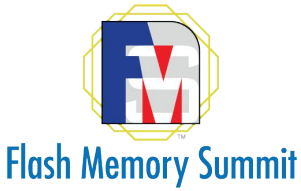
Centralizing Management Challenges on Automotive Storage Using an PCIe/NVMe SSD

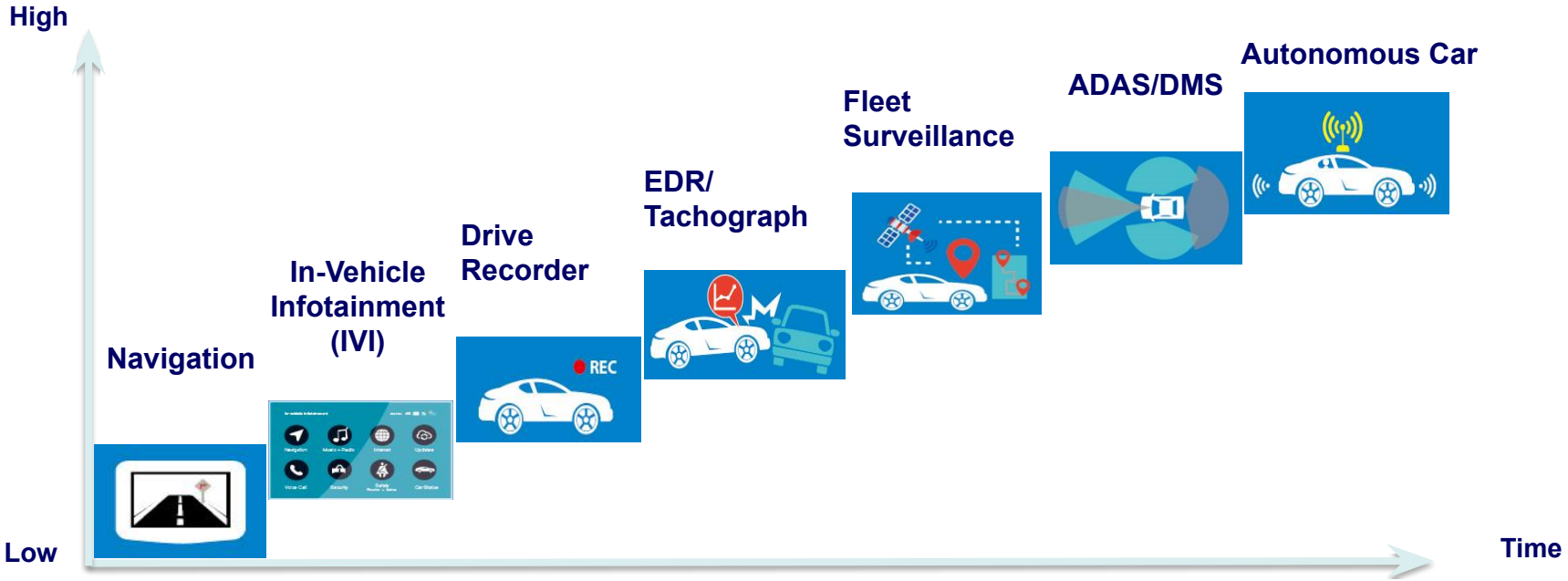
ATP Electronics Inc., Chris Lien



Agenda

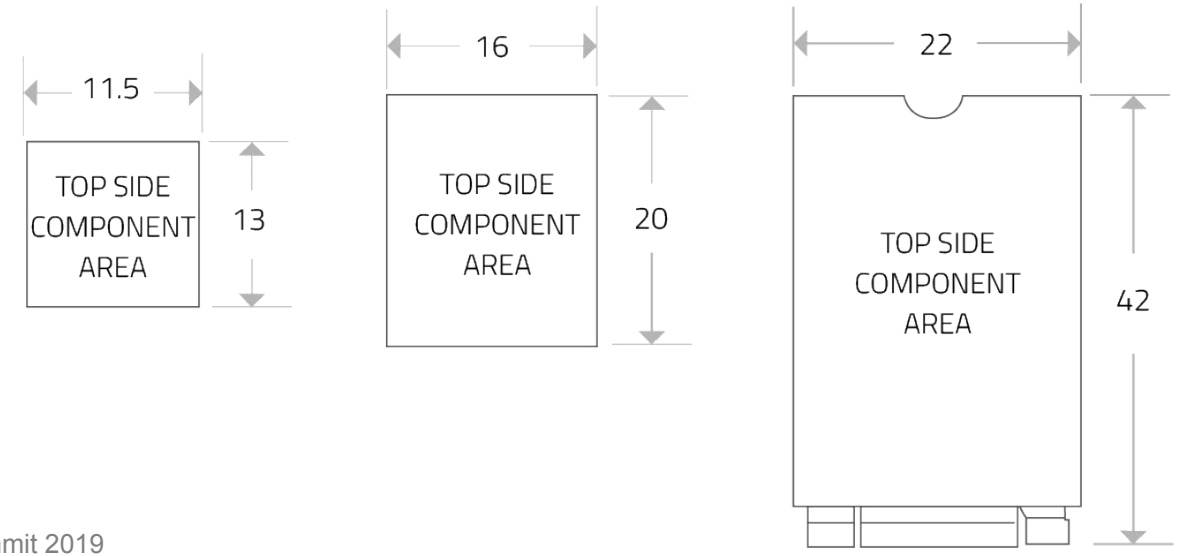
- Evolution of BGA Storages
- Known BGA SSD Advantages
  - Compact size / Vibration-Proof / Performance
- How to utilize and save infrastructure cost by centralizing SSD storage
  - Stream operation, Namespace, SR-IOV
  - Application
- Challenges of Storage Centralization
- Conclusion

