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# V5 - UK PSTN MAPPING REQUIREMENTS

Issue 2

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**Normative Information**



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# SSPE SPECIFICATION NUMBER 001-1

# V5 - UK PSTN MAPPING REQUIREMENTS

## ISSUE 2

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## Contents

## 0.1. Normative Information



## 0.2. History

Issue 1. August 1997

Issue 2, July 1998

Reference [11] modified.

Reference [12] added.

Abbreviations added to 0.4.1.

New definition added to 0.4.1.

The following FEs added to Tables 1 and 5;

FE-line_signal Off Hook

FE-line_signal Digit Signal

FE-line_signal Pulsed On Hook

FE-est_ack_ind Pulsed No Battery

The following FEs added to Tables 2 and 4;

FE-line_signal B-Wire connected to earth

FE-line_signal No Battery

FE-line_signal Normal Polarity

FE-line_signal Reversed Polarity

FE-sub_seize No Battery

FE-sub_release

The following FEs added to Tables 6 and 8;

FE-line_sig_ind B-Wire connected to earth

FE-line_sig_ind No Battery

FE-line_sig_ind Normal Polarity

FE-line_sig_ind Reversed Polarity

FE-establish_ind No Battery

FE-sub_release

The following FEs added to Tables 7 and 9;

FE-establish_req Off Hook

FE-line_sig_req Digit Signal

FE-line_sig_req Pulsed On Hook

FE-establish_ack Pulsed No Battery

Labels added to SDL branches.

New SDL branches added for PBX Line Types.

Additional modification to existing states in Annex L;

4.3.2.2 (h) Fig L.9.10 (AN7) Receipt of Timeout T3.

Table 24, DISCONNECT CLEAR description modified.

Table 24, END OF CALL description modified.

Complete re-write and addition specification of DEL autonomous actions.

Options removed from DEL MSCs.

New DEL MSCs added.

General editorial modifications made to Clause 5.

Clause 6, Loop Calling PBX added.

Clause 7, Earth Calling PBX added.

Clause 8, DDI PBX added.

## 0.3. References

[1] ETS 300 324-1, February 1994

Signalling Protocols and Switching (SPS);
V interfaces at the digital Local Exchange (LE)
V5.1 interface for the support of Access Network (AN)
Part 1: V5.1 interface specification as amended by
ETS 300 324-1 Amendment A1.

[2] NET 4
Attachments to Public Switched Telephone Network (PSTN); General Technical Requirements for Equipment Connected to an Analogue Subscriber Interface in the PSTN.

[3] BS 6305 - 1992
Specification for General Requirements for Apparatus for Connection to Public Switched Telephone Networks Run by Certain Public Telecommunications Operators.

[4] BS 6450
Private Branch Exchanges for Connection to Public Switched Telephone Networks Run by Certain Public Telecommunications Operators.

[5] BS 6317
British Standard Specification for Simple Telephone Extension for Connection to Public Switched Telephone Networks Run by Certain Public Telecommunications Operators.

[6] ETS 300 376-1, December 1994

Signalling Protocols and Switching (SPS);
Q3 interface at the Access Network (AN) for configuration management of V5 interfaces and associated user ports;
Part 1: Q3 interface specification

[7] ETS 300 377-1, December 1994

Signalling Protocols and Switching (SPS);
Q3 interface at the Local Exchange (LE) for configuration management of V5 interfaces and associated customer profiles;
Part 1: Q3 interface specification

[8] ETS 300 324 - 2, February 1994: Signalling Protocols and Switching (SPS) V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Network (AN); Part 2 Protocol Implementation Conformance Statement (PICS) proforma

[9] ISO/IEC 9646-1: “Information technology - Open systems interconnection Conformance testing methodology and framework - Part 1: General Concepts”

[10] ISO/IEC 9646-7: Information technology - Open systems interconnection Conformance testing methodology and framework - Part 7: Implementation Conformance Systems”

[11] ETS 300 347-1, September 1994
Signalling Protocols and Switching (SPS);
V interfaces at the digital Local Exchange (LE)
V5.2 interface for the support of Access Network (AN)
Part 1: V5.2 interface specification as amended by
ETS 300 347-1 Amendment A1.

[12] ETR 150, September 1994: Signalling Protocols and Switching (SPS); V5 Interface, Public Switched Telephone Network (PSTN) Mappings.

[13] PD 7003: 1996 Essential requirements for terminal equipment intended for connection to analogue interfaces of the PSTN using direct dialling in.

## 0.4. Glossary of Terms

### 0.4.1. Abbreviations

| | |
|---|---|
| ACK | Acknowledge signal |
| AN | Access Network |
| C7 (NUP) | CCITT Signalling System Number 7 National User Part |
| CCITT | International Telegraph and Telephone Consultative Committee |
| CLASS | Customer Local Area Signalling Services |
| CPE | Customers Premises Equipment |
| CSH | Called Subscriber Hold |
| DEL | Direct Exchange Line |
| DDI | Direct Dial In |
| Ds | Digit Signal |
| DTMF | Dual Tone Multi Frequency |
| EC-PBX | Earth Calling PBX |
| EOC | End Of Call |
| ETS | European Telecommunications Standard |
| ETSI | European Telecommunications Standards Institute |
| FE | Function Element |
| I/C | Incoming |
| IE | Information Element |
| LC-PBX | Loop Calling PBX |
| LE | Local Exchange |
| MCI | Malicious Call Indication |
| MSC | Message Sequence Chart |
| N/A | Not Applicable |
| O/G | Outgoing |
| PBX | Private Branch Exchange |
| PICS | Protocol Implementation Conformance Statement |
| Ps | Pulsed Signal |
| pps | Pulses Per Second |
| Pn | Pulse Notification |
| PSTN | Public Switched Telephone Network |
| Q(AN) | Q interface at the AN |
| Q(LE) | Q interface at the LE |

| | |
|---|---|
| SDL | Specification and Description Language |
| SPM | Subscribers Private Meter |
| SPS | Signalling Protocols and Switching |
| Ss | Steady Signal |
| TE | Terminal Equipment |
| TMN | Telecommunications Management Network |
| UK | United Kingdom of Great Britain & Northern Ireland |
| V5 | A generic term for an ETSI interface family that is used to interconnect ANs and LEs. |
| V5.1 | An interface conforming to ETS 300 324-1 [1] |
| V5.2 | An interface conforming to ETS 300 347-1 [11] |

### 0.4.2. Definitions

| | |
|---|---|
| AN | Access Network - A system implemented between the Local Exchange (LE) and user, replacing part or the whole of the local line distribution network. |
| Analogue port | The physical port implemented in the AN to provide the relevant interface functions towards the user. The analogue port is addressed by a logical address used in the relevant protocols on the V5 interface. |
| CPE | Any equipment that can be connected to an analogue port and is located at the customer premises such as a telephone or small call routing apparatus. |
| LE | Local Exchange - An exchange on which user lines may be terminated via an AN. |
| Disconnect Clear Primitive Indicator | An indicator introduced into the specification to prevent unnecessary repetitions of the DISCONNECT CLEAR signal during call clear down. |

## 1. SCOPE

ETS 300 324-1 [1] specifies the V5 protocol and a set of Messages and Information Elements to enable a Local Exchange (LE) to control an analogue line that is remote from the LE in an Access Network (AN), (see Figure 1).


**Figure 1 - V5 PSTN Physical Architecture**

An Access Network (AN), may terminate Direct Exchange Lines (DEL), Loop Calling PBX, Earth Calling PBX, and DDI PBX Lines .

Within the UK neither the precise electrical characteristics of the analogue line signals nor the call control within an LE are standardised and may vary dependent on the public network concerned.

The introduction of V5 is not intended to standardise either of these aspects, instead it is intended to enable the PSTN service that is provided on lines that are directly connected to an exchange to be extended via a remote Access Network.

This specification details the requirements for an LE and an AN to transparently extend the existing UK PSTN service. However the actual implementation of the requirements is not specified or intended to be constrained by this document.

Details of the LE call control and the electrical conditions appearing on the 2 wire analogue line are outside the scope of this specification and are detailed elsewhere (e.g. in Operator specific documentation).

## 2. INTRODUCTION

The general requirements for the V5 PSTN Signalling Protocol are given in ETS 300 324-1 [1], however the precise use of the protocol and how it maps onto the electrical signals and conditions of an analogue line is left for national specification. SSPE/SPEC/001-1 specifies the national PSTN mapping requirements for the UK.

SSPE/SPEC/001-1 is conformant to the normative clauses of the PSTN Protocol as specified in Clause 13 and Annex D of ETS 300 324-1 [1].

The SSPE/SPEC/001-1 is structured as follows:

| | |
|---|---|
| Clause 3 | Outline Description |
| Clause 4 | PSTN V5 Mapping Requirements |
| Clause 5 | Direct Exchange Line |
| Clause 6 | Loop Calling PBX |
| Clause 7 | Earth Calling PBX |
| Clause 8 | DDI PBX |

Clause 3 gives a general outline description of V5 in the UK PSTN along with the method in which the requirements are specified. The clause introduces a “functional architecture” that is used to describe the relationship between the V5 Protocol, the UK PSTN mapping and the existing national network.

Clause 4 gives the detailed requirements for the V5 messages and Information Elements and how they convey the analogue signals and conditions for the analogue applications that are used in the UK, e.g. DEL, Earth Calling PBX. Within Clause 4 the requirements are given in terms of text, mapping tables and SDL diagrams.

Clauses 5 - 8 are produced to a common format and contain the requirements that are specific to the application concerned, e.g. DEL, PBX etc. Within each clause the requirements are given in terms of:

- Textual Description
  Giving details of the external analogue signals and conditions that are used by the application and how these relate to internal primitives that are used by the LE Call Control. The textual description also includes Autonomous Actions that are taken by the AN.
- Message Sequence Charts [MSCs]
  Showing a number of message flows for valid call cases that may occur within the application. These MSCs describe certain common call cases and take the format described in ETR 150 [12].

Throughout SSPE/SPEC/001-1 there is no reference to optionality of any of the described signals or messages. Any optionality is identified in SSPE/SPEC/001-2 (PICS).

## 3. OUTLINE DESCRIPTION

The purpose of this document is to specify a standard mapping for the UK between the electrical signals on an analogue line and the Messages and Information Elements on a V5 Interface. While this could be specified in a "monolithic" manner with an AN and an LE being treated as single entities (see Fig 1), the ETS 300 324-1 [1] introduces the concept of specifying the requirements in terms of separate internal processes.

In order to align with ETS 300 324-1 [1] this specification also adopts a method of specification based on a number of separate but interacting processes as shown in Figure 2.

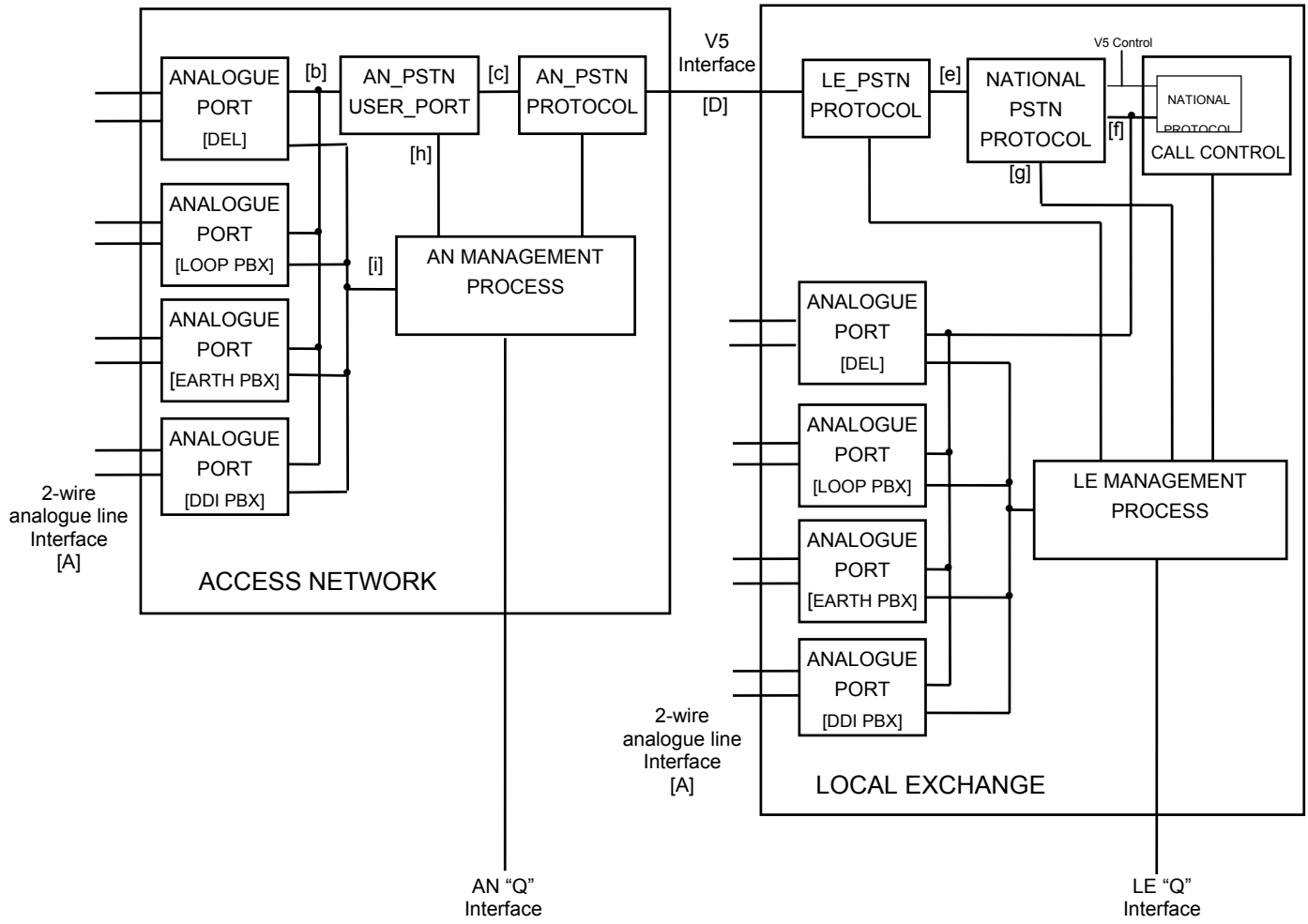



**Figure 2 - V5 PSTN Functional Architecture**

The "V5 PSTN Functional Architecture" shown in Figure 2 is for explanation and overall functional specification only and is not intended to constrain any implementation of the AN or LE. However overall functional equivalence to this specification when considered from the external interfaces [A & D] shown in Figure 2 must be achieved. Compliance to individual processes or internal interfaces need not be achieved.

The AN_PSTN_User_Port and National_PSTN_Protocol processes are identified within ETS 300 324-1 [1] but they are left for national specification. Clause 4 of this specification includes the requirements of these two processes for the UK.

- The function of the AN_PSTN_User_Port process is to provide the mapping between the primitives received on interfaces [b] and [c].
- The function of the National_PSTN_Protocol process is to provide the mapping between the primitives received on interfaces [e] and [f].

The functionality of the AN_PSTN_Protocol and LE_PSTN_Protocol processes is specified in ETS 300 324-1 [1]. Additional information relevant to the UK is included in Clause 4 of this specification.

The functionality of the Analogue Port and Call Control processes is assumed to be the same as when both exist within a Local Exchange, i.e. when the Analogue Line is directly connected to an LE. These two processes are not described in detail in this specification but some functionality is described in Clauses 5 - 8 to provide context for the V5 mapping.

An outline of each process shown in Figure 2, the interfaces between them is given in Subclauses 3.1 and 3.2.

## 3.1. OUTLINE DESCRIPTION OF PROCESSES

A short description of each of the processes shown in Figure 2 is given below:

### 3.1.1. Analogue Port process

The Analogue Port process terminates the 2-wire analogue line from the customer's premises and is responsible for:

a) Detecting and validating the analogue signals and conditions from the CPE and once validated converting them into internal primitives which are sent to the AN_PSTN_User_Port process.

b) Applying analogue signals and conditions towards the CPE as commanded by the AN_PSTN_User_Port process by means of internal primitives.

c) In addition to the primitives relating to the external analogue signals and conditions the Analogue Port process also sends and receives analogue control primitives to and from the AN_PSTN_User_Port process.

d) The Analogue Port process also performs a number of autonomous actions, e.g. the removal of Call Arrival Indication on receipt of an Off Hook signal.

Within the UK the characteristics of the analogue signals and conditions that appear on the 2-wire analogue line are not standardised and consequently may differ between ANs.

The detailed requirements for the analogue signals and conditions are therefore outside the scope of this specification and is a matter of bilateral agreement between an Operator and the chosen AN Supplier.

However a list of the analogue signals and conditions for each analogue port application along with a brief outline of their use is given in Clause 5 onwards of this specification.

### 3.1.2. AN_PSTN_User_Port process

The AN_PSTN_User_Port process is responsible for mapping the internal analogue primitives received from the Analogue Port process to the V5 Function Element (FE) primitives required by the AN_PSTN_Protocol process and vice versa.

The detailed requirements for this process are given in 4.2.

### 3.1.3. AN_PSTN_Protocol process

The AN_PSTN_Protocol process is responsible for the control of the V5 path related procedures within the AN. Part of this role is to convert the FE primitives received from the AN_PSTN_User_Port process into V5 messages and Information Elements and vice versa.

The FEs are primarily used to control the AN_PSTN_Protocol process and to map to and from V5 messages. The FEs may also carry “Additional Line Signal Information” that maps to and from Information Elements within the V5 messages.

ETS 300 324-1 [1] describes the AN_PSTN_Protocol process and the mapping of FEs to V5 messages. However the specification of the additional “Line Signal Information” and its mapping to the V5 Information Elements is left for national resolution.

For the purpose of specification within this document the additional line signal information is appended to the FE within brackets e.g. FE-establish_request (Ss=Off-Hook). The mapping of the FE and Line Signal Information to V5 messages and Information Elements is given in 4.3.

### 3.1.4. AN Management process

The AN Management process is responsible for the operations and maintenance of the V5 PSTN functionality within the AN. The functionality of this process is implementation specific and outside the scope of this specification. However it is assumed to have internal interfaces to the other processes within the AN. Only the interfaces to the Analogue Port process [i] and the AN_PSTN_User_Port process [h] are described in this specification.

### 3.1.5. LE_PSTN_Protocol process

The LE_PSTN_Protocol process is responsible for the control of the V5 path related procedures within the LE. Part of this role is to convert the FE primitives received from the National_PSTN_Protocol process into V5 messages and Information Elements and vice versa.

The FEs are primarily used to control the LE_PSTN_Protocol process and to map to and from V5 messages. In addition the FEs may also carry “Line Signal Information” that maps to and from Information Elements within the V5 messages.

ETS 300 324-1 [1] describes the LE_PSTN_Protocol process and the mapping of FEs to V5 messages. However the specification of the additional “Line Signal Information” and its mapping to the V5 Information Elements is left for national resolution.

For the purpose of specification within this document the additional line signal information is appended to the FE within brackets e.g. FE-establish_request (Ss=Reversed Polarity). The mapping of the FE and Line Signal Information to V5 messages and Information Elements is given in 4.4.

### 3.1.6. National_PSTN_Protocol process

The National_PSTN_Protocol process provides the functionality within an LE that is necessary in order to map the analogue primitives from the “National Protocol Entity” within the Call Control process to the V5 FEs that are required by the LE-PSTN Protocol process and vice versa.

The detailed requirements for this process are given in 4.5.

### 3.1.7. Call Control process

The Call Control process is responsible for the call control functions of the LE and is assumed to contain the “National Protocol Entity” referred to in Subclause 13.1 of ETS 300 324-1 [1].

The operation of the Call Control process will be the same whether a customer’s line is directly connected to the LE or is served via V5 and an AN. It is therefore convenient to consider the Call Control process in terms of sending and receiving the internal analogue primitives that could directly drive a co-sited Analogue Port process.

When the Analogue Port process is in an AN, these analogue primitives are mapped into V5 FE Primitives and then into V5 Messages and Information Elements for transmission via the V5 communication channel to the AN.

Within the UK the functionality of the Call Control process, including the “National Protocol Entity” is not standardised and consequently may differ between LEs.

The detailed requirements of the Call Control process is therefore outside the scope of this specification and is a matter of bilateral agreement between an Operator and the chosen Exchange Supplier.

The call control requirements are often expressed in terms of Message Sequence Charts and a number of valid call cases that may occur within the UK are shown in Clause 5 onwards of this specification.

### 3.1.8. LE Management process

The LE Management process is responsible for the operations and maintenance of the V5 PSTN functionality within the LE. The functionality of this process is implementation specific and outside the scope of this specification. However it is assumed to have internal interfaces to the other processes within the LE. Only the interface to the National PSTN Protocol [g] is described in this specification.

## 3.2. OUTLINE DESCRIPTION OF INTERFACES BETWEEN PROCESSES

A short description of each of the interfaces shown in Figure 2 is given below:

### 3.2.1. Interface [A]: 2-Wire Analogue Line

Interface [A] corresponds to Interface (Z) referred to in ETS 300 324-1 [1].

The 2-wire analogue line is required to exhibit the same electrical characteristics towards the CPE, whether it is connected to an AN or directly connected to an LE. In the UK the electrical characteristics of Local Exchanges may differ between Network Operators and between different exchange types. The Analogue Port process, when located in the Access Network, may be required to reflect these differences. Consequently the actual electrical characteristics of the 2-wire analogue line interface are outside the scope of this specification.

Within this specification each electrical signal and condition used on the 2-wire analogue line is given a “generic name”. The signals and conditions used over the 2-wire analogue line will differ depending on the application concerned, e.g. DEL, PBX etc. These signals/conditions along with a brief description of use and an outline of their possible electrical characteristics are given in Clause 5 onwards of this specification.

### 3.2.2. Interface [b]: Analogue Port process to AN_PSTN_User_Port process

There are two types of analogue primitives specified at internal interface [b], these are:

1) The validated equivalent of the external signals/conditions that appear at Interface [A]. These primitives have the same names as their external equivalent but appear in this specification in lower case. These are called “analogue line primitives”.
2) Primitives that have no external equivalent signal/condition, e.g. an inter process acknowledgement or a primitive to modify the behaviour of the Analogue Port process itself. These are called “analogue control primitives”.

The meanings of the analogue line primitives are the same as that for their external equivalents that appear at Interface [A].

The analogue control primitives used will differ depending on the application concerned, e.g. DEL, PBX etc. A list of the analogue control primitives along with a brief description of their use in a particular application is given in Clause 5 onwards of this specification.

### 3.2.3. Interface [c]: AN_PSTN_User_Port process to AN_PSTN_Protocol process

Interface [c] is an internal interface introduced in ETS 300 324-1 [1] to describe how the AN_PSTN_Protocol process interacts with the AN_PSTN_User_Port process. Information is passed over this interface by means of primitives called Function Elements (FE).

Within the UK specification the following additional FEs have been included:-

- FE-establish_ack
- FE-establish_ack_ind
- FE-disconnect_req
- FE-disconnect_complete_ind
- FE-protocol_parameter_ind

The FEs used will differ depending on the application concerned, e.g. DEL, PBX etc. A list of FEs along with the associated Line Signal Information in each application is given in 4.2.

### 3.2.4. Interface [D]: AN_PSTN_Protocol process to LE_PSTN_Protocol process

Interface [D] is the external V5 interface and this is specified within ETS 300 324-1 [1]. Information is passed over this interface by means of Information Elements within V5 messages. A complete list of possible Information Elements that may be sent via V5 is given in ETS 300 324-1 [1].

The messages and Information Elements used may differ depending on the application concerned. The messages and Information Elements used for each application are given in 4.3 and 4.4.

### 3.2.5. Interface [e]: LE_PSTN_Protocol process to National_PSTN_Protocol process

Interface [e] is an internal interface introduced in ETS 300 324-1 [1] to describe how the LE_PSTN_Protocol process interacts with the National_PSTN_Protocol process. Information is passed over this interface by means of primitives called Function Elements (FE).

The FEs used may differ depending on the application concerned, e.g. DEL, PBX etc. A list of FEs along with the associated Line Signal Information in each application is given in 4.5.

### 3.2.6. Interface [f]: National_PSTN_Protocol process to Call Control process

Interface [f] is functionally equivalent to Interface [b], this ensures that a ubiquitous service level can be provided to PSTN customers connected via V5 or directly to the Local Exchange.

### 3.2.7. Interface [g]: National_PSTN_Protocol process to LE Management process

Interface [g] is an internal interface which carries management primitives from the LE Management process to the National PSTN Protocol process. These management primitives may be instigated as a result of receiving a message via the LE “Q” interface, or a control protocol message via interface [D] or due to internal system maintenance action.

### 3.2.8. Interface [h]: AN_PSTN_User_Port process to AN Management process

Interface [h] is an internal interface which carries management primitives from the AN Management process to the AN_PSTN_User_Port process. These management primitives may be instigated as a result of receiving a message via the AN “Q” interface, or a control protocol message via interface [D] or due to internal system maintenance action.

### 3.2.9. Interface [i]: Analogue Port process to AN Management process

Interface [i] is an internal interface which carries management primitives from the AN Management process to the Analogue Port process. These management primitives may be

instigated as a result of receiving a message via the AN “Q” interface, or a control protocol message via interface [D] or due to internal system maintenance action.

# 4. PSTN V5 MAPPING REQUIREMENTS

## 4.1. INTRODUCTION

Clause 3 of this specification describes the method by which the UK PSTN V5 Mapping Requirements are specified using an assumed functional architecture based on a number of inter-acting processes (See Figure 2). A general outline description of the function of each process is also given in Clause 3.

This Clause of the Specification uses the method described in Clause 3 to detail the mapping requirements necessary to convey the analogue signals and conditions that are used in the UK over a V5 interface. This functionality is described in terms of the following processes.

- The AN_PSTN_User_Port process 4.2
- The AN_PSTN_Protocol process 4.3
- The LE_PSTN_Protocol process 4.4
- The National_PSTN_Protocol process 4.5

The UK V5 Coding Requirements are detailed in 4.6

Within the UK the call priority shall give preference to outgoing calls and this is reflected in the requirements given in this specification.

## 4.2. AN_PSTN_USER_PORT PROCESS

This Subclause specifies the requirements for the AN_PSTN_User_Port process. The requirements are specified in terms of a Finite State Machine situated between the Analogue Port process (Interface [b]) and the AN_PSTN_Protocol process (Interface [c]).

The AN_PSTN_User_Port process also acts on a number of analogue management primitives that appear on Interface [h].

- The analogue primitives are detailed in Clauses 5 onwards of this specification.
- The mapping between the analogue primitives and the FEs is given in 4.2.1.
- The analogue management primitives are described in 4.2.2.

### 4.2.1. Mapping Between Analogue Primitives and Function Elements

The mapping between the analogue primitives that appear at interface [b] and the FEs that appear at interface [c] are given in Tables 1 & 2.

The mapping shown in Tables 1 & 2 is dependant on the state of the Finite State Machine and this is specified using SDL in 4.2.3. The SDL also specifies the handling of unexpected events and events that result from signal/message crossovers.

| Function Element (FE) at Interface [c] | | Analogue Primitive at Interface [b] | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|
| **FE** | **Additional Line Signal Information** | **Primitive Name** | **Additional Instructions** | **5** | **6** | **7** | **8** |
| FE-line_signal | Normal Polarity | normal power feed | None | Y | Y | Y | N |
| FE-line_signal | Reversed Polarity | reversed power feed | None | Y | Y | Y | N |
| FE-line_signal | Pulsed Reduced Battery:-<br>Pulse Duration Type<br>Suppression Indicator | end of call | Pulse Duration Type<br>Suppression Indicator | Y | N | N | N |
| FE-line_signal | Pulsed No Battery:-<br>Pulse Duration Type<br>Suppression Indicator | disconnect clear | Pulse Duration Type<br>Suppression Indicator | Y | Y | Y | N |
| FE-line_signal | Pulsed No Battery:-<br>Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | disconnect clear | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | Y | Y | Y | N |
| FE-line_signal | Reduced Battery | parked line feed | None | Y | Y | Y | N |
| FE-line_signal | Meter Pulse:-<br>Pulse Duration Type<br>Suppression Indicator | spm pulse | Pulse Duration Type<br>Suppression Indicator | Y | Y | Y | N |
| FE-line_signal | Meter Pulse:-<br>Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | spm pulse | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | Y | Y | Y | N |
| FE-line_signal | Cadenced Ringing:-<br>Cadenced Ringing Type | call arrival indication | Cadenced Ringing Type | Y | Y | Y | N |
| FE-line_signal | Initial Ring:-<br>Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | initial ring | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | Y | Y | N | N |
| FE-line_signal | Off Hook | ddi seize | None | N | N | N | Y |
| FE-line_signal | Digit Signal:-<br>Digit Information<br>Digit Ack Request Ind | ddi digit | Digit Information<br>Digit Ack Request Ind | N | N | N | Y |
| FE-line_signal | Pulsed On Hook:-<br>Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | ddi exchange release | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | N | N | N | Y |

**Table 1 - Analogue Primitive Mapping from FEs Received by the AN_PSTN_User_Port Process (Continues on next page)**

| Function Element (FE) at Interface [c] | | Analogue Primitive at Interface [b] | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|
| **FE** | **Additional Line Signal Information** | **Primitive Name** | **Additional Instructions** | **5** | **6** | **7** | **8** |
| FE-est_ack_ind **(Note)** | Pulsed Reduced Battery:- Pulse Duration Type Suppression Indicator | end of call | Pulse Duration Type Suppression Indicator | Y | N | N | N |
| FE-est_ack_ind **(Note)** | None | LE acknowledge | None | Y | Y | Y | Y |
| FE-est_ack_ind **(Note)** | Reduced Battery | parked line feed | None | Y | Y | Y | N |
| FE-est_ack_ind **(Note)** | Pulsed No Battery:- Pulse Duration Type Suppression Indicator | disconnect clear | Pulse Duration Type Suppression Indicator | N | Y | Y | N |
| FE-est_ack_ind **(Note)** | Pulsed No Battery:- Pulse Duration Type Suppression Indicator Number of Pulses Ack Request Ind | disconnect clear | Pulse Duration Type Suppression Indicator Number of Pulses Ack Request Ind | N | Y | Y | N |
| FE-disc_comp_ind **(Note)** | None | 30kΩ change ack | None | Y | Y | Y | N |
| FE-disc_comp_ind **(Note)** | None | call finished | None | Y | Y | Y | Y |
| FE-prot_param_ind **(Note)** | Recognition Time:- Off Hook Duration Type | off hook recognition time update | Duration Type | Y | Y | N | N |

**Note:** This FE is not defined in ETS 300 324-1 [1] but has been added for clarification.

**Table 1 (continued) - Analogue Primitive Mapping from FEs Received by the AN_PSTN_User_Port Process**

| Analogue Primitive at Interface [b] | | Function Element (FE) at Interface [c] | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|
| **Primitive Name** | **Additional Instructions** | **FE** | **Addition Line Signal Information** | **5** | **6** | **7** | **8** |
| 30kΩ loop change | On | FE-line_info | Imp Marker Set | Y | Y | Y | N |
| 30kΩ loop change | Off | FE-line_info | Imp Marker Reset | Y | Y | Y | N |
| pulse notification | None | FE-line_signal | Pulse Notification | Y | Y | Y | Y |
| off hook | None | FE-line_signal | Off Hook | Y | Y | Y | N |
| off hook | None | FE-sub_seize | Off Hook | Y | Y | Y | N |
| digit | Digit Information | FE-line_signal | Digit Signal:-<br>Digit Information | Y | Y | Y | N |
| on hook | None | FE-line_signal | On Hook | Y | Y | Y | N |
| on hook | None | FE-sub_release | None | Y | Y | Y | N |
| analogue port ack | None | FE-establish_ack<br>**(Note)** | None | Y | Y | Y | Y |
| hook flash | None | FE_line_signal | Register Recall | Y | Y | Y | N |
| no resources | Copy of IE | FE-line_signal | Resource Unavailable:-<br>Copy of IE | Y | Y | Y | Y |
| no resources | Copy of IE | FE-disc_req<br>**(Note)** | None | Y | Y | Y | Y |
| faulty seize | None | FE-line_signal | B-Wire connected to earth | N | N | Y | N |
| ddi no battery | None | FE-sub_seize | No Battery | N | N | N | Y |
| ddi no battery | None | FE-line_signal | No Battery | N | N | N | Y |
| ddi normal polarity | None | FE-line_signal | Normal Polarity | N | N | N | Y |
| ddi normal polarity | None | FE-sub_release | None | N | N | N | Y |
| ddi reversed polarity | None | FE-line_signal | Reversed Polarity | N | N | N | Y |

**Note**: This FE is not defined in ETS 300 324-1 [1] but has been added for clarification.

**Table 2 - FE Mapping from Analogue Primitives Received by the AN_PSTN_User_Port Process**

### 4.2.2. Analogue Management Primitives

The analogue management primitives are passed from the AN Management process to the AN_PSTN_User_Port process (Interface [h]). The primitives, along with a short description of their function, are given in Table 3.

| Analogue Management Primitive at Interface [h] | Description |
|---|---|
| **Block** | The Block primitive is used to place the AN_PSTN_User_Port process immediately into the "Free" state. This primitive is generated when the blocking procedures defined in ETS 300 324-1 [1] are applied. |
| **Restart** | The Restart primitive is used to place the AN_PSTN_User_Port process immediately into the "Free" state. This primitive is generated when the restart procedures defined in ETS 300 324-1 [1] are applied. |

**Table 3 - Analogue Management Primitives**

### 4.2.3. AN_PSTN_User_Port process SDL Diagrams

This subclause details the AN_PSTN_User_Port process in terms of a finite state machine comprising the following states:

**UP1: Free**

There is no call in progress and a new incoming or out going call request can be detected.

**UP2: V5 Path Requested by AN**

An outgoing call request has been detected and establishment of the V5 path has been requested by the AN and a response to this is awaited.

**UP3: V5 Path Requested by LE**

A new incoming call request has been forwarded to the Analogue Port process and a response is awaited.

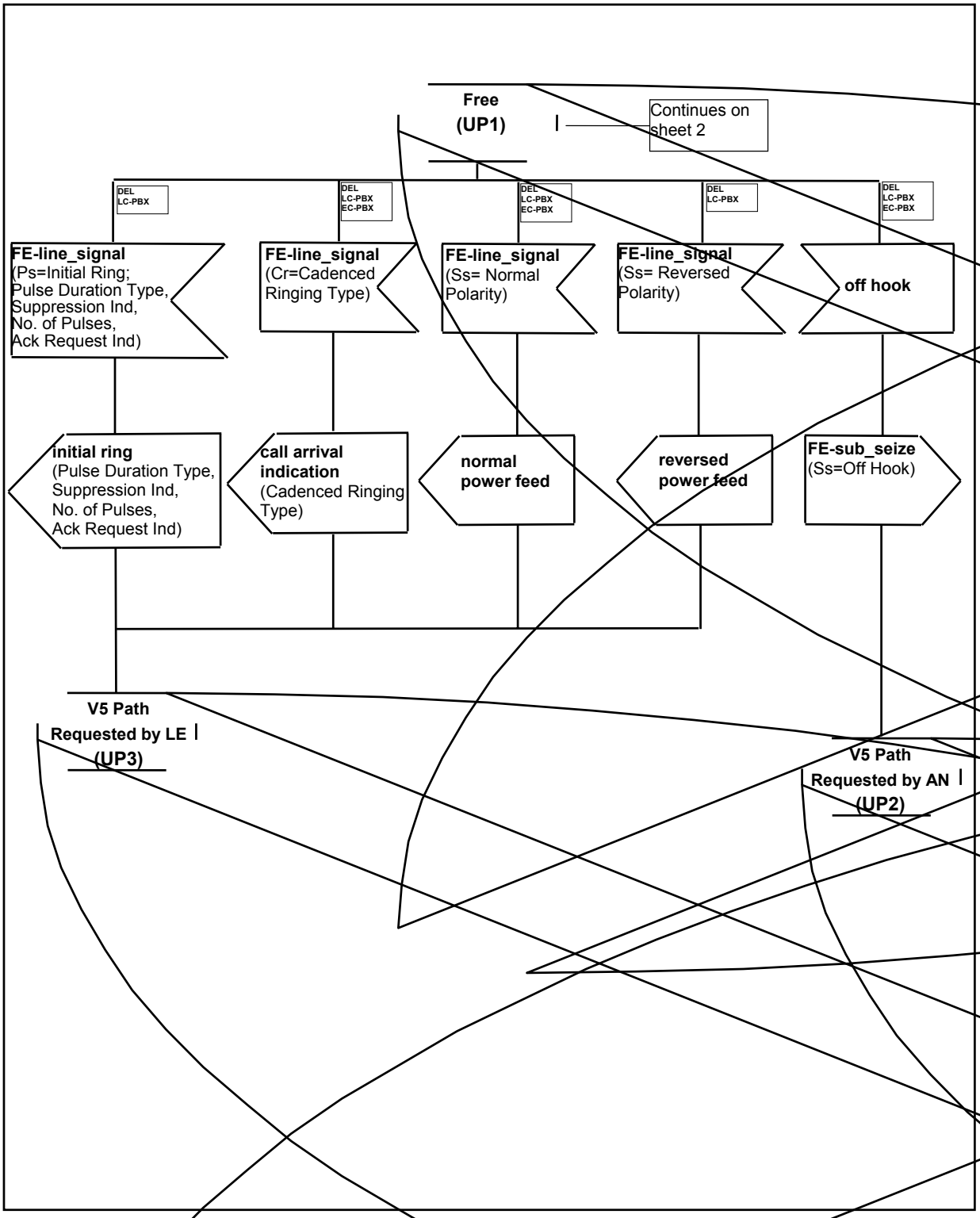
**UP4: Active**

The V5 path has been successfully established and the call may proceed with call establishment, communication or call clearing.

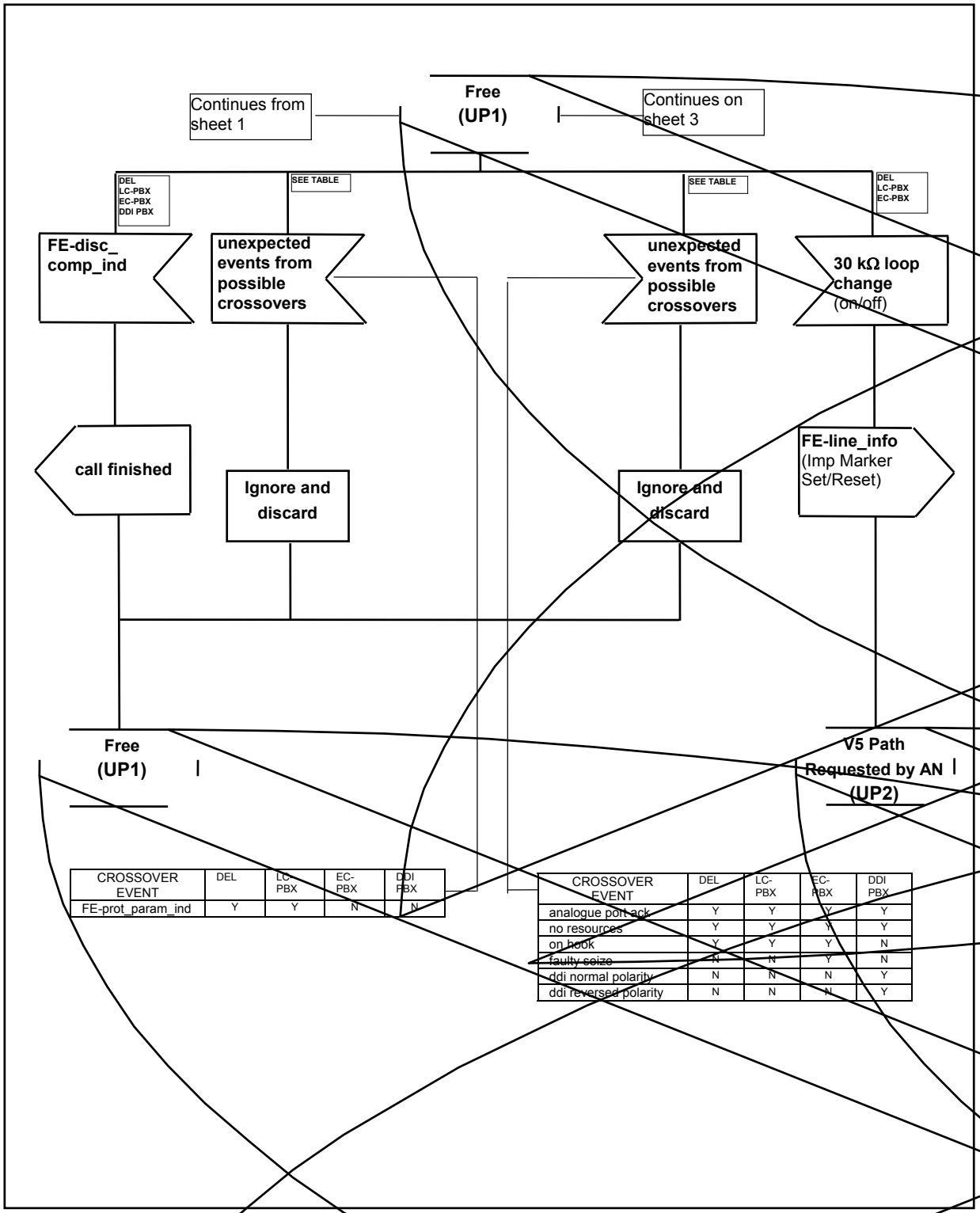
**UP5: V5 Path Abort Requested by AN**

An on hook or ddi normal polarity has been detected whilst the V5 path is still in the process of being established.

The SDL takes account of crossovers of FEs between the AN_PSTN_User_Port process and the AN_PSTN_Protocol process and of Analogue Primitives between the AN_PSTN_User_Port process and the Analogue Port process.



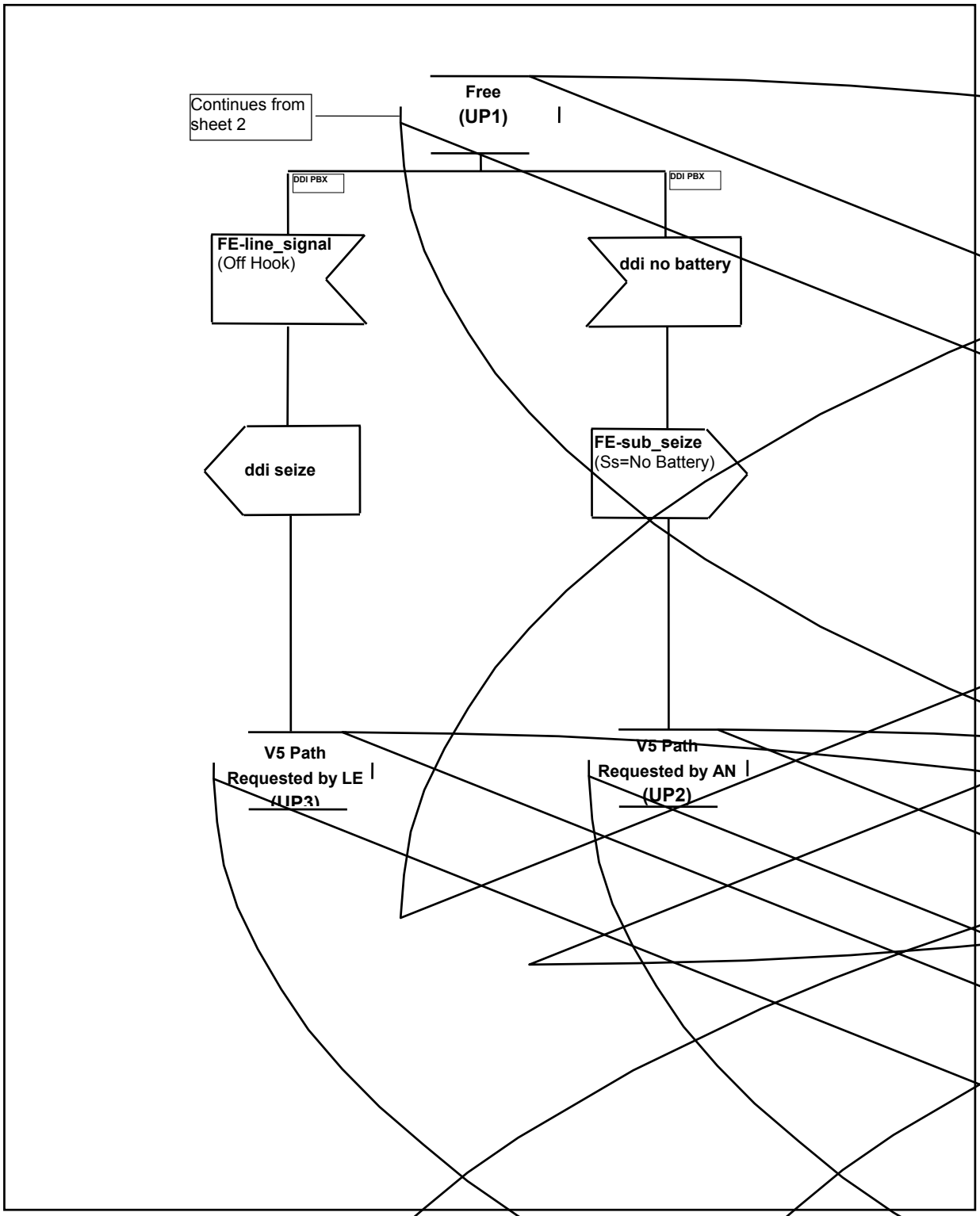

**AN_PSTN_User_Port process: State Free (UP1) Sheet 1 of 3**



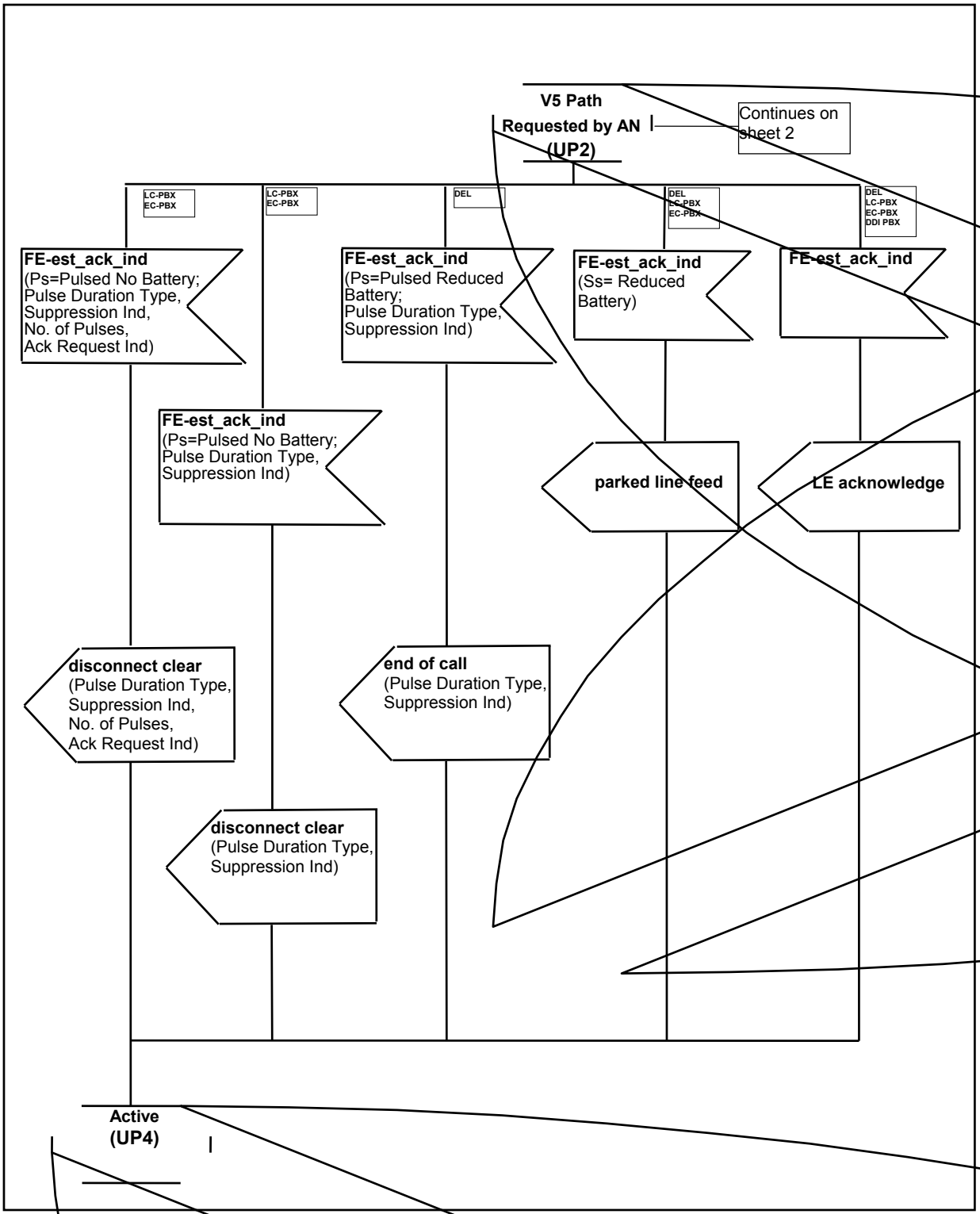

| CROSSOVER EVENT | DEL | LC-PBX | EC-PBX | DDI PBX |
|---|---|---|---|---|
| FE-prot_param_ind | Y | Y | N | N |

| CROSSOVER EVENT | DEL | LC-PBX | EC-PBX | DDI PBX |
|---|---|---|---|---|
| analogue port ack | Y | Y | Y | Y |
| no resources | Y | Y | Y | Y |
| on hook | Y | Y | Y | N |
| faulty seize | N | N | Y | N |
| ddi normal polarity | N | N | N | Y |
| ddi reversed polarity | N | N | N | Y |

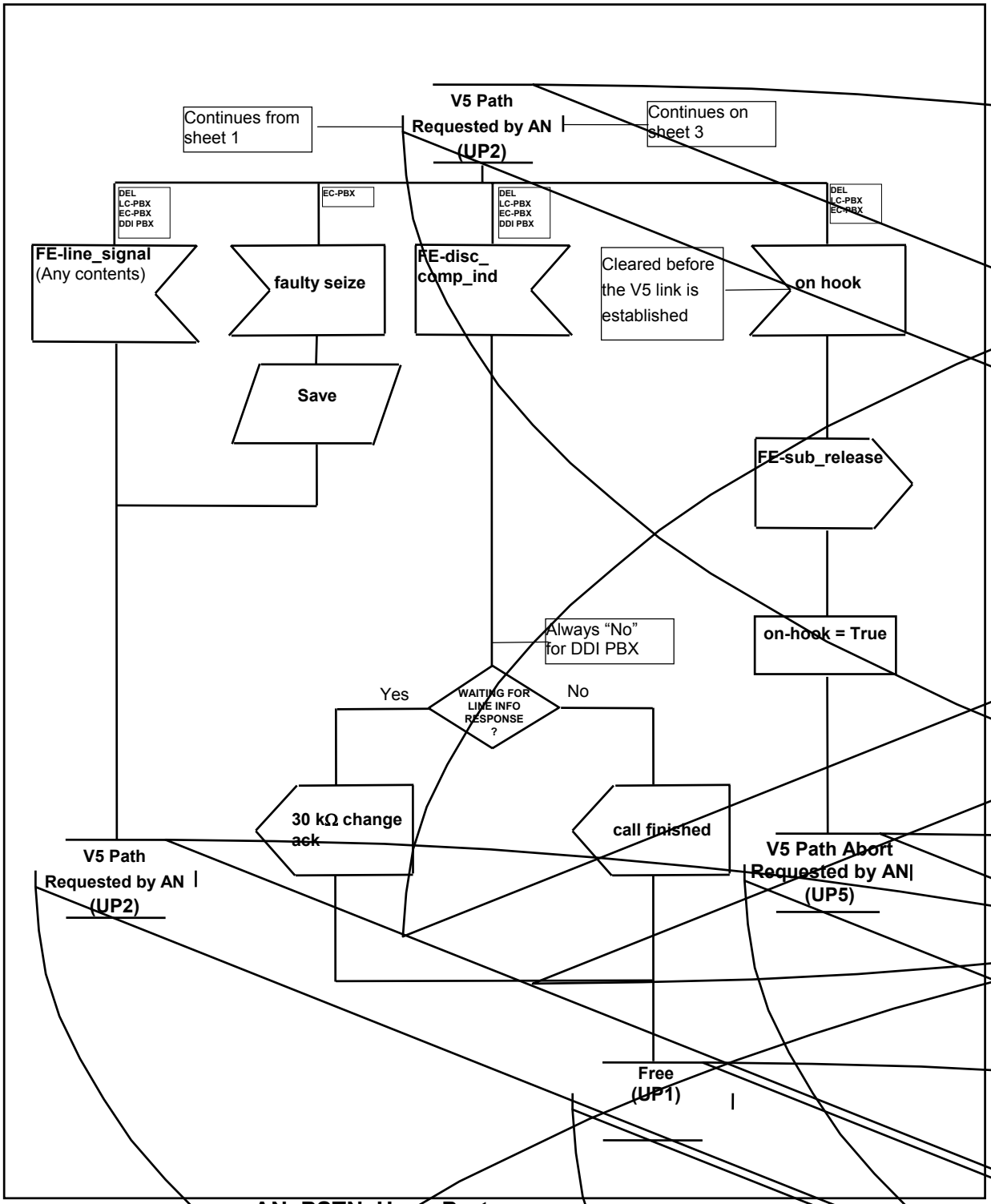
**AN_PSTN_User_Port process: State Free (UP1) Sheet 2 of 3**



