STORAGE DEVELOPER CONFERENCE

SDC 21

BY Developers FOR Developers

Virtual Conference
September 28-29, 2021

A SNIA. Event

Computational Storage:
Moving Forward with an Architecture and API

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Agenda

- Overview of SNIA Computational Storage Standards

- CS Device architecture

- CS Discovery

- CS Configuration

- CS computation execution examples

SNIA Computational Storage specifications

- [SNIA Computational Storage Architecture and Programming Model version 0.8R0](#)

- [Computational Storage API version 0.5R1](#)

- Other presentations on SNIA Computational Storage Specifications at SDC

  - Scott Shadley/Jason Molgaard:

    - [Computational Storage Update from the Working Group](#)

  - Oscar Pinto:

    - [Computational Storage APIs](#)
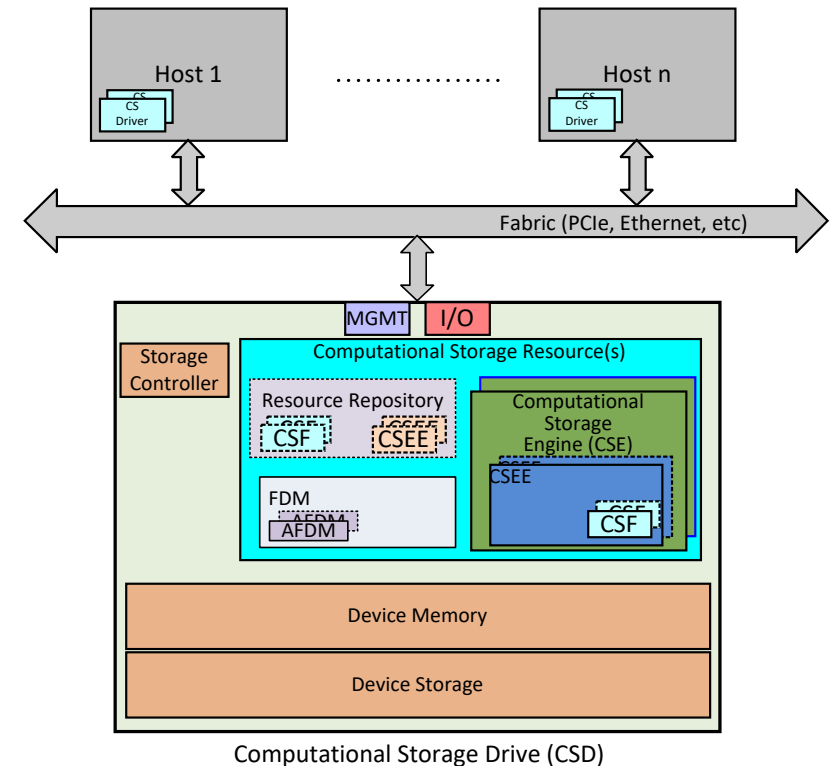
Three Computational Storage Models

Computational Storage Processor (CSP)

Computational Storage Drive (CSD)

