STORAGE DEVELOPER CONFERENCE

SDC 23

BY Developers FOR Developers

SNIA Computational Storage Standards

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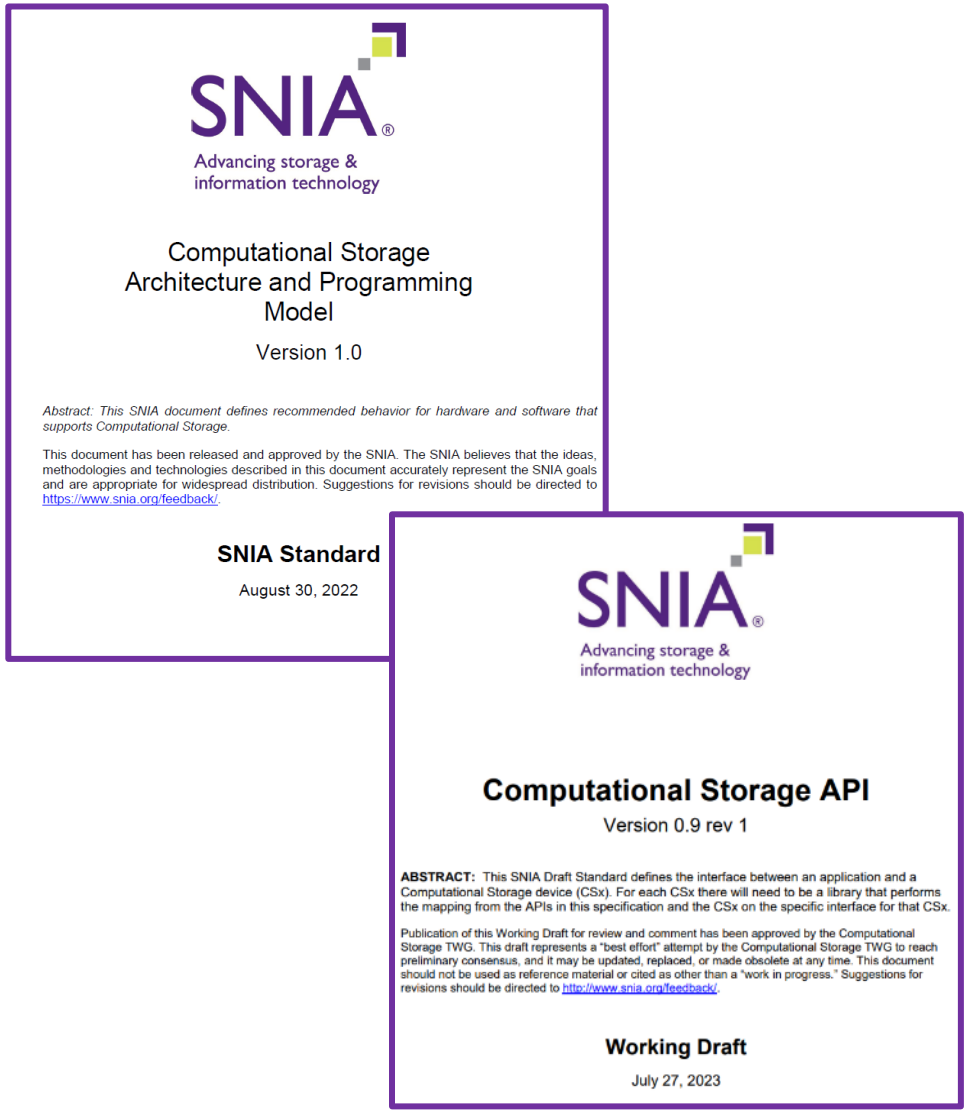
Agenda

- Current status of SNIA Computational Storage Standardization
- Overview of SNIA CS Architecture
- Overview of SNIA CS API
- SNIA and NVMe™ Computational Storage
- CS and SDXI

Current Progress of TWG Output

- Architectural Document
  - v1.0 Released August 2022
    - Received the Most Innovative Memory Technology award at FMS 2022
  - v1.1 under development
    - Security enhancements for multiple tenants (complete)
    - Sequencing of Commands (in-progress)
- API
  - v0.8 public review version was available June 2022
  - v0.9 public review version available
    - In SNIA Membership vote towards v1.0



