

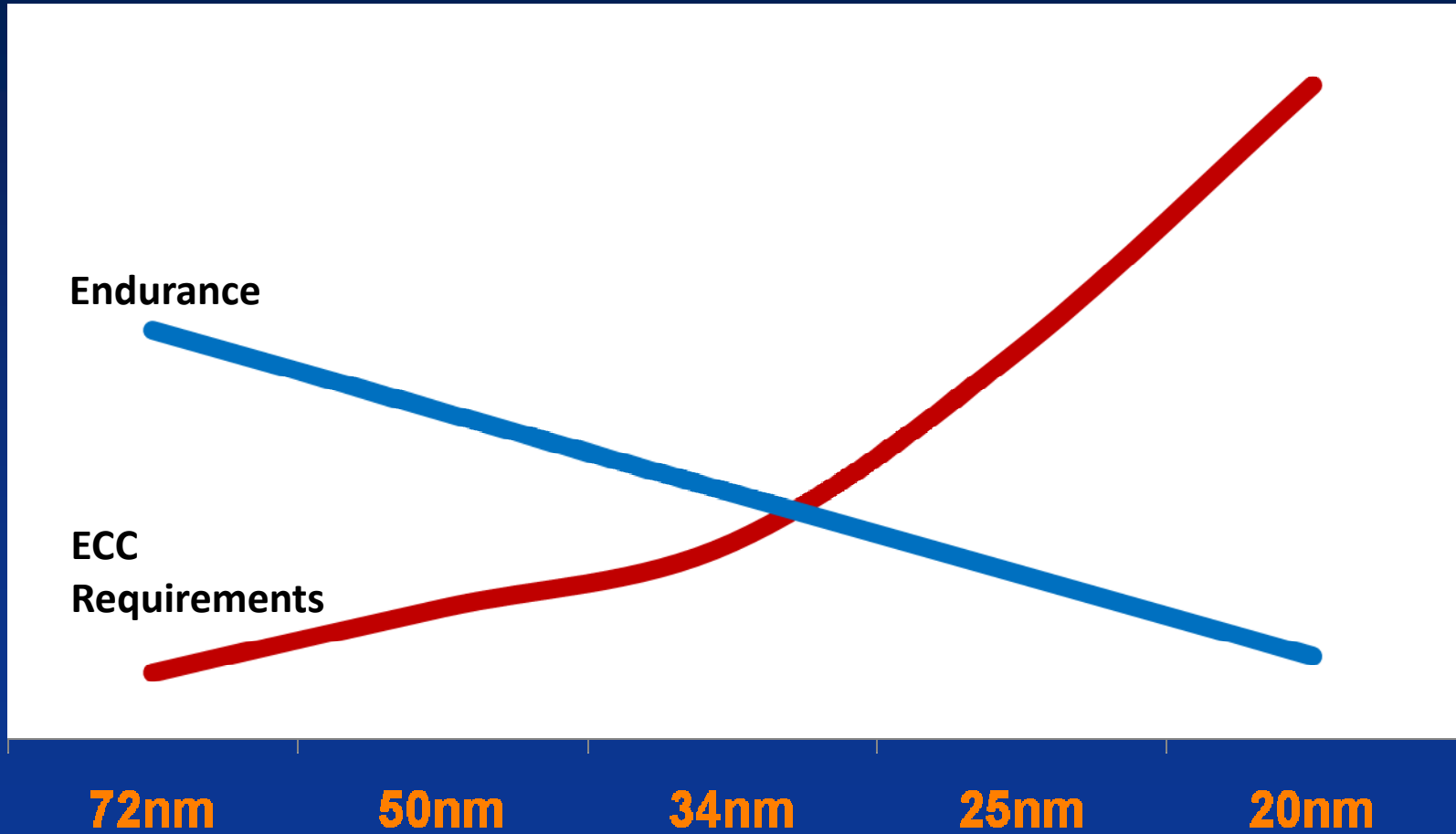


System Benefits of EZ-NAND/Enhanced ClearNAND™ Flash

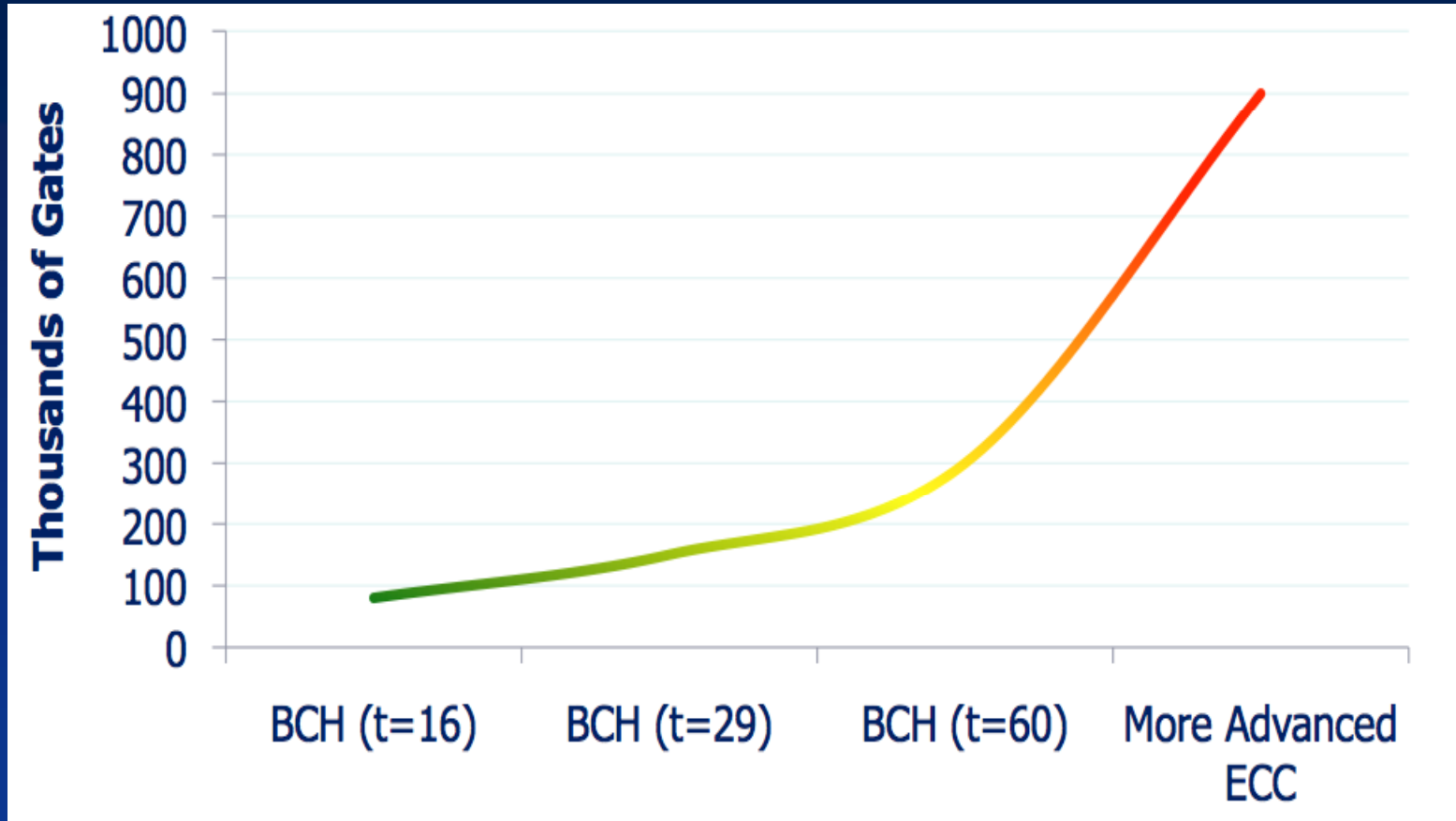
Carla Lay
Micron Technology, Inc.

