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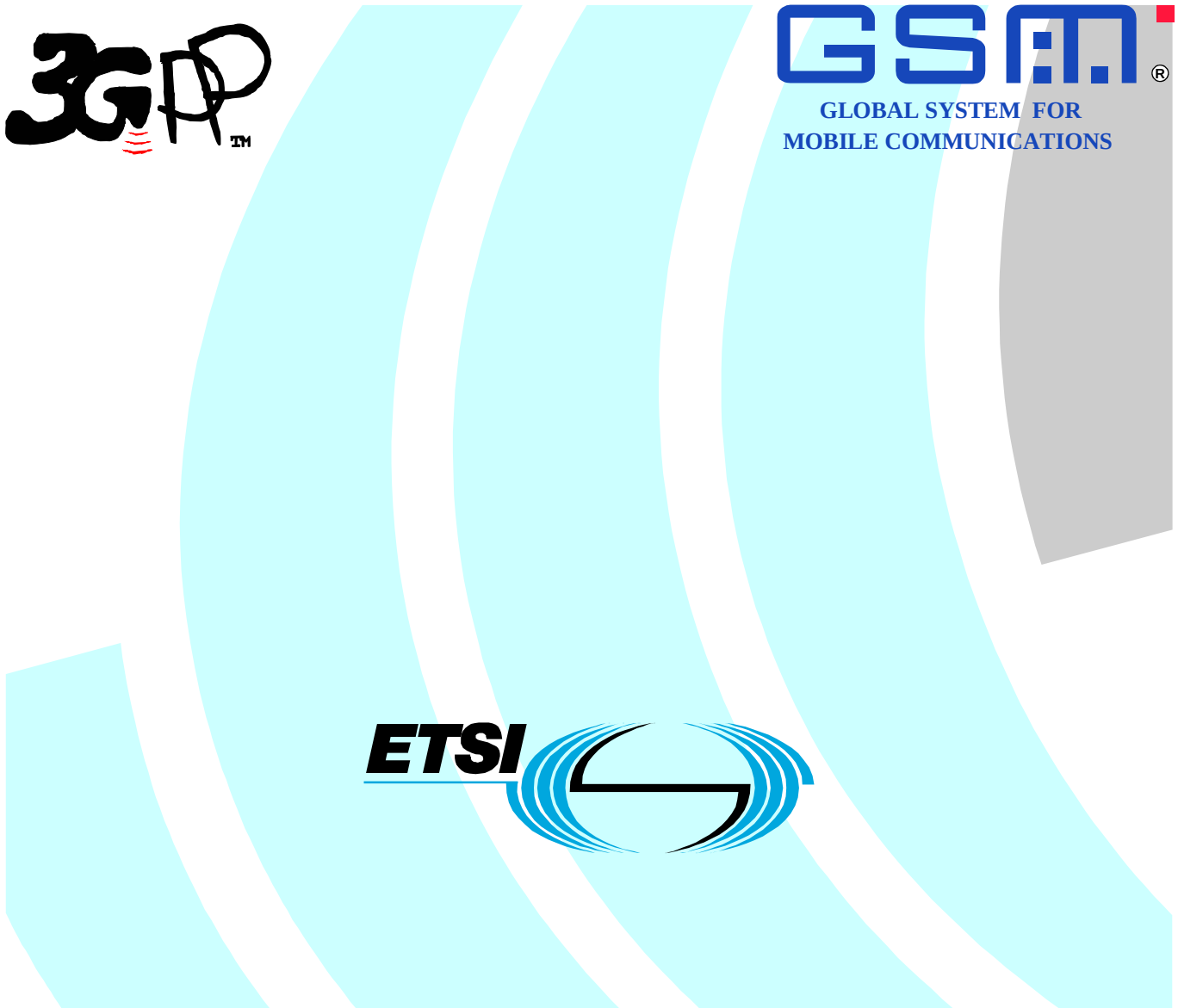
Technical Report

Digital cellular telecommunications system (Phase 2+);
Universal Mobile Telecommunications System (UMTS);
Codec for Circuit switched Multimedia Telephony Service;
Terminal Implementor's Guide
(3GPP TR 26.911 version 3.4.0 Release 1999)



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Foreword

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Contents

Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project, Technical Specification Group Services and System Aspects, Working Group 4 (Codec).

