INTERNATIONAL TELECOMMUNICATION UNION

ITU-T Q.923

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(02/95)

DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 1 (DSS 1)

SPECIFICATION OF A SYNCHRONIZATION AND COORDINATION FUNCTION FOR THE PROVISION OF THE OSI CONNECTION-MODE NETWORK SERVICE IN AN ISDN ENVIRONMENT

ITU-T Recommendation Q.923

(Previously "CCITT Recommendation")

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation Q.923 was prepared by ITU-T Study Group 11 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 7th of February 1995.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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SUMMARY

In the field of ISDN customer accesses, various protocols were defined for use in different protocol stacks to suit different needs of a range of services. These different protocol stacks have in common the control-plane, or management-plane if appropriate, and user-plane concept of the ISDN, thus require some coordination between these two planes. This coordination is in particular required, if the OSI Connection-mode Network Service (OSI-CONS) according to Recommendation X.213 [2] is to be provided in an ISDN environment.

For the purpose of coordination of the C-plane, or M-plane if appropriate, with the U-plane, Recommendation I.320 "ISDN Protocol Reference Model (PRM)" [1] defines a function called synchronization and coordination function (SCF) and established an architecture for C- and U-plane coordination.

This Recommendation specifies a state machine which provides synchronization and coordination capabilities based on the handling of network (N-) primitives, rather than processing protocol data units (PDU) used by the layer 3 protocols which form a particular stack. Any C-plane service, or M-plane service if appropriate, and U-plane service whose repertoire of (N-) primitives matches the repertoire of (N-) primitives defined in Recommendation X.213 [2] can be coordinated. In addition, the repertoire of (N-) primitives was enhanced in order to make provision in the coordination process, that a connection is released by means of C-plane call control protocol after completion of the disconnection of the U-plane protocols, avoiding premature interruption of the U-plane information flow. The SCF offers different coordination functionality which can be selected by means of predicates.

This Recommendation does not address the mapping of various cause values in reason parameters contained in primitives and the handling of parameters contained in primitives.

This Recommendation covers Switched Virtual Circuit (SVC) and Permanent Virtual Circuit (PVC) arrangements in the narrow-band and broadband ISDN.
It is expected that there will be a growing demand for such a function since also B-ISDN and TMN may have this coordination problem.

Keywords

C-plane	Control plane
CONS	Connection-mode Network Service
ISDN	Integrated Services Digital Network
M-plane	Management plane
NC	Network connection
NS	Network Service
OSI-CONS	OSI Connection-mode Network Service
PRM	Protocol Reference Model
PVC	Permanent Virtual Circuit
SCF	Synchronization and Coordination Function
SVC	Switched Virtual Circuit
U-plane	User plane

Recommendation Q.923

SPECIFICATION OF A SYNCHRONIZATION AND COORDINATION FUNCTION FOR THE PROVISION OF THE OSI CONNECTION-MODE NETWORK SERVICE IN AN ISDN ENVIRONMENT

(Geneva, 1995)

1 Scope and field of application

The intent of this Recommendation is to specify a function which is used to provide the OSI Network Service in an ISDN environment. Recommendation I.320 [1] identifies this function as Synchronization and Coordination Function (SCF).

This Recommendation specifies the provision of the OSI Network Service in terms of the interrelationship between primitives at the upper and lower boundary of the Synchronization and Coordination Function (SCF) and is applicable to an ISDN customer access using an ISDN access signalling system such as the DSS 1 within the C-plane for the provision of a Switched Virtual Circuit (SVC), and Permanent Virtual Circuit (PVC) arrangements.

This Recommendation does not require a particular protocol within the U-plane, but rather relies on Service Data Units (SDUs) to be exchanged between the SCF as service user and the U-plane as service provider.

The SCF performs the synchronization between C-plane, or M-plane if appropriate, and U-plane on a per NC basis and is not concerned with any functionality which is required, if multiplexing within U-plane underlying layers is used.

2 Normative references

The following Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision: all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] CCITT Recommendation I.320 (1988), ISDN protocol reference model. Blue Book, Fascicle III.8.

[2] CCITT Recommendation X.213 (1992), Information technology – Network service definition for Open Systems Interconnection.

3 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used:

CES	Connection Endpoint Suffix
CONS	Connection-mode Network Service
DC	Disconnect Control
DLCI	Data Link Connection Identifier
FMBS	Frame Mode Bearer Service
ISDN	Integrated Services Digital Network
N-	Primitive between SCF and Transport Layer, Network Layer Primitive
N(c)-	Primitive between SCF and C-plane Network Entity

N(m)-	Primitive between SCF and M-plane Network Entity
N(u)-	Primitive between SCF and U-plane Network Entity
NC	Network Connection
N(c)C	Network Connection within C-plane
N(m)C	Network Connection within M-plane
N(u)C	Network Connection within U-plane
NS	Network Service
N(c)S	Network Service provided by C-plane
N(m)S	Network Service provided by M-plane
N(u)S	Network Service provided by U-plane
OSI	Open Systems Interconnection
OSI-CONS	OSI Connection-mode Network Service
PDU	Protocol Data Unit
PRM	Protocol Reference Model
PVC	Permanent Virtual Circuit
SCF	Synchronization and Coordination Function
SDU	Service Data Unit
SVC	Switched Virtual Circuit

4 General

An ISDN customer access consists of one protocol stack which incorporates protocols of different layers within C-, or M-plane if appropriate, and U-plane. The relationship between protocols of adjacent layers within one plane is defined in form of interactions between these layers making use of primitives, whereby as a result of the exchange of primitives protocol data units are exchanged between peer entities. In order to define the relationship between C-, or M-plane if appropriate, and U-plane, a Synchronization and Coordination Function (SCF) is required which relates procedures of the C-plane, or M-plane if appropriate, to the procedures of the U-plane and vice versa. The function SCF can also include a specification for the provision of the OSI Connection-mode Network Service (CONS) in an ISDN control-plane, or management-plane if appropriate, and user-plane environment.

This Recommendation is based on the ISDN Protocol Reference Model (PRM) contained in Recommendation I.320 "ISDN Protocol Reference Model" [1]. The ISDN PRM identifies a Synchronization and Coordination Function (SCF) which performs the coordination between C-, or M-plane if appropriate, and U-plane of the ISDN. The model used in this Recommendation is consistent with the model defined in Recommendation I.320 [1]. This Recommendation specifies the SCF functionality in order to provide an OSI Network Service according to X.213 [2] in an ISDN control-plane, or management-plane if appropriate, and user-plane environment.

The SCF is specified in form of a state machine which provides synchronization and coordination capabilities for different C-plane call control procedures, or M-plane management capabilities if appropriate, and distinct U-plane Sub-N-Services. The desired SCF functionality can be selected by means of predicates in order to accommodate the needs for the coordination of C-, or M-plane if appropriate, and U-plane protocols.

The objectives of this Recommendation are:

- to specify the SCF which handles primitives at three connection endpoints (C-plane, or M-plane if appropriate, U-plane and Network) for the purpose of coordination;
- to provide at a "coordinated network connection endpoint" a Network Service consistent with Recommendation X.213 [2];
- to avoid that SCF has to handle Protocol Data Units (PDUs) used by C- or U-protocol blocks in order to minimize impact of protocols on SCF;
- to avoid that SCF has to handle parameters contained in primitives;

– to provide a comprehensive description of the relationship between peer-to-peer procedures at various layers within C- and U-plane for the purpose of conformance testing of endsystems connected to the ISDN.

The SCF specified in this Recommendation is in principle able to coordinate any C-, or M-plane if appropriate, and U-plane protocol which conforms to the primitive procedures specified at the appropriate connection endpoint.

The major impact of protocols and services on SCF is caused by:

– the capability of the call control protocol within the C-plane to convey information relevant for Network Service (NS) users allowing the NS user to participate at C-plane connection establishment;

– the characteristics of the release service within the U-plane with respect to avoidance of premature release of the C-plane connection.

5 Model of coordination between the C-plane and U-plane

This Recommendation specifies the provision of the network service according to Recommendation X.213 [2] to the (N + 1)-Layer at the boundary between the network layer of the ISDN and the (N + 1)-Layer. It provides for the designers of Network protocols a definition of the Synchronization and Coordination Function (SCF) in order to coordinate the Control-plane (C-plane) and User-plane (U-plane) Network protocols for the provision of an ISDN network service through the action of service primitives and the related C-plane and U-plane network protocols over the underlying services. This relationship is illustrated in Figure 1.

