

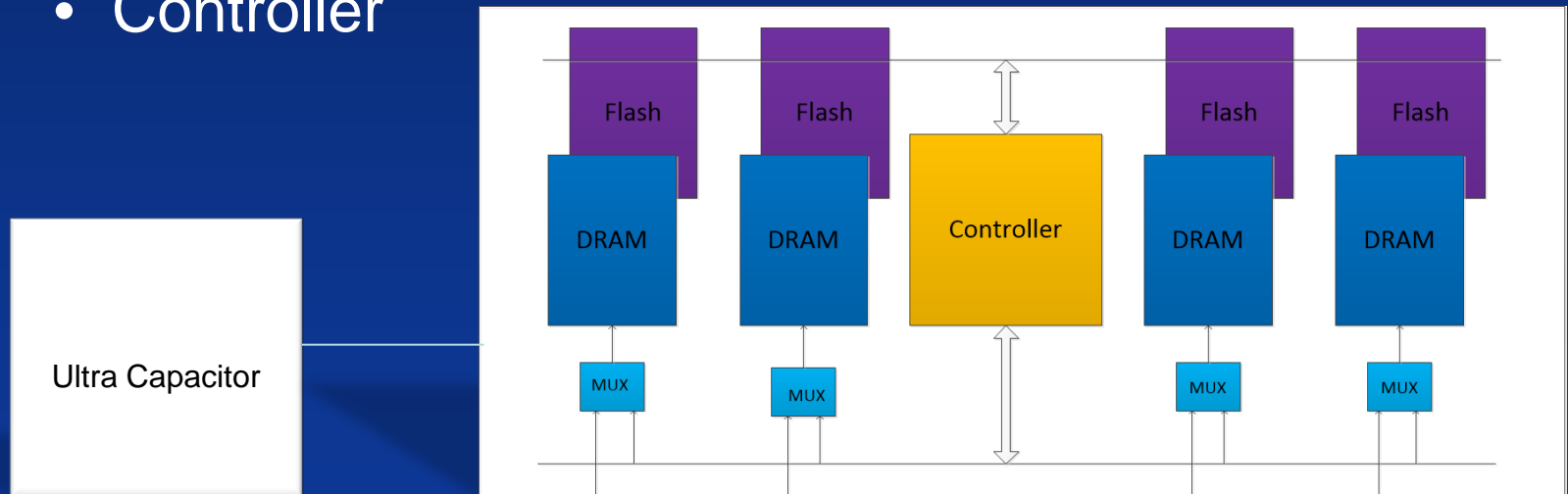


Design Persistent System With NVDIMM

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A Brief Review of NVDIMM Module

- Major components of NVDIMM module
 - DRAM
 - Flash
 - Ultra Capacitor
 - Isolation Mux
 - Controller



Bridging Technology Toward SCM

- Candidates for Storage Class Memory
 - ReRAM, STT-RAM, PCM etc.
 - Fulfill both short/long term memory requirements
 - Commercially not mature yet

