STORAGE DEVELOPER CONFERENCE

SDC22 | Fremont, CA
September 12-15, 2022

BY Developers FOR Developers

A SNIA Event

OPI (Open Programmable Infrastructure) Overview

13-SEP-2022

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OPEN PROGRAMMABLE INFRASTRUCTURE PROJECT

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The objective of the Open Programmable Infrastructure Project is to foster a community-driven ***standards-based open ecosystem*** *for next generation architectures and frameworks based on* ***DPU and IPU technologies****.*

https://opiproject.org

https://github.com/opiproject

OPEN PROGRAMMABLE INFRASTRUCTURE PROJECT

Joins

THE LINUX FOUNDATION

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Tencent Cloud

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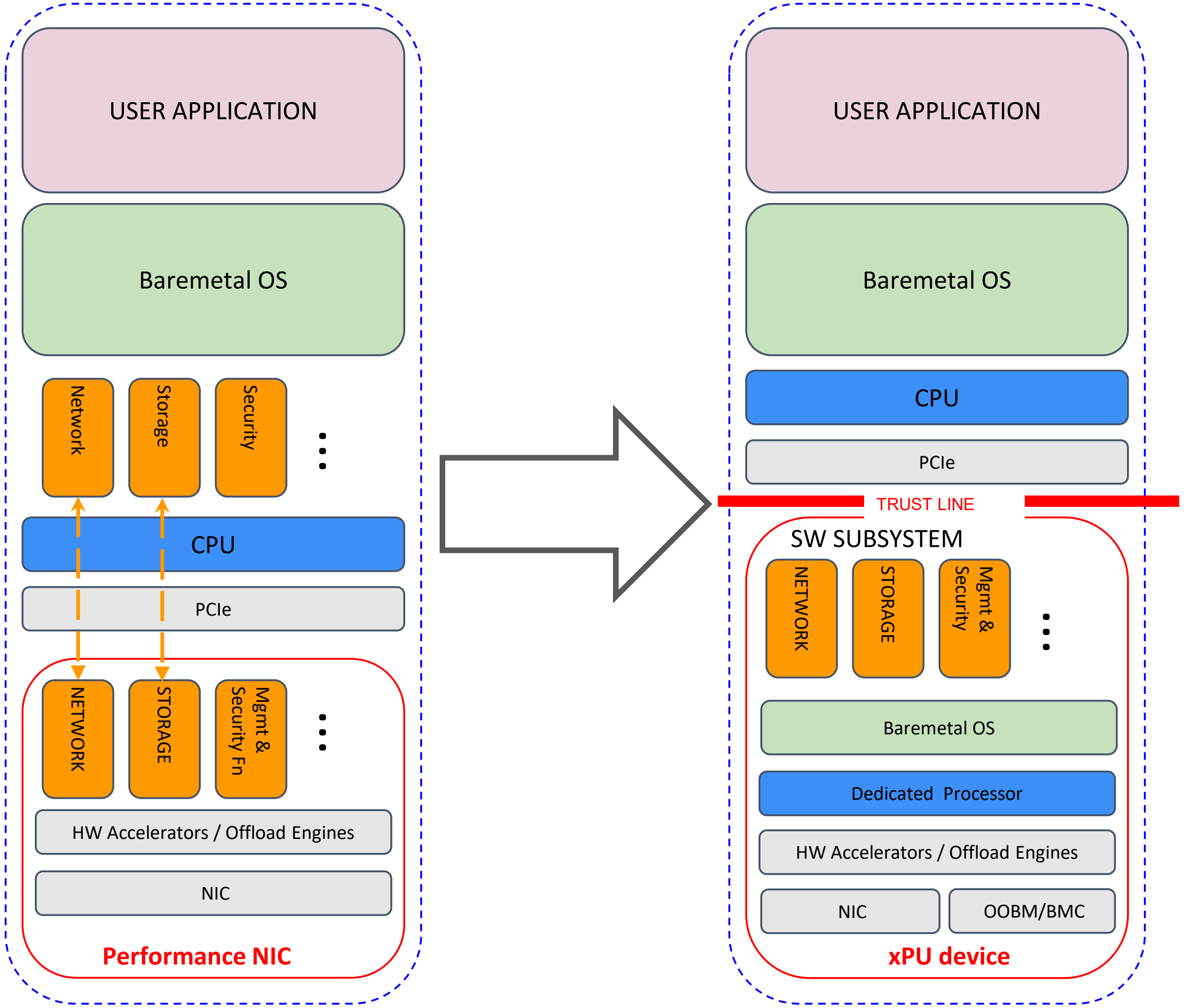
Founding Members listed

