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INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

INTERNETWORK INTERFACES

PARAMETER EXCHANGE FOR ISDN INTERWORKING

ITU-T Recommendation I.515

(Previously "CCITT Recommendation")

FOREWORD

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

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

ITU-T Recommendation I.515 was revised by the ITU-T Study Group XVIII (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

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

CONTENTS

PARAMETER EXCHANGE FOR ISDN INTERWORKING

(Melbourne, 1988; amended at Helsinki, 1993)

1 General

1.1 Scope

The objective of this Recommendation is to provide overall parameter exchange principles and functional descriptions for ISDN interworking. This Recommendation describes the principles for parameter exchange mechanisms. It is recognized that depending on the available (end-to-end) signalling capability, the exchange of parameters may use either out- or in-band procedures.

Parameter exchange may be necessary to establish compatible interworking functions for a variety of applications. Typical examples where parameter exchange takes place include, terminal adaption compatibility establishment, modem type selection and voice encoding compatibility establishment. This does not imply, however, any requirement for an ISDN to support network based modem interworking.

Figure 1 illustrates several voice and data applications, supported by different networks and mechanisms. Parameter exchange may be necessary where interworking between different terminals or networks (as per other Recommendations) is required.

NOTE – Where interworking procedures exist, the appropriate references are made herein.

1.2 Definitions

Use is made of the following terms within this Recommendation. These terms do not necessarily refer to any existing protocol structure, rather they define information requirements in the context of this Recommendation.

bearer capability information: Specific information defining the lower layer characteristics of the network.

low layer compatibility information: Information defining the lower layer characteristics of a TE or TA.

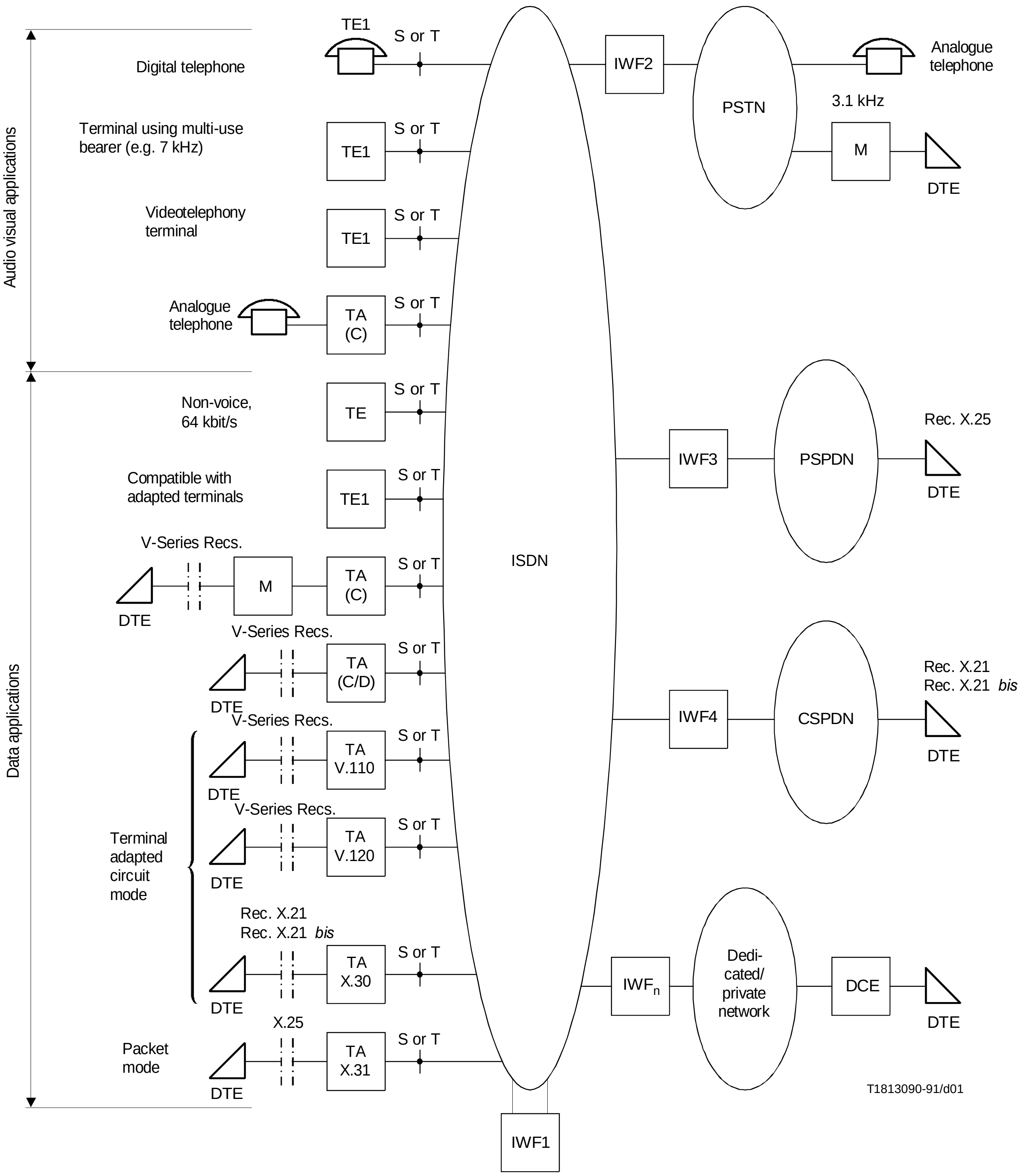
high layer compatibility information: Information defining the higher layer characteristics of a terminal.

