ONFi 3.0: The Path to 400MT/s NAND Interface Speeds

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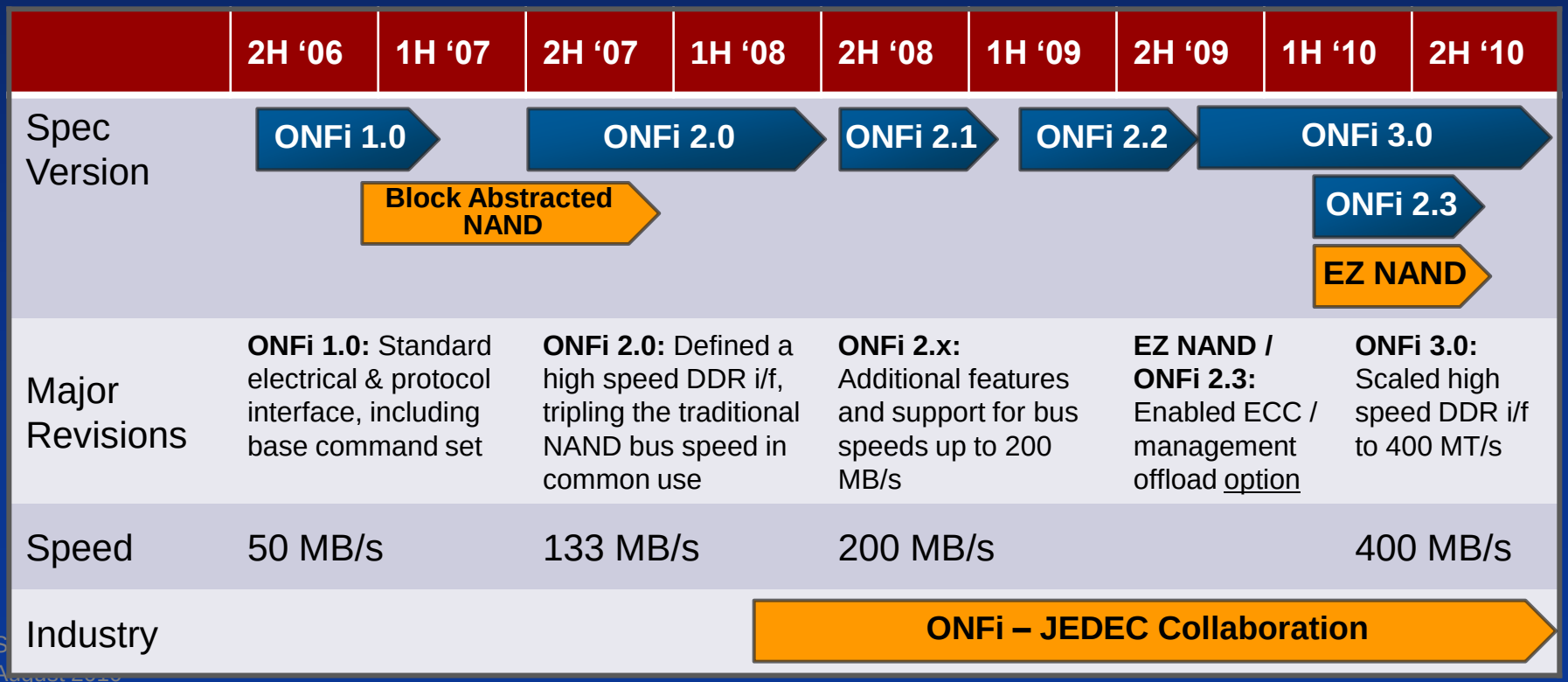
ONFi Workgroup produces results!

