Telecommunications Administration Centre,
Finland

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edition 2

GUIDELINES FOR IMPLEMENTATION

NATIONAL PSTN MAPPING FOR V5 INTERFACE

FOREWORD

This **Guidelines for implementation, National PSTN mappings for V5 interface,** provides definitions on how national analogue user signalling protocols shall be mapped onto the common PSTN protocol in V5 interface defined in ETS 300 324-1 and ETS 300 347-1. This mapping is intended to allow the integration of Access Network units and Local exchanges from different manufacturers in Finland.

This Guideline document has been prepared under the mandate of the national standardization group for Public Exchanges. The Steering Group of Telecommunications Standardization has discussed this document and recommends it to be followed when implementing national PSTN protocol parts of V5 interface signalling.

Contents

1 SCOPE

The scope of this specification is to provide V5 interface PSTN signal flows for the Finnish networks. Basis for this document is ETSI standard [1] that specifies ISDN, leased lines and control procols for V5 interface. Finnish PSTN mapping is formed of a subset of all the possibilities offered by the ETSI standard. All kinds of ANs are supported by this specification as far as they are possible to implement using signalling flows presented below. The following exchange interfaces are examples of those taken into consideration during forming of this document:

Analogue subscribers
dialling supported
flash supported
metering pulse (16 kHz) supported
polarity reversal supported
ringing cadences supported
CLI supported

ISDN
Out of scope of this PSTN specification (defined in [1])

Semipermanent lines
Out of scope of this PSTN specification (defined in [1])

PABX with DDI
Not supported

Concentration behind AN (e.g. radio equipment)
Restricted support by queuing possibility in AN

Pay-phone
Supported

2 NORMATIVE REFERENCES

This specification incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter.

[1] EN 300 324-1: "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".
[2] EN 300 347-1: "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".
[3] SFS 5665 ed. 3: Telecommunication network exchanges. Interfaces.
[4] SFS 5876: Telecommunications network exchanges. Tones and ringing signals
[5] GFI 9803 Guidelines for Implementation; Kansalliset tilaajatoiminteet.

3 DEFINITIONS, SYMBOLS AND ABBREVIATIONS

3.1 Definitions

For the purposes of this document, the following definitions apply:
Access Network (AN): see ETS 300 324-1 [1].
Control protocol: see ETS 300 324-1 [1].
Local Exchange (LE): see ETS 300 324-1 [1].

Semi-permanent leased line: see ETS 300 324-1 [1].
Time slot number: see ETS 300 324-1 [1].
V5 interface: see ETS 300 324-1 [1].

3.2 Symbols and abbreviations

For the purpose of this document the following abbreviations apply:
AN Access Network
Asis Autonomous-signalling-sequence
CLI Calling Line Identification
Cr Cadenced-ringing
DDI Direct Dialling In
Ds Digit-signal
DTMF Dual Tone Multiple Frequency
ISDN Integrated Services Digital Network
LE Local Exchange
MPH primitive between Physical layer and layer 2 Management
NE Network Element
OS Operations System
PH primitive between Physical layer and layer 2
Pn Pulse notification
Ps Pulsed-signal
PSTN Public Switched Telephone Network
PABX Private Automatic Branch eXchange
Rt Recognition time
Ru Resource-unavailable
Ss Steady-signal

4 MAPPINGS

4.1 General notes

In the flow diagram interpretation A-party release type have to be taken into consideration.
It has been found useful in AN to know when LE expects the subscriber to release the connection. For that purpose a SIGNAL (on hook) message is sent to AN at the same time with the busy tone. No action is required after such a message, but AN may use the information for internal purposes.
The in band data transmission (e.g. Calling Line Identification) is possible before ringing or between ringings. Also data transmission without ringing is possible.
LE is not allowed to send a new metering pulse message (SIGNAL, Ps = meter pulse) before AN sends SIGNAL (Pn) indicating that all previous pulses have been transmitted.
In the case of path collision (AN and LE transfer simultaneously ESTABLISH messages) the originating call shall prevail.

4.2 Used messages and predefined descriptions for message fields

This document specifies only PSTN associated message flows. Used messages and message fields are presented below. Other messages are used as specified in [1].

4.2.1 Establish

4.2.1.1 Off hook

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
ESTABLISH	4
Steady-signal *Note 1	5
Length of Steady-signal content	6
Steady-signal type = off hook	7

Figure 1: Establish message from An to LE, Ss = off hook
Note 1: Either Steady-signal information element, Pulsed-signal information element or Cadenced ringing information element shall be included in the ESTABLISH-message.
National options: None.

4.2.1.2 Initial ring

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
ESTABLISH	4
Pulsed-signal *Note 1	5
Length of Pulsed-signal content	6
Pulse type = initial ring	7
Suppr. ind. | Pulse duration type	8
Ack. req. ind. | Number of pulses	9

Figure 2: Establish message from LE to AN, Ps = initial ring
Note 1: Either Steady-signal information element, Pulsed-signal information element or Cadenced ringing information element shall be included in the ESTABLISH-message.
National options:

Parameter name	Value	Meaning
Suppress indicator	2	Suppression allowed by pre-defined line signal off hook from TE.
Acknowledge request indicator	2	Ending acknowledgement requested when finished all pulses.
Number of pulses	1	One "ringing pulse" shall be sent. A "ringing pulse" may contain 0-3 separate ringing fragments composing one main ringing phase. Please refer to [4].
Pulse duration type	variable	Coding according to table 1.

Table 1: Pulse duration types

Bits 5 4 3 2 1	**Meaning**
0 0 0 0 0	normal ringing
0 0 0 0 1	1st informative ringing
0 0 0 1 0	2nd informative ringing
0 0 0 1 1	3rd informative ringing
0 0 1 0 0	ring back
0 0 1 0 1	establish without ringing
0 0 1 1 0 . . . 0 1 1 1 1	Pulse duration types 6...15 are reserved for special applications. If duration type is not defined in AN normal ringing shall be used.

Pulse duration types 0...4 are defined in [4].

