STORAGE DEVELOPER CONFERENCE

SDC22

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BY Developers FOR Developers

A SNIA Event

SPDK and Infrastructure Offload

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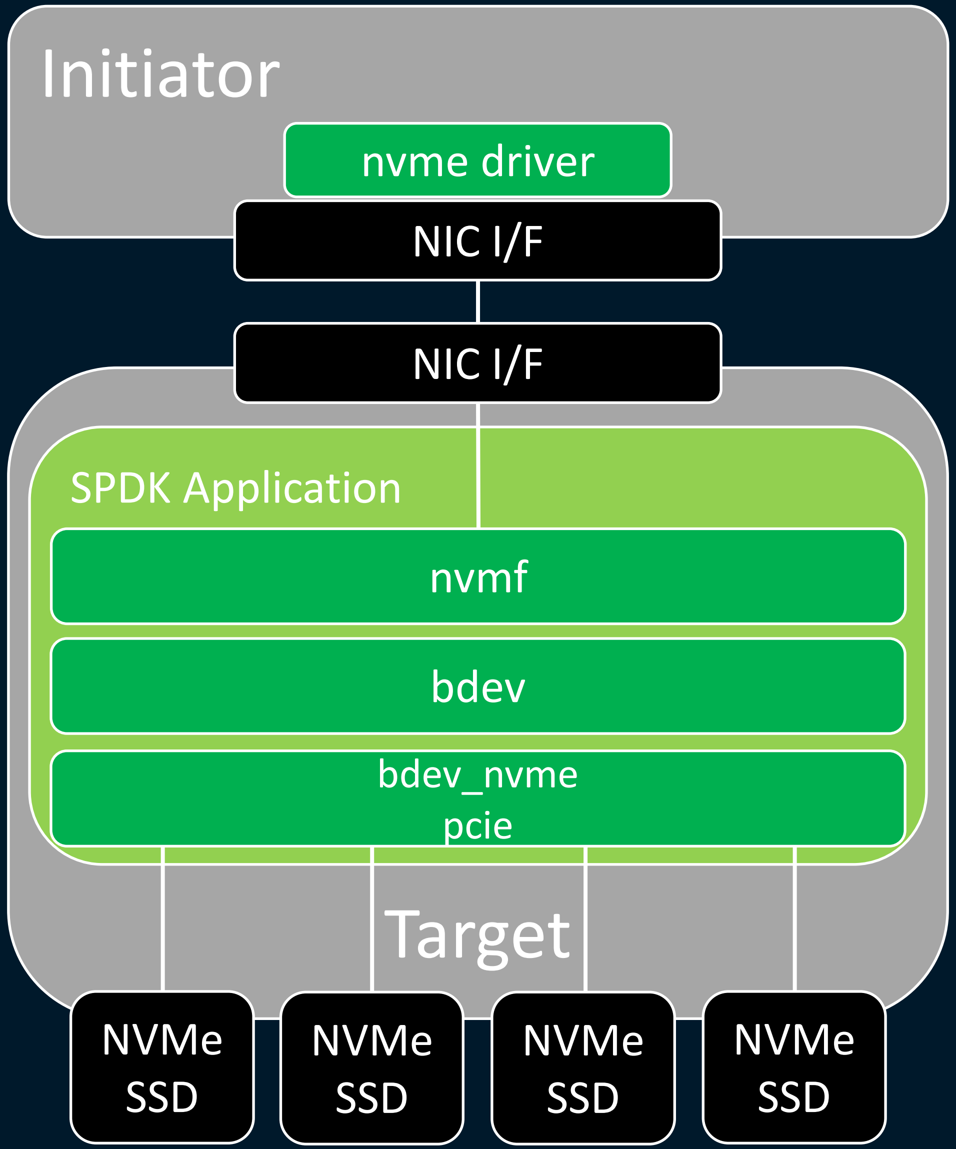
Agenda

- SPDK NVMe Target and Infrastructure Offload
  - SPDK NVMe Target History and Background
  - How does this apply to Infrastructure Processing Units (IPUs)?
  - NVMe Target Transport Abstraction
  - Extensions for non-fabrics use cases
- Bonus: Storage Management Agent