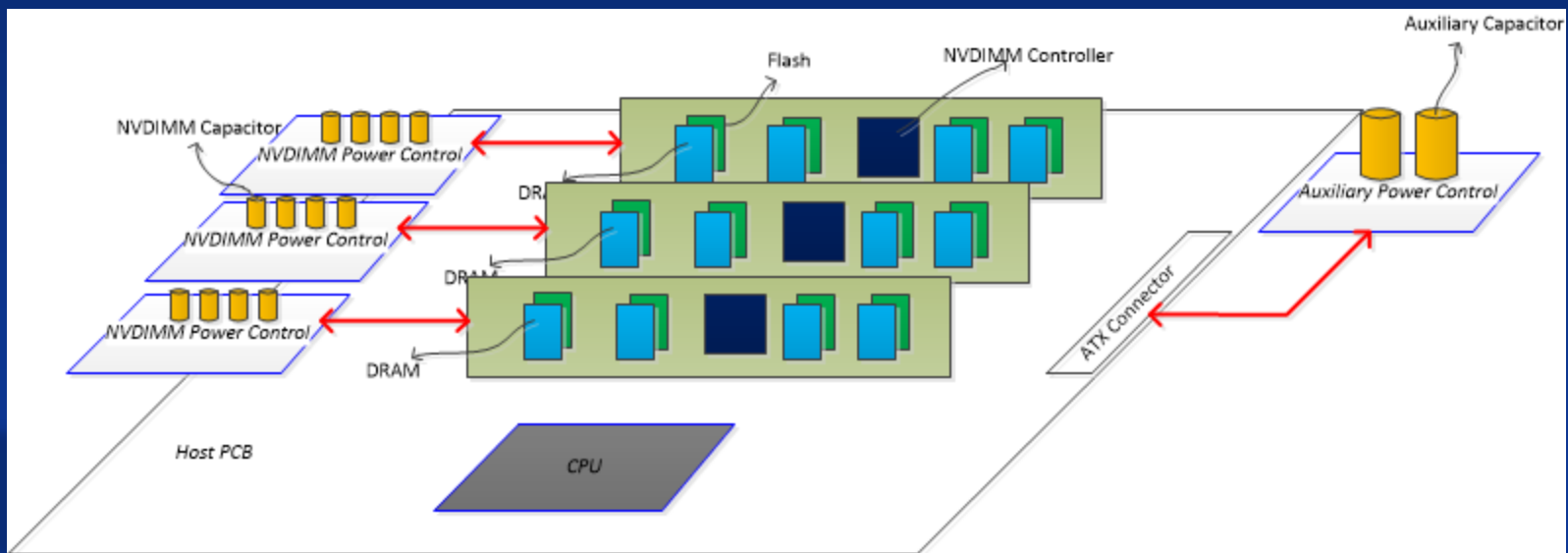
- Features of NVDIMM module
 - Non-volatile
 - High speed
 - Mixture of mature technologies
 - Commercially available
 - Compatible with current computer system