4.2.1.3 Cadenced ringing

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
ESTABLISH	4
Cadenced-ringing *Note 1	5
Length of Cadenced-ringing content	6
Cadenced-ringing type	7

Figure 3: Establish message from LE to AN, cadenced ringing
Note 1: Either Steady-signal information element, Pulsed-signal information element or Cadenced ringing information element shall be included in the ESTABLISH-message.
National options: Predefined Cadenced-ringing types shall be coded according to table 2.

Table 2: Cadenced-ringing types

Bits 5 4 3 2 1	**Meaning**
0 0 0 0 0	normal ringing
0 0 0 0 1	1st informative ringing
0 0 0 1 0	2nd informative ringing
0 0 0 1 1	3rd informative ringing
0 0 1 0 0	ring back
0 0 1 0 1	establish without ringing
0 0 1 1 0 . . . 0 1 1 1 1	Cadenced ringing types 6...15 are reserved for special applications. If ringing type is not defined in AN normal ringing shall be used.

Cadenced ringing types 0...4 are defined in [4].

4.2.2 Establish ack

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
ESTABLISH ACK	4

Figure 4: ESTABLISH ACK message
National options: None.

4.2.3 Signal

4.2.3.1 Cadenced ringing

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
SIGNAL	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Cadenced-ringing	8
Length of Cadenced-ringing content	9
Cadenced-ringing type	10

Figure 5: SIGNAL message from AN to LE, cadenced ringing
National options: Predefined Cadenced-ringing types shall be coded according to table 2.

4.2.3.2 Off hook

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
SIGNAL	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Steady-signal	8
Length of Steady-signal content	9
Steady-signal type = off hook	10

Figure 6: SIGNAL message from AN to LE, Ss = off hook
National options: None.

4.2.3.3 On hook

	Octet
Protocol discriminator	1
Layer 3 address	2

Layer 3 address (lower)	3
SIGNAL	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Steady-signal	8
Length of Steady-signal content	9
Steady-signal type = on hook	10

Figure 7: SIGNAL message, Ss = on hook
National options: None.

4.2.3.4 Reversed polarity

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
SIGNAL	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Steady-signal	8
Length of Steady-signal content	9
Steady-signal type = reversed polarity	10

Figure 8: SIGNAL message from LE to AN, Ss = reversed polarity
National options: None.

4.2.3.5 Digit sending

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
SIGNAL	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Digit-signal	8
Length of Digit-signal content	9
Digit ack. req. ind. | Digit information	10

Figure 9: SIGNAL message from AN to LE, digit sending
National options: Dialled digits shall be coded according to table 3.
Table 3: Digit information coding

Number of pulses	**Digit inform 4 3 2 1**	**Dialled digit**
-	0 0 0 0	invalid
1	0 0 0 1	1
2	0 0 1 0	2

3	0 0 1 1	3
4	0 1 0 0	4
5	0 1 0 1	5
6	0 1 1 0	6
7	0 1 1 1	7
8	1 0 0 0	8
9	1 0 0 1	9
10	1 0 1 0	0
11	1 0 1 1	B
12	1 1 0 0	C
13	1 1 0 1	D
14	1 1 1 0	E
15	1 1 1 1	F

4.2.3.6 Meter pulse sending

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
SIGNAL	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Pulsed-signal	8
Length of Pulsed-signal content	9
Pulse type = meter pulse	10
Suppr. ind. | Pulse duration type	11
Ack. req. ind. | Number of pulses	12

Figure 10: SIGNAL message from LE to AN, meter pulse sending
National options:

Parameter name	Value	Meaning
Suppress indicator	0	No suppression.
Acknowledge request indicator	2	Ending acknowledgement requested when finished all pulses.
Number of pulses	1...31	
Pulse duration type	16	Always 16.

4.2.3.7 Pulse notification

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
SIGNAL	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Pulse-notification	8

Figure 11: SIGNAL message from AN to LE, pulse notification
National options: none.

4.2.3.8 Register recall

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
SIGNAL	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Pulsed-signal	8
Length of Pulsed-signal content	9
Pulse type = register recall	10

Figure 12: SIGNAL message from AN to LE, register recall
National options: none.

4.2.3.9 Reduced battery

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
SIGNAL	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Steady-signal	8
Length of Steady-signal content	9
Steady-signal type = reduced battery	10

Figure 8: SIGNAL message from LE to AN, Ss = reduced battery
National options: None.

4.2.4 Disconnect

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
DISCONNECT	4

Figure 13: DISCONNECT message
National options: none. When receiving DISCONNECT message AN shall set relevant subscriber interface to physical idle state.

4.2.5 Disconnect complete

	Octet

Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
DISCONNECT_COMPLETE	4

Figure 14: DISCONNECT COMPLETE message
National options: none.

4.2.6 Protocol parameter

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
PROTOCOL PARAMETER	4
Sequence-number	5
Length of Sequence-number content	6
Sequence-number (see 13.4.7.1 of [1])	7
Recognition-time	8
Length of Recognition-time content	9
Register recall	10
Duration type	11

Figure 15: PROTOCOL PARAMETER message from LE to AN
National options: Duration type shall be coded according to table 4.
Table 4: Duration type coding

Dur. type	**Meaning**
0 0 0 0 0 0	Register recall is not detected
0 0 0 0 0 1	Register recall detection is required according to a predefined and possibly provisionalable criteria (ref. [3]).

Other values are reserved.

4.2.7 Status

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
STATUS	4
State	5
Cause	6
Length of Cause content	7
Cause type = response to STATUS ENQUIRY	8

Figure 16: STATUS message from AN to LE
STATUS message above is used in the message flows of this document. Other STATUS messages are used in fault situations as defined in [1].
National options: none.

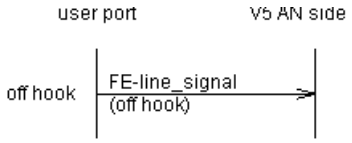
4.2.8 Status enquiry

	Octet
Protocol discriminator	1
Layer 3 address	2
Layer 3 address (lower)	3
STATUS ENQUIRY	4

Figure 17: STATUS ENQUIRY message from LE to AN
STATUS ENQUIRY message above is used in the message flows of this document. Other STATUS ENQUIRY messages are used in fault situations as defined in [1].
National options: none.

