SPDK Based IPU/DPU Storage Solutions

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Agenda

- IPU/DPU Storage Usages and SPDK support
- SPDK Enhancements for IPU/DPU support
- Storage Management Agent
- SPDK and IPDK/OPI
- Summary
IPU Storage Usages and SPDK

NVMe-oF Initiator Usage
- Storage Disaggregation in Cloud
- Bare-metal hosting
- SPDK provides NVMe-oF initiators

Local Storage Disaggregation
- IPU provides NVMe virtualization
- SPDK for NVMe driver and local storage provisioning

IPU based JBOF Design
- Storage datapath acceleration
- Optional PCIe switch for fanout
- SPDK provides full solution for NVMe-oF targets

IPU + Storage Server
- Storage datapath acceleration
- SPDK for initiator and target usages
SPDK NVMe-oF Software Stack

- SPDK provides a flexible architecture for supporting a choice of protocols and enables customizations.
- SPDK is an ideal framework for IPU/DPU based storage solutions.

SPDK Components for NVMe-oF solutions. For details, please refer to [https://spdk.io/](https://spdk.io/)
Example: SPDK in IPU based JBOF

**IPU based JBOF Design**
- Storage datapath acceleration
- Optional PCIe switch for fanout
- **SPDK provides a full solution for NVMe-ofF targets**
Example: IPU based NVMe/TCP Initiator

**NVMe-oF Initiator Usage**
- Storage Disaggregation in Cloud
- Bare-metal hosting
- SPDK provides NVMe-oF initiators
NVMe over TCP Initiator on Intel® IPU E2000 series

- SPDK modular design enables a clean integration with an IPU NVMe initiator
- NPI (NVMe Protocol Initiator) Transport to interface with nvmf layer
- NPI Transport interacts with IPU SDK and API for device configurations and CMDs processing.
SPDK Enhancements for IPU/DPU Support

- Enhancements over last couple of years enabled a clean integration with IPU storage initiators (e.g. NPI transport).
- Add Storage Management Agent (SMA) to simplify the integration of IPU storage initiators with orchestration frameworks (e.g. K8s CSI node driver)
- Add auto discovery service
- Asymmetric Namespace Access (ANA) and Multi-path support
- Look forward
  - Storage data-path accelerations, compression/crypto/CRC/HASH
  - NVMe/RDMA offload
  - …
Storage Management Agent

- Storage Management Agent (SMA) is a service providing a gRPC interface for orchestrating SPDK applications.
  - Provides a secure and authenticated configuration channel for IPU storage applications.
  - Abstractions out low-level details of SPDK JSON RPCs.
  - Simplifies integrations with K8s and OpenStack.
- For details, please refer to https://spdk.io/doc/sma.html
SPDK, a key component for IPDK and OPI

OPI – Open Programmable Infrastructure
IPDK – Infrastructure Programmer Development Kit
SPDK and IPDK Storage Recipes

- SPDK is a key component for IPDK to enable different storage recipes
- SPDK containers for IPU initiator and target simplifies IPU SW developments
- IPDK proposes an environment for IPU SW development
- OPI discusses interfaces for devices like IPU
IPDK is a community-driven target agnostic framework for infrastructure programming that runs on a CPU, IPU, DPU, or network switch.
IPDK and OPI

- IPDK and OPI coexist
- IPDK is an official sub project of OPI
- IPDK development is now under OPI umbrella
- OPI defines management API across IPU/DPU vendors
  - Opi-spdk-bridge enables integration with SPDK based storage solutions
  - https://github.com/opiproject/opi-spdk-bridge
IPDK Storage Recipes

IPDK Virtual Block Storage Recipe

IPDK recipes simplify and make it easy for IPU/DPU application development
- ipu-storage-container
- storage-target container
- ipu management API (based on OPI bridge)
Summary

- SPDK is an ideal framework for supporting IPU/DPU storage solutions.
- SPDK enhancements make IPU/DPU storage solutions better and better.
- We highly recommend SPDK for IPU/DPU storage solutions.
- We encourage and welcome to SPDK development and integration with IPDK/OPI.
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