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GENERAL RECOMMENDATIONS ON TELEPHONE SWITCHING AND SIGNALLING

INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING

PROTECTION AGAINST THE EFFECTS OF FAULTY TRANSMISSION ON GROUPS OF CIRCUITS

ITU-T Recommendation Q.33

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation Q.33 was published in Fascicle VI.1 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 Q.33

PROTECTION AGAINST THE EFFECTS OF FAULTY TRANSMISSION ON GROUPS OF CIRCUITS

1 General

1.1 Although certain signalling systems may have the capability to provide an indication when an individual circuit is faulty, in order to maintain the required availability of the public network, it is considered necessary to provide alarm facilities to alert maintenance staff when a group of circuits provided by a multiplex transmission system is faulty.

1.2 An alarm indication can be initiated on failure of a FDM system by means of pilot supervision. On failure of a PCM system, and alarm indication initiated at both ends by the loss of frame alignment (or multiframe alignment as appropriate) [1],[2].

These failure indicators provide the means whereby the faulty circuits can be removed from service automatically and, when the fault condition no longer exists, be restored automatically by the switching control of an international exchange (see § 1.4 below).

Additionally, the existence of such failure indications allow an end-to-end indication of circuit availability which is a prerequisite to the operation of Signalling System No. 7 without a per call continuity check [see Recommendations Q.724 (TUP) and Q.764 (ISUP)].

1.3 Where transmission links comprise several transmission systems in tandem, the protection against the effects of faulty transmission on groups of circuits can only be maintained if the primary multiplex structure is maintained from end-to-end together with a transparency of alarm indications. In other cases the provisions of §§ 2 and 3 below apply.

1.4 Following a transmission failure a number of specific signalling actions are required to be carried out by the switching control of an international exchange. These actions are designed to:

a) prevent failure of new call attempts;

b) provide appropriate failure indications on established calls;

c) provide a means of releasing circuit connections beyond the point of transmission failure.

Paragraph 4 below details the actions to be taken for circuits employing Signalling Systems Nos. 5, 6 and 7 (TUP and ISUP). For circuits employing Signalling System R2, Recommendation Q.416 details the actions to be taken.

1.5 The recognition time used by the international exchange to validate the alarm ON/alarm OFF states shall be 20 ± 10 milliseconds. The recognition time is defined as the duration that signals representing the alarm ON/OFF states must be present at the input of the exchange terminal equipment.

Following recognition of the alarm ON or alarm OFF states the exchange shall carry out the actions detailed in § 4.

2 Mixed transmission systems

2.1 Some transmission links comprise differing transmission systems which for maintenance purposes are treated separately (see Recommendation G.704). Examples of such transmission links are those with:

- analogue/digital conversion via transmultiplexers;
- conversion between 24 and 30 channel PCM systems;
- links via TDMA/DSI satellite systems.

In these cases, failure indications from the local multiplex equipment can be used, but alone these do not provide an end-to-end indication of circuit availability. Since the multiplex systems use different standards, it is usually impossible to provide a ready conversion of alarms from one system to another. In order to retain the benefits of the alarm indications for groups of circuits it is necessary to carry the fault indications on a circuit basis. This may be inherent in the normal circuit signalling (as in the case of the digital version of Signalling System R2) but in the general case some form of individual circuit supervision is required.

2.2 *Circuit supervision for digital systems*

2.2.1 *2048 kbit/s systems* (Recommendations G.732, G.734)

8448 kbit/s systems (Recommendation G.744)

In these systems there are two frame structure possibilities. One supports channel associated signalling, and the other is intended for common channel signalling which allows extra time-slots to be used for speech circuits. In order to provide circuit supervision it is necessary to use the frame structure for channel associated signalling, even in the case of voice frequency and common channel signalling systems. This implies a number of restrictions:

- in the 2048 kbit/s system time slot 16 is not available for speech. Additionally, the common channel signalling links of Systems No. 6 and No. 7 must use a time slot other than number 16;
- similarly, in the 8448 kbit/s system time slots 67-70 are required for the circuit supervision and cannot be used for speech.

