CES 2021 Download Digital Storage, Memory and other things

Tom Coughlin

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LG's Transparent TV

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Game consoles go solid state

- Both game consoles have optical drives playing Ultra HD Blu-ray discs

- Both game consoles use internal NVMe SSDs.

- PS5 SSD offers 5.5. GB/s while MS Series X offers 2.4 GB/s data rates

- MS Series X offers USB expansion storage while the PS5 does not

VS

Sony PlayStation 5

Microsoft Xbox Series X

USB 3.0 Thumb Drives

- Lots of USB drives out there with different form factors, performance and security features
- Some offering dual interfaces (e.g. USB and lighting)
- These are from Verbatim (CMC Magnetics) and SanDisk

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Kingston Workflow Station

- Kingston introduced its Workflow Station products.

- The Workflow Station and readers (which plug into the workflow station dock) is meant to serve customers such as content creators who need to transfer video, photos and audio from multiple sources at once with USB 3.2 performance.

- The workflow readers can be used standalone connecting to a laptop via a USB-C cable, or plug into the dock.

- These readers provide USB miniHub, SD or microSD reading (UHS-II and UHS-I card) capability.

- The Workflow station works with Windows and Mac OS's

Memory Cards

- A few companies were showing their memory card products including Verbatim and Kingston

- Kinston refreshed its 'Canvas' series memory cards and introduced UHS-II memory cards as Canvas Plus

- UHS-II features high data rates for 4K/8K video capture, android devices, action cameras and drones

M.2 SSDs

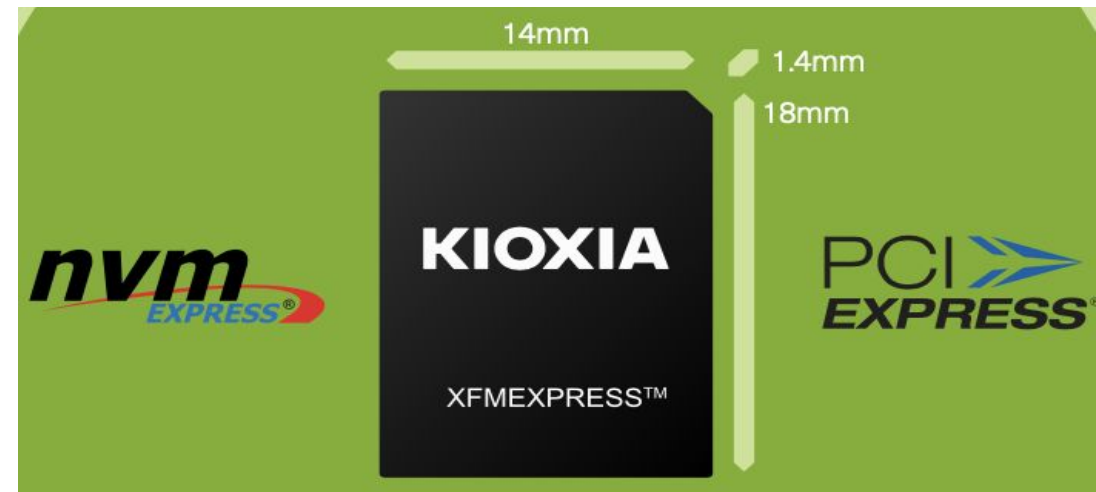Verbatim NVMe M.2 SSD
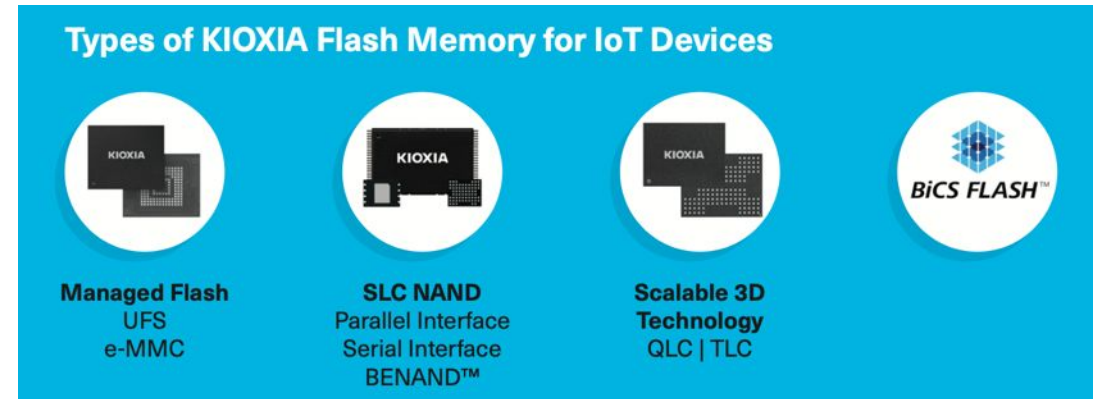

Kioxia PCIe Gen 4 NVMe M.2 SSD

Kingston Gen4 NVME M.2 SSD

- The Verbatim (brand name owned by Taiwanese CMC Magnetics) Vi3000 PCIe Gen 3 X4 NVMe M.2 SSD has read speeds up to 3.0GB/s and write speeds up to 2.9GB/s

- The Kioxia XG7/XG7-P series of consumer SSDs has storage capacities of up to about 4 TB offers 2x the sequential read speed and approximately 1.6x the sequential write speed of the PCIe Gen3 based XG6 Series.

- The upcoming Kingston High-Performance Gen 4.0, 8-channel SSD codenamed "Ghost Tree" is targeting speeds of 7.0GB/s read and write, with capacities ranging from 1TB-4TB.

Kioxia's NAND Flash Products

- Kioxia supplies Managed UFS and e-MMC flash, SLC NAND and scalable 3D QLC and TLC flash memory to many companies for consumer products. The company had an infographic about the role of flash memory in connected IoT devices for consumer, industrial, agricultural and civic applications.

- Kioxia was also showing their XFMXPRESS PCIe/NVMe-based small form factor SSD designed for compact embedded and removable storage. This is a PCIe Gen 3X2 and NVMe 1.3b device with capacities up to a bit over 1 TB. The company said that JEDEC standardization is underway on this device

Types of KIOXIA Flash Memory for IoT Devices

Managed Flash
UFS
e-MMC

SLC NAND
Parallel Interface
Serial Interface
BENAND™

Scalable 3D Technology
QLC | TLC

BiCS FLASH™

14mm
1.4mm
18mm

nvm EXPRESS®

KIOXIA
XFMEXPRESS™

PCI EXPRESS®

Samsung 870 Series Consumer SSDs

Samsung's 870 QVO 2.5-inch FF SSD

- Samsung had a big presence at the 2021 CES with a lot of focus on its C-Labs internal and external product collaborations.

