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

Submission Title: Proposed OFDM PHY resolution for HCS calculation

Date Submitted: September 16, 2013

Source: Soo-Young Chang (SYCA), Cheolho Shin (ETRI), Jaewhan Kim (ETRI), Sangsung Choi (ETRI), Cristina Seibert (Silver Spring Networks)

Contact: sychang@ecs.csus.edu

Voice: +1-530-574-2741 E-Mail: sychang@ecs.csus.edu

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.

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 G16(x) = x16 + x12 + x5 + 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, G16(x). The one's complement of this remainder is the HCS field.

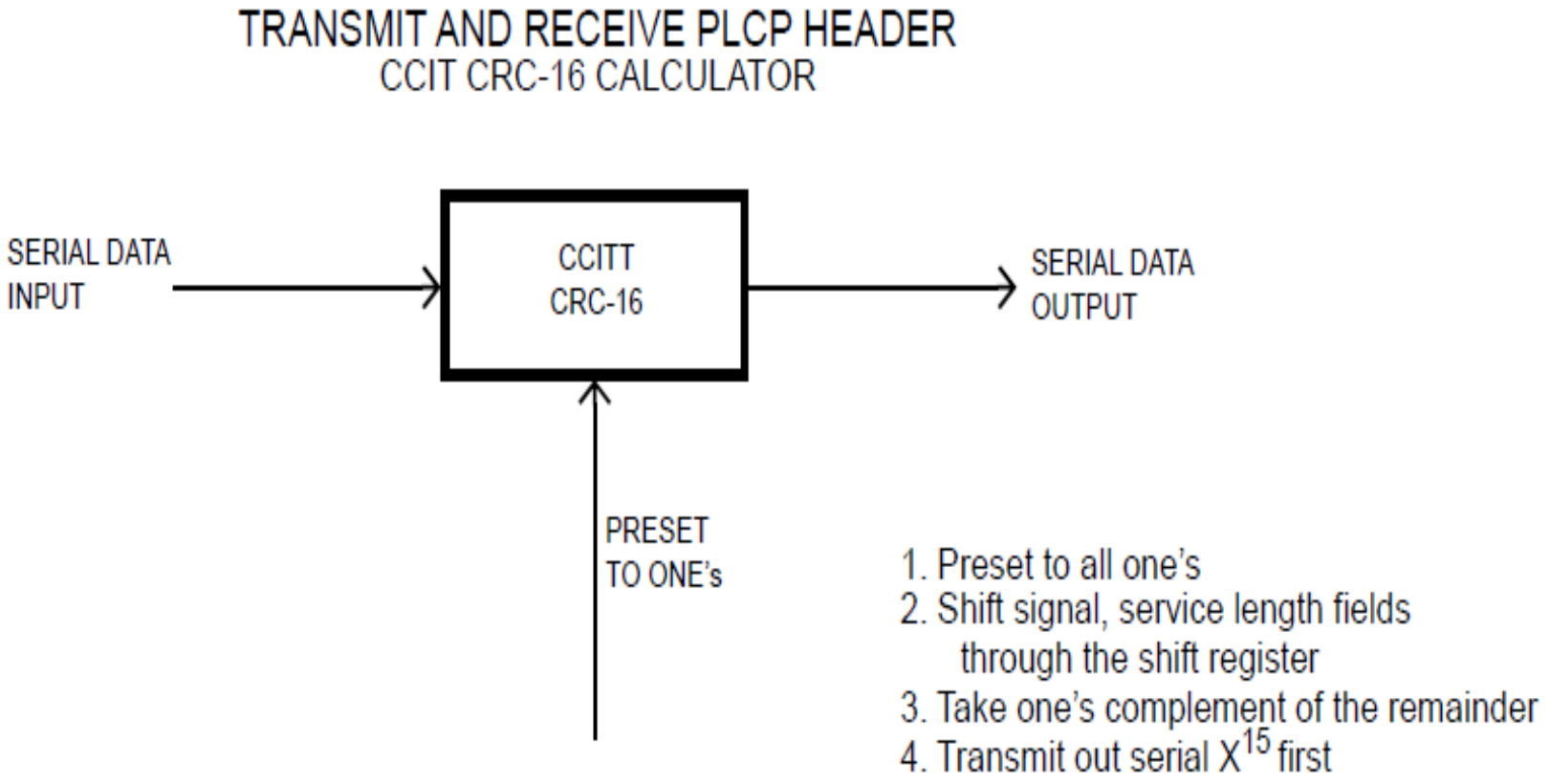
Text from 802.15.4g-2011 standard regarding HCS

- **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 G16(x) = x16 + x12 + x5 + 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 $[x^k(x^{15}+x^{14}+\ldots+1)]$ 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, G16(x). The one's complement of this remainder is the HCS field.

