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Digital sections and digital line system – Digital section
and digital transmission systems for customer access to
ISDN

**V-interfaces at the digital local exchange (LE) –
V5.2 interface (based on 2048 kbit/s) for the
support of access network (AN)**

ITU-T Recommendation G.965

(Formerly CCITT Recommendation)

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ITU-T Recommendation G.965

V-interfaces at the digital local exchange (LE) – V5.2 interface (based on 2048 kbit/s) for the support of access network (AN)

Summary

This Recommendation defines a V-interface (V5.2) for the connection of an Access Network (AN) and the Local Exchange (LE) for the support of the following access types

- analogue telephone access;
- ISDN basic access with an NT1 separate from the AN, or integrated in the AN, based on ITU-T G.960 and I.430;
- ISDN primary rate access with an NT1 separate from the AN, or integrated in the AN, based on ITU-T G.962 and I.431;
- other analogue or digital accesses for semi-permanent connections without associated outband signalling information,

with flexible information channel (bearer channel) allocation by use of a bearer channel connection protocol providing concentration capability within the AN.

This Recommendation is based on ITU-T G.964 and refers to it for those parts which are common in both Recommendations.

The electrical and functional interface specification for the interface links uses the 2048 kbit/s parts of ITU-T G.703, G.704 and G.706. Up to 16 interface links may be operated in parallel forming the V5.2 interface.

The signalling from the PSTN user port is converted into a stimulus protocol with a functional part for the signalling path using layer 3 multiplexing for the information from the different user ports.

The information from the ISDN D-channels is frame relayed in the Access Network using the mechanisms defined in ITU-T Q.933.

A control protocol defined in this Recommendation is used for the exchange of the individual port status and control functions required for the coordination with the call control procedures in the Local Exchange.

A bearer channel connection protocol establishes and de-establishes bearer connections required on demand, identified by the signalling information, under the control of the Local Exchange.

A link control protocol is defined for the mult-link management to control link identification, link blocking and link failure conditions.

In order to coordinate the traffic demands in the various protocols, up to three communication channels can be provisioned per interface link to transport the various protocols and frame relayed information. The data link layer for the protocols is defined on the bases of ITU-T Q.920 and Q.921.

A protection protocol, operated on two separate data links for security reasons, is defined to manage the protection switching of communication channels in case of link failures.

Source

ITU-T Recommendation G.965 was revised by ITU-T Study Group 15 (2001-2004) and approved under the WTSA Resolution 1 procedure on 1 March 2001.

FOREWORD

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NOTE

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Introduction

Major differences between the V5.1 interface and the V5.2 interface

The V5.1 Recommendation (ITU-T G.964) is a complete Recommendation in itself whereas this V5.2 Recommendation references parts of ITU-T G.964.

V5.1 uses only one 2048 kbit/s link whereas V5.2 may use up to sixteen (16) 2048 kbit/s links on one interface.

V5.1 does not support concentration whereas V5.2 is inherently designed to support it using a dedicated protocol known as the Bearer Channel Connection (BCC) protocol.

V5.1 does not support ISDN primary rate access user ports whereas V5.2 does.

V5.1 has no concept of communication channel protection whereas this function is available for V5.2 when that particular V5.2 interface uses more than one 2048 kbit/s link. A specific protocol, known as the protection protocol, is provided for this function.

The control protocol for V5.2 is slightly modified to that used for V5.1.

A link control protocol is specified for V5.2 as multiple links have to be managed.

The following major changes have improved this version of ITU-T G.965, as compared against the previous version (dated 1995).

- [clause 4]: Generalizing the electrical and physical requirements;
- [5.1.1]: Link-ID verification not required for a single-link V5.2 interface;
- [5.1.2]: Enhancements of the link blocking in case of AN internal failures;
- [8.7.4]: Added reference to V5.1 about the need for a flow control mechanism on layer 2;
- [10.3]: Added pointers to V5.1 for control-field and frame type;
- [15.4]: Accelerated port alignment is an additional function that reduces the messages over the V5 interface during startup procedures;
- [16.2.1]: Clarification of link blocking and unblocking procedures;
- [16.2.4.3.1]: Immediate link blocking (and protection) on AN internal failure;
- [16.2.4.3.4]: Enhancements of the coordinated unblocking procedures;
- [16.2.4.3.5]: Simultaneous (AN+LE) link identification, but with priority for LE if on the same link;
- [17.3]: General for the message types with optional information elements: optional (O) has changed to conditional (C);
- [Figure 22]: Octet-1 changed from 0×40 to 0×44 ;
- [17.4.2.5/6]: Length of diagnostics in Reject/Protocol-error Cause IE;
- [Figure 24]: Note added on the use of the "extension" domain;
- [17.5.8.1a]: Added clause on BCC Reference Number coding error;
- [17.5.8.4/5/6]: Added Note on mandatory and optional IEs;
- [18.1.1]: Enhanced introduction for the Protection protocol;
- [18.1.5]: Improved text on monitoring of link failures;
- [Table 62]: Added coding for Logical C-Channel identification error;
- [18.6.6.1a]: Added clause on Logical C-Channel identification error;
- [Annex A]: Added A.7 "Possible AN/LE configuration using the V5 standard";

- [Annex C]: This annex is rewritten, to be in line with ITU-T G.964. When an item is the same, it only references V5.1. Procedures that have been modified are mostly related to startup, restart of the interface and also link blocking/unblocking. Supervision of the processing of startup sometimes has been added;
- [Annex E/Table E.2]: Three added IEs on PSTN (metering and attenuation);
- [Annex K.6]: Rewrite of AN internal failure rules;
- [Annex K.10]: Added clause on Link failure rules;
- [Annex L]: Added annex on Interoperability.

ITU-T Recommendation G.965

V-interfaces at the Digital Local Exchange (LE) – V5.2 interface (based on 2048 kbit/s) for the support of access network (AN)

1 Scope

This Recommendation specifies the electrical, physical, procedural and protocol requirements for the V5.2 interface between an Access Network (AN) and the Local Exchange (LE) for the support of the following access types:

- analogue telephone access;
- ISDN basic access with a line transmission system conforming to ITU-T G.960 [4] for the case with a NT1 separate from the AN;
- ISDN basic access with a user network interface according to ITU-T I.430 [3] at the user side of the AN (i.e. the interface at the T reference point);
- ISDN primary rate access with a line transmission system conforming to ITU-T G.962 [10] for the case with a NT1 separate from the AN;
- ISDN primary rate access with a user network interface according to ITU-T I.431 [9] at the user side of the AN (i.e. the interface at the T-reference point);
- other analogue or digital accesses for semi-permanent connections without associated out-band signalling information,

with flexible information channel (bearer channel) allocation on a call by call basis which provides concentration capability within the AN and over the V5.2 interface. This Recommendation does not specify the implementation of the requirements within the AN and does not constrain any implementation alternative as long as the functionality at the V5.2 interface as specified in this Recommendation is met.

This Recommendation should be used in conjunction with ITU-T G.964 [8]. The two Recommendations share a common format and clauses within ITU-T G.964 [8] are referenced in this Recommendation.

A link control capability is provided in order to manage the possible multi-link arrangements within a V5.2 interface. See clause 16.

A protection capability is provided in order to allow the interface to continue functioning in the event of 2048 kbit/s link failures.

Annex A provides an overview of the service scenarios and architecture taken as the conceptual basis for the specification of the V5.2 interface.

Annex B defines the use of the protocol information elements for the definition of the national PSTN protocols and information flow diagrams to the PSTN protocol specification. Annex H provides the definition of the Layer 3 PSTN protocol error detection.

Annex C specifies the basic assumptions of the management function in the LE and the AN to support correct operation and control of the configuration.

Annex D describes the protocol architecture for the ISDN and PSTN user port status control information transfer.

Annex E provides an overview of frame formats used in the V5.2 interface and also the message types allocated to the V5.2 interface.

Annexes F, G and H refer to Annexes F, H and K of ITU-T G.964.

Annex J presents explanatory notes and information flow for the Protection protocol.

Annex K gives information on principles for the BCC protocol application.

Annex L gives examples for an implementation with high interoperability.

2 Normative 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; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of currently valid ITU-T Recommendations is regularly published.

- [1] ITU-T G.703 (1998), *Physical/electrical characteristics of hierarchical digital interfaces*.
- [2] ITU-T G.704 (1998), *Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels*.
- [3] ITU-T I.430 (1995), *Basic user-network interface – Layer 1 specification*.
- [4] ITU-T G.960 (1993), *Access digital section for ISDN basic rate access*.
- [5] ITU-T Q.920 (1993), *ISDN user-network interface data link layer – General aspects*; and ITU-T Q.921 (1998), *ISDN user-network interface – Data link layer specification*.
- [6] ITU-T Q.931 (1998), *ISDN User-network interface layer 3 specification for basic call control*.
- [7] ITU-T G.823 (2000), *The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy*.
- [8] ITU-T G.964 (2001), *V-interfaces at the digital local exchange (LE) – V5.1 interface (based on 2048 kbit/s) for the support of access network (AN)*.
- [9] ITU-T I.431 (1993), *Primary rate user-network interface – Layer 1 specification*.
- [10] ITU-T G.962 (1993), *Access digital section for ISDN primary rate at 2048 kbit/s*.
- [11] ITU-T G.706 (1991), *Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in Recommendation G.704*.
- [12] ITU-T Q.824.5 (1997), *Stage 2 and stage 3 description for the Q3 interface – Customer administration: Configuration management of V5 interface environments and associated customer profiles*.
- [13] ITU-T Q.831 (1997), *Fault and performance management of V5 interface environments and associated customer profiles*.

3 Definitions, symbols and abbreviations

3.1 Definitions

This Recommendation defines the following terms, in addition to those given in ITU-T G.964 [8] and in the normative references:

3.1.1 active C-channel: A physical C-channel which is currently carrying a logical C-channel. An active C-channel becomes a standby C-channel when it is not carrying a logical C-channel.

3.1.2 bearer channels: Bearer channels are used to provide the bidirectional transmission capability for allocated B-channels from basic access user ports, primary rate access user ports, or A-law PCM encoded 64 kbit/s channels from PSTN user ports. They may be used in multiples of 64 kbit/s channels in order to facilitate certain ISDN services.

3.1.3 bearer channel connection (BCC) protocol: A protocol which allows the LE to instruct the AN to allocate bearer channels, either singly or in multiples, on demand.

3.1.4 communication channel (C-channel): A 64 kbit/s time slot on a V5.2 interface provisioned to carry communication paths.

3.1.5 communication path (C-path): Any one of the following information types (see also 8.4.1):

- the layer 2 data link carrying the Control protocol;
- the layer 2 data link carrying the Link control protocol;
- the layer 2 data link carrying the PSTN signalling;
- each of the layer 2 data links carrying the Protection protocol;
- the layer 2 data link carrying the BCC protocol;
- all the ISDN Ds-type data from one or more user ports;
- all the ISDN p-type data from one or more user ports;
- all the ISDN f-type data from one or more user ports.

It should be noted that this definition includes the possibility that there is more than one C-path of the same information type, each allocated to a different logical C-channel.

3.1.6 ISDN D-channel information: ISDN D-channel information is defined as that D-channel information from basic or primary rate access user ports (including Ds-, p- and f-type data).

3.1.7 logical communication channel (logical C-channel): A group of one or more C-paths, all of different types, but excluding the C-path for the protection protocol.

3.1.8 multi-link: A collection of more than one 2048 kbit/s link which together make up a V5.2 interface (although a V5.2 interface need not have more than one 2048 kbit/s link).

3.1.9 multi-slot: A group of more than one 64 kbit/s channels providing 8 kHz and time slot sequence integrity, generally used together within an ISDN Primary Rate Access (ISDN-PRA) user port, in order to supply a higher bit-rate service.

3.1.10 physical communication channel (physical C-channel): A 64 kbit/s time slot on a V5.2 interface which has been assigned for carrying logical C-channels. A physical C-channel may not be used for carrying bearer channels.

Time slots 16 in the primary link and the secondary link (only in a V5.2 interface with more than one 2048 kbit/s link) are always physical C-channels.

3.1.11 pre-connected bearer channels: Any bearer channel or multiples thereof, set up using the BCC protocol in order to provide switched services within the AN over bandwidth reserved on the V5.2 interface reserved for it.

