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SERIES V: DATA COMMUNICATION OVER THE
TELEPHONE NETWORK

Interworking with other networks

Modem-over-IP networks: Procedures for the end-to-end connection of V-series DCEs

ITU-T Recommendation V.150.1

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ITU-T Recommendation V.150.1

Modem-over-IP networks: Procedures for the end-to-end connection of V-series DCEs

Summary

This Recommendation defines the inter-operation of two PSTN to IP network gateways that facilitate the end-to-end connection of V-series DCEs over an IP network. The principal characteristics of these gateways are: a mechanism to allow the transparent transport of modem signals end-to-end, a mechanism to allow the termination of modem signals at the gateways and the transport of the data between gateways, the definition of a transport protocol, which is suitable to relay data between gateways, and procedures to allow gateways to transition between Voice-over-Internet Protocol and Modem-over-Internet Protocol operation.

Source

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FOREWORD

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ITU-T Recommendation V.150.1

Modem-over-IP networks: Procedures for the end-to-end connection of V-series DCEs

1 Scope

This Recommendation specifies the operation between two IP network gateways to facilitate the end-to-end connection of V-series DCEs over an IP network. The gateways are specified herein in terms of their functionality, signals and messages and operating procedures. The principal characteristics of these gateways are as follows:

- a) Support of a mechanism to allow the transparent transport of modem signals end-to-end.
- b) Support of mechanisms to allow the termination of modem signals at the gateways and the transport of the data between gateways.
- c) The definition of a transport protocol, which can be used to relay the data between gateways.
- d) The definition of procedures to allow gateways to transition between Voice-over-Internet Protocol and Modem-over-Internet Protocol operation.

This Recommendation includes mandatory requirements, recommendations and options; these are designated by the words "shall," "should," and "may" respectively.

1.1 Recommendation version

For the purposes of forward and backward compatibility, this Recommendation is assigned a version number.

The usage and definition of this version number is defined in ITU-T Rec. V.150.0.

Version: 1

NOTE – The reader is encouraged to check on the ITU-T website for any normative or informative amendments to this Recommendation.

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 Recommendation G.711 (1988), *Pulse Code Modulation (PCM) of voice frequencies*.
- ITU-T Recommendation H.245 (2003), *Control protocol for multimedia communication*.
- ITU-T Recommendation H.248 (2000), *Gateway control protocol*.
- ITU-T Recommendation H.323, Annex P (2003), *Transfer of modem signals over H.323*.
- ITU-T Recommendation T.38 (2002), *Procedures for real-time Group 3 facsimile communication over IP networks*.

- ITU-T Recommendation V.8 (2000), *Procedures for starting sessions of data transmission over the public switched telephone network.*
- ITU-T Recommendation V.8 bis (2000), *Procedures for the identification and selection of common modes of operation between data circuit-terminating equipments (DCEs) and between data terminal equipments (DTEs) over the public switched telephone network and on leased point-to-point telephone-type circuits.*
- ITU-T Recommendation V.14 (1993), *Transmission of start-stop characters over synchronous bearer channels.*
- ITU-T Recommendation V.17 (1991), *A 2-wire modem for facsimile applications with rates up to 14 400 bit/s.*
- ITU-T Recommendation V.18 (2000), *Operational and interworking requirements for DCEs operating in the text telephone mode.*
- ITU-T Recommendation V.21 (1988), *300 bits per second duplex modem standardized for use in the general switched telephone network.*
- ITU-T Recommendation V.22 bis (1988), *2400 bits per second duplex modem using the frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits.*
- ITU-T Recommendation V.23 (1988), *600/1200-baud modem standardized for use in the general switched telephone network.*
- ITU-T Recommendation V.24 (2000), *List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE).*
- ITU-T Recommendation V.25 (1996), *Automatic answering equipment and general procedures for automatic calling equipment on the general switched telephone network including procedures for disabling of echo control devices for both manually and automatically established calls.*
- ITU-T Recommendation V.26 bis (1988), *2400/1200 bits per second modem standardized for use in the general switched telephone network.*
- ITU-T Recommendation V.26 ter (1988), *2400 bits per second duplex modem using the echo cancellation technique standardized for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits.*
- ITU-T Recommendation V.27 ter (1988), *4800/2400 bits per second modem standardized for use in the general switched telephone network.*
- ITU-T Recommendation V.29 (1988), *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits.*
- ITU-T Recommendation V.32 bis (1991), *A duplex modem operating at data signalling rates of up to 14 400 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits.*
- ITU-T Recommendation V.34 (1998), *A modem operating at data signalling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits.*
- ITU-T Recommendation V.42 (2002), *Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion.*
- ITU-T Recommendation V.42 bis (1990), *Data compression procedures for data circuit-terminating equipment (DCE) using error correction procedures.*

- ITU-T Recommendation V.44 (2000), *Data compression procedures*.
- ITU-T Recommendation V.90 (1998), *A digital modem and analogue modem pair for use on a Public Switched Telephone Network (PSTN) at data signalling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream*.
- ITU-T Recommendation V.91 (1999), *A digital modem operating at data signalling rates of up to 64 000 bit/s for use on a 4-wire circuit switched connection and on leased point-to-point 4-wire digital circuits*.
- ITU-T Recommendation V.92 (2000), *Enhancements to Recommendation V.90*.
- ITU-T Recommendation X.680 (2002) | ISO/IEC 8824-1:2002, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.
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- IETF RFC 2327 (1998), *SDP: Session Description Protocol*.
- IETF RFC 2733 (1999), *An RTP Payload format for Generic Forward Error Correction*.
- IETF RFC 2833 (2000), *RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals*.
- IETF RFC 3407 (2000), *Session Description Protocol (SDP) Simple Capability Declaration*.

3 Definitions and abbreviations

3.1 Definitions

This Recommendation defines the following terms:

3.1.1 call discrimination time-out timer: An optional timer that is started on receipt of a modem signal (such as an answer tone) and stopped on the basis of criteria in the Call Discrimination SDL diagrams in this Recommendation.

3.1.2 control channel: Is the channel provided by the IP-Transport Layer Protocol that is used for the sending of IP-Transport Layer Protocol control messages.

3.1.3 double-trans-compression gateway: Is a gateway that has the resources to support Trans-Compression in both directions of the data flow.

3.1.4 effective data signalling rate: Is the data-signalling rate in bits/s with all format and frame information removed from the data stream (e.g., Start, Stop, Parity bits, protocol headers, CRC, HDLC Flags, pre-ambls, post-ambls, etc.). The effective data signalling rate is always less than or equal to the data signalling rate of the input data stream.

3.1.5 gateway: A gateway converts media provided in one type of network to the format required in another type of network. For example, a gateway could terminate bearer channels from a switched circuit network (e.g., DS0s) and media streams from a packet network (e.g., RTP streams in an IP network).

3.1.6 modem relay: The transport of modem data across a packet network using modem termination at the gateways.

3.1.7 MoIP gateway: A gateway that is compliant with this Recommendation.

3.1.8 no-trans-compression gateway: Is a gateway whose data input in both directions is transferred transparently.

3.1.9 off-ramp gateway: The IP network access point that calls an Answering DCE. (Abbreviated to G2.)

3.1.10 on-ramp gateway: The access point that is called by an originating DCE that interfaces to the IP network. (Abbreviated to G1.)

3.1.11 repeated-break: A break with the same sequence number as a previously received Break.

3.1.12 selective destructive: A transport protocol is "selectively destructive" if the local protocol user can trigger the discard of data that has been given to the transmitter by the local protocol user and not delivered to the peer protocol user by the receiver.

3.1.13 single-trans-compression gateway: Is a gateway that has the ability to perform a Trans-Compression in only one direction of the data flow (serial). For the other direction, the data is passed through transparently with minimum of delay to the outputs.

3.1.14 trans-coding: Translation from one companding law to another (i.e., G.711 A-law to μ -law or vice versa).

3.1.15 trans-compression: A Trans-Compression function consists of a decompression element whose output is connected to the input of a compression element. The input to the Trans-Compression is the input to the decompression element and the output of the Trans-Compression function is the output of the compression element. (See clause 13.)

3.1.16 voiceband data: The transport of modem signals over a voice channel of a packet network with the encoding appropriate for modem signals.

3.1.17 XID/LR: In V.42 LAPM, the XID command or response. In Annex A/V.42, the LR command or response.

The definition of DCE line signals used in this Recommendation is described in Appendix V.

3.2 Abbreviations

This Recommendation uses the following abbreviations:

ANS	V.25 Answer Tone
ASN.1	Abstract Syntax Notation One
ASNam	V.8 Answer Tone
CM	V.8 Call Menu
DE	Destructive and Expedited
DLCI	Data Link Connection Identifier
DS0	Digital Signal level 0
D-TCX	Double Trans-Compression

Cx	Compression Function
Cx'	Disabled Compression Function
DCE	Data Circuit-terminating Equipment (Modem)
DTE	Data Terminal Equipment
Dx	Decompression Function
Dx'	Disabled Decompression Function
FEC	Forward Error Correction
FoIP	Fax over Internet Protocol
G1	On-Ramp Gateway
G2	Off-Ramp Gateway
HDLC	High-level Data Link Control
IP	Internet Protocol
IP-TLP	IP Transport Layer Protocol
JM	V.8 Joint Menu
LAPM	Link Access Protocol for Modems (an error control protocol defined in ITU-T Rec. V.42)
LR	Link Request (Frame defined in Annex A/V.42 (1996))
LRc	Link Request command
LRr	Link Request response
M1	Originating end-point DCE
M2	Answering end-point DCE
MIPS	Millions Instructions Per Second
MNP5	A compression method as defined in Appendix VI.4
MoIP	Modem over Internet Protocol
MR	Modem Relay
MR1	Modem Relay Connection Scenario 1
MR2	Modem Relay Connection Scenario 2
MR3	Modem Relay Connection Scenario 3
MR4	Modem Relay Connection Scenario 4
NDE	Non-Destructive and Expedited
NDNE	Non-Destructive and Non-Expedited
N-TCX	No Trans-Compression
PCM	Pulse Code Modulation
PDU	Protocol Data Unit
PHY	Physical transport Layer of modem connection
PSTN	Public Switched Telephone Network
QoS	Quality of Service

RC	Reason Code
RIC	Reason Identifier Code
RNR	Receiver Not Ready
RR	Receiver Ready
RSC	Reliable Sequenced Channel
RTP	Real-time Transfer Protocol
SPRT	Simple Packet Relay Transport
SPU	Signal Processing Unit
SSE	State Signalling Events
SSRC	Synchronization SouRCe
S-TCX	Single Trans-Compression
TCX	Trans-Compression
UDP	User Datagram Protocol
U-MR	Universal-Modem Relay
USC	Unreliable Sequenced Channel
VBD	Voice Band Data mode
V-MR	V.8-Modem Relay
VoIP	Voice over Internet Protocol
XID	Exchange Identification
XID _C	LAPM XID command
XID _{def}	XID corresponding to the default compression parameters for N-TCX
XID _r	LAPM XID response

4 Conventions

The following convention is used to indicate the elements of PDU defined in this Recommendation.

