Backplane Auto-negotiation Based on Clause 37

Presentation to

IEEE 802.3ap Task Force

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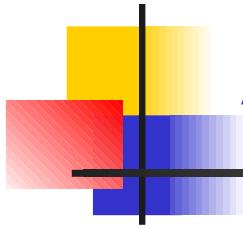
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Contributors and Supporters
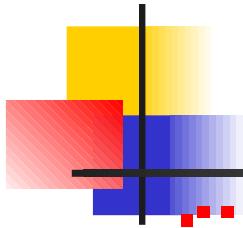
- Pat Thaler – Agilent
- Young Kim – Broadocm
- John Louie -Broadcom
- Uri Elzur – Broadcom
- Joe Abler – IBM
- Jeff Lynch – IBM
- Paravin Patel - IBM

- Tom Palkert – Xillinx
- Brian Braun - Xillinx

Auto-Neg /Signaling Objective
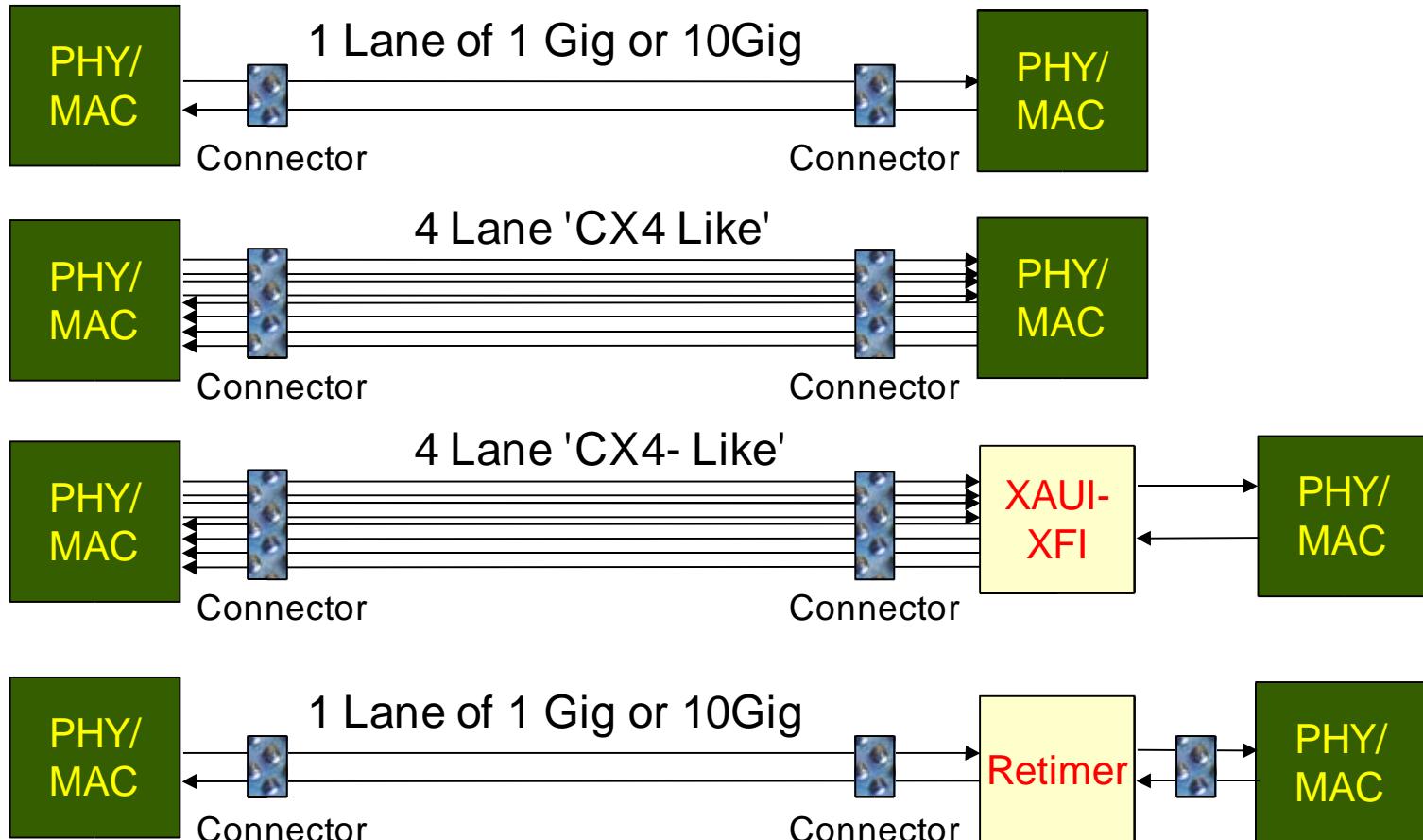
- Backward compatibility

