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Network-specific data protocol stacks for multimedia conferencing

ITU-T Recommendation T.123

ITU-T Recommendation T.123

Network-specific data protocol stacks for multimedia conferencing

(revised in 1999)

Summary

ITU-T Recommendation T.123 specifies network-specific aspects of the T.120-series data protocols for multimedia conferencing. The networks currently identified are ISDN, CSDN, PSDN, PSTN, B-ISDN, and LAN. Communication profiles are specified which provide reliable point-to-point connections between a terminal and a multipoint control unit, between pairs of terminals or between pairs of MCUs. In some cases, a lower protocol layer allows the multiplexing of audio and video signals in addition to data connections. In other cases, separate calls, over the same or a different network, may be established to carry audio or video signals.

In addition, Annex B specifies a protocol that may be used to negotiate connection services beyond reliable data transfer. This protocol also provides for the use of alias address lists when making a connection. Alias lists will allow proxy services for T.120 communications to be created and used.

This revised version of ITU-T Recommendation T.123 introduces a number of clarifications to the previous version.

Source

ITU-T Recommendation T.123 was approved on 13 January 2007 by ITU-T Study Group 16 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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ITU-T Recommendation T.123

Network-specific data protocol stacks for multimedia conferencing

(revised in 1999)

1 Scope

This Recommendation, which defines protocol stacks for terminals and MCUs, specifies network-specific aspects of the T.120 protocol suite in the form of profiles for each network identified. Each profile specifies a set of protocols that extend to layer 4 of the OSI reference model.

The rationale for this Recommendation is as follows: audiographic and video conferencing are intended to form part of the repertoire of ISDN services. Teleconferencing via ISDN involves the integration of multiple media (audio, video and data) in a connection, which may be the aggregate of a number of physical channels. The provision of these services is not, however, limited to the ISDN, and a range of other network scenarios is identified. For instance, CSDN may provide a similar, though less flexible, service to that of ISDN, and PSTN may provide a service that, though limited in performance, is more readily available. Teleconferencing may also be extended over PSDN and B-ISDN. LANs may provide conferencing locally within an enterprise or a means of access to wide area networks.

1.1 Networks identified

Network-specific profiles are defined for ISDN, CSDN, PSDN and PSTN, as required by [ITU-T F.702]. The scope of this Recommendation also includes B-ISDN and LAN.

1.2 Audio and video signals

The handling of audio and video signals in a multimedia conference is not part of this Recommendation, other than the possibility of their multiplexed transport over the same connection in some cases.

1.3 ISDN call set-up

Examples of ISDN call set-up procedures for the audiographic teleconference are given in Appendix I. These procedures illustrate:

- a) the use of ISDN information elements;
- b) coordination of the D-channel and the B-channel;
- c) the phases of connection establishment;
- d) interworking with telephone services.

2 References

The following ITU-T 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; 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. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T F.702] ITU-T Recommendation F.702 (1996), *Multimedia conference services*.
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- [ITU-T H.223] ITU-T Recommendation H.223 (2001), *Multiplexing protocol for low bit rate multimedia communication*.
- [ITU-T H.230] ITU-T Recommendation H.230 (2004), *Frame-synchronous control and indication signals for audiovisual systems*.
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- [ITU-T H.310] ITU-T Recommendation H.310 (1998), *Broadband audiovisual communication systems and terminals*.
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- [ITU-T I.320] ITU-T Recommendation I.320 (1993), *ISDN protocol reference model*.
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- [ITU-T I.431] ITU-T Recommendation I.431 (1993), *Primary rate user-network interface – Layer 1 specification.*
- [ITU-T I.432.1] ITU-T Recommendation I.432.1 (1999), *B-ISDN user-network interface – Physical layer specification: General characteristics.*
- [ITU-T I.432.2] ITU-T Recommendation I.432.2 (1999), *B-ISDN user-network interface – Physical layer specification: 155 520 kbit/s and 622 080 kbit/s operation.*
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- [ISO/IEC 7776] ISO/IEC 7776:1995, *Information technology – Telecommunications and information exchange between systems – High-level data link control procedures – Description of the X.25 LAPB-compatible DTE data link procedures.*
- [ISO/IEC 8208] ISO/IEC 8208:2000, *Information technology – Data communications – X.25 Packet Layer Protocol for Data Terminal Equipment.*
- [ISO/IEC 8802] ISO/IEC TR 8802-1:2001, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks specific requirements – Part 1: Overview of Local Area Network Standards.*

3 Definitions

This Recommendation uses the following terms defined in [ITU-T F.700]:

- Audiographic conference service;
- Multipoint control unit.

This Recommendation uses the following terms defined in [ITU-T I.320]:

- Control plane;
- User plane.

This Recommendation uses the following term defined in [ITU-T Q.920]:

- Data link connection identifier.

This Recommendation uses the following term defined in [ITU-T Q.922]:

- Synchronization and convergence function.

This Recommendation uses the following term defined in [ITU-T V.7]:

- Start-stop transmission.