3.1.12 primary link: The 2048 kbit/s link in a multi-link V5.2 interface whose physical C-channel in time slot 16 carries a C-path for the protection protocol and, on V5.2 initialization, also the C-path for the control protocol, link control protocol, and the BCC protocol. Other C-paths may also be carried in the time slot 16.

3.1.13 protected group: A group of N logical C-channels.

3.1.14 protection group: A group of $(N + K)$ physical C-channels, where K is the number of physical C-channels which act as standby C-channels for the N logical C-channels.

3.1.15 secondary link: The 2048 kbit/s link in a multi-link V5.2 interface whose time slot 16 carries a C-path for the protection protocol and, on V5.2 initialization, acts as the standby C-channel for the control protocol, link control protocol, and BCC protocol and any other C-paths initially carried in time slot 16 of the primary link.

3.1.16 standby C-channel: A physical C-channel which is not carrying a logical C-channel, but is used for the protection of logical C-channels. Once it is used to carry a logical C-channel, a standby C-channel becomes an active C-channel.

3.1.17 T-reference point: The term T-reference point is used in a general sense. If an ISDN terminal or terminal adapter is connected to the interface at the T-reference point then, according to the ISDN reference configuration, the S- and T-reference points coincide or, if a network termination type 2 is connected to the interface at the T-reference point, then this is the explicit T-reference point.

3.2 Symbols and abbreviations

This Recommendation uses the following abbreviations, in addition to those given in ITU-T G.964 [8]:

BCC	Bearer Channel Connection
dB	Decibel
ISDN-PRA	ISDN Primary Rate Access
H0	Channel with 384 kbit/s accompanied by timing
H12	Channel with 1920 kbit/s accompanied by timing
LFA	Loss of Frame Alignment
M	Mandatory protocol element
NOF	Normal Operational Frame
O	Optional protocol element
REQ	Request
SN	Sequence Number
TSSI	Time Slot Sequence Integrity
VP(R)	Receive state Variable for Protection protocol
VP(S)	Send state Variable for Protection protocol

4 Electrical and physical interface requirements

The V5.2 interface may have between one and sixteen 2048 kbit/s links, as required.

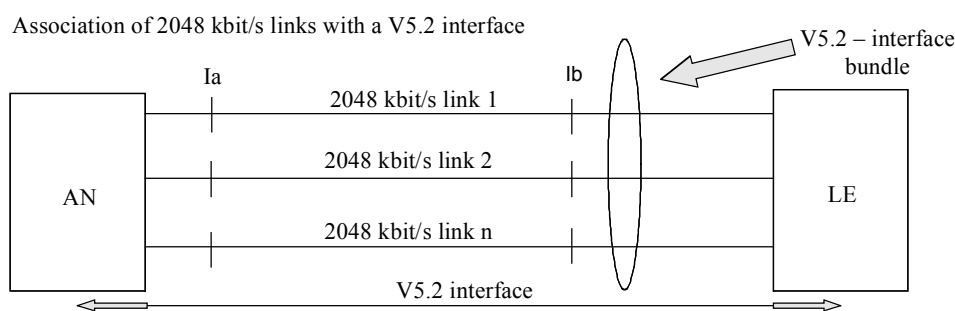
The interface may use any standard transmission system [1] and [2] that is designed to transport 2048 kbit/s signals. The interface shall conform to the electrical (optical) and format requirements appropriate for the selected structure.

NOTE – The remainder of this Recommendation is based on 2048 kbit/s electrical interface specifications.

For those cases when multiple (1-16) 2048 kbit/s electrical interfaces are used, the electrical and physical characteristics of each of the 2048 kbit/s interfaces shall conform to ITU-T G.703 [1], 2048 kbit/s case.

Two interface presentation alternatives are defined in ITU-T G.703 [1], the balanced interface pair type and the coaxial type. According to the two alternatives of interface applications shown in Figure 1, it is left to the network operator to request the interface presentation required.

The jitter requirements for each of the 2048 kbit/s links shall be the same as for ITU-T G.964 [8].



NOTE – n 2048 kbit/s links shown (n = 1 to 16).

Any/all 2048 kbit/s links may use a transparent digital link as shown:

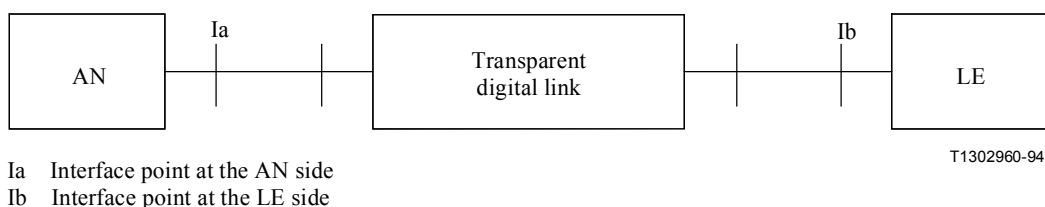


Figure 1/G.965 – V5.2 application with and without transparent digital link

5 Procedural interface requirements

The functional and procedural requirements of each of the 2048 kbit/s links shall be the same as for ITU-T G.964 [8].

5.1 Link control requirements and procedures

Since the V5.2 interface may consist of multiple 2048 kbit/s links, there is a need for link ID-verification and for blocking of a specific link. Two procedures have been defined for these functions in 16.2 and are performed through the link control protocol.

5.1.1 Link-ID verification

The link-ID verification is a symmetrical procedure that shall be applied from both ends of the V5.2-interface links, when the interface Layer 1 Finite State Machine (L1-FSM) enters the normal state. If the procedure fails, the FSM shall return to the non-operational state.

This procedure shall apply to all links, including the primary and secondary links. It may also be performed when permanently in the normal state, e.g. on a timed basis, or on a request from the Q-interface (AN/LE).

5.1.2 Link blocking

For link-maintenance additional functionality is required for blocking a single 2048 kbit/s link of a V5.2 interface. Link blocking is an asymmetrical procedure, where the AN may request the blocking of a link, but the LE decides, as master of the service. The LE releases any switched connection on the requested link as appropriate to the service and, in due time, re-establishes semi-permanent and pre-connected connections onto other links within the same V5.2 interface. The LE shall use the protection protocol to move affected logical C-channels, if at all possible.

In case of AN internal failures which result in the link not being available any longer the AN may apply immediate blocking of the link. In parallel, protection of any affected C-channels shall be initiated if available.

These procedures may be applied even in the case of the single 2048 kbit/s V5.2 interface.

NOTE – In this case, blocking takes the complete interface out of service.

6 Services and architecture aspects and requirements

The services to be supported by the V5.2 interface shall include all those supported by V5.1 (as defined in ITU-T G.964 [8]) with the addition of ISDN-PRA. However, it is not the intention of this Recommendation to restrict any implementation of ANs or LEs to support the full set or a subset of the services listed in this Recommendation.

The architecture of V5.2 from a service point of view is shown in Figure 2.

6.1 On-demand services

On-demand services pass through the V5.2 interface. The following three types of accesses are supported.

6.1.1 PSTN

The contents of this clause are identical to 6.1.1/G.964 [8].

6.1.2 ISDN Basic Access (ISDN-BA)

The contents of this clause are identical to 6.1.2/G.964 [8].

In addition, the 2×64 kbit/s multi-slot bearer service may be supported through the bearer channel capability defined in this Recommendation.

6.1.3 ISDN Primary Rate Access (ISDN-PRA)

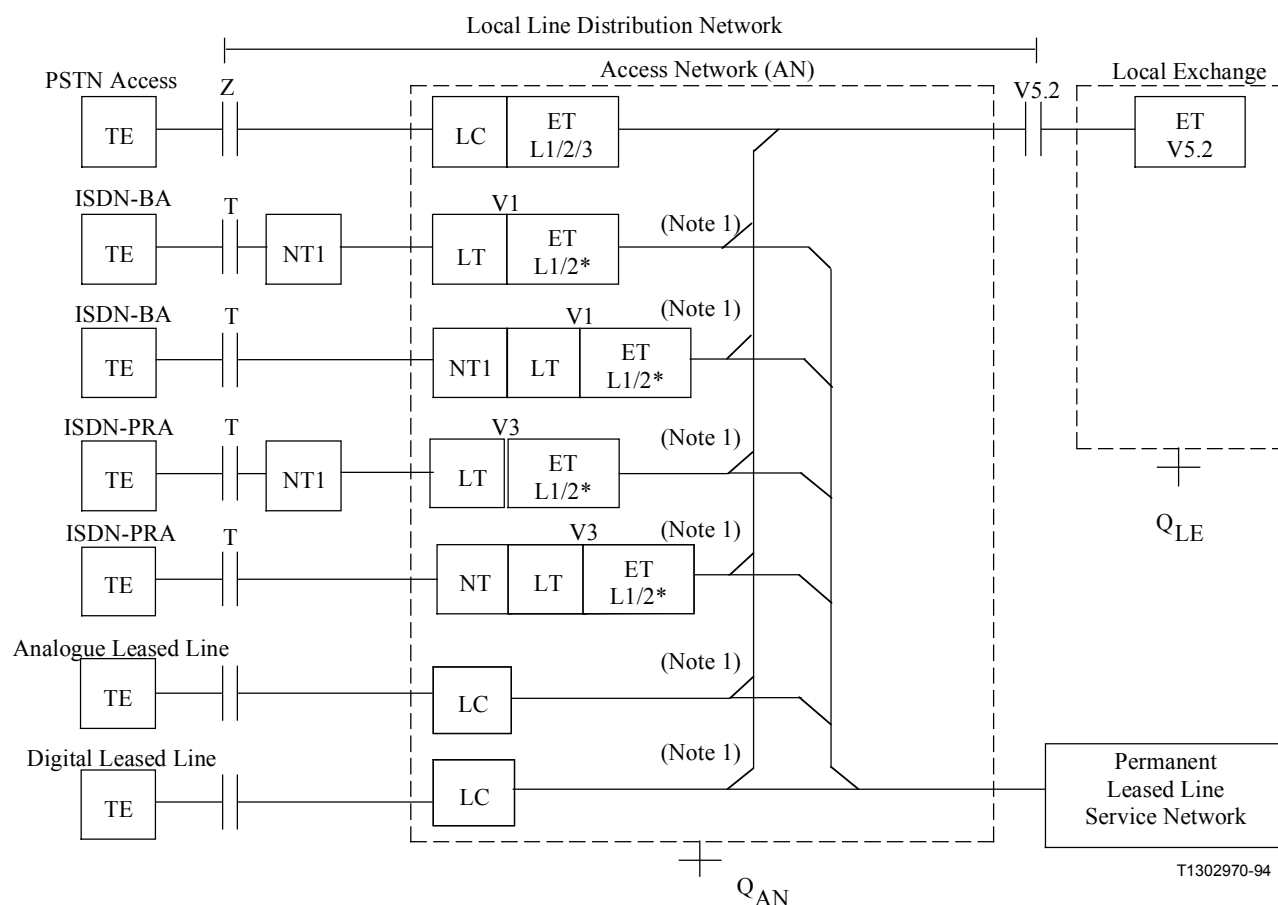
ISDN-PRA is supported either with an NT1 as an integral part of the AN, or as a separate equipment supporting transmission systems conforming to ITU-T G.962 [10] for the support of NT2 (e.g. ISDN PABX), connected at the T-reference point.

Bit rates lower than 64 kbit/s are not supported directly. They are seen as user applications within a 64 kbit/s B-channel in the PRA.

One or more B-channels in the PRA may be used for the optional permanent line capability or semi-permanent leased line service.

Multi-rate bearer services, which may use H0, H12 or other multi-slot channels between userport and LE are also supported by any V5.2 interface supporting ISDN-PRA using the appropriate ISDN signalling systems.

NOTE – Without support for these services from the LE or AN, they will be unavailable to users.



NOTE 1 – The selection of channels and the service allocation are part of the provisioning.

NOTE 2 – The asterisk indicates that layer 2 is only partially terminated in the AN.

Figure 2/G.965 – Architecture of V5.2 interface from a service point of view

6.2 Permanent Line (PL) capability

The contents of this clause are identical to 6.2/G.964 [8]. However, the PL capability shall be provided for the ISDN-PRA service as specified in 15.3.

6.3 Semi-permanent leased line

The contents of this clause are identical to 6.3/G.964 [8]. However, the semi-permanent leased line requirement shall be applicable for the ISDN-PRA as well.

6.4 Permanent leased line service

The contents of this clause are identical to 6.4/G.964 [8].