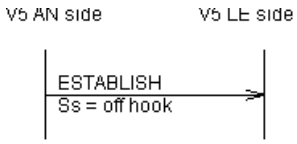
4.3 General information on mappings layout

In the following flow diagrams, time is shown running top to bottom, with no scale. The vertical bars represent the following entity:
user port national PSTN interface between subscriber equipment and Access Network
V5 AN side V5 AN PSTN protocol entity
V5 LE side V5 LE PSTN protocol entity
national PSTN protocol National PSTN protocol implementation in the LE
Line conditions detected or forwarded on the user line and primitives originated by the National Protocol in the LE have been mapped onto function elements (FE) according to tables 1 and 2 of the ETS for V5.1 interface, ETS 300 324-1.
A brief description of the physical conditions detected or generated on the PSTN line is shown in brackets below the function element, for example:



The diagrams do not give information about the timers involved in the V5 PSTN protocol message exchange (refer to table 28 of the ETS on V5.1, ETS 300 324-1).
States of the PSTN protocol are shown on the right side of the vertical bars only when a state transition occurs (for further information refer to tables 29 to 31 of the ETS on V5.1, ETS 300 324-1).
The message types visible on the V5 interface are represented in capital letters and are given along with an indication of their direction in the centre portion of the diagrams. Below the message a further explanation of the structure of the message itself is given (i.e. Information Element and line signal). For editorial reasons some abbreviations have been adopted to represent the Information Elements. Abbreviations are explained in chapter Definitions, symbols and abbreviations.

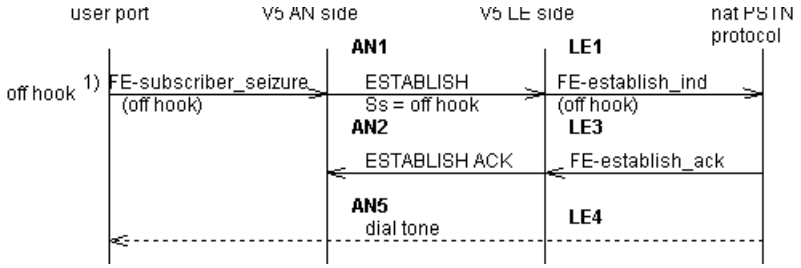
An example is given below of how an ESTABLISH message carrying an off hook indication (Steady signal) can be represented.



Note that the SIGNAL ACK messages, used to acknowledge SIGNAL messages, may occur at any time during the PATH ACTIVE state and their position within the protocol is arbitrary. The occurrence of the SIGNAL ACK message is independent from the mappings and is therefore not shown in the following drawings.

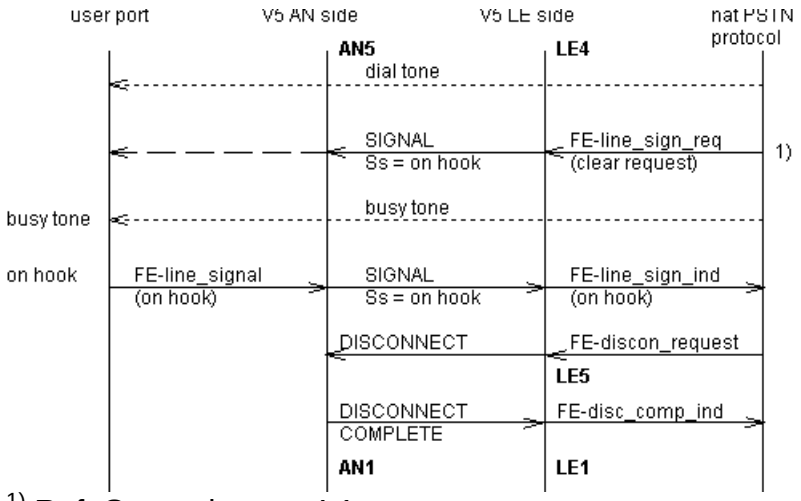
4.4 A-side cases

4.4.1 A-side seizure until dial tone applied



1) Seizure detection defined in [3]

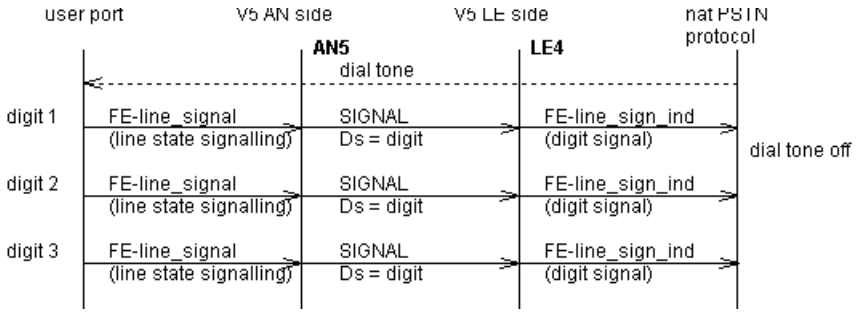
4.4.2 Dial tone supervision expired - release of connection



1) Ref. General notes 4.1.
If subscriber does not put the phone on hook, line parked follows (ref. 4.5.5).

4.4.3 Dialling

4.4.3.1 Decadic dialling

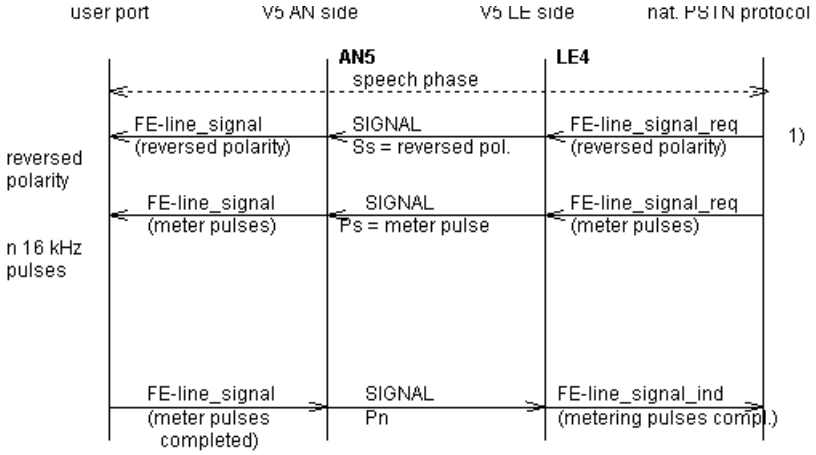


The AN is responsible for dial tone suppression during decadic dialling digit reception.