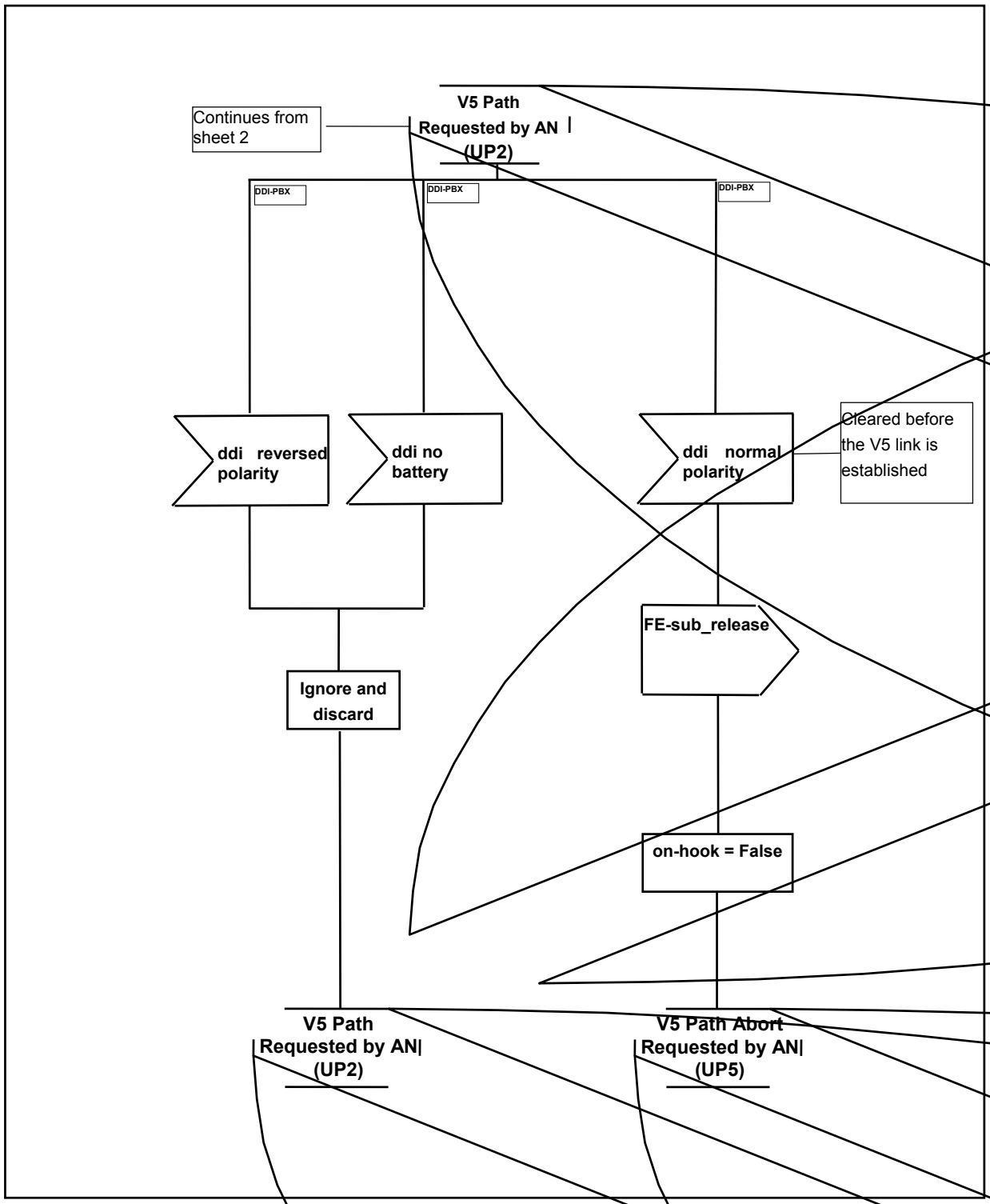

**AN_PSTN_User_Port process: State Free (UP1) Sheet 3 of 3**



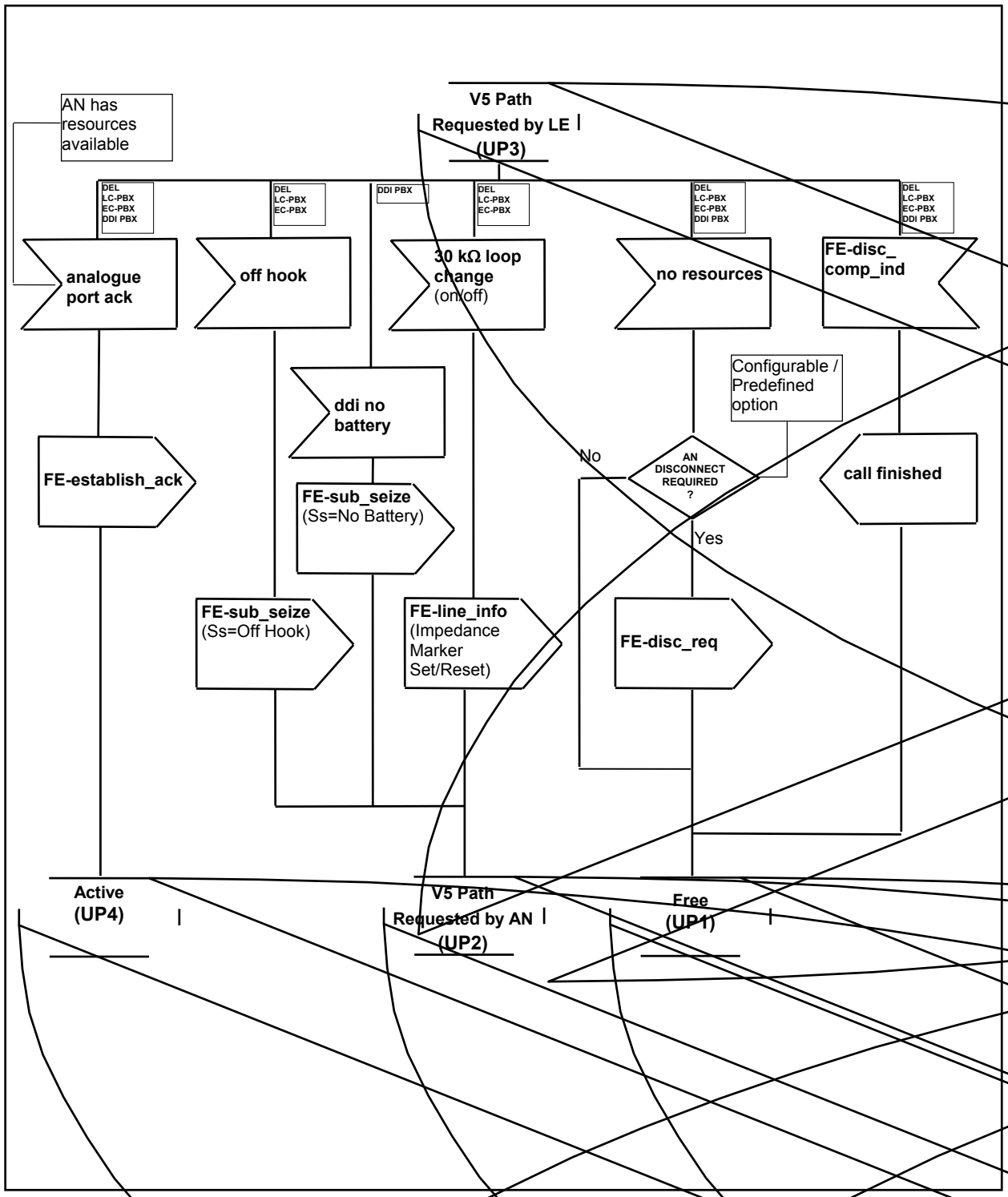

**AN_PSTN_User_Port process:**
**State V5 Path Requested by AN (UP2) Sheet 1 of 3**



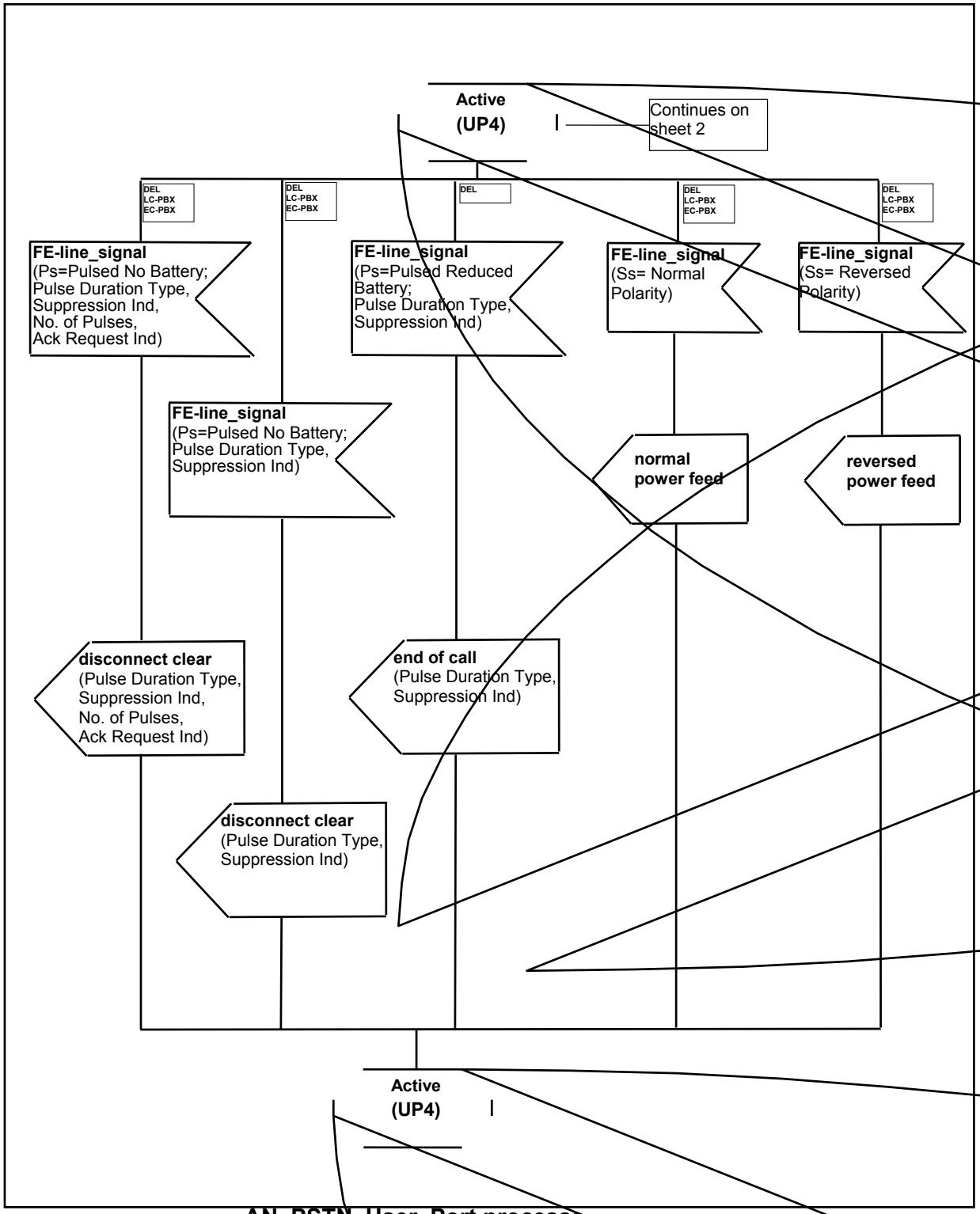

**AN_PSTN_User_Port process:**
**State V5 Path Requested by AN (UP2) Sheet 2 of 3**



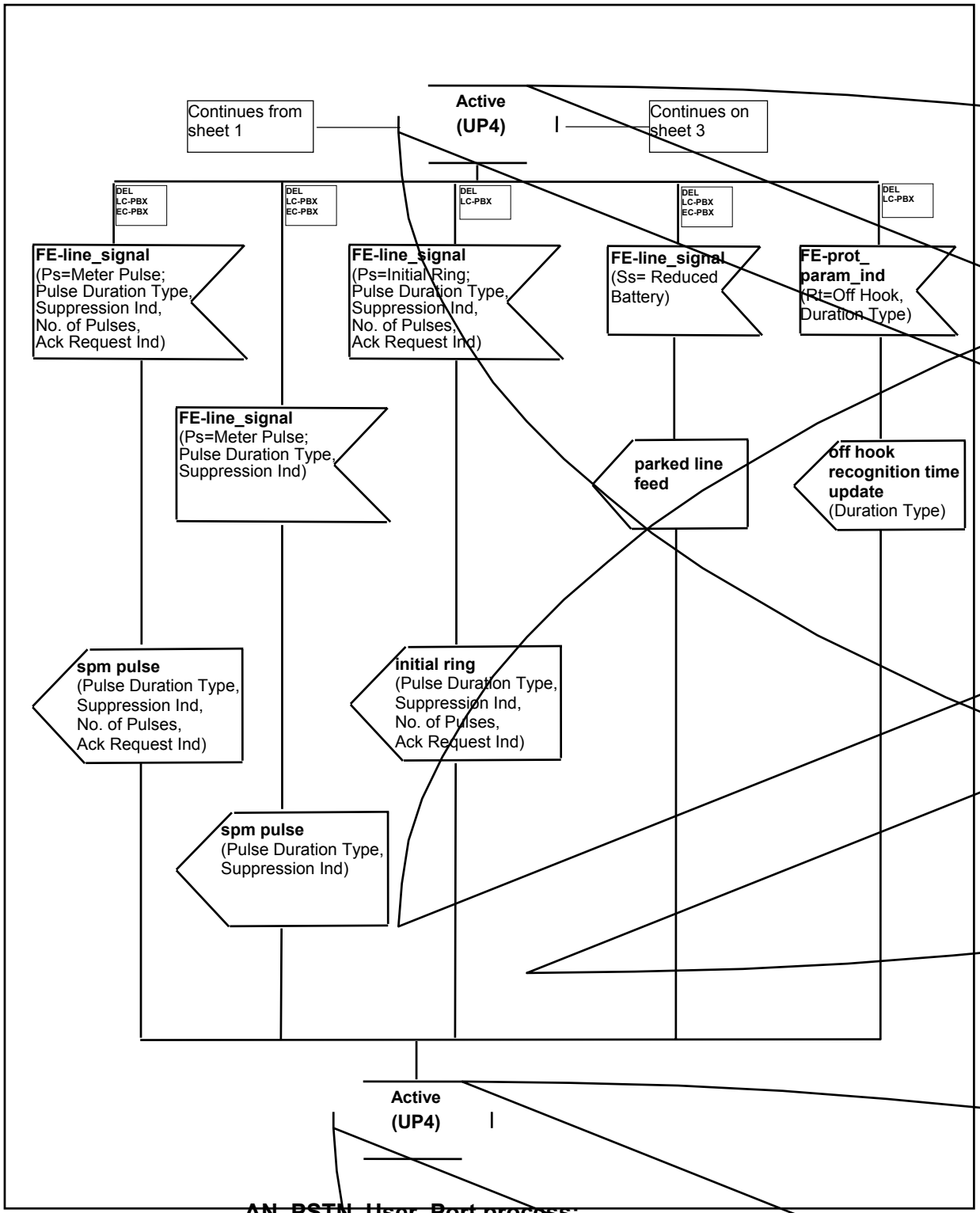

**AN_PSTN_User_Port process:**
**State V5 Path Requested by AN (UP2) Sheet 3 of 3**



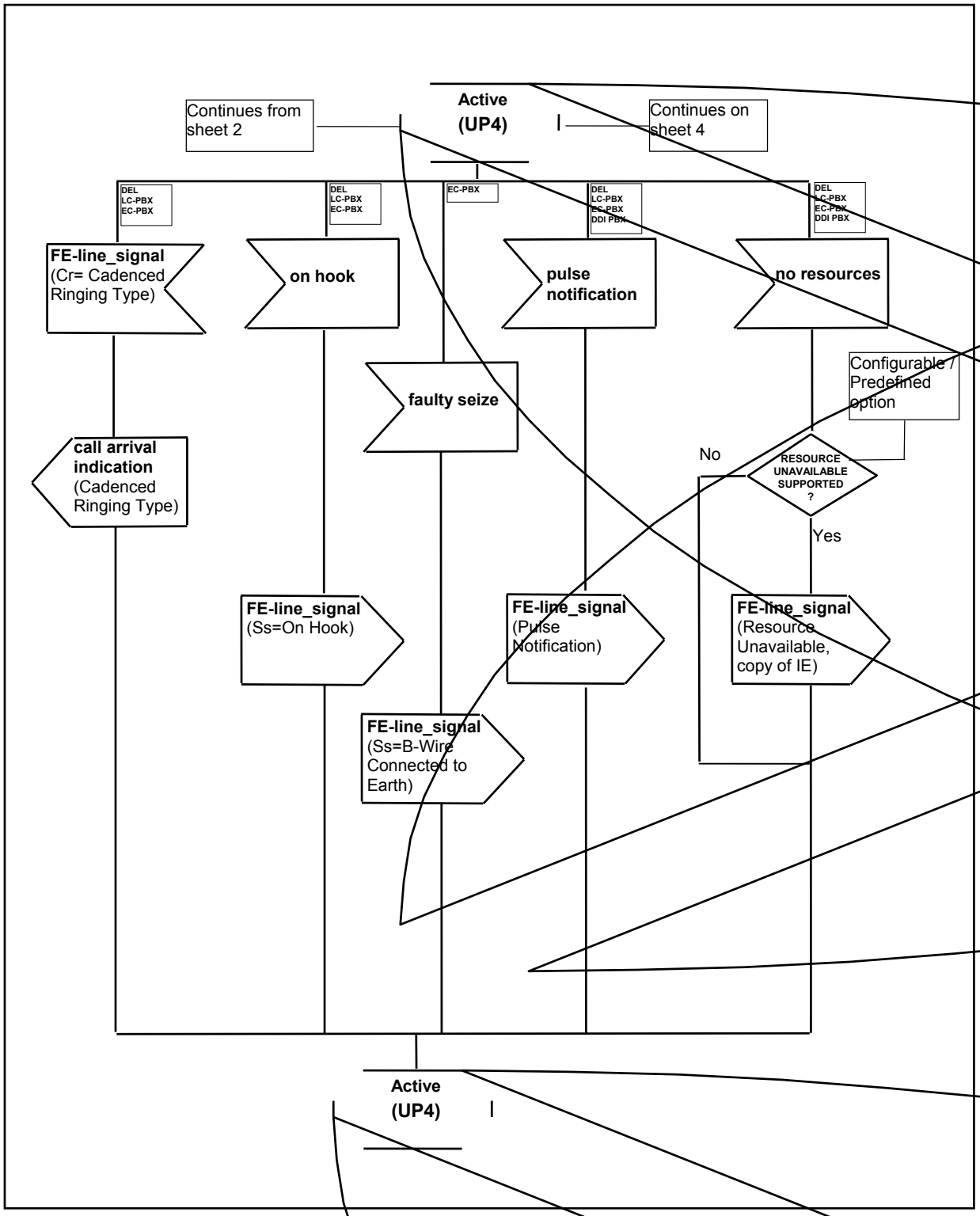

**AN_PSTN_User_Port process:**
**State V5 Path Requested by LE (UP3) Sheet 1 of 1**



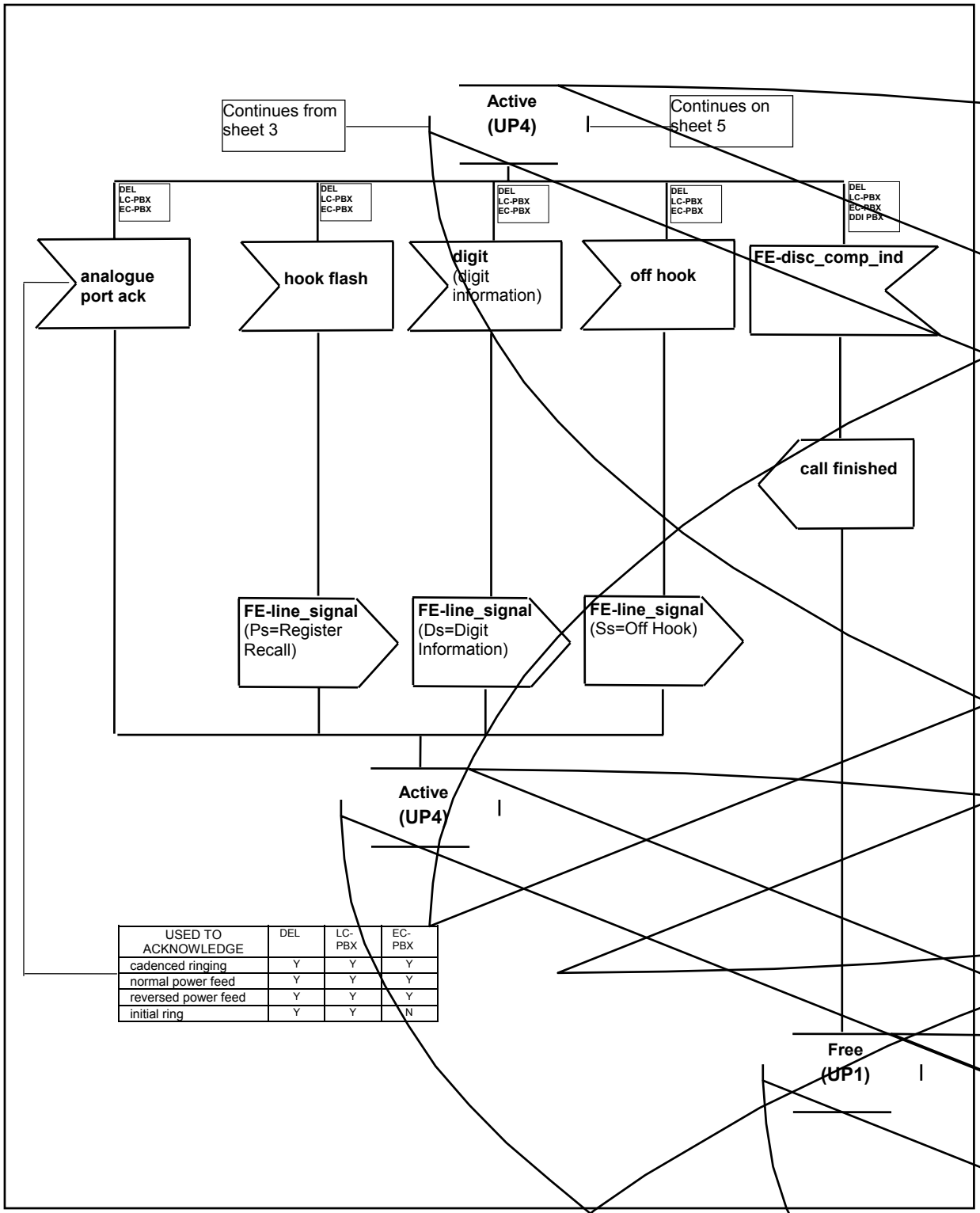

**AN_PSTN_User_Port process:**
**State Active (UP4) Sheet 1 of 5**




**AN_PSTN_User_Port process:**
**State Active (UP4) Sheet 2 of 5**

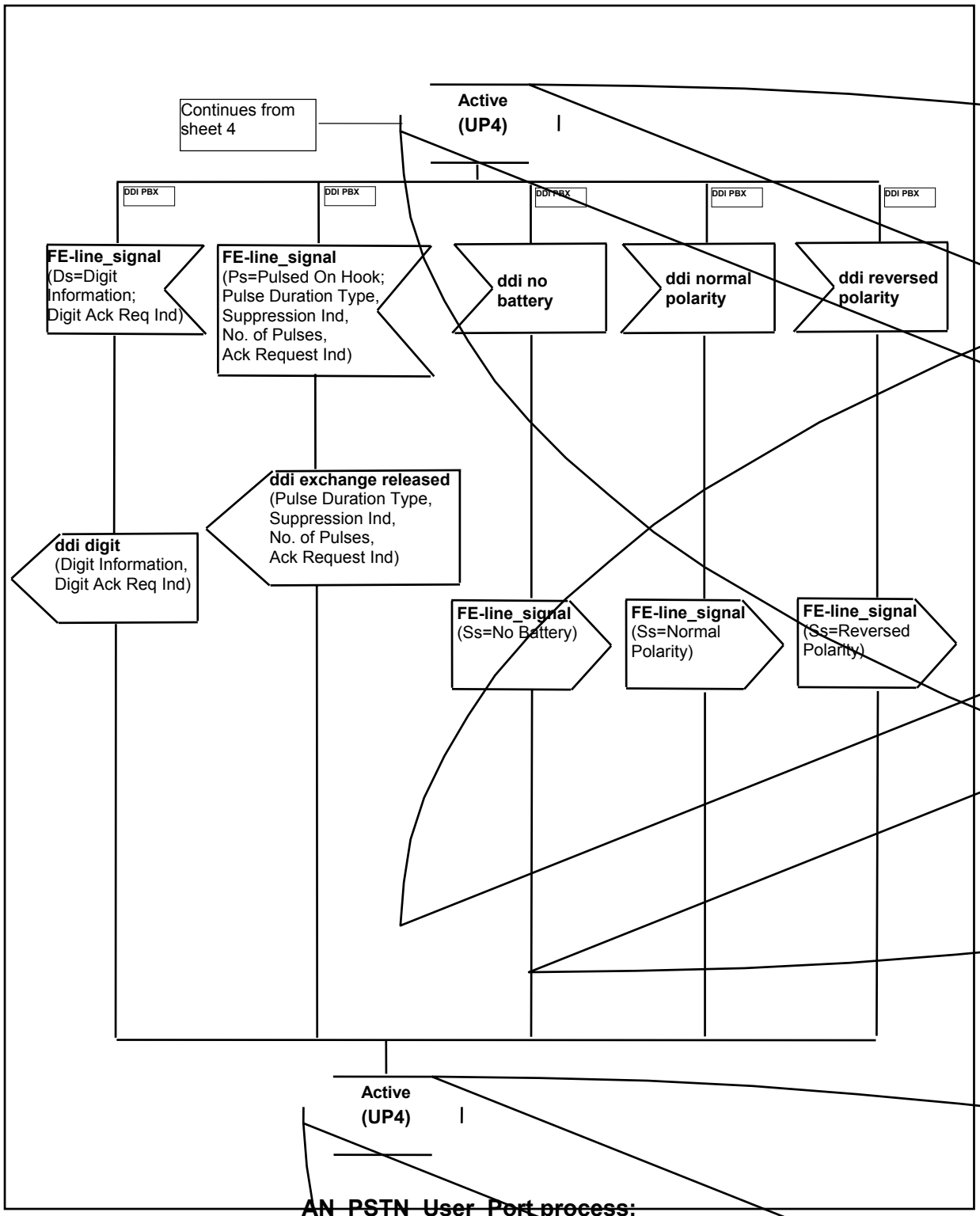



**AN_PSTN_User_Port process:**
**State Active (UP4) Sheet 3 of 5**

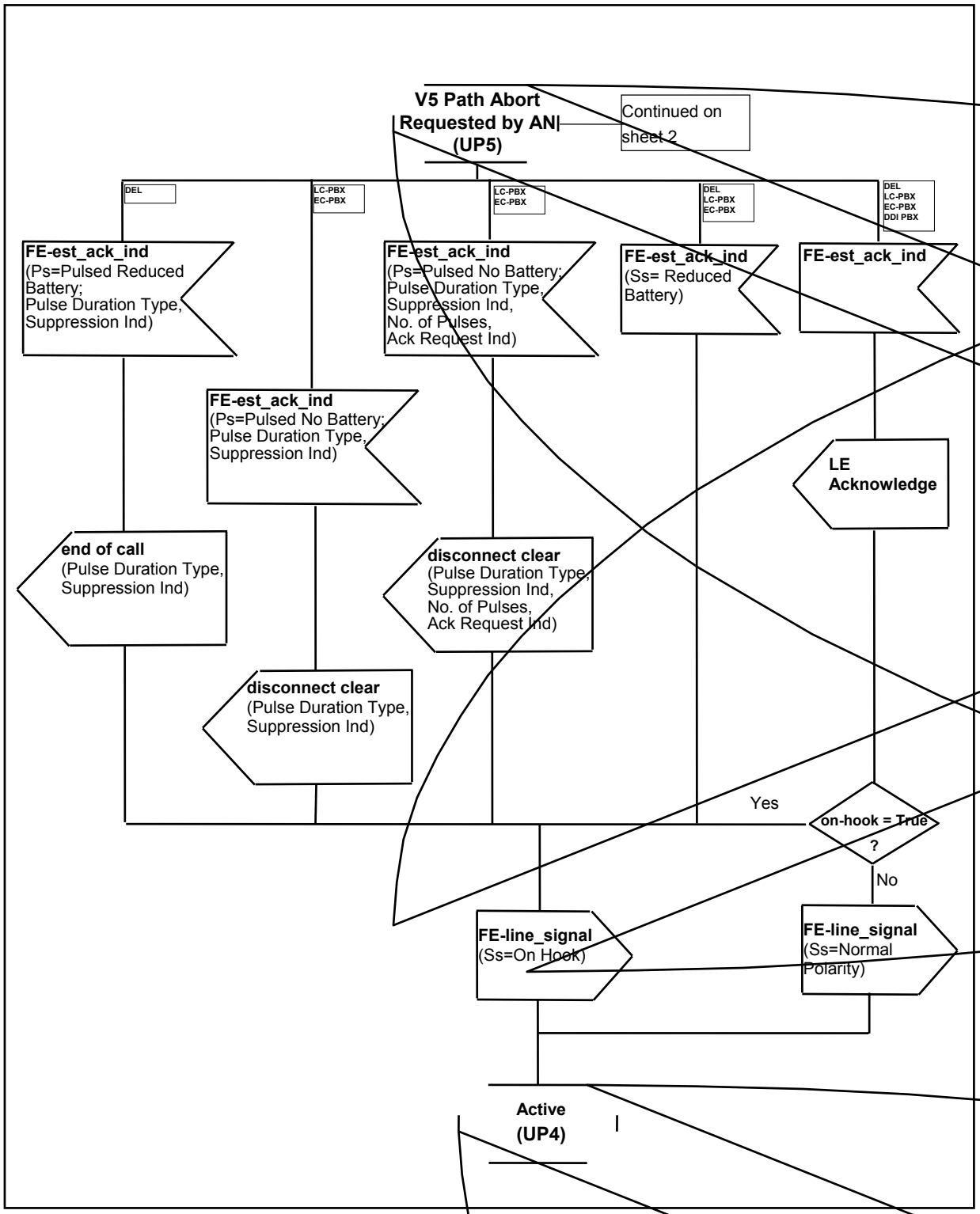



| USED TO ACKNOWLEDGE | DEL | LC-PBX | EC-PBX |
|---|---|---|---|
| cadenced ringing | Y | Y | Y |
| normal power feed | Y | Y | Y |
| reversed power feed | Y | Y | Y |
| initial ring | Y | Y | N |

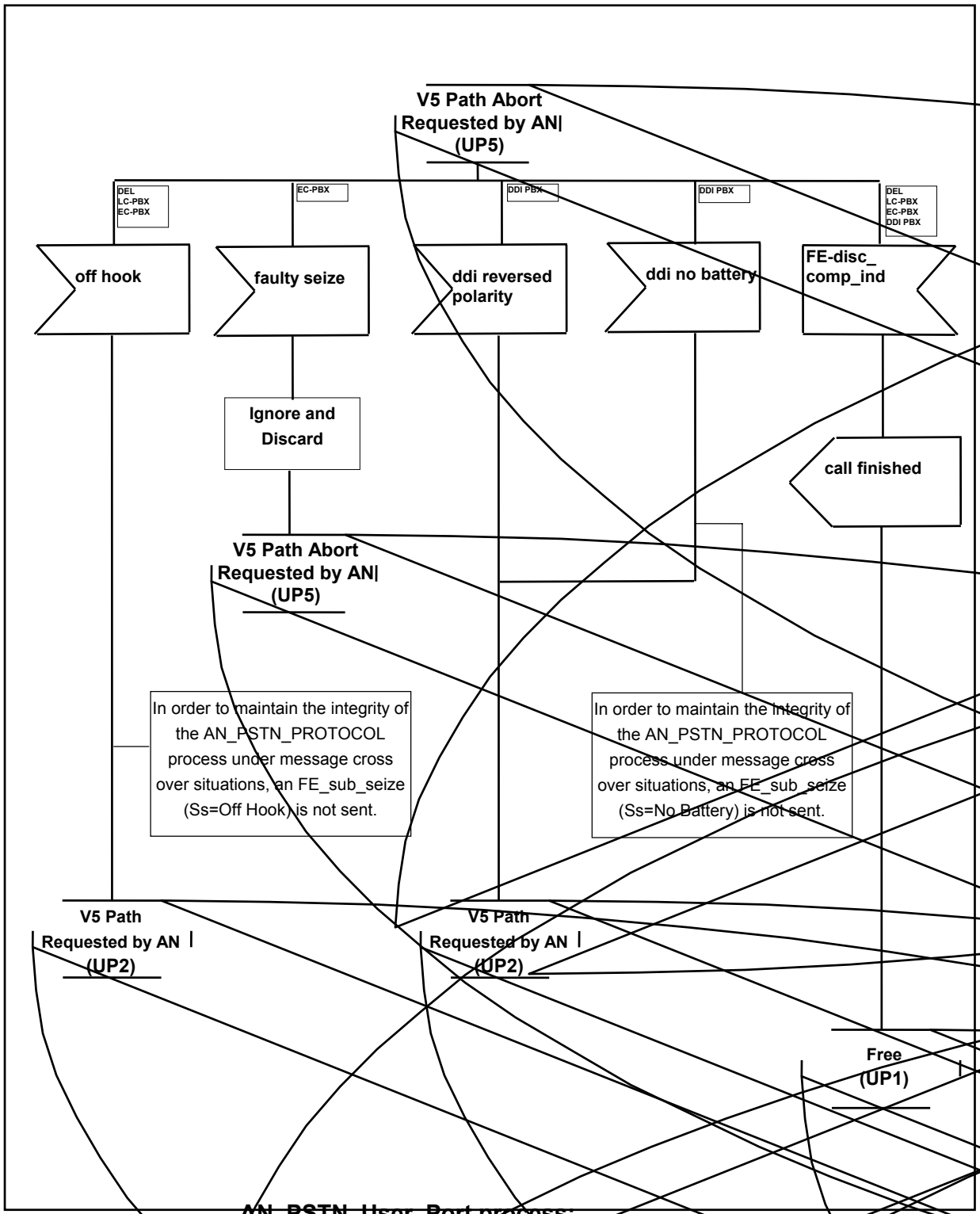
**AN_PSTN_User_Port process:**
**State Active (UP4) Sheet 4 of 5**



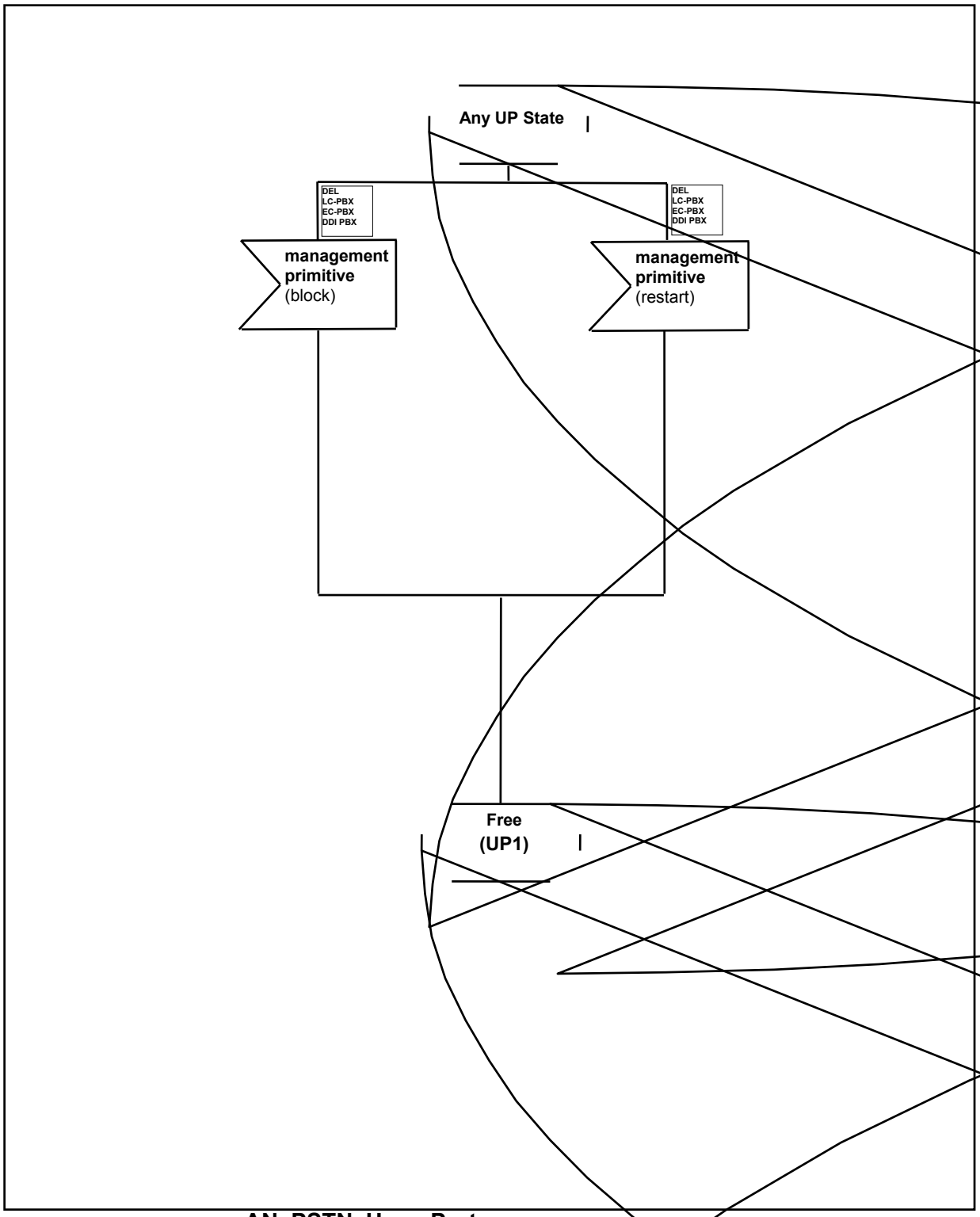

**AN_PSTN_User_Port process:**
**State Active (UP4) Sheet 5 of 5**




**AN_PSTN_User_Port process:**
**State V5 Path Abort Requested by AN (UP5) Sheet 1 of 2**




**AN_PSTN_User_Port process:**
**State V5 Path Abort Requested by AN (UP5) Sheet 2 of 2**




**AN_PSTN_User_Port process:**
**Management Primitives in any State, Sheet 1 of 1**

## 4.3. AN_PSTN_PROTOCOL PROCESS

This Subclause specifies the requirements for the AN_PSTN_Protocol process.

The requirements for the AN_PSTN_Protocol process shall be as specified in ETS 300 324-1 [1] plus the additional requirements given in this Specification.

The additional requirements can be categorised as:

- Mapping details between FE (additional line signal information) and V5 Information Elements. This is given in 4.3.1.
- Coding details for V5 Information Elements, this is given in 4.6.

For the purpose of description SDL diagrams showing an additional AN State “Path Initiated by LE” plus other SDL changes necessary to accommodate the new state and the new FE primitives introduced by this specification are given in 4.3.2.

### 4.3.1. Mapping Between Function Elements and V5 Messages

The mapping between the Function Elements that appear at interface [c] and the V5 Messages that appear at interface [D] are given in Tables 4 and 5.

| Function Element (FE) at Interface [c] | | V5 MESSAGE at Interface [D] | | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|---|
| **FE** | **Additional Line Signal Information** | **Message Type** | **Info-Element** | **Parameter/ Signal Type** | **5** | **6** | **7** | **8** |
| FE-line_info | Imp Marker Set | ESTABLISH | Line Information | Imp Marker Set | Y | Y | Y | N |
| FE-line_info | Imp Marker Reset | ESTABLISH | Line Information | Imp Marker Reset | Y | Y | Y | N |
| FE-line_signal | Pulse Notification | SIGNAL | Pulse Notification | N/A | Y | Y | Y | Y |
| FE-line_signal | Digit Signal:- Digit Information | SIGNAL | Digit Signal | Digit Information | Y | Y | Y | N |
| FE-sub_seize | Off Hook | ESTABLISH | Steady Signal | Off Hook | Y | Y | Y | N |
| FE-line_signal | Off Hook | SIGNAL | Steady Signal | Off Hook | Y | Y | Y | N |
| FE-sub_release | None | NONE | N/A | N/A | Y | Y | Y | Y |
| FE-line_signal | On Hook | SIGNAL | Steady Signal | On Hook | Y | Y | Y | N |
| FE-establish_ack **(Note)** | None | ESTABLISH ACK | None | N/A | Y | Y | Y | Y |
| FE-line_signal | Resource Unavailable:- Copy of IE | SIGNAL | Resource Unavailable | Copy of IE | Y | Y | Y | Y |
| FE-disc_req **(Note)** | None | DISCONNECT | None | N/A | Y | Y | Y | Y |
| FE-line_signal | Register Recall | SIGNAL | Pulsed Signal | Register Recall | Y | Y | Y | N |
| FE-line_signal | B-Wire Connected to Earth | SIGNAL | Steady Signal | B-Wire Connected to Earth | N | N | Y | N |
| FE-sub_seize | No Battery | ESTABLISH | Steady Signal | No Battery | N | N | N | Y |
| FE-line_signal | No Battery | SIGNAL | Steady Signal | No Battery | N | N | N | Y |
| FE-line_signal | Normal Polarity | SIGNAL | Steady Signal | Normal Polarity | N | N | N | Y |
| FE-line_signal | Reversed Polarity | SIGNAL | Steady Signal | Reversed Polarity | N | N | N | Y |

**Note**: This FE is not defined in ETS 300 324-1 [1] but has been added for clarification.

**Table 4 - V5 Message Mapping from FEs Received by the AN_PSTN_Protocol Process**

| V5 MESSAGE at Interface [D] | | | Function Element (FE) at Interface [c] | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|---|
| **Message Type** | **Info-Element** | **Parameter/ Signal Type** | **FE** | **Additional Line Signal Information** | **5** | **6** | **7** | **8** |
| ESTABLISH | Steady Signal | Normal Polarity | FE-line_signal | Normal Polarity | Y | Y | Y | N |
| SIGNAL | Steady Signal | Normal Polarity | FE-line_signal | Normal Polarity | Y | Y | Y | N |
| ESTABLISH | Steady Signal | Reversed Polarity | FE-line_signal | Reversed Polarity | Y | Y | N | N |
| SIGNAL | Steady Signal | Reversed Polarity | FE-line_signal | Reversed Polarity | Y | Y | Y | N |
| ESTABLISH ACK | Pulsed Signal | Pulsed Reduced Battery:- Pulse Duration Type, Suppression Indicator | FE-est_ack _ind **(Note)** | Pulsed Reduced Battery:- Pulse Duration Type, Suppression Indicator | Y | N | N | N |
| SIGNAL | Pulsed Signal | Pulsed Reduced Battery:- Pulse Duration Type, Suppression Indicator | FE-line_signal | Pulsed Reduced Battery:- Pulse Duration Type, Suppression Indicator | Y | N | N | N |
| ESTABLISH ACK | Pulsed Signal | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator | FE-est_ack _ind **(Note)** | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator | N | Y | Y | N |
| ESTABLISH ACK | Pulsed Signal | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | FE-est_ack _ind **(Note)** | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | N | Y | Y | N |
| SIGNAL | Pulsed Signal | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator | FE-line_signal | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator | Y | Y | Y | N |
| SIGNAL | Pulsed Signal | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | FE-line_signal | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | Y | Y | Y | N |
| ESTABLISH ACK | Steady Signal | Reduced Battery | FE-est_ack _ind **(Note)** | Reduced Battery | Y | Y | Y | N |
| SIGNAL | Steady Signal | Reduced Battery | FE-line_signal | Reduced Battery | Y | Y | Y | N |
| SIGNAL | Pulsed Signal | Meter Pulse:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | FE-line_signal | Meter Pulse:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | Y | Y | Y | N |
| SIGNAL | Pulsed Signal | Meter Pulse:- Pulse Duration Type, Suppression Indicator | FE-line_signal | Meter Pulse:- Pulse Duration Type, Suppression Indicator | Y | Y | Y | N |

**Table 5 - FE Mapping from V5 Messages Received by the AN_PSTN_Protocol Process**
**(Continues on next page)**

| V5 MESSAGE at Interface [D] | | | Function Element (FE) at Interface [c] | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|---|
| **Message Type** | **Info-Element** | **Parameter/ Signal Type** | **FE** | **Additional Line Signal Information** | **5** | **6** | **7** | **8** |
| ESTABLISH | Cadenced Ringing | Cadenced Ringing Type | FE-line_signal | Cadenced Ringing:-<br>Cadenced Ringing Type | Y | Y | Y | N |
| SIGNAL | Cadenced Ringing | Cadenced Ringing Type | FE-line_signal | Cadenced Ringing:-<br>Cadenced Ringing Type | Y | Y | Y | N |
| ESTABLISH | Pulsed Signal | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | FE-line_signal | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | Y | Y | N | N |
| SIGNAL | Pulsed Signal | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | FE-line_signal | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | Y | Y | N | N |
| DISCONNECT | None | N/A | FE-disc_comp_ind **(Note)** | None | Y | Y | Y | Y |
| DISCONNECT COMPLETE | None | N/A | FE-disc_comp_ind **(Note)** | None | Y | Y | Y | Y |
| ESTABLISH ACK | None | N/A | FE-est_ack_ind **(Note)** | None | Y | Y | Y | Y |
| PROTOCOL PARAMETER | Recognition Time | Off Hook,<br>Duration Type | FE-prot_param_ind **(Note)** | Recognition Time:-<br>Off Hook,<br>Duration Type | Y | Y | N | N |
| ESTABLISH | Steady Signal | Off Hook | FE-line_signal | Off Hook | N | N | N | Y |
| SIGNAL | Digit Signal | Digit Information<br>Digit Ack Req Ind | FE-line_signal | Digit Signal:-<br>Digit Information<br>Digit Ack Req Ind | N | N | N | Y |
| SIGNAL | Pulsed Signal | Pulsed On Hook:-<br>Pulse Duration Type<br>Suppression Ind<br>Number of Pulses<br>Ack Request Ind | FE-line_signal | Pulsed On Hook:-<br>Pulse Duration Type<br>Suppression Ind<br>Number of Pulses<br>Ack Request Ind | N | N | N | Y |

**Note**: This FE is not defined in ETS 300 324-1 [1] but has been added for clarification.

**Table 5 (Continued) - FE Mapping from V5 Messages Received by the AN_PSTN_Protocol Process**

### 4.3.2. Modifications to ETS 300 324-1 [1]

In order to align with the description given in this specification a number of modifications to ETS 300 324-1 [1] Clause 13, Annex L and Annex G have been assumed. These modifications take the form of a new AN_PSTN_Protocol process state [Path Initiated by LE] plus changes to a number of existing states.

The modifications are for the purpose of description and do not change the external behaviour specified by the ETS.

- The changes to Clause 13 of ETS 300 324-1 [1] are given in 4.3.2.1.
- The changes to existing SDL states in Annex L of ETS 300 324-1 [1] are given in 4.3.2.2.
- The additional SDL state to Annex L of ETS 300 324-1 [1] is given in 4.3.2.3.
- The changes to Annex G of ETS 300 324-1 [1] are given in 4.3.2.4.

#### 4.3.2.1.Modifications to Clause 13

a) Page 48, subclause 13.2.1.1 Path states in the AN (AN(PSTN))

Add the following additional state:-

**Path initiated by LE state (AN1a):** the LE has sent an ESTABLISH message to the AN and is waiting for an ESTABLISH-ACK. The AN is awaiting a response from AN_PSTN_USER_PORT before responding to the LE. Call collision resolution shall be achieved by the AN and LE during this phase of the call.

NOTE: If the AN is required to send a STATUS message while in state AN1a it shall indicate state AN1 in the State IE.

Replace **Line information state (AN4):** 2nd sentence with the following:-

This state may be entered from the NULL state or from the Path initiated by LE state.

b) Page 50, Table 2 Primitives, messages and timers used in the AN (PSTN) FSM

Add the following new entries to table 2:-

| | | |
|---|---|---|
| FE-establish_ack | PSTN_AN ← SUB | Positive response indicating that the signal indicated in the ESTABLISH message has been successfully applied. |
| FE-disconnect_req | PSTN_AN ← SUB | The AN PSTN user port requests clearing of the PSTN path. |
| FE-establish_ack_ind | PSTN_AN → SUB | A positive response indicating that the LE has established the PSTN path. |
| FE-disc_complete_ind | PSTN_AN → SUB | Indication that the PSTN path has been cleared. |
| FE-protocol_parameter_ind | PSTN_AN → SUB | A request to change the recognition time of a signal, or to enable or disable autonomous acknowledgement of a signal. |

c) Page 69, subclause 13.5 PSTN call control procedures

Add the following additional FE groups:-

- FE-establish_ack
- FE-disconnect_req
- FE-establish_ack_ind
- FE-disc_complete_ind
- FE-protocol_parameter_ind

Add the following note at the end of subclause 13.5:-

**Note:** The term “line condition” covers both analogue line conditions, e.g. Off-Hook, Cadenced Ringing etc. and control signals, e.g. Pulse Notification, No Resources etc.

d) Page 78, subclause 13.5.3.1.2.1 Normal Operation

Replace the second paragraph with the following:-

The AN V5 Protocol entity receiving in the PATH INITIATED BY AN state an ESTABLISH ACK message shall stop timer T1 or T2, depending on which is running, apply the procedures described in subclause 13.5.5.2.1, re-connect the transmission path, generate an FE-establish_ack_ind and enter the PATH ACTIVE state.

e) Page 79, subclause 13.5.3.2.1.1 Normal Operation

Replace the three bullet items with the following:-

- send a FE-line-signal to the subscriber port (If appropriate);

- enter the PATH INITIATED BY LE state.

f) Page 80, subclause 13.5.3.2.2 Establish acknowledge

Replace this entire subclause with the following:-

The LE V5 Protocol entity is in the PATH INITIATED BY LE state and the AN V5 Protocol entity is in the PATH INITIATED BY LE state.

Normal operation: the AN V5 Protocol entity receives an FE-establish_ack and the LE V5 Protocol entity receives an ESTABLISH ACK message.

Exceptional procedures: any other event or message.

g) Page 80, subclause 13.5.3.2.2.1 Normal operation

Add the following new paragraph:-

The AN V5 Protocol entity receiving in the PATH INITIATED BY LE state a FE_establish_ack shall send an ESTABLISH ACK message to the LE, apply the procedures described in subclause 13.5.5.2.1 and enter the PATH ACTIVE state.

h) Page 80, subclause 13.5.3.2.2.2 Exceptional procedures

Add the following new paragraph:-

If the AN V5 Protocol entity receives in the PATH INITIATED BY LE state:

- an ESTABLISH message, then it shall be discarded
- a FE-disconnect_request, then it shall generate a DISCONNECT message to the LE and apply the procedures specified in subclause 13.5.3.5.
- a FE-subscriber-seizure, then it shall apply the procedures defined in subclause 13.5.3.3

i) Page 80, subclause 13.5.3.3.1 Originating call prevail

Add the following new paragraph after the first paragraph:-

Upon receipt of an ESTABLISH message from the LE, the AN V5 Protocol entity enters the PATH INITIATED BY LE state. If a FE-subscriber_seizure message is received in this state, then an ESTABLISH message shall be sent to the LE, timer T1 started, transmission path shall be interrupted (bearer non transparent), if the autonomous seizure acknowledge option applies, then it shall be acknowledged via a FE-line_signal and finally the PATH INITIATED BY AN state shall be entered.

j) Page 81, subclause 13.5.3.3.2 Destination call prevail

Add the following new paragraph after the first paragraph:-

Upon receipt of an ESTABLISH message from the LE, the AN V5 Protocol entity enters the PATH INITIATED BY LE state. If a FE-subscriber_seizure message is received in this state, then it shall be discarded and no state change shall occur.

k) Page 82, subclause 13.5.3.5 Disconnecting path

Replace the text of the first bullet item with:-

- generate the DISCONNECT message, if being in the PATH ABORT REQUEST state and an ESTABLISH ACK message is received, or if a FE_disconnect_request is received in the PATH INITIATED BY LE state, or the layer 3 error detection mechanism (see subclause 13.5.5) detects a failure;

l) Page 83, subclause 13.5.3.5.1.1 Normal operation

Replace first paragraph with the following:-

Except when the AN is in the PATH ABORT REQUEST state, or the PATH INITIATED BY LE state, or when the layer 3 detection mechanism detects a failure, disconnection shall always be initiated by the national functional protocol which sends to the LE V5 Protocol entity a FE-disconnect_request or FE_disconnect_complete_request.

Replace the third paragraph (Disconnection initiated by LE) with the following:-

The AN V5 Protocol entity receiving a DISCONNECT message shall stop all timers, generate a FE-line_signal indication if a steady signal information element is contained within the message, generate a FE-disconnect_complete_indication, return a DISCONNECT COMPLETE message and enter the NULL STATE. The user port is responsible for monitoring the status of the line and if it determines the call is not to be cleared, then it is responsible for generating the appropriate signal.

Replace the fourth paragraph (Disconnection initiated by AN) with the following:-

The AN V5 Protocol entity shall send a DISCONNECT message to the LE, start timer T3 and enter the DISCONNECT REQUEST state under the following circumstances;

- an ESTABLISH ACK is received in the PATH ABORT REQUEST state;
- a FE-disconnect_request is received in the PATH INITIATED BY LE state;
- layer 3 error detection mechanism detects a failure.

Replace the fifth paragraph (Disconnection initiated by AN) with the following:-

The AN V5 Protocol entity receiving a DISCONNECT COMPLETE message shall stop all timers, generate a FE-line_signal indication if a steady signal information element is contained within the message, generate a FE-disconnect_complete_indication and enter the NULL STATE. The user port is responsible for monitoring the status of the line and if it determines the call is not to be cleared, then it is responsible for generating the appropriate signal.

m) Page 84, subclause 13.5.3.6.1 Normal operation

Replace first paragraph with the following:-

The AN V5 Protocol entity receiving a FE-line-information in the NULL or PATH INITIATED BY LE states shall send an ESTABLISH message to the LE with the Line-information element, start timer T1 and enter the LINE INFORMATION state.

n) Page 85, subclause 13.5.4.1.1 Normal operation

Replace third paragraph with the following:-

The AN V5 Protocol entity, being in the PATH ACTIVE state and receiving a PROTOCOL PARAMETER message shall generate a FE-protocol_parameter_indication, and remain in the current state.

o) Page 91, subclause 13.7 AN and LE side state tables

Add following FE groups to the item list:-

- FE-establish_ack
- FE-disconnect_req
- FE-establish_ack_ind
- FE-disc_complete_ind
- FE-protocol_parameter_ind

**Note:** The term "line condition" covers both analogue line conditions, e.g. Off-Hook, Cadenced Ringing etc. and control signals, e.g. Pulse Notification, No Resources etc.

Add the following shaded column and rows to Table 29:-

| Event | **PATH INITIATED BY LE AN1a** | All other states |
|---|---|---|
| FE-Subscriber_seizure (e.g. off hook) | If o/g call priority then; bearer non transparent, start T1, ESTABLISH, FE-line_signal, (Note 1); AN2<br>Otherwise; - | |
| FE-line_information | start T1, ESTABLISH; AN4 | |
| FE-subscriber_release (e.g. off hook) | / | |
| FE-establish_ack | ESTABLISH ACK, initialise counters S(S), S(A), S(R); AN5 | / |
| FE-disconnect_request | start T3, DISCONNECT; AN7 | / |
| ESTABLISH ACK | STATUS (note state AN1 is returned); - | |
| ESTABLISH | - | |
| DISCONNECT | FE-disconnect_complete_ind, DISCONNECT COMPLETE; AN1 | |
| SIGNAL | STATUS (note state AN1 is returned); - | |
| FE_line_signal | - | |
| MDU-CTRL (port unblocked) | - | |
| DISCONNECT COMPLETE | FE-disconnect_complete_ind; AN1 | |

| Event | **PATH INITIATED BY LE AN1a** | All other states |
|---|---|---|
| PROTOCOL PARAMETER | STATUS (note state AN1 is returned); - | |
| MDU-CTRL (port blocked) | stop timers, clear port, DISCONNECT COMPLETE; AN6 | |
| SIGNAL ACK | STATUS (note state AN1 is returned); - | |
| STATUS ENQURY | STATUS (note state AN1 is returned); - | |
| MDU-CTRL(restart request) | clear port, DISCONNECT COMPLETE, MDU_CTRL(restart ack); AN0 | |
| MDU-CTRL(restart complete) | / | |
| timeout T1/T2 | / | |
| timeout T3 | / | |
| timeout Tr | / | |
| Timeout Tt | / | |

Changes to existing columns and rows in table 29;

Row Establish Ack, Column AN2

Replace with following actions:

“FE-establish_ack_ind, bearer transparent, stop T1/T2; AN5”.

Row Establish, Column AN1

Replace with following actions:

“FE-line_signal; AN1a”.

Row Establish, Column AN2

Replace with following actions:

“If originating call priority, then; -.

Otherwise stop T1/T2, FE-line_signal; AN1a”.

Row Establish, Column AN3

Replace with following actions:

“If originating call priority, then; - .

Otherwise stop T1/T2, FE-line_signal; AN1a”.

Row Disconnect, Column AN2, AN3, AN4, AN5, AN7

Add following action:

“FE-disconnect_complete_ind ”.

Row Disconnect Complete, Column AN2, AN3, AN4, AN5, AN7

Add following action;

“FE-disconnect_complete_ind”.

Row Protocol Parameter, Column AN5

Replace actions for cell where a valid sequence number is received with the following:

“ If M(S) = S(R), then: FE-protocol-parameter-indication, increment S(R), Start Tr if not already running, -. Otherwise stop all timers, MDU_error_indication, DISCONNECT, start T3; AN7”.

Row timeout T1/T2, Column AN3

Add following action:

“FE_disconnect_complete_ind”

Row timeout T3, Column AN7

Replace cell covering second occurrence of expiry of T3 with

“FE_disconnect_complete_ind, MDU-error_indication; AN1”.

**4.3.2.2.Modifications to existing states in Annex L (Informative)**

a) Remove all occurrences of “Set Protocol Parameter to Default” task boxes.

b) Figure L.9.2 (AN1): Receipt of “ESTABLISH”:

Remove:-

- “ESTABLISH ACK” output.
- “Initialise Counters” task box.
- “Send Signal” decision box.

Replace:-

- "Path Active" state with the new state "Path Initiated by LE".

a) Figure L.9.3 (AN2): Receipt of "ESTABLISH ACK":

Insert:-

- Output "FE-est_ack_ind" after "bearer transparent" task box.

a) Figure L.9.3 (AN2): Receipt of "ESTABLISH":

Remove:-

- "ESTABLISH ACK" output.
- "Initialise Counters" task box.
- "Send Signal" decision box.

Replace:-

- "Path Active" state with the new state "Path Initiated by LE".

a) Figure L.9.4 (AN3): Receipt of "ESTABLISH":

Remove:-

- "ESTABLISH ACK" output.
- "Initialise Counters" task box.
- "Send Signal" decision box.

Replace:-

- "Path Active" state with the new state "Path Initiated by LE".

a) Figure L.9.4 (AN3): Receipt of "Timeout T1/T2":

Insert:-

- "FE-disconnect_complete_ind" output.

a) Figure L.9.8 (AN5): Receipt of "PROTOCOL PARAMETER":

Change:-

- Task " update protocol parameter" to output "FE-prot_param_ind".

a) Figure L.9.10 (AN7): Receipt of "Timeout T3":

Insert:-

- "FE-disconnect_complete_ind" output after "MDU_error_indication" output.

a) Figure L.9.11 (Any State Except AN0, AN6 and AN7): Receipt of "STATUS ENQUIRY" or "unexpected MESSAGE":

Add:-

- If these messages are received in the new "Path Initiated by LE" state, then the state returned within the responding STATUS message shall indicate "NULL (AN1)".

a) Whenever “DISCONNECT” or “DISCONNECT COMPLETE” are received and the “NULL” state is entered, an “FE-disc_comp_ind” output shall be inserted prior to entering the “NULL” state.

### 4.3.2.3. Additional AN_PSTN_Protocol State [Path Initiated by LE]

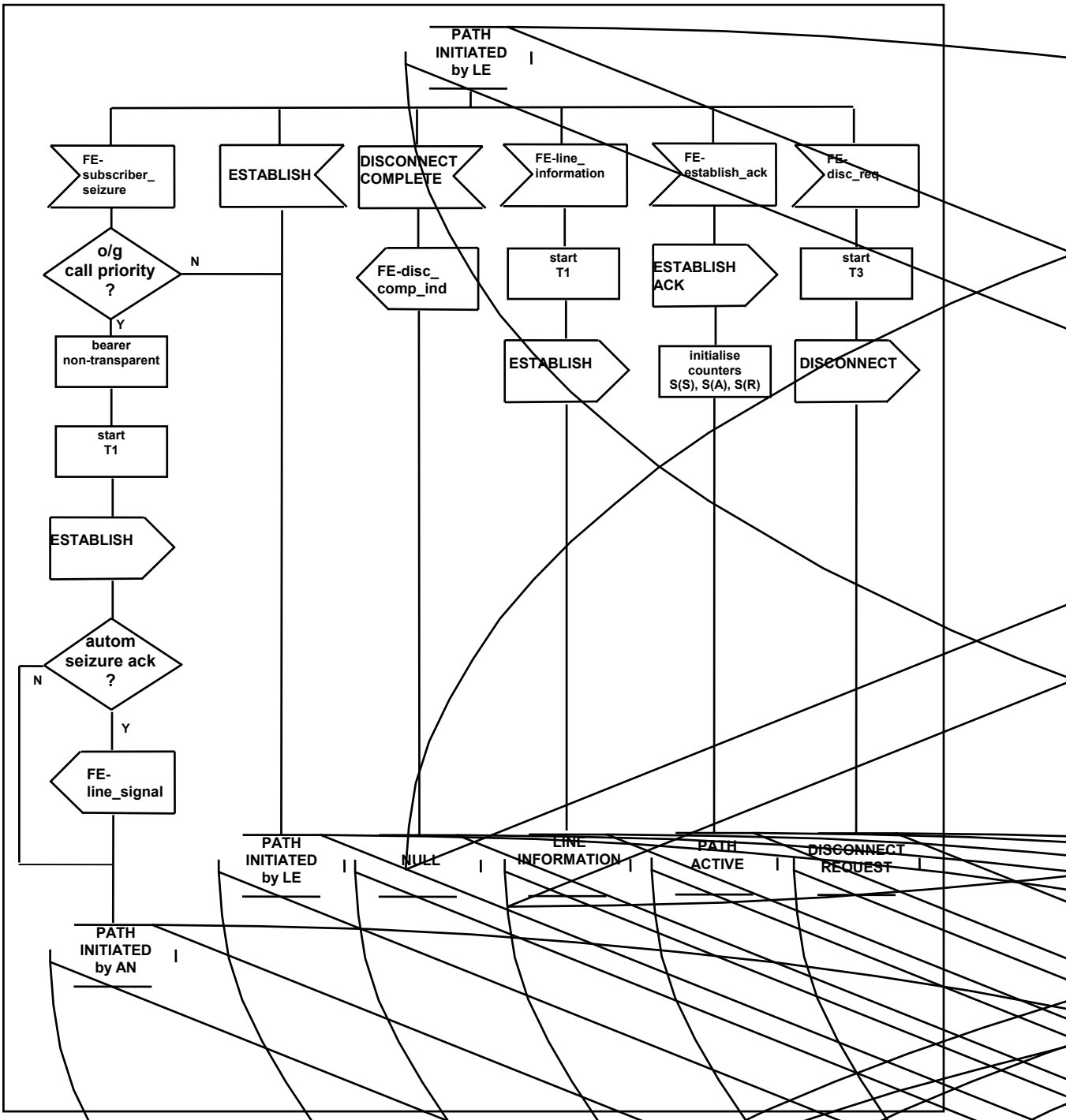



**Figure L.9.12: PSTN protocol AN-side; state PATH INITIATED BY LE (AN1a (PSTN))**

#### 4.3.2.4. Modifications to Annex G (Informative)

a) Add the following FE primitives to G.2:-

**G.2.5 FE-establish_acknowledge**

This primitive shall be used to inform the LE that the requested (electrical) condition has been applied to the user port and to confirm to the LE the set up of a PSTN signalling path across the V5 interface.

This primitive is only valid when sent from the user port to the PSTN protocol entity in the AN.

This primitive is only valid in cases where the PSTN protocol entity in the AN is in the PATH INITIATED BY LE state.

This primitive shall not carry additional information.

**G.2.6 FE-disconnect_request**

This primitive shall be used when the user port wishes to clear the PSTN signalling path across the V5 interface. The primitive is typically sent if the (electrical) condition requested by the LE cannot be applied to the user port due to no resources being available in the AN.

This primitive is only valid when sent from the user port to the PSTN protocol entity in the AN.

This primitive is only valid in cases where the PSTN protocol entity in the AN is in the PATH INITIATED BY LE state.

This primitive shall not carry additional information.

**G.2.7 FE-establish_acknowledge_indication**

This primitive shall be used whenever the PSTN protocol entity in the AN wishes to indicate to the user port that it has received a positive response to a previously requested set-up of a PSTN signalling path across the V5 interface.

This is usually an acknowledgement to a previous FE-subscriber_seizure.

The primitive is valid only when sent from the PSTN protocol entity in the AN to the user port.

This primitive is valid only in cases where the PSTN protocol entity is in the PATH INITIATED BY AN state.

This primitive shall carry additional information concerning the signalling to be applied by the user port.

**G.2.8 FE-disc_complete_indication**

This primitive shall be used whenever the PSTN protocol entity in an AN wishes to indicate to the user port that the PSTN signalling path across the V5 interface has been cleared completely.

This primitive is valid only when sent from the PSTN protocol entity in the AN to the user port.

This primitive is valid only in cases where the PSTN protocol entity is in the PATH INITIATED BY AN, PATH INITIATED BY LE, PATH ABORT REQUEST, LINE INFORMATION, PATH ACTIVE or DISCONNECT REQUEST state.

This primitive shall not carry additional information.

**G.2.9 FE-protocol_parameter_indication**

This primitive shall be used whenever the PSTN protocol entity in an AN wishes to indicate to the user port that it has received a request to change a PSTN protocol parameter.

This primitive is valid only when sent from the PSTN protocol entity in the AN to the user port.

This primitive is valid only in cases where the PSTN protocol entity in the AN is in the PATH ACTIVE state.

The primitive shall carry additional information concerning the protocol parameter to be changed.

b) Modify the following FE primitives in G.2:-

**G.2.1 FE-subscriber_seizure**

Replace paragraph 3 with

“This primitive is valid only in cases where the PSTN protocol entity in the AN is in the NULL, PATH ABORT REQUEST or PATH INITIATED BY LE state.

**G.2.3 FE-line_information**

Replace paragraph 3 with

“This primitive is valid only in cases where the PSTN protocol entity in the AN is in the NULL or PATH INITIATED BY LE state.

**G.2.4 FE-line_signal**

Replace the penultimate paragraph with

“This primitive is valid only in cases where the PSTN protocol entity in the AN is in the NULL, PATH INITIATED BY AN, PATH ABORT REQUEST, PATH ACTIVE or PATH INITIATED BY LE state.

## 4.4. LE_PSTN_PROTOCOL PROCESS

This Subclause specifies the requirements for the LE_PSTN_Protocol process.

The requirements for the LE_PSTN_Protocol process shall be as specified in ETS 300 324-1 [1] plus the additional requirements given in this Specification.

The additional requirements can be categorised as:

- Mapping details of V5 Information Elements to FE (additional line signal information). This is given in Tables 6 and 7.
- Coding details for V5 Information Elements, this is given in 4.6.

| V5 MESSAGE at Interface [D] | | | Function Element (FE) at Interface [e] | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|---|
| Message Type | Info-Element | Parameter/ Signal Type | FE | Additional Line Signal Information | 5 | 6 | 7 | 8 |
| ESTABLISH | Line Information | Imp Marker Set | FE-establish_ind | Imp Marker Set | Y | Y | Y | N |
| ESTABLISH | Line Information | Imp Marker Reset | FE-establish_ind | Imp Marker Reset | Y | Y | Y | N |
| SIGNAL | Pulse Notification | N/A | FE-line_sig_ind | Pulse Notification | Y | Y | Y | Y |
| SIGNAL | Digit Signal | Digit Information | FE-line_sig_ind | Digit Signal:- Digit Information | Y | Y | Y | N |
| ESTABLISH | Steady Signal | Off-Hook | FE-establish_ind | Off-Hook | Y | Y | Y | N |
| SIGNAL | Steady Signal | Off-Hook | FE-line_sig_ind | Off-Hook | Y | Y | Y | N |
| SIGNAL | Steady Signal | On-Hook | FE-line_sig_ind | On-Hook | Y | Y | Y | N |
| ESTABLISH ACK | None | N/A | FE-est_ack _ind | None | Y | Y | Y | Y |
| SIGNAL | Resource Unavailable | Copy of IE | FE-line_sig_ind | Resource Unavailable:- Copy of IE | Y | Y | Y | Y |
| SIGNAL | Pulsed Signal | Register Recall | FE-line_sig_ind | Register Recall | Y | Y | Y | N |
| DISCONNECT | None | N/A | FE-disc_comp _ind | None | Y | Y | Y | Y |
| SIGNAL | Steady Signal | B-Wire Connected to Earth | FE-line_sig_ind | B-Wire Connected to Earth | N | N | Y | N |
| DISCONNECT COMPLETE | None | N/A | FE-disc_comp _ind | None | Y | Y | Y | Y |
| SIGNAL | Steady Signal | Normal Polarity | FE-line_sig_ind | Normal Polarity | N | N | N | Y |
| SIGNAL | Steady Signal | Reversed Polarity | FE-line_sig_ind | Reversed Polarity | N | N | N | Y |
| SIGNAL | Steady Signal | No Battery | FE-line_sig_ind | No Battery | N | N | N | Y |
| ESTABLISH | Steady Signal | No Battery | FE-establish_ind | No Battery | N | N | N | Y |

**Table 6 - FE Mapping from V5 Messages received by the LE_PSTN_Protocol Process**

| Function Element (FE) at Interface [e] | | V5 MESSAGE at Interface [D] | | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|---|
| FE | Additional Line Signal Information | Message Type | Info-Element | Parameter/ Signal Type | 5 | 6 | 7 | 8 |
| FE-establish_req | Normal Polarity | ESTABLISH | Steady Signal | Normal Polarity | Y | Y | Y | N |
| FE-line_sig_req | Normal Polarity | SIGNAL | Steady Signal | Normal Polarity | Y | Y | Y | N |
| FE-establish_req | Reversed Polarity | ESTABLISH | Steady Signal | Reversed Polarity | Y | Y | N | N |
| FE-line_sig_req | Reversed Polarity | SIGNAL | Steady Signal | Reversed Polarity | Y | Y | Y | N |
| FE-line_sig_req | Pulsed Reduced Battery:- Pulse Duration Type, Suppression Indicator | SIGNAL | Pulsed Signal | Pulsed Reduced Battery:- Pulse Duration Type, Suppression Indicator | Y | N | N | N |
| FE-establish_ack | Pulsed Reduced Battery:- Pulse Duration Type, Suppression Indicator | ESTABLISH ACK | Pulsed Signal | Pulsed Reduced Battery:- Pulse Duration Type, Suppression Indicator | Y | N | N | N |
| FE-line_sig_req | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator | SIGNAL | Pulsed Signal | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator | Y | Y | Y | N |
| FE-line_sig_req | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | SIGNAL | Pulsed Signal | Pulsed No Battery:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | Y | Y | Y | N |
| FE-line_sig_req | Reduced Battery | SIGNAL | Steady Signal | Reduced Battery | Y | Y | Y | N |
| FE-establish-ack | Reduced Battery | ESTABLISH ACK | Steady Signal | Reduced Battery | Y | Y | Y | N |
| FE-line_sig_req | Meter Pulse:- Pulse Duration Type, Suppression Indicator | SIGNAL | Pulsed Signal | Meter Pulse:- Pulse Duration Type, Suppression Indicator | Y | Y | Y | N |
| FE-line_sig_req | Meter Pulse:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | SIGNAL | Pulsed Signal | Meter Pulse:- Pulse Duration Type, Suppression Indicator, Number of Pulses, Ack Request Ind | Y | Y | Y | N |
| FE-establish_req | Cadenced Ringing:- Cadenced Ringing Type | ESTABLISH | Cadenced Ringing | Cadenced Ringing Type | Y | Y | Y | N |
| FE-line_sig_req | Cadenced Ringing:- Cadenced Ringing Type | SIGNAL | Cadenced Ringing | Cadenced Ringing Type | Y | Y | Y | N |

**Table 7 - V5 Message Mapping from FEs Received by the LE_PSTN_Protocol Process (Continues on next page)**

| Function Element (FE) at Interface [e] | | V5 MESSAGE at Interface [D] | | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|---|
| **FE** | **Additional Line Signal Information** | **Message Type** | **Info-Element** | **Parameter/ Signal Type** | **5** | **6** | **7** | **8** |
| FE-establish_req | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | ESTABLISH | Pulsed Signal | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | Y | Y | N | N |
| FE-line_sig_req | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | SIGNAL | Pulsed Signal | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | Y | Y | N | N |
| FE-disc_req | None | DISCONNECT | None | N/A | Y | Y | Y | Y |
| FE-establish_ack | None | ESTABLISH ACK | None | N/A | Y | Y | Y | Y |
| FE-disc_comp _req | None | DISCONNECT COMPLETE | None | N/A | Y | Y | Y | Y |
| FE-prot_param _req | Recognition Time:-<br>Off-Hook,<br>Duration Type | PROTOCOL PARAMETER | Recognition Time | Off-Hook,<br>Duration Type | Y | Y | N | N |
| FE-establish_ack | Pulsed No Battery:-<br>Pulse Duration Type,<br>Suppression Indicator | ESTABLISH ACK | Pulsed Signal | Pulsed No Battery:-<br>Pulse Duration Type,<br>Suppression Indicator | N | Y | Y | N |
| FE-establish_ack | Pulsed No Battery:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | ESTABLISH ACK | Pulsed Signal | Pulsed No Battery:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | N | Y | Y | N |
| FE-establish_req | Off Hook | ESTABLISH | Steady Signal | Off Hook | N | N | N | Y |
| FE-line_sig_req | Pulsed On Hook:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | SIGNAL | Pulsed Signal | Pulsed On Hook:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | N | N | N | Y |
| FE-line_sig_req | Digit Signal:-<br>Digit Information<br>Digit Ack Req Ind | SIGNAL | Digit Signal | Digit Information<br>Digit Ack Request Ind | N | N | N | Y |

**Table 7(Continued) - V5 Message Mapping from FEs Received by the LE_PSTN_Protocol Process**

## 4.5.NATIONAL_PSTN_PROTOCOL PROCESS

This Subclause specifies the requirements for the National_PSTN_Protocol process. The requirements are specified in terms of a Finite State Machine situated between the LE_PSTN_Protocol process (Interface [e]) and the Call Control process (Interface [f]).

The National_PSTN_Protocol process also acts on an analogue management primitive that appears on Interface [g].

The mapping between the analogue primitives and the Function Elements is given in 4.5.1.

The analogue management primitive is described in 4.5.2.

### 4.5.1. Mapping between Analogue Primitives and Function Elements

The mapping between the analogue primitives that appear at Interface [f] and the FEs that appear at Interface [e] are given in Tables 8 & 9.

The mapping shown in Tables 8 & 9 is dependant on the state of the Finite State Machine and this is specified using SDL in 4.5.3. The SDL also specifies the handling of unexpected events and events that result from signal/message crossovers.

| Function Element (FE) at Interface [e] | | Analogue Primitive at Interface [f] | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|
| **FE** | **Addition Line Signal Information** | **Primitive Name** | **Additional Instructions** | **5** | **6** | **7** | **8** |
| FE-establish_ind | Imp Marker Set | 30kΩ loop change | On | Y | Y | Y | N |
| FE-establish_ind | Imp Marker Reset | 30kΩ loop change | Off | Y | Y | Y | N |
| FE-establish_ind | Off Hook | off hook | None | Y | Y | Y | N |
| FE-line_sig_ind | Off hook | off hook | None | Y | Y | Y | N |
| FE-line_sig_ind | Pulse Notification | pulse notification | None | Y | Y | Y | Y |
| FE-line_sig_ind | Digit Signal:-<br>Digit Information | digit | Digit Information | Y | Y | Y | N |
| FE-line_sig_ind | On Hook | on hook | None | Y | Y | Y | N |
| FE-line_sig_ind | Resource Unavailable:-<br>Copy of IE | no resources | Copy of IE | Y | Y | Y | Y |
| FE-est_ack_ind | None | analogue port ack | None | Y | Y | Y | Y |
| FE-line_sig_ind | Register Recall | hook flash | none | Y | Y | Y | N |
| FE-disc_comp_ind | None | V5 Path Released | None | Y | Y | Y | Y |
| FE-line_sig_ind | B-Wire Connected to Earth | faulty seize | None | N | N | Y | N |
| FE-line_sig_ind | Normal Polarity | ddi normal polarity | None | N | N | N | Y |
| FE-line_sig_ind | Reversed Polarity | ddi reversed polarity | None | N | N | N | Y |
| FE-line_sig_ind | No Battery | ddi no battery | None | N | N | N | Y |
| FE-establish_ind | No Battery | ddi no battery | None | N | N | N | Y |

**Table 8 - Analogue Primitive Mapping from FEs Received by the National_PSTN_Protocol Process**

| Analogue Primitive at Interface [f] | | Function Element (FE) at Interface [e] | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|
| **Primitive Name** | **Additional Instructions** | **FE** | **Addition Line Signal Information** | **5** | **6** | **7** | **8** |
| normal power feed | N/A | FE-establish_req | Normal Polarity | Y | Y | Y | N |
| normal power feed | N/A | FE-line_sig_req | Normal Polarity | Y | Y | Y | N |
| reversed power feed | N/A | FE-establish_req | Reversed Polarity | Y | Y | N | N |
| reversed power feed | N/A | FE-line_sig_req | Reversed Polarity | Y | Y | Y | N |
| call arrival indication | Cadenced Ringing Type | FE-line_sig_req | Cadence Ringing:-<br>Cadenced Ringing Type | Y | Y | Y | N |
| call arrival indication | Cadenced Ringing Type | FE-establish_req | Cadenced Ringing:-<br>Cadenced Ringing Type | Y | Y | Y | N |
| initial ring | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | FE-establish_req | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | Y | Y | N | N |
| initial ring | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | FE-line_sig_req | Initial Ring:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | Y | Y | N | N |
| end of call | Pulse Duration Type<br>Suppression Indicator | FE-establish_ack | Pulsed Reduced Battery:-<br>Pulse Duration Type,<br>Suppression Indicator | Y | N | N | N |
| end of call | Pulse Duration Type<br>Suppression Indicator | FE-line_sig_req | Pulsed Reduced Battery:-<br>Pulse Duration Type,<br>Suppression Indicator | Y | N | N | N |
| disconnect clear | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | FE-line_sig_req | Pulsed No Battery:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | Y | Y | Y | N |
| disconnect clear | Pulse Duration Type<br>Suppression Indicator | FE-line_sig_req | Pulsed No Battery:-<br>Pulse Duration Type,<br>Suppression Indicator | Y | Y | Y | N |
| spm pulse | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | FE-line_sig_req | Meter Pulse:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | Y | Y | Y | N |

**Table 9 - FE Mapping from Analogue Primitives Received by the National_PSTN_Protocol Process (Continues on next page)**

| Analogue Primitive at Interface [f] | | Function Element (FE) at Interface [e] | | Used in Clause | | | |
|---|---|---|---|---|---|---|---|
| **Primitive Name** | **Additional Instructions** | **FE** | **Addition Line Signal Information** | **5** | **6** | **7** | **8** |
| spm pulse | Pulse Duration Type<br>Suppression Indicator | FE-line_sig_req | Meter Pulse:-<br>Pulse Duration Type,<br>Suppression Indicator | Y | Y | Y | N |
| parked line feed | N/A | FE-line_sig_req | Reduced Battery | Y | Y | Y | N |
| parked line feed | N/A | FE-establish_ack | Reduced Battery | Y | Y | Y | N |
| LE acknowledge | N/A | FE-establish_ack | None | Y | Y | Y | Y |
| call finished | N/A | FE-disc_req<br>or<br>FE-disc_comp_req | None | Y | Y | Y | Y |
| 30kΩ change ack | N/A | FE-disc_comp_req | None | Y | Y | Y | N |
| off-hook recognition time update | Duration Type | FE-prot_param_req | Recognition Time:-<br>Off-Hook,<br>Duration Type | Y | Y | N | N |
| disconnect clear | Pulse Duration Type<br>Suppression Indicator | FE-establish_ack | Pulsed No Battery:-<br>Pulse Duration Type,<br>Suppression Indicator | N | Y | Y | N |
| disconnect clear | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | FE-establish_ack | Pulsed Reduced Battery:-<br>Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | N | Y | Y | N |
| ddi seize | None | FE-establish_req | Off Hook | N | N | N | Y |
| ddi digit | Digit Information<br>Digit Ack Req Ind | FE-line_sig_req | Digit Signal:-<br>Digit Information,<br>Digit Ack Req Ind | N | N | N | Y |
| ddi exchange release | Pulse Duration Type<br>Suppression Indicator<br>Number of Pulses<br>Ack Request Ind | FE-line_sig_req | Pulsed On Hook:-<br>Pulse Duration Type<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind | N | N | N | Y |

**Table 9 (Continued) - FE Mapping from Analogue Primitives Received by the National_PSTN_Protocol Process**

### 4.5.2. Analogue Management Primitives

The analogue management primitive is passed from the LE Management process to the National_PSTN_Protocol process (Interface [g]). The primitive, along with a short description of its function, is given in Table 10.

| Analogue Management Primitive | Description |
|---|---|
| **Reset** | The Reset primitive is used to place the National_PSTN_Protocol process immediately into the "Free" state. This may be generated on exit from exchange overload. |

**Table 10: Analogue Management Primitives**

### 4.5.3. National PSTN Protocol SDL Diagrams

This subclause details the National PSTN Protocol process in terms of a finite state machine comprising the following states:

**NP1: Free**

There is no call in progress and a new incoming or out going call request can be detected.

**NP2: V5 Path Requested by LE**

An incoming call request has been detected and establishment of the V5 path has been requested by the LE and a response to this is awaited.

**NP3: V5 Path Requested by AN**

A new outgoing call request has been forwarded to the Call Control process and a response to this is awaited.

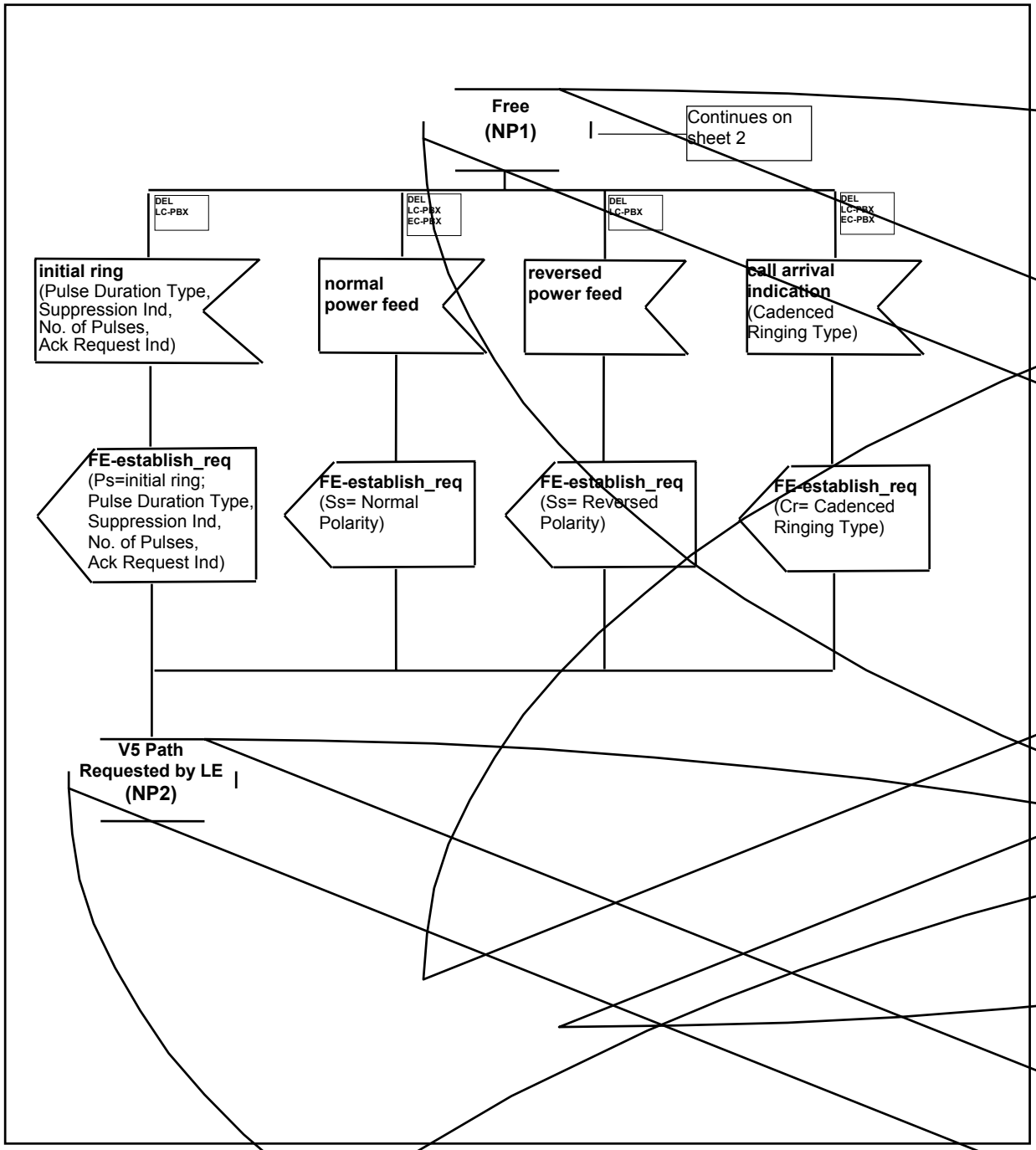
**NP4: Active**

The V5 path has been successfully established and the call may proceed with call establishment, communication or call clearing.