7 Control and provisioning

7.1 Control principles

7.1.1 General requirements and assumptions

Based on Figure 3, the following general requirements have been defined for both the ISDN-BA port and the ISDN-PRA port. They shall be relevant for the PSTN ports as well if not stated otherwise:

- 1) The responsibility for call control resides in the LE (i.e. the AN may have no knowledge of the call state during normal operation of the V5.2 interface).
- 2) The access management in the AN and the service management in the LE each maintain their FSMs and protocol entities and communicate over the V5.2 interface.

FSMs are required for each user port and for the 2048 kbit/s interfaces as well as protocol entities for the layer 2 links, in both the AN and the LE (see Figure 4 for clarification and clause 15 for the definition of the FSMs, protocol entities and the layer 3 protocol). The information provided from the individual FSM or protocol entity to the management shall be used to decide on the appropriate action towards other FSMs and protocol entities, the call control function and the operating system. Further information on some basic assumptions is provided in Annex C.

- 3) Port blocking request, for non-urgent port maintenance via the Q-interface of the AN, can only be granted by the LE, (i.e. blocking request should not interfere with on-going calls, calls being set up or cleared down or semi-permanent connections).
- 4) Urgent port maintenance requested via the Q-interface of the AN shall be indicated to the LE irrespective of the state in the LE (i.e. "immediate blocking" effective immediately, but new state to be synchronized with the LE).
- 5) Detected layer 1 failures related to bearer channels within the failed 2048 kbit/s links shall result in the calls being cleared. Detected layer 1 failures relating to physical C-channels within a failed 2048 kbit/s link shall result in the protection protocol reassigning these C-channels if it has sufficient resources to do so. Pre-emption of physical C-channels autonomously by the protection protocol is not permitted. Detected layer 1 failures relating to semi-permanent leased lines within a failed 2048 kbit/s link shall result in the resource manager within the LE attempting to set up another bearer connection on which the service is to be provided. There may be anomalies and defects which may degrade the service but do not result in a total loss of service and thus do not result in the generation of the above re-configurations. Such anomalies or defects affecting PSTN service may impact the PSTN protocol, for instance through the negative acknowledgement of a request message, but shall not affect the port FSM.
- 6) It is required that detected anomalies and other events are reported to the associated management within the AN or LE and logged.

- 7) When a port is blocked, originating calls are not possible and terminating calls should be treated by the LE as if the port is out of service according to the national protocol.
- 8) The LE shall know the transmission quality level relating to user ports via "grading" messages from the AN to the LE which do not affect the port status FSMs. These messages contain grading information to be registered in the LE. The LE may use this information to decide whether a requested service should be delivered or not.

This requirement is only relevant to an ISDN port with an NT1 which lies outside the AN. The performance between user port and V5.2 interface shall not be impacted unduly by a reduced performance due to bit errors occurring on AN internal links. This shall be excluded by in-service monitoring and blocking of AN internal links from service in the case of reduced error performance.

- 9) Loop-backs shall only be applied when the port is in the blocked state. This function is under the control of the AN.

The execution of failure localization within the AN and the user port is the responsibility of the AN. Active testing which interferes with the service under the responsibility of the LE, shall not be carried out until the port is blocked (FSM in blocked condition) by the LE.

- 10) There shall be a mechanism to identify individual V5 interfaces, and the labels of their current and new provisioning variants. The provisioning variant is a unique label of a complete provisioning data set applied via the Q-interfaces (see 15.7).
- 11) It shall be possible to identify each individual 2048 kbit/s link on a V5.2 interface. A (symmetrical) procedure for checking the identity of 2048 kbit/s links shall be applied on any restoration of frame alignment and after reprovisioning (which may or may not affect V5.2 links).
- 12) It shall be possible to block an individual 2048 kbit/s link for a V5.2 interface. The AN may issue a request, but the LE decides: for switched connections it will wait for calls to terminate, semi-permanent and AN reserved connections will be re-established onto other links. LE system management will use the protection protocol to move affected logical C-channels before a 2048 kbit/s link is blocked. Using a slightly different mechanism, the AN may perform an immediate block of a designated 2048 kbit/s link.
- 13) 2048 kbit/s links may be removed from service within a V5.2 interface for maintenance purposes via Q_{LE} and Q_{AN} with the support of the V5.2-interface link control protocol. They will be brought back into service, also using the V5.2-link control protocol.
- 14) Individual bearer channels within a V5.2 interface may be barred from use via Q_{LE} .

7.1.2 Control of ISDN-BA user port for the PL capability

The control of ISDN-BA user ports when the PL capability is provided shall be the same as that provided by 7.1.2/G.964 [8].

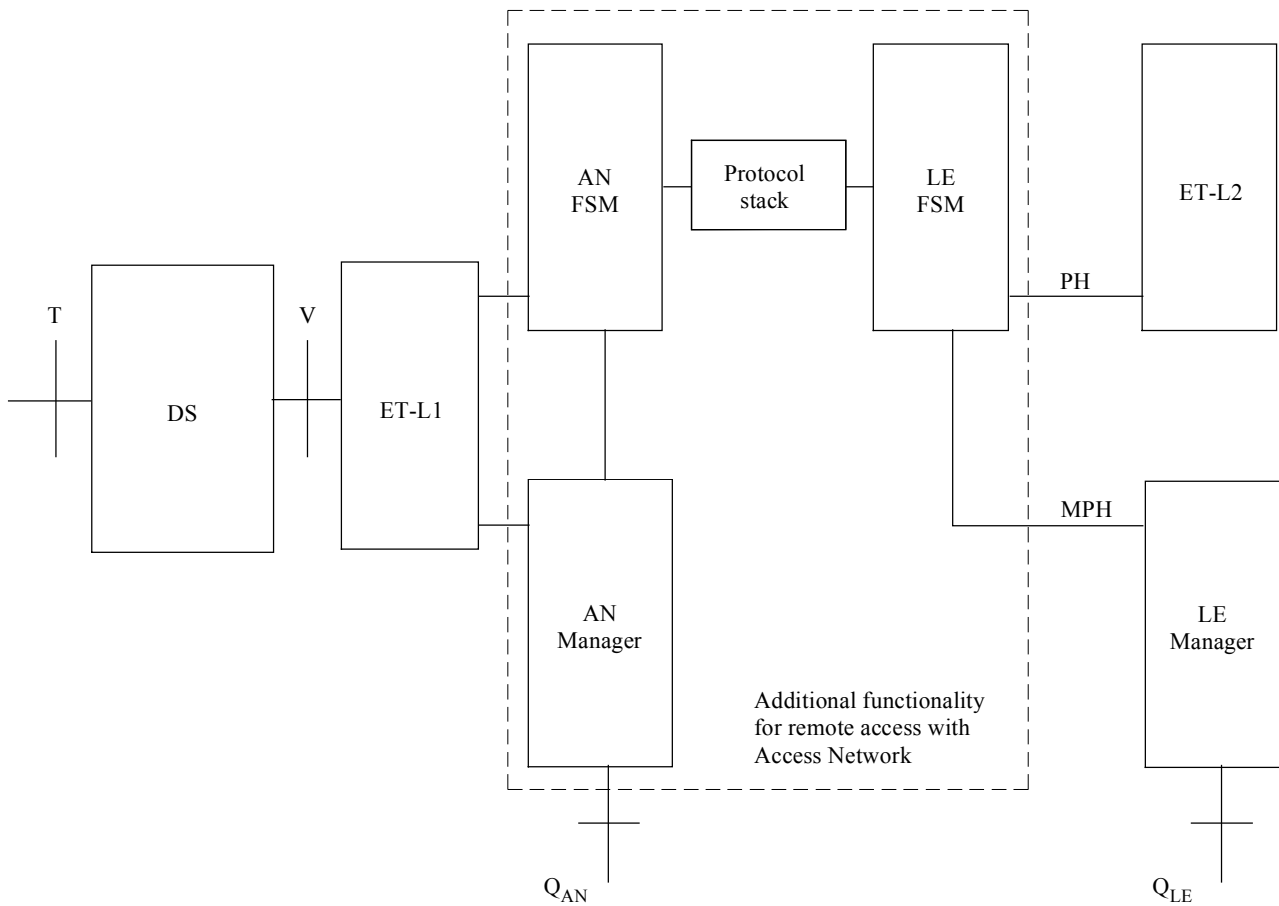
7.1.3 Control of ISDN-PRA user ports when the PL capability is provided

The provision of a PL capability shall not affect the operation of an ISDN-PRA user port.

7.1.3.1 Statements and assumptions

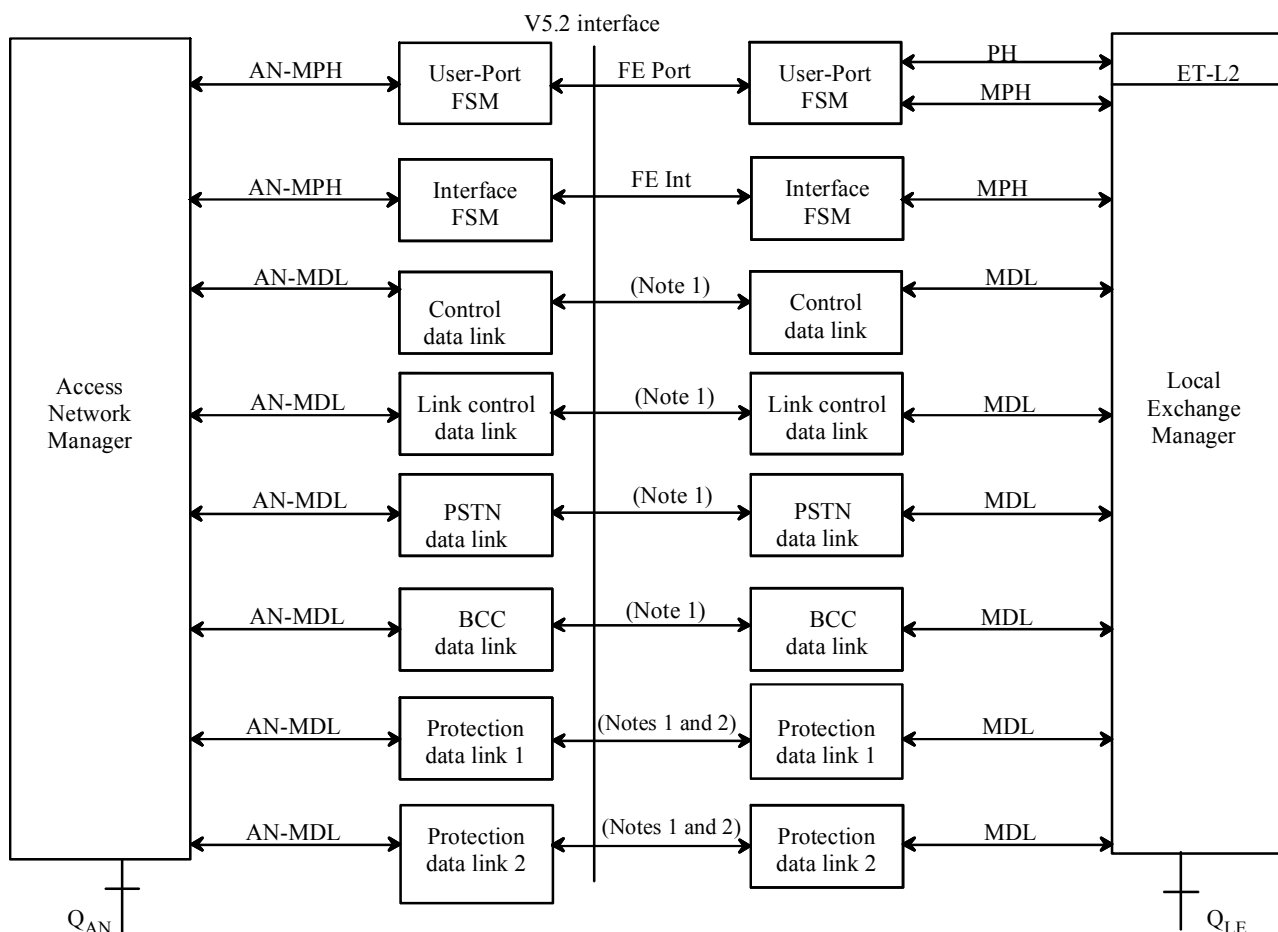
- 1) The PL capability supported by an AN in the V5.2 configuration is an additional feature at an ISDN user network interface, which cannot be supported by an access connected directly to an LE.