* Red part is included only in 15.4g.

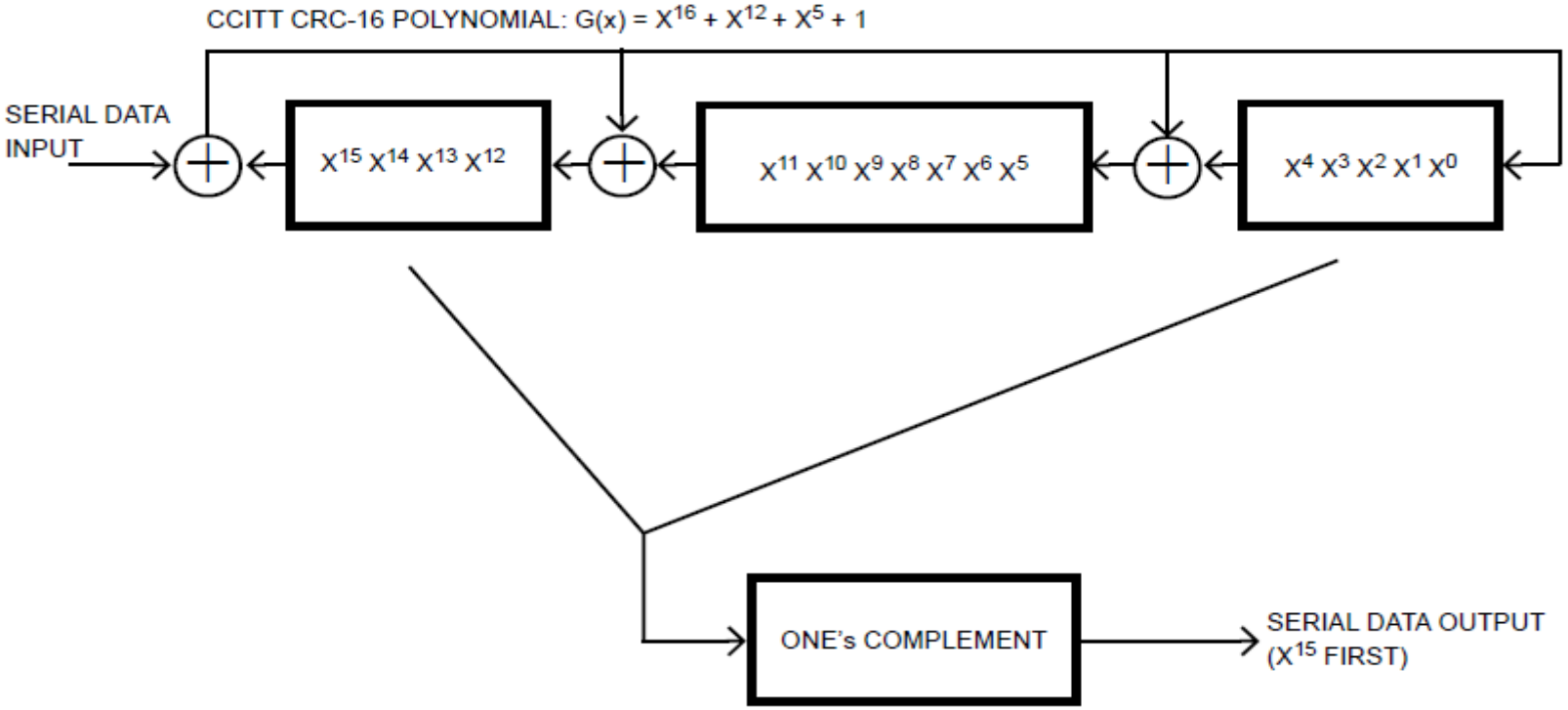
Some of IEEE 802.11 standards use this scheme.

- **One of them is 802.11b**



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 $[x^k(x^{15}+x^{14}+\ldots+1)]$ 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.