Computational Storage Array (CSA)
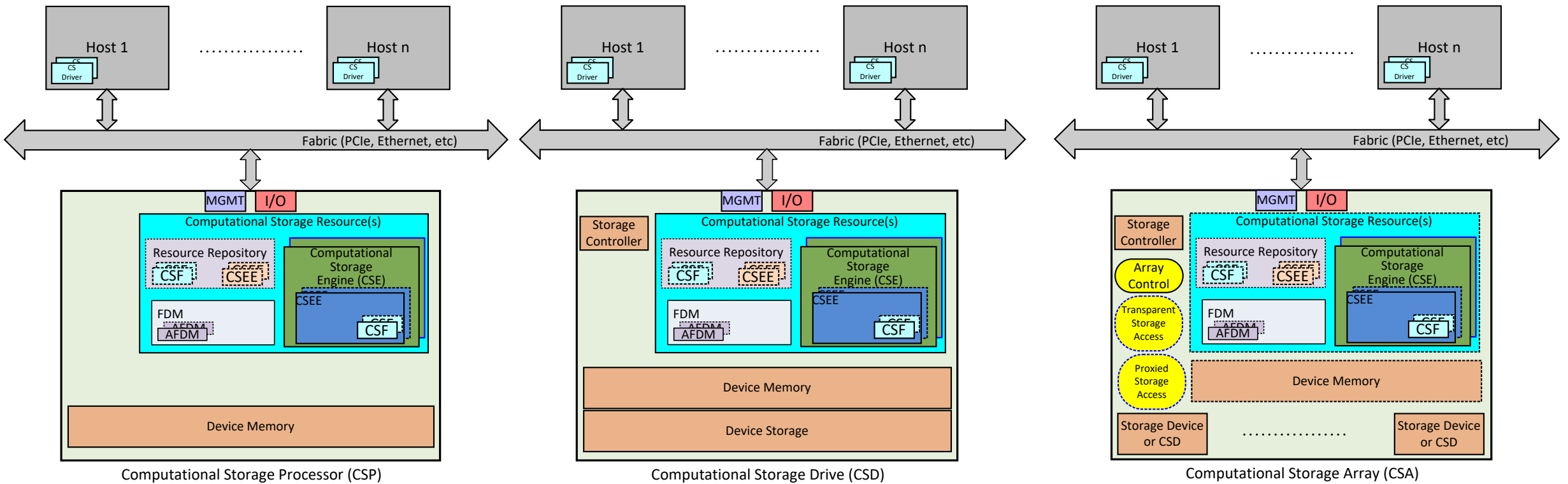
Inter-relationship of elements of the architecture

- **Computational Storage Resources**
- **Computational Storage Engine (CSE)**
  - Basic component of Computational Storage Device (CSx)
    - Example
      - CPU
      - FPGA
  - Computational Storage Engine Environment (CSEE)
    - Example
      - Linux Operating Environment
    - Activated on a CSE
    - One or more must be activated to perform computation
    - Computational Storage Function (CSF)
      - Activated within a CSEE
   - One or more must be activated to perform computation

Computational Storage Drive (CSD)
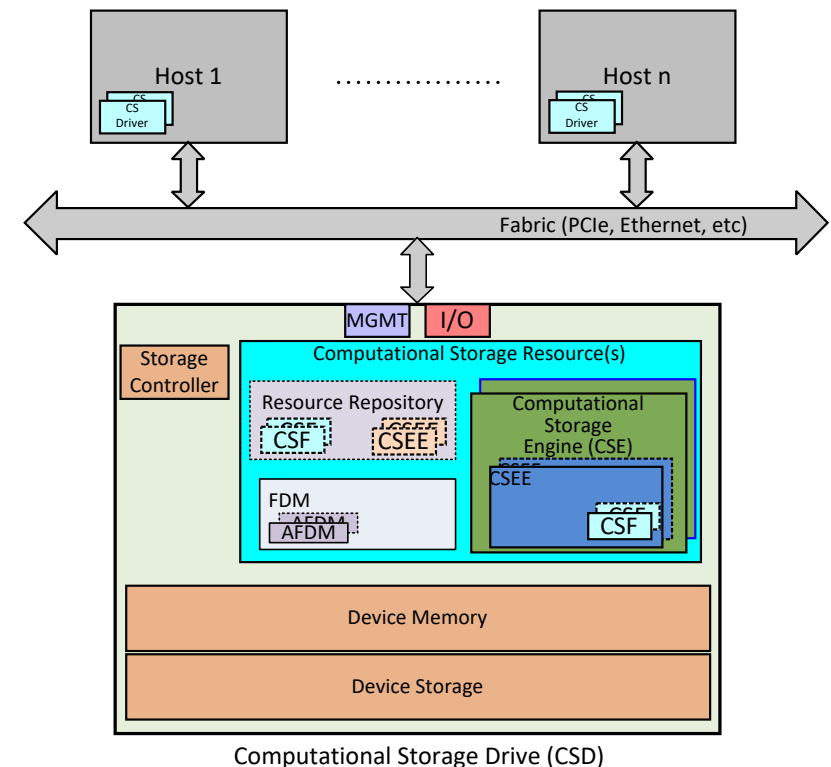
Inter-relationship of elements of the architecture (Continued)

