IEC 62379-1

Edition 1.0 2007-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Common control interface for networked digital audio and video products – Part 1: General

Interface de commande commune pour produits audio et vidéo numériques connectés en réseaux – Partie 1: Généralités

IEC 62379-1:2007

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Common control interface for networked digital audio and video products – Part 1: General

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COMMON CONTROL INTERFACE FOR NETWORKED DIGITAL AUDIO AND VIDEO PRODUCTS –

Part 1: General

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FDIS	Report on voting
100/1248/FDIS	100/1281/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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0 Introduction

0.1 Overview

This family of standards specifies a control framework for networked audiovisual equipment.

It provides a means for management entities to control not only transmission across the network but also other functions within interface equipment.

Although it was originally developed for audio over asynchronous transfer mode (ATM) in radio broadcasting, the control framework has been extended to encompass video and other time-critical media, as well as other networking technologies and other applications in both professional and consumer environments.

The control framework provides a number of key features:

- it provides a consistent interface to the functionality in an audiovisual unit;
- it enables systems to be built that are truly "plug and play", by providing the means for equipment to discover what units are connected to the network and what their capabilities are;
- it links discrete areas or blocks of functionality together in a consistent and structured way;
- it allows us to define small focused building blocks from which more complex functionality can be built;
- it ensures new functionality can be developed and integrated consistently and easily into the framework.

The functionality provided by an audiovisual unit is represented using one or more "blocks" (such as a cross-point switch or a gain control), structured and connected together using the control framework.

As a further aid to the "plug-and-play" functionality, a common format for audio and video being conveyed across the network is also specified, to avoid situations in which two pieces of equipment fail to communicate because there is no format which both support. Equipment may, of course, also support other formats appropriate to particular applications, and the standard mechanisms for initiating and terminating communication will work for those formats in the same way as for the standard formats.

0.2 Structure of the family of standards

IEC 62379 is intended to include the following parts:

Part 1: General

Part 2: Audio

Part 3: Video

Part 4: Data

Part 5: Transmission over networks

Part 6: Packet transfer service

Part 1 specifies aspects which are common to all equipment.

Parts 2 to 4 specify control of internal functions specific to equipment carrying particular types of media; in the case of Part 4, this would be time-critical media other than audio and video, for instance, RS232 and RS422 data for applications such as machine control, or the state of the "on air" light in a broadcast studio. Part 4 does not refer to packet data such as the control messages themselves.

Part 5 specifies control of transmission of these media over each individual network technology, with a separate subpart for each technology. It includes network specific management interfaces along with network specific control elements that integrate into the control framework.

Part 6 specifies carriage of control and status messages and non-audiovisual data over transports that do not support audio and video, such as RS232 serial links, with (as with Part 5) a separate subpart for each technology.

0.3 Model of the equipment being controlled

0.3.1 Blocks

A piece of equipment (a "unit") is regarded as being composed of functional elements or "blocks" which may be linked to each other through internal routing.

Blocks may have inputs, outputs and internal functionality. In general, the output of one block connects to the input of the next block in the processing chain. Blocks can have some associated control parameters and/or status monitoring accessible via the control framework management interface.

Figure 1 – A block

A typical block would be a pre-amplifier, which has one input, one output, and a parameter which sets the gain. Another would be a mixer, with several inputs, one output, and parameters to select the contribution of each input to the mix; these parameters are effectively fader settings. A tone generator would have one output and no inputs, and parameters that set the level, frequency, etc.

There is a special class of blocks called "ports"; ports provide an external connection to other equipment. An "input port" is one where audio, video, or other data enters the unit and an "output port" is one where it leaves the unit. Sometimes the port corresponds to a physical connection, for instance, an XLR socket for analogue audio; sometimes it is a virtual entity which can be one end of a connection across a network, or one channel on an interface such as AES10 (MADI) which conveys multiple audio streams.

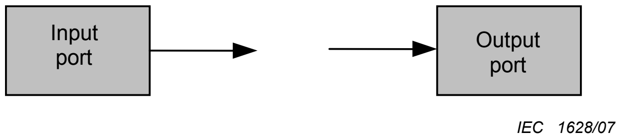

Figure 2 – Ports

An input port has no inputs (or rather, no internal inputs; it will have an external input, but that is not part of the model of the internal structure of the unit) and a single output, which supplies the incoming stream to the inputs of other blocks. In the case of a network port, parameters would specify the network address; a physical audio port might have parameters which show the sampling rate and bit depth. Similarly, an output port has a single input and no (internal) outputs.

Figure 3 shows an example of how the various blocks connect together within a unit. Note that each input is connected to exactly one output, but an output may be connected to several inputs, or to none.

