CS TWG Update

A Lot Has Been Accomplished in 2021/2022

Presented by the Co-Chairs of the CS TWG
Jason Molgaard – SNIA TC Member
Principal Engineer, Storage Architecture and Strategy, AMD
Scott Shadley – SNIA BoD Member
Director of Strategic Planning, Solidigm Technology

Agenda

- Updates on the TWG Membership
- Updates on the TWG Work Efforts
- Status of the Architecture
- Status of the SW API
- What is Next?

The Continued Growth of Experience

- TWG Working group is continuing to see growth
  - 52 companies, 265 individual members

52 Participating Companies - 258 Member Representatives

- Work within SNIA Efforts
  - CS SIG – Webinars, Blogs, Events
  - SDXI – New Sub-Group Collaboration
  - Security TWG – Ensuring Alignment
  - xPU Engagements
- Collaborating with External Groups
  - NVM Express – Computational Programs
  - Exploration with OCP, SODA, others

The Efforts to Get Information Out is Continuing

Flash Memory Summit

Why Is Computational Storage Inevitable?

by Sarah Lee | Mar 7, 2022 | Technology, All

DISCOVER / NEWS / 0321 COMPUTATIONAL STORAGE

Accelerated Box of Flash: Powerful computational storage for big data projects

Radically new approach to storage acceleration aids data manipulation for research and discovery

MARCH 21, 2022

2022 Strategic Roadmap for Storage

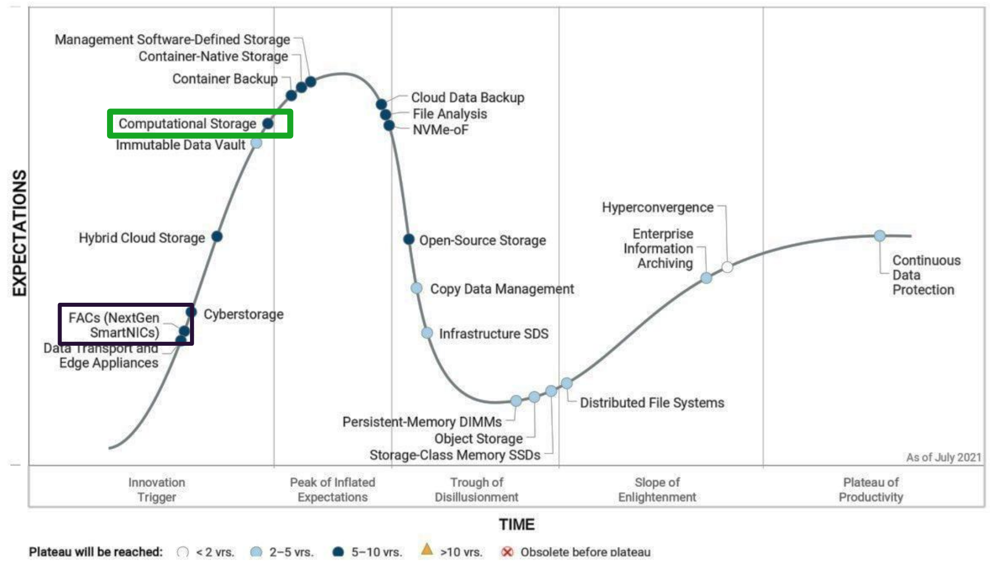
Published 16 March 2022 - ID G00760294 - 35 min read

By Jeff Vogel, Julia Palmer, and 3 more

Computational Storage

Computational storage device (CSD) combines processing and storage to reduce performance inefficiencies in the movement of data between storage and compute resources to address latency-sensitive application issues. CS offloads host processing from the main memory of the CPU to the storage device.

