ACT Link Efficiency Without EEE: Architecture Power Analysis

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Introduction

Automotive ADAS and display links are fundamentally different from enterprise and data-center Ethernet.

- These links are designed around latency, jitter, and continuous service availability

EEE was designed to reduce PHY power for **bursty**, **opportunistic traffic** with a long idle period

- This fundamental behavior conflicts with always-on time synchronous automotive links

EEE quiet-refresh signalling (also called “LPI mode”) was introduced to deal with echo-canceller drift

Refresh signal allows: Maintaining precise timing needed by echo cancellers in the presence of drift

Quiet-refresh signaling may be used in non-echo-cancelled systems, but with substantially longer quiet periods

ACT links primarily serve deterministic, real-time sensor and display streams.

https://www.ieee802.org/3/bj/public/sep11/bennett_01a_0911.pdf

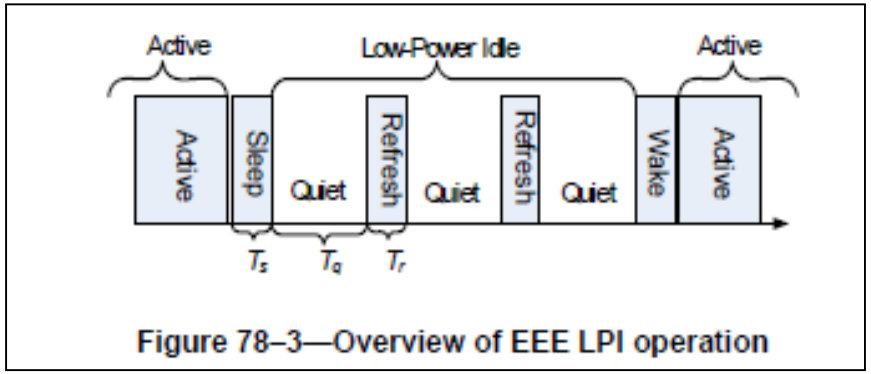
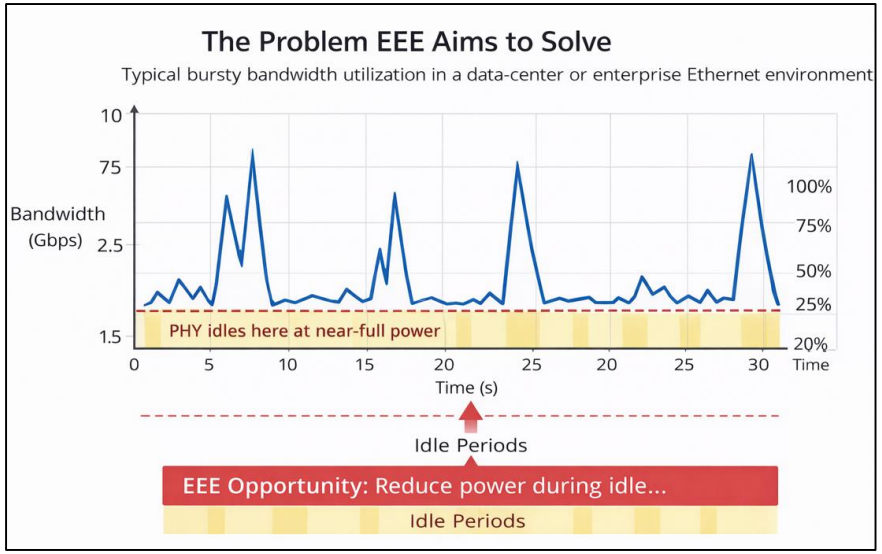


Figure 78–3—Overview of EEE LPI operation



EEE Implication

EEE mechanisms provide negligible power savings for ACT links while introducing:

Additional PHY state complexity

- LPI entry/exit sequencing
- Clock Recovery and equalization re-lock behavior

Latency and jitter variability

- Non-deterministic wake times
- Frame level delay uncertainty, which is not compatible with real-time streams

Increased verification and EMC risk

- Additional state transitions increase corner cases
- Repeated spectral transients during wake/sleep cycles

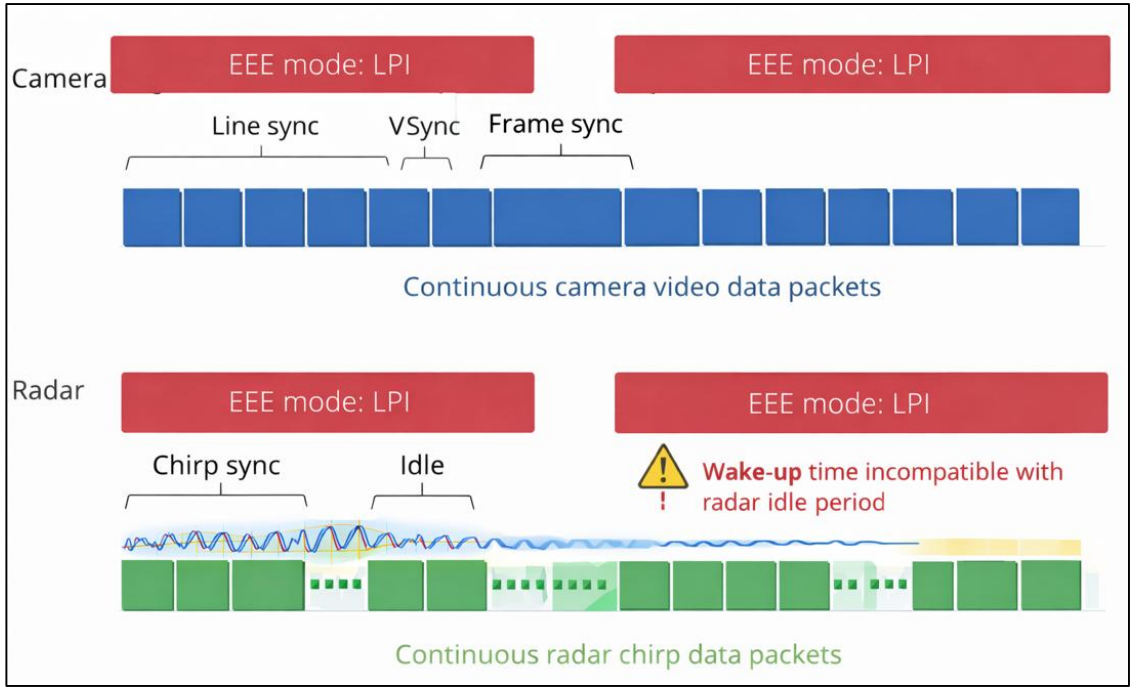
Traffic characteristics of ACT Use Cases

ADAS sensors and displays do not create idle links – They create continuous or periodic, time-synchronous data flows.

Camera: Continuous, constant-rate streaming

Radar & LIDAR: Periodic, high-duty deterministic traffic

Display: Continuous pixel streams during active video.



Summary

Energy Efficient Ethernet (EEE) was not defined for ACT Links

- EEE (IEEE 802.3az) was created to reduce PHY power during idle periods in bursty and jitter requirements
- Supporting EEE for 802.3dm ACT would require new PHY state definitions, wake behavior, and verification scope
- Even with modifications, residual risk remains due to wake latency, jitter, and EMC transients

EEE provides negligible power benefit for ACT use cases while introducing complexity, risk, and misalignment with 802.3dm

THANK YOU

Questions?