

Specification Number DPNSS [189-I] — Interworking between DPNSS 1 and ISDN Signalling Systems

ICS 33.040.30; 33.080

National foreword

This Published Document has been prepared by Technical Committee TCT/50. It details the additional requirements, including procedural changes, to those given in DPNSS[188] that are necessary for PBXs to support interworking between DPNSS 1 and ISDN signalling systems.

This Published Document has been produced with place markers for some sections, not yet available, which will be issued as amendments to this Published Document when they become available.

This Published Document is not to be regarded as a British Standard

Summary of pages

This document comprises a front cover, an inside front cover, the NICC title page, the NICC disclaimer page, the table of contents, a blank page, section 1 (5 pages), a blank page, section 2 (1 page), a blank pages, section 3 (1 page), a blank page, section 4 (2 pages), section 4 annex 1 (16 pages), section 5 (10 pages), section 6 (64 pages), an inside back cover and a back cover.

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SPECIFICATION NUMBER DPNSS[189-I]

**INTERWORKING BETWEEN DPNSS 1
AND ISDN SIGNALLING SYSTEMS**

NETWORK INTEROPERABILITY CONSULTATIVE COMMITTEE

Office of Telecommunications

50 Ludgate Hill

London EC4M 7JJ

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INTERWORKING BETWEEN DPNSS 1 AND ISDN SIGNALLING SYSTEMS

SECTION 1 - GENERAL

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HISTORY

Issue 1 - December 1992

Issue 2 - October 2001 - Specification renamed as DPNSS[189-I]
- Glossary referred to DPNSS[188]

1 GENERAL

1.1 This specification details the additional requirements, including procedural changes, to those given in DPNSS[188] that are necessary for PBXs to support interworking between DPNSS 1 and ISDN signalling systems.

1.2 This issue of the specification details only interworking between the DPNSS 1 Simple Call (Telephony or Data) and the ISDN Basic Call. The fact that interworking between DPNSS 1 and ISDN supplementary services is not described in this issue of this specification, however, does not mean that interworking between supplementary services is not possible.

The references in Subsection 4 of this Section list the documents which detail Basic Call requirements for the ISDN signalling systems relevant to this specification.

1.3 Two levels of interworking between DPNSS 1 and the ISDN signalling systems are specified in this specification; these are, Basic Interworking and Enhanced Interworking and are defined as follows:

1.3.1 Basic Interworking defines mapping between DPNSS 1 and ISDN at a Gateway PBX, based on the minimum requirements of each signalling system, as detailed in DPNSS[188], DPNSS[189] and the relevant ISDN signalling standards.

1.3.2 Enhanced Interworking provides maximum integration of DPNSS 1 and ISDN by defining more complex DPNSS 1 signalling procedures than those detailed for Basic Interworking. This is achieved by specifying a comprehensive mapping between DPNSS 1 and ISDN at a Gateway PBX, utilising additional DPNSS 1 Supplementary Information Strings.

NOTE: The fact that interworking is specified in this specification in the terms of paragraphs 1.3.1 and 1.3.2 does not preclude an implementation from achieving a level of interworking between these two extremes, by supporting a subset of the procedures specified for Enhanced Interworking.

1.4 Reference is made in this specification to the terms "Basic Gateway" and "Enhanced Gateway"; these are defined as follows:

1.4.1 A Basic Gateway is a Gateway PBX that supports Basic Interworking as defined in paragraph 1.3.1.

1.4.2 An Enhanced Gateway is a Gateway PBX that supports Enhanced Interworking as defined in paragraph 1.3.2.

1.5 Two Enhanced Gateways linked by DPNSS 1, will be able to provide full transparency on all ISDN Basic Calls that can be supported on 64 kbit/s bearers between two ISDN interfaces. (Transparency of Supplementary Services is outside the scope of this issue of the specification.)

Where two ISDN Gateway PBXs are linked by DPNSS 1, and they are not both Enhanced Gateways, the level of transparency that can be achieved on a call between ISDN interfaces on these PBXs will be dependent on the precise level of functionality offered by each of the PBXs.

The level of functionality offered between the two Gateway PBXs can be determined by reference to the Compliance Tables of SECTION 6, completed for each PBX.

