ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

LOCAL AREA NETWORKS
INTERWORKING UNITS
FOR DISTRIBUTED SYSTEMS

TR/21

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1 General

1. GENERAL

1.1 Scope

To facilitate the design and implementation of distributed systems conforming to Open Systems Interconnection architecture and protocols, this Technical Report ECMA TR/21:

- describes the architecture of a Distributed Open System;
- describes the architecture of a Distributed System Interworking-Unit which supports the lower four layers of a Distributed Open System.

1.2 References

ECMA-72	Transport Protocol
ECMA-92	Connectionless Internetwork Protocol
ECMA TR/14	Local Area Networks - Layer 1 to 4 Architecture and Protocols
ECMA TR/20	Layer 4 to 1 Addressing
ISO 7498	Data Processing - Open Systems Interconnection - Basic Reference Model

1.3 Definitions

1.3.1 Reference Model Definitions

The following terms in this Technical Report have the definition given in ISO 7498.

1.3.1.1 Address

An identifier which tells where an (N)-service-access-point may be found.

1.3.1.2 Connection

An association established by the (N)-layer between two or more (N+1)-entities for the transfer of data.

1.3.1.3 Open System

A system which obeys OSI standards in its communication with other systems. In ISO 7498, except in clause 4, the term open system is used to refer only to those aspects of a real open system pertinent to OSI.

1.3.1.4 Protocol

A set of rules (semantic and syntactic) which determines the communication behaviour of (N)-entities in the performance of (N)-functions.

1.3.1.5   Protocol Data Unit (PDU)

A unit of data specified in a (N)-protocol and consisting of (N)-protocol-control-information and possibly (N)-user-data.

1.3.1.6   Service

A capability of the (N)-layer and of the layers beneath it, which is provided to (N+1)-entities at the boundary between the (N)-layer and the (N+1)-layer.

1.3.1.7   Service Data Unit (SDU)

An amount of (N)-interface-data whose identity is preserved from an end of an (N)-connection to the other.

1.3.1.8   Service Access Point

The point at which (N)-services are provided by an (N)-entity to an (N+1)-entity.

1.3.1.9   System

A set of one or more computers, the associated software, peripherals, terminals, human operators, physical processes, information transfer means, etc., that forms an autonomous whole capable of performing information processing and/or information transfer. In ISO 7498, except in clause 4, the term system is synonymous with the term open system.

1.3.2   Additional Definitions

For the purpose of this Technical Report the following additional definitions apply.

1.3.2.1   Distributed End System

An End System which is constructed from logically and physically separate parts.

1.3.2.2   Distributed End System Component

One of the logically and physically separate parts of a Distributed End System.

1.3.2.3   Distributed End System Interworking-Unit (DSI)

A Distributed End System component which functions as an Interworking-Unit to support the lower four layers of a Distributed End System.

1.3.2.4   End System

An Open System which contains all seven layers of the Open Systems Interconnection Architecture.

1.4. Acronyms

The following acronyms are used in this Technical Report.

DSI   Distributed System Interworking-Unit
LAN   Local Area Network
NSAP   Network Service Access Point
TS   Transport Service
TSAP   Transport Service Access Point

2 Distributed System

2.   DISTRIBUTED SYSTEM

2.1 General

Suppose that it is required to divide an end system hierarchically between two physical components. It will then be necessary to choose an appropriate layer at which to perform the division and also an appropriate interfacing mechanism. A division at the layer 5/4 boundary offers a convenient separation of functions, and it is attractive to consider an interfacing mechanism based on a LAN carrying layer 4-1 protocols. With such a division, the end system Network Service Access Points (NSAPs) lie in the "front end" (the Interworking-Unit) and its Transport Service Access Points (TSAPs) lie in the "back end" (the data processing system).