Many other companies and individuals participating & contributing

Infrastructure Transformation



Physical server

Physical server

xPU models

- Offload and Accelerate CPU functions
- Security Isolation
- Independent infrastructure endpoint

Project Goals

OPEN PROGRAMMABLE INFRASTRUCTURE PROJECT

Open-Source and Standards for xPU/DPU/IPU Technologies

- Community-driven standards-based **open ecosystem**
- Vendor agnostic framework and architecture
- Define new APIs and Standards where needed
- Reuse already existing APIs and Standards
- Provide implementation examples + Reference Platform

SNIA Dictionary Definition

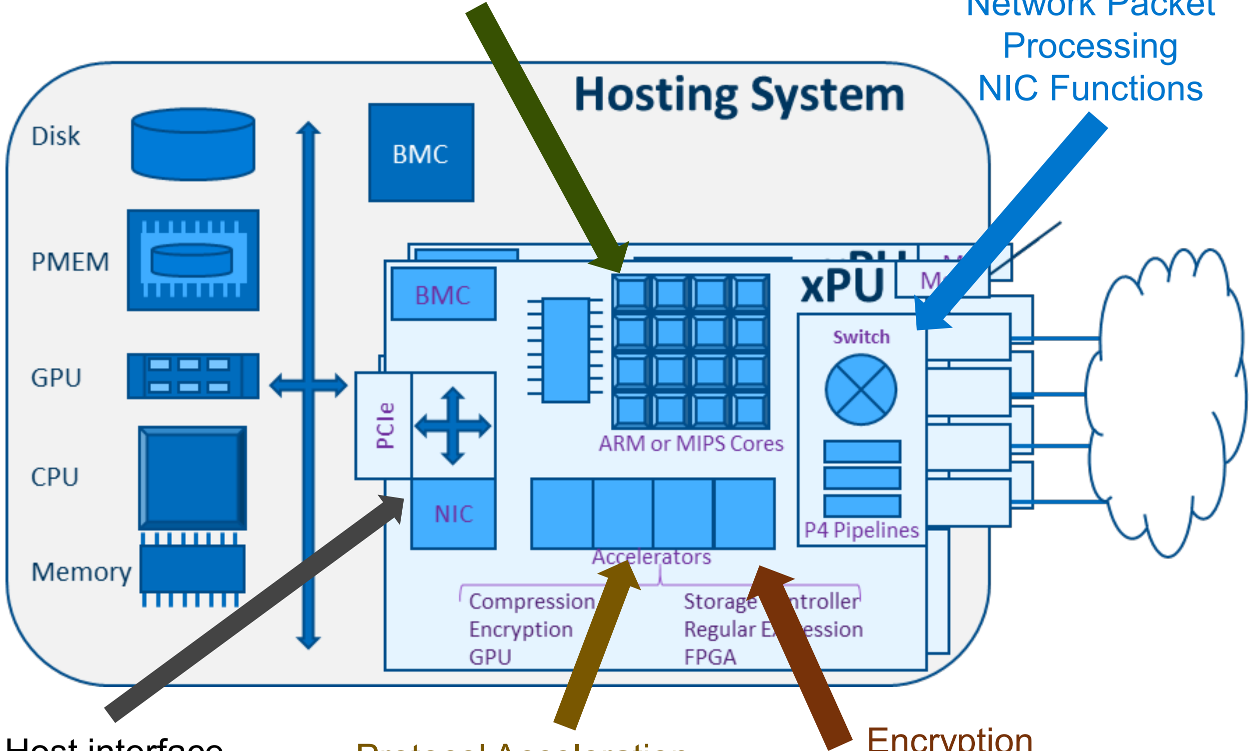
DPU: An accelerator element capable of parsing, processing, and transferring data with performance efficiency.

A Data Processing Unit (DPU) usually has a set of programmable acceleration engines that offload and improve performance for applications such as AI/ML, security, telecommunications, and storage. DPUs may also be called SmartNICs, IPUs or NAPUs.