protocol identifier: Information defining the specific protocols used by a terminal to support data transfer.

progress indicator: Information supplied to indicate to the ISDN terminal that interworking has occurred.

out-band parameter exchange: Information exchanged via signalling channels which are not within the channel used for user information transfer.

in-band parameter exchange: Information exchanged using the same information channel as that used for the user information transfer.



IWF	Interworking function (may include: physical requirements, signalling requirements, terminal adaptation modulation,etc.)
M	Modem
TA(C)	Terminal adaptor with codec
TA(C/D)	Terminal adaptor with codec, modem and support of V.110 or V.120. This terminal or terminal adaptation may use the Multi-Use-Bearer service and associated procedure specified in Recommendation Q.931.

NOTES

1 IWFs may be located:
a) within the network(s);
b) separate to the network(s);
c) within the customers premises.

2 The requirement for interworking between terminals may not be inferred from this figure.

3 This figure is not exhaustive.

FIGURE 1/I.515

2 Principles

2.1 Types of parameter exchanges

Three types of parameter exchange need to be considered:

i) end-to-end, out-band as shown in Figure 2. Parameter exchange is accomplished via the D-channel and Signalling Systems No. 7;

ii) end-to-end, in-band as shown in Figure 3;

iii) parameter exchange to select IWFs as shown in Figure 4.

The in-band parameter exchange occurs after the establishment of an end-to-end connection and may provide for establishment of compatibility between the endpoints, based on characteristics such as protocol, rate adaption scheme and modem type.

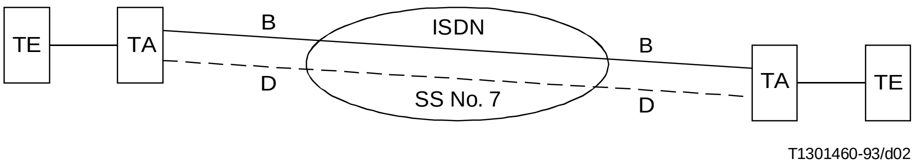
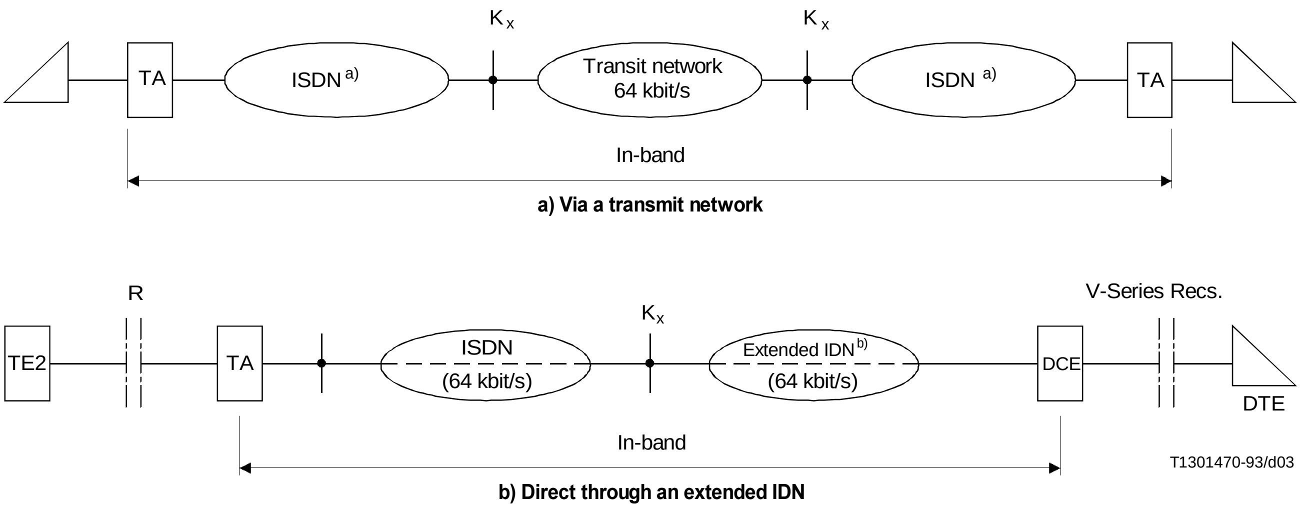


FIGURE 2/I.515

Out-band parameter exchange via D-channel



a) 64 kbit/s connection type is assumed for ISDN.

b) The extended IDN shown has a 64 kbit/s transmission channel (see Recommendation I.231), however its signalling system is not compatible with that of the ISDN.