Other systems of transmitting circuit supervision information (for example, using a common channel) are for further study.

2.2.2 *1544 kbit/s systems* (Recommendations G.733, G.735)

In this system the S bit is used for circuit supervision in a similar manner to its use for channel associated signalling.

2.2.3 *Non-standard systems*

In non-standard transmission systems it will often be necessary to provide a discrete signalling path for the transmission of circuit supervision indications. Annex A to this Recommendation describes the arrangements used for circuit supervision on TDMA/DSI satellite systems together with the interfacing with the terrestrial channels.

3 Signalling of circuit supervision indications

3.1 In integrated digital transmission systems interfacing directly with exchanges (e.g. Recommendations G.734, G.744) and where systems connect to the other Administrations, it is recommended that a standard form of circuit supervision be used. This is detailed below for 2048 kbit/s PCM systems and 1544 kbit/s PCM systems.

3.2 *2048 kbit/s PCM systems*

Signalling bits "a" and "b" of time slot 16 are used. Under abnormal (alarm) conditions both a and b bits are set to 1. The normal (no-alarm) condition is when "a" and "b" bits are not both equal to 1.

3.3 *1544 kbit/s PCM systems*

In this system the circuit supervision information is generated:

- by forcing bit 2 in every channel time slot to the value 0, or
- by modifying the S bit as described in § 3.1.3.2.2 of Recommendation G.704 for the 12 frame multiframe, or
- by sending a frame alignment alarm sequence (1111111100000000) as described in § 3.1.1.3 of Recommendation G.704 for the 24 frame multiframe[1)] .

4 Actions in Signalling Systems Nos. 5, 6 and 7 when a transmission alarm occurs

This section details the actions which should be taken on circuits using Signalling Systems No. 5, No. 6 and No. 7 when a transmission alarm occurs concerning the speech path. This annex is intended to be applied to new exchange equipment only.

It is split into two broad areas dealing firstly with Signalling System No. 5 and then with Signalling Systems No. 6 and No. 7. This split is required because the actions taken for inband signalling systems is slightly different to that taken for common channel signalling systems.

4.1 *Signalling System No. 5*

The action taken if a transmission alarm occurs during the states shown below is as follows:

4.1.1 *Outgoing circuit failure*

4.1.1.1 *IDLE STATE*

Take the circuit out of service to outgoing traffic. Return to service when transmission is restored.

4.1.1.2 *REGISTER STATE*

The register state is assumed to start with sending of seizure signal and to end with sending of end of pulsing signal (ST).

- Send clear forward.
- Send a call unsuccessful indication on incoming circuit or possibly carry out a repeat attempt.
- If clear forward release guard sequence fails, inhibit the repeat clear forward sequence. Resume the repeat clear forward sequence when the transmission is restored limiting the number of simultaneous signals to a value which will prevent overload of the transmission system.
- If the clear forward release guard sequence is successful, take the circuit out of service to outgoing traffic.

4.1.1.3 *SEIZED BUT AFTER REGISTER STATE*

- Wait for calling party to clear and send clear forward.
- If answer signal has not been returned from called party, send a call unsuccessful indication on incoming circuit.
- If clear forward release guard sequence fails, inhibit the repeat clear forward sequence. Resume the repeat clear forward sequence when the transmission is restored limiting the number of simultaneous signals to a value which will not overload the transmission system.
- If clear forward release guard sequence is successful take the circuit out of service to outgoing traffic.

4.1.1.4 *BLOCKED*

- No special action required.

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1) The third method proposed cannot ensure a proper end to end supervision if a TDMA system with multidestination of multiplexes or a CME is involved in the connection.

4.1.2 *Incoming circuit failure*

4.1.2.1 *IDLE STATE*

No special action required, respond to incoming call as normal.

4.1.2.2 *ALL OTHER STATES*

- In answered state no special action to be taken, send all signals as normal.
- If answer signal has not been returned from called party, start a time out device which after a certain interval clears the chain beyond the faulty circuit.