1.6 Where a Supplementary Information String that is defined explicitly for Enhanced Interworking is received by a PBX that does not support that String (for example a Basic Gateway) it shall be processed in accordance with the general procedures for handling unrecognised Strings, as defined in DPNSS[188], SECTION 5.

1.7 The Physical Characteristics (Layer 1) and the Link Access Protocol (Layer 2) are referenced in SECTION 2 and SECTION 3, respectively of this specification and are unchanged for the purposes of interworking.

1.8 The Layer 3 coding and definition of DPNSS 1 Supplementary Information Strings and Parameters and the rules for commonly used mappings between DPNSS 1 message contents and ISDN Information Elements are contained in SECTION 4 of this specification. References in SECTION 4 to DPNSS[188] and ISDN source documents are given for all other coding.

1.9 An outline of the structure of SECTION 6; a guide to the text and MSD conventions; a list of ISDN Progress Descriptions, and an overview of the signalling procedures used in this specification, are contained in SECTION 5.

1.10 Use of the signalling procedures defined in this specification explicitly for interworking between DPNSS 1 and ETS 300 172 (Private ISDN) and ETS 300 102 (Public ISDN) may be appropriate in other contexts, for example:

- when interworking DPNSS 1 with other signalling systems that have similar characteristics to those of ISDN, or
- in conjunction with the signalling procedures defined in DPNSS[188], SECTION 6 to support the interworking of DPNSS 1 with ISDN terminals (or ISDN-like terminals) directly connected to DPNSS 1 End PBXs, or

- by PBXs on behalf of non-ISDN interfaces to utilise the functionality of remote ISDN Gateway PBXs.

1.11 Throughout this specification, the term "PBX" is used to indicate a "switching node" on a network. Generally, this term is used to mean a Private Branch Exchange, but can mean Centrex, Virtual Private Network, or other types of switching nodes, or other types of equipment, including those which have no telephone terminations (eg a transit exchange, a data switch or a multiplexer).

2 COMPLIANCE TABLE FOR DPNSS 1 PBXS INTERWORKING WITH ISDN SIGNALLING SYSTEMS FOR THE BASIC CALL

TABLE 1 indicates for which types of ISDN interface Gateway Working, as defined in this specification, is supported.

For a PBX to be compliant to this specification a "YES" must be entered in at least one of the boxes in TABLE 1 below.

TABLE 1

PBX FUNCTION (ISDN BASIC CALL REFERENCE DOCUMENT)	YES /NO	DETAILED COMPLIANCE
Gateway with a Private ISDN (ETS 300 172)		SECTION 6 Subsection 3.1
Gateway with a Public ISDN (ETS 300 102-1) (Point to Point Mode of Operation)		SECTION 6 Subsection 3.2

3 HISTORY OF DPNSS[189-I]

NOTE: At Issue 1 this specification was known as BTNR 189-I.

Issue 1 - December 1992

Issue 2 - October 2001 - Specification renamed as DPNSS[189-I]
- Specific changes made to the following SECTIONS:
SECTION 1
SECTION 4
SECTION 4, ANNEX 1
SECTION 6

4 REFERENCES

DPNSS[188] Global Issue 7

DPNSS[189] Global Issue 4

ETS 300 102-1 (1990)

ETS 300 172 (1992)

5 GLOSSARY OF TERMS

The glossary for DPNSS 1 appears in SECTION 1 of DPNSS[188].

INTERWORKING BETWEEN DPNSS 1 AND ISDN SIGNALLING SYSTEMS

SECTION 2 - PHYSICAL CHARACTERISTICS (LAYER 1)

REQUIREMENTS

There is no interworking at Layer 1; the DPNSS 1 and ISDN ports on a Gateway PBX shall each conform to their respective Layer 1 standards.

HISTORY

Issue 1 - December 1992

Issue 2 - October 2001 - Specification renamed as DPNSS[189-I]

INTERWORKING BETWEEN DPNSS 1 AND ISDN SIGNALLING SYSTEMS

SECTION 3 - DATA LINK LAYER (LAYER 2)

REQUIREMENTS

There is no interworking at Layer 2; the DPNSS 1 and ISDN ports on a Gateway PBX shall each conform to their respective Layer 2 standards.

