RECOMMENDATION 584-1*

STANDARD CODES AND FORMATS FOR INTERNATIONAL RADIO PAGING**

(Question 12/8, Study Programme 12A/8)

(1982-1986)

The CCIR,

CONSIDERING

(a) Recommendation 539, Reports 499 and 900 which describes codes and formats presently used by a number of administrations;

(b) that the studies necessary to define the requirements for international radio-paging systems are not complete;

(c) that the results of such studies may make it desirable to amend any standard selection on the basis of the present limited information;

(d) that some administrations have an urgent need to implement national radio-paging systems which might be developed to provide for international radio paging;

(e) that, among other things, standard code(s) and format(s) are necessary to permit international radio paging;

(f) that, for paging systems unlikely to be extended to provide for international paging, some other codes might be more suitable,

RECOMMENDS

1. that the codes and formats described in Annex I are generally suitable for national use and should be considered for systems which an administration might intend to extend to international paging;

2. that system design should allow for possible future changes in the recommended codes and formats;

3. that studies should continue in order to define the requirements for international paging systems.

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* The Director of the CCIR is requested to bring this Recommendation to the attention of the CCITT in relation to Recommendation 539.

** *Radio paging:* non-speech, one-way, personal selective calling system with alert, without message or with defined message such as numeric or alphanumeric. (This definition should be brought to the attention of the CMV.)

ANNEX I

RADIO-PAGING CODE No. 1

1. Code and format

A transmission consists of a preamble followed by batches of complete codewords, each batch commencing with a synchronization codeword (SC). The format of the signals is illustrated in Fig. 1. Transmission may cease at the end of a batch when there are no further calls.

