



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.767

(10/98)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Digital transmission systems – Terminal equipments –
Principal characteristics of transcoder and digital
multiplication equipment

**Digital circuit multiplication equipment using
16 kbit/s LD-CELP, digital speech interpolation
and facsimile demodulation/remodulation**

ITU-T Recommendation G.767

(Previously CCITT Recommendation)

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
INTERNATIONAL ANALOGUE CARRIER SYSTEM	
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TESTING EQUIPMENTS	
TRANSMISSION MEDIA CHARACTERISTICS	
General	G.600–G.609
Symmetric cable pairs	G.610–G.619
Land coaxial cable pairs	G.620–G.629
Submarine cables	G.630–G.649
Optical fibre cables	G.650–G.659
Characteristics of optical components and sub-systems	G.660–G.699
DIGITAL TRANSMISSION SYSTEMS	
TERMINAL EQUIPMENTS	G.700–G.799
General	G.700–G.709
Coding of analogue signals by pulse code modulation	G.710–G.719
Coding of analogue signals by methods other than PCM	G.720–G.729
Principal characteristics of primary multiplex equipment	G.730–G.739
Principal characteristics of second order multiplex equipment	G.740–G.749
Principal characteristics of higher order multiplex equipment	G.750–G.759
Principal characteristics of transcoder and digital multiplication equipment	G.760–G.769
Operations, administration and maintenance features of transmission equipment	G.770–G.779
Principal characteristics of multiplexing equipment for the synchronous digital hierarchy	G.780–G.789
Other terminal equipment	G.790–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999

For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION G.767

DIGITAL CIRCUIT MULTIPLICATION EQUIPMENT USING 16 kbit/s LD-CELP, DIGITAL SPEECH INTERPOLATION AND FACSIMILE DEMODULATION/REMODULATION

Summary

This Recommendation specifies the elements of DCME using 16 kbit/s LD-CELP, Digital Speech Interpolation (DSI) and Facsimile Demodulation/Remodulation in order to achieve interworking of such equipment. It specifies extensions and deviations for Recommendations G.763 and G.766 which specify a 32 kbit/s ADPCM DCME, and Facsimile Demodulation/Remodulation.

Source

ITU-T Recommendation G.767 was prepared by ITU-T Study Group 15 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 13th of October 1998.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 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

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

© ITU 1999

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the ITU.

CONTENTS

	Page
1 Scope	1
2 References	1
3 Definitions	1
4 Abbreviations	1
5 DCME frame structure	2
5.1 General	2
5.1.1 Supported services.....	2
5.1.2 PCM frame	2
5.1.3 DCME frame	2
5.1.4 DCME multiframe.....	2
5.1.5 16 kbit/s DCME frames.....	3
6 Bearer frame structure	3
6.1 Cliques, destinations and bearers	3
6.1.1 Number of cliques	3
6.1.2 Number of destinations	3
6.1.3 Multiple outgoing bearers	3
6.2 Assignment Messages (AM)	3
6.3 Bearer Channels (BC).....	4
6.4 Control Channel (CC).....	4
6.5 BC numbering and the use of the bearer frame	4
6.5.1 8-bit (64 kbit/s transparent calls) BCs.....	4
6.5.2 5-bit (VBD optimized 40 kbit/s LD-CELP) BCs.....	5
6.5.3 4-bit BCs (BB, FB)	5
6.5.4 Normal range 2-bit BCs (LD-CELP voice).....	5
6.5.5 Overload BCs	5
6.5.6 Pre-assigned BCs.....	5
7 Control channel	5
7.1 General	5
7.2 Number of assignment messages.....	5
7.2.1 Single/double AM mode criterion.....	5
7.2.2 Total number of assignment messages.....	5
7.3 Control channel content.....	6
7.3.1 CC synchronization	6
7.3.2 Assignment messages.....	6