Suppose further that it is required to subdivide the "back end" into a number of components. Although in principle a TSAP could be shared between two such components, there seems to be little benefit and much extra complexity in permitting this. TSAPs are therefore strictly partitioned between the "back end" components. The resultant structure for the LAN and its components is designed in Fig. 1.
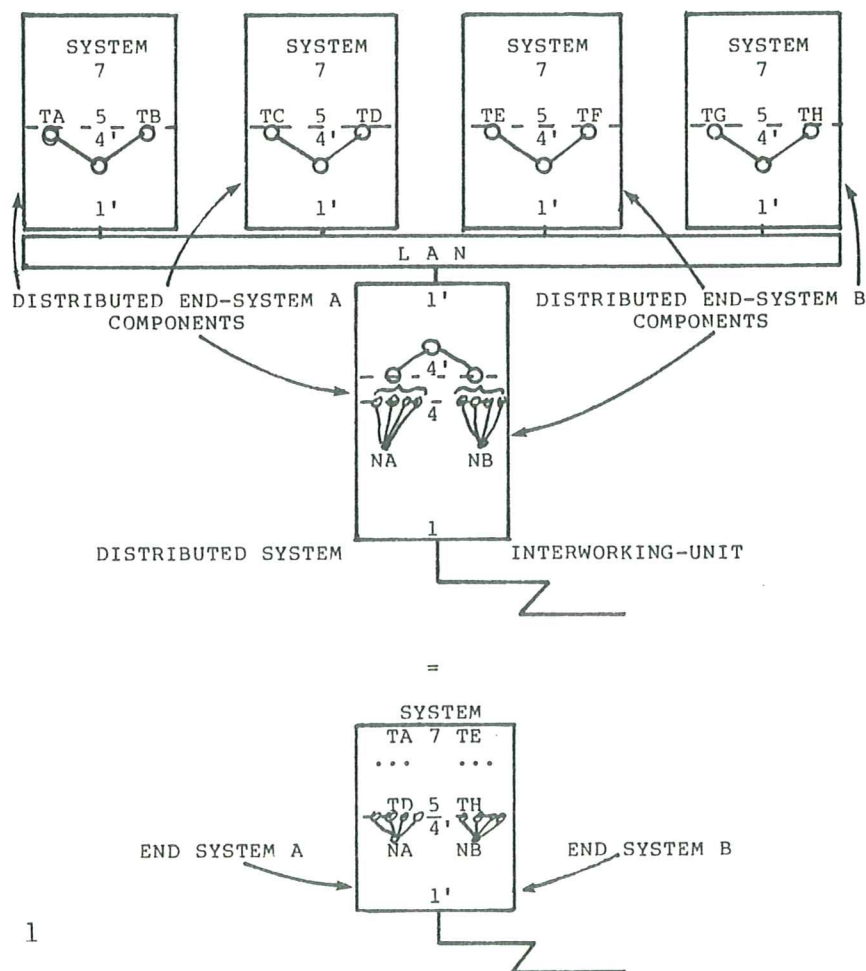

