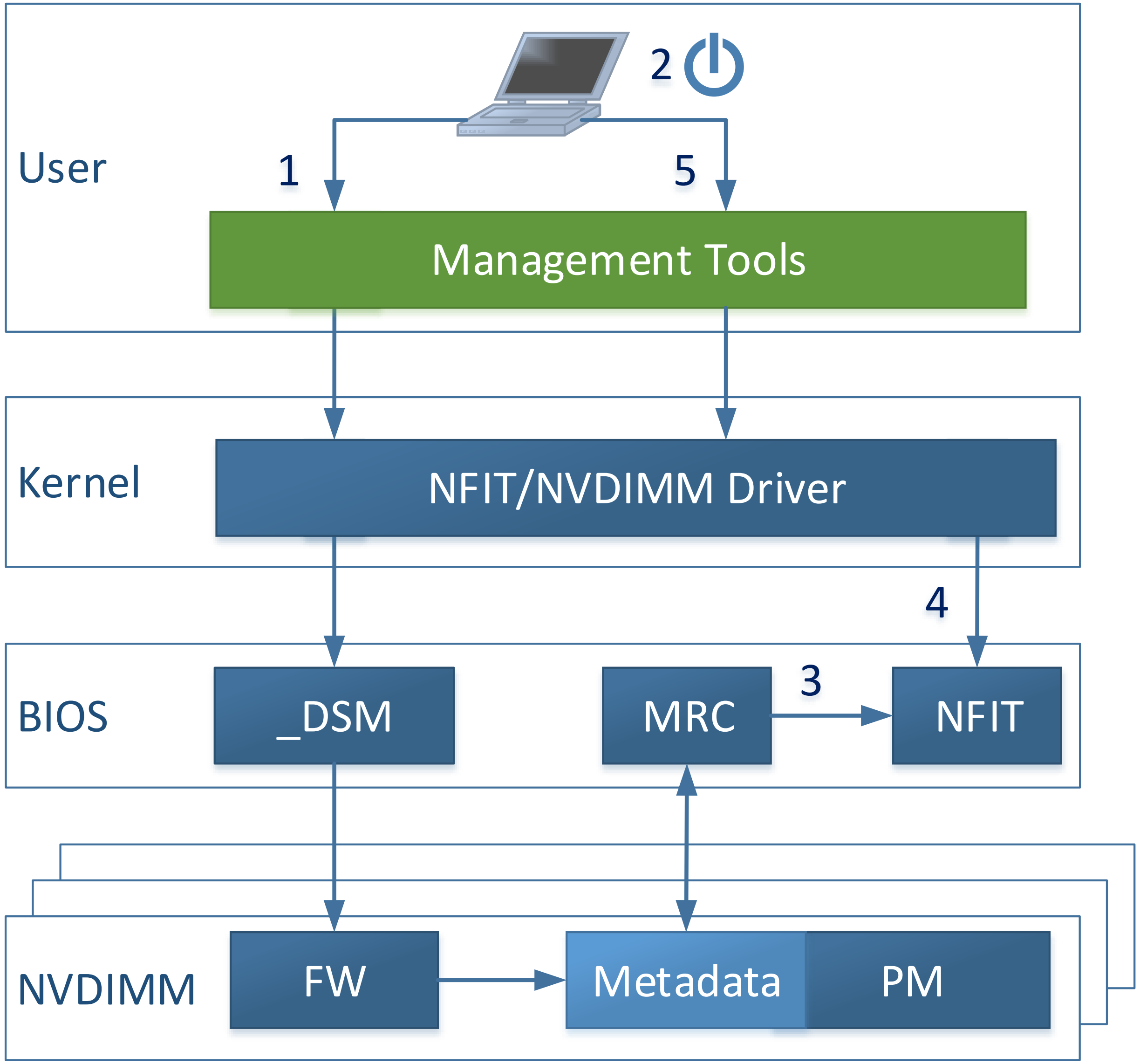
Instrumentation:
FW update, SW versioning, data-at-rest security, FW settings and policies

Discovery

- DRAM/NVDIMM Topology
  - SMBIOS Type 17 (memory device) data
  - NVDIMM socket, memory controller, channel population
- Aggregated Memory Resources
- Capabilities
  - Platform BIOS, NVDIMM, FW, SW
- NVDIMM Information
  - Identifying - serial number, model number, device ID
  - Status – manageability, health, security
  - Provisioning – partitioning, attributes, state

Memory Provisioning

1. Create memory allocation goal
2. Reboot
3. BIOS writes NFIT
4. Driver reads NFIT
5. Create namespace
6. Mount file system



Diagnostics

- Quick Health Check
- Platform Configuration Check
- Security Check
- FW Consistency and Settings Check
- Persistent Memory Metadata Check
- Address Range Scrub Results

Packages

Component	Package	Repository
cli	ixpdimm-cli	https://github.com/01org/IXPDIMMSW
cim	libixpdimm-cim	https://github.com/01org/IXPDIMMSW
core	libixpdimm-core	https://github.com/01org/IXPDIMMSW
api	libixpdimm-api libixpdimm-api-devel	https://github.com/01org/IXPDIMMSW
monitor	ixpdimm-monitor	https://github.com/01org/IXPDIMMSW
cli framework	libintelnvm-cli libintelnvm-cli-devel	https://github.com/01org/intelnvmclilibrary
i18n framework	libintelnvm-i18n libintelnvm-i18n-devel	https://github.com/01org/intelnvmi18nlibrary
cim framework	libintelnvm-cim libintelnvm-cim-devel	https://github.com/01org/intelnvmcimlibrary

Distribution Plan

- Open source 3-clause BSD license
- Hosted on 01.org/github – Intel maintainers
  - https://01.org/ixpdimm-sw
  - https://01.org/intel-nvm-cim-library
  - https://01.org/intel-nvm-cli-library
  - https://01.org/intel-nvm-i18n-library
- Targeted OS Distributions:
  - RHEL/Fedora
  - SLES/OpenSuSE

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