Backplane Auto-negotiation Base Page Format Analysis

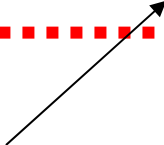## Yong Kim + contributors

Agenda

- Problem Statement
- Analysis of Options
- Recommendation

What are the problems to solve?

- Establish Link – Robust, Fast, Interoperable
  - Speed negotiation
  - Required Driver/Receiver parameter selection for link establishment (10G)
- Separate the two issues
  - Auto negotiation Link Signaling
  - Information Content ("base-page")

This presentation addresses this problem

Information Content

- **Technology Identification**
  - If Common MDI
- **PHY Identification/Capability**
  - Speed
  - Fault Indication (RF)
  - Equalization (if any, not yet used).
- **MAC Identification/Capability**
  - Full/Half Duplex
  - Pause (and Asymmetric Pause)
- **Consideration for legacy technology**
  - Parallel Detect support
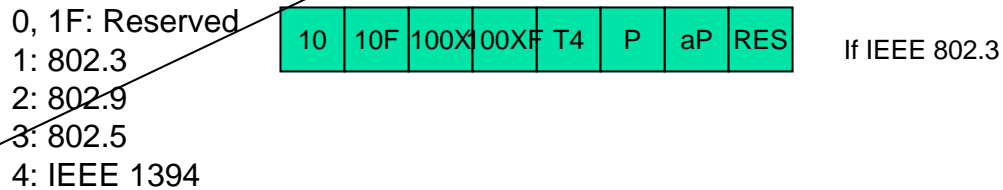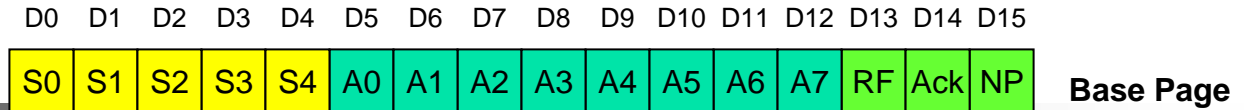
Past Approaches to Solving Problem

- **Clause 28 Constraints**
  - Oriented toward CAT-5 cabling based environment
  - Existing 10BASE-T, 100BASE-TX/T4 used up most base page fields
  - 1000BASE-T uses next page
  - 10GBASE-T likely to use next page

- **Clause 37 Constraints**
  - 1000BASE-X only (i.e. no speed negotiation)
  - No parallel detect support

Options

- **Extend what was done**
  1. Clause 28 (RJ45) + Clause 40 (1000BT)
  2. Clause 37 (Serdes/Fiber),

- or
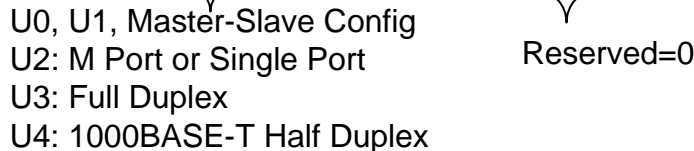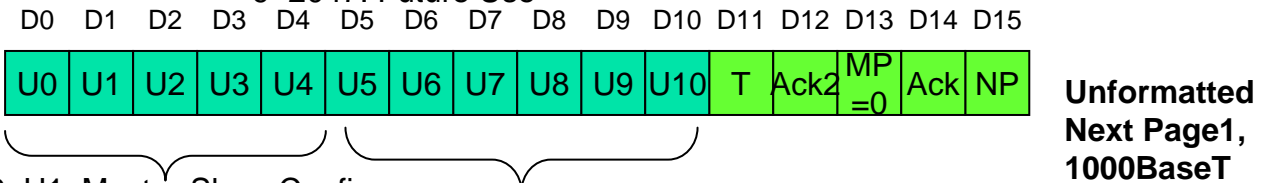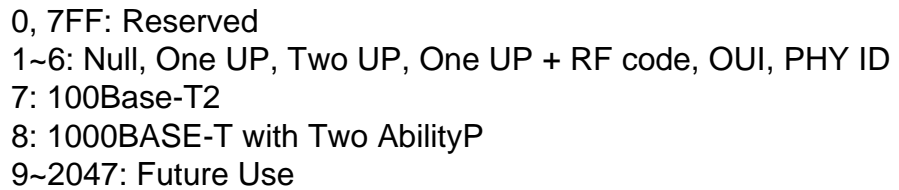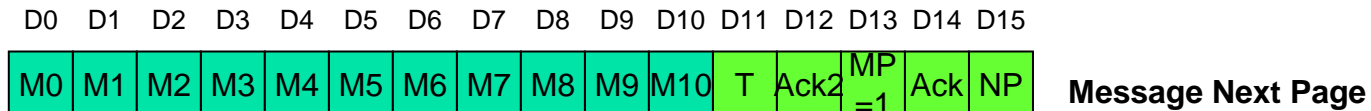 3. Create New Information Format('Base Page').

