

Recommendation T/CS 49-07 (Vienna 1982, revised in Montpellier 1984)

SYSTEM L1 MULTIFREQUENCY CODE INTERREGISTER SIGNALLING

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

Revised text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

- Multifrequency Code (MFC) signalling may enable faster call set-up than decadic pulse signalling;
- that MFC signalling provides more codes than decadic pulse signalling;
- that MFC signalling employs in-band signals, and is thus suitable for use between private automatic branch exchanges (PABXs) for end-to-end interregister signalling;
- that MFC signalling is suitable for a dialogue-like interchange of signalling information;
- that the compelled nature of MFC signalling provides a secure means of exchanging information,

recommends

that members, in conditions favouring MFC signalling over links between analogue transmission interfaces of private automatic branch exchanges located in different countries, use System L1 MFC interregister signalling as specified below."

1. GENERAL

1.1. Line signalling

System L1 MFC interregister signalling is used in conjunction with System L1 line signalling according to Recommendation T/CS 49-01 [1]. The individual line signals to be provided, and their use, are specified in Recommendation T/CS 49-08 [2] on System L1 MFC call control signalling procedures.

1.2. Principles and fields of application

1.2.1. System L1 MFC is suitable for automatic and semi-automatic working between private automatic branch exchanges (PABXs), via terrestrial circuits. When a satellite circuit is used in the connection, the echo-suppressor control principles as described in Recommendation Q.479 [10] are applicable.

1.2.2. System L1 MFC can be used in private networks containing PABXs of different capability, which may range from the set-up of simple calls to a wide variety of supplementary services.

1.2.3. System L1 MFC is specified in terms of a standard selection procedure, followed by one of a number of alternative subsets of signalling procedures for transfer of additional information.

The available subsets are:

- simple calls only, called *basic* subset;
- simple calls and access to supplementary services, called *enhanced* subset;
- specific procedures defined by the PABX providers, called *manufacturer* subset.

Signals have been reserved to provide access to an *enhanced routing subset*, which may be specified when necessary.

1.2.4. The procedure subset used on a call after the standard selection procedure depends upon the capabilities of the interconnected PABXs, and is determined by a compatibility check procedure. The specified signalling procedures include selection, compatibility checking and transfer of additional information (see Recommendation T/CS 49-08 [2]).

1.2.5. A PABX, for which System L1 MFC is used, must be capable of providing at least the selection procedure, plus the *basic* subset of procedures for additional information transfer. This ensures a minimum level of interworking if compatibility using the optional *enhanced* or *manufacturer* subsets cannot be achieved.

1.2.6. The system is for use on four-wire circuits, and the PABX termination arrangements set out in Recommendation T/CS 49-01 [1] apply. The maximum number of tandem connections over which a call may be setup is determined by the type of interconnecting circuits, and is subject to mutual agreement by the parties concerned. All circuits used in System L1 links should be to the standard of CCITT Recommendations G.171 [3] and M.1010 to M.1060 [4].

2. INTERREGISTER SIGNALS

2.1. Line signalling frequency interregister signals

In System L1 interregister signalling, a line frequency (2,280 Hz) backward signal is used for initiating MFC signal transfer, the proceed-to-send signal. This signal is introduced in accordance with Recommendation T/CS 41-01 [5] and T/CS 49-02 [6].

2.2. MFC interregister signals

System L1 MFC is based on System R2, the multifrequency codes used are in accordance with CCITT Recommendation Q.441, Table 3/Q.441 [7].

When using the *enhanced* subset, the number of signal groups in each direction is extended. Forward signal groups are designated groups I, II, III, etc., and backward signal groups A, B, C, etc.

Tables 1 (T/CS 49-07) to 8 (T/CS 49-07) show the interregister signals specified in System L1 MFC.

All signal names are in accordance with Recommendation T/CS 41-01 [5].