Automotive Devices VS. NAND Storage Form Factor



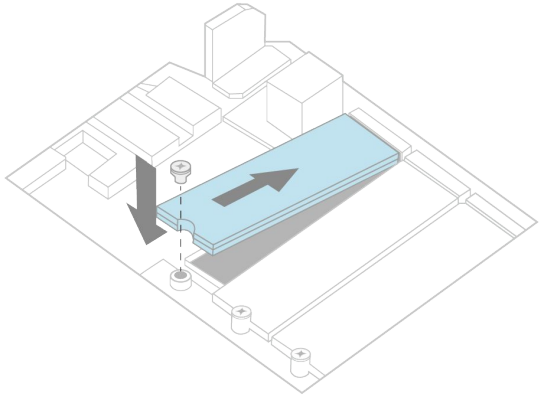
Known Benefits of BGA SSD

- **Compact Size with Big Capacity**
  - M.2-2242: 5X of Type 1113, 3X of Type 1620

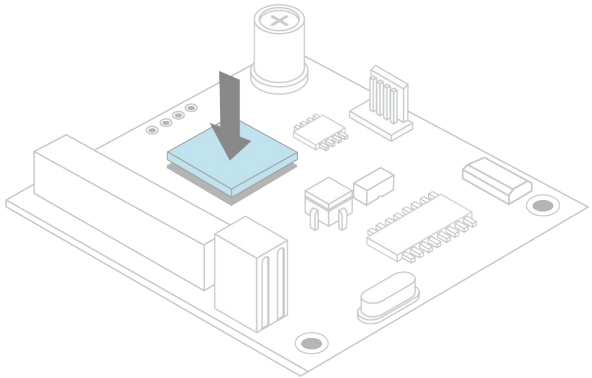


Known Benefits of BGA SSD

- **Vibration-Proof**
  - Directly solder-down to save connector and solid design



