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# An Efficient CDMA System Based on Reed Solomon Code (RS Code)

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***Abstract***

*Accurate Error control is a necessary constraint for the design of Cellular Code Division Multiple Access (CDMA) systems. The Block codes can correct twice as many erasures as errors; the coded performance can be improved. In this paper, we propose 'An efficient Error correcting coding in CDMA systems. The system performance is improved using FEC based on Walsh code and PN sequence. The power consumption of transreceiver is the requirement for low power communication systems such as wireless personal area networks, low data rate networks. The FEC schemes are selected based on its performance. To improve communication robustness, the correcting capabilities shall be seen to determine the transmit power. The probability of incorrect Decoding can be significantly improved using RS codes.*

***Index Terms:*** *Code-Division Multiple Access (CDMA), Reed-Solomon (RS) Code, Coding, Correction.*

## INTRODUCTION

The power consumption of trans-receiver is the requirement for low power communication system, such as wireless personnel area networks, low data networks. The FEC scheme is selected based on its performance.

In this paper, we propose an efficient Error correcting coding in CDMA system. CDMA system can provide resilience to frequency-selective fading channel by transmitting high bit rate data into multiple low-rate streams.

The rest of this paper is organized as follows. Section II describes the review of encoding and decoding of Reed-Solomon (RS) codes the system. Conclusions are given in section III.

## REED SOLOMON CODE

The Reed Solomon codes are defined by RS (n,k). The n symbol codewords are generated with encoder by taking k data symbols and check symbols. The RS codes correct many bit errors because of byte correcting capabilities.

The t error s in codewords is corrected when 2t n- k Reed-Solomon codes are based on finite field arithmetic. The key idea behind a Reed-Solomon code is that the data encoded is first visualized as a polynomial. The code relies on a theorem from algebra that states that any $k$ distinct points uniquely determine a polynomial of degree at most $k$-1.
The sender determines a degree $k-1$ polynomial, over a finite field that represents the $k$ data points. During the transmission the values which are sent are calculated by encoding the polynomial by its various points. As long as appropriate

values are received correctly, the receiver can deduce what the original polynomial was, and decode the original data.

The RS code can bridge a series of errors in a block of data. In the receiver the coefficient s of polynomial that drew the original curve.

At the receiver the codeword is valid codeword c(x) plus any errors R(x). Each codeword is generated using a generator polynomial. All valid codewords are exactly divisible by the generator polynomial. The codeword is generated such that $c(x)=g(x)i(x)$ where $g(x)$ is the generator polynomial, $i(x)$ is the information block, and $c(x)$ is a valid codeword.
The generator polynomial of a primitive t-error correcting RS code of length $2^m$ -1 is.
$g(x) = (x + \alpha)(x + \alpha^2)\ldots\ldots(x + \alpha^{2t})$
$= g_0 + g_1x + g_2x^2 + \ldots. g_{2t-1} x^{2t-1} + x^{2t}$
Where, gi € GF ($2^m$)

Let $c(X)= c_0 + c_1x + c_2 x^2+ \ldots\ldots\ldots c_{k-1}x^{k-1}$ the message to be encoded, where k=n-2t.
And $c_i$€GF($2^m$).
Dividing $x^{2t}$ c(x) by g(x) we have,
$X^{2t}$ c(x) = a(x), g(x) + b(x)
Where $b(x) = b_0 + b_1x + \ldots\ldots b_{2t-1} x^{2t-1}$ is the remainder, Then $v(x)= b(x) + X^{2t}c(X)$ is the Codeword for message c (x).

The symbol error location is found by using two algorithms Berlekamp-Massey algorithm and Euclid's algorithm. The Chien search algorithm is used to find the roots of the error location polynomial. Also, they can be used efficiently on channels where the set of input symbols is large. An interesting feature of the R-S code is that as many as two information symbols can be added to an R-S code of length *n* without reducing its minimum distance. This extended R-S code has length *n* + 2 and the same number of parity check symbols as the original code.

**THE ERROR CORRECTING SYSTEM**

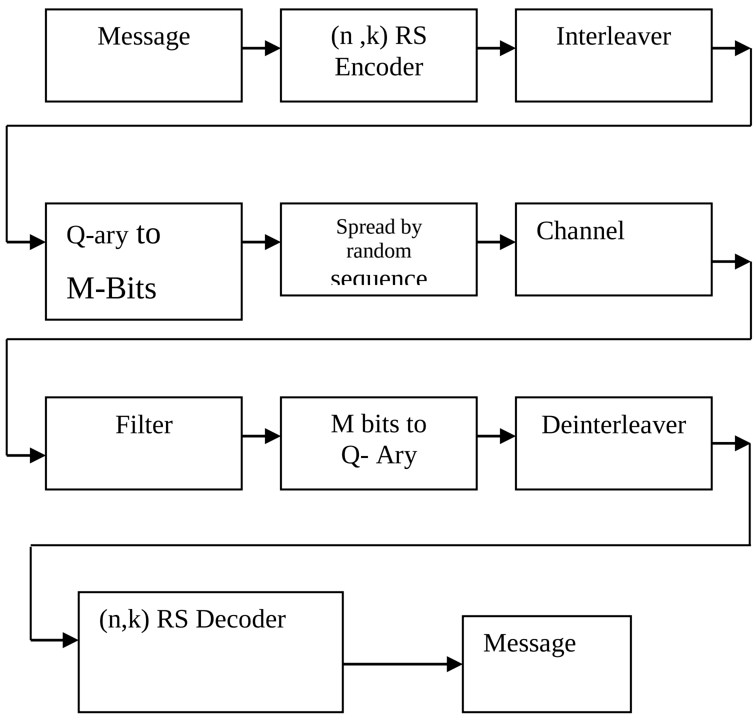


***Fig: 1.*** *The Error correcting system*

We consider a CDMA system with K active transmitter communicating with a common receiver. The block diagram of transmitter and Receiver is shown in fig.1

 

Each packet of data is encoded by (n,k) Reed-Solomon (RS) code over GF(Q). An ideal interleaver/deinterleaver is assumed to randomize error bursts

The encoding and stage-1 decoding are standard processes and known for the relatively simple implementation. The determination of an error location polynomial and processing of this polynomial (Berlekamp Massey or Euclidean algorithms). One measure of complexity of calculation is the number of multiplications of Galois field elements per processed data byte. For the implementation of an 'n-k' encoder requires four GF multiplications per byte. The encoder may be stepped at the same rate as the data, with the required parity bytes available immediately after the last data byte.

An initial data block of size K bytes is randomly generated. This represents the message data.
The encoded message is modulated using BPSK modulation, where each '0' bit becomes a +1, and each '1' it becomes a -1. This generates a stream of +1 and -1 values of length 2040.
The stream of BPSK modulated values is affected by shadowing and fading as it passes through the noisy channel.

To determine if the codeword will be decoded properly, we simulate the soft-decision demodulation process which is performed by the erasure generator.

By comparing the received data stream to the original stream, we can quickly determine how many errors introduced. The codeword would be decoded properly are found by comparing the number of erasures and unflagged errors
The algorithm for determining the SNR with respect to shadowing is:
1. Generate values of xi,
2. Generate SNRi values via the equation SNRi = SNR_mean + xi. Each SNRi value represents the channel as seen by the decoder over the course of a single codeword, measured in decibels (dB).

The resulting series of SNRi values are representative of what the decoder measures during operation. The average of these values over time is used by the decoder to determine how to reconfigure the system in response to channel variations

## CONCLUSION
We proposed a T Error correcting coding in CDMA systems based on RS codes. We can increase the performance using RS codes.

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