



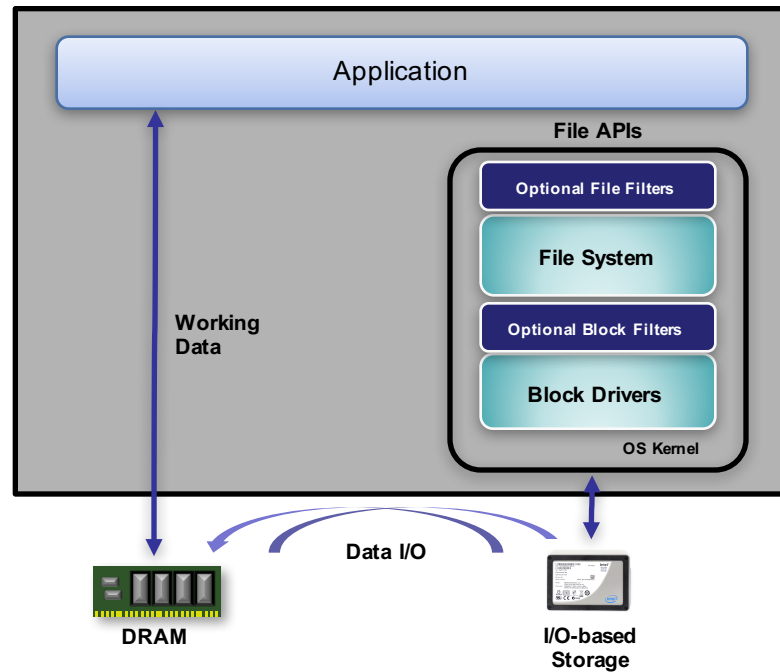
# The In-place Working Storage Tier

## Opportunities for Software Innovators

Ken Gibson,  
Intel  
Director, Memory SW Architecture



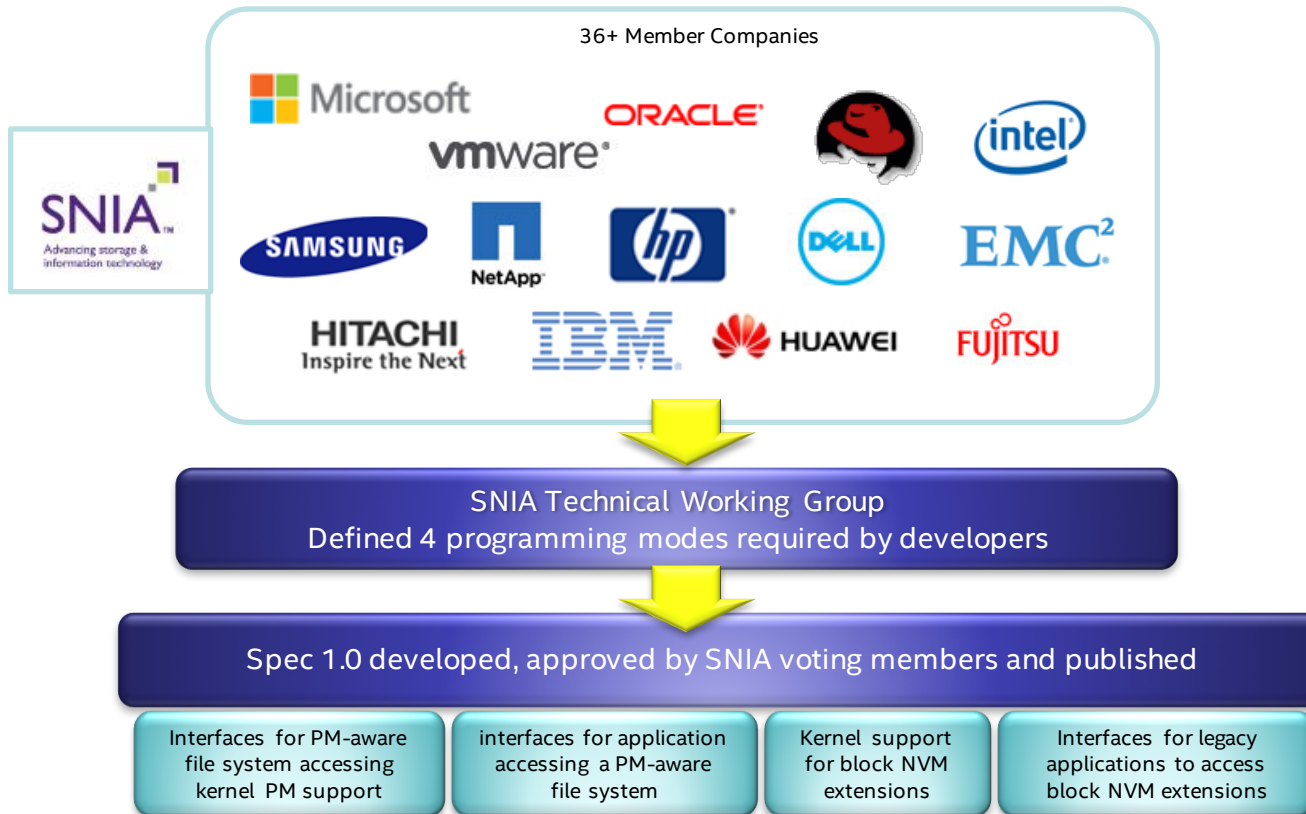
# The Traditional Storage I/O Architecture