4.4.3.2 DTMF dialling

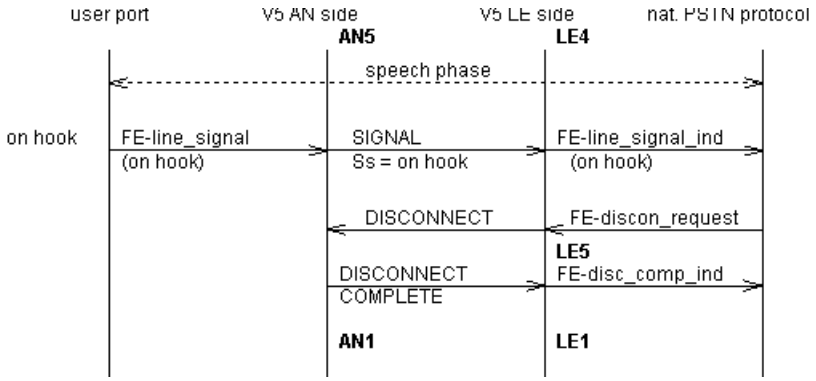
V5 standard is transparent to the DTMF dialling.

4.4.4 Meter pulse billing (and polarity reversal)

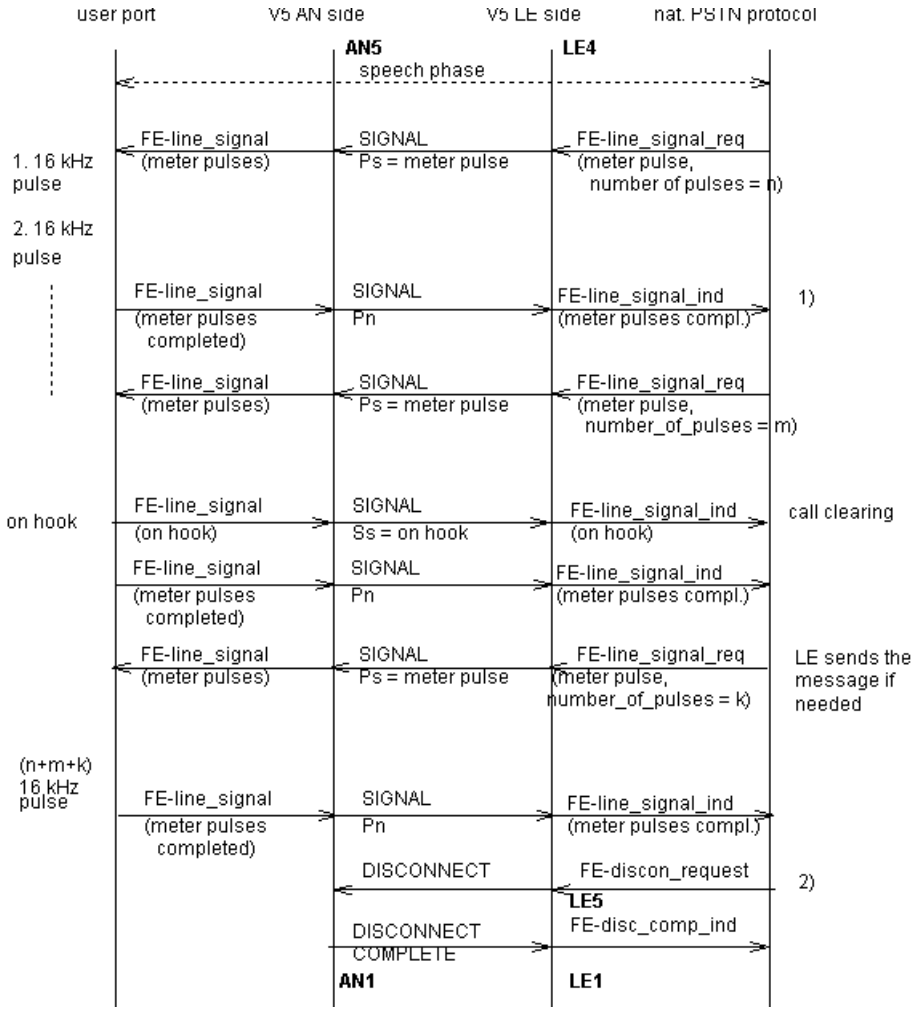


[1] LE sends reversed polarity request to AN only if needed.

4.4.5 Subscriber A goes on hook



4.4.6 Subscriber A goes on hook during multiple meter pulse feeding

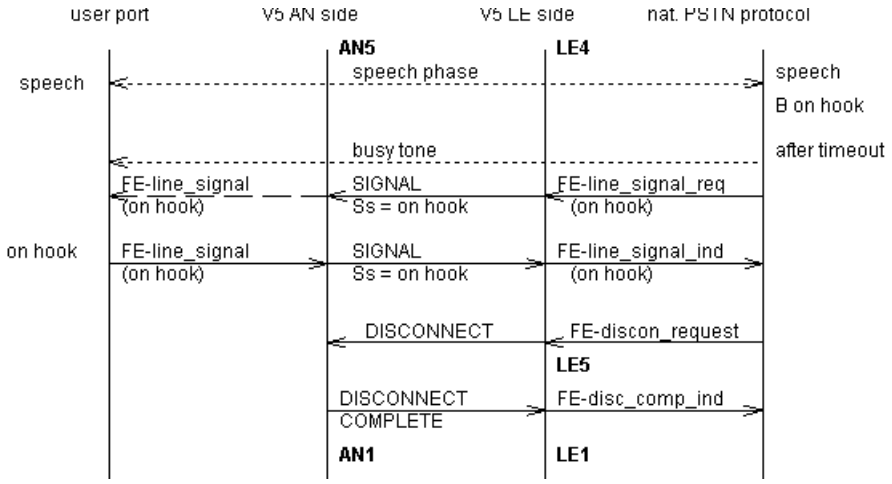


[1)]The LE is not allowed to send a new metering pulse message before it receives acknowledge message to previous metering pulse message from the AN.