4.1.3 *Bothway circuit*

4.1.3.1 *IDLE STATE*

- Take the circuit out of service to outgoing traffic, respond normally to incoming signals.
- Return to outgoing service when transmission is restored.

4.1.3.2 *OUTGOING REGISTER STATE*

- See § 4.1.1.2.

4.1.3.3 *OUTGOING AFTER REGISTER STATE*

- See § 4.1.1.3.

4.1.3.4 *INCOMING ANY STATE*

- See § 4.1.2.

4.1.3.5 *BLOCKED*

- See § 4.1.1.4.

4.2 *Signalling System No. 6 or Signalling System No. 7*

The action taken per speech circuit is as follows.

4.2.1 *Outgoing circuit failure*

4.2.1.1 *IDLE STATE*

- Take the circuit out of service to outgoing traffic. Return to service when the transmission is restored.

4.2.1.2 *REGISTER STATE*

The register state is assumed to start with sending of Initial Address Message and to end with the receipt of an address complete message.

- Send clear forward.
- Send a call unsuccessful indication on incoming circuit or possibly carry out a repeat attempt to set up the call on another circuit.
- Following receipt of release guard signal, take the circuit out of service to outgoing traffic. Return to service when transmission is restored.
- Inhibit any repeat continuity check which may be taking place.

4.2.1.3 *SEIZED BUT AFTER REGISTER STATE*

- If answer signal has not been received from called party, send a call unsuccessful indication on incoming circuit.
- If answer signal received, no special action required.
- Take the circuit out of service when it becomes idle. Return to service when the transmission is restored.

4.2.1.4 *BLOCKED*

- No special action required.

4.2.2 *Incoming circuit failure*

4.2.2.1 *CIRCUIT IN ANY STATE*

- If answer signal has not been returned from called party, start a time out device which after a certain interval clears the chain beyond the faulty circuit.
- If answer has been received no special action is required, the transmission of blocking messages when end to end alarm continuity is not provided should be for further study.

4.2.3 *Bothway circuit failure*

4.2.3.1 *IDLE STATE*

- Take the circuit out of service to outgoing traffic, the transmission of blocking messages when end to end alarm continuity is not provided should be for further study.
- Return to outgoing service when transmission is restored.

4.2.3.2 *OUTGOING REGISTER STATE*

- See § 4.2.1.2 above.

4.2.3.3 *OUTGOING AFTER REGISTER STATE*

- See § 4.2.1.3 above.

4.2.3.4 *INCOMING CIRCUIT IN ANY STATE*

- See § 4.2.2 above.

4.2.3.5 *BLOCKED*

- No special action required.

ANNEX A

(to Recommendation Q.33)

Circuit supervision via TDMA/DSI satellite systems

A.1 *General*

A.1.1 When satellite systems employ Time Division Multiple Access (TDMA) transmission techniques with Digital Speech Interpolation (DSI) equipment at an earth station, the integrity of multiplex transmission systems, FDM as well as PCM, used for terrestrial access to the satellite system cannot be maintained within the satellite system. For example, time slots 0 and 16 of a 2048 kbit/s PCM system of the group pilot of a FDM system may not be available between earth stations for the transfer of signalling or transmission alarm information. The provision of equivalent facilities over the satellite section therefore needs special consideration.

A.1.2 Although not necessarily a fault condition, an increase in circuit activity on a TDMA/DSI system may lead to an overload condition, e.g. "bit stealing" in the DSI equipment. Conveyance of overload indicators to the associated ISC may be used to initiate appropriate network management actions to reduce or eliminate the overload conditions on groups of circuits routed on the TDMA/DSI systems.

Implementation of this capability is at the discretion of individual Administrations.

A.1.3 In accordance with Recommendation Q.7, specified signalling systems considered to be suitable for international application via TDMA/DSI satellite systems are:

- System R2, provided that the satellite system is designed to be transparent to pulsed inter-register signals;
- System No. 5,
- Systems Nos. 6 and 7.

