

Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Proposed OFDM PHY resolution for HCS calculation

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Re: [802.15 TG4m]

Abstract: This document provides proposed OFDM resolution for HCS calculation..

Purpose: To provides proposed resolution for a comment regarding HCS calculation of TG4m sponsor ballot.

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Introduction

- In the TG4m draft, a HCS calculation procedure is explained in Subclause **20.2.1.3 PHR**.
 - This procedure is not clear to follow.
- Other standards use the same procedure.
 - 802.15.4g and some of 802.11 standards
 - Texts for this procedure from these standards are reviewed to get ideas to modify the text of TG4m draft.

Text from d3P802-15-4m draft regarding HCS

- **20.2.1.3 PHR**
 - The Header Check Sequence (HCS) field (H15-H0) is a 16-bit CRC taken over the PHY header (PHR) fields.
 - The HCS shall be computed using the first 28 bits of the PHR. The HCS shall be calculated using the polynomial $G_{16}(x) = x^{16} + x^{12} + x^5 + 1$.
 - At the transmitter, the initial remainder of the division shall be preset to all ones and then be modified via division of the calculation field by the generator polynomial, $G_{16}(x)$. The one's complement of this remainder is the HCS field.

Text from 802.15.4g-2011 standard regarding HCS

- **18.2.1.3 PHR**

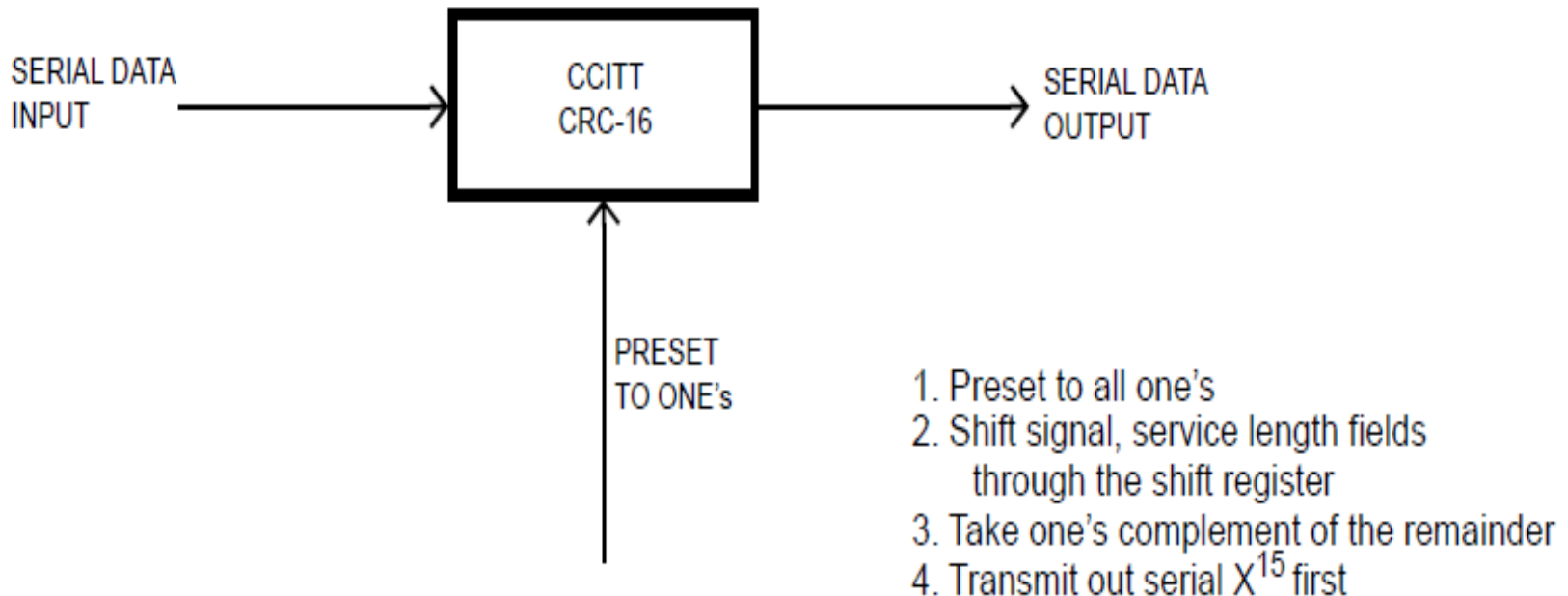
- The Header Check Sequence (HCS) field (H15-H0) is a 16-bit CRC taken over the PHY header (PHR) fields.
- The HCS shall be computed using the first 28 bits of the PHR. The HCS shall be calculated using the polynomial $G_{16}(x) = x^{16} + x^{12} + x^5 + 1$.
- The HCS is the one's complement of the modulo 2 sum of the two remainders in a) and b):
 - a) The remainder resulting from $[x^k(x^{15}+x^{14}+\dots+1)]$ divided (modulo 2) by $G_{16}(x)$, where the value k is the number of bits in the calculation field.
 - b) The remainder resulting from the calculation field contents, treated as a polynomial, multiplied by x^{16} and then divided (modulo 2) by $G_{16}(x)$.
- At the transmitter, the initial remainder of the division shall be preset to all ones and then be modified via division of the calculation field by the generator polynomial, $G_{16}(x)$. The one's complement of this remainder is the HCS field.

