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European Standard (Telecommunications series)

V interfaces at the digital Service Node (SN); Interfaces at the VB5.1 reference point for the support of broadband or combined narrowband and broadband Access Networks (ANs); Part 1: Interface specification

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Reference

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Foreword

This draft European Standard (Telecommunications series) has been produced by the Signalling Protocols and Switching (SPS) Technical Committee of the European Telecommunications Standards Institute (ETSI) and is now submitted for the Public Enquiry phase of the ETSI standards Two-step Approval Procedure (TAP).

The present document is part 1 of a multi-part standard covering the interfaces at the VB5.1 reference point as described below:

Part 1: "Interface specification";

Part 2: "Protocol Implementation Conformance Statemen (PICS) specification".

NOTE: Further parts covering conformance testing may be identified later.

Proposed national transposition dates	
Date of latest announcement of the present document (doa):	3 months after ETSI publication
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Introduction

General

The work on a new broadband VB reference point concept was initiated by ETSI Technical Committee SPS to consider possible new structures and reference points for the connection of new broadband and combined narrowband/broadband access arrangements to Service Nodes (SN), in co-operation with other TCs.

The VB5 reference point concept, based on ITU-T Recommendation G.902, was split into two variants. The first variant based on an ATM cross-connect with provisioned connectivity, called the VB5.1 reference point, is described in the present document. The other variant which further enables on-demand connectivity within the AN, called the VB5.2 reference point, is covered under work item DEN/SPS-03047-1.

Relationship between the VB5.1 and VB5.2 reference point concepts

VB5.2 extends the capabilities at the VB5.1 reference point to include on-demand connectivity in the AN under the control of SN. The major common features between the VB5.1 and VB5.2 interfaces are:

- both VB5 interfaces support B-ISDN as well as narrowband and other non-B-ISDN customer access types;
- both VB5 interfaces support ATM multiplexing/cross-connecting in the AN at the VP and/or VC level.

It is anticipated that the Real Time Management Co-ordination (RTMC) protocol for the VB5.1 reference point will be a subset of the RTMC protocol for the VB5.2 reference point.

1 Scope

This first part of EN 301 005 specifies the physical, procedural and protocol requirements for interfaces at the VB5.1 reference point between an Access Network (AN) and a Service Node (SN) with flexible (provisioned) Virtual Path Link (VPL) allocation and flexible (provisioned) Virtual Channel Link (VCL) allocation (controlled by Q3 interfaces) at the VB5.1 reference point.

The following Broadband Integrated Service Digital Network (B-ISDN) customer access types are supported:

a) B-ISDN accesses with a User-Network Interface (UNI) according to ITU-T Recommendation I.432.2 [22] at the user side of the access network, in particular:

   1) Synchronous Digital Hierarchy (SDH) based according to ETS 300 300 [4];

   2) Cell based according to ETS 300 299 [3],

b) B-ISDN access with a UNI according to ITU-T Recommendation I.432.3 [23] case of PDH-framed symmetrical 2 048 kbit/s (electrical interface).

NOTE: B-ISDN accesses with a UNI according to future standards may require additional functionality at the VB5.1 reference point.

In order to provide for a migration from narrowband to broadband access network and service node arrangements, also narrowband access types as specified for:

- V5.1 interface according to ETS 300 324-1 [6]/ITU-T Recommendation G.964; and/or

- V5.2 interface according to ETS 300 347-1 [7]/ITU-T Recommendation G.965,

are supported according to the integration scenario given in ITU-T Recommendation G.902 [15], appendix III.2.2, using a circuit emulation function for the transfer of circuit mode into Asynchronous Transfer Mode (ATM).

In addition to these B-ISDN and narrowband customer access types, other non-B-ISDN access types are also supported.

Examples for such non-B-ISDN access types are given below:

a) access types supporting asymmetric/multimedia services (i.e. video on demand) (if not part of B-ISDN access types);

b) access types supporting broadcast services (if not part of B-ISDN access types);

c) access types supporting LAN interconnect functionality (if not part of B-ISDN access types);

d) access types that can be supported via an ATM VP cross-connect (i.e. access types according to the ATM Forum standards).

The concept of Virtual User Ports (VUP), as described in clause 8 of the present document, may be applied to enable any specific implementation.

In accordance with the principles of B-ISDN (see CCITT Recommendation I.121 [29]), remote access arrangements across interfaces at the VB5.1 reference point support switched and (semi-) permanent point-to-point and point-to-multipoint connections and provide on demand, reserved and permanent services of a mono- and/or multimedia type and of a connectionless or connection-oriented nature and in a bi-directional or unidirectional configuration as supported and provided for direct access arrangements to SNs.

Functions to support security management (see CCITT Recommendation X.800 [39]) related to the customer access are out of the scope of the present document. Such security management functions have no impact on the VB5.1 reference point.

The present document does not specify the implementation of the requirements within the AN and does not constrain any implementation alternative as long as the functionality at the interfaces at the VB5.1 reference point as specified in the present document is met. Furthermore, the present document does not require that an AN shall support all the customer access types listed above.

The present document is not intended to define any systems or equipment in, or connected to, a SN via interfaces at the VB5.1 reference point. Therefore only the characteristics of the interfaces at the VB5.1 reference point are described.

2 References

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

2.1 Normative references

[1] ETS 300 298-1: "Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); Part 1: B-ISDN ATM functional characteristics [ITU-T Recommendation I.150 (1995)]".

[2] ETS 300 298-2: "Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); Part 2: B-ISDN ATM layer specification [ITU-T Recommendation I.361 (1995)]".

[3] ETS 300 299: "Broadband Integrated Services Digital Network (B-ISDN); Cell based user network access for 155 520 kbit/s and 622 080 kbit/s; Physical layer interfaces for B-ISDN applications".

NOTE 1: This ETS is based on parts of ITU-T Recommendation I.432.2 [22].

[4] ETS 300 300: "Broadband Integrated Services Digital Network (B-ISDN); Synchronous Digital Hierarchy (SDH) based user network access; Physical layer interfaces for B-ISDN applications".

NOTE 2: This ETS is based on parts of ITU-T Recommendation I.432.2 [22].

[5] ETS 300 301: "Broadband Integrated Services Digital Network (B-ISDN); Traffic control and congestion control in B-ISDN [ITU-T Recommendation I.371 (1996)]".

[6] ETS 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" (see also ITU-T Recommendation G.964).

[7] ETS 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" (see also ITU-T Recommendation G.965).

[8] ETS 300 404: "Broadband Integrated Services Digital Network (B-ISDN); B-ISDN Operation And Maintenance (OAM) principles and functions".

NOTE 3: This ETS is based on ITU-T Recommendation I.610 [24].

[9] ETS 300 428: "Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM) Adaptation Layer (AAL) specification - type 5".

[10] ETS 300 436-1: "Broadband Integrated Services Digital Network (B-ISDN); Signalling ATM Adaptation Layer (SAAL); Service Specific Connection Oriented Protocol (SSCOP); Part 1: Protocol specification [ITU-T Recommendation Q.2110 (1995), modified]".

[11] ETS 300 437-1: "Broadband Integrated Services Digital Network (B-ISDN); Signalling ATM Adaptation Layer (SAAL); Service Specific Co-ordination Function (SSCF) for support of signalling at the User-Network Interface (UNI); Part 1: Specification of SSCF at UNI [ITU-T Recommendation Q.2130 (1995), modified]".

[12] ETS 300 443-1: "Broadband Integrated Services Digital Network (B-ISDN); Digital Subscriber Signalling System No. two (DSS2) protocol; B-ISDN user-network interface layer 3 specification for basic call/bearer control; Part 1: Protocol specification [ITU-T Recommendation Q.2931 (1995), modified]".

[13] ETS 300 486-1: "Broadband Integrated Services Digital Network (B-ISDN); Meta-signalling protocol; Part 1: Protocol specification [ITU-T Recommendation Q.2120 (1995), modified]".

[14] ITU-T Recommendation G.704 (1995): "Synchronous frame structures used at 1 544, 6 312, 2 048, 8 488 and 44 736 kbit/s hierarchical levels".

[15] ITU-T Recommendation G.902 (1995): "Framework Recommendation on functional access networks - Architecture and functions, access types, management and service node aspects".

[16] ITU-T Recommendation I.311 (1996): "B-ISDN general network aspects".

[17] ITU-T Recommendation I.321 (1991): "B-ISDN protocol reference model and its application".

[18] ITU-T Recommendation I.363.1 (1996): "B-ISDN ATM Adaptation layer specification - Types 1 and 2".

[19] ITU-T Recommendation I.363.5 (1996): "B-ISDN ATM Adaptation layer specification - Type 5".

[20] Draft revised ITU-T Recommendation I.414 (1996): "Overview of Recommendations on layer 1 for ISDN and B-ISDN customer accesses".

[21] ITU-T Recommendation I.432.1 (1996): "B-ISDN User-Network Interface - Physical layer specification - General characteristics".

[22] ITU-T Recommendation I.432.2 (1996): "B-ISDN User-Network Interface - Physical layer specification - 155 520 kbit/s and 622 080 kbit/s operation".

[23] ITU-T Recommendation I.432.3 (1996): "B-ISDN User-Network Interface - Physical layer specification - 1 544 kbit/s and 2048 kbit/s operation".

[24] ITU-T Recommendation I.610 (1995): "B-ISDN operation and maintenance principles and functions".

[25] ITU-T Recommendation I.732 (1996): "Functional characteristics of ATM equipment".

[26] ITU-T Recommendation Z.100 (1993): "Specification and Description Language (SDL)".

[27] ITU-T Recommendation Z.120 (1993): "Message Sequence Charts (MSC)".

2.2 Informative references

[28] ETS 300 414: "Methods for Testing and Specification (MTS); Use of SDL in European Telecommunication Standards; Rules for testability and facilitating validation".

[29] CCITT Recommendation I.121 (1991): "Broadband aspects of ISDN".

[30] CCITT Recommendation I.324 (1991): "ISDN network architecture".

[31] ITU-T Recommendation I.327 (1993): "B-ISDN functional architecture".

[32] ITU-T Recommendation I.356 (1993): "B-ISDN ATM layer cell transfer performance".

[33] ITU-T Recommendation I.731 (1996): "Types and general characteristics of ATM equipment".

[34] ITU-T Recommendation I.751 (1996): "Asynchronous tranfer mode management of the network element view".

[35] ITU-T Recommendation M.3010 (1996): "Principles for a telecommunications management network".

[36] ITU-T Recommendation Q.2763 (1995): "Signalling System No.7 B-ISDN user part (B-ISUP) - Format and codes".

[37] ITU-T Recommendation Q.2764 (1995): "Signalling System No.7 B-ISDN User-Part (B-ISUP) - Basic call procedures".

[38] ITU-T Recommendation X.731 | ISO/IEC 10164-2: "Information technology - Open Systems Interconnection - Systems management: State management function".

[39] CCITT Recommendation X.800 (1991): "Security architecture for Open Systems Interconnection for CCITT applications".

3 Definitions and abbreviations

3.1 Definitions

The following definitions apply, together with those given in the referenced publications:

logical service port: The set of Virtual Paths (VPs) at one VB5.1 reference point (i.e. associated with one and only one service node) carried on one or several transmission convergence functions.

logical user port: The set of VPs at the UNI or at a Virtual User Port (VUP) associated with one single VB5.1 reference point.

physical service port: The physical layer functions related to a single transmission convergence function at the VB5.1 interface.

physical user port: The physical layer functions related to a single transmission convergence function at the UNI.

Real Time Management Co-ordination (RTMC) function: The set of management plane functions providing for the co-ordination of time-critical management information (i.e. status information which has a direct impact on the service provision capability) between the AN and SN across the VB5.1 reference point.

RTMC protocol: The layer 3 protocol between AN and SN to support the RTMC function.

Virtual User Port (VUP): An AN internal reference point which has parallels with the physical user port though its full functions are not specified due to the wide range of potential non-B-ISDN access types that could be supported using this concept. A VUP concept is defined to enable the support of non-B-ISDN access types over the VB5.1 reference point in a manner consistent with B-ISDN access types.

VB5.1 interface: An interface (including the physical layer) at the VB5.1 reference point.

3.2 Abbreviations

The following abbreviations apply:

AAF	ATM Adaptation Functions
AAL	ATM Adaptation Layer
AAL1/5	AAL type 1/5
AIS	Alarm Indication Signal
AN	Access Network
ATM	Asynchronous Transfer Mode
ATM-SAP	ATM - Service Access Point
AXC	ATM Cross Connect
B-BCC	Broadband Bearer Connection Control
B-ET	Broadband Exchange Termination
B-ISDN	Broadband ISDN
B-ISUP	Broadband ISDN Signalling User Part
B-LEX	Broadband Local Exchange
B-UNI	Broadband UNI
BA	Basic (rate) Access
CBR	Constant Bit Rate
CE	Connection Element
CE2	Circuit Emulation of 2 048 kbit/s signal
CLP	Cell Loss Priority
CLR	Cell Loss Ratio
CLS	Connectionless Server
CPCS	Common Part Convergence Sub-layer
CPE	Customer Premises Equipment
CRF	Connection Related Functions
DXI	(ATM) Data Exchange Interface
EFCI	Explicit Forward Congestion Indication
ET	Equipment Terminal
FSM	Finite State Machine
GFC	Generic Flow Control
HEC	Header Error Control
HED	Head-End for Distribution services
ID	Identity
IE	Information Element
INI	Inter-Network Interface
ISDN	Integrated Services Digital Network
LAN	Local Area Network
LE	Local Exchange
LMI	Local Management Interface
LSP	Logical Service Port
LT	Line Termination
LUP	Logical User Port
MIB	Management Information Base
MSC	Message Sequence Chart
N-ISDN	Narrowband ISDN
NNI	Network-to-Network Interface
NPC	Network Parameter Control
NT1	Network Termination type 1
OAM	Operations Administration and Maintenance
OH	Overhead
PDH	Plesiochronous Digital Hierarchy
POH	Path Overhead
PRA	Primary Rate Access
PRM	Protocol Reference Model
PSP	Physical Service Port
PSTN	Public Switched Telephone Network
PTI	Payload Type Identifier

ptm	Point-to-Multipoint
ptp	Point-to-Point
PUP	Physical User Port
Q3	"Q" management interface reference point as in ITU-T Recommendation M.3010 [35]
RDI	Remote Defect Indication
RET	Remote Entry Terminal
RTMC	Real Time Management Co-ordination
SAAL	Signalling ATM Adaptation Layer
SAF	Specific Access Functions
SAP	Service Access Point
SAR	Segmentation and Reassembly
SDH	Synchronous Digital Hierarchy
SDL	Specification and Description Language
SDU	Service Data Units
SN	Service Node
SNI	Service Node Interface
SOH	Section Overhead
SP	Service Port
SPF	Service Port Function
SPS	Signalling Protocols and Switching
SSCF	Service Specific Co-ordination Function
SSCOP	Service Specific Connection Oriented Protocol
SSF	Server Signal Fail
STM	Synchronous Transport Module
TC	Technical Committees
TE	Terminal Equipment
TMN	Telecommunication Management Network
TM	Transmission Media
TP	Transmission Path
TP-T	Transmission Path Termination
TV	Television
UNI	User-Network Interface
UPC	Usage Parameter Control
UPF	User Port Function
VB	Broadband "V" reference point
VC	Virtual Channel (ATM)
VC	Virtual Container (SDH)
VC4	Virtual Container type 4
VC4c	Virtual Container type 4c
VCC	Virtual Channel Connection
VCCT	Virtual Channel Connection Termination
VCE	Virtual Channel Entity
VCI	Virtual Channel Identifier
VCL	Virtual Channel Link
VCME	Virtual Channel Multiplex Entity
vcTTP	Virtual Channel Trail Termination Point
vpTTP	Virtual Path Trail Termination Point
VP	Virtual Path
VPC	VP Connection
VPCI	VP Connection Identifier
VPCI-CC	VP Connection Identifier - Consistency Check
VPCT	VP Connection Termination
VPE	VP Entity
VPI	VP Identifier
VPL	VP Link
VPME	VP Multiplex Entity
VUP	Virtual User Port

4 Field of application

Within the general framework of the evolution to and application of the B-ISDN, the present document is intended to be applied to remote access arrangements with access networks as specified in ITU-T Recommendation I.414 [20] (case of B-ISDN customer access; remote access application of ATM multiplexing/cross connecting in access network/VB5.1 reference point), providing customer access to various service node types as listed in subclause 4.4.

Reference to access types, functions, interfaces, etc. in the present document does not imply that each of them has necessarily to be provided in every access network type or configuration. In general, the selection of features, functions and interfaces to be provided in an AN in a particular network application will be determined by the access network and service providers concerned.

4.1 Applications of the VB5.1 interface

Figure 1 depicts two different applications of the VB5.1 interface. It is left to the network operator to select the application required.

The physical medium of the interface is denoted with the symbol I. A subscript is added in order to indicate a physical position on the medium. I_a represents the VB5.1 interface point physically adjacent to the AN equipment (i.e. at the place of a connector, if used). I_b represents the VB5.1 interface point physically adjacent to the SN equipment. Additional interface points are introduced adjacent to the transport network equipment (I_{aa} and I_{bb}).

The physical specification of the indicated interface points (I_a, I_b, etc.) shall be compliant with the applicable physical layer standards.

The transport network includes additional equipment placed between the AN and SN equipment and is defined below.

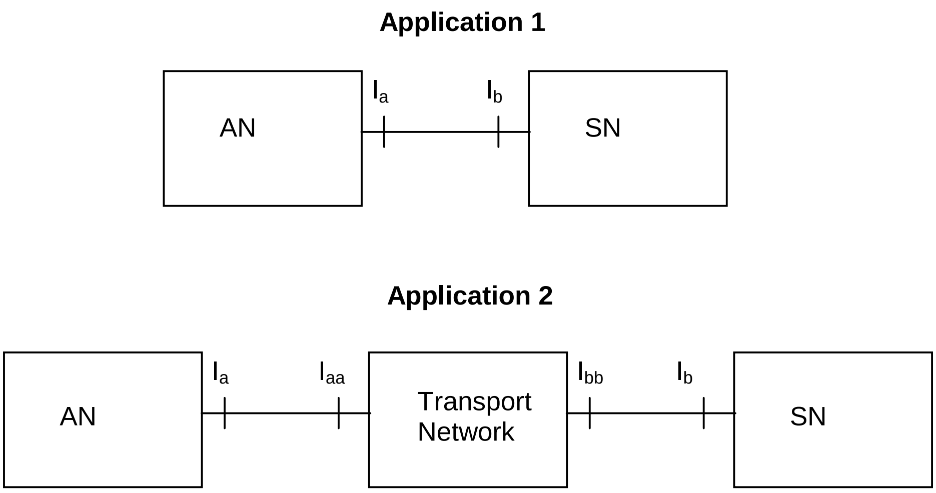


Figure 1: Basic applications of the VB5.1 interface

With respect to the physical link (i.e. (I_a, I_{aa})), two (sub)application types are envisaged:

Intra-office: the physical link is constrained within a single building or can comply to a likely environment.

Inter-office: the physical link interconnects remote equipment, normally situated in different buildings.

Figure 2 gives some examples of these VB5.1 applications.

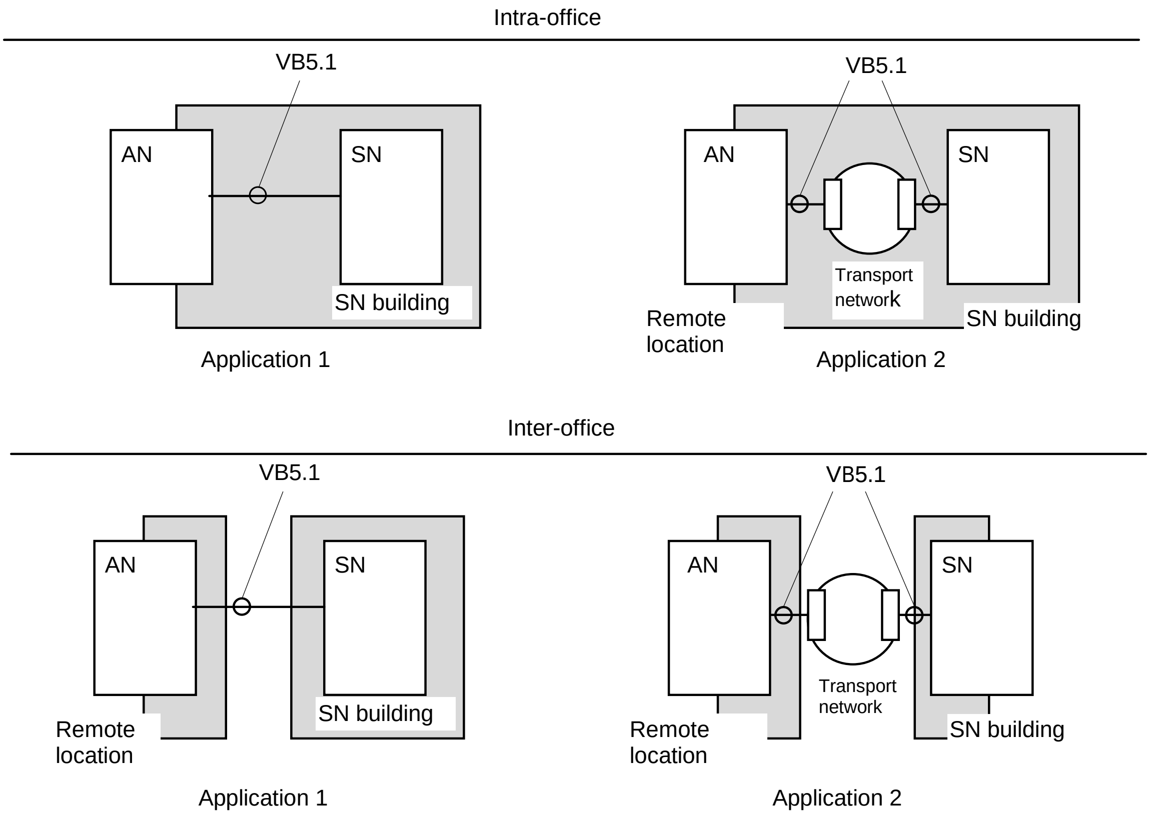


Figure 2: Example applications of the VB5.1 interface

As the VB5.1 interface can consist of different physical media, in principle different applications for the different physical media are not excluded, i.e. the active link of the VB5.1 interface is intra-office and the standby link for protection is inter-office.

4.1.1 Transport network

The VB5.1 reference point concept provides high flexibility with respect to the physical interface applied at the SNI and the interconnection between the AN and the SN.

If the AN side and the SN side of the SNI are not at the same location (see case of inter-office application 2 in Figure 2) the remote connection of an AN and a SN shall be provided by a transport network. A transport network between an AN and a SN shall not change the structure and the content of the information at the VB5.1 reference point, i.e. it is considered as transparent to the information structure and content at the VB5.1 reference point. The transport network may include VP connecting point functions (for point-to-point connections) as specified in the standards for the ATM VP cross connect, but is not allowed to perform VC connecting point functions (i.e. translation of VCI values).

From a management point of view a transport network between AN and SN is separate from the AN and the SN and is managed via a separate interface to the TMN. However, a co-ordinated management of the transport network and the AN (and SN) may be required. The definition of these management functions is outside the scope of the present document.

Some simple examples of possible implementation cases of the interconnection between the AN and the SN are given in Figure 3.

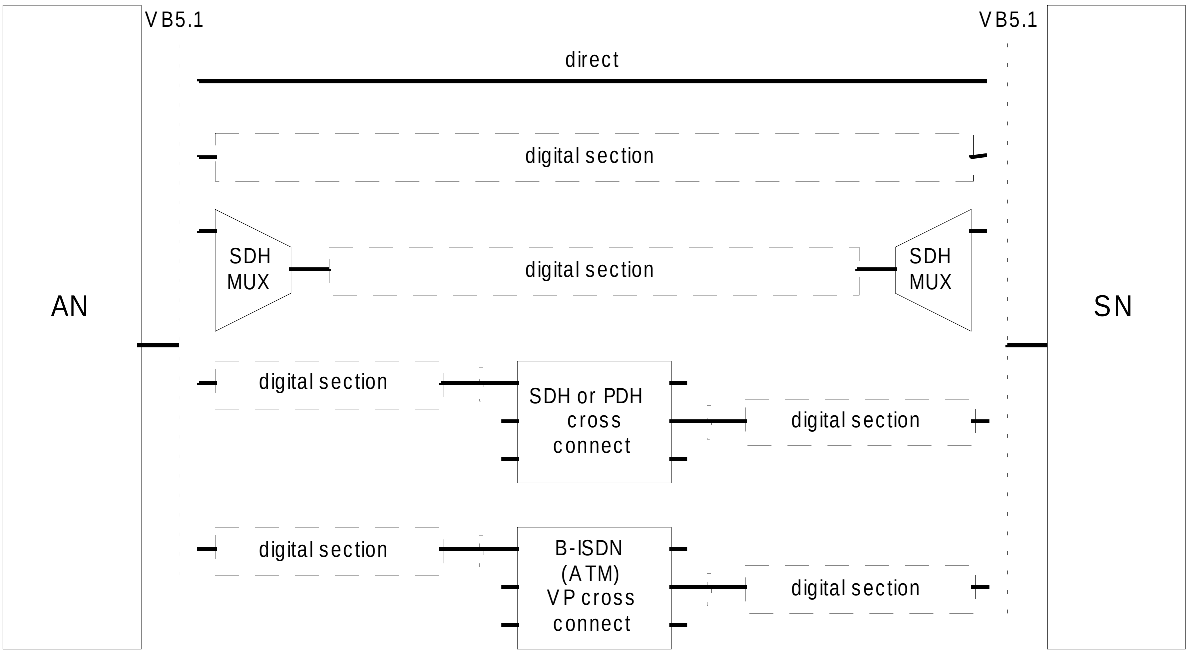


Figure 3: Examples for transport network implementation between AN and SN

4.2 Integration of narrowband customer access types

A key feature of VB5.1 reference point concept is the integration of narrowband customer access types.

The VB5.1 reference point concept allows the integration of narrowband (i.e. PSTN and N-ISDN) accesses with B-ISDN accesses into one access network. Thus, the VB5.1 reference point concept provides for a step-by-step migration from circuit based (access) networks to the ATM based B-ISDN.

Figure 4 shows the integration of narrowband accesses (using circuit mode) and B-ISDN accesses applying multiplexing at the ATM layer and using a circuit emulation function to transfer the circuit mode into ATM and vice versa. The aggregate ATM based information stream is conveyed through the interface(s) at the VB5.1 reference point. At the SN side the information stream is demultiplexed and the narrowband local exchange is accessed using a circuit emulation function.

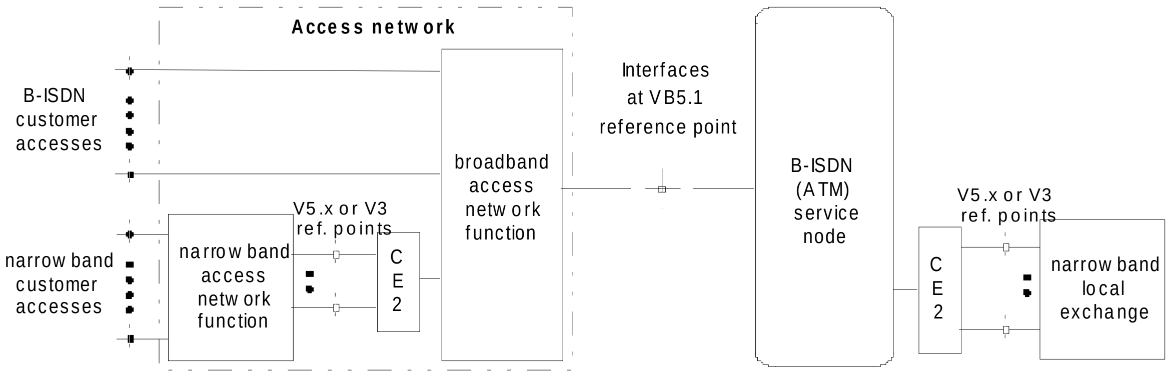


Figure 4: Service architecture for the case of separate broadband and narrowband SNs

The functional architecture in Figure 4 illustrates the applicability of existing narrowband access network functions and circuit mode based SNIs at the narrowband local exchange, i.e. the standardized V5.1 and V5.2 reference points as specified in ETS 300 324-1 [6] and ETS 300 347-1 [7].

Figure 5 shows the same access network architecture as in Figure 4, but for the support of an integrated SN providing both broadband and narrowband services. In this case, the SN is demultiplexing the aggregate information stream internally and handles both types of information transfer modes internally.

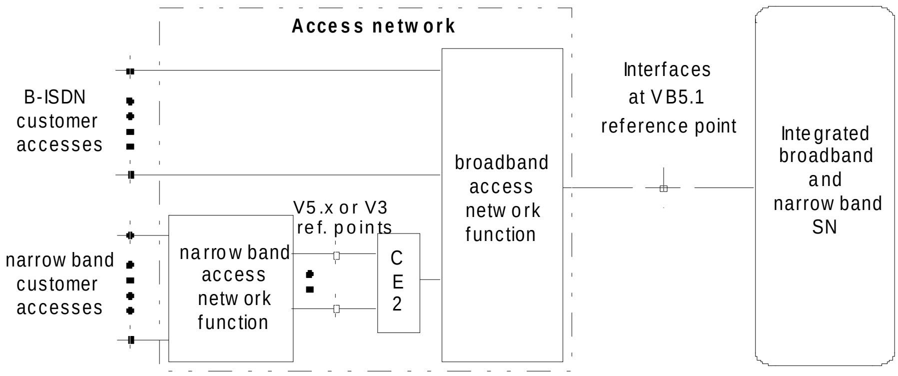


Figure 5: Service architecture for the case of integrated broadband and narrowband SN

4.3 Support of other non-B-ISDN access types

A key feature of VB5.1 reference point concept is the support of other non-B-ISDN customer access types.

In addition to the integration of narrowband customer access types, remote access arrangements with VB5.1 reference point may integrate further non-B-ISDN access types (i.e. access types supporting asymmetric/multimedia services, access types supporting broadcast services, access types according to the ATM forum standards).

However, this requires additional access type specific access adaptation functions in order to adapt the specific non-B-ISDN UNI to the requirements and capabilities of the broadband access network. Further details of this concept are described in clause 8 of the present document. The specification of access adaptation functions is outside the scope of the present document.

4.4 Support of various service node types

The VB5.1 reference point concept is independent from the specific service(s) provided by the SN as long as the SNI meets the functional requirements at the VB5.1 reference point. One of the essential requirements is the support of the Real Time Management Co-ordination (RTMC) function as specified in clause 13 of the present document. Further functional requirements are identified in clause 6.

Remote access arrangements with VB5.1 reference point can therefore be applied to provide access to various types of SNs. A SN may be either a service specific SN (i.e. providing one specific service), as for example:

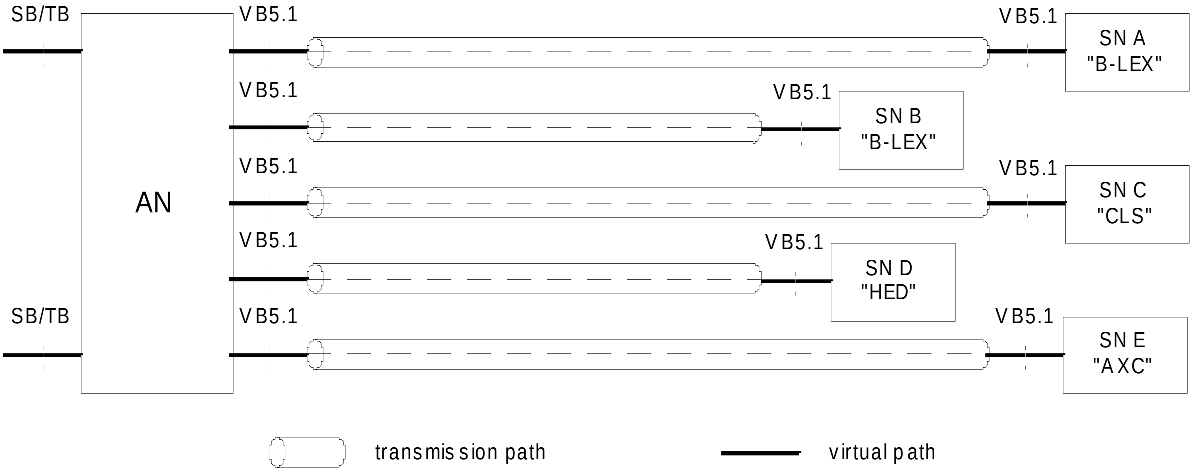
- Broadband Local Exchange (B-LEX);
- ConnectionLess Server (CLS) providing broadband connectionless data services;
- Head-End for Distribution services (HED);
- SNs providing digital video and audio on-demand services;
- SNs providing leased line services, i.e. ATM VP (and/or VC) cross connect,

or a modular SN providing more than one type of service.

Furthermore, remote access arrangements with VB5.1 reference point support access configurations which allow that a customer can access more than one SN through a single UNI at the same time. This is a feature which can not be supported within direct access arrangements by definition.

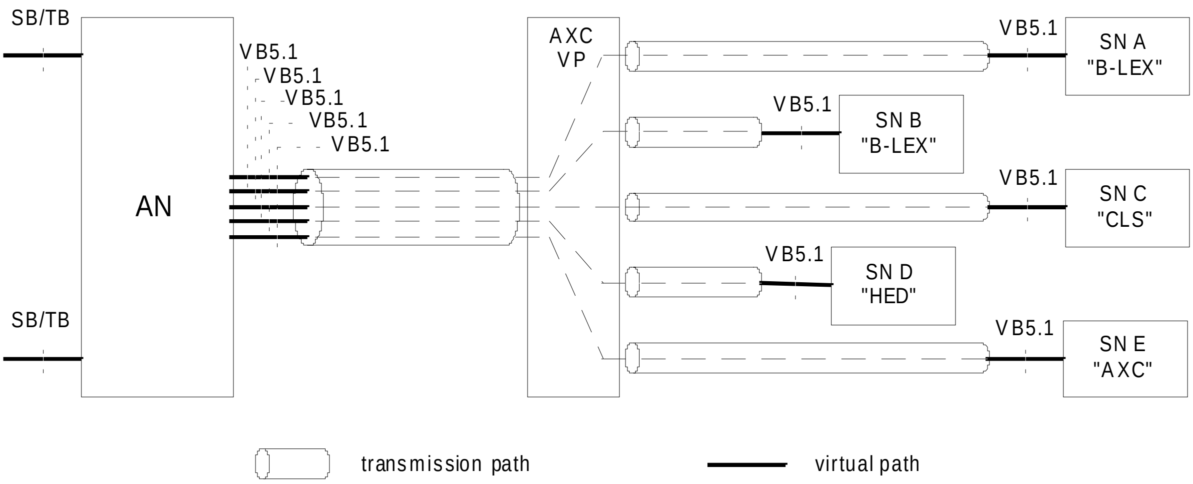
The customer access to several SNs via a single AN may be realized:

- either by applying individual transmission paths at the VB5.1 reference points as illustrated in Figure 6. This does not preclude the application of any multiplexing or cross connecting function at the transmission layer (i.e. SDH or PDH cross connect);
- or with the help of ATM VP cross connect functions between the ANs and the SNs as illustrated in Figure 7.



NOTE: For simplicity only one VP per VB5.1 reference point is shown.

Figure 6: Support of several SNs via individual transmission paths at VB5.1 reference points

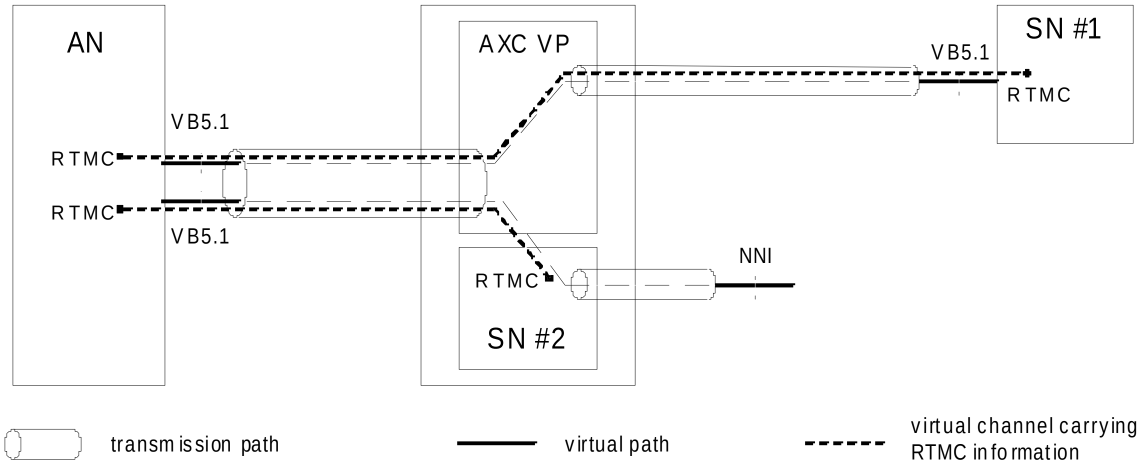


NOTE: For simplicity only one VP per VB5.1 reference point is shown.

Figure 7: Support of several SNs via an ATM VP cross connect

However, for a particular access from a UNI to a SN it is required that not more than one VB5.1 reference point is present within the relevant access connection element, i.e. VB5.1 reference points and the associated RTMC functions can not be concatenated.

As a consequence, it is not supported within the framework of the VB5.1 reference point concept that the remote access to a SN#1 is realized via a SN#2 between the AN and SN#1. As illustrated in Figure 8, access to a SN behind a SN with VB5.1 reference point requires the application of other reference points and/or interfaces (i.e. network-to-network interface).



NOTE: For simplicity only one VP per VB5.1 reference point is shown.

Figure 8: Configuration examples for remote access to different SNs

5 Introduction to the VB5.1 reference point concept

This clause defines the fundamental principles and requirements as well as the general functional architecture of remote access arrangements with a VB5.1 reference point.

The interface at the VB5.1 reference point is an ATM based instance of a Service Node Interface (SNI).The VB5.1 reference point concept is based on and in-line with ITU-T Recommendation G.902 [15].

Applying the terminology and definitions introduced in ITU-T Recommendation G.902 [15], the general characteristics of the VB5.1 reference point concept can be described as follows:

- the VB5.1 reference point belongs to the access integrating class of V reference points, i.e. the signal structure is a multiplex of several accesses of the same or of different access types;
- the VB5.1 reference point supports both service specific SNs (i.e. broadband local exchange, ATM based leased line SN) and modular SNs (i.e. combined narrowband and broadband local exchange).

5.1 General VB5.1 design principles

Within this subclause the fundamental principles for remote access arrangements with VB5.1 reference point are defined:

a) an AN is used in order to multiplex/demultiplex the signalling and data streams from UNIs in a cost effective manner and then to present this information stream to the SN in a manner such that the SN can determine the source or sink UNI;

b) the AN does not interpret (user) signalling;

c) the responsibility for call control and associated connection control resides in the SN (i.e. the AN may have no knowledge of ongoing services and the call state during normal operation of the VB5.1 reference point);

d) selection of the service provider by the AN based on user signalling information shall not be possible, because this would require SN functionality in the AN.

   However, for ATM based access types the AN shall support access to different SNs through a single UNI at the same time by using the corresponding VPs associated to these SNs via provisioning (see also subclause 5.3.1, shared UNI). In this case the selection of the service provider is a matter of the user terminal and does not concern the AN or the SNI;

e) time critical management functions which require real time co-ordination between AN and SN shall be performed by communication across the VB5.1 reference point;

f) according to ITU-T Recommendation I.414 [20] the VB5.1 reference point concept supports ATM multiplexing/cross connecting in the AN, but does not support on-demand VP or VC link allocation in the AN;

g) charging information is only provided by the SN. This information may be passed over the VB5.1 reference point when a user requires it as part of the service to which he has subscribed and is not passed over the VB5.1 reference point as a means of providing information for use by the AN.

   Also tones and announcements shall be generated in the SN and not in the AN;

h) if multicasting is provided in the AN, this shall be allowed to be performed in the SNI to UNI direction only. Otherwise multicasting is presumed to be a service provided by the SN;

i) traffic control and congestion control functions (at the ATM layer) such as:

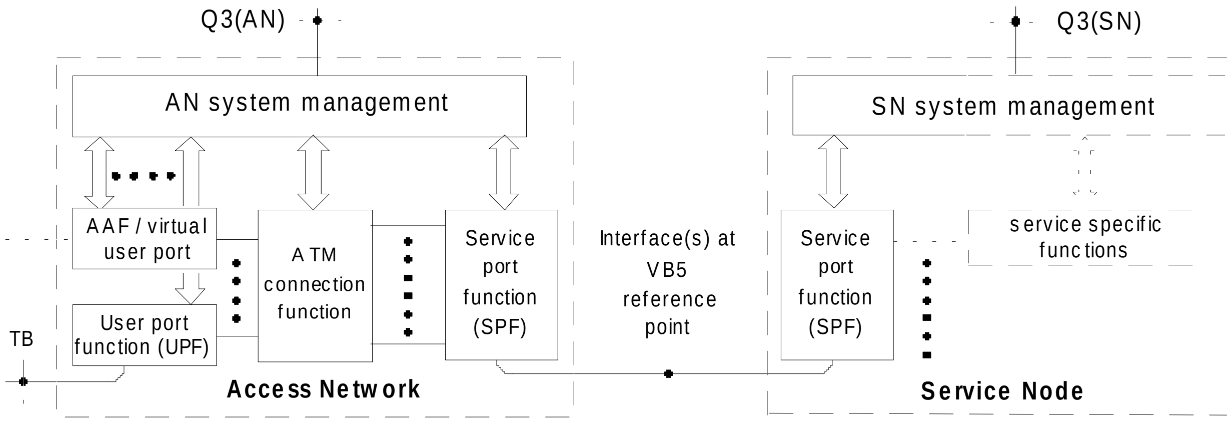
- use of VPs for network resource management;
- Connection Admission Control (CAC);
- User Parameter Control (UPC)/Network Parameter Control (NPC) functions;
- priority control;
- traffic shaping;
- fast resource management;
- congestion control by selective cell discard and/or explicit forward congestion indication;

shall be performed in accordance with ITU-T Recommendation I.371/ETS 300 301 [5] and ITU-T Recommendation I.732 [25].

Some of the traffic control and congestion control functions (i.e. NPC, traffic shaping) are network options according to ITU-T Recommendation I.371/ETS 300 301 [5].

5.2 General reference model for the VB5.1 reference point

In this subclause the individual and specific resources to be operated, administered and maintained (i.e. with the help of provisioning and control functions) for remote access arrangements with VB5.1 reference point are identified. The overall framework for such remote access arrangements with VB5.1 reference points is illustrated in Figure 9.



NOTE 1: The ATM connection function in Figure 9 covers both transport functions and core functions as defined in ITU-T Recommendation G.902 [15].

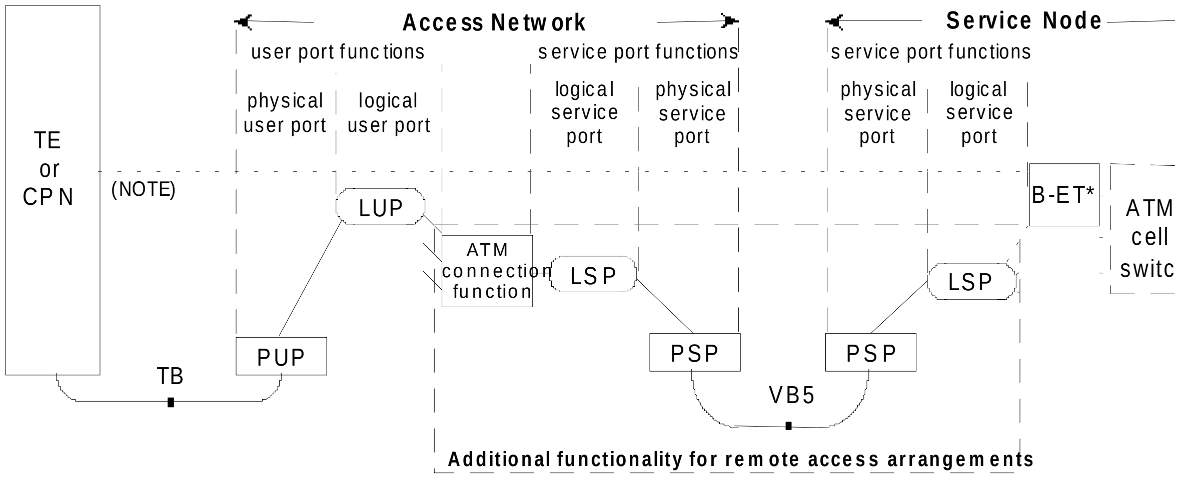
NOTE 2: The ATM connection function, used in conjunction with the VUP, is provided for modelling purposes and may not necessarily exist in practice.

Figure 9: Access arrangements with VB5.1 reference point

Based on this overall framework for remote access arrangements across VB5.1 reference points as illustrated in Figure 9 a functional modelling approach to identify the resources to be provisioned and controlled is illustrated in Figure 10. This approach concentrates on the functional groupings identified in Figure 9, i.e. the User Port Function (UPF), the ATM connection function and Service Port Function (SPF).

The specification model illustrated in Figure 10 is based on a separation of the user port function into a physical and a logical user port function and a separation of the service port function into a physical and a logical service port function.

A virtual user port has parallels with a physical user port though its full functions are not specified due to the wide range of non-B-ISDN access types that can be supported using this concept. Therefore the virtual user port is not shown as a separate entity within Figure 10. Details of the virtual user port concept are given in clause 8 of the present document.



NOTE: Control plane communication between TE/CPN and SN.

Figure 10: Overall functional specification model for VB5.1 reference point concept

The following general relationships between functional blocks within the access network and the service node are identified:

a) a Physical User Port (PUP) comprises the physical layer functions related to a single transmission convergence function at the UNI. A PUP has no counterpart at the SN side;

b) a Logical User Port (LUP) comprises the set of VPs at the UNI associated with one single VB5.1 reference point. An LUP is logically associated with the B-ET* in the SN and configuration management actions have to be co-ordinated with the SN;

NOTE: The term "B-ET*" is used to make a clear distinction between the B-ET for the direct access and the remote access via an access network.

c) a physical service port comprises the physical layer functions related to a single transmission convergence function at the VB5.1 reference point. A PSP exists both at AN side and SN side. In the general case of an ATM based transport network (i.e. VP cross connect function) between AN and SN, a one-to-one relationship between PSP at the AN side and PSP at SN side does not exist;

d) a logical service port comprises the set of VPs at one VB5.1 reference point. An LSP exists both at the AN and SN side and there is always a one-to-one relationship between LSP at the AN side and LSP at the SN side.

5.3 General characteristics of individual functional groups

5.3.1 User port function characteristics

The general requirements for the concept applied to user ports within an access arrangement with VB5.1 reference point are defined below. Only those aspects having impact on a modelling approach for a user port function in a VB5.1 environment are detailed here:

a) multiple physical UNI:

   a UNI may consist of one or several physical interfaces, i.e. the user VPs assigned to a VB5.1 reference point may be carried on different transmission convergence functions. These VPs may be controlled by the same signalling virtual channel (i.e. non-associated signalling).

b) shared UNI:

   the UNI may be a shared UNI as defined in ITU-T Recommendation G.902 [15] i.e. at the UNI it is possible to access different SNs at the same time by activating the corresponding logical user port functions. The individual logical user ports carry all the required information providing the access bearer capability including signalling.

5.3.2 ATM connection function characteristics

a) Association of user VPs to VB5.1 reference point:

   a VP at the UNI shall be associated to one and only one VB5.1 reference point. The association is established on a static basis through provisioning of the corresponding logical user port and has to be co-ordinated with the relevant SN.

b) ATM cross connections:

   the ATM connection function provides ATM cross connections at the VP and/or the VC level.

5.3.3 Service port function characteristics

The general requirements for the concept applied to service ports within an access arrangement with a VB5.1 reference point are defined below. Only those aspects having impact on a modelling approach for a service port function in a VB5.1 environment are detailed here:

a) Multiple physical SNI:

   the information flow at the VB5.1 reference point is carried via one or several transmission convergence functions.

b) Remote connection:

   in case of a remote connection the transparent transport network between AN and SN may include ATM cross connection functions at VP level.

c) Shared SNI:

   VPs assigned to different VB5.1 reference points may be carried on common physical link(s), i.e. the transmission convergence function(s) may be shared between information flows belonging to separate VB5.1 reference points.

5.4 Functional modelling

This subclause specifies the modelling concepts applied to the user port function, service port function and the ATM connection function within an access arrangements with VB5.1 reference point. The modelling concepts are based on the general characteristics identified in subclauses 5.3.1 and 5.3.2.

5.4.1 Modelling of user port function

The concept applied for the modelling of a user port takes into account the general user port function characteristics identified in subclause 5.3.1. It is based on a separation of physical user port functions and logical user port (i.e. service related) functions as defined above and illustrated in Figure 11.

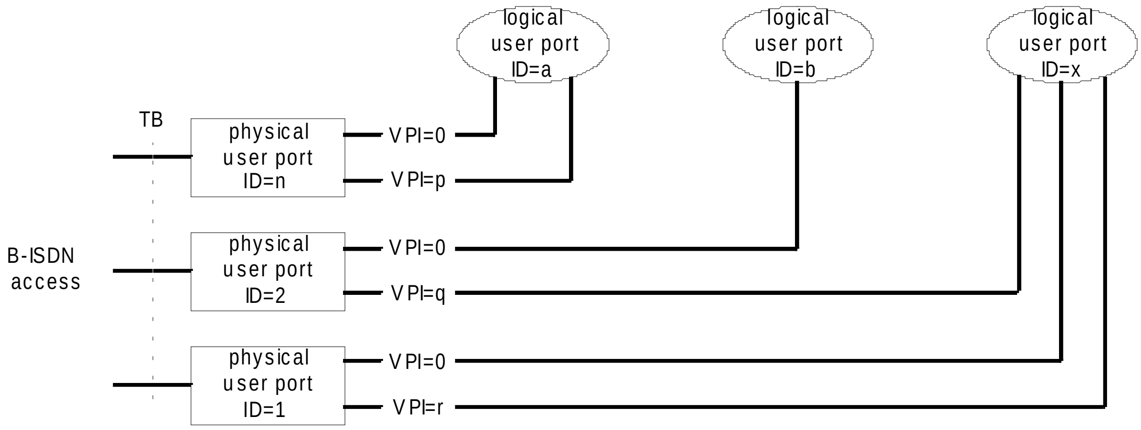
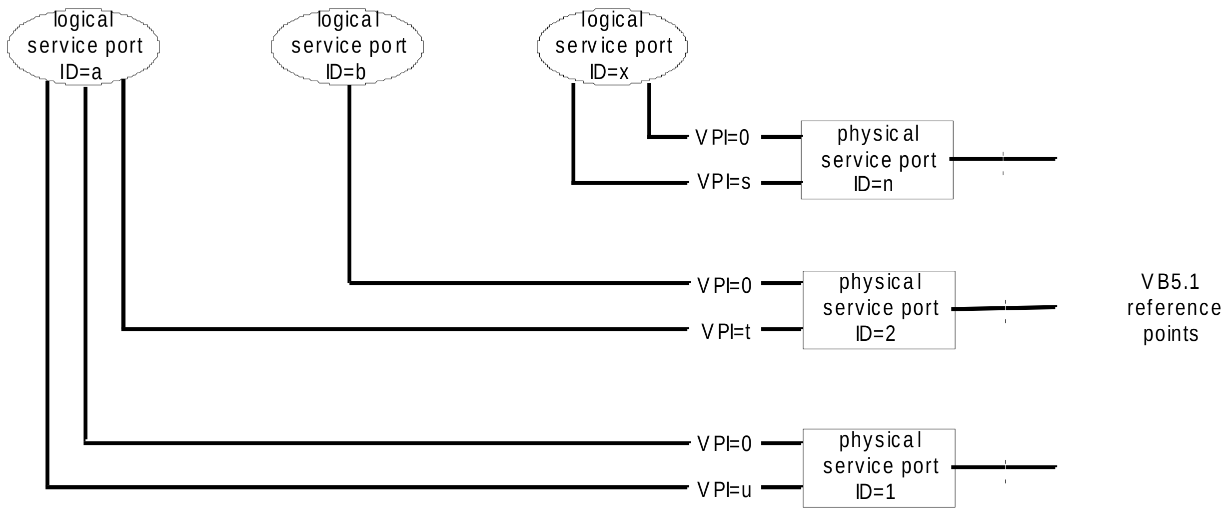


Figure 11: Functional modelling of the user port functions

5.4.2 Modelling of service port function

The concept for the modelling of a service port takes into account the general service port function characteristics identified in subclause 5.3.2. It is based on a separation of physical layer functions and service related functions as defined above and is illustrated in Figure 12.



NOTE: As illustrated for the PSPs with ID=1 and ID=2, in general a one-to-one relationship between VB5.1 reference point and PSP does not exist.

Figure 12: Functional modelling of the service port functions

5.4.3 Modelling of ATM connection function

The ATM connection function within an AN with a VB5.1 reference point provides:

- ATM cross connections at VP level;
- ATM cross connections at VC level,

within the provisioned association of a logical user port to a logical service port. In case of a VC cross connection function all VC links within a VP at a logical user port are cross connected to VC links at the same logical service port.

The functional model for the ATM connection function within the AN is illustrated in Figure 13 for a configuration example where two logical service ports (i.e. VB5.1 reference points) exist in the AN.

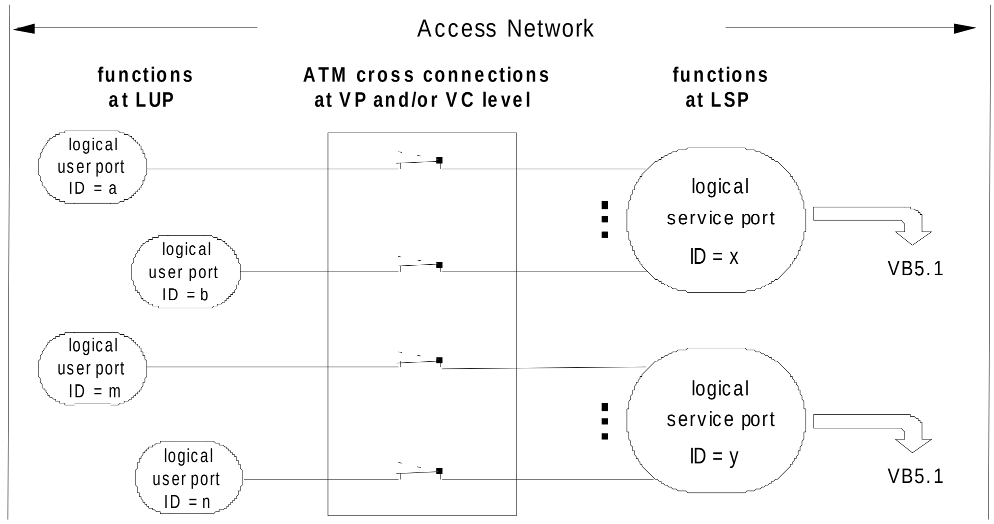


Figure 13: Functional model for ATM connection function within AN

The modelling approach of the individual ATM cross connections at VP and/or VC level is described in ITU-T Recommendation I.751 [34].

5.5 AN view and SN view of physical and logical ports

One of the main issues of the VB5 reference point concept is the decoupling of the different views related to the B-ISDN access infrastructure provider (the operator of the access network) and the B-ISDN service provider (the operator of the service node).

This subclause describes the different views of the access network and the service node with regard to physical and logical functional groupings as relevant to the VB5.1 reference point concept.

A summary of the AN view and SN view of physical and logical ports related to management is given in Table 1.

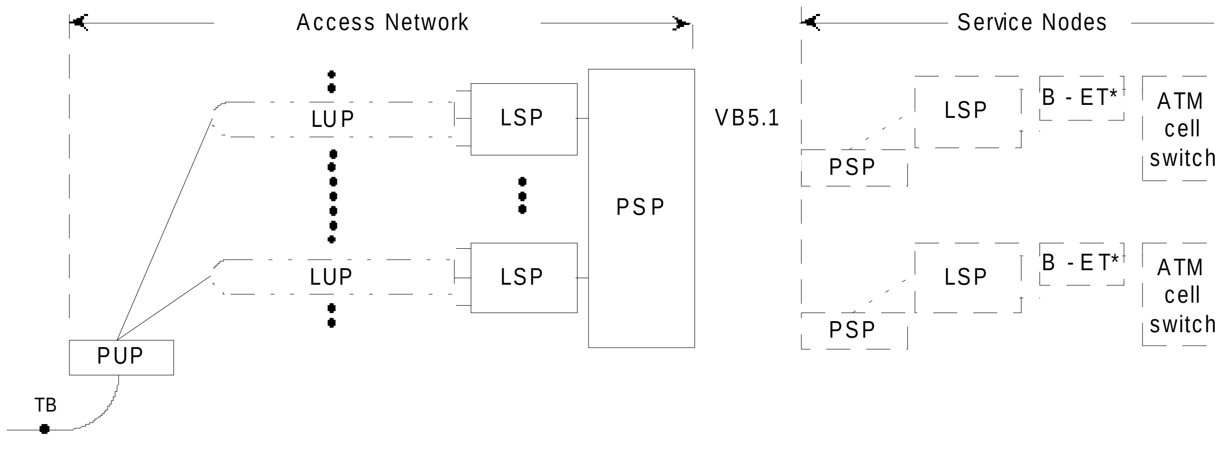
Table 1: Overview on management of user port and service port functions

	physical user port	logical user port		logical service port		physical service port	
		SN side	AN side	SN side	AN side	SN side	AN side
Management of admin. states via Q3(AN)	Y	-	N	-	Y	-	Y
Management of admin. states via Q3(SN)	-	Y	-	Y	-	Y	-
Responsibility for provisioning	Q3(AN)	C	C	C	C	Q3(SN)	Q3(AN)

C Co-ordinated provisioning via Q3(SN) and Q3(AN).
Y Management of administrative state is possible.
N Management of administrative state is not possible.
- Not applicable.

5.5.1 View from access network

The view of user ports and service ports from the B-ISDN access infrastructure provider (i.e. operator of the access network) is illustrated in Figure 14. Within this figure a UNI with only a single physical link is shown for simplicity reasons.

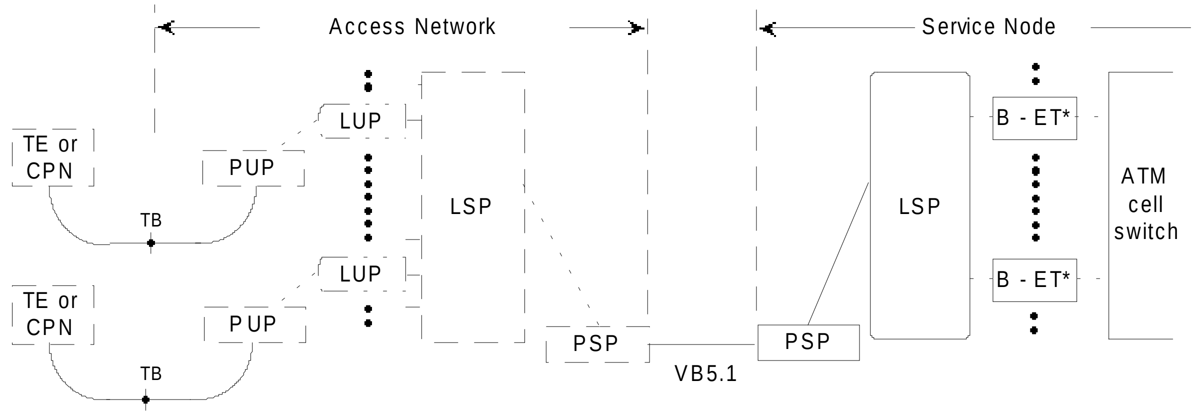


solid boxes: Both configuration management actions (i.e. provisioning of VPs) and manipulation of administrative state are under the responsibility of the AN operator. For some configuration management actions co-ordination with the SN operator is required.
dashed-dotted boxes: Configuration management actions (i.e. provisioning of VPs) are under the responsibility of the AN operator, but no administrative state is present. For some configuration actions co-ordination with the SN operator is required.
dashed boxes: Not visible to the AN operator.

Figure 14: View of physical and logical ports from access network

5.5.2 View from service node

The view of physical and logical ports from the B-ISDN service provider (i.e. operator of the service node) is illustrated in Figure 15. In this figure only one single access network is shown for simplicity reasons.



solid boxes:	Both configuration management actions (i.e. provisioning of VPs) and manipulation of administrative state are under the responsibility of the SN operator. For some configuration management actions co-ordination with the AN operator is required.
dashed-dotted boxes:	The logical user port is used as a naming convention. It is logically associated with B-ET*.
dashed boxes:	Not visible to the SN operator.

Figure 15: View of physical and logical ports from service node

6 Procedural interface requirements

6.1 Introduction

The functional description of the VB5.1 reference point at a (physical) interface is illustrated in Figure 16.

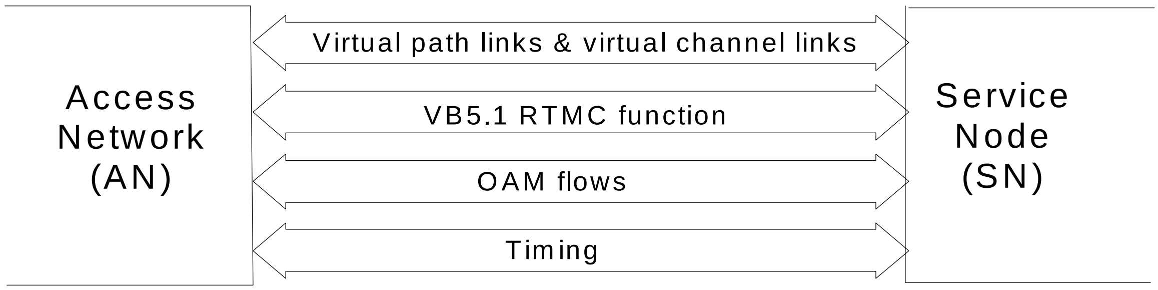


Figure 16: Functions at an interface at the VB5.1 reference point

The indicated functions are shortly described below:

a) Virtual path links and virtual channel links:

the VB5.1 supports the ATM layer for user plane (i.e. user data), control plane (i.e. user to network signalling) and management plane (i.e. meta-signalling, if any, and RTMC protocol) information. This information will be carried on virtual channel links. The virtual channel links will be carried in virtual path links.

b) VB5.1 Real Time Management plane Co-ordination (RTMC) function:

this function provides management plane co-ordination (including, synchronization and consistency) between access network and service node via a dedicated protocol (referred to as RTMC protocol) across the VB5.1 reference point. The protocol is used for exchanging time critical management plane information between AN and SN.

Non-time critical functions (i.e. interface and user port provisioning) that require a co-ordinated view at both sides of the VB5.1 are performed via Q3 interfaces (i.e. via system management functions of AN and SN) (see also ITU-T Recommendation G.902 [15]).

c) OAM flows:

this function provides layer related exchange of OAM information. These flows exist at the at the ATM layer and may exist at the physical layer.

d) Timing:

this function provides the necessary information for bit (signal element) transmission, octet and cell boundaries (i.e. cell delineation).

For the definition of the functional and procedural interface requirements, the B-ISDN Protocol Reference Model (PRM) defined in ITU-T Recommendation I.321 [17] is applied in the following subclauses.

6.2 Physical layer requirements

6.2.1 General

In order to enable interconnection of an access network from one provider with a service node of another provider, the physical layer needs to be specified. It is however outside the scope of the present document to fully specify the physical layer. Instead some general requirements will be given in this subclause.

The specifications within the present document are decoupled from the physical layer specifications as far as possible. This allows manufacturers and purchasers to develop the most flexible designs from the standard without having to modify the basic mechanisms whenever a new physical layer alternative is introduced.

However, the physical layer at the VB5.1 reference point shall apply existing physical layer standards. The relevant standards provide the necessary physical medium and transmission convergence sublayer specifications.

6.2.2 Basic characteristics of the VB5.1 interface

The VB5.1 interface carries ATM layer characteristic information over one or more transmission paths (i.e. VC4 in case of SDH) for which ATM mapping is specified (see Figure 17 for a single transmission path and Figure 18 for multiple transmission paths).

Even in the case of a single transmission path, the VB5.1 interface can be carried over different physical media, provided that the information flow of the different media is combined via physical layer functionality to a single transmission path, e.g. for reasons of bi-directional information transport or for reasons of protection different physical media may be required.

The physical layer may also support multiple VB5.1 interfaces within a single transmission path. The latter case is i.e. possible by the use of a VP cross-connect in between one or more ANs and one or more SNs (see Figure 19).

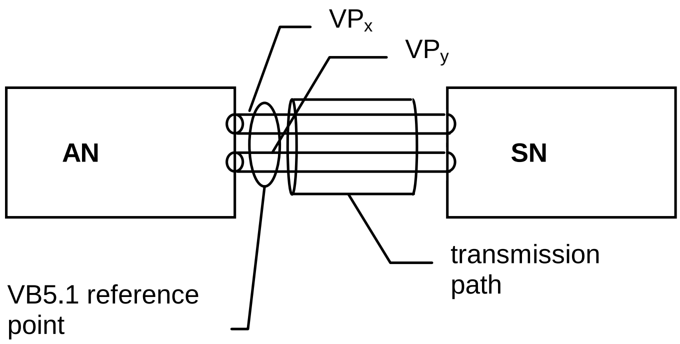


Figure 17: VB5.1 interface, grouping of VPLs within a single transmission path

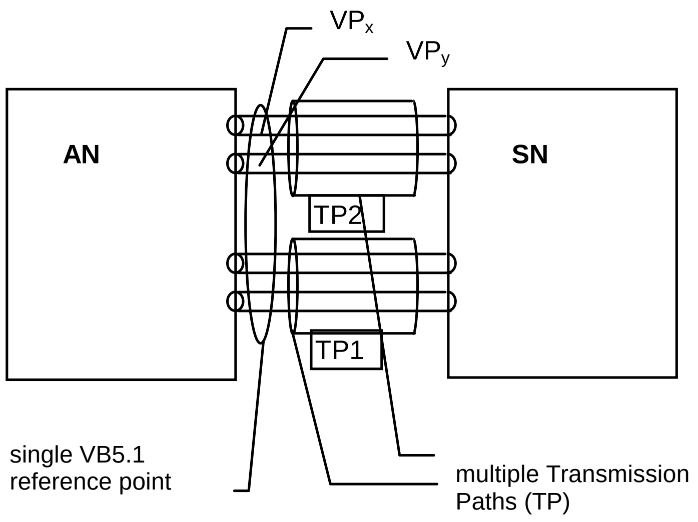


Figure 18: VB5.1 interface, grouping of VPLs within multiple transmission paths

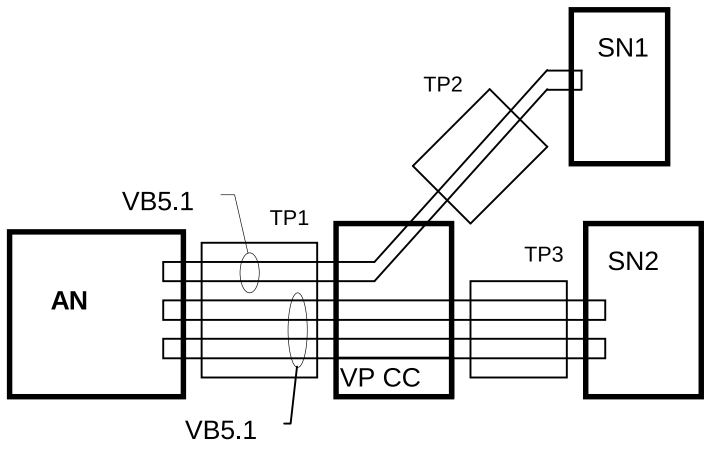


Figure 19: Multiple VB5.1 reference point within single transmission path

6.2.3 VB5.1 interface options

Annex F gives examples of some recommended physical layer options for the VB5.1 interface.

6.2.4 Interface requirements

6.2.4.1 Interface topology and transfer capability

The interface at the VB5.1 reference point is point-to-point at the physical layer in the sense that there is only one sink (receiver) in front of one source (transmitter).

The transfer capability is defined for each individual physical interface at VB5.1 reference point, i.e. it is part of the transmission convergence sublayer specification.

6.2.4.2 Timing

In normal operation, the transmitter is locked to the timing received from the network clock. However, the methods for overall network synchronization are outside the scope of the present document.

The AN may use the timing information of the physical layer at the VB5.1 reference point to synchronize on the network clock. The associated operation and maintenance procedures (i.e. failure detection and consecutive actions, timing status communication) shall be part of the relevant standards of the physical layer, i.e. no additional procedures/protocols are introduced at the VB5.1 reference point.

6.2.4.3 OAM

OAM procedures as specified by the relevant standard for the physical layer shall be applied. At the physical layer, the ITU-T Recommendation I.610 [24] is applicable as it specifies relations between the ATM layer and the physical layer (i.e. primitives for generation of the VP-AIS).

The operational functions as defined in ITU-T Recommendation I.432.1 [21] (i.e. state matrix for layer 1 functions) relate to the UNI and shall be handled by the AN.

6.2.4.4 Protection

For the VB5.1 no additional protection mechanisms are provided other than those which are available at the physical layer (i.e. section protection mechanism of SDH). The relevant standard for the physical layer shall be applied.

6.2.4.5 Transmission path identification

The physical layer at the VB5.1 reference point shall provide an embedded transmission path identification method (i.e. path trace mechanism in SDH). No additional transmission path identification mechanisms are provided other than those which are available at the physical layer. The relevant standard for the physical layer shall be applied.

6.2.4.6 Pre-assigned cell headers for use by the physical layer

Pre-assigned cell header values for use by the physical layer are defined in ITU-T Recommendation I.361/ ETS 300 298-2 [2].

6.3 ATM layer requirements

The user information together with the information for connection related functions (i.e. user-to-network signalling) and OAM information (at the ATM layer or at a higher layer) are carried in ATM cells belonging to a virtual channel link and virtual path link.

6.3.1 Cell header format and encoding and pre-assigned cell headers for use by the ATM layer

The cell header format and encoding and the pre-assigned headers for use by the ATM layer used at the VB5.1 reference point shall comply with the Network-to-Network Interface (NNI) specifications of ITU-T Recommendation I.361/ ETS 300 298-2 [2].

The VPI and VCI value to be applied for the RTMC VCC at the VB5.1 reference point shall be provisionable (see also clause 10).

6.3.2 Cell Loss Priority (CLP)

Depending on the network conditions, cells where the CLP is set (i.e. value of the CLP bit is 1) are subject to be discarded prior to cells where the CLP is not set (i.e. value of the CLP bit is 0). See ITU-T Recommendation I.371/ ETS 300 301 [5] for further details about the use of the CLP bit.

6.3.3 OAM

The operation and maintenance principles based on F4 and F5 OAM flows as defined in ETS 300 404 [8]/ITU-T Recommendation I.610 [24] are applicable.

6.4 Higher layer interface requirements

6.4.1 User plane

For ATM based accesses the layers above the ATM layer is transparent to the access network.

For the support of non-B-ISDN access types which do not support the ATM layer, ATM Adaptation Layer (AAL) functions have to be provided within the access network.

No other higher layer interface requirements are identified for the transfer of user plane information across the VB5.1 reference point.

6.4.2 Control plane

If applied, user to network signalling and associated procedures belong to the control plane functions of the CPE, AN and SN. User to network signalling applied at the CPE is handled transparently within the AN. The peer entity is the SN.

In order to support some specific non-B-ISDN accesses (see clause 8), also the AN may apply B-UNI signalling.

At the VB5.1 reference point, B-ISDN user to network signalling (refer to ITU-T Recommendation Q.2931/ ETS 300 443-1 [12]) shall be applied for the allocation of on-demand virtual channel links at the VB5.1 reference point, which are handled transparently between the user ports or virtual user ports (see clause 8) and the SN. The signalling VCC is carried over the VB5.1 reference point.

It is noted that an access network conformant to VB5.1 can be used with other broadband user to network signalling systems (i.e. ATMF UNI signalling) applied at the CPE and the SN and transported transparently over the AN. This feature is a consequence of the basic principle that user to network signalling is not terminated by the AN. This is however outside the scope of the present document.

6.4.3 Management plane

For the management of an AN/SN configuration using a VB5.1 interface, co-ordination between management plane functions of the AN and SN is required. Two types of co-ordination exist:

- non-real time management co-ordination;
- real time management co-ordination.

Non-real time management co-ordination is realized via the TMN and hence the respective Q3 interfaces of the involved network elements: i.e. Q3(AN) and Q3(SN).

VB5.1 Real Time Management Co-ordination (RTMC) shall be supported via a dedicated protocol (i.e. RTMC protocol). The RTMC protocol and associated procedures belong to the plane management functions of AN and SN. These functions are specified in separate clauses in the present document. The AAL for the VB5.1 RTMC protocol is specified in subclause 6.4.5.

6.4.4 Establishment of VP and VC links/connections

6.4.4.1 Establishment of VP links and connections

Virtual Path Links (VPLs) at the VB5.1 reference point are established via management plane functions of the AN and SN. This applies both to VPLs of VPCs cross-connected in the AN and to VPLs of VPCs terminated in the AN.

Also, the VPLs at the UNI or VUP are established via management plane functions of the AN and SN.

A VPL at the VB5.1 reference point shall not extend from the VB5.1 reference point up to the UNI, i.e. at least a single cross-connection is assumed in the AN. A VPC which is terminated in the AN shall consist of one or more VPLs, i.e. with cross-connections in the AN.

In case VP cross connect functionality is in between the AN and SN its management plane functions (via one or more Q3 interfaces) shall be involved.

6.4.4.2 Establishment of VC links and VC connections

VCLs at the VB5.1 reference point are carried by VPLs/VPCs, which are established at the VB5.1 reference point according to previous subclause (i.e. 6.4.4.1). The same is valid for the VCLs at the UNI or VUP. With relation to the VCLs and VCCs, the following types can be distinguished:

a) VCLs of VCCs cross-connected in the AN.

   VCLs which are part of VCCs that are cross-connected in the AN are established via management plane functions of the AN and SN.

b) VCLs carried in VPCs that are cross-connected in the AN.

   VCLs which are cross-connected in the AN are established either via management plane functions or via control plane functions. These management plane or control plane functions are located in the SN; and

   - are in the B-ISDN customer premises equipment (i.e. in case of B-ISDN access types);

   - or in access adaptation functions which are considered to be part of the AN (i.e. in case of non-ATM based access types).

c) the VCL of the VCC carrying the RTMC protocol.

   The VCL of the VCC which is carrying the RTMC protocol is established via management plane functions of the AN and SN.

6.4.5 ATM adaptation layer for the RTMC protocol

6.4.5.1 General AAL requirements

The VB5.1 RTMC protocol shall use the Signalling ATM Adaptation Layer (SAAL). This AAL consists of the following parts: ITU-T Recommendations I.363.5 [19], ITU-T Recommendation Q.2110/ETS 300 436-1 [10] and ITU-T Recommendation Q.2130/ETS 300 437-1 [11].

6.4.5.2 AAL5 requirements

The requirements for the AAL5 are defined in ITU-T Recommendation I.363.5 [19] and ETS 300 428 [9].

The following selections apply:

- only the message mode service is needed for the VB5.1 protocols;

- corrupted messages will not be delivered to the RTMC protocol entity.

6.4.5.3 SSCOP requirements

The requirements for the SSCOP are defined in ITU-T Recommendation Q.2110/ETS 300 436-1 [10].

The following selections apply:

- local data retrieval: this function is not needed by the VB5.1 RTMC protocol;
- re-synchronization is an inherent part of the SSCOP and has to be supported;
- status reporting: No management data needs to be exchanged between the two peer entities for the VB5.1 RTMC protocol;
- the SSCOP protocol entities will not exchange extra data between them (SSCOP-UU) for the VB5.1 RTMC protocol;
- at release of the connection also the message buffers should be cleared;
- the value for MaxSTAT as defined in clause 7.7 of ITU-T Recommendation Q.2110/ETS 300 436-1 [10] shall be one of the default values;
- the other values are given in subclause 6.4.5.4 of the present document;
- the default window size shall be 5 as defined in appendix IV of ITU-T Recommendation Q.2110/ ETS 300 436-1 [10].

6.4.5.4 SSCF requirements

The requirements for the SSCF are defined in ITU-T Recommendation Q.2130/ETS 300 437-1 [11].

The following selections apply:

- the VB5.1 RTMC protocol needs only the assured transfer of data but not the "Unacknowledged Transfer of Data";
- the VB5.1 RTMC protocol does not need the AA-Parameter SSCOP-UU;
- the parameters of table 4 of ITU-T Recommendation Q.2130/ETS 300 437-1 [11] shall apply.

6.5 Meta-signalling

If applied, broadband meta-signalling and associated procedures belong to the management plane functions of the CPE, AN and SN. Broadband meta-signalling applied at the CPE is handled transparently within the AN. The peer entity is the SN.

In order to support some specific non-B-ISDN accesses (see clause 8), also the AN may apply broadband meta-signalling.

At the VB5.1 reference point, B-ISDN user meta-signalling (refer to ITU-T Recommendation Q.2120/ ETS 300 486-1 [13]) shall be applied for the allocation of signalling virtual channel links at the VB5.1 reference point, which are handled transparently between the user ports or virtual user ports (see clause 8) and the SN. The meta-signalling VCC is part of and carried over the VB5.1 reference point.

It is noted that an access network conform to VB5.1 can be used with other broadband meta-signalling systems applied at the CPE and the SN and transported transparently over the AN. This feature is a consequence of the basic principle that meta-signalling is not terminated by the AN. This is however outside the scope of the present document.

7 Broadband access network connection types

This clause specifies the basic broadband connection types which are required across access networks with VB5.1 reference point. The present document does not imply that every access network with VB5.1 reference point shall have the capability to support all these connection types.

7.1 Introduction to connections/connection elements

An overall B-ISDN connection may comprise a number of "tandem" connections (also called segments) of different networks (i.e. public B-ISDN and private B-ISDN) as illustrated in Figure 20 and may be further decomposed into local, transit and international B-ISDN connection elements.

The overall B-ISDN connection can be considered to end either at the SB reference point (in the case where the customer network is a B-ISDN, i.e. providing the same B-ISDN connection as in the public B-ISDN) or at the coincident SB/TB reference point (in the case where the customer network is null).

CCITT Recommendation I.324 [30] (related to ISDN) and ITU-T Recommendation I.327 [31] (related to B-ISDN) explain how an overall B-ISDN connection is made up of Connection Elements (CE).

This concept is illustrated in Figure 20 with the inclusion of a new additional connection element which is representing the "public access network" and the related "public access network" Connection Related Functions (CRF).

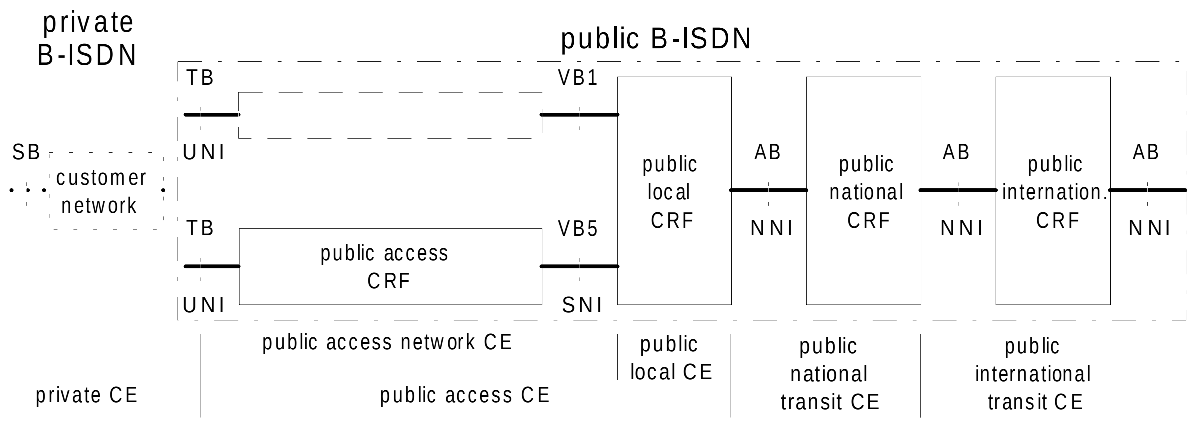


Figure 20: Connection elements within overall B-ISDN connection

7.2 Multipoint requirements

The access network (i.e. the ATM cross connection function) shall be capable of supporting a point-to-multipoint (multicast) function on a given number of virtual connections.

The cell sequence integrity of the source shall be maintained for the point-to-multipoint connections.

The point-to-multipoint connections are unidirectional in the direction SN to UNI.

NOTE: Requirements for bi-directional point-to-multipoint connections are for further study within ITU-T and their impact on the VB5 reference point will have to be investigated (for example, for the case of bi-directional point-to-multipoint connections the return peak cell rate on the root link may be required not to exceed the sum of the return peak cell rates on all the leaf ATM links to maintain suitable cell loss performance for the overall connection). A multipoint-to-multipoint connection is for further study within ITU-T (see ITU-T Recommendation Q.298x) and its impact on the VB5.1 reference point will have to be investigated.

7.3 Broadband access network connection element identifiers

Connection element identifiers have already been introduced in direct access arrangements for use by the user signalling procedures. For remote access arrangements with VB5.1 reference point, connection element identifiers are additionally required for the RTMC function.

7.3.1 Connection element identifiers in user-to-network signalling messages

The use of connection element identifiers (i.e. VPCIs and VCIs) in user-to-network signalling messages is described in ITU-T Recommendation Q.2931/ETS 300 443-1 [12].

7.3.2 Connection element identifiers in RTMC messages

For the RTMC function a mechanism for the unique identification of VPCs both at the UNI and the VB5.1 reference point is required.

The concept of VPCIs shall be applied within the RTMC protocol in order to identify the corresponding user information flow, i.e. VPC. Both the AN and the SN must understand the relationship between the VPCI value used in the RTMC protocol and the actual VPI value used in the cell header for the user information flow.

a) Identification of a VPC cross-connected in the AN (see also Figure 24):

   the VPCI allocated to a given VPC shall be unique within the corresponding logical user port. The logical user port is identified by an LUP_ID which is unique within each VB5.1 reference point.

   Where user-to-network signalling is applied, the RTMC function shall use the same VPCI values as they are applied in the user-to-network signalling protocol.

b) Identification of a VPC at the UNI terminated at the user port function of the AN:

   the same mechanism as for a VPC cross-connected in the AN shall be applied.

c) Identification of a VPC at the VB5.1 reference point terminated at the service port function of the AN (see also Figure 28):

   for the identification of a VPC at the VB5.1 reference point terminated at the service port side of the AN the concept of VPCIs is applied as well. The VPCI allocated to a given VPC of this type shall be unique within the corresponding logical service port. The logical service port is identified by an LSP_ID.

7.4 Broadband access network connection type matrix

The mapping between the service point of view and the access network point of view of broadband access network connections is provided in Table 2.

The two views of a broadband AN connection mentioned above differ in some cases, e.g.:

- on-demand VC connections may be provided to the user via a AN which supports only VP connection and VP cross connect functions, the VC connections being completely transparent to an AN;
- a point-to-multipoint connection in the direction from the SN to several T_B reference points may have its replication functions in the SN and would then be considered in the AN to be a set of individual point-to-point connections;
- a multipoint-to-point connection in the direction from several T_B reference points to the SN will at the AN be considered as a set of individual point-to-point connections.

Table 2: Broadband Access Network connection type matrix

Broadband AN connection types		Services													
		(Semi-)permanent connections											Switched connections		
		User-to-User and User-to-SN connections				AN to SN connections		Support of NB access Types	Support of other non-B-ISDN access types				User-to-User connections	Support of other non-B-ISDN access types	
		VP		VC		VP	VC	VC	VP (note 1)		VC		VC	VC	
		ptp	ptm	ptp	ptm	ptp	ptp	ptp	ptp	ptm	ptp	ptm	ptp	ptp	ptm
A-VP	ptp	x		x									x		
(7.5.1.1)	ptm		x		x										
A-VC	ptp			x											
(7.5.1.2)	ptm				x										
B-VP (7.5.2)	ptp					x									
B-VC (7.5.2)	ptp						x								
D-VP	ptp							x	x		x			x	
(7.6.1)	ptm									x		x			
D-VC	ptp							x			x				
(7.6.2)	ptm											x			

NOTE 1: Only applicable to ATM based non-B-ISDN access types.
NOTE 2: This table includes only those connection types which go across the VB5.1 reference point. User to AN connections are not included in this table.
NOTE 3: Type C broadband access network connections are not applicable to the VB5.1 reference point.
NOTE 4: Cell replication only in the AN support point-to-multipoint services is considered above. The possibility of replicating cells in the SN to achieve the same function to the user is not indicated.
NOTE 5: Type B-VP connections can carry A-VC, B-VC and D-VC connections.

7.5 B-ISDN type broadband access network connections

7.5.1 Type A broadband access network connections

Type A broadband access network connections are established, released and maintained by provisioning (i.e. management plane functions) and support the application of connections where the access network provides connection point functions as defined in ITU-T Recommendation I.311 [16].

7.5.1.1 Type A-VP broadband access network connection

Type A-VP broadband access network connections support the application of point-to-point (see Figure 21) and unidirectional point-to-multipoint (see Figure 22) VP links where the access network provides VP connection point functions (i.e. translation of VPI values).

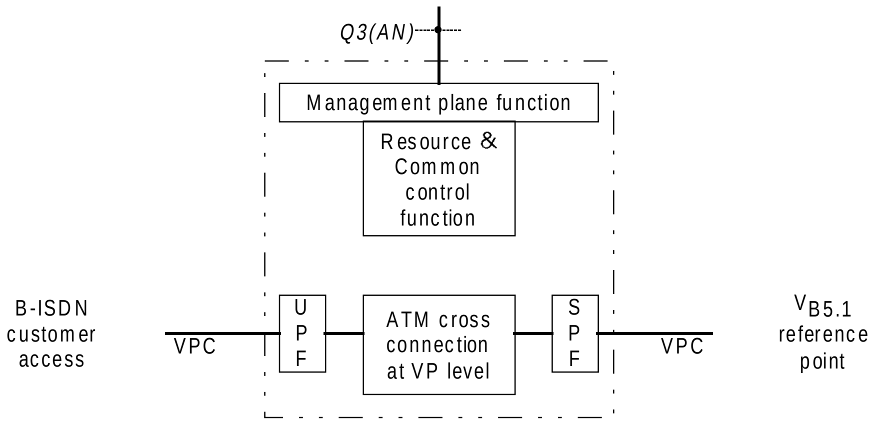


Figure 21: Type A-VP point-to-point broadband access network connection

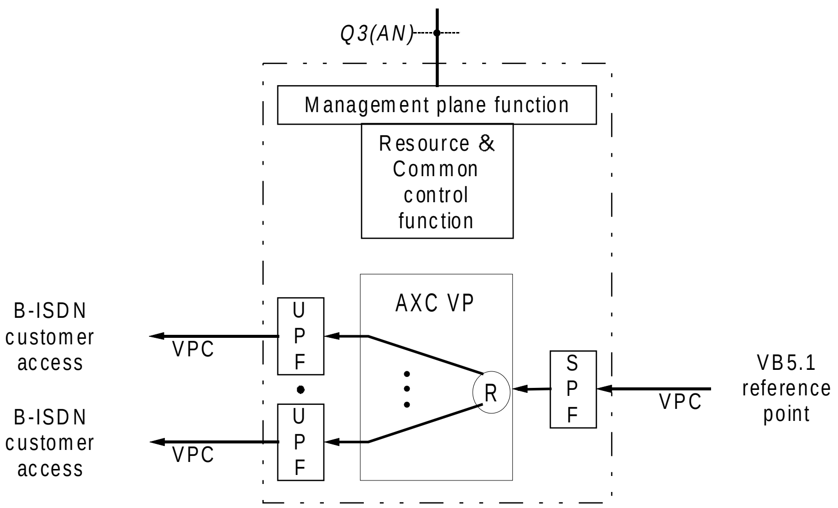
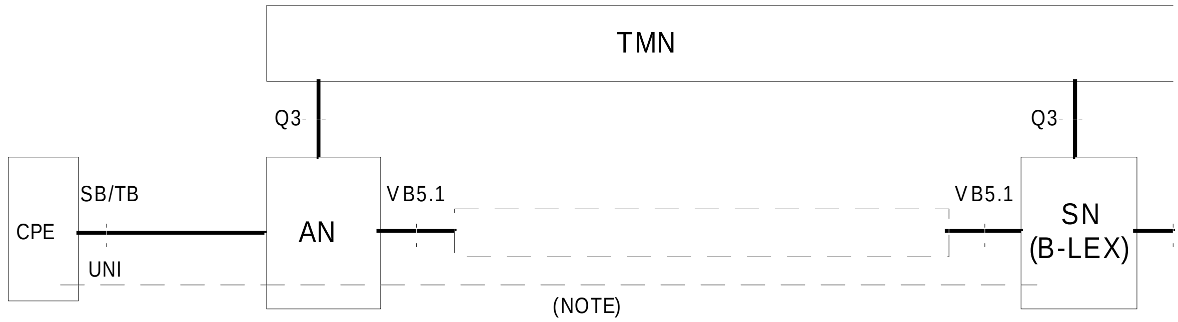


Figure 22: Type A-VP point-to-multipoint broadband access network connection

In addition to the VP connection point functions the AN also provides the cell replication function.

7.5.1.1.1 Application of type A-VP ptp broadband AN connection

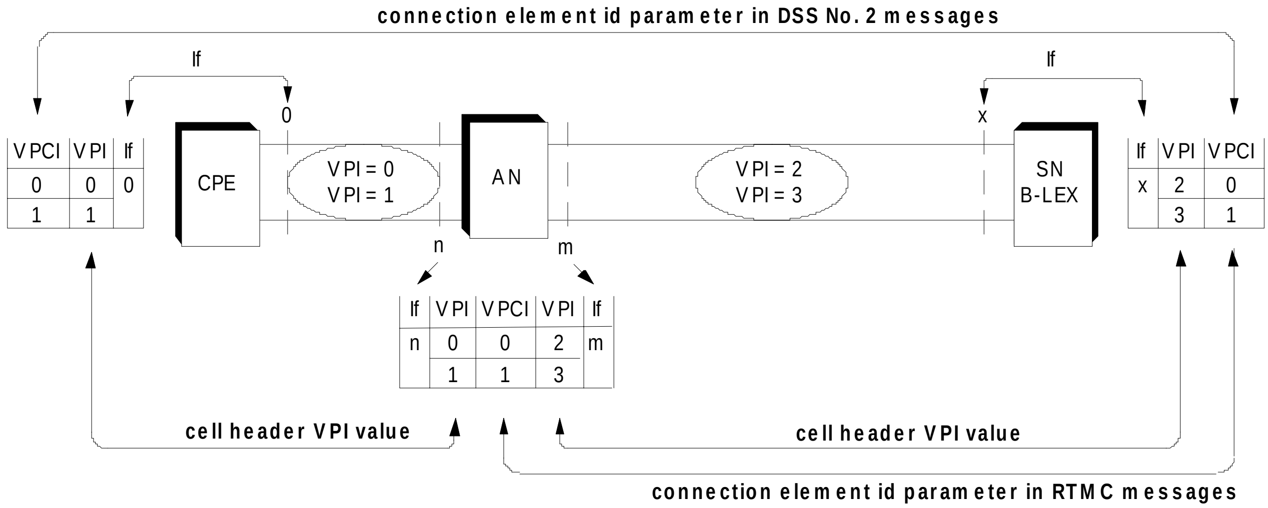
A scenario related to on-demand VCCs controlled by the SN is illustrated in Figure 23. This scenario consists of a AN providing VP cross connect functionality and a SN providing broadband local exchange functions.



NOTE: Control plane communication (user-network signalling).

Figure 23: Remote access via VB5.1 reference point to a "B-LEX" SN

An example for the handling of VPI and VPCI values of such a user-to-SN connection related to the configuration given in Figure 23 is illustrated in Figure 24.



NOTE 1: The interface identifier If refers to a single physical interface (i.e. transmission convergence function).
NOTE 2: The use of VCIs is not illustrated in this example.

Figure 24: Example for VPI and VPCI handling

7.5.1.2 Type A-VC broadband access network connections

Type A-VC broadband access network connections support the application of point-to-point (see Figure 25) and unidirectional point-to-multipoint (see Figure 26) VC links where the access network provides VC connection point functions (i.e. translation of VCI values and re-assignment of VPI values).

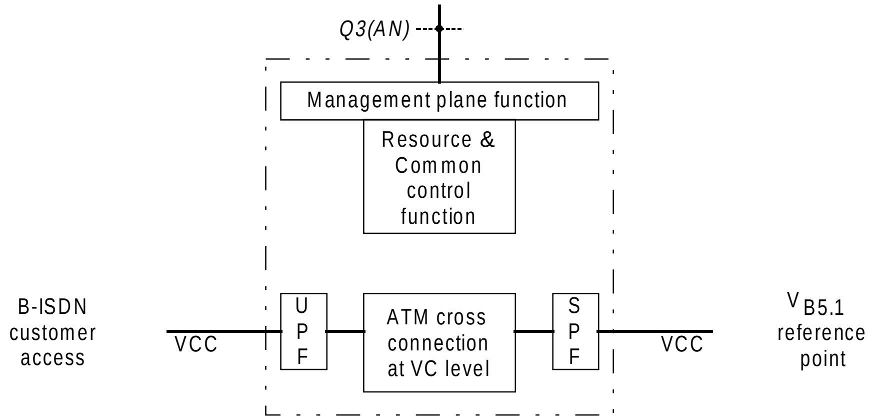
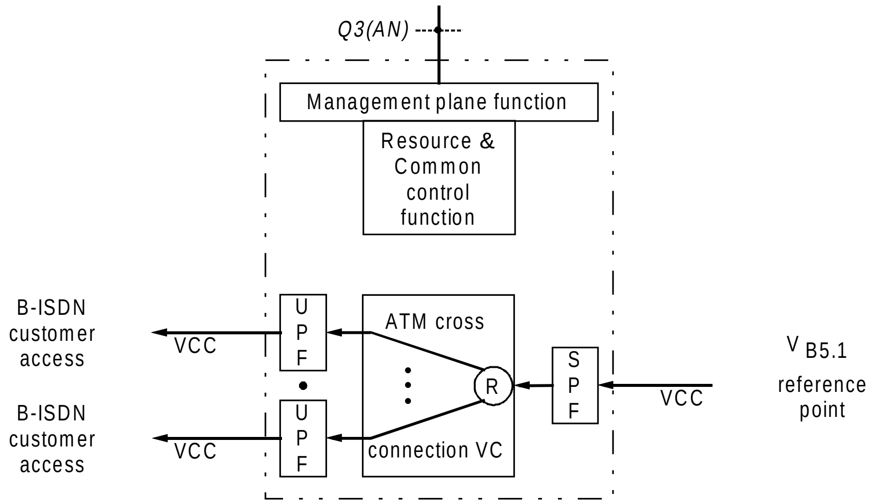


Figure 25: Type A-VC ptp broadband access network connection



NOTE: In addition to the VC connection point functions the AN also provides the cell replication function ®.

Figure 26: Type A-VC ptm broadband access network connection

7.5.1.2.1 Application of type A-VC ptp broadband AN connection

A scenario related to (semi-) permanent VCCs provisioned between a user and a SN is illustrated in Figure 27. The scenario illustrated in Figure 27 consists of a AN and a SN which may provide higher layer services as i.e. connectionless broadband data service.

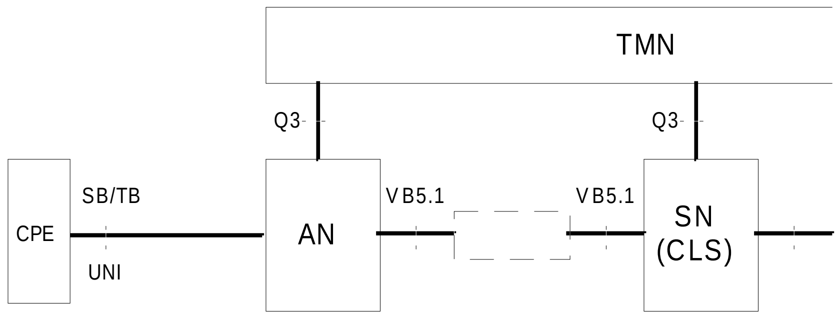
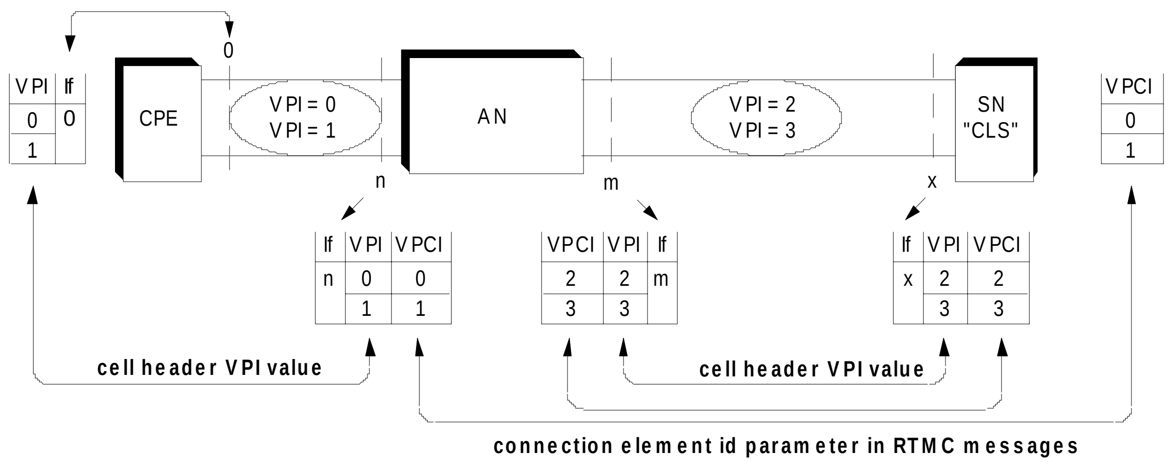


Figure 27: Remote access via VB5.1 reference point to a "CLS" SN

An example for the handling of VPI and VPCI values of such a connection related to the configuration given in Figure 27 is illustrated in Figure 28.



NOTE 1: The interface identifier If refers to a single physical interface (i.e. transmission convergence function).
NOTE 2: The use of VCIs is not illustrated in this example.

Figure 28: Example for VPI and VPCI handling

7.5.2 Type B broadband access network connections

Type B broadband access network connections (see Figure 29) are established, released and maintained by provisioning (i.e. management plane functions) and support the application of both point-to-point VP connections (type B-VP) and point-to-point VC connections (type B-VC) where the access network and the service node provide connection end-point functions (i.e. termination of VPCs and VCCs, respectively) as defined in ITU-T Recommendation I.311 [16].

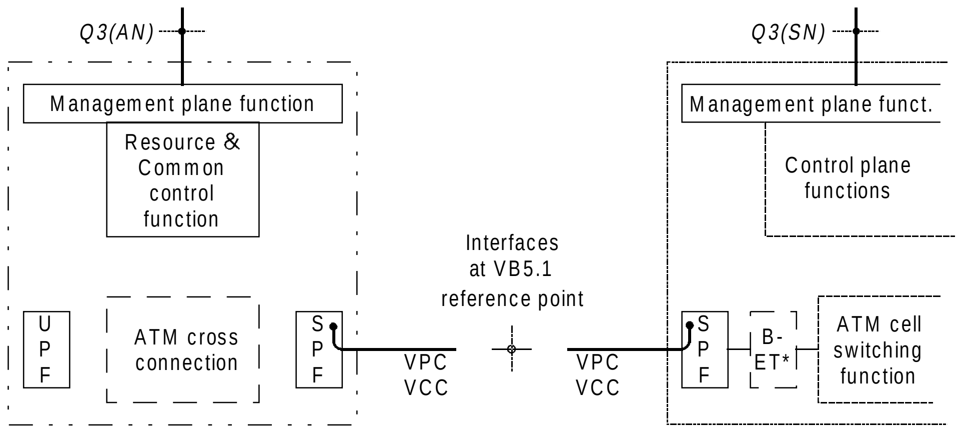


Figure 29: Type B broadband access network connection

7.6 Non-B-ISDN type broadband access network connections (type D)

Type D broadband access network connections are established, released and maintained by provisioning (i.e. management plane functions) and supports the application of connections between a circuit emulation function or a virtual user port and the VB5.1 reference point as defined in ITU-T Recommendation I.311 [16].

7.6.1 Type D-VP broadband access network connection

Type D-VP broadband access network connection support the application of point-to-point and point-to-multipoint VP links where the access network provides VP connection point functions. In the case of non-ATM based accesses the AN additionally provides VC and VP connection end-point functions (as part of the access adaptation functions).

7.6.2 Type D-VC broadband access network connection

Type D-VC broadband access network connection supports the application of point-to-point and point-to-multipoint VC links where the access network provides VC connection point functions. In the case of non-ATM based accesses the AN additionally provides VC connection end-point functions (as part of the access adaptation functions).

7.6.3 Application example of non-B-ISDN type broadband access network connections for the support of narrowband access types

A specific application example of the non-B-ISDN type broadband access network connections is the support of narrowband access types (see Figure 30). In this case, the access network connection (either of type D-VP ptp or type D-VC ptp) provides the capability to transfer 2 048 kbit/s bearer information between a narrowband access network function on one side and a 64 kbit/s based local exchange on the other side.

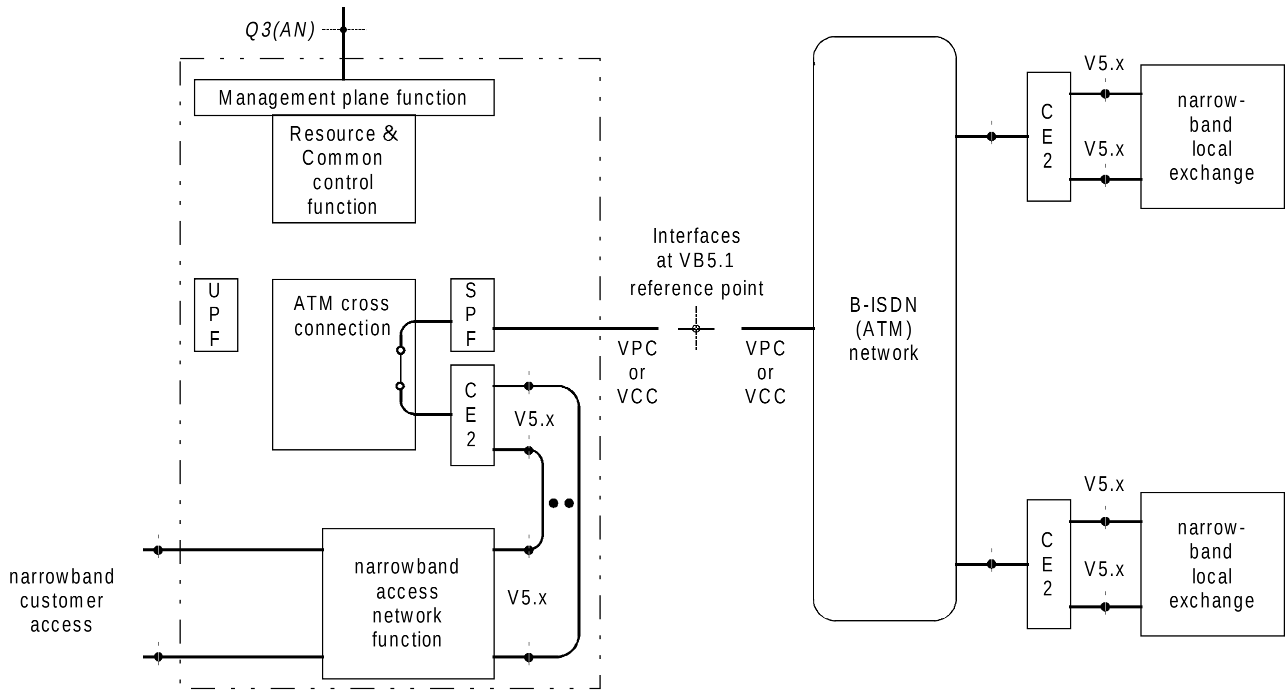


Figure 30: Application example of non-B-ISDN type broadband access network connections

8 Non-B-ISDN access

8.1 General considerations

The broadband accesses defined under the general title of B-ISDN should become the predominant accesses to support telecommunications services at some point in the future. At present, the narrowband accesses such as the access to the PSTN, ISDN-BA and ISDN-PRA are the predominant accesses for service offerings by telecommunications operators. There will need to be an interim changeover period when broadband and narrowband accesses co-exist over the same access network infrastructure. In addition, other non-B-ISDN accesses will be supported by the access network.

The following non-B-ISDN access types have been identified and are supported by VB5.1:

- narrowband accesses;
- other non-B-ISDN accesses.

The non-B-ISDN access types are split into two clearly defined subgroups: those supporting ATM as the only possible transport mode and those which do not support ATM at all. The latter subgroup includes the narrowband accesses. An access supporting a mix of ATM and non-ATM transport modes is not excluded (i.e. ATM and STM provided on a single physical access). The principles for ATM based and non-ATM based accesses shall be combined in such cases.

It is indicated that the VB5.1 reference point and associated functions are specified in a way that the AN is service independent. Therefore, the inclusion of service specific access types are not mandatory. Instead, they are considered as "plug-in" entities which rely on the service independent capabilities of the VB5.1 reference point and the associated AN.

Further, it is noticed that non-B-ISDN accesses can also be supported by siting interworking/terminal adaptation functions on the customer side of the B-UNI.

It is as well reminded that descriptions given is next subclauses do not restrict any implementation strategy with respect to non-B-ISDN accesses.

8.2 ATM based accesses

8.2.1 General approach

A number of interfaces, supporting the ATM layer, are currently being defined in order to provide cost-effective solutions to interconnect customer premises equipment to a broadband public network (i.e. ATM forum interfaces, interfaces at the A1 reference point in DAVIC). It is likely that these interfaces will be supported in first implementations of broadband access networks, and should therefore be considered within the scope of the present documents on VB5.1 interfaces.

NOTE: It is possible that some of these accesses become part of B-ISDN as soon as the relevant standards are agreed upon (i.e. within the UNI specification ITU-T Recommendation I.432). This is out of the scope of the present document.

As a general principle, the support of these types of interfaces shall not impact the VB5.1 interface specifications as defined for B-ISDN accesses. In other words, all specifics related to these interfaces shall be hidden to the VB5.1 interface by additional functions within the AN.

The additional functions of the AN, to support ATM based non-B-ISDN accesses, is referred "Access Adaptation Functions" (see Figure 31). Such functions may be necessary in the user plane and/or control plane and/or management plane. One or more Virtual User Ports (VUPs) may be introduced at the boundary of the Access Adaptation Functions and the remaining ATM based access network functions. The introduction of VUPs is only required if otherwise the characteristic information and protocols over the VB5.1 would be impacted.

Access adaptation functions may be introduced in any combination of user, control or management planes.

It is noted that the introduction of virtual user ports for the sake of adaptations in the management or control plane does not exclude the existence of physical user ports in the user plane.

A description along the line of the B-ISDN protocol reference model is given in following subclauses.

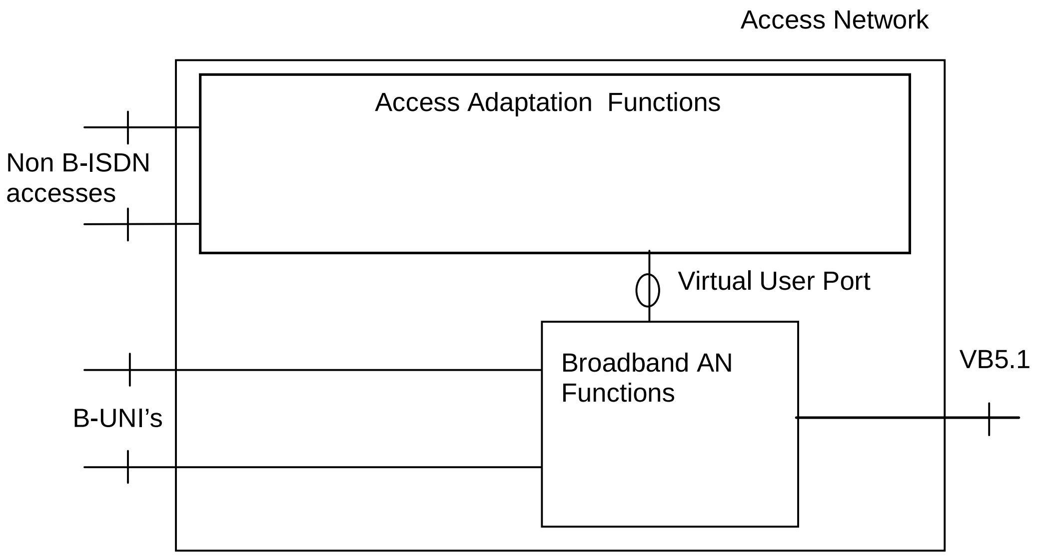


Figure 31: Generic model for support of non-B-ISDN accesses

8.2.2 User plane

If ATM, as described in ITU-T Recommendations I.361/ETS 300 298-2 [2] and I.610 [24], is used on the non-B-ISDN ATM based access, it shall have no additional impact on the VB5.1 reference point. The physical layer of the UNI is only known in the AN (i.e. not at the SN). In addition, no physical layer related information shall be conveyed across the VB5.1 reference point.

Deviation from the above shall be accommodated by the introduction the appropriate ATM Adaptation Functions.

8.2.3 Control plane

The virtual channels supported on non-B-ISDN, ATM based accesses shall be on-demand or semi-permanent.

On demand VC connections are either allocated via B-ISDN user-network-signalling or by other means at the UNI. In order to comply with the control plane requirements (see subclause 6.4.2) for VB5.1, the latter case requires access adaptation functions in the control plane. These access adaptation functions will then generate the B-ISDN user to network signalling.

The concept of virtual user port can be used to support terminals at the CPE which do not have B-ISDN User to network signalling capabilities. Instead, such terminals could support dedicated signalling protocols which trigger the B-ISDN user to network signalling facility within the AN. This capability supports i.e. proxy signalling agents within the AN.

For the support of semi-permanent VC connections, only management plane functions are involved.

8.2.4 Management plane

Access adaptation functions may be required as part of management plane procedures (i.e. conversion to B-ISDN meta-signalling).

The introduction of the virtual user port does not preclude that ATM based, non-B-ISDN access specifics are managed via the Q3(AN) interface, e.g. the MIB of the AN should be extended if it is required to configure/monitor the physical layer of the UNI.

The establishment of a semi-permanent virtual channel connection, with one endpoint in the access adaptation functions, shall be possible via the Q3(AN). Cross-connections within the access adaptation function are outside the scope of the present document.

Towards the CPE a Local Management Interface (LMI) is optional as part of the AN (i.e. user port function). This is outside the scope of the present document.

8.3 Non-ATM based accesses

8.3.1 General approach

Non-ATM based accesses need to be handled case by case to identify the functions within the AN supporting this access.

As a general principle, the support of these types of interfaces shall not impact the VB5.1 interface specifications. In other words, all specifics related to these interfaces shall be hidden to the VB5.1 interface by additional functions within the AN.

The additional functions of the AN, to support non-ATM, non-B-ISDN accesses, is referred "Access Adaptation Functions" (see Figure 31). Such functions will be required in the user plane. In addition, adaptation functions may be required for control plane and/or management plane.

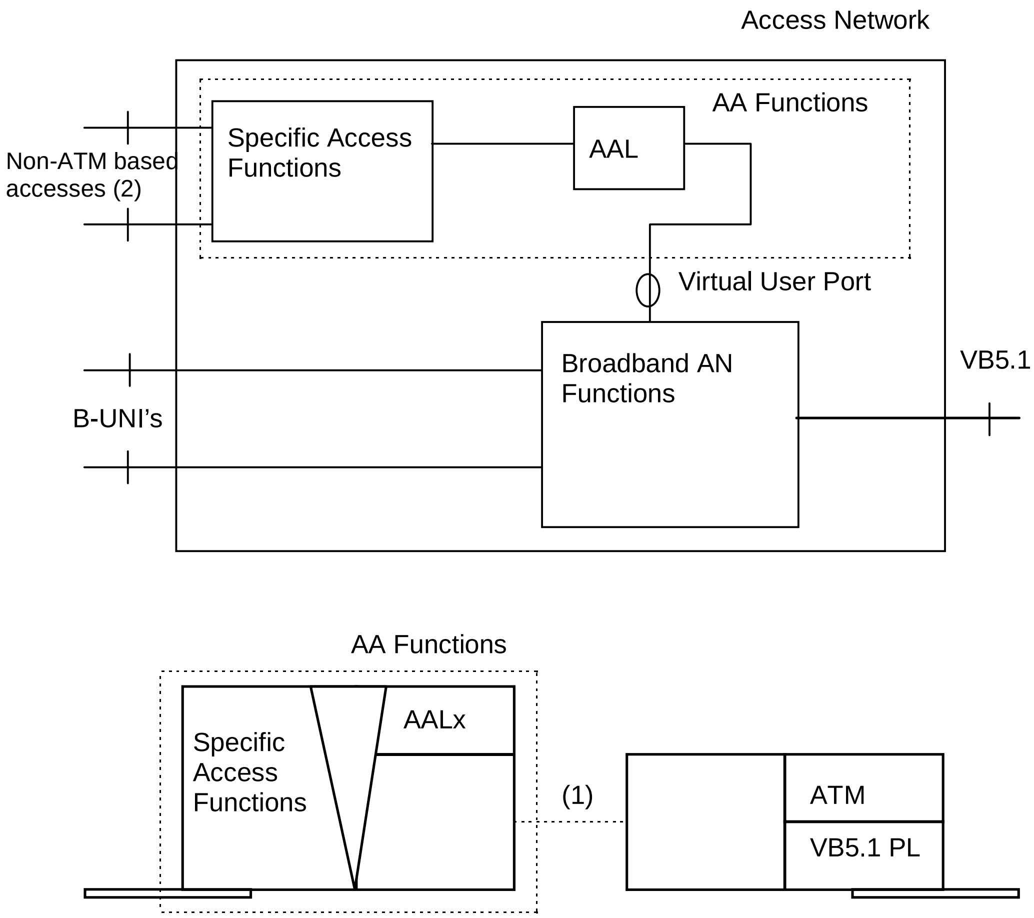
A description along the lines of the B-ISDN protocol reference model is given in following subclauses.

8.3.1.1 User plane

The required functionality and associated protocol stack is depicted in Figure 32.

Compared to the case of a B-UNI access, a non-ATM based access will require AAL functionality to be performed in the access network. This AAL shall be a standardized type. Other functionality will depend on the type of the access and is referred "Specific Access Functions" (SAF) in Figure 32.

Figure 32 gives the general approach for treating non-ATM based accesses. The SAF and associated AAL functionality, apart from the narrowband access (see subclause 8.3.2), is out of the scope of the present document and is covered by other standards.



(1) Internal reference point representing the Virtual User Port, which is assumed to be ATM based.
(2) Including narrowband accesses; these are further described in clause 8.3.2.

Figure 32: User plane functionality and protocol stack for non-ATM based accesses

At the level of the VB5.1 interface, traffic from non-ATM based accesses will be supported via virtual channels. The associated virtual channel connections are terminated within the access adaptation functions. The other connection termination point can be located in the SN or further on in the network.

Within the AN there may or may not exist a connection point for this virtual channel.

8.3.1.2 Control plane

The virtual channels supporting the user plane traffic from non-ATM based accesses shall be on-demand or semi-permanent. For on-demand VC connections, B-ISDN User to network signalling will be required within the AN as part of the AAFs. The signalling originated in the AAF shall be treated as transparent data within the AN.

For semi-permanent VC connections only management plane functions are involved.

8.3.1.3 Management plane

Access adaptation functions may be required as part of management plane procedures (i.e. conversion to B-ISDN meta-signalling).

The introduction of the virtual user port does not preclude that non-ATM based, non-B-ISDN access specifics are managed via the Q3(AN) interface. i.e. the MIB of the AN should be extended for the AAL and the access specific functions.

The establishment of a semi-permanent virtual channel connection, with one endpoint in the access adaptation functions, shall be possible via the Q3(AN).

8.3.2 Analogue and 64 kbit/s based narrowband accesses as supported by V5 interfaces

Narrowband accesses as supported by the V5.1 and V5.2 interfaces are also supported by VB5.1. These will include analogue telephone access, ISDN basic access, ISDN primary rate access, and other analogue or digital accesses for semi-permanent connections without associated out-band signalling information.

8.3.2.1 Principles

Narrowband support shall be provided by 2 048 kbit/s circuit emulation of V5.1 and/or V5.2 links and/or V3 interfaces, each carried by different virtual channels across the VB5.1 interface.

Each V5.1 and/or V5.2 and/or V3 interface carried over a VB5.1 interface shall contain the full set of protocols as defined in the relevant V5/V3 interface specifications including the frame format according to ITU-T Recommendation G.704 [14], but with the exception of the physical medium. The physical layer may or may not be reproduced in order to terminate the narrowband streams in a defined manner, inside the AN or SN.

NOTE: The application of OAM flows at the circuit emulation function (i.e. insertion of AIS signals in case of failure detection) has yet to be defined in relevant specifications.

The circuit emulation principle follows the general approach for non-ATM based accesses as defined above. The AAF includes the narrowband AN functionality, including management, control and user plane functions. A single AAF may cover multiple narrowband accesses.

Further specifics for narrowband accesses are:

a) circuit emulation is performed by applying standard AAL1 functions as specified in subclause 8.3.2.2;

b) the ATM layer connection characteristics for the support of circuit emulation information are given in subclause 8.3.2.3;

c) for the PRA, two alternatives exist:

   - transport via a V5.2 circuit emulation;

   - transport via V3 circuit emulation;

d) digital accesses used for semi-permanent connections without associated out-band signalling shall be handled as NB access or as other non-B-ISDN, non-ATM based access (see subclause 8.3.3);

e) analogue accesses, either used as access to the PSTN or used for semi-permanent connections, shall always be handled as NB access;

f) other means for transporting data originating from NB accesses across the VB5.1 are outside the scope of the present document (i.e. circuit emulation of a BA);

g) configuration, fault and performance management of the circuit emulation function shall be possible via the Q3(AN).

8.3.2.2 AAL for 2 048 kbit/s circuit emulation

The AAL type 1 "unstructured mode" according to ITU-T Recommendation I.363.1 [18] shall be applied for emulation of 2 048 kbit/s streams (i.e. V5.1 and/or V5.2 links and/or V3 interfaces). For the AAL type 1 protocol the parameters provided in ITU-T Recommendation I.363.1 [18], appendix 2 paragraph 2.1.2 case of synchronous transport shall be used.

CBR rate at AAL service boundary:	2 048 kbit/s
Source clock frequency recovery:	synchronous
Error correction mode:	not used
Error status indication at receiver:	not used
Pointer:	not used
Partially cell fill method:	not used

8.3.2.3 Connection characteristics for circuit emulation

The broadband access network connection type shall be of type D-VP or D-VC. The attribute values are:

Broadband Connection Oriented Bearer	
Service sub-category:	A
Information transfer rate:	2 048 kbit/s, augmented with AAL1 overhead and OAM cell rate.
Establishment of communication:	(semi-)permanent
Channel:	VCC
Symmetry:	symmetric bi-directional
Communication configuration:	point-to-point

8.3.3 Other non-ATM based non-B-ISDN accesses

The general approach shall be applied. A virtual user port shall be introduced to support one or more accesses.

NOTE: This category may include the support of narrowband accesses handled by using i.e. the emerging AAL-CU (ATM adaptation layer - composite user: under definition in ITU-T SG13 Q6). The impact on the VB5 protocol is for further study.

The specification of the "Specific Access Functions" and "AAL" functions are outside the scope of the present document.

9 Transfer and layer management functions

This clause covers the definition of the transfer and layer management functions to support services and includes a specification of a functional model of remote access arrangements with VB5.1 reference point.

The present document does not preclude the realization of further transfer functions (i.e. additional cross-connections) within the AN. However, the behaviour from the UNI to the SNI is normative within the present document, i.e. from a SNI point of view a remote access arrangement with VB5.1 references point shall behave as if the functions in this clause were implemented.

9.1 General functional architecture

In Figure 33 the application of the functional architecture for a general ATM network element as defined in ITU-T Recommendation I.731 [33] to remote access arrangements with VB5.1 reference point is illustrated. It is based on the B-ISDN protocol reference model described in ITU-T Recommendation I.321 [17].

This divides the AN into functional areas as follows:

a) Transfer functions:

   Transfer functions are mainly related to the lower layers of the B-ISDN protocol reference model (i.e. physical and ATM layer) and include all functions required for the transport of user, signalling, OAM and resource management information. The transfer functions are common for all higher layer services in B-ISDN.

   ATM adaptation layer functions are considered as part of the transfer functions and are required to enable higher layer protocols (i.e. RTMC protocol) to use the service-independent ATM layer.

   AAL functions in the AN are also required to provide for the transport of information from (non-ATM based) non-B-ISDN access types across the VB5.1 reference point.

b) Layer management functions:

   Management information associated with a given transfer layer function is passed to (or received from) the corresponding layer management functions, i.e. for processing of configuration, fault monitoring, performance monitoring, UPC/NPC. Configuration, performance, fault, and accounting information may be passed to plane management for further processing and/or communication to external network management entities and/or operating systems. Layer management functional blocks correspond one-to-one with transfer functional blocks.

c) Plane management functions:

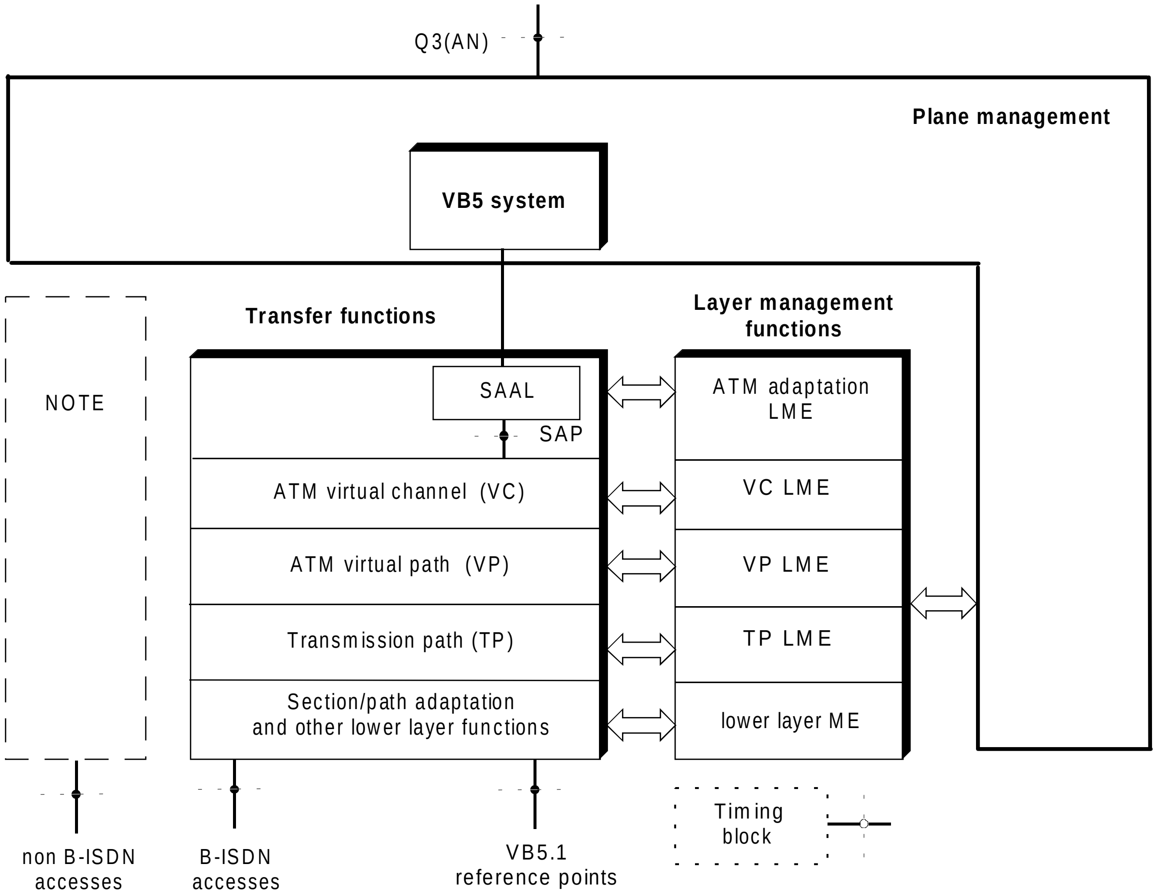
   Plane management deals with the set of functions applicable to management of the network element as a whole or those functions related to the relationships with management systems external to the network element. It includes co-ordination between layer management entities.

   Plane management includes the VB5 system. The VB5 system is responsible for the real time co-ordination between AN and SN across the VB5.1 reference point. Requirements for real time co-ordination are described in clause 11, structure and architecture of the VB5 system are specified in clause 13 of the present document.

NOTE: Within the present document only those aspects of plane management are described which are not specified in DE/SPS-03049-1 covering management interfaces associated with the VB5.1 reference point.

d) Timing functions:

   these functions deal with the actions required to synchronize the equipment interfaces, either ATM based interfaces or non-ATM interfaces, to a clock source (i.e. network, external or internal).



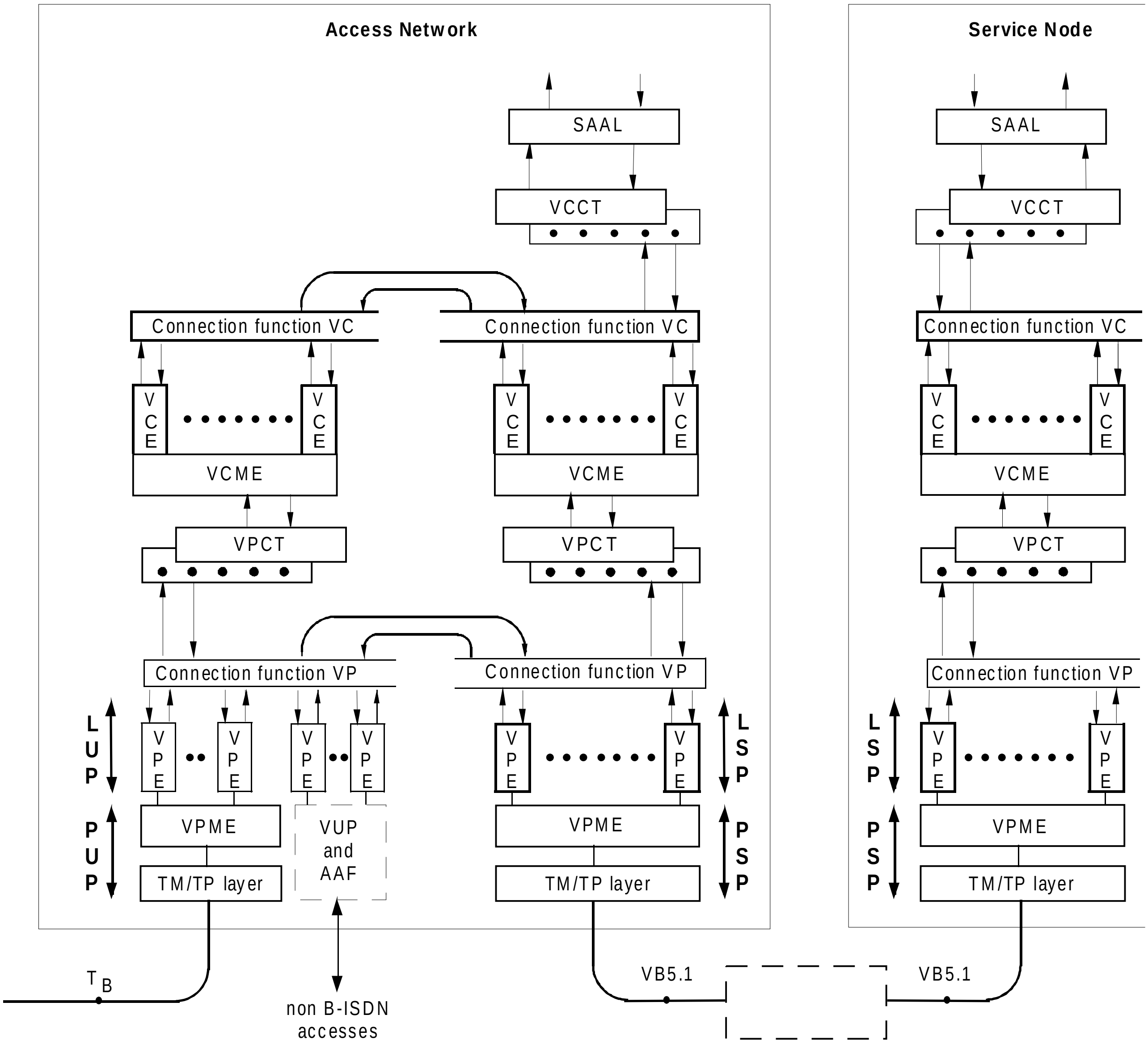
NOTE: Access adaptation functions to support non-B-ISDN access types. For specific non-B-ISDN access types, these functions include AAL functions.

Figure 33: General functional architecture of the AN

9.2 Functional architecture of transfer and layer management functions

The general functional architecture of the transfer functions within the AN and SN are illustrated in Figure 34. This illustration is based on the protocol reference model representation as given in ITU-T Recommendation I.732 [25].

This functional description concentrates on the "edge functions" of the AN and SN in order to ensure interoperability with other equipment (i.e. customer premises equipment or transport network equipment).



PSP	Physical Service Port	VCCT	Virtual Channel Connection Termination
PUP	Physical User Port	VCE	Virtual Channel Entity
LSP	Logical Service Port	VCME	Virtual Channel Multiplex Entity
LUP	Logical User Port	VPCT	Virtual Path Connection Termination
VUP	Virtual User Port	VPE	Virtual Path Entity
AAF	Access Adaptation Function	VPME	Virtual Path Multiplex Entity
TM/TP	Transmission Media/Path		

NOTE: The ATM connection function, used in conjunction with the VUP, is provided for modelling purposes and may not necessarily exist in practice.

Figure 34: Functional architecture of transfer functions in remote access arrangements

9.3 Transfer functions required for individual broadband AN connection types

In Table 3 the subset of transfer (and layer management) functions required to support a specific broadband AN connection type (see clause 7 of the present document) is identified.

Table 3: Transfer functions for broadband AN connection types

Connection type (note)	**User port side**	**Connection function**	**Service port side**
B-ISDN connection types			
Type A-VP connections	VPE VPME TM/TP layer	VP connection entity	VPE VPME TM/TP layer
Type A-VC connections	VCE VCME VPCT VPE VPME TM/TP layer	VC connection entity	VCE VCME VPCT VPE VPME TM/TP layer
Type B-VP connections			VPCT VPE VPME TM/TP layer
Type B-VC connections			VCCT VCE VCME VPCT VPE VPME TM/TP layer
Non B-ISDN connection types			
Type D-VP connections	VPE VUP/AAF	VP connection entity	VPE VPME TM/TP layer
Type D-VC connections	VCE VCME VPCT VPE VUP/AAF	VC connection entity	VCE VCME VPCT VPE VPME TM/TP layer
NOTE: Specifications for transfer and layer management functions for connections with point-to-multipoint configuration are still under study within ITU-T. The impact of these specifications on the functions required for the broadband AN connection types will have to be investigated.			

9.4 Functions associated with the physical user port

Within this subclause the functions at the physical user port of ANs are defined. The mapping between the general modelling concept for user ports specified in clause 5 of the present document and the B-ISDN protocol reference model of functions at the physical user port is illustrated in Figure 34.

The physical user port provides the following functionality:

a) section/path adaptation, section termination and lower layer functions (i.e. physical medium dependent functions);

b) transmission path termination (TP-T) function;

c) virtual path multiplex entity (VPME).

A list of the transfer and layer management functions associated with the PUP including references to the relevant specifications is given in Table 4.

Table 4: Transfer and layer management functions associated with PUP

Function	Specification
Section/path adaptation and lower layer functions	ETS 300 300 [4] and ETS 300 299 [3]/ ITU-T Recommendation I.432.2 [22] (SDH based and cell based interfaces) ITU-T Recommendation I.432.3 [23] (PDH based interfaces; only 2 048 kbit/s case applies)
Transmission path termination	ITU-T Recommendation I.432.2 [22] (SDH based and cell based interfaces) ITU-T Recommendation I.432.3 [23] (PDH based interfaces; only 2 048 kbit/s case applies)
VP multiplex entity (direction from TB) Mapping Cell delineation, scrambling, HEC processing Cell rate decoupling TP usage measurement Cell header verification Generic flow control (GFC) (note) VPI verification, congestion control VP demultiplexing	ITU-T Recommendation I.732 [25], § 5.3.1
VP multiplex entity (direction to TB) VP multiplexing, congestion control Generic flow control (GFC) (note) TP usage measurement Cell rate decoupling HEC processing, scrambling, cell stream mapping	ITU-T Recommendation I.732 [25], § 5.3.2
NOTE: Only the "uncontrolled transmission" set of procedures is implemented where the GFC is ignored (see ITU-T Recommendation I.150/ETS 300 298-1 [1], subclause 3.4.4). The GFC field in assigned cells is set to "0 0 0 0".	

9.5 Functions associated with the logical user port

Within this subclause the functions at and on top of the logical user port of ANs are defined. These functions are divided into ATM VP sublayer and ATM VC sublayer functions as illustrated in Figure 34.

9.5.1 ATM virtual path sublayer functions at the LUP

The ATM VP sublayer at the logical user port provides the Virtual Path Entity function (VPE) which includes all functions that are performed per individual VP, i.e. usage parameter control (VP), processing of segment F4 OAM flows. There is one instance of these functional blocks per VP.

9.5.2 ATM virtual channel sublayer functions on top of the LUP

The ATM VC sublayer on top of the logical user port provides the following functionalities:

a) Virtual Path Connection Termination (VPCT):

   performs functions devoted to VP connection endpoints;

b) Virtual Channel Multiplexing Entity (VCME):

   includes functions that are common to all VCs (i.e. multiplexing/demultiplexing of VCs);

c) Virtual Channel Entity (VCE):

includes all functions that are performed per individual VC, i.e. usage parameter control (VC), processing of segment F5 OAM flows. There is one instance of these functional blocks per VC.

A list of the transfer and layer management functions associated with and on top of the LUP including references to the relevant specifications is given in Table 5 and Table 6.

Table 5: VP sublayer functions associated with LUP

Function	Specification
Functions at virtual path sublayer	
VP entity (direction from TB) VP usage measurement VP UPC (note 1) Traffic shaping (for further study) F4 OAM non-intrusive monitoring Resource Management (note 2) F4 OAM cell insertion/extraction and processing	ITU-T Recommendation I.732 [25], § 5.4.1
VP entity (direction to TB) F4 OAM cell insertion/extraction and processing Resource Management (note 2) F4 OAM non-intrusive monitoring VP usage measurement EFCI setting, VPI setting	ITU-T Recommendation I.732 [25], § 5.4.2
NOTE 1: VP UPC shall be performed as described in annex C. NOTE 2: The specification of this function is still for further study within ITU-T Recommendation I.732 [25]. Its impact on the VB5.1 reference point will have to be investigated.	

Table 6: VC sublayer functions on top of the LUP

Function	Specification
Functions at virtual channel sublayer **(only for broadband AN connections of type A-VC and type D-VC)**	
VP connection termination (direction from TB) End-to-end F4 OAM cell extraction and processing	ITU-T Recommendation I.732 [25], § 5.6.1
VP connection termination (direction to TB) End-to-end F4 OAM cell insertion	ITU-T Recommendation I.732 [25], § 5.6.2
VC multiplex entity (direction from TB) VCI verification and invalid cell discard Congestion control, VC demultiplexing Meta-signalling (note 1)	ITU-T Recommendation I.732 [25], § 5.7.1
VC multiplex entity (direction to TB) VC multiplexing, congestion control Meta-signalling (note 1)	ITU-T Recommendation I.732 [25], § 5.7.2
VC entity (direction from TB) VC usage measurement Traffic shaping (for further study) F5 OAM non-intrusive monitoring F5 OAM cell insertion/extraction and processing VC UPC (note 2) Resource Management (note 3)	ITU-T Recommendation I.732 [25], § 5.8.1
VC entity (direction to TB) F5 OAM cell insertion/extraction and processing F5 OAM non-intrusive monitoring VC usage measurement EFCI setting, VCI setting Resource Management (note 3)	ITU-T Recommendation I.732 [25], § 5.8.2
NOTE 1: The AN is transparent for meta-signalling, i.e. no specific actions required. NOTE 2: VC UPC shall be performed as described in annex B. NOTE 3: The specification of this function is still for further study within ITU-T Recommendation I.732 [25]. Its impact on the VB5.1 reference point will have to be investigated.	

9.6 Functions associated with the adaptation of non-B-ISDN access types

9.6.1 Functions for the support of narrowband accesses as supported by V5 interfaces

See subclause 8.3.2.

9.6.2 Functions for the support of other non-B-ISDN access types

The access adaptation functions to enable the support of other non-B-ISDN access types (either ATM based or non-ATM based) are outside the scope of the present document.

9.7 Connection functions

Connection functions in the AN exist at the VP and/or the VC sublayer.

a) VP connection entity:

   includes functions for assigning VP links at service ports to VP links at user ports;

b) VC connection entity:

   includes functions for assigning VC links at service ports to VC links at user ports.

The connection functions are specified in Table 7.

Table 7: Connection functions

Function	Specification
VP connection entity VP link inter-connection (note 1)	ITU-T Recommendation I.732 [25], § 5.5
VC connection entity VC link interconnection (note 2)	ITU-T Recommendation I.732 [25], § 5.9
NOTE 1: Only for broadband AN connections of type A-VP and type D-VP. NOTE 2: Only for broadband AN connections of type A-VC and type D-VC.	

9.8 Functions associated with the physical service port

Within this subclause the functions at the physical service port of the AN and the SN are defined. The mapping between the general modelling concept for service ports specified in clause 5 of the present document and the B-ISDN protocol reference model of functions at the physical service port is illustrated in Figure 34.

The physical service port provides the following functionalities:

a) section/path adaptation, section termination and lower layer functions (i.e. physical medium dependent functions);

b) transmission path termination (TP-T) function;

c) virtual path multiplex entity (VPME) function.

A list of the transfer and layer management functions associated with the PSP including references to the relevant specifications is given in Table 8.

Table 8: Transfer and layer management functions associated with PSP

Function	Specification
Section/path adaptation and lower layer functions	(note 1)
Transmission path termination	(note 1)
VP multiplex entity (direction from VB5) (note 2) Mapping Cell delineation, scrambling, HEC processing Cell rate decoupling TP usage measurement Cell header verification VPI verification, congestion control VP demultiplexing	ITU-T Recommendation I.732 [25], § 5.3.1
VP multiplex entity (direction to VB5) (note 2) VP multiplexing, congestion control TP usage measurement Cell rate decoupling HEC processing, scrambling, cell stream mapping	ITU-T Recommendation I.732 [25], § 5.3.2
NOTE 1: Physical layer principles are described in clause 6 of the present document. NOTE 2: These functions shall be performed when a physical interface at the VB5.1 reference point is implemented.	

9.9 Functions associated with the Logical Service Port (LSP)

Within this subclause the functions at and on top of the logical service port of ANs are defined. These functions are divided into ATM VP sublayer and ATM VC sublayer functions as illustrated in Figure 34.

9.9.1 ATM virtual path sublayer functions at the LSP

The ATM VP sublayer at the logical service port provides the following functionalities:

- Virtual Path Entity (VPE):

  includes all functions that are performed per individual VP. There is one instance of these functional block per VP.

9.9.2 ATM virtual channel sublayer functions on top of the LSP

The ATM VC sublayer on top of the logical service port provides the following functionalities:

a) Virtual Path Connection Termination (VPCT):

   performs functions devoted to VPC endpoints;

b) Virtual Channel Multiplexing Entity (VCME):

   includes functions that are common to all VCs;

c) Virtual Channel Entity (VCE):

   includes all functions that are performed per individual VC;

d) Virtual Channel Connection Termination (VCCT):

   performs functions devoted to VCC endpoints.

Adaptation functions (i.e. SAAL functions) on top of the logical service port are described in clause 13 of the present document.

A list of the transfer and layer management functions at and on top of the LSP including references to the relevant specifications is given in Table 9 (VP sublayer functions at AN and SN side) and Table 10 (VC sublayer functions at AN side).

For the AN to SN connection(s) carrying the RTMC protocol (i.e. broadband AN connection of type B-VC) the specifications given in Table 10 also apply to the LSP at the SN side.

Table 9: VP sublayer functions associated with LSP at AN and SN side

Function	Specification
Functions at virtual path sublayer	
VP entity (direction from VB5) VP usage measurement VP NPC (note 1) Traffic shaping (for further study) F4 OAM non-intrusive monitoring Resource Management (note 2) F4 OAM cell insertion/extraction and processing	ITU-T Recommendation I.732 [25], § 5.4.1
VP entity (direction to VB5) F4 OAM cell insertion/extraction and processing Resource Management (note 2) F4 OAM non-intrusive monitoring VP usage measurement EFCI setting VPI setting	ITU-T Recommendation I.732 [25], § 5.4.2
NOTE 1: The application of VP NPC is a network operator option. NOTE 2: The specification of this function is still for further study within ITU-T Recommendation I.732 [25]. Its impact on the VB5.1 reference point will have to be investigated.	

Table 10: VC sublayer functions on top of LSP at AN side

Function	Specification
Functions at virtual channel sublayer (only for broadband AN connections of type A-VC, type B-VC and type D-VC)	
VP connection termination (direction from VB5) End-to-end F4 OAM cell extraction and processing	ITU-T Recommendation I.732 [25], § 5.6.1
VP connection termination (direction to VB5) End-to-end F4 OAM cell insertion	ITU-T Recommendation I.732 [25], § 5.6.2
VC multiplex entity (direction from VB5) VCI verification and invalid cell discard Congestion control VC demultiplexing Meta-signalling (note 1)	ITU-T Recommendation I.732 [25], § 5.7.1
VC multiplex entity (direction to VB5) VC multiplexing Congestion control Meta-signalling (note 1)	ITU-T Recommendation I.732 [25], § 5.7.2
VC entity (direction from VB5) VC usage measurement Traffic shaping (for further study) F5 OAM non-intrusive monitoring F5 OAM cell insertion/extraction and processing VC NPC (note 2) Resource Management (note 3)	ITU-T Recommendation I.732 [25], § 5.8.1
VC entity (direction from VB5) F5 OAM cell insertion/extraction and processing F5 OAM non-intrusive monitoring VC usage measurement EFCI setting VCI setting Resource Management (note 3)	ITU-T Recommendation I.732 [25], § 5.8.2
VC connection termination (direction from VB5) End-to-end F5 OAM extraction and processing (note 4)	ITU-T Recommendation I.732 [25], § 5.10.1
VC connection termination (direction to VB5) End-to-end F5 OAM insertion (note 4)	ITU-T Recommendation I.732 [25], § 5.10.2
NOTE 1: The AN is transparent for meta-signalling information, i.e. no specific actions required. NOTE 2: The application of VC NPC is a network operator option. NOTE 3: The specification of this function is still for further study within ITU-T Recommendation I.732 [25]. Its impact on the VB5.1 reference point will have to be investigated. NOTE 4: Only for broadband AN connections of type B-VC at VC level.	

10 Provisioning principles and requirements

10.1 General

Provisioning is one of a number of aspects related to management plane functions. It has been separated from other management plane requirements because provisioning shall be performed through the Q3 interfaces of the AN and the SN and is therefore not directly relevant to the VB5.1 interface specification. Only those provisioning aspects having at least conceptual or indirect implication to the interface definition are defined below.

10.2 Principles

a) All data for provisioning, including modification and cessation, shall be handled by the relevant Q3 interface, i.e. Q3(AN) and Q3(SN). Data for provisioning shall be consistent with the splitting of management plane functionality between the SN and the AN, as specified in clause 11 of the present document, e.g. parameters necessary to perform the GFC function have to be available in the AN, whereas i.e. parameters to limit the maximum number of simultaneously active VCCs have to available in the SN.

b) All data related to a VUP and associated access adaptation functions are outside the scope of the present document. This does however not preclude provisioning in the AN. A VUP is not known in the SN, except through its associated LUPs and VP/VC connections.

c) The association of a VP link at the UNI or VUP to a LUP shall be provisioned in the AN and SN independently of the transmission path.

d) The association of a VP link at the interface at the VB5.1 reference point to a LSP shall be provisioned in the AN and SN independently of the transmission path.

e) The association of a VPCI to a VPC shall be provisioned in the AN and SN. The VPCI allocated to a given VPC shall allow a unique identification of that VPC with regard to the RTMC protocol (i.e. unique within a LUP).

f) The access network shall support the provisioning of VP and/or VC cross connectivity functions.

- In case of a VP cross-connection in the AN, the association of a VP link at the UNI or VUP to a VP link at the VB5.1 reference point shall be provisioned in the AN.

- In case of a VC cross-connection in the AN, the association of a VPC/VCL at the UNI or VUP to a VPC/VCL at the VB5.1 reference point shall be provisioned in the AN.

g) Provisioning of VP/VC connections in order to support the VB5.1 RTMC protocol shall be performed in the AN and SN. The VCI value shall be in the range of 32 up to 65 535.

h) A single AN may have multiple VB5.1 interfaces. The association of a LUP to a VB5.1 interface, i.e. a LSP, shall be performed via provisioning in the AN and SN.

i) The AN may support ports and services which are not associated to the VB5.1 interface. These ports and services shall not impact the operability of ports associated with the VB5.1 interface.

j) Provisioning includes any installation testing of the AN carried out prior to its connection to the SN. AN testing shall be initiated by the Q3 interface and can be used to check the AN during this phase.

The management information models and Q3 specifications necessary to manage SN and AN are based on existing information models and Q3 specifications for ATM network elements (see ITU-T Recommendation I.751 [34]). VB5.1 specific information models to manage VB5.1 interfaces and ANs and SNs interconnected via VB5.1 interfaces are specified in the relevant Q3 specifications for VB5.1 interfaces.

11 Principles and requirements for Real Time Management Co-ordination (RTMC)

11.1 General principles for RTMC

The requirements for RTMC between the AN and the SN across the VB5.1 reference point are based on the principles given below:

a) the SN shall be able to determine whether in principle it is possible to offer service to a user, or not. Therefore the AN shall inform the SN about changes of the availability of resources inside the AN. The availability of this information in the SN is time-critical and requires real time co-ordination between AN and SN (refer to ITU-T Recommendation G.902 [15]).

   The relevant AN resources with regard to the service provision capability are given below:

   - physical user port;
   - physical service port;
   - logical service port (i.e. complete VB5.1 reference point);
   - VPC.

   With regard to RTMC the logical user port in the AN is only a naming convention.