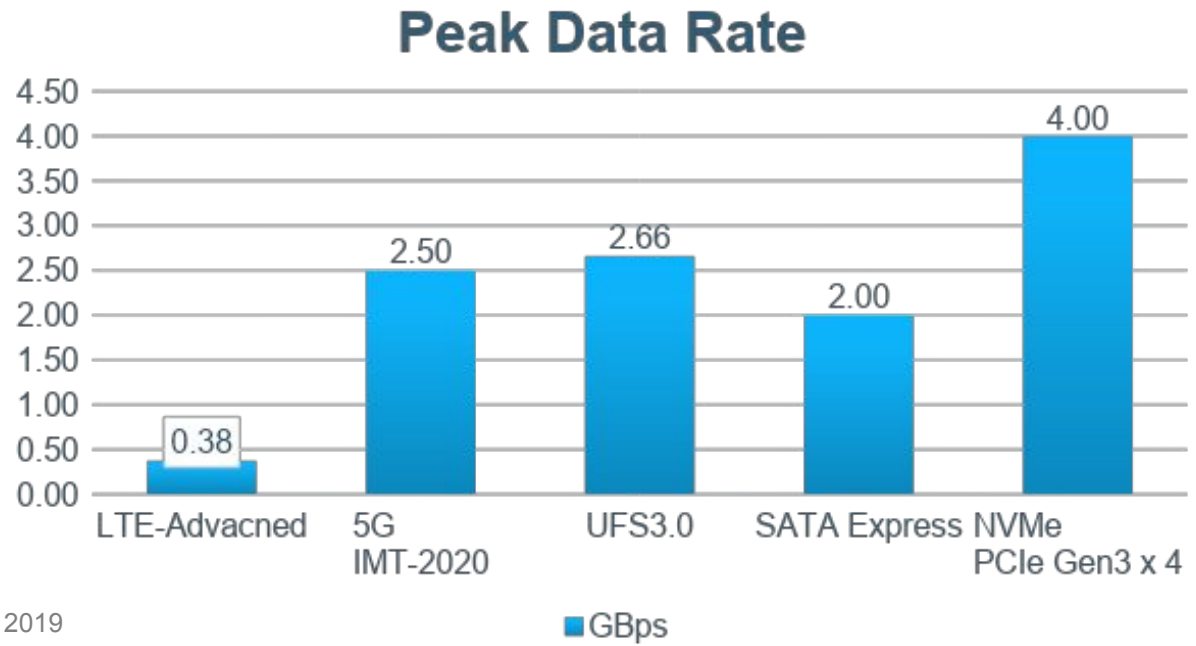
M.2 module



M.2 BGA SSD Solder down

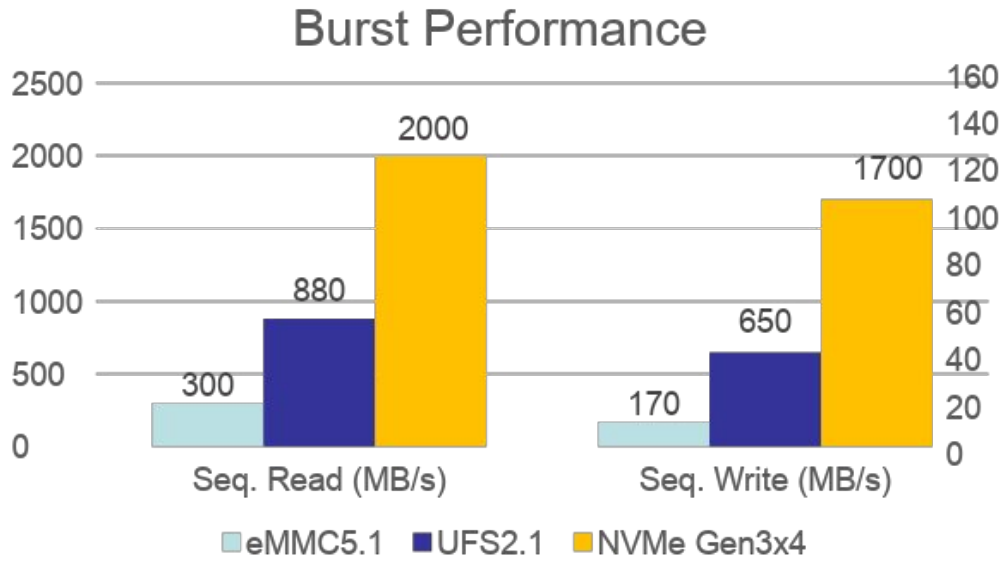
5G-Connected Bandwidth

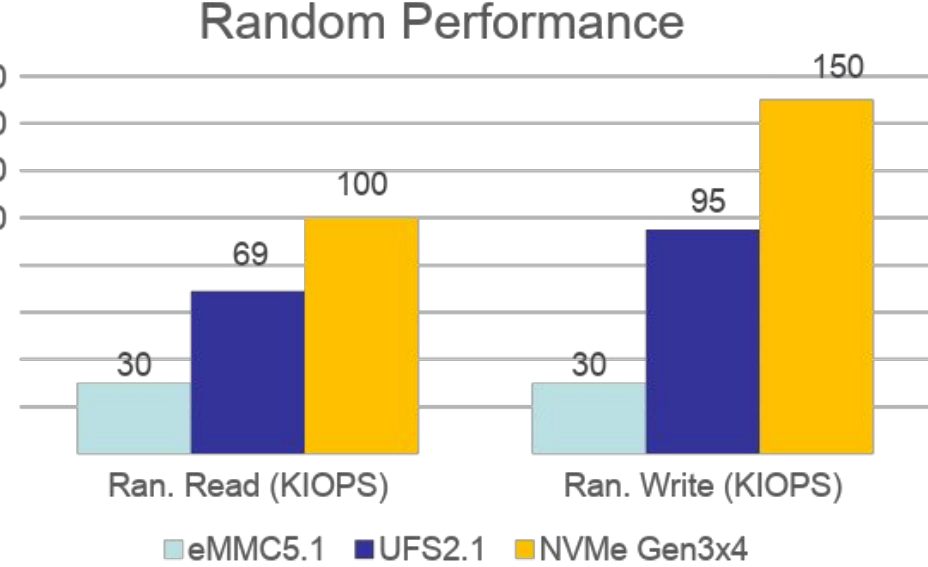
- **Performance comparison (GBps)**



NVMe BGA Gen3x4 vs UFS2.1

- **Real Test Data**

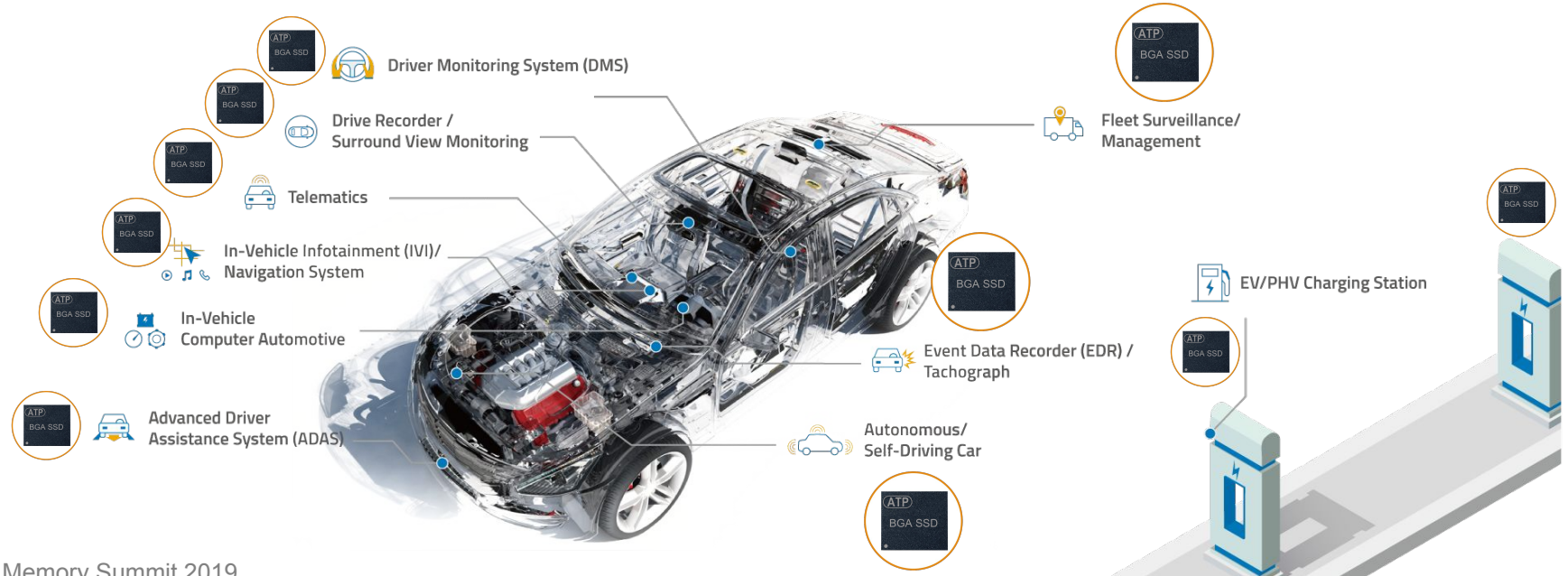




Test under below configuration, which explores max. performance