Hype Cycle for Storage and Data Protection Technologies, 2021



Source: Gartner (July 2021)
747395

YEARS OF INNOVATION

Current Progress of TWG Output

Flash Memory Summit

- Architectural Document has been Released
  - V 0.9 Is Now Live
  - V 1.0 release after SNIA member review
- V 0.8 of API Document is also live
  - Customer interface and support
- Security has now been incorporated
  - In Collaboration with Security TWG

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Computational Storage Architecture and Programming Model

Version 0.9

Abstract: This SNIA document defines recommended behavior for hardware and software that supports Computational Storage.

g Draft for review and comment has been approved by the Computational
presents a "best effort" attempt by the Computational Storage TWG to reach
d it may be updated, replaced, or made obsolete at any time. This document
erence material or cited as other than a "work in progress." Suggestions for
d to http://www.snia.org/feedback/.

Working Draft

June 23, 2022

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Computational Storage API

Version 0.8 rev 0

ABSTRACT:

This SNIA Draft Standard defines the interface between an application and a Computational Storage device (CSx). For each CSx there will need to be a library that performs the mapping from the APIs in this specification and the CSx on the specific interface for that CSx.

Publication of this Working Draft for review and comment has been approved by the Computational Storage TWG. This draft represents a "best effort" attempt by the Computational Storage TWG to reach preliminary consensus, and it may be updated, replaced, or made obsolete at any time. This document should not be used as reference material or cited as other than a "work in progress." Suggestions for revisions should be directed to http://www.snia.org/feedback/.