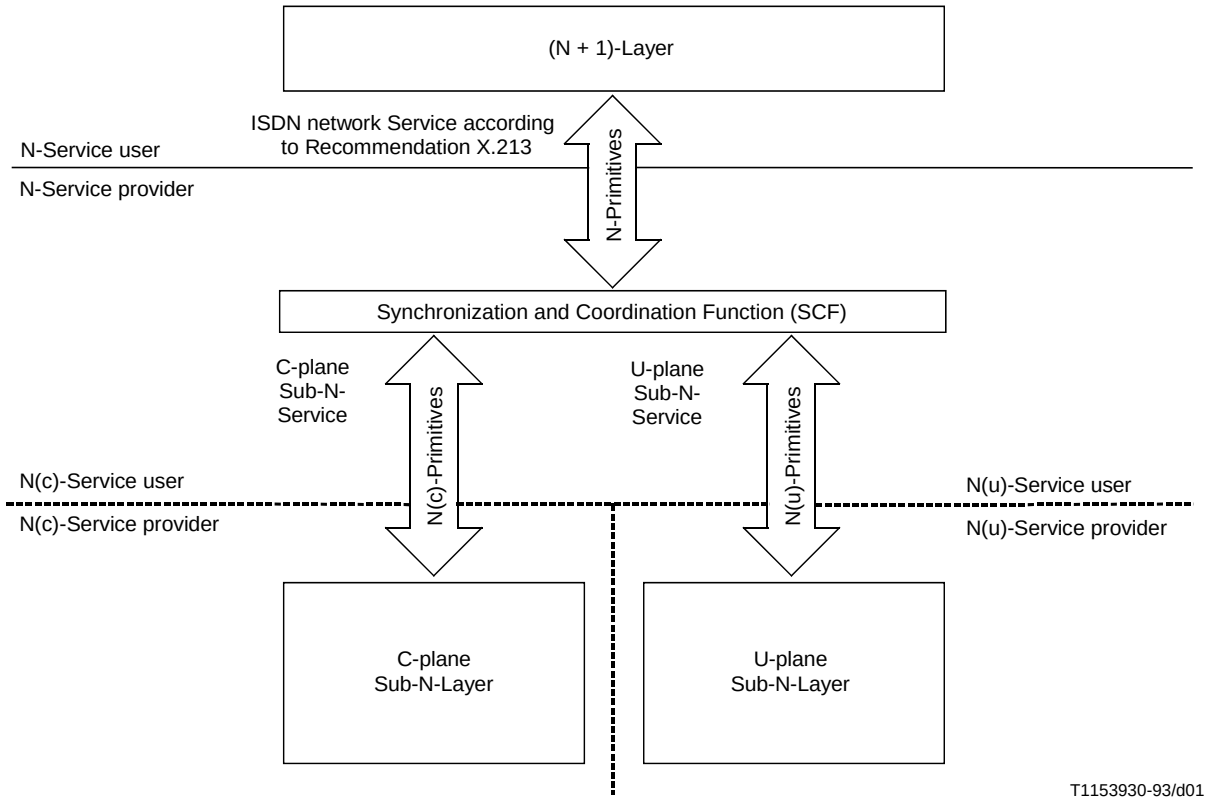

FIGURE 1/Q.923

Relationship of the network service to the services provided by C-plane Sub-N-Layer and U-plan Sub-N-Layer

The model adopts a concept where primitive procedures at three connection endpoints “coordinated Network Connection NC”, “C-plane Network Connection N(c)C” and “U-plane Network Connection N(u)C” are defined, in order to specify the SCF state machine as a coordination process of the three primitive procedures. At the NC endpoint the SCF provides a network service according to Recommendation X.213 [2], while the primitive procedures at the two other connection endpoints depend on the capabilities of the underlying protocol blocks.

The SCF state machine provides synchronization and coordination capabilities for different C-plane call control procedures and distinct U-plane Sub-N-Services, including confirmed N(u)C release. The desired SCF functionality can be selected by means of predicates in order to accommodate the needs for the coordination of C- and U-plane protocols.

This Recommendation covers two options of the SCF:

i) option 1 does not involve the NS user in the call establishment within the C-plane;

ii) option 2 involves the NS user in the call establishment within the C-plane.

Option 1 applies to scenarios where the C-plane call control does not provide the capability to convey all the parameters for the support of a network service according to Recommendation X.213 [2], while option 2 requires the conveyance of all parameters as part of C-plane call control.

6 Sequence of service primitives for coordination of C-plane and U-plane

According to the model, a Network Connection (NC) provided to the Network Service (NS) user, which is the (N + 1)-Layer, is composed of a network connection provided by the C-plane [N(c)C] and a network connection provided by the U-plane [N(u)C].

This clause defines the constraints on the sequences in which the primitives defined in this Recommendation may occur, at the connection endpoints of NC, N(c)C, and N(u)C. Other constraints, such as flow control of Service Data Units (SDU), will affect the ability of an NS user or an NS provider to issue a primitive at any particular time.

6.1 Sequence of primitives at NC endpoint

The NS primitives, their association with phases, services and their parameters are defined in Table 5/X.213 [2] and the state transition diagram for sequences of primitives at the NC endpoint is defined in Figure 4/X.213 [2] .

6.2 Sequence of primitives at N(c)C endpoint

The services provided by the C-plane are U-plane connection establishment up to the layer which is to be handled by C-plane call control, and U-plane connection release, based on C-plane capabilities. This may include a layer 1 connection only, e.g. a transparent B-channel, or also addresses to be used within the U-plane, such as DLCI for a Layer 2 U-plane connection for the support of the Frame Mode Bearer Service (FMBS), or VPI/VCI in a B-ISDN environment. In order to provide these services, the C-plane has to invoke suitable signalling connections; however, this is not visible at the NC endpoint.

Table 1 is a summary of the N(c)S primitives and their parameters.

The possible overall sequences of primitives at N(c)C endpoint are defined in the state transition diagram, Figure 2. This state transition diagram is closely related to the capabilities provided by an ISDN access signalling system such as DSS 1 call control according to the Q.930-Series of Recommendations. In particular no reset service is defined in this context. In the diagram:

a) A primitive which is not shown as resulting in a transition from one state to a different state is not permitted in that state.

b) N(c)-DISCONNECT stands for either the request or the indication form of the primitive in all cases.

c) It is assumed that the primitives passed between layers are implemented by a "first in first out" queue without synchronization mark objects. Therefore, collisions between the NS user primitives request or response and the NS provider primitives indication or confirm may occur. These collisions do not harm the proper operation of the layer interface. They are not shown in the diagram, since their occurrence depends on implementation.

d) The idle state (state 1) reflects the absence of the signalling capability within the C-plane. It is the initial and final state of any sequence, and once it has been re-entered, the signalling capability is not available anymore.

e) The U-plane ready state (state 4) reflects that the U-plane connection has been established by C-plane call control up to the degree which is under control of the C-plane.

TABLE 1/Q.923

Summary of the Sub-N-Service primitives at the N(c)C endpoint [N(c)S primitives] and their parameters

Phase	Service	Primitive	Provision	Parameters
NC establishment	Establishment	N(c)-CONNECT-request	M M UO UO UO CO	Called address Calling address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
		N(c)-CONNECT-indication	M M UO UO UO CO	Called address Calling address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
		N(c)-CONNECT-response	M UO UO UO CO	Responding address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
		N(c)-CONNECT-confirm	M UO UO UO CO	Responding address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
NC release	Release	N(c)-DISCONNECT-request	M CO M	Reason NS-user-data Responding address
		N(c)-DISCONNECT-indication	M M CO M	Originator Reason NS-user data Responding address

M Mandatory (Note 1).

CO Option within C-plane (Note 2).

UO Option within U-plane (Note 3).

NOTES

1 The provision of this capability may require the support of supplementary services.

2 The support of these parameters depends on the capabilities of the signalling systems for C-plane call control.

3 The support of these parameters depends on the capabilities of the U-plane and of the signalling systems for C-plane call control. Alternatively, these parameters may be completely conveyed within the U-plane.

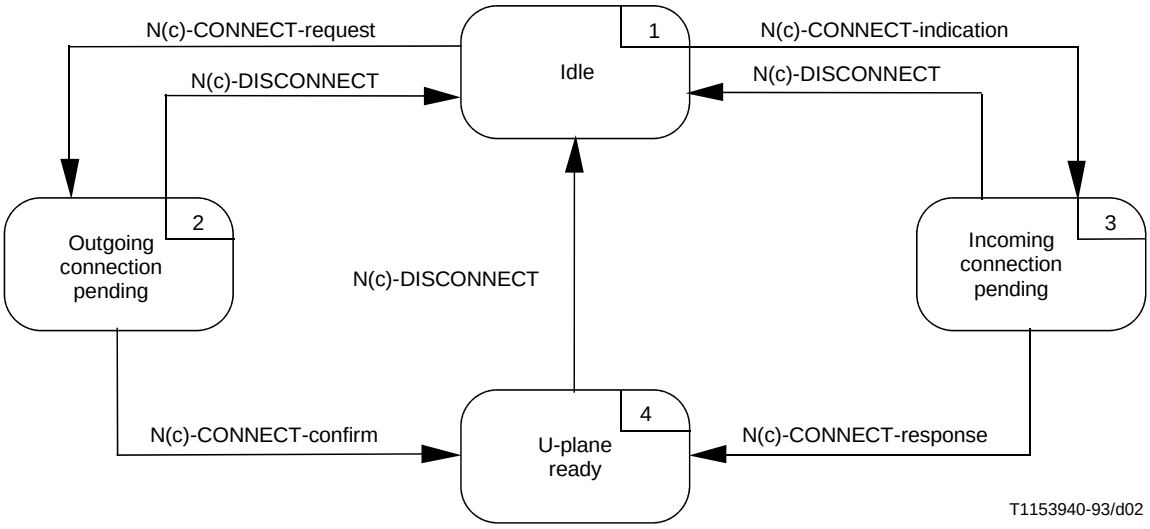

FIGURE 2/Q.923

State transition diagram for sequences of primitives at a network connection endpoint of the C-plane Sub-N-Layer [N(c)C endpoint]

6.3 Sequence of primitives at N(u)C endpoint

The sequences at an network connection endpoint of the U-plane Sub-N-Layer [N(u)C endpoint] depend on the type of network service which may be:

a) Recommendation X.213 [2] type of service;

b) ISDN U-plane Sub-N-Service.

6.3.1 Recommendation X.213 [2] type of service

The N(u)S primitives, their association with phases, services and their parameters are the NC primitives defined in Table 5/X.213 [2] and the state transition diagram for sequences of primitives at the N(u)C endpoint is the state transition diagram for sequences of primitives at the NC endpoint defined in Figure 4/X.213 [2]. Instead of N-primitives, N(u)-primitives apply.

6.3.2 ISDN U-plane Sub-N-Service

The ISDN U-plane Sub-N-Service provides, in addition to the network service according to Recommendation X.213 [2], a confirmed N(u)C release service. This confirmed release service provides to the SCF the means to make provision that the connection within the C-plane is released after completion of connection release within the U-plane, based on explicit confirmation, the receipt of the N(u)-DISCONNECT-confirm.

The N(u)S primitives, their association with phases, services and their parameters are basically the NC primitives defined in Table 5/X.213 [2] . Instead of N-primitives, N(u)-primitives apply. The set of primitives is enhanced to include the N(u)-DISCONNECT-confirm in order to support the confirmed NC release service. The N(u)-DISCONNECT-confirm primitive does not contain a parameter.

The services “receipt confirmation” (see 14.2/X.213 [2]) and “expedited data transfer” (see 14.3/X.213 [2]) are N(u)S provider options; for applicability see relevant Recommendations.

