Proposed changes to D1.2 for Clauses 147 and 45

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Contributors

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Outline

- Proposed Clock Accuracy specification
- Proposed Differential Decoding Changes
- Proposed Preamble/BEACON changes

Comment #365 147.5.3.4 Transmit clock accuracy

Proposed Text:

147.5.3.4 Transmit clock frequency

The symbol transmission rate shall be within the range 12.5 MBd ± **100** ppm.

Reason:

802.1AS-2011 [1] Annex B.1.1 Frequency accuracy specifies:

"frequency offset of local clock relative to TAI* frequency shall be within ± 100 ppm."

*temps atomique international

Comments #366, #367, #374 Differential Detection

- Background: [2] presented case for differential detection.

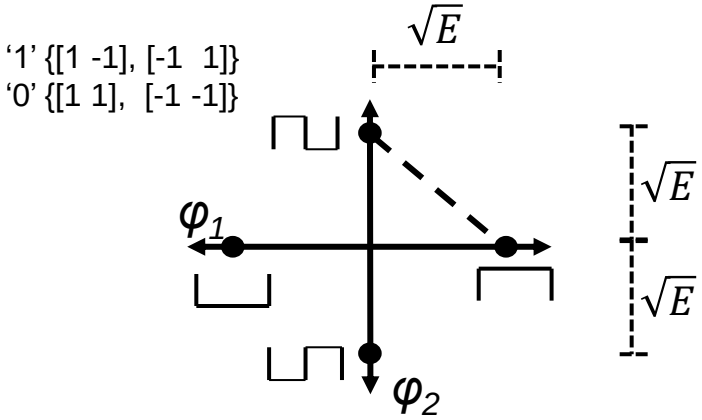


Figure showing Orthogonal Detection Symbol Distance

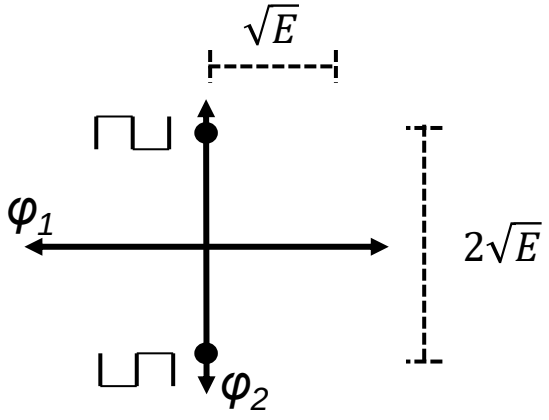


Figure showing Differential Detection Symbol Distance

- Increased signal distance improves performance in any type of noise.
- comments #366, #367, #374 address adding trailing DME zero for differential detection

Error Analysis of Differential Detection and Scrambler Error Propagation

Using Beruto [3] terminology (G(x)=CRC32, D(x)=Payload, S(x)=Scrambler Payload, E(x)=scrambler error polynomial=(1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1)

Multiplicative scrambler causes error pattern $D(x)+S(x)*E(x)$ per Beruto.

Let DD(x)=differential error multiplication (11)

Let E'(x)=DD(x)*E(x)=(1 1 0 1 1 0 0 0 0 0 0 0 0 0 0 0 1 1)

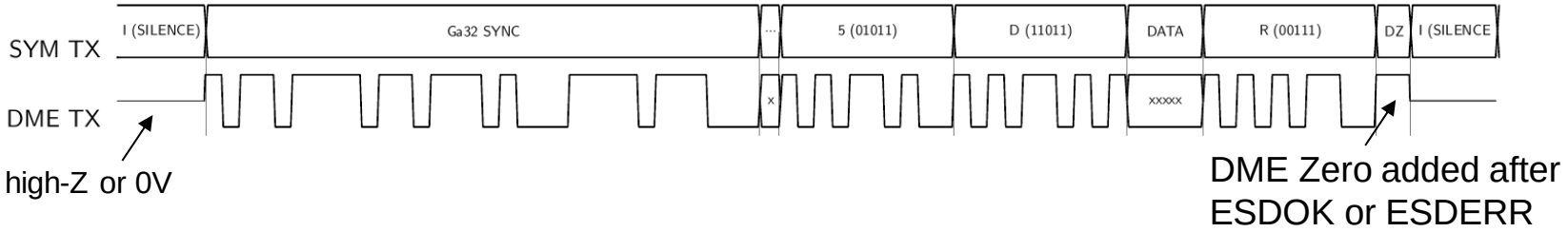
$$\frac{D(X)+S(X)*E'(X)}{G(X)} = \frac{D(X)}{G(X)} + \frac{S(X)*E'(X)}{G(X)}$$

$\frac{E'(X)}{G(X)}$ has no residue (E'(x) is not divisible by G(x) over GF(2))

Multiplicative scrambler error propagation combined with differential detection error propagation will not compromise the CRC performance.