- ONFi has and continues to deliver innovation & interoperability enabling faster NAND adoption



ONFI – JEDEC Collaboration

JEDEC and the Open NAND Flash Interface Workgroup Collaborate on NAND Standardization Defining a Next-Generation NAND Standard wtih Global Reach

Arlington, VA - May 30, 2008 - JEDEC and The Open NAND Flash Interface Workgroup (ONFi) announced today that they have entered into a collaborative agreement under which they will work together to develop NAND flash specification(s). ONFi is submitting the ONFi 2.0 specification as part of this joint effort. The goal of this joint activity will be to unify the industry and develop a standard which is backward compatible with existing flash interface technologies, including ONFi 2.0……..

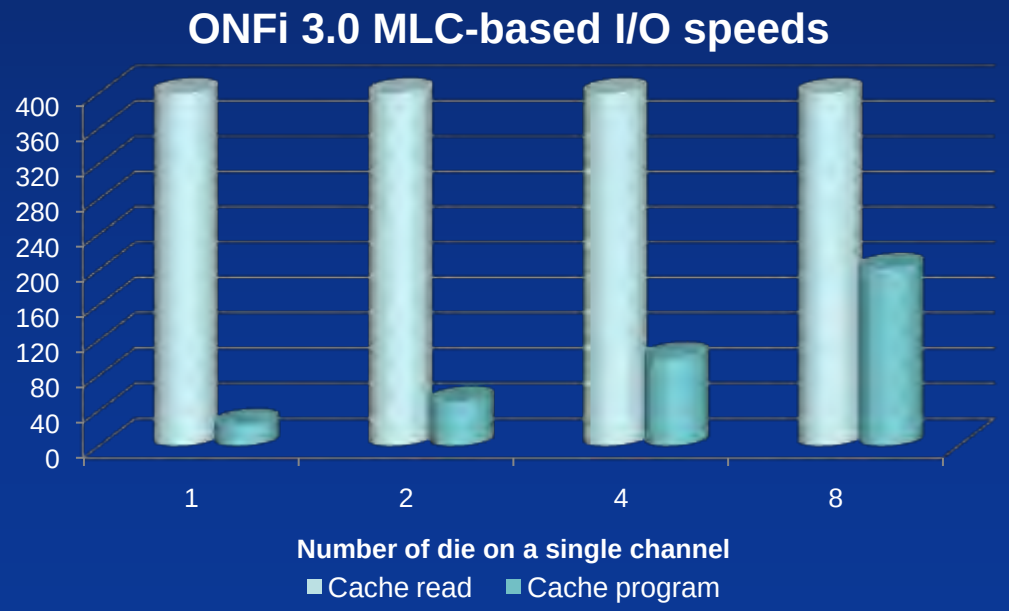
- Goal of harmonizing ONFi and Toggle Mode
- 200 MT/s compatibility: command set, packaging, impedance, etc
  - This specification is ~6 months away
- 400 MT/s: Achieve compatibility for data interface. Specification will be actively developed after 200 MT/s specification is completed

ONFi 3.0 Overview

- ONFi 3.0 will enable speeds up to 400 MT/s
  - Differential signaling
  - Control signal reduction with Volume addressing
  - On Die Termination
  - Reduced input voltage requirements
  - External Vref
  - Maintain backwards compatibility

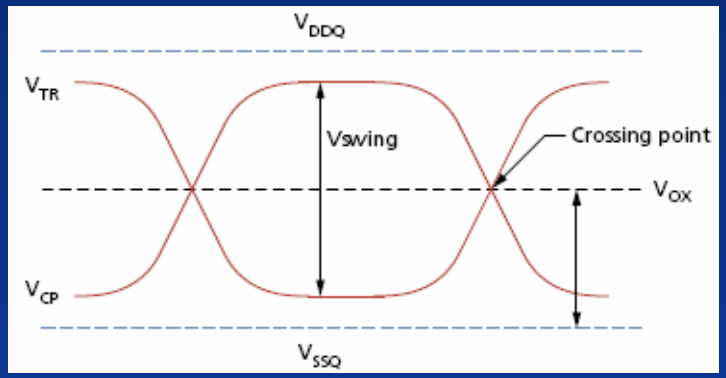
Achieving 400 MT/s

- Highly dependent on form factor and topology
  - How many devices per channel?
  - How many packages per channel?
  - Distance from host controller to NAND technology?
  - PCB trace widths and spacing