- ## Resource Repository
  - May be in:
    - Device Memory
    - Device Storage
  - Contains:
    - CSEEs that may be activated
    - CSFs that may be activated
- ## Function Data Memory (FDM)
  - Area that CSFs have available for performing computation
  - Allocated Function Data Memory
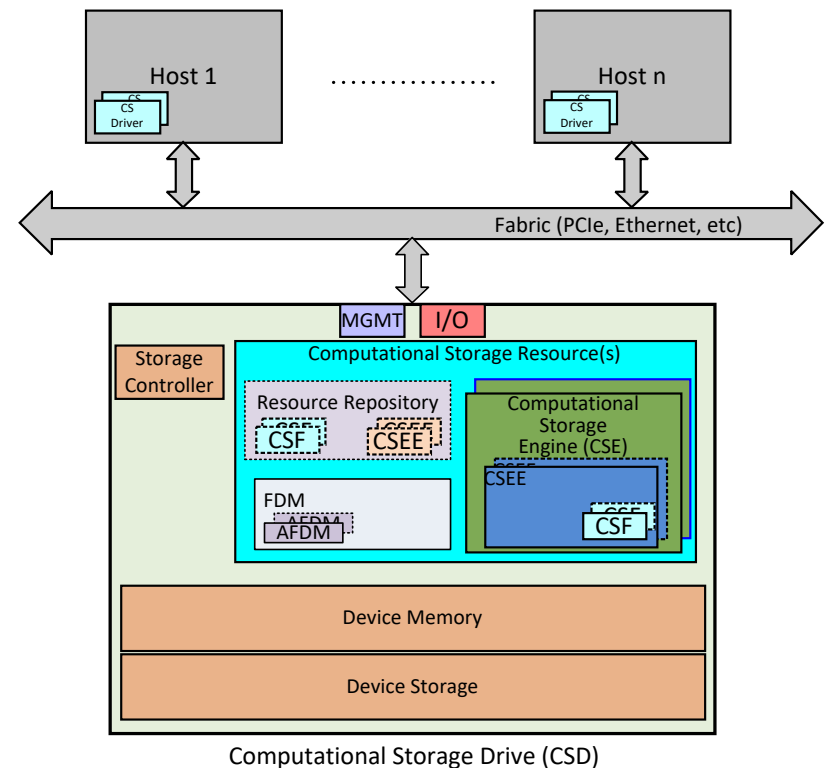   - Allocated for a specific computation

Computational Storage Drive (CSD)

Computational Storage Engine Environment

- ## Computational Storage Engine Environment (CSEE)

