INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

Q.400

Supplement 3
(11/1988)

SERIES Q: SWITCHING AND SIGNALLING

Supplements to the Series Q Recommendations concerning Signalling Systems R1 and R2

USE OF THE ANALOGUE LINE SIGNALLING VERSION ON 2048 kbit/s PCM TRANSMISSION SYSTEMS

Reedition of CCITT Recommendation Q.400, Supplement No. 3, published in the Blue Book, Fascicle VI.4 (1988)

NOTES

1 CCITT Recommendation Q.400 Supplement No. 3 was published in Fascicle VI.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 Q.400 Supplement No. 3

USE OF THE ANALOGUE LINE SIGNALLING VERSION ON 2048 kbit/s PCM TRANSMISSION SYSTEMS

(refer to Recommendation G.732)

This solution is restricted for use within national networks or internationally subject to bilateral agreements because it requires some conventions which otherwise would have to be agreed upon in CCITT. However, cost aspects may be a more decisive factor than the required conventions.

The analogue version of the line signalling is used on both the analogue and the digital transmission systems.

Two examples of the use of the analogue line signalling on digital transmission systems are shown in Figure 1.

Apart from the interruption control handling, the transmultiplexer or other conversion equipment is transparent to the line signalling.

The out-slot signalling is carried in time slot 16 of 2048 kbit/s systems (refer to Recommendation G.732, Table 3). Bit *a* of time slot 16 is used to transmit the line signalling state of the corresponding analogue channel. Bit *b* is used to indicate that the analogue transmission system is in the alarm condition with the following convention. For all the digital circuits connected to the circuits of this analogue group bit $b = 1$ means alarm condition on the analogue group.

1 In order to ensure the correct working of the line signalling under fault conditions when employing T MUX some time requirements must be fulfilled.

1.1 *The fault occurs on a PCM multiplex* (see Figure 2)

If the fault occurs on PCM multiplex No. 1, the transmission of the alarm indication will take place in the following time conditions:

- the fault occurs at T;
- the fault is detected by the transmultiplexer at $T + t_1$;
- the transmultiplexer stops sending the pilot on GP_1, GP_2 and GP_3 at $T + t_1 + t_2$;
- the alarm indication is detected at the analogue distant end at $T + t_1 + t_2 + t_3 + t_p$,

where:

- t_1 is the time needed for recognition of the faulty transmission on a PCM 2048 kbit/s multiplex;
- t_2 is a processing time needed by the transmultiplexer after detection of alarm on the PCM multiplex;
- t_3 is the response time for the pilot receiver when the pilot level falls: it is the time t specified in Recommendation Q.416 ($t < t_{rs\,\min} + 13$ ms), applicable only for the recognition time $t = 20 \pm 7$ ms;
- t_p is the propagation delay on the analogue section.

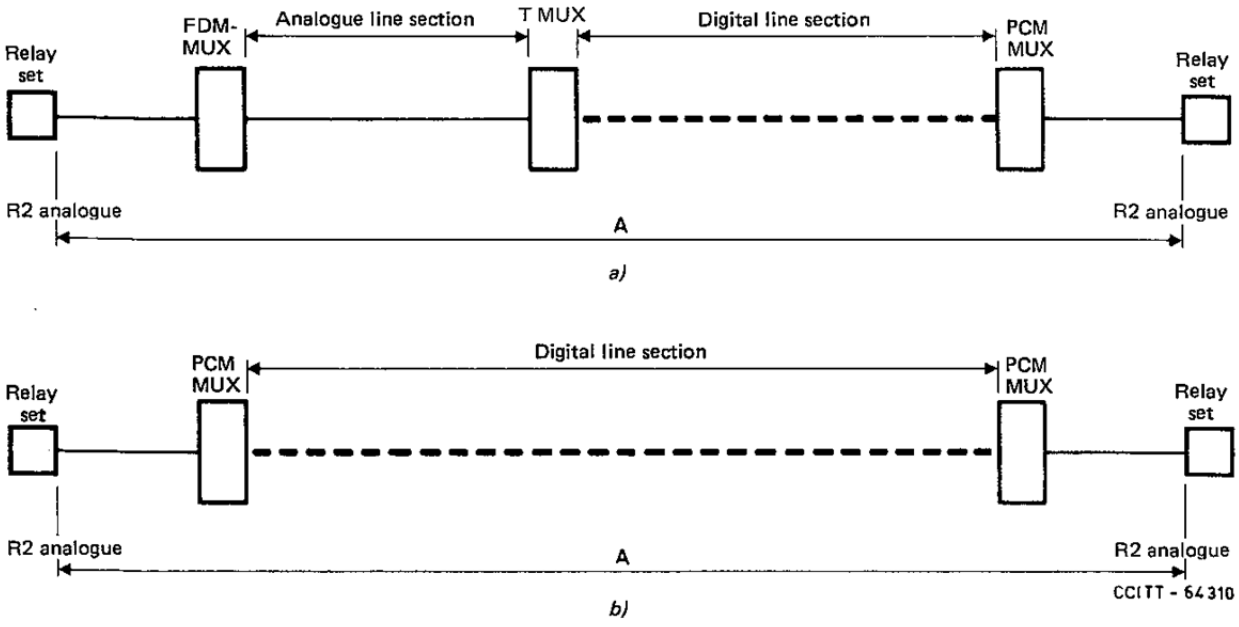

FIGURE 1

Examples of the use of the analogue line signalling on digital transmission systems

