Cl 73 AN Future Considerations – Phase 2

Kent Lusted, Intel Corporation

Jeff Slavick, Broadcom

Adee Ran, Cisco

Supporters

- Arthur Marris, Cadence

Clause 73 Auto-Negotiation Process

- Provides mechanism for links to negotiate the fastest common rate that both sides advertise.

- Useful for plug-and-play linking up

- Backplane and copper cable assembly support only

Problem Statement

- The 3df Task Force needs to support at least 5 new Ethernet PHY types:
    - "800G-R8"
    - "1600G-R8"
    - "200G-R1"
    - "400G-R2"
    - "800G-R4"
  - New FEC modes, as required (Exact number is TBD)

- The IEEE 802.3 Auto-Negotiation link codeword Base page for Backplane and Copper Cable Assembly (Clause 73) does not have enough free bits
  - See https://www.ieee802.org/3/df/proj_doc/objectives_P802d3df_220317.pdf

AN73 Base Page – After 3ck

- 3 bits are left unassigned in the base page

- Need to advertise at least 5 more PHYs (that we know of right now)

Table 73–4—Technology Ability Field encoding

Bit	Technology
...	
A15	200GBASE-KR4 or 200GBASE-CR4
A16	100GBASE-KR1 or 100GBASE-CR1
A17	200GBASE-KR2 or 200GBASE-CR2
A18	400GBASE-KR4 or 400GBASE-CR4
A16A19 through A21A22	Reserved

AN73 Message Base Page, see Figure 73-6

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
S0	S1	S2	S3	S4	E0	E1	E2	E3	E4	E5	C0	C1	RF	ACK	NP

D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
T0	T1	T2	T3	T4	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10

D32	D33	D34	D35	D36	D37	D38	D39	D40	D41	D42	D43	D44	D45	D46	D47
A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	F4	F2	F3	F0	F1

[A19:A21] remain open after 3ck

Suggested Approach

- Phase 1 - Done: Update Clause 73 AN Link codeword Base page to support the eight-lane 800GbE PHY type
  - Using bit A19/D40 for "800GBASE-CR8 or 800GBASE-KR8"
  - See: https://www.ieee802.org/3/df/public/adhoc/electrical/22_0502/lusted_3df_elec_01a_220502.pdf

- Phase 2 - later: Define extensible solution for remaining PHY types
  - Follow the 802.3by/cd/ck approach of not distinguishing between the Backplane and Copper Cable Assembly PHYs during AN.
    - The same SerDes generally supports both Direct Attach Copper (DAC) and Backplane (BP)
    - Implementations know if the Port is DAC or BP so they can take care of all the necessary SerDes setup before starting AN to configure the appropriate PMD operation
  - Note: No 200G/lane backplane objectives are adopted at this time

Phase 2 - Later: Looking Beyond

Phase 2: Looking Beyond

- In Annex 73A, define a new Clause 73 Next Page (NP) message code 2
  - The contents of the new Next Page message code will expand the Clause 73 Technology Ability Field (TAF) and FEC Capability field to include more bits without changing the base page format nor the resolution protocol.
- Use the two remaining reserved bits in the base page as follows:
  - One unused bit is assigned to indicate that additional bits of the Cl 73.6.4 Technology Ability Field (TAF) will be transmitted in a NP message code 2.
  - The other unused bit is assigned to indicate that additional bits of the Cl 73.6.5 FEC Capability field will be transmitted in a NP message code 2.

