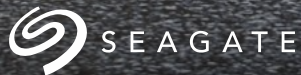




# CU4HDD Coding Options Overview



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# Introduction

- **Presentation Goals:**
  - Continue the conversation on the coding options for 2.5Gb/s and 5Gb/s
  - Give an overview of the options as I understand them
  - State my current opinion on the topic
- 8b/10b implies 8b/10b with no scrambling
- 64b/66b implies 64b/66b with scrambling
- Ethernet rates expressed in units of data rate
- SAS rates expressed in units of line rate (up until SAS4)

# 8b/10b

- 8b/10b for both 2.5Gb/s and 5Gb/s
  - Argument For:
    - The Ethernet backplane market has outpaced the 802.3 standard in terms 2.5Gb/s and 5Gb/s support. The market deployed 8b/10b outside of the standard, which implies there are Ethernet backplanes running 8b/10b at both 2.5Gb/s and 5Gb/s rates.
    - 10GBASE-KX4 operates with 8b/10b and has a single lane data rate of 2.5Gb/s
    - Current 1Gb/s Ethernet HDD's use SGMII, which is 8b/10b
    - If the market already has an installed base of 8b/10b based systems, why change it and disrupt the current ecosystem?
  - Argument Against:
    - This approach does not utilize the advancements made in 10GBASE-KR such as more efficient encoding, scrambling, and training.
    - Is 5Gb/s robust enough without these advancements?

# 64b/66b

- 64b/66b for both 2.5Gb/s and 5Gb/s
  - Argument For:
    - There is currently no 2.5Gb/s or 5Gb/s backplane standard, which implies we can utilize the work done for 10GBASE-KR and scale the bit rate.
    - Encoding will be consistent across 2.5Gb/s, 5Gb/s, and 10Gb/s
    - A scrambler is used in combination with 64b/66b encoding, providing more robust receiver training
    - Provides the option for transmitter training
  - Argument Against:
    - This does not account for the fact that the market has already moved to 8b/10b encoding for 2.5Gb/s and 5Gb/s
    - Consistency should be secondary to any technical merits
    - If it's not broken, why fix it?

# 8b/10b and 64b/66b

- 8b/10b for 2.5Gb/s and 64b/66b for 5Gb/s
  - Argument For:
    - Utilizes the strengths of the 1<sup>st</sup> two options
    - 2.5Gb/s has enough margin with 8b/10b, so stay with it to keep in line with the current Ethernet backplane ecosystem
    - Use 64b/66b with scrambling to make 5Gb/s more robust
      - Receiver training and operation will be more robust with scrambled data
      - Transmitter training is an option
  - Argument Against:
    - If we're defining a new standard, why don't we have consistent encoding across the new rates?

# Conclusion

- Current preference is 8b/10b for 2.5Gb/s and 64b/66b for 5Gb/s
  - The current Ethernet backplane ecosystem utilizes 8b/10b encoding
  - Based on 3Gbps SAS experience, my assumption is that 2.5Gb/s will be robust with 8b/10b encoding
  - Based on 6Gbps SAS experience, I'm not convinced that 5Gb/s with 8b/10b will be robust enough
    - **6Gbps SAS is 8b/10b encoded, uses data scrambling , and has receiver training**
    - **Further group discussions with Ethernet experts are needed**
  - Supporting multiple coding schemes is common in other standards
    - **USB, PCIe, and FCAL currently support multiple coding schemes depending on bit rate**
    - **SAS4 will transition from 8b/10b as well**