- There was one storage product featured in the Samsung exhibit. It was the 870 EVO/QVO SATA consumer 2.5-inch form factor SSDs.

- The EVO drives use three level cell (TLC) 3D NAND flash, while the QVO SSDs use four (quad) level cell (QLC) 3D NAND flash. The EVO is available with up to 4TB capacity, while the QVO has up to 8TB capacity.

- The company says the 870 series has up to 30% higher sustained write performance, compared to its predecessors. The EVO version has a 5-year limited warranty while the QVO has a 3-year limited warranty.

External Storage

- Kingston's XS2000 external USB 3.2 SSD has capacities from 500GB to 2TB with data transfers up to 2.0 GB/s

- The OWC Envoy Pro FX portable SSD supports up to 2.8GB/s data rates and is dust/drop and waterproof.

- The OWC U2 Shuttle for 3.5" drive bays combines four NCMe M.2 SSDs into a swappable massive capacity flexible RAID ready storage product, supporting RAID 0, 1, 4, 5 or 6 via various RAID utilities.

Kingston XS2000 External USB 3.2 SSD

OWC Envoy Pro FX Thunderbolt 3 (USB-C) External SSD

OWC U2 Shuttle

WDC's 4 for 4

- Although not officially at the 2021 CES Western Digital announced a line of four 4TB portable consumer SSDs during the CES, under the SanDisk brand.

- The SanDisk Extreme Pro Portable SSD offers up to 2 GB/s read and write speeds with a forged aluminum chassis to act as a heatsink to enable higher sustained data rates.

- The SanDisk Extreme Portable SSD offers up to 1.05GB/s read and 1.00GB/s write speeds and features up to two-meter drop protection and IP55 water and dust resistance.

- The WD Black P50 Game SSD offers read speeds up to 2.0 GB/s and is provides storage expansion for PCs, PS4 and Xbox One game libraries.

- The My Passport SSD is shock and vibration resistant and drop resistant up to 6.5 feed and comes in a range of colors with read speeds up to 1.05GB/s and write speeds up to 1.00GB/s.

BIWIN Storage Technology

- At the 2021 CES and at the accompanying Showstoppers, 25-year old China-based Biwin Storage Technology Co., Ltd. talked about the launch of the company's own brand of Biwintech memory and storage products as well as its HP brand consumer storage products, produced and marketed by Biwin, under license.

- The company also said it is making storage used by an established wearable technology company and will probably be announcing a strategic partnership with a top global ICT brand soon
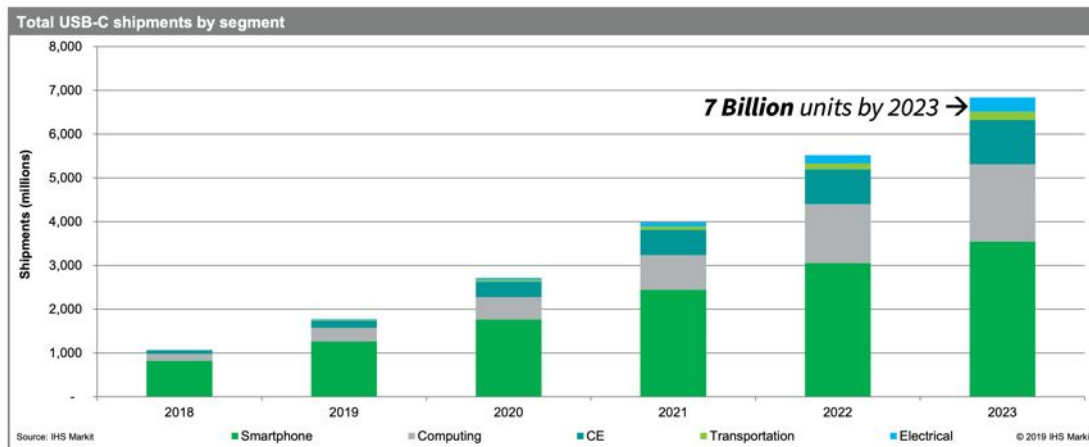
USB4

Brand Name	Packaging Logo	Port & Cable Logo	USB Type-C® Charging Trident Logo
USB4™ 20Gbps	CERTIFIED USB20™ Gbps	(20 ⟶™	(20⟶ ™
USB4™ 40Gbps	CERTIFIED USB40™ Gbps	(40 ⟶™	(40⟶ ™

*Performance indicates maximum aggregate bandwidth

USB Type-C® Global Device Shipments
IHS Report – December 2019

Total USB-C shipments by segment

7 Billion units by 2023 →

Source: IHS Markit | Smartphone | Computing | CE | Transportation | Electrical | © 2019 IHS Markit
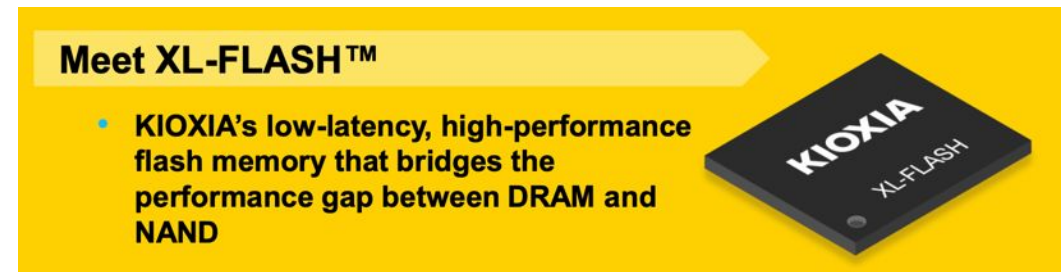
- The USB Implementers Forum was at the 2021 Pepcom event, talking about USB Gen 4 (USB4).

- This was based on the Thunderbolt 4 protocol from Intel. USB4 includes two-lane operation using existing USB Type-C cables and up to 40Gbps operation over 40Gbps certified cables.

- It also supports multiple data and display protocols that effectively share the maximum aggregate bandwidth and backward compatibility with USB 3.2, 2.0 and Thunderbolt 3. USB4 also offers up to 100 W power via USB PD 3.0.

- The Samsung Galaxy S20 series were reported to be the first smartphones to receive certification based on the USB Power Delivery (PD) 3.0 specification.

- The roadmap supports USB performance up to 80Gbps in the future.