A.2 *Circuit supervision*

Possible methods of passing circuit supervision information for these signalling systems via a TDMA/DSI satellite system are as follows:

A.2.1 *Signalling System R2*

A.2.1.1 In the case of System R2, only the digital version of line signalling (Recommendations Q.421 -Q.424) is specified for use on international digital links.

A.2.1.2 A satellite Line Signalling Channel (LSC) is required to convey the System R2 digital line signalling code. Two signalling bits, "a" and "b" are required in the LSC for each System R2 terrestrial circuit accessing the satellite section. Under transmission failure conditions, bits "a" and "b" are set to State 1, so that the line signalling protocols of digital R2 will eventually block the circuit.

Appendix I shows a typical format and organization of the LSC for System R2 line signalling.

A.2.1.3 Fault conditions detected at the earth station and the consequent actions to be taken are given: in Tables A-1/Q.33 and A-2/Q.33 when terrestrial access is via a 2048 kbit/s PCM system or via an FDM system with signalling conversion employed at the earth station, respectively.

The application of actions given in these tables enables appropriate end-to-end supervision to be provided on a per-circuit basis.

A.2.2 *Signalling System No. 5*

A.2.2.1 It should be noted that on circuits employing System No. 5 signalling, some administrations utilize a repeat forward clear procedure as a means of achieving clear down under failure conditions. This procedure, which may involve periodic sending of forward clear signals synchronously on a number of circuits, can result in severe periodic overloading of DSI channels. In order to avoid this possible overloading of DSI channels it is preferable to limit the number of simultaneous forward clear signals on the circuits involved.

A.2.2.2 In order to convey circuit supervision information via the satellite system, it will be necessary to provide a satellite signalling channel.

The preferred method of conveying circuit supervision information by use of a satellite digital non-interpolated (DNI) channel is described in § A.2.2.3.

If an LSC, as provided for in System R2, is available, then a second method of passing circuit supervision information is as described in § A.2.2.4.

A.2.2.3 *Use of a DNI supervision channel*

When a DNI channel is utilized for circuit supervision purposes, detection by an earth station of circuit failures on its terrestrial sector will result in the setting of bits in the DNI channel to "1", in accordance with the information contained in Appendix II.

Thus, if the failed circuits are digital, the detection of failure conditions, such as loss of frame alignment, described in Table A-3/Q.33 will result in the setting to "1" of bits in the DNI channel associated with the affected circuits.

When the affected circuits are analogue, the failure will be detected at the earth station, e.g. by the loss of pilot, or if appropriate, by receipt of a pulsed backward pilot. Fault conditions and consequent actions when analogue access links are employed are given in Table A-4/Q.33.

The alarm information passed over the DNI channel can be forwarded by the receiving earth station to its associated ISC as described in Recommendation Q.33.

An Administration may utilize the alarm information at its ISC to block or busy affected circuits, or, for example, to inhibit the sending of repeat forward clear signals.

Appendix II shows the format and organization of the DNI supervisory channel.

A.2.2.4 *Use of System R2 LSC*

In this case the "a" and "b" signalling bits in the LSC corresponding to the Terrestrial Channels (TCs) for which supervision is applied shall assume the following meaning:

Under normal conditions:

b = 0 indicates that the relevant TC is in a normal condition. The b = 0 state may be established either within the TDMA terminal or at the ISC.

The "a" signalling bit contained in the same slot shall be set, as convenient, either to zero or "1".

Under abnormal conditions:

a = b = 1 indicates that the relevant TC is in an abnormal condition.

Thus, for effective application, the failure of a distant terrestrial transmission system (FDM or PCM) in either direction between an earth station and its associated ISC should result in the sending of a = b = 1 for each affected circuit backward over the satellite section. The alarm information passed via the LSC is transferred from the receiving earth station to its associated ISC as follows:

- when digital access circuits are provided, bits a and b, in Time Slot 16 corresponding to the faulty circuits, are set to "1";
- when analogue access circuits are employed receipt by the earth station of bits a = b = 1 for 6 or more circuits in an analogue group should result in the removal of the group pilot towards the ISC.