  - May be hard coded in a CSE
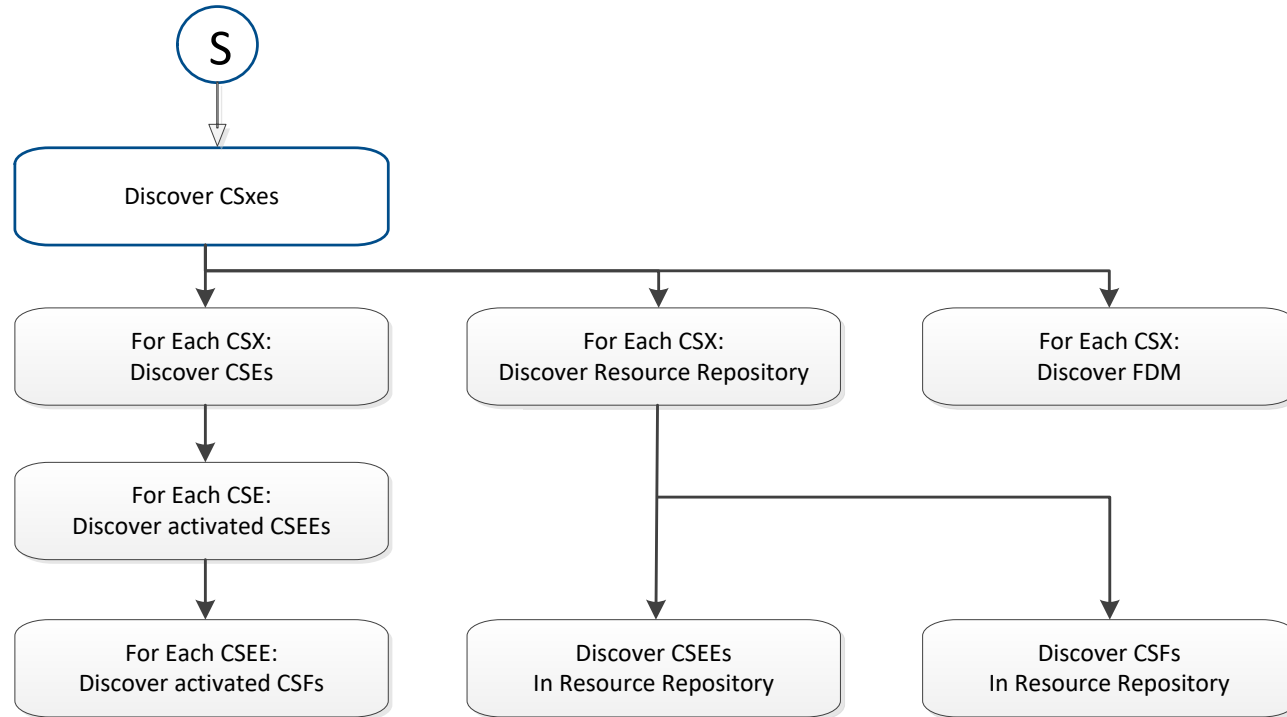
  - May be in the Resource Repository
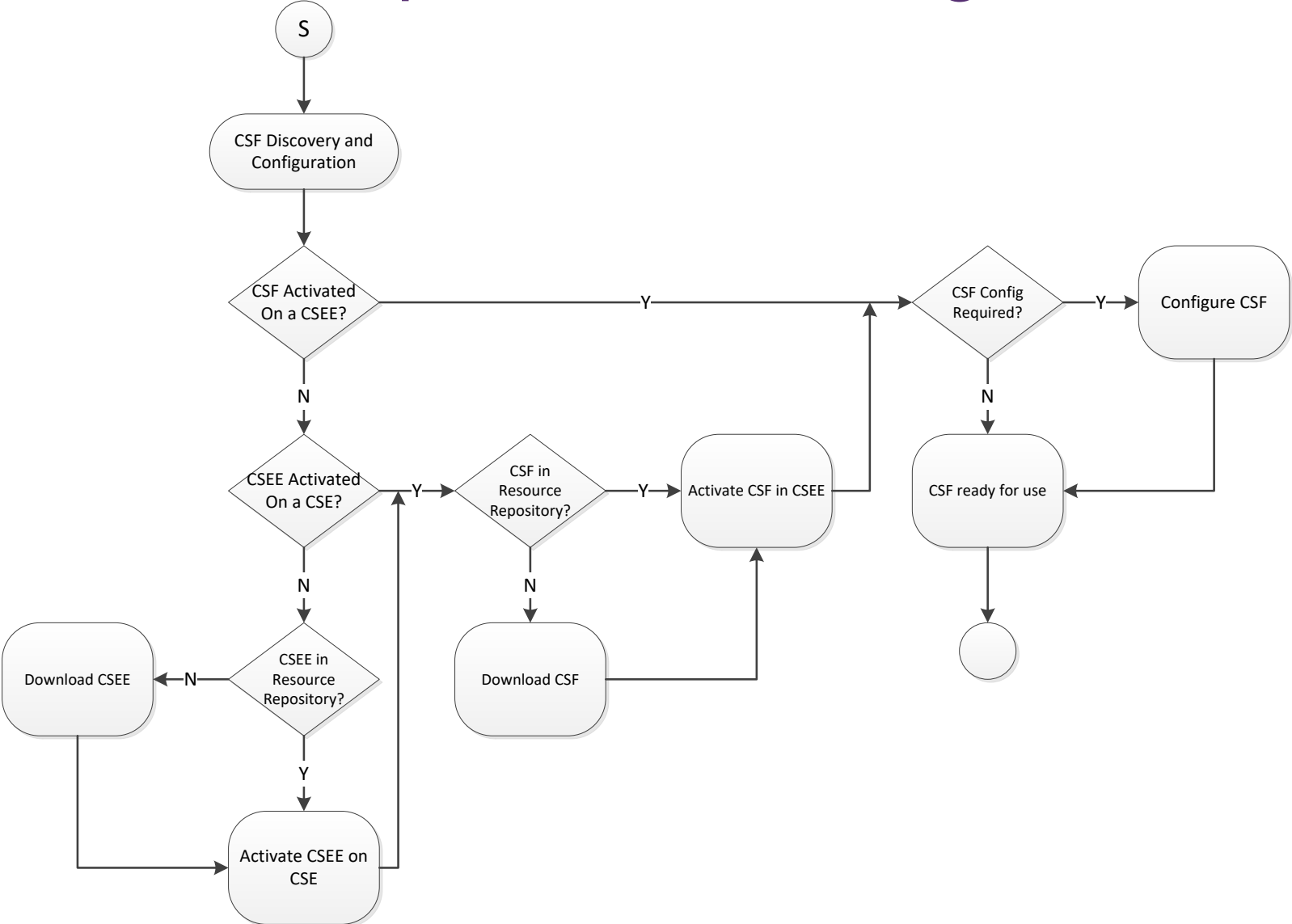
  - May be virtual