This Recommendation uses the following term defined in [ITU-T X.213] and [ITU-T X.214]:

- Quality of Service.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AAL	ATM Adaptation Layer
AL	Adaptation Layer
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband Integrated Services Digital Network
CPCS	Common Part Convergence Sublayer

CSDN	Circuit Switched Data Network
DCE	Data Circuit-terminating Equipment
DLCI	Data Link Connection Identifier
DLSAP	Data Link Service Access Point
DTE	Data Terminal Equipment
FCS	Frame Check Sequence
ISDN	Integrated Services Digital Network
LAN	Local Area Network
MCS	Multipoint Communication Service
MCSAP	Multipoint Communication Service Access Point
MCU	Multipoint Control Unit
MLP	Multi-Layer Protocol
NSAP	Network Service Access Point
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
PES	Packetized Elementary Stream
PhSAP	Physical Service Access Point
PSDN	Packet Switched Data Network
PSTN	Public Switched Telephone Network
QoS	Quality of Service
SCF	Synchronization and Convergence Function
SDU	Service Data Unit
TPDU	Transport Protocol Data Unit
TSAP	Transport Service Access Point
UNERM	Unacknowledged Non-Error Recovery Mode
VC	Virtual Channel

5 Multipoint configuration

A multipoint configuration is created from point-to-point connections between three or more terminals and MCUs. Figure 1 shows a typical configuration where terminals are connected in a multipoint star around each MCU. It also shows how MCUs may be interconnected to form a larger conference.

Figure 2 shows the framework of the T.120 protocol suite. This Recommendation defines the network-specific protocols in any direct connection between terminal and MCU, between two terminals, or between two MCUs.

The point-to-point connections to a single MCU need not have identical communication profiles. Operation of the MCS protocol layer supports communication across different networks.

If two terminals lack a common profile, they cannot be connected directly to one another. In that case, an MCU may serve as an intermediary making communication possible. This is a special example of multipoint configuration.

