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SERIES Q: SWITCHING AND SIGNALLING

Clauses applicable to ITU-T standard systems – Logic and protocols for the control of signal processing network elements and functions

Logic for the control of voice enhancement devices and functions

ITU-T Recommendation Q.115.2

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ITU-T Recommendation Q.115.2

Logic for the control of voice enhancement devices and functions

Summary

ITU-T Recommendation Q.115.2 describes the network logic for the control of voice enhancement devices/functions (VEDs) to be deployed in the network(s). A VED is defined as certain signal processing (acoustic echo control and noise reduction) in the digital transmission path. Mobile networks, where acoustic echo and noise is a common problem, are examples of where VEDs are deployed. The signal processing network equipment for VED (SPNE:VED) is the platform that incorporates the VED. The network logic described in ITU-T Recommendation Q.115.2 avoids multiple provisioning of voice enhancement devices/functions in the same digital transmission path of a connection.

Source

ITU-T Recommendation Q.115.2 was approved on 13 January 2007 by ITU-T Study Group 16 (2005-2008) under the ITU-T Recommendation A.8 procedure.

Keywords

Acoustic echo control, noise reduction, signal processing network equipment, signalling.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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CONTENTS

ITU-T Recommendation Q.115.2

Logic for the control of voice enhancement devices and functions

1 Scope

Acoustic echo and noise is a common problem in many networks, e.g., mobile networks. Special signal processing network equipment (SPNE) containing voice enhancement devices/functions (VEDs) has been designed to enhance voice quality. This SPNE:VED can be provided as a stand-alone version or integrated into other network equipment. This Recommendation defines a network logic that provides the optimal placement (nearest to the source) of, and avoids multiple provisioning of, VEDs in a connection. This voice enhancement control logic (VECL) is applicable to network entities that control a VED on a per-call basis. As VEDs will normally be deployed in mobile networks, the VECL described in this Recommendation is considered to be applicable in any network that provides VED.

NOTE – Multiple VEDs in a connection would waste resources and the interaction between VEDs could impair the voice quality (in the sense of VEDs processing a signal that has already been processed by a VED).

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Q.115.0] ITU-T Recommendation Q.115.0 (2002), *Protocols for the control of signal processing network elements and functions*.

3 Definitions

This Recommendation defines the following terms:

3.1 acoustic echo: The reflected signal resulting from the acoustic path between the earphone/loudspeaker and microphone of a hand-held or hands-free mobile station.

3.2 noise: In the context of voice enhancement, noise is defined as a slowly varying stochastic process appearing additive to the desired speech signal. Specifically, the variation in the characteristics of the noise process is such that it can be considered approximately stationary over much longer time intervals than a typical speech signal.

3.3 signal processing function (SPF): A software function that performs voice processing such as electric and acoustic echo control, noise reduction or automatic level control.

3.4 signal processing network equipment (SPNE): Type of network equipment which contains one or more signal processing function(s). In this Recommendation, the focus is on the SPNE:VED (a SPNE that incorporates VED).

3.5 voice enhancement: Combination of acoustic echo cancellation and noise reduction in order to improve voice quality.

3.6 voice enhancement device/function (VED): The combination of acoustic echo cancellation and noise reduction in the digital transmission send path provided on a hardware/software basis.

NOTE – [b-ITU-T G.160] defines a VED for mobile networks.

3.7 voice enhancement control logic (VECL): A network control logic that provides the optimal placement (nearest to the source) of VEDs and avoids multiple provisioning of VEDs in a connection.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AEC	Acoustic Echo Control
CS MGW	Circuit Switched Media Gateway
DB	Database (data administered by the network operator)
EC	(network) Echo Canceller
GMSC	Gateway Mobile Switching Centre
IPE	Incoming Protocol Entity
MSC	Mobile Switching Centre
NR	Noise Reduction
OPE	Outgoing Protocol Entity
SDL	Specification and Description Language
SPF	Signal Processing Function
SPNE	Signal Processing Network Equipment/Function
SPNE:VED	SPNE that incorporates VED
TFO	Tandem Free Operation
VE	Voice Enhancement
VECL	Voice Enhancement Control Logic
VED	Voice Enhancement Device/Function
VEDb i.	Voice Enhancement Device in backward direction included
VEDb n.i.	Voice Enhancement Device in backward direction not included
VEDCF	Voice Enhancement Device Control Function
VEDCI	Voice Enhancement Device Control Info
VEDf i.	Voice Enhancement Device in forward direction included
VEDf n.i.	Voice Enhancement Device in forward direction not included
VEDIB	Voice Enhancement Device Information backward
VEDIF	Voice Enhancement Device Information forward
VEDSF	Voice Enhancement Device Switching Function

5 Conventions

None.

