Gigabit Ethernet Serial Link Codes, Change Summary Rev 4

Change summary for serial link codes and receiver/transmitter states proposal based on the PCS protocol requirements.

Contents

- Link startup codes
- Automatic link configuration data
- SOP/EOP and Idle codes
- Data and invalid character codes
- Link synchronization states and protocols

IEEE 802.3z Gigabit Ethernet Task Force
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Coeur d'Alene Inn and Conference Center
Coeur d'Alene, Idaho
Richard Taborek, Amdahl

The following companies have indicated their support for the concepts outlined in this proposal (in alphabetical order):

3Com, Amdahl, Cisco, Compaq, DEC, Granite, H-P, Madge, Packet Engines, Sun, VLSI Logic and Xaqti

Changes in Revision 4

- Howard Johnson - Interchanged **T** (EOP) and **R** (carrier extension) codes to improve error robustness.
- Group consensus - Removed support for the **defer bit** transported by idle codes. This removes the **I2** and **I4** codes. Also removed defer bit from Config_Register
  - Remaining idle code, **I1** and **I3** are renumbered as **I1** and **I2**.
- Group consensus - Removed support for **Long Topology** and **Short Topology** bits from the Config_Register
  - July , 1996 meeting in Enschede, Motion #2 (Technical), Modify objective 12 to read: Support maximum collision domain diameter of 200m., M: Grow, S: Thomson, Passed: by acclamation
- Corrected error in 8B10B tables with **D0.2** code. Ending running disparity is "**flip**", was "**same**".
- Config_Register historic labels Selector and Technology Ability Field removed.

Reasoning Behind Interchange of T and R codes

- Of the codes previously assigned to **S** (K27.7), **R** (K29.7), **H** (K30.7), and **T** (K23.7), **K23.7** is more error robust than the other three codes.
- However, **R** may be used as a sequence (used repeatedly), whereas S, H, and T are always signals (single use).
- Interchanging **T** and **R** codes **improves error robustness**.
  - **R** is reassigned code **K23.7** and **T** is reassigned code **K29.7**.
- Proof:
  - No data characters are a distance of one from a K23.7 of opposite beginning running disparity.
  - Four data characters are a distance of one from a K23.7 of the same beginning running disparity.
  - Two data characters are a distance of one from each of the K27.7, K29.7 and K30.7 characters of opposite beginning running disparity.
  - Four data characters are a distance of one from each of the K27.7, K29.7 and K30.7 characters of the same beginning running disparity.

Listing of Ordered Sets

Code	Function	Encoding	Beg. RD	End RD
F	Link_Not_Available	K28.5 D21.5	?	flip
C	Link_Configuration	K28.5 D10.5 config_reg	?	?
I1	Idle/Flip Disparity	K28.5 D5.6	+	-
I2	Idle/Disparity OK	K28.5 D16.2	-	-
S	SOP	K27.7	?	same
T	EOP1	K29.7	?	same
R	EOP2	K23.7	?	same
H	EOPinvalid	K30.7	?	same

Link Information Example
Part 1/2

802.3 info	8B10B codes
LINK_NOT_AVAILABLE	F
LINK_NOT_AVAILABLE	F
~	~
LINK_NOT_AVAILABLE	F
LINK_CONFIGURATION	C
LINK_CONFIGURATION	C
~	~
LINK_CONFIGURATION	C
Idle/Disparity OK	I2
Idle/Disparity OK	I2
~	~
Idle/Disparity OK	I2
0 PREAMBLE	S (single short packet)
1 PREAMBLE	Data = 10101010
2 PREAMBLE	Data = 10101010
3 PREAMBLE	Data = 10101010
4 PREAMBLE	Data = 10101010
5 PREAMBLE	Data = 10101010
6 PREAMBLE	Data = 10101010
7 SFD	Data = 10101011
8 DA	Data = DA...
~	~
LLC DATA	Data = LLC DATA...
~	~
FCS1	Data = FCS1 octet...

