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Information technology — Open Systems Interconnection — Network service definition

Technologies de l'information — Interconnexion des systèmes ouverts — Définition du service de réseau

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of the joint technical committee is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 8348 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 Rec. X.213.

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This third edition cancels and replaces the second edition (ISO/IEC 8348:1996), which has been technically revised. It also incorporates Amendment 1:1998 and Amendment 2:2002.

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Annex A forms a normative part of this International Standard. Annexes B and C are for information only.

Introduction

This Recommendation | International Standard is one of a set of Recommendations and International Standards produced to facilitate the interconnection of computer systems. It is related to other Recommendations and International Standards in the set as defined by the Reference Model of Open Systems Interconnection (OSI). The OSI Reference Model (ITU-T Rec. X.200 | ISO/IEC 7498-1) subdivides the area of standardization for interconnection into a series of layers of specification, each of a manageable size.

This Recommendation | International Standard defines the Service provided by the Network Layer to the Transport Layer at the boundary between the Network and Transport Layers of the Reference Model. It provides for the designers of Transport protocols a definition of the Network Service existing to support the Transport protocol and for the designers of Network protocols a definition of the services to be made available through the action of the Network protocol over the underlying service. This relationship is illustrated in Figure 0.

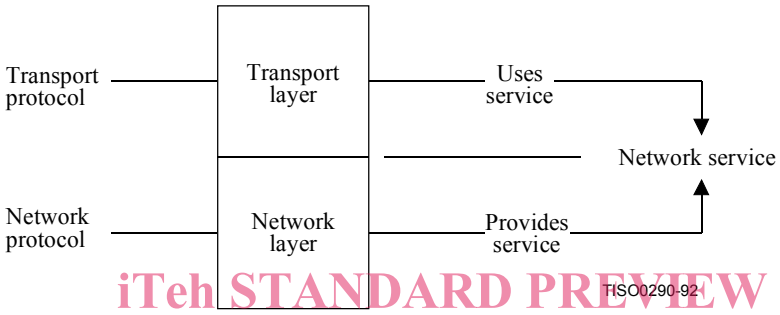

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Figure 0 – Relationship of the Network Service to OSI Network and Transport protocols

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The use of the word "Network" to name the "Network" Layer of the OSI Reference Model should be distinguished from the use of the word "network" to denote a communications network as conventionally understood. To facilitate this distinction, the term "subnetwork" is used for a collection of physical equipment, commonly called a "network" (see Rec. X.200 | ISO/IEC 7498-1). Subnetworks may be either public networks or privately supplied networks. In the case of public networks, their properties may be determined by separate Recommendations such as CCITT Rec. X.21 for a circuit-switched network or ITU-T Rec. X.25 for a packet-switched network.

Throughout the set of OSI Recommendations and International Standards the term "Service" refers to the abstract capability provided by one layer of the OSI Reference Model to the layer above it. Thus, the Network Service defined in this Recommendation | International Standard is a conceptual architectural Service, independent of administrative divisions.

NOTE – It is important to distinguish the specialized use of the term "Service" within the set of OSI Recommendations and International Standards from its use elsewhere to describe the provision of a service by an organization (such as the provision of a service, as defined in other Recommendations, by an Administration).

Any particular subnetwork may or may not support the OSI Network Service. The OSI Network Service may be provided by a combination of one or more subnetworks and optional additional functions between or outside these subnetworks.

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INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

Information technology – Open Systems Interconnection – Network service definition

SECTION 1 – GENERAL

1 Scope

This Recommendation | International Standard defines the OSI Network Service in terms of:

a) the primitive actions and events of the Service;

b) the parameters associated with each primitive action and event, and the form which they take;

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

The principal objectives of this Recommendation | International Standard are:

1) To specify the characteristics of a conceptual Network Service and thus, supplement the Reference Model in guiding the development of Network Layer protocols.

2) To encourage convergence of the capabilities offered by providers of subnetworks.

3) To provide a basis for the individual enhancement of existing heterogeneous subnetworks to a common subnetwork-independent Network Service to enable them to be concatenated for the purpose of providing global communication. (Such concatenation may involve optional additional functions which are not defined in this Recommendation | International Standard.) A definition of the quality of service is an important element of this Recommendation | International Standard.