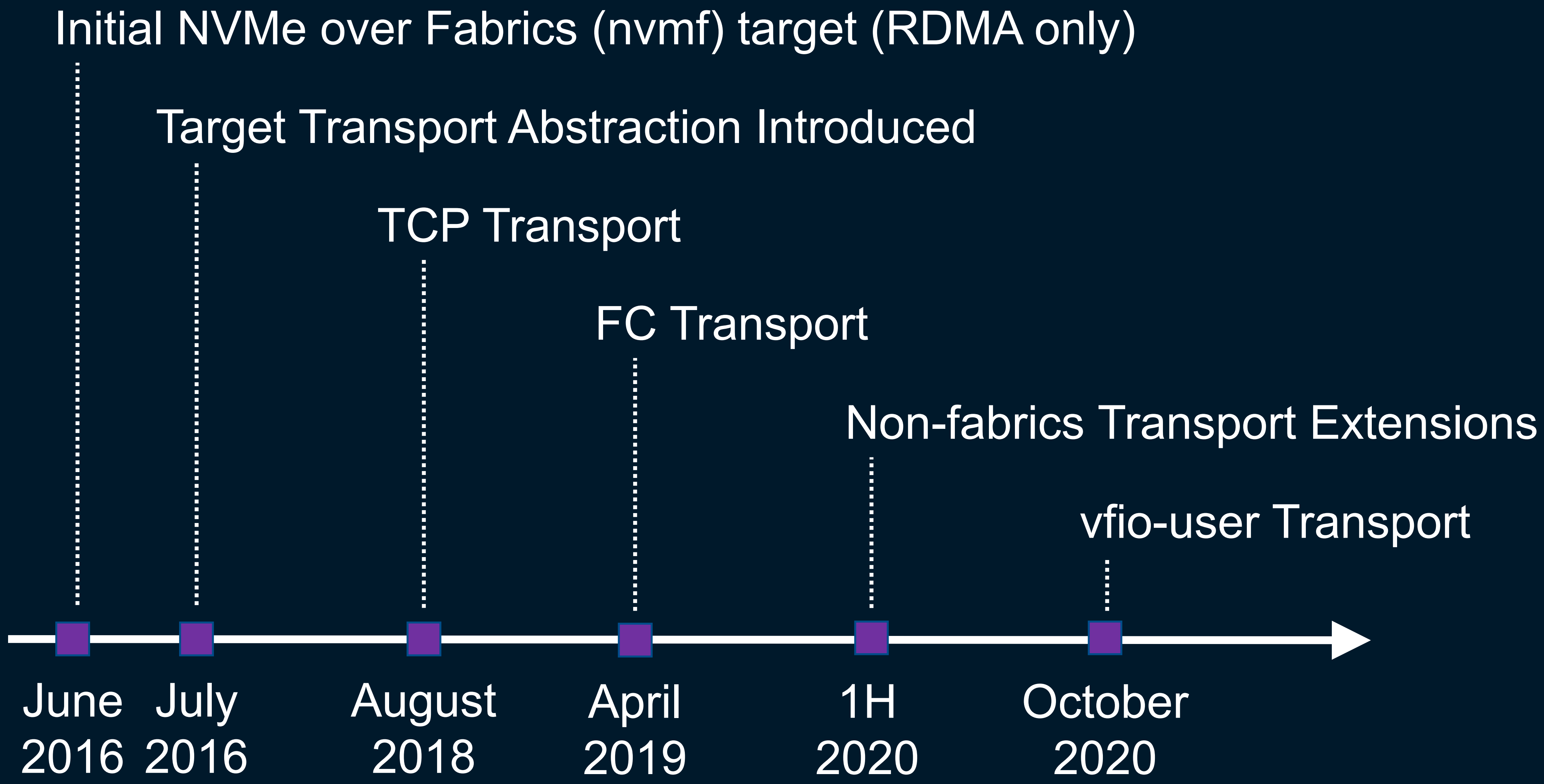
SPDK NVMe Target and Infrastructure Offload

SPDK NVMe Target Primer

- Accepts NVMe commands over network fabric
  - RDMA, TCP, FC
- Forwards commands to SPDK block device (bdev) layer
- SPDK block devices backed by storage
  - Examples
    - Local NVMe SSD
    - Logical volume on NVMe SSD
    - Remote storage (NVMe, iSCSI, Ceph)



SPDK and NVMe Target Timeline



Initial NVMe over Fabrics (nvmf) target (RDMA only)

