Recommendation T/CS 42-09 (Nice 1985)

SIGNALLING AND CIRCUIT SUPERVISION VIA THE EUROPEAN COMMUNICATIONS SATELLITE (ECS)

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

— that the ECS system is to be integrated into the European telephone network;

— that the use of multidestination and terrestrial multiplex techniques is proposed in order to economise on satellite capacity;

— that System R2 is recommended for use and conveys per-circuit information concerning the state of the transmission media utilised;

— that for Signalling Systems Nos. 5 and 7, it will be advantageous for ISC's to be informed of the state of the transmission media utilised,

recommend

that members of the CEPT who use the European Communications Satellite for the telephone service should adopt the procedures specified below."

PREAMBLE

This recommendation has no direct equivalent CCITT recommendation although some information is similar to that in red book Recommendation Q.33 [3].

This recommendation reviews the ECS system briefly and highlights potential alarm problems which occur because of the optimisation of the satellite path.

It further reviews the problems which may be encountered when using systems SS R2, SS No. 5, SS No. 6 and SS No. 7 via ECS if alarm transparency end to end is not provided.

A solution is proposed to provide end to end transmission of alarms, and it is left to the administration/RPOA to decide whether or not to adopt this solution.

1. GENERAL

1.1. The European Communications Satellite (ECS) employs Time Division Multiplex Access (TDMA) techniques with Digital Speech Interpolation (DSI) (see specification ECS/C 11-17 Rev. 1) [1]. With such application of DSI at earth stations the integrity of primary multiplex systems, either FDM or 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 2,048 kbit/s PCM system or the group pilot of an FDM system will not be available between earth stations for the transfer of signalling or transmission alarm information. The provision of equivalent facilities over the satellite section needs special consideration.

1.2. When sections of a transmission link are maintained as separate entities, transmission alarms are not transferred between sections for maintenance purposes (see CCITT Recommendation G.704) [2]. However, the transfer of relevant alarm information between sections is necessary for end-to-end circuit supervision when this cannot be provided by other means, such as normal circuit signalling.

Such transmission failure indications provide the means whereby affected circuits can be automatically removed from, and restored to, service under control of the ISC (see CCITT Recommendation Q.33) [3].

1.3. 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 via the TDMA/DSI system.

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

2. SIGNALLING SYSTEMS

In accordance with Recommendation T/CS 14-01 [4] and CCITT Recommendation Q.7 [5] specified signalling systems considered to be applicable for ECS operation using TDMA/DSI are:

— System R2, provided that the digital version of line signalling is employed (see Recommendation T/CS 42-03) [6].

— System No. 5 [7].

— System No. 7 [8].

2.1. Signalling System R2

2.1.1. In the case of System R2, only the digital version of line signalling is recommended for this use. However, the analogue version of line signalling may still be used at ISC's accessing the satellite system, with signalling conversion being provided, at either the ISC or the earth station, in accordance with Recommendation T/CS 42-04 [9].

2.1.2. Figure 1 (T/CS 42-09) shows the possible arrangements that Administrations may employ in order to utilise System R2 analogue and digital signalling equipment with FDM and/or PCM terrestrial transmission systems to provide the digital line signalling required on the satellite section.

2.1.3. A satellite Line Signalling Channel (LSC) is provided 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 System R2 will eventually block the circuit.

2.1.4. Fault conditions detected at the earth station and the consequent actions to be taken are given in Tables 1 and 2 (T/CS 42-09) respectively when terrestrial access is via a 2,048 kbit/s PCM system or via a FDM system with signalling conversion at the earth station.

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

Table 3 (T/CS 42-09) shows the format and organisation of the LSC for System R2 line signalling.

2.2. Signalling System No. 5

Note: 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 send the periodic forward clear signals cyclically on the circuits involved.

2.2.1. The in-band signalling of System No. 5 does not require information to be conveyed in a separate signalling channel, so a satellite LSC would not normally be required for this signalling system.

2.2.2. However, the LSC used for System R2, shown in Table 3 (T/CS 42-09) may be utilised to provide end-to-end supervision on a per-circuit basis for circuits employing System No. 5. In this case the 'a' and 'b' signalling bits in the LSC corresponding to the Terrestrial Channels (TC's) 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 '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.

2.2.3. 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, depending on the requirements of individual Administrations.

Administrations may then utilise this information at their ISC to block or busy affected circuits, or for example, to inhibit the sending of repeat forward clear signals.

