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OF ITU

INTERWORKING OF SIGNALLING SYSTEMS No. 4 AND No. 5

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ITU-T Recommendation Q.180

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation Q.180 was published in Fascicle VI.2 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.180

INTERWORKING OF SYSTEMS No. 4 AND No. 5

General

It is possible to ensure normal operation for both semi-automatic and automatic service when interworking takes place between Signalling Systems No. 4 and No. 5, in either the "4 to 5" or "5 to 4" direction.

The interworking is possible because:

- the line signals (i.e. the supervisory signals) generally have the same meaning and the same function in both systems;
- the numerical (address) information is sent in the same sequence in both systems;
- all conditions for the use of the language digit in the semi-automatic service and the discriminating digit in the automatic service are the same in both systems.

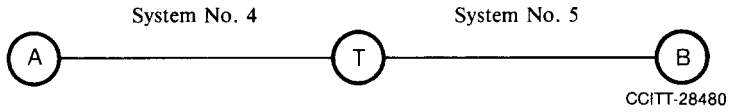
In general, the interworking of the two systems merely requires that a signal received in the code of one of the systems be converted into the corresponding signal of the code used by the other system. Nevertheless, in a transit exchange where there is interworking of Systems No. 4 and No. 5, special precautions are necessary with regard to signals which are used differently in the two systems. These differences are as follows:

a) System No. 5 always uses a forward end-of-pulsing signal (the ST signal), whereas the end-of-pulsing signal (code 15) is not always given in System No. 4;

b) System No. 4 uses a backward number-received signal which is not provided in System No. 5.

2 *Calls from System No. 4 to System No. 5*

2.1 *Semi-automatic calls from System No. 4 to System No. 5*



1. In semi-automatic operation, the outgoing exchange A of System No. 4 sends an end-of-pulsing signal over link AT and the outgoing register at A is released.
2. The end-of-pulsing signal of System No. 4, which is a numerical type signal (code 15), is acknowledged.
3. On receipt of an end-of-pulsing signal from A, the incoming part of System No. 4 at transit exchange T sends to A an acknowledgement of the end-of-pulsing signal and then sends to A a number-received signal.
4. At T, an end-of-pulsing signal ST is sent over link TB on System No.5; this ST signal is obtained by converting the end-of-pulsing signal (code 15) of System No. 4.
5. At T, the outgoing register[1)] of System No. 5 is released as soon as the signal ST has been sent over link TB on System No. 5. At T, the incoming register[1)] of System No. 4 is released after the number-received signal of System No. 4 has been sent back to A.

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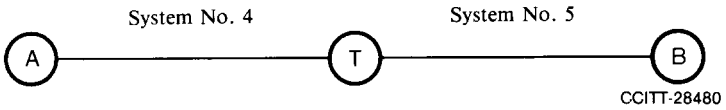
1) These register functions may be combined in a single register.

Note - The number-received signal is sent from T over link TA in order to conform to the specifications of System No. 4. Since the outgoing register at A will be released as soon as A has sent the end-of-pulsing signal (in accordance with the specifications of System No. 4), the only possible role of the number-received signal at A is to indicate to the operator that the selection procedure has been effected. However, since the number-received signal relates only to operations on the link AT on System No. 4, this signal provides no information about the entire selection process from A to B; the indication to the operator is hence of little value.

2.2 *Automatic calls from System No. 4 to System No. 5*



1. The System No. 4 link AT does not provide for an end-of-pulsing signal from exchange A in automatic operation; the transit exchange T will therefore have to recognize that all the digits have been received in order to:

   a) send a forward ST signal to B in System No. 5; and

   b) send a backward number-received signal to A in System No. 4.

In this situation, the System No. 5 register signalling at T will be *en bloc* non-overlap[2]. (See Recommendation Q.152, § 3.2.1 b) (2) for the action to be taken by the System No. 5 register at T to recognize that all digits have been received.)

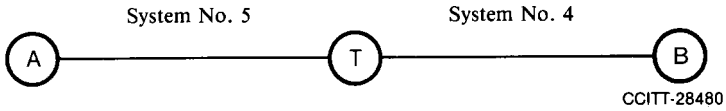
2. At A, release of the outgoing register of System No. 4 depends upon reception of the number-received signal.

At the incoming end of System No. 4 at T, the incoming register[3] of System No. 4 is released as soon as the number-received signal is sent backward and all the numerical information necessary for setting up the call is sent to B.

At T, an ST end-of-pulsing signal is sent to B by System No. 5 after the numerical information has been sent, and the outgoing register[3] of System No. 5 at T is then released.