4) To provide a basis for the development and implementation of subnetwork-independent Transport Layer protocols decoupled from the variability of underlying public and private subnetworks and their specific interface requirements.

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This Recommendation | International Standard does not specify individual implementations or products nor does it constrain the implementation of entities and interfaces within a system.

There is no conformance of equipment to this Recommendation | International Standard. Instead, conformance is achieved through implementation of conforming OSI Network protocols which fulfil the Network Service defined in this Recommendation | International Standard.

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 the 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.224 (1995) | ISO/IEC 8073:1997, *Information technology – Open Systems Interconnection – Protocol for providing the connection-mode transport service.*

2.2 Additional references

- CCITT Recommendation E.163 (1988), *Numbering plan for the international telephone service*.
- ITU-T Recommendation E.164 (1997), *The international public telecommunication numbering plan.*
- ITU-T Recommendation E.191 (2000), *B-ISDN addressing.*
- ITU-T Recommendation E.191.1 (2001), *Criteria and procedures for the allocation of ITU-T International Network Designator Addresses.*
- ITU-T Recommendation F.69 (1994), *The international telex service – Service and operational provisions of telex destination codes and telex network identification codes*.
- CCITT Recommendation T.50 (1992), *International Reference Alphabet (IRA) (Formerly International Alphabet No. 5 or IA5) – Information technology – 7-bit coded character set for information interchange.*
- ITU-T Recommendation X.121 (2000), *International numbering plan for public data networks*.
- ITU-T Recommendation X.300 (1996), *General principles for interworking between public networks and between public networks and other networks for the provision of data transmission services*.
- ISO/IEC 646:1991, *Information technology – ISO 7-bit coded character set for information interchange*.
- ISO 2375:1985, *Data processing – Procedure for registration of escape sequences*.
- ISO 3166-1:1997, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*.
- ISO/IEC 6523-1:1998, *Information technology – Structure for the identification of organizations and organization parts – Part 1: Identification of organization identification schemes*.
- ISO 8648:1988, *Information processing systems – Open Systems Interconnection – Internal organization of the Network Layer*.
- Internet Standard 2, Assigned Numbers.
- IETF RFC 1888 (1996), **OSI NSAPs and IPv6**.

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3 Definitions

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

3.1 Basic reference model definitions

This Recommendation | International Standard is based on the concepts developed in the Basic Reference Model for Open Systems Interconnection and makes use of the following terms defined in ITU-T Rec. X.200 | ISO/IEC 7498-1:

a) expedited Network Service data unit;

b) Network-address;

c) Network Connection;

d) Network-entity;

e) Network-protocol control information;

f) Network-protocol data unit;

g) Network Layer;

h) Network-relay;

i) Network-routing;

j) Network Service;

k) Network Service access point;

l) Network Service access point address;

m) Network Service data unit;

n) OSI environment;

o) subnetwork;

p) title.

3.2 Service conventions definitions

This Recommendation | International Standard also makes use of the following terms defined in ITU-T Rec. X.210 | ISO/IEC 10731, as they apply to the Network Layer:

a) confirm;

b) indication;

c) Network Service user;

d) Network Service provider;

e) primitive;

f) request;

g) response.

3.3 Network Service definitions

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

3.3.1 calling NS user: An NS user that initiates an NC establishment request.

3.3.2 called NS user: An NS user with whom a calling NS user wishes to establish an NC.

NOTE – Calling NS users and called NS users are defined with respect to a single NC. An NS user can be both a calling and a called NS user simultaneously.

3.3.3 generic address: An address which identifies a set of NSAPs rather than a single specific NSAP.

3.3.4 network connection: An association established by a Network Layer between two NS users for the transfer of data, which provides explicit identification of a set of Network data transmissions and agreement concerning the services to be provided by the set.

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NOTE – This definition clarifies that given in ITU-T Rec. X.200 | ISO/IEC 7498-1.

3.3.5 network connection-mode data transmission: The transfer of an NSDU from a source NSAP to a destination NSAP within the context of an NC that has previously been established.

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3.3.6 network connectionless-mode data transmission: The transmission of an NSDU from a source NSAP to a destination NSAP or group of destination NSAPs outside the context of an NC and without any requirement to maintain any logical relationship among multiple invocations.

3.3.7 network connectionless-mode multicast transmission: The transmission of an NSDU from a source NSAP to a set of destination NSAPs.

