

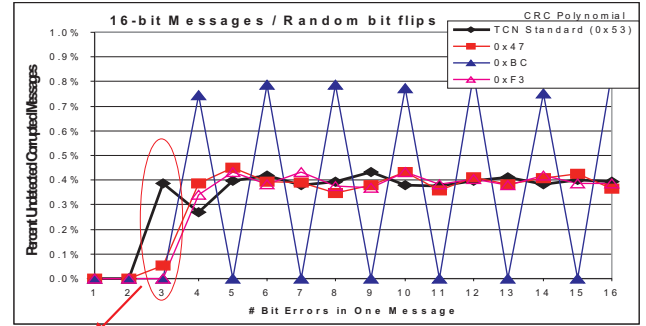
Cyclic Redundancy Codes

- CRCs are a primary defense against bit corruptions that can occur on networks
- CRCs yield a digest value when applied to the message bits
- Digest value is computed by the sender before transmission and re-computed by the receiver after transmission to determine if message bits were corrupted over the network

Motivation : Train Communication Network

- We were determining the effectiveness of the 7 bit standard polynomial (0x53) being used by a master slave polling based embedded network - Multifunction Vehicle Bus
- Employed a simple Monte Carlo simulation to search all 7 bit polynomial codes
- Standard code performed poorly for typical workloads found on MVB

TCN: 16 bit message payload



Recommended CRC (0x47) shows an improvement of 7.5 for P-undetected over CRC standard (0x53)

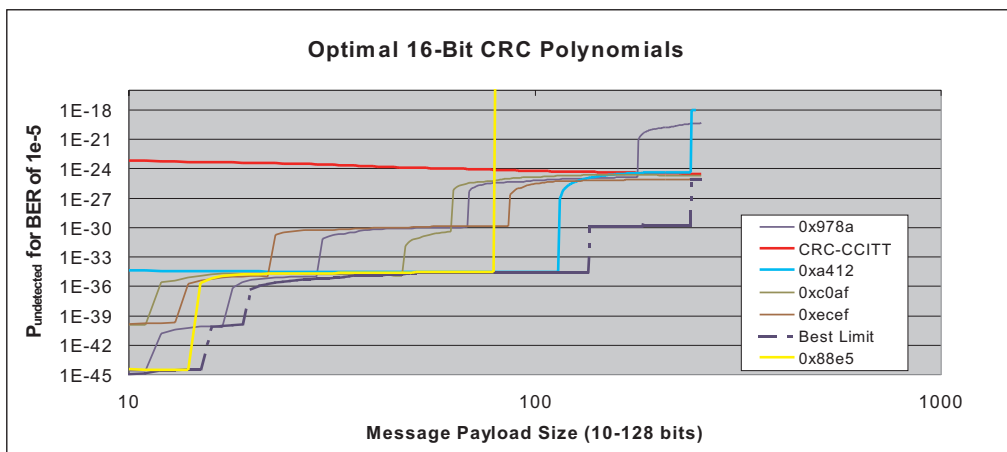
Current Standard CRC Codes

- Looked at further standards and found that most of them are sub-optimal for shorter length embedded messages as they are optimized for longer length messages
- Previous work looked only into a special class of polynomials, namely polynomials that had parity built into them

New Approach to Determine Truly Optimal Codes

- Determined an algorithm that gave exact results in a short time
- Computed Hamming Distance for all message length (8 bits - 256 bits), CRC length (4 bits - 16 bits) pairs

RESULTS: Optimal 16 bit CRC Polynomials



Results Graph

- P-undetected is the probability with which a CRC will let a bit corruption go undetected
- The blue line is the best any polynomial can do for that message length
- Optimal Codes will straddle the Best-Limit Curve
- CRC CCITT is a standard used by many embedded protocols with payload lengths of 0-256 bits eg. Bitbus, Modbus and MVB

What do the Results mean?

- Results show that performance of codes varies over message lengths
- Thus, to recommend a truly optimal code, one needs to examine the probability of message lengths in the workload and pick a code that performs the best for those lengths:
- CRC 0xa412 is optimal from message lengths 30 bits - 122 bits; 0x88e5 is optimal from message lengths 10 - 79 bits; CRC-CCITT is sub optimal for this message payload range