Target Transport Abstraction Introduced

TCP Transport

FC Transport

Non-fabrics Transport Extensions

vfio-user Transport

June 2016

July 2016

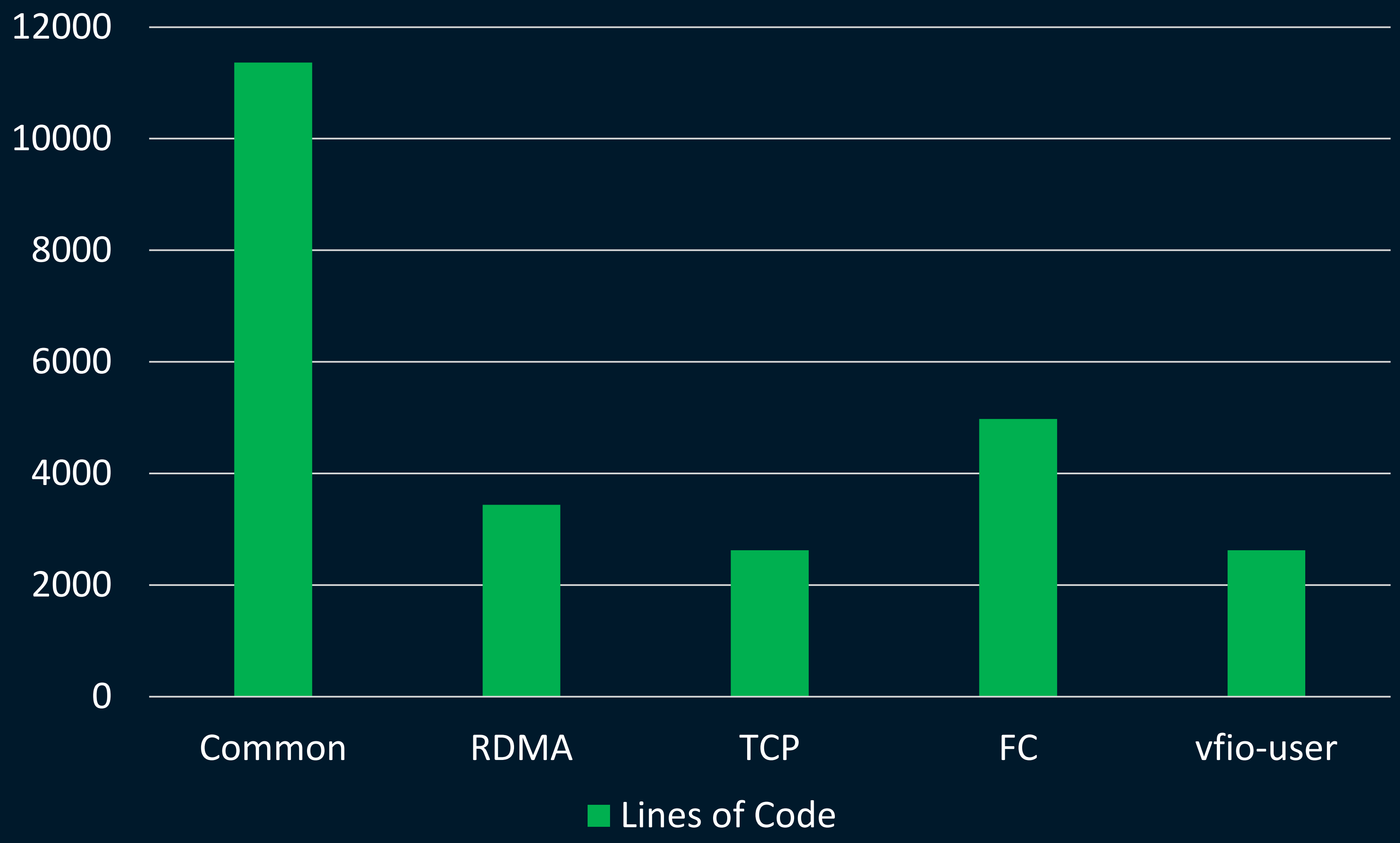
August 2018

April 2019

1H 2020

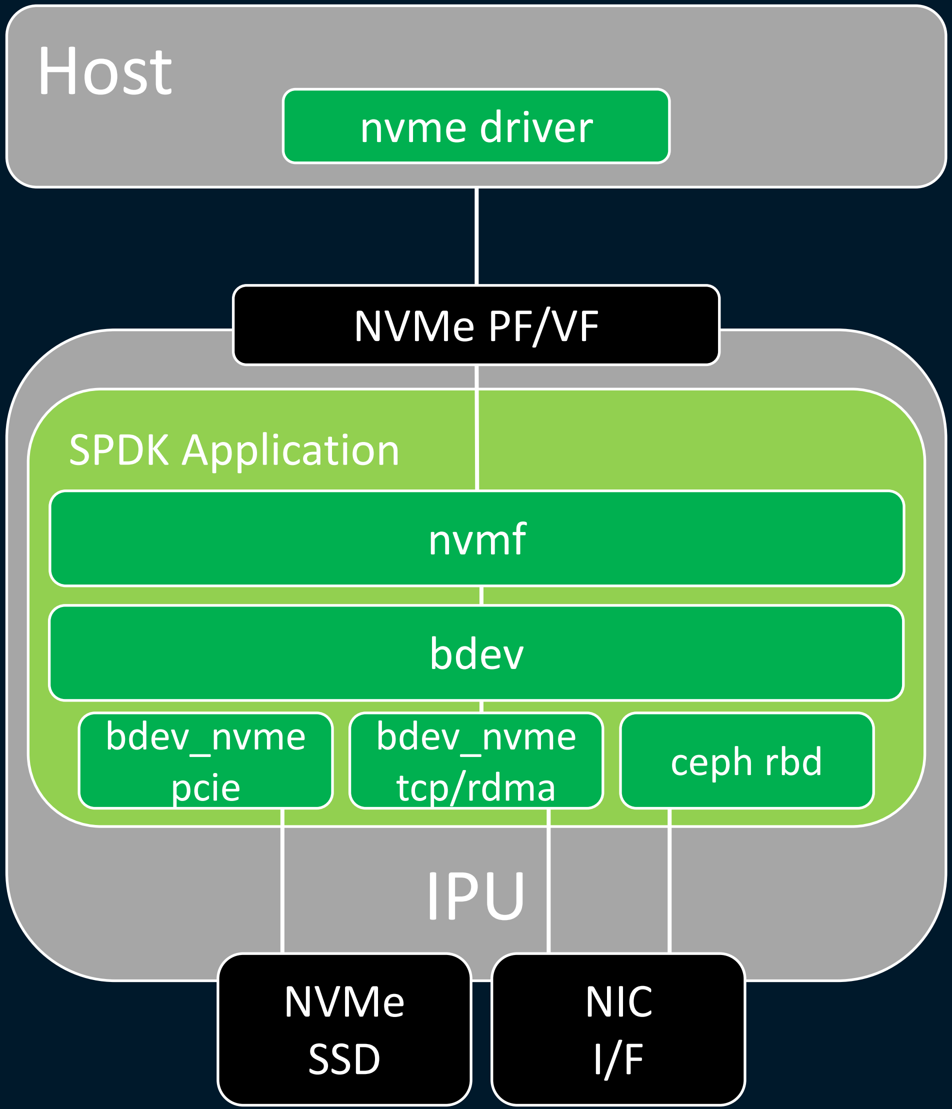
October 2020

Code Breakdown



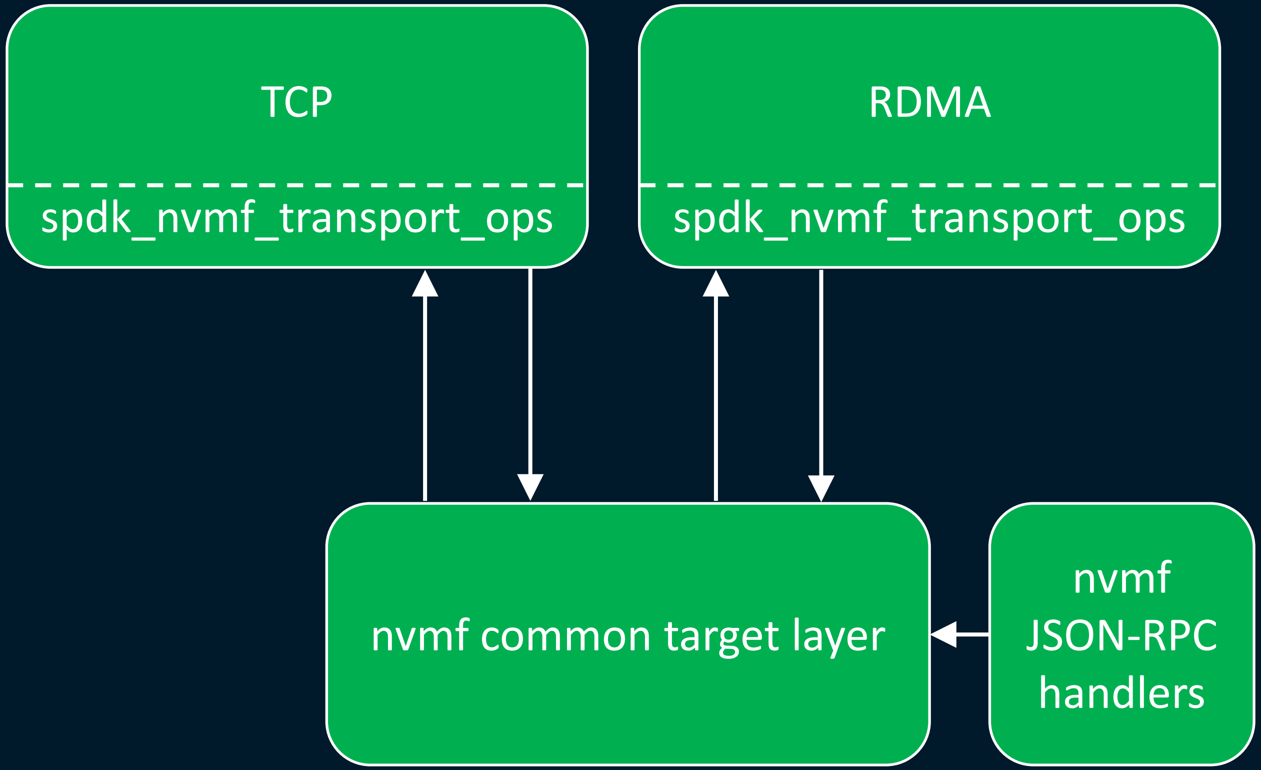
How does this apply to IPUs?

- IPUs with NVMe interface are an NVMe target!
  - But with an IPU-specific transport
- Goal: share all of the NVMe target common code for non-fabrics use cases



NVMe Target Transport Abstraction

- Transports implement spdk_nvmf_transport_ops
- Operations include
  - create, destroy
  - listen, stop_listen
  - poll_group_create, poll_group_add, poll_group_remove, poll_group_poll
- Common layer calls transport to perform transport-specific operations
- Transports notify common layer of new connections and new requests
  - spdk_nvmf_tgt_new_qpair
  - spdk_nvmf_request_exec