HISTORY

Issue 1 - December 1992

Issue 2 - October 2001 - Specification renamed as DPNSS[189-I]

INTERWORKING BETWEEN DPNSS 1 AND ISDN SIGNALLING SYSTEMS

SECTION 4 - MESSAGE CONTENTS CODING AND MAPPING

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ANNEX 1: MAPPING BETWEEN DPNSS 1 MESSAGE CONTENTS AND ISDN
 INFORMATION ELEMENTS

HISTORY

Issue 1 - December 1992

Issue 2 - October 2001 - Specification renamed as DPNSS[189-I]
 - Annex 1 removed to DPNSS[188]
 - Annex 2 renumbered as Annex 1

1 GENERAL

1.1 All requirements relating to the coding of DPNSS 1 Messages and Message Contents are specified in DPNSS[188], SECTION 4.

1.2 Reference should be made to the relevant ISDN Standards (see SECTION 1 Subsection 4) for all requirements relating to ISDN messages and message contents.

1.3 The rules for commonly used mappings between DPNSS 1 message contents and ISDN Information Elements, are contained in ANNEX 1 of this Section. Other mappings are detailed within the text of SECTION 6.

INTERWORKING BETWEEN DPNSS 1 AND ISDN SIGNALLING SYSTEMS**SECTION 4****ANNEX 1 : MAPPING BETWEEN DPNSS 1 MESSAGE CONTENTS AND ISDN
INFORMATION ELEMENTS****CONTENTS**

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HISTORY

Issue 1 - December 1992

Issue 2 - October 2001 - Specification renamed as DPNSS[189-I]
- Annex renumbered
- Data SICs for DASS 2 and DPNSS 1 aligned

1. GENERAL

The signalling procedures described in this specification for interworking between DPNSS 1 and ISDN signalling systems include specification of the messages and message contents of each signalling system that have to be generated as a result of the information received from the other.

This Annex details some general mappings between ISDN message contents and DPNSS 1 message contents. In most cases, these mappings are independent of the context in which they occur in that receipt of a particular component in one system always requires the generation of a particular component in the other, whether it be during signalling for the Simple/Basic Call or a Supplementary Service. Where a mapping specific to a particular case is required, this is defined within the appropriate Section of this specification.

The mapping details given assume that the DPNSS 1 Strings received are valid in accordance with SECTION 4 of this specification and that the ISDN information elements received are valid in accordance with the relevant ISDN standard. It is assumed that any invalid information received from a signalling system has been handled in accordance with the appropriate error handling procedures for that system and can therefore be ignored for mapping purposes.

In general, for each mapping that exists, two directions are specified; these are ISDN to DPNSS 1 and DPNSS 1 to ISDN. In some cases, the mappings may be applicable only to one type of Gateway (i.e. public ISDN or private ISDN). Any limitations of applicability are identified within the relevant mapping descriptions.

2 MAPPING DETAILS

2.1 ISDN Bearer Capability and Low Layer Compatibility information elements <--> DPNSS 1 SIC

2.1.1 ISDN to DPNSS 1

It is assumed that the Bearer Capability and any Low Layer Compatibility information elements received are compatible with routing of a call via DPNSS 1 and that CCITT standard coding is used both for the information elements themselves and for the contents of the fields within the information elements. In particular, it is assumed that:

- The Bearer Capability contains octets 3 and 4.
- Octet 3, bits 7 and 6 indicate a coding standard of "CCITT".

-
- Octet 4, bits 7 and 6 indicate a transfer mode of "circuit".
 - Octet 4, bits 5 to 1 indicate a transfer rate of "64 kbit/s".

Use of non-CCITT codings, for example octet 3 indicating a coding standard of "national", or octet 5 indicating a coding standard of "non-CCITT rate adaptation" is covered below in the paragraph headed, "Non-CCITT Coding".

The DPNSS 1 SIC is generated from the contents of Bearer Capability and, if present, Low Layer Compatibility as described below.

