Design Considerations for EEE

Contribution to IEEE 802.3cy

Ragnar Jonsson and Alireza Razavi Majomard
Marvell

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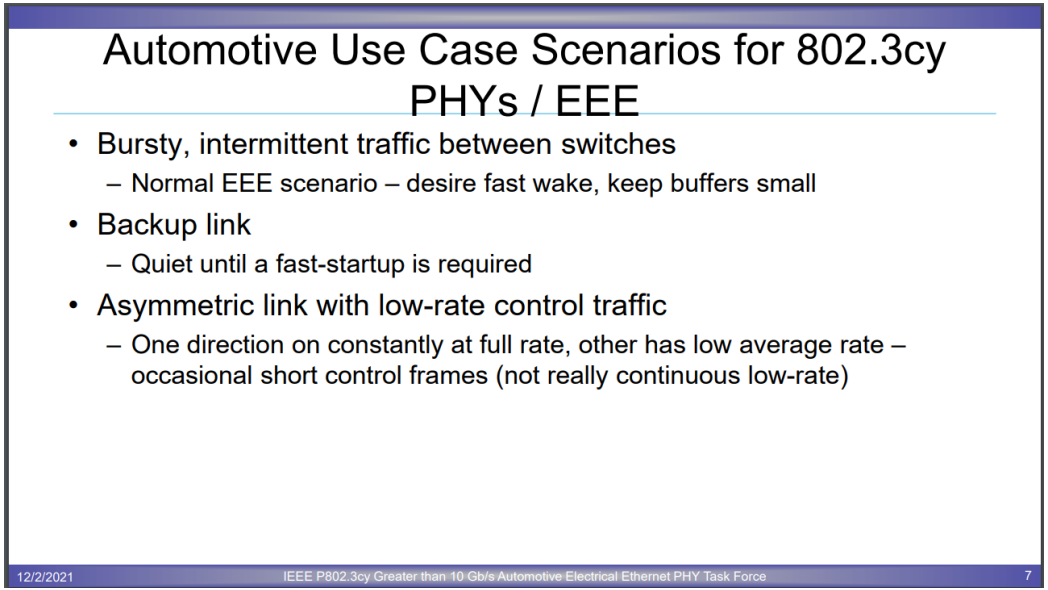
EEE for Automotive Links

The various EEE scenarios for automotive links are discussed in zimmerman_3cy_01_12_07_21

This presentation reviews design considerations for 802.3cy EEE



From zimmerman_3cy_01_12_07_21.pdf

Design Criteria for EEE

Requirements for EEE:

- Low power consumption while in EEE mode
- Go quickly into data mode again
- Maintain clock synchronization for PTP, etc.
- Support asymmetric link
- Support backup links
- Other requirements?

Derived requirements:

- Maintain Clock Sync
- Detect (and adapt to) changes to the channel response
- Support key protocols for asymmetric use cases
- Simple EEE standard description would increase probability of successful interoperability

Maintaining Clock Synchronization

It is important to maintain clock synchronization because

- In master-slave configuration the slave clock must always track the master clock, to maintain good SNR for the link
- Too much timing slip can cause problems with frame alignment, which can bring down the link
- In timing sensitive applications, like PTP, the link may be used to synchronize time reference in “remote” devices

Possible practical problems

- If the master is silent and the slave is transmitting, the slave clock can drift such that master is receiving at suboptimal sampling phase
- If the master is silent and the slave is transmitting, the slave may quickly recover the clock when the master starts transmitting, which causes fast phase change in the slave transmit signal, which can cause problems for the master receiver

Track Changes in the Channel

The system needs to come quickly and reliably out of EEE mode

- The link channel response can change over time due to temperature change or other factors
- The link channel noise can change over time due to temperature change or external noise sources
- There may be noise burst on the link when coming out of EEE mode

Monitoring channel changes in EEE mode

- The receivers need to be able to monitor the channel condition, while in EEE mode
- This can be done by regularly sending signals that can be used to probe the channel response (both IL and RL)

Transition to and from EEE Mode

Transition to Data Mode

- Some applications may require specific limits on the latency in transitioning from EEE mode to data mode
- Transition to data mode can not cause link drop if the other transmit direction is already in data mode
- There may be requirements on super-frame alignment when transitioning to data mode

Transition to Low Power Mode

- The transition should be done in such a way that both transmitter and receiver can take full advantage of power savings in low power mode
- While in low power mode the requirements on the transmitter and receiver should be such that both sides can minimize power consumption

The EEE transitions should minimize constraints on transmitter and receiver, while ensuring reliable interaction between the transmitter and receiver

Other Considerations

The following applications and protocols may need to be considered in the EEE design

- PTP
- Synchronous Ethernet ?!?
- MACsec
- 1588 and 1722
- I2C camera control
- What else?

Some Questions

- What are the maximum delay requirements when transitioning into data mode?
- Are there important asymmetric use cases that differ significantly from the camera and display use cases?
- Are there full EEE use cases that differ significantly from back-up link or the switch-to-switch use cases?
- Are there any significant requirements for EEE that have not been addressed in this document?

Summary

- We have reviewed key design considerations for 802.3cy EEE
- It is important to enable low power consumption in EEE mode
- It is important to maintain clock synchronization during EEE mode
- It is important to monitor the channel characteristics during EEE mode
- It is important that EEE mode can support the asymmetric data applications

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