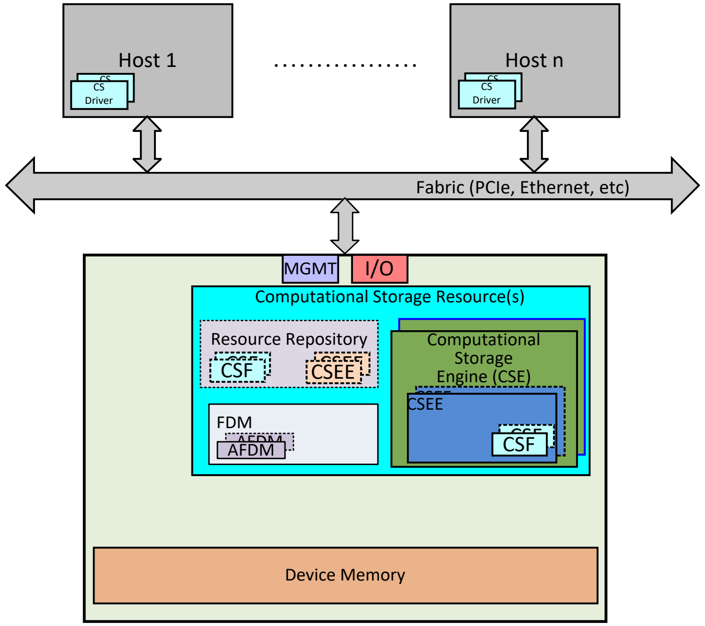
Working Draft

June 29, 2022

35 YEARS OF NAND FLASH MEMORY INNOVATION

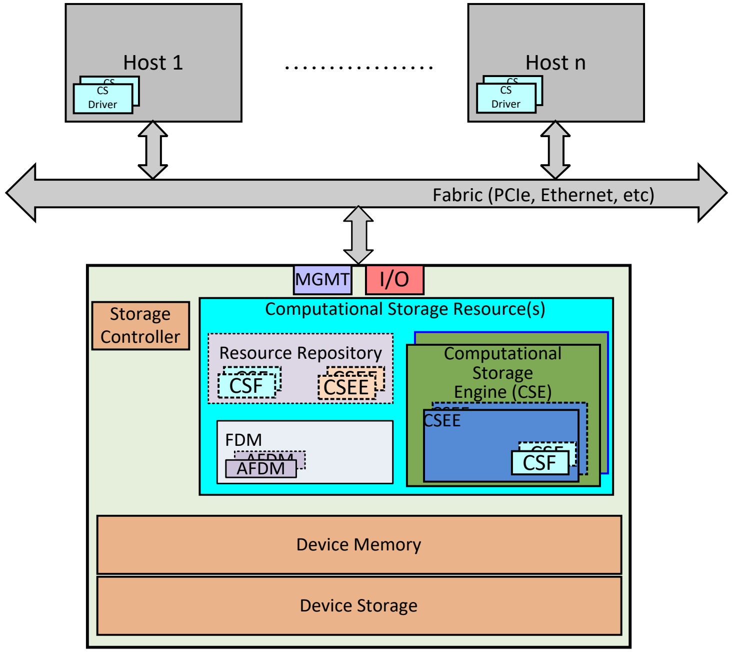
Computational Storage Architecture

Computational Storage Processor



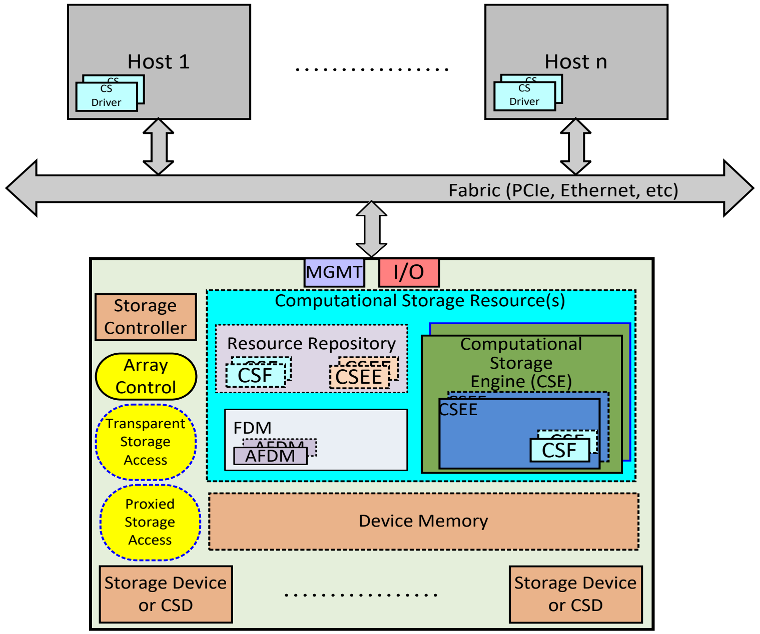
Computational Storage Processor (CSP)

Computational Storage Drive



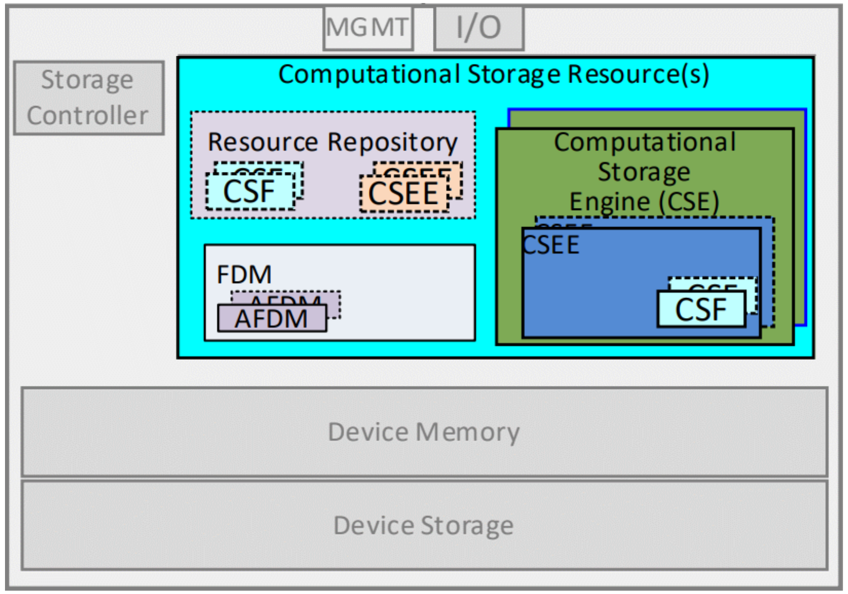
Computational Storage Drive (CSD)

Computational Storage Array



Computational Storage Array (CSA)

A Deeper Dive of the CSx Resources



Computational Storage Drive (CSD)

CSR - Computational Storage Resources are the resources available in a CSx necessary for that CSx to store and execute a CSF.