eMMC – 128GB (1-CH, 8-Die) ; UFS2.1 – 240GB (2-CH, 8-Die); NVMe Gen3x4 – 480GB (4-CH, 16-Die, Non-DRAM)

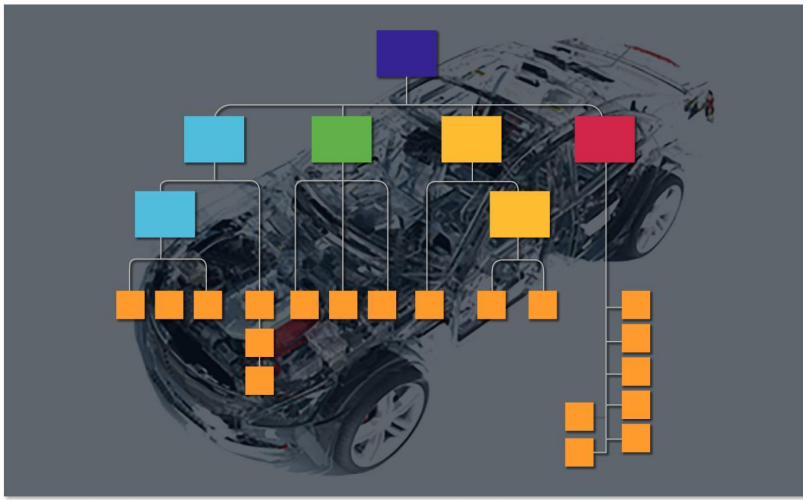
Current Situation of Features Car

- **Storages increased by more electronics and connected data**



Trend to Maximize and Reuse Hardware

- **Same OS + Same Controller, but Different Applications**
  - Bottleneck of Storage on Virtualization & Centralization



