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TERMINAL EQUIPMENTS

GENERAL CHARACTERISTICS OF A 48-CHANNEL TRANSCODER EQUIPMENT

ITU-T Recommendation G.762

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.762 was published in Fascicle III.4 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

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

Recommendation G.762

GENERAL CHARACTERISTICS OF A 48-CHANNEL TRANSCODER EQUIPMENT

(Melbourne, 1988)

1 General

The 48-channel transcoder provides for the conversion between two 24-channel 1544 kbit/s PCM streams and one 48-channel 1544 kbit/s ADPCM stream. In the 24-channel 1544 kbit/s streams, the voice-frequency signals are coded at 64 kbit/s according to the PCM μ-law defined in Recommendation G.711. In the 48-channel 1544 kbit/s stream, the voice-frequency signals are coded at 32 kbit/s according to the ADPCM encoding law defined in Recommendation G.721.

Figure 1/G.762 represents the nomenclature used for the three different signal ports X, Y and Z.

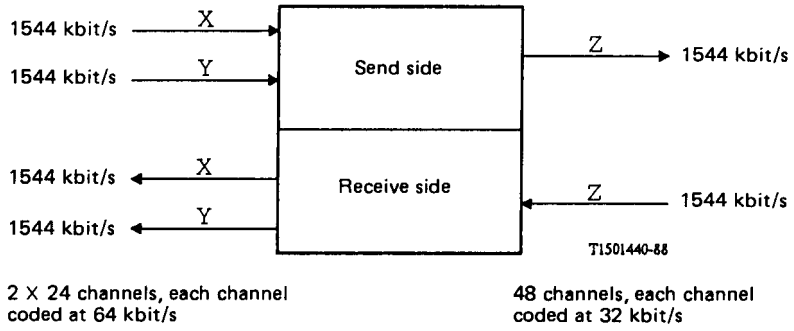

FIGURE 1/G.762
48-channel transcoder ports

The 1544 kbit/s stream associated with port Z can be partitioned into four independent 384 kbit/s entities defined as time slot groupings. Each 384 kbit/s time slot grouping consists of twelve 32 kbit/s time slots which can be used to transport up to 12 voice-frequency channels or 11 voice-frequency channels plus their channel associated a-b-c-d signalling information. Therefore, the 1544 kbit/s stream associated with port Z will have a maximum channel capacity of between 44 and 48 voice-frequency channels.

Note 1 - Administrations should take into account the guidance given in Recommendation G.721 concerning the use and transmission performance of 32 kbit/s ADPCM.

Note 2 - It should be noted that the transcoder equipment described in this Recommendation has a limited capability of transparently transporting 64 kbit/s data channels and this should be taken into account in the planning of networks which are likely to evolve into an ISDN (see § 4.4).

This Recommendation is divided into three parts:

- Paragraph 2 contains the interface requirements associated with port Z;
- Paragraph 3 contains the interface requirements associated with ports X and Y;
- Paragraph 4 contains the requirements which are specific to a 48-channel transcoder equipment realization.

2 Characteristics of a 1544 kbit/s signal organized in 32 kbit/s and/or 64 kbit/s time slots (port Z)

2.1 *Interface Z*

The electrical characteristics of the 1544 kbit/s interface are in accordance with § 2 of Recommendation G.703.

2.2 *Frame structure*

2.2.1 *Frame structure at 1544 kbit/s*

Refer to § 3.2.1 of Recommendation G.704 for the frame structure and use of derived channel time slots.

2.2.2 *Frame structure at 384 kbit/s*

Refer to § 3.2.3 of Recommendation G.704 for the frame structure at 384 kbit/s.

2.3 *Loss and recovery of frame and multiframe alignment*

2.3.1 *Loss and recovery of 1544 kbit/s frame and multiframe alignment*

The criteria for loss and recovery of the frame alignment and multiframe alignment signal for port Z are in accordance with § 2.1 of Recommendation G.706 for the 24-frame multiframe and for the 12-frame multiframe.

2.3.2 *Loss and recovery of delta channel multiframe alignment*

The criteria for loss and recovery of the signalling grouping channel multiframe alignment signal are in accordance with § 3.2.6 of Recommendation G.704.

2.4 *Signalling*

Refer to § 3.2.4 of Recommendation G.704 for signalling in the 384 kbit/s stream.