	Page
7.3.3 Asynchronous data word	8
7.3.4 Error correction	10
7.4 CC message transmission scheme	11
7.4.1 Control channel structure	11
7.4.2 CC bit mapping	11
8 Variable bit rate and overload channel creation	16
8.1 Principles	16
8.1.1 Creation of 16 kbit/s channels	16
8.1.2 Creation of 12.8 kbit/s channels	16
8.1.3 Creation of 9.6 kbit/s channels	16
8.2 Overload channel creation	16
8.2.1 Notations	16
8.2.2 Packaging schemes	16
8.3 Overload channel creation process – The VBR scheme	17
8.3.1 VBR lists	17
8.3.2 Notations	18
8.3.3 VBR not required	18
8.3.4 VBR required	18
9 ABPS calculations	20
10 Channel check procedure	20
11 Facsimile demodulation/remodulation	20
11.1 General	20
11.2 Facsimile blocks, facsimile transport channels and fax banks	20
11.3 Facsimile data channel	21
11.4 Facsimile control channel and forward error correction	22
11.5 FCC location on the bearer	23
12 System statistics measurement	23

Introduction

The introduction of the 16 kbit/s LD-CELP speech compression algorithm by ITU-T (Recommendation G.728), with its expansions to variable bit rates below and above 16 kbit/s, has enabled the enhancement of circuit multiplication equipment performance in both speech quality and multiplication gain. Third generation DCME follows the operation principles of the second generation DCME (DCME in accordance with Recommendations G.763 and G.766), with modifications dictated by the transition from ADPCM, which is a single sample based speech compression algorithm, to LD-CELP, which operates on a 5-sample vector. This Recommendation is, therefore, an extension to Recommendations G.763 (Digital Circuit Multiplication Equipment Using 32 kbit/s ADPCM and Digital Speech Interpolation) and G.766 (Facsimile Demodulation/Remodulation for DCME), as it specifies only the deviations of the third generation DCME from its predecessor.

Recommendation G.767**DIGITAL CIRCUIT MULTIPLICATION EQUIPMENT USING 16 kbit/s LD-CELP,
DIGITAL SPEECH INTERPOLATION AND FACSIMILE
DEMODULATION/REMODULATION***(Geneva, 1998)***1 Scope**

This Recommendation specifies the elements of DCME using 16 kbit/s LD-CELP, Digital Speech Interpolation (DSI) and facsimile demodulation/remodulation (namely a 16 kbit/s DCME) in order to achieve interworking of such equipment. It is an extension to Recommendations G.763 (Digital Circuit Multiplication Equipment Using 32 kbit/s ADPCM and Digital Speech Interpolation) and G.766 (Facsimile Demodulation/Remodulation for DCME), as it specifies only the deviations of the 16 kbit/s DCME from the G.763 32 kbit/s DCME.

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; all 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.

- ITU-T Recommendation G.763 (1998), *Digital circuit multiplication equipment using ADPCM (Recommendation G.726) and digital speech interpolation.*
- ITU-T Recommendation G.766 (1996), *Facsimile demodulation/remodulation for digital circuit multiplication equipment.*

3 Definitions

The same definitions of Recommendations G.763 and G.766 are used in this Recommendation.

4 Abbreviations

The abbreviations used in the above-referenced Recommendations are also used in this Recommendation as well. This Recommendation uses also the following abbreviations.

ABPS	Averaged Bit Per Sample
AM	Assignment Message
BB	Bit Bank
BCH	Bose-Chaudhuri-Hocquenghem
FB	Fax Bank
FCC	Facsimile Control Channel
FDC	Facsimile Data Channel

**Documents**

Document Sharing Hub

Recommendation G.767 (10/98)

1

FTC	Facsimile Transport Channel
Info	Information
LD-CELP	Low-Delay Code Excited Linear Prediction
PCM	Pulse Code Modulation
QB	Quarter Byte
Rx	Receive
Tx	Transmit
VBD	Voice-Band Data

5 DCME frame structure

5.1 General

5.1.1 Supported services

The 16 kbit/s DCME frame structure accommodates the following services:

- 8-bit channels to support 64 kbit/s transparent calls.
- 2-bit channels to support voice calls at LD-CELP 16 kbit/s, 12.8 kbit/s, 9.6 kbit/s according to Recommendation G.728 and its Annex H.
- 5-bit channels to support VBD calls at 40 kbit/s according to Recommendation G.728 and its draft Annex J.
- 4-bit channels to support fax banks carrying demodulated fax calls similar to Recommendations G.763 and G.766.
- 8-, 5-, 2-bit channels to support 64 kbit/s, 40 kbit/s, 16 kbit/s, 12.8 kbit/s and 9.6 kbit/s pre-assigned channels.