   The SN shall be informed whether the unavailability of the relevant AN resource(s) is due to administrative actions taken by the AN operator or due to faults;

b) there is no requirement that the SN informs the AN about the availability of resources inside the SN;

c) it shall be possible to perform service level tests from the AN while the user information flow for on-demand connections is excluded;

d) it shall be possible to verify the correct allocation of a VPCI to a VPC at the VB5.1 reference point;

e) the RTMC function shall allow a re-synchronization of the logical service ports (i.e. complete VB5.1 reference point) in the AN and SN.

11.2 RTMC requirements related to administrative actions

11.2.1 General

a) Management services may change the availability of resources inside the AN or SN from an administrative point of view. The administrative state of resources may be changed by means other than Q3 interfaces (i.e. craft terminals).

   The administrative events which shall be supported by the managed entity corresponding to a specific AN resource and require RTMC between AN and SN are summarized in Table 11 and described in subclauses 11.2.2 and 11.2.3.

b) The RTMC function shall facilitate the co-ordination of the required status information between the AN and the SN, so that in the case of a specific event at a managed entity of the AN the following service relevant information is available at the SN:

1) resources which are affected from a SN point of view;

2) the status of these resource(s) with regard to availability at the AN:

- available (from an administrative point of view);

- not available for switched connections, but test calls allowed;

- unavailable due to an administrative event

either the resource itself or another resource which it depends on has been administratively prohibited from use.

c) The SN operator may change administrative states of VB5.1 specific entities in the SN. However, this has no impact on the RTMC requirements since it is not required that the SN informs the AN about any state change resulting from such an action.

d) If an AN resource becomes unavailable due to a non-Q3 action which is not distinguishable from a fault, then it shall be treated as a fault at that resource.

Table 11: Administrative events which require RTMC between AN and SN

AN Resource	Event at AN	Description
PUP	LOCK SHUT DOWN UNLOCK	see subclause 11.2.2
	PARTIAL LOCK PARTIAL SHUT DOWN PARTIAL UNLOCK	see subclause 11.2.3
PSP (note 1)	LOCK SHUT DOWN UNLOCK	see subclause 11.2.2
LUP (note 2)	—	
LSP (note 1)	PARTIAL LOCK PARTIAL UNLOCK	see subclause 11.2.3
VPC related entities (applicable to VPC cross-connected at AN, VPC terminated at user port, VPC terminated at service port)	LOCK SHUT DOWN UNLOCK	see subclause 11.2.2
Broadcast or multicast VPC with branching point inside the AN	(note 3)	
Any other AN resource where the VPCs dependent on that resource can be unambiguously identified	(note 4)	
NOTE 1: This type of resource also exists at the SN side where the same events at the corresponding managed entity may be supported. However, according to the general RTMC principles, changes of the status of SN resources has no impact on the RTMC function and is therefore out of the scope of the present document. NOTE 2: With regard to the RTMC the LUP is only a naming convention. The LUP does not have an administrative state in the AN. NOTE 3: Administrative actions related to VPCs of this type are for further study. NOTE 4: Events due to administrative actions which affect the service provision capability of those VPCs.		

11.2.2 Manipulation of generic administrative state attributes

These manipulations are related to events LOCK, UNLOCK and SHUT DOWN as defined in ITU-T Recommendation X.731 [38] at the managed entity corresponding to an AN resource. The generic administrative state events shall be supported for the following AN resources: PUP, PSP, VPC(s).

a) A LOCK event administratively prohibits the resource being used.

NOTE: As a result, the cell flow carried on the resource is inhibited according to DE/SPS-03049-1. Neither normal calls nor test calls across the AN are possible in this case. The flow of cells on (semi-)permanent connections is interrupted.

b) A SHUT DOWN event causes a graceful shutting down of a resource without interference with ongoing on-demand services. After this event has occurred, no new switched connections (including new test calls) can be established on the resource. When the last switched connection has been released, the status of the resource automatically changes to locked and the user cell flow is inhibited. As a consequence, also the cell flow on (semi-) permanent connections is interrupted at this point in time.

   In contrast to a lock or unlock procedure, a shutting down procedure of an AN resource may require additional co-ordination with the SN, because the shutting down process needs information about the usage state of a resource which may not be present in the AN.

   With regard to the RTMC function, in these cases the shutting down of an AN resource is considered as a two step procedure:

   - if a SHUT DOWN event occurs at the AN, the AN shall inform the SN via the RTMC function that no new switched connections shall be established on the relevant resource;

   - if no switched connection is present or if the last switched connection on the resource has been released, the SN shall inform the AN via the RTMC function that the resource is no longer used by switched connections.

c) An UNLOCK event may occur at any point in time and permits the resource being used again.

d) If the service provision capability of a VPC in the AN is affected due to administrative actions at another (i.e. implementation specific) AN resource, the SN should also be informed about the change of the availability status of that VPC.

11.2.3 Manipulation of VB5.1 specific state attributes.

These manipulations are related to events PARTIAL LOCK, PARTIAL UNLOCK and PARTIAL SHUT DOWN at the managed entity corresponding to an AN resource. The VB5.1 specific state events shall be supported for the following AN resources: PUP, LSP. For the LSP, a partial shut down is not required.

a) A PARTIAL LOCK event shall stop all switched connections and prohibit establishment of new switched connections on the resource. However, test calls across the AN, initiated by the operator shall be possible. This event has no impact on the cell flow on (semi-)permanent connections, including the VC carrying the RTMC protocol.

b) A PARTIAL SHUT DOWN event causes a graceful shutting down of a resource without interference with ongoing on-demand services. After this event has occurred, no new switched connections (including new test calls) can be established on the resource. When the last switched connection has been released, the status of the resource automatically changes to partial locked.

   In contrast to a partial lock or partial unlock procedure, a shutting down procedure of an AN resource may require additional co-ordination with the SN, because the partial shutting down process needs information about the usage state of a resource which may not be present in the AN.

With regard to the RTMC function, in these cases the partial shutting down of an AN resource is considered as a two step procedure:

- if a PARTIAL SHUT DOWN event occurs at the AN, the AN shall inform the SN via the RTMC function that no new switched connections shall be established on the relevant resource;
- if no switched connection is present or if the last switched connection on the resource has been released, the SN shall inform the AN via the RTMC function that the resource is no longer used by switched connections.

c) A PARTIAL UNLOCK event may occur at any point in time.

11.3 RTMC requirements related to the occurrence of fault conditions

a) The occurrence of fault conditions may change the availability of resources inside the AN or SN from an operational point of view.

The AN resources that require RTMC between AN and SN in the case of the occurrence/disappearance of fault conditions are given in Table 12.

b) The RTMC function shall facilitate the co-ordination of the required status information between the AN and the SN, so that in the case of a fault condition at the AN the following service relevant information is available at the SN:

1) resources which are affected from a SN point of view;

2) the status of these resource(s) with regard to availability at the AN:

- available (from an operational point of view);
- unavailable due to the occurrence of a fault condition.

c) The triggering of the RTMC function shall include correlation of fault conditions so that only the root fault conditions and no consequent (secondary) fault conditions are reported.

Table 12: RTMC functions related to fault conditions at the AN

AN Resource	Event at AN
PUP	Occurrence/Disappearance of FAULT CONDITION at UNI
PSP	Occurrence/Disappearance of FAULT CONDITION at VB5.1 interface
LUP (note 1)	
LSP (note 2)	Occurrence/Disappearance of FAULT CONDITION
VPC related entities (applicable to VPC cross-connected at AN, VPC terminated at user port, VPC terminated at service port)	Occurrence/Disappearance of FAULT CONDITION
Broadcast or multicast VPC with branching point inside the AN (note 3)	Occurrence/Disappearance of FAULT CONDITION
Any other AN resource where the VPCs dependent on that resource can be unambiguously identified	Occurrence/Disappearance of FAULT CONDITION
NOTE 1: With regard to the RTMC the LUP in the AN is only a naming conventions. NOTE 2: In case of a fault condition at the LSP the transfer of RTMC information may no longer be possible. NOTE 3: These VPCs are unidirectional from the SN to the UNIs.	

11.4 Verification of LSP ID

The RTMC function shall provide a mechanism that allows (i.e. at system start-up time) checking of the correct connection of VB5.1 interfaces, by verifying an LSP ID, which is exchanged with the peer side.

11.5 Interface reset procedure

The RTMC function shall provide a procedure that forces all protocol entities and finite state machines on the peer side into a defined state. This procedure may be used i.e. at interface start-up, after detection of severe failures or after major re-provisioning.

11.6 VPCI consistency check

The VPCI consistency check is provided to verify the consistent and correct allocation of a logical VPCI to a VP on the VB5.1 reference point.

The check is performed to guarantee that a user plane information flow is possible between the AN and SN using the bilaterally agreed VPCI at the VB5.1 reference point. This is done using the loopback capability of ETS 300 404 [8]/ITU-T Recommendation I.610 [24] that operates at the VP level. The consistency of the VPCI is checked in the SN by monitoring the receipt of a user plane test flow in a VPC at a LSP that is indicated by the VPCI. After completion of the check the result of the monitoring function (receipt of loopback cells at the VPC level) is available in the SN. The procedure can be initiated automatically or by operator command. Also at the AN a monitor function is to be established after the activation of a loopback. This function will check if loopback cells are received. This result shall be made available to the SN.

The VPCI consistency check shall be initiated by the SN. The VPCI consistency check should be initiated for only one VPC per VB5.1 reference point at a time.

NOTE: In case when multiple VPCI consistency check procedures are running across different VB5.1 reference points simultaneously, the result of the check may be incorrect due to a possible interference of the corresponding loopback cells. However, the probability of such an interference is considered insignificant.

The VPCI consistency check shall be performed on those VPCs at the LSP which are terminated both at the LSP(AN) and the LSP(SN).

11.7 Activation/deactivation of B-ISDN accesses under control of the SN

Activation of remote B-ISDN terminals is for further study.

NOTE: Currently no specification defining the activation and deactivation of B-ISDN accesses connected directly to the SN is available. As soon as such a procedure is standardized, the present document would have to be enhanced to cover this function.

11.8 Procedural RTMC requirements

For the RTMC function the following procedural requirements apply:

a) the RTMC function shall facilitate the exchange information about the availability of the AN resources:

   - LSP (i.e. complete VB5.1 reference point);

   - VPC(s).

   This shall be applied to both VPCs cross connected in the AN and VPCs terminated in the AN.

   Changes of the availability of the resources PUP, LUP and PSP shall be co-ordinated through the exchange of information about the availability of the individual VPCs associated with the particular resource.

b) the RTMC protocol shall support messages which carry status information about a set of VPCs. Whenever possible, such messages shall be applied in order to avoid a flood of RTMC messages across the VB5.1 reference point in the case where a status change in the AN affects the availability of a number of VPCs simultaneously.

11.9 Summary of RTMC functions

A summary of the RTMC functions across the VB5.1 reference point with regard to specific resources in the AN and SN is provided in Table 13. In addition, Table 13 provides a mapping between the detailed RTMC requirements and the specification of the corresponding RTMC procedures by referring to the relevant subclauses of the present document.

Table 13: Overview of RTMC functions at VB5.1 reference point

Resource	RTMC function/ information flow	Resource identifier in RTMC information	Specification of RTMC requirements	Specification of RTMC procedures
PUP (AN)	Co-ordination of availability status/ AN ⇒ SN	set of LUP/VPCI combinations	see subclauses 11.2 and 11.3	see subclauses 13.3.2 and 13.3.3
	Activation/deactivation of B-ISDN accesses		For further study	For further study
PSP (AN)	Co-ordination of availability status/ AN ⇒ SN	set of LSP/VPCI and/or LUP/VPCI combinations (note 1)	see subclauses 11.2 and 11.3	see subclauses 13.3.2 and 13.3.3
LUP (AN) (note 2)				
LSP (AN)	Co-ordination of availability status/ AN ⇒ SN	LSP	see subclauses 11.2 and 11.3	see subclauses 13.3.2 and 13.3.3
	Verify LSP ID/ AN ⇒ SN or SN ⇒ AN	LSP	see subclause 11.4	see subclause 13.3.6
	Reset/ AN⇒ SN or SN ⇒ AN	LSP	see subclause 11.5	see subclause 13.3.7
VPC (AN)	Co-ordination of availability status/ AN ⇒ SN	LUP/VPCI or LSP/VPCI (note 1)	see subclauses 11.2 and 11.3	see subclauses 13.3.2 and 13.3.3
PSP (SN)	—			
LUP (SN)	—			
LSP (SN)	Verify LSP ID/ SN ⇒ AN or AN ⇒ SN	LSP	see subclause 11.4	see subclause 13.3.6
	Reset/ SN ⇒ AN or AN ⇒ SN	LSP	see subclause 11.5	see subclause 13.3.7
VPC (SN)	VPCI consistency check/ SN ⇒ AN	LSP/VPCI	see subclause 11.6	see subclause 13.3.4
NOTE 1: The application of connection element identifiers is described in subclause 7.3.2. NOTE 2: With regard to the RTMC the LUP (AN) is only a naming convention.				

12 Performance design objectives

Performance requirements as defined within the present document should be considered as design objectives for systems under the conditions stated in the present document. These conditions are defined by such parameters as traffic loads, average circuit occupancy, busy hour call attempts, etc.

Two distinct performance areas are identified:

a) Transfer functions - concerned with the transfer of user signalling and data via the interface;

b) RTMC functions - concerned with the real time management of the interface.

12.1 Performance design objectives for transfer functions

For further study (see clause J.1).

12.2 Performance design objectives for RTMC functions

For further study (see clause J.2).

13 VB5.1 system architecture, structure and procedures

13.1 Introduction

This clause describes the VB5.1 RTMC protocol in two ways. First the static protocol architecture (see subclause 13.2) is presented, then the dynamic behaviour is described (see subclause 13.3).

The static structure is described by SDL system diagrams (see subclauses 13.2.1.3 and 13.2.1.4) and block diagrams (see subclause 13.2.2).

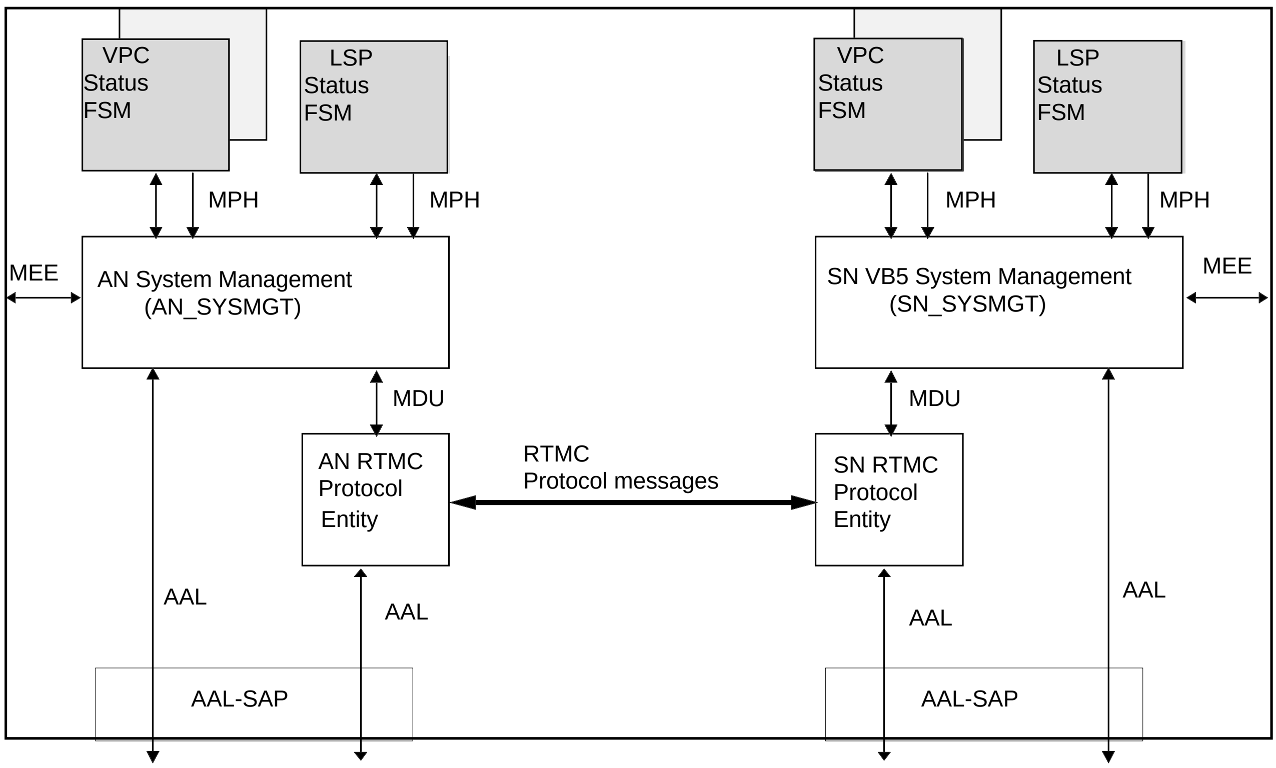
The dynamic behaviour is presented by text, describing the principles of the procedures and how the procedures are embedded in the environment and by MSC's which are used to show the basic procedures of the RTMC protocol. (see subclause 13.3) Finally the lowest level of the SDL hierarchy, the process diagrams describe the detailed procedures. They can be found in annex A. The behaviour represented by the SDLs plus the set of primitives which drive them is normative within the present document. However, no implementation is implied by the specification language employed within the normative part of the present document. It is the functionality represented within clauses 13 and 14 and annex A which defines the VB5.1 system. In the case of ambiguities between text and process diagrams, the diagrams take precedence.

13.2 VB5.1 system architecture

13.2.1 System diagrams

13.2.1.1 SN and AN overview

An overview showing the basic VB5.1 functional blocks in AN and SN and how the RTMC protocol is related to these entities is provided by Figure 35.



NOTE: The abbreviations shown at the arrows are classes of primitives used by VB5.1 (see Table 14).

Figure 35: VB5.1 system overview

13.2.1.2 Naming conventions

VB5 primitives exchanged within the AN and SN are indicated by a leading M. Primitives represent, in an abstract way, the exchange of information and control between entities internal to the AN and SN. They do not specify or constrain implementation. The following table classifies the introduced primitives.

Table 14: Classification of VB5.1 primitives

Primitives between VB5.1 system management and VPC/LSP status FSMs	MPH_XXX
Primitives between the VB5.1 system management and ATM adaptation layer service access point	AAL_XXX
Primitives between VB5 AN/SN system management and the environment within VB5.1 is running (the part of plane management which is external to VB5.1)	MEE_XXX
Primitives between VB5 system management and RTMC protocol	MDU_XXX
Primitives internal to a SDL block	MIE_XXX
NOTE: VB5 messages are passed to the AAL-SAP via AAL DATA primitives. For the specification of the RTMC protocol the messages are the relevant information. Therefore in the following SDL diagrams reference is made to the messages only.	

Symbols used to describe the SDL system and block diagrams as well as the message sequence charts are specified in ETS 300 414 [28].

13.2.1.3 AN VB5.1 system

This subclause presents as a SDL system diagram the decomposition of an AN into functional entities related to the VB5.1 interface.

Each functional entity defined in this subclause comprises a number of processes. These processes are defined with SDL block diagrams in subclause 13.2.2.

The functional entities composing an AN VB5.1 system are shown in Figure 36 and further defined in Table 15.

The connection of the AN VB5.1 system to any non-VB5 AN entities is realized by AN_ENV which summarizes the environment within AN VB5 system is running. The VB5 system communicates with this external environment via channels (CH_...). The terms in square brackets reference the signallists, which contain all signals which are transported on that channel (see Figure 38 up to Figure 42). The external entities are beyond the scope of VB5.1 and not specified in further detail. Only basic requirements which are essential for co-operation between AN and SN are given.

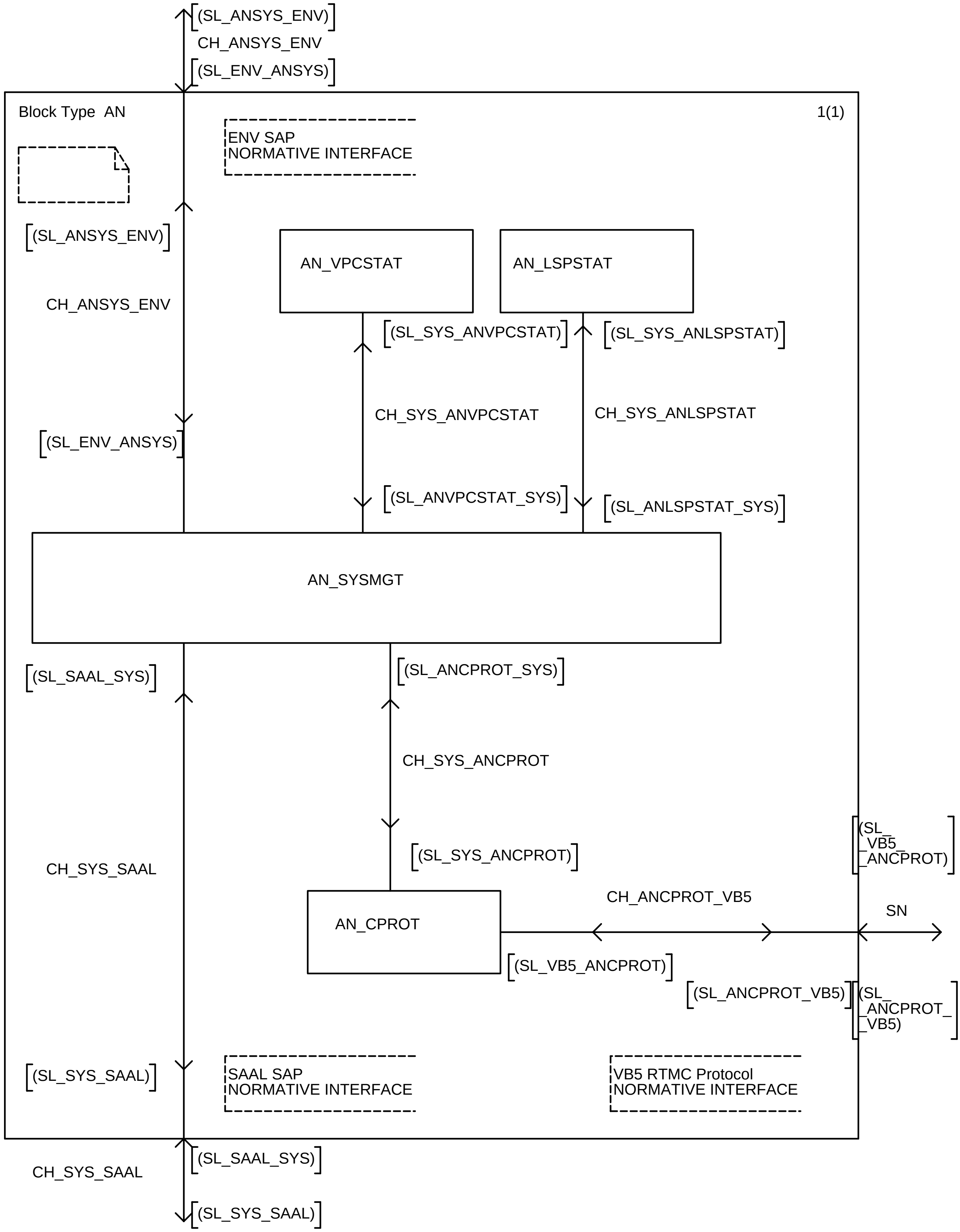


Figure 36: AN VB5.1 system

Table 15: AN functional entities

Functional entity	Abbreviation in Figure 36	Purpose
AN System Management	AN_SYSMGT	AN system management represents the co-ordination function of the AN VB5.1 system. In the case of an administrative state change of a resource affecting the availability of User VPCs, VB5 VPCs or the LSP itself the AN system management shall: – initiate, co-ordinate and supervise state transitions of VPC Status FSMs and/or LSP status FSM; – invoke the RTMC protocol entity in order to inform the SN about the unavailability of VPCs and/or LSP. In the case of a faulty resource affecting the availability of User VPCs, VB5 VPCs or the LSP itself the AN system management shall: – initiate, co-ordinate and supervise state transitions of VPC Status FSMs and/or LSP status FSM; – invoke the RTMC protocol entity in order to inform the SN about the unavailability of VPCs and/or LSP. During interface start-up the AN system management shall: – request the SAAL establishment for the RTMC protocol; – invoke the RTMC protocol entity in order to inform the SN about a reset of the VB5 interface; – co-ordinate the unblocking of VPC Status FSMs and the LSP status FSM; – invoke the RTMC protocol entity in order to request the VB5 IF ID from the SN and verify the ID. On request of AN_ENV the AN system management shall: – invoke the RTMC protocol entity in order to inform the SN about a reset of the VB5 interface; – invoke the RTMC protocol entity in order to request the LSP ID from the SN and verify the ID. The AN system management shall relay VPCI consistency information either to AN_ENV or AN_CPROT. AN system management supervises the RTMC protocol, i.e. reacts on errors and time-outs and passes them on to the AN_ENV entity.
RTMC protocol Entity	AN_CPROT	The RTMC protocol entity terminates the VB5.1 RTMC protocol and shall: – build up the RTMC protocol messages, – supervise message transmission by timers, – re-transmit messages on timer expiration.
VPC Status Finite State Machine	AN_VPCSTAT	The VPC status FSM represents the availability due to local administrative reasons or fault conditions of user VPCs as well as of VB5 VPCs.In the case of a state change the VPC Status FSM decides upon the message to be sent to the SN. One FSM is provided per VPC.
LSP Status Finite State Machine	AN_LSPSTAT	The LSP status finite state machine represents the availability due to local administrative reasons or fault conditions of the VB5 interface. In the case of a state change the LSP Status FSM decides upon the message to be sent to the SN.
NOTE: This does not necessarily imply that the administrative state of the VPCs has changed as well. The term User VPCs addresses VPCs crossing the UNI, or at the VUP the term VB5 VPCs addresses VPCs crossing the VB5 interface and terminating in the AN.		

The functional entities are connected via channels on which messages and primitives are conveyed. The channels are defined in Table 16.

Table 16: Channels in the AN

Channel	Abbreviation in Figure 36	Purpose/comments
AN System Management ⇔ AN environment	CH_ANSYS_ENV	Via CH_ANSYS_ENV the AN_ENV entity shall trigger the AN VB5.1 system management to invoke the VB5.1 procedures: – interface start-up, – block/unblock/shutdown resources, – check VB5 interface ID, – VPCI Consistency check
AN System Management ⇔ AN SAAL entity	CH_SYS_SAAL	Via CH_SYS_SAAL the AN system management shall supervise the establishment/release of the SAAL of the VB5.1 RTMC protocol.
AN System Management ⇔ AN VPC status FSM	CH_SYS_ANVPCSTAT	Via CH_SYS_ANVPCSTAT the AN system management shall update the AN VPC status FSM in the case of state changes due to administrative or operational reasons.
AN System Management ⇔ AN LSP status FSM	CH_SYS_ANLSPSTAT	Via CH_SYS_ANLSPSTAT the AN system management shall update the AN LSP status FSM in the case of state changes due to administrative or operational reasons.
AN System Management ⇔ AN RTMC protocol entity	CH_SYS_ANCPROT	Via CH_SYS_ANCPROT the AN system management shall trigger the AN RTMC protocol entity to send messages to the SN. The RTMC protocol entity shall inform AN system management about receipt of messages from the SN. (note 1)
AN RTMC protocol entity ⇔ VB5 interface	CH_ANCPROT_VB5	Via CH_CPROT_VB5 the RTMC protocol entity sends/receives VB5 RTMC messages to/from the SN. (note 2)
NOTE 1: For state changes of VPC/LSP the RTMC protocol entity is not invoked directly by the VPC/LSP FSMs because of the possibility of having "multi VPC" messages. NOTE 2: The underlying SAAL is not taken into account because it is beyond the scope of the VB5.1 protocol procedures.		

13.2.1.4 SN VB5.1 system

This subclause presents as a SDL system diagram the decomposition of a SN into functional entities related to the VB5.1 interface.

Each functional entity defined in this subclause comprises a number of processes. These processes are defined with SDL block diagrams in subclause 13.2.2.

The functional entities composing a SN VB5.1 system are shown in Figure 37 and further defined in Table 17.

The connection of the SN VB5.1 system to any non-VB5 SN entities is realized by SN_ENV. SN_ENV itself is beyond the scope of VB5.1 and not specified in further detail. Only basic requirements which are essential for co-operation between AN and SN are given.

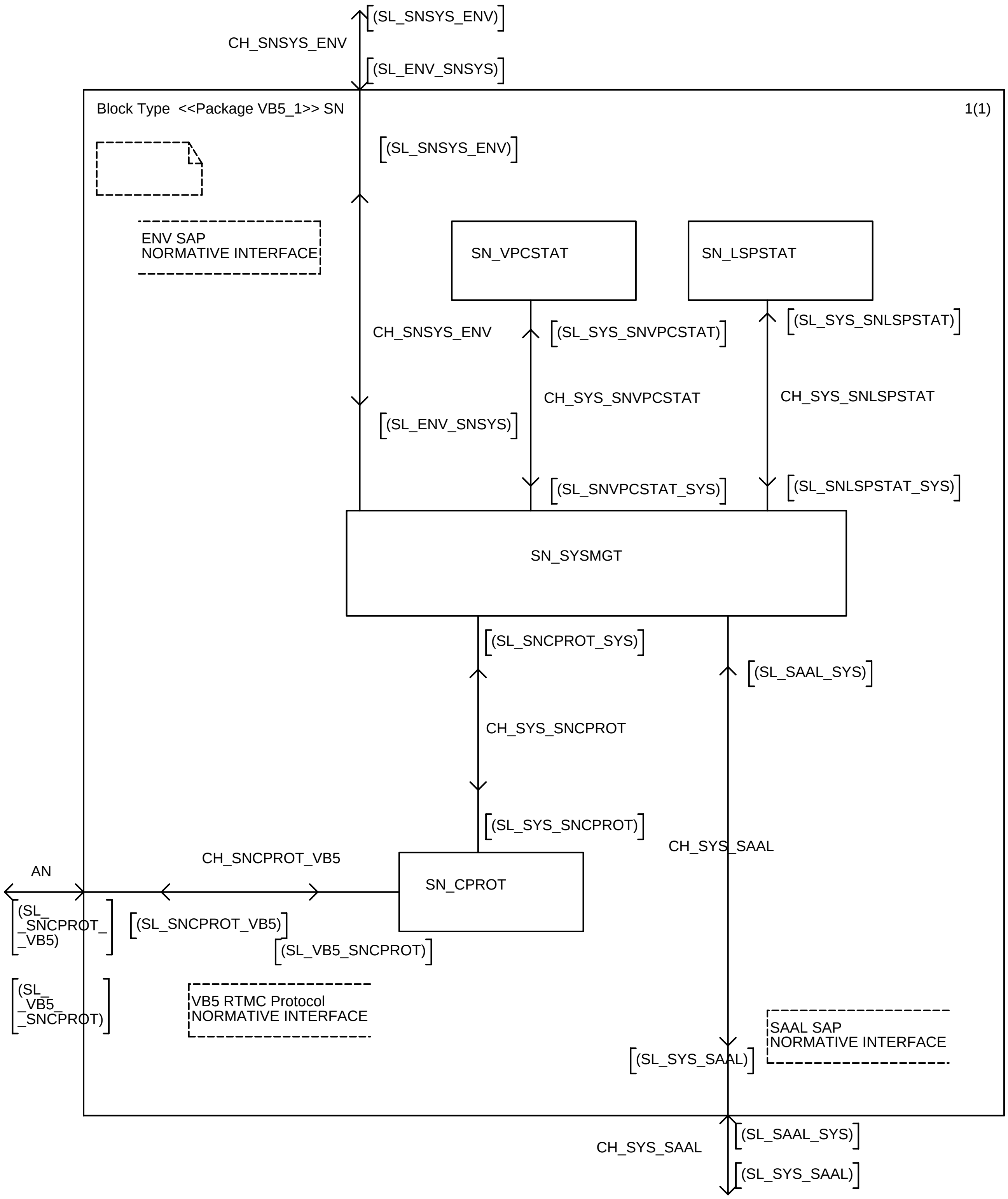


Figure 37: SN VB5.1 system

Table 17: SN functional entities

Functional entity	Abbreviation in Figure 37	Purpose
SN System Management	SN_SYSMGT	SN system management represents the co-ordination function of the SN VB5.1 system. During interface start-up the SN system management shall: – request the SAAL establishment for the RTMC protocol; – invoke the RTMC protocol entity in order to inform the AN about a reset of the VB5 interface; – co-ordinate the VPC Status FSMs and the LSP status FSM; – invoke the RTMC protocol entity in order to request the LSP ID from the SN and verify the ID. On request of SN_ENV the SN system management shall: – invoke the RTMC protocol entity in order to inform the AN about a reset of the VB5 interface; – invoke the RTMC protocol entity in order to request the LSP ID from the AN and verify the ID; – transport VPCI consistency messages. On receipt of messages from the AN, indicating the availability status of VPCs/LSP the SN VPC/LSP status FSM is informed. SN system management supervises the RTMC protocol, i.e. reacts on errors and time-outs and passes them on to the SN_ENV entity.
RTMC protocol Entity	SN_CPROT	The RTMC protocol entity terminates the VB5.1 RTMC protocol and shall: – build up the RTMC protocol messages; – supervise message transmission by timers; – re-transmit messages on timer expiration.
VPC Status Finite State Machine	SN_VPCSTAT	The VPC status FSM represents the availability due to remote administrative reasons or fault conditions of user VPCs as well as of VB5 VPCs. One FSM is provided per VPC.
LSP Status Finite State Machine	SN_LSPSTAT	The LSP status finite state machine represents the availability due to remote administrative reasons or fault conditions of the VB5 interface.

The functional entities are connected via channels on which messages and primitives are conveyed. The channels are defined in Table 18.

Table 18: Channels in the SN

Channel	Abbreviation in Figure 37	Purpose/comments
SN System Management ⇔ SN environment	CH_SNSYS_ENV	Via CH_SNSYS_ENV the SN_ENV entity shall trigger the SN VB5.1 system management to invoke the VB5.1 procedures: - interface start-up; - check VB5 interface ID; - VPCI Consistency check. SN VB5.1 system management informs SN_ENV about state changes of the LSP and or VPC status FSMs
SN System Management ⇔ SN SAAL entity	CH_SYS_SAAL	Via CH_SYS_SAAL the SN system management shall supervise the establishment/release of the SAAL of the VB5.1 RTMC protocol.
SN System Management ⇔ SN VPC status FSM	CH_SYS_SNVPCSTAT	Via CH_SYS_SNVPCSTAT the SN system management shall update the SN VPC status FSM in the case of state changes due to administrative or operational reasons.
SN System Management ⇔ SN LSP status FSM	CH_SYS_SNLSPSTAT	Via CH_SYS_SNLSPSTAT the SN system management shall update the SN LSP status FSM in the case of state changes due to administrative or operational reasons.
SN System Management ⇔ SN RTMC protocol entity	CH_SYS_SNCPROT	Via CH_SYS_CPROT the SN system management shall trigger the SN RTMC protocol entity to send messages to the AN. The RTMC protocol entity shall inform SN system management about receipt of messages from the AN.
SN RTMC protocol entity ⇔ VB5 interface	CH_SNCPROT_VB5	Via CH_SNCPROT_VB5 the RTMC protocol entity sends/receives VB5 control messages to/from the AN. (note 1)
NOTE 1: The underlying SAAL is not taken into account because it is beyond the scope of the VB5.1 protocol procedures.		

13.2.1.5 Signallists

This subclause defines the signallists which group the various signals appearing on the channels. Refer to annex A.1 for detailed signal declarations.

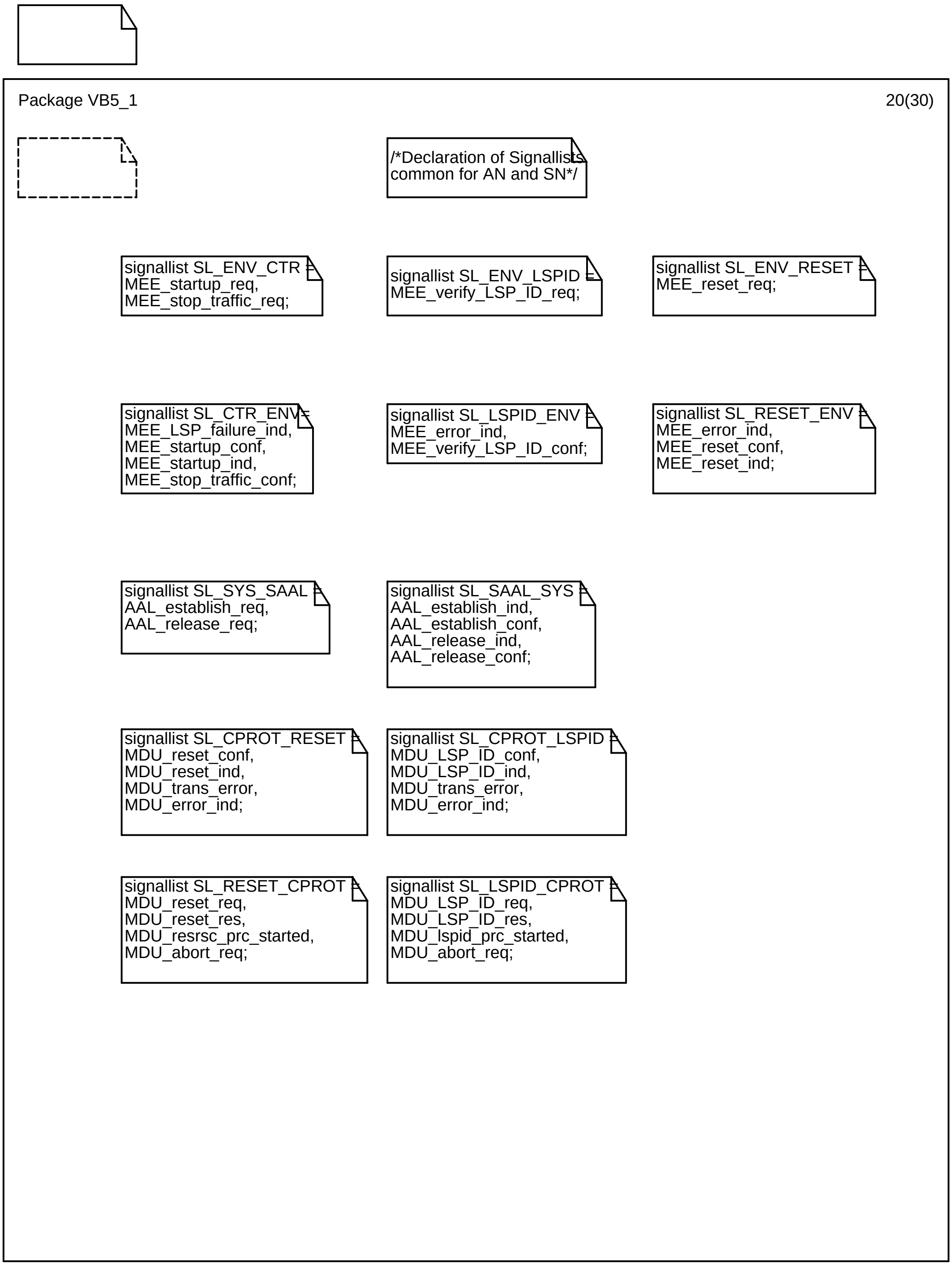


Figure 38: Signallists common for AN and SN

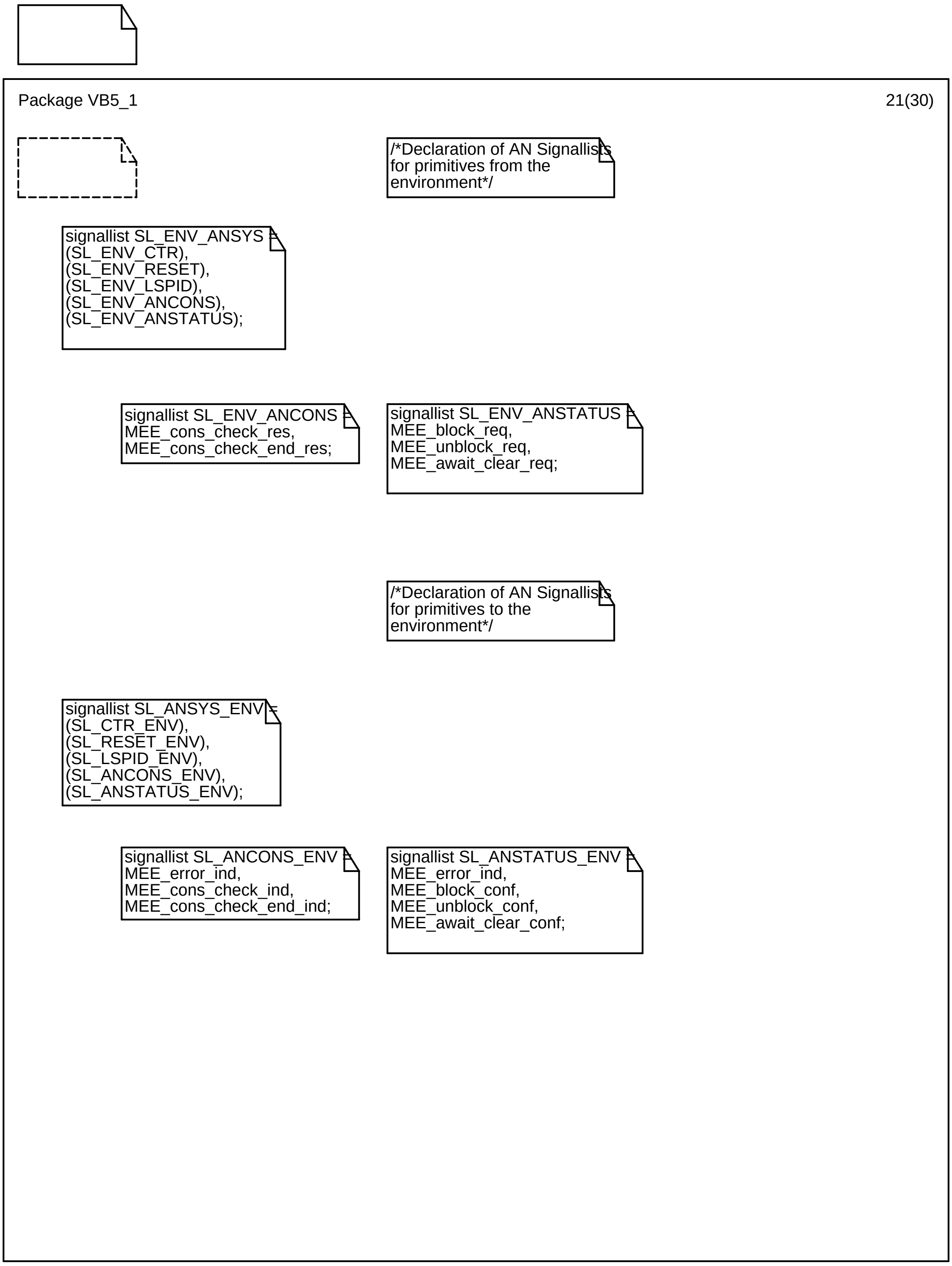


Figure 39: Signallists in the AN (1)

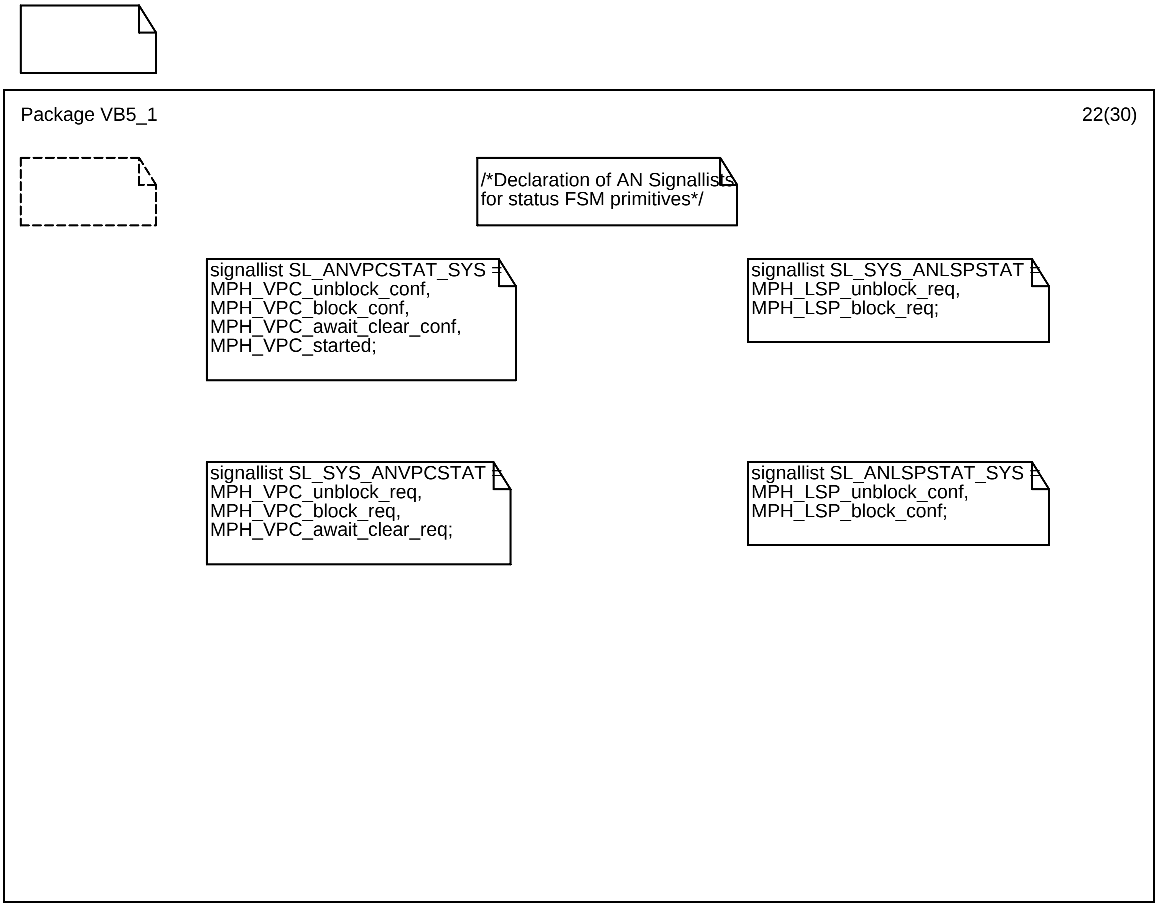


Figure 40: Signallists in the AN (2)

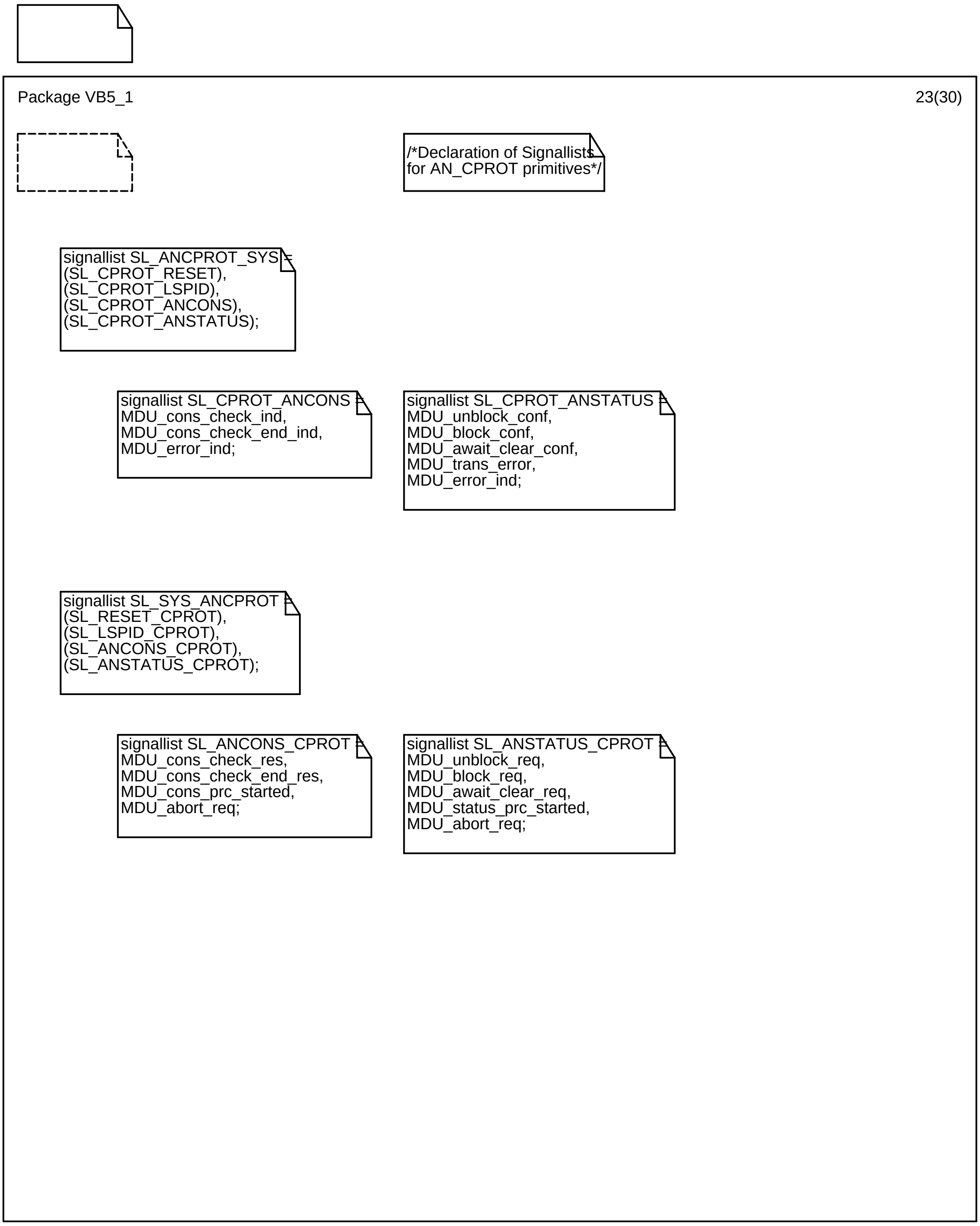


Figure 41: Signallists in the AN (3)

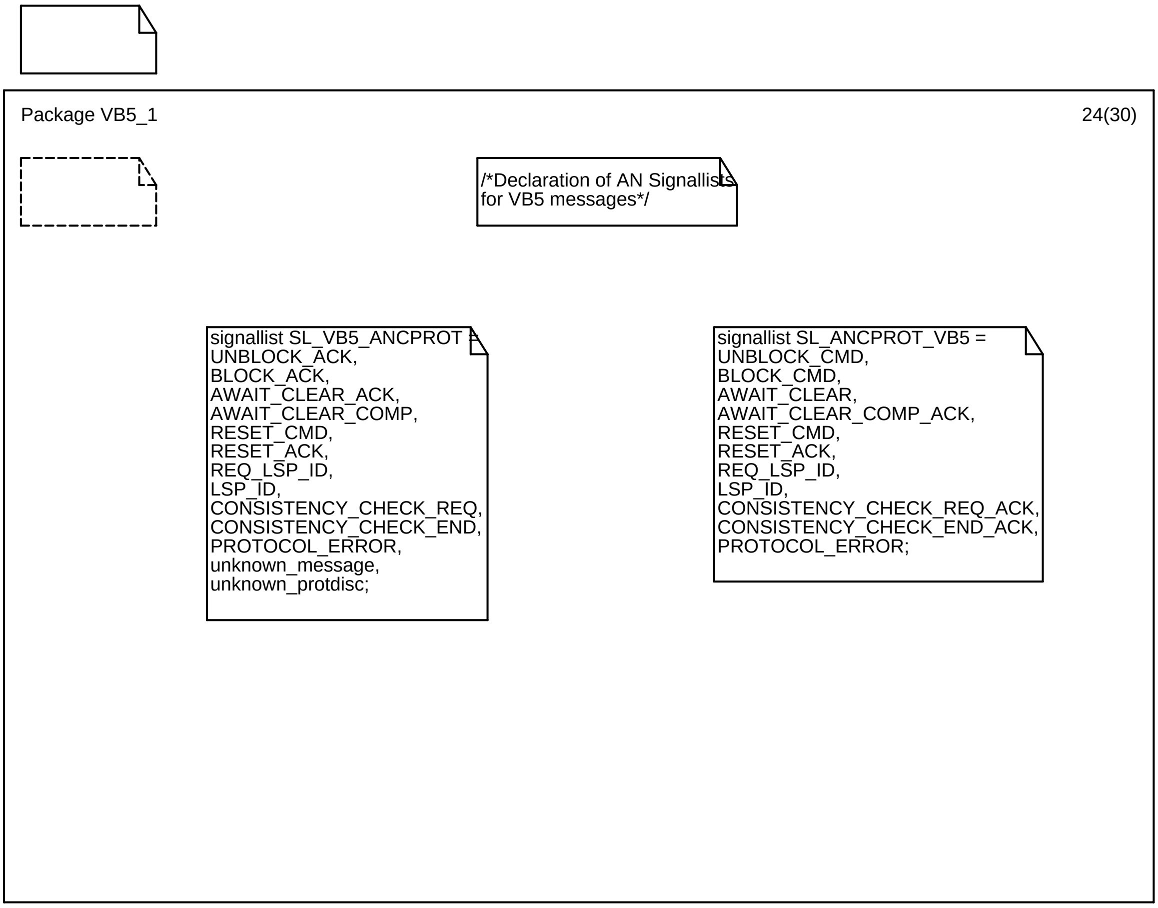


Figure 42: Signallists in the AN (4)

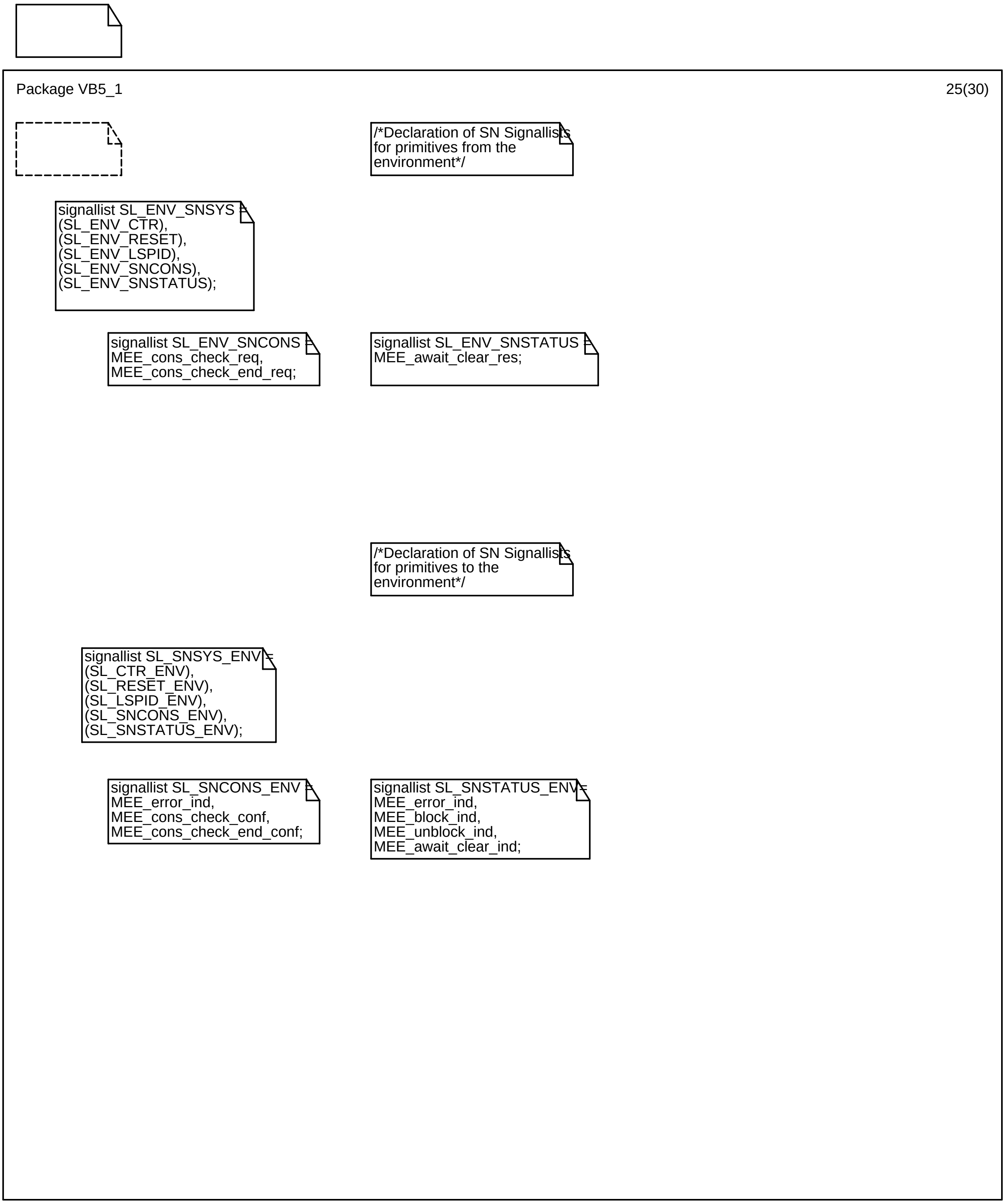


Figure 43: Signallists in the SN (1)

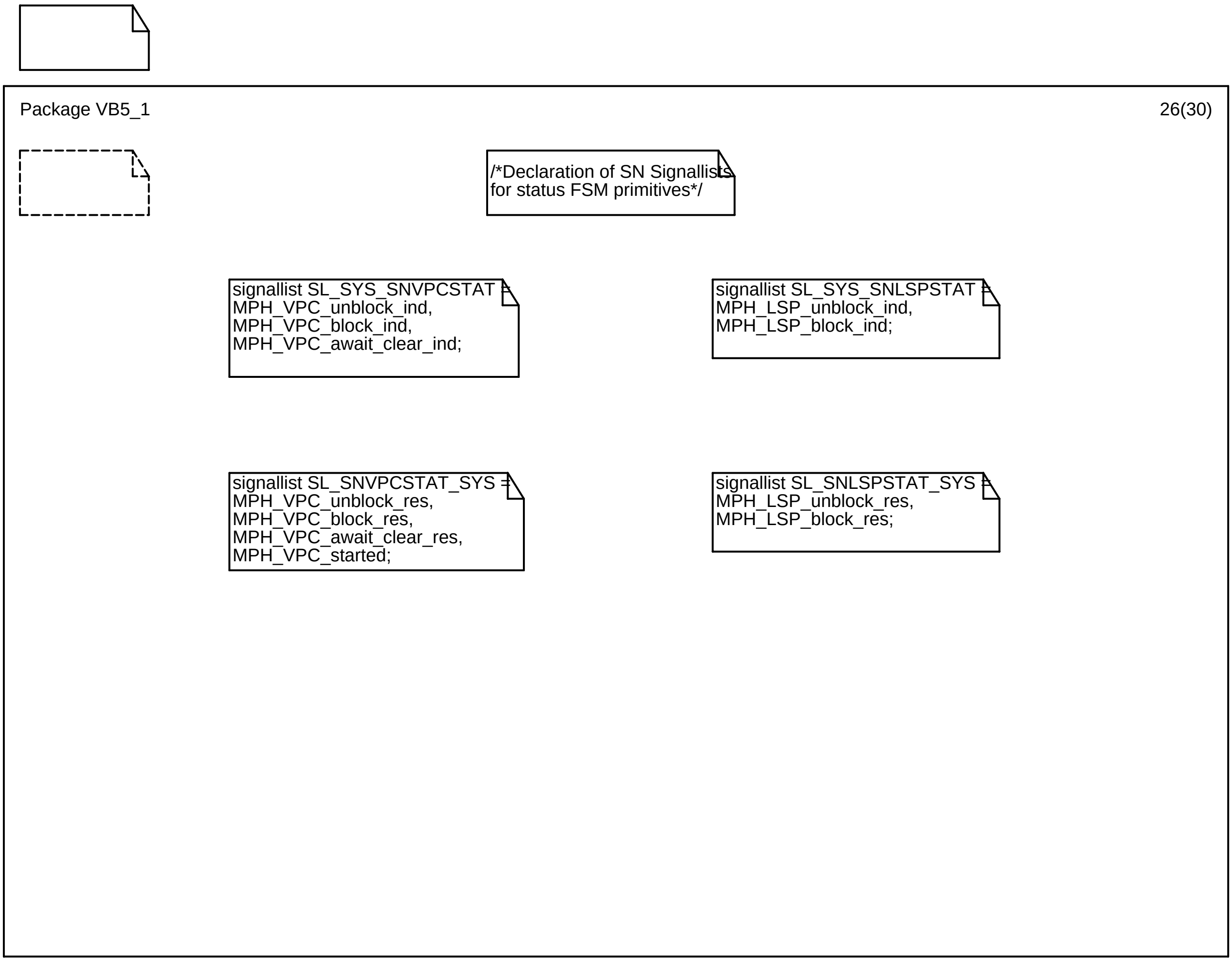


Figure 44: Signallists in the SN (2)

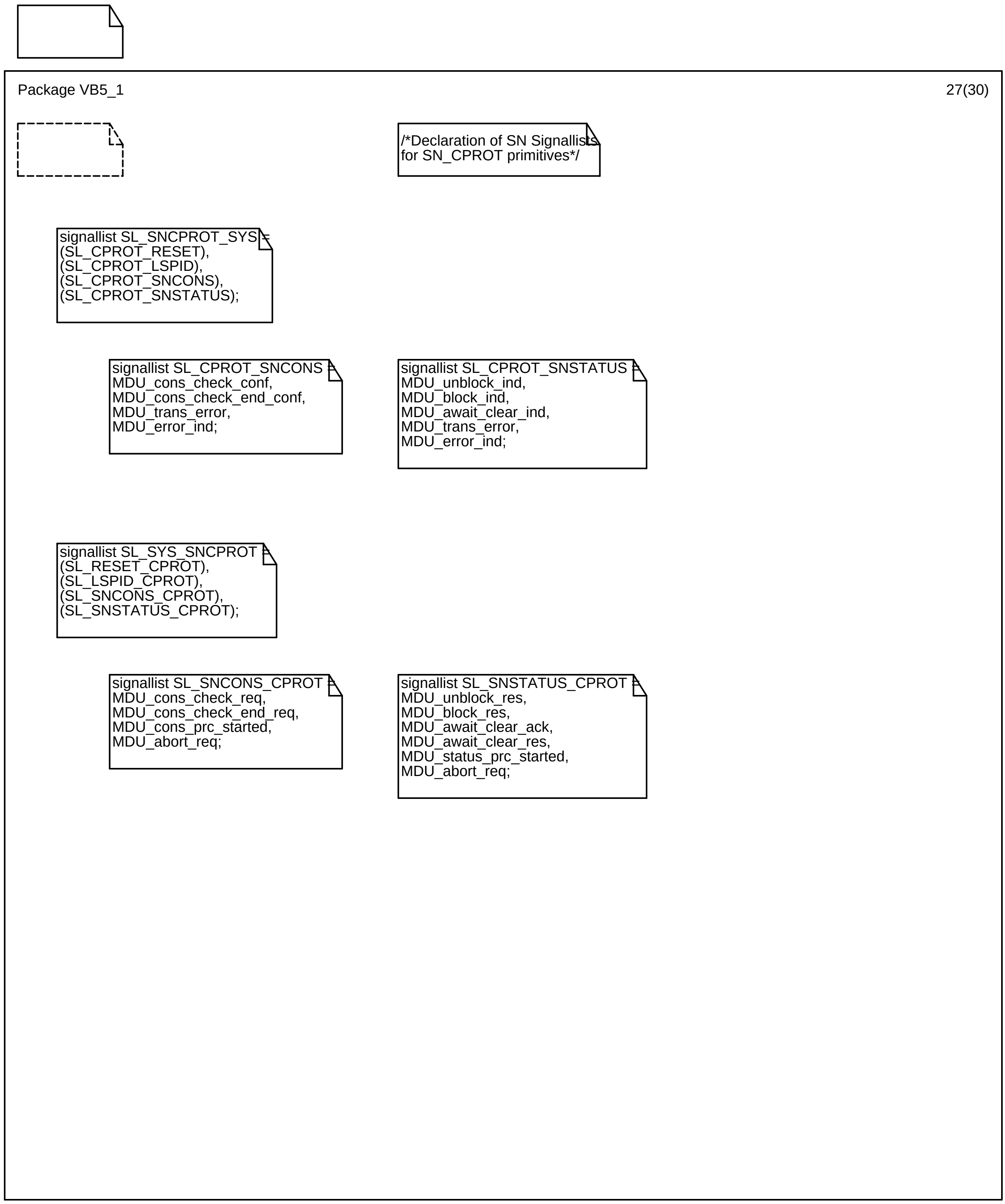


Figure 45: Signallists in the SN (3)

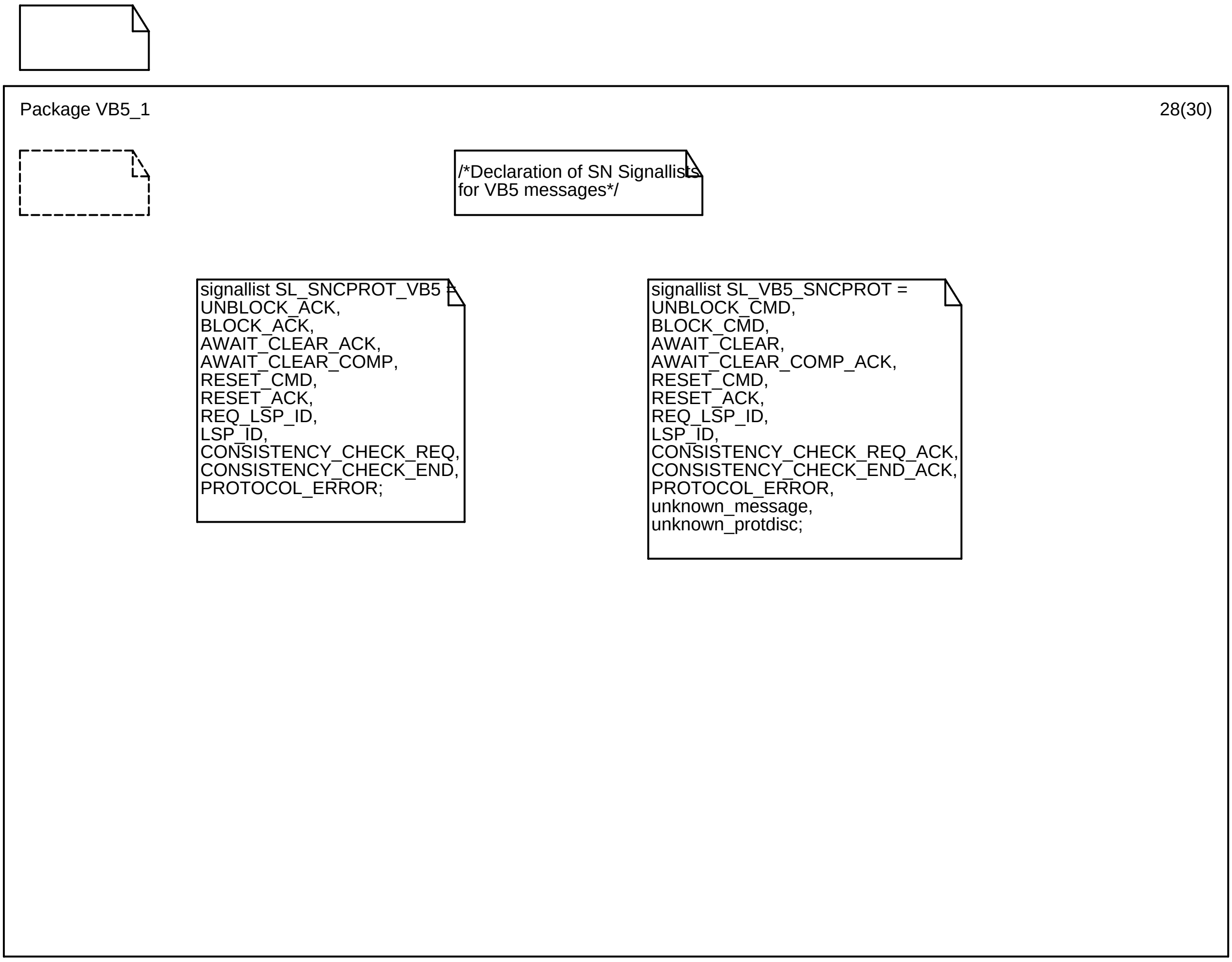


Figure 46: Signallists in the SN (4)

13.2.2 Block diagrams

13.2.2.1 System management

13.2.2.1.1 AN system management

The AN system management blocks are shown in Figure 47 and further defined in Table 19.

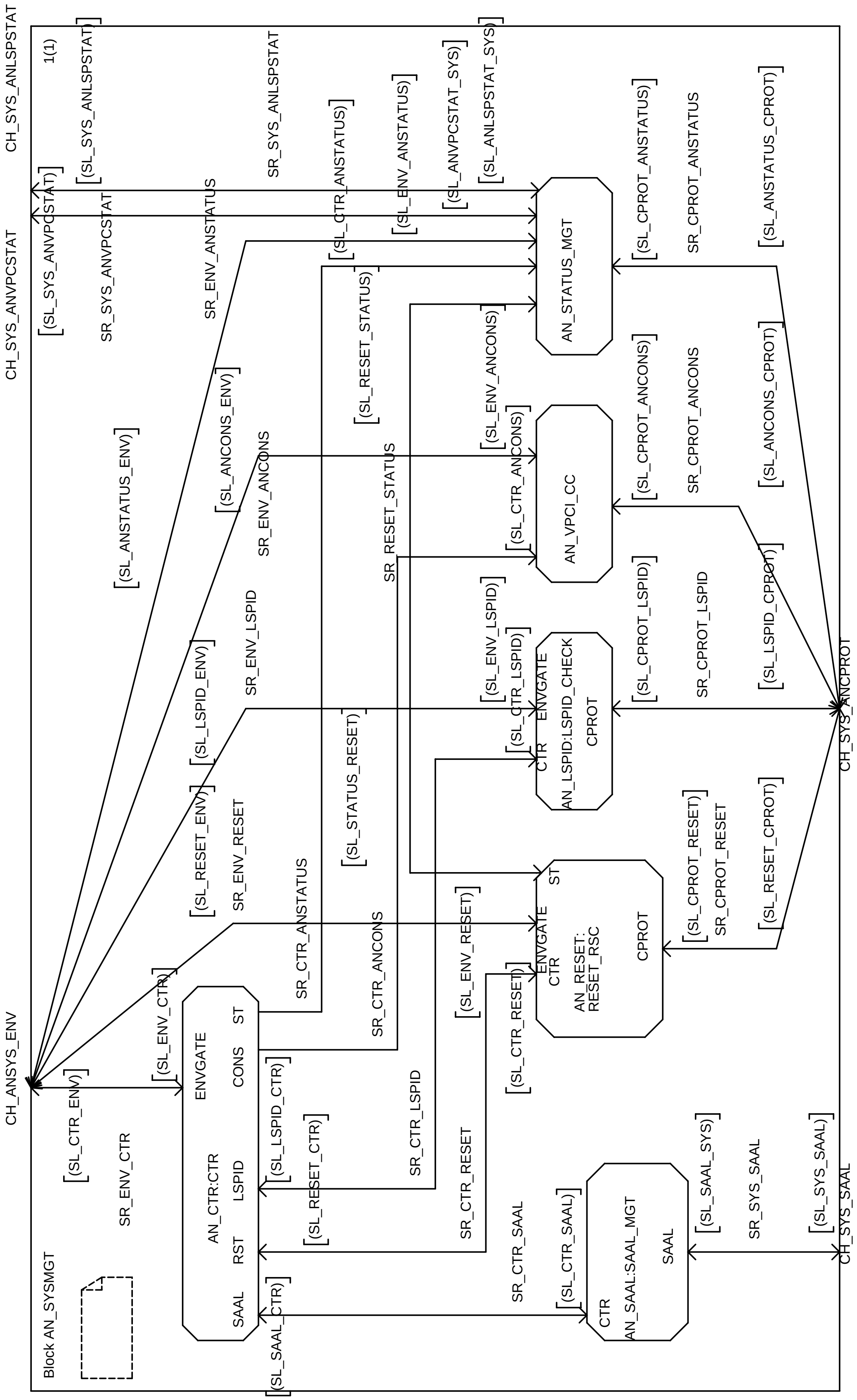


Figure 47: AN system management blocks

Table 19: AN system management processes

System Management Processes	Abbreviation in Figure 47	Purpose
Interface control	AN_CTR:CTR	Co-ordination of VB5 interface start-up
SAAL control	AN_SAAL:SAAL_MGT	Supervision of SAAL establishment and release
Reset resources	AN_RESET:RESET_RSC	Supervision of the reset of the VB5 interface
Check LSP ID	AN_LSPID:LSPID_CHECK	Supervision of requesting the SN LSP ID and checking for consistency
Status Control	AN_STATUS_MGT	Supervision of status changes of VPCs and LSPs
VPCI consistency check	AN_VPCI_CC	Co-ordination between Environment and AN_CPROT for the VPCI consistency check

The AN system management processes are connected via signal routes to each other which are defined in Table 20.

Table 20: Internal signal routes in AN system management

Signal Route	Abbreviation in Figure 47	Purpose/comments
Interface Control ⇔ SAAL control	SR_CTR_SAAL	Via SR_CTR_SAAL the interface control process shall request a SAAL establishment.
Interface Control ⇔ Reset resources	SR_CTR_RESET	Via SR_ CTR_RESET the interface control process shall request a reset of the VB5 interface.
Interface Control ⇔ Check LSP ID	SR_CTR_LSPID	Via SR_CTR_LSPID the interface control process shall request the SN LSP ID.
Interface Control ⇔ Status Control	SR_CTR_ANSTATUS	Via SR_CTR_ANSTATUS the interface control process shall request a blocking/unblocking of all VPCs and of the LSP.
Interface Control ⇒VPCI CC Control	SR_CTR_ANCONS	Via SR_CTR_ANCONS the interface control process shall start/stop the AN_VPCI_CC process
Reset process ⇒Status Control	SR_RESET_STATUS	Via SR_RESET_STATUS the interface control process shall request a blocking/unblocking of all VPCs and of the LSP.

13.2.2.1.2 SN system management

The blocks of the SN system management are shown in Figure 48 and further defined in Table 21.

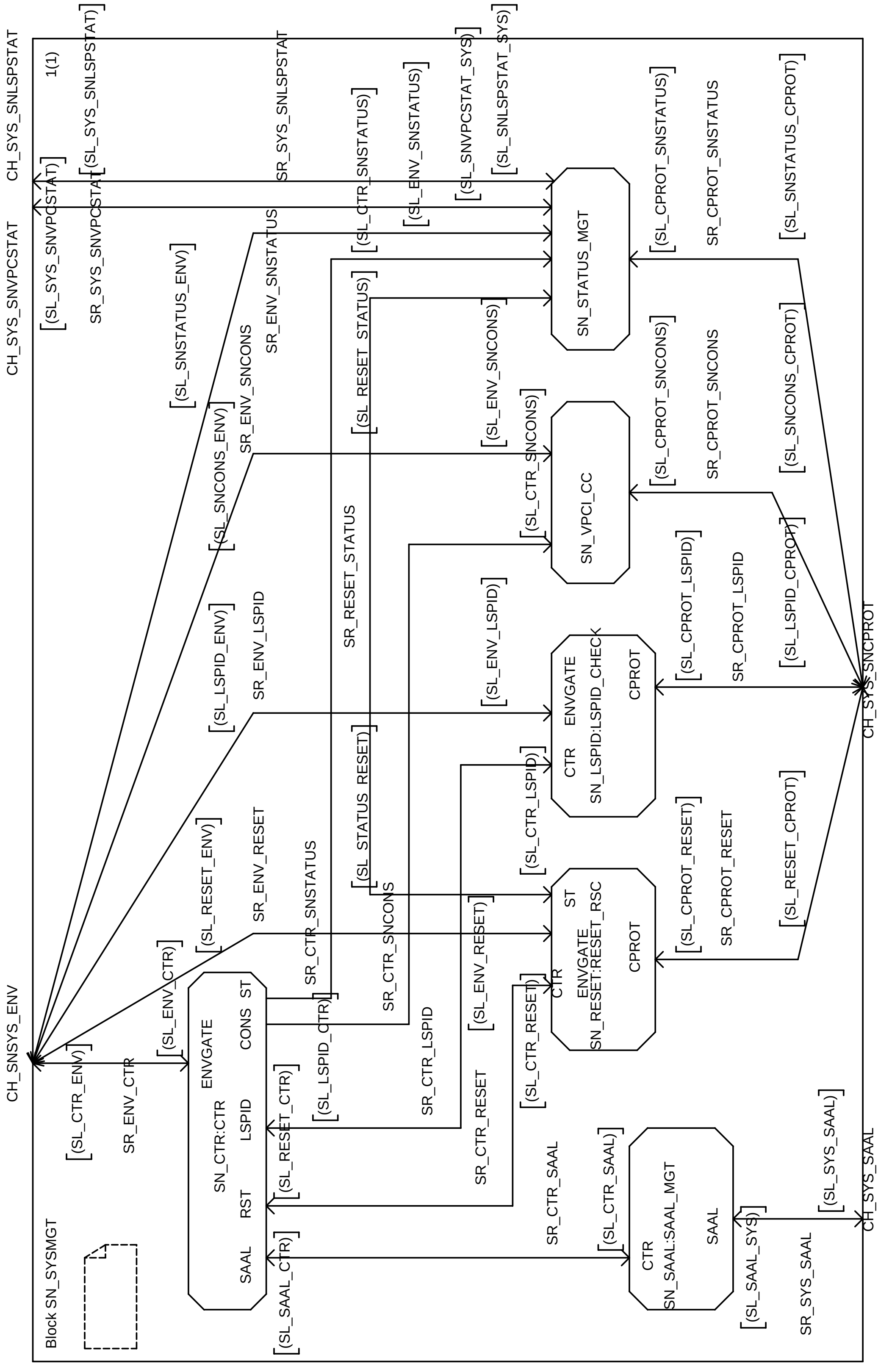


Figure 48: SN system management block

Table 21: SN system management processes

System Management Processes	Abbreviation in Figure 48	Purpose
Interface control	SN_CTR:CTR	Co-ordination of VB5 interface start-up
SAAL control	SN_SAAL:SAAL_MGT	Supervision of SAAL establishment and release
Reset resources	SN_RESET:RESET_RSC	Supervision of the reset of the VB5 interface
Check LSP ID	SN_LSPID:LSPID_CHECK	Supervision of requesting the SN LSP ID and checking for consistency
Status Control	SN_STATUS_MGT	Supervision of status changes of VPCs and LSPs
VPCI Consistency Check	SN_VPCI_CC	Co-ordination between Environment and SN_CPROT for the VPCI consistency check

The SN system management processes are connected via signal routes to each other which are defined in Table 22.

Table 22: Internal signal routes in system management

Signal Route	Abbreviation in Figure 48	Purpose/comments
Interface Control ⇔ SAAL control	SR_CTR_SAAL	Via SR_CTR_SAAL the interface control process shall request a SAAL establishment.
Interface Control ⇔ Reset resources	SR_CTR_RESET	Via SR_ CRT_RESET the interface control process shall request a reset of the VB5 interface.
Interface Control ⇔ Check LSP ID	SR_CTR_LSPID	Via SR_CTR_LSPID the interface control process shall request the SN LSP ID.
Interface Control ⇔ Status Control	SR_CTR_SNSTATUS	Via SR_CTR_SNSTATUS the interface control process shall request a blocking/unblocking of all VPCs and of the LSP.
Interface Control ⇔VPCI CC Control	SR_CTR_SNCONS	Via SR_CTR_SNCONS the interface control process shall start/stop the SN_VPCI_CC process
Reset process ⇒Status control	SR_RESET_STATUS	Via SR_RESET_STATUS the interface control process shall request a blocking/unblocking of all VPCs and of the LSP.

13.2.2.1.3 System management internal signallists

The system management processes communicate with each other via internal signalling lists which are declared in Figure 49. Refer to clause A.1 for the signal declarations.

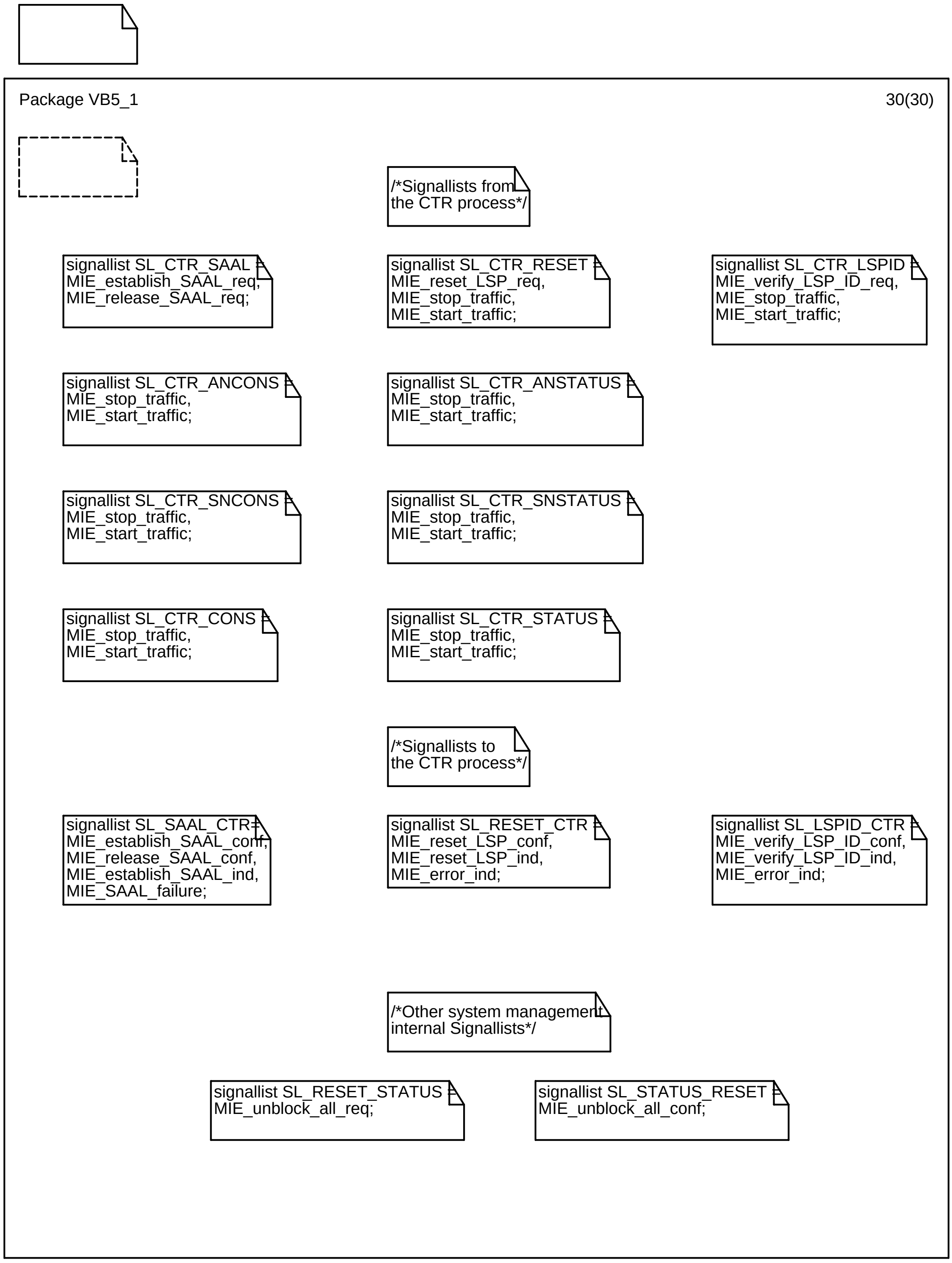


Figure 49: System management internal signallists

The system management processes are connected to other functional entities via signal routes which are connected to channel endpoints. Signallists conveyed on those signal routes are declared in Figure 38 up to Figure 46.

13.2.2.2 LSP status FSM

13.2.2.2.1 AN LSP status FSM

The AN LSP status FSM entity consists of one process (AN_LSPSTAT) which represents the local availability status of the LSP. The LSP status process is shown in Figure 50.

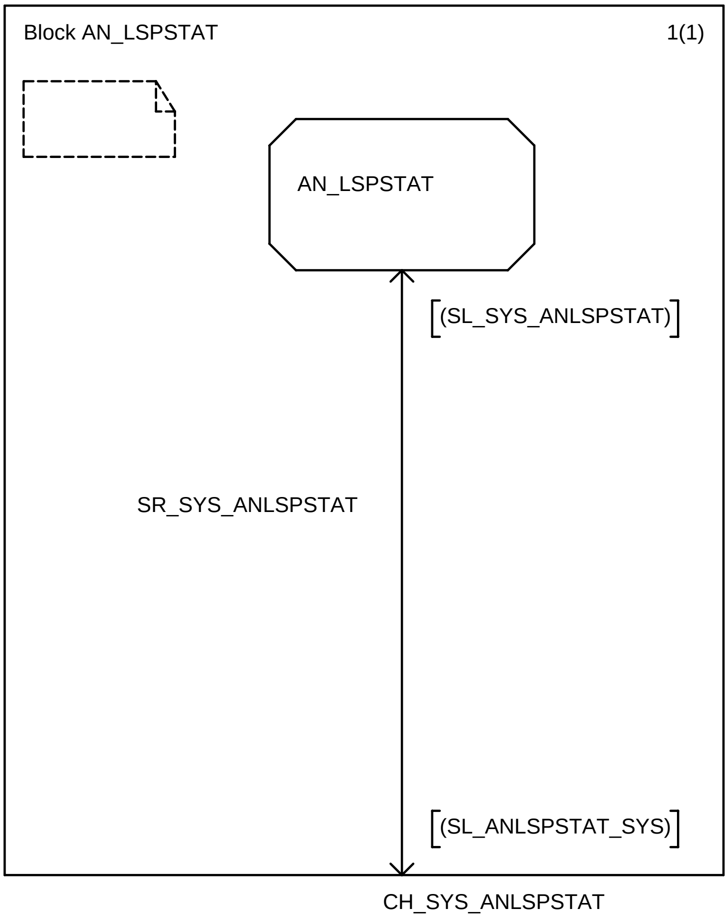


Figure 50: AN LSP status FSM block

13.2.2.2.2 SN LSP status FSM

The SN LSP status FSM entity consists of one process (SN_LSPSTAT) which represents the remote availability status of the LSP. The LSP status process is shown in Figure 51.

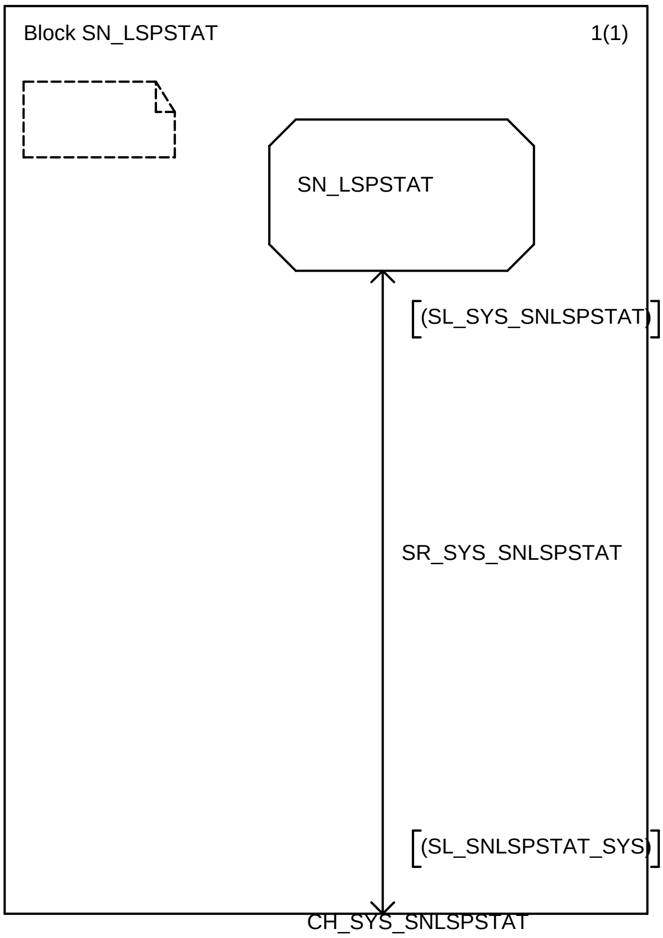


Figure 51: SN LSP status FSM block

13.2.2.2.3 LSP status FSM primitives

The LSP status FSM process is connected to other functional entities via signal routes which are connected to channel endpoints. Signallists conveyed on those signal routes are declared in Figure 40 and Figure 44.

13.2.2.3 VPC status FSM

13.2.2.3.1 AN VPC status FSM

The AN VPC status FSM entity consists of one process (AN_FVPCSTAT) which represents the local availability status of the VPC. For each VPC there exists one process instance. The VPC status process is shown in Figure 52.

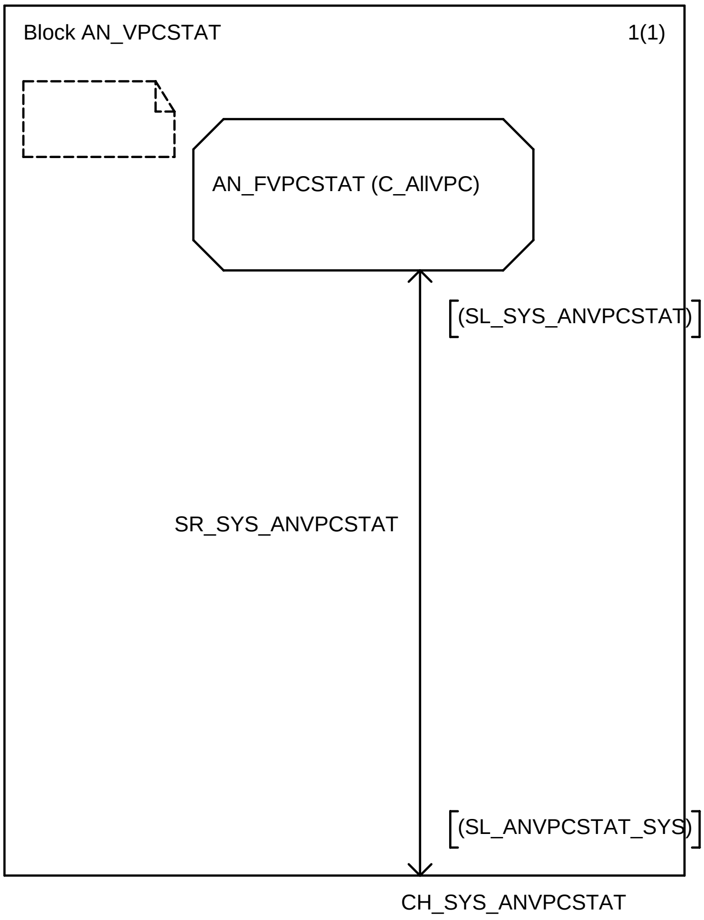


Figure 52: AN VPC status FSM block

13.2.2.3.2 SN VPC status FSM

The SN VPC status FSM entity consists of one process (SN_FVPCSTAT) which represents the remote availability status of the VPC. For each VPC there exists one process instance. The VPC status process is shown in Figure 53.

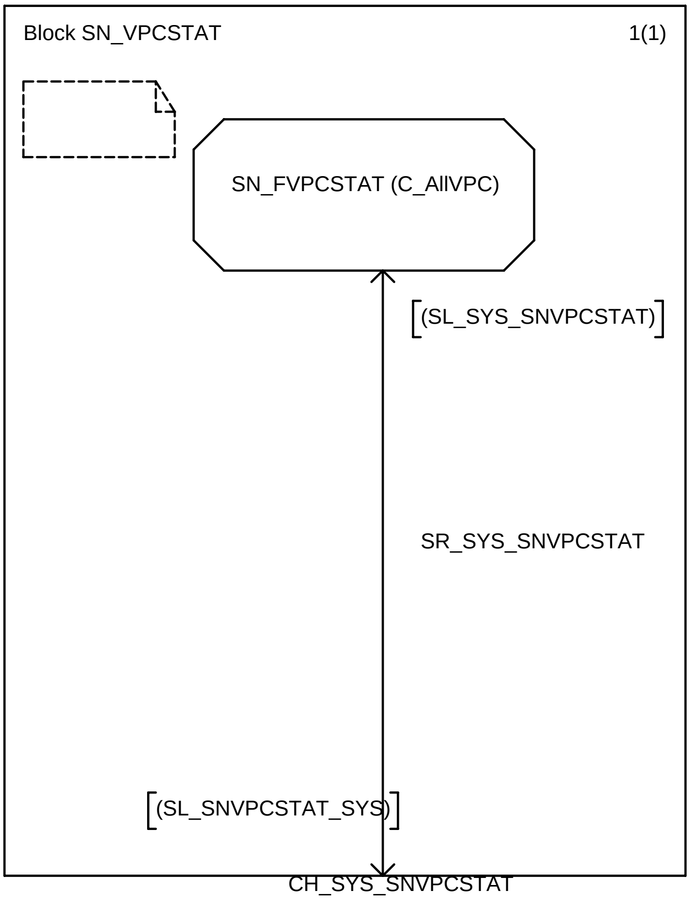


Figure 53: SN VPC status FSM block

13.2.2.3.3 VPC status FSM primitives

The VPC status FSM process is connected to other functional entities via signal routes which are connected to channel endpoints. Signallists conveyed on those signal routes are declared in Figure 40 and Figure 44.

13.2.2.4 RTMC protocol entity

13.2.2.4.1 AN RTMC protocol entity

The VB5.1 AN RTMC protocol entity consists of two processes.

Table 23: AN CPROT blocks

Block	Abbreviation in Figure 54	Purpose
AN RTMC protocol manager	AN_MGR_CPROT	Creates dynamically AN_CPROT processes for handling RTMC transactions. Allocates RTMC signalling identifiers.
AN RTMC protocol handler	AN_CPROT	Handles a single RTMC transaction

The RTMC protocol process is shown in Figure 54.

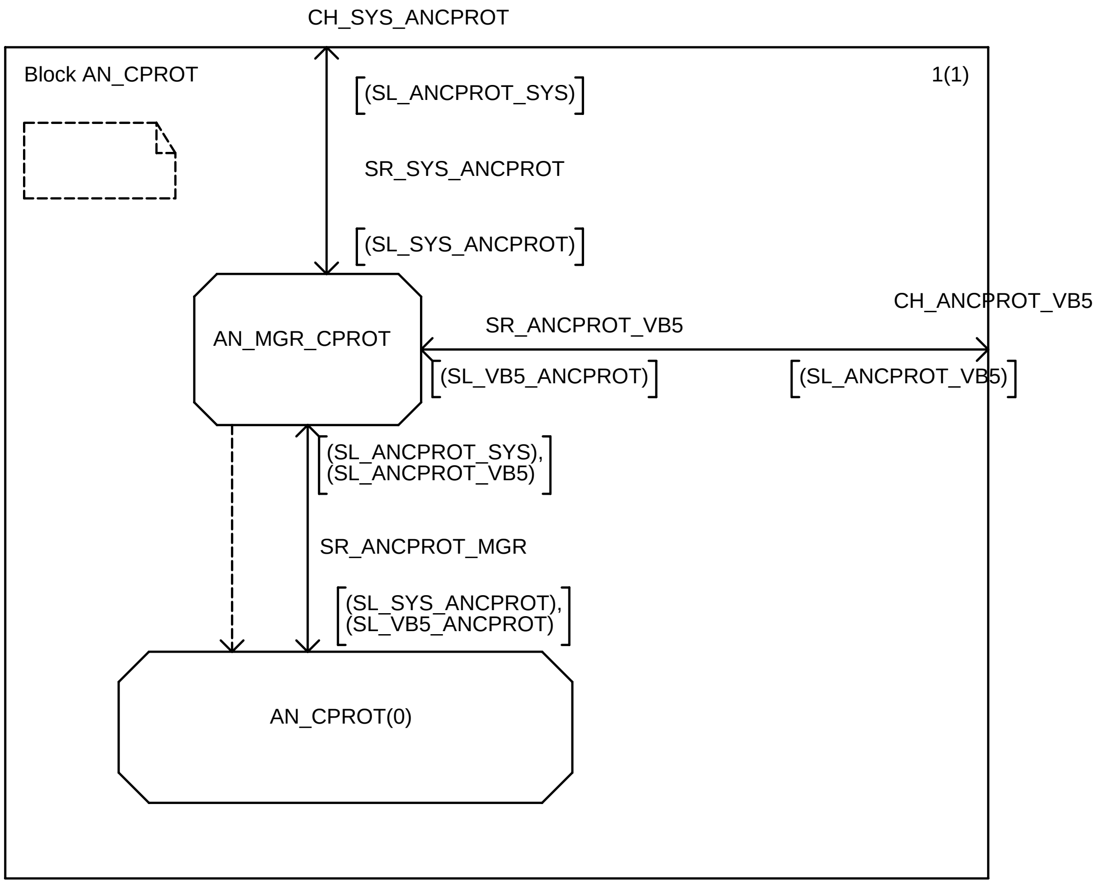


Figure 54: AN VB5.1 RTMC protocol block

13.2.2.4.2 SN RTMC protocol entity

The VB5.1 SN RTMC protocol entity consists of two processes.

Table 24: SN CPROT blocks

Block	Abbreviation in Figure 55	Purpose
SN RTMC protocol manager	SN_MGR_CPROT	Creates dynamically SN_CPROT processes for handling RTMC transactions. Allocates RTMC signalling identifiers.
SN RTMC protocol handler	SN_CPROT	Handles a single RTMC transaction

The RTMC protocol process is shown in Figure 55.

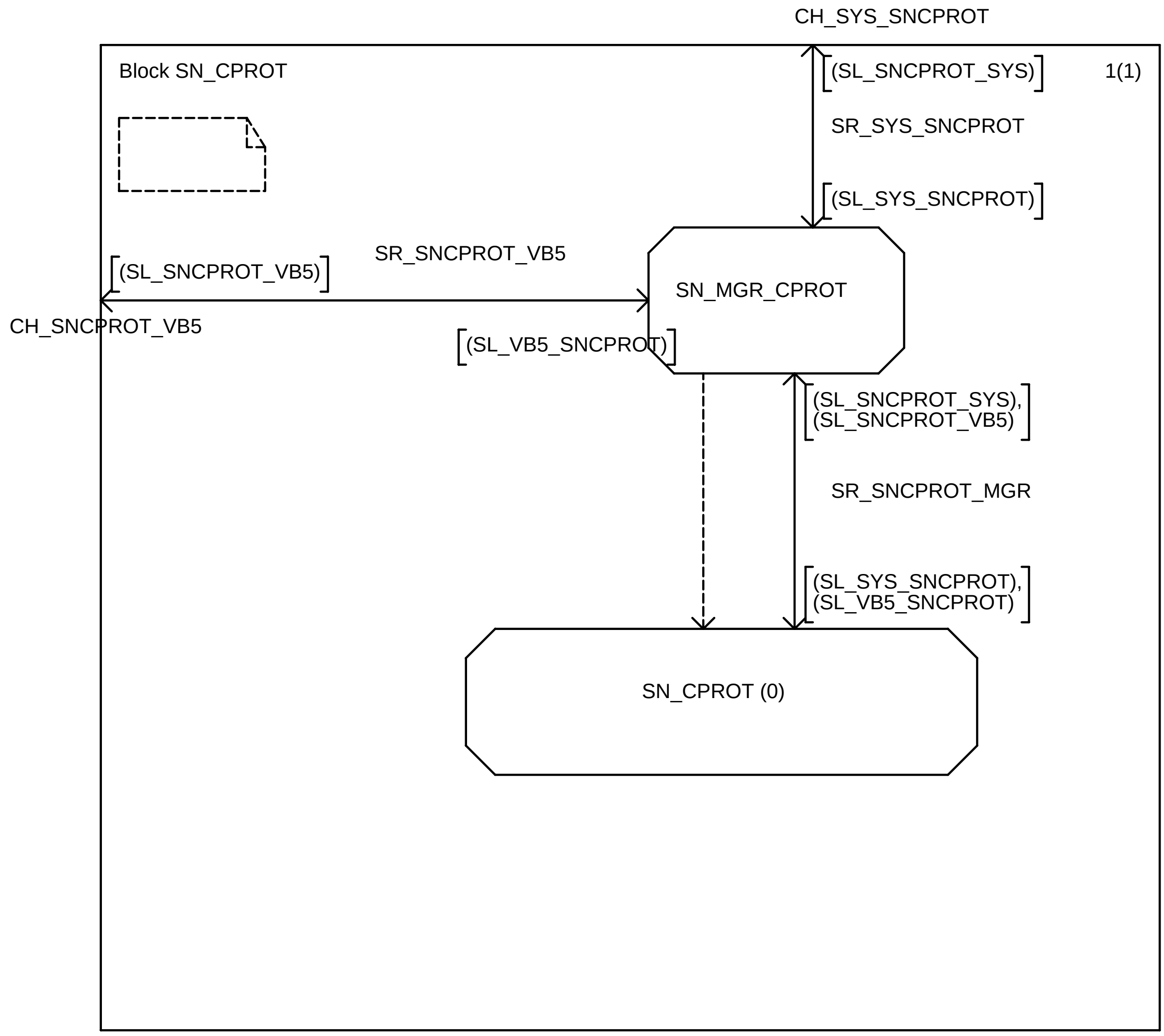


Figure 55: SN VB5.1 RTMC protocol block

13.2.2.4.3 RTMC protocol entity primitives

The VB5.1 SN RTMC protocol process is connected to other functional entities via signal routes which are connected to channel endpoints. Signallists conveyed on those signal routes are declared in Figure 38, Figure 41 and Figure 45.

13.3 RTMC procedures

13.3.1 General principles

This clause describes principles and mechanisms independent of the specific procedures defined for the VB5.1 interface.

13.3.1.1 External events to VB5

As stated in clause 11, information related to changes of administrative states of managed entities and fault conditions shall be communicated from the AN to the SN. However the actions triggered within the environment are filtered and mapped by the environment to the external events as seen by the VB5 system (see Figure 39).The only AN resources seen by the VB5.1 system are those known to the SN, namely VPCs and LSP. The receiver of the information, the SN, is only interested in the service relevance of the actions taken in the AN, i.e. the effect on existing connections and the connection set up handling. It is the responsibility of AN VB5.1 system management in co-operation with the status FSMs to decide whether an event from the environment has service relevance for the SN and a message transfer to the SN is required.

13.3.1.2 Single VP messages and multi VP messages

Whenever commands are executed in the AN, which manipulate a single VPC or a LSP, the environment informs the VB5 system. But also other commands i.e. locking of a PUP which have VP relevance are mapped by the environment to VP specific actions and forwarded to VB5. In that case VB5 system management may receive together with the action required a list of affected VPCs. To avoid the generation of a multitude of messages of the same type, VB5 system management uses the list and requests the AN RTMC protocol entity to build a message where the resource identifier information elements are repeated. This method is used as a mere optimization, the VB5 logic is VPCI or LSP based. The method has some impact on the use of the signalling identifier (see subclause 13.3.3).

The SAAL transfers SDUs up to 4 096 octets. The RTMC protocol keeps track of that restriction and supports the decomposition of lists of VPCs into multiple messages. For the AN environment this decomposition is transparent and therefore it shall receive one primitive as acknowledgement. The decomposition is also transparent to the receiver in the SN. In the SN it is seen as two independent transactions.

13.3.1.3 Acknowledgements

VB5 makes use of the assured data transfer mode of SAAL. SAAL takes care for the transport of the messages. In addition functional acknowledgements for all applications using the RTMC protocol are introduced to keep the synchronization between AN and SN as close as possible. The receiving application either returns a positive response, if it will execute or has executed the requested action(s) or returns a negative response if the requested action(s) can not be performed. To indicate the status the resource identifier information element is contained in the acknowledgement.

It is the task of the RTMC protocol entity to supervise the acknowledgement messages by timers. The timer values shall be application dependent. In the case of time out the messages are repeated once. After the second time out an error indication is sent to the environment.

13.3.1.4 General error handling

The RTMC protocol entity is responsible for checking the syntactical correctness of messages. In the case of an error a protocol error message is generated. Detailed error cases can be found in the syntax check procedure diagram (refer to annex A.4.6).

If the receiving application can not perform the requested action on the indicated resource, i.e. it is unknown to the receiver, this has to be reported to the peer side. An acknowledgement is used, where the result is given in the resource identifier via an error code. In the case of a multi VP message the resource identifiers are repeated. In a multi VP message only the resource identifiers with negative acknowledgements are listed.

13.3.1.5 Use of signalling identifiers

The service node and the access network both assign their own signalling identifiers for a signalling association between the RTMC protocol entities. They are used to identify the RTMC process instance to which a transmitted or received message applies. The SN signalling identifier is assigned by the SN and used to identify the signalling association in the SN. Therefore it is reflected by the AN. The AN signalling identifier is used in the same way. Both signalling identifier are not necessarily present in a message.

The destination signalling identifier information element provides the identification of the signalling association at the destination protocol side (receiver) of a message (see subclause 14.2.7).

The origination signalling identifier information element provides the identification of the signalling association at the origination protocol side (sender) of a message (see subclause 14.2.8).

13.3.1.6 Reporting of status changes

Status changes relevant for VB5 occur due to administrative actions or the occurrence of a fault condition which affects VPCs or the LSP. To report status changes of VPCs or the LSP from the AN to the SN the following principles apply:

a) the AN environment shall inform the VB5 system about all status changes of VPCs or the LSP. The AN environment shall provide the AN VB5 system with the full information about the reasons of status changes;

b) the AN VB5 system has the full knowledge about the current status of the VPCs and the LSP. The VPC/LSP status in the AN is reflected by the states of the AN_LSPSTAT and AN_FVPCSTAT processes;

c) in the case of status changes the AN_LSPSTAT and AN_FVPCSTAT processes determine the appropriate RTMC messages and reasons to be sent to the SN;

d) the AN VB5 system shall inform the SN only about state changes with service relevance. The current service relevant status in the SN is reflected by the states of the SN_LSPSTAT and SN_FVPCSTAT processes. Error states are regardless of the service relevance to the SN always reported to allow in the SN the distinction of unavailability because of error or administrative reasons;

e) as long as a VPC or the LSP is not fully available for service, state changes shall only be reported to the SN by using BLOCK_CMD messages. The UNBLOCK_CMD message shall only be sent, if a VPC or the LSP are fully available for service again;

f) the SN_LSPSTAT and SN_FVPCSTAT processes act as a pure slave of the AN_LSPSTAT and AN_FVPCSTAT processes, i.e. they perform no self-standing state event logic but take the reason delivered by the AN as the new overall status of the reported resource.

13.3.2 Block/unblock procedure

13.3.2.1 General

The block/unblock procedure is used by the AN to inform the SN about the service relevance of the administrative actions taken in the AN as well of fault conditions occurring in the AN.

Administrative actions:

- a lock/unlock of a VPC;
- a partial lock/unlock of the LSP;
- a lock or partial lock/unlock of an object which affects VPCs.

Fault conditions:

- occurrence/disappearance of a fault which affects a VPC or VPCs;
- occurrence/disappearance of a LSP fault.

As the effect on normal calls in the SN (see Table 25) is independent whether a lock or partial lock is applied or a fault occurred, the same messages are used. Nevertheless the SN needs the information whether a resource is not available for normal service but i.e. available for test calls, whether no service at all is possible or a fault occurred. This is done by using the following reason codes in the block messages:

- admFull: resource not available due to administrative actions in the AN. It does not necessarily mean that the resource is locked in the AN;
- admPart: resource not available for normal traffic due to administrative reasons in the AN, but available for test calls;
- Err: resource not available due to a fault condition in the AN.

The reason code admFull does not apply for the resource LSP.

The meaning of the UNBLOCK_CMD message is as follows:

- all blocking conditions are cleared and the resource is available for service again.

13.3.2.2 Procedure

In all cases VB5 system management is triggered by a MEE_block_request primitive which includes the reason code (see Figure 56).

VB5 system management in co-operation with the relevant status FSM determines whether the requested action has service relevance for the SN, and only in this case the BLOCK_CMD is sent.

That applies also for multiple VP messages, where only those VPCs are listed which undergo a state change which has service relevance.

When receiving a block_CMD message the SN VB5.1 system informs the environment The reaction is listed in Table 25.

Table 25: Effect of block message in the SN

Resource	Action in the SN environment
VPC	- all switched connections allocated to that VPC are released - no new connections are allocated to that VPC. Whether test calls are possible or not is controlled by the remote blocked state in the SN, which reflects the reason code in the BLOCK_CMD
LSP	- all switched connections allocated to that LSP are released - no new connections are allocated to that LSP with the exception that test calls are possible, because the only reason code allowed is admPart - no impact on the VCC carrying the RTMC protocol
NOTE: For VPCs cross connected in the SN no action is taken.	

The SN acknowledges the BLOCK_CMD by a BLOCK_ACK if the affected entities have changed their state.

If the partial lock or lock condition is removed in the AN, VB5.1 system management is informed via the MEE_unblock_REQ.

Since the environment sees unlock of the lock or partial lock condition as independent actions, the MEE primitive provides the reason code, indicating which condition was removed. Again the status FSM is used to determine whether or not the SN has to be informed. Table 26 shows the principles of the interaction between block/unblock i.e. how the primitives from the environment, the AN internal states of the status FSM and the VB5 messages are related in the case the treated entity is a VPC. For the LSP resource a subset applies.

Table 26: Relationship between MEE primitives and messages for block/unblock in the AN

state adm.	**local full blocked 1**		**local partial blocked 2**		**local full+partial blocked 3**		**local unblocked 4**		**local shutting down 5**	**local partial blocked shutting down 6**	**local partial shutting down 7**	**local shutting down partial shutting down 8**
fault	**no 1.1**	**yes 1.2**	**no 2.1**	**yes 2.2**	**no 3.1**	**yes 3.2**	**no 4.1**	**yes 4.2**	**5**	**6**	**7**	**8**
primitive from environment												
MEE block_req admFull	1.1	1.2	3.1 BLOCK_CMD Full	3.2 BLOCK_CMD Full/Err	3.1	3.2	1.1 BLOCK_CMD Full	1.2 BLOCK_CMD Full/Err	1.1 BLOCK_CMD Full	1.1 BLOCK_CMD Full	1.1 BLOCK_CMD Full	3.1 BLOCK_CMD Full
MEE block_req admPart	3.1	3.2	2.1	2.2	3.1	3.2	2.1 BLOCK_CMD Part	2.2 BLOCK_CMD Part/Err	6	6	2.1 BLOCK_CMD Part	6
MEE block_req Err	1.2 BLOCK_CMD Full/Err	1.2	2.2 BLOCK_CMD Error/ Part	2.2	3.2 BLOCK_CMD Full/Err	3.2	4.2 BLOCK_CMD Err	4.2	1.2 BLOCK_CMD Full/Err	2.2 BLOCK_CMD Err/ Part	2.2 BLOCK_CMD Err/ Part	3.2 BLOCK_CMD Full/Err
MEE unblock_req admFull	4.1 UN-BLOCK_CMD	4.2 BLOCK_CMD Err	2.1	2.2	2.1 BLOCK_CMD Part	2.2 BLOCK_CMD Err/ Part	4.1	4.2	4.1 UN-BLOCK_CMD	2.1 BLOCK_CMD Part	7	7
MEE unblock_req admPart	1.1	1.2	4.1 UN-BLOCK_CMD	4.2 BLOCK_CMD Err	1.1	1.2	4.1	4.2	5	5	4.1 UN-BLOCK_CMD	5
MEE unblock_req Err	1.1	1.1 BLOCK_CMD Full	2.1	2.1 BLOCK_CMD Part	3.1	3.1 BLOCK_CMD Full	4.1	4.1 UN-BLOCK_CMD	5	6	7	8

Table 26 reflects the clear separation of fault condition processing and processing of administrative actions.

The input are the MEE primitives from the environment, the states and the respective state transitions are the states as defined in FVPCSTAT, LSPSTAT (see annex A) and the actions are the messages generated by AN_CPROT for transmission to the SN. Not shown are the acknowledgments which come either from the SN and are passed to the environment without affecting the state or in the case the requested action has no service relevance for the SN, are immediately acknowledged by VB5 system management.

Figure 57 shows the unblock procedure, where after a full block condition the service becomes available again.

Figure 58 shows the blocking of a PUP which results in a BLOCK_CMD message which contains a list of VPCs. In the case that the SN successfully executes the complete list, a list in the BLOCK_ACK message may be omitted.

Figure 59 shows the blocking of a PUP, where not all reported VPCs by the AN are known to the SN. Still the BLOCK_CMD is acknowledged via a BLOCK_ACK message. Via the resource identifier element in the message (see subclause 14.2.12) the resource (LUP ID, VPCI2) is reported as unknown. This situation is considered to be a problem of co-ordinated provisioning and is therefore brought via the SN and AN environment to the operator's attention.

If a PUP is unlocked and many VPCs are affected, then some of the VPCs may remain in a block condition while others may change to the unblock state. So AN VB5.1 system management requests from the AN_CPROT process to generate two types of messages:

- UNBLOCK_CMD message with the list of VPCs, which are available for service;
- BLOCK_CMD message for those VPCs remaining in a block condition, but the change within the block condition has service relevance, i.e. change from full blocked to partial blocked.

AN VB5 system management co-ordinates the ACK messages from the SN, and the environment is informed by a single MEE primitive.

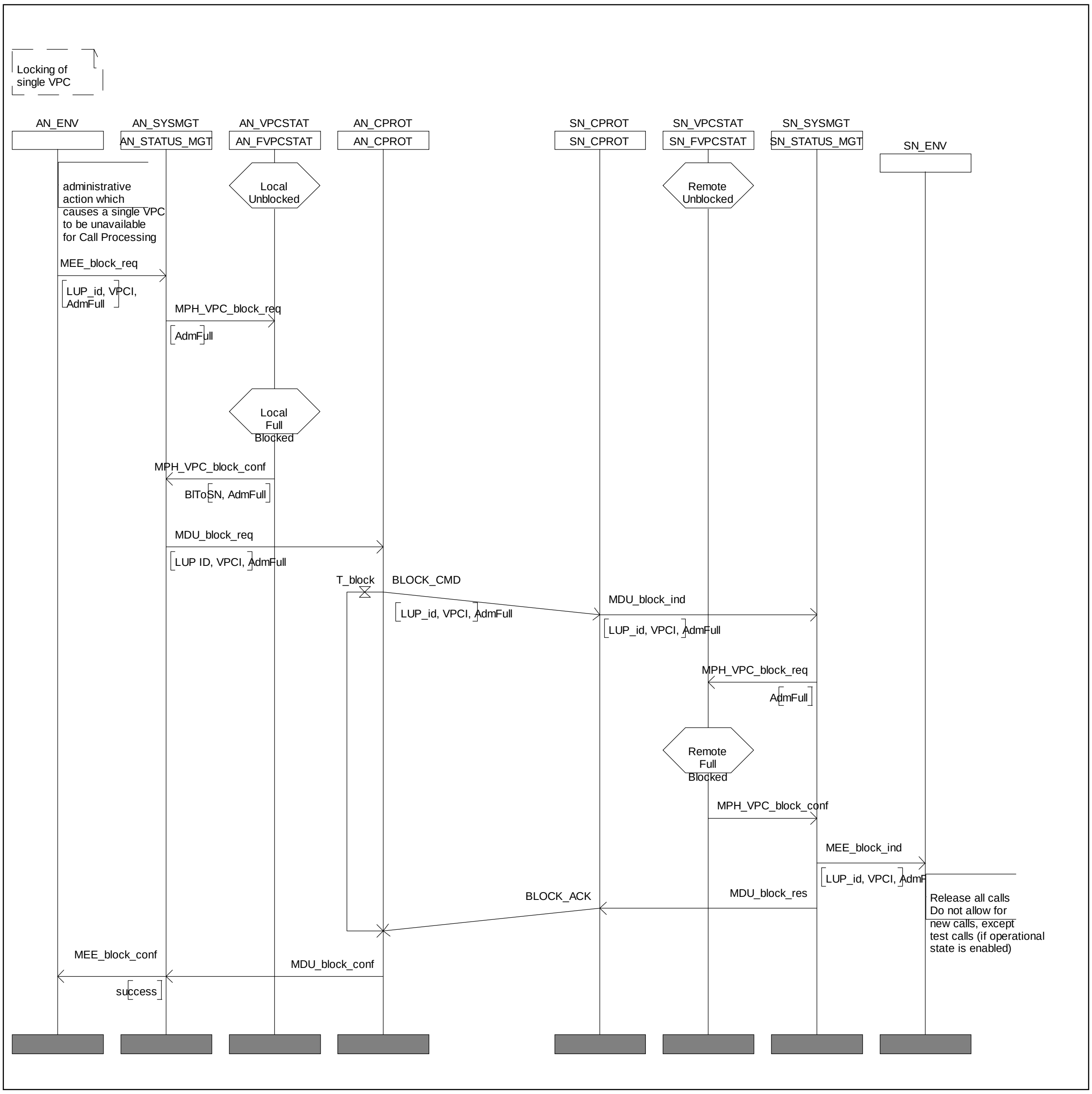


Figure 56: Blocking of single VPC

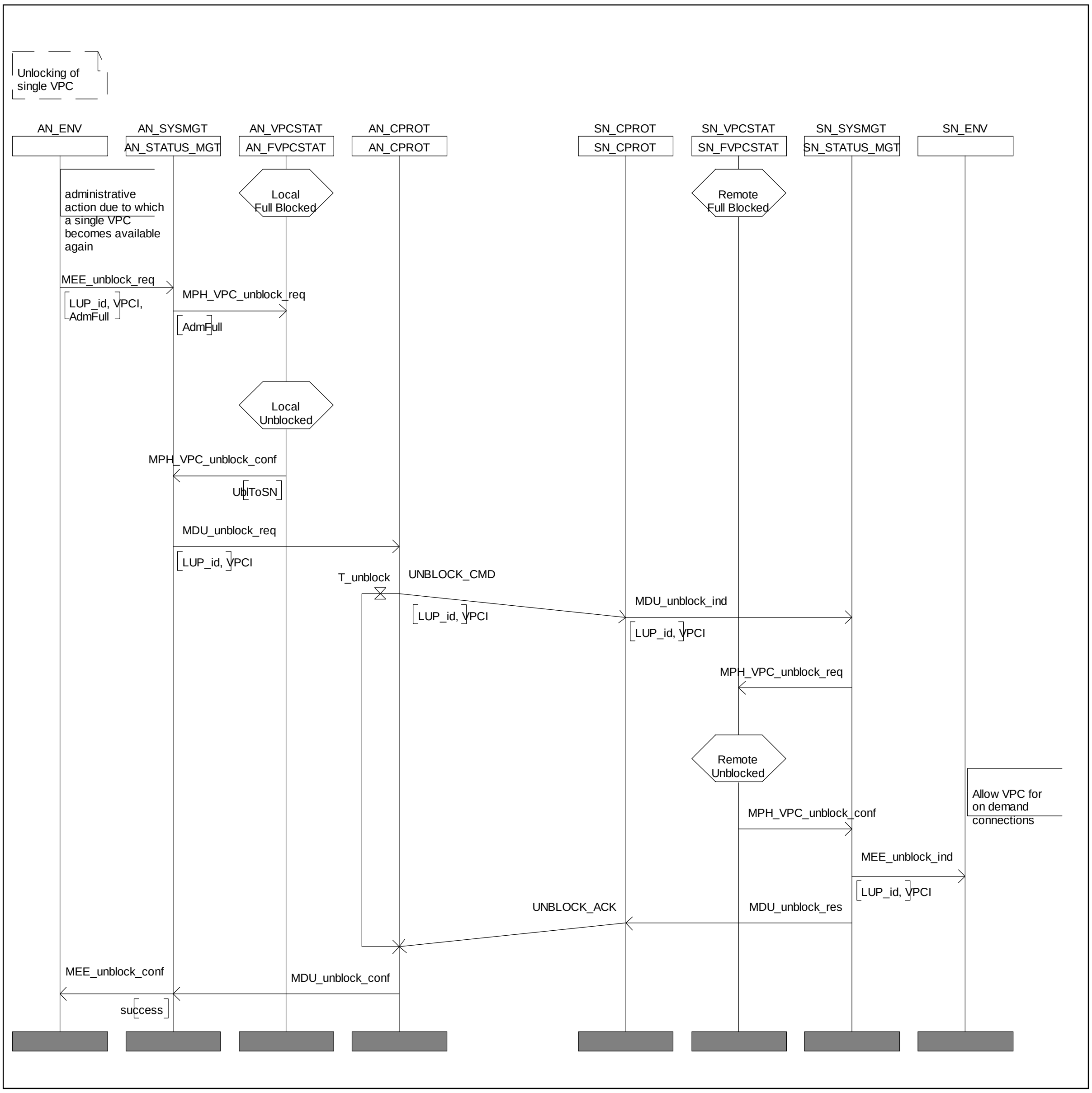


Figure 57: Unblocking of single VPC

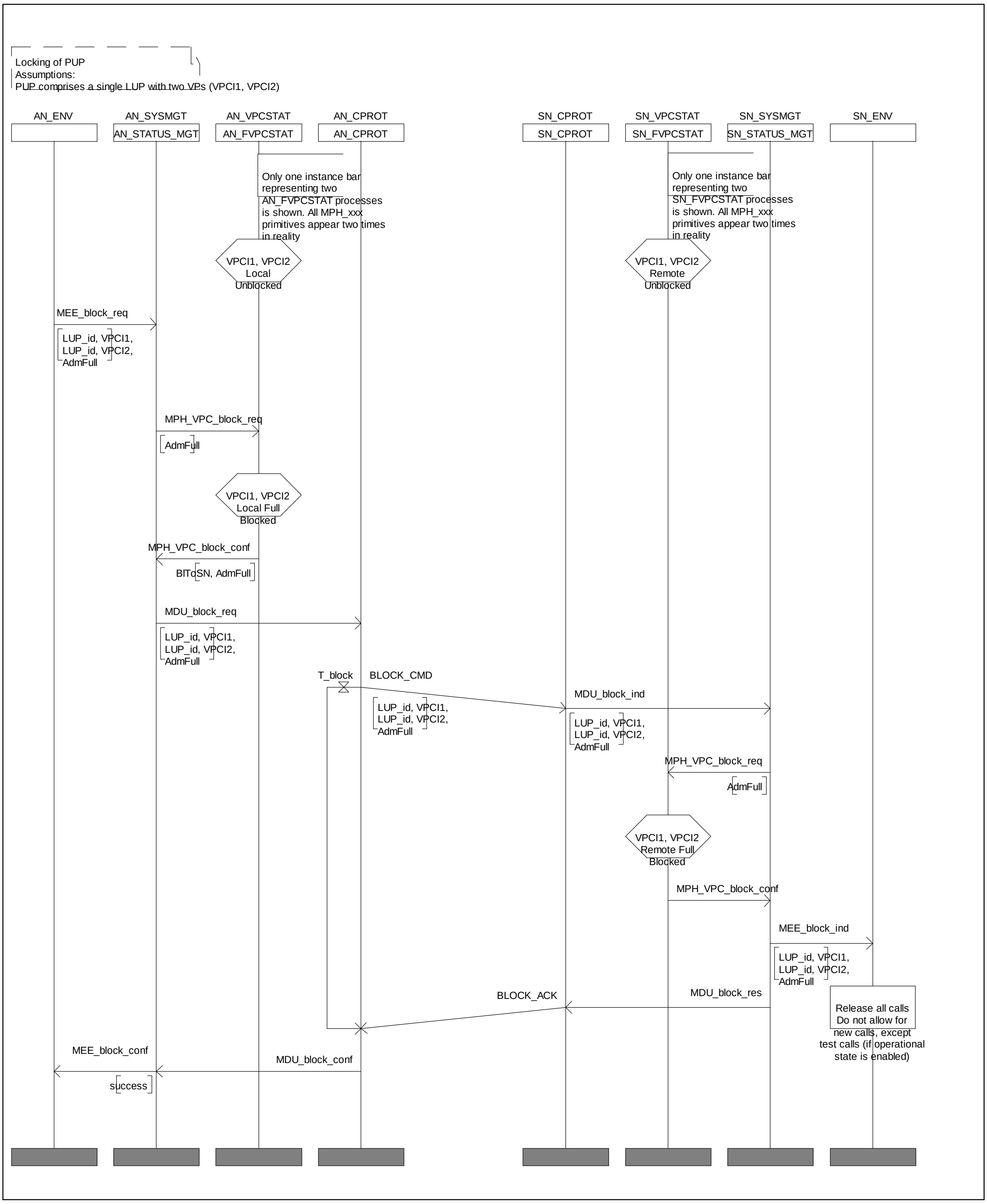


Figure 58: Blocking of a PUP, normal case

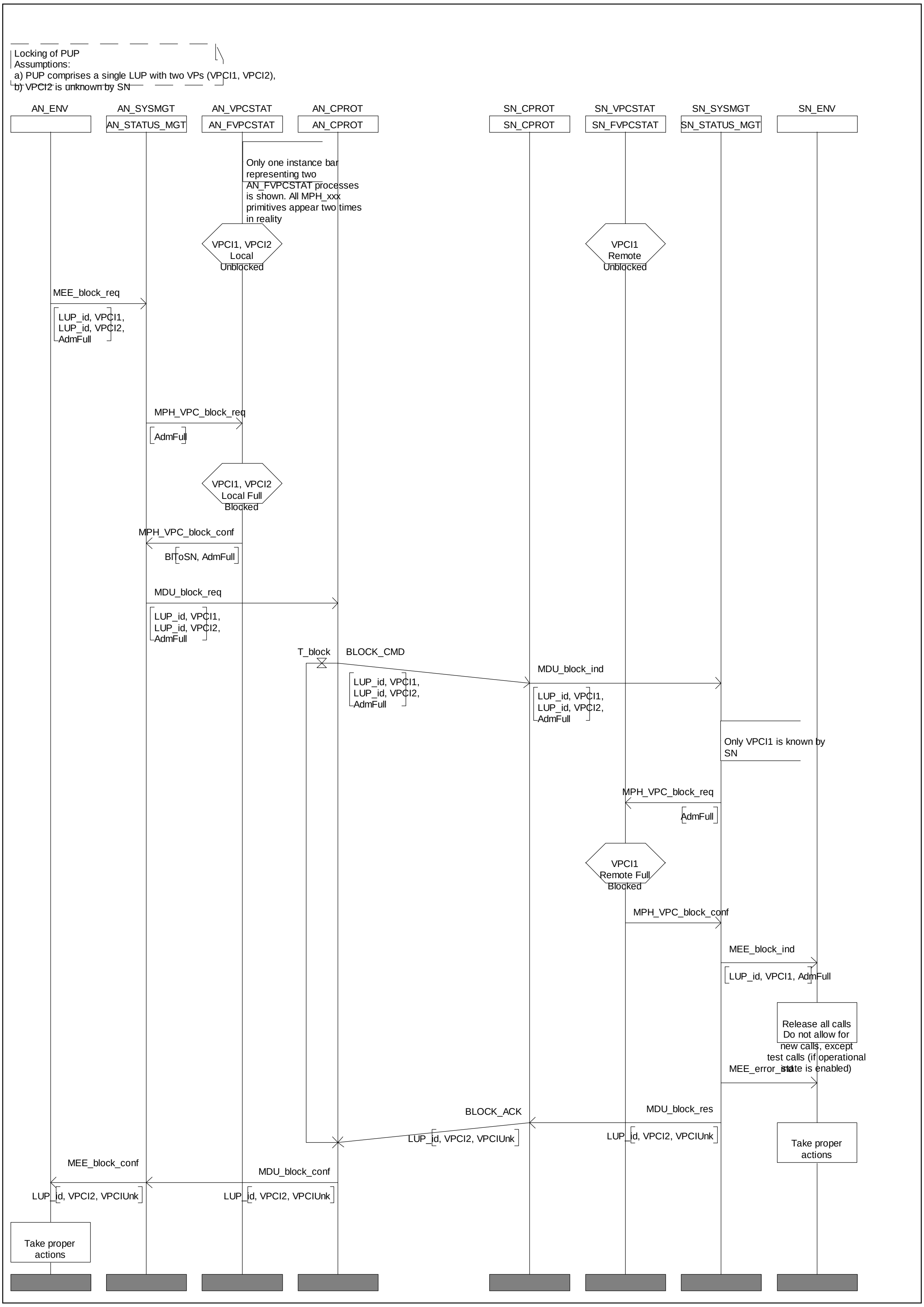


Figure 59: Blocking of a PUP, exceptional case

13.3.3 Shutting down of resources

13.3.3.1 General

The shutting down of resources as seen by the operator as a graceful locking/partial locking is broken down into two procedures on VB5 system level:

- shutting down procedure;
- block procedure (see subclause 13.3.2).

This subclause deals with the shutting down procedure. For shutdown or partial shutdown of a resource the same procedure applies. The operator may at any point of time unlock or lock resources i.e. VPCs, for which the shutting down procedure is running.

13.3.3.1 Procedure

The shutting down procedure is subdivided to two independent transactions (see Figure 60).

a) AWAIT_CLEAR/AWAIT_CLEAR_ACK

   The AN VB5 system is triggered by the AN environment via a MEE_await_clear_req primitive, which may include a list of VPCs. The shutting down procedure via the VB5 interface is identical for partial shutting down and shutting down. AN system management has to co-ordinate the possible interactions between partial shutting down and shutting down. Dependent on the current state within AN_FVPCSTAT/AN_LSPSTAT VB5 system determines one of the following actions (see Table 27):

   - request from AN_CPROT to generate a AWAIT_CLEAR message which in the general case is a multiple VPC message;
   - generate immediately MEE_await_clear_conf to the environment (see below).

   For one MEE_await_clear_req primitive with a list of VPCs both actions may apply dependent on the states of the VPCs.

   The response (AWAIT_CLEAR_ACK) from the SN also refers to the received list of VPCs and indicates that the shutting down in the SN is in progress. The acknowledgement is not shown in the table because it has no effect on the states and normally no effect on the environment. Only in the case that the SN reports VPCs for which the shut down procedure in the SN could not be started, a MEE_await_clear_conf is given to the environment (see below).

b) AWAIT_CLEAR_COMP/AWAIT_CLEAR_COMP_ACK

   Even when using multi VPC messages the shut down procedure works on VPC basis. VB5 system management in the SN is triggered by the environment whenever a VPC or some VPCs are free of switched connections. VPCs which contain only permanent connections or no connections are reported immediately. This results in multiple transactions generated by SN_CPROT. Table 27 also shows this transaction. Dependent on the current state in the AN_FVPCSTAT/AN_LSP_STAT, system management determines which primitive has to be passed to the AN environment. It is the AN environment which correlates the received AWAIT_CLEAR_COMP messages and finally triggers VB5 with a MEE_block_request primitive. Figure 60 further clarifies the principle of using individual AWAIT_CLEAR_COMP transactions. While a resource is being shutdown, the AN operator may perform actions on VB5 specific or AN internal entities, which have effects on VPCs being shutdown and therefore VB5 system is triggered. The example (see Figure 61) shows the blocking of VPCs which are in the shutting down state. For the AN VB5 system it is a new transaction, which is immediately executed. For the affected VPCs the shut down is stopped and these VPCs will no longer be reported in a AWAIT_CLEAR_COMP message. The AN environment has to supervise and co-ordinate the operator actions.

Table 27 summarizes the interaction between the environment and VB5 management for the shutting down procedure in the AN.

Table 27: Interaction between environment and VB5 for shutting down in the AN

state external event to VB5	local full blocked and/or error condition 1	local unblocked 2	local shutting down 3	local partial blocked 4	local partial blocked/ shutting down 5	local partial shutting down 6	local shutting down/ partial shutting down 7
MEE_await_clear-req	1 MEE_await_clear_conf	3 AWAIT_CLEAR	3	5 AWAIT_CLEAR	5	7	7
MEE_await_clear-req Part	1 MEE_await_clear_conf/ Part	6 AWAIT_CLEAR	7	4 MEE_await_clear_conf/ Part	5 MEE_await_clear_conf/ Part	6	7
AWAIT_CLEAR_COMP	1 ignore	2 ignore	3 MEE_await_clear_conf	4 ignore	5 MEE_await_clear_conf	6 MEE_await_clear_conf/ Part	7 MEE_await_clear_conf/ MEE_await_clear_conf/ Part
NOTE: In all states where there is no reaction given, when receiving a MEE primitive, an immediate MEE_await_clear_conf is given							

Shutting down in the state blocked partial is a valid action to allow the graceful termination of test calls.

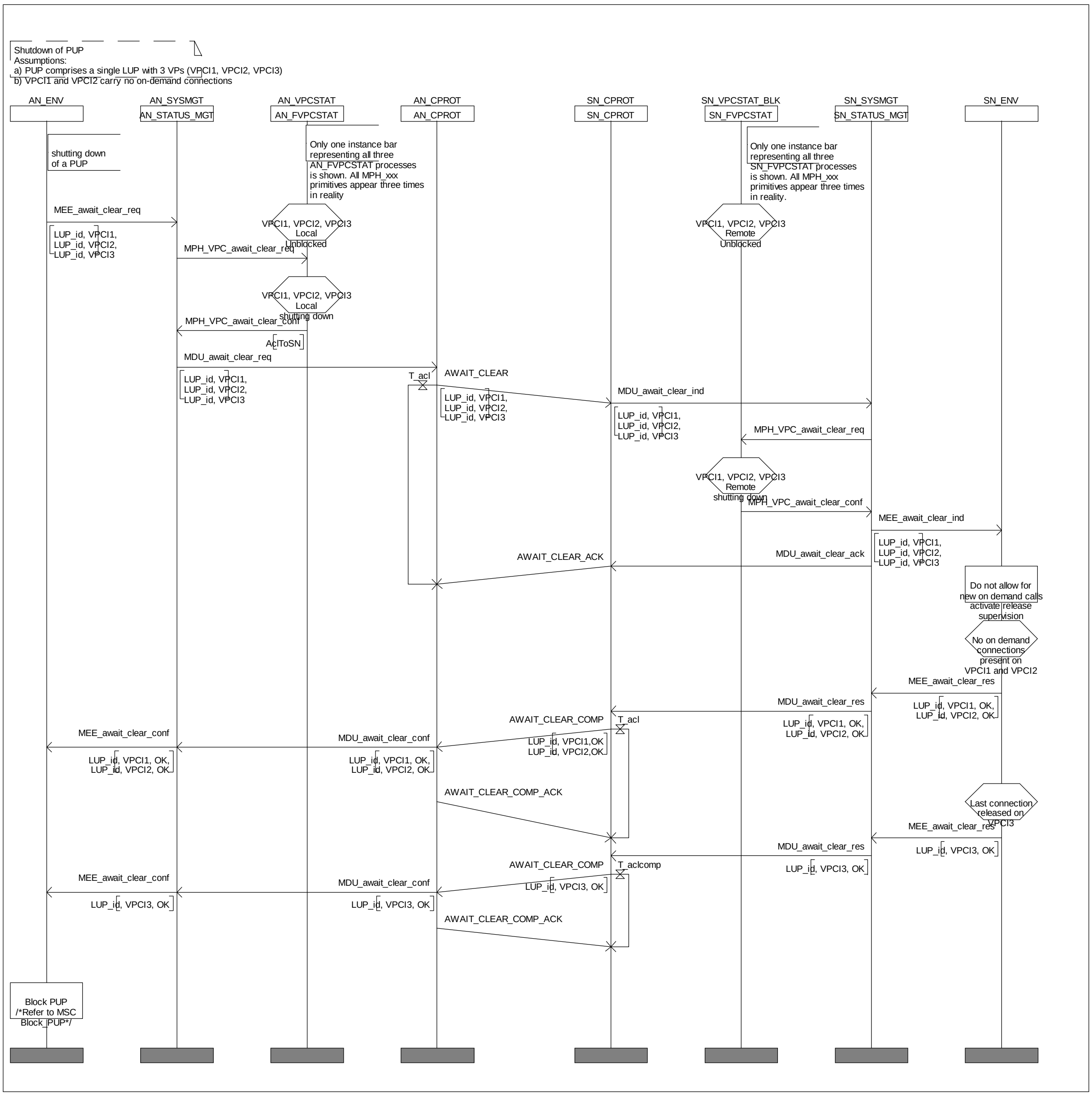


Figure 60: Shutting down of a PUP, normal case

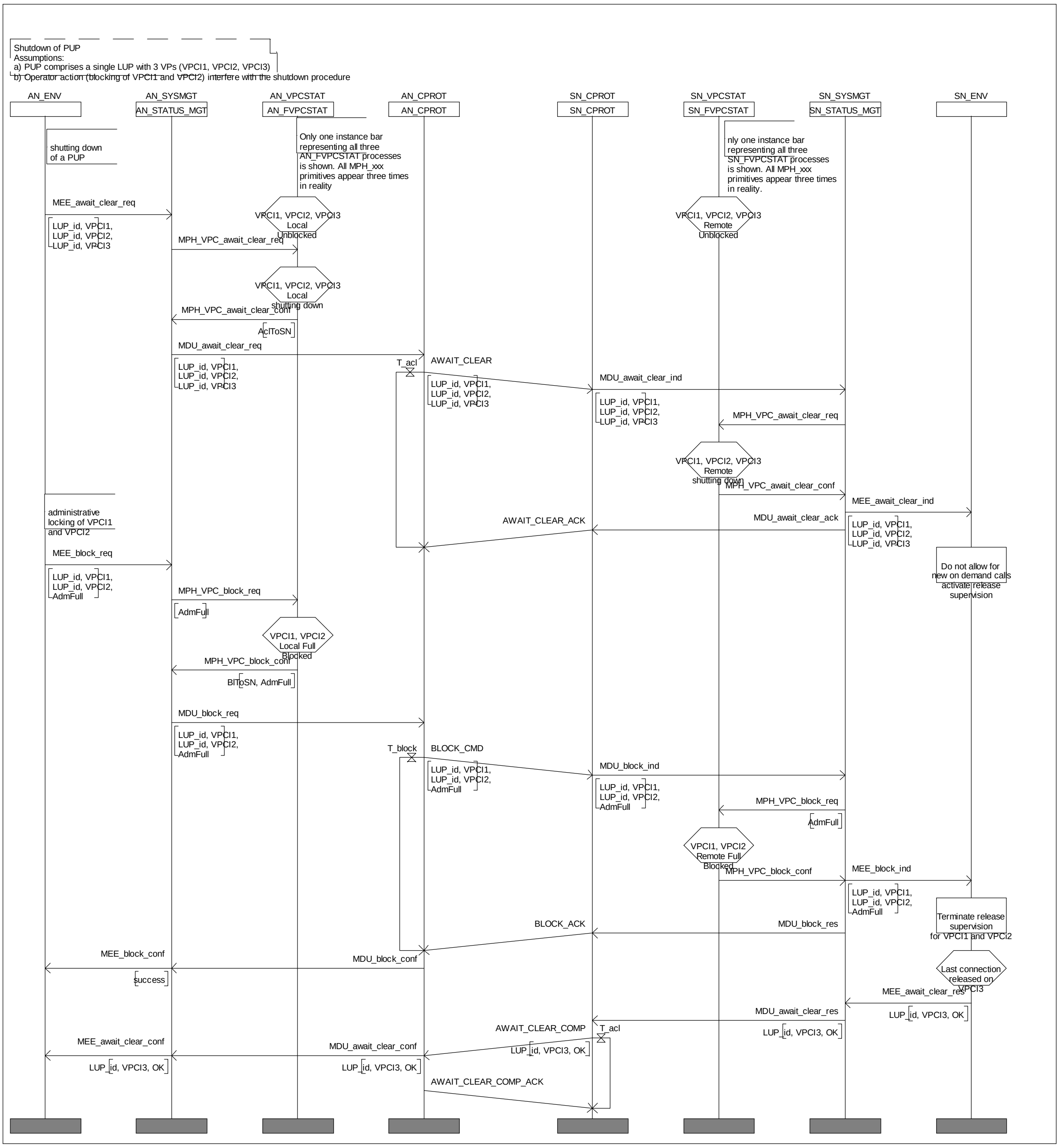


Figure 61: Shutting down of PUP, operator interference

13.3.4 VPCI consistency check

13.3.4.1 General

The VPCI consistency check is provided to verify the consistent and correct allocation of a logical Virtual Path Connection Identifier (VPCI) to a VPC on the VB5.1 reference point. The check is performed to guarantee that the user plane information flow is possible between the AN and SN using the bilaterally agreed VPCI at the VB5.1 interface.

The VPCI consistency check procedure makes use of the loopback capability of ETS 300 404 [8] (ITU-T Recommendation I.610 [24]) that operates on the VP level. The OAM cell format shall be as defined in ITU-T Recommendation I.610 [24] subclauses 7.1 and 7.2.4. The loopback location field ID shall not be used, i.e. the value of the field shall be all 1's. The procedures for the loopback are defined in annex C of ITU-T Recommendation I.610 [24].

The consistency of the VPCI is checked in the AN by monitoring the receipt of a user plane test flow in a VPC of a LSP that is indicated by the VPCI given by the SN the initiator of the test. After the performance of the check the result of the monitoring function (receipt of loopback cells at the VPC level) is made available to the SN.

13.3.4.2 Procedure

The VPCI consistency check consists of a procedure between the AN and SN to control the test and in addition relies on user plane information flow using the loop back capability (refer to ITU-T Recommendation I.610 [24]). The responsible entity to perform and control the test is SN and AN environment. The VB5.1 system supports the procedure between AN and SN by transporting the requested messages to the peer entity. The VPCI consistency check has no impact on existing connections.

The VPCI consistency check request and VPCI consistency check end are confirmed operations. The acknowledgement is not sent before the relevant actions for performing the check have been performed (i.e. activation of loopback cell monitoring function in the AN). An acknowledgement is also send, if the AN is not able to perform the VPCI consistency check. The operational status within the resource identifier is set to reject. The message flow is shown in Figure 62.

13.3.4.3 Initiating VPCI consistency check

The VPC to be tested has to be in the operational state enabled. When the environment in the SN initiates a VPCI-CC, VB5 system management is triggered and a CONSISTENCY_CHECK_REQ message is sent to the AN by SN CPROT. The message includes the relevant VPCI.

On receipt of a CONSISTENCY_CHECK_REQ message from the SN, the AN environment will, if the VPC is applicable for the check, connect the monitor function to the standardized VC for F4 flows in the indicated VPC. The point where the loopback is performed is an endpoint, where the VPC is terminated in the AN. The AN environment shall confirm activation of the monitor function by requesting the VB5 system to send a CONSISTENCY_CHECK_REQ_ACK message to the SN.

On receipt of the CONSISTENCY_CHECK_REQ_ACK message in the SN, the SN environment starts the loopback according to ITU-T Recommendation I.610 [24].

13.3.4.4 Terminating VPCI consistency check

When the SN environment terminates a VPCI-CC, a CONSISTENCY_CHECK_END message is sent to the AN. The message includes the relevant VPCI.

On receipt of a CONSISTENCY_CHECK_END message from the SN, the AN environment will disconnect the monitor function from the standardized VC for F4 flows in the indicated VPC. The AN shall return a CONSISTENCY_CHECK_END_ACK message to the SN, which shall include the consistency check result information (see subclause 14.2.6). The test shall be considered passed, if the AN has detected the loopback cells on the relevant VPC. Otherwise the test shall be considered failed.

If the VPCI consistency check failed due to the provided result by the AN or time out in the SN, the operator in the SN shall be informed.

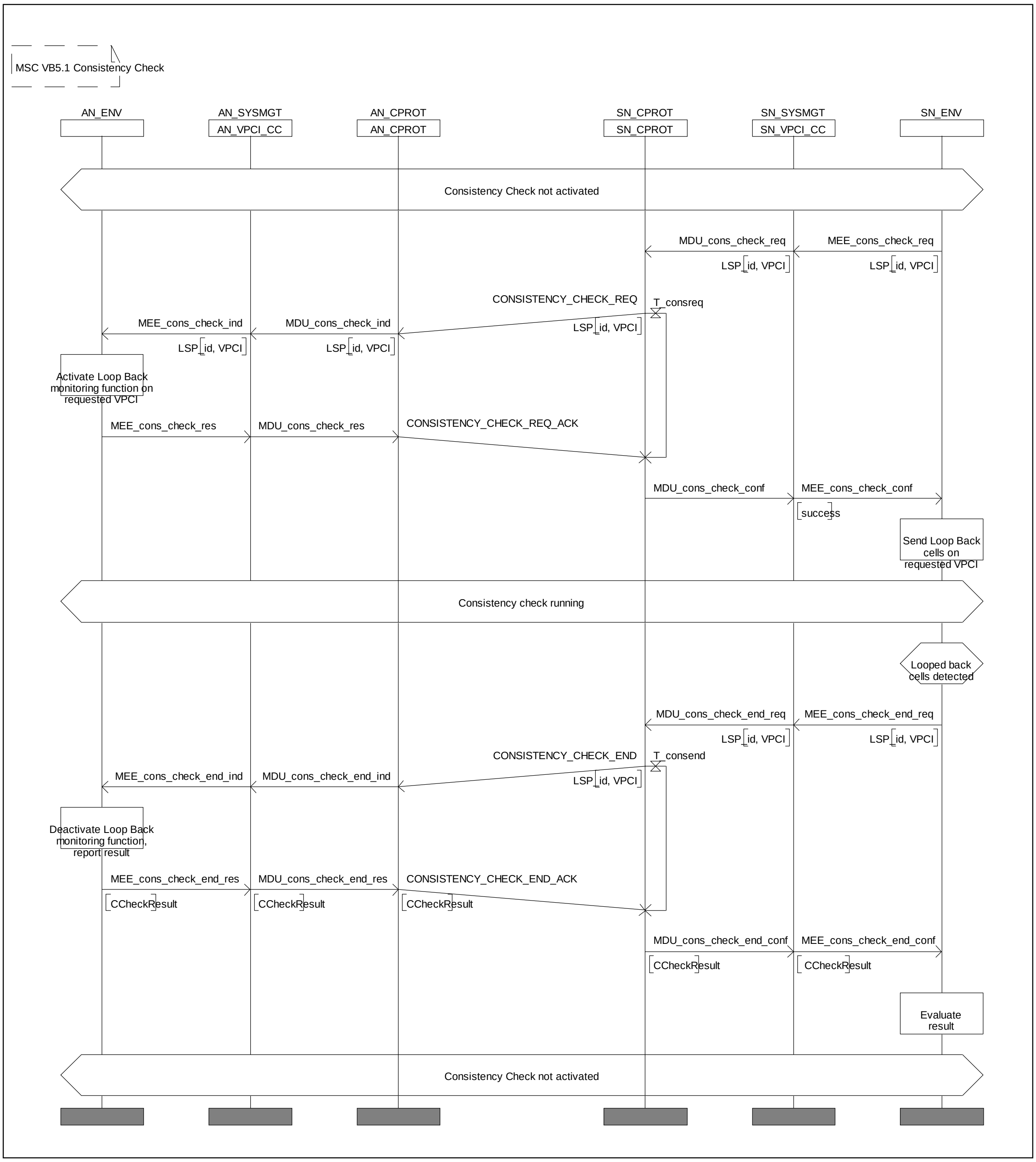


Figure 62: VPCI consistency check

13.3.5 Start-up procedure

13.3.5.1 General

The start up procedure can be triggered in two circumstances:

a) operator requested start up:

   only VB5.1 specifics are discussed in this subclause;

b) failure of the SAAL:

   the functionality of SSCOP allows that short term problems are handled by SSCOP recovery actions. If the "NO Response" timer of SSCOP expires and VB5 system management is informed via AAL release indication, it assumes that a non-recoverable error occurred. Consequently all VB5 system management processes enter the out of service state. The environment is informed. The SN side shall release all existing on demand connections (see Figure 64).