3 Characteristics of ports X and Y

3.1 *Interfaces X and Y*

The electrical characteristics of the 1544 kbit/s interface are in accordance with § 2 of Recommendation G.703.

3.2 *Frame structure*

Refer to § 2.1 of Recommendation G.704 for the frame structure and use of derived channel time slots.

3.3 *Loss and recovery of 1544 kbit/s frame and multiframe alignment*

The criteria for loss and recovery of the frame alignment and multiframe alignment signal for ports X and Y are in accordance with § 2.1 of Recommendation G.706 for the 24-frame alignment and for the 12-frame multiframe.

3.4 *Signalling*

Refer to § 3.1.3 of Recommendation G.704 and § 4.3 below.

4 Other characteristics of the 48-channel transcoder equipment

4.1 *48-channel frame structure*

In the case where streams X and Y are each carrying 24 voice-frequency signals and no channel-associated signalling information is present, stream Z will transmit the full complement of 48 channels. Table 1/G.762 shows the correspondence between the 64 kbit/s PCM channels in streams X and Y and the 32 kbit/s ADPCM channels in stream Z. Time slots 1-12 correspond to channels 1-12 from PCM stream X coded with 4 bits. Time slots 13-24 correspond to channels 13-24 from PCM stream X coded with 4 bits. Time slots 25-36 correspond to channels 1-12 from PCM stream Y coded with 4 bits. Time slots 37-48 correspond to channels 13-24 from PCM stream Y coded with 4 bits.

TABLE 1/G.762

Organization of the 1544 kbit/s frame for up to 48 channels at 32 kbit/s in stream Z

4 bit time slot of stream Z	1	2	3	4	5	6	7	8	9	10	11	12	Time slot Grouping 1
8 bit channel of stream X	1X	2X	3X	4X	5X	6X	7X	8X	9X	10X	11X	12X or SGC	
4 bit time slot of stream Z	13	14	15	16	17	18	19	20	21	22	23	24	Time slot Grouping 2
8 bit channel of stream X	13X	14X	15X	16X	17X	18X	19X	20X	21X	22X	23X	24X or SGC	
4 bit time slot of stream Z	25	26	27	28	29	30	31	32	33	34	35	36	Time slot Grouping 3
8 bit channel of stream Y	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y	9Y	10Y	11Y	12Y or SGC	
4 bit time slot of stream Z	37	38	39	40	41	42	43	44	45	46	47	48	Time slot Grouping 4
8 bit channel of stream Y	13Y	14Y	15Y	16Y	17Y	18Y	19Y	20Y	21Y	22Y	23Y	24Y or SGC	

The signalling grouping channels for time slot groupings 1-4, when present in stream Z, occupy time slots 12, 24, 36 and 48 respectively. As shown in Table 2/G.762, the channel capacity for stream X (respectively Y) is reduced by one for each time slot grouping associated with stream X (respectively Y) configured with a signalling grouping channel. Selection of the time slot grouping format to include the signalling grouping channel (SGC) is made on a per-time slot grouping basis, independent of the other time slot groupings associated with stream X or Y.

TABLE 2/G.762

Unused channels in streams X and Y when the signalling grouping channel is present in a time slot grouping

Signalling grouping channel present	Unused channel
Time slot grouping 1	Channel 12 in stream X
Time slot grouping 2	Channel 24 in stream X
Time slot grouping 3	Channel 12 in stream Y
Time slot grouping 4	Channel 24 in stream Y

4.1.1 *Unused channels*

As explained in § 4.1, the presence of a signalling grouping channel in a time slot grouping causes a given channel in stream X or Y to be configured as unused.

The unused channels on the receive side of streams X and Y should have their data and signalling bits conditioned in a way that is compatible with downstream equipment.

The unused channels on the send side of streams X and Y are not processed.

4.2 *Selection of 1544 kbit/s multiframe formats*

Selection of either the 24-frame or 12-frame multiframe format at ports X, Y or Z is independent of the multiframe frame formats selected at the other ports.

4.3 *Signalling*

4.3.1 *Common-channel signalling*

A channel being used to convey common-channel signalling information in stream X or Y will not undergo the transcoding function. The signalling channel will be transmitted transparently in stream Z at the 64 kbit/s rate, as can other channels from streams X and Y in accordance with § 4.4.

4.3.2 *Channel-associated signalling*

Refer to Table 1/G.762 and Table 7/G.704 for the association of channel associated a-b-c-d signalling bits between streams X and Y and the signalling grouping channels in stream Z.