6 Voice enhancement control logic

6.1 Abstract model

Voice enhancement control logic (VECL) is associated with call/bearer control and has an interface to the incoming and outgoing protocol entities as well as to the voice enhancement device switching function (VEDSF). The VEDSF is either associated with the incoming or outgoing protocol entity. This allows the incoming/outgoing protocol entity to take into consideration the call state when actually controlling the VED (e.g., enabling the VED only after the call has been answered and not during call set-up). In case of a stand-alone SPNE:VED the control protocols used on the interface between VEDSF and the voice enhancement device control function (VEDCF) are those defined in [ITU-T Q.115.0], whereas, in case of an integrated SPNE:VED, this interface is an implementation matter.

The VECL process can run in addition to other signal processing control logic, e.g., echo control logic (as defined in [b-ITU-T Q.115.1]), if a node provides those signal processing functions in addition to VED. An example of such a node could be a gateway mobile switching centre (GMSC) that provides the VED for its mobile subscribers as well as the echo canceller (EC) for the interconnection to the fixed network.

Figure 1 shows the functional entities and their interrelation.

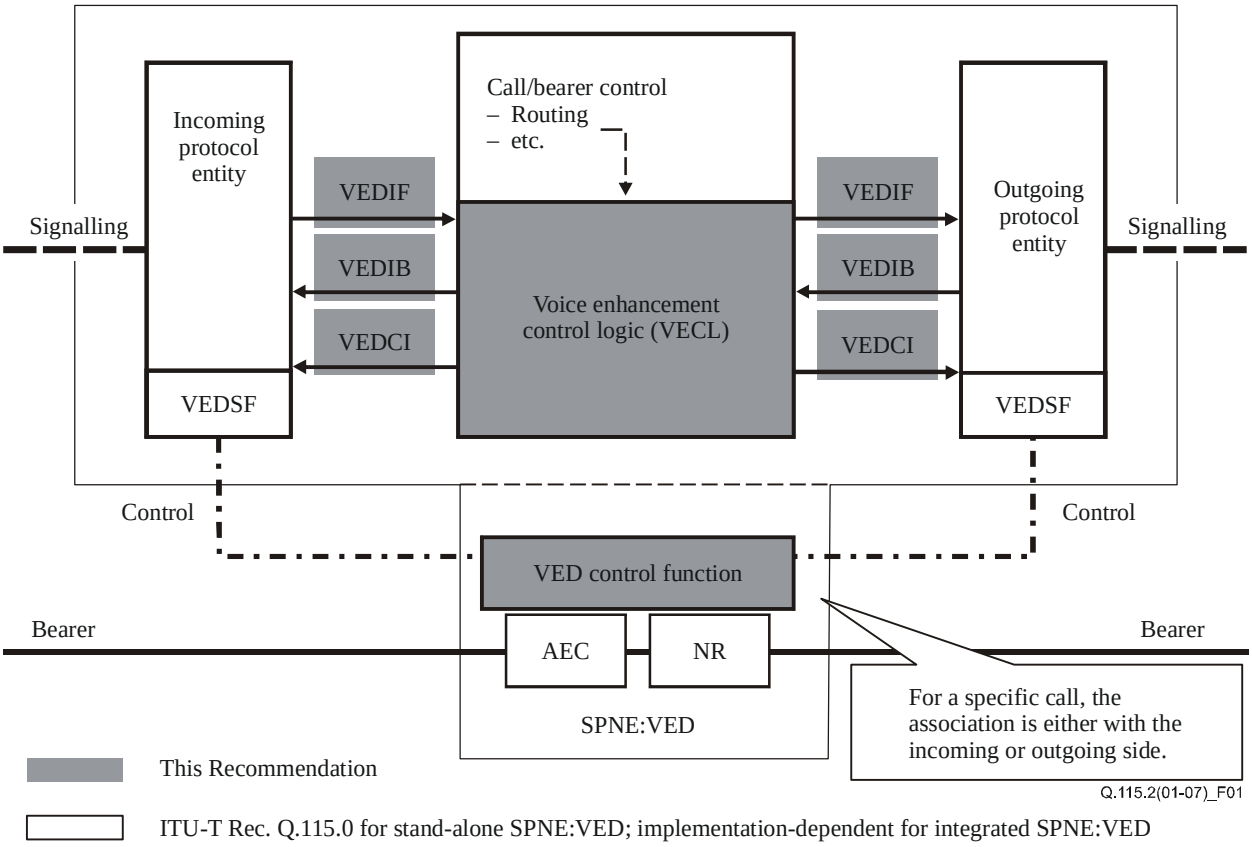

Figure 1 – Voice enhancement control

6.2 SPNE:VED

The SPFs of a VED can be controlled by the VECL described in this Recommendation, if the SPNE:VED does provide a VEDCF. This applies to stand-alone as well as integrated SPNE:VEDs.