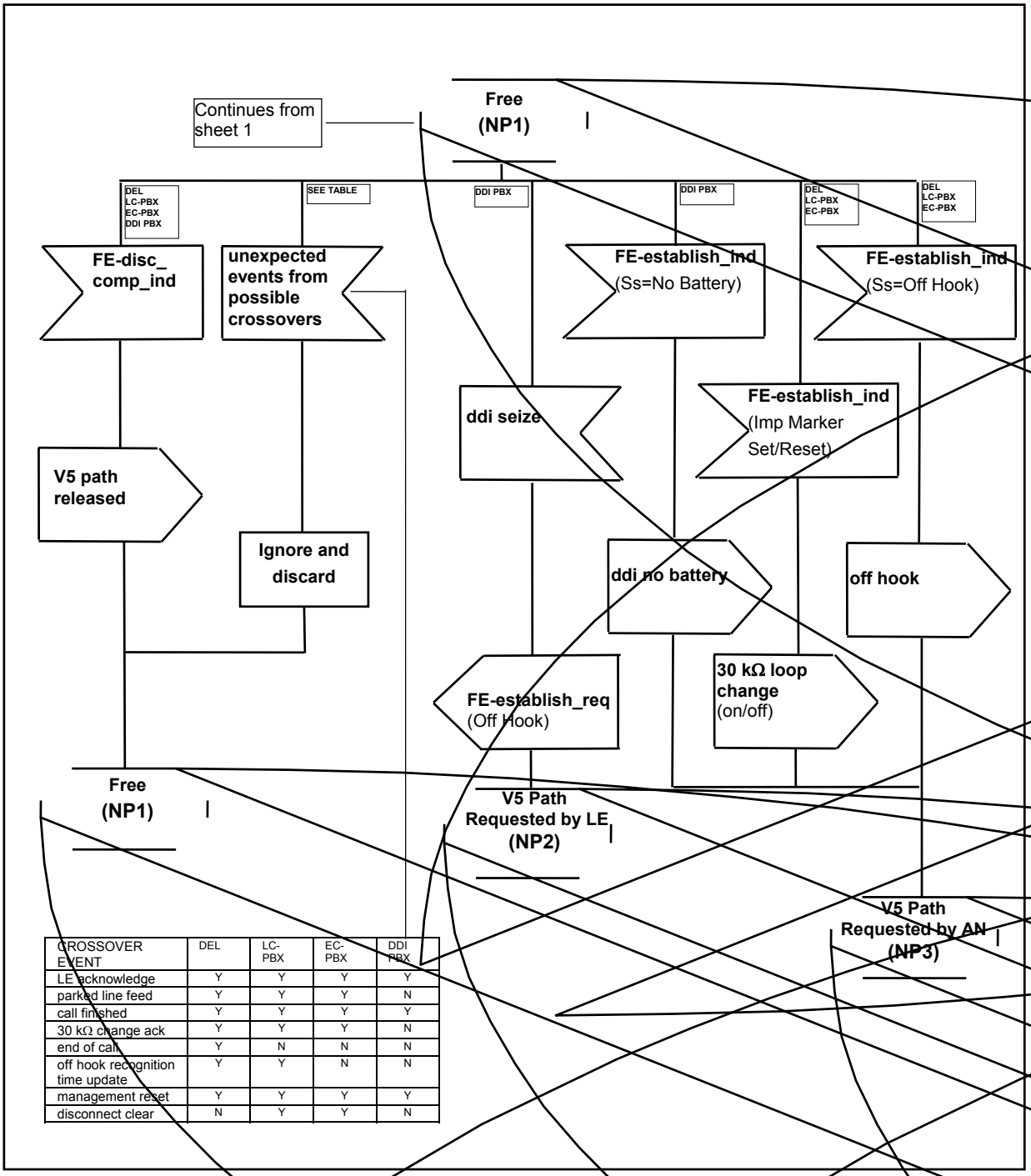
**NP5: V5 Path Disconnection Requested by LE**

Release of V5 path has been requested and a response to this is awaited.

The SDL takes account of crossovers of FEs between the National_PSTN_Protocol process and the LE_PSTN_Protocol process and of Analogue Primitives between the National_PSTN_Protocol process and the Call Control process.

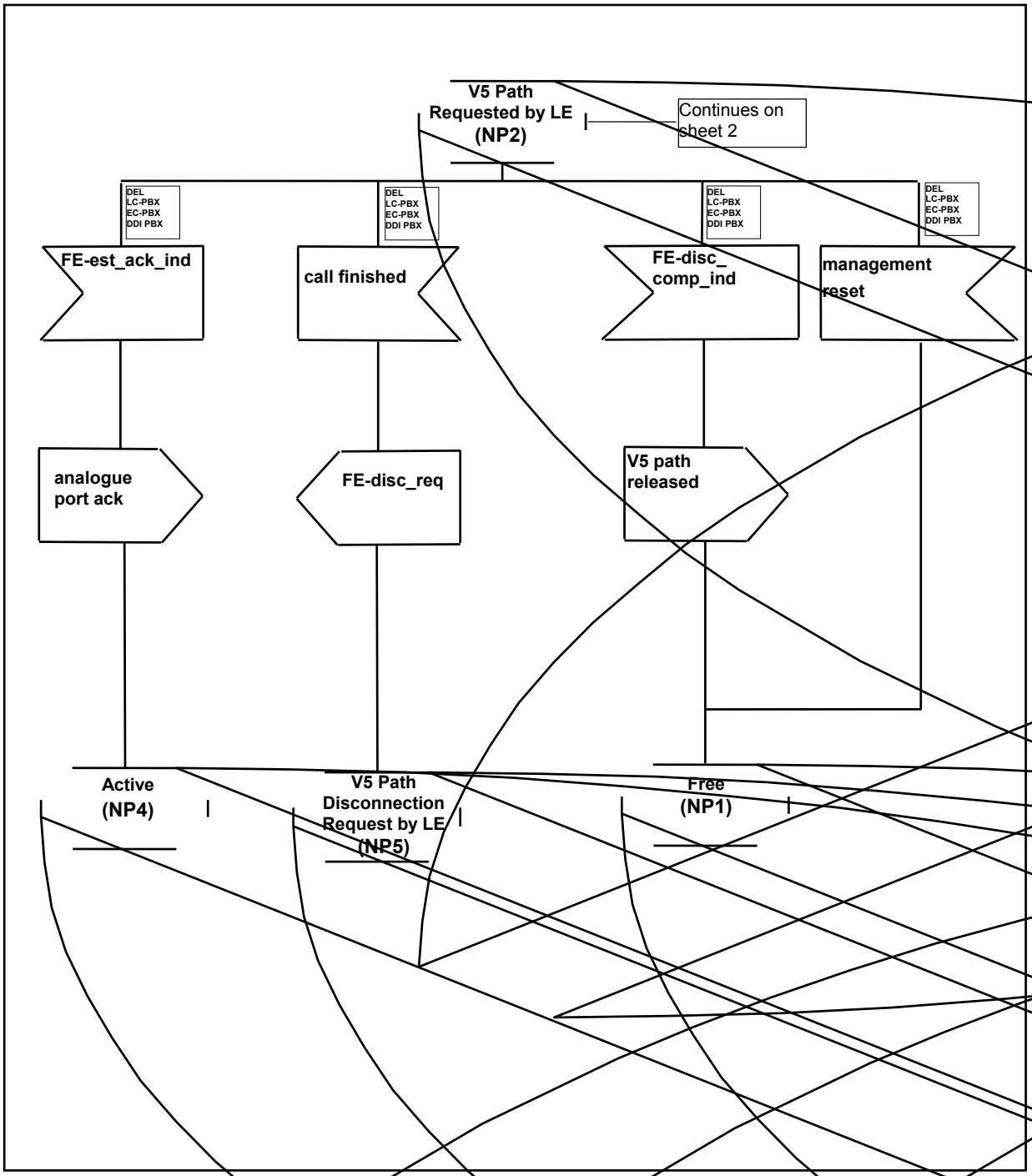



**National_PSTN_Protocol process:**
**State Free (NP1) Sheet 1 of 2**

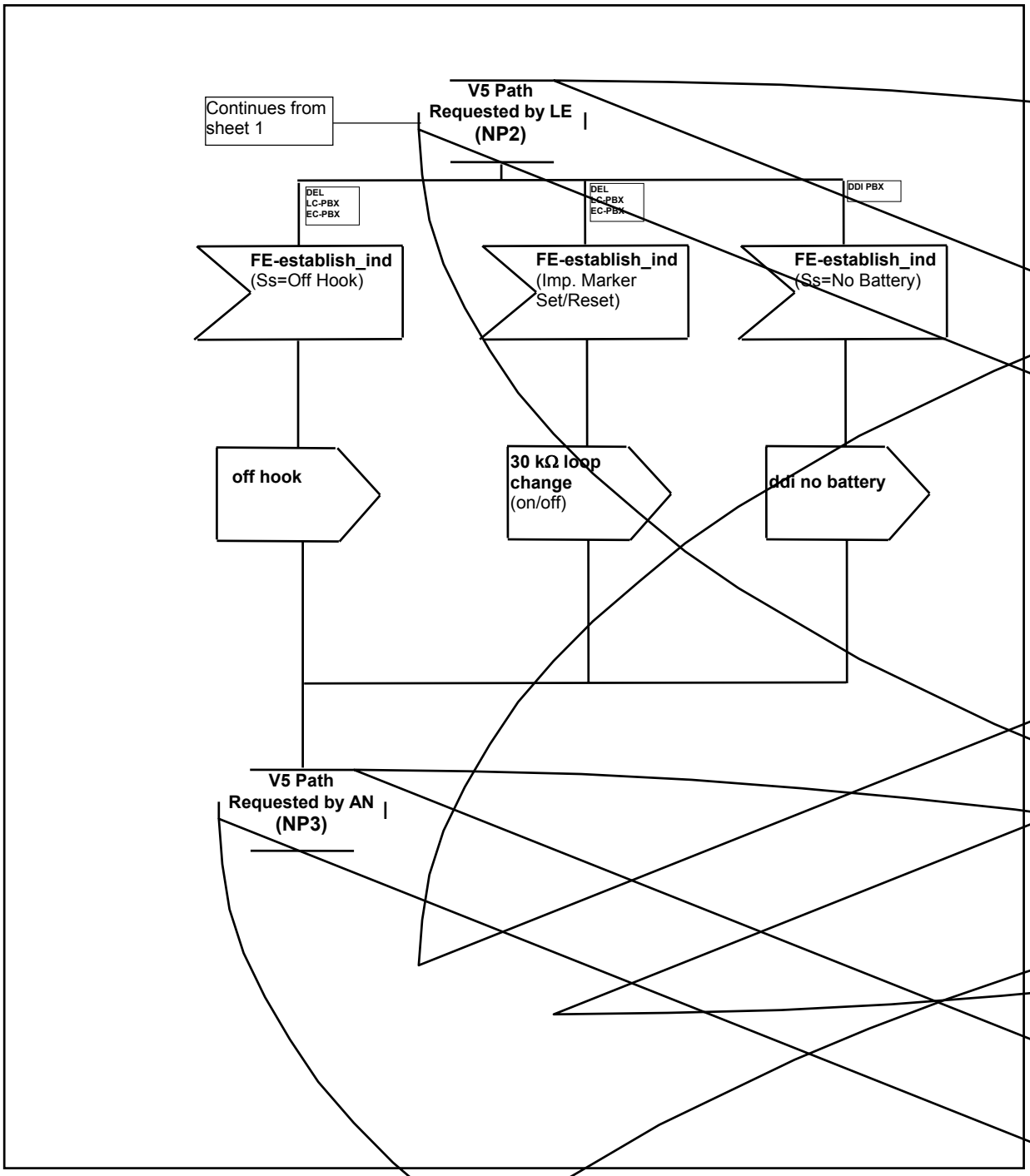



| CROSSOVER EVENT | DEL | LC-PBX | EC-PBX | DDI PBX |
|---|---|---|---|---|
| LE acknowledge | Y | Y | Y | Y |
| parked line feed | Y | Y | Y | N |
| call finished | Y | Y | Y | Y |
| 30 kΩ change ack | Y | Y | Y | N |
| end of call | Y | N | N | N |
| off hook recognition time update | Y | Y | N | N |
| management reset | Y | Y | Y | Y |
| disconnect clear | N | Y | Y | N |

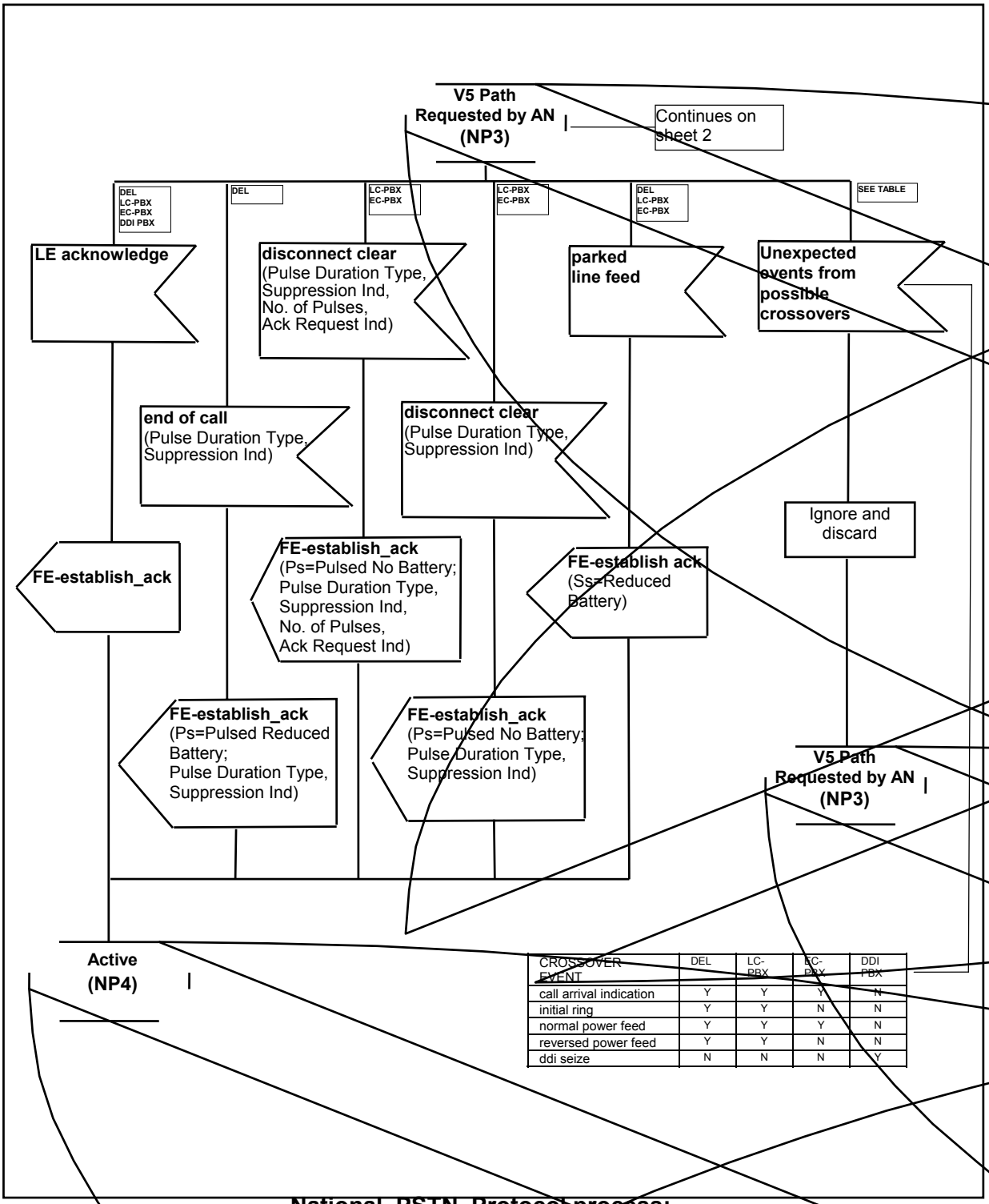
**National_PSTN_Protocol process:**
**State Free (NP1) Sheet 2 of 2**




**National_PSTN_Protocol process:**
**State V5 Path Requested by LE (NP2) Sheet 1 of 2**

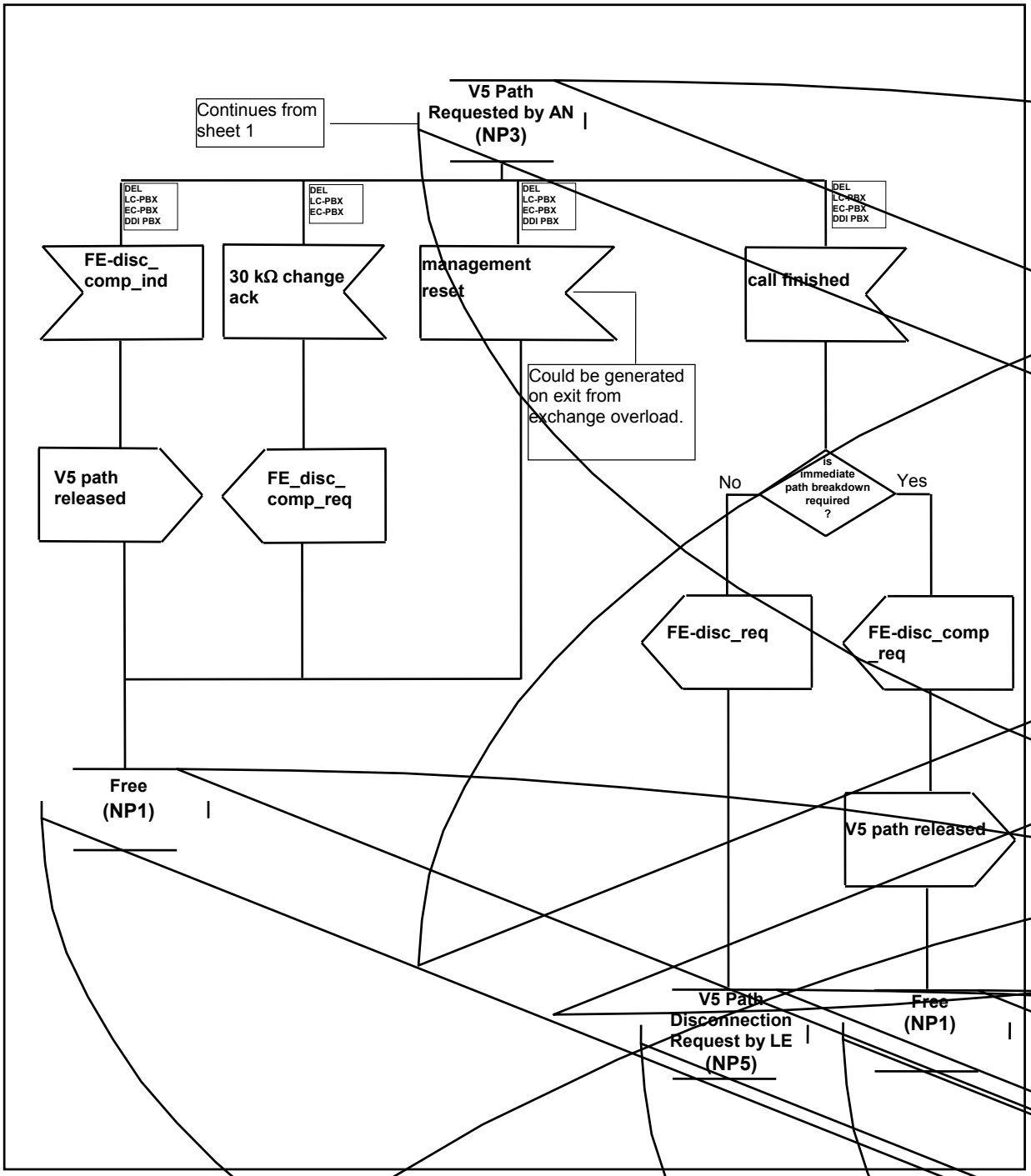



**National_PSTN_Protocol process:**
**State V5 Path Requested by LE (NP2) Sheet 2 of 2**

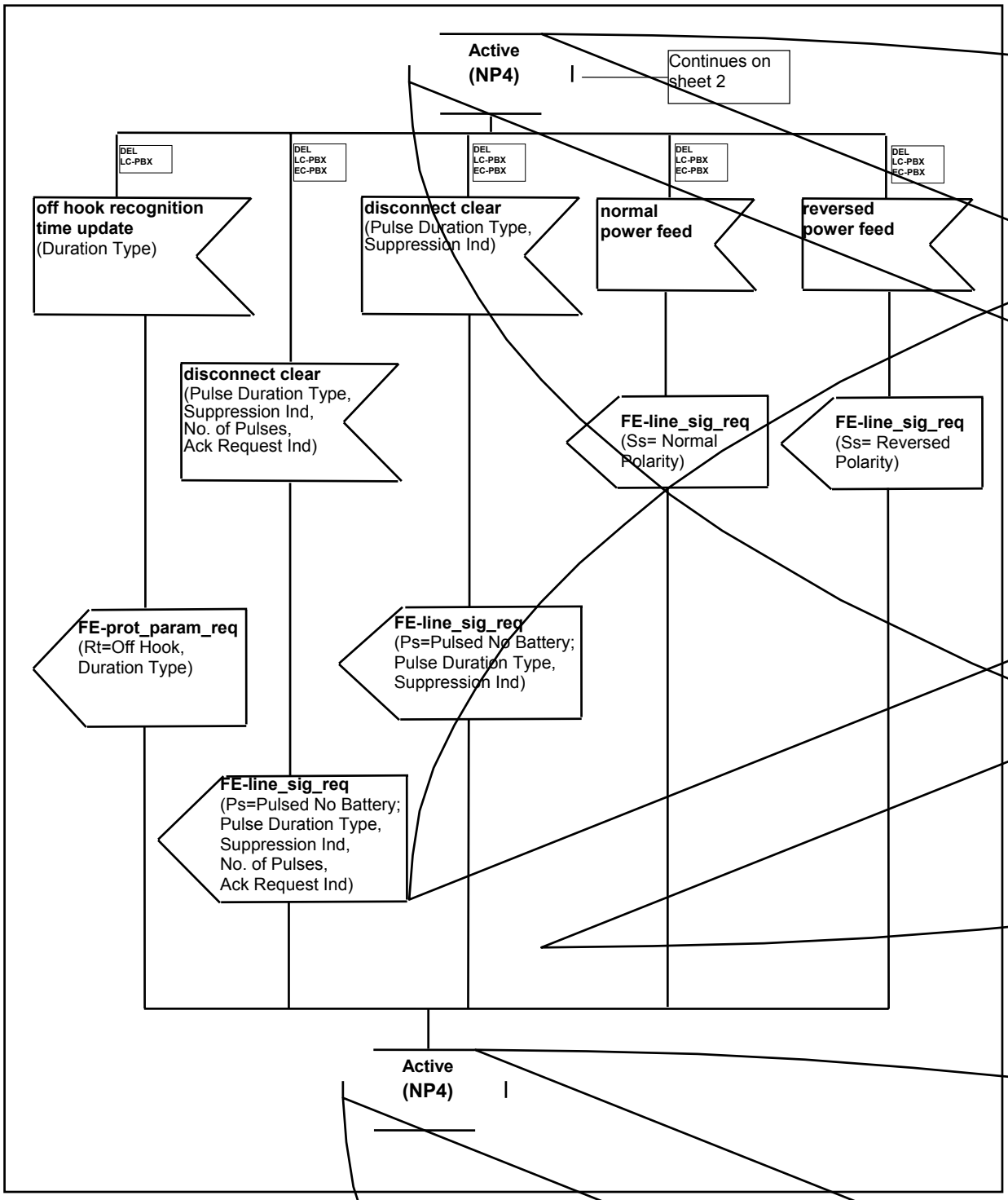



| CROSSOVER EVENT | DEL | LC-PBX | EC-PBX | DDI PBX |
|---|---|---|---|---|
| call arrival indication | Y | Y | Y | N |
| initial ring | Y | Y | N | N |
| normal power feed | Y | Y | Y | N |
| reversed power feed | Y | Y | N | N |
| ddi seize | N | N | N | Y |

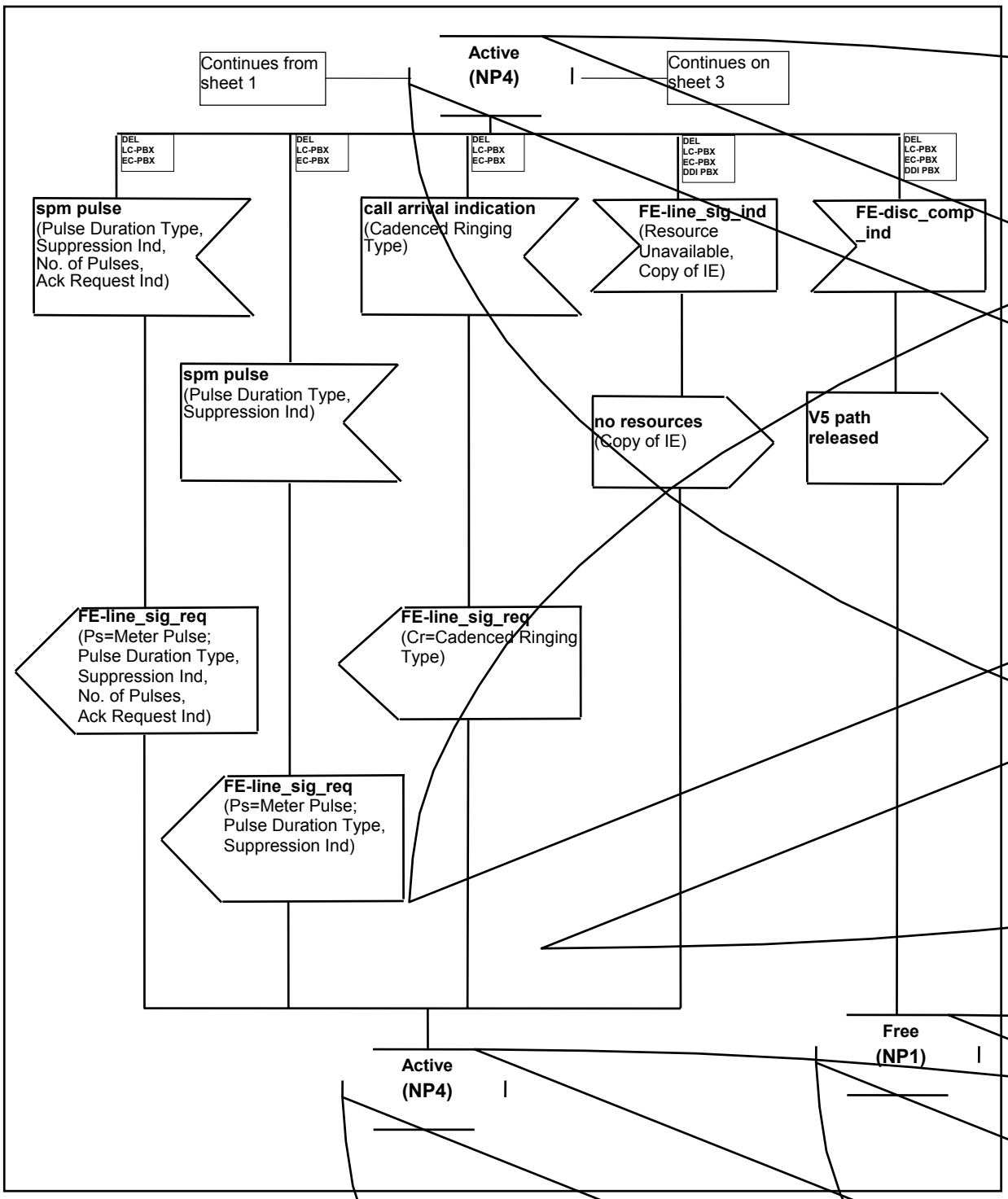
**National_PSTN_Protocol process:**
**State V5 Path Requested by AN (NP3) Sheet 1 of 2**



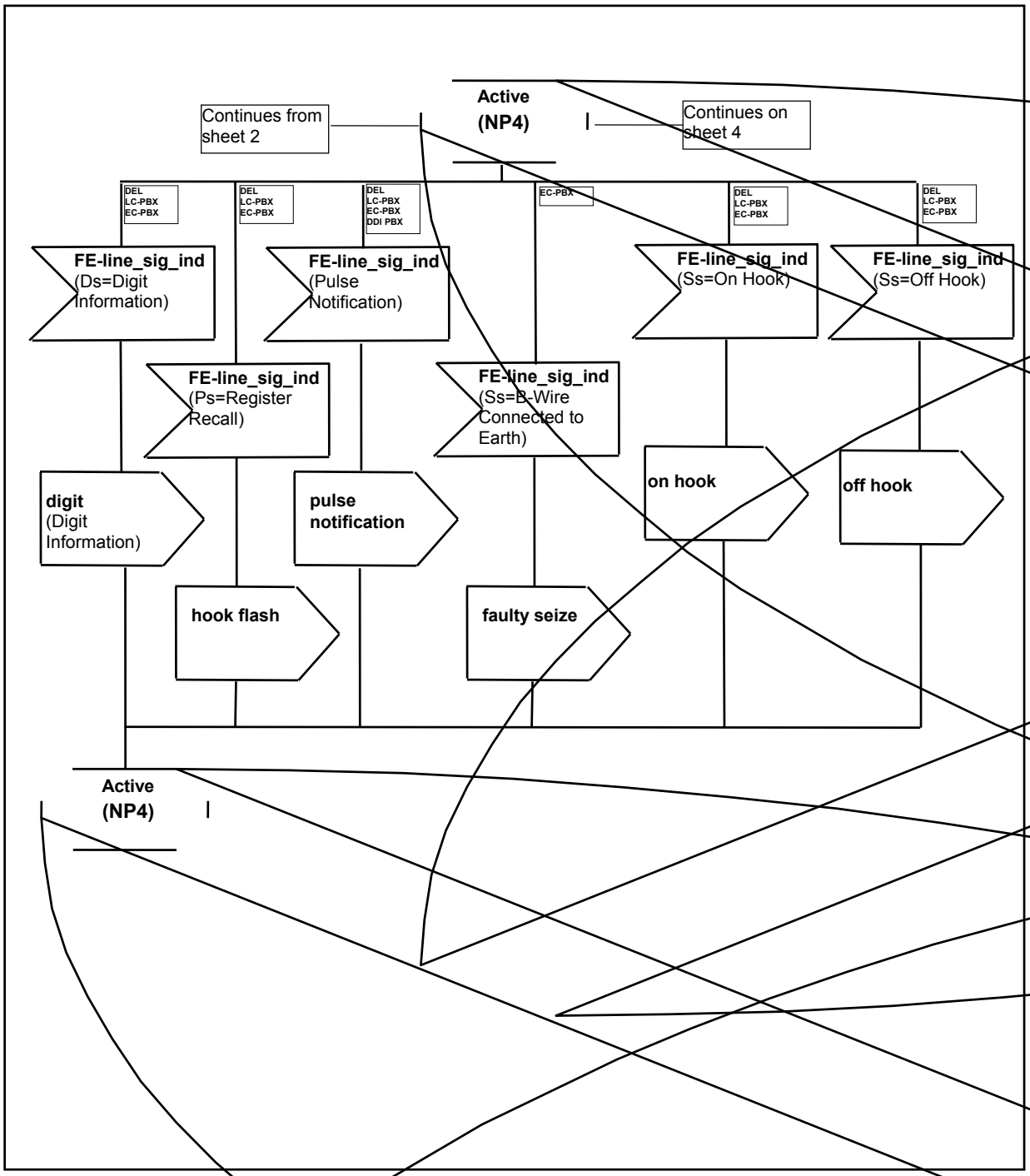

**National_PSTN_Protocol process:**
**State V5 Path Requested by AN (NP3) Sheet 2 of 2**



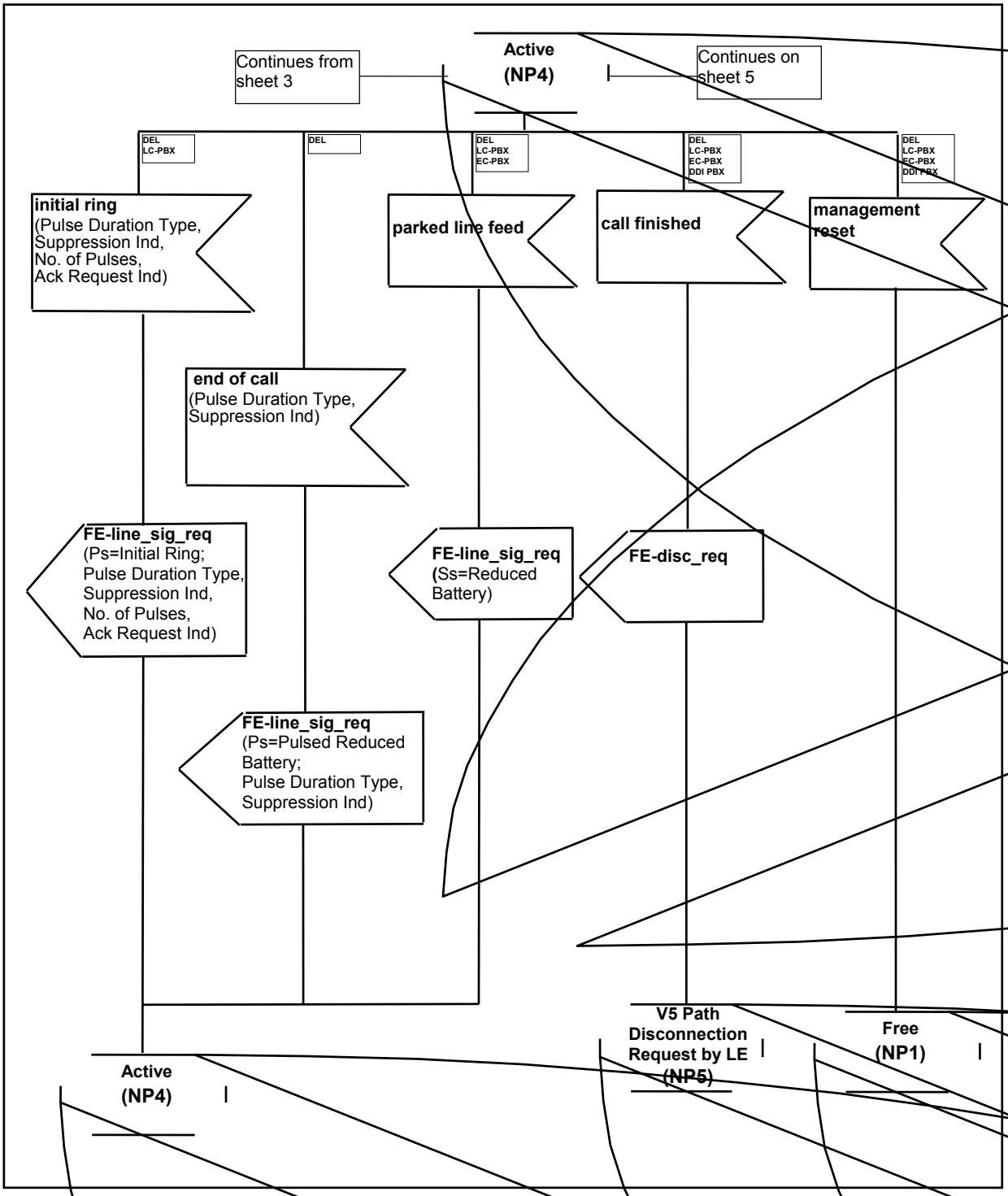

**National_PSTN_Protocol process:
State Active (NP4) Sheet 1 of 5**



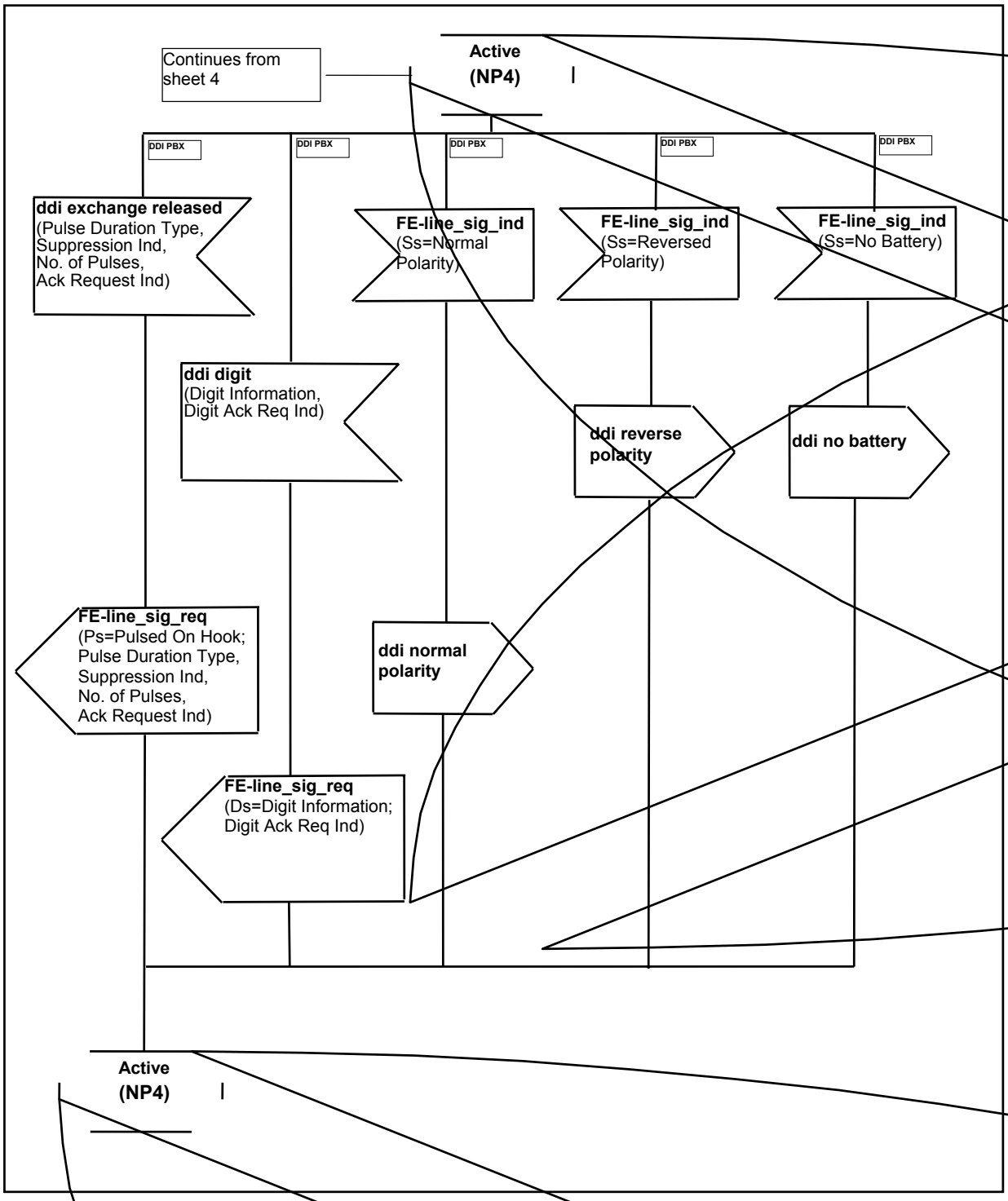

**National_PSTN_Protocol process:**
**State Active (NP4) Sheet 2 of 5**



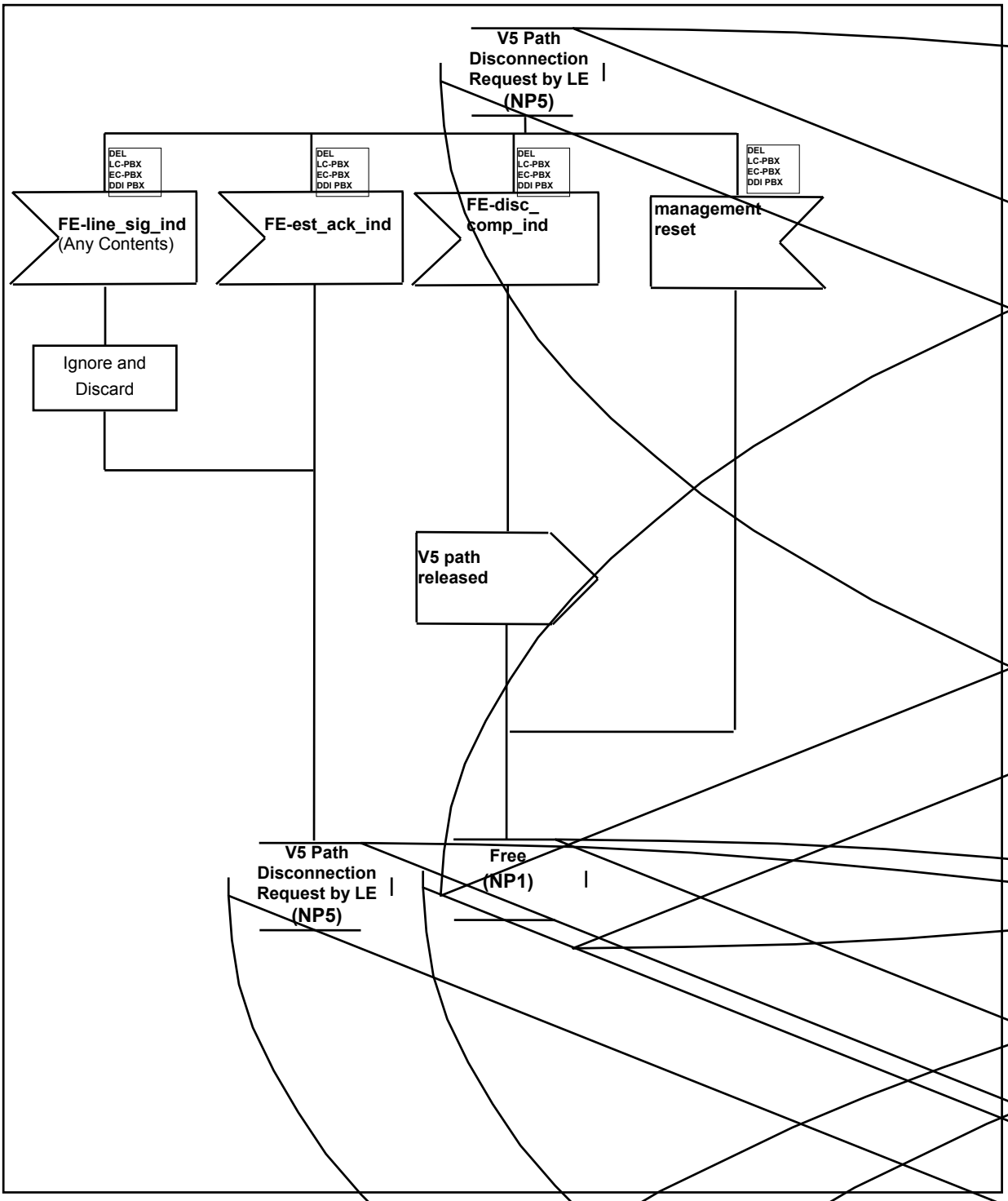

**National_PSTN_Protocol process:**
**State Active (NP4) Sheet 3 of 5**




**National_PSTN_Protocol process:**
**State Active (NP4) Sheet 4 of 5**




**National_PSTN_Protocol process:**
**State Active (NP4) Sheet 5 of 5**




**National_PSTN_Protocol process:**
**State V5 Path Disconnection Requested by LE (NP5) Sheet 1 of 1**

## 4.6. UK V5 CODING REQUIREMENTS

### 4.6.1.Coding of Information Elements

This Subclause gives the Information Elements and contents that may be used in the UK.

The relationships between Information Elements and Messages are described earlier in subclauses 4.2 to 4.5. The exception to this being the Cause and State IEs which are carried in the STATUS message and the Sequence-number IE which is carried in the SIGNAL, SIGNAL ACK and PROTOCOL PARAMETER messages.

The Information Elements that may be used are listed in Table 11.

Details of the permitted coding within the Information Elements are given 4.6.1.1 to 4.6.1.11.

The handling of error conditions is given in 4.6.2.

| Information Element | ETS 300 324-1 Reference | Reference within this document | Used in Clause | | | |
|---|---|---|---|---|---|---|
| | | | 5 | 6 | 7 | 8 |
| Pulse-notification | 13.4.6.1 | 4.6.1.1 | Y | Y | Y | Y |
| Line-information | 13.4.6.2 | 4.6.1.2 | Y | Y | Y | N |
| State | 13.4.6.3 | 4.6.1.3 | Y | Y | Y | Y |
| Sequence-number | 13.4.7.1 | 4.6.1.4 | Y | Y | Y | Y |
| Cadenced-ringing | 13.4.7.2 | 4.6.1.5 | Y | Y | Y | N |
| Pulsed-signal | 13.4.7.3 | 4.6.1.6 | Y | Y | Y | Y |
| Steady-signal | 13.4.7.4 | 4.6.1.7 | Y | Y | Y | Y |
| Digit-signal | 13.4.7.5 | 4.6.1.8 | Y | Y | Y | Y |
| Recognition-time | 13.4.7.6 | 4.6.1.9 | Y | Y | N | N |
| Cause | 13.4.7.9 | 4.6.1.10 | Y | Y | Y | Y |
| Resource-unavailable | 13.4.7.10 | 4.6.1.11 | Y | Y | Y | Y |

**Table 11 - V5 PSTN Protocol Information Elements used in the UK.**

#### 4.6.1.1. Pulse Notification

The Information Element is coded in accordance with ETS 300 324-1 [1].

#### 4.6.1.2. Line Information

The Information Element is coded in accordance with ETS 300 324-1 [1] with the following additional constraint.

- Only the Line Information parameters 'Impedance marker reset' (30kΩ loop removed by CPE) and 'Impedance marker set' (30kΩ loop applied by CPE) shall be valid.

#### 4.6.1.3. State

The Information Element is coded in accordance with ETS 300 324-1 [1].

#### 4.6.1.4. Sequence Number

The Information Element is coded in accordance with ETS 300 324-1 [1].

#### 4.6.1.5. Cadenced-Ringing

The Information Element is coded in accordance with ETS 300 324-1 [1] and includes the Cadenced ringing type field, which is coded as in Table 12.

| Bits<br>7 6 5 4 3 2 1 | Definition | Meaning |
|---|---|---|
| 0 0 0 0 0 0 0 | 0.4 sec ON, 0.2 sec OFF<br>0.4 sec ON, 2.0 sec OFF<br>which may be preceded by an<br>initial burst of<br>0.35 sec ON, 0.22 sec OFF | Normal ringing cadence. |
| Other values | Network operator specific - see Annex A | Network operator specific - see Annex A |

**Table 12 - Coding for Cadenced Ringing Type**

#### 4.6.1.6. Pulsed-Signal

The Information Element is coded in accordance with ETS 300 324-1 [1] with the following additional constraints.

Only the codings for the pulse types shown in Table 13 shall be valid.

| Bits<br>7 6 5 4 3 2 1 | Meaning |
|---|---|
| 1 1 1 1 0 1 1 | Pulsed Reduced Battery |
| 1 1 1 1 0 1 0 | Pulsed No Battery |
| 1 1 1 1 0 0 1 | Initial Ring |
| 1 1 1 1 0 0 0 | Meter Pulse |
| 1 1 1 0 1 1 0 | Register Recall |
| 1 1 1 1 1 0 0 | Pulsed On Hook |

**Table 13 - Coding for pulse Type**

The coding of octets 4 and 4a is pulse type specific and shall be in accordance with Table 14. Note in this table the value "X" is used to indicate that either value is valid.

| Pulse Type | Length of content<br>(Octets) | Pulse Duration Type<br>5 4 3 2 1 | Suppression Indicator<br>7 6 | Number of Pulses<br>5 4 3 2 1 | Ack Request Ind<br>7 6 |
|---|---|---|---|---|---|
| Pulsed Reduced Battery | 2 | as for Table 15 | 0 0 | N/A | N/A |
| Pulsed No Battery | 2 | as for Table 16 | 0 0 | N/A | N/A |
| Pulsed No Battery | 3 | as for Table 16 | 0 0 | 0 0 0 0 1 | X X |
| Initial Ring | 3 | As Table 17 | 1 0 | Any value | X X |
| Meter Pulse | 2 | 0 0 0 0 0<br>**(Note)** | 0 0 | N/A | N/A |
| Meter Pulse | 3 | 0 0 0 0 0<br>**(Note)** | 0 0 | Any value except<br>0 0 0 0 0 | X X |
| Register Recall | 1 | N/A | N/A | N/A | N/A |
| Pulsed On Hook | 3 | as for Table 18 | 1 0 | 0 0 0 0 1 | 0 1 |

**Note:** For SPM pulses in the UK this field conveys no information to the AN. Its value is fixed with all bits being "0" for validation / compatibility purposes only.

**Table 14 - Coding for Pulsed-signal octets 4 and 4a**

| Bits<br>5 4 3 2 1 | Pulse Duration | Comment |
|---|---|---|
| 0 0 0 0 0 | 100 ms pulse | Typical pulsed reduced battery pulse duration. |
| 0 0 0 0 1 | 100 ms pulse | Note 1. |
| 0 0 0 1 0 | 200 ms pulse | Note 1. |
| 0 0 0 1 1 | 300 ms pulse | Note 1. |
| 0 0 1 0 0 | 400 ms pulse | Note 1. |
| 0 0 1 0 1 | 500 ms pulse | Note 1. |
| 0 0 1 1 0 | 600 ms pulse | Note 1. |
| 0 0 1 1 1 | 700 ms pulse | Note 1. |
| 0 1 0 0 0 | 800 ms pulse | Note 1. |
| 0 1 0 0 1 | 900 ms pulse | Note 1. |
| 0 1 0 1 0 | 1sec pulse | Note 1. |
| 0 1 0 1 1 | zero duration pulse | Note 2. |
| Other values | Network operator specific | Note 3. |

**Table 15 - Coding for Pulse duration type for Pulsed reduced battery**

**Notes:** 1 The use of these values is network operator specific but they have been pre-assigned to ensure compatibility with the Pulsed-signal (Pulsed no battery) IE field.

2 The use of this value is network operator specific but has been pre-assigned to enable the same functionality to be achieved as is possible with the Pulsed-signal (Pulsed no battery) IE field.

3 The use of these values is network operator specific with no pre-assigned pulse duration.

| Bits<br>5 4 3 2 1 | Definition<br>(pulse duration) |
|---|---|
| 0 0 0 0 0 | Zero duration pulse |
| 0 0 0 0 1 | 100 ms pulse |
| 0 0 0 1 0 | 200 ms pulse |
| 0 0 0 1 1 | 300 ms pulse |
| 0 0 1 0 0 | 400 ms pulse |
| 0 0 1 0 1 | 500 ms pulse |
| 0 0 1 1 0 | 600 ms pulse |
| 0 0 1 1 1 | 700 ms pulse |
| 0 1 0 0 0 | 800 ms pulse |
| 0 1 0 0 1 | 900 ms pulse |
| 0 1 0 1 0 | 1sec pulse |
| Other values | Network operator specific |

**Table 16 - Coding for Pulse duration type for Pulsed no battery**

| Bits<br>5 4 3 2 1 | Definition | Meaning |
|---|---|---|
| 0 0 0 0 0 | 0.4 sec ON | Pulse of normal ringing. |
| 0 0 0 0 1 | 0.4 sec ON, 0.2 sec OFF | Pulse of normal ringing (including silence). |
| Other values | Network operator specific | Network operator specific - see Annex B for examples |

**Table 17 - Coding for Pulse duration type for Initial ring**

| Bits<br>5 4 3 2 1 | Definition<br>(pulse duration) |
|---|---|
| 0 0 0 0 0 | 1350ms |
| All other values | Network Operator Specific |

**Table 18 - Coding for Pulse Duration Type for Pulsed On Hook**

#### 4.6.1.7. Steady-Signal

The Information Element is coded in accordance with ETS 300 324-1 [1] with the following additional constraint.

Only the coding of Steady-signal types shown in Table 19 shall be valid.

| Bits 7 6 5 4 3 2 1 | Meaning |
|---|---|
| 0 0 0 0 0 0 0 | Normal Polarity |
| 0 0 0 0 0 0 1 | Reversed Polarity |
| 0 0 0 0 1 0 0 | Off-Hook |
| 0 0 0 0 1 0 1 | On-Hook |
| 0 0 0 1 0 1 0 | Reduced Battery |
| 0 0 0 1 0 1 1 | No Battery |
| 0 0 1 0 0 1 0 | B-Wire Connected to Earth |

**Table 19 - Coding for Steady-signal type**

#### 4.6.1.8. Digit-Signal

The Information Element is coded in accordance with ETS 300 324-1 [1] with the following clarifications.

- The digit acknowledge request indicator field shall be set to zero.
- The digit information field shall be coded as in Table 20.

| Bits 4 3 2 1 | Meaning |
|---|---|
| 0 0 0 1 | digit 1 |
| 0 0 1 0 | digit 2 |
| 0 0 1 1 | digit 3 |
| 0 1 0 0 | digit 4 |
| 0 1 0 1 | digit 5 |
| 0 1 1 0 | digit 6 |
| 0 1 1 1 | digit 7 |
| 1 0 0 0 | digit 8 |
| 1 0 0 1 | digit 9 |
| 1 0 1 0 | digit 0 |

**Table 20. Coding of Digit Information Field.**

#### 4.6.1.9. Recognition Time

This Information Element is coded in accordance with ETS 300 324-1 [1] with the following constraints.

Only the coding shown in Table 21 shall be valid.

| Bits | Meaning |
|---|---|
| 7 6 5 4 3 2 1 | |
| 0 0 0 0 1 0 0 | Off hook |

**Table 21 - Coding for Signal**

Only the coding for Duration Type shown in Table 22 shall be valid.

| Bits | Meaning |
|---|---|
| 6 5 4 3 2 1 | (Off-hook duration) |
| 0 0 0 0 0 0 | 50 ms |
| 0 0 0 0 0 1 | 100 ms |
| 0 0 0 0 1 0 | 150 ms |
| 0 0 0 0 1 1 | 200 ms |
| All other values | Network Operator Specific |

**Table 22 - Coding of Duration Type.**

#### 4.6.1.10. Cause

The Information Element is coded in accordance with ETS 300 324-1 [1].

#### 4.6.1.11. Resource Unavailable

The Information Element is coded in accordance with ETS 300 324-1 [1] with the following additional constraint.

The “Copy of information element with failed request” contained in the resource unavailable IE must be a Cadence-ringing IE, Pulsed-signal IE or Steady-signal IE as defined in 4.6.1.5 to 4.6.1.7 above.

### 4.6.2. Handling of Error Conditions

The error handling procedures defined in ETS 300 324-1 [1] shall apply with the following clarification to the definition of “unrecognised Information Elements” and “content errors of Information Elements”.

#### 4.6.2.1. Unrecognised Information Elements

Within ETS 300 324-1 [1] unrecognised information elements are specified as being:

“those that are not defined in the ETS, or are not implemented in supporting the national PSTN protocol”.

Within the UK there is a further layer of optionality allowed between Network Operators and consequently the following definition of unrecognised Information Elements applies within this specification.

“An Information Element is deemed to be unrecognised if it is not defined in SSPE/SPEC/001-1 clause 4.6 or is indicated as not supported in SSPE/SPEC/001-2 (PICS)”.

#### 4.6.2.2. Content Error of Manadatory / Optional Information Elements

Within ETS 300 324-1 [1] Information Element content errors are specified as being:

“codepoints included within a particular Information Element that are not defined within the ETS, or are not implemented in supporting the national PSTN protocol”.

Within the UK there is a further layer of optionality allowed between Network Operators and consequently the following definition of content error of Information Elements applies within this specification.

“An Information Element is deemed to have a content error if the codepoints included are not defined in SSPE/SPEC/001-1 clause 4.6 or are not defined as supported within the operator specific range of codepoints in SSPE/SPEC/001-2 (PICS)”.

# 5. DIRECT EXCHANGE LINE

## 5.1. INTRODUCTION

Clause 3 of this specification describes the method by which the UK PSTN V5 Mapping Requirements are specified using an assumed functional architecture based on a number of inter-acting processes (See Figure 2). A general outline description of the function of each process is also given in Clause 3.

This Clause of the Specification uses the method described in Clause 3 to detail the specific requirements necessary for a Direct Exchange Line application. This functionality is described in terms of the Analogue Port process and the Call Control process.

- Subclause 5.2 details the requirements for the Analogue Port process.
- Subclause 5.3 details the requirements for the Call Control process.
- Subclause 5.4 contains a number of valid call cases in the form of Message Sequence Charts (MSCs).

## 5.2. ANALOGUE PORT PROCESS

This Subclause describes the Direct Exchange Line requirements for the Analogue Port process.

Throughout Clause 5 the term “Analogue Port process” shall be taken to mean “Analogue Port process for the Direct Exchange Line application”.

The Analogue Port process is responsible for:

- Detecting and Validating the analogue signals from the 2-wire analogue Direct Exchange Line and once validated converting them into internal “analogue line primitives” that are sent to the AN_PSTN_User_Port process.
- Applying analogue signals and conditions to the 2-wire analogue Direct Exchange Line on receipt of internal analogue line primitives.
- Generating and responding to a number of internal analogue control primitives to and from the AN_PSTN_User_Port process.
- Responding to a number of management primitives from the AN Management process.
- Performing the Autonomous actions detailed in 5.2.3.

The external analogue signals and conditions for a DEL are given in 5.2.1.

The analogue line primitives, analogue control primitives and analogue management primitives are detailed in 5.2.2

### 5.2.1. Analogue Signals and Conditions

The terms given in this specification to the external analogue signals and conditions used for the Direct Exchange Line (Interface [A]) are given in Tables 23 and 24 along with a brief description of their use.

Although the precise characteristics of the external analogue signals and conditions are outside the scope of this specification, some examples of possible characteristics are given in Tables 23 and 24 as an informative description in order to assist general understanding. Reference is also made to other related specifications where available.

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **ON-HOOK** | The On-Hook signal is a very high resistance applied across the A and B wires by the CPE to indicate that it is free to accept incoming calls. | BS 6305 [3], 4.1 and 4.2 |
| **OFF-HOOK** | The Off-Hook signal is a relatively low resistance that is applied across the A and B wires of a line by CPE in order to make an outgoing call or to accept an incoming call (i.e. to trip the Call Arrival Indication). | |
| **3OkΩ LOOP** | The application of a 30kΩ resistance across the A and B wires by the CPE. The 30kΩ loop does not constitute an Off-Hook and has no effect on the normal operation of the line when making or receiving calls. A typical use of the 30kΩ loop is to cause the exchange to divert normal incoming calls to another line, while allowing incoming calls that use a special "By-Pass" number. | |
| **DIGITS** | Digits are sent by the CPE in the form of disconnect pulses during Off-Hook. The Digit Signals are typically one to ten pulses sent at a speed of 10 pulses per second.<br>If the CPE sends "DTMF digits", they are carried inband to the Local Exchange and do not give rise to any V5 signalling. | BS 6305 [3], 4.4.2 and 4.4.3 |
| **REGISTER RECALL** | Register Recall is a single disconnect pulse sent by the CPE during an active call to indicate that the exchange should reconnect a digit receiver (normally DTMF) to the line.<br>Within the UK the Register Recall pulse duration overlaps with that of a dialled digit 1 and the signal is therefore conveyed over V5 as a Digit 1. | BS 6305 [3], 4.4.4.1 |
| **HOOK FLASH** | Hook Flash is a single disconnect pulse sent by the CPE during an active call to either indicate that the exchange should reconnect a digit receiver (normally DTMF) to the line or to signify feature invocation. It is typically invoked by a subscriber by manually depressing the hook switch on a telephone set for a small amount of time. The duration of the Hook Flash signal must be longer than a digit "1" and shorter than the On-Hook validation period. | |

**Table 23 - Analogue Signals Received by the Analogue Port**

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **NORMAL POWER FEED** | Normal Power Feed is the condition applied by the Analogue Port process during free and speech. Typically the electrical characteristics of Normal Power Feed is that the potential of the A-Wire is positive with respect to the B-Wire. | |
| **REVERSED POWER FEED** | Reversed Power Feed is a reversal of the Normal Power Feed. This condition can be used to indicate to the Calling Party that the Called Party has answered. It may also be used on incoming calls to "wake up" special CPE without applying ringing to the line (e.g. for calling number display). | |
| **SPM PULSES** | SPM Pulses are pulses generated by the Analogue Port process in order to increment a meter within the CPE. The SPM pulses are inaudible to the user and may be sent during an active call. Typical electrical characteristics of an SPM pulse are:<br>• 50 Hz longitudinal voltage<br>• 16 kHz transverse voltage | |
| **DISCONNECT CLEAR** | The Disconnect Clear signal is a short disconnection of either the "Normal Power Feed" or the "Reversed Power Feed" applied by the Analogue Port process. On completion of the Disconnect Clear Signal the Analogue Port process applies Normal Power Feed regardless of the line condition that existed prior to sending the signal<br>The Disconnect Clear signal is normally used in response to an On-Hook from the CPE to indicate that the Local Exchange has accepted the On-Hook and has cleared the call. | |
| **INITIAL RING** | The Initial Ring signal is a single pulse of AC voltage applied to the CPE by the Analogue Port process. This signal is typically used as a "Wake Up" signal to special CPE, (e.g. Number Display equipment) or to indicate that an incoming call has been forwarded. | |

**Table 24 - Analogue Signals and Conditions sent by the Analogue Port (Continues on next page)**

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **END OF CALL** | The End of Call signal is a short disconnection of either the "Normal Power Feed" or the "Reversed Power Feed" applied by the Analogue Port process. On completion of the End Of Call signal the Analogue Port process shall, as an implementation option, either:<br>a) Apply the electrical condition that existed prior to sending the signal. or<br>b) Apply Normal Power Feed regardless of the line condition that existed prior to sending the signal<br>The End Of Call signal is used, while the CPE is applying an Off-Hook signal, to indicate that the network has released the call towards the other user. Typical examples could be:<br>• To indicate to the Called CPE that the Calling Party has cleared.<br>• To indicate to the Calling CPE that the Called Party has cleared and that the CSH Timer has expired.<br>• To indicate to the Calling CPE that the outgoing call has been released due to no reply. | |
| **PARKED LINE FEED** | Parked Line Feed is a reduced power feed which may be applied to a line where the CPE continues to send an Off-Hook signal although no other party is involved in the call. The reduced power is sufficient to enable the Analogue Port process to monitor for On-Hook from the CPE. | |
| **CALL ARRIVAL INDICATION** | Call Arrival Indication is the signal applied by the Analogue Port process to alert the CPE. Typically the Call Arrival Indication comprises pulses of AC voltage superimposed on a DC voltage, the pattern of the AC pulses is known as the "cadence". The DC voltage is often the opposite polarity to the Normal Power Feed and is used to enable the Analogue Port process to detect an Off-Hook signal from the CPE. When an Off-Hook signal is detected, the Analogue Port process removes the Call Arrival Indication and applies Normal Power Feed. | BS 6305 [3], Annex C.3 |

**Table 24 (Continued) - Analogue Signals and Conditions sent by the Analogue Port**

## 5.2.2. ANALOGUE PRIMITIVES

### 5.2.2.1. Analogue Line Primitives

The analogue line primitives that are passed between the Analogue Port process and the AN_PSTN_User_Port process (Interface [b]) have the same names as their external equivalent but are shown in lower case (see Table 25). Some of the analogue line primitives contain additional instructions for the Analogue Port, e.g. Duration of Pulse.

Not all Analogue Signals have a Line Primitive equivalent, i.e.:

- 30kΩ Loop Signal which is reported to the AN_PSTN_User_Port by means of the analogue control primitive "30kΩ loop change", see Table 27.
- Register Recall Signal which is reported as a Line Primitive "digit 1".

| ANALOGUE SIGNAL at Interface [A] | Analogue Primitive at Interface [b] and [f] | |
|---|---|---|
| | Primitive Name | Additional Instructions |
| ON-HOOK | on hook | none |
| OFF-HOOK | off hook | none |
| 30kΩ LOOP | See 5.2.2.2, Table 27 | on/off |
| DIGITS | digit | Digit Information |
| REGISTER RECALL | digit | Digit Information = 1 |
| NORMAL POWER FEED | normal power feed | none |
| REVERSED POWER FEED | reversed power feed | none |
| END OF CALL | end of call | Pulse Duration Type,<br>Suppression Indicator |
| DISCONNECT CLEAR | disconnect clear | Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind<br>or<br>Pulse Duration Type,<br>Suppression Indicator |
| PARKED LINE FEED | parked line feed | none |
| CALL ARRIVAL INDICATION | call arrival indication | Cadenced Ringing Type |
| INITIAL RING | initial ring | Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind |
| SPM PULSES | spm pulse | Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind<br>or<br>Pulse Duration Type,<br>Suppression Indicator |
| HOOK FLASH | hook flash | none |

**Table 25 - Analogue Primitives Used for a DEL**

#### 5.2.2.2. Analogue Control Primitives

A number of analogue control primitives are passed between the Analogue Port process and the AN_PSTN_User_Port process (Interface [b]).

The analogue control primitives along with a short description of their function are given in Tables 26 and 27.

| Analogue Control Primitive | Description |
|---|---|
| **call finished** | This analogue control primitive is used to reset the Analogue Port process to the free state. In the free state the Analogue Port process will apply Normal Power Feed to the A and B wires, all timers are cancelled and the off-hook recognition time is returned to the default value. |
| **off-hook recognition time update** | This analogue control primitive is sent by the LE to modify the period that an Off-Hook condition must exist on the A & B wires before the Analogue Port process accepts it and sends an off-hook primitive to the AN_PSTN_User_Port process. |
| **30kΩ change acknowledge** | This analogue control primitive notifies the Analogue Port process that the last "30kΩ Loop Change" primitive sent to the LE has been received and acted upon. |
| **LE acknowledge** | This analogue control primitive notifies the Analogue Port process that an off-hook primitive sent towards the LE has been received and accepted by the LE Call Control process. |

**Table 26 - Control Primitives Received by the Analogue Port**

| Analogue Control Primitive | Description |
|---|---|
| **30kΩ loop change** | This analogue control primitive is sent by the Analogue Port process to notify the LE that the 30kΩ loop status has changed from that last reported. The status can only be checked when the Analogue Port process is in the free state, the primitive is not sent if no change has occurred when the Analogue Port process returns to free.<br><br>This primitive is also sent following a restart of the AN. |
| **pulse notification** | This analogue control primitive is sent by the Analogue Port process to notify the LE that the previously requested Pulsed Signal has been applied to the A and B wires.<br><br>The Analogue Port process will only generate a pulse notification primitive if the pulsed signal primitive contained an Ack Request Ind indicating that an acknowledgement is required.<br><br>If a pulse ends in a silent period then the pulse notification is sent on completion of the silent period. |
| **analogue port acknowledge** | This analogue control primitive is sent by the Analogue Port process to indicate that the electrical condition associated with one of the following analogue line primitives has been applied to the A and B wires;<br><br>• normal power feed<br>• reverse power feed<br>• call arrival indication<br>• initial ring<br><br>**NOTE:** The V5 Protocol (Interface[D]) can only transport the analogue port acknowledge primitive as an ESTABLISH ACK message. Consequently, if the Information Elements associated with the above analogue line primitives are not received in an ESTABLISH message, the analogue port acknowledge primitive cannot be transferred via the V5 link. |
| **no resources** | This analogue control primitive is sent by the Analogue Port process to indicate that it cannot complete the action requested by the LE. This may be due to unavailability of resources or because the Analogue Port process is still sending a pulsed signal (e.g. SPM) for the previous call.<br><br>**NOTE:** When the Analogue Port process is situated in a V5 AN and the request that cannot be completed was conveyed in a ESTABLISH message, the no resources primitive may result in a DISCONNECT message being sent. Under these circumstances the LE will interpret the message as meaning “V5 path released” rather than “no resources”. |

**Table 27 - Control Primitives Sent by the Analogue Port**

#### 5.2.2.3. Analogue Management Primitives.

A number of analogue management primitives are passed from the AN management process to the Analogue Port process (Interface [i]).

The analogue management primitives along with a short description of their function are given in Table 28.

| Analogue Management Primitive | Description |
|---|---|
| **Block** | The Block primitive is used to prevent incoming and outgoing calls to and from the Analogue Port process. This may be achieved by the Analogue Port process denying power to the A and B wires, so that no service can be provided. |
| **Unblock** | The Unblock primitive is used to remove a previously applied Blocking condition and to return the Analogue Port process back to its free state, so that service can be provided. |
| **Restart** | The Restart primitive is used to place an Analogue Port process that is not Blocked into the free state. |

**Table 28 - Analogue Management Primitives**

### 5.2.3. Autonomous Actions of the Analogue Port Process

The subsequent sub-clauses describe the autonomous actions performed by the Analogue Port for a Direct Exchange Line.

#### 5.2.3.1. Whilst a Pulsed Signal is being applied

This sub-clause describes the autonomous actions performed whilst a pulsed signal is being applied. A pulsed signal is deemed to be in the process of being applied until all pulses requested in the associated analogue line primitive have been applied for the specified duration. Similar pulses requested in a subsequent analogue line primitive will be treated as a new pulsed signal.

##### 5.2.3.1.1. Receipt of an analogue line or control primitive

The primitive shall be stored and the pulsed signal continues

##### 5.2.3.1.2. Receipt of a management primitive

The Analogue Port process performs one of the following actions:

a) the primitive is stored and the pulsed signal continues.

or

b) the pulsed signal is truncated without the generation of a pulse notification primitive, all stored primitives are discarded and the management primitive is processed in accordance with the procedures (including the autonomous actions) defined for the receipt of the primitive whilst a pulsed signal is not being applied.

#### 5.2.3.1.3. Receipt of any External Analogue Signal

The actions performed are based on the suppression indicator in the previously received pulsed signal primitive;

a) “no suppression” - If the call is still in progress (i.e. a call finished, restart or block primitive not received), then the external analogue signal shall be processed normally without disrupting the pulsed signal (e.g. ON-HOOK during SPM PULSES). If the call is no longer in progress (i.e. a call finished, restart or block primitive has been received), then the external analogue signal shall be ignored and the pulsed signal shall not be disrupted (e.g. OFF-HOOK during SPM PULSES).

b) “suppression allowed by pre-defined signal from CPE” - If the external signal is pre-defined as “allowed to suppress the pulsed signal” (see note), then it shall be processed normally and the pulsed signal shall be truncated and no pulse notification primitive shall be sent (e.g. OFF-HOOK during INITIAL RING). Otherwise, the analogue signal shall be processed normally without disrupting the pulsed signal.

Note: Within this specification the only suppression allowed by a pre-defined signal for a DEL is that an OFF-HOOK signal shall suppress an INITIAL RING signal.

#### 5.2.3.1.4. Receipt of a new incoming call

The incoming call shall be rejected by sending the analogue control primitive “no resources” to the AN_PSTN_User_Port process.

Note: This situation can occur under fault conditions when the LE considers the Analogue Port to be free, but it is busy within the AN (e.g. call arrival indication received whilst SPM PULSES are being applied).