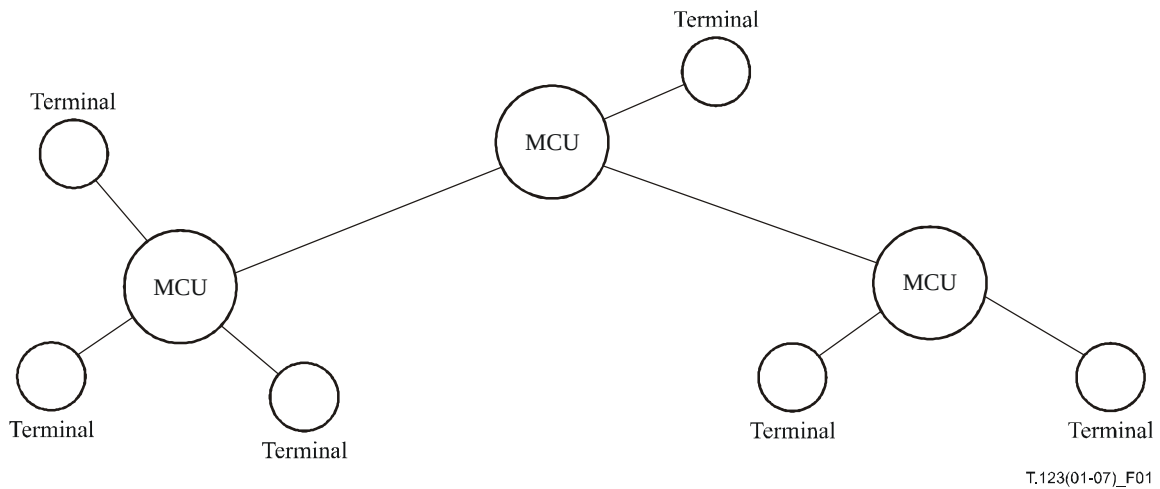


Figure 1 – Typical multipoint configuration

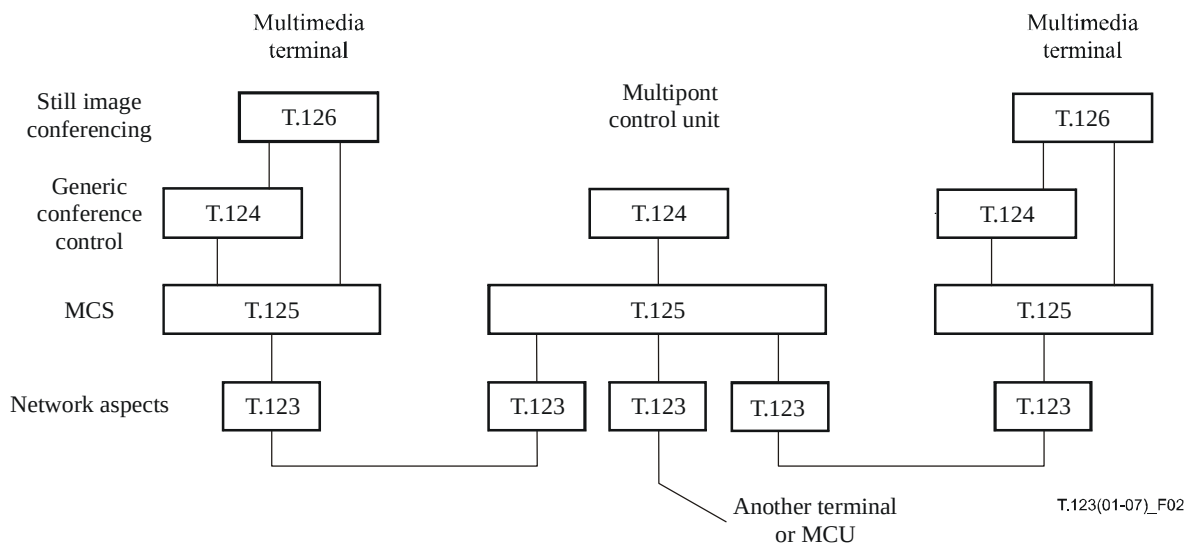


Figure 2 – Framework of the T.120 protocol suite

6 Profile overview

The general structure of the network-specific profiles is shown in Figure 3. Profiles are defined in detail in the following clauses.

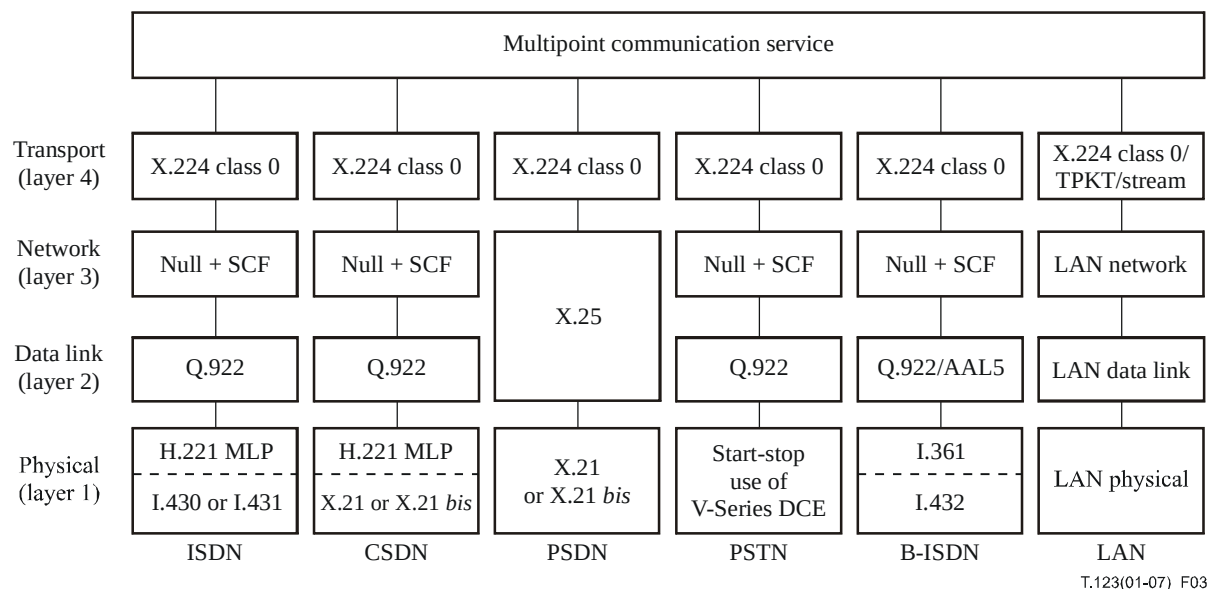


Figure 3 – Basic profiles general structure

NOTE 1 – The use of [ITU-T Q.922] over ISDN does not imply the use of a frame relay bearer service. [ITU-T Q.922] is used to enhance the quality of service provided by the physical layer of an ISDN, CSDN, PSTN, or B-ISDN. This Recommendation exploits the error recovery mechanisms of Q.922 multiframe acknowledged mode for operation of one or more data links over a point-to-point connection provided by the corresponding network.

The service that MCS requires from lower layers is the reliable, sequential, flow-controlled transfer of data units of unlimited size. One MCS connection consists of between one and four transport connections. The number depends on how many MCS data transfer priorities are implemented distinctly.

Multiple transport connections are derived from a point-to-point connection over a specific network by multiplexing in some lower protocol layer. This occurs at layer 2 for those cases where [ITU-T Q.922] is used and at layer 3 where [ITU-T X.25] or a LAN protocol is used.

Figure 4 shows the location of an MCS provider in the OSI reference model. An MCS provider exchanges MCS protocol data units with remote MCS providers. For this purpose, it uses transport-layer services. An MCS provider communicates with MCS users through an MCSAP by means of the MCS primitives defined in [ITU-T T.122].