CSE - Computational Storage Engine is a CSR that is able to be programmed to provide one or more specific operation(s).

CSEE - A Computational Storage Engine Environment is an operating environment space for the CSE.

CSF - A Computational Storage Function is a set of specific operations that may be configured and executed by a CSE in a CSEE in a CSEE

FDM - Function Data Memory is device memory that is available for CSFs to use for data that is used or generated as part of the operation of the CSF.

AFDM - Allocated Function Data Memory is a portion of FDM that is allocated for one or more specific instances of a CSF operation

Direct Usage Model – Example

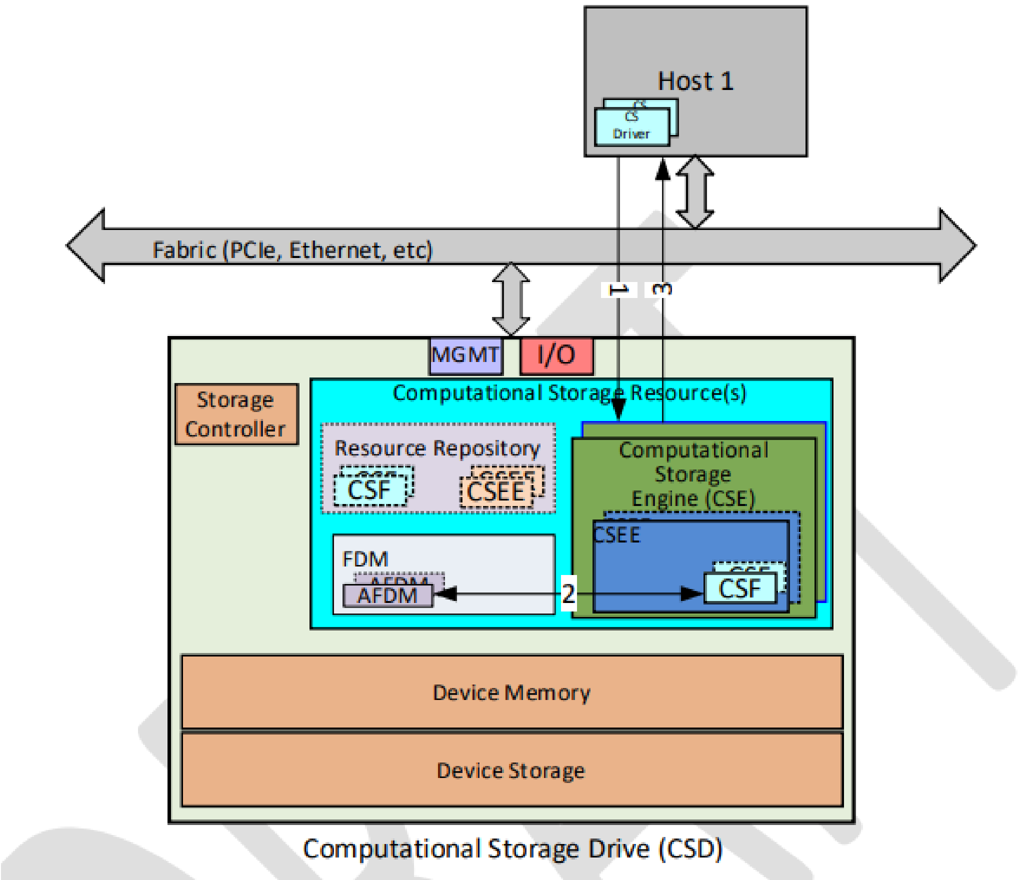


Figure 4.3 - Direct Usage Model

1. The host sends a command to invoke the CSF
2. The CSE performs the requested computation on data that is in AFDM and places the result, if any, into AFDM
3. The CSE returns a response to the host.