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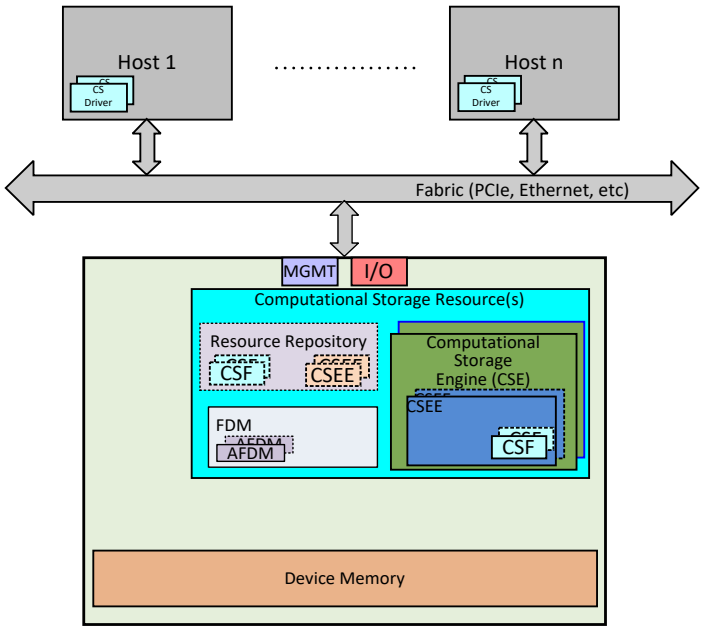
Architecture Overview

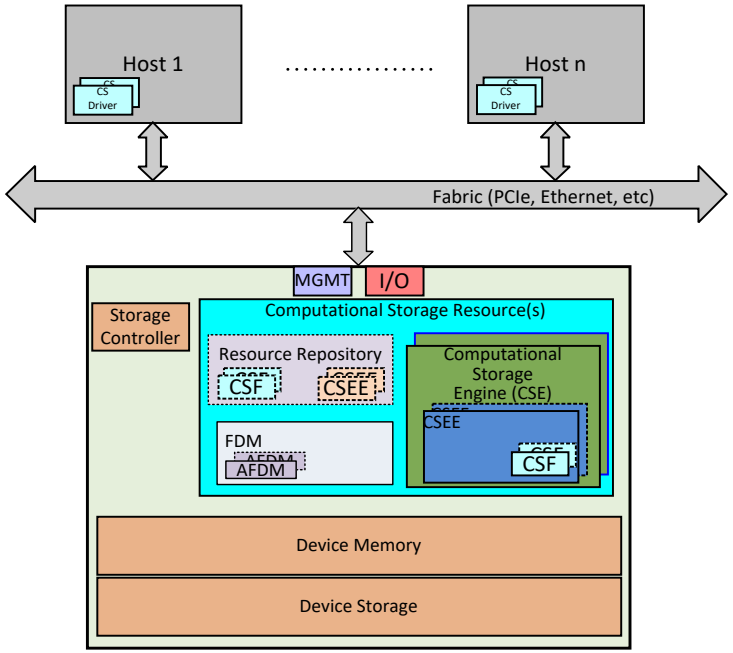
Computational Storage Architecture

Computational Storage Processor



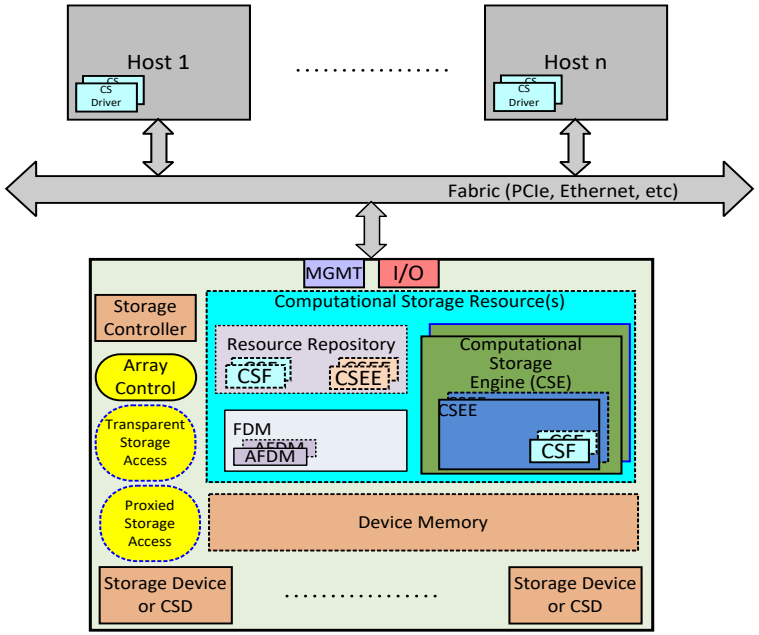
Computational Storage Processor (CSP)