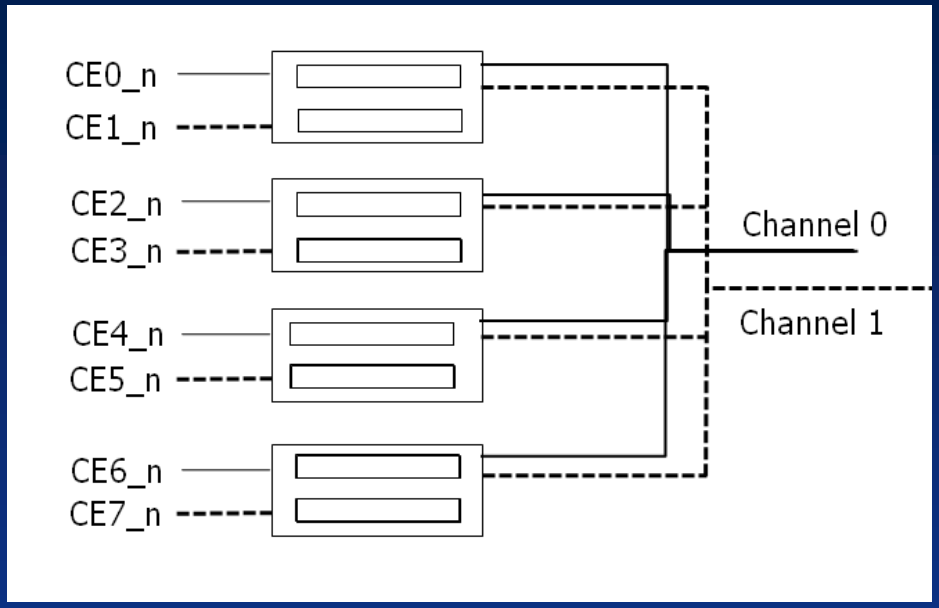


Differential Signaling

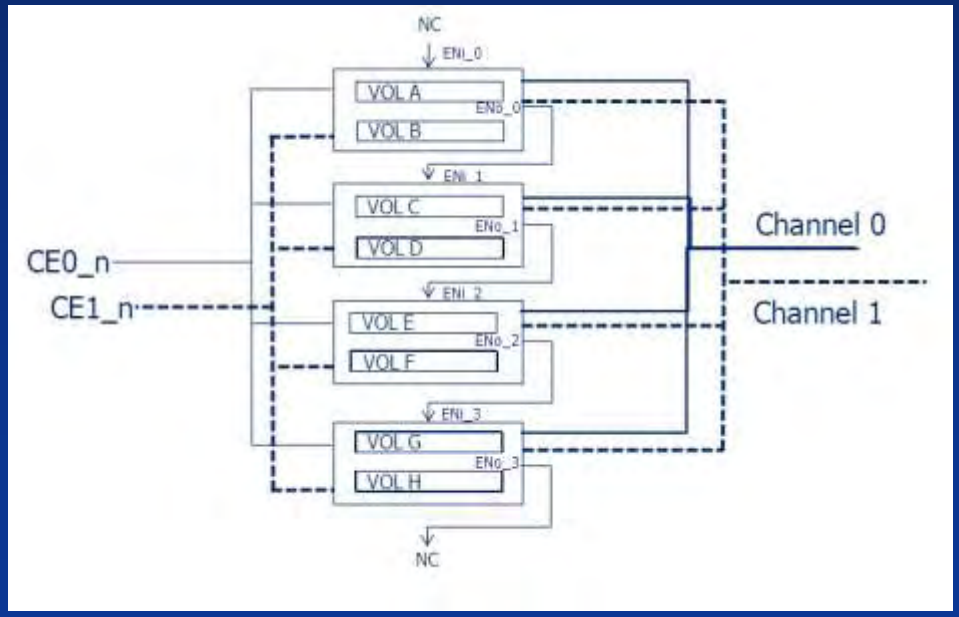
- ONFi 3.0 adds differential signaling for DQS and RE
  - Independent enablement of RE and DQS
  - Immunity to GND noise
  - Immunity to Cross Talk
  - Small voltage swings reduce power