Fig. 1

An alternative view of the same architecture is that the
Transport Service interface has been distributed using the
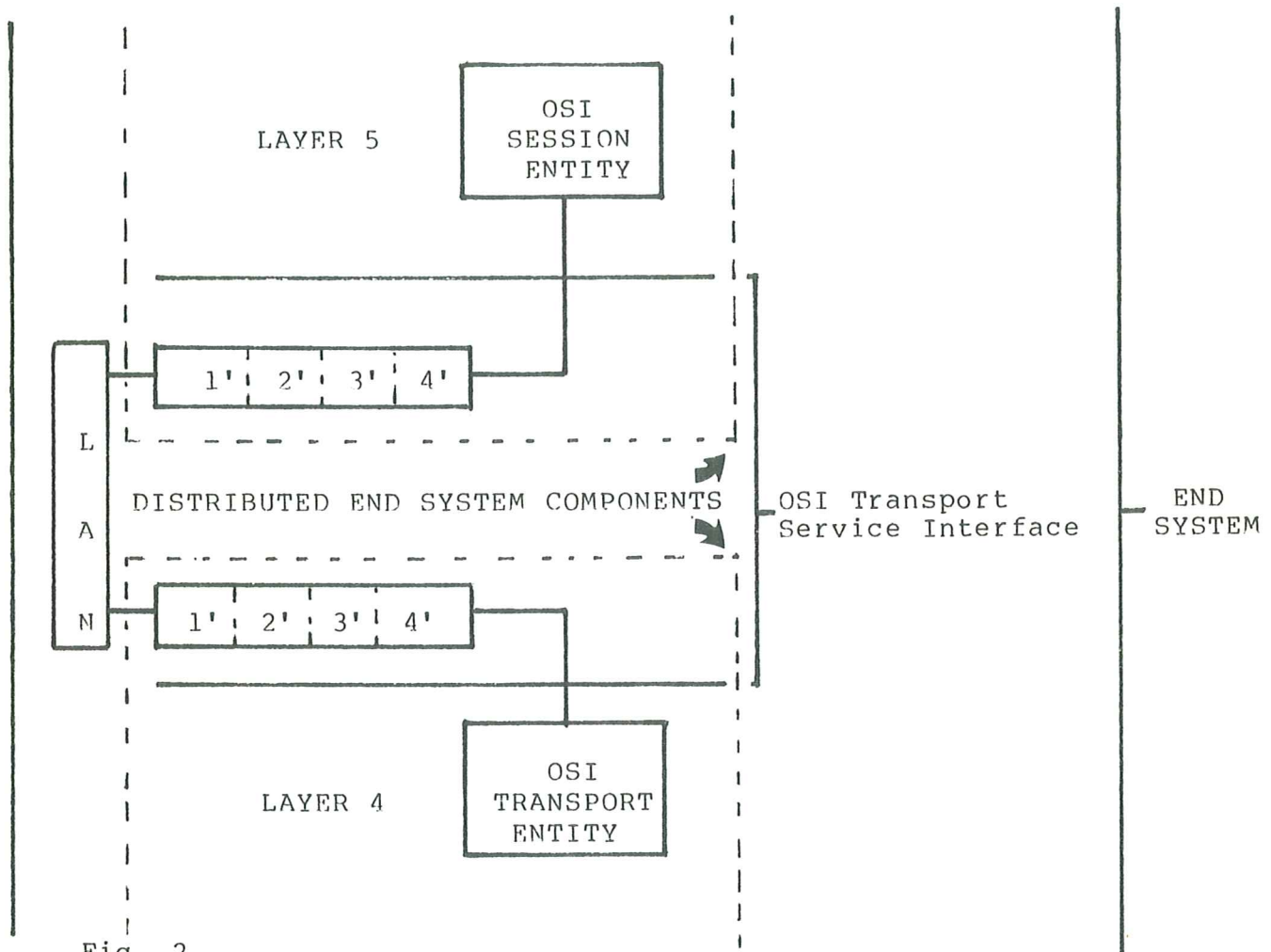LAN. This may be depicted as in Fig. 2.

Fig. 2

Note several attractive features of this approach:

- the LAN and the external networking environments are
  totally decoupled, giving freedom for optimized
  solutions to be devised in each case;

- the system components and the LAN behave as systems with
  respect to each other;

- the end system distribution is not visible externally;

- the grouping of LAN systems is dicted solely by their
  design and degree of cooperation.

2.2 DSI Architecture

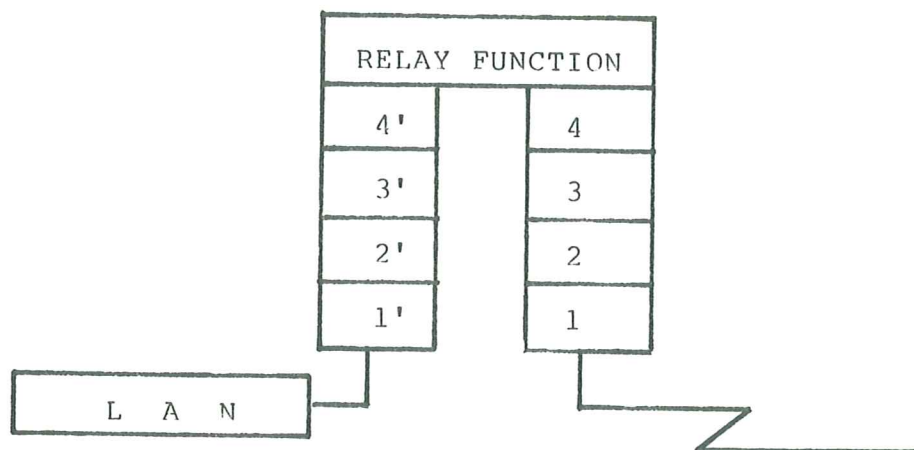The DSI may be re-drawn as in Fig. 3 to emphasize its nature as a relay.

