



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Series G

Supplement 37
(10/98)

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

**ITU-T Recommendation G.763 digital circuit
multiplication equipment (DCME) tutorial and
dimensioning**

ITU-T G-series Recommendations – Supplement 37

(Previously CCITT Recommendations)



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SUPPLEMENT 37 TO ITU-T G-SERIES RECOMMENDATIONS

**ITU-T RECOMMENDATION G.763 DIGITAL CIRCUIT MULTIPLICATION
EQUIPMENT (DCME) TUTORIAL AND DIMENSIONING**

Summary

This supplement gives tutorial information on DCME techniques and describes various DCME dimensioning methods for different route characteristics.

Source

Supplement 37 to ITU-T G-series Recommendations was prepared by ITU-T Study Group 15 (1997-2000) and was approved under the WTSC Resolution No. 5 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

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Supplement 37 to G-series Recommendations**ITU-T RECOMMENDATION G.763 DIGITAL CIRCUIT MULTIPLICATION
EQUIPMENT (DCME) TUTORIAL AND DIMENSIONING***(Geneva, 1998)***1 DCME tutorial****1.1 Use of Digital Circuit Multiplication System (DCMS)**

DCMS provide the means to reduce the cost of transmission (e.g. long distance transmission) by making use of the combination of Digital Speech Interpolation (DSI) and Low Rate Encoding (LRE) techniques.

DSI is used to concentrate a number of input channels (generally referred to as trunk channels) onto a smaller number of output channels (generally referred to as bearer channels). It does this by connecting a trunk channel to a bearer channel only for the period that the trunk channel is active, i.e. is carrying a burst of speech or voiceband data. Since in average conversations one direction of transmission is active only for 30% to 40% of the time, if the number of trunks is large the statistics of the speech and silence distributions will permit a significantly smaller number of bearer channels (bearer channel pool) to be used. Control information must also be passed between the terminals to make sure that bearer and trunk channel assignments at each end remain synchronized.

LRE uses digital filtering techniques to construct an estimate of the waveform at both the encoder and the decoder. Since the actual information rate of speech is much lower than the channel Nyquist rate, the link used between the LRE encoder and the decoder can operate at a rate which is dependent mainly on the quality of the models and the permissible amount of transmission degradation. The ITU-T has standardized in Recommendations G.726 and G.727 a type of LRE known as ADPCM, the performance of which has been extensively characterized. DCME uses the ADPCM defined in Recommendation G.726.

Facsimile demodulation/remodulation uses recognition and decoding of some or all of the voiceband signals sent by the modem to enable the sub-multiplexing of the digital information from a number of trunk channels onto a reduced number of bearer channels with the object of enhancing both the quality and the efficiency of transmission as compared to rate reduction of the signals using ADPCM.

The simplest way to use DCMS is in the single destination mode as shown in Figure 1/G.763. This mode of operation is most economic for the largest routes. For smaller routes there are two options:

- operation in multi-clique mode;
- operation in multi-destination mode.

Operation in multi-clique mode, see Figure 2/G.763, divides the bearer channels into a number of blocks or cliques, each associated with a different route. There is normally a fixed boundary between cliques, and trunk/bearer channel assignments are generally carried in a control channel within the clique to which they refer. This limits the dynamic processing of received channels to those which are contained in the wanted clique; selection of the wanted clique channels can be done using a simple static digital switch without reference to the assignment information. With a 2048 kbit/s bearer system in multi-clique DCMS the statistics of the DSI are unpromising with more than three routes. Recommendation G.763 provides for two cliques.

Operation in multi-destination mode, see Figure 3/G.763, permits any bearer channel to be associated with any trunk channel of any of a number of different routes. There is no segregation of routes on the bearer, and therefore at the receive terminal it is impossible to select the wanted channels without reference to the assignment information. Multi-destination mode is economic for very small routes via satellite, but practical difficulties limit the number of routes which it is desirable to have on a single DCMS.

1.2 Location

Location of DCME depends on its use. Equipment used in single destination mode or in multi-clique mode can in general be located at:

- ISC;
- earth station;
- cable head,

without significant restrictions. Equipment used in the multi-clique mode will typically be located at the ISC so that the advantages of DCMG can be extended over the national section. Equipment used in the multi-destination mode will typically be located at the earth station or cable head. The reason for this is that whereas in multi-clique mode the number of receive bearer channels at the DCME terminal is approximately equal to the number of transmit bearer channels, in multi-destination mode the number of receive bearer channels at the DCME terminal is the number of transmit bearer channels multiplied by the number of destinations. It therefore may be uneconomic to provide sufficient transmission capacity between earth station and ISC to permit location of multi-destination DCME at an ISC.

1.3 Transmission requirements

DCMSs are usually required to carry any traffic which can be carried on ordinary General Switched Telephone Network (GSTN) connections. That includes voiceband data using V-series Recommendation GSTN modems, facsimile calls following Recommendations T.4 and T.30 and using V.29 modems. In addition, in the ISDN 64 kbit/s unrestricted on-demand digital data and alternate speech/64 kbit/s unrestricted bearer services must be carried.

DCMSs are primarily designed to maximize the efficiency of speech transmission. Use with voiceband data, especially at high rates, presents problems. These problems are mainly due to the difficulty for 32 kbit/s ADPCM of encoding voiceband data waveforms.

1.4 DCME gain (DCMG)

The gain of DCME is the input trunk channel transmission multiplication ratio, which is achieved through application of DCME, including LRE and DSI (for a specified speech quality at a certain level of bearer channel activity). The maximum available gain depends on:

- number of trunk channels;
- number of bearer channels;
- trunk channel occupancy;
- speech activity;
- voiceband data traffic;
- ratio of half duplex to full duplex voiceband data;
- type of signalling;
- 64 kbit/s traffic;