FIGURE 3/I.515

In-band parameter exchange

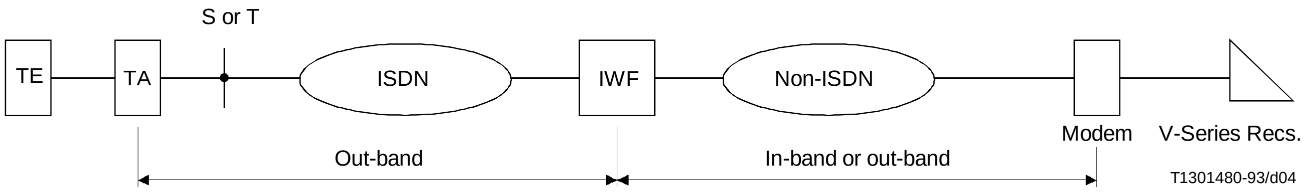


FIGURE 4/I.515

Parameter exchange to select IWFs

2.2 Relationship of parameter exchange to call establishment

Parameter exchange may occur

i) prior to call establishment (call negotiation). In this case parameter exchange will occur using out-band techniques;

ii) after call establishment, prior to information transfer. In this case parameter exchange may occur using either in-band or out-band techniques;

iii) during the information transfer phase of the call. In this case parameter exchange will occur using either in-band or out-band techniques.

2.2.1 Parameter exchange prior to call establishment (call negotiation)

Call negotiation may be used to satisfy a number of basic call requirements in ISDN. In addition, call negotiation may be necessary for interworking as described in Recommendation I.510 (between terminals, services and networks) for:

a) terminal section (see Recommendations I.333, Q.931, Q.932);

b) selection of interworking requirements when interworking between ISDN and other dedicated networks is identified (e.g. modem type);

c) the appropriate selection of network (ISDN or other network) functions to support the service required (e.g. use of call progress indicator);

d) the selection of network functions when interworking between incompatible terminals is identified or when interworking of different services is required.

Each of the requirements a) through d) above are necessary during the call establishment phase. Therefore, call or service negotiation mechanisms should be included within basic call establishment procedures. Further study is required.

2.2.1.1 Call negotiation types

Three types of call negotiation are currently envisaged:

- user to network;
- network to user;
- user to user.

The relationship between user-to-user call negotiation and network-to-user call negotiation required further study.

Call negotiation in each of the above cases may involve the forwarding of parameters to the destination, may involve forwarding of parameters on request, or may involve forward and backward negotiation to establish compatible terminal and network parameters.

2.2.1.2 Information elements available for call negotiation

Three information elements are currently associated with call negotiation (see Note):

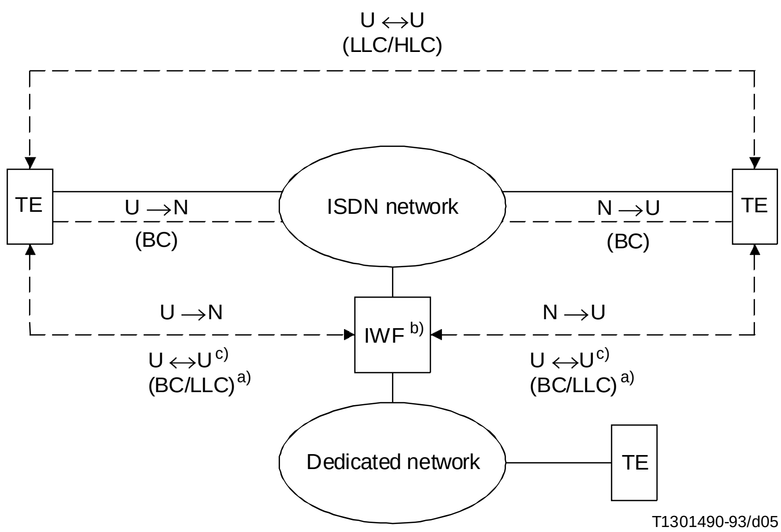
- bearer capability (BC);
- low layer compatibility (LLC);
- high layer compatibility (HLC).

The relationship of these information elements to parameter exchange functions is for further study.

NOTE – BC, LLC, HLC are information elements defined in Recommendation Q.931.

2.2.1.3 Transfer of information

The transfer of information associated with call negotiation is illustrated in Figure 5.



U →N	User-to-network	LLC	Lower layer compatibility
N →U	Network-to-user	HLC	High layer compatibility
U ↔U	User-to-user	BC	Bearer capability

a) The examination of LLC by the network when the IWF is not an addressed entity, is for further study.

b) The IWF can be distributed (see Recommendation I.510 for definiton of IWF).

c) When the IWF is on the customer premises, examination of additional information elements to satisfy basic call requirements may be appropriate (e.g. sub-adress called party ID).