Persistent System Model

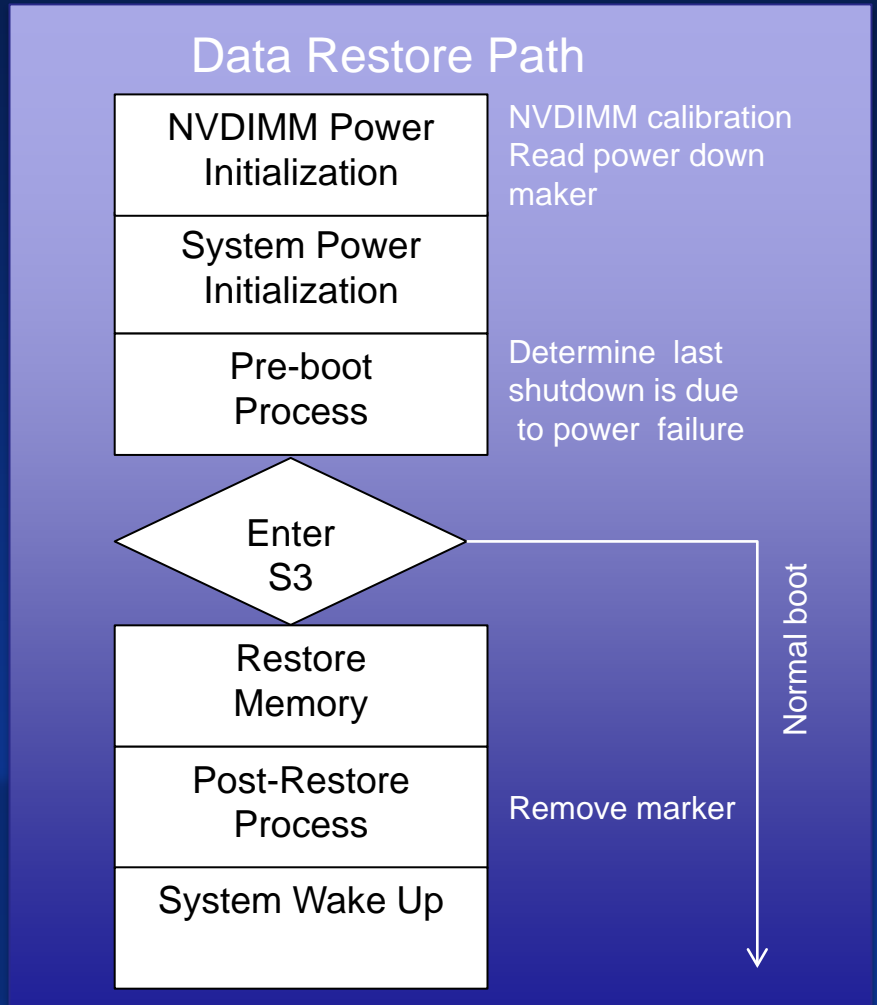
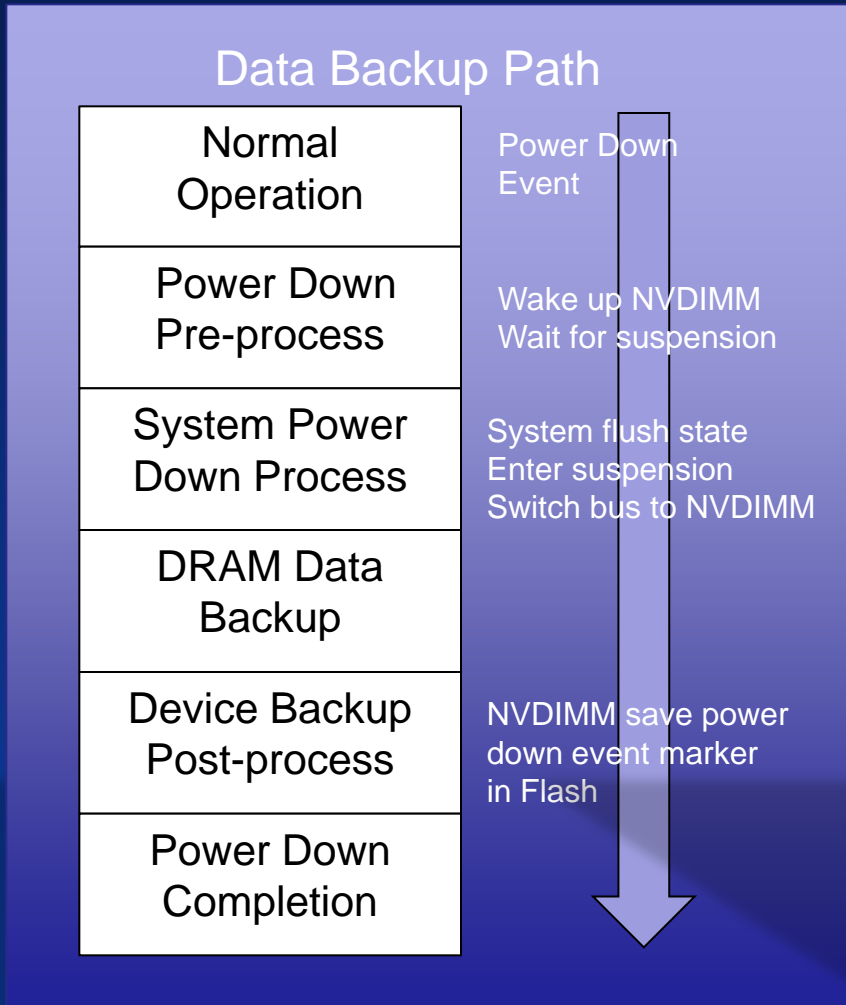
- Partial persistence
 - Block based, Non-volatile heap
 - Require state conversion
 - Difficult to transform and maintain legacy programs
- Whole system persistence
 - All state retained in non-volatile memory
 - Can be achieved by “Flush-On-Fail”
 - Good for backward compatibility