### 5.2.3.2. When a Pulsed Signal completes or is truncated

On completion or truncation of a pulsed signal the actions specified in 5.2.3.2.1 followed by 5.2.3.2.2 below shall be performed.

#### 5.2.3.2.1. Application of Steady Signal

a) If the completed pulsed signal is a DISCONNECT CLEAR, then the Analogue Port process shall autonomously apply NORMAL POWER FEED.

b) If the completed pulsed signal is an END OF CALL signal, then the Analogue Port process shall perform one of the following;

   I. autonomously apply NORMAL POWER FEED.
   or

   II. re-apply the steady signal that was present immediately preceeding the application of the pulsed signal.

c) For any other pulsed signal, the Analogue Port process shall re-apply the steady signal which was present immediately preceeding the application of the pulse.

#### 5.2.3.2.2. Handling of Stored Primitives

Any analogue line, control or management (in the case where 5.2.3.1.2.a is supported) primitives that were stored during the sending of the pulsed signal shall be processed in the order that they were received and in accordance with the procedures (including the autonomous actions) defined for the receipt of the primitive whilst a pulsed signal is not being applied.

### 5.2.3.3. Receipt of Call Finished primitive while a pulsed signal is not being applied

The action of the Analogue Port process is dependant on the setting of the disconnect clear primitive indicator and whether the CPE is applying an ON-HOOK or OFF-HOOK signal.

#### 5.2.3.3.1.Disconnect Clear Primitive Indicator = Received

a) If the CPE is applying an ON-HOOK then the Analogue Port process shall reset all line conditions and recognition times to their pre-defined default values, set the disconnect clear primitive indicator to “not received” and return to the free state.

b) If the CPE is applying an OFF-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values and set the disconnect clear primitive indicator to “not received”.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, send an off hook primitive to the AN_PSTN_User_Port process if the CPE is still applying OFF-HOOK. Otherwise, if the CPE is applying ON-HOOK, then the free state is entered.

#### 5.2.3.3.2.Disconnect Clear Primitive Indicator = Not Received

a) If the CPE is applying an ON-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values.

II. Optionally send a DISCONNECT CLEAR signal for the pre-defined duration.

III. If a DISCONNECT CLEAR is applied, then return to the free state when the pulse completes. Otherwise immediately return to the free state.

b) If the CPE is applying an OFF-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, send an off hook primitive to the AN_PSTN_User_Port process if the CPE is still applying OFF-HOOK. Otherwise, if the CPE is applying ON-HOOK, then the free state is entered.

#### 5.2.3.4. Receipt of Restart management primitive while a pulsed signal is not being applied

The action of the Analogue Port process is dependant on whether the port is blocked, the setting of the Disconnect Clear Primitive Indicator and whether the CPE is applying an ON-HOOK or OFF-HOOK signal.

If the port is blocked then the Analogue Port process takes no action. If the port is not blocked the Analogue Port process shall act as follows:

##### 5.2.3.4.1.Disconnect Clear Primitive Indicator = Received

a) If the CPE is applying an ON-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values and set the disconnect clear primitive indicator to “not received”.

II. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

III. If 30kΩ loop capability is not supported, then the free state is entered.

b) If the CPE is applying an OFF-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values and set the disconnect clear primitive indicator to “not received”.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal the Analogue Port process shall perform either (i) or (ii), followed by (iii).

i. If the CPE is still applying OFF-HOOK, then send an off hook primitive to the AN_PSTN_User_Port process.

ii. If the CPE is applying ON-HOOK, then enter the free state.

iii. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity on return to the free state. This action is performed irrespective of whether or not the AN_PSTN_User _Port process has previously been notified of the 30kΩ loop status.

##### 5.2.3.4.2.Disconnect Clear Primitive Indicator = Not Received

a) If the CPE is applying an ON-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values.

II. Optionally send a DISCONNECT CLEAR signal for the pre-defined duration.

III. If a DISCONNECT CLEAR signal is applied, then the following actions are performed upon completion of the pulsed signal. Otherwise the actions are performed immediately:

i. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

ii. If 30kΩ loop capability is not supported, then return to the free state.

b) If the CPE is applying an OFF-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR . signal the Analogue Port process shall perform either (i) or (ii), followed by (iii).

i. If the CPE is still applying OFF-HOOK, then send an off hook primitive to the AN_PSTN_User_Port process.

ii. If the CPE is applying ON-HOOK, then enter the free state.

iii. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity on return to the free state. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

#### 5.2.3.5. Receipt of Block management primitive while a pulsed signal is not being applied

The action of the Analogue Port process is dependant on the setting of the Disconnect Clear Primitive Indicator and whether the CPE is applying an ON-HOOK or OFF-HOOK signal.

##### 5.2.3.5.1.Disconnect Clear Primitive Indicator = Received

a) If the CPE is applying an ON-HOOK then the Analogue Port process shall set the disconnect clear primitive indicator to “not received” and block the port to incoming and outgoing calls.

b) If the CPE is applying an OFF-HOOK then the Analogue Port process shall:

I. Set the disconnect clear primitive indicator to “not received”.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, the port shall be blocked to incoming and outgoing calls.

##### 5.2.3.5.2. Disconnect Clear Primitive Indicator = Not Received

a) If the CPE is applying an ON-HOOK then the Analogue Port process shall:

I. Optionally send a DISCONNECT CLEAR signal for the predefined duration.

II. If a DISCONNECT CLEAR signal is applied, then block the port to incoming and outgoing calls upon completion of the signal. Otherwise immediately block the port to incoming and outgoing calls.

b) If the CPE is applying an OFF-HOOK then the Analogue Port process shall:

I. Send a DISCONNECT CLEAR signal for the predefined duration.

II. Block the port to incoming and outgoing calls upon completion of the signal.

#### 5.2.3.6. General autonomous actions

This sub-clause describes the general autonomous actions which are not covered in the previous clauses.

##### 5.2.3.6.1. Receipt of DIGITS in any valid state

a) If a DIGIT signal in excess of 10 pulses is received from the CPE, the Analogue Port process shall ignore and discard the digit signal. The AN may report the occurrence to the AN Management process.

b) If a DIGIT signal is received from the CPE whilst the Analogue Port process is awaiting an LE acknowledge control primitive, then the DIGIT signal shall be discarded.

##### 5.2.3.6.2. Receipt of OFF-HOOK during the application of CALL ARRIVAL INDICATION

The CALL ARRIVAL INDICATION shall be removed and NORMAL POWER FEED shall be applied.

##### 5.2.3.6.3. Receipt of external 30 kΩ loop signal in any valid state

The 30kΩ loop status shall only be reported to the AN_PSTN_User_Port process when the port is in the free state (i.e. ON-HOOK is being received and no call is present).

##### 5.2.3.6.4. Receipt of steady signal primitive in any valid state

The Analogue Port process shall apply the steady line condition indicated by the primitive. If the same steady condition as that already being applied is requested, then the Analogue Port shall make no detectable change to the 2-wire analogue line.

##### 5.2.3.6.5. Receipt of call arrival indication primitive in any valid state

The Analogue Port process shall apply the cadenced ringing type indicated by the call arrival primitive. If the same cadenced ringing type as that already being applied is requested, then the CALL ARRIVAL INDICATION shall continue with no detectable change.

##### 5.2.3.6.6. Receipt of any analogue line primitive in any valid state which requires additional AN resources

If upon receipt of an analogue line primitive requiring AN resources (e.g. call arrival indication requiring a ringer) those resources are unavailable, then a “no resources” control primitive shall be sent to the AN_PSTN_User_Port process.

##### 5.2.3.6.7. Receipt of analogue management primitive Unblock whilst the port is blocked

The Analogue Port process shall remove blocking to incoming and outgoing calls, reset all line conditions and recognition timers to their pre-defined default values and return to the free state. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

**5.2.3.6.8. Receipt of REGISTER RECALL or HOOK FLASH whilst awaiting an LE acknowledge**

The REGISTER RECALL or HOOK FLASH signal is discarded and the Analogue Port process remains in the current state.

**5.2.3.6.9. Setting of the Disconnect Clear Primitive Indicator**

On receipt of a disconnect clear primitive the Analogue Port process sends a DISCONNECT CLEAR signal and sets the disconnect clear primitive indicator to "received".

**5.2.3.7. General error handling autonomous actions**

This sub-clause describes the autonomous action performed as a result of applying the general error handling procedures.

**5.2.3.7.1. Receipt of unrecognised analogue primitives**

If the Analogue Port process receives an analogue primitive not defined in Tables 25 and 26 or is not supported by the AN, then the primitive shall be discarded and optionally a report of the occurrence may be sent to the AN Management process.

**5.2.3.7.2. Receipt of unexpected analogue primitives**

If an unexpected analogue primitive is received (i.e. not valid for the current state), then the primitive shall be discarded and optionally a report of the occurrence may be sent to the AN Management process.

## 5.3. CALL CONTROL PROCESS

This Subclause describes the Direct Exchange Line requirements for the Call Control process.

Throughout Clause 5 the term " Call Control process" shall be taken to mean "Call Control process for the Direct Exchange Line application".

The Call Control process represents the call control within the Local Exchange and contains the "National Protocol Entity" referred to in clause 13.1 of ETS 300 324-1 [1].

The Call Control process is responsible for:

- Controlling the establishment and release of calls both to directly connected analogue lines and analogue lines that are served via a V5 Interface.
- Generating and responding to internal analogue line primitives and analogue control primitives to /from the National_PSTN_Protocol process.
- Responding to a number of Analogue Management Primitives from the LE Management process.
- Responding to the V5 control primitive "V5 path released". This is described in 5.3.1.3.

### 5.3.1. Analogue Primitives

#### 5.3.1.1. Analogue Line Primitives

The analogue line primitives passed between the Call Control process and the National_PSTN_Protocol process [Interface "f"] are the same as those that appear at Interface [b], see 5.2.2.1. The values assigned by the Call Control process to the additional instructions e.g. Pulse Duration Type are the same whether a customer line is directly connected to the LE or is served via V5 and consequently is outside the scope of this specification.

#### 5.3.1.2. Analogue Control Primitives

The analogue control primitives passed between the Call Control process and National_PSTN_Protocol process [Interface "f"] are the same as those that appear at Interface [b], see 5.2.2.2.

#### 5.3.1.3. V5 Path Released Primitive

The "V5 path released primitive" is used to indicate to the call control that the V5 Path has been released and that the user port should be marked as free by the LE. The primitive is normally generated by the National PSTN Protocol process as a result of receipt of a DISCONNECT or DISCONNECT COMPLETE message from the AN.

### 5.3.2. Operation of the Call Control Process

The operation of the Call Control process is the same whether a customer's line is directly connected to the Local Exchange or is served via V5. Consequently the services provided and the manner in which the exchange controls those services is outside the scope of this specification. However a number of valid call cases are shown in the form of Message Sequence Charts in Subclause 5.4 of this specification.

## 5.4. MESSAGE SEQUENCE CHARTS FOR A DEL

The message sequences given in this Subclause are valid for certain call cases, they should not be a constraining factor for services.

The following assumptions are made within the MSCs

a. SIGNAL ACK messages are excluded from the MSCs but shall be sent in accordance with ETS 300 324-1 [1].

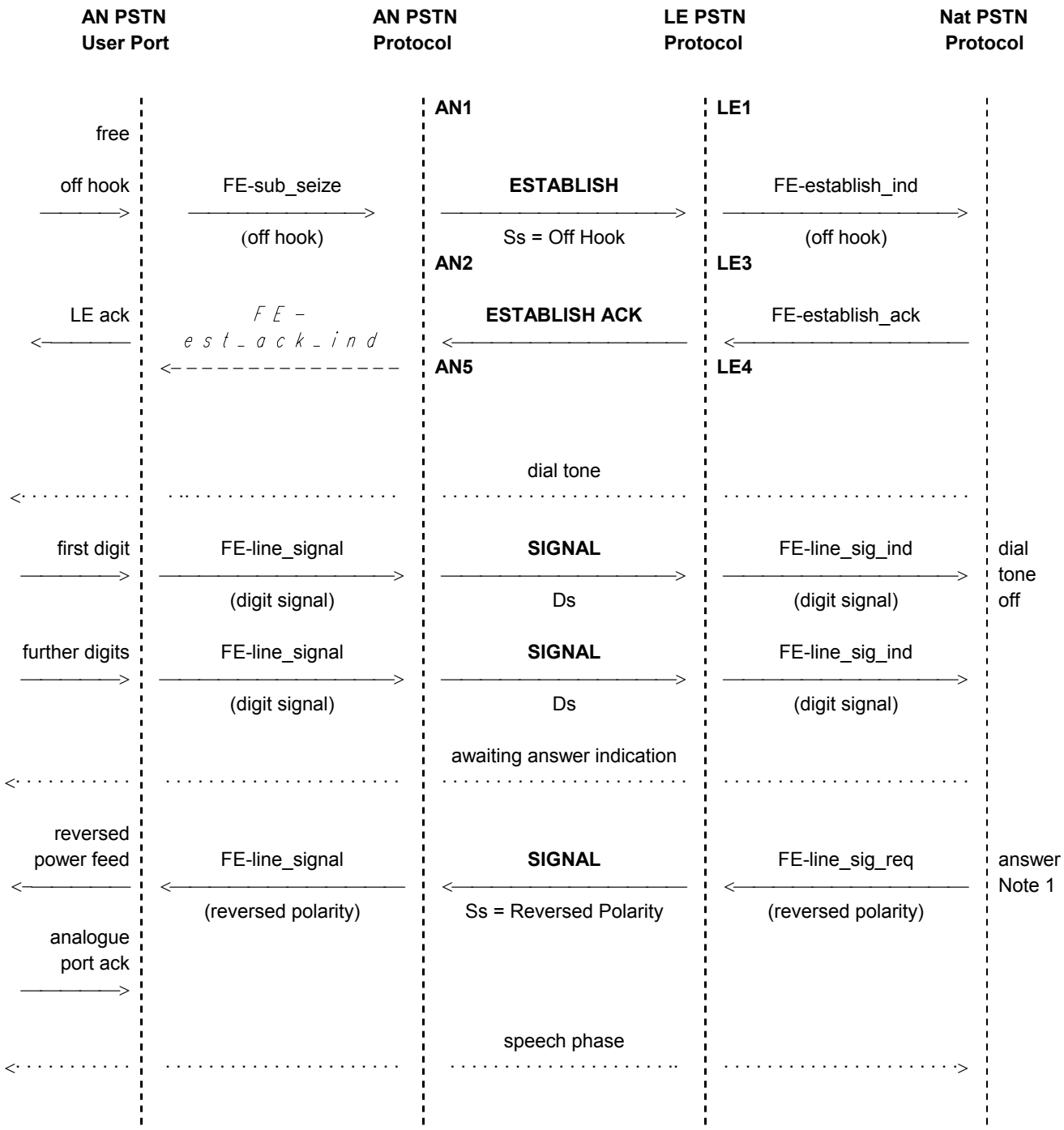
b. The inputs to the AN_PSTN_User_Port process from the customer side are primitives from the Analogue Port process.

c. Function Elements shown in italics are not defined in the standard for V5.1 but the functions they cause are. They are therefore deemed necessary to demonstrate how the function might be achieved but should not constrain an implementation.

d. If no Information Elements are shown in the brackets under a message on the V5 interface then the message carries no optional IEs.

## 5.4.1. DEL - SUCCESSFUL CALLS

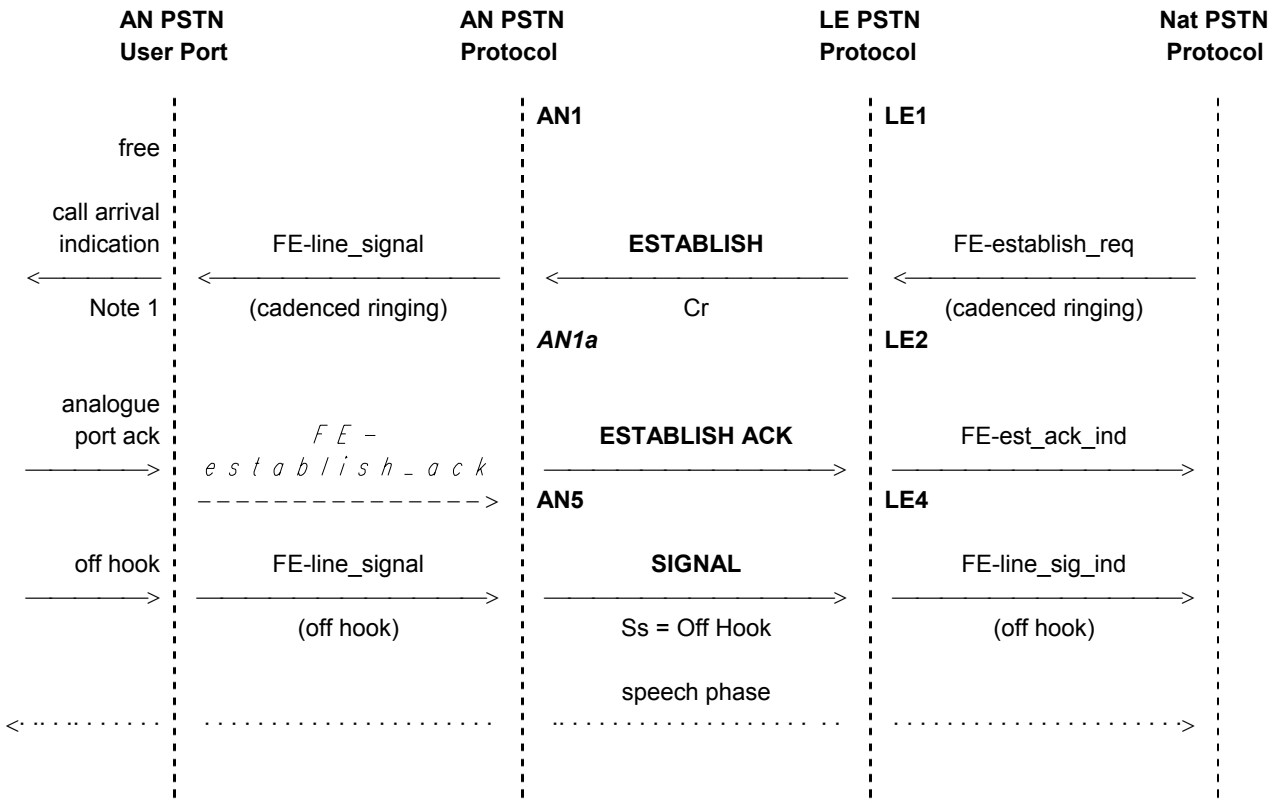
### 5.4.1.1. DEL - SUCCESSFUL Call (O/G Call including answer): 'A' end




**NOTES**

1. This message is only sent if the analogue port is provisioned for it within the LE. It may be used to notify a CPE that the called subscriber has answered.
2. In the case of DTMF dialling the tones are transported transparently and no messages are required.

### 5.4.1.2. DEL - SUCCESSFUL Call (I/C Call including answer): 'B' end

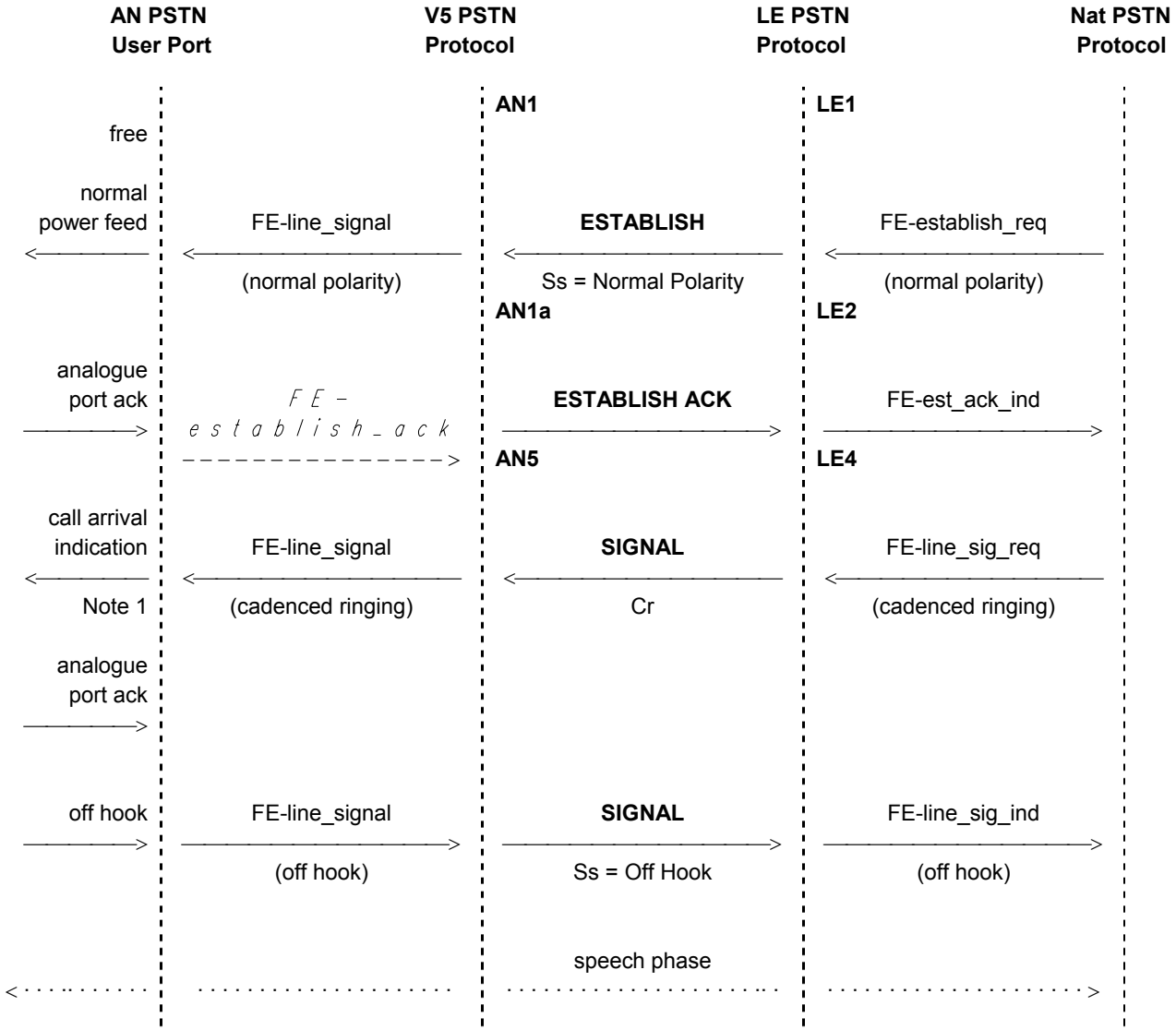



**NOTES**

1. If the ringing resource is not available then the no resources analogue control primitive may be returned by the Analogue Port process. The no resources analogue control primitive will also be returned if the Analogue Port process is still sending SPM pulses from the previous call.

### 5.4.1.3. DEL - Alternative SUCCESSFUL Call (I/C Call including answer): 'B' end

This MSC provides an alternative way of setting up the incoming call. This MSC illustrates the principle that an incoming call could be delivered with a SIGNAL message containing cadenced ringing. This principle may also apply as an alternative to other MSCs in this document but will not be illustrated.

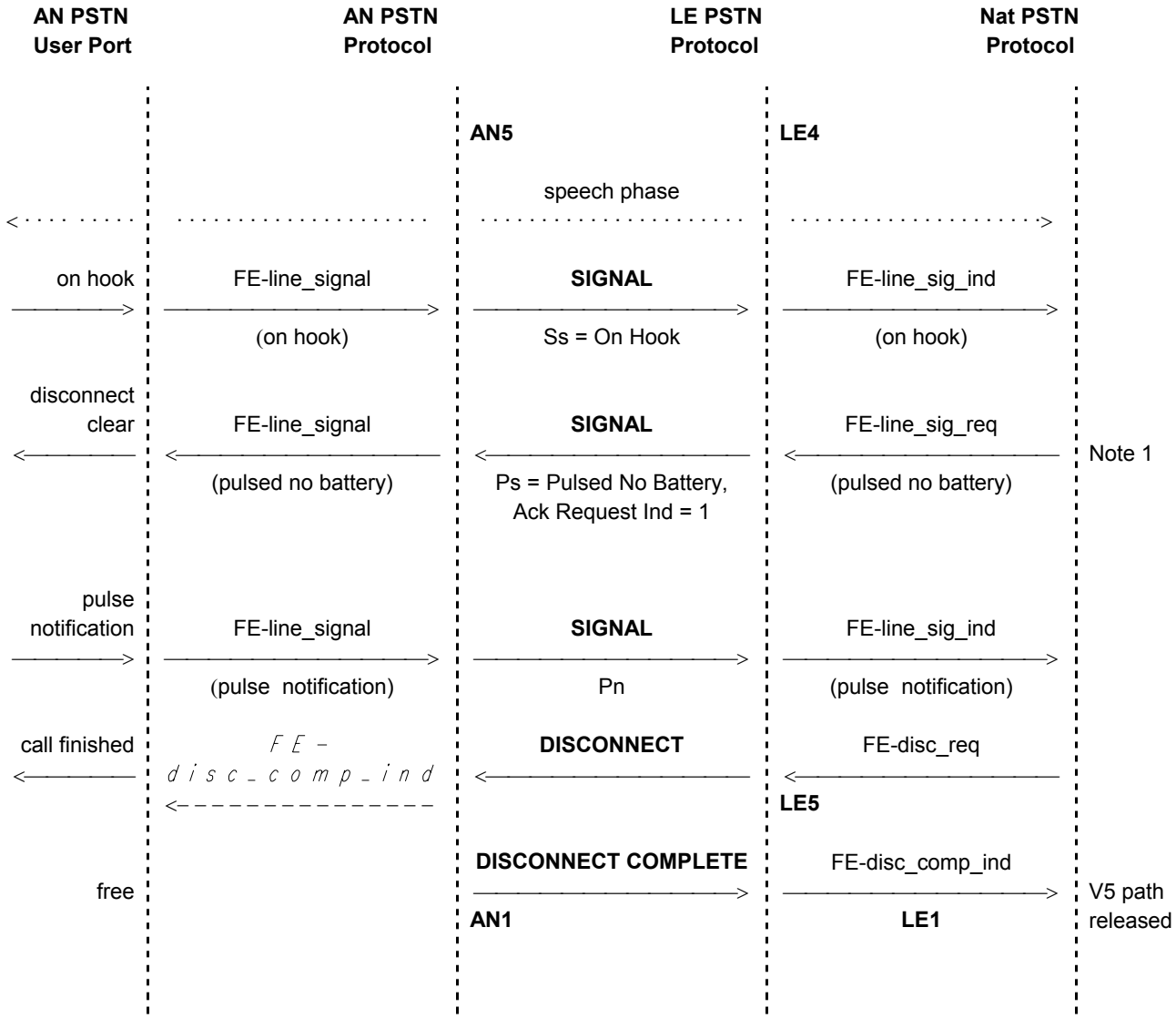



**NOTES**

1. If the ringing resource is not available then the no resources analogue control primitive may be returned by the Analogue Port process. The no resources control primitive will also be returned if the Analogue Port process is still sending SPM pulses from the previous call.

## 5.4.2. DEL - CALL CLEARING

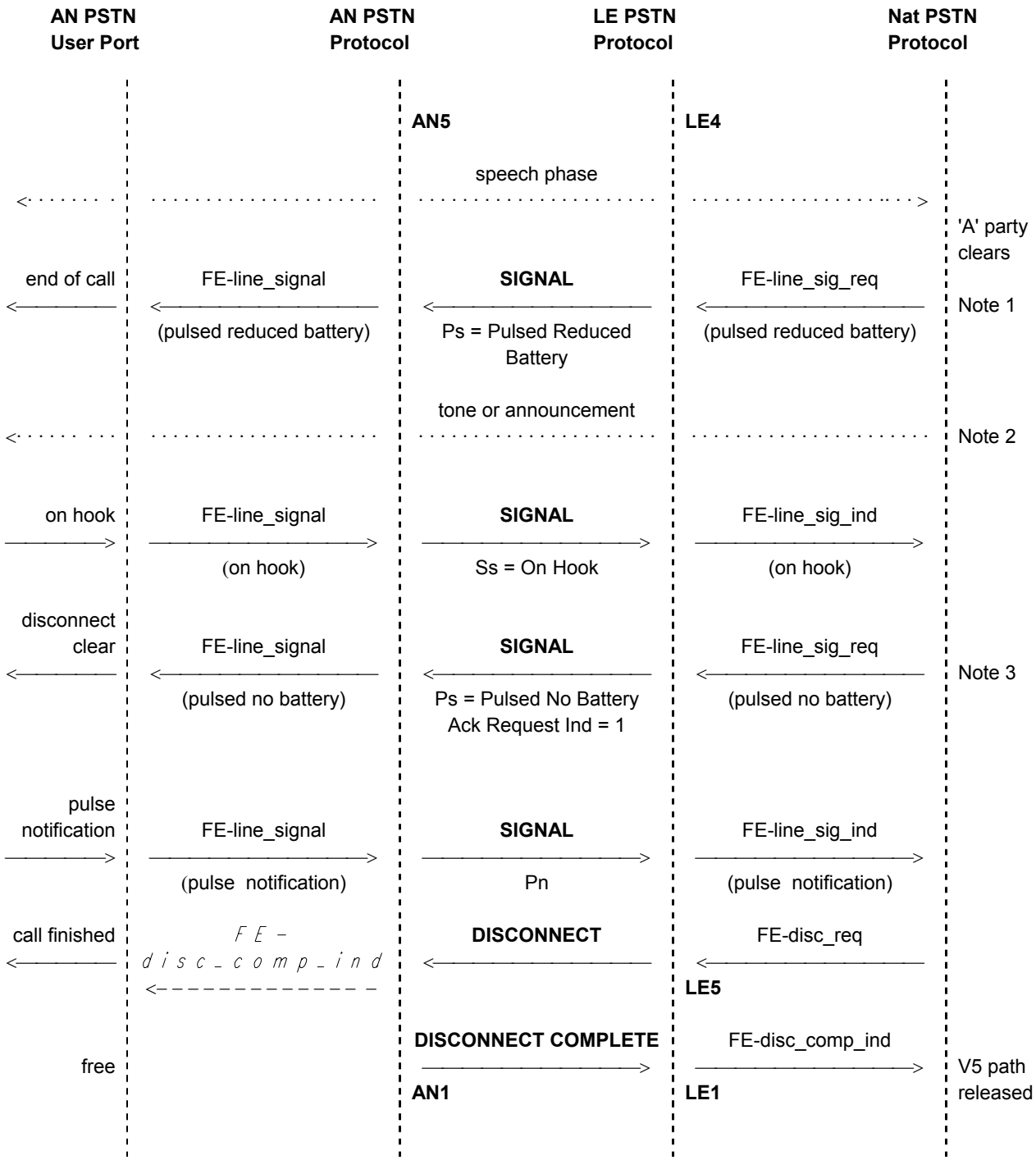
### 5.4.2.1. DEL - Call Clearing ('A' end clears first, followed by 'B'): 'A' end




**NOTES**

1. The duration of the disconnect clear pulse is an LE provisioned item. The pulse may be sent to certain CPEs (e.g. small call routing apparatus) as confirmation that the LE has accepted the clear.

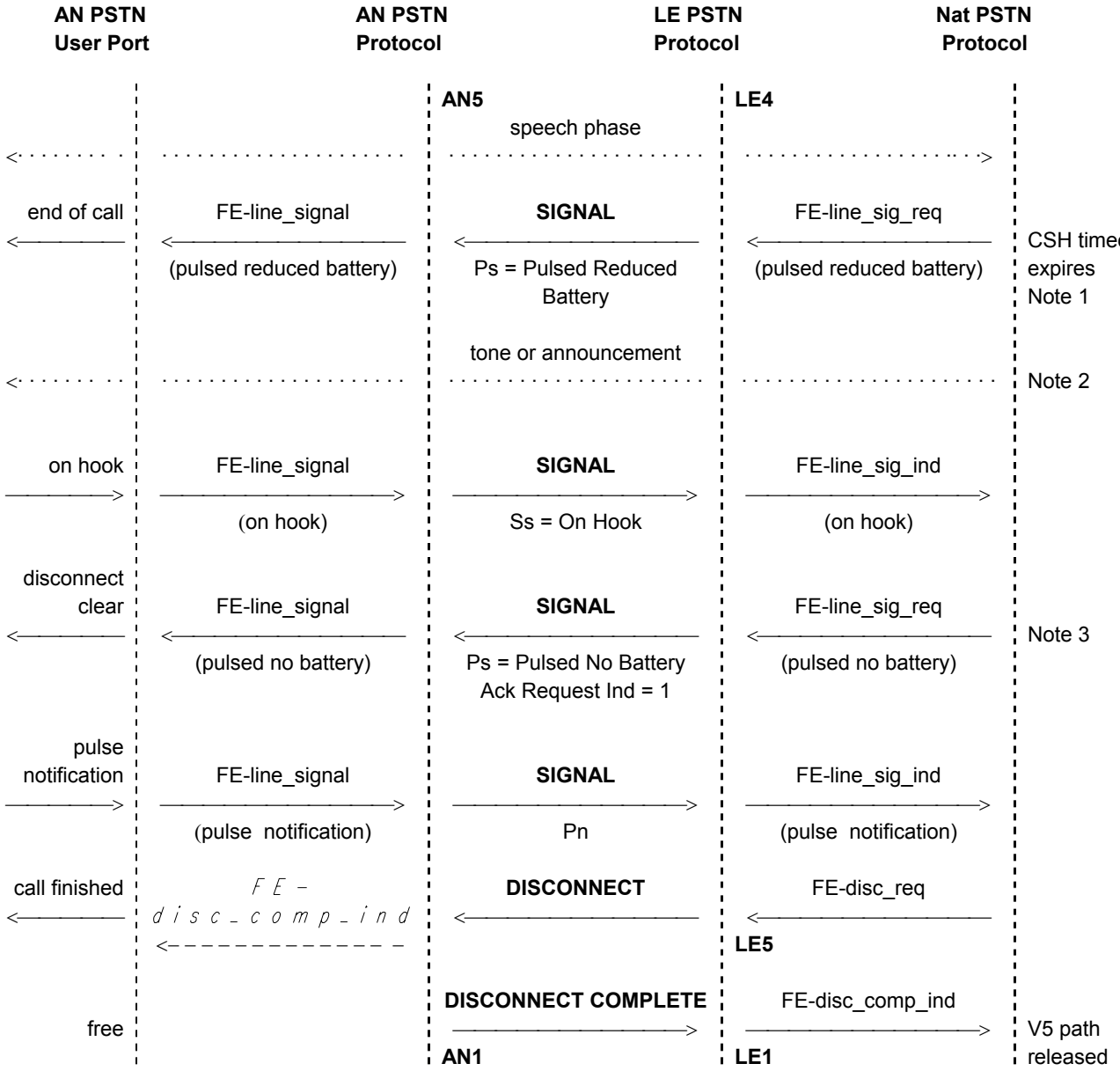
### 5.4.2.2. DEL - Call Clearing ('A' end clears first, followed by 'B'): 'B' end




**NOTES**

1. The end of call signal may be sent to inform a CPE that it may clear forward if no tones or announcements are desired. The duration of the pulse may be an LE provisioned item.
2. A tone or announcement is only applied if the LE determines that it is required (e.g. to indicate that the other party has cleared). This announcement may be sent prior to the end of call signal.
3. The disconnect clear is sent as confirmation to the CPE that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.

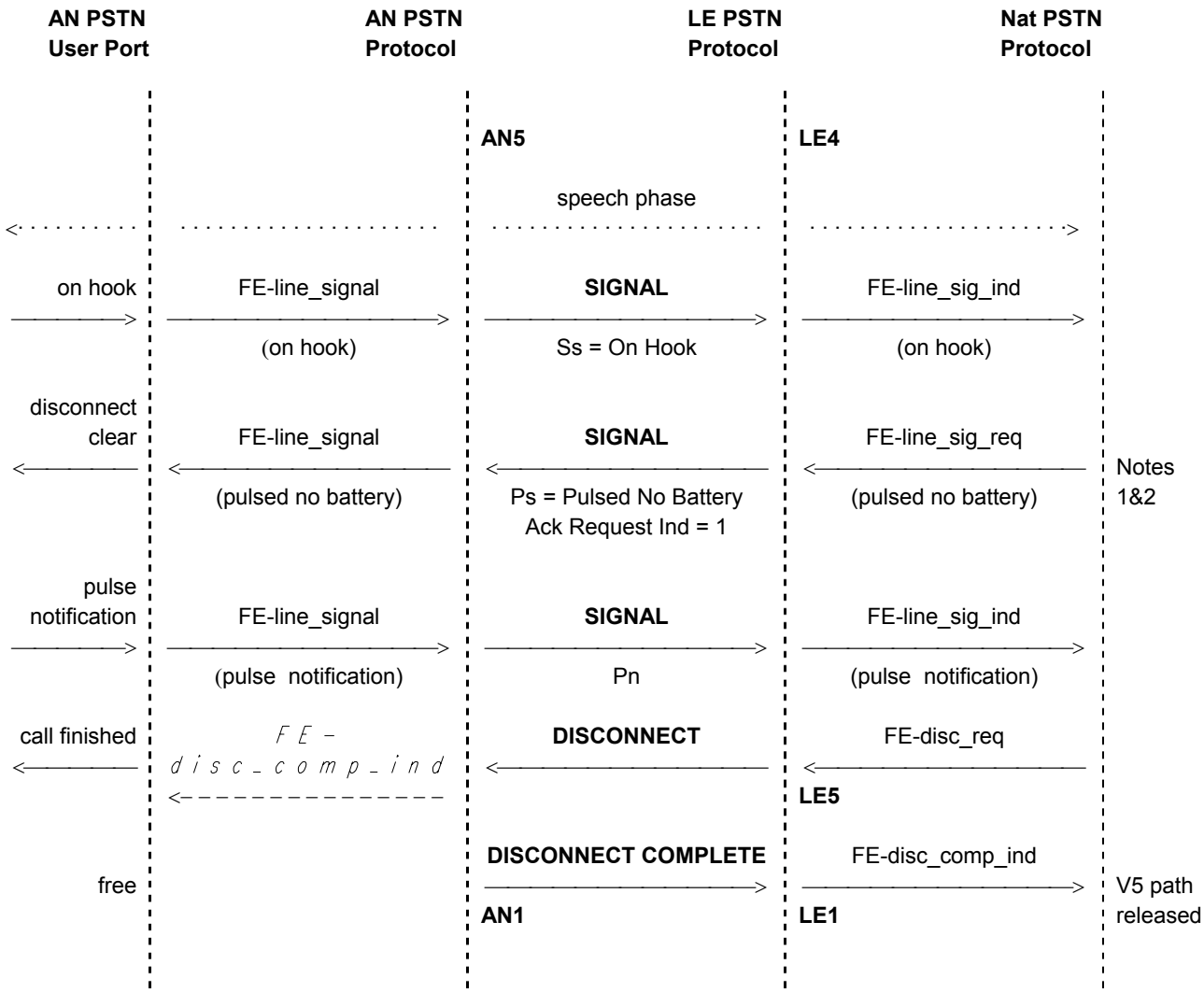
### 5.4.2.3. DEL - Call Clearing ('B' end clears first, followed by 'A'): 'A' end




**NOTES**

1. The signal may be sent to inform a CPE that it may clear forward if no tones or announcements are desired.
2. A tone or announcement is only applied if the LE determines that it is required. This announcement may be sent prior to the end of call signal.
3. The disconnect clear is sent as confirmation to the CPE that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.

### 5.4.2.4. DEL - Call Clearing ('B' end clears first, followed by 'A'): 'B' end

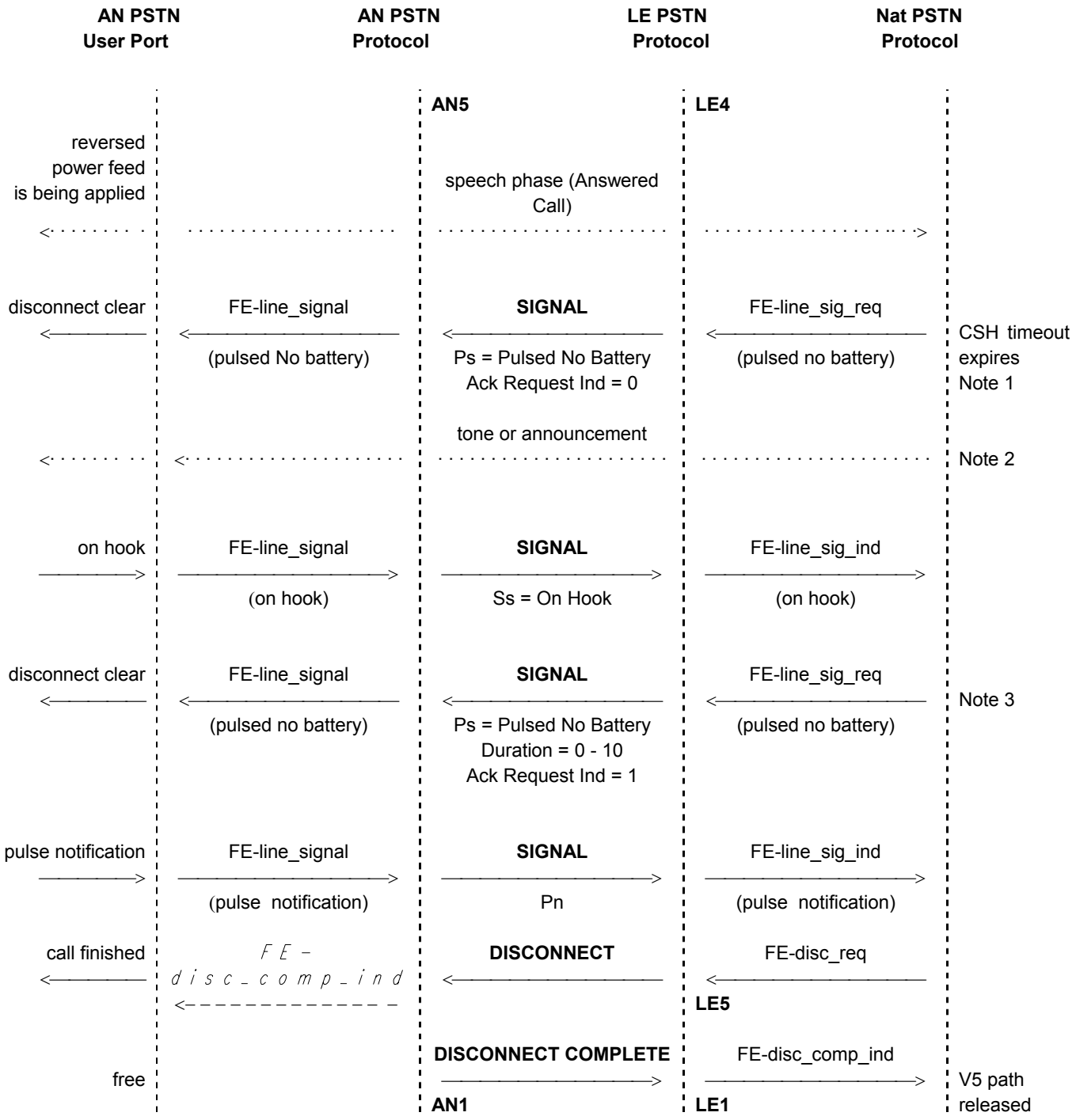



**NOTES**

1. The duration of the disconnect clear pulse is an LE provisioned item. The pulse may be sent to CPEs as confirmation that the LE has accepted the clear.
2. The disconnect clear signal is sent when the LE has determined that the call is to be released, e.g. when the 'A' end clears or the called subscriber held (CSH) timer expires.

### 5.4.2.5. DEL - Alternative Call Clearing ('B' end clears first, followed by 'A'): 'A' end

This MSC provides an alternative way of clearing a call. This MSC illustrates the principle that the disconnect clear could also be generated using a SIGNAL message containing Pulsed No Battery with an Ack Request Ind = 0, thereby not generating a pulse notification. This disconnect signal serves a similar purpose as the end of call signal. This principle may also apply as an alternative to other MSCs in this document but will not be illustrated.

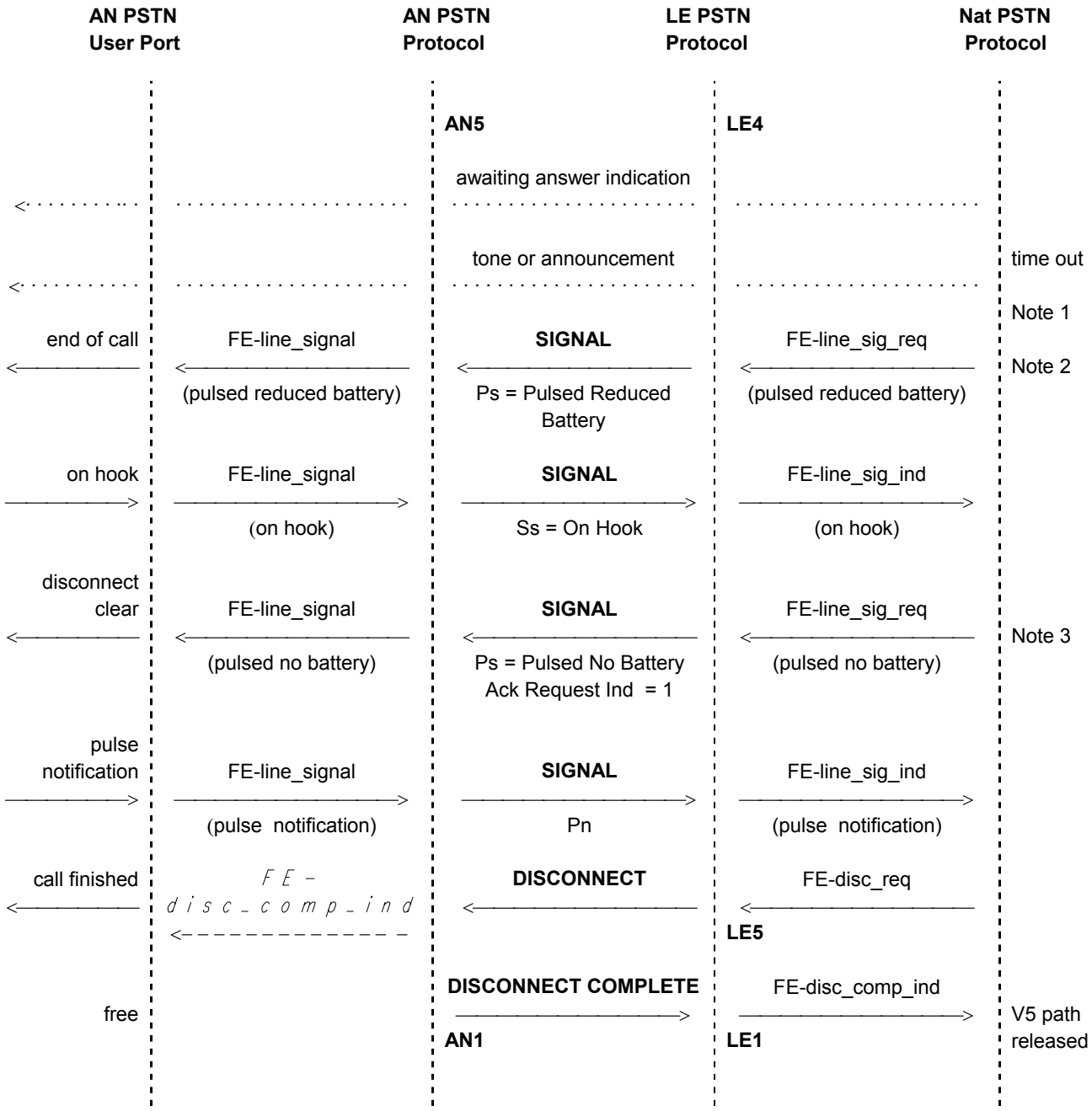


**NOTES**

1. The signal may be sent to inform a CPE that it may clear forward if no tones or announcements are desired.
2. A tone or announcement is only applied if the LE determines that it is required. This announcement may be sent prior to the end of call signal.
3. The disconnect clear is sent as confirmation to the CPE that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.

## 5.4.3. DEL - UNSUCCESSFUL CALLS

### 5.4.3.1. DEL - UNSUCCESSFUL Call (LE clears prior to answer): 'A' end

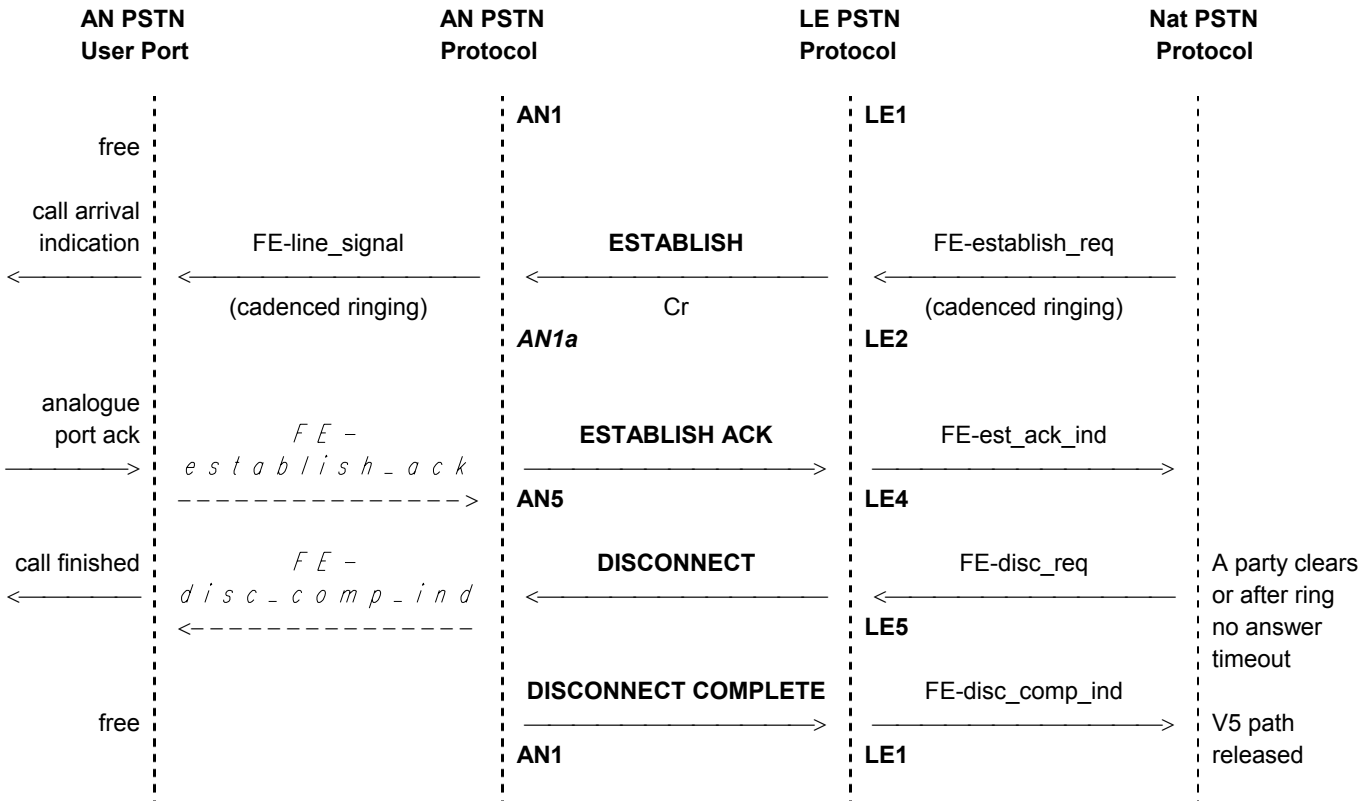



**NOTES**

1. A tone or announcement is only applied if the LE determines that it is required.
2. The signal may be sent to inform a CPE that it may clear forward if no tones or announcements are desired.
3. The disconnect clear is sent as confirmation to the CPE that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.

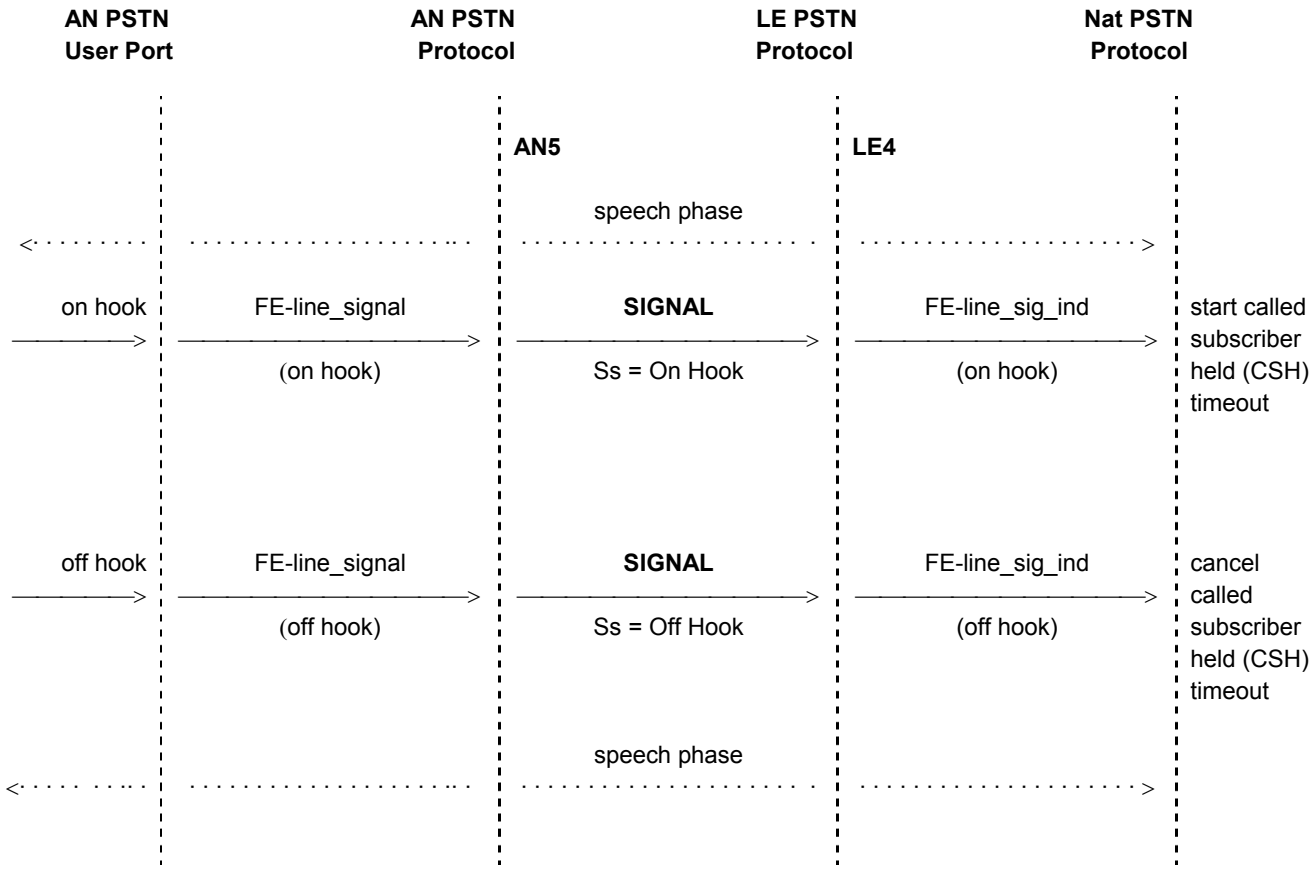
### 5.4.3.2. DEL - UNSUCCESSFUL Call (LE clears call prior to answer): 'B' end

This MSC is relevant to the case of A-party clearing prior to answer and in the case of ring no answer time out.



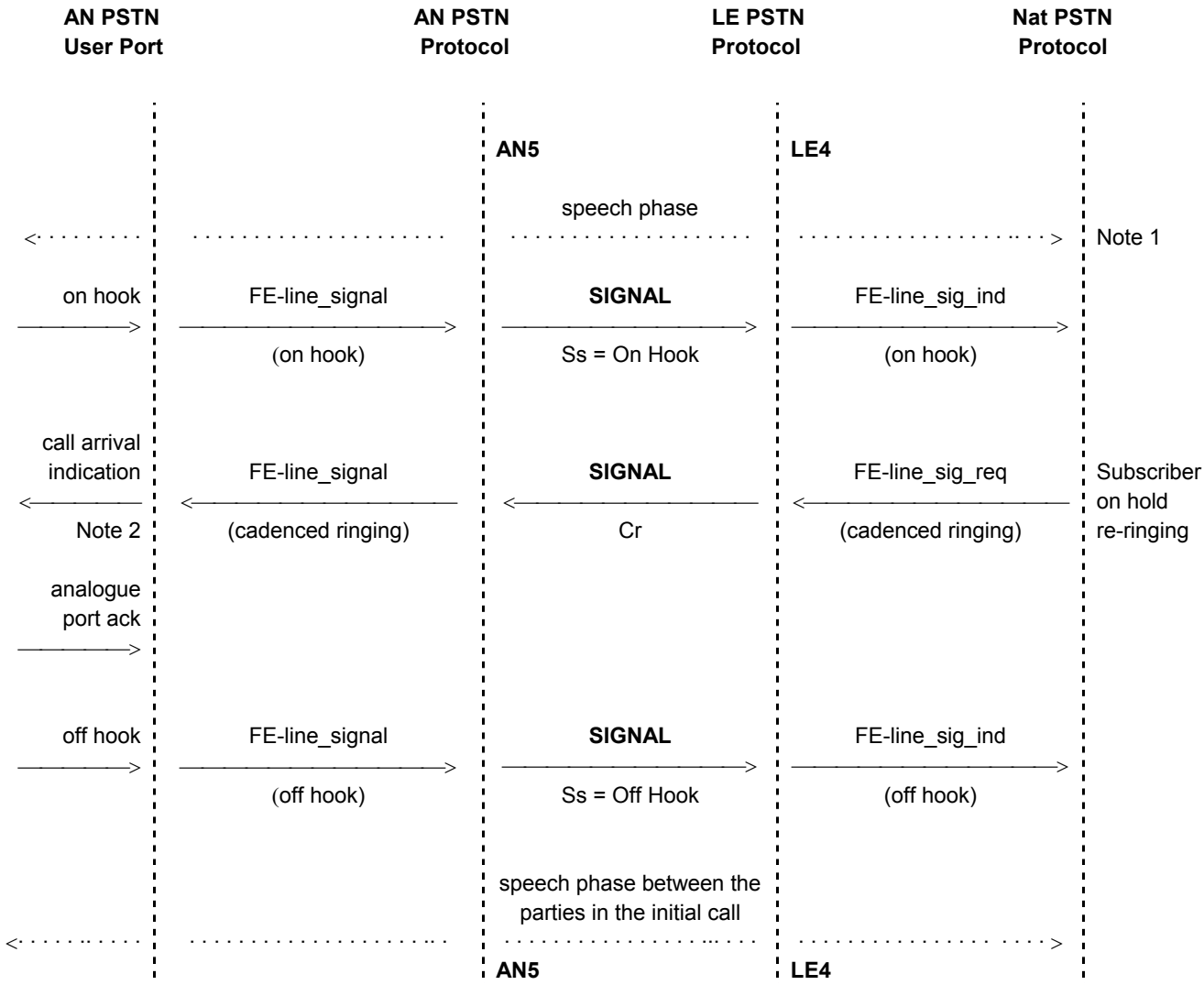
## 5.4.4. CALLS WHICH HAVE NOT COME TO AN IRREVOCABLE END

### 5.4.4.1. 'B' END RE-ANSWERS - 'B' end



### 5.4.4.2. Re-ringing of Held Subscriber

#### 5.4.4.2.1. Re-ringing of Held Subscriber - 'A' or 'B' end

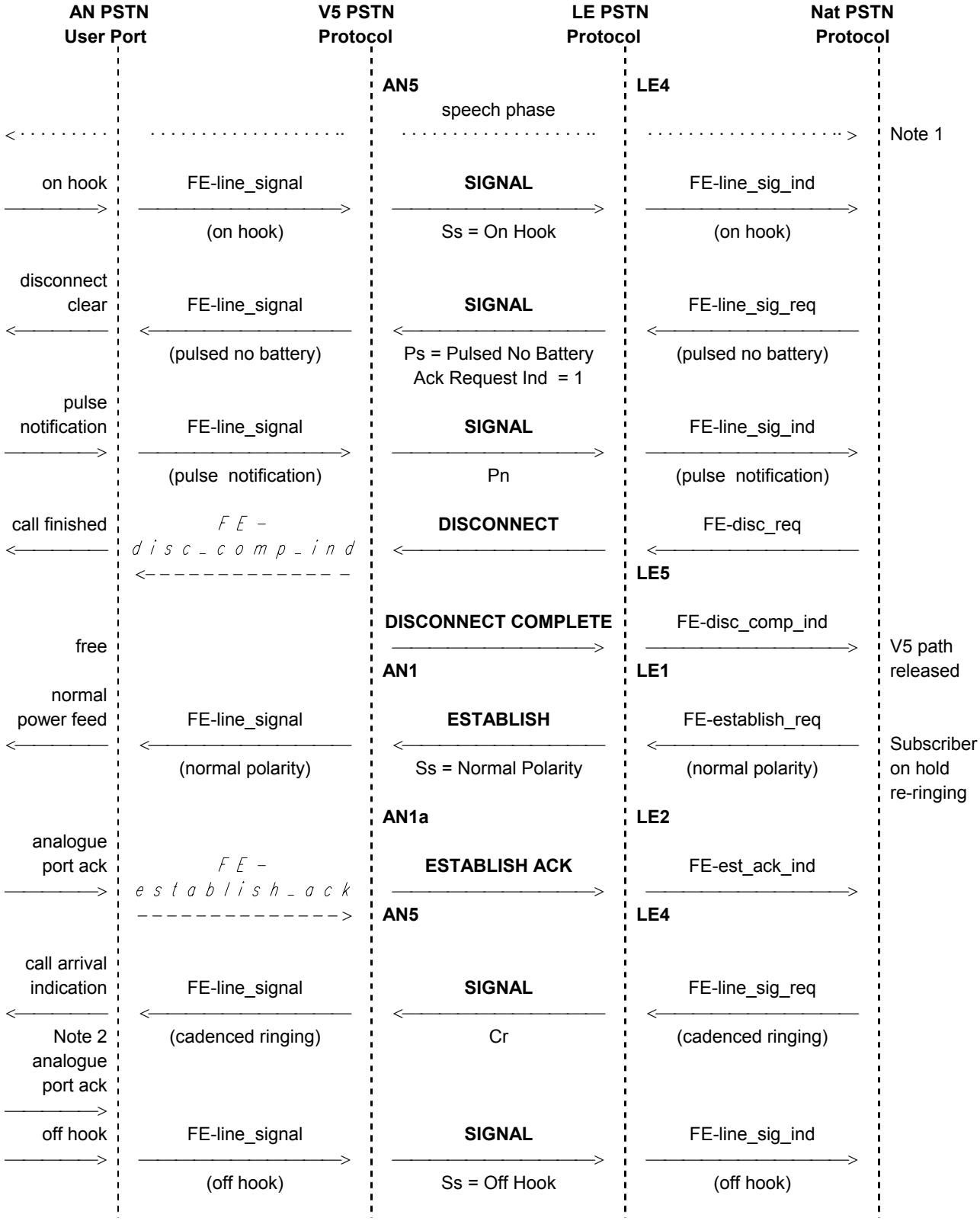


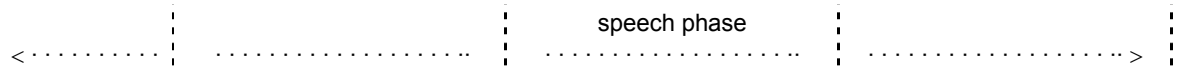

**NOTES**

1. This sequence occurs when the exchange does not permit a call to be cleared. The call waiting feature is one example of when this sequence may occur.
2. If the ringing resource is not available then the no resources analogue control primitive may be returned by the Analogue Port process.

### 5.4.4.2.2. Alternative Method of Re-ringing of Held Subscriber - 'A' or 'B' end

This MSC provides an alternative way of re-ringing of held calls. This MSC illustrates the principle that held calls can be cleared and then set up as a incoming call.




speech phase

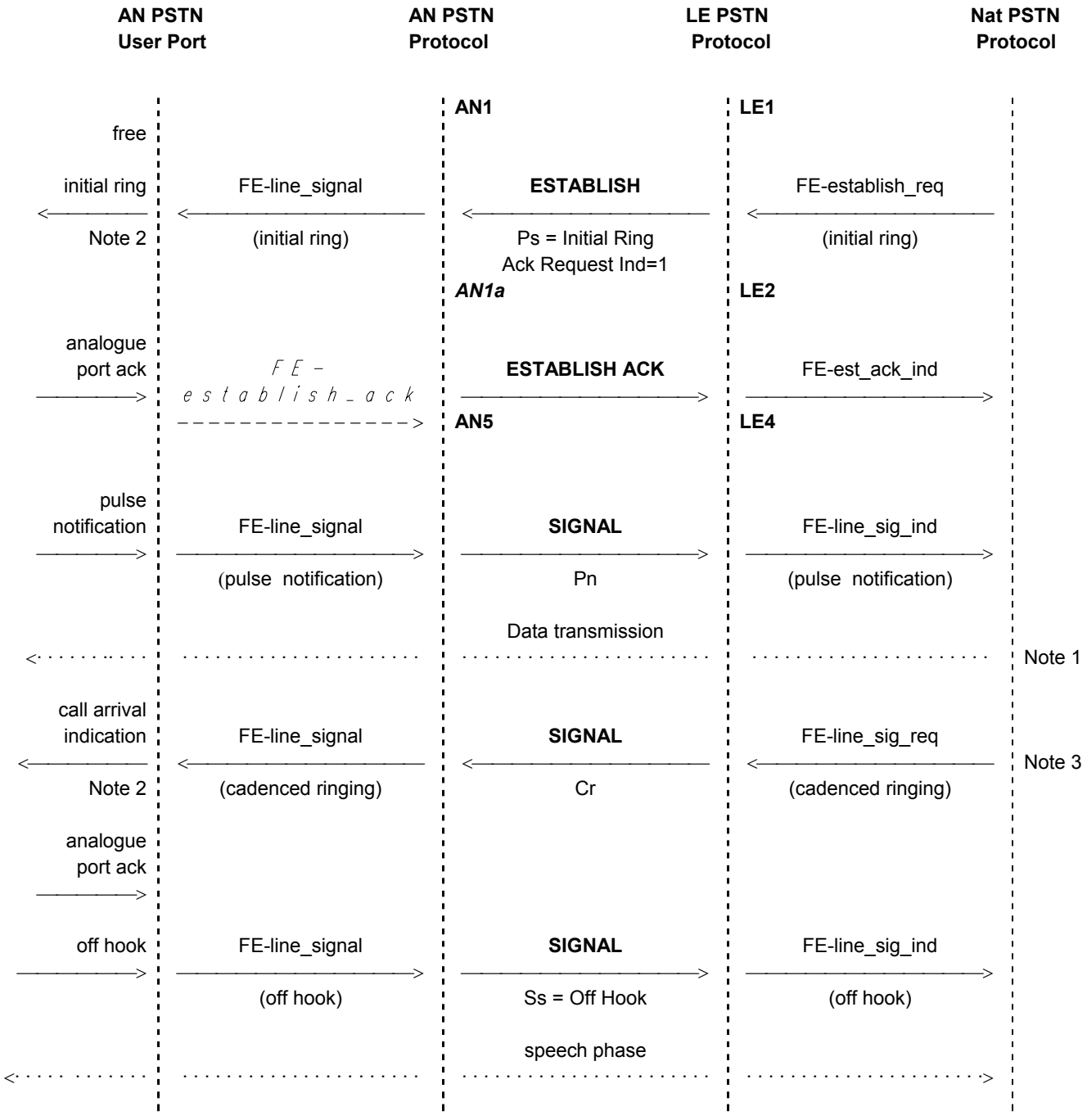
**NOTES**

1. This sequence occurs when the exchange does not permit a call to be cleared. The call waiting feature is one example of when this sequence may occur.

2. If the ringing resource is not available then the no resources analogue control primitive may be returned by the Analogue Port process.

## 5.4.5. DEL - Data Transmission (including Calling Identity Display)

### 5.4.5.1. DATA TRANSMISSION DURING RINGING-'B' end

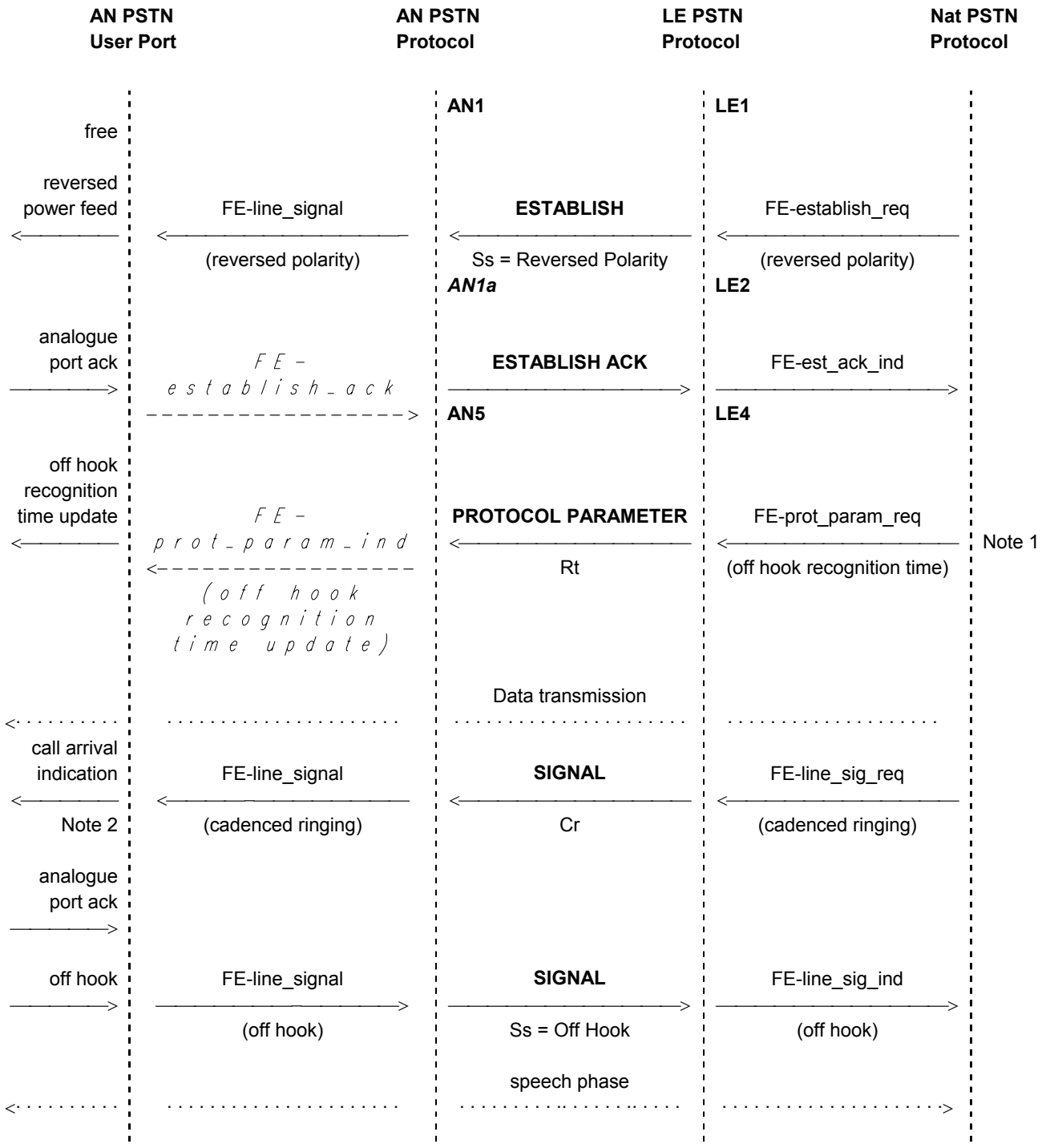



**NOTES**

1. The time gap for data transmission is supervised by the LE.
2. If the ringing resource is not available then the no resources analogue control primitive may be returned by the Analogue Port process.