FIGURE 5/I.515

Transfer of information associated with call negotiation

2.2.2 Parameter exchange after call establishment and prior to information transfer phase

This parameter exchange may be necessary when signalling to allow adequate compatibility checking during the call set-up phase is not available, or when additional capability checking is required due to characteristics of the terminals which are not defined in call establishment procedures.

When out-band parameter exchange is used refer to 3.1.2.

When in-band parameter exchange is used refer to 3.2.1.

2.2.3 Parameter exchange during information transfer phase

This parameter exchange may be necessary when configurations change during the information transfer phase (e.g. maintenance, sub-channel information). Detailed aspects are for further study.

3 Parameter exchange procedures

3.1 Out-band parameter exchange

3.1.1 Prior to call establishment

Refer to Recommendations Q.931 and Q. 764. Other protocols are for further study.

3.1.2 After call establishment and prior to information transfer phase

Refer to Recommendations Q.931 and Q.764.

3.1.3 During information transfer phase

Refer to Recommendations Q.931 and Q.764.

3.2 In-band parameter exchange

3.2.1 After call establishment and prior to information transfer

The following parameter exchange sequence identifies one method of establishment compatibility during interworking between an ISDN and existing networks and between ISDNs:

- call establishment phase (e.g. see Recommendations Q.931 and Q.764);
- originating terminal changes from idle condition to busy condition;
- connection enters parameters exchange phase;
- connection enters information transfer phase.

3.2.1.1 Voice services

Refer to Recommendation G.725.

3.2.1.2 Parameter exchange mechanism for terminal adaption protocol identification

Some in-band parameter exchange (IPE) procedures are in existence, e.g. Appendix I/V.110. Two circuit mode terminal adaption procedures are defined within CCITT (i.e. I.463/V.110 and I.465/V.120). In many countries, the terminal adaptor (TA) design may not be controlled by the Administration so that special forms of terminal adaption may be deployed. To support multiple forms of terminal adaption in a mixed ISDN/non-ISDN network, terminal adaption implementations which support multiple terminal adaption protocols will be required. For use with such implementations, a method is needed for some applications to identify the specific terminal adaption protocol to be used by the multifunctional adaptor (MTA) devices. This will allow the terminal equipment (or appropriate network component), to release the call where compatibility cannot be achieved, or to request the network to provide an appropriate interworking function.

It should be noted that it is good practice to design data terminals, for circuit-mode applications, which can automatically answer or originate calls, automatically establish compatibility if possible and, if necessary, to disconnect when connected to an incompatible terminal.

Though it is recognized that out-band procedures are preferable where applicable (i.e. intra-ISDN situations), for interworking with dedicated networks, in-band parameter exchange procedures may be required.

Alternative methods exist for distinguishing between terminal adaption protocols. One satisfactory method is the use of self-identification by examining the incoming bit stream. The method would be based on the need to provide, in any TA or TE1, the ability to determine when it is connected to an incompatible TE1 or TA/TE2 or, through an IWF, with an incompatible terminal or another network. Appendix II describes one such procedure.

An alternative satisfactory method is to use protocol identification (PID) procedure. Appendix I presents an in-band parameter exchange procedure for establishing a common terminal adaption (TA) protocol between communicating TA devices.

3.2.2 During the information transfer phase

For further study.

4 Parameter exchange functions

Parameters exchanged to support interworking may be divided into the following five categories. These parameters may be exchanged end-to-end or between an endpoint and an IWF. The list of parameters presented here are examples; for any given instances of communication, different parameters may be required.

4.1 Numbering parameters

- subscriber number;
- sub-address;
- terminal selection (see Recommendation I.333).

4.2 Protocol control parameters

Protocol control parameters can be used to identify the protocol supported. An example is the terminal adaption protocol supported, defined in Recommendations V.110 and V.120.

4.3 DTE/DCE configuration parameters

DTE/DCE configuration parameters are used to identify specific transmission or communication capabilities of the called DTE. The following is a list of such configuration parameters:

- modem type (e.g. V-Series number);
- data rate (e.g. 9.6 kbit/s, 56 kbit/s);
- synchronization (e.g. synchronous or asynchronous);
- parity (odd, even or no parity);
- transmission mode (e.g. half or full duplex);
- number of start/stop bits (e.g. 1 or 2);
- terminal clock source (e.g. network provided, network independent);
- terminal interface signals (e.g. 106, 108);
- sub-channel information.

4.4 Operations and maintenance parameters

Operations and maintenance parameters are used to convey/monitor the status of the DTE/DCE at the terminating points. Status monitored may include

- terminal power (ON or OFF);
- terminal presence (connected or disconnected);
- terminal interface signals status (e.g. 106, 108);
- terminal clock source (e.g. network provided, network independent);
- loopback status (e.g. ON or OFF).