Message Formats

Clause 28

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
S0	S1	S2	S3	S4	A0	A1	A2	A3	A4	A5	A6	A7	RF	Ack	NP

Base Page

0, 1F: Reserved
1: 802.3
2: 802.9
3: 802.5
4: IEEE 1394

10	10F	100X	100XF	T4	P	aP	RES

If IEEE 802.3

Valuable Coding space is taken up by legacy and not used.

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
M0	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	T	Ack2	MP =1	Ack	NP

Message Next Page

0, 7FF: Reserved
1~6: Null, One UP, Two UP, One UP + RF code, OUI, PHY ID
7: 100Base-T2
8: 1000BASE-T with Two AbilityP
9~2047: Future Use

T2 mutually exclusive with 1000BASE-T (single Msg Pg)

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
U0	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	T	Ack2	MP =0	Ack	NP

Unformatted Next Page1, 1000BaseT

After 4 pages, 1000BASE-T is negotiated.

U0, U1, Master-Slave Config
U2: M Port or Single Port
U3: Full Duplex
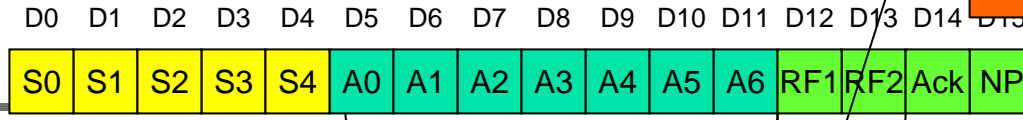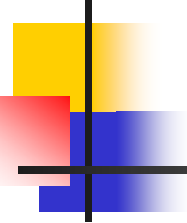U4: 1000BASE-T Half Duplex

Reserved=0

Clause 28 Observations

- PHY/MAC – individual capability advertisement
    - 10 HD, 10 FD, 100 TX HD, 100 TX FD, 100 TX HD, 100 T2 HD, 100 T2 FD, 1000 T FD, 1000 T HD
    - Pause, No Pause, Asymmetric Pause (1000BASE-T only)
- PHY
    - Remote Fault
- New PHYs - multiple message + next pages.
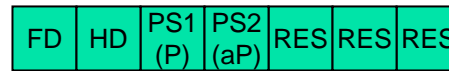   - Extends link up time

Message Formats

Clause 37

Base Page

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
S0	S1	S2	S3	S4	A0	A1	A2	A3	A4	A5	A6	RF1	RF2	Ack	NP

Base Page

All Reserved

Remote Fault for 4 lane CX4/XAUI may require more bits, w/o using Msg Page

FD	HD	PS1 (P)	PS2 (aP)	RES	RES	RES

0: OK
1: Offline   1000BASE-LX, SX, and CX
2: LinkFail
3: AutoNegErr

Valuable Coding space is NOT used
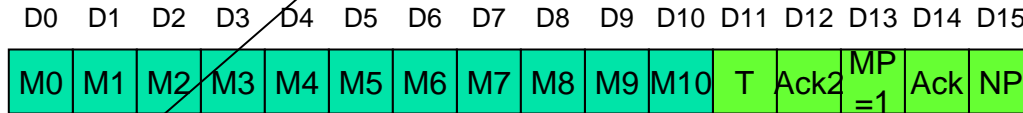
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
M0	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	T	Ack2	MP =1	Ack	NP

Message Next Page

0, 7FF: Reserved
1~6: Null, One UP, Two UP, One UP + RF code, OUI, PHY ID
7: 100Base-T2
8: 1000BASE-T with Two AbilityP
9~2047: Future Use

3 speeds may not be enough to provide future proofing….

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
U0	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	T	Ack2	MP =0	Ack	NP
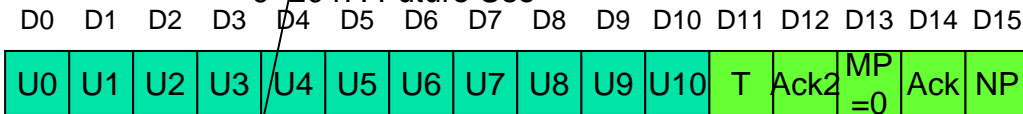
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Message Page not really meaningful in Clause 37. But we may still want to use Message Page(s) for future requirements

Clause 37 Observations

- Selector Base Page not used.
- PHY/MAC
  - Fixed Speed at 1000 Mb/s
  - Full/Half Duplex
- PHY
  - RF – Better Resolution but only valid for one lane
- New PHYs
  - Three reserved bits could be used for
    - 1G – 1 lane
    - 10G – 4 lane
    - 10G – 1 lane
  - Difficult for other future speeds and capabilities.