The contents of this TR may be subject to continuing work within the 3GPP and may change following formal TSG approval. Should the TSG modify the contents of this TR, it will be re-released with an identifying change of release date and an increase in version number as follows:

Version m.t.e

where:

- m indicates [major version number]
- x the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- y the third digit is incremented when editorial only changes have been incorporated into the specification.

1 Scope

The present report provides non-mandatory recommendations for the use of the different codec implementation options for the circuit switched multimedia telephony service which is based on ITU-T Recommendation H.324 [4], and Annex C of H.324 in particular. These recommendations address issues specific to the 3G operating environment, including guaranteeing sufficient error resilience and interworking between terminals.

The contents of this document are provided for information to assist in high quality implementation of multimedia telephony terminals. All references to "terminals" in this report are to terminals supporting the Circuit Switched Multimedia Telephony Service as described in [7-9].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1a] ITU-T Recommendation H.223: "Multiplexing protocol for low bitrate multimedia communication"

[1b] ITU-T Recommendation H.223 – Annex A: " Multiplexing protocol for low bit rate multimedia mobile communication over low error-prone channels "

[1c] ITU-T Recommendation H.223 – Annex B: " Multiplexing protocol for low bit rate multimedia mobile communication over moderate error-prone channels "

[1d] ITU-T Recommendation H.223 – Annex C: " Multiplexing protocol for low bit rate multimedia mobile communication over highly error-phone channels "

[2] ITU-T Recommendation H.245: "Control protocol for multimedia communication"

[3] ITU-T Recommendation H.261: "Video codec for audiovisual services at px64 kbit/s"

[4] ITU-T Recommendation H.324: "Terminal for low bitrate multimedia communication"

[5] ITU-T Recommendation G.723.1: "Dual rate speech coder for multimedia communications transmitting at 5.3 and 6.3 kbit/s"

[6] ITU-T Recommendation H.263: "Video coding for low bit rate communication"

[7] 3rd Generation Partnership Project (3GPP), TSG-SA Codec Working Group, 3GPP TS 26.110, Codec(s) for Circuit Switched Multimedia Telephony Service: General Description

[8] 3rd Generation Partnership Project (3GPP), TSG-SA Codec Working Group, 3GPP TS 26.111 Codec(s) for Circuit Switched Multimedia Telephony Service, Modifications to H.324

[9] 3rd Generation Partnership Project (3GPP), TSG-SA Codec Working Group, 3GPP TS 26.112 Codec(s) for Circuit Switched Multimedia Telephony Service, Call Set Up Requirements

[10] 3rd Generation Partnership Project (3GPP), TSG-SA Codec Working Group, 3GPP TR 26.912, Quantitative performance evaluation of H.324 Annex C over 3G

[11] International Standard ISO/IEC 14496-2, Information technology -Generic coding of audio-visual objects- Part 2: Visual, 1999

[12] ISO/IEC JTC1/SC29/WG11 MPEG 99/N2724 "MPEG-4 Applications", March 1999

[13] 3rd Generation Partnership Project (3GPP), 3GPP TS 25.301, Radio Interface Protocol Architecture.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

3G-324M terminal: A multimedia telephony terminal conforming to 3GPP TS 26.110 [7] and targeted for use in 3G mobile networks.

3G-324M codec: The implementation of H.324 and all its elements adapted to the 3G environment (known as 3G-324M) is seen as a "codec" consisting of an encoder and a decoder.

3G-324M encoder: Encoder part of the 3G-324M codec.

3G-324M decoder: Decoder part of the 3G-324M codec.

