TSG-RAN Working Group 3 meeting #7 **TSGW3#7(99)C10**
France, Sofia Antipolis, 20th-24th September

Agenda Item: **14.1, 14.2**

Source: **Ericsson**

Title: CRC Lenghts in the frame protocol

Document for: **Decision**

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1. INTRODUCTION

During TSG-RAN WG3 #6 a decisions was made that there will be one CRC for the header and one CRC for the payload in data frames on the Iub Frame Protocol.

This contribution proposes for the Iub frame protocols the lenghts of the CRC fields and the cyclic generator polynomials to be used in Cyclic Redundancy Check. The placement of the CRC field is proposed in contribution "Data frame protocol headers" ref [3].

2. RATIONALE

The following assumptions were used while defining the lengths of the CRC fields and the corresponding generator polynomials:

1. The errors are rare and error events are relatively short even when microwave links are used.
2. The maximum header length is around 50 bits for the DCH frames and smaller for other frame protocols.
3. The maximum length of the payload is around 15 000 bits.

2.1 CRC calculation

The whole block of the data (header or payload) is used to calculate the CRC parity bits. Denote the data bits $b_1,b_2 \ldots b_N$ where N is the length of the data and the CRC bits $p_1,p_2 \ldots p_L$,where L is the length of the CRC. The transmitted block is then defined as $(b_1, b_2, \ldots, b_N, p_1, p_2 \ldots p_L)$. The CRC bits are just appended to the data bits.

The CRC bits $p_1,p_2 \ldots p_L$ are chosen such that the binary polynomial

$$b_1 * D^{N+L} + b_2 * D^{N+L-1} \ldots + b_N * D^{L+1} + p_1 * D^L + p_2 * D^{L-1} + \ldots + p_L$$

yields to reminder zero when divided with the generator polynomial G(D) of degree L. All the arithmetic is over GF(2) i.e. Galois Field arithmetic with modulo 2 addition and multiplication.

"CRC-theory" states that when errors are scarce, good efficient polynomial can be obtained by multiplying the primitive binary polynomial with the polynomial (D+1).

For CRC length of 7 bits this results in the following generator polynomial

$$G(D) = D^7+D^6+D^2+1$$

This scheme will detect all odd errors, all error bursts shorter than 8 bits and all double errors when the whole header part (including CRC bits) is less than 63 bits.

When length of the CRC is 16 bits the corresponding generator polynomial is:

$$G(D) = D^{16}+D^{15}+D^2+1$$

This scheme will detect all odd errors, all error bursts shorter than 17 bits and all double errors when the whole header part (including CRC bits) is less than 32767 bits. As a reference in the GSM A-bis interface the LAPD protocol uses the 16 bit Frame Check Sum with the above mentioned generator polynomial.

2.2 Error detection for data frames

As a result the length of the CRC for the header is proposed to be 7 bits and the corresponding generator polynomial:

$$G(D) = D^7+D^6+D^2+1.$$

For the payload the CRC is proposed to be 16 bits and the corresponding generator polynomial:

$$G(D) = D^{16}+D^{15}+D^2+1.$$

2.3 Error detection for control frames

Assuming that the maximum length of control frames will be around 63 bits it is proposed to have a CRC with 7 bits and the corresponding generator polynomial:

$$G(D) = D^7+D^6+D^2+1.$$

This allows, apart from the CRC and the frame-type indication, 7 bytes of data.

3. PROPOSAL

It is proposed to update the current description of data frame header and payload CRC's in FP [1] and [2] in line with the proposals included in chapter 2.2 and 2.3 of this contribution.

4. REFERENCES

[1] TS 25.435 V0.4.1. TSG RAN: "UTRAN Iub user plane protocols for common transport channel data streams"

[2] TS 25.427 v0.4.1. TSG RAN: "UTRAN Iub/Iur Interface User Plane Protocols for DCH Data Streams"

[3] TSGR3#7(99) C12: "User plane frame protocol headers"