DPU Definition Expanded

4-32 Cores (ARM)
DRAM &HBM

2-8 Ports
Embedded Switching
Network Packet Processing
NIC Functions



Host interface
SR-IOV

Protocol Acceleration
NVMe-oF, TCP, RoCE
P4 Pipeline
Inline micro-processors
HBM

Encryption
Secure Keys
RegEx
Hashing

DPU - Data Processing Unit (aka xPU)

Effectively a micro-server optimized for dataflow and packet processing providing accelerators, offload engines, & local services

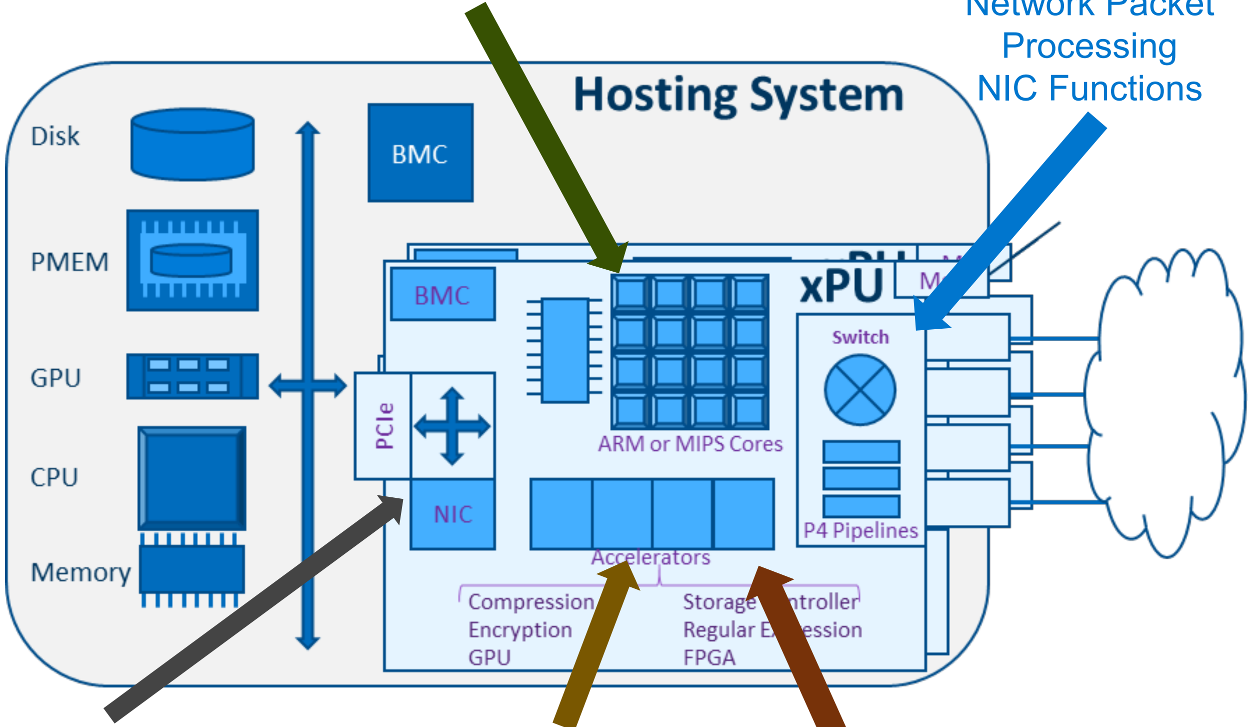
Presents virtual functions to a host (looks like a NIC, GPU, etc)

- DPU Internal Components
  - General Purpose CPU Cores with Memory
  - PCIe Interface with Local Switching
  - Network Interfaces (Data and Management) with Local Switching
  - Accelerators, Offloads Hardware, Programmable Pipelines
  - Embedded BMC
- Server Architecture
  - DPUs typically a built as a PCIe Card (>1 allowed)
  - Other instantiations like switch embedded or standalone possible
  - DPUs present conventional PCIe functions to hosting servers
  - DPUs can directly access PCIe Devices
- DPU Operating System
  - Linux (N flavors, Ubuntu/Debian is common)
  - VMware
  - proprietary
- Common Tool Chains Apply
  - System configuration and management
  - Network configuration and management
- K8s
  - container installation and management