Figure 2 shows a block diagram of a SPNE:VED with a control interface.

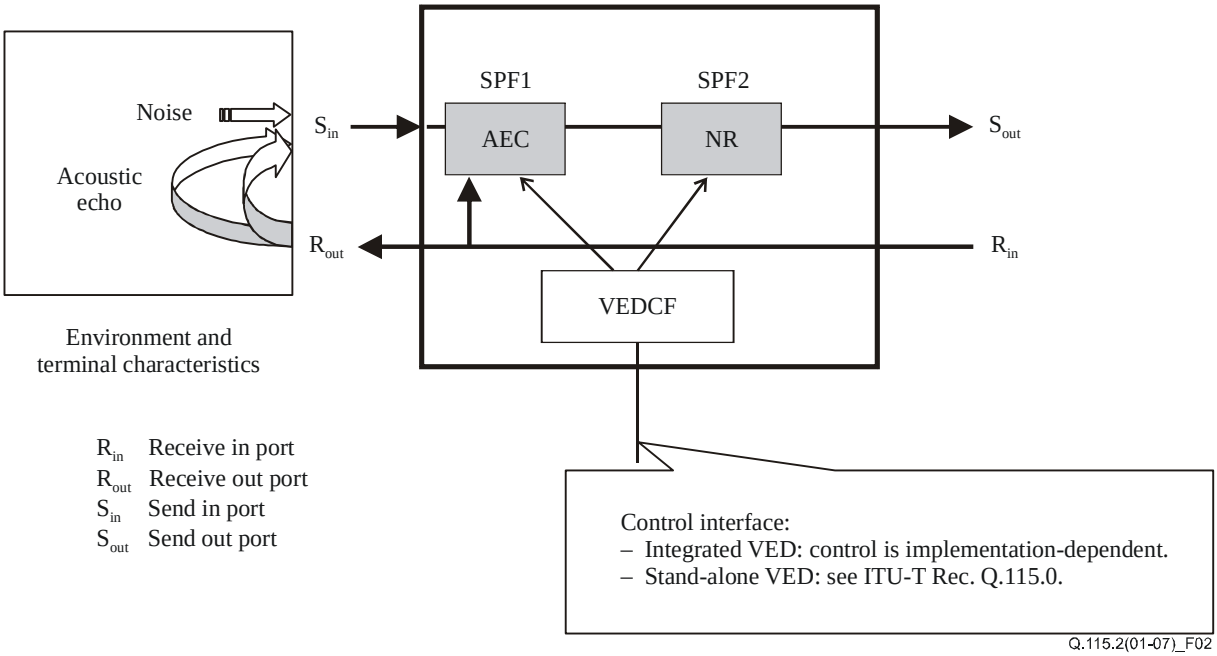

Figure 2 – SPNE:VED (AEC and NR controlled by VECL)

6.3 Voice enhancement control logic

6.3.1 General principles

The voice enhancement control logic (VECL) is invoked for voice calls during call set-up, when recognizing the need for the provisioning of a voice enhancement device/function. The need for providing voice enhancement may be based on specific information, e.g., the subscriber profile, origin/destination-dependent responsibilities (agreements) or simply on the fact that voice enhancement devices/functions are available.

The network operator can administer the use of TFO or VED for connections where both mechanisms TFO and VED are available.

The voice enhancement control logic analyses the voice enhancement control information received via the signalling systems/protocols (if none is received, information from a local database or subscriber profile may be used instead), as well as origin/destination-related information that is stored in the database of the call/bearer control node. Based on all these data, the voice enhancement control logic determines:

a) VED-related actions (i.e., enable/disable) on the VED under control; and

b) the VED information that has to be transmitted by the signalling systems/protocols in their call set-up messages.

The voice enhancement control logic does not directly control the VED. It is the task of the VED switching function which communicates the result of the voice enhancement control logic to the VED control function (master-slave relation). Protocols to be used between the VED switching function and the VED control function are described in [ITU-T Q.115.0].

The voice enhancement control logic is applicable to any mobile-originating or mobile-terminating call, irrespective of the peer entity connected to the same network (arrow 2 in Figure 3) or another (mobile) network (arrow 1 in Figure 3). A VED may be provided not only for the own mobile subscriber(s), based on e.g., the subscriber profile, but also for a (mobile) subscriber connected to another network, based on origin- and destination-related information respectively.