Kioxia Enterprise SSDs

- Kioxia was showing enterprise-oriented products as well as consumer products at the 2021 CES.

- These included a PCIe 4.0 Open Compute Platform (OCP) NVMe cloud specification-enabled SSD (E1.S) and its high performance PCIe Gen 5 SSDs (E3.S)

- Kioxia was also promoting the company's low-latency, high-performance flash memory (XL-Flash) that it hopes will offset some use of Intel's Optane memory


E1.S (25mm)
KIOXIA
XD6
Data Center
NVMe SSD
BiCS FLASH
KIOXIA
E3.S
BiCS FLASH
Enterprise NVMe SSD
E3.S

Meet XL-FLASH™
- KIOXIA's low-latency, high-performance flash memory that bridges the performance gap between DRAM and NAND

KIOXIA XL-FLASH

Kioxia Enterprise Software

Meet KumoScale™

- KIOXIA's software delivers disaggregated storage management and native NVMe-oF™ performance at data center scale
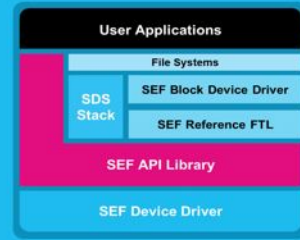
Hardware and Software Working Together
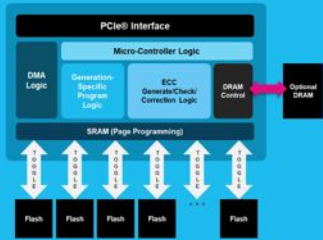
Purpose-built, media-centric flash controller
- Flash Page programming and cell health management
- ECC and defect management
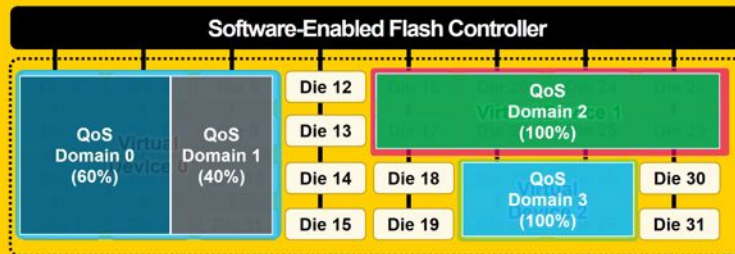- Flexible DRAM configurations (normal, reduced, none)

Open sourced API and libraries
- An Application Programming Interface (API) and library
- Open source Linux® block driver & reference FTL
- Sample source code demonstrates how to use SEF

Tenant Isolation

Flexibility to define both hardware and software regions to isolate Tenants, Workloads, and Streams

Isolation by Flash Die (Virtual Device) — Hardware Isolation
Isolation by Flash Block (QoS Domain) — Software Isolation

- Kioxia announced new additions to its KumoScale software to bring faster NVMe-oF storage to containers.

- Kioxia's Software Enabled Flash (SEF) requires special HW, available in 2nd half of 2021 as well as open source SW. It incorporates the ZNS capabilities

- SEF offers data placement and workload isolation at the flash-die level, multiprotocol capabilities and latency control and optimization through advanced queuing

Quantum R-Series

- The Quantum R-Series in-vehicle storage solution can storing automotive sensor, GPU, cameras and processed data for autonomous vehicle development.

- This rugged compact storage unit running on 12V DC power allows room for other electronic equipment in a development vehicle. The removable magazine includes either 2.5 or 3.5-inch SSDs or HDDs and allows RAID 5 or 6 for data protection.

- Data stored on an R-Series magazine can be uploaded into a StorNext environment using dual 10 GbE ports using the StorNext FlexSync feature to quickly upload content to a shared storage environment.


Quantum.
Mobile Storage

Impressive Storage Capacity

Automated Data-Upload
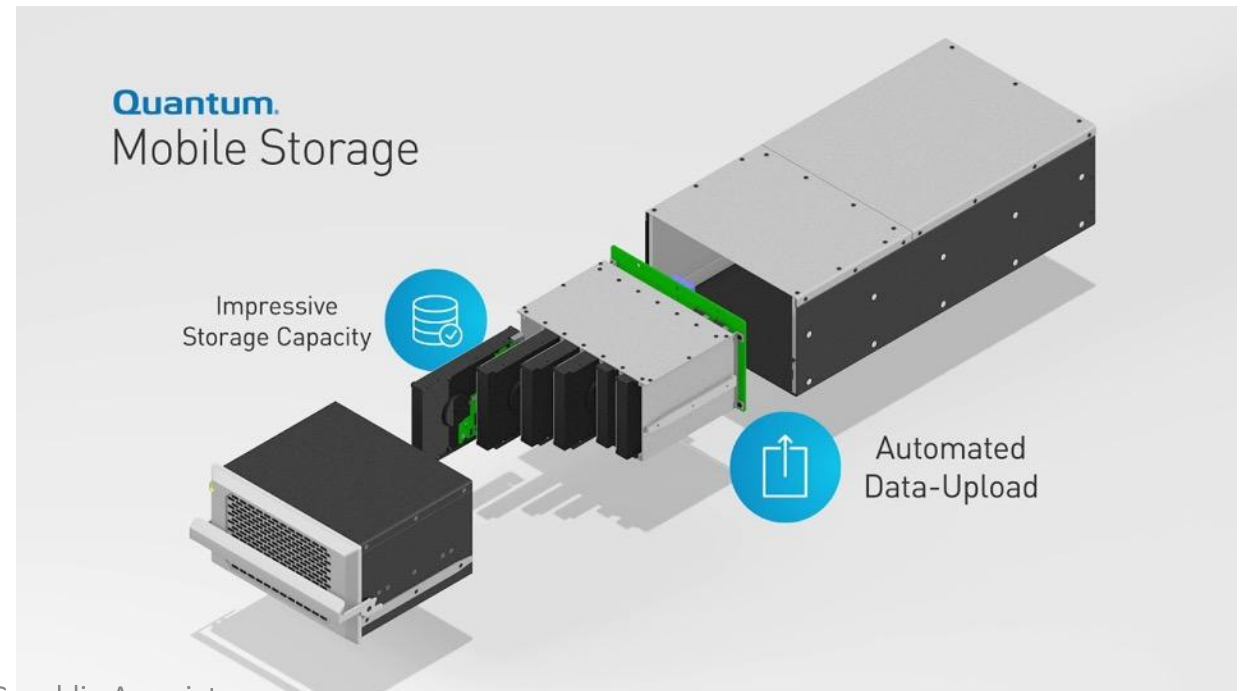
SwissVault and H-L Data Storage