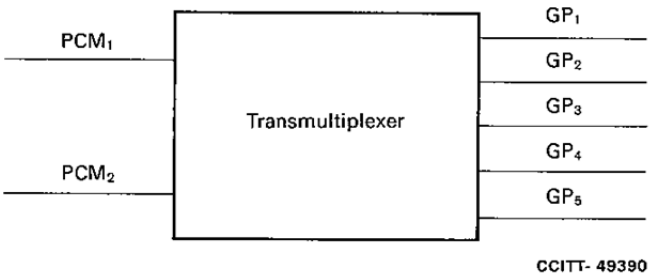

FIGURE 2

In the same situation, if the transmission fault disturbs signalling information, erroneous signals will be transmitted in the following time conditions:

- the fault occurs at T;
- the erroneous signalling condition appears at the input of the analogue channel at $T + t_4$;
- the erroneous signalling condition appears at the input of the distant signalling equipment at $T + t_4 + t_5 + t_p$,

where:

- t_4 is the time needed for transferring a line signal from digital access to analogue access;
- t_5 is the response time of the line signals receiver at the distant analogue end (t_{rs} in Signalling System R2 Specifications);
- t_p is the propagation delay on the analogue section.

If t_r is the recognition time of line signals specified in Recommendation Q.412, correct working can be ensured if:

$$t_1 + t_2 + t_3 + t_p \leq t_4 + t_5 + t_p + t_r$$

or

$$t_1 + t_2 + t_3 \leq t_4 + t_5 + t_r$$

or

$$t_1 + t_2 + t \leq t_4 + t_{rs} + t_r.$$

Recommendation Q.416 specifies that $t \leq t_{rs\ min.} + t_{r\ min.}$ (where $t_{r\ min.}$ = 13 ms). Thus, if $t_1 + t_2 \leq t_4$, correct working of line signalling can be ensured.

This inequality indicates simply that the time needed for detection of a faulty transmission on a PCM multiplex plus the time needed for stopping pilot sending when the alarm is detected must be less than the transfer time of a line signal across the transmultiplexer. This time requirement can be fulfilled, if necessary, by introducing in the transmultiplexer a small delay in line signals transmission.

1.2 *The fault occurs on an analogue group*

If, for example, the fault occurs on the analogue group GP_1, the transmission of the alarm indication will take place in accordance with the following time conditions:

- the fault occurs at T;
- the fault is detected by the transmultiplexer at $T + t_1$;
- bit b is set to 1 on the digital channels concerned at $T + t_1 + t_2$;
- the alarm indication appears at the distant digital end at $T + t_1 + t_2 + t_3 + t_p$,

where:

- t_1 is the time needed for detection of loss of pilot;
- t_2 is the time needed for transferring alarm information to the digital output;
- t_3 is the response time of the signalling equipment of the digital multiplex;
- t_p is propagation delay.

If the same fault disturbs signalling information, erroneous signals will be transmitted in the following time conditions:

- the fault occurs at T;
- the erroneous signalling condition is detected by the transmultiplexer at $T + t_4$;
- bit a is changed at the sending end of the digital section by the transmultiplexer at $T + t_4 + t_5$;
- the erroneous signalling condition appears at the input of the distant signalling equipment at $T + t_4 + t_5 + t_6 + t_p$,

where:

- t_4 is the response time of the signalling tone receiver in the transmultiplexer;
- t_5 is the time needed for transferring a line signal from the output of the signalling tone receiver to the digital output (change of bit a);
- t_6 is the response time of the signalling equipment of the PCM 2048 kbit/s multiplex ($t_3 = t_6$).

Correct working of line signalling is ensured if:

$$t_1 + t_2 + t_3 + t_p \leq t_4 + t_5 + t_6 + t_p + t_r$$

or

$$t_1 + t_2 \leq t_4 + t_5 + t_r$$

and if t_r has its minimum value $t_1 + t_2 \leq t_4 + t_5 + 13$ ms.

This inequality indicates that the time for detecting loss of pilot plus the time needed for setting bit b to 1 after loss of pilot detection by the transmultiplexer must be less than the response time of the signalling tone receiver in the transmultiplexer plus the transfer time of line signal plus 13 ms.

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Printed in Switzerland

Geneva, 2011