Physical Header Data content for PCS encoding, PHY control and OAM implementation in GEPOF

Rubén Pérez-Aranda
(rubenpda@kdpof.com)
David Ortiz

IEEE 802.3bv Task Force - Plenary, March 2015

Agenda

- Background and objectives
- PHD content definition
- PHD bit ordering
- Fix-point format definition

Background & Objectives

- In 802.3bv TF interim meeting of January 2015, the FEC and modulation schemes proposed in [1] were adopted for the baseline together with the transmission structure defined in [2]
- The main objective of this presentation is to define the information that is encoded within the Physical Header Data (PHD), which is transmitted periodically once per transmission block as defined in [2]
- PHD serves as communication side-channel that will be used by several parts of the PCS and PMA for:
  - Adaptive configuration: PHY is able to dynamically adapt THP coefficients
  - Advertise the link status
  - Negotiate physical transmission capabilities
  - Link startup
  - OAM (Operations, Administration and Management)
- Encoding for error detection and correction, scrambling and modulation for PHD transmission were defined in [2]
- The PCS TX shall include a block in charge of collecting all the information transmitted within the PHD. This block is named as Header Builder in [2].

PHD content definition

Symbol	Description	# of bits	Valid values
PHD.TX.NEXT.MODE	Transmission mode of the next transmit block, indicated to link partner to align its reception (see [7])	3	0: Normal transmission 1: Zeroes transmission for BER test 2..7: Reserved
PHD.TX.NEXT.THP.SETID	THP coefficients set Id that will be used in the next transmit block (see [4])	2	0: the next block is not TH precoded 1 .. 3: THP set identifier
PHD.TX.NEXT.PDB.OFFSET	Offset (in number of bits) of the first PDB in Payload of the next transmit block (see [3])	7	0x00 .. 0x40
PHD.RX.REQ.THP.SETID	Requested THP coefficients set Id (see [4])	2	0: no request for changing the THP coefficients is performed 1 .. 3: THP set identifier
PHD.RX.REQ.THP.COEF[0..8]	Requested THP coefficients set when PHD.RX.REQ.THP.SETID is not equal to 0. 9 b(k) coefficients of 12 bits	108	Each b(k) is fix-point formatted (12,2) Ordered from b(0) to b(8)
PHD.RX.STATUS	Indicates that local PMA receive function is able to make the reception of PAM symbols with reliability. This corresponds with the content of variable loc_rcvr_status. The PCS receive function shall use this PHD field to determine the rem_rcvr_status. See [4].	1	0: NOT_OK 1: OK
PHD.RX.LINKMARGIN	This field reports the link margin measured as extra SNR available in decoding respect to min SNR needed to provide BER < 10^{-12}	14	This field is fix-point formated (14,6) and is provided in $\log_2(\cdot)$ units. e.g. LM = 3.5 dB is equivalent to $\log_2(10^{0.35}) = 1.1627$ in $\log_2$ units, which is equal to 0x012A in (14,6) format.

PHD content definition

Symbol	Description	# of bits	Valid values
PHD.CAP.EEE	This field signals the capability of the PHY to transmit and receive Low Power Idles during the payload sub-blocks (see [6])	1	0: LPI is not supported 1: LPI is supported
PHD.CAP.OAM	This field signals the capability of the PHY for OAM implementation, so that the PHY is able to transmit and receive management information by using PHD.OAM fields (see [5])	1	0: OAM is not supported 1: OAM is supported
	Reserved for future extensions	53	0

