

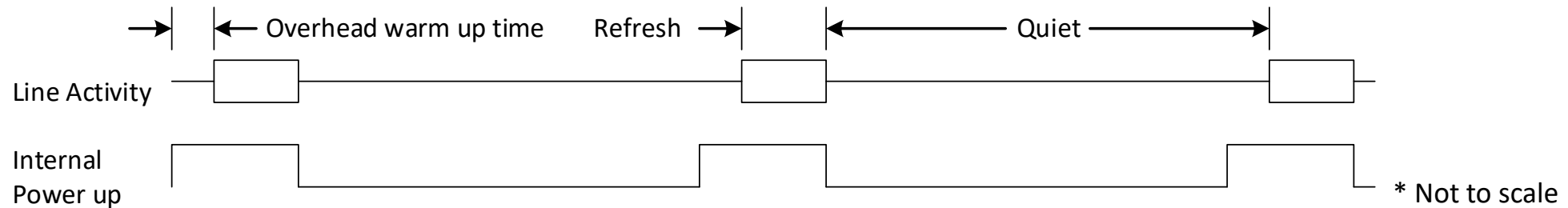
Asymmetric Operation Power and Modulation Considerations

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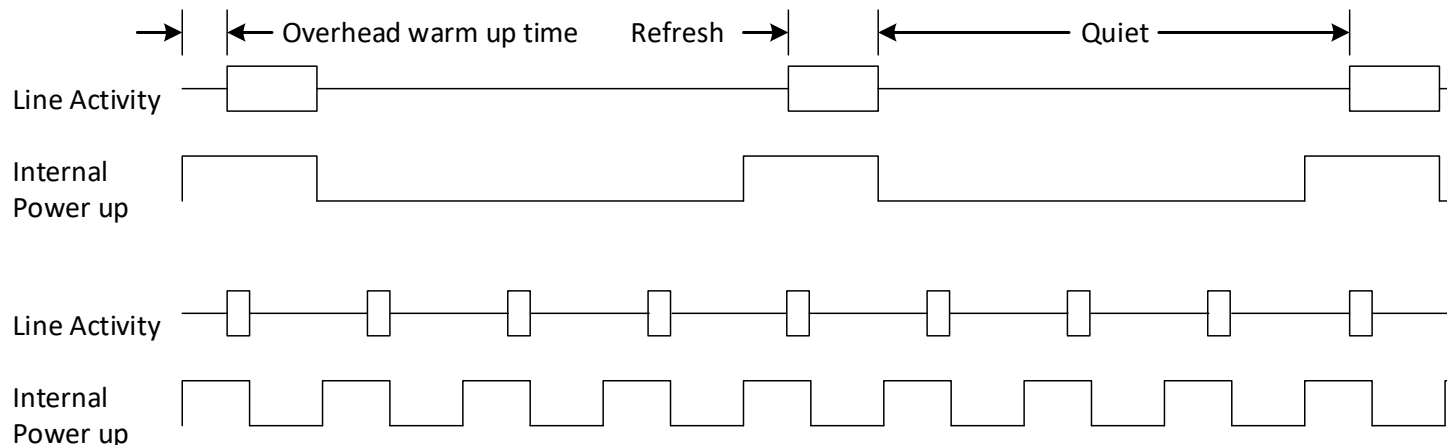
Background: Energy Efficient Ethernet

- Burst on/off – Power savings during quiet period
- Theoretical power consumption is
$$\frac{T_{\text{refresh}}}{(T_{\text{quiet}} + T_{\text{refresh}})} \times \text{Normal power} + \text{power to detect alert/wake}$$
$$\frac{T_{\text{refresh}}}{(T_{\text{quiet}} + T_{\text{refresh}})} \text{ about } 1:100$$
- Actual power savings less due to ramp up and other overhead
1000BASE-T about 1:10, 10GBASE-T about 1:2



Higher baud rate effect on EEE

- Refresh keeps timing and signal process parameters from drifting
→ Limits to how far apart refresh can be spaced
i.e. http://www.ieee802.org/3/ch/public/nov18/southern_3ch_01_1118.pdf slide 6
- Higher baud rate → refresh occurs closer together even though duty cycle remains the same
- Some warm up time does not scale with baud rate. i.e. analog circuits → Less power down time
- In some circuits cannot shut down at all because of fast turn on time required