3.2 Symbols

(void)

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AL1,2,3: H.223 Adaptation layers 1, 2 and 3 (see [1a])

AL-SDU: Adaptation Layer Service Data Unit (see [1a])

AMR: Adaptive Multi-Rate (Audio Codec)

CIF: Common Intermediate Format (a picture format for Video Codec)

CRC: Cyclic Redundancy Check

GOB: Group of blocks (a sub-part of a video picture)

GSM: Global System for Mobile communications

GSTN: General Switched Telephone Network

ISDN: Integrated Services Digital Network

ITU-T: International Telecommunication Union – Telecommunication Standardization Sector

MUX-PDU: Multiplex Packet Data Unit (see [1a])

PSC: Picture start code (synchronization field for Video Codec)

QCIF: Quarter CIF (a picture format for Video Codec)

RVLC: Reversible Variable Length Code (see [11])

SQCIF: Sub QCIF (a picture format for Video Codec)

T401: Acknowledgement timer used by H.245 implementations

VOP: Video Object Plane (see [11])

4 General

The following sections give implementation recommendations for different parts of the 3G-324M codec. The section division loosely follows the structure of ITU-T Recommendation H.324 [4].

Most of the recommendations in this document assume that both transmitting and receiving terminals operate within the 3G system and conform to 3G-324M specifications in [7-9]. Section 11 additionally includes recommendations relevant for interoperability between 3G-324M terminals and other terminals.

The recommendations are primarily targeted for such aspects of the codec implementation which have a significant effect on the quality perceived by the user at the other end of the connection which usually implies emphasizing encoder recommendations over decoder recommendations, although this division cannot be made in all cases. It should be recognized that the H.324 specification leaves substantial amount of freedom for terminal implementations and no definite quality guarantee can be given even if all recommendations in this document are followed.

5 Multiplex Protocol

Multiplexing of video, audio, data, and control information is based on the ITU-T Recommendation H.223 [1a-1d]. The following general guidelines are recommended to be followed in the implementation of H.223.

MUX-PDU size should be limited to be smaller than in typical GSTN use. Specific values depend on the bit-rate and channel characteristics, but suitable upper limits for MUX-PDU size are often in the range of 100-200 octets.

Encoders are recommended to support the boolean H.245 *maxMUXPDUSizeCapability* (section 7.2.2.4 of [2] Version 3) to indicate that they are able to restrict the size of the MUX-PDUs that they transmit. Decoders are recommended to utilize the *maxH223MUXPDUsize* H.245 command (section 7.11.5 of [2] Version 3) to restrict the size of the MUX-PDUs, sent by the encoder, to a maximum of the specified number of octets.

H.324 mandates that H.263 encoders shall align picture start codes (PSC) with the start of an AL-SDU (see [4], Section 6.6.1). It is here further recommended that AL-SDUs that do not start with a PSC should start with a GOB header to improve error resilience.

No more than 1-3 audio frames should be included in one MUX-PDU to avoid excessive delay.