**The File I/O Programming Model**



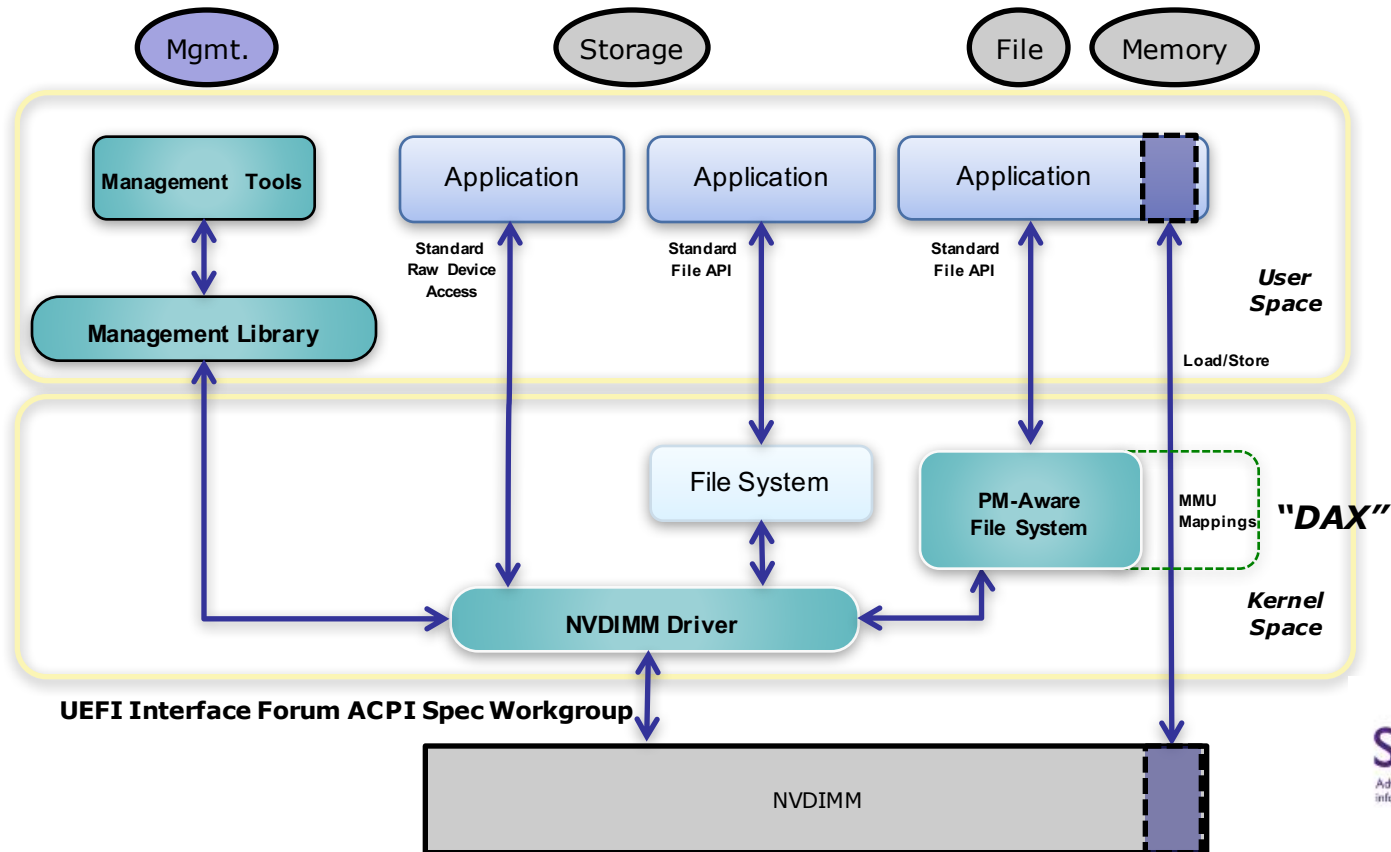
# Establishing the Open Persistent Memory Programming Model