This method of using two signalling bits to convey circuit supervision information for System No. 5 circuits is inefficient in the utilization of satellite channel capacity. However, Administrations may need to take into account the possible advantages of such utilization, for example, a common terrestrial interface module for both System R2 and System No. 5 circuits may be employed at the earth station.

Appendix I shows the format and organization of the LSC for System R2 line signalling. Where appropriate to such use of circuits employing System No. 5 signalling, the fault conditions and consequent actions given in Tables A-1/Q.33 and A-2/Q.33 also apply.

A.2.3 *Signalling System No. 6 and No. 7*

A.2.3.1 These signalling systems employ a common signalling channel which may be conveyed via the satellite system (for example, via a 64 kbit/s signalling channel) or via a terrestrial transmission path.

A.2.3.2 The provision of transmission alarm information for circuit supervision purposes is necessary because:

a) Although a speech path continuity check, where used, will remove faulty circuits from service, a faster method is required if severe operational problems at the ISC are to be avoided when a large number of circuits are affected by a transmission system failure.

b) In the case of circuits employing System No. 7, end-to-end circuit supervision is required in accordance with Recommendation Q.724.

c) It is not mandatory for an ISC recognizing a transmission system failure to send a blocking signal for each affected circuit.

A.2.3.3 If the common signalling channel and associated circuits are routed via the same satellite system, methods of conveying circuit supervision information are identical to those described for System No. 5. This will require a DNI satellite channel to carry circuit supervision information in addition to the common signalling channel. Digital terrestrial access systems will also require a time slot for circuit supervision purposes besides that required for common channel signalling.

A.2.3.4 Methods of utilizing the common signalling channel in lieu of the DNI channel for the purpose of conveying information on the status of the transmission path of the speech circuits require further study.

A.2.3.5 Fault conditions and consequent actions to be taken at earth stations when system No. 6 or No. 7 is employed, via digital and analogue access links, are given in Tables A-3/Q.33 and A-4/Q.33, respectively.

TABLE A-1/Q.33

Fault conditions and consequent actions at earth stations with 2048 kbit/s digital access links for System R2 circuits

Digital earth station equipment (digital access links) — Consequent actions / Fault conditions		Terrestrial link to own CT					Satellite link						
		Remote backward alarm indication (bit 3, TS 0, even frames)	Backward alarm indication (bit 6, TS 16, frame 0)	a = b = 1 in TS 16 for all circuits concerned	AIS in non-inter-polated channels	Prompt maintenance alarm	Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	a = b = 1 in satellite signalling channel for circuits concerned	Block switched circuits concerned	Backward alarm indication concerning satellite signalling channel
Transmitting part	Loss of frame alignment, BER exceeded or loss of incoming signal	Yes				Yes Note 1				Yes	Yes	Yes	
	Loss of multiframe alignment		Yes			Yes Note 1					Yes		
	Alarm indication from CT (bit 3 TS 0 even frame, bit 6 TS 16 frame 0)										Yes		
	Power supply failure - TDMA/DSI			Yes if possible		Yes				Yes if possible	Yes if possible	Yes if possible	
	Power supply failure - satellite signalling equipment			Yes if possible		Yes					Yes if possible		
Receiving part	Loss of reference timing			Yes	Yes	Yes	Yes						
	BER exceeded in satellite path			Yes	Yes	Yes		Yes					
	Backward alarm indication from remote ES concerning BER in satellite path			Yes		Yes Note 2							
	Loss of data unique word			Yes	Yes	Yes			Yes				