Computational Storage Drive



Computational Storage Drive (CSD)

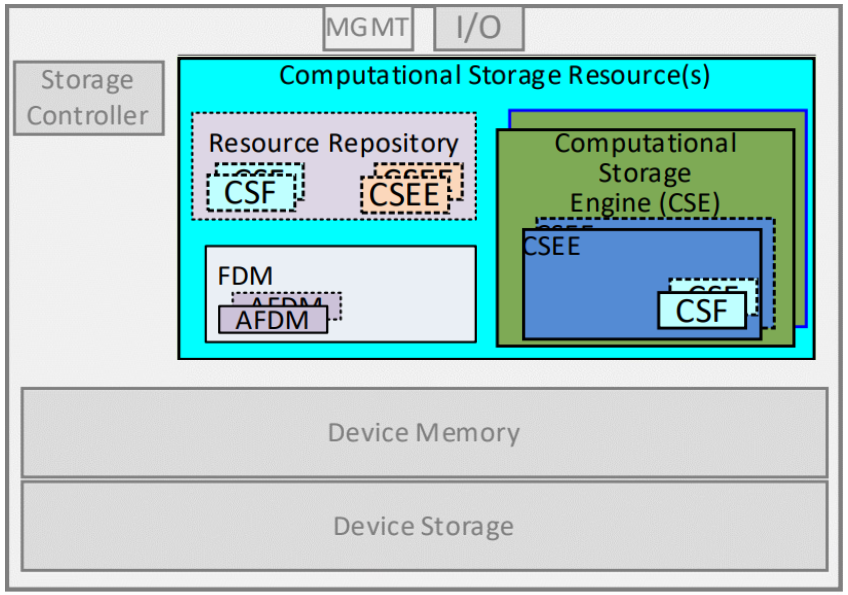
Computational Storage Array



Computational Storage Array (CSA)

CSx = Computational Storage **Device** – CSP or CSD or 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.

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

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.

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.

Security Considerations for v1.0

- Assumptions
  - The environment consists of a single physical host or virtual host with one or more CSxes
  - The host is responsible for the security of the ecosystem that the CSxes operate within
  - CSx security requirements are comparable to the security requirements common to SSDs/HDDs
- Privileged Access
  - Elevated privileges necessary for operations

Security Considerations for v1.1

- Assumptions
  - The environment consists of multiple physical hosts or multiple virtual hosts with one or more CSxes
  - CSx security requirements are comparable to the security requirements common to SSDs/HDDs in multi-tenant environment
- Trust Relationships
- Elements required for a trust relationship are
  1. Identification
     - Exchanged between participating parties
  2. Authentication
     - Is done following identification
     - Exchange of authentication information is done with the same element as Identification
  3. Authorization
     - Is done following authentication
     - Authorizes specific actions on specific resources
     - May be done at a lower-level element than the element that was authenticated
  4. Access Control
     - Controls access to elements of the CSx that are within the scope of the authorization
     - May be access to a CSE, a CSEE, or a CSF
- Different elements of the trust relationship may be at different levels
  - Identification and Authentication may be at the CSx
  - Authorization may be at the CSEE within the CSx
  - Access Control may be at the CSF activated in the CSEE