[http://snia.org/sites/default/files/NVMProgrammingModel\\_v1.pdf](http://snia.org/sites/default/files/NVMProgrammingModel_v1.pdf)



# The Open Industry Programming Model



# Software Adoption

## Open Interfaces



Persistent Memory  
Programming Model



Standard NVDIMM Platform  
Interface ACPI 6.0

[www.PMEM.io](http://www.PMEM.io)

Open API

## Operating Environments & Applications



Linux Kernel 4.4



cloudera

ORACLE®

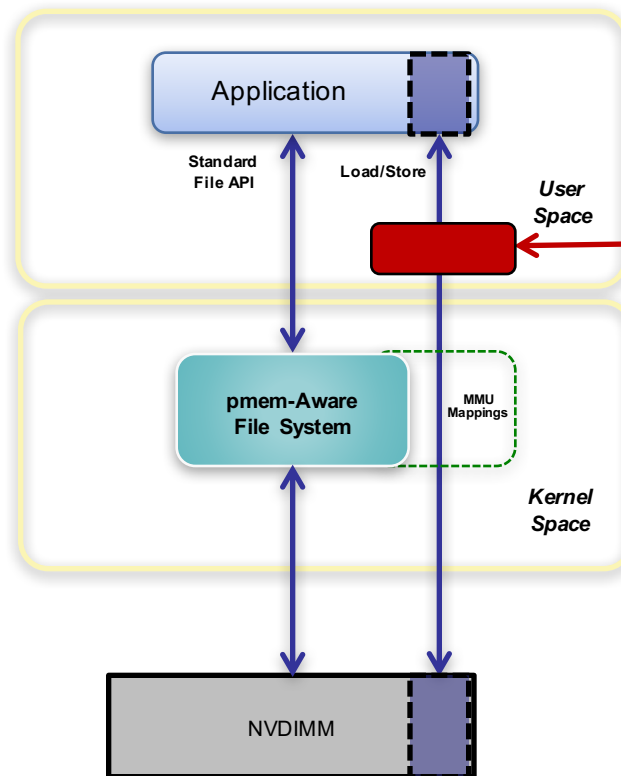




# Creating the API

## The Open Source NVM Library

[www.PMEM.io](http://www.PMEM.io)