PHD content definition

Symbol	Description	# of bits	Valid values
PHD.OAM.CTRL	OAM Message Control field (see [5])	12	0x000 .. 0x7FF
PHD.OAM.MSGT	OAM Message Toggle Bit. This bit toggles with each successive transmitted OAM message and is a message identifier.	1	0 .. 1
PHD.OAM.MERT	OAM Management Entity Read Toggle Bit. This bit provides the toggle bit of the last OAM message read by the management entity.	1	0 .. 1
PHD.OAM.PHYT	OAM PHY Toggle Bit. This bit provides the toggle bit of the last OAM message correctly received by the PHY	1	0 .. 1
	Reserved	1	0
PHD.OAM.DATA0	OAM Message Data field 0	16	0x0000 .. 0xFFFF
PHD.OAM.DATA1	OAM Message Data field 1	16	0x0000 .. 0xFFFF
PHD.OAM.DATA2	OAM Message Data field 2	16	0x0000 .. 0xFFFF
PHD.OAM.DATA3	OAM Message Data field 3	16	0x0000 .. 0xFFFF
PHD.OAM.DATA4	OAM Message Data field 4	16	0x0000 .. 0xFFFF
PHD.OAM.DATA5	OAM Message Data field 5	16	0x0000 .. 0xFFFF
PHD.OAM.DATA6	OAM Message Data field 6	16	0x0000 .. 0xFFFF
PHD.OAM.DATA7	OAM Message Data field 7	16	0x0000 .. 0xFFFF

PHD content definition

Symbol	Description	# of bits	Valid values
	Reserved for future extensions	368	0
PHD.CRC16	Cyclic redundancy code of 16 bits. See [2] for generator polynomial and CRC16 encoder definitions.	16	0x0000 .. 0xFFFF
Total (bits)		**720**	

PHD bit ordering

- All the PHD fields are ordered from the least to the most significant bit and transmitted top to bottom of previous tables, therefore starting from PHD.TX.NEXT.MODE and ending by PHD.CRC16.
- Time ordering for PHD.CRC16 is defined in [2].

Fix-point format definition

- Fix-point format (m, n) is used for representation of real (floating point) numbers by using fixed length 2-complement binary words and a fixed location of decimal point
- m stands for the word length
- n stands for the number of bits devoted to represent the integer part plus sign of the real number
- (m - n) bits are used to represent the decimal part
- This format is proposed for PHD.RX.REQ.THP.COEF and PHD.RX.LINKMARGIN fields
- Formal definition by using Matlab programming language:

```
% Float-point to fix-point formal definition
Parameters  :
%      fdata  : Row vector in floating point format
%      m      : Word length # of bits
%      n      : Integer part # of bits, including sign
%      rdata  : Fix-point format w/o sign extension

function rdata = float2fix(fdata, m, n)

bdata = round(fdata*2^(m-n));
bdata = min(bdata, 2^(m-1) - 1);
bdata = max(bdata, -2^(m-1));
idx_n = find(bdata < 0);
rdata = bdata;
rdata(idx_n) = 2^m + rdata(idx_n);
rdata = bitand(rdata, 2^m - 1);
```

```
% Fix-point to floating-point formal definition
% Parameters  :
%      rdata  : Row data in fix-point
%      m      : Word length # of bits
%      n      : Integer part # of bits, including sign
%      fdata  : Float-point format

function fdata = fix2float(rdata, m, n)

% Sign extension
bdata = bitand(rdata, 2^m - 1);
idx_n = find(bitand(bdata, 2^(m-1)) ~= 0);
bdata(idx_n) = bdata(idx_n) - 2^m;

% Fix to float conversion
fdata = bdata / (2^(m - n));
```

References

- [1] *Rubén Pérez-Aranda, et al., "High spectrally efficient coded 16-PAM scheme for GEPOF based on MLCC and BCH", IEEE 802.3bv TF, Interim Meeting, January 2014*
- [2] *Rubén Pérez-Aranda, "Transmission scheme for GEPOF", IEEE 802.3bv TF, Interim Meeting, January 2014*
- [3] *Rubén Pérez-Aranda, et al., "64b/65b PCS encoding for GEPOF", IEEE 802.3bv TF, Plenary Meeting, March 2014*
- [4] *Rubén Pérez-Aranda, et al., "PCS and PMA control state machines for GEPOF", IEEE 802.3bv TF, Plenary Meeting, March 2014*
- [5] *Rubén Pérez-Aranda, et al., "Operations, Administration and Management (OAM) for GEPOF", IEEE 802.3bv TF, Plenary Meeting, March 2014*
- [6] *Rubén Pérez-Aranda, et al., "Energy Efficient Ethernet (EEE) proposal for GEPOF", IEEE 802.3bv TF, Plenary Meeting, March 2014*
- [7] *Rubén Pérez-Aranda, et al., "Test mode definition for BER test in GEPOF PHY", IEEE 802.3bv TF, Plenary Meeting, March 2014*

Questions?