13.3.5.2 Procedure

The procedure is controlled by the AN/SN VB5.1 system management control process and includes the following steps:

- SAAL establishment;
- check LSP ID;
- reset LSP.

When all steps are successfully completed then the VB5.1 interface is in service, the RTMC protocol is active and the states of the LSP and VPC unblocked. If VPCs are not available for service due to administrative reasons or fault conditions they shall be blocked again via the block procedure triggered by AN environment. Whenever one of the above mentioned steps fails, then the start-up is stopped, and the environment informed.

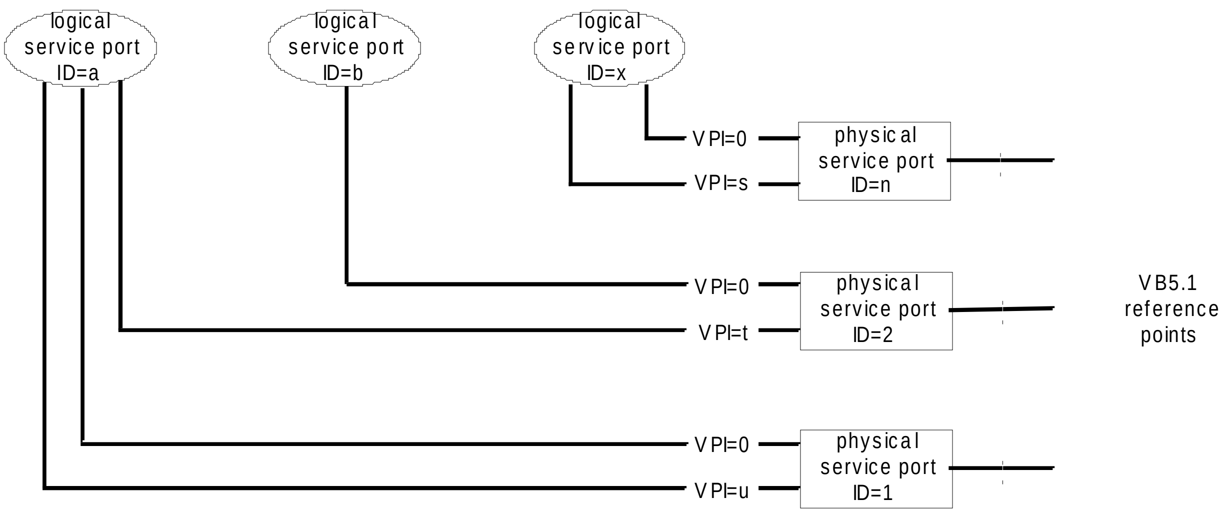


Figure 63: VB5.1 interface start-up

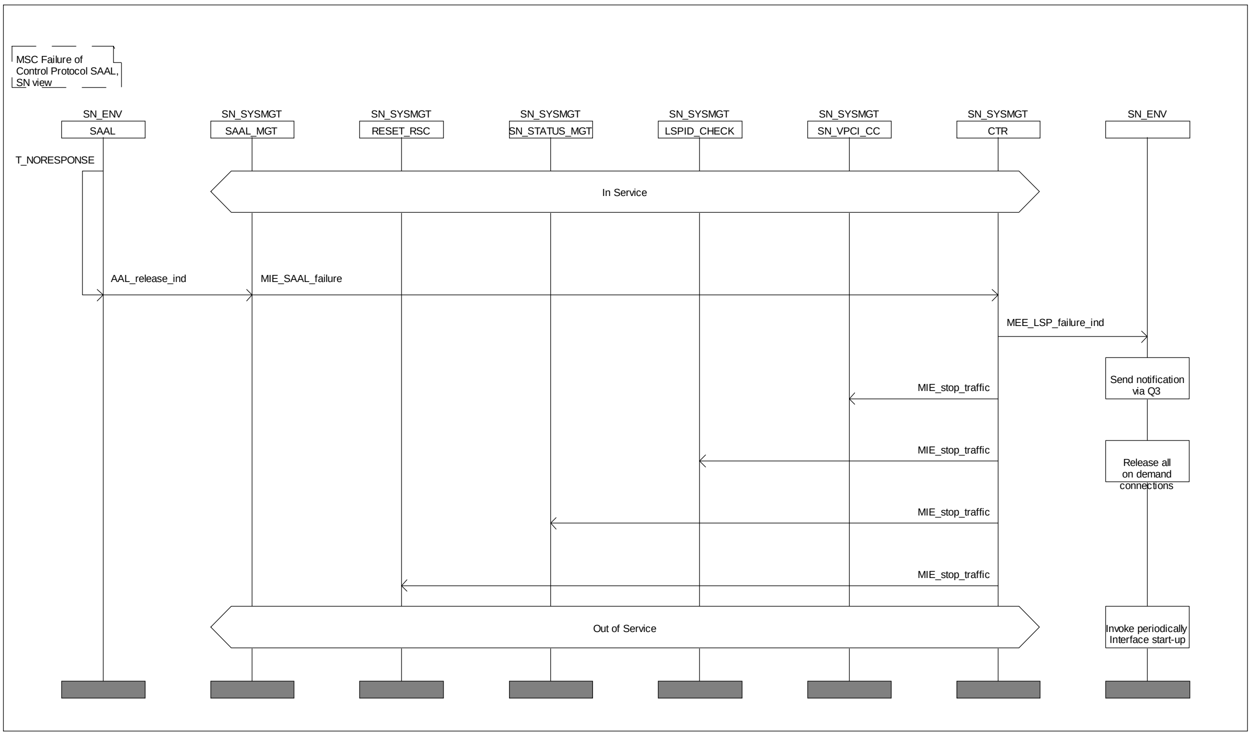


Figure 64: SAAL failure

13.3.6 Check LSP ID procedure

13.3.6.1 General

The Check LSP ID procedure is triggered by two events:

a) by the environment as a result of input via the Q3 interface;

b) by the start up procedure.

13.3.6.2 Procedure

A simple handshaking procedure between the AN and SN LSPID_CHECK processes is performed (see Figure 65). In the case of start up the LSPID_CHECK process is triggered by VB5 system management process CTR. If the check was successful start-up continues. If the check failed, VB5 system management CTR stops the start-up and informs the environment by a MEE_startup_conf primitive with a negative result indicator.

If the trigger was provided by the environment, then the procedure is the same, but VB5 system takes no action in the case of failure and simply informs the environment via a MEE_verify_LSP_ID_conf primitive with a negative result indicator.

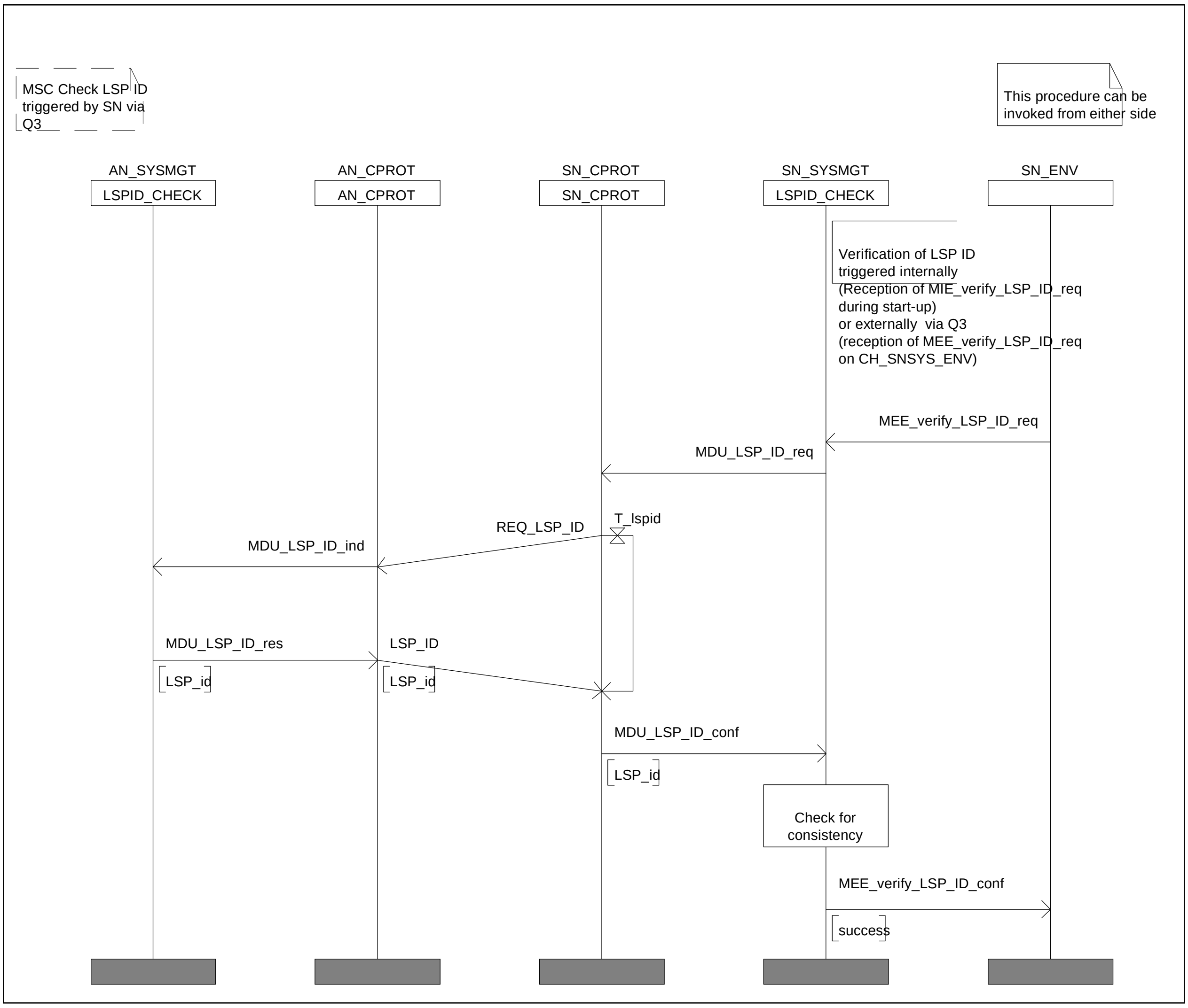


Figure 65: Verify LSP ID

13.3.7 Reset LSP procedure

13.3.7.1 General

The reset LSP procedure is triggered by two events:

a) by the environment via a MEE reset_req [LSP] primitive;

b) by the start up procedure.

13.3.7.2 Procedure

The reset LSP procedure is a handshaking procedure between the CTR_RESET_RSC processes in AN and SN (see Figure 66). If the reset is triggered by the environment in the SN, the environment has to take care that all on demand connections are released. If the reset is triggered by the environment in the AN, then CTR_RESET_RSC in the SN informs the environment via MEE_reset_ind. All on demand connections have to be released. Reset indication is also the trigger to the environment, that the reset procedure is completed and new calls are possible.

The result of the LSP reset procedure is that the states of all VPCs and the state of the LSP is unblocked. VPCs not available for service due to administrative reasons shall be brought to blocked again by the environment. Shut down procedures and VPCI consistency checks in progress shall be aborted by the environment.

If the LSP reset procedure fails, then the environment is informed either by a MEE_reset_conf or a MEE_startup-conf primitive with negative result indicator.

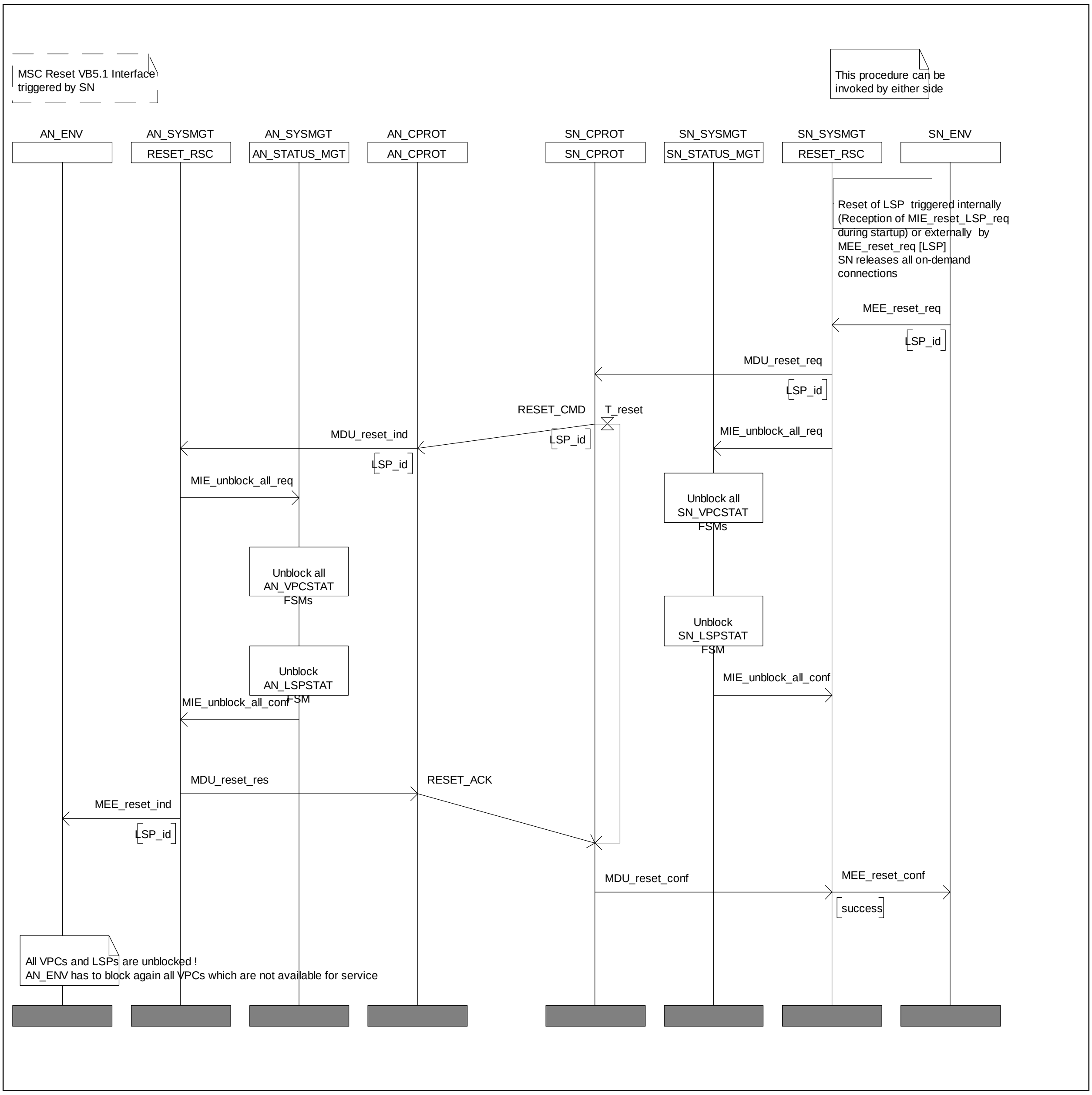


Figure 66: Reset LSP

14 Message format and codes

14.1 Message functional definition and content

This subclause provides an overview of the message structure, including the functional definition and information content of each message. Each message definition includes:

a) a brief description of the message use;

b) a table listing the information elements. For each information element, the table indicates:

1) the section of this ITU-T Recommendation describing the information element;

2) whether inclusion is mandatory "M" or optional "O", with a reference to notes explaining the circumstances under which the information element shall be included; and

3) the length of the information element (or permissible range of lengths), in octets.

14.1.1 RTMC protocol messages for VB5.1

14.1.1.1 General

Table 28 summarizes the messages for the VB5.1 RTMC protocol.

For each message the direction in which the message and the corresponding information elements may be sent is indicated; i.e. access network to service node "AN → SN", service node to access network "SN → AN", or "both".

Table 28: Messages for the VB5.1 RTMC protocol

Message	Direction	Reference
AWAIT_CLEAR	AN → SN	14.1.1.2
AWAIT_CLEAR _ACK	SN → AN	14.1.1.3
AWAIT_CLEAR _COMP	SN → AN	14.1.1.4
AWAIT_CLEAR _COMP_ACK	AN → SN	14.1.1.5
BLOCK_ACK	SN → AN	14.1.1.6
BLOCK_CMD	AN → SN	14.1.1.7
CONSISTENCY_CHECK_END	SN → AN	14.1.1.8
CONSISTENCY_CHECK_END_ACK	AN → SN	14.1.1.9
CONSISTENCY_CHECK_REQ	SN → AN	14.1.1.10
CONSISTENCY_CHECK_REQ_ACK	AN → SN	14.1.1.11
LSP_ID	both	14.1.1.12
PROTOCOL_ERROR	both	14.1.1.13
REQ_LSP_ID	both	14.1.1.14
RESET_ACK	both	14.1.1.15
RESET_CMD	both	14.1.1.16
UNBLOCK_ACK	SN → AN	14.1.1.17
UNBLOCK_CMD	AN → SN	14.1.1.18

In following subclauses the RTMC message layout is defined.

NOTE 1: The information elements indicated in a specific message may be sent in those directions in which the message itself may be sent. If certain information elements in a message may only be sent in a specific direction, then this is indicated as necessary.

All messages are composed by the common information as indicated in Table 29.

NOTE 2: The destination signalling identifier information element and the origination signalling identifier information element are used as described in ITU-T Recommendation Q.2764 [37].

Table 29: Commonly used information in a message

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Destination signalling identifier	14.2.7	O (note 1)	8
Origination signalling identifier	14.2.8	O (note 2)	8
NOTE 1: The origination signalling identifier is mandatory for all messages which establish a transaction and their direct responses. NOTE 2: The destination signalling identifier is mandatory for all subsequent messages used during this transaction.			

14.1.1.2 AWAIT_CLEAR

This message is sent by the AN to the SN to ask the SN not to allow any new switched call/connection set-up for normal traffic on the indicated VPCs (see Table 30).

Table 30: AWAIT_CLEAR message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Origination signalling identifier	14.2.8	M	8
Repeat indicator	14.2.11	O (note 1)	5
Resource identifier (VPC(s)) note 2	14.2.12	M	11 to 13
NOTE 1: The repeat indicator information element is included if the following information element, i.e. the resource identifier, is repeated. NOTE 2: The resource identifier shall indicate VPC(s).			

14.1.1.3 AWAIT_CLEAR_ACK

This message is sent by the SN to the AN to acknowledge that the first activities upon receiving the AWAIT_CLEAR message by the SN have been completed (see Table 31).

Table 31: AWAIT_CLEAR_ACK message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Destination signalling identifier	14.2.6	M	8
Origination signalling identifier	14.2.8	M	8
Repeat indicator	14.2.11	O (note 1)	5
Resource identifier (VPC(s)) note 2	14.2.12	O (note 3)	11 to 13
NOTE 1: The repeat indicator information element is included if the following information element, i.e. the resource identifier, is repeated. NOTE 2: The resource identifier shall indicate VPC(s). NOTE 3: The resource identifier information element shall be included if the shut down procedure was not successful for some requested resources. Otherwise, if the procedure was successful for all requested resources then the resource identifier may be omitted.			

14.1.1.4 AWAIT_CLEAR_COMP

This message is sent by the SN to the AN to inform the AN about the result of the shut-down procedure, i.e. all calls have been cleared or some failure has occurred (see Table 32).

Table 32: AWAIT_CLEAR _COMP message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Origination signalling identifier	14.2.8	M	8
Repeat indicator	14.2.11	O (note 1)	5
Resource identifier (VPC(s)) note 2	14.2.12	M	11 to 13
NOTE 1: The repeat indicator information element is included if the following information element, i.e. the resource identifier, is repeated. NOTE 2: The resource identifier shall indicate VPC(s).			

14.1.1.5 AWAIT_CLEAR_COMP_ACK

This message is sent by the AN to the SN to inform the SN on the receipt of the AWAIT_CLEAR_COMP message (see Table 33).

Table 33: AWAIT_CLEAR_COMP_ACK message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Destination signalling identifier	14.2.7	M	8
Origination signalling identifier	14.2.8	M	8

14.1.1.6 BLOCK_ACK

This message is sent by the SN to the AN to acknowledge that the initiated activities upon receiving the BLOCK_CMD message by the SN have been completed (see Table 34).

Table 34: BLOCK_ACK message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Destination signalling identifier	14.2.7	M	8
Origination signalling identifier	14.2.8	M	8
Repeat indicator	14.2.11	O (note 1)	5
Resource identifier (LSP, VPC(s)) note 2	14.2.12	O (note 3)	9 to 13
NOTE 1: The repeat indicator information element is included if the following information element, i.e. the resource identifier, is repeated. NOTE 2: The resource identifier shall indicate a LSP or VPC(s). NOTE 3: The resource identifier information element shall be included if the block procedure was not successful for some requested resources. Otherwise, if the procedure was successful for all requested resources then the resource identifier may be omitted.			

14.1.1.7 BLOCK_CMD

This message is sent by the AN to the SN to inform the SN that resources in the AN have been administratively locked (see Table 35).

Table 35: BLOCK_CMD message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Origination signalling identifier	14.2.8	M	8
Repeat indicator	14.2.11	O (note 1)	5
Blocked resource identifier note 2	14.2.5	M	18 to 22
NOTE 1: The repeat indicator information element is included if the following information element, i.e. the blocked resource identifier, is repeated. NOTE 2: The blocked resource identifier shall indicate a LSP or VPC(s).			

14.1.1.8 CONSISTENCY_CHECK_END

This message is sent by the SN to the AN to indicate that the consistency check is finalized and to request the consistency check result of the peer entity (see Table 36).

NOTE: This message corresponds to the consistency check end message of ITU-T Recommendation Q.2763 [36] (see table 24/Q.2763).

Table 36: CONSISTENCY_CHECK_END message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Origination signalling identifier	14.2.8	M	8

14.1.1.9 CONSISTENCY_CHECK_END_ACK

This message is sent by the AN to the SN to return the consistency check result to the requesting entity (see Table 37).

NOTE: This message corresponds to the consistency check end acknowledgement message of ITU-T Recommendation Q.2763 [36] (see table 25/Q.2763).

Table 37: CONSISTENCY_CHECK_END_ACK message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Consistency check result information	14.2.6	M	5
Destination signalling identifier	14.2.7	M	8
Origination signalling identifier	14.2.8	M	8

14.1.1.10 CONSISTENCY_CHECK_REQ

This message is sent by the SN to the AN to check the consistency of a single VPC at the VB5.1 interface (see Table 38).

NOTE: This message corresponds to the consistency check request message of ITU-T Recommendation Q.2763 [36] (see table 22/Q.2763).

Table 38: CONSISTENCY_CHECK_REQ message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Origination signalling identifier	14.2.8	M	8
Resource identifier (VPC) note	14.2.12	M	11
NOTE: The resource identifier shall indicate a single VPC.			

14.1.1.11 CONSISTENCY_CHECK_REQ_ACK

This message is sent by the AN to the SN to indicate the acceptance of a CONSISTENCY_CHECK_REQ (see Table 39).

NOTE: This message corresponds to the consistency check request acknowledgement message of ITU-T Recommendation Q.2763 [36] (see table 23/Q.2763).

Table 39: CONSISTENCY_CHECK_REQ_ACK message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Destination signalling identifier	14.2.7	M	8
Origination signalling identifier	14.2.8	M	8
Resource identifier (VPC) note 1	14.2.12	O (note 2)	11
NOTE 1: The resource identifier shall indicate a single VPC. NOTE 2: The resource identifier information element shall be included if the consistency check request procedure was not successful. Otherwise, if the procedure was successful for all requested resources then the resource identifier may be omitted.			

14.1.1.12 LSP_ID

This message is sent by the SN to the AN or by the AN to the SN to return the result of the verification to the requesting entity (see Table 40).

Table 40: LSP_ID message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Destination signalling identifier	14.2.7	M	8
Origination signalling identifier	14.2.8	M	8
Resource identifier (LSP) note	14.2.12	M	9
NOTE: The resource identifier shall indicate a single LSP.			

14.1.1.13 PROTOCOL_ERROR

This message is sent by the AN to the SN or by the SN to the AN to report certain error conditions (see Table 41).

Table 41: PROTOCOL_ERROR message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Destination signalling identifier	14.2.7	M	8
Protocol error cause	14.2.9	M	5 to 7
NOTE: Mandatory if the PROTOCOL_ERROR message is the first message in response to a message establishing a transaction. Otherwise this information element is absent.			

14.1.1.14 REQ_LSP_ID

This message is sent by the AN to the SN or by the SN to the AN to request the verification of the identity of a logical service port (see Table 42).

Table 42: REQ_LSP_ID message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Origination signalling identifier	14.2.8	M	8
NOTE: The resource identifier shall indicate a single LSP.			

14.1.1.15 RESET_ACK

This message is sent by the SN to the AN or by the AN to the SN to acknowledge that the initiated activities upon receiving the RESET_CMD message have been completed (see Table 43).

Table 43: RESET_ACK message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Destination signalling identifier	14.2.7	M	8
Origination signalling identifier	14.2.8	M	8
Resource identifier (LSP) note 1	14.2.12	O (note 2)	9
NOTE 1: The resource identifier shall indicate a single LSP. NOTE 2: The resource identifier information element shall be included if the reset procedure was not successful. Otherwise, if the procedure was successful for all requested resources then the resource identifier may be omitted.			

14.1.1.16 RESET_CMD

This message is sent by the AN to the SN or by the SN to the AN to reset a Logical Service Port (see Table 44).

Table 44: RESET_CMD message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Origination signalling identifier	14.2.8	M	8
Resource identifier (LSP) note	14.2.12	M	9
NOTE: The resource identifier shall indicate a single LSP.			

14.1.1.17 UNBLOCK_ACK

This message is sent by the SN to the AN to acknowledge that the initiated activities upon receiving the UNBLOCK_CMD message by the SN have been completed (see Table 45).

Table 45: UNBLOCK_ACK message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Destination signalling identifier	14.2.6	M	8
Origination signalling identifier	14.2.8	M	8
Repeat indicator	14.2.11	O (note 1)	5
Resource identifier (LSP, VPC(s)) note 2	14.2.12	O (note 3)	9 to 13
NOTE 1: The repeat indicator information element is included if the following information element, i.e. the resource identifier, is repeated. NOTE 2: The resource identifier shall indicate a LSP or VPC(s). NOTE 3: The resource identifier information element shall be included if the unblock procedure was not successful for some requested resources. Otherwise, if the procedure was successful for all requested resources then the resource identifier may be omitted.			

14.1.1.18 UNBLOCK_CMD

This message is sent by the AN to the SN to inform the SN that resources in the AN have been administratively unlocked (see Table 46).

Table 46: UNBLOCK_CMD message content

Information element	Reference	Type	Length
Protocol discriminator	14.2.2	M	1
Message type	14.2.3	M	2
Message length	14.2.3	M	2
Origination signalling identifier	14.2.8	M	8
Repeat indicator	14.2.11	O (note 1)	5
Resource identifier (LSP, VPC(s)) note 2	14.2.12	M	9 to 13
NOTE 1: The repeat indicator information element is included if the following information element, i.e. the resource identifier, is repeated. NOTE 2: The resource identifier shall indicate a LSP or VPC(s).			

14.2 Message format and information element coding

This subclause defines the message format and the coding of the information elements. For each information element the coding of the different fields is provided.

Within each octet, the bit designated "bit 1" shall be transmitted first, followed by bits 2, 3, 4, etc.

Similarly, the octet shown at the top of each figure shall be sent first.

14.2.1 Overview

Within this protocol, every message shall consist of the following parts:

a) protocol discriminator;

b) message type (including message compatibility instruction indicator);

c) message length;

d) other information elements, as required.

The protocol discriminator, the message type and the message length are common to all the messages and shall always be present, while other information elements are specific to each message type.

This organization is illustrated in the example shown in Figure 67.

Bits 8 7 6 5 4 3 2 1	Octet
Protocol Discriminator	1
Message Type	2 3
Message Length	4 5
Variable length information elements as required	6, etc.

Figure 67: General message organization example

Unless specified otherwise, a particular information element shall not be present more than once in a given message.

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

Table 47 summarizes the information elements for the VB5.1 RTMC protocol.

Table 47: Information elements for the VB5.1 RTMC protocol

Information element	Reference	Length
Protocol discriminator	14.2.2	1
Message type	14.2.3	2
Message length	14.2.3	2
Blocked resource identifier	14.2.5	18, 20, 22
Consistency check result information	14.2.6	5
Destination signalling identifier	14.2.7	8
Origination signalling identifier	14.2.8	8
Protocol error cause	14.2.9	5 to 7
Reason	14.2.10	5
Repeat indicator	14.2.11	5
Resource identifier	14.2.12	9, 11, 13

14.2.2 Protocol discriminator

The purpose of the protocol discriminator is to distinguish messages corresponding to the protocols defined in this ITU-T Recommendation from others corresponding to other protocols (not defined in the present document) making use of the same data link connection.

The protocol discriminator shall be the first part of every message.

The protocol discriminator shall be coded according to Figure 68.

Bits 8	7	6	5	4	3	2	1	Octet
Protocol discriminator								
0	1	0	0	1	0	0	1	1

Figure 68: Protocol discriminator coding

14.2.3 Message type and message length

14.2.3.1 Message type

The purpose of the message type is to identify both, the specific VB5.1 protocol the message belongs to and the function of the message being sent. The second part of the message type is the message compatibility instruction indicator which allows the sender of a message to indicate explicitly the way the peer entity shall handle unrecognized messages.

The message type shall be the second part of every message.

The message type is coded as shown in Figure 69 and Table 48. The length of this the message type is 2 octets. The format and coding of the message compatibility instruction indicator is shown in Figure 69 and Table 49.

Bits 8	7	6	5	4	3	2	1	Octet
Message type								1
X	X	X	X	X	X	X	X	
1 ext.	0 Spare	0	Flag	0 Spare	0	Message Action Indicator		2

Figure 69: Message type fields

Table 48: Message type coding

Bits 8	7	6	5	4	3	2	1	Message type (octet 1)
0	0	0	x	x	x	x	x	VB5.1 RTMC protocol
			0	0	0	0	0	BLOCK_CMD
			0	0	0	0	1	BLOCK_ACK
			0	0	0	1	0	CONSISTENCY_CHECK_REQ
			0	0	0	1	1	CONSISTENCY_CHECK_REQ_ACK
			0	0	1	0	0	CONSISTENCY_CHECK_END
			0	0	1	0	1	CONSISTENCY_CHECK_END_ACK
			0	0	1	1	0	REQ_LSP_ID
			0	0	1	1	1	LSP ID
			0	1	0	0	0	PROTOCOL_ERROR
			0	1	0	1	0	RESET_CMD
			0	1	0	1	1	RESET_ACK
			0	1	1	0	0	AWAIT_CLEAR
			0	1	1	0	1	AWAIT_CLEAR _ACK
			0	1	1	1	0	AWAIT_CLEAR _COMP
			0	1	1	1	1	AWAIT_CLEAR _COMP_ACK
			1	0	0	0	0	UNBLOCK_CMD
			1	0	0	0	1	UNBLOCK_ACK
All acknowledge messages shall be coded with bit 1 set to "1", while the corresponding normal message is coded with bit 1 set to "0". All other values are reserved.								

Table 49: Message compatibility instruction indicator

Bits 5	Flag (octet 2)
0	Message instruction field not significant (= regular error handling procedures apply)
1	Follow explicit instructions (these supersede the regular error handling procedures)

Bits 2	1	Message action indicator (octet 2)
0	0	Reject (by PROTOCOL_ERROR message)
0	1	Discard and ignore, i.e. the information shall be treated as if it was not received (note 1).
1	0	Discard and report (note 2)

NOTE 1: Reserved for future versions of the VB5 interface and not used by the present document.
NOTE 2: Reserved by ITU-T Recommendation Q.2931/ETS 300 443-1 [12] and not used by the present document.

All other values are reserved.

14.2.3.2 Message length

The purpose of the message length is to identify the length of the contents of a message. It is the binary coding of the number of octets of the message contents, i.e. the number of octets following the message length octets themselves.

The message length is the third part of every message.

The message length is coded as shown in Figure 70. The message length indication has a length of 2 octets.

The coding of the message length follows the coding rules for integer values outlined in subclause 14.2.4.

Bits 8	7	6	5	4	3	2	1	Octet
Message length								1 2

Figure 70: Message length coding

14.2.4 Coding rules for variable length information elements

For the coding of the information elements the same rules apply as defined in ITU-T Recommendation Q.2931/ ETS 300 443-1 [12], clause 4.5.1, without the Broadband shift functionality, i.e. there shall be only one codeset.

From a terminology point of view the following holds:

- The VB5.1 coding of integer shall be as defined in ITU-T Recommendation Q.2931/ ETS 300 443-1 [12].
- The VB5.1 SN is represented by the "exchange" of ITU-T Recommendation Q.2931/ETS 300 443-1 [12] while the VB5.1 AN is indicated by the "user/equipment" of ITU-T Recommendation Q.2931/ETS 300 443-1 [12].
- The VB5.1 "Repeat indicator" is equivalent to the "Broadband repeat indicator" of ITU-T Recommendation Q.2931/ETS 300 443-1 [12].

The information element identifiers are defined in Table 50, which also gives the coding of the information identifier bits.

Table 50: Information element identifiers

Bits								Information element identifiers
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
1	0	0	0	0	0	0	0	Blocked resource identifier
1	0	0	0	0	0	0	1	Consistency check result information
1	0	0	0	0	0	1	0	Destination signalling identifier
1	0	0	0	0	0	1	1	Origination signalling identifier
0	0	0	0	1	0	0	0	Protocol error cause
1	0	0	0	0	1	0	0	Reason
0	1	0	0	0	0	1	1	Repeat indicator
1	0	0	0	0	1	0	1	Resource identifier
NOTE: The coding is the same as in ITU-T Recommendation Q.2931/ETS 300 443-1 [12], where applicable. For VB5.1 specific information elements bit 8 is coded as "1". All other values are reserved.								

The information element action indicator defined in ITU-T Recommendation Q.2931/ETS 300 443-1 [12] shall be used as indicated in Table 51.

Table 51: Information element action indicator

Bits			Information element action indicator (octet 2)
3	**2**	**1**	
0	0	0	Reject (by PROTOCOL_ERROR message)
0	0	1	Discard information element and proceed
0	1	0	Discard information element, proceed, and report status (note)
1	0	1	Discard message, and ignore, i.e. the information shall be treated as if it was not received.
1	1	0	Discard message, and report status (note)
NOTE: Reserved by ITU-T Recommendation Q.2931/ETS 300 443-1 [12] and not used by the present document. All other values are reserved.			

14.2.5 Blocked resource identifier

The blocked resource identifier information element is a container which carries the Resource identifier (refer to subclause 14.2.12) and the Reason (refer to subclause 14.2.10) information elements. It identifies the resources on which the BLOCK_CMD message applies and gives in addition the reason for blocking the resource.

The blocked resource identifier information element is coded as shown in Figure 71. The maximum length of this information element is 22 octets.

Bits 8	7	6	5	4	3	2	1	Octet
Blocked resource identifier information element identifier: 1	0	0	0	0	0	0	1	1
1 ext.	Coding Standard		Information element instruction field: Flag	Res.	IE Action Indicator			2
Length of Blocked resource identifier content								3 4
Resource Identifier information element (refer to subclause 14.2.12)								
Reason information element (refer to subclause 14.2.10)								

Figure 71: Blocked resource identifier information element coding

14.2.6 Consistency check result information

The consistency check result information element provides the result of a consistency check procedure.

The consistency check result information element is coded as shown in Figure 72 and Table 52. The length of this information element is 5 octets.

Bits 8	7	6	5	4	3	2	1	Octet
Consistency check result information element identifier: 1	0	0	0	0	0	0	0	1
1 ext.	Coding Standard		Information element instruction field: Flag	Res.	IE Action Indicator			2
Length of Consistency check result information contents								3 4
1 ext.	0	0	0	0	0	VPCI check result indicator		5
	Spare							

Figure 72: Consistency check result information element coding

Table 52: Consistency check result information element - check result indicator coding

Bits 2	Bits 1	VPCI check result indicator (octet 5)
0	0	Virtual Path Connection Identifier check not successful
0	1	Virtual Path Connection Identifier check successful
1	0	Virtual Path Connection Identifier check not performed
All other values are reserved.		

14.2.7 Destination signalling identifier

The destination signalling identifier information element provides the identification of the signalling association at the destination protocol side (receiver) of a message.

The destination signalling identifier information element is coded as shown in Figure 73. The length of this information element is 8 octets.

Bits 8	7	6	5	4	3	2	1	Octet
Destination signalling identifier information element identifier								
1	0	0	0	0	0	0	1	1
1 ext.	Coding Standard		Information element instruction field: Flag	Res.	IE Action Indicator			2
Length of Destination signalling identifier information contents								3, 4
Control ID								5, 6, 7, 8

Figure 73: Destination signalling identifier information element coding

The control ID shall be coded as a 32 bit binary value. It is a bit string representing the identification allocated to the signalling association.

14.2.8 Origination signalling identifier

The origination signalling identifier information element provides the identification of the signalling association at the origination protocol side (sender) of a message.

The origination signalling identifier information element is coded as shown in Figure 74. The length of this information element is 8 octets.

Bits 8	7	6	5	4	3	2	1	Octet
Origination signalling identifier information element identifier								
1	0	0	0	0	0	1	0	1
1 ext.	Coding Standard		Information element instruction field: Flag	Res.	IE Action Indicator			2
Length of Origination signalling identifier information contents								3, 4
Control ID								5, 6, 7, 8

Figure 74: Origination signalling identifier information element coding

The control ID shall be coded as a 32 bit binary value. It is a bit string representing the identification allocated to the signalling association.

14.2.9 Protocol error cause

The protocol error cause information element provides the cause for rejection of a message or request.

The protocol error cause information element is coded as shown in Figure 75 and Table 53. The length of this information element is 5 to 7 octets.

<table>
<tr><td colspan="8">Bits</td><td></td></tr>
<tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>Octet</td></tr>
<tr><td colspan="8">Protocol error cause
0 0 0 0 1 0 0 0
information element identifier</td><td>1</td></tr>
<tr><td>1
ext.</td><td colspan="2">Coding
Standard</td><td colspan="5">Information element instruction field
Flag | Res. | IE Action Indicator</td><td>2</td></tr>
<tr><td colspan="8">Length of Protocol error cause information contents</td><td>3
4</td></tr>
<tr><td>1 ext</td><td colspan="7">Protocol error cause value</td><td>5</td></tr>
<tr><td colspan="8">Diagnostic(s) (if any)</td><td>6*
6n*</td></tr>
</table>

Figure 75: Protocol error cause information element coding

Table 53: Protocol error cause values

Bits 7	6	5	4	3	2	1	Protocol error cause value (octet 5)	Diagnostics
0	0	0	0	0	0	1	Message type unrecognized	Message type identifier
0	0	0	0	0	1	0	Repeated information element	Message type identifier Information element identifier
0	0	0	0	0	1	1	Mandatory information element missing	Message type identifier Information element identifier
0	0	0	0	1	0	0	Unrecognized information element	Message type identifier Information element identifier
0	0	0	0	1	0	1	Information element content error	Message type identifier Information element identifier
0	0	0	0	1	1	0	Information element not allowed	Message type identifier Information element identifier
0	0	0	0	1	1	1	Message not compatible with path state	Message type identifier
All other values are reserved.								

14.2.10 Reason

The purpose of the reason information element is to indicate the reason for the message send.

The Reason information element is coded as shown in Figure 76 and Table 54. The length of this information element is 5 octets.

Bits 8	7	6	5	4	3	2	1	Octet
Reason 1	0	0	0	0	0	1	1	1
information element identifier								
1 ext.	Coding Standard		Information element instruction field Flag	Res.	IE Action Indicator			2
Length of Reason information contents								3 4
1 ext	Error Reason Value		Administrative reason value					5

Figure 76: Reason information element coding

Table 54: Administrative reason information element values

Bits 5	**4**	**3**	**2**	**1**	**Administrative reason (octet 5)**
0	0	0	0	0	None
0	0	0	0	1	Administrative reason - test calls allowed
0	0	0	1	0	Administrative reason - cell flow inhibited
All other values are reserved.					

Table 55: Error reason information element values

Bits 7	**6**	**Error reason (octet 5)**
0	0	None
0	1	Error
NOTE: Indication of the error location (user equipment or B-DS) is for further study. All other values are reserved.		

14.2.11 Repeat indicator

The purpose of the repeat indicator information element is to indicate how repeated information elements shall be interpreted, when included in a message. The repeat indicator information element is included before the first occurrence of the information element which will be repeated in a message.

The current use of the repeat indicator information element is to indicate the repetition of the resource identifier information element for multiple VPCs to be operated on.

The maximum number of allowed repetitions of the resource identifier information element shall be 185.

NOTE: The value 185 is calculated as follows:

maximum message length	4 096	octets
protocol discriminator information element	- 1	octets
message type information element	- 2	octets
message length information element	- 2	octets
destination signalling identifier information element	- 8	octets
originating signalling identifier information element	- 8	octets
repeat information element	- 5	octets
left for resource identifier information elements	= 4 070	octets
blocked resource identifier information element	/ 22	octets
maximum number of repetitions	= 185	

Use of the repeat indicator information element in conjunction with an information element that occurs only once in a message shall not in itself constitute an error.

The repeat indicator information element is coded as shown in Figure 77 and Table 56. The length of this information element is 5 octets.

Bits 8	7	6	5	4	3	2	1	Octet
Repeat indicator information element identifier: 0	1	0	0	0	0	1	1	1
1 ext.	Coding Standard		Information element instruction field: Flag	Res.	IE Action Indicator			2
Length of Repeat indicator information contents								3 4
1 ext.	0 Spare	0	0	Repeat indication				5

Figure 77: Repeat indicator information element coding

Table 56: Repeat indicator information element values

Bits 4	**3**	**2**	**1**	**Repeat indication (octet 5)**
0	0	1	1	List of multiple information elements
All other values are reserved.				

14.2.12 Resource identifier

The resource identifier information element identifies the resources on which the message applies.

The resource identifier information element is coded as shown in Figure 78 and Table 57. The maximum length of this information element is 13 octets.

Bits 8	7	6	5	4	3	2	1	Octet
Resource identifier information element identifier: 1	0	0	0	0	1	0	0	1
1 ext.	Coding Standard		Information element instruction field: Flag	Res.	IE Action Indicator			2
Length of resource identifier contents								3, 4
1 ext	0 (Spare)	0	0	0	Resource indicator			5
1 ext	Resource and operation status							6
Logical user port identifier (note 1)/ Logical service port identifier								7, 8, 9
VPCI (note 2)								10 *, 11 *
VPCI								12 *, 13 *

NOTE 1: The VPCI(s) shall be present if octets 6 to 8 indicates a Logical User Port Identifier.
NOTE 2: The VPCI may be repeated once to indicate a range of VPCs.

Figure 78: Resource identifier information element coding

Table 57: Resource identifier information element values

Bits 3	2	1	Resource indicator (octet 5)	VPCI field
0	0	0	Complete logical service port	no
0	0	1	Connection(s) at the logical service port: VPCs	repeat
1	0	1	Connection(s) at the logical user port: VPCs	repeat

All other values are reserved.

no: This field shall be absent.
repeat: This field shall be present and may be repeated one time to indicate a range of values.

Bits 7	6	5	4	3	2	1	Resource and operation status
0	0	0	0	0	0	0	Unspecified (note)
0	0	0	0	0	0	1	OK, operation successful
0	0	0	0	0	1	0	LSP ID unknown
0	0	0	0	0	1	1	LUP ID unknown
0	0	0	0	1	0	0	VPCI unknown
0	0	0	0	1	0	1	Rejected

NOTE: This value shall be used by the sending side of BLOCK_CMD, UNBLOCK_CMD, AWAIT_CLEAR and RESET_CMD messages. The receiving side shall ignore this value.

All other values are reserved.

Logical user port identifier/ Logical service port identifier	binary 24 bit value	This value identifies a Logical user port or a logical service port (note 1) The numeric value is in the range of 0 through 16 777 215
VPCI	binary 16 bit value	This value identifies a virtual path connection (note 2) The numeric value is in the range of 0 through 65 535

NOTE 1: For the use of logical user port/logical service port identifiers see subclause 7.3.2.
NOTE 2: For the use of VPCIs see subclause 7.3 "Broadband access network connection element identifiers".

Annex A (normative): SDL process diagrams

A.1 Messages and primitives

A.1.1 Data type definitions

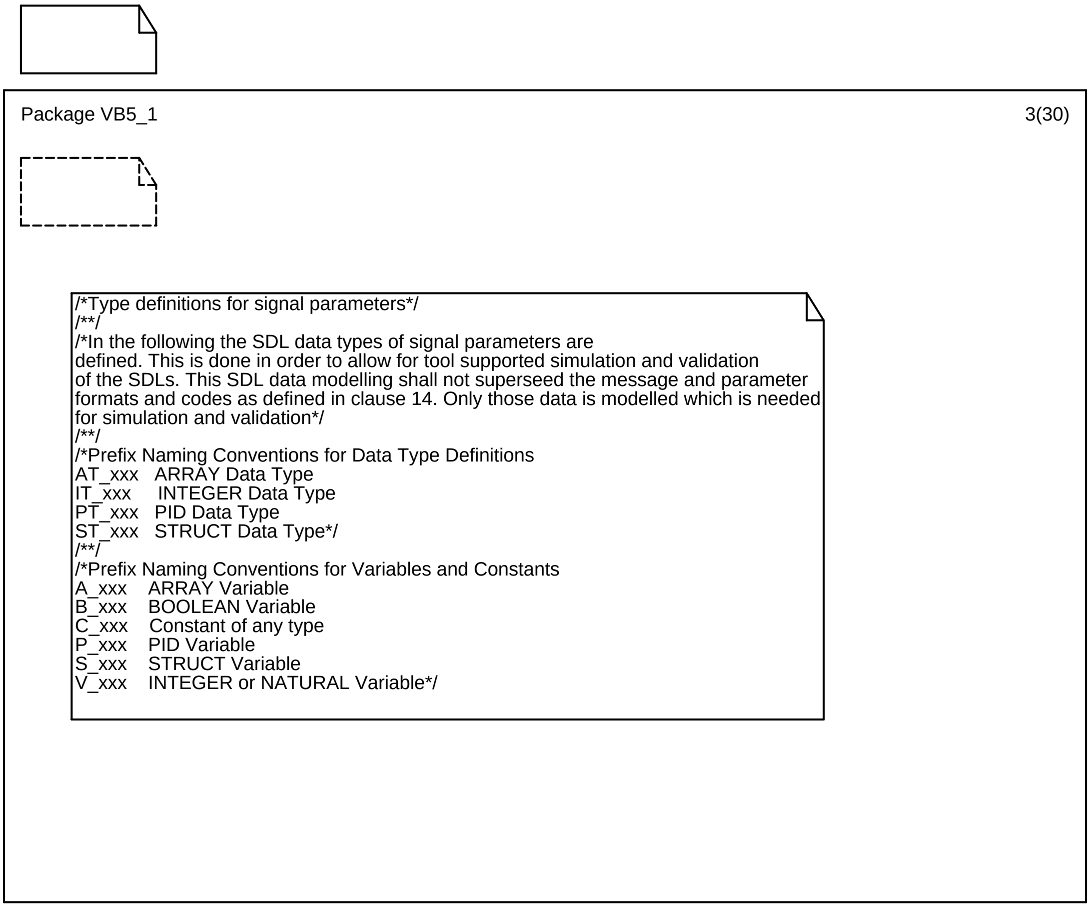


Figure A.1: Data naming conventions

Package VB5_1 4(30)

/*Data Type Definitions for VB5 messages*/

```
/*RESOURCE IDENTIFIER Information Element*/
/*refer to subclause 14.2.11*/
/**/
/*Typedefinition for Resource Indicator*/
/*refer to table 50*/
SYNTYPE IT_RTMCRscInd = INTEGER
   CONSTANTS 0:2
ENDSYNTYPE IT_RTMCRscInd;
/*Possible Resource Indicator Values*/
SYNONYM C_CompLSP IT_RTMCRscInd = 0; /*Complete LSP*/
SYNONYM C_ConnLSP IT_RTMCRscInd = 1; /*Connections at LSP*/
SYNONYM C_ConnLUP IT_RTMCRscInd = 2; /*Connections at LUP*/
/**/
/*Typedefinition for Resource and Operation Status*/
/*refer to table 50*/
SYNTYPE IT_RTMCRscOpStatus = INTEGER
   CONSTANTS 0:4
ENDSYNTYPE IT_RTMCRscOpStatus;
/*Possible Resource and Operation Status values*/
SYNONYM C_OpSuccess   IT_RTMCRscOpStatus = 1; /*Operation successful*/
SYNONYM C_LSPidUnk    IT_RTMCRscOpStatus = 2; /*LSP id unknown*/
SYNONYM C_LUPidUnk    IT_RTMCRscOpStatus = 3; /*LUP id unknown*/
SYNONYM C_VPCIUnk     IT_RTMCRscOpStatus = 4; /*VPCI unknown*/
/**/
/*Typedefinition for Resource Identifier Information Element*/
/*refer to figure 89*/
NEWTYPE ST_RTMCRscId STRUCT
   V_RscInd           IT_RTMCRscInd;       /*Resource Indicator*/
   V_RscOpStatus   IT_RTMCRscOpStatus;   /*Resource and Operation Status*/
   V_LogId            NATURAL;          /*LUP Identifier/LSP Identifier*/
   V_VPCI             NATURAL;          /*VPCI*/
ENDNEWTYPE;
/**/
/*Typedefinition for Unknown Resource Identifier Information Element*/
SYNTYPE ST_RTMCUnkRscId = ST_RTMCRscId
ENDSYNTYPE ST_RTMCUnkRscId;
```

```
/*BLOCKED RESOURCE IDENTIFIER Information Element*/
/*refer to subclause xxx*/
/**/
/*Typedefinition for Blocked Resource Identifier Information Element*/
/*refer to figure xx*/
NEWTYPE ST_RTMCBlRscId STRUCT
   S_RTMCRscId         ST_RTMCRscId;       /*Resource Identifier IE*/
   S_RTMCReason        ST_RTMCReason;   /*Reason IE*/
ENDNEWTYPE;
```

Figure A.2: Data type definitions for VB5.1 messages (1)

Package VB5_1 5(30)

```
/*Data Type Definitions for
VB5 messages*/
```

```
/*Typedefinition for repeated information elements*/
/**/
/*Definition of maximum number of repetitions*/
SYNONYM C_RTMCMaxRep INTEGER =184;
/**/
/*Typedefinition for indexing a specific repeated information element*/
SYNTYPE IT_RTMCRscTabIndex = INTEGER
   CONSTANTS 1:C_RTMCMaxRep
ENDSYNTYPE IT_RTMCRscTabIndex;
/**/
/*Typedefinition for repeated Resource Identifier Information Elements in a RTMC message*/
NEWTYPE AT_RTMCRscTab ARRAY
   (IT_RTMCRscTabIndex,ST_RTMCRscId)
ENDNEWTYPE;
/**/
/*Typedefinition for repeated Blocked Resource Identifier Information Elements in a RTMC message*/
NEWTYPE AT_RTMCBlRscTab ARRAY
   (IT_RTMCRscTabIndex,ST_RTMCBlRscId)
ENDNEWTYPE;
/**/
/*Typedefinition for list of resources unknown by the peer side*/
/**/
SYNTYPE AT_RTMCUnkRscTab = AT_RTMCRscTab
ENDSYNTYPE AT_RTMCUnkRscTab;
```

Figure A.3: Data type definitions for VB5.1 messages (2)

```
Package VB5_1                                                    6(30)

/*Data Type Definitions for
VB5 messages*/

/*REASON Information Element*/
/*refer to subclause 14.2.9*/
/**/
/*Typedefinition for Administrative Reason Value*/
/*refer to table 48*/
SYNTYPE IT_RTMCAdmReasonVal = INTEGER
   CONSTANTS 0:2
ENDSYNTYPE IT_RTMCAdmReasonVal;
/*Possible Administrative Reason Values*/
SYNONYM C_RTMCAdmNone IT_RTMCAdmReasonVal = 0;
SYNONYM C_RTMCAdmPart IT_RTMCAdmReasonVal = 1;
SYNONYM C_RTMCAdmFull IT_RTMCAdmReasonVal = 2;
/**/
/*Typedefinition for Error Reason Value*/
/*refer to table 48*/
SYNTYPE IT_RTMCErrReasonVal = INTEGER
   CONSTANTS 0:1
ENDSYNTYPE IT_RTMCErrReasonVal;
/*Possible Error Reasons*/
SYNONYM C_RTMCErrNone IT_RTMCErrReasonVal = 0;
SYNONYM C_RTMCErr IT_RTMCErrReasonVal = 1;
/**/
/*Typedefinition for Reason IE*/
/*refer to table 48*/
NEWTYPE ST_RTMCReason STRUCT
   V_RTMCAdmReasonVal IT_RTMCAdmReasonVal;
   V_RTMCErrReasonVal    IT_RTMCErrReasonVal;
ENDNEWTYPE ST_RTMCReason;
```

Figure A.4: Data type definitions for VB5.1 messages (3)

Package VB5_1 7(30)

```
/*Data Type Definitions for
VB5 messages*/
```

```
/*PROTOCOL ERROR CAUSE Information Element*/
/*refer to subclause 14.2.8*/
/**/
/*Typedefinition for Protocol Error Cause Value*/
/* refer to table 47*/
SYNTYPE IT_RTMCProtErrCause = INTEGER
   CONSTANTS 1:7
ENDSYNTYPE IT_RTMCProtErrCause;
/**/
/*Possible Protocol Error Cause Values*/
SYNONYM C_UnkMsgType                IT_RTMCProtErrCause = 1;
SYNONYM C_RepIE                     IT_RTMCProtErrCause = 2;
SYNONYM C_MandIEMiss                IT_RTMCProtErrCause = 3;
SYNONYM C_UnrecogIE                 IT_RTMCProtErrCause = 4;
SYNONYM C_IEContErr                 IT_RTMCProtErrCause = 5;
SYNONYM C_IENotAllowed              IT_RTMCProtErrCause = 6;
SYNONYM C_MsgNotCompatWithProtState IT_RTMCProtErrCause = 7;
```

```
/*CONSISTENCY CHECK RESULT Information Element*/
/*refer to subclause 14.2.5*/
/**/
/*Typedefinition for VPCI check result indicator*/
/* refer to table 46*/
SYNTYPE IT_RTMCCCheckResult = INTEGER
   CONSTANTS 0:2
ENDSYNTYPE IT_RTMCCCheckResult;
```

```
/*Destination Signalling Identifier IE*/
/*refer to subclause 14.2.6*/
SYNTYPE PT_DestSigId = PID
ENDSYNTYPE PT_DestSigId;
/**/
/*Origionation Signalling Identifier IE*/
/*refer to subclause 14.2.7*/
SYNTYPE PT_OrigSigId = PID
ENDSYNTYPE PT_OrigSigId;
```

Figure A.5: Data type definitions for VB5.1 messages (4)

Package VB5_1 8(30)

/*Data Type Definitions for Primitives*/

```
/* REQUIRED ACTION TO SN*/
/**/
/*used in MPH_ confirmation primitives between AN_VPCSTAT/AN_LSPSTAT and the AN_STATUS_MGT process*/
/**/
SYNTYPE IT_ActToSn = INTEGER
ENDSYNTYPE IT_ActToSn;
/*Possible Values*/
/**/
SYNONYM C_NoActToSN IT_ActToSn = 0;  /*No message to be sent to SN*/
SYNONYM C_BlToSN    IT_ActToSn = 1;  /*Send BLOCK_CMD to SN*/
SYNONYM C_UblToSN   IT_ActToSn = 2;  /*Send UNBLOCK_CMD to SN*/
SYNONYM C_AclToSN    IT_ActToSn = 3;  /*Send AWAIT_CLEAR to SN*/
```

```
/*NUMBER OF RESOURCES*/
/**/
/*Used in MEE_ request primitives to the AN_STATUS_MGT process*/
/**/
SYNTYPE IT_NoOfRsc = INTEGER
ENDSYNTYPE IT_NoOfRsc;
```

```
/*STATUS CHANGE REASONS*/
/**/
/*Used in MEE_ request messages to AN_STATUS_MGT process*/
/**/
SYNTYPE IT_EnvReasonVal = INTEGER
   CONSTANTS 0:3
ENDSYNTYPE IT_EnvReasonVal;
/**/
/*Used in MPH_ confirmation primitives from AN_VPCSTAT/AN_LSPSTAT processes to AN_STATUS_MGT process*/
/**/
SYNTYPE IT_IntReasonVal = INTEGER
   CONSTANTS 1:6
ENDSYNTYPE IT_IntReasonVal;
/**/
/*Possible Values*/
SYNONYM C_Uncond    INTEGER = 0;  /*Unconditional State Change (used by reset procedure)*/
SYNONYM C_AdmPart    INTEGER = 1;  /*Admin Partial*/
SYNONYM C_AdmFull    INTEGER = 2;  /*AdminFulll*/
SYNONYM C_Err    INTEGER = 3;  /*Error*/
SYNONYM C_AdmPart_Err    INTEGER = 4;  /*Admin Partial and Error*/
SYNONYM C_AdmFull_Err    INTEGER = 5;  /*Admin Full and Error*/
```

Figure A.6: Data type definitions for primitives (1)

```
Package VB5_1                                                    9(30)

/*Data Type Definitions for
Primitives*/

/*LIST OF RESOURCES*/
/**/
/*List of resources used in MEE_ request primitives*/
/**/
NEWTYPE AT_EnvRscTab ARRAY
    (INTEGER, ST_RTMCRScId)
ENDNEWTYPE AT_EnvRscTab;
/**/
/*List of resources unknown by the peer side, used in MEE_ confirmation primitives*/
/**/
NEWTYPE AT_EnvUnkRscTab ARRAY
    (INTEGER, ST_RTMCRScId)
ENDNEWTYPE AT_EnvUnkRscTab;
/**/
/*List of blocked resources used in MEE_block_ind primitive in the SN*/
/**/
NEWTYPE ST_BlRsc STRUCT
   S_RscId              ST_RTMCRscID;
   V_IntReasonVal   IT_IntReasonVal;
ENDNEWTYPE ST_BlRsc;
/**/
NEWTYPE AT_EnvBlRscTab ARRAY
   (INTEGER, ST_BlRsc)
ENDNEWTYPE AT_EnvBlRscTab;

/*OPERATION RESULT*/
/**/
/*used in MEE_ confirmation primitives to the environment*/
/**/
SYNTYPE IT_Result = INTEGER
ENDSYNTYPE IT_Result;
/**/
/*Possible Values*/
SYNONYM C_Success   IT_Result = 0;
SYNONYM C_NoSuccess IT_Result = 1;
SYNONYM C_Incomplete IT_Result = 2;

/*INTERNAL TRANSACTION IDENTIFIER*/
/**/
/*used in MDU_ primitives from/to AN_STATUS_MGT process in order to identify all RTMC messages which have
  been triggered by a single MEE_ request*/
/**/
SYNTYPE IT_IntTransActId = INTEGER
ENDSYNTYPE IT_IntTransActId;
/**/
/*Data Type Definitions for CPROT Process instance ID*/
/**/
SYNTYPE PT_CprotPID = PID
ENDSYNTYPE PT_CprotPID;
```

Figure A.7: Data Type definitions for primitives (2)

A.1.2 VB5.1 RTMC messages

Package VB5_1 10(30)

/*Declaration of VB5 messages*/

```
signal
BLOCK_CMD (PT_OrigSigId, AT_RTMCBlRscTab),
/*Indication from AN to SN that resources (LSP or VPCs) have become unavailable for Call Processing
*/
BLOCK_ACK (PT_DestSigId, PT_OrigSigId, AT_RTMCUnkRscTab),
/*Direct acknowledgement  on BLOCK_CMD
*/
UNBLOCK_CMD (PT_OrigSigId, AT_RTMCRscTab),
/*Indication from AN to SN that resources (LSP or VPCs) have become available for Call Processing
*/
UNBLOCK_ACK (PT_DestSigId, PT_OrigSigId, AT_RTMCUnkRscTab),
/*Direct acknowledgement  on UNBLOCK_CMD
*/
AWAIT_CLEAR (PT_OrigSigId, AT_RTMCRscTab),
/*Request from AN to SN to shutdown resources (VPCs)
*/
AWAIT_CLEAR_ACK (PT_DestSigId, PT_OrigSigId, AT_RTMCUnkRscTab),
/*Direct acknowledgement  on AWAIT_CLEAR
*/
AWAIT_CLEAR_COMP (PT_OrigSigId, AT_RTMCRscTab),
/*Indication from SN to AN that no on-demand connections are any longer present on the indicated resources
*/
AWAIT_CLEAR_COMP_ACK (PT_DestSigId, PT_OrigSigId),
/*Direct acknowledgement  on SHUTDOWN_COMP
*/
REQ_LSP_ID (PT_OrigSigId),
/*Request to the peer side to report its LSP ID
*/
LSP_ID (PT_DestSigId, PT_OrigSigId, ST_RTMCRscId),
/*Direct acknowledgement  on REQ_LSP_ID
*/
RESET_CMD (PT_OrigSigId, ST_RTMCRscId),
/*Request to the peer side to reset resources (LSP), i.e. to release all on-demand connections
*/
RESET_ACK (PT_DestSigId, PT_OrigSigId, ST_RTMCUnkRscId),
/*Direct acknowledgement  on RESET_CMD
*/
CONSISTENCY_CHECK_REQ (PT_OrigSigId, ST_RTMCRscId),
/*Request from SN to AN to start VPCI consistency check procedure
*/
CONSISTENCY_CHECK_REQ_ACK (PT_DestSigId, PT_OrigSigId, ST_RTMCUnkRscId),
/*Direct acknowledgement  on CONSISTENCY_CHECK_REQ
*/
CONSISTENCY_CHECK_END (PT_OrigSigId, ST_RTMCRscId),
/*Request from SN to AN to stop VPCI consistency check procedure
*/
CONSISTENCY_CHECK_END_ACK (PT_DestSigId, PT_OrigSigId, IT_RTMCCCheckResult),
/*Direct acknowledgement  on CONSISTENCY_CHECK_END
*/
PROTOCOL_ERROR (PT_DestSigId, IT_RTMCProtErrCause);
/*Reporting of protocol errors to the peer side*/
```

Figure A.8: VB5.1 RTMC messages

A.1.3 Primitives

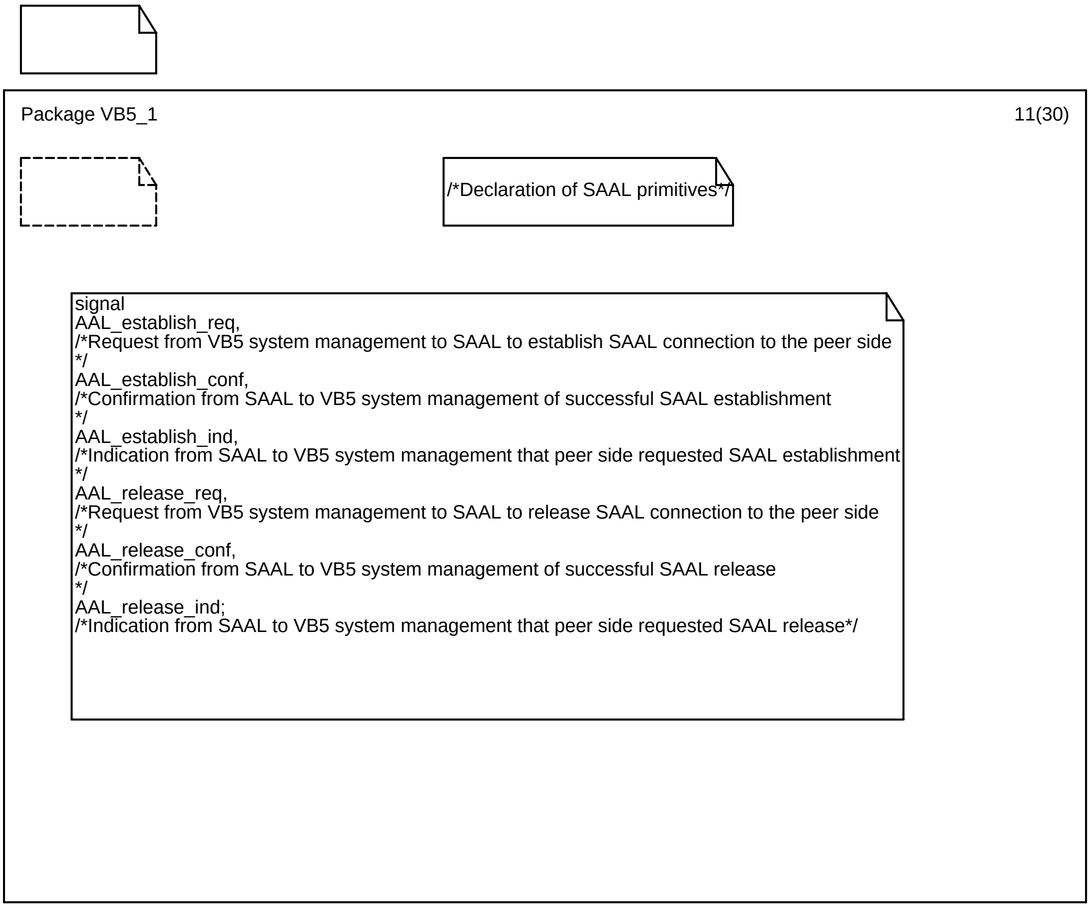


Figure A.9: SAAL primitives

Package VB5_1 12(30)

```
/*MPH Primitive, common for AN and SN*/
/**/
signal
MPH_VPC_started (ST_RTMCRscId);
/*VPCSTATFM informs AN_STATUS_MGT and SN_STATUS_MGT processes abour its start up*/
```

```
/*Declaration of primitives from/to
AN_LSPSTAT and AN_VPCSTAT processes*/
```

```
signal
MPH_VPC_unblock_req (ST_RTMCRscId, IT_EnvReasonVal),
/*VPC STATFSM is requested to reset a blocking reason
*/
MPH_VPC_unblock_conf ( IT_ActToSn, ST_RTMCRscId, IT_IntReasonVal),
/*VPC STATFSM confirms the resetting of a blocking reason
*/
MPH_VPC_block_req (ST_RTMCRscId, IT_EnvReasonVal),
/*VPC STATFSM is requested to set a blocking reason
*/
MPH_VPC_block_conf ( IT_ActToSn, ST_RTMCRscId, IT_IntReasonVal),
/*VPC STATFSM confirms the setting of a blocking reason
*/
MPH_VPC_await_clear_req  (ST_RTMCRscId, IT_EnvReasonVal),
/*VPC STATFSM is requested to enter the shutdown state
*/
MPH_VPC_await_clear_conf ( IT_ActToSn, ST_RTMCRscId),
/*VPC STATFSM confirms the transition to the shutdown state
*/
MPH_LSP_unblock_req (IT_EnvReasonVal),
/*LSP STATFSM is requested to reset a blocking reason
*/
MPH_LSP_unblock_conf ( IT_ActToSn, IT_IntReasonVal),
/*LSP STATFSM confirms the resetting of a blocking reason
*/
MPH_LSP_block_req (IT_EnvReasonVal),
/*LSP STATFSM is requested to set a blocking reason
*/
MPH_LSP_block_conf ( IT_ActToSn, IT_IntReasonVal);
/*LSP STATFSM confirms the setting of a blocking reason*/
```

Figure A.10: AN_LSPSTAT and AN_VPCSTAT primitives

Package VB5_1 13(30)

```
/*Declaration of primitives from/to
SN_LSPSTAT and SN_VPCSTAT processes*/
```

```
signal
MPH_VPC_unblock_ind,
/*Indication to SN_VPCSTAT process that all blocking reason have been reset in the AN
*/
MPH_VPC_unblock_res,
/* SN_VPCSTAT process confirms the resetting of all blocking reasons
*/
MPH_VPC_block_ind (IT_IntReasonVal),
/*Indication to SN_VPCSTAT process that a blocking reason has been set in the AN
*/
MPH_VPC_block_res,
/*VPC STATFSM confirms the setting of a blocking reason
*/
MPH_VPC_await_clear_ind,
/*VPC STATFSM is requested to enter the shutdown state
*/
MPH_VPC_await_clear_res,
/*VPC STATFSM confirms the transition to the shutdown state
*/
MPH_LSP_unblock_ind,
/*Indication to SN_LSPSTAT process that all blocking reason have been reset in the AN
*/
MPH_LSP_unblock_res,
/* SN_VPCSTAT process confirms the resetting of all blocking reasons
*/
MPH_LSP_block_ind (IT_IntReasonVal),
/*Indication to SN_VPCSTAT process that a blocking reason has been set in the AN
*/
MPH_LSP_block_res;
/*VPC STATFSM confirms the setting of a blocking reason*/
```

Figure A.11: SN_LSPSTAT and SN_VPCSTAT primitives

Package VB5_1 14(30)

/*Declaration of common primitives from/to the environment*/

```
signal
MEE_verify_LSP_ID_req,
/*Environment requests the verification of the LSP ID
*/
MEE_verify_LSP_ID_conf (IT_Result),
/* Environment is informed about the result of the verify LSP ID procedure
*/
MEE_reset_req (ST_RTMCRscId),
/*Environment requests the reset of resources (LSP), SN shall be informed
*/
MEE_reset_conf (ST_RTMCUnkRscId, IT_Result),
/* Environment is informed about the result of the reset procedure
*/
MEE_reset_ind (ST_RTMCRscId),
/*Environment is informed about the reset of resources (LSP) by the peer side
*/
MEE_startup_req,
/*Environment requests the start-up of the VB5 interface
*/
MEE_startup_conf (IT_Result),
/* Environment is informed about the result of the startup procedure
*/
MEE_startup_ind,
/* Environment is informed about the startup of the interface invoked by the other side
*/
MEE_stop_traffic_req,
/* Environment requests the stopping of all communication to the peer side, SAAL is to be released
*/
MEE_stop_traffic_conf,
/* Environment is informed about the stopping of communication to the peer side
*/
MEE_LSP_failure_ind,
/* Environment is informed about an LSP failure (i.e SAAL failure)
*/
MEE_error_ind;
/*Environment is informed about detected protocol errors*/
```

Figure A.12: Environment primitives common for AN and SN

Package VB5_1 15(30)

/*Declaration of AN specific primitives
from/to the environment*/

```
signal
MEE_block_req (IT_NoOfRsc, AT_EnvRscTab,  IT_EnvReasonVal),
/*Environment requests the blocking of resources (LSP or VPCs), SN shall be informed
*/
MEE_block_conf (AT_EnvUnkRscTab, IT_Result),
/* Environment is informed about the result of the block procedure
*/
MEE_unblock_req (IT_NoOfRsc, AT_EnvRscTab,  IT_EnvReasonVal),
/*Environment requests the unblocking of resources (LSP or VPCs), SN shall be informed
*/
MEE_unblock_conf (AT_EnvUnkRscTab, IT_Result),
/* Environment is informed about the result of the unblock procedure
*/
MEE_await_clear_req (IT_NoOfRsc, AT_EnvRscTab, IT_EnvReasonVal),
/*Environment requests the shutting down of resources (VPCs), SN shall be informed
*/
MEE_await_clear_conf (AT_RTMCRscTab),
/* Environment is informed about the result of the shutdown procedure
*/
MEE_cons_check_ind (ST_RTMCRscId),
/* Environment is informed about the request of invoking a VPCI consistency check procedure
*/
MEE_cons_check_res (ST_RTMCUnkRscId),
/*Environment responds to the VPCI consistency check request
*/
MEE_cons_check_end_ind (ST_RTMCRscId),
/* Environment is informed about the request of terminating a VPCI consistency check procedure
*/
MEE_cons_check_end_res ( IT_RTMCCCheckResult);
/*Environment responds to the VPCI consistency check end request*/
```

Figure A.13: Environment primitives specific for AN

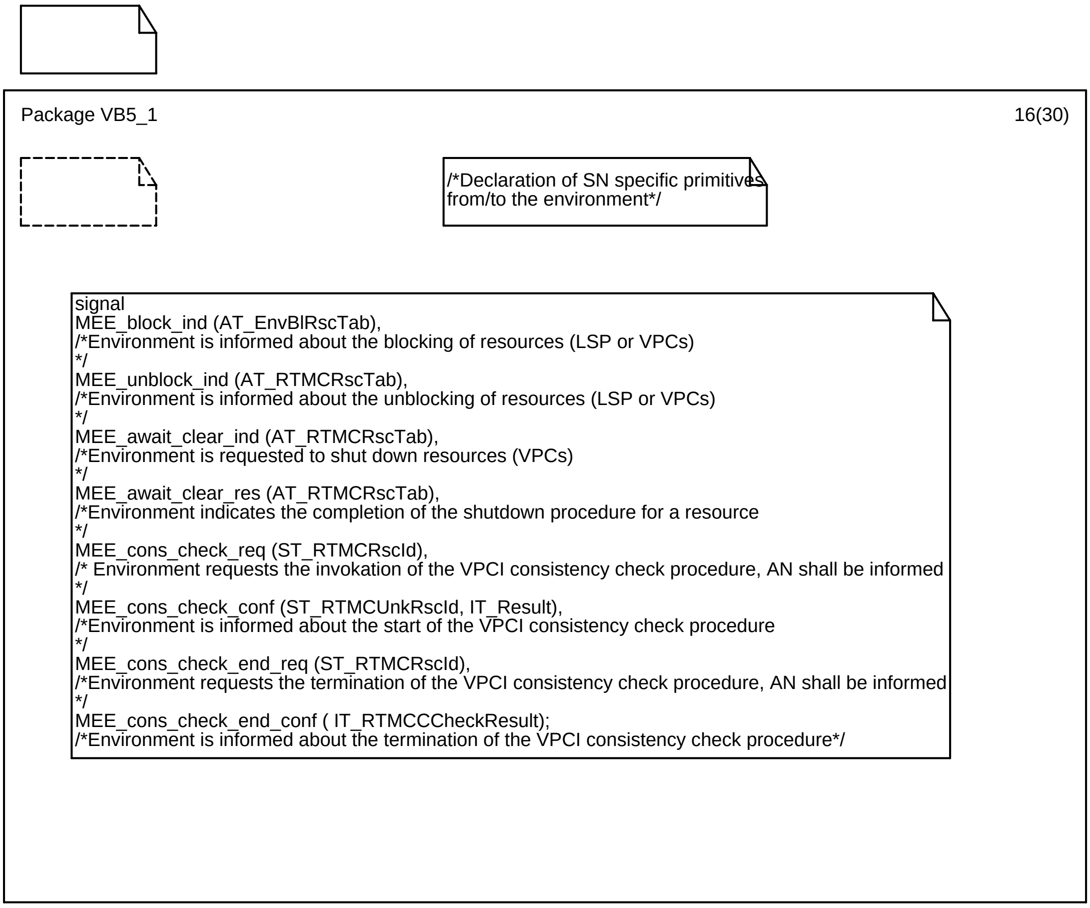


Figure A.14: Environment primitives specific for SN

Package VB5_1 17(30)

/*Declaration of common primitives
from/to CPROT entitiy*/

signal
MDU_reset_req (ST_RTMCRscId),
/*CPROT entity is requested to send a RESET_CMD message for the LSP to the SN
*/
MDU_reset_ind (PT_CprotPID, ST_RTMCRscId),
/*CPROT entity indicates the reception of a RESET_CMD message for the LSP from the SN
*/
MDU_reset_res (PT_CprotPID, ST_RTMCUnkRscId),
/*CPROT entity is requested to send a RESET_ACK message for the LSP to the SN
*/
MDU_reset_conf (ST_RTMCUnkRscId),
/*CPROT entity confirms the execution of the reset LSP procedure
*/
MDU_LSP_ID_req,
/*CPROT entity is requested to send a REQUEST_LSP_ID message to the SN
*/
MDU_LSP_ID_ind (PT_CprotPID),
/*CPROT entity indicates the reception of a REQUEST_LSP_ID message from the SN
*/
MDU_LSP_ID_res (PT_CprotPID, ST_RTMCRscId),
/*CPROT entity is requested to send a LSP_ID message for the LSP to the SN
*/
MDU_LSP_ID_conf (ST_RTMCRscId),
/*CPROT entity confirms the receipt of the LSP_ID message
*/
MDU_error_ind,
/*CPROT entity reports a detected protocol error
*/
MDU_abort_req,
/*CPROT entity is requested to abort the transaction immediately
*/
MDU_trans_error (IT_IntTransActId),
/*CPROT reports a unsuccessful transmission of a message with an allocated internal transaction ID
(valid for BLOCK_CMD, UNBLOCK _CMD and AWAIT_CLEAR) This primitive is only sent to the AN_STATUS_MGT
process
*/
MDU_resrsc_prc_started,
/*System Management process RESET RESOURCES announces its PID to AN_CPROT entity
*/
MDU_lspid_prc_started,
/*System Management process LSPID CHECK announces its PID to AN_CPROT entity
*/
MDU_cons_prc_started,
/*System Management process VPCI CONSISTENCY CHECK announces its PID to AN_CPROT entity
*/
MDU_status_prc_started;
/*System Management process STATUS MGT announces its PID to AN_CPROT entity*/

/*Primitives to the RTMC protocol entity representing errorneous VB5 messages */
signal
unknown_message,
/*Representation of a message containing an unspecified message type information element
*/
unknown_protdisc;
/*Representation of a message containing an unspecified protocol discriminator information element*/

Figure A.15: RTMC primitives common for AN and SN

Package VB5_1 18(30)

/*Declaration of primitives
from/to AN_CPROT entitiy*/

```
signal
MDU_unblock_req (AT_RTMCRscTab, IT_IntTransActId),
/*CPROT entity is requested to send an UNBLOCK_CMD message to the SN
*/
MDU_unblock_conf (AT_RTMCUnkRscTab, IT_IntTransActId),
/*CPROT entity confirms the execution of the unblock procedure
*/
MDU_block_req (AT_RTMCBlRscTab, IT_IntTransActId),
/*CPROT entity is requested to send a BLOCK_CMD message for VPC(s) to the SN
*/
MDU_block_conf (AT_RTMCUnkRscTab, IT_IntTransActId),
/*CPROT entity confirms the execution of the VPC block procedure
*/
MDU_await_clear_req (AT_RTMCRscTab),
/*CPROT entity is requested to send a SHUTDOWN message for VPC(s) to the SN
*/
MDU_await_clear_conf (AT_RTMCRscTab),
/*CPROT entity confirms the execution of the VPC shutdown procedure
*/
MDU_cons_check_ind (PT_CprotPID, ST_RTMCRscId),
/*CPROT entity indicates the reception of  a CONSISTECNY_CHECK_REQ message from the SN
*/
MDU_cons_check_res (PT_CprotPID, ST_RTMCUnkRscId),
/*CPROT entity is requested to send  a CONSISTECNY_CHECK_REQ_ACK  message to the SN
*/
MDU_cons_check_end_ind (PT_CprotPID, ST_RTMCRscId),
/*CPROT entity indicates the reception of  a CONSISTECNY_CHECK_END message from the SN
*/
MDU_cons_check_end_res (PT_CprotPID, IT_RTMCCheckResult);
/*CPROT entity is requested to send  a CONSISTECNY_CHECK_END_ACK  message to the SN
```

Figure A.16: RTMC primitives in the AN

Package VB5_1 19(30)

/*Declaration of primitives
from/to SN_CPROT entitiy*/

```
signal
MDU_unblock_ind (PT_CprotPID, AT_RTMCRscTab),
/*CPROT entity indicates the receipt of a UNBLOCK_CMD message
*/
MDU_unblock_res (PT_CprotPID, AT_RTMCUnkRscTab),
/*CPROT entity is requested to send a UNBLOCK_ACK message
*/
MDU_block_ind (PT_CprotPID, AT_RTMCBlRscTab),
/*CPROT entity indicates the receipt of a BLOCK_CMD message
*/
MDU_block_res (PT_CprotPID, AT_RTMCUnkRscTab),
/* CPROT entity is requested to send a BLOCK_ACK message
*/
MDU_await_clear_ind (PT_CprotPID, AT_RTMCRscTab),
/*CPROT entity indicates the receipt of an AWAIT CLEAR message
*/
MDU_await_clear_res (AT_RTMCRscTab),
/*CPROT entity is requested to send an AWAIT_CLEAR_COMP message to the AN
*/
MDU_await_clear_ack (PT_CprotPID, AT_RTMCUnkRscTab),
/*CPROT entity is requested to send an AWAIT_CLEAR_ACK message for VPCs to the AN
*/
MDU_cons_check_req (ST_RTMCRscId),
/*CPROT entity is requested to send a CONSISTENCY_CHECK_REQ message to the AN
*/
MDU_cons_check_conf (ST_RTMCUnkRscId),
/*CPROT entity indicates the reception of  a CONSISTENCY_CHECK_ACK  message from the AN
*/
MDU_cons_check_end_req (ST_RTMCRscId),
/*CPROT entity is requested to send a CONSISTENCY_CHECK_END message to the AN
*/
MDU_cons_check_end_conf ( IT_RTMCCCheckResult);
/*CPROT entity indicates the reception of  a CONSISTENCY_CHECK_END_ACK  message from the AN*/
```

Figure A.17: RTMC primitives in the SN

Package VB5_1 29(30)

```
/* Declaration of
Internal System Management Primitives */
```

```
signal
MIE_unblock_all_req,
/*RESET-process requests the unblocking of all VPCFSMs and the LSPFSM
*/
MIE_unblock_all_conf,
/*STATUS-process confirms the unblocking of all VPCFSMs and the LSPFSM
*/
MIE_establish_SAAL_req,
/*CTR-process requests the establishment of the SAAL connection
*/
MIE_establish_SAAL_conf,
/*SAAL-process confirms the establishment of the SAAL connection
*/
MIE_establish_SAAL_ind,
/*SAAL-process indicates the establishment of the SAAL connection
*/
MIE_release_SAAL_req,
/*CTR-process requests the release of the SAAL connection
*/
MIE_release_SAAL_conf,
/*SAAL-process confirms the release of the SAAL connection
*/
MIE_reset_LSP_req,
/*CTR-process requests the reset of the LSP (e.g. during startup)
*/
MIE_reset_LSP_conf (IT_Result),
/*RESET-process confirms the reset of the LSP (e.g. during startup)
*/
MIE_reset_LSP_ind (IT_Result),
/*RESET-process indicates the reset of the LSP (e.g. during startup)
*/
MIE_verify_LSP_ID_req,
/*CTR-process requests the verification of the LSP ID (e.g. during startup)
*/
MIE_verify_LSP_ID_conf (IT_Result),
/*LSPID-process confirms the verification of the LSP ID (e.g. during startup)
*/
MIE_verify_LSP_ID_ind (IT_Result),
/*LSPID-process indicates the verification of the LSP ID (e.g. during startup)
*/
MIE_stop_traffic,
/*CTR-process requests the stop of all processes (e.g. in case of SAAL failure)
*/
MIE_start_traffic,
/*CTR-process requests the start of all processes (e.g.after startup)
*/
MIE_SAAL_failure,
/*CTR-process is informed about detected SAAL failure
*/
MIE_error_ind;
/*error indication towards CTR process*/
```

Figure A.18: System management internal primitives

A.2 AN diagrams

A.2.1 Processes of AN_SYSMGT

A.2.1.1 Process AN_STATUS_MGT

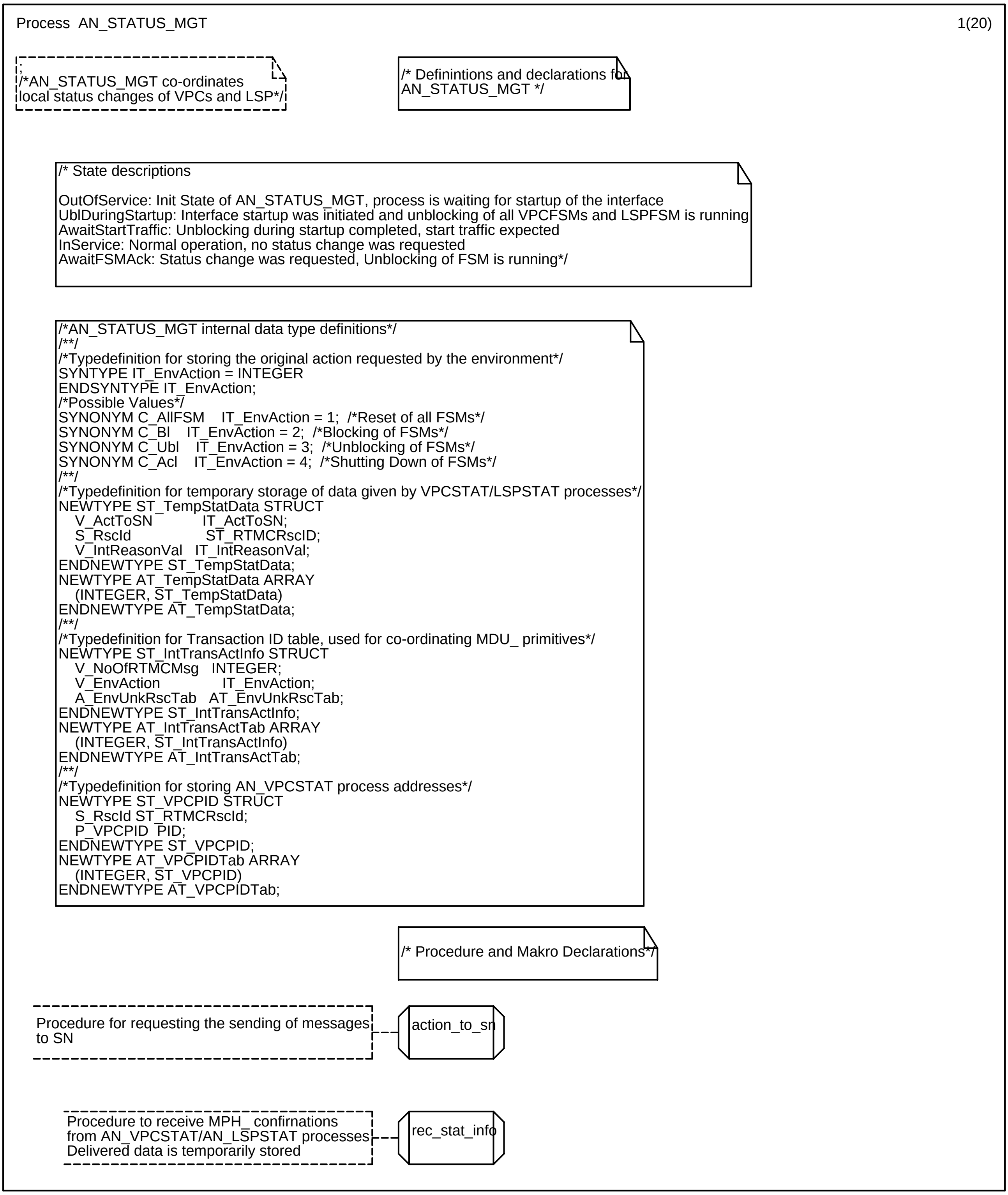


Figure A.19: AN_STATUS_MGT (1)

Process AN_STATUS_MGT 2(20)

```
;
/*AN_STATUS_MGT co-ordinates
local status changes of VPCs and LSP*/
```

```
/* Definintions and declarations for
AN_STATUS_MGT */
```

```
/*AN_STATUS_MGT internal variables and constants */
/**/
/*Variables for co-ordinating "unblock_all" procedure (e.g. during interface startup or reset of LSP)*/
DCL
B_VPCUblDone,    /*MPH_VPC_unblock_conf received from all requested VPC STATFSM*/
B_LSPUblDone    /*MPH_LSP_unblock_conf received*/
BOOLEAN;
/**/
/*Variables for controlling VPCSTAT/LSPSTAT responses*/
DCL
V_TotalConf,    /*number of expected VPC state change confirmations*/
V_RecConf    /*number of received VPC state change confirmations*/
IT_NoOfRsc;
/**/
/*Variable for storing the original action requested by the environment*/
DCL V_EnvAction IT_EnvAction;
/**/
/*Variable for temporary storage of data given by VPCSTAT/LSPSTAT processes*/
DCL A_TempStatData AT_TempStatData;
/**/
/*Variable for storage of transaction Id data*/
DCL A_IntTransActTab AT_IntTransActTab;
/**/
/*Variable for indexing resources given by the environment*/
DCL V_EnvRscIdx INTEGER;
/**/
/*Variable for deciding whether any action to the SN is required*/
DCL B_AnyActToSn BOOLEAN;
/**/
/*Variable for storing AN_VPCSTAT PIDs*/
DCL A_VPCPIDTab AT_VPCPIDTab;
DCL V_VPCPIDIdx INTEGER; /*Variable for indexing PID Table*/
```

Figure A.20: AN_STATUS_MGT (2)

Process AN_STATUS_MGT 3(20)

;
/*AN_STATUS_MGT co-ordinates
local status changes of VPCs and LSP*/

/* Definintions and declarations for
AN_STATUS_MGT */

```
/*Signal data declarations*/
/**/
/*Resource identifier, used for identifying VPCSTAT/LSPSTAT process*/
DCL S_RscId ST_RTMCRscID;
/**/
/*List of Resource identifiers*/
DCL A_RTMCRscTab AT_RTMCRscTab ;
/**/
/*Status change reason given by the environment*/
DCL V_EnvReasonVal IT_EnvReasonVal;
/**/
/*Status change reason given byVPCSTAT/LSPSTAT process*/
DCL V_IntReasonVal IT_IntReasonVal;
/**/
/*Required action to SN determined byVPCSTAT/LSPSTAT process*/
DCL V_ActToSn IT_ActToSn;
/**/
/*Number of resources given by the environment*/
DCL V_EnvNoOfRsc IT_NoOfRsc;
/**/
/*List of resource received from the environment*/
DCL
A_EnvRscTab AT_EnvRscTab;
/**/
/*Transaction identifier for communication with AN_CPROT process*/
DCL V_IntTransActId IT_IntTransActId;
/**/
/*List of resources unknown by the peer side, reported by AN_CPROT*/
DCL A_RTMCUnkRscTab AT_RTMCUnkRscTab;
/**/
/*List of resources unknown by the peer side, reported to the environment*/
DCL A_EnvUnkRscTab AT_EnvUnkRscTab;
```

Figure A.21: AN_STATUS_MGT (3)

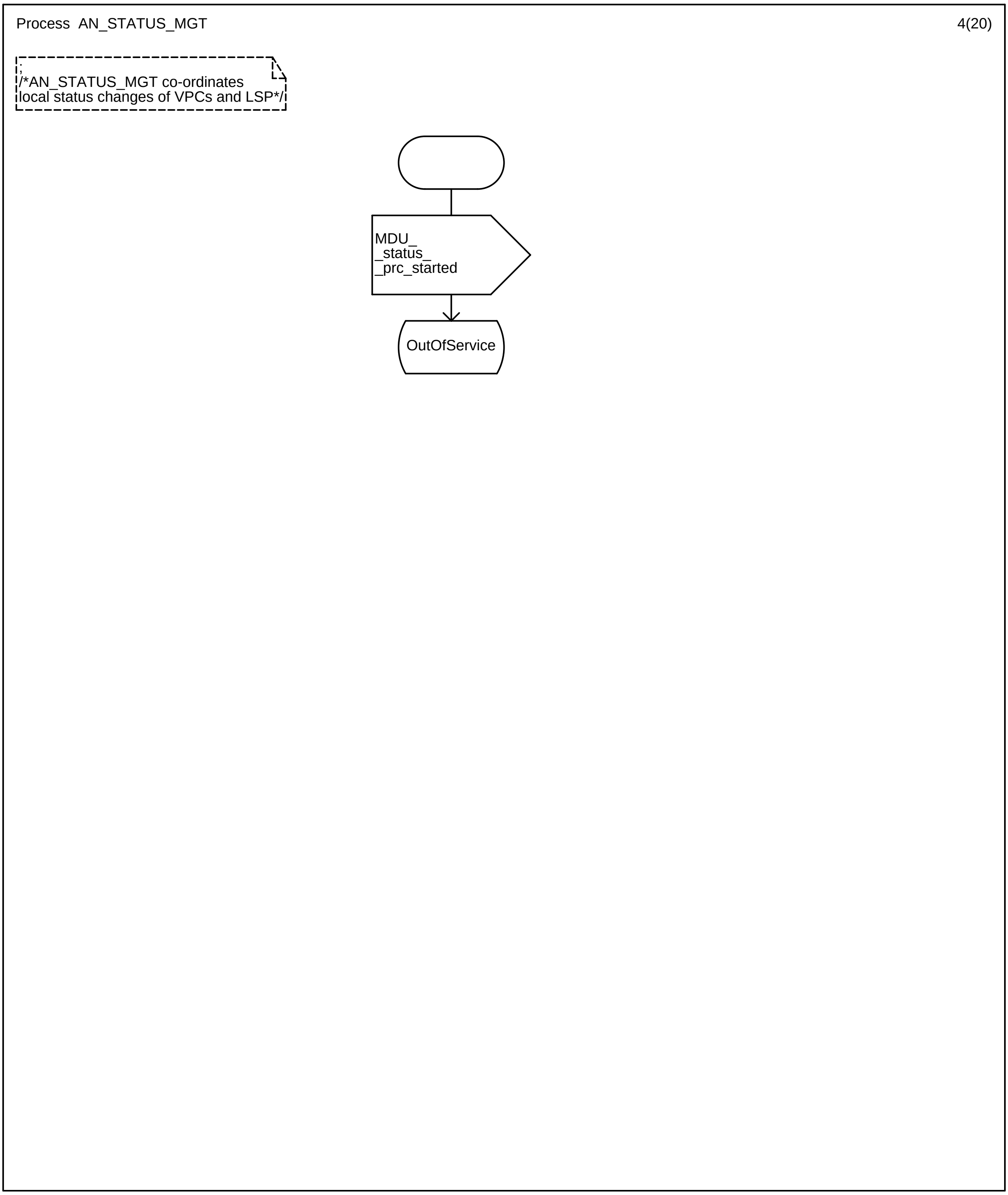


Figure A.22: AN_STATUS_MGT (4)

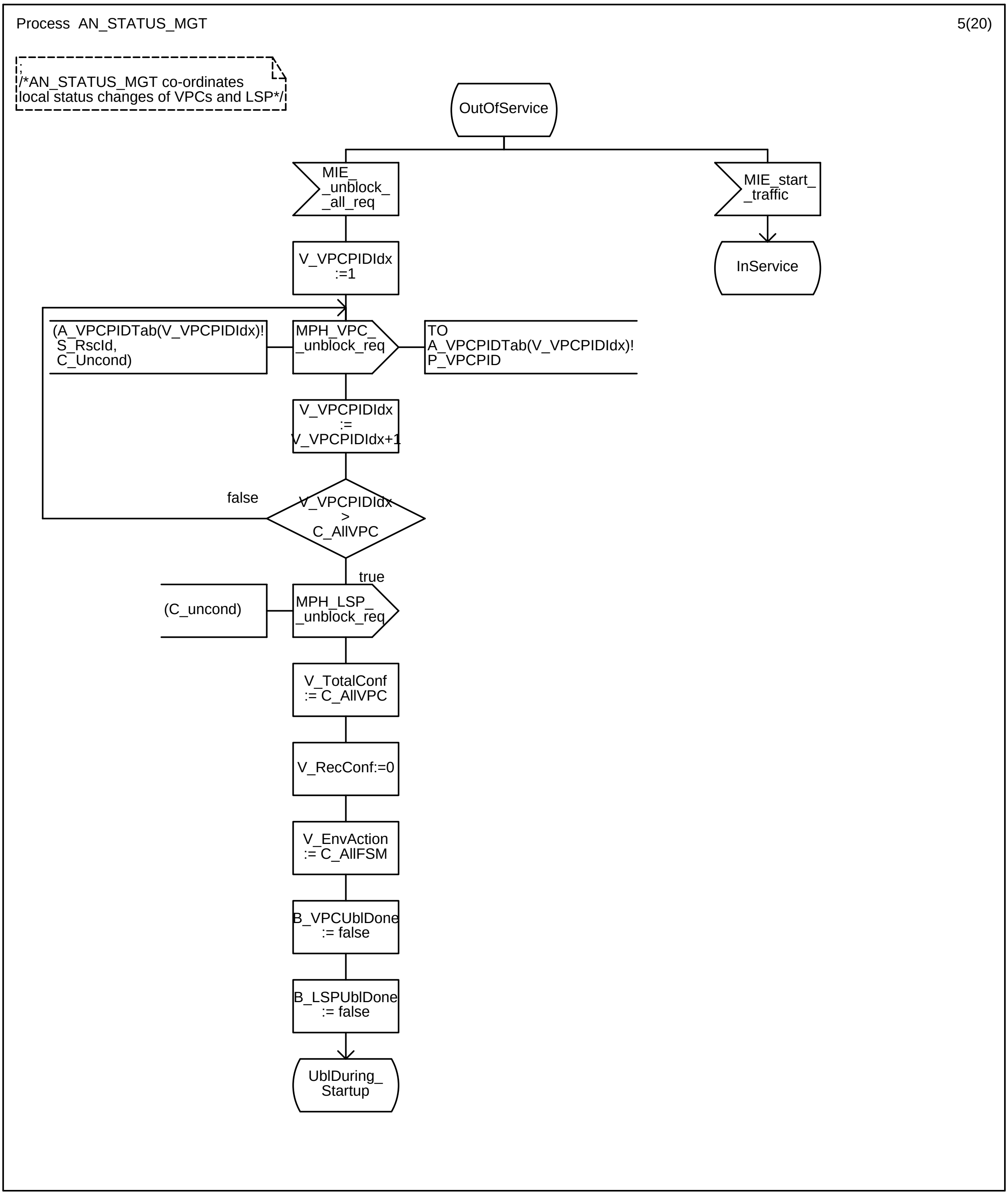


Figure A.23: AN_STATUS_MGT (5)

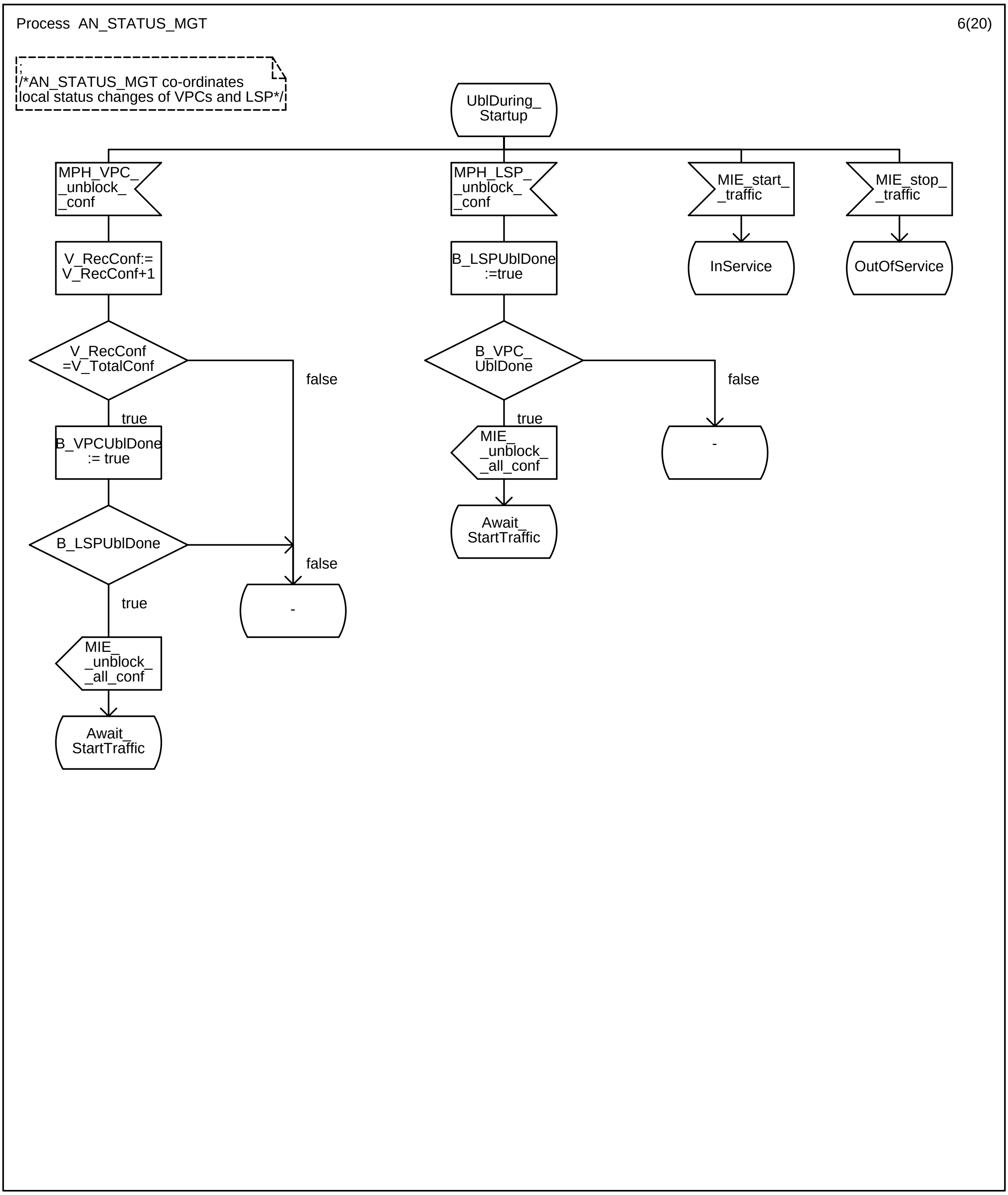


Figure A.24: AN_STATUS_MGT (6)

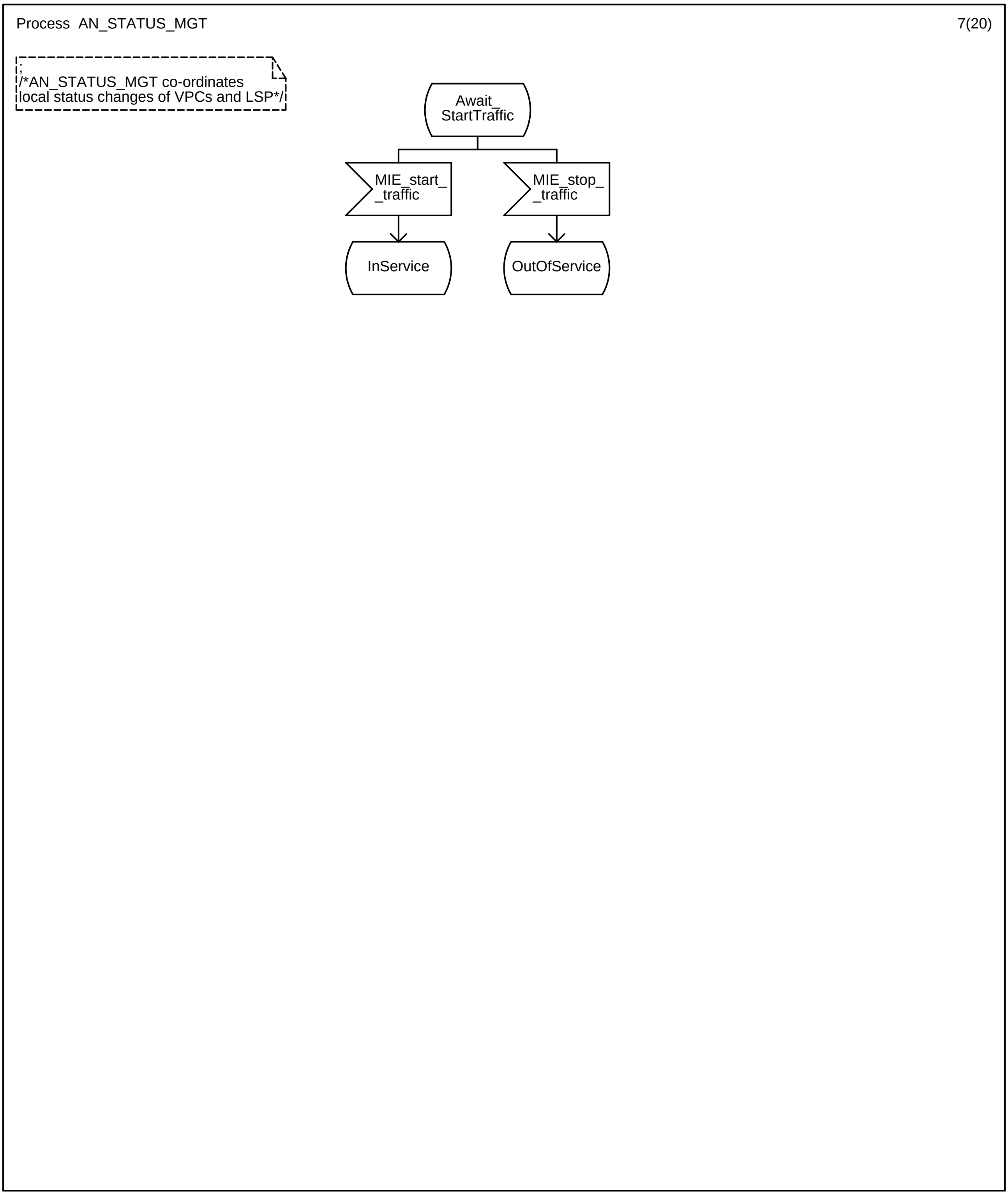


Figure A.25: AN_STATUS_MGT (7)

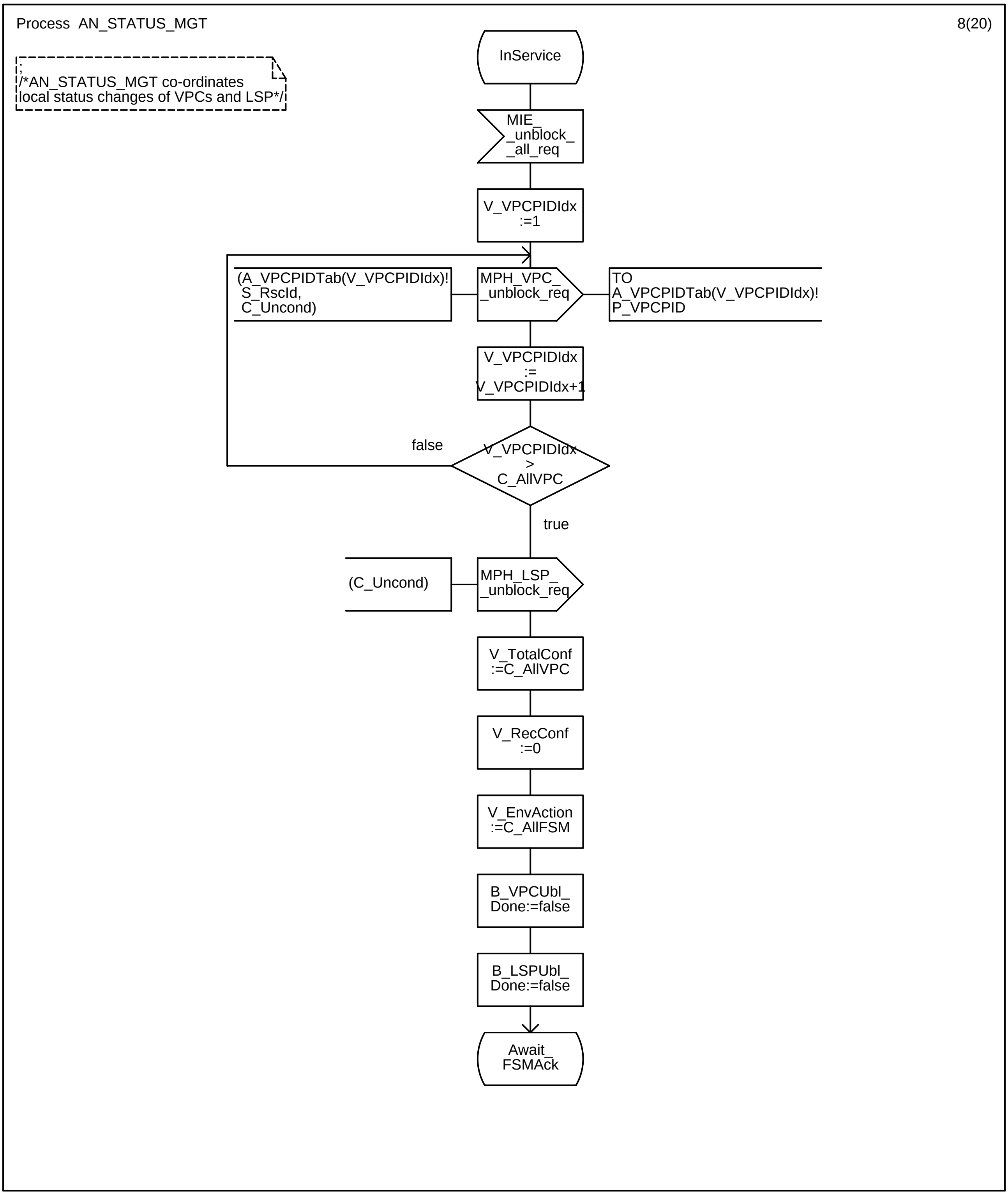


Figure A.26: AN_STATUS_MGT (8)

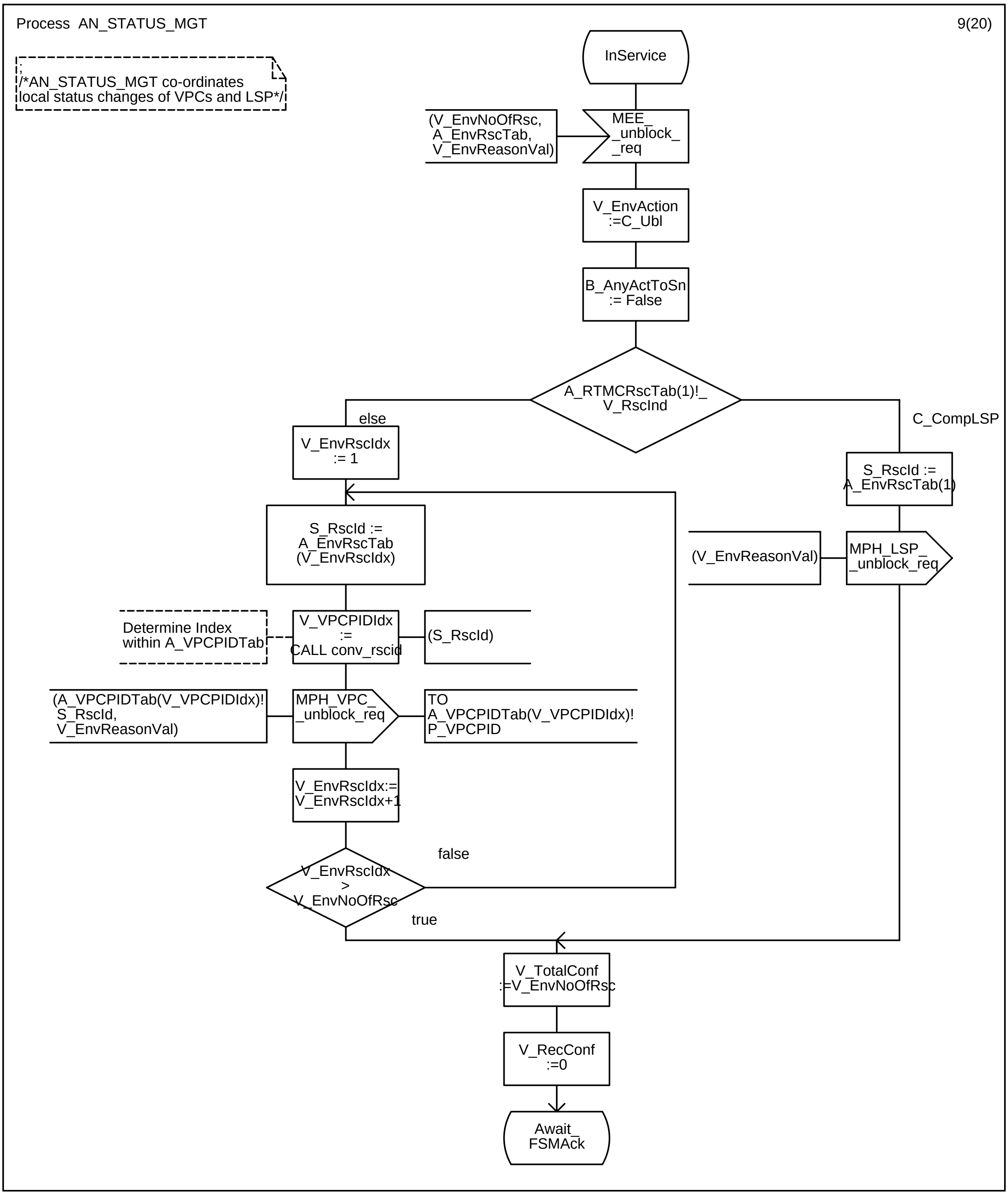


Figure A.27: AN_STATUS_MGT (9)

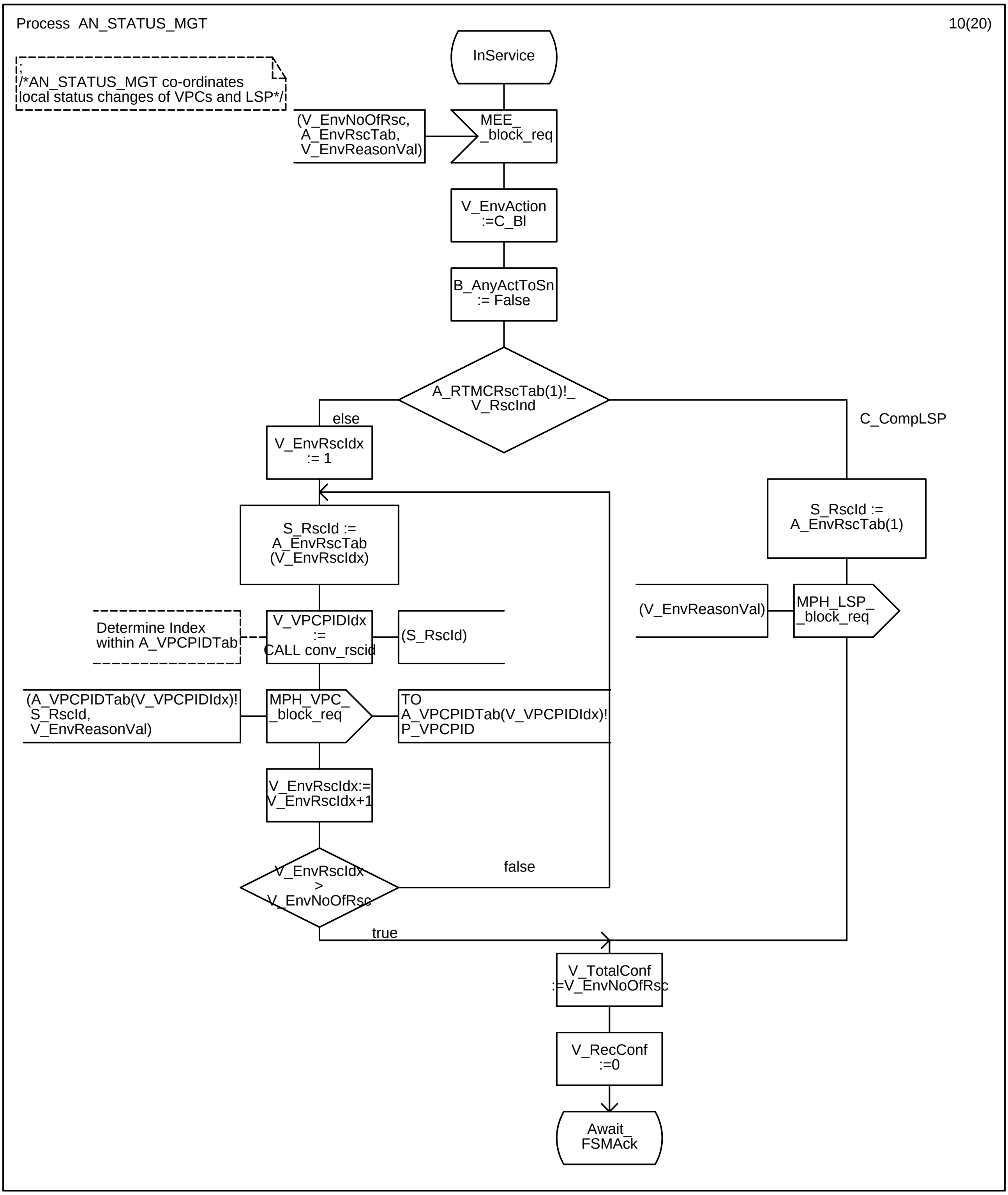


Figure A.28: AN_STATUS_MGT (10)

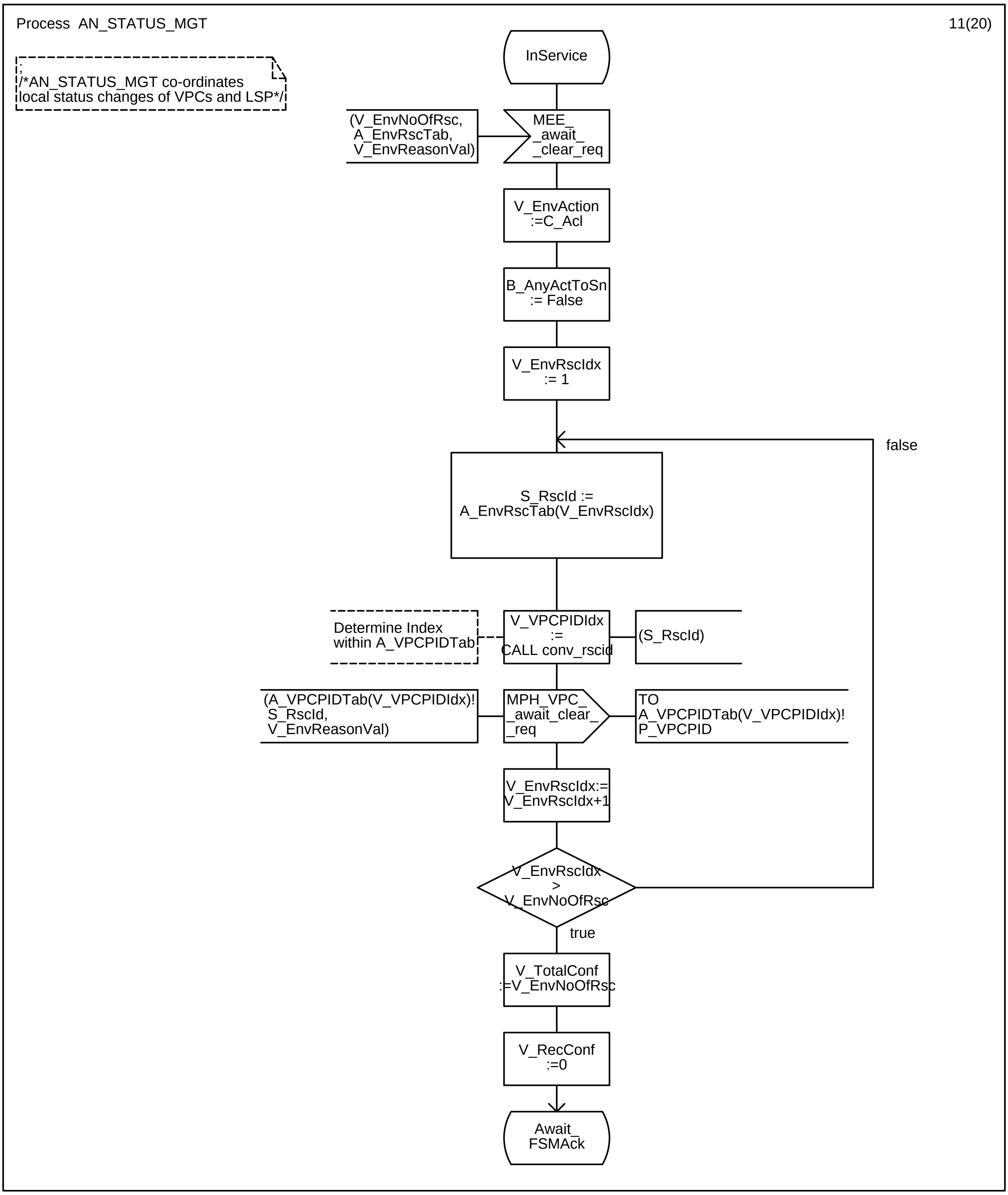


Figure A.29: AN_STATUS_MGT (11)

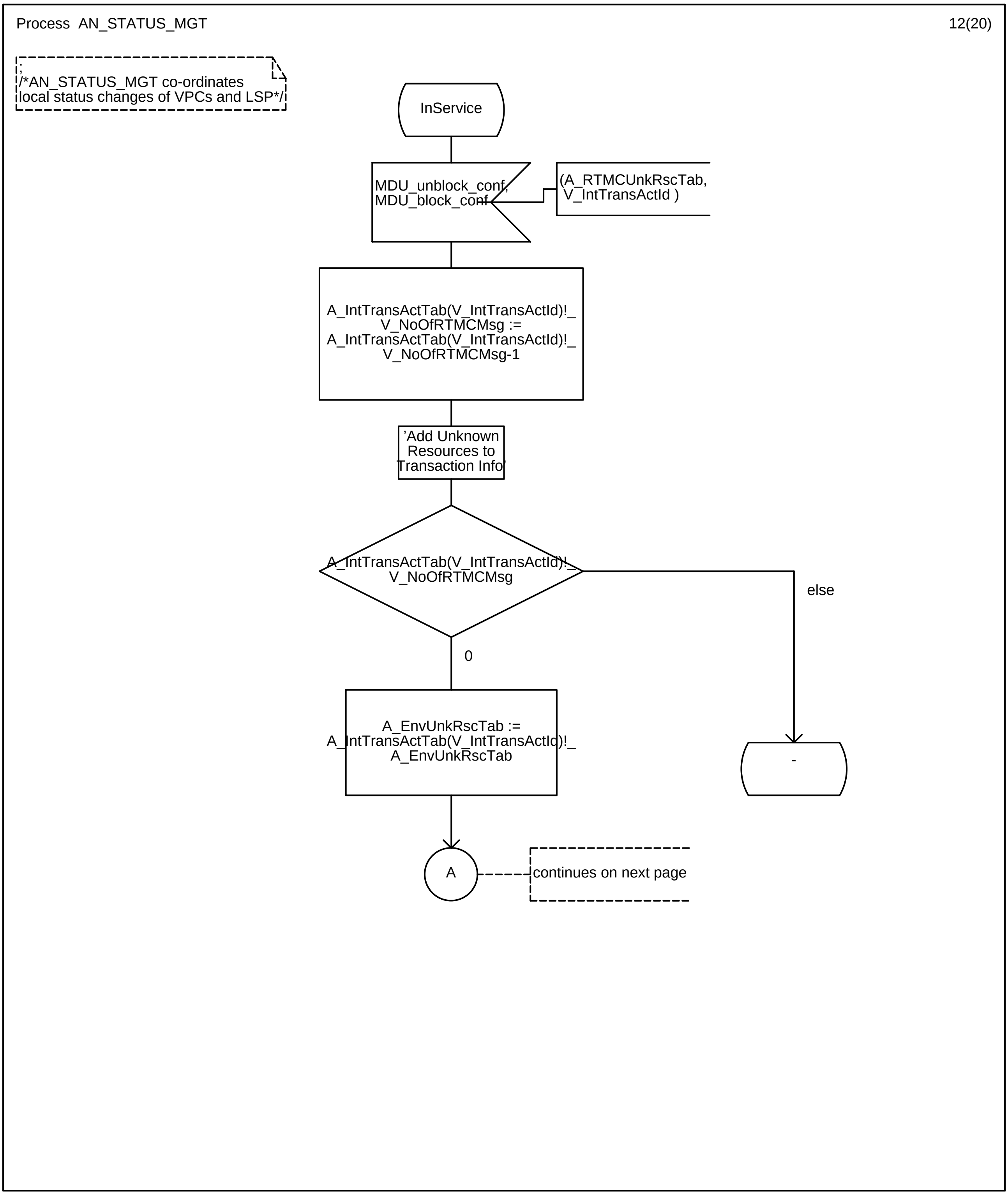


Figure A.30: AN_STATUS_MGT (12)

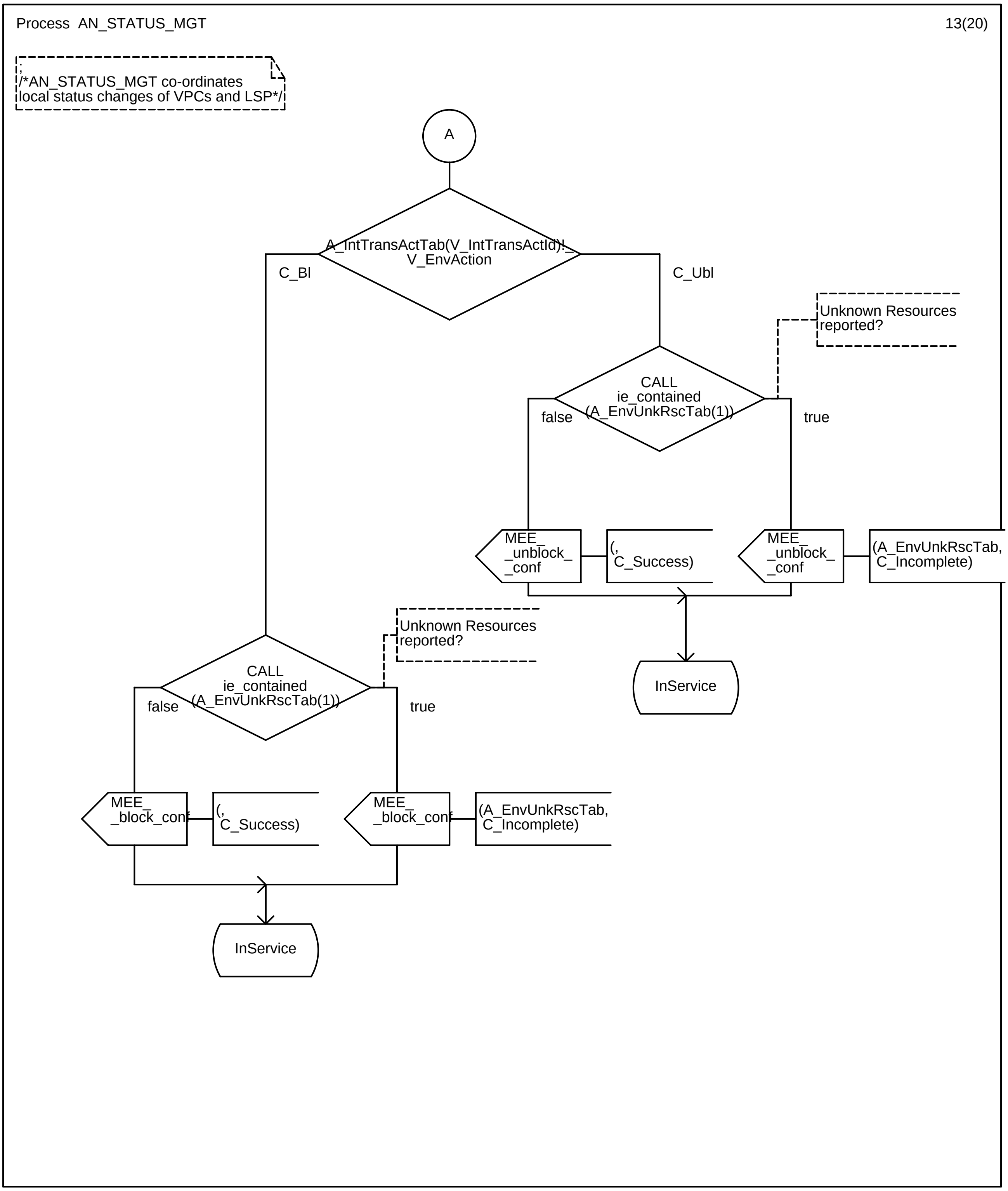


Figure A.31: AN_STATUS_MGT (13)

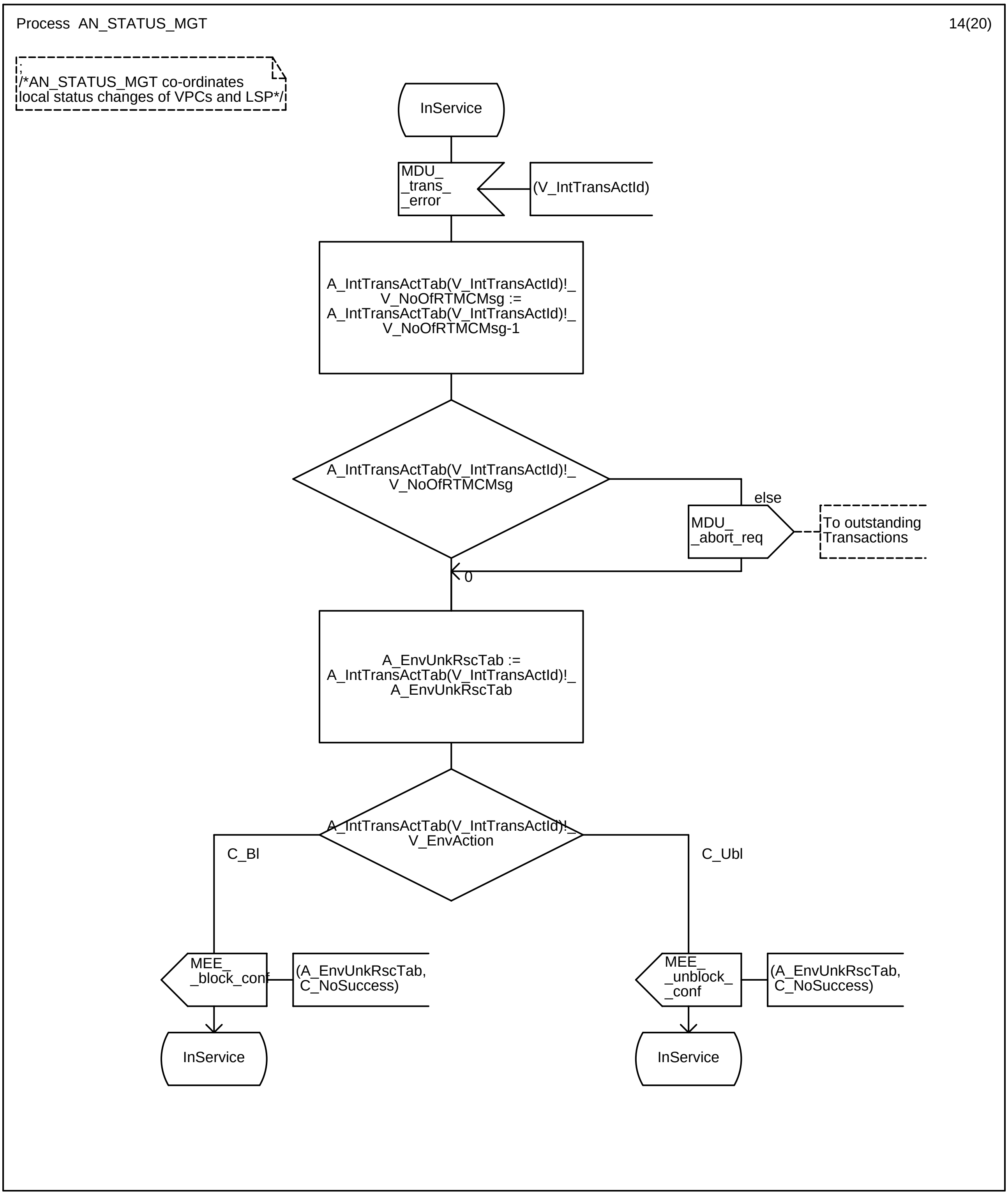


Figure A.32: AN_STATUS_MGT (14)

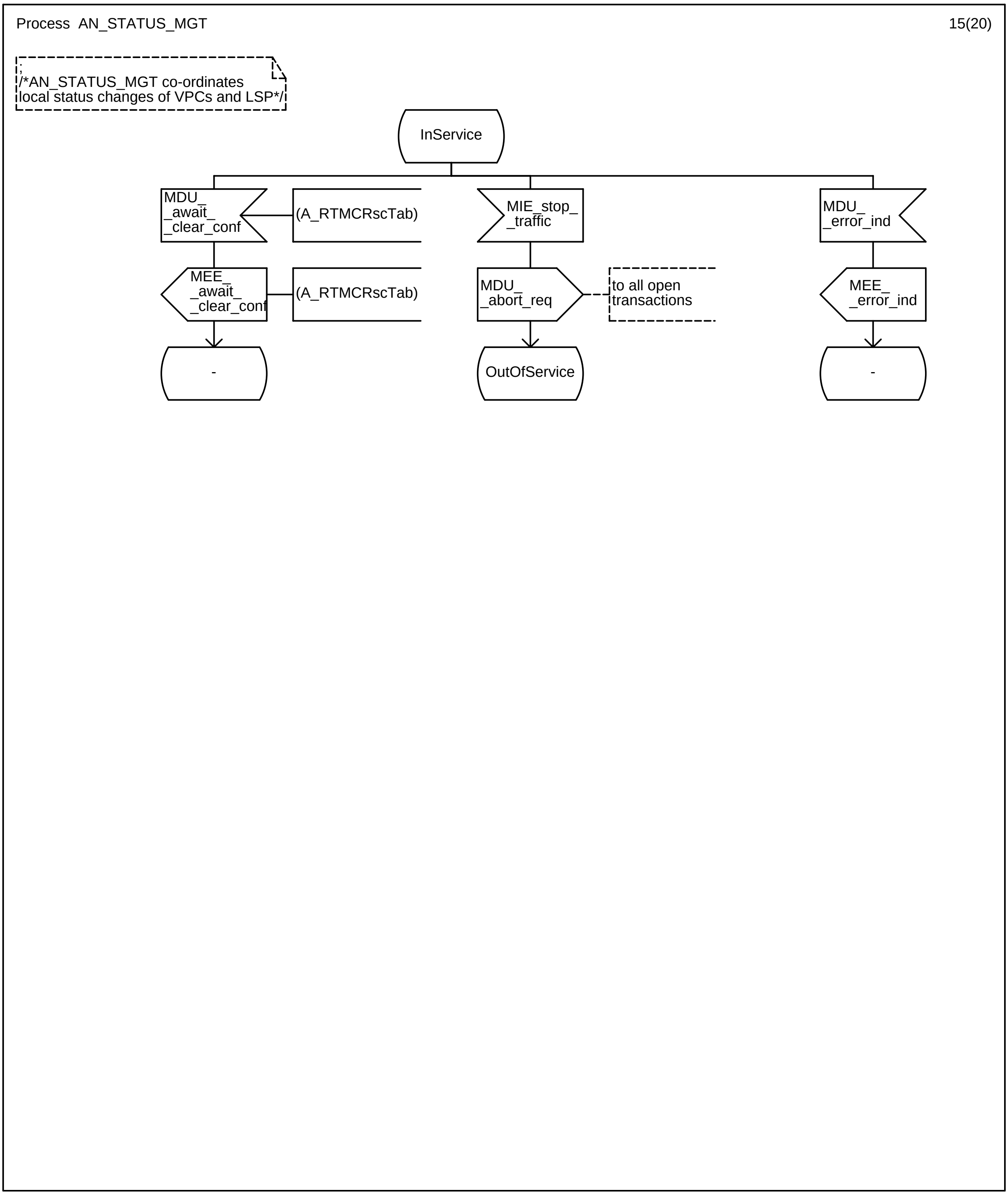


Figure A.33: AN_STATUS_MGT (15)

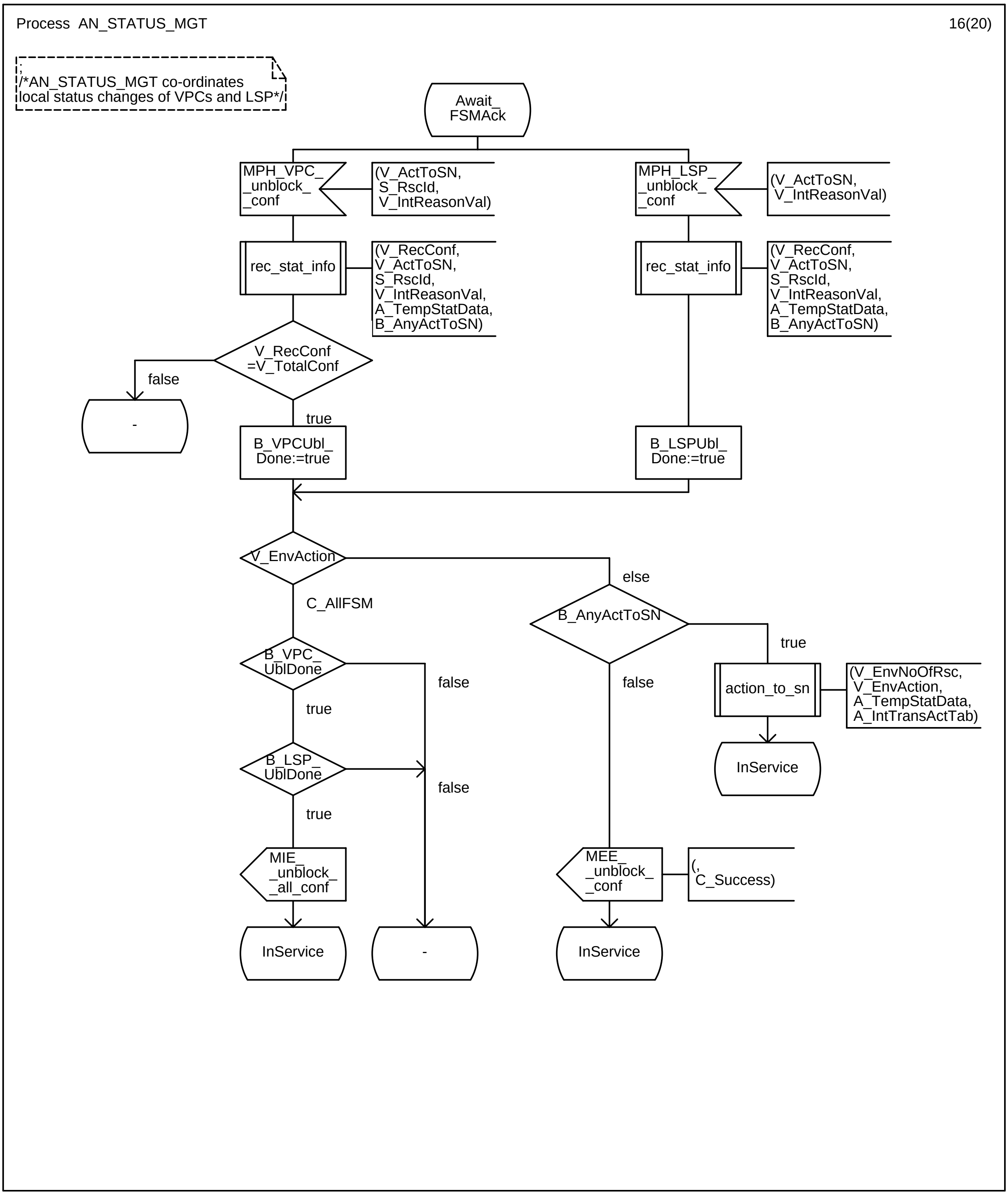


Figure A.34: AN_STATUS_MGT (16)

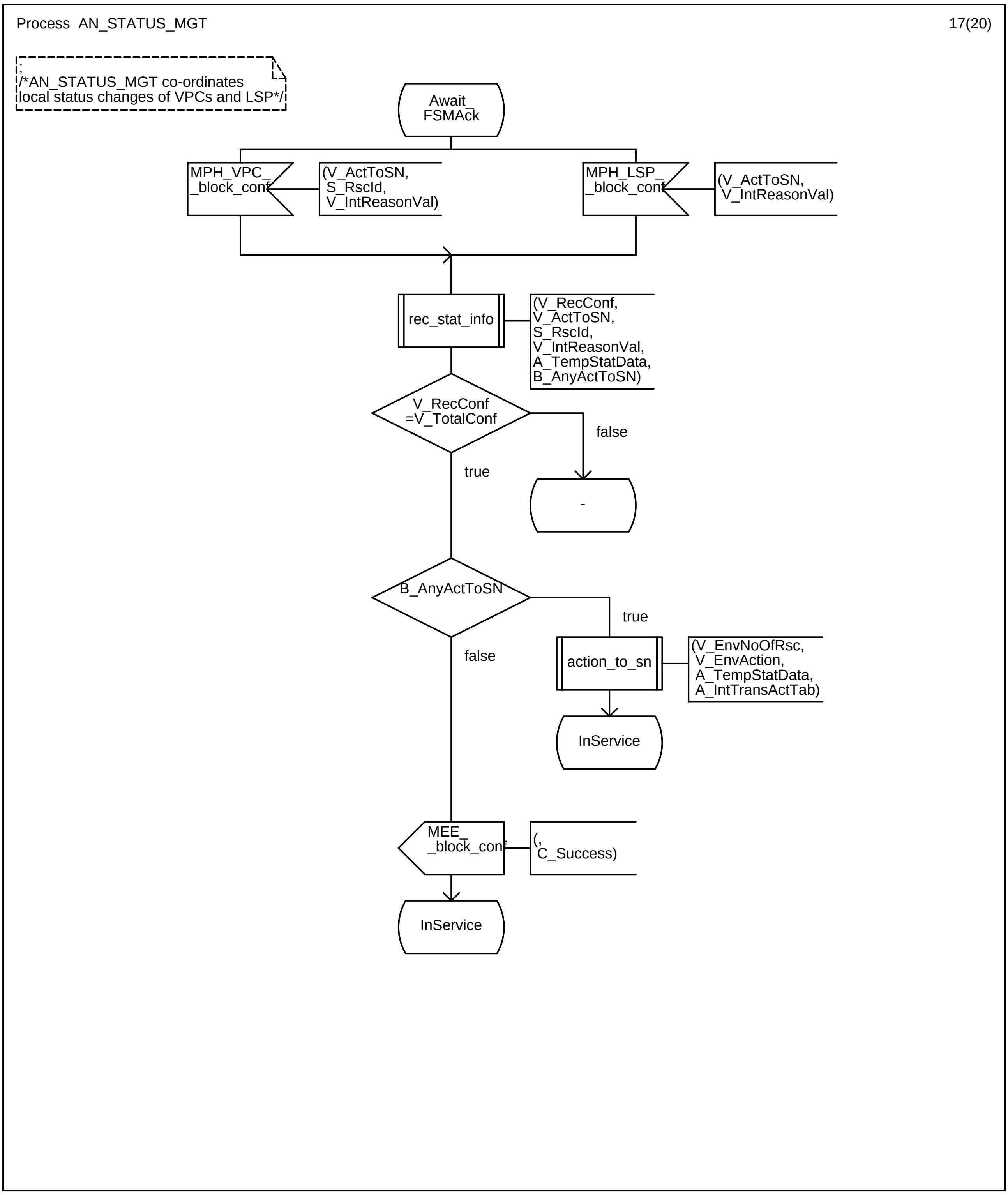


Figure A.35: AN_STATUS_MGT (17)

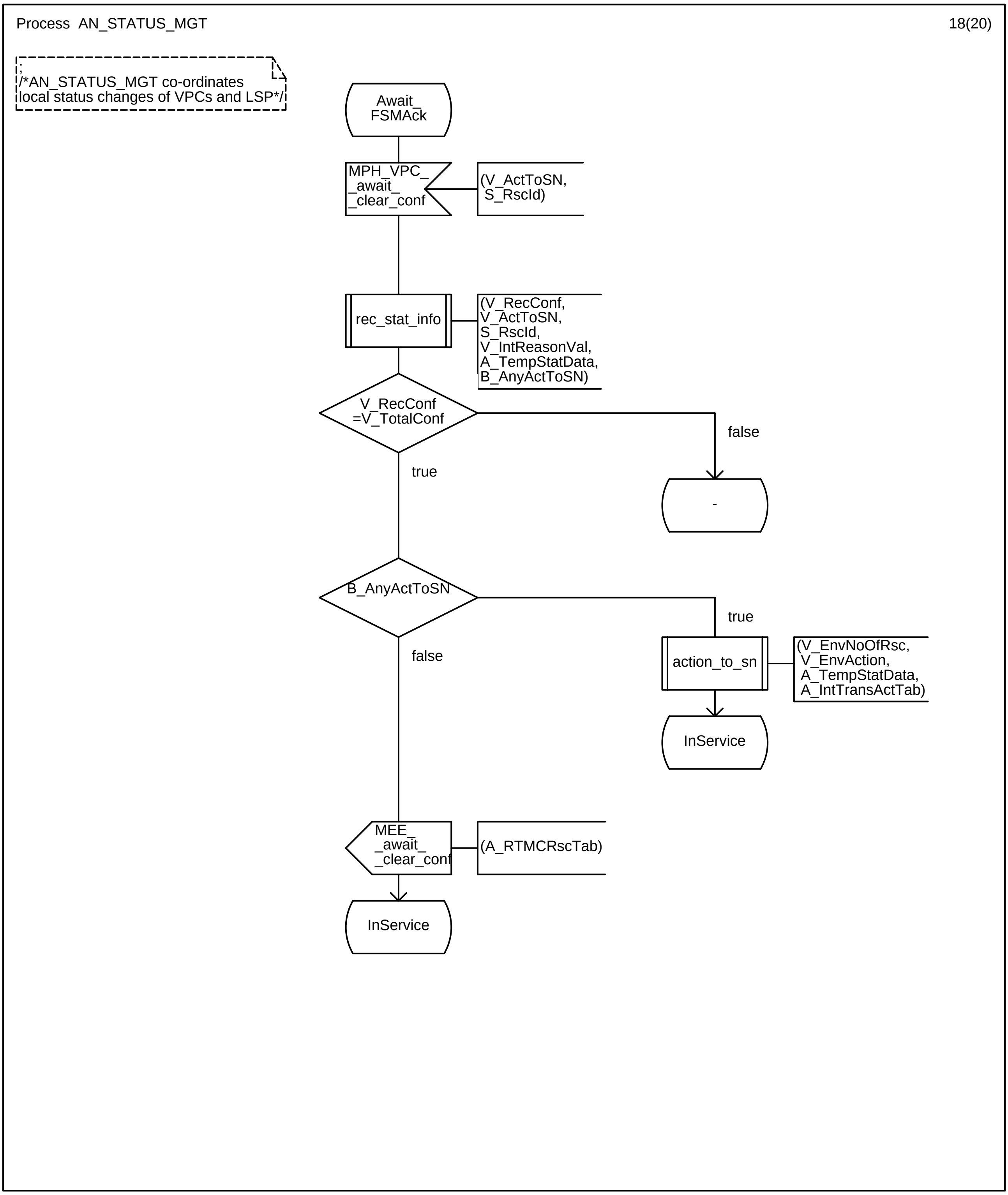


Figure A.36: AN_STATUS_MGT (18)