2.2.4. Where appropriate to the use of System No. 5, the fault conditions and consequent actions given in Tables 1 and 2 (T/CS 42-09) are also applicable.

2.3. Signalling System No. 7

2.3.1. This signalling System employs a common signalling channel which may be conveyed via the satellite system (for example, via a 64 kbit/s signalling channel) or via an associated terrestrial transmission path.

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

— Although a speech path continuity check (when provided) 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.
— It is not mandatory for an ISC recognising a transmission system failure to send a blocking signal for each affected circuit.

2.3.3. If the common signalling channel and associated speech circuits are routed via ECS, methods of conveying circuit supervision information via the LSC are similar to those described for System No. 5. This will require a 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 beside that required for common channel signalling.

2.3.4. Methods of utilising the common signalling channel for the purpose of conveying information on the status of the transmission path of the speech circuits require further study.

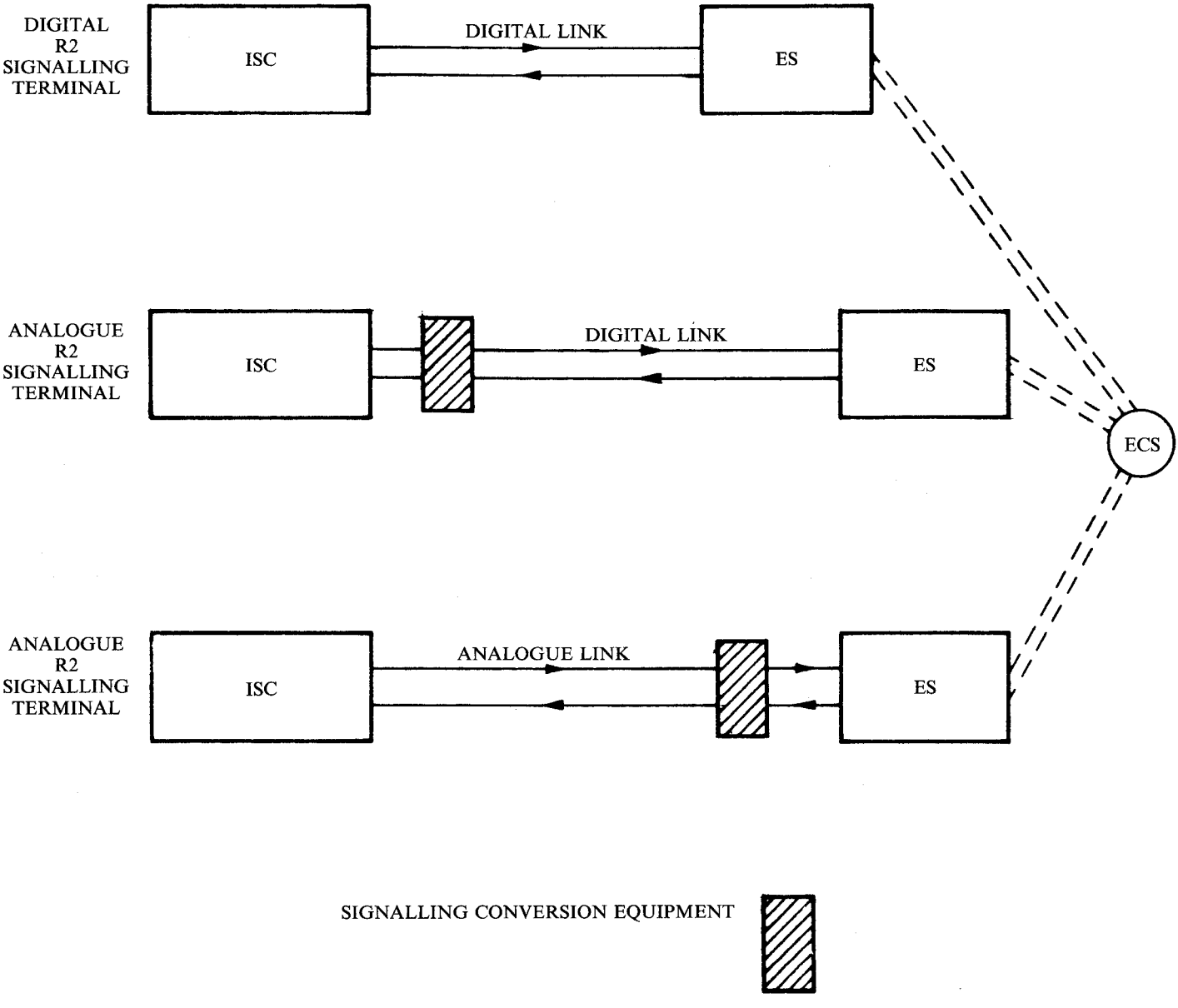

Figure 1 (T/CS 42-09). System R2 — ECS access configurations.