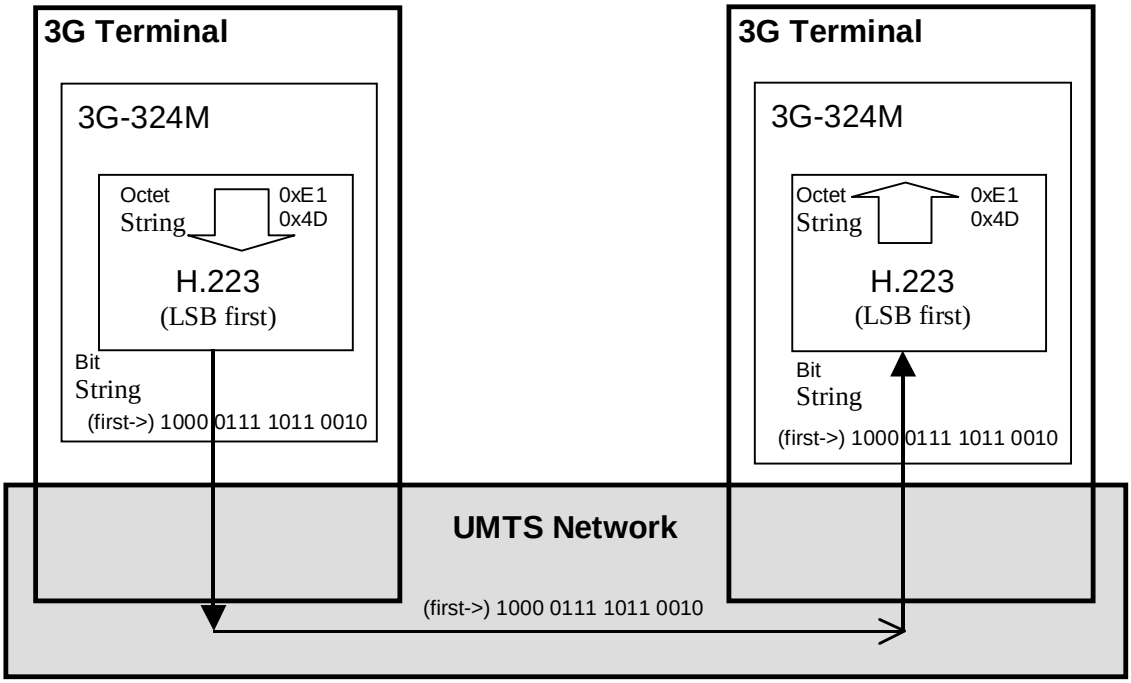
Use of the optional retransmission procedure for video when using Adaptation Layer Type 3 (AL3) is not recommended due to delay considerations. This recommendation implies that receiving terminals should not send retransmission requests. It is recommended that terminals support video also using Adaptation Layer Type 2 (AL2) where retransmission is not possible and overhead is slightly smaller.

The H.223 abort procedures should not be used (see [1a], H.223 Sections 6.4.3, 7.2.3, 7.3.4, and 7.4.4).

5.1 H.223 Multiplex Transmission Bit Order

H.223 multiplex transmission bit order is defined in H.223 [1a] Sec 3.2.2 as LSB first. This first bit is transparently mapped to the first bit of “higher layer PDU” depicted in 5.3.5 of TS25.301 [13], and vice versa.

An example is given by the following figure:



UMTS Network Model (3G Terminal <-> 3G Terminal)

6 Control Protocol

It is recommended that terminals support the latest possible version of H.245. Capability to support latest improvements in H.324 are usually dependent on supporting the corresponding signalling in H.245. Most of the recommendations in the present document require support for at least H.245 Version 3 and some require even newer versions.

Recommendations for the control protocol are not limited to this section of the present document. Other sections of this document give recommendations for the different parts of the terminal often implying corresponding support from H.245. These recommendations are not replicated in this section, but they should still be interpreted as recommendations for the H.245 control protocol implementation.

The end-to-end transmission delay in the 3G system is expected to be somewhat higher than in GSTN. This will need to be considered for timer settings in connection with the H.245 implementation. For that reason, H.324 Annex C (and hence also 3G-324M) mandates the use of H.324 Annex E for initializing the timer T401. The following additional guidelines for initializing and updating the timer T401 should be considered: ffs

6.1 Usage of DRAWING_ORDER-information for MPEG-4 video objects

3G-324M decoders should ignore any drawing order information as signalled by H.245 drawingOrder Capability, see Table E.5/H.245, if the MPEG-4 simple profile level 1 is used.

7 Video Codec

This section gives recommendations for the video codec implementations within 3G-324M terminals. Section 7.1 is applicable to the use of any mandatory or optional video codec. Section 7.2 includes specific recommendations for using the H.263 codec. Section 7.3 gives specific recommendations for the use of MPEG-4 and other possible optional video codecs.

7.1 General Recommendations

Regardless of which specific video codec standard is used, all video decoder implementations should include basic error concealment techniques. These techniques may include replacing erroneous parts of the decoded video frame with interpolated picture material from previous decoded frames or from spatially different locations of the erroneous frame. The decoder should aim to prevent the display of substantially corrupted parts of the picture. In any case, it is recommended that the terminal should tolerate *every* possible bitstream without catastrophic behaviour (such as the need for a user-initiated reset of the terminal).
3G-324M encoders and decoders are recommended to support the 1:1 pixel format (square format) . Encoders should signal this capability using H.245 capability exchange and the appropriate header fields in video codecs so that unnecessary pixel shape conversions can be avoided.

