

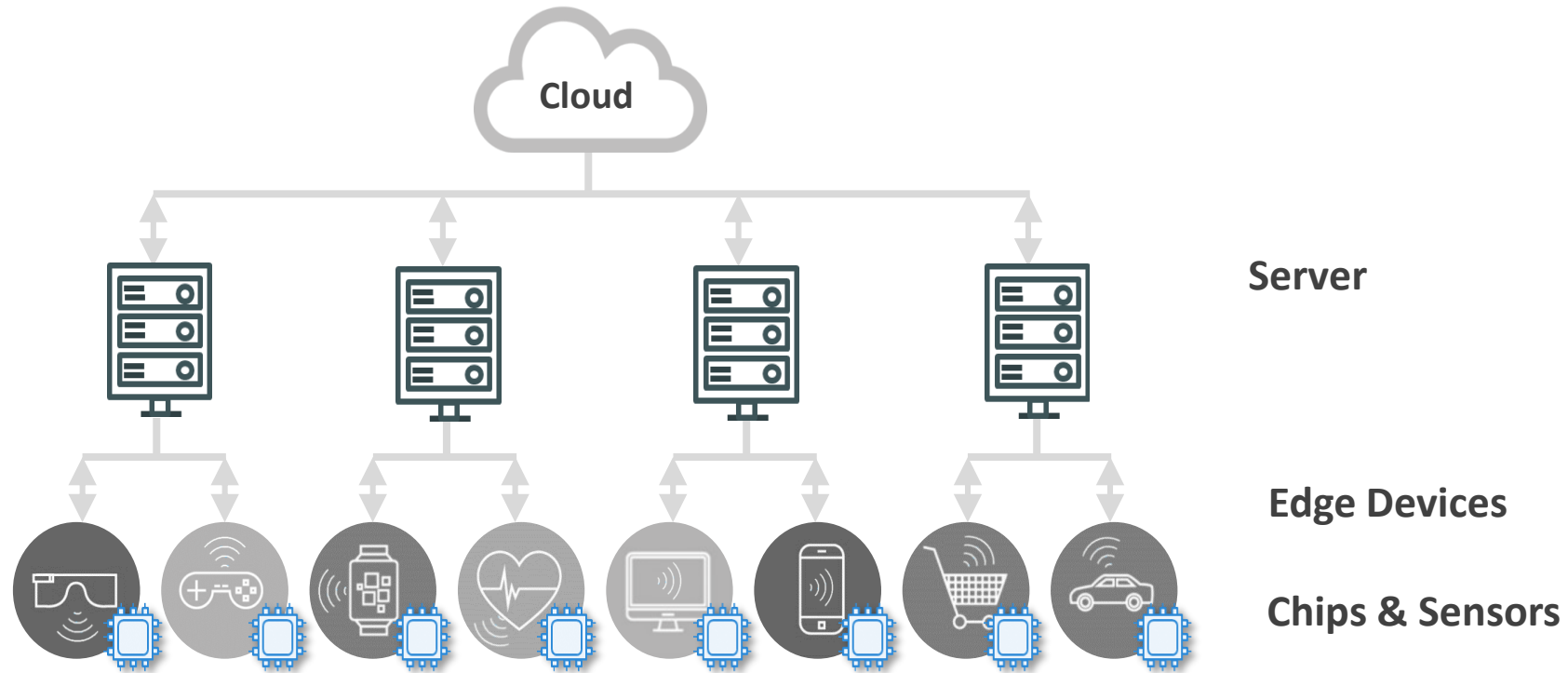


Flash Memory Summit

Flash Enables Memory-Centric AI Computing in Computational Storage

Donald Huang, Ph.D.
Director of Product Marketing
Macronix International