4.5 Network parameters

- bearer service;
- A/μ-law conversion;
- echo control.

5 Parameter exchange for selection of IWF

When an IWF is involved in a connection, parameters can be exchanged to establish compatibility.

There are a variety of techniques that can be used to provide compatibility of functions in an interworking environment. These can be categorized into two types. A single stage approach in which the network automatically inserts the IWF, and a two-stage approach in which the user must provide additional information to complete the interworking connection.

NOTE – For examples of interworking configurations, refer to the appropriate I.500-Series Recommendations.

5.1 Single stage

In a single stage approach, the interworking function is handled automatically by the network. In order to ensure compatibility of the parameters, the following techniques may be used:

i) *Parameter registration (service profile*) – The DTE/DCE parameters are registered with the ISDN.

ii) *Parameter negotiation* – Parameter negotiation may be possible between networks and end-users or between networks or between users to determine parameter compatibility where suitable signalling exists. The signalling capabilities and parameters required may vary and are for further study. For example, see Appendix I/V.110.

iii) *Default parameter identification* – The network provides an interworking function with common parameters. Any DCE must conform to the IWF common parameters.

iv) *Parameter adaption* – The interworking function recognizes and adapts to the end-user's parameters. For example, for ISDN-PSTN the interworking function may adapt to the modulation standard of the modem.

5.2 Two stages

In the two-stage approach, during the first stage, the user accesses the IWF and establishes the required parameters. In the second stage of the call, the IWF uses the parameters to complete the end-to-end connection.

6 Reference

See Recommendation I.500.

Appendix I

Protocol for identification of terminal adaption protocols

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

I.1 As shown in Figure I.1 the total in-band parameter exchange consists of two distinct phases:

a) *Phase 1* – The protocol identification (PID) phase, which occurs at the bearer rate (64 kbit/s);

b) *Phase 2* – The in-band parameter exchange (IPE) which is part of the rate adaption (RA) protocol used during the call.

Both these phases are optional and may or may not be implemented depending on the particular situation.

1) *Phase 1* – PID: After call establishment PID phase begins.

2) *Phase 2* – IPE: The IPE is imbedded within the TA protocol. It is the responsibility of the RA protocol designers to create an IPE that is applicable to the services and requirements of a particular TA protocol. An example is given in Appendix I/V.110 in which a complete IPE is specified for Recommendation V.110.

   – The IPE allows parameters to be exchanged between TA devices to ensure end-to-end compatibility before entering the data (information) phase.

   – In the case of a successful IPE the protocol enters the data (information) phase.

   – In the case of unresolvable differences between the TA devices, the IPE will provide a call progress message that can be used to take further action or clear the call.

I.2 Identification procedure

All TA devices that follow this procedure shall start with the simple protocol identification technique described herein before entering the TA protocol phase. The method is designed especially for digital networks.

The protocol identification is performed during the following three steps after the call is placed by using the normal call establishment procedures:

1) end-to-end synchronization;

2) passing the protocol identifier (PI);

3) making a decision regarding the type of TA to use for the call.

For the case of a device with a PID and one without a PID which interwork, a timer value (N_{pid}) should be set in the PID for defaulting to the preferred terminal adaption protocol. N_{pid} must be long enough to allow for initial line settling and short enough to prevent the PID from causing the terminal adaption protocol to time out and clear its call. The value of timer N_{pid} should be set to allow for long delay connections (e.g. satellites).