- 2) The PL capability may, as an option, use one or more (or possibly all) of the B-channels on a user port that are not provisioned in the AN or LE to carry on-demand services. Only Normal Operational Frames (NOF) may be sent to the V-reference point as shown in Figure 3.
- 3) The LE is responsible for on-demand services.
- 4) When the LE blocks the user port, which puts the user port into a non-operational state for all types of services, the AN may regain control in order to allow ports with a PL capability to continue operating.



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Figure 3/G.965 – ISDN user port functional model



NOTE 1 – Refer to 10.4.

NOTE 2 – The protection link protocol entities shall only be used in the case of a V5.2 interface with more than one 2048 kbit/s link.

Figure 4/G.965 – Layer 1 and layer 2 FSM functional model

7.1.3.2 ISDN and PL capability

The PL service shall not use the D-channel for messages to the LE. The currently defined ISDN-PRA service, ITU-T G.962 [10], delivered to an ISDN user port at an AN shall be the same as for direct access connections to the LE.

For an AN, no impact on an ISDN on-demand service can be accepted from any service (e.g. the PL service) that uses one or more of the B-channels for other than on-demand service.

7.2 Provisioning strategy and requirements

7.2.1 General

Provisioning is one of many aspects to control functions. It has been separated from the other control requirements because provisioning shall be performed through the Q-interfaces of the AN and the LE and is therefore not directly relevant to the V5.2-interface specification. Only those provisioning aspects having at least conceptual or indirect implication to the interface definition are defined.

7.2.2 Provisioning requirements

See 7.2.2/G.964 [8] for a list of items to be provisioned in addition to those below. The first item of the referenced list however is not valid for the V5.2 interface because the association of bearer channels is under the control of the BCC protocol and not statically associated through provisioning.

Provisioning requirements

- 1) The number of 2048 kbit/s links used on a V5.2 interface and their identification are assigned by provisioning.
- 2) Physical C-channels are assigned to time slots/links by provisioning.
- 3) The physical C-channels of time slots 16 of primary and secondary link form the protection group 1, including the protection protocol. (This assumes more than one 2048 kbit/s links on that V5.2 interface). Otherwise, this provisioning is invalid.
- 4) One of the physical C-channels of protection group 1 acts as the active C-channel. The other physical C-channel of protection group 1 acts as the standby C-channel of this group.
- 5) Logical C-channels are assigned to physical C-channels by provisioning as a default assignment.
- 6) A physical C-channel without assigned logical C-channel acts as a standby C-channel. (Assignment of C-paths to logical C-channels shall be through provisioning.)
- 7) The assignment of C-paths for Ds-type data (also for p-type and f-type data) or PSTN signalling is a provisioned option.
- 8) The active physical C-channel of protection group 1 shall carry at least the C-paths of the protection protocol, the BCC protocol, the control protocol, and the link control protocol.
- 9) Q_{LE} may be used to remove a logical C-channel's assignment from a physical C-channel.
- 10) Q_{LE} may be used to assign a particular logical C-channel to a physical C-channel. Protection may change it later.
- 11) When provisioning physical C-channels for an installation, care has to be taken if the LE and/or the AN consists of modules which share the software termination functions for the V5.2 interface. The effect of which physical C-channel is served by which module on load distribution has to be taken into account. Care has to be taken when provisioning physical C-channels for standby use in order that future protection switching onto these physical C-channels will not cause undue unevenness in the load on these modules.

Similarly, if an LE and/or AN is modularized for the purpose of safeguarding performance in the presence of failures, care has to be taken that physical C-channels (both used and provided for standby) are provisioned in such a way that performance can be safeguarded through protection switching, not only in the presence of failures of 2048 kbit/s links but also in the presence of module failures within the LE and the AN.

7.3 Bearer Channel Connection (BCC)

The BCC protocol is used to allocate bearer channels on a specific 2048 kbit/s link to user ports, generally on a call by call basis. It is assumed that bearer channel resource management systems are provided within the LE and the AN but this Recommendation only defines the functions which directly impact the V5.2 interface.

The bearer channels allocated by means of the BCC protocol but not on a call by call basis are given below:

- *The semi-permanent leased line connection* – These use one or more bearer channels which are assigned to user ports using Q_{LE} and are set up using the BCC protocol;
- *The pre-connected bearer channels* – These use one or more bearer channels which are assigned to user ports using Q_{LE} and are set up using the BCC protocol.

An audit function is provided via the BCC protocol in order that V5.2-bearer channel allocation and connections within the AN may be checked.

An AN internal failure function is also provided in the BCC protocol in order that the AN may notify the LE about internal failures affecting bearer channel connections.

7.4 Protection

The protection protocol is used in the case of interfaces with more than one 2048 kbit/s link. It is required that the link control, the control, and the BCC protocols have a communication path over the V5.2 interface, even in the event of one 2048 kbit/s link failure (i.e. primary or secondary link).

The protection protocol has the responsibility to ensure that there is a method by which entities in the LE and AN can communicate for the purpose of protecting logical C-channels in the case of a single link failure, if standby physical C-channels are provisioned.

In the event of protection switching being required for logical C-channels, it is the responsibility of the protection management function to initiate the switch-over in a controlled manner using the protection protocol.

8 Protocol architecture and multiplexing structure

8.1 Functional description

The functional description is illustrated in Figure 5. Items in ITU-T G.964 [8] related to ISDN basic access shall also apply to ISDN primary rate access. The following functional requirements are defined in addition to those given in ITU-T G.964 [8]:

- a BCC protocol is used to assign bearer channels under the control of the LE;
- service requiring multi-slot connections, shall be provided over one 2048 kbit/s link within a V5.2 interface. In this case, 8 kHz and time slot sequence integrity shall always be provided;
- a link control protocol is defined which will support the management functions of the 2048 kbit/s links of the V5.2 interface;
- a protection protocol is defined which will support switching of logical C-channels between physical C-channels as appropriate.

8.2 Protocol requirements for PSTN and ISDN

Figure 6 shows the protocol architecture in a simplified form. The functions specified in this Recommendation are shaded.

The functions are defined in the following clauses:

- envelope function sublayer of LAPV5 (LAPV5-EF): clause 9;
- data link sublayer of LAPV5 (LAPV5-DL): clause 10;

- frame relaying sublayer of the AN (AN-FR): clause 11;
- sublayer-to-sublayer communication and mapping function: clause 12;
- general layer 3 protocol structures: clause 13;
- PSTN signalling protocol specification: clause 14;
- control protocol: clause 15;
- link control protocol: clause 16;
- BCC protocol: clause 17;
- protection protocol: clause 18.

The ISDN D-channel information from ISDN-BA and ISDN-PRA ports shall be multiplexed at layer 2 and frame relayed over the V5.2 interface. The capability to separate p-type and f-type data from Ds-type signalling data onto different communication channels shall be supported by the AN and the LE, but it shall be possible to carry them on a single communication channel as a provisioning option (see also 8.4).

Annex E gives an overview of message codepoints and frame formats used in the V5.2 interface.

The protocol specification for PSTN ports is specified in ITU-T G.964 [8].

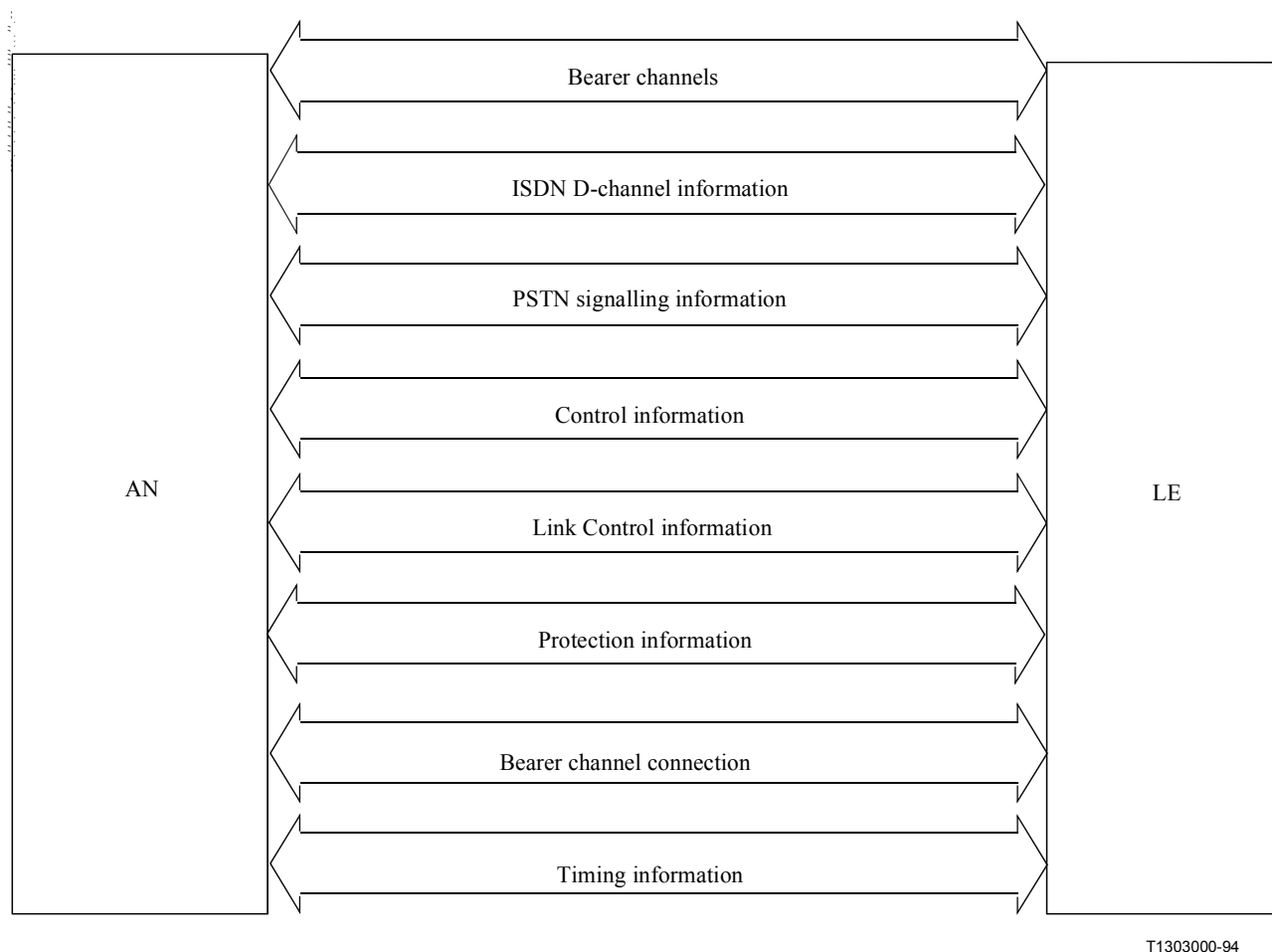


Figure 5/G.965 – Functional description of the V5.2 interface

8.3 Time slots

There shall be a minimum of one and a maximum of sixteen 2048 kbit/s links on a V5.2 interface. Each of these shall have a layer 1 structured according to clauses 4 and 5.

Time slots 16, 15 and 31 of each 2048 kbit/s link may be used as physical communication channels and shall be allocated as required by provisioning.

Time slots not provisioned as physical communications channels are available to be used as bearer channels under the control of the BCC protocol.