Phase 2: Solution Details - 1

- Define bits D41:D42 of the Link codeword Base page to be as follows:
- D41 = (Extended_TAF_1 capability)
  - 0 = device does not have additional "Technology Ability" fields
  - 1 = device has additional "Technology Ability" field bits defined in Next Page message code 2
- D42 = (Extended_FEC_1 capability)
  - 0 = device does not have additional "FEC Capabilities" fields
  - 1 = device has additional "FEC Capability" bits defined in Next Page message code 2
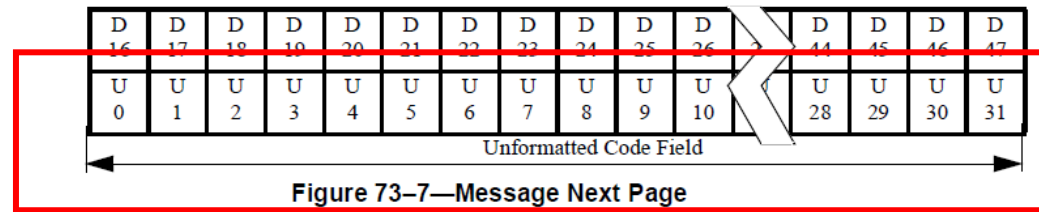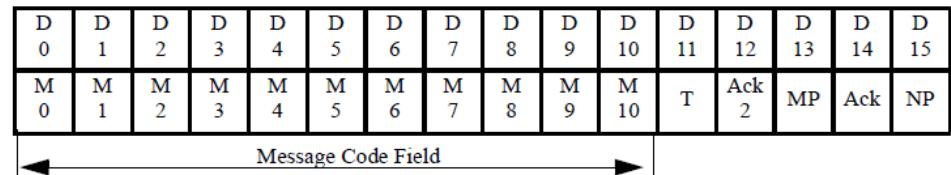
Phase 2: Solution Details - 2

- A new Message Next Page of type code 2 is defined as follows:

AN73 Message Next Page, see Figure 73-7															
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
Message Code Field (11 bits)											T	ACK2	MP	ACK	NP
D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
Extended_TAF_1[0:15]															
D32	D33	D34	D35	D36	D37	D38	D39	D40	D41	D42	D43	D44	D45	D46	D47
Extended_TAF_1[16:27]												Extended_FEC_1[3:0]			

- The "Technology Ability and FEC extension" message type shall consist of only a Message Next Page.

- The message code field is 2 (M10:M0 = 00 0000 0010)

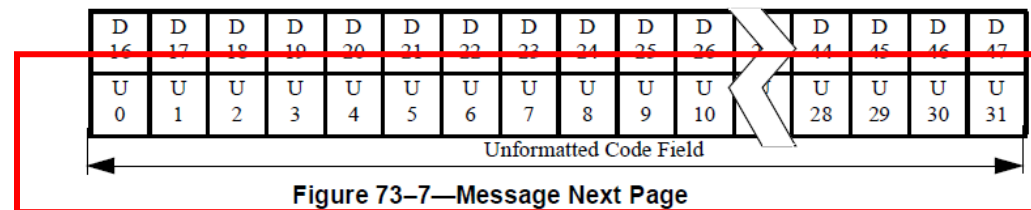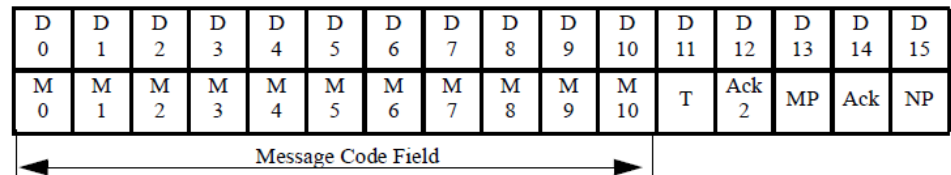- [D15:D11] retain their function per Cl 73.7.7.1.

Phase 2: Solution Details - 3

- The contents of the Unformatted Code Field U27:U0 (D43:D16) shall be as defined as the Extended_TAF_1[27:0] field with the following assignments
    - Bit ordering per slide 10
    - Bit 0 = 1.6TBASE-CR8
    - Bit 1 = 800GBASE-CR4
    - Bit 2 = 400GBASE-CR2
    - Bit 3 = 200GBASE-CR1
    - Bit [27:4] = reserved for future use

Figure 73–7—Message Next Page

Phase 2: Solution Details - 4

- The contents of the Unformatted Code Field U31:U28 (D47:D44) shall be as defined as the Extended_FEC_1[0:3] field with the following assignments
    - Bit ordering per slide 10
    - Used for additional FEC capabilities, if needed (e.g. interleave FEC, low-latency FEC, high-correction capability FEC)
    - All bits reserved for future use at this time

D 0	D 1	D 2	D 3	D 4	D 5	D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15
M 0	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	T	Ack 2	MP	Ack	NP

Message Code Field

D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 44	D 45	D 46	D 47
U 0	U 1	U 2	U 3	U 4	U 5	U 6	U 7	U 8	U 9	U 10	U 28	U 29	U 30	U 31