Frequency combination	Name of signal	Abbrev.	Note	
1	Address, digit 1	I- 1	<i>Note 1</i>	
2	Address, digit 2	I- 2		
3	Address, digit 3	I- 3		
4	Address, digit 4	I- 4		
5	Address, digit 5	I- 5		
6	Address, digit 6	I- 6		
7	Address, digit 7	I- 7		
8	Address, digit 8	I- 8		
9	Address, digit 9	I- 9		
10	Address, digit 0	I-10		
11	Address, character ★	I-11		
14	Address, character #	I-14		
15	End-of-digits	I-15		
13	Change-over-to-enhanced-routing-subset	I-13		<i>Note 2</i>
12	Request-rejected	I-12		<i>Note 3</i>

Table 1 (T/CS 49-07). Group I forward signals.

Note 1: Signals used for selection.

Note 2: Signals used to enable special actions during the selection phase.

Note 3: Signal for subset compatibility check, e.g. for rejection of a *manufacturer-request*.

Frequency combination	Name of signal	Abbrev.	Note
1	Send-next-digit	A- 1	<i>Note 1</i>
13	Send-next-digit, PSTN-encountered	A-13	
14	Send-next-digit, transit-encountered	A-14	
2	Transit-encountered, send-first-digit	A- 2	
8	Transit-encountered, alternatively-routed, send-first-digit	A- 8	
4	Call-failure	A- 4	
9	Routing-congestion	A- 9	
5	Send-calling-party's-category	A- 5	<i>Note 2</i>
10	<i>Enhanced-routing</i> , information-ready	A-10	
12	<i>Enhanced-routing</i> , no-information	A-12	
3	Address-complete, <i>basic</i> , change-over-to-groups-II-and-B	A- 3	<i>Note 3</i>
6	Address-complete, no-MFC	A- 6	
7	Change-over-to- <i>manufacturer</i> -subset Address-complete, request- <i>manufacturer</i> -identity	A- 7	
11	Address-complete, <i>enhanced</i> , change-over-to-groups-II-and-B	A-11	
15	Spare	A-15	

Table 2 (T/CS 49-07). Group A backward signals.

Note 1: Signals used during the selection phase.

Note 2: Signals used to enable special actions to be taken during the selection phase.

Note 3: Signals used for the subset compatibility check.

Frequency combination	Name of signal	Abbrev.	Note
1	Ordinary-extension	II- 1	<i>Note 1</i>
2	Private-circuit, restricted-signalling capability	II- 2	
3	Maintenance-equipment	II- 3	
4	Public-switched-telephone-network (PSTN)	II- 4	
5	Operator	II- 5	
6	Data-transmission-equipment	II- 6	
7	Operator-assisting, ordinary-extension	II- 7	
8	Operator-assisting, PSTN	II- 8	
9	Operator-assisting, restricted-signalling	II- 9	
10	Network	II-10	<i>Note 2</i>
11	Ordinary-extension, holding-PSTN	II-11	
13	Extraordinary-extension	II-13	
14	ISDN	II-14	
12	<i>Enhanced</i> -subset-request-rejected	II-12	<i>Note 3</i>
15	Spare	II-15	

Table 3 (T/CS 49-07). Group II forward signals.

Note 1: Signals used in both the *basic* and the *enhanced* subset.

Note 2: These signals shall not be used in the *basic* subset.

Note 3: Signal used for the subset compatibility check.

Frequency combination	Name of signal	Abbrev.	Note
1	Parked	B- 1	<i>Note 1</i>
2	Call-failed, PSTN-barred	B- 2	
3	Busy, intrudable	B- 3	
4	Destination-PABX-call-failure	B- 4	
5	Unallocated-number, temporarily-out-of-service	B- 5	
6	Free, intrudable	B- 6	
7	Free, non-intrudable	B- 7	
8	Call-failed, incoming-call-barred	B- 8	
9	Destination-PABX-congestion	B- 9	
10	Busy, non-intrudable	B-10	
11	Free, operator	B-11	<i>Note 2</i>
12	Busy, partially-intrudable	B-12	
13	Free, partially-intrudable	B-13	
14	State-of-destination-indeterminable	B-14	
15	Spare	B-15	

Table 4 (T/CS 49-07). Group B backward signals.