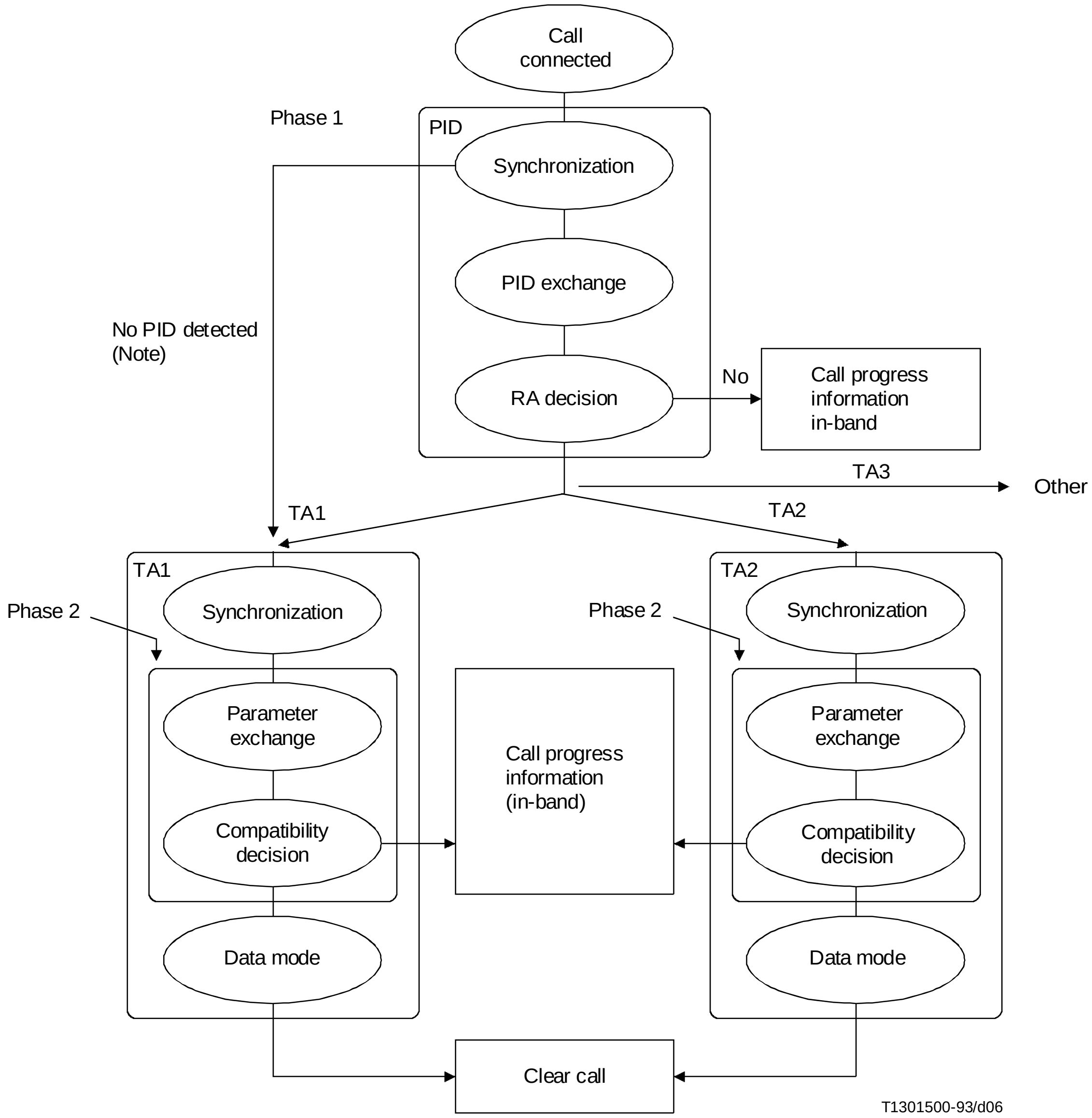
Refer to Figure I.2 for the timer sequence diagram of a successful protocol identification procedure. The sequence and acronyms in Figure I.2 are described in I.3 to I.5.

I.3 End-to-end synchronization

After the physical call has been established, the originating end sends continuous ready bytes (5F in hexadecimal) waiting to detect the answering end. The answering end sends continuous sync bytes (57 in hexadecimal). (See Figure I.3).

When the originating end sees at least 32 contiguous sync bytes (57 in hexadecimal) it is in sync and starts sending continuous sync bytes (57 in hexadecimal).

