Considerations on power consumption for IEEE 802.3dm PHY

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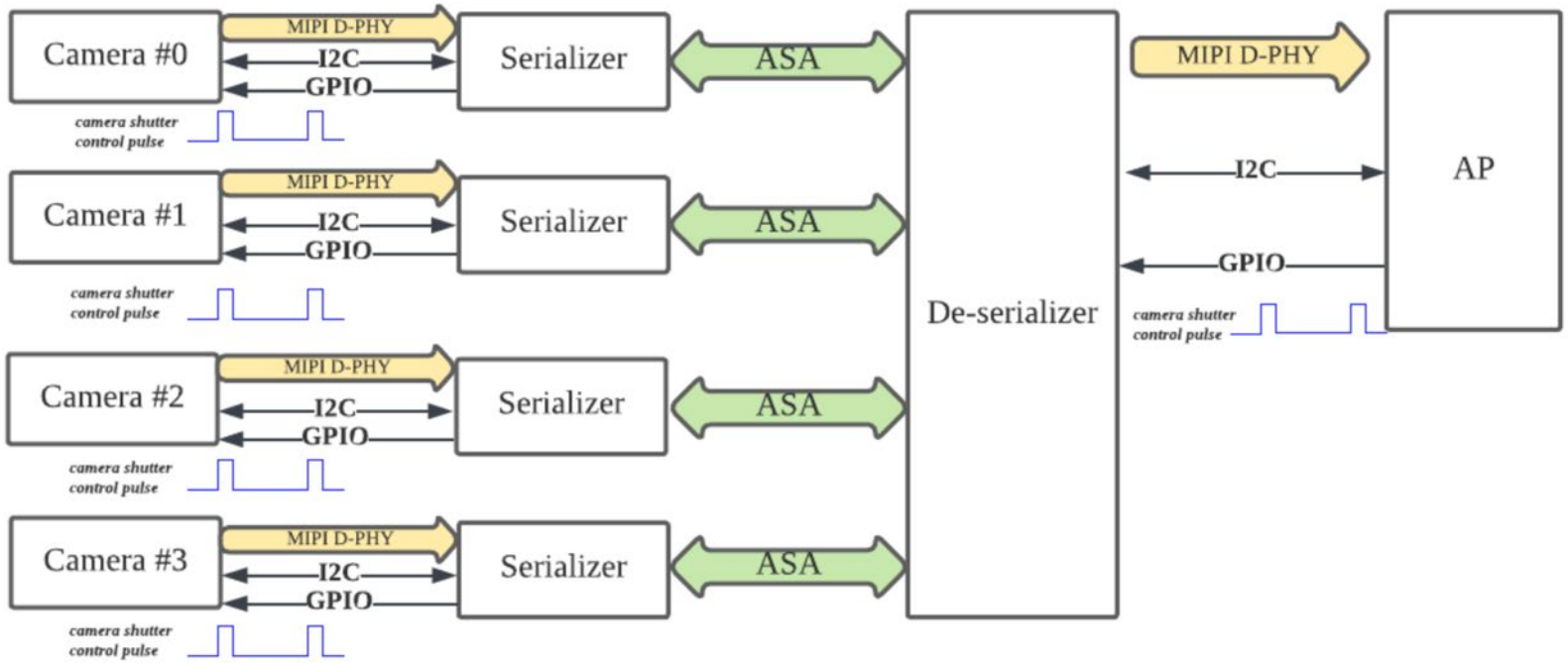
Outline

- Review of asymmetric transmission approaches for IEEE 802.3ch and the competing ASA-MLE approach
- Compare power consumption
- Observations, questions and discussion
- Summaries

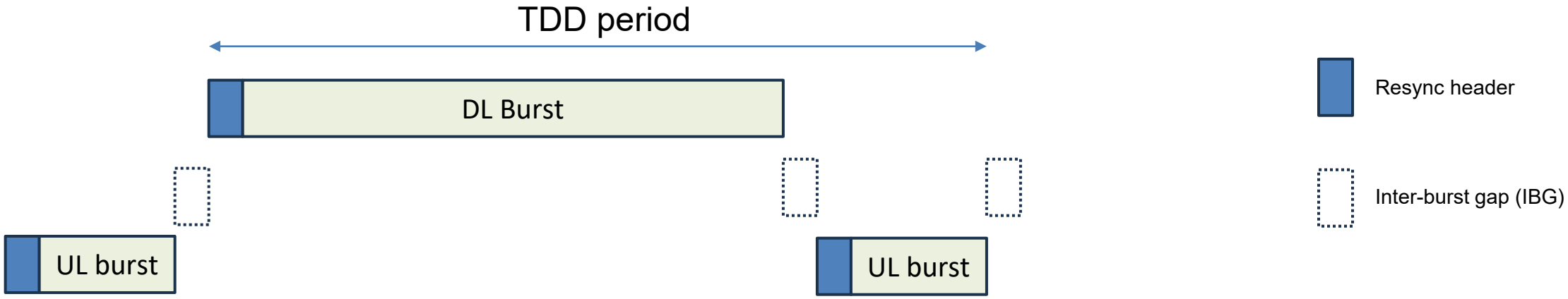
Requirements on Uplink Transmission

- **Due to the need for periodic transmission requirement from ECU to camera such as camera sync signal delivery and maintenance, it is required to provide periodic upstream transmission slot.**



