SMPTE ENGINEERING GUIDELINE

EG 30-1995

Implementation of ESlan Standards

1 Scope

This guideline defines the architecture, the component layers, and the relationships governing the ESlan-1 and ESlan-2 suite of control and data networks to be used for audio and television program production, post-production, and distribution equipment. It should be read in conjunction with SMPTE EG 29, which describes the basic control system; with SMPTE 275M, which defines the services and protocols contained within the lower layers of the network model for moderate-scale systems; and with other documents as listed in annex A.

2 Introduction

The function of a remote control system is to establish connection between operational controlling and controlled devices. The ESlan specification is based on the concept of distributed intelligence. The use of distributed intelligence within the control system offers a number of advantages:

– the ability to modify elements of the configuration without affecting other users;

– high resilience - the majority of failures can be contained within a single node network;

– the number of time-critical messages for transfer between nodes is minimized;

– the control system is independent of the type of device connected to the node.

3 OSI Model

3.1 OSI and its relationship with the ESlan control system

In keeping with common networking practice, the interface for the ESlan remote-control system has been defined so as to comply with the layered structure of the open systems interconnection (OSI) model of the ISO (see ISO 7498).

3.2 Principle of layering

Layering divides the whole service offered by a communications system into logical layers (see figure 1). Each layer adds value to the service provided by the preceding layer. The additional value is established by an entity residing in that layer. Two entities operating in the same layer, but in different parts of the network, are called peer entities. The objective is to permit communication between peer entities. This communication is governed by a protocol.

The communication path between peers passes through lower layers, is connected over a physical medium, and is passed up again through the layers to the peer entity. Such communication is effected transparently to the entity.

The separation between any two layers is called an interface. The point where a communication path crosses an interface is called a service access point (SAP). The SAP that provides a physical connection is called a connection end point (CEP).

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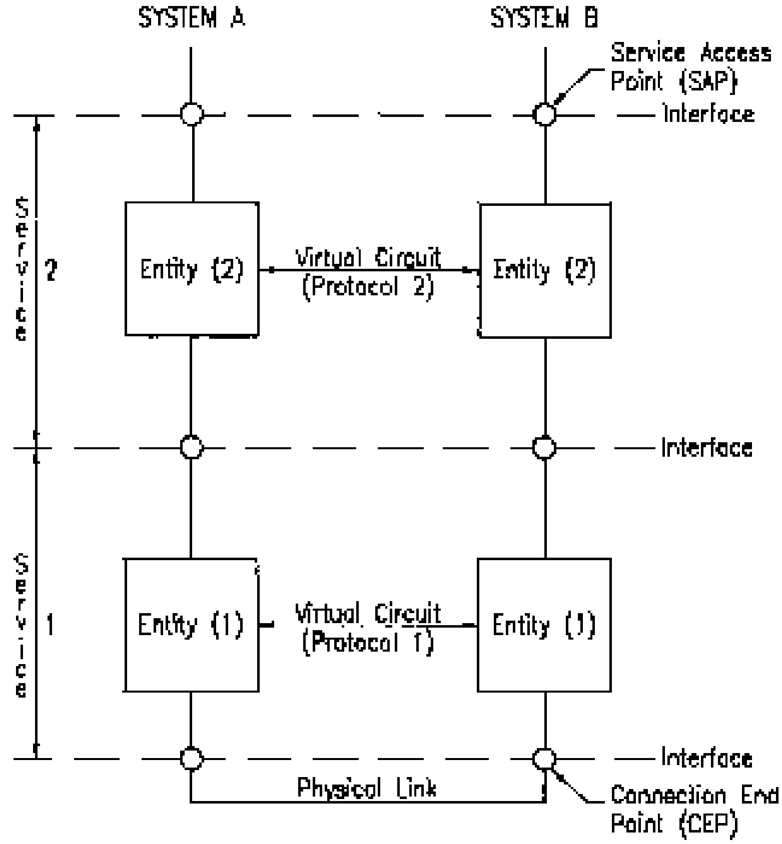

Figure 1 – System architecture terminology

3.3 OSI model

3.3.1 The OSI model defines a seven-layer model providing the following functions:

3.3.1.1 Application layer 7 defines the user's application tasks in abstract terms. Each applications entity serves a physical device, and is device specific, varying according to the characteristics of the device.