CE_n Reduction



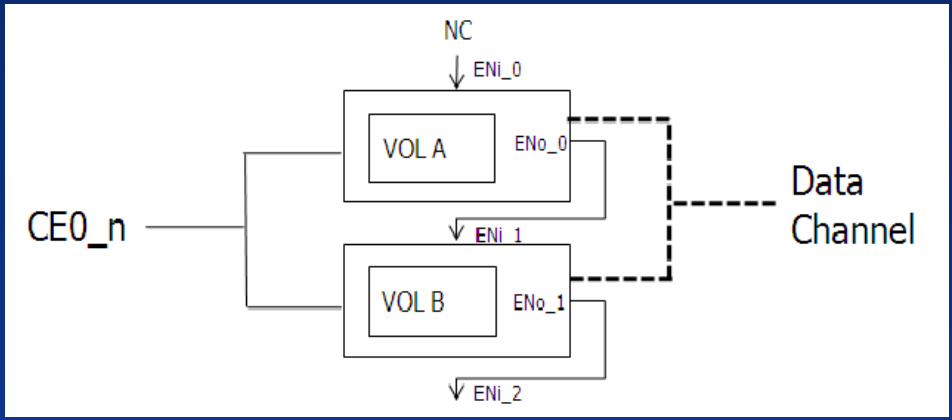
Discrete CE_n per package



CE_n Reduction

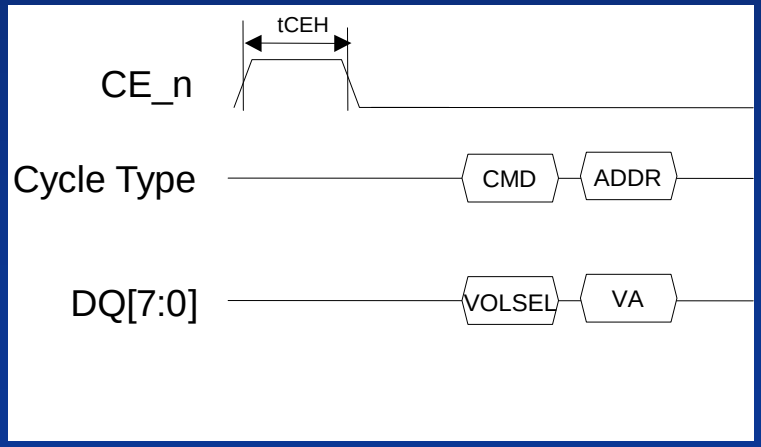
Mechanism for Volume Appointment

- Simple Example of Volume addressing
  - Host appoints Volume address at initialization



