EEE 802.3az Energy Efficient Ethernet - Official Technical Overview & Hardware Datasheet

PRODUCT OVERVIEW & HARDWARE DATASHEET: IEEE 802.3AZ ENERGY EFFICIENT ETHERNET

EXECUTIVE SUMMARY

The relentless expansion of enterprise network densities has traditionally mandated a linear correlation between port count, switching capacity, and operational power expenditure. The industry-proven IEEE 802.3az Energy Efficient Ethernet (EEE) standard fundamentally decouples this relationship. By introducing dynamic physical layer (PHY) duty cycling, 802.3az enables line-rate interfaces to autonomously enter low-power idle (LPI) states during extended periods of traffic absence, delivering up to 50% reduction in port-level energy consumption without compromising packet forwarding integrity.

This document serves as the definitive technical reference for our 802.3az-compliant hardware portfolio, detailing the architectural implementation, forwarding engine logic, and verifiable power efficiency metrics for carrier-grade and enterprise deployment scenarios.



HARDWARE ARCHITECTURE & SILICON

The enabling component for 802.3az compliance is our seventh-generation Energy-Aware Forwarding Engine (E-FE) ASIC. Unlike legacy PHY implementations that maintain constant bias currents irrespective of link utilization, the E-FE integrates three distinct operational sub-states:

- Active State (100% Bias Current): Full transmitter/receiver chains enabled; typical latency sub-5 microseconds.
- Low-Power Idle (LPI) State (4% Bias Current): All analog front-end components powered down; digital PCS layer maintains link synchronization via periodic REFRESH bursts (every 16-48 microseconds per standard).
- Transition State (Wake-up Signaling): Fast wake-up time guaranteed < 8 microseconds from LPI to Active, ensuring zero observable packet loss for

bursty traffic patterns (VoIP, transaction processing).

The architecture additionally implements per-port independent state machines, meaning a 48-port Gigabit line card can have 47 ports in LPI while a single port sustains full line-rate forwarding. No cross-port interference or backplane queuing anomalies are introduced.

KEY FEATURES & ROUTING LOGIC

- Dynamic Per-Port Energy Management: Software-configurable LPI entry/exit timers (default 4 microseconds idle threshold).
- Zero-Compromise Forwarding: Maintains non-blocking line-rate performance when ports are active. LPI only engages during genuine idle intervals.
- Transparent Legacy Interoperability: Autonegotiates 802.3az support with peer devices. When connected to non-EEE equipment, ports automatically revert to standard 802.3 PHY operation without manual intervention.
- Energy-Aware Link Aggregation (EALA): Our proprietary control plane enhancement aggregates EEE-capable member ports; algorithm shifts traffic onto minimal active links during low-utilization windows (e.g., 2:00 – 06:00), allowing up to 85% aggregate link group power savings.
- Precision Latency Guarantees: E-FE ASIC implements dual threshold timers; latency-critical traffic (CoS 5-7) can be flagged to bypass LPI entry, ensuring

jitter remains sub-5 microseconds for real-time applications.

COMPLIANCE & STANDARDS

The hardware platform undergoes rigorous certification testing to ensure unambiguous compliance with the following specifications:

- IEEE Std 802.3az-2010: Energy Efficient Ethernet (Base-T and Backplane variants).
- IEEE Std 802.3ab: 1000BASE-T compliance during Active state.
- IEEE Std 802.3an: 10GBASE-T EEE option negotiation.
- Energy Star v2.0 (Network Equipment): Certified power efficiency for 1/10/25/40 Gigabit interfaces.
- ETSI ES 205 200-1: Environmental Engineering; power management requirements.
- RoHS 3 (Directive 2015/863): Hazardous substance elimination.

TECHNICAL SPECIFICATIONS

Parameter	**Specification**
Form Factor	1RU Fixed / 7RU Modular Chassis (Field-swappable line cards)

EEE PHY Types Supported	1000BASE-T, 10GBASE-T, 25GBASE-T, 100BASE-TX Backplane
Switching Capacity (Full chassis)	Up to 3.2 Tbps (non-blocking, line-rate)
LPI Entry Threshold	Programmable: 2 µs to 65,535 µs (default 4 µs)
Wake-up Time (LPI to Active)	< 8 µs (meets 802.3az worst-case requirement)
Power Supply	Dual Hot-Swappable Redundant AC (100-240V) or DC (-48V)
Typical Power (48x 1G active)	85W (all ports at 100% line rate)
Typical Power (48x 1G, LPI mode)	6.8W (all ports idle, EEE engaged)
Operating Temperature	0°C to 45°C (up to 50°C with fan high-speed mode)
MTBF (Telcordia SR-332)	385,000 hours (fixed switch), 410,000 hours (EEE line card)