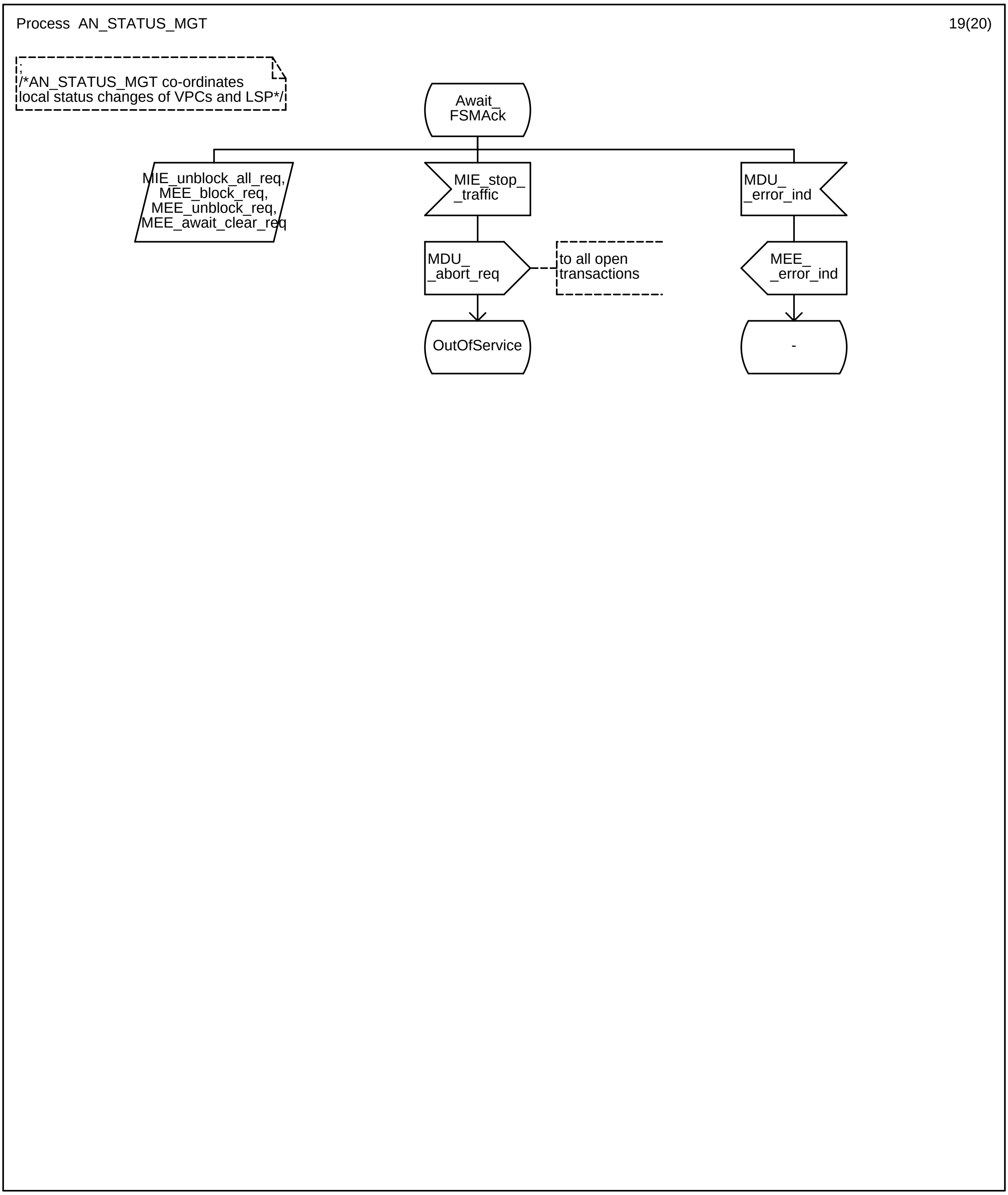


Figure A.37: AN_STATUS_MGT (19)

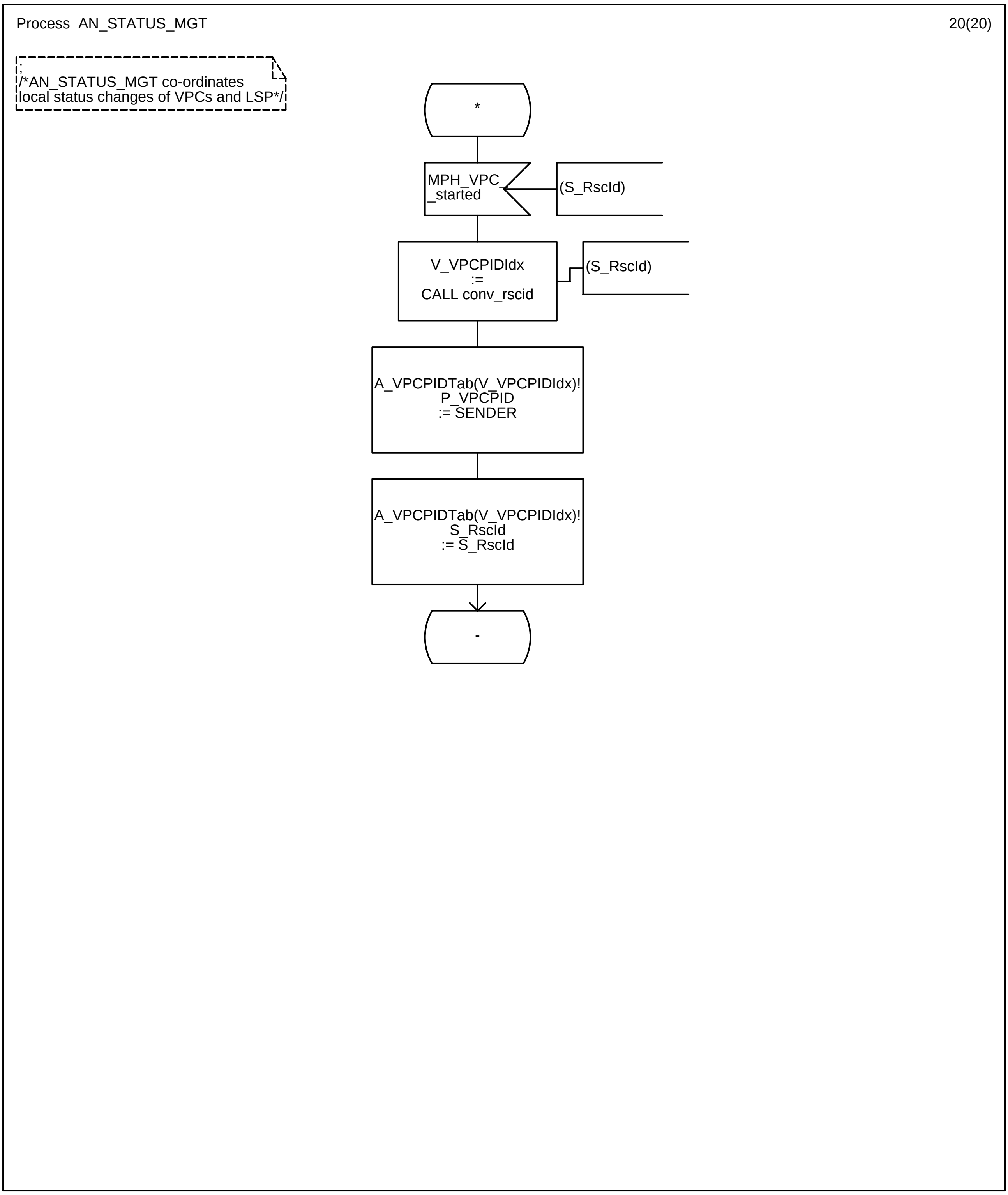


Figure A.38: AN_STATUS_MGT (20)

Procedure ACTION_TO_SN 1(8)

```
;FPAR
V_EnvNoOfRsc        IT_NoOfRsc,
V_EnvAction          IT_EnvAction,
A_TempStatData    AT_TempStatData,
A_IntTransActTab   AT_IntTransActTab;
```

```
/*Definitions and
declarations*/
```

```
/*Signal data declarations used in MDU primitives*/
/**/
DCL
A_RTMCRscTab AT_RTMCRscTab;  /*Array of Resource Identifier Information Elements*/
/**/
DCL
A_RTMCBlRscTab AT_RTMCBlRscTab;  /*Array of Blocked Resource Identifier Information Elements*/
/**/
DCL
V_NoOfMsg,                 /*Number of messages sent to the SN*/
V_IntTransActId              /*Internal transaction Id*/
INTEGER;
```

```
/*Internal Data*/
/**/
/*Indices for data accessing arrays*/
DCL
V_TempIdx ,           /*Index for A_TempStatData*/
V_RTMCBlRscIdx, /*Index fo A_RTMCBlRScTab*/
V_RTMCUblRscIdx,     /*Index for A_RTMCRScTab*/
V_RTMCAclRscIdx     /*Index for A_RTMCRScTab*/
IT_RTMCRscTabIndex;
```

Figure A.39: AN_STATUS_MGT, Procedure ACTION_TO_SN (1)

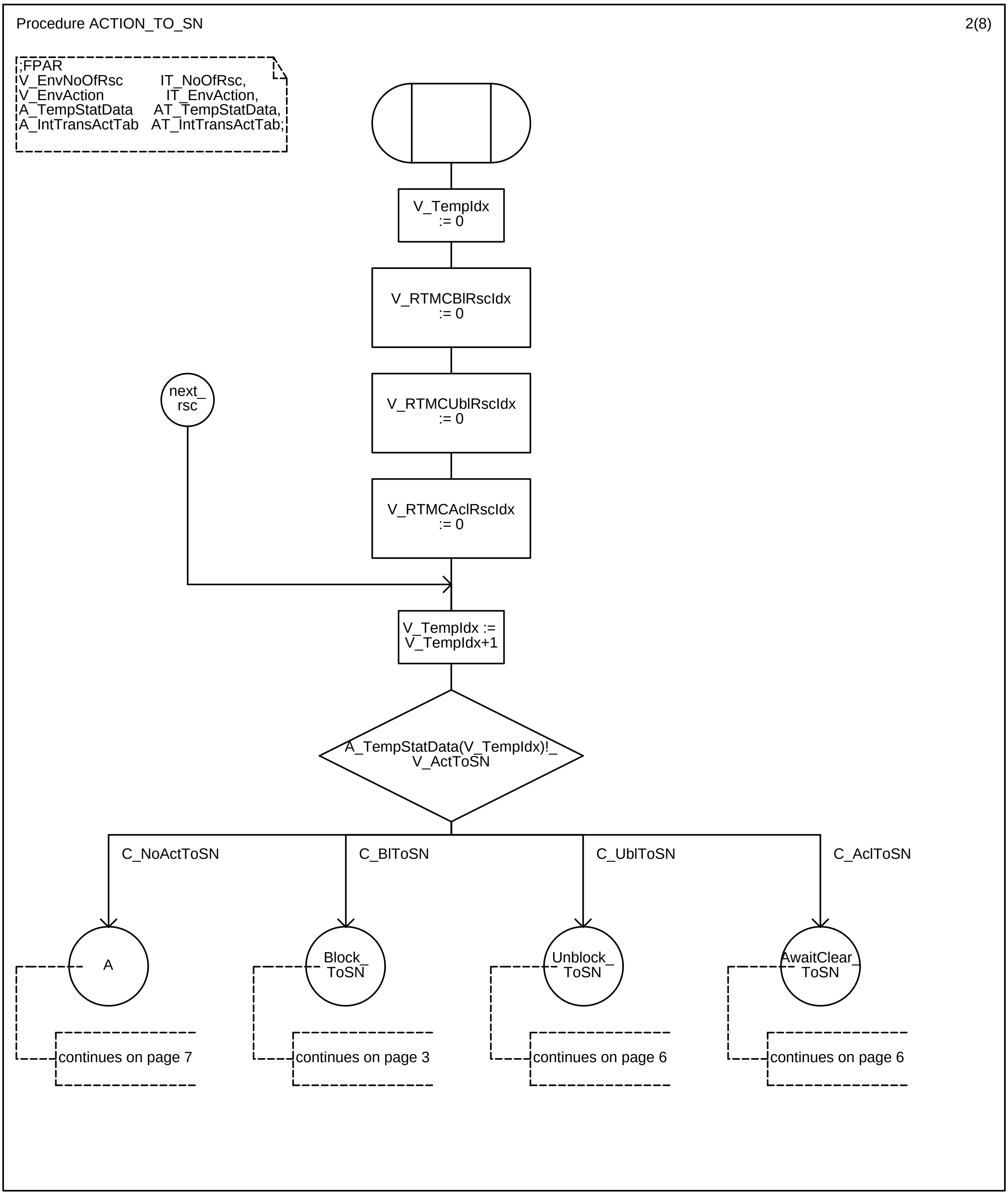


Figure A.40: AN_STATUS_MGT, Procedure ACTION_TO_SN (2)

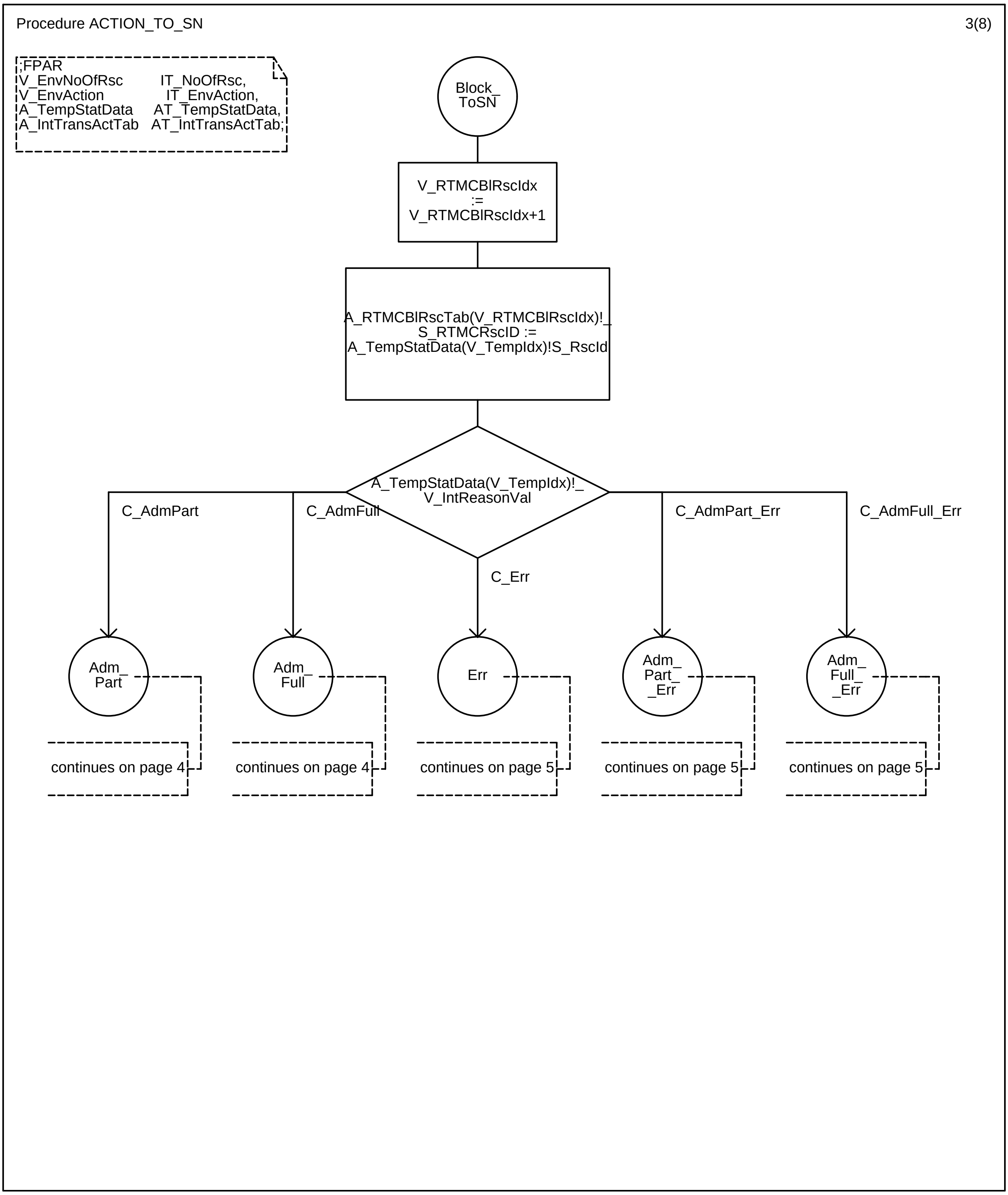


Figure A.41: AN_STATUS_MGT, Procedure ACTION_TO_SN (3)

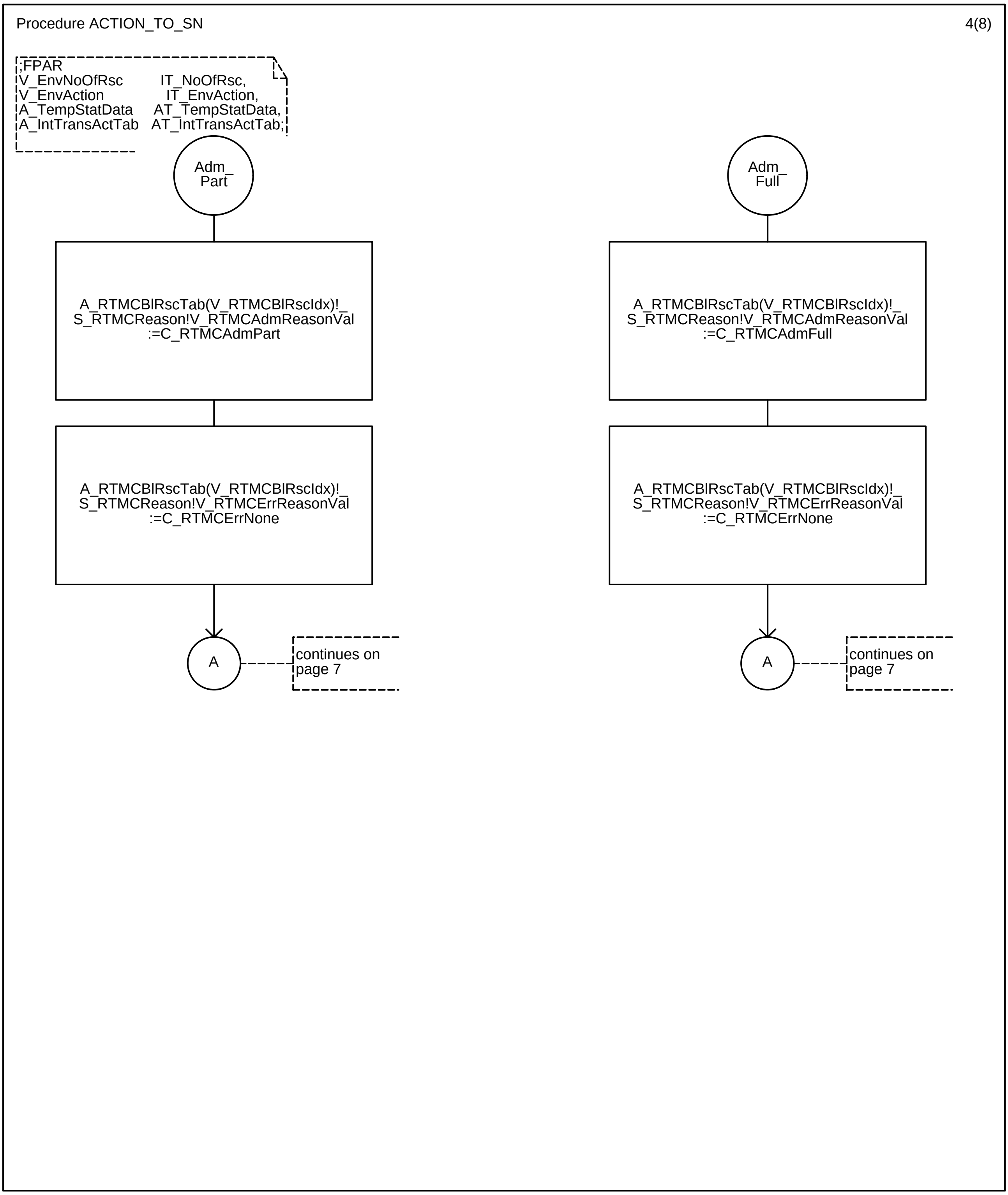


Figure A.42: AN_STATUS_MGT, Procedure ACTION_TO_SN (4)

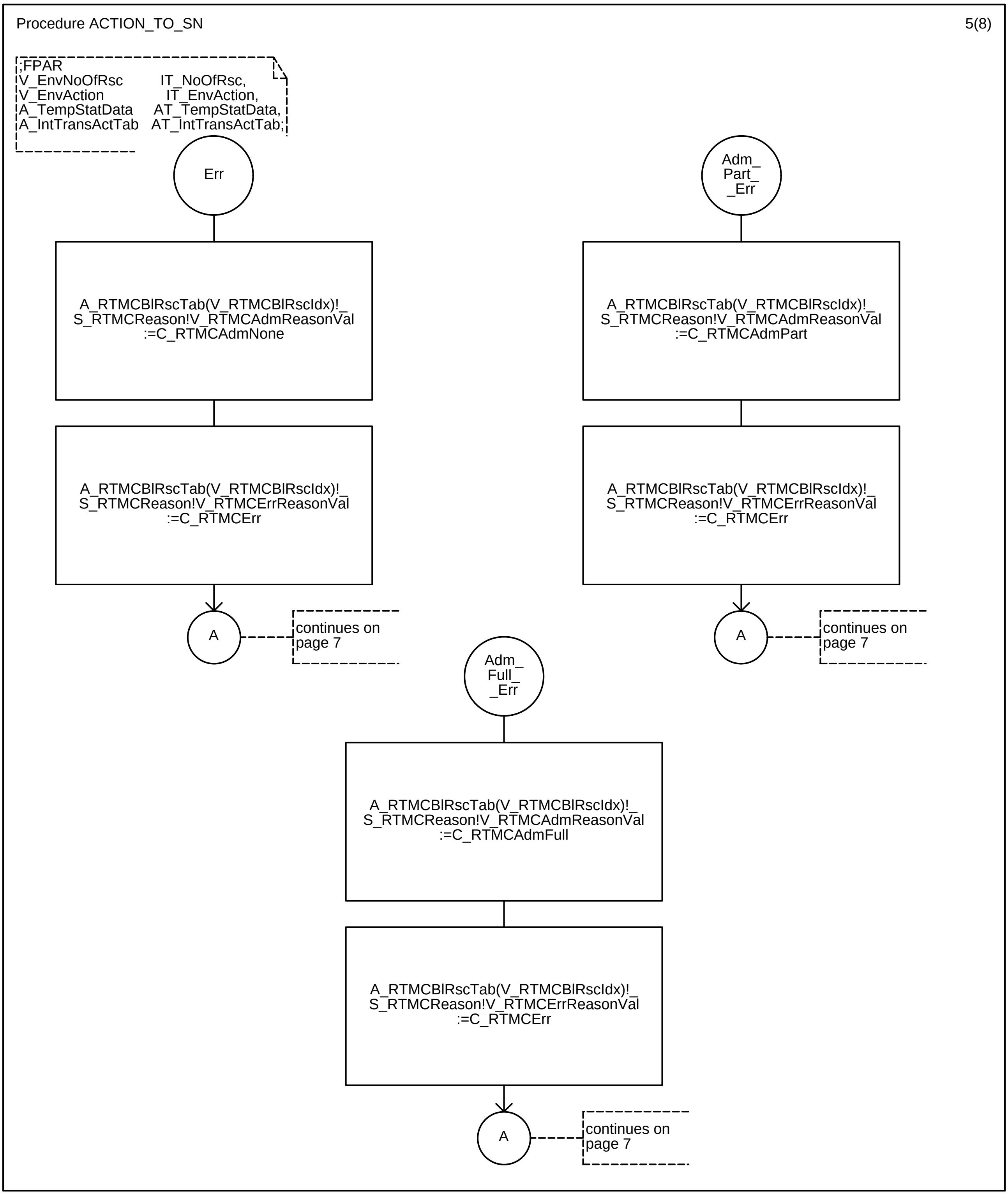


Figure A.43: AN_STATUS_MGT, Procedure ACTION_TO_SN (5)

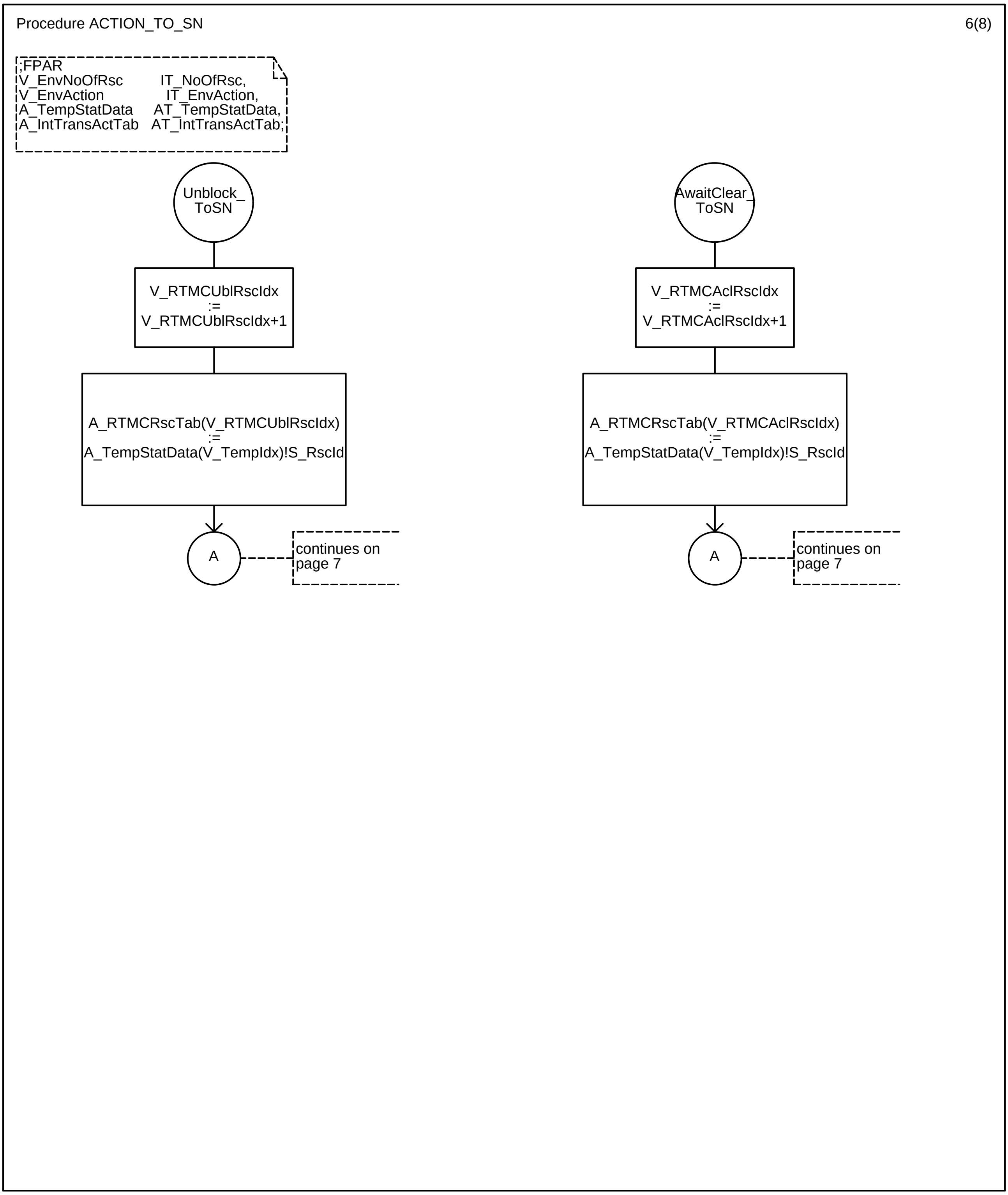


Figure A.44: AN_STATUS_MGT, Procedure ACTION_TO_SN (6)

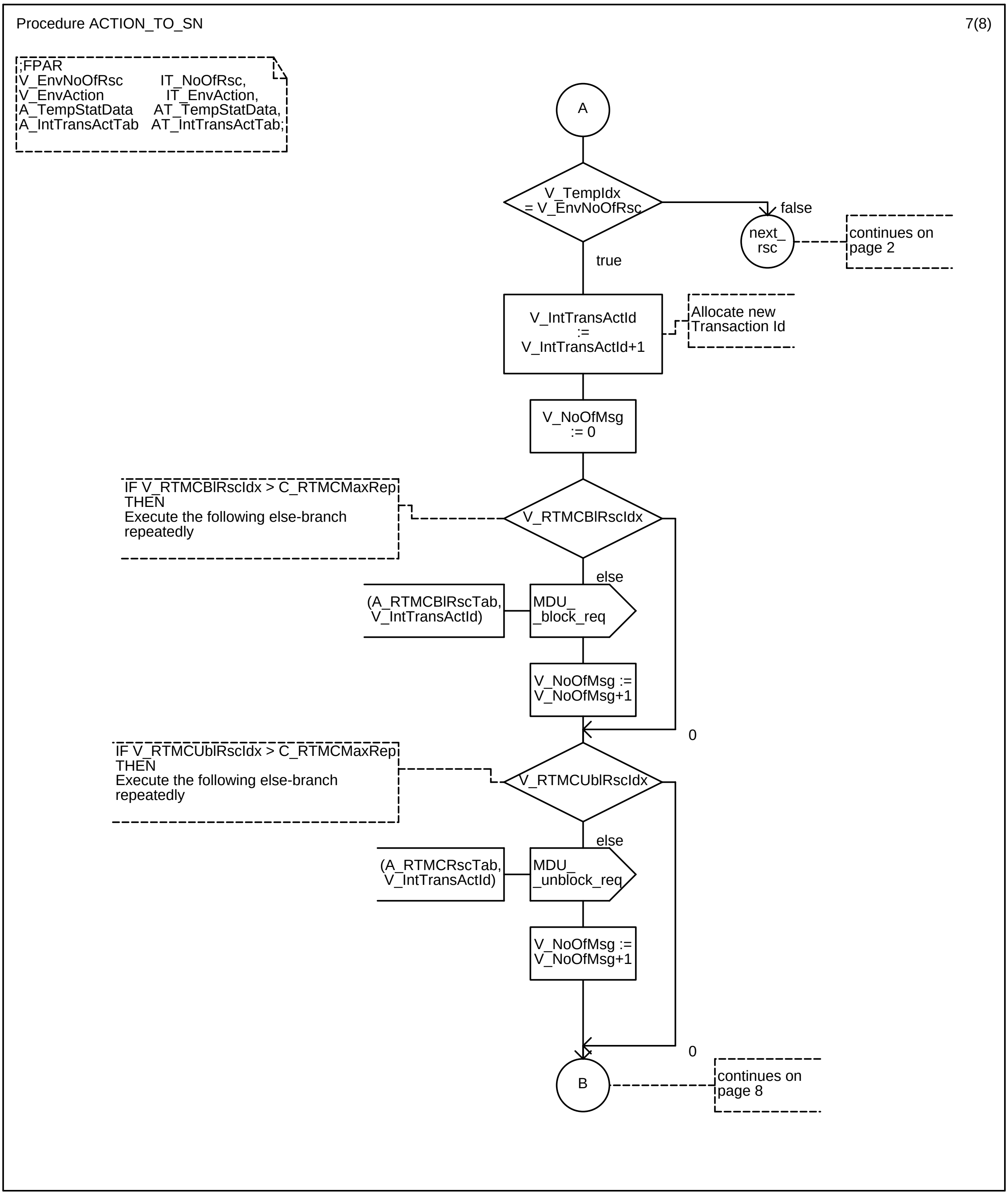


Figure A.45: AN_STATUS_MGT, Procedure ACTION_TO_SN (7)

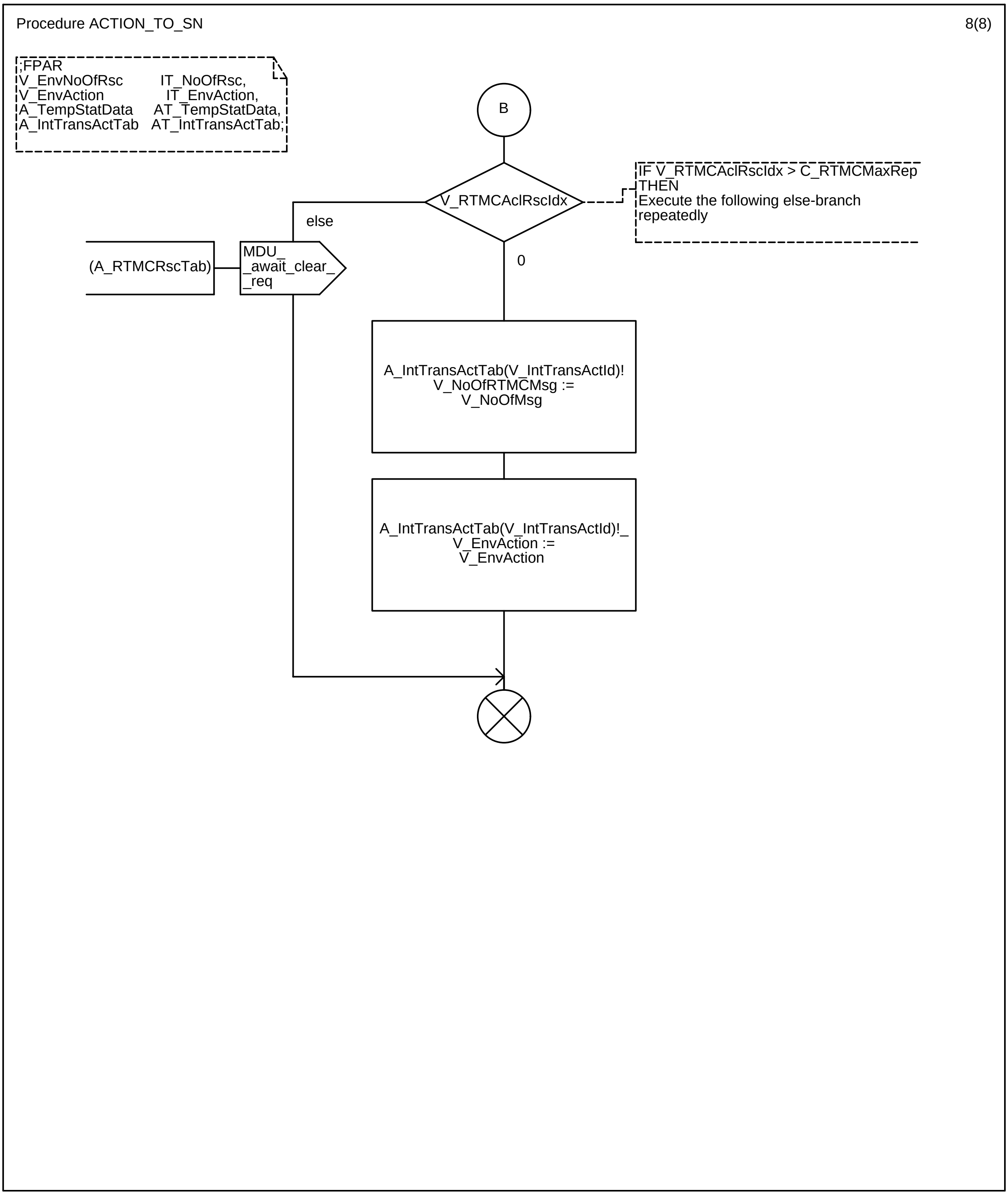


Figure A.46: AN_STATUS_MGT, Procedure ACTION_TO_SN (8)

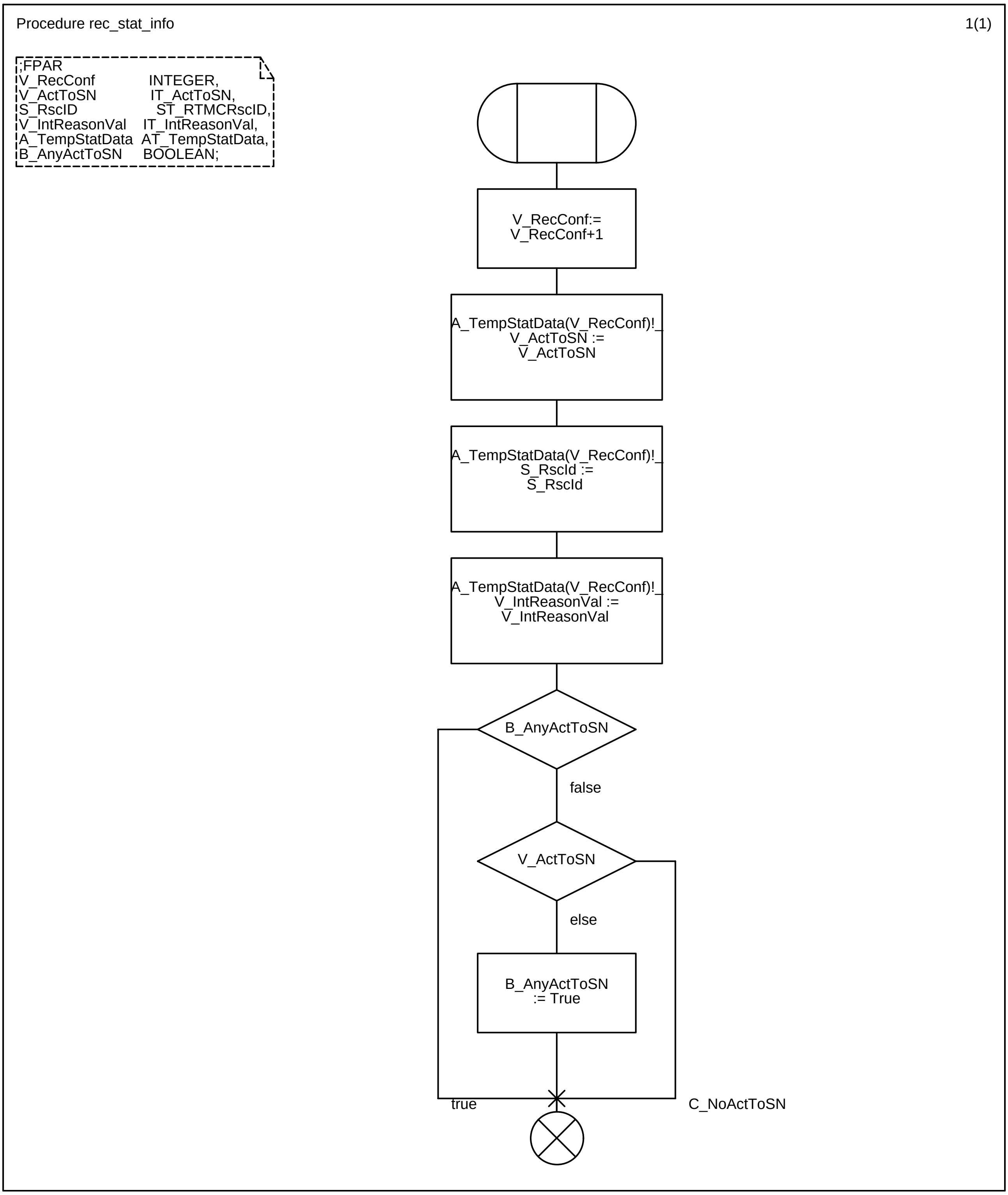


Figure A.47: AN_STATUS_MGT, Procedure RECEIVE_STATUS_INFO

A.2.1.2 Process AN_VPCI_CC

Process AN_VPCI_CC 1(7)

/*VB5.1 System Management
Process AN_VPCI_CC
Applicable to AN side*/

/* Definitions and declarations
for process AN_VPCI_CC */

/* State descriptions
OutOfService: Initial state. Process is waiting for activation from CTR process.
InService: Process is waiting for request for VPCI consistency check
AwaitLoopAct: Check has been requested from SN side. Process is waiting for response for activation of the loop back function on requested VPCI.
CheckRunning: VPCI consistency check is running.
AwaitLoopDeact: Process is waiting for response for deactivation of the loop back function on requested VPCI. */

```
/*Signal data declarations*/
DCL
S_RTMCRscId ST_RTMCRscId; /*Resource Identifier Information Element*/
/**/
DCL
S_RTMCUnkRscId ST_RTMCUnkRscId; /*Unknown Resource Identifier Information Element*/
/**/
DCL
A_RTMCRscTab AT_RTMCRscTab; /*Resource Identifier Information Element Table (needed for interface to ana_res procedure)*/
/**/
DCL
A_RTMCUnkRscTab AT_RTMCUnkRscTab; /*Unknown Resource Identifier IE  Table (needed for interface to ana_res procedure)*/
/**/
DCL
V_RTMCCCheckResult IT_RTMCCCheckResult; /*Consistency Check Result*/
/**/
DCL
V_NoOfRsc IT_NoOfRsc; /*Number of resources*/
/**/
DCL
V_NoOfUnkRsc IT_NoOfRsc; /*Number of unknown resources*/
/**/
DCL
P_CprotPID PID; /*PID of CPROT instance responsible for transaction*/
```

Figure A.48: AN_VPCI_CC (1)

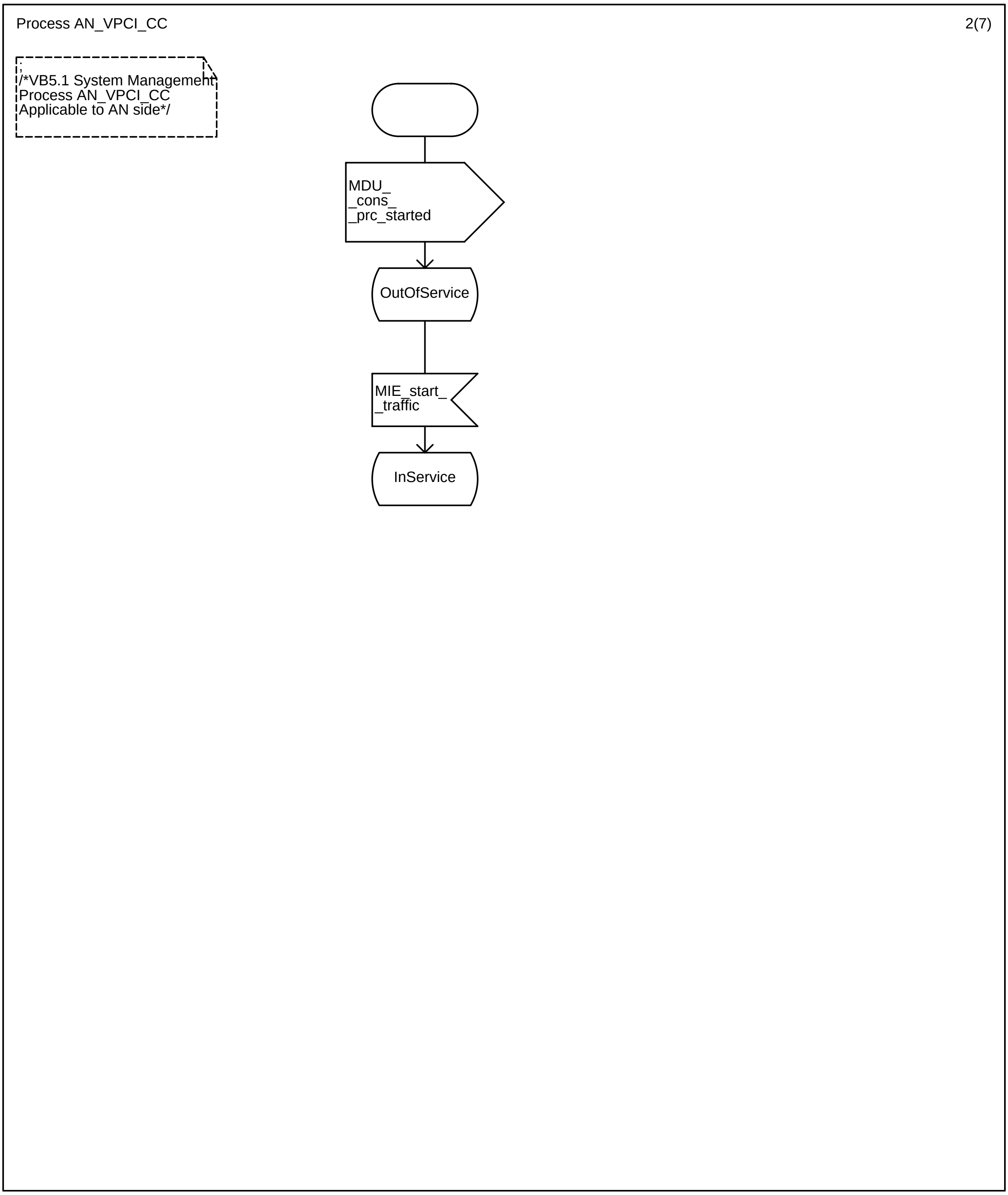


Figure A.49: AN_VPCI_CC (2)

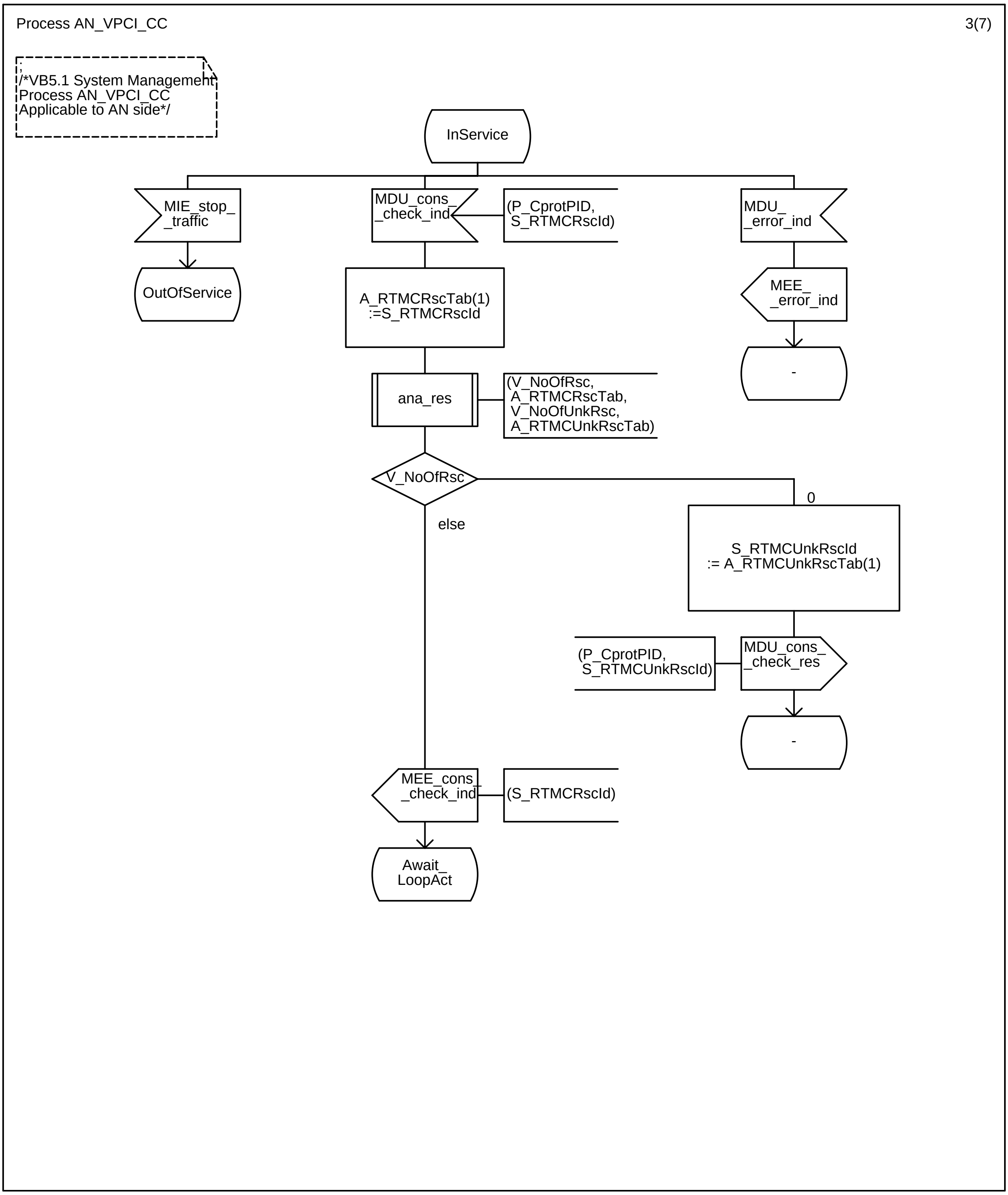


Figure A.50: AN_VPCI_CC (3)

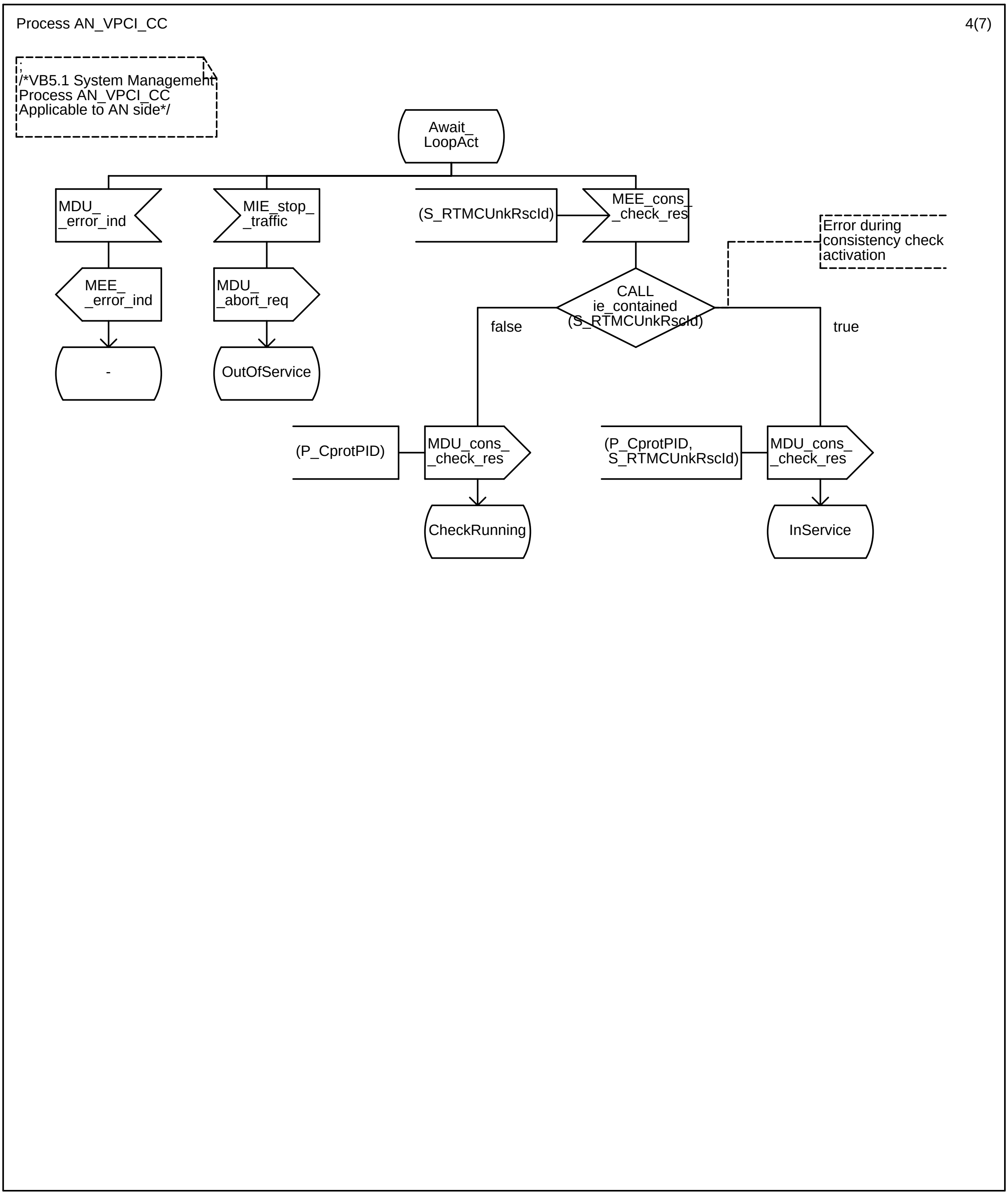


Figure A.51: AN_VPCI_CC (4)

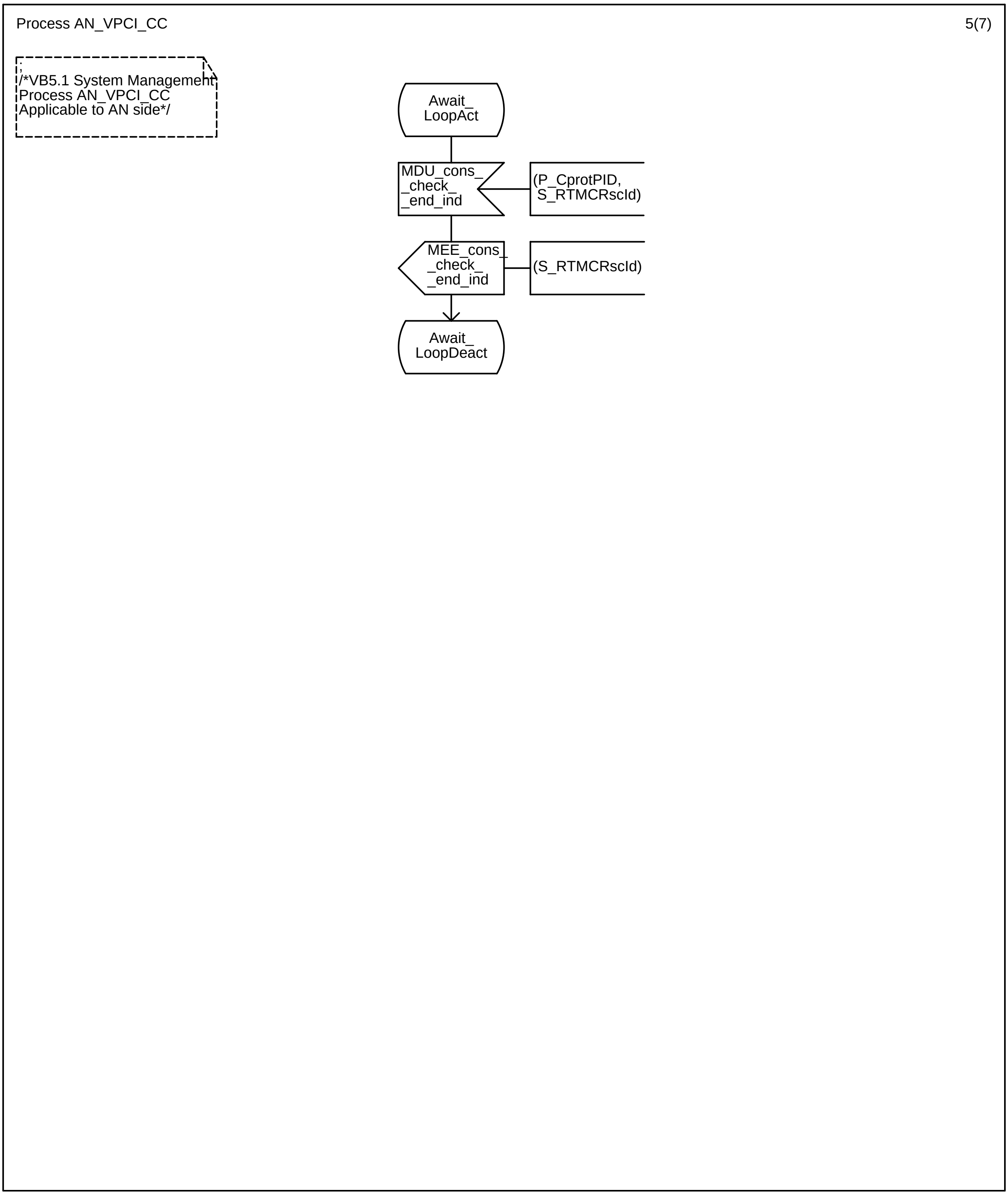


Figure A.52: AN_VPCI_CC (5)

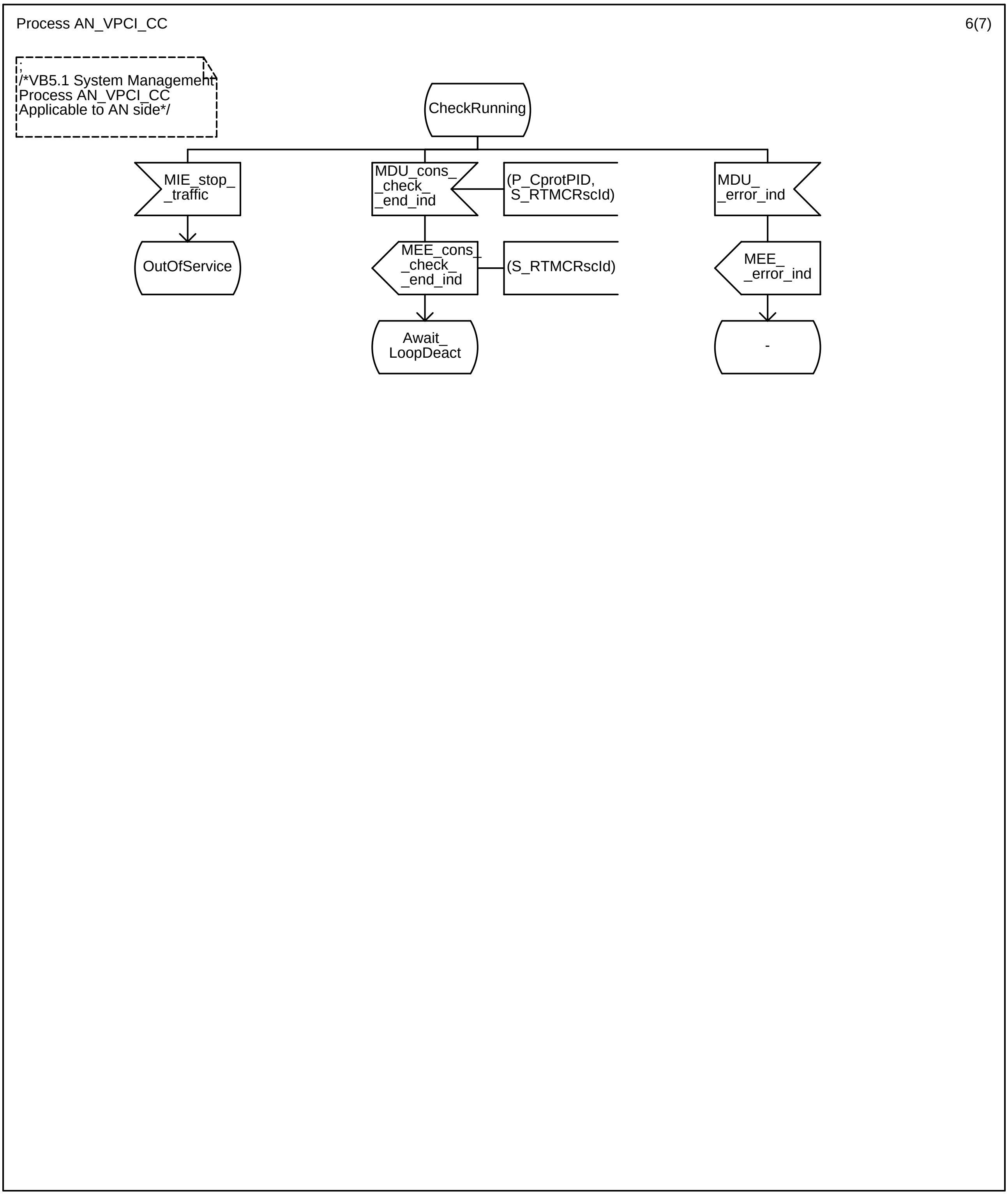


Figure A.53: AN_VPCI_CC (6)

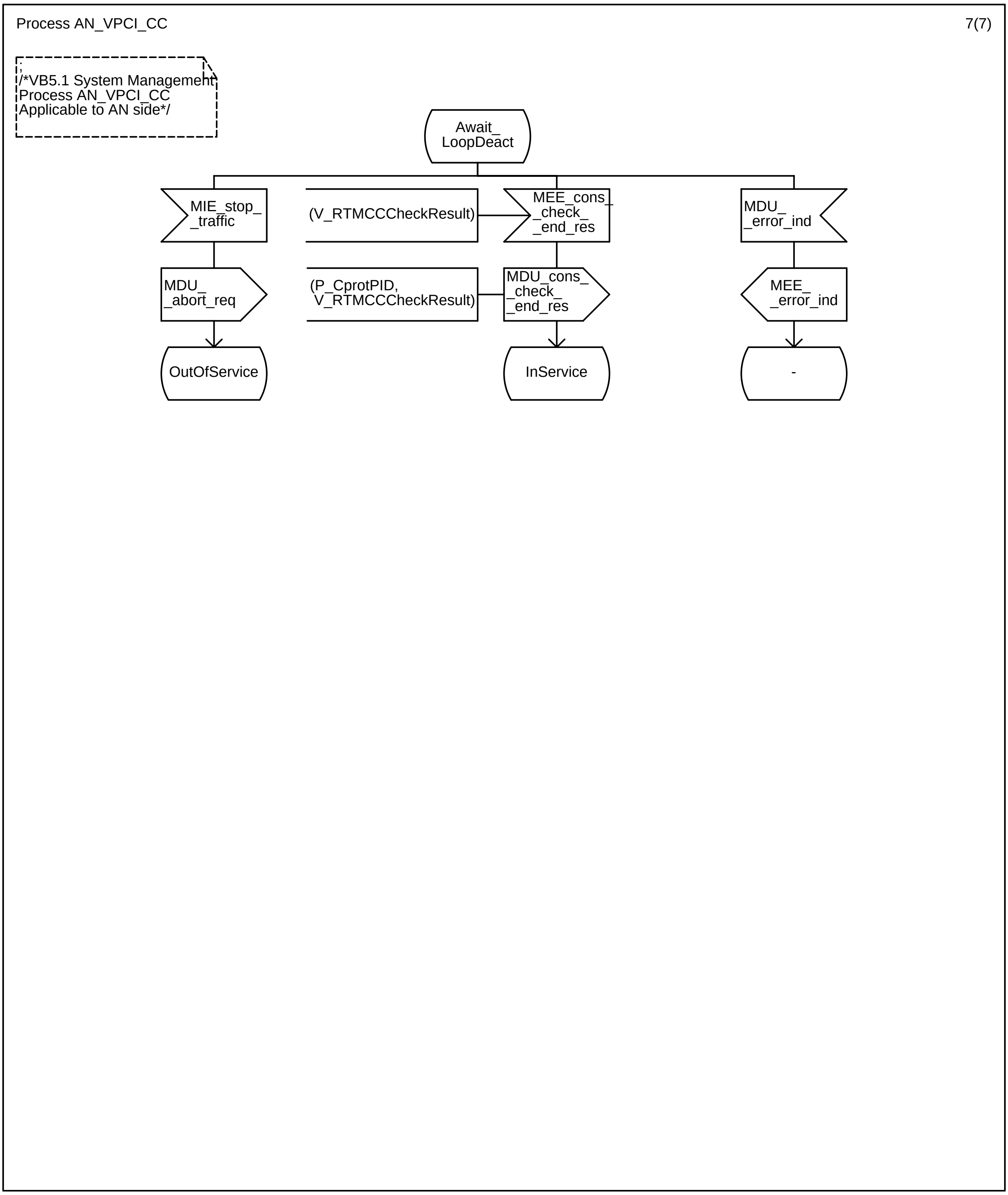


Figure A.54: AN_VPCI_CC (7)

A.2.2 Process AN_LSPSTAT

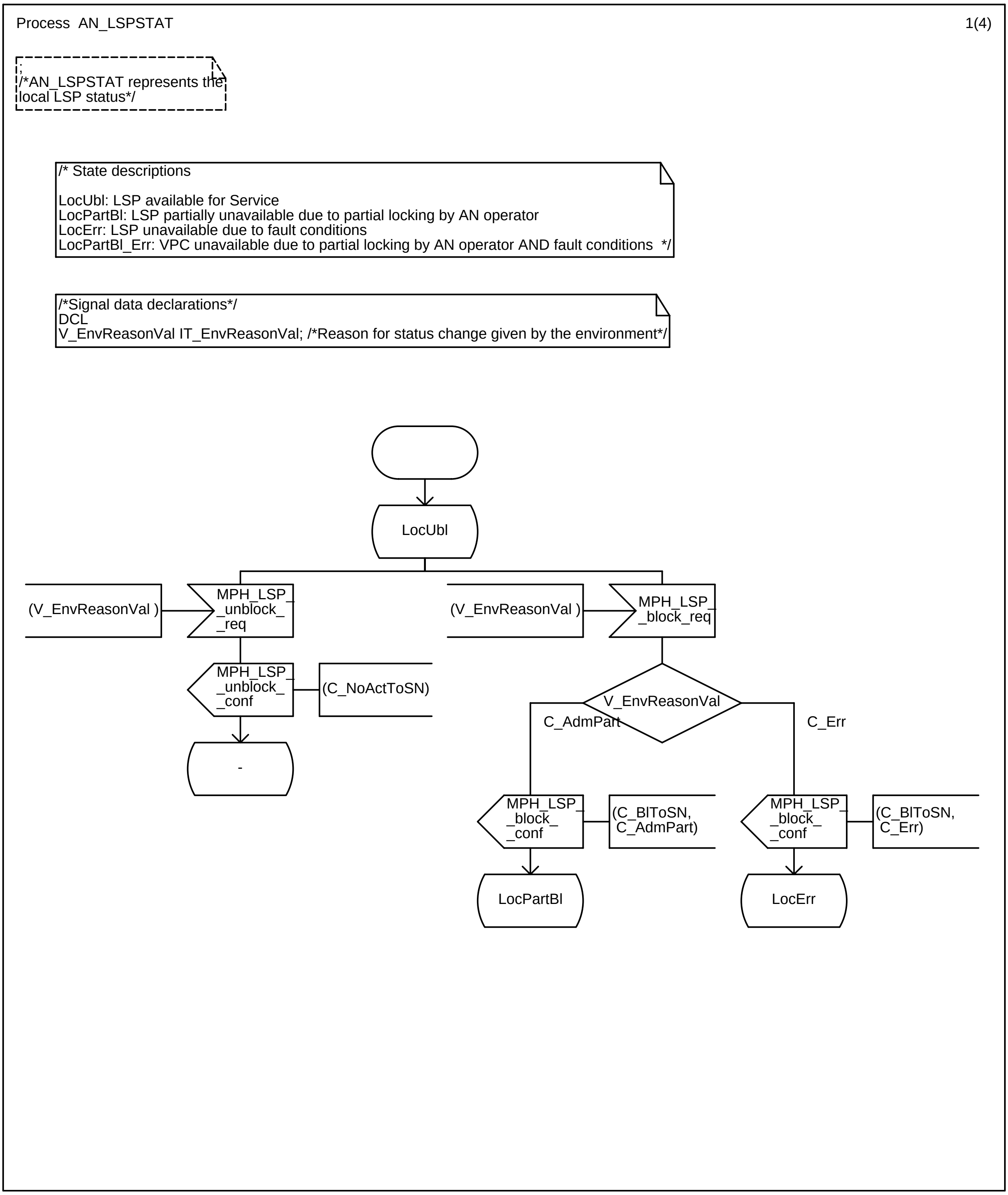


Figure A.55: AN_LSPSTAT_FSM (1)

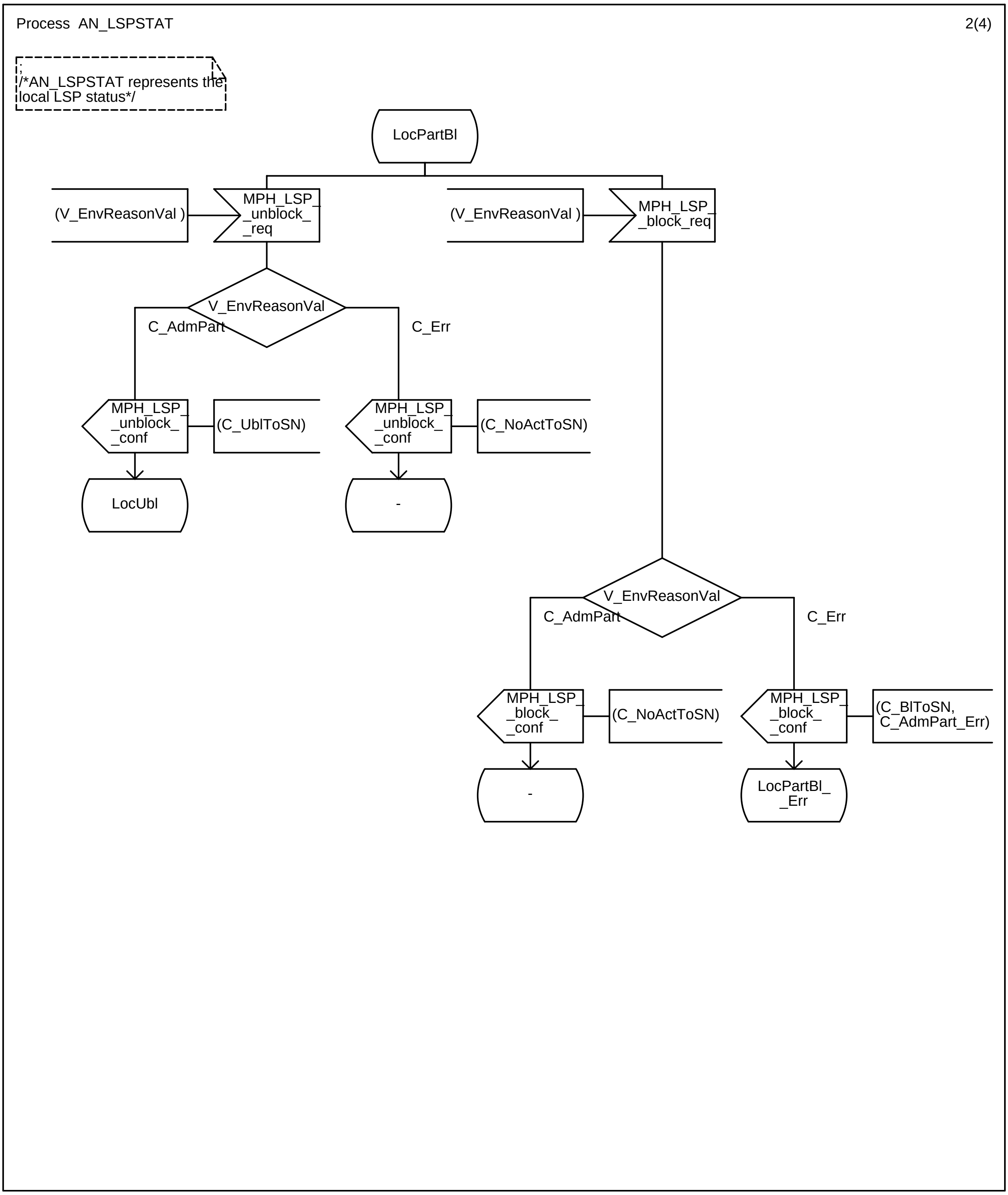


Figure A.56: AN_LSPSTAT_FSM (2)

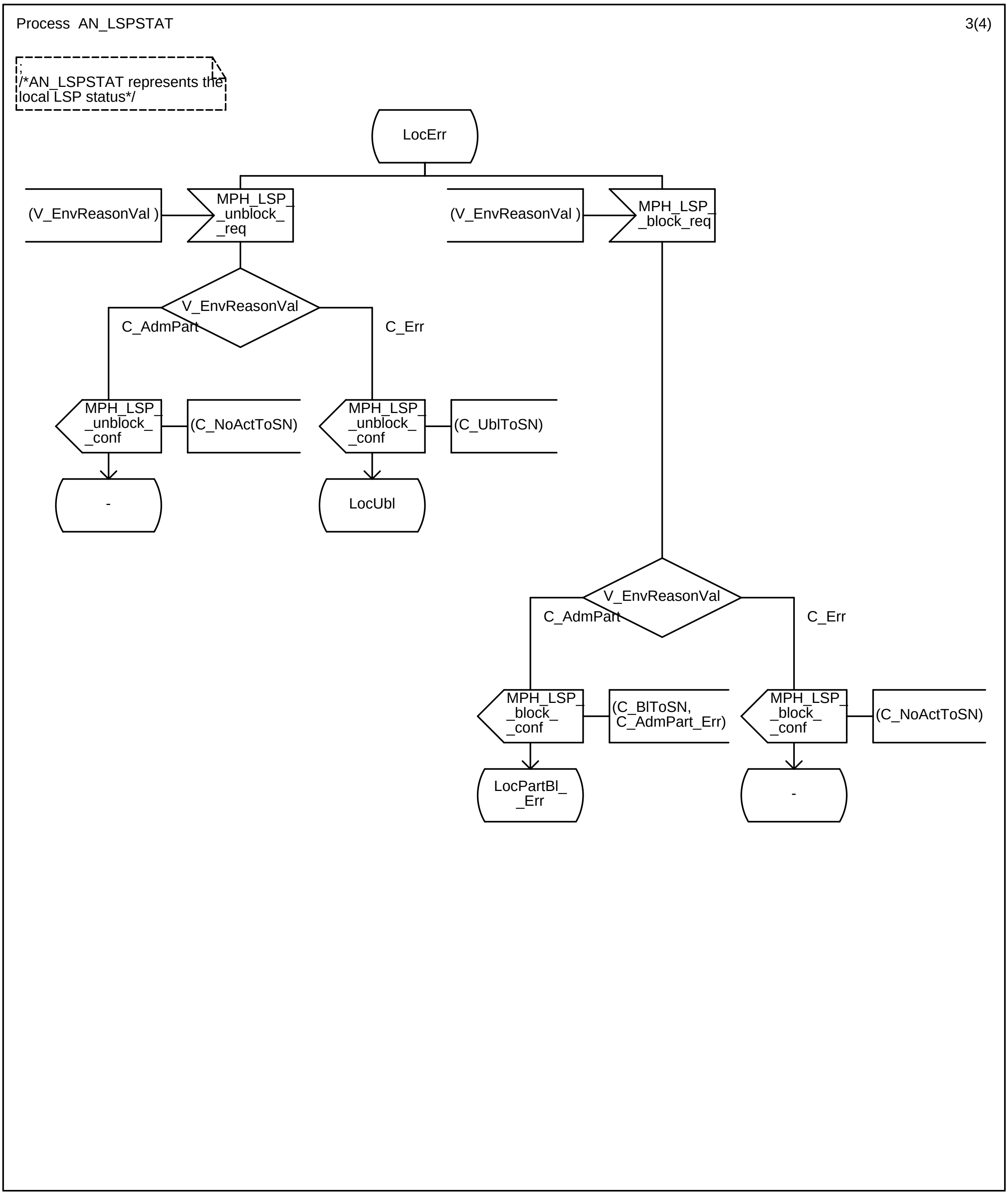


Figure A.57: AN_LSPSTAT_FSM (3)

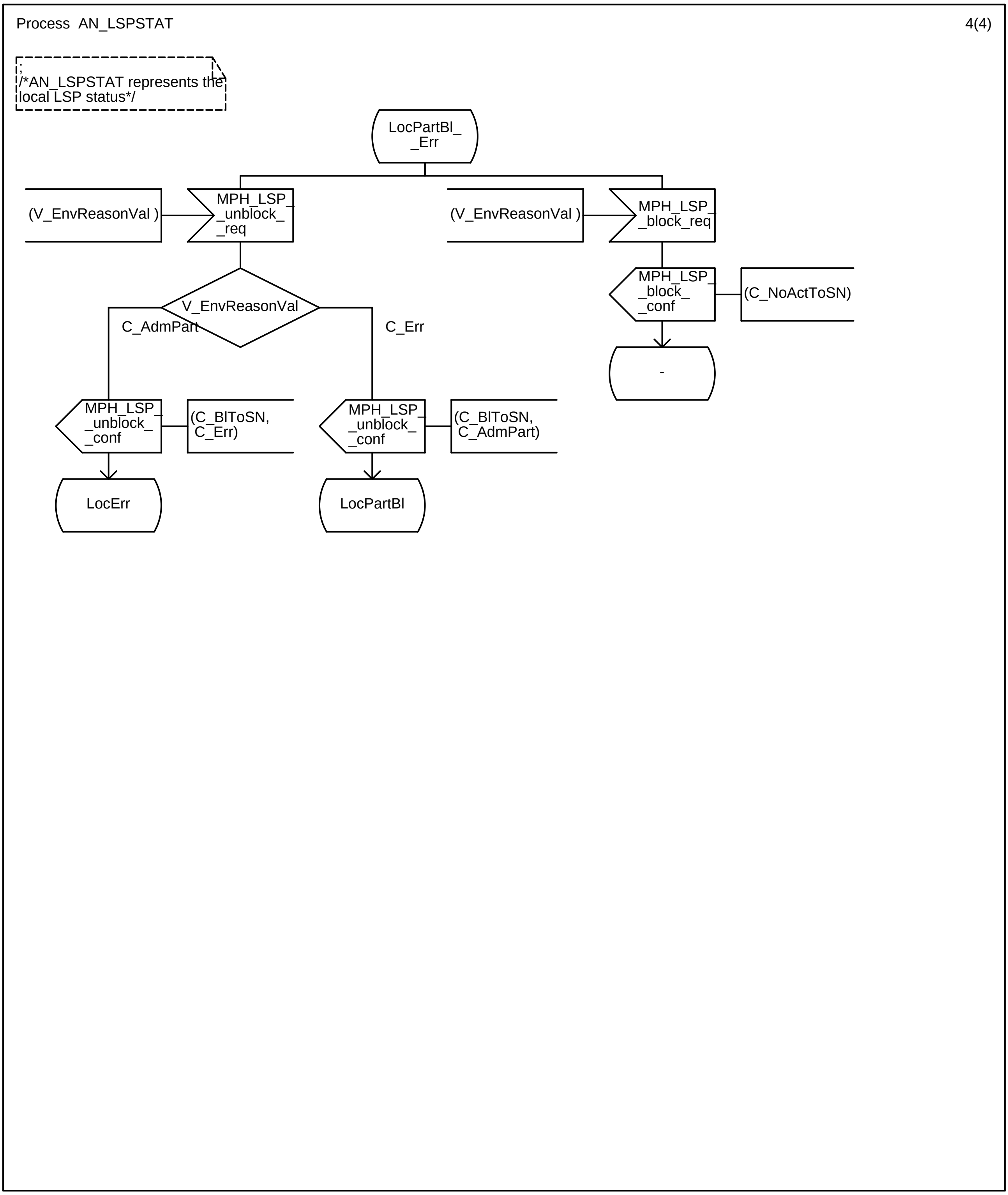


Figure A.58: AN_LSPSTAT_FSM (4)

A.2.3 Process AN_FVPCSTAT

Process AN_FVPCSTAT 1(25)

```
;
/*AN_FVPCSTATS is an FSM which
represents the local VPC states.
It determines the required
aaction towards the SN in
case of state changes*/
```

```
/*Definitions and
declarations for AN_VPCSTAT*/
```

```
/* State descriptions

LocUbl: VPC available for Service
LocFullBl: VPC unavailable for service due to locking by AN operator
LocPartBl: VPC partially unavailable due to partial locking by AN operator
LocErr: VPC unavailable due to fault conditions
LocPartAndFullBl: VPC unavailable due to locking AND partial locking by AN operator
LocFullBl_Err: VPC unavailable due to locking by AN operator AND fault conditions
LocPartBl_Err: VPC unavailable due to partial locking by AN operator AND fault conditions
LocPartAndFullBl&Err: VPC unavailable due to locking by  AND partial locking by AN operator AND fault conditions
LocShutDown: Shutting Down of VPC was requested by AN operator
LocPartShutDown: Partial Shutting Down of VPC was requested by AN operator
LocShutDownAndPartShutDown:  Partial Shutting Down AND Shutting Down of VPC was requested by AN operator
LocPartBlAndShutDown: Shutting Down of a partial locked VPC was requested by AN operator */
```

```
/*Signal data declarations*/
DCL
V_EnvReasonVal IT_EnvReasonVal; /*Reason for status change given by the environment*/
/**/
DCL
S_RscID ST_RTMCRscId;  /*Resource identification*/
/**/
/*Resource Identifiers allocated to AN_FVPCSTAT processes*/
DCL S_ANOwnRscId ST_RTMCRscId := C_OwnRscId;
```

Figure A.59: AN_FVPCSTAT (1)

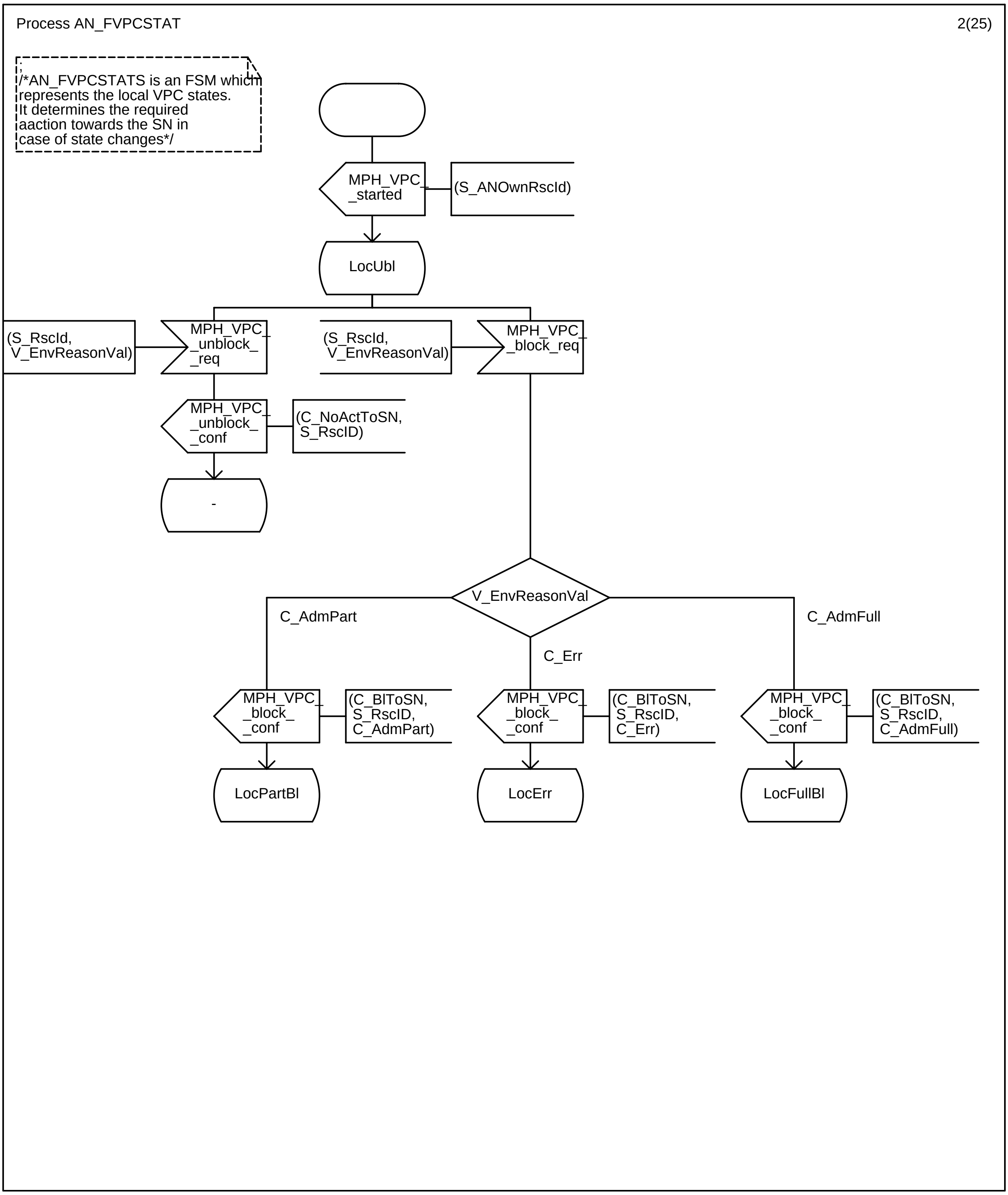


Figure A.60: AN_FVPCSTAT (2)

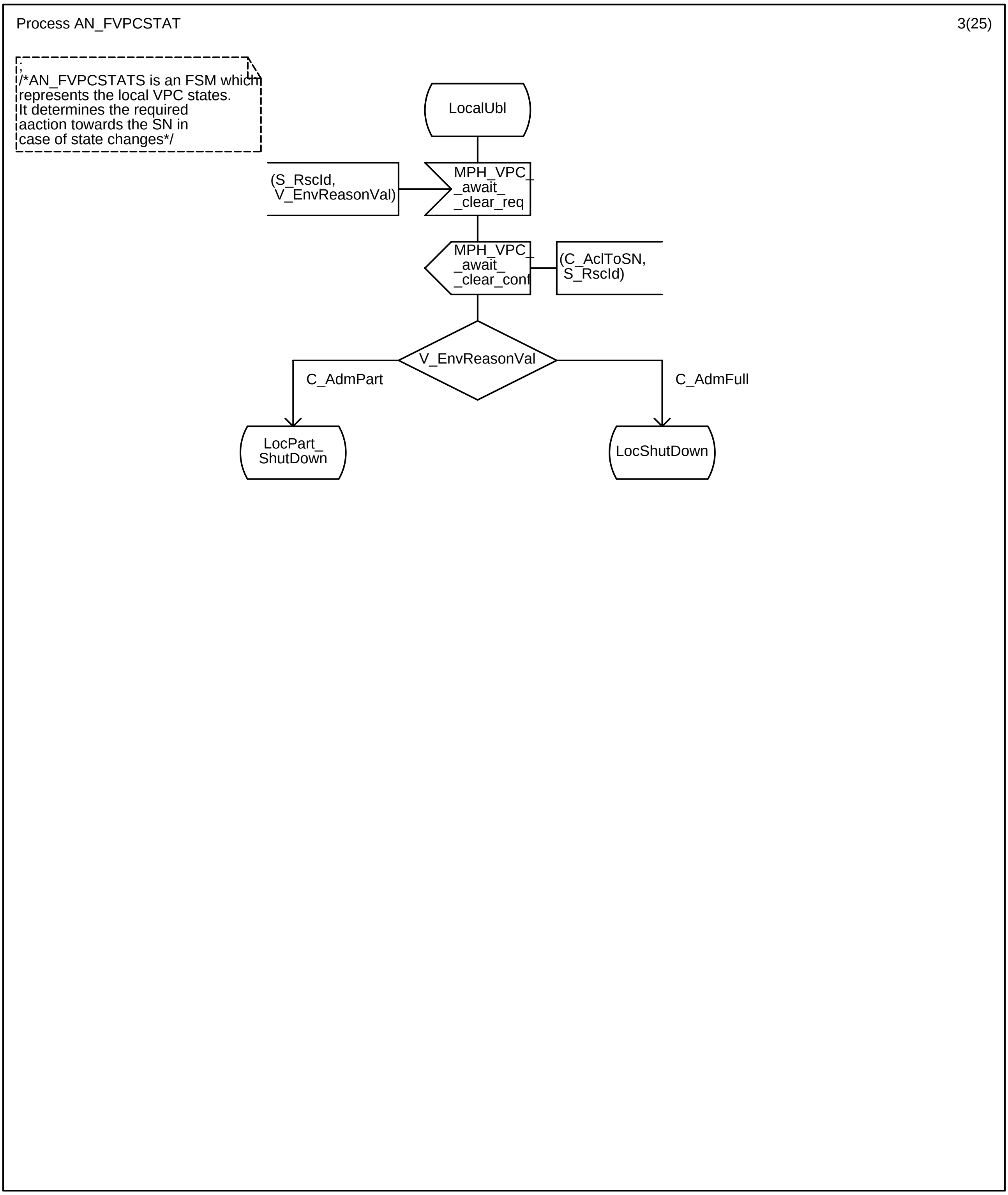


Figure A.61: AN_FVPCSTAT (3)

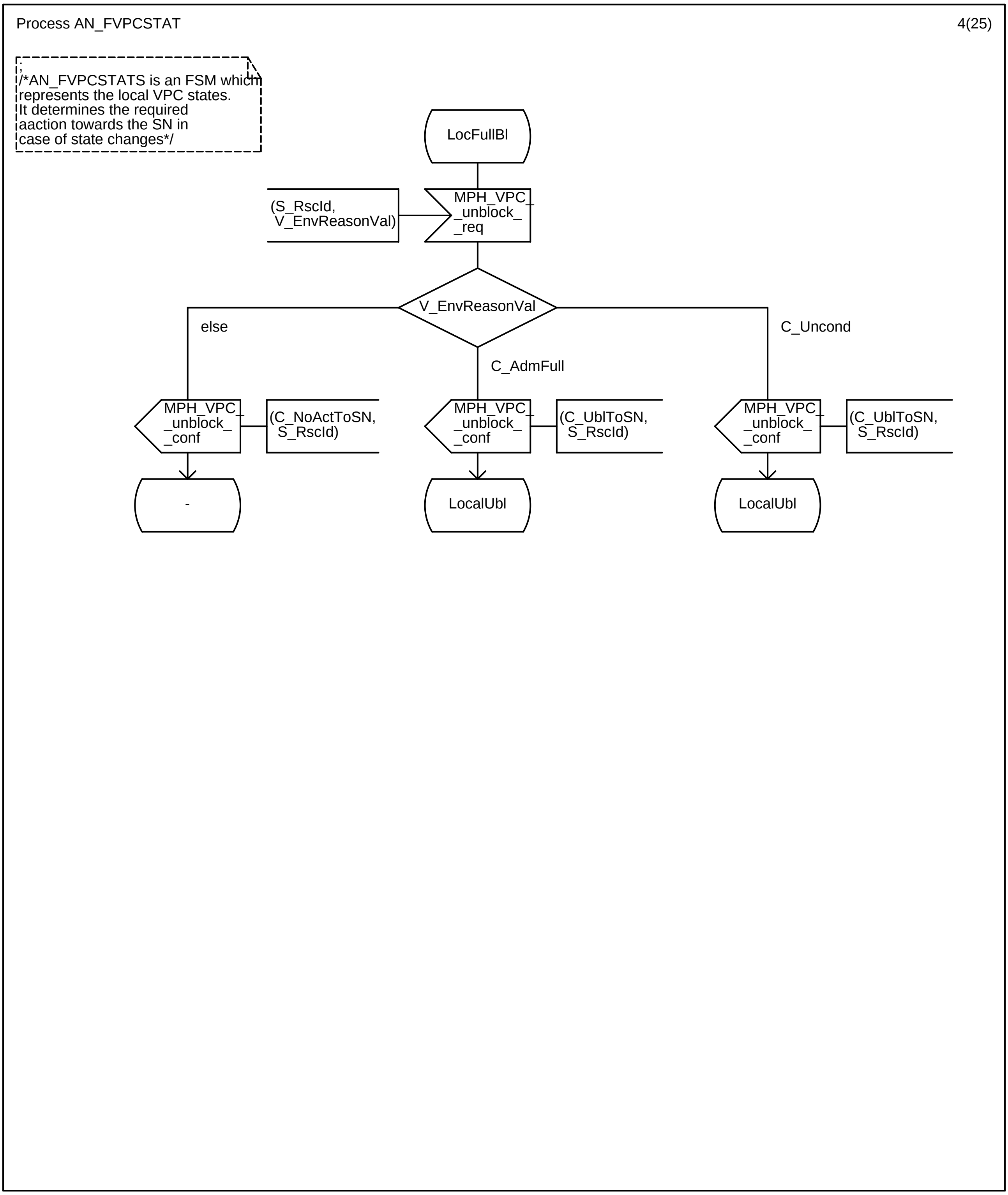


Figure A.62: AN_FVPCSTAT (4)

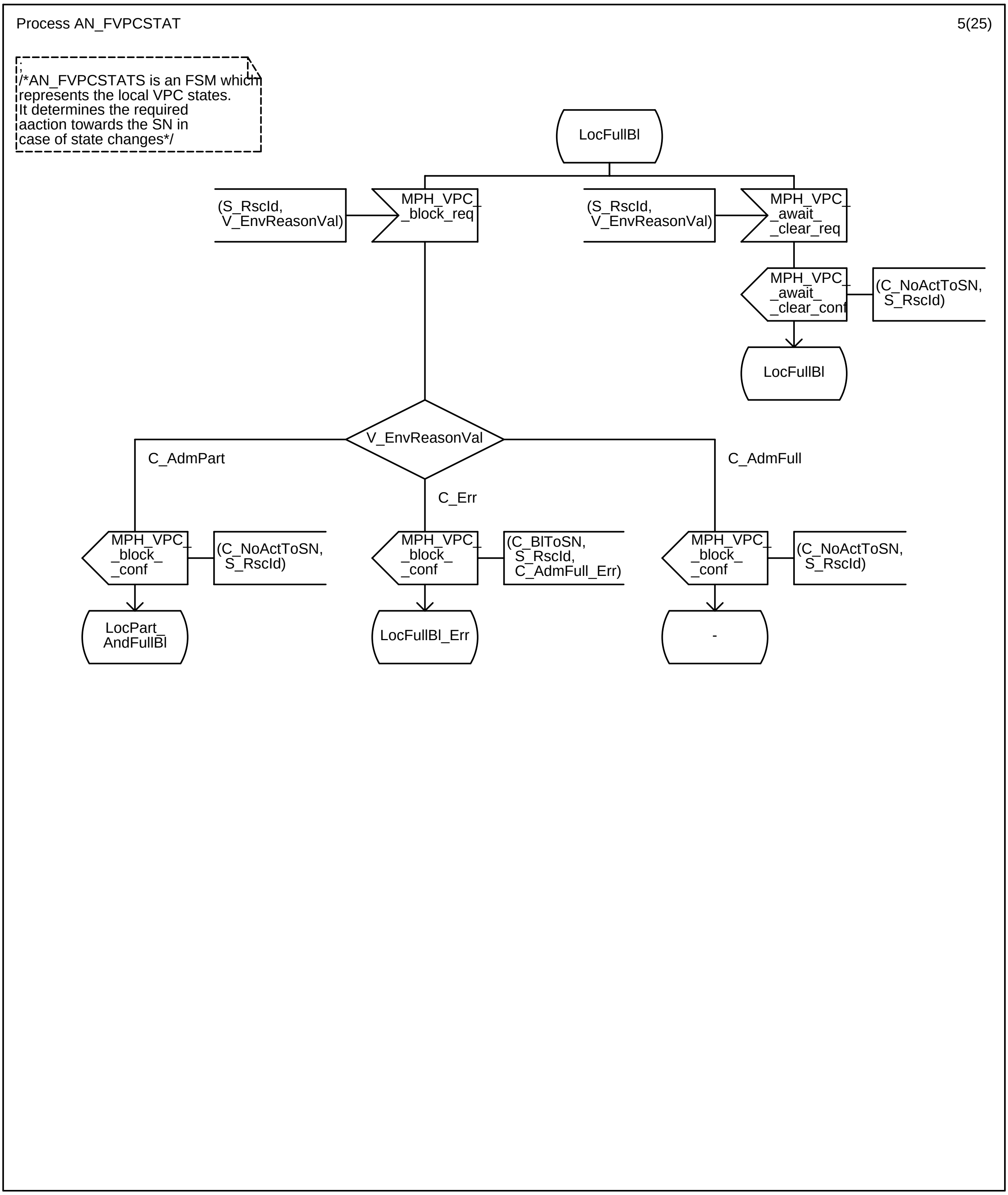


Figure A.63: AN_FVPCSTAT (5)

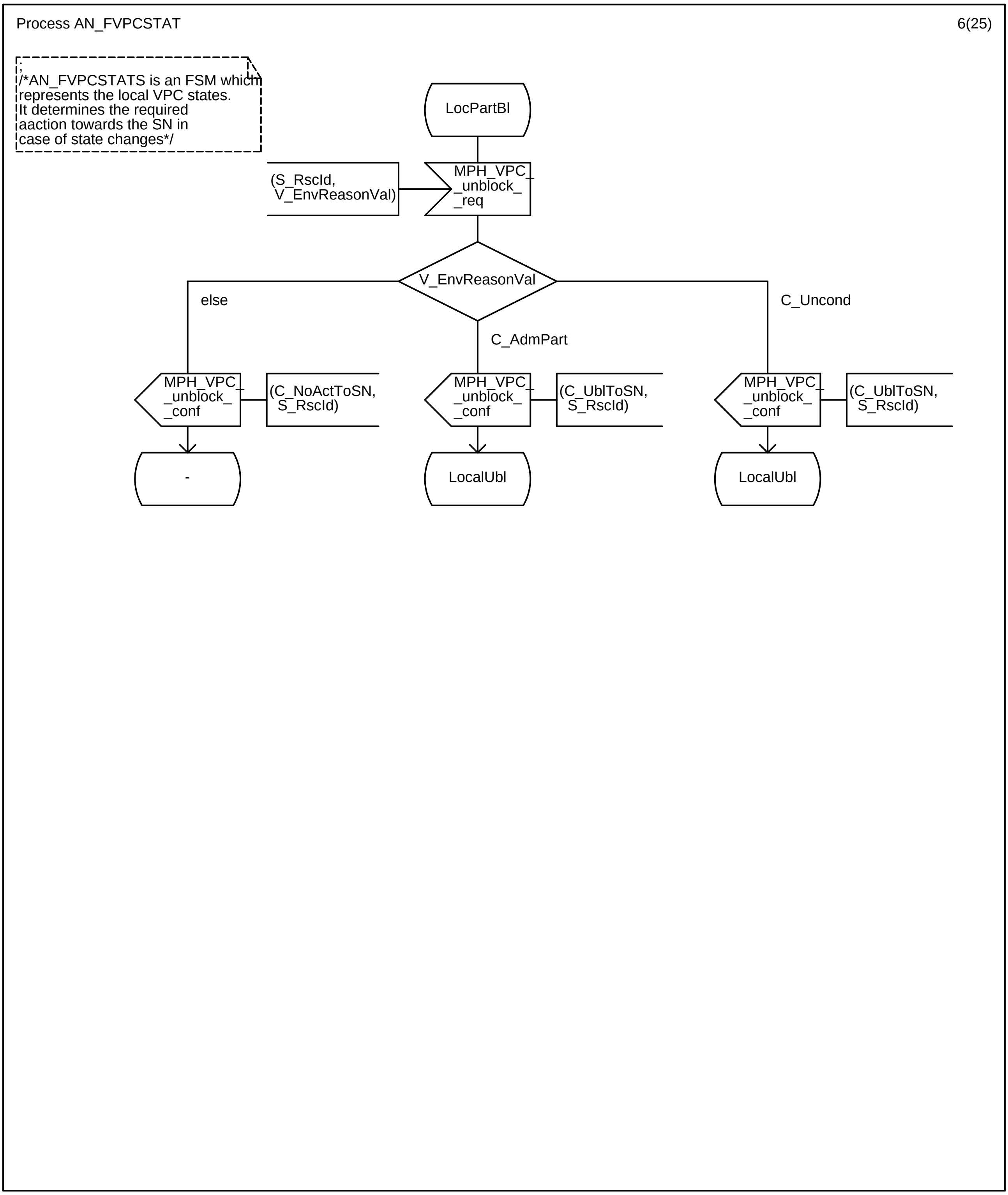


Figure A.64: AN_FVPCSTAT (6)

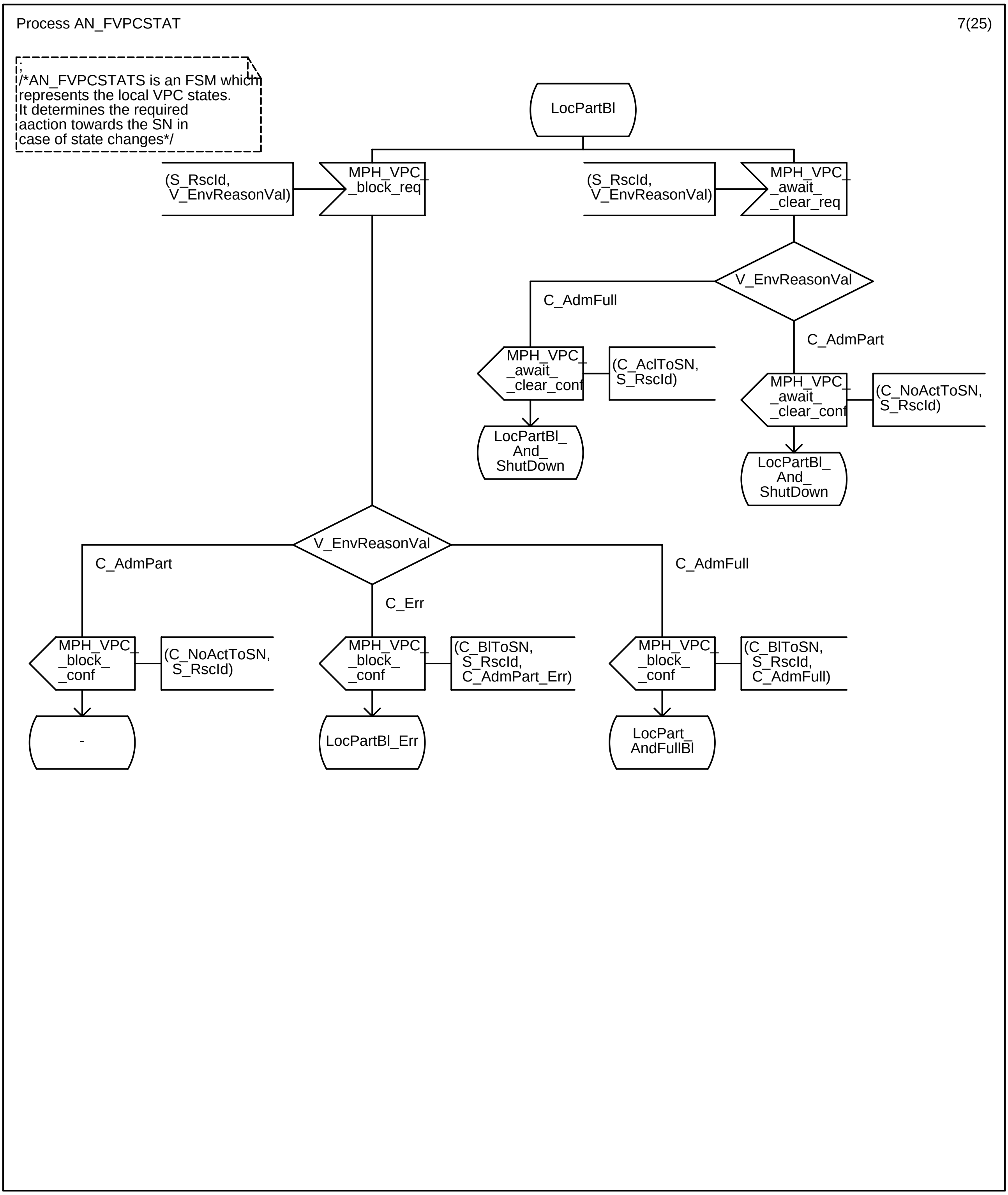


Figure A.65: AN_FVPCSTAT (7)

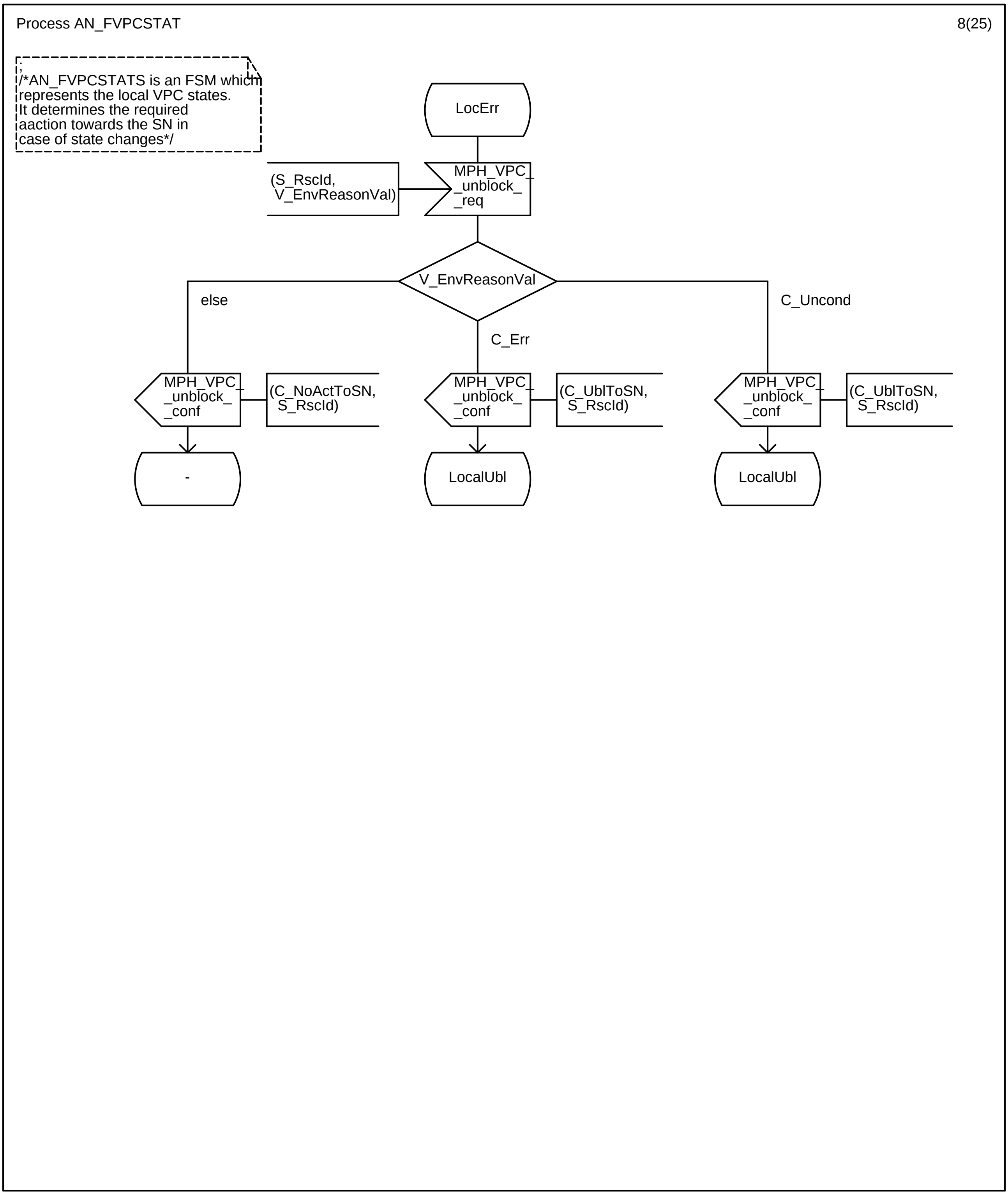


Figure A.66: AN_FVPCSTAT (8)

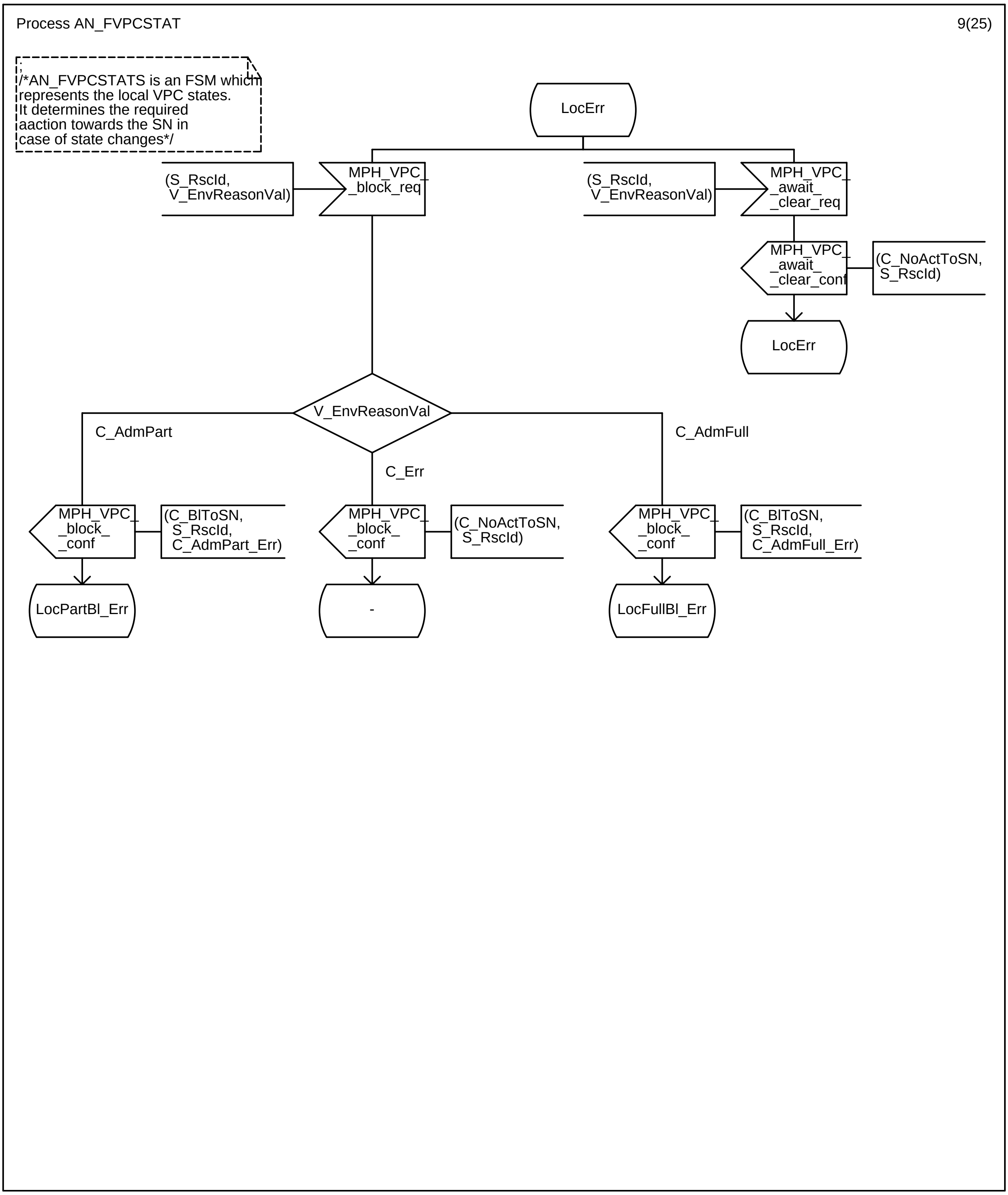


Figure A.67: AN_FVPCSTAT (9)

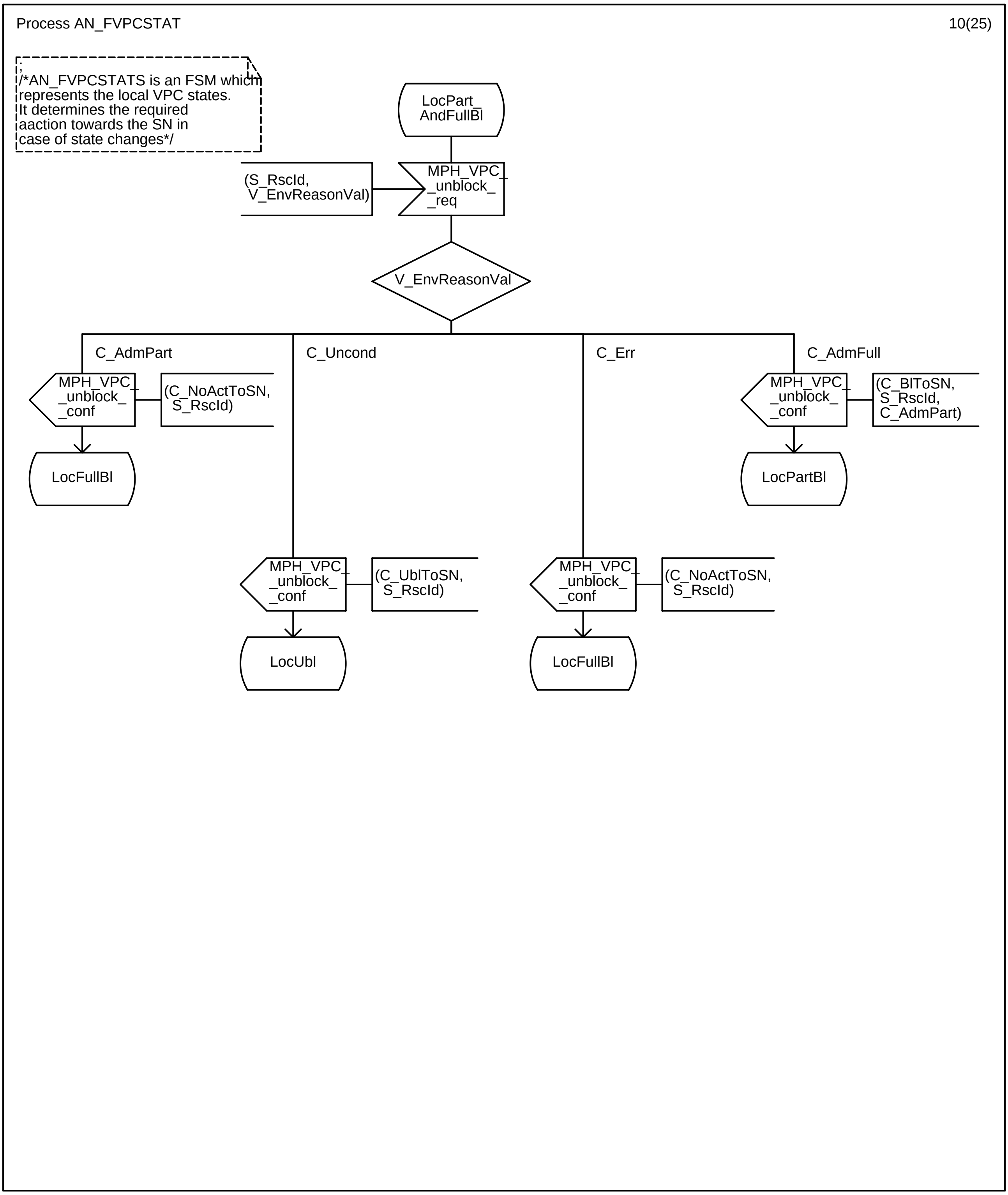


Figure A.68: AN_FVPCSTAT (10)

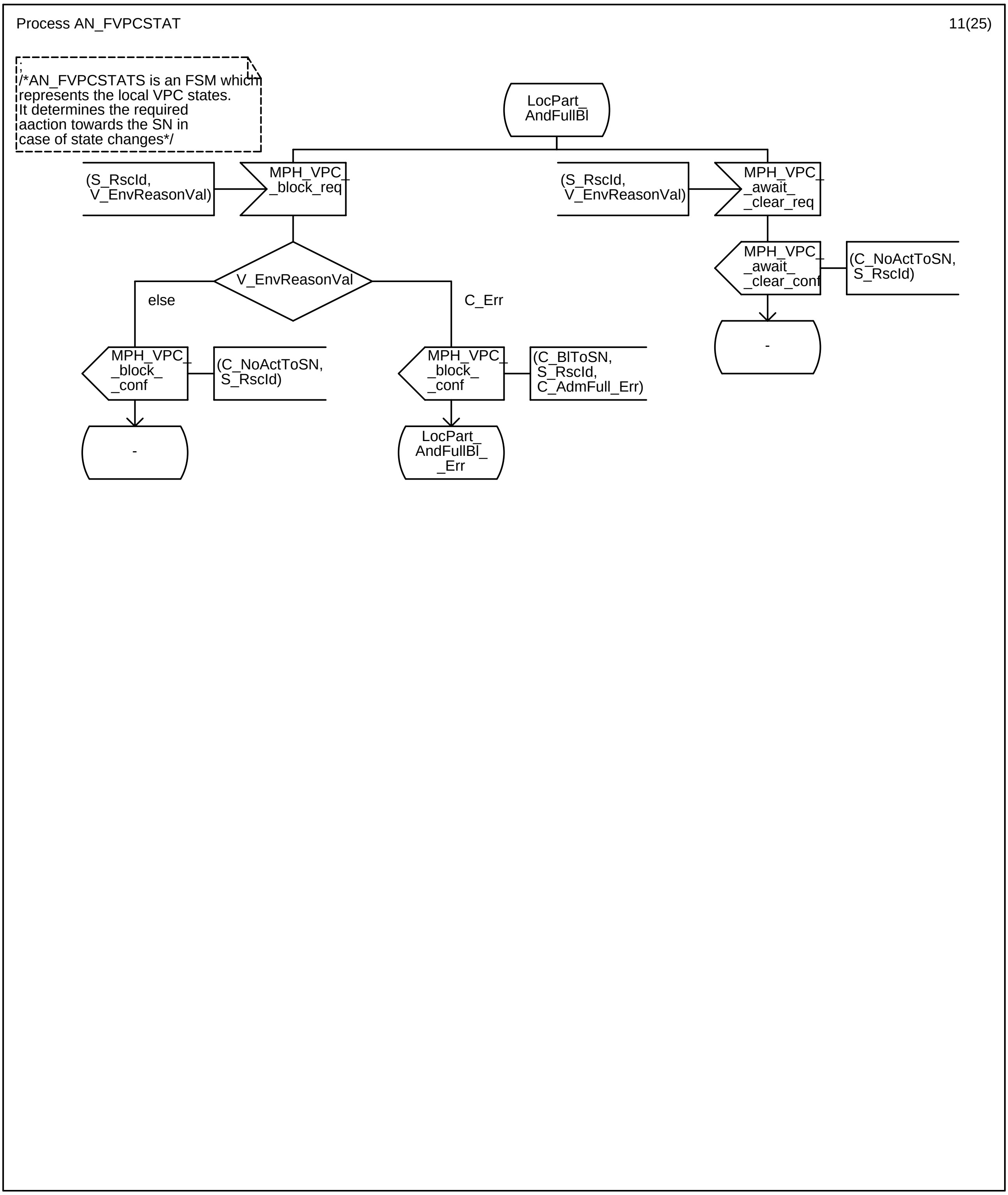


Figure A.69: AN_FVPCSTAT (11)

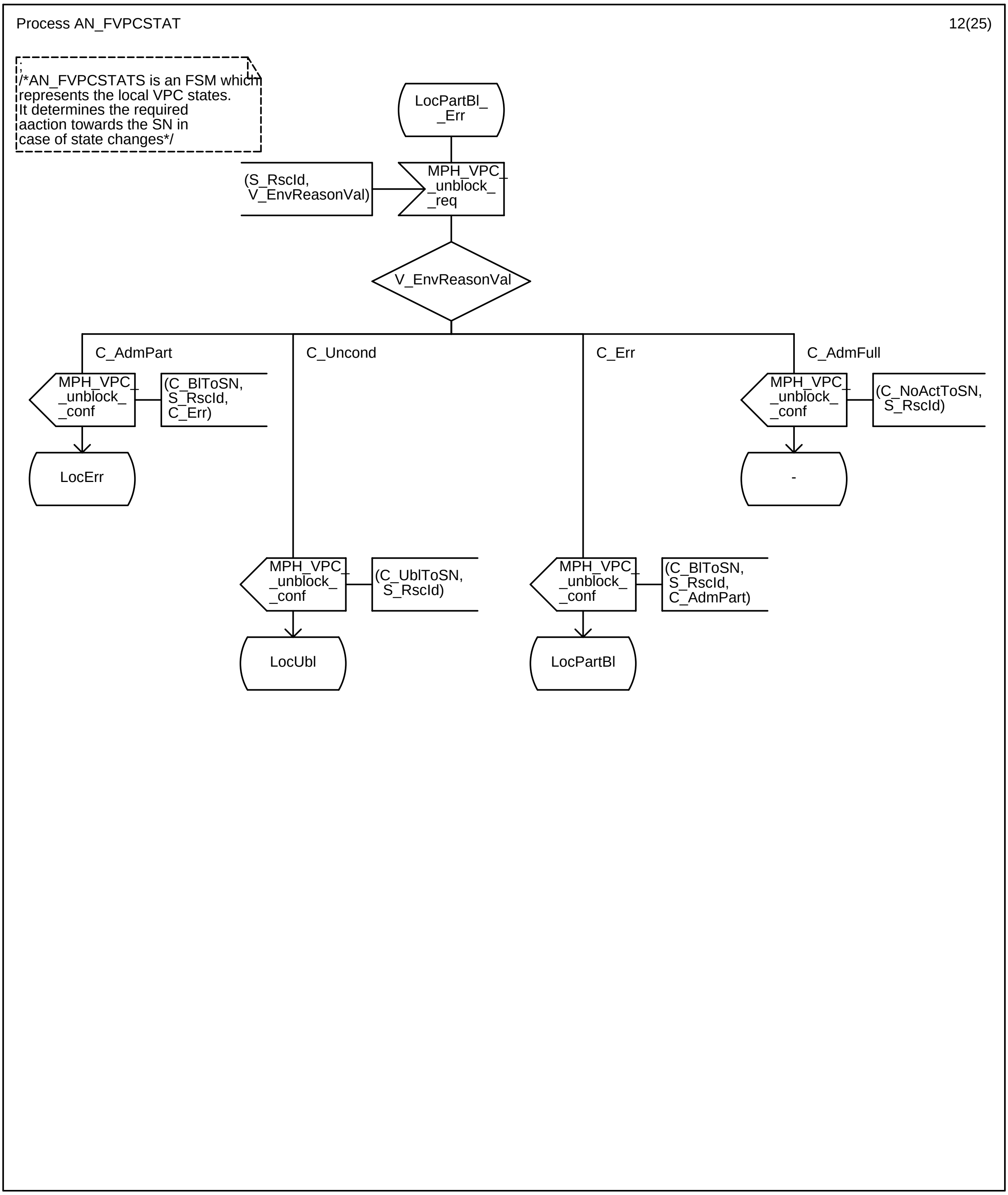


Figure A.70: AN_FVPCSTAT (12)

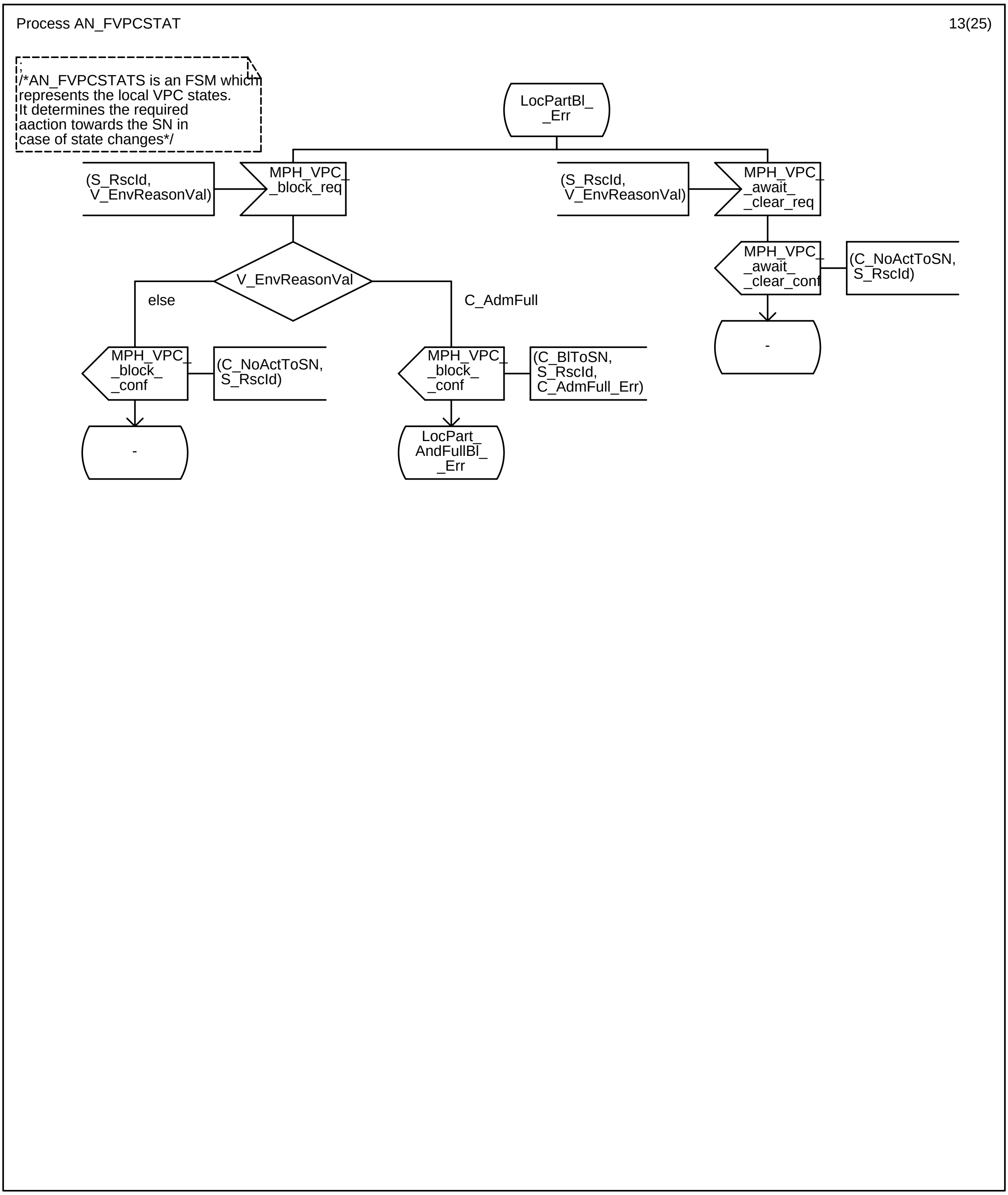


Figure A.71: AN_FVPCSTAT (13)

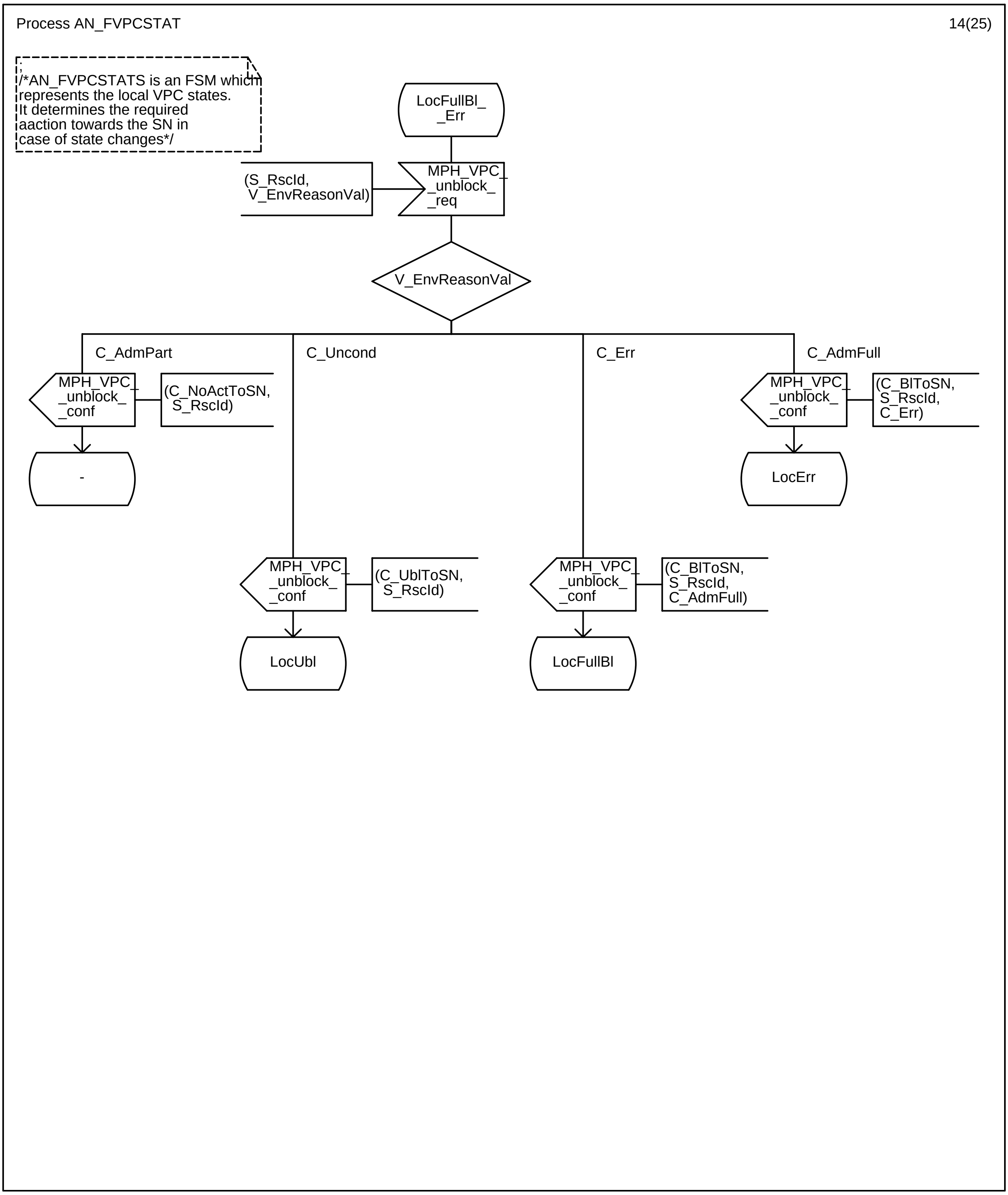


Figure A.72: AN_FVPCSTAT (14)

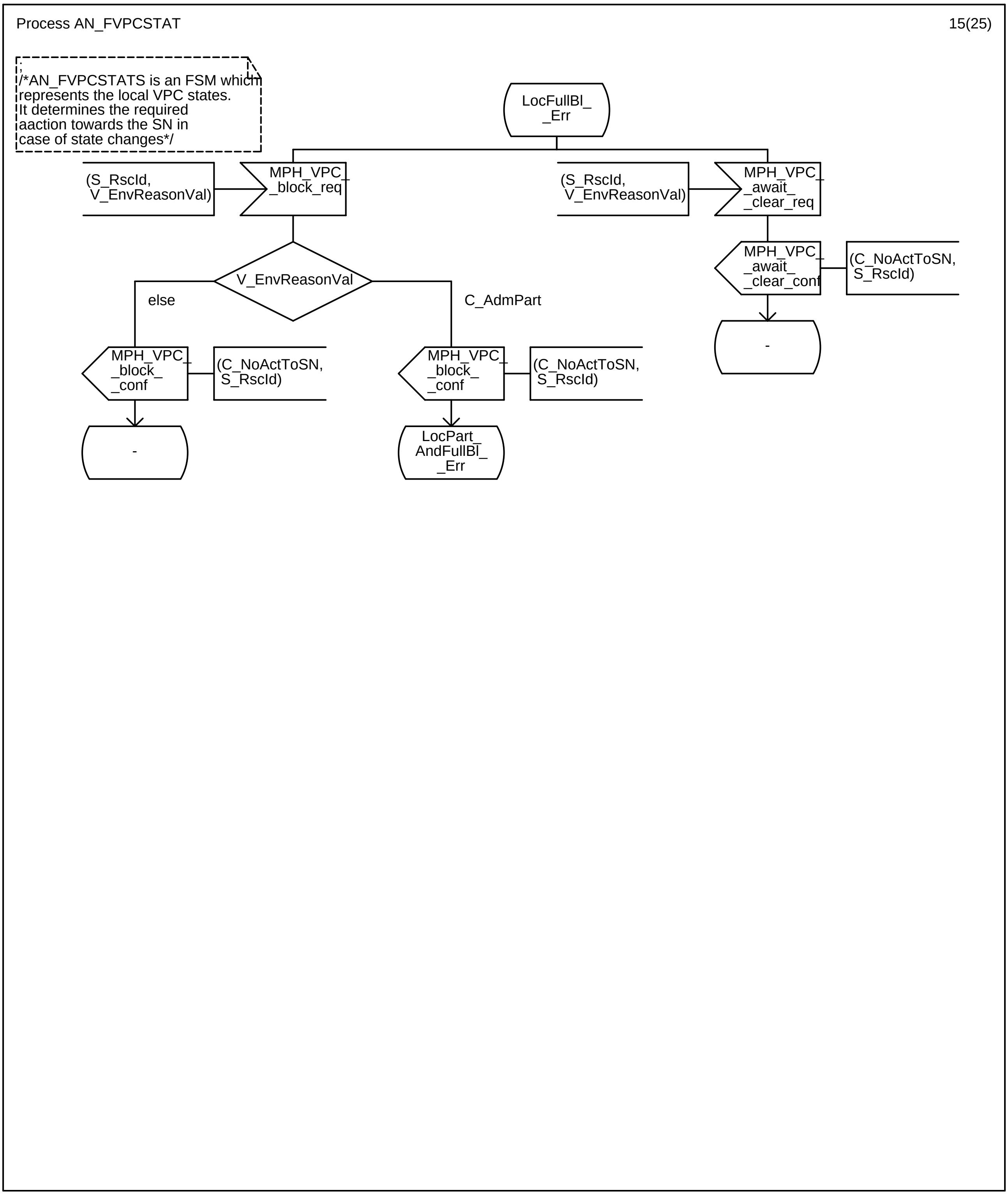


Figure A.73: AN_FVPCSTAT (15)

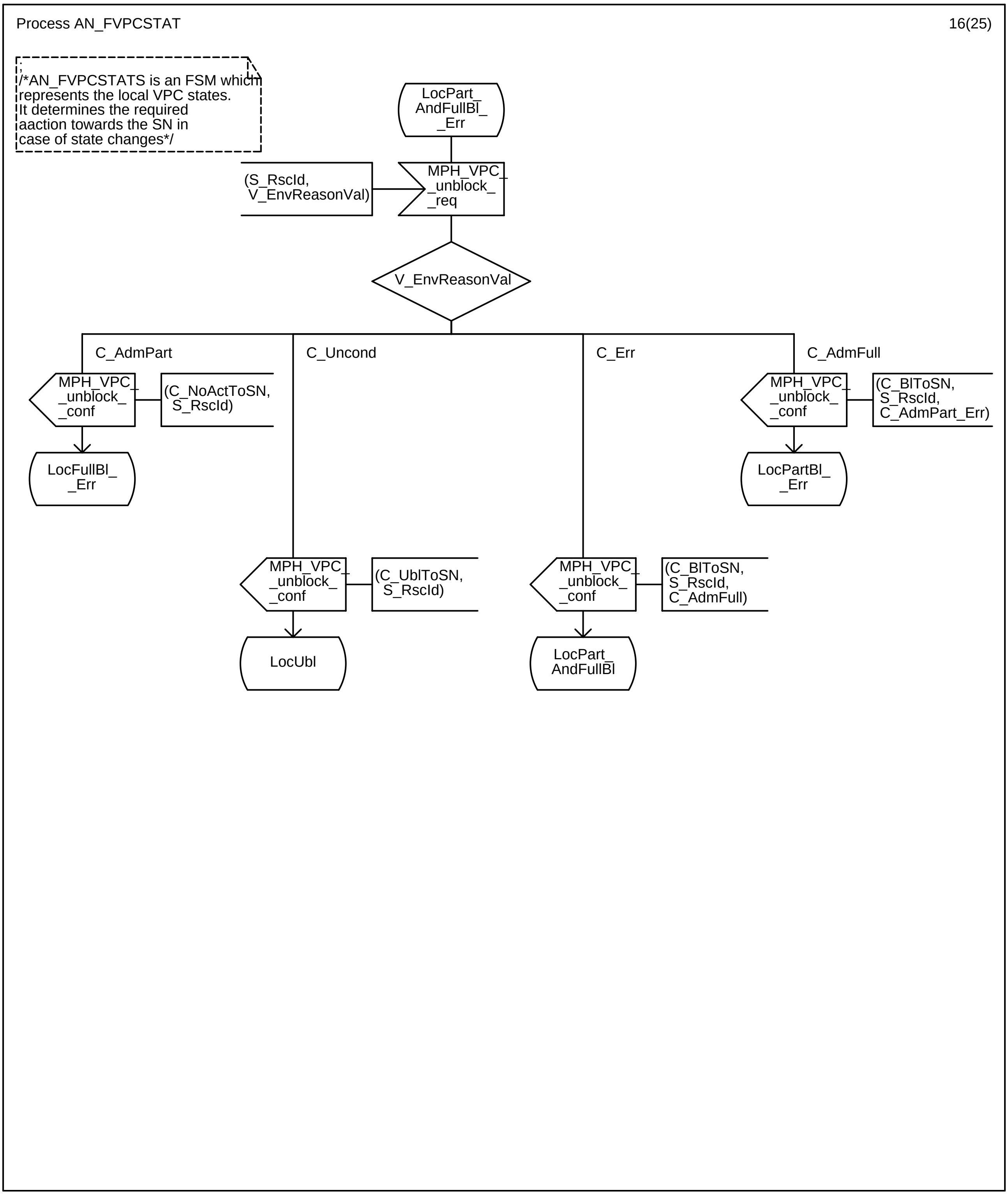


Figure A.74: AN_FVPCSTAT (16)

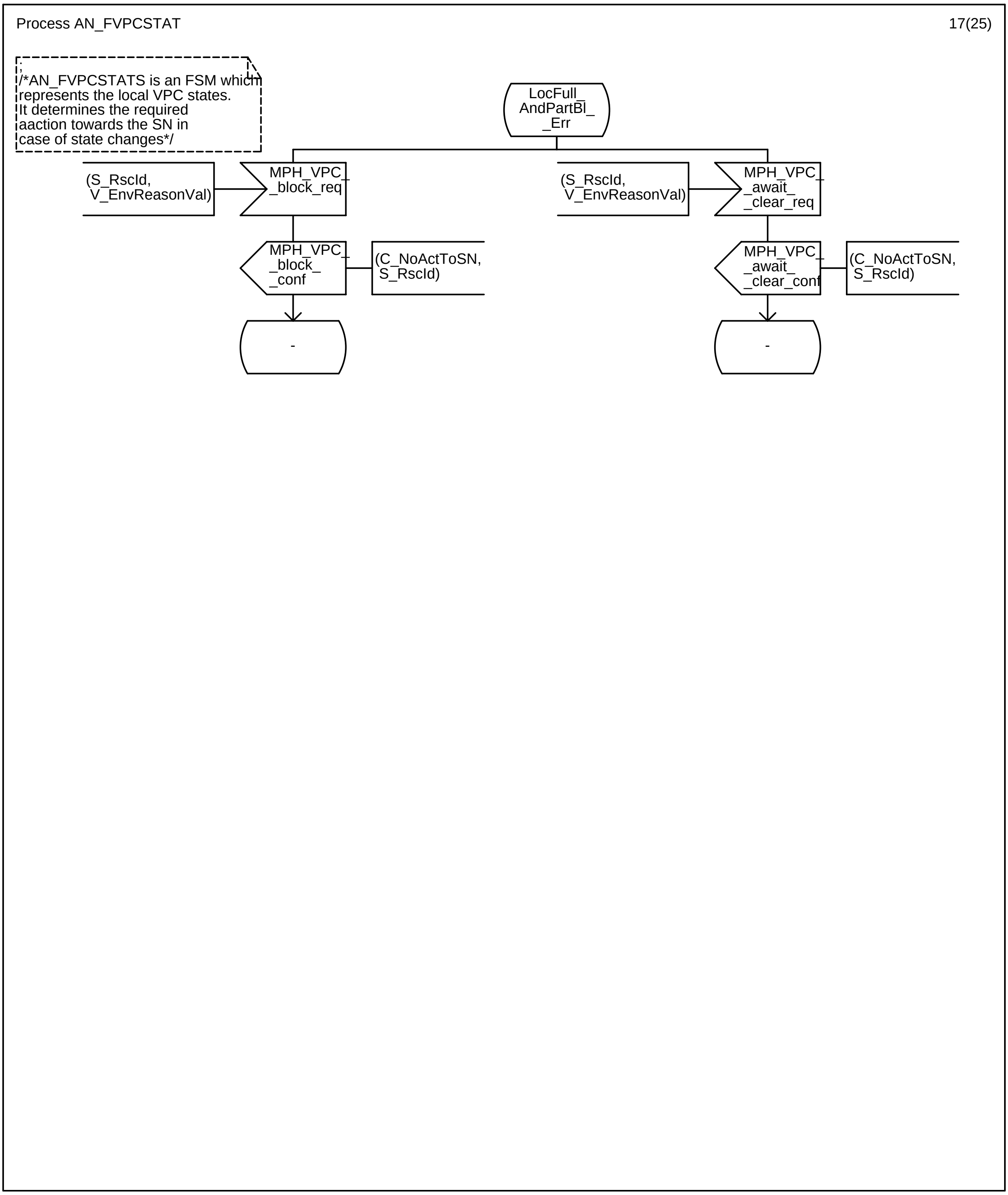


Figure A.75: AN_FVPCSTAT (17)

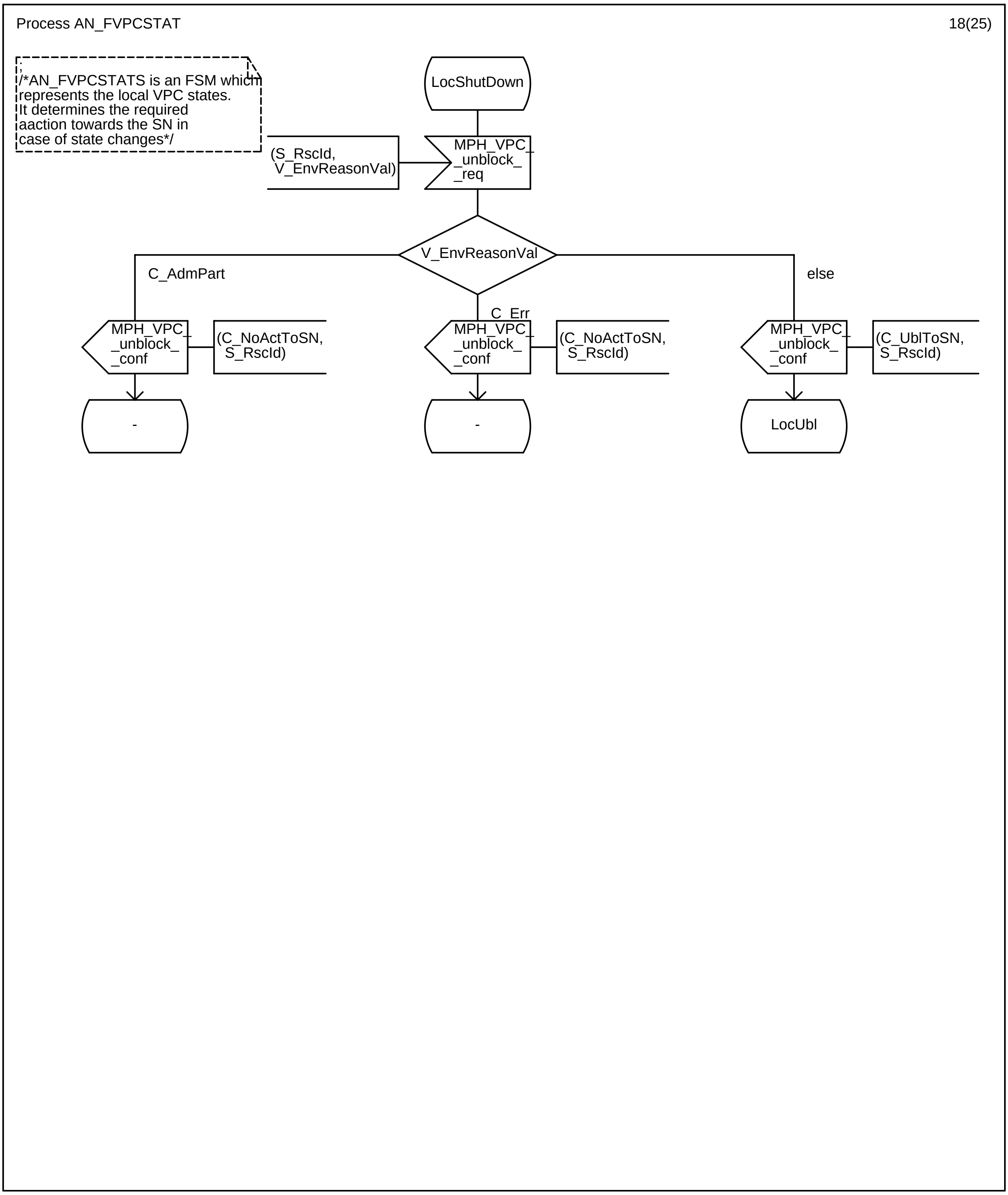


Figure A.76: AN_FVPCSTAT (18)

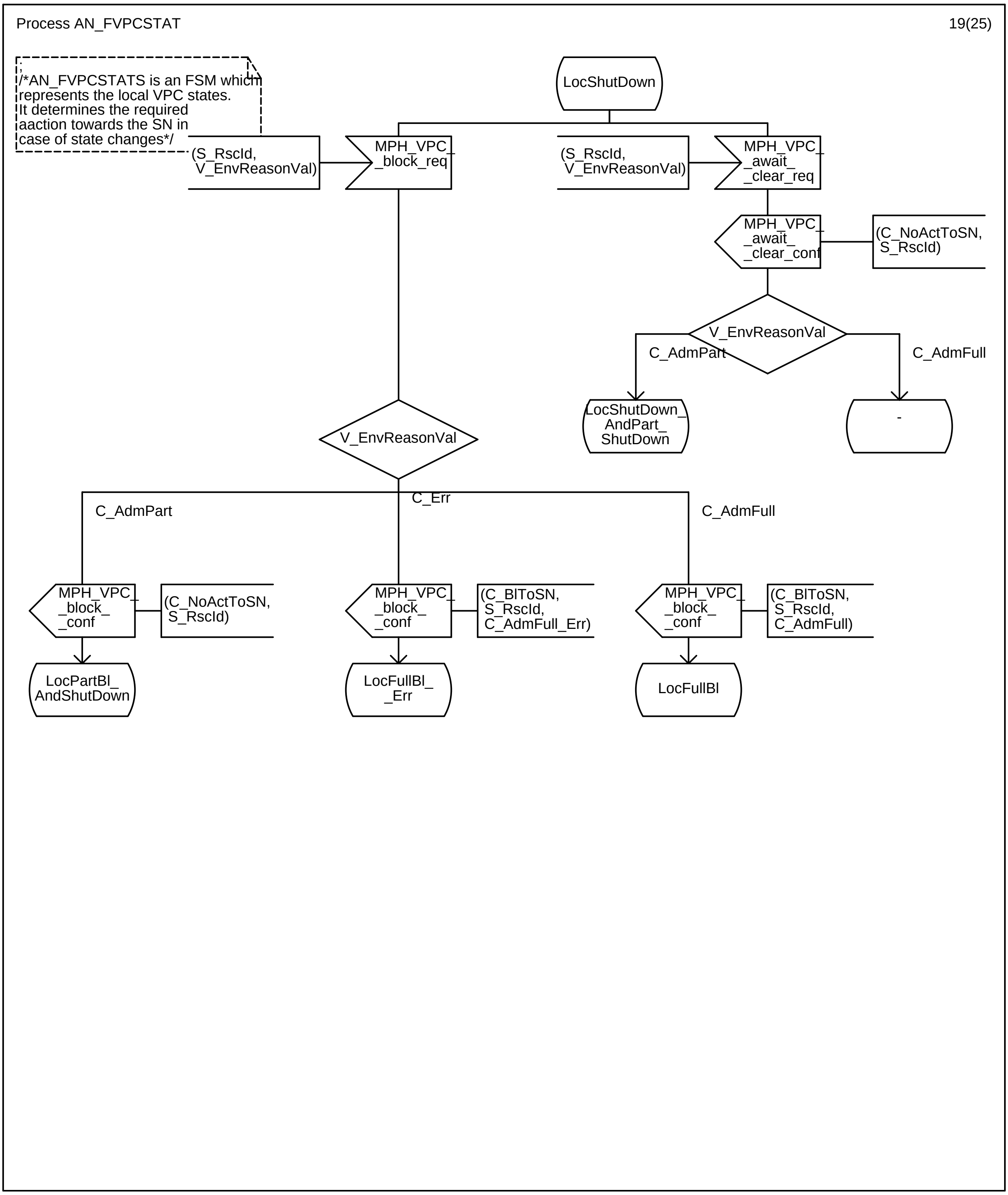


Figure A.77: AN_FVPCSTAT (19)