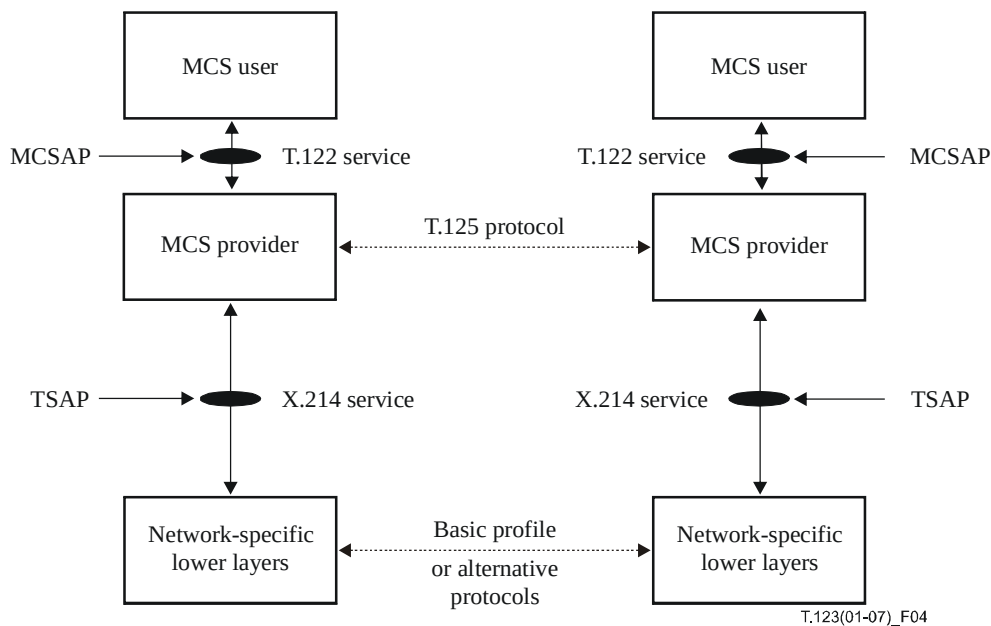


Figure 4 – Location of an MCS provider in the OSI reference model

To simplify the address information that must be supplied when establishing an MCS connection, it is recommended that terminals and MCUs be administered so that null NSAP and TSAP selectors will resolve to a default MCS provider at the destination system.

This does not preclude the possibility that a specific selector may be required to reach an MCS provider in a particular context. This may be the case, for example, if the data connection is to be associated with an audio or video connection that is established independently. It may also be the case if the MCS connection is to join a conference hosted in one partition of a large MCU. Ideally, the specific selector to be used will be communicated dynamically through some prior exchange.

NOTE 2 – An NSAP selector may occur in the domain-specific part of an NSAP address. The format for this is not standardized.

NOTE 3 – In each of the profiles specified here, the transport layer protocol is [ITU-T X.224]. It conveys TSAP selectors as TSAP-ID parameters of connection establishment TPDU.

NOTE 4 – Annex B specifies the profiles that shall be used when establishing T.120 extended transport connections.

7 Basic profiles

When call set-up protocols or audio and video are shown in the profiles that follow, it is only to aid understanding. They are not a normative part of this Recommendation.

7.1 ISDN basic profile

Figure 5 defines the ISDN basic profile.

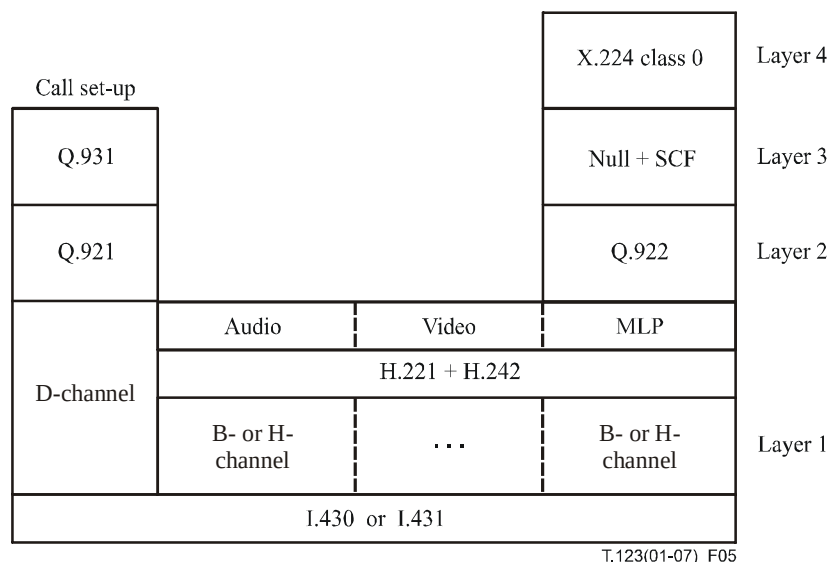


Figure 5 – ISDN basic profile

Layer 4

- X.224.
- Class 0 preferred, no alternative class.
- Maximum TPDU size shall not exceed layer 2 parameter N201.

Layer 3

- User plane: null (no extra protocol during data transfer).
- Control plane: SCF as specified in clause 9.

