Note - A Yes in the table signifies that a certain action should be taken as a consequence of the relevant fault condition. An open space in the table signifies that the relevant action should not be taken as a consequence of the relevant fault condition, if this condition is the only one present. If more than one fault condition is simultaneously present, the relevant action should be taken if, for at least one of the conditions, a Yes is defined in relation to this action.

Fault conditions and consequent actions

```
+----------+-------------+-----------------------------------------------------------
-+
_        _         _          Consequent actions (see § 10.2)          _
_        _         +-------------+-------------+-----------------------------------+
_        _         _         _         _         AIS applied         _
_        _         _         _         +-------------+-------------+-------------+
_Equipment_Fault      _Prompt     _Alarm     _          _         _To the   _
_part     _condition   _maintenance_indication_          _         _relevant _
_        _(see § 10.1)_alarm      _to the    _To all the _To the   _time     _
_        _          _indication _remote    _tributaries_composite_slots of _
_        _          _generated  _multiplex _          _signal   _the      _
_        _          _          _equipment _          _         _composite_
_        _          _          _generated _          _         _signal   _
+----------+-------------+-------------+-------------+-------------+-------------+---------
-+
_Multi-   _Failure of  _  Yes      _         _Yes, if    _Yes, if  _        _
_plexer   _power       _          _         _practicable_practi-  _        _
_and      _supply      _          _         _          _cable    _        _
_demulti- _           _          _         _          _         _        _
_plexer   _           _          _         _          _         _        _
+----------+-------------+-------------+-------------+-------------+-------------+---------
-+
_Multi-   _Loss of in- _  Yes      _         _          _         _ Yes    _
_plexer   _coming      _          _         _          _         _        _
_only     _signal on a _          _         _          _         _        _
_        _tributary   _          _         _          _         _        _
+----------+-------------+-------------+-------------+-------------+-------------+---------
-+
_        _Loss of in- _  Yes      _  Yes     _   Yes     _         _        _
_        _coming      _          _         _          _         _        _
_        _signal      _          _         _          _         _        _
_        +-------------+-------------+-------------+-------------+-------------+-------------+
_Demulti- _Loss of     _  Yes      _  Yes     _   Yes     _         _        _
_plexer   _frame       _          _         _          _         _        _
_only     _alignment   _          _         _          _         _        _
_        +-------------+-------------+-------------+-------------+-------------+-------------+
_        _Alarm       _          _         _          _         _        _
_        _indication  _          _         _          _         _        _
_        _received    _          _         _          _         _        _
_        _from the    _          _         _          _         _        _
_        _remote      _          _         _          _         _        _
_        _multiplex   _          _         _          _         _        _
_        _equipment   _          _         _          _         _        _
+----------+-------------+-------------+-------------+-------------+-------------+---------
-+
```

5)detection of an alarm indication received from the remote multiplex equipment at a demultiplexer input port;

6)detection of alarm indication signal (AIS) at a demultiplexer input port.

Note 1 - The equivalent binary content of the AIS at 2048 and 6312 kbit/s should be a continuous stream of binary ones (marks) as recommended in Recommendation M.20.

Note 2 - Some current 44736-6312 kbit/s demultiplexers do not issue a 6312 kbit/s AIS. Thus no detection can take place in that case.

Note 3 - The strategy for detecting the presence of the AIS should be such that the AIS is detectable even in the presence of an error ratio of 1.10^{-3}. However, a signal with all bits except the frame alignment signal in the state of 1, should not be mistaken as an AIS.

10.1.2The need to monitor the degradation of the incoming 6312 kbit/s signal for the purpose of end-to-end error performance monitoring of the 6312 kbit/s digital block as well as the procedure for detecting such degradation are for further study.

10.2Consequent actions

Further to the detection of a fault condition, the appropriate actions should be taken as specified in Table 2/G.747.

Note 1 - The concept and definition of prompt maintenance alarm indication is given in Recommendation M.20.