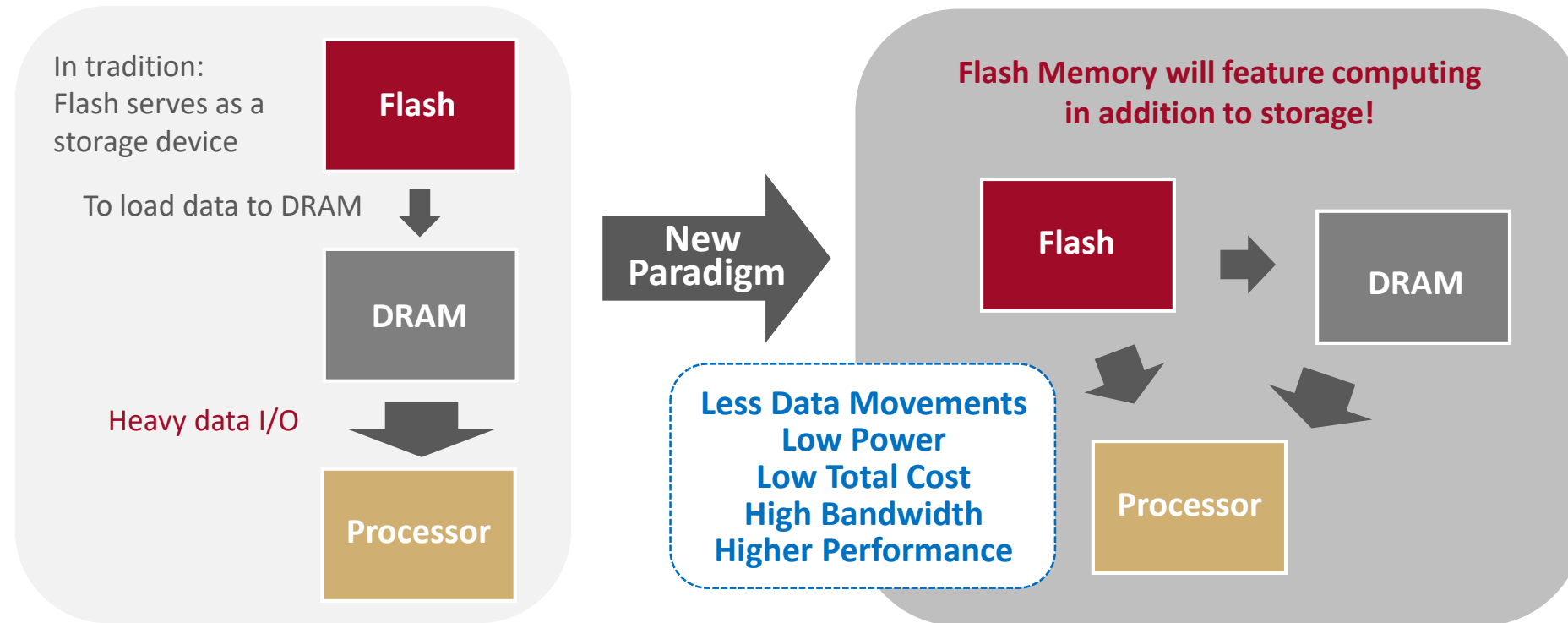
AI Applications and Requirements



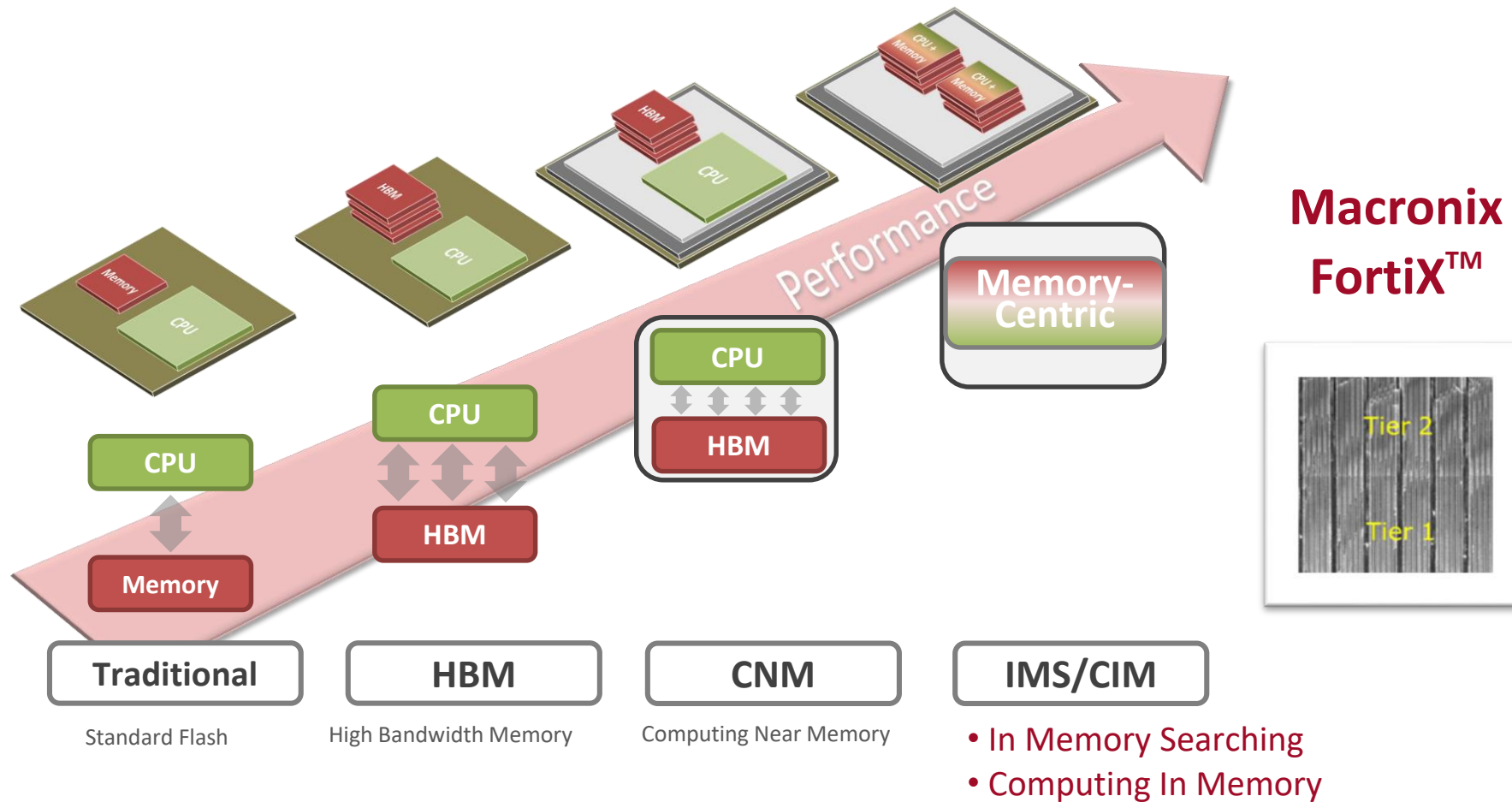
- ✓ Real Time Data Processing
- ✓ High Bandwidth Needed

- ✓ Low Power Consumption
- ✓ Low System Cost

Flash Memories Enable Memory-Centric Computing to Complement Process-Centric Computing

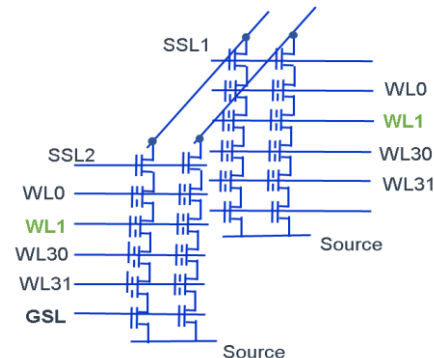
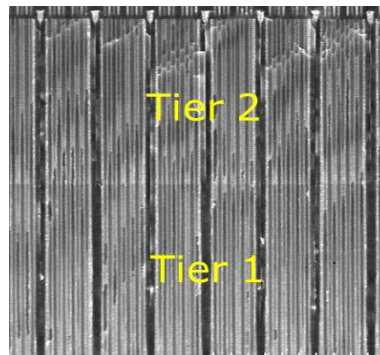