3. *Calls from System No. 5 to System No. 4*

3.1 *Semi-automatic calls from System No. 5 to System No. 4*



1. In semi-automatic operation at transit exchange T the incoming register[3] part of System No. 5 receives an ST end-of-pulsing signal 55 ms after reception of the last numerical signal.
2. At T, the ST end-of-pulsing signal of System No. 5 is converted into an end-of-pulsing signal of System No. 4, which is sent to the incoming end B of this system.
3. The end-of-pulsing signal of System No. 4, which is a numerical type signal (code 15), is acknowledged.
4. At A, the outgoing register of System No. 5 is released after the ST signal has been sent.
5. At T, the outgoing register[3] of System No. 4 is released when the end-of-pulsing signal is sent.

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2) See for this term the footnote to Recommendation Q.151.

3) These register functions may be combined in a single register.

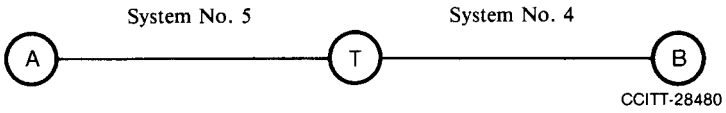
6. At B, the incoming register of System No. 4 is released as soon as the number-received signal is sent backward to T on System No.4 and all the numerical information necessary for setting up the call in the incoming country has been sent forward.

7. The number-received signal is sent over link BT upon reception at B of the end-of-pulsing signal. It will be noted that number-received signal is sent over link BT solely in order to conform to the specifications of System No. 4, even though this signal is superfluous in this case as:

   a) the number-received signal is not needed to release the outgoing register of System No. 4 at T since it is released when it sends the end-of-pulsing signal;

   b) this signal cannot be used to give any information to the operator at A since it cannot be passed by System No. 5 on link AT.

3.2 *Automatic calls from System No. 5 to System No. 4*



1. This situation raises no difficulties since System No. 5 posses the ST signal which, by determining the end-of-pulsing at T, places the outgoing register of System No. 4 a T in conditions that are comparable to those existing with semi-automatic operation in System No. 4.

2. At T, the ST signal of System No. 5 is converted into the end-of-pulsing signal (code 15) of System No. 4.

3. The specifications of System No. 4 require that the incoming exchange B of System No. 4 must send the number-received signal as soon as:

   a) an end-of-pulsing signal has been received, or

   b) it has recognized that all the digits have been received.

In this case of interworking, condition a) is generally fulfilled first. It may happen, however, that a complete national number is recognized before the end-of-pulsing signal is received (for example, when the number of digits in the national number of the incoming country is constant). The transit exchange T must hence be capable of receiving the number-received signal not only after emission of the end-of-pulsing signal but also when the last digit preceding that signal has been sent.

4. Exchange B must be capable of receiving the end-of-pulsing signal (code 15) on automatic calls.

4. *Overflow from System No. 5 to System No. 4*

4.1 In an exchange equipped with System No. 4 and System No. 5, it may be desirable to provide for overflow from a group of circuits operated by System No. 5 to a group operated by System No. 4. This may be the case for a call outgoing from an exchange A (Figure 1/Q.180) or for a call from an outgoing exchange K (Figure 2/Q.180) and arriving via a group of circuits in System No. 4 at transit exchange T where a choice must be made between a first-choice route operated by System No. 5 and an overflow route operated by System No. 4.

4.2 There are two possible ways of arranging for the overflow, in particular with respect to the moment at which the decision is taken to use the overflow route:

- Single exploration;
- Double exploration.

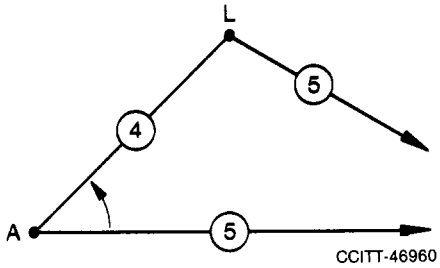


FIGURE 1/Q.180

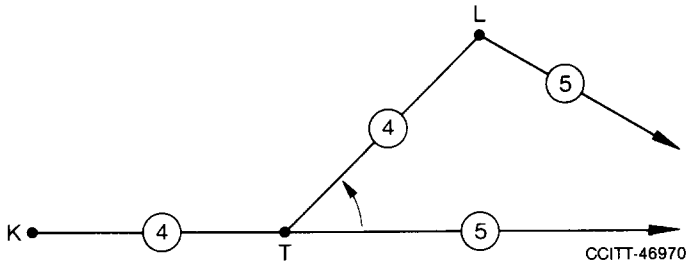


FIGURE 2/Q.180

4.2.1 *Single exploration*

With single exploration, the state of occupation, or availability, of the System No. 5 group at exchange A or exchange T is considered only when the condition ST is determined at this exchange in the System No. 5 outgoing register.

a) If the exploration at A or at T shows that no free circuit in the System No. 5 group is available, overflow to the System No. 4 group takes place.