3.4 Network addressing definitions

Annex A, describing network addressing, makes use of the following terms as defined below:

3.4.1 DTE address: Information used to identify a point of attachment to a public data network.

3.4.2 subnetwork point of attachment: A point at which a real end system, interworking unit, or real subnetwork is attached to a real subnetwork, and a conceptual point at which a subnetwork service is offered within an end or intermediate system.

3.4.3 subnetwork point of attachment address: Information used in the context of a particular real subnetwork to identify a subnetwork point of attachment; or information used in the context of a particular subnetwork to identify the conceptual point within an end or intermediate system at which the subnetwork service is offered. This term is used interchangeably with the (equivalent) shortened form *subnetwork address*.

3.4.4 network protocol address information: Information encoded in a Network protocol data unit to carry the semantics of a Network service access point address. (This is known as an "address signal" or as the "coding of an address signal" in the public network environment.)

3.4.5 naming domain: A context within which a name allocated by a naming authority is unambiguous. Where the name is an address, the context within which the name is allocated is called an *addressing domain*.

3.4.6 global network addressing domain: An addressing domain consisting of all of the Network service access point addresses in the OSI environment.

3.4.7 network addressing domain: A subset of the global network addressing domain consisting of all of the Network service access point addresses allocated by one or more addressing authorities.

3.4.8 naming authority: That which allocated names from a specified naming domain, and which ensures that names so allocated are unambiguous. Where the naming authority allocates addresses, it is called an *addressing authority*.

3.4.9 network addressing authority: An addressing authority that assigns and administers Network service access point addresses within one or more network addressing domains.

3.4.10 abstract syntax: A notation which enables data types to be defined, and values of those types specified, without determining the way in which they will be represented (encoded) for transfer by protocols.

3.4.11 group Network address: An address that identifies a set of zero or more Network service access points; these may belong to multiple Network entities, in different end systems.

3.4.12 individual Network address: An address that identifies a single NSAP.

NOTE – Where the distinction between a group Network address and an individual Network address is not important, the term **NSAP address** is used.

3.5 Network layer architecture definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.300 and ISO 8648.

a) subnetwork;

b) real subnetwork;

c) subnetwork service;

d) real end system;

e) interworking unit;

f) intermediate system;

g) relay entity.

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4 Abbreviations

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

AFI	Authority and Format Identifier
CC	Country Code
COR	Confirmation of Receipt
DCC	Data Country Code
DSP	Domain Specific Part
ENSDU	Expedited Network Service data unit
ICD	International Code Designator
IDI	Initial Domain Identifier
IDP	Initial Domain Part
ISDN	Integrated Services Digital Network
N	Network
NC	Network Connection
NL	Network Layer
NPAI	Network Protocol Addressing Information
NPDU	Network Protocol Data Unit

NS	Network Service
NSAP	Network Service access point
NSDU	Network Service data unit
OSI	Open Systems Interconnection
PSTN	Public Switched Telephone Network
PTT	Postal, Telephone and Telegraph
QOS	Quality of Service
RPF	Reference Publication Format
SNPA	Subnetwork Point of Attachment

5 Conventions

5.1 General conventions

This Service Definition uses the descriptive conventions given by ITU-T Rec. X.210 | ISO/IEC 10731.

The layer service model, service primitives, and time-sequence diagrams taken from those conventions are entirely abstract descriptions; they do not represent a specification for implementation.

5.2 Parameters

Service primitives, used to represent service-user/service-provider interactions (see ITU-T Rec. X.210 | ISO/IEC 10731), convey parameters which indicate information available in the user/provider interaction.

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The parameters which apply to each group of Network Service primitives are set out in tables in clauses 12 to 14 and 19. 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.

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

a) an indication that the parameter is conditional in some way:

   (C) indicates that the parameter is not present on the primitive for every NC; the parameter definition describes the conditions under which the parameter is present or absent;

b) a parameter specific constraint:

   (=) indicates that the value supplied in an indication or confirm primitive is always identical to that supplied in the corresponding request or response primitive occurring at the peer NSAP;

c) an indication that some note applies to the entry:

   (Note x) indicates that the referenced note contains additional information pertaining to the parameter and its use.

In any particular interface, not all parameters need be explicitly stated. Some may be implicitly associated with the NSAP at which the primitive is issued.