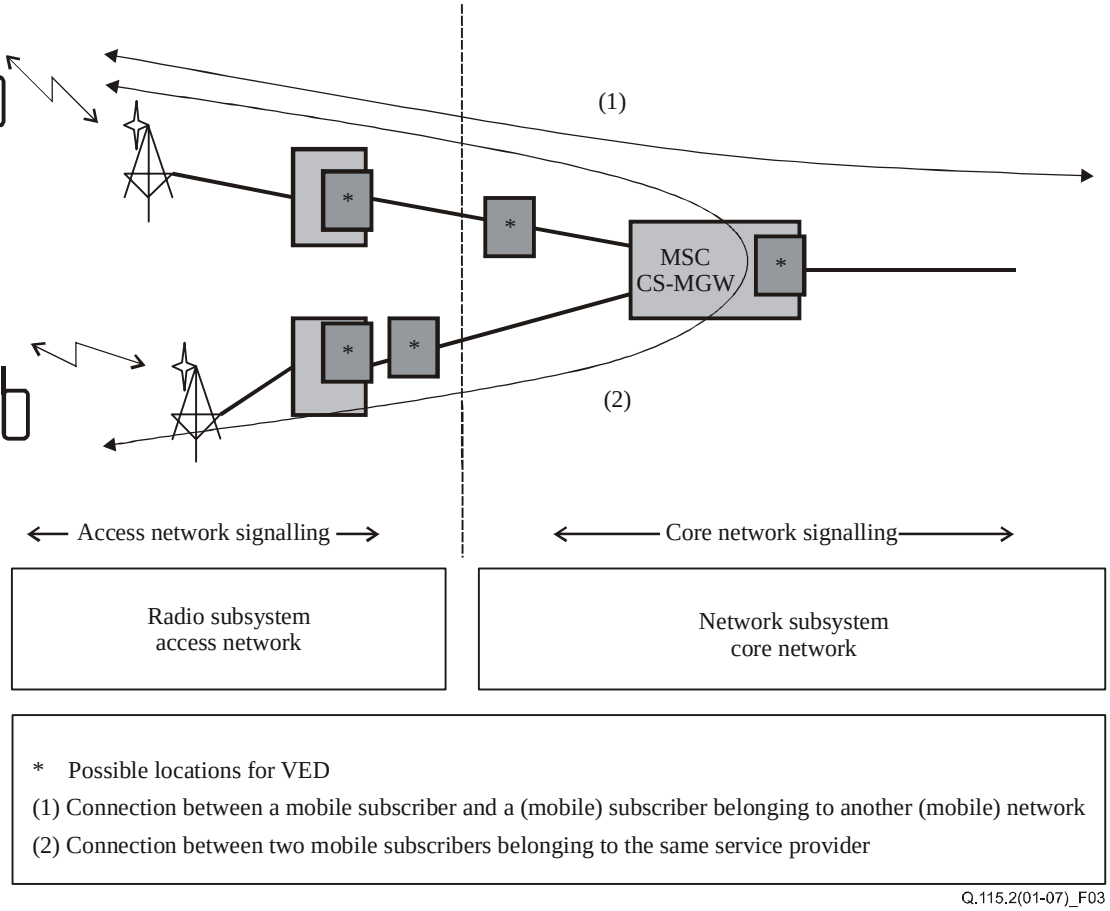

Figure 3 – Basic call scenarios for providing VED in mobile networks

6.3.2 SDL diagrams

Figures 4 to 9 show the finite state machine and the procedures of the voice enhancement control logic.