3. As an alternative to sending cadenced ringing at this point, the LE may disconnect the path (e.g. in the case where the data tansmission was used to deliver a Message Waiting Indication).

### 5.4.5.2. DATA TRANSMISSION PRIOR TO RINGING-'B' end



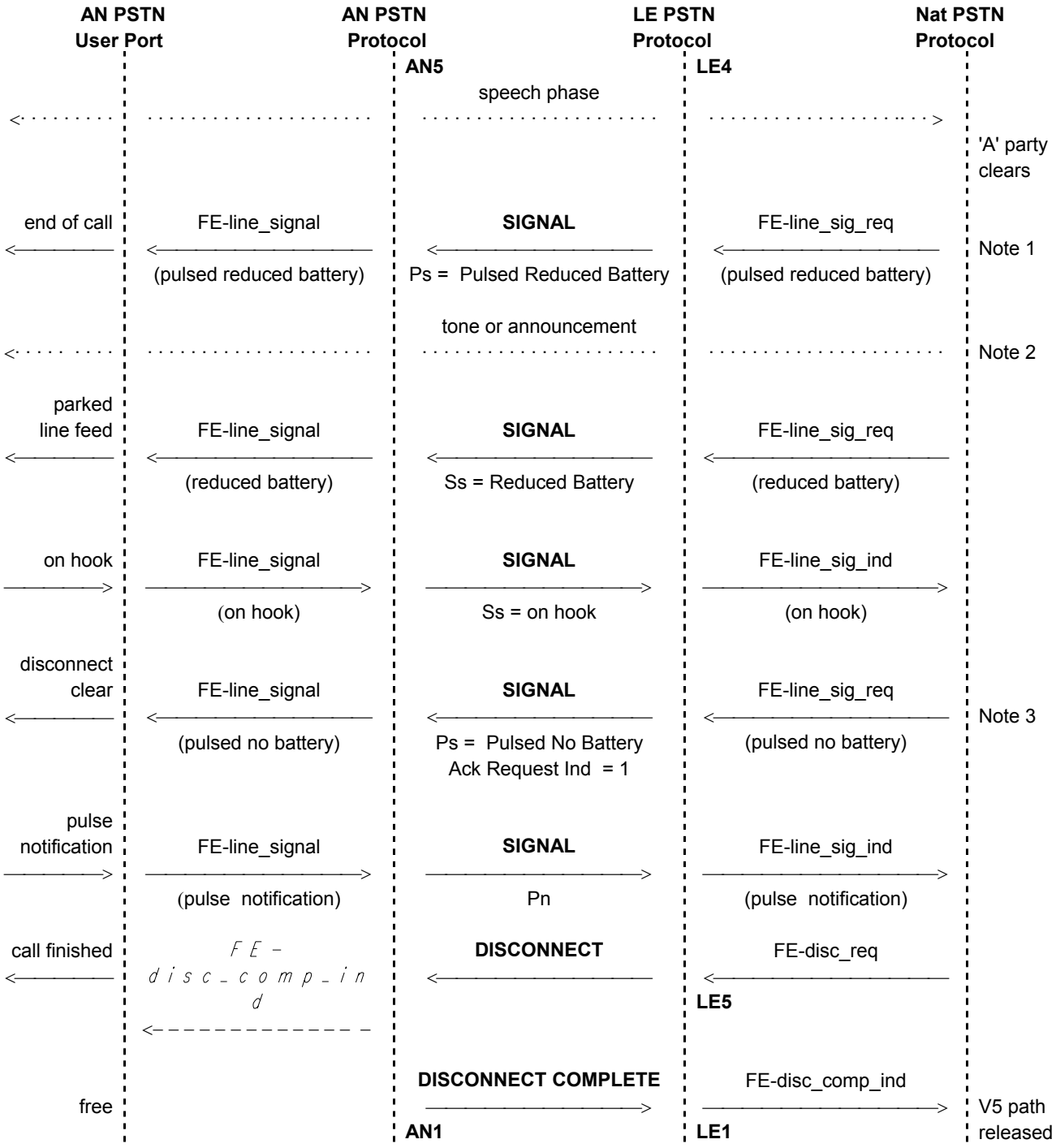

**NOTES**

1. This message is used to modify the off hook recognition time (i.e. the persistence of an off hook condition before it is validated as a signal to be acted upon by the Analogue Port process). An example of the use of this message would be to prevent current pulse wetting (CPW) from generating a false off hook.

2. If the ringing resource is not available then the no resources analogue control primitive may be returned by the Analogue Port process.

## 5.4.6. PARKING AND CLEARING FROM PARKED

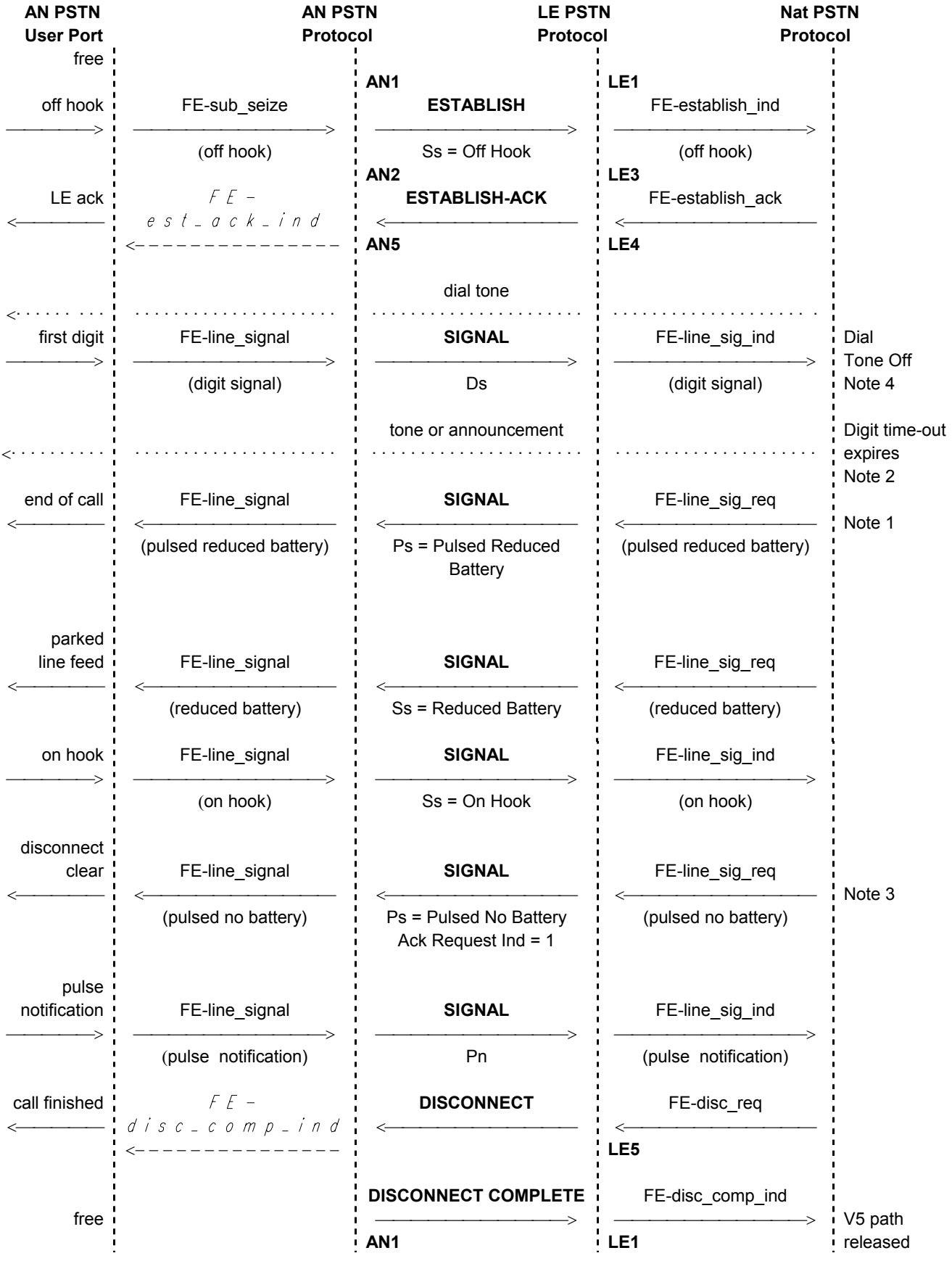
### 5.4.6.1. 'A' CLEARS, 'B' REMAINS OFF HOOK, 'B' end




**NOTES**

1. The end of call signal is only sent if the LE determines that it is required. The signal may be sent to inform a CPE that it may clear forward if no tones or announcements are desired.
2. A tone or announcement is only applied if the LE determines that it is required. This announcement may be sent prior to the end of call signal.
3. The disconnect clear is sent as confirmation to the CPE that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.

### 5.4.6.2. 'A' REMAINS OFF HOOK AFTER DIALLING INSUFFICIENT DIGITS

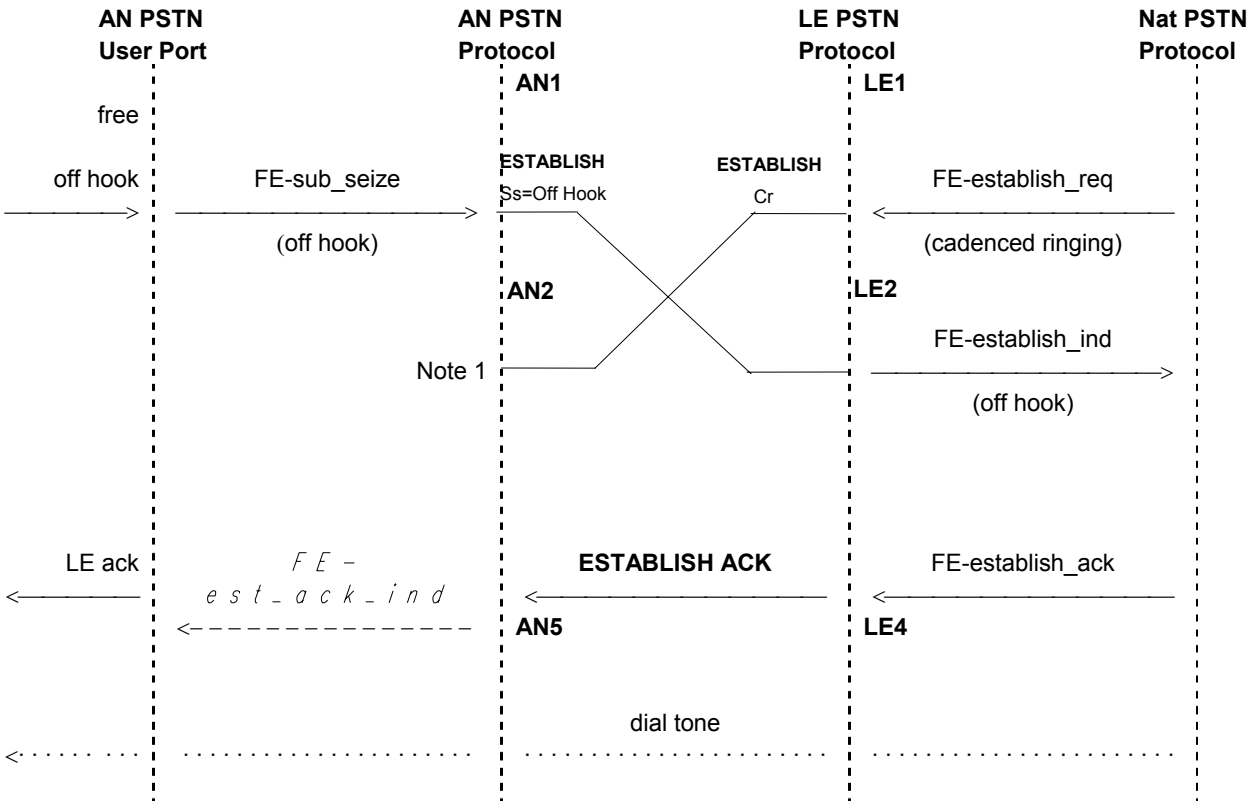


**NOTES**

1. The end of call signal may be sent to inform a CPE that it may clear forward if no tones or announcements are desired.
2. A tone or announcement is only applied if the LE determines that it is required.
3. The disconnect clear is sent as confirmation to the CPE that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.
4. This sequence shows the digit timeout expiring after the first digit has been received. Subsequent actions are the same if no or more than one but insufficient digits are received within the required time.
5. In the case of DTMF dialling the tones are transported transparently and no messages are required.

## 5.4.7. Collision Cases

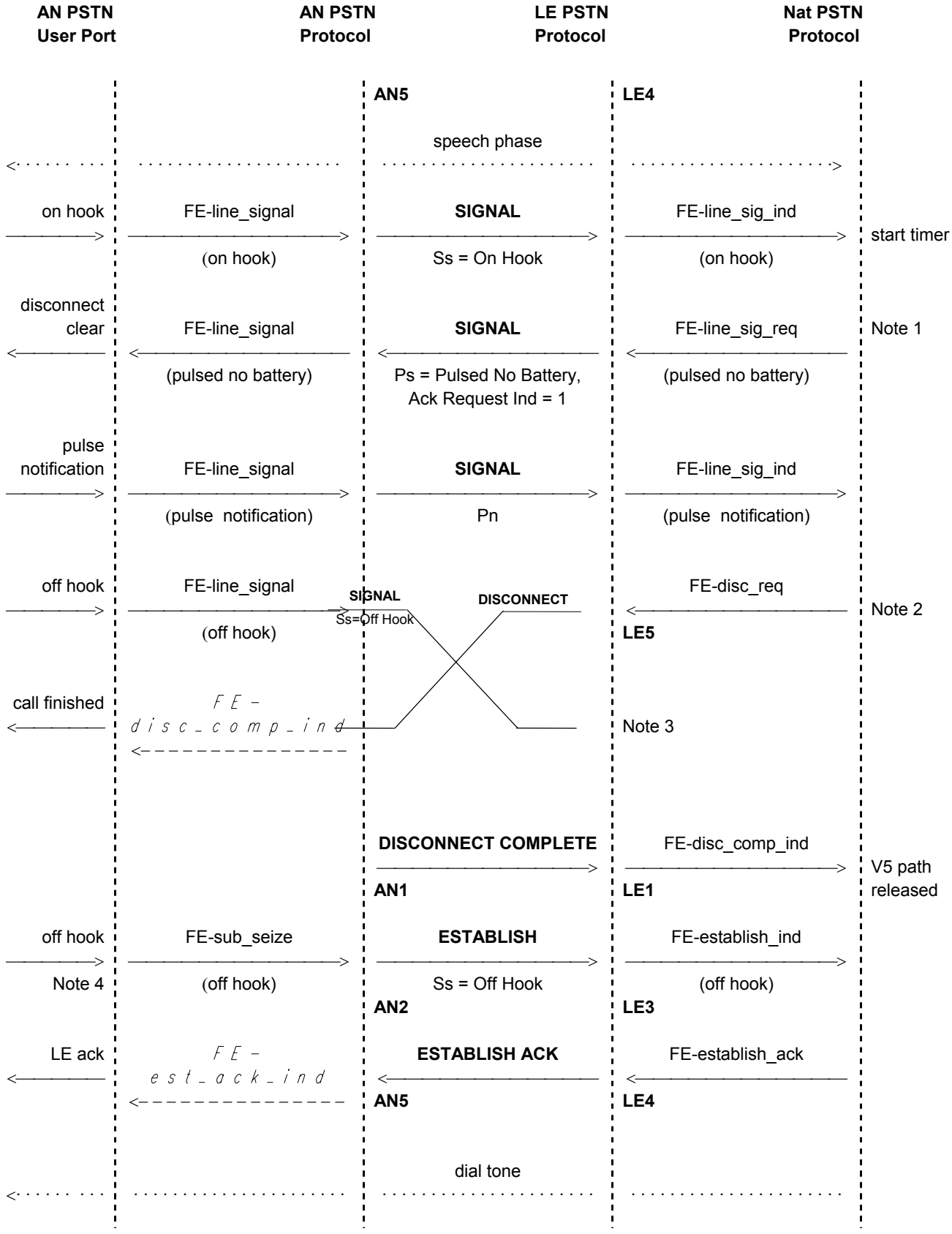
### 5.4.7.1. Outgoing Call Priority




**NOTES**

1. The AN ignores this Establish (Cr) message.
2. The UK implementation only supports out going call priority.

**5.4.7.2. Subscriber 'B' clears then goes off hook resulting in collision between release of connection from LE and O/G Call**

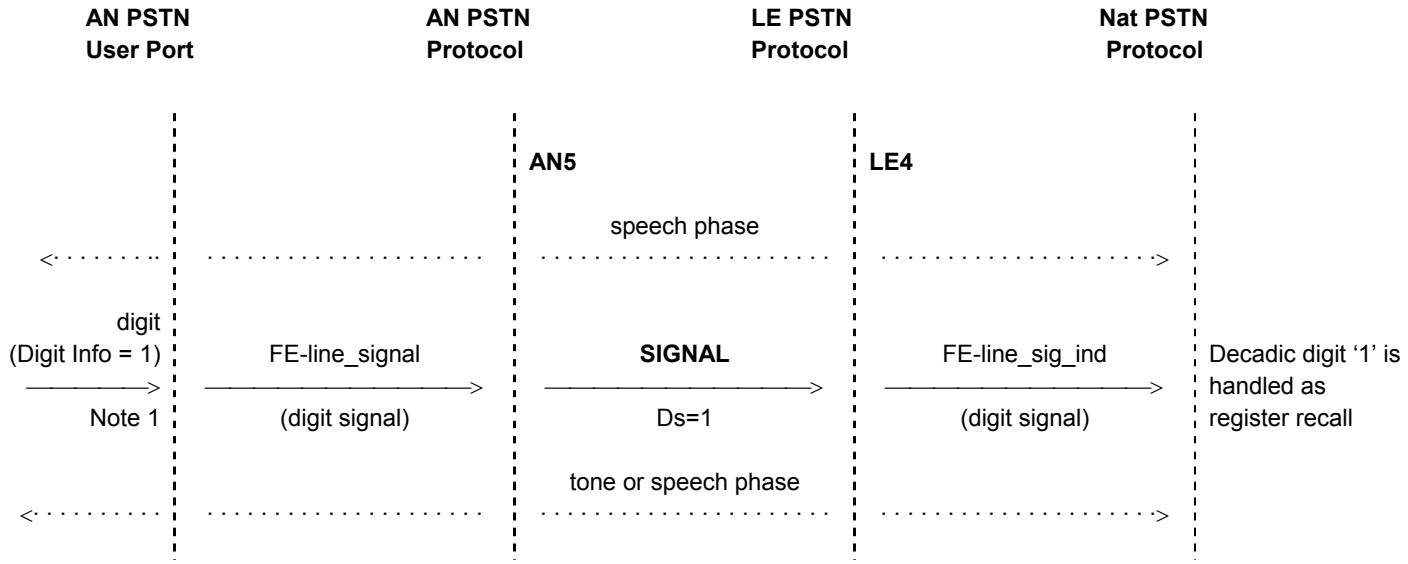


**NOTES**

1. This optional disconnect clear signal is only sent if the LE determines that it is required.
2. This message occurs after a timeout or the A party goes on hook.
3. The LE ignores this SIGNAL Ss=Off Hook message.
4. The Analogue Port process generates this primitive autonomously if the off hook is still present when a call finished is received.

## 5.4.8. FEATURES

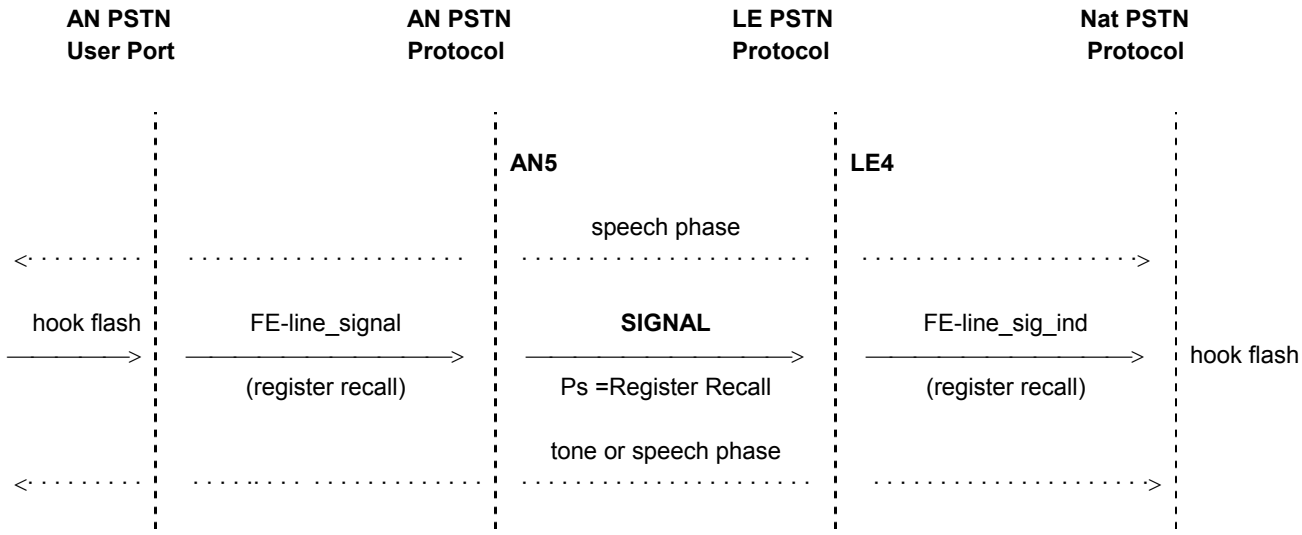
### 5.4.8.1. Register Recall - 'A' or 'B' end



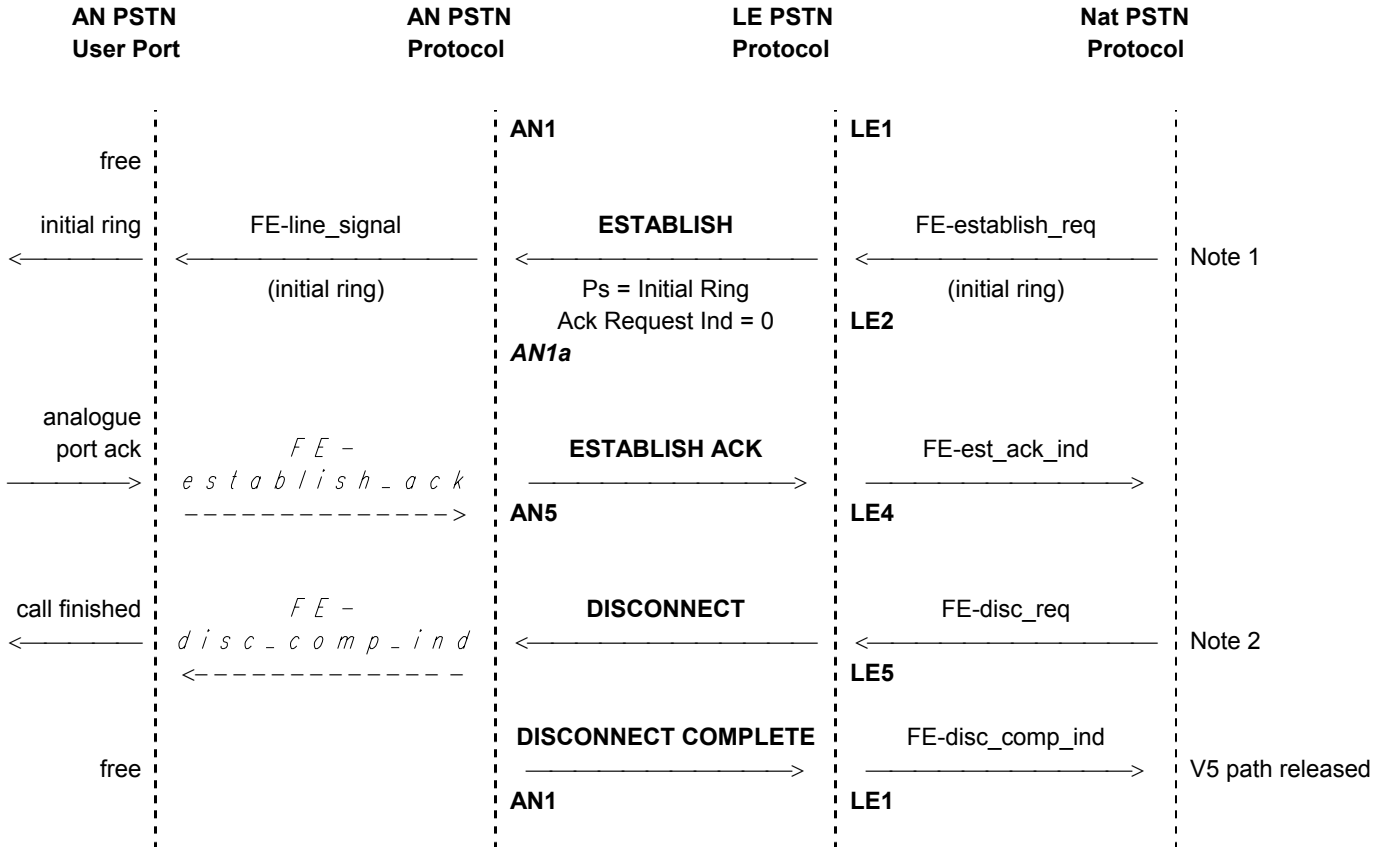

**NOTES**

1. The digit 1 primitive is generated by the Analogue Port process on receipt of a Register Recall signal from the CPE.

### 5.4.8.2. Hook Flash - 'A' or 'B' end



### 5.4.8.3. Call Forwarding Indication - 'B' end

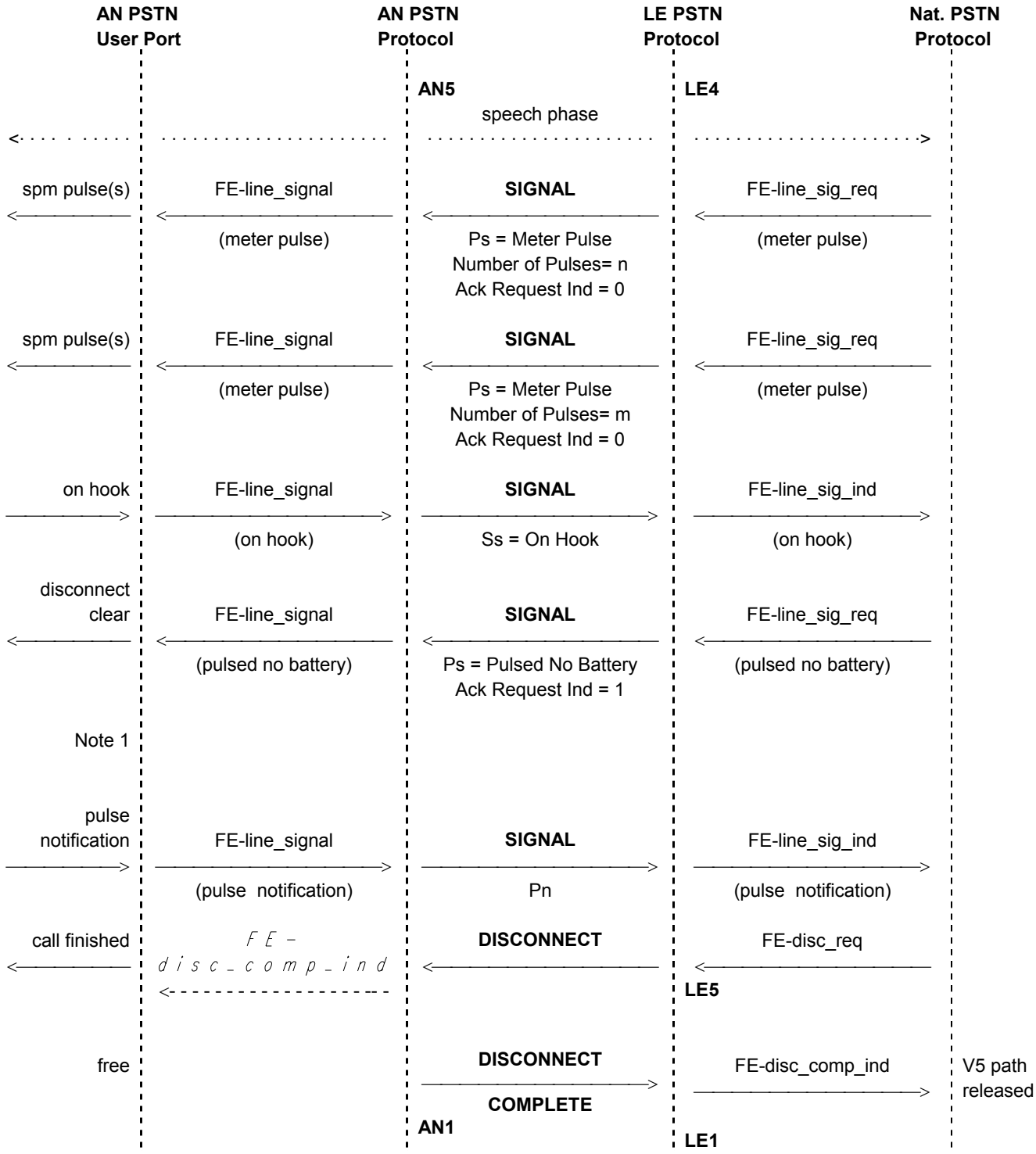



**NOTES**

1. A call arrives at the forwarding subscriber (i.e. the subscriber who has call forwarding service active in its service profile).
2. The FE-disc_req is sent by the LE. The precise point in time it is sent is service specific and is outside the scope of the V5 PSTN mapping document.

## 5.4.9. SPM Delivery

### 5.4.9.1. SPM delivery : "A" clears before all SPM pulses are sent by Analogue Port process

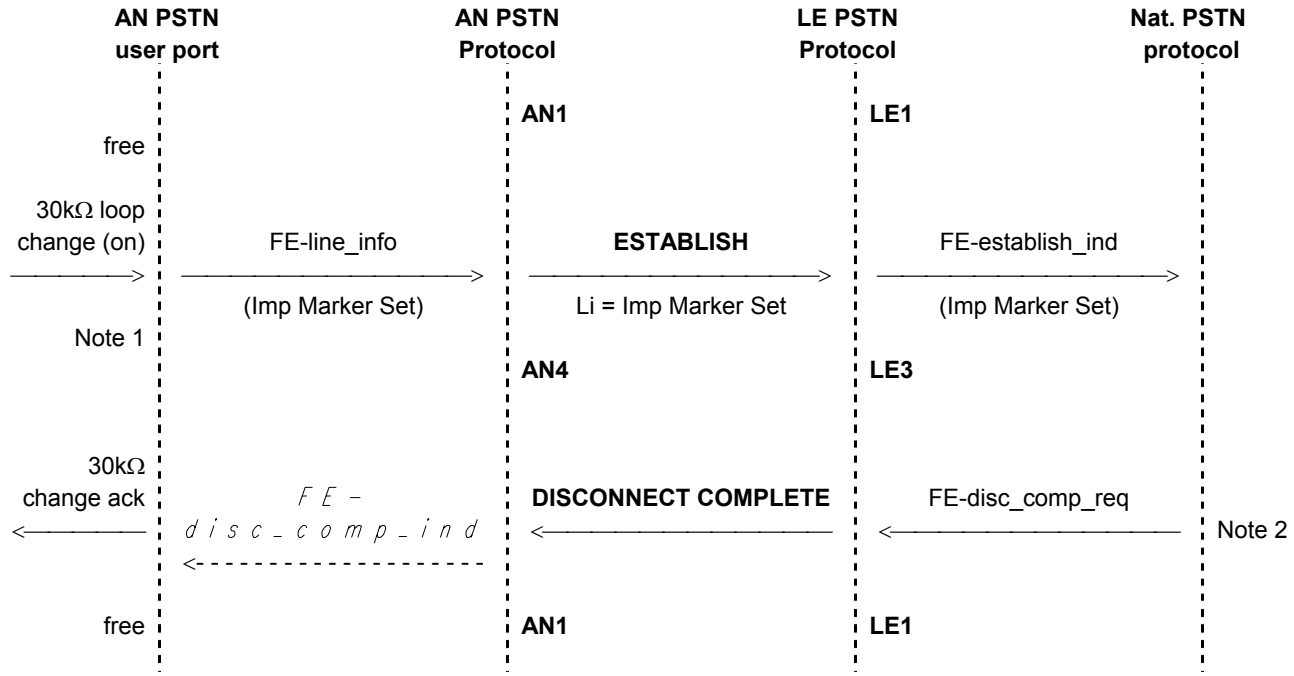



**NOTES**

1. The Analogue Port Process will complete the sending of SPM pulses before sending a DISCONNECT CLEAR signal to the user and returning a pulse notification to the AN_PSTN_User_Port process.

## 5.4.10. 30kΩ LOOP STATE CHANGE

### 5.4.10.1. 30kΩ LOOP ACTIVATION




**NOTES**

1. The complete procedure from the sending of the ESTABLISH message by the AN, to the receipt of the DISCONNECT COMPLETE message by the AN can be thought of as a non-speech call.

2. Return of a DISCONNECT COMPLETE message from the LE signifies that the LE has successfully registered the application/removal of the 30kΩ loop. Any other response will be assumed to mean that the LE has not acknowledged the change of state of the 30kΩ loop. The LE will maintain a record of the state of the subscriber line. Whenever it changes, the AN sends another ESTABLISH message with Line information to keep the LE aligned.

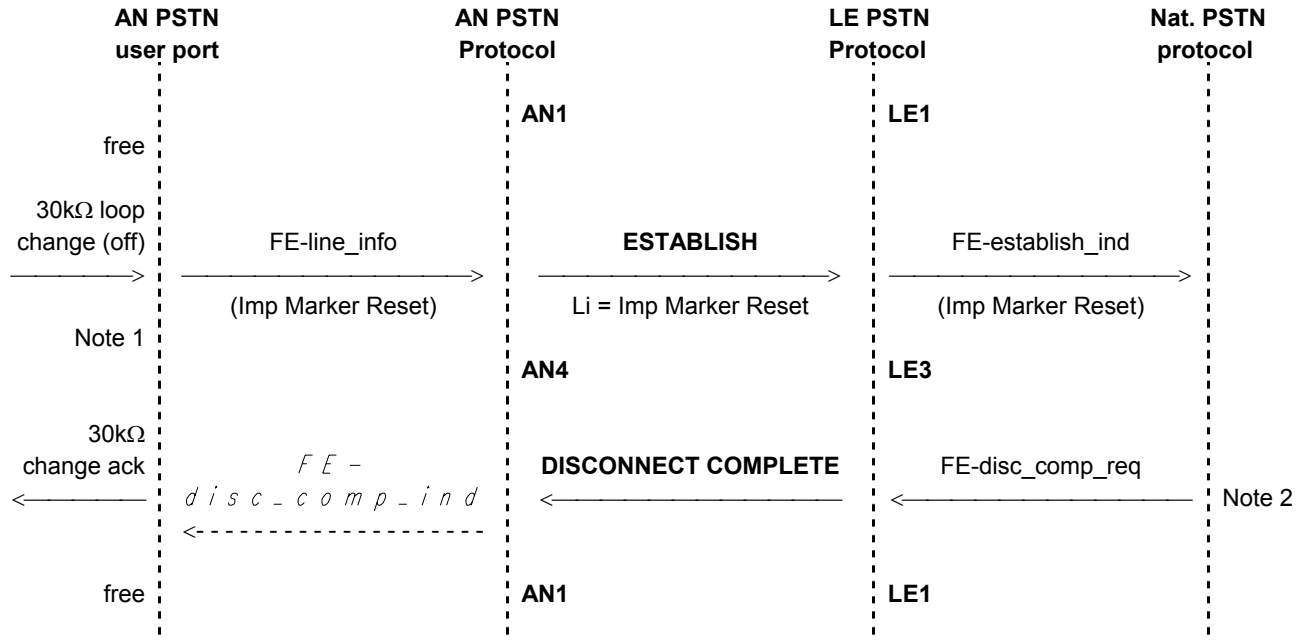
   In the absence of such an acknowledgement from the LE, e.g. if the LE is in overload, the AN should repeat the ESTABLISH message with the Line information. This could occur as a result of the AN timer T1/T2 expiring, or after invoking some other procedure which eventually results in completing the call with the DISCONNECT/DISCONNECT COMPLETE procedure.

3. The AN should always report the status of the 30kΩ loop, whether applied or removed, after a restart or after the V5 user port unblocks. This applies only for subscribers service marked with the 30kΩ facility. The LE will act on the message if this indicates a change of status. If the LE is already aware of the loop status as reported by the AN, it will respond with the DISCONNECT COMPLETE message but ignore it internally. This procedure :-

   - prevents the LE from locking out the subscriber if the AN had previously reported its application,
   - allows the LE to invoke the service if the AN had previously reported its removal.

4. It is assumed that detection of a 30kΩ loop in the presence of an off-hook may prove to be difficult. Accordingly this service has been defined such that application/removal of the 30kΩ loop during an existing call is ignored until the call finishes. After the call, any change of state of the 30kΩ loop is reported by the AN to the LE via the normal ESTABLISH/DISCONNECT COMPLETE procedure described in 5.4.10.1 and 5.4.10.2.

### 5.4.10.2. 30kΩ LOOP DEACTIVATION




**NOTES**

1. The complete procedure from the sending of the ESTABLISH message by the AN, to the receipt of the DISCONNECT COMPLETE message by the AN can be thought of as a non-speech call.

2. Return of a DISCONNECT COMPLETE message from the LE signifies that the LE has successfully registered the application/removal of the 30kΩ loop. Any other response will be assumed to mean that the LE has not acknowledged the change of state of the 30kΩ loop. The LE will maintain a record of the state of the subscriber line. Whenever it changes, the AN sends another ESTABLISH message with Line information to keep the LE aligned.

   In the absence of such an acknowledgement from the LE, e.g. if the LE is in overload, the AN should repeat the ESTABLISH message with the Line information. This could occur as a result of the AN timer T1/T2 expiring, or after invoking some other procedure which eventually results in completing the call with the DISCONNECT/DISCONNECT COMPLETE procedure.

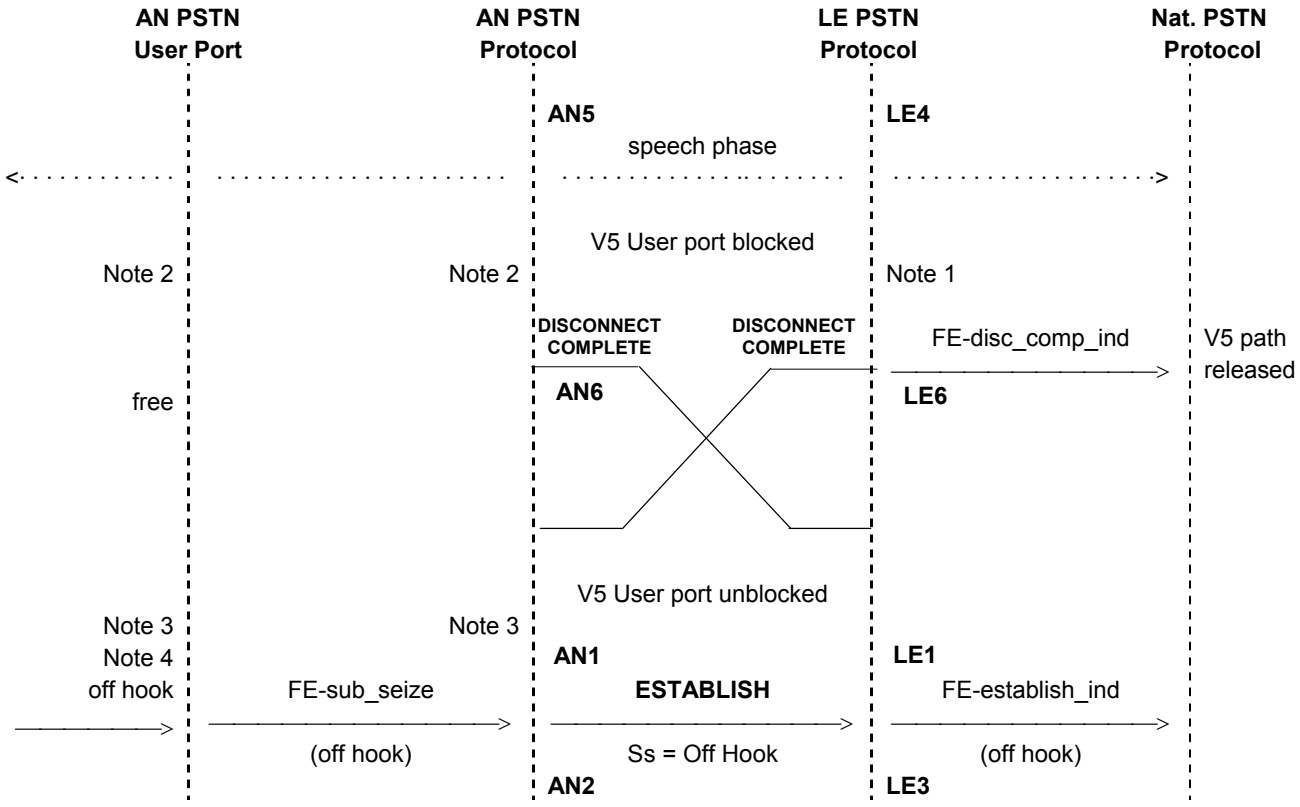
3. The AN should always report the status of the 30kΩ loop, whether applied or removed, after a restart or after the V5 user port unblocks. This applies only for subscribers service marked with the 30kΩ facility. The LE will act on the message if this indicates a change of status. If the LE is already aware of the loop status as reported by the AN, it will respond with the DISCONNECT COMPLETE message but ignore it internally. This procedure :-

   - prevents the LE from locking out the subscriber if the AN had previously reported its application,
   - allows the LE to invoke the service if the AN had previously reported its removal.

4. It is assumed that detection of a 30kΩ loop in the presence of an off-hook may prove to be difficult. Accordingly this service has been defined such that application/removal of the 30kΩ loop during an existing call is ignored until the call finishes. After the call, any change of state of the 30kΩ loop is reported by the AN to the LE via the normal ESTABLISH/DISCONNECT COMPLETE procedure described in 5.4.10.1 and 5.4.10.2.

## 5.4.11. USER PORT BLOCKING AND UNBLOCKING

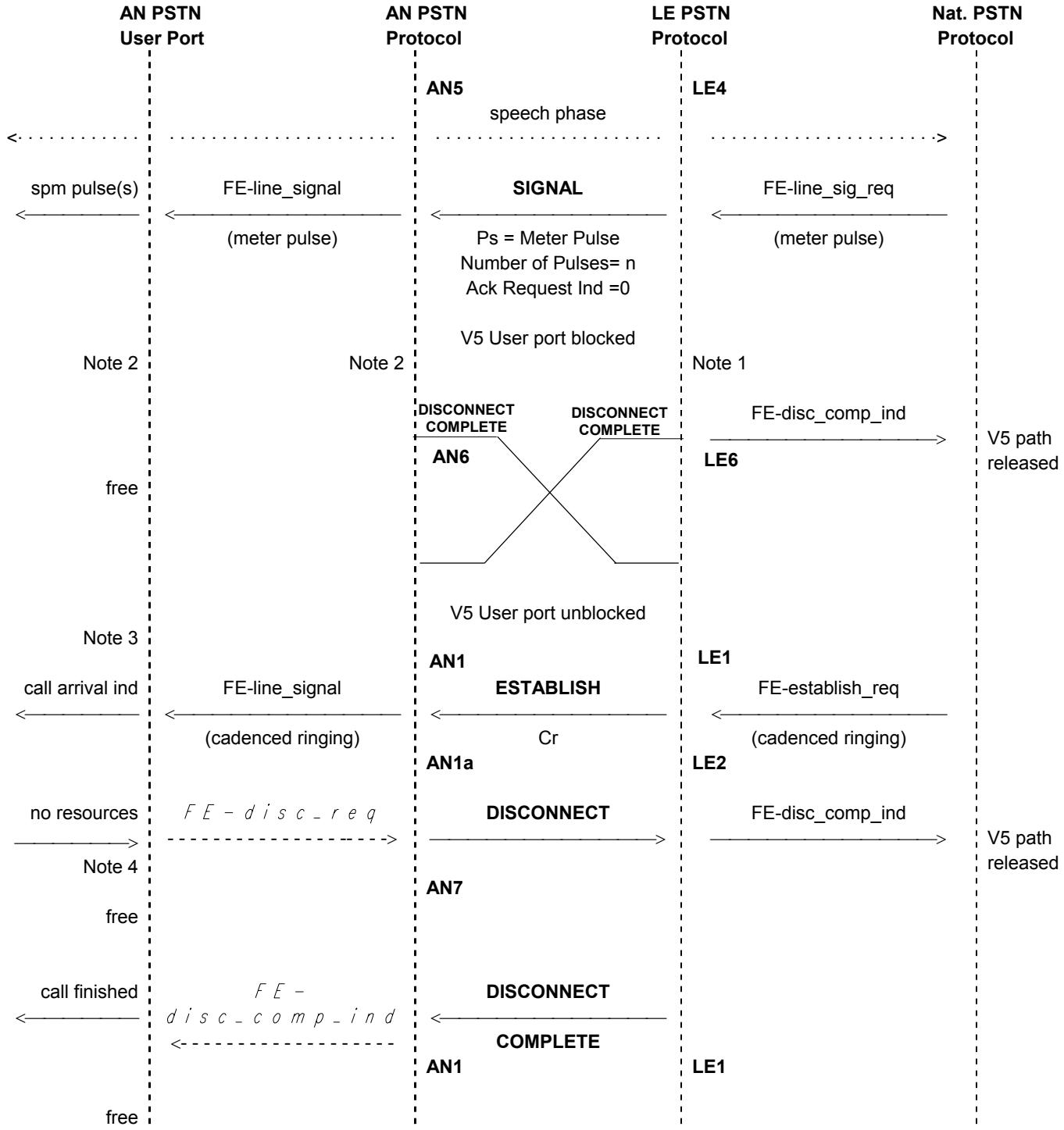
### 5.4.11.1. User port blocks and unblocks during call, user remains off-hook




**NOTES**

1. When the V5 port is to be blocked the LE Management process notifies the LE_PSTN_Protocol process which sends a DISCONNECT COMPLETE message to the AN and an FE-disc_comp_ind to the National_PSTN_Protocol process.
2. When the V5 port is to be blocked the AN Management process notifies the AN_PSTN_Protocol process, AN_PSTN_User_Port process and the Analogue Port process.
    - The AN_PSTN_Protocol process sends a DISCONNECT COMPLETE message to the LE.
    - The AN_PSTN_User_Port process goes to the free state.
    - The Analogue Port process sends a DISCONNECT CLEAR to the CPE and then goes into the power denied state.
3. When the V5 port is unblocked the AN Management process notifies the AN_PSTN_Protocol process, AN_PSTN_User_Port process and the Analogue Port process. The Analogue Port and AN_PSTN_User_Port process return to Free. The AN_PSTN_Protocol process returns to Null.
4. If, after the port is unblocked and the Analogue Port process has returned to the Free state the user is still off hook, then the Analogue Port process will send an off hook primitive to the AN_PSTN_User_Port process.

**5.4.11.2. User port blocks and unblocks during SPM pulsing, new incoming call arrives before pulsing complete.**

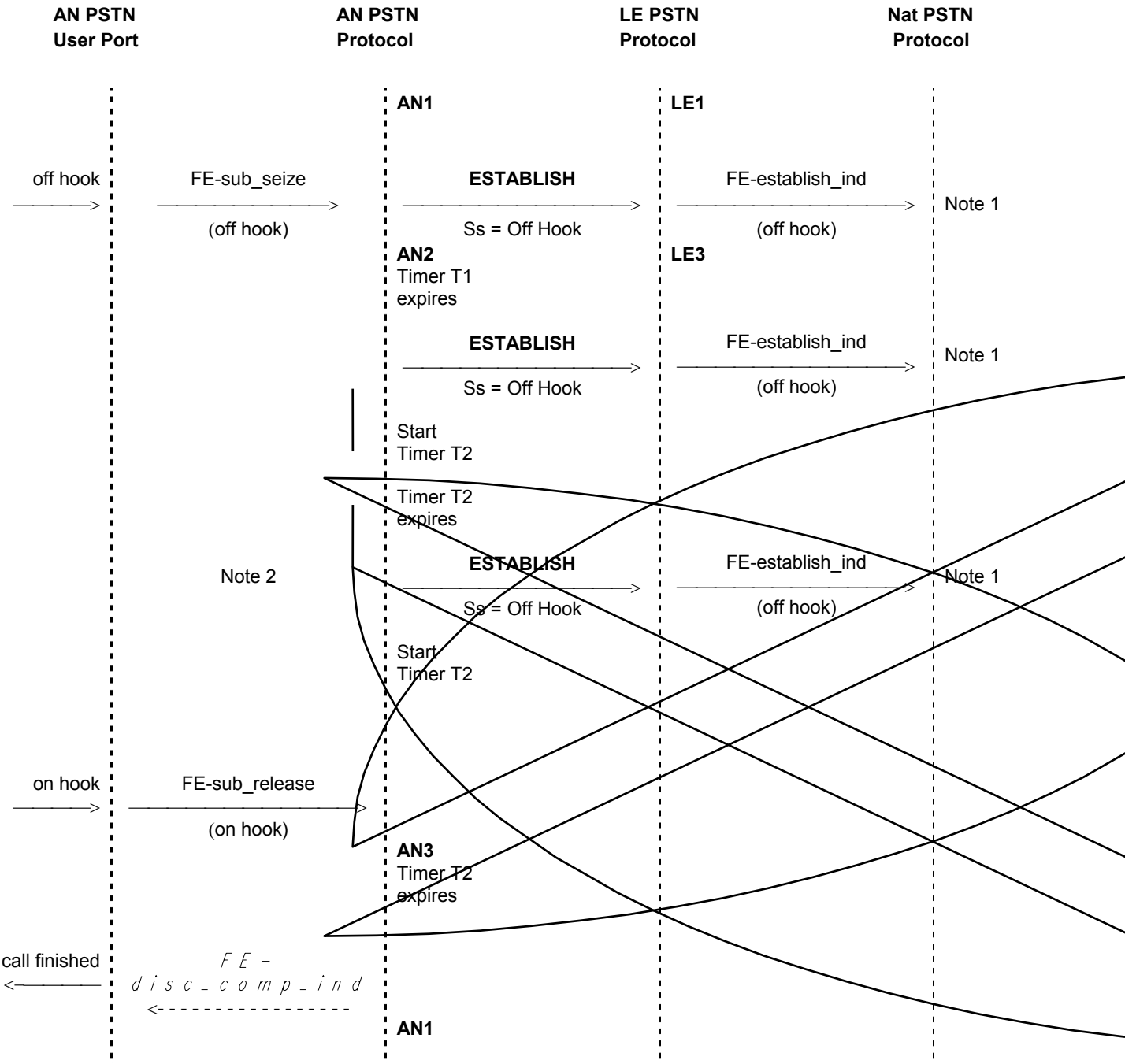


**NOTES**

1. When the V5 port is to be blocked the LE Management process notifies the LE_PSTN_Protocol process which sends a DISCONNECT COMPLETE message to the AN and an FE-disc_comp_ind to the National_PSTN_Protocol process.
2. When the V5 port is to be blocked the AN Management process notifies the AN_PSTN_Protocol process, AN_PSTN_User_Port process and the Analogue Port process.
    - The AN_PSTN_Protocol process sends a DISCONNECT COMPLETE message to the LE.
    - The AN_PSTN_User_Port process goes to the free state.
    - The Analogue Port process shall continue applying the pulsed signal (i.e. SPM) and store the received block primitive (see 5.2.3.1).
3. When the V5 port is unblocked the AN Management process notifies the AN_PSTN_Protocol process, AN_PSTN_User_Port process and the Analogue Port process. The AN_PSTN_Protocol process will return to the Null state. The AN_PSTN_User_Port process will return to the Free state. The Analogue Port process acts in accordance with 5.2.3.1 and thus will complete applying the pulsed signal (i.e. SPM) and store the received unblock primitive. Upon completion of the pulsed signal (i.e. SPM) all stored primitives will be processed, which will result in the Analogue Port process returning to the free state.
4. If a call arrival indication for a new call is received while SPM pulses are still being sent to the user, the Analogue Port process will return a no resources primitive (see 5.2.3.1.4).

## 5.4.12. EXCHANGE OVERLOAD

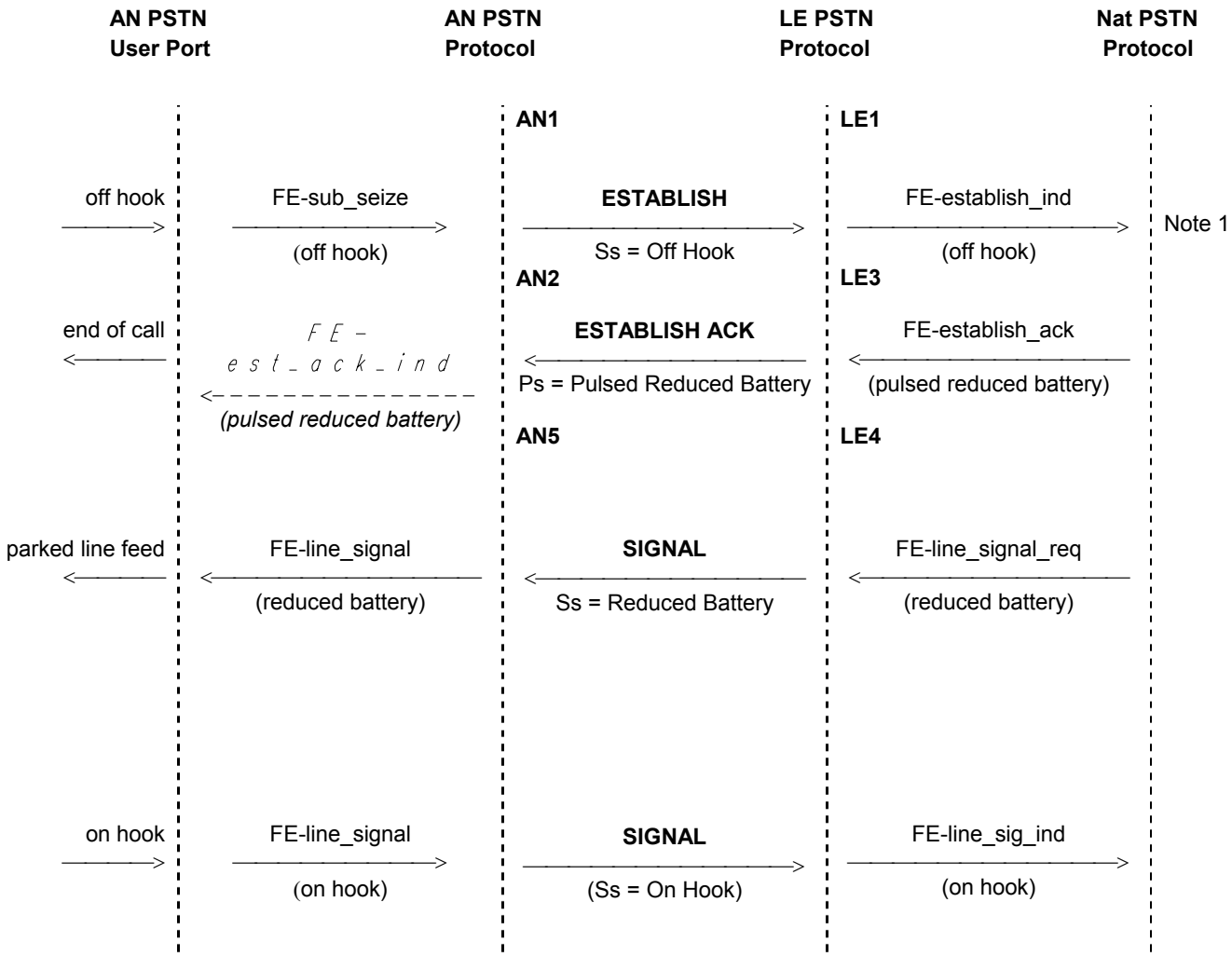
### 5.4.12.1. Off-hook during overload - ETSI Sequence.




**NOTES**

1. The LE is in overload and thus discards the received primitive.
2. This set of events is repeated until the sub goes on hook. There is no limit to the number of times T2 expires and is restarted.

### 5.4.12.2. Alternative 1 for Off-hook during overload.

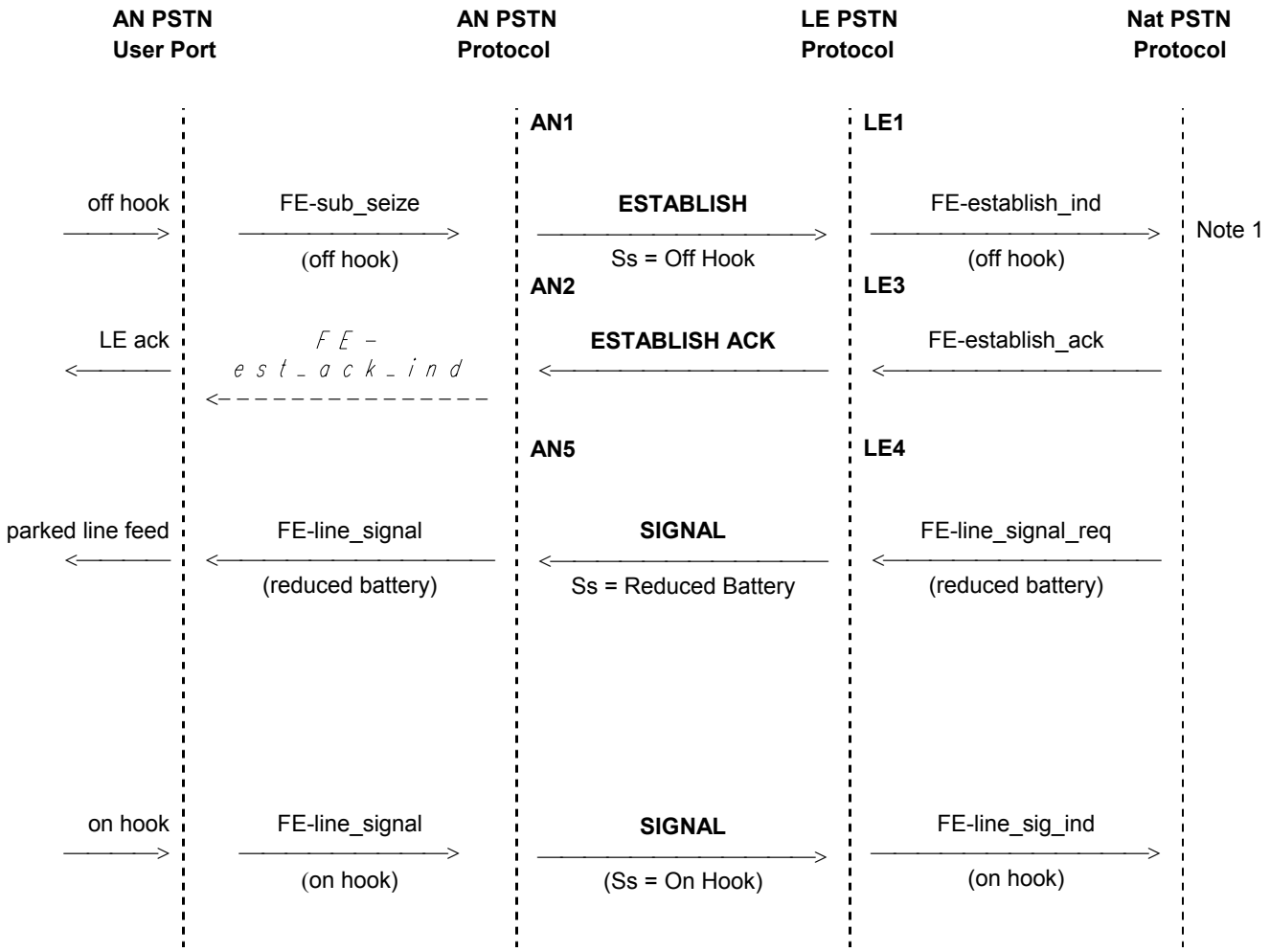



From this point the normal call cleardown sequence applies.

**NOTES**

1. The LE is in overload and thus rejects the outgoing call attempt.

### 5.4.12.3. Alternative 2 for Off-hook during overload.

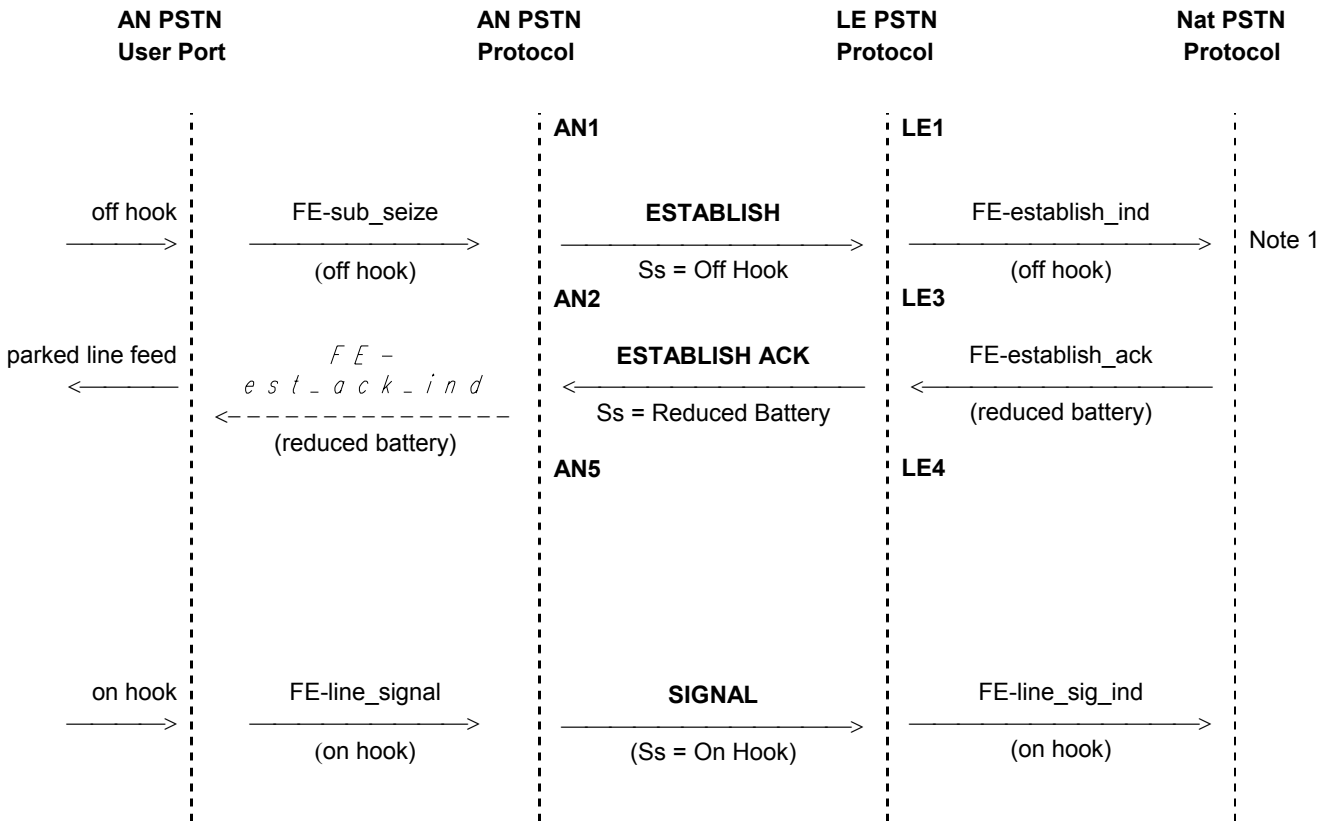



From this point the normal call cleardown sequence applies.

**NOTES**

1. The LE is in overload and thus rejects the outgoing call attempt.

### 5.4.12.4. Alternative 3 for Off-hook during overload.



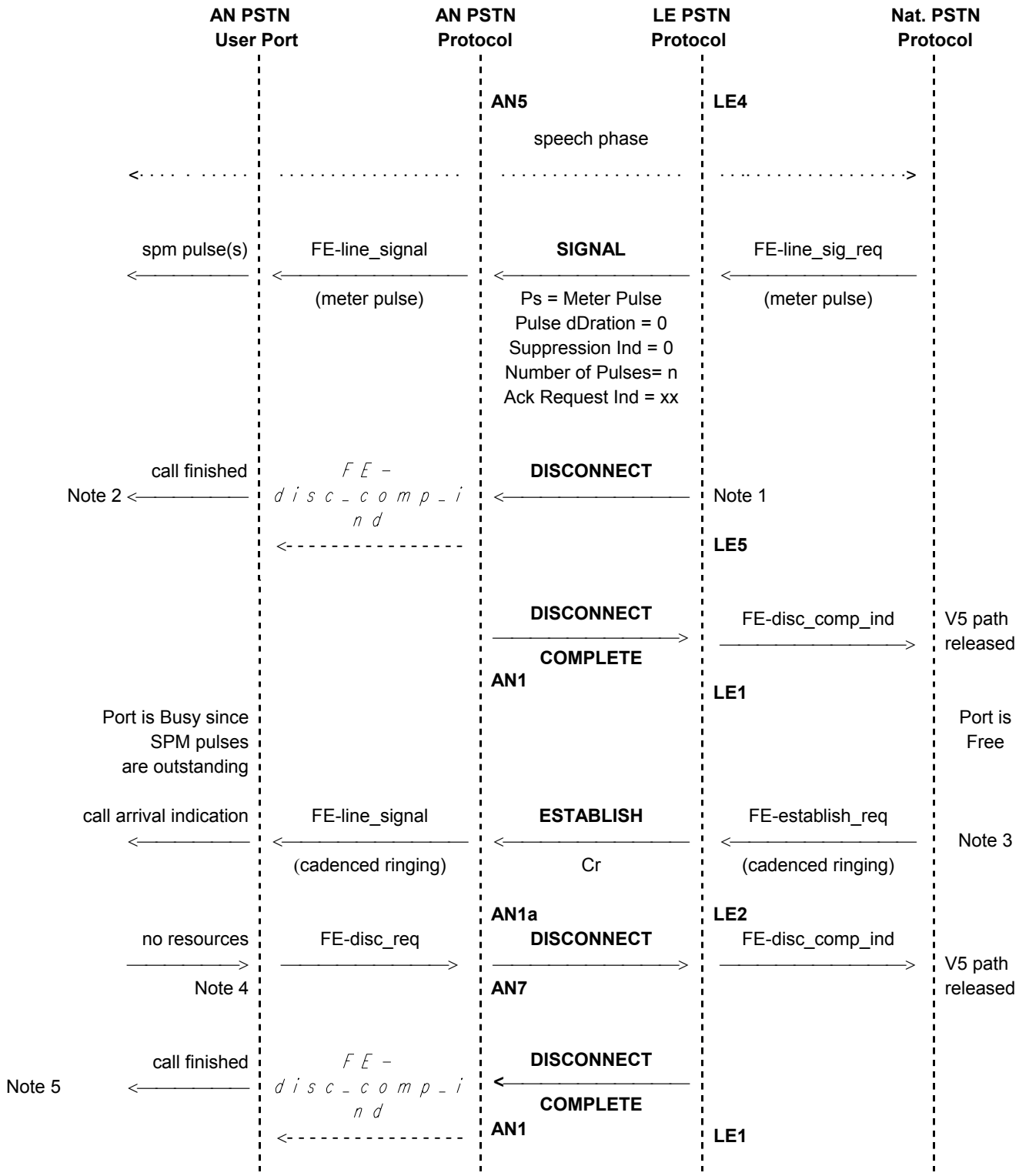

From this point the normal call cleardown sequence applies.

**NOTES**

1. The LE is in overload and thus rejects the outgoing call attempt.

## 5.4.13. MISALIGNMENT OF AN AND LE

### 5.4.13.1. New Incoming Call Presented by LE is rejected by the AN as a Result of Executing Autonomous Action 5.2.3.1.4



**NOTES**

1. LE initiates call clearing due to non receipt of SIGNAL ACK message (i.e. expiry of timer Tt).
2. Since SPM pulses are outstanding the call finished primitive is stored as defined by clause 5.2.3.1.1.
3. The LE offers a new incoming call to the AN since the port is marked as free within the LE.
4. Since SPM pulses are still outstanding the analogue port rejects the incoming call by sending the analogue control primitive no resources, as defined by 5.2.3.1.4.
5. Since SPM pulses are outstanding the call finished primitive is stored as defined by clause 5.2.3.1.1.
   The stored primitives will be processed once all SPM pulses have been delivered as defined in clause 5.2.3.2.2.