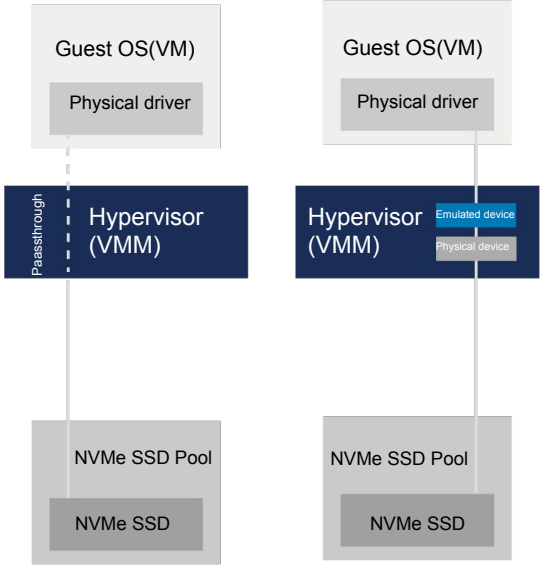
Reference from NXP-S32

- **Fusion: Rader/Camera/Lidar**
- **Powertrain Domain Controller**
  (Motion/Pressure, Speed, Airbag)
- **Body Domain/Infotainment Controller**
  (Smart Light, Access, Door control)
- **Connectivity Domain Controller:**
  (V2X, WiFi/BT/NFC, Smart Car Access)

How can Storage Solution Provider Join This Evolution?