4.4 *Direct time slot transfer*

It should be possible to select and pass through 64 kbit/s channels from streams X and Y transparently into stream Z. Furthermore, it should be possible to pass through at least one 64 kbit/s channel in each time slot grouping stream Z.

The priority for selecting which time slots from streams X and Y should be directly transferred and their placement into stream Z is for further study.

4.4.1 *Channel-associated signalling in 64 kbit/s pass-through time slots*

The transcoder should allow for selection of reinsertion or no reinsertion of channel-associated signalling bits into the receive side of streams X and Y for channels which are passed-through transparently at 64 kbit/s.

4.4.2 *Conditioning of unused channels*

When 64 kbit/s channels from stream X (respectively Y) are transferred transparently into stream Z, the transmission capacity of PCM stream X (respectively Y) is reduced. The unused channels in stream X (respectively Y) should be conditioned as described in § 4.1.1.

4.5 *Signalling grouping channel alarm indications*

When signalling grouping channel frame alignment is lost (as per § 3.2.6 of Recommendation G.704), updating of the channel-associated signalling bits on the receive side of streams X and Y should be inhibited for the affected channels until frame alignment is regained.

A time slot grouping alarm is declared when the signalling grouping channel multiframe alignment signal is lost for 2 to 3 seconds.

When signalling grouping channel multiframe alignment is declared (as per § 3.2.6 of Recommendation G.704), updating of the channel-associated signalling bits on the receive side of streams X and Y will be enabled.

The time slot grouping alarm is released when signalling grouping channel multiframe alignment has been reacquired for 10 to 20 seconds.

On the send side, M_1 is set to 1 to transmit a time slot grouping alarm to the remote end when the near end is in time slot grouping alarm. On the receive side, a remote time slot grouping alarm is declared when M_1 has been set for 335 to 1000 milliseconds. Remote time slot grouping alarm is released when M_1 has been reset for 20 to 1000 milliseconds.

On the send side, M_2 is used to indicate a 1544 kbit/s alarm or a 1544 kbit/s AIS has been received on port X (time slot groupings 1 or 2) or port Y (time slot groupings 3 or 4). On the receive side, a signalling grouping channel AIS alarm is declared when M_2 has been set for 335 to 1000 milliseconds. Signalling grouping channel AIS is released when M2 has been reset for 20 to 1000 milliseconds.

On the send side, M_3 is used to indicate a remote 1544 kbit/s alarm has been received on port X (time slot groupings 1 or 2) or port Y (time slot groupings 3 or 4). On the receive side, a remote signalling grouping channel AIS alarm is declared when M_3 has been set for 335 to 1000 milliseconds. Signalling grouping channel remote AIS alarm is released when M_3 has been reset for 20 to 1000 milliseconds.

4.6 *Fault conditions and consequent actions*

4.6.1 *1544 kbit/s fault conditions associated with stream Z*

A summary of the 1544 kbit/s fault conditions associated with the receive side of stream Z and the consequent actions are listed in Table 3/G.762.

The transcoder shall detect the following 1544 kbit/s fault conditions associated with stream Z:

i) loss of incoming signals at 1544 kbit/s;

ii) loss of 1544 kbit/s frame alignment;

iii) 1544 kbit/s alarm indication signal (AIS) received;

iv) 1544 kbit/s alarm indication received from the remote end.

4.6.2 *Consequent actions associated with stream Z*

Upon detection of 1544 kbit/s fault conditions in stream Z, appropriate actions should be taken which are in accordance with § 3.2 of Recommendation G.733. In addition, the following consequent actions should be taken as indicated in Table 3/G.762:

i) declare a 1544 kbit/s alarm on the receive side of port Z;

ii) send a 1544 kbit/s alarm indication to the remote end on the send side of port Z in accordance with § 4.2.4 of Recommendation G.733;

iii) send a 1544 kbit/s alarm indication signal (AIS) on the receive side of streams X and Y. The AIS consists of an all-1s signal in all channels including the framing bit;

iv) declare 1544 kbit/s AIS on the receive side of port Z;

v) declare a remote 1544 kbit/s alarm on the receive side of port Z;

vi) send a 1544 kbit/s alarm indication to the remote end on the receive side of streams X and Y in accordance with § 4.2.4 of Recommendation G.733.