Note 2 - When the alarm indication signal (AIS) is detected at the input of the demultiplexer, the prompt maintenance alarm indication associated with loss of frame alignment should be inhibited, while the rest of the consequent actions are in accordance with those associated in Table 2/G.747 with the fault condition.

10.2.1Alarm indication to the remote multiplex equipment should be generated by changing bit 1 of Set II (see Table 1/G.747) from the state 0 to the state 1.

10.2.2AIS should be applied to the following as specified in Table 2/G.747:

-all three 2048 kbit/s tributary outputs from the demultiplexer;

- 6312 kbit/s output of the multiplexer;

-the time slots of the 6312 kbit/s signal at the output of the multiplexer, corresponding to the relevant 2048 kbit/s tributary.

TABLE 2/G.747

Peak-to-peak sinusoidal jitter amplitude		Frequency				
A_1 [UI]	A_2 [UI]	f_1 [Hz]	f_2 [Hz]	f_3 [Hz]	f_4 [Hz]	
5.0	0.15	10	120	4 k	60 k	

FIGURE 2/G.747

Lower limit of maximum tolerable sinusoidal input jitter at 6312 kbit/s

7. Digital interfaces

The digital interfaces at 2048 kbit/s and 6312 kbit/s should be in accordance with Recommendation G.703.

8. Timing signal

If it is economically feasible, it may be desirable to be able to derive the multiplexing timing signal from an external source as well as from an internal source.

9. Service digits

Three bits per frame are available for service functions (see Table 1/G.747): bit 1 of Set II is used to transmit an alarm indication to the remote multiplex equipment when specific fault conditions are detected in the multiplex equipment (see section 10 below); bit 2 of Set II may be used for parity check; bit 3 of Set II is reserved for future use.

10. Fault conditions and consequent actions

10.1 Fault conditions

10.1.1 The digital multiplex equipment should detect the following fault conditions:

1) failure of power supply;

2) loss of an incoming 2048 kbit/s tributary signal at a multiplexer input port;

3) loss of an incoming 6312 kbit/s multiplex signal at a demultiplexer input port;

4) loss of frame alignment signal at a demultiplexer input port;

0.2 UI over a measurement interval of one minute in the frequency range from f_0 to 100 kHz (see Note 1).

When measured with an instrument incorporating a bandpass filter having a lower cutoff frequency of 18 kHz, a roll-off of 20 dB/decade and an upper limit of 100 kHz, the peak-to-peak output jitter should not exceed 0.05 UI when measured over a one minute interval (see Note 2).

Note 1 - The frequency f_0 should be as low as possible, taking into account the limitations of measurement equipment. In any case f_0 should be no greater than 10 Hz.

Note 2 - For interfaces meeting the national high Q option, detailed in Recommendation G.823, the lower cutoff frequency for the above measurement should be 700 Hz.

6.2.2 Multiplexer output jitter

The peak-to-peak jitter at the 6312 kbit/s output port should not exceed 0.05 UI when it is measured over an interval of one minute within the frequency range from f_1 = 10 Hz to f_4 = 60 Hz.

6.3 Input jitter

6.3.1 Tributary input jitter

The 2048 kbit/s input port should be capable of accommodating levels of input jitter up to the limits given in G.823.

6.3.2 Demultiplexer input jitter

The 6312 kbit/s input port should be capable of accommodating levels of input jitter up to the limits given in Figure 2/G.747.

Note 1 - Current Recommendation G.703 does not refer to the jitter to be tolerated at the digital distribution frame at 6312 kbit/s nor at the input port of equipment connected to this distribution frame.

Note 2 - The jitter accommodation requirement should be met when the jittered input signal is composed of the multiplexed tributary signals having any value of jitter allowed for the 2048 kbit/s.

Note 4 - This bit should be set to 1 when not used.

Note 5 - C_{ji} (j=1,2,3; i=1,2,3) indicates the ith justification control bit of the jth tributary.

6.Jitter

6.1Muldex jitter transfer characteristic

A 2048 kbit/s signal, modulated by sinusoidal jitter, should be subject to a muldex jitter transfer characteristic within the gain/frequency limits given in Figure 1/G.747. The equivalent binary content of the test signal should be 1000.