Layer 2

- Q.922.
- Protocol parameters and options as specified in clause 10, Q.922 protocol parameters and options.

Layer 1

Sublayer formed by H.221 MLP channels:

- As specified in clause 12, Physical sublayer formed by H.221 MLP channels.

Sublayer formed by ISDN:

- 1-6 B-channels, or 1-5 H0-channels, or 1 H1-channel.
- Unrestricted digital information, optionally with tones and announcements.
- B-channels may be rate-adapted to 56 kbit/s for restricted networks.
- D-channel is used for network signalling only, not for user data.

NOTE – This Recommendation does not specify call set-up in the ISDN (although possible scenarios are illustrated in Appendix I). The SCF shown here operates only in the MLP channel, after ISDN call set-up and H.242 mode switching have occurred.

7.2 CSDN basic profile

Figure 6 defines the CSDN basic profile. Layers above H.221 are identical to the ISDN basic profile.

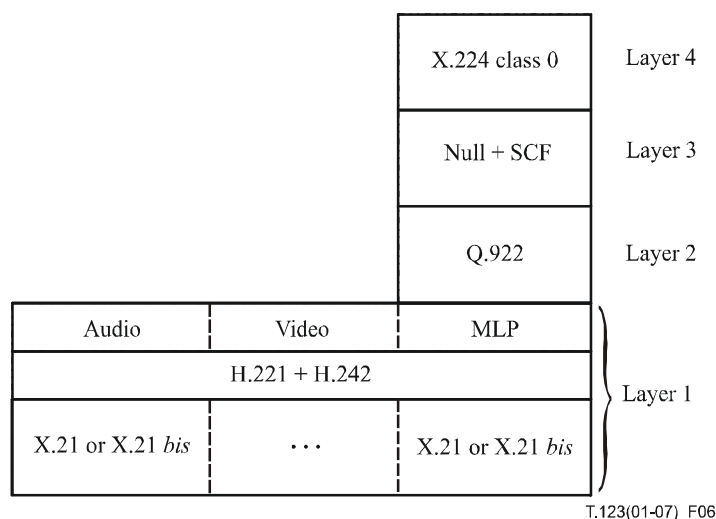


Figure 6 – CSDN basic profile

Layer 4

- As specified in clause 7.1, ISDN basic profile.

Layer 3

- As specified in clause 7.1, ISDN basic profile.

Layer 2

- As specified in clause 7.1, ISDN basic profile.

Layer 1

Sublayer formed by H.221 MLP channels:

- As specified in clause 12, physical sublayer formed by H.221 MLP channels.

Sublayer formed by CSDN:

- X.21 or X.21 *bis* for each circuit switched connection.
- Bit rates shall be a uniform multiple of 64 kbit/s or 56 kbit/s.

7.3 PSDN basic profile

Figure 7 defines the PSDN basic profile.

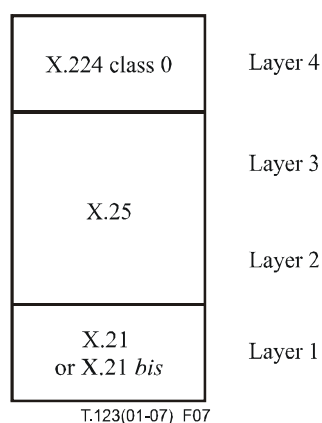


Figure 7 – PSDN basic profile

Layer 4

- X.224.
- Class 0 preferred, no alternative class.

Layer 3

- X.25 virtual call service.

Layer 2

- X.25 LAPB single link procedure.

Layer 1

- X.21 or X.21 *bis*.

7.4 PSTN basic profile

Figure 8 defines the PSTN basic profile. Layers above Q.922 are identical to the ISDN basic profile.

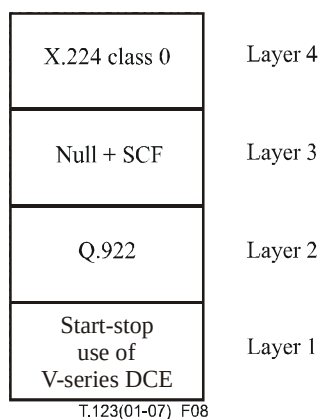


Figure 8 – PSTN basic profile

Layer 4

- As specified in 7.1, ISDN basic profile.

Layer 3

- As specified in 7.1, ISDN basic profile.

Layer 2

- Q.922.
- Protocol parameters and options as specified in clause 10, Q.922 protocol parameters and options.
- Modified frame transparency based on [ISO/IEC 3309] as specified in clause 11, Data link frame structure transparency for start-stop transmission.

Layer 1

- Start-stop transmission by DTE.
- When using V.14: one start bit, one stop bit, eight data bits, no parity.
- Any compatible V-series DCE operating over PSTN may be employed.
- The DTE and DCE may be logical functions that are not physically separated if integrated equipment can produce the same transmitted signals.

- The choice of V-series DCE is unrestricted and includes, for example, V.34, V.61 and V.70 modems, with optional use of V.42 and V.42 *bis*. Selection of a compatible operating mode may be assisted by V.8 or V.8 *bis*.