TABLE 3/G.762

1544 kbit/s fault conditions associated with stream Z
and consequent actions

Consequent actions / Fault conditions	Declare 1544 kbit/s alarm on Z	Send 1544 kbit/s alarm indication to remote end on Z	Send 1544 kbit/s AIS on X and Y	Declare 1544 kbit/s AIS on Z	Declare remote 1544 kbit/s alarm on Z	Send 1544 kbit/s alarm indication to remote end on X and Y
Loss of incoming signal at 1544 kbit/s	Yes	Yes	Yes			
Loss of 1544 kbit/s frame alignment	Yes	Yes	Yes			
1544 kbit/s AIS received		Yes	Yes	Yes		
1544 kbit/s alarm indication received from remote end					Yes	Yes

4.6.3 *Fault conditions associated with the signalling grouping channel*

A summary of the signalling grouping channel fault conditions associated with the receive side of stream Z and the consequent actions are listed in Table 4/G.762.

The transcoder shall detect the following signalling grouping channel fault conditions associated with stream Z:

i) loss of signalling grouping channel multiframe alignment on a single time slot grouping associated with port X or a single time slot grouping associated with port Y;

ii) loss of signalling grouping channel multiframe alignment on both time slot groupings associated with port X or both time slot groupings associated with port Y;

iii) remote time slot grouping alarm indication (M_1) received from the remote end on a single time slot grouping associated with port X or a single time slot grouping associated with port Y;

iv) remote time slot grouping alarm indication (M_1) received from the remote end on both time slot groupings associated with port X or both time slot groupings associated with port Y;

v) signalling grouping channel AIS (M_2) received from the remote end on a single time slot grouping associated with port X or a single time slot grouping associated with port Y;

vi) signalling grouping channel AIS (M_2) received from the remote end on both time slot groupings associated with port X or both time slot groupings associated with port Y;

vii) remote signalling grouping channel AIS (M_3) received from the remote end on a single time slot grouping associated with port X or a single time slot grouping associated with port Y;

viii) remote signalling grouping channel AIS (M_3) received from the remote end on both time slot groupings associated with port X or both time slot groupings associated with port Y.

4.6.4 *Consequent actions associated with the signalling grouping channel*

Upon detection of signalling grouping channel fault conditions in stream Z, the following consequent actions shall be taken as indicated in Table 4/G.762:

i) declare time slot grouping alarm on the associated time slot grouping;

ii) send a time slot grouping alarm indication to the remote end by forcing the M_1 bit within the affected signalling grouping channel to 1;

iii) condition the data in the affected channels on the receive side of streams X or Y to provide a signal that is compatible with downstream equipment;

iv) condition the channel-associated signalling bits in affected channels on the receive side of streams X or Y to provide a signal that is compatible with downstream equipment. An example for most signalling types would be universal trunk conditioning where the signalling bits should be forced to the idle state for 2 to 3 seconds, and then conditioned to simulate the channel seized condition;

v) send a 1544 kbit/s AIS on the receive side of stream X (for time slot groupings 1 and 2) or stream Y (for time slot groupings 3 and 4). The AIS consists of an all 1s signal in all channels including the framing bit;

vi) declare a remote time slot grouping alarm condition on the associated time slot grouping to indicate the reception of a remote time slot grouping alarm indication in the M_1 bit of the affected signalling grouping channel;

vii) send a 1544 kbit/s alarm indication to the remote end on the receive side of stream X (for time slot groupings 1 and 2) and stream Y (for time slot groupings 3 and 4);

viii) declare a signalling grouping channel AIS condition on the associated time slot grouping to indicate the reception of a signalling grouping channel AIS indication in the M_2 bit of the affected signalling grouping channel;

ix) declare a remote signalling grouping channel AIS condition on the associated time slot grouping to indicate the reception of a remote signalling grouping channel AIS indication in the M_3 bit of the affected signalling grouping channel.

4.6.5 *Fault conditions associated with streams X and Y*

A summary of the fault conditions associated with the frames of streams X and Y and the consequent actions are listed in Table 5/G.762.

The transcoder shall detect the following fault conditions associated with streams X and Y:

i) loss of incoming signals at 1544 kbit/s;

ii) loss of 1544 kbit/s frame alignment;

iii) 1544 kbit/s AIS received from remote end;

iv) 1544 kbit/s alarm indication received from the remote end.