- A European company, called SwissVault was showing its Space Odysee 25TB NVMe SSD storage network server

- H-L Data Storage from Korea was showing an optical drive equipped data hub for multiple input sources for a computer

Space Odysee
Quiet, High Efficiency, Storage Network Server

Features:
- Ultra-compact stackable design
- 25 TB Storage
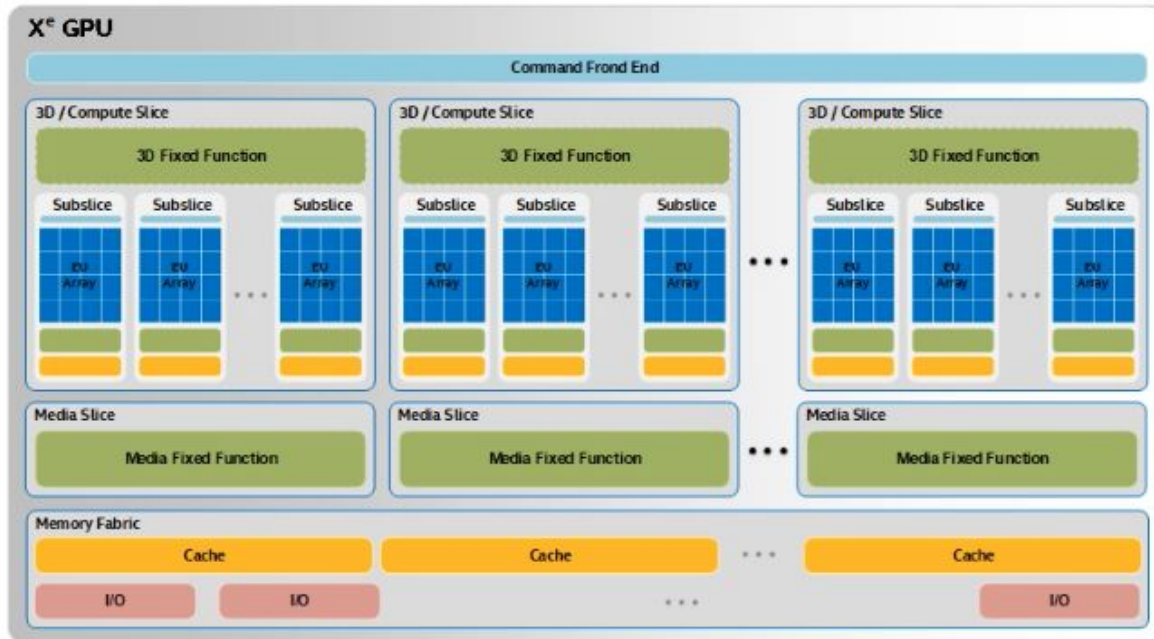- Linux OS
- Supports M.2 NVMe SSD
- Ideal for EDGE applications
- Data backup protection

QUIET OPERATION   2.5 Gbps Ethernet   USB 3.0   intel CELERON inside   STACKABLE   4K ULTRA HD
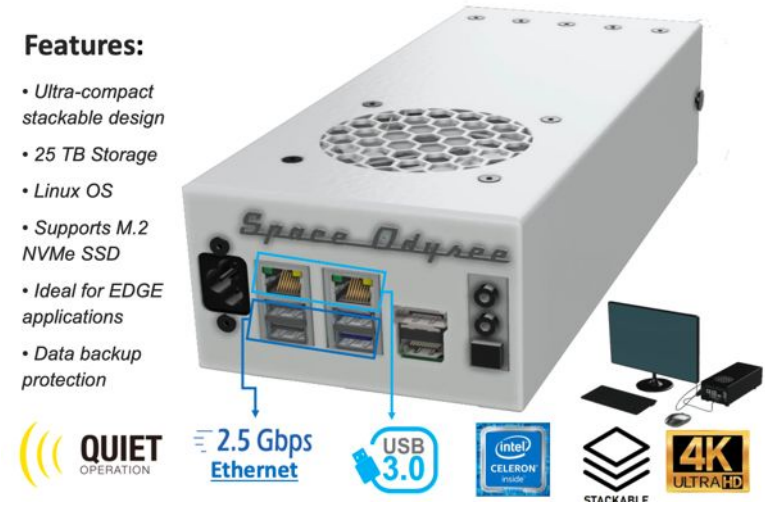
Universal Data Station   UD Station

'UD Station' supports various storage media such as CD, DVD, micro SD card, USB memory, external hard drive and etc.

Volumetric Video

- In a demonstration of this technology the viewer was able to see different content on a screen by moving his head (using face tracking) to render an image reflecting the change in apparent viewpoint of the viewed video objects

- At the 2021 IEEE ICCE conference there was an interesting series of talks from Intel on Next Generation Video Applications on Consumer Integrated and Discrete Client GPUs.

- The Intel graphics architecture used is called X^e and was introduced by Intel in 2020.

- The figure shows the high-level architecture of a X^e GPU including cache shared via a memory fabric and a division of video processing via 3D/Compute slices and media slices.

Volumetric Video (2)

- At Canon's 690 square foot Volumetric Video Studio in Kawasaki, Japan the company used 100 cameras to film, scan and create virtual representations of Japanese skateboarders doing their routines at the Love Park skateboarding field in Philadelphia (which was demolished in 2016).

- The 100 4K cameras simultaneously shot videos at up to 60fps and was able to record up to 10 people simultaneously.

- The videos from the cameras were then processed and combined together to create a 3D representation of the skateboarders.

- The enabled video playback from any possible (and even very incredible) camera angles and any path, with a latency of only three seconds.

