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Information technology — Enhanced communications transport service definition

Technologies del'information — Définition du service de transport de communications amélioré

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 13252 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.605.

Annex A forms an integral part of this International Standard.

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Introduction

This Recommendation | International Standard defines a transport service, named Enhanced Communications Transport Service (ECTS), which provides for a multicast capability and enhanced Quality of Service (QoS). This Recommendation | International Standard defines a wide range of services ranging from unreliable unicast with best-effort QoS to reliable multicast with guaranteed QoS. In this way, this Recommendation | International Standard is meant to provide for a uniform and universal service interface between transport protocols and applications of the present and the future information age, especially for those applications requiring versatile and powerful multimedia group communication capabilities underneath. Figure Intro.1 depicts the general architectural block diagram showing how ECTS relates to other protocols in the transport, application as well as network layers.

ECTP in Figure Intro. 1 is a protocol which is supposed to support all the services defined by this Recommendation | International Standard. ECTP is (to be) defined in a separate Recommendation | International Standard.

Note that not all the transport protocols shown in Figure Intro. 1 support all the services defined by ECTS. For example, TCP provides a best-effort reliable unicast service; UDP supports a best-effort unreliable multicast service. MTP, RMP, and SRM support reliable multicast but with null QoS. RTP provides means for exchanging synchronization information but does not define mechanisms to provide the synchronization itself.

ECTP, a companion protocol to ECTS, further will utilize, wherever possible, the multicast capabilities of the underlying network infrastructures. For example, in operation in Internet, ECTP will make extensive use of the multicast capabilities of IPv4 and IPv6 and rely on RSVP for QoS provisioning by network resource reservation. As another example, in operation over intrinsic ATM networks, ECTP will rely on the ATM capabilities for both multicast and QoS.

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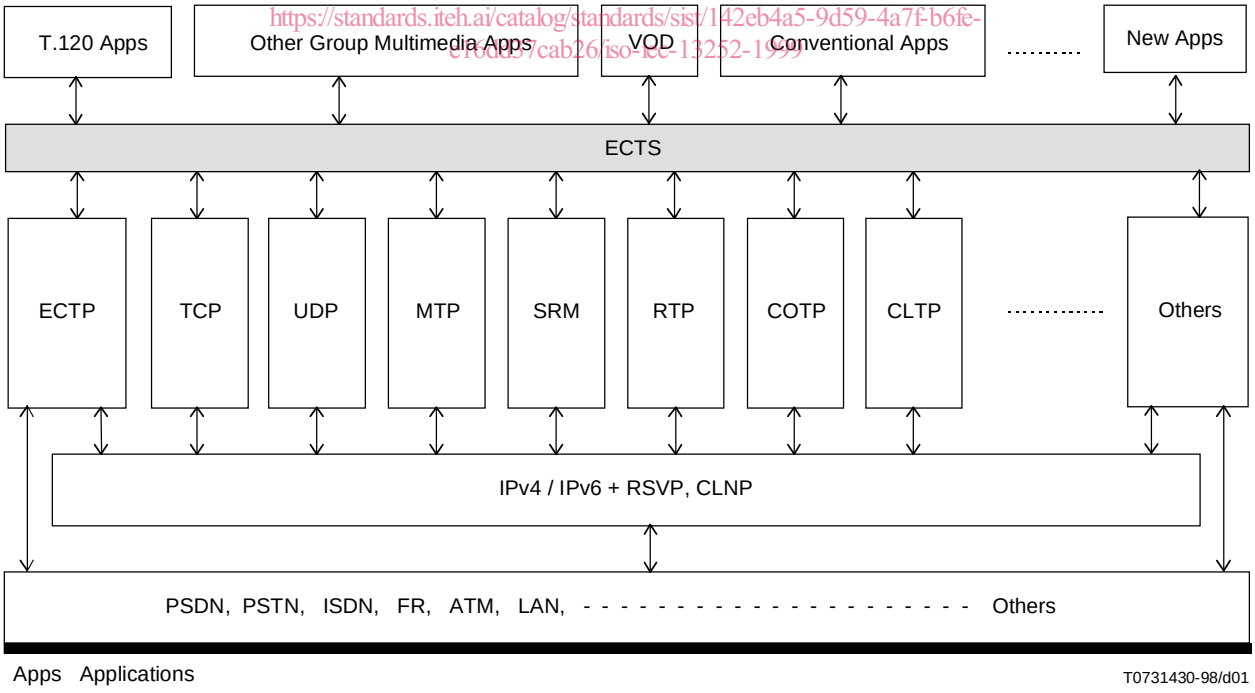