NVDIMM Based Whole System Persistence (WSP)

- WSP requires
 - NVDIMM
 - Power monitor/supply
 - Software control
- Use “Flush-on-Fail” (ACPI S3 state)



WSP Function Flow





Product Design Goal

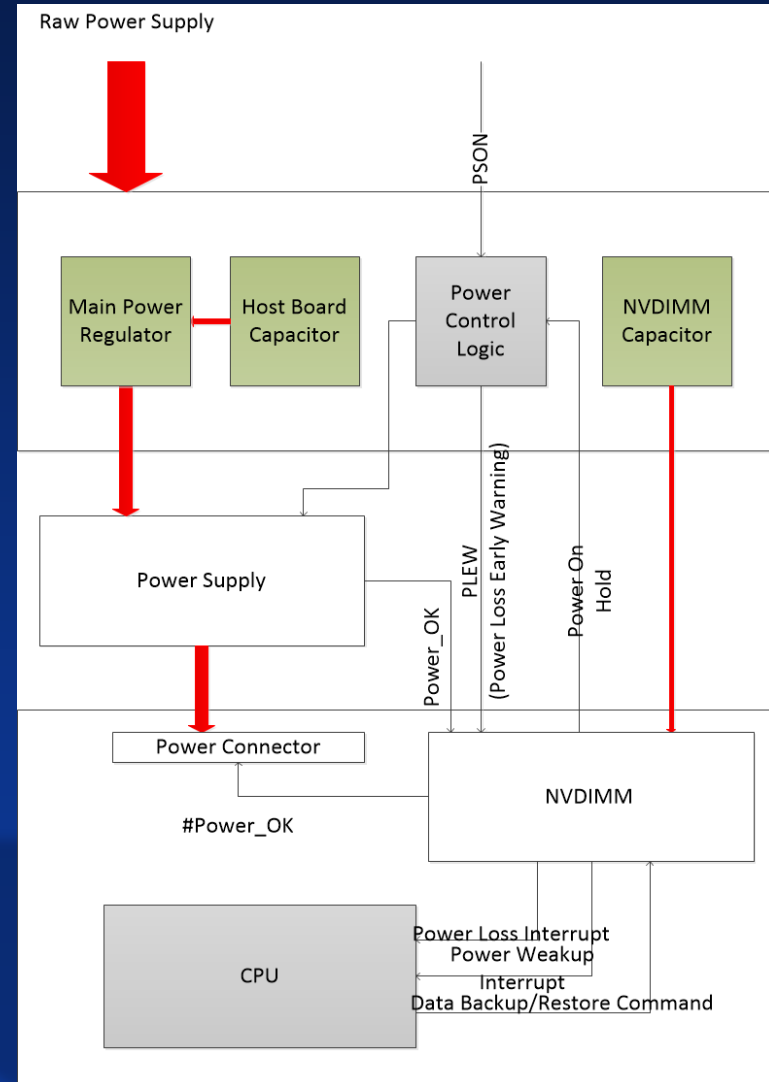
- All state retainable non-volatile system
- Compatible with existing computer architecture
- Can be back-fitted to support off-the-shelf computer systems
- Cost-effective system upgrade

NVDIMM WSP Design Challenges

- Save data in time – two factors
 - Energy ultra-capacitor provided during save
 - Bandwidth of data transportation during save routine
- Software support
 - BIOS
 - Device firmware
- Compatibility with existing computer
 - Plug and Play
 - Placement of ultra-capacitors