Note 1: Signals used in both the *basic* and *enhanced* subset.

Note 2: These signals shall not be used in the *basic* subset.

Frequency combination	Name of signal	Abbrev.	Note
1	Simple call	III- 1	<i>Note 1</i>
2	Simple call, diverted	III- 2	
3	Simple call, non-intrudable	III- 3	
4	Simple call, diverted, non-intrudable	III- 4	
9	Simple call, partially-intrudable	III- 9	
10	Simple call, diverted, partially-intrudable	III-10	
15	No-further-supplementary-services-required	III-15	
5	Supplementary-service	III- 5	<i>Note 2</i>
6	Supplementary-service, diverted	III- 6	
7	Supplementary-service, non-intrudable	III- 7	
8	Supplementary-service, diverted, non-intrudable	III- 8	
11	Supplementary-service, partially-intrudable	III-11	
12	Supplementary-service, diverted, partially-intrudable	III-12	
13	Spare	III-13	
14	Spare	III-14	

Table 5 (T/CS 49-07). Group III forward signals.

Note 1: These signals indicate that the originating PABX has no further need for MFC signalling.

Note 2: These signals indicate that the originating PABX wishes to request a forward supplementary service, and that further MFC signalling is required beyond this group.

Frequency combination	Name of signal	Abbrev.	Note
1	Conclude-MFC, no-additional-information	C- 1	<i>Note 1</i>
2	Conclude-MFC, PSTN barred	C- 2	
3	Conclude-MFC, no-additional-information, non-intrusion-request-rejected	C- 3	
4	Call-failure	C- 4	
5	Conclude-MFC	C- 5	
7	Supplementary-service, non-intrusion-request-rejected	C- 7	<i>Note 2</i>
8	Supplementary-service	C- 8	
10	Supplementary-service, PSTN-barred	C-10	
13	Supplementary-service, PSTN-barred, non-intrusion-request-rejected	C-13	
9	Send-calling-line identity (CLI)	C- 9	
11	Send-CLI, PSTN-barred	C-11	
12	Send-CLI, non-intrusion-request-rejected	C-12	
14	Send-CLI, PSTN-barred, non-intrusion-request-rejected	C-14	
15	Request-forward-supplementary-service category	C-15	
6	Spare	C- 6	

Table 6 (T/CS 49-07). Group C backward signals.

Note 1: These signals conclude MFC signalling and return control of the call to System L1 line signals.

Note 2: These signals cause change-over to groups IV and D signalling.

Frequency combination	Previous backward signal which determines the group VI signal meaning									
	Request forward-suppl.-service category, C-15 or register recall	Request forward-suppl.-service identity, D-15, <i>Note 1</i>	Suppl.-service signal, C-7, C-8, C-10 or C-13	Backward suppl.-service category, D-1 to D-15	Backward suppl.-service-identity digit, D-1 to D-15	Send-CLI, C-9, C-11, C-12 or C-14 or send-next-CLI-digit, D-15				
1	Forward service category digit	Suppl. service identity digit	Invalid	Spare (<i>Note 3</i>) Must not be sent in response to the escape signal D-10	Signals provided for suppl. service procedures, see <i>Note 2</i>	CLI-digit 1				
2						2				
3						3				
4						4				
5						5				
6						6				
7						7				
8						8				
9						9				
10	Escape					10				
11	<i>Note 2:</i> See Annexes to Recommendation T/CS 49-08 [2] or manufacturer documentation.					OK, no-further MFC-required	CLI-digit ★			
12						Request-rejected, no-further-MFC-required				Invalid
13						Invalid	Spare (<i>Note 3</i>)	OK, no-further MFC-possible	Invalid	
14						Request-rejected, further-MFC-possible				CLI-digit #
15			Request-backw. suppl.-service-category	Request-backward-suppl.-service-identity, <i>Note 1</i>	Spare	End-of-digits				

Table 7 (T/CS 49-07). Group IV forward signals.