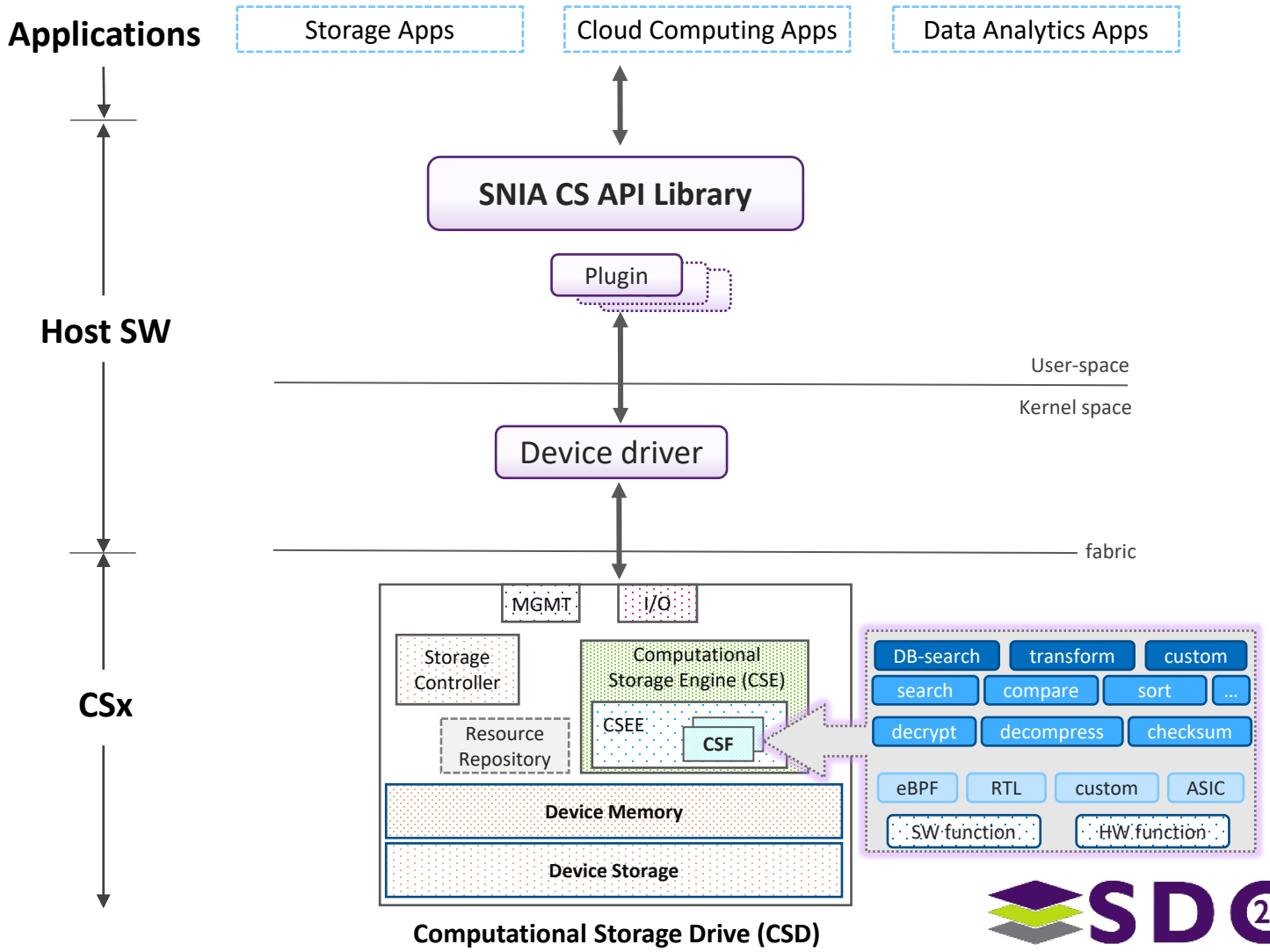
Sequencing of Commands

- Enables sequences of CSFs to execute in succession
  - Sequence executes in-order
  - Allows multiple CSFs to execute with minimal host involvement
- Aggregator CSF
  - Manages execution of the sequence
  - Tracks completion status of each CSF
  - May be downloaded or Pre-installed
  - Fixed Sequence or Variable Sequence defined by parameters passed by the host
- Error Handling
  - May be handled by the host or the aggregator CSF

API Overview

SNIA Computational Storage APIs

- One set of APIs for all CSx types
- APIs hide device details
  - Hardware, Connectivity
- Abstracts device details
  - Discovery
  - Access
  - Device Management
  - Memory Management
    - alloc/free/init
  - Storage/Memory Access
  - Download
  - Execute CSFs
- APIs are OS agnostic