Fig. 3

Some specialized characteristics of a DSI are the following:

- the DSI is an integral part of the end system;
- no more than two DSIs in series are possible;
- the relay function of the DSI concatenates two Transport Services which have, per definition, the same logical properties;
- the DSI supports the Transport Service: no further requirement for resilience or end-to-endness is implied by the use of DSIs;
- a DSI together with its associated distributed end system components are addressed as normal end systems.

The interpretation of the term "Transport Routing" and its relevance to the DSI is for further study.
The protocols supported by the DSI on the LAN side are specified in ECMA TR/14 (see 1.2). The protocols supported by the DSI on the external side are Transport and lower-layer protocols. Higher-layer protocols above the Transport layer are supported by the associated distributed end system components.

2.3 Connection Management

The DSI conforms to the applicable provisions of ECMA-72. The DSI maintains a close association between two Transport connections, one on the LAN side and one externally. Establishment and release of Transport connections through the gateway is end-to-end, see Fig. 4 in the following page.

SYSTEM	LAN(s)	DSI	EXTERNAL SUBNETWORK(s)	SYSTEM

Connection
Request

Connection
Request

Connection
Confirm

Connection
Confirm

Disconnect
Request

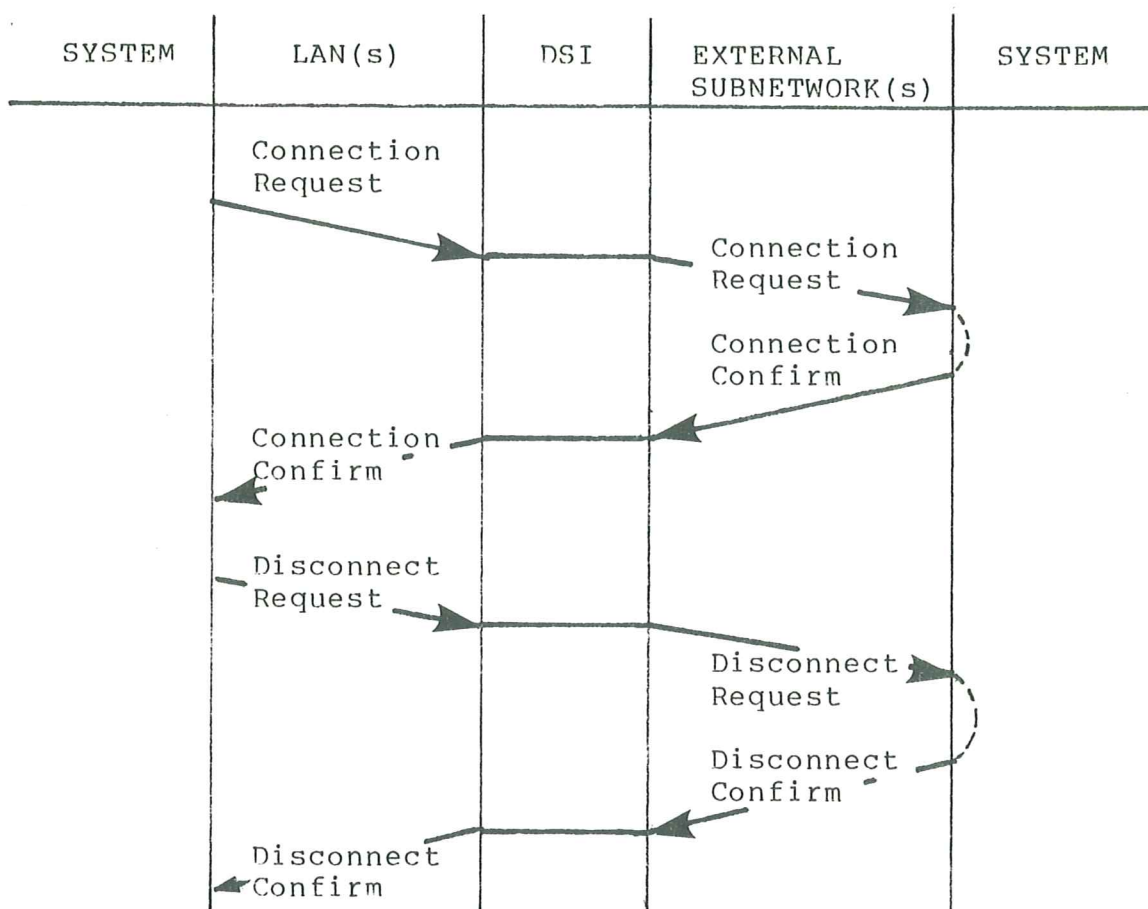Disconnect
Request

Disconnect
Confirm

Disconnect
Confirm

Fig. 4

The relay function of the DSI is responsible for
establishing and maintaining the association between the
paired Transport connections. During connection
establishment the relay function participates in
negotiation of service options (such as Expedited) and
quality-of-service characteristics (such as throughput and
transit delay). As an implementation-dependent matter it
may also negotiate a suitable choice of Transport protocol
parameters (such as Transport Protocol Data Unit size).

Figure 4 above shows only the straightforward cases of
connection and disconnection. Other cases such as refusal
of the Transport connection by the DSI or remote system
are also possible. If one Transport connection should fail
(after Transport protocol recovery action, if applicable),
the DSI releases the other Transport connection. Each
Transport connection operates as normal and has its own
protocol, protocol class, parameters, options, etc. Only
in the relay function, which is above the normal Transport
service level, is the association between the Transport
connection made.

2.4 Data Management