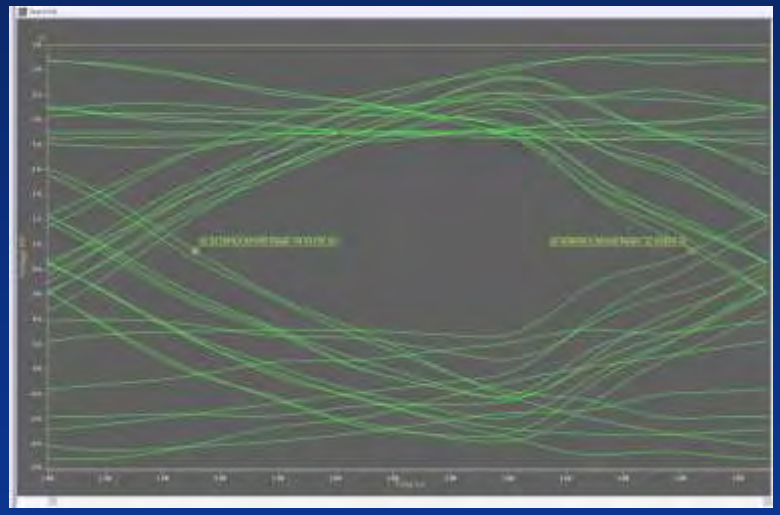
Volume addressing

- Operation using volume addressing
  - CE_n is brought high and then low
  - Volume Select command is issued by host to select target volume
  - Non-target Volumes are deselected until next CE_n pulse followed by Volume Select command
- Volume interleaving can be used to improve performance

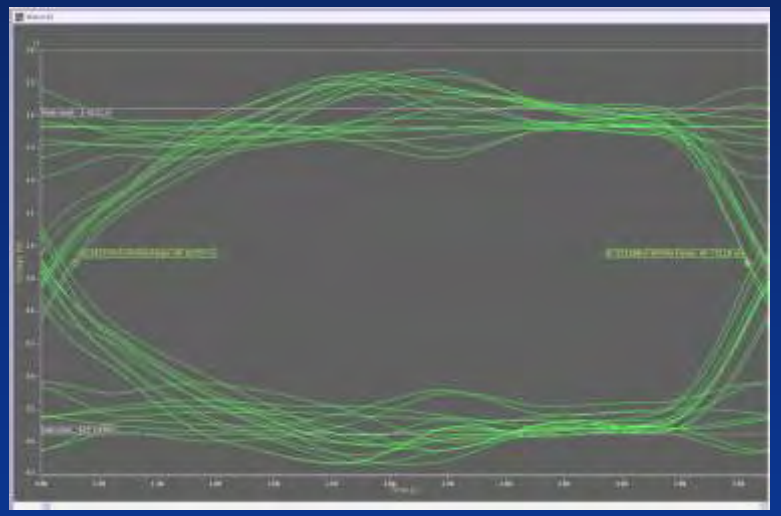


Benefits of On Die Termination

- ODT is a key enabler for 400 MT/s operation
  - RE, DQS, and DQ[7:0]
- Data eye with and without termination at 400 MT/s