- Using a green-screen backdrop, that footage can be rendered with any backdrop of location, such as Love Park.
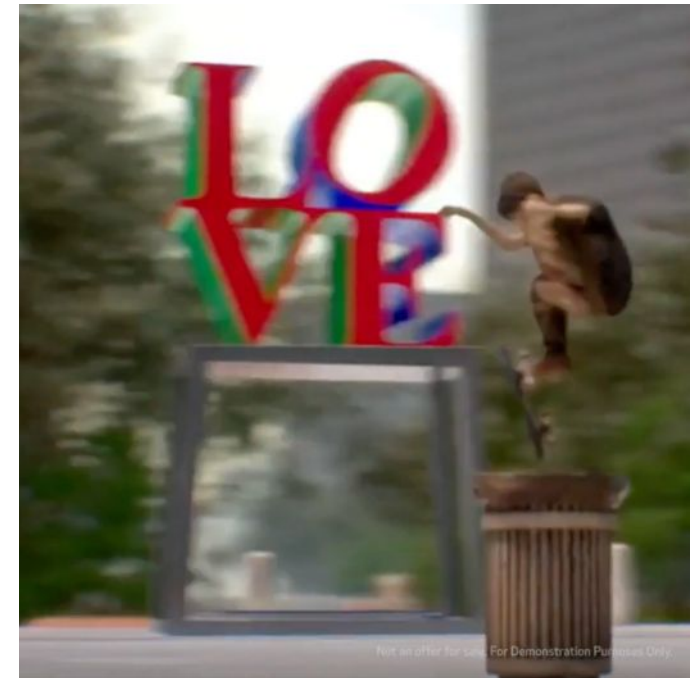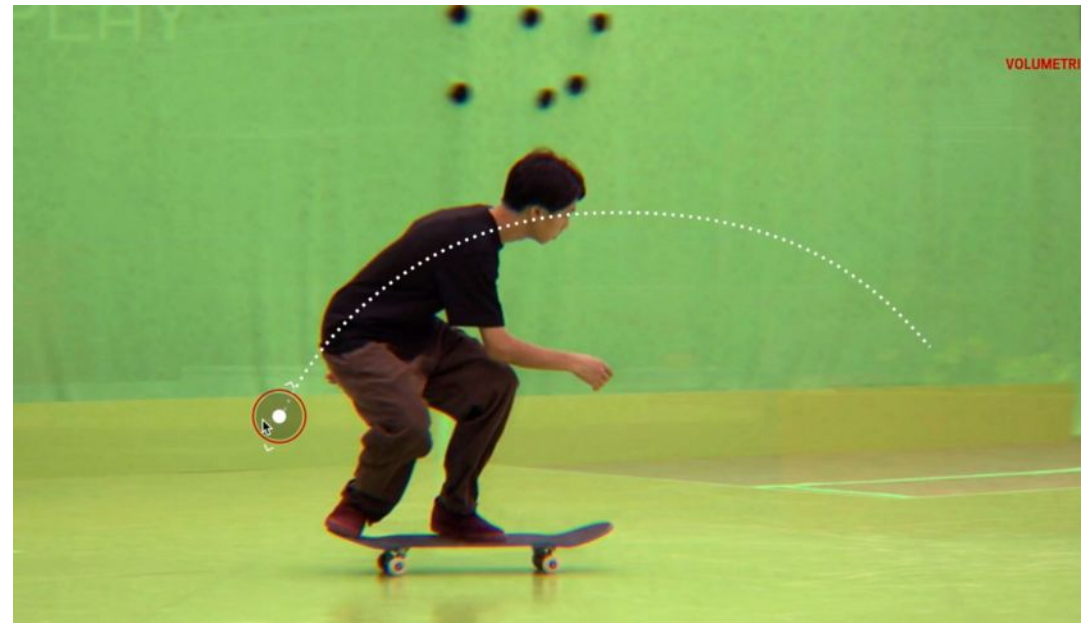
Holograms and Transparent TVs

A full-circle viewing 3D hologram

Full-circle viewing 3D holographic display

- Other developments showing more immersive content including floating holographic projections from ETRI in Korea.

- LG was showing a transparent OLED TV that slid down into a piece of furniture when not in use

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Why Emerging Persistent Memories are Necessary in Embedded Devices

- Flash can't scale with process advances
  - NAND flash went 3D at 15nm
    - 3D is not cost-effective in a CMOS logic process
  - NOR scaling stops with FinFET
    - 28nm & smaller processes need something new
  - SRAM embedded scaling may stop at 14nm
- DRAM consumes lots of power with refreshes
- Standalone PM applications are growing
- Low power high density memory needed for embedded applications

Emerging Non-Volatile Memories

- There is intense effort to commercialize several non-volatile memories that could replace current volatile memories, such as DRAM and SRAM

- These technologies can be applied to stand along memory chips as well as in embedded memory

- This could reduce energy expenditure in battery and low power devices and also create more efficient data centers

- These NV memories will enable both IoT devices as well as data centers at the edge or in the cloud

- The memory technologies under consideration include magnetic random access memory (MRAM), resistive RAM (RRAM or ReRAM), phase change RAM (PRAM) and ferroelectric RAM (FRAM or FeRAM)