Figure Intro. 1 – Architectural block diagram for ECTS

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INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – ENHANCED COMMUNICATIONS TRANSPORT SERVICE DEFINITION

1 Scope

This Recommendation | International Standard defines in an abstract way the externally visible service provided by the Transport Layer in terms of:

a) the primitive actions and events of the service;

b) the parameter data associated with each primitive action and event;

c) the relationship between, and the valid sequences of, these actions and events.

The service defined in this Recommendation | International Standard is that which is provided by the Enhanced Communications Transport Protocol (in conjunction with the Network Service) and which may be used by any application protocol. The service can also be provided by other protocols possibly each supporting a subset of the services defined herein.

The primitives specified in this Recommendation | International Standard support a connection-mode service and a connectionless service. In some cases of connectionless-mode service supporting enhanced communications, certain operations may also be necessary prior to the commencement of data transfer, e.g. agreement on quality of service.

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For the data transfer phase of either connection-mode or connectionless-mode services, there may be a range of data-ordering characteristics.

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No implication is made in this Recommendation | International Standard regarding the inclusion or exclusion of any of the above characteristics given the service primitives specified herein.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

– ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection - Basic Reference Model: The Basic Model.*

– ITU-T Recommendation X.210 (1993) | ISO/IEC 10731:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: Conventions for the definition of OSI services.*

– ITU-T Recommendation X.214 (1995) | ISO/IEC 8072:1996, *Information technology – Open Systems Interconnection – Transport service definition.*

– ITU-T Recommendation X.641 (1997) | ISO/IEC 13236:1998, *Information technology – Quality of Service: Framework.*

– ITU-T Recommendation X.802 (1995) | ISO/IEC TR 13594:1995, *Information technology – Lower layers security model.*

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.1 Reference Model definitions

This service definition is based on the concepts developed in the OSI Basic Reference Model (see ITU-T Rec. X.200 | ISO/IEC 7498-1), and makes use of the following terms defined in it:

a) Transport Layer;

b) Transport Service;

c) transport-service-access-point;

d) transport-service-access-point address;

e) transport-service-data-unit;

f) Network Layer;

g) Network Service.

3.2 Service definition conventions

This service definition also make use of the following terms defined in ITU-T Rec. X.210 | ISO/IEC 10731, as they apply to the Transport Layer:

a) service-user;

b) service-provider;

c) primitive;

d) request;

e) indication;

f) response;

g) confirm.

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3.3 Quality-of-Service Framework definitions

This service definition is compliant with the QoS Framework (see ITU-T Rec. X.641 | ISO/IEC 13236) in that it describes facilities which pertain to the Transport Layer as specified in the relevant clause of the QoS Framework:

a) QoS characteristic;

b) QoS mechanism;

c) QoS parameter.

3.4 Enhanced Communications Transport Service definitions

For the purposes of this Recommendation | International Standard, the following definitions also apply:

3.4.1 transport connection: A *multicast* connection established among TS-users for the purpose of transferring data. In the case where there are only two participants involved, it reduces to a peer-to-peer connection.

3.4.2 enrolled group: A group of TS-users who can participate in a transport connection, which is identified with a group TSAP address.

3.4.3 group TSAP address: A TSAP address which maps to a set of individual TSAP addresses of the enrolled group members. Note that, in general, a TSAP address may be a unicast – or group – address.

3.4.4 active group: A group of Transport Service users which maintain the shared state information required to support the mechanisms of the data transfer phase.

3.4.5 active group integrity: A set of conditions concerning the active group which must be true in order for a transport connection to enter or remain in the transfer state of the data transfer phase.

3.4.6 QoS level of agreement: The level of agreement reached during the QoS negotiation between users and the provider. It may be best-effort or guaranteed.