8.4 Time slot allocation for physical communication channels

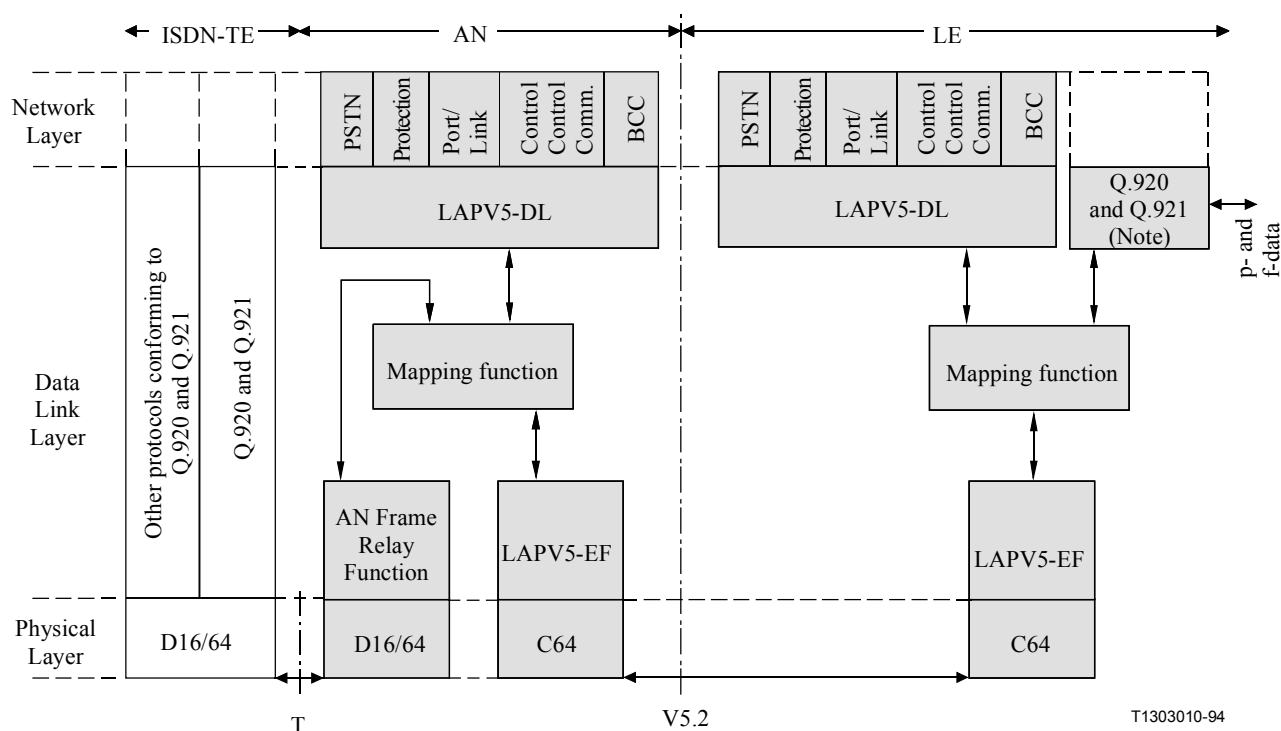
In the case of only one 2048 kbit/s link, the time slot allocation for the physical C-channels shall be the same as that for the physical C-channels in ITU-T G.964 [8]. This is to ensure full compatibility with V5.1.

In the case of more than one 2048 kbit/s links forming a V5.2 interface, then the protection protocol shall be used. In this case, time slot 16 of the primary link will contain the protection protocol and any C-path which has been provisioned to be within the same C-channel. Time slot 16 of the secondary link will also contain the protection protocol.

Further physical C-channels should preferably be allocated in the following sequence:

- Time slots 16 of the remaining 2048 kbit/s links as required. If more are required, then:
- Time slot 15 of a 2048 kbit/s link. If still more are required, then:
- Time slot 31 of the same 2048 kbit/s link shall be allocated. If still more are required, then:
- Continue the allocation by allocating time slot 15 and then 31 of the next 2048 kbit/s link as indicated in the previous subclause. This process may be repeated until all time slots 15 and 31 on all 2048 kbit/s links have been allocated.

The above guidelines have been created to allow for maximum flexibility when allocating time slots as physical C-channels whilst not constraining future service additions such as the ISDN H-channels. The allocation indicated above need not be followed, in particular when either upgrading from V5.1 to V5.2, or when increasing the capacity of a V5.2 interface, as to follow these guidelines explicitly may result in a total rearrangement of the physical C-channels on a V5.2 interface being required.



NOTE – Except those functions terminated in the AN Frame Relay function in the AN.

Figure 6/G.965 – Protocol architecture

8.4.1 Data types for V5.2 C-paths

The following types of data have been defined which are conveyed over the V5.2 interface as communication paths:

- p-type data – This is ISDN D-channel data with SAPI 16.
- f-type data – This is ISDN D-channel data with SAPI = 32 to 62.
- Ds-type – This is ISDN D-channel signalling type data with SAPI not equal to any of those above.

NOTE – It has been identified that services using previously reserved SAPs may be provided in the future. Giving a default allocation at least allows earlier implementations of V5.2 to transport these D-channel signalling types across the AN although their future data type allocation may be changed.

- PSTN – This is PSTN signalling information.
- Control – This is control information data.
- Link control – This is link control information data.
- BCC – This is a protocol which allocates bearer channels on demand.
- Protection – This is a protocol which assigns logical C-channels to different physical C-channels when there are link failures within a V5.2 interface.

The control, BCC, link control and the protection communication paths shall always be allocated to time slot 16 of the primary link on initialization. The other communication paths shall be allocated to any logical C-channel excluding time slot 16 of the secondary link or those provided for protection purposes.

8.4.2 Communication paths when PSTN is provided on a V5.2 interface

Only one logical C-channel shall contain the PSTN protocol.

8.4.3 Communication paths when ISDN is provided on a V5.2 interface

p-type data from ISDN user ports may be placed in one or more logical C-channels.

f-type data from ISDN user ports may be placed in one or more logical C-channels.

Ds-type data from ISDN user ports may be placed in one or more logical C-channels.

The communication paths carrying p-type, f-type or Ds-type data from an ISDN user port may be placed in the same logical C-channel or split over different logical C-channels.

p-type data from any single user port shall not be split into different logical C-channels.

f-type data from any single user port shall not be split into different logical C-channels.

Ds-type data from any single user port shall not be split into different logical C-channels.

NOTE – p-type or f-type data may also be routed by an AN through the leased line service network by provisioning. There is no impact on this Recommendation.

8.5 Layer 2 sublayering and multiplexing on communication channels

The protocol specification and procedures for V5.2 follow directly from those provided in 8.5/G.964 [8].

8.6 Layer 3 multiplexing

In general, layer 3 multiplexing is the same as for 8.6/G.964 [8] with the following V5.2-relevant additions:

The link control protocol multiplexes information at layer 3 which is carried via the link control layer 2 data link over the V5.2 interface. The link control protocol is defined in clause 16.

The BCC protocol multiplexes information at layer 3 which is carried via the BCC layer 2 data link over the V5.2 interface. The BCC protocol is defined in clause 17.

The protection protocol multiplexes information at layer 3 which is carried via two protection layer 2 data links, one over the primary and the other over the secondary 2048 kbit/s links. The protection protocol is defined in clause 18.

8.7 Congestion control

The contents of this clause are identical to those of 8.7/G.964 [8].

8.7.1 Flow control end to end

The contents of this clause are identical to those of 8.7.1/G.964 [8].

8.7.2 Congestion control on the V5.2 interface

The contents of this clause are identical to those of 8.7.2/G.964 [8].

8.7.3 Blocking of ISDN user ports at layer 2

The contents of this clause are identical to those of 8.7.3/G.964 [8] and will also cover ISDN-PRA ports as well.

8.7.4 Flow control using LAPV5-DL mechanisms

The contents of this clause are identical to clause 8.7.4/G.964 [8].

9 Envelope Function sublayer of LAPV5 (LAPV5-EF)

The contents of this clause are identical to those of clause 9/G.964 [8].

10 Data Link sublayer of LAPV5 (LAPV5-DL)

10.1 Frame structure for peer-to-peer communication

The contents of this clause are identical to those of 10.1/G.964 [8].

10.2 Invalid frames

The contents of this clause are identical to those of 10.2/G.964 [8].

10.3 Elements of procedures and formats of fields for data link sublayer peer-to-peer communication

10.3.1 Link address field format

The contents of this clause are identical to those of 10.3.1/G.964 [8].

10.3.2 Link address field variables

10.3.2.1 Address field extension bit (EA)

The contents of this clause are identical to those of 10.3.2.1/G.964 [8].

10.3.2.2 Command/response field bit

The contents of this clause are identical to those of 10.3.2.2/G.964 [8].

10.3.2.3 V5DLaddr

The V5DLaddr shall be a 13-bit number. Values in the range of 0 up to 8175 shall not be used to identify a layer 3 protocol entity, because that range is used for identifying ISDN user ports.

Defined values of the V5DLaddr are given in Table 1.

10.3.3 Control field formats

The contents of this clause are identical to subclause 10.3.3/G.964 [8].

10.3.4 Control field parameters and associated state variables

The contents of this clause are identical to subclause 10.3.4/G.964 [8].

10.3.5 Frame types

The contents of this clause are identical to subclause 10.3.5/G.964 [8].

10.4 Definition of the peer-to-peer procedures of the data link sublayer

The contents of this clause are identical to those of 10.4/G.964 [8].

11 AN frame relay sublayer

The contents of this clause are identical to those of clause 11/G.964 [8].

12 Sublayer-to-sublayer communication and mapping function

The contents of this clause are identical to those of clause 12/G.964 [8].

Table 1/G.965 – Coding of V5DL address values

Bits								V5DLaddr
8	7	6	5	4	3	2	1	
1	1	1	1	1	1	C/R	EA	Octet 1
								Octet 2
1	1	1	0	0	0	0	EA	PSTN signalling (8176 decimal)
1	1	1	0	0	0	1	EA	Control protocol (8177 decimal)
1	1	1	0	0	1	0	EA	BCC protocol (8178 decimal)
1	1	1	0	0	1	1	EA	Protection protocol (8179 decimal)
1	1	1	0	1	0	0	EA	Link control protocol (8180 decimal)

13 General layer 3 protocol structures

13.1 General

Within the V5.2 interfaces, different layer 3 protocols are supported, all of them using the same "protocol discriminator". Hence, the full set of protocols can be seen as a unique "V5.2" protocol composed by different sub-protocols:

- PSTN protocol;
- control protocol (common control and userport control);
- link control protocol;
- BCC protocol; and
- protection protocol.

All of these layer 3 protocols are defined as message-oriented protocols. Every message shall consist of the following parts (information elements). For each of them is indicated its number of octets (between brackets):

- protocol discriminator (1 octet);
- layer 3 address (2 octets);
- message type (1 octet); and
- other information elements, as required (the number of octets is information element dependent).

Information elements a), b) and c) shall be present in all messages, acting as a "header" for each of the messages; while information elements d) are specific to each message type.

This organization is illustrated in the example shown in Figure 7.

8	7	6	5	4	3	2	1	Octets
Protocol discriminator								1
Layer 3 address								2
Layer 3 address (lower)								3
0	Message type							4
Other information element								etc.

Figure 7/G.965 – General message organization example

For all the V5.2 protocols, every particular information element can be present only once in a particular message.

For each of the octets composing each of the information elements, the bit designated "bit 1" is transmitted first, followed by bits 2, 3, 4, etc. Similarly, for each of the information elements, the octet designated "octet 1" is transmitted first, followed by octets 2, 3, 4, etc.

When a field extends over more than one octet, the order of bit values progressively decreases as the octet number increases. The least significant bit of the field is represented by the lowest numbered bit of the highest numbered octet of the field.

The possible bits not used within the octet structure of a particular information element are considered as "reserved" and shall be coded as binary "all 0". However, the reception of a reserved field coded as something different than "all 0" will not cause a protocol error.

13.2 Information elements that appear in every message (header)

Within this clause, the information elements that appear in every message (acting as a message header) are described.

These information elements do not include an explicit information element identifier field. Hence each of them will be identified from the position of the octets in every message.

13.2.1 Protocol Discriminator information element

The purpose of the Protocol Discriminator information element is to distinguish messages corresponding to one of the V5 protocols (PSTN protocol, Control protocol, Link control protocol, BCC protocol or Protection protocol) defined in ITU-T G.964 [8] and this Recommendation, from other messages corresponding to other protocols (not defined within these Recommendations) making use of the same V5 (in this case V5.2) data link connections.

NOTE – The Protocol Discriminator information element has been included within the V5 protocols for structure compatibility with other protocols (e.g. with ITU-T Q.931 [6]). It provides a mechanism for future compatibility, allowing the use of the same V5-data link connection for other Layer 3 protocols not yet identified.

The Protocol Discriminator information element is the first part of every message.

The length of the Protocol Discriminator information element shall be 1 octet.

The structure and coding of the Protocol Discriminator information element shall be as indicated by Figure 8.

8	7	6	5	4	3	2	1	Octet
0	1	0	0	1	0	0	0	1

NOTE – All other values are reserved.

Figure 8/G.965 – Protocol Discriminator information element

13.2.2 Layer 3 Address information element

The purpose of the Layer 3 Address information element is to identify the layer 3 entity, within the V5.2 interface, to which the transmitted or received message applies.