# Embedded MRAM
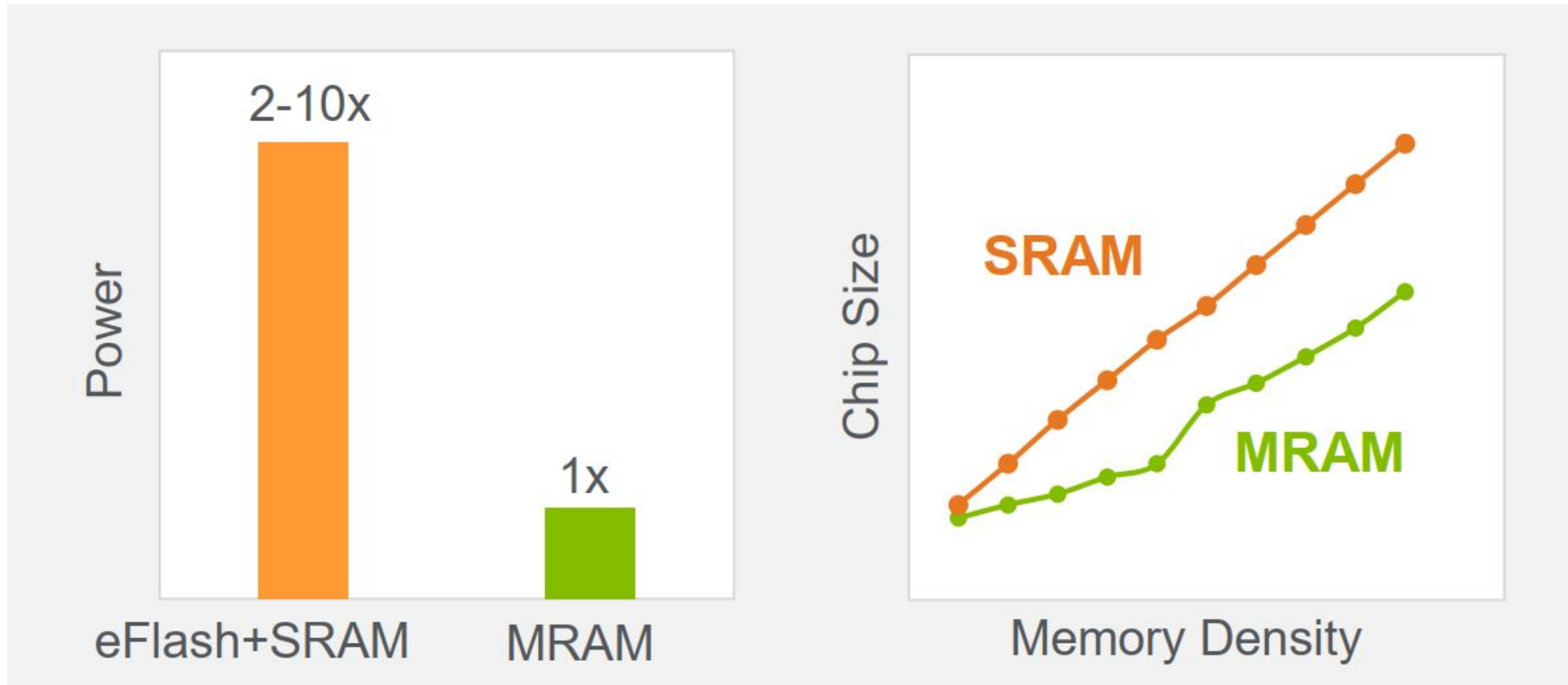
Source: AMAT, 2019

Embedded Devices Will Prime the Pump
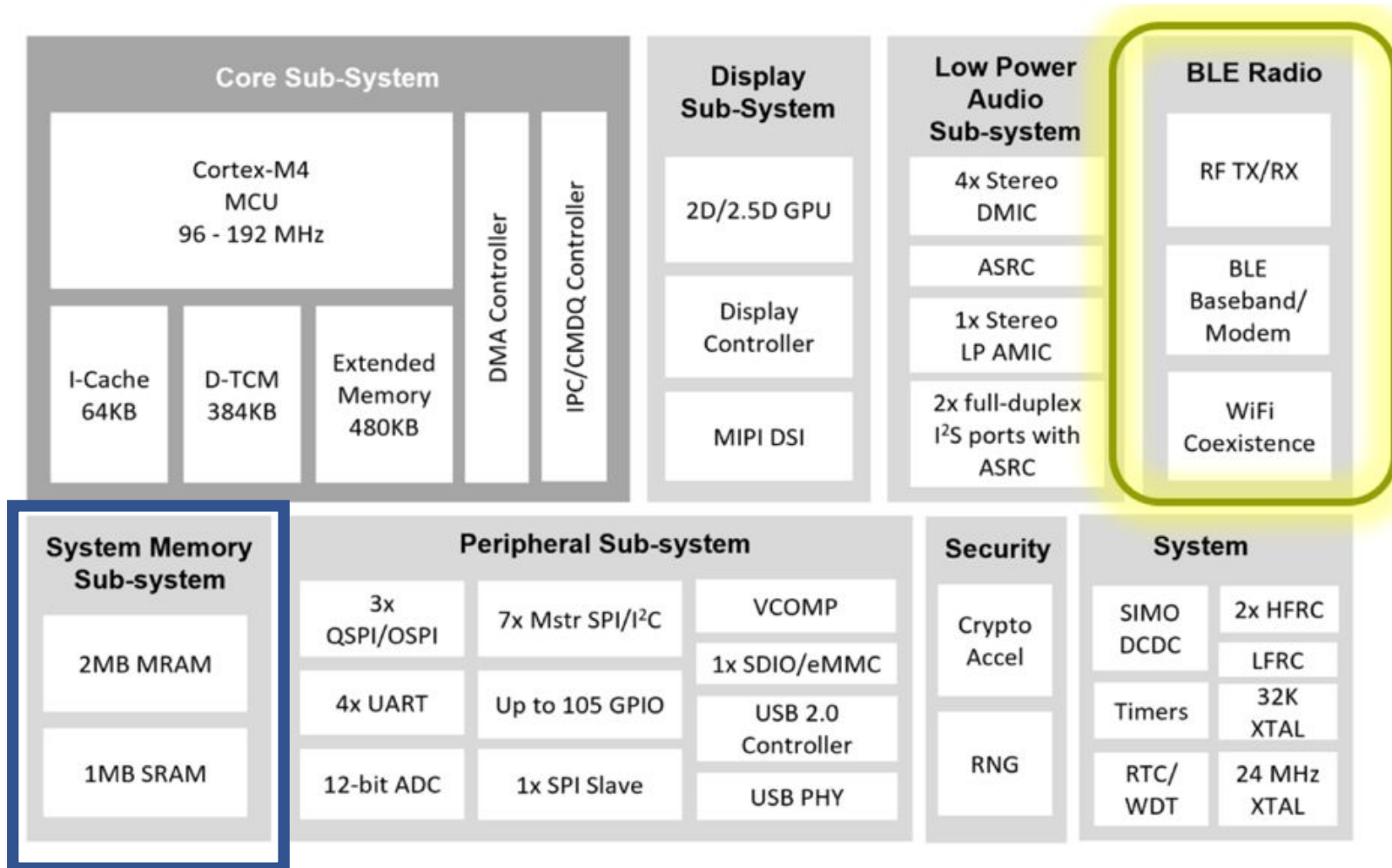
- Ambiq 4th generation Apollo SoC for ultra-low power intelligent endpoint IoT devices
- Note the use of 2 MB MRAM memory
- The Apollo4 serves as both an application processor and a coprocessor for battery-powered endpoint devices

Numen MRAM DNN Accelerator Chip

- Used by NASA for distributed computing for space

- MRAM is radiation hard, high endurance and its non-volatility reduces energy requirements