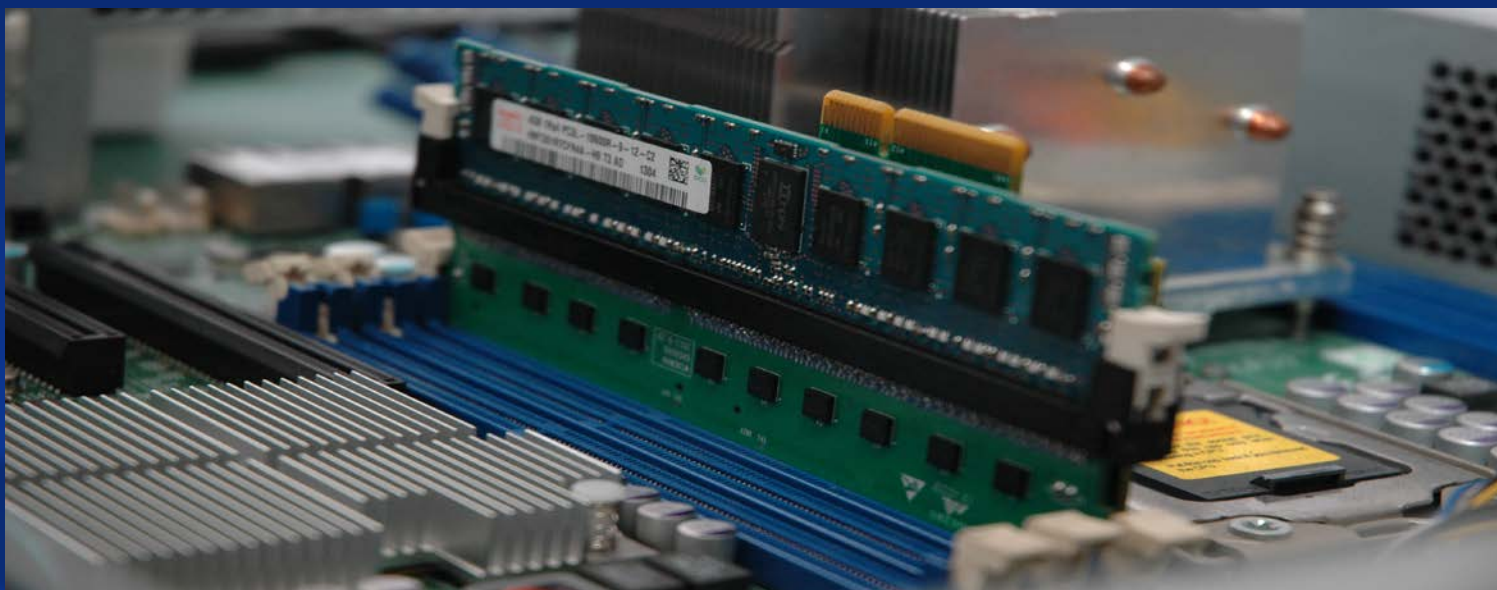
Centralized Backup Power Supply

- Power monitoring circuit
- Power off warning signal
- Ultra-capacitor emergency power supply