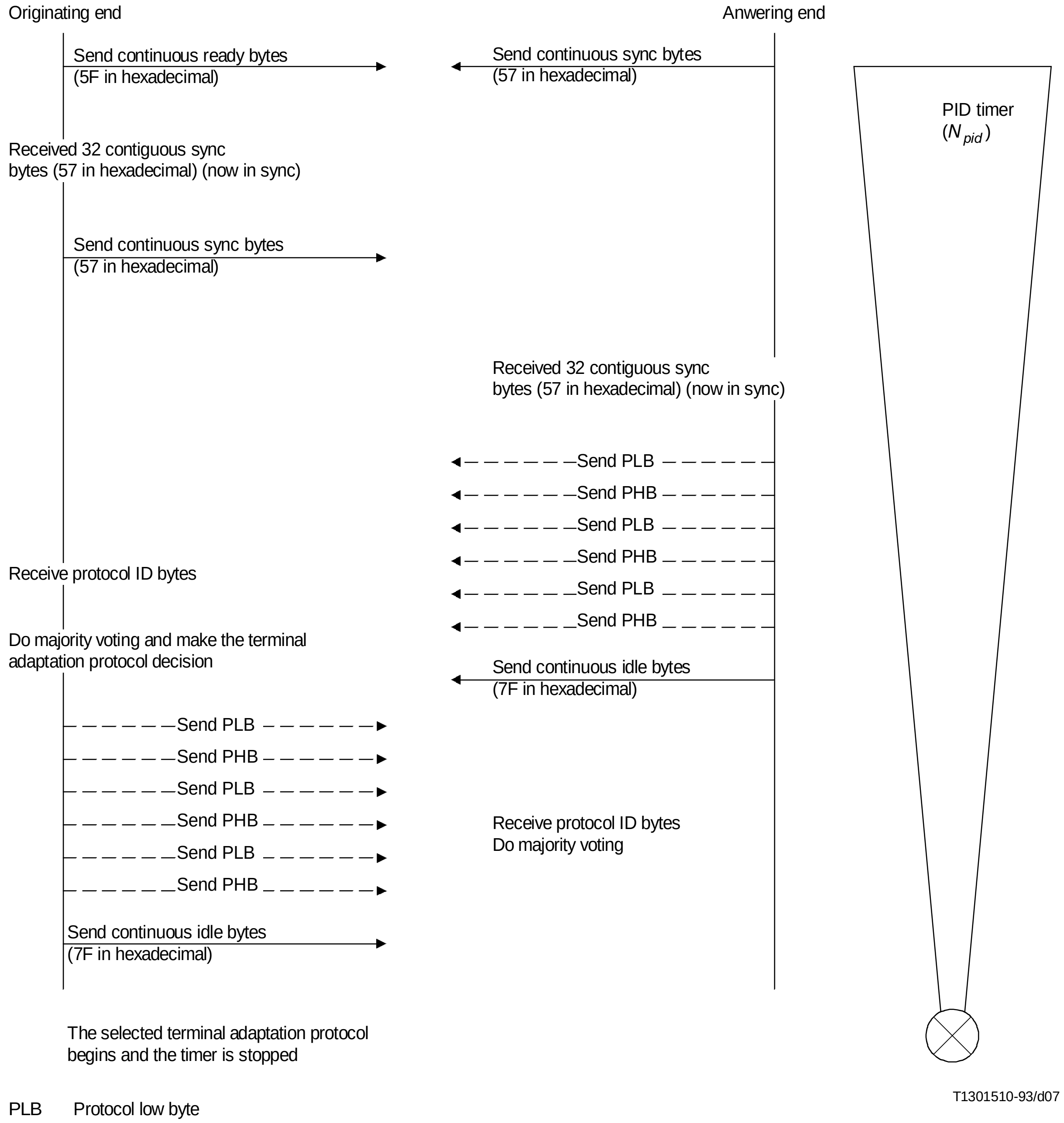
When the answering end sees 32 contiguous sync bytes it is in sync.



NOTE – If no PID is detected, the TA defaults to a user selected TA protocol.

FIGURE I.I/I.515

IPE flow diagram



PLB Protocol low byte
PHB Protocol high byte

NOTE – If the PID phase fails for whatever reason (e.g. no PID, error in PID) and the timer expires, the TA device can default to a preferred TA protocol as shown in the flow diagram of Figure I.1.

FIGURE I.2/I.515

Time sequence diagram of a successful protocol identification procedure

	Initialization bytes								
	B1	B2	B3	B4	B5	B6	B7	B8	
Originating end	0	1	0	1	1	1	1	1	(5F in hexadecimal)
Answering end	0	1	0	1	0	1	1	1	(57 in hexadecimal)

NOTES

1 B1 is transmitted and received first.

2 B8 is set to 1 for transmission and ignored on reception

FIGURE I.3/I.515

The receivers at each end wait for at least 32 contiguous occurrences (4 ms) of the sync byte to be received without corruption before initiating the protocol. The sequence can then proceed to the next step.

The synchronization method described in this clause allows for:

1) settling of the physical circuit;

2) notice in the network;

3) positive identification of the fact that TA devices are present at both ends;

4) transmission on restricted 64 kbit/s links and through networks that use bit 8 for signalling; and

5) simple implementation.

I.4 Passing the protocol identifier (PI)

This is the critical information that is to be passed and therefore a special technique is used to provide robustness in the face of noise, and yet maintain simplicity.

The PI is split into two bytes and three identical pairs are sent (see Figure I.4).

The PI passing technique described in this clause:

1) provides positive identification of the protocol bytes (low and high byte codes);

2) provides redundant pairs of byte codes which allows for a technique to determine the protocol identification in the presence of noise (i.e. repeated three times);

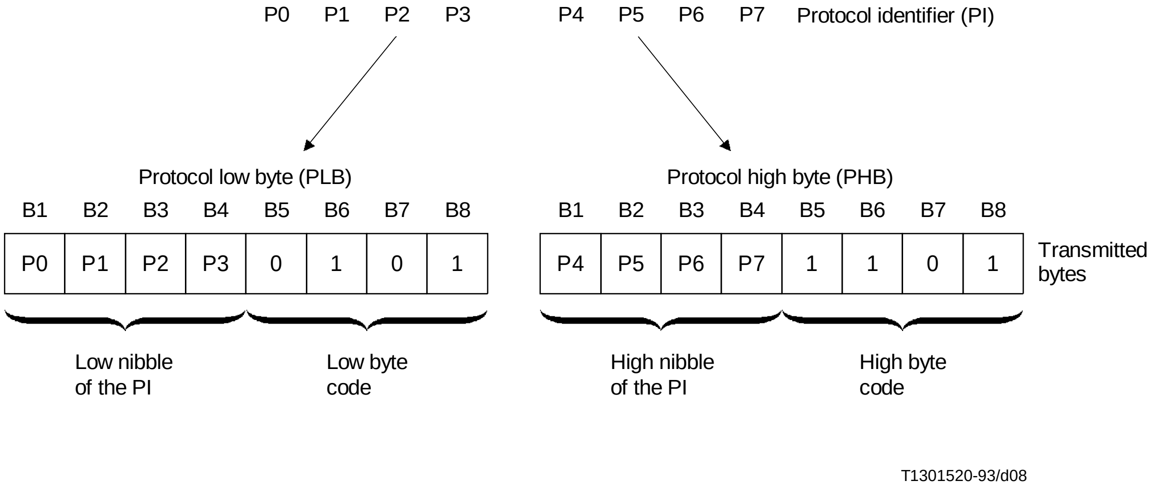
3) allows all eight bits of the PI to be used even on networks that use bit 8 for signalling; and

