

STANDARDS AND INFORMATION DOCUMENTS

AES50-2020
(revision of AES50-2011)



AES standard for digital audio engineering — High-resolution multi-channel audio interconnection (HRMAI)

Users of this standard are encouraged to determine if they are using the latest printing incorporating all current amendments and editorial corrections. Information on the latest status, edition, and printing of a standard can be found at:
<http://www.aes.org/standards>

AUDIO ENGINEERING SOCIETY, INC.
132 East 43rd St., Suite 405, New York NY 10017, US.



The AES Standards Committee is the organization responsible for the standards program of the Audio Engineering Society. It publishes technical standards, information documents and technical reports. Working groups and task groups with a fully international membership are engaged in writing standards covering fields that include topics of specific relevance to professional audio. Membership of any AES standards working group is open to all individuals who are materially and directly affected by the documents that may be issued under the scope of that working group.

Complete information, including working group scopes and project status is available at <http://www.aes.org/standards>. Enquiries may be addressed to standards@aes.org

The AES Standards Committee is supported in part by those listed below who, as Standards Sustainers, make significant financial contribution to its operation.



audio-technica



CLAIR



WEISS



LAWO



This list is current as of 2020/7/30

AES standard for digital audio engineering - High-resolution multi-channel audio interconnection (HRMAI)

Published by
Audio Engineering Society, Inc.
Copyright ©2011, 2020 by the Audio Engineering Society

Abstract

HRMAI provides a professional multi-channel audio interconnection with a number of distinctive characteristics:

- Support for a wide range of commonly-used digital audio coding formats
- Low and deterministic latency
- Use of ubiquitous “Category-5” data cable
- Interconnect span up to 100 m
- High-quality full-duplex clocks transmitted in parallel with audio data
- Full-duplex audio interconnection
- 5 Mbit/sec full-duplex auxiliary data connection, compatible with Ethernet networks.

HRMAI is a high-performance point-to-point audio interconnection rather than a network, although the auxiliary data may operate as a true network, independently of the audio.

An AES standard implies a consensus of those directly and materially affected by its scope and provisions and is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an AES standard does not in any respect preclude anyone, whether or not he or she has approved the document, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in agreement with the standard. Prior to approval, all parties were provided opportunities to comment or object to any provision. Attention is drawn to the possibility that some of the elements of this AES standard or information document may be the subject of patent rights. AES shall not be held responsible for identifying any or all such patents. Approval does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the standards document. This document is subject to periodic review and users are cautioned to obtain the latest edition. Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Audio Engineering Society Inc., 132 East 43rd St., Suite 405, New York NY 10017, US.
www.aes.org/standards standards@aes.org

Contents

Introduction	5
0 Preamble	6
0.1 Patents	6
0.2 Documentation conventions	6
1 Scope	6
2 Normative references	6
3 Definitions and abbreviations	8
4 Physical Interface	10
4.1 Physical medium	10
4.2 Medium dependent interface (MDI)	10
4.3 Visible link status indicators	10
4.4 Audio data physical layer	11
4.5 Synchronization signal physical layer	11
4.6 Synchronisation signal automatic crossover configuration	13
5 Audio data frame format	15
5.1 Overview	15
5.2 Frame structure (MAC compatibility)	16
5.3 Frame structure (protocol identification headers)	16
5.4 User octet	16
5.5 Frame format identifier header	17
5.6 Frame format identifier error control	18
5.7 Receiver behaviour on processing frame format identifier	18
5.8 Frame data payload	19
6 Frame payload format	19
6.1 Overview	19
6.2 Logical channels	20
6.3 PCM sample subframe formatting	21
6.4 Audio channel multiplexing	22
6.5 LC sub-segment packing	23
6.6 Forward error correction (FEC) encoding	23
6.7 Encoded block interleaving	25
7 Frame payload: receiver behaviour	25
7.1 General	25
7.2 Forward error correction (FEC) decoding	25
7.3 Receiver error records	26
7.4 Receiver behaviour on detection of corrected error	26
7.5 Receiver behaviour on detection of uncorrected error	26
8 Auxiliary data system	27
8.1 Auxiliary data bit-stream	27
8.2 Auxiliary data packets	27
8.3 Auxiliary data packet scrambling	27
8.4 Auxiliary data packet structure example	28
9 Synchronisation, link initialization and latency control	29
9.1 Synchronisation signal phase indicators	29
9.2 Clock synchronisation – system behaviour	30
9.3 f_s initialization mode	31

9.4 $2048 \cdot f_s$ initialization mode	32
Annex A (Normative) Frame format identifier: Field definitions.....	33
Annex B (Informative) AES3-mode metadata: M-bit encoding	35
B1 Examples	35
B2 Validity bit sub-sampling implications.....	35
Annex C (Normative) Audio channel multiplexing definitions	36
Annex D (Normative) Link latency	39
Annex E (Normative) AES EtherType and protocol identifier.....	40
Annex F Bibliography.....	41

Foreword

These forewords are not part of AES50, *AES standard for digital audio engineering - High-resolution multi-channel audio interconnection (HRMAI)*.