Memory Trends on AI Applications



3D IMS/CIM Flash Memory

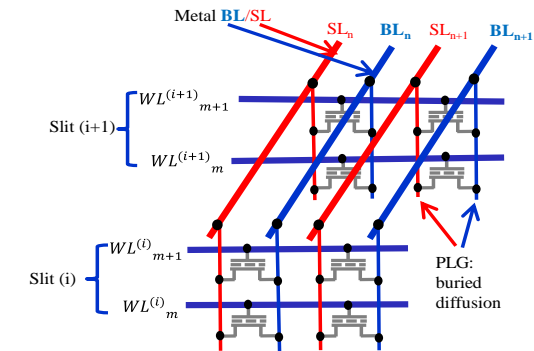
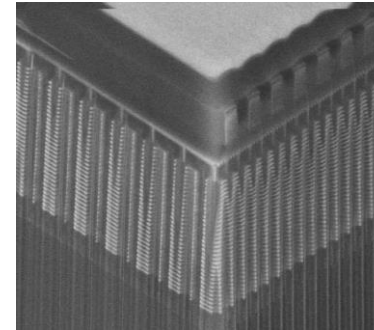
1st Gen FortiX 3D NAND



96 3D NAND
Layers

- In Development
- > 64Gb

1st Gen FortiX 3D NOR

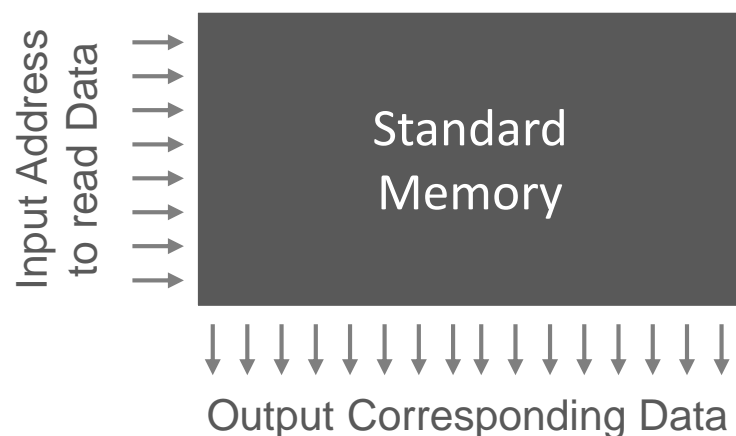


32 3D NOR
Layers

- Concepts & Device Operations ready
- 4Gb – 1Gb
- Lower Latency (~100ns)