No Termination



Termination

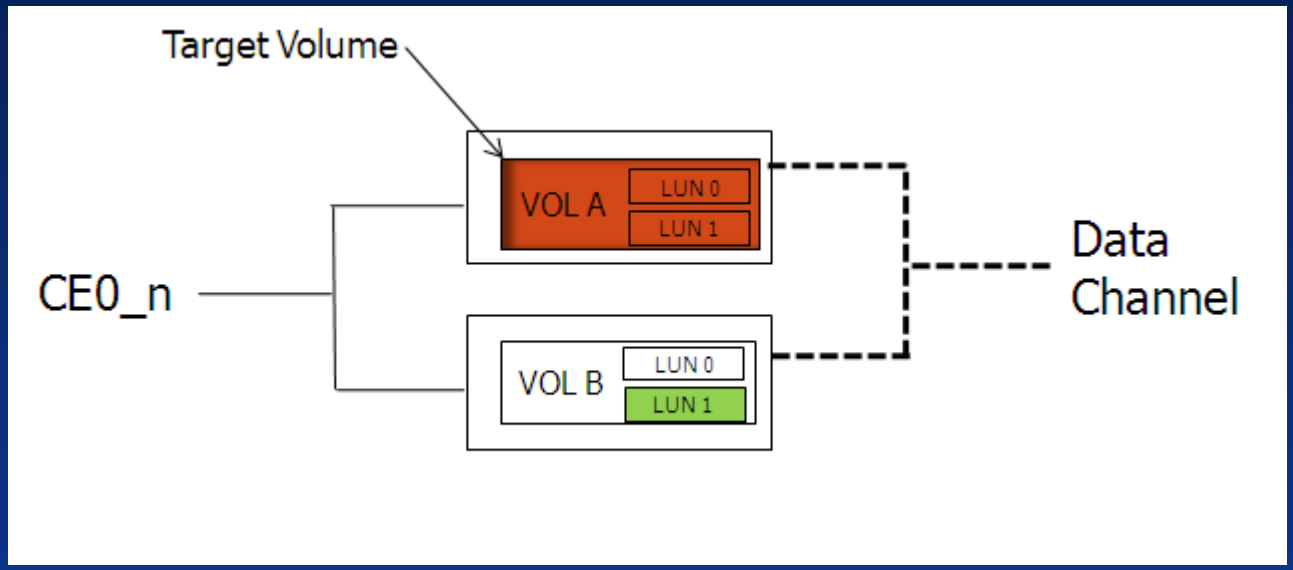
On Die Termination

- Each LUN (die) may be the terminator for any volume
  - Terminator for its volume: Target termination
  - Terminator for another volume: Non-target termination
- At initialization, the LUN is configured with the volumes it will terminate for
  - This provides a very flexible termination matrix
- If Volume Select command is issued to a volume the LUN is the terminator for, it stays partially active and terminates when data is transferred

Volume	7	6	5	4	3	2	1	0
Volume Byte 0	VOL7	VOL6	VOL5	VOL4	VOL3	VOL2	VOL1	VOL0
Volume Byte 1	VOL15	VOL14	VOL13	VOL12	VOL11	VOL10	VOL9	VOL8

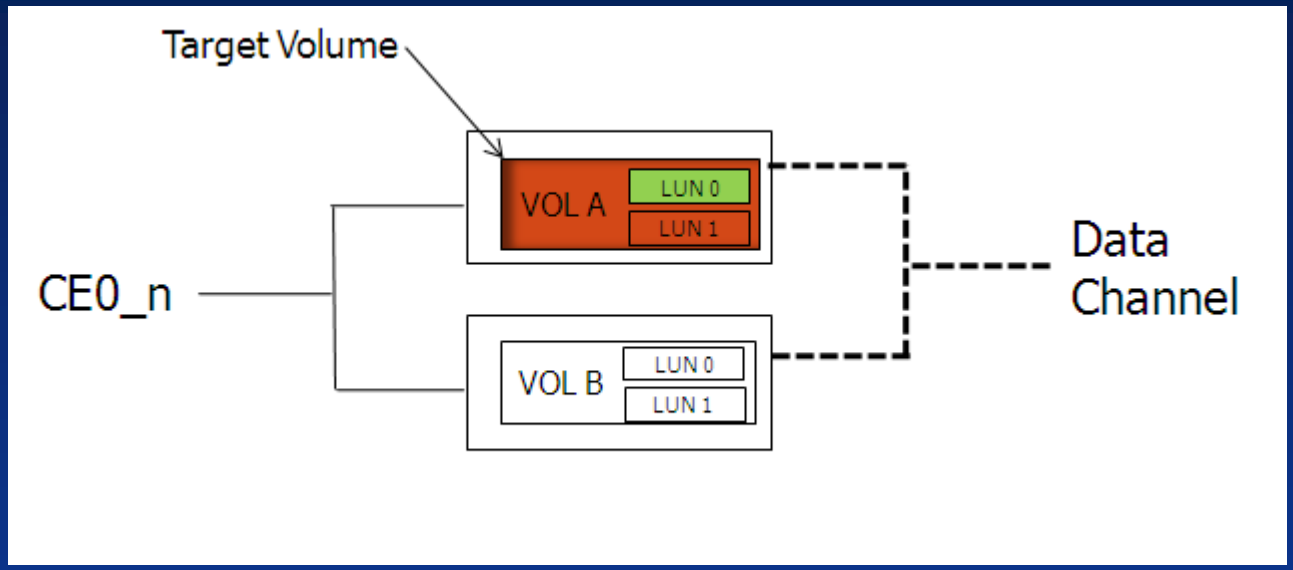
Matrix of Volumes that LUN may enable termination