NOTE 1 – If the error control function of V.42 is activated, system parameters should be set to avoid adverse interaction with the error-correcting operation of Q.922. Important elements are the acknowledgement timer, the maximum number of octets in an information field, and the data forwarding conditions.

NOTE 2 – The effectiveness of V.42 *bis* data compression will vary depending on how much of the application data exchanged in a conference has already been compressed by other means.

NOTE 3 – V.70 DCE, if made aware that this profile is being employed, may negotiate between themselves the use of enhanced techniques, such as UNERM tunnelling for T.120, as long as the service provided at the DTE interface remains start-stop transmission.

7.5 B-ISDN basic profile

Figure 9 defines the B-ISDN basic profile. Layers above Q.922 are identical to the ISDN basic profile.

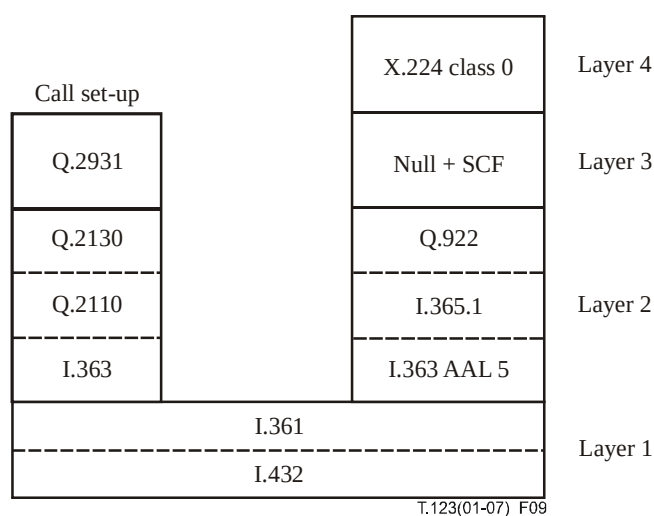


Figure 9 – B-ISDN basic profile

Layer 4

- As specified in 7.1, ISDN basic profile.

Layer 3

- As specified in 7.1, ISDN basic profile.

Layer 2

- Q.922.
- Protocol parameters and options as specified in clause 10, Q.922 protocol parameters and options.
- PDU structure defined in Figure 3 of [ITU-T I.365.1] (no use of flags, transparency or FCS).
- PDU octets conveyed as one CPCS-SDU using AAL type 5.

Layer 1

- ATM virtual channel.

7.6 LAN basic profile

Figure 10 defines the LAN basic profile.

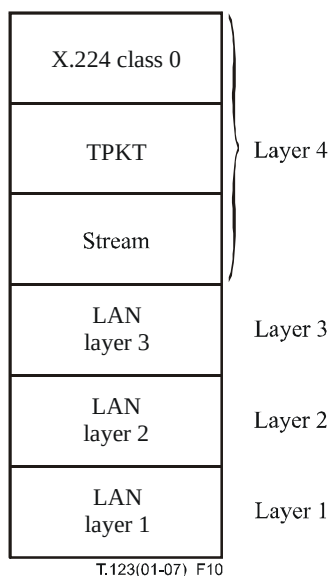


Figure 10 – LAN basic profile

Layer 4

- X.224 class 0 preferred, no alternative class.
- Default TPDU size 65531, but smaller values may be negotiated.
- TPKT packet header to delimit TPDU's, as specified in clause 8, Packet header to delimit data units in an octet stream.

NOTE 1 – TPKT is required because an octet-stream service does not mark where data unit boundaries occur.

- Octet-stream transfer with the following characteristics:
 - a) Connection-oriented service preserving octet sequence.
 - b) Boundary between data units *not* retained as part of the transfer.
 - c) Residual error rate low enough to use as a type A network service.
 - d) Flow control mechanism to exert back-pressure on a transmitter.

NOTE 2 – The following specifies a protocol for octet-stream transfer that is a common example of the above:

- a) RFC 793, Transmission control protocol.
- b) By default, destination port number 1503 per RFC 1700, Assigned numbers, but others may be used.

Layer 3

- Commonly, RFC 791, 792, 919, 922, 950, 1112, Internet protocol.

Layer 2

- Commonly, [ISO/IEC 8802] logical link control and medium access sublayers.

Layer 1

- Commonly, [ISO/IEC 8802] physical medium.

8 Packet header to delimit data units in an octet stream

[ITU-T X.224] expects information to be transmitted and received in discrete units termed network service data units (NSDUs), which can be an arbitrary sequence of octets. Although other classes of the transport protocol may combine more than one TPDU inside a single NSDU, X.224 class 0 does not use this facility. Hence, in the context of T.123 protocol stacks, a TPDU may be identified with its underlying NSDU.

A fundamental difference between the network service expected by [ITU-T X.224] and an octet-stream transfer service, as characterized in clause 7.6, is that the latter conveys a continuous sequence of octets with no explicit boundaries between related groups of octets.