# 6. LOOP CALLING PBX

## 6.1. INTRODUCTION

Clause 3 of this specification describes the method by which the UK PSTN V5 Mapping Requirements are specified using an assumed functional architecture based on a number of inter-acting processes (See Figure 2). A general outline description of the function of each process is also given in Clause 3.

This Clause of the Specification uses the method described in Clause 3 to detail the specific requirements necessary for a Loop Calling PBX (LC-PBX) application. This functionality is described in terms of the Analogue Port process and the Call Control process.

- Subclause 6.2 details the requirements for the Analogue Port process.
- Subclause 6.3 details the requirements for the Call Control process.
- Subclause 6.4 contains a number of valid call cases in the form of Message Sequence Charts (MSCs).

## 6.2. ANALOGUE PORT PROCESS

This Subclause describes the Loop Calling PBX requirements for the Analogue Port process.

Throughout Clause 6 the term “Analogue Port process” shall be taken to mean “Analogue Port process for the Loop Calling PBX application”.

The Analogue Port process is responsible for:

- Detecting and Validating the analogue signals from the 2-wire analogue Loop Calling PBX line and once validated converting them into internal “analogue line primitives” that are sent to the AN_PSTN_User_Port process.
- Applying analogue signals and conditions to the 2-wire Loop Calling PBX line on receipt of internal analogue line primitives.
- Generating and responding to a number of internal analogue control primitives to and from the AN_PSTN_User_Port process.
- Responding to a number of management primitives from the AN Management process.
- Performing the Autonomous actions detailed in 6.2.3.

The external analogue signals and conditions for a Loop Calling PBX are given in 6.2.1.

The analogue line primitives, analogue control primitives and analogue management primitives are detailed in 6.2.2.

### 6.2.1. Analogue Signals and Conditions

The terms given in this specification to the external analogue signals and conditions used for the Loop Calling PBX (Interface [A]) are given in Tables 29 and 30 along with a brief description of their use or a reference to such a description.

Although the precise characteristics of the external analogue signals and conditions are outside the scope of this specification, some examples of possible characteristics are given in Tables 29 and 30 as an informative description in order to assist general understanding. Reference is also made to other related specifications where available.

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **ON-HOOK** | As for DEL, see Table 23 | |
| **OFF-HOOK** | As for DEL, see Table 23 | |
| **3OkΩ LOOP** | As for DEL, see Table 23 | |
| **DIGITS** | As for DEL, see Table 23 | |
| **REGISTER RECALL** | As for DEL, see Table 23 | |
| **HOOK FLASH** | As for DEL, see Table 23 | |

**Table 29 - Analogue Signals Received by the Analogue Port**

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **NORMAL POWER FEED** | As for DEL, see Table 24 | |
| **REVERSED POWER FEED** | As for DEL, see Table 24 | |
| **DISCONNECT CLEAR** | The Disconnect Clear signal is a short disconnection of either the "Normal Power Feed" or the "Reversed Power Feed" applied by the Analogue Port process. The Disconnect Clear signal may be sent when the PBX is applying either an On-Hook or an Off-Hook signal.<br><br>When the PBX is applying an On-Hook signal the Disconnect Clear indicates that the Local Exchange has accepted the On-Hook and has cleared the call.<br><br>When the PBX is applying an Off-Hook signal the Disconnect Clear indicates that the network has released the call towards the other user. Typical examples could be:<br><br>a) To indicate to the Called PBX that the Calling Party has cleared.<br><br>b) To indicate to the Calling PBX that the Called Party has cleared and that the CSH Timer has expired.<br><br>c) To indicate to the Calling PBX that the outgoing call has been released due to no reply.<br><br>On completion of the Disconnect Clear Signal the Analogue Port process applies Normal Power Feed regardless of the line condition that existed prior to sending the signal | |
| **PARKED LINE FEED** | As for DEL, see Table 24 | |
| **CALL ARRIVAL INDICATION** | As for DEL, see Table 24 | |
| **INITIAL RING** | As for DEL, see Table 24 | |
| **SPM PULSES** | As for DEL, see Table 24 | |

**Table 30 - Analogue Signals and Conditions sent by the Analogue Port**

## 6.2.2. ANALOGUE PRIMITIVES

### 6.2.2.1. Analogue Line Primitives

The analogue line primitives that are passed between the Analogue Port process and the AN_PSTN_User_Port process (Interface [b]) have the same names as their external equivalent but are shown in lower case (see Table 31). Some of the analogue line primitives contain additional instructions for the Analogue Port, e.g. Duration of Pulse.

Not all Analogue Signals have a Line Primitive equivalent, i.e.:

- 30kΩ Loop Signal which is reported to the AN_PSTN_User_Port by means of the analogue control primitive "30kΩ loop change", see Table 33.
- Register Recall Signal which is reported as a Line Primitive "digit 1".

| ANALOGUE SIGNAL at Interface [A] | Analogue Primitive at Interface [b] and [f] | |
|---|---|---|
| | Primitive Name | Additional Instructions |
| ON-HOOK | on hook | none |
| OFF-HOOK | off hook | none |
| 30kΩ LOOP | See 6.2.2.2, Table 33 | on/off |
| DIGITS | digit | Digit Information |
| REGISTER RECALL | digit | Digit Information = 1 |
| NORMAL POWER FEED | normal power feed | none |
| REVERSED POWER FEED | reversed power feed | none |
| DISCONNECT CLEAR | disconnect clear | Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind<br>or<br>Pulse Duration Type,<br>Suppression Indicator |
| PARKED LINE FEED | parked line feed | none |
| CALL ARRIVAL INDICATION | call arrival indication | Cadenced Ringing Type |
| INITIAL RING | initial ring | Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind |
| SPM PULSES | spm pulse | Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind<br>or<br>Pulse Duration Type,<br>Suppression Indicator |
| HOOK FLASH | hook flash | none |

**Table 31 - Analogue Primitives Used for a Loop Calling PBX**

#### 6.2.2.2. Analogue Control Primitives

A number of analogue control primitives are passed between the Analogue Port process and the AN_PSTN_User_Port process (Interface [b]).

The analogue control primitives along with a reference to a short description of their function are given in Tables 32 and 33.

| Analogue Control Primitive | Description |
|---|---|
| **call finished** | As for DEL, see Table 26 |
| **off-hook recognition time update** | As for DEL, see Table 26 |
| **30kΩ change acknowledge** | As for DEL, see Table 26 |
| **LE acknowledge** | As for DEL, see Table 26 |

**Table 32 - Control Primitives Received by the Analogue Port**

| Analogue Control Primitive | Description |
|---|---|
| **30kΩ loop change** | As for DEL, see Table 27 |
| **pulse notification** | As for DEL, see Table 27 |
| **analogue port acknowledge** | As for DEL, see Table 27 |
| **no resources** | As for DEL, see Table 27 |

**Table 33 - Control Primitives Sent by the Analogue Port**

#### 6.2.2.3. Analogue Management Primitives.

A number of analogue management primitives are passed from the AN management process to the Analogue Port process (Interface [i]).

The analogue management primitives along with a reference to a short description of their function are given in Table 34.

| Analogue Management Primitive | Description |
|---|---|
| **Block** | As for DEL, see Table 28 |
| **Unblock** | As for DEL, see Table 28 |
| **Restart** | As for DEL, see Table 28 |

**Table 34 - Analogue Management Primitives**

### 6.2.3. Autonomous Actions of the Analogue Port Process

The subsequent sub-clauses describe the autonomous actions performed by the Analogue Port for a Loop Calling PBX Line.

#### 6.2.3.1. Whilst a Pulsed Signal is being applied

This sub-clause describes the autonomous actions performed whilst a pulsed signal is being applied. A pulsed signal is deemed to be in the process of being applied until all pulses requested in the associated analogue line primitive have been applied for the specified duration. Similar pulses requested in a subsequent analogue line primitive will be treated as a new pulsed signal.

##### 6.2.3.1.1. Receipt of an analogue line or control primitive

The primitive shall be stored and the pulsed signal continues.

##### 6.2.3.1.2. Receipt of a management primitive

The Analogue Port process performs one of the following actions:

a) the primitive is stored and the pulsed signal continues.

or

b) the pulsed signal is truncated without the generation of a pulse notification primitive, all stored primitives are discarded and the management primitive is processed in accordance with the procedures (including the autonomous actions) defined for the receipt of the primitive whilst a pulsed signal is not being applied.

#### 6.2.3.1.3. Receipt of any External Analogue Signal

The actions performed are based on the suppression indicator in the previously received pulsed signal primitive;

a) "no suppression" - If the call is still in progress (i.e. a call finished, restart or block primitive not received), then the external analogue signal shall be processed normally without disrupting the pulsed signal (e.g. ON-HOOK during SPM PULSES). If the call is no longer in progress (i.e. a call finished, restart or block primitive has been received), then the external analogue signal shall be ignored and the pulsed signal shall not be disrupted (e.g. OFF-HOOK during SPM PULSES).

b) "suppression allowed by pre-defined signal from CPE" - If the external signal is pre-defined as "allowed to suppress the pulsed signal" (see note), then it shall be processed normally and the pulsed signal shall be truncated and no pulse notification primitive shall be sent (e.g. OFF-HOOK during INITIAL RING). Otherwise, the analogue signal shall be processed normally without disrupting the pulsed signal.

Note: Within this specification the only suppression allowed by a pre-defined signal for LC-PBX is that an OFF-HOOK signal shall suppress an INITIAL RING signal.

#### 6.2.3.1.4. Receipt of a new incoming call

The incoming call shall be rejected by sending the analogue control primitive "no resources" to the AN_PSTN_User_Port process.

Note: This situation can occur under fault conditions when the LE considers the Analogue Port to be free, but it is busy within the AN (e.g. call arrival indication received whilst SPM PULSES are being applied).

### 6.2.3.2. When a Pulsed Signal completes or is truncated

On completion or truncation of a pulsed signal the actions specified in 6.2.3.2.1 followed by 6.2.3.2.2 below shall be performed.

#### 6.2.3.2.1. Application of Steady Signal

a) If the completed pulsed signal is a DISCONNECT CLEAR, then the Analogue Port process shall autonomously apply NORMAL POWER FEED.

b) For any other pulsed signal, the Analogue Port process shall re-apply the steady signal which was present immediately preceeding the application of the pulse.

#### 6.2.3.2.2. Handling of Stored Primitives

Any analogue line, control or management primitives that were received and stored during the pulsed signal shall be processed in the order that they were received received and in accordance with the procedures (including the autonomous actions) defined for the receipt of the primitive whilst a pulsed signal is not being applied.

#### 6.2.3.3. Receipt of Call Finished primitive while a pulsed signal is not being applied

The action of the Analogue Port process is dependant on the setting of the disconnect clear primitive indicator and whether the CPE is applying an ON-HOOK or OFF-HOOK signal.

##### 6.2.3.3.1.Disconnect Clear Primitive Indicator = Received

a) If the CPE is applying an ON-HOOK then the Analogue Port process shall reset all line conditions and recognition times to their pre-defined default values, set the disconnect clear primitive indicator to “not received” and return to the free state.

b) If the PBX is applying an OFF-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values and set the disconnect clear primitive indicator to “not received”.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, send an off hook primitive to the AN_PSTN_User_Port process if the PBX is still applying OFF-HOOK. Otherwise, if the CPE is applying ON-HOOK, then the free state is entered.

##### 6.2.3.3.2.Disconnect Clear Primitive Indicator = Not Received

a) If the PBX is applying an ON-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values.

II. Optionally send a DISCONNECT CLEAR signal for the pre-defined duration.

III. If a DISCONNECT CLEAR is applied, then return to the free state when the pulse completes. Otherwise immediately return to the free state.

b) If the PBX is applying an OFF-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, send an off hook primitive to the AN_PSTN_User_Port process if the PBX is still applying OFF-HOOK. Otherwise, if the CPE is applying ON-HOOK, then the free state is entered.

#### 6.2.3.4. Receipt of Restart management primitive while a pulsed signal is not being applied

The action of the Analogue Port process is dependant on whether the port is blocked, the setting of the Disconnect Clear Primitive Indicator and whether the CPE is applying an ON-HOOK or OFF-HOOK signal.

If the port is blocked then the Analogue Port process takes no action. If the port is not blocked the Analogue Port process shall act as follows:

##### 6.2.3.4.1.Disconnect Clear Primitive Indicator = Received

a) If the PBX is applying an ON-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values and set the disconnect clear primitive indicator to “not received”.

II. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status. This action is performed irrespective of

whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

III. If 30kΩ loop capability is not supported, then the free state is entered.

b) If the PBX is applying an OFF-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values and set the disconnect clear primitive indicator to “not received”.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal the Analogue Port process shall perform either (i) or (ii), followed by (iii).

i. If the CPE is still applying OFF-HOOK, then send an off hook primitive to the AN_PSTN_User_Port process.

ii. If the CPE is applying ON-HOOK, then enter the free state.

iii. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity on return to the free state. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

**6.2.3.4.2. Disconnect Clear Primitive Indicator = Not Received**

a) If the PBX is applying an ON-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values.

II. Optionally send a DISCONNECT CLEAR signal for the pre-defined duration.

III. If a DISCONNECT CLEAR signal is applied, then the following actions are performed upon completion of the pulsed signal. Otherwise the actions are performed immediately:

i. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

ii. If 30kΩ loop capability is not supported, then return to the free state.

b) If the PBX is applying an OFF-HOOK then the Analogue Port process shall:

I. Reset all line conditions and recognition times to their pre-defined default values.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal the Analogue Port process shall perform either (i) or (ii), followed by (iii).

i. If the CPE is still applying OFF-HOOK, then send an off hook primitive to the AN_PSTN_User_Port process.

ii. If the CPE is applying ON-HOOK, then enter the free state.

iii. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity on return to the free state. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

#### 6.2.3.5. Receipt of Block management primitive while a pulsed signal is not being applied

The action of the Analogue Port process is dependant on the setting of the disconnect clear primitive indicator and whether the PBX is applying an ON-HOOK or OFF-HOOK signal.

##### 6.2.3.5.1.Disconnect Clear Primitive Indicator = Received

a) If the PBX is applying an ON-HOOK then the Analogue Port process shall set the disconnect clear primitive indicator to “not received” and block the port to incoming and outgoing calls.

b) If the PBX is applying an OFF HOOK then the Analogue Port process shall:

I. set the disconnect clear primitive indicator to “not received”.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, the port shall be blocked to incoming and outgoing calls.

##### 6.2.3.5.2. Disconnect Clear Primitive Indicator = Not Received

a) If the PBX is applying an ON-HOOK then the Analogue Port process shall:

I. Optionally send a DISCONNECT CLEAR signal for the predefined duration.

II. If a DISCONNECT CLEAR signal is applied, then block the port to incoming and outgoing calls upon completion of the signal. Otherwise immediately block the port to incoming and outgoing calls.

b) If the PBX is applying an OFF-HOOK then the Analogue Port process shall:

I. Send a DISCONNECT CLEAR signal for the predefined duration.

II. Block the port to incoming and outgoing calls upon completion of the signal.

#### 6.2.3.6. General autonomous actions

This sub-clause describes the general autonomous actions which are not covered in the previous clauses.

#### 6.2.3.6.1. Receipt of DIGITS in any valid state

a) If a DIGIT signal in excess of 10 pulses is received from the PBX, the Analogue Port process shall ignore and discard the digit signal. The AN may report the occurrence to the AN Management process.

b) If a DIGIT signal is received from the PBX whilst the Analogue Port process is awaiting an LE acknowledge control primitive, then the DIGIT signal shall be discarded.

#### 6.2.3.6.2. Receipt of OFF-HOOK during the application of CALL ARRIVAL INDICATION

The CALL ARRIVAL INDICATION shall be removed and NORMAL POWER FEED shall be applied.

#### 6.2.3.6.3. Receipt of external 30 kΩ loop signal in any valid state

The 30kΩ loop status shall only be reported to the AN_PSTN_User_Port process when the port is in the free state (i.e. ON-HOOK is being received and no call is present).

#### 6.2.3.6.4. Receipt of steady signal primitive in any valid state

The Analogue Port process shall apply the steady condition indicated by the primitive. If the same steady condition as that already being applied is requested, then the Analogue Port shall make no detectable change to the 2-wire analogue line.

#### 6.2.3.6.5. Receipt of call arrival indication primitive in any valid state

The Analogue Port process shall apply the cadenced ringing type indicated by the call arrival primitive. If the same cadenced ringing type as that already being applied is requested, then the CALL ARRIVAL INDICATION shall continue with no detectable change.

#### 6.2.3.6.6. Receipt of any analogue line primitive in any valid state which requires additional AN resources

If upon receipt of an analogue line primitive requiring AN resources (e.g. call arrival indication requiring a ringer) those resources are unavailable, then a “no resources” control primitive shall be sent to the AN_PSTN_User_Port process.

#### 6.2.3.6.7. Receipt of analogue management primitive Unblock whilst the port is blocked

The Analogue Port process shall remove blocking to incoming and outgoing calls, reset all line conditions and recognition times to their pre-defined default values and return to the free state. If 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

#### 6.2.3.6.8. Receipt of REGISTER RECALL or HOOK FLASH whilst awaiting an LE acknowledge

The REGISTER RECALL or HOOK FLASH signal is discarded and the Analogue Port process remains in the current state.

#### 6.2.3.6.9. Setting of the Disconnect Clear Primitive Indicator

On receipt of a disconnect clear primitive the Analogue Port process sends a DISCONNECT CLEAR signal and sets the disconnect clear primitive indcator to “received”.

#### 6.2.3.7. General error handling autonomous actions

This sub-clause describes the autonomous action performed as a result of applying the general error handling procedures.

##### 6.2.3.7.1. Receipt of unrecognised analogue primitives

If the Analogue Port process receives an analogue primitive not defined in Tables 31 and 32 or is not supported by the AN, then the primitive shall be discarded and optionally a report of the occurrence may be sent to the AN Management process.

##### 6.2.3.7.2. Receipt of unexpected analogue primitives

If an unexpected analogue primitive is received (i.e. not valid for the current state), then the primitive shall be discarded and optionally a report of the occurrence shall be sent to the AN Management process.

## 6.3. CALL CONTROL PROCESS

This Subclause describes the Loop Calling PBX requirements for the Call Control process.

Throughout Clause 6 the term " Call Control process" shall be taken to mean "Call Control process for the Loop Calling PBX application".

The Call Control process represents the call control within the Local Exchange and contains the "National Protocol Entity" referred to in clause 13.1 of ETS 300 324-1 [1].

The Call Control process is responsible for:

- Controlling the establishment and release of calls both to directly connected analogue lines and analogue lines that are served via a V5 Interface.
- Generating and responding to internal analogue line primitives and analogue control primitives to / from the National_PSTN_Protocol process.
- Responding to a number of Analogue Management Primitives from the LE Management process.
- Responding to the V5 control primitive "V5 path released". This is described in 6.3.1.3.

### 6.3.1. Analogue Primitives

#### 6.3.1.1. Analogue Line Primitives

The analogue line primitives passed between the Call Control process and the National_PSTN_Protocol process [Interface "f"] are the same as those that appear at Interface [b], see 6.2.2.1. The values assigned by the Call Control process to the additional instructions e.g. Pulse Duration Type are the same whether a Loop Calling PBX line is directly connected to the LE or is served via V5 and consequently is outside the scope of this specification.

#### 6.3.1.2. Analogue Control Primitives

The analogue control primitives passed between the Call Control process and National_PSTN_Protocol process [Interface "f"] are the same as those that appear at Interface [b], see 6.2.2.2.

#### 6.3.1.3. V5 Path Released Primitive

The "V5 path released primitive" is used to indicate to the call control that the V5 Path has been released and that the user port should be marked as free by the LE. The primitive is normally generated by the National PSTN Protocol process as a result of receipt of a DISCONNECT or DISCONNECT COMPLETE message from the AN.

### 6.3.2. Operation of the Call Control Process

The operation of the Call Control process is the same whether a Loop Calling PBX line is directly connected to the Local Exchange or is served via V5. Consequently the services provided and the manner in which the exchange controls those services is outside the scope of this specification. However a number of valid call cases are shown in the form of Message Sequence Charts in Subclause 6.4 of this specification.

## 6.4. MESSAGE SEQUENCE CHARTS

The MSCs shown in clause 5.4 are also valid for a Loop Calling PBX line (see Note) with the following exceptions:

5.4.2.2. Call Clearing ("A" end clears first, followed by "B"): "B" end
5.4.2.3. Call Clearing ("B" end clears first, followed by "A"): "A" end
5.4.3.1. UNSUCCESSFUL Call (LE clears prior to answer): "A" end
5.4.6.1. "A" Clears, "B" Remains Off Hook, "B" end
5.4.6.2. "A" Remains Off Hook After Dialling Insufficient Digits
5.4.12.2. Alternative 1 for Off Hook during Overload

Additionally a number of MSCs are given in this clause showing other valid call cases for a Loop Calling PBX.

The following assumptions are made within the MSCs

a. SIGNAL ACK messages are excluded from the MSCs but shall be sent in accordance with ETS 300 324-1 [1].

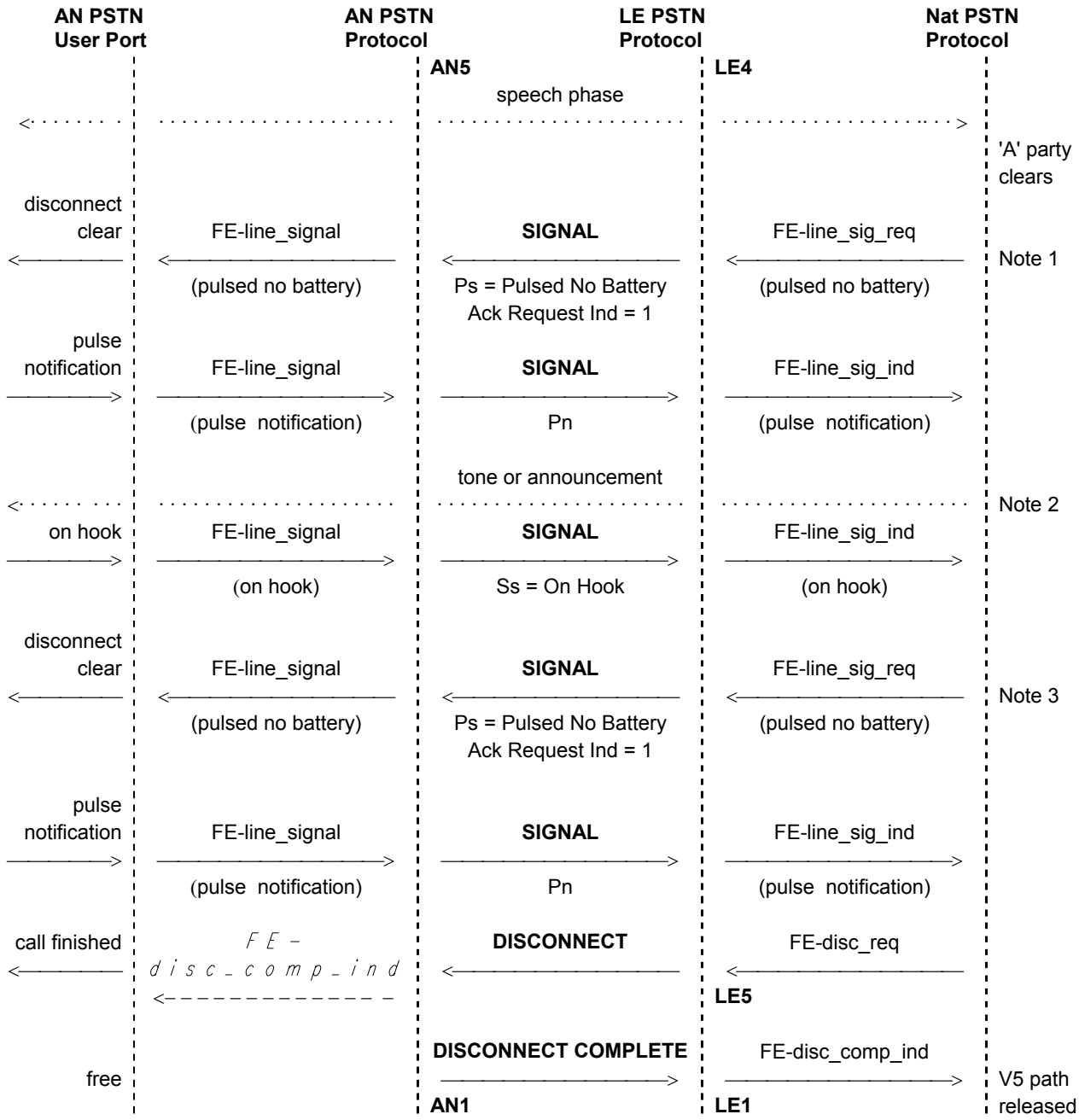
b. The inputs to the AN_PSTN_User_Port process from the customer side are primitives from the Analogue Port process.

c. Function Elements shown in italics are not defined in the standard for V5.1 but the functions they cause are. They are therefore deemed necessary to demonstrate how the function might be achieved but should not constrain an implementation.

d. If no Information Elements are shown in the brackets under a message on the V5 interface then the message carries no optional IEs.

**Note:** Although these MSCs are valid for a Loop Calling PBX line some PBX implementations may not have the functionality necessary to support all of the sequences shown. An example of this could be MSC 5.4.4.1, where the PBX extensions operate in the "first party release" mode and consequently cannot clear and re-answer.

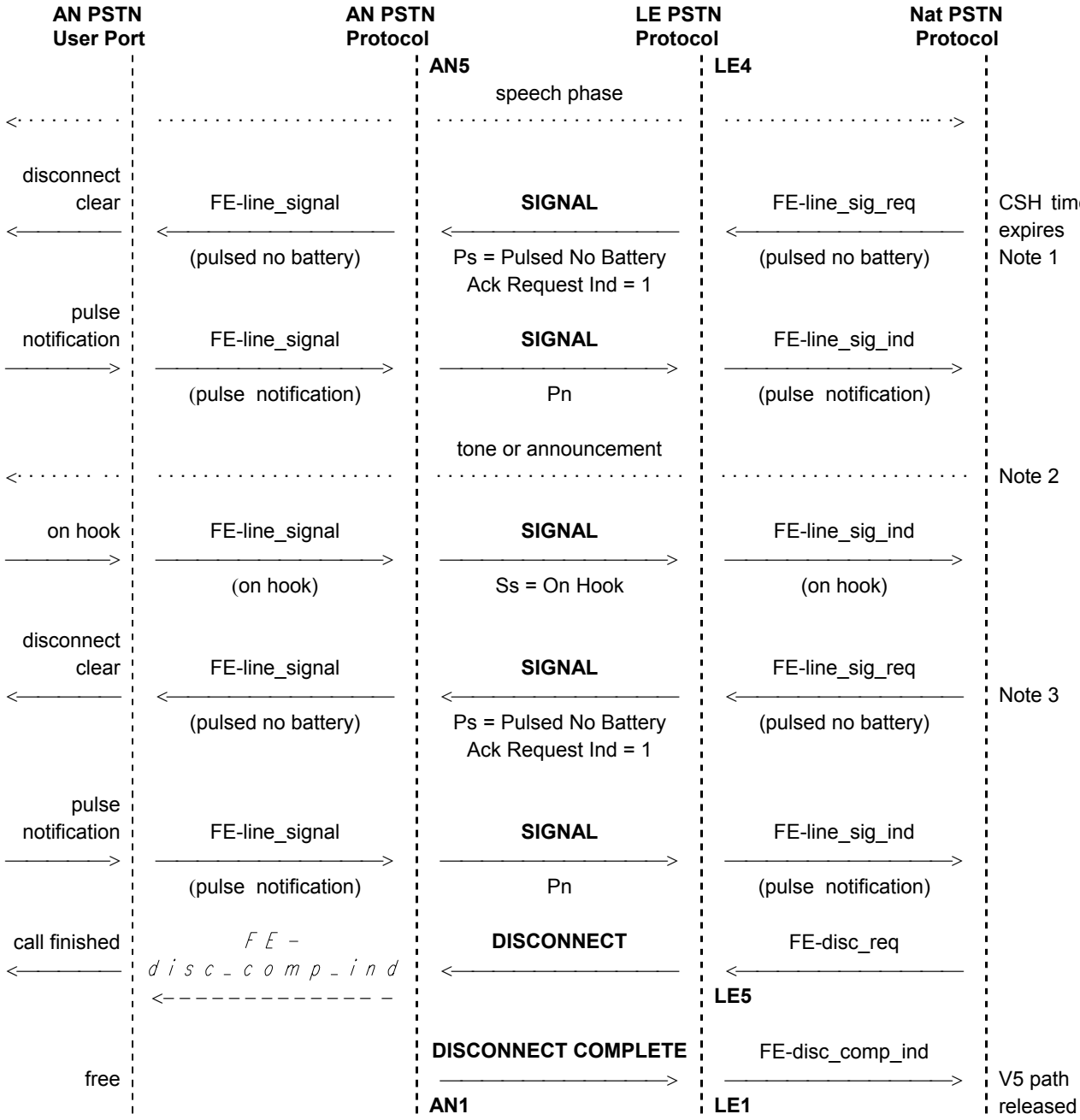
### 6.4.1. LC-PBX - Call Clearing ('A' end clears first, followed by 'B'): 'B' end




**NOTES**

1. This signal may be sent to inform a PBX that it may clear forward if no tones or announcements are desired. The duration of the pulse may be an LE provisioned item.
   In some implementations this first disconnect clear may be requested with the Ack Request Ind = 0.
   This principle may also apply to other MSCs in this document but will not be illustrated.
2. A tone or announcement is only applied if the LE determines that it is required (e.g. to indicate that the other party has cleared). This announcement may be connected prior to the disconnect clear signal.
3. The disconnect clear is sent as confirmation to the PBX that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.

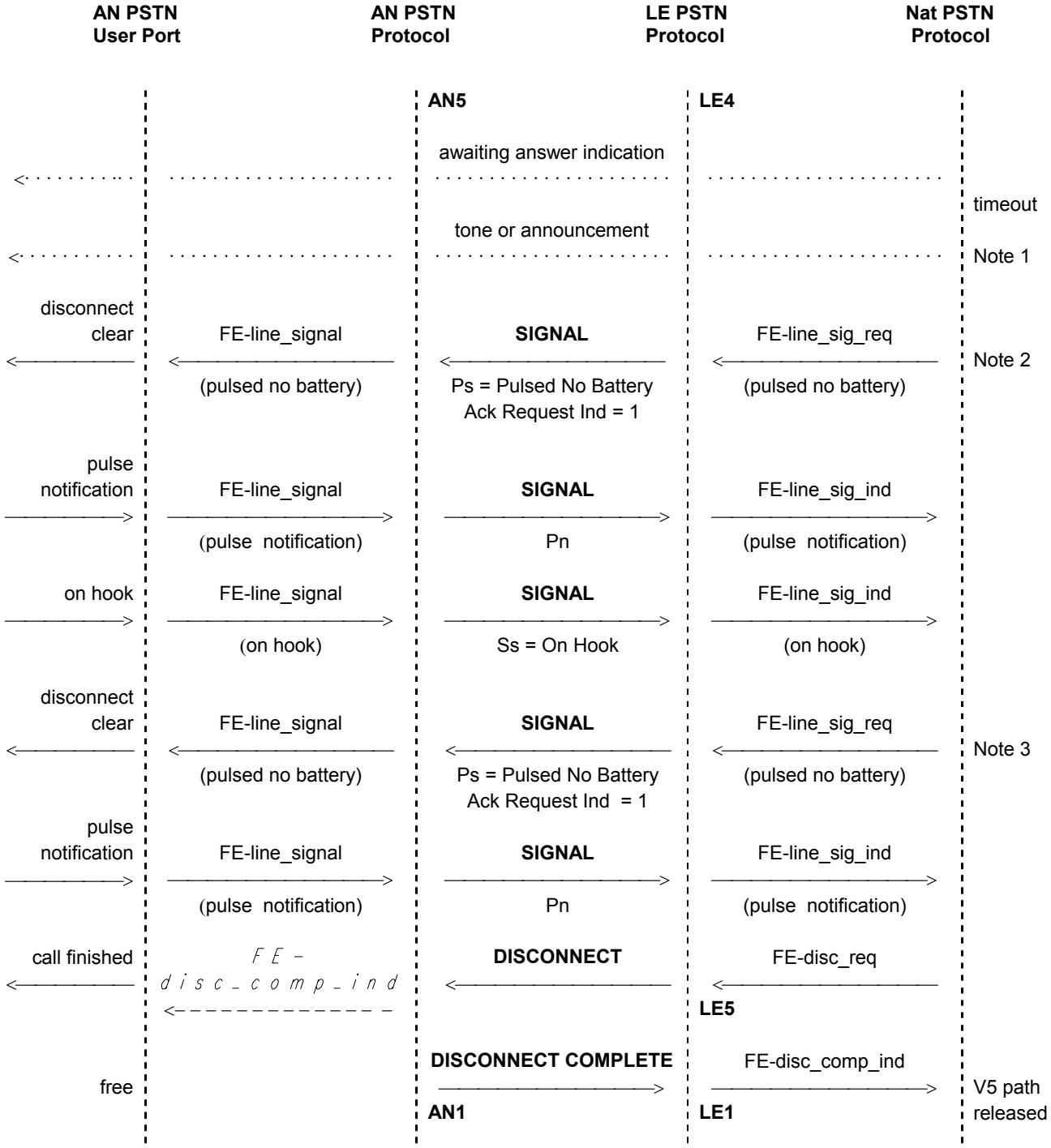
### 6.4.2. LC-PBX - Call Clearing ('B' end clears first, followed by 'A'): 'A' end




**NOTES**

1. The signal may be sent to inform a PBX that it may clear forward if no tones or announcements are desired.
2. A tone or announcement is only applied if the LE determines that it is required. This announcement may be sent prior to the disconnect clear signal.
3. The disconnect clear is sent as confirmation to the PBX that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.

### 6.4.3. LC-PBX - UNSUCCESSFUL Call (LE clears prior to answer): 'A' end

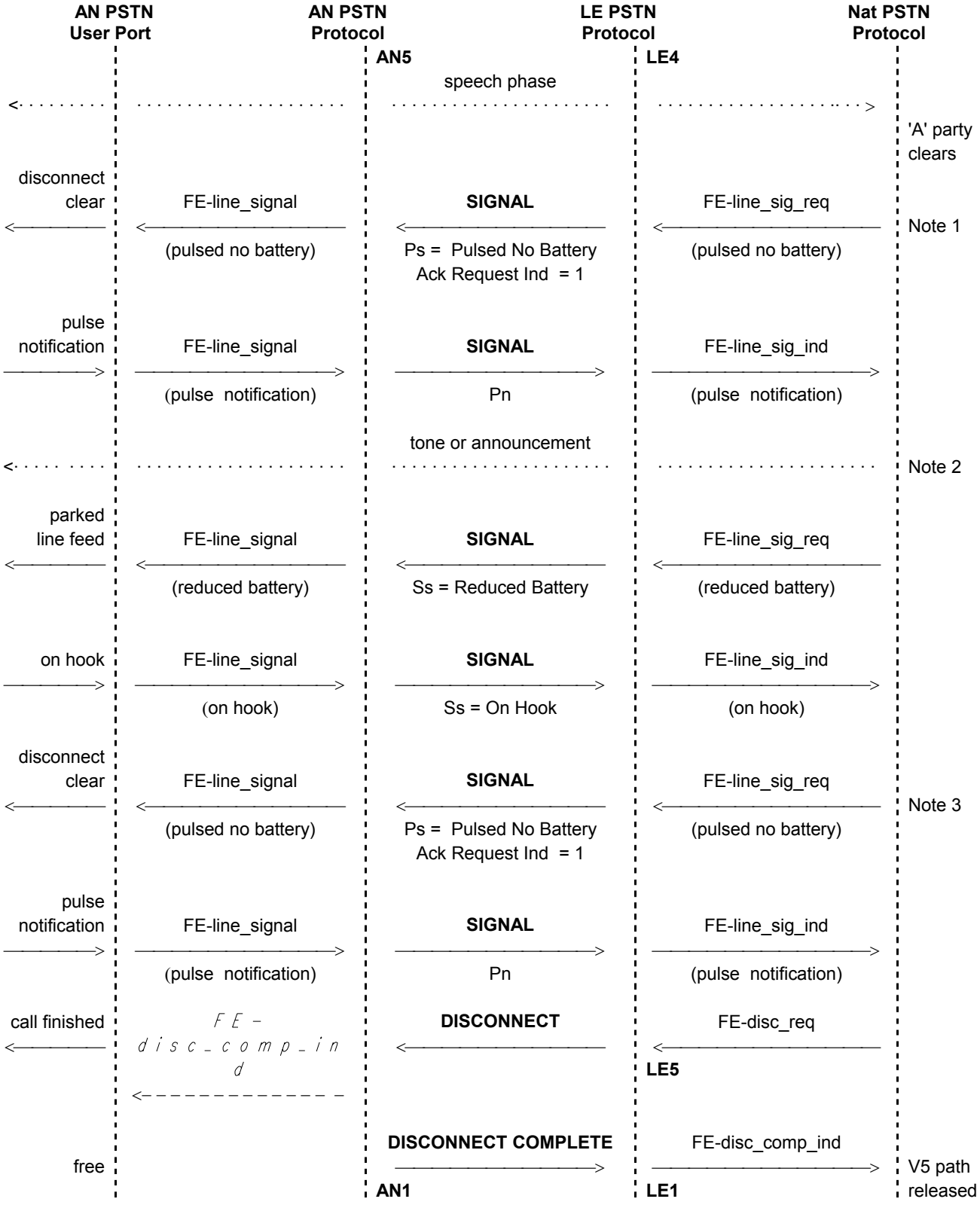



**NOTES**

1. A tone or announcement is only applied if the LE determines that it is required.
2. The signal may be sent to inform a PBX that it may clear forward if no tones or announcements are desired.
3. The disconnect clear is sent as confirmation to the PBX that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.

## 6.4.4. LC-PBX PARKING AND CLEARING FROM PARKED

### 6.4.4.1. 'A' Clears, 'B' Remains Off Hook Until Parked & Then Clears , ‘B’ end



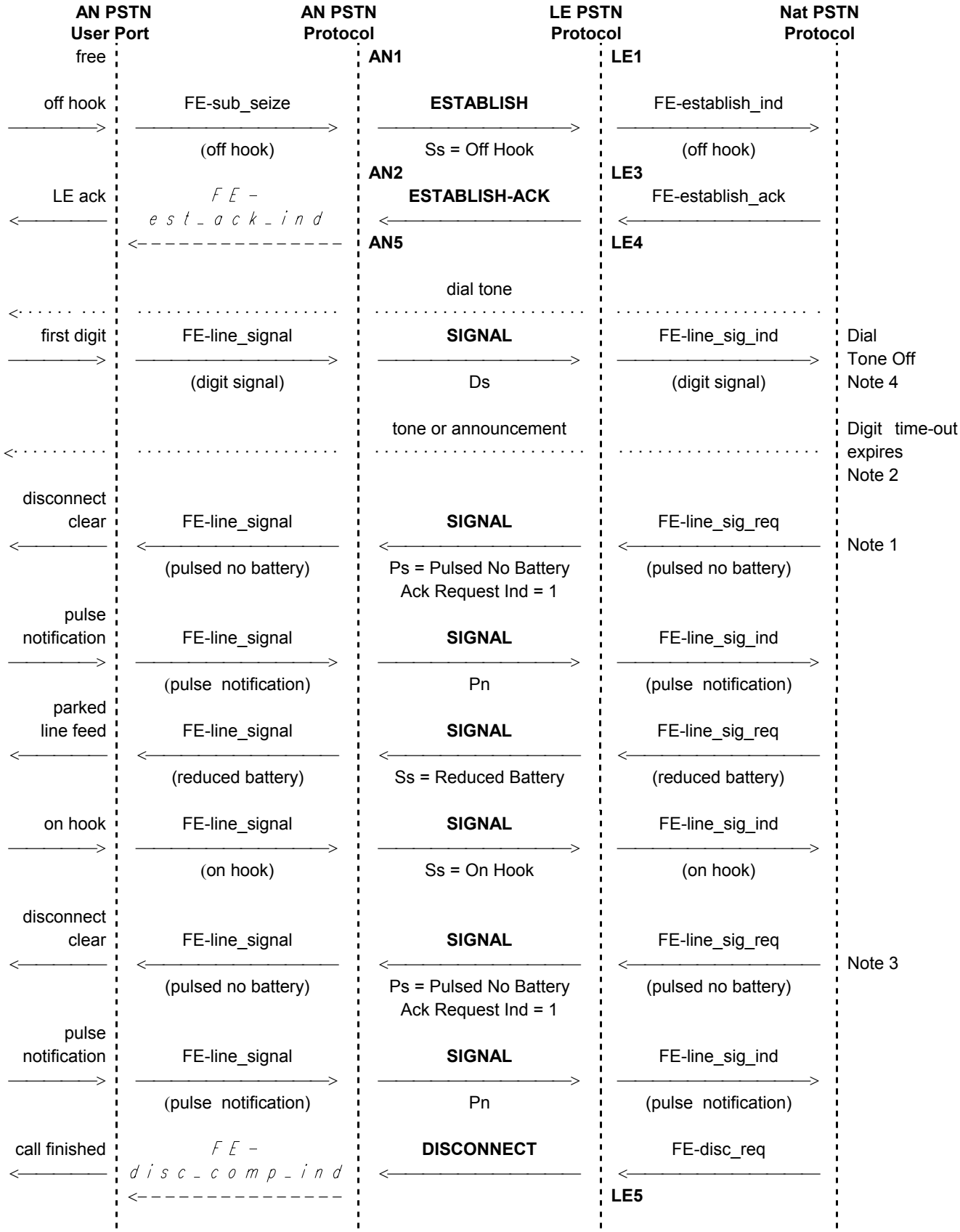
**NOTES**

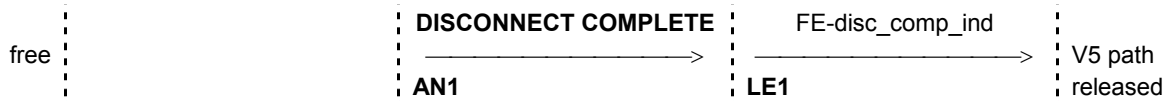
1. The disconnect clear signal is only sent if the LE determines that it is required. The signal may be sent to inform a PBX that it may clear forward if no tones or announcements are desired.

2. A tone or announcement is only applied if the LE determines that it is required. This announcement may be connected prior to the disconnect clear signal.

3. The disconnect clear is sent as confirmation to the PBX that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.

### 6.4.4.2. LC-PBX 'A' Remains Off Hook After Dialling Insufficient Digits



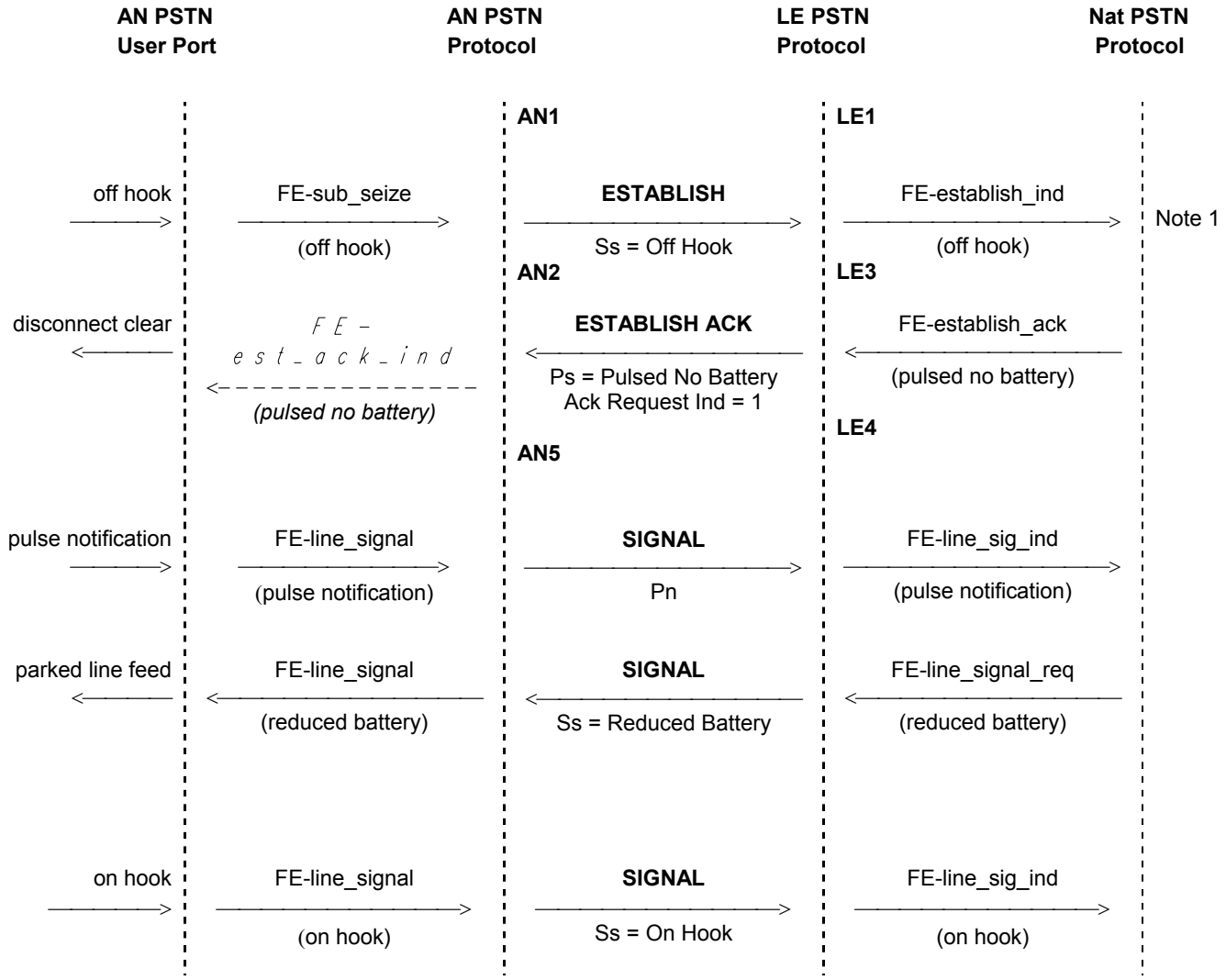

free
DISCONNECT COMPLETE
AN1
FE-disc_comp_ind
LE1
V5 path
released

**NOTES**

1. The disconnect clear signal may be sent to inform a PBX that it may clear forward if no tones or announcements are desired.
2. A tone or announcement is only applied if the LE determines that it is required.
3. The disconnect clear is sent as confirmation to the PBX that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.
4. This sequence shows the digit timeout expiring after the first digit has been received. Subsequent actions are the same if no or more than one but insufficient digits are received within the required time.
5. In the case of DTMF dialling the tones are transported transparently and no messages are required.

## 6.4.5. EXCHANGE OVERLOAD

### 6.4.5.1. Alternative 1 for Off Hook During Overload




From this point the normal call cleardown sequence applies.

**NOTES**

1. The LE is in overload and thus discards the received primitive.

# 7. EARTH CALLING PBX

## 7.1. INTRODUCTION

Clause 3 of this specification describes the method by which the UK PSTN V5 Mapping Requirements are specified using an assumed functional architecture based on a number of inter-acting processes (See Figure 2). A general outline description of the function of each process is also given in Clause 3.

This Clause of the Specification uses the method described in Clause 3 to detail the specific requirements necessary for an Earth Calling PBX (EC-PBX) application. This functionality is described in terms of the Analogue Port process and the Call Control process.

- Subclause 7.2 details the requirements for the Analogue Port process.
- Subclause 7.3 details the requirements for the Call Control process.
- Subclause 7.4 contains a number of valid call cases in the form of Message Sequence Charts (MSCs).

## 7.2. ANALOGUE PORT PROCESS

This Subclause describes the Earth Calling PBX requirements for the Analogue Port process.

Throughout Clause 7 the term “Analogue Port process” shall be taken to mean “Analogue Port process for the Earth Calling PBX application”.

The Analogue Port process is responsible for:

- Detecting and Validating the analogue signals from the 2-wire analogue Earth Calling PBX line and once validated converting them into internal “analogue line primitives” that are sent to the AN_PSTN_User_Port process.
- Applying analogue signals and conditions to the 2-wire Earth Calling PBX line on receipt of internal analogue line primitives.
- Generating and responding to a number of internal analogue control primitives to and from the AN_PSTN_User_Port process.
- Responding to a number of management primitives from the AN Management process.
- Performing the Autonomous actions detailed in 7.2.3.

The external analogue signals and conditions for an Earth Calling PBX are given in 7.2.1.

The analogue line primitives, analogue control primitives and analogue management primitives are detailed in 7.2.2.

### 7.2.1. Analogue Signals and Conditions

The terms given in this specification to the external analogue signals and conditions used for the Earth Calling PBX (Interface [A]) are given in Tables 35 and 36 along with a brief description of their use or reference to such descriptions.

Although the precise characteristics of the external analogue signals and conditions are outside the scope of this specification, some examples of possible characteristics are given in Tables 35 and 36 as an informative description in order to assist general understanding. Reference is also made to other related specifications where available.

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **ON-HOOK** | As for DEL, see Table 23 | |
| **EC-PBX SEIZE** | The EC-PBX Seize signal is an earth connected to the B-Wire by the PBX.<br>Normally the PBX applies no condition to the A-Wire during the EC-PBX Seize signal but some PBX implementations may apply a loop in conjunction with the earth on the B-Wire.<br>The EC-PBX Seize signal indicates that the PBX wishes to make an outgoing call. | |
| **OFF-HOOK** | The Off Hook signal is a relatively low resistance applied across the A and B wires by the PBX.<br>On incoming calls the Off Hook signal indicates that the PBX has answered.<br>On outgoing calls the Off Hook is applied by the PBX in response to the application of Normal Power Feed by the Analogue Port process during the seizing sequence. The transition from EC-PBX Seize signal to Off Hook is described in BS6450 [4]. | BS6450 [4]. |
| **3OkΩ LOOP** | As for DEL, see Table 23 | |
| **DIGITS** | As for DEL, see Table 23 | |
| **REGISTER RECALL** | As for DEL, see Table 23 | |
| **HOOK FLASH** | As for DEL, see Table 23 | |

**Table 35 - Analogue Signals Received by the Analogue Port**

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **IDLE LINE FEED** | The Idle Line Feed is the condition applied by the Analogue Port process to indicate to the PBX that it is free to make or receive a call.<br>Typically the electrical characteristics of the Idle Line Feed is that the potential on the B-Wire is negative with respect to earth. The A-Wire is either disconnected or is connected to earth via a very high impedance (this may be to facilitate detection of a 30kΩ Loop). | |
| **NORMAL POWER FEED** | Typically Normal Power Feed is applied by the Analogue Port process in the following situations:<br>• In response to a EC-PBX Seize signal (i.e. as a PSTN Equipment Seized signal as defined in BS 6450 [4]). This may be an autonomous action or on receipt of an LE acknowledge control primitive.<br>• While awaiting answer on outgoing calls.<br>• During speech.<br>• Prior to sending Call Arrival Indication<br>Typically the electrical characteristics of Normal Power Feed is that the potential of the A-Wire is positive with respect to the B-Wire. | BS 6450 [4] |
| **REVERSED POWER FEED** | Reversed Power Feed is a reversal of the polarity of Normal Power Feed. This condition can be used on outgoing calls to indicate that the called party has answered. | |
| **DISCONNECT CLEAR** | As for Loop Calling PBX , see Table 30 | |
| **PARKED LINE FEED** | As for DEL, see Table 24 | |
| **CALL ARRIVAL INDICATION** | As for DEL, see Table 24 | |
| **SPM PULSES** | As for DEL, see Table 24 | |

**Table 36 - Analogue Signals and Conditions sent by the Analogue Port**

## 7.2.2. ANALOGUE PRIMITIVES

### 7.2.2.1. Analogue Line Primitives

The analogue line primitives that are passed between the Analogue Port process and the AN_PSTN_User_Port process (Interface [b]) have the same names as their external equivalent but are shown in lower case (see Table 37). Some of the analogue line primitives contain additional instructions for the Analogue Port, e.g. Duration of Pulse.

Not all Analogue Signals have a Line Primitive equivalent, i.e.:

- 30kΩ Loop Signal which is reported to the AN_PSTN_User_Port by means of the analogue control primitive "30kΩ loop change", see Table 39.
- Register Recall Signal which is reported as a Line Primitive "digit 1".
- EC-PBX Seize signal which is reported to the AN_PSTN_User_Port process as the analogue line primitive "off hook".
- Idle Line Feed which is applied on receipt of the analogue control primitive "call finished"

| ANALOGUE SIGNAL at Interface [A] | Analogue Primitive at Interface [b] and [f] | |
|---|---|---|
| | Primitive Name | Additional Instructions |
| ON-HOOK | on hook | none |
| OFF-HOOK | off hook | none |
| EC-PBX SEIZE | off hook | none |
| 30kΩ LOOP | See 7.2.2.2, Table 39 | on/off |
| DIGITS | digit | Digit Information |
| REGISTER RECALL | digit | Digit Information = 1 |
| NORMAL POWER FEED | normal power feed | none |
| REVERSED POWER FEED | reversed power feed | none |
| DISCONNECT CLEAR | disconnect clear | Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind<br>or<br>Pulse Duration Type,<br>Suppression Indicator |
| PARKED LINE FEED | parked line feed | none |
| CALL ARRIVAL INDICATION | call arrival indication | Cadenced Ringing Type |
| SPM PULSES | spm pulse | Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind<br>or<br>Pulse Duration Type,<br>Suppression Indicator, |
| HOOK FLASH | hook flash | none |
| IDLE LINE FEED | | |

**Table 37 - Analogue Primitives Used for an Earth Calling PBX**

#### 7.2.2.2. Analogue Control Primitives

A number of analogue control primitives are passed between the Analogue Port process and the AN_PSTN_User_Port process (Interface [b]).

The analogue control primitives along with a short description of their function or a reference to such a description are given in Tables 38 and 39.

| Analogue Control Primitive | Description |
|---|---|
| **call finished** | This analogue control primitive is used to reset the Analogue Port process to the free state. In the free state, the Analogue Port process will cancel all timers and apply Idle Line Feed. |
| **30kΩ change acknowledge** | As for DEL, see Table 26 |
| **LE acknowledge** | This analogue control primitive notifies the Analogue Port process that the off hook primitive sent towards the LE has been received and accepted by the LE Call Control process. At this point NORMAL POWER FEED is applied, if not already being applied, by the Analogue Port process (see autonomous action 7.2.3.6). |

**Table 38 - Control Primitives Received by the Analogue Port**

| Analogue Control Primitive | Description |
|---|---|
| **30kΩ loop change** | As for DEL, see Table 27 |
| **pulse notification** | As for DEL, see Table 27 |
| **analogue port acknowledge** | This analogue control primitive is sent by the Analogue Port process to indicate that the electrical condition associated with one of the following analogue line primitives has been applied to the A and B wires;<br>• normal power feed<br>• call arrival indication<br>**NOTE:** The V5 Protocol (Interface[D]) can only transport the analogue port acknowledge primitive as an ESTABLISH ACK message. Consequently, if the Information Elements associated with the above analogue line primitives are not received in an ESTABLISH message, the analogue port acknowledge primitive cannot be transferred via the V5 link. |
| **no resources** | As for DEL, see Table 27 |

**Table 39 - Control Primitives Sent by the Analogue Port**

**(Continues on next page)**

| Analogue Control Primitive | Description |
|---|---|
| **faulty seize** | This analogue primitive is sent when the Analogue Port process has detected an invalid seize sequence. The following are examples of invalid seize sequences:<br>• The PBX continues to maintain an EC-PBX SEIZE signal after NORMAL POWER FEED has been applied by the Analogue Port process for a period in excess of the Seize Validation Timer.<br>• The PBX removes the EC-PBX SEIZE signal but does not apply OFF HOOK after NORMAL POWER FEED has been applied by the Analogue Port process for a period in excess of Seize Validation Timer. |

**Table 39 (Continued) - Control Primitives Sent by the Analogue Port**

#### 7.2.2.3. Analogue Management Primitives

A number of analogue management primitives are passed from the AN management process to the Analogue Port process (Interface [i]).

The analogue management primitives along with a reference to a short description of their function are given in Table 40.

| Analogue Management Primitive | Description |
|---|---|
| **Block** | As for DEL, see Table 28 |
| **Unblock** | As for DEL, see Table 28 |
| **Restart** | As for DEL, see Table 28 |

**Table 40 - Analogue Management Primitives**

### 7.2.3. Autonomous Actions of the Analogue Port Process

The subsequent sub-clauses describe the autonomous actions performed by the Analogue Port for an Earth Calling PBX Line.

#### 7.2.3.1. Whilst a Pulsed Signal is being applied

This sub-clause describes the autonomous actions performed whilst a pulsed signal is being applied. A pulsed signal is deemed to be in the process of being applied until all pulses requested in the associated analogue line primitive have been applied for the specified duration. Similar pulses requested in a subsequent analogue line primitive will be treated as a new pulsed signal.

##### 7.2.3.1.1. Receipt of an analogue line or control primitive

The primitive shall be stored and the pulsed signal continues.

##### 7.2.3.1.2. Receipt of a management primitive

The Analogue Port process performs one of the following actions:

a) the primitive is stored and the pulsed signal continues.

or

b) the pulsed signal is truncated without the generation of a pulse notification primitive, all stored primitives are discarded and the management primitive is processed in accordance with the procedures (including the autonomous actions) defined for the receipt of the primitive whilst a pulsed signal is not being applied.

##### 7.2.3.1.3. Receipt of any External Analogue Signal

The action performed is based on the suppression indicator in the previously received pulsed signal primitive. In the case of an Earth Calling PBX line all pulsed signals covered by this specification have the suppression indicator set to “no suppression”.

a) If the call is still in progress (i.e. a call finished, restart or block primitive has not been received), then the external analogue signal shall be processed normally without disrupting the pulsed signal (e.g. ON-HOOK during SPM PULSES).

b) If the call is no longer in progress (i.e. a call finished, restart or block primitive has been received), then the external analogue signal shall be ignored and the pulsed signal shall not be disrupted (e.g. OFF-HOOK during SPM PULSES).

##### 7.2.3.1.4. Receipt of a new incoming call

The incoming call shall be rejected by sending the analogue control primitive “no resources” to the AN_PSTN_User_Port process.

Note: This situation can occur under fault conditions when the LE considers the Analogue Port to be free, but it is busy within the AN (e.g. call arrival indication received whilst SPM PULSES are being applied).

#### 7.2.3.2. When a Pulsed Signal completes

On completion of a pulsed signal the actions specified in 7.2.3.2.1 followed by 7.2.3.2.2 below shall be performed.

##### 7.2.3.2.1. Application of Steady Signal

a) If the completed pulsed signal is a DISCONNECT CLEAR, then the Analogue Port process shall autonomously apply NORMAL POWER FEED.

b) For any other pulsed signal, the Analogue Port process shall re-apply the steady signal which was present immediately preceeding the application of the pulse.

##### 7.2.3.2.2. Handling of Stored Primitives

Any analogue line, control or management primitives that were received and stored during the sending of the pulsed signal shall be processed in the order that they were received and in accordance with the procedures (including the autonomous actions) defined for the receipt of the primitive whilst a pulsed signal is not being applied.

#### 7.2.3.3. Receipt of Call Finished primitive while a pulsed signal is not being applied

The Analogue Port process shall perform either option 7.2.3.3.1 or 7.2.3.3.2 below.

##### 7.2.3.3.1. Signal From PBX Not Checked

The action of the Analogue Port process in this option is dependant on the setting of the disconnect clear primitive indicator.

a) Disconnect Clear Primitive Indicator = Received

The Analogue Port Process shall apply IDLE LINE FEED, set the disconnect clear primitive indicator to “not received” and return to the free state.

b) Disconnect Clear Primitive Indicator = Not Received

The Analogue Port Process shall perform the following:

I. Cancel the Seize Validation Timer if running.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, apply IDLE LINE FEED and return to the free state.

##### 7.2.3.3.2. Signal From PBX Checked

The action of the Analogue Port process in this option is dependant on the setting of the disconnect clear primitive indicator and whether the PBX is applying EC-PBX SEIZE, OFF-HOOK or ON-HOOK.

a) Disconnect Clear Primitive Indicator = Received

The Analogue Port Process shall check the analogue line signal being received from the PBX and act as follows:

I. If an EC-PBX SEIZE or OFF-HOOK is being received, then the Analogue Port process shall send a DISCONNECT CLEAR signal for the predefined duration and on completion of the signal shall act as follows:

i. If an OFF-HOOK is being received, the Analogue Port process shall apply NORMAL POWER FEED if not already applied, send an off hook primitive to the AN_PSTN_User_Port process, set the disconnect clear primitive indicator to “not received” and await an LE acknowledge primitive.

ii. If an EC-PBX SEIZE is being received, then the Analogue Port process shall set the disconnect clear primitive indicator to “not received”, apply IDLE LINE FEED and then act as described in 7.2.3.6.

iii. If an ON-HOOK is being received, then the Analogue Port process shall set the disconnect clear primitive indicator to “not received”, apply IDLE LINE FEED and return to the free state.

II. If an ON-HOOK is being received, then the Analogue Port process shall set the disconnect clear primitive indicator to “not received”, apply IDLE LINE FEED and return to the free state.

b) Disconnect Clear Primitive Indicator = Not Received

The Analogue Port Process shall perform the following:

I. Cancel the Seize Validation Timer if running.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, check the analogue line signal being received from the PBX and act as follows:

i. If an OFF-HOOK is being received, then the Analogue Port process shall apply NORMAL POWER FEED if not already applied, send an off hook primitive to the AN_PSTN_User_Port_process and await an LE acknowledge primitive.

ii. If an EC-PBX SEIZE is being received, then the Analogue Port process shall apply IDLE LINE FEED and then act as described in 7.2.3.6.

iii. If an ON-HOOK is being received, then the Analogue Port process shall apply IDLE LINE FEED and return to the free state.

#### 7.2.3.4. Receipt of Restart management primitive while a pulsed signal is not being applied

The action of the Analogue Port process is dependant on whether or not the port is blocked. If the port is blocked then the Analogue Port process takes no action. If the port is not blocked the Analogue Port process shall perform either option 7.2.3.4.1 or 7.2.3.4.2 below.

##### 7.2.3.4.1. Signal From PBX not Checked

The action of the Analogue Port process in this option is dependant on the setting of the disconnect clear primitive indicator and is unaffected by the signal being received from the PBX.

a) Disconnect Clear Primitive Indicator = Received

The Analogue Port Process shall apply IDLE LINE FEED, set the disconnect clear primitive indicator to “not received” and return to the free state. In addition, if 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity. This action is performed irrespective of

whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

b) Disconnect Clear Primitive Indicator = Not Received

I. Cancel the Seize Validation Timer if running.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal the Analogue Port Process shall apply IDLE LINE FEED and return to the free state. In addition, if 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

#### 7.2.3.4.2. Signal From PBX Checked

The action of the Analogue Port process in this option is dependant on the setting of the disconnect clear primitive indicator and whether the PBX is applying EC-PBX SEIZE, OFF-HOOK or ON-HOOK.

a) Disconnect Clear Primitive Indicator = Received

The Analogue Port Process shall check the analogue line signal being received from the PBX and act as follows:

I. If an EC-PBX SEIZE or OFF-HOOK is being received, then the Analogue Port process shall send a DISCONNECT CLEAR signal for the predefined duration and on completion of the signal shall act as follows:

i. If an OFF-HOOK is being received, the Analogue Port process shall apply NORMAL POWER FEED if not already applied, send an off hook primitive to the AN_PSTN_User_Port process, set the disconnect clear primitive indicator to “not received” and await an LE acknowledge primitive. Additionally, if 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity on return to the free state. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

ii. If an EC-PBX SEIZE is being received, then the Analogue Port process shall set the disconnect clear primitive indicator to “not received”, apply IDLE LINE FEED and then act as described in 7.2.3.6. Additionally, if 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity on return to the free state. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

iii. If an ON-HOOK is being received and 30kΩ loop capability is not supported, then the Analogue Port process shall return to the free state and apply IDLE LINE FEED.

iv. If an ON-HOOK is being received and 30kΩ loop capability is supported, then the Analogue Port process shall apply IDLE LINE FEED and send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

II. If an ON-HOOK is being received and 30kΩ loop capability is not supported, then the Analogue Port process shall, set the disconnect clear primitive indicator to "not received", apply IDLE LINE FEED and return to the free state.

III. If an ON-HOOK is being received and 30kΩ loop capability is supported, then the Analogue Port process shall apply IDLE LINE FEED, set the disconnect clear primitive indicator to "not received" and send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

b) Disconnect Clear Primitive Indicator = Not Received

The Analogue Port Process shall perform the following:

I. Cancel the Seize Validation Timer if running.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, check the analogue line signal being received from the PBX and act as follows:

i. If an OFF-HOOK is being received, then the Analogue Port process shall apply NORMAL POWER FEED if not already applied, send an off hook primitive to the AN_PSTN_User_Port process and await an LE acknowledge primitive. In addition, if 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity on return to the free state. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

ii. If an EC-PBX SEIZE is being received, then the Analogue Port process shall apply IDLE LINE FEED and then act as described in 7.2.3.6. In addition, if 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity on return to the free state. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

iii. If an ON-HOOK is being received and 30kΩ loop capability is not supported, then the Analogue Port process shall return to the free state and apply IDLE LINE FEED.

iv. If an ON-HOOK is being received and 30kΩ loop capability is supported, then the Analogue Port process shall apply IDLE LINE FEED and send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

#### 7.2.3.5. Receipt of Block management primitive while a pulsed signal is not being applied

The Analogue Port process shall perform either option 7.2.3.5.1 or 7.2.3.5.2 below.

##### 7.2.3.5.1.Signal From PBX Not Checked

The action of the Analogue Port process in this option is dependent on the setting of the disconnect clear primitive indicator and is unaffected by the signal being received from the PBX.

a) Disconnect Clear Primitive Indicator = Received

The Analogue Port process shall set the disconnect clear primitive indicator to “not received” and block the port to incoming and outgoing calls.

b) Disconnect Clear Primitive Indicator = Not Received

The Analogue Port process shall:

I. Cancel the Seize Validation Timer if running.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, the port shall be blocked to incoming and outgoing calls.

##### 7.2.3.5.2.Signal From PBX Checked

The action of the Analogue Port process in this option is dependent on the setting of the disconnect clear primitive indicator and the signal being received from the PBX.

a) Disconnect Clear Primitive Indicator = Received

The actions of the Analogue Port process are dependent on the signal from the PBX:

I. If the PBX is applying an ON-HOOK then the Analogue Port process shall set the disconnect clear primitive indicator to “not received” and block the port to incoming and outgoing calls.

II. If the PBX is applying an EC-PBX SEIZE or an OFF-HOOK then the Analogue Port process shall:

i. Set the disconnect clear primitive indicator to “not received”.

ii. Send a DISCONNECT CLEAR signal for the pre-defined duration.

iii. At the end of the DISCONNECT CLEAR signal, the port shall be blocked to incoming and outgoing calls.

b) Disconnect Clear Primitive Indicator = Not Received

Regardless of the signal being received form the PBX the Analogue Port process shall:

I. Cancel the Seize Validation Timer if running.

II. Send a DISCONNECT CLEAR signal for the pre-defined duration.

III. At the end of the DISCONNECT CLEAR signal, the port shall be blocked to incoming and outgoing calls.

#### 7.2.3.6. On Receipt of an EC-PBX SEIZE Signal

The Analogue Port process shall perform either option 7.2.3.6.1 or 7.2.3.6.2 below:

##### 7.2.3.6.1. Apply NORMAL POWER FEED Autonomously

The Analogue Port process shall:

- Send an off hook primitive to the AN_PSTN_User_Port process.
- Apply NORMAL POWER FEED to the PBX.
- Start the Seize Validation Timer (typically 2 seconds).
- Continue as described below.

a) If the PBX replaces the EC-PBX SEIZE signal with an OFF-HOOK signal before the Seize Validation Timer expires, then the Analogue Port process shall stop the timer and subsequent analogue primitives and line signals shall be processed when received or detected.

b) If the Seize Validation Timer expires and the PBX is still applying an EC-PBX SEIZE signal, the Analogue Port process shall:

I. Optionally send a faulty seize primitive to the AN_PSTN_User_Port process.

II. Process any subsequently received analogue primitives or line signals in the normal manner.

c) If the Seize Validation Timer expires and the PBX has removed the EC-PBX SEIZE signal but is applying an ON-HOOK signal then the Analogue Port process shall:

I. Optionally send a faulty seize primitive to the AN_PSTN_User_Port process.

II. Send an on hook primitive to the AN_PSTN_User_Port process.

III. Process any subsequently received analogue primitives or line signals in the normal manner

d) If a disconnect clear primitive is received then the Analogue Port process shall stop the Seize Validation Timer, set the disconnect clear primitive indicator to “received” and apply a DISCONNECT CLEAR signal to the PBX. The Analogue Port process shall process any subsequently received analogue primitives or line signals in the normal manner (see 7.2.3.1 and 7.2.3.2).

e) If a parked line feed primitive is received then the Analogue Port process shall stop the Seize Validation Timer and apply a PARKED LINE FEED to the PBX. Subsequently received analogue primitives or line signals shall be processed in the normal manner.

#### 7.2.3.6.2. Apply Normal Power Feed on Receipt of LE Acknowledge

The Analogue Port Process shall:

- Send an off hook primitive to the AN_PSTN_User_Port process.
- Await an LE Acknowledge primitive from the AN_PSTN_User_Port process.

On receipt of an LE Acknowledge the Analogue Port Process shall:

- Apply NORMAL POWER FEED to the PBX.
- Start the Seize Validation Timer (typically 2 seconds).
- Continue as described below.

a) If the PBX replaces the EC-PBX SEIZE signal with an OFF-HOOK signal before the Seize Validation Timer expires, then the Analogue Port process shall stop the timer and subsequent analogue primitives and line signals shall be processed when received or detected.

b) If the Seize Validation Timer expires and the PBX is still applying an EC-PBX SEIZE signal, the Analogue Port process shall:

I. Optionally send a faulty seize primitive to the AN_PSTN_User_Port process.

II. Process any subsequently received analogue primitives or line signals in the normal manner.

c) If the Seize Validation Timer expires and the PBX has removed the EC-PBX SEIZE signal but is applying an ON-HOOK signal then the Analogue Port process shall:

I. Optionally send a faulty seize primitive to the AN_PSTN_User_Port process.

II. Send an on hook primitive to the AN_PSTN_User_Port process.

III. Process any subsequently received analogue primitives or line signals in the normal manner.

d) If a disconnect clear primitive is received then the Analogue Port process shall stop the Seize Validation Timer if running, set the disconnect clear primitive indicator to “received” and apply a DISCONNECT CLEAR signal to the PBX. The Analogue Port process shall process any subsequently received analogue primitives or line signals in the normal manner (see 7.2.3.1 and 7.2.3.2).

e) If a parked line feed primitive is received then the Analogue Port process shall stop the Seize Validation Timer if running and apply a PARKED LINE FEED to the PBX. Subsequently received analogue primitives or line signals shall be processed in the normal manner.

