Standardization for a Key-Value Interface underway at SNIA and NVM Express

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What is Key Value

- A mechanism to store user data associated with a key
- Key may be any length (byte granularity)
- Value may be any length (byte granularity)
Differences between KV and Block interface

• **Block**
  - User data is in multiples of block length
  - Logical block address is a number from 0 to max LBA

• **KV**
  - Variable length user data
  - Key is a variable length identifier
Differences between Object and KV interface

**KV**
- Tool to facilitate object storage
- Keys may not be ordered
- Not searchable based on contents of value

**Object**
- Keys are ordered
- More functionality to search objects
  - Does value contain “X”
- Support logging or other mechanisms to maintain database integrity
Key Value SSD layers

Application(s)

KV API

SNIA KV Library

e.g. SNIA KV API

e.g. C Library, Java, etc. Written by vendors, open source, etc.

KV Protocol Host Interface

KV Wire Protocol

e.g. NVMe KV commands

KV Protocol Device Interface

KV Device

e.g. KV SSD
SNIA KV API Status

- Version 1.0 has been approved and is publically available:
  - https://www.snia.org/tech_activities/standards/curr_standards/kvsapi
- Open Source code available:
  - https://github.com/OpenMPDK/KVSSD
- Allows library calls independent of the underlying transport:
  - NVME
  - SCSI
  - SATA
What does the API define?

Structure

- **Structure**
  - **Key Space**
    - Equivalent of Namespace in NVMe
  - **Key Group**
    - Group of keys based on portion of key and mask
  - **Key Value Pair**
    - Unit of user data storage
  - **Device info**
    - Characteristics of device (all key spaces)
  - **Key Space info**
    - Characteristics of specific Key Space
What does the API define?

**Access**

- Access
  - Store
  - Retrieve
  - Delete
  - Delete Group
    - Delete all Key Value pairs in a Key Group
- Exist
- List
- Iterator
Iterator Function

• enables a device to prepare a Key Group of keys for iteration by matching a given bit pattern
• Allows listing/deleting keys/values within the iterator group
NVMe KV work

• Working on a Key Value Command standard
• Relies on other work in NVMe to provide supporting structure for NVMe KV
  • Namespace Types/ Multiple Command sets
• Expect to release later this year
NVMe

Namespace Type

Multiple Command sets

- One Command set per namespace type
- NVM Command set is traditional block storage
- Key Value Command set being defined
- Zoned Namespace Command set being defined
Features of KV Command set

Keys

- Currently Key limited to 16 bytes
- A Key of 4 bytes CANNOT match a Key of 8 bytes even if it is null padded
  
  \[
  \text{AD87 90EF} \\
  <> \\
  0000 0000 \text{AD87 90EF}
  \]

- A Key is of byte granularity
- Future work will extend Key length
Features of KV Command set

- Comparable commands to the API definitions in SNIA
  - Store
    - Key Value pair stored
  - Retrieve
    - Key Value pair retrieved
  - Delete
    - Delete a single Key Value Pair
  - List
    - List in device specific order Keys
      - Start from a specified Key if that Key exists in the device
  - Exist
    - Does a specific Key exist in the device
Future work on NVMe KV

- Extended key length
- Append
- Retrieve (Index)
- Key Group support
- Sorted Keys
- Exist multiple
- Delete multiple
Software/Driver Support

- Samsung has open source code available
  - Currently proprietary
  - SNIA API available in next 2 months
  - Samsung KV API, Kernel driver
    - Public github:
      - [https://github.com/OpenMPDK/KVSSD](https://github.com/OpenMPDK/KVSSD)
    - Kv userspace driver:
      - [https://github.com/OpenMPDK/uNVMe](https://github.com/OpenMPDK/uNVMe)
  - KV Ceph: Ceph object storage designed for Samsung Key-Value SSD
    - [https://github.com/OpenMPDK/KVCeph](https://github.com/OpenMPDK/KVCeph)
Thank You