- NAND challenges
 - Scaling
 - ECC complexity
- The EZ-NAND solution
- Additional controller benefits
- Enhanced ClearNAND™ Flash
- Summary

The Drawbacks of NAND Scaling



ECC Complexity vs. Logic



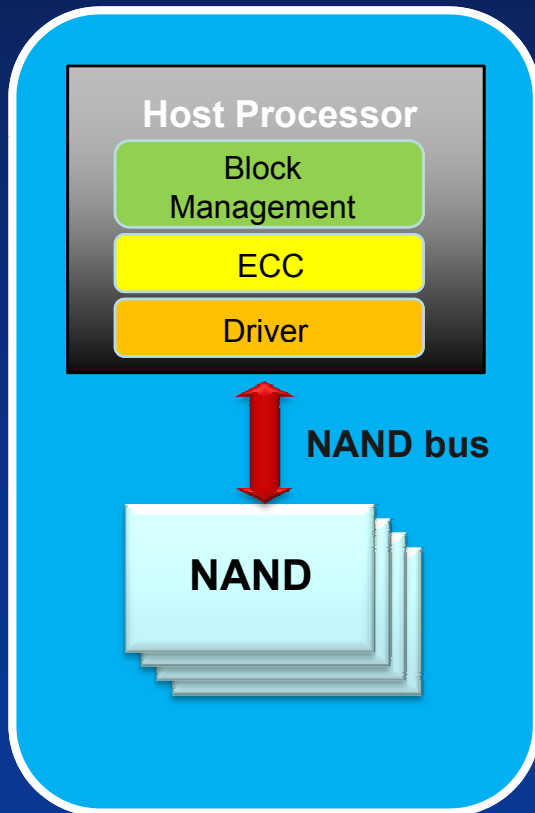
Increasing RBERs requires more ECC to achieve equivalent UBERs

The EZ-NAND Solution

- Minimizes impact of NAND technology transitions
- Current technology can be used **sooner**
- Allows host processor to focus on **system-level optimization**
- Internal controller offers performance and scaling benefits
- Provides buffer to reduce channel loading, **improving** signal integrity

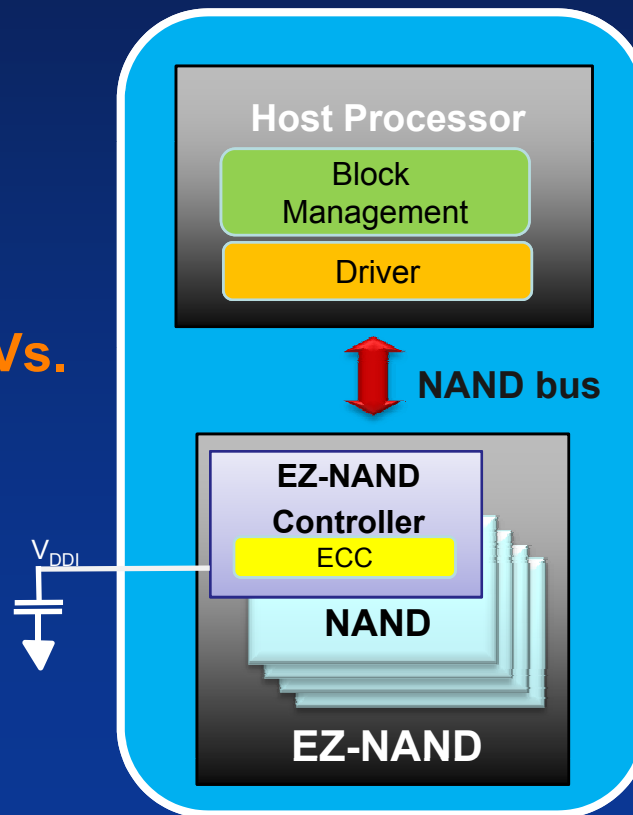
Raw NAND vs. EZ-NAND

System Using Raw NAND



Vs.

System Using EZ-NAND

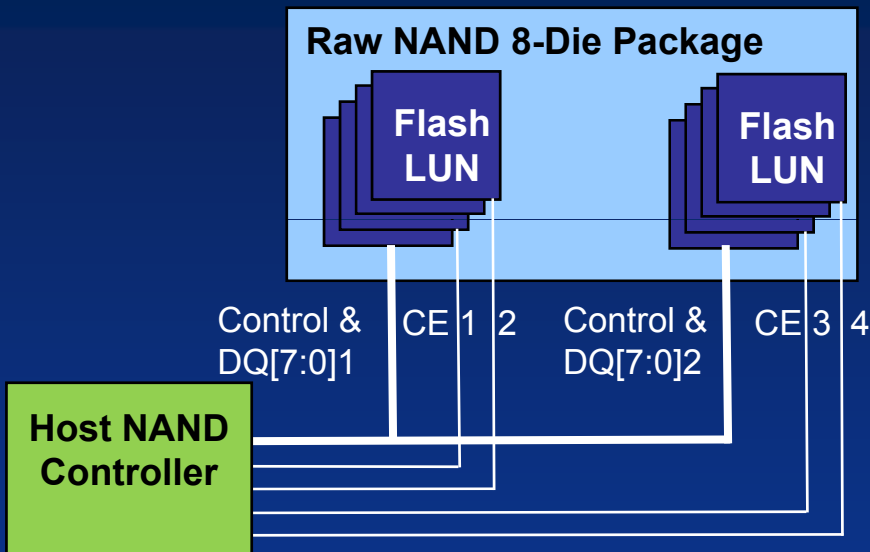


EZ-NAND

- Relieves host's ECC burden
- Host maintains control
 - Block management
 - Driver optimization
- Allows higher NAND densities
 - Serves as NAND buffer
 - Reduces loading

EZ-NAND: Loading Improvements

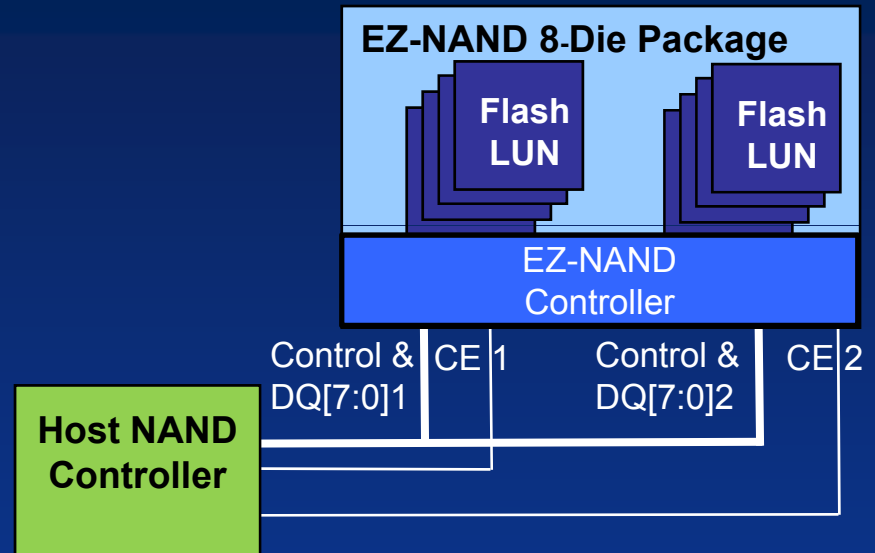
System Using Raw NAND



Raw NAND

- Loading increases with additional NAND die
- May limit I/O speed; reduces system performance