5.3 NC end-point identification convention

If an NS user needs to distinguish among several NCs at the same NSAP, then a local NC end-point identification mechanism must be provided. All primitives issued at such an NSAP would be required to use this mechanism to identify NCs. Such an implicit identification is not described as a parameter of the service primitives in this Service Definition.

NOTE – The implicit NC end-point identification must not be confused with the address parameters of the N-CONNECT primitives (see 12.2).

6 Overview and general characteristics

The Network Service provides for the transparent transfer of data (i.e. NS-user-data) between NS users. It makes invisible to these NS users the way in which supporting communications resources are utilized to achieve this transfer.

In particular, the Network Service provides for the following:

a) *Independence of underlying transmission media* – The Network Service relieves NS users from all concerns regarding how various subnetworks are used to provide the Network Service. The Network Service hides from the NS user differences in the transfer of data over heterogeneous subnetworks, other than quality of service.

b) *End-to-end transfer* – The Network Service provides for transfer of NS-user-data between NS users in end systems. All routing and relaying functions are performed by the NS provider including the case where several similar or dissimilar transmission resources are used in tandem or in parallel.

c) *Transparency of transferred information* – The Network Service provides for the transparent transfer of octet-aligned NS-user-data and/or control information. It does not restrict the content, format or coding of the information, nor does it ever need to interpret its structure or meaning.

d) *Quality of service selection* – The Network Service makes available to NS users a means to request and to agree to the quality of service for the transfer of NS-user-data. Quality of service is specified by means of QOS-parameters representing characteristics such as throughput, transit delay, accuracy and reliability.

e) *NS-user-addressing* – The Network Service utilizes a system of addressing (NSAP addressing and group Network addressing) which allows NS users to refer unambiguously to one another.

7 Types and classes of Network Service

There are two types of Network Service:

a) a connection-mode service (defined in Section 2); and

b) a connectionless-mode service (defined in Section 3).

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For a given instance of communication, the mode of service provided to all NS users is the same (i.e. connection-mode or connectionless-mode). Choice of provision of the connectionless-mode Network Service or the connection-mode Network Service is made in accordance with ITU-T Rec. X.200 | ISO/IEC 7498-1.

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When referring to this Service Definition, an NS user or NS provider shall state which types(s) of service it expects to use or provide.

There are no distinct classes of Network Service defined.

However, for the connection-mode service, two Network Layer Services, Receipt Confirmation and Expedited Data Transfer, are NS provider-options.

A service which is an NS provider-option is one which an NS provider can choose either to provide or not to provide for a particular NC. In circumstances where the NS provider chooses not to provide a provider-option service, it will not be available in the Network Service. If the provider-option Receipt Confirmation or Expedited Data Transfer is provided, it shall be as defined in 14.1 to 14.3.

SECTION 2 – DEFINITION OF THE CONNECTION-MODE SERVICE

8 Features of the connection-mode Network Service

The connection-mode Network Service offers the following features to an NS user:

a) The means to establish an NC with another NS user for the purpose of transferring NS-user-data in the form of NSDUs. More than one NC may exist between the same pair of NS users.

b) The establishment of an agreement between the two NS users and the NS provider for a certain QOS associated with each NC.

c) The means of transferring NSDUs in sequence on an NC. The transfer of NSDUs, which consist of an integer number of octets, is transparent, in that the boundaries of NSDUs and the contents of NSDUs are preserved unchanged by the Network Service, and there are no constraints on the NSDU content imposed by the Network Service.

d) The means by which the receiving NS user may flow control the rate at which the sending NS user may send NSDUs.

e) In some circumstances, the means of transferring separate expedited NSDUs in sequence (see clause 7). Expedited NSDUs are limited in length and their transmission is subject to a different flow control from normal data across the NSAP.

f) The means by which the NC can be returned to a defined state and the activities of the two NS users synchronized by use of a reset service.

g) In some circumstances, the means for the NS user to confirm the receipt of an NSDU (see clause 7).

h) The unconditional, and therefore possibly destructive, release of an NC by either of the NS users or by the NS provider.

9 Model of the connection-mode Network Service

9.1 Model of the connection-mode Network Layer Service

This Service Definition uses the abstract model for a layer service defined in clause 4 of ITU-T Rec. X.210 | ISO/IEC 10731. The model defines the interactions between the NS users and the NS provider which take place at the two NSAPs. Information is passed between the NS user and the NS provider by service primitives, which may convey parameters.