[2)] LE is not allowed to send DISCONNECT message to AN before receiving the acknowledgement of meter pulses, because new calls are not allowed before all meter pulses of the previous call are completed. LE must check that pulse notification is the response of the message sent last.

If AN sends SIGNAL (Ss = on hook) followed by SIGNAL (Ss = off hook) before all the metering pulses are sent LE waits for the last SIGNAL (Pn) before disconnecting the call. After sending DISCONNECT COMPLETE AN shall send ESTABLISH (Ss = off hook).

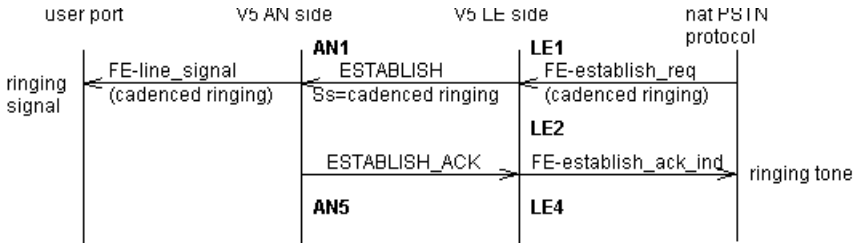
4.4.7 Clear back time supervision expires at subscriber A



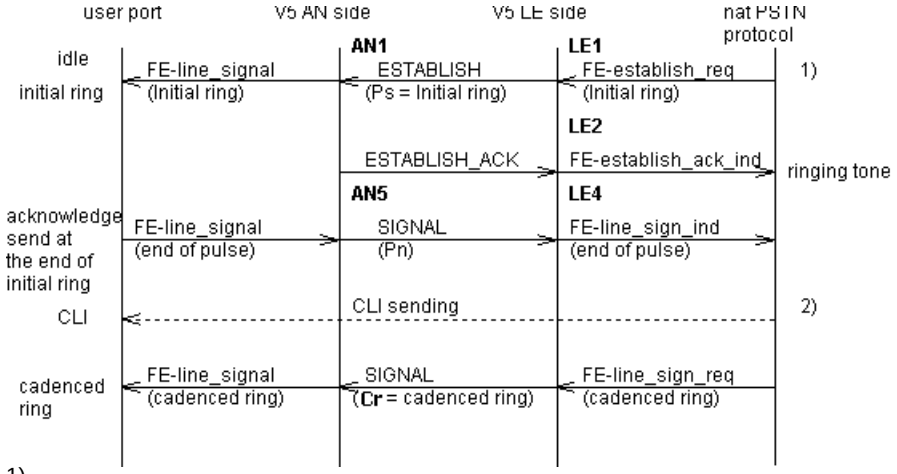
4.5 B-side cases

4.5.1 B-side seizure until ring tone applied

Normal case



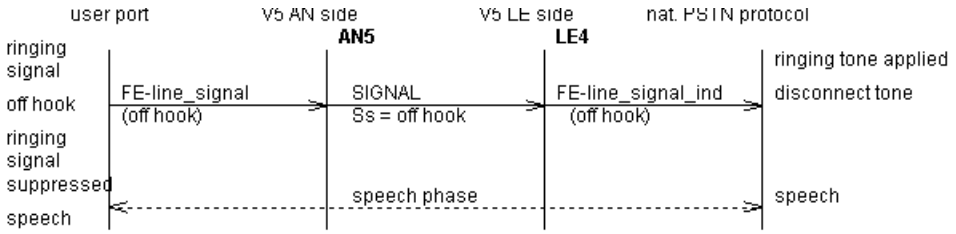
The in band data transmission



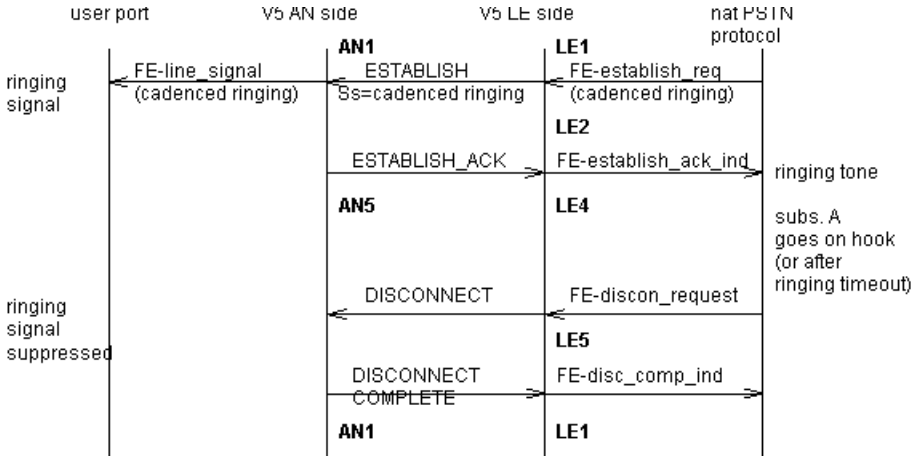
[1)] Initial ring is used to originate one ringing sequence. At the end of initial ring an acknowledgement is sent. LE may send optional in band data (e.g. Calling Line Identification) and start cadenced ringing. Initial ring sequence is the same as used in the succeeding cadenced ringing unless no ringing is wanted before CLI. Ringing cadences are specified in standard SFS 5644 version 3.

[2)] Optional Calling Line Identification is sent to B-subscriber with in band tones. The time gap for CLI sending is supervised by LE. If B-subscriber answers during CLI transmission LE stops tone sending and connects the speech path. All unsent information is lost.