System Using EZ-NAND



EZ-NAND

- EZ-NAND controller serves as buffer to NAND die
- Allows for faster I/O speed with more NAND die

Additional Controller Benefits

- Internal controller allows for additional features
 - Command queuing; multi-core/multi-threaded architecture support
 - LUN optimization
 - Commands optimized to utilize LUNs efficiently
 - Reduces host command complexity
 - Power management limits number of active LUNs

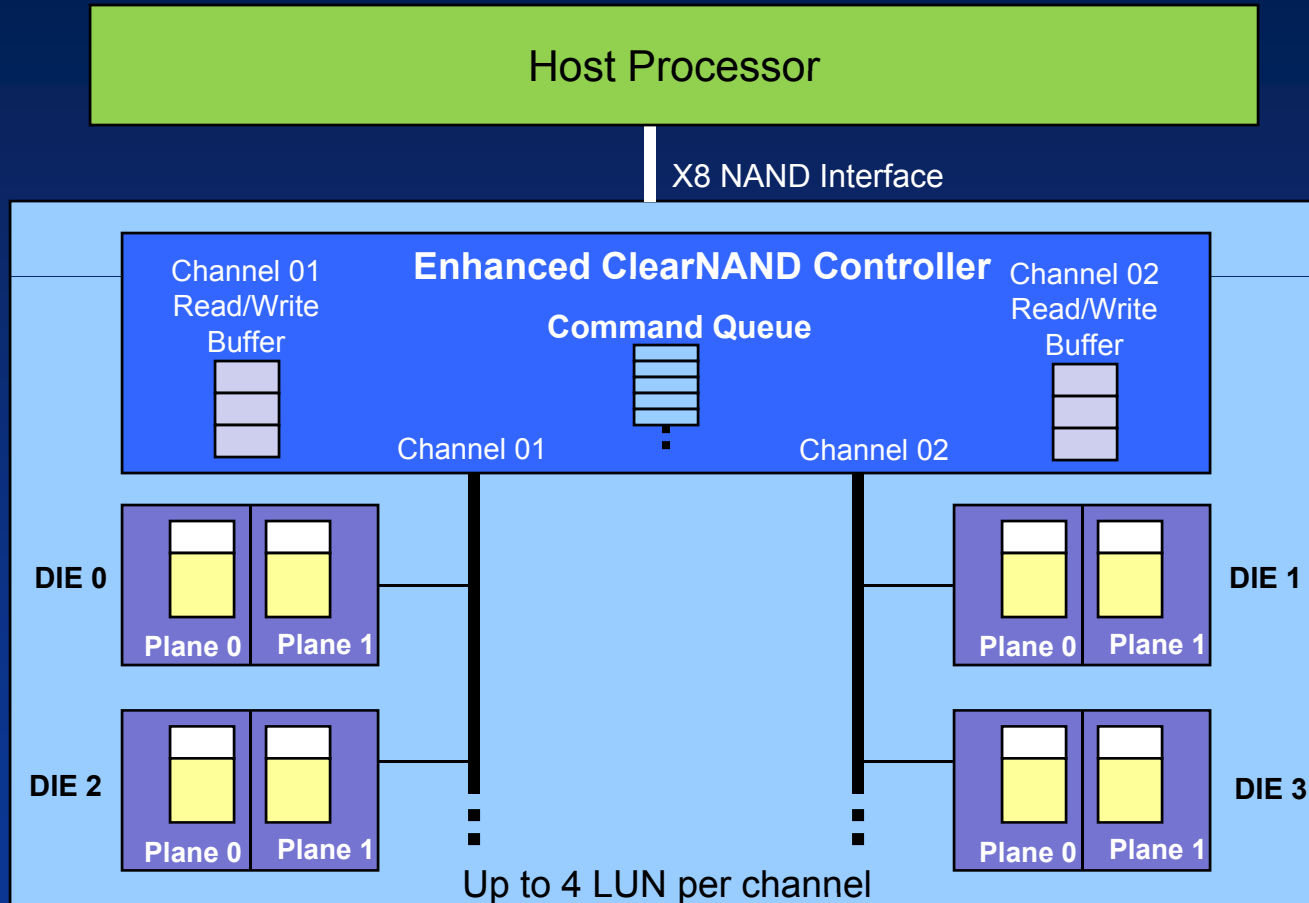
Command Queuing

- Available on enhanced ClearNAND Flash via enhanced command set
- Allows commands to be queued if LUNs are busy
 - READ/ERASE queue dependent on command queue depth
 - PROGRAM queue dependent on buffer availability

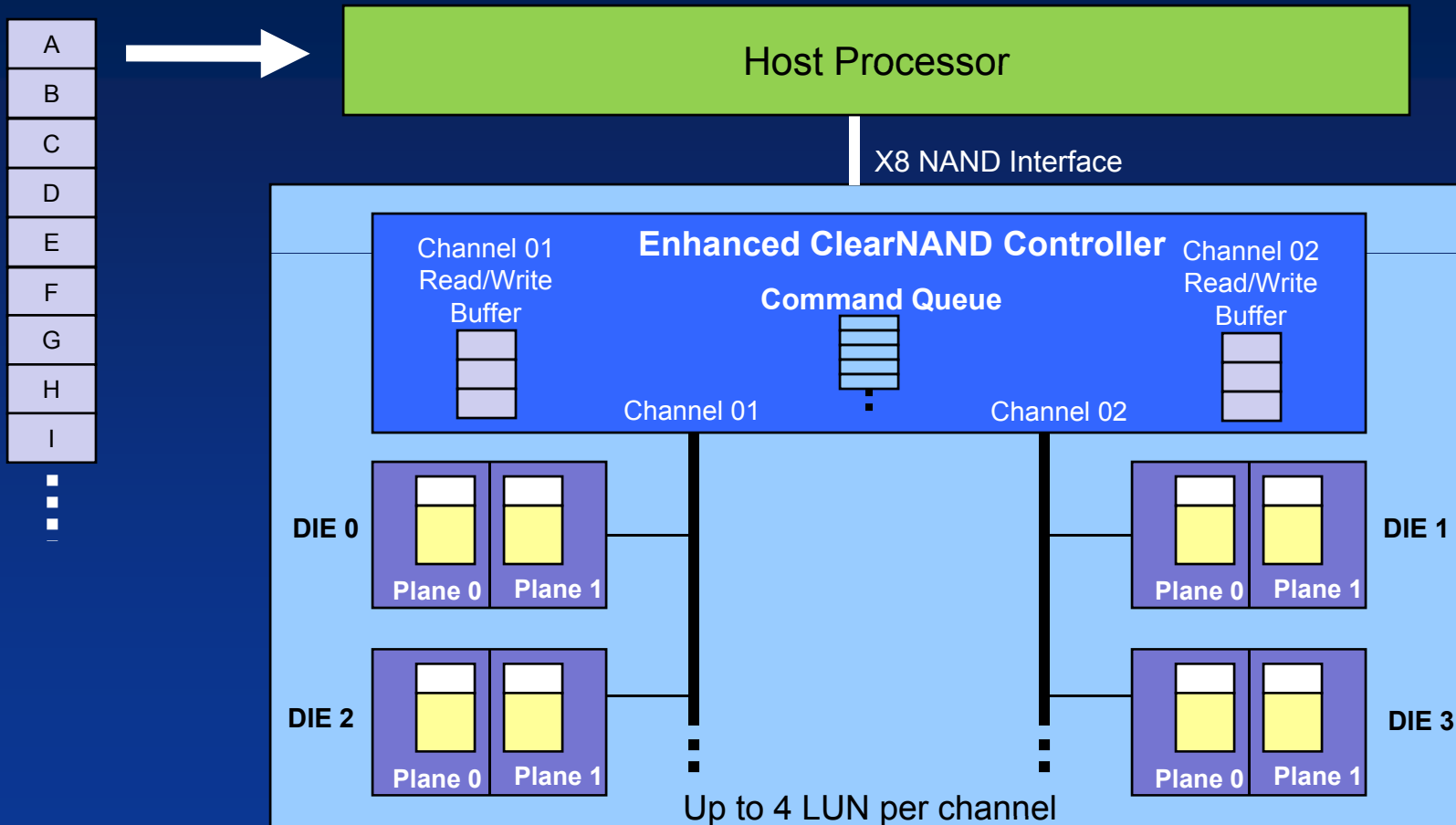
- Internal controller able to optimize LUN usage by combining commands where possible
 - Multi-LUN commands
 - Additional NAND optimization
- Allows each NAND vendor to utilize expertise without requiring host to customize commands

