**x.x.x FEC encoding process**

The {1000BASE-T1} stream is Reed-Solomon (RS) encoded using a (450, 406) code over GF(512) for forward error correction (FEC). This code can correct up to t = 22 symbol errors per RS code block.

The RS encoder implementation is described in this subclause. A systematic encoder is utilized to implement a (450,406) RS code over GF(512). The primitive polynomial used to form the field GF(512) is:



with a primitive element  satisfying .

The RS code generator polynomial used by encoder is



Inputs to the RS encoder consists of 406, 9-bit symbols, starting with first symbol $m\_{405}$ and ending with last symbol $m\_{0}$ . For each group of 9-bit output from the PCS encoder, where  is the first bit in time and  is the last bit in time, they are mapped to a RS symbol  with the field representation.

The message polynomial input to the encoder is described by:



This message polynomial is first multiplied by, and then divided by the generator polynomial g(x) to form a remainder, described by:



The generated code word can now be presented by the following polynomial:



The output from the RS encoder is:



where the order is from left to right.

x.x.x. **Two dimensional PAM3 and 3B2T mapping**

After RS encoding, the output bits stream of the encoder (with or without doing scramble) must be mapped to a 2-dimensional (2-D) PAM3 ternary stream. The 2-D PAM3 constellation and the mapping are described in this subclause.

Denote the output bit stream of the RS encoder (with or without scramble) by, where is the first bit out from the encoder. The three bits tuple, where is the least significant bits (LSB), must be mapped to a ternary pairin a 2-D PAM3 constellation, where is transmitted first. The final transmitted ternary sequence is , where the first transmitted ternary symbol is .

The detailed 2-D PAM3 constellation and the 3-bit to 2 ternary (3B2T) mapping are depictured in Figure xxx.a.

-1

0

1

1

0

-1

101

100

110

001

111

000

010

011

t1

t0

Figure xxx.a 2-D PAM3 constellation and 3B2T mapping

Moreover, the ordering of the three bits and its corresponded two ternaries is described in Table xxx.x, where and, 

|  |  |
| --- | --- |
| **b2b1b0** | **t1 t0** |
| 000 | -1 -1 |
| 001 | 0 -1 |
| 010 | -1 0 |
| 011 | -1 +1 |
| 100 | +1 0 |
| 101 | +1 -1 |
| 110 | +1 +1 |
| 111 | 0 +1 |

Table xxx.b 3B2T mapping and ordering