Memory vs. FortiX™ IMS Flash Memory

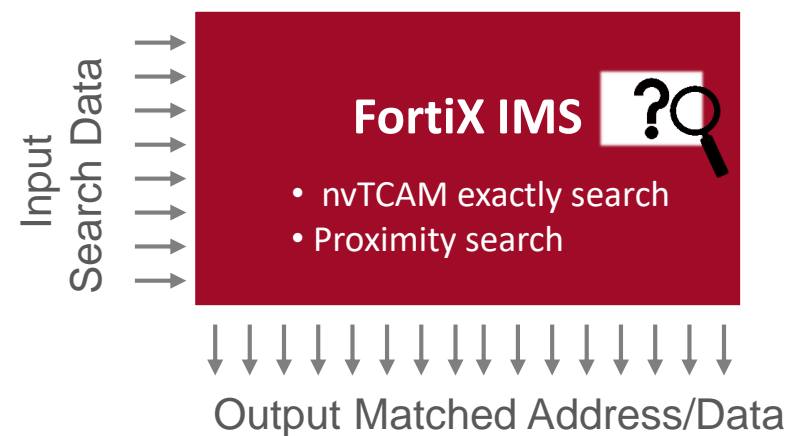
Standard Memory



- **High-bandwidth I/O Needed**

- Busy I/O
- Heavy data movement

FortiX IMS Flash or TCAM

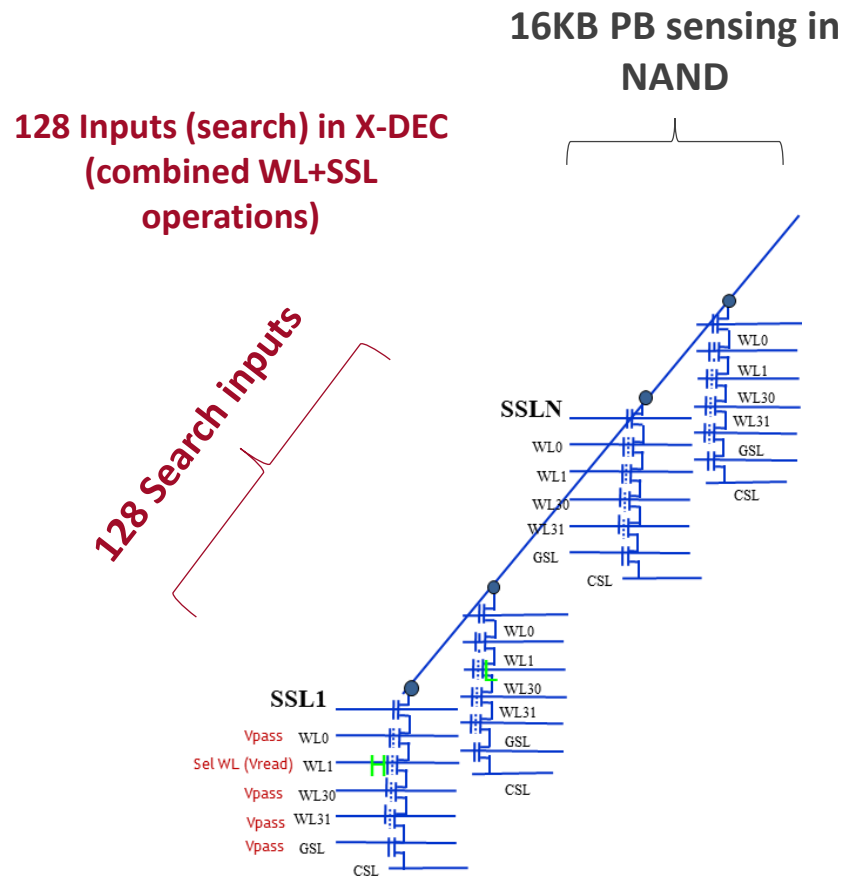


- **High-bandwidth Internal Search**

- No busy I/O
- Reduced data movement
- Lower power consumption
- Higher System efficiency

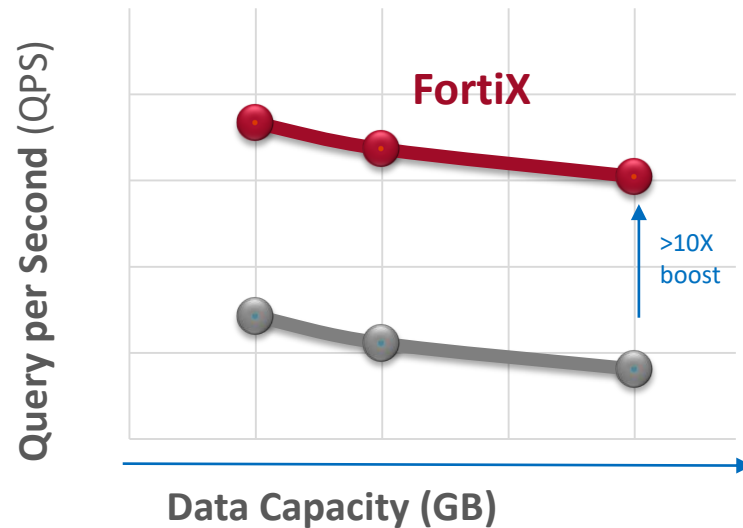
- **Accelerator Ultra high search bandwidth**