The possible overall sequences of primitives at N(u)C endpoint are defined in the state transition diagram, Figure 3. In the diagram:

a) A primitive which is not shown as resulting in a transition (from one state to the same state, or from one state to a different state) is not permitted in that state.

b) The labelling of the states "NS user invoked reset pending" (state 5) and "NS provider invoked reset pending" (state 6) indicates the party which started the local interaction. The name for state 6 does not necessarily reflect the value of the originator parameter in the associated N(u)-RESET indication primitive which indicates that state 6 has been entered, since the originator could be the peer NS user.

c) It is assumed that the primitives passed between layers are implemented by a "first in first out" queue without synchronization mark objects. Therefore, collisions between the N(u)S user primitives request or response and the N(u)S provider primitives indication or confirm may occur. These collisions do not harm the proper operation of the layer interface.

d) The idle state (state 1) reflects the absence of an N(u)C. It is the initial and final state of any sequence, and once it has been re-entered, the N(u)C is released.

6.4 Sequence of primitives at related NC, N(c)C and N(u)C endpoints

This subclause combines the state transition diagrams defined in 6.1, 6.2 and 6.3 into a single state transition diagram. This function is performed by the Synchronization and Coordination Function (SCF) which refers each state at each connection endpoint, i.e. NC, N(c)C and N(u)C, to those states of the two other connection endpoints to which it is related according to the valid sequences of primitives at the three connection endpoints. This relationship of the states at the three connection endpoints is defined in form of composed states in the generic form:

state NC, N(c)C, N(u)C.

The combined state transition diagram includes those primitives which cause a state transition in the composed state machine contained in the SCF. The primitives which are issued by the SCF as result of a state transition are not shown.

6.4.1 Combined state transition diagram for SCF option 1 in case of Recommendation X.213 [2] type of service

The state transition diagram defined in this subclause is the combination of the state transition diagrams according to 6.1, 6.2 and 6.3.1. The possible overall sequences of primitives at NC, N(c)C and N(u)C endpoints for SCF option 1 and their interrelationship are defined in the state transition diagram, Figure 4. The state transition diagram individually applies to a triple of network connection endpoints {NC, N(c)C, N(u)C} associated with an NC. A suitable mapping has to make provision that an association is established between the Connection Endpoint Suffixes (CES) which are members of a particular triple. The primitives which cause a state transition are:

a) N-CONNECT-request;

b) N-CONNECT-response;

c) N-DISCONNECT-request;

d) N-RESET-request;

e) N-RESET-response;

f) N(c)-CONNECT-indication;

g) N(c)-CONNECT-confirm;

h) N(c)-DISCONNECT-indication;

i) N(u)-CONNECT-indication;

j) N(u)-CONNECT-confirm;

k) N(u)-DISCONNECT-indication;

l) N(u)-RESET-indication;

m) N(u)-RESET-confirm.

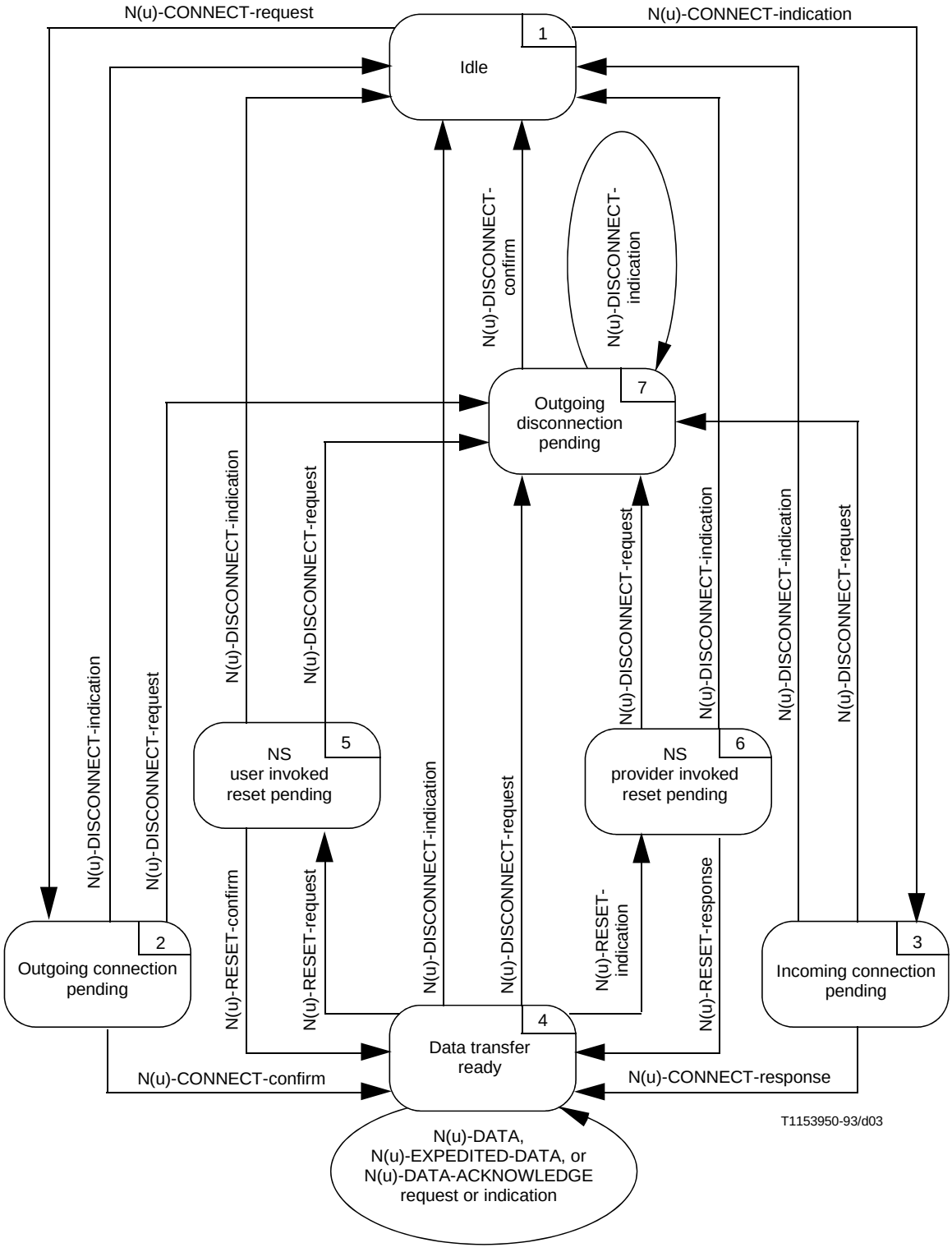

FIGURE 3/Q.923

State transition diagram for sequences of primitives at a network connection endpoint of the U-plane Sub-N-Layer [N(u)C endpoint] for ISDN U-plane Sub-N-Service

The state numbers used in the state transition diagram are structured as follows:

state NC, state N(c)C, state N(u)C and timer "DC" status.

This structure identifies individually the state at NC, N(c)C, N(u)C and if timer "DC" is running ("0" indicates not running, "1" indicates running), if the SCF state machine is in a particular state.

The timer "Disconnect Control" (DC) makes provision that the connection within the C-plane is released after completion of connection release within the U-plane (avoidance premature release of the connection within the C-plane). This timer is required because according to Recommendation X.213 [2] network service definition, NC release is an unconfirmed service.

In the diagram:

a) With the exception of the primitives N-EXPEDITED-DATA, N-DATA or N-DATA-ACKNOWLEDGE-request or N(u)-EXPEDITED-DATA, N(u)-DATA or N(u)-DATA-ACKNOWLEDGE-indication while in state 4.4.4.0, a primitive which is not shown as resulting in a transition from one state to a different state is not permitted in that state.

b) The labelling of the states 5.4.5.0 and 6.4.6.0 indicates the party which started the local interaction, and does not necessarily reflect the value of the originator parameter in the associated N(u)-RESET-indication primitive which indicates that state 6.4.6.0 has been entered, since the originator could be the peer NS user.

c) It is assumed that the primitives passed between layers are implemented by a "first in first out" queue without synchronization mark objects. Therefore, collisions between the NS user primitives request or response and the NS provider primitives indication or confirm may occur. These collisions do not harm the proper operation of the layer interface. They are not shown in the diagram, since their occurrence depends on implementation. The various possible collision situations are explained in the Notes to Table 2 (see clause 7).

d) The state 1.1.1.0 reflects the absence of an NC. It is the initial and final state of any sequence, and once it has been re-entered, the NC is released. Once state 4.4.4.0 has been left, not entering states 5.4.5.0 or 6.4.6.0, there is no return possibility and state 1.1.1.0 has to be entered.

6.4.2 Combined state transition diagram for SCF option 2 in case of ISDN U-plane Sub-N-Service

The state transition diagram defined in this subclause is the combination of the state transition diagrams according to 6.1, 6.2 and 6.3.2. The possible overall sequences of primitives at NC, N(c)C and N(u)C endpoints for SCF option 2 and their interrelationship are defined in the state transition diagram, Figure 5. The state transition diagram individually applies to a triple of network connection endpoints {NC, N(c)C, N(u)C} associated with an NC. A suitable mapping has to make provision that an association is established between the Connection Endpoint Suffixes (CES) which are members of a particular triple. The primitives which cause a state transition are:

a) N-CONNECT-request;

b) N-CONNECT-response;

c) N-DISCONNECT-request;

d) N-RESET-request;

e) N-RESET-response;

f) N(c)-CONNECT-indication;

g) N(c)-CONNECT-confirm;

h) N(c)-DISCONNECT-indication;

i) N(u)-CONNECT-indication;

j) N(u)-CONNECT-confirm;

k) N(u)-DISCONNECT-indication;

l) N(u)-RESET-indication;

m) N(u)-RESET-confirm;

n) N(u)-DISCONNECT-confirm.

The state numbers used in the state transition diagram are structured as follows:

state NC, state N(c)C, state N(u)C and timer "DC" status.

This structure identifies individually the state at NC, N(c)C, N(u)C and if timer "DC" is running ("0" indicates not running, "1" indicates running), if the SCF state machine is in a particular state.