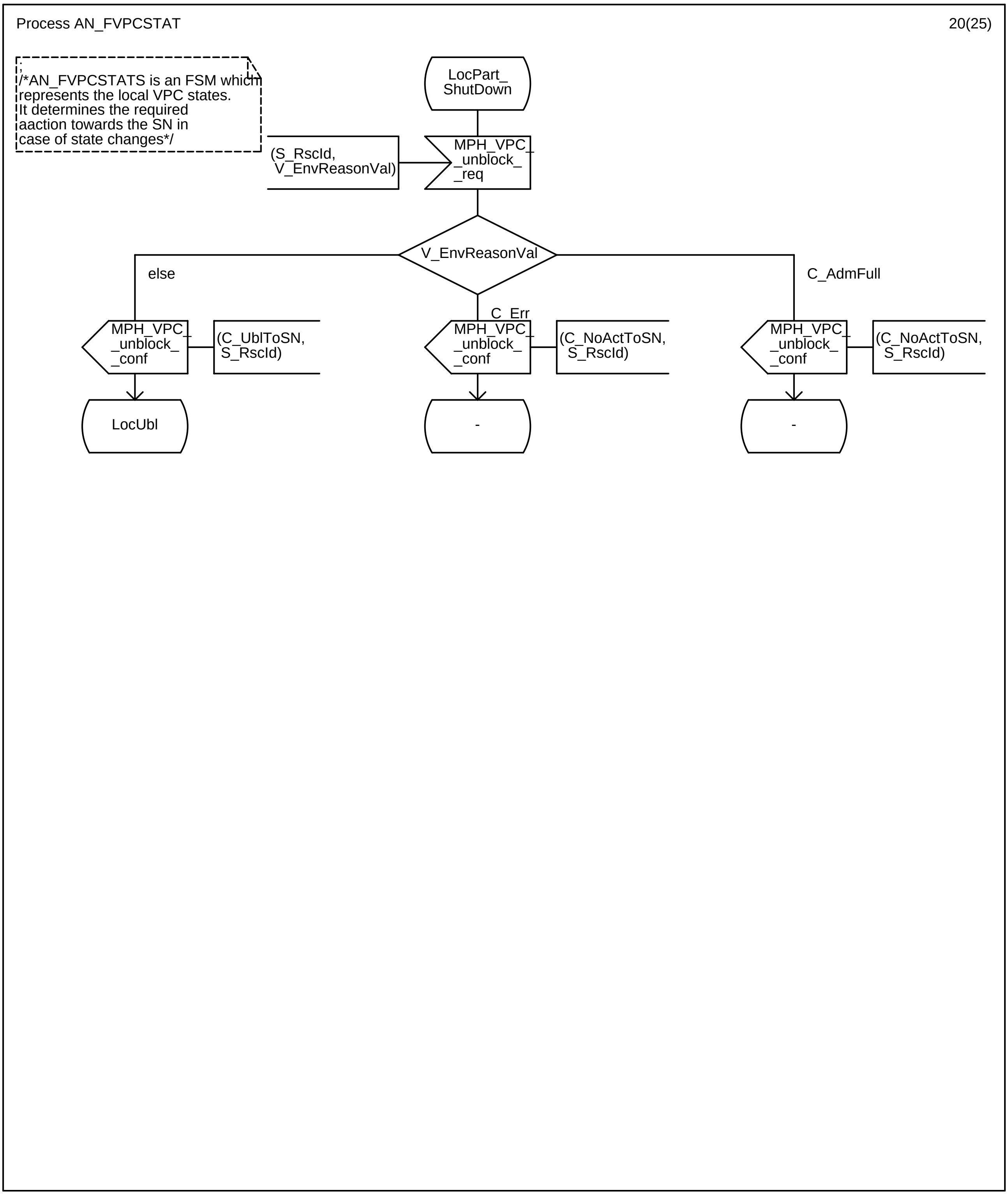


Figure A.78: AN_FVPCSTAT (20)

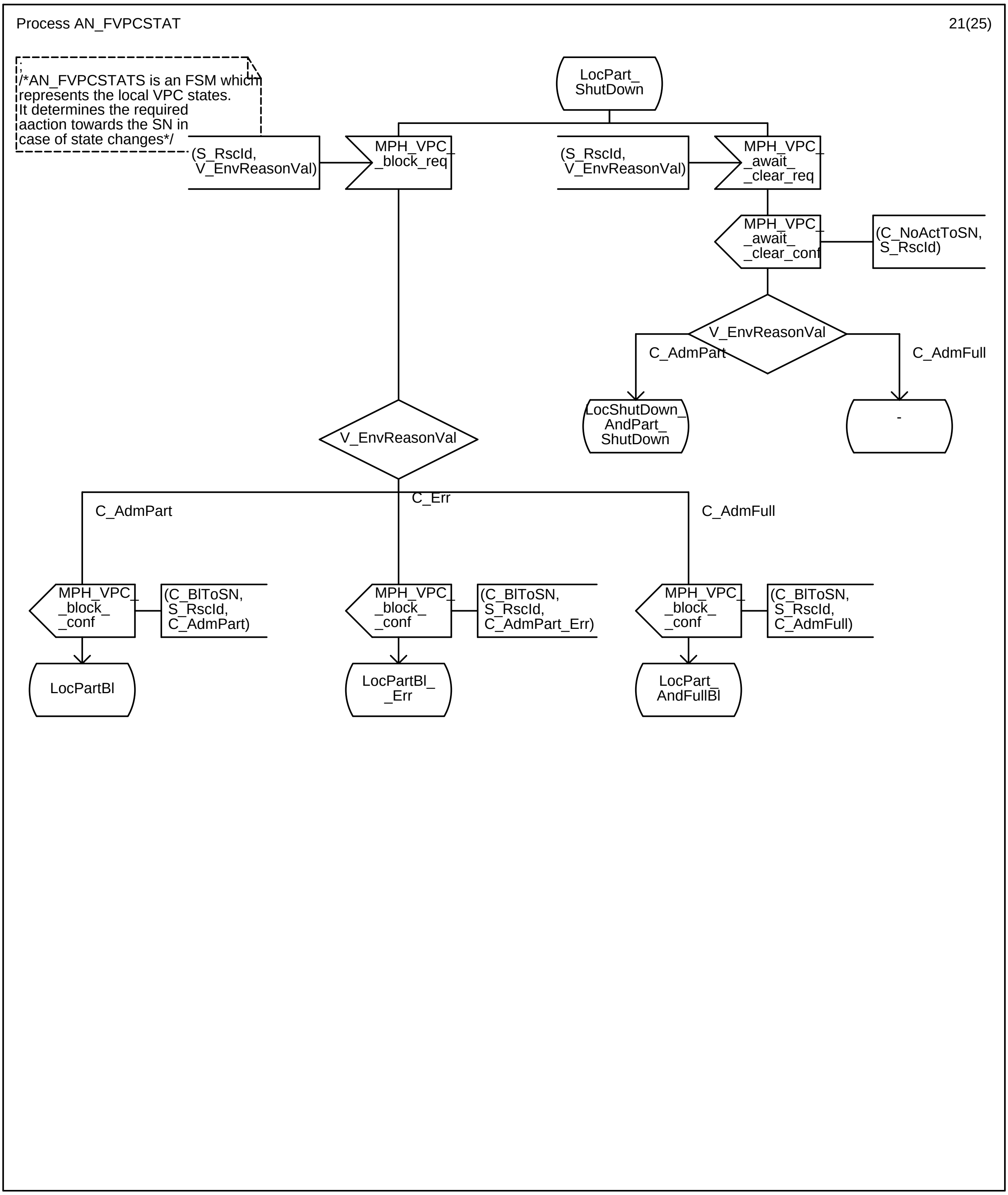


Figure A.79: AN_FVPCSTAT (21)

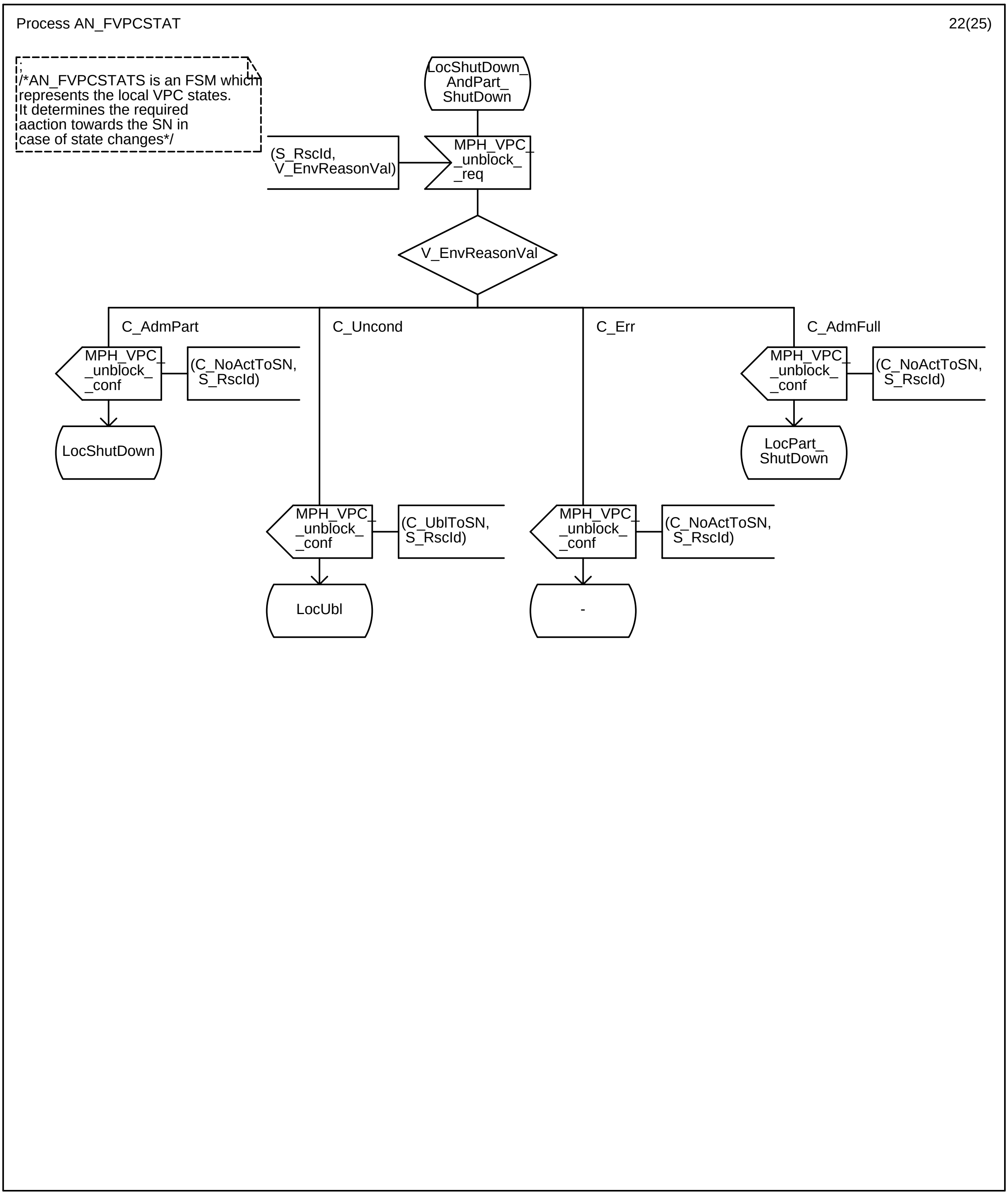


Figure A.80: AN_FVPCSTAT (22)

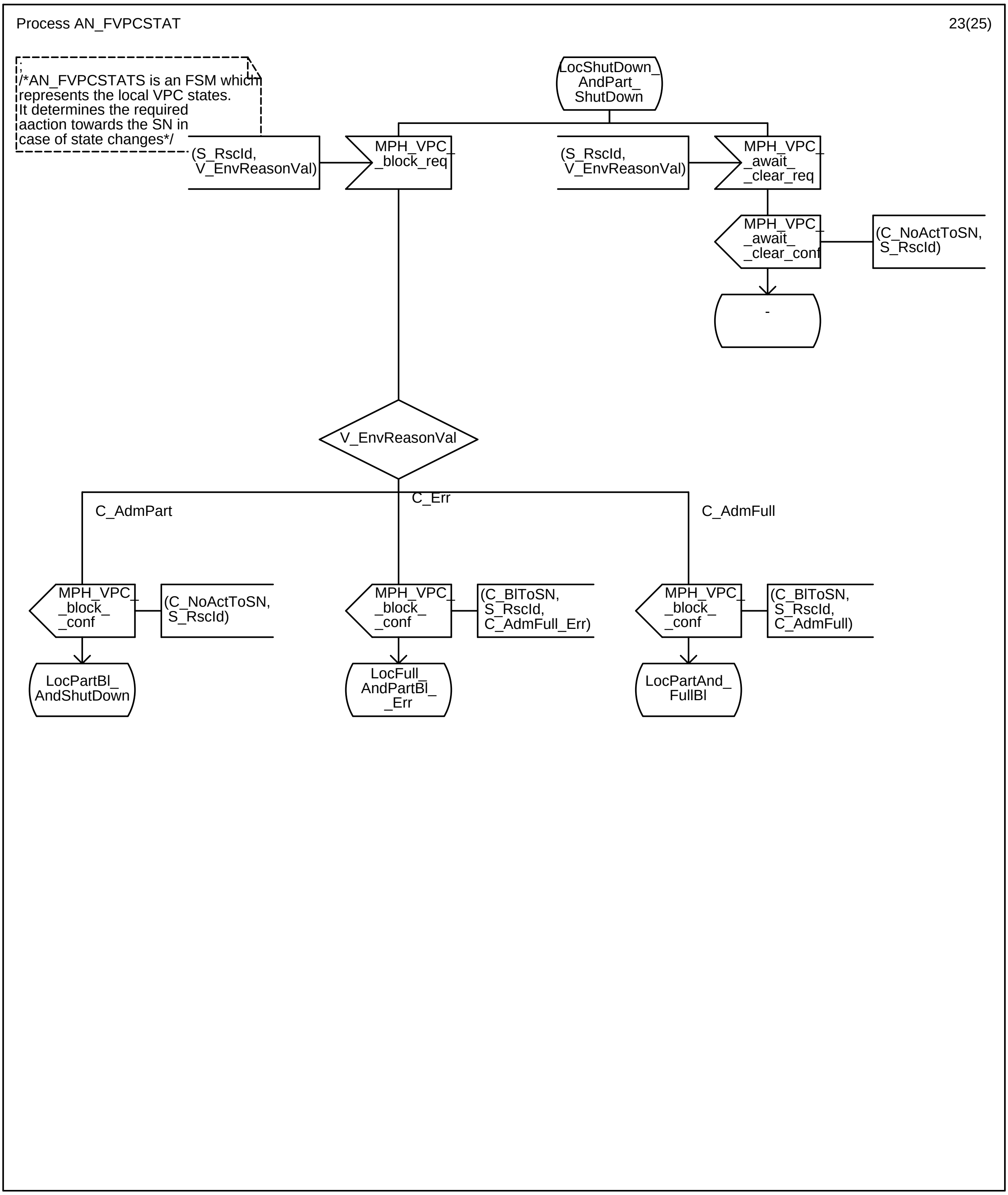


Figure A.81: AN_FVPCSTAT (23)

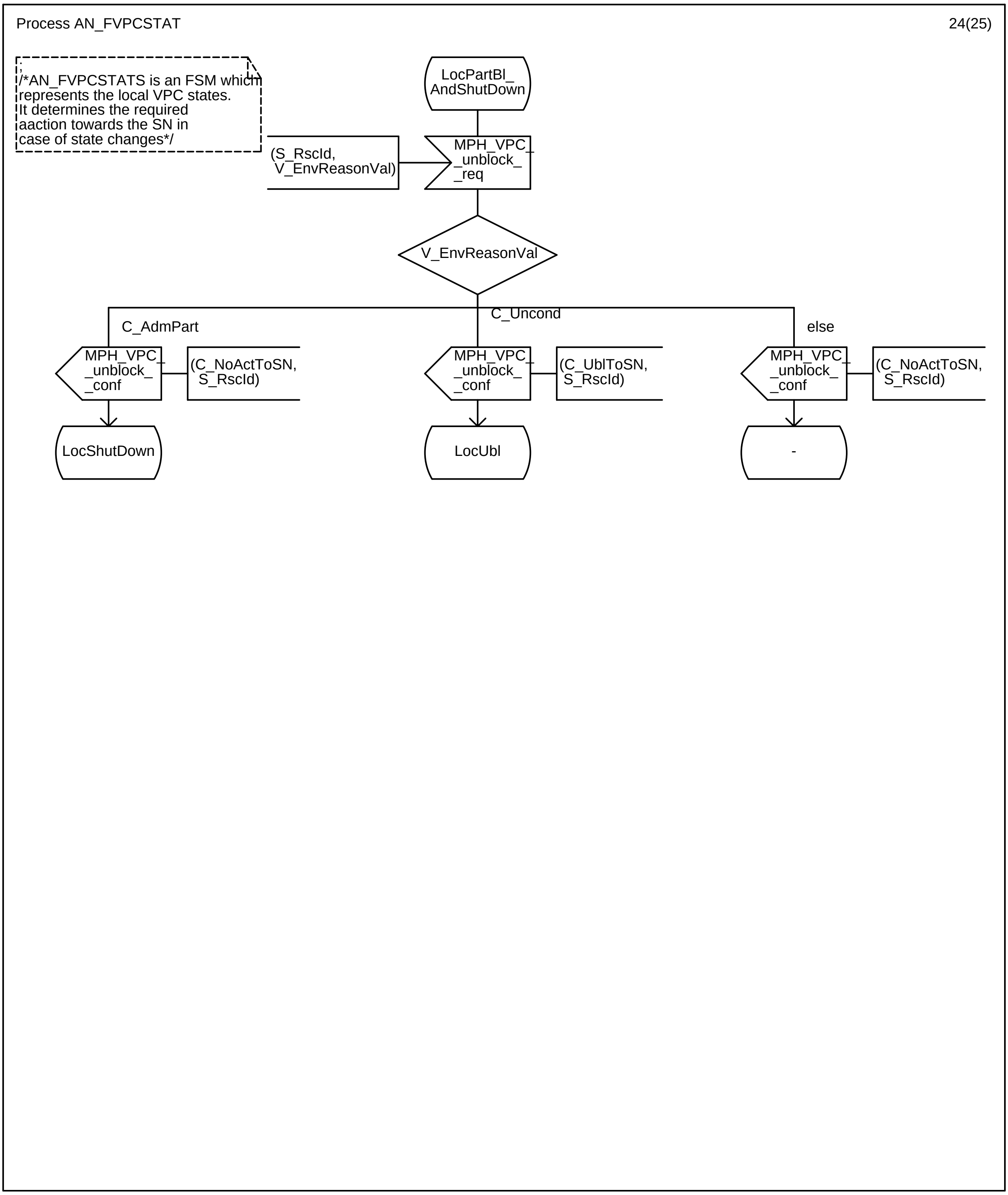


Figure A.82: AN_FVPCSTAT (24)

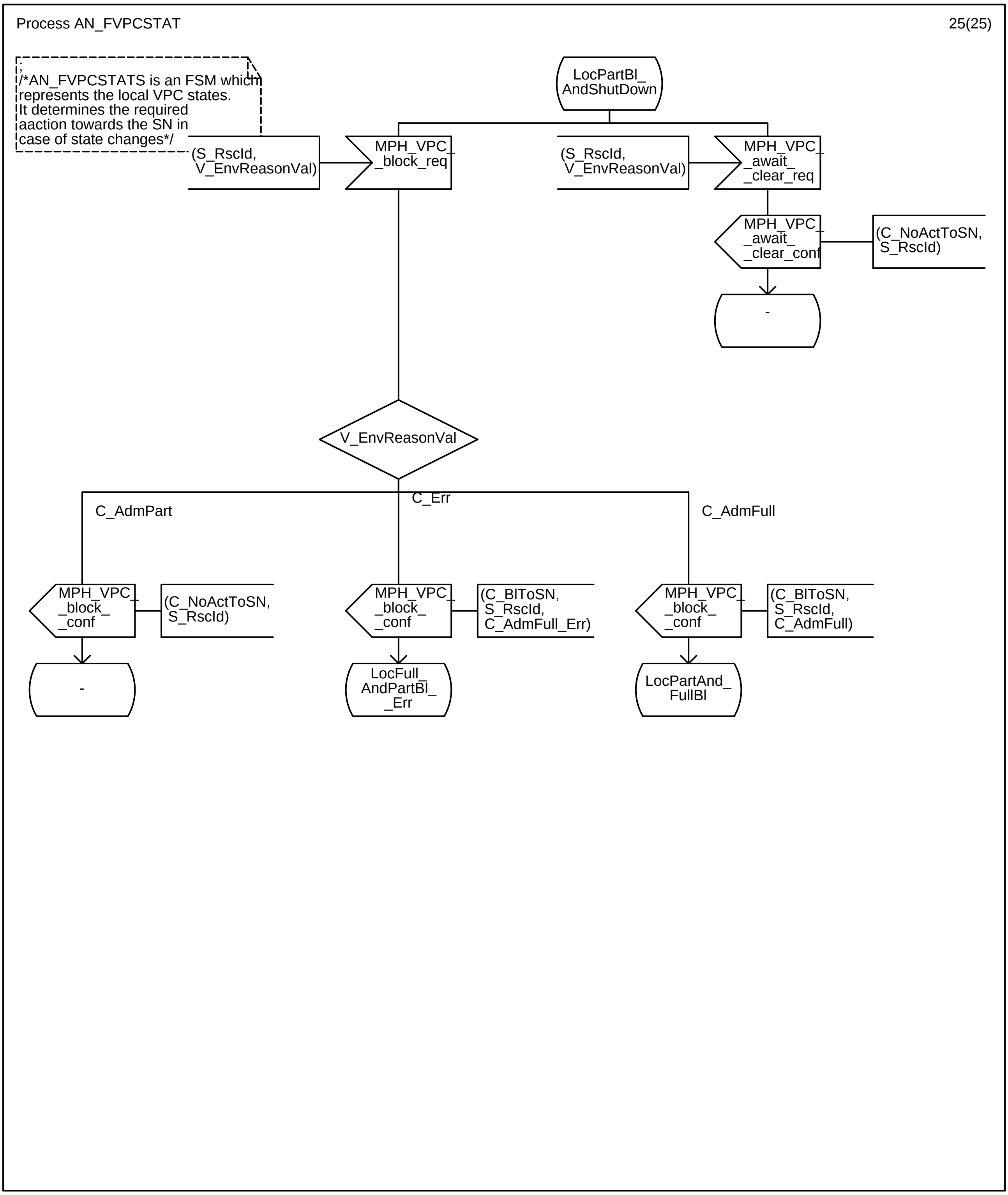


Figure A.83: AN_FVPCSTAT (25)

A.2.4 Processes of RTMC protocol entity

A.2.4.1 Process AN_MGR_CPROT

```
Process AN_MGR_CPROT                                                                1(16)

/*AN_CPROT Manager, controls
instantiation of AN_CPROT
processes*/

NEWTYPE AT_PIDTab ARRAY /*This array maps the PID of the AN_CPROT instance on the PID of the requesting system management process*/
   (PID, PID)
ENDNEWTYPE AT_PIDTab;

/*Primitive Data Declarations*/
DCL
A_RTMCBlRscTab AT_RTMCBlRscTab;
/**/
DCL
A_RTMCRscTab AT_RTMCRscTab;
/**/
DCL
A_RTMCUnkRscTab AT_RTMCUnkRscTab;
/**/
DCL
S_RTMCRscId ST_RTMCRscID;
/**/
DCL
S_RTMCUnkRscId ST_RTMCUnkRscID;
/**/
DCL
V_RTMCCCheckResult IT_RTMCCCheckResult;
/**/
DCL
V_IntTransId IT_IntTransActId;
/**/
DCL
P_StatusPID,    /*PID of AN_STATUS_MGT process*/
P_ResetPID,     /*PID of RESET_RSC process*/
P_ConsPID,      /*PID of AN_CONS process*/
P_LSPIdPID,     /*PID ofCHECK_LSPID process*/
P_CprotPID,     /*PID of AN_CPROT process instance*/
P_SNSigId,      /*PID of SN_CPROT process instance*/
P_DestSigId,  /*PID of destination process instance*/
P_OrigSigId     /*PID of origination process instance*/
PID;
/**/
DCL
A_PIDTab AT_PIDTab;
```

Figure A.84: AN_MGR_CPROT (1)

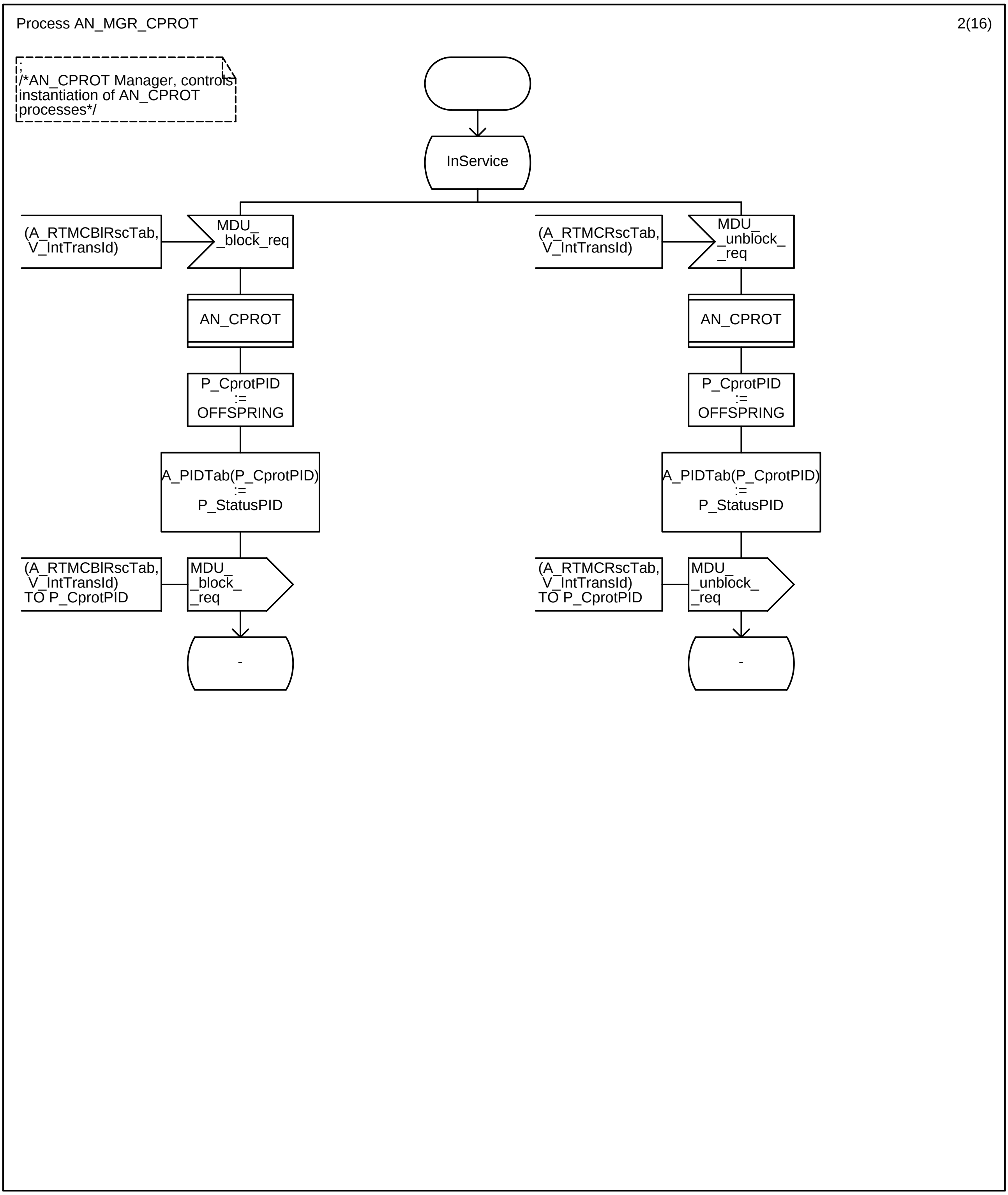


Figure A.85: AN_MGR_CPROT (2)

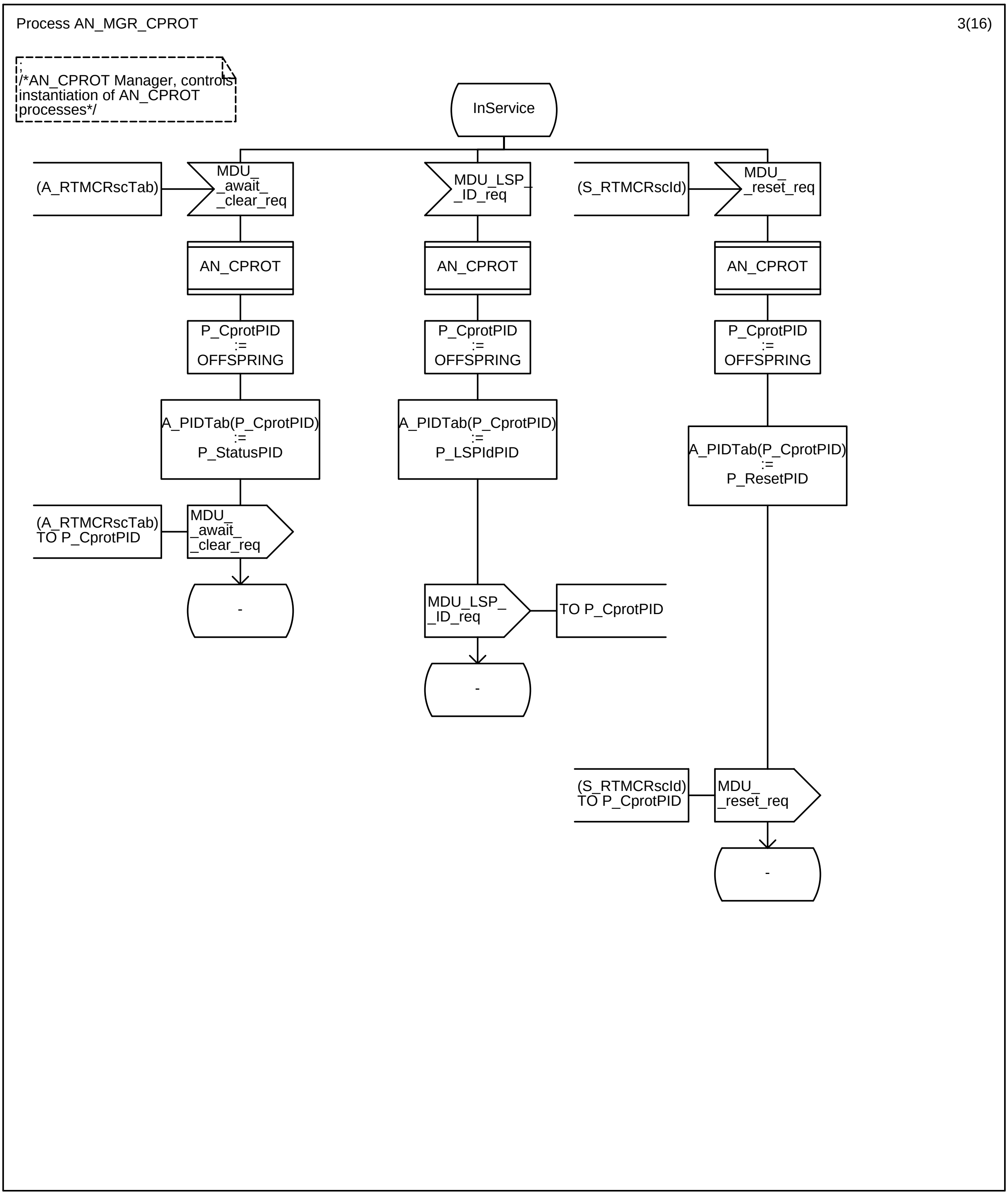


Figure A.86: AN_MGR_CPROT (3)

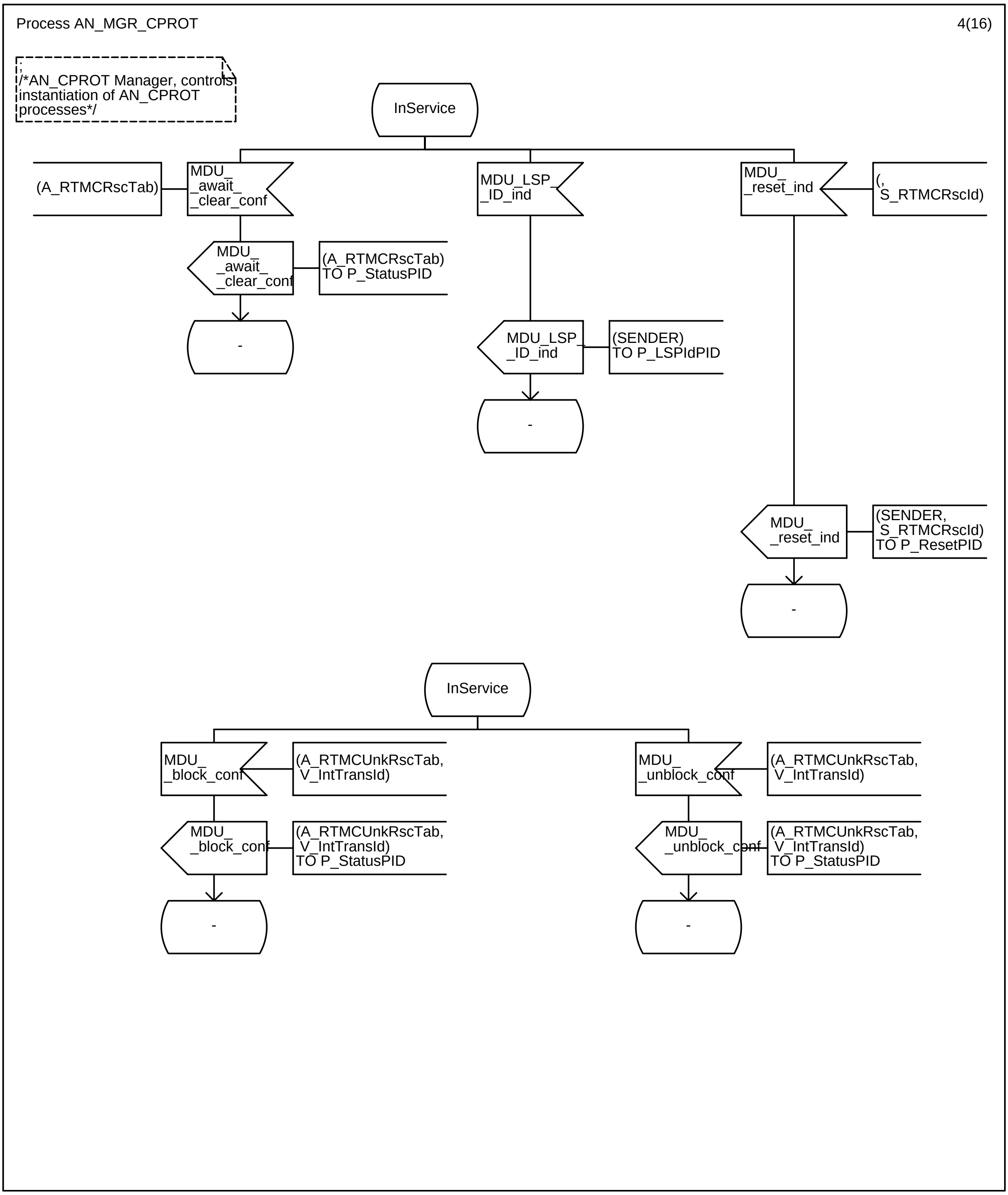


Figure A.87: AN_MGR_CPROT (4)

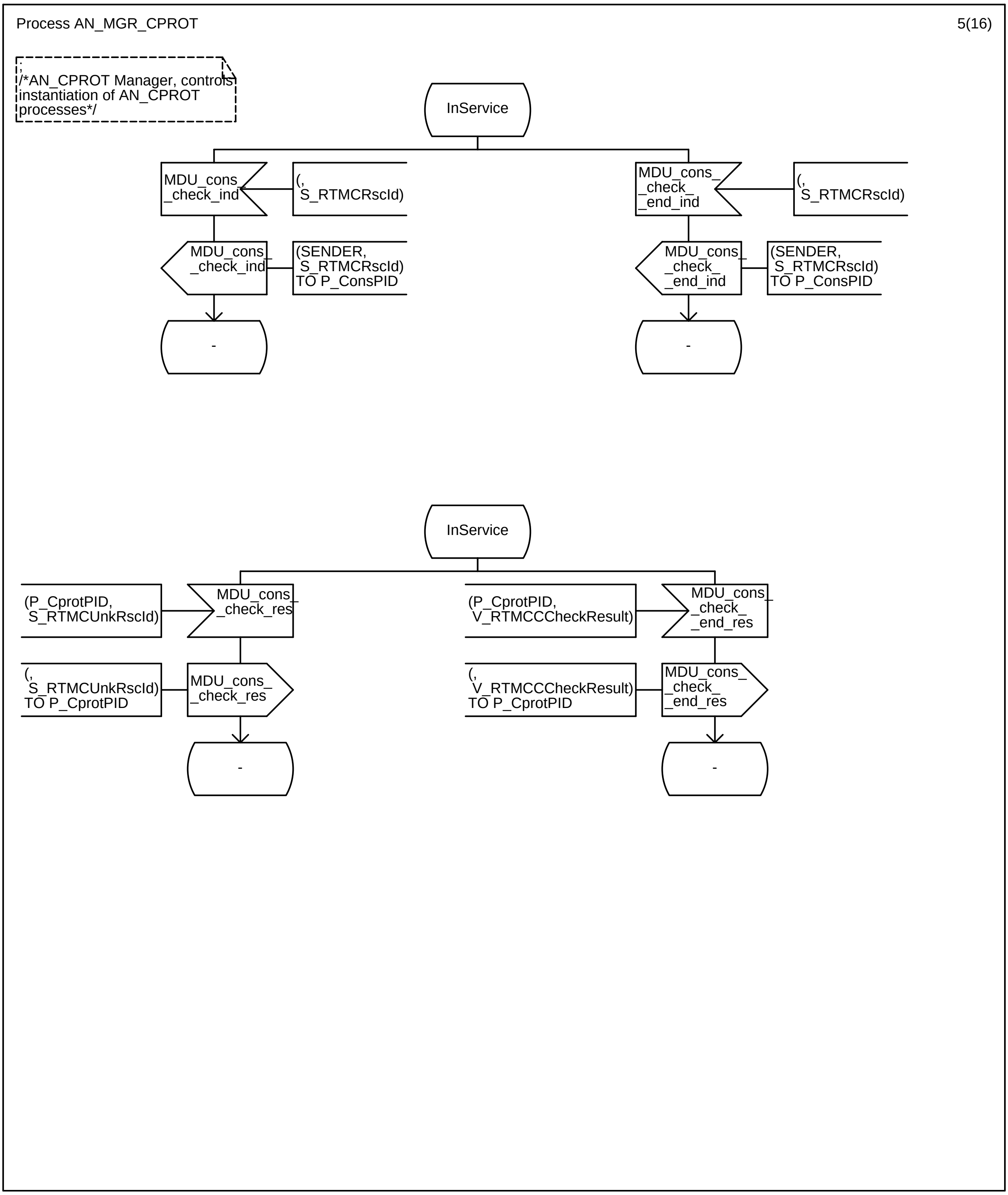


Figure A.88: AN_MGR_CPROT (5)

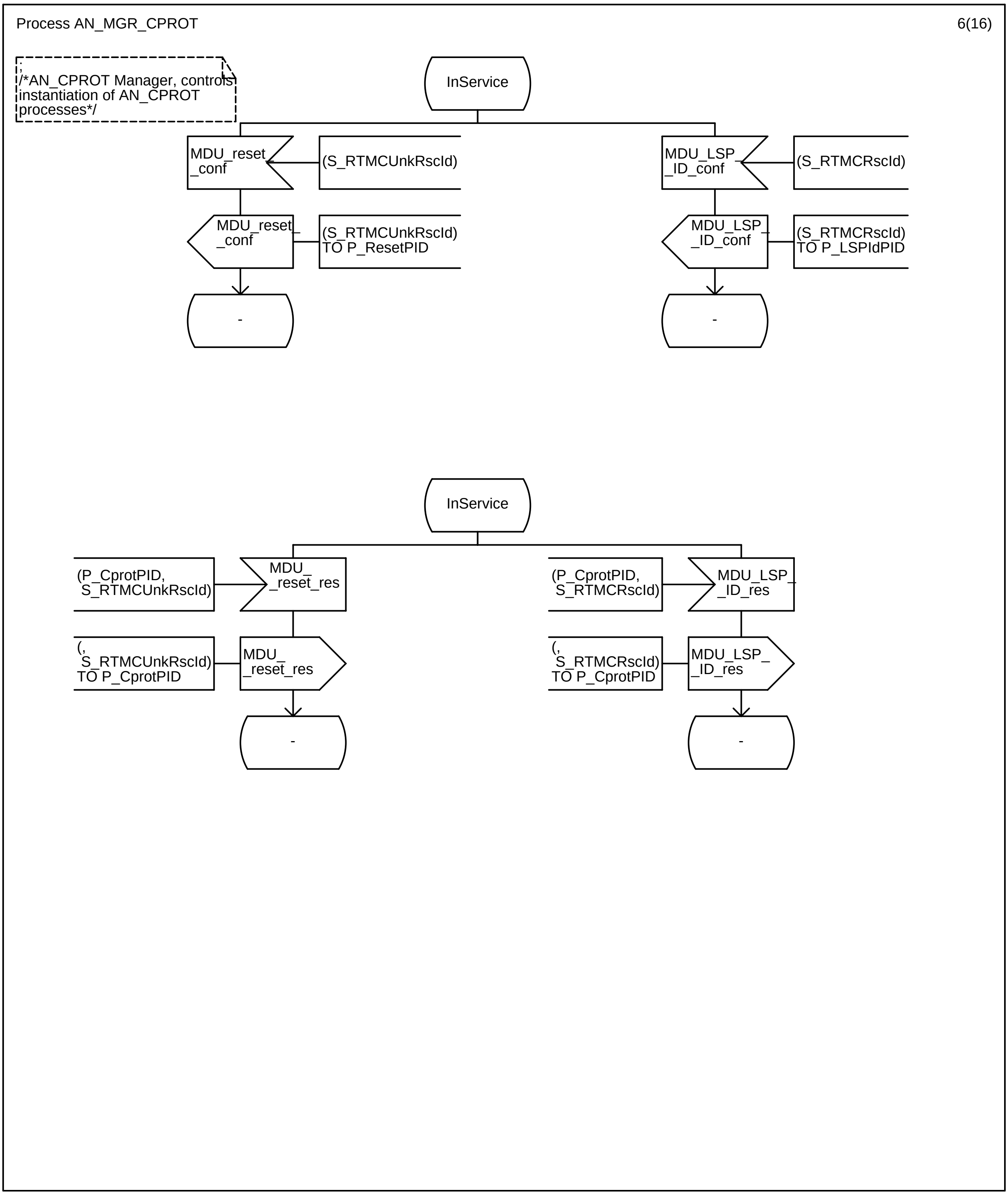


Figure A.89: AN_MGR_CPROT (6)

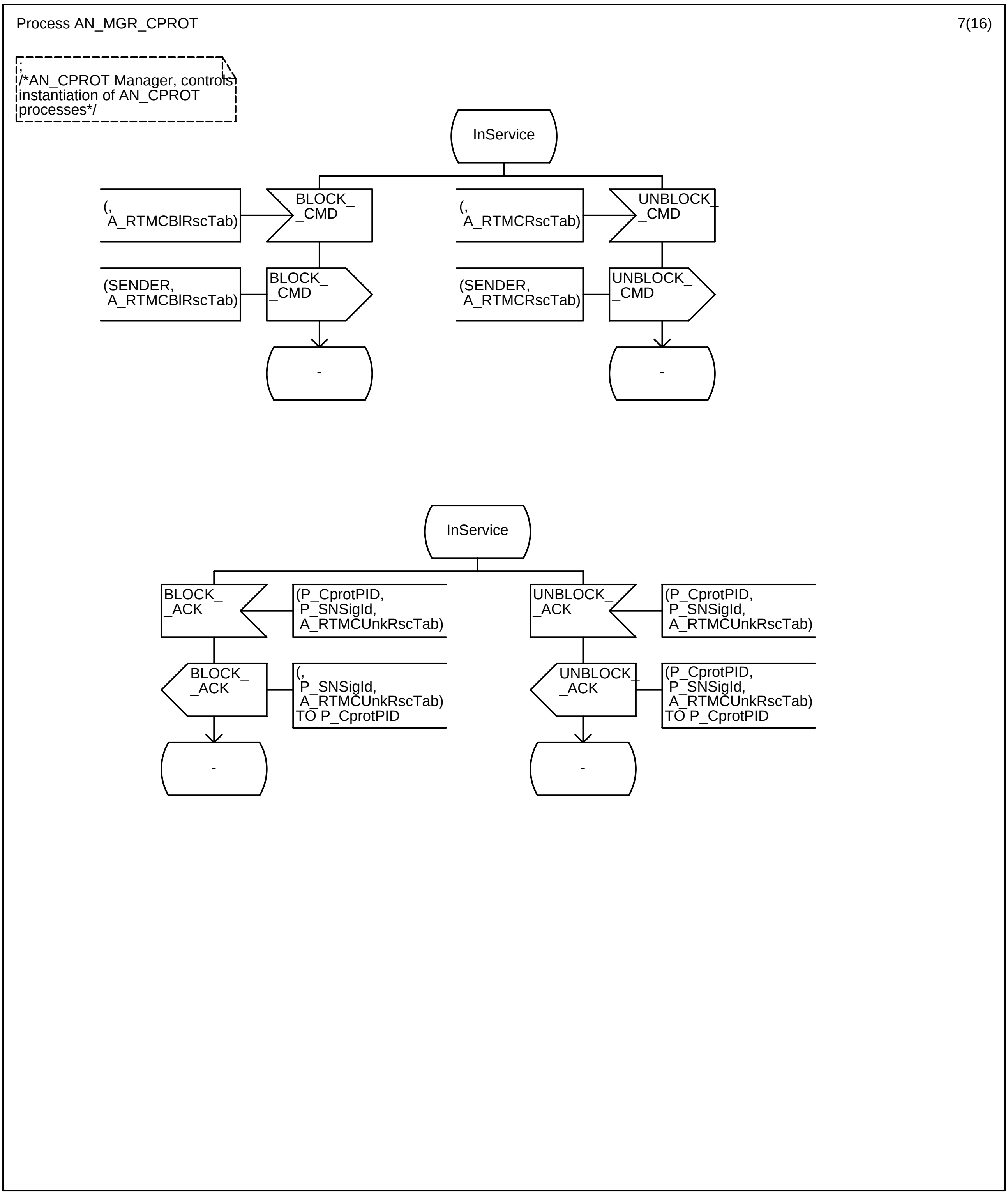


Figure A.90: AN_MGR_CPROT (7)

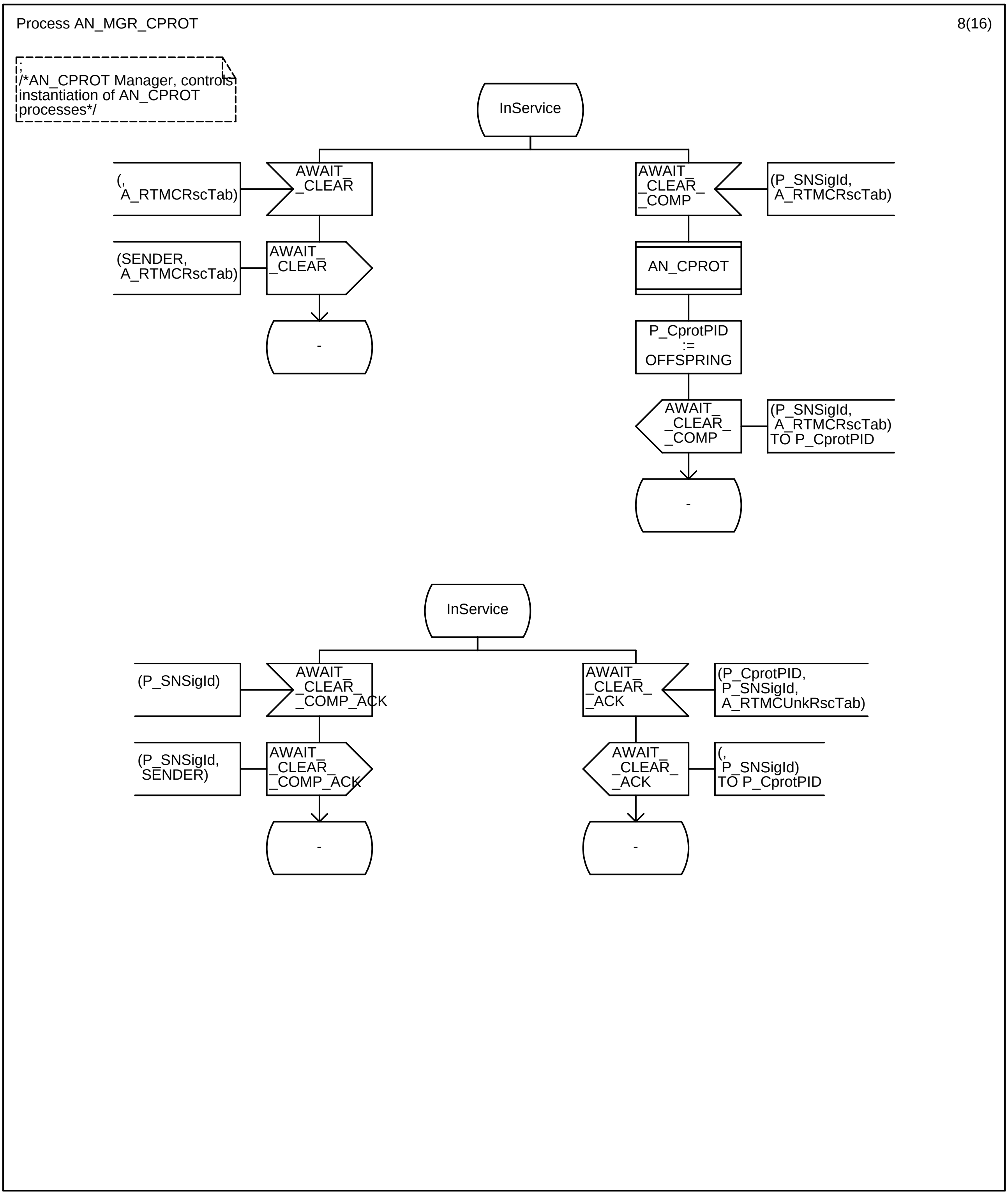


Figure A.91: AN_MGR_CPROT (8)

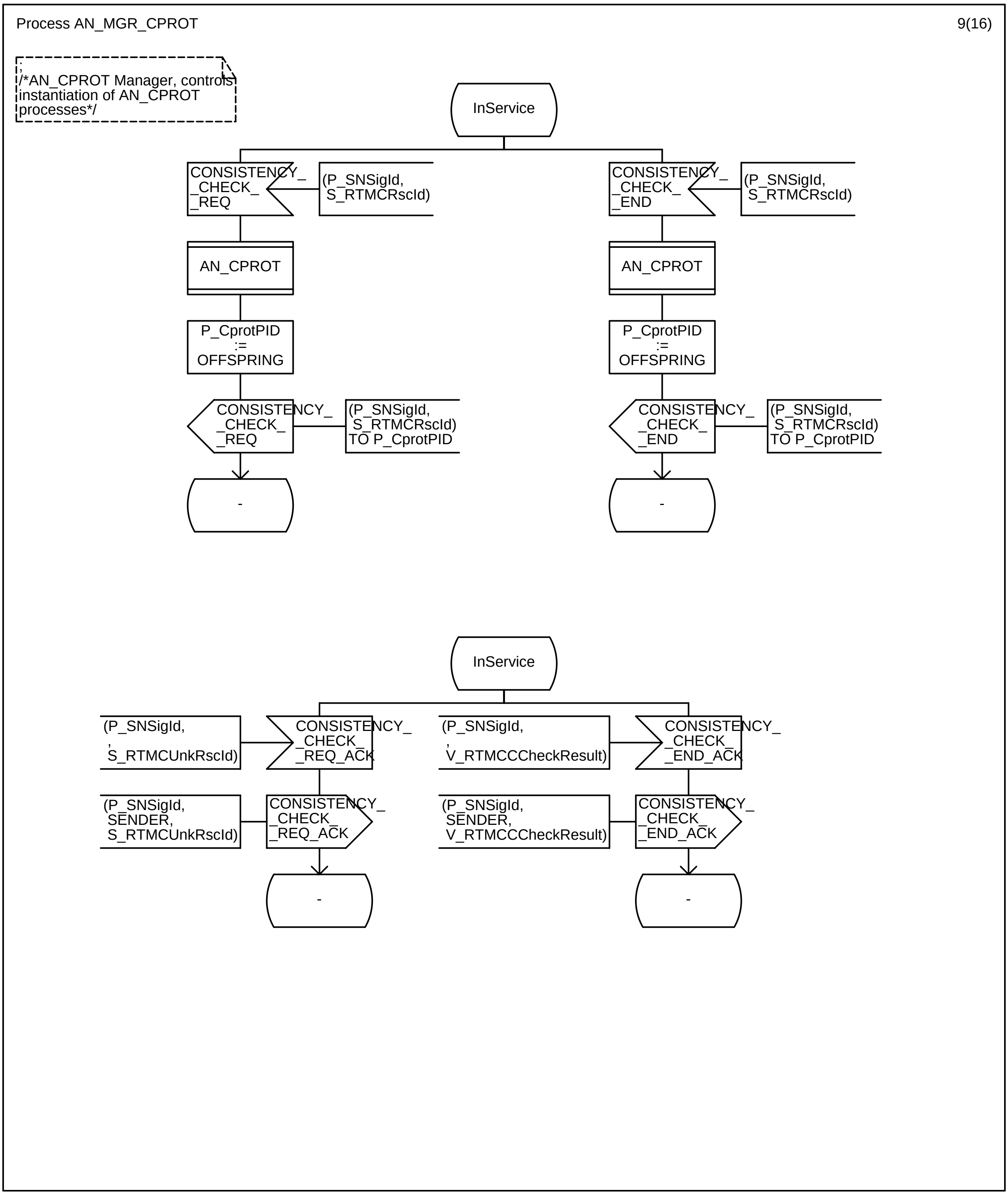


Figure A.92: AN_MGR_CPROT (9)

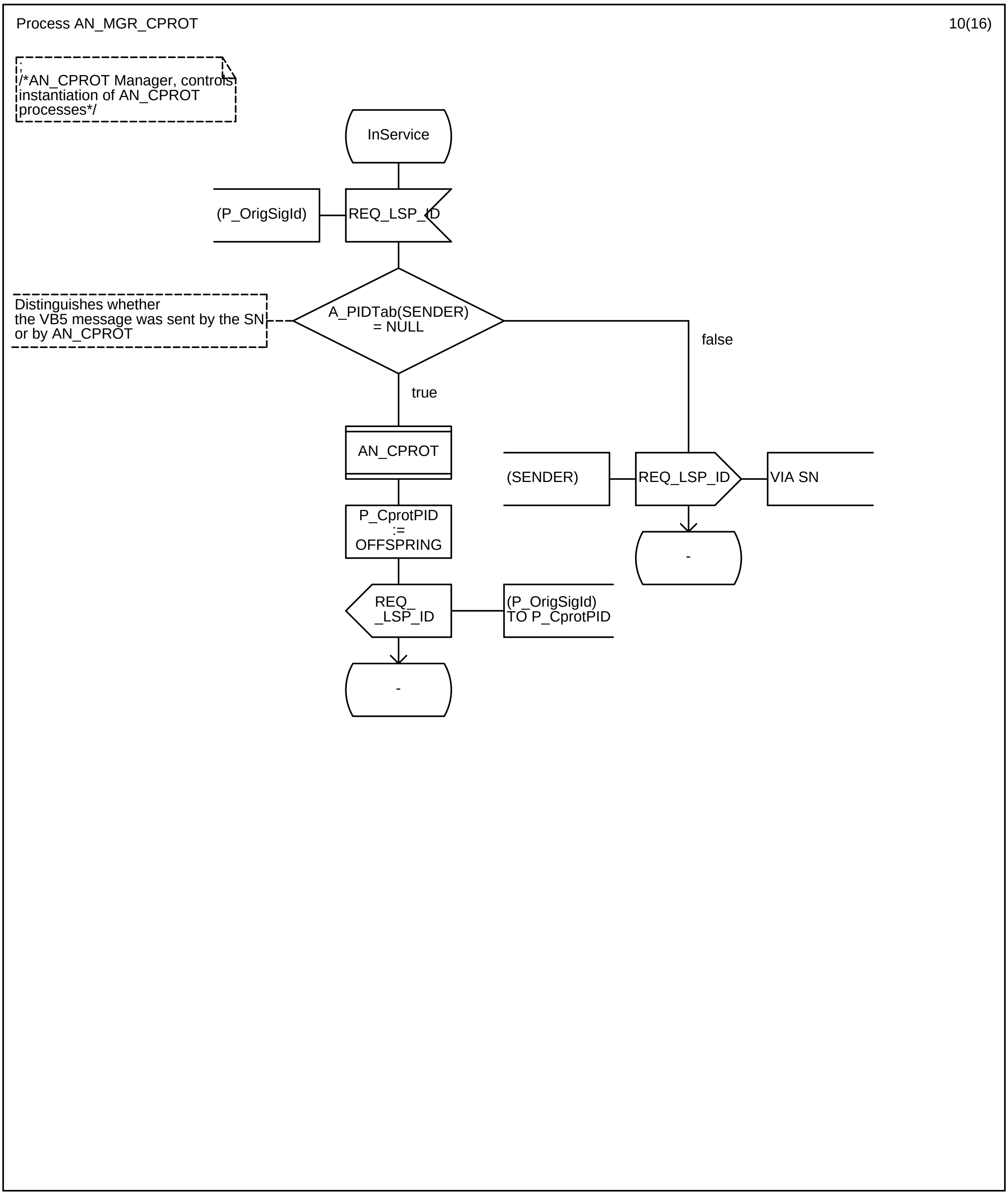


Figure A.93: AN_MGR_CPROT (10)

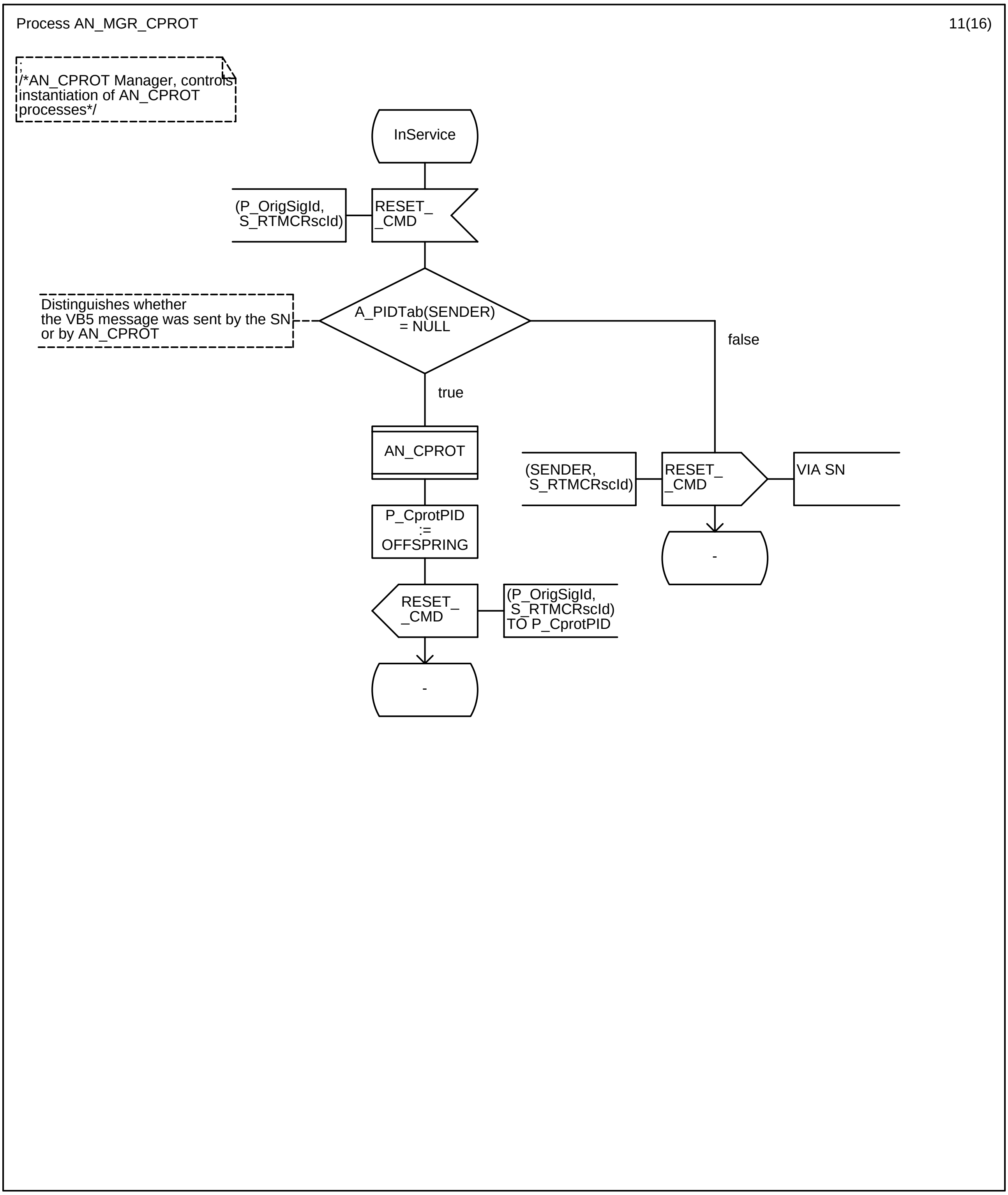


Figure A.94: AN_MGR_CPROT (11)

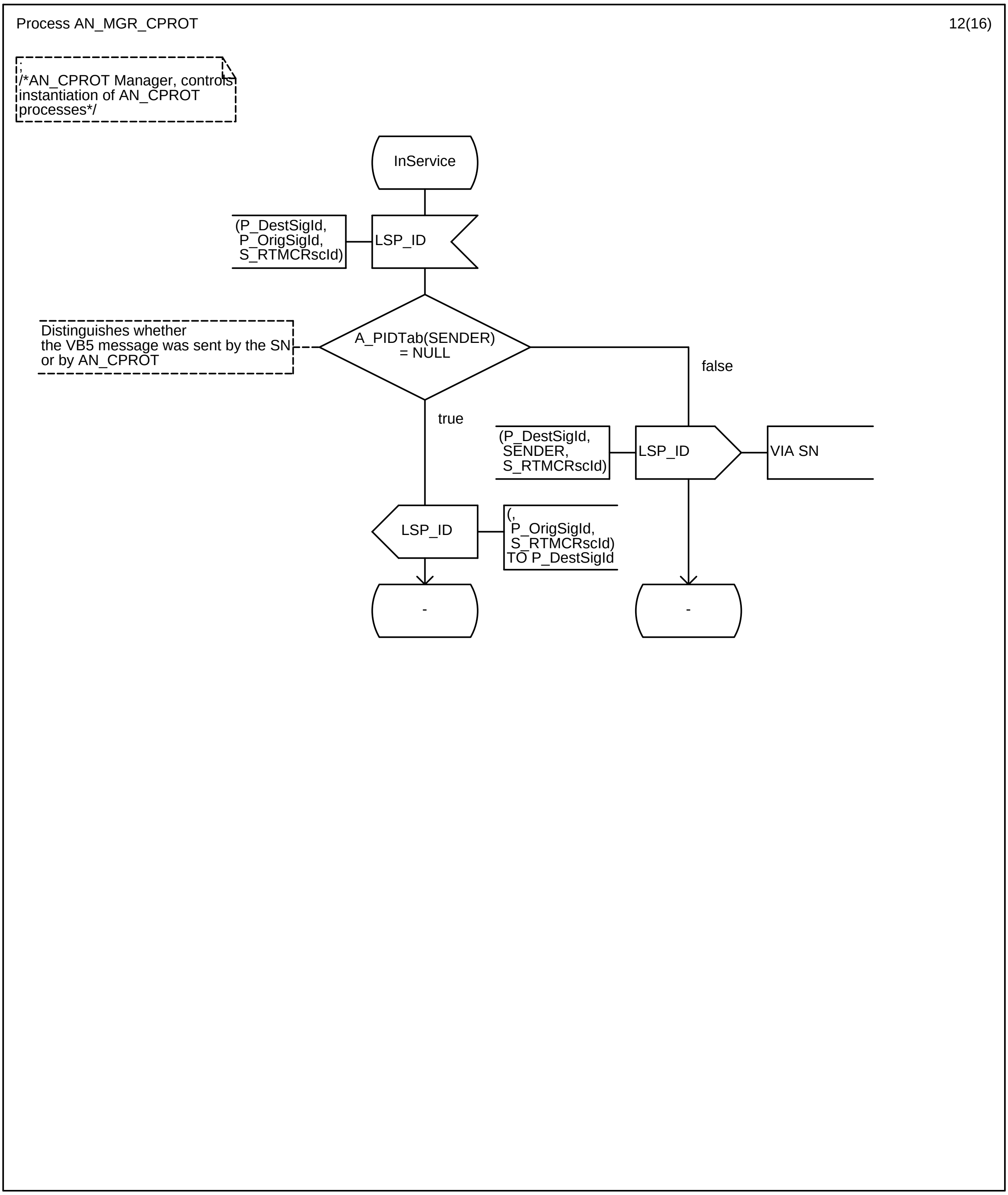


Figure A.95: AN_MGR_CPROT (12)

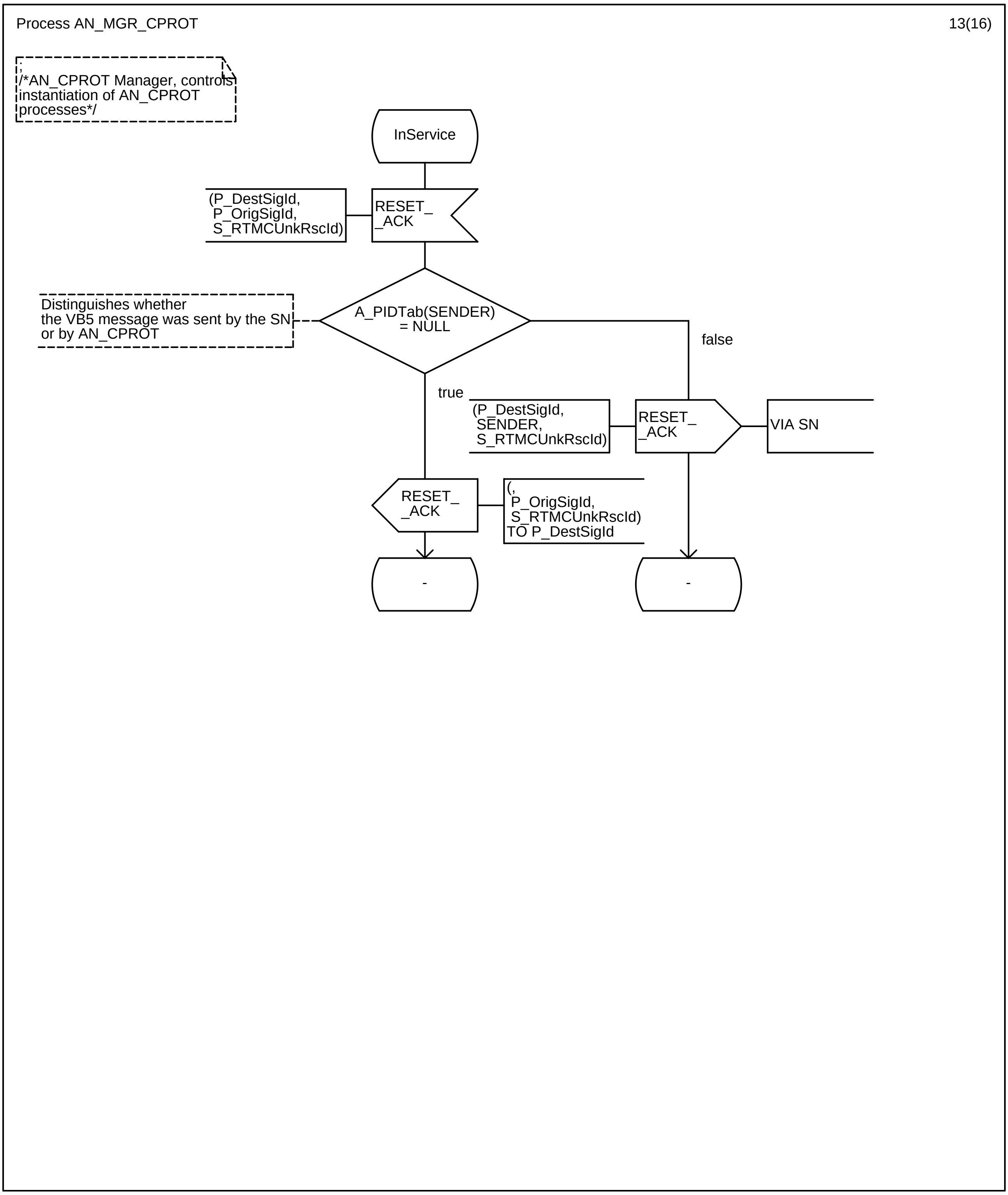


Figure A.96: AN_MGR_CPROT (13)

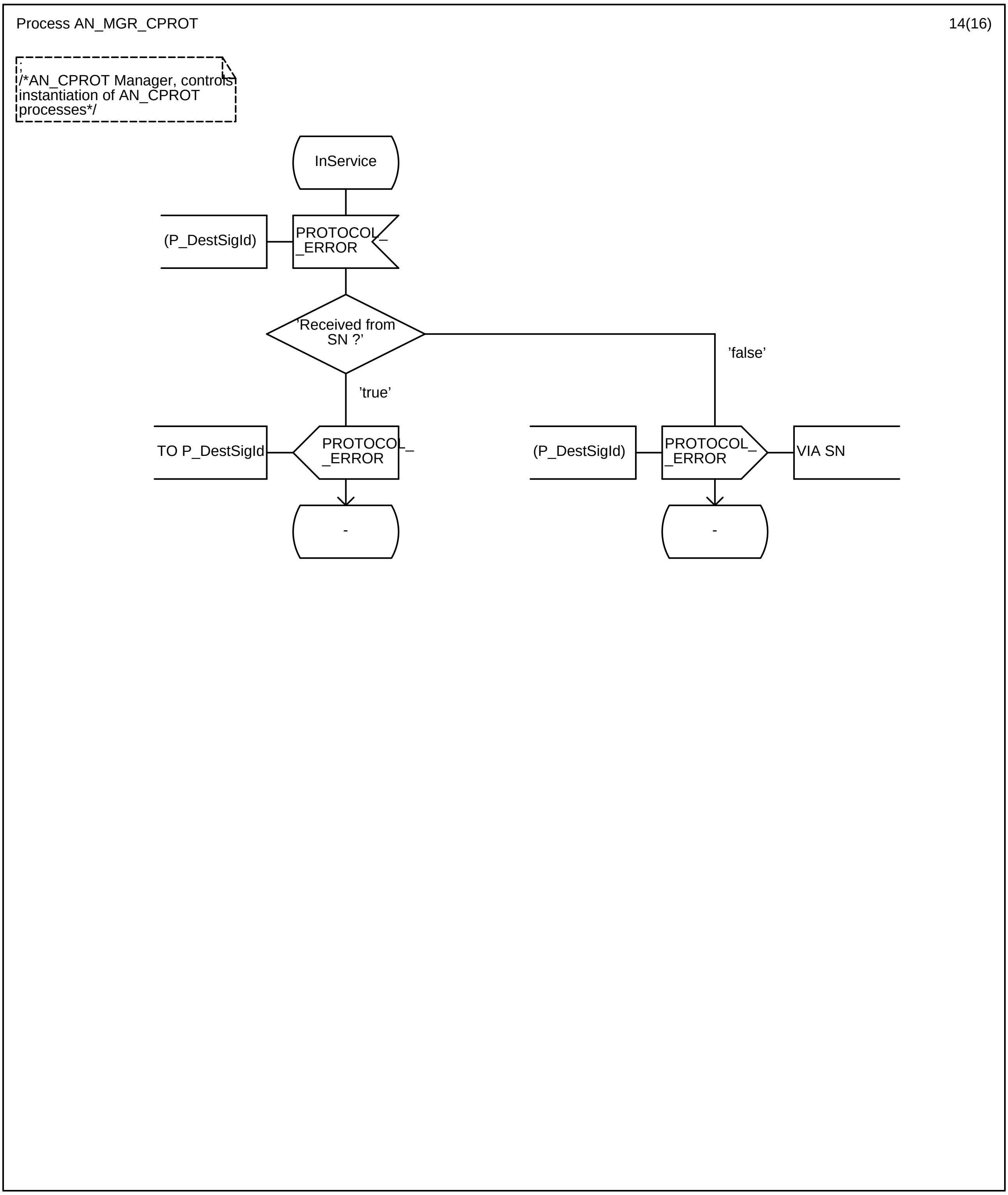


Figure A.97: AN_MGR_CPROT (14)

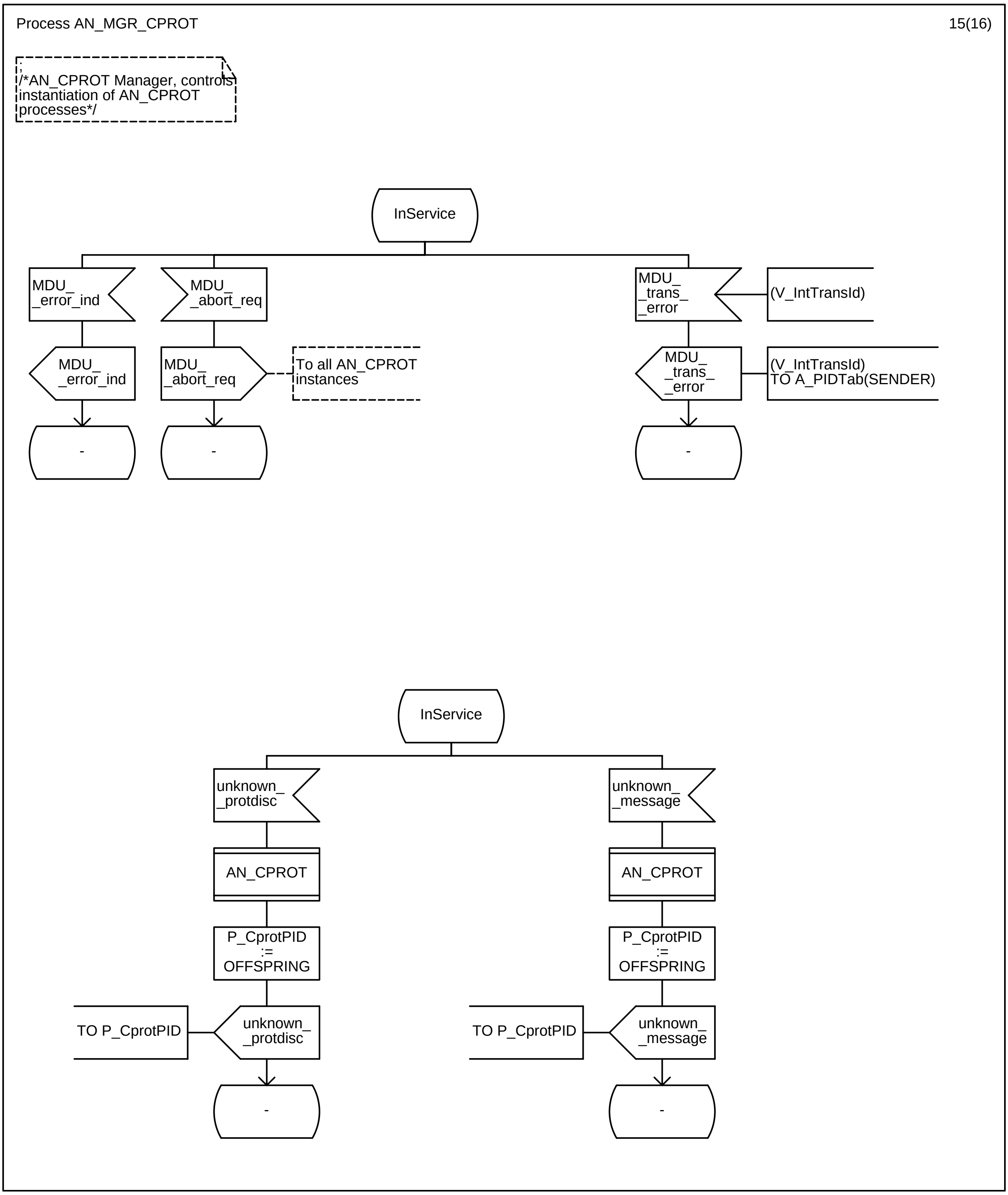


Figure A.98: AN_MGR_CPROT (15)

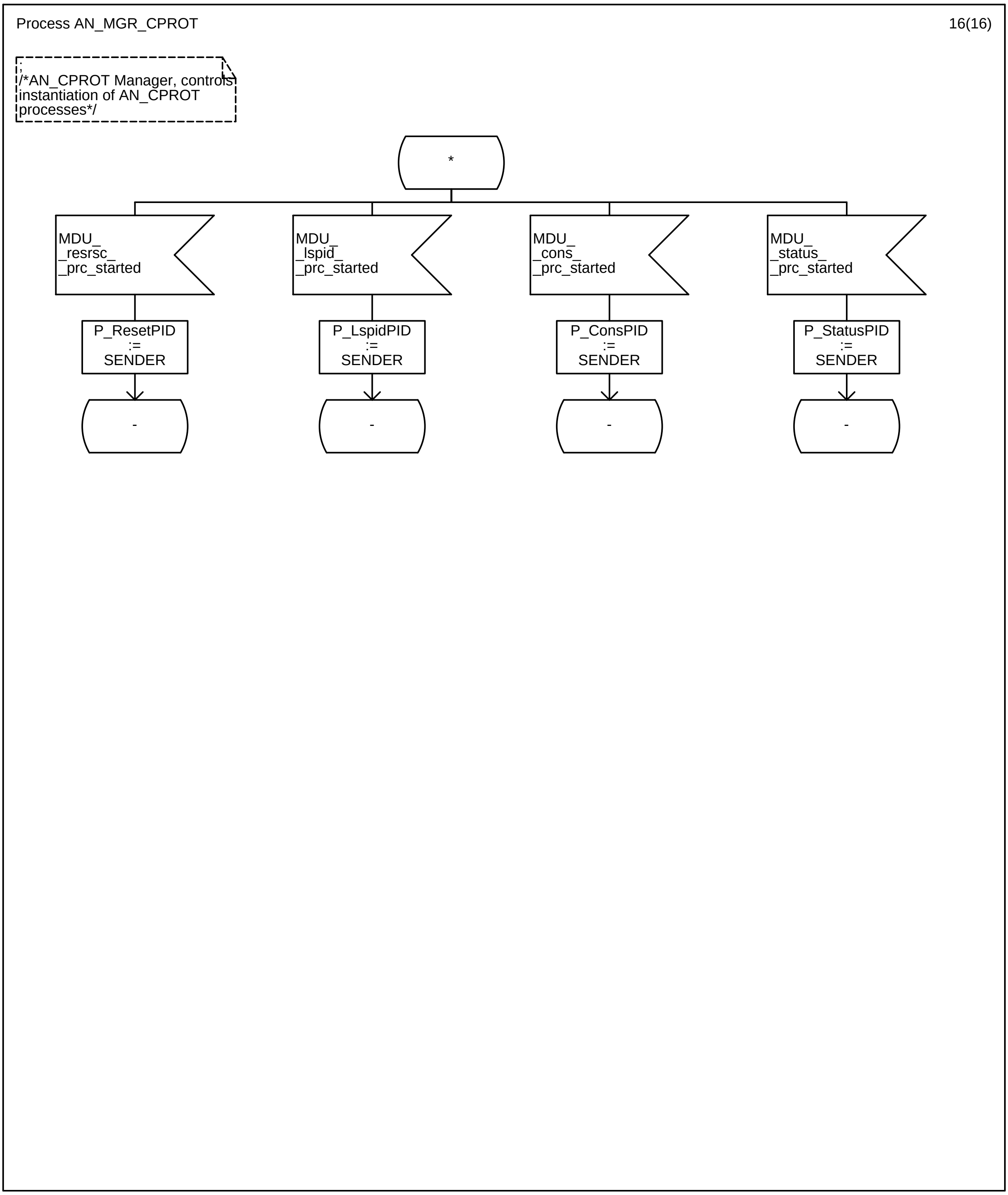


Figure A.99: AN_MGR_CPROT (16)

A.2.4.2 Process AN_CPROT

Process AN_CPROT 1(18)

```
/*AN_CPROT is responsible for sending/
receiving RTMC messages*/
```

```
/* Definintions and declarations for
AN_CPROT */
```

```
/* State descriptions

InService: Init State of AN_CPROT, process is waiting for initial AN_SYSMGT primitives or SN messages
AwaitRemAck: AN_CPROT has sent a VB5 message to the SN and is now awaiting the SN response
AwaitLocAck: AN_CPROT has passed a SN request to AN_SYSMGT and is now awaiting the AN_SYSMGT response */
```

```
/* Timerdefinitions */
TIMER
T_block      := 1   /* Default value for BLOCK_CMD supervision timer is 1 sec, Tolerance +/- 10% */,
T_unblock    := 1   /* Default value for UNBLOCK_CMD supervision timer is 1 sec, Tolerance +/- 10% */,
T_acl        := 1   /* Default value for SHUTDOWN supervision timer is 1 sec, Tolerance +/- 10% */,
T_lspid      := 1   /* Default value for REQUEST_LSP_ID supervision timer is 1 sec, Tolerance +/- 10% */,
T_reset      := 60 /* Default value for RESET_CMD supervision timer is 60 sec, Tolerance +/- 10% */;
```

```
/* AN_CPROT internal variables and constants*/
/**/
/* timer handling */
DCL V_ExpCount NATURAL;          /*number of actual message repetitions*/
/*possible values*/
SYNONYM C_ExpMax INTEGER = 1;     /*maximum number of message repetitions is 1*/
/**/
/*syntax check handling*/
DCL V_SynResult INTEGER;          /*syntax check result, provided by procedure CPROT_SYNTAX_CHECK*/
/*possible values*/
SYNONYM C_Proceed INTEGER =1;     /*possible result of syntax check: proceed with message processing*/
```

```
/*Signal data declarations*/
DCL
S_RTMCRscId ST_RTMCRscID; /*Resource Identifier Information Element*/
/**/
DCL
S_RTMCUnkRscId ST_RTMCUnkRscID; /*Resource Identifier Information Element  unknown by the peer side*/
/**/
DCL
A_RTMCRscTab AT_RTMCRscTab;  /*Array of Resource Identifier Information Elements*/
/**/
DCL
A_RTMCBlRscTab AT_RTMCBlRscTab;  /*Array of Blocked Resource Identifier Information Elements*/
/**/
DCL
A_RTMCUnkRscTab AT_RTMCUnkRscTab;  /*Array of Resource Identifier Information Elements unknown by the peer side*/
/**/
DCL
V_RTMCCCheckResult IT_RTMCCCheckResult; /*Consistency Check Result*/
/**/
DCL
V_IntTransId IT_IntTransActID; /*identifies the transaction towards AN_STATUS_MGT process*/
/**/
DCL
P_SNSigId,
P_SNUnexpSigId PID; /*CPROT SN signalling identifier*/
```

Figure A.100: AN_CPROT (1)

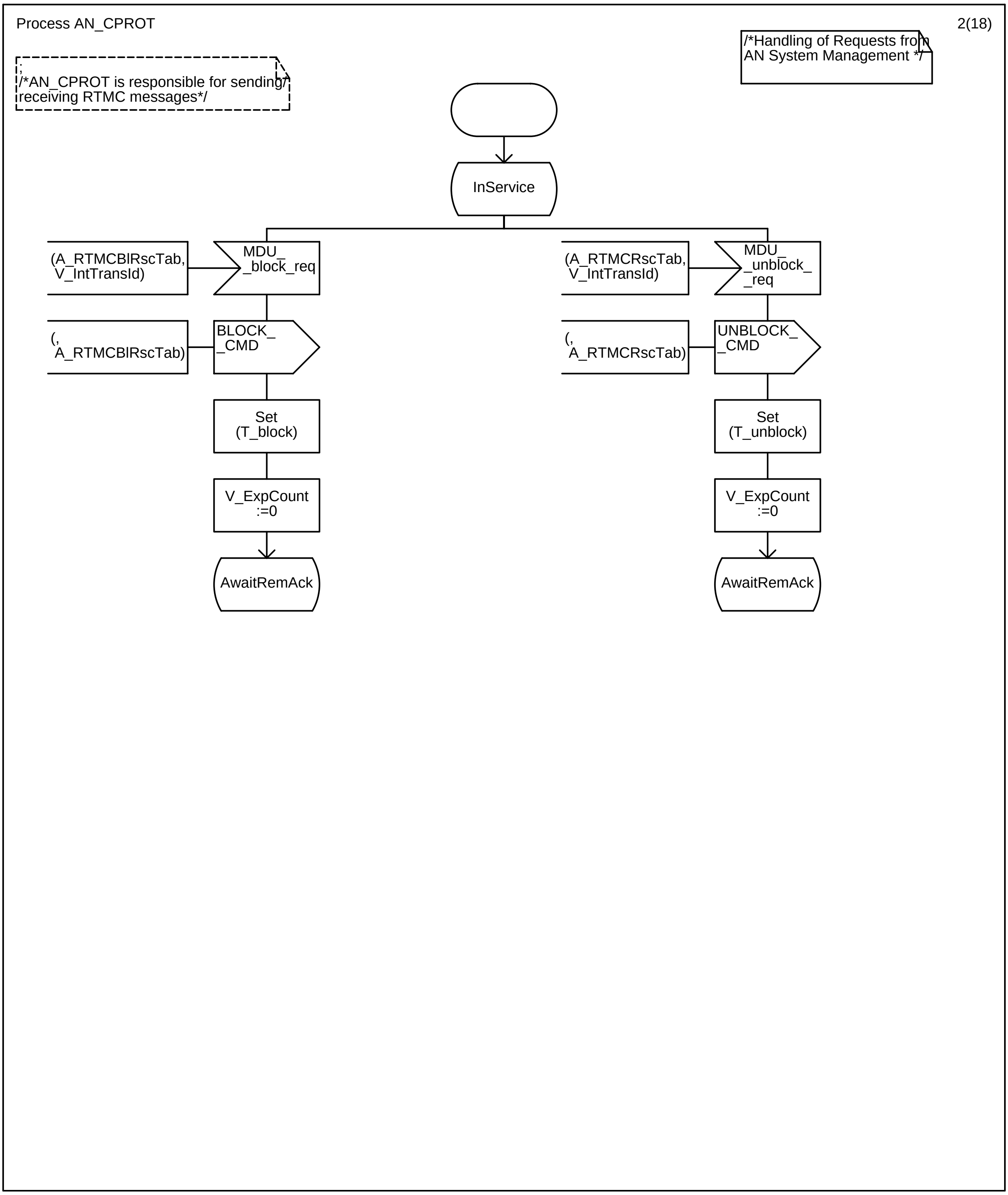


Figure A.101: AN_CPROT (2)

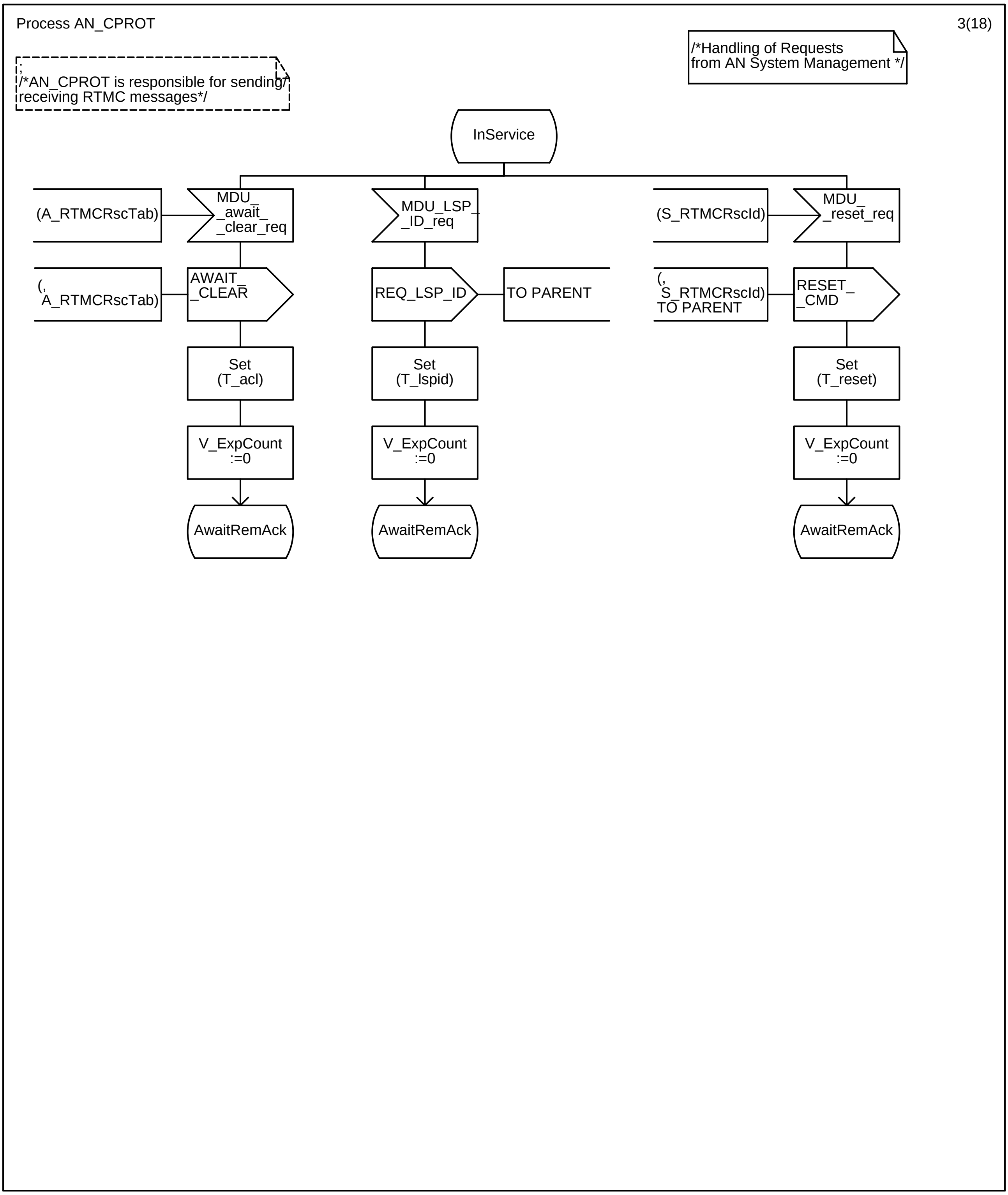


Figure A.102: AN_CPROT (3)

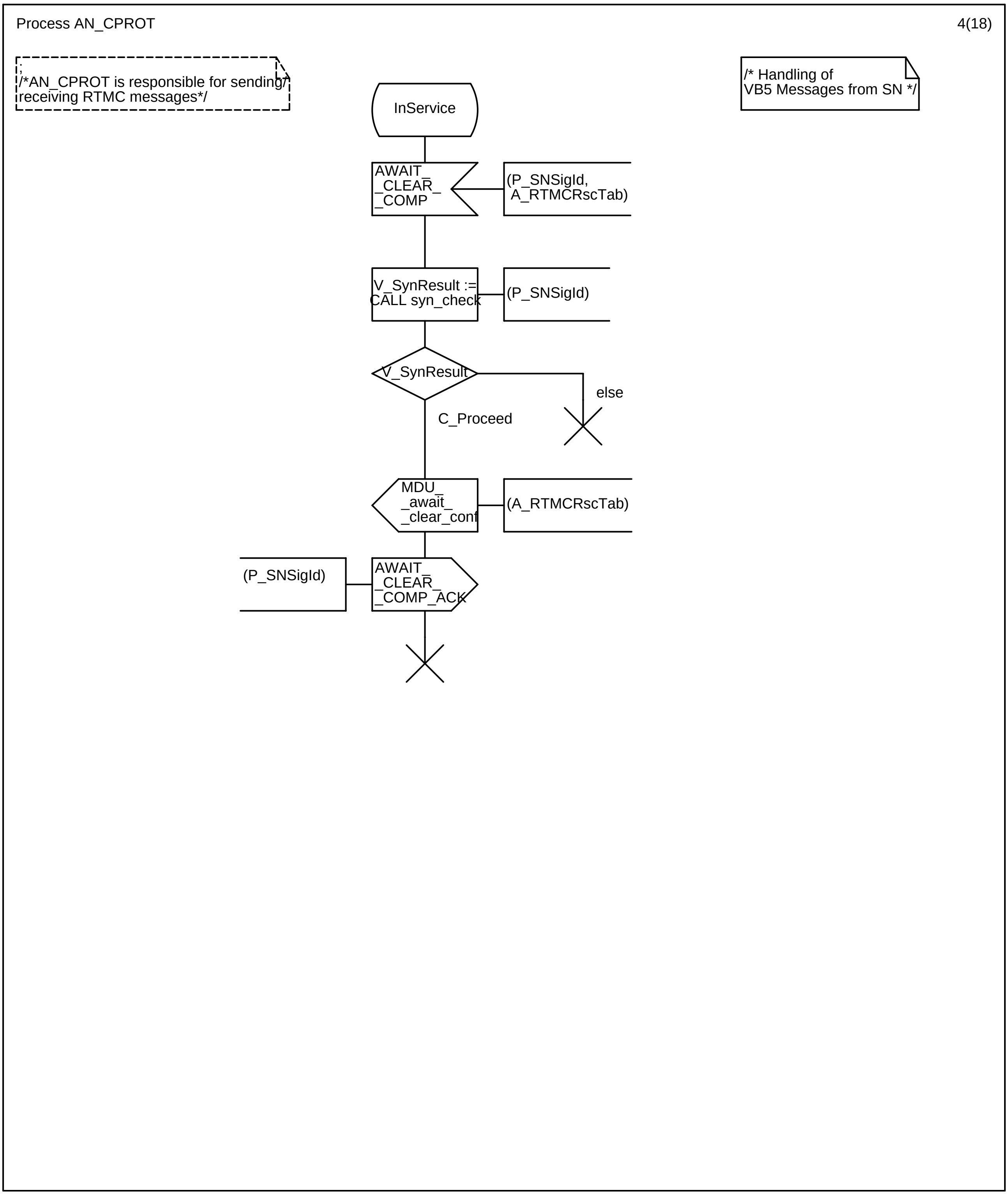


Figure A.103: AN_CPROT (4)

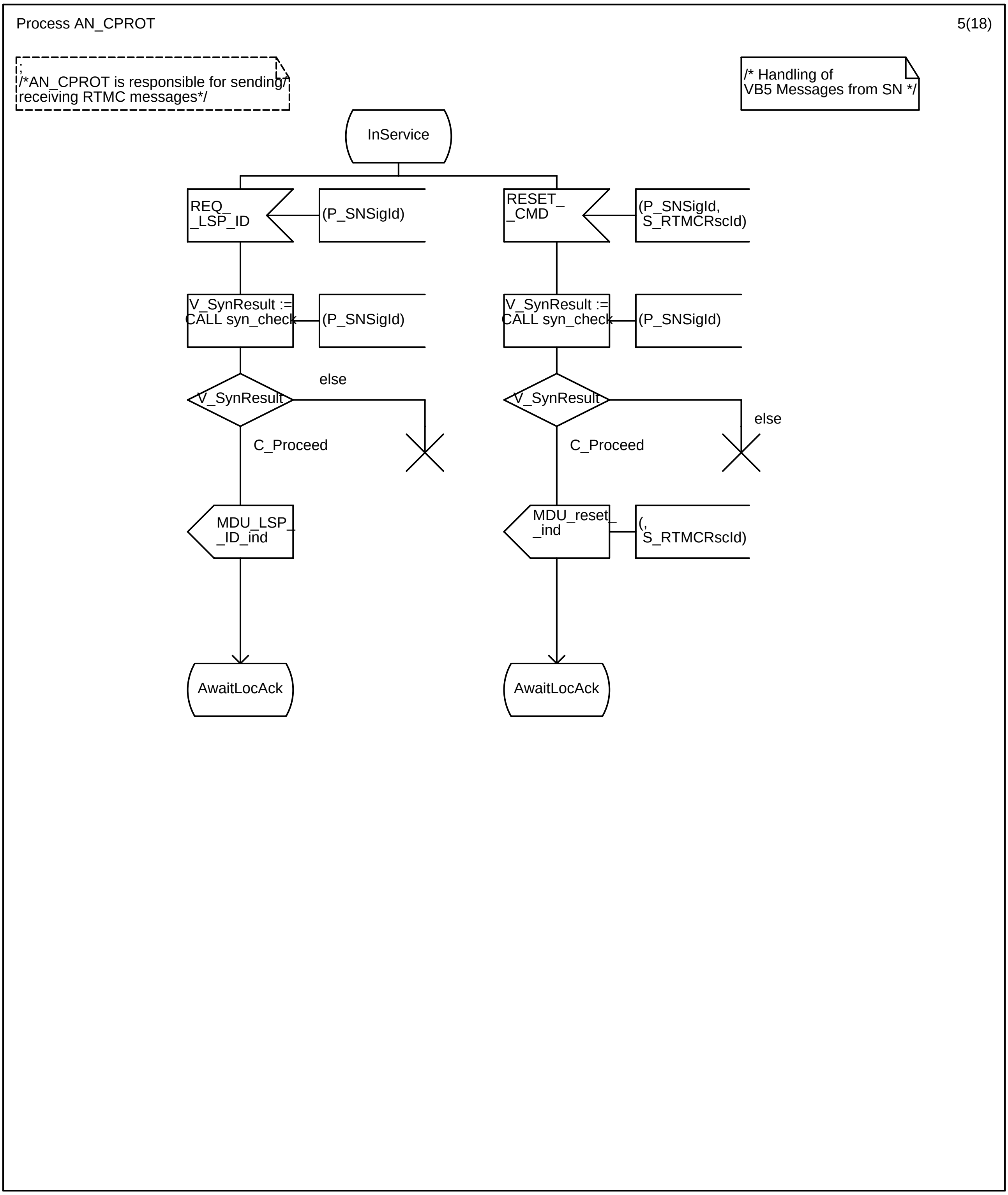


Figure A.104: AN_CPROT (5)

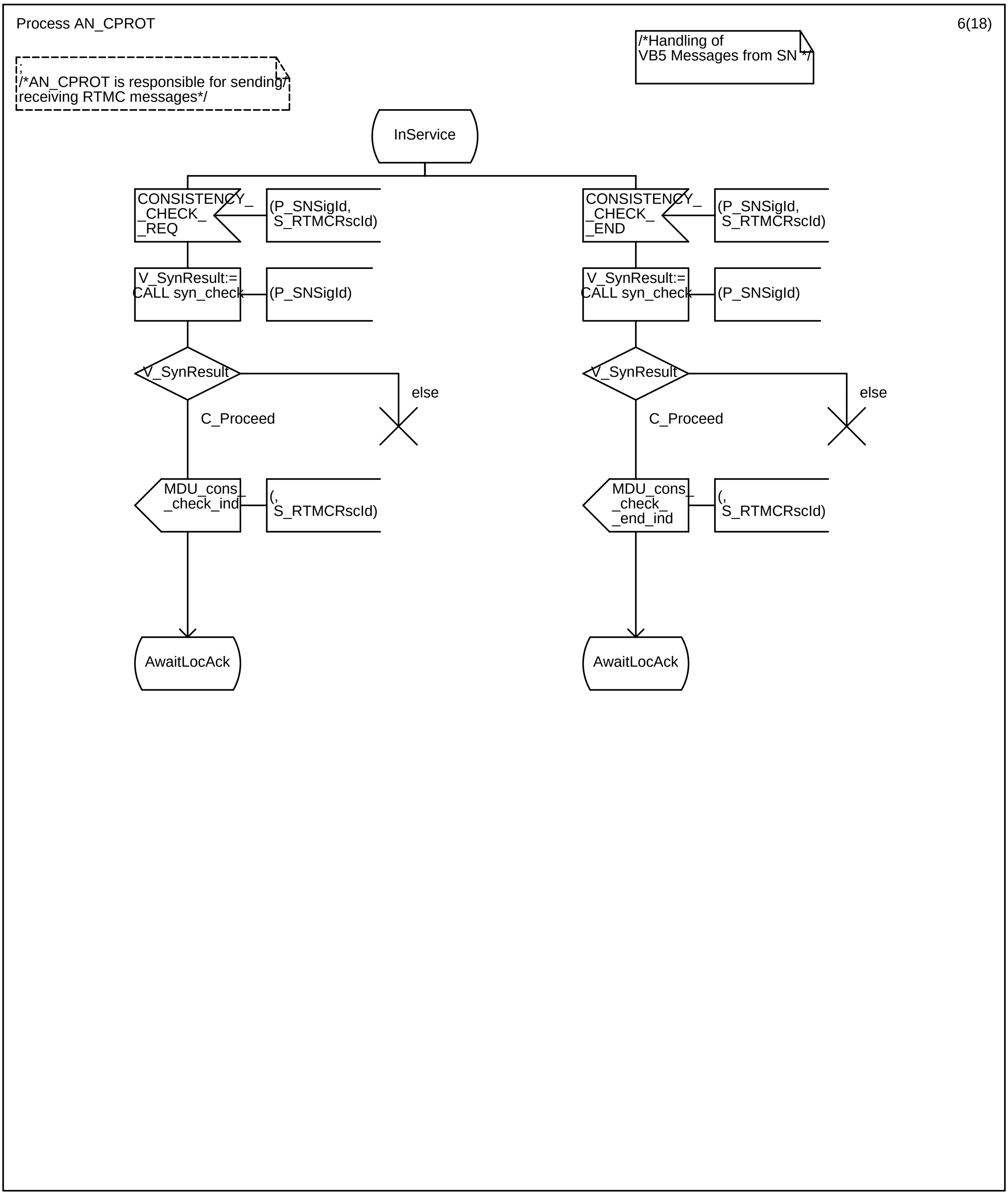


Figure A.105: AN_CPROT (6)

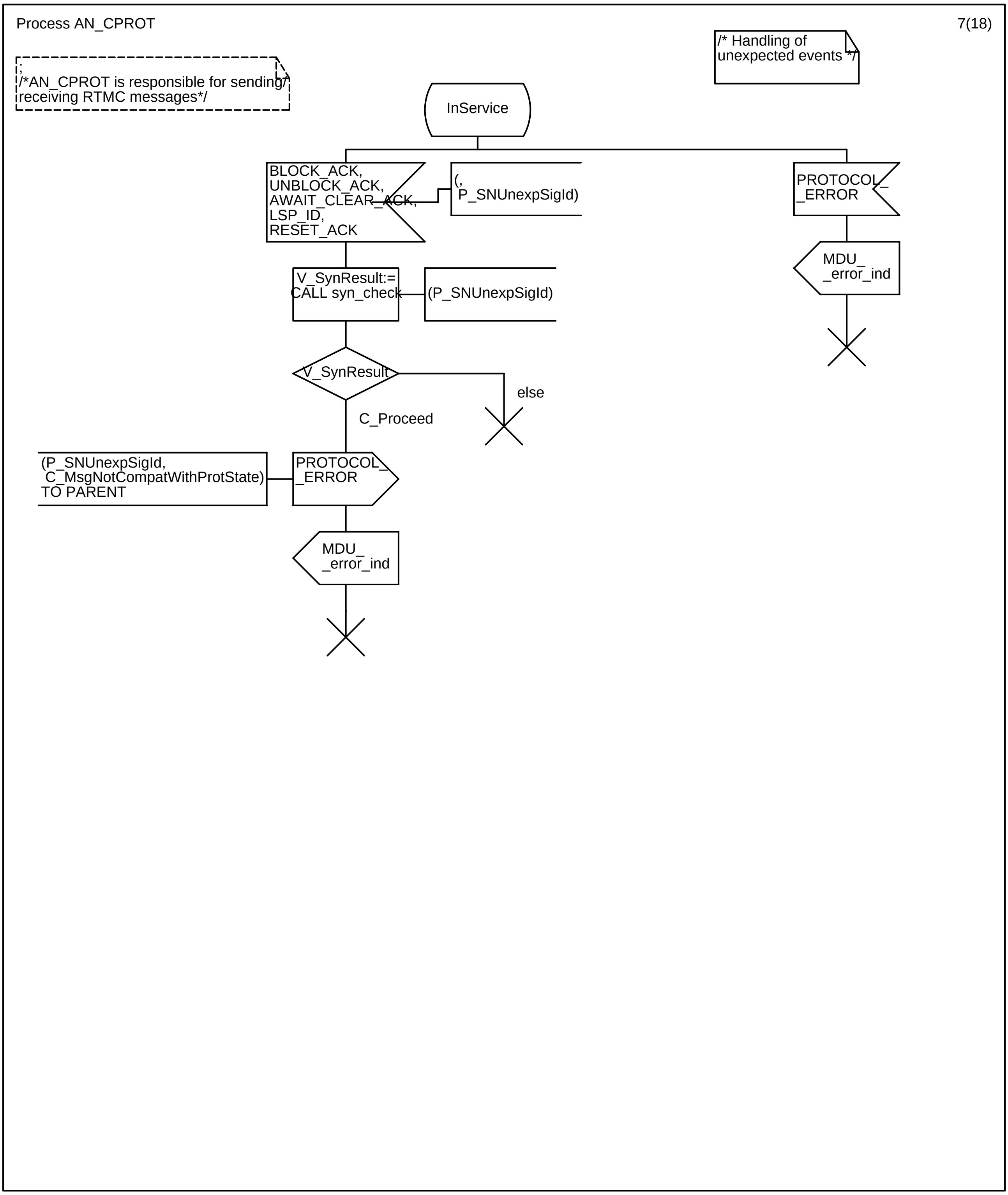


Figure A.106: AN_CPROT (7)

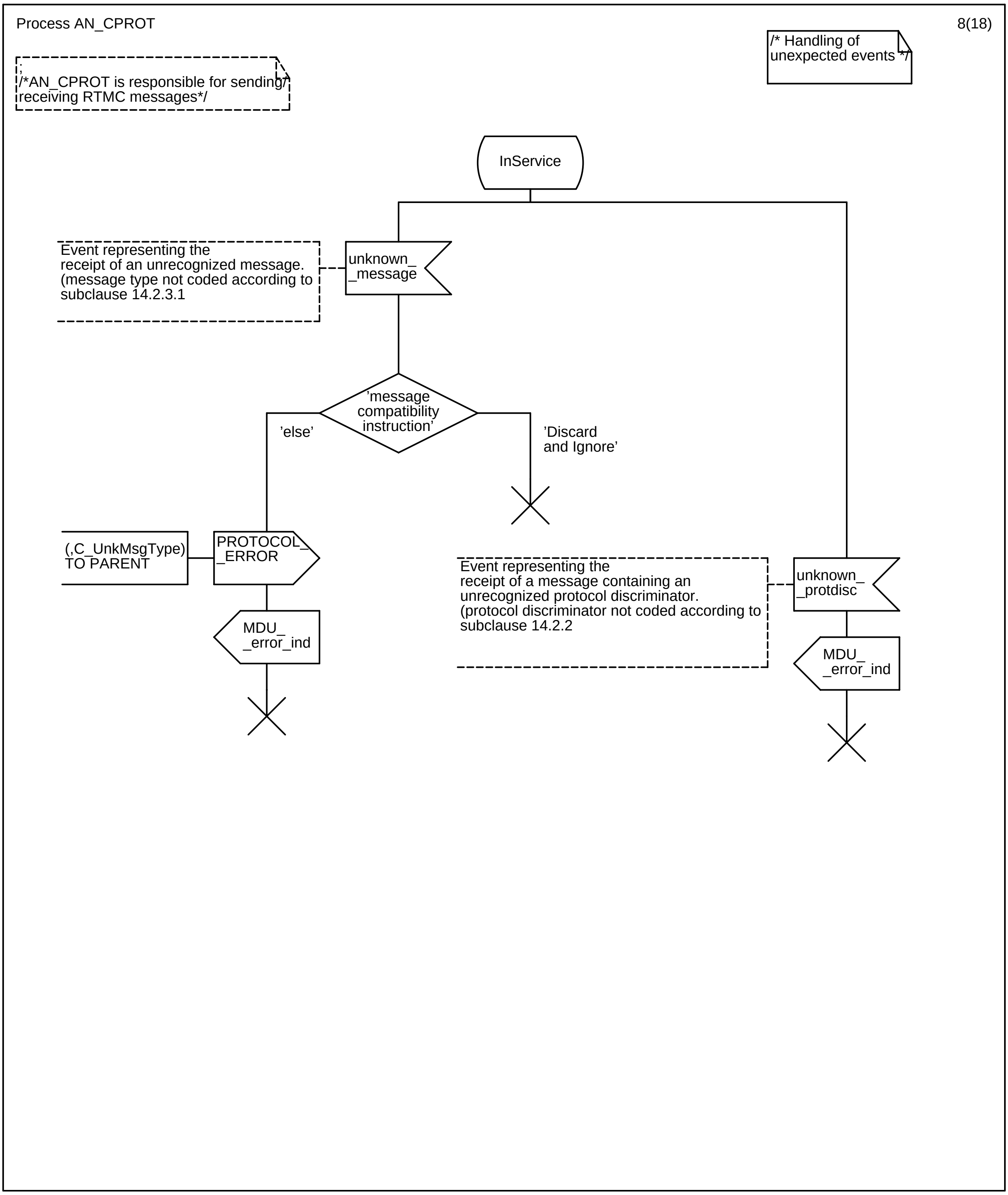


Figure A.107: AN_CPROT (8)

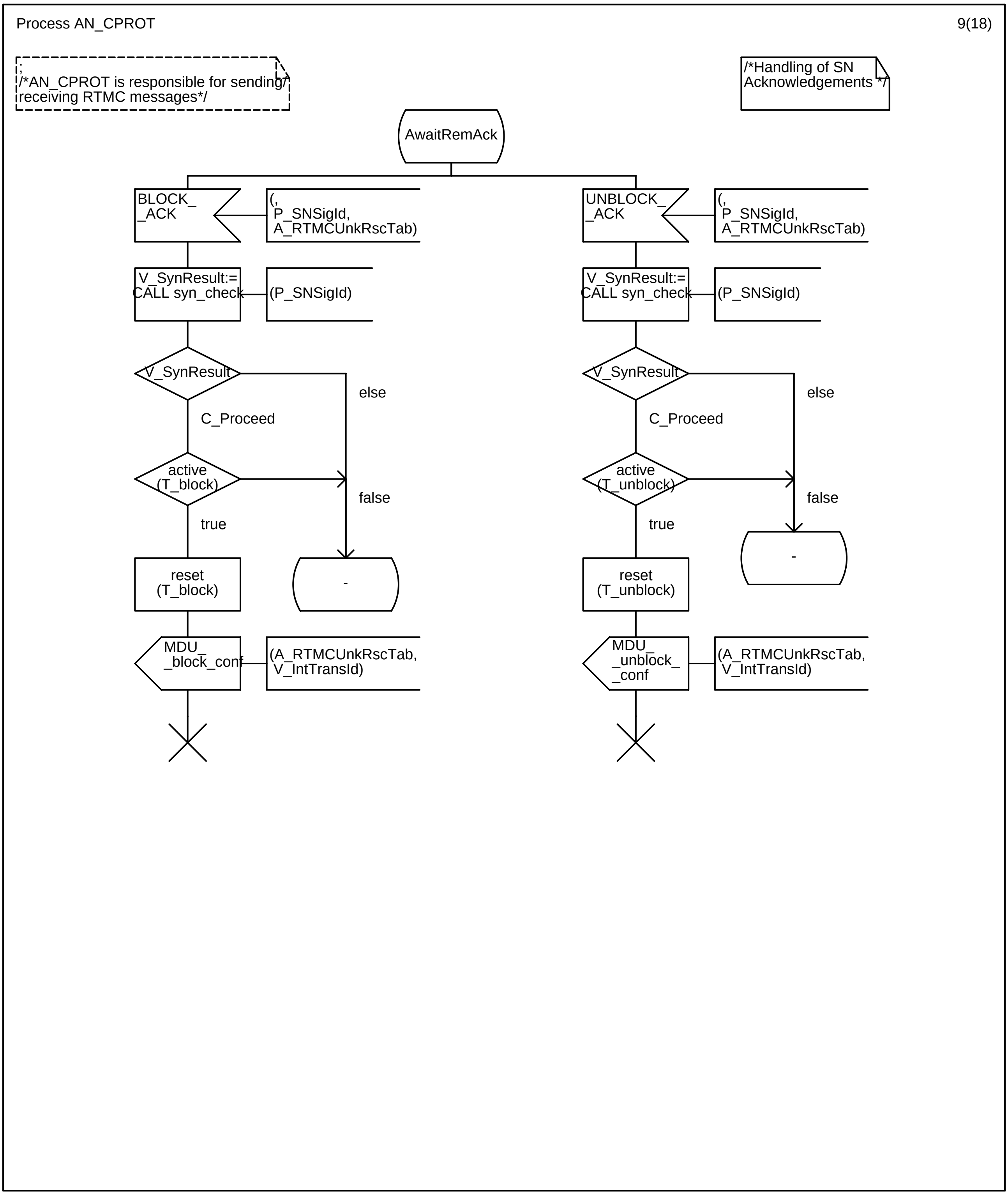


Figure A.108: AN_CPROT (9)

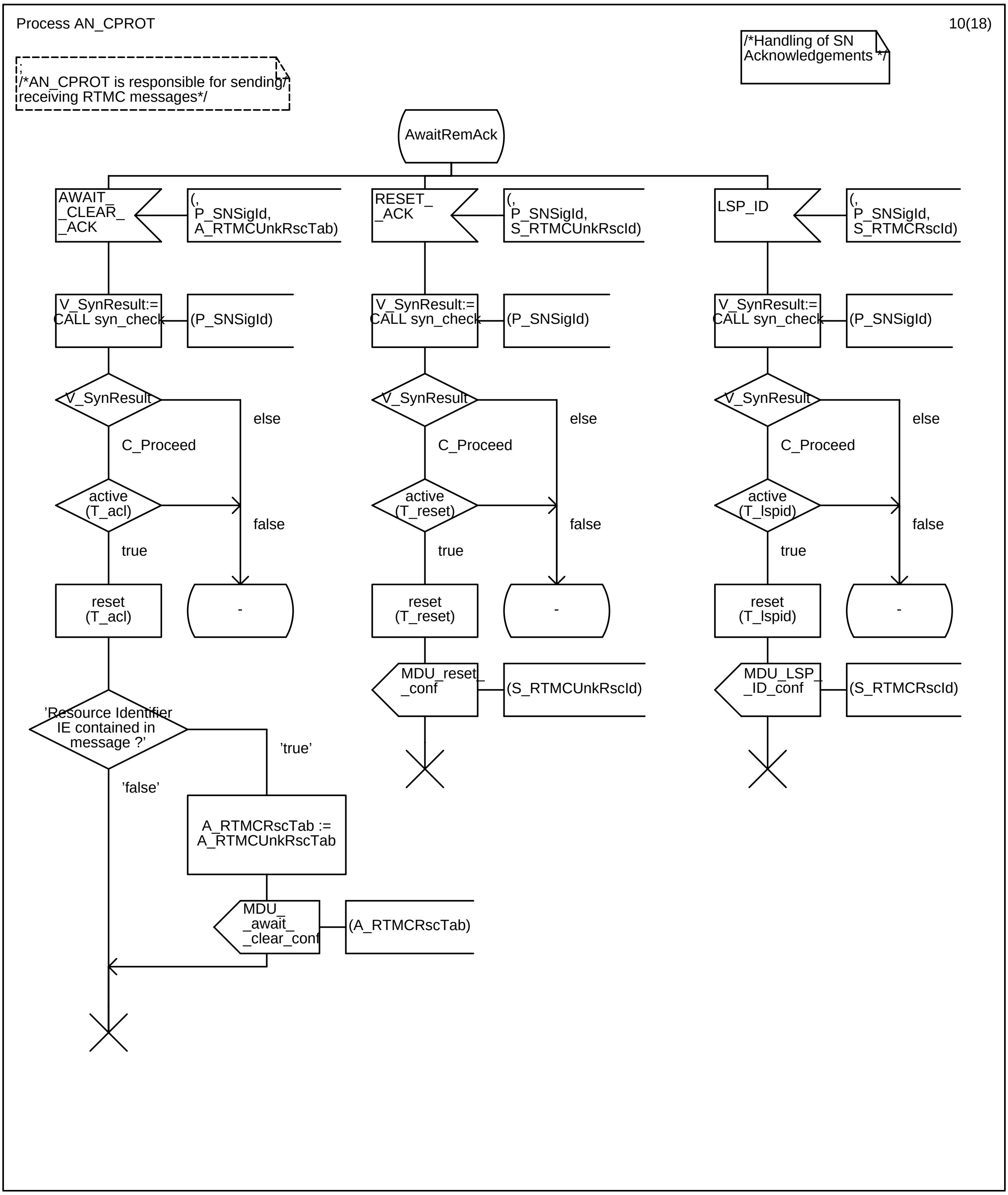


Figure A.109: AN_CPROT (10)

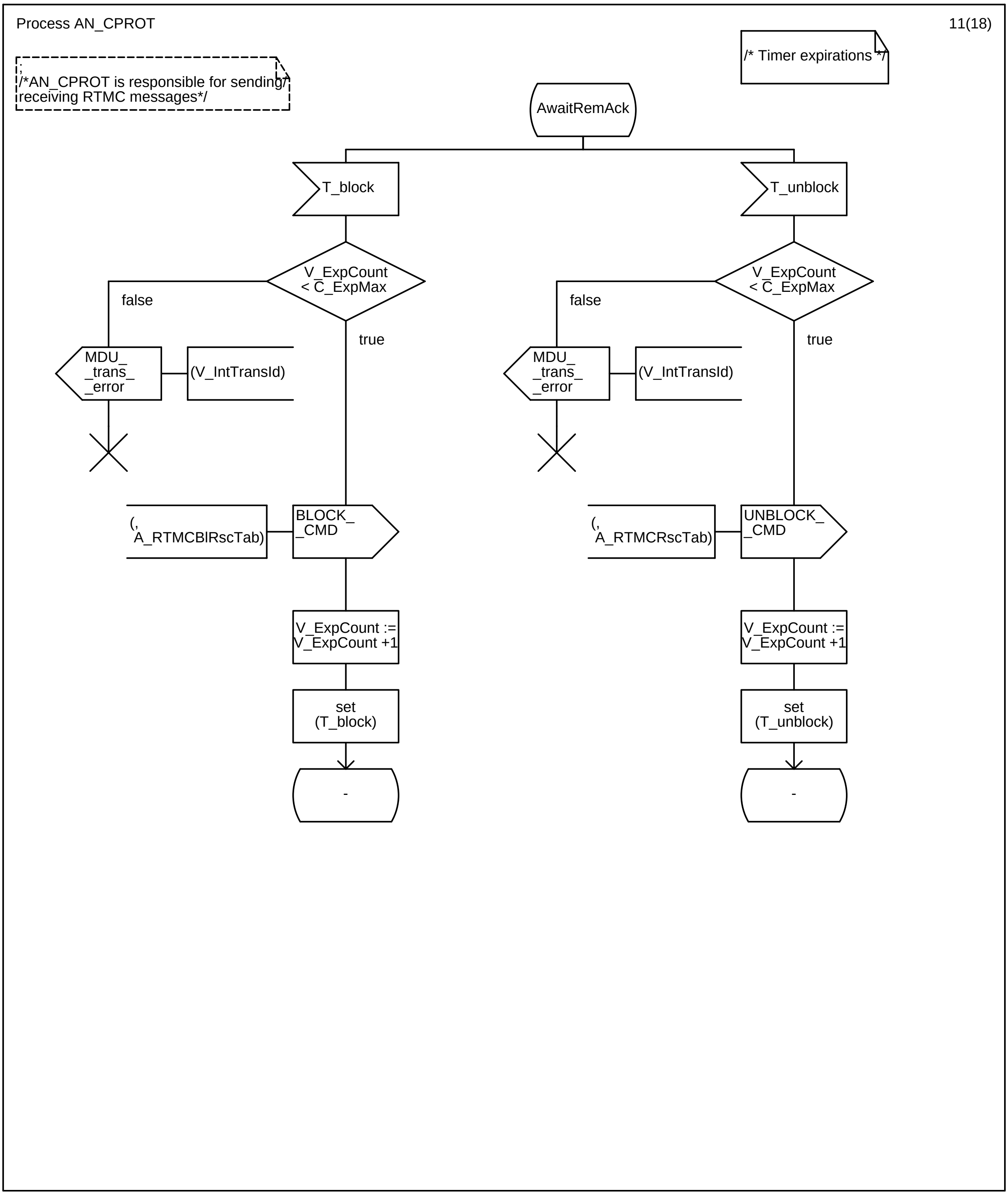


Figure A.110: AN_CPROT (11)

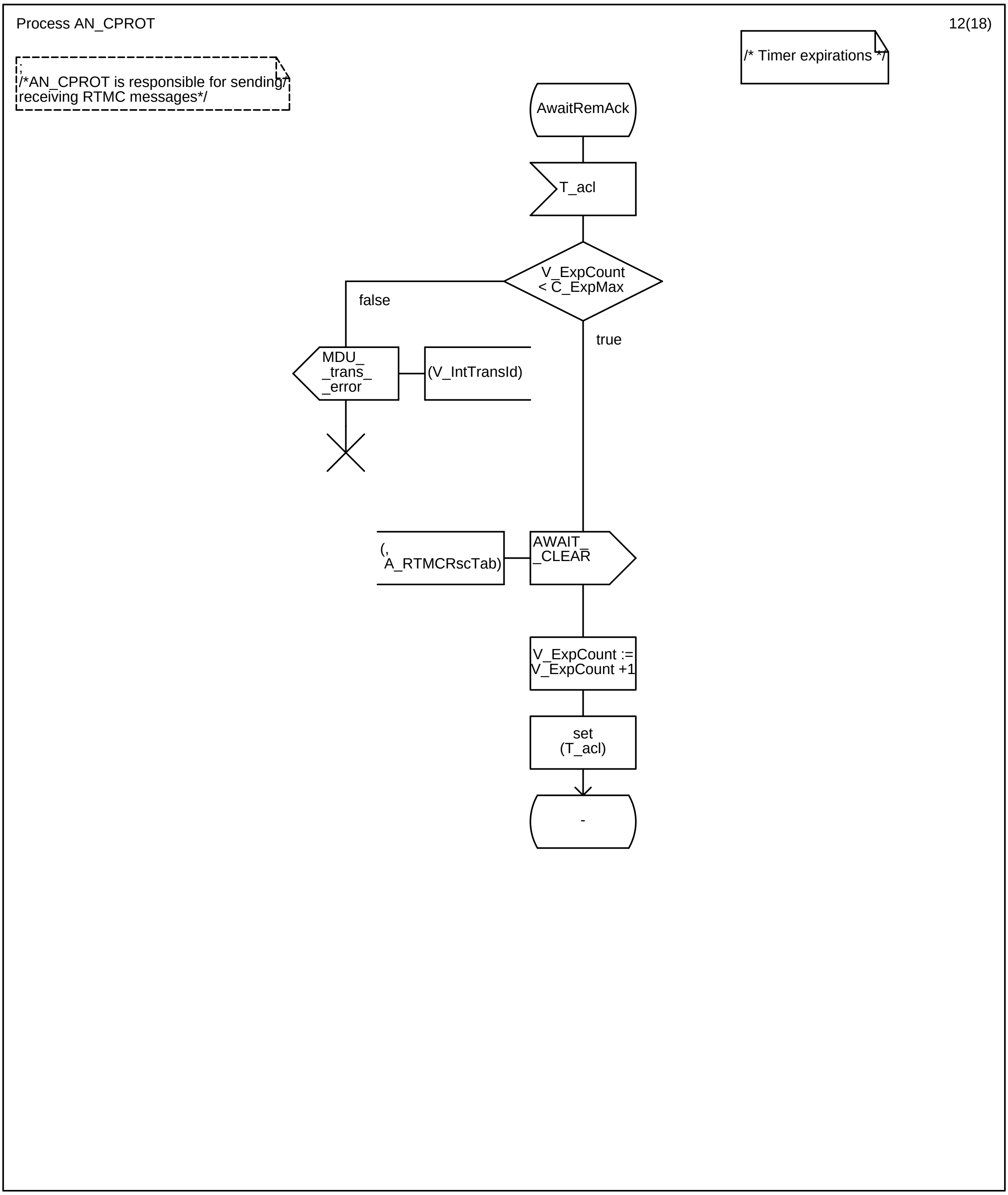


Figure A.111: AN_CPROT (12)

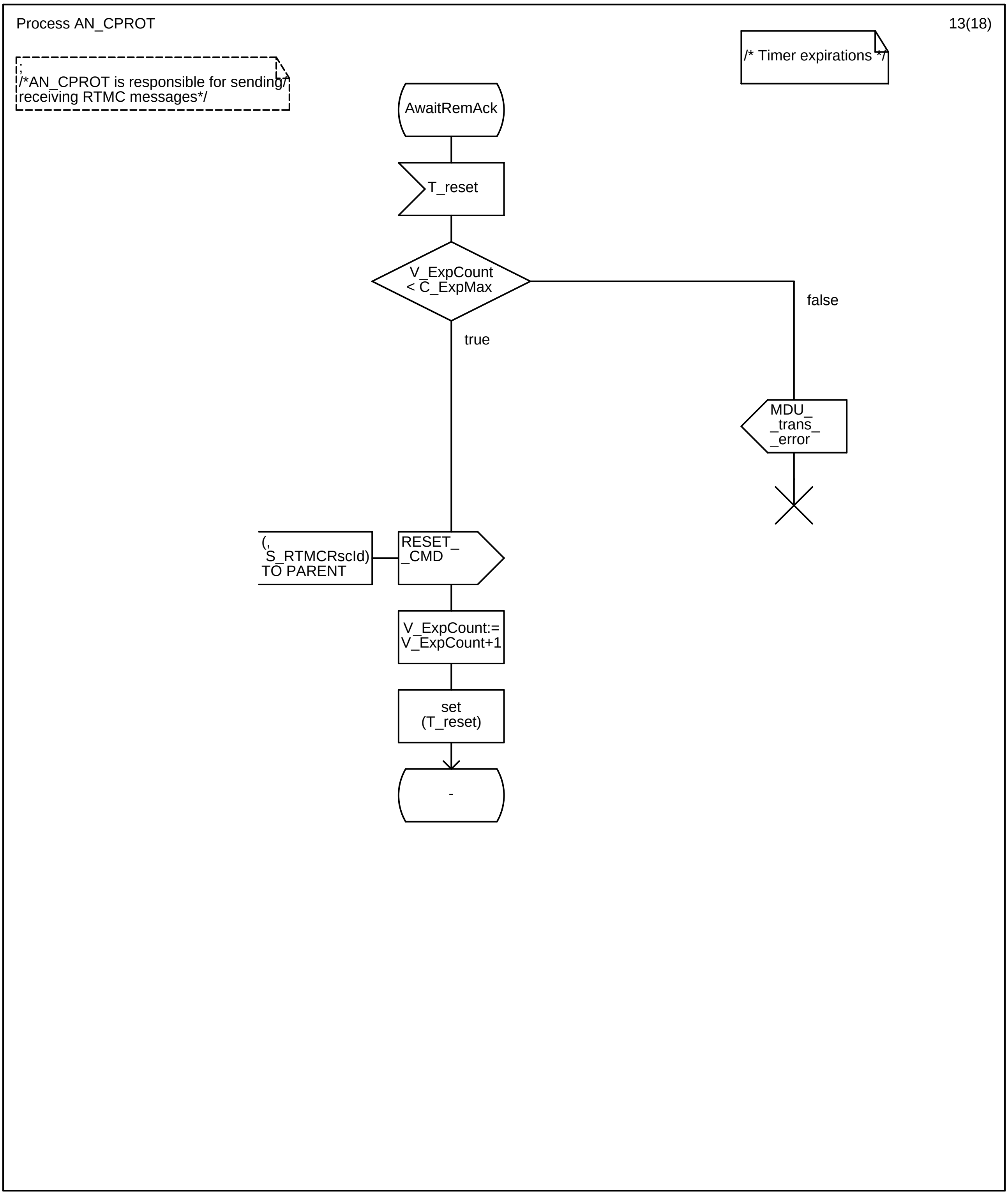


Figure A.112: AN_CPROT (13)

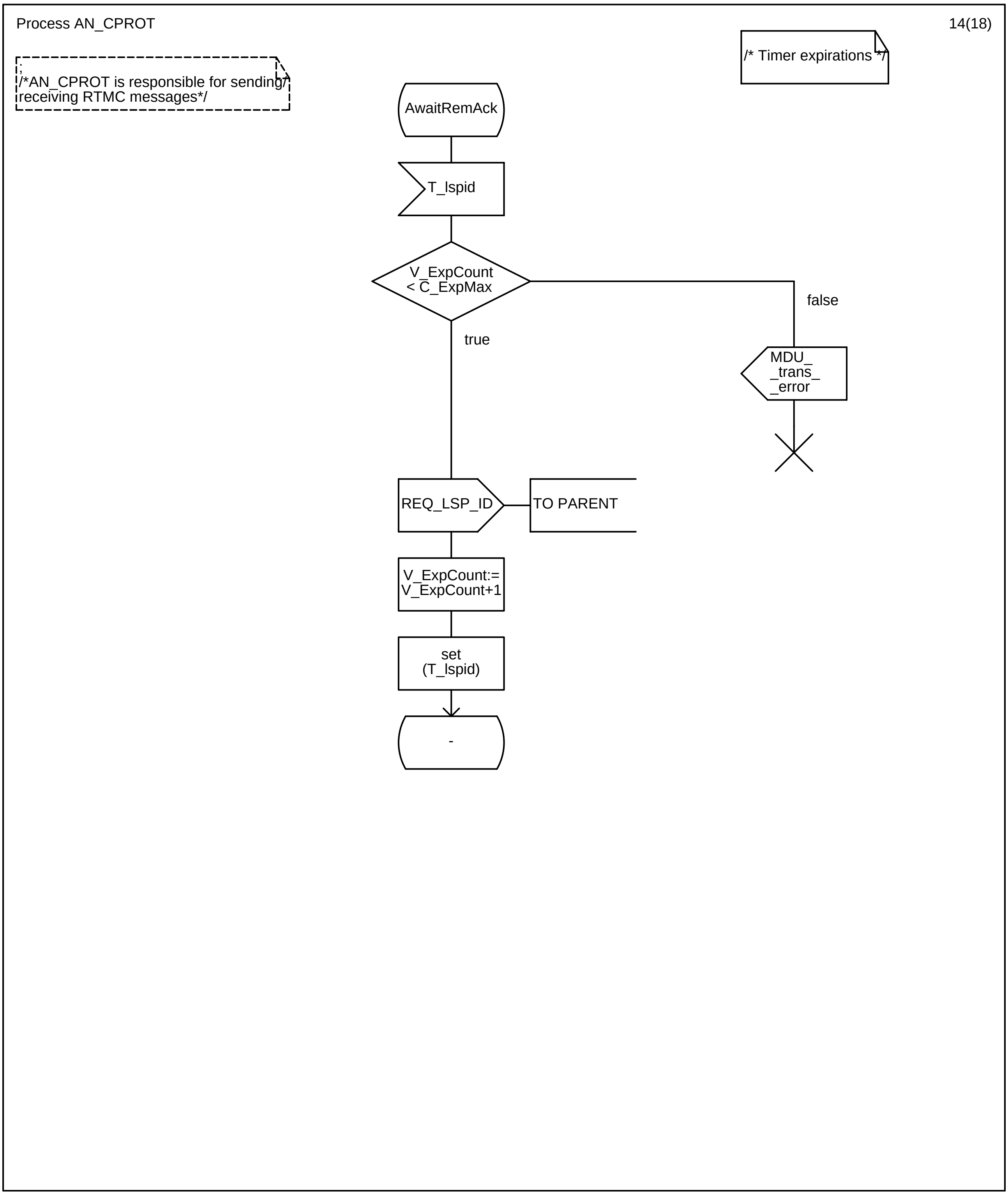


Figure A.113: AN_CPROT (14)

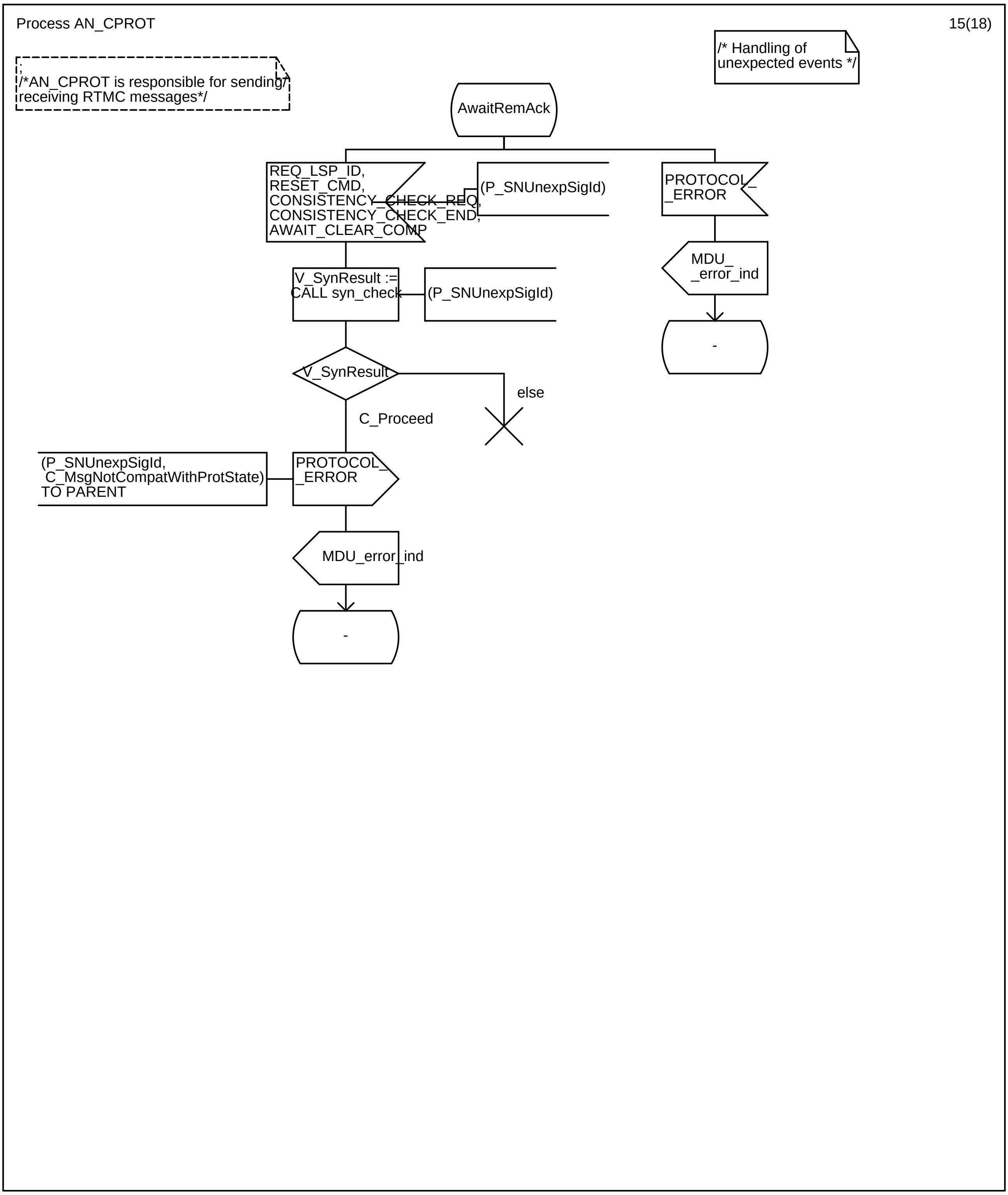


Figure A.114: AN_CPROT (15)

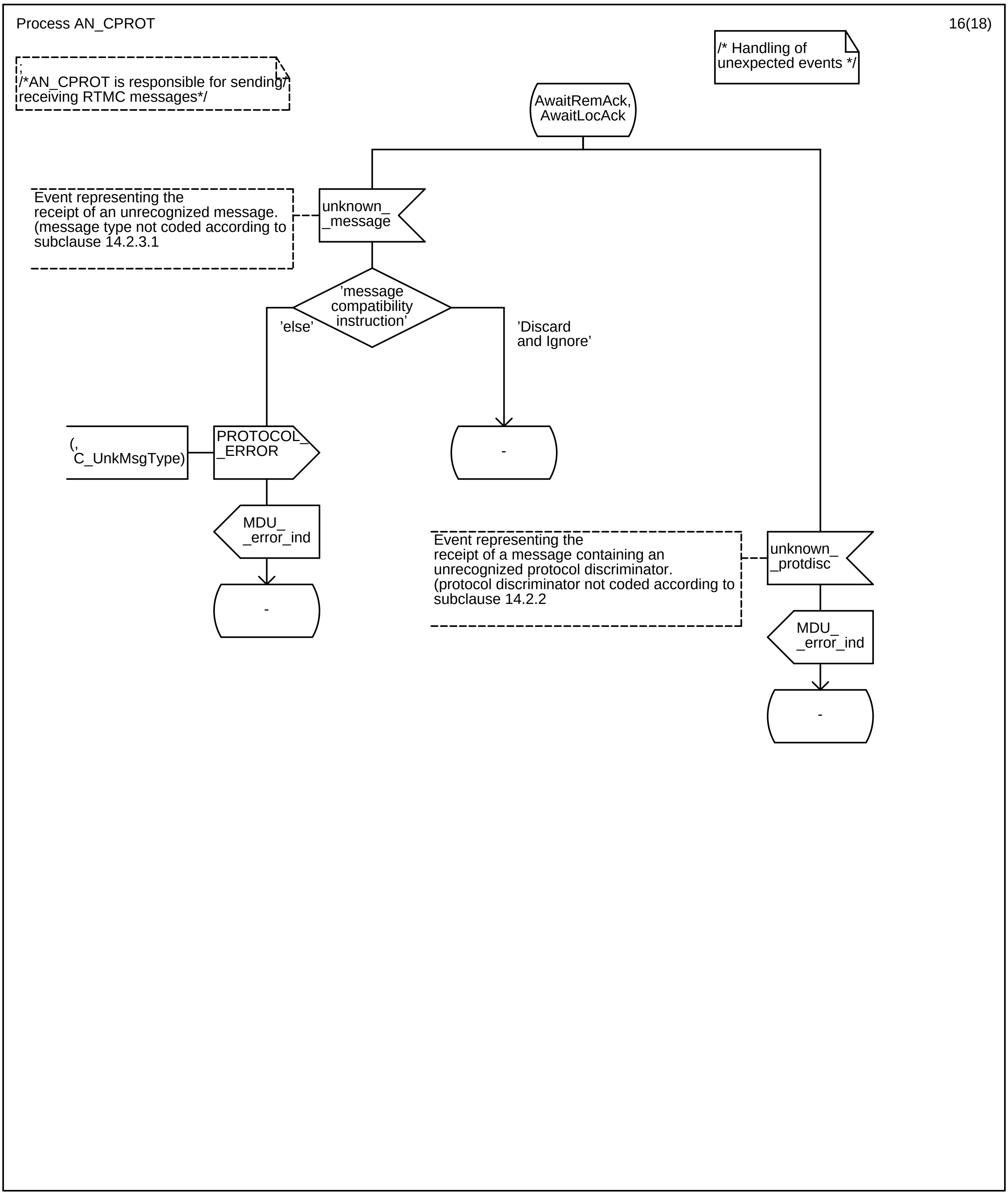


Figure A.115: AN_CPROT (16)

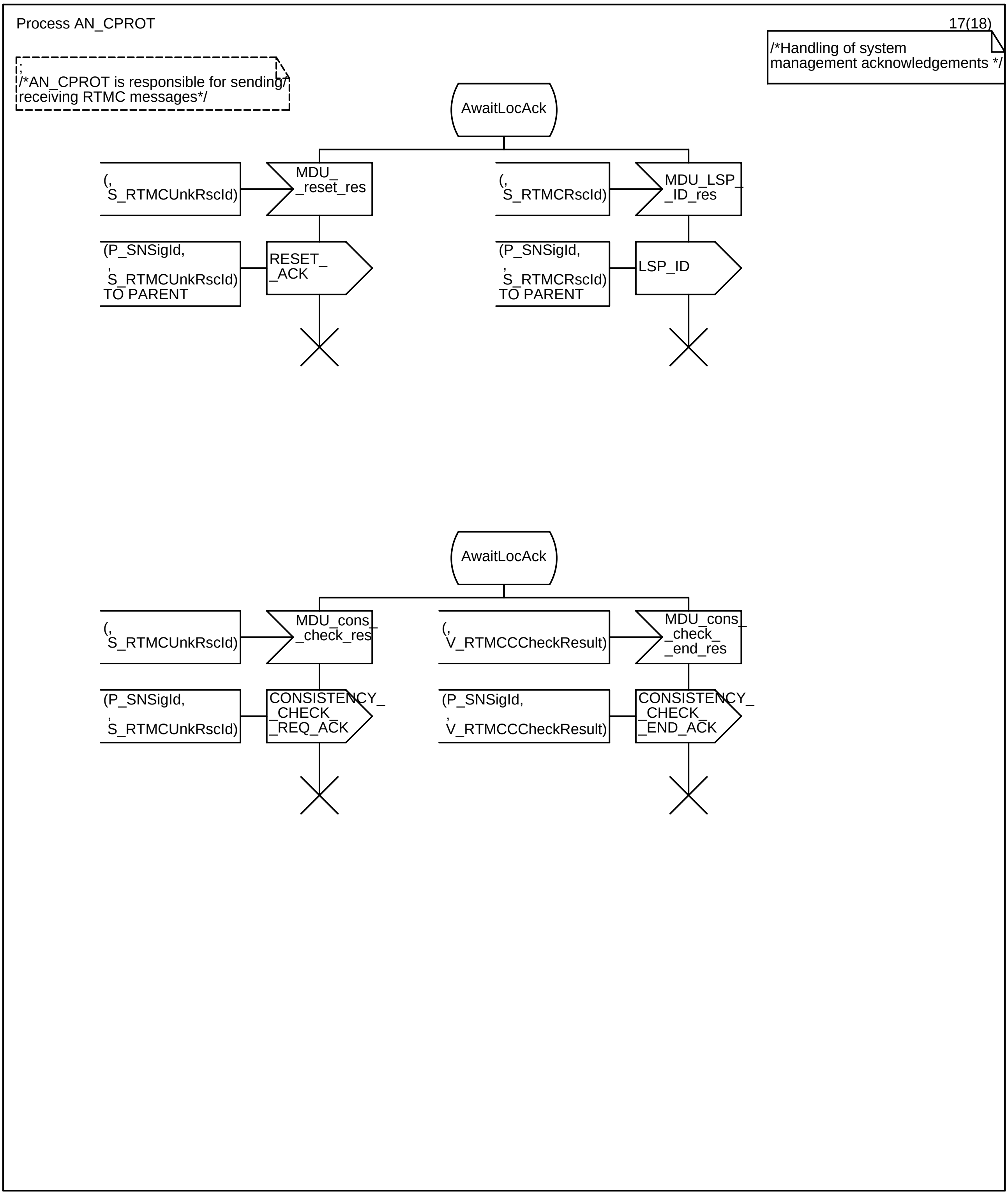


Figure A.116: AN_CPROT (17)