#### 7.2.3.7. Receipt of an unblock management primitive

The Analogue Port process shall perform either option 7.2.3.7.1 or 7.2.3.7.2 below.

##### 7.2.3.7.1. Signal From PBX Not Checked

The Analogue Port Process shall remove blocking to incoming and outgoing calls, apply IDLE LINE FEED and return to the free state. In addition, if 30kΩ loop capability is supported, then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

##### 7.2.3.7.2. Signal From PBX Checked

The Analogue Port process shall remove blocking to incoming and outgoing calls and shall then act upon the signal being received from the PBX as follows:

a) If an OFF-HOOK is being received, then the Analogue Port process shall apply NORMAL POWER FEED, send an off hook primitive to the AN_PSTN_User_Port process and await an LE acknowledge primitive. In addition, if 30kΩ loop capability is supported then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

b) If an EC-PBX SEIZE is being received, then the Analogue Port process shall apply IDLE LINE FEED and then act as described in 7.2.3.6. In addition, if 30kΩ loop capability is supported then the Analogue Port process shall send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status at the earliest opportunity. This action is performed irrespective of whether or not the AN_PSTN_User_Port process has previously been notified of the 30kΩ loop status.

c) If an ON-HOOK is being received and 30kΩ loop capability is not supported, then the Analogue Port process shall apply IDLE LINE FEED and return to the free state.

d) If an ON-HOOK is being received and 30kΩ loop capability is supported, then the Analogue Port process shall apply IDLE LINE FEED and send a 30kΩ loop change control primitive to the AN_PSTN_User_Port process specifying the current 30kΩ loop status.

#### 7.2.3.8. General autonomous actions

##### 7.2.3.8.1. Receipt of DIGITS in any valid state

The Analogue Port process performs the following sequence of actions;

a) On receipt of a 10 pps DIGIT signal in excess of 10 pulses, the Analogue Port process shall ignore and discard the digit signal. The AN may report the occurrence to the AN Management process.

b) If a DIGIT signal is received whilst awaiting an LE acknowledge control primitive and the seize validation procedure is active, then it shall be discarded.

##### 7.2.3.8.2.Receipt of OFF-HOOK during the application of CALL ARRIVAL INDICATION

The CALL ARRIVAL INDICATION shall be removed and NORMAL POWER FEED shall be applied.

##### 7.2.3.8.3. Receipt of external 30 kΩ loop signal in any valid state

The 30kΩ loop status shall only be reported to the AN_PSTN_User_Port process when the port is in the free state (i.e. ON-HOOK is being received and no call is present).

##### 7.2.3.8.4. Receipt of steady signal primitive in any valid state

The Analogue Port process shall apply the steady condition indicated by the primitive. If the same steady condition as that already being applied is requested, then the Analogue Port shall make no detectable change to the 2-wire analogue line.

##### 7.2.3.8.5. Receipt of call arrival indication primitive in any valid state

The Analogue Port process shall apply the cadenced ringing type indicated by the call arrival primitive. If the same cadenced ringing type as that already being applied is requested, then the CALL ARRIVAL INDICATION shall continue with no detectable change.

##### 7.2.3.8.6. Receipt of any analogue line primitive in any valid state which requires additional AN resources

If upon receipt of an analogue line primitive AN resources (e.g. call arrival indication requiring a ringer) are unavailable, then a “no resources” control primitive shall be sent to the AN_PSTN_User_Port process.

##### 7.2.3.8.7. Receipt of REGISTER RECALL or HOOK FLASH whilst awaiting an LE acknowledge

The REGISTER RECALL or HOOK FLASH signal is discarded and the Analogue Port process remains in the current state.

##### 7.2.3.8.8. Setting of the Disconnect Clear Primitive Indicator

On receipt of a disconnect clear primitive the Analogue Port process sends a DISCONNECT CLEAR signal and sets the disconnect clear primitive indicator to “received”; see also 7.2.3.6.1.d and 7.2.3.6.2.d.

#### 7.2.3.9. General error handling autonomous actions

This sub-clause describes the autonomous action performed as a result of applying the general error handling procedures.

##### 7.2.3.9.1. Receipt of unrecognised analogue primitives

If the Analogue Port process receives an analogue primitive not defined in Tables 37 and 38 or is not supported by the AN, then the primitive shall be discarded and optionally a report of the occurrence may be sent to the AN Management process.

##### 7.2.3.9.2. Receipt of unexpected analogue primitives

If an unexpected analogue primitive is received (i.e. not valid for the current state), then the primitive shall be discarded and optionally a report of the occurrence may be sent to the AN Management process.

## 7.3. CALL CONTROL PROCESS

This Subclause describes the Earth Calling PBX requirements for the Call Control process.

Throughout Clause 7 the term " Call Control process" shall be taken to mean "Call Control process for the Earth Calling PBX application".

The Call Control process represents the call control within the Local Exchange and contains the "National Protocol Entity" referred to in clause 13.1 of ETS 300 324-1 [1].

The Call Control process is responsible for:

- Controlling the establishment and release of calls both to directly connected analogue lines and analogue lines that are served via a V5 Interface.
- Generating and responding to internal analogue line primitives and analogue control primitives to /from the National_PSTN_Protocol process.
- Responding to a number of Analogue Management Primitives from the LE Management process.
- Responding to the V5 control primitive "V5 path released". This is described in 7.3.1.3.

### 7.3.1. Analogue Primitives

#### 7.3.1.1. Analogue Line Primitives

The analogue line primitives passed between the Call Control process and the National_PSTN_Protocol process [Interface "f"] are the same as those that appear at Interface [b], see 7.2.2.1. The values assigned by the Call Control process to the additional instructions e.g. Pulse Duration Type are the same whether an Earth Calling PBX line is directly connected to the LE or is served via V5 and consequently is outside the scope of this specification.

#### 7.3.1.2. Analogue Control Primitives

The analogue control primitives passed between the Call Control process and National_PSTN_Protocol process [Interface "f"] are the same as those that appear at Interface [b], see 7.2.2.2.

#### 7.3.1.3. V5 Path Released Primitive

The “V5 path released primitive” is used to indicate to the call control that the V5 Path has been released and that the user port should be marked as free by the LE. The primitive is normally generated by the National PSTN Protocol process as a result of receipt of a DISCONNECT or DISCONNECT COMPLETE message from the AN.

### 7.3.2. Operation of the Call Control Process

The operation of the Call Control process is the same whether an Earth Calling PBX line is directly connected to the Local Exchange or is served via V5. Consequently the services provided and the manner in which the exchange controls those services is outside the scope of this specification. However a number of valid call cases are shown in the form of Message Sequence Charts in Subclause 7.4 of this specification.

## 7.4. MESSAGE SEQUENCE CHARTS

The MSCs shown in clause 5.4 are also valid for an Earth Calling PBX line (see Note) with the following exceptions:

5.4.1.1. Successful Call (O/G Call including answer): "A" end
5.4.2.2. Call Clearing ("A" end clears first, followed by "B"): "B" end
5.4.2.3. Call Clearing ("B" end clears first, followed by "A"): "A" end
5.4.3.1. UNSUCCESSFUL Call (LE clears prior to answer): "A" end
5.4.5.1. Data Transmission During Ringing - "B" end
5.4.5.2. Data Transmission Prior to Ringing - "B" end
5.4.6.1. "A" Clears, "B" Remains Off Hook, "B" end
5.4.6.2. "A" Remains Off Hook After Dialling Insufficient Digits
5.4.7.1. Outgoing Call Priority
5.4.7.2. Subscriber "B" clears then goes off hook resulting in collision between release of connection from LE and O/G Call
5.4.8.3. Call Forwarding Indication - "A" end
5.4.12.1. Off-hook during overload - ETSI Sequence
5.4.12.2 Alternative 1 for Off Hook During Overload
5.4.12.3 Alternative 2 for Off Hook During Overload
5.4.12.4 Alternative 3 for Off Hook During Overload

The following MSCs, shown in clause 6.4, are also valid for an Earth Calling PBX line:

6.4.1. Call Clearing ("A" end clears first, followed by "B"): "B" end
6.4.2. Call Clearing ("B" end clears first, followed by "A"): "A" end
6.4.3. Unsuccessful Call (LE clears prior to answer): "A" end
6.4.4.1 "A" Clears, "B" Remains Off Hook, "B" end

Additionally a number of MSCs are given in this clause showing other valid call cases for a Earth Calling PBX.

The following assumptions are made within the MSCs

a. SIGNAL ACK messages are excluded from the MSCs but shall be sent in accordance with ETS 300 324-1 [1].

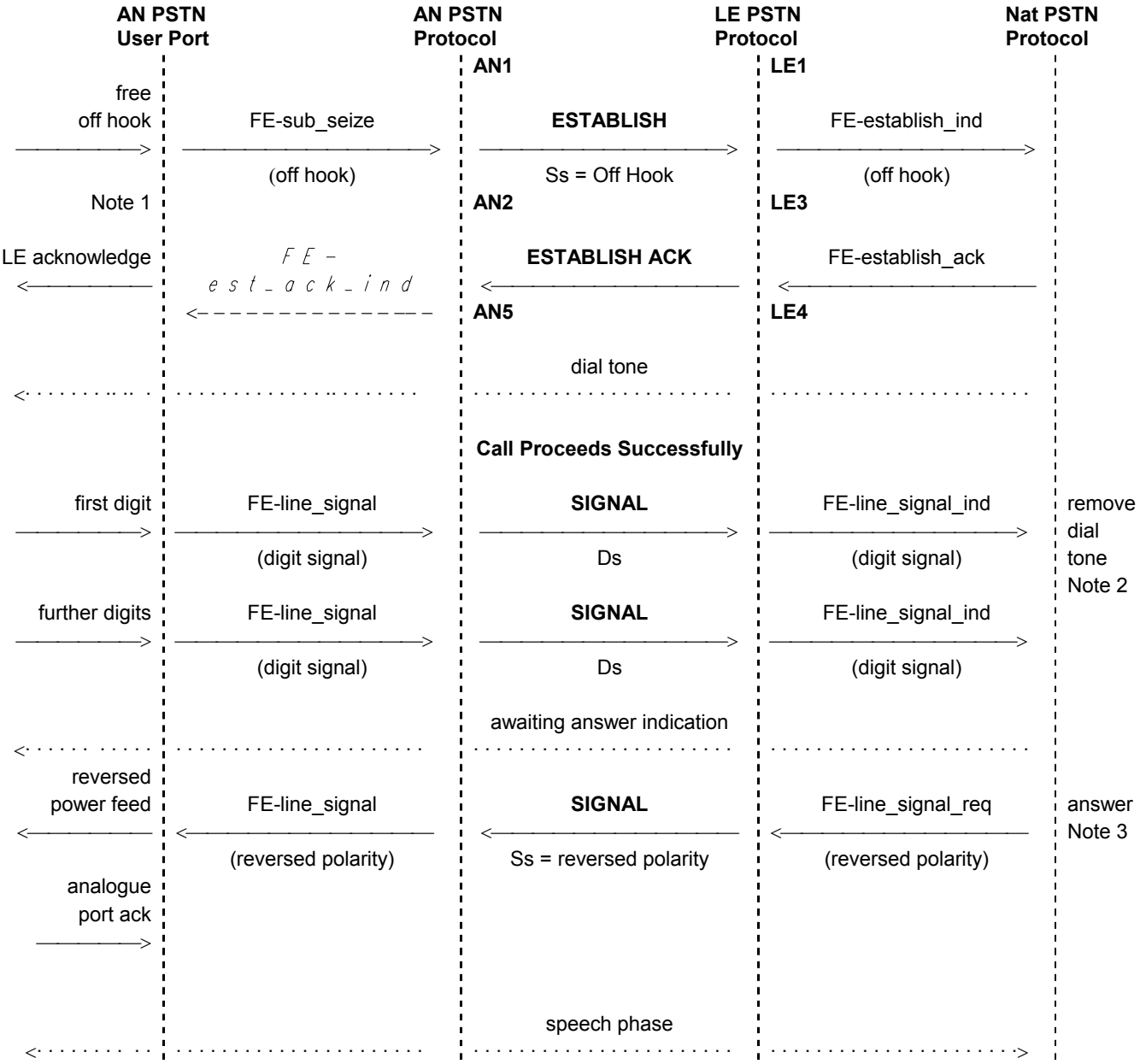
b. The inputs to the AN_PSTN_User_Port process from the customer side are primitives from the Analogue Port process.

c. Function Elements shown in italics are not defined in the standard for V5.1 but the functions they cause are. They are therefore deemed necessary to demonstrate how the function might be achieved but should not constrain an implementation.

d. If no Information Elements are shown in the brackets under a message on the V5 interface then the message carries no optional IEs.

**Note:** Although these MSCs are valid for a Earth Calling PBX line some PBX implementations may not have the functionality necessary to support all of the sequences shown. An example of this could be MSC 5.4.4.1, where the PBX extensions operate in the "first party release" mode and consequently cannot clear and re-answer.

### 7.4.1. EC-PBX - SUCCESSFUL Call (O/G Call including answer): 'A' end

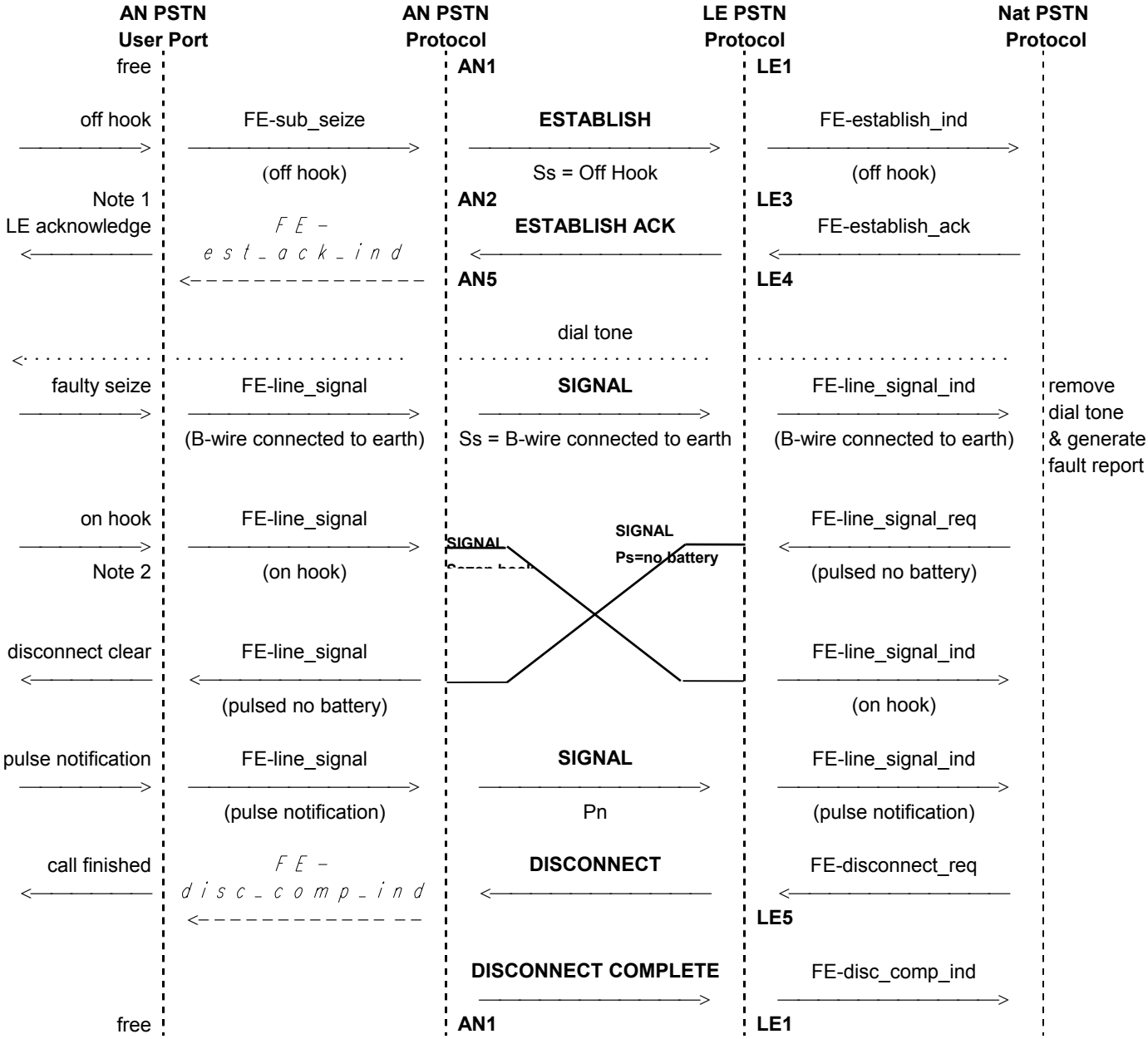



**NOTES**

1. After the sending of NORMAL POWER FEED (i.e. the Analogue Port process connects A-wire to earth), the Analogue Port process runs a seize validation timer during which the PBX should apply the off-hook condition and remove the B-wire from earth for this sequence to be considered as a valid seize. (See 7.2.3.6)
2. In the case of DTMF dialling the tones are transported transparently and no messages are required.
3. This message is only sent if the user port is provisioned for it within the LE. It may be used to notify a CPE that the called subscriber has answered

## 7.4.2. EC-PBX - UNSUCCESSFUL CALLS

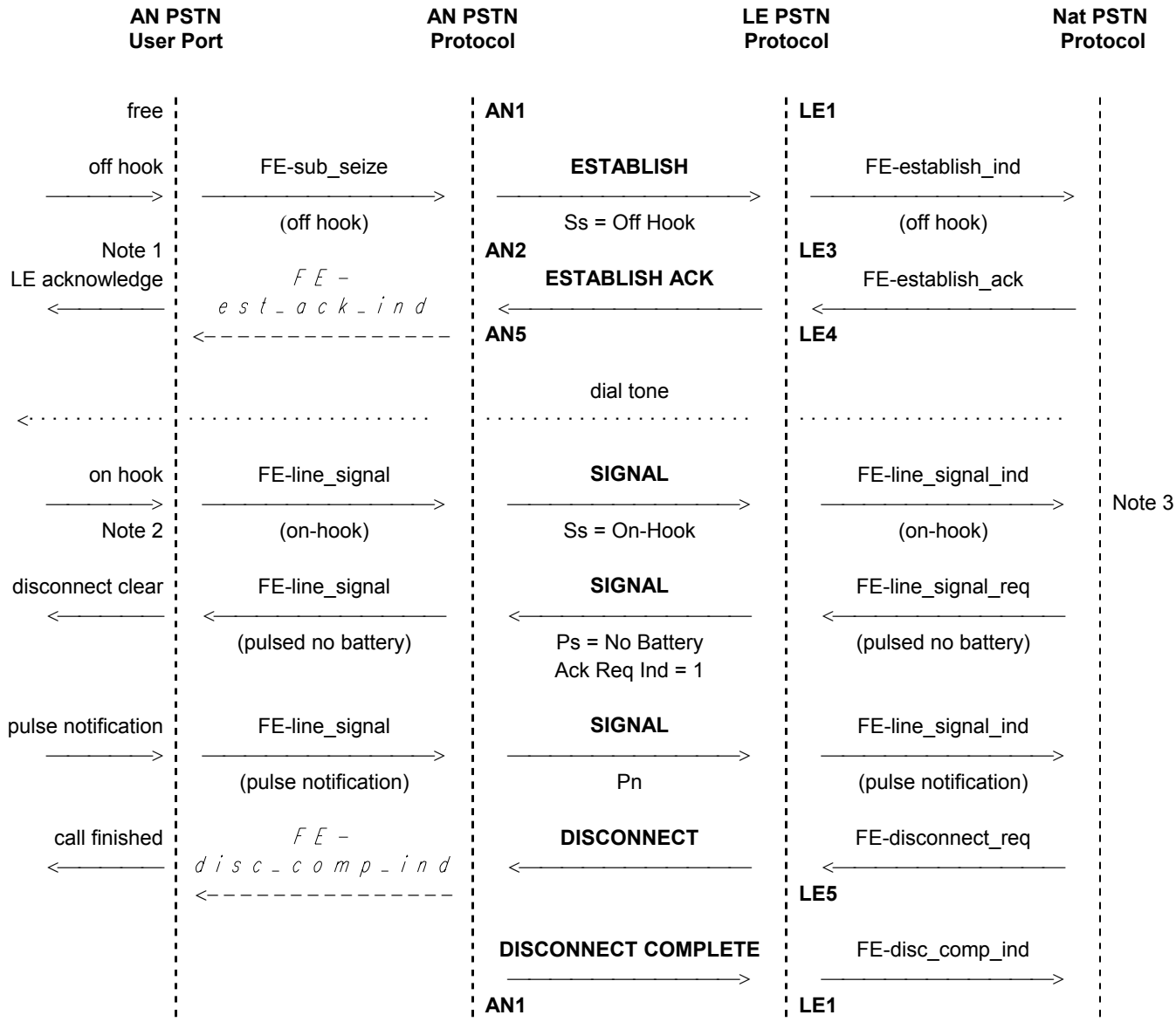
### 7.4.2.1. EC-PBX Faulty Seize: "A" end (PBX Removes EC-PBX SEIZE signal and does not apply OFF HOOK)




**NOTES**

1. After the sending of NORMAL POWER FEED (i.e. the Analogue Port process connects A-wire to earth), the Analogue Port process runs a seize validation timer during which the PBX should apply the off-hook condition and remove the B-wire from earth for this sequence to be considered as a valid seize. (See 7.2.3.6)
2. The PBX removes the EC-PBX SEIZE signal but does not apply an OFF HOOK signal during the seize validation period. This MSC shows the case where the Analogue Port process reports a faulty seize before sending an on hook primitive. The faulty seize primitive may be used by a Local Exchange to generate a fault report.

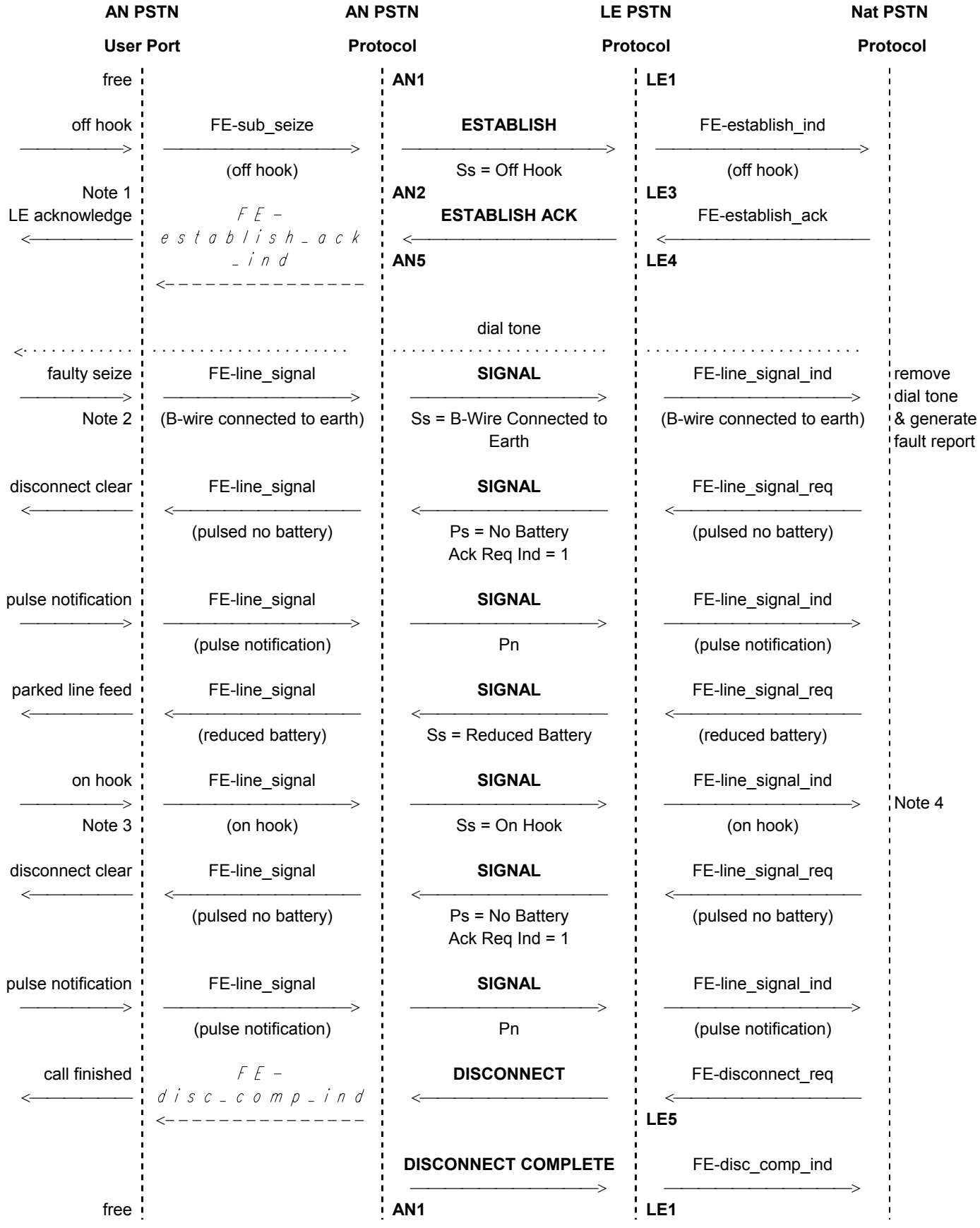
### 7.4.2.2. Alternative EC-PBX Faulty Seize: "A" end (PBX Removes EC-PBX SEIZE signal and does not apply OFF HOOK)




**NOTES**

1. After the sending of NORMAL POWER FEED (i.e. the Analogue Port process connects A-wire to earth), the Analogue Port process runs a seize validation timer during which the PBX should apply the off-hook condition and remove the B-wire from earth for this sequence to be considered as a valid seize. (See 7.2.3.6)
2. The PBX removes the EC-PBX SEIZE signal but does not apply an OFF HOOK signal during the seize validation period. This MSC shows the case where the Analogue Port process does not report a faulty seize before sending an on hook primitive.
3. Dial tone is removed but no fault report is generated.

### 7.4.2.3. EC-PBX Faulty Seize: "A" end (PBX does not remove EC-PBX SEIZE signal)

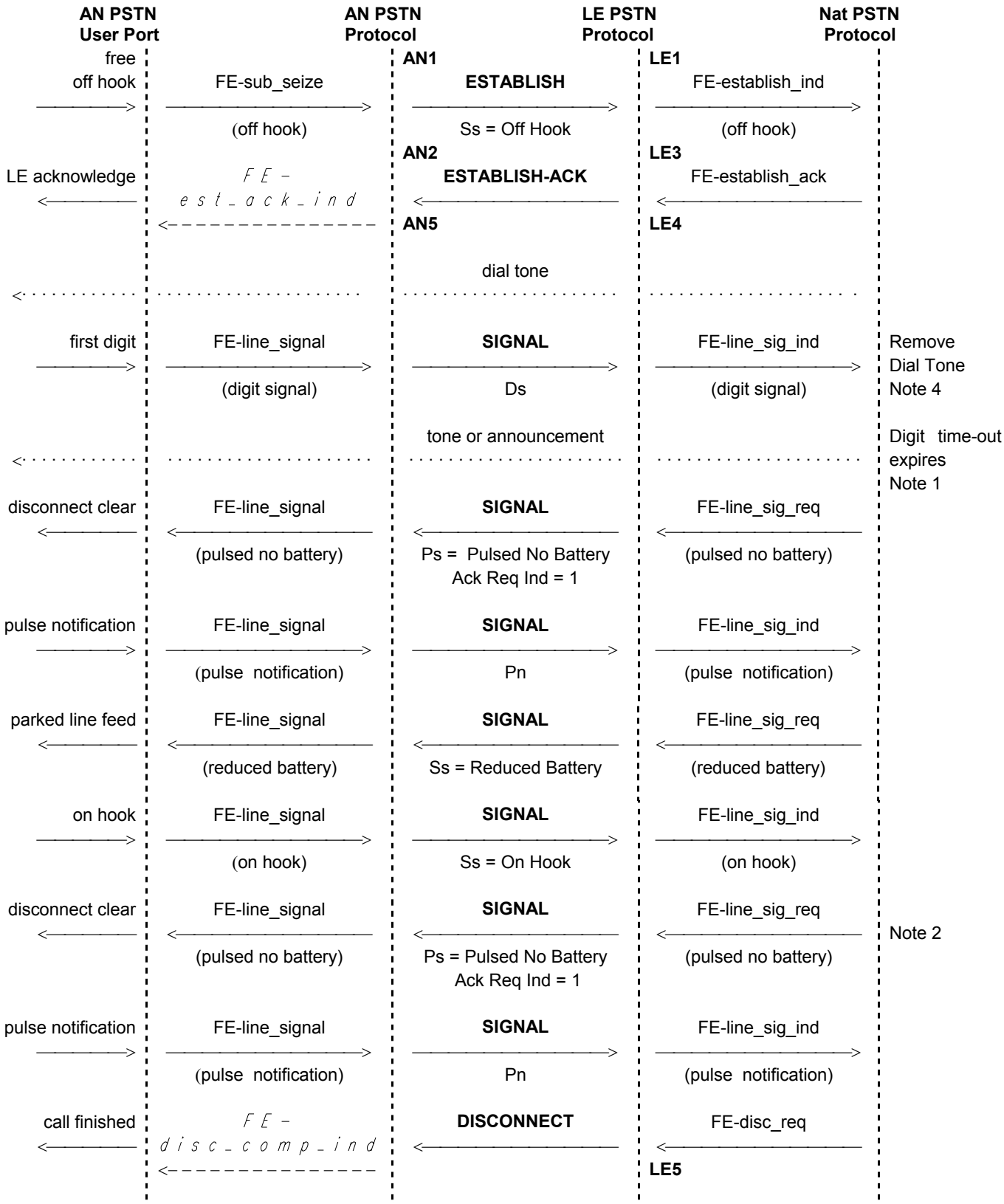


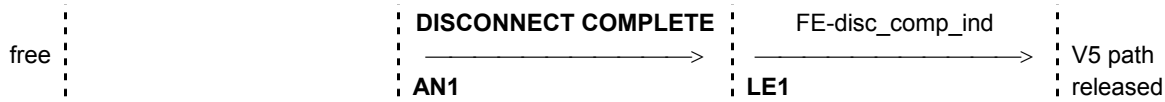
**NOTES**

1. After the sending of NORMAL POWER FEED (i.e. the Analogue Port process connects A-wire to earth), the Analogue Port process runs a seize validation timer during which the PBX should apply the off-hook condition and remove the B-wire from earth for this sequence to be considered as a valid seize. (See 7.2.3.6)
2. The PBX continues to maintain a EC-PBX SEIZE signal after the seize validation period. The Analogue Port process sends a fault seize primitive which may be used by the LE to generate a fault report.
3. The PBX removes the EC-PBX SEIZE signal and replaces it with an ON HOOK signal. The Analogue Port process sends an on hook primitive.
4. The LE initiates the call clearing sequence.

## 7.4.3. PARKING AND CLEARING FROM PARKED

### 7.4.3.1. 'A' REMAINS OFF HOOK AFTER DIALLING INSUFFICIENT DIGITS



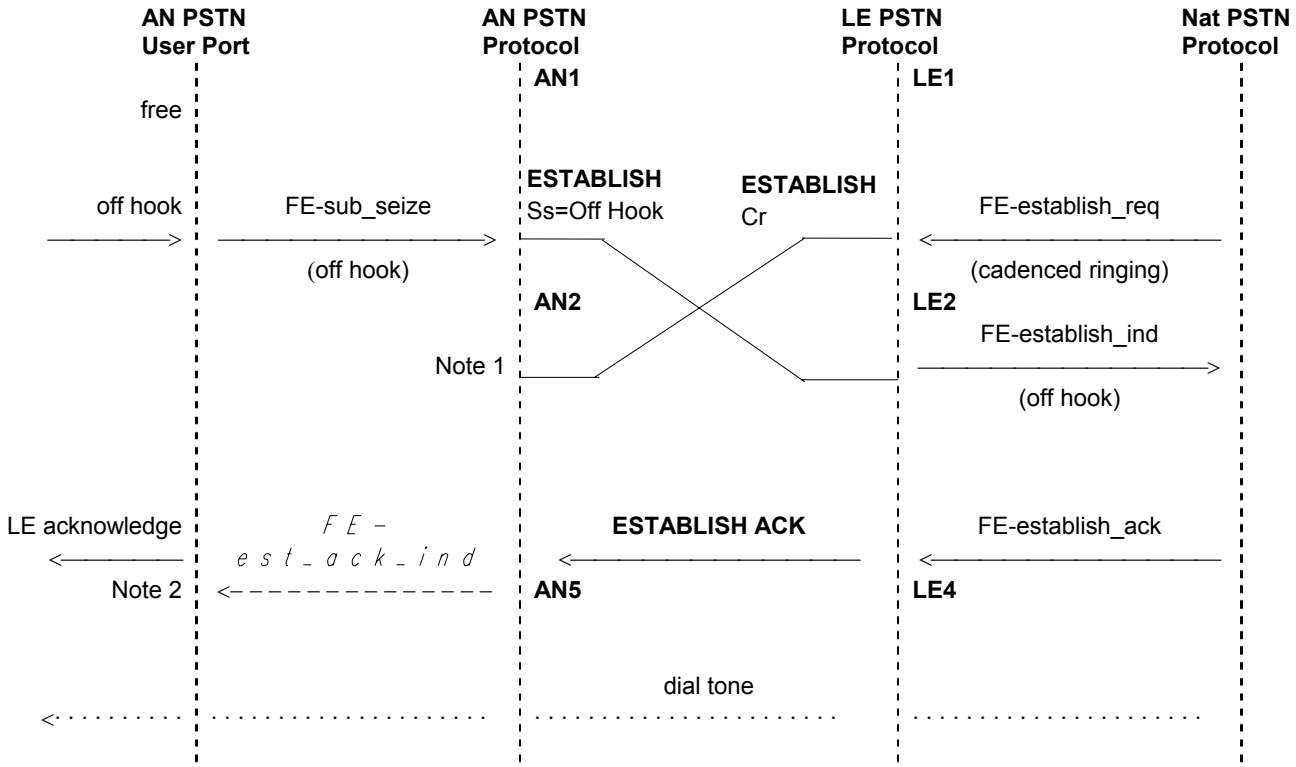

free
DISCONNECT COMPLETE
AN1
FE-disc_comp_ind
LE1
V5 path
released

**NOTES**

1. A tone or announcement is only applied if the LE determines that it is required.
2. The disconnect clear is sent as confirmation to the CPE that the LE has accepted the clear. The duration of the pulse is an LE provisioned item.
3. This sequence shows the digit timeout expiring after the first digit has been received. Subsequent actions are the same if no or more than one but insufficient digits are received within the required time.
4. In the case of DTMF dialling the tones are transported transparently and no messages are required.

## 7.4.4. Collision Cases

### 7.4.4.1. Outgoing Call Priority

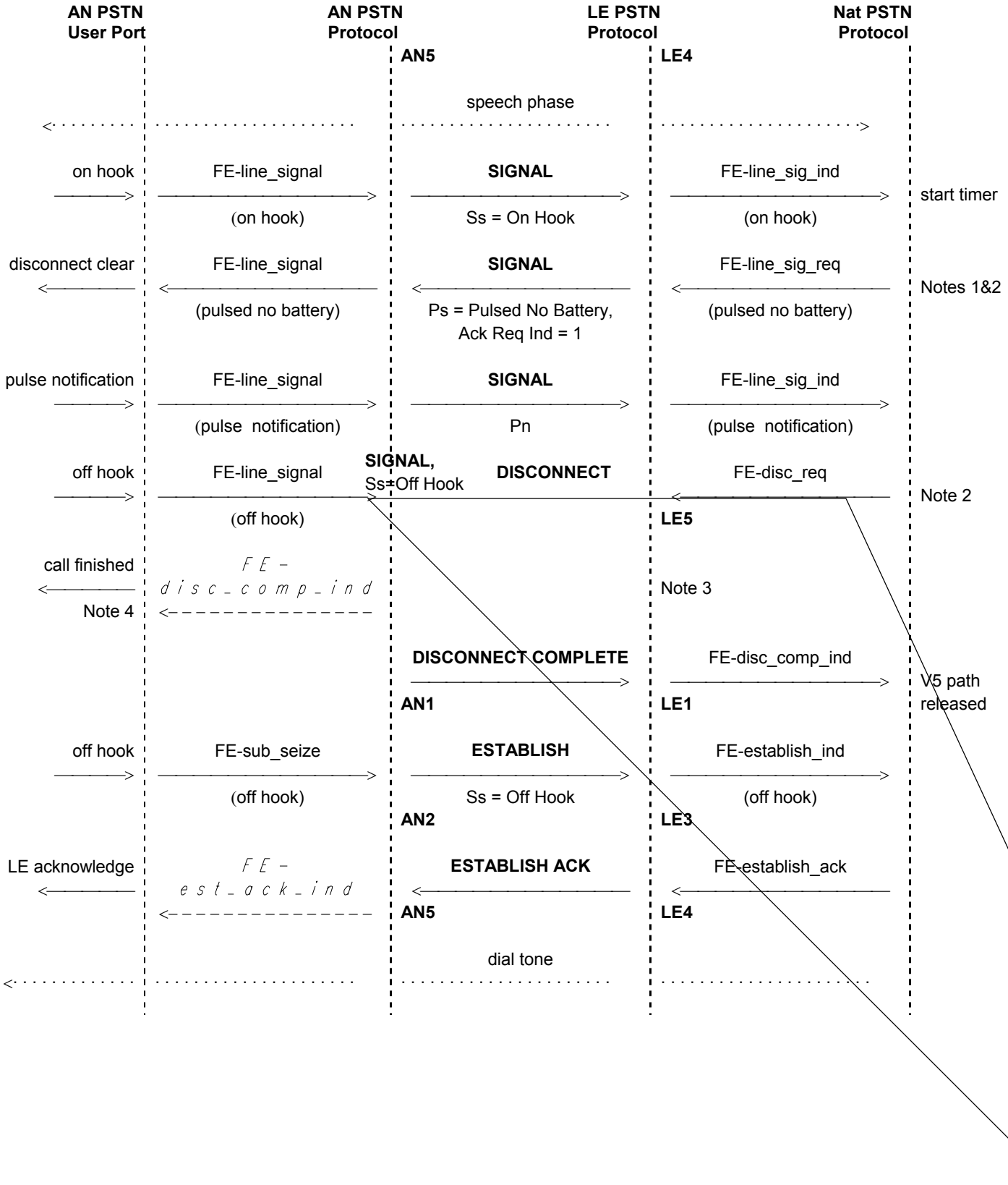



**NOTES**

1. The AN ignores this Establish (Cr) message.
2. After the sending of NORMAL POWER FEED (i.e. the Analogue Port process connects A-wire to earth), the Analogue Port process runs a seize validation timer during which the PBX should apply the off-hook condition and remove the B-wire from earth for this sequence to be considered as a valid seize (see 7.2.3.6).

**7.4.4.2. PBX sends ON HOOK followed by OFF HOOK resulting in collision between release of connection from LE and O/G Call (O/G Call Continues).**

**NOTE: This MSC is catering for faulty PBX behaviour.**

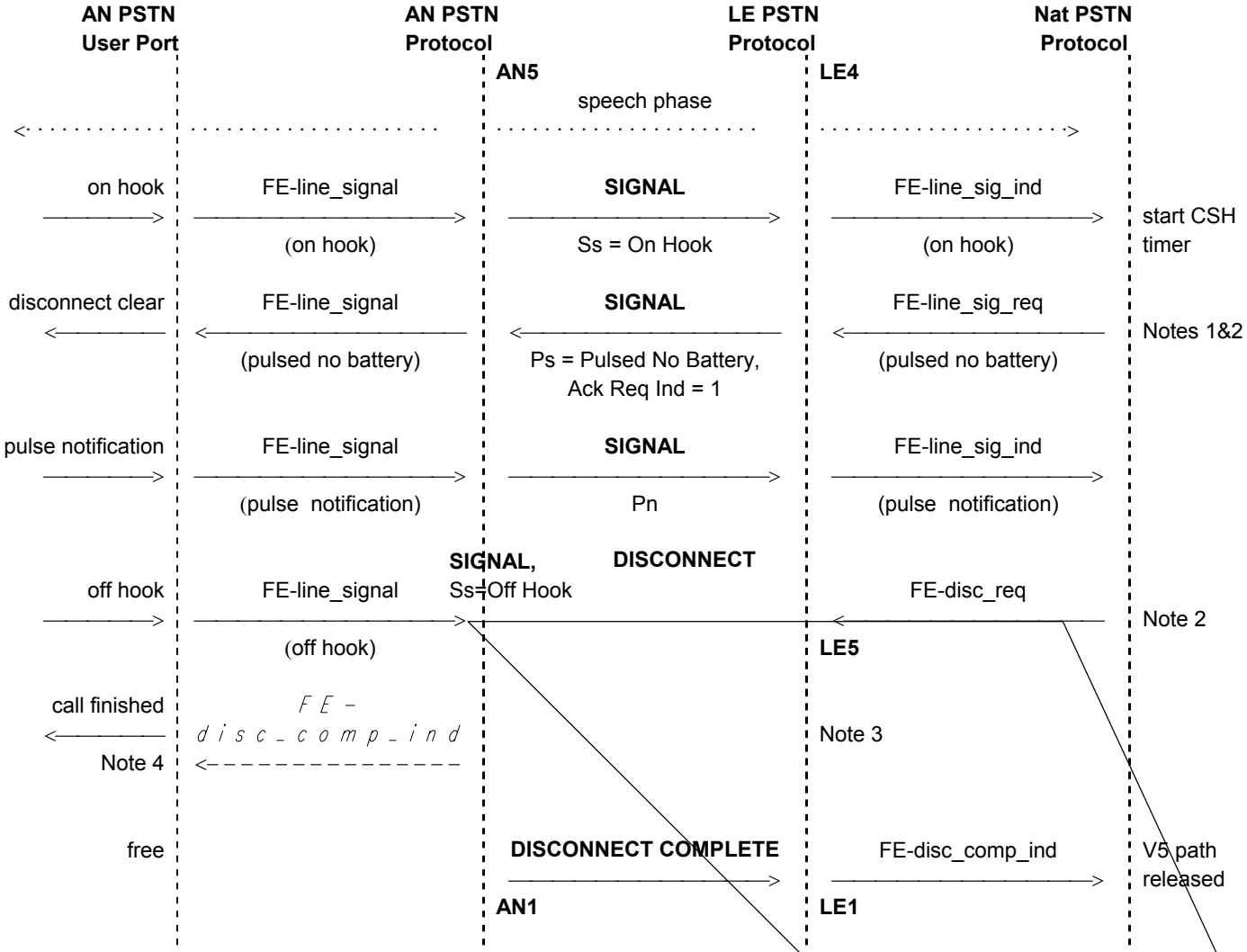


**NOTES**

1. This optional disconnect clear signal is only sent if the LE determines that it is required.
2. This message occurs after a timeout or the A party goes on hook.
3. The LE ignores this SIGNAL Ss=Off Hook message.
4. The action of the Analogue Port process on receipt of a call finished primitive at this point in the sequence is dependant on which option is supported in subclause 7.2.3.3. This MSC shows the option where the Analogue Port process checks for the presence of an OFF HOOK signal.

**7.4.4.3. PBX sends ON HOOK followed by OFF HOOK resulting in collision between release of connection from LE and O/G Call (O/G Call Aborted).**

**NOTE: This MSC is catering for faulty PBX behaviour.**

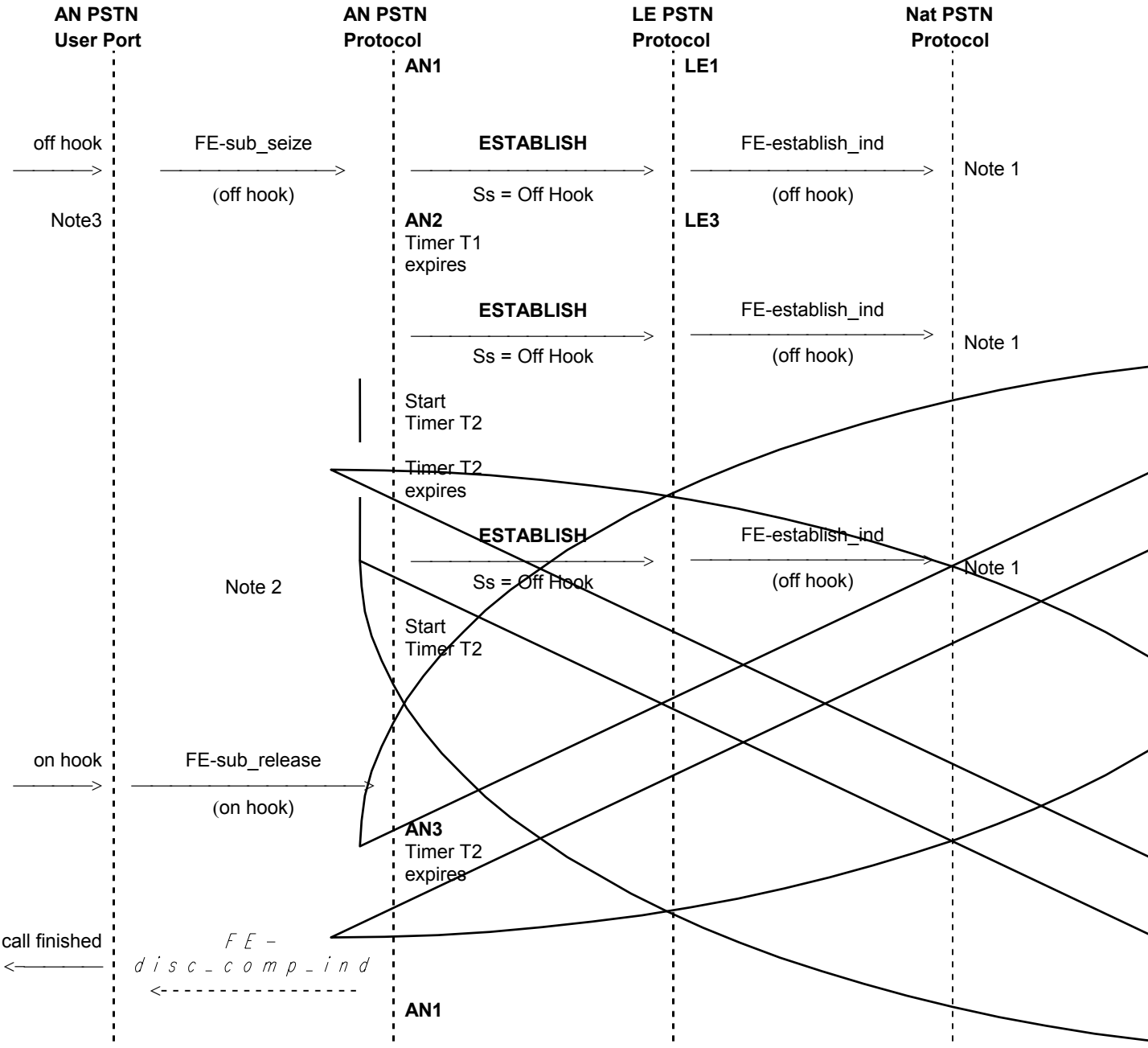



**NOTES**

1. This optional disconnect clear signal is only sent if the LE determines that it is required.
2. This message occurs after expiry of the CSH timer or the A party goes on hook.
3. The LE ignores this SIGNAL Ss=Off Hook message.
4. The action of the Analogue Port process on receipt of a call finished primitive at this point in the sequence is dependant on which option is supported in subclause 7.2.3.3. This MSC shows the option where the Analogue Port process immediately returns to free.

## 7.4.5. Exchange Overload

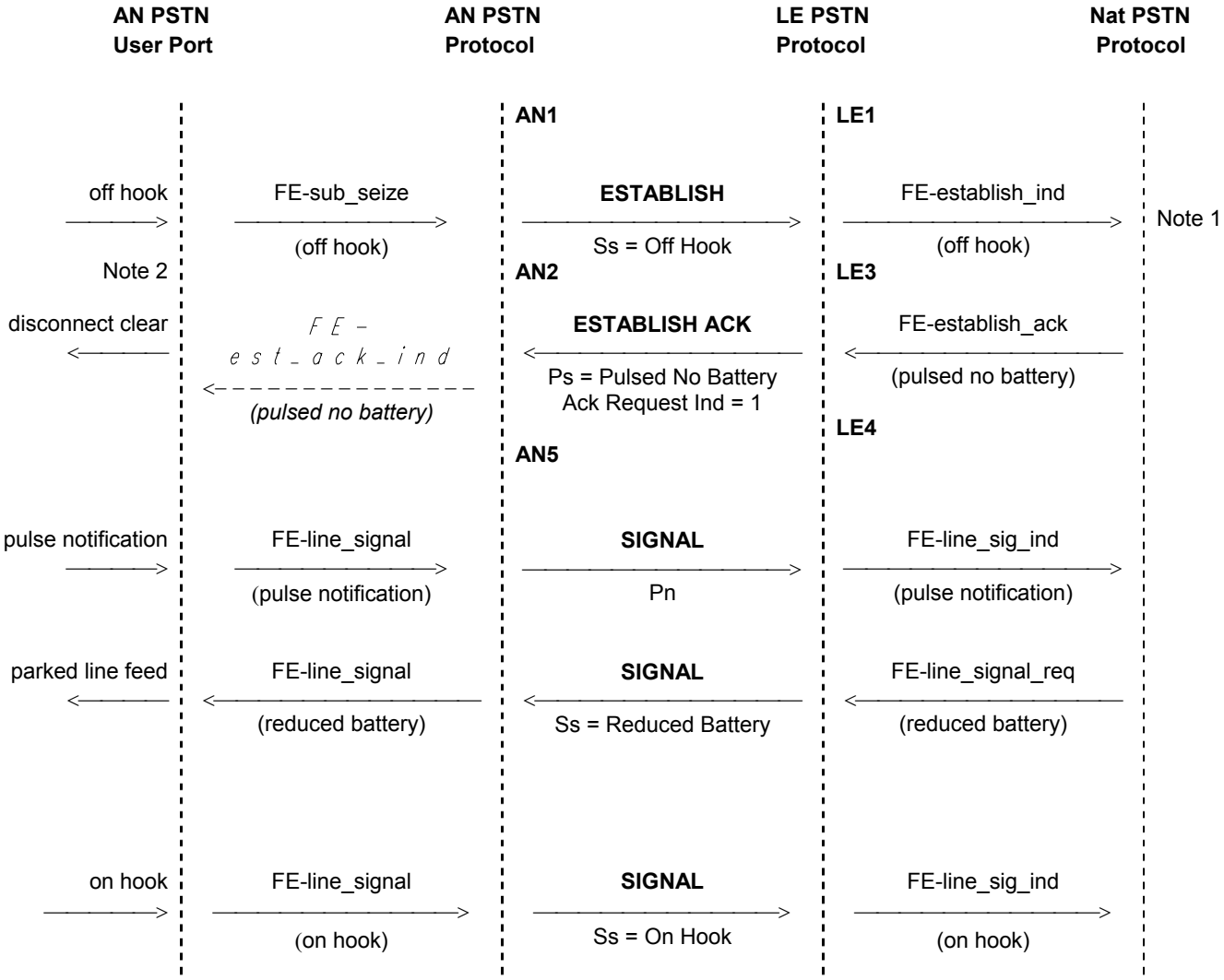
### 7.4.5.1. Off Hook During Overload - ETSI Sequence




**NOTES**

1. The LE is in overload and thus discards the received primitive.
2. This set of events is repeated until the sub goes on hook. There is no limit to the number of times T2 expires and is restarted.
3. After the sending of NORMAL POWER FEED (i.e. the Analogue Port process connects A-wire to earth), the Analogue Port process runs a seize validation timer during which the PBX should apply the off-hook condition and remove the B-wire from earth for this sequence to be considered as a valid seize (see 7.2.3.6).

### 7.4.5.2. Alternative 1 for Off Hook During Overload

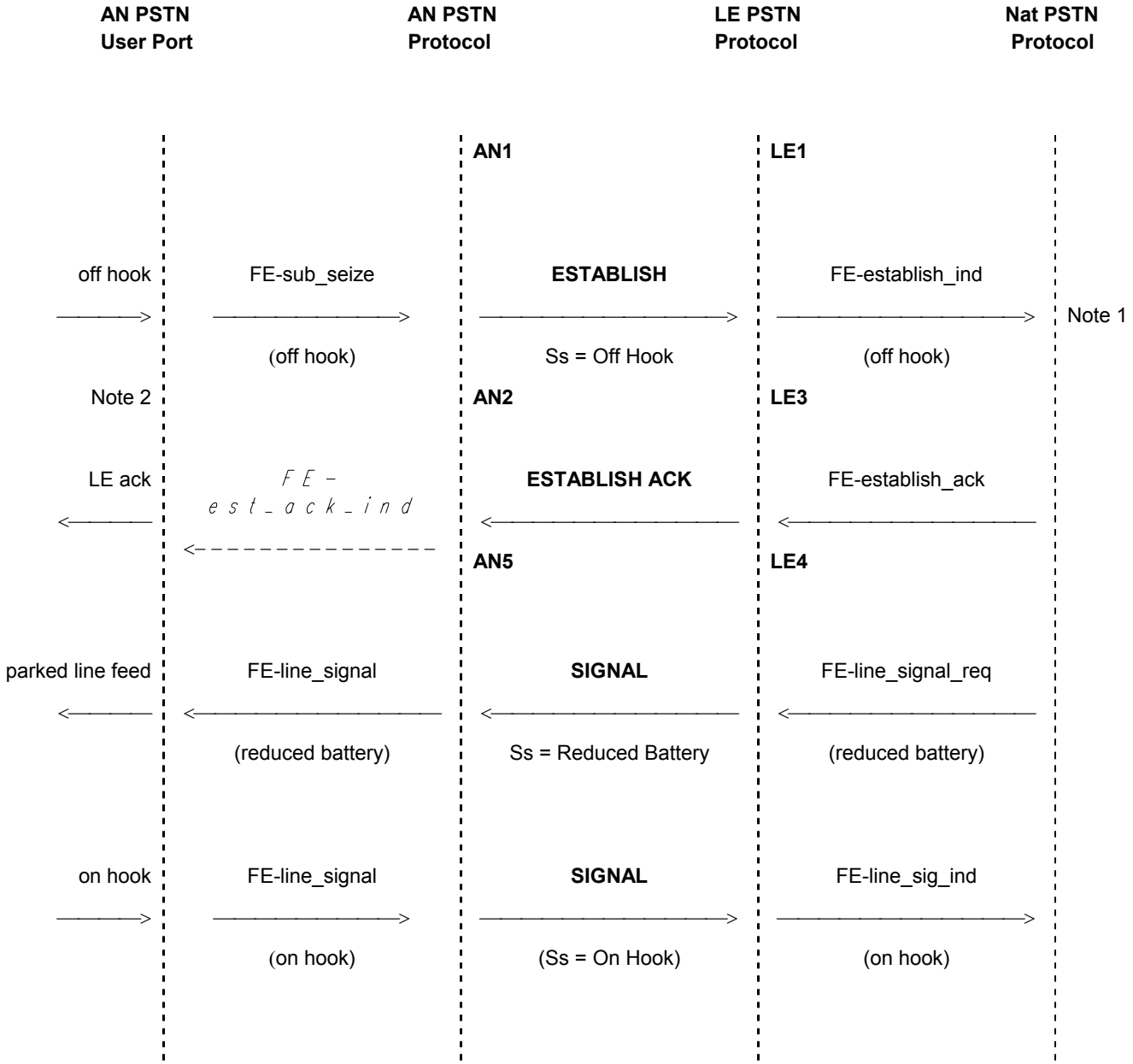



From this point the normal call cleardown sequence applies.

**NOTES**

1. The LE is in overload and thus rejects the outgoing call attempt.
2. After the sending of NORMAL POWER (i.e. the Analogue Port process connects A-wire to earth), the Analogue Port process runs a seize validation timer during which the PBX should apply the off-hook condition and remove the B-wire from earth for this sequence to be considered as a valid seize (see 7.2.3.6).

### 7.4.5.3. Alternative 2 for Off Hook During Overload

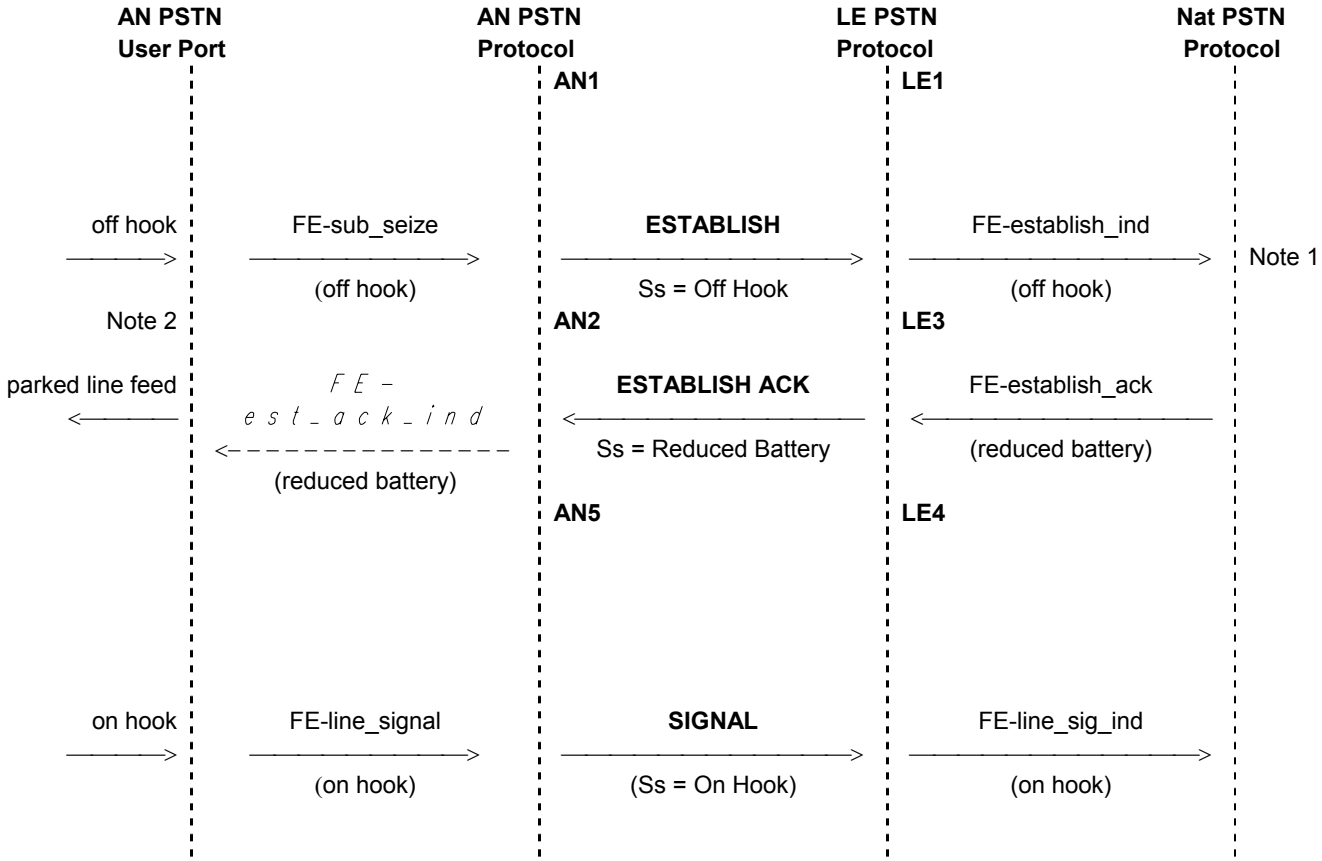



From this point the normal call cleardown sequence applies.

**NOTES**

1. The LE is in overload and thus rejects the outgoing call attempt.
2. After the sending of NORMAL POWER FEED (i.e. the Analogue Port process connects A-wire to earth), the Analogue Port process runs a seize validation timer during which the PBX should apply the off-hook condition and remove the B-wire from earth for this sequence to be considered as a valid seize (see 7.2.3.6).

### 7.4.5.4. Alternative 3 for Off Hook During Overload




From this point the normal call cleardown sequence applies.

**NOTES**

1. The LE is in overload and thus rejects the outgoing call attempt.
2. After the sending of NORMAL POWER FEED (i.e. the Analogue Port process connects A-wire to earth) the Analogue Port process runs a seize validation timer during which the PBX should apply the off-hook condition and remove the B-wire from earth for this sequence to be considered as a valid seize (see 7.2.3.6).

# 8. DDI PBX

## 8.1. INTRODUCTION

Clause 3 of this specification describes the method by which the UK PSTN V5 Mapping Requirements are specified using an assumed functional architecture based on a number of inter-acting processes (See Figure 2). A general outline description of the function of each process is also given in Clause 3.

This Clause of the Specification uses the method described in Clause 3 to detail the specific requirements necessary to a DDI PBX application. This functionality is described in terms of the Analogue Port process and the Call Control process.

- Subclause 8.2 details the requirements for the Analogue Port process.
- Subclause 8.3 details the requirements for the Call Control process.
- Subclause 8.4 contains a number of valid call cases in the form of Message Sequence Charts (MSCs).

Note: Only incoming calls are presented to a user port marked as DDI. Outgoing calls from a DDI PBX are presented on a user port marked as either earth calling or loop calling.

## 8.2. ANALOGUE PORT PROCESS

This Subclause describes the DDI PBX requirements for the Analogue Port process.

Throughout Clause 8 the term “Analogue Port process” shall be taken to mean “Analogue Port process for the DDI PBX application”.

The Analogue Port process is responsible for:

- Detecting and Validating the analogue signals from the 2-wire analogue DDI PBX line and once validated converting them into internal “analogue line primitives” that are sent to the AN_PSTN_User_Port process.
- Applying analogue signals and conditions to the 2-wire DDI PBX line on receipt of internal analogue line primitives.
- Generating and responding to a number of internal analogue control primitives to and from the AN_PSTN_User_Port process.
- Responding to a number of management primitives from the AN Management process.
- Performing the Autonomous actions detailed in 8.2.3.

The external analogue signals and conditions for a DDI PBX are given in 8.2.1.

The analogue line primitives, analogue control primitives and analogue management primitives are detailed in 8.2.2.

### 8.2.1. Analogue Signals and Conditions

The terms given in this specification to the external analogue signals and conditions used for the DDI PBX (Interface [A]) are given in Tables 41 and 42 along with a brief description of their use.

Although the precise characteristics of the external analogue signals and conditions are outside the scope of this specification, some examples of possible characteristics are given in Tables 41 and 42 as an informative description in order to assist general understanding. Reference is also made to other related specifications where available.

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **DDI NORMAL POLARITY** | The DDI NORMAL POLARITY signal is the condition applied by the DDI PBX to indicate that it is ready to accept incoming calls.<br>Typically the electrical characteristics of the DDI NORMAL POLARITY signal is Earth on A wire, Negative Battery on B-wire. | PD 7003: 1996 [13] |
| **DDI REVERSED POLARITY** | DDI REVERSED POLARITY signal is the condition applied by the DDI PBX to indicate that the called party has answered. This condition will be maintained by the PBX until the call is cleared and the PBX has returned to idle and is again ready to accept incoming calls.<br>Typically the electrical characteristics of the DDI REVERSED POLARITY is a reversal of the DDI NORMAL POLARITY signal. | |
| **DDI NO BATTERY** | DDI NO BATTERY signal is the condition applied by the DDI PBX to indicate that it does not wish to receive calls and should be considered to be busy. This signal is sometimes referred to as “Back Busy”.<br>Typically the electrical characteristics of the DDI NO BATTERY is the disconnection of the A & B wires. | |

**Table 41 - Analogue Signals Received by the Analogue Port**

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **DDI IDLE** | The DDI IDLE signal is the condition applied by the Analogue Port process to indicate to the DDI PBX that the Local Exchange has returned the line to free and is able to present new calls to the PBX.<br><br>Typically the characteristics of the DDI IDLE signal is a very high resistance applied across the A & B wires (see also DDI EXCHANGE RELEASED above).<br><br>The Analogue Port process must be able to detect the signals shown in Table 41 from the PBX whilst applying the DDI IDLE signal. | |
| **DDI DIGIT** | DDI DIGITs are sent to the PBX in the form of disconnect pulses subsequent to a DDI SEIZE. | |
| **DDI EXCHANGE RELEASED** | The DDI EXCHANGE RELEASED signal is the term given to the initial period of the DDI IDLE signal, when applied at the end of a call, during which the PBX is expected to clear down.<br><br>The DDI EXCHANGE RELEASED signal becomes the DDI IDLE signal either on receipt of a DDI NORMAL POLARITY signal from the PBX or when the pulse duration period indicated by the LE (e.g. 1350 ms) has elapsed. In either case the Analogue Port process normally indicates the end of the DDI EXCHANGE RELEASED signal by sending a pulse notification primitive.<br><br>The electrical characteristics of the DDI EXCHANGE RELEASED signal (and the DDI IDLE signal) is a very high resistance applied between the A and B wires.<br><br>The Analogue Port process must be able to detect the signals shown in Table 41 from the PBX whilst applying the DDI EXCHANGE RELEASED signal. | |

**Table 42 - Analogue Signals and Conditions sent by the Analogue Port**
**(Continues on next page)**

| Signal | Outline [Informative] Description | Reference to related specifications |
|---|---|---|
| **DDI SEIZE** | The DDI SEIZE signal is the condition applied by the Analogue Port process to indicate the arrival of an incoming call to the PBX. The DDI SEIZE signal will be maintained throughout the duration of the call.<br><br>Typically the electrical characteristics of a DDI SEIZE signal is a relatavely low resistance applied across the A & B wires. The Analogue Port process must be able to detect the signals shown in Table 41 from the PBX whilst it is applying the DDI SEIZE signal. | |

**Table 42 (Continued) - Analogue Signals and Conditions sent by the Analogue Port**

## 8.2.2. ANALOGUE PRIMITIVES

### 8.2.2.1. Analogue Line Primitives

The analogue line primitives that are passed between the Analogue Port process and the AN_PSTN_User_Port process (Interface [b]) have the same names as their external equivalent but are shown in lower case (See Table 43). Some of the analogue line primitives contain additional instructions for the Analogue Port, e.g. Duration of Pulse.

The Analogue signal, DDI IDLE does not have an analogue line primitive equivalent. The DDI IDLE signal is normally sent if DDI NORMAL POLARITY is detected whilst the DDI EXCHANGE RELEASED is being applied or when the DDI EXCHANGE RELEASED pulse duration period (e.g. 1350ms) has elapsed.

| ANALOGUE SIGNAL at Interface [A] | Analogue Primitive at Interface [b] and [f] | |
|---|---|---|
| | **Primitive Name** | **Additional Instructions** |
| DDI NORMAL POLARITY | ddi normal polarity | none |
| DDI REVERSED POLARITY (When not free) | ddi reversed polarity | none |
| DDI REVERSED POLARITY (When free) | ddi no battery | none |
| DDI NO BATTERY | ddi no battery | none |
| DDI SEIZE | ddi seize | none |
| DDI DIGIT | ddi digit | Digit Information<br>Digit Ack Req Ind |
| DDI EXCHANGE RELEASED | ddi exchange released | Pulse Duration Type,<br>Suppression Indicator,<br>Number of Pulses,<br>Ack Request Ind |
| DDI IDLE | | |

**Table 43 - Analogue Primitives Used for a DDI PBX**

#### 8.2.2.2. Analogue Control Primitives

A number of analogue control primitives are passed between the Analogue Port process and the AN_PSTN_User_Port process (Interface [b]).

The analogue control primitives along with a short description of their function are given in Tables 44 and 45.

| Analogue Control Primitive | Description |
|---|---|
| **call finished** | This analogue control primitive is used to reset the Analogue Port process to the free state. In the free state, the Analogue Port process will cancel all timers and will apply the DDI IDLE signal if not already being applied. |
| **LE acknowledge** | This analogue control primitive notifies the Analogue Port process that the ddi no battery primitive sent towards the LE has been received and accepted by the LE Call Control process. |

**Table 44 - Control Primitives Received by the Analogue Port**

| Analogue Control Primitive | Description |
|---|---|
| **pulse notification** | As for DEL, see Table 27 |
| **analogue port acknowledge** | This analogue control primitive is sent by the Analogue Port process to indicate that the electrical condition associated with the analogue line primitive, ddi seize, has been applied to the A and B wires. |
| **no resources** | As for DEL, see Table 27 |

**Table 45 - Control Primitives Sent by the Analogue Port**

#### 8.2.2.3. Analogue Management Primitives

A number of analogue management primitives are passed from the AN management process to the Analogue Port process (Interface [i]).

The analogue management primitives along with a short description of their function are given in Table 46.

| Analogue Management Primitive | Description |
|---|---|
| **Block** | The Block primitive is used to prevent incoming calls to the Analogue Port process. |
| **Unblock** | As for DEL, see Table 28 |
| **Restart** | As for DEL, see Table 28 |

**Table 46 Analogue Management Primitives**

### 8.2.3. Autonomous Actions of the Analogue Port Process

The subsequent sub-clauses describe the autonomous actions performed by the Analogue Port for a DDI PBX.

#### 8.2.3.1. Whilst a DDI EXCHANGE RELEASED signal is being applied

This sub-clause describes the autonomous actions performed whilst a DDI EXCHANGE RELEASED signal is being applied.

##### 8.2.3.1.1. Receipt of an analogue line or control primitive

The primitive is stored and the DDI EXCHANGE RELEASED signal continues.

##### 8.2.3.1.2. Receipt of a management primitive

The primitive is stored and the DDI EXCHANGE RELEASED signal continues.