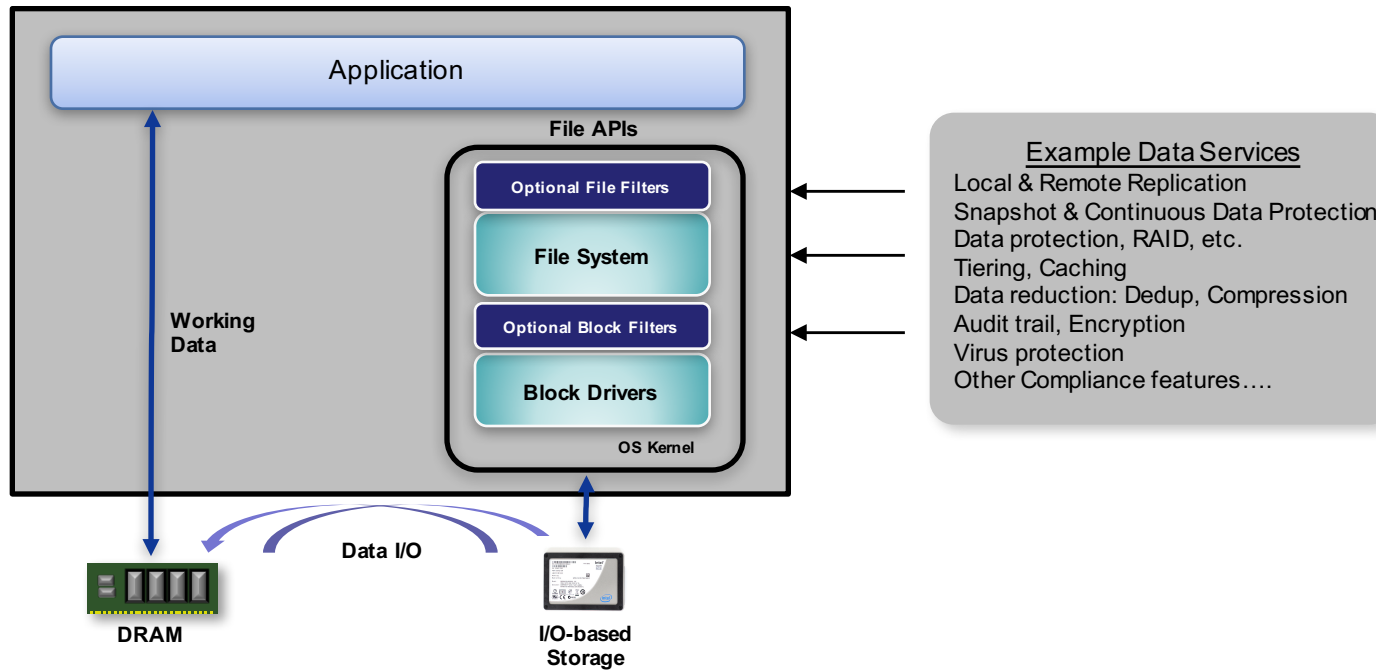


NVM Libraries

- Open Source
    - <http://pmem.io>
  - Libpmem
  - libvmem
  - libvmmalloc
  - libpmemobj
  - libpmemblk
  - libpmemlog
- } Atomic & Transactional