There are some instances where the information in Bearer Capability or Low Layer Compatibility cannot be represented adequately in the SIC. In these circumstances a PBX may still route a call via DPNSS 1, however, under the following conditions:

- If it is known that it is not necessary to pass end-to-end compatibility information in order for the call to be correctly established, then a default SIC that forces the selection of a 64 kbit/s bearer shall be used. If Enhanced Gateway procedures are used and hence I-BC and possibly I-LLC are included in the ISRM (as defined in SECTION 6) then in this case, the String Identifier Codes of I-BC and I-LLC shall be allocated no suffix.
- If it is necessary to pass end-to-end compatibility information which must be understood at the called party's PBX, then a default SIC that forces the selection of a 64 kbit/s bearer shall be used and the Enhanced Gateway procedures which make use of the I-BC and I-LLC Strings in an ISRM (as defined in SECTION 6) shall be utilised. In this case a "B" suffix shall be added to the String Identifier Code of I-BC (if Bearer Capability was inadequately represented in the SIC) and/or to the String Identifier Code of I-LLC (if Low Layer Compatibility was inadequately represented in the SIC).

Where the information in Bearer Capability and Low Layer Compatibility can be adequately represented in the SIC, I-BC and I-LLC shall be allocated no String Identifier Code suffix when included in the ISRM.

The mapping of Bearer Capability and Low Layer Compatibility into the DPNSS 1 SIC is covered by three basic cases, according to what is represented by the "information transfer capability" and "user information layer 1" fields.

Case 1: The information transfer capability field indicates either "speech" or "3.1 kHz audio".

In this case, a single octet SIC shall be constructed with bits 7 to 5 set to indicate "speech" and bits 4 to 1 assigned according to the coding of the user information layer 1 protocol field in bits 5 to 1 of octet 5 of Bearer Capability/Low Layer Compatibility.

Case 2: The information transfer capability field indicates either "unrestricted digital" or "restricted digital", and in addition the user information layer 1 field is either not present or it indicates "V.110/X.30 rate adaptation".

In this case, unless octet 5a indicates a user rate that cannot be represented by a valid DPNSS 1 SIC, a two octet SIC shall be constructed where bits 7 to 1 of the first octet shall be assigned according to the user rate indicated by bits 5 to 1 of octet 5a. Bits 7 to 1 of the second octet shall be assigned according to the remainder of octet group 5 and octets 6 and 7 of Bearer Capability/Low Layer Compatibility as follows:

- If bit 7 of octet 5a indicates "asynchronous", bits 3 to 1 of the second octet of the SIC shall be set to one of the asynchronous indications according to the number of stop bits indicated by bits 7 and 6 of octet 5c. Otherwise bits 3 to 1 of the second octet of the SIC shall be set to indicate synchronous data with a value "100" or "011". It is recommended that the value "100" is used to avoid interworking problems with DASS 2.
- If bit 7 of octet 5d indicates "half duplex", bit 4 of the second octet of the SIC shall indicate "half duplex". Otherwise it shall indicate "full duplex".
- In the synchronous case, bit 5 of the second octet of the SIC shall be set to indicate byte timing not provided, bit 6 shall be set to "anonymous or unformatted" unless octets 6 and 7 of Bearer Capability/Low Layer Compatibility indicate that it should be set to "X.25 packet mode", and bit 7 shall be set according to the Network Independent Clock indications in octet 5b.

- In the asynchronous case, bit 7 of the second octet of the SIC shall be set according to the Flow Control indications in octet 5b, and bits 6 and 5 shall be set according to the number of data bits indicated by bits 5 and 4 (Number Of Data Bits) and bits 3 to 1 (Parity) of octet 5c. Where there is no parity bit, the coding of bits 5 and 4 of octet 5c can be directly mapped onto bits 6 and 5 of the second octet of the SIC. Where a parity bit is indicated, the number of data bits in the SIC can only be explicitly indicated (as 8) if the number of data bits indicated by octet 5c is 7. In all other cases where a parity bit is indicated, the number of data bits indicated by the SIC shall be set to "unspecified".

Where the relevant octets of Bearer Capability/Low Layer Compatibility are not present (e.g. octet 5a), values for the SIC coding shall be assigned according to the default meanings associated with missing Bearer Capability/Low Layer Compatibility octets.