For the IP-TLP, a message is indicated by its mnemonic, e.g., INIT, CONNECT etc. An element of the message is indicated by mnemonic in parentheses, e.g., MR_EVENT(PHYSUP), CONNECT(NCP).

A SSE message is indicated using SSE:<X>(<code>), where <X> is one of the defined media states and <code> is the applicable reason code.

5 Introduction

Modem over Internet Protocol (MoIP) is the application of V-series DCEs over a Voice-over-Internet Protocol (VoIP) connection. There are two basic models suitable to this application. The first is as shown in Figure 1. This is the generic establishment of a voice connection using a suitable call establishment protocol (e.g., H.323, RFC 2327, etc.). The end-point DCEs attempt to connect without any knowledge that they are using an IP network with an undetermined Quality of Service (QoS). The second model, also shown in Figure 1, is similar; the exception is that the IP network has a well-managed QoS.

Architecturally, this Recommendation only considers the support of a PSTN to IP to PSTN structure. PSTN to IP structures are for further study.

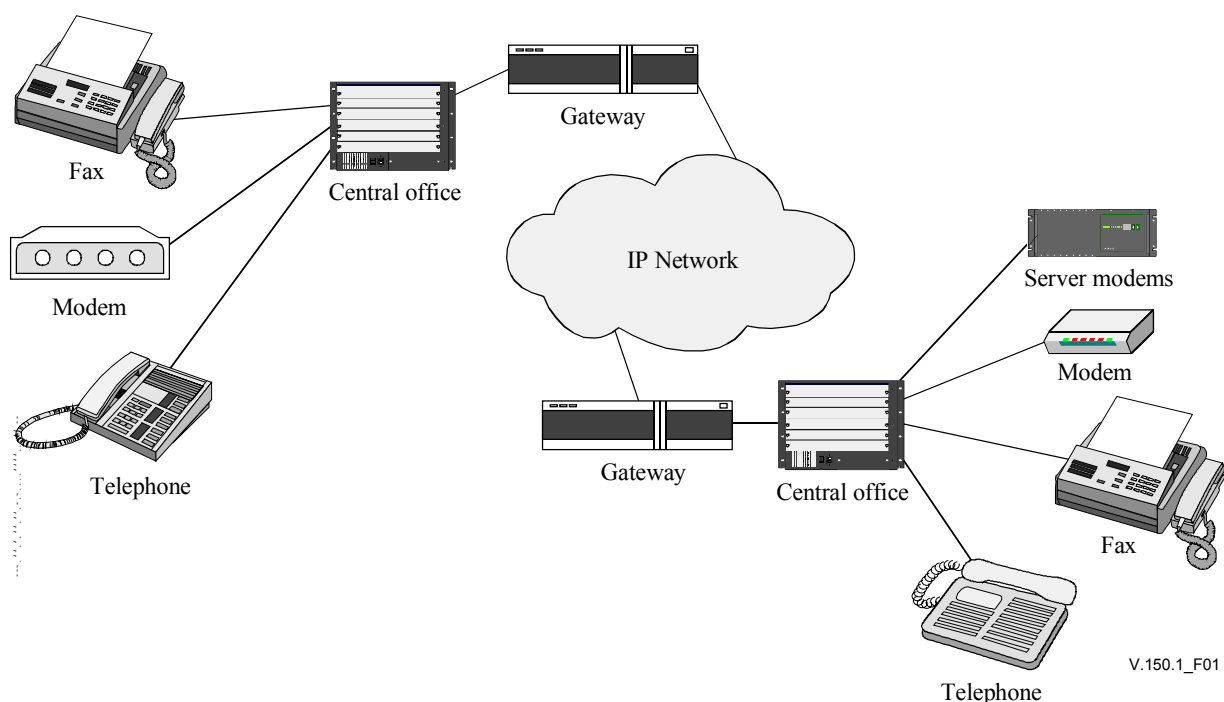


Figure 1/V.150.1 – Typical modem over IP application

5.1 Compliance requirements

The Recommendation does not require behaviour that is inconsistent with other V-series PSTN modem Recommendations, or with national regulatory requirements, and shall be interpreted accordingly. Neither does it preclude the use of proprietary or non-standard modems, however, it does caution that if such devices are used, then care should be taken as not to harm the functionality and procedures defined herein.

In order to be compliant with this Recommendation an implementation must provide functionality that is defined as mandatory.

6 Modem-over-IP gateway functions

Figure 2 provides a conceptual reference model for a MoIP gateway. The model shows two stacks conjoined by the MoIP application. The left-hand stack is that of a typical modem which has a signal converter (modulation), an error correction protocol and a data compression protocol. Apart from the signal converter, the other two protocols may or may not be present. The right-hand stack represents the IP networking functions of a MoIP gateway. The MoIP application as indicated in Figure 2 is defined by the normative contents of this Recommendation. This Recommendation defines a default IP transport layer protocol called SPRT (see Annex B), but does not preclude the use of another protocol that conforms to the requirements as defined in clause 25.

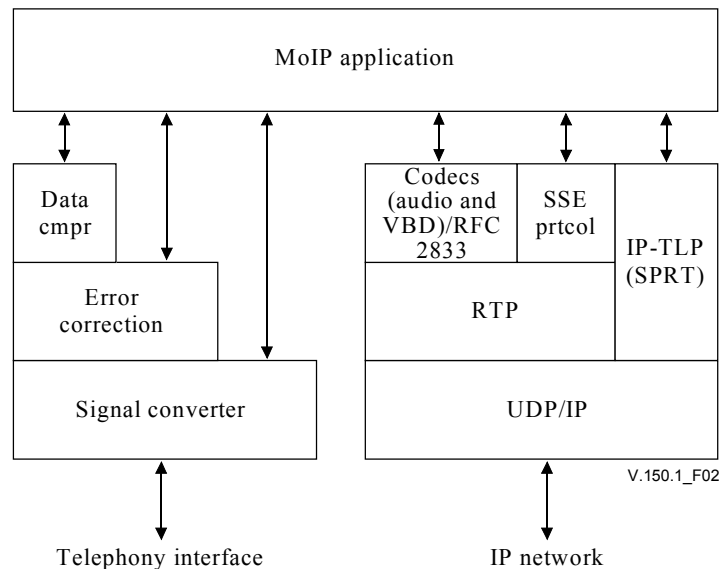


Figure 2/V.150.1 – Gateway reference model

This Recommendation defines two classes of operation for Modem-Over-IP gateways: Voiceband Data and Modem Relay. The two classes of operation are because of the variety of IP networks, DCE feature sets, and gateway capabilities.

7 Audio mode

In this mode, the channel processes speech signals. The mode may include the use of compression algorithms and other processing functions that are not suitable for the transport of modem or facsimile signals.

8 Voiceband data mode

For Voice Band Data (VBD) mode of operation, the path between G1 and G2 remains in a voice configuration. The modem signals are encoded using an appropriate speech codec suitable for the task, and the samples are transported across a packet network.

VBD should:

- Use a voice codec that passes voiceband modulated signals with minimal distortion.
- Have end-to-end constant latency.
- Disable Voice Activity Detection and Comfort Noise Generation during the data transfer phase.
- Disable any DC removal filters that may be integral with the speech encoder used.

VBD should consider the appropriate application of:

- The use of echo cancellers on a VBD channel.
- Forward Error Correction (FEC) (e.g., RFC 2733) or other forms of Redundancy (e.g., RFC 2198).
- Voice packet loss concealment techniques and algorithms that are suitable for modem and facsimile modulations.

8.1 Selection of VBD voice codecs and other enhanced functionality

VBD capabilities are indicated during the Call Set-up phase. See Annexes E and F.

Gateways should undertake appropriate action to avoid more than one trans-coding when in VBD.

8.2 Minimum requirements for VBD

For purposes of interoperability, MoIP gateways shall support at least both G.711 A-law and G.711 μ -law codecs.

9 Modem relay mode

Modem Relay mode of operation is characterized by the termination of both the physical layer and error-correction functions at the gateway. Appendix I provides diagrams of the reference configurations considered by this Recommendation. Modem Relay gateways, depending upon their type demodulate the DCE signals, perform local error correction and pass on the data in one of four ways. These four modes of MR operation are defined in clause 13 and are uniquely defined by the capability and configuration of the gateway Trans-Compression functions.

Figure 3 describes a basic reference model for MR mode of operation. Cx and Dx represent the compression and decompression functions. EC is the Error Correction layer, which also includes any link layer formatting such as HDLC.

NOTE – This reference model shows the functions that may be present depending upon the outcome of the gateway capability exchanges and modem negotiation.

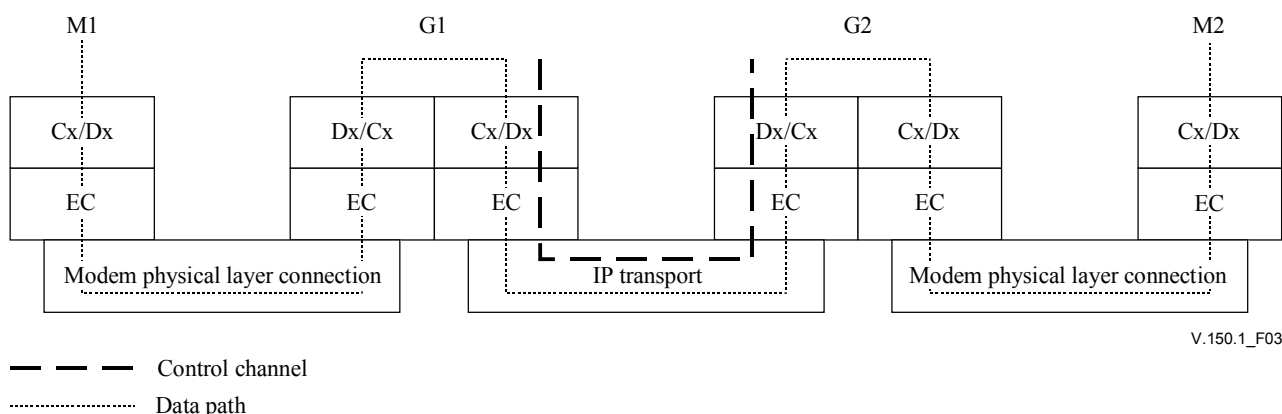


Figure 3/V.150.1 – Modem relay reference model

In addition to the primary data path between the gateways, a secondary control channel is also provided for the exchange of information directly between the gateways. Note the characteristics and format of this control channel are dependent upon the IP transport Protocol being used. The requirements for this control channel are described in 14.7.