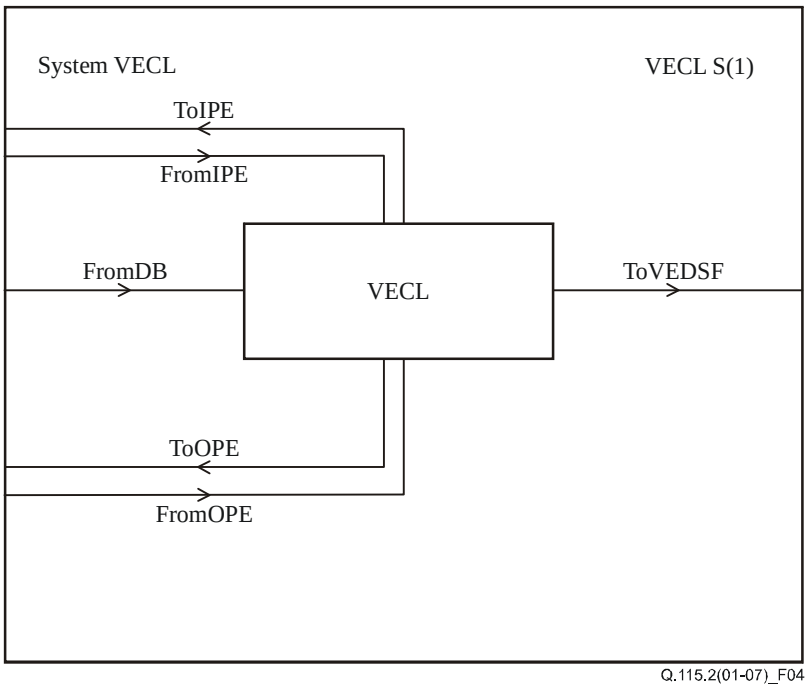

Figure 4 – SDL system of the voice enhancement control logic

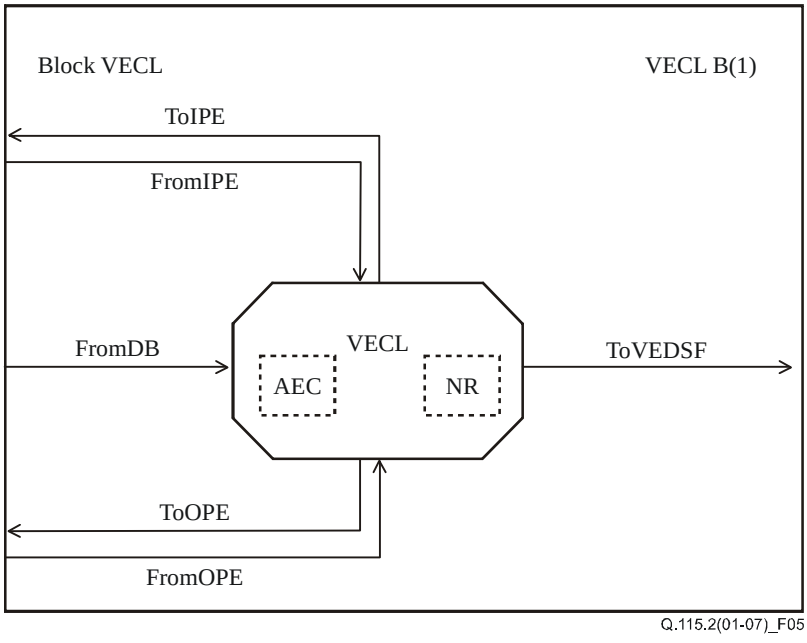

Figure 5 – SDL block structure of the voice enhancement control logic

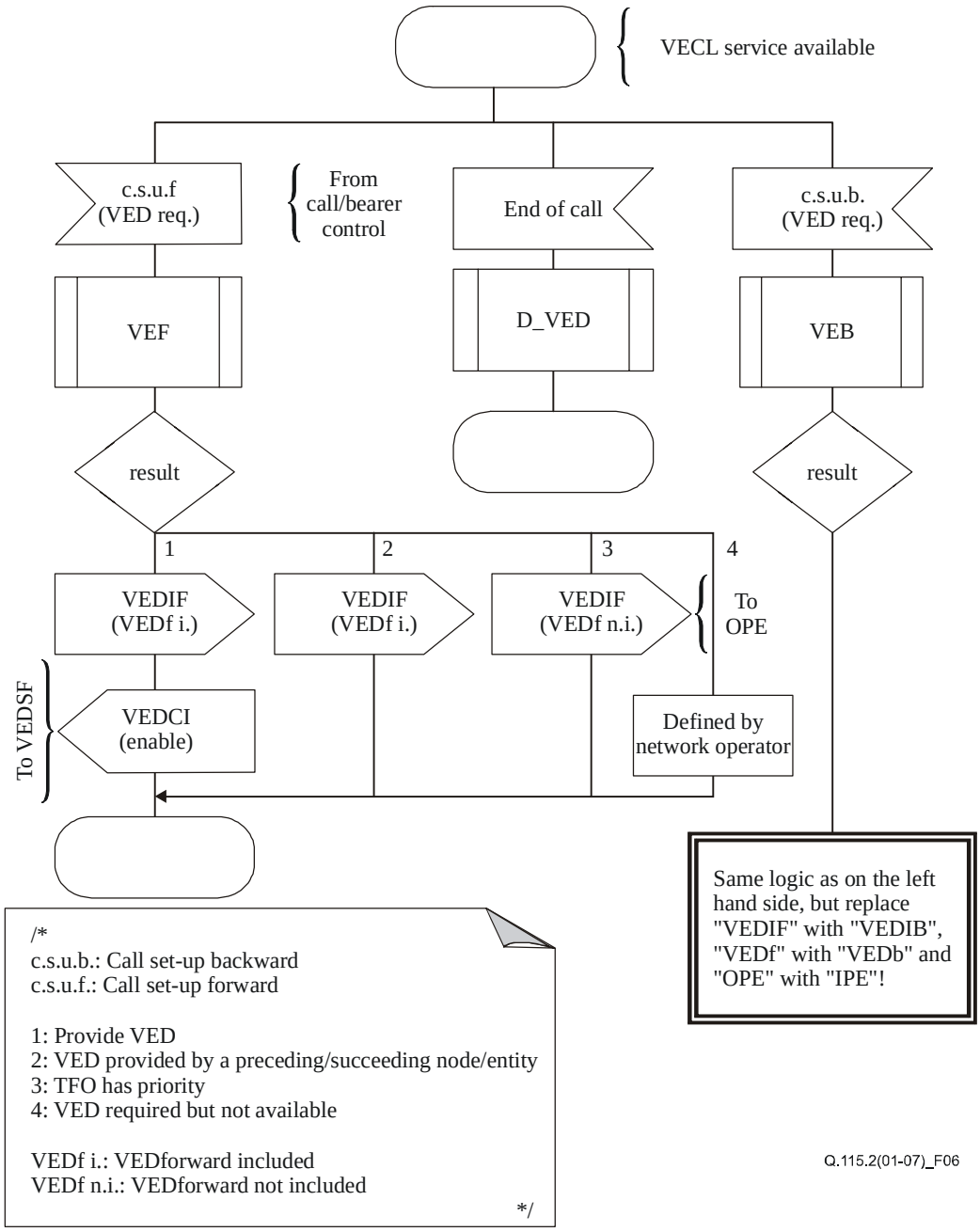

Figure 6 – SDL diagram for voice enhancement control logic

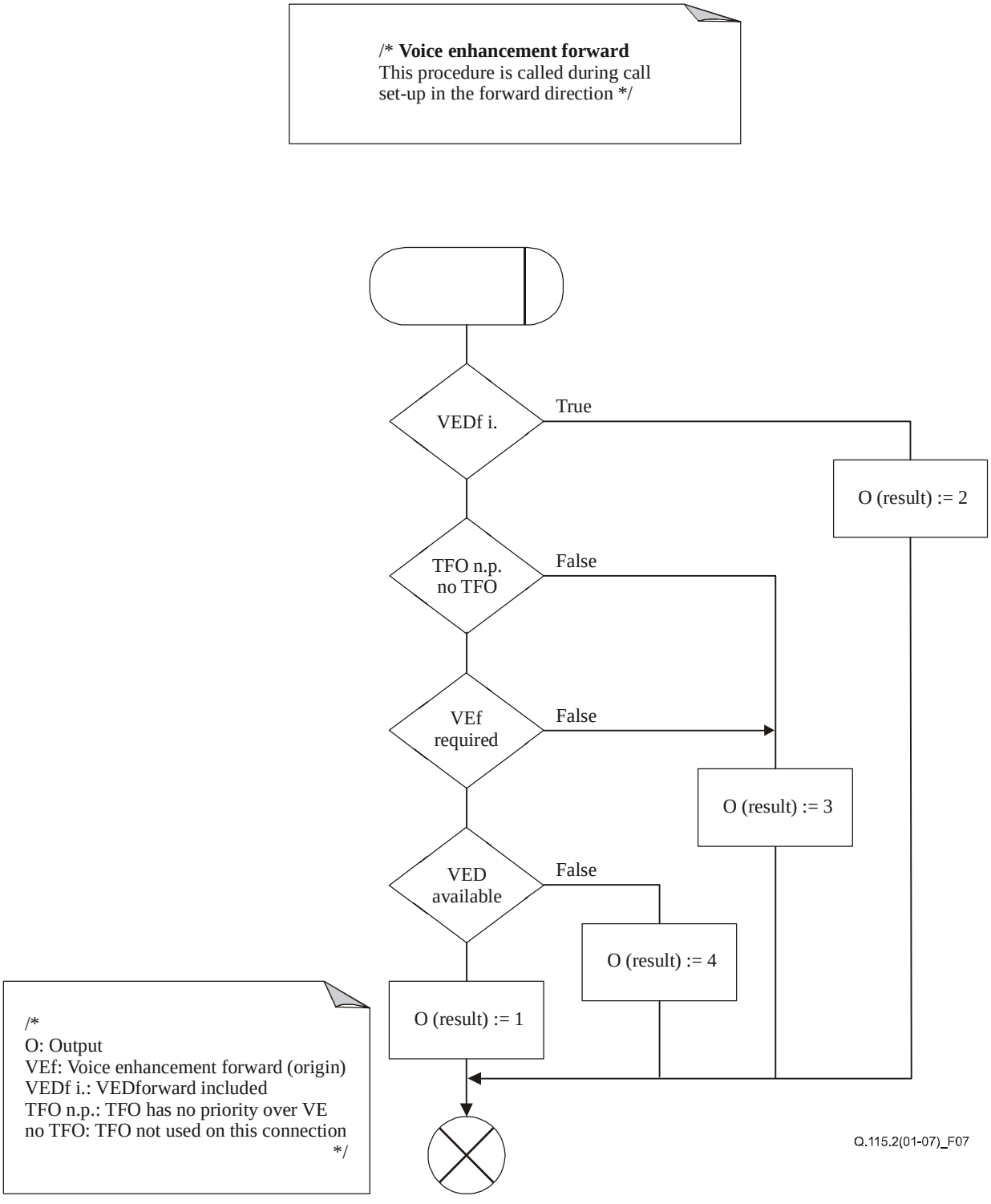

Figure 7 – Voice enhancement forward procedure

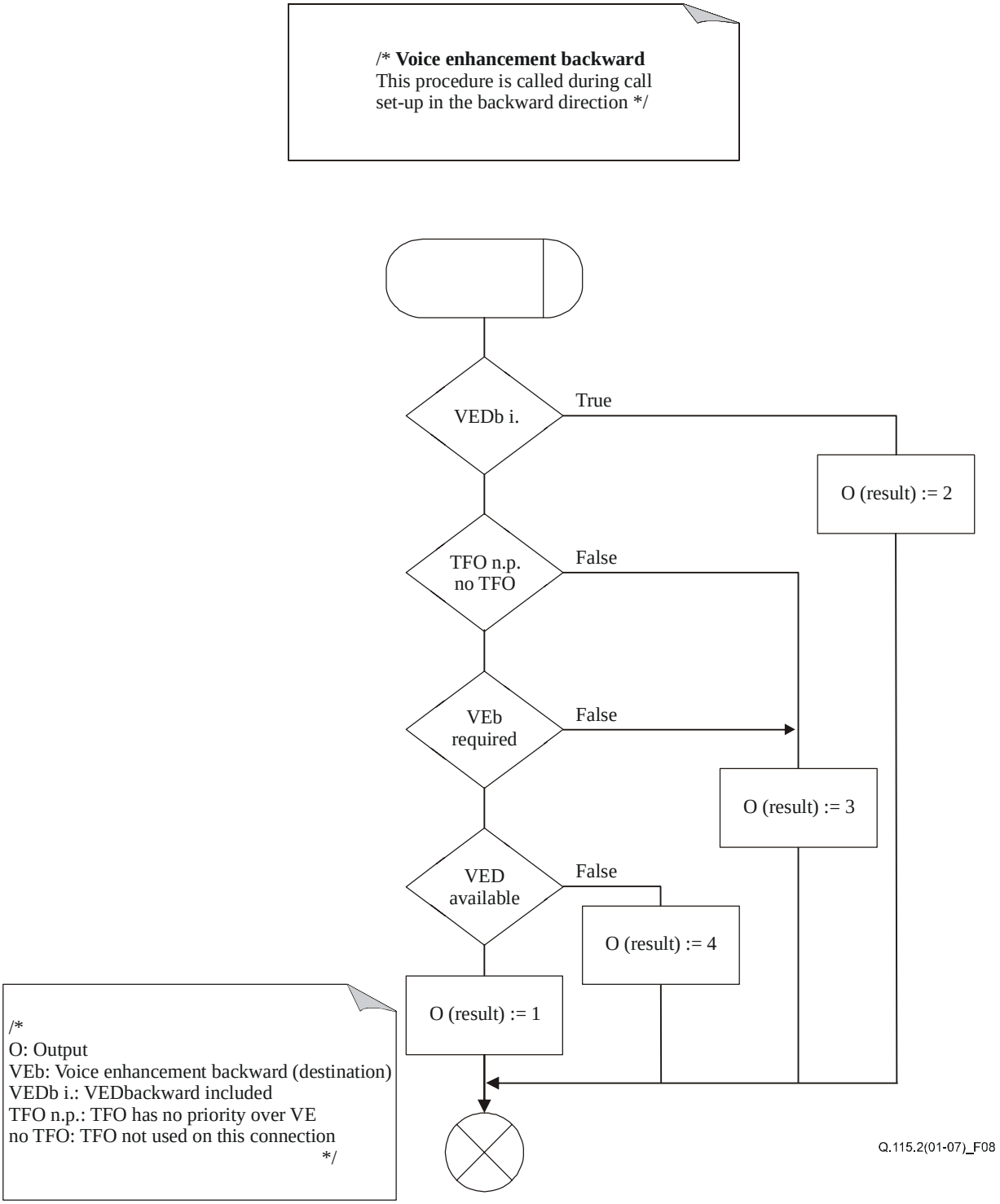

Figure 8 – Voice enhancement backward procedure

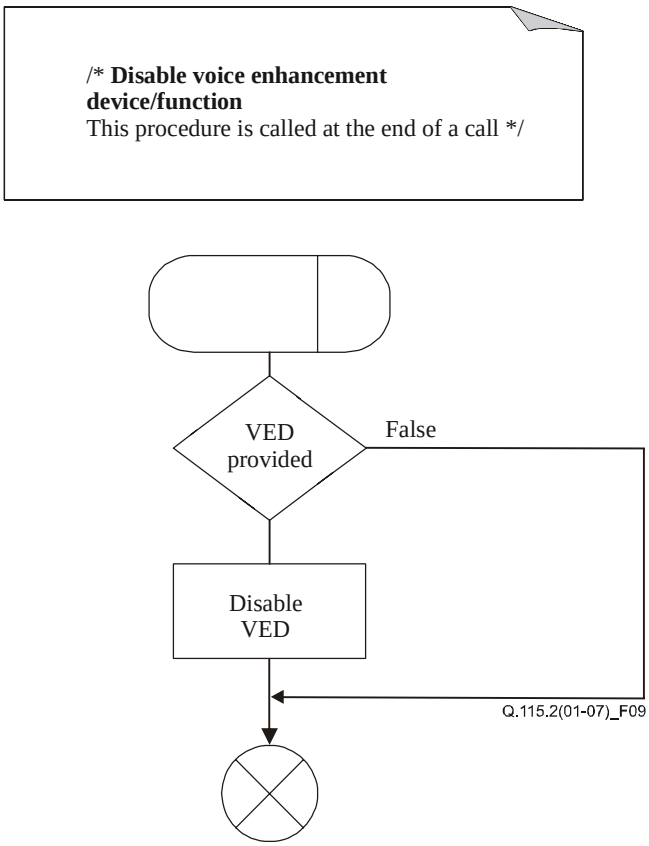

Figure 9 – Disable voice enhancement device/function