9.2 Model of a Network Connection

Between the two end-points of an NC, there exists a flow control function which relates the behaviour of the NS user at one end receiving NS-user-data to the ability of the NS user at the other end to send NS-user-data. As a means of specifying this flow control feature and its relationship with other capabilities provided by the Network Service, the queue model of an NC, described in the following subclauses, is used.

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This queue model of an NC is discussed only to aid in the understanding of the end-to-end service features perceived by users of the Network Service. It is not intended to serve as a substitute for a precise, formal description of the Network Service, nor as a complete specification of all allowable sequences of NS primitives (allowable primitive sequences are specified in clause 11 – also, see Note below.) In addition, this model does not attempt to describe all the functions or operations of Network Layer entities (including relay entities) which are used to provide the Network Service. No attempt to specify or constrain Network Service implementations is implied.

In interpreting this Service Definition, statements in clauses 12 to 14 concerning the properties of individual primitives have precedence over the general statements in this clause.

NOTE – In addition to the interaction between service primitives described by this model, there may be constraints applied locally on the ability to invoke primitives, as well as service procedures defining particular sequencing constraints on some primitives.

9.2.1 Queue model concepts

The queue model represents the operation of an NC in the abstract by a pair of queues linking the two NSAPs. There is one queue for each direction of information flow (see Figure 1).

Each queue represents a flow control function in one direction of transfer. The ability of an NS user to add objects to a queue will be determined by the behaviour of the NS user removing objects from that queue and the state of the queue. Objects are entered or removed from the queue, either as the result of interactions at the two NSAPs, or as the result of NS provider initiatives.

The pair of queues is considered to be available for each potential NC.

The objects which may be placed in a queue as a result of interactions at an NSAP (see clauses 12 to 14) are:

a) connect objects (associated with N-CONNECT primitives and all of their parameters);

b) octets of normal NS-user-data (associated with an N-DATA primitive);

c) indications of end-of-NSDU (associated with completion of an N-DATA primitive);

d) expedited NSDUs (associated with N-EXPEDITED-DATA primitives and all their parameters);

e) data acknowledgment objects (associated with N-DATA-ACKNOWLEDGE primitives);

f) reset objects (associated with N-RESET primitives and their parameters);

g) disconnect objects (associated with N-DISCONNECT primitives and all their parameters).

NOTE – The description of flow control (see 9.2.3) requires a less abstract description than that used for describing sequences of primitives in clauses 11 to 14. While primitives are defined to be indivisible, for purposes of this queue model, information associated with N-DATA primitives is conceptually subdivided into a sequence of octets of NS-user-data followed by an end-of-NSDU indication. This does not imply any particular subdivision in any real interface.

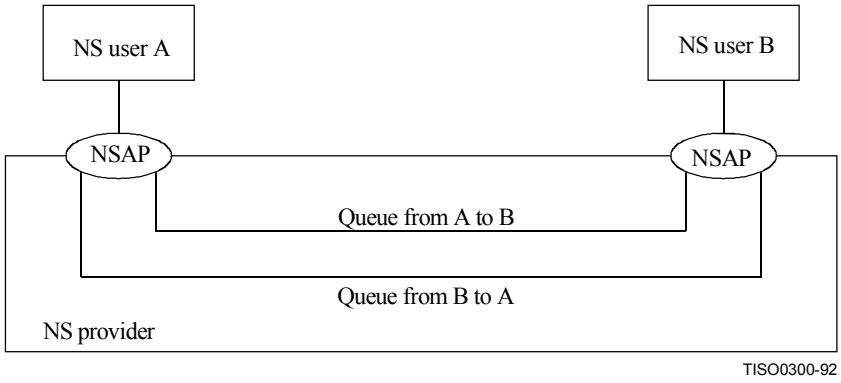

Figure 1 – Queue model of a Network Connection

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The objects which may be placed in a queue as a result of NS provider initiatives (see clauses 12 to 14) are:

1) reset objects (associated with N-RESET primitives and all their parameters);

2) synchronization mark objects (see 9.2.4);

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3) disconnect objects (associated with N-DISCONNECT primitives and all their parameters).