Unformatted Code Field

Figure 73–7—Message Next Page

Phase 2: Solution Details - 5

- Amend Cl 73.6.4 to incorporate the extended Technology Ability Field
- Add a new Table 73-4a with the appropriate mapping of Extended_TAF_1 fields to Technologies
  - Add a note "If the Extended Technology Ability Field is not received or not sent, then its effective value is all zeros."
- Amend Cl 73.6.5 to include any newly defined FEC fields in the Extended_TAF_1 and the capabilities

Phase 2: Solution Details - 6

- In Figure 73-1, update to add 1.6TMII
- In Cl 73.5.1, update the second paragraph to add references to the new 1.6TBASE-CR8, 800GBASE-CR4, 400GBASE-CR2 and 200GBASE-CR1 clauses
- In Table 73-5, update Priority Resolution to insert "1.6TBASE-CR8" as priority 1 and renumerate the table accordingly
  - 1. 1.6TBASE-CR8
  - 2. 800GBASE-CR4
  - 3. 800GBASE-CR8 or KR8
  - 4. 400GASE-CR2
  - 5. 400GBASE-CR4 or 400GBASE-KR4
  - 6. 200GBASE-CR1
  - …

Phase 2: Solution Details - 7

- In Cl 73.10.1, add new entries into the variable list:
  - "1.6TR8; represents the 1.6TBASE-CR8 PMD"
  - "800GR4; represents the 800GBASE-CR4 PMD"
  - "400GR2; represents the 400GBASE-CR2 PMD"
  - "200GR1; represents the 200GBASE-CR1 PMD"
- In the single_link_ready entry in Cl 73.10.1, add in the appropriate place:
  - "link_status_[1.6TR8] = OK"
  - "link_status_[800GR4] = OK"
  - "link_status_[400GR2] = OK"
  - "link_status_[200GR1] = OK"

Phase 2: Solution Details - 8

- In Table 73-7 Timer min/max value summary, add a new row for "link_inhibit_timer (when the link is 1.6TBASE-CR8, 800GBASE-CR4, 400GBASE-CR2 or 200GBASE-CR1)" with value TBD

- Modify Table 45-388 Backplane Ethernet, BASE-R copper status 2 register bit definitions to include an entry for "1.6TBASE-CR8, 800GBASE-CR4, 400GBASE-CR2 and 200GBASE-CR1"

Phase 2: Solution Details - 9

- In Cl 73.7.7, change the last sentence of the fifth paragraph into a new paragraph as follows:
  - "A PHY that advertises any of the abilities in the Extended Technology Ability Field shall send a Next Page with Message code 2 (see Annex 73.X) immediately following the Base Page. Other than Next Pages with Message code 2, any number of Next Pages may be sent in any order; however, it is recommended that the total number of Next Pages sent be kept small to minimize the link startup time."

- In Cl 73.7.6, change the last sentence of the first paragraph to :
  - "The single PHY enabled to connect to the MDI by Auto-Negotiation shall be the technology corresponding to the bit in the Technology Ability Field and the Extended Technology Ability Field that is common to the local device and link partner that has the highest priority as defined in Table 73–5 (listed from highest priority to lowest priority)."

Proposed Straw Polls:

- I would support the Clause 73 changes to extend the Technology Ability Field and FEC capabilities Field as proposed in lusted_3df_xxx_yyyy slides 9-17
- Y, N,

Thanks!

Reference

Annex 73A

(normative)

Next page message code field definitions

This Annex defines the Next Page message code fields for devices using Clause 73 Auto-Negotiation. The message code field of a message page used in Next Page exchange shall be used to identify the meaning of a message. Table 73A–1 identifies the types of messages that may be sent. As new messages are developed, this table will be updated accordingly.

The Message code field uses an 11-bit binary encoding that allows 2048 messages to be defined. All message codes not specified are reserved for IEEE use or allocation.

Table 73A–1—Message code field values

Message code	M 10	M 9	M 8	M 7	M 6	M 5	M 4	M 3	M 2	M 1	M 0	Message code description
1	0	0	0	0	0	0	0	0	0	0	1	Null Message
5	0	0	0	0	0	0	0	0	1	0	1	Organizationally Unique Identifier Tagged Message
6	0	0	0	0	0	0	0	0	1	1	0	AN device Identifier Tag Code
10	0	0	0	0	0	0	0	1	0	1	0	EEE Technology Message Code. EEE capability is advertised using unformatted message code field in the Message Next Page (see 73A.4).