New Information Page

- **Why?**
  - Backplane is a new medium for Ethernet
- **Objectives**
  - Allow for reliable link for frame exchange
    - Minimal exchange based on chosen auto negotiation signaling method.
    - Multiple speed support.
    - Multiple lane support.
  - Extend 802.1ab MAC discovery to provide efficient configuration data exchange.

Recommendation

- Summary
  - Existing Clauses contain legacy baggage
  - Clause 28 is efficient for cabling, but running out of room
  - Clause 37 can be extended, but after three new PHY/MAC support the same problem occurs.
- New work would require time for IP development and interoperability.
- New Base page design based on Best of Clause 28/37 desired.
  - Remove legacy
  - Focus on Backplane – speed, equalization, lanes, RF.
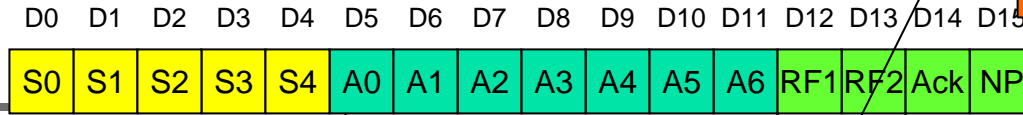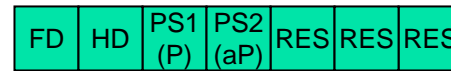
Solution Considerations

- New Base Page
  - Honor selector fields
    - New base page design w/ new selector field
    - Not consistent – RJ45 MDI selector, not applicable for BP.
  - Not Honor existing selector field and define new base page.
    - SerDes/BP-PHY compatibility.
- Some value in preserving Clause 37 base page
  - 1G serdes in use (not std)
  - Clause 37 legacy only use base page (confirm!).
    - If true, use next msg page for additional speeds and RF code extentions.
    - If not, then use next unformated page for additional speeds.
- Little value in preserving Clause 28 base page

Proposed Message Format

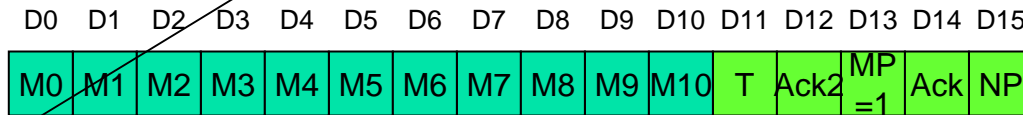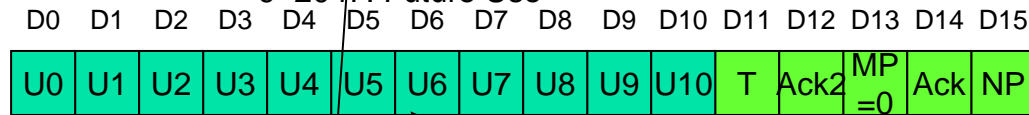**Remote Fault – Preserve (does not address CX-4 Lane status)**

D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15

| S0 | S1 | S2 | S3 | S4 | A0 | A1 | A2 | A3 | A4 | A5 | A6 | RF1 | RF2 | Ack | NP |

Base Page

All Reserved

| FD | HD | PS1 (P) | PS2 (aP) | RES | RES | RES |

0: OK
1: Offline   1000BASE-LX, SX, and CX
2: LinkFail
3: AutoNegErr

Create a new selector values for 802.3ap. Legacy = 0

D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15

| M0 | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | T | Ack2 | MP =1 | Ack | NP |

Message Next Page

**RES bits:
1 G 1 Lane
10 G 4 Lane
10G 1 Lane**

0, 7FF: Reserved
1~6: Null, One UP, Two UP, One UP + RF code, OUI, PHY ID
7: 100Base-T2
8: 1000BASE-T with Two AbilityP
9~2047: Future Use

D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15

| U0 | U1 | U2 | U3 | U4 | U5 | U6 | U7 | U8 | U9 | U10 | T | Ack2 | MP =0 | Ack | NP |

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**Define Message Page for continuation of PHY/MAC speed/lane capability (and RF code extension in the msg NP)
Define Equalization parameter exchange code in anticipation for 10G**

**Define Message Page for continuation of PHY/MAC speed/lane capability.
Define Equalizaiton parameter exchange code in anticipation for 10G**

Conclusions

- Existing base pages have issues
  - Legacy code points no longer needed
  - Not enough code space w/o next page
  - Un-due complexity due to the above
- Recommend new base page for 802.3ap
- If an existing base page is to be used, recommend Clause 37