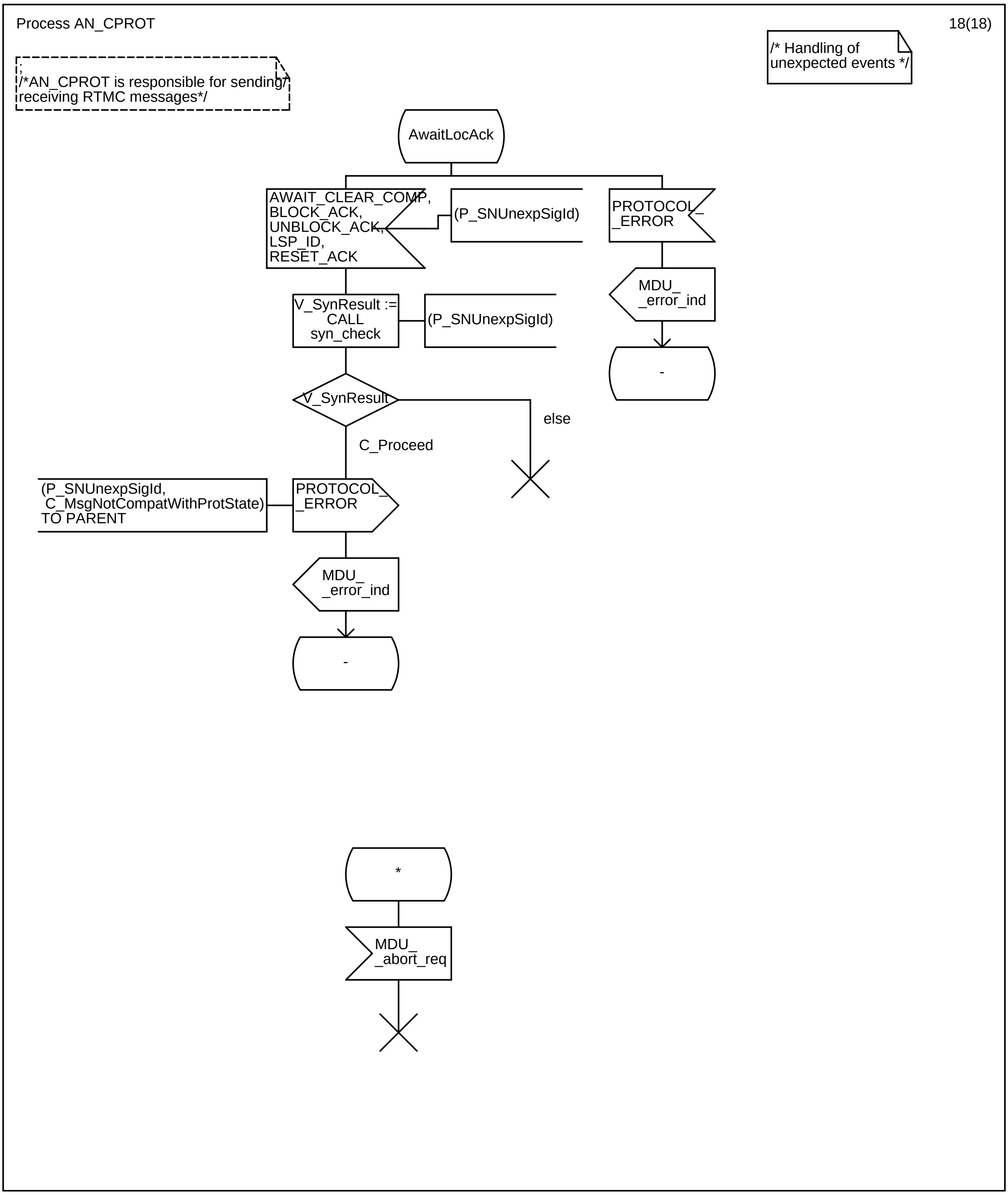


Figure A.117: AN_CPROT (18)

A.3 SN diagrams

A.3.1 Processes of SN_SYSMGT

A.3.1.1 Process SN_STATUS_MGT

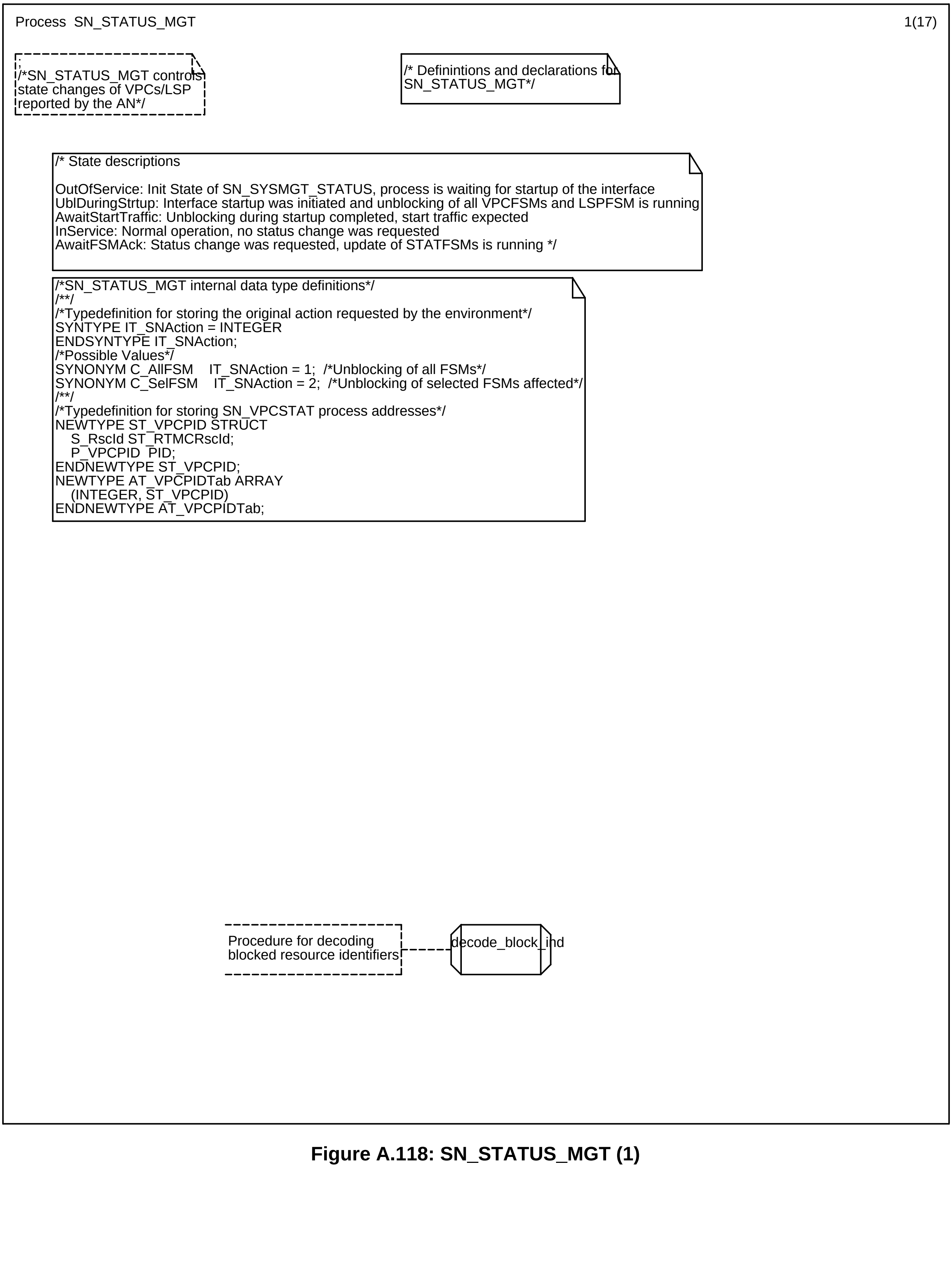


Figure A.118: SN_STATUS_MGT (1)

Process SN_STATUS_MGT 2(17)

```
/*SN_STATUS_MGT controls
state changes of VPCs/LSP
reported by the AN*/
```

```
/* Definintions and declarations for
SN_STATUS_MGT*/
```

```
/*Signal data declarations*/
/**/
DCL
A_RTMCRscTab AT_RTMCRscTab;  /*Array of Resource Identifier Information Elements*/
/**/
DCL
A_RTMCBlRscTab AT_RTMCBlRscTab;  /*Array of Blocked Resource Identifier Information Elements*/
/**/
DCL
A_RTMCUnkRscTab AT_RTMCUnkRscTab;  /*Array of Unknown Resource Identifier Information Elements*/
/**/
DCL
V_IntReasonVal IT_IntReasonVal;  /*Status change reason given to VPCSTAT/LSPSTAT process*/
/**/
DCL
V_NoOfRsc IT_NoOfRsc; /*Number of resources*/
/**/
DCL
V_NoOfUnkRsc IT_NoOfRsc; /*Number of resources*/
/**/
DCL
S_RscId ST_RTMCRscId; /*Resource identifier of  SN_VPCSTAT_FSM*/
/**/
DCL
P_CprotPID PID; /*PID of CPROT process responsible for transaction*/
```

```
/* SN_STATUS_MGT internal variables and constants */
/**/
/*Variables for co-ordinating "unblock_all" procedure (e.g. during interface startup or reset of LSP)*/
/**/
DCL
B_VPCUblDone,    /*MPH_VPC_unblock_conf received from all requested VPC STATFSM*/
B_LSPUblDone    /*MPH_LSP_unblock_conf received*/
BOOLEAN;
/**/
DCL
V_Totalconf,    /*number of expected VPC state change confirmations*/
V_RecConf    /*number of received VPC state change confirmations*/
IT_NoOfRsc;
/**/
/*Variable for identifying the original requested action*/
DCL
V_SNAction IT_SNAction;
/**/
/*Variable for decoded blocked resources*/
DCL A_EnvBlRscTab AT_EnvBlRscTab;
/**/
/*Variable for storing AN_VPCSTAT PIDs*/
DCL A_VPCPIDTab AT_VPCPIDTab;
DCL V_VPCPIDIdx INTEGER; /*Variable for indexing PID Table*/
```

Figure A.119: SN_STATUS_MGT (2)

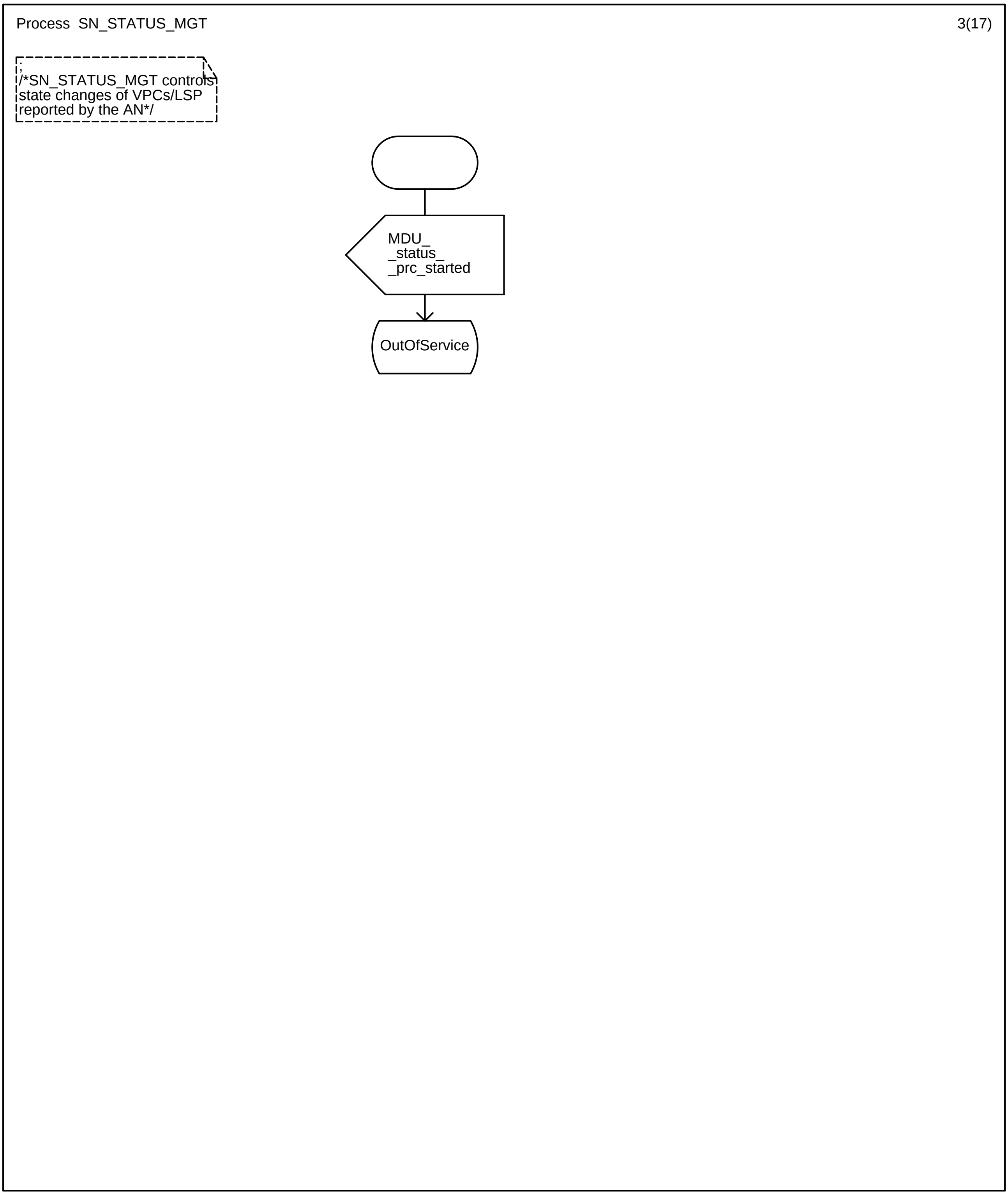


Figure A.120: SN_STATUS_MGT (3)

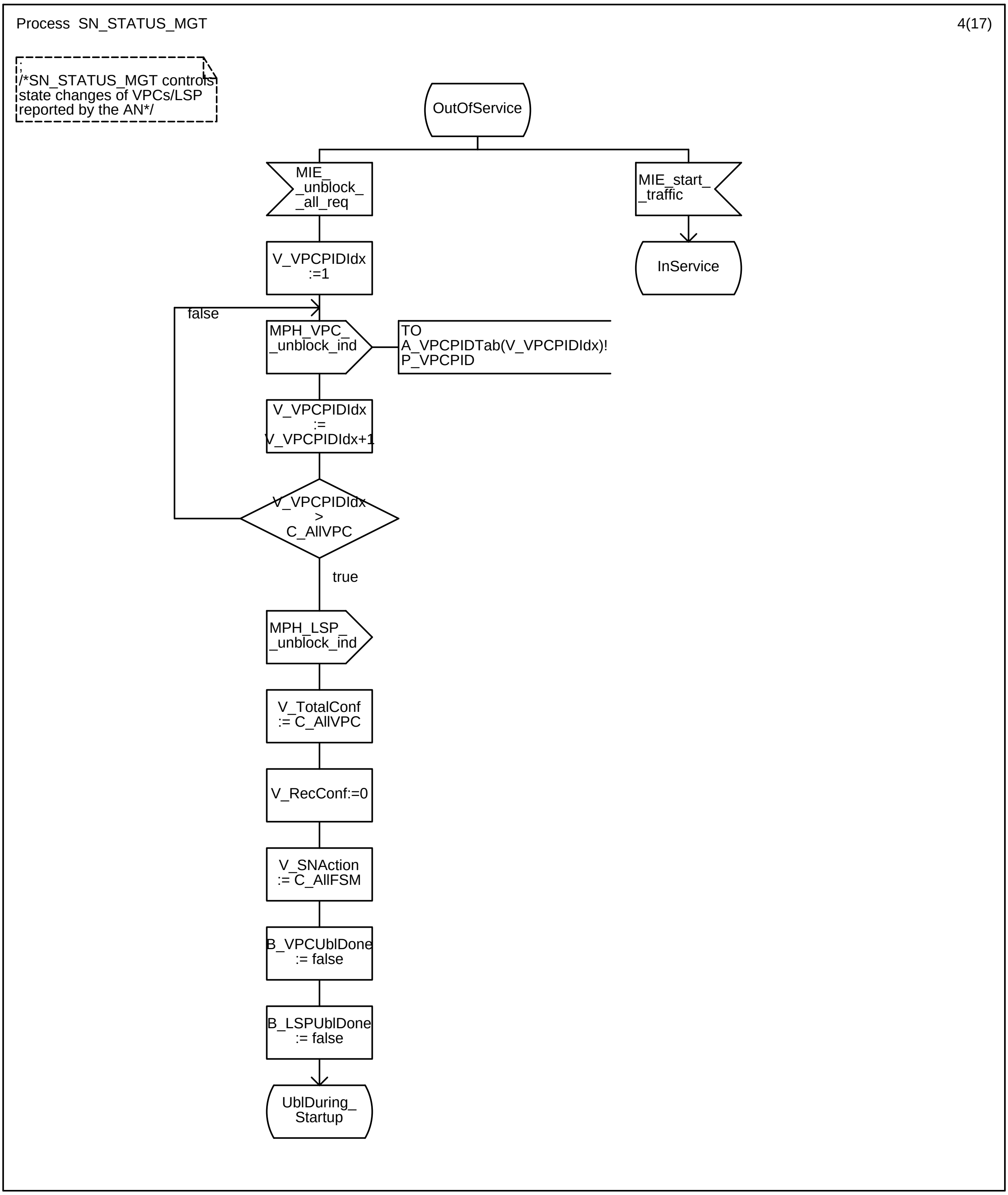


Figure A.121: SN_STATUS_MGT (4)

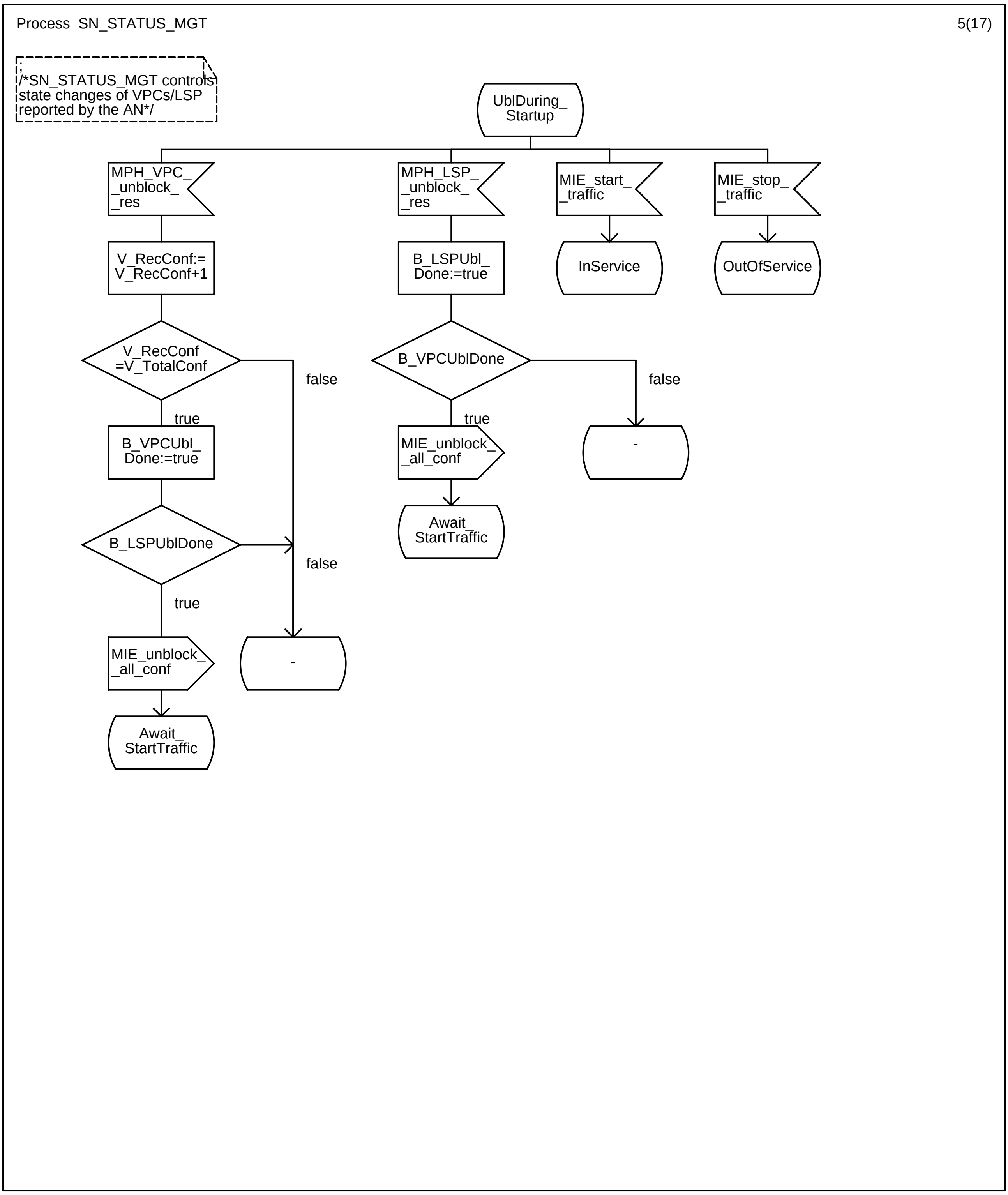


Figure A.122: SN_STATUS_MGT (5)

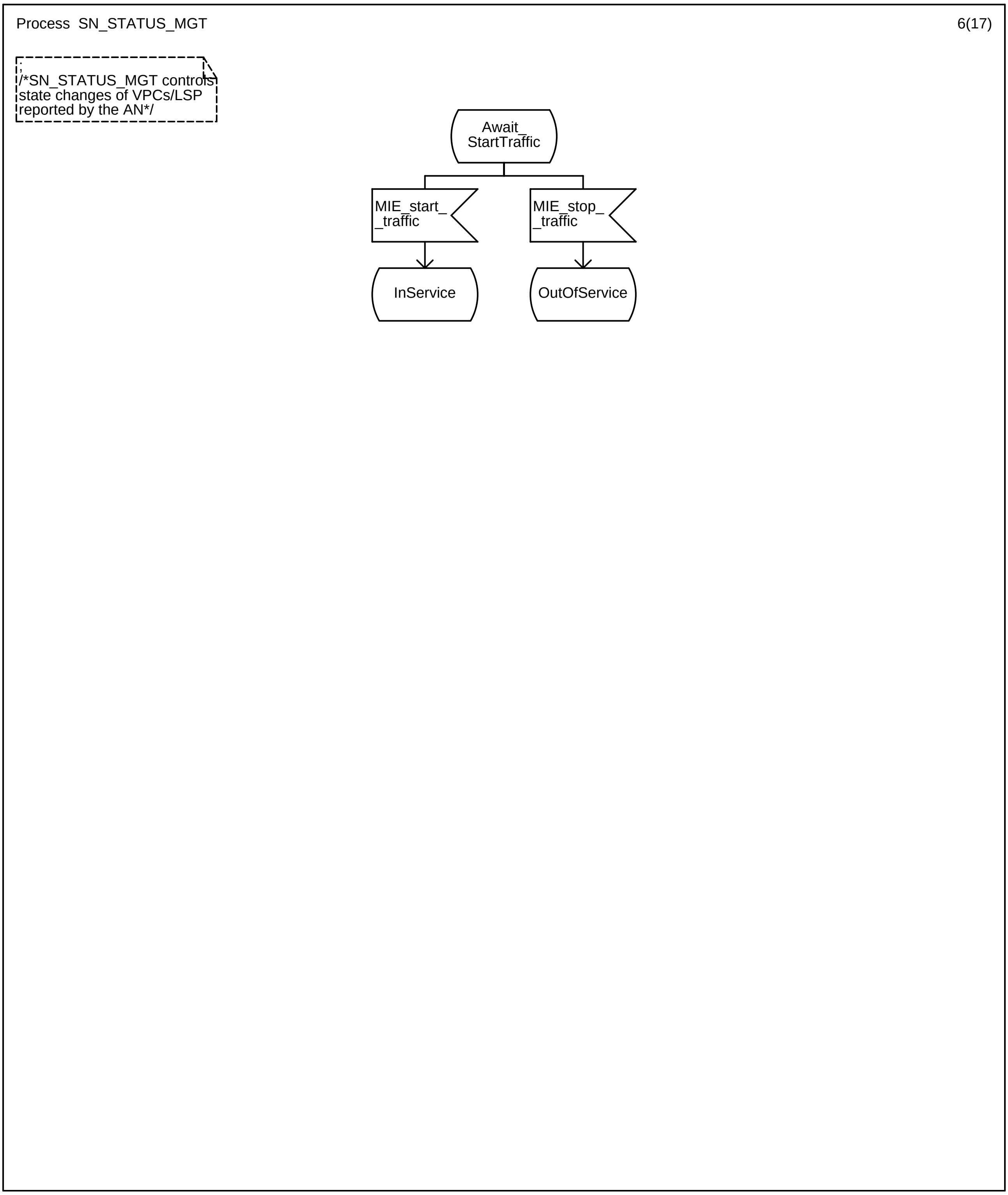


Figure A.123: SN_STATUS_MGT (6)

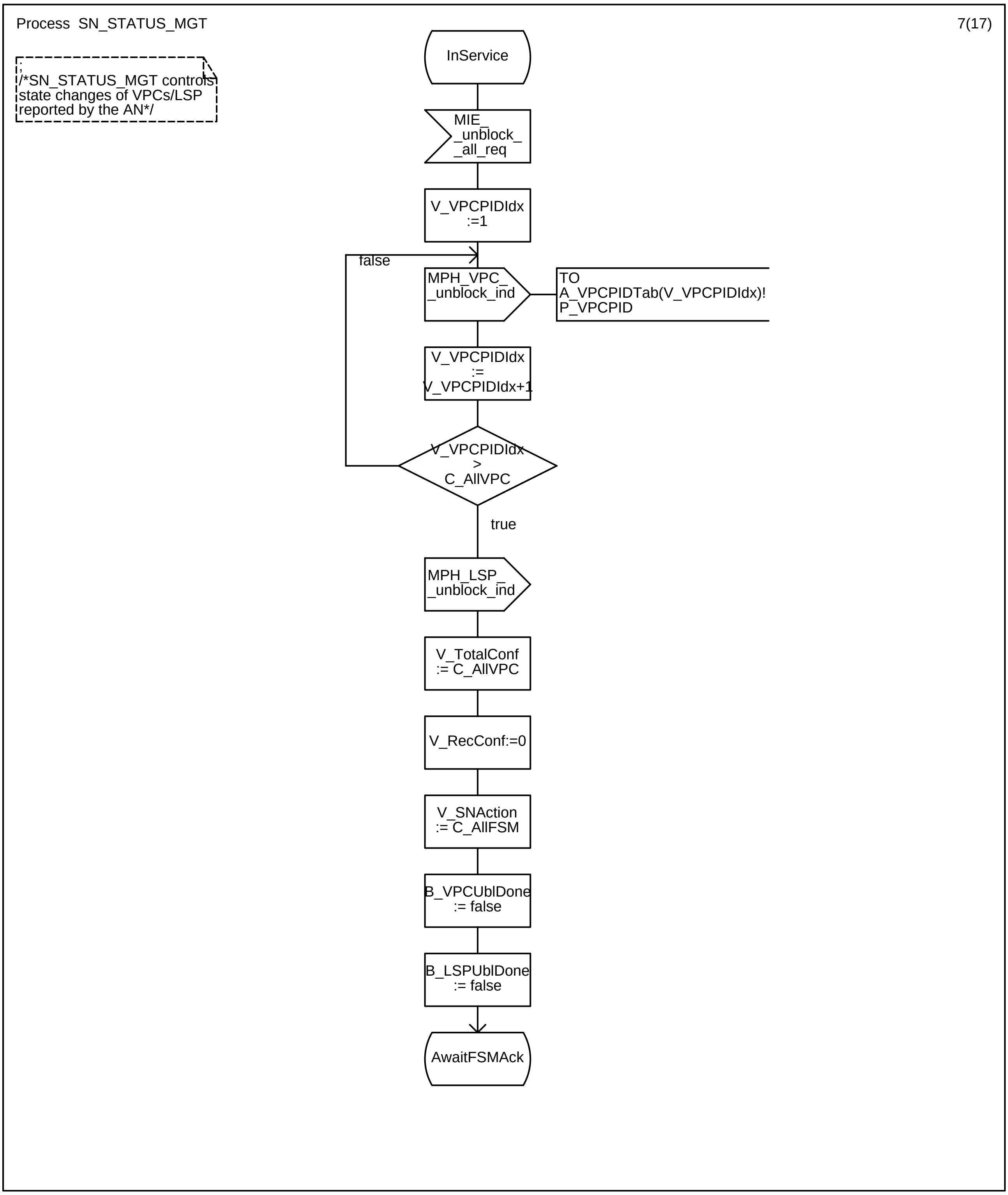


Figure A.124: SN_STATUS_MGT (7)

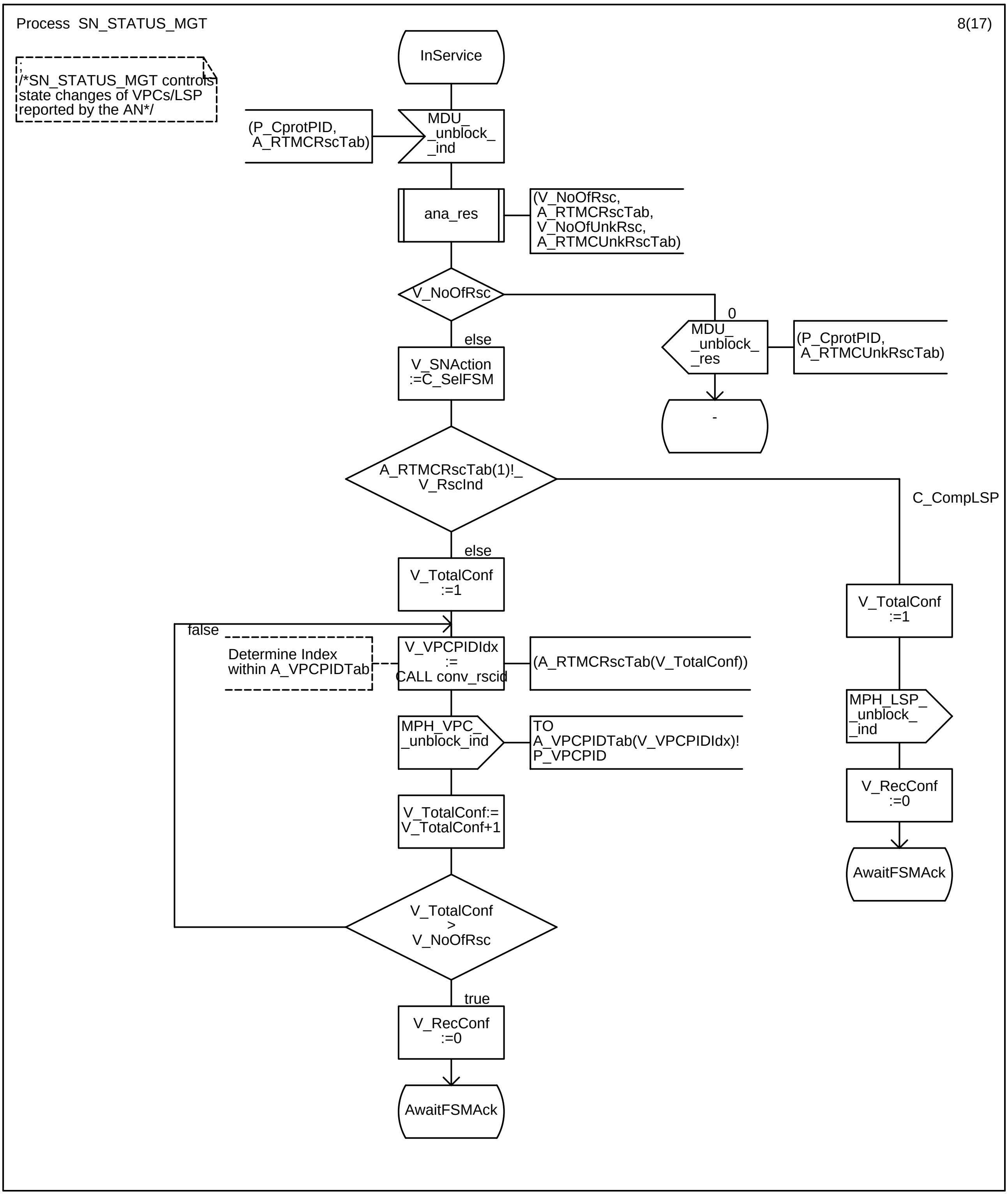


Figure A.125: SN_STATUS_MGT (8)

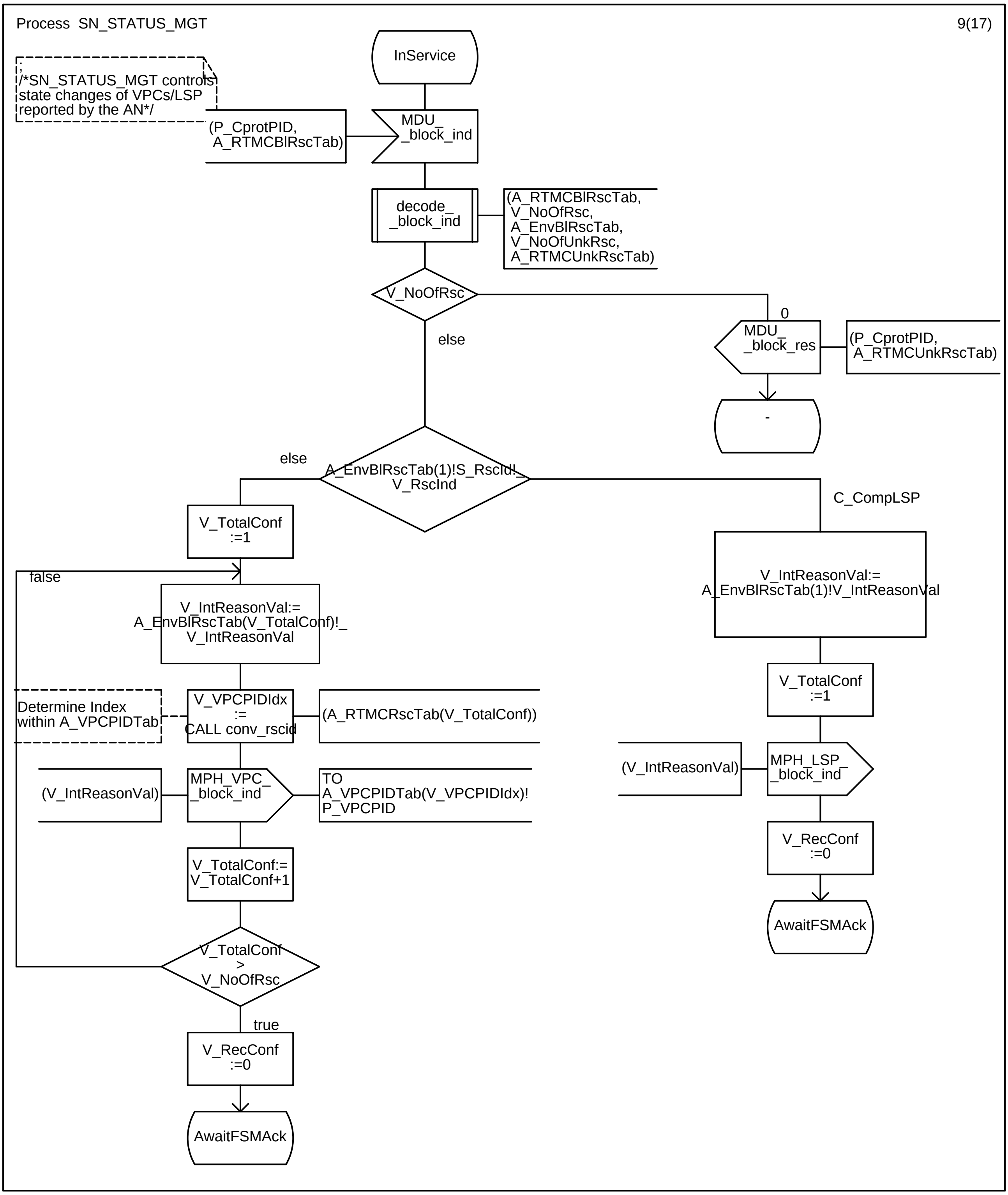


Figure A.126: SN_STATUS_MGT (9)

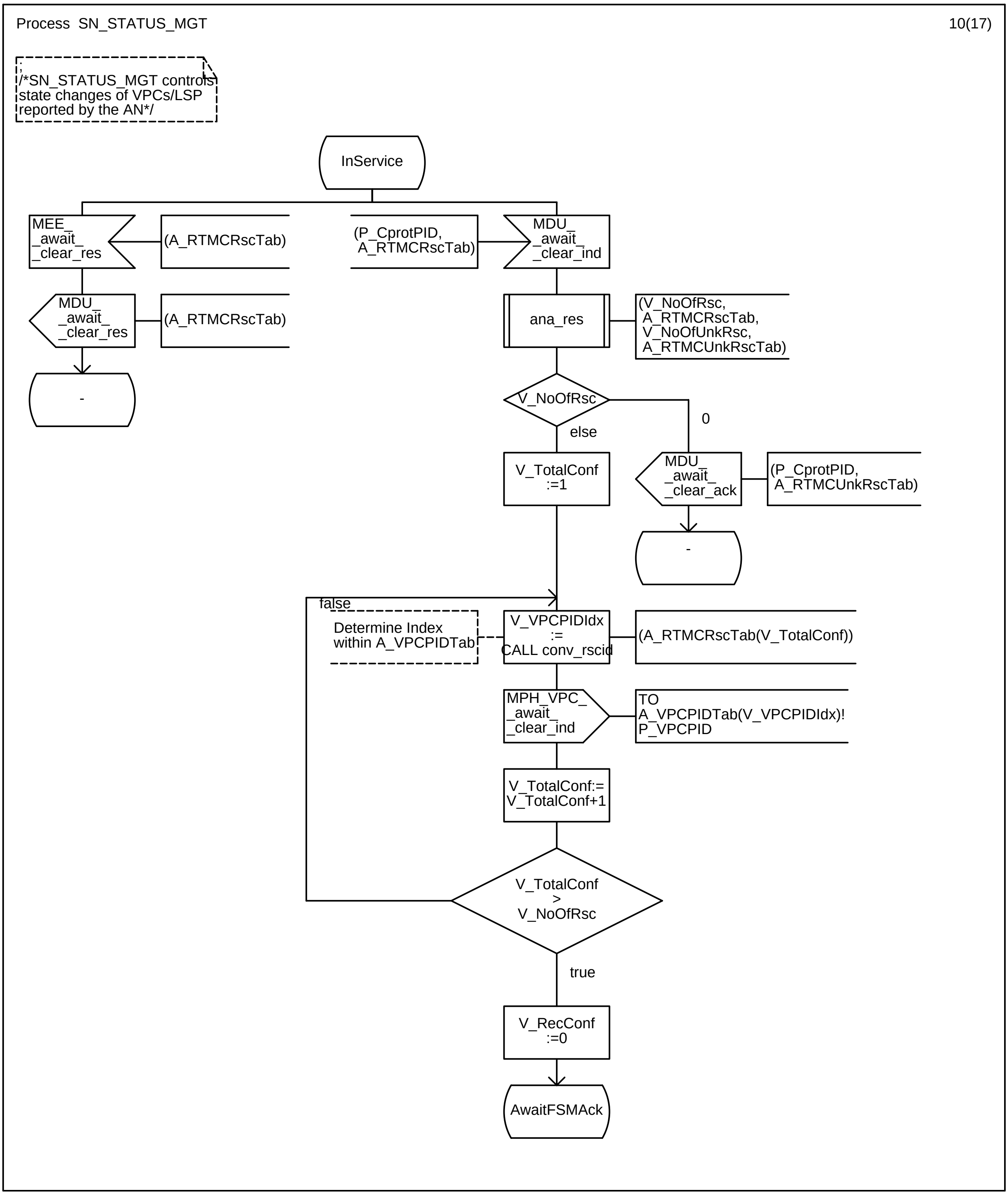


Figure A.127: SN_STATUS_MGT (10)

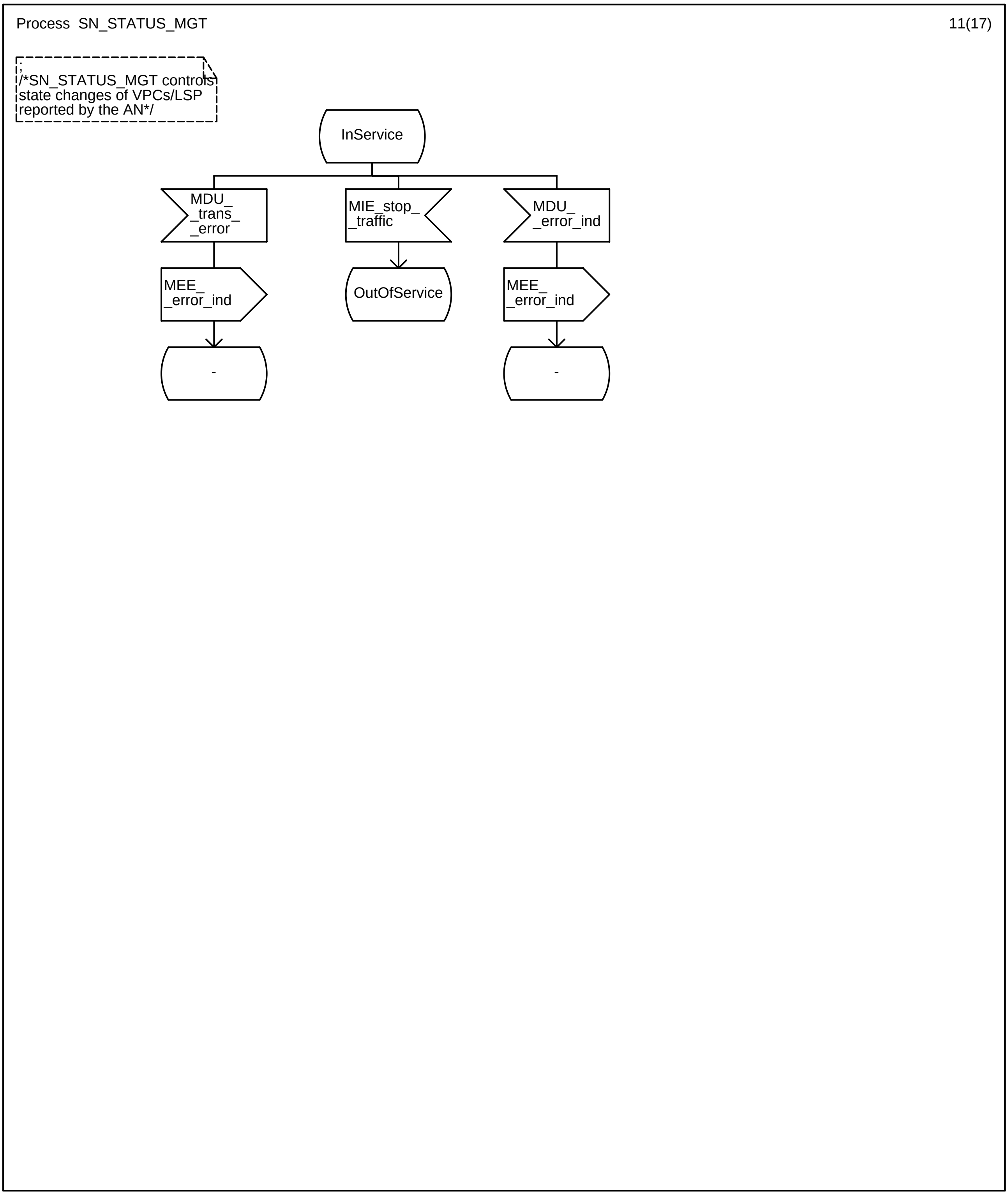


Figure A.128: SN_STATUS_MGT (11)

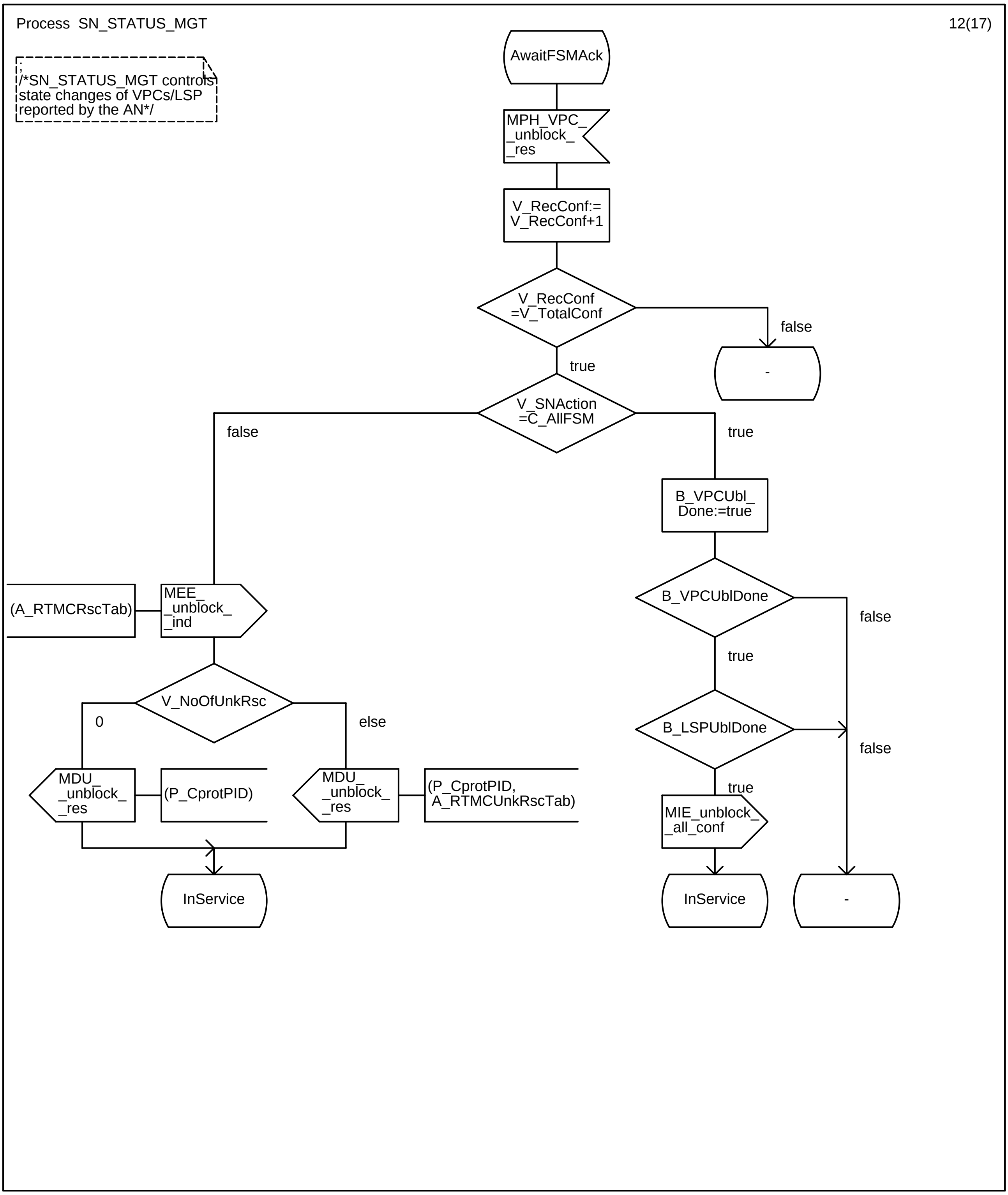


Figure A.129: SN_STATUS_MGT (12)

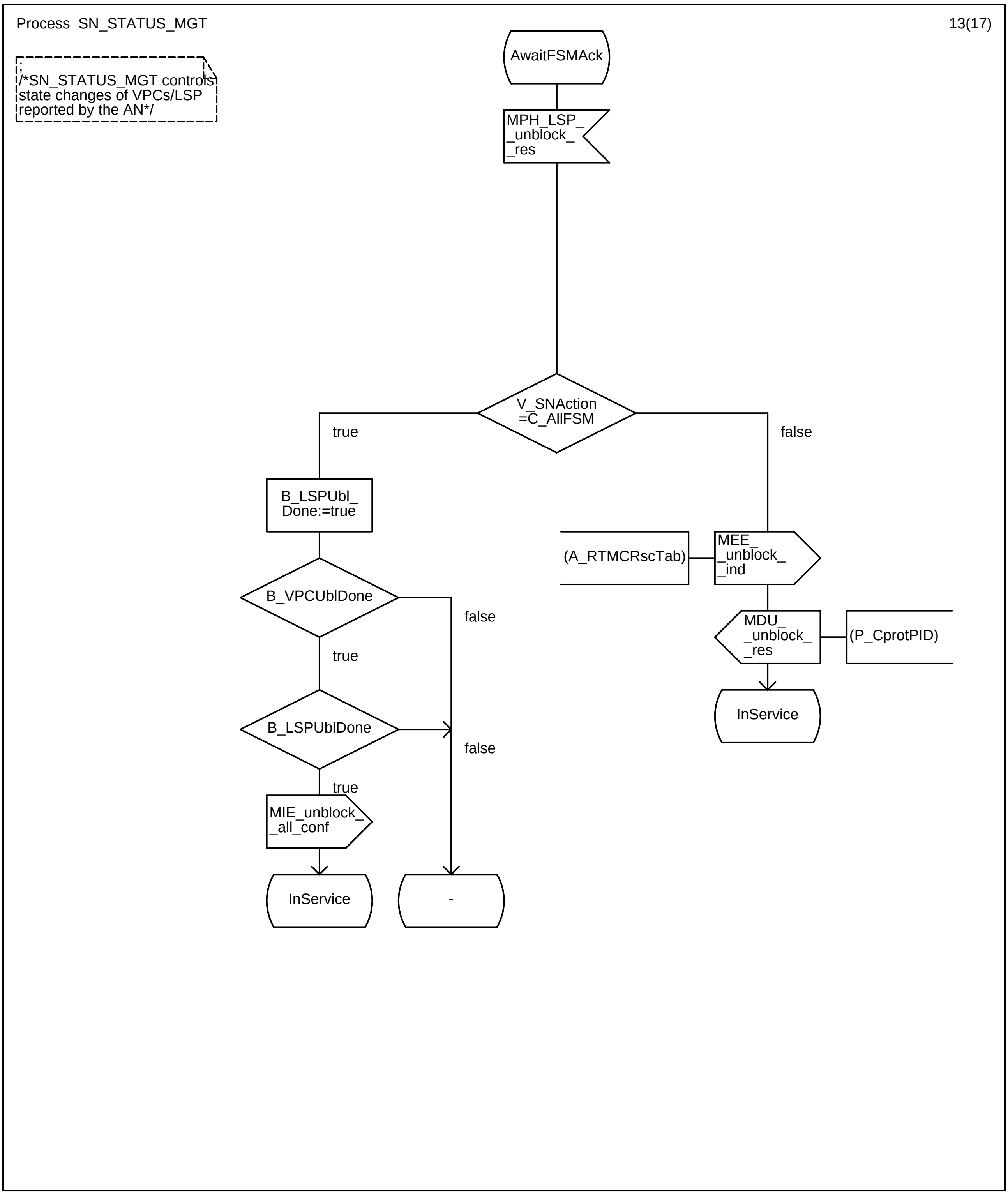


Figure A.130: SN_STATUS_MGT (13)

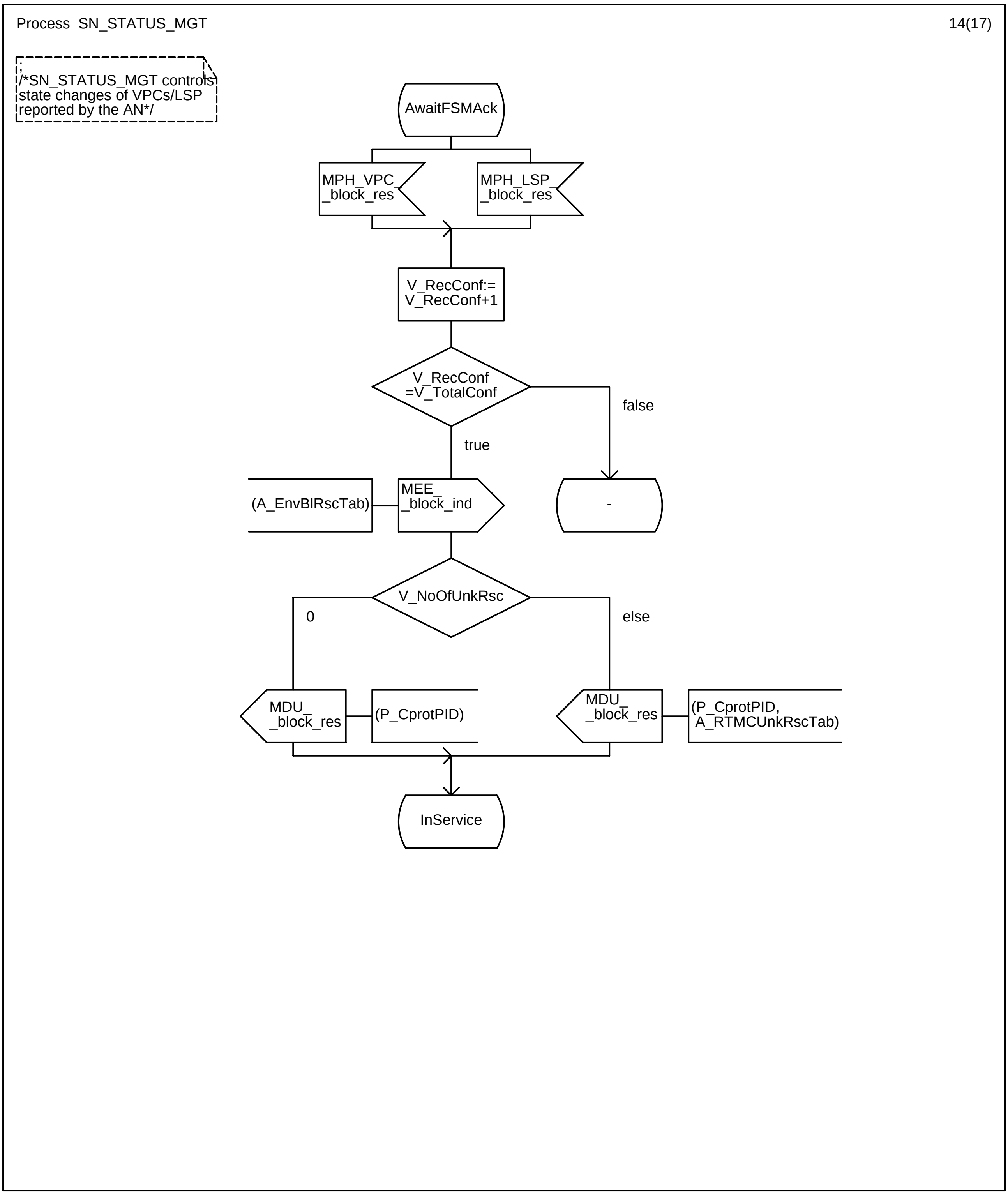


Figure A.131: SN_STATUS_MGT (14)

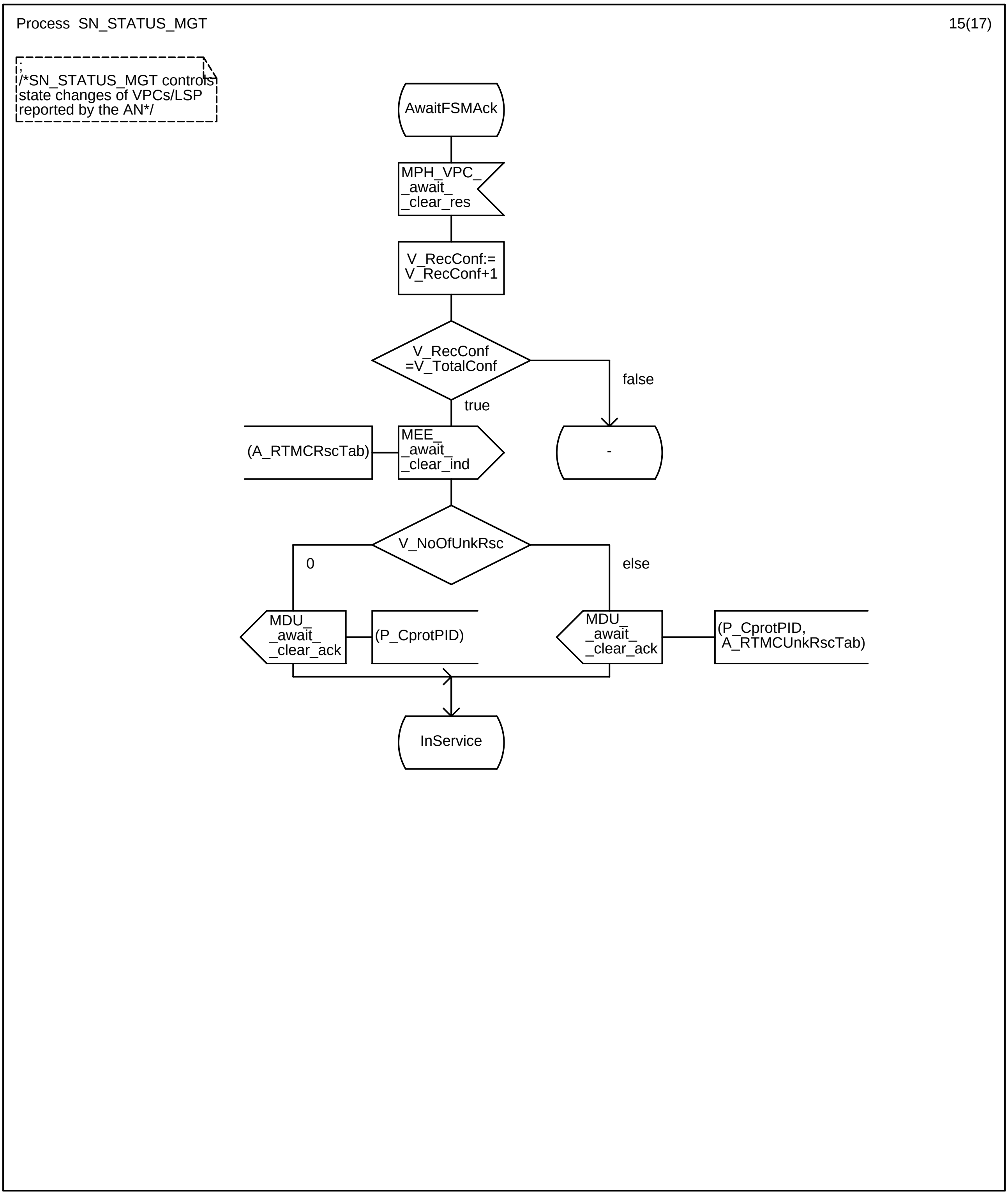


Figure A.132: SN_STATUS_MGT (15)

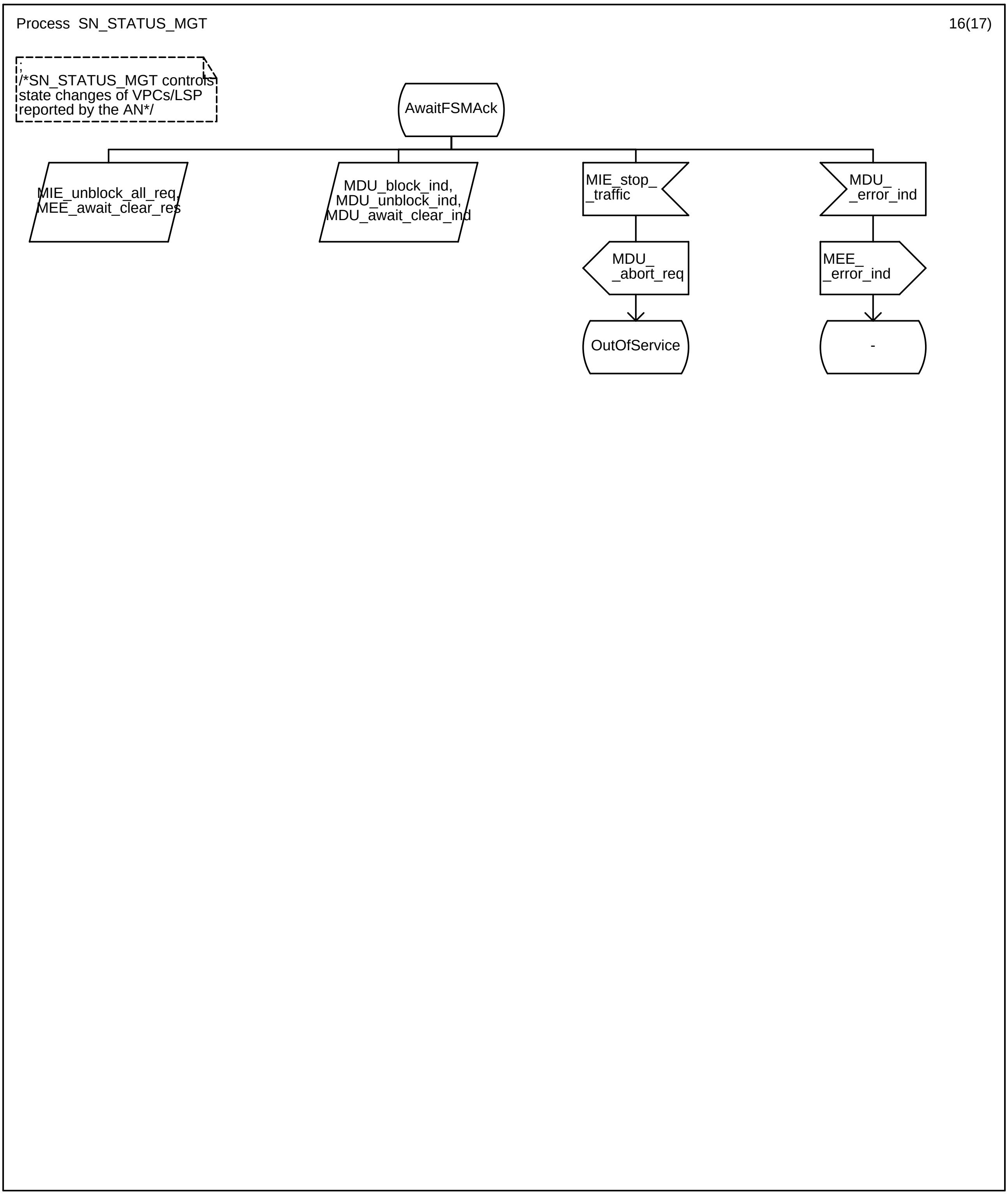


Figure A.133: SN_STATUS_MGT (16)

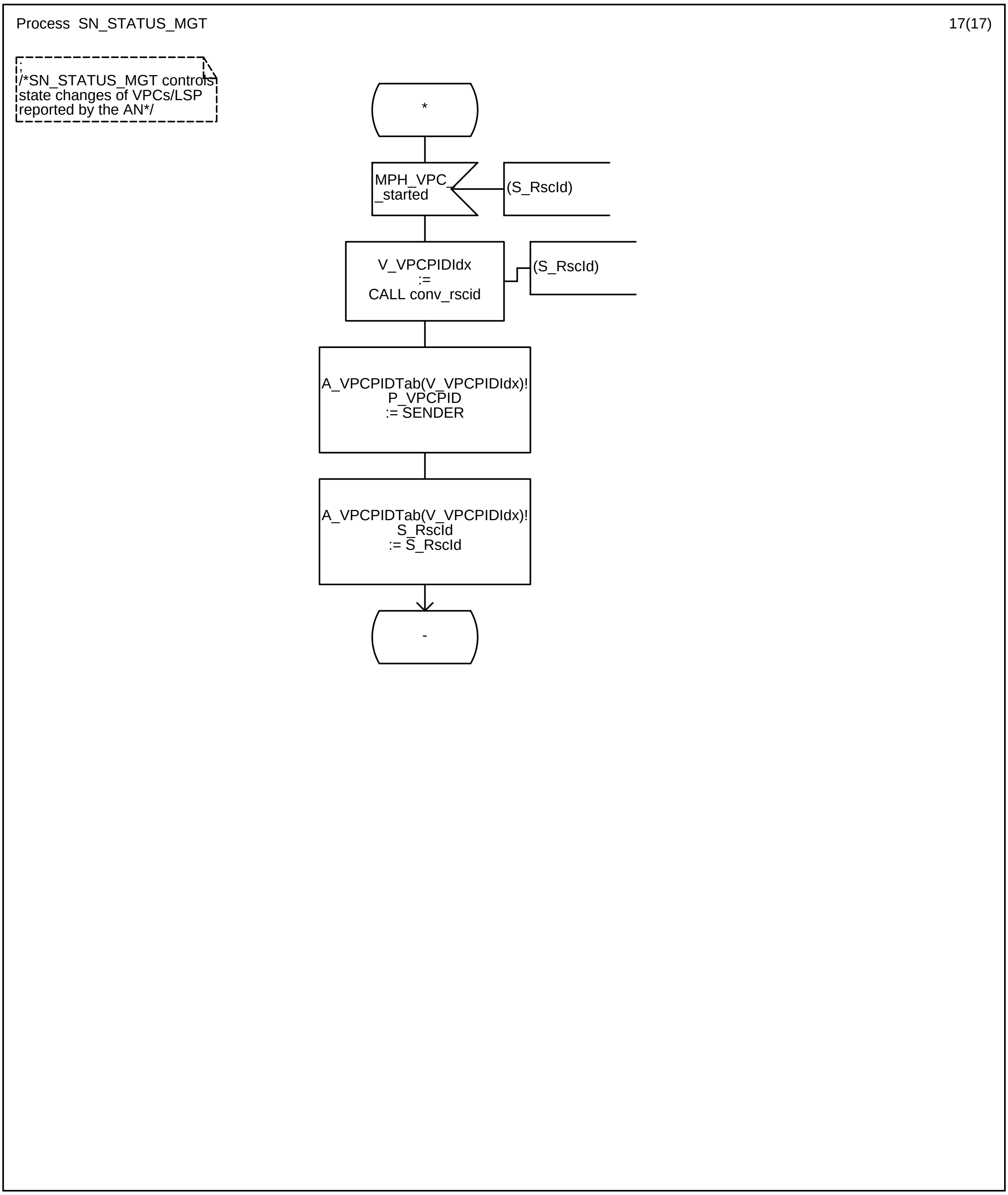


Figure A.134: SN_STATUS_MGT (17)

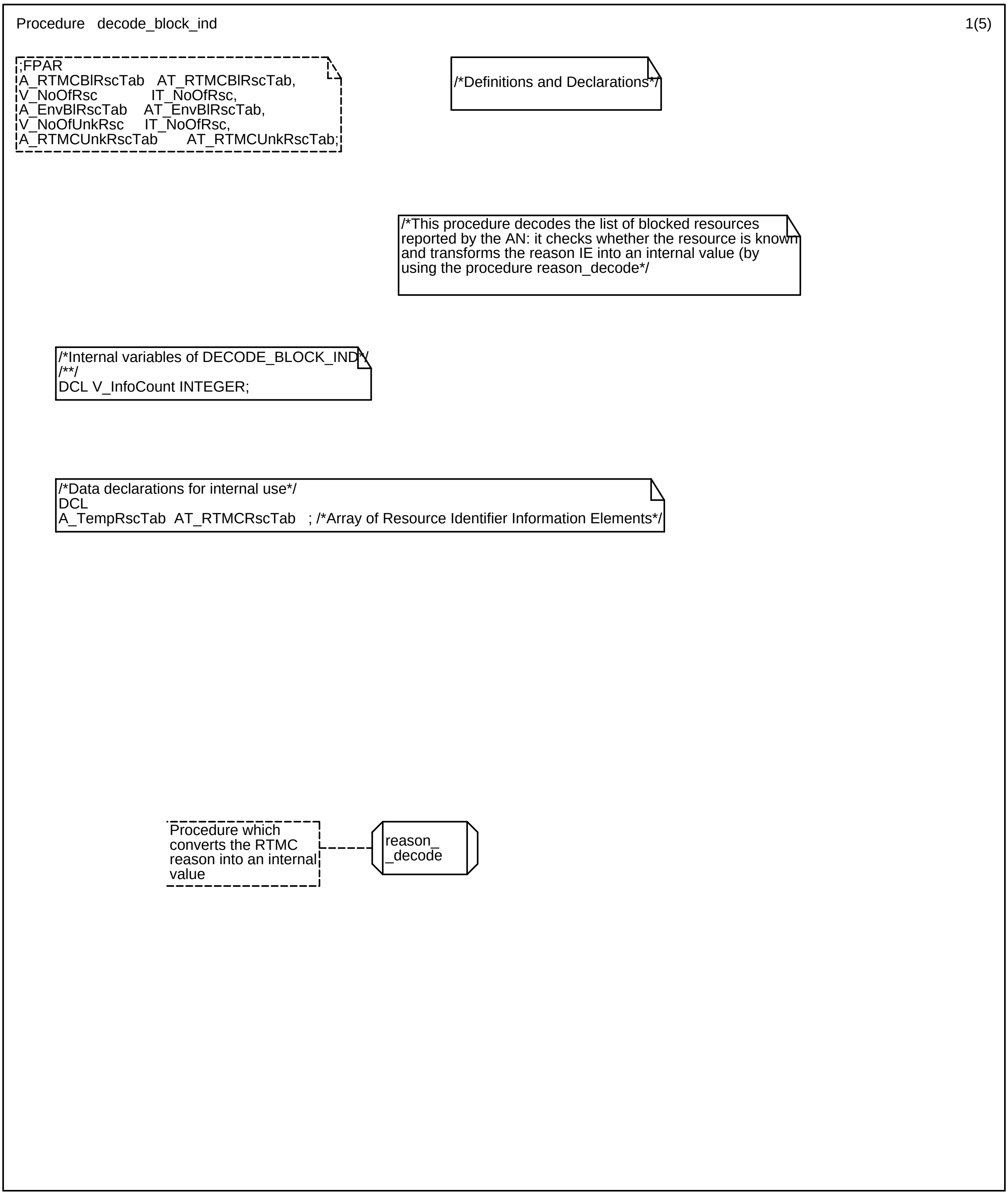


Figure A.135: SN_STATUS_MGT, Procedure DECODE_BLOCK_INDICATION (1)

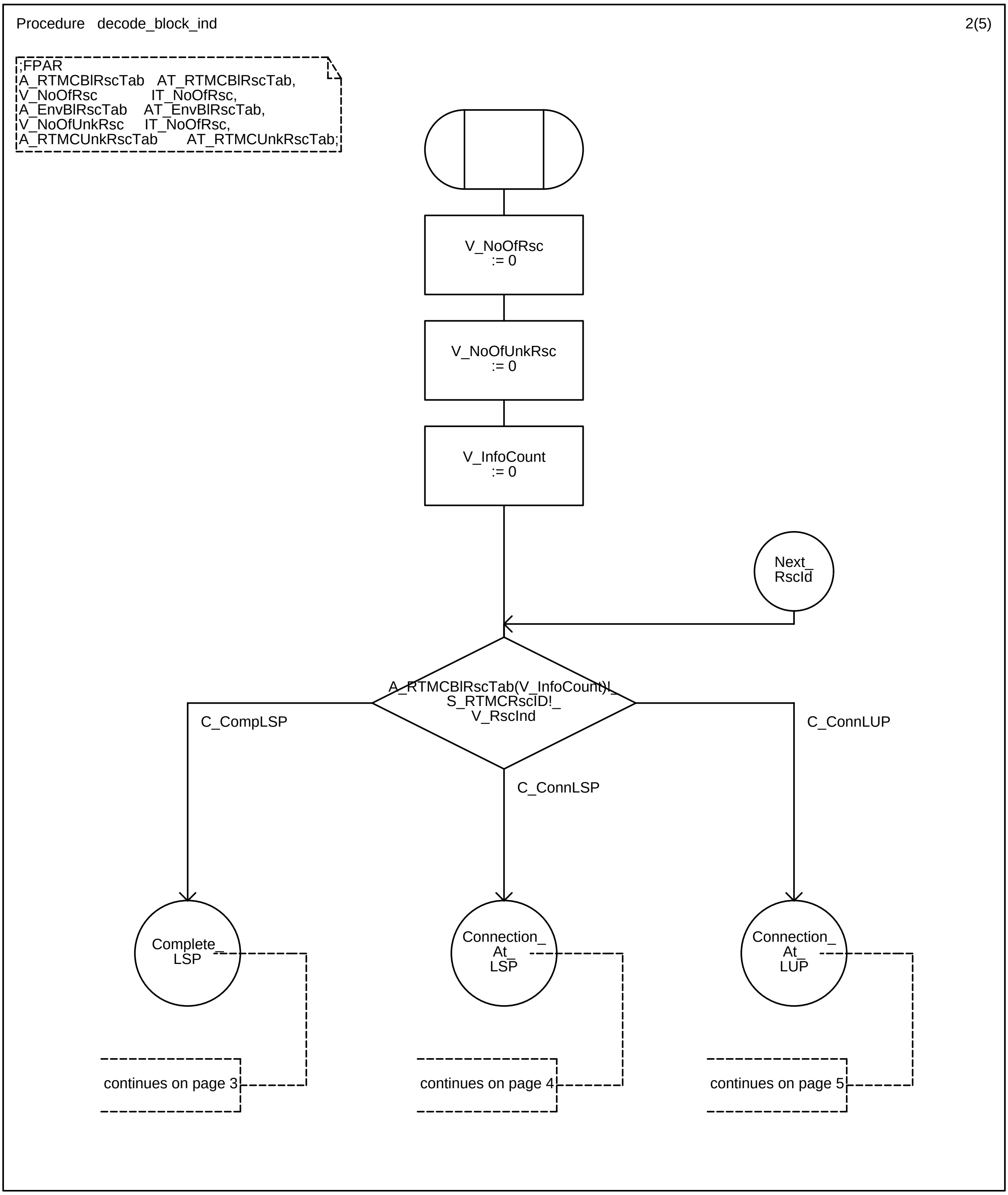


Figure A.136: SN_STATUS_MGT, Procedure DECODE_BLOCK_INDICATION (2)

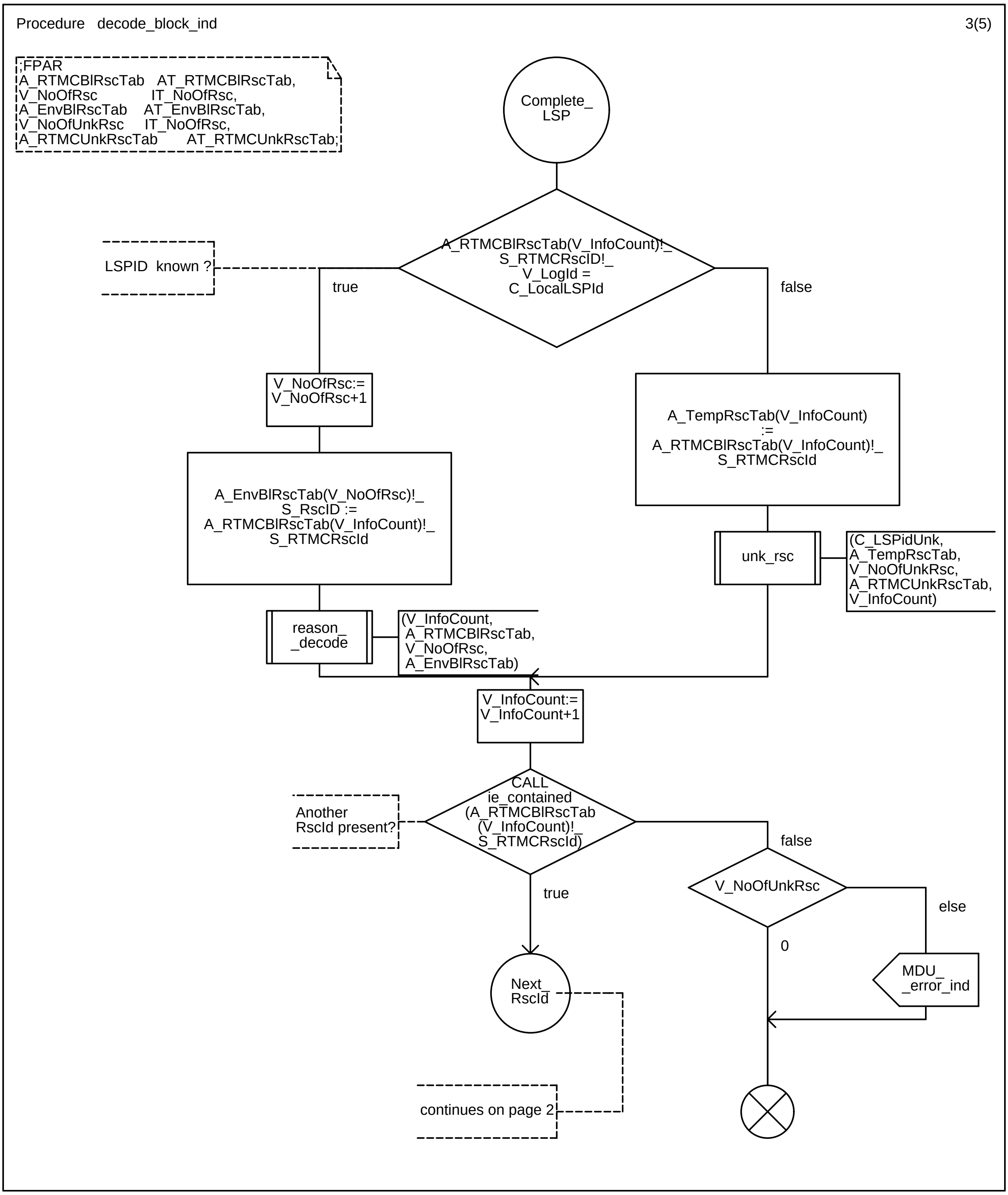


Figure A.137: SN_STATUS_MGT, Procedure DECODE_BLOCK_INDICATION (3)

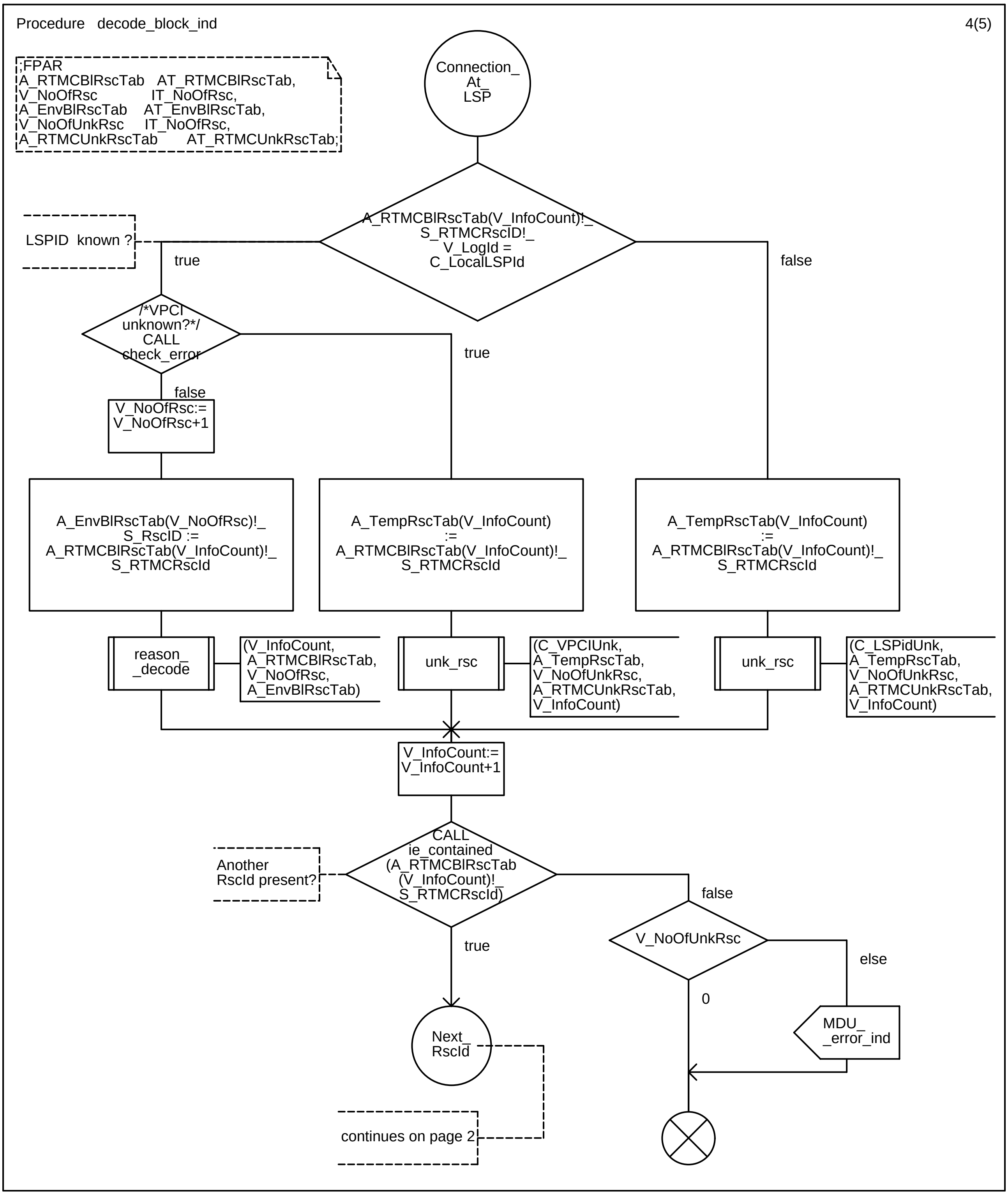


Figure A.138: SN_STATUS_MGT, Procedure DECODE_BLOCK_INDICATION (4)

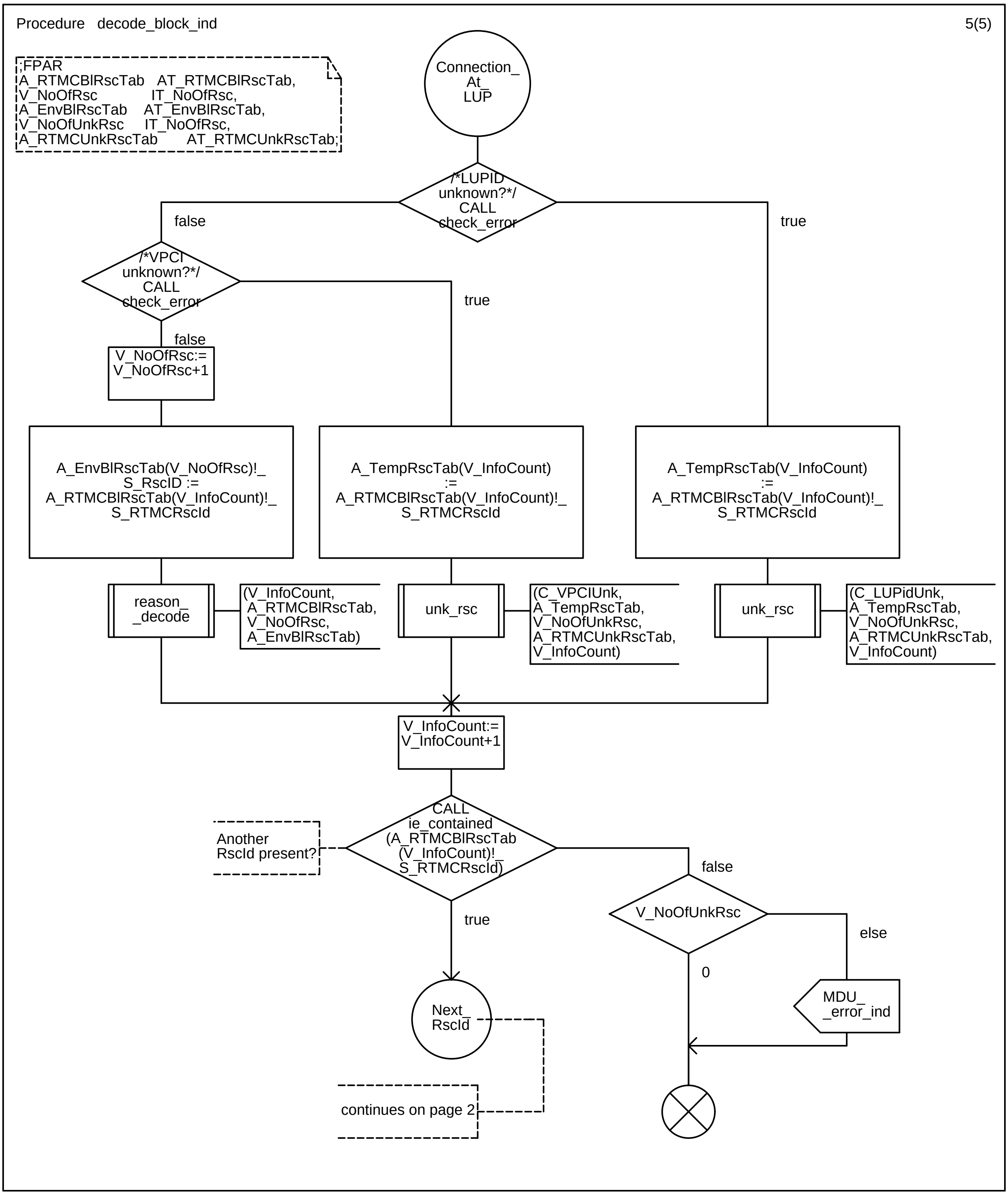


Figure A.139: SN_STATUS_MGT, Procedure DECODE_BLOCK_INDICATION (5)

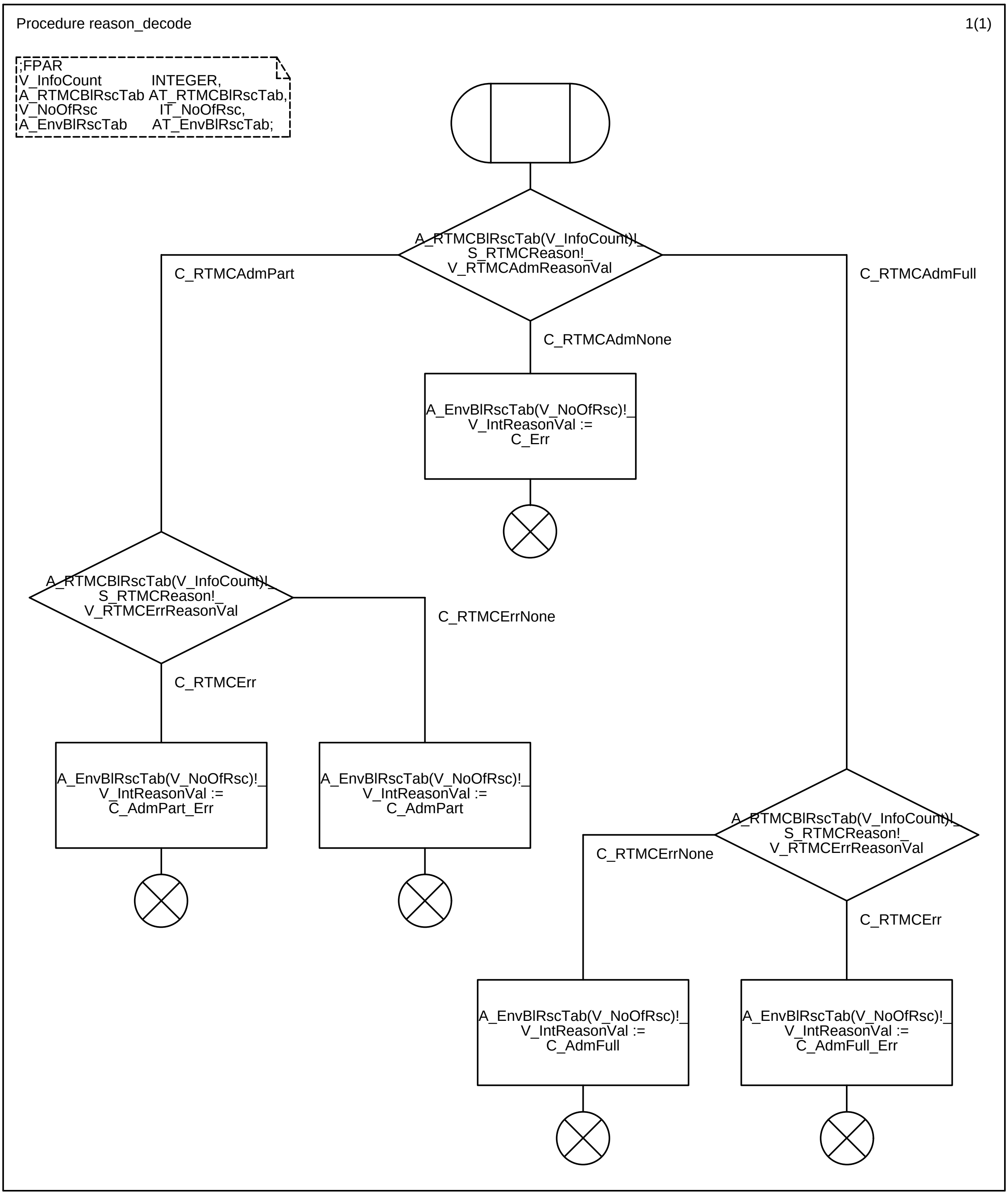


Figure A.140: SN_STATUS_MGT, Procedure REASON_DECODING

A.3.1.2 Process SN_VPCI_CC

Process SN_VPCI_CC 1(7)

/*VB5.1 System Management
Process SN_VPCI_CC
Applicable for SN side*/

/* Definitions and declarations
for process SN_VPCI_CC */

/*State descriptions
OutOfService: Initial state. Process is waiting for activation with start traffic.
InService: Process is waiting for request for VPCI consistency check
AwaitCheckStart: Process is waiting for confirmation from AN side.
CheckRunning: Loop Back will be sent requested VPCI. Process is waiting for end of VPCI check.
AwaitCheckEnd: Process is waiting for confirmation of check end from AN side. */

/*Signal data declarations*/
DCL
S_RTMCRscId ST_RTMCRscID; /*Resource Identifier Information Element*/
/**/
DCL
S_RTMCUnkRscId ST_RTMCUnkRscID; /*Resource Identifier Information Element*/
/**/
DCL
V_RTMCCCheckResult IT_RTMCCCheckResult; /*Consistency Check Result*/

Figure A.141: SN_VPCI_CC (1)

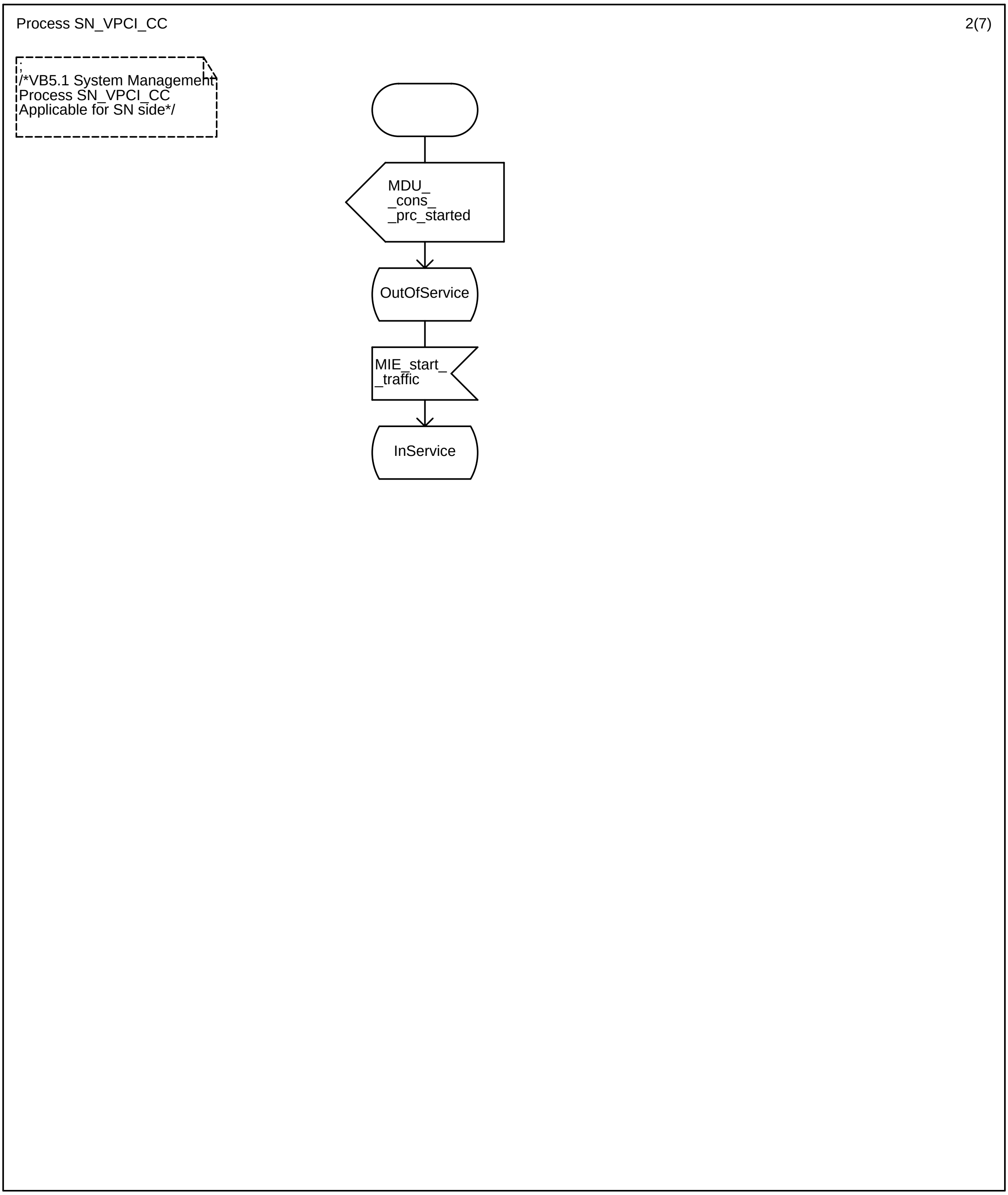


Figure A.142: SN_VPCI_CC (2)

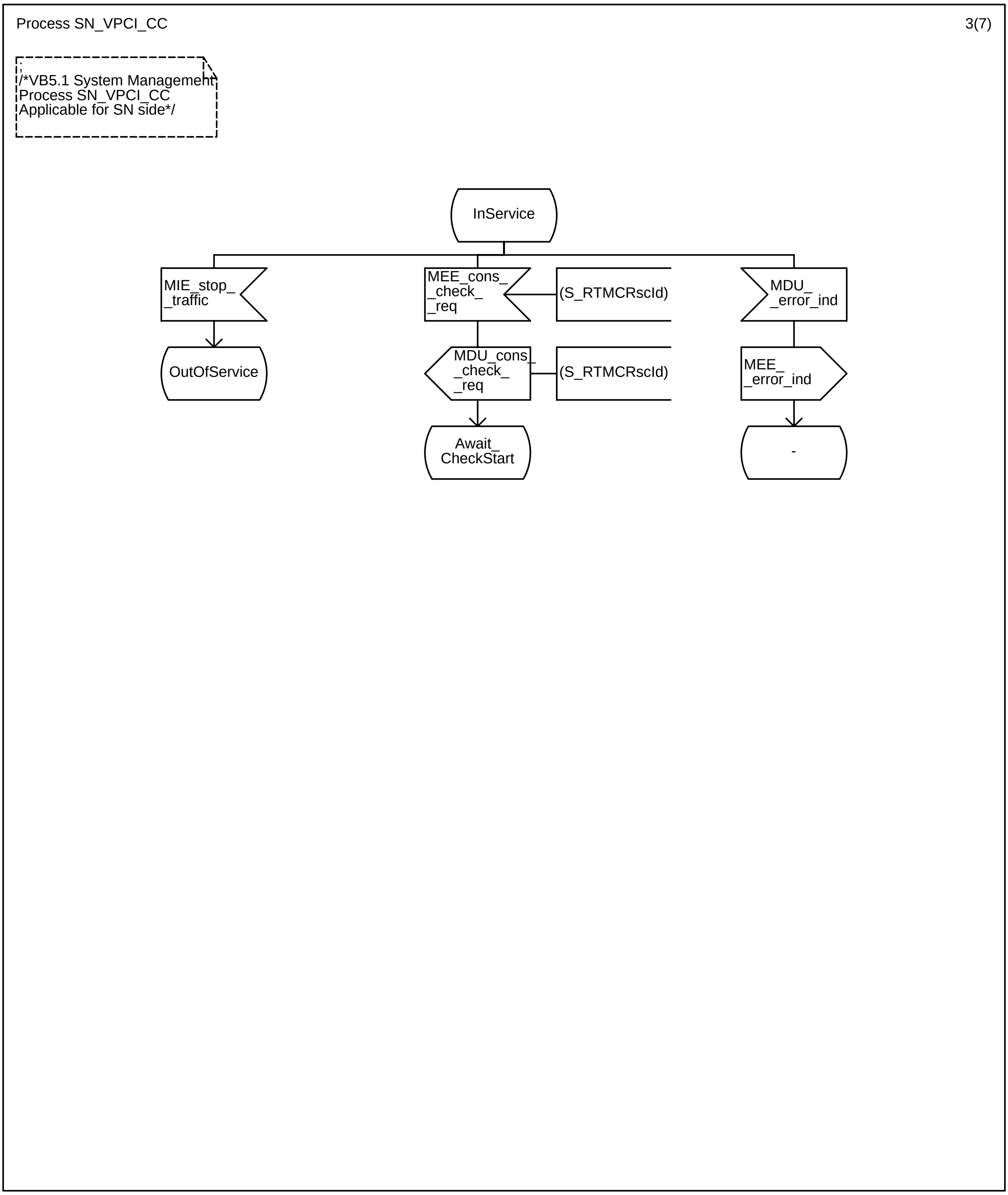


Figure A.143: SN_VPCI_CC (3)

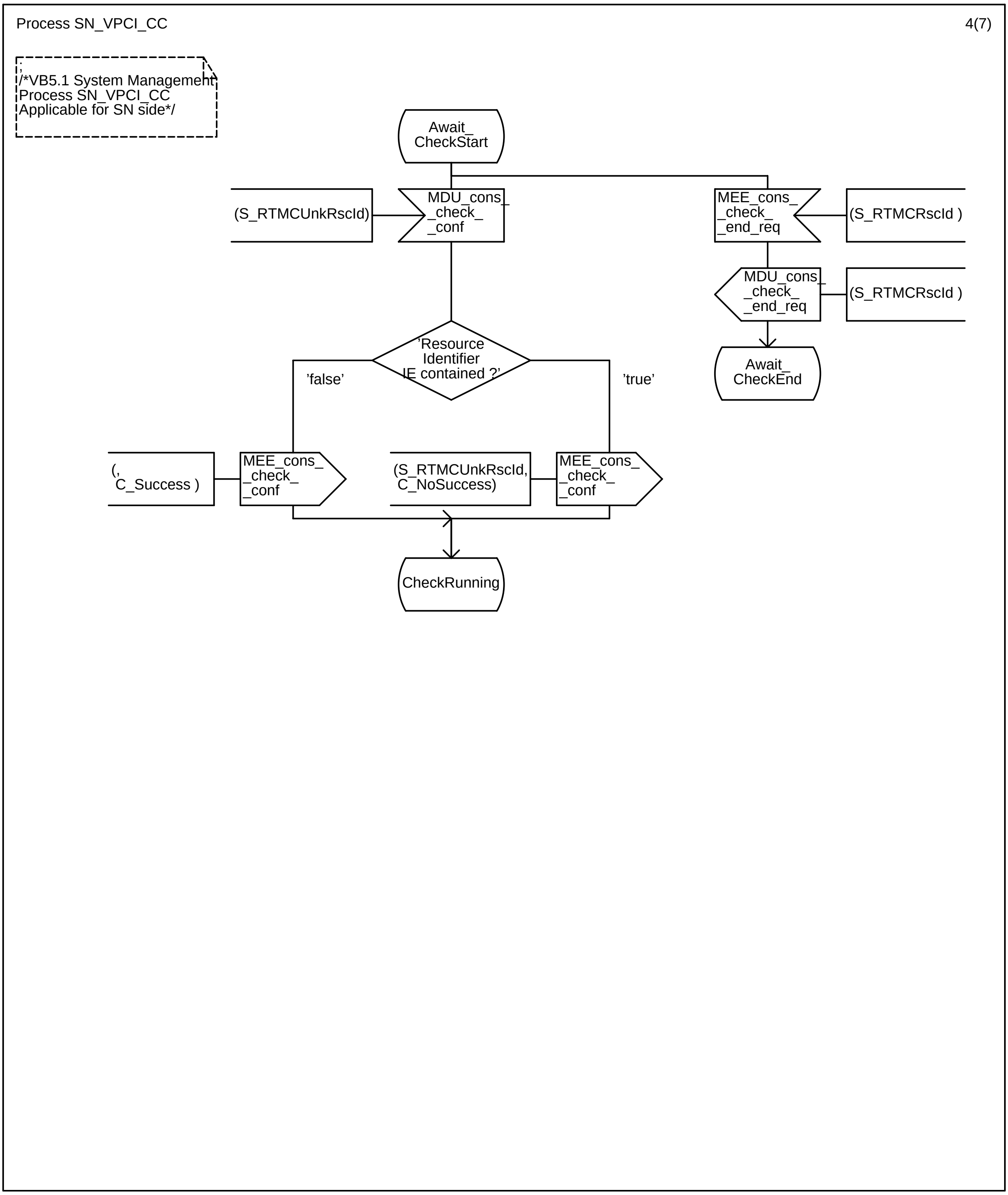


Figure A.144: SN_VPCI_CC (4)

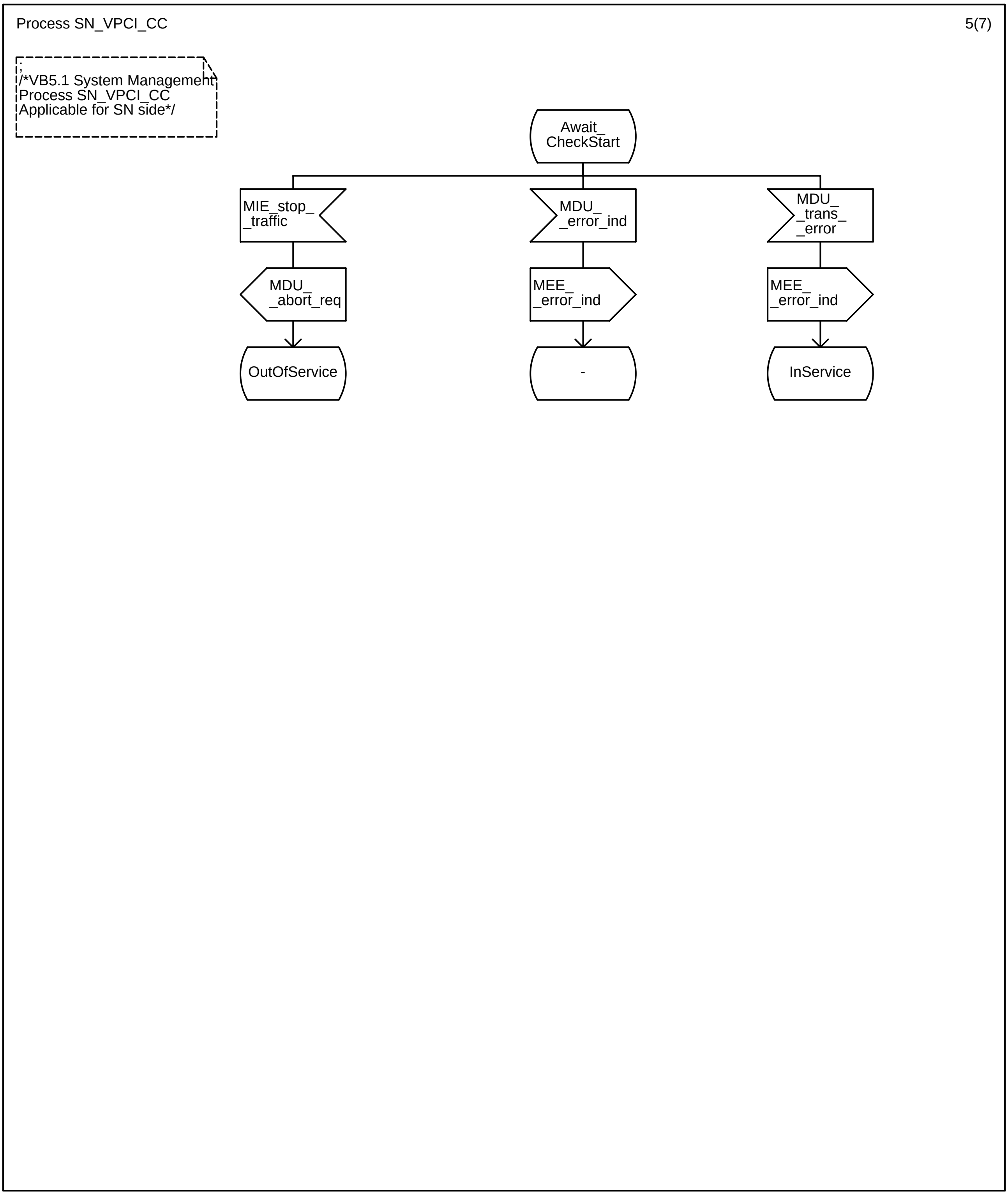


Figure A.145: SN_VPCI_CC (5)

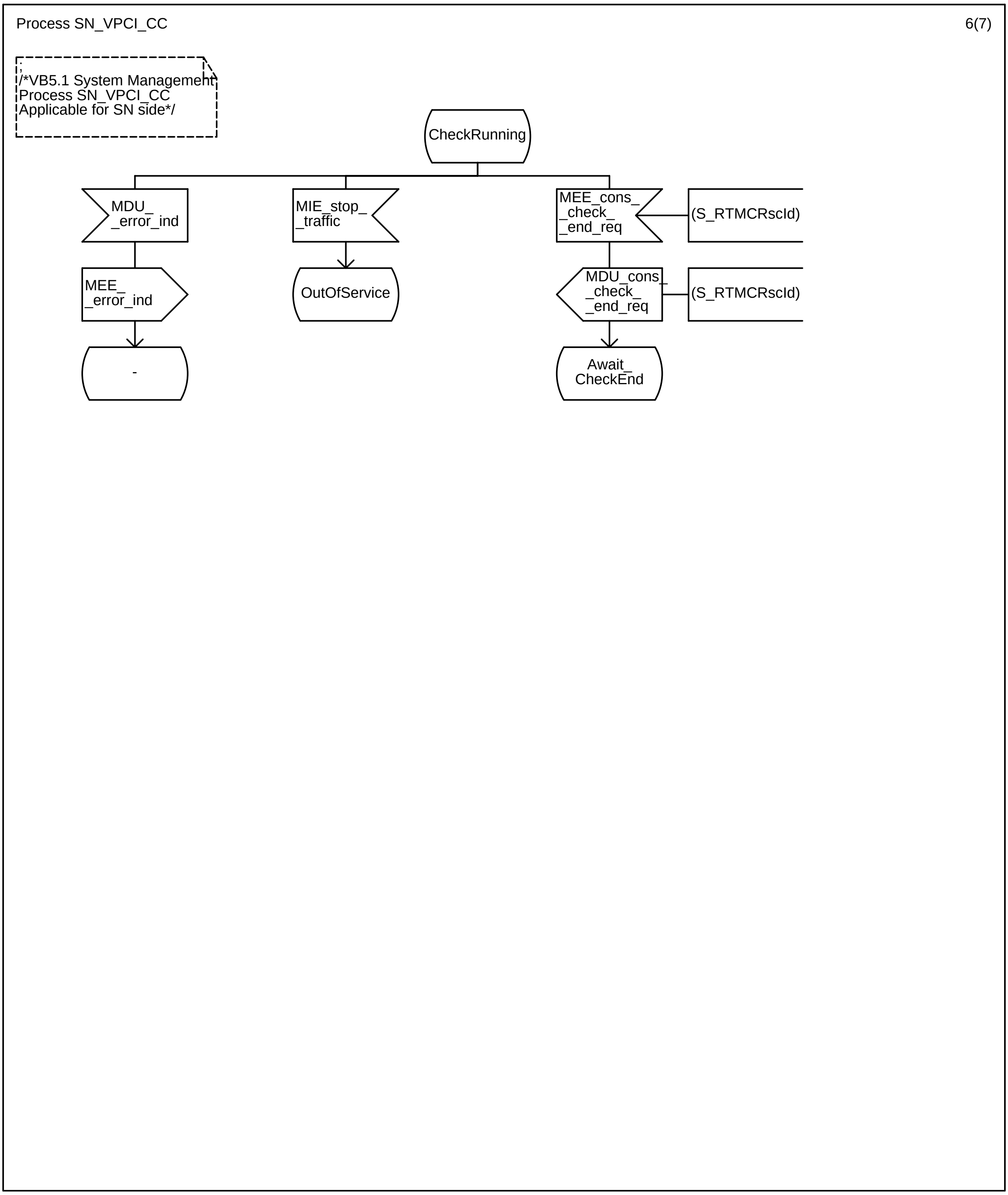


Figure A.146: SN_VPCI_CC (6)

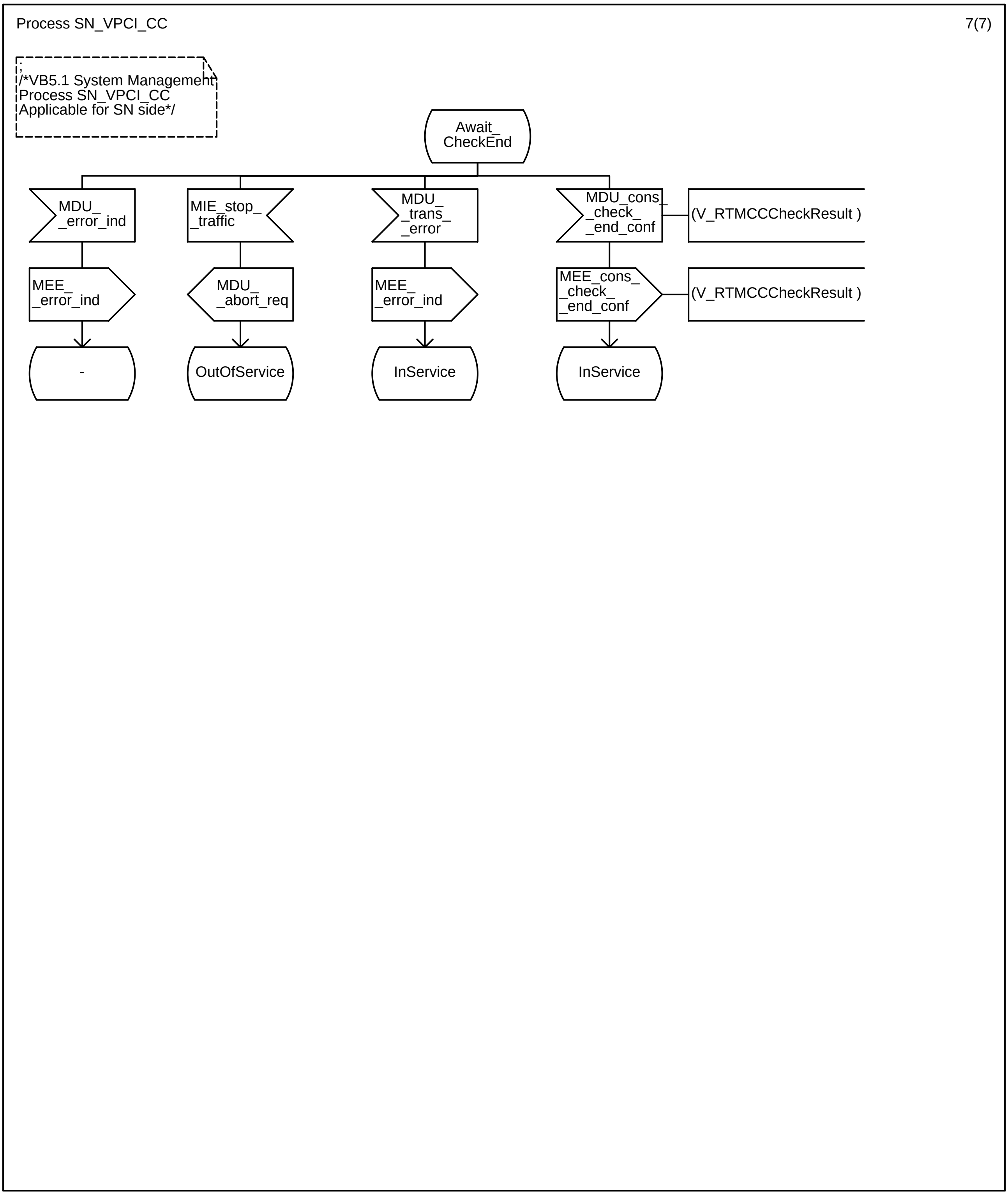


Figure A.147: SN_VPCI_CC (7)

A.3.2 Process SN_LSPSTAT

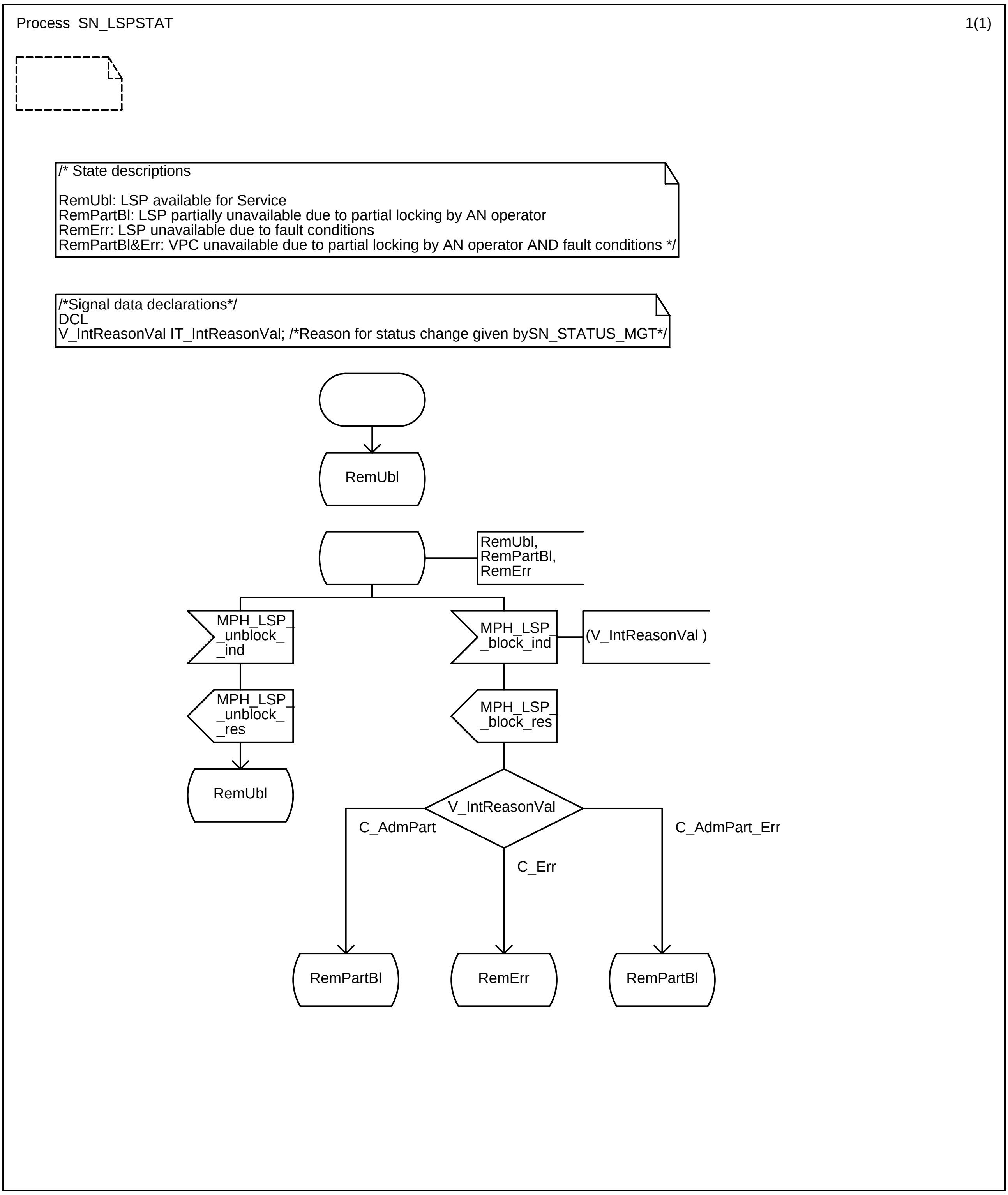


Figure A.148: SN_FLSPSTAT

A.3.3 Process SN_FVPCSTAT

Process SN_FVPCSTAT 1(2)

/* State descriptions

RemUbl: VPC available for Service
RemFullBl: VPC unavailable for service due to locking by AN operator
RemPartBl: VPC partially unavailable due to partial locking by AN operator
RemErr: VPC unavailable due to fault conditions
RemFullBl_Err: VPC unavailable due to locking by AN operator AND fault conditions
RemPartBl_Err: VPC unavailable due to partial locking by AN operator AND fault conditions
RemShutDown: Shutting Down of VPC was requested by AN operator */

/*Signal data declarations*/
DCL
V_IntReasonVal IT_IntReasonVal; /*Reason for status change given bySN_STATUS_MGT*/
/**/
/*Resource Identifiers allocated to SN_FVPCSTAT processes*/
DCL S_SNOwnRscId ST_RTMCRscId := C_OwnRscId;

Figure A.149: SN_FVPCSTAT (1)

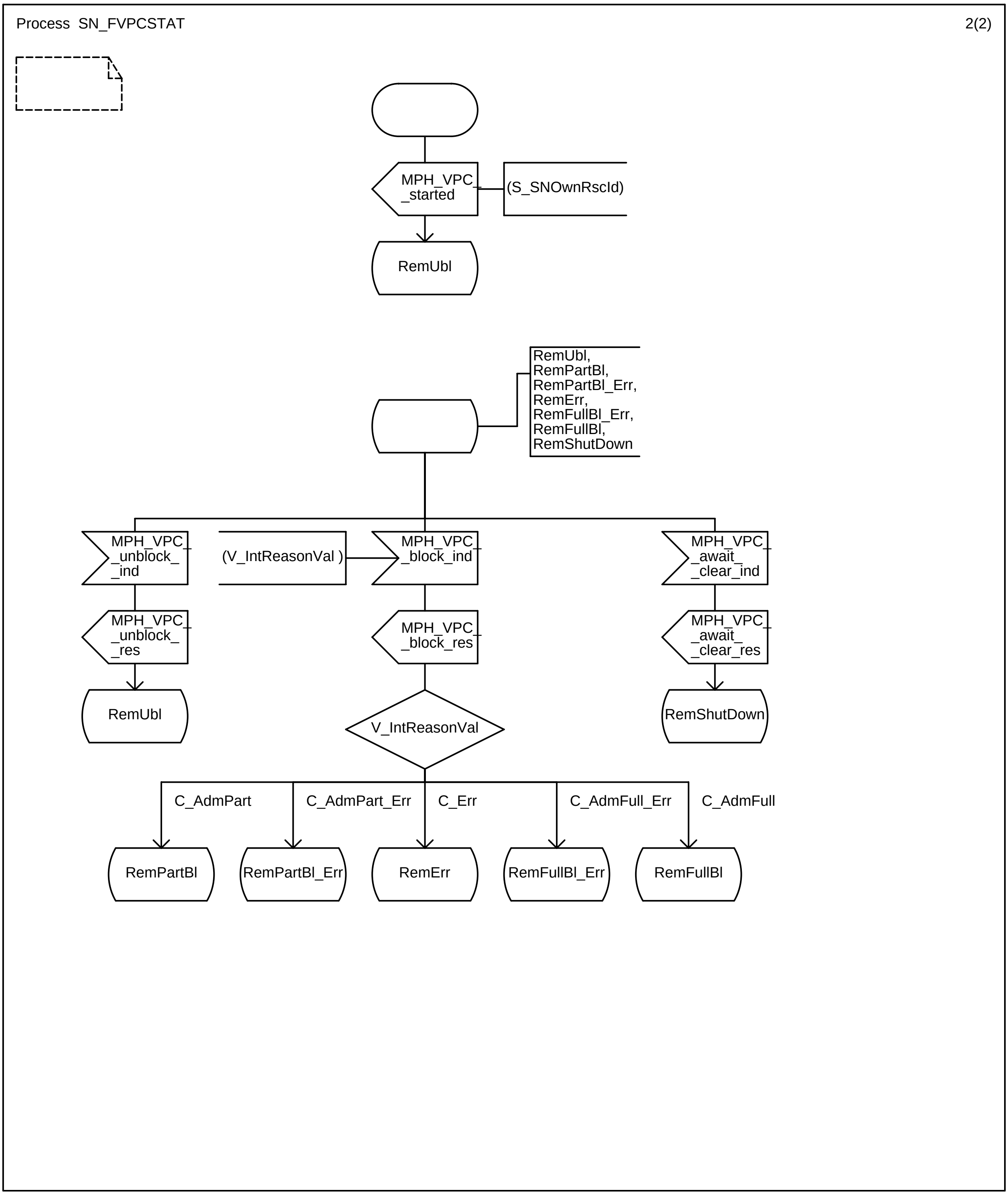


Figure A.150: SN_FVPCSTAT (2)

A.3.4 Processes of RTMC protocol entity

A.3.4.1 Process SN_MGR_CPROT

Process SN_MGR_CPROT 1(16)

```
/*SN_CPROT Manager, controls
instantiation of SN_CPROT
processes*/
```

```
NEWTYPE AT_PIDTab ARRAY /*This array maps the PID of the SN_CPROT instance on the PID of the requesting system management process*/
   (PID, PID)
ENDNEWTYPE AT_PIDTab;
```

```
/*Primitive Data Declarations*/
DCL
A_RTMCBlRscTab AT_RTMCBlRscTab;
/**/
DCL
A_RTMCRscTab AT_RTMCRscTab;
/**/
DCL
A_RTMCUnkRscTab AT_RTMCUnkRscTab;
/**/
DCL
S_RTMCRscId ST_RTMCRscID;
/**/
DCL
S_RTMCUnkRscId ST_RTMCUnkRscID;
/**/
DCL
V_RTMCCCheckResult IT_RTMCCCheckResult;
/**/
DCL
V_IntTransId IT_IntTransActId;
/**/
DCL
P_StatusPID,    /*PID of AN_STATUS_MGT process*/
P_ResetPID,     /*PID of RESET_RSC process*/
P_ConsPID,      /*PID of AN_CONS process*/
P_LSPIdPID,     /*PID ofCHECK_LSPID process*/
P_CprotPID,     /*PID of SN_CPROT process instance*/
P_ANSigId,      /*PID of AN_CPROT process instance*/
P_DestSigId,  /*PID of destination process instance*/
P_OrigSigId     /*PID of origination process instance*/
PID;
/**/
DCL
A_PIDTab AT_PIDTab;
```

Figure A.151: SN_MGR_CPROT (1)

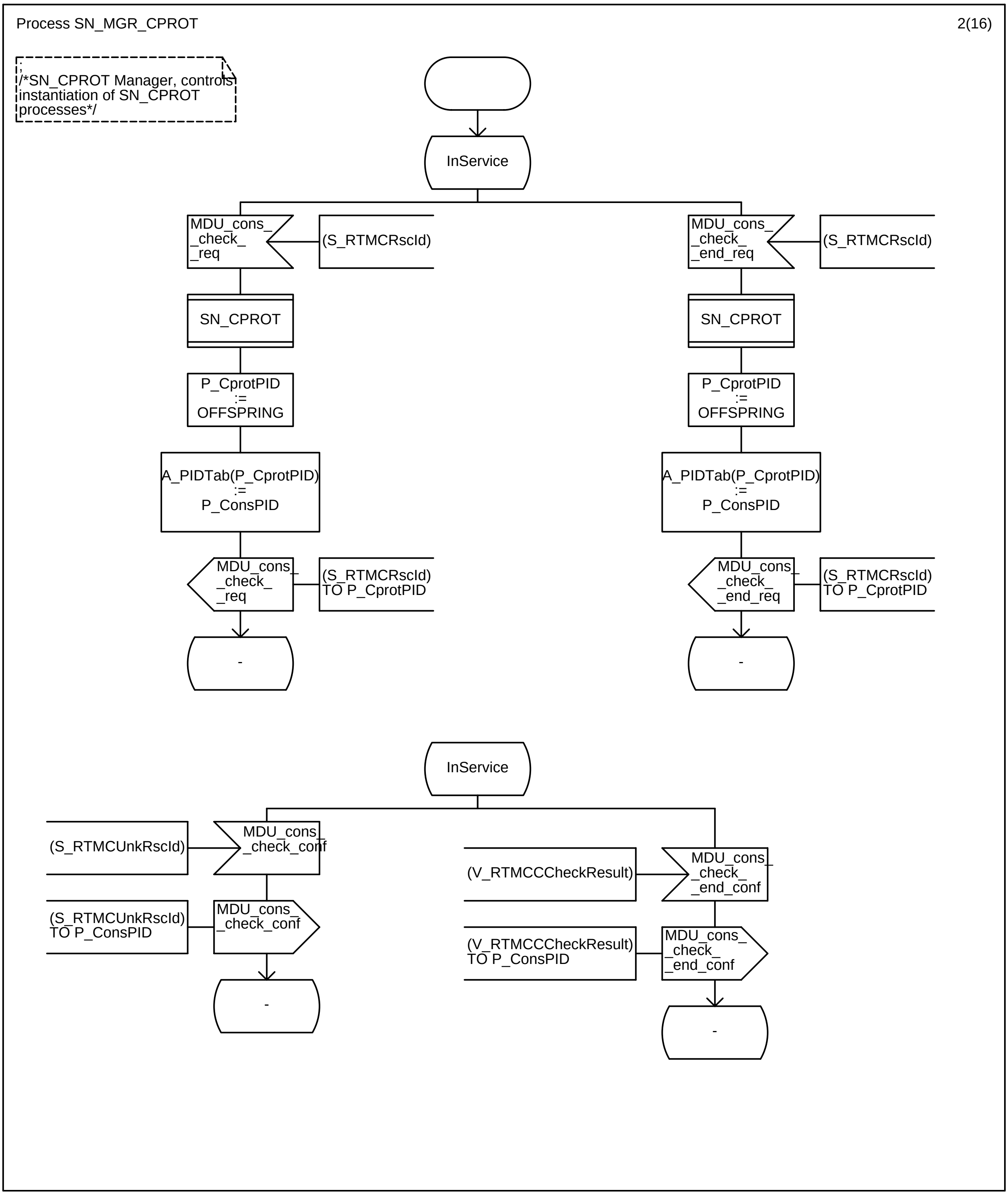


Figure A.152: SN_MGR_CPROT (2)

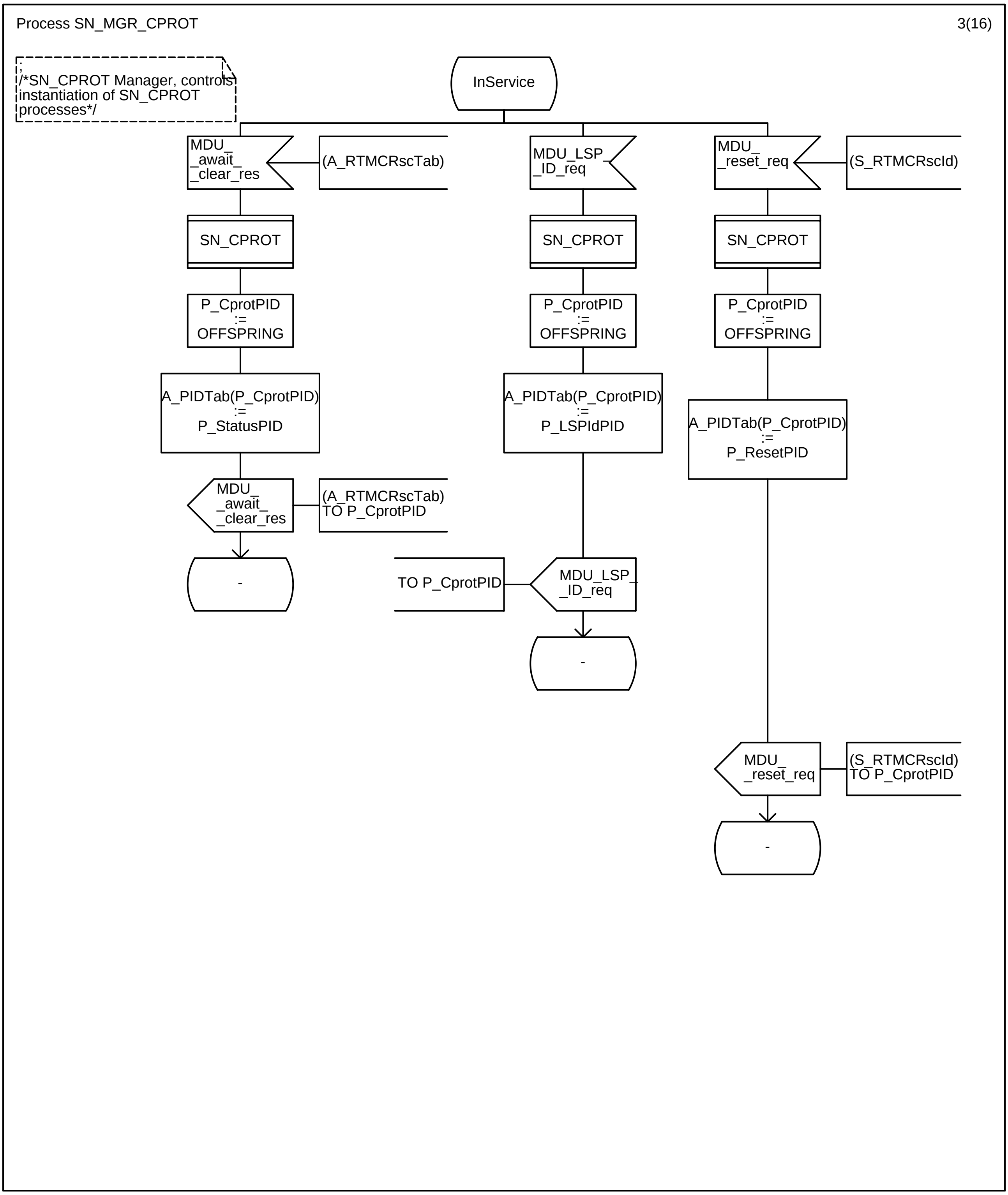


Figure A.153: SN_MGR_CPROT (3)

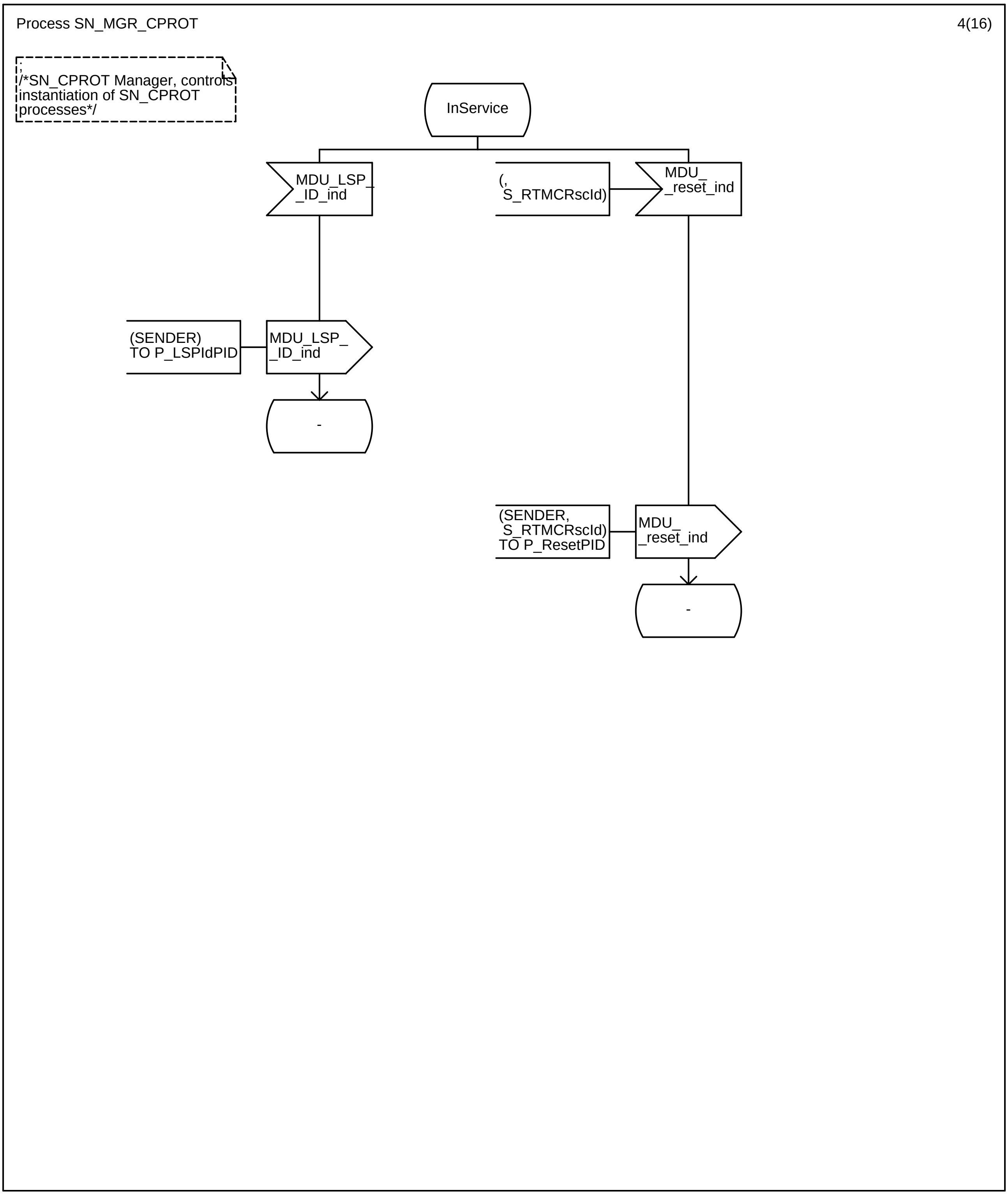


Figure A.154: SN_MGR_CPROT (4)

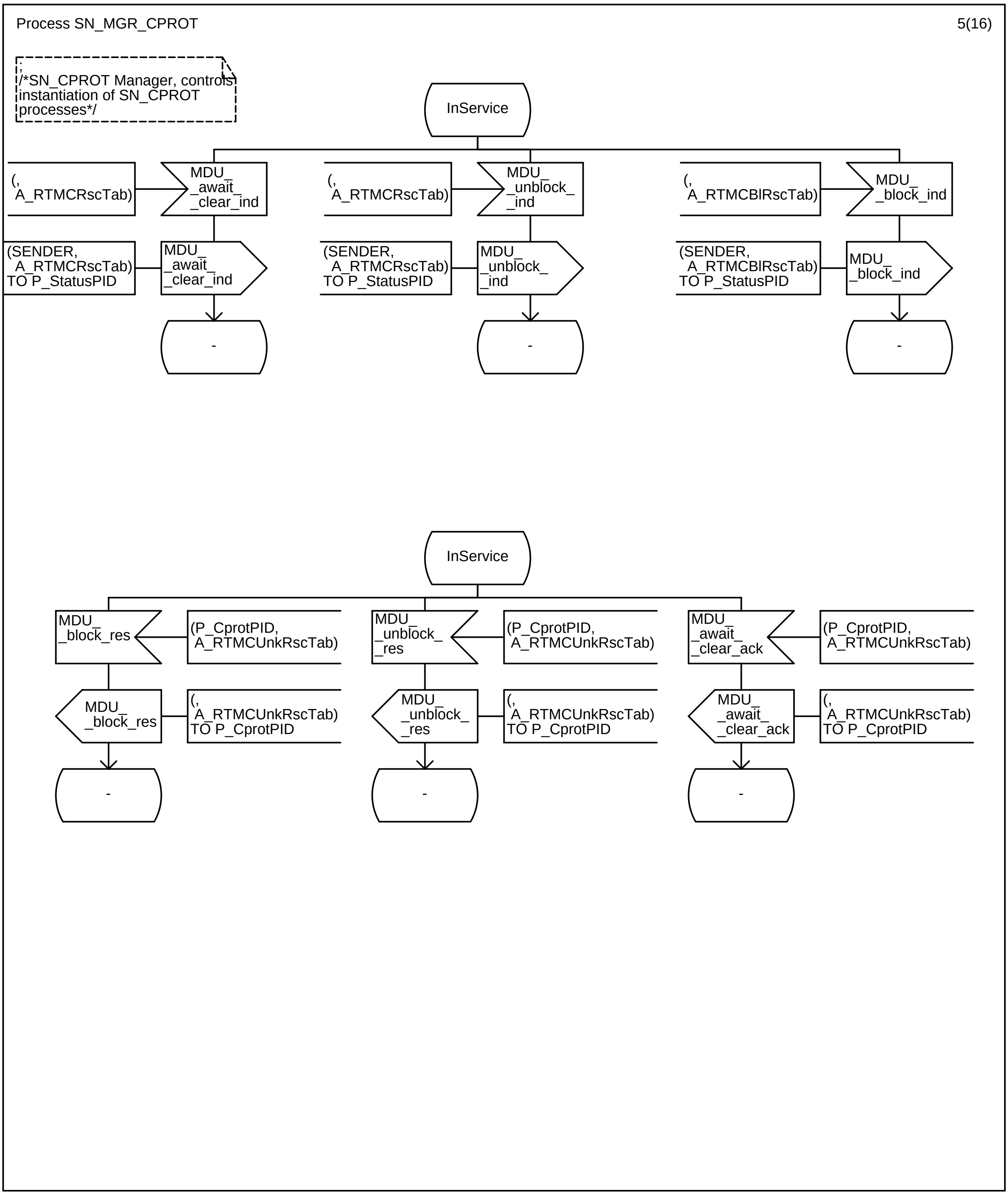


Figure A.155: SN_MGR_CPROT (5)

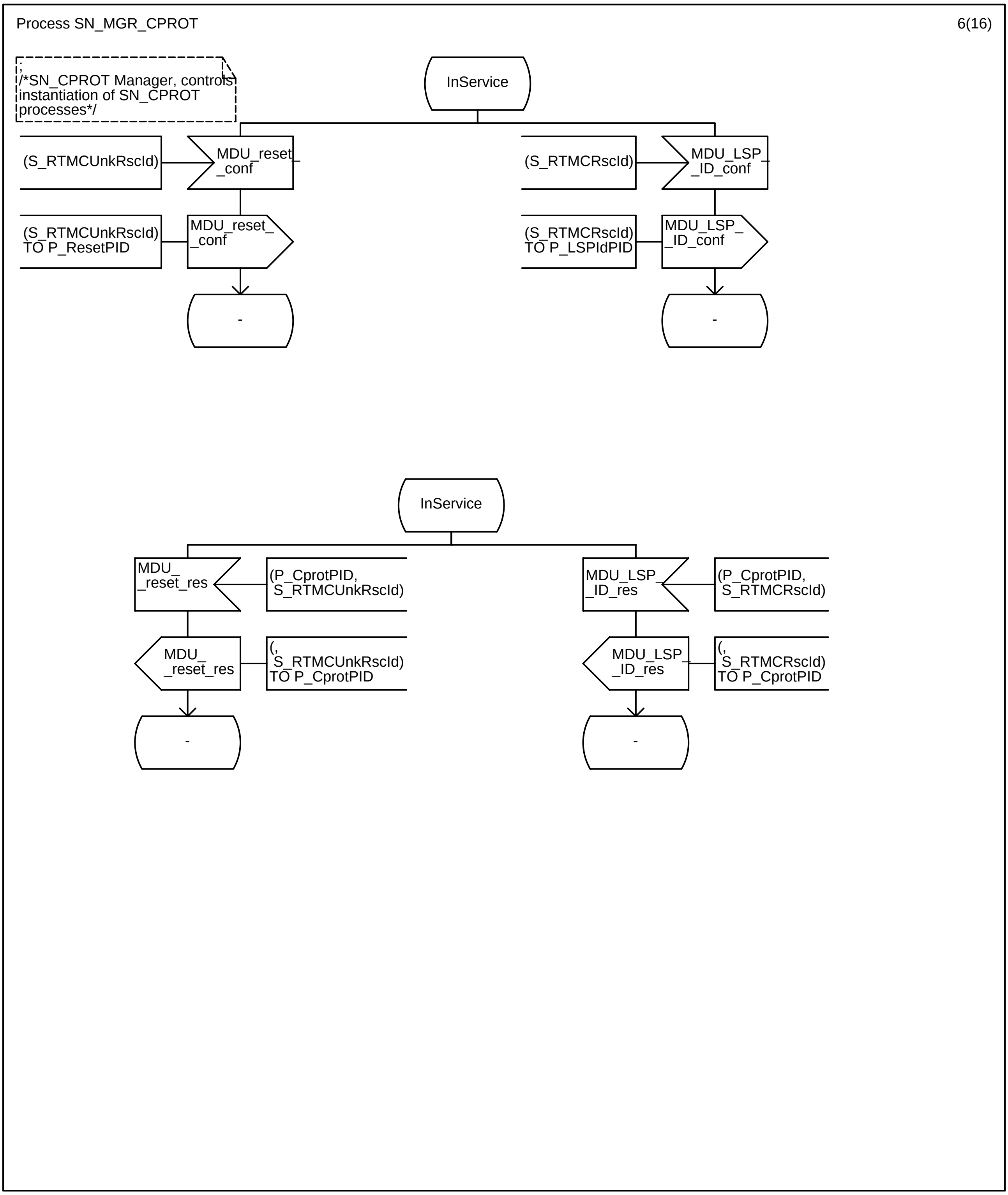


Figure A.156: SN_MGR_CPROT (6)

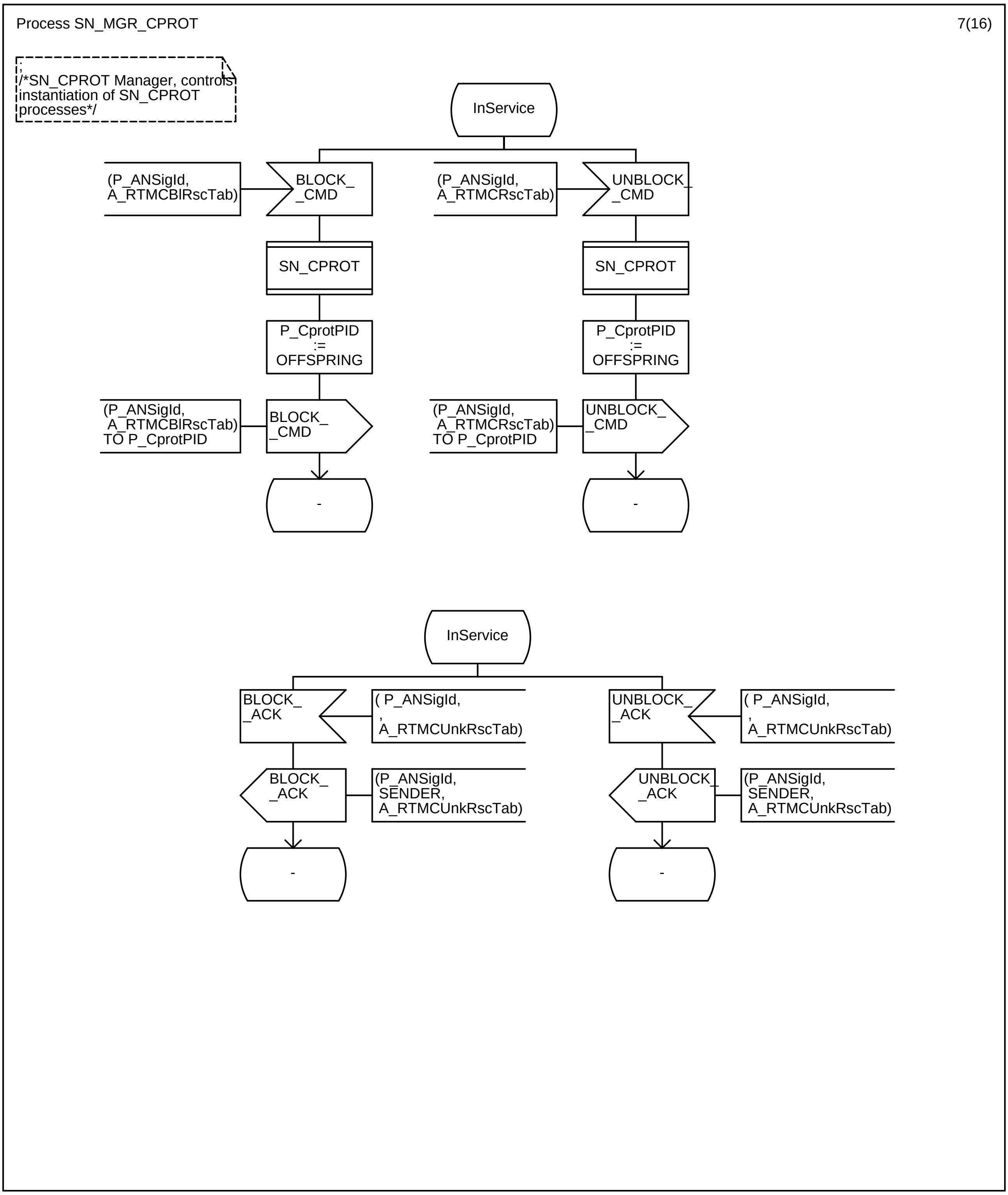


Figure A.157: SN_MGR_CPROT (7)

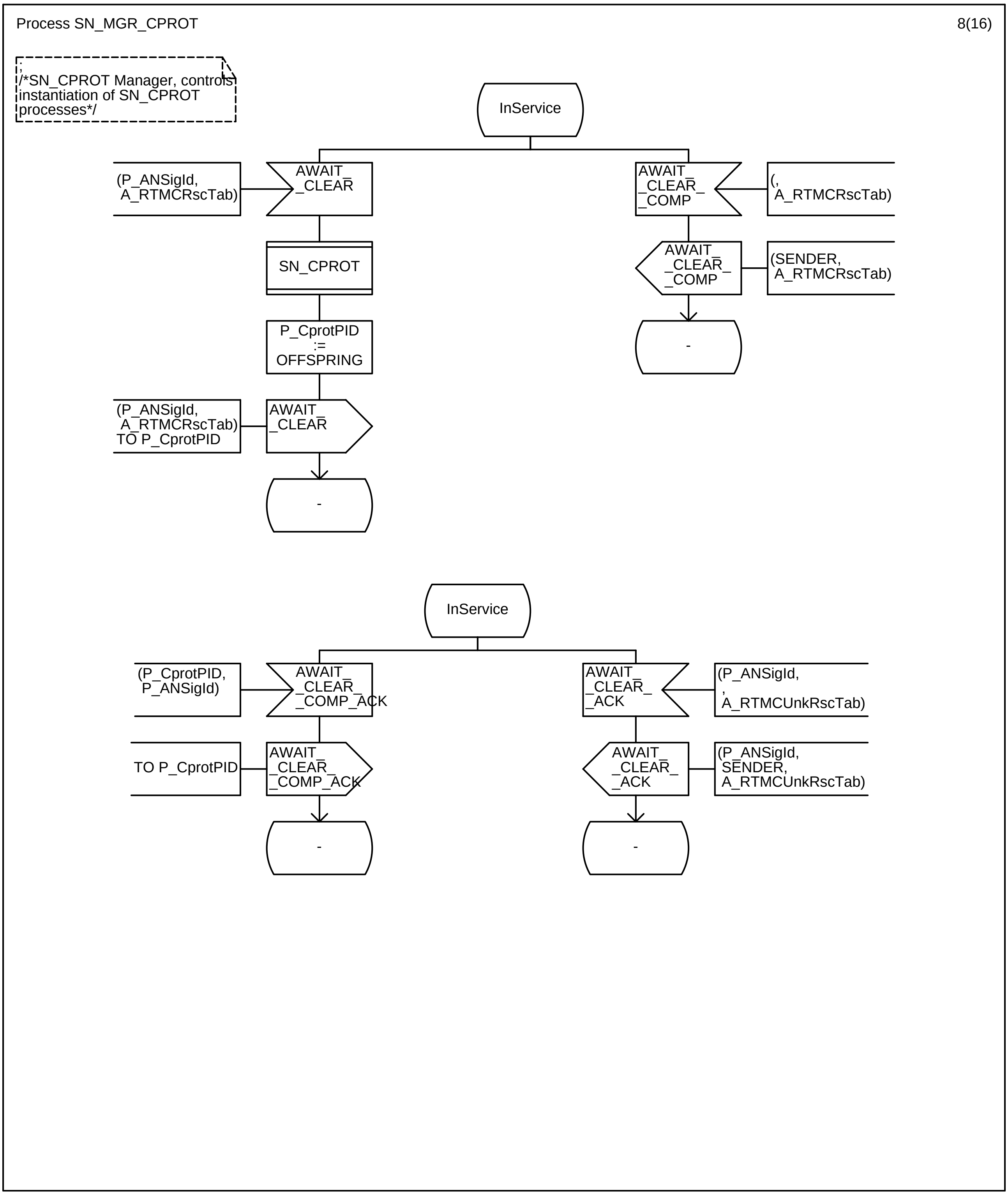


Figure A.158: SN_MGR_CPROT (8)