Key characteristics of DPU based architectures

4-32 Cores (ARM)
DRAM &HBM

2-8 Ports
Embedded Switching
Network Packet Processing
NIC Functions



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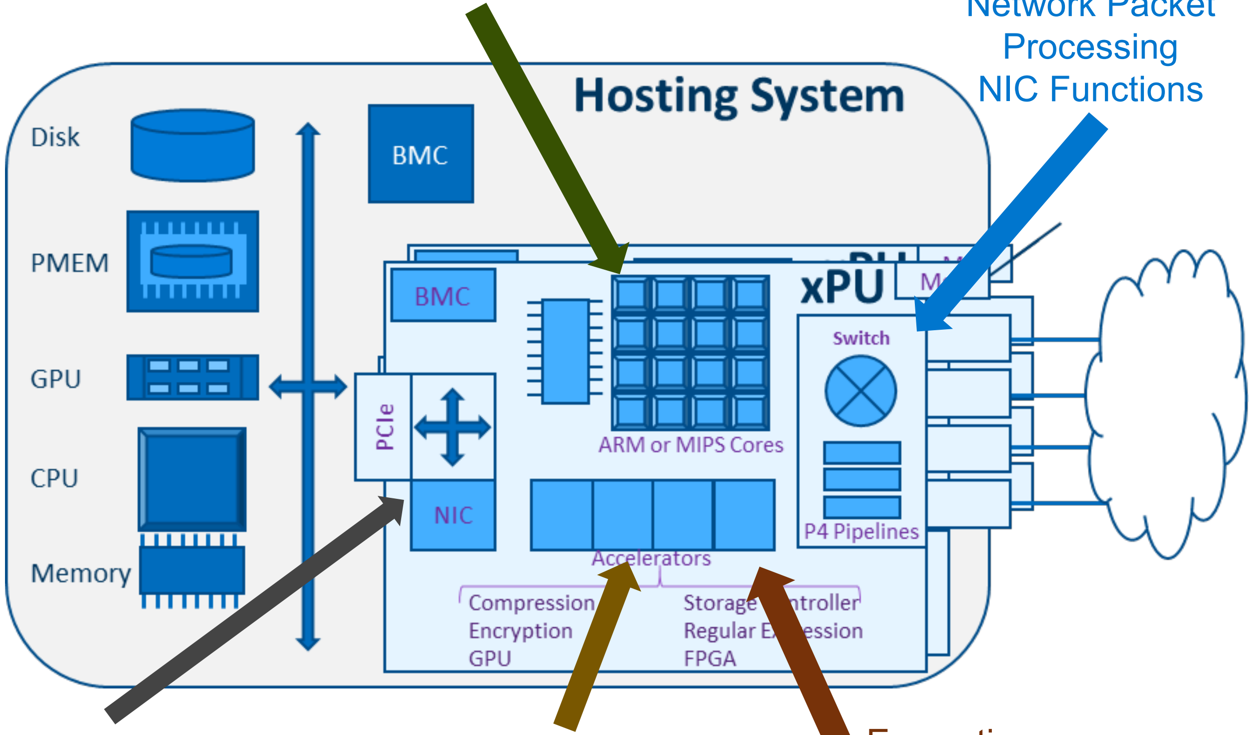
- Capable of booting a general-purpose OS
- Domain-specific HW acceleration capabilities
- Software-defined device functions
  - allow the software components to be flexibly deployed
  - define the device's functions that are presented to the host
  - Offloading complete software subsystems, (eg Networking or Storage stack)
  - Control planes
- Security isolation from the host at the hardware-level
- Unique network identity
- Management
  - Capable of being managed as part of the hosting server (through BMC or hosting OS)
  - Capable of being directly managed (out-of-band) separately from the hosting server
  - Capable of managing the hosting server

DPU Use Cases

4-32 Cores (ARM)
DRAM &HBM

2-8 Ports
Embedded Switching
Network Packet
Processing
NIC Functions



Host interface
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- Common Industry Acceleration & Offload Use Cases
  - Network Switching
  - Network Connectivity
  - Gateway
  - Storage Connectivity including NVMe/TCP, NVMe/RoCE
  - Storage Services
  - Expose Hosting System Resources
  - Security (Firewall, DPI, Key Management, Intrusion Detection/Protection, Host Isolation)
  - Telemetry Collection and Processing
  - Hypervisor
  - CNF/NFV Hosting
  - Provide Accelerators/Co-processing to Hosting system
  - Boot and provisioning

OPI Compliant Devices Minimum Expectations

- Presence of their own general purpose processor
- The ability to boot a general purpose OS
- Domain-specific HW acceleration capabilities
- Software-defined device functions that allow the software components deployed to them to define the device's functions that are presented to the host
- Offloading of whole software subsystems, such as the Networking or Storage stack, including their control planes
- Strict security isolation from the host on the hardware-level
- Unique network identity
- Mangement
  - Capable of being managed as part of the hosting server (through BMC or hosting OS)
  - Capable of being directly managed (out-of-band) separately from the hosting server
  - Capable of managing the hosting server