The Layer 3 Address information element shall be the second part of every message (located after the Protocol Discriminator information element).

The length of the Layer 3 Address information element shall be 2 octets.

The structure of the Layer 3 Address information element is protocol dependent, for the PSTN protocol (see 13.4.3/G.964 [8]) and for the Control protocol (see 14.4.2.3/G.964 [8]). For the link control protocol, this information element retains the name layer 3 address although it is used to refer to 2048 kbit/s links (it is defined in 16.3.2.1). For the BCC protocol this information element has been named the "BCC Reference Number" information element and is defined in 17.4.1. For the Protection protocol this information element has been named the "Logical C-channel identification" information element and is defined in 18.5.1.

13.2.3 Message Type information element

The purpose of the Message Type information element is to identify the function of the message being sent or received.

The Message Type information element shall be the third part of every message (located after the Layer 3 address information element).

The length of the Message Type information element shall be 1 octet.

The structure of the Message Type information element shall be as indicated by Figure 9.

8	7	6	5	4	3	2	1	Octet
0	Message Type						1	

Figure 9/G.965 – Message Type information element

The coding of the Message Type information element shall be as specified within this Recommendation. See Annex E for a full listing of message codepoints.

The general layout of the coding of the Message Type field shall be as indicated in Table 2.

Table 2/G.965 – Message type coding structures for the V5.2 protocols

Bits							Message types
7	6	5	4	3	2	1	
0	0	0	–	–	–	–	PSTN protocol message types
0	0	1	0	–	–	–	Control protocol message types
0	0	1	1	–	–	–	Protection protocol message types
0	1	0	–	–	–	–	BCC protocol message types
0	1	1	0	–	–	–	Link control protocol message types
NOTE – All other values are reserved.							

13.3 Other information elements

These information elements may appear in the different messages, being optional or mandatory depending on the message semantics and/or the protocol application of the message.

These information elements are specific for each of the protocols. For the PSTN protocol specific information elements see 13.4/G.964 [8], for the control protocol specific information elements see 14.4.4.2/G.964 [8], for the link control protocol specific information elements see 16.3.2, for the BCC protocol specific information elements see 17.4 and for the protection protocol specific information elements see 18.5.

See Annex E for a complete list of V5.2-information elements.

13.4 Protocol message functional definition and information content

In the protocol definitions of this Recommendation the different messages are specified highlighting the functional definition and information content (i.e. semantics) of each message. Each definition includes:

- a) A brief description of the message, direction and use.
- b) A table listing the information elements in the order of their appearance in the message (same relative order for all message types). For each information element the table indicates:
 - 1) the clause of this Recommendation describing the information element;
 - 2) the direction in which it may be sent: i.e. AN to LE, LE to AN, or both;
 - 3) whether inclusion is mandatory ("M") or optional ("O");
 - 4) the length of the information element in octets.

13.5 Codesets

For the coding of the information elements the same rules apply as defined in 4.5.1/Q.931 [6], without the functionality of the Shift information element, i.e. there shall be only one codeset.

14 PSTN signalling protocol specification and layer 3 multiplexing

The contents of this clause are identical to those of clause 13/G.964 [8].

15 Control requirements and protocol

This clause defines the port control and common control requirements, protocols and procedures in the form of normative FSM specifications and supporting prose description of the procedures.

15.1 ISDN-BA user port status indication and control

The contents of this clause are identical to those of 14.1/G.964 [8].

15.2 PSTN user port status indication and control

The contents of this clause are identical to those of 14.2/G.964 [8].

15.3 ISDN primary rate user port status indication and control

15.3.1 General aspects

The ISDN primary rate user port status indication is based on the defined split of responsibilities between AN and LE. Only that status information of the user port having call control relevance shall influence the state machine in the LE via the V5.2 interface.

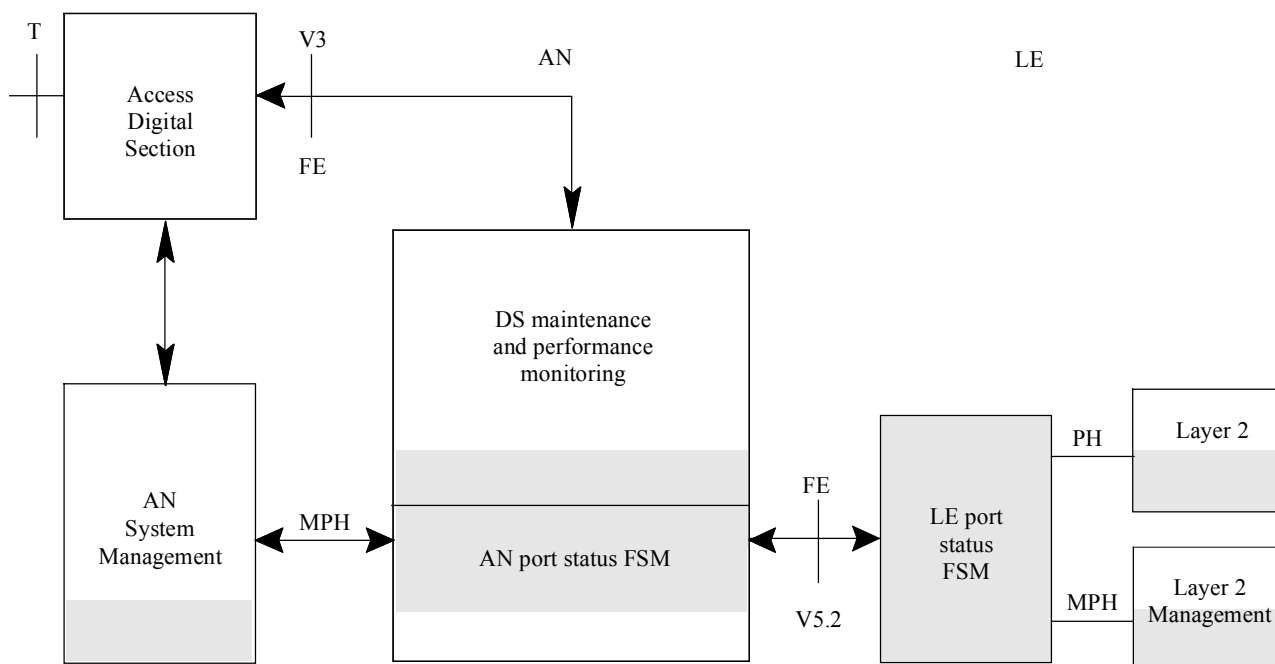
Port tests, e.g. loop back operation, shall be the responsibility of the AN. However, those tests which interfere with the service shall only be performed when the port is "Blocked", either due to failure or on request to and permission by the LE. This requires two groups of states, relevant to the V5.2-interface protocol, at both sides:

- operational state; and
- non-operational state.

Additional states are required in the AN for maintenance of the DS and the user port. ISDN primary rate access is permanently active at layer 1. If the DS detects a loss of layer 1 capability at its user side, the access shall be considered as non-operational from the LE point of view, while from the AN point of view, the DS is still in normal condition. This distinction is made by the AN system management and reported to the LE using additional Function Elements (FEs) and management primitives.

Figure 10 shows the functional model for control of the ISDN primary rate user port. The shading indicates the area defined in this Recommendation. The definition of the other functions and capabilities are outside the scope of this Recommendation. Reference is made to Annex C for further information about assumptions for the system management functions in the AN and LE.

In the following, only those functions and procedures are specified having relevance to the V5.2 interface.



NOTE – The FEs and primitives to this figure are defined in 15.3.2.

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Figure 10/G.965 – Primary rate port control functional model

15.3.2 Events and function elements relevant for the control of the state machines

Tables 3, 4, 5 and 6 give the set of FEs relevant for the V5.2 interface, the FEs defined in ITU-T G.962 [10] and the primitives (PH and MPH) towards layer 2 and the system management function in AN or LE (see also Figures 3/G.964 and 4/G.964 [8]). Figure 10 gives the definitions and the procedures for the FEs and the events used in Tables 3 to 6.

Table 3/G.965 – ITU-T G.962 [10] set of function elements with relevance to interface V5.2

FE	Name	DS ⇔ ET	Meaning at ET in LE
FE-A	Normal operation of DS	→	Not directly relevant
FE-B	Normal operation of ET	←	Not directly relevant
FE-C	Unintentional loopback	AN maintenance	Not directly relevant
FE-D	LOS/LFA at TE (FC2)	AN maintenance	Not directly relevant
FE-E	LOS at line side of NT1 (FC3)	AN maintenance	Not directly relevant
FE-F	LOS/LFA at V3 reference point of ET (FCL)	AN maintenance	Not directly relevant
FE-G	LOS/LFA at T reference point of NT1 (FC4)	AN maintenance	Not directly relevant
FE-H	FC3 and FC4 simultaneously	AN maintenance	Not directly relevant
FE-I	Loss of power at NT1	AN maintenance	Not directly relevant

**Table 3/G.965 – ITU-T G.962 [10] set of function elements
with relevance to interface V5.2**

FE	Name	DS ⇔ ET	Meaning at ET in LE
FE-K	FE-I and FE-D simultaneously	AN maintenance	Not directly relevant
FE-L	LOS at line side of LT (FC1)	AN maintenance	Not directly relevant
NOTE – FE-M to FE-P of ITU-T G.962 [10] refer to failures in a separate digital link and are not relevant. FE-Q to FE-T refer to loopback operation and are outside the scope of interface V5.2. FE-U to FE-Y are related to CRC-4 error detection and relevant to performance monitoring only (see 15.3.4).			

Table 4/G.965 – Set of function elements of interface V5.2

FE	Name	AN ⇔ LE	Description
FE201	Unblock	←	Request or acknowledgement
FE202	Unblock	→	Request or acknowledgement
FE203	Block	←	Command
FE204	Block	→	Command
FE205	Block request	→	Request
FE206	Grading	→	Performance information (Note 1)
FE207	D-channel block	←	Command (Note 2)
FE208	D-channel unblock	←	Command (Note 2)
FE209	TE out of service	→	Indication of user failure
FE210	Failure inside network	→	Indication of network failure
NOTE 1 – The grading information may be sent from the AN system management when being in state AN/LE2.0, see also 15.3.4.			
NOTE 2 – The commands "D-channel block" and "D-channel unblock" shall be used to interrupt or resume the operation of the upstream D-channel of an individual ISDN user port according to the requirement in 8.7.3/G.964 [8]. These commands may appear when being in state AN/LE2.0 without change of state.			

The function elements are reported by the DS immediately after detection of an event. The effect on the port control, which has relevance to the call control procedures, shall be delayed by an appropriate persistence check procedure. This is outside the scope of this Recommendation and not reflected in the AN (ISDN primary port) FSM. Reference is made to ITU-T I.431 [9] which gives an example of an appropriate persistence check procedure.

Table 5/G.965 – Set of primitives in the LE

Primitive	FSM ⇔ L2/Management	Description
MPH-UBR	←	Unblock request
MPH-UBR	→	Unblock request
MPH-UBI	→	Unblock indication
MPH-BI	←	Block command
MPH-BI	→	Block command
MPH-BR	→	Incoming block request
PH/MPH-AI	→	Access activated (operational)
PH/MPH-DI	→	Access deactivated (not operational)
MPH-UF	→	User failure indication
MPH-NF	→	Network failure indication
MPH-GI	→	Grading information with parameter (Note 1)
MPH-DB	←	Block D-channel from user port (Note 2)
MPH-DU	←	Unblock D-channel from user port (Note 2)
NOTE 1 – The grading information may be sent from the AN system management when in state LE2.0, see also 15.3.4.		
NOTE 2 – The commands "MPH-DB" and "MPH-DU" shall be used to interrupt or resume the operation of the upstream D-channel of an individual ISDN user port according to the requirement in 8.7.3/G.964 [8]. These commands may appear when in state LE2.0 without change of state.		

15.3.3 ISDN-PRA user port FSMs, AN (ISDN port) and LE (ISDN port)

The primitives, FEs and the state tables are given for the definition of the functional behaviour and cooperation between the various functional blocks. There is no restriction for the implementation of these functions as long as the implementation is in conformance with the functionality defined in this Recommendation over the interface V5.2 and with the primary rate access digital section.