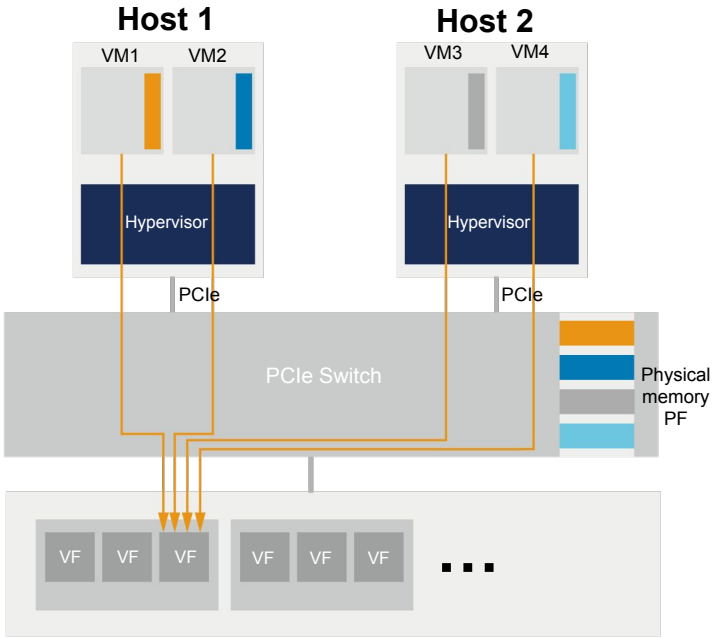
SR-IOV in PCIe-SIG, NVMe v1.3

- **Hypervisor Latency Overhead Reduced**



NVMe without SR-IOV. Passthrough model

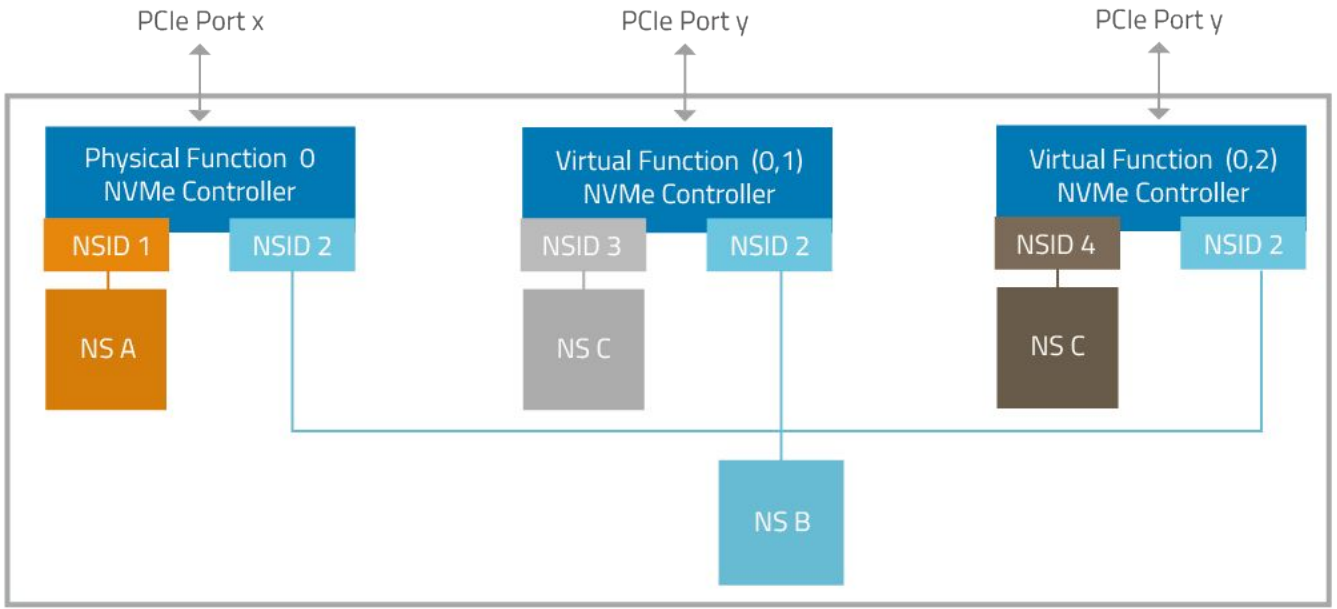
NVMe without SR-IOV. Hypervisor manage VMs to NVMe SSD



NVMe with SR-IOV. VM talk to directly. PF is sit on PCIe switch.

Namespaces + SR-IOV

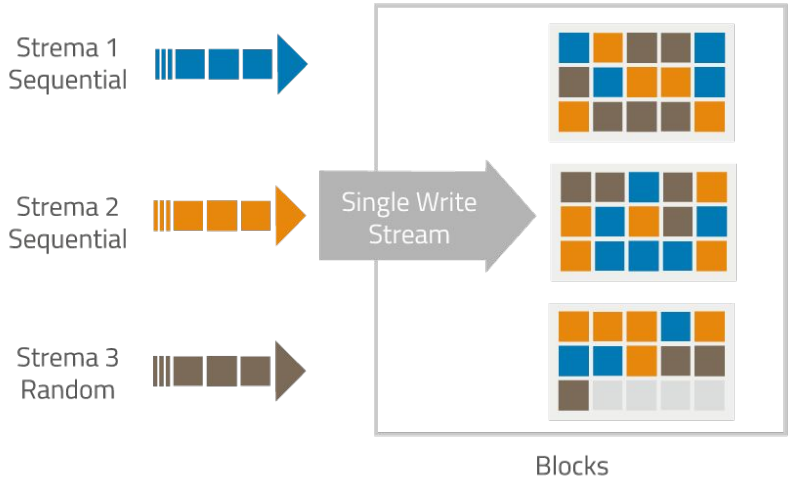
- **One storage directly support virtual I/Os to multiple VFs**