4.5.2 Subscriber B answers after ringing

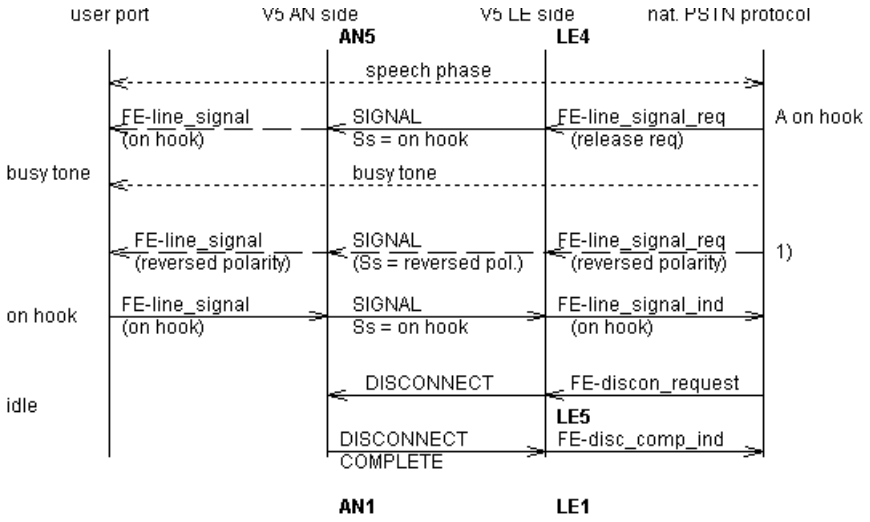


4.5.3 Release of connection initiated by LE before subscriber B answers



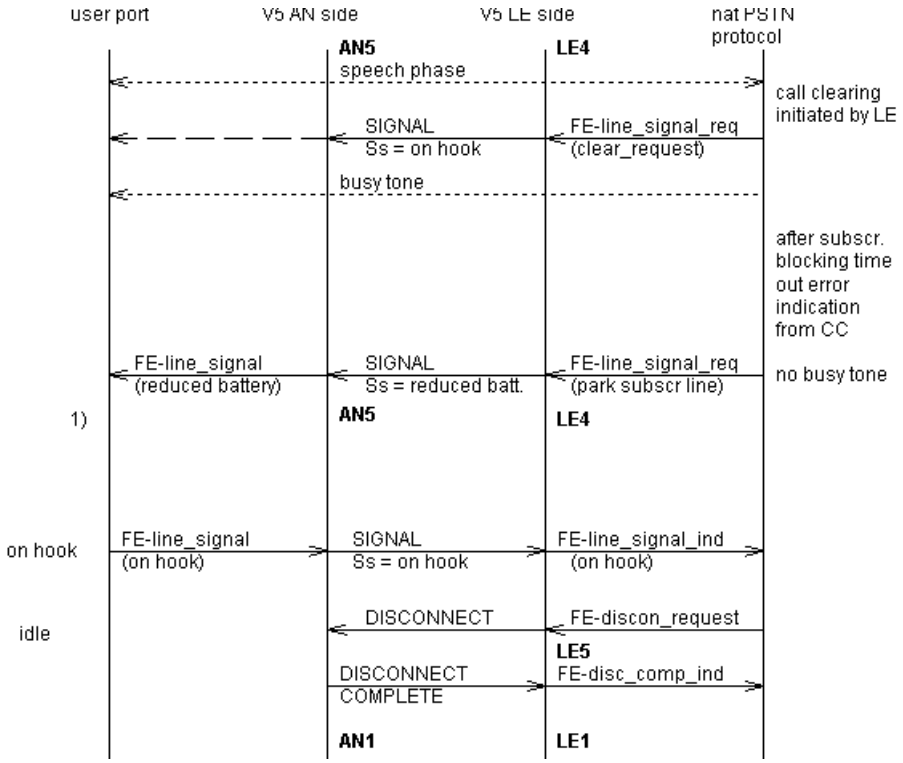
Function in collision between the answer and disconnect request is the same as in case "Subscriber B goes on hook in talk state, collision between reanswer and release of connection from LE".

4.5.4 Subscriber A goes on hook in talk state, subscriber B goes also on hook



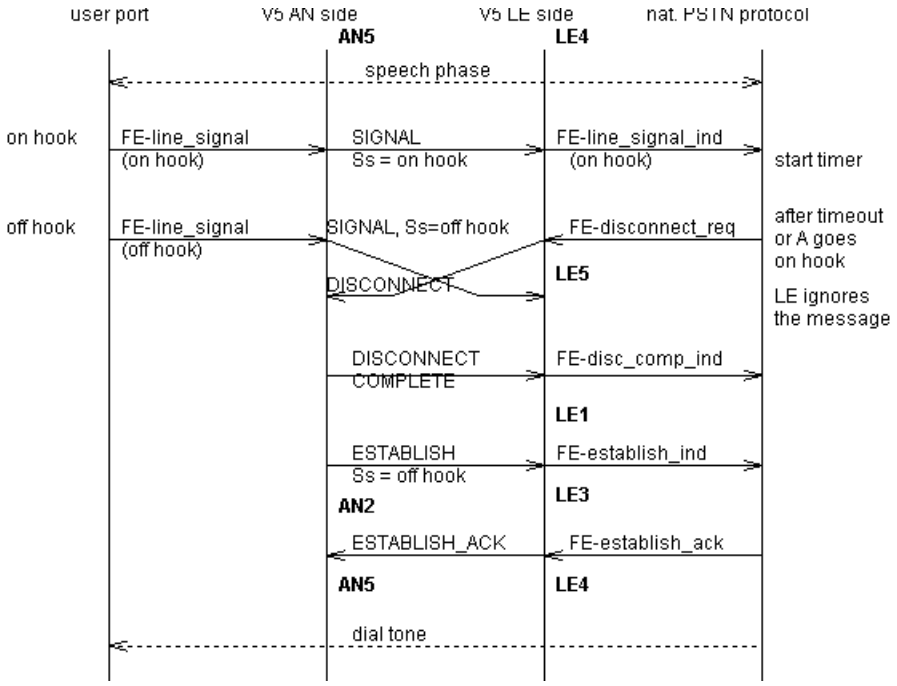
[1)] Depending on the application an optional SIGNAL message (Ss = reversed polarity) may be sent here.