3.3.1.2 Presentation layer 6 gives a presentation of these abstract terms in coded and strictly formatted forms.

3.3.1.3 Session layer 5 is concerned only with a session involving more than one participant. It associates the coded and formatted data with a particular participant of those available in the session. It connects two presentation entities, providing housekeeping services (remapping, error recovery etc.).

3.3.1.4 Transport layer 4 provides for safe transport of data from end to end of a system.

3.3.1.5 Network layer 3 dismembers and reassembles transported data into packages for sequential transfer via a network system.

3.3.1.6 Data link layer 2 establishes a data link providing reliable error-free transmission in the presence of line disturbances. Where applicable, the association achieved in layer 5 is converted to an absolute system address. Layer 2 establishes a communication between physical units.

3.3.1.7 Physical layer 1 defines the hardware properties needed to set up a physical link for the logically linked data.

It should be emphasised that data passes physically only at layer 1. Higher layers are connected by a virtual (logical) connection.

No layer provides confirmation of delivery by itself. An appropriate protocol is necessary if this capability is required.

The above description shows:

– how data generated by each layer is handed on from layer to layer; and

– how the quality of service increases from bottom to top.

It should be noted that layers 7,6, and 5 are concerned with the specific application services and layers 4 to 1 relate to the general transport service.

3.3.2 The OSI model applied to a television or audio equipment control system provides the following functions:

3.3.2.1 Application layer 7 provides an applications process which performs a specified system function such as playing a video tape. Each applications entity consists of a physical device and the necessary hardware and software interface to connect the entity to the lower network layers. The interface is device specific, and will vary according to the characteristics of the equipment being controlled. The application layer is not within the scope of ESlan (or ESbus) documentation.

3.3.2.2 Presentation layer 6 contains the virtual machine which responds to defined data — the control language — in a defined way, regardless of the characteristics of the physical machine used at the applications level. Each type of virtual machine utilizes a distinct dialect within the overall control language. Common and virtual machine (type-specific) messages are presentation layer constructs.

3.3.2.3 Session layer 5 connects two presentation entities and controls communications between them. It provides services such as mapping logical addresses to physical addresses, error recovery, and identification of the dialect required for the type of machine used. System service control messages relating to linking and grouping are considered session layer activities.

3.3.2.4 Transport layer 4 manages data to and from the session layer, isolating it from potential changes in hardware technology. To do this, the layer may break up messages into smaller packets, and provide a means for them to be received correctly at the other end. The layer provides for safe transport of system data.

3.3.2.5 Network layer 3 provides message blocking (concatenation) and segmentation to allow more effective use of the message block.

3.3.2.6 Data link layer 2 establishes communication between physical units connected to a network, and provides data synchronization, data transfer, and error recovery services. Local networks include an access sublevel within the data link layer which apportions the use of the network between several connected entities. The access method to be used for ESlan-2 is yet to be defined; for ESlan-1 it is ANSI/IEEE 802.3 (CSMA/CD) with the “length” field replaced with a 2-octet “type” field; and for ESbus, it is polling initiated by the bus controller.

3.3.2.7 Physical layer 1 consists of electrical and mechanical specifications which define the actual communications channel.

3.4 ESlan architecture

ESlan is defined in terms of the six lower layers of the OSI model (see table 1). Taken together, these six layers provide all the essential features of the remote-control system. (Proprietary machine commands are considered to be resident in the OSI application layer and are, therefore, beyond the scope of the ESlan specification.)

ESlan defines control-system elements in terms of an ideal “virtual” machine for each specific machine type — video tape recorder, audio tape recorder, telecine, router, etc. The virtual machine command structure is referred to as the control message architecture. Each specific machine type is allocated a set of messages — a dialect — which takes account of all user-accessible control functions and machine responses. The lists of messages appropriate to each equipment type, and details of the corresponding bit representations, are provided as individual SMPTE Recommended Practices. Additionally, control messages common to all types of equipment are defined in SMPTE RP 172 and are termed common messages.