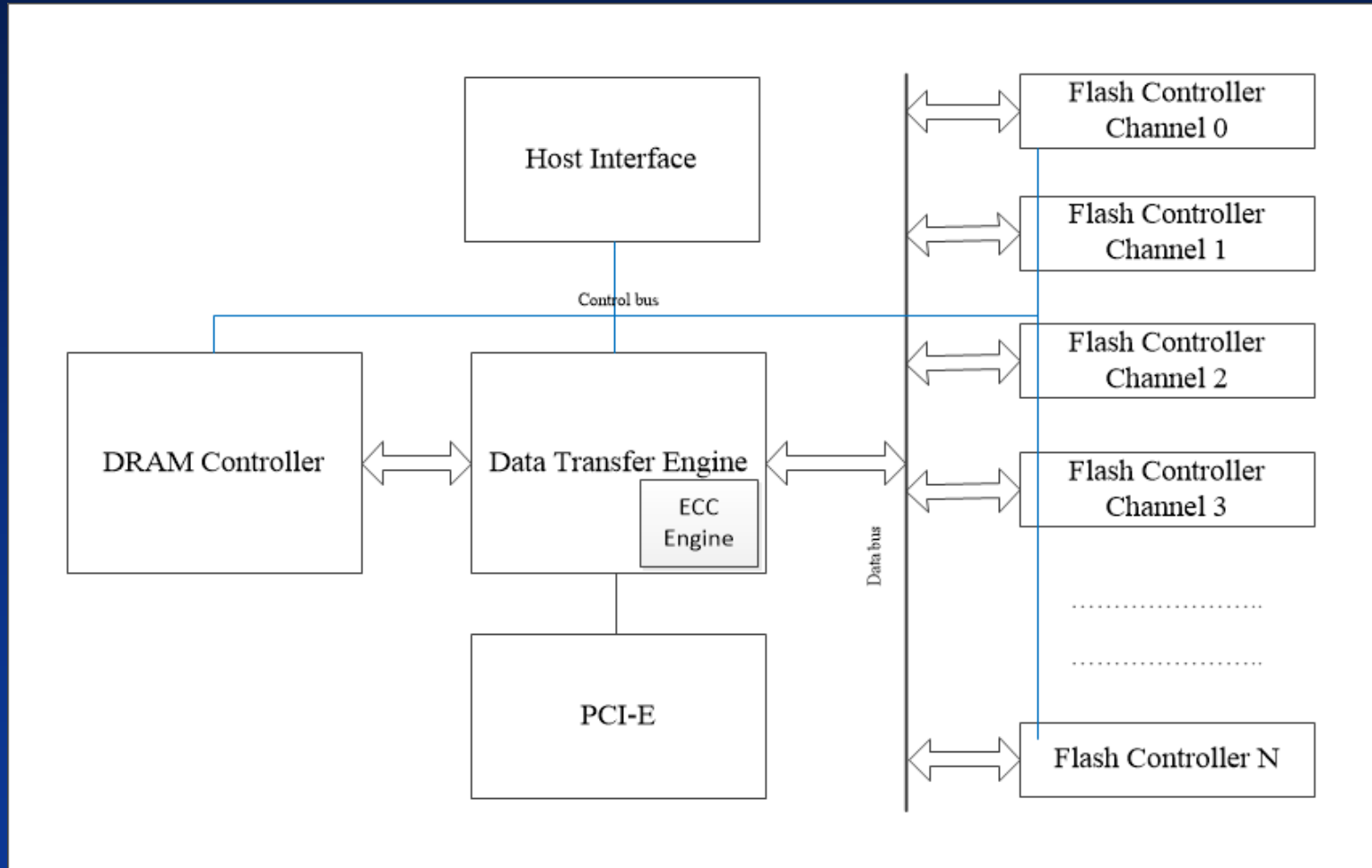
Adapter Based NVDIMM Design

- Adapts to existing memory modules
- Directly transform DRAM to NVDIMM
- Good for future memory consolidation



NVDIMM Controller Design

-Multi-channels controller design



NVDIMM Controller Performance

- WuGou IIE
 - 8 Channel DDR2 controller
 - Program 125MB/s
 - Read 266MB/s

- WuGou III
 - 16 Channel DDR3 controller
 - Program 350MB/s
 - Read 590MB/s



Keynotes To Remember

- With NVDIMM, Whole System Persistence can be achieved without change to existing hardware
- Centralized ultra-cap power supply is good for WSP control
- Multi-channel controller increases bandwidth reduces size of ultra-capacitor requirements
- NVDIMM is the “bridging technology” toward future generation of SCM



Flash Memory Questions

- Windawn Technology WSP demonstration at <https://www.youtube.com/watch?v=dpyZHDEHtxY>
- Contact NVM@windawn.com

THANK YOU!