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Ultra-320 SCSI Calibration Strategy
00-105r1

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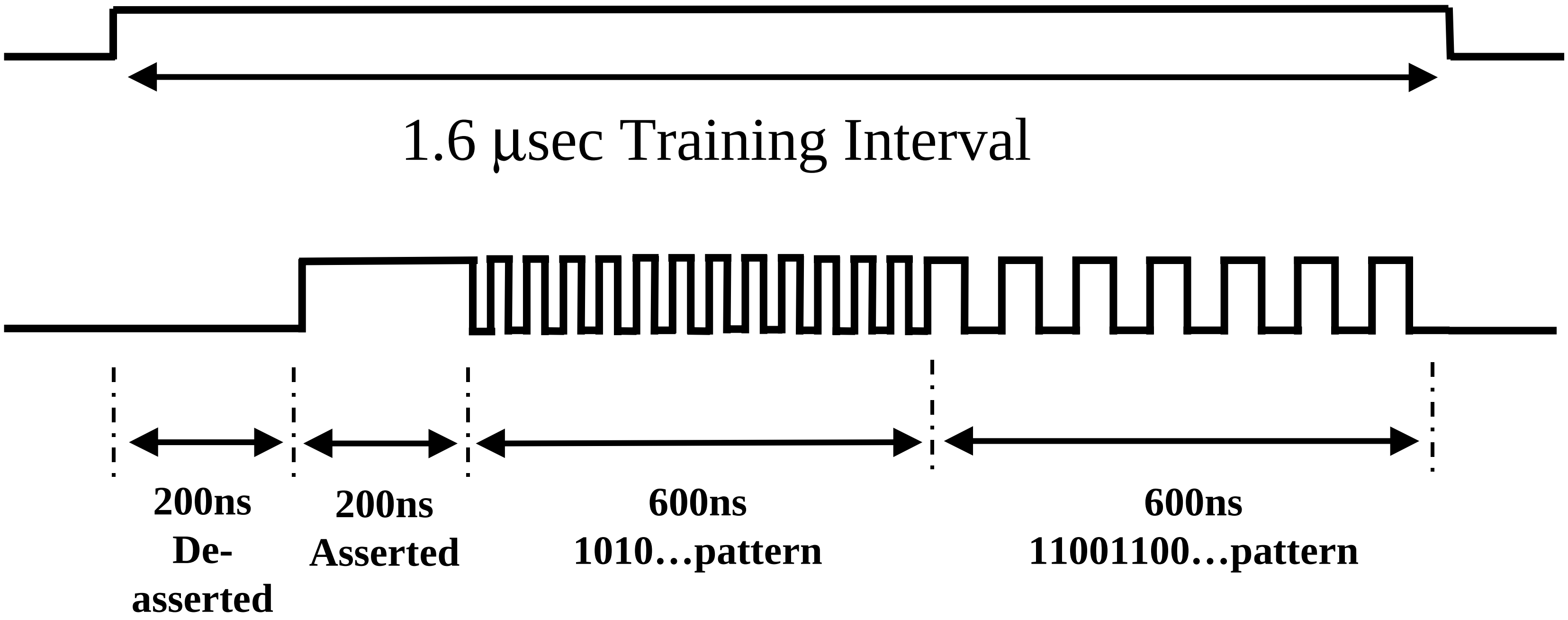
Objectives

- Discuss calibration and training pattern requirements
- Propose a flexible training pattern suitable for various timing de-skew and other receiver adjustment techniques
- Discuss calibration options for Ultra-320 SCSI.

CAL and Training Pattern Requirements:

- Provide for calibrations with sufficient stability to withstand infrequent re-CALs
- Minimize protocol overhead
- Simple implementation in protocol and hardware
- Adequate pattern length to accommodate calibration with averaging for timing de-skew and other receiver calibrations as required.
- Allow flexibility for various vendor-specific CAL circuit techniques by including:
  - Settled asserted and de-asserted LVD levels
  - Isolated rising and falling edges
  - Maximum frequency 101010 and lower frequency 11001100 patterns

Proposed Training Pattern



CAL Stability Issue

- All Calibrations must be stable over longest data transmissions (can be msec range).
  - Switching from Transmit-to-Receive will cause receiver chip temperature changes during a data transmission (receive power is much lower).
  - Power supply changes due to other activities during a data phase (eg. Disk Drive Seek or Servo-Idle-Read sequencing) could also affect cal settings.
- Expected short-term power supply and temperature factors will be comparable to long term changes in ambient power supply and temperature, therefore:
  - CAL circuitry must be designed with good stability over power supply and temperature
  - Minor Update CAL with each data transmission is not expected to have a significant CAL accuracy advantage over less frequent Major CALs

CAL Strategy Options

- Calibration options for Ultra-320 SCSI.
  - **A:** Major CAL at start of each transmission
  - **B:** Host-initiated Major CAL on system commands, plus Minor Update CAL on each transmission
  - **C:** Host-initiated Major CAL on system commands

A: Major CAL at start of each transmission

- Pros:
  - No need to store CAL data for multiple targets & initiators
  - CAL sequence built into the data phase
- Cons:
  - All CALs must be full-range and not just updates, because there is no guarantee of CAL interval
  - Overhead is high on short transmissions
  - Minimizing CAL time restricts the use of averaging, and multiple calibrations

CAL Strategy B

B: Host-initiated Major CAL on power-up, timer, or detected error; plus Minor Update CAL on each transmission:

- Pros:
  - Works well with frequent short transfers
- Cons:
  - Update CAL duration is overhead on every data transmission
  - Must store CAL data for multiple targets & initiators
  - Requires CAL control sequences for both major and update CALs

C: Host-initiated Major CAL only, on power-up, timer, or detected error:

- Pros:
  - Least overhead of A, B or C
  - Single CAL protocol sequence
  - Allows time for a flexible training pattern
    - accommodates multiple calibrations
    - accommodates different vendor-specific calibration techniques
  - Allows time for calibration averaging
    - better CAL accuracy
- Cons:
  - Must store CAL data for multiple targets & initiators

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Cal Strategy Pro/Con Summary

	CAL Strategy		
Requirement	A	B	C
Protocol Overhead	👎	👎	👍
Complexity	👍	👎	👍
Memory Requirements	👍	👎	👎
Flexibility	👎	👍	👍
Averaging	👎	👍	👍

CAL Strategy Conclusions

Recommended Approach:

- Host-Initiated Major CAL only, on power-up, timer, or detected error:
  - Least transmission time overhead
  - Least impact on control and signaling
  - Maximum flexibility for CAL approaches and averaging
  - CAL circuit stability vs. temperature and voltage is required in all A, B, or C strategies
    - Temperature and supply voltage changes during a data phase, e.g. due to IC power changes on Transmit-to-Receive mode change, expected to be the most severe stability requirement.
  - Requirement to store CAL data is not severe.