5.1.2 PCM frame

As in Recommendation G.763, the bearer structure of the 16 kbit/s DCME retains compatibility with Recommendation G.704, so it contains 32 consecutively numbered 8-bit time slots, from 0 to 31¹.

5.1.3 DCME frame

The low rate encoding algorithm used in the 16 kbit/s DCME is LD-CELP according to Recommendation G.728. The LD-CELP algorithm handles a speech vector of 5 consecutive PCM samples (at 64 kbit/s) and results in a vector of 10, 8 or 6 bits (at 16, 12.8 or 9.6 kbit/s respectively). The encoding rate can be altered once every 4 speech vectors, i.e. every 2.5 ms. A DCME frame of 2.5 ms, which contains 20 G.704 PCM frames, is used in the 16 kbit/s DCME.

5.1.4 DCME multiframe

The IT related circuit supervision/alarm condition field of the asynchronous word supports up to 360 ITs, carried over up to 12 primary rate interfaces. The G.767 DCME multiframe of 72 DCME frames is used to accommodate that.

¹ The case of T1 bearer interface is similar to E1 and handled as in Recommendation G.763

5.1.5 16 kbit/s DCME frames

The 16 kbit/s DCME frame and multiframe structures are depicted in Figure 1.

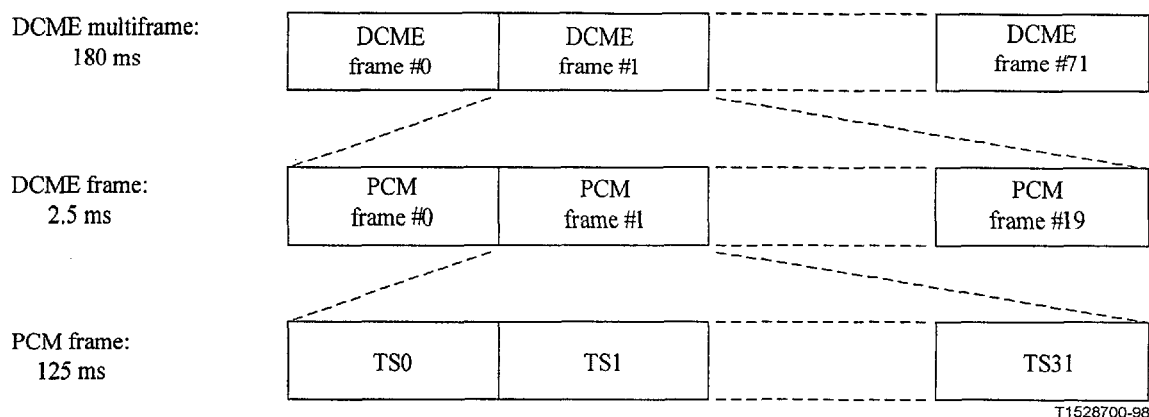


Figure 1/G.767 – 16 kbit/s frame and multiframe structures

6 Bearer frame structure

6.1 Cliques, destinations and bearers

6.1.1 Number of cliques

With LD-CELP, small cliques (compared to G.763 DCME) can support a fairly large amount of traffic. Therefore the maximum number of cliques (pools) carried on a single bearer in 16 kbit/s DCME is increased to 4. Each pool starts and ends on TS boundaries (and therefore occupies an integral number of time slots).

6.1.2 Number of destinations

The maximum number of destinations is 4 including the cases of mixed operation between multi-clique and multi-destination modes.

6.1.3 Multiple outgoing bearers

Optionally, a 16 kbit/s DCME will support up to 4 outgoing bearers. A single bearer will be able to carry up to 4 cliques. A clique shall not be split across bearers.

6.2 Assignment Messages (AM)

When using LD-CELP, the DCME gain increases significantly and the number of supported ITs is increased accordingly (compared to ADPCM). As a result, the number of activity events (and assignment messages) increases. Taking into account the fact that the DCME frame is extended (from 2 ms to 2.5 ms), the control channel can support up to two assignment messages (namely double AM) every DCME frame, so as to avoid long queues and freeze-out due to limited control channel capacity. The option of operating with a single Assignment Message (single AM), when smaller configurations are applied, is maintained.