This document was developed under project AES-X140: High-resolution multi-channel audio interconnection (HRMAI). It was developed by task group SC-02-02-H from an initial draft by M Page.

The members of the task group were: P. Eastty, C. Gaunt, J. Grant, S. Harris, J. McTigue, M. Page, S. Scott, T. Thompson, and M. Yonge.

J Grant
Chair, SC-02-02 Working Group on Digital Input/Output Interfacing
2005-03

Foreword to the second edition, 2011

This new edition revises AES50-2005 and contains amendments resulting from a real-world implementation of the standard.

J Grant
Chair, SC-02-02 Working Group on Digital Input/Output Interfacing
2011-05-04

Foreword to the third edition, 2020

This revision includes minor changes to remove insensitive terms.

J. Grant
Chair, SC-02-02 Working Group on Digital Input/Output Interfacing
2020-11-27

Note on normative language

In AES standards documents, sentences containing the word “shall” are requirements for compliance with the document. Sentences containing the verb “should” are strong suggestions (recommendations). Sentences giving permission use the verb “may”. Sentences expressing a possibility use the verb “can”.

AES standard for digital audio engineering - High-resolution multi-channel audio interconnection (HRMAI)

Introduction

HRMAI provides a professional multi-channel audio interconnection with a number of distinctive characteristics:

- Support for a wide range of commonly-used digital audio coding formats, including “high-resolution” formats such as high sample-rate linear PCM, and one-bit delta-sigma modulated formats.
- Low and deterministic latency (< 100 μ s)
- Use of ubiquitous “Category-5” data cable
- Interconnect span up to 100 m
- High-quality full-duplex clocks transmitted in parallel with audio data
- Full-duplex audio interconnection
- 5 Mbit/sec full-duplex auxiliary data connection, compatible with Ethernet networks.

HRMAI is a high-performance point-to-point audio interconnection, rather than a network (although the auxiliary data may operate as a true network, independently of the audio). It is thus an alternative to AES10 (MADI). AES10 lacks many of the features listed above, which are enabled by developments in underlying technology in the thirteen years since AES10 was introduced. However, for applications which do not need these additional facilities, AES10 will continue to be appropriate.

It is recommended that this standard be read in conjunction with the accompanying AESSC Technical Report, AES-R6, *Guidelines for AES standard for digital audio engineering - High-resolution multi-channel audio interconnection (HRMAI), AES50*. This provides additional background, rationale and implementation advice. In particular, the first section of AES-R6 is an overview of the technology, providing context which may aid understanding of the normative clauses of this standard.

0 Preamble

0.1 Patents

The Audio Engineering Society draws attention to the fact that it is claimed that compliance with this AES standard or information document may involve the use of patents owned by Midas Klark Teknik Ltd..

The AES holds no position concerning the evidence, validity and scope of these patent rights.

The holder of these patent rights has assured the AES that it is willing to negotiate licenses under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is archived with the AES.

Information may be obtained from:

MUSIC Group IP, Ltd.
Trident Chambers Wickhams Cay
PO. Box 146
Road Town
Tortola
British Virgin Islands

Attention is drawn to the possibility that some of the elements of this AES standard or information document may be the subject of patent rights other than those identified above. AES shall not be held responsible for identifying any or all such patent rights.

0.2 Documentation conventions

Following ISO convention, decimal points are conventionally shown as commas (,).

Non-decimal numbers are shown by a subscript suffix indicating the number base. For example, 10_{16} is a hexadecimal number.

To identify the bits within an octet, 0 = LSB, 7 = MSB

1 Scope

This document specifies a means to carry multiple channels of digital audio in AES3 or bit-stream formats, plus system synchronisation information, over a structured data cable using the IEEE Std 802.3 physical layer. It includes a means to convey arbitrary packet-based data over the link, in addition to the specified audio interconnection.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

AES3-2009 *AES recommended practice for digital audio engineering – Serial transmission format for two-channel linearly represented digital audio data, Parts 1 to 4*. Audio Engineering Society, New York, NY., US.

ISO/IEC 8802-3: 2000 *Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*. International Organisation for Standardisation, Geneva, Switzerland.