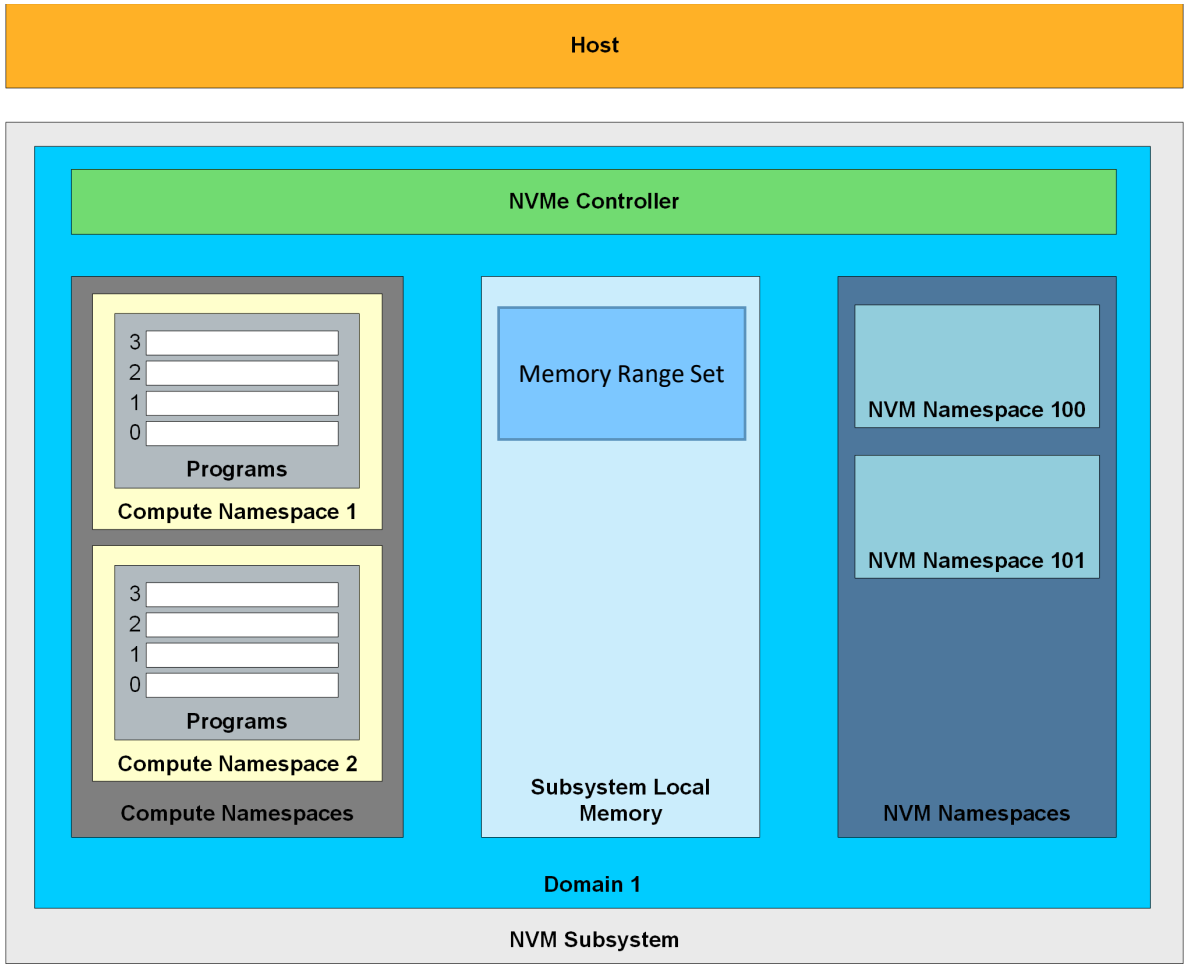


Computational Storage API

- For more information about the SNIA CS API, please attend:
  - “Programming Computational Storage with the SNIA API” by Oscar Pinto

SNIA and NVMe Computational Storage

NVMe Computational Storage Architectural Components



- Compute Namespaces
  - Compute Engines
  - Programs
- Programs operate on data in Subsystem Local Memory
  - Allocated as Memory Range Set
  - Includes program input, output
- NVM Namespaces
  - Persistent storage of data
  - NVM
  - ZNS
  - KV
- Data is transferred between NVM Namespaces and SLM using the Memory Copy command

This presentation discusses NVMe work in progress, which is subject to change without notice.