TCP

spdk_nvmf_transport_ops

RDMA

spdk_nvmf_transport_ops

nvmf common target layer

nvmf JSON-RPC handlers

Extensions for non-fabrics use cases

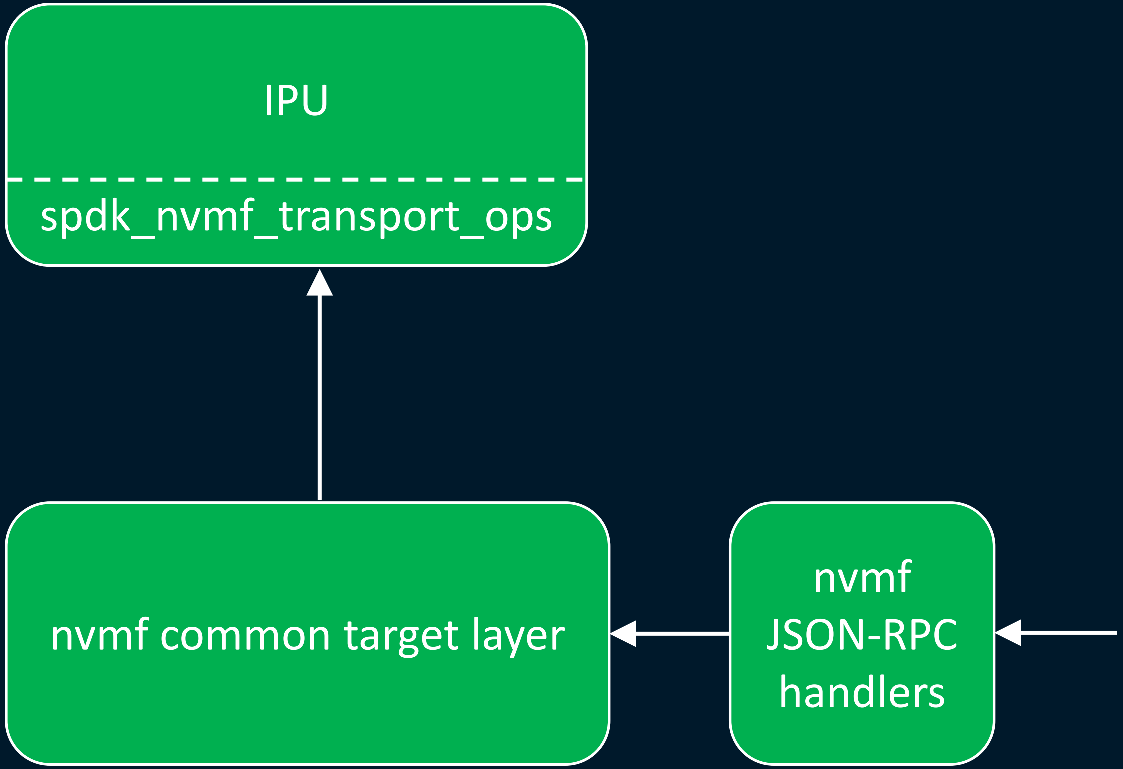
- What’s different about non-fabrics use cases?
  - Listen and connect
  - Namespace notifications
  - Register reads/writes v. Property get/set
  - Various IDENTIFY feature reporting (i.e. SGL support)

Listen and Connect

- Fabrics (i.e. TCP)
  - Listen = Listen for new TCP connections on given address/port
  - Accept = Accept new TCP connection and start processing NVMe capsules
  - Connect = NVMe Fabrics command that specifies which subsystem to associate with the connection
- IPU
  - No explicit Connect command from the host!

Listen and Connect

- nvmf_subsystem_add_listener RPC
- spdk_nvmf_tgt_listen_ext()
  - Calls ops::listen
  - Listen on IPU-specified “address”
- spdk_nvmf_subsystem_add_listener()
  - Calls ops::listen_associate
    - Pass listener and subsystem as parameters
- When host “connects”, IPU transport sends common layer a fake CONNECT command to associate the connection with specified subsystem



Namespace Notifications

- Fabrics
  - All namespace enumeration and notifications handled in-band
  - IDENTIFY NAMESPACE
  - ASYNCHRONOUS EVENT REQUEST
- Non-fabrics
  - IPU may require special handling when namespaces are added or removed
  - ops::subsystem_add_ns, ops::subsystem_remove_ns added to notify transport
    - These operations are optionally implemented by each transport

Register Reads/Writes

- Fabrics
  - NVMe uses “property” instead of “register”
  - Fabrics commands PROPERTY_GET, PROPERTY_SET
  - Host sends fabrics commands to get/set CC, CSTS, CAP, VS, etc. during init
- Non-fabrics
  - PCIe host doesn’t send Fabrics commands to PCIe controller
    - It read/writes registers in PCI BAR using load/store instructions
  - Non-fabrics transports sends common layer fake PROPERTY_GET/SET commands to simulate PCIe register accesses

IDENTIFY feature reporting

- Fabrics
  - Always reports SGLs are enabled
- Non-fabrics
  - Some IPUs may only support PRP
  - ops::cdata_init called during controller creation to allow transport to override fields in IDENTIFY CONTROLLER data structure
  - Enables common layer to handle IDENTIFY CONTROLLER requests same for all transports

