Ethernet-Based Automotive Applications

The automotive industry is trending toward Ethernet for in-vehicle networking (IVN) based on open IEEE standards. Driven by the OPEN Alliance SIG, these standards aim to develop a simpler but more powerful automotive electrical/electronic (E/E) architecture. Demand for deterministic, high-performance bandwidth features and for low-cost cabling solutions is accelerating market penetration of Ethernet-based networks. Ethernet for IVN provides the lowest-cost cabling solution for the automotive industry with low-weight, single-pair, unshielded twisted cable.

Cadence is an active member of the OPEN Alliance SIG. Our ongoing contributions to the Ethernet standard not only support automotive requirements for better in-vehicle safety, comfort, and infotainment, but also reduce network complexity and cabling costs.

Cadence Automotive Ethernet MAC Design IP

The Cadence Automotive Ethernet MAC supports three different operating speeds (10/100/1000M) and is widely licensed for high-volume production. It enables:

- Deterministic real-time data transfer for safety-critical applications such as reliable anti-lock braking
- High data bandwidth, accurate timing, and high quality of service (QoS) to synchronize and transmit audio/video streams, using audio/video bridging (AVB) for camera-based driver-assist systems
- IEEE 802.1AS: time stamping over Ethernet using the Precision Time Protocol (PTP) to support real-time high-speed data transfer for safety-critical and other automotive applications
- IEEE 802.1Qav: priority queuing and traffic shaping to distribute packets evenly in time over Ethernet to ensure high QoS

High QoS ensures that Ethernet can be used in strictly deterministic embedded applications for time-, safety- and mission-critical systems. High QoS also enables unified Ethernet communication of critical data without traffic congestion in shared networks.

Key Features

- Configurable 10, 100, and 1,000 Mbps (1Gbps) operation in full- and half-duplex modes
- Compatible with IEEE standard 802.3
- Support for 802.3az for Energy-Efficient Ethernet
- Support for 802.1AS PTP for timing and synchronization for time-sensitive applications
- Recognition of IEEE 1588 and 802.1AS PTP frames
- Support for 802.1Q VLAN tagging with recognition of incoming VLAN and priority-tagged frames
- Support for 802.1Qav forwarding and queuing for time-sensitive streams (FQTSS) to ensure QoS
- Support for 802.1AS and 802.1Qav specifications for AVB
• Support for 802.1Qbb priority-based flow control
• Support for up to 8 priority queues on transmit and receive
• Full-duplex flow control with recognition of incoming pause frames and hardware generation of transmitted pause frames
• Automatic pad and cyclic redundancy check (CRC) generation on transmitted frames
• Receive and transmit IP, TCP, and UDP checksum offload
• Address checking logic for 4 or 32 specific 48-bit addresses, 4 type IDs, promiscuous mode, external address checking, hash matching of uni-cast and multi-cast destination addresses, and wake-on-LAN
• Interrupt generation to signal receive and transmit completion or errors
• Support for both IPv4 (with IP options) and IPv6 (with extension headers) packet types
• Support for physical layer management through MDIO interface
• Support for jumbo frames up to 10,240 bytes
• Programmable IPG stretch

Silicon-proven

Cadence is renowned for its Ethernet IP domain knowledge and design implementation, and has a proven record of designing, delivering, and supporting high-quality Ethernet IP. Cadence Ethernet Design IP is UNH-tested and silicon-proven in dozens of high-volume commercial products.

Leveraging membership and participation in the OPEN Alliance SIG and IEEE 802.3 standards community, Cadence IP solutions reliably conform to the latest standards to give customers the highest confidence in their Ethernet implementations.

Early availability

Cadence is consistently one of the first suppliers to market with IP that is optimized for maximum performance and functionality for the newest, most advanced Ethernet standards.

Cadence acts on insights gained from membership in the OPEN Alliance SIG, participation in IEEE 802.3 standards meetings, 802.3 working groups, and co-editing the 802.3ah, 802.3ap, and 802.3ba standards. Early visibility into standards under development enables Cadence to identify and adapt to important changes to published standards ahead of the curve.

Supported Interfaces

• ARM® AMBA® AHB™/AXI™/APB™ bus master DMA to the host and MII, RMII, SGMII, GMII, and RGMII interface to the PHY
• MII and RMII interface to the PHY for 10/100M operation
• GMII, RGMII, and SGMII interface to the PHY for 1G Ethernet operation
• Ten-bit interface (TBI) to the physical medium attachment (PMA) layer
• Statistics counter registers for RMON/MIB
• Configurable interface to the application side: either an external FIFO interface or an AHB/AXI bus master DMA interface to external memory

Deliverables

• Verilog HDL
• Encounter® RTL Compiler synthesis scripts
• Verilog testbench
• User’s guide with full programming interface and instructions for parameterization and synthesis
• Optional transaction-level model (TLM)