

# Comment R1-2: issues with “symbol” in p802.3cx

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# “symbol” in IEEE Std 1588-2019

- IEEE 1588-2019 does not define “symbol”
- In IEEE Std 1588-2019 "message timestamp point" is defined in clause 7.3.4.1 as: "Unless otherwise specified in a transport-specific annex to this standard, the message timestamp point for a PTP event message shall be the beginning of the first symbol after the start of frame delimiter."
  - This seems to match the definition used in P802.3cx D3.1.
  - The term “symbol” is unclear in this clause in IEEE 1588: is it referring to a serial symbol (bit), octet, or PHY-type-specific symbol?
- As used elsewhere in IEEE 1588, symbol refers to UTF-8 characters, octets, bits, or 10-bit 8B10B symbol

# “symbol” in IEEE Std 802.3-2018

- In clause 1.4.466, IEEE Std. 802.3-2018 defines "Symbol" as "Within IEEE 802.3, the smallest unit of data transmission on the medium. Symbols are unique to the coding system employed. For example, 100BASE-T4 and 100BASE-T1 use ternary symbols; 10BASE-T uses Manchester symbols; 100BASE-X uses binary symbols or code-bits; 100BASE-T2 and 1000BASE-T uses quinary symbols. For 1000BASE-X PMDs operating at 1.25 GBd, a symbol corresponds to a code-bit after the 8B/10B encoding operation i.e., has the duration of 0.8 ns. For 10GBASE-R PMDs operating at 10.3125 GBd, a symbol corresponds to a code-bit after the 64B/66B encoding operation i.e., has the duration of approximately 0.097 ns."

# Corrections to my comment

- I stated "A single symbol may contain both the SFD and the first nibble/octet/bit/etc. after the SFD. An example is a 64B66B encoded data, where the same symbol may contain both the SFD and the first octets of the data. It is not clear if the "first symbol after the SFD" is the 64B66B symbol that includes both the SFD and the following octets or the 64B66B symbol following this symbol
- The first part is correct: A single symbol may contain both part of the SFD as well as data following the SFD.
- The example I gave was incorrect – in 64B66B, a symbol would be a bit, not the entire 66 bits of the 64B66B encoding) per the 802.3 definition of symbol.
- A better example would be PAM3 / PAM4 / PAM5 / PAM16 where a single symbol or set of symbols could include both parts of the SFD as well as data following the SFD.

# Issues with PAMx

- A symbol or set of symbols may represent some number of bits
- Examples
  - Clause 96 (100BASE-T1) PAM3
    - 3 bits of data are converted to 2 symbols of PAM3
    - First data bit following SFD will always be in a symbol covering the last bit of SFD and the first two bits of data. First bit of SFD will always be in a symbol covering the last 2 bits of preamble prior to SFD as well as the first bit of SFD.
  - Clause 126 (2.5GBASE-T and 5GBASE-T) PAM16
    - After 64B65B and LDPC each 4 bits of data are mapped to a PAM16 symbol
    - Due to the use of 64B65B encoding, SFD and data can start at any bit offset within the PAM16 symbol
    - LDPC blocks are aligned to symbol boundaries, so if the recommendation to use start of FEC block is used, the issues are avoided

# Proposed fix

- change every instance of "first symbol after SFD" to "the symbol representing the first data bit after the SFD".
  - Note that this is different than the text originally proposed in the comment: "the symbol containing the first data bit after the SFD"
- The comment proposed adding text to annex 90A explaining how to interpret this for different types of symbols, but I think this would be better done in clause 90.7. Here is my proposed text:
- "For a PHY that atomically maps N bits to M symbols (such as 100BASE-T1 in Clause 96 that uses 3B2T to convert 3 bits to 2 symbols), the path data delay measurement should use the start of the first symbol as the time event used for any of the N bits encoded in the M symbols."