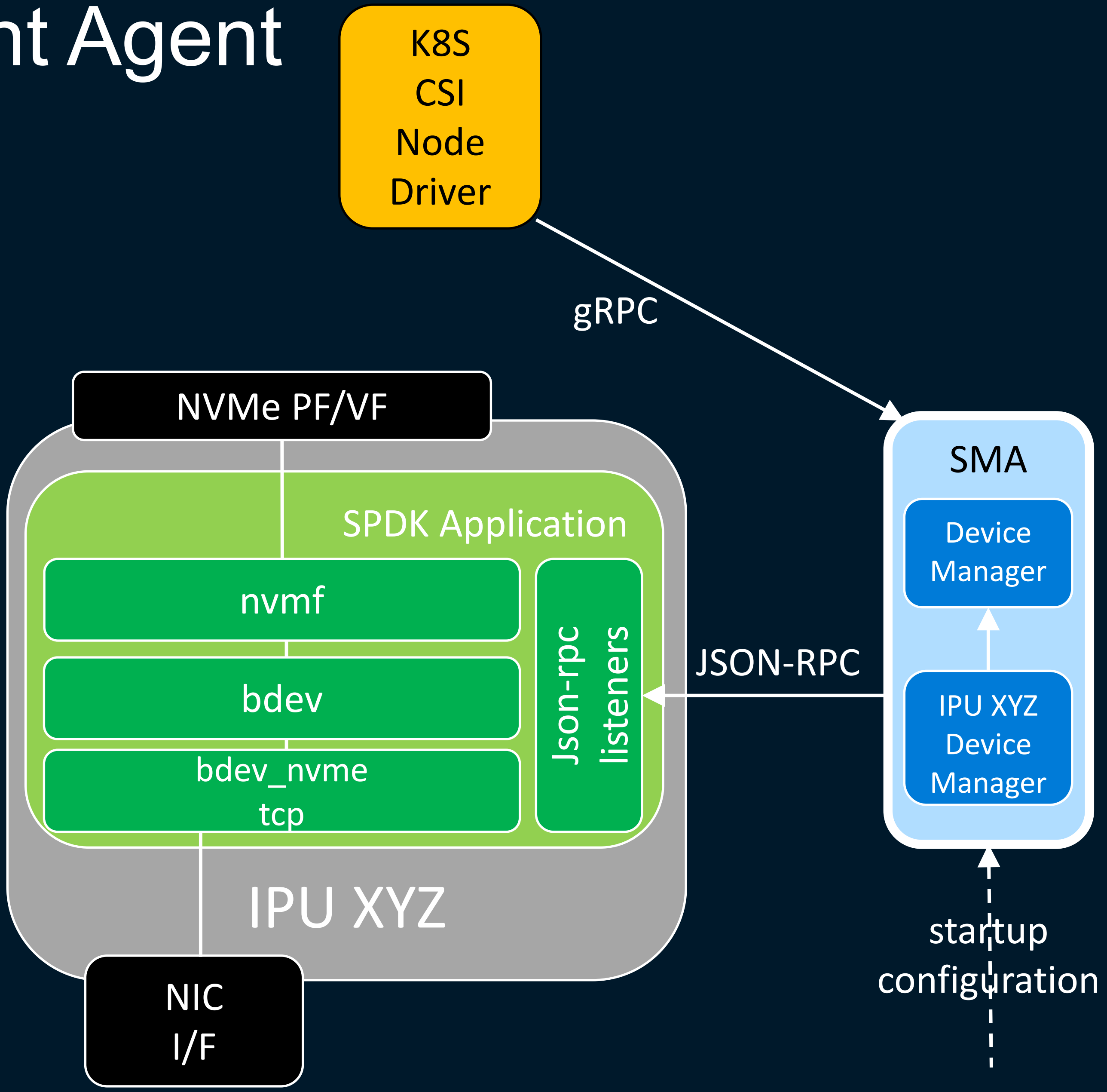
Storage Management Agent

Orchestrating SPDK-based IPUs

- SPDK JSON-RPCs are intentionally very low level
- Connecting an IPU host to its backend storage requires many steps (and error handling if any of those steps fail!)
  - bdev_nvme_attach_controller
  - nvmf_create_subsystem
  - nvmf_subsystem_add_ns
  - nvmf_subsystem_add_listener
- IPU-specific RPC parameters
- How do we make it easier to write something like a K8S CSI node driver?

SPDK Storage Management Agent

- gRPC based application
- Attach existing storage to host
  - Provisioning currently out of scope
- Basic operation set
  - CreateDevice
    - With optional volume
  - DeleteDevice
  - AttachVolume
  - DetachVolume
- IPUs implement DeviceManager interface



Current Status

- DeviceManagers:
  - nvmf_vfiouser, nvmf_tcp, vhost_blk
- Supports connecting to NVMe/TCP volumes
- In progress (targeted for SPDK v22.09 release)
  - Data encryption keys
  - Quality of service parameters

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