Note - In addition, the need to specify a demultiplexer tributary jitter transfer characteristic from the 6312 kbit/s demultiplexer input to the 2048 kbit/s demultiplexer output is for further study.

Note - The frequency f_0 should be as low as possible, taking into account the limitations of measuring equipment. In any case f_0 should be no greater than 10 Hz.

The selective measurement method should be used.

FIGURE 1/G.747

Muldex jitter transfer characteristic

6.2Output jitter

6.2.1Tributary output jitter

With no jitter applied to the input ports of the multiplexer and with the multiplexer directly connected to the demultiplexer, the peak-to-peak jitter at the tributary output port should not exceed

Table l/G.747 gives the maximum justification rate per tributary and the nominal justification ratio.

TABLE 1/G.747

6312 kbit/s multiplexing frame structure

Nominal tributary bit rate (kbit/s)	2048
Number of tributaries	3
Frame structure	**Bit number**
Set I	
Frame alignment signal (111010000)	1 to 9
Bits from tributaries	10 to 168
Set II	
Alarm indication to the remote multiplex equipment (Note 1)	1
Parity bit (Notes 2 and 3)	2
Bit reserved for future use (Note 4)	3
Bits from tributaries	4 to 168
Set III	
Justification control bits C_{j1} (Note 5)	1 to 3
Bits from tributaries	4 to 168
Set IV	
Justification control bits C_{j2} (Note 5)	1 to 3
Bits from tributaries	4 to 168
Set V	
Justification control bits C_{j3} (Note 5)	1 to 3
Bits from tributaries available for justification	4 to 6
Bits from tributaries	7 to 168
Frame length (bits)	840
Bits per tributary in a frame (bits)	273
Maximum justification rate per tributary (kbit/s)	7.5
Nominal justification ratio	0.453

Note l - See section 10.2.1.

Note 2 - The parity bit = 1 if the number of marks in all tributary bits including the bits in the justifiable time-slots in the preceding frame is odd; the parity bit = 0 if the number of marks in all tributary bits including the bits in the justifiable time-slots in the preceding frame is even.

Note 3 - The implementation and the use of this parity bit procedure are for further study.

13.Recommendation G.747

SECOND ORDER DIGITAL MULTIPLEX EQUIPMENT OPERATING AT 6312 KBIT/S AND MULTIPLEXING THREE TRIBUTARIES AT 2048 KBIT/S

1.General

The digital multiplex equipment described in this Recommendation is intended for use between networks using different digital hierarchies as specified in Recommendations G.702 and G.802.

2.Bit rate

The bit rates of the tributary and multiplex signals should be 2048 kbit/s ± 50 ppm and 6312 kbit/s ± 30 ppm, respectively, as specified in Recommendation G.703.

3.Frame structure

Table l/G.747 gives the recommended 6312 kbit/s multiplexing frame structure.

4.Loss and recovery of frame alignment and consequent action

Loss of frame alignment should be assumed to have taken place when four consecutive frame alignment signals have been incorrectly received in their predicted positions.

When frame alignment is assumed to be lost, the frame alignment device should decide that such alignment has effectively been recovered when it detects the presence of three consecutive correct frame alignment signals.

The frame alignment device having detected the appearance of a single correct frame alignment signal, should begin a new search for the frame alignment signal when it detects the absence of the frame alignment signal in one of the two following frames.

Note - As it is not strictly necessary to specify the detailed frame alignment strategy, any suitable frame alignment strategy may be used provided the performance achieved is at least as efficient in all respects as that obtained by the above frame alignment strategy.

5.Multiplexing and justification methods

Cyclic bit interleaving in the tributary numbering order and positive justification are recommended.

The justification control signal should be distributed and use the C_{ji}-bits (j=1,2,3; i=1,2,3) (see Note 5 to Table 1/G.747).

Positive justification should be indicated by the justification control signal 111 and no justification by the signal 000. Majority decision is recommended.