Table 6/G.965 – Set of management primitives in the AN relevant to interface V5.2

Primitive	Management ⇔ FSM	Description
MPH-UBR	→	Unblock request
MPH-UBR	←	Unblock request
MPH-UBI	←	Unblock indication
MPH-BI	→	Block command
MPH-BI	←	Block command
MPH-BR	→	Block request
MPH-NOF	←	User and DS normal
MPH-Eic	←	AN maintenance
MPH-Eid	←	AN maintenance

Table 6/G.965 – Set of management primitives in the AN relevant to interface V5.2

Primitive	Management ⇔ FSM	Description
MPH-Eie	←	AN maintenance
MPH-Eig	←	AN maintenance
MPH-Eih	←	AN maintenance
MPH-Eii	←	AN maintenance
MPH-Eik	←	AN maintenance
MPH-Eil	←	AN maintenance
MPH-Ellos	←	AN maintenance
MPH-UF	→	User failure indication
MPH-NF	→	Network failure indication
MPH-GI	→	Grading information with parameter (Note 1)
MPH-DB	←	Block D-channel from user port (Note 2)
MPH-DU	←	Unblock D-channel from user port (Note 2)
MPH-PAR	→	Request for port operation for PL capability (Note 3)
MPH-PAI	←	Port operation for PL capability indication (Note 3)
MPH-PDR	→	Request port non-operation for PL capability (Note 3)
MPH-PDI	←	Port non-operation for PL capability indication (Note 3)
MPH-LxAR	→	Activate loopback (Note 3)
MPH-AI	←	Loopback activation indication (Note 3)
MPH-DR	→	Loopback release request (Note 3)
NOTE 1 – The grading information may be sent from the AN system management when being in state AN2.0, see also 15.3.4. NOTE 2 – The commands "MPH-DB" and "MPH-DU" are used to interrupt or resume the operation of the upstream D-channel of an individual ISDN user port according to the requirement in 8.7.3/G.964 [8]. These commands may appear when being in state AN2.0 without change of state. NOTE 3 – The last seven primitives are not directly relevant for the interface V5.2 but given for information and complete description of the reaction in the FSM on receipt of those events even in states relevant to interface V5.2.		

15.3.3.1 Description of the states

The procedure for blocking and unblocking of the user port as specified in the port FSMs takes account of the principles given in 7.1/G.964 [8].

Blocking request shall be issued from the AN system management only when being in the operational state. This request does not have any effect on the state unless the LE responds with FE203.

Immediate blocking indication has immediate effect in any relevant state in both FSMs. No specific confirmation of this indication is required.

Unblocking needs to be coordinated on both sides. Therefore, an unblock request requires confirmation from the other side. The Coordination is guaranteed through the two unblock states. If a block indication is received from the other side when in local unblock state this shall only be interpreted as no confirmation and may be relevant only for the management system.

The unblock request may also be used by the management system to confirm the status of the layer 1 state machines.

The AN-FSM defined for the ISDN primary rate port supports the optional PL-capability which requires that the access digital section and the user terminal may become operational under the control of the AN while the LE is non-operational. The procedure uses the states AN1.1 and AN3.0.

Maintenance of the DS and loopback tests (see FE-Q to FE-T of ITU-T G.962 [10]) may use the additional states AN4 which are outside the scope of this Recommendation. These states shall only be entered from the state AN1.0 or AN1.2.

State AN4 can only be entered from states AN1 and shall only return to AN1.0. To align AN and LE FSM FE204 shall be sent to the LE and the unblock procedure may then be applied.

15.3.3.2 Definition of port control states

The user port FSMs reflect the AN and LE view of the layer 1 state of the ISDN port only. Call control is the responsibility of the ISDN protocol.

15.3.3.2.1 ISDN-PRA user port FSM – AN (ISDN port)

Non-operational (AN1 and AN3): D-channel blocking has been applied to the port. Therefore, no layer 2 information shall be frame relayed to the LE, and the port cannot be used to originate or terminate calls.

Blocked (AN1.0): The port is in the non-operational state and neither side has initiated unblocking. Two sub-states are required to satisfy the DS and the user-network interface specification.

Local unblock (AN1.1): The AN has initiated unblocking (by sending FE202) and is awaiting confirmation from the LE. Although the DS is in normal condition the AN-FSM has to signal to the TE that the access is not operational by sending RAI.

Remote unblock (AN1.2): The LE has initiated unblocking (by sending FE201) and is awaiting confirmation from the AN. Two sub-states are required to satisfy the DS and the user-network interface specification. They correspond to the two sub-states of AN1.0.

NOTE – States AN1.1 and AN1.2 provide a mechanism for the synchronized unblocking of ports.

PL operational (AN3): The AN system management has initiated the port operation for PL capability when the LE does not support unblocking of the port (AN1.1). In case of a failure report from the DS or on request from the AN system management the AN port FSM goes back to state AN1.02.

Operational (AN2.0): The port is operational from the AN and LE point of view, layer 2 (and layer 3) links may be established and the port can be used to originate or terminate calls.

15.3.3.2.2 ISDN-PRA user port FSM – LE (ISDN port)

Non-operational (LE1): No layer 2 information is expected at the LE, and the port cannot be used to originate or terminate calls.

Blocked (LE1.0): The port is in the non-operational state and neither side has initiated unblocking.

Local unblock (LE1.1): The LE has initiated unblocking (by sending FE201) and is awaiting confirmation from the AN.

Remote unblock (LE1.2): The AN has initiated unblocking (by sending FE202) and is awaiting confirmation from the LE.

NOTE – States LE1.1 and LE1.2 provide a mechanism for the synchronized unblocking of ports.

Operational (LE2.0): Layer 1 of the primary rate access is operational. Layer 2 (and layer 3) links may be established. The port can be used to originate or terminate calls.

15.3.3.3 Principles and procedures

15.3.3.3.1 General

The next subclauses describe the mechanism implemented in the FSMs in AN and LE for ISDN (primary rate access) ports, which are presented in the relevant state transition tables.

The following mechanisms are described:

- blocking;
- blocking request;
- coordinated unblocking;
- user failure/network failure indication;
- support of the permanent line capability.

15.3.3.3.2 Blocking

A user port, when being in the operational state (AN2/LE2), can be blocked from either sides. However, the AN system management has no knowledge about the call state of the port, and hence shall only apply this procedure under failure and other conditions (when the persistence check procedure has been passed), that allow for affecting the service.

When AN system management issues MPH-BI, the FSM sends FE204 (Block Command) to the LE and goes to the Blocked state AN1.0, sub-state AN1.02 to signal the non-operational condition to the TE.

The AN-FSM may also block the port autonomously when the DS indicates a failure condition. The appropriate sub-state supports the port control through the DS as specified in the relevant Recommendations.

When LE system management issues MPH-BI, the FSM sends FE203 (Block Command) to the AN and goes to the Blocked state LE1.0.

15.3.3.3.3 Blocking request

The blocking request mechanism allows for non-urgent port blocking (e.g. deferrable maintenance). In this case AN system management issues a Blocking Request (MPH-BR) resulting in FE205 to the LE. This request shall be passed by the LE-FSM to LE System management by MPH-BR.

LE System management, knowing the call state, may grant the request by issuing MPH-BI, resulting in FE203 (Block Command) to the AN, then goes to Blocked state.

In case of a semi-permanent connection the LE System management will not grant this request but send MPH-UBR as a negative confirmation.

The AN system management may cancel the blocking request by issuing MPH-UBR. The LE system management may then receive MPH-UBI and cancel the blocking request (i.e. ignore the previously received request) if the port has not yet been blocked. In the latter case, the LE may start the unblock procedure by issuing MPH-UBR.

15.3.3.3.4 Coordinated unblocking

Unblocking a port, needs to be Coordinated at both sides. An unblock request requires confirmation from the other side. To guarantee this Coordination there are two separate Unblock states (Local & Remote Unblock) in both FSMs. This procedure is fully symmetrical between AN and LE. If the LE wants to unblock, it issues MPH-UBR, sends FE201 (Unblock request) and goes to "Local Unblock" (LE1.1). The AN goes to "Remote Unblock" (AN1.2), to the corresponding sub-state as in state AN1.0, and sends MPH-UBR to its system management, which may agree, then responds with MPH-UBR (unblock acknowledge), sends FE202 and goes to "Access Operational" state (AN2.0).

For the LE in "Local unblock" and receiving this acknowledgement, the FSM goes to "Access Operational" (LE2.0) and issues MPH-UBI to its system management. The AN System management may as well take the initiative, for which the same procedure applies.

For AN and LE, when in "Remote unblock" (AN1.2x, LE1.2x) state and receiving FE204 or FE203 respectively, the port state FSM is returned back to "Blocked" (AN1.0, LE1.0), and a MPH-BI sent to system management. This undoes a previous Unblock Request from the other side.

The AN system management may cancel the blocking request by issuing MPH-UBR. The LE system management may then receive MPH-UBI and cancel the blocking request (i.e. ignore the previously received request) if the port has not yet been blocked. In the latter case the LE may start the unblock procedure by issuing MPH-UBR.

See C.5 for basic system management requirements.

15.3.3.3.5 User failure/network failure indication

For the full support of the ISDN service the LE needs to know the reason for the blocking of the port, i.e. the port was blocked due to failure in the user's responsibility or in the network's responsibility. This information can only be provided by the AN system management knowing the location of the failure from the information provided by the access digital section and internal failure detection capabilities. Failure conditions (FC) 2 and 4 (FE-G only, FE-G and FE-K together, under certain conditions) are understood as user failures but the AN may confirm this by applying failure localization prior to the indication to the LE. The identification of "loss of power at NT1" (FE-I) as user failure or network failure depends on the NT1 powering arrangement.

The AN system management shall inform the LE system management by sending the appropriate information (MPH-UF or MPH-NF) to the AN (ISDN primary port) FSM which will send FE209 or FE210 to the LE (ISDN primary port) FSM respectively. The FSM in the LE will then inform the LE system management accordingly.

15.3.3.3.6 Support of the permanent line capability

Since the primary rate user port is permanently active there is no particular requirement for the V5.2 primary rate port control above the procedures already defined. If the LE blocks the user port or, if after restoration from a failure in the DS or TE, the unblock procedure is not supported by the LE, the AN system management may bring the user port into PL operational by issuing MPH-PAR. The AN FSM will go into state AN3.0 and confirm with MPH-PAI. With MPH-PDR the AN system management may disable PL capability which will be responded by the FSM with a change to state AN1.02 and MPH-PDI. This procedure is not relevant to the LE.

15.3.3.4 ISDN port FSM at the AN

The ISDN-PRA user port FSM is defined in Table 7 in accordance with Figure 10.

Table 7/G.965 – AN (ISDN primary port) FSM for ISDN-PRA user ports

State	AN1.01	AN1.02	AN1.1	AN1.21	AN1.22	AN2.0	AN3.0
State name	Blocked 1	Blocked 2	Local unblock	Remote unblock 1	Remote unblock 2	Access operational	PL operational
Event							
Signal to V3	NOF	RAI	RAI	NOF	RAI	NOF	NOF
FE201	MPH-UBR 1.21	MPH-UBR 1.22	MPH-UBI 2.0	MPH-UBR –	MPH-UBR –	FE202; MPH-UBI –	MPH-UBI 2.0
FE203	–	–	MPH-BI 1.02	MPH-BI 1.01	MPH-BI 1.02	MPH-BI 1.02	MPH-BI –
MPH-UBR	MPH-BI –	FE202 1.1	FE202 –	FE204; MPH-BI 1.01	FE202; MPH-UBI 2.0	FE202; MPH-UBI –	MPH-PAI –
MPH-BI	FE204 –	FE204 –	FE204 1.02	FE204 1.01	FE204 1.02	FE204 1.02	FE204 1.02
MPH-BR	–	–	/	/	/	FE205 –	/
NOF	MPH-NOF 1.02	MPH-NOF –	–	MPH-NOF 1.22	MPH-NOF –	–	–
LOS/LFA	MPH-Eilos 1.02	MPH-Eilos –	FE204; MPH-Eilos 1.02	FE204; MPH-Eilos 1.02	FE204; MPH-Eilos 1.02	FE204; MPH-Eilos 1.02	FE204; MPH-Eilos 1.02
FE-C	MPH-EIc 1.02	MPH-Eic –	FE204; MPH-Eic 1.02	FE204; MPH-Eic 1.02	FE204; MPH-Eic 1.02	FE204; MPH-Eic 1.02	FE204; MPH-Eic 1.02
FE-D	MPH-EId –	MPH-EId 1.01	FE204; MPH-EId 1.01	FE204; MPH-EId 1.01	FE204; MPH-EId 1.01	FE204; MPH-EId 1.01	FE204; MPH-EId 1.01
FE-E	MPH-EIe –	MPH-EIe 1.01	FE204; MPH-EIe 1.01	FE204; MPH-EIe 1.01	FE204; MPH-EIe 1.01	FE204; MPH-EIe 1.01	FE204; MPH-EIe 1.01
FE-G	MPH-EIg 1.02	MPH-EIg –	FE204; MPH-EIg 1.02	FE204; MPH-EIg 1.02	FE204; MPH-EIg 1.02	FE204; MPH-EIg 1.02	FE204; MPH-EIg 1.02
FE-H	MPH-EIh 1.02	MPH-EIh –	FE204; MPH-EIh 1.02	FE204; MPH-EIh 1.02	FE204; MPH-EIh 1.02	FE204; MPH-EIh 1.02	FE204; MPH-EIh 1.02
FE-I	MPH-EIi –	MPH-EIi –	MPH-EIi –	MPH-EIi –	MPH-EIi –	MPH-EIi –	MPH-EIi –
FE-K	MPH-EIk –	MPH-EIk 1.01	FE204; MPH-EIk 1.01	FE204; MPH-EIk 1.01	FE204; MPH-EIk 1.01	FE204; MPH-EIk 1.01	FE204; MPH-EIk 1.01
FE-L	MPH-EIL 1.02	MPH-EIL –	FE204; MPH-EIL 1.02	FE204; MPH-EIL 1.02	FE204; MPH-EIL 1.02	FE204; MPH-EIL 1.02	FE204; MPH-EIL 1.02
MPH-LxAR	FE-Q/R 4.x	FE-Q/R 4.x	/	FE-Q/R 4.x	FE-Q/R 4.x	/	/