FortiX™ IMS 3D NAND Accelerator Operation



- ✓ **High-bandwidth Internal Search**
 - Max. ~300Gb/s
- ✓ **nvTCAM (Exactly Search)**
 - Key words search
- ✓ **Hamming Distance (Proximity Search)**
 - In the analog sensing current
 - Tunable Iref for Hamming Distance Sorter
- ✓ **Compute 8 Pictures at the Same Time**
 - Less overlapping btw matched/mis-matched
 - Effective “Voting” by hardware method
- ✓ **More Search Bits (128b * N)**
 - By accumulation; 2-bit output score of similarity
- ✓ **Fast “Blind” Similarity Search**
 - Within big unstructured data

Advantages of FortiX™ IMS 3D NAND Accelerator



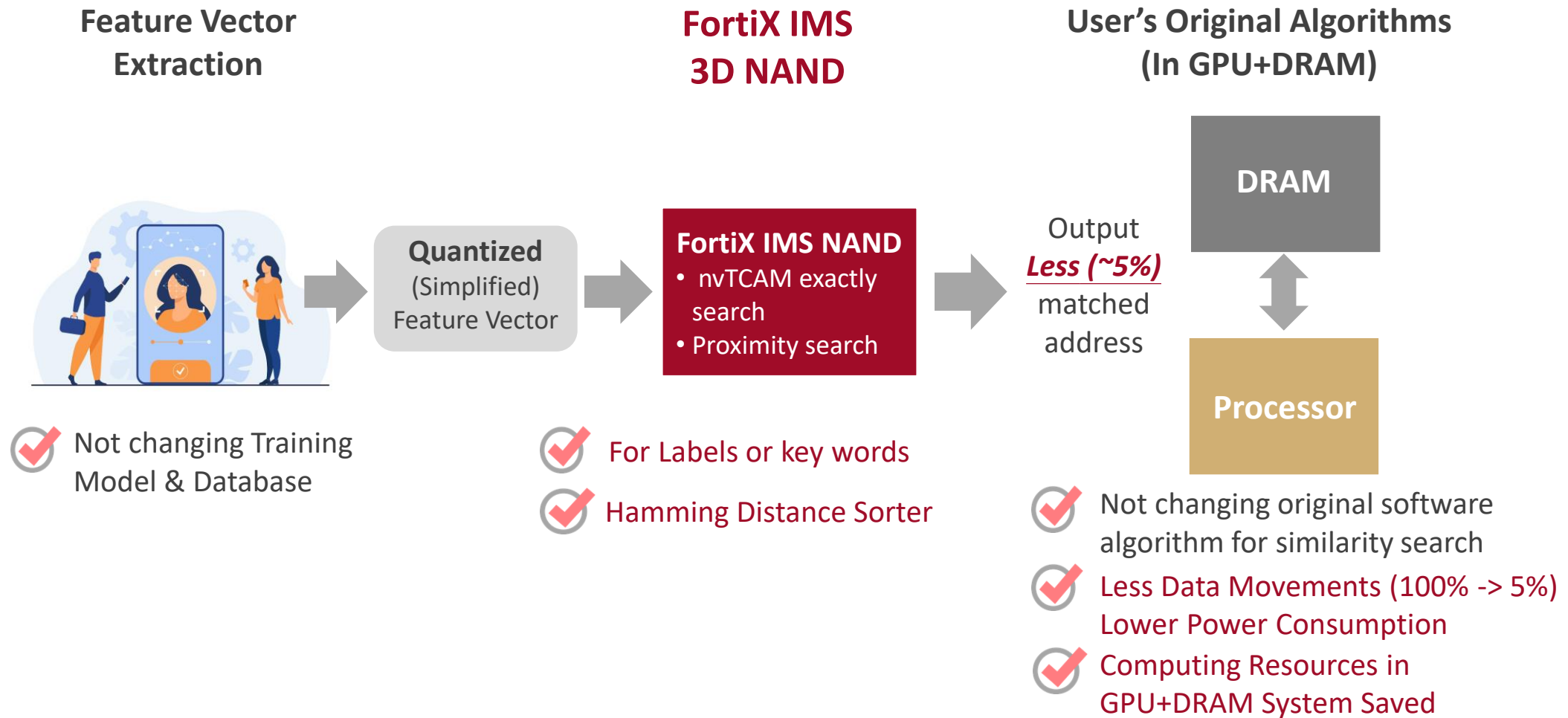
>10X boost for query per second

	IMS 3D NAND	DRAM