- Proven implementation

- Fast negotiation (ms not seconds)

- Minimal impact to existing PHYs (SerDes friendly, no analog changes)

- Friendly to "pass through" blades and external PHY
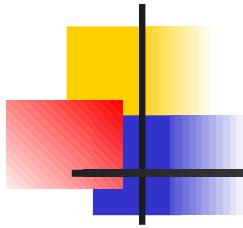
What are the Problems to Solve?

- Establish Link - Robust, Fast, Interoperable
  - Speed negotiation
  - Required SERDES/Driver/Receiver parameter selection, if required for link establishment (10G)

- Considerations - Nice-to-have
  - Lane Negotiation
  - Remote Fault (Multi-lane also).
- Backward Compatibility
  - 1000Base-x
  - CX4 (XAUI-like)
  - 10GBase-R LAN/PHY (if we choose 64/66B Coding)

Backplane Ethernet Implementation Scenario

PHY/ MAC — Connector — 1 Lane of 1 Gig or 10Gig — Connector — PHY/ MAC

PHY/ MAC — Connector — 4 Lane 'CX4 Like' — Connector — PHY/ MAC

PHY/ MAC — Connector — 4 Lane 'CX4- Like' — Connector — XAUI-XFI — PHY/ MAC

PHY/ MAC — Connector — 1 Lane of 1 Gig or 10Gig — Connector — Retimer — PHY/ MAC

Establishing a Link

- Negotiate Speed (and Lane)
- SERDES/Driver/Receiver
  - Parameters (if needed for 10G single lane or higher speed).
- I/O Compatibility
- Protocol Clause 37 Exchange Pages [1], kim [2].
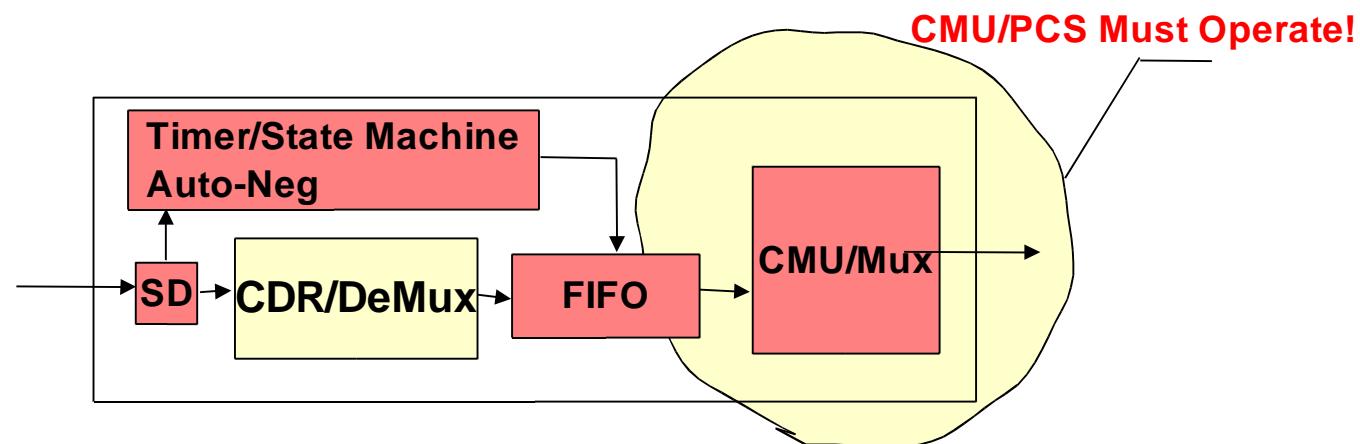
Overview of Clause 28 and 37 Auto Negotiation
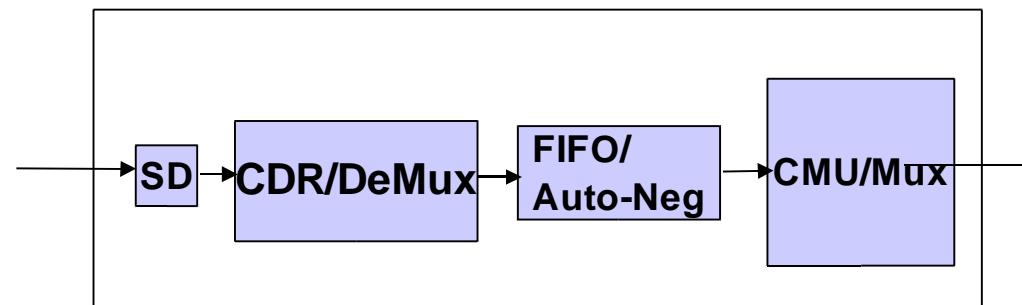
	Clause 28 -Link Pulse	Clause 37 -Code Word
I/O	**Medium AnalogComplexity.** **Require Analog SD to parallel detect incoming pulses**	**No Change to Analog.** **Simple Digital Implementation**
Link Operation	**CMU/Mux Must Operate to pass Config Register**	**CMU/CDR must be operational to Pass Config Register**