- 1-32 processing engines, 32-1024 ALUs per chip

- Efficient processing for matrix multiplication, convolution, etc.
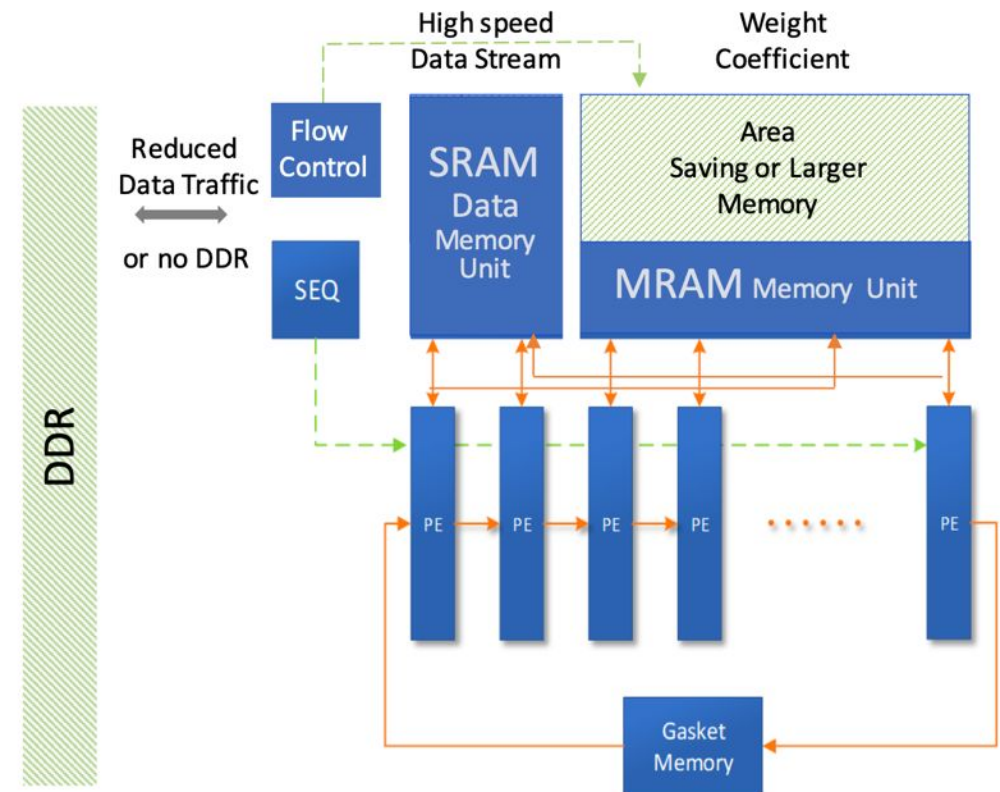
Representative Neural Network Applications

Function	Application	Algorithm
Sensor Fusion	Super Resolution	MSG-Net, MS-Net
Terrain Mapping	Depth Mapping, Terrain Classification	SPOC, VGG16
Navigation/ Guidance	Object Detection, Tracking	YOLO, REQ-YOLO, GOTURN, ORB-SLAM

ST Micro PCM in MCU

ST Automotive MCU Embedded Memory

ST: long history of Automotive Embedded memories
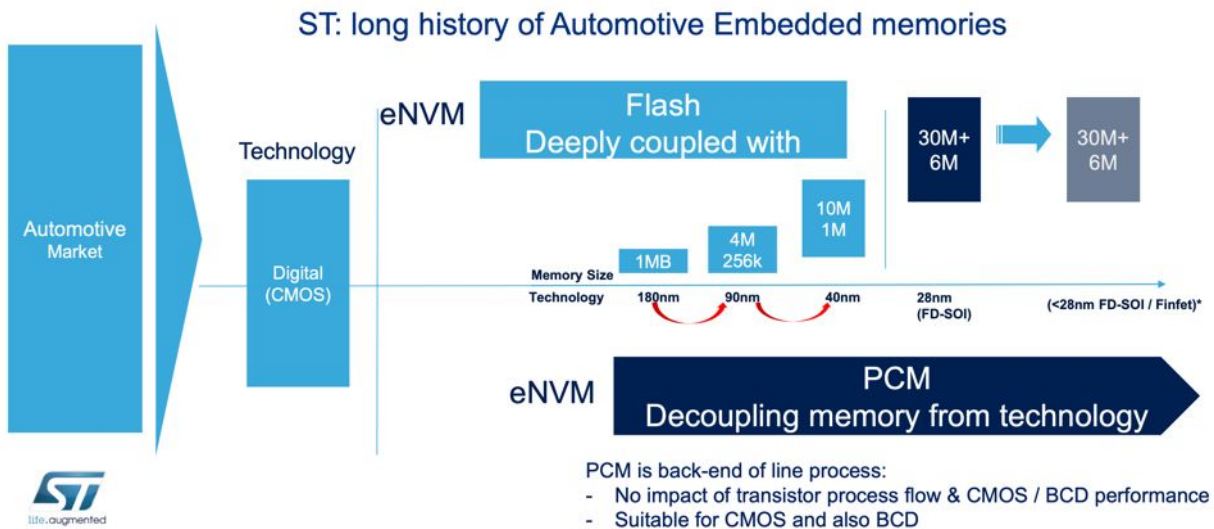
Major applications for Stellar MCUs include smart control for hybrid powertrain, the broad electrification of car systems with on-board chargers, battery-management systems and DC-DC controllers, as well as smart gateways, advanced driver assistance systems (ADAS) and enhanced vehicle stability controls.

- ST Micro has introduced phase change memory into its Steller 32-bit automotive microcontroller units (MCU's), allowing higher density memory than is possible with NOR flash eNVM

- These chips include multiple Arm Cortex-R52 cores

- The Stellar family of automotive MCUs support next-generation car architectures, which rely on broad "domain controllers" that enable the transition toward software- and data-oriented architectures by providing data fusion from connected sensors while reducing harness complexity and electronic-component weight.

TSMC announcements in 2020

New eNVMs: RRAM and MRAM

- 40/22RRAM ready for production
  - eFlash alternative for IoT and smartcard
  - Extends to support 10yrs retention @ 125C after 10K cycles
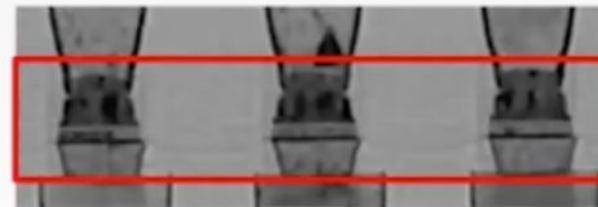 - Multiple customers T/O in 2H20