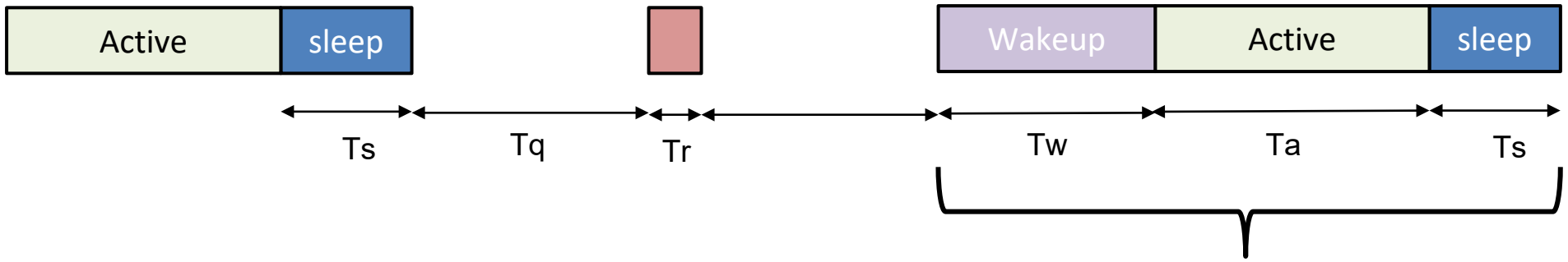
Typical camera system used in a vehicle

ASA-MLE Burst Structure



Standard	DL/UL Speed	TDD period	DL burst time	UL burst time	IBG time	Resync header time	Line speed
ASA-MLE	2.5G/100M	3.95us	2.88us	0.48us	0.104us	0.192us	4G/4G
	5G/100M	2.99us	2.16us	0.24us			8G/8G
	10G/1G	2.99us	2.16us	0.24us			16G/16G
	10G/100M	26.83us	25.92us	0.32us			12G/12G
ASA-ML	All SG	27.38us	25.92us	0.86us			All SG