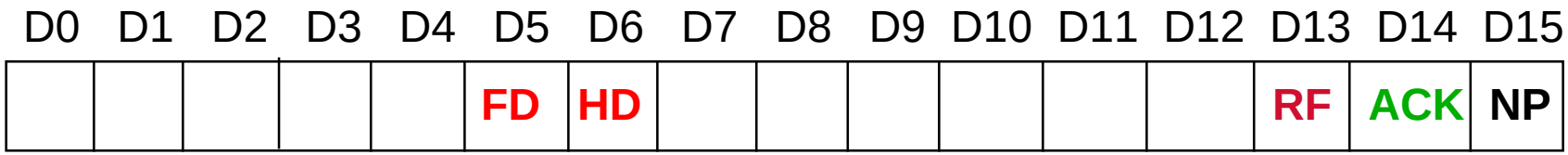
802.3 info	8B10B codes
FCS2	Data = FCS2 octet...
FCS3	Data = FCS3 octet...
FCS4	Data = FCS4 octet...
EOP1	T
EOP2	R
EOP2	R
~	~
EOP2	R (odd-num character)
Idle/Flip Disparity	I1
Idle/Disparity OK	I2
~	~
Idle/Disparity OK	I2
LINK_NOT_AVAILABLE	F (error or reconfig)
LINK_NOT_AVAILABLE	F
~	~
LINK_NOT_AVAILABLE	F
LINK_CONFIGURATION	C
LINK_CONFIGURATION	C
~	~
LINK_CONFIGURATION	C
Idle/Flip Disparity	I1
Idle/Disparity OK	I2
~	~
Idle/Disparity OK	I2
~	~

Link Information Example
Part 2/2

802.3 info	8B10B codes
Idle/Disparity OK	I2
0 PREAMBLE	S (1st packet of burst)
1 PREAMBLE	Data = 10101010
2 PREAMBLE	Data = 10101010
3 PREAMBLE	Data = 10101010
4 PREAMBLE	Data = 10101010
5 PREAMBLE	Data = 10101010
6 PREAMBLE	Data = 10101010
7 SFD	Data = 10101011
8 DA	Data = DA...
~	~
LLC DATA	Data = LLC DATA...
~	~
FCS1	Data = FCS1 octet...
FCS2	Data = FCS2 octet...
FCS3	Data = FCS3 octet...
FCS4	Data = FCS4 octet...
EOP1	T (even char/no extension)
EOP2	R
0 PREAMBLE	S (2nd packet of burst)
1 PREAMBLE	Data = 10101010
2 PREAMBLE	Data = 10101010
3 PREAMBLE	Data = 10101010
4 PREAMBLE	Data = 10101010
5 PREAMBLE	Data = 10101010

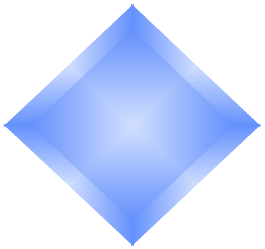
802.3 info	8B10B codes
6 PREAMBLE	Data = 10101010
7 SFD	Data = 10101011
8 DA	Data = DA...
~	~
LLC DATA	Data = LLC DATA...
~	~
FCS1	Data = FCS1 octet...
FCS2	Data = FCS2 octet...
FCS3	Data = FCS3 octet...
FCS4	Data = FCS4 octet...
EOP1	T (even char/no extension)
EOP2	R
Idle/Flip Disparity	I1
Idle/Disparity OK	I2
~	~
Idle/Disparity OK	I2

Config_Register



Config_Register bit usage:

- D5/FD: Full duplex capable
- D6/HD: Half duplex capable
- D13/RF: Remote Fault
- D14/ACK: Acknowledge
- D15/NP: Next Page (Escape)



Summary

- 8B10B codes and the proposed coding structure is **efficient, robust, and flexible** enough to meet **Gigabit Ethernet PCS requirements**.
- Future activities:
  - **Packet Burst:** Currently supported. Need Task Force decision;
  - **Idle addition/removal:** Currently included for multi-link clock frequency compensation. If not required, running disparity requirements may be relaxed and only a single idle code is required;
  - **Maintenance/Test mode:** PCS additions pending proposal acceptance;
  - **Transparent Signaling Channel:** PCS additions pending proposal acceptance;
  - **Preamble Priority and VLAN Tagging:** PCS additions pending proposal acceptance;
  - Other direction from Task Force.