3.4.7 **ordering**: Ordering is concerned with the following two aspects:

i) In the case of a single sender, ordering if needed ensures that the data units generated by the sender are delivered to each receiver in the active group in the same order as they were sent.

ii) In the case of multiple senders, ordering determines the relative sequencing of data received from multiple senders. The ordering relationship defines the arrangement or interleaving of data from the multiple senders.

The ordering relationship can be: no, local, partial, causal, or total.

NOTE – When there are only two participants in the active group, local ordering, causal ordering, and total ordering are the same.

3.4.8 **TC-participant**: A TS-user that is a member of the active group participating in a transport connection.

3.4.9 **TC-owner**: A TS-user that owns the right to invite, monitor, and terminate a transport connection.

3.4.10 **focal TS-user**: A TS-user that intends to transmit on a TC and initiates the QoS negotiation of the 1×N transport channel relating to the data it transmits and the reception of that data by other TS-users.

3.4.11 **sending TS-user**: A TS-user that is a member of the active group participating in a transport connection and submits data to the Transport Service provider during the data transfer phase.

3.4.12 **receiving TS-user**: A TS-user that is a member of the active group participating in a transport connection and receives data from the Transport Service provider during the data transfer phase.

3.4.13 **transmit diversity**

i) ***Homogeneous***: Condition wherein all TS-users have agreed to a common set of transmit QoS values and so all sending TS-users transmit data at the same rate.

ii) ***Heterogeneous***: Condition wherein different sending TS-users may transmit data at different rates.

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3.4.14 **receive diversity**

i) ***Receivers-wide***: Condition wherein all receiving TS-users receive the data of a given sending TS-user at the same QoS value.

In the case of a simplex TC, this term is synonymous with "connection-wide" defined in the QoS Framework.

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ii) ***Receiver-selected***: Condition wherein different receivers may receive the data of the same sending TS-user at different QoS values not better than the transmit QoS. It is out of the scope of this Recommendation | International Standard how it can be made possible, through some facilities and mechanisms within the TS-provider, that data of a given QoS may be delivered at different QoS values.

3.4.15 **transmit concurrency**

i) ***Controlled***: Condition wherein only senders with a token may transmit data. The maximum number of such senders is specified by *Ntok*.

ii) ***Uncontrolled***: Condition wherein all senders may transmit data concurrently.

3.4.16 **Channel**: A 1×N simplex data flow within a transport connection.

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply.

AGI	Active Group Integrity
CHQ	Controlled Highest Quality
ECTP	Enhanced Communications Transport Protocol
ECTS	Enhanced Communications Transport Service
LQA	Lowest Quality Acceptable
NSAP	Network-service-access-point
OA	Owner Arbitration

OSIE	Open Systems Interconnection Environment
OT	Operating Target
QoS	Quality of Service
SWA	Step-wise Arbitration
TC	Transport Connection
TPDU	Transport-protocol-data-unit
TS	Transport Service
TSAP	Transport-service-access-point
TSDU	Transport-service-data-unit

5 Conventions

5.1 General conventions

This service definition uses the descriptive conventions given in ITU-T Rec. X.210 | ISO/IEC 10731.

5.2 Parameters

The available parameters for each group of primitives are set out in tables in clauses 12 to 22. Each 'X' in the tables indicates that the primitive labelling the column in which it falls may carry the parameter labelling the row in which it falls.

Some entries are further qualified by items in brackets. These may be:

a) indications that the parameter is optional in some way:

(U) indicating that the inclusion of the parameter is a choice made by the user;

b) parameter specific constraints:

(=) indicating that the value supplied in an indication or confirmation primitive is always identical to that supplied in the respective previous request or response primitive issued at the peer service access point.

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5.3 Notations

The following notations are used in this Recommendation | International Standard to denote some numerical quantities:

a) *Nmax*: The maximum number of members that can be allowed in the active group.

b) *Nact*: The actual number of members in the active group.

c) *Ntok*: The maximum number of members that can transmit data concurrently.

6 Overview and general characteristics

The Transport Service provides for the transparent transfer of data among TS-users. It relieves the TS-users from any concern about the detailed way in which supporting communications media are utilized to achieve this transfer.