Propose changes to add DME Zero suffix to ESDERR or ESDOK.

Proposed Changes for Differential detection

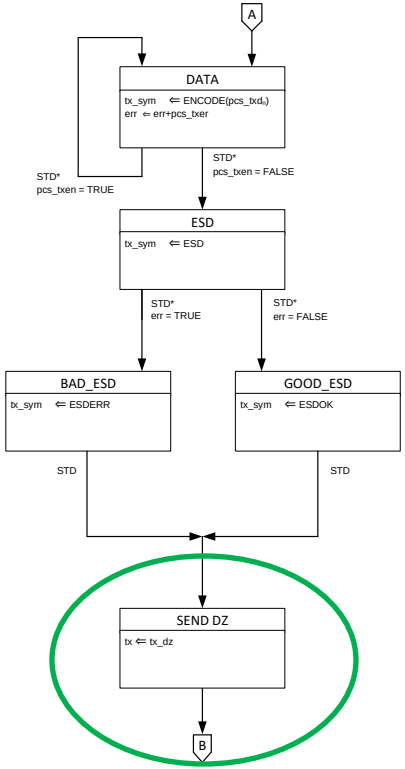


380 Figure 147-9 – Example DME Encoding of 5B Symbols

- #367 **147.3.2.1 PCS Transmit overview** Insert text after first paragraph on page 134, line 2

  Following the deassertion of TX_EN, the PCS Transmit generates a special code ESD, followed by either ESDOK or ESDERR when a transmit error is encountered. *ESDOK or ESDERR is followed by a DME zero to assist in differential decoding.*

Comments #374 Figure 147-5 & #366



#374 Figure 147-5 – PCS Transmit state diagram (2 of 2)

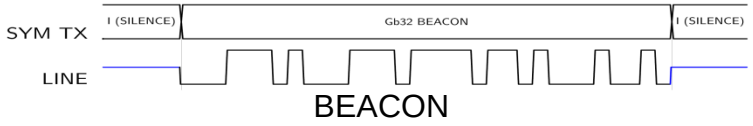
{place page 134 line 3 sec 147.3.2.1}

- After the 5B ESDOK or ESDERR symbol, a logical zero bit tx_dz is transmitted as an end delimiter. The purpose of this DME zero bit end delimiter is to assist in differential decoding of the DME 10BASE-T1S packet. See figure 147-9 and figure 147-5.

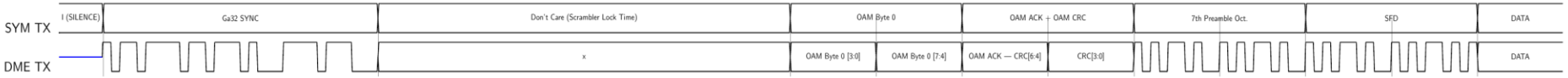
{place below on page 134 line 42 sec 147.3.2.2 between tx_cmd and tx_sym}

- tx_dz An end delimiter consisting of a logical zero.

Proposed BEACON & Preamble Format



BEACON



Preamble

- Proposed preamble is 2-Level and consists of Ga32
- + 24 bits to align scrambler.

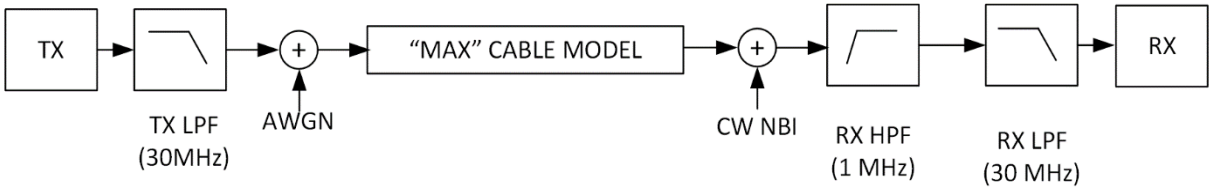
  + Remainder of preamble:

  Optional OAM byte + OAM ACK & OAM CRC + 7th preamble octet and SFD
- Add registers in Clause 45 for optional cable diagnostics.
- Synchronization performance shown in [2] is the same.

Matched Filter

- Good synchronization can give improved detection if using a matched filter.
- The matched filter receiver will have better SNR, (in AWGN and lots of other types of noise), at the correct sampling point, than any other receiver which doesn't have *a priori* information about the channel and noise.
- If we can agree on 178mV_{RMS} noise represents a reasonable worst-case CW target [4], how does the receiver perform decoding DME with CW noise after synchronizing with proposed Ga32 SYNC?

