INTERNATIONAL TELECOMMUNICATION UNION

ITU-T Q.422

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

SPECIFICATIONS OF SIGNALLING SYSTEM R2

LINE SIGNALLING, DIGITAL VERSION

CLAUSES FOR EXCHANGE LINE SIGNALLING EQUIPMENT

ITU-T Recommendation Q.422

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation Q.422 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.

3.2 CLAUSES FOR EXCHANGE LINE SIGNALLING EQUIPMENT

3.2.1 *Recognition of a change of signalling code*

3.2.1.1 *Signalling channel transitions*

The recognition time for a transition from 0 to 1 or vice versa on a signalling channel is 20 ± 10 ms. This value presupposes the existence of protection against the effects of faulty transmission conditions on the PCM multiplex.

The recognition time is defined as the duration that the signals representing 0 or 1 must have at the output of the terminal equipment of a signalling channel in order to be recognized by the exchange equipment.

3.2.1.2 *Change of signalling code*

Recognition of a change of signalling code is thus defined as either of the following:

a) Recognition of a transition detected on one signalling channel with no transition detected on the second signalling channel during the recognition period.

b) Recognition of a transition detected on the second signalling channel during the recognition period already being applied to the first signalling channel. In this case, a change of signalling code is recognized only when both recognition timing periods have elapsed.

3.2.2 *Sent signal time tolerance*

The time difference between application of transitions intended to be simultaneous on two signalling channels in the same direction of transmission must not exceed 2 ms.

3.2.3 *States and procedures under normal conditions* (see Table 2/Q.421)

In the forward direction $b_f = 0$ is established permanently.

3.2.3.1 *Idle state*

In the idle state the outgoing end sends $a_f = 1$, $b_f = 0$. At the incoming end this results in sending $a_b = 1$, $b_b = 0$ in the backward direction, provided that the switching equipment at the incoming end of the circuit is idle.

3.2.3.2 *Seizing procedure*

i) *Seizure*

Seizing should occur only if $a_b = 1$, $b_b = 0$ is recognized. The outgoing end changes $a_f = 1$ into $a_f = 0$. The code $a_f = 0$, $b_f = 0$ must be maintained until the seizing acknowledgement signal is recognized. In this way the outgoing switching equipment will only be able to send the clear-forward signal after recognition of the seizing acknowledgement signal.

ii) *Seizure acknowledgement*

After having recognized the seizing signal, the incoming end sends $a_b = 1$, $b_b = 1$ as an acknowledgement.

3.2.3.3 *Answering*

The off-hook condition of the called subscriber's line provokes the incoming switching equipment to send $a_b = 0$, $b_b = 1$.

The answered state must be established on the preceding link immediately after it is recognized: see also § 3.2.3.6 below.

3.2.3.4 *Clear-back*

The on-hook condition of the called subscriber's line provokes the incoming switching equipment to send $a_b = 1$, $b_b = 1$. The clear-back state must be established on the preceding link immediately after it is recognized: see also § 3.2.3.6 below.

3.2.3.5 *Clear-forward procedure*

The cleared condition of the calling subscriber's line or the release of the outgoing switching equipment will normally result in sending $a_f = 1$, $b_f = 0$. The outgoing switching equipment will not be restored to the idle state until recognition of the code $a_b = 1$, $b_b = 0$: see also §§ 3.2.3.2, 3.2.3.6 and Table 3/Q.422.

3.2.3.6 *Release procedure*

Recognition of the clear-forward signal in the incoming switching equipment initiates the release of the succeeding link even though answering or clearing by the called party has occurred. Upon complete release of the incoming switching equipment, the code $a_b = 1$, $b_b = 0$ is established on the circuit. This will cause the circuit to be restored to the idle state and the outgoing switching equipment to become available for another call.

3.2.3.7 *Blocking and unblocking procedure*

Blocking of an idle circuit to new calls at the outgoing end must occur as soon as $a_b = 1$ and $b_b = 1$ is recognized: see also Tables 3/Q.422 and 4/Q.422.

The recognition of $a_b = 1$, $b_b = 0$ restores the circuit to the idle state.

3.2.4 *Actions appropriate to various signalling conditions*

In addition to normal conditions described in Table 2/Q.421 other conditions due to faults may be encountered. Tables 3/Q.422 and 4/Q.422 indicate the states appropriate to each signalling code recognized and the actions to be taken at the outgoing and incoming end respectively of a circuit operated with the digital version of System R2 line signalling.