TABLE A-1/Q.33 *(cont.)*

Digital earth station equipment (digital access links) — Consequent actions / Fault conditions		Terrestrial link to own CT					Satellite link						
		Remote backward alarm indication (bit 3, TS 0, even frames)	Backward alarm indication (bit 6, TS 16, frame 0)	a = b = 1 in TS 16 for all circuits concerned	AIS in non-inter-polated channels	Prompt maintenance alarm	Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	a = b = 1 in satellite signalling channel for circuits concerned	Block switched circuits concerned	Backward alarm indication concerning satellite signalling channel
Receiving part	Backward alarm indication from remote ES concerning data unique word			Yes		Yes Note 2	Yes Note 3						
	Loss of alignment or BER exceeded in satellite signalling channel			Yes		Yes							Yes
	Backward alarm indication from remote ES concerning satellite signalling channel			Yes		Yes Note 2							
	Power supply failure - TDMA/DSI			Yes if possible	Yes if possible	Yes					Yes if possible		
	Power supply failure - satellite signalling equipment			Yes if possible		Yes					Yes if possible		

Note 1 - Prompt maintenance alarm is inhibited if AIS is present.

Note 2 - Prompt maintenance alarm shall be inhibited if the backward alarm is received from only one origin if the interface concerned is working to more than one destination. It is not inhibited when working to a single destination.

Note 3 - If prompt maintenance alarm according to Note 2 is not inhibited.

TABLE A-2/Q.33

Fault conditions and consequent actions at earth stations with analogue access links for System R2 circuits and signalling conversion at the earth station

	Digital earth station equipment (analogue access links) — Consequent actions / Fault conditions	Terrestrial link to own CT		Prompt maintenance alarm	Satellite link						
		Relevant blocking signal (Note 1)	a = b = 1 at the input of the converter		Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	a = b = 1 in satellite signalling channel for circuits concerned	Block switched circuits concerned	Backward alarm indication concerning satellite signalling channel
Transmitting part	Loss of forward signal (Group pilot failure)	Yes		Yes				Yes	Note 4	Yes	
	Power supply failure from trans. equip.	Yes if possible		Yes				Yes if possible	Note 4	Yes if possible	
	Failure of line signal converter	Yes		Yes					Note 5		
	Power supply failure - TDMA/DSI	Note 6	Yes if possible	Yes				Yes if possible	Yes if possible	Yes if possible	
	Power supply failure - satellite signalling equipment		Yes if possible	Yes					Yes if possible		
Receiving part	Loss of reference timing	Note 6	Yes	Yes	Yes						
	BER exceeded in satellite path		Yes	Yes		Yes					
	Backward alarm indication from remote ES concerning BER in satellite path		Yes	Yes Note 2							
	Loss of data unique word		Yes	Yes			Yes				

TABLE A-2/Q.33 *(cont.)*

Digital earth station equipment (analogue access links) — Consequent actions / Fault conditions		Terrestrial link to own CT		Prompt maintenance alarm	Satellite link						
		Relevant blocking signal (Note 1)	a = b = 1 at the input of the converter		Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	a = b = 1 in satellite signalling channel for circuits concerned	Block switched circuits concerned	Backward alarm indication concerning satellite signalling channel
Receiving part	Backward alarm indication from remote ES concerning data unique word	Note 6	Yes	Yes Note 2	Yes Note 3						
	Loss of alignment or BER exceeded in satellite signalling channel		Yes	Yes							Yes
	Backward alarm indication from remote ES concerning satellite signalling channel		Yes	Yes Note 2							
	Power supply failure - TDMA/DSI		Yes if possible	Yes					Yes if possible		
	Power supply failure - satellite signalling equipment		Yes if possible	Yes					Yes if possible		

Note 1 - The "relevant blocking signal" is that signal which the Recommendation for analogue R.2 line signalling calls for in the event of interruption control or it may be the defined blocking condition resulting from busying equipment (Orange Book, Recommendation Q.416 and Q.424).

Note 2 - Prompt maintenance alarm shall be inhibited if the backward alarm is received from only one origin if the interface concerned is working to more than one destination. It is not inhibited when working to a single destination.

Note 3 - If prompt maintenance alarm according to Note 2 is not inhibited.

Note 4 - In this case the line signalling converter shall apply this condition. It is assumed that power supply failure on FDM transmission equipment will result in a group pilot failure.