In the case where octet 5a indicates a user rate that cannot be represented by a valid DPNSS 1 SIC, and the call is still to be routed via DPNSS 1, a default SIC forcing selection of a 64 kbit/s bearer shall be used. Where the enforcement of end-to-end compatibility checking is required, I-BC and, if appropriate, I-LLC shall be included in the ISRM in accordance with the procedures defined for an Enhanced Gateway (see SECTION 6) with one or both of the Strings being allocated a "B" suffix, as appropriate.

Case 3: The information transfer capability field indicates anything other than "speech", "3.1 kHz audio", "unrestricted digital" or "restricted digital", or in the case of unrestricted digital or restricted digital, the user information layer 1 field indicates something other than "V.110/X.30 rate adaptation".

In this case, if the call is still to be routed via DPNSS 1, a default SIC forcing selection of a 64 kbit/s bearer shall be used. Where the enforcement of end-to-end compatibility checking is required, I-BC and, if appropriate, I-LLC shall be included in the ISRM in accordance with the procedures defined for an Enhanced Gateway (see SECTION 6) with one or both of the Strings being allocated a "B" suffix, as appropriate.

Where a default SIC is to be used, the recommended coding is 64kbit/s synchronous data, full duplex, no byte timing, anonymous format, clock linked to transmission. For this default case, the SIC has the value: Octet 1 = "10100000", Octet 2 = "00000100".

Non-CCITT Coding

Where Bearer Capability or Low Layer Compatibility information elements employing non-CCITT codings are received, it will depend on the meaning of these codings, as defined for the incoming ISDN interface, whether it is possible to map them to a suitable SIC.

If it is possible to construct a SIC, then the call may be routed via DPNSS 1 using that SIC. In such a case, it may be inappropriate to convey also the received information element(s) as I-BC and/or I-LLC, unless they are first converted into a CCITT coded equivalent, as the Terminating PBX might not have sufficient information available to understand the non-CCITT codings. If it would be inappropriate to send I-BC or I-LLC, then these Strings should be omitted from the ISRM, even at an Enhanced Gateway PBX.

If a SIC cannot be generated, then either the call shall not be routed via DPNSS 1, or the default SIC (see above) may be used and I-BC and/or I-LLC sent with a "B" suffix as appropriate. In choosing the latter course of action, however, consideration will need to be given regarding the ability of a Terminating PBX to be able to process satisfactorily, I-BC and/or I-LLC Strings containing non-CCITT codings.

2.1.2 DPNSS 1 to ISDN

The following mapping description assumes that the outgoing ISDN interface expects Bearer Capability and Low Layer Compatibility information elements to be coded without recourse to non-CCITT coding. Where this is not the case, coding appropriate to the outgoing interface shall be used. The derivation of this coding from the SIC is outside the scope of this specification.

If Bearer Capability and Low Layer Compatibility have not been derived from the receipt of I-BC and I-LLC, a Bearer Capability information element and, optionally, a Low Layer Compatibility element shall be constructed from the SIC as follows:

The coding standard in octet 3, bits 7 and 6 shall be set to indicate "CCITT", the transfer mode in octet 4, bits 7 and 6 shall be set to indicate "circuit", and the transfer rate in octet 4, bits 5 to 1 shall be set to indicate "64 kbit/s". The remainder of the coding of the information element(s) shall depend on which of the following cases applies.

Case 1: Single octet SIC, with bits 7 to 5 indicating "speech".

The information transfer capability field in bits 5 to 1 of octet 3 of Bearer Capability and/or Low Layer Compatibility shall be set to indicate "3.1 kHz audio" or "speech" and the user information layer 1 field in bits 5 to 1 of octet 5 of Bearer Capability and/or Low Layer Compatibility shall be assigned according to the coding of bits 4 to 1 of the SIC.

Note: The choice between Speech and 3.1 kHz Audio is an implementation option which may be applied to all calls or on a call by call basis. In addition, where 3.1 kHz Audio is used, it may be beneficial to include CCITT Progress Indicator 1 in the SETUP message ("call is not end to end ISDN"). This would be the case, for example, if it were possible for the call to be routed to an ISDN destination where the absence of progress indicator 1 would cause rigorous enforcement of checks such that if "Speech" was expected but 3.1 kHz Audio was received the call would fail, whereas progress indicator 1 might cause the destination to accept a 3.1 kHz Audio call in case it represented a speech call.