Computational Storage Drive (CSD)
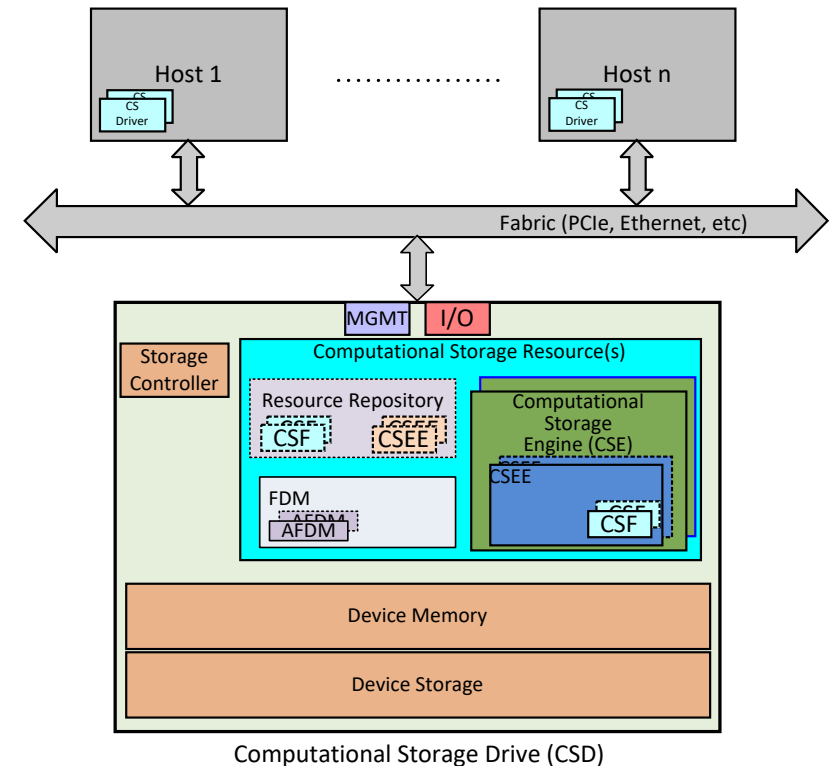
Computational Storage Function

- ## Computational Storage Function (CSF)
  - May be hard coded in a CSEE
  - May be in the Resource Repository

Computational Storage Drive (CSD)

Discovery of Computational Storage Elements

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# Configuration of Computational Storage Function

Performing Computation Directly

- ## Assumption
  - data on which computation is to be performed is placed in the FDM, prior to the request to the CSE, through some process that is not shown in this figure
  - Result data, if any, is returned to the host through some process that is not shown in this figure

- ## Process
  1. The host sends a command to the CS controller to invoke the CSF;
  2. The CSE performs the requested computation on data that is in FDM and places the result, if any, into FDM; and
  3. The CSE returns a response to the host.