For this overflow the register has all the numerical information (even in the case of a transit register like that of the T exchange mentioned above), and the end-of-pulsing indication ST. The register at the transit exchange T will be regarded, for successive selection operations, as an outgoing System No. 4 register. Thus, in this case, signalling between the three System No. 4 registers involved will be link-by-link and not end-to-end.

In the case of Figure 2, as soon as the ST condition is available (at the latest immediately after the 5 ± 1 seconds delay provided for in the specifications for System No. 5) the number-received signal will be sent back from T to K in System No. 4.

The ST condition will also be used to cause the end-of-pulsing signal (code 15) to be sent forward from T to L, even in automatic working. The code 15 signal will cause the number-received signal to be sent back from L to T, so that there will be no need to wait for five or ten seconds at L before it is known that a complete number has been received.

The number-received signal sent by T will be received at K and will, in the case of an automatic call, release the outgoing register at that exchange. The second number-received signal, which will be sent by L, will be received at T to release the register at that exchange, despite the fact that the register has transmitted an end-of-pulsing signal which could have been used for releasing the register. The establishment of the speech path at T takes place immediately after the release of the register.

If in the case of Figure 1/Q.180 the ST condition is recognized in the outgoing exchange A, even in automatic operation. This end-of-pulsing signal will in the same way cause the number-received signal to be sent back from L to A.

b) If the exploration at A or at T shows that a free circuit in the System No. 5 group is available, the *en bloc* numerical information has to be transmitted over this circuit, followed by the end-of-pulsing signal ST, in accordance with the specifications for System No. 5.

In the case of Figure 2/Q.180, the conditions for the number-received signal and the release of the outgoing register are the same as under 4.2.1 a).

4.2.2 *Double exploration*

With double exploration the state of availability of the System No. 5 circuit group is examined twice, namely:

- as soon as the direction to be chosen is determined;
- after receipt of the complete numerical information.

With the double exploration, advantage is taken of the fact that, without awaiting condition ST, exchange A or exchange T can know that the direct route by System No. 5 is occupied as soon as the direction to be chosen is determined.

a) If the first exploration at A or at T shows that no free circuit in the System No. 5 group is available, overflow to the System No. 4 group should take place immediately; the use of the signals on the System No. 4 circuit(s) must be in accordance with the normal procedure of that system:

   - in the case of Figure 2, end-to-end working (K-T-L) for the numerical signals and the number-received signal,
   - the end-of-pulsing signal (code 15) only for semi-automatic calls.

The procedure of overflow at this first exploration reduces post-dialling delay in automatic working since there is no need to wait until all the digital information is assembled *en bloc* before proceeding with the setting up of the connection. On the other hand, there is a slight reduction in the efficiency of the first choice System No. 5 group.

b) After the first exploration has shown no congestion of the System No. 5 group, it may happen, during or after reception in the outgoing register at A (or transit register, in the case of T) of the digits following the digits necessary to determine the routing, that the System No. 5 group gets busy, more particularly because such a circuit group is a first-choice high-usage route with consequently a high probability of loss. When this happens, after noting by this second exploration that all circuits in the System No. 5 group are busy, overflow to the System No. 4 group takes place.

For this case of overflow, the conditions can be considered to be the same as in 4.2.1 a).

c) If also the second exploration shows no congestion of System No. 5 group, the conditions mentioned in 4.2.1 b) fully apply.

4.3 Line signalling for calls set up in overflow through two successive No. 4 systems will be done normally, that is, end-to-end. The number-received signal, however, will be sent as stated in 4.2.1 a), 4.2.2 a) or 4.2.2 b).

5. *Interworking line signalling conditions*

5.1 *Forward-transfer signal*

The forward-transfer signal, in the event of a transit call going from System No. 4 to System No. 5, or from System No. 5 to System No. 4, should cause the assistance operator to intervene in the country of arrival, and not at the transit exchange.

The incoming line relay set of the first system at the transit exchange is informed, e.g. by the transit register, that the call is a transit call. Hence, when a forward-transfer signal arrives on the first system, it causes the forward-transfer signal to be transferred to the outgoing line relay set of the second system without intervention by the operator at the transit exchange.

5.2 *Answer signal*

5.2.1 *System No. 4 to System No. 5 (traffic direction)*

The answer signal on the System No. 4 link should be sent only after complete recognition of the answer signal received from the System No. 5 link, i.e. overlap transmission should not be used.