Frequency combination	Previous forward signal which determines the group D signal meaning					
	Suppl.-service category IV-1 to 15	Suppl.- service identity-digit IV-1 to 15	Request-backward-suppl.-service-category IV-15	Request-backward-suppl.-service-identity IV-15	CLI-digit, IV-1 to 10 or end-of-digits, IV-15	OK or request-rejected, IV-11, IV-12, IV-13, IV-14
1 2 3 4 5 6 7 8 9	Spare (Note 3) Can never be sent in response to escape signal IV-10	Signals provided for suppl.-service procedures, see Note 2	Suppl.-service-category digit	Suppl.-service identity digit	Invalid	Invalid
10						
11		OK, conclude MFC	Note 1: Request-suppl.-service-identity signal equals send-next-suppl.-service-digit signal, see Recommendation T/CS 41-01 [5].	Note 2: See Annexes to Recommendation T/CS 49-08 [2] or manufacturer documentation.	OK, conclude MFC	Accept-acknowledged conclude MFC
12	Request-rejected, conclude MFC				Invalid	Reject-acknowledged, conclude MFC
13	Spare (Note 3)	OK, change-over-to-groups-III-and-C			OK, change-over-to-groups-III-and-C	Accept-acknowl., change-over-to-groups-III-and-C
14	Request-rejected, change-over-to-group-III-and-C				Invalid	Reject-acknowl., change-over-to-groups-III-and-C
15	Request-forward-suppl.-service	Spare			Send-next-CLI-digit	Invalid

Table 8 (T/CS 49-07). Group D backward signals.

3. SYSTEM L1 MFC SIGNALLING GROUP STRUCTURE

The signals are allocated to the 15 MFC codes in five forward and five backward signal groups. The signal group represented by the MFC codes is changed at defined points in the call; the same MFC code will therefore represent a different signal, depending on its position in the sequence of the call.

Each signal group is used for a particular part of the call.

- Groups I and A are used for selection, network control and subset compatibility checks.
- Groups II and B are used to exchange calling and called party information.
- Groups I and A, plus part of groups II and B, provide the necessary signals for establishing a simple call using the *basic* subset for the transfer of additional information.
- The remaining groups II and B signals, and the groups beyond, are only provided when enhanced procedures for the transfer of additional information are used.
- Groups III and C are provided to exchange additional calling and called party information, and to gain access to the supplementary services request procedures.
- Groups IV and D are provided to convey supplementary service request information and provide calling-line-identification.
- Groups V and E are for the *enhanced routing subset*. The *enhanced routing subset* is still under study.

4. PULSED SIGNALLING

A pulsed signal is a signal sent in the backward direction for the period specified in CCITT Recommendation Q.422 [6].

Signals assigned for use in the pulsed mode are backward signals A-4, A-6, A-9, B-4, B-9, C-4, and D-12, see Tables 2 (T/CS 49-07), 4 (T/CS 49-07), 6 (T/CS 49-07) and 8 (T/CS 49-07).

A pulsed signal may be sent when either of the following conditions arise:

1. when the time-out on non-receipt of a signal matures before the first forward signal is received;
2. following completion of a compelled signalling cycle, if no subsequent forward signal has been recognised, and at least 100 ms have elapsed since the end of transmission of a backward signal.

The initiating PABX shall terminate any forward signal in the course of transmission, on receipt of a pulsed signal.

It is desirable that reception of a forward signal by the responding PABX during transmission of a pulsed signal shall cause that PABX to complete the signalling cycle in the compelled mode. However, the responding PABX shall not act upon the information contained in such a forward signal.

A pulsed signal shall have the same meaning as the corresponding signal within the compelled mode, and shall be interpreted accordingly by the initiating PABX.

5. SIGNAL GROUP CHANGING

This section gives details of the signal group changing procedures that occur at various points in the progress of signalling procedures.