Indirect Usage Model – Example

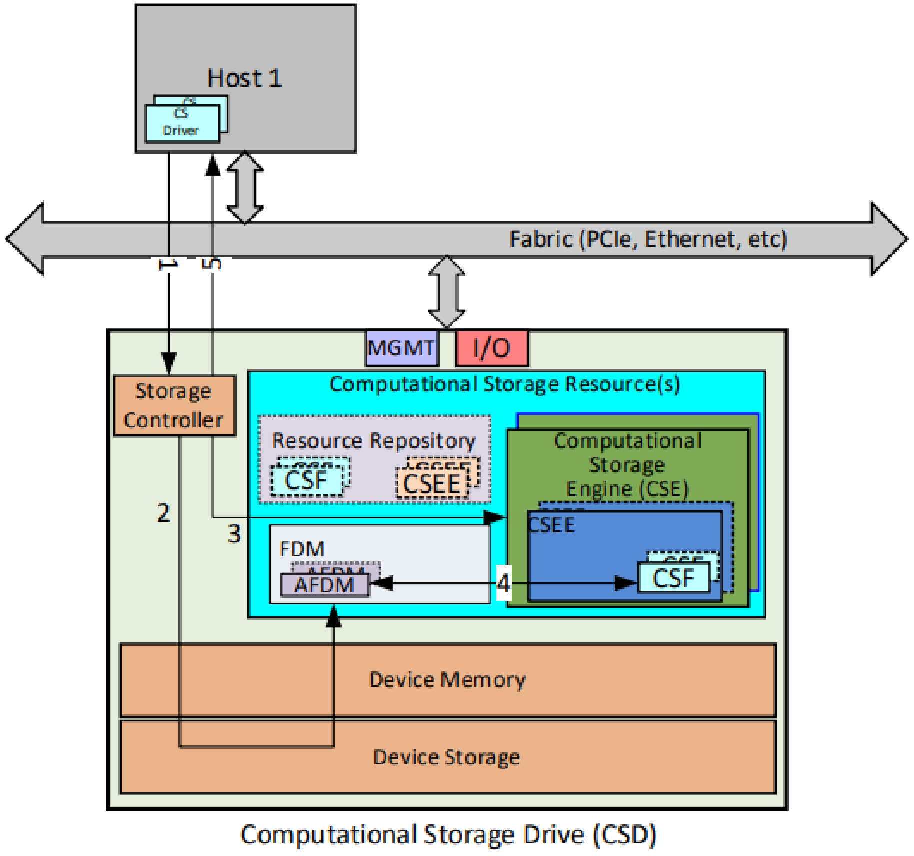


Figure 4.4 – Indirect Usage Interactions

1. The host configures the CSD to associate a specific CSF with reads that have specific characteristics
2. The host sends a storage request to a Storage Controller where:
    1. That storage request is associated with that target CSF
    2. The storage controller determines what CSF is associated with the storage request
3. The Storage Controller moves data from storage into the FDM
4. The Storage Controller instructs the CSE to perform the indicated computation on the data in the FDM
5. The CSE performs the computation on the data and places the result, if any, into the FDM
6. The Storage Controller returns the computation results, if any, from the FDM to the host.

Security Discussed Within Architecture (4.4)

4.4.1 General Security requirements for computational storage vary significantly

As such, security is presented as considerations that may be used to help determine the security that is appropriate to the risks. Some of the considerations are written such that specific requirements are identified for certain elements of security