Inband "Clause 37" vs Pseudo Inband "Clause 28" Auto Negotiation
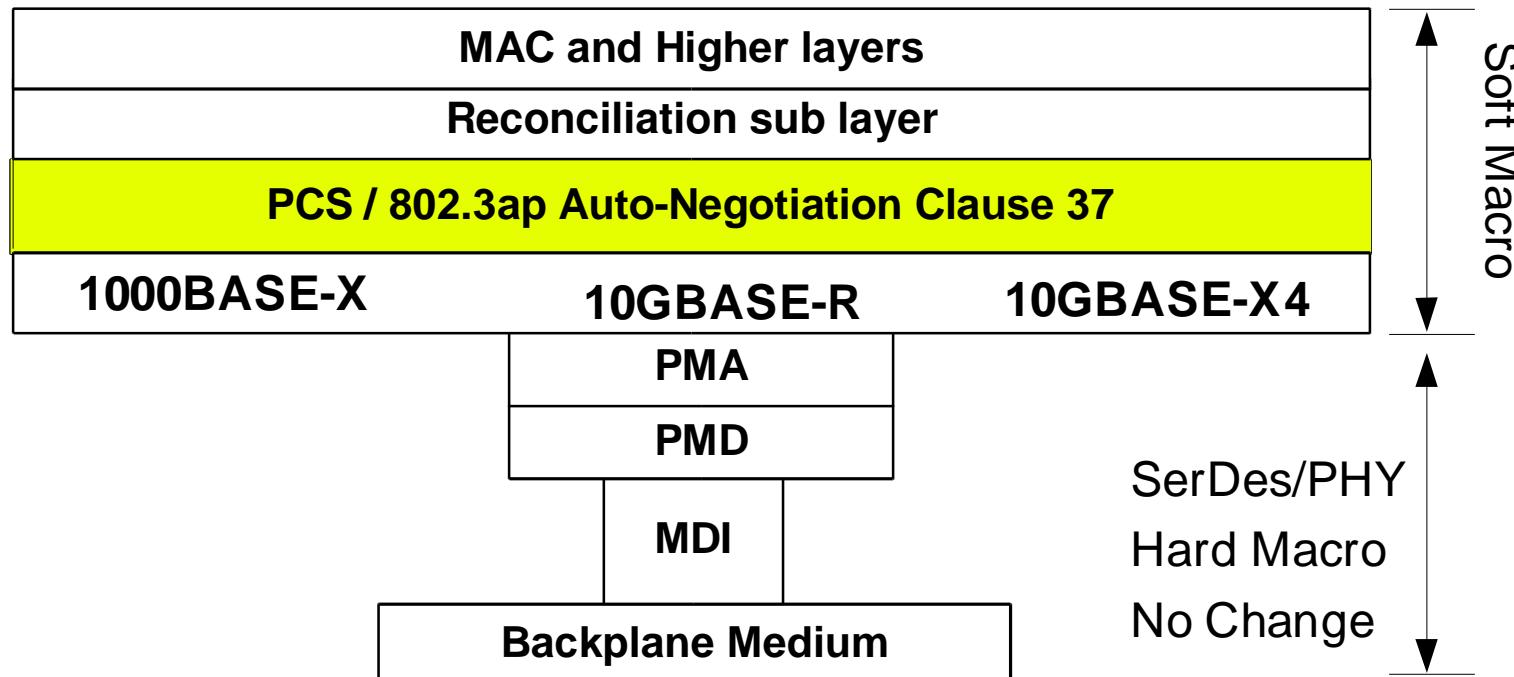
Clause 28 - More Complexity just not to operate the CDR during AutoNeg!