OPI Scope

Platform

- Device Discovery
- Zero Touch
- Zero Trust
- Inventory
- Lifecycle & Updates

API

- Storage
- Network
- Security
- AI/ML Interface

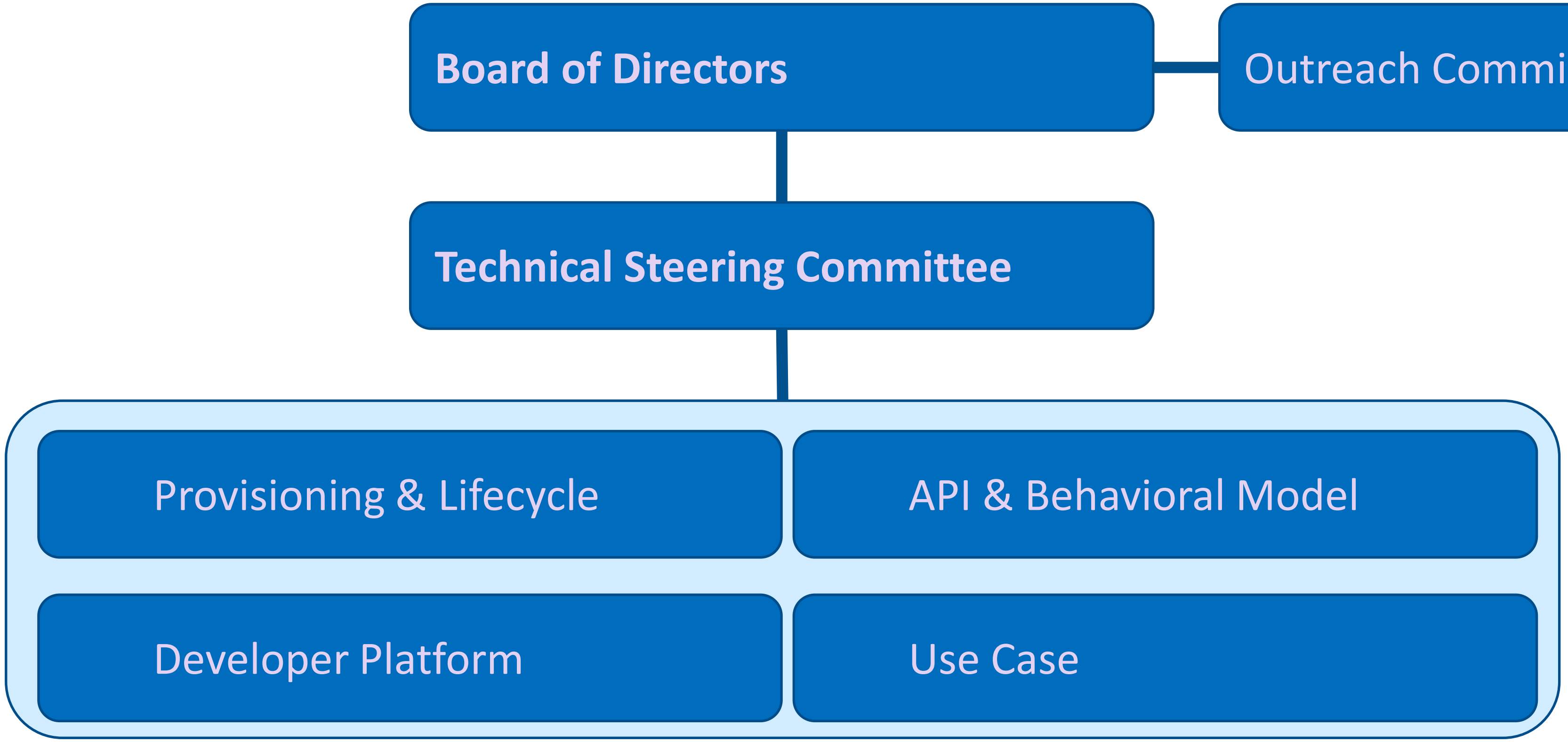
Device Monitoring

- Open Telemetry (OTEL)
- Metrics
- Logs
- Tracing

Developer Platform

- Real devices & emulation
- CI/CD pipeline

OPI Overall Structure

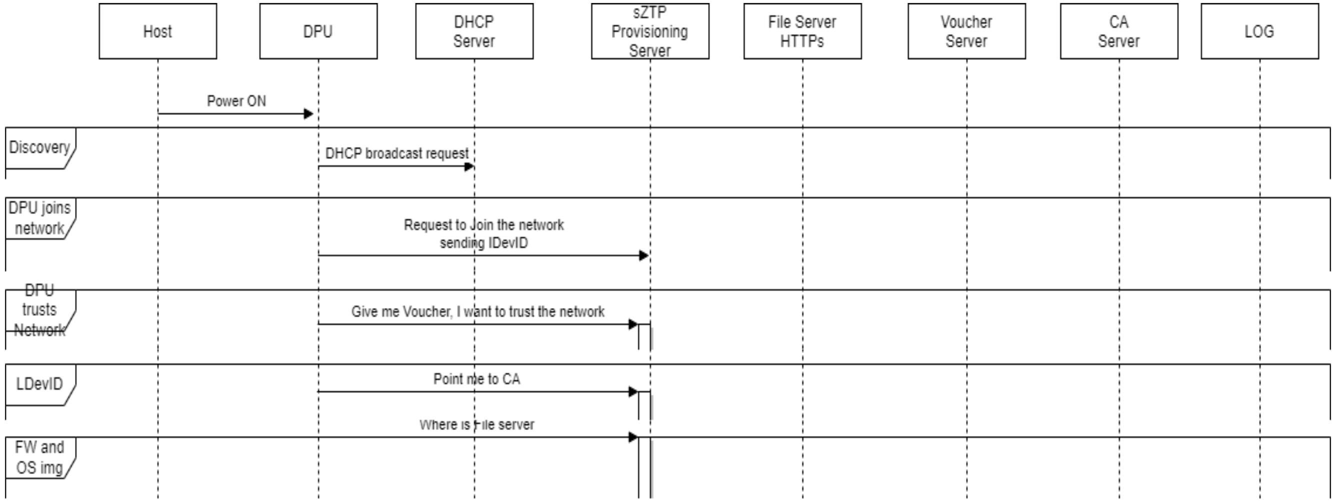


OPI Technical Deliverables

- Open-Source Projects
- Specifications/Standards
- Reference Platforms
- Test Suites & Cases
- POC/Prototypes

Provisioning and Lifecycle Working Group

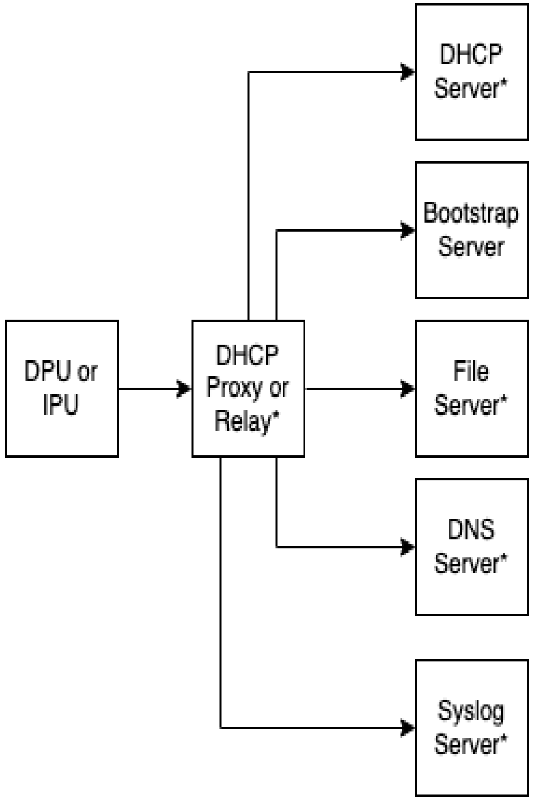
- ❑ Discovery & Provisioning
- ❑ Inventory
- ❑ Boot sequencing
- ❑ Lifecycle & Updates
- ❑ Monitoring & Telemetry



Host
DPU
DHCP Server
sZTP Provisioning Server
File Server HTTPs
Voucher Server
CA Server
LOG
Power ON
Discovery
DHCP broadcast request
DPU joins network
Request to Join the network sending IDevID
DPU trusts Network
Give me Voucher, I want to trust the network
LDevID
Point me to CA
Where is File server
FW and OS img

Device Discovery and Provisioning

- ❑ Security first (mutual trust)
  - ❑ sZTP & FIDO
- ❑ Zero-Touch
  - ❑ Plug & Play
- ❑ Monitoring all the way
  - ❑ OTEL
- ❑ Multiple use cases
  - ❑ Challenges