The queues are defined to have the following general properties:

i) a queue is empty until a connect object has been entered and can be returned to this state, with loss of its contents, by the NS provider (see 9.2.4 and 9.2.5);

ii) objects may be entered into a queue as a result of the actions of the source NS user, subject to control by the NS provider; objects may also be entered into a queue by the NS provider;

iii) objects are removed from the queue under the control of the receiving NS user;

iv) objects are normally removed under the control of the NS user in the same order that they were entered (however see 9.2.3);

v) a queue has a limited capacity, but this capacity is not necessarily either fixed or determinable.

9.2.2 NC establishment

A pair of queues is associated with an NC between two NSAPs when the NS provider receives an N-CONNECT request primitive at one of the NSAPs and a connect object is entered into one of the queues. From the standpoint of one of the NS users of the NC, the queues remain associated with the NC until a disconnect object (associated with an N-DISCONNECT primitive) is either entered or removed from a queue at that NSAP.

If NS user A denotes the NS user who initiates NC establishment (resulting in a connect object being entered into the queue from NS user A to NS user B), then no object other than a disconnect object may be entered into the queue from A to B until after the connect object associated with the N-CONNECT confirm has been removed. In the queue from NS user B to NS user A, objects can be entered only after a connect object associated with an N-CONNECT response from NS user B has been entered; it is possible for a disconnect object to be placed in the queue from B to A instead of a connect object to release the NC.

The properties exhibited by the queues while the NC exists represent the agreements reached among the NS users and the NS provider during the NC establishment procedure concerning quality of service and the use of the receipt and expedited data transfer services.

9.2.3 Data transfer operations

Flow control on the NC is represented in this queue model by the management of the queue capacity, allowing objects of certain types to be added to the queues. The conditions affecting entry of reset and disconnect objects are described in item b) below and in 9.2.4 and 9.2.5. The flow control relationship between the other types of objects is summarized by Table 1.

Table 1 – Flow control relationships between queue model objects

The addition of object x / may prevent further addition of object y	Octets of NS-user-data or end-of-NSDU	Expedited NSDU	Data acknowledgment
Octets of normal NS-user-data or end-of-NSDU	Yes	Yes	No
Expedited NSDU	No	Yes	No
Data acknowledgment	No	No	No

Once in the queue, the NS provider may manipulate pairs of adjacent objects, resulting in:

a) *Change of order* – The order of any pair of objects may be reversed, if and only if, the following object is of a type defined to be able to advance ahead of the preceding object. No object is defined to be able to advance ahead of another object of the same type.

b) *Deletion* – Any object may be deleted if, and only if, the following object is defined to be destructive with respect to the preceding object. If necessary, the last object in the queue will be deleted to allow a destructive object to be entered. Destructive objects may therefore always be added to the queue. Disconnect objects are defined to be destructive with respect to all other objects. Reset objects are defined to be destructive with respect to all other objects except connect and disconnect objects.

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The relationships between objects which may be manipulated as described in a) and b) above are summarized in Table 2.

Whether the NS provider performs actions resulting in change of order and deletion or not will depend upon the behaviour of the NS users and the agreed QOS for the NC. In general, if an NS user does not cause objects to be removed from a queue, the NS provider shall, after some unspecified period of time, perform all permitted actions of types a) and b).

9.2.4 Reset operations

The invocation of a reset procedure is represented in the two queues as follows:

a) Invocation of a reset procedure by the NS provider is represented by the introduction into each queue of a reset object followed by a synchronization mark object.

b) A reset procedure invoked by an NS user is represented by the addition of a reset object to one queue. In this case, the NS provider will insert a reset object followed by a synchronization mark object into the other queue.

The completion of a reset procedure by the issuance of an N-RESET response by an NS user results in a reset object being placed in the queue from the responding NS user.

A synchronization mark object cannot be removed from a queue by an NS user; a queue appears empty to an NS user when a synchronization mark object is the next object in it. Unless destroyed by a disconnect object, a synchronization mark object remains in the queue until the next object following it in the queue is a reset object. Both the synchronization mark object and the following reset object are then deleted by the NS provider.

NOTE – Associated with the invocation of a reset procedure are restrictions on the issuance of certain other types of primitives. These restrictions will result in restrictions on the entry of certain object types into the queue until the reset procedure is complete.