Update on 1000BASE-T1 RS Forward Error Correction

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FEC for 1000BASE-T1

- Baseline proposal in July meeting
  - 3B2T mapping [adopted]
  - Baud rate 750MHz 9-bit Reed-Solomon (450,406,t=22) code
- Content in this contribution
  - Finite field $GF(2^9)$ description
  - Reed-Solomon code description

Generator polynomials of GF(2^9) and RS (450.406) code

- Field $GF(2^9)$
  - Primitive generator polynomial: $p(x)=x^9+x^7+x^5+x+1$
    - $GF(2^9)=\{f(x) \bmod p(x) \mid f(x)$ is binary polynomial of degree <9$\}$
  - Primitive element: $\alpha=02$ *(in octal)*
    - $GF(2^9)=\{0,1, \alpha^1, \alpha^2 \ldots, \alpha^{510}\}$

- (450,406) RS code
  - Generator polynomial: $g(x)=(x- \alpha^0)(x- \alpha^1)\ldots(x- \alpha^{43})$

Reasons on the field generator

- Allow a low complexity inverse and fast field modification
  - 3-bit field $GF(2^3)$ as a sub-field of $GF(2^9)$
    - Primitive generator polynomial $p_3(x)=x^3+x+1$, which is the minimal polynomial of $\lambda=\alpha^{73}$ in $GF(2^3)$
  - $GF(2^9)$ as a composite field $GF((2^3)^3)$ over $GF(2^3)$
    - Generated by the polynomial $x^3+x+\lambda$

Proposals

- Adopt the following two generator polynomials
  - Generator polynomial for GF(2^9): $p(x)=x^9+x^7+x^5+x+1$
  - Generator polynomial for RS (450,406) code: $g(x)=(x-\alpha^0)(x-\alpha^1)\ldots(x-\alpha^{43})$ with $\alpha=02$