3.5 Relationship between ESlan and ESbus

SMPTE 207M, SMPTE RP 113, SMPTE RP 138, and SMPTE RP 139 together define the ESbus standard, which can be employed for localized, small-scale, network operation. Devices communicate on the ESbus through communication handlers called tributaries. Using a polling protocol, a bus controller transfers messages between tributaries at a data rate of 38.4 kb/s. To attain higher performance, ESlan uses the higher data rates provided by CSMA/CD networking technology. ESbus networks can coexist with ESlan on the same network through the use of gateways.

It must be emphasised that the virtual machine control messages are identical across all ES systems.

4 Network structure

To accommodate the requirements of various sized facilities, ESlan has been implemented in a performance hierarchy of compatible network architectures (see table 1 which includes ESbus for reference).

ESlan-1 (as shown in table 1) is intended for application in small- to moderate-sized facilities requiring modest levels of performance. A study to determine limiting parameters on the size of ESlan-1 installations is presently being undertaken by the SMPTE.

ESlan-2 is intended for application in facilities which a) are of larger size than those anticipated by ESlan-1, or b) require a wider range of services than those anticipated by ESlan-1, or c) require a greater range of traffic types than that permitted by ESlan-1.

Table 1 – Comparative structures of the ES architectures

OSI layer	[ESbus]	ESlan-1	Eslan-2
Application	[Proprietary]	Proprietary	Proprietary
Presentation	[Virtual machine]	Virtual machine	Virtual machine
Session	[System service 0] (SMPTE RP 163)	System service 1 (SMPTE EG 30)	System service 2 (To be developed)
Transport	[System service 0] (SMPTE RP 163)	RFC 768	To be decided
Network	[Supervisory protocol]	RFC 791 RFC 826	RFC 791 RFC 826
Data link	[Supervisory protocol]	ANSI/IEEE 802.3	One or more interconnected standard networks providing an aggregate data rate much greater than that of CSMA/CD, to be specified in ESlan-2 documentation.
Physical	[Electrical/mechanical]	Physical interfaces	

5 Comparative ESlan layer structure (ESbus is included for reference)

5.1 Application layer

5.1.1 ESlan-1

The application layer employs proprietary manufacturer-specific commands outside the scope of the specification.

5.1.2 ESlan-2

The application layer employs proprietary manufacturer-specific commands outside the scope of the specification.

5.1.3 ESbus

The application layer employs proprietary manufacturer-specific commands outside the scope of the specification.

5.2 Presentation layer

5.2.1 ESlan-1

The presentation layer is referred to as the virtual machine level. It contains the virtual machine, a logical entity that responds to defined data (the control messages) in a defined manner, regardless of the characteristics of the physical machine attached at the application level. Each type-specific virtual machine utilizes a distinct dialect.

5.2.2 ESlan-2

The presentation layer is referred to as the virtual machine level. It contains the virtual machine, a logical entity that responds to defined data (the control messages) in a defined manner, regardless of the characteristics of the physical machine attached at the application level. Each type-specific virtual machine utilizes a distinct dialect.

5.2.3 ESbus

The presentation layer is referred to as the virtual machine level. It contains the virtual machine, a logical entity that responds to defined data (the control messages) in a defined manner, regardless of the characteristics of the physical machine attached at the application level. Each type-specific virtual machine utilizes a distinct dialect.

5.3 Session layer

5.3.1 ESlan-1

A system service level (defined within SMPTE 275M) provides all necessary services of the session layer. These include mapping logical addresses to physical addresses, identification of the dialect required for each type of machine used, message segmentation and assembly, message blocking, and error recovery.

5.3.2 ESlan-2

A further system service level (yet to be determined) will expand upon the range of services contained within ESlan-1, to provide additional facilities such as name serving and priority definition.

5.3.3 ESbus

The system service level (SMPTE RP 163) provides all necessary services of the session layer.

5.4 Transport layer

5.4.1 ESlan-1

Services within this layer are provided by UDP (see RFC 768).

5.4.2 ESlan-2

A protocol for the transport layer within ESlan-2 is under current consideration by the SMPTE. No recommendation can be made at the present time.

5.4.3 ESbus

The system service level provides all necessary services of the transport layer (see SMPTE RP 163).

5.5 Network layer

5.5.1 ESlan-1

Services within this layer are provided by RFC 791 (IP).