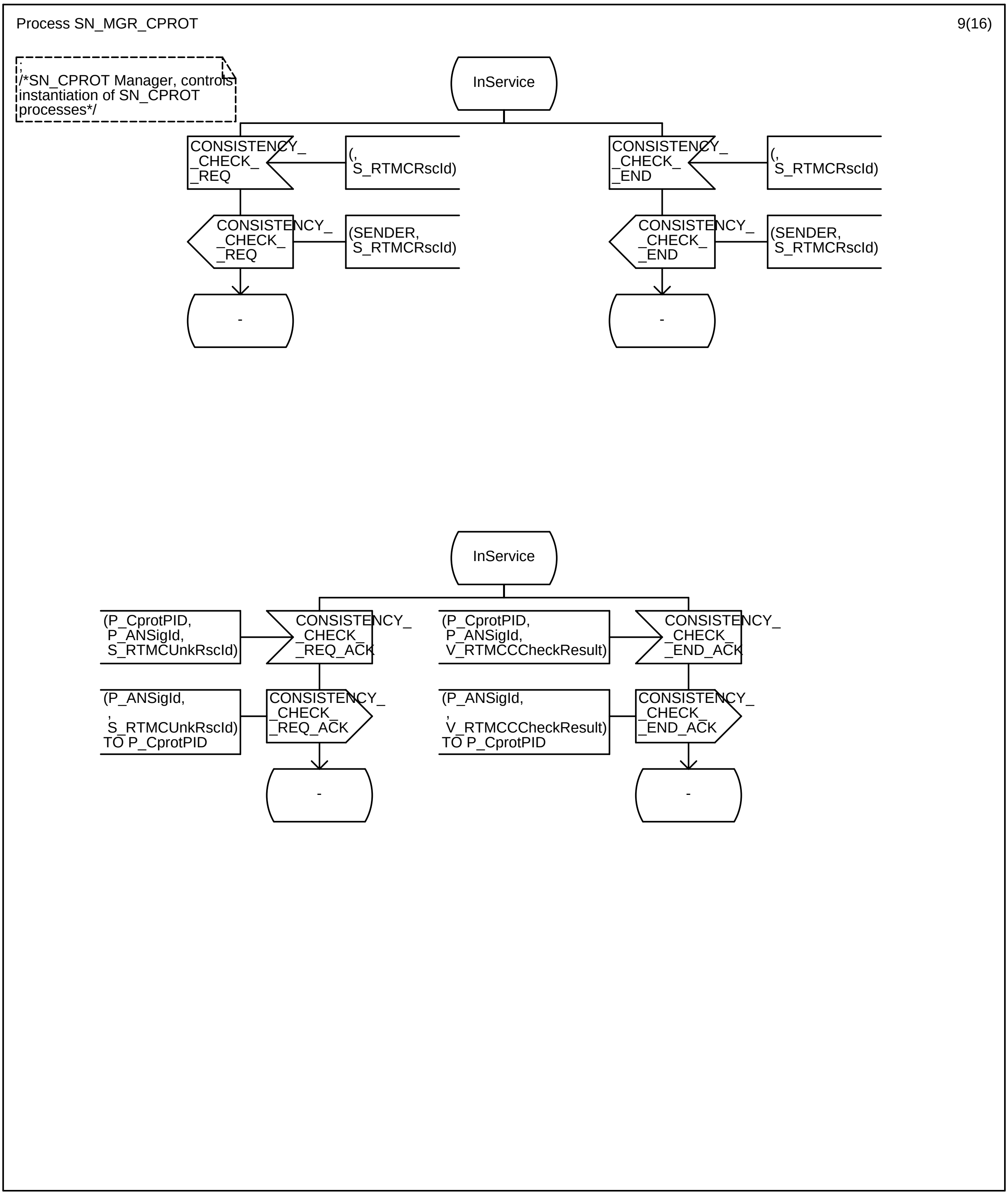


Figure A.159: SN_MGR_CPROT (9)

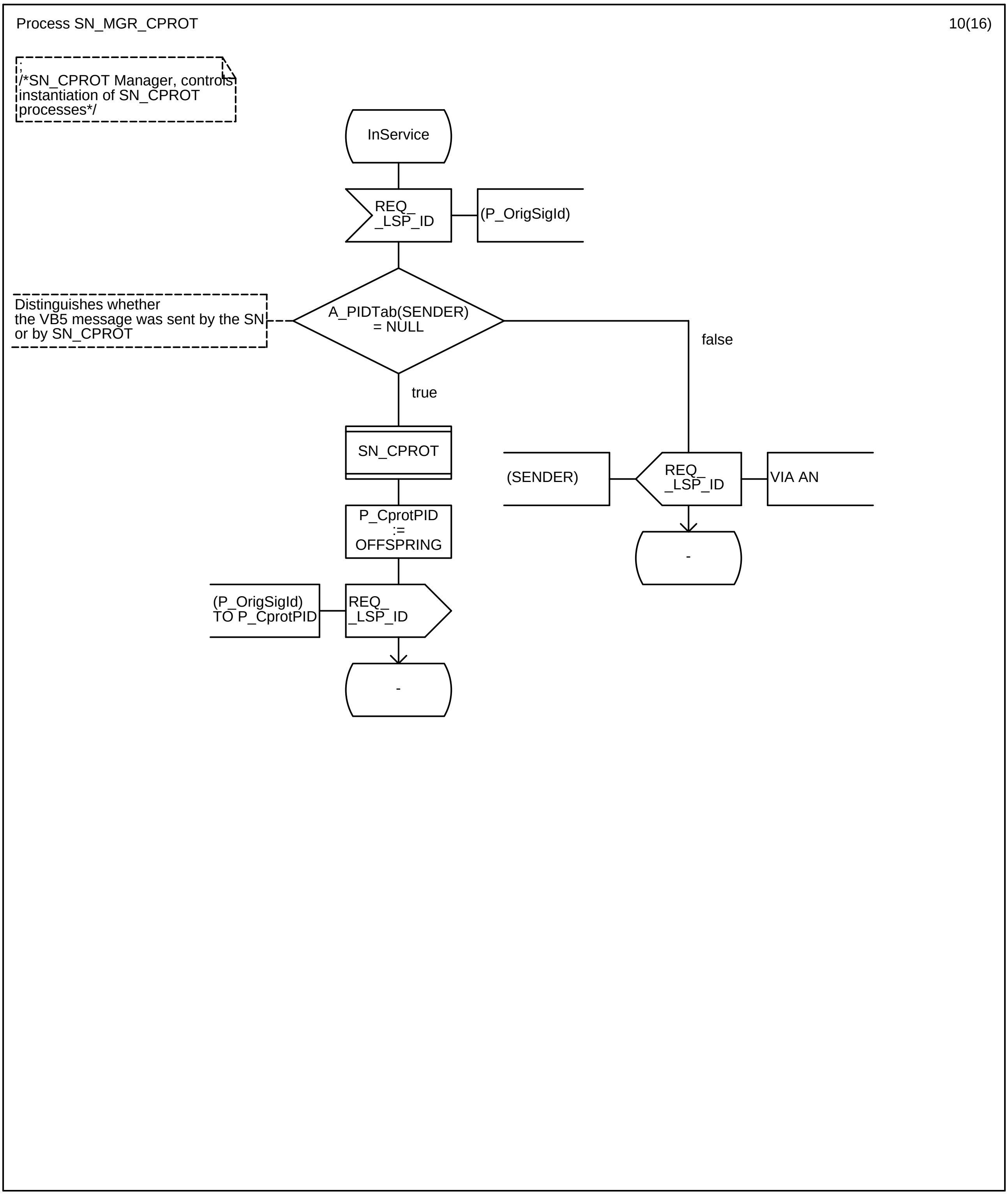


Figure A.160: SN_MGR_CPROT (10)

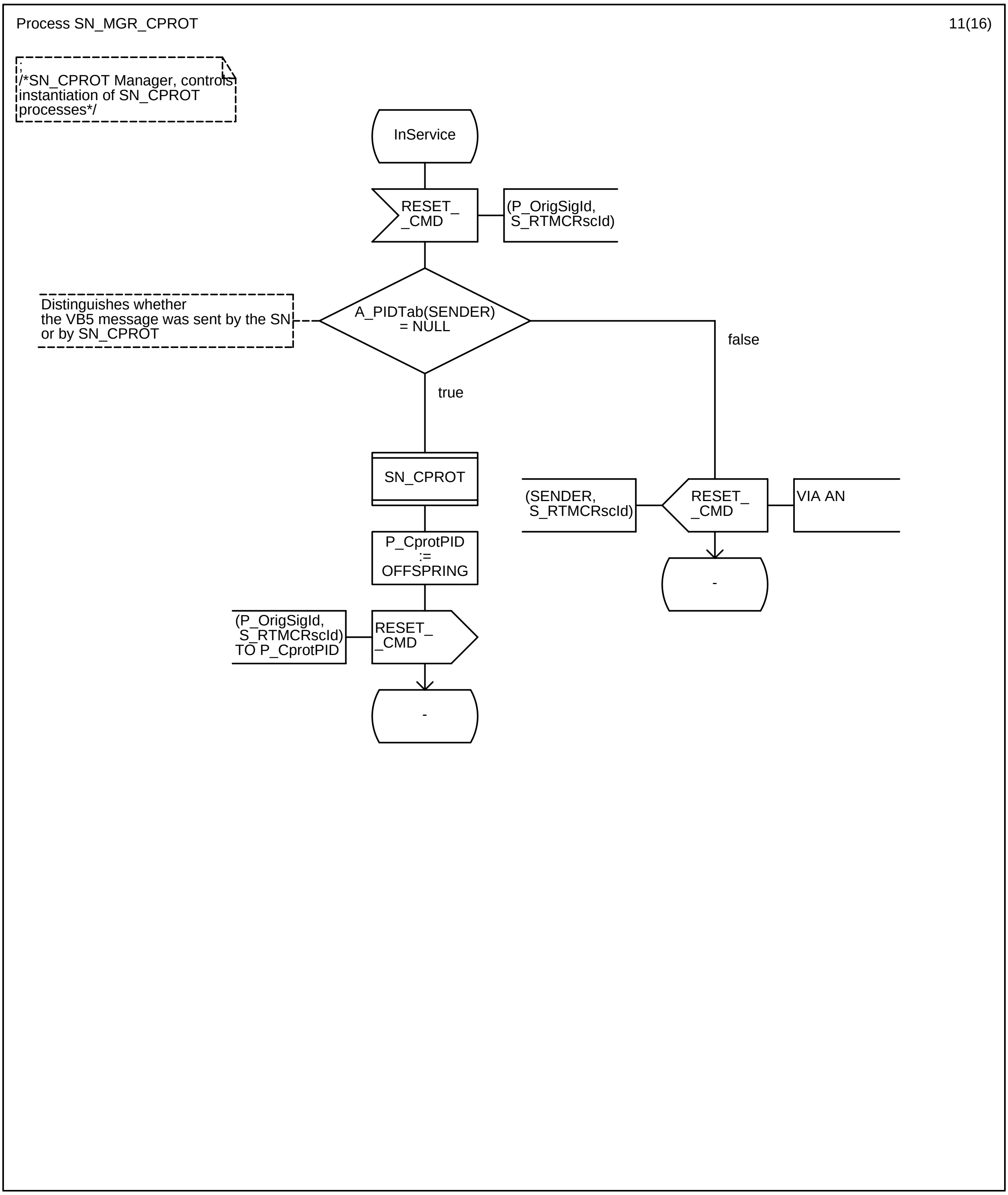


Figure A.161: SN_MGR_CPROT (11)

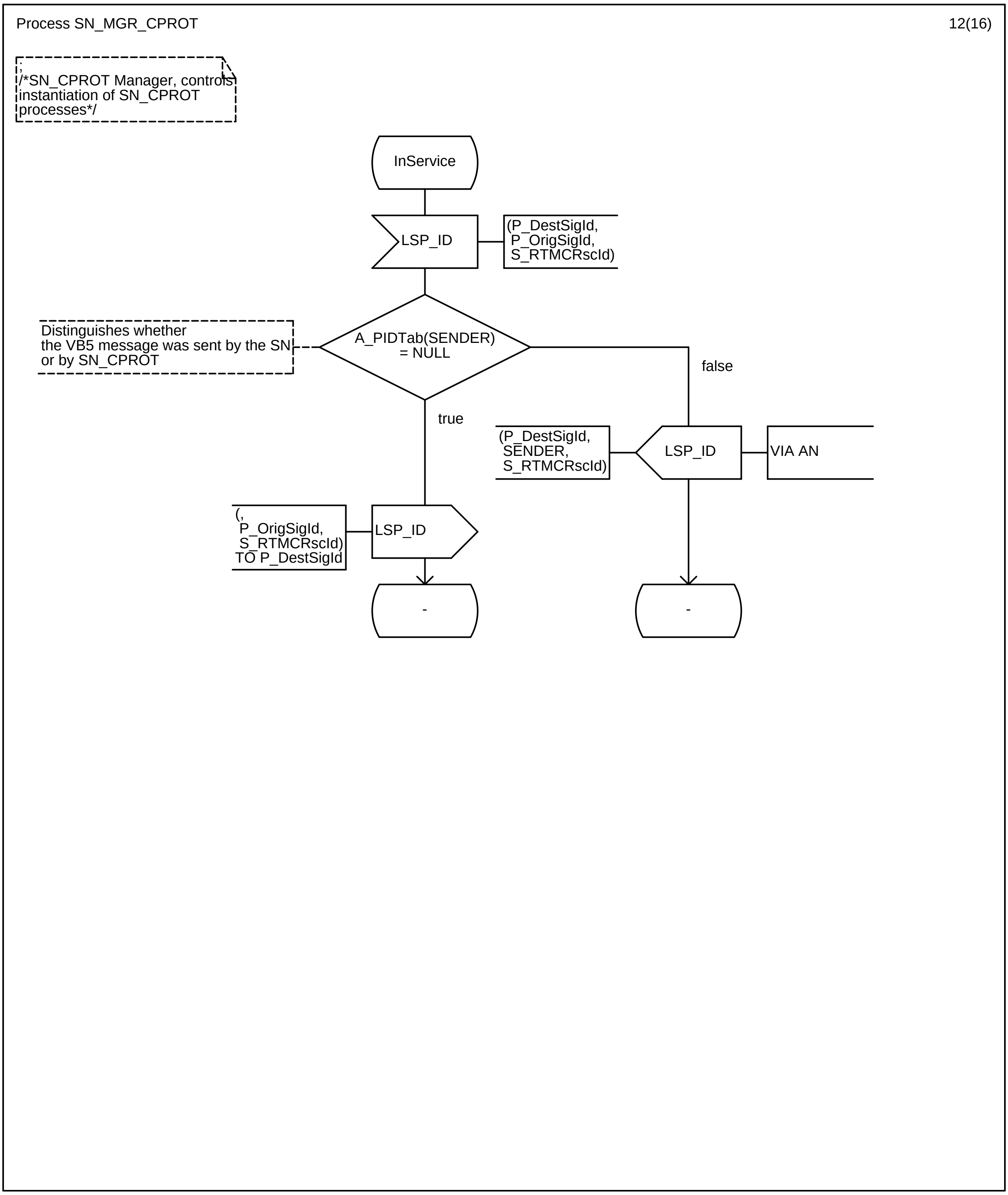


Figure A.162: SN_MGR_CPROT (12)

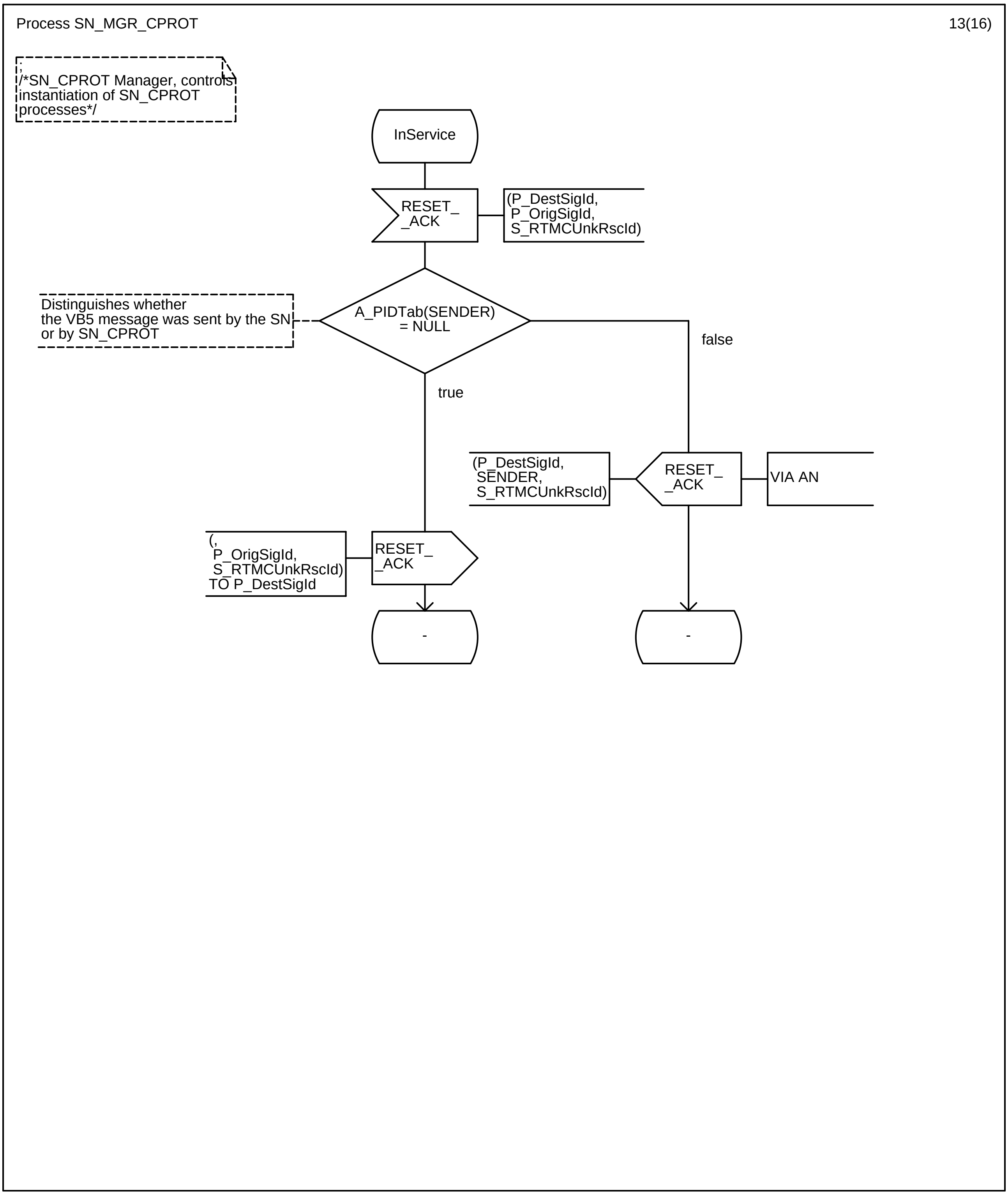


Figure A.163: SN_MGR_CPROT (13)

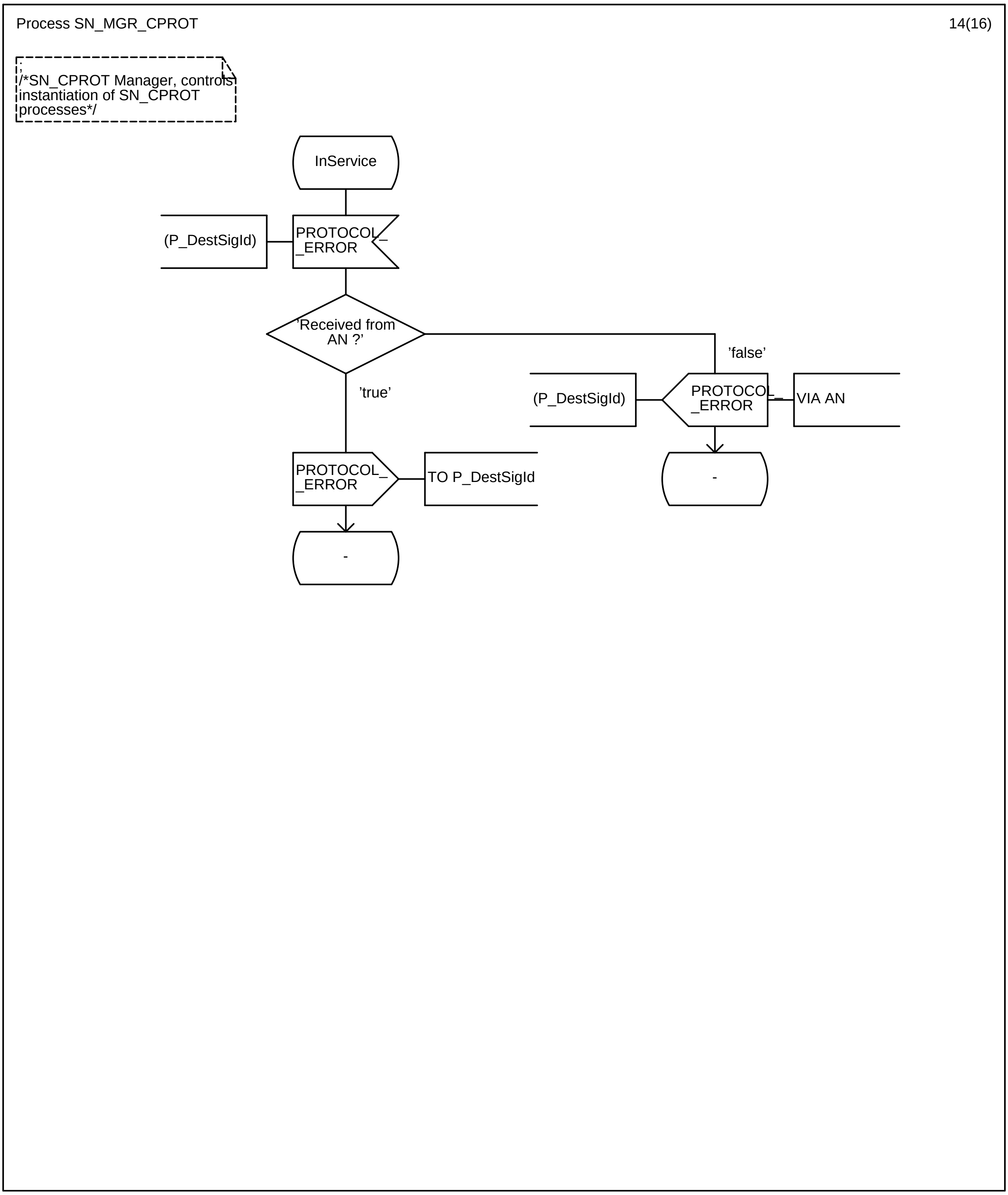


Figure A.164: SN_MGR_CPROT (14)

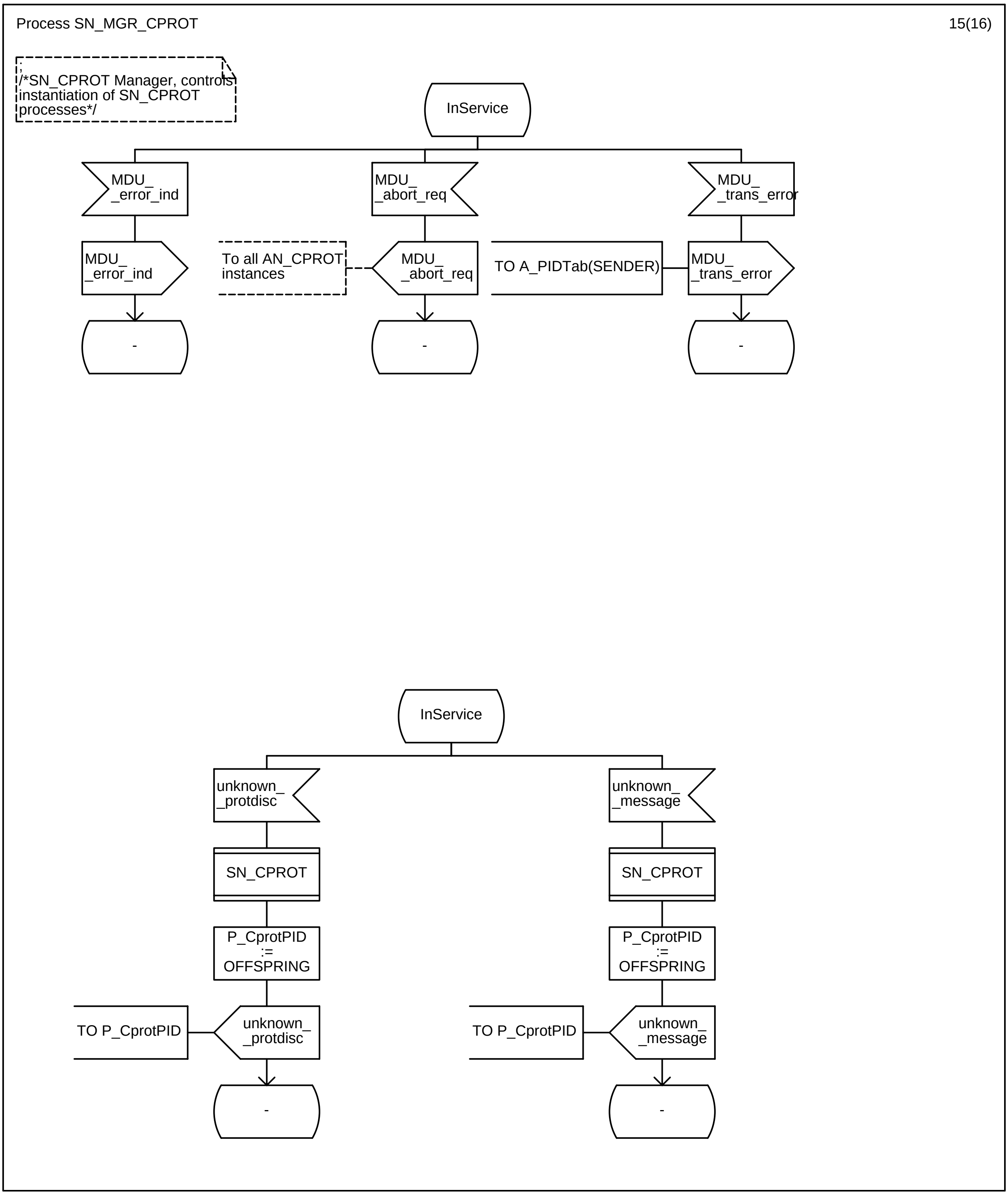


Figure A.165: SN_MGR_CPROT (15)

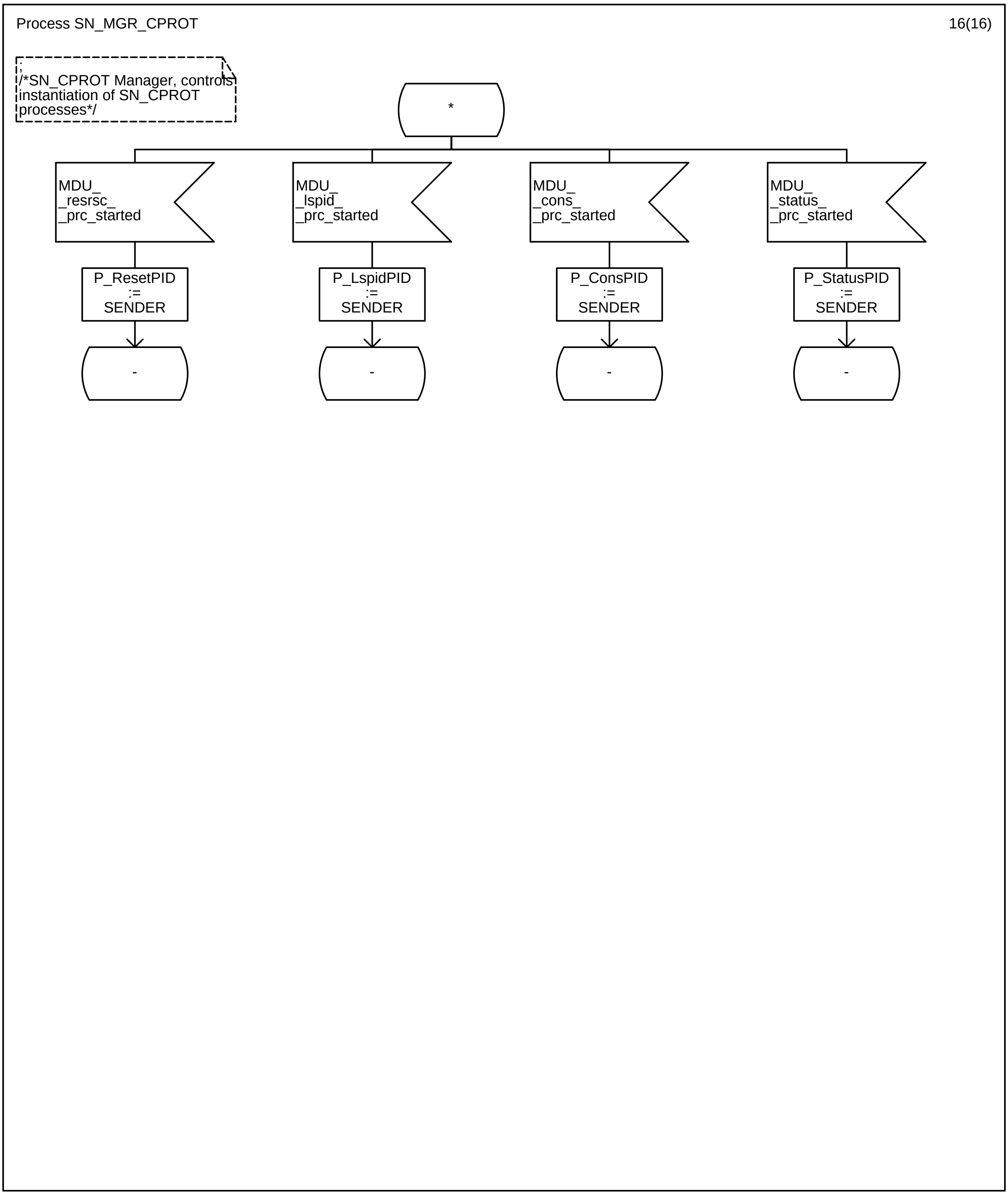


Figure A.166: SN_MGR_CPROT (16)

A.3.4.2 Process SN_CPROT

Process SN_CPROT 1(16)

```
/*SN_CPROT is responsible for sending/
receiving RTMC messages*/
```

```
/* Definintions and declarations for
SN_CPROT */
```

```
/* State descriptions

InService: Init State of SN_CPROT, process is waiting for initial SN_SYSMGT primitives or AN messages
AwaitRemAck: SN_CPROT has sent a VB5 message to the AN and is now awaiting the AN response
AwaitLocAck: SN_CPROT has passed an AN request to SN_SYSMGT and is now awaiting the SN_SYSMGT response */
```

```
/* Timerdefinitions */
TIMER
T_acl      := 1  /* Default value for SHUTDOWN_COMPLETE supervision timer is 1 sec, Tolerance +/- 10%  */,
T_lspid    := 1  /* Default value for REQUEST_LSP_ID supervision timer is 1 sec, Tolerance +/- 10%  */,
T_consreq := 10 /* Default value for CONSISTENCY_CHECK_REQ supervision timer is 10 sec, Tolerance +/- 10%  */,
T_consend := 10 /* Default value for CONSISTENCY_CHECK_END supervision timer is 10 sec, Tolerance +/- 10%  */,
T_reset    := 60 /* Default value for RESET_CMD supervision timer is 60 sec, Tolerance +/- 10%  */;
```

```
/* SN_CPROT internal variables and constants*/
/**/
/* timer handling */
DCL V_ExpCount NATURAL;  /*number of actual message repetitions*/
/*possible values*/
SYNONYM C_ExpMax INTEGER = 1;       /*maximum number of message repetitions is 1*/
/**/
/*syntax check handling*/
DCL V_SynResult INTEGER;  /*syntax check result, provided by procedure CPROT_SYNTAX_CHECK*/
/*possible values*/
SYNONYM C_Proceed INTEGER =1;    /*possible result of syntax check: proceed with message processing*/
```

```
/*Signal data declarations*/
DCL
S_RTMCRscId ST_RTMCRscID; /*Resource Identifier Information Element*/
/**/
DCL
S_RTMCUnkRscId ST_RTMCUnkRscID; /*Resource Identifier Information Element  unknown by the peer side*/
/**/
DCL
A_RTMCRscTab AT_RTMCRscTab;  /*Array of Resource Identifier Information Elements*/
/**/
DCL
A_RTMCBlRscTab AT_RTMCBlRscTab;  /*Array of Blocked Resource Identifier Information Elements*/
/**/
DCL
A_RTMCUnkRscTab AT_RTMCUnkRscTab;  /*Array of Resource Identifier Information Elements unknown by the peer side*/
/**/
DCL
V_RTMCCCheckResult IT_RTMCCCheckResult; /*Consistency Check Result*/
/**/
DCL
P_ANSigId,
P_ANUnexpSigId /*AN signalling identifier*/
PID;
```

Figure A.167: SN_CPROT (1)

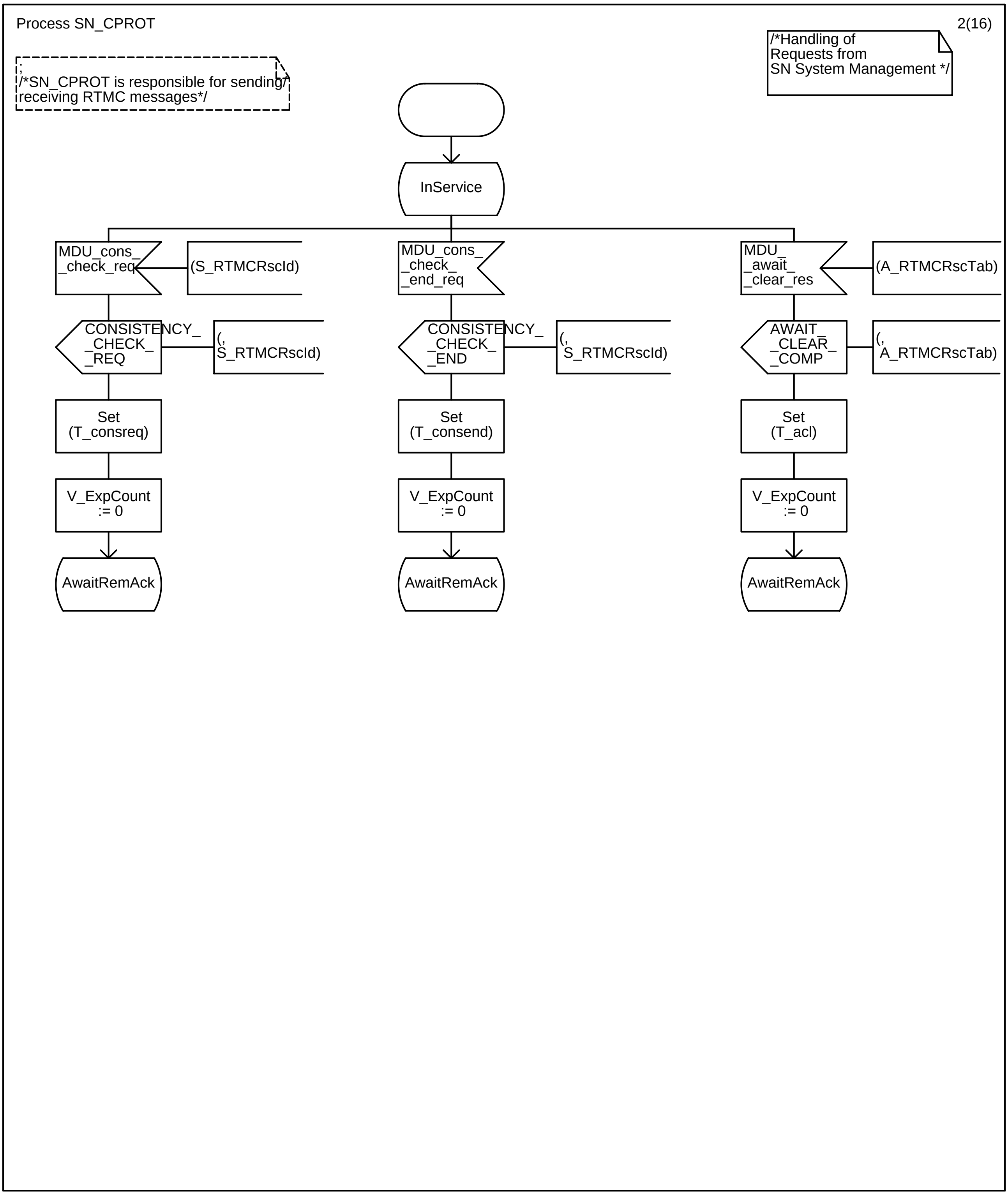


Figure A.168: SN_CPROT (2)

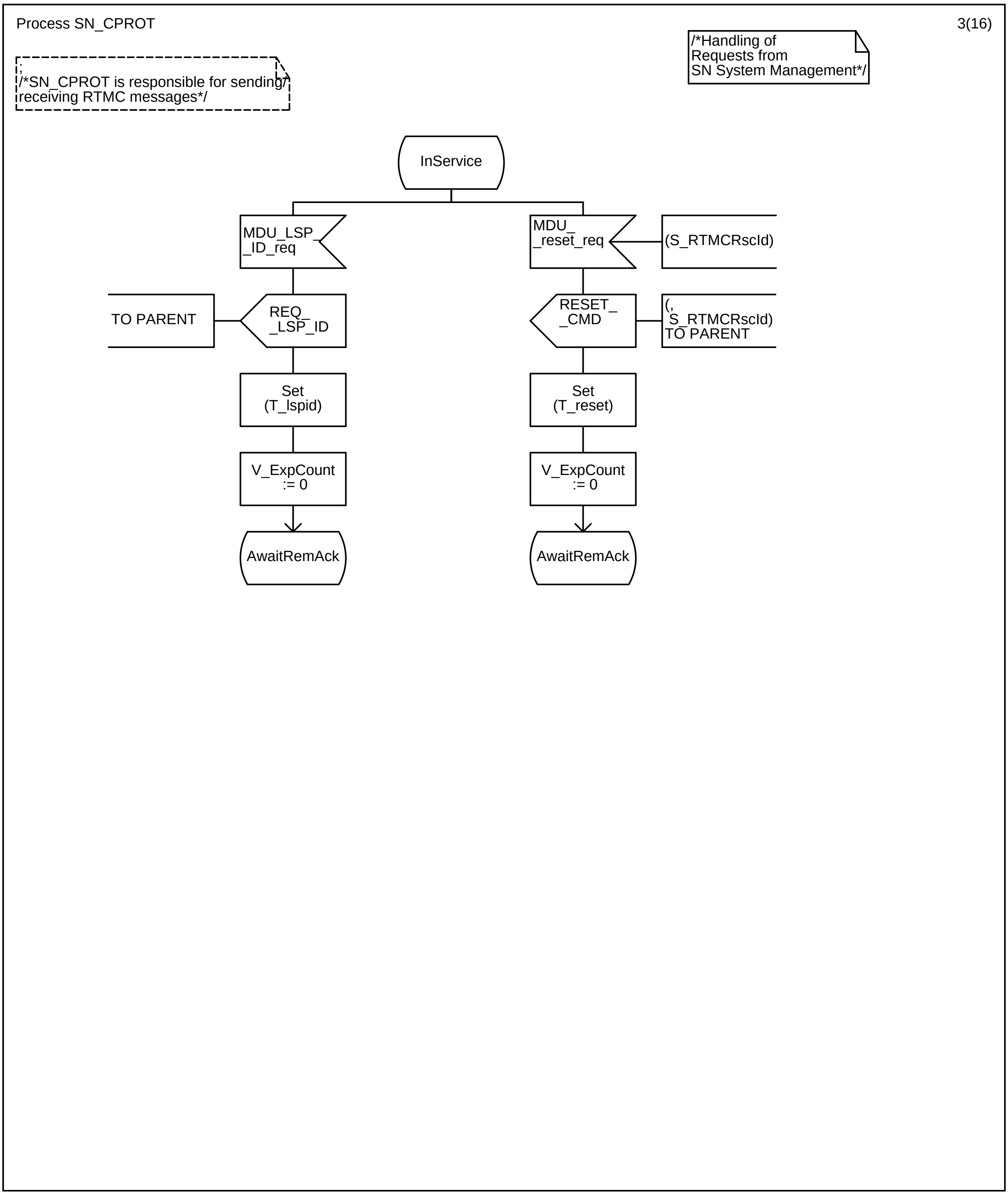


Figure A.169: SN_CPROT (3)

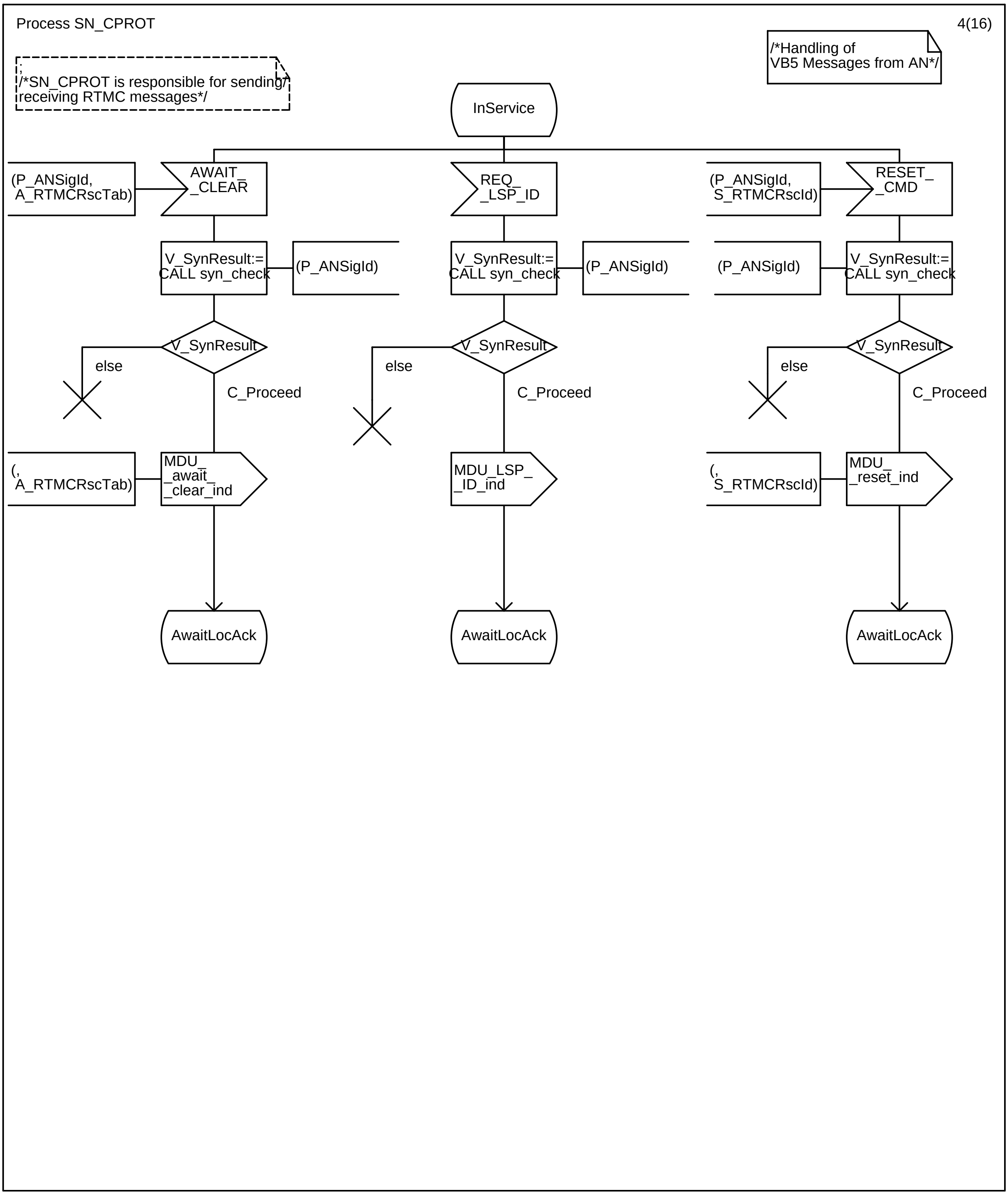


Figure A.170: SN_CPROT (4)

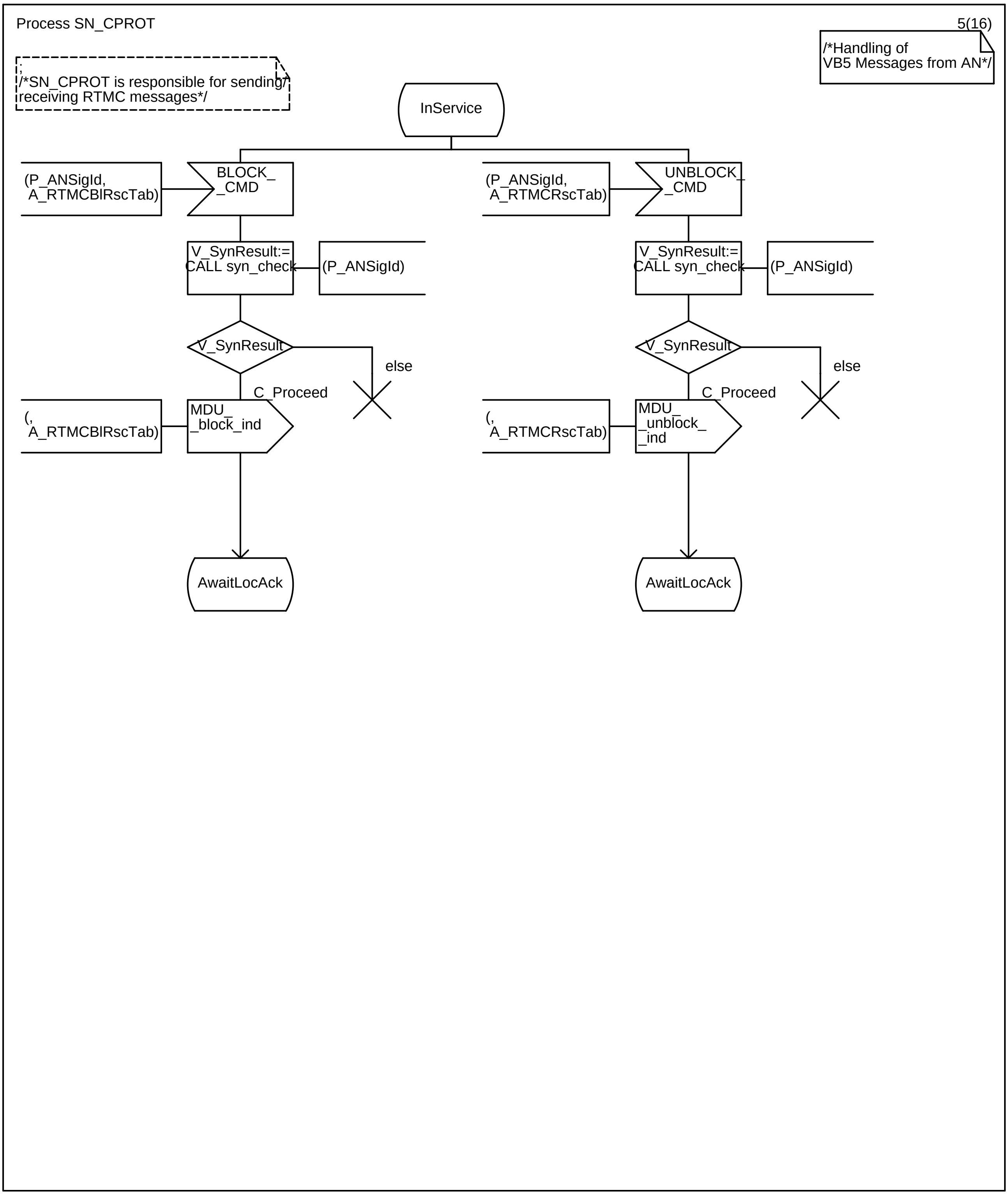


Figure A.171: SN_CPROT (5)

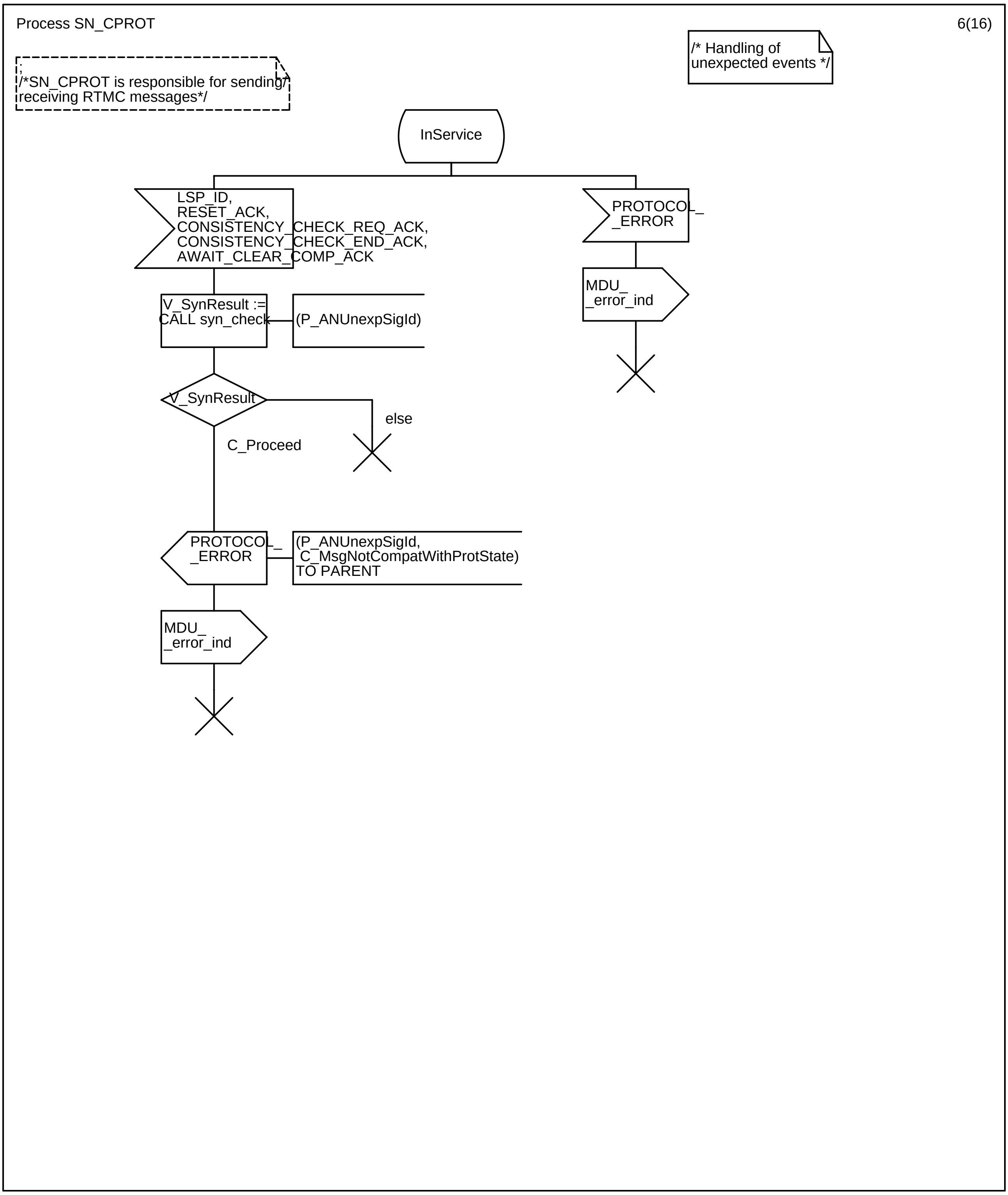


Figure A.172: SN_CPROT (6)

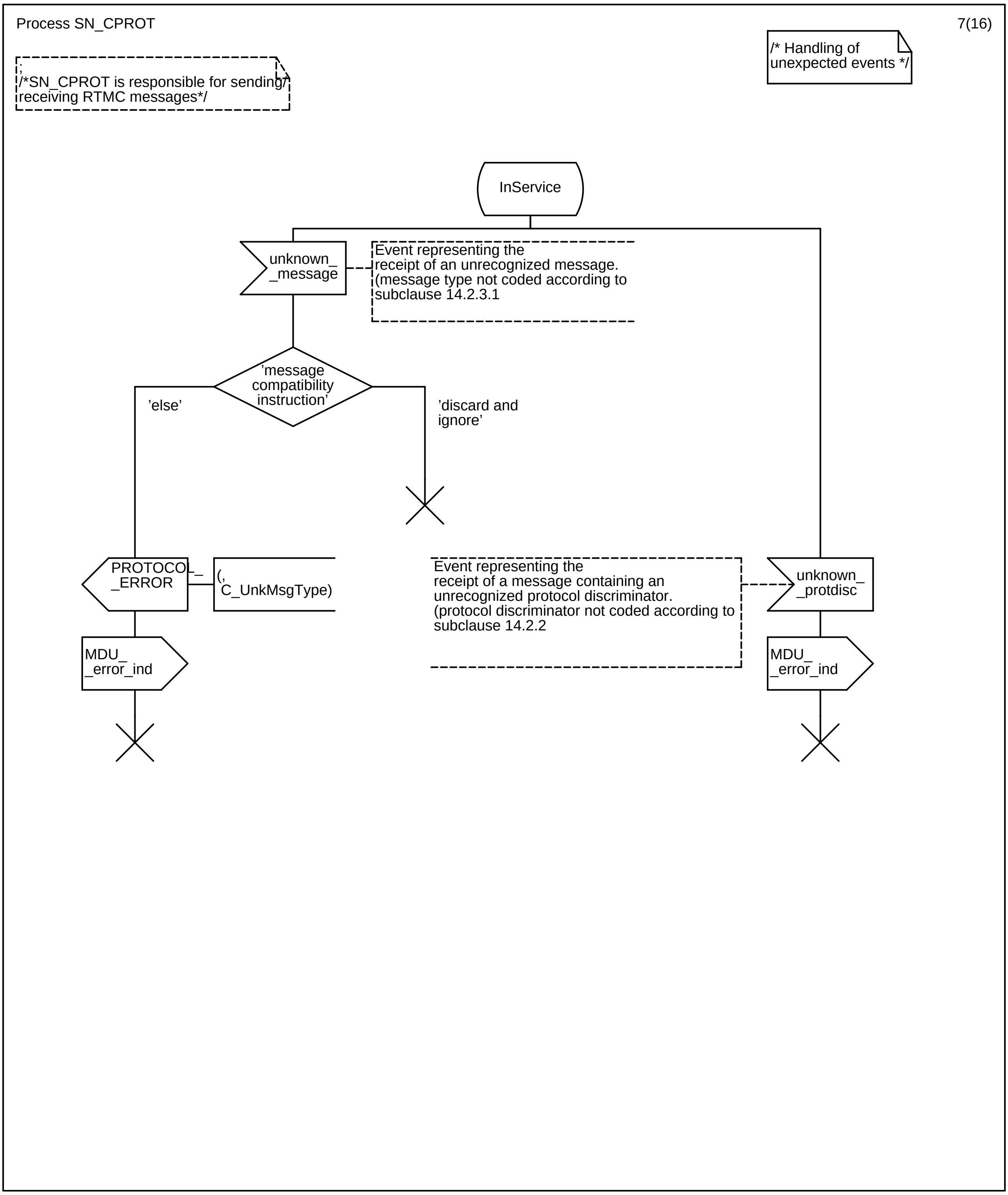


Figure A.173: SN_CPROT (7)

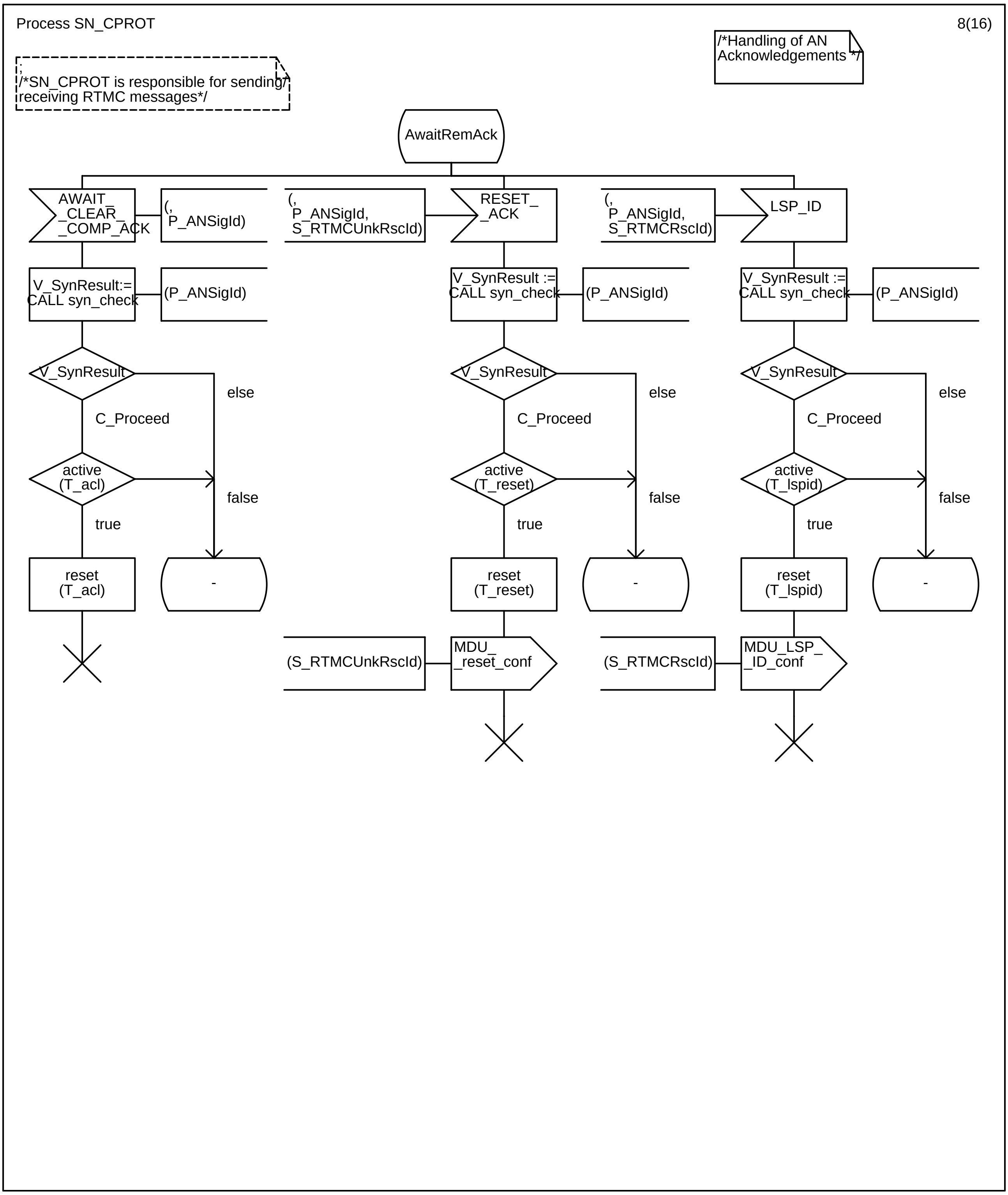


Figure A.174: SN_CPROT (8)

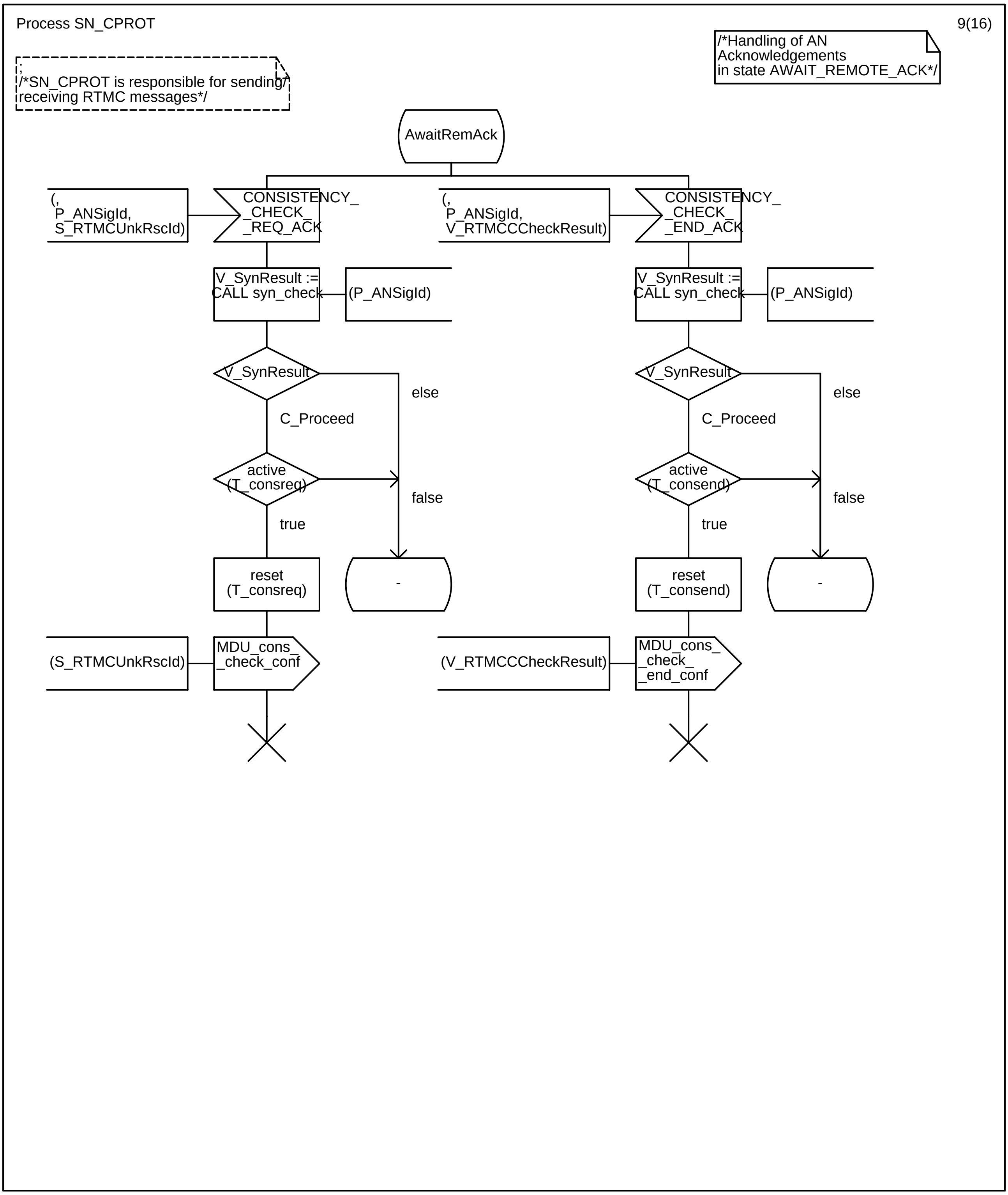


Figure A.175: SN_CPROT (9)

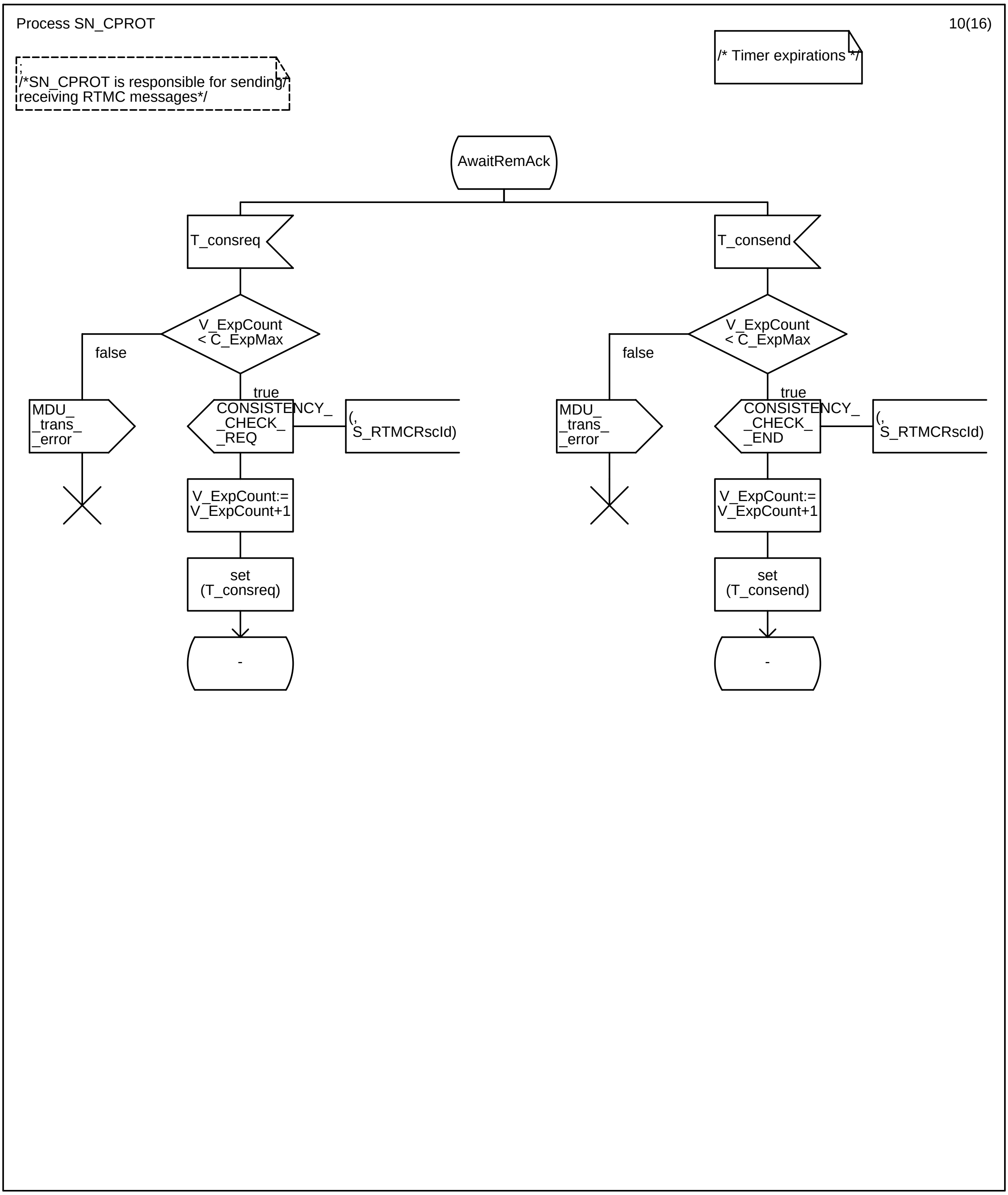


Figure A.176: SN_CPROT (10)

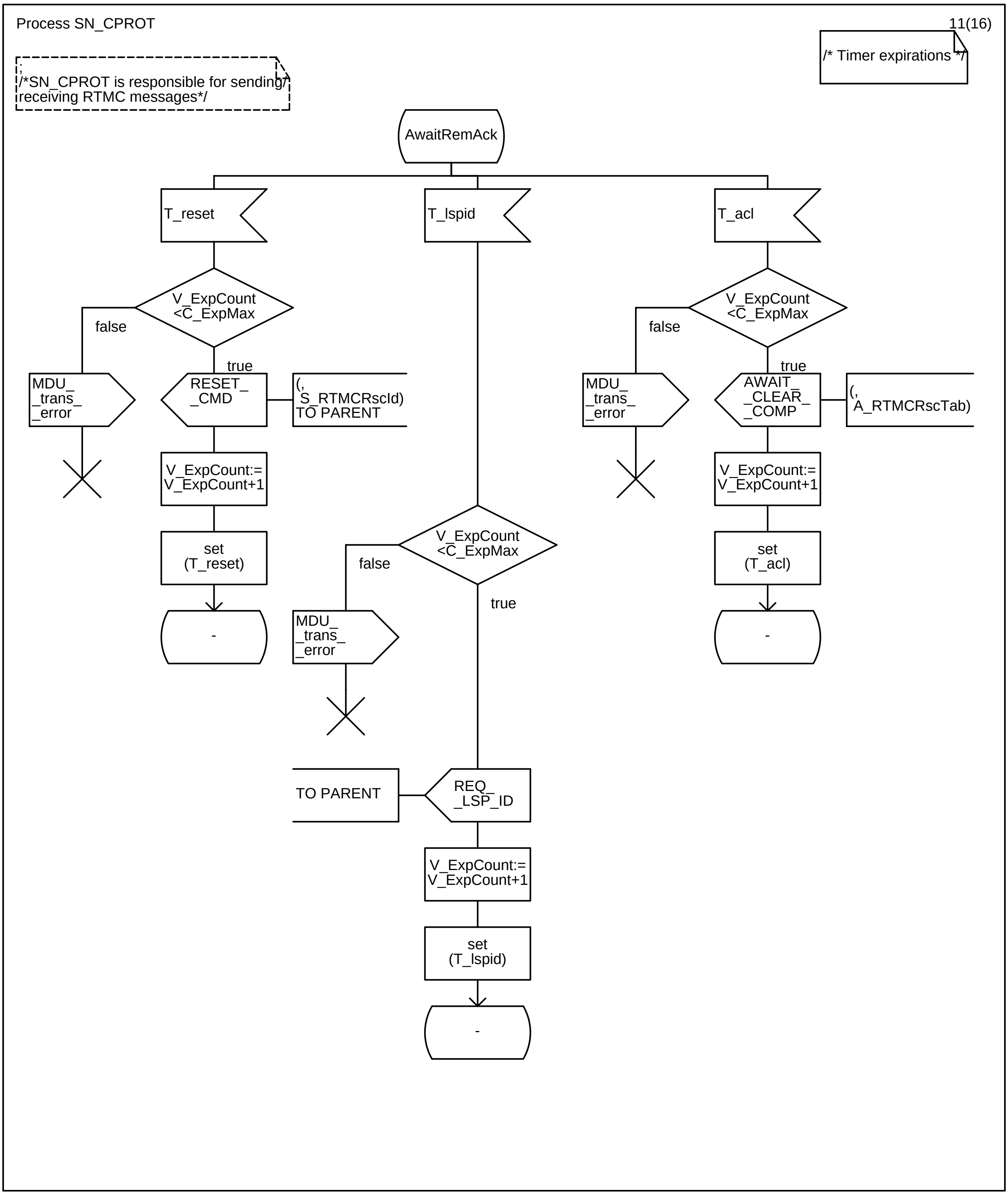


Figure A.177: SN_CPROT (11)

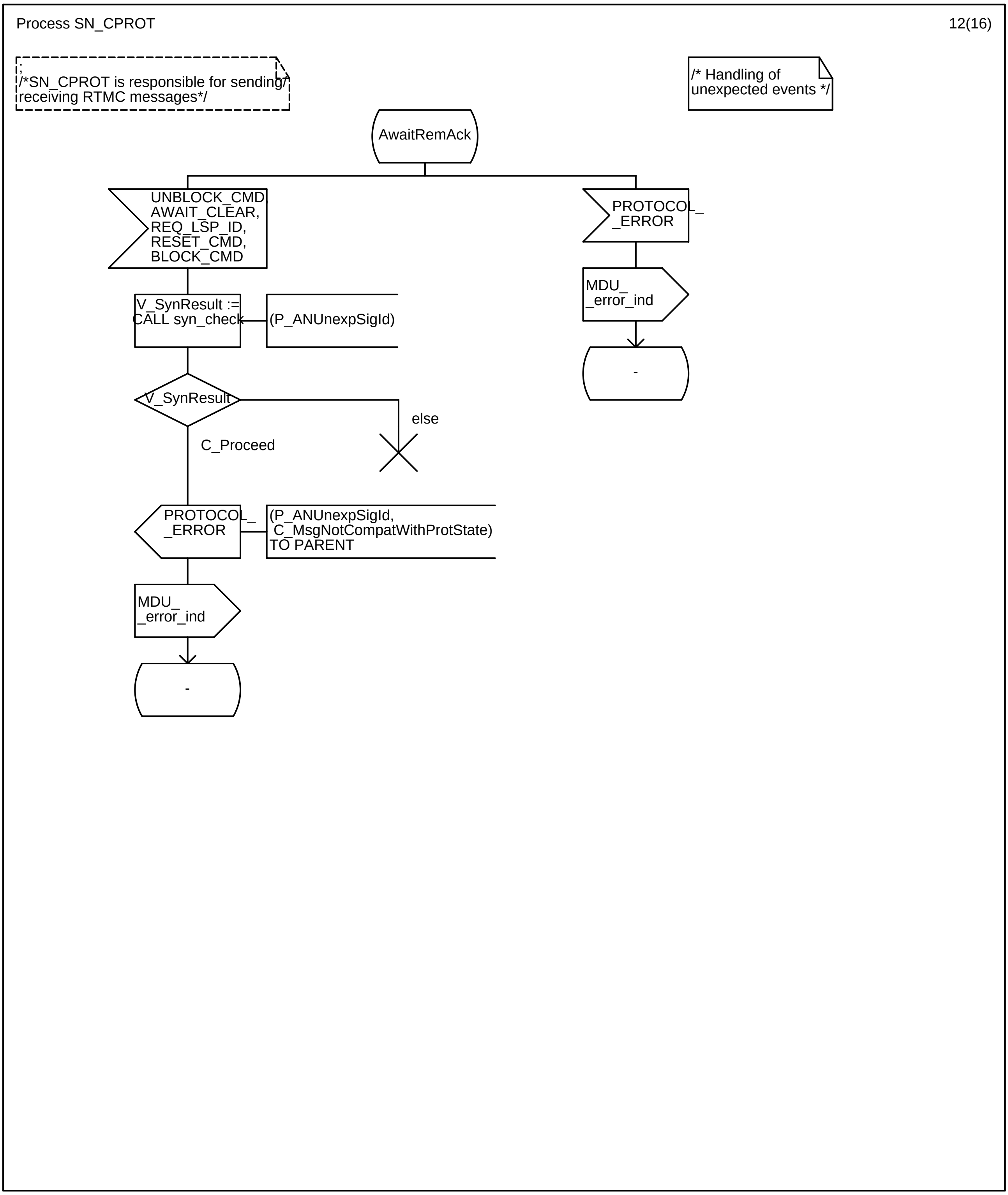


Figure A.178: SN_CPROT (12)

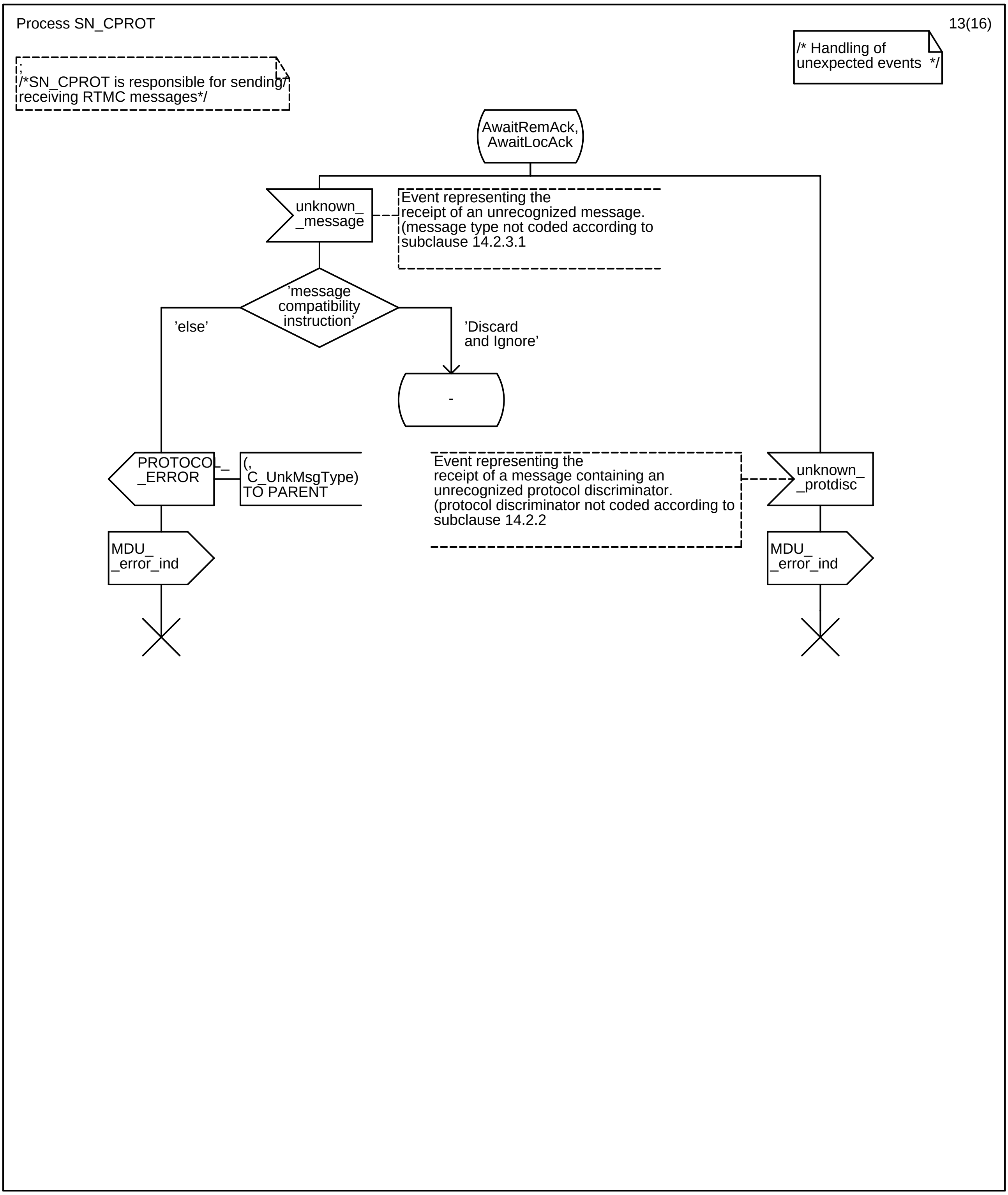


Figure A.179: SN_CPROT (13)

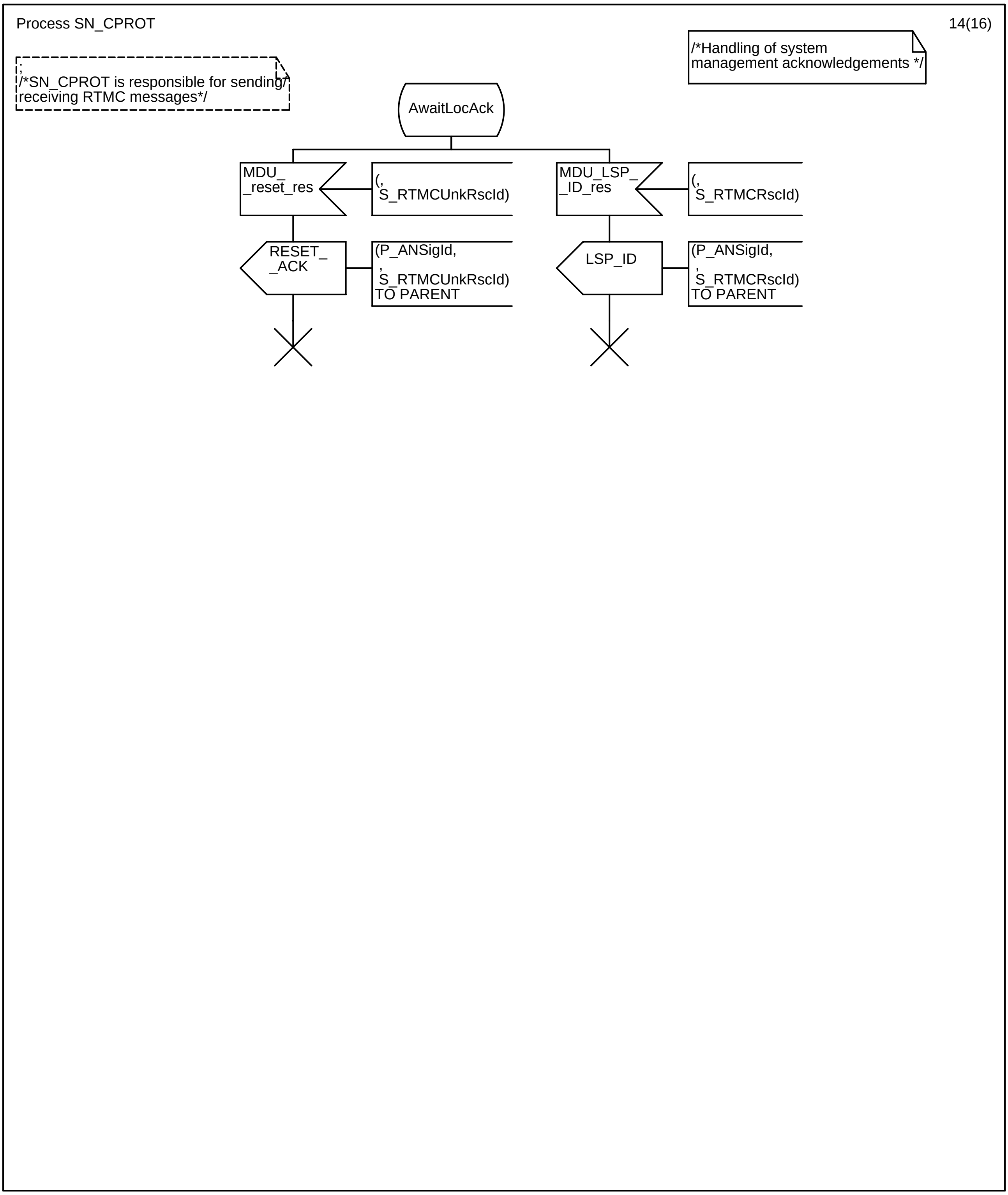


Figure A.180: SN_CPROT (14)

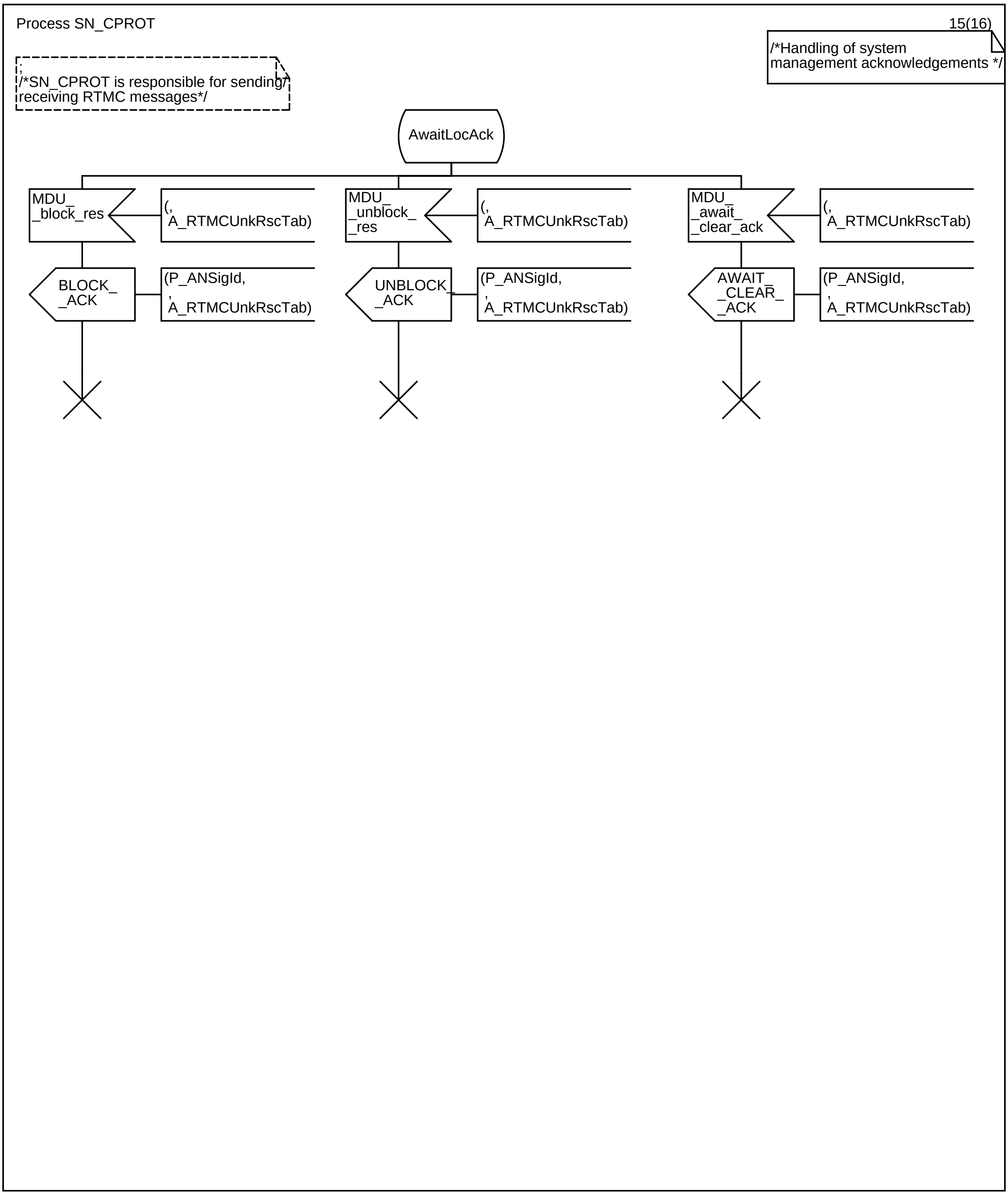


Figure A.181: SN_CPROT (15)

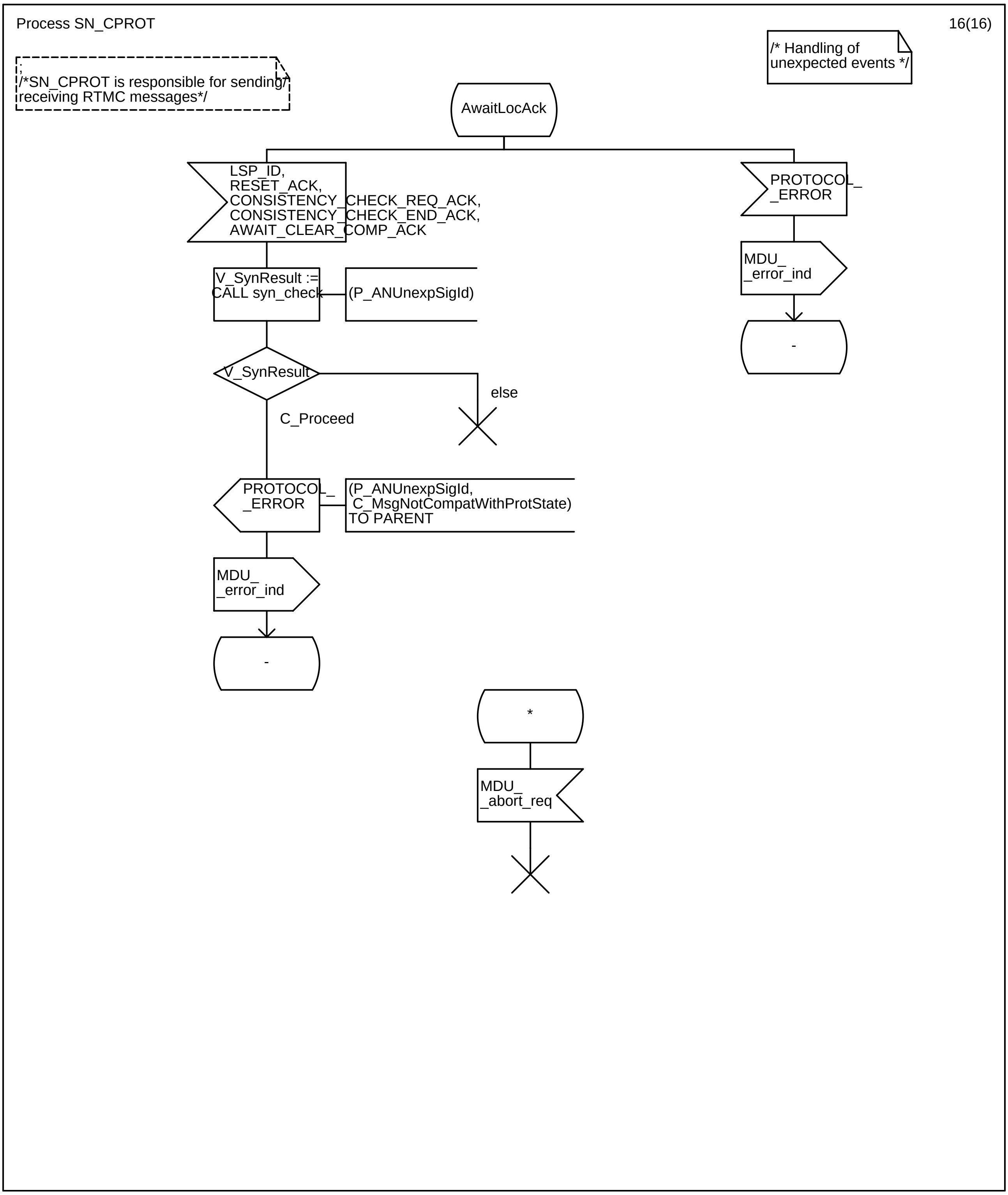


Figure A.182: SN_CPROT (16)

A.4 Common processes and procedures

A.4.1 Overview

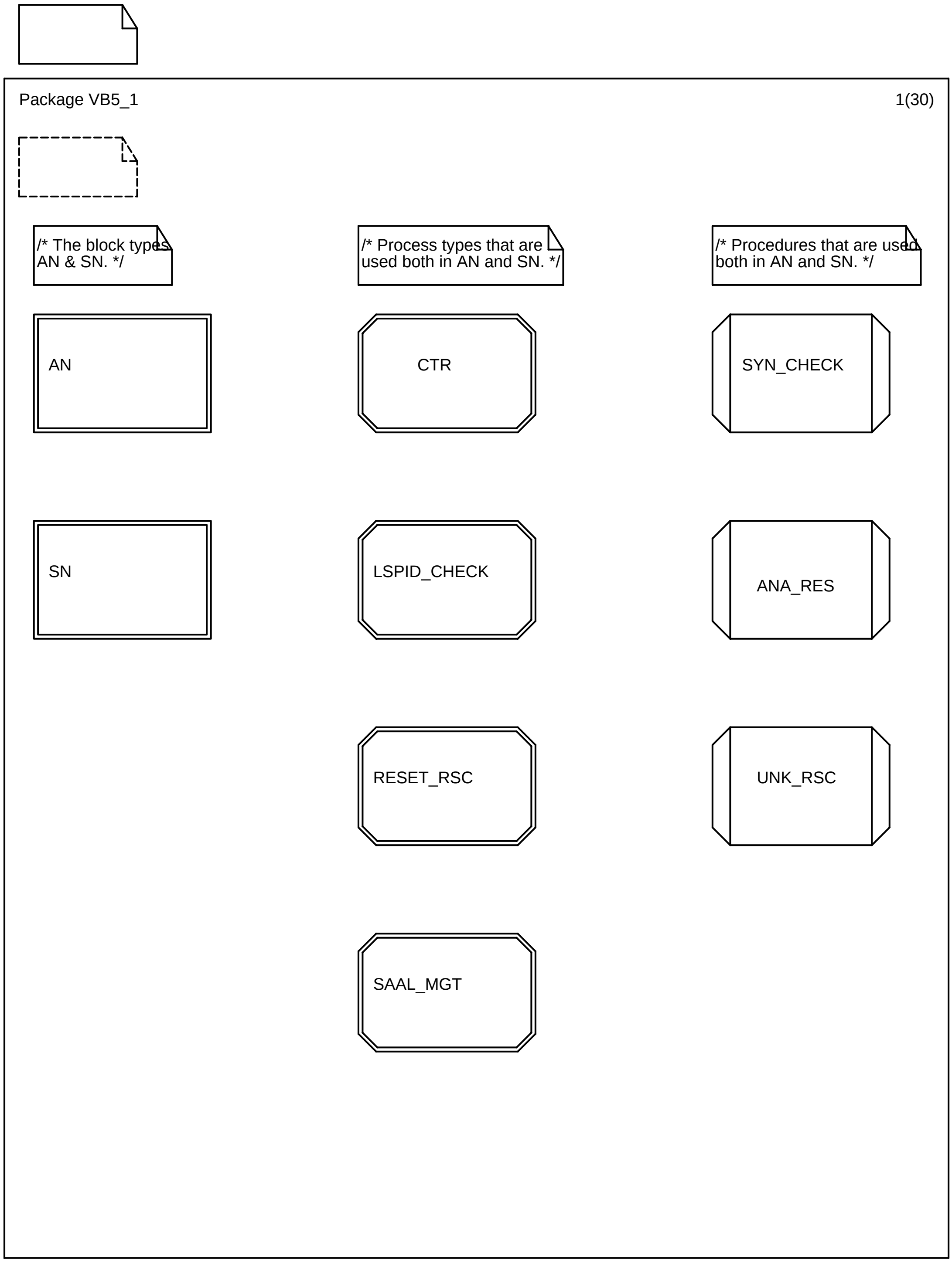


Figure A.183: Overview of common processes and procedures

A.4.2 Process CTR

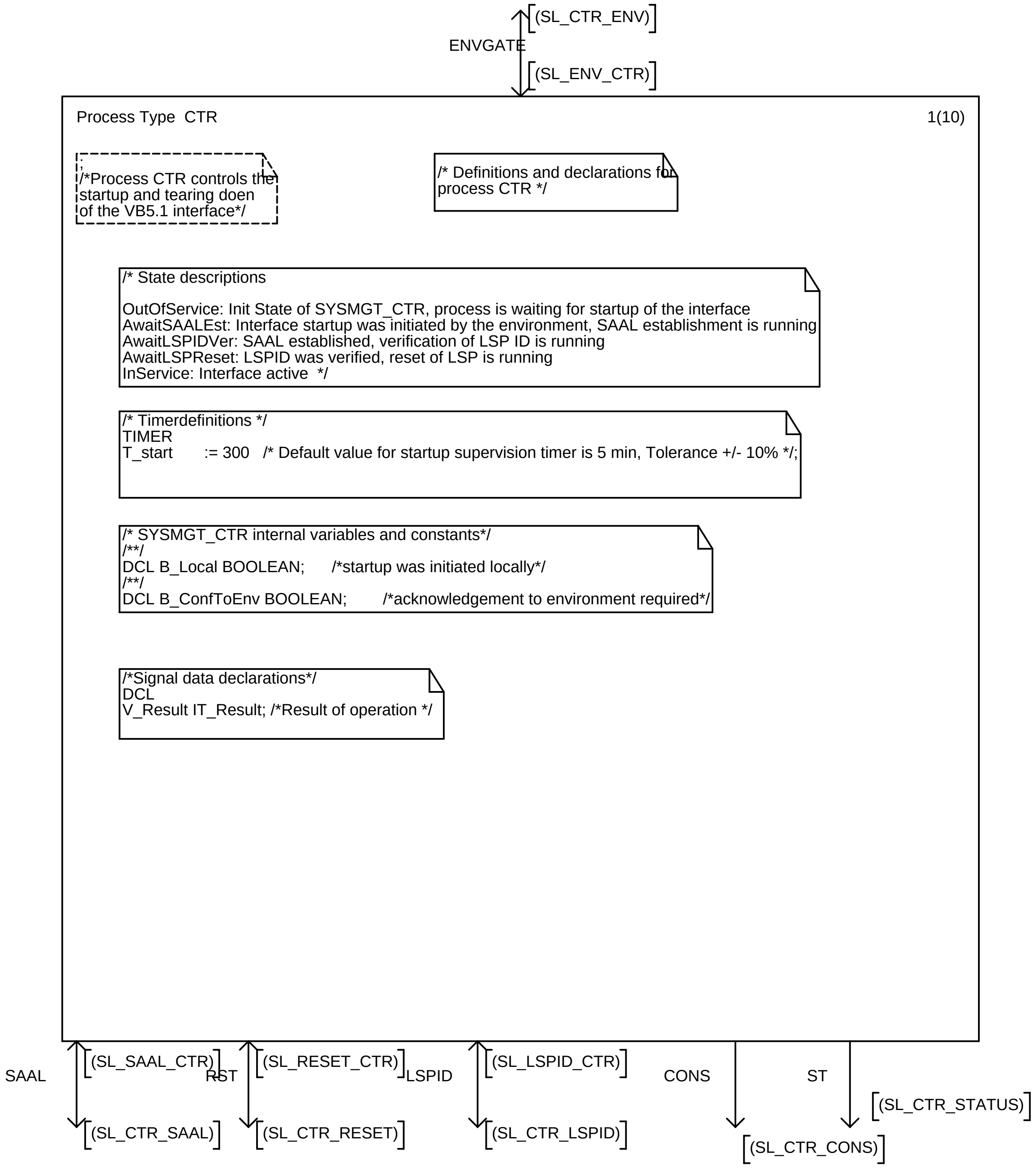


Figure A.184: CTR (1)

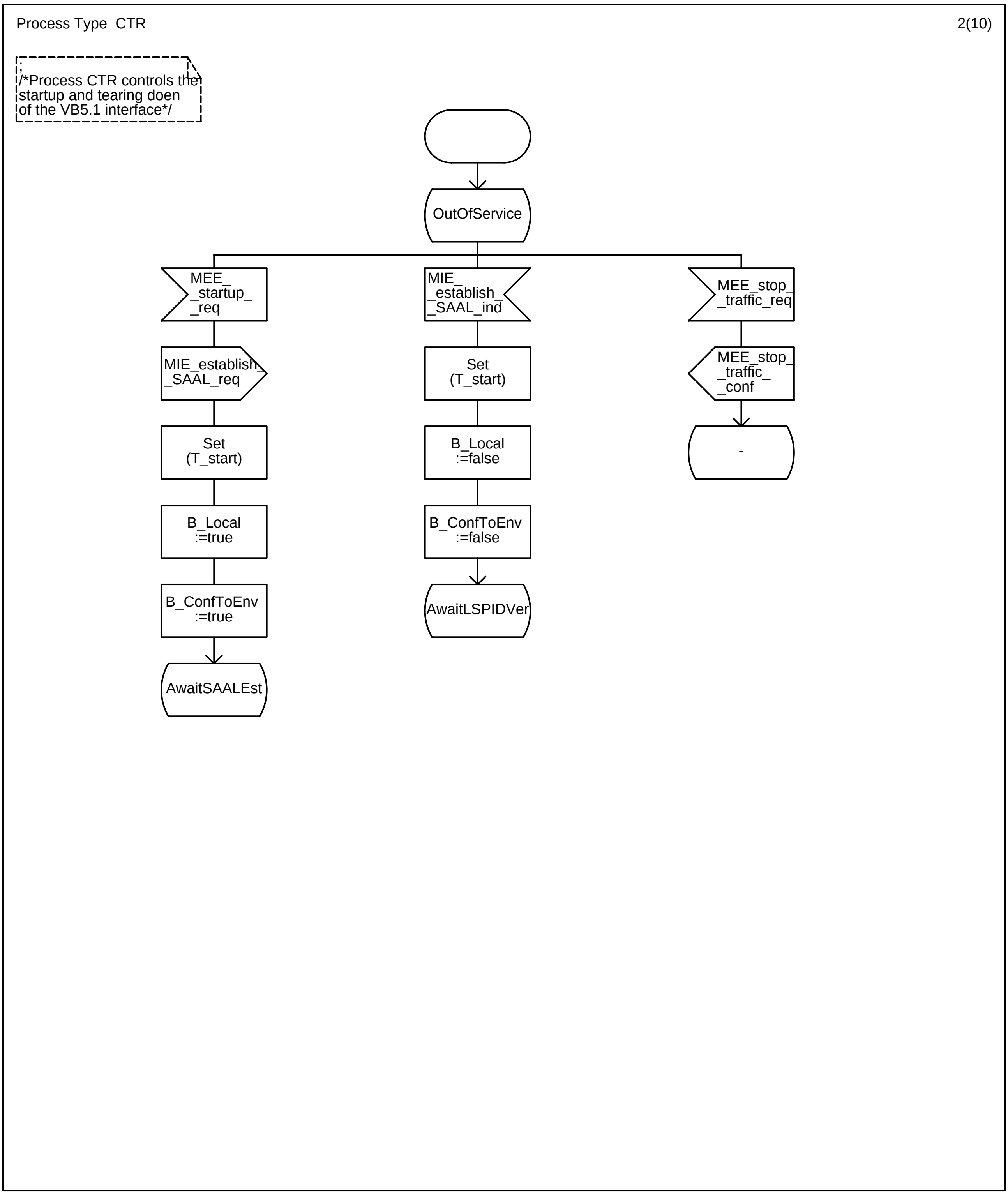


Figure A.185: CTR (2)

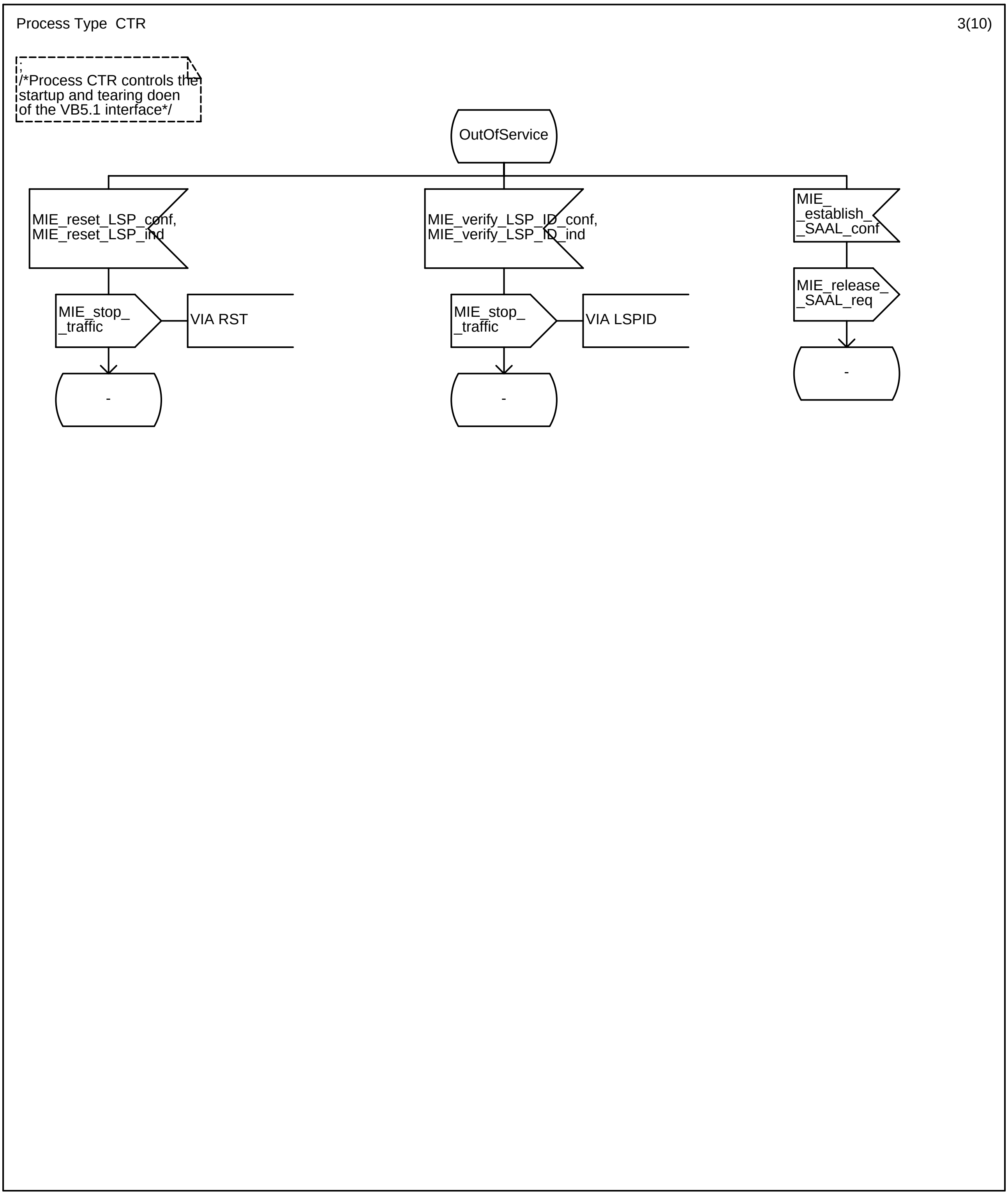


Figure A.186: CTR (3)

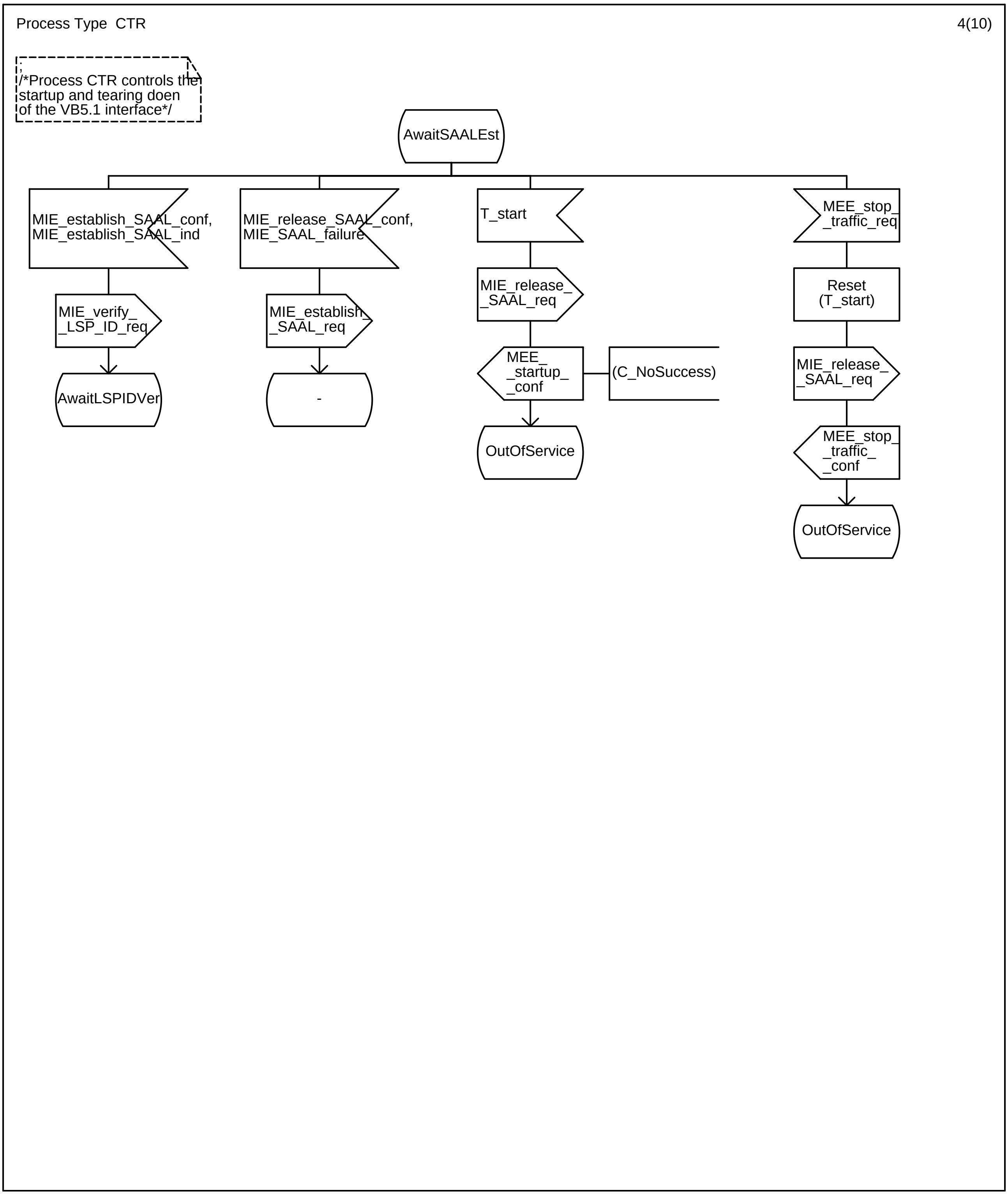


Figure A.187: CTR (4)

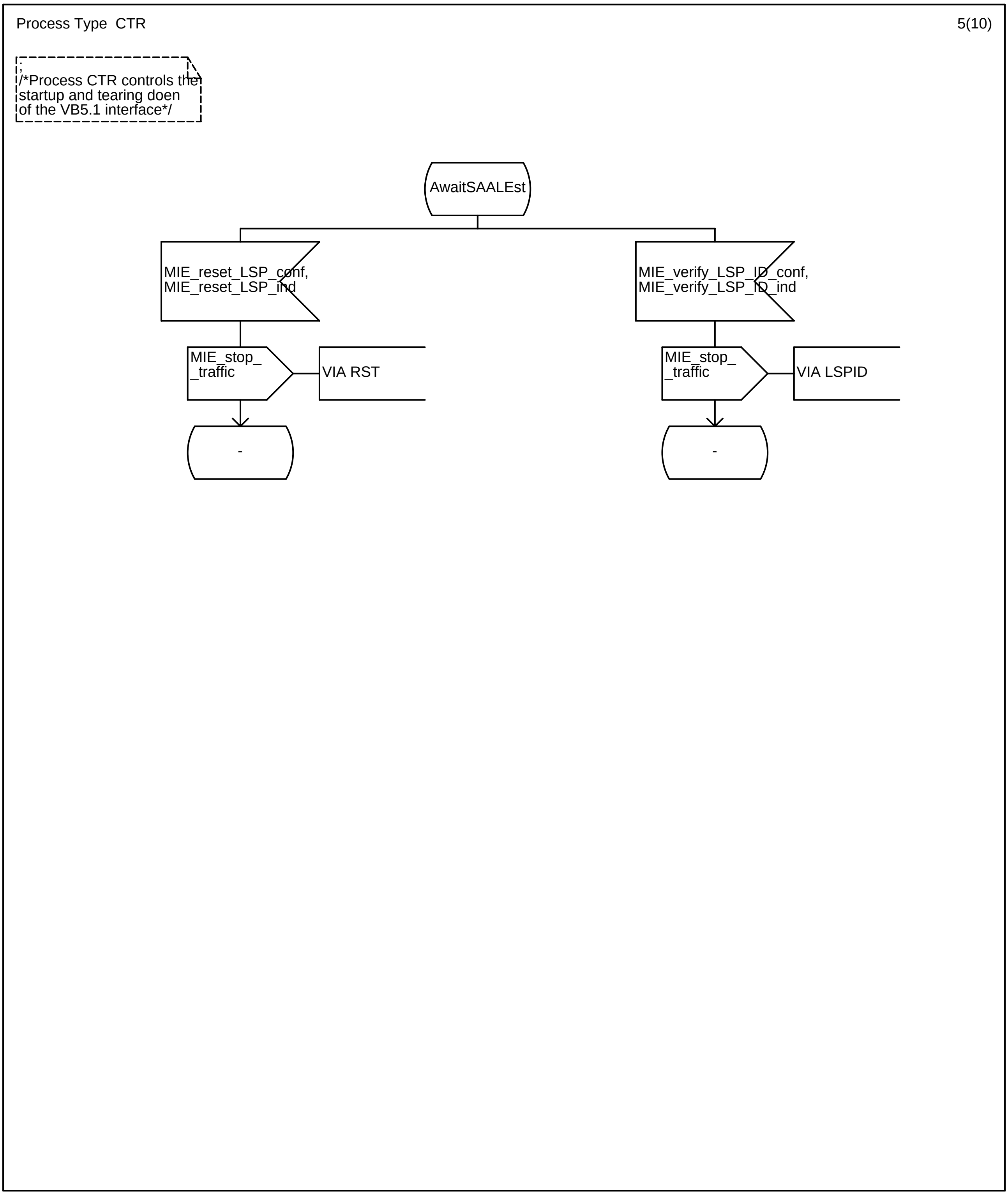


Figure A.188: CTR (5)

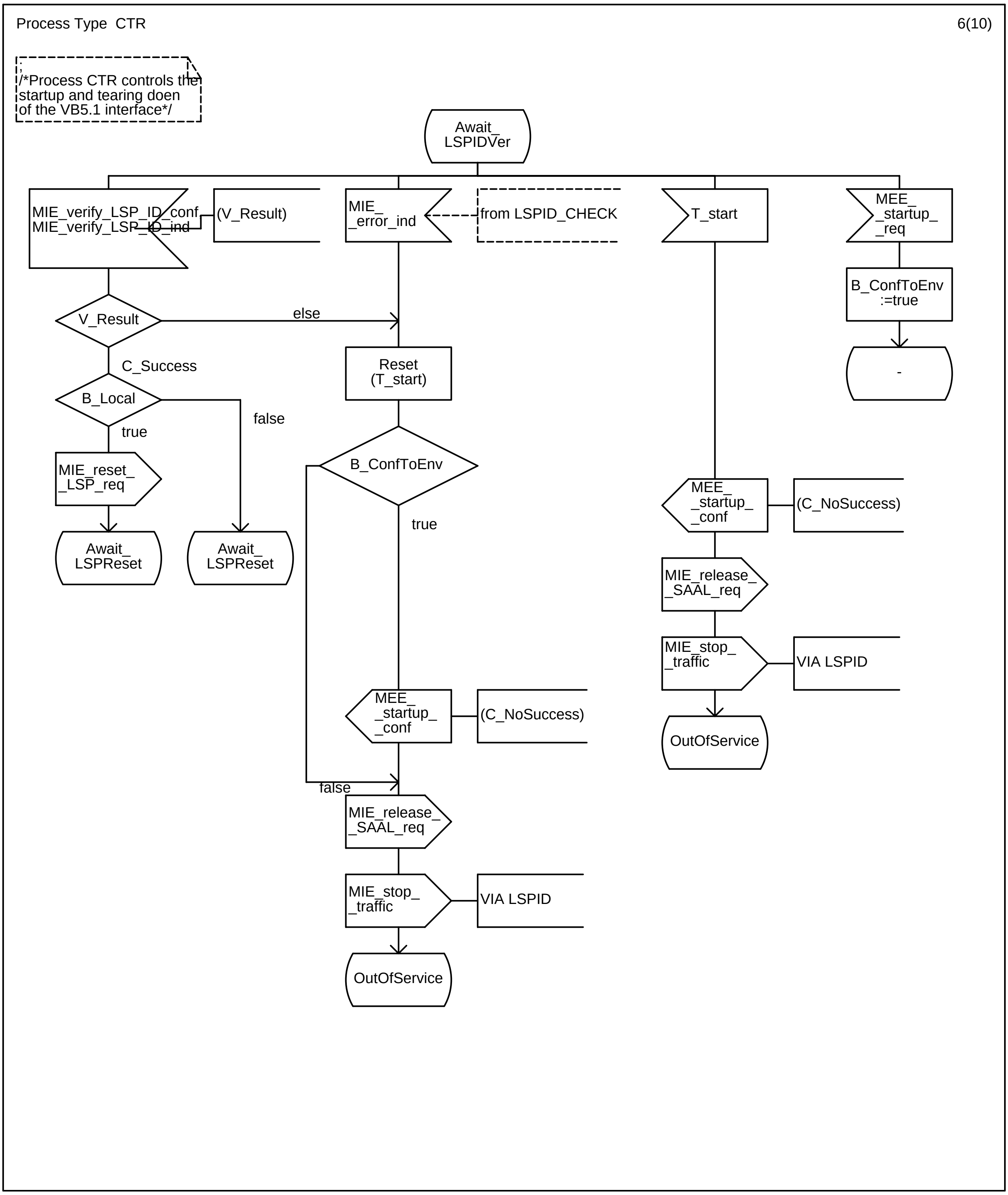


Figure A.189: CTR (6)

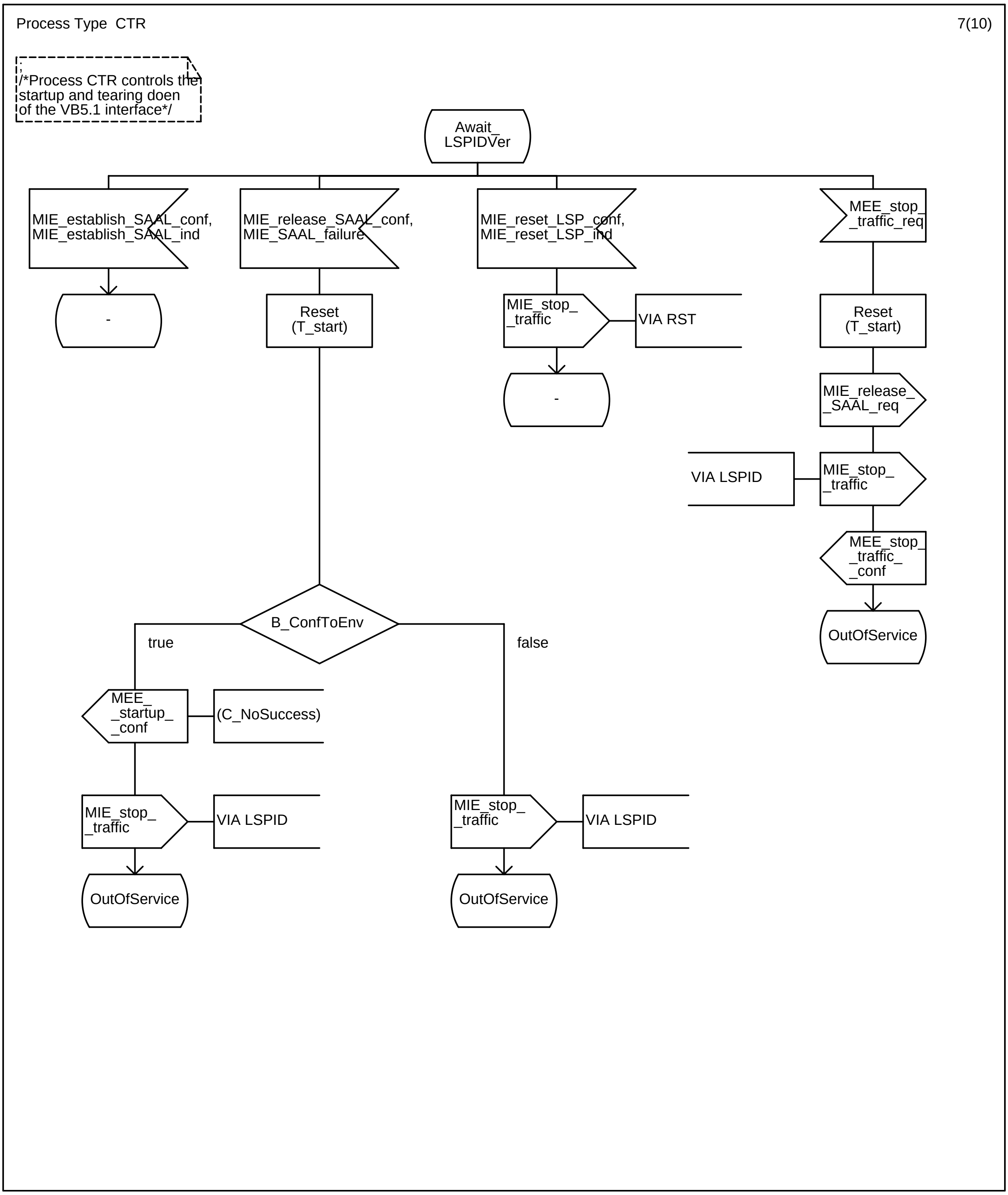


Figure A.190: CTR (7)

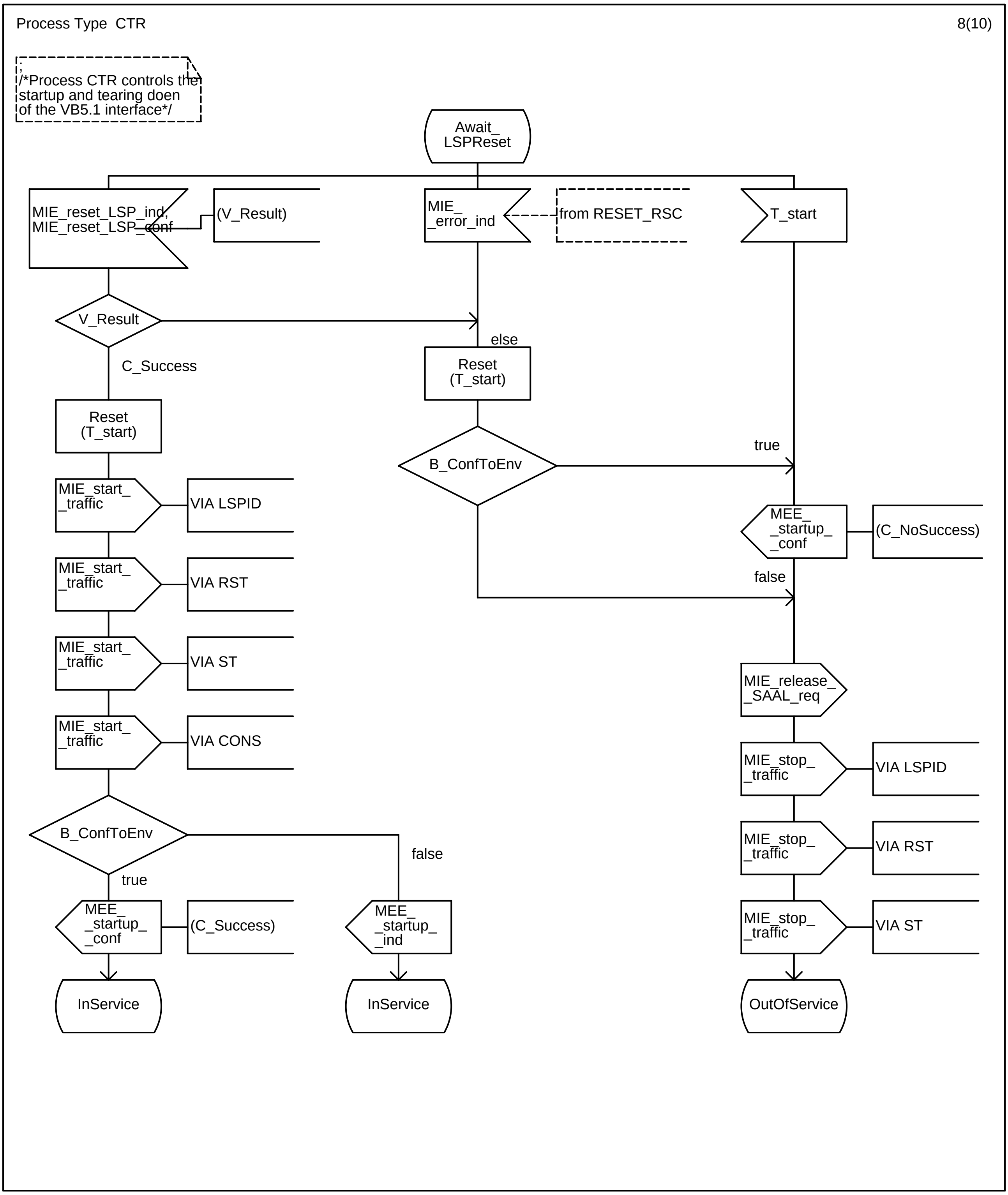


Figure A.191: CTR (8)

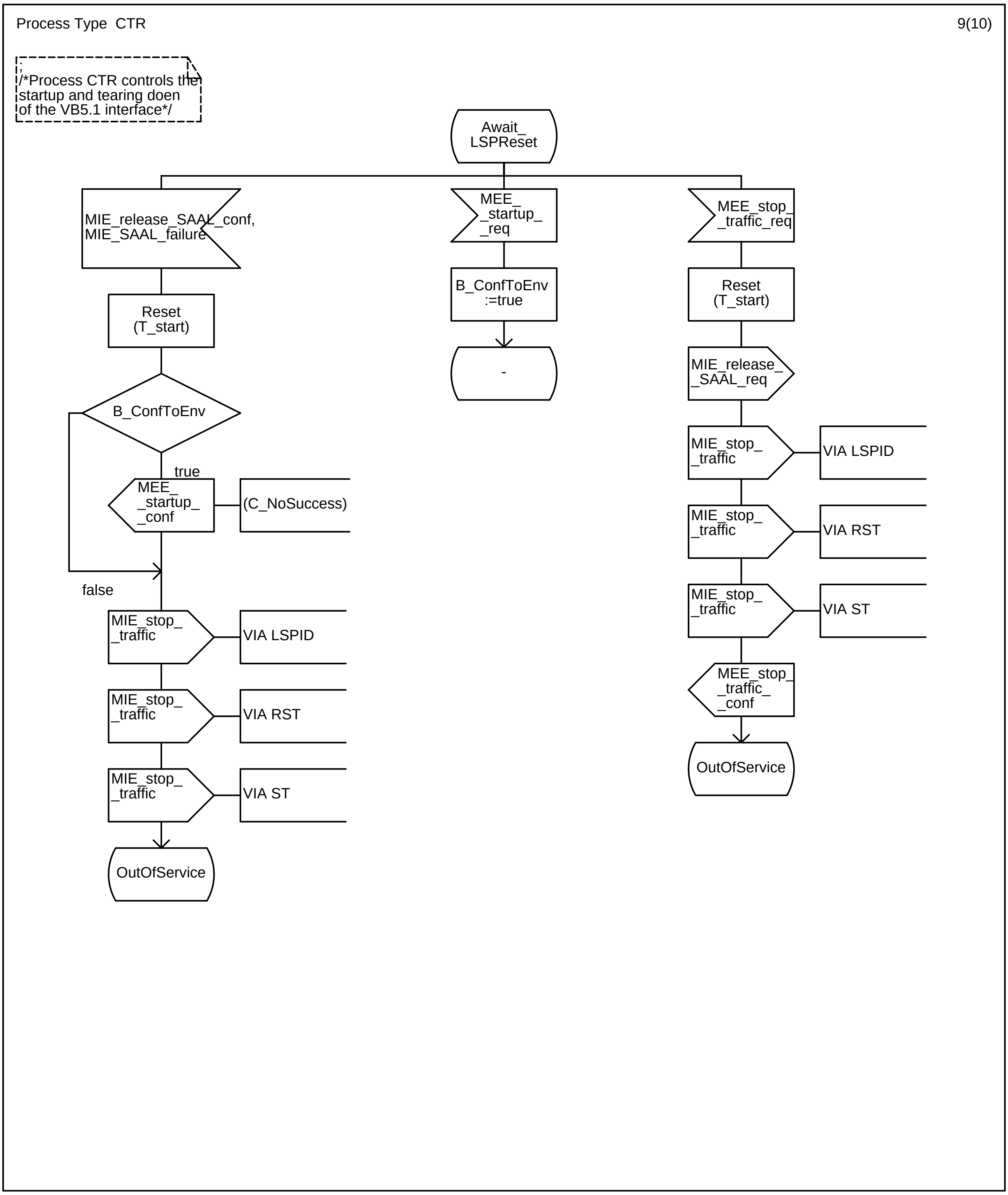


Figure A.192: CTR (9)

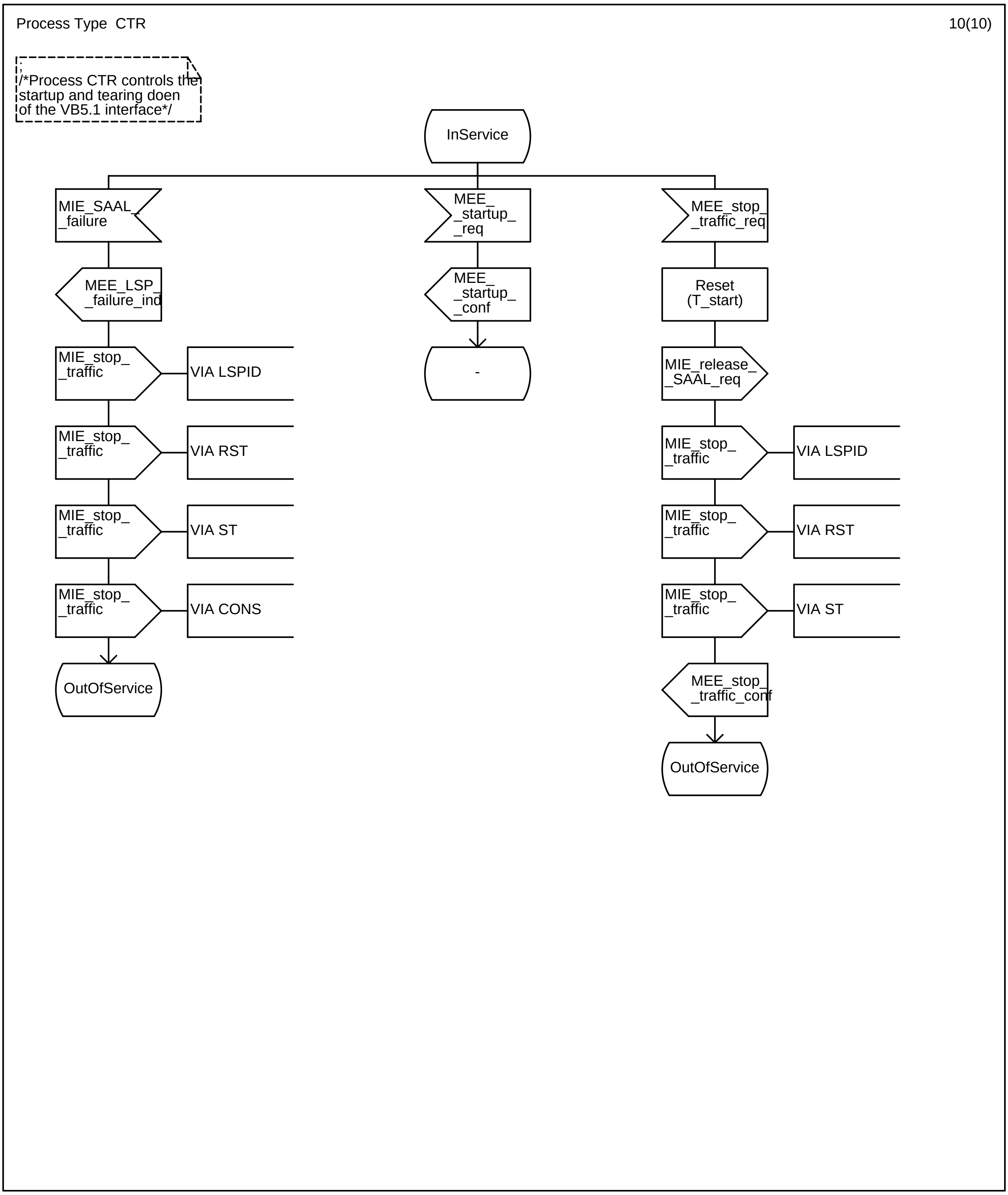


Figure A.193: CTR (10)

A.4.3 Process LSPID_CHECK

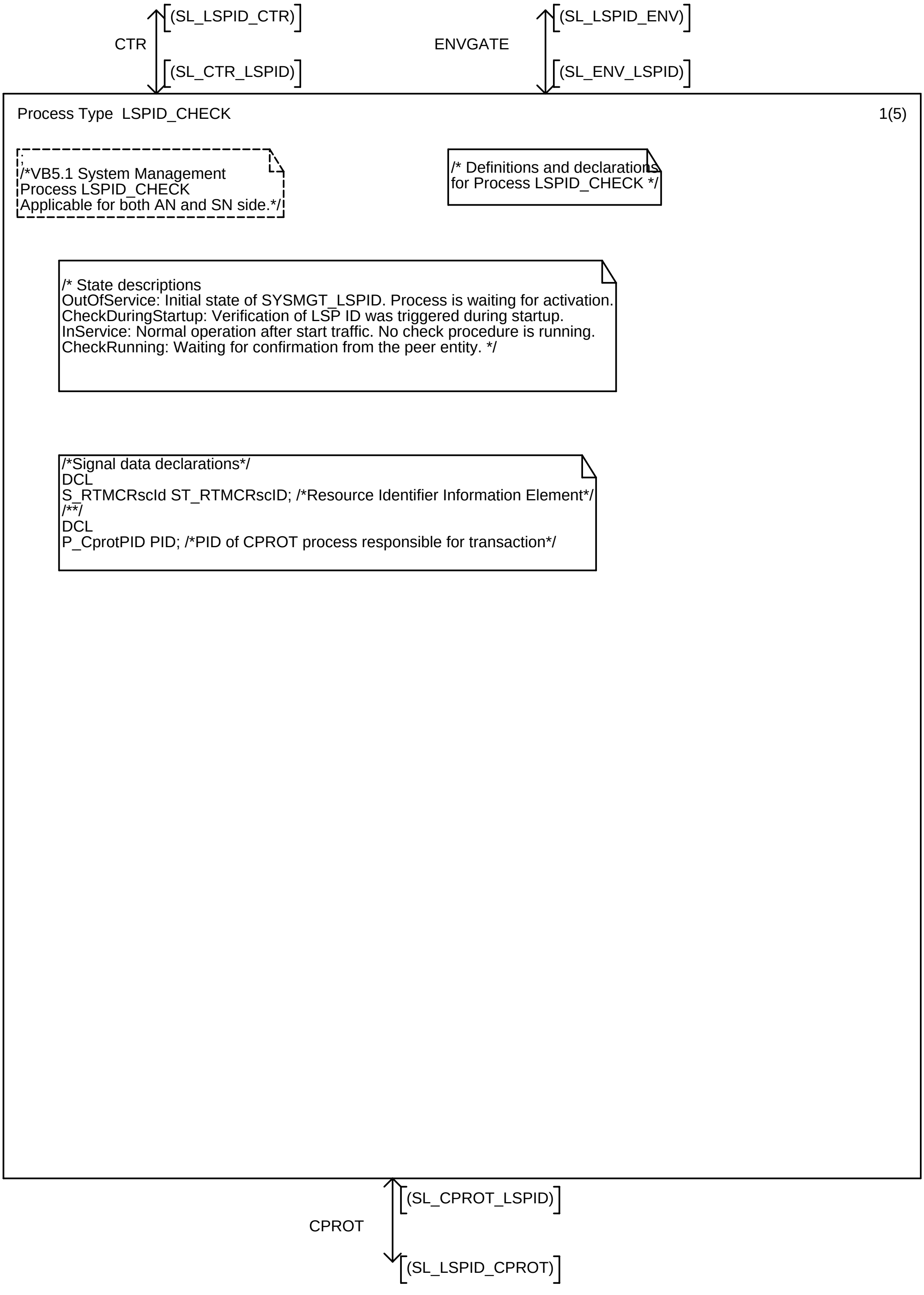


Figure A.194: LSPID_CHECK (1)

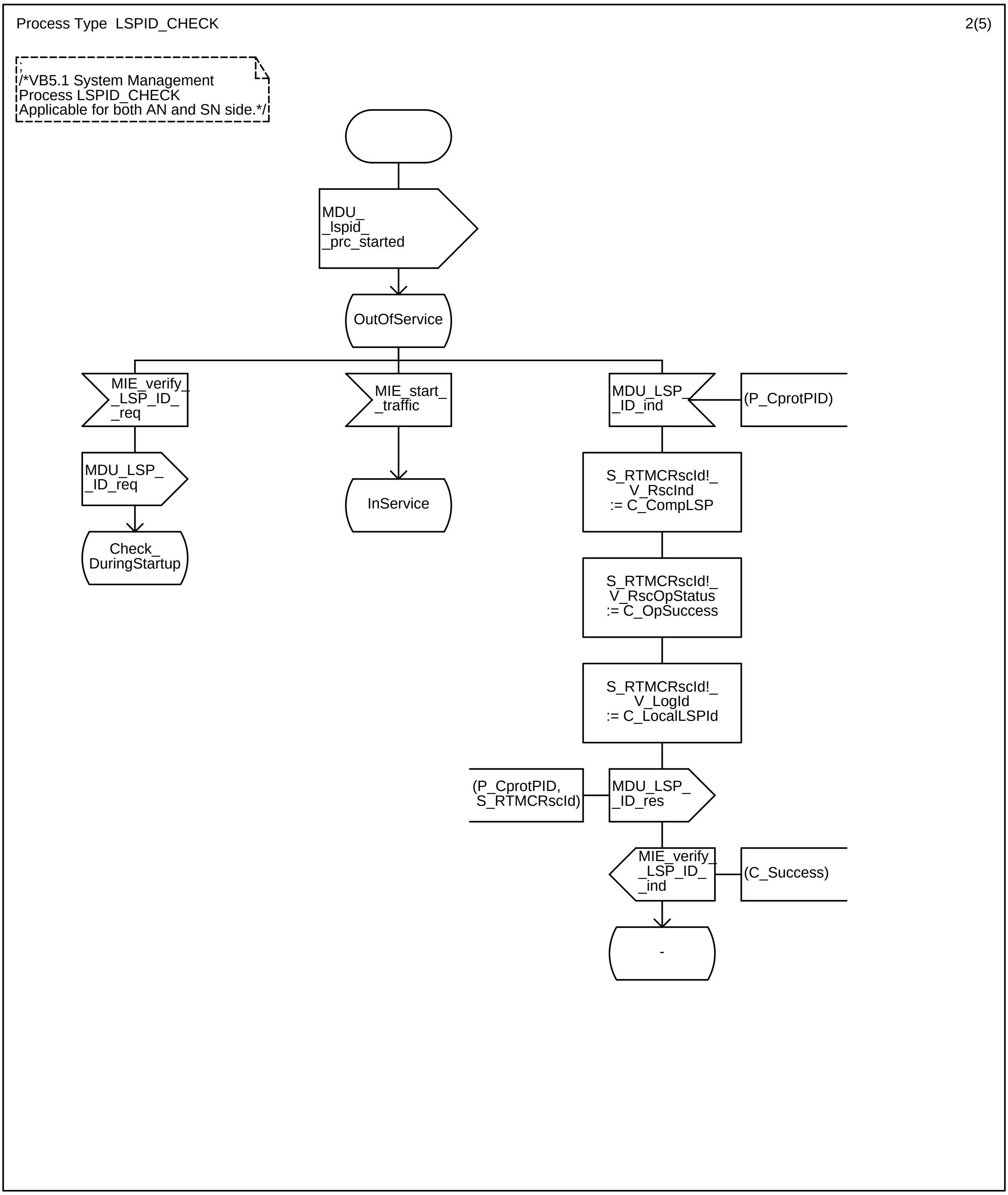


Figure A.195: LSPID_CHECK (2)

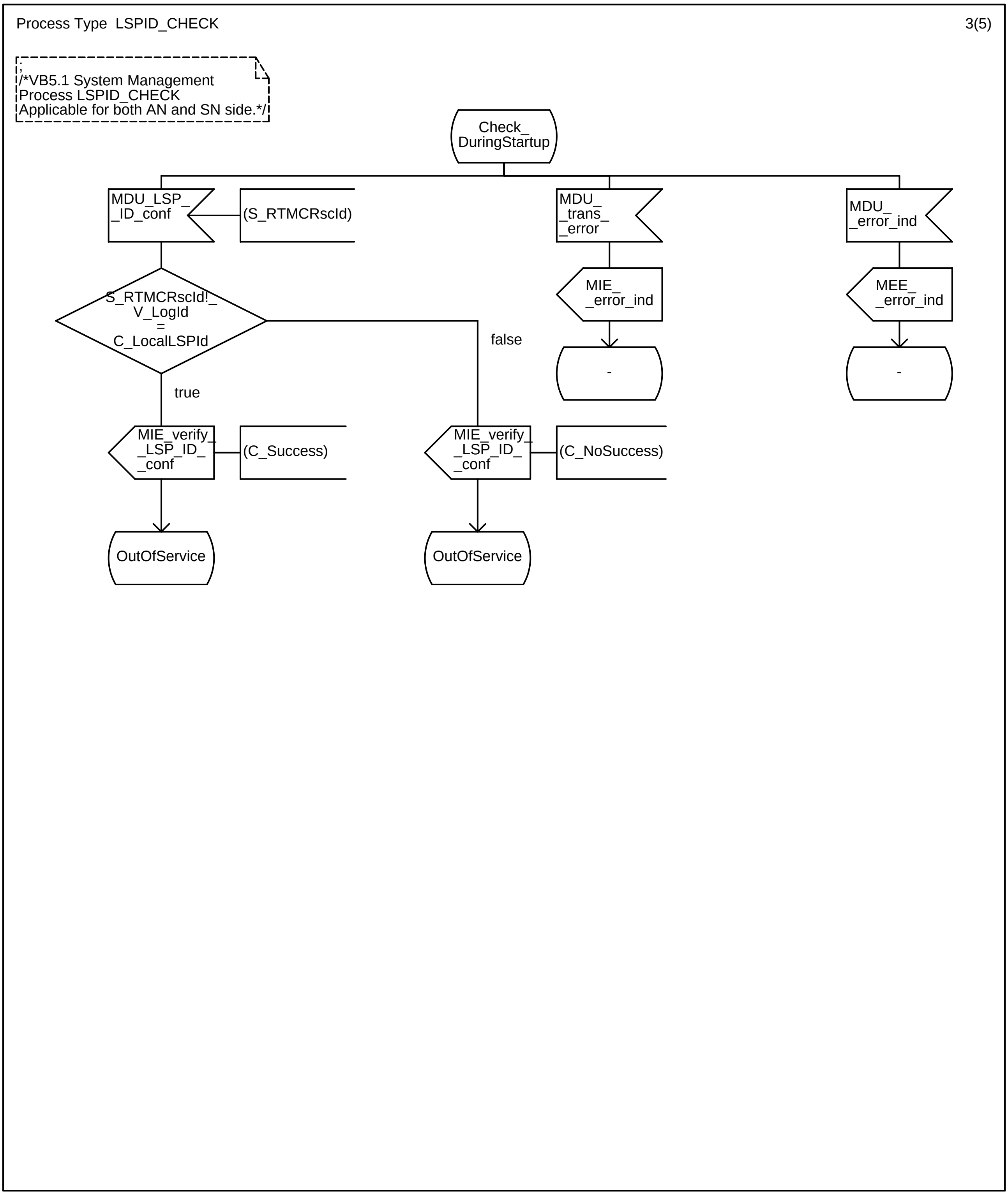


Figure A.196: LSPID_CHECK (3)

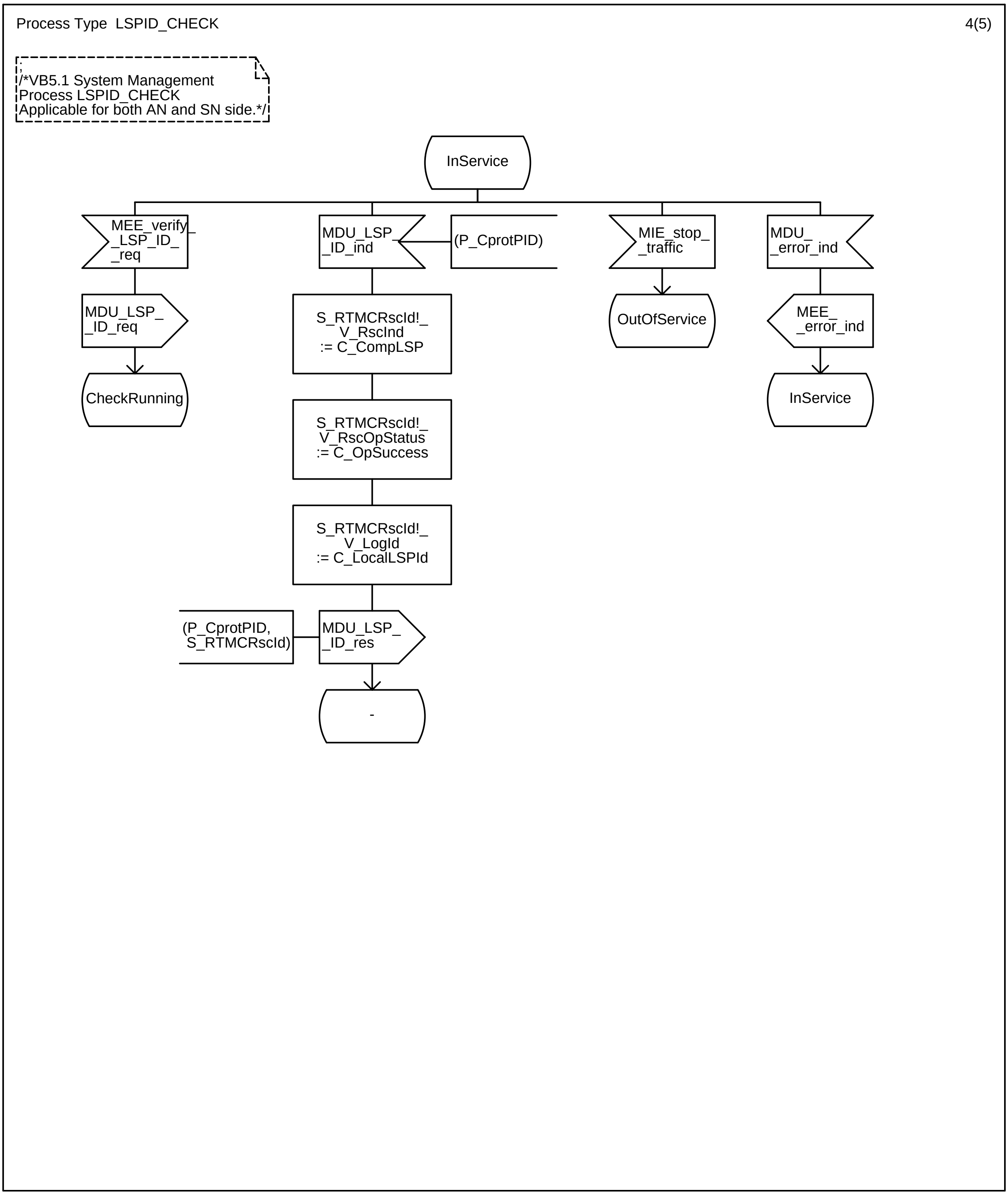


Figure A.197: LSPID_CHECK (4)