This clause specifies a distinct protocol layer to repair the discrepancy and meet the needs of [ITU-T X.224]. It defines a simple packet format whose purpose is to delimit TPDU. Each packet, termed a TPKT, is a unit composed of a whole integral number of octets, of variable length.

A TPKT consists of two parts: a packet header, followed by a TPDU. The format of the packet header is constant, independent of the type of TPDU. The packet header consists of four octets as shown in Figure 11.

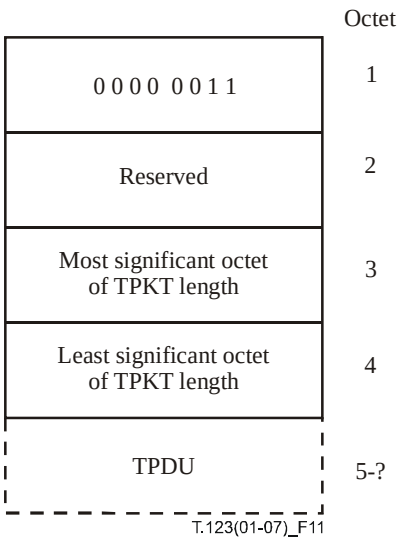


Figure 11 – Format of the TPKT packet header

Octet 1 is a version number, with binary value 0000 0011. Octet 2 is reserved for further study. Octets 3 and 4 are the unsigned 16-bit binary encoding of the TPKT length. This is the length of the entire packet in octets, including both the packet header and the TPDU.

Since an X.224 TPDU occupies at least 3 octets, the minimum value of TPKT length is 7. The maximum value is 65535. This permits a maximum TPDU size of 65531 octets.

NOTE – This description of the TPKT protocol layer agrees with RFC 1006, *ISO transport services on top of the TCP*.

9 Synchronization and convergence function

9.1 SCF overview

The SCF resides in the network layer of each communication profile whose data link layer is specified to be Q.922. It coordinates network connection establishment and release between the control plane and the user plane as described in clause 4 of [ITU-T Q.922]. The purpose of the SCF is to provide network services to the transport layer. Figure 12 is the architectural model of the SCF.