Note 5 - The line signalling converter should comply with the principles described in Recommendation Q.422.

Note 6 - A relevant blocking signal will be generated by the converter in the analogue part.

TABLE A-3/Q.33

Fault conditions and consequent actions at earth stations using DNI supervision channel for circuits using in-band and common channel signalling with digital access links

Digital earth station equipment (digital access links) / Consequent actions / Fault conditions		Terrestrial link to own CT				Prompt maintenance alarm	Satellite link					
		Remote backward alarm indication	Backward alarm indication	Circuit supervision signal for all circuits concerned	AIS in non-interpolated channels		Action to prevent overlap of burst in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in-non-interpolated channels	Indication of fault in affected channels via circuit supervision channel	Block switched circuits concerned
Transmitting part	Loss of frame alignment. BER exceeded or loss of incoming signal	Yes Note 4				Yes Note 1				Yes	Yes	Yes
	Loss of multiframe alignment		Yes			Yes Note 1					Yes	
	Alarm indication from CT										Yes	
	Power supply failure - TDMA/DSI			Yes if possible		Yes				Yes if possible	Yes if possible	Yes if possible
	Power supply failure - service supervision signalling equipment			Yes if possible		Yes					Yes if possible	
Receiving part	Loss of reference timing or burst			Yes	Yes	Yes	Yes					
	BER exceeded in satellite path			Yes	Yes	Yes		Yes				
	Backward alarm indication from remote ES concerning BER in satellite path			Yes		Yes Note 2						
	Loss of data unique word			Yes	Yes	Yes			Yes			

TABLE A-3/Q.33 *(cont)*

Digital earth station equipment (digital access links) / Consequent actions / Fault conditions		Terrestrial link to own CT					Satellite link					
		Remote backward alarm indication	Backward alarm indication	Circuit supervision signal for all circuits concerned	AIS in non-interpolated channels	Prompt maintenance alarm	Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	Indication of fault in affected channels via circuit supervision channel	Block switched circuits concerned
Receiving part	Backward alarm indication from remotes ES concerning data unique word			Yes		Yes Note 2	Yes Note 3					
	Loss of TDMA frame alignment			Yes		Yes						
	Power supply failure - TDMA/DSI			Yes if possible	Yes if possible	Yes					Yes if possible	
	Power supply failure - service supervision signalling equipment			Yes if possible		Yes					Yes if possible	
	Indication of remote end transmission failure via circuit supervision channel			Yes								

Note 1 - Prompt maintenance alarm is inhibited if AIS is present.

Note 2 - Prompt maintenance alarm shall be inhibited if the backward alarm is received from only one origin. If the interface concerned is working to more than one destination. It is not inhibited when working to a single destination.

Note 3 - If prompt maintenance alarm according to Note 2 is not inhibited.

Note 4 - For a 2048 kbit/s digital access, bit 3 (TS 0, even frames) could be used for this indication. For a 1544 kbit/s digital access, fault indication as described in G.733, § 4.2.4 could be used for this indication.

TABLE A-4/Q.33

Fault conditions and consequent actions at earth stations using DNI supervision channel for circuits using in-band and common channel signalling with analogue access links

Digital earth station equipment (analogue access links) Note 3 — Consequent actions / Fault conditions		Terrestrial link to own CT		Prompt maintenance alarm	Satellite link					
		Removal of group pilot or supergroup pilot			Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	Indication of fault in affected channels via circuit supervision channel	Block switched circuits concerned
Transmitting part	Loss of forward signal (group pilot failure) or supergroup			Yes				Yes	Yes	Yes
	Power supply failure from trans. equip.			Yes				Yes if possible	Yes	Yes if possible
	Power supply failure - TDMA/DSI			Yes				Yes if possible	Yes if possible	Yes if possible
	Power supply failure - service supervision signalling equipment			Yes					Yes if possible	
Receiving part	Loss of reference timing or burst	Yes		Yes	Yes					
	BER exceeded in satellite path	Yes		Yes		Yes				
	Backward alarm indication from remote ES concerning BER in satellite path	Yes		Yes Note 1						
	Loss of data unique word	Yes		Yes			Yes			