Case 2: Two octet SIC, with bits 7 to 5 of the first octet indicating "data".

In this case the information transfer capability field in bits 5 to 1 of octet 3 of Bearer Capability and/or Low Layer Compatibility shall be set to indicate "unrestricted digital". Octets 5 onwards of Bearer Capability and/or Low Layer Compatibility shall be generated in accordance with the requirements for coding Bearer Capability and/or Low Layer Compatibility in the ISDN into which the call is being routed. In particular:

- If octet 5 is to be included, the user information layer 1 field in bits 5 to 1 shall be set to indicate "V.110/X.30 rate adaptation".
- Octet 5a shall be included if the user rate indicated by the SIC is less than 64 kbit/s.
- Where octet 5a is included, the user rate field in bits 5 to 1 of octet 5a shall be assigned according to the coding of bits 7 to 1 of the first octet of the SIC, the Synch/Asynch bit (bit 7) shall be assigned according to whether bits 3 to 1 of the second octet of the SIC indicate synchronous or asynchronous data, and the Negotiation bit (bit 6) shall be set to zero.

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- Octets 5b and 5c shall be included if bits 3 to 1 of the SIC indicate "asynchronous".
 - If octet 5b is included, the intermediate rate field shall be coded on the basis that V.110/X.30 rate adaptation is in use. In the case of synchronous data, the Network Independent Clock indications shall be assigned according to bit 7 of the second octet of the SIC. In the case of asynchronous data, the Flow Control indications shall be set according to bit 7 of the second octet of the SIC.
 - If asynchronous data is indicated, the number of stop bits field in octet 5c shall be coded according to bits 3 to 1 of the second octet of the SIC, the number of data bits field in octet 5c shall be coded according to bits 6 and 5 of the second octet of the SIC, and the parity field in octet 5c shall be set to indicate "none".
 - Octet 5d shall be included to indicate half duplex operation if bit 4 of the second octet of the SIC indicates "half duplex".
 - Octets 6 and 7 may be included in the case of synchronous data to indicate X.25 layer 2 and layer 3 if bit 6 of the second octet of the SIC indicates "X.25 packet mode".

2.2 ISDN Party Category and Progress Indicator information elements <--> DPNSS 1 CLC

This mapping is only applicable at a Gateway between DPNSS 1 and ETS 300 172 (private ISDN).

2.2.1 ISDN to DPNSS 1

This mapping can only be performed if at least one of the following has been received:

- A Party Category information element, other than one indicating "unknown".
- A Progress Indicator information element indicating progress description 16, with a location field indicating the local private network.
- A Progress Indicator information element indicating progress description 1, with a location field indicating the local private network, that has not subsequently been negated by receipt of a progress description 4 with a corresponding location field value.

Progress descriptions received other than as described above, e.g. with a location field indicating the public network, or a progress description 1 that has been followed by a progress description 4 with the same location field value, shall be ignored for the purpose of this mapping.

The mapping shall take account of all relevant progress descriptions received up to the point where CLC is to be generated.

If no Party Category information element has been received, other than one indicating "unknown", but either or both of progress descriptions 16 or 1 has been received as described above, CLC-DEC, CLC-PSTN or CLC-ISDN shall be generated as follows:

- CLC-DEC shall be generated if progress description 1, but not 16, has been received.
- CLC-PSTN shall be generated if both progress descriptions 16 and 1 have been received.
- CLC-ISDN shall be generated if progress description 16, but not 1, has been received.
- In addition, if progress description 17 or 19 has been received, the Parameter to the CLC shall indicate "unable to supply a release signal", and if progress description 18 has been received, the Parameter to the CLC shall indicate "unable to supply a release signal before answer".

If a Party Category information element indicating "extension" has been received CLC-ORD shall be generated.

If a Party Category information element indicating "emergency extension" has been received, CLC-ORD with a Service Marking Parameter indicating "emergency telephone" shall be generated.

If a Party Category information element indicating "operator" has been received, CLC-OP shall be generated.

2.2.2 DPNSS 1 to ISDN

If CLC-ORD without a Service Marking Parameter indicating "emergency telephone" has been received, a Party Category information element indicating "extension" shall be generated.