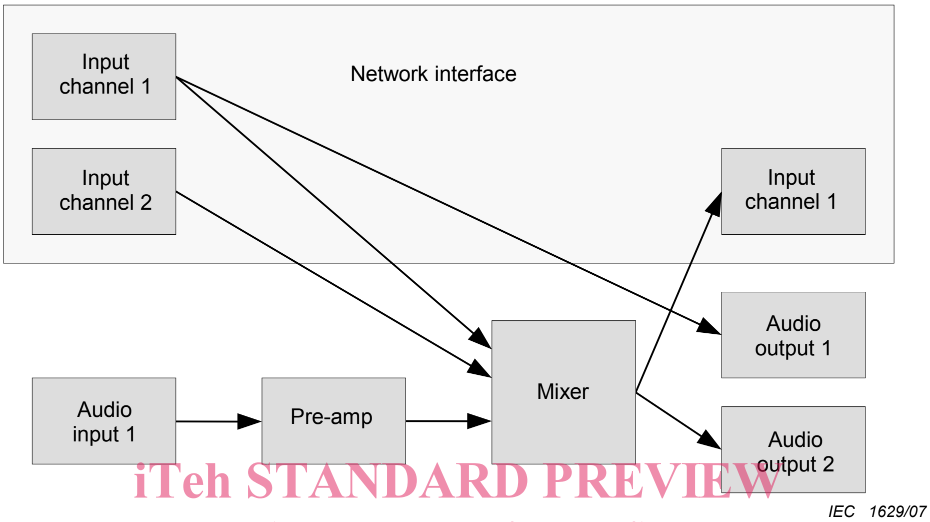

Figure 3 – Example of a "unit"

There is a block which performs a mix between three inputs, two from the network and one from a physical audio port (or, looking at it another way, two from remote sources and one from a local source). The local source is connected via a pre-amplifier. The resulting signal is output locally at output 2 and also transmitted on the network. There is another local output which carries a copy of one of the remote sources.

The set of available blocks, the connectivity between them, and the parameter settings for each may be fixed, or changeable by a management terminal, or read-only but changeable by external factors. Where blocks are implemented in software, a unit may provide the ability for a management terminal to create and delete them. Where blocks are implemented in physical hardware, the blocks themselves cannot be changed but it may still be possible for the management terminal to reprogramme the routing between them.

0.3.2 Control framework

The control framework consists of two lists; a list of blocks (also called control elements), and a list of connections between them. In both lists, an individual block is identified by a "block id", which is a number that is different for each block in a unit.

A block's entry in the list of blocks shows what type of block it is, represented by a globally unique value as described in 0.3.5.

Groups of blocks that are connected together are called processing chains. A processing chain typically represents what a unit does as a whole, so, for instance, a unit that alters the gain of an input to produce an output would have one simple processing chain that consists of an input port connected to a gain block which is connected to an output port.

0.3.3 How the framework helps when designing units

The standard anticipates that many control blocks will be designed and implemented over time to control the many different sorts of functionality audio and audiovisual units provide.

Units can be built from existing blocks or new ones created as required. It will often be possible to represent complex, product-specific control functionality using a number of linked instances of simpler, standard blocks that together provide the functionality required.

0.3.4 How the framework enables "plug and play"

A management terminal simply needs to recognize those blocks that are relevant to the functions it controls. (The term "management terminal" covers a wide variety of equipment, from a broadcast control system to the user interface of a device on a home network.)

It can discover what units are present on the network and what functions each contains; it does not need to recognize the units themselves, only the blocks that describe the functionality in which it is interested.

The discovery process would be:

- to create a list of the units, beginning with those to which it is directly connected; units can be uniquely identified by their 48-bit MAC address;
- to retrieve the list of blocks from each device on the list; if any are network ports which give access to further devices, to add those devices to the list (unless they are already on it);
- to retrieve the connectivity between any blocks for which it is relevant.

For instance, the user interface to a surround-sound audio system might search for units containing audio sources, find those for which a processing chain exists that allows them to be made available to the user, and offer them in a menu. It would also identify functions in the processing chain such as volume control and play-out controls (pause, rewind, skip track, etc.).

In a radio broadcast control system, a similar process could be performed when the system is installed and at any time when equipment is added or replaced. This process would be under the control of the installer, rather than occurring automatically, but should at least relieve the installer of the necessity to type in network addresses.

0.3.5 Defining a new type of block

A block's entry in the block list shows what type of block it is, represented by an object identifier (OID) (see 0.4.2) which is a globally unique value that identifies the block type definition.

The main requirement when adding a new type of block to the control framework is for its block type definition to follow the conditions below:

- the globally unique OID identifies a MIB table or group of MIB tables, with each table containing a variable number of rows.
- the table(s) are indexed using the block id to access control objects associated with individual instances of this block type.

In effect, the framework provides the entry point to controlling each block of functionality. The actual details of how to control that functionality will always need to be specified individually.