Correlation of SNIA/NVMe terms

SNIA Terms

- Computational Storage Engine
- Computational Storage Engine Environment
- Resource Repository
  - Downloaded CSF and CSEE
  - Pre-loaded CSF and CSEE
- Activation
- Function Data Memory (FDM)
- Allocated FDM (AFDM)
- Device Storage

NVMe Terms

- Compute Engine/Compute Namespace
- Virtual (Not currently defined)
- Programs
  - Downloaded programs
  - Device-defined programs
- Activation
- Subsystem Local Memory (SLM)
- Memory Range Set
- NVM Namespaces

NVMe Computational Storage

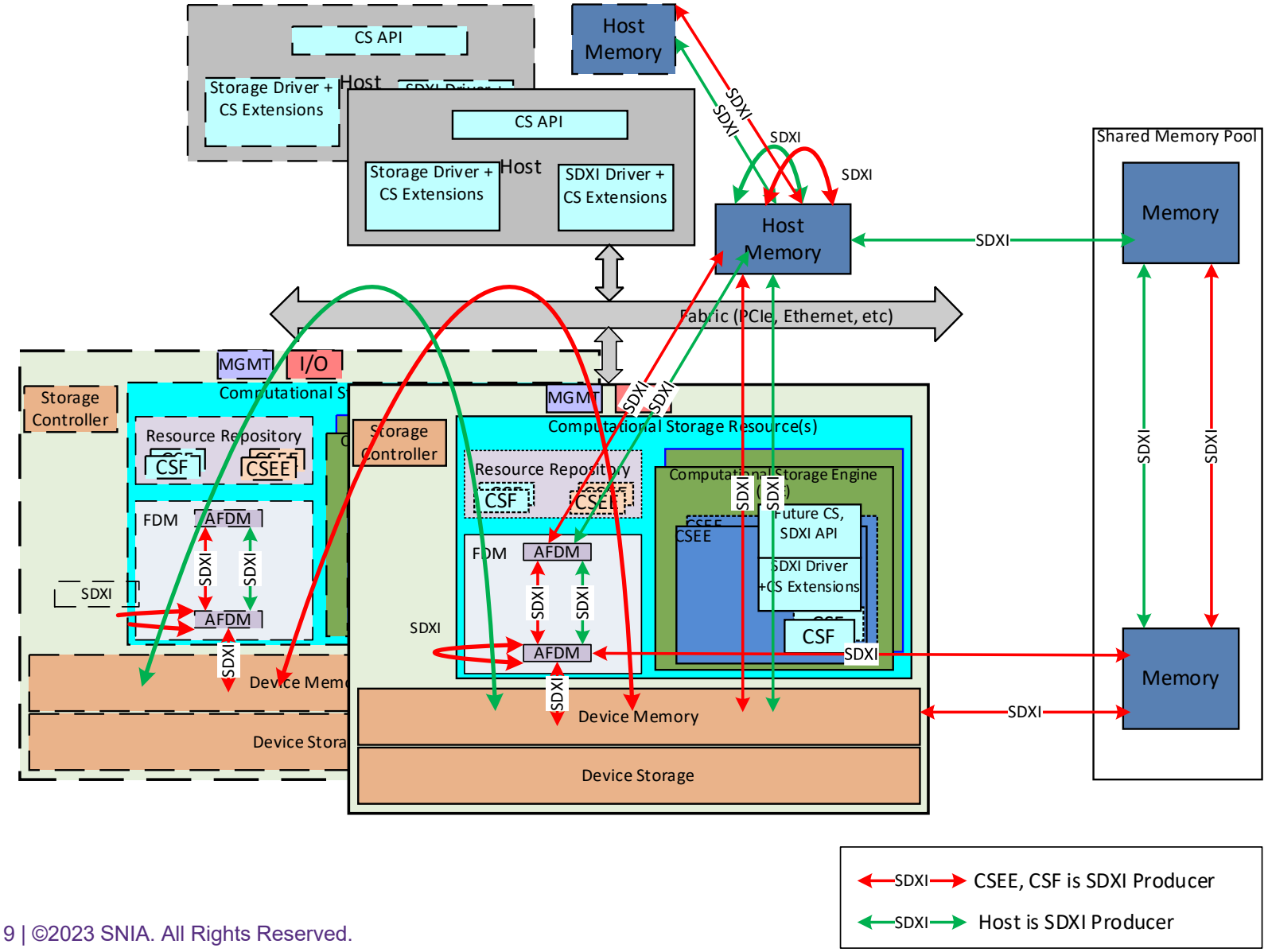
- For more information about NVMe Computational Storage, attend:
  - “NVMe Computational Storage Standards” by Kim Malone and Bill Martin