- Internal controller can assist with power management
 - Limit number of active LUNs
 - Additional power management techniques
- Allows each EZ-NAND device to be tailored for power/performance based on application requirements

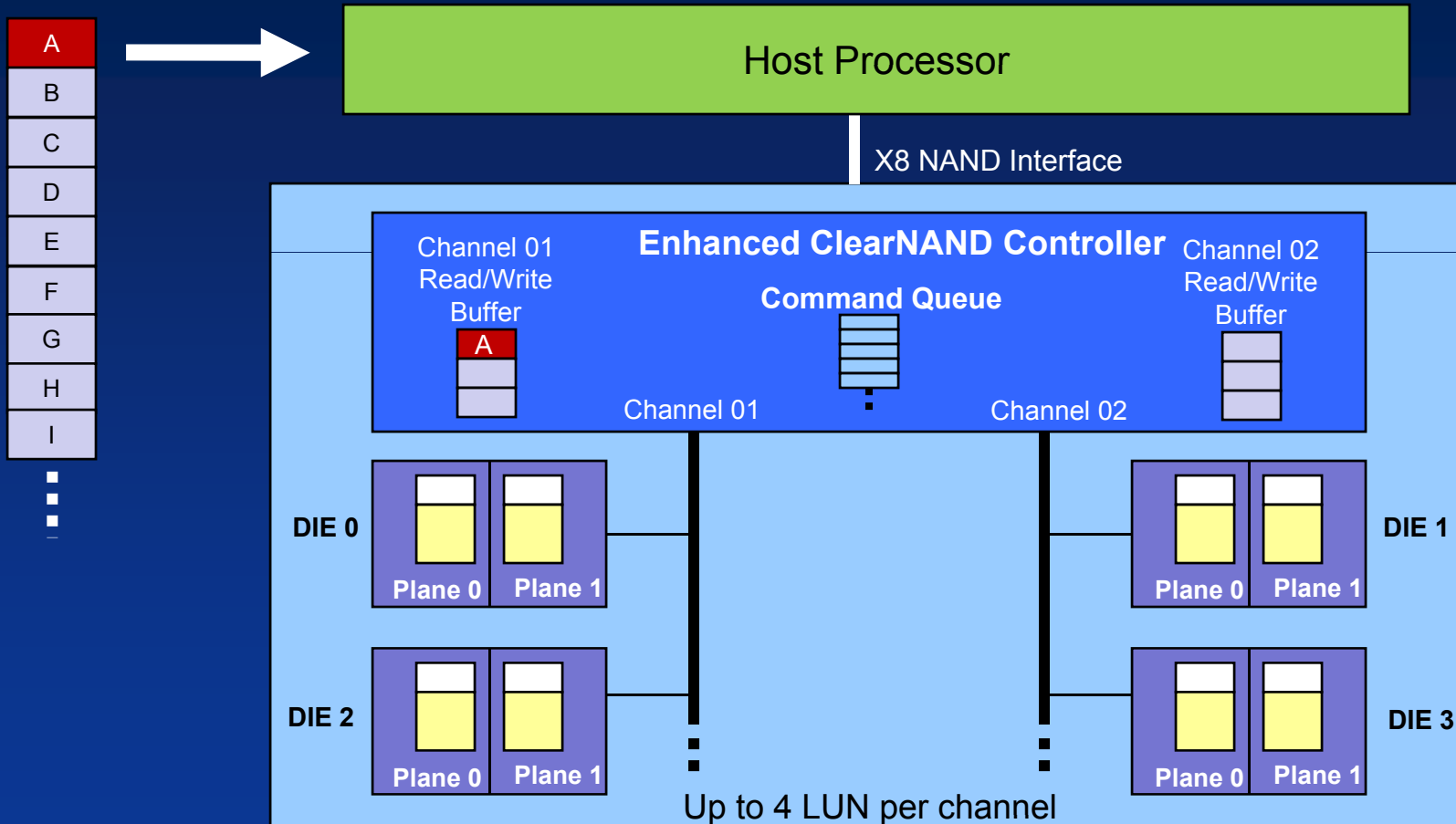