0.4 Management information base (MIB)

0.4.1 Objects

Communication between the management terminal and the managed unit is by the simple network management protocol (SNMP), which defines all management operations in terms of reads and writes on a hierarchically organized collection of variables, or "managed objects", known as a MIB.

Each object is identified by an OID which is a sequence of numbers; in the descriptions they are separated by dots, and there are also alphanumeric names which can be used instead. Identifiers of objects defined in one of this family of standards begin 1.0.62379.*p* if defined in part *p*, or 1.0.62379.*p*.*s* if defined in part *p*-*s*.

Each block is described by a group of objects (a "record"). These objects are the control parameters and status variables. For each type of block, the structure of the record is specified in one of the parts of IEC 62379 or (for product-specific or application-specific blocks) elsewhere. The connectivity is described by a table containing an identification of the output to which each input is connected (see `connectorTable` in 4.2.5).

Thus, the management terminal can discover what functionality a unit has and may be able to reprogramme some of it. The SNMP protocol dictates that a command to change an object is always confirmed by a message showing the new value of the object, so if a unit does not support the full range of possible values of a parameter it can choose the one nearest to the requested value and will report back to the management terminal exactly what it has done.

0.4.2 Other uses of OIDs

Sometimes OIDs are used to identify things other than objects. Each block type is represented by an OID; in this case, it is also the root (the first few numbers in the sequence) of the OIDs for all the objects in the record that describes each block of that type.

The OIDs are not confined to those specified in the various parts of IEC 62379; for product-specific blocks, implementers may define other types with OIDs rooted at, for example, 1.3.6.1.4.1.*n*, where *n* is the enterprise number of the manufacturer of the unit. A general-purpose management terminal which only recognized the standard OIDs would see these product-specific blocks as "black boxes"; it would recognize their connectivity but not be able to control or monitor their operation.

Media formats (audio, video, etc.) are also identified by OIDs. Here, again, OIDs not rooted at 1.0.62379 may be used for formats that are not defined in this family of standards; provided the sending and receiving devices both support the format, a call can be set up without the management terminal being able to recognize it, though the management terminal might not be able to display a user-friendly description of it.

0.4.3 Migration to XML

Increasingly, XML is being used as the interface to network management applications. However, communication with the management agents in the networked devices is usually through a gateway that translates between SNMP and XML, so that the managed unit only needs to support SNMP.

A future addition to IEC 62379 (amendment or additional part) might standardize the XML form; however, in that event, the underlying managed objects would remain the same in both forms.

0.5 Status broadcasts

0.5.1 Introduction

Status pages are messages containing structured values representing some internal state of a unit. Each page is organized into a fixed format of related information. A unit may define and support multiple types of status page.

Related status pages are collected together into groups called status broadcast groups. When a remote entity requests a status broadcast, it specifies which group it wants to receive. Status broadcast groups are identified by OIDs.

Status pages are the preferred method for regularly monitoring the state of a unit. Polling fields in the MIB put more load on both the unit and the network, because they require the unit to process an SNMP request on every occasion, rather than just once to set up the broadcast. If the same information is required at multiple locations, there will be a separate request from each, and multiple copies of the information must be sent, whereas with the broadcast only one copy is sent, being duplicated by the network as required to reach all its destinations.

This standard defines a number of status pages and groups. Other parts define their own status pages and groups. Manufacturers may also define product-specific status pages and groups.

0.5.2 Status page information sources

Status pages and groups may be associated either with a single block or with the unit as a whole.

Three pieces of information are required to initiate a status page broadcast call (other information may be required; however, this will be network-specific and specified in the relevant subpart of Part 5):

- the block id – of the block that is to be the source of the status broadcast group call (a null value is used for status broadcasts associated with the unit as a whole);
- the page group OID – of the particular status broadcast group to be produced;
- the required page rate – the rate at which the pages are generated.

If a unit supports multiple instances of a block type (for instance, an AES3 audio output, which supports an audio level status broadcast group), it is not required to implement the associated status broadcast group for each instance – it may implement it for just a subset of them.

0.5.3 Status page general format

The first two octets of a status page indicate the page type. Page type identifiers are required to be unique for all pages that are part of a given page group, but otherwise may be freely allocated by the organization or manufacturer that specifies the page content. The format of the rest of the page depends on the page type; the maximum length is 484 octets.

Numbers are coded in binary using a fixed number of bytes and big-endian. Text strings are in UTF-8.

0.6 Calls

The network is expected to provide the following two kinds of services.

- Fixed bit rate one-to-many service for media streams and status broadcasts, with guaranteed latency and throughput.
- "Best-effort" bidirectional one-to-one packet transfer service for control messages.

On an ATM network, these map onto CBR point-to-multipoint and UBR point-to-point calls, respectively.