The Transport Service provides for the following:

a) *QoS selection:*

The Transport Layer is required to optimize the use of available communications resources to provide the QoS required by communicating TS-users at the minimum cost. QoS requirements are specified through the selection of values for QoS parameters.

b) *Independence of underlying communications resources:*

The Transport Service hides from TS-users the difference in the QoS provided by the Network Service. This difference in QoS arises from the use of a variety of communications media by the Network Layer to provide the Network Service.

c) *End-to-end significance:*

The Transport Service provides for the transfer of data among TS-users in end systems.

d) *Transparency of transferred information:*

The Transport Service provides for the transparent transfer of octet-aligned TS-user data and/or control information. It neither restricts the content, format, or coding of the information, nor does it ever need to interpret its structure or meaning.

e) *TS-user addressing:*

The Transport Service utilizes a system of addressing which is mapped into the addressing scheme of the supporting Network Service. Transport addresses can be used by TS-users to refer unambiguously to TSAPs.

f) *AGI monitor:*

The Transport Layer may be required to monitor the AGI of TS-users participating in the active transport connection. AGI is specified through the selection of values for AGI parameters.

7 Features of the Enhanced Communications Transport Service

ECTS provides the following features to the TS-user:

a) The means for a TC-owner to create a TC with other TS-users of the same enrolled group for the purpose of exchanging TSDUs. Only one TC may exist among the TS-users of a given enrolled group. Some QoS agreements may have been determined during enrolment. Refinement of some of these QoS agreements may occur during the create operation and others may be initially determined at that time.

b) The means for a TS-user to join an existing TC under the constraints of QoS, AGI, and other control conditions. Further QoS refinements may be made as part of the join operation.

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c) The means of transferring TSDUs on a TC under the constraints imposed by QoS. The transfer of TSDUs is transparent, in that the boundaries of TSDUs and the contents of TSDUs are preserved unchanged by the Transport Service and that there are no constraints on the TSDU content imposed by the Transport Service. It may or may not be known whether any or all of the potential receivers receive the TSDUs.

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d) The means of transferring TSDUs with no QoS imposed except, optionally, transit delay. The transfer of TSDUs is transparent in that no constraints on the TSDU content are imposed by ECTS and the contents of TSDUs are preserved unchanged by ECTS. It may not be known whether any or all of the potential receivers receive the TSDUs.

e) The means for a TS-user to leave a TC unconditionally and/or under the constraints of AGI and QoS.

f) The means for a TC-owner unconditionally and therefore destructively to terminate a TC.

8 Model of the Enhanced Communications Transport Service

8.1 Types of Transport Connection

Figure 1 gives the three types of TC considered in ECTS. They are:

a) Simplex TC, wherein one TC-participant, called TC-owner, is send only and all others are receive only.

b) Duplex TC, wherein one TC-participant, called TC-owner, can both send to and receive from all others whereas all other TC-participants can receive only from and send only to the TC-owner. Hence, send/receive among the TC-participants other than the TC-owner is not possible.

c) N-plex TC, wherein any TC-participant is a sender as well as a receiver. At any moment, anyone can send something, and, if someone does so, all others may receive it.

The three basic types of TC defined here are thought to cover all the other types as degenerate cases. For example, a unicast simplex TC is a degenerate case of the simplex TC. A unicast duplex (peer-to-peer) TC is a degenerate case of the N-plex TC. An M×N TC wherein M of the total N members are send-and-receive participants while the rest are receive-only can be modelled as a degenerate of the N-plex TC; some members may announce their intention not to send any data as part of QoS negotiation.

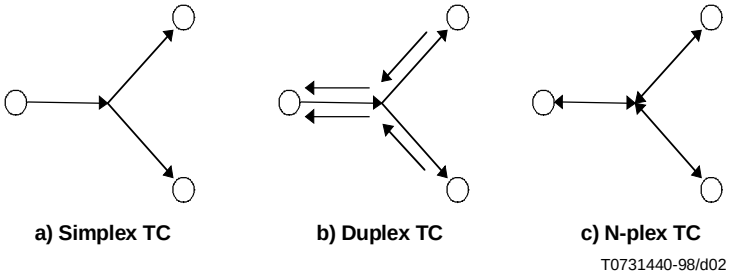

Figure 1 – Types of Transport Connections

8.2 Model of Transport Connection

An enrolled group may be involved in only one TC. Figure 2 gives an example of a TC for an enrolled group. In this example, the enrolled group consists of six TS-users A to F. The group is identified by a group TSAP address pointing to the TSAPs of the group members A to F.