If CLC-ORD with a Service Marking Parameter indicating "emergency telephone" has been received, a Party Category information element indicating "emergency extension" shall be generated.

If CLC-OP has been received, a Party Category information element indicating "operator" shall be generated.

If CLC-ISDN has been received, a Progress Indicator information element containing progress description 16 shall be generated. A Party Category information element indicating "unknown" may also be generated.

If CLC-PSTN has been received, a Progress Indicator information element containing progress description 16 and a Progress Indicator information element containing progress description 1 shall be generated. A Party Category information element indicating "unknown" may also be generated.

If CLC-DEC has been received, a Progress Indicator information element containing progress description 1 shall be generated. A Party Category information element indicating "unknown" may be generated.

If the CLC Status Parameter indicates that release capability is limited, then additional progress descriptions shall be generated as follows:

- If the Parameter indicates "unable to supply a release signal" then a Progress Indicator information element containing progress description 17 shall be generated.
- If the Parameter indicates "unable to supply a release signal before answer" then a Progress Indicator information element containing progress description 18 shall be generated.

2.3 ISDN Cause information element <--> DPNSS 1 Clearing Cause

2.3.1 ISDN to DPNSS 1

Since there is limited correspondence between ISDN Causes and DPNSS 1 Clearing Causes, a mandatory mapping is not given. TABLE 1, however, shows recommended mappings between Causes and Clearing Causes which may normally be expected during a Simple Call. Alternative mappings are permissible. In particular, the Cause information element may contain Location and Diagnostic information which the Gateway PBX may use to derive a more appropriate Clearing Cause. Mappings that are not shown are an implementation option, however, an implementation should avoid the use of mappings which could give rise to undesirable actions, e.g. inappropriate mapping of a Cause information element to Clearing Cause: Busy (BY) may result in the unwanted invocation of DPNSS 1 Supplementary Services such as Call Back When Free, Intrusion, etc.

If a Cause is received which suggests that a protocol error has occurred within the ISDN network, it is recommended that this is mapped to the DPNSS 1 Clearing Cause, Network Termination (NT).

Under certain circumstances at a public ISDN Gateway, more than one Cause information element may be received in an ISDN message. In this case the Gateway PBX shall choose one of these for mapping to a DPNSS 1 Clearing Cause. The choice of which Cause information element to map is an implementation option.

TABLE 1

RECOMMENDED MAPPINGS FROM ISDN CAUSE TO DPNSS 1 CLEARING/REJECTION CAUSE			
ISDN CAUSE		DPNSS 1 CAUSE	
Number	Meaning	Mnemonic	Meaning
1	Unallocated (Unassigned) Number	NU	Number Unobtainable
16	Normal Call Clearing	CT	Call Termination
17	User Busy	BY	Busy
22	Number Changed	NU	Number Unobtainable
27	Destination Out of Order	SOS	Subscriber Out of Service
28	Invalid Number Format	AI	Address Incomplete
31	Normal, Unspecified	CT	Call Termination
34	No Circuit/Channel Available	CON	Congestion
38	Network Out of Order	ROS	Route Out of Service
41	Temporary Failure	CON	Congestion
42	Switching Equipment Congestion	CON	Congestion
44	Requested Circuit/Channel Not Available	CON	Congestion
65	Bearer Capability Not Implemented	INC	Service Incompatible
70	Only Restricted Digital Information Bearer Capability Implemented	INC	Service Incompatible
88	Incompatible Destination	SI	Subscriber Incompatible
102	Recovery on Timer Expiry	NT	Network Termination

2.3.2 DPNSS 1 to ISDN

Since there is limited correspondence between DPNSS 1 Clearing Causes and ISDN Causes, a mandatory mapping is not given. TABLE 2, however, shows recommended mappings between Clearing Causes and Causes which may normally be expected during a Simple Call. Alternative mappings are permissible.

Mappings that are not shown are an implementation option, however, an implementation should avoid the use of inappropriate mappings which could give rise to undesirable actions in the ISDN network.

If a Clearing Cause is received indicating a protocol error has occurred within the DPNSS 1 network, it is recommended that this is mapped to the ISDN Cause number 31 (Normal, Unspecified).