Table 7/G.965 – AN (ISDN primary port) FSM for ISDN-PRA user ports

State	AN1.01	AN1.02	AN1.1	AN1.21	AN1.22	AN2.0	AN3.0
State name	Blocked 1	Blocked 2	Local unblock	Remote unblock 1	Remote unblock 2	Access operational	PL operational
Event							
Signal to V3	NOF	RAI	RAI	NOF	RAI	NOF	NOF
MPH-UF	FE209 –	FE209 –	/	FE209 –	FE209 –	/	/
MPH-PAR	/	/	MPH-PAI 3.0	/	/	/	–
MPH-PDR	/	/	/	/	/	/	MPH-PDI 1.02
MPH-NF	FE210 –	FE210 –	/	FE210 –	FE210 –	/	/
MPH-GI	/	/	/	/	/	FE206 –	/
FE207	/	/	/	/	/	MPH-DB –	/
FE208	/	/	/	/	/	MPH-DU –	/
– No state change / Unexpected event, no state change NOF Normal Operational Frames LOS/LFA Loss of Signal/Loss of Frame Alignment NOTE 1 – States AN4 are not relevant to interface V5.2 and not defined in this Recommendation. NOTE 2 – If D-channel blocking has been applied to a user port after receipt of FE207, when in state AN2.0 and if the port FSM leaves state AN2.0, then D-channel blocking shall be removed.							

The AN FSM covers single failure events from the DS only except where multiple failures are reported by the DS, i.e. FE-H and FE-K. A new detected event means that a previously reported failure has disappeared.

The AN FSM provides a mechanism which allows the system management of the AN to verify that the FSM is in the Operational state, without having to go through the sequence of blocking and unblocking. This mechanism is internal to the AN. To do so the AN system management issues MPH-UBR and receives the information whether the FSM is in a non-operational state.

15.3.3.5 ISDN port FSM at the LE

Table 8 gives the FSM of the LE.

Table 8/G.965 – LE (ISDN primary port) FSM for ISDN-PRA user ports

State	LE1.0	LE1.1	LE1.2	LE2.0
State name Event	Blocked	Local unblock	Remote unblock	Access operational
MPH-UBR	FE201 1.1	FE201 –	PH/MPH-AI; FE201 2.0	FE201 –
MPH-BI	FE203 –	FE203 1.0	FE203 1.0	FE203 1.0
FE202	MPH-UBR 1.2	PH/MPH-AI 2.0	MPH-UBR –	MPH-UBI
FE204	–	MPH-BI 1.0	MPH-BI 1.0	MPH-BI; PH/MPH-DI 1.0
FE205	–	–	–	MPH-BR –
FE206	/	/	/	MPH-GI –
FE209	MPH-UF –	MPH-UF –	/	/
FE210	MPH-NF –	MPH-NF –	/	/
MPH-DB	/	/	/	FE207 –
MPH-DU	/	/	/	FE208 –
– No state change / Unexpected event, no state change NOTE – If the D-channel blocking has been applied to a user port when in state LE2.0, by issuing the MPH-DB primitive, the system management shall be aware that D-channel blocking in the AN will be removed, after the port FSM in the AN leaves state AN2.0.				

The LE FSM provides a mechanism which allows the system management of the LE to verify that the FSM is in the operational state by issuing MPH-UBR, without having to go through the sequence of blocking and unblocking.

Unlike the corresponding situation for the AN, this mechanism is not internal to the LE and requires the cooperation of the AN FSM, and confirms the alignment of both FSMs and the link between them.

The asymmetry here reflects the responsibility of the LE for supporting the service.

15.3.4 Performance monitoring aspects

The performance of the primary rate access digital section, if implemented with the NT1 implemented separately from the AN, shall be monitored by the AN (FE-U for the downstream direction or CRC-4 block in error detected in AN for the upstream direction). The application of the mechanism is to be provisioned at the AN and LE on a per port basis.

As reflected in ITU-T G.964 [8] (7.1.1, item 7), the working concept is that on the V5 interface there is no impact from any implementation of the user-port. The AN is supposed to monitor the performance of the access digital section. Parameters for validation algorithms and specific thresholds shall be pre-defined in the AN. Only passing the threshold will be reported ("Grading" with parameter indicating which grade is now relevant) at a maximum rate of once a minute. The LE may use these reports to decide whether or not a requested service shall be delivered. This concept makes performance monitoring on V5 access-implementation independent, having no effect on the Port-Status FSM.

The persistent excess of a bit error ratio of 10^{-3} shall be considered as a failure requiring maintenance (according to the M-series Recommendations and ITU-T G.921), and therefore immediate blocking of the user port.

The use of FE-W, FE-X and FE-y for remote user maintenance under control of the AN is optional and left to the operator. This does not have any impact on the V5.2 interface.

15.4 Control protocol

15.4.1 Control protocol message definition and content

The contents of this clause are identical to 14.4.1/G.964 [8].

Table 9/G.965 – Coding of Control function element

Bits (octet 3)							Control function element
7	6	5	4	3	2	1	
0	0	0	0	0	0	1	FE101 (activate access)
0	0	0	0	0	1	0	FE102 (activation initiated by user)
0	0	0	0	0	1	1	FE103 (DS activated)
0	0	0	0	1	0	0	FE104 (access activated)
0	0	0	0	1	0	1	FE105 (deactivate access)
0	0	0	0	1	1	0	FE106 (access deactivated)
0	0	1	0	0	0	1	FE201/202 (unblock)
0	0	1	0	0	1	1	FE203/204 (block)
0	0	1	0	1	0	1	FE205 (block request)
0	0	1	0	1	1	0	FE206 (performance grading)
0	0	1	0	1	1	1	FE207 (D-channel block)
0	0	1	1	0	0	0	FE208 (D-channel unblock)
0	0	1	1	0	0	1	FE209 (TE out of service)
0	0	1	1	0	1	0	FE210 (failure inside network)
NOTE – All other values are reserved.							

15.4.2 General message format and information element coding

The contents of this clause are identical to 14.4.2/G.964 [8] with the exception of Table 54/G.964 [8] which is modified due to two additional Control function elements required for the ISDN primary rate port, and with the exception of Table 55/G.964 [8] which is modified due to 20 additional Control function IDs for the accelerated alignment procedure. Tables 9 and 9a show the modified Tables 54 and 55/G.964 [8], respectively.

Table 9a/G.965 – Coding of Control function ID

Bits (octet 3)							Control function ID	Optional information element considered mandatory
7	6	5	4	3	2	1		
0	0	0	0	0	0	0	Verify re-provisioning	Variant
0	0	0	0	0	0	1	Ready for reprovisioning	Variant
0	0	0	0	0	1	0	Not ready for reprovisioning	Variant, Rejection cause
0	0	0	0	0	1	1	Switch over to new variant	Variant
0	0	0	0	1	0	0	Re-provisioning started	Variant
0	0	0	0	1	0	1	Cannot re-provision	Variant, Rejection cause
0	0	0	0	1	1	0	Request variant and interface ID	–
0	0	0	0	1	1	1	Variant and Interface ID	Variant, Interface ID
0	0	0	1	0	0	0	Blocking started	–
0	0	1	0	0	0	0	Restart	–
0	0	1	0	0	0	1	Restart complete	–
0	0	1	0	0	1	0	UNBLOCK ALL RELEVANT PSTN AND ISDN PORTS REQUEST	Note 1, Note 2
0	0	1	0	0	1	1	UNBLOCK ALL RELEVANT PSTN AND ISDN PORTS ACCEPTED	Note 1, Note 2
0	0	1	0	1	0	0	UNBLOCK ALL RELEVANT PSTN AND ISDN PORTS REJECTED	Note 1, Note 2
0	0	1	0	1	0	1	UNBLOCK ALL RELEVANT PSTN AND ISDN PORTS COMPLETED	Note 1, Note 2
0	0	1	0	1	1	0	UNBLOCK ALL RELEVANT PSTN PORTS REQUEST	–
0	0	1	0	1	1	1	UNBLOCK ALL RELEVANT PSTN PORTS ACCEPTED	–
0	0	1	1	0	0	0	UNBLOCK ALL RELEVANT PSTN PORTS REJECTED	–
0	0	1	1	0	0	1	UNBLOCK ALL RELEVANT PSTN PORTS COMPLETED	–

Table 9a/G.965 – Coding of Control function ID

Bits (octet 3)							Control function ID	Optional information element considered mandatory
7	6	5	4	3	2	1		
0	0	1	1	0	1	0	UNBLOCK ALL RELEVANT ISDN PORTS REQUEST	Note 1
0	0	1	1	0	1	1	UNBLOCK ALL RELEVANT ISDN PORTS ACCEPTED	Note 1
0	0	1	1	1	0	0	UNBLOCK ALL RELEVANT ISDN PORTS REJECTED	Note 1
0	0	1	1	1	0	1	UNBLOCK ALL RELEVANT ISDN PORTS COMPLETED	Note 1
0	0	1	1	1	1	0	BLOCK ALL PSTN PORTS REQUEST	–
0	0	1	1	1	1	1	BLOCK ALL PSTN PORTS ACCEPTED	–
0	1	0	0	0	0	0	BLOCK ALL PSTN PORTS REJECTED	–
0	1	0	0	0	0	1	BLOCK ALL PSTN PORTS COMPLETED	–
0	1	0	0	0	1	0	BLOCK ALL ISDN PORTS REQUEST	Note 1
0	1	0	0	0	1	1	BLOCK ALL ISDN PORTS ACCEPTED	Note 1
0	1	0	0	1	0	0	BLOCK ALL ISDN PORTS REJECTED	Note 1
0	1	0	0	1	0	1	BLOCK ALL ISDN PORTS COMPLETED	Note 1
– All other values reserved.								
NOTE 1 – "ISDN ports" means ISDN basic access ports and ISDN primary rate access ports.								
NOTE 2 – See the definition of the relevant port in 3.1.								

15.4.3 State definition of the control protocol

The contents of this clause are identical to 14.4.3/G.964 [8].

15.4.4 Control protocol procedures

The contents of this clause are identical to 14.4.4/G.964 [8].

15.4.5 Accelerated alignment of the port related protocol entities and FSMs

Alternatively it is possible to align port states in AN and LE by the commands:

- Unblock all relevant PSTN and ISDN ports request (Note 1);
- Unblock all relevant PSTN ports request;
- Unblock all relevant ISDN ports request (Note 1);
- Block all PSTN ports request;
- Block all ISDN ports request (Note 1);

NOTE 1 – The terminus ISDN includes ISDN basic access and ISDN primary rate access.

NOTE 2 – See the definition of the relevant port in 3.1.

This can be accepted or rejected.