Flexible Termination Matrix



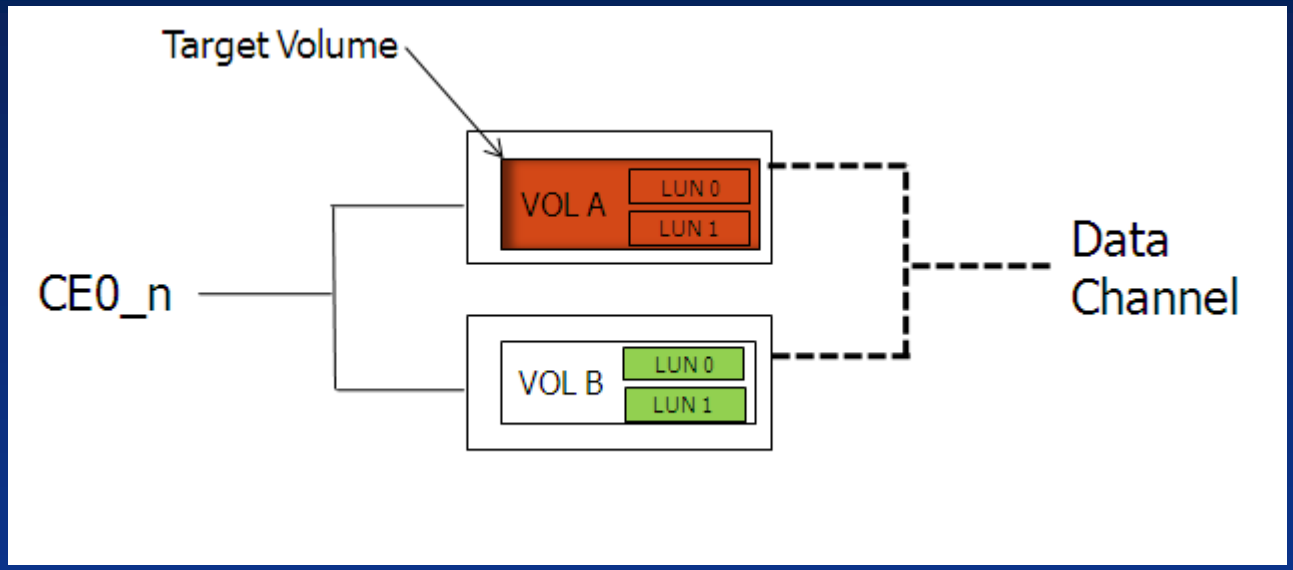
NON-TARGET TERMINATION EXAMPLE

Flexible Termination Matrix



TARGET TERMINATION EXAMPLE

Flexible Termination Matrix



PARALLEL NON-TARGET TERMINATION EXAMPLE

Reduced Input Voltage Requirements

- SSTL_18
  - 400 MT/s only supported at 1.8V VccQ
  - Industry standard that is easily adaptable
  - Allows for higher speeds and lower power consumption
- External Vref
  - VccQ/2
  - Allows for tighter setups/holds due to controlled reference
  - Reduces effects from external GND bounce

Backwards Compatibility

- ONFi 3.0 adds “Enhanced” Sync DDR for up to 400 MT/s that is enabled with Set Features command
- “Conventional” Sync DDR up to 200 MT/s and Async interface are still supported.
- ONFi 3.0 features to reach 400 MT/s are designed to be enabled independently on a system required basis allowing system designer cost vs. performance flexibility.
- ONFi 3.0 is compatible with ONFi-JEDEC Joint Task Group standardization efforts

Summary

- ONFi 3.0 is coming soon!
  - ONFi will be published by the end of the year
  - Enabling 400 MT/s interface speeds
  - Features designed with flexibility for system designer
  - CE_n reduction for cost savings
  - Volume addressing for ODT flexibility