Computational Storage Drive (CSD)
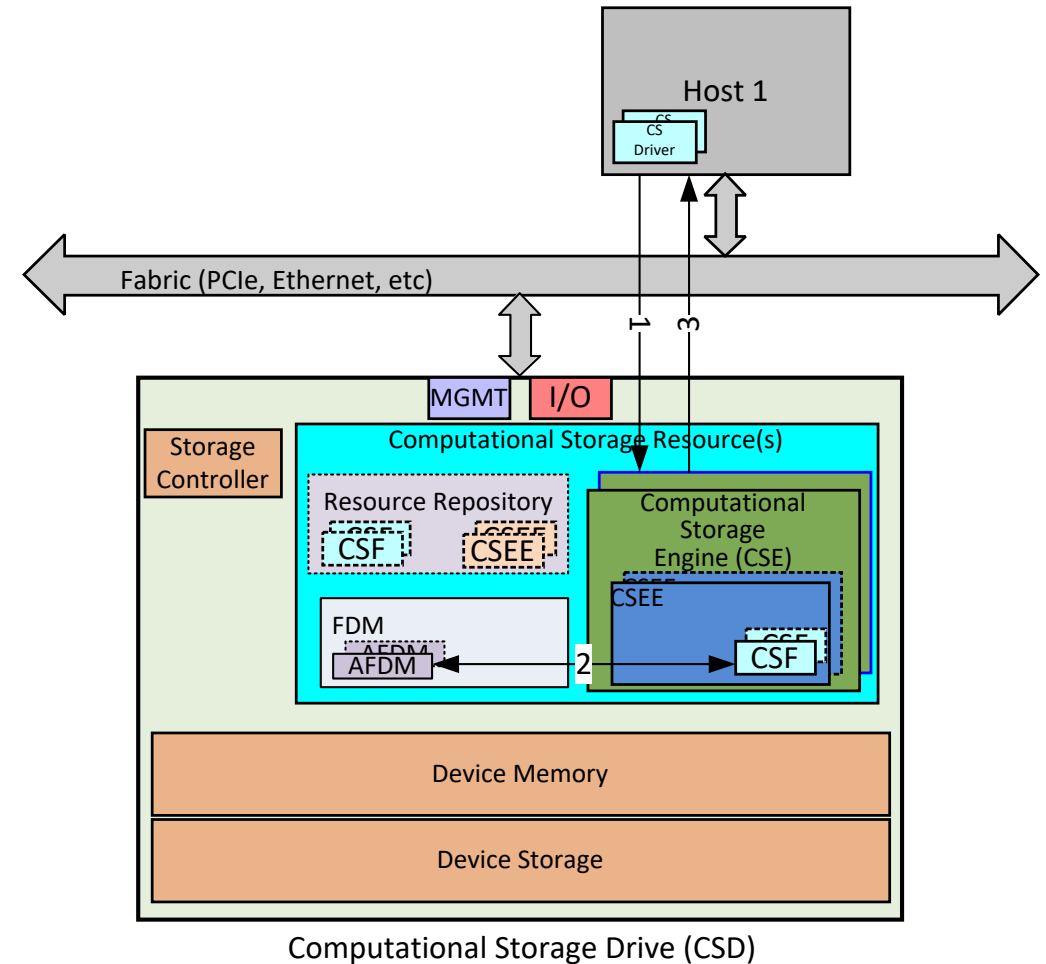
Performing Computation Directly on Data in Device Storage

- ## Assumption
  - This example is for a computation on data that is in device storage