Enhanced ClearNAND Flash



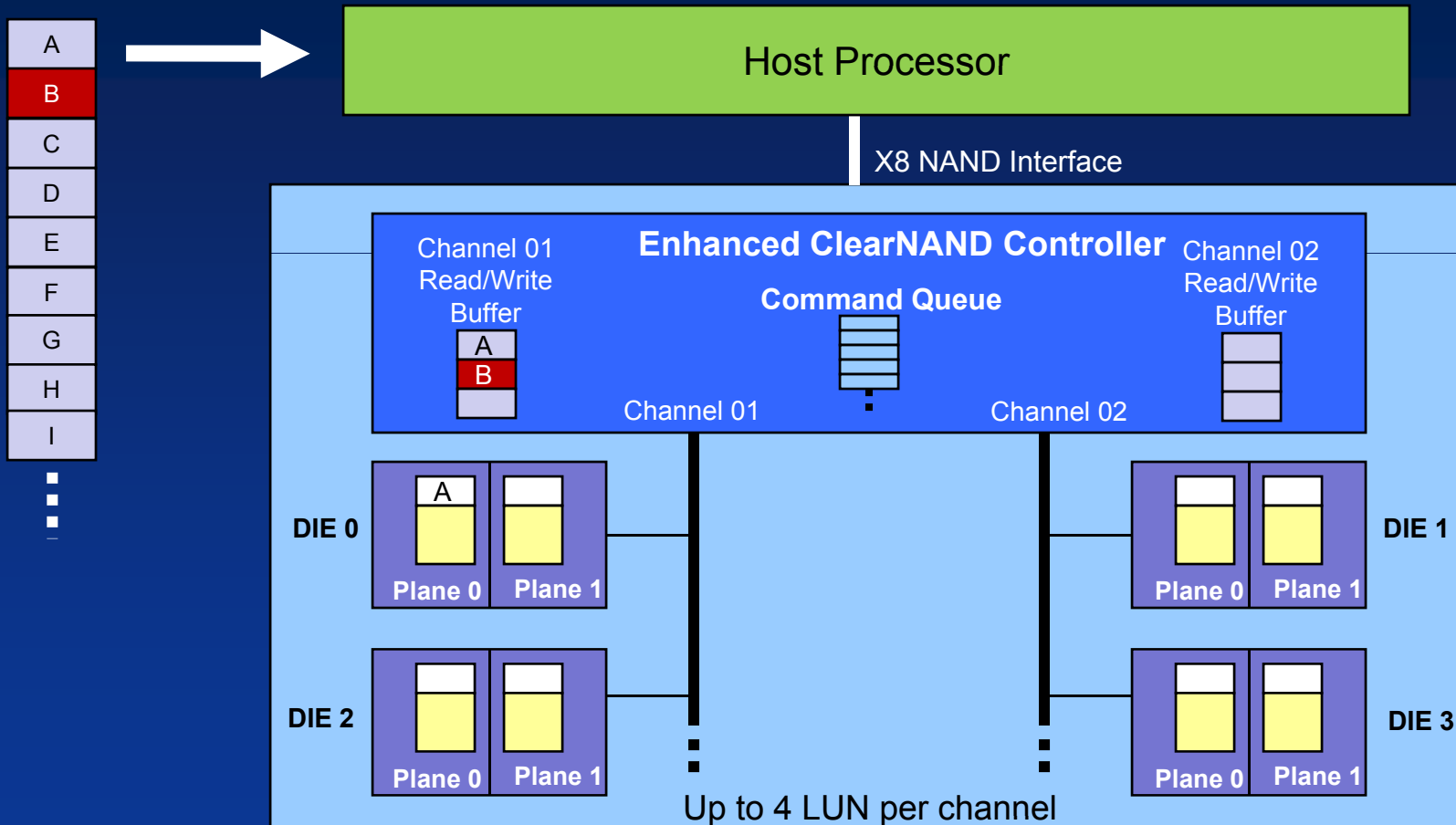
Enhanced ClearNAND Flash



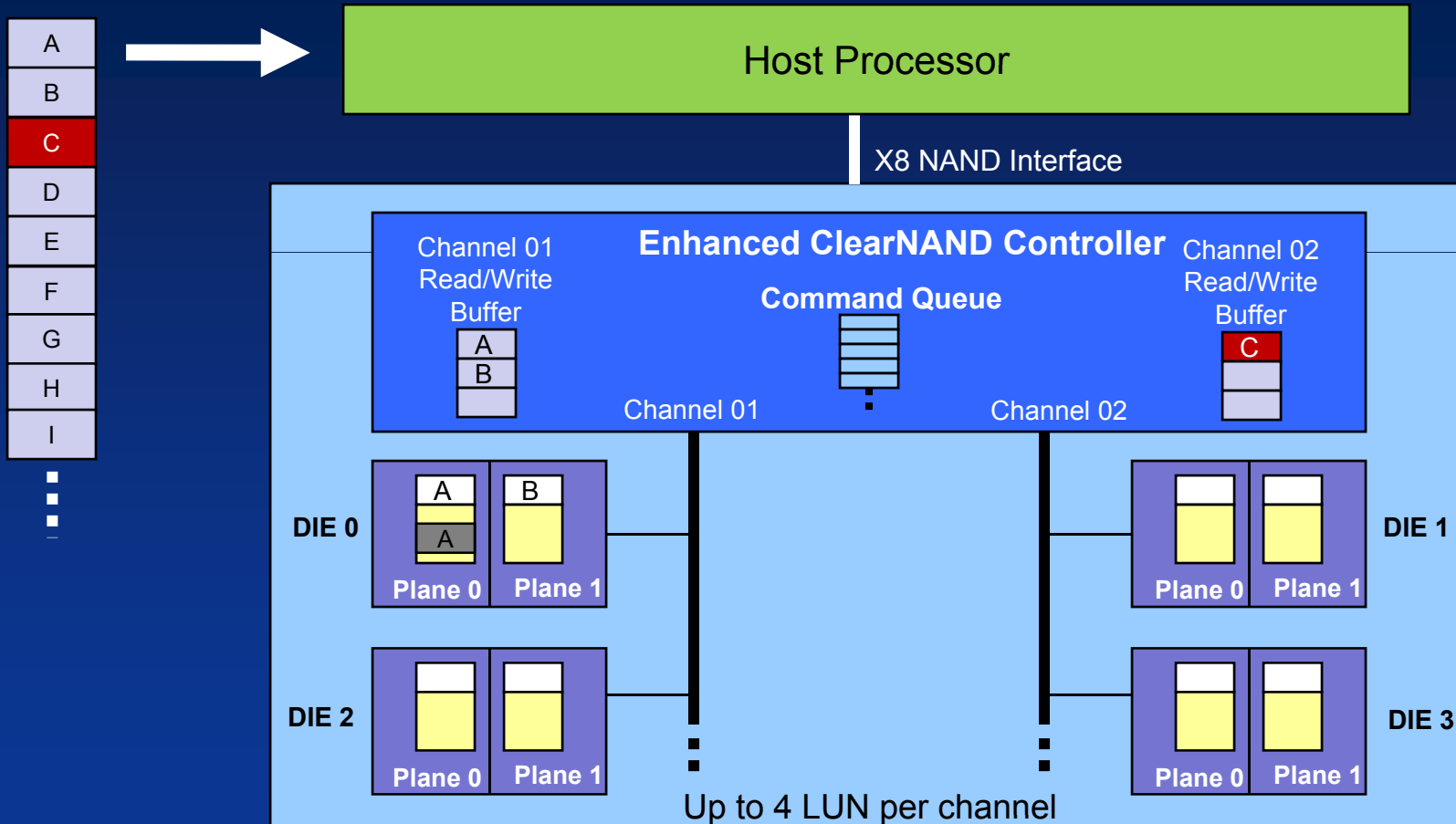
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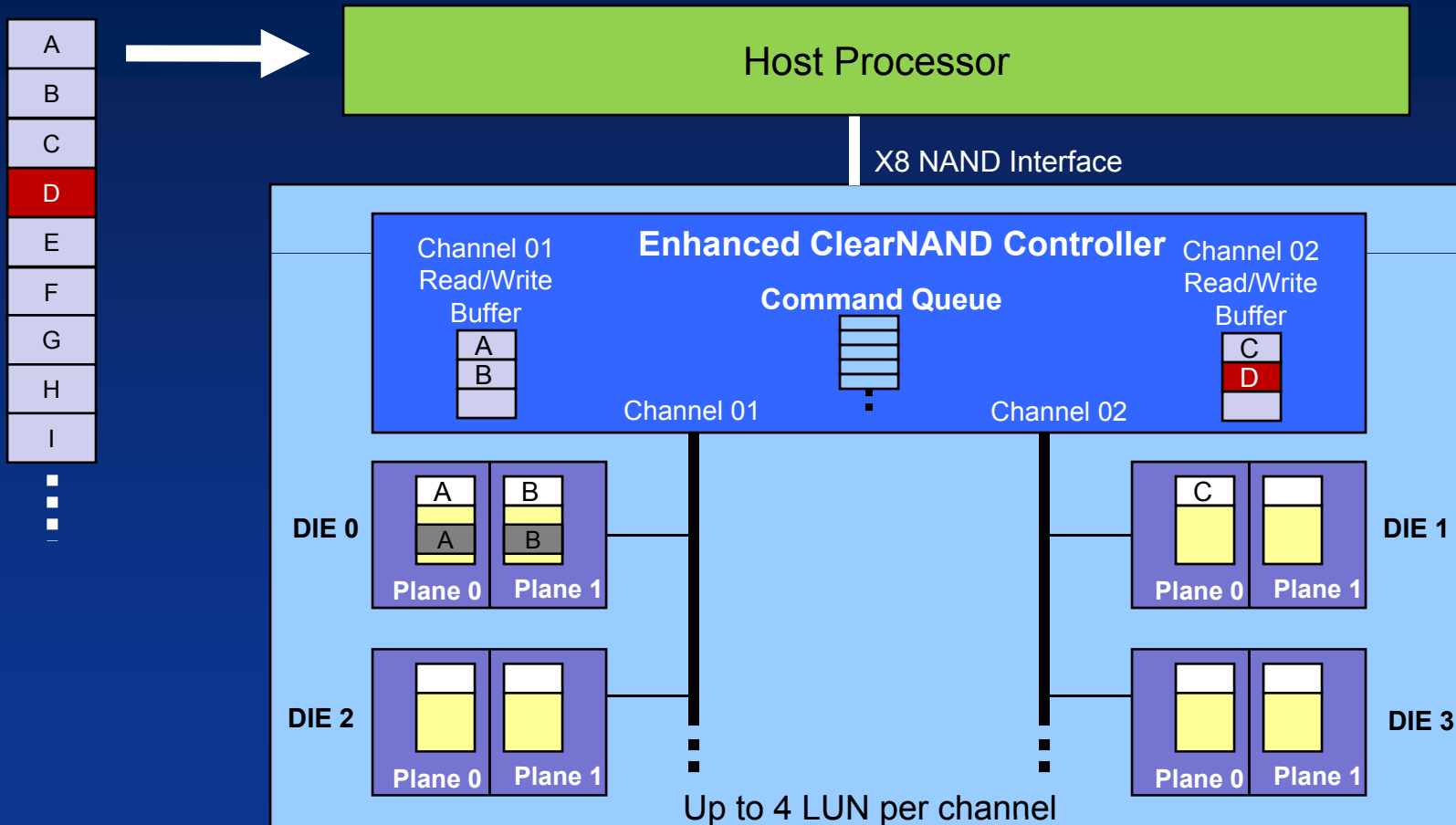