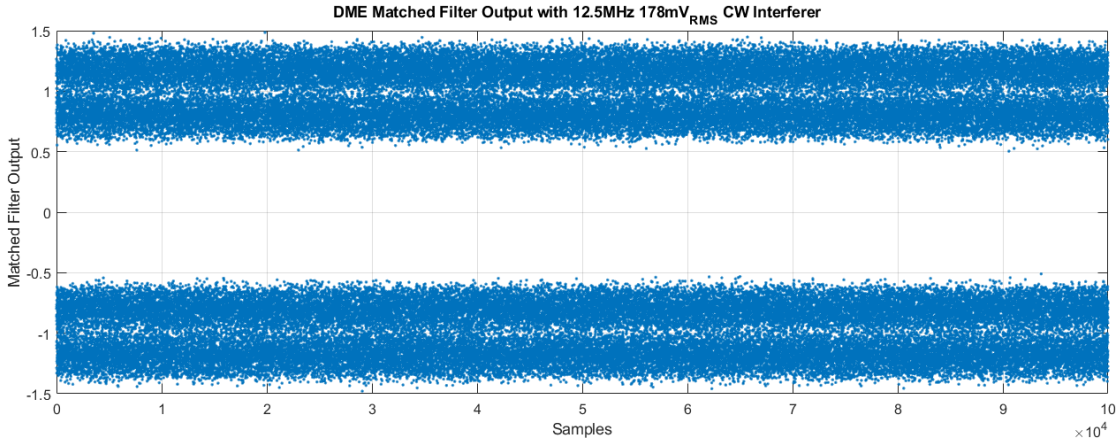
Simulation Setup



- Preamble: Ga32 SYNC (Proposed)
- TX Voltage: 1V pk-pk
- TX filtering: 2nd order Butterworth
  - fc of 30MHz
- White noise: -30dBc added
- H(t) "Max" Cable model. 100BASE-T1 cables and magnetics.
- Node 2->Node3 presented.

- CW interference: 0.178V_{RMS} @12.5MHz (0° phase offset)
- RX Filtering:
  - 1st order HPF fc of 1 MHz.
  - 2nd order Butterworth RX LPF fc 30MHz.
- RX: Synchronize on Ga32 SYNC, run through DME matched filter 100K bits.

Simulation Result



Robust synchronization allows DME receiver to meet target BER requirement even with 178mV$_{RMS}$ interferer.

Comments #378, 372, 368

#378 **147.3.7.1 Generation of BEACON indication**

(Line 10) …When a Gb32 BEACON is received (see Table 147-2), the MII signals RX_DV, RX_ER and RXD shall be set to the BEACON indication as shown in Table 22-2, overriding the current state. Override shall cease as soon as the the BEACON timer has expired…

#372

Name	Sequence	Special Function
Ga32 SYNC	1 0 1 1 0 1 1 1 1 0 1 1 0 1 1 1 0 1 0 0 0 1 1 1 1 0 1 1 1 0 0 0	SYNC / Cable Diagnostics
Gb32 BEACON	0 0 0 1 1 1 0 1 0 0 0 1 1 1 0 1 1 1 1 0 1 1 0 1 0 0 0 1 0 0 1 0	BEACON / Cable Diagnostics

Table 147-2 Special Function Encoding

147.3.2.1 PCS Transmit overview

Upon the assertion of TX_EN, the PCS Transmit function passes the Ga32 SYNC word to the PMA, which replaces the first 16 bits of the preamble. After the Ga32 SYNC word, 24 bits of data are transmitted. It is recommended the data be random to prevent the multiplicative scrambler from aligning with the payload and causing a peak emissions issue. Twenty-four bit times after Ga32 SYNC word, if OAM is supported, two OAM octets are transmitted into 5B symbols using the encoding rules specified in Table 147-1. After the two OAM words, starting with the 7th preamble octet, TXD is encoded into 5B symbols using encoding rules specified in Table 147-1, until TX_EN is deasserted. If the PMA does not support OAM transmission, 24 bit times after the Ga32 SYNC word, TXD is encoded into 5B symbols using encoding rules specified in Table 147-1, until TX_EN is deasserted.

Conclusion

- Change clock tolerance to ± 100 ppm to support 802.1AS
- Add DME zero to end of packet to support differential detection at receiver
- Adopt proposed Ga32 SYNC preamble and Gb32 BEACON for improved synchronization and decoding performance.

References

[1] IEEE Std 802.1AS-2011

https://standards.ieee.org/findstds/standard/802.1AS-2011.html

[2] “Proposed Preamble: Synchronization and Harness Defect Detection” J. Cordaro
http://www.ieee802.org/3/cg/public/adhoc/cordaro_3cg_06_0418.pdf

[3] “EEE802.3cg TF T1S scrambler proposal” P. Beruto & A. Orzelli
http://www.ieee802.org/3/cg/public/adhoc/beruto_3cg_scrambler.pdf

[4] “Follow-up to 10BASE-T1S Immunity Measurements” J. Cordaro
http://www.ieee802.org/3/cg/public/adhoc/cordaro_3cg_05_04418.pdf