* Not to scale

Methods to reduce power

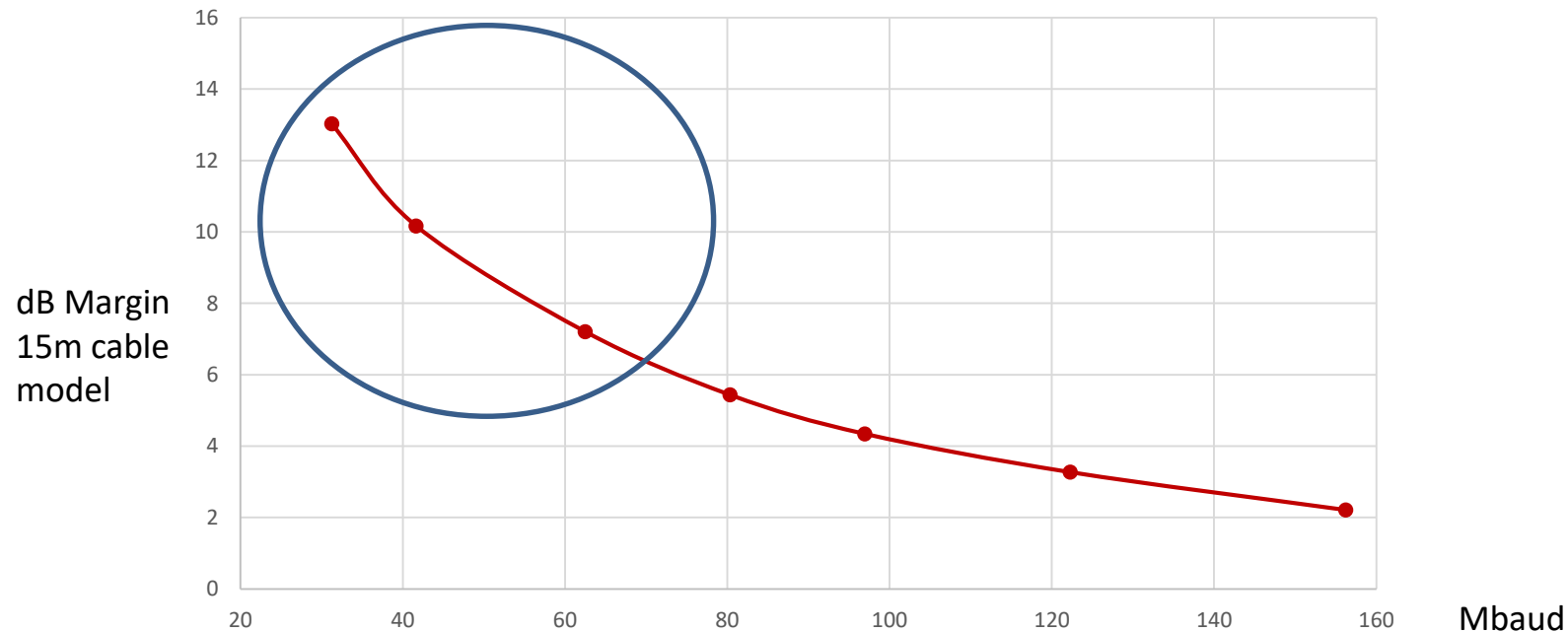
- Reduce duty cycle (i.e. EEE bursting)
- Slow down clock frequency
- Simplify signal processing
- Reduce amplitude
- Others??

One possible approach

- Instead of controlling power via duty cycle we define a modulation that:
- Run at lower baud rate (Slow down clock frequency)
- Eliminate need for digital echo (Simplify signal processing)

Impact on high speed receiver by low speed transmitter

- High pass filter out low speed transmit signal (no digital echo)
- Look at margin at high speed receiver for given low speed baud rate



- Recommendation: Modulation of low speed signal to below 70 Mbaud.

THANK YOU