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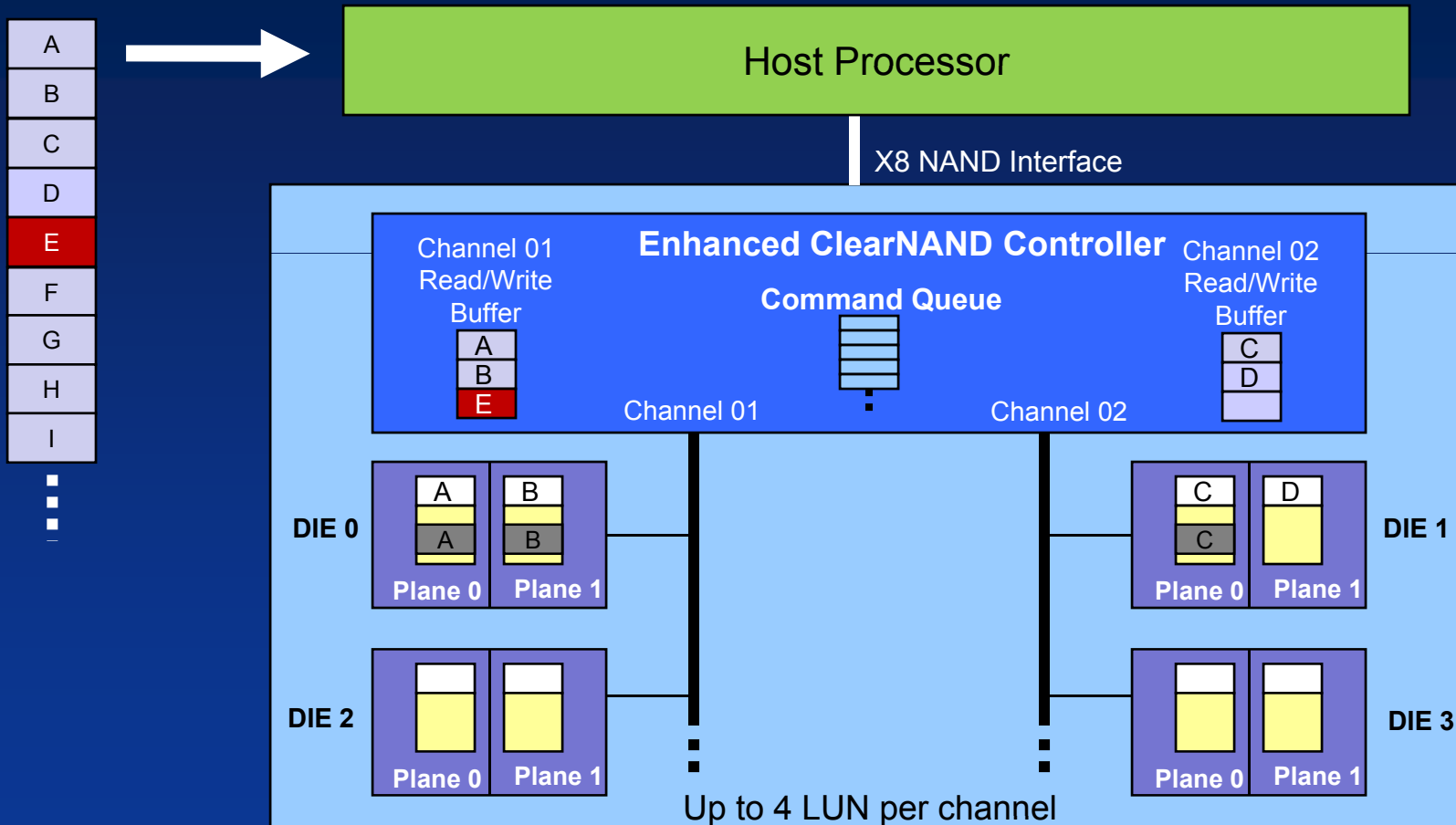
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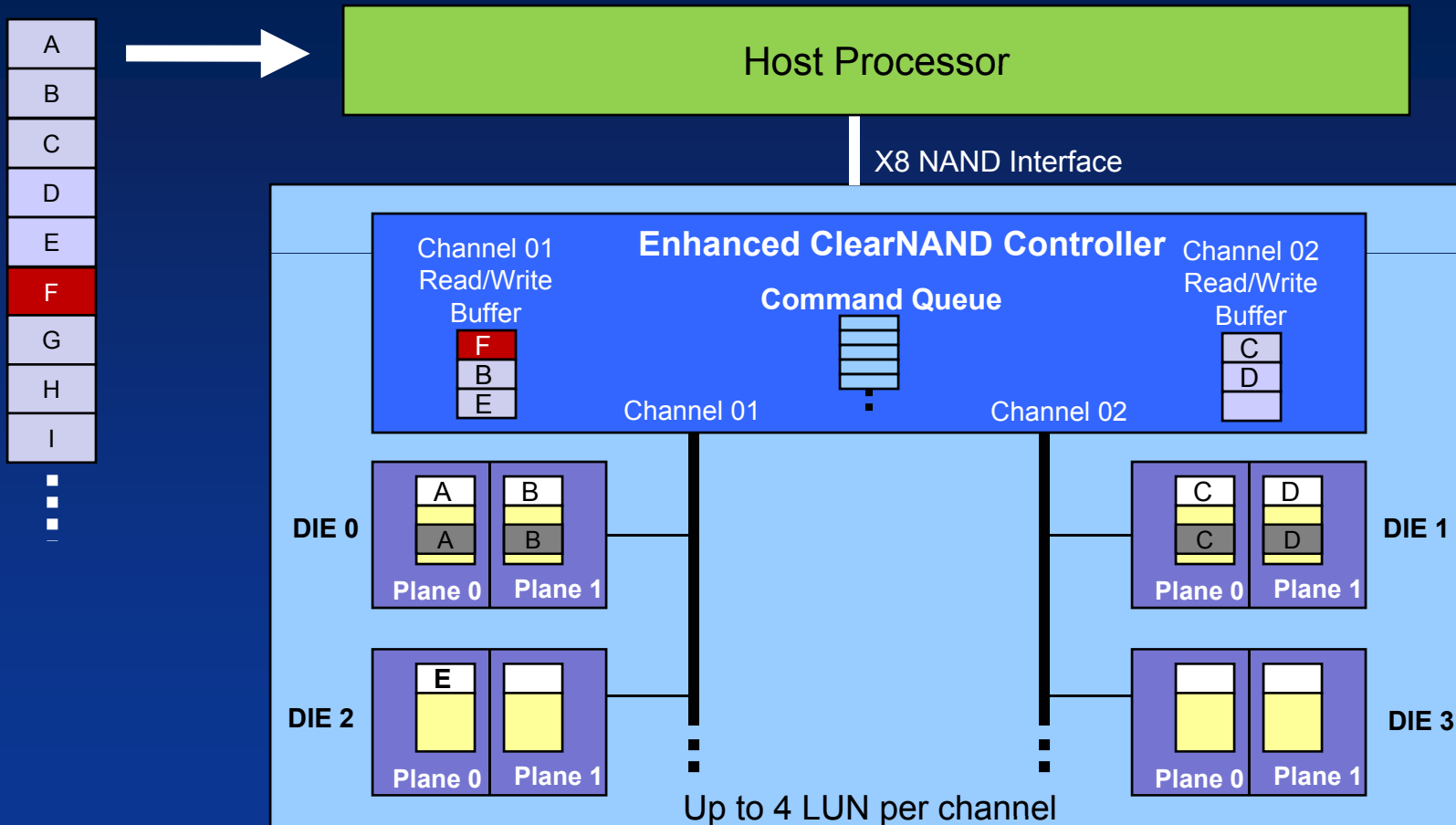
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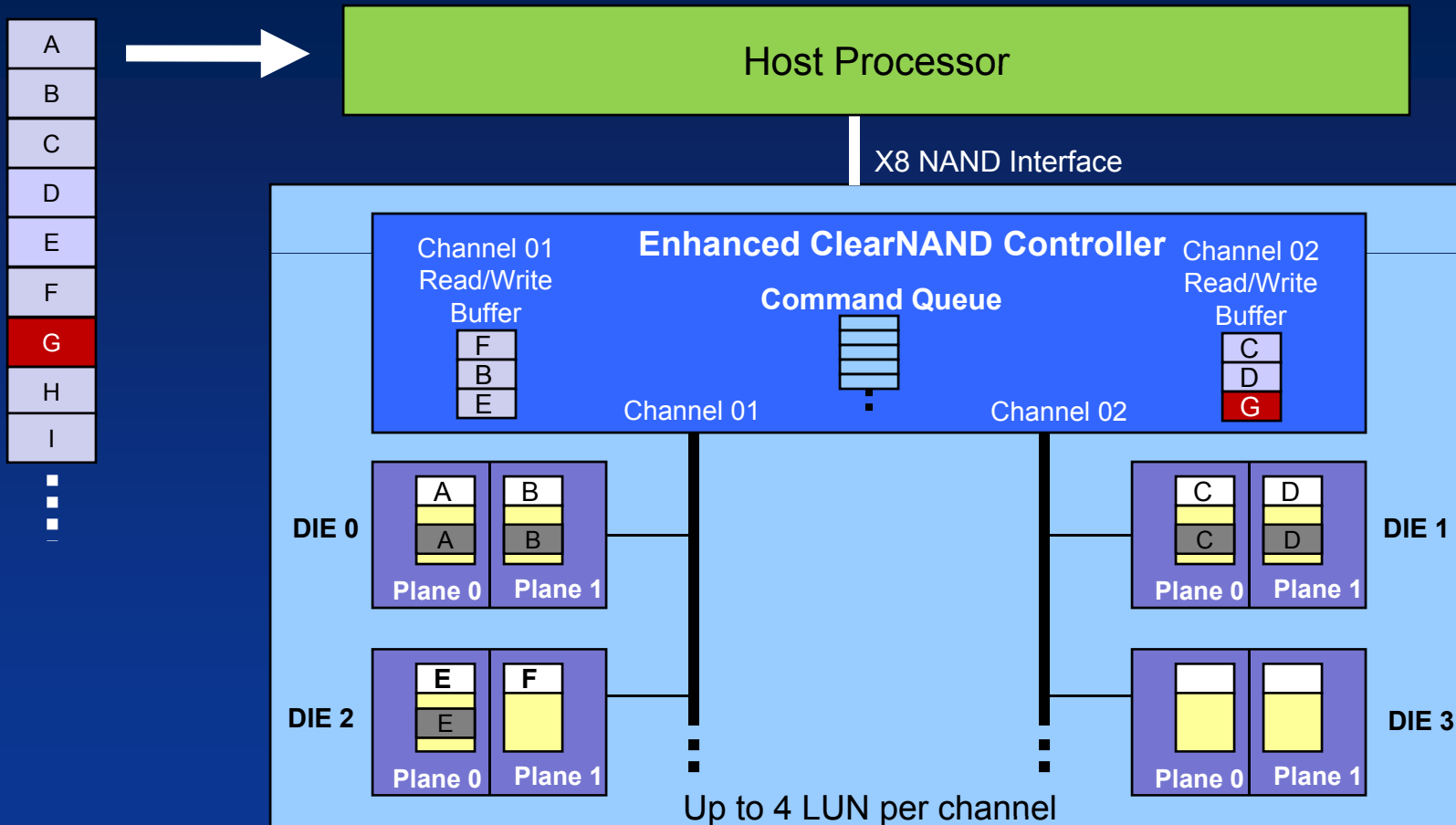