In the example, TS-users A, B, C, and E are involved in a simplex TC, wherein A is the owner; they are said to form the active group for TC. TS-users D and F are not involved in any TC.

The TC is identified by the group TSAP address which is unique within the scope of OSIE. Each terminal of a TC is identified by the TSAP address of the TS-user participating in the active group.

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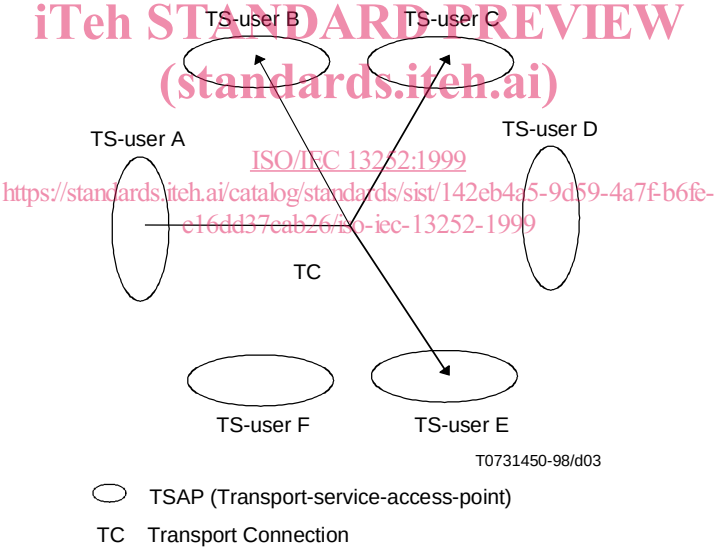

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Figure 2 – An example of a TC for an enrolled group

9 Transport Connection characteristics

The TC characteristics consist of AGI and QoS. While QoS may be changed through negotiation in TC establishments, AGI is a predefined requisite for a TC and is not for negotiation. Therefore, AGI may be irrelevant for some primitives, i.e. response and confirm, where the AGI might be of a null value or even absent.

9.1 Active group integrity

The active group integrity specifies conditions on the active group membership of a TC. The following is the AGI conditions identified and defined in this Recommendation | International Standard. Inclusion of other AGI conditions is for further study.

9.1.1 AGI policy

a) *Soft*: Policy for which the TC is to be suspended when the AGI is violated. The TC is to be restored when the AGI is recovered.

b) *Hard*: Policy for which the TC is to be terminated when the AGI is violated.

9.1.2 Population

The AGI population characteristic for a TC can be one or more of the following.

a) *Mandatory*: Condition that specifies the selected enrolled group members required to be present in the active group.

b) *Minimum*: Condition that specifies the minimum number of enrolled group members required to be present in the active group.

c) *Quorum*: Condition wherein the majority of enrolled group members are required to be present in the active group.

d) *Maximum*: Condition that specifies, *Nmax*, the maximum number of members that can be allowed in the active group.

e) *Atomic*: Condition wherein all of enrolled group members are required to be present in the active group.

9.1.3 TC type

The type eligible for a group will be one of the following:

a) Simplex TC;

b) Duplex TC;

c) N-plex TC.

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9.1.4 Transmit diversity

The transmit diversity eligible for a group will be one of the following:

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a) Homogeneous;

b) Heterogeneous.

9.1.5 Receive diversity

The receive diversity eligible for a group will be one of the following:

a) Receivers-wide;

b) Receiver-selected.

9.1.6 Transmit concurrency

The transmit concurrency eligible for a group will be one of the following:

a) Controlled;

b) Uncontrolled.

NOTE – In the controlled mode of transmit concurrency, *Ntok* is less than *Nmax*; *Ntok* < *Nmax*. When *Ntok* equals *Nmax*, the case reduces to the uncontrolled mode.

9.2 Quality of service

The term Quality of Service (QoS) refers to certain characteristics of a TC that are managed by the TS-users and the TS-provider. They are:

– throughput, transit delay and transit delay jitter, which are classed as TC performance characteristics;

– corrupted TSDU error rate and lost TSDU error rate, which are classed as TC reliability characteristics;

– TC ordering;

– TC protection;

– TC precedence.

Definitions of these characteristics are given in 10.1.