Bibliography

[b-ITU-T G.160] ITU-T Recommendation G.160 (draft), *Voice enhancement device for mobile networks*.

[b-ITU-T G.UCPSPNE] ITU-T Recommendation G.UCPSPNE (draft), *SPNE mechanisms/auxiliary functions*.

[b-ITU-T Q.115.1] ITU-T Recommendation Q.115.1 (2002), *Logic for the control of echo control devices and functions*.

[b-ITU-T Q.762] ITU-T Recommendation Q.762 (1999), *Signalling System No. 7 – ISDN User Part general functions of messages and signals.* Amendment 4: *Transport of Voice Enhancement Device related information.*

[b-ITU-T Q.763] ITU-T Recommendation Q.763 (1999), *Signalling System No. 7 – ISDN User Part formats and codes.* Amendment 5: *Transport of Voice Enhancement Device related information*.

[b-ITU-T Q.764] ITU-T Recommendation Q.764 (1999), *Signalling System No. 7 – ISDN User Part signalling procedures.* Amendment 5: *Transport of Voice Enhancement Device related information*.

[b-ITU-T Q.1902.2] ITU-T Recommendation Q.1902.2 (2001), *Bearer Independent Call Control protocol (Capability Set 2) and Signalling System No. 7 ISDN User Part: General functions of messages and parameters.* Amendment 4: *Transport of Voice Enhancement Device related information*.

[b-ITU-T Q.1902.3] ITU-T Recommendation Q.1902.3 (2001), *Bearer Independent Call Control protocol (Capability Set 2) and Signalling System No. 7 ISDN User Part: Formats and codes.* Amendment 4: *Transport of Voice Enhancement Device related information.*

[b-ITU-T Q.1902.4] ITU-T Recommendation Q.1902.4 (2001), *Bearer Independent Call Control protocol (Capability Set 2): Basic call procedures.* Amendment 4: *Transport of Voice Enhancement Device related information*.

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