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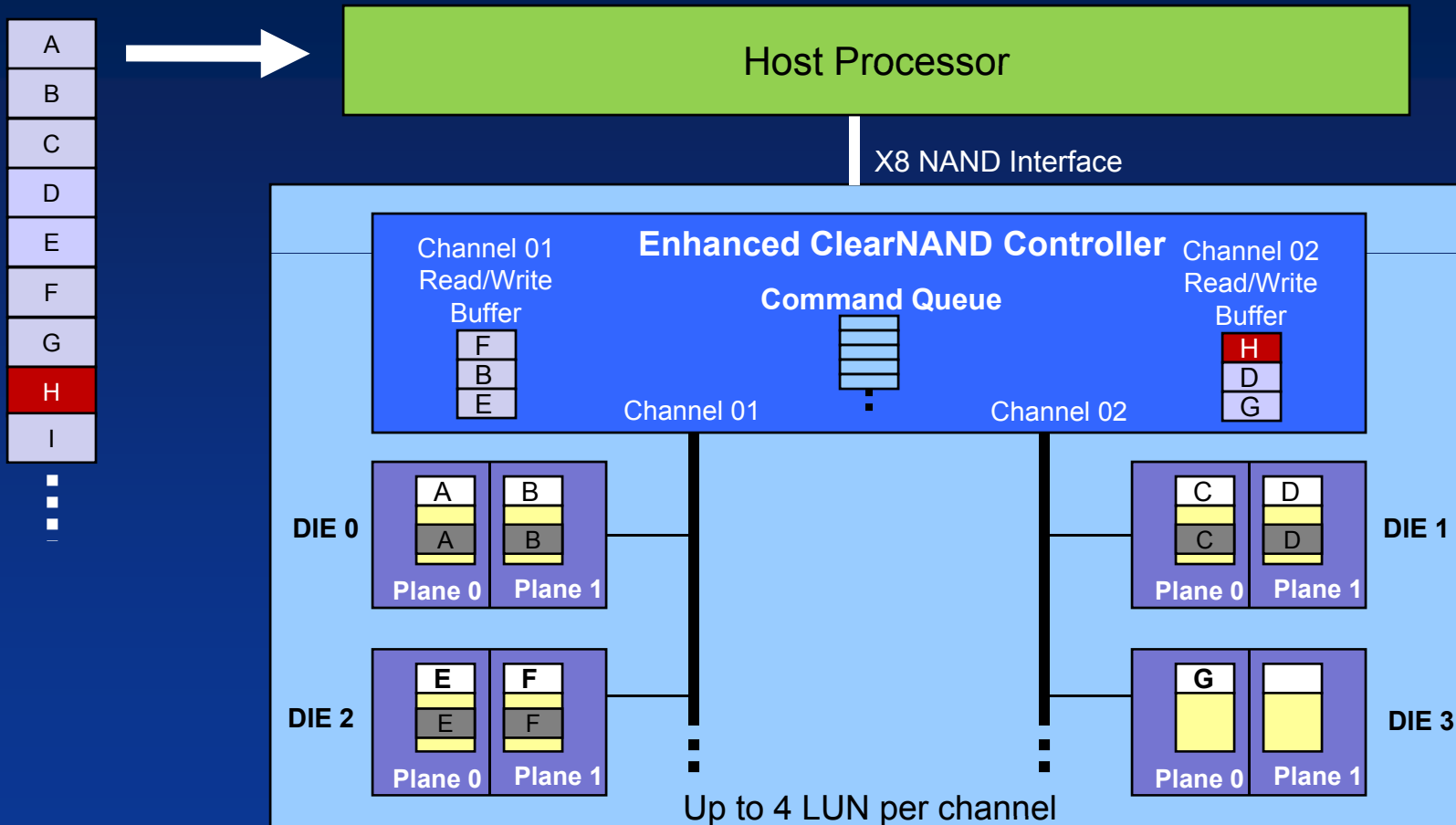
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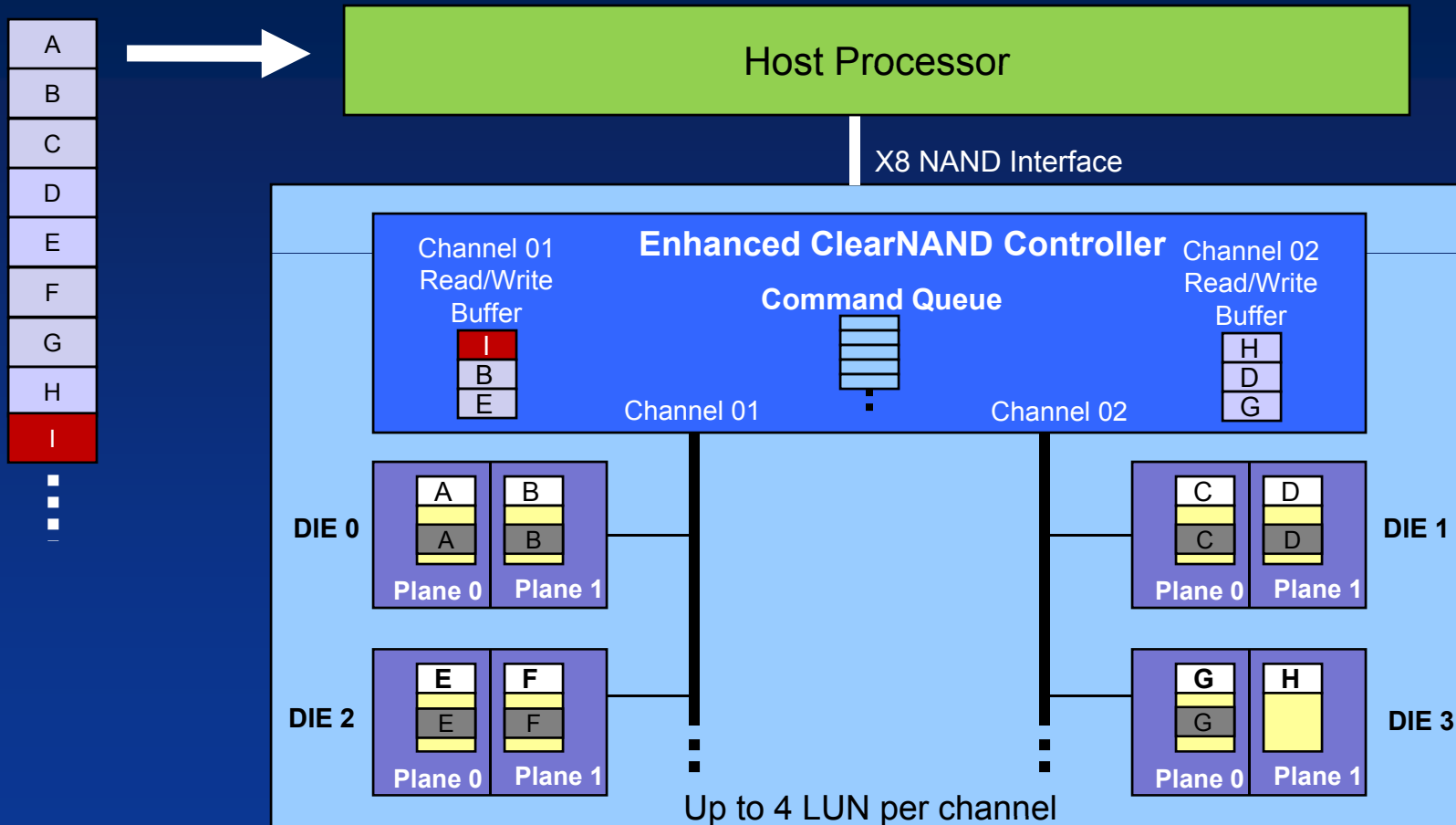
Enhanced ClearNAND Flash



Enhanced ClearNAND Flash



Enhanced ClearNAND Flash



- EZ-NAND allows host to optimize NAND usage for each application
- Additional features are available based on internal controller capabilities
- Enhanced ClearNAND provides **flexible** NAND solution to suit many applications

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