Modem Relay defines two gateway types: these are the Universal-Modem Relay (U-MR) gateway and the V.8-Modem Relay (V-MR) gateway.

9.1 Universal-modem relay gateway type

A Universal-Modem Relay gateway (U-MR) provides full termination for a minimum set of V-series modulations, whether negotiated through V.8 or not. This minimum set is defined as:

V.92 Digital, V.90 Digital, V.34, V.32 *bis*, V.32, V.22 *bis*, V.22, V.23 and V.21.

Other modulations may also be supported but are not part of the mandatory set and should be indicated by the gateway during the Call Set-up phase.

9.2 V.8-modem relay gateway type

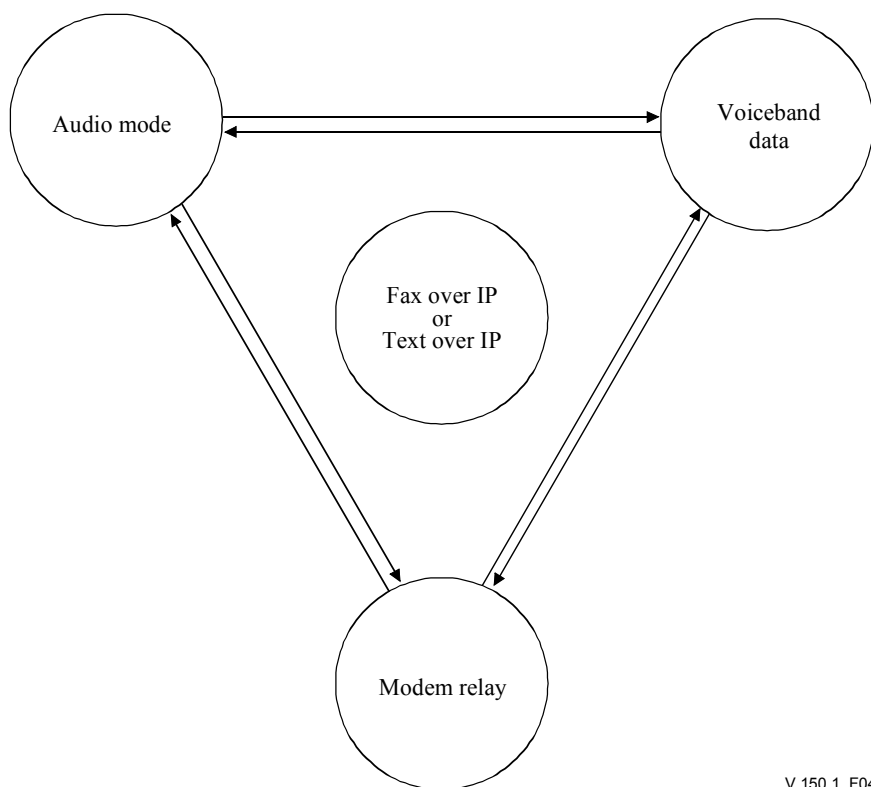
A V.8-Modem Relay gateway (V-MR) provides full termination for V-series modulations that are selected via the V.8 negotiation procedures. There are no requirements on the set of modulations to be supported by this type of gateway. The modulations that are supported are indicated in the inter-gateway messages exchanged during the Call Set-up Phase.

10 Operational modes of MoIP

A Modem-over-IP (MoIP) gateway has three operational modes. These are Audio Mode, Voice Band Data (VBD) mode and Modem Relay (MR) mode. If available, Audio mode is the initial or default mode of operation for MoIP (see clause 7). If Audio Mode is not an available mode, then a MoIP gateway may begin in either VBD or MR modes.

Other modes of operation that may be optionally provided by MoIP gateways are Fax over IP (FoIP) and Text over IP (ToIP). The procedures for FoIP are defined in ITU-T Rec. T.38. Procedures for ToIP are beyond the scope of this Recommendation. The transitions between MoIP and FoIP/ToIP using the SSE protocol are for further study.

Figure 4 illustrates the relationship between these defined modes. At any given time, a MoIP gateway shall be either in or in transition to one of these modes.



V.150.1_F04

Figure 4/V.150.1 – MoIP operational modes and transition state

11 Modem relay PHY layer functions

This clause describes the functionality and expected behaviour of the Modem Relay PHY. The PHY in this context is defined as the physical layer of the modem to gateway connection and does not include the IP physical layer.

The goal of MoIP is to ensure connectivity of V-series modems on IP networks. The Recommendation does not require nor preclude the use of non-standard modulations. The MoIP procedures take into account that there are two independent PSTN connections to be established in order to provide a single end-to-end connection of the end-point modems. The establishment of the modem physical layer consists of two stages. The first is that of call discrimination and the second is of modem training and capability negotiation. The procedures that define this process are described in clause 20 and Appendix II.

The overall connection physical layer may be selectively transported in either VBD or Modem Relay. The call discrimination and mode selection procedures define the rules for this choice. The behaviour of Modem Relay is determined whether a Universal-Modem Relay (U-MR) or V.8-Modem Relay (V-MR) gateway is being used. Modem Relay supports the ability for a gateway to use different modulation modes on each of the different PSTN links. It is also possible to match the modulations on each PSTN link if necessary. To aid the call discrimination process, gateways exchange their preference for call discrimination and Answer Tone treatment, their supported modulation capability set and whether they are a V-MR- or U-MR-type gateway.

When modems are connected using V.8 negotiation procedures, MoIP defines three cases that are dependent upon the modulation capabilities of the gateways (see 20.5). The gateways are able to determine *a priori* the most appropriate call discrimination procedures to be used when using V.8.

For modulations that allow the selection of multiple data signalling rates, MoIP allows the gateway to either have data signalling rates independent of the two PSTN links or have them matched. Note that the MoIP error control procedures also influence the selection of the link data signalling rates especially in the non-error correcting case.

During the modulation start-up procedures, the gateway shall activate its IP-TLP. This is indicated by transmission of an INIT message (see 15.4.1). The gateways may transmit other IP-TLP messages types once it has received an INIT from the remote gateway.

When the physical layer on the PSTN link has achieved data mode (i.e., the point in time when either V.24 Circuit 106 or 109 may be turned on) the gateway shall transmit the IP-TLP MR_EVENT(PHYSUP) message (see 15.4.8). The selected modulation, data signalling rates and symbol rate of the modem may be used by the remote gateway. The same information (excluding the optional symbol rates) is also made available by the IP-TLP CONNECT message, which is transmitted after the link layer negotiation is complete.

Once established, interruptions to the PSTN PHY caused by retrains and rate-renegotiations may occur and stop the flow of data across the PSTN link. These events shall be reported to the remote gateway using the IP-TLP MR_EVENT message. When the modems return to a stable data mode state the gateway informs its peer by means of the MR_EVENT(PHYSUP) message its current physical layer characteristics. This procedure is described in clause 23.

The only requirement specified for a cleardown of a MoIP session, is that the gateway shall return to its initial state. A gateway shall not initiate a cleardown of the PSTN PHY at its own discretion. Session cleardown and related procedures are described in clause 24.

12 Modem relay error control functions

This clause describes the functionality necessary to support Error Control and No-Error Control modes of Modem Relay.

All the supported connection scenarios for Modem Relay, as described in Appendix I, have the PSTN link error control functions terminated locally by the gateways. Modem Relay may have the same or different error control functions on each of the PSTN links. Figure 5 illustrates possible combinations of error control function configurations. This Recommendation defines procedures that allow the support of links where the end-point modems may either enable or disable their error control functions. For a MoIP gateway the importance of having error control on both the PSTN and the IP links is that it provides full end-to-end flow control. This ability helps to prevent loss of data due to a mismatch in PSTN link characteristics such as different modulation or data signalling rates.

The type of data being transferred across the connection also has relevance to the error control configuration. Much of PSTN modem traffic is start-stop delimited character formatted data and error control is provided by the procedures defined in ITU-T Rec. V.42 which provides the mechanism for conveying start-stop characters over a synchronous data link. If error control is not negotiated, then V.14 procedures provide the method of conveyance as defined in 7.9/V.42. V.14 does not explicitly provide flow control.

Applications that use synchronous data tend to use a link layer protocol that is external to the modem. This is often considered part of an application. From the perspective of a gateway, error control would be disabled intentionally and the link would appear as non-error correction or V.14.

Non-error correction mode of operation of modem relay shall be supported using the procedures defined in this Recommendation. These procedures try to minimize any loss of user data on connections where there is not full end-to-end error control. However, despite a best effort made by a transmitting gateway, there is always a possibility that data may be discarded by a receiving gateway in these circumstances.

12.1 Error control configurations

The following error control configurations are defined because of a link layer negotiation.