7.2 H.263

Several of the optional annexes of H.263 are useful for improving the compression efficiency and error resilience of the codec. The annexes below form a balanced set of tools with respect to error robustness, compression efficiency, quality, and complexity. It is recommended that an H.263 video decoder should support the following annexes. The main feature of each annex is also mentioned:

- Annex I (Advanced Intra Coding), improves error resilience and compression efficiency.
- Annex J (Deblocking Filter), improves compression efficiency.
- Annex K (Slice Structure Mode, without RS submode), improves error resilience.
- Annex T (Modified Quantizer), improves compression efficiency.

Non-empty GOB headers should be used frequently to improve error resilience (see [6], Section 5.2).

H.263 encoders in 3G-324M terminals should respond to all videoFastUpdate commands received via the H.245 control channel (i.e., videoFastUpdatePicture, videoFastUpdateGOB, and videoFastUpdateMB presented in section 7.11.5 of [2] Version 3). Using this feedback information to make a focused picture update can significantly improve the error performance of the codec. 3G-324M decoders are correspondingly recommended to transmit videoFastUpdate commands when the received picture is detected to be significantly corrupted due to transmission errors.

It is recommended that H.263 decoders take advantage of the GOB and slice header GOB Frame ID (GFID) field in recovering corrupted picture header data (see Sections 5.2.5 and K.2 of H.263 recommendation version 2). For this purpose it is recommended that H.263 encoders should not use the Rounding Type (RTYPE) bit of the extended picture header as described in Section 5.1.4.3 of [1]. The RTYPE bit should always be set to 0 since it otherwise effectively prevents the use of the GFID field for picture header recovery.

7.3 Other Video Codecs

It is recommended that all 3G-324M terminals additionally support the ISO/IEC 14496-2 (MPEG-4 Visual) video codec [11]. The explanatory text below gives justification and further detail for this recommendation.

One of the main target environments for MPEG-4 Visual is mobile use. For this purpose the following error resilient techniques have been adopted in MPEG-4 Visual: Resynch Marker, Header Extension Code, Data Partitioning, and Reversible Variable Length Code. With these techniques MPEG-4 Visual codec can be used over errorprone channels enabling highly efficient low delay multimedia communication services for 3G networks. Support for MPEG-4 Visual potentially provides capabilities for communicating with heterogeneous networks without transcoding, or reusing pictures/video from 3G multimedia telephony service by different applications and vice versa.

MPEG-4 Visual and H.263 have substantial technical similarities. MPEG-4 Visual also includes support for the H.263 baseline codec.

Because of multi-functionality of MPEG-4 Visual, subsets of different tools have been defined in order to allow effective implementations of the standard. These subsets, called “Profiles”, limit the tool set which shall be implemented. For each of these Profiles one or more Levels have been set to restrict the computational complexity of implementations. It is here recommended that the Simple Visual Profile @ Level 0 is supported to achieve adequate

error resilience for transmission error and low complexity simultaneously. No other Profiles are recommended to be supported. Higher Levels for the Simple Visual Profile may be supported depending on the terminal capabilities.

MPEG-4 Visual accepts various sizes of input picture within the capability specified from the Profile and Level. Picture size of QCIF for Level 1 should be used for the sake of interoperability.

All of the error resilience tools in Simple Visual Profile are recommended to be activated.

Resync Marker is a tool which increases the opportunities for the decoder to resynchronize with the bitstream and after loss of synchronization due to errors in the bitstream, thus enabling normal decoder operation to continue. The encoder should insert Resync Marker in the bitstream, in order to enable the decoder to search for the Resync Marker in addition to the Start Code.

Header Extension Code (HEC) enables independent decoding of each video packet. One or more than one video packet in a VOP should have HEC in order for. the decoder to utilize information derived from HEC, to avoid discarding a whole VOP when the VOP header could not be received.