3.2.4.1 *Outgoing end*

TABLE 3/Q.422

Normal state at the out-going end	Sent code	Received code			
		$a_b = 0, b_b = 0$	$a_b = 0, b_b = 1$	$a_b = 1, b_b = 0$	$a_b = 1, b_b = 1$
Idle/Released	$a_f = 1, b_f = 0$	Abnormal, see Note 1	Abnormal, see Note 1	Idle	Blocked
Seized	$a_f = 0, b_f = 0$	Abnormal, see Note 2	Abnormal, see Note 2	Seized see Note 2	Seizure acknowledged
Seizure acknowledged	$a_f = 0, b_f = 0$	Abnormal, see Note 3	Answered	Abnormal, see Note 3	Seizure acknowledged
Answered	$a_f = 0, b_f = 0$	Abnormal, see Note 4	Answered	Abnormal,see Note 4	Clear-back
Clear-back	$a_f = 0, b_f = 0$	Abnormal, see Note 4	Answered	Abnormal, see Note 4	Clear-back
Clear-forward	$a_f = 1, b_f = 0$	Abnormal, see Note 1	Clear-forward	Released = Idle	Clear-forward
Blocked	$a_f = 1, b_f = 0$	Abnormal, see Note 1	Abnormal, see Note 1	Idle	Blocked

Note 1 - In these abnormal conditions the outgoing end must prevent a new seizure of the circuit. A delayed alarm should also be given (see § 3.2.6).

Note 2 - Non-recognition of the seizing acknowledgement signal 100 ms-200 ms after sending the seizing signal on a terrestrial link or 1-2 seconds after sending the seizing signal on a satellite link results in an alarm and either congestion information being sent backward or a repeat attempt being made to set up the call. The outgoing end must prevent a new seizure of the circuit. When the seizing acknowledgement signal is recognized after the time-out period has elapsed, the clear-forward signal must be sent.

Note 3 - Receipt of $b_b = 0$ by the outgoing switching equipment for 1-2 seconds after recognition of the seizing acknowledgement signal and prior to recognition of the answer signal, results in an alarm and either congestion information being sent backward or a repeat attempt being made to set up the call. The outgoing end must prevent new seizures of the circuit. When b_b, reverts to 1 after the 1-2 seconds timeout period has elapsed, the clear-forward signal must be sent.

Note 4 - In the case of recognition of $b_b = 0$ whilst in the answered or clear-back state, immediate action is not necessary. On receipt of clearing from the preceding link, the clear-forward signal ($a_f = 1, b_f = 0$) must not be sent until b_b is restored to 1. A delayed alarm should also be given.

3.2.4.2 *Incoming end*

TABLE 4/Q.422

Normal state at the incoming end	Sent code	Received code			
		$a_f = 0, b_f = 0$	$a_f = 0, b_f = 1$	$a_f = 1, b_f = 0$	$a_f = 1, b_f = 1$
Idle/Released	$a_b = 1, b_b = 0$	Seized	Fault see Note 1	Idle	Fault see Note 1
Seizure acknowledged	$a_b = 1, b_b = 1$	Seizure acknowledged	Fault see Note 2	Clear-forward	Fault see Note 2
Answered	$a_b = 0, b_b = 1$	Answered	Fault see Note 3	Clear-forward	Fault see Note 3
Clear-back	$a_b = 1, b_b = 1$	Clear-back	Fault see Note 4	Clear-forward	Fault see Note 4
Clear-forward	$a_b = 0, b_b = 1$ or $a_b = 1, b_b = 1$	Abnormal seized see Note 7	Fault see Note 7	Clear-forward see Note 7	Fault see Note 7
Blocked	$a_b = 1, b_b = 1$	Abnormal seized see Note 5	Fault see Note 6	Blocked	Fault see Note 6

Note 1 - When in the idle/released state b_f changes to 1, b_b must be changed to 1.

Note 2 - In these cases a time-out device is started, which after a certain interval clears the connection beyond the faulty circuit: this timing arrangement may be the one specified in Recommendation Q.118, Section 4.3.3. If the answer signal is recognized during the time-out delay, the timer is stopped but the answer signal is not sent on the preceding link until recognition of $a_f = 0, b_f = 0$. If the clear-back signal is recognized while the fault persists, the connection beyond the faulty circuit must be released immediately. Additionally, when the incoming register has not started to send the last backward signal, the rapid release procedure described in Note 5 may be used.

Note 3 - In these cases no action is taken until the clear-back signal is recognized, at which stage the connection beyond the faulty circuit is immediately released.

Note 4 - Under these conditions the succeeding link must be released immediately.

Note 5 - In this case immediate action is not necessary. However, rapid release of the circuit should occur if the incoming end simulates answer by sending $a_b = 0, b_b = 1$.

Note 6 - Under these conditions no action is taken.