The considerations for this requirement are:

- the overlap technique could give rise to troubles in signalling system No. 4 in case of imitation of the P signal;
- in the transfer of the answer signal from System No. 5 to System No. 4 the sending end line split (silent period) before starting P is a necessity due to the pulse type signals of System No. 4. The requirement for this sending-end line split period (40 ± 10 ms) would have meant little speed advantage of overlap operation in transferring the answer signal from System No. 5 to System No. 4 (about 40 ms);
- overlap operation would be contrary to the design characteristic of System No. 4 in that once the sending of a signal has begun it must be sent completely.

5.2.2 *System No. 5 to System No. 4 (traffic direction)*

In the interworking arrangements in a transit centre for transferring the answer signal backward from System No. 4 to System No. 5, overlap transmission should not be used.

In System No. 4, overlap operation is incompatible with the use of time measurement for recognition of the suffix signal (short suffix or long suffix). The overlap operation would not permit waiting for the end of a signal PY (answer signal), to determine that it is not a PYY signal release-guard signal).

5.3 *Busy-flash signal*

In the case of interworking at a transit point from System No. 4 to System No. 5 or vice visa, a busy-flash signal received at that transit point from the outgoing circuit is to be converted to a busy-flash signal on the incoming circuit.

In the case of interwoking from System No. 5 to System No. 4, the busy-flash signal will cause the release of the international connection initiated from the outgoing exchange.

In the case of interworking from System No. 4 to System No. 5, the System No. 5 equipment at this transit exchange should function as an outgoing System No. 5 equipment on the receipt of a busy-flash signal and release the System No. 5 circuit from the transit point. It should be noted that the System No. 4 circuit is also released in the case of automatic calls.

Note - In the case of interworking from System No. 5 to System No. 4 it has been determined that no advantage is to be gained by the release of the international connection being initiated only by the outgoing exchange. Therefore in both cases of interworking, the transit exchange and the forward connection may be released immediately on receipt of the busy-flash signal. However, there is no need to modify existing equipment.

5.4 *Time-out delays to clear a connection in the event of signal failures*

5.4.1 *Non-reception of a clear-forward signal after a clear-back signal has been sent*

In the event of transit working System No. 4 to System No. 5 at an exchange T, this latter represents the terminal for System No. 4.

The action to be taken at an international incoming exchange for System No. 4 holds good for the exchange T. After a time-out of 2 to 3 minutes, the System No. 4 incoming equipment at T should produce an effect forward on the circuit of System No. 5, so as to release the international circuit (for example, should there be some interruption in the System No. 4 circuit). This release should proceed in the same way as the release of the national part of the connection, when the incoming exchange is indeed the incoming international exchange of the international connection.

For symmetry's sake, the action at T to release the connection should also be undertaken when there is transit working from System No. 5 to System No. 4, since a time-out of 2 to 3 minutes exists in System No. 5 to release the connection forward.

5.4.2 *Delay in clearing by the calling subscriber in automatic working*

In the case of automatic calls with interworking from System No. 4 to System No. 5, or from System No. 5 to System No. 4, release of the international connection as brought about by the time-out of 1 to 2 minutes must take place *at the outgoing exchange only*, and not at the exchange T, the point of connection of the two systems. In exchange T, the outgoing line relay sets of the second system in the connection must accordingly be marked that they are acting, not as relay sets for the terminal outgoing end of the system in question, but as transit exchange relay sets.

5.4.3 *Non-reception of an answer-signal at the outgoing exchange after reception of a number-received signal or generation of the ST condition*

When a connection passes through System No. 4 towards System No. 5, or vice versa, release must be undertaken *at the outgoing exchange only*. Hence nothing must be done at the transit exchange T, the point at which Systems Nos. 4 and 5 are connected.

In the case of System No. 4 towards System No. 5, exchange T represents the connection transit exchange for both systems. Non-reception at T of an answer-signal within 2 to 4 minutes after condition ST has been determined must produce *no* effect at exchange T. It will be for the outgoing exchange to cause release (by sending the clear-forward signal) on the 2 to 4 minutes' time-out after reception of the number-received signal from exchange T.

In the case of System No. 5 towards System No. 4 exchange T represents the connecting transit exchange for both systems. Non-reception at T of an answer-signal within 2 to 4 minutes after reception of the number received-signal from the incoming exchange must *not* affect exchange T. It will be for the outgoing exchange to cause release of the connection (by sending the clear-forward signal) after the delay of 2 to 4 minutes following the generation of the ST condition at that exchange.