CS and SDXI Collaboration

SDXI (Smart Data Accelerator Interface)

- Smart Data Accelerator Interface (SDXI) is:
  - A SNIA standard for a memory to memory data movement and acceleration interface
  - Extensible
  - Forward-compatible
  - Independent of I/O interconnect technology
  - Provides data transformation features
- v1.0 was published November 2022
  - https://www.snia.org/sdxi

Combined SDXI+CS Architecture



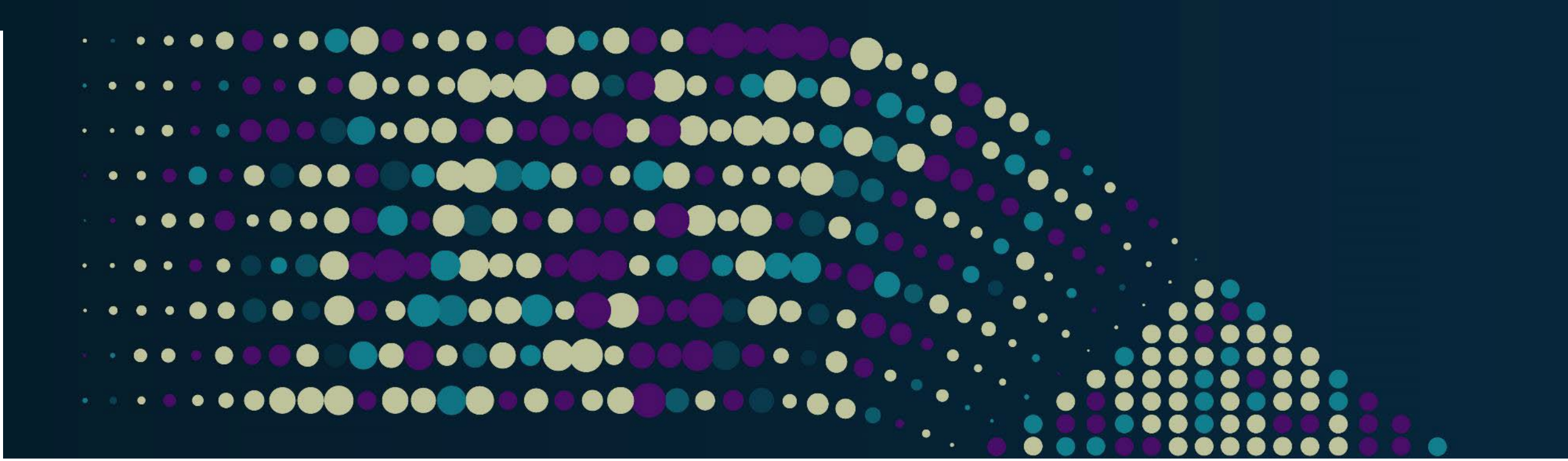
- SDXI used for data movement with Computational Storage used for compute
- Multiple SDXI producers in a CS Architecture
- SDXI enables data movement across multiple AFDM regions

CS + SDXI

- For more information about CS + SDXI, please attend:
  - “Envisioning a Computational Storage Architecture with an SDXI Data Mover: Early Efforts” by Shyam Iyer and Jason Molgaard
- For more information about SDXI, please attend:
  - “SNIA SDXI Specification v1.0 and Beyond” by Shyam Iyer

Interested? Join Us!

- Join SNIA: https://www.snia.org/member_com/join-SNIA
- Join the Computational Storage TWG: https://members.snia.org/workgroup/index



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