TABLE A-4/Q.33 *(cont.)*

Digital earth station equipment (analogue access links) Note 3 Fault conditions / Consequent actions		Terrestrial link to own CT			Satellite link					
		Removal of group pilot or supergroup pilot		Prompt maintenance alarm	Action to prevent overlap of bursts in a TDMA frame	Backward alarm indication concerning satellite path	Backward alarm indication concerning data unique word	AIS in non-interpolated channels	Indication of fault in affected channels via circuit supervision channel	Block switched circuits concerned
Receiving part	Backward alarm indication from remote ES concerning data unique word	Yes		Yes Note 1	Yes Note 2					
	Loss of TDMA frame alignment	Yes		Yes						
	Power supply failure - TDMA/DSI	Yes		Yes					Yes if possible	
	Power supply failure - service supervision signalling equipment	Yes		Yes					Yes if possible	
	Indication of remote end transmission failure via circuit supervision channel	Yes Note 4								

Note 1 - Prompt maintenance alarm shall be inhibited if the backward alarm is received from only one origin if the interface concerned is working to more than one destination. It is not inhibited when working to a single destination.

Note 2 - If prompt maintenance alarm according to Note 1 is not inhibited.

Note 3 - Apart from the requirements concerning the loss of group or supergroup pilots and indication of remote and transmission failure, all other fault conditions and subsequent actions are optional.

Note 4 - An Administration’s decision to remove group or supergroup pilot is dependent on the number of failed circuits in the group or supergroup.

APPENDIX I

(to Annex A of Recommendation Q.33)

Format of each 64 kbit/s unit forming a satellite line signalling channel (LSC) for System R2 line signalling

Symbol N	1	2	3	4	5	6	7	63	64
P channel	0	1	Y_1	Y_3	a_{x+1}	a_{x+2}	a_{x+3}	a_{x+59}	a_{x+60}
Q channel	1	0	Y_2	Y_4	b_{x+1}	b_{x+2}	b_{x+3}	b_{x+59}	b_{x+60}

Symbols 1 and 2 carry the fixed pattern shown.

Symbols 3 and 4 carry Backward Alarm Indications related to the satellite system.

a_n and b_n are the signalling bits relating to the terrestrial channel connected to International Circuit (IC) number n.

Indicated by the subscript, where:

x = 0 in the first 64 kbit/s unit,

x = 60 in the second 64 kbit/s unit,

x = 120 in the third 64 kbit/s unit,

x = 180 in the fourth 64 kbit/s unit.

APPENDIX II

(to Annex A of Recommendation Q.33)

**End-to-end circuit supervision
for in-band and common channel
signalling systems**

End-to-end circuit supervision between corresponding Administrations may be provided using a pre-assigned digital non-interpolated (DNI) supervisory channel allocated for the purpose.

A recommended method of providing such supervision, which uses the binary information content of the DNI supervisory channel, is shown below. It should be noted that multi-destination operation requires a DNI supervisory channel from each destination.

**Format of satellite circuit supervision channel
(non-interpolated)**

Symbol No.	1	2	3	4	5	6	7	-	63	64
P Channel	0	1	1	0	a_1	a_3	a_5	-	a_{117}	a_{119}
Q Channel	1	0	1	0	a_2	a_4	a_6	-	a_{118}	a_{120}

Symbols 1, 2, 3 and 4 are not used and carry the fixed sequence shown.

Symbols 5 to 64 represent supervision conditions, with bit a_n being used for supervision of the Terrestrial Channels (TCs) 2n and (2n - 1), connected to international circuits.

The meaning of each bit a_n is shown below:

$a_n = 0$ Indicates that both of the relevant TCs are in a normal condition.

$a_n = 1$ Indicates that either or both of the relevant TCs are in an abnormal or fault condition.

References

[1] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s*, Vol. III, Rec. G.732.

[2] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 1544 kbit/s*, Vol. III, Rec. G.733.