- 5.1. On seizure, the MFC codes represent groups I and A.
- 5.2. The forward signal change-over-to-*enhanced-routing-subset* (I-13) will cause a change to groups V and E. Signals in group V will change back to groups I and A on completion of the enhanced signal interchange.
- 5.3. The backward signal send-calling-party-category (A-5) causes change-over to group II for one signal only, then signalling reverts to groups I and A. The group II signal will belong to the *basic* subset (II-1 to II-9). During this signal interchange, the originating PABX will receive group A signals only.
- 5.4. On completion of *call selection*, the destination PABX initiates change-over to groups II and B by sending either:
 - Address-complete, *basic*, change-over-to-groups-II-and-B (A-3) or
 - Address-complete, *enhanced*, change-over-to-groups-II-and-B (A-11).
- 5.5. When working *enhanced*, the groups II and B will be followed by group III and group C signals, except for conditions such as call-failure.
- 5.6. Supplementary service or calling-line-identity (CLI) indication in groups III and C will cause change-over to groups IV and D.
- 5.7. Certain group IV and D signals cause change-over to III and C.

6. REGISTER-RECALL SIGNALLING

Register-recall provides the means for control information transfer after dismissal of common-control equipment. Register-recall can, as forward or backward recall, be initiated in either direction, regardless of the direction of the original call set-up.

When the common-control equipment at the destination or originating PABX is required to be recalled, the forward or backward service-request-recall signal shall be sent. The service-request-recall signal shall not recall the common-control equipment of transit switches. However, certain call states may require response by a transit switch on recognition of a service-request-recall signal, e.g. in a three-party call where branching occurs at a transit switch.

When the common-control equipment at a transit switch is required to be recalled, the forward or backward link-recall signal shall be sent to the *adjacent* transit switch.

On receipt of a register-recall signal, the MFC codes will represent group IV and D signals. MFC signalling shall start with a forward group IV signal sent by the PABX that initiated the register-recall. No proceed-to-send-on-recall signal is used.

There will be a finite period following the sending of a recall signal before the responding PABX isolates the line from the user. To reduce the possibility of interference from voice during this period it is recommended that the originating PABX delays application on the MFC receiver for a period of approximately one second after sending a recall signal.

7. TRANSIT WORKING

When a transit switch in a private network recognises a seizing signal, it responds by returning the proceed-to-send signal. The originating PABX will send the first address signal (routing digit) appropriate to that transit switch. On receipt of this address signal, the transit switch will request further address signals until sufficient signals have been received to route the call. When sufficient information has been received, a suitable circuit is seized, the tandem-encountered or alternatively-routed-call signal is returned, the MFC registers are released and switch-through is initiated. The transit switch will then be ready for System L1 MFC end-to-end signalling through its switch path.

If no idle circuit can be found, the routing-congestion signal is returned, and MFC signalling with the transit switch concerned is ended.

8. SYSTEM L1 MFC SIGNALLING SENDING AND DETECTING REQUIREMENTS

The sending and detecting requirements for System L1 MFC signalling shall be in accordance with CCITT Recommendations Q.450 to Q.458 [9].

References

- [1] Recommendation T/CS 49-01. *System L1 line signalling over international inter-private automatic branch exchange lines.*
- [2] Recommendation T/CS 49-08. *System L1 MFC signalling call control signalling procedures.*
- [3] CCITT Recommendation G.171. *Transmission characteristics of leased circuits forming part of a private telephone network.*
- [4] CCITT Recommendations M.1010 to M.1060. *International leased circuits.*
- [5] Recommendation T/CS 41-01. *Signal and signalling message names and meanings.*
- [6] Recommendation T/CS 49-02. *System L1 decadic pulsing signalling.*
- [7] CCITT Recommendation Q.441. *Signalling code.*
- [8] CCITT Recommendation Q.442. *Pulse transmission of backward signals.*
- [9] CCITT Recommendations Q.450-458. *Specifications of signalling System R2.*
- [10] CCITT Recommendation Q.479. *Echo-suppressor control—signalling requirements.*