12.1.1 Error-controlled

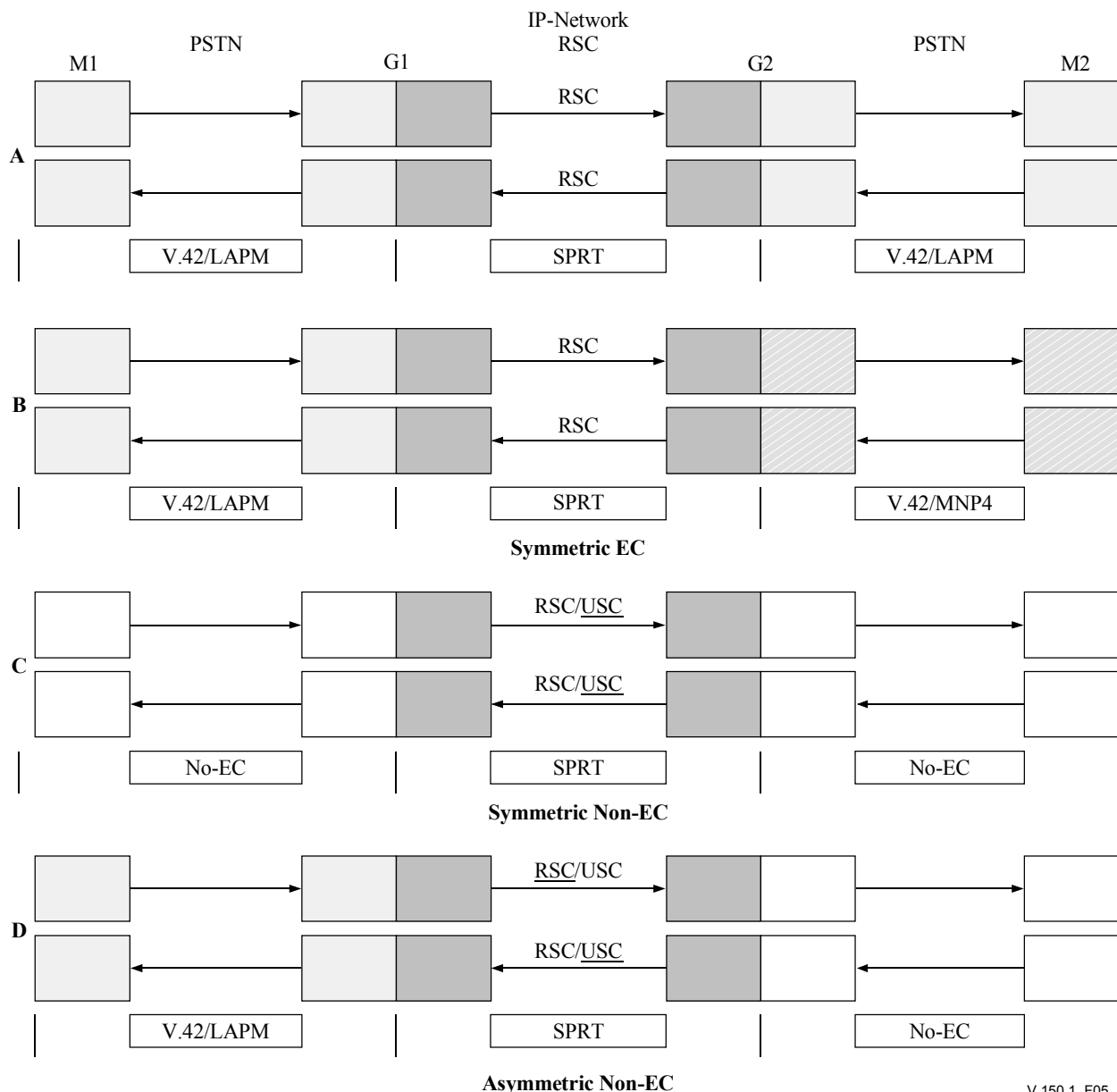
This configuration occurs when both MoIP gateways connect using MR have their error control functions as negotiated between the gateways and the end-point modems (G1/M1 and G2/M2) to be the same. The example depicted in Figure 5A shows both PSTN links selecting V.42/LAPM. Also included are configurations where both MoIP gateways connecting using MR have their error control functions as negotiated between the gateways and the end-point modems (G1/M1 and G2/M2) to be different. The example in Figure 5B shows one PSTN link using V.42/LAPM and the other PSTN link using Annex A/V.42 (1996).

12.1.2 Symmetric-non-error-controlled

Figure 5C illustrates the configuration in which MoIP gateways connecting using MR have both their PSTN link error control functions disabled by the end-point modems (M1 and M2).

12.1.3 Asymmetric-non-error-controlled

For this configuration, the MoIP gateways when connecting using MR have a mixture of enabled and disabled PSTN Error-Control functions. Figure 5D shows the example where one PSTN link uses V.42/LAPM and the other PSTN link does not have any error control.



NOTE – For the Non-EC cases the default transport channels are shown with an underline.
RSC is reliable sequenced channel and USC is unreliable sequenced channel.

Figure 5/V.150.1 – Example of error control configurations

12.1.4 Transport channel selection

For the non-error-controlled configuration, a gateway has the option to select the transport channel it wishes to transmit on, depending upon the remote gateway's capabilities. The selection of these capabilities may be based upon a trade-off between channel reliability and latency, which is implementation-specific. For each of the two configurations, a default transport channel is defined and shall be supported by both gateways. A gateway may indicate its receiving transport channel capability.

Each gateway may indicate it has a capability to receive a non-default transport channel. If a peer gateway has indicated this capability, the transport channel transmitter shall decide whether to use the non-default option for the transport channel prior to initial transmission.

Once a gateway has selected which transport channel it shall use to transmit, it shall not be permitted to use the other channel during the Modem Relay session. This does not apply to the use of the expedited channel.

12.2 Error-controlled PSTN links

This is the typical operational mode of Modem Relay connections. The two PSTN links and the IP-TLP all negotiate their own error control and operational parameters independent of each other. Note this Recommendation does not allow for the exchange of Error Control parameters between the end-to-end modem pair.

12.2.1 Transport channel selection for error-controlled configurations

For error-controlled configurations the IP-TLP shall use a Reliable Sequenced Channel (RSC) (e.g., SPRT Channel 1) for both directions of packet transmission.

12.2.2 Flow control for error-controlled configurations

With an error-controlled link, full end-to-end flow control is present. The flow control for each of the separate error-controlled links is independent of each other. Such data flow control may be performed using V.42 or IP-TLP (e.g., SPRT) procedures. For example, M1/G1 and G2/M2 modem pairs may flow off data from each other by transmitting V.42 RNR: G1 and G2 can flow off by using the window flow control mechanisms of the IP-TLP.

12.3 Non-error-controlled PSTN links

Connections occurring in one of the non-error-controlled configurations may occur:

- Due to an application requiring a synchronous data link; or
- Be disabled to reduce link layer latencies (e.g., electronic gaming); or
- The modems have failed to negotiate error control due to PSTN line conditions.

If a modem fails to establish an error-controlled link, 7.9/V.42 defines that the fallback shall be according to ITU-T Rec. V.14. V.14 is based upon start-stop delimited data.

12.3.1 Transport channel selection for non-error-controlled links

For the non-error-controlled links the selection of the transport channel depends upon whether the links are symmetrically or asymmetrically non-error-controlled.

12.3.1.1 Symmetric No-EC transport channel selection

For the Symmetric No-EC connection, either RSC or an Unreliable Sequenced Channel (USC) (e.g., SPRT Channel 3) may be used for both of the transmission paths of the IP-TLP. The default Transport Channel in this configuration is USC.

12.3.1.2 Asymmetric No-EC transport channel selection

There are independent options for each of the transmit directions for this hybrid mode of operation. For the No-EC to EC transmit direction both the RSC and USC may be used, with the default transport channel being USC. For the EC to No-EC transmit direction again both RSC and USC may be optionally chosen, however, in this case the default is RSC.

12.3.2 Effective data signalling rate matching

The relationship between the physical layer and the link layer for MoIP is very important. It is possible for there to be a mismatch in either modulation or data signalling rate between the two PSTN links. A mismatch in the data signalling rates as selected by the PSTN links requires certain considerations to minimize data loss. In general, modulations may be categorized as being either low-speed or high-speed modulations. For this Recommendation, the term high-speed modulations

refers to V.32/V.32 *bis*, V.34, V.90 etc. and low-speed modulations are V.22/V.22 *bis*, V.23, V.21 etc. The general distinction used is that high-speed modulations provide mechanisms to change their data-signalling rate during a connection and low speed modulations do not. For MoIP this is an important characteristic.

12.3.2.1 Rate match rule

The following rule shall be applied where possible to ensure the best possible reduction in data loss due to mismatched data-signalling rates.

12.3.2.1.1 The effective data-signalling rate that a gateway injects into the IP network should be less than the effective data-signalling rate that can be transmitted by the remote gateway onto its telephony leg.

12.3.3 Symmetric non-error-controlled

In this subconfiguration of non-error-controlled links, there are three categories of PSTN link signalling rates to consider: matched high-speed modulations, matched low-speed modulations and mismatched modulations.

12.3.3.1 Matched high-speed modulations

In this category, both the PSTN links have selected a modulation that has the ability to modify their data-signalling rates during the connection, either by retrain or a rate renegotiation procedure. The Rate Match Rule (see 12.3.2.1.1) should be applied during a MR session.

12.3.3.2 Matched low-speed modulations

In this category, both PSTN links have selected to operate in a low-speed modulation. Since there is no ability to modify the data-signalling rate for this type of connection, the gateways should use appropriate buffering to minimize loss of data while avoiding excess latency.

Note that the use of data buffering is implementation specific and is beyond the scope of this Recommendation.

12.3.3.3 Mismatched modulations

This category is where one of the PSTN links has selected a high-speed modulation and, the other link, a low-speed modulation. If possible, the high-speed link should change its data-signalling rate to meet the requirements of the Rate Match Rule. If a match of rate is not possible due to non-overlap in the supported rates in the links, a best effort should be made. As with the matched low-speed modulation case, use of data buffering and reduced latency may reduce data loss.

12.3.3.4 IP-TLP data under-run

For connections where an effective data signalling rate mismatch is unavoidable, there is a possibility that the IP network data being received by the gateway with the higher speed PSTN link will under-run. If appropriate to the data type being transported, this gateway may attempt to fill out the data by inserting the correct idle symbol.

12.3.4 Asymmetric non-error-controlled

This considers the case where the connection has both an error-controlled PSTN link and a non-error-controlled PSTN link. Loss of data due to mismatched data-signalling rates is mitigated to some degree by the presence of one error-controlled entity in the connection. There are four combinations to consider for this type of connection.

12.3.4.1 Low-speed error-controlled link to low-speed non-error-controlled link

For this example, there are also two conditions to consider. Although the modulations selected for the links are considered low-speed, there may still be mismatched data-signalling rates. For example, V.22 *bis* to V.21, which would give 2400 bit/s on one of the links and 300 bit/s on the other. The symmetric case could also occur.

12.3.4.1.1 Error-controlled has higher rate

Since the link with the higher rate is error-controlled, its effective data-signalling rate being input to the IP network can be less than the rate at which it is being delivered from the peer gateway to its local modem. This meets the Rate Match Rule defined in 12.3.2.1.1.