On a connectionless (and stateless) network such as IP, there is no direct equivalent of the concept of an ATM "call". However, if the network is to provide the necessary quality of service (QoS) guarantees for media streams, there will need to be some kind of mechanism for allocating the resources needed for a stream. This mechanism must, in many ways, be similar to the call set-up process on connection-oriented networks.

In the case of the packet transfer service, which may well be connectionless at the network layer, for many applications there will be a relationship between the management terminal and the managed unit within which some "state" information persists between transactions. For instance, when updating software in the unit (see 0.9), only one management terminal can write a given memory area at a time. Thus a "session" will exist between the management terminal and the managed unit, which corresponds to a call on a connection-oriented network.

Associated with any media stream is "call identity" information which can include information about the stream itself, the point where it enters the system, and each destination. Destinations have an "importance" assigned to them, and it is normally only the most important destinations that are reported. More details are given in Clause A.4.

0.7 Privilege levels

Throughout IEC 62379, the concept of "privilege levels" is used to distinguish different kinds of user. This concept was developed for radio broadcasting studios, and the names of the levels reflect that but will also be useful in other applications.

Four privilege levels are defined:

- listener;
- operator;
- supervisor;
- maintenance.

Listener is the lowest privilege level, intended for use by those who wish to monitor audio or video signals passing through the unit (for example, someone who wishes to listen in on the output of a studio via their PC). Listeners can set up calls from audio and video sources to equipment which is local to them but cannot change anything that would affect the experience of other users.

Operator is the next privilege level, intended for use by those who are controlling the day-to-day operation of the unit (for example, a studio technical operator). Operators can change things which affect other users, such as the mix of signals that provides the output from a studio, or by issuing "pause", "seek", etc. commands to play-out equipment.

Supervisor is the next privilege level, intended for use by those who are controlling and maintaining the network such as a control room technical operator.

Maintenance is the highest privilege level, intended for use by those who need to perform tasks that might disrupt normal operation of the unit, such as updating firmware or causing the unit to enter a diagnostic mode.

Privilege levels are intended to be used for two purposes. The first is to allow management call capacity to be reserved for each category of caller, to prevent important management calls being blocked because too many lower-level calls are in progress. The second is to prevent callers from performing inappropriate control tasks, by limiting the commands accepted at lower levels.

To enable the latter functionality, every call has a privilege level associated with it, and a call may not be set up, modified, or torn down by a management call of lower privilege. For instance, an operator can set up calls with operator privilege which then cannot be affected by management calls that only have listener privilege, although they can be modified or torn down by other operators and by supervisors. Supervisors can set up calls which neither listeners nor operators can disturb; the connection between a continuity studio and the transmission chain might be an example.

This specification requires that at least one management call must be accepted at each privilege level at any given time. In practice, the call capacity that needs to be reserved for each level is likely to depend on the context within which the unit is used, so a means of configuring this is also specified. It is intended that any unreserved call capacity will be allocated on a first-come first-served basis.

0.8 Automation

The automation mechanism allows for single or multiple values to be set at a given time. The actual scheme uses a list of automation events where each event consists of a time, the OID of an object in the MIB, and the value to put in it at that time.

This removes the uncertainty introduced by the best-effort service on the network; the controller can add the event to the table far enough in advance to give time to repeat the request if it is lost. Also, it can programme a number of events to occur simultaneously.

Also, multiple events can be associated so they occur one after the other much like a macro.

0.9 Uploading software

This standard includes (in 4.2.8 and 5.2) a mechanism for updating software and other configuration information in units supporting the common control interface.

The intention is for a management terminal to be able to update software in a large number of different pieces of equipment from different manufacturers without needing to run manufacturer-specific applications.

The MIB objects defined in 4.2.8 are intended to provide a model which is common to all the various kinds of memory that might be used in the managed unit. A unit may contain more than one “class” of memory; different classes may be physically different, for instance, flash memory and rotating magnetic memory, and/or reserved for different kinds of data, for instance, software and audio clips.

EXAMPLE 1: Simple system using flash memory

Flash memory is composed of blocks, typically 64K bytes each. An individual byte can be written provided this does not involves changing any bit from 0 to 1. A whole block can be “erased”, after which every bit in the block is a 1.

Each area consists of either a single block or several adjacent blocks; a few bytes are reserved to hold the length, type, and serial number. The "handle" which identifies an area is the high part of the address of the first byte of the area.

Deletion is by erasing all the blocks that comprise the area, which may take several seconds for some flash memory chips. After deletion, if there is an adjacent empty area the two areas are merged to form a single empty area (so one of them will disappear from the table).

If there is no other memory into which components can be loaded, all areas should be class 1.

EXAMPLE 2: Disc with filing system

Each file is an “area”, and there is another (single) area containing all the free space. In the case of a Unix filing system, the "handle" might be the file's inode number.