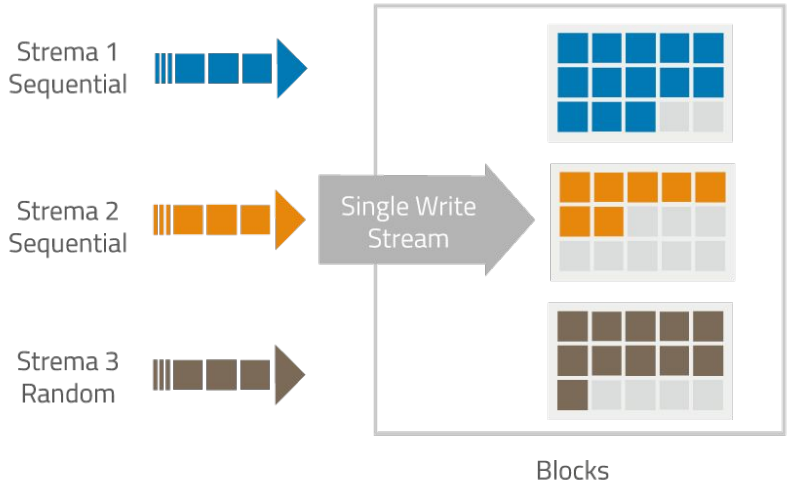
Directive and Stream Operation

- **WAI Efficiency Improved**

SSD with no Stream Separation

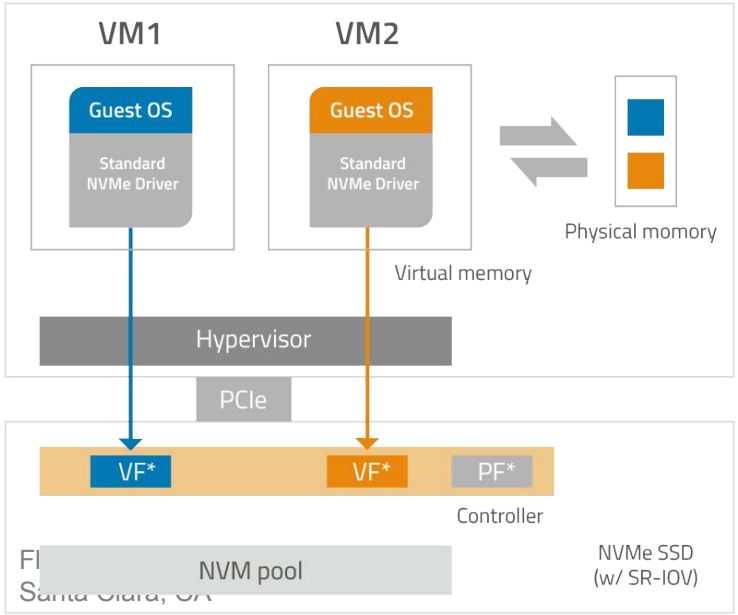


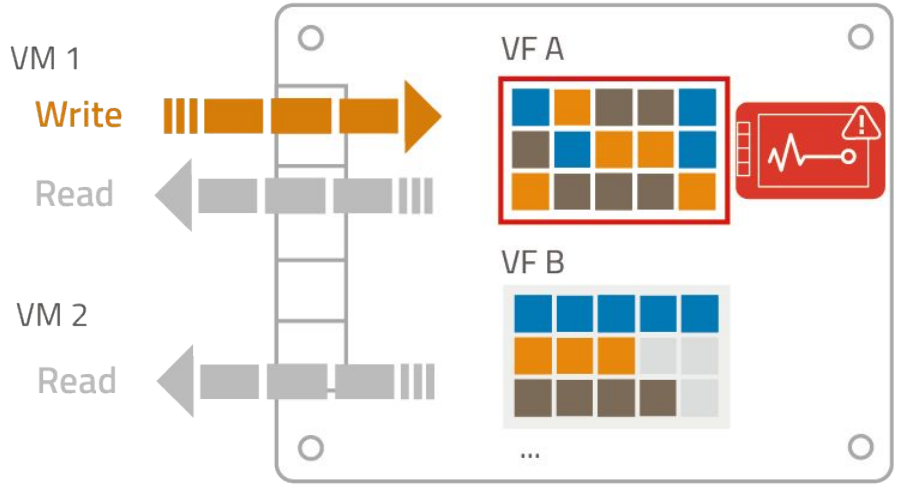
SSD with Stream Separation



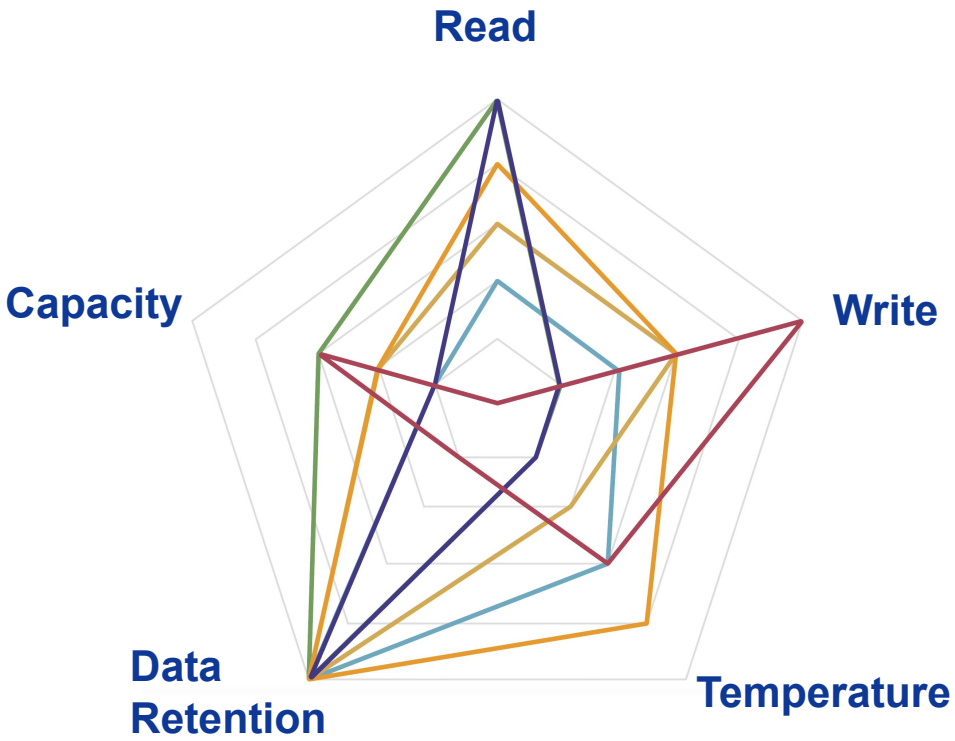
Challenge on SR-IOV with Write intensive applications