4.4.2 Privileged Access and Operations

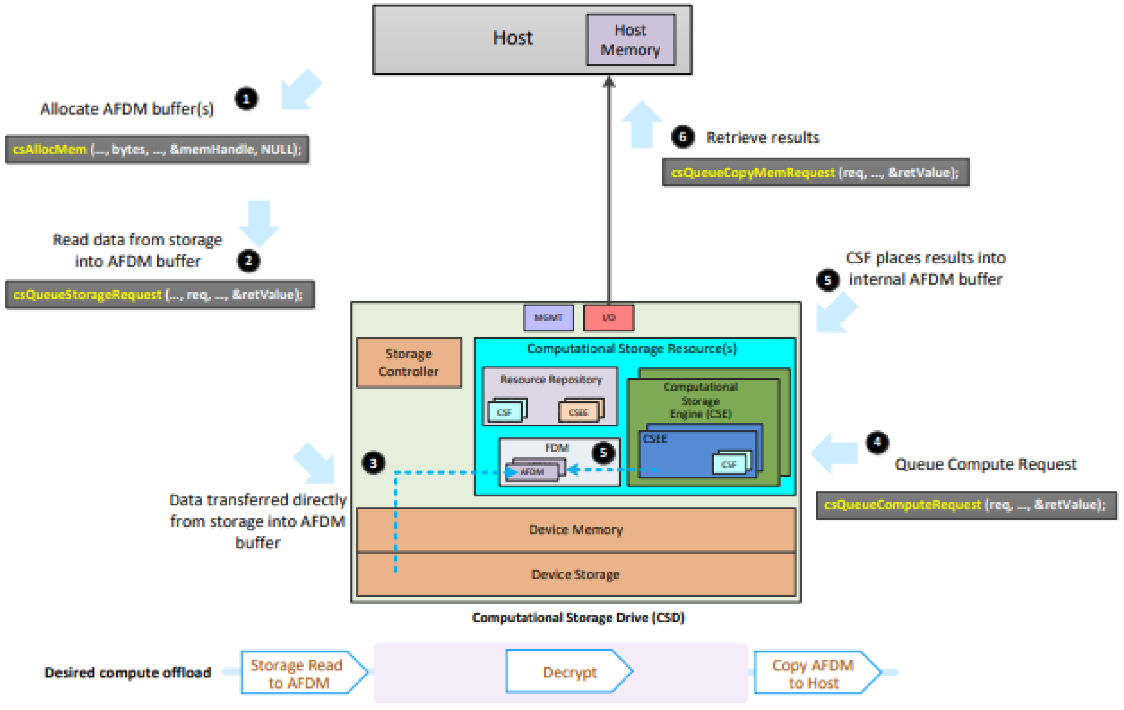
4.4.3 CSx Security Considerations

- 4.4.3.1 CSx Sanitization
- 4.4.3.2 CSx Data at-rest Encryption
- 4.4.3.3 CSx Key Management
- 4.4.3.4 CSx Storage Sanitization
- 4.4.3.5 CSx Roots of Trust (RoT)
- 4.4.3.6 CSx Software Security

The API - What Has Been Going On?

In this example, the CSD provides decrypt function capability and does not expose FDM to the host. The steps below depict the individual items in the Figure for a CSD.

1. Host application allocates FDM input and output buffers for processing in CSx.
2. Data is next initiated to load from the storage device into input AFDM.
3. Data is loaded from the storage device into the AFDM by P2P transfer.
4. The decryption CSF is invoked to work on data in the AFDM.
5. The CSF posts the output data into the output AFDM buffer and notifies the application that the decryption is complete.
6. The output results are copied from the output AFDM to host memory.



Flash Memory Summit

What Next?

Moving Beyond Architecture

- Security and Computational Storage
  - Moving beyond single host usage
- Illustrative Examples Growth
  - More and more ways to deploy
- CS and SDXI Collaboration
  - Ensuring proper cross-platform support
- xPU – The coordination of Compute
  - CSP or xPU and how they align

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  - Computational Storage Technical Work Group

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Computational Storage

Today, Computational Storage is transforming enterprises worldwide. The SNIA Computational Storage Technical Work Group (TWG) is actively working on establishing hardware and software architectures to allow for compute to be more tightly coupled with storage at the system and drive level. In addition, the SNIA Compute, Memory, and Storage Initiative (CMSI) is focused on fostering the acceptance and growth of computational storage in the marketplace with the activities of the Computational Storage Special Interest Group. To achieve those goals, the CMSI provides education, performs market outreach, and influences and promotes standards.

NVMe Computational Storage Task Group

The charter of Computational Storage Task Group is to develop features associated with the concept of Computational Storage on NVM Express devices. The scope of work encompasses how these features are discovered, configured and used inside an NVM Express framework. Examples of these features include general compute, compression, encryption, data filtering, image manipulation and database acceleration.

The target audience consists of the vendors and customers of NVMe Storage Devices that support computational features.

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Thank You!

Feel free to reach out to the chairs:

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