TABLE 2

RECOMMENDED MAPPINGS FROM DPNSS 1 CLEARING/REJECTION CAUSE TO ISDN CAUSE			
DPNSS 1 CAUSE		ISDN CAUSE	
Mnemonic	Meaning	Number	Meaning
AI	Address Incomplete	28	Invalid Number Format (Address Incomplete)
BY	Busy	17	User Busy
CON	Congestion	34	No Circuit/Channel Available
CT	Call Termination	16	Normal Call Termination
ICB	Incoming Calls Barred	21	Call Rejected
INC	Service Incompatible	65	Bearer Capability Not Implemented
NT	Network Termination	31	Normal, Unspecified
ROS	Route Out of Service	38	Network Out of Order
SI	Subscriber Incompatible	88	Incompatible Destination
SOS	Subscriber Out of Service	27	Destination Out of Order

2.4 ISDN Transit Counter information element
<--> DPNSS 1 String LA

This mapping is only applicable at a DPNSS 1 to ETS 300 172 (private ISDN) Gateway.

The generation of a Transit Counter information element is not dependent on receipt of a Loop Avoidance (LA) String from DPNSS 1, nor is generation of a Loop Avoidance String in DPNSS 1 dependent on receipt of a Transit Counter information element from ISDN.

If there are mechanisms in place to prevent indefinite looping between the ISDN and DPNSS 1 parts of a private network, the looping control mechanisms available can be independently applied in the DPNSS 1 and ISDN parts of a private network to prevent looping in the private network as a whole.

The mapping between Loop Avoidance and Transit Counter described below provides a mechanism for controlling looping in a combined network where there is no restriction imposed on the number of times a call can cross between the DPNSS 1 and ISDN parts of a private network. Implicit in this is the notion of a "global transit limit" for the combined ISDN/DPNSS 1 network which represents the maximum number of transit PBXs which a call may pass through during call setup.

2.4.1 ISDN to DPNSS 1

When a Transit Counter information element is received and the call is to be routed into the DPNSS 1 part of the network, the Parameter value shall be subtracted from the global transit limit. If the value resulting is less than 1, then the call shall be deemed to have encountered congestion. If the value resulting is greater than or equal to 1, then it shall be decremented by 1 and the decremented value shall be encoded as the parameter to a Loop Avoidance String passed forward in ISRM/SSRM message sequence.

For example, with a global transit limit of 6, a received Parameter of 3 would be mapped onto "C" (representing 2 further transits allowed).

The Number Of Further Alternative Routes Parameter may be added as required by the Gateway PBX.

2.4.2 DPNSS 1 to ISDN

When a Loop Avoidance String is received and the call is to be routed to the ISDN part of the network, the Number Of Further Transits Parameter shall be decoded to ascertain the number of further transit PBXs which the call can pass through. If this indicates zero, the call shall be deemed to have encountered congestion. If a non-zero value results, this shall be decremented by 1 and subtracted from the global transit limit. The resulting value shall be passed forward in the Transit Counter information element included in the SETUP message.

For example, with a global transit limit of 4, a received Parameter of "D" (representing 3 further transits allowed) would be mapped onto a transit count of 2.

The Number Of Further Alternative Routes Parameter (if present) shall be discarded when routing from DPNSS 1 to ISDN although it may be used by the gateway PBX to decide whether or not to allow alternative routing into the ISDN.

2.5 ISDN Progress Indicator information elements <--> DPNSS 1 String RTI

This mapping is only applicable at a Gateway between DPNSS 1 and ETS 300 172 (private ISDN) during the routing phase of the call (i.e. before a NAM has been sent or received).

2.5.1 ISDN to DPNSS 1

This mapping can only be performed if at least one of the following has been received:

- A Progress Indicator information element indicating progress description 16, with a location field indicating the local private network.
- A Progress Indicator information element indicating progress description 1, with a location field indicating the local private network, that has not been subsequently negated by receipt of a progress description 4 with a corresponding location field value.

Progress descriptions received other than as described above, e.g. with a location field indicating the public network, or a progress description 1 that has been followed by a progress description 4 with the same location field value, shall be ignored for the purpose of this mapping.

The mapping shall take account of all relevant progress descriptions received up to the point where RTI is to be generated.