12.3.4.1.2 Non-error-controlled has higher rate

In this type of connection, the Rate Match Rule for the error-controlled to non-error-controlled transmit path is established, so there are no issues with data over-run. However, in the non-error-controlled to error-controlled transmission path, the data-signalling rate from the G2/M2 link is higher than that of the M1/G1 link. It will require appropriate buffering of data to minimize data loss due to over-running of data.

12.3.4.2 High-speed error-controlled link to low-speed non-error-controlled link

This connection type is similar to that described in 12.3.4.1.1. The ability for the high-speed modulated link to modify its data-signalling rate, such that it meets the Rate Match Rule, is an advantage for this case.

12.3.4.3 Low-speed error-controlled link to high-speed non-error-controlled link

This connection type is similar to that described in 12.3.4.1.2. The data-signalling rate from the error-controlled link is less than that of the non-error-controlled link. In the opposite direction, it is possible for the rate from non-error-controlled link to exceed the ability of the error-controlled link to receive it without over-running.

Since the non-error-controlled link has the ability to modify its data-signalling rate to meet the Rate Match Rule, then loss of data can be mitigated. In the case where the Rate Match Rule cannot be met, additional buffering may help, but loss of data may still occur.

12.3.4.4 High-speed error-controlled link to high-speed non-error-controlled link

For this connection type, both links have the ability to modify their data-signalling rate. Applying the Rate Match Rule to adjust the effective data-signalling rates of the two PSTN links will mitigate any potential data loss due to over-run.

12.4 Break handling

This clause introduces how a MoIP gateway supports the transport of break signals that are generated by an end-point DCE. Also described are the methods used to handle the break acknowledgement signal when it is applicable. Clauses 15.4.6 and 15.4.7 define the message formats and 22.1.1 defines the procedures.

The following error-correcting scenarios (as defined in 12.1) are all considered: error corrected; symmetrical non-error corrected and asymmetrical non-error corrected.

Every unique (non-repeated) break signal generated by a local end-point DCE shall be relayed to the remote end-point DCE. Repeated break signals shall not be relayed to the end-point DCE. For the case where the error control protocols are different, or not present on each end of the connections, a break type translation or mapping rule is defined (see Table 38). Also specified are the IP-TLP channels that the break and break acknowledgment messages shall use.

In the symmetric non-error corrected scenario, the transport of the break signal may or may not be transparent, depending upon the data type being used in the MR session.

13 Modem relay trans-compression functions

This clause describes the Trans-Compression functionality. The Trans-Compression Message definitions are described in 15.2.2, 15.4.2 and 15.4.5. The procedures used to select and operate the Trans-Compression functions are defined in 22.2.3 and 22.2.4.

Gateways can be classified by their Trans-Compression (TCX) functionality. TCX is defined as:

An element that consists of a Decompression function of Type A (Dx) and a Compression function of Type B (Cx), where the output of Dx is connected to the input of Cx. Compression and Decompression Types (e.g., V.42 *bis*, V.44) A and B may or may not be the same.

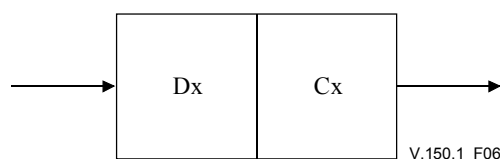


Figure 6/V.150.1 – Trans-compression function

Figure 6 shows the Trans-compression function. Note that Dx, Cx or both can be on or off depending upon the outcome of compression negotiations.

In the situation where a trans-compression element has identical characteristics for both the Dx and Cx, then trans-compression is unnecessary. Gateways may disable trans-compression and revert to a no trans-compression configuration or transparent case for TCX.

This Recommendation defines three basic configurations of TCX. These are described below.

Gateways that implement trans-compression shall support V.42 *bis* compression. Other compression mechanisms are optional.

13.1 No Trans-Compression (N-TCX)

In this configuration as shown in Figure 7, the gateways do not perform any trans-compression but, by means of a proxy-procedure, negotiate on behalf of the modems a common compression mode in terms of algorithm and parameters. The compressed data generated by modems M1 and M2 is transferred end to end.

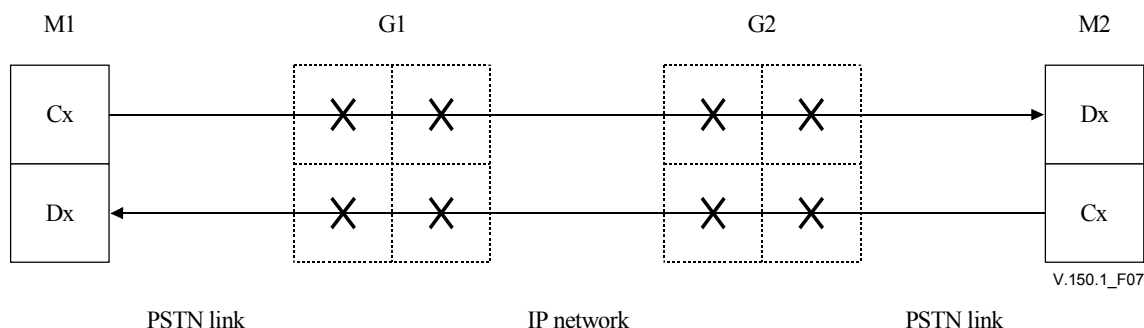


Figure 7/V.150.1 – No trans-compression

13.2 Single Trans-Compression (S-TCX)

In this configuration, the gateways only perform a single Trans-Compression function and the trans-compression functions are equally shared between the gateways.

By convention, the On-Ramp gateway (G1) shall place its trans-compression function in the G1 to M1 transmission path and the Off-Ramp gateway (G2) shall place its trans-compression function in the G2 to M2 transmission path as illustrated in Figure 8.

A Single Trans-Compression gateway shall also provide No Trans-Compression mode of operation.

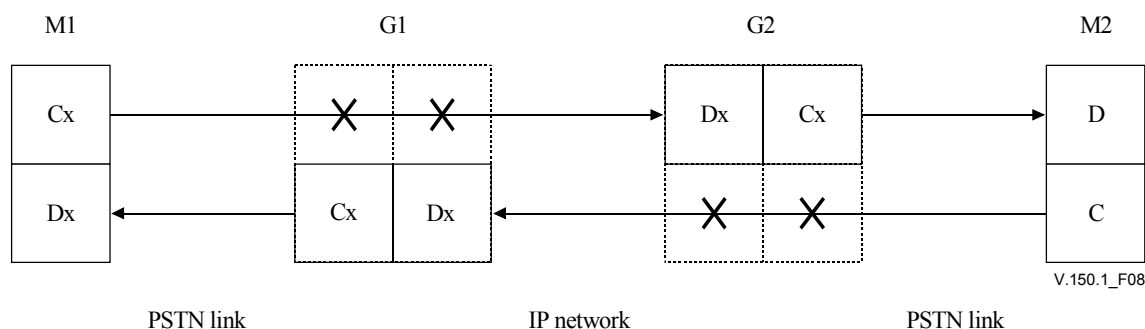


Figure 8/V.150.1 – Single trans-compression

13.3 Double Trans-Compression (D-TCX)

A Double Trans-Compression gateway is one that has two such functions, one in each transmission path. Figures 9 and 10 illustrate the configuration of the Double Trans-Compression gateway. In Figure 9, G2 is the Double Trans-compression and in Figure 10, both G1 and G2 are Double Trans-compression functions.

A Double Trans-Compression gateway shall also support Single Trans-Compression and No Trans-Compression modes of operation.

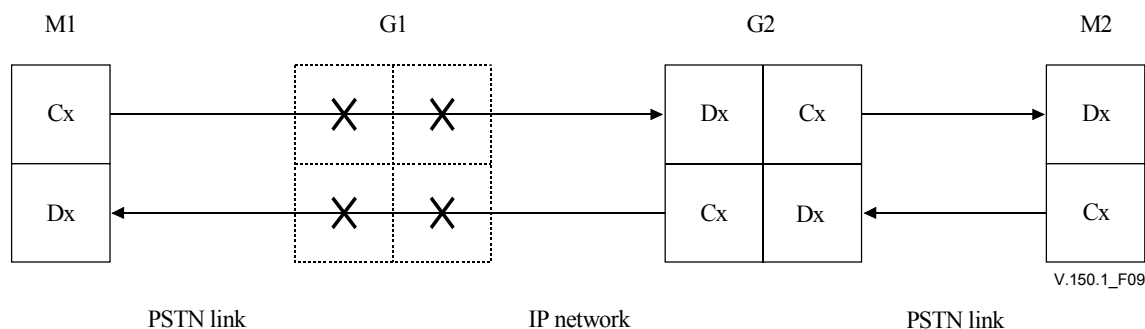


Figure 9/V.150.1 – Double trans-compression (asymmetric)

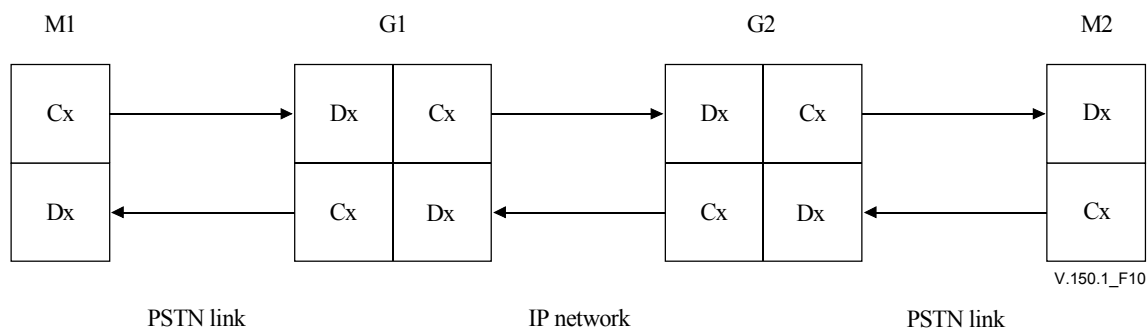
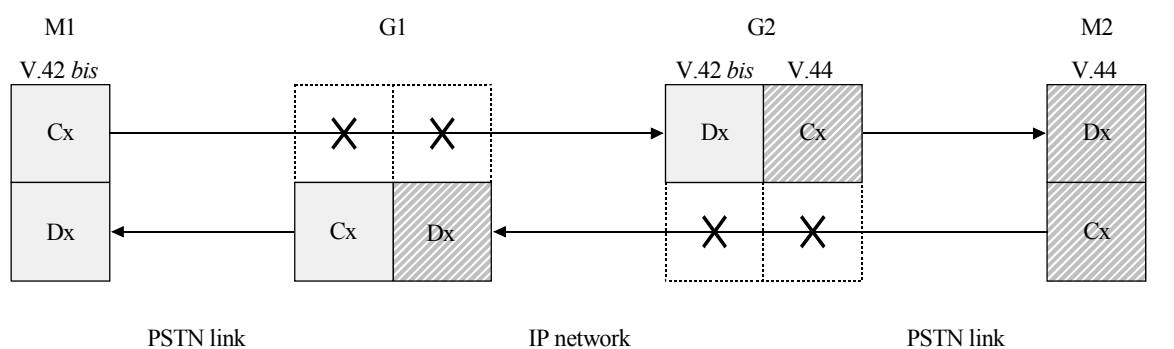