The timer "Disconnect Control" (DC) makes provision that the connection within the C-plane is released under exceptional conditions within the U-plane.

In the diagram:

a) With the exception of the primitives N-EXPEDITED-DATA, N-DATA or N-DATA-ACKNOWLEDGE-request or N(u)-EXPEDITED-DATA, N(u)-DATA or N(u)-DATA-ACKNOWLEDGE-indication while in state 4.4.4.0, a primitive which is not shown as resulting in a transition from one state to a different state is not permitted in that state.

b) The labelling of the states 5.4.5.0 and 6.4.6.0 indicates the party which started the local interaction, and does not necessarily reflect the value of the originator parameter in the associated N(u)-RESET-indication primitive which indicates that state 6.4.6.0 has been entered, since the originator could be the peer NS user.

c) It is assumed that the primitives passed between layers are implemented by a "first in first out" queue without synchronization mark objects. Therefore, collisions between the NS user primitives request or response and the NS provider primitives indication or confirm may occur. These collisions do not harm the proper operation of the layer interface. They are not shown in the diagram, since their occurrence depends on implementation. The various possible collision situations are explained in the Notes to Table 2 (see clause 7).

d) The state 1.1.1.0 reflects the absence of an NC. It is the initial and final state of any sequence, and once it has been re-entered, the NC is released. Once state 4.4.4.0 has been left, not entering states 5.4.5.0 or 6.4.6.0, there is no return possibility and state 1.1.1.0 has to be entered.

7 Synchronization and coordination function for C-plane and U-plane

For the provision of the NS, the Synchronization and Coordination Function (SCF) forms the upper boundary of the C- and U-protocol blocks, according to Recommendation I.320 [1].

The SCF consists of a state machine which performs the state changes as a result of the receipt of a primitive from the NS user, the N(c)S provider or the N(u)S provider, or the expiry of timer "Disconnect Control" (DC). The SCF state machine is defined in Table 2. It details the state transitions defined in the state transition diagrams according to Figures 4 and 5, and defines the primitives which will be issued if a state transition occurs. The SCF state machine does not handle Protocol Data Units (PDU) used by C or U-protocol blocks and parameters contained in primitives received at a connection endpoint are transparently passed to the concerned connection endpoint(s) by means of the appropriate primitive, if any.

The SCF state machine provides synchronization and coordination capabilities for different C-plane call control procedures and distinct U-plane Sub-N-Services, including confirmed N(u)C release. The desired SCF functionality can be selected by means of the predicates P1 and P2. A predicate is true if the description applies, otherwise it is false. The predicates P1 and P2 are defined as follows:

Name	Description
P1	NS user involved in call establishment within C-plane
P2	Confirmed release service within U-plane

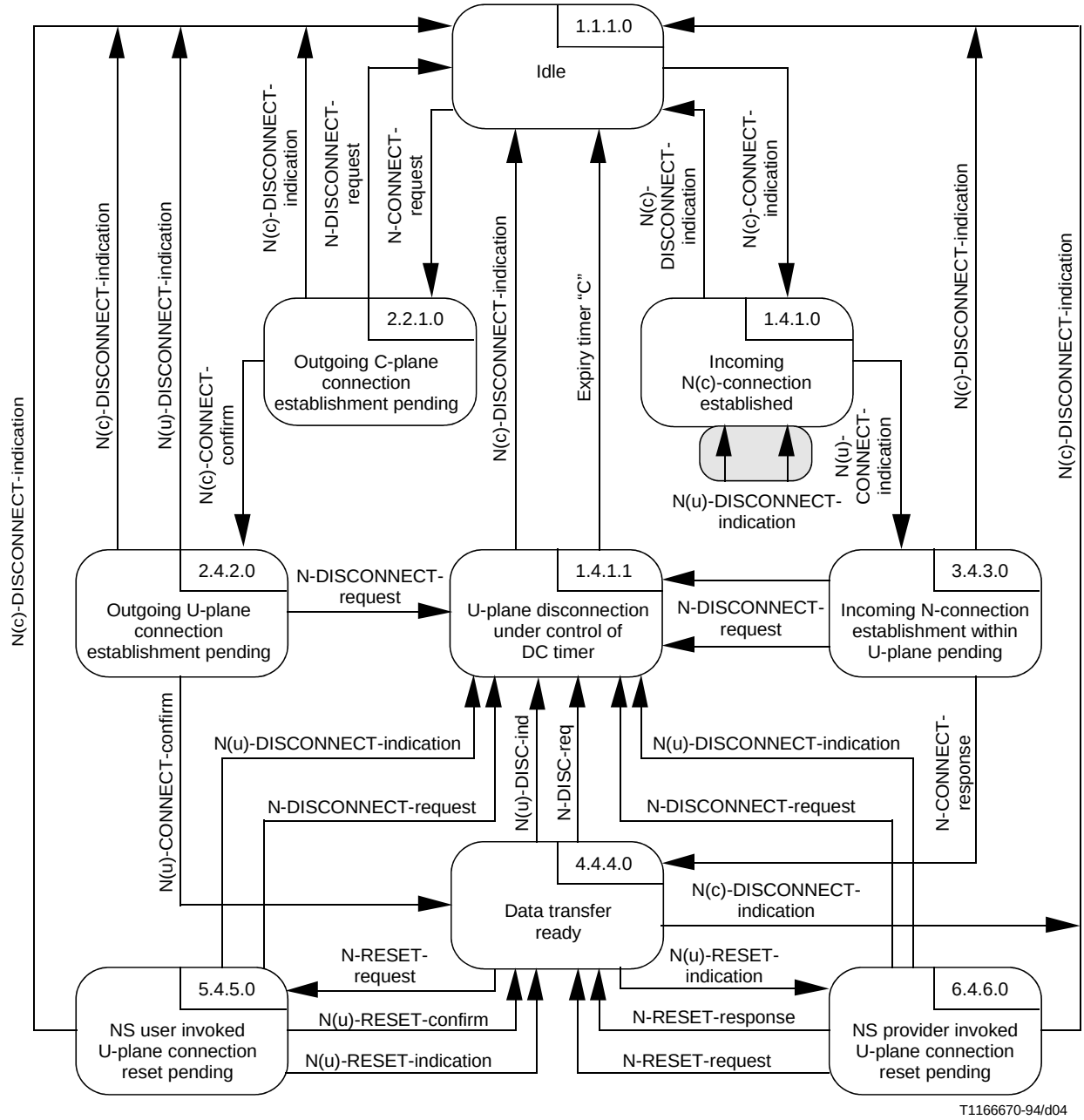

FIGURE 4/Q.923

State transition diagram for sequences of primitives at network connection endpoits NC, N(c)C and N(u)C for SCF option 1 and their interrelationship for Recommendation X.213 [2] type of U-plane Sub-N-Service

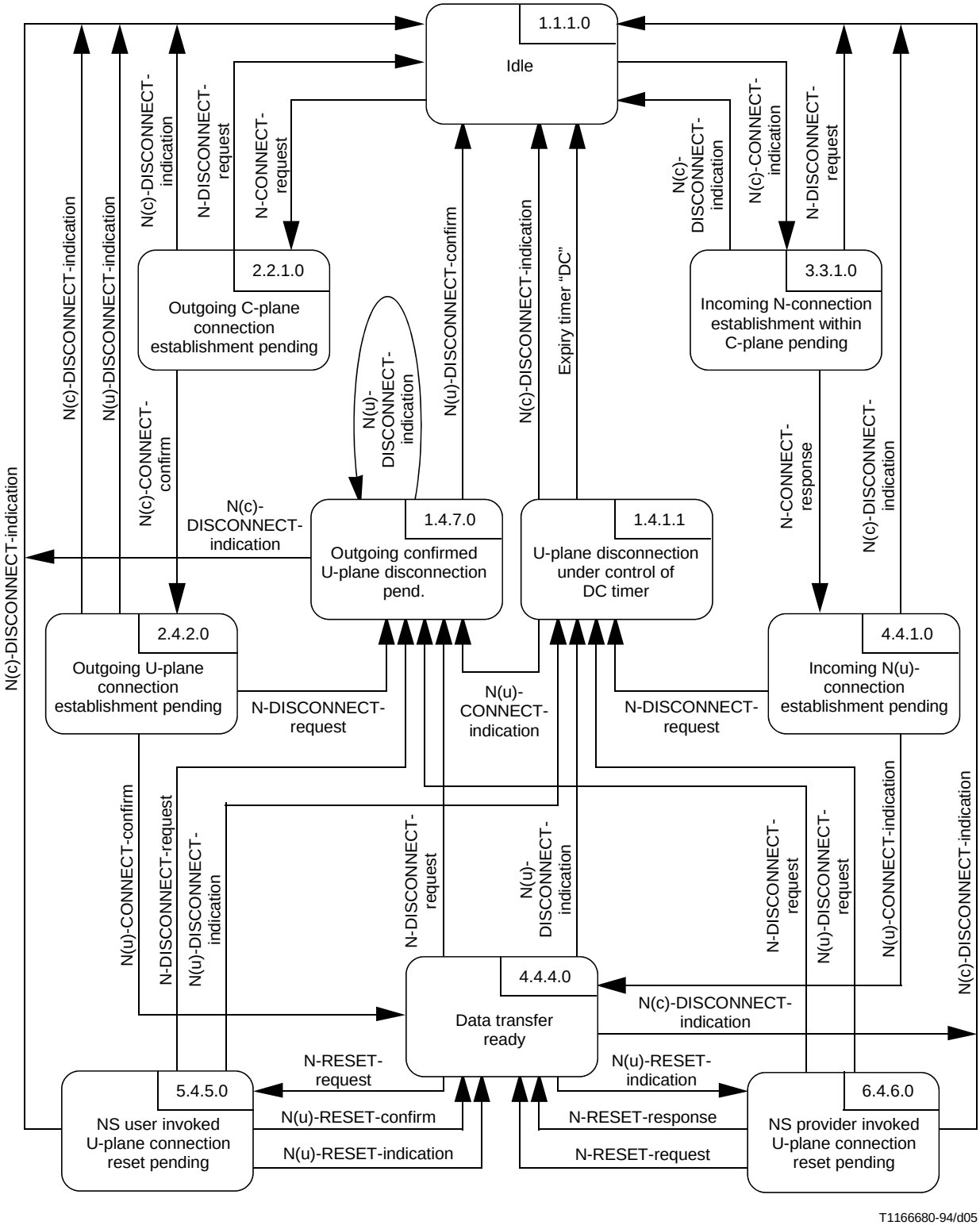

FIGURE 5/Q.923

State transition diagram for sequences of primitives at network connection endpoits NC, N(c)C and N(u)C and their interrelationship for ISDN U-plane Sub-N-Service

These predicates offer four combinations of C-plane call control procedures and U-plane Sub-N-Services. However, in this Recommendation, the combinations "P1 false AND P2 false" (see 6.4.1) and "P1 true AND P2 true" (see 6.4.2) are described in more detail.