##### 8.2.3.1.3. Receipt of any External Analogue Signal

The action of the Analogue Port process depends on whether or not the call is still present:

a) If the call is still present (i.e. a call finished, restart or block primitive has not been received), then the actions specified in either (I) or (II) shall apply:

   I. If the external analogue signal is the pre-defined signal (i.e. DDI NORMAL POLARITY) that is allowed to suppress the DDI EXCHANGE RELEASED, then the following actions are performed:

      i. The DDI EXCHANGE RELEASED signal is truncated.

      ii. A pulse notification primitive is sent to the AN_PSTN_User_Port process.

      iii. A ddi normal polarity primitive is sent to the AN_PSTN_User_Port process.

      iv. A DDI IDLE signal is applied.

v. Any stored analogue line, control and management primitives that were received and stored during the sending of the DDI EXCHANGE RELEASED signal are processed in the order that they were received and in accordance with the procedures (including the autonomous actions) defined for the receipt of the primitive whilst a DDI EXCHANGE RELEASED signal is not being applied.

II. If the external analogue signal is not the pre-defined signal (i.e. is not DDI NORMAL POLARITY) that is allowed to suppress the DDI EXCHANGE RELEASED, then the external analogue signal shall be processed normally without disrupting the DDI EXCHANGE RELEASED signal.

b) If the call is no longer present (i.e. a call finished, restart or block primitive has been received), then the actions in either (I) or (II) shall apply:

I. If the external analogue signal is the pre-defined signal (i.e. DDI NORMAL POLARITY) that is allowed to suppress the DDI EXCHANGE RELEASED, then:

i. The DDI EXCHANGE RELEASED signal is truncated.

ii. A DDI IDLE signal is applied.

iii. Any stored analogue line, control and management primitives that were received and stored during the sending of the DDI EXCHANGE RELEASED signal are processed in the order that they were received and in accordance with the procedures (including the autonomous actions) defined for the receipt of the primitive whilst a DDI EXCHANGE RELEASED signal is not being applied.

II. If the external analogue signal is not the pre-defined signal (i.e. is not DDI NORMAL POLARITY) that is allowed to suppress the DDI EXCHANGE RELEASED, then the external analogue signal shall be discarded without disrupting the DDI EXCHANGE RELEASED signal.

#### 8.2.3.1.4. Receipt of a new incoming call

The incoming call shall be rejected by sending the analogue control primitive “no resources” to the AN_PSTN_User_Port process.

Note: This situation can occur under fault conditions when the LE considers the Analogue Port to be free, but it is busy within the AN (e.g. a ddi seize primitive is received whilst a DDI EXCHANGE RELEASED signal is being applied).

### 8.2.3.2. When the DDI EXCHANGE RELEASED signal completes

On completion (not truncation) of the DDI EXCHANGE RELEASED signal the following actions are performed:

a) A pulse notification primitive is sent to the AN_PSTN_User_Port process, if the call is still present (i.e. a call finished, restart or block primitive has not been received).

b) A DDI IDLE signal is applied.

c) Any stored analogue line, control and management primitives that were received and stored during the sending of the DDI EXCHANGE RELEASED signal are processed in the order that they were received and in accordance with the procedures (including

the autonomous actions) defined for the receipt of the primitive whilst a DDI EXCHANGE RELEASED signal is not being applied.

#### 8.2.3.3. Receipt of a call finished primitive whilst a DDI EXCHANGE RELEASED signal is not being applied

The action of the Analogue Port process depends on the analogue signal being applied.

##### 8.2.3.3.1. DDI SEIZE Signal Being Applied

If a DDI SEIZE signal is being applied, then the following sequence of actions is performed:

a) The received primitive is stored.

b) A DDI EXCHANGE RELEASED signal shall be applied for a pre-defined duration.

##### 8.2.3.3.2. DDI IDLE Signal Being Applied

If a DDI IDLE signal is being applied, then the following sequence of actions is performed:

a) If a DDI REVERSED POLARITY or DDI NO BATTERY signal is being received, then a “ddi no battery” primitive is sent to the AN_PSTN_User_Port process and an LE acknowledge awaited.

b) If a DDI NORMAL POLARITY signal is being received, then the free state shall be entered. Upon return to the free state received analogue primitives or signals shall be processed normally.

#### 8.2.3.4. Receipt of a restart primitive whilst a DDI EXCHANGE RELEASED signal is not being applied

The action of the Analogue Port process is dependant on whether or not the port is blocked. If the port is blocked then the Analogue Port process takes no action. If the port is not blocked then the actions performed by the Analogue Port process depend on the analogue signal being applied.

##### 8.2.3.4.1. DDI SEIZE Signal Being Applied

If a DDI SEIZE signal is being applied, then the following sequence of actions is performed:

a) The received primitive is stored.

b) A DDI EXCHANGE RELEASED signal shall be applied for a pre-defined duration.

##### 8.2.3.4.2. DDI IDLE Signal Being Applied

If a DDI IDLE signal is being applied, then the following sequence of actions is performed:

a) If a DDI REVERSED POLARITY or DDI NO BATTERY signal is being received, then a “ddi no battery” primitive is sent to the AN_PSTN_User_Port process and an LE acknowledge awaited.

b) If a DDI NORMAL POLARITY signal is being received, then the free state shall be entered. Upon return to the free state received analogue primitives or signals shall be processed normally.

#### 8.2.3.5. Receipt of a block primitive whilst a DDI EXCHANGE RELEASED signal is not being applied

The action of the Analogue Port process depends upon the analogue signal being applied.

##### 8.2.3.5.1. DDI SEIZE Signal Being Applied

If a DDI SEIZE signal is being applied, then the following sequence of actions is performed:

a) The received primitive is stored.

b) A DDI EXCHANGE RELEASED signal shall be applied for a pre-defined duration.

##### 8.2.3.5.2. DDI IDLE Signal Being Applied

If a DDI IDLE signal is being applied, then the port is blocked to incoming and outgoing calls.

#### 8.2.3.6. General autonomous actions

This sub-clause describes the general autonomous actions which are not covered in the previous clauses.

##### 8.2.3.6.1. Receipt of ddi digits primitive in any valid state

The Analogue Port process shall perform the following sequence of actions:

a) Apply pre-sending and inter-digit pauses when forwarding digits to the DDI PBX.

b) The rate at which digits are pulsed to the DDI PBX may be configurable or pre-defined.

##### 8.2.3.6.2. Receipt of DDI REVERSED POLARITY signal whilst DIGITS are being sent

The Analogue Port process shall perform the following sequence of actions:

a) The Analogue Port process shall discard any stored digits and subsequently received “ddi digit” primitives.

b) Send a “ddi reversed polarity” to the AN_PSTN_User_port process.

##### 8.2.3.6.3. Receipt of DDI REVERSED POLARITY signal in the free state.

The Analogue Port process shall perform the following sequence of actions:

a) Send a “ddi no battery” to the AN_PSTN_User_port process.

b) Await the receipt of an LE acknowledge primitive.

##### 8.2.3.6.4. Receipt of any analogue line primitive in any valid state which requires additional AN resources

If upon receipt of an analogue line primitive AN resources (e.g. ddi digits requiring additional buffer capacity) are unavailable, then a “no resources” control primitive shall be sent to the AN_PSTN_User_Port process.

#### 8.2.3.6.5. Receipt of management primitive Unblock whilst the port is blocked

The Analogue Port process performs the following sequence of actions based upon the analogue signal being received:

a) Remove blocking to incoming and outgoing calls.

b) If a DDI REVERSED POLARITY or DDI NO BATTERY signal is being received, then a "ddi no battery" primitive is sent to the AN_PSTN_User_Port process and an LE acknowledge awaited.

c) If a DDI NORMAL POLARITY signal is being received, then the free state is entered. Upon return to the free state received analogue primitives or signals shall be processed normally.

### 8.2.3.7. General error handling autonomous actions

This sub-clause describes the autonomous action performed as a result of applying the general error handling procedures.

#### 8.2.3.7.1. Receipt of unrecognised analogue primitives

If the Analogue Port process receives an analogue primitive not defined in Tables 43 and 44 or is not supported by the AN, then the primitive shall be discarded and optionally a report of the occurrence may be sent to the AN Management process.

#### 8.2.3.7.2. Receipt of unexpected analogue primitives

If an unexpected analogue primitive is received (i.e. not valid for the current state), then the primitive shall be discarded and optionally a report of the occurrence may be sent to the AN Management process.

## 8.3. CALL CONTROL PROCESS

This Subclause describes the DDI PBX requirements for the Call Control process.

Throughout Clause 8 the term " Call Control process" shall be taken to mean "Call Control process for the DDI PBX application".

The Call Control process represents the call control within the Local Exchange and contains the "National Protocol Entity" referred to in clause 13.1 of ETS 300 324-1 [1].

The Call Control process is responsible for:

- Controlling the establishment and release of calls both to directly connected analogue lines and analogue lines that are served via a V5 Interface.
- Generating and responding to internal analogue line primitives and analogue control primitives to /from the National_PSTN_Protocol process.
- Responding to a number of Analogue Management Primitives from the LE Management process.
- Responding to the V5 control primitive "V5 path released". This is described in 8.3.1.3.

### 8.3.1. Analogue Primitives

#### 8.3.1.1. Analogue Line Primitives

The analogue line primitives passed between the Call Control process and the National_PSTN_Protocol process [Interface "f"] are the same as those that appear at Interface [b], see 8.2.2.1. The values assigned by the Call Control process to the additional instructions e.g. Pulse Duration Type are the same whether a customer line is directly connected to the LE or is served via V5 and consequently is outside the scope of this specification.

#### 8.3.1.2. Analogue Control Primitives

The analogue control primitives passed between the Call Control process and National_PSTN_Protocol process [Interface "f"] are the same as those that appear at Interface [b], see 8.2.2.2.

#### 8.3.1.3. V5 Path Released Primitive

The "V5 path released primitive" is used to indicate to the call control that the V5 Path has been released and that the user port should be marked as free by the LE. The primitive is normally generated by the National PSTN Protocol process as a result of receipt of a DISCONNECT or DISCONNECT COMPLETE message from the AN.

### 8.3.2. Operation of the Call Control Process

The operation of the Call Control process is the same whether a customer's line is directly connected to the Local Exchange or is served via V5. Consequently the services provided and the manner in which the exchange controls those services is outside the scope of this specification. However a number of valid call cases are shown in the form of Message Sequence Charts in Subclause 8.4 of this specification.

## 8.4. MESSAGE SEQUENCE CHARTS FOR A DDI PBX

The message sequences given in this Subclause are valid for certain call cases, they should not be a constraining factor for services.

The following assumptions are made within the MSCs

a. SIGNAL ACK messages are excluded from the MSCs but shall be sent in accordance with ETS 300 324-1 [1].

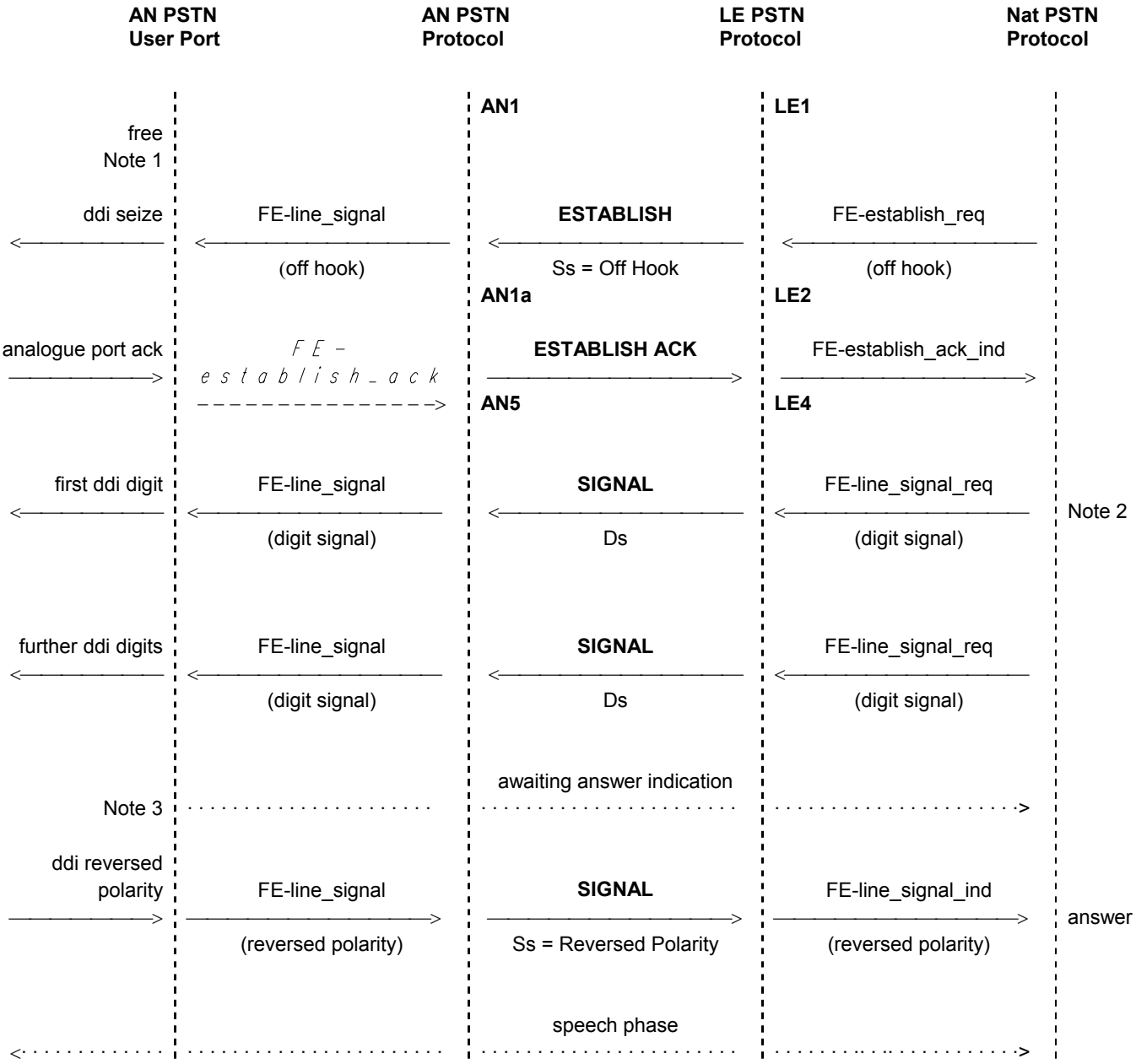
b. The inputs to the AN_PSTN_User_Port process from the customer side are primitives from the Analogue Port process.

c. Function Elements shown in italics are not defined in the standard for V5.1 but the functions they cause are. They are therefore deemed necessary to demonstrate how the function might be achieved but should not constrain an implementation.

d. If no Information Elements are shown in the brackets under a message on the V5 interface then the message carries no optional IEs.

## 8.4.1. DDI PBX - SUCCESSFUL CALL

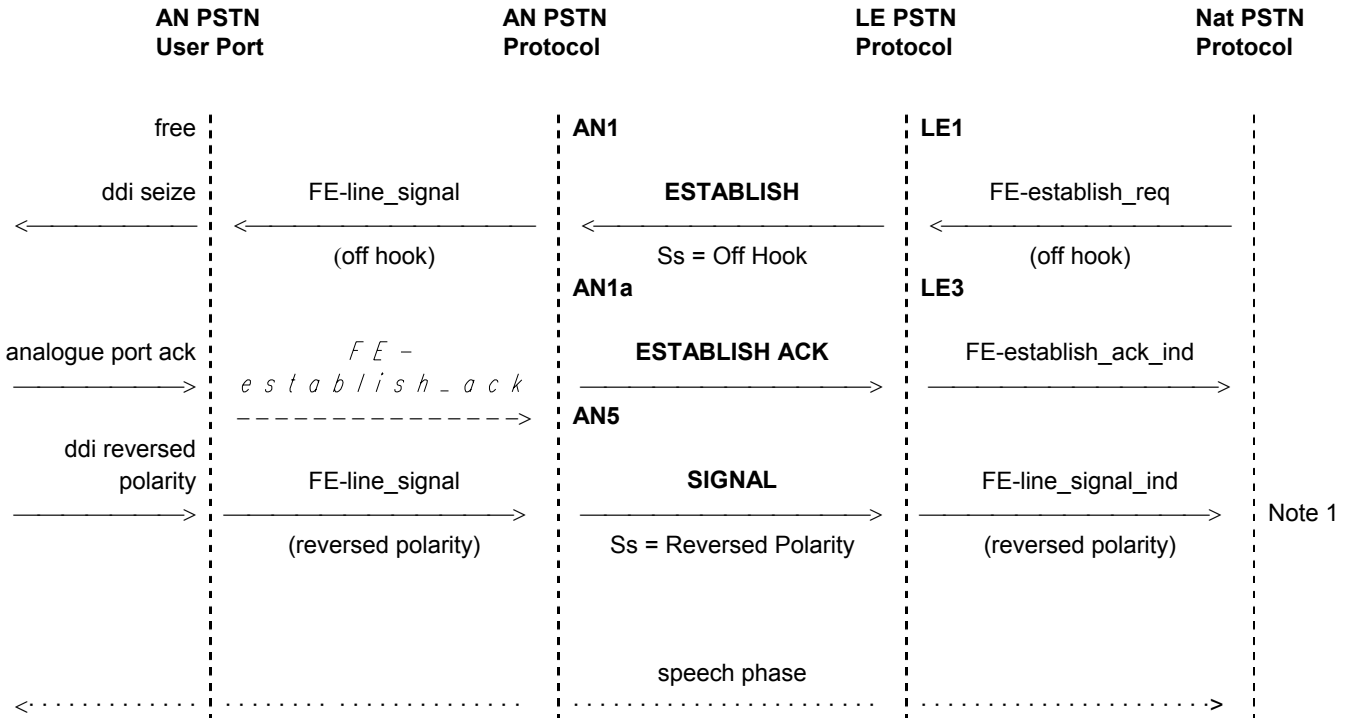
### 8.4.1.1. I/C Call including answer




**NOTES**

1. The PBX is applying DDI NORMAL POLARITY signal.
2. In the case of DTMF dialling, the tones are transported transparently and no messages are required.
3. The PBX is alerting (e.g. applying call arrival indication to) the called party and the LE is receiving awaiting answer indication (ring tone) from the PBX.

### 8.4.1.2. Early Answer (PBX sends answer prior to extension digits being sent)

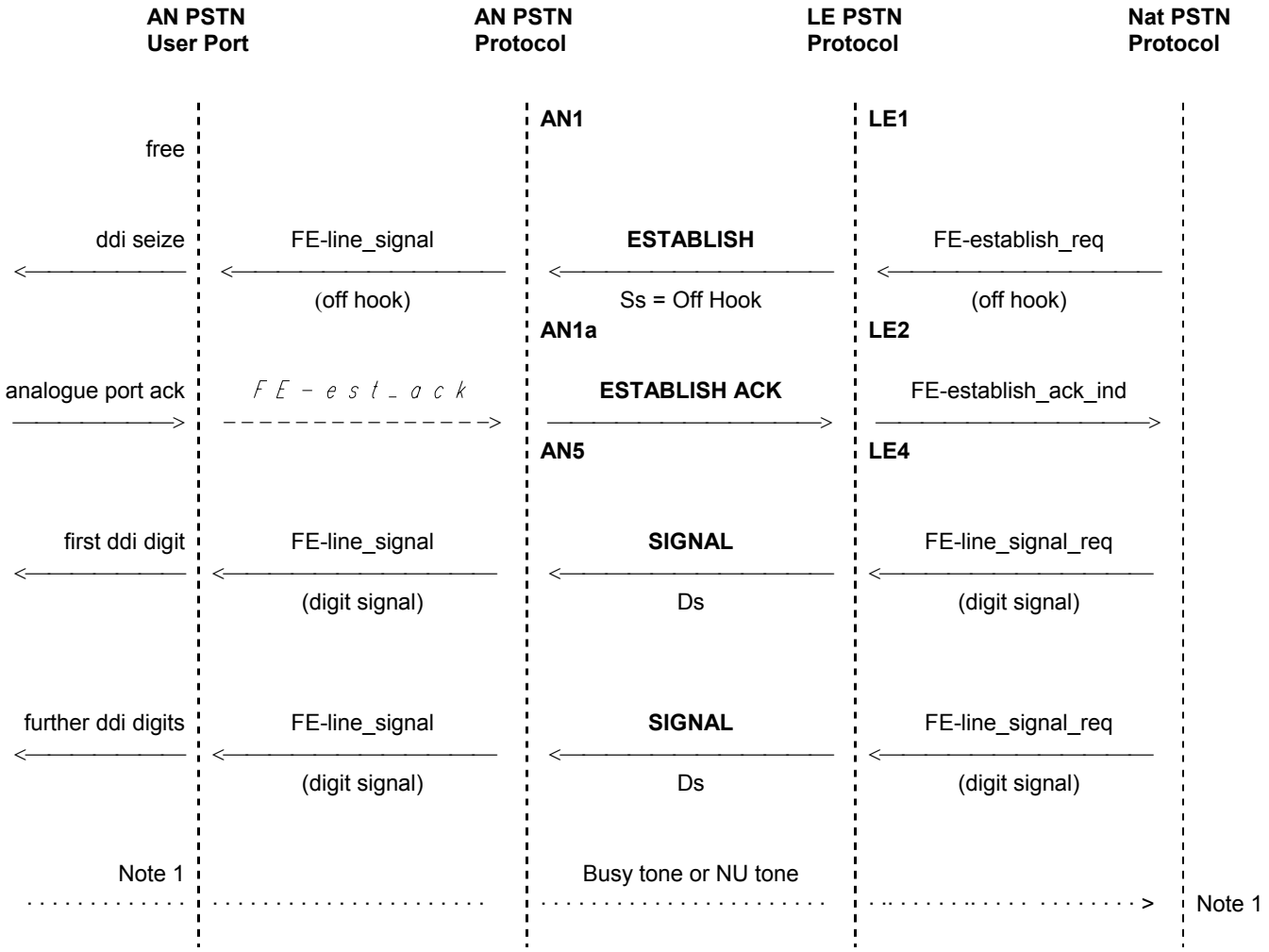



**NOTES**

1. It is the responsibility of the LE to decide on the action to be taken on receipt of a ddi reversed polarity signal at this point. The LE may treat the signal as an early answer indication or may terminate the call.

## 8.4.2. DDI PBX - UNSUCCESSFUL CALL

### 8.4.2.1. DDI Unsuccessful Call - PBX Extension is either Busy or Unobtainable

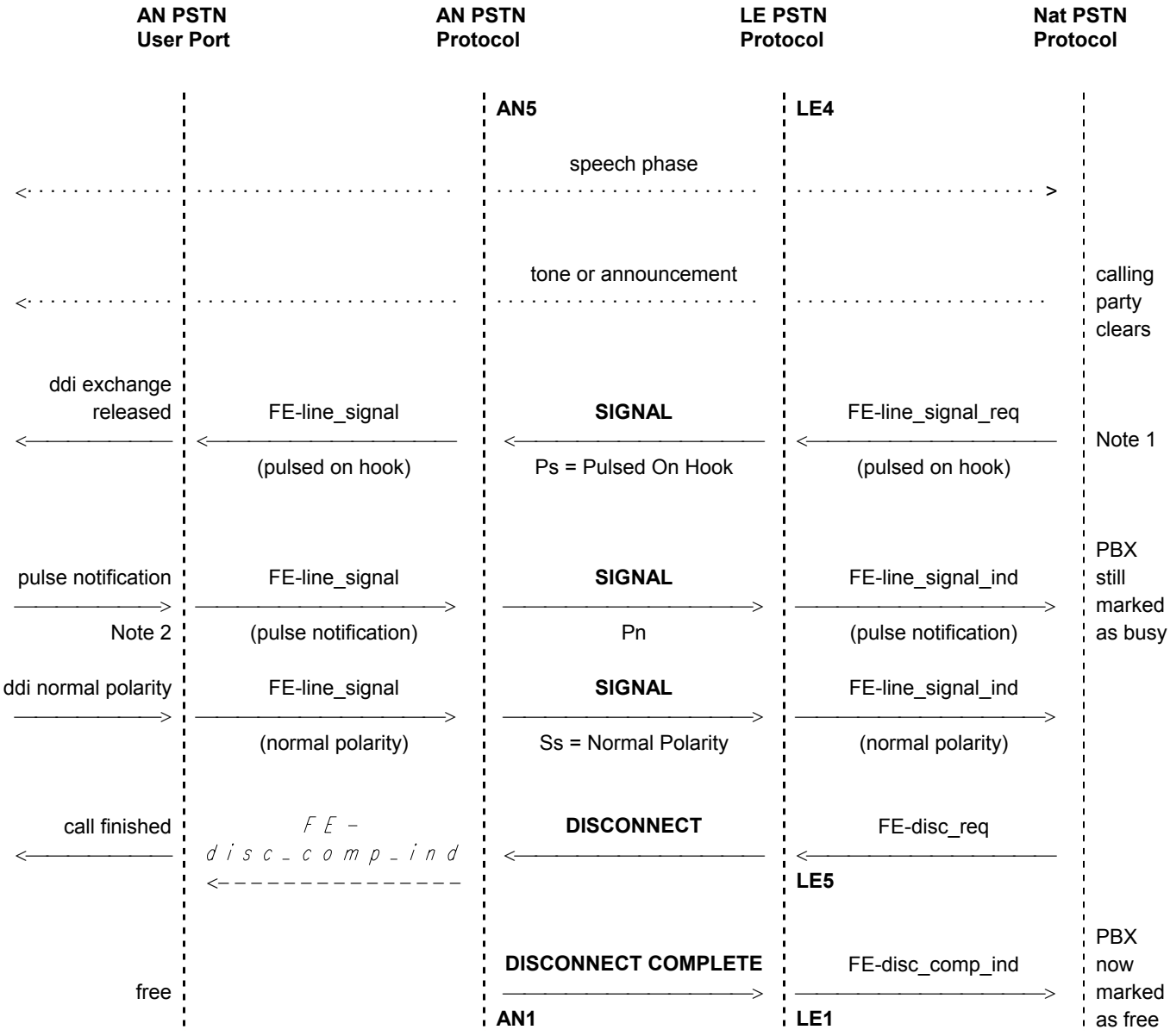



**NOTES**

1. Neither the AN nor the LE will be aware of the BUSY/NU tone. Eventually the caller will release the call or the network will time-out due to no answer.

## 8.4.3. DDI PBX - CALL CLEARING

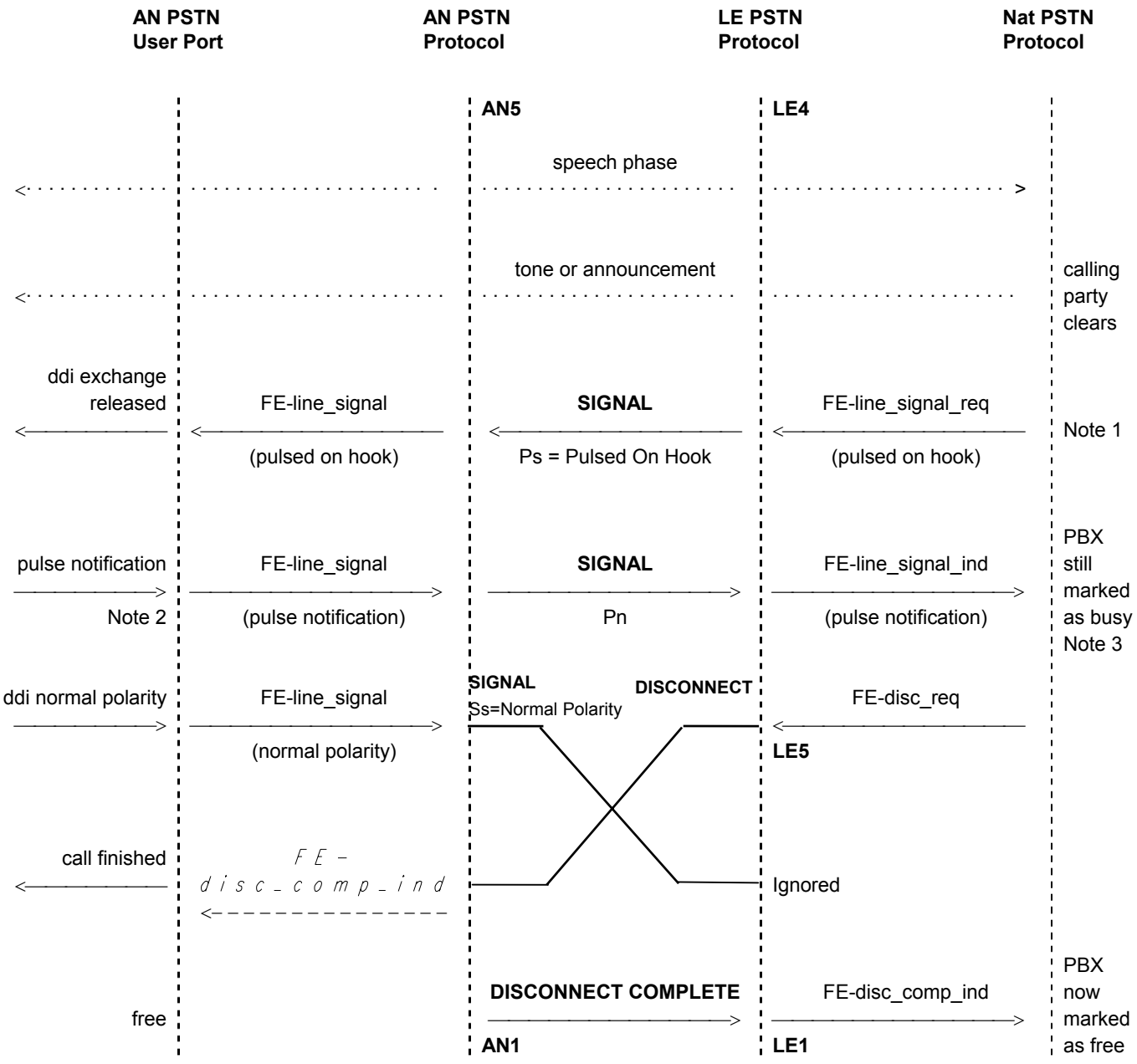
### 8.4.3.1. DDI Call Clearing - Caller clears first after answer then PBX clears during DDI EXCHANGE RELEASED Signal




**NOTES**

1. This signal is normally not sent until completion of the tone or announcement.
2. If the DDI NORMAL POLARITY signal is received from the PBX before completion of the DDI EXCHANGE RELEASED signal then the Analogue Port process will send a pulse notification primitive followed immediately by the ddi normal polarity primitive.

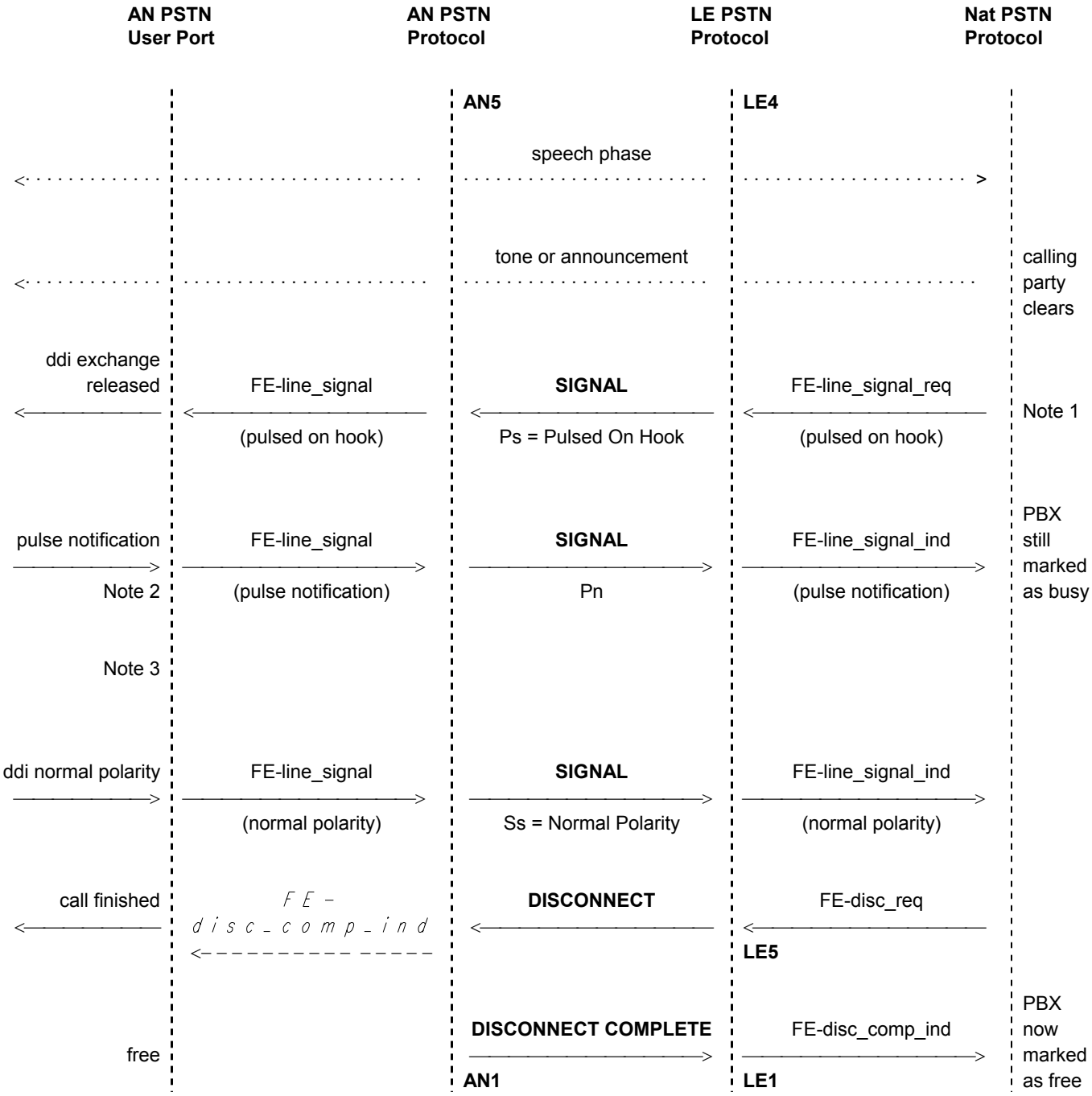
### 8.4.3.2. DDI Call Clearing - Caller clears first after answer then PBX clears during DDI EXCHANGE RELEASED Signal (Alternative Sequence)




**NOTES**

1. This signal is normally not sent until completion of the tone or announcement.
2. If the DDI NORMAL POLARITY signal is received from the PBX before completion of the DDI EXCHANGE RELEASED signal then the Analogue Port process will send a pulse notification primitive followed immediately by the ddi normal polarity primitive. The Analogue Port process also replaces the DDI EXCHANGE RELEASED signal with a DDI IDLE signal.
3. On receipt of a pulse notification the LE commences the release sequence. The LE assumes the PBX to be free and ignores any subsequent primitives from the AN.

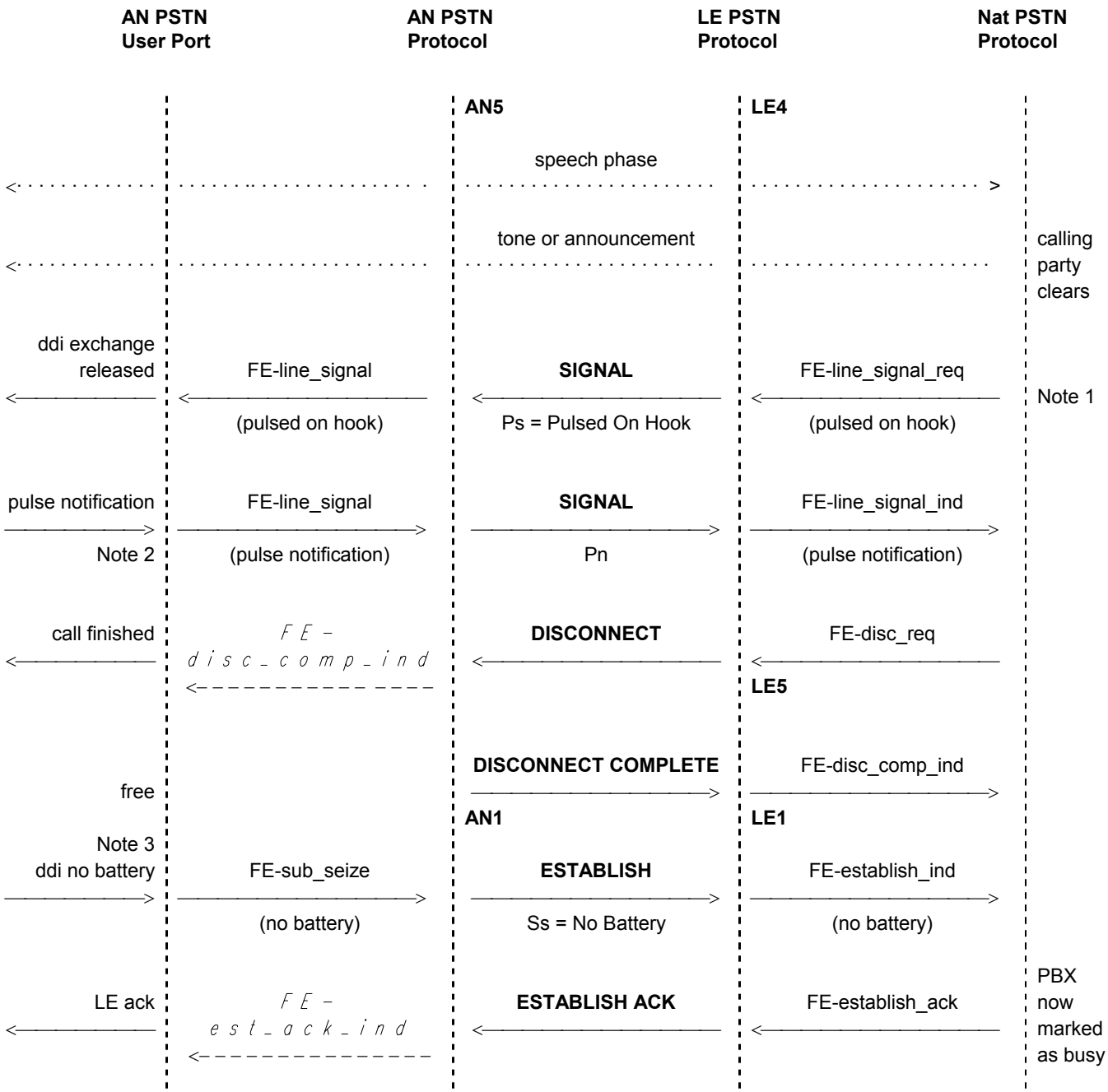
### 8.4.3.3. DDI Call Clearing - Caller clears first after answer then PBX does not clear during DDI EXCHANGE RELEASED Signal




**NOTES**

1. This signal is normally not sent until completion of the tone or announcement.
2. The Analogue Port process has replaced the DDI EXCHANGE RELEASED with a DDI IDLE signal.
3. The Analogue Port process will await the receipt of a DDI NORMAL POLARITY signal from the PBX before sending the ddi normal polarity primitive.

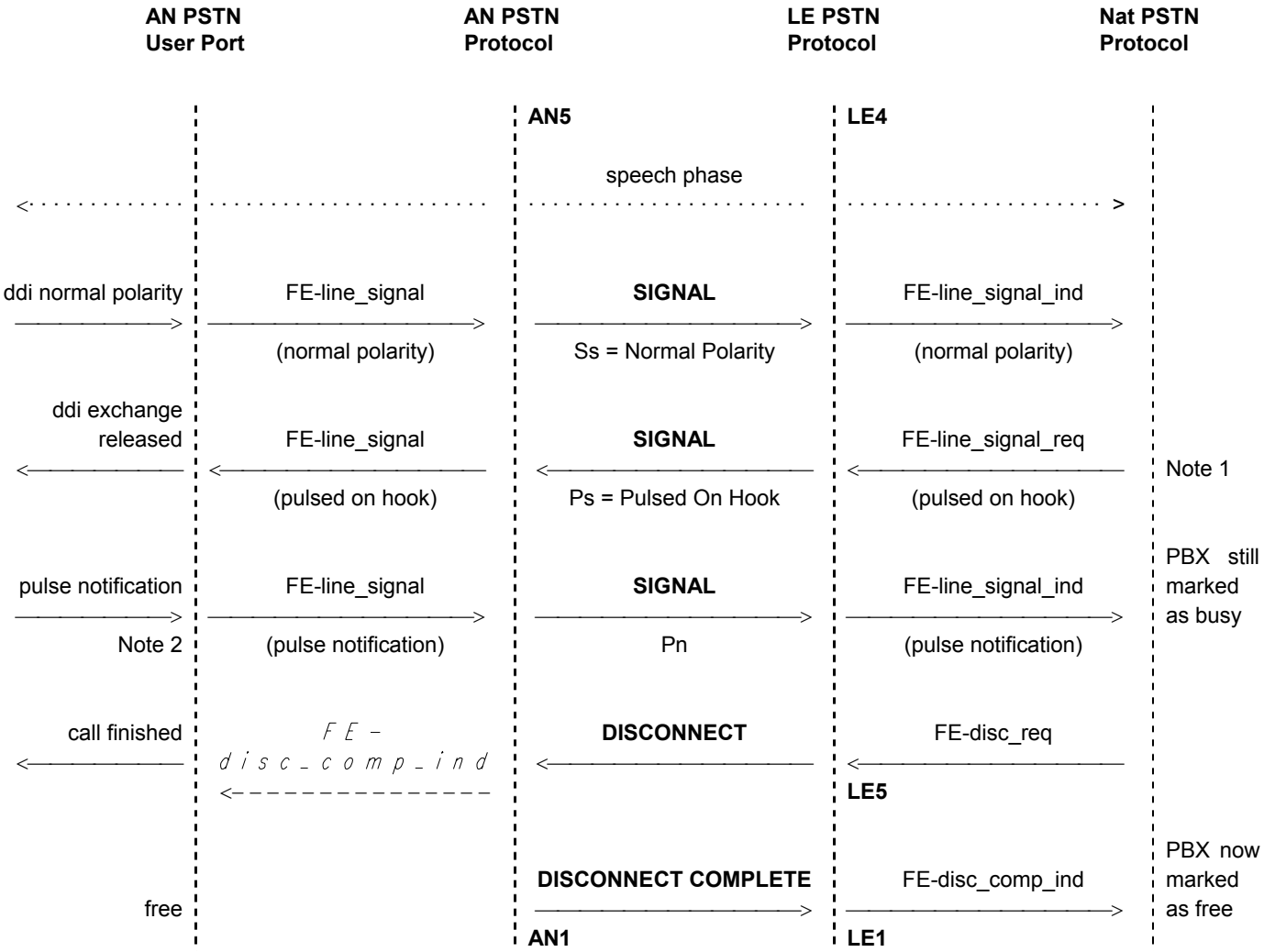
### 8.4.3.4. DDI Call Clearing - Caller clears first after answer then PBX does not clear during DDI EXCHANGE RELEASED Signal (Alternative sequence)




**NOTES**

1. This signal is normally not sent until completion of the tone or announcement.
2. If the DDI NORMAL POLARITY signal is received from the PBX before completion of the DDI EXCHANGE RELEASED signal then the Analogue Port process will send a pulse notification primitive followed immediately by the ddi normal polarity primitive. The Analogue Port process also replaces the DDI EXCHANGE RELEASED signal with a DDI IDLE signal.
3. The Analogue Port process detects the continued DDI REVERSED POLARITY signal.

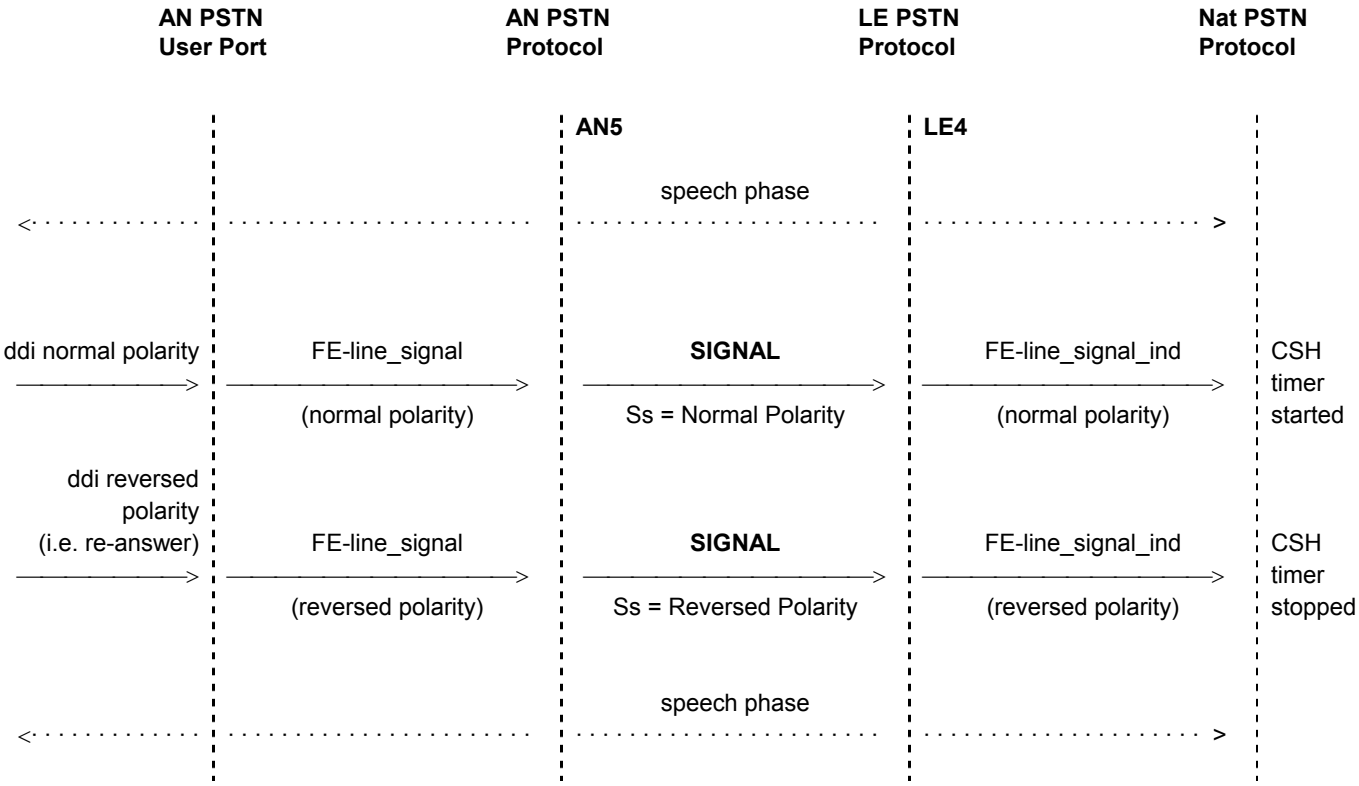
### 8.4.3.5. DDI Call Clearing - PBX clears first after answer



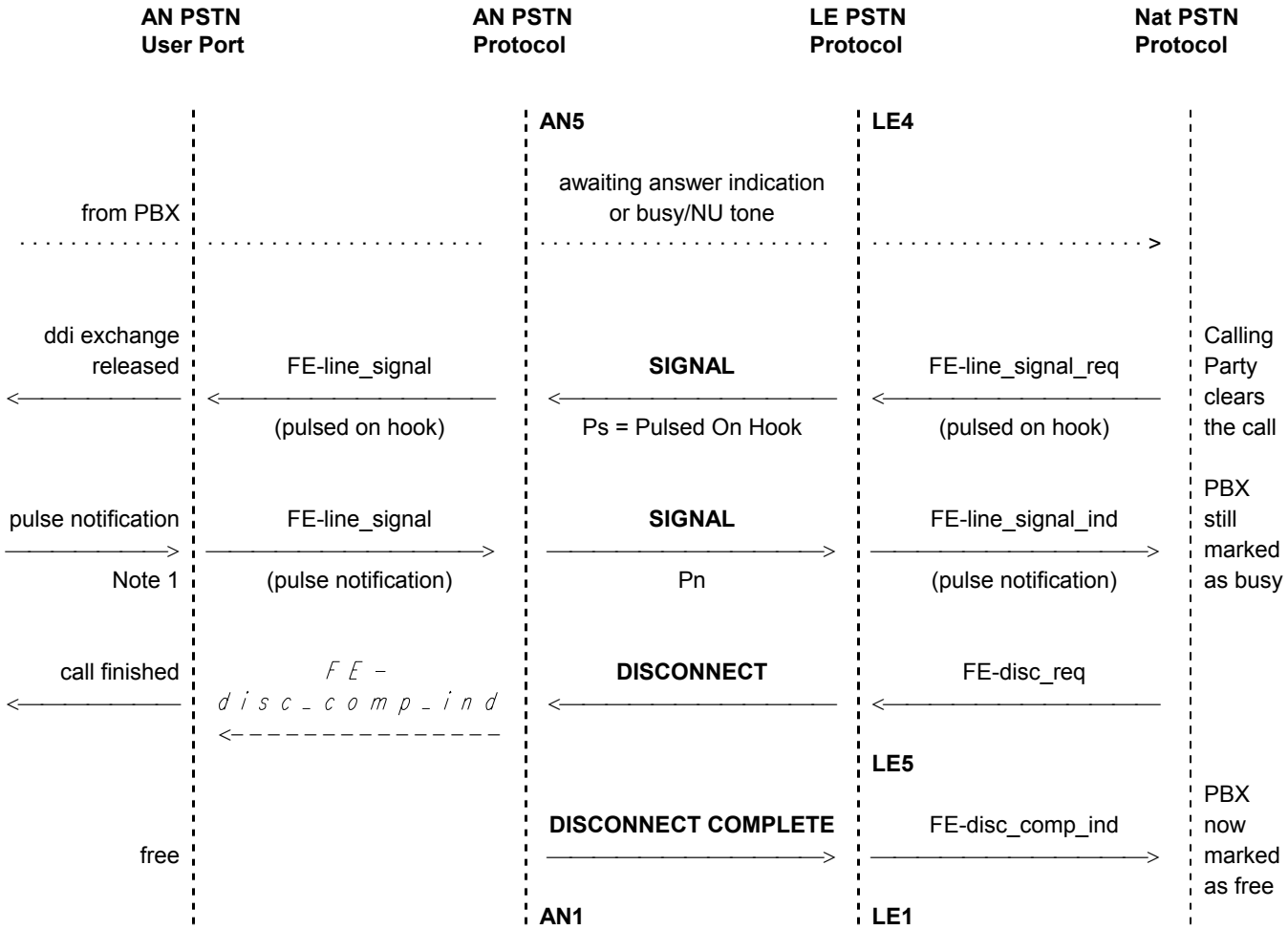

**NOTES**

1. The calling party clears or the Called Subscriber Held (CSH) timer expires.
2. This primitive is sent by the Analogue Port process on completion of the DDI EXCHANGE RELEASED signal. The Analogue Port process also replaces the DDI EXCHANGE RELEASED signal with a DDI IDLE signal.

### 8.4.3.6. DDI Call Clearing - PBX clears and re-answers



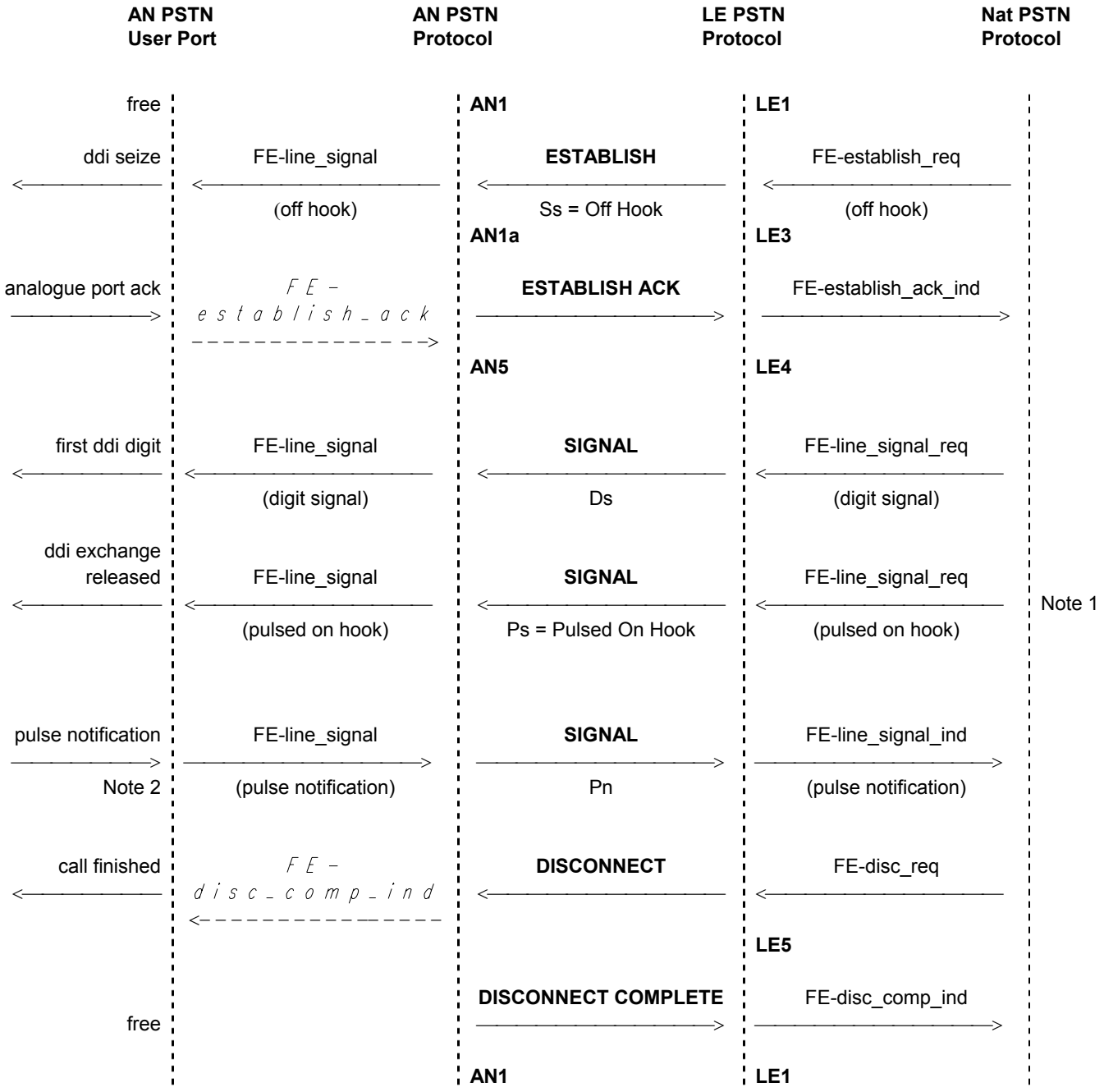
### 8.4.3.7. DDI Call Clearing - Caller clears an unanswered, unavailable or busy extension




**NOTES**

1. This primitive is sent by the Analogue Port process on completion of the DDI EXCHANGE RELEASED signal. The Analogue Port process also replaces the DDI EXCHANGE RELEASED signal with a DDI IDLE signal.

### 8.4.3.8. DDI Call Clearing - Caller goes on-hook during call set-up

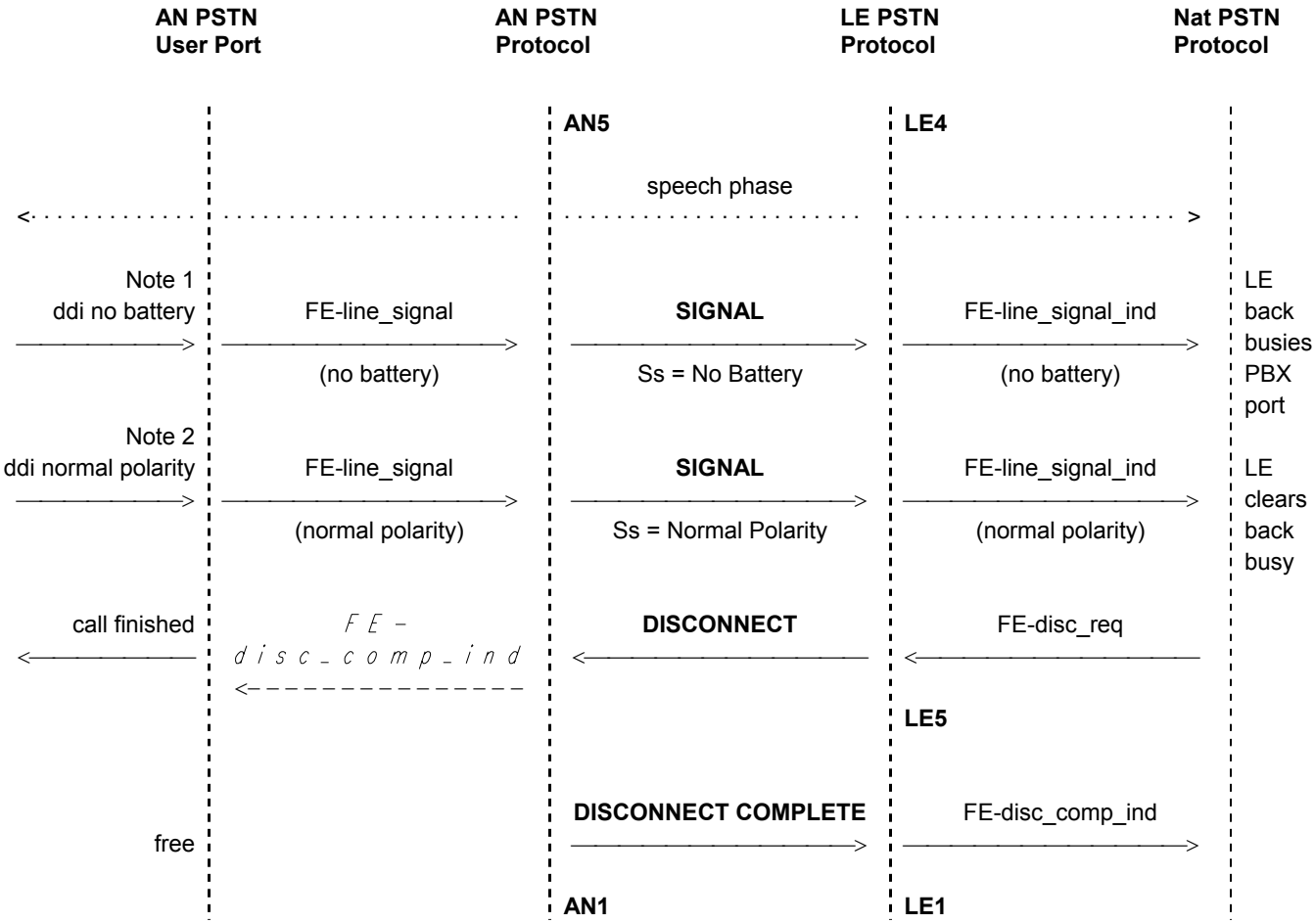



**NOTES**

1. The calling party clears before all digits are sent.
2. This primitive is sent by the Analogue Port process on completion of the DDI EXCHANGE RELEASED signal. The Analogue Port process also replaces the DDI EXCHANGE RELEASED signal with a DDI IDLE signal.

## 8.4.4. DDI PBX - PORT BUSIED

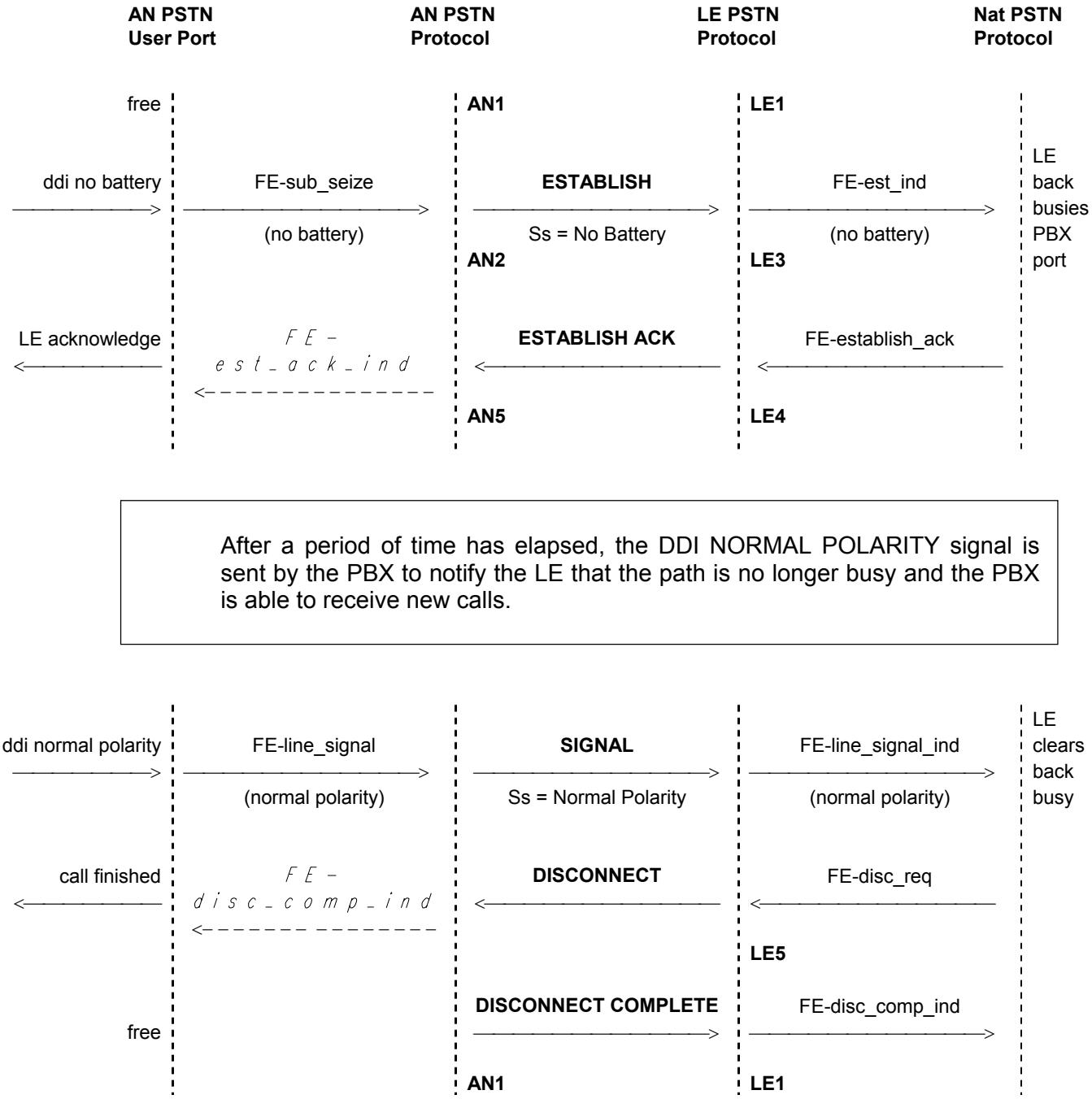
### 8.4.4.1. DDI Port Busying - PBX busies the line post call set-up



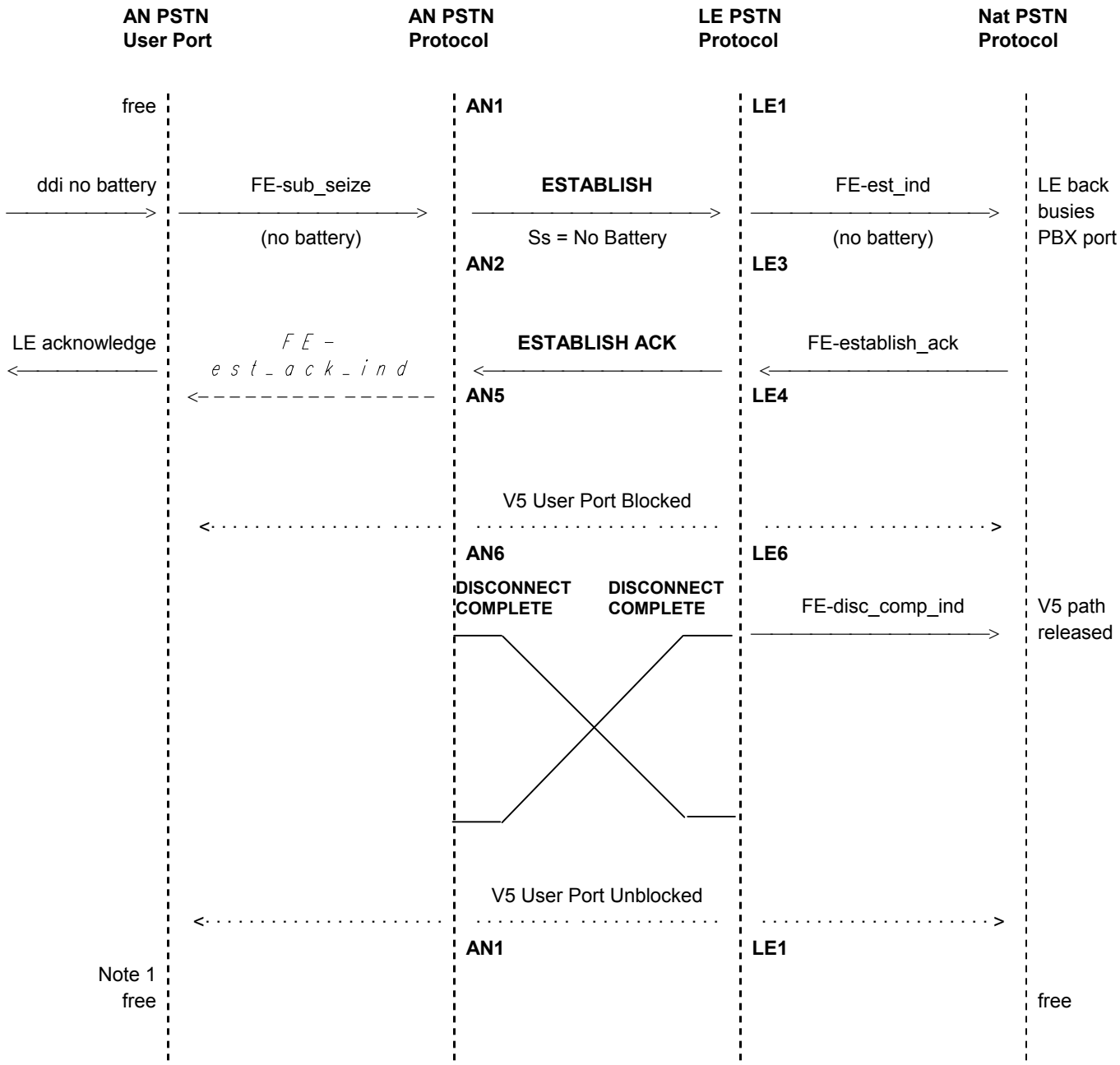

**NOTES**

1. The PBX line may be busied by disconnection of the feed from both A and B wires.
   The signalling path shall be maintained until a clear signal (i.e. Normal Polarity) is received by the LE.
2. The clear signal (i.e. DDI NORMAL POLARITY) is sent by the PBX to notify the LE that the path is no longer busy and the PBX is able to receive new calls.

#### 8.4.4.2. DDI Port Busying - PBX busies the port in the Free state



### 8.4.4.3. DDI Port Unblocking - LE Blocks and Unblocks the user port after it has been back busied




**NOTES**

1. After the Unblock, the LE assumes that the PBX is free. If the PBX is still busy, the AN sends an ESTABLISH message with Ss = no battery.

## ANNEX A - CADENCED RINGING DEFINITIONS (INFORMATIVE)

This Annex contains a set of cadence ringing definitions as an example of how the information element might be coded in a particular operator's network. The cadence used will depend on the service offered by that operator. The inclusion of the definitions here does not preclude changes and agreement should be reached between an operator and their supplier(s) as to what is actually required.

| Bits 7 6 5 4 3 2 1 | Definition | Meaning |
|---|---|---|
| 0 0 0 0 0 0 0 | 0.4 sec ON, 0.2 sec OFF<br>0.4 sec ON, 2.0 sec OFF<br>which may be preceded by an initial burst of<br>0.35 sec ON, 0.22 sec OFF | Normal ringing cadence.<br><br>(Note 1) |
| 0 0 0 0 0 0 1 | 0.4 sec ON, 0.2 sec OFF<br>0.4 sec ON, 2.0 sec OFF<br>which may be preceded by an initial burst of<br>0.35 sec ON, 0.22 sec OFF | Normal ringing cadence.<br><br>(Note 1) |
| 0 0 0 0 0 1 0 | 0.4 sec ON, 0.8 sec OFF | Ringing cadence used for call diversion. |
| 0 0 0 0 0 1 1 | 0.25 sec ON, 0.25 sec OFF<br>0.25 sec ON, 0.25 sec OFF<br>0.25 sec ON, 1.75 sec OFF | Ringing cadence used for ring back on call completion. |
| 0 0 0 0 1 0 0 | 2.0 sec ON, 4.0 sec OFF | Ringing cadence for distinctive ringing. |
| 0 0 0 0 1 0 1 | Continuous ringing | Continuous ringing calls. |
| 0 0 0 0 1 1 0 | 1.0 sec ON, 2.0 sec OFF | Ringing cadence for an internal business exchange call. |
| 0 0 0 0 1 1 1 | No ringing | No ring call type. |
| All other values | | Reserved. |

Note 1: These first two values have the same definition for reasons of compatibility with existing implementations. It is likely in practice that an LE implementation would use one or other of the values but not both.

**Table A.1. Coding for Cadenced ringing type**

## ANNEX B - INITIAL RING PULSE DEFINITIONS (INFORMATIVE)

This section contains a set of initial ring pulse definitions. They provide an example of how the information element might be coded in a particular operators network. The choice of pulse used will depend on the service offered by that operator. The inclusion of the definitions here does not preclude changes and agreement should be reached between an operator and their supplier(s) as to what is actually required.

| Bits<br>5 4 3 2 1 | Definition | Meaning |
|---|---|---|
| 0 0 0 0 0 | 0.4 sec ON | Pulse of normal ringing |
| 0 0 0 0 1 | 0.4 sec ON, 0.2 sec OFF | Pulse of normal ringing (including silence) |
| 0 0 0 1 0 | 0.25 sec ON | Pulse of call back ringing |
| 0 0 0 1 1 | 2.0 sec ON | Pulse of distinctive ringing |
| 0 0 1 0 0 | 1.0 sec ON | Pulse of business ringing |

**Table B.1. Coding for Initial ring pulse duration type**

**END**