- ## Process
  1. The host sends a command to invoke the CSF;
     a. The command specifies the Device Storage location of the data;
  2. The CSE moves data from Device Storage to FDM;
  3. The CSE performs the requested computation on data that is in FDM and places the result, if any, into FDM; and
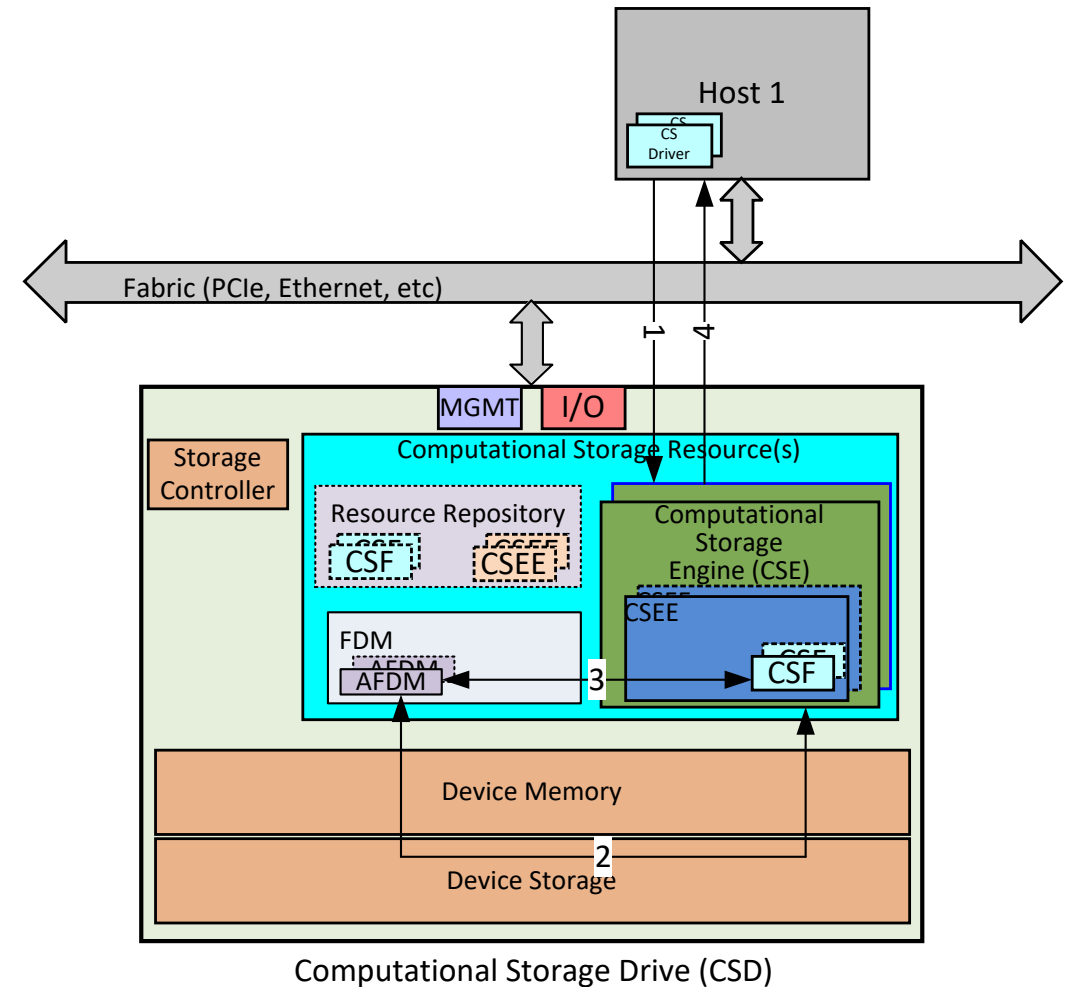 4. The CSE returns a response to the host.

Computational Storage Drive (CSD)

Performing Computation Indirectly

- Assumption:
  - This example is for a device to host operation
- Process
  1. The host sends a storage request to a Storage Controller where:
     a. that storage request is associated with a target CSF; and
     b. the storage controller determines what CSF is associated with the storage request;
  2. The Storage Controller moves data from storage into the FDM;
  3. The Storage Controller instructs the CSE to perform the indicated computation on the data in the FDM;
  4. The CSE performs the computation on the data and places the result, if any, into the FDM; and
  5. The Storage Controller returns the computation results, if any, from the FDM to the host.