The state transition diagram defined in Figure 4 is covered by an SCF state machine according to Table 2 (1 of 3) and (2 of 3). The state transition diagram defined in Figure 5 is covered by an SCF state machine according to Table 2 (1 of 3) and (3 of 3).

Table 2 (1 of 3) defines the common portion of all possible combinations. Table 2 (2 of 3) applies, if P1 is false. Table 2 (3 of 3) applies, if P1 is true or if P2 is true.

State names:

1.1.1.0 Idle

1.4.1.1 U-plane disconnection under control of DC timer

2.2.1.0 Outgoing C-plane Connection establishment pending

2.4.2.0 Outgoing U-plane Connection establishment pending

4.4.4.0 Date Transfer Ready

5.4.5.0 NS user invoked U-plane connection reset pending

6.4.6.0 NS provider invoked U-plane connection reset pending

1.4.1.0 Incoming N(c)-Connection established

3.4.3.0 Incoming N-Connection establishment within U-plane pending

3.3.1.0 Incoming N-Connection establishment within C-plane pending

4.4.1.0 Incoming N(u)-Connection establishment pending

1.4.7.0 Outgoing confirmed U-plane disconnection pending

8 Provision of C-plane Sub-N-Service

8.1 C-plane connection and U-plane connection

According to the model used in this Recommendation, there is a one-to-one relationship between a C-plane connection and a U-plane connection. The C-plane call control provides the capability to coordinate multiplexing within the U-plane. As an example, in case of layer 2 multiplexing into a single B-channel connection, the layer 3 C-plane call control makes provision that the B-channel is available as long as there is at least one U-plane layer 2 protocol entity active.

This concept ensures that SCF is not concerned with the management of various multiplexing possibilities which may be used for the support of Frame Mode Bearer Services (FMBS), Recommendation X.25-like layer 3 multiplexing, etc.

9 Application of SCF to Permanent Virtual Circuit (PVC) arrangement

9.1 Protocol stack for PVC arrangement

The SSCF may also be used in a PVC arrangement. In this case, the underlying C-plane Sub-N-Layer is replaced by an M-plane Sub-N-Layer which acts as a substitute. This relationship is illustrated in Figure 6. According to this figure, N(m)-primitives apply instead of N(c)-primitives.

TABLE 2/Q.923 (1A of 3)

State transition table of the Synchronization and Coordination Function (SCF) – Common part

State	Idle	U-plane disc. under control of DC timer	Outg. C-plane conn. establishm. pending	Outg. U-plane conn. establishm. pending	Data transfer ready	NS user invoked U-plane conn. reset pend.	NS provider invoked U-plane conn. reset pend.
	1.1.1.0	1.4.1.1	2.2.1.0	2.4.2.0	4.4.4.0	5.4.5.0	6.4.6.0
Event							
N-CONNECT-request	N(c)-CON.-request 2.2.1.0	|	|	|	|	|	|
N-CONNECT-response	– (Note 2)	(Note 14)	|	|	|	|	|
N-DIS-CONNECT-request	– (Note 3)	– (Note 15)	N(c)-DISC.-request 1.1.1.0	N(u)-DISC.-request not P2: start timer "DC" 1.4.1.1 P2: 1.4.7.0	N(u)-DISC.-request not P2: start timer "DC" 1.4.1.1 P2: 1.4.7.0	N(u)-DISC.-request not P2: start timer "DC" 1.4.1.1 P2: 1.4.7.0	N(u)-DISC.-request not P2: start timer "DC" 1.4.1.1 P2: 1.4.7.0
N-RESET-request	– (Note 4)	– (Note 16)	|	|	N(u)-RES-request 5.4.5.0	|	N(u)-RES.-response N-RES.-conf. 4.4.4.0 (Note 26)
N-RESET-response	– (Note 5)	– (Note 17)	|	|	|	|	N(u)-RES. response 4.4.4.0
N-DATA-request	– (Note 6)	– (Note 18)			N(u)-DATA-request –		(Note 27)

|	Impossible by the definition of the layer service.
/	Impossible by the definition of SCF internal events.
–	No state change.
n.a.	not applicable.
N-x-y	Issue primitive related to NC endpoint.
N(c)-x-y	Issue primitive related to N(c)C endpoint.
N(u)-x-y	Issue primitive related to N(u)C endpoint.
NC.N(c)C.N(u)C."DC"	Enter state NC=a AND N(c)C=b AND N(u)=c AND "DC" ("0" OR "1").
not Px: action	If predicate Px false then action (because not Px becomes true).
Px: action	If predicate Px true then action.

TABLE 2/Q.923 (1B of 3)

State transition table of the Synchronization and Coordination Function (SCF) – Common part

State	Idle	U-plane disc. under control of DC timer	Outg. C-plane conn. establishm. pending	Outg. U-plane conn. establishm. pending	Data transfer ready	NS user invoked U-plane conn. reset pend.	NS provider invoked U-plane conn. reset pend.
	1.1.1.0	1.4.1.1	2.2.1.0	2.4.2.0	4.4.4.0	5.4.5.0	6.4.6.0
Event							
N(c)-CONNECT indication	not P1: N(c)-CON.-response 1.4.1.0 P1: N-CON.-indication 3.3.1.0	|	|	|	|	|	|
N(c)-CONNECT-confirm	– (Note 7)	|	N(u)-CON.-request 2.4.2.0	|	|	|	|
N(c)-DIS-CONNECT-indication	– (Note 8)	stop timer "DC" 1.1.1.0	N-DISC.-indication 1.1.1.0	N-DISC. indication 1.1.1.0	N-DISC. indication N(u)-DISC.-request 1.1.1.0	N-DISC. indication N(u)-DISC.-request 1.1.1.0	N-DISC. indication N(u)-DISC.-request 1.1.1.0
N(c)-RESET-indication	– (Note 1)	– (Note 1)	|	– (Note 1	– (Note 1)	– (Note 1)	– (Note 1)
State	not P3: – (Note 9) P3: N(m)-CON.-request 1.2.3.0	N(u)-DISC.-request stop timer "DC" 1.4.7.0	|	|	|	|	|
N(u)-CONNECT-confirm	– (Note 9)	– (Note 19)	|	N-CON.-confirm 4.4.4.0	|	|	|
N(u)-DIS-CONNECT-indication	– (Note 10)	– (Note 20)	|	N-DISC.-indication N(c)-DISC.-request 1.1.1.0	N-DISC.-indication start timer "DC" 1.4.1.1	N-DISC.-indication start timer "DC" 1.4.1.1	N-DISC.-indication start timer "DC" 1.4.1.1
N(u)-RESET-indication	– (Note 11)	– (Note 21)	|	|	N-RES.-indication 6.4.6.0	N-RES.-confirm 4.4.4.0	|
N(u)-RESET-confirm	– (Note 12)	– (Note 22)	|	|	– (Note 24)	N-RES.-confirm 4.4.4.0	|
N(u)-DATA-indication	– (Note 13)	– (Note 23)	|	|	N-DATA-indication –	– (Note 25)	|
Expiry timer "DC"	/	N(c)-DISC.-request 1.1.1.0	/	/	/	/	/
N(u)-DIS-CONNECT-confirm	|	|	|	|	|	|	|

TABLE 2/Q.923 (2 of 3)

State transition table of the Synchronization and Coordination Function (SCF) – Part which applies if NS user is not involved in call establishment within C-plane (predicate not P1 TRUE)

State	Incom. N(c)-Connection established	Incom. N-Con. establ. within U-plane pend.
	1.4.1.0	3.4.3.0
Event		
N-CONNECT-request	|	|
N-CONNECT-response	|	N(u)-CON-response 4.4.4.0
N-DISCONNECT-request	|	N(u)-DISC.-request start timer "DC" 1.4.1.1
N-RESET-request	|	|
N-RESET-response	|	|
N-DATA-request	|	|
N(c)-CONNECT-indication	|	|
N(c)-CONNECT-confirm	|	|
N(c)-DISCONNECT-indication	1.1.1.0	N-DISC.-indication N(u)-DISC.-request 1.1.1.0
N(c)-RESET-indication	|	– (Note 1)
N(u)-CONNECT-indication	N-CON.-indication 3.4.3.0	|
N(u)-CONNECT-confirm	|	|
N(u)-DISCONNECT-indication	– |	N-DISC.-indication start timer "DC" 1.4.1.1
N(u)-RESET-indication	|	|
N(u)-RESET-confirm	|	|
N(u)-DATA-indication	|	|
Expiry timer "DC"	/	/
N(u)-DISCONNECT-confirm	n.a.	n.a.