Search Bandwidth	~300Gb/s	3.2GB/s
Active Power	~300mW	~1W
Memory Density	>64Gb per chip	8-16Gb per chip

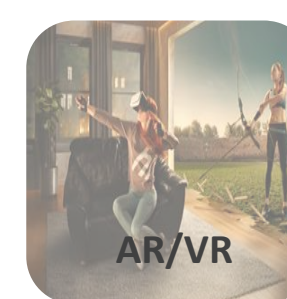
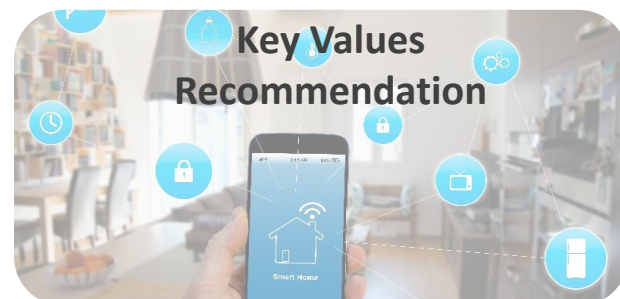
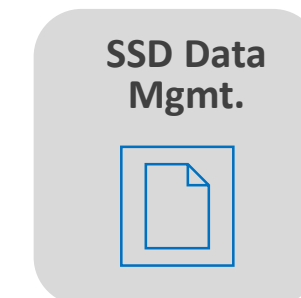
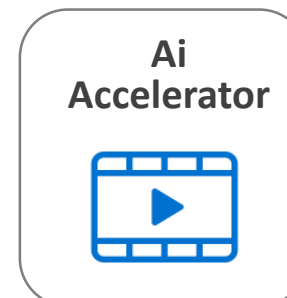
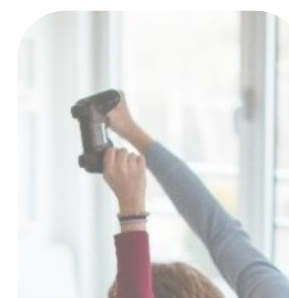
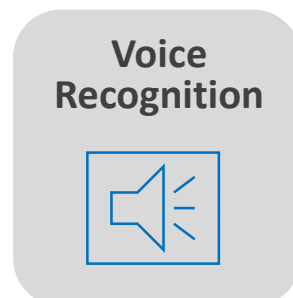
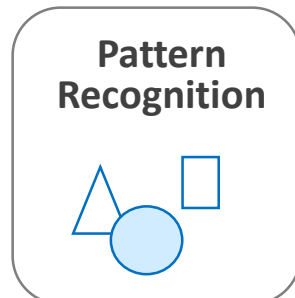
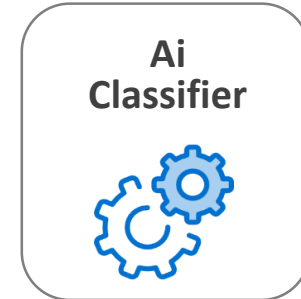
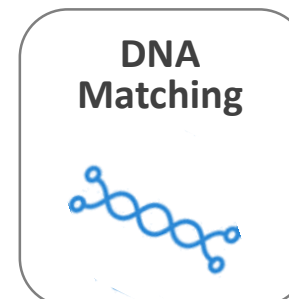
IMS 3D NAND

- High Bandwidth ~300Gb/s
- Low Power ~300mW
- High Density, >64Gb
- Non-volatile Memory

IMS 3D NAND Accelerator for Similarity Computing



FortiX™ IMS/CIM Flash Applications





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