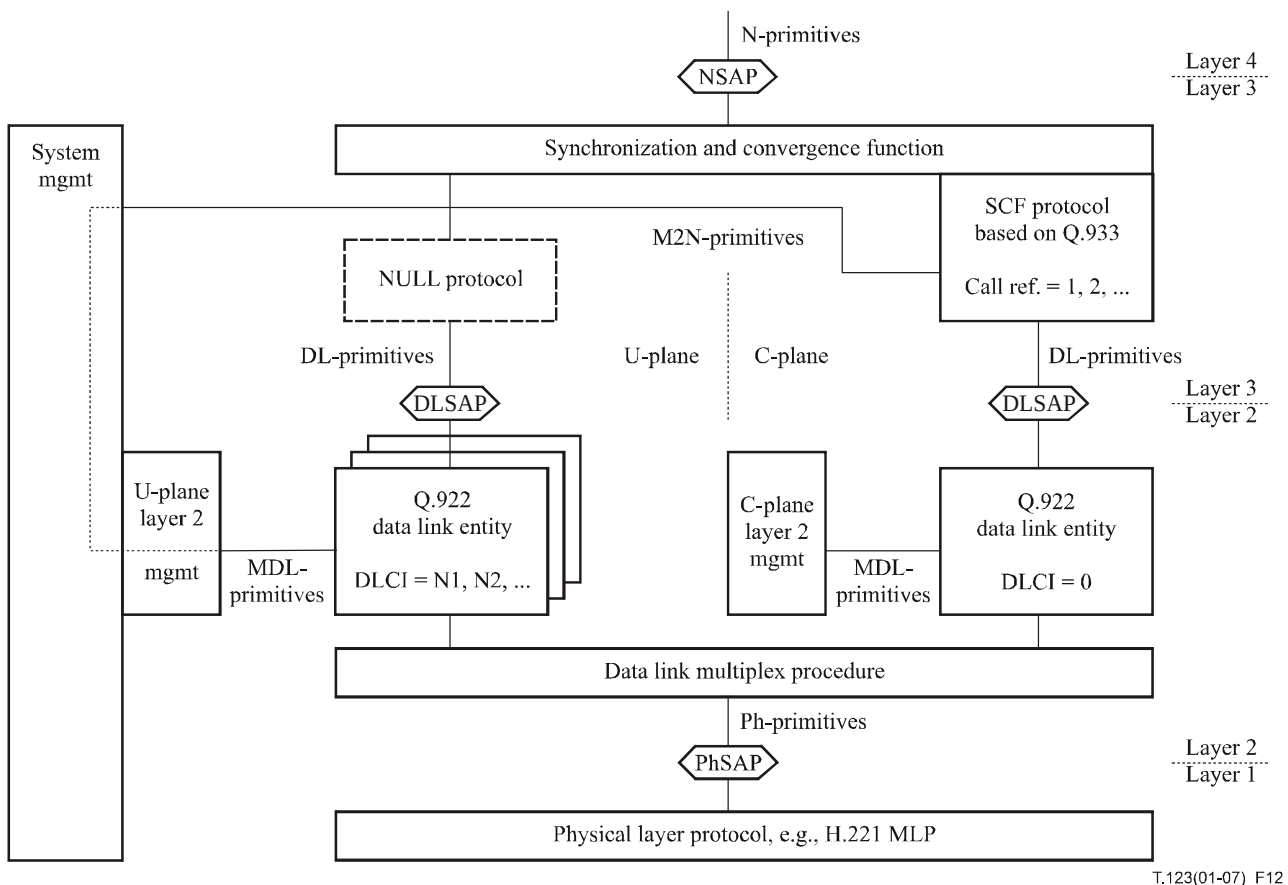


Figure 12 – Architectural model of the SCF

Network services required by the X.224 transport protocol are listed in Table 1. This table is derived from Table 2 of [ITU-T X.224] by excluding optional features and N-RESET (because N-RESET is never requested, according to Table A.3 of [ITU-T X.224], and any indication of it can be escalated to N-DISCONNECT).

Table 1 – Network services required by X.224

Primitives	Parameters
N-CONNECT request N-CONNECT indication	Called address Calling address QoS parameter set
N-CONNECT response N-CONNECT confirm	Responding address QoS parameter set
N-DATA request N-DATA indication	NS user data
N-DISCONNECT request N-DISCONNECT indication	

The SCF implements the N-CONNECT and N-DISCONNECT primitives. During data transfer it is inactive, and N-DATA maps directly to DL-DATA with no extra protocol. This requires that the transport layer limit the size of its TPDUs to one Q.922 I-frame.

[ITU-T Q.922] supports multiple data link connections distinguished by DLCI. Acting through layer 2 management, the SCF controls DLCI assignments. It communicates with a peer SCF by

sending and receiving Q.933 messages over DLCI 0, which is reserved for in-channel signalling. DLCI 0 serves the control plane, supporting SCF control. Other DLCIs serve the user plane, supporting data transfer.

SCF procedures are based on those specified in [ITU-T Q.933], in which are defined case A covering circuit switched access to a remote frame handler, and case B covering integrated access to a local frame handler. The SCF use of Q.933 messages may be considered a new case C, covering circuit switched access directly to another network user. This new case C does not use DLCIs to distinguish connections to different destinations. It uses DLCIs to distinguish multiple connections between the same two end points. Each such connection may have a different quality of service.

The sequence of actions to obtain a physical circuit between two users can vary with the communication profile and other circumstances. A circuit may be established without the aid of SCF prior to the first N-CONNECT request and indication. When these primitives are finally invoked, called and calling addresses may be omitted or ignored. Alternatively, N-CONNECT request may initiate events, and network addresses may be required for circuit routing.

9.2 SCF procedures

The SCF shall act as a network user required to act for Q.933 case A of frame relaying. It shall behave as though connected semi-permanently to a remote frame handler, even though the bit rate allotted to the physical circuit may not be exactly the same as an ISDN information transfer rate.

The sole exception is clause 5.6 of ITU-T Rec. Q.933 (1995) concerning DLCI collisions. To maintain a symmetric relationship between two network users, the SCF shall give neither direction preference as incoming. Instead, it shall resolve collisions by forcing new DLCI selections on both sides, as specified in detail below.

The SCF shall obey the additional requirements stated in the remainder of this clause.

As soon as a duplex physical circuit is activated, the SCF shall assign and establish DLCI 0 to serve the control plane. DLCI 0 shall carry Q.933 messages in Q.922 I-frames. If DLCI 0 is ever re-established, which indicates a protocol error, the SCF shall cause it to be released. If DLCI 0 is ever released, the SCF shall remove all other DLCIs assigned to the physical circuit and shall indicate that their data links are disconnected. The SCF may then attempt to establish DLCI 0 again and reinitialize Q.933 signalling.

As a positive response to SETUP, the SCF shall transmit CONNECT, and this shall be answered by CONNECT ACKNOWLEDGE. In this situation, there is no advantage in transmitting ALERTING, CALL PROCEEDING, or PROGRESS. If received, these messages may be ignored.

The negative response to SETUP shall be RELEASE COMPLETE. This is also the simplest means of clearing an active call. In this situation there is no advantage in transmitting DISCONNECT, STATUS, or STATUS ENQUIRY. If received, these messages may stimulate the transmission of RELEASE COMPLETE. If RELEASE is received during most call states specified in [ITU-T Q.933], e.g., while the call is active but not while awaiting a response to SETUP or RELEASE, it shall cause the transmission of RELEASE COMPLETE. Although an unexpected RELEASE COMPLETE is considered a message sequence error, it achieves the intended effect of forcing the receiver to clear a call.

Figure 13 shows the messages exchanged and primitives invoked during a successful N-CONNECT. This figure assumes that DLCI 0 is already established, as the result of exchanging SABME and UA when the physical circuit was activated.