TABLE 2/Q.923 (3 of 3)

State transition table of the Synchronization and Coordination Function (SCF) – Part which applies if NS user is involved in call establishment within C-plane (predicate P1 TRUE) or if confirmed release service is used within U-plane (predicate P2 TRUE)

State	Incom. N-Con. establ. within C-plane pend.	Incom. N(u)-Connection establishm. pending	Outg. conf U-plane disconnect. pending
	3.3.1.0	4.4.1.0	1.4.7.0
Event			
N-CONNECT-request	|	|	|
N-CONNECT-response	N(c)-CON.-response 4.4.1.0	|	|
N-DISCONNECT-request	N(c)-DIS.-request 1.1.1.0	start timer "DC" 1.4.1.1	|
N-RESET-request	|	N-RES.-conf. –	|
N-RESET-response	|	|	|
N-DATA-request	|	SAVE	|
N(c)-CONNECT-indication	|	|	|
N(c)-CONNECT-confirm	|	|	|
N(c)-DISCONNECT-indication	N-DISC.-indication 1.1.1.0	N-DISC.-indication 1.1.1.0	1.1.1.0
N(c)-RESET-indication	|	– (Note 1)	– (Note 1)
N(u)-CONNECT-indication	|	N(u)-CON.-response 4.4.4.0	|
N(u)-CONNECT-confirm	|	|	– (Note 19)
N(u)-DISCONNECT-indication	|	|	– (Note 20)
N(u)-RESET-indication	|	|	– (Note 21)
N(u)-RESET-confirm	|	|	– (Note 22)
N(u)-DATA-indication	|	|	– (Note 23)
Expiry timer "DC"	/	/	/
N(u)-DISCONNECT-confirm	|	|	N(c)-DISC-request 1.1.1.0

Normative Notes to Table 2:

1 Reset services provided by C-plane, if any, are not used and nothing happens at the N-layer interface as a result of the receipt of N(c)-RESET primitives.

Informative Notes to Table 2 to describe various collision situations:

2 Possible in case of a collision between N-DISCONNECT-indication and N-CONNECT-response. The N-DISCONNECT-indication was issued upon the receipt of an N(c)-DISCONNECT-indication while in state 3.4.3.0

3 Possible in case of a collision between N-DISCONNECT-indication and N-DISCONNECT-request. The N-DISCONNECT-indication was issued upon the receipt of an N(c)-DISCONNECT-indication while in state 2.2.1.0, 2.4.2.0, 3.4.3.0, 4.4.4.0, 5.4.5.0 or 6.4.6.0.

4 Possible in case of a collision between N-DISCONNECT-indication and N-RESET-request. The N-DISCONNECT-indication was issued upon the receipt of an N(c)-DISCONNECT-indication while in state 4.4.4.0 or 6.4.6.0. In the latter case there is a multiple collision which also involves an N-RESET-indication which was issued while in state 4.4.4.0 when entering state 6.4.6.0.

TABLE 2/Q.923 (3 of 3) (*continuation*)

5 Possible in case of a collision between N-DISCONNECT-indication and N-RESET-response. The N-DISCONNECT-indication was issued upon the receipt of an N(c)-DISCONNECT-indication while in state 6.4.6.0.

6 Possible in case of a collision between N-DISCONNECT-indication and N-DATA-request. The N-DISCONNECT-indication was issued upon the receipt of an N(c)-DISCONNECT-indication while in state 4.4.4.0 or 6.4.6.0. In the latter case there is a multiple collision which also involves an N-RESET-indication which was issued while in state 4.4.4.0 when entering state 6.4.6.0.

7 Possible in case of a collision between N(c)-DISCONNECT-request and N(c)-CONNECT-confirm. The N(c)-DISCONNECT-request was issued upon the receipt of an N-DISCONNECT-request while in state 2.2.1.0 or on expiry of timer "DC" while in state 1.4.1.1.

8 Possible in case of a collision between N(c)-DISCONNECT-request and N(c)-DISCONNECT-indication. The N(c)-DISCONNECT-request was issued upon the receipt of an N-DISCONNECT-request while in state 2.2.1.0 or on expiry of timer "DC" while in state 1.4.1.1.

9 Possible in case of C-plane error release and successful U-plane connection establishment. The error release occurred while in state 2.4.2.0 awaiting for N(u)-CONNECT-confirm, or while in state 1.4.1.0 awaiting for N(u)-CONNECT-indication.

10 Possible in case of a collision between N(u)-DISCONNECT-request and N(u)-DISCONNECT-indication. The N(u)-DISCONNECT-request was issued upon the receipt of an N(c)-DISCONNECT-indication while in state 3.4.3.0, 4.4.4.0, 5.4.5.0 or 6.4.6.0.

11 Possible in case of a collision between N(u)-DISCONNECT-request and N(u)-RESET-indication. The N(u)-DISCONNECT-request was issued upon the receipt of an N(c)-DISCONNECT-indication while in state 5.4.5.0.

12 Possible in case of a collision between N(u)-DISCONNECT-request and N(u)-RESET-confirm. The N(u)-DISCONNECT-request was issued upon the receipt of an N(c)-DISCONNECT-indication while in state 5.4.5.0.

13 Possible in case of a collision between N(u)-DISCONNECT-request and N(u)-DATA-indication. The N(u)-DISCONNECT-request was issued upon the receipt of an N(c)-DISCONNECT-indication while in state 4.4.4.0.

14 Possible in case of a collision between N-DISCONNECT-indication and N-CONNECT-response. The N-DISCONNECT-indication was issued upon the receipt of an N(u)-DISCONNECT-indication while in state 3.4.3.0.

15 Possible in case of a collision between N-DISCONNECT-indication and N-DISCONNECT-request. The N-DISCONNECT-indication was issued upon the receipt of an N(u)-DISCONNECT-indication while in state 2.4.2.0, 3.4.3.0, 4.4.4.0, 5.4.5.0 or 6.4.6.0.

16 Possible in case of a collision between N-DISCONNECT-indication and N-RESET-request. The N-DISCONNECT-indication was issued upon the receipt of an N(u)-DISCONNECT-indication while in state 4.4.4.0 or 6.4.6.0. In the latter case there is a multiple collison which also involves an N-RESET-indication which was issued while in state 4.4.4.0 when entering state 6.4.6.0.

17 Possible in case of a collision between N-DISCONNECT-indication and N-RESET-response. The N-DISCONNECT-indication was issued upon the receipt of an N(u)-DISCONNECT-indication while in state 6.4.6.0.

18 Possible in case of a collision between N-DISCONNECT-indication and N-DATA-request. The N-DISCONNECT-indication was issued upon the receipt of an N(u)-DISCONNECT-indication while in state 4.4.4.0 or 6.4.6.0. In the latter case there is a multiple collison which also involves an N-RESET-indication which was issued while in state 4.4.4.0 when entering state 6.4.6.0.

19 Possible in case of a collision between N(u)-DISCONNECT-request and N(u)-CONNECT-confirm. The N(u)-DISCONNECT-request was issued upon the receipt of an N-DISCONNECT-request while in state 2.4.2.0.

20 Possible in case of a collision between N(u)-DISCONNECT-request and N(u)-DISCONNECT-indication. The N(u)-DISCONNECT-request was issued upon the receipt of an N-DISCONNECT-request while in state 2.4.2.0, 3.4.3.0, 4.4.4.0, 5.4.5.0 or 6.4.6.0.

21 Possible in case of a collision between N(u)-DISCONNECT-request and N(u)-RESET-indication. The N(u)-DISCONNECT-request was issued upon the receipt of an N-DISCONNECT-request while in state 5.4.5.0.

22 Possible in case of a collision between N(u)-DISCONNECT-request and N(u)-RESET-confirm. The N(u)-DISCONNECT-request was issued upon the receipt of an N-DISCONNECT-request while in state 5.4.5.0.

23 Possible in case of a collision between N(u)-DISCONNECT-request and N(u)-DATA-indication. The N(u)-DISCONNECT-request was issued upon the receipt of an N-DISCONNECT-request while in state 4.4.4.0.

24 Possible in case of a collision between N(u)-RESET-request and N(u)-RESET-indication. The N(u)-RESET-indication was received while in state 5.4.5.0 awaiting N(u)-RESET-confirm. The N(u)-RESET-confirm may be received in state 4.4.4.0 which was entered upon receipt of N(u)-RESET-indication. If this happens depends on N(u) protocol block.

25 Possible in case of a collision between N(u)-RESET-request and N(u)-DATA-indication. The N(u)-RESET-request was issued upon the receipt of an N-RESET-request while in state 4.4.4.0.

26 Possible in case of a collision between N-RESET-indication and N-RESET-request. The N-RESET-indication was issued upon the receipt of an N(u)-RESET-indication while in state 4.4.4.0.

27 Possible in case of a collision between N-RESET-indication and N-DATA-request. The N-RESET-indication was issued upon the receipt of an N(u)-RESET-indication while in state 4.4.4.0.

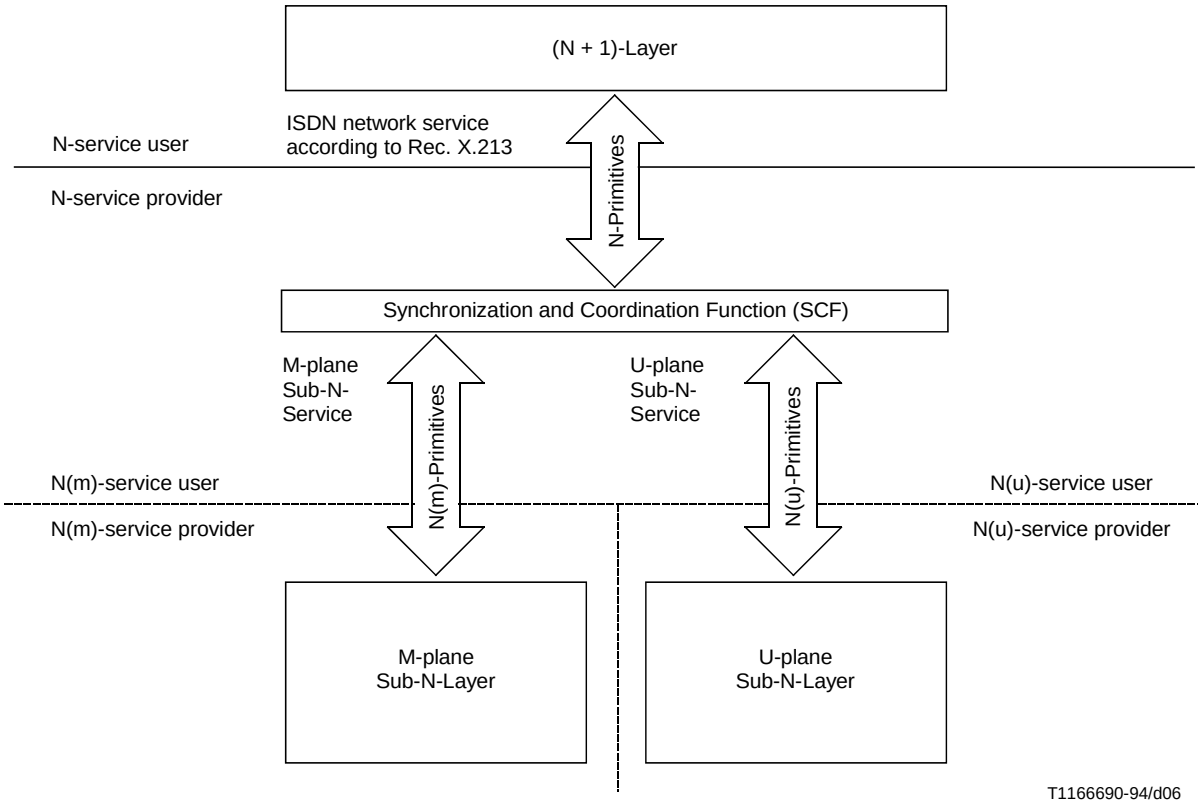

FIGURE 6/Q.923

Relationship of the network service to the services provided by M-plane Sub-N-Layer and U-plane Sub-N-Layer in a PVC arrangement