Computational Storage Drive (CSD)
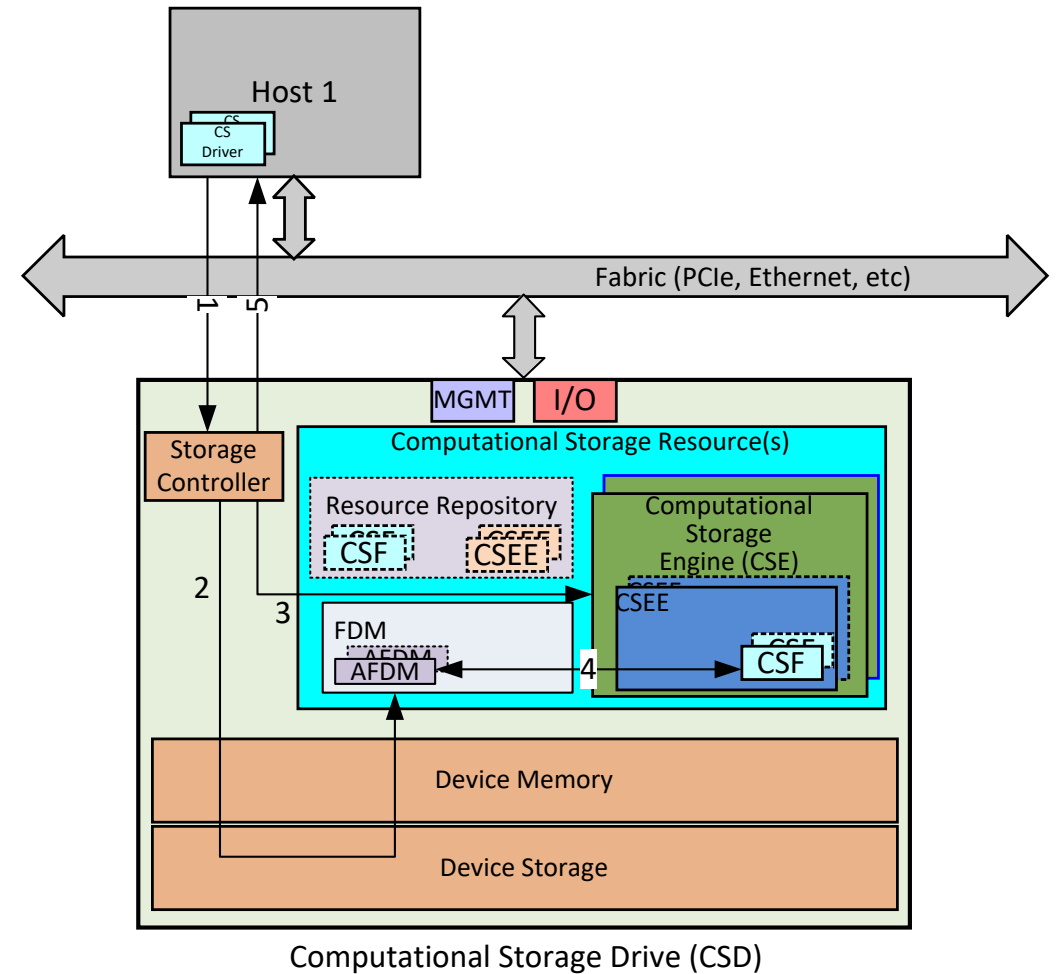
API Support

- APIs for:
  - Discovery
  - Configuration
  - Memory allocation
  - Execution
- For complete details see SDC presentation by Oscar Pinto
  - [Computational Storage APIs](#)

Other Computational Storage Presentations

- Kim Malone & Stephen Bates:
  - [NVMe Computational Storage Update](#)
- Computational Storage Birds of a Feather
  - Today (Wednesday September 29) 4:00 – 5:00 PDT
  - [Computational Advances](#)
- Numerous others in the Computational Storage Track

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