Asymmetric Ethernet based upon 802.3ch + EEE

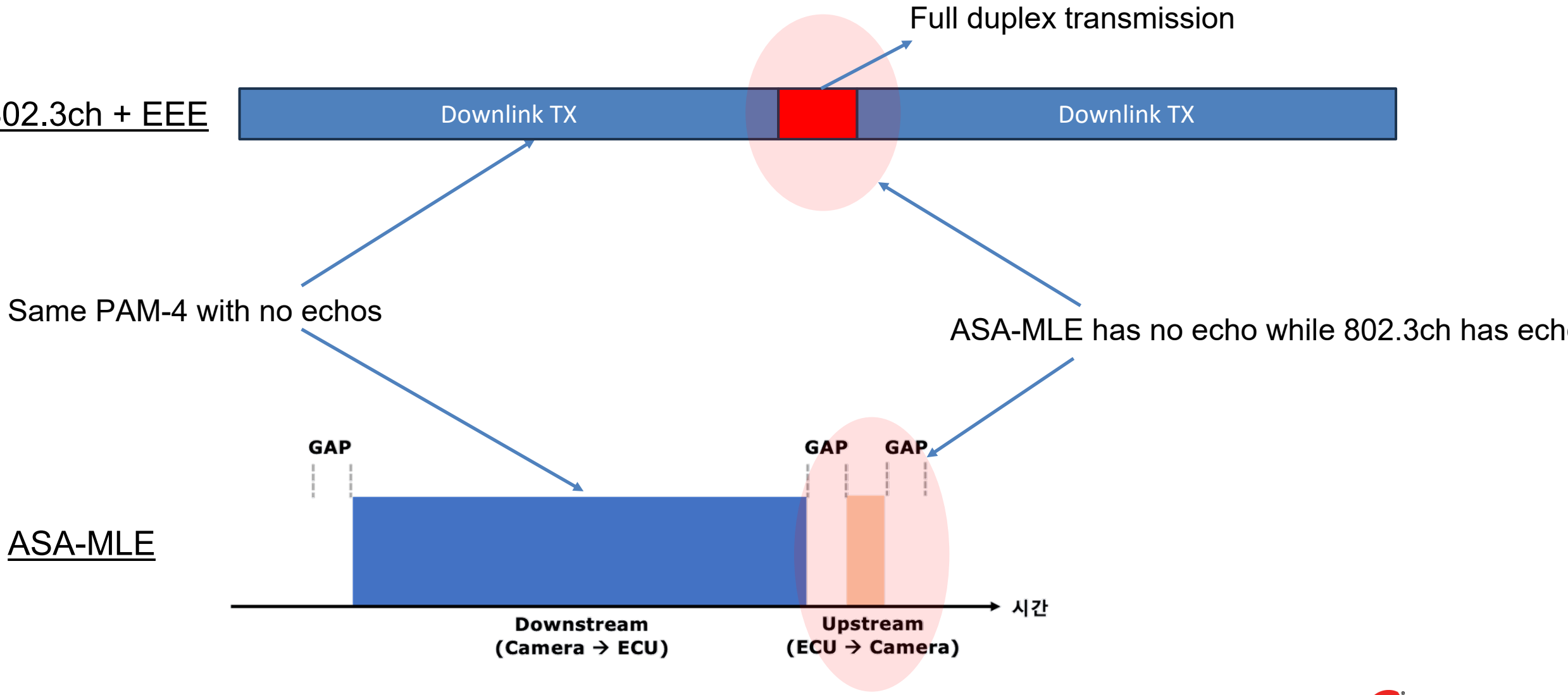


Timing parameters for 10G case

Parameter	Duration
Quiet period (Tq)	30.4 µs
Refresh time (Tr)	320 ns
Sleep time (Ts)	2560 ns
Wake-up time (Tw)	6.4 µs
Minimum active time (Ta)	320ns

Minimum time for wake-up + active + sleep =
6.4 + 0.32 + 2.56 = 9.2 µsec

802.3ch vs ASA-MLE



MICROCHIP

Uplink transmission slot

- **ASA-MLE has time slot from 2.5us to 26.8us, while ASA-ML has fixed TDD period of 27.3 us**
- **802.3ch has quiet period of ~30us similar to the TDD period of ASA-MLE**
- **10G/100M of ASA-MLE has line rate similar to 802.3ch 10G EEE**
  - ASA-MLE 10G/100M: 802.3ch 10G = 12G : 11.25G
- **To compare ASA-MLE against IEEE 802.3ch, it is assumed that both schemes use an 30µs period for upstream transmissions.**
  - Comparison against shorter TDD cycle of ASA-MLE needs to be performed later as well

Discussions

- **802.3ch EEE spend more time&energy for uplink transmission**
  - 802.3ch would require at least 9.2us for wakeup + TX + Sleep
    - ASA-MLE requires 0.512us (=0.32us+0.192us)
  - When uplink transmission period is assumed to be set to 30µs, the receiver in the camera would be active for
    - ASA-MLE : 0.512µs out of 30µs => 1.7%
    - 802.3ch : 9.2us out of 30µs => 30.6%
  - Increasing TX transmission period beyond 30us (~ 1ms) could improve the power saving effiency for 802.3ch
    - Intermittent transmission for tunneling I2C and GPIO (periodic shutter control) signal could bring challenges to existing camera system design
  - ASA-MLE provides guaranteed bandwidth/latency

Discussions (cont'd)

- **Receiver complexity and performance could affect power consumption**
  - 802.3ch requires stable echo canceller for each uplink reception along with very high timing precision
  - ASA-MLE has lower requirement on timing accuracy (no echo canceller)
- **Power on the camera side increases significantly during uplink RX reception with both TX and RX circuits turned on**
  - Power fluctuation impact on PoC circuits
  - Increased uplink transmission & reception period could increase power consumption on camera side

Summary Observations

Item	3ch + EEE	ASA-MLE	Comments and Questions
Upstream line rate	11.25G/5.62G/2.81G	16G/12G/8G/4G	Higher rate uplink transmission causes more power to be consumed on both transmitter and receiver, but with smaller period. Need to investigate the impact on the power with different speed combinations What is the overall power impact in practice?
% of time when uplink is active (when 30us period is assumed)	9.2µs out of 30µs (30.6%)	0.51µs out of 30µs (1.7%)	ASA-MLE provides higher power saving when uplink transmits every 30us. For infrequent uplink transmission, the difference becomes smaller. When lower speed grade of 5G or 2.5G is used for 802.3ch, active time is doubled and quadrupled for 802.3ch, resulting in decrease in power saving

Summary Observations (continued)

Item	3ch + EEE	ASA-MLE	Comments and Questions
Echo canceller	Required	Not needed	The echo canceller adds complexity and power
Timing precision circuitry	Requires very high precision	Relatively relaxed precision	High precision required for proper echo canceller operation resulting in increased power
Power at the camera during an upstream burst	Transmit and receive circuits plus echo canceller are active	No echo canceller, and transmit & receive are never active simultaneously	What is the impact on the power at the camera during the higher power for 3ch during an upstream burst? What are the implications for the PoC filters and how should system designers design the power circuits? Against maximum power or average power.
Power saving	EEE can be activated 1 sec after full duplex transmission	Always active	

Summary

Power at the camera module is one of the key factors for evaluating 802.3dm alternatives

- Comparing the proposed 802.3ch approaches with ASA-MLE raises a number of issues regarding the relative power consumption

What is the primary power emphasis? For example:

- Peak power?
- Average power?
- Variation between peak and average power?
- How should system designer design power/PoC circuits?

We propose that further analysis is needed to address the questions identified in this presentation.

Thank You