9.2 Sequence of primitives at N(m)C endpoint

The services provided by the M-plane are U-plane connection management up to the layer which is to be handled by M-plane connection management, based on M-plane capabilities. This may include a layer 1 connection only, e.g. a transparent B-channel, or also addresses to be used within the U-plane, such as DLCI for a layer 2 U-plane connection for the support of the Frame Mode Bearer Service (FMBS), or VPI/VCI in a B-ISDN environment. In order to provide these services, the M-plane has to have suitable connection management capabilities; however, this is not visible at the NC endpoint.

Table 3 is a summary of the N(m)S primitives and their parameters.

The N(m)S primitives defined in Table 3 impose requirements on the N(u)S primitives. Table 4 is a summary of the N(u)S primitives and their parameters.

The possible overall sequences of primitives at N(m)C endpoint are defined in the state transition diagram, Figure 7. In the diagram:

a) A primitive which is not shown as resulting in a transition from one state to a different state is not permitted in that state.

b) N(m)-DISCONNECT stands for either the request or the indication form of the primitive in all cases.

c) It is assumed that the primitives passed between layers are implemented by a “first in first out” queue without synchronization mark objects. Therefore collisions between the NS user primitives request or response and the NS provider primitives indication or confirm may occur. These collisions do not harm the proper operation of the layer interface. They are not shown in the diagram, since their occurrence depends on implementation.

d) The idle state (state 1) reflects the situation where the services offered by the management capability have not been invoked. It is the initial and final state of any sequence, and once it has been re-entered, the management capability is not involved in the N-connection anymore.

e) The U-plane ready state (state 4) reflects that the U-plane connection has been established up to the degree which is under control of the M-plane.

TABLE 3/Q.923

Summary of the Sub-N-Service primitives at the N(m)C endpoint [N(m)S primitives] and their parameters

Phase	Service	Primitive	Provision	Parameters
NC Establishment	Establishment	N(m)-CONNECT-request	M M UO UO UO UO	Called address Calling address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
		N(m)-CONNECT-confirm	M M UO UO UO UO	Called address Calling address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
NC release	Release	N(m)-DISCONNECT-request	M UO M	Reason NS-user-data Responding address
		N(m)-DISCONNECT-indication	M M	Reason Responding address

M Mandatory (Note 1).

UO Option within U-plane if pre-arranged (Note 2).

NOTES

1 The provision of this capability is making use of mandatory functionality within the U-plane which conveys the required information.

2 The peer-to-peer conveyance of these parameters depends on the capabilities of the U-plane.

9.3 Sequence of primitives at related NC, N(m)C and N(u)C endpoints

This subclause combines the state transition diagrams defined in 6.1, 9.2 and 6.3 into a single state transition diagram. This function is performed by the Synchronization and Coordination Function (SCF) which refers each state at each connection endpoint, i.e. NC, N(m)C and N(u)C, to those states of the two other connection endpoints to which it is related according to the valid sequences of primitives at the three connection endpoints. This relationship of the states at the three connection endpoints is defined in form of composed states in the generic form:

state NC, N(m)C, N(u)C.

The combined state transition diagram includes those primitives which cause a state transition in the composed state machine contained in the SCF. The primitives which are issued by the SCF as a result of a state transition are not shown.

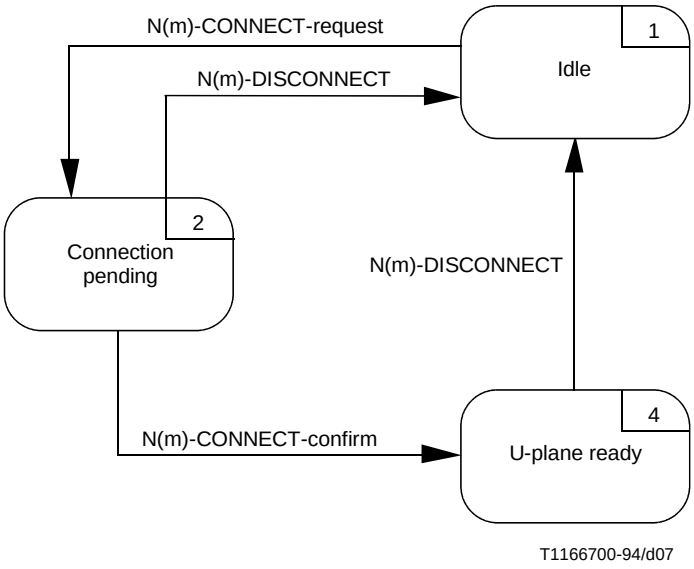

FIGURE 7/Q.923

State transition diagram for sequences of primitives at a network connection endpoint of the M-plane Sub-N-Layer [N(m)C endpoint] in a PVC arrangement

9.3.1 Combined state transition diagram for SCF in support of PVC

The state transition diagram defined in this subclause is the combination of the state transition diagrams according to 6.1, 9.2 and 6.3.2. The possible overall sequences of primitives at NC, N(m)C and N(u)C endpoints for SCF in support of PVC and their interrelationship are defined in the state transition diagram, Figure 8. The state transition diagram individually applies to a triple of network connection endpoints {NC, N(m)C, N(u)C} associated with an NC. A suitable mapping has to make provision that an association is established between the Connection Endpoint Suffixes (CES) which are members of a particular triple. The primitives which cause a state transition are:

a) N-CONNECT-request;

b) N-CONNECT-response;

c) N-DISCONNECT-request;

d) N-RESET-request;

e) N-RESET-response;

f) N(m)-CONNECT-confirm;

g) N(m)-DISCONNECT-indication;

h) N(u)-CONNECT-indication;

i) N(u)-CONNECT-confirm;

j) N(u)-DISCONNECT-indication;

k) N(u)-DISCONNECT-confirm;

l) N(u)-RESET-indication;

m) N(u)-RESET-confirm;

The state numbers used in the state transition diagram are structured as follows:

state NC, state N(m)C, state N(u)C and timer “DC” status.

This structure identifies individually the state at NC, N(m)C, N(u)C and if timer "DC" is running ("0" indicates not running, "1" indicates running), if the SCF state machine is in a particular state.

The timer "Disconnect Control" (DC) makes provision that the connection within the M-plane is released after completion of connection release within the U-plane.

TABLE 4/Q.923

Summary of the Sub-N-Service primitives at the N(u)C endpoint [N(u)S primitives] and their parameters for support of N(m)S primitives and their parameters

Phase	Service	Primitive	Provision	Parameters
NC Establishment	Establishment	N(u)-CONNECT-request	M M UO UO UO UO	Called address Calling address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
		N(u)-CONNECT-indication	M M UO UO UO UO	Called address Calling address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
		N(u)-CONNECT-response	M UO UO UO UO	Responding address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
		N(u)-CONNECT-confirm	M UO UO UO UO	Responding address Receipt confirmation selection Expedited data selection QOS-parameter set NS-user-data
NC release	Release	N(u)-DISCONNECT-request	M UO M	Reason NS-user-data Responding address
		N(u)-DISCONNECT-indication	M M UO M	Originator Reason NS-user-data Responding address
M Mandatory. UO Option within U-plane.				

In the diagram:

a) With the exception of the primitives N-EXPEDITED-DATA, N-DATA or N-DATA-ACKNOWLEDGE-request or N(u)-EXPEDITED-DATA, N(u)-DATA or N(u)-DATA-ACKNOWLEDGE-indication while in state 4.4.4.0, a primitive which is not shown as resulting in a transition from one state to a different state is not permitted in that state.

b) The labelling of the states 5.4.5.0 and 6.4.6.0 indicates the party which started the local interaction, and does not necessarily reflect the value of the originator parameter in the associated N(u)-RESET-indication primitive which indicates that state 6.4.6.0 has been entered, since the originator could be the peer NS user.

c) It is assumed that the primitives passed between layers are implemented by a “first in first out” queue without synchronization mark objects. Therefore, collisions between the NS user primitives request or response and the NS provider primitives indication or confirm may occur. These collisions do not harm the proper operation of the layer interface. They are not shown in the diagram, since their occurrence depends on implementation. The various possible collision situations are explained in the Notes to Table 2 (see clause 7);

d) The state 1.1.1.0 reflects the absence of an NC. It is the initial and final state of any sequence, and once it has been re-entered, the NC is released. Once state 4.4.4.0 has been left, not entering states 5.4.5.0 or 6.4.6.0, there is no return possibility and state 1.1.1.0 has to be entered.

9.4 Synchronization and coordination function in support of PVC

The synchronization and coordination function (SCF) is specified in clause 7, where Table 2 specifies the state machine. Table 5 specifies how the functionality of the state machine specified in Table 2 is to be enhanced in order to support PVC. Tables 2 and 5 detail the state transitions defined in the state transition diagrams according to Figure 8.