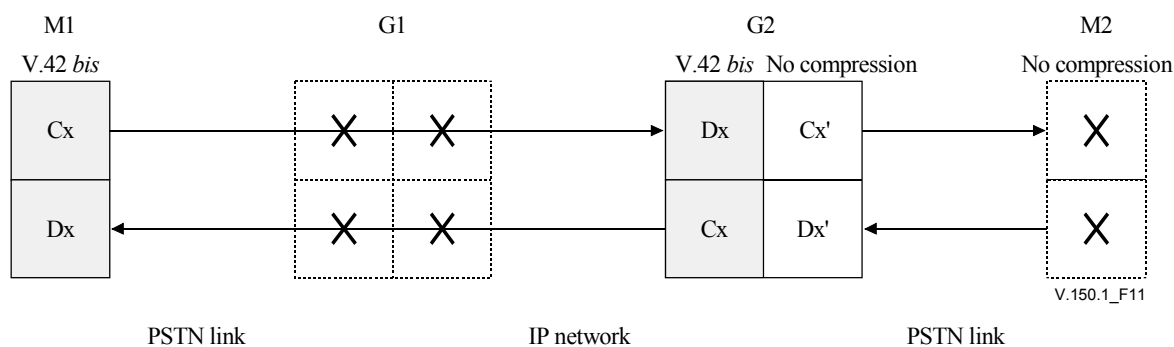
Figure 10/V.150.1 – Double trans-compression (symmetric)

13.4 Mixed-function operation

These previous figures describe the generic reference model for the gateway compression. There are many possible permutations of the trans-compression function along with different compression types. Figure 11 shows two such examples. The first illustrates a trans-compression between V.42 *bis* and V.44 and the second is between V.42 *bis* and a no compression case.



a) Single trans-compression (V.42 *bis* to V.44)



b) Double trans-compression (asymmetric) with M2 disabling compression and M1 using V.42 *bis*

NOTE – Cx' and Dx' represent disabled compression and decompression functions.

Figure 11/V.150.1 – Two examples of mixed-function trans-compression configuration

13.5 Hierarchy for interoperability

To support the ability of a gateway to choose a configuration that best suits its needs (i.e., MIPS, memory and performance optimization), the gateway may support any of the basic configurations of Trans-Compression as described in 13.1, 13.2 and 13.3. However, in order to guarantee

interoperability, this clause defines a hierarchy of minimum Trans-Compression functionality that a gateway is required to support.

There are two phases in the process to determine the configuration of the TCX. The first phase is the capability exchange phase. This occurs during the call set-up. These messages are defined in 15.2.2 and are exchanged between the On-Ramp and Off-Ramp gateways. The gateways declare whether they are of the None, Single or Double Trans-Compression types.

For the case where both G1 and G2 declare they are Double Trans-Compression gateways, their initial configuration can be Single-to-Single configuration or if both gateways indicate their desire they can mutually choose the Symmetric Double Trans-Compression configuration. This option is indicated as part of the gateways compression capability message during the call set-up phase (see 15.2.10).

As a result of the Trans-Compression capability exchange, the gateways shall select the mode of operation as defined in Table 1.

Table 1/V.150.1 – Trans-compression mode selection

Trans-compression mode capabilities exchanged		Resultant trans-compression mode selected by gateways	
G1	G2	G1	G2
No	No	No	No
No	Single	No	No
No	Double	No	Double
Single	No	No	No
Single	Single	Single	Single
Single	Double	Single	Single
Double	No	Double	None
Double	Single	Single	Single
Double	Double	Single/Double (Note)	Single/Double (Note)
NOTE – If both gateways indicate their ability and desire to support Double-Double configuration it shall do so, otherwise they shall use the Single-Single configuration.			

13.6 XID/LR profiles for use in modem relay connection scenario MR1

Modem relay connection Scenario MR1 requires both M1 and M2 to negotiate identical compression parameters. This clause defines an optional method to provide the ability to predict trans-compression parameters based upon knowledge gained from a previous connection, or by other means. This will allow the gateways to optimize the protocol XID/LR exchange for improved connect time, compression efficiency, and connectivity.

The gateways may exchange their knowledge as described in 22.2.5, and use this information to agree on optimal and consistent XID/LR command and response sequences that each will send when the particular physical connection comes up.

The advantage of using this prior knowledge is that an actual synchronous end-to-end exchange is not necessary, thus minimizing the timing problems associated with such exchanges.

The method and means for the gateways to determine or predict the XID/LR profiles is outside the scope of this Recommendation. Only the procedures to allow the exchange of information are defined.

As indicated, these procedures and messages are optional and are only used when a gateway indicates that it has the ability to receive the new PROF_XCHG (XID/LR profile exchange) message. This indication is provided in the IP-TLP INIT message.

14 Modem relay data transfer

This Recommendation supports the following modem relay data types that are used to exchange user information between the gateways. A set of mandatory data types is defined along with a set of optional types. This clause describes the functionality of the modem relay data types. Their format is described in 15.4.11 and procedures associated with their use in 22.3.

14.1 Data type definitions

Octet Data types may or may not contain formatted data.

The Raw Data types contain data that is in the exact same format and state as it was being transmitted over the PSTN link. No modification to the data is allowed apart from the optional use of compression to reduce the overall amount of data being exchanged between the gateways. The compression defined is lossless and allows for exact representation of the data at a receiver.

14.2 Support of DLCI

The support of DLCI is indicated by a code point in the IP-TLP CONNECT message. This bit when received by a gateway indicates that the peer gateway transmitter is to include a DLCI. If transmitted the DLCI shall be interpreted as specified in 8.2.1.1/V.42. Note that the DLCI may be eight or sixteen-bit fields.

14.3 General statement on the use of start-stop characters

Unless specifically indicated Start-Stop character data shall be sent unpacked, that is one character per octet and one octet per character. MoIP requires implementations to support Start-Stop character formats of one stop bit and whose character may be represented in an eight-bit data field, which may consist of both data and parity. This allows the transparent support of seven-bit data and parity or eight-bit data no parity characters.

14.4 Selection of data types

For a given error-correction mode of operation a default data type is defined. For symmetrical data type operation, both gateway IP transmitters shall use the same data type. Asymmetric data types may be used if both gateways indicate support in their INIT message. A gateway shall use symmetric data types by default.

A gateway shall not change the data type during that modem relay session.

14.5 Mandatory modem relay data types

The choice of mandatory data types is dependent upon the error correction configuration negotiated. For each of these configurations a default is specified. The default data type for error-controlled configurations is octet without format. For asymmetric non-error-controlled, it is also octet without format. In the symmetric non-error-controlled configuration the default is raw octet compressed.

For the error-controlled and asymmetric non-error-controlled configurations, raw octet compressed may not be used; the only choice from the mandatory set is octet without format. For symmetric non-error-corrected configurations, both octet without formatting and raw octet compressed may be chosen. If the configuration is symmetric non-error-controlled octet without format is treated as an optional data type in the data type selection procedures.

14.5.1 Octet without formatting

This data type may be used for error-controlled data or character data mode. When used in character data mode, it shall not include start-stop bits. This data type may include DLCI. The use of the DLCI is indicated by a codepoint in the IP-TLP CONNECT message.

14.5.2 Raw octet compressed

This data type has application with synchronous data streams. This raw data type shall preserve all bits received from the DCE interface. The amount of data exchanged may be reduced by use of simple compression. Repeated octet patterns are coded and removed by the transmitter from the data stream. The receiver decodes the stream and restores it to original form.

14.6 Optional modem relay data types

Gateways shall indicate the capability and support of their receivers for the optional data types defined in this Recommendation. Gateway packet transmitters shall not use an optional data type if the peer gateway receiver does not support it and there is no obligation of the transmitter of an optional data types to use a capability indicated by a receiver.

14.6.1 Character with formatting data type

This data type allows for the transport of Start-Stop characters of different formats. The characters are transmitted unpacked (i.e., one character per octet, one octet per character). This data type shall use the same format rules as defined in Annex B/V.42. The mandatory Start-Stop character capabilities a gateway shall support are Data plus Parity shall equal eight bits and one stop-bit.

There are two forms of this data type; both are indicated as separate options. The first allows for the changing of character format during a MR session and the second does not. Each type has a unique message ID.

14.6.2 Raw bit compressed data type

This data type is used in the same application as the raw octet compressed type. This format codes and decodes N-bit repeated patterns. N may have the value of 8.

14.6.3 Framed data type

This optional data type is for use by a pair of consenting gateways if a gateway is able to determine that the data format is Framed data consistent with ISO/IEC 3309 and 4335. If this data type is selected by the gateways, it may transmit the data with the framing elements removed. These elements if removed shall be replaced by the receiver such that the data remains consistent with ISO/IEC 3309 and 4335. The means and method by which a gateway determines the data type is beyond the scope of this Recommendation.

This data type shall not be used when either or both gateways have negotiated V.42 or Annex A/V.42 (1996).

14.7 Gateway-to-gateway control channel functionality and interfaces

The gateway-to-gateway control channel shall be reliable and provide expedited delivery of control information (IP-TLP messages).

15 Modem-over-IP functionality and interfaces

15.1 Gateway-to-gateway protocol definitions and procedures

15.1.1 General

The gateway-to-gateway communication is specified by the ASN.1 description in Annex A. This description complies with the specification of ASN.1 (see ITU-T Rec. X.680). The ASN.1 encoding in Annex A shall employ the BASIC-ALIGNED version of Packed Encoding Rules (PER) according to ITU-T Rec. X.691. In the case of a conflict between the ASN.1 and the text, the ASN.1 governs.

