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IEEE Standard for Adoption of MIPI Alliance Specification for A-PHY Interface (A-PHY) Version 1.0

STANDARDS

Developed by the
IEEE Board of Governors Corporate Advisory Group (CAG)

IEEE SA Industry Affiliate Network (IAN)
base specification contributed by MIPI Alliance

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Developed by the

Corporate Advisory Group (BOG/CAG)
of the
IEEE SA Board of Governors

Approved 16 June 2021

IEEE SA Standards Board

Abstract: This standard adopts MIPI Alliance—MIPI A-PHY Specification Version 1.0 as an IEEE Standard. The adopted standard provides an asymmetric data link in a point-to-point or daisy-chain topology, with high-speed unidirectional data, embedded bidirectional control data and optional power delivery over a single cable. In this way, it reduces wiring, cost and weight, as high-speed data, control data and optional power share the same physical wiring. For integration with existing network backbones, it complements Ethernet, Controller Area Network (CAN), FlexRay, and other interfaces.

Keywords: 8B/10B PCS, ACMD, ACMP, adoption, advanced driver assistance systems, A-Header, A-Packet, A-Payload, APDLL, A-PHY, APPI, asymmetric, automotive, autonomous driving systems, camera, car noise, Clock Forwarding Service, coaxial cable, Control and Management System Architecture, CSE, CSI, CSI-2, descrambler, Display, DSE, DSI, DSI-2, Duplication Table, Eye Diagram, functional safety, gear, high-speed uni-directional data stream, I2C, I3C, infotainment, inline connectors, IEEE 2977, ISO 26262, jitter, Lidar, Local Functions, long reach, low-speed bi-directional command and control data, MIPI Alliance, Multi-Port, NRZ, optimal wiring cost and weight, Packet Duplication, Packet Forwarding, PAL/CSI-2, PAL/DSI-2, PAL/eDP-DP, PAL/GPIO, PAL/I2C, PAM, PAM16, PAM-X PCS, Phy, Physical layer, PMD, power distribution, power over coax, Power over Differential Line, Profile, protocol adaptation layer, Radar, Routing Table, scrambler, sensor, SerDes, Serial interface, serializer-deserializer, Shielded Differential Pair (SDP), Shielded Parallel Pair (SPP), Shielded Twisted Pair (STP), test modes

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The following members of the individual Standards Association balloting group voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

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Introduction

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The A-PHY v1.0 specification was developed in 2018–2020 by member companies of the MIPI Alliance and adopted by the MIPI Board of Directors in September 2020. MIPI Alliance is a collaborative global organization serving industries that develop mobile and mobile-influenced devices.

In October 2020 a memorandum of understanding between MIPI Alliance and IEEE was announced, with the purpose of facilitating a MIPI A-PHY v1.0 adoption process within IEEE. IEEE Std 2977 is intended to bring MIPI A-PHY to a broader ecosystem beyond MIPI's membership, which in turn will foster greater interoperability, choice, and economies of scale for the global automotive industry. For IEEE, the contribution of MIPI A-PHY will add a new asymmetric approach to its existing portfolio of IEEE automotive standards.

MIPI A-PHY v1.0 is a long-reach serializer-deserializer (SerDes) physical layer interface for automotive applications, including Advanced Driver-Assistance Systems (ADAS), Automated Driving Systems (ADS), and other surround-sensor applications.

Ongoing development of the A-PHY specification will remain with MIPI Alliance.

Users should note that the only normative reference listed in the Reference clause of this adoption is to Section 4.5 of M-PHY Specification [MIPI08]. The referenced section is provided in Annex B.

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Release History

Date	Version	Description
06-Aug-2020	v1.0	Initial Board adopted release.

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1 Introduction

This document specifies MIPI A-PHY, a serial interface technology with high bandwidth capabilities developed particularly for long reach (e.g., automotive) applications, enabling low pin count and a high level of power efficiency.

A-PHY is designed for a wide range of long reach applications, and specifically for automotive market, to carry multiple protocols from MIPI Alliance such as CSI-2 for cameras, and DSI and DSI-2 for displays. Non-MIPI protocols are also supported using a generic Data Link Layer Interface (APPI).

A-PHY features include:

- Long reach capability – optimized to support cables up to 15 m with up to 4 inline connectors
- Multiple speed gears ranging from 2 Gbps up to 16 Gbps
- Support for multiple cable types commonly used in automotive
- Strong noise immunity for the harsh automotive environment
- Generic Data Link Layer, supporting multiple protocols from MIPI Alliance and external entities

1.1 Scope

1.1.1 In Scope

This A-PHY Specification document specifies the implementation of the A-PHY, including its layering, electrical characteristics, and its optional features.

1.1.2 Out of Scope

Protocol Adaptation Layers (PALs)

A single A-PHY can serve multiple protocols at the same time, and each protocol has its own interface to the Data Link Layer, called a Protocol Adaptation Layer (PAL). PALs are not part of this document.

Specific Channel Configurations

Different protocols employing A-PHY technology can have different constraints, which can require the use of different approaches for operation control. Therefore, while this document provides the features to enable stable, optimized Link configuration, it does not mandate specific configurations for specific channels.

1.2 Purpose

Long reach devices, and specifically automotive devices, face increasing bandwidth demands for each of their functions, as well as an increase in the number of functions integrated into the system.

Addressing this demand requires wide bandwidth, low pin count (serial), highly power-efficient (network) interfaces with sufficient flexibility to be attractive for multiple applications, while employing just a single physical layer technology.

A-PHY complements MIPI Alliance's existing D-PHY and C-PHY interfaces by addressing the long reach automotive channel.