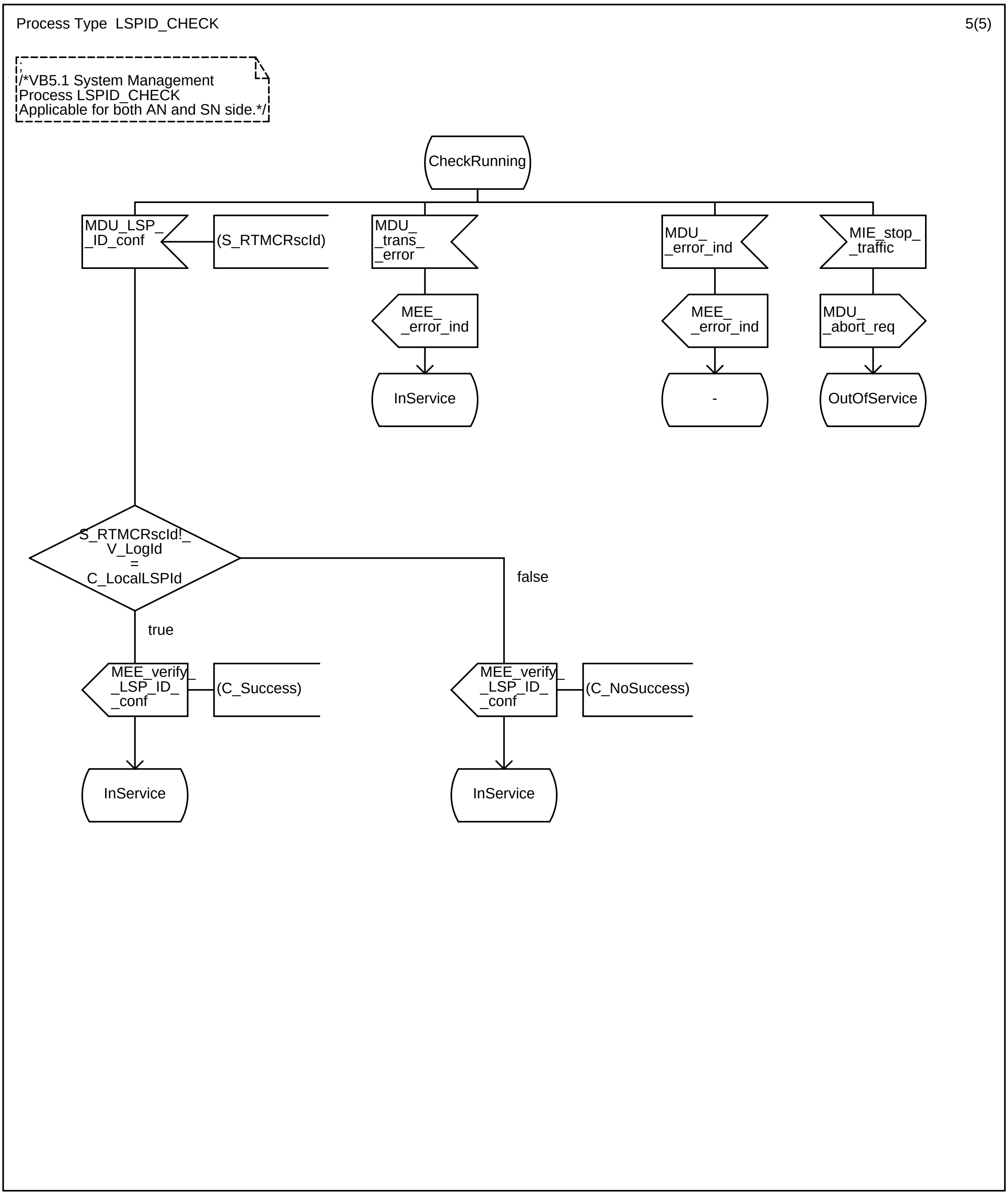


Figure A.198: LSPID_CHECK (5)

A.4.4 Process RESET_RSC

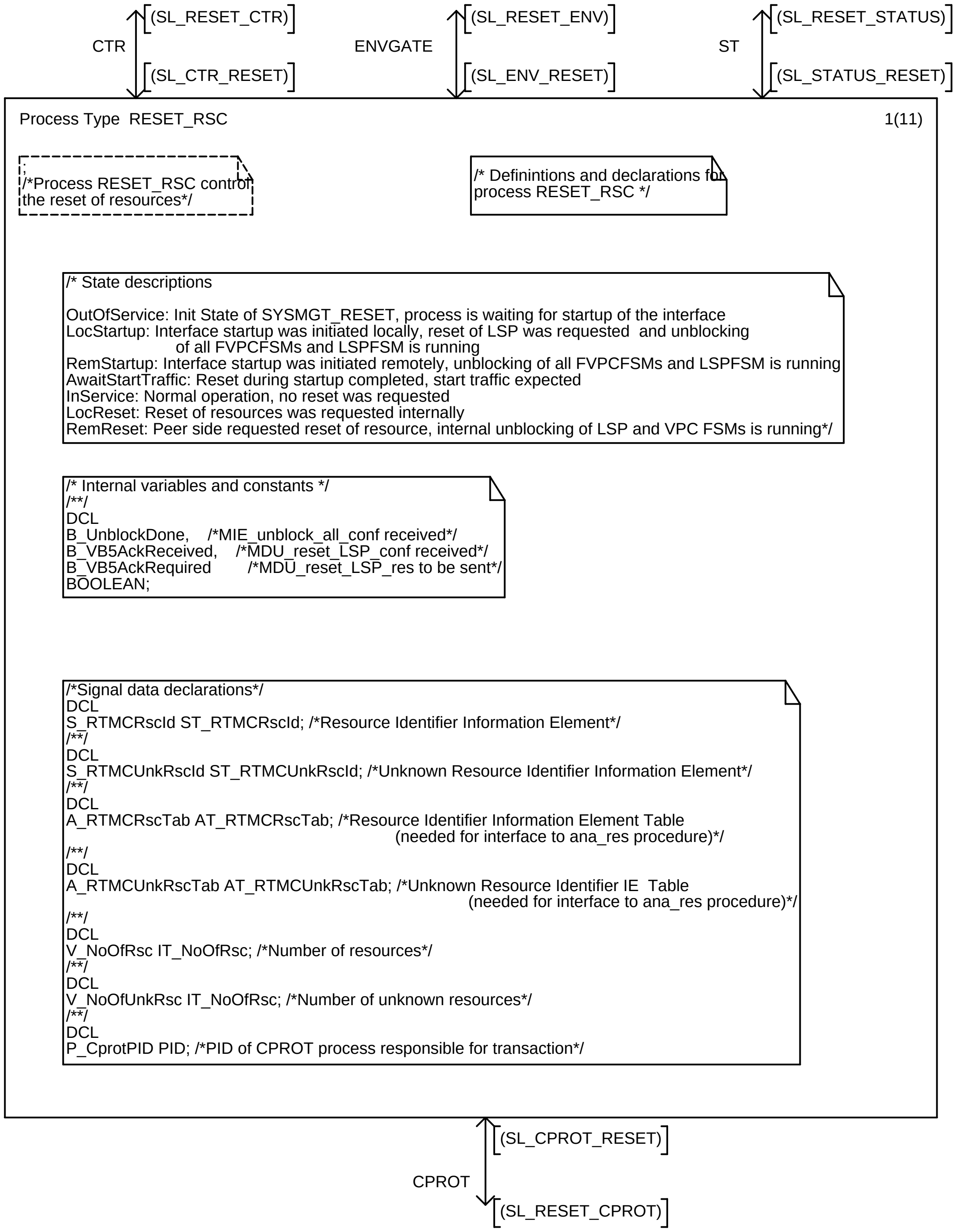


Figure A.199: RESET_RSC (1)

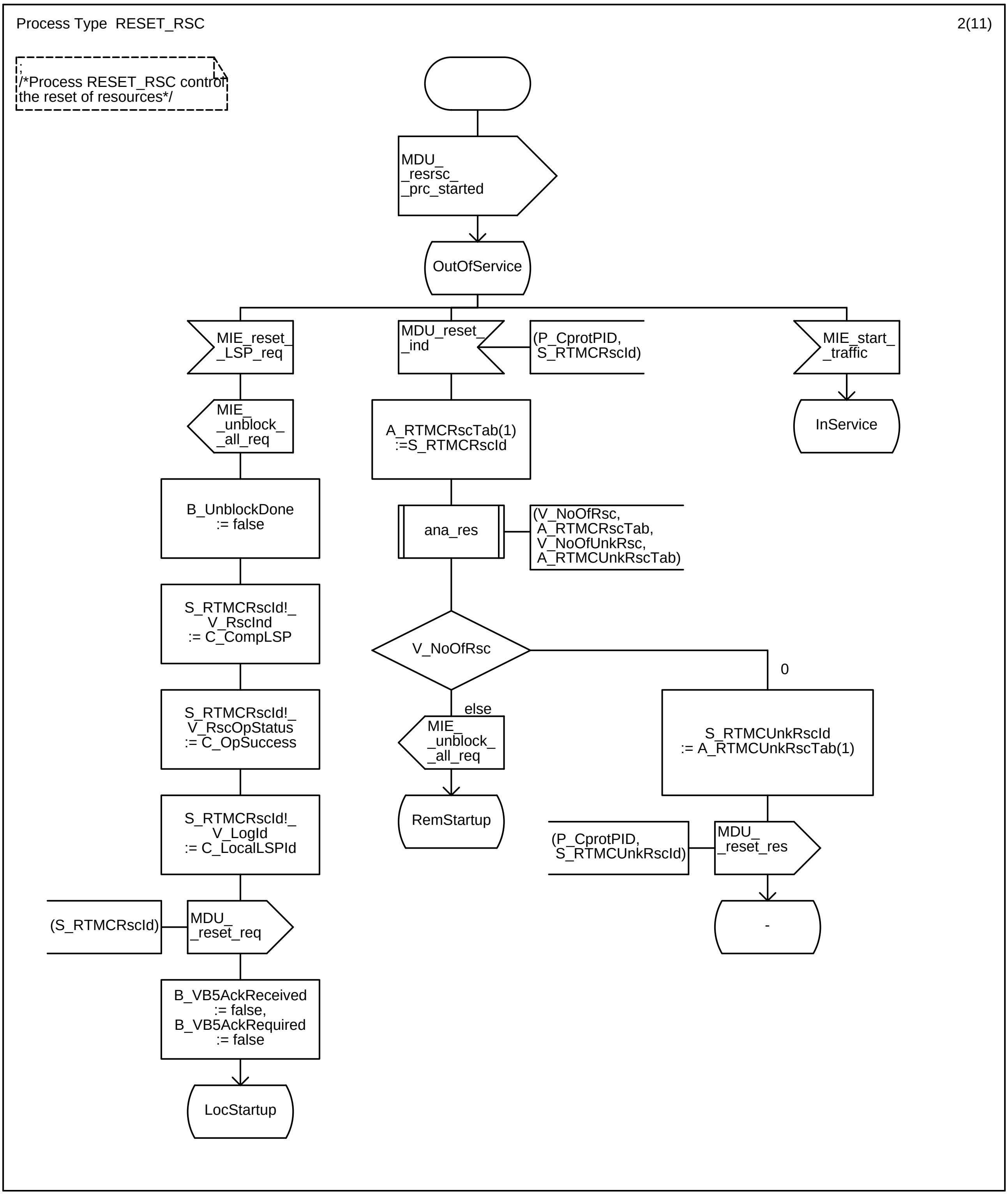


Figure A.200: RESET_RSC (2)

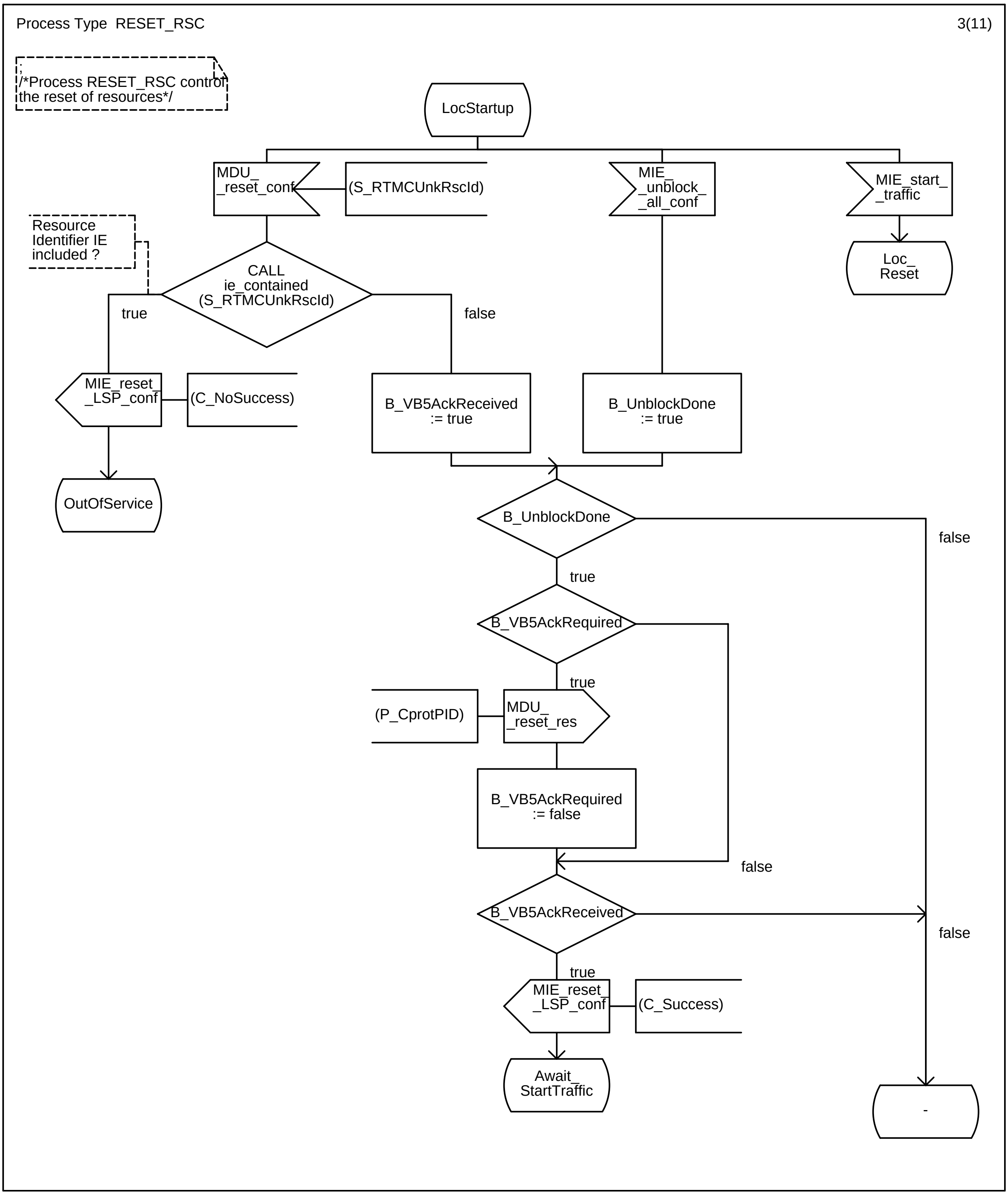


Figure A.201: RESET_RSC (3)

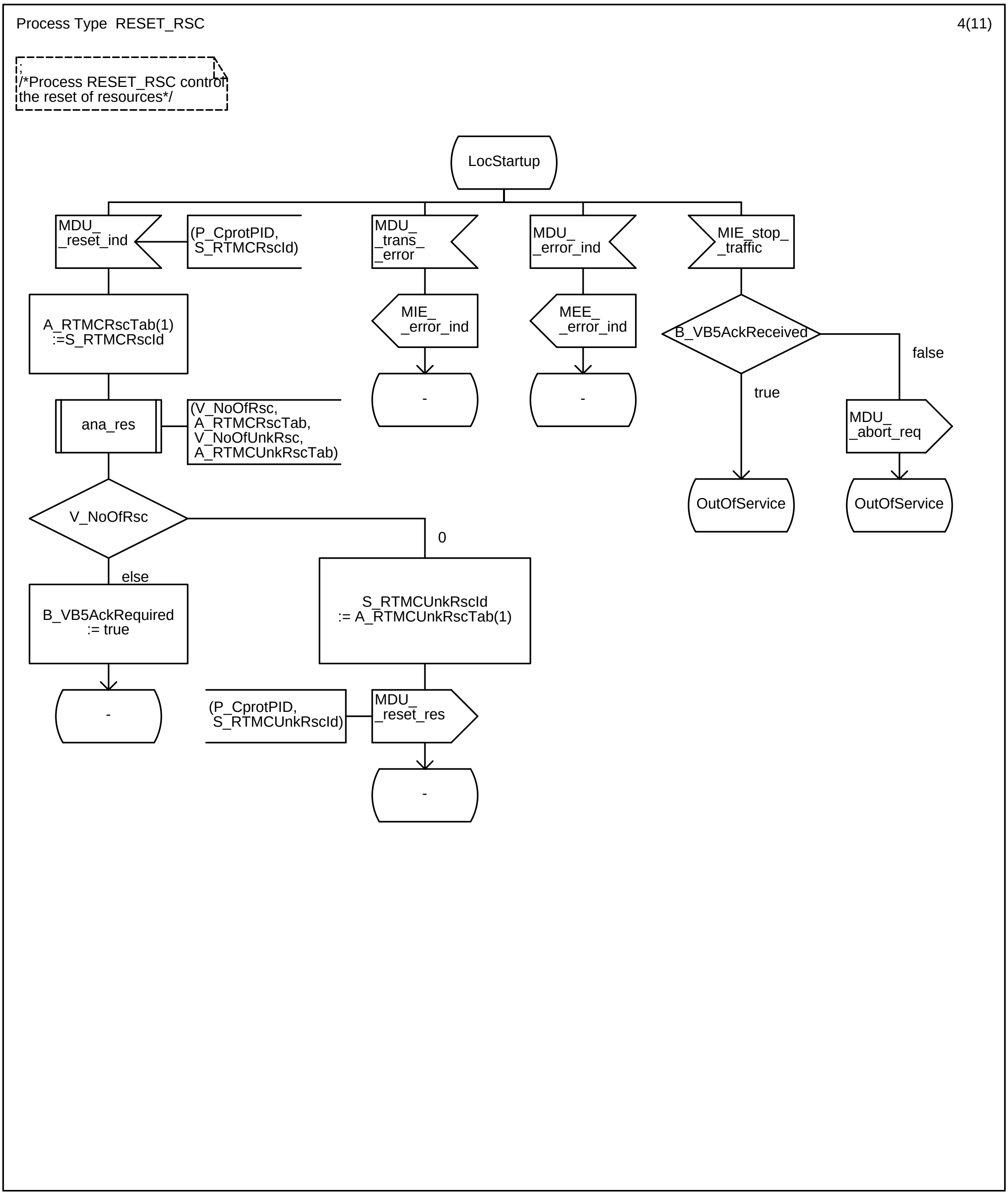


Figure A.202: RESET_RSC (4)

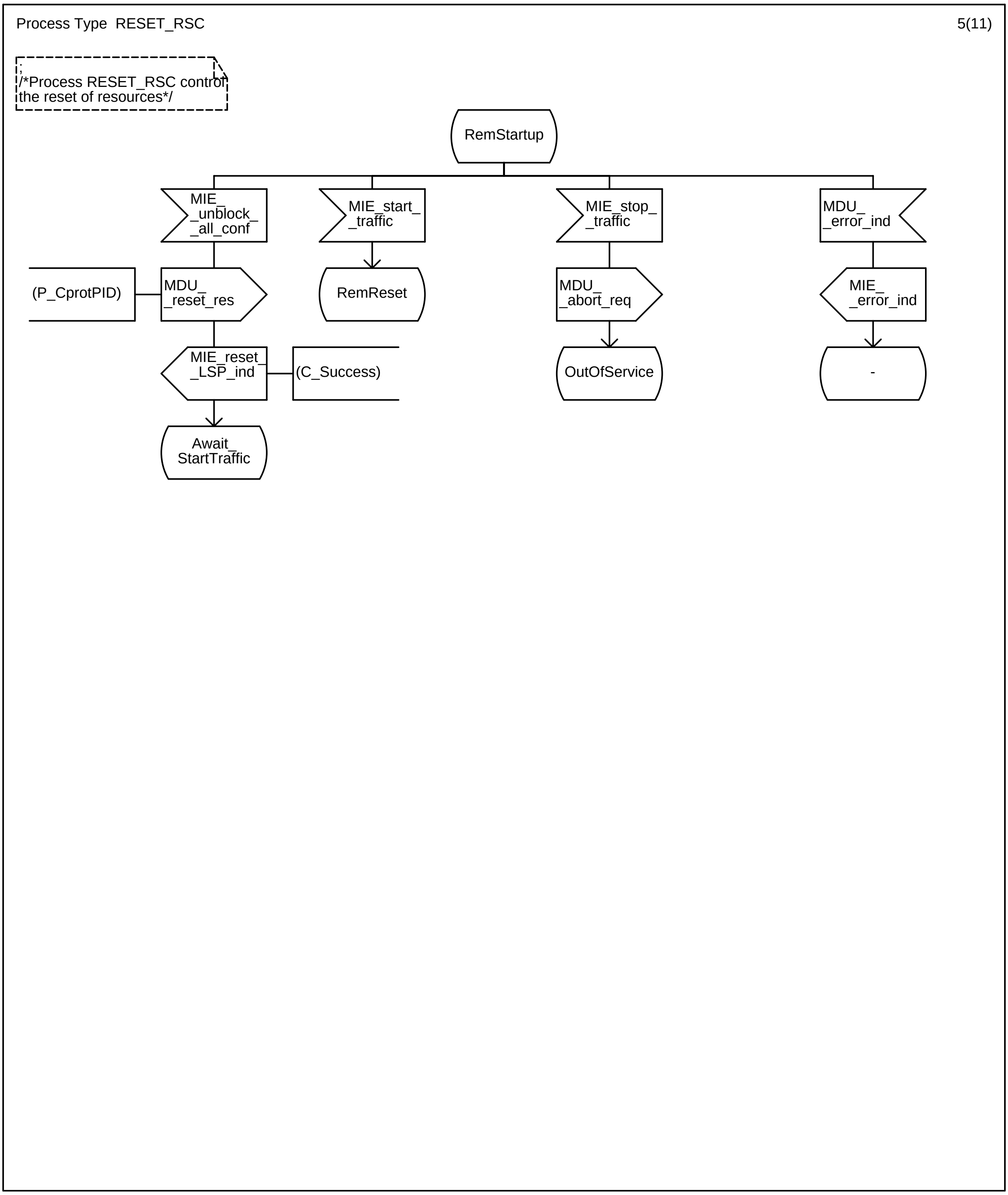


Figure A.203: RESET_RSC (5)

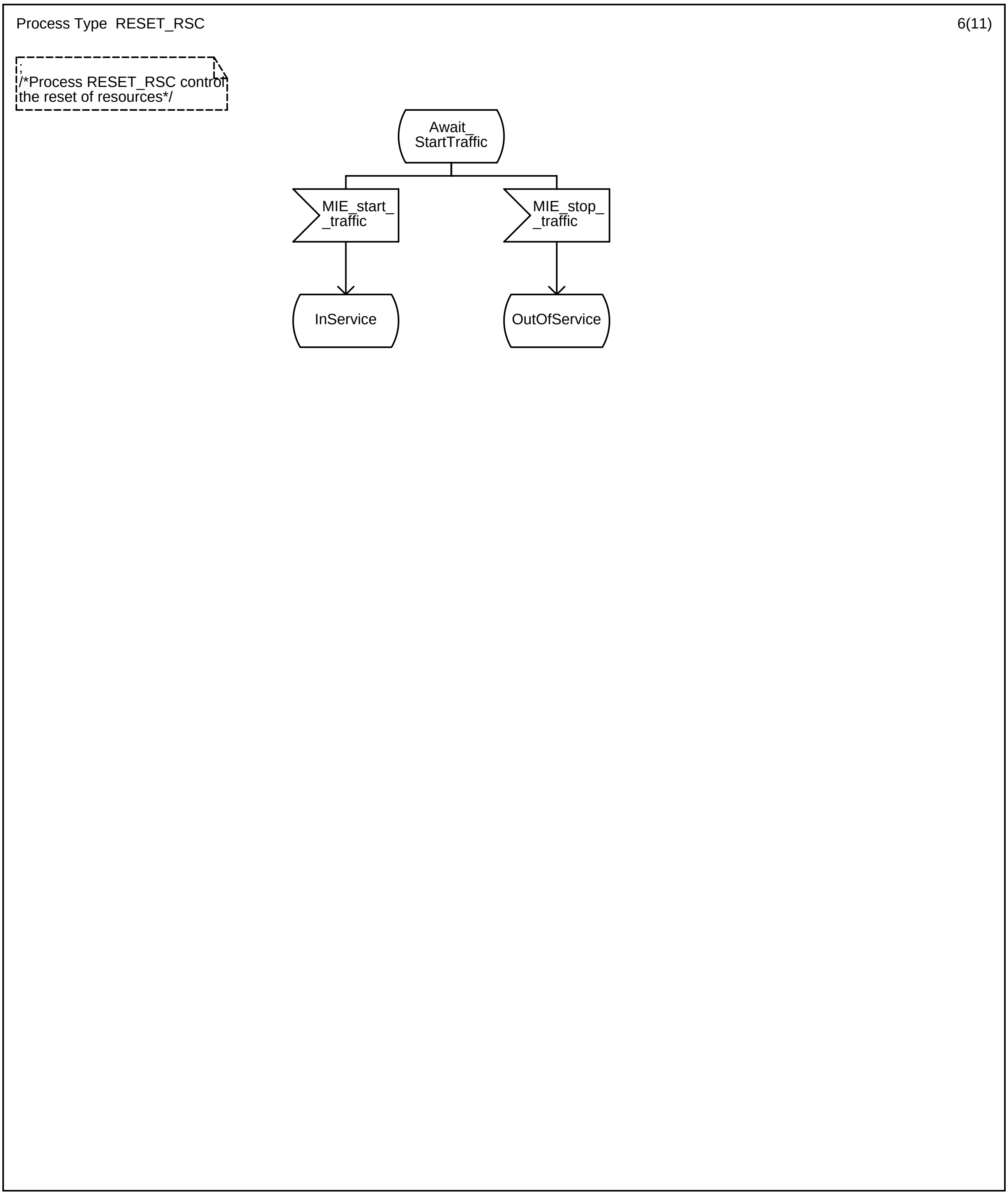


Figure A.204: RESET_RSC (6)

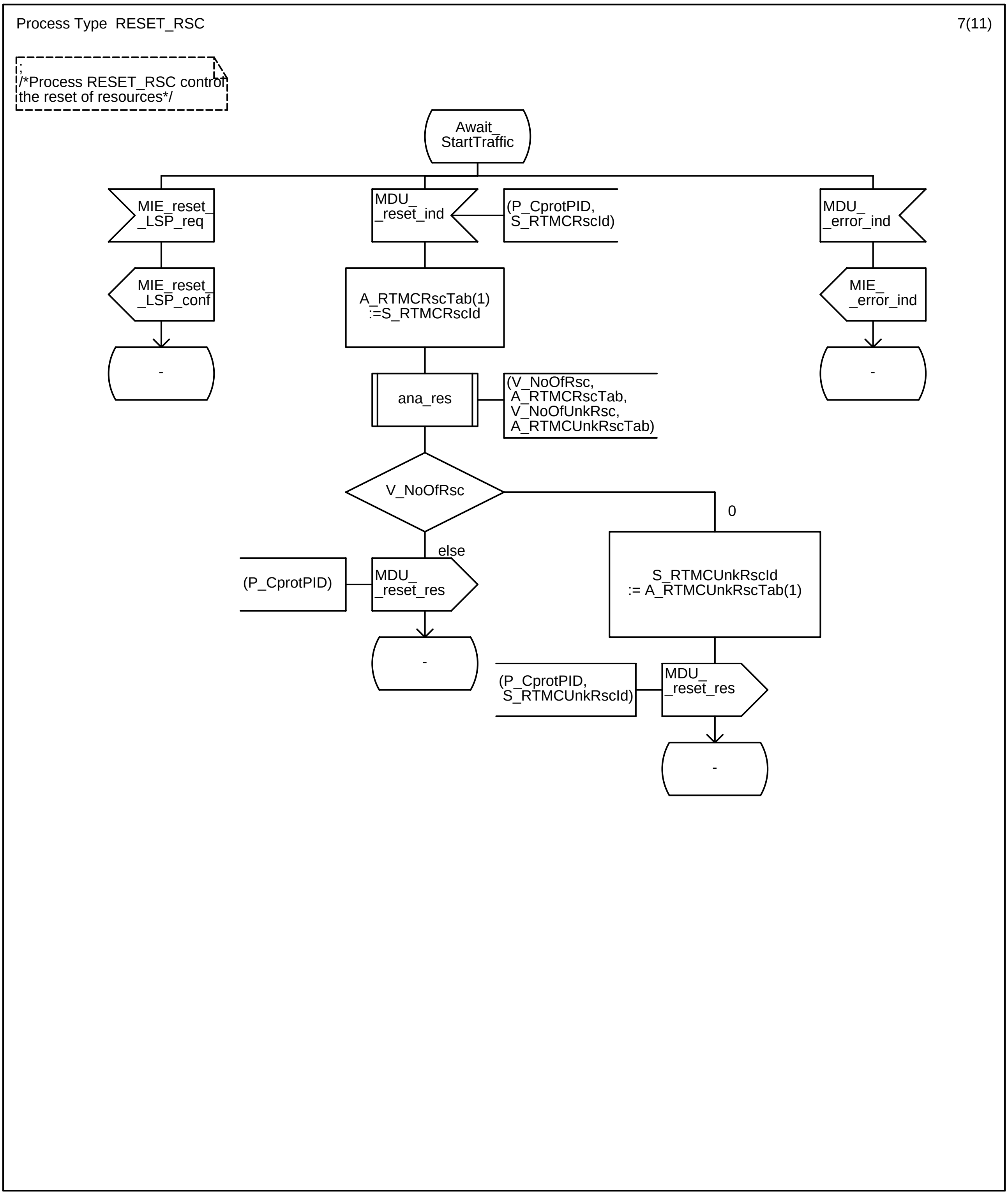


Figure A.205: RESET_RSC (7)

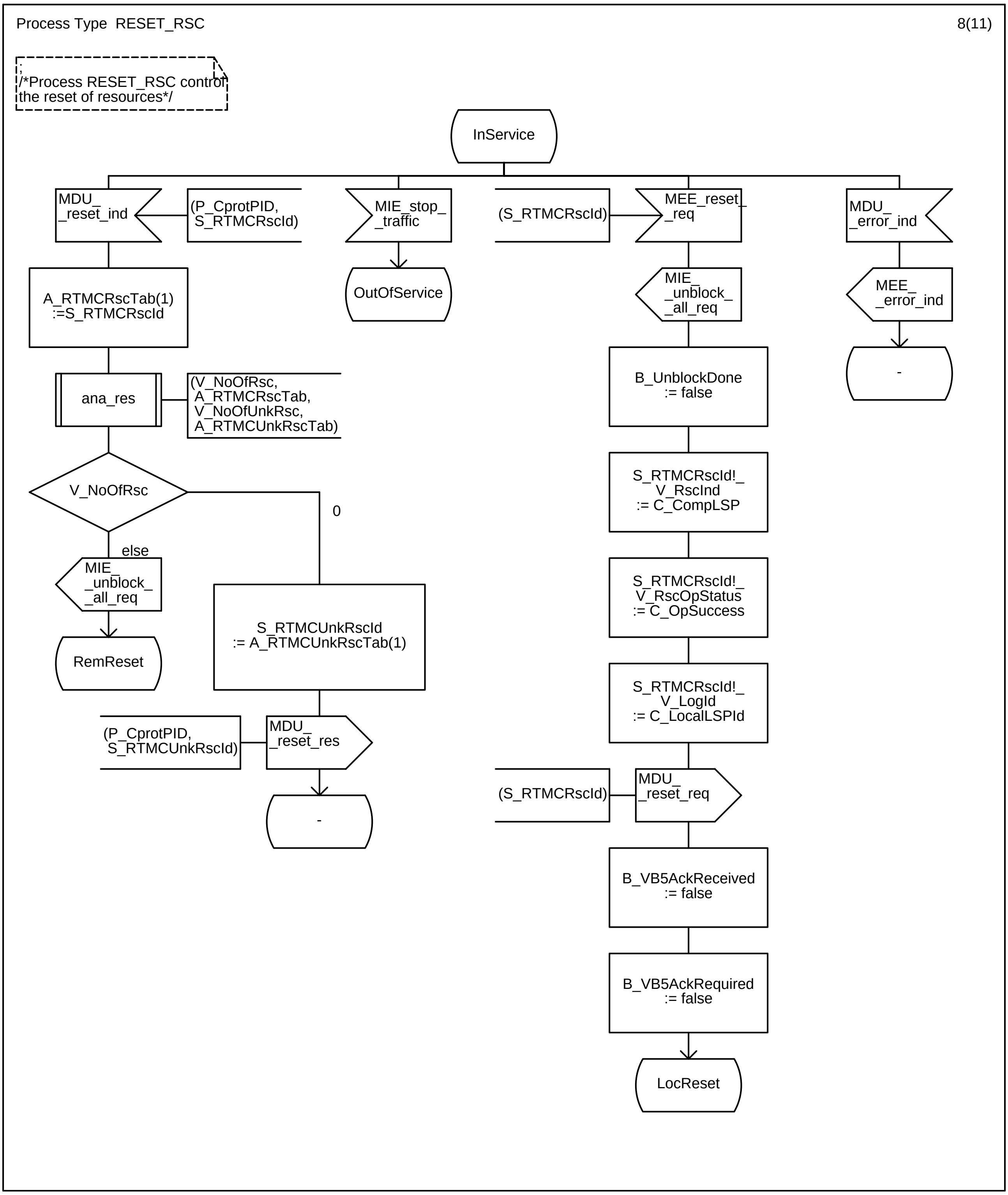


Figure A.206: RESET_RSC (8)

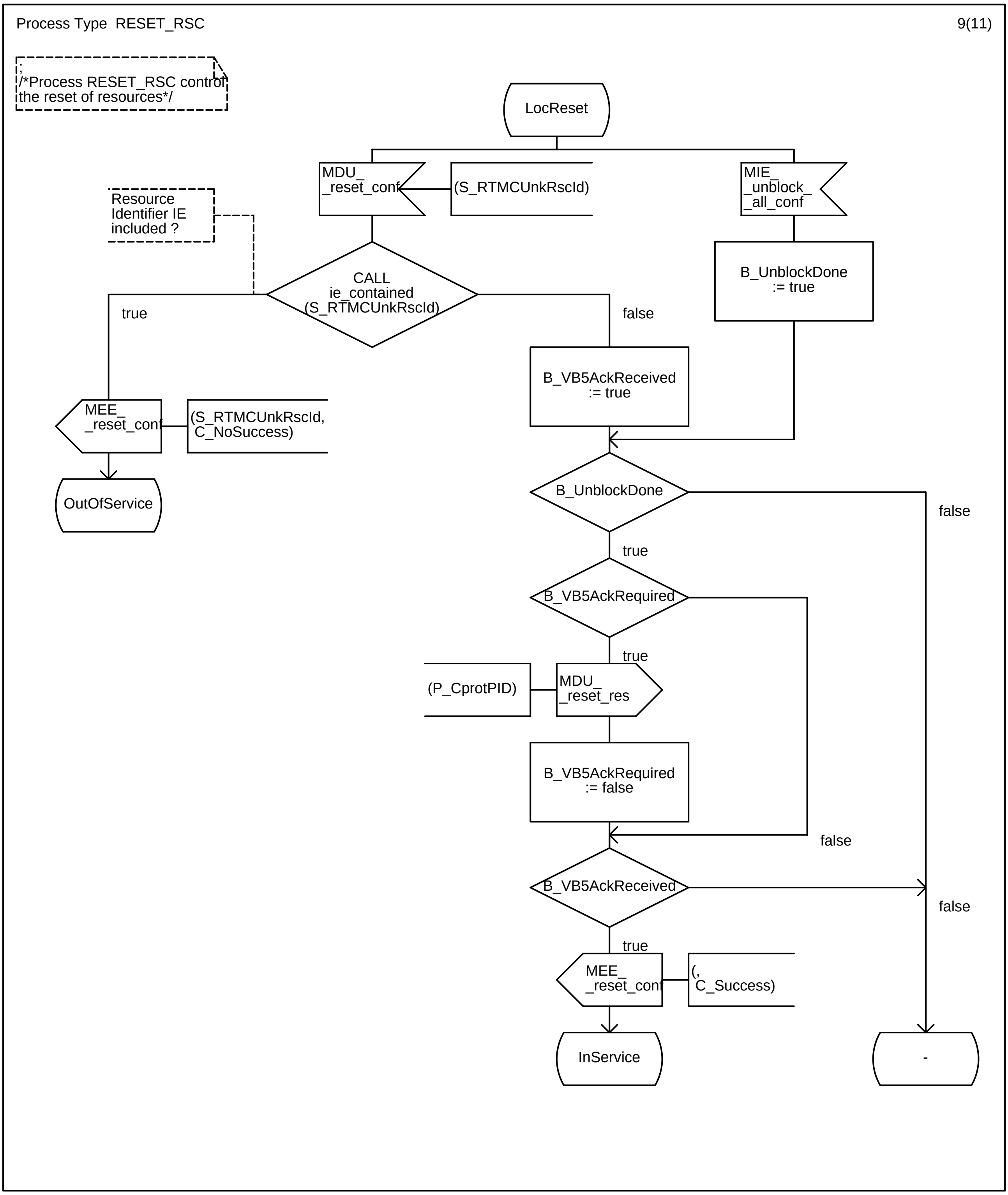


Figure A.207: RESET_RSC (9)

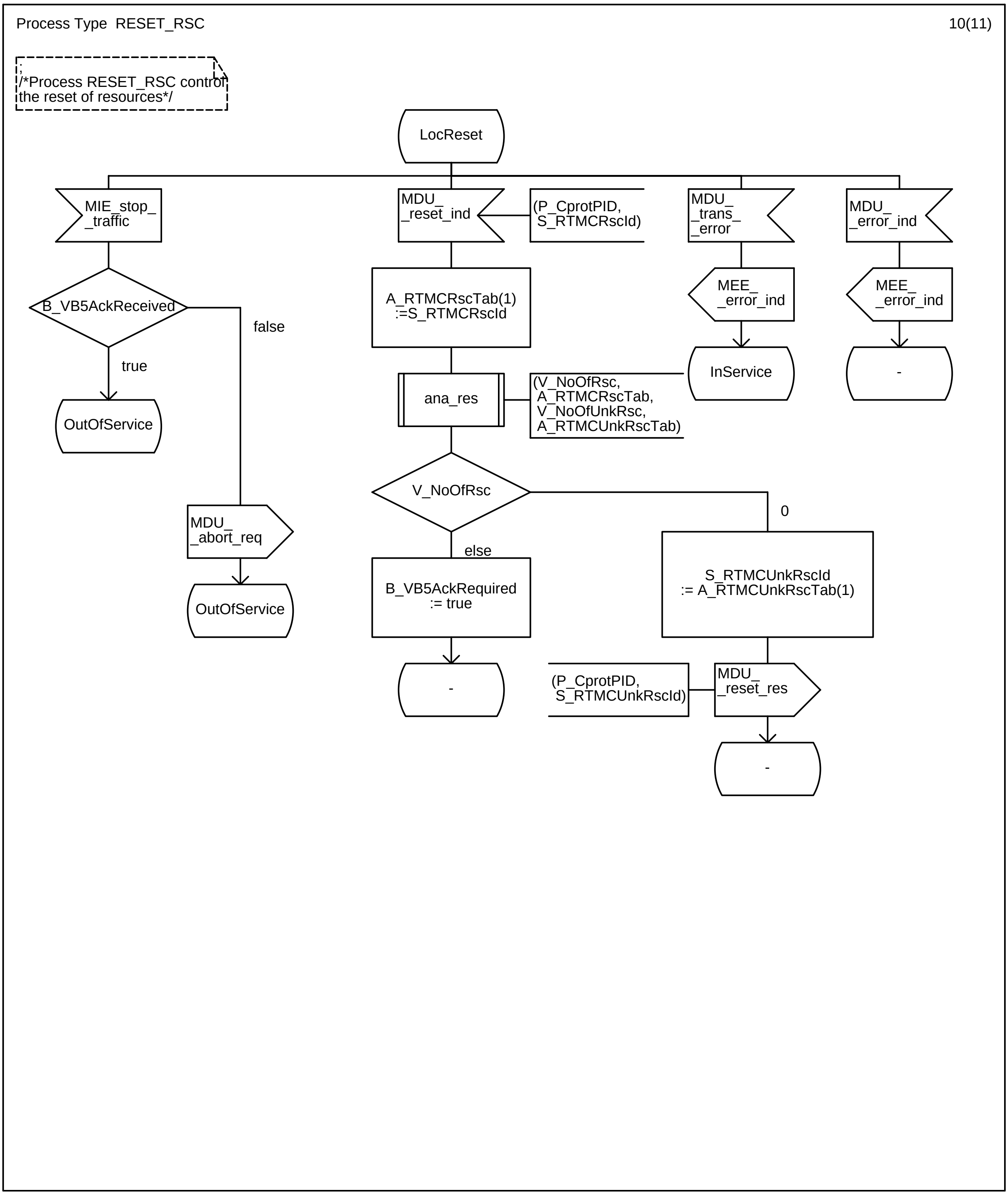


Figure A.208: RESET_RSC (10)

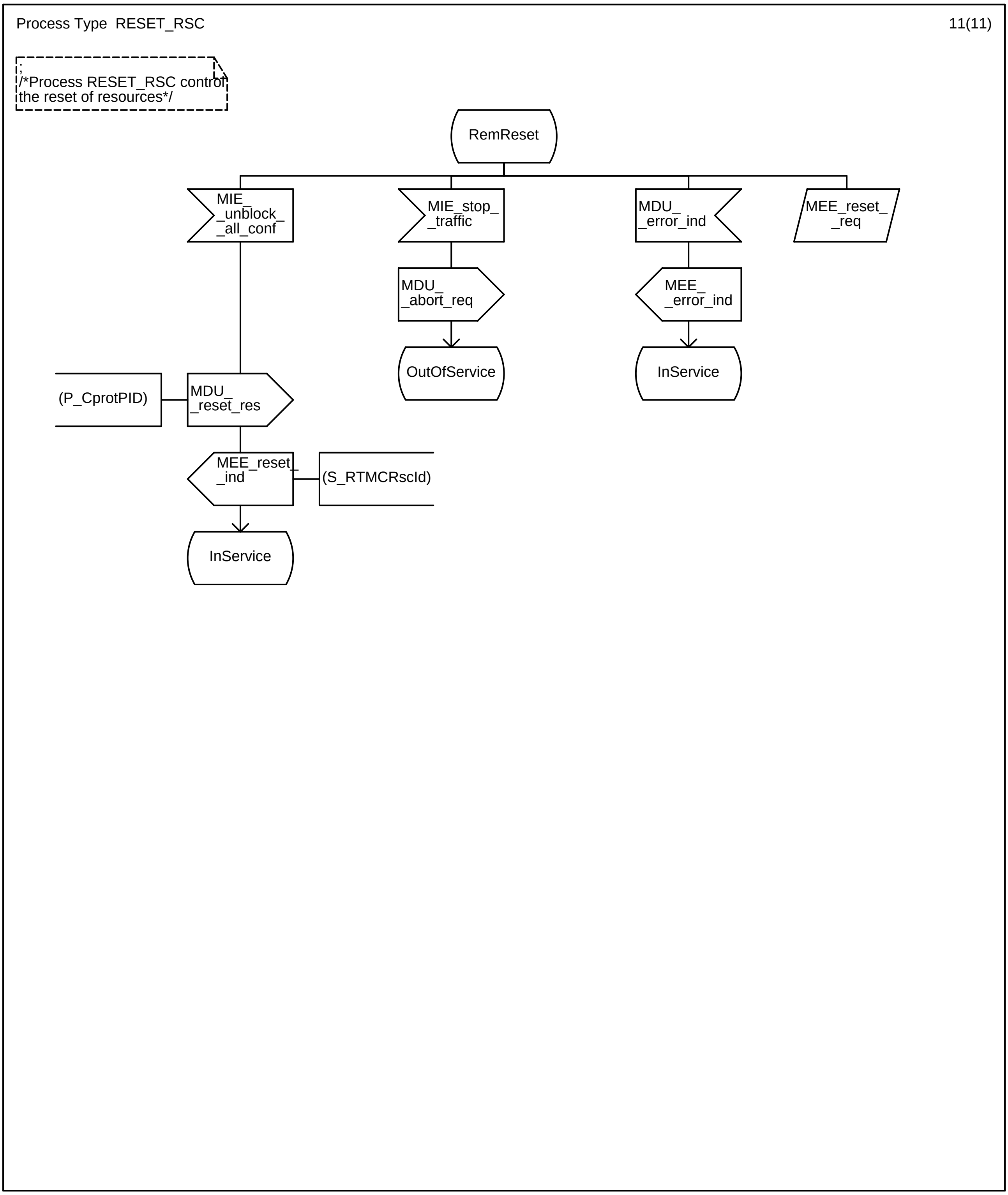


Figure A.209: RESET_RSC (11)

A.4.5 Process SAAL_MGT

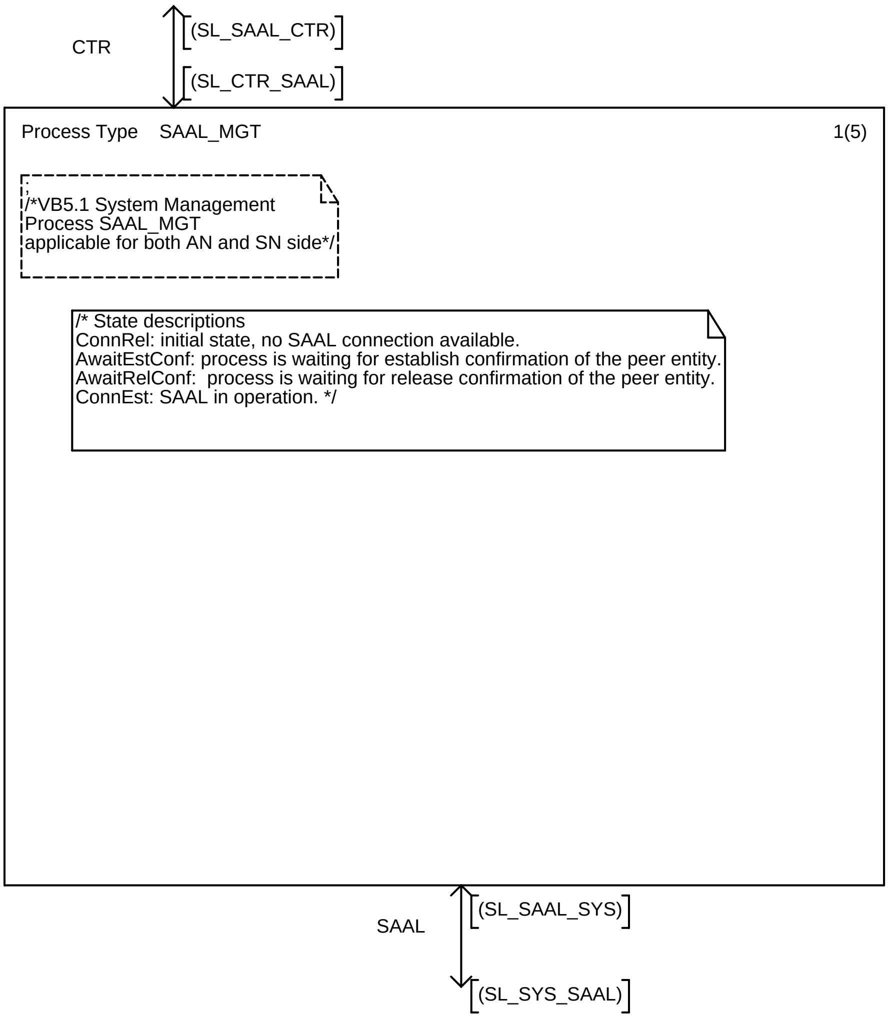


Figure A.210: SAAL_MGT (1)

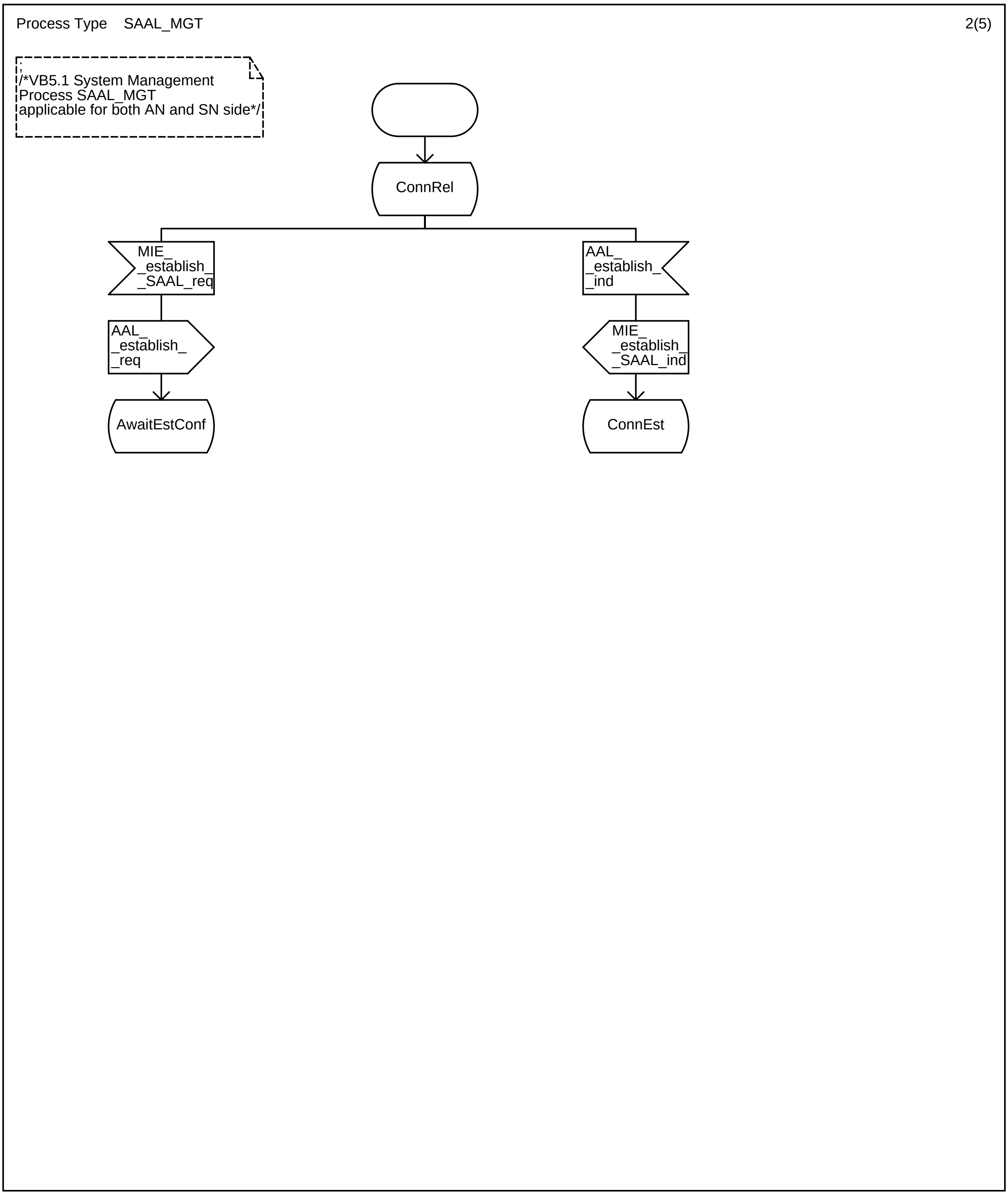


Figure A.211: SAAL_MGT (2)

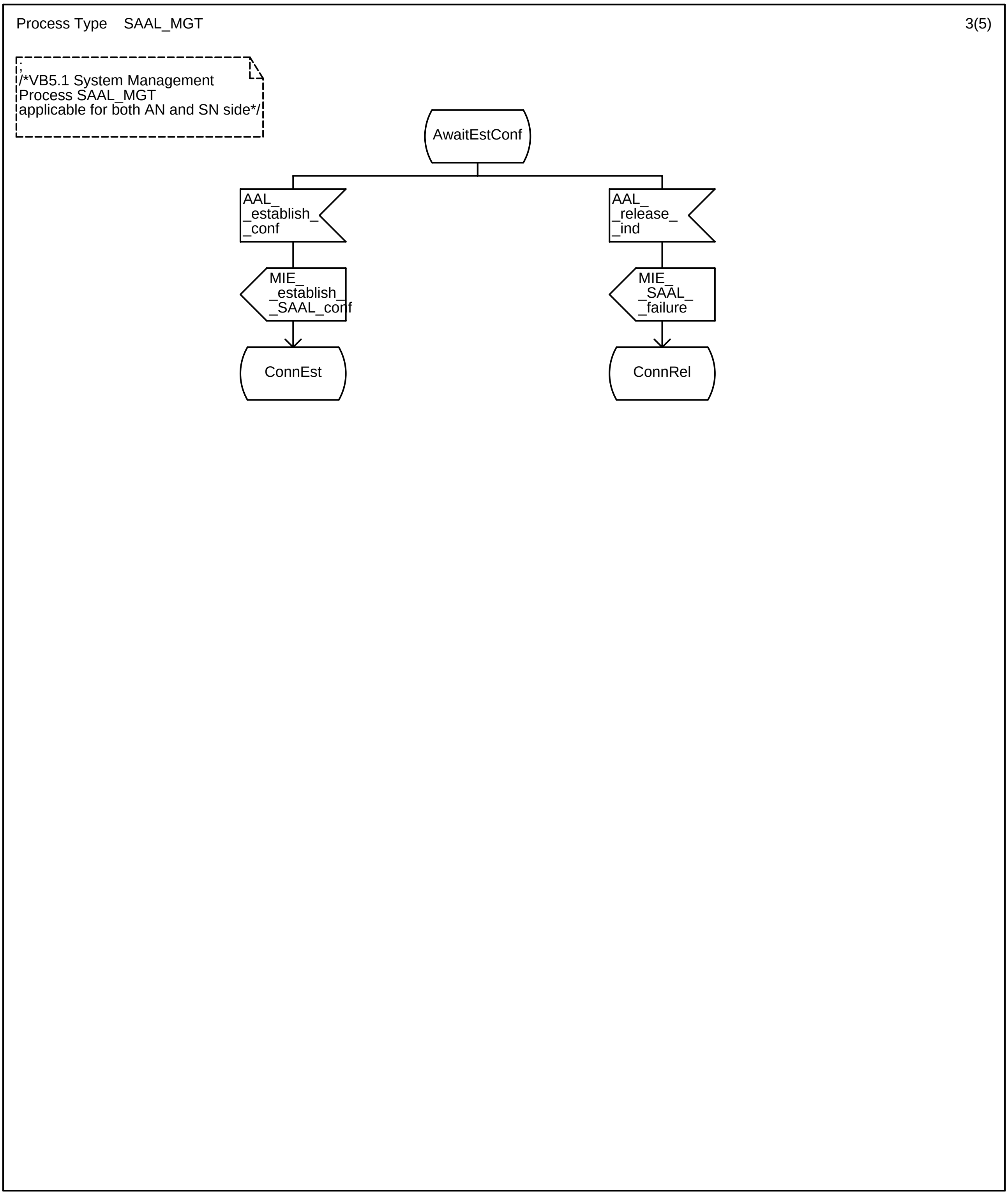


Figure A.212: SAAL_MGT (3)

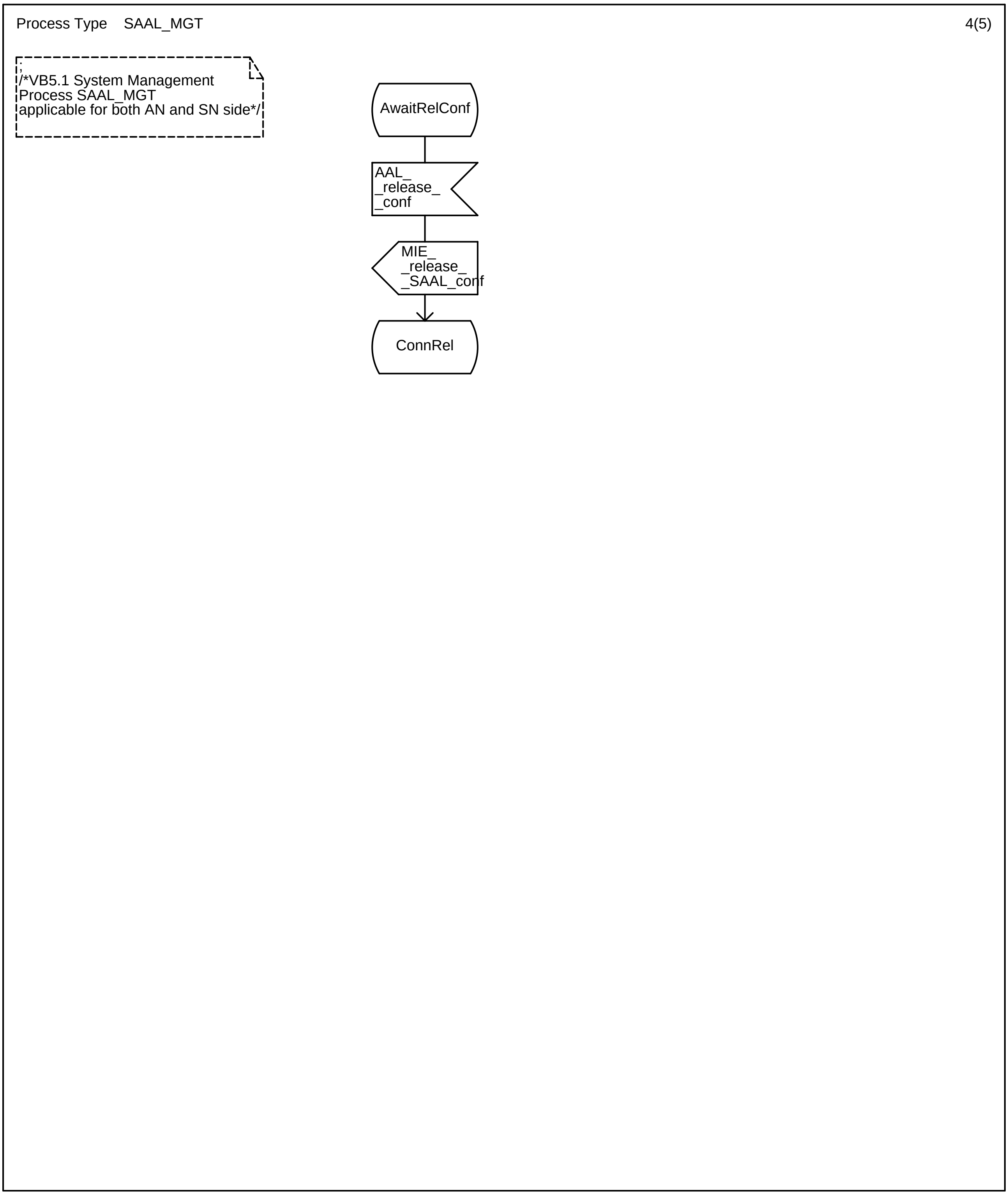


Figure A.213: SAAL_MGT (4)

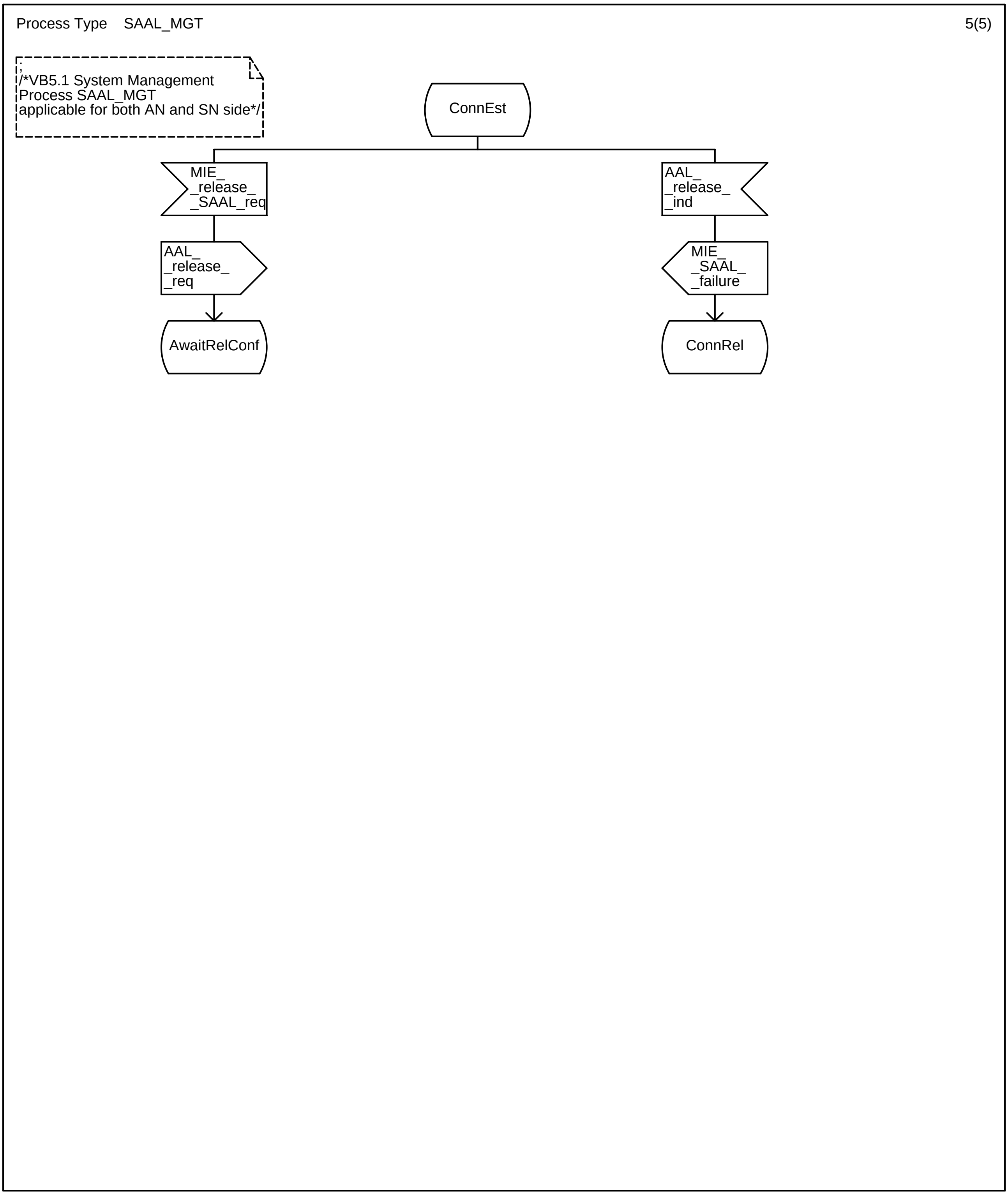


Figure A.214: SAAL_MGT (5)

A.4.6 Syntax check procedure

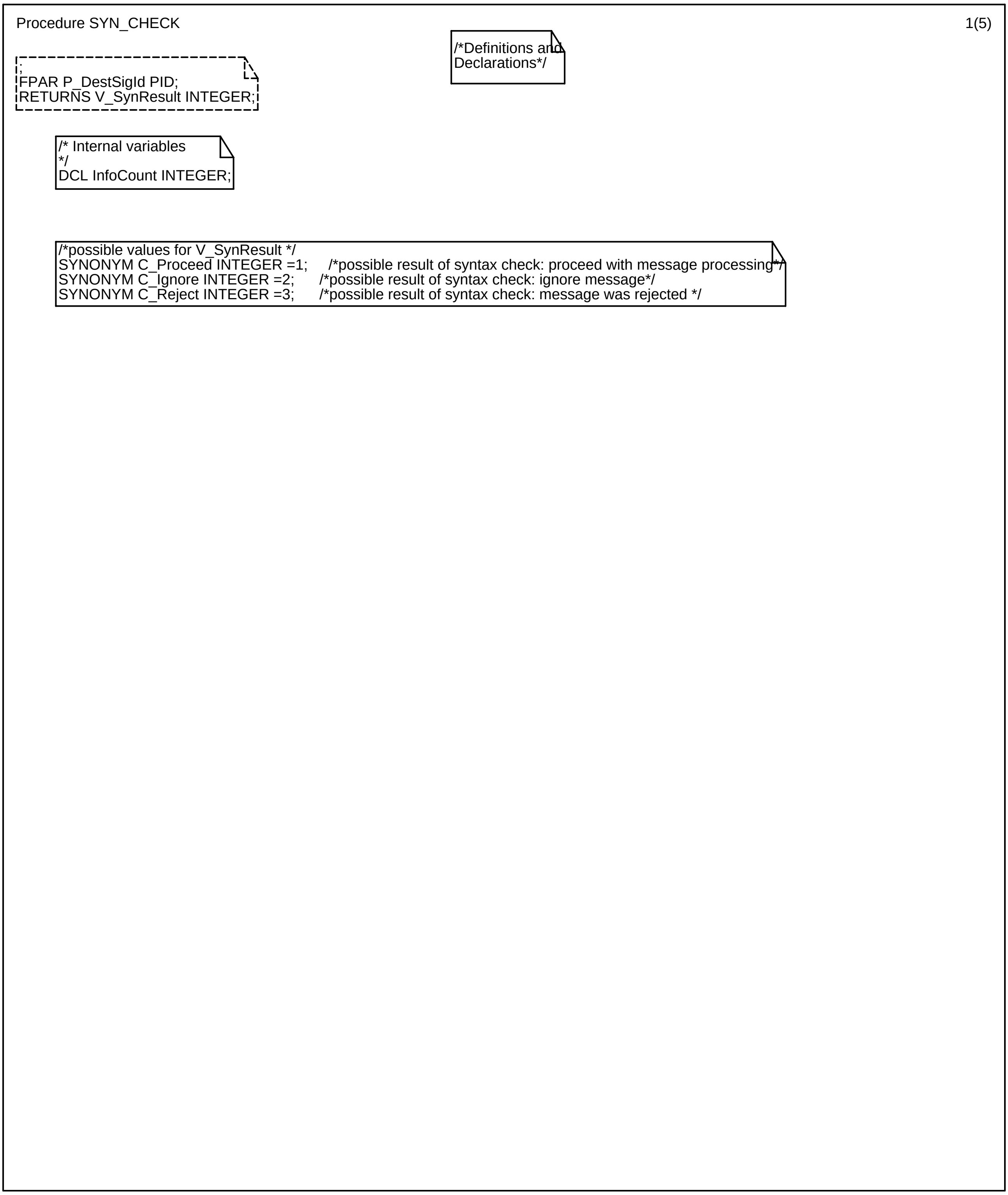


Figure A.215: Common CPROT procedure: VB5 RTMC protocol syntax check (1)

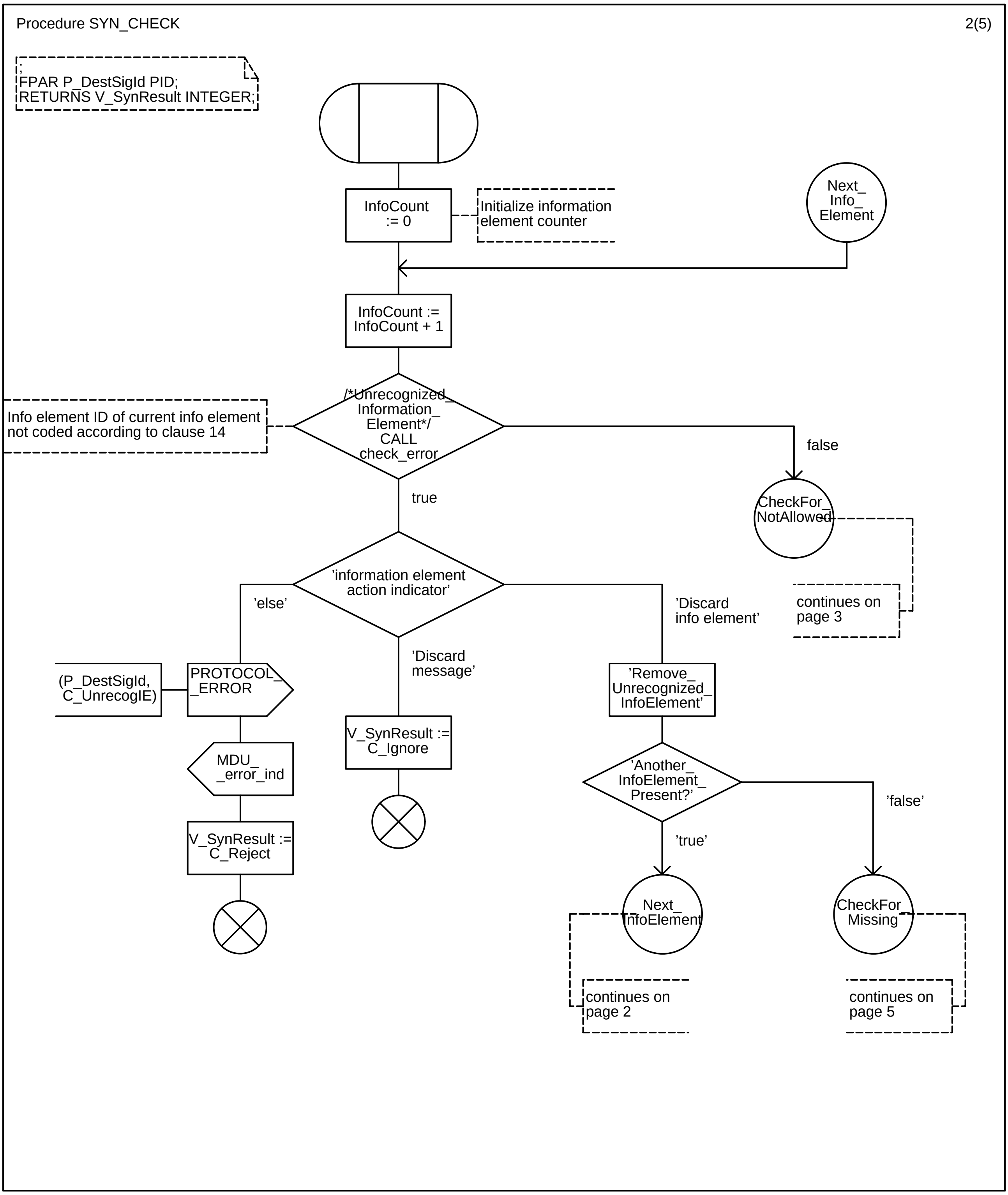


Figure A.216: Common CPROT procedure: VB5 RTMC protocol syntax check (2)

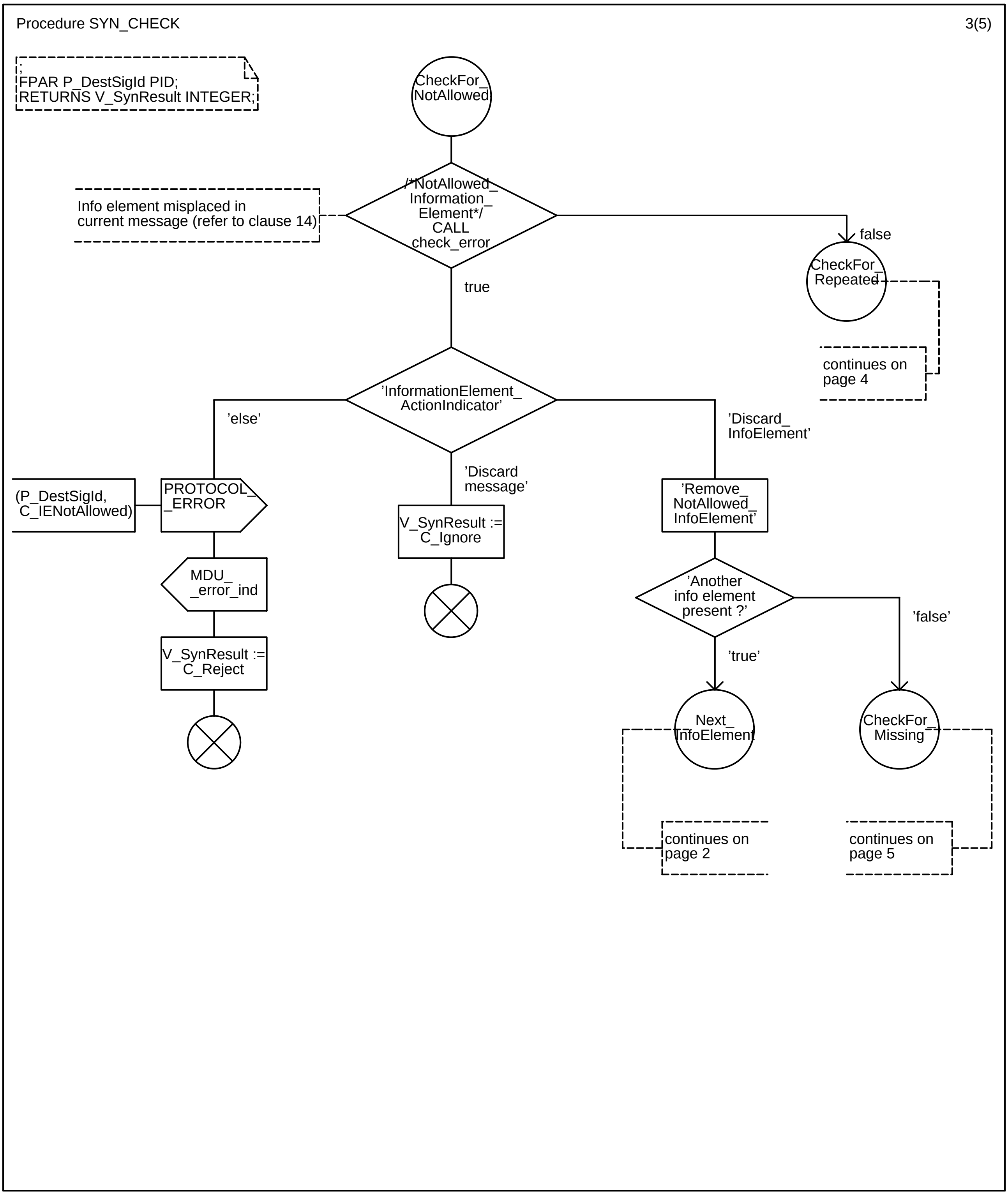


Figure A.217: Common CPROT procedure: VB5 RTMC protocol syntax check (3)

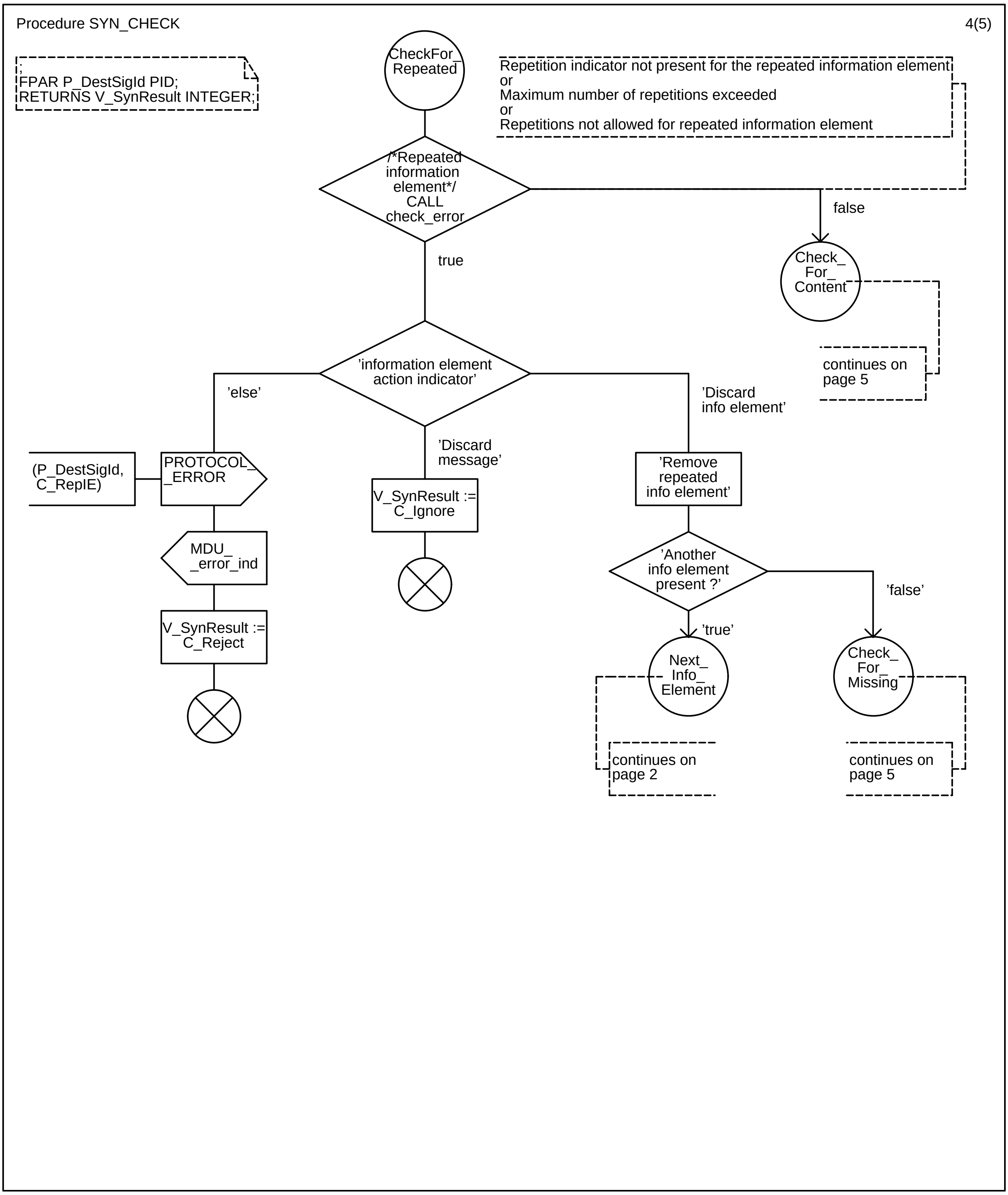


Figure A.218: Common CPROT procedure: VB5 RTMC protocol syntax check (4)

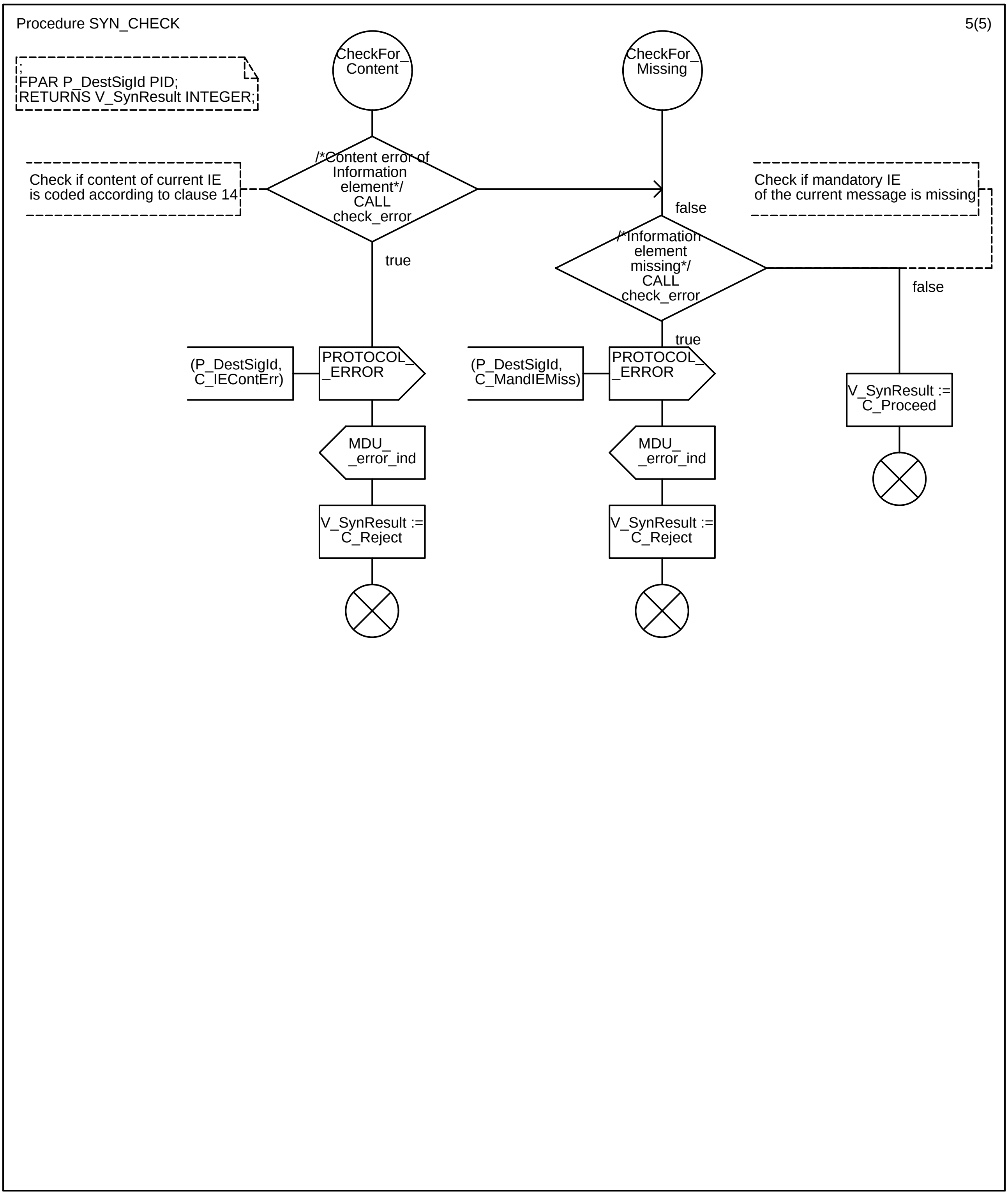


Figure A.219: Common CPROT procedure: VB5 RTMC protocol syntax check (5)

A.4.7 Analyse resource procedure

```
Procedure <<Package VB5_1>> ANA_RES                                    1(5)

;FPAR
V_NoOfRsc          IT_NoOfRsc,
A_RTMCRscTab   AT_RTMCRscTab,
V_NoOfUnkRsc     IT_NoOfRsc,
A_RTMCUnkRscTab       AT_RTMCUnkRscTab;

/*Definitions and Declarations*/

/*Internal variables of ANALYZE_RESOURCE*/
/**/
DCL
V_InfoCount
INTEGER;

/*Data declarations for internal use*/
DCL
A_TempRscTab  AT_RTMCRscTab   ; /*Array for temporary storage of Resource Identifier Information Elements*/
```

Figure A.220: Common SYSMGT procedure: Analyse received resource identifiers (1)

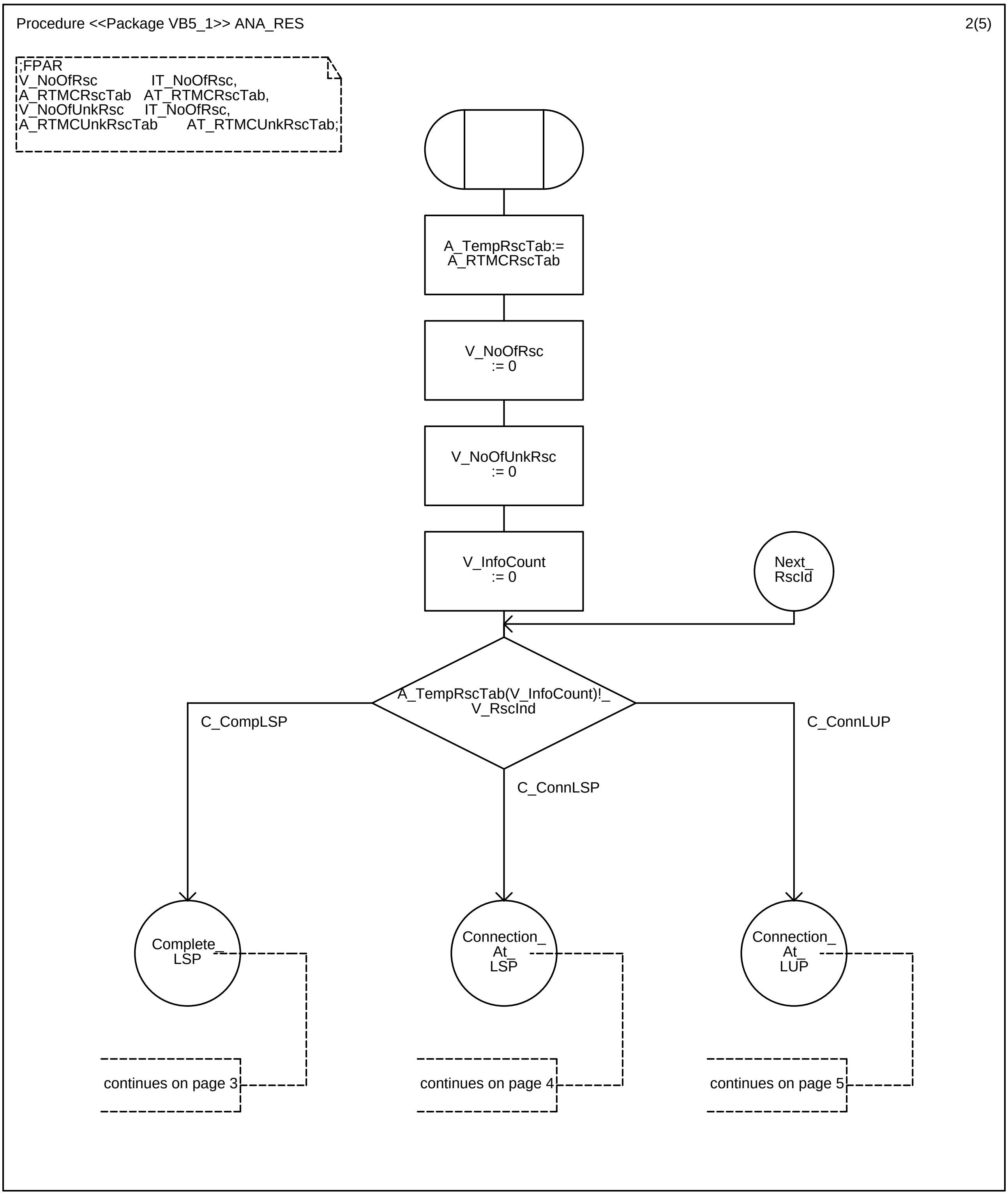


Figure A.221: Common SYSMGT procedure: Analyse received resource identifiers (2)

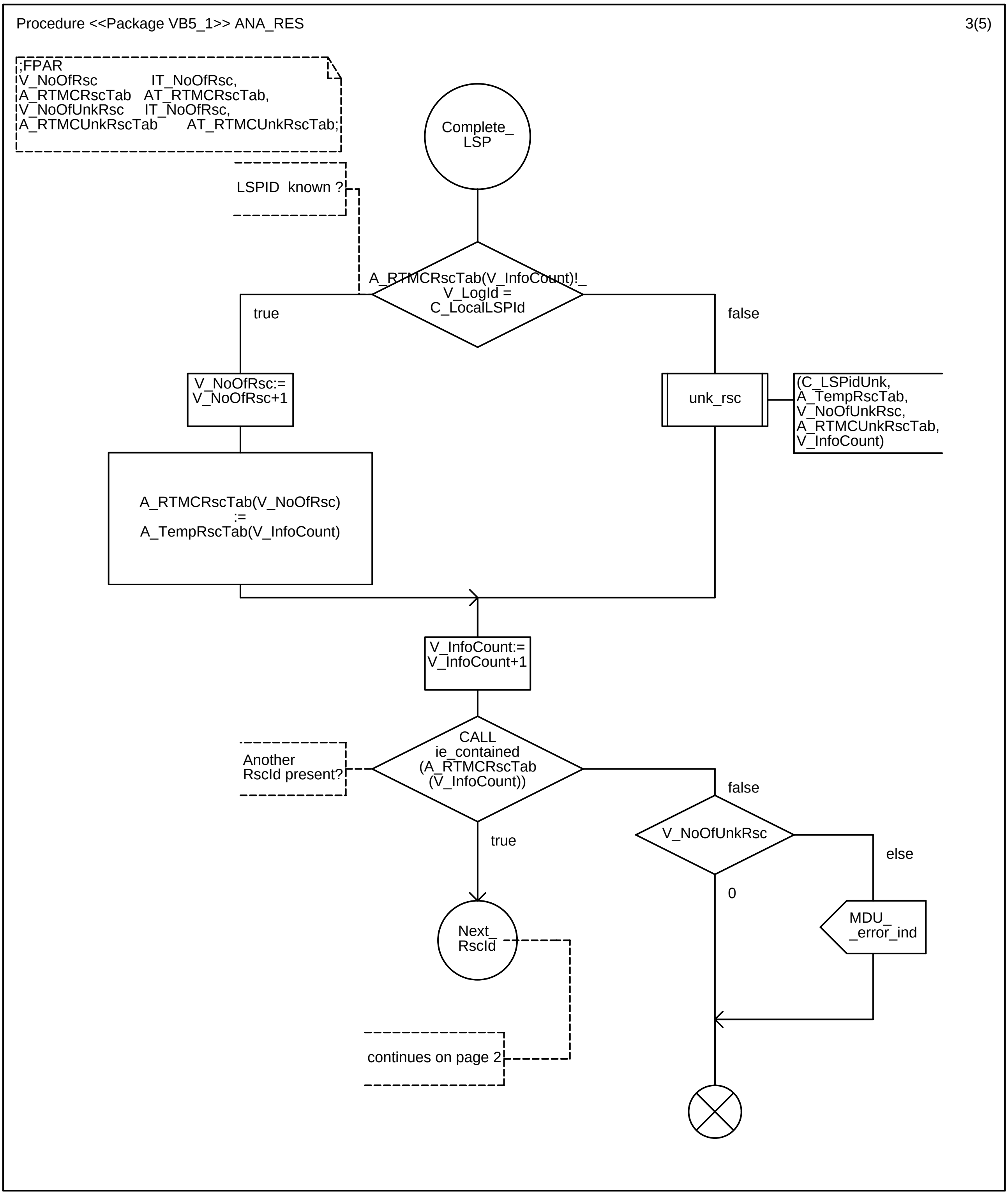


Figure A.222: Common SYSMGT procedure: Analyse received resource identifiers (3)

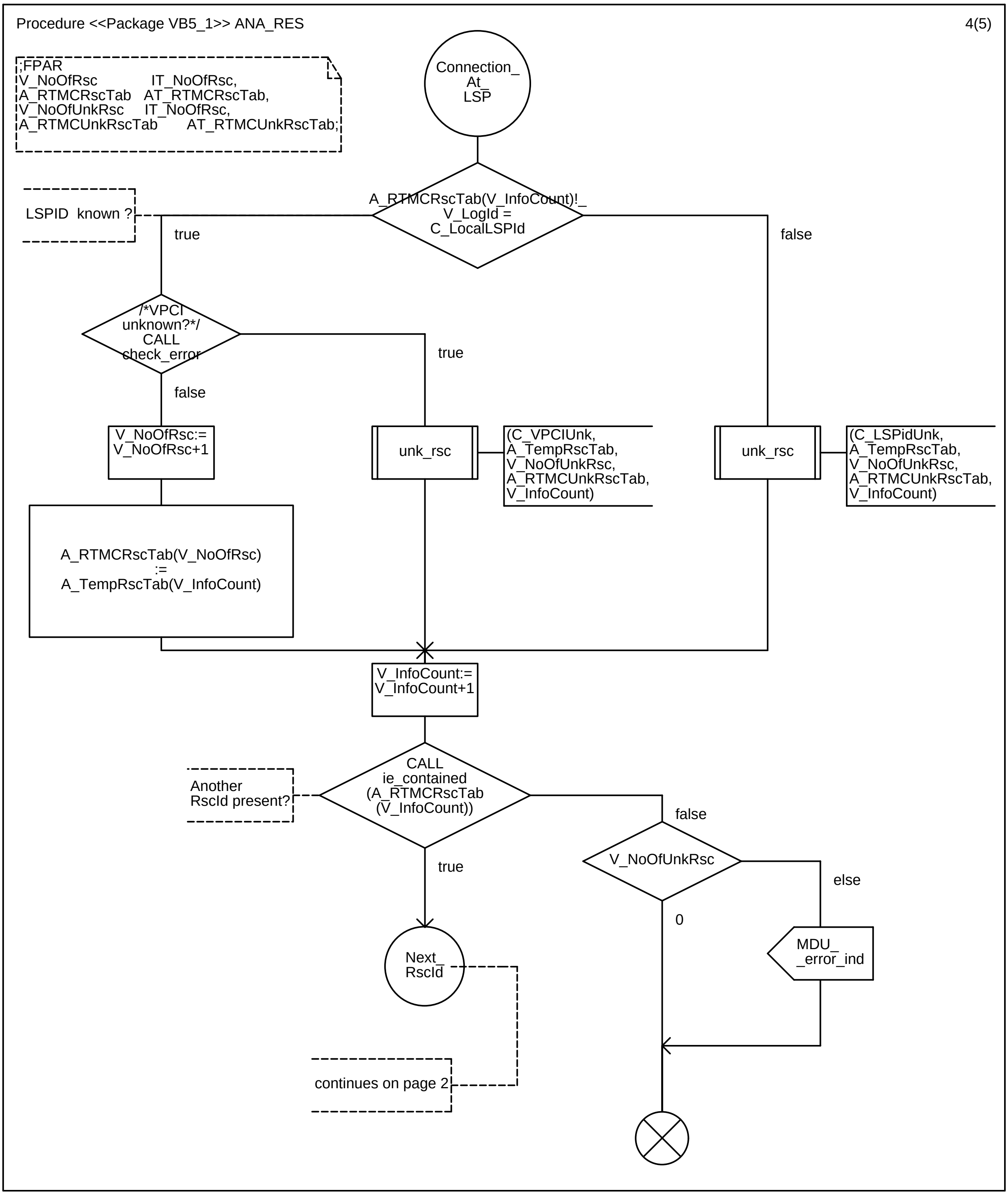


Figure A.223: Common SYSMGT procedure: Analyse received resource identifiers (4)

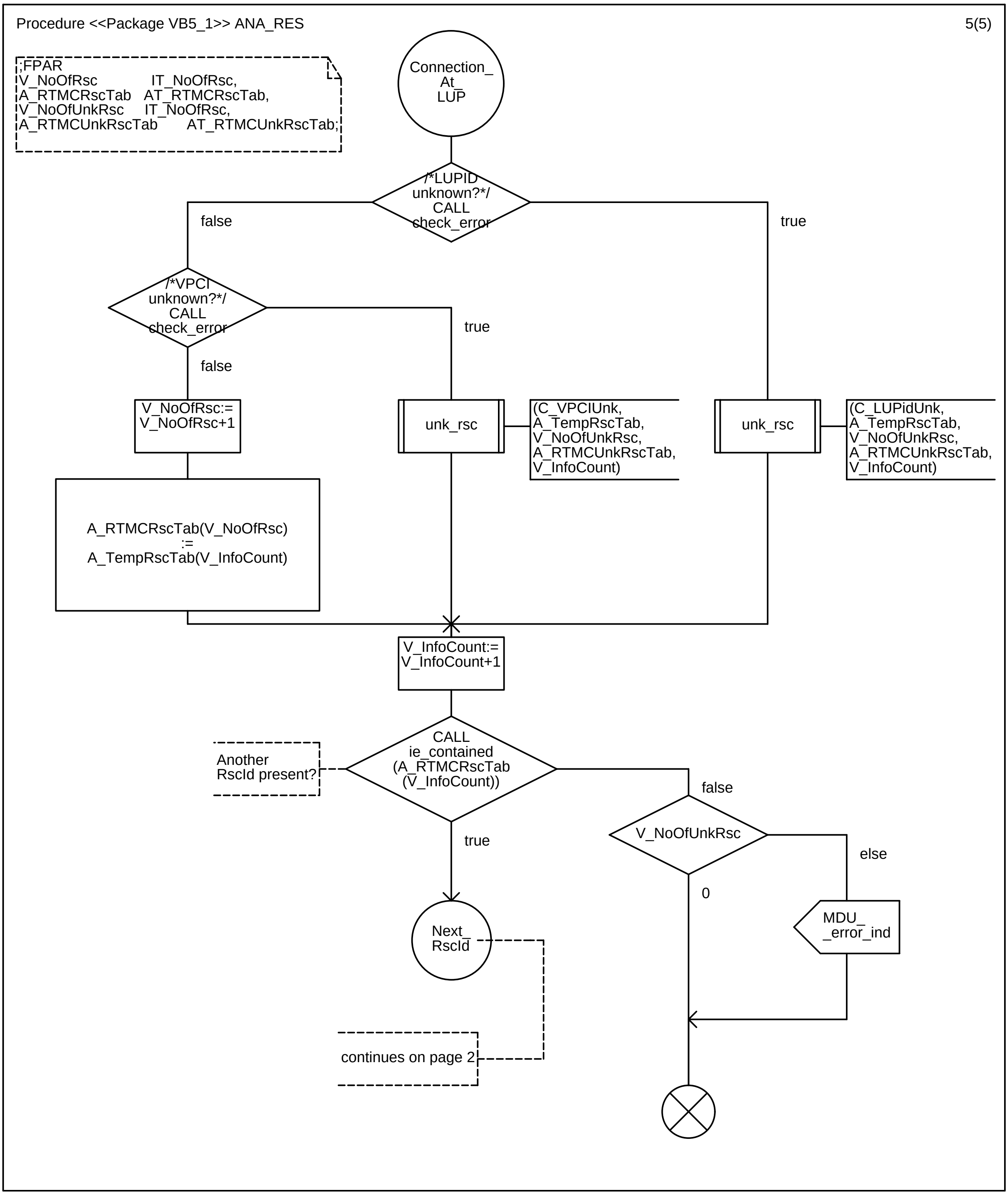


Figure A.224: Common SYSMGT procedure: Analyse received resource identifiers (5)

A.4.8 Handle unknown resources procedure

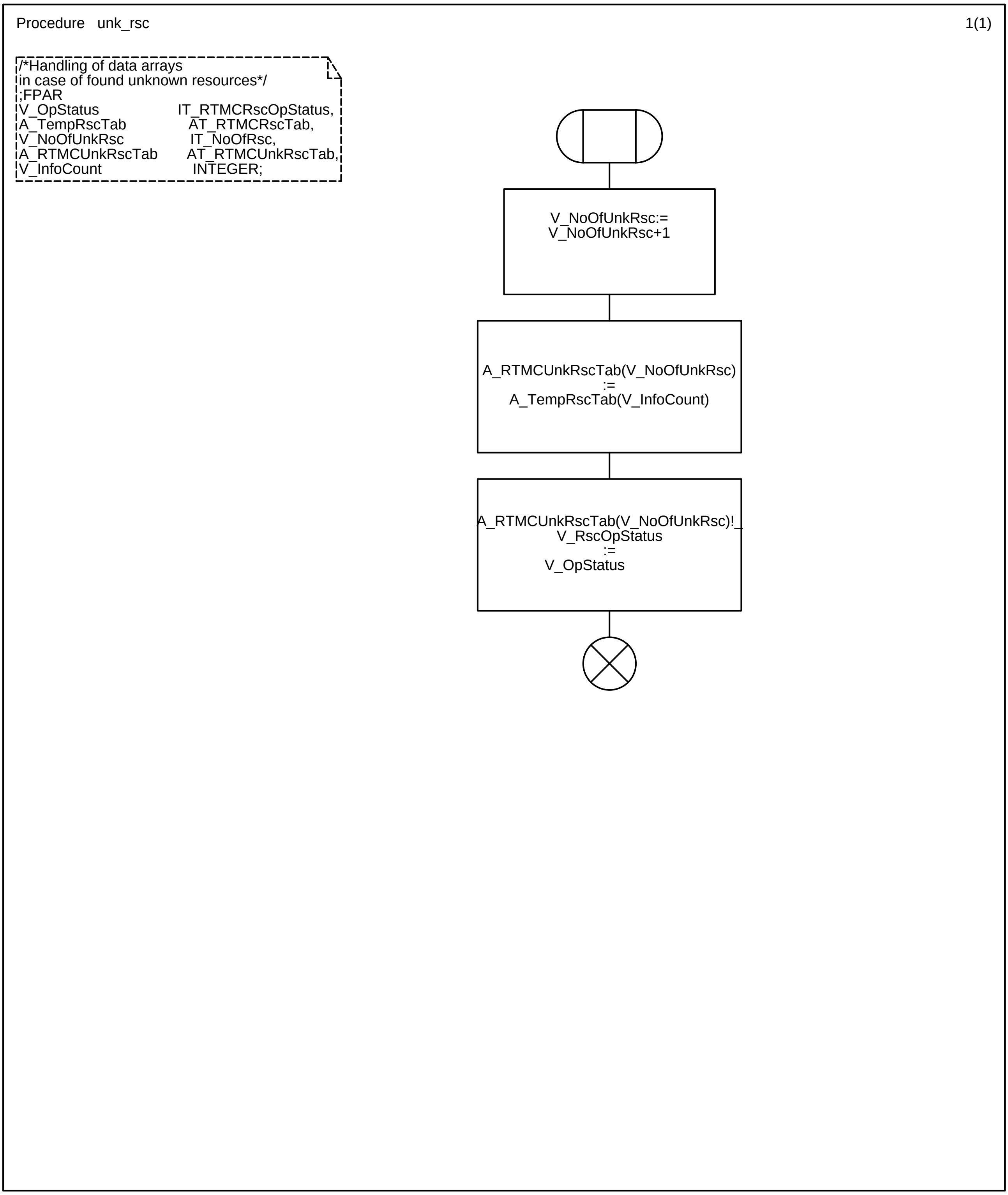


Figure A.225: Common SYSMGT procedure: Handle data arrays in case of found unknown resources

Annex B (normative): UPC and NPC function location

B.1 Introduction

The main purpose of the UPC and NPC function is to protect network resources from malicious as well as unintentional misbehaviour which can affect the Quality of Service of other already established connections by detecting violations of negotiated parameters and taking appropriate actions.

This annex shows the locations where the UPC and NPC functions are performed for the different cases of user VP termination in VB5.1 access arrangements. VB5.1 does not impose any requirements on policing other than already specified in ITU-T Recommendation I.371/ETS 300 301 [5]. Figure B.1 gives an overview of the possible user VP termination points which are relevant for the VB5.1 interfaces.

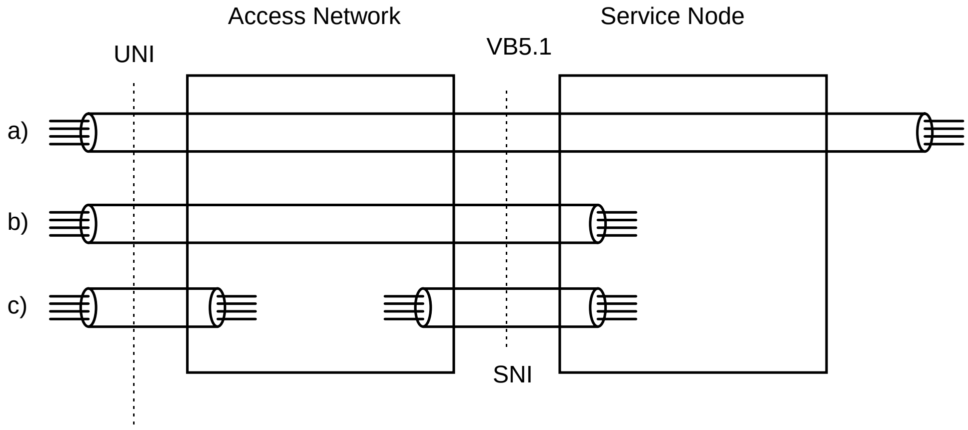


Figure B.1: User VP termination point locations

Figures B1, B2 and B3 illustrate:

a) the user VP is cross connected both in the AN and in the SN. This is the case for a user-to-user permanent VP connection;

b) the user VP is cross connected in the AN and terminated in the SN. VC switching and/or cross connecting takes place in the SN;

c) the user VP is terminated in the AN. VC cross connecting takes place in the AN.

B.2 Location of the UPC function

The use of the UPC function is recommended in ITU-T Recommendation I.371/ETS 300 301 [5]: "*Usage parameter control is performed on VCCs or VPCs at the point where the first VP or VC links are terminated within the network*".

The locations of the UPC functions are shown in figure B.2. The locations of these functions do not change if a VP cross connect is placed between the AN and SN.

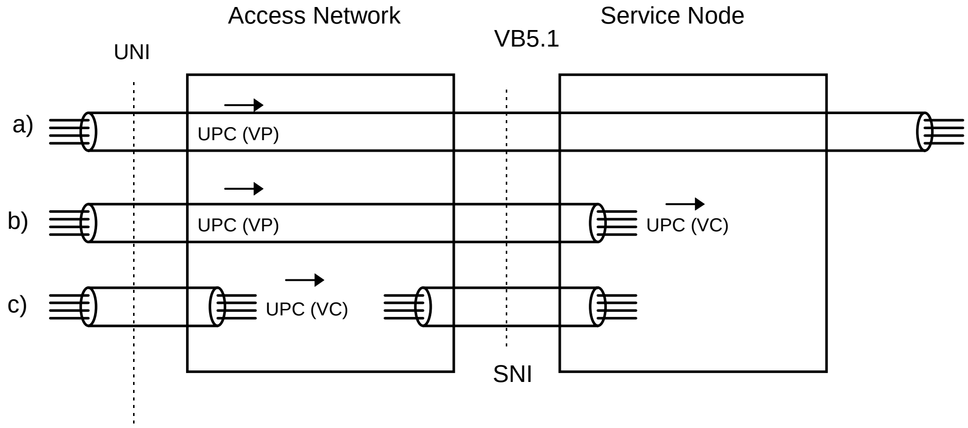


Figure B.2: UPC function location

B.2.1 Location of the UPC (VP) function

Both the recommended location for the UPC (VP) function (at the point where the first VP link is terminated within the network) and the purpose of the UPC function (protect network resources) imply that UPC (VP) must be performed in the AN for those user VPs which are cross connected in the AN and multiplexed on the VB5.1 interface.

B.2.2 Location of the UPC (VC) function

The ITU-T Recommendation for the UPC (VC) location implies that UPC (VC) is always performed at the point where the user VP is terminated within the network: in case a) no UPC (VC) is done, in case b) UPC (VC) is performed in the SN and in case c) UPC (VC) is performed in the AN.

B.3 Location of the NPC function

The use of the NPC function is optional in ITU-T Recommendation I.371/ETS 300 301 [5]: "*Network parameter control is performed on VCCs or VPCs at the point where they are first processed in a network after having crossed an Inter-Network Interface (INI)*".

The locations of the NPC functions are shown in figure B.3. In this figure the INI is at the SNI.

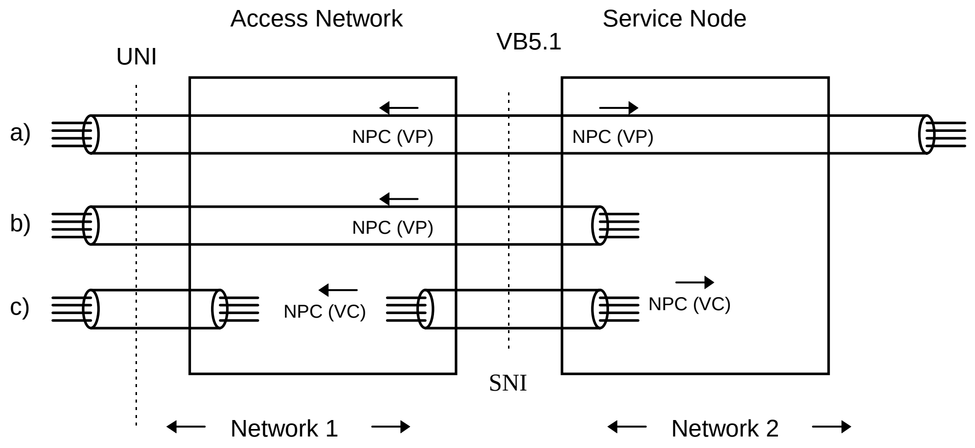


Figure B.3: NPC function location

B.3.1 Location of the NPC (VP) function

NPC (VP) may be performed at the point where the VP which is crossing the INI is entering the first NE and is not terminated in that NE. This means that in case 1) NPC (VP) may be performed both in the AN and the SN, in case b) NPC (VP) may be performed in the AN and in case c) no NPC (VP) will be performed.

The location of the NPC (VP) functions will change if a VP cross connect is placed between the AN and SN. If the VP cross connect is part of network 1 (see figure B.3), the NPC (VP) functions move from the AN to the VP cross connect. If the VP cross connect is part of network 2, the NPC (VP) functions move from the SN to the VP cross connect.

B.3.2 Location of the NPC (VC) function

NPC (VC) may be performed at the point where the VP crossing the INI which carries the VC is terminated within the network. This implies that for case a) no NPC (VC) needs to be performed, for case b) no NPC (VC) needs to be performed because UPC (VC) is done in the SN for this case and for case c) NPC (VC) may be performed in the AN and SN.

Annex C (informative): SDL process simulation

This annex provides information for tool supported simulation of the SDL model. Figure C.1 presents an overview for defined data and procedures in order to facilitate simulation.

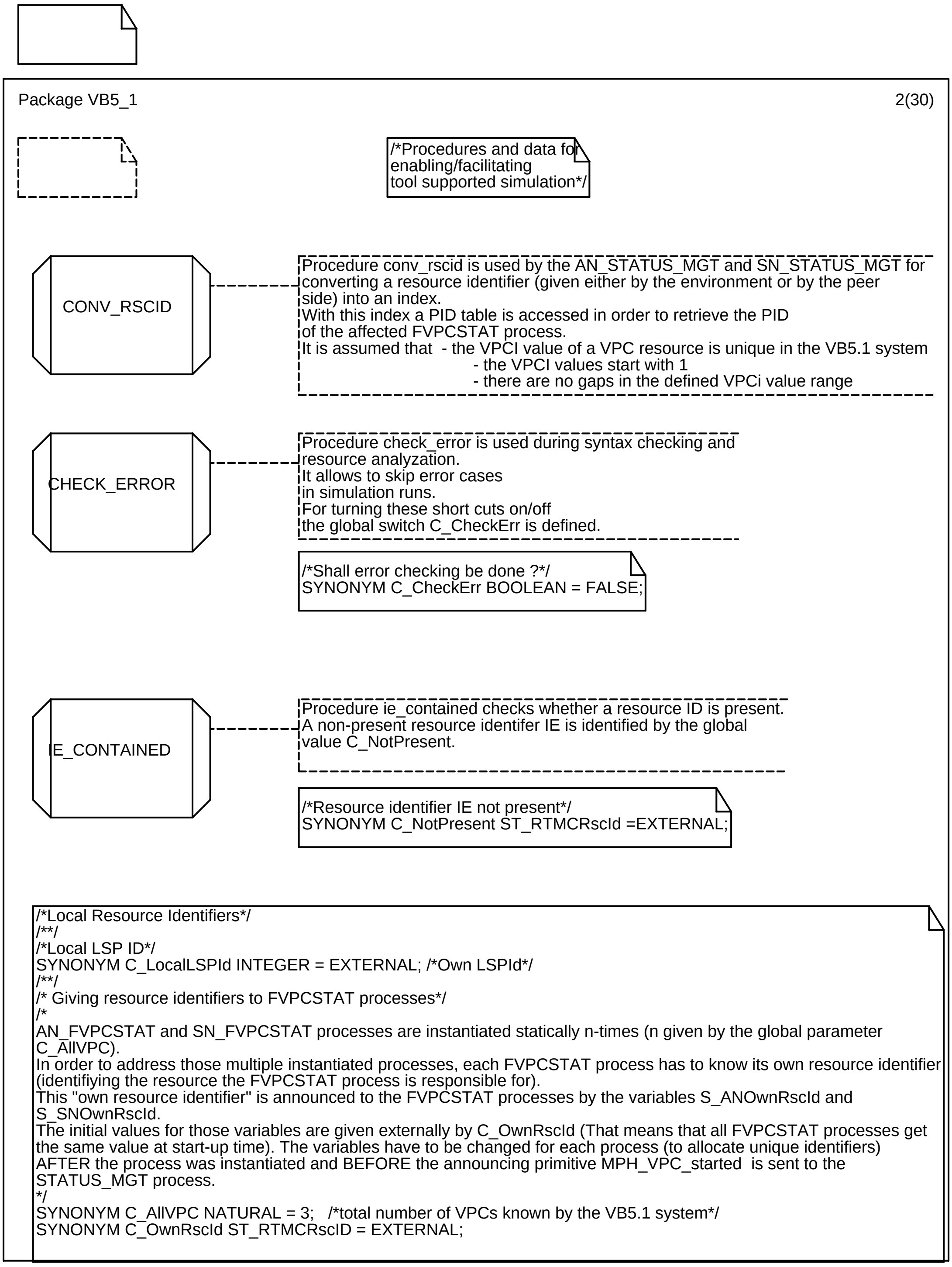


Figure C.1: Overview of simulation procedures and data

The SDL diagrams of the provided simulation procedures are shown in the following figures.

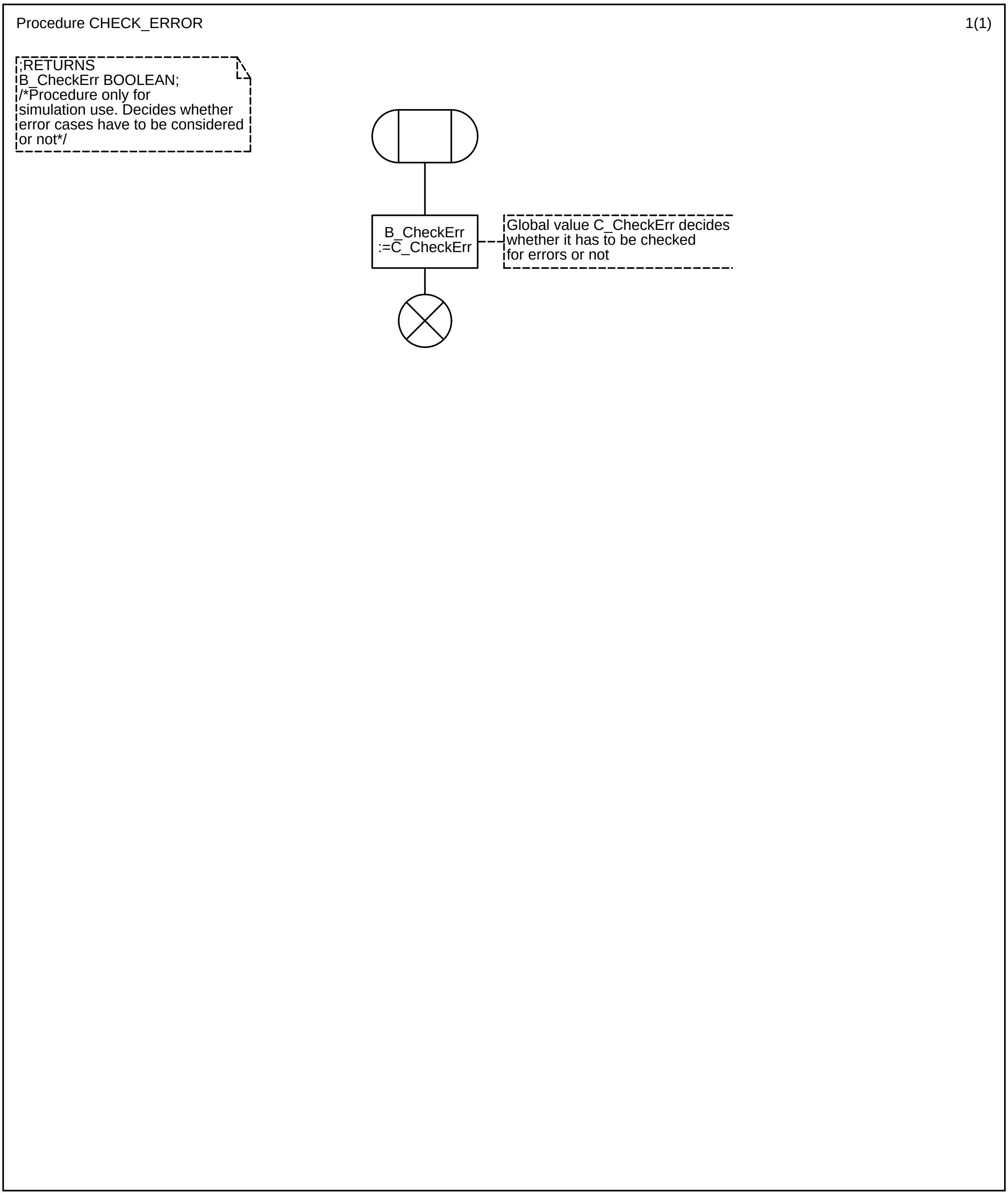


Figure C.2: Procedure CHECK_ERROR

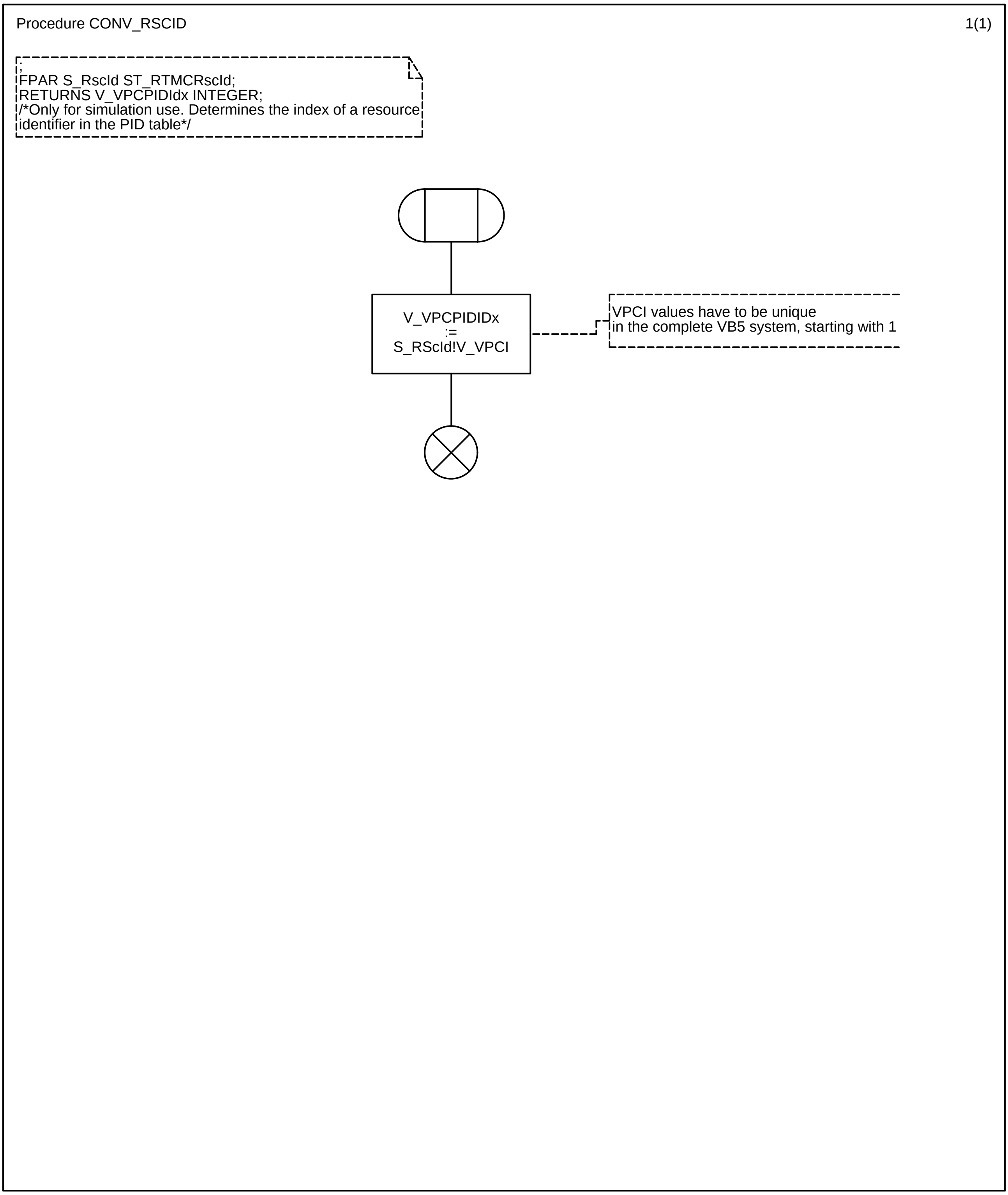


Figure C.3: Procedure CONVERT_RESOURCE_IDENTIFIER

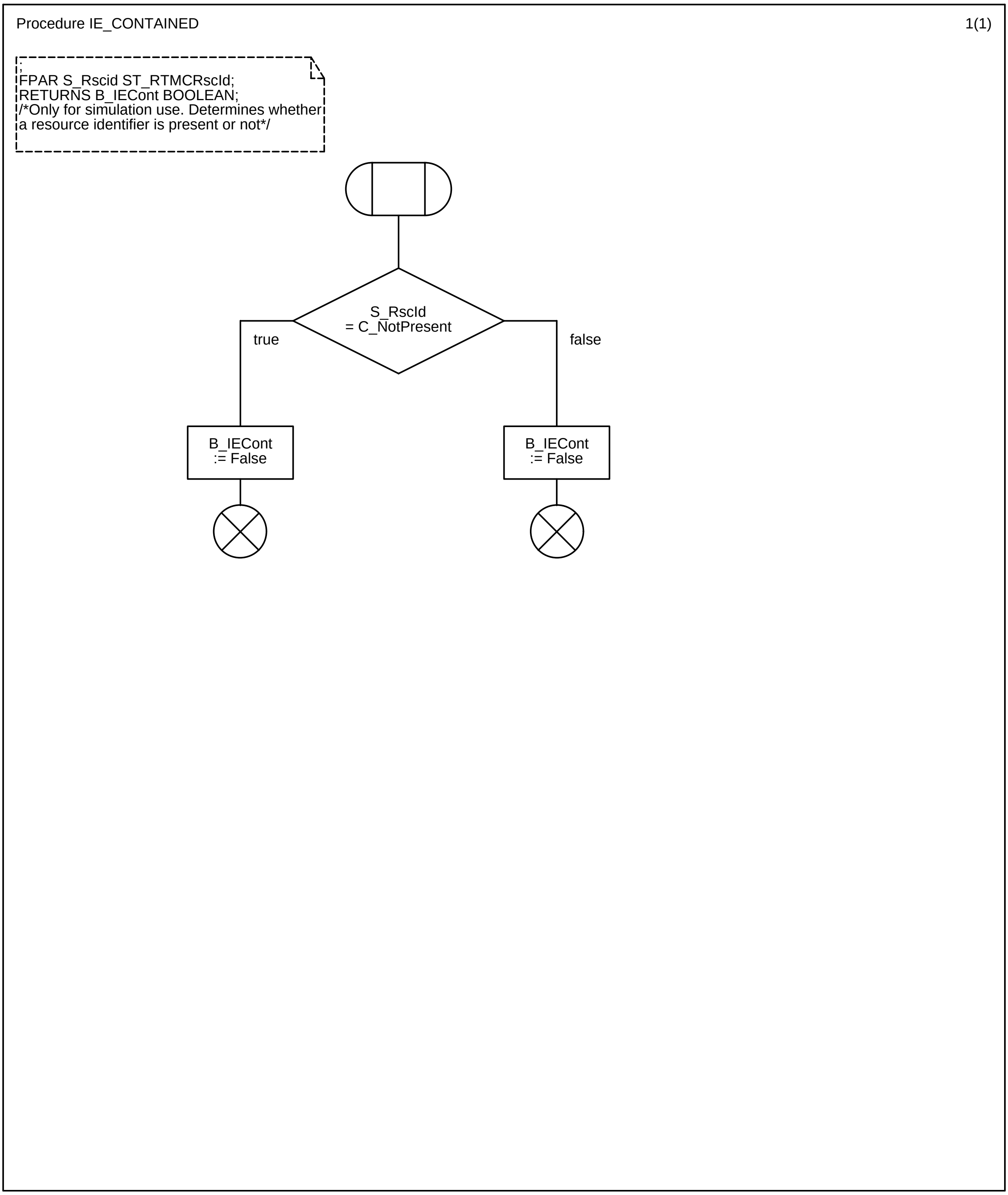


Figure C.4: Procedure INFORMATION_ELEMENT_CONTAINED

Annex D (informative): Added value features of VB5.1 interfaces applicable to other VBx interfaces

This annex addresses the applicable added value features of the VB5.1 reference point to other VBx interfaces.

VBx interfaces, other than VB5.1, which inherit some value added features of the VB5.1 interface specification may be defined. The added value features of VB5.1 are e.g.:

- VB5.1 specific facilities provided via Q3(AN) and Q3(SN);
- similar configuration and supported connection types as well as the addressing facilities;
- conceptual methodology to handle non-B-ISDN accesses and in particular narrowband accesses;
- functional split-up between AN and SN: i.e. AN is transparent for user signalling;
- application of existing F4/F5 flows, according to ITU-T Recommendation I.610 [24], accross the VB5.1 reference point and/or across or within the associated access network;
- value added features of the VB5.1 RTMC protocol.

The merit of the RTMC protocol in VB5.1 lies in:

- time critical co-ordinated management between AN and SN.

Non time critical co-ordination (i.e. user port provisioning) is performed via Q3 interfaces of AN and SNs. Examples of time critical co-ordinated management across VB5.1 are:

- informing the SN on administrative state changes in the AN which are service affecting. Such state changes are triggered by the AN operator via Q3(AN);
- interface management: i.e. Reset and Interface ID Verification;
- VP connection identification verification: i.e. VPCI consistency check.

In VB5.1, the information exchange about failures (and operational states of AN resources) is covered by embedded ATM maintenance flows (i.e. F4 and F5) and no additional messages on the RTMC protocol are required.

It is understood that other VBx (than VB5.1) interfaces could emerge for:

- AN to SN interconnection, where the SN has restricted capabilities, e.g. a SN which can not handle the RTMC protocol (i.e. a non-intelligent SN, such as an ATM cross-connect);
- initial deployment of a VBx interface which shall evolve to a VB5.1 interface in a later stage;
- AN to SN interconnection, where bilateral agreements are the basis for AN-SN co-ordination.(i.e. trial networks).

For these type of VBx interfaces it is recommended to inherit as much as possible the added value features of the VB5.1.

Deviations from the VB5.1 specifications may lead to shortcomings otherwise, e.g. if the RTMC protocol is not supported, graceful shutdown of AN resources may not be possible at all or needs to rely on co-ordinated actions in the AN and SN via their respective Q3 interfaces. The same is valid for putting AN resources in dedicated state for i.e. test purposes (i.e. partial lock and shutdown). It should be noticed that co-ordination via human interactions may lead to unacceptable delays for handling AN resources. This could be particularly important in case of automated and repetitive test procedures.

In absence of the RTMC protocol, the SN operator will not be able to be informed on a real time basis about administrative actions being performed by the AN operator. Indeed, if the unavailability of the AN resources is only communicated via F-flows, the SN can not differentiate between administrative actions and operational state changes. In addition, the management capabilities of the RTMC may show extremely useful as mismatches (i.e. VP connection identifier) at both sides of the interfaces might only be detected after a long period of operation.

Annex E (informative): Application of the protection facility of SDH on the VB5.1 interface

Figure E.1 shows some examples to illustrate the protection methods on the VB5.1 interface.

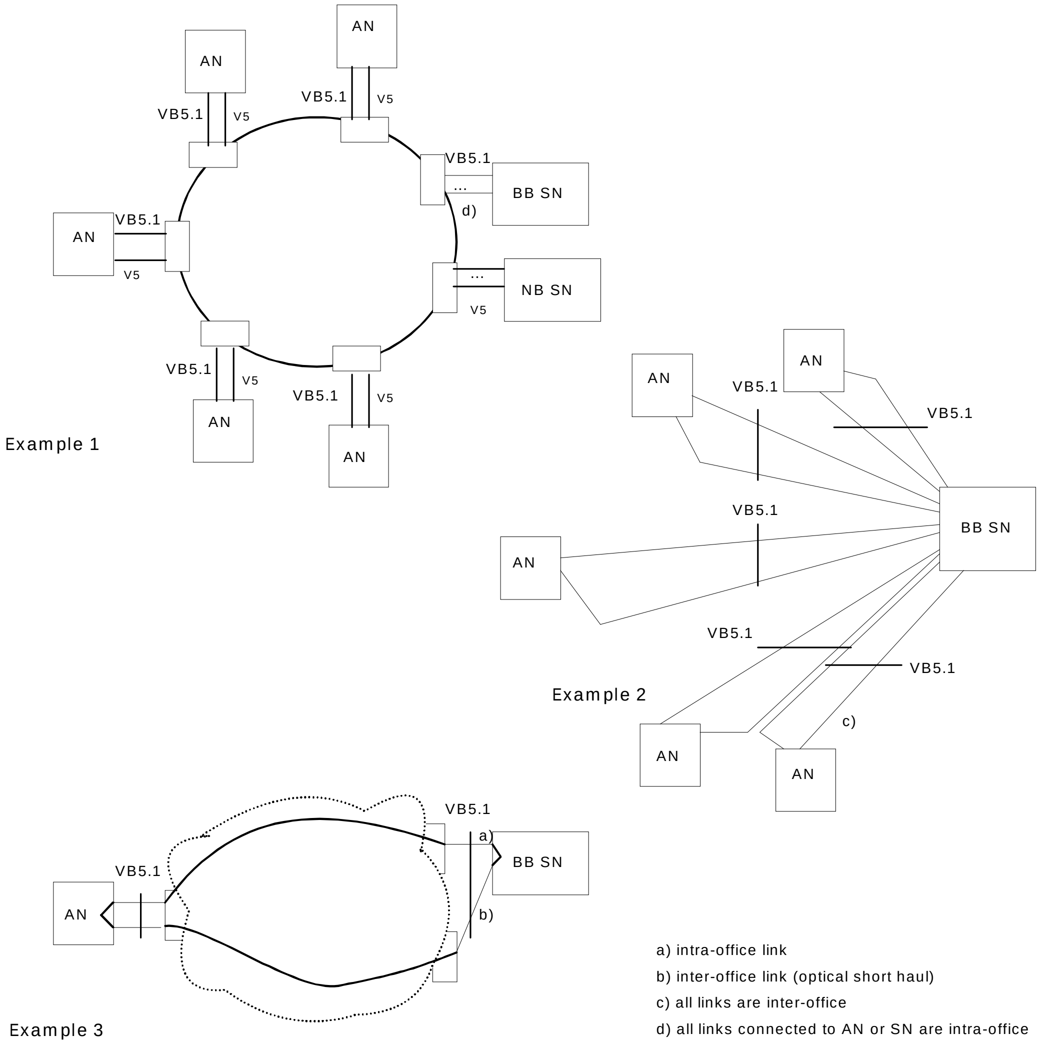


Figure E.1: Protection methods of SDH on the VB5.1 interface

Example 1 shows how several ANs can be connected to the SN using one or more SDH rings. The VB5.1 interfaces themselves are not protected, the protection is provided by the SDH ring mechanisms, transparent to the network users. The narrowband V5 interface may use the same SDH network and have the same level of protection.

Example 2 shows how the short haul interface can be applied. The traffic is protected at the SDH section level (duplicated 1+1 fibres). For an effective protection, the 4 fibres going to the same AN should not share the same cables or ducts. This method might only be used for small capacity ANs within a short range of the SN, in order to limit the number of optical fibres.

Example 3 shows how a general purpose SDH network, that supports diverse path routing, can be applied. The two VC4 SDH paths are routed through the SDH network avoiding the use of any shared resource. In this example, the connection to the SN is even protected against failure of the transmission equipment itself, by having the duplicated path connected to a remote transmission node, using short haul optical transmission. The protection is at the path level, the subnetwork connection point that performs the protection is located in the AN and the SN. For clarity only one AN is shown.

Annex F (informative): Examples of physical interface options for the VB5.1 interface

The selection of options is based on what is currently practical and on dimensioning considerations of real applications, e.g. the use of ATM mapping in concatenated VC4s (i.e. VC4c) is not suggested as this transmission method is not widely deployed in current or planned transmission networks. Moreover, the capacity of a VC4c, compared to a VC4, hardly brings any gain with respect to dimensioning ANs conforming to the VB5.1 principles. Indeed, the bandwidth capacity required per access, in real situations, is expected to be sufficiently small compared to the capacity of a VC4. It results, that a VC4 capacity can efficiently be filled up with the traffic coming from a number of accesses. In order to support more accesses by a VB5.1 compliant AN, additional VB5.1 interfaces can be introduced.

Table F.1: Physical layer options for the VB5.1 interface.

Applications	**Intra-office**				**Inter-office**	
Digital Hierarchy	PDH	SDH			SDH	
Medium (note 1)	Electrical G.703	Electrical G.703	Optical G.957 Intra-office		Optical G.957 Short haul	
Line rate (note 2)	E3	STM1	STM1	STM4	STM1	STM4
Characteristics						
Max. span length (note 3)	~100m		~2km		~15km	
Type of medium	Coax cable		1 310 nm - G.652 - one fibre for each direction			
Section	no OH	SDH G.707 **reduced** SOH				
Path	G.832	VC4 G.707 POH				
ATM mapping	G.804	ATM cells in SDH VC4 conform G.707				
Protection (note 4)						
Section protection (note 5)	none		1+1 **single ended**			
Path protection (note 6)	none	1+1 VC4 subnetwork connection protection - **single ended** - **inherent monitoring** - G.841				

NOTE 1 The topology is point-to-point.

NOTE 2 Both directions have the same rate. Although the services supported on VB5.1 may to a large extend be asymmetrical in nature (more downstream bandwidth than upstream), this feature is not exploited.

NOTE 3 Span length values are only give as an indication, and are not specified. Long haul optical applications are supported through the use of a transport network.

NOTE 4 The protection options (section, path) are optional. The same interfaces can operate without protection. Example applications using the protection facility of SDH on the VB5.1 interface are given in annex E.

NOTE 5 Section protection is only applied to the optical interfaces. The electrical intra-office sections are assumed to be reliable enough so that cabling is not duplicated.

NOTE 6 Subnetwork connection protection (known as path protection) with inherent monitoring relies on indications available at the SDH (high order) path layer to initiate protection switching (i.e. K1 and K2 bytes are not used). These indications reflect a failure that can be detected locally (i.e. via SSF - server signal fail) or somewhere remote in the transport network (i.e. via path-AIS). This protection method is therefore more generic than the section protection, where the protection switch and the optical line termination have to be located in one single equipment.

Annex G (informative): Examples of non-ATM based non-B-ISDN accesses

The examples given below mainly refer to a specific service or class of services. It is understood that all of these services might also be provided as part of B-ISDN. With respect to the customer access, this means that these services may also be supported via B-ISDN accesses and by ATM based non-B-ISDN accesses. The latter access types are possible due to the fact that service independency is yet possible at ATM layer within the B-ISDN concepts.

Due the concept of the virtual user port, also non-ATM based non-B-ISDN accesses can be supported over the VB5.1 reference point. Some examples are given in clause G.2.

G.1 Local Area Network (LAN) accesses

In the context of the present document, a **Local Area Network** is considered to be a data communication network confined to a small area within the customer premises. In its simplest form it can be reduced to an interface, interconnecting a single data communication terminal to the public network.

LAN accesses can be supported via the VB5.1 reference point. The general approach is applicable, i.e. a virtual user port may be introduced for one or more LAN accesses. Examples of LAN accesses are: Ethernet (IEEE 802.3), ATM DXI on n × 64 kbit/s or E1 rate, 2 048kbit/s (E1) on a physical link conforming to ITU-T Recommendation G.703, etc.

G.2 Accesses for TV distribution services

For the VB5.1 reference points, digital broadcast TV channels presented across the VB5.1 reference point should be connectable to more than one access within the Access Network. In specific, this is required for dedicated accesses for TV distribution (i.e. cable TV coax). For these type of accesses the general approach is applicable. The AAF may support one ore more of these non-B-ISDN, non-ATM based accesses. Typical, for a shared medium (i.e. coax tree and branch network), the AAF supports multiple accesses.

It is noted that digital broadcast TV channels can also be presented towards the AN via other type of VB interfaces. Nevertheless, the concept of the virtual user port can be applied as defined in subclause 8.3.1.1 of the present document.

The specific requirements for TV distribution services should be specified in dedicated standards such as those specified by DAVIC. These requirements should not impact the VB5.1 interface, if this type of SNI is used to feed the TV channels to the AN, .e.g., when a broadcast connection for a TV channel is not being used by any access on the AN, then there is no requirement to continue feeding that TV channel into the AN unless a particular Access Network requires it. For this requirement the VB5.1 concept provides the facility to remove a VCL (carrying the TV channel), either by SN switching capabilities or via (re)provisioning via Q3(AN) or Q3(SN).

G.3 Access for asymmetric services/multimedia

The specific requirements for asymmetric/multimedia services (i.e. video on demand) should be specified in dedicated standards such as those specified by DAVIC. These requirements should not impact the VB5.1 interface, if this type of SNI is used to carry the associated traffic. For the cases where the access is non-ATM based, the general VB5.1 principle based on the virtual user port should be applied.

It is noted that DAVIC handles ATM based accesses. Therefore, the general approach for ATM based accesses (B-ISDN and non-B-ISDN) for the VB5.1 reference point should be applied, if the SNI is VB5.1.

Annex H (informative): Performance design objectives

Performance requirements as defined within the present document should be considered as design objectives for systems under the conditions stated in the present document. These conditions are defined by such parameters as traffic loads, average circuit occupancy, busy hour call attempts, etc.

Two distinct performance areas are identified:

a) transfer functions - concerned with the transfer of user signalling and data via the interface;

b) control functions - concerned with the real time management of the interface.

H.1 Performance design objectives for transfer functions

Access Networks supporting the VB5.1 interface carry ATM cells between the UNI and SNI in VP/VCs which do not terminate in the AN. The factors affecting the transfer of these cells are related directly to the performance of the transmission systems and cross-connects in the AN and SN.

ATM transmission performance parameters are described in ITU-T Recommendation I.356 [32], in particular:

- cell transfer delay;
- cell delay variation;
- cell error ratio;
- cell loss ratio;
- cell misinsertion rate.

The performance of the physical transmission systems supporting the ATM layer is not directly specified in the present document.

H.2 Performance design objectives for control functions

Control of the VB5.1 interface is principally via Q3 interfaces to the AN and SN. Time critical OAM information is transferred via the VB5.1 interface itself using two mechanisms:

a) by OAM cells as described in ITU-T Recommendation I.610 [24];

b) a VB5.1 specific RTMC protocol.

The RTMC protocol is unique to VB5.

H.3 Related documents

The following documents are specifically related to performance design objectives (for details, see clause 2 and annex J):

ITU-T Recommendation I.211
ITU-T Recommendation I.356
ITU-T Recommendation I.35bcp
ITU-T Recommendation I.371
ITU-T Recommendation I.731
ITU-T Recommendation G.96x
ITU-T Recommendation Q.2541
ITU-T Recommendation Q.2542

Annex J (informative): Bibliography

The following material gives supporting information:

- ETR 240: "Transmission and Multiplexing (TM); Optical Access Networks (OANs); Operations and Maintenance (OAM) of OANs".
- ETR 326: "Transmission and Multiplexing (TM); Broadband Integrated Services Digital Network (B-ISDN) access".
- ETS 300 147: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Multiplexing structure".
- ETS 300 166: "Transmission and Multiplexing (TM); Physical and electrical characteristics of hierarchical digital interfaces for equipment using the 2 048 kbit/s based plesiochronous or synchronous digital hierarchies".
- ETS 300 167: "Transmission and Multiplexing (TM); Functional characteristics of 2 048 kbit/s interfaces".
- ETS 300 233: "Integrated Services Digital Network (ISDN); Access digital section for ISDN primary rate".
- ETS 300 297: "Integrated Services Digital Network (ISDN); Access digital section for ISDN basic rate".
- ETS 300 337: "Generic frame structures for the transport of various signals (including ATM cells and SDH elements) at the G.702 hierarchical rates of 2 048 kbit/s, 34 368 kbit/s and 139 264 kbit/s".
- ETS 300 353: "Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM) B-ISDN ATM Adaptation Layer (AAL) specification - type 1".
- ETS 300 354: "Broadband Integrated Services Digital Network (B-ISDN); Protocol Reference Model (PRM)".
- ETS 300 464: "ATM layer cell transfer performance for B-ISDN connection types".
- I-ETS 300 465: "Availability and retainability for B-ISDN semi-permanent connections".
- ETS 300 469: "Broadband Integrated Services Digital Network (B-ISDN); Asynchronous Transfer Mode (ATM); B-ISDN management architecture and management".
- ETS 300 485: "Integrated Services Digital Network (ISDN); Definition and usage of cause and location in Digital Subscriber Signalling System No. one (DSS1) and Signalling System No.7 ISDN User Part (ISUP) [ITU-T Recommendation Q.850 (1993), modified]".
- ETS 300 495: "Broadband Integrated Services Digital Network (B-ISDN); Signalling System No.7; Interworking between Broadband ISDN User Part (B-ISUP) and Digital Subscriber Signalling System No. two (DSS2) [ITU-T Recommendation Q.2650 (1995), modified]".
- ETS 300 656: "Broadband Integrated Services Digital Network (B-ISDN); Signalling System No.7; B-ISDN User Part (B-ISUP) Capability Set 1 (CS1); Basic services [ITU-T Recommendations Q.2761 to Q.2764 (1995), modified]".
- ETS 300 685: "Broadband Integrated Services Digital Network (B-ISDN); Usage of cause and location in Digital Subscriber Signalling System No. two (DSS2) and Signalling System No.7 B-ISDN User Part (B-ISUP) [ITU-T Recommendation Q.2610 (1995), modified]".
- ETS 300 771-1: "Broadband Integrated Services Digital Network (B-ISDN); Digital Subscriber Signalling System No. two (DSS2) protocol; B-ISDN user-network interface layer 3 specification for point-to-multipoint call/bearer control; Part 1: Protocol specification [ITU-T Recommendation Q.2971 (1995), modified]".

- CCITT Recommendation G.102 (1980): "Transmission performance objectives and Recommendations".
- ITU-T Recommendation G.652 (1993): "Characteristics of a single-mode optical fibre cable".
- CCITT Recommendation G.702 (1988): "Digital hierarchy bit rates".
- CCITT Recommendation G.703 (1991): "Physical/electrical characteristics of hierarchical digital interfaces".
- ITU-T Recommendation G.707 (1996): "Network node interface for the synchronous digital hierarchy" (replaces former G.707, G.708, G.709).
- CCITT Recommendation G.735 (1988): "Characteristics of primary PCM multiplex equipment operating at 2 048 kbit/s and offering synchronous digital access at 384 kbit/s and/or 64 kbit/s".
- ITU-T Recommendation G.783 (1994): "Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks".
- ITU-T Recommendation G.803 (1993): "Architectures of transport networks based on the synchronous digital hierarchy (SDH)".
- ITU-T Recommendation G.804 (1993): "ATM cell mapping into plesiochronous digital hierarchy (PDH)".
- ITU-T Recommendation G.805 (1995): "Generic functional architecture of transport networks".
- ITU-T Recommendation G.832 (1995): "Transport of SDH elements on PDH networks - Frame and multiplexing structures".
- ITU-T Recommendation G.841 (1995): "Types and characteristics of SDH network protection architectures".
- ITU-T Recommendation G.957 (1995): "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy".
- ITU-T Recommendation G.964 (1994): "V-Interfaces at the digital local exchange (LE) - V5.1-interface (based on 2 048 kbit/s) for the support of access network (AN)".
- ITU-T Recommendation G.965 (1995): "V-Interfaces at the digital local exchange (LE) - V5.2 Interface (based on 2048 kbit/s) for the support of access network (AN)".
- Draft new ITU-T Recommendation G.96x: "Access digital section for B-ISDN".
- ITU-T Recommendation I.113 (1993): "Vocabulary of terms for broadband aspects of ISDN".
- ITU-T Recommendation I.150 (1995): "B-ISDN asynchronous transfer mode functional characteristics".
- ITU-T Recommendation I.211 (1993): "B-ISDN service aspects".
- ITU-T Recommendation I.320 (1993): "ISDN protocol reference model".
- ITU-T Recommendation I.326 (1995): "Functional architecture of transport networks based on asynchronous transfer mode".
- Draft new ITU-T Recommendation I.341: "B-ISDN connection types".
- ITU-T Recommendation I.352 (1993): "Network performance objectives for connection processing delays in an ISDN".
- ITU-T Recommendation I.353 (1996): "Reference events for defining ISDN and B-ISDN performance parameters".
- ITU-T Recommendation I.357 (1996): "B-ISDN semi-permanent connection availability".
- Draft new ITU-T Recommendation I.35bcp: "Call processing performance for a B-ISDN (*contained in ITU-T Study Group 13 Report 43, pages 57-63)*".
- ITU-T Recommendation I.361 (1995): "B-ISDN ATM layer specification".

- ITU-T Recommendation I.362 (1993): "B-ISDN ATM adaptation layer (AAL) functional description".
- ITU-T Recommendation I.364 (1995): "Support of broadband connectionless data service by the B-ISDN".
- ITU-T Recommendation I.371 (1996): "Traffic control and congestion control in B-ISDN".
- Draft new ITU-T Recommendation I.375: "Network capabilities to support multimedia services".
- ITU-T Recommendation I.413 (1993): "B-ISDN user-network interface".
- ITU-T Recommendation I.580 (1995): "General arrangements for interworking between B-ISDN and 64 kbit/s based ISDN".
- CCITT Recommendation Q.9 (1988): "Vocabulary of switching and signalling terms".
- ITU-T Recommendation Q.850 (1993), "Use of cause and location in the digital subscriber Signalling System No.1 and the Signalling System No. 7 ISDN user part".
- ITU-T Recommendation Q.2010 (1995): "B-ISDN overview - Signalling capability set 1, release 1".
- ITU-T Recommendation Q.2100 (1994): "B-ISDN signalling ATM adaptation layer (SAAL) overview description".
- ITU-T Recommendation Q.2110 (1994): "B-ISDN ATM adaptation layer - Service specific connection oriented protocol (SSCOP)".
- ITU-T Recommendation Q.2120 (1995): "B-ISDN meta-signalling protocol".
- ITU-T Recommendation Q.2130 (1994): "B-ISDN signalling ATM adaptation layer - Service specific coordination function for support of signalling at the user-network interface (SSCF at UNI)".
- Draft new ITU-T Recommendation Q.2541.
- Draft new ITU-T Recommendation Q.2542.
- ITU-T Recommendation Q.2610 (1995): "Usage of cause and location in B-ISDN user part and DSS 2".
- ITU-T Recommendation Q.2650 (1995): "Interworking between Signalling System No.7 broadband ISDN User Part (B-ISUP) and digital subscriber Signalling System No.2 (DSS2)".
- ITU-T Recommendation Q.2761 (1995): "Functional description of the B-ISDN user part (B-ISUP) of signalling system No.7."
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- ITU-T Recommendation Q.2931 (1995): "Digital subscriber signalling system No.2 - User-Network Interface (UNI) layer 3 specification for basic call/connection control".
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- Draft new ITU-T Recommendation Q.298x.

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