# From Persistent to Durable to Compliant

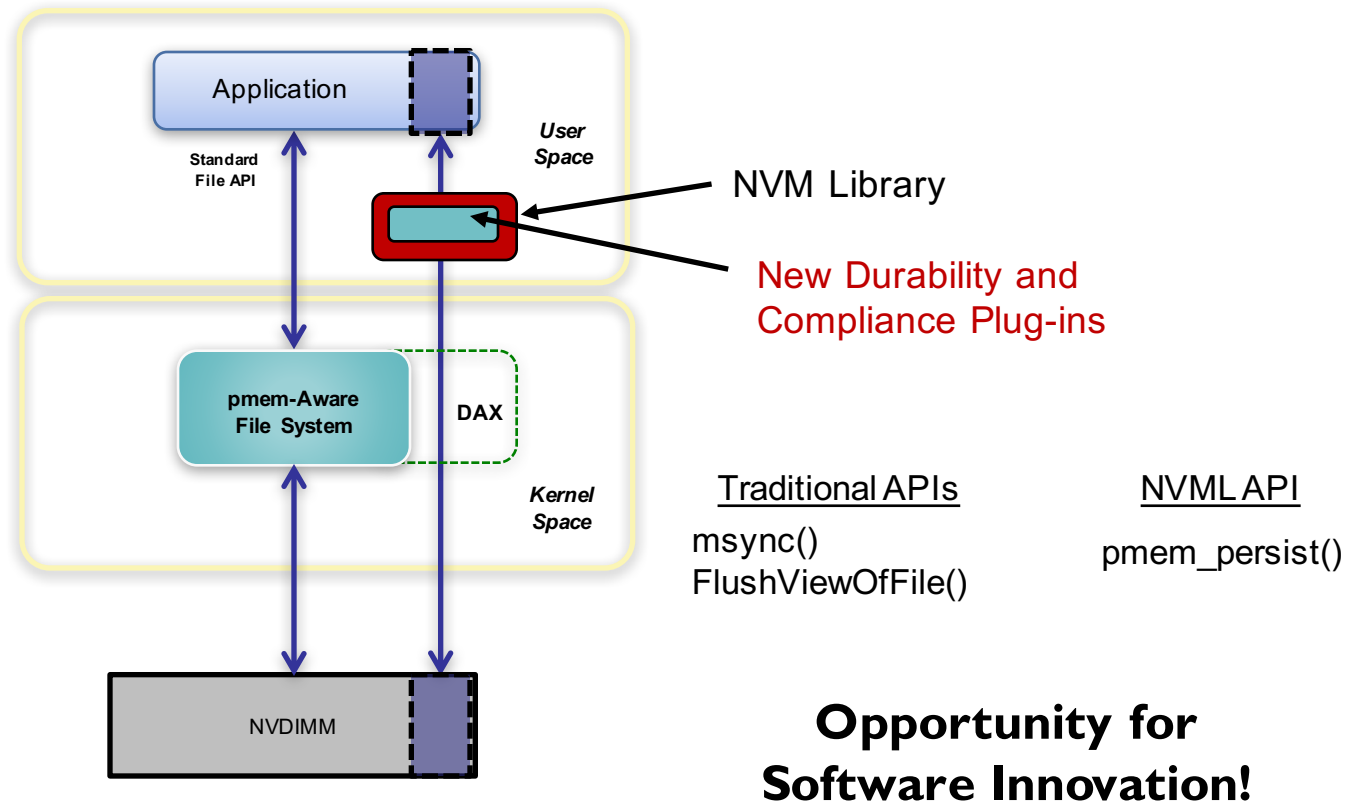


**Intercepting I/O to add Durability and Compliance**



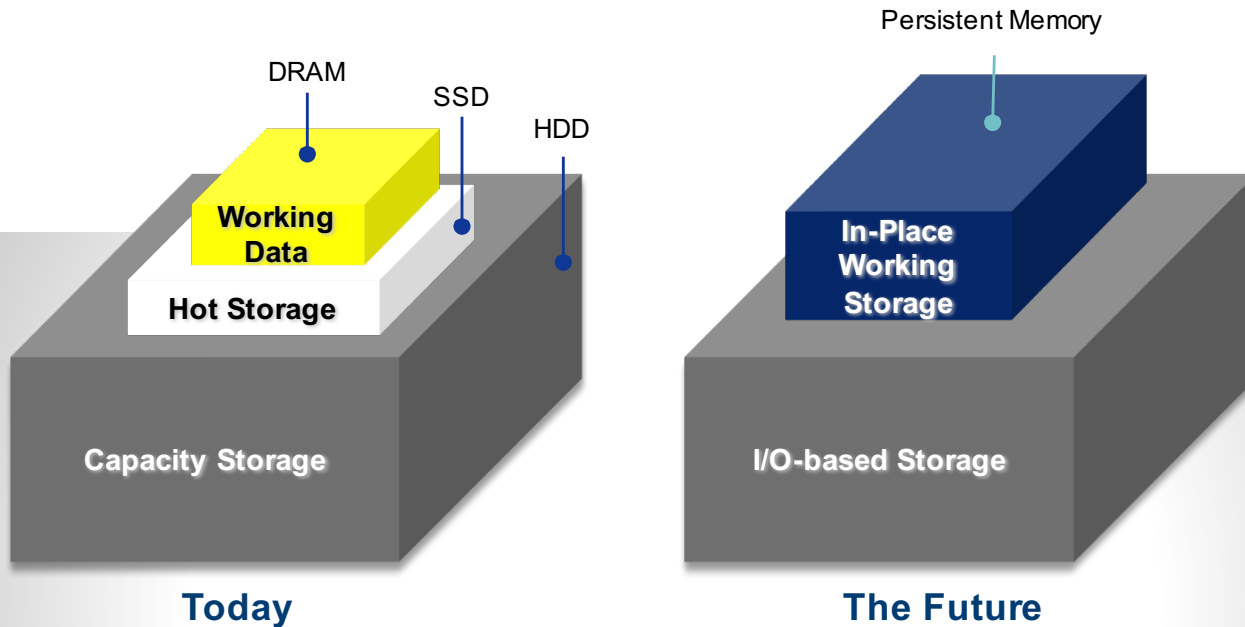


# Write I/O Replaced with Persist Points





# The End State Memory as the New Active Storage Tier



**Working Memory and Hot Storage Tier Merge**



## Join the Discussion

- Learn about the Persistent Memory programming model  
<http://www.snia.org/forums/sssi/nvmp>
- Join the pmem NVM Libraries Open Source project  
<http://pmem.io>
- Read the documents and code supporting ACPI 6.1 and Linux NFIT drivers  
[http://www.uefi.org/sites/default/files/resources/ACPI\\_6.1.pdf](http://www.uefi.org/sites/default/files/resources/ACPI_6.1.pdf)  
<https://github.com/pmem/ndctl>  
<http://pmem.io/documents/>  
<https://github.com/01org/prd>
- Intel 3D XPoint™ Memory  
<http://www.intel.com/content/www/us/en/architecture-and-technology/non-volatile-memory.html>



**Thank You**