4.6.6 *Consequent actions associated with streams X and Y*

Upon detection of the 1544 kbit/s fault conditions associated with streams X and Y, the following consequent actions shall be taken in Table 5/G.762:

i) declare 1544 kbit/s alarm on the send side of port X and Y;

ii) send a 1544 kbit/s alarm indication to the remote end on the receive side of streams X and Y in accordance with § 4.2.4 of Recommendation G.733;

iii) send a signalling grouping channel AIS to the remote end by forcing the M_2 bit within the affected signalling grouping channel(s) to 1 ;

iv) condition the affected channels on the send side of stream Z to provide a signal in all channels that is compatible with downstream equipment;

v) declare 1544 kbit/s AIS on the send side of port X or Y;

vi) declare remote 1544 kbit/s alarm on the send side of port X or Y;

vii) send a signalling grouping channel AIS to the remote en by forcing the M_3 bit within the affected signalling grouping channel(s) to a 1.

TABLE 4/G.762

Signalling grouping channel fault conditions associated with stream Z and consequent actions

Consequent actions / Fault conditions	Declare time slot grouping alarm	Send time slot grouping alarm indication to remote end	Condition affected channels on X or Y	Condition signalling in affected channels on X or Y	Send 1544 kbit/s AIS on X or Y	Declare remote time slot grouping alarm	Send 1544 kbit/s alarm indication to remote end on X or Y	Declare signalling grouping channels AIS	Declare remote signalling grouping channel AIS
Loss of signalling grouping channel multiframe alignment (single time slot grouping)	Yes	Yes	Yes	Yes					
Loss of signalling grouping channel multiframe alignment (time slot grouping pair)	Yes	Yes			Yes				
Remote time slot grouping alarm indication received (single time slot grouping)			Yes	Yes		Yes			
Remote time slot grouping alarm indication received (time slot grouping pair)						Yes	Yes		

TABLE 4/G.762 *(cont.)*

Consequent actions / Fault conditions	Declare time slot grouping alarm	Send time slot grouping alarm indication to remote end	Condition affected channels on X or Y	Condition signalling in affected channels on X or Y	Send 1544 kbit/s AIS on X or Y	Declare remote time slot grouping alarm	Send 1544 kbit/s alarm indication to remote end on X or Y	Declare signalling grouping channels AIS	Declare remote signalling grouping channel AIS
Signalling grouping channel AIS received (single time slot grouping)			Yes	Yes				Yes	
Signalling grouping channel AIS received (time slot grouping pair)					Yes			Yes	
Remote signalling grouping channel AIS received (single time slot grouping)			Yes	Yes					Yes
Remote signalling grouping channel AIS received (time slot grouping pair)							Yes		Yes

TABLE 5/G.762

1544 kbit/s fault conditions associated with streams X and Y and consequent action

Consequent actions / Fault conditions	Declare 1544 kbit/s alarm	Send 1544 kbit/s alarm indication to remote end	Send signalling grouping channel AIS	Condition affected channels in stream Z	Declare 1544 kbit/s AIS	Declare remote 1544 kbit/s alarm	Send signalling grouping channels AIS indication to remote end
Loss of incoming signal at 1544 kbit/s	Yes	Yes	Yes	Yes			
Loss of 1544 kbit/s frame alignment	Yes	Yes	Yes	Yes			
1544 kbit/s AIS received		Yes	Yes	Yes	Yes		
1544 kbit/s alarm received from remote end						Yes	Yes

4.7 *Synchronization*

It should be possible to currently synchronize the outgoing streams of ports X, Y and Z to any one of the following:

- timing signal associated with incoming PCM stream X;
- timing signal associated with incoming PCM stream Y;
- timing signal associated with incoming stream Z;
- internal 1544 kbit/s timing signal.

4.8 *Absolute delay*

The overall absolute delay introduced by a single transcoder in either direction (PCM to ADPCM or ADPCM to PCM) should be no greater than 750 microseconds for any of the 48 channels.

When a 64 kbit/s signal is transparently transferred through a single transcoder, the absolute delay introduced should be no greater than 750 microseconds in either direction. Frame integrity should be maintained for adjacent 64 kbit/s channels (i.e. equal delay).

In the case of channel associated signalling, the overall delay introduced by a single transcoder should be no greater than 5.0 milliseconds.

4.9 *Jitter*

For further study.