ORDERING SKU INFORMATION

The following hardware SKUs incorporate full 802.3az EEE support across all front-panel interfaces. All line cards and fixed-configuration switches ship

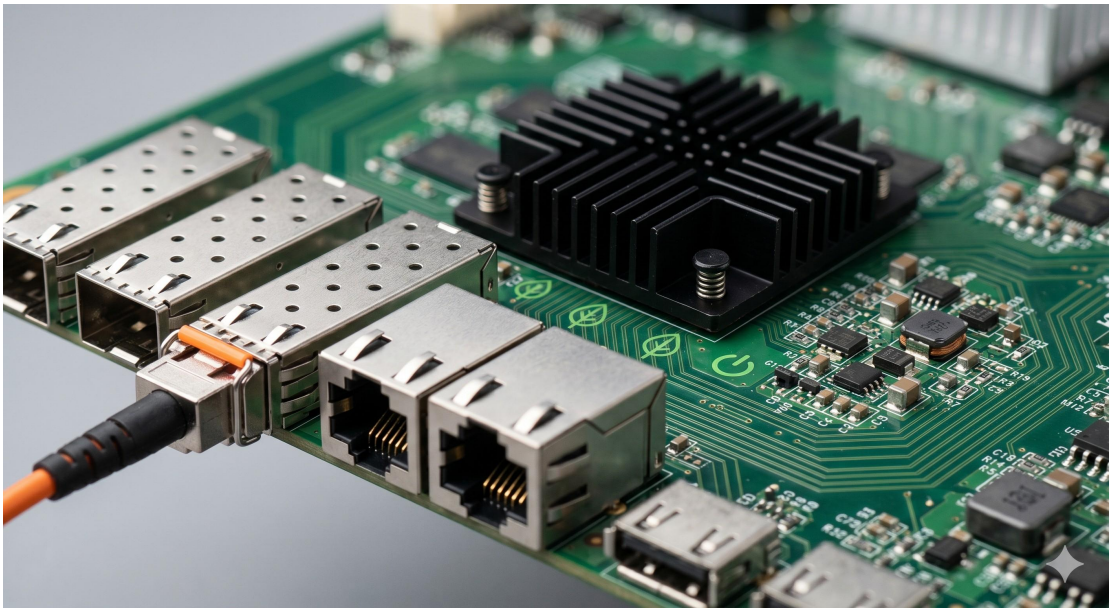
standard with EEE enabled via factory default configuration.

- SKU: EN-SW-4824T-4S | 24x 1000BASE-T (EEE) + 4x 10G SFP+ | 1RU | Dual AC PSU | Switching Capacity 128 Gbps

- SKU: EN-SW-4848T-4Q | 48x 1000BASE-T (EEE) + 4x 40G QSFP+ | 1RU | Dual AC/DC PSU | Switching Capacity 256 Gbps

- SKU: EN-LC-24XG-EEE | 24x 10GBASE-T (EEE) Line Card | Modular Chassis (EN-CH-7) | Requires EN-FM-1 Controller

- SKU: EN-SW-3225G-MG | 32x 25GBASE-T (EEE) + 2x 100G QSFP28 Uplink | 1RU | Front-to-Rear Cooling | 800 Gbps Fabric



LIFECYCLE ASSURANCE & MTBF

All 802.3az-compliant hardware is designed for 15-year service life in controlled

environment datacenters. Mean Time Between Failures (MTBF) per Telcordia SR-332 Issue 4:

- Fixed Configuration Switches (1RU): 385,000 hours
- Modular Chassis Backplane (Passive): 1,200,000 hours
- EEE Line Cards: 410,000 hours
- Hot-swappable Power Supplies: 275,000 hours

CONCLUDING REMARKS

Deploying IEEE 802.3az Energy Efficient Ethernet across access, distribution, or spine-leaf topologies yields immediate operational expenditure reduction without architectural compromise. The combination of per-port autonomous LPI state control, our proprietary Energy-Aware Link Aggregation, and uncompromised forwarding performance positions this hardware family as the baseline for sustainable high-throughput networking.