4) allows for operation on restricted 64 kbit/s networks and networks that use bit 8 for signalling (i.e. guarantees one’s density, bit 8 set to 1).

I.5 TA decision

After the answering end has received 32 contiguous sync-bytes (see I.3), it then sends its PI. The protocols supported by the answering end are coded in the PI byte (see Figure I.5) and transmitted to the originating end. The originating end will check the PI and decide which (if any) TA protocol it wishes to support.

After the answering end has sent its PI, it sends a distinct “idle byte” (see Figure I.6) continuous and waits for the matching PI from the originating end.



NOTE

1 P0 and P4 are the first bits transmitted and received in their respective bytes.

2 Bit 8 of all bytes is set to 1 for transmission and ignored on reception.

3 The transmission sequence, PLB PHB PLB PHB PLB PHB, facilitates detection of the protocol identifier code by the originating ends receiver.

FIGURE I.4/I.515

Protocol identifier

P7	P6	P5	P4	P3	P2	P1	P0
V.110	V.120	X.30	X.31	res.	res.	res.	res.[a)]

a) Use of P0 as an extension bit is for further study.

Example: 11000000 supports V.110 and V.120 protocols.

NOTE – Bits marked “res.” are set to 0, pending future allocation.

FIGURE I.5/I.515

PI interpretation

B1	B2	B3	B4	B5	B6	B7	B8	
0	1	1	1	1	1	1	1	(7F in hexadecimal)

NOTES

1 B1 is transmitted and received first.

2 B8 is set to 1 for transmission and ignored on reception.

FIGURE I.6/I.515

Idle byte

The originating end then sends back its PI with only the bit that corresponds to the desired TA protocol set to 1.

If the originating end cannot support any of the answering end's TA protocols, it sends back a null PI byte (Figure I.7), and then terminates the call using normal call disconnection procedures.

P0	P1	P2	P3	P4	P5	P6	P7	
0	0	0	0	0	0	0	0	(00 in hexadecimal)

FIGURE I.7/I.515

Null PI byte

The method described in this clause:

a) supports various CCITT recognized forms of TA schemes;

b) allows for future TA schemes;

c) limits the proliferation of TA schemes;

d) allows the originating end to control the selection of the common TA protocol; and

e) provides a positive indication of a failed call.

Appendix II

TA protocol self identification

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

This appendix discusses guidelines for self-identification procedures that may be used by multi-protocol terminal adaptor (MTA) implementations in selecting the protocol to be used on an individual connection. It is assumed that the multi-protocol terminal adaptor supports the procedures of Recommendations I.463/V.110 and I.465/V.120. Where out-band signalling is available, multi-protocol terminal adaptors should function in accordance with the protocol negotiated during call set-up. Self-identification procedures are only applicable where such signalling capabilities are not available.

II.1 MTAs intended to interwork with uni-protocol TAs

The MTA may initiate transmission as if it were a uni-protocol TA conforming to any of the capabilities provided. The received signals would be examined by the MTA and the MTA should revert to transmission in accordance with the procedures of the protocol of the uni-protocol TA as indicated by the received signals. If compatibility is not achieved it would provide a disconnect.

It is noted that there is a range of capabilities that may be implemented in TAs conforming to either Recommendations I.463/V.110 or I.465/V.120. For distinguishing the capabilities of the different TA protocols, an MTA should follow the procedures specified in the individual Recommendations.

II.2 MTAs intended to interwork with other MTAs

The MTA should initiate transmission, following the connect indication, in accordance with Recommendation I.465/V.120.

NOTE – Self-identification can be extended to accommodate multiple protocols. It is only necessary to define the priority for the use of each protocol and a retry procedure. The general rule would be that an MTA would always initiate transmission assuming the protocol of the highest priority supported that has not been tried. The MTA would always delay disconnect, when the received signal is not recognized, for a period long enough for the necessary number of retries (this is protocol and implementation dependent – see, for example, Recommendations I.463/V.110 and I.465/V.120).