15.1.2 Bit and octet transmission order

Transmission order is as defined in Internet RFC 791 "Internet Protocol," quoted herein as reference:

- The order of transmission of the header and data described in this Recommendation is resolved to the octet level. Whenever a diagram shows a group of octets, the order of transmission of those octets is the normal order in which they are read in English. For example, in the following diagram the octets are transmitted in the order they are numbered.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1								2								3								4							
5								6								7								8							
9								10								11								12							

Figure 12/V.150.1 – Transmission order of octets (based on RFC 791, Figure 10)

- Whenever an octet represents a numeric quantity the left most bit in the diagram is the high order or most significant bit. This is, the bit labelled 0 is the most significant bit. For example, the following diagram represents the value 170 (decimal).

0	1	2	3	4	5	6	7
1	0	1	0	1	0	1	0

Figure 13/V.150.1 – Significance of bit (based on RFC 791, Figure 11)

- Similarly, whenever a multi-octet field represents a numeric quantity the left most bit of the whole field is the most significant bit. When a multi-octet quantity is transmitted the most significant octet is transmitted first.

15.1.3 V.42 I/UI frame preservation

Information is copied between V.42 I/UI frames and the appropriate MoIP gateway PDU without regard to any field structure of the V.42 I/UI frames. It is copied as a sequence of octets, with the order of the octets preserved.

15.2 Gateway capability and call set-up messages

This clause defines the functionality of the messages that are exchanged between gateways during the Call Set-up phase. These definitions are used by the following protocols: Annex P/H.323, H.248 (TBD), H.245 and SIP/SDP. The values shown in this set of messages represent what should

be functionally indicated by the signalling protocol. Actual values are outside the scope of this Recommendation.

NOTE – In the following definitions default parameter values, if they exist, are shown in bold.

15.2.1 V.150.1 version

This is the version of this Recommendation that the gateway implements. See 1.1.

15.2.2 TCX definitions

The following definitions are included in the Call Set-up message. These are used as part of the TCX procedures as defined in 22.2.

15.2.2.1 Supported trans-compression capability

(Mnemonic: tcxMode) This message indicates the TCX capability of the gateway. Only one mode should be indicated.

Table 2/V.150.1 – Supported TCX capability values

Parameter	Value
Supported TCX capability	Non-TCX/ Single-TCX/Double-TCX

15.2.2.2 Compression modes available

(Mnemonic: cpxSupport) This bit field indicates the compression capabilities the gateway is able to support.

Table 3/V.150.1 – Optional compression modes available

Optional compression mode	Value
V.44	Available/Not Available
MNP5 mode (See Appendix VI)	Available/Not Available

15.2.2.3 V.42 *bis* parameters

(Mnemonic: v42bisParam) If the gateway supports V.42 *bis* compression this message would indicate the maximum parameters the gateway supports for V.42 *bis*.

Table 4/V.150.1 – V.42 *bis* parameters

Mnemonic	Description
V42bNumCodewords	Proposed number of codewords. Valid values from 512 to 65535.
v42bMaxStringLength	Maximum string length. Valid values from 6 to 250.

15.2.2.4 V.44 parameters

(Mnemonic: v44Param) If the gateway supports V.44 compression as indicated above, this message would indicate the maximum parameters the gateway supports for V.44.

Table 5/V.150.1 – V.44 parameters

Mnemonic	Description
v44NumTxCodewords	Proposed number of codewords in the transmitter. Valid values from 256 to 65535.
v44NumRxCodewords	Proposed number of codewords in the receiver. Valid values from 256 to 65535.
v44MaxTxStringLength	Maximum string length in the transmitter. Valid values from 32 to 255.
v44MaxRxStringLength	Maximum string length in the receiver. Valid values from 32 to 255.
V44LenTxHistory	Proposed size of the transmitter history. Valid values from 512 to 65535.
V44LenRxHistory	Proposed size of the receiver history. Valid values from 512 to 65535.

15.2.3 Modem relay mode

This parameter indicates the gateways Modem Relay type is of type V-MR or U-MR.

Table 6/V.150.1 – Modem relay mode

Parameter	Value
Supported Modem Relay Type	V-MR/U-MR

15.2.4 Modulation support

A list of the V-series modulations supported in Modem Relay mode by the gateway.

The list is comprised of V.17, V.21, V.22/V.22 *bis*, V.23 (duplex and half-duplex), V.26 *bis*, V.26 *ter*, V.27 *ter*, V.32/V.32 *bis*, V.34 (duplex and half-duplex), V.90 (analogue and digital), V.91 and V.92 (analogue and digital).

15.2.5 VBD parameters

The specification of the VBD parameters are beyond the scope of this Recommendation. See 8.1.

15.2.6 Answer tone treatment

As part of the Answer tone processing, all MoIP gateways are required to support and indicate at a minimum, the following RFC 2833 events:

ANS (32), /ANS (33), ANSam (34) and /ANSam (35).

15.2.7 SPRT parameters

If the default IP-TLP SPRT is to be used, then the following parameters are required to be indicated:

Maximum payload size of SPRT channels 0 to 3 and maximum window size for SPRT channels 1 and 2.

15.2.8 FoIP support

This parameter indicates that the gateway has the ability to support T.38 FoIP. It is not necessary for an external signalling mechanism to include specific indication of this ability in the MoIP messaging set, if an alternative mechanism is already defined. However, the information as to the peer gateways ability to support FoIP should be passed to the MoIP application. This will allow the gateway to make appropriate decisions should it determine that a connection is a facsimile call during its discrimination procedures.

Table 7/V.150.1 – FoIP support values

Parameter	Value
T.38 FoIP Supported	Supported/Not Supported

15.2.9 JM delay support

This parameter indicates the ability of a gateway to support the JM delay procedure as defined in 20.7. The default is Not Supported. If both gateways have negotiated connection scenario MR1 and both indicate JM delay procedure support they shall follow the procedures as defined in 20.7 for both On-ramp and Off-ramp gateways.

Table 8/V.150.1 – JM delay support values

Parameter	Value
JM Delay Procedure Supported	Supported/Not Supported

15.2.10 Double-to-double TCX preference

This parameter indicates the preference of a D-TCX gateway, when connecting to another D-TCX gateway as to which TCX mode it shall use as the basis for its initial configuration. The default is Single.

Table 9/V.150.1 – Double-to-double TCX support values

Parameter	Value
D-TCX to D-TCX initial preference	Single/Double

15.2.11 Call discrimination mode selection

(Mnemonic: *CDSCselect*) This parameter indicates which of the three call discrimination modes a gateway prefers. The three possible mode choices for this parameter are (refer to 20.3): Audio (RFC 2833), VBD-select and Mixed.

Table 10/V.150.1 – Supported TCX capability values

Parameter	Value
Call discrimination mode Preferred	Audio (RFC 2833)/VBD-select/Mixed

15.2.12 ToIP support

The support of ToIP is for future study.

15.3 Gateway call discrimination messages

During this phase of MoIP gateway operation, the following signals may be transmitted or received. The support of both SSE and RFC 2833 events ANS, /ANS, ANSam and /ANSam is required. The use of Tone Packets as defined in section 4 of RFC 2833 shall not be used for transporting the Answer Tone events.

Table 11/V.150.1 – Call discrimination messages

Title	Transport channel	Event codes (decimal)	Functional description of message content	Comments
ANS	RFC 2833	32	G2 detect ANS	Uses section 3 of RFC 2833
/ANS	RFC 2833	33	G2 detect /ANS	Uses section 3 of RFC 2833
ANSam	RFC 2833	34	G2 detect ANSam	Uses section 3 of RFC 2833
/ANSam	RFC 2833	35	G2 detect /ANSam	Uses section 3 of RFC 2833
Audio Mode	SSE (Note)	1	Switch to Audio	Includes Reason Code
VBD mode	SSE (Note)	2	Switch to VBD per capabilities	Includes Reason Code
Modem Relay Mode	SSE (Note)	3	Switch to MR per capabilities	Includes Reason Code plus Information field
Fax Relay	SSE (Note)	4	Switch to FoIP	Procedures for this media switch are for further study
Text Relay	SSE (Note)	5	Switch to ToIP	Procedures used for this media switch are for further study
NOTE – The SSE protocol is defined in Annex C. The Event codes are defined also in the same annex.				

15.3.1 SSE reason identifier codes

The following are the Reason Identifier Codes to be used with the SSE protocol as defined in Annex C.

Table 12/V.150.1 – SSE RIC codes for MoIP

Name	Code (decimal)	Additional informational content
Null	0	None
CM	1	Available modulation modes as indicated in the CM sequence (Format is defined in Table 13)
JM	2	Available modulation modes as indicated in the JM sequence (Format is defined in Table 13)
AA	3	None
AC	4	None
USB1	5	None
SB1	6	None
S1	7	None
V.21 Ch2	8	None
V.21 Ch1	9	None
V.23 High channel	10	None
V.23 Low channel	11	None
Tone (2225 Hz)	12	None
V.21 Ch2 HDLC Flags	13	None
Indeterminate signal	14	None
Silence	15	None

Table 12/V.150.1 – SSE RIC codes for MoIP

Name	Code (decimal)	Additional informational content
CNG	16	None
Voice	17	None
Time-Out	18	Indicates that a timeout has occurred. The timeout event and format is defined in Table 14.
p' State Transition	19	None
Cleardown	20	Indicates reason for clear down. Format is defined in Table 15.
ANS/CED (2100 Hz)	21	None
ANSam	22	None
/ANS	23	None
/ANSam	24	None
QC1a	25	None
QC1d	26	None
QC2a	27	None
QC2d	28	None
Cre	29	None
CRd	30	None
Reserved	31-127	Reserved for use by ITU-T
Vendor Specific	128-255	For use by vendor.

Table 13/V.150.1 – CM and JM additional information format in SSE payload (Bits 16 to 31)

Bit numbers																Modulation availability
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
X																PCM mode
	X															V.34 duplex
		X														V.34 half-duplex
			X													V.32/V.32 bis
				X												V.22/V.22 bis
					X											V.17
						X										V.29 half-duplex
							X									V.27 ter
								X								V.26 ter
									X							V.26 bis
										X						V.23 duplex
											X					V.23 half-duplex
												X				V.21
													X			V.90 or V.92 analogue
														X		V.90 or V.92 digital
															X	V.91

Table 14/V.150.1 – SSE timeout reason code definitions in SSE payload (Bits 16 to 31)

Time-out MSB:LSB	Definition
b16:b23	This field indicates the eight-bit code used to identify the timeout event. The values for this field are: 0: NULL 1: Call discrimination timeout 2: IP-TLP timeout 3: SSE explicit acknowledgement timeout
b24:b31	This field provides an eight-bit field which may be used to provide additional vendor specific information regarding the timeout.

