Thoughts on Low-pin-count Low-power Media Independent Interface

Fort Worth

September, 2016

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Agenda

- Overview
- Goals & Assumptions
- Media Independent Interface Options
- Conclusions

Overview

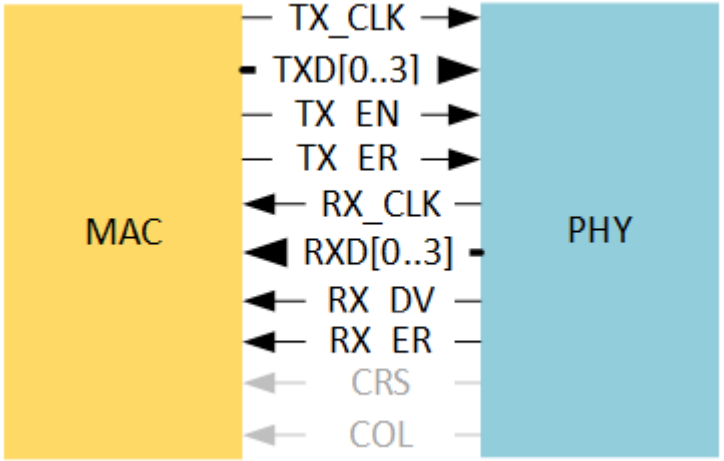
- The standard **Clause 22** MII interface, operating at **10Mbps** requires 14-16 pins.
- Industry standard **RGMII** requires 12 pins.
- Some targets of **10Mbps** single pair will not have integrated **PHY**s and will have a price point which requires keeping pin count down and implementation complexity as low as possible to meet the cost objective.

Goals and Assumptions

- While some targets are cost constrained, other targets require a MAC interface which is already standardized, namely MII.
- The goal of this presentation is not to preclude implementation of a 10SPE PHY with MII.
- Rather, it is to suggest feasibility for a low-power, low-pin count MAC interface for those cost constrained nodes which require it.
- This presentation enumerates some MAC interface possibilities “xMII” where xMII is used for a generic media interface.

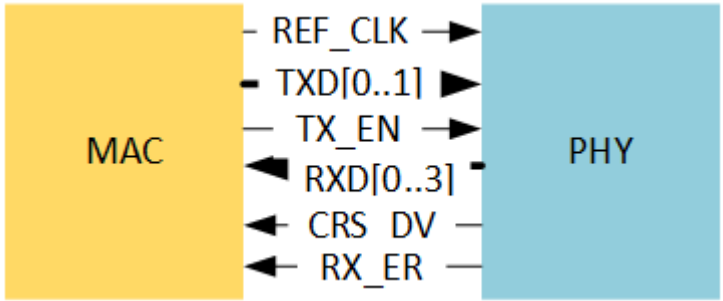
MII

- **MII** interface defined for 100Mbps operation. It has 16 pins.
- If half duplex capability is eliminated **(MII-Lite)**, 14 pins are required.



RMII

- Industry standard RMII was defined to save pins vs. MII. It requires 8 pins and the clock runs at 50MHz, 10Mbps data is repeated 10 x.
- 50MHz can increase emissions.
- Repeating data 10x is wasteful.

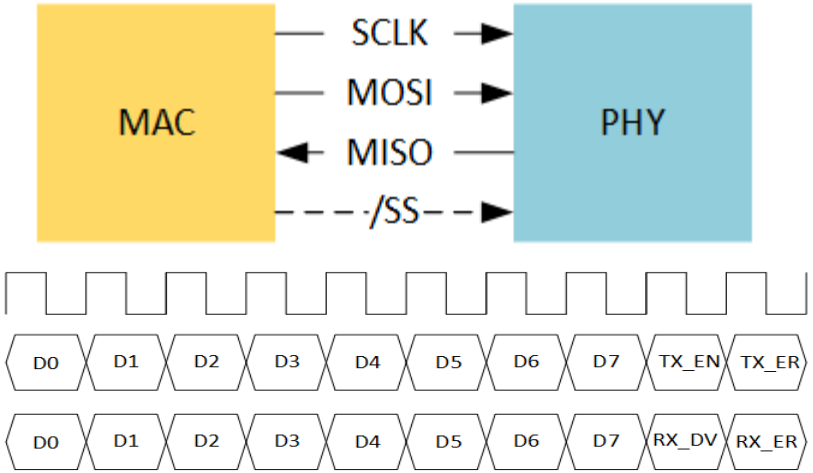


xMII Option: DME

- One option for a low-pin count interface between the **MAC** and the **PHY** is to utilize Differential Manchester Encoding **(DME)**.
- **DME** is used in **Clause 73** and **Clause 98**
- Self-synchronizing, eliminates need for clock. Could drive single-ended with 2 pins, or differential with 4.
- More complex and **EMC** may be a concern

xMII Option: SPI

- SPI is used for many microcontroller peripherals including moderate-rate ADCs and is defined in SDIO (SD Card specification)
- Widespread use in various technologies
- 3-4 pin serial interface:
  - SCK Provided by MAC controller (Master)
  - MOSI (Master Output, Slave Input)
  - MISO (Master Input, Slave Output)
  - /SS Slave Select



- Data pins could send 10 bits per data octet @ 12.5MHz SCK, with TX_EN, TX_ER RX_DV, RX_ER added at end of octet.
- If clock stops when no data transferred to save power, may require additional pin to signal to MAC to start clock.

xMII Option: SPI-like Variants

- Many possible variations on **SPI**:
  - Can make the **PHY** the master instead of the **MAC**
  - Run double data rate (1 bit transferred per level change
  - Use Clock line to indicate start of packet.
- **SPI** may provide a starting point for a reduced-pin **xMII**.

Media Independent Interface Options

xMII	# of PINS	Clock	Complexity	EMC Concern
MII	14-16	2 x 2.5 MHz	Simple	No
RMII	8	1 x 50 MHz	High	Yes
SPI	3-4	1 x 12.5 MHz	Medium	No
Serial DME	2 or 4	N/A	High	Yes
SPI-like Variations	3 - 5	1 x 10MHz or 1 x 5MHz	Medium	No

Other Thoughts

- All of the clocks suggested are below **30MHz** which should help with the fundamental radiating.
- With automotive **EMC**, possibility exists for significant radiation at harmonics of the clock, which might make board design more costly.
- Optionally, **FM** modulating the clock(s) could significantly reduce detected radiation from clock harmonics.

Management Interface

- **MII** defined the data interface and the management interface.
- The management interface should be separate from the **MAC** interface.
- It could be **Clause 45 MDIO** which is a 2-pin interface or a management interface used in the industry.

Conclusions

- DME, SPI, or an SPI-variant interface can help 10SPE achieve its cost and complexity objectives by reducing pin count substantially
- Each interface has its advantages and disadvantages
  - SPI is already an industry standard and could be utilized with existing MAC interface equipment.
  - DME eliminates the clock.
  - An variant of SPI could allow stopping the clock for power savings.
- There exist feasible options for a low-pin-count low power media independent interface for 10SPE

Thank You!