Additionally, RFC 826 (ARP) is employed in order to relate IP addresses to CSMA/CD addresses. (It should be noted that ARP requests are sent as "broadcasts" and all receiving devices must be capable of responding to ARP requests.)

5.5.2 ESlan-2

As with ESlan-1, services within this layer are provided by the IP and by ARP.

5.5.3 ESbus

The supervisory level provides all necessary services of the network layer (see SMPTE RP 113). It establishes communication between physical units connected to the network, and provides data synchronization, data transfer and error-recovery services.

5.6 Data link layer

5.6.1 ESlan-1

ANSI/IEEE 802.3 (CSMA/CD) is selected to provide the necessary services of the data link layer.

5.6.2 ESlan-2

For installations up to those of moderate size, CSMA/CD is selected. For larger installations, one or more interconnected standard networks providing an aggregate data rate much greater than that of CSMA/CD will be considered by the SMPTE.

5.6.3 ESbus

The supervisory level provides all necessary services of the data link layer. Local networks incorporate an access sublevel within the data link layer, which apportions the use of the network among several connected entities. The access method used by ESbus is polling, initiated by the bus controller.

5.7 Physical layer

5.7.1 ESlan-1

As in the data link layer, ANSI/IEEE 802.3 (CSMA/CD) has been selected, operating at 10 Mb/s.

The physical medium and its access mechanism shall be in accordance with accepted CSMA/CD practice. These may include AUI, 10Base2, 10BaseT, etc.

5.7.2 ESlan-2

The network configuration will include one or more interconnected standard networks providing an aggregate data rate much greater than that of CSMA/CD, to be specified in ESlan-2 documentation. Equipment bearing ESlan-1 (or ESbus) interfaces will remain connectable via protocol translation adapters.

5.7.3 ESbus

The physical layer functions of ESbus are provided by the electrical/mechanical level (see ANSI/SMPTE 207M). This details the electrical and mechanical specifications which define the actual bit-by-bit communication channel operating at 38.4 kb/s.

Annex A (informative)
Bibliography

ANSI X3.139-1987 (R1992), Information Systems — Fiber Distributed Data Interface (FDDI) — Token Ring Media Access Control (MAC)

ANSI/IEEE 802.3-1993, Information Technology — Local and Metropolitan Area Networks — Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

SMPTE 275M, Television and Audio Equipment — ESlan-1 Remote Control System

ANSI/SMPTE 207M-1992, Television — Digital Control Interface — Electrical and Mechanical Characteristics

SMPTE RP 113-1992, Supervisory Protocol for Digital Control Interface

SMPTE RP 138-1992, Control Message Architecture

SMPTE RP 139-1992, Tributary Interconnection

SMPTE RP 163-1992, Television — System Service Messages

SMPTE RP 170-1993, Video Tape Recorder Type-Specific Messages for Digital Control Interface

SMPTE RP 171-1993, Type-Specific Messages for Digital Control Interface of Analog Audio Tape Recorders

SMPTE RP 172-1993, Common Messages for Digital Control Interface

SMPTE EG 29-1993, Remote Control of Television Equipment

CCITT Recommendations X.1 to X.29, Yellow Book, VIIth Plenary Assembly, Geneva, 1980, Volume VIII, Fascicle VIII.2 — Data Communication Networks — Services and Facilities, Terminal Equipment and Interfaces

ISO/IEC 3309:1993, Information Technology — Telecommunications and Information Exchange Between Systems — High-Level Data Link Control (HDLC) Procedures — Frame Structure

ISO/IEC 4335:1993, Information Technology — Telecommunications and Information Exchange Between Systems — High-Level Data Link Control (HDLC) Procedures — Elements of Procedures

ISO 4902:1989, Information Technology — Data Communication — 37-Pole DTE/DCE Interface Connector and Contact Number Assignments

ISO 7498:1984, Information Processing Systems — Open Systems Interconnection — Basic Reference Model

RFC 768, User Datagram Protocol (UDP)

RFC 791, Internet Protocol (IP)

RFC 826, Ethernet Address Resolution Protocol (ARP)

RFC 894, Standard for Transmission of IP Datagrams Over Ethernet Networks

RFC 1045, Versatile Message Transaction Protocol (VMTP)

Note – For information on obtaining RFC documents, contact the SMPTE Engineering Department.