Table 15/V.150.1 – SSE clear down reason code definitions in SSE payload (Bits 16 to 40)

Cleardown MSB:LSB of SSE payload	Definition
b16:b23	This field indicates the eight-bit code used to identify the clear down event. The values used for this field are the same as used for bits 0 through 7 of the IP-TLP CLRDOWN message and are defined in Table 28.
b24:b31	Reserved for use by the ITU-T. Each of these shall be set to binary-zero.
b48:b55	This field contains the eight-bit vendor-Tag as defined in clause 8/V.150.0.
b56:b63	This field provides an eight-bit field which may be used to provide additional vendor specific information regarding the clear down.
NOTE – The fields used to optionally indicate vendor-specific information uses the extension capability of the SSE payload as described in C.3.2.	

15.4 Modem relay status messages

Table 16 lists the IP-TLP messages and their message identifier used to transport MoIP control and user data. This clause defines the functionality and format of these messages.

Table 16/V.150.1 – List of modem relay messages

Message Name	Message ID (decimal)	Transport Channel	Description
NULL	0	N/A	Reserved for use by ITU-T
INIT	1	2	Sent upon IP-TLP activation. Indicates: transport channel capabilities, data type and XID profile exchange
XID_XCHG	2	2	Message contains the XID information to be used for compression negotiation for connection scenarios in which either gateway is a N-TCX
JM_INFO	3	2	Contains JM signal information for CM-JM procedure
START_JM	4	2	See JM delay procedures in 20.7
CONNECT	5	2	Sent when gateway is ready to exchange user-data. Message indicates the local dial-up link connection parameters (e.g., modulation, data signalling rates, error control and compression)

Table 16/V.150.1 – List of modem relay messages

Message Name	Message ID (decimal)	Transport Channel	Description
Break	6		Sent when a gateway detects a break signal from its local DCE
Break_Ack	7		Used to indicate to a peer gateway that a break acknowledge signal has been detected
MR_EVENT	8	2	Sent by gateway to indicate a change of data mode state during modem relay. Includes physical layer parameters (modulation, data signalling rate and symbol rate), Retrain and Rate renegotiation event indication
CLEARDOWN	9	2	Indicates cleardown event and reason
PROF_XCHG	10	2	Indicates to the peer gateway the XID profile of the gateway's local modem
Reserved	11-15	N/A	Reserved for use by ITU-T
I_RAW-OCTET	16	1 or 3	Raw Octet compressed
I_RAW-BIT	17	1 or 3	Raw bit compressed (optional)
I_OCTET	18	1 or 3	Octet without formatting
I_CHAR-STAT	19	1 or 3	Character with static formatting (optional)
I_CHAR-DYN	20	1 or 3	Character with dynamic formatting (optional)
I_FRAME	21	1 or 3	Framed Data (optional)
Reserved	22-99	N/A	Reserved for use by ITU-T
VENDOR	100-127	N/A	Vendor specific messages

15.4.1 Initialization message (INIT)

This message is sent immediately upon IP-TLP activation. It indicates that an IP-TLP is active on the gateway sending the message. The message indicates the gateways capability for optional data types, IP-TLP receiver channel and XID profile exchange.

Table 17/V.150.1 – INIT definitions

INIT bits MSB:LSB	Definition
0	NECRxCH if set to binary-one indicates to the gateway receiving the message that if the peer gateway has no Error Control then it prefers to receive on the IP-TLP using the non-default transport channel (RSC). If binary zero then the default channel is used (USC).
1	ECRxCH if set to binary-one indicates to the gateway receiving the message that if the connection ends up in an asymmetric non-EC configuration and if the peer gateway is using an Error Control protocol, then the local gateway prefers to receive on the IP-TLP using the non-default transport channel (USC). If binary zero then the default channel is used (RSC).
2	XID Profile exchange . This optional capability is supported if set to a binary one.

Table 17/V.150.1 – INIT definitions

INIT bits MSB:LSB	Definition
3	Asymmetrical Data Types. If this bit is set it indicates that the gateway has the optional capability of supporting different data types in its transmitter and receiver simultaneously.
4:15	Optional MoIP Data types. This field indicates the optional data types that are supported by the gateway's receiver. Support is indicated by a value of binary ONE in the appropriate bit position. A binary ZERO indicates no support. b4: I_RAW-BIT support b5: I_FRAME support b6: I_CHAR-STAT support b7: I_CHAR-DYN support b8...b15: Reserved for ITU-T; these bits are set to zero by the transmitter and not interpreted by the receiver.

15.4.2 N-TCX XID exchange message (XID_XCHG)

This message is sent by the gateway to indicate the XID parameters for compression negotiation. XID_MSG may only be used in connection scenario MR1.

Table 18/V.150.1 – XID_XCHG definitions

XID_XCHG bits MSB:LSB	Definition
0:7	Error correcting protocol (ECP). The following values are used to indicate the error correction protocol contained in the local link negotiation. 0: No link layer protocol (compression is not negotiated) 1: V.42/LAPM 2: Annex A/V.42 (1996) 3...255: Reserved
8:15	XID/LR field Octet 1: These fields are only valid if the ECP field above has the value of 1 or 2. This field contains the XID/LR compression parameters. The XID directional parameters have the same reference as the view of the originating modem (i.e., transmit direction is the direction of flow from the originating modem towards the answering modem). This octet indicates the compression supported, b8: V.42 <i>bis</i> b9: V.44 b10: MNP5 b11...b15: Reserved for ITU-T; these bits are set to zero by the transmitter and not interpreted by the receiver.
16:23	XID/LR field Octet 2: Indicates V.42 <i>bis</i> data compression request (P0)
24:39	XID/LR field Octet 3 and 4: V.42 <i>bis</i> number of codewords (P1)
40:47	XID/LR field Octet 5: V.42 <i>bis</i> maximum string length (P2)
48:55	XID/LR field Octet 6: V.44 capability (C0)

Table 18/V.150.1 – XID_XCHG definitions

XID_XCHG bits MSB:LSB	Definition
56:63	XID/LR field Octet 7: V.44 data compression request (P0)
64:79	XID/LR field Octet 8 and 9: V.44 number of codewords in transmit direction (P1T)
80:95	XID/LR field Octet 10 and 11: V.44 number of codewords in receive direction (P1R)
96:103	XID/LR field Octet 12: V.44 maximum string length in transmit direction (P2T)
104:111	XID/LR field Octet 13: V.44 maximum string length in receive direction (P2R)
112:127	XID/LR field Octet 14 and 15: V.44 length of history in transmit direction (P3T)
128:143	XID/LR field Octet 16 and 17: V.44 length of history in receive direction (P3R)
NOTE – Compression parameter fields that are not selected in the compression-supported fields shall be present and set to zero.	

15.4.3 V.8 JM Information (JM_INFO)

This message is transmitted by G2 to indicate the JM signal it receives from its local modem to G1. This message is used during the CM-JM procedure. JM signal information categories used to indicate modulation (i.e., modulation modes and PCM modem availability) shall be included. The following information categories, if present in the received JM, should also be included: Call Function, Protocol and PSTN Access. Other information categories shall not be included in JM_INFO.

The JM_INFO messages are defined to be of variable length. Each information category consists of 16 bits. The first four bits contain a category identifier and the remaining 12 bits contain the information. If JM_INFO contains multiple categories then bits 0 to 15 are repeated for each instance.

Table 19/V.150.1 – JM_INFO definitions

JM_INFO bits MSB:LSB	Definition																																			
0:3	Category ID: This field indicates the category information being indicated in the next field. Bits <table> <tr> <th>b0</th> <th>b1</th> <th>b2</th> <th>b3</th> <th></th> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>Call Function 1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>Modulation modes 5</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>Protocols</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>PSTN access</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>PCM modem availability</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>Indicates that this is an extension of the current category</td> </tr> </table>	b0	b1	b2	b3		1	0	0	0	Call Function 1	1	0	1	0	Modulation modes 5	0	1	0	1	Protocols	1	0	1	1	PSTN access	1	1	1	0	PCM modem availability	0	0	0	0	Indicates that this is an extension of the current category
b0	b1	b2	b3																																	
1	0	0	0	Call Function 1																																
1	0	1	0	Modulation modes 5																																
0	1	0	1	Protocols																																
1	0	1	1	PSTN access																																
1	1	1	0	PCM modem availability																																
0	0	0	0	Indicates that this is an extension of the current category																																
4:15	Category information: This field contains the JM signal information. If more than 12 bits are used then the extension mechanism is used to complete the fields. The values defined for each of the allowable categories are defined in Tables 20 through 24.																																			

Table 20/V.150.1 – Call function values for JM_INFO

Bits 4 5 6	Call function values
1 0 0	PSTN Multimedia Terminal (ITU-T Rec. H.324)
0 1 0	Textphone (ITU-T Rec. V.18)
1 1 0	Videotext (ITU-T Rec. T.101)
0 0 1	Transmit facsimile from call terminal (ITU-T Rec. T.30)
1 0 1	Receive facsimile at call terminal (ITU-T Rec. T.30)
0 1 1	Data (V-series modem Recommendations)

Table 21/V.150.1 – Modulation mode values for JM_INFO

Bit	Modulation modes
4	1 denotes V.34 duplex availability
5	1 denotes V.34 half-duplex availability
6	1 denotes V.32 <i>bis</i> /V.32 availability
7	1 denotes V.22 <i>bis</i> /V.22 availability
8	1 denotes V.17 availability
9	1 denotes V.29 half-duplex availability (as used in ITU-T Rec. T.30)
10	1 denotes V.27 <i>ter</i> availability
11	1 denotes V.26 <i>ter</i> availability
12	1 denotes V.26 <i>bis</i> availability
13	1 denotes V.23 duplex availability
14	1 denotes V.23 half-duplex availability
15	1 denotes V.21 availability

Table 22/V.150.1 – Protocol values for JM_INFO

Bits 4 5 6	Protocol values
1 0 0	Calls for LAPM protocol according to ITU-T Rec. V.42 NOTE – This value also indicates that the modem is able to bypass the ODP/ADP exchange per 9.3.1/V.92.

Table 23/V.150.1 – PSTN access values for JM_INFO

Bits 4 5 6	PSTN access category values
X	1 denotes that the call DCE is on a cellular connection
X	1 denotes that the answer DCE is on a cellular connection
X	1 denotes a DCE on a digital network connection 0 denotes a DCE on an analogue network connection