- **Write Intensive App Consume TBW Faster. One EOL VF Impact All**





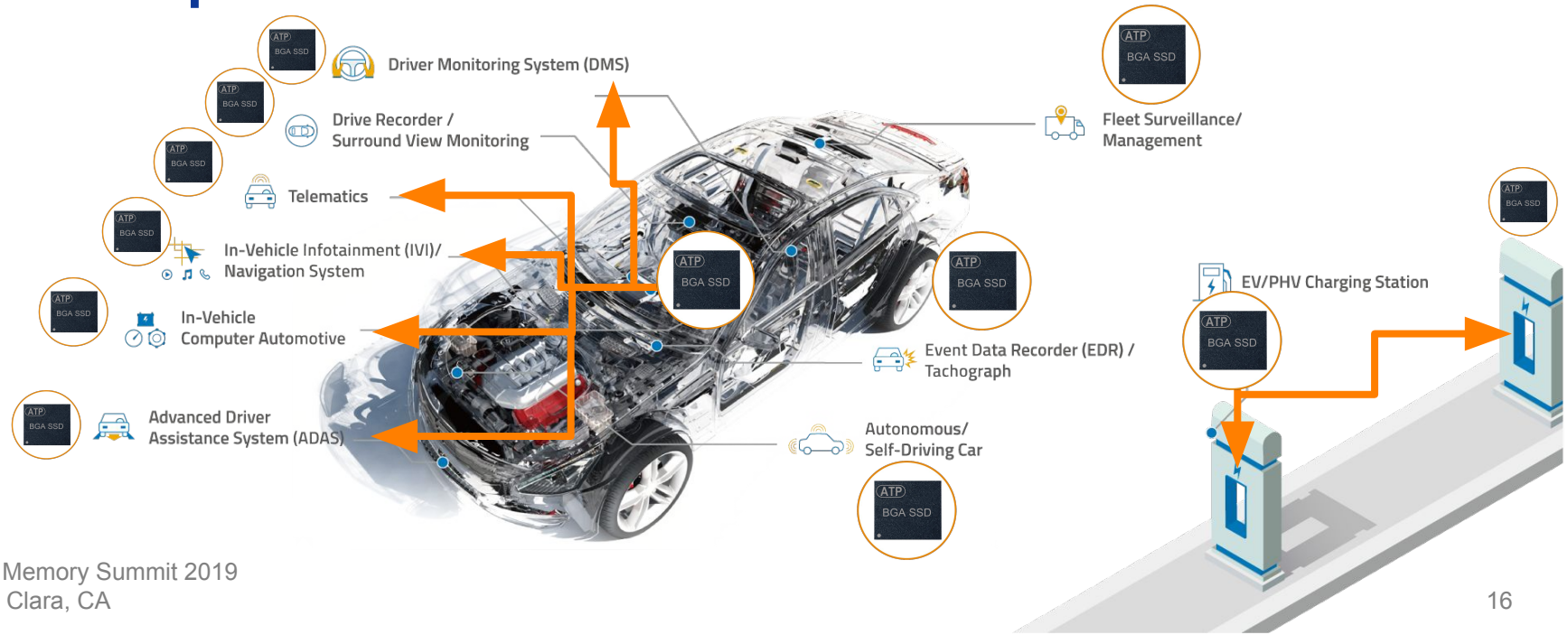
Functional Weight of Head Units



- **DMS:** Driver Monitoring System
- **Driver Recorder /Surround View Monitoring**
  (Better to use single device)
- **Telematics**
- **IVI, Navigation System**
- **In-Vehicle Computer Automotive**
- **ADAS**

Application on Connected Car

- **One Centralized Storage Support Multiple Selected Endpoints**



Challenges of Storage Centralization

- System architecture and management will totally different (like Virtual Machines Management, Security)
- SoC/Platform provider not fully support this centralization on more product lines
- Equal Trust Reliability on Hardware-Based and Software-Based

Keep moving on NVMe BGA

- Compact size with Big Capacity
- Vibration-Proof
- Performance
- Write Intensive: Keep single storage
- Read Intensive: Consider centralization (SR-IOV) to reduce infrastructure cost, space saving
- Easier management in Central Control Panel

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