The SECDED error processing scheme is based on error detection and correction codes devised by R. W. Hamming.† An 8-bit check byte is appended to the 64-bit data word before the data is written in memory. The 8 check bits are each generated as even parity bits for a specific group of data bits. The Error Correction Matrix shows the bits of the data word used to determine the state of each check bit. An X in the horizontal row indicates that data bit contributes to the generation of that check bit. Thus, check bit 0 is the bit making group parity even for the group of bits 2^1, 2^3, 2^5, 2^7, 2^9, 2^{11}, 2^{13}, 2^{15}, 2^{17}, 2^{19}, 2^{21}, 2^{23}, 2^{25}, 2^{27}, 2^{29}, and 2^{31} through 2^{55}.

The 8 check bits and the data word are stored in memory at the same location. When read from memory, the same 64-bit matrix is used to generate a new set of check bits, which are compared with the old check bits. The resulting 8 comparison bits are called syndrome†† bits (S bits). The states of these S bits are all symptoms of any error that occurred (1 = no compare). If all syndrome bits are 0, no memory error is assumed.

Any change of state of a single bit in memory causes an odd number of syndrome bits to be set to 1. A double error (an error in two bits) appears as an even number of syndrome bits set to 1.

The matrix is designed so that:

1. If all syndrome bits are 0, an error did not occur.

2. If only one syndrome bit is a 1, the associated check bit is in error.

3. If more than one syndrome bit is 1 and the parity of all syndrome bits (S0 - S7) is even, then a double error occurred within the data bits or check bits.

4. If more than one syndrome bit is a 1 and the parity of all syndrome bits (S0 - S7) is odd, and there are 3 ones and a zero in one half of the syndrome code, then a single and correctable error occurred. The syndrome bits can be decoded to identify the 8-bit byte containing the error as well as the altered bit in that byte.

5. If more than two errors occurred, the results are unpredictable.

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† Hamming, R.W., "Error Detection and Correcting Codes," Bell System Technical Journal, 29, No. 2, pp. 147-160 (April, 1950)

†† Syndrome: Any set of characteristics regarded as identifying a certain type, condition, etc. Websters New World Dictionary.