Data Partitioning is a tool that separates the information within a video packet to improve the degree of error localization and concealment. When the decoder detect errors in a video packet, the decoder may not discard whole the packet if themotion information or the I-VOP DC coefficients are decoded correctly. The decoder may reconstruct the corresponding part of the picture utilizing the above motion information or DC coefficients. The encoder should use Data Partitioning syntax in order to enable the decoder the above operation.

Reversible Variable Length Code (RVLC) is a tool which reduce the number of discarded bits.. RVLC decoding operation as described in section E.1.4 of Annex E in [11] may be performed. The encoder should utilize RVLC to enable the decoder to perform such operation.

In addition to these tools, Intra Refresh should be inserted in order to prevent inter-frame propagation of errors. Adaptive Intra Refresh (AIR) described in section E.1.5 in Annex E of [11] should be used in conjunction with cyclic Intra Refresh.

One Video Packet of MPEG-4 Visual should be mapped to one AL-SDU of ITU-T H.223 Adaptive Layer.

When an incoming bi-directional openLogicalChannel request has unsuitable reverse parameters for the local encoder, e.g., unsuitable MPEG-4 decoderConfigurationInformation, the terminal should reject the request. The cause field of openLogicalChannelReject should be set to value unsuitableReverseChannelParameters. A new openLogicalChannel request should be sent to the other end, now using the forward channel parameters of the rejected request as reverse channel parameters, and specifying new preferred forward channel parameters.

All MPEG-4 encoders should accept and respond to H.245 videoTemporalSpatialTradeOff commands. Support for temporal-spatial trade-off cannot be signaled for MPEG-4 encoders, but the encoders should provide that support by default. MPEG-4 decoders are encouraged to utilize the videoTemporalSpatialTradeOff command. The specific response to the TemporalSpatialTradeOff command by MPEG-4 encoders is not defined and it is up to the implementation to decide how to respond to the command.

8 Audio Codec

8.1 AMR Codec

FFS. This section will include guidance on how to utilize the different modes of the AMR codec.

8.2 Other Audio Codecs

FFS.

9 Data Protocols

FFS.

10 Terminal Procedures

FFS.

11 Interoperation with Other Terminals

11.1 Audio Codecs

It is recommended that terminals additionally support the ITU-T G.723.1 audio codec [5] when it is expected that interoperability with GSTN is needed, because it cannot be guaranteed that H.324 terminals developed for GSTN use will support the AMR codec.

12 Optional Enhancements

FFS.

13 Multipoint Considerations

FFS.

14 Other Recommendations

FFS.

Annex A (informative): Change Request History

TSG_MEETING	TSG_DOC	SPEC	VERS_CURRENT	VERS_NEW	CR	REV	SUBJECT
SP-05	SP-99357	26.911	3.0.1	3.1.0	001		Recommendation for video feedback channel support in a 3G-324 terminal
SP-05	SP-99358	26.911	3.0.1	3.1.0	002	1	Proposals for updates to implementor's guide for video in 3G-324
SP-06	SP-99571	26.911	3.1.0	3.2.0	003	2	Disabling depth information for MPEG-4 video in 3G-324M
SP-06	SP-99623	26.911	3.1.0	3.2.0	004	1	Error resilience improvements to using video in 3G-324M
SP-06	SP-99571	26.911	3.1.0	3.2.0	005	1	Modification on MPEG-4 Visual implementation
Oct 00			3.2.0	3.2.1			Editorial mistake corrected in the front page (TS -> TR)
SP-10	SP-000579	26.911	3.2.1	3.3.0	006	1	Annex K submodes of H.263 video codec for 3G-H324 specification
SP-10	SP-000579	26.911	3.2.1	3.3.0	008		Changes due to Correction of TS 26.111
SP-19	SP-030093	26.911	3.3.0	3.4.0	011		Clarification of bit-order handling for 3G-324M terminals

History

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V3.2.0	January 2000	Publication
V3.3.0	December 2000	Publication
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