* Red part is included only in 15.4g.

Some of IEEE 802.11 standards use this scheme.

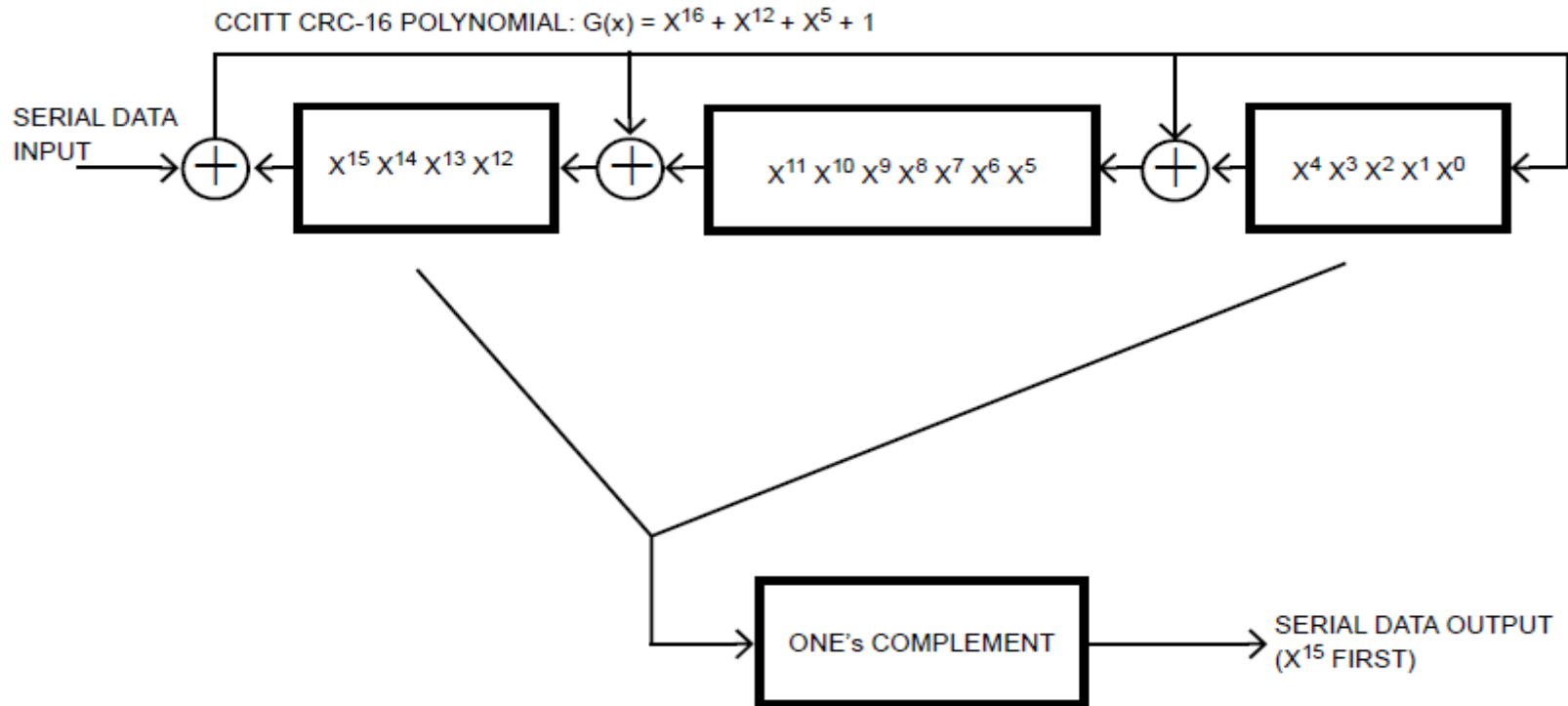
- One of them is 802.11b

TRANSMIT AND RECEIVE PLCP HEADER CCITT CRC-16 CALCULATOR



Some of IEEE 802.11 standards use this scheme. (cont'd)

- One of them is 802.11b (cont'd)



CCITT CRC-16 implementation - Figure 129 of 802.11b standard, 1999

Conclusion

- All three standards – 802.15.4m, 802.15.4g, and 802.11b - use the same scheme for HCS.
- It is recommended to add a text (in red) in 20.2.1.3 PHR of TG4m draft as follows to clarify the calculation procedure:
 - The Header Check Sequence (HCS) field (H15-H0) is a 16-bit CRC taken over the PHY header (PHR) fields. The HCS shall be computed using the first 28 bits of the PHR. The HCS shall be calculated using the polynomial $G_{16}(x) = x^{16} + x^{12} + x^5 + 1$.
 - The HCS is the one's complement of the modulo 2 sum of the two remainders in a) and b): a) The remainder resulting from $[x^k(x^{15}+x^{14}+\dots+1)]$ divided (modulo 2) by $G_{16}(x)$, where the value k is the number of bits in the calculation field. b) The remainder resulting from the calculation field contents, treated as a polynomial, multiplied by x^{16} and then divided (modulo 2) by $G_{16}(x)$.
 - At the transmitter, the initial remainder of the division shall be preset to all ones and then be modified via division of the calculation field by the generator polynomial, $G_{16}(x)$. The one's complement of this remainder is the HCS field.