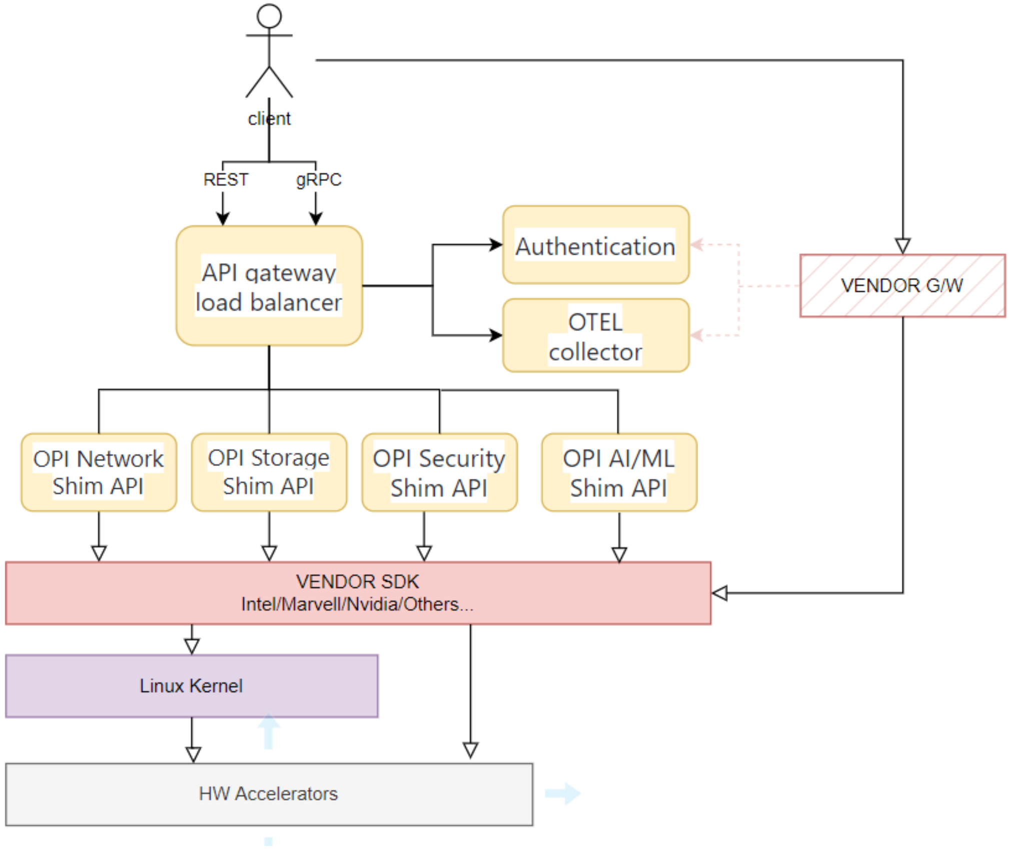


Monitoring & Telemetry via OTEL

- OPI adopted OTEL for xPUs
- Single integration with OTEL instead of with multiple systems
- Supports Traces, Metrics, Logs
- OPI mandates only OTEL Specification
  - Not OTEL SDK, OTEL Collector
- Micro-Aggregator in xPUs, Marco-Aggregator across xPUs
- Common Metrics across xPU vendors

API & Behavioral Model Working Group

- ❑ Object models
- ❑ Host & Management facing APIs
- ❑ Taxonomy for Services
- ❑ Re-use industry standard APIs
- ❑ Reference Orchestration Client



DPU Open APIs

- System
  - Systems Management & Lifecycle
    - (Redfish, BMC, etc.)
  - Monitoring, Metering, & Telemetry
- Operating System (Linux)
  - Standard Linux Libraries and packages
  - Container and Application Hosting
  - Leverage commonly used APIs
    - DPDK, SPDK, EBPF
- Hardware (PCIe…)
  - Virtual Function Mapping
  - Offload Configuration
- Low Level (likely Vendor specific APIs)
  - Micro-Code in Data Flow Processing Cores
  - P4 Packet Processing Pipelines
- Vendor Unique API & SDK
  - *These are NOT common/Open APIs*
  - ASAP2, SNAP

- Storage
  - Networked Storage
    - NVMe/TCP
    - NMVe/RoCE(RDMA)
  - Storage Services
    - RAID/Erasure Coding/etc
  - Compression
  - SDXI Offload