Digital earth station equipment / Consequent actions / Fault conditions		Terrestrial link to own ISC				Prompt maintenance alarm	Satellite link						
		Backward alarm indication (Bit 3, TS O. Even frames)	Backward alarm indication (Bit 6, TS 16. Frame 0)	a = b = 1 in TS 16 for all circuits concerned	AIS in non-interpolated channels		Action to prevent overlap of burs TS 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 ISC (Bit 3, TS 0. Even Frame. Bit 6, TS 16. Frame 0)										Yes		
	Power supply failure — TDMA/DSI			Yes If Poss		Yes				Yes If Poss	Yes If Poss	Yes If Poss	
	Power supply failure — satellite signalling equipment			Yes If Poss		Yes					Yes If Poss		
Receiving part	Loss of reference timing			Yes	Yes	Yes	Yes						
	BER exceeded in satellite path			Yes	Yes	Yes		Yes					
	Backward alarm indication from remotees concerning BER in satellite path			Yes		Yes Note 2							
	Loss of data unique word			Yes	Yes	Yes			Yes				
	Backward alarm indication from remotees 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 remotees concerning satellite signalling channel			Yes		Yes Note 2							
	Power supply failure — TDMA/DSI			Yes If Poss	Yes If Poss	Yes					Yes If Poss		
	Power supply failure — satellite signalling equipment			Yes If Poss		Yes					Yes If Poss		

Table 1 (T/CS 42-09). Fault conditions and consequent actions at earth stations with 2,048 kbit/s digital access links.

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.

Digital earth station equipment / 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 FDM trans. equip.	Yes If Poss		Yes				Yes If Poss	Note 4	Yes If Poss	
	Failure of line signal converter	Yes		Yes					Note 5		
	Power supply failure — TDMA/DSI	Note 6	Yes If Poss	Yes				Yes If Poss	Yes If Poss	Yes If Poss	
	Power supply failure — satellite signalling equipment		Yes If Poss	Yes					Yes If Poss		
Receiving part	Loss of reference timing	Note 6	Yes	Yes	Yes						
	BER exceeded in satellite path		Yes	Yes		Yes					
	Backward alarm indicating from remotees concerning BER in satellite path		Yes	Yes Note 2							
	Loss of data unique word		Yes	Yes			Yes				
	Backward alarm indication from remotees 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 remotees concerning satellite signalling channel		Yes	Yes Note 2							
	Power supply failure — TDMA/DSI		Yes If Poss	Yes					Yes If Poss		
	Power supply failure — satellite signalling equipment		Yes If Poss	Yes					Yes If Poss		

Table 2 (T/CS 42-09). Fault conditions and consequent actions at earth stations with analogue access links and signalling conversion at the earth station.

Note 1: The "relevant blocking signal" is that signal which the recommendation for analogue R2 line signalling calls for in the event of interruption control or it may be the defined blocking condition resulting from busying equipment.

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 T/CS 42-03, Section 3.

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

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}

Table 3 (T/CS 42-09). Format of each 64 kbit/s unit forming a satellite line signalling channel (LSC) for system R2 line signalling. (See specification ECS/C 11-17 Rev. 1).

— 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 International Circuit 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.

References

[1] Specification ECS/C 11-17 Rev. 1. *Time Division Multiplex Access techniques with Digital Speech Interpolation.*
[2] CCITT Recommendation G.704. *Functional characteristics of interfaces associated with network nodals.*
[3] CCITT Recommendation Q.33. *Protection against the effects of faulty transmission on groups of circuits.*
[4] CEPT Recommendation T/CS 14-01. *Use of Signalling System R2 in European telephone networks.*
[5] CCITT Recommendation Q.7. *Signalling systems to be used for international automatic and semi-automatic telephone working.*
[6] CEPT Recommendation T/CS 42-03. *System R2 line signalling digital version.*
[7] CCITT Signalling System No. 5.
[8] CCITT Signalling System No. 7.
[9] CEPT Recommendation T/CS 42-04. *Conversion between analogue and digital versions of System R2 line signalling.*