The relay function of a DSI maps Transport Service Data
Units on one side onto the other in the obvious way. As an
implementation-dependent matter, a relay function may

optimize its buffering and flow control by a judicious choice of Transport protocol parameters and by a suitable design of its Transport service interface.

2.5 Service Concatenation

The relay function of the DSI operates above the normal Transport service and so is unaware of the underlying Transport protocol and, indeed, of any lower layer protocols. Provided the Transport protocol on each of the paired Transport connections offers the same service in terms of logical properties, then service concatenation is possible.

The logical properties of the Transport service to be concatenated have to be the same in the following sense:

- the addressing scheme of a particular TS provider has to be foreseen by the addressing conventions of another TS provider;

- service primitives and associated parameters of one TS provider need to be mapped onto service primitives and associated parameters of the other TS provider.

The quality of service offered by a concatenation of Transport services will in general be lower than the quality of service offered by an individual Transport service.

2.6 Addressing

The DSI conforms to the applicable provisions of ECMA TR/20 (see 1.2). A DSI together with its associated distributed end system components is addressed like a normal end system. The relay function in the DSI determines the mapping of the externally known Transport address onto the addressing scheme used internally on the LAN.

In the case of a Connection Request made from a system on the LAN to an external system, the DSI must be given sufficient information for it to determine the Transport address in that external system.
Two possible ways of achieving this are:

- supply the full Transport address in the Transport Service Access Point Identifier parameter of the Transport protocol on the LAN;

- supply the Transport selector in the Transport Service Access Point Identifier parameter of the Transport protocol on the LAN, and supply the global Network Address in the Internet Protocol Address parameter on the LAN.

The second method is applicable to hierarchic Transport addresses only. Other methods of conveying the full Transport address to the DSI (e.g. by using local address synonyms) are for further study.

APPENDIX A

ITEMS FOR FURTHER STUDY

The following items are for further study:

- terminology (see 1.3.2)
- interpretation of the term "Transport routing" (see 2.2)
- conveyance of Transport addresses to the DSI (see 2.6)