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**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")

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## FOREWORD

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## 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**

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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.

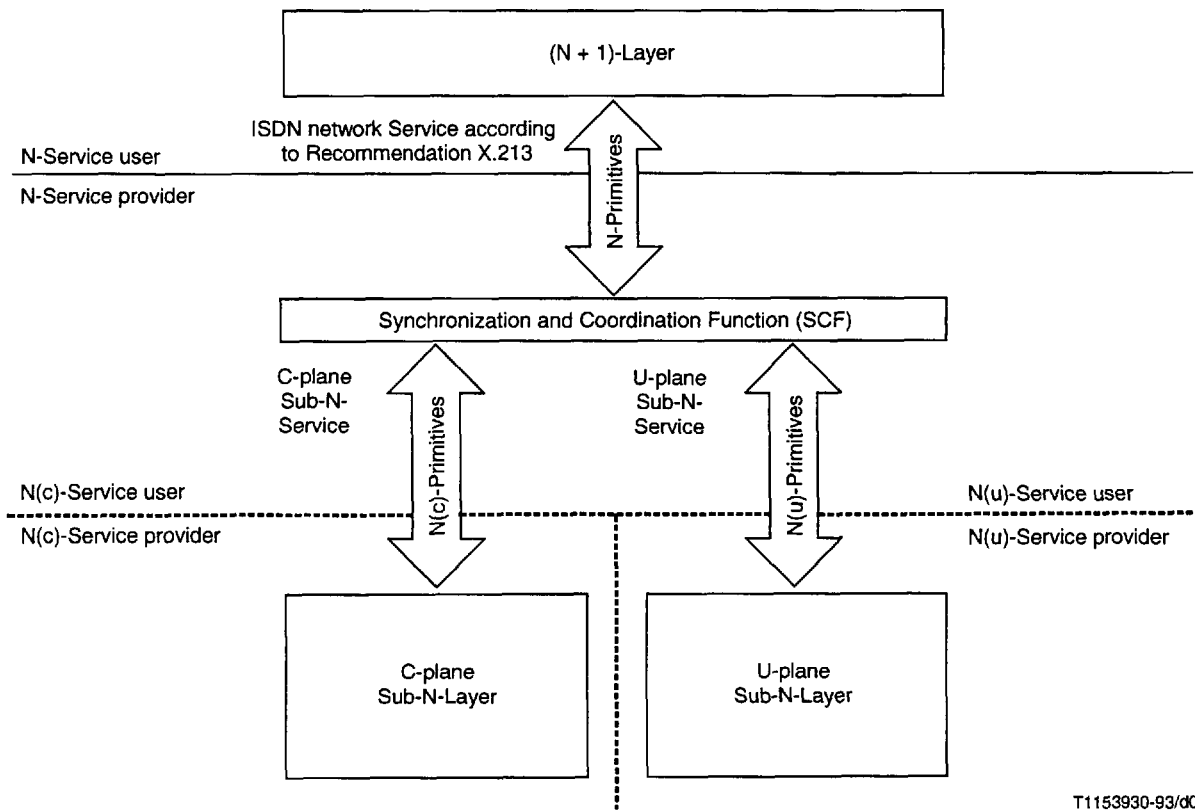


FIGURE 1/Q.923  
 Relationship of the network service to the services provided by C-plane Sub-N-Layer and U-plan Sub-N-Layer

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<br>M<br>UO<br>UO<br>UO<br>CO | Called address<br>Calling address<br>Receipt confirmation selection<br>Expedited data selection<br>QOS-parameter set<br>NS-user-data |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               | N(c)-CONNECT-indication    | M<br>M<br>UO<br>UO<br>UO<br>CO | Called address<br>Calling address<br>Receipt confirmation selection<br>Expedited data selection<br>QOS-parameter set<br>NS-user-data |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               | N(c)-CONNECT-response      | M<br>UO<br>UO<br>UO<br>CO      | Responding address<br>Receipt confirmation selection<br>Expedited data selection<br>QOS-parameter set<br>NS-user-data                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               | N(c)-CONNECT-confirm       | M<br>UO<br>UO<br>UO<br>CO      | Responding address<br>Receipt confirmation selection<br>Expedited data selection<br>QOS-parameter set<br>NS-user-data                |
| NC release                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Release       | N(c)-DISCONNECT-request    | M<br>CO<br>M                   | Reason<br>NS-user-data<br>Responding address                                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               | N(c)-DISCONNECT-indication | M<br>M<br>CO<br>M              | Originator<br>Reason<br>NS-user data<br>Responding address                                                                           |
| <div>M    Mandatory (Note 1).</div> <div>CO   Option within C-plane (Note 2).</div> <div>UO   Option within U-plane (Note 3).</div> <div>NOTES</div> <div>1    The provision of this capability may require the support of supplementary services.</div> <div>2    The support of these parameters depends on the capabilities of the signalling systems for C-plane call control.</div> <div>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.</div> |               |                            |                                |                                                                                                                                      |

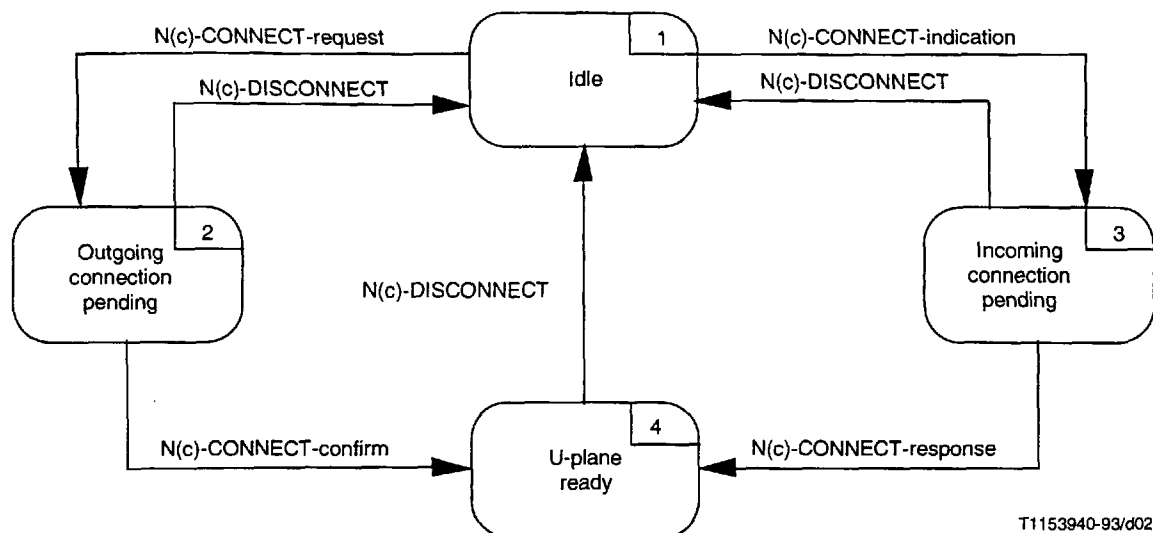


FIGURE 2/Q.923

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.