RRAM

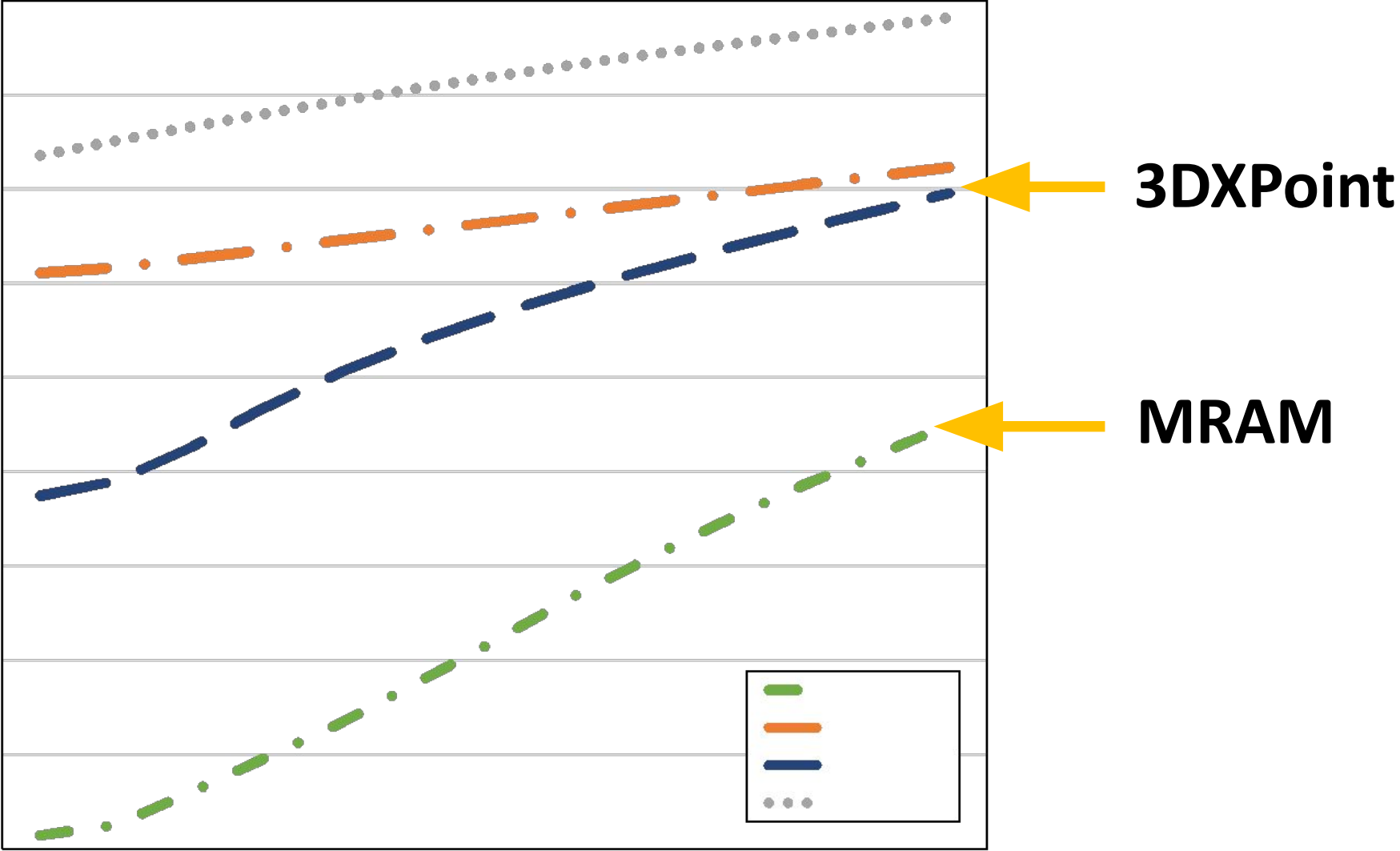Change the resistance of the memory cell with conductive filament connected or disconnected

- 22MRAM ready for production; automotive qualification in 4Q20
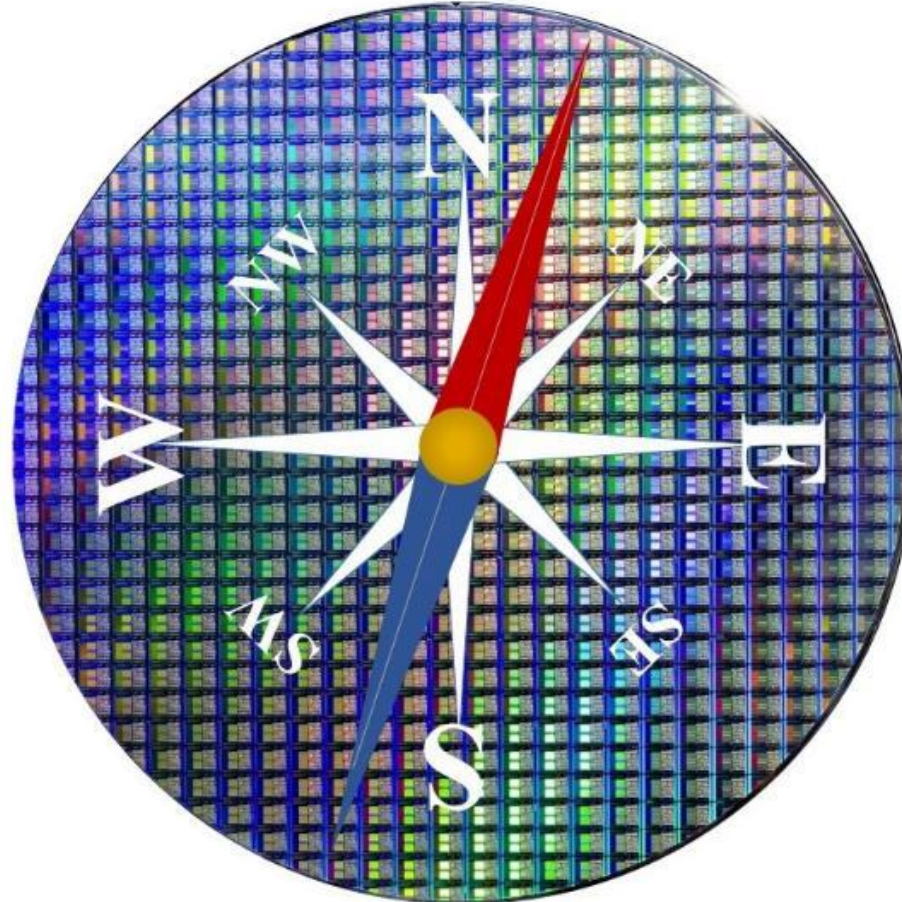- 16MRAM targets risk production for eFlash-like in 4Q21, and RAM-like in 4Q22

MRAM

Change the resistance of the memory cell by altering magnetic field direction

Growth in New Memory Shipments

Report: Emerging Memories Find Their Direction

Now Available!

http://www.tomcoughlin.com/techpapers.htm
https://Objective-Analysis.com/reports/#Emerging

Thanks

https://tomcoughlin.com