4.5.5 LE expects release of the connection, but subscriber doesn’t go on hook, line is parked

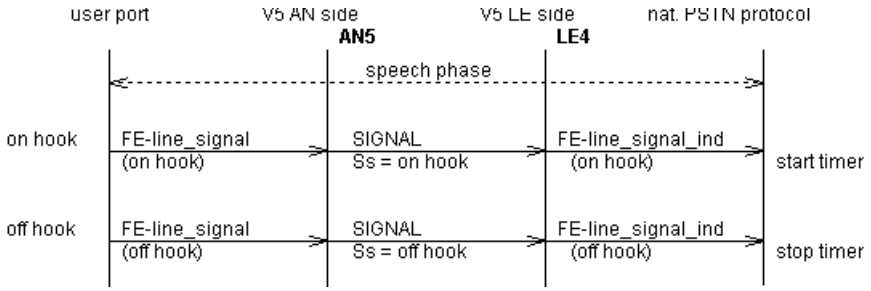


[1)] Time gap between SIGNAL (Ss = reduced battery) and on hook may be very long (eg. because of a line fault). AN may reduce line feeding power after the message.
This state is entered for example from the following states:
- Dial tone supervision expired but the A-subscriber does not go on hook.
- A-subscriber goes on hook, B-subscriber does not go on hook.
- B-subscriber goes on hook, A-subscriber does not go on hook.
- Busy tone timer expires, but subscriber doesn't go on hook

4.5.6 Subscriber B goes on hook in talk state, collision between reanswer and release of connection from LE

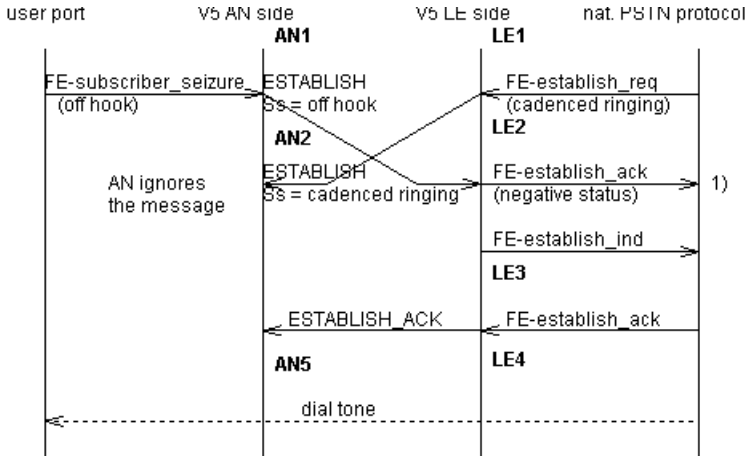


4.5.7 Subscriber B goes on hook in talk state, reanswer before release of connection from LE



4.6 Other cases

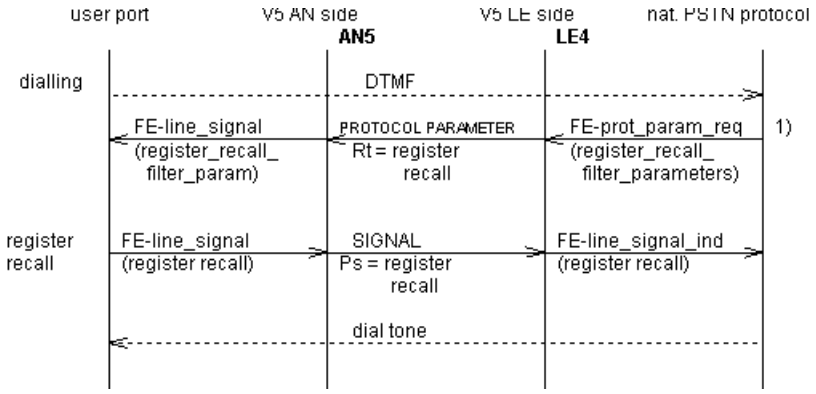
4.6.1 Seizure collision; subscriber goes off hook and LE send B-side seizure



[1)] In LE negative acknowledgement may be sent to national PSTN protocol for B side seizure.

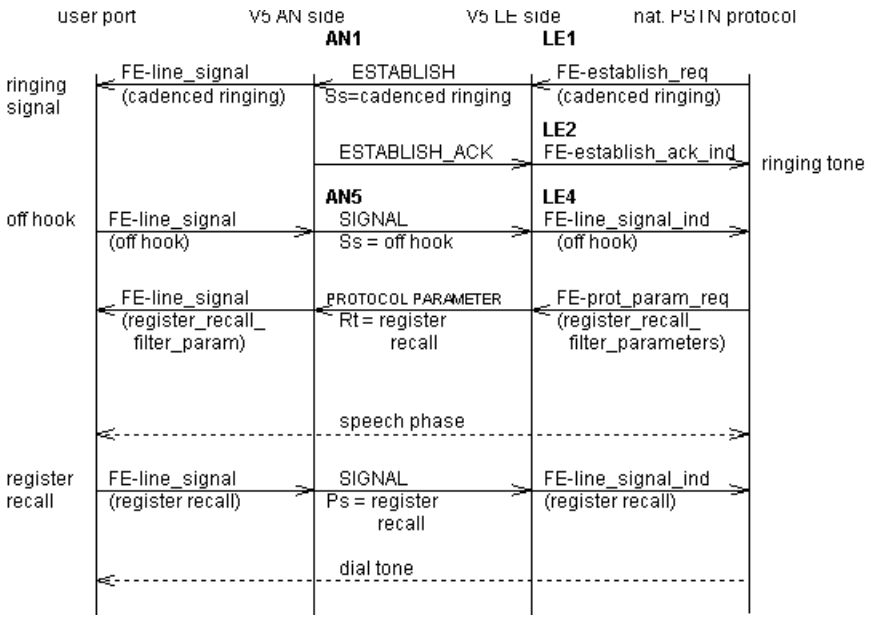
4.6.2 Register recall signal detection control