In addition to the two predicates P1 and P2 defined in clause 7 as follows:

Name	Description
P1	NS user involved in call establishment within C-plane
P2	Confirmed release service within U-plane,

the following additional predicate is defined:

P3	PVC arrangement.

In a PVC arrangement the predicate P1 is not applicable since the N(m)-CONNECT-indication primitive does not occur, see Figure 7.

In a PVC arrangement the combination “P2 true and P3 true” applies and an additional state is defined:

1.2.3.0	Incoming N-Connection establishment within M-plane pending.

State 1.2.3.0 is entered on N(u)-CONNECT-indication while in state 1.1.1.0 if predicate P3 is TRUE.

The following states apply to PVC arrangements:

Table 2 (1 of 3)	1.1.1.0, 1.4.1.1, 2.2.1.0, 2.4.2.0, 4.4.4.0, 5.4.5.0, 6.4.6.0
Table 2 (2 of 3)	3.4.3.0
Table 2 (3 of 3)	1.4.7.0
Table 5	1.2.3.0

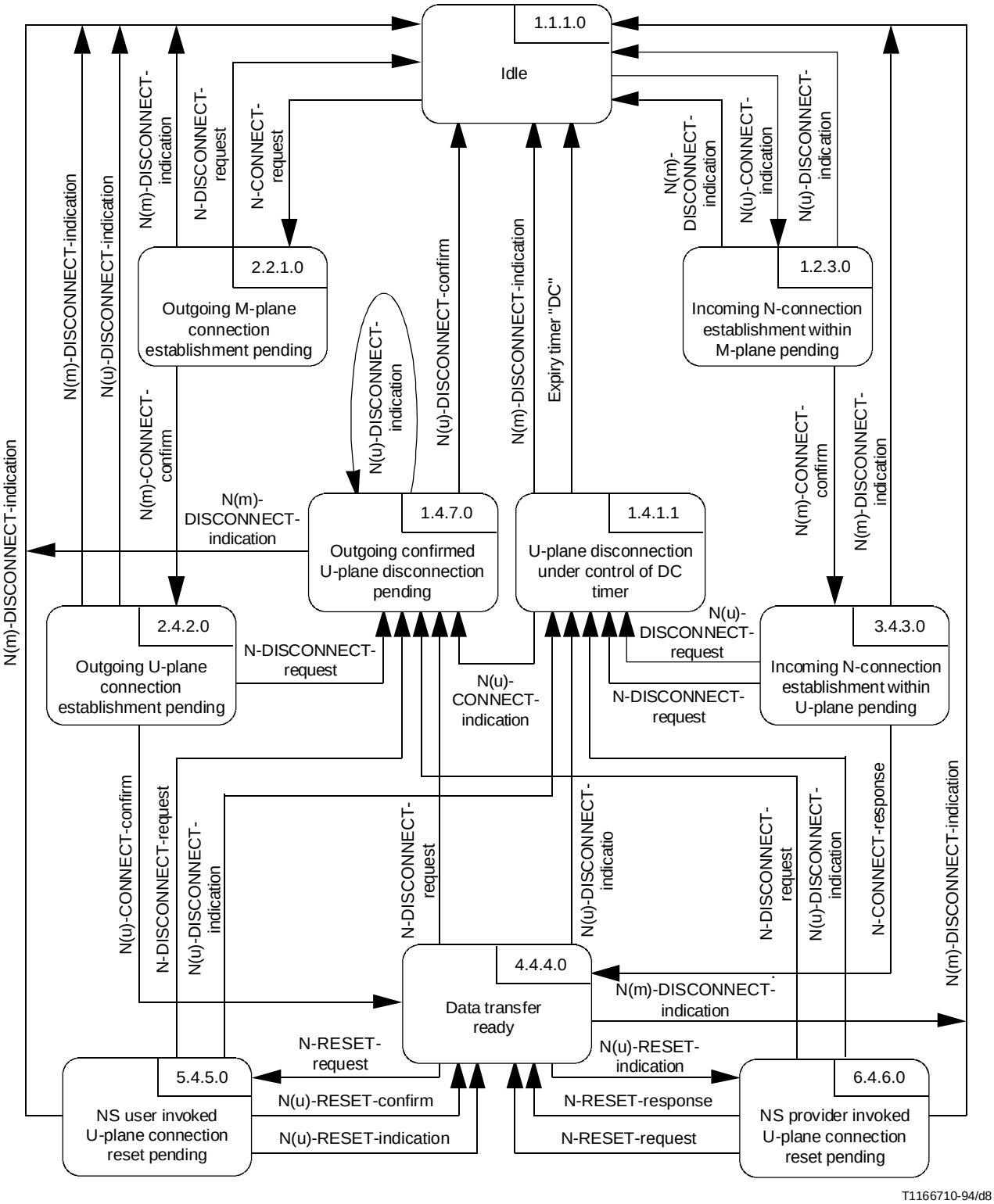

FIGURE 8/Q.923

State transition diagram for sequences of primitives at network connection andpoints NC, N(m)C and N(u)C in a PVC arragement and their interrelationship for ISDN U-plane Sub-N-Service

TABLE 5/Q.923 (1A of 1)

State transition table of the Synchronization and Coordination Function (SCF) – Part which applies to Permanent Virtual Circuit (PVC) arrangements (predicate P3 TRUE)

State	Incom. N-Con. establ. within M-plane pend.
	1.2.3.0
Event	/
N-CONNECT-request	|
N-CONNECT-response	|
N-DISCONNECT-request	|
N-RESET-request	|
N-RESET-response	|
N-DATA-request	|
N(m)-CONNECT-indication	|
N(m)-CONNECT-confirm	N-CON.-indication 3.4.3.0
N(m)-DISCONNECT-indication	N(u)-DISC.-request 1.1.1.0
N(m)-RESET-indication	|
NOTE – This part applies to PVC in combination with Table 2 (1A of 3), Table 2 (2 of 3) state 3.4.3.0, and Table 2 (3 of 3) state 1.4.7.0.	

TABLE 5/Q.923 (1B of 1)

State transition table of the Synchronization and Coordination Function (SCF) – Part which applies to Permanent Virtual Circuit (PVC) arrangements (predicate P3 TRUE)

State	Incom. N-Con. establ. within M-plane pend.
	1.2.3.0
Event	
N(u)-CONNECT-indication	|
N(u)-CONNECT-confirm	|
N(u)-DISCONNECT-indication	N(m)-DISC.-request 1.1.1.0
N(u)-RESET-indication	|
N(u)-RESET-confirm	|
N(u)-DATA-indication	|
Expiry timer "DC"	/
N(u)-DISCONNECT-confirm	|
NOTE – This part applies to PVC in combination with Table 2 (1B of 3), Table 2 (2 of 3) state 3.4.3.0, and Table 2 (3 of 3) state 1.4.7.0.	

Appendix I

Mapping between N(c)-primitive parameters and information elements of DSS 2 messages specified in Recommendation Q.2931

(This appendix does not form an integral part of this Recommendation)

This appendix provides one example of mapping specification which is required to supplement this Recommendation. Such mappings are placed between the C-plane Sub-N-Service boundary and call control at the user's side of the user network interface.

Depending on the environment in which the SCF is to be deployed the mapping may be defined to different call control procedures, e.g. Recomendations Q.931, Q.2931, etc., and for different connection establishment parameters, e.g. sets of quality of service parameters, etc.

The example in this appendix maps the primitive and their parameters specified in Recommendation X.213 [2] to messages and information elements specified in Recommendation Q.2931. (See Tables I.1 to I.3.)

TABLE I.1/Q.923

Mappings for ATM connection release phase

N(c)-primitives according to this Recommendation and their parameters	Messages according to Recommendation Q.2931 CS1 and referenced supplementary service Recommendations
PRIMITIVES: N(c)-CONNECT-request N(c)-CONNECT-indication N(c)-CONNECT-response N(c)-CONNECT-confirm	MESSAGES: SETUP (U → N) SETUP (N → U) CONNECT (U → N) CONNECT (N → U)
PARAMETERS: Called address Calling address Responding address Receipt confirmation selection Expedited data election QOS-parameter set: Throughput Transit delay Protection Priority NS-User-Data	INFORMATION ELEMENTS: Called party number Called party address Calling party number Calling party sub-address according to clause 8/Q.2951 Connected party number Connected party sub-address – – ATM traffic descriptor End-to-end transit delay – – User-to-user information according to clause 1/Q.2957
NOTES 1 The parameter, which could not be transferred on C-plane, should be transferred on U-plane. 2 Each parameter might be transferred on both C-plane and U-plane.	

TABLE I.2/Q.923

Mapping for ATM connection release phase

N(c)-primitives according to this Recommendation and their parameters	Messages according to Recommendation Q.2931 CS1 and referenced supplementary service Recommendations
PRIMITIVES: N(c)-DISCONNECT-request N(c)-DISCONNECT-indication	MESSAGES: RELEASE (U → N) RELEASE COMPLETE (U → N) RELEASE (N → U) RELEASE COMPLETE (N → U) RESTART (N → U)
PARAMETERS: Originator reason Responding address NS-User-Data	INFORMATION ELEMENTS: Cause Connected party number Connected party sub-address according to Recommendation Q.2957 User-to-user information
NOTES 1 The parameter, which could not be transferred on C-plane, should be transferred on U-plane. 2 Each parameter might be transferred on both C-plane and U-plane..	

TABLE I.3/Q.923

Mapping of throughout QOS sub-parameters to Q.2931 messages and the ATM traffic descriptor information element

N(c)-primitives according to this Recommendation and their parameters		Messages according to Recommendation Q.2931 CS1	
Sub-parameter	Primitive	ATM traffic descriptor information element	Message
Target	N(c)-CONNECT-request	Peak cell rate	SETUP (U → N)
Lowest quality acceptable	N(c)-CONNECT-request		
Available	N(c)-CONNECT-indication	Peak cell rate	SETUP (N → U)
Lowest quality acceptable	N(c)-CONNECT-indication		
Selected	N(c)-CONNECT-response		
Selected	N(c)-CONNECT-confirm		

NOTES

1 The parameter, which could not be transferred on C-plane, should be transferred on U-plane.

2 Each parameter might be transferred on both C-plane and U-plane.