CMU/PCS Must Operate!

Timer/State Machine Auto-Neg

SD **CDR/DeMux** **FIFO** **CMU/Mux**

Clause 37 - Simpler

SD **CDR/DeMux** **FIFO/ Auto-Neg** **CMU/Mux**

802.3ap Layer Model

MAC and Higher layers
Reconciliation sub layer
PCS / 802.3ap Auto-Negotiation Clause 37
1000BASE-X   10GBASE-R   10GBASE-X4

Soft Macro

PMA

PMD

MDI

Backplane Medium

SerDes/PHY
Hard Macro
No Change

Layer Model
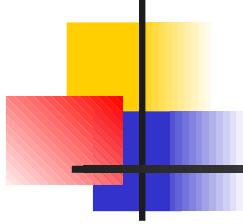
Comparison of Clause 28, 37, and FC AutoNeg

Parameter	OLP-Clause 28	Code Word Clause 37	FC
Independent TX and RX Rate	No	No	Yes
AutoNeg Layer Location	PCS/Analog	PCS	FC-2
Backward Compatablity	None	1000Base-x	FC-AL
Complexity	Med	Low	Low
AutoNeg Speed	> 1s	100 ms	500 ms
Parallel Receive Detect Circuitry	--	++	++
Low Frequency Cutoff Requirement	--	++	++
Allow Retimer / External SerDes	--	++	++

Clause 37 1000Base-X AutoNeg Implementation
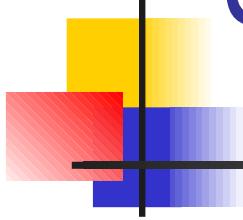
- Transmit alternating /C1/ and /C2/
  - C1 Order Set Configuration 1 defined as / K28.5/D21.5/Config_Reg.
  - C2 Order Set Configuration 2 defined as / K28.5/D2.2/Config_Reg.

- Config_Reg is defined as two Bytes to Auto-Negotiate 1000Base-x and defined in Clause 37.
  - Config_Reg pages can be extended to accommodated other speed like 10G and 40G.
  - Next page support exist already

- /C1/ and /C2/ are supported in 10GBase-R.

Advantages of Using Clause 37
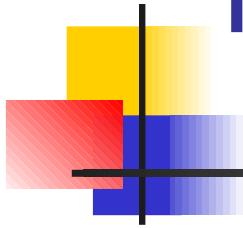
- SerDes Friendly and Compatible with existing PHY:
  - 1000Base-X, 10GBase-X4, and 10GBase-R
- Backward compatible to1000Base-X [3]
- Simple clean implementation in PCS layer
- Maintain Signal Detect for Diagnostics
- Robust / immune from noise and crosstalk
- Does not limit AC coupling caps

Summary

- Backplane Ethernet should be backward compatible to 1000Base-X, 10GBase-X4, and 10GBase-R.

- Clause 37 is the only existing and proven AutoNeg beside FC with " no change to the SerDes" .

- SerDes Friendly means " no change to SerDes" and " allow external PHY" .

References

[1] IEEE Standards 802.3-2002 Clause 37 and 802.3ae-2002 Clause 49

[2] Kim, Clause 37 Protocol IEEE 802.3 July 2004 Portland.

[3] UNH-IOL Clause 37 Auto-Negotiation Test Suite
http://www.iol.unh.edu/testsuites/ge/