A-side

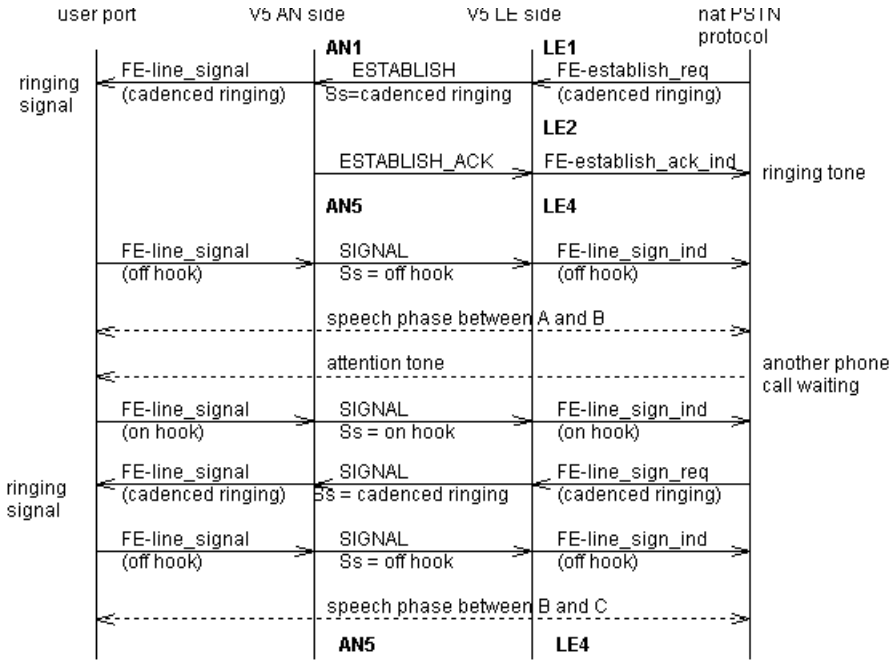


[1)] LE sends a protocol parameter message when the detection of flash key is required. After the message decadic dialling is not decoded. When the call is disconnected the parameters for register recall are cleared by AN.

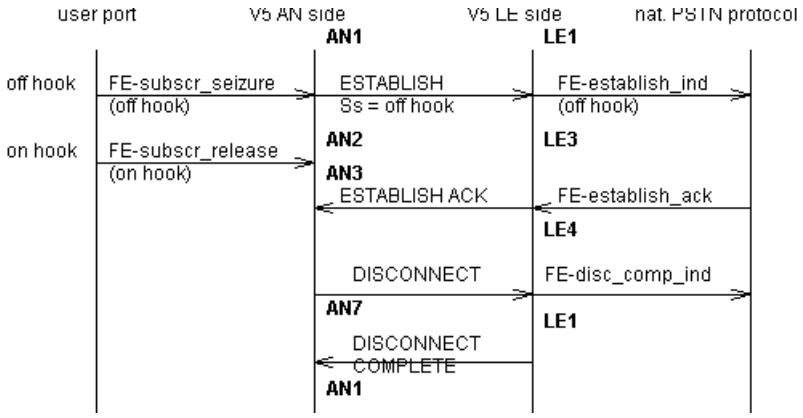
B-side



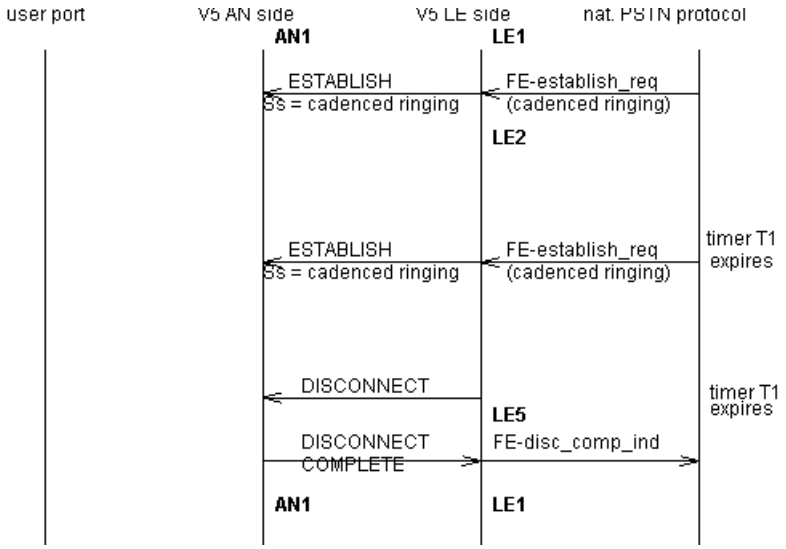
4.6.3 Reringing after multiparty feature (exaple: call waiting)



4.6.4 Seizure from AN, subscriber goes on hook before ESTABLISH ACK.

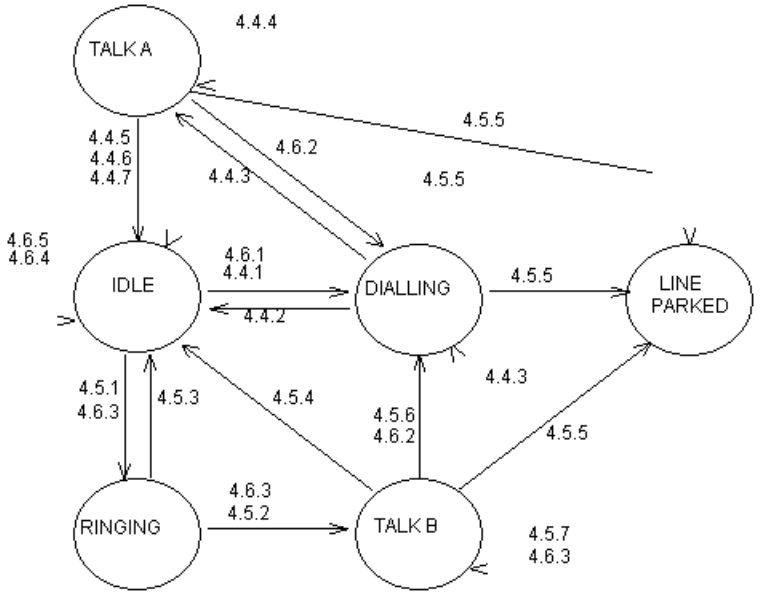


4.6.5 Lack of resources in AN



Annex A: State transition diagram

The diagram below is not associated with AN nor LE side signalling states but is intended to be a quick reference help only.



For further information: Ari Karppanen