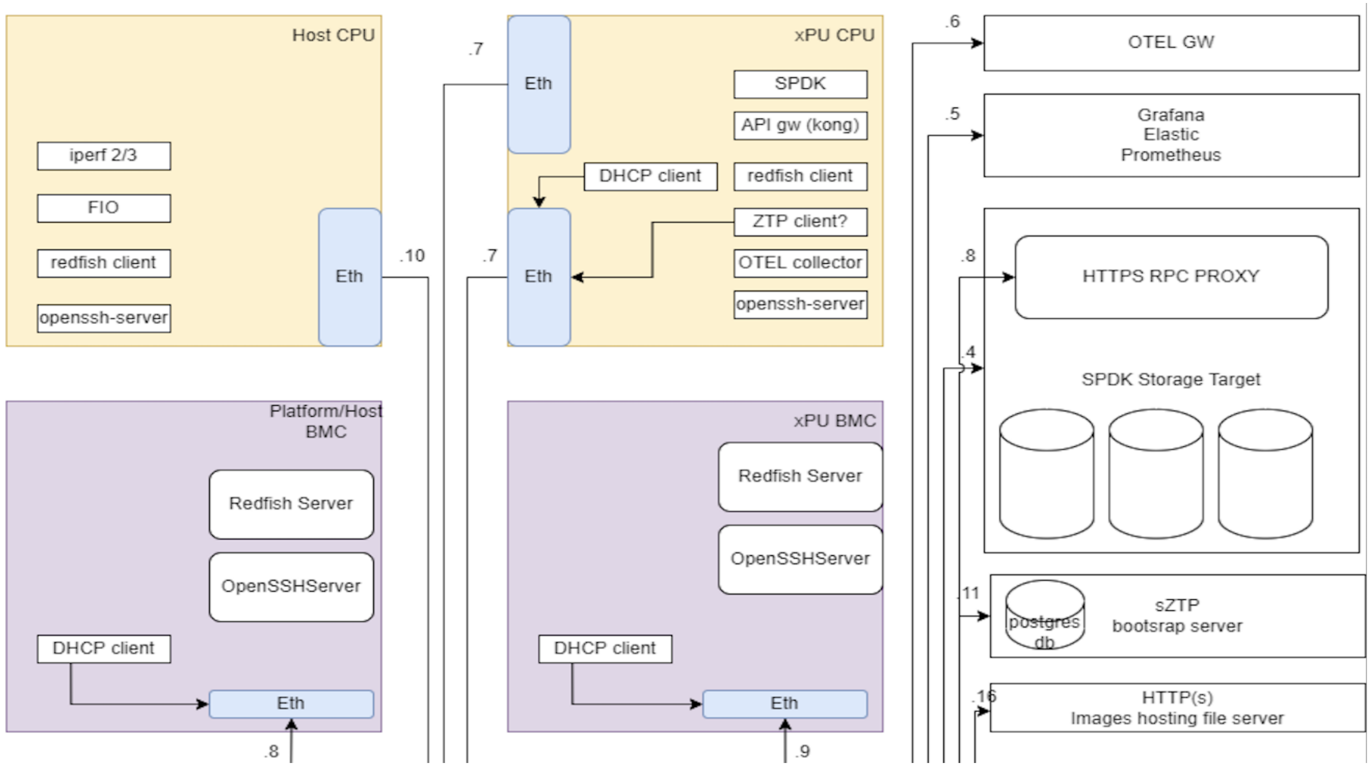
- Gateway
  - Connection Tracking
  - Load Balancing
  - NAT
  - Tunnels

- Networking
  - SONiC
    - OpenConfig (includes BGP, etc)
    - SAI implementation by the DPU
  - Policing and QoS and SLA
  - Multi-tenant Overlay
  - Host facing NIC Configurations
  - OVS

- Security
  - Policy & Filters
  - Crypto Offloads
  - Secure Storage
    - keys, secrets, attestation, …
  - Key Management
  - Network security offload
    - (TLS, IPSec)
  - RegEx matching

Developer Platform Working Group

- Multi-Vendor Lab
  - Considering UNH
- Virtual & Hardware POCs
- Simulation Environment
- CI/CD



Use Cases Working Group

- Initial Use Cases
  - NVMe/PCIe to NVMe/TCP bridge
  - Basic Firewall with rule-based filtering
- General High Interest Areas
  - Storage
  - Security
  - Networking
  - AI/ML

OPEN PROGRAMMABLE INFRASTRUCTURE PROJECT

Key Takeaways and Call to Action

- Industry interest for developing common xPU APIs is strong
  - Customers, xPU Vendors, Software Vendors, Solution Providers
- Immediate Relevance to Storage and Storage Networking
- **Brand new effort so Join Now!**
  - We need input and contributions across the working groups

Join the Project

Anyone can participate and contribute to the OPI Project

1. **To Participate,** check out the OPI Mailing List, and the OPI Slack channels.
   a. Join the subgroup lists and channels in which you would like to participate.
   b. Join the subgroup meetings via the invites found here.
2. **Contribute** by following the steps here on GitHub.
3. **Become a Member** and support the OPI Project at the Linux Foundation link.
   a. Open Programmable Infrastructure would not exist without the support of the member organizations.

Please take a moment to rate this session.

Your feedback is important to us.

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PROJECT