Note 7 - After clear-forward signal is recognized and until the code $a_b = 1, b_b = 0$ is sent, all transitions in the forward direction shall be ignored.

3.2.5 *Abnormal conditions*

3.2.5.1 *Special release arrangements*

a) If an exchange where an outgoing R2 register is situated recognizes $a_b = 0, b_b = 1$ (premature answer) before an address-complete signal A-6 or a Group B signal is received, the connection must be released. Congestion information is then sent backward or a repeat attempt is made to set up the call.

b) In the cases of non-receipt of the answer signal, of delay in clearing by the calling subscriber in automatic working and of non-receipt of the clear-forward signal by the incoming exchange after the clear-back signal has been sent, the provisions of Recommendation Q.118 apply.

3.2.5.2 *Safeguard against failures*

The PCM equipment and the exchange line signalling equipment should be designed in such a way that at least those faults which are most likely to occur in this equipment or in the interconnecting cables, result in blocking of the circuit at the outgoing end and in the ultimate clearing of the connection beyond the incoming switching equipment. This can be achieved, as far as possible, by ensuring that a = 1, b = 1 is sent on line upon:

- removal of PCM or switching equipment by maintenance personnel;
- occurrences of abnormal conditions (e.g. open wire, low voltage) in switching equipment.

3.2.6 *Alarms for technical staff*

According to Recommendation Q.117, an alarm must in principle be given to the technical staff upon recognition of abnormal conditions.

Arrangements for these alarms are to be specified by the Administrations.

It is recommended that a delayed alarm be given at the outgoing end for the procedure described under § 3.2.3.7 above (blocking) and for the following reasons:

- when the abnormal conditions covered by Note 1 to Table 3/Q.422 are applicable;
- when the seizing acknowledgement signal is not recognized within the time specified in Note 2 to Table 3/Q.422 after sending the seizing signal;
- when, after recognition of the seizing acknowledgement signal and prior to recognition of the answer signal, $b_b = 0$ is received for 1-2 seconds;
- when the abnormal conditions covered by Note 4 to Table 3/Q.422 are applicable.

It is also recommended that a delayed alarm be given under PCM failure conditions specified in Recommendations G.732 and G.734.

3.2.7 *Both-way working*

System R2 is specified for one-way working, but in principle the line signalling code detailed in Recommendation Q.421 is also suitable for use on both-way circuits. Where Administrations have undertaken, by bilateral agreement, to use both-way working, the clauses and additional specifications for exchange signalling equipment detailed in §§ 3.2.7.1 and 3.2.7.2 below, must be observed.

3.2.7.1 *Procedures under normal conditions*

a) *Double seizure*

Double seizure is assumed if the outgoing equipment is in a seized state and the signalling code $a_b = 0$, $b_b = 0$ is recognized instead of $a_b = 1$, $b_b = 1$ (seizure acknowledgement). In such a situation the connection must be released at both ends and congestion information sent to the calling subscriber or a repeat attempt must be made. On recognition of double seizure the line signalling equipment at both ends must maintain the seized state for a minimum of 100 ms after which the clear-forward signal $a_f = 1$, $b_f = 0$ must be sent.

100 ms after sending the clear-forward signal and on recognition of $a_b = 1$, $b_b = 0$ each end may assume the idle state.

The clear-forward state $a_f = 1$, $b_f = 0$ must be maintained for at least 100 ms to ensure that it is recognized at the other end.

In the sense of preventive action it is recommended that an opposite order of circuit selection be used by each exchange of a both-way circuit group to minimize double seizure.

b) *Requirements for circuit release*

When a both-way circuit is released, the end which acted as the incoming end must maintain the signalling code $a_b = 1$, $b_b = 0$ for at least 100 ms to ensure that the signal is recognized at the other end after which the circuit becomes idle.

c) *Blocking and unblocking procedure*

When a both-way circuit is blocked manually in its idle state at one end (e.g. end B) the blocking signal must be sent to the other end (A). The circuit must then be kept blocked locally (at end A) against all calls in the A to B traffic direction as long as the blocked state persists in the B to A direction.

In order to avoid permanent blocking, end A should maintain the signalling code a = 1, b = 0 in the direction A to B.

When the blocked state is removed, end B must send the clear-forward signal and must maintain that state for at least 100 ms, before assuming the idle state.

3.2.7.2 *Special arrangement*

The physical realization of signalling equipment terminating a bothway circuit may allow that part of the equipment concerned with outgoing calls to be removed without preventing the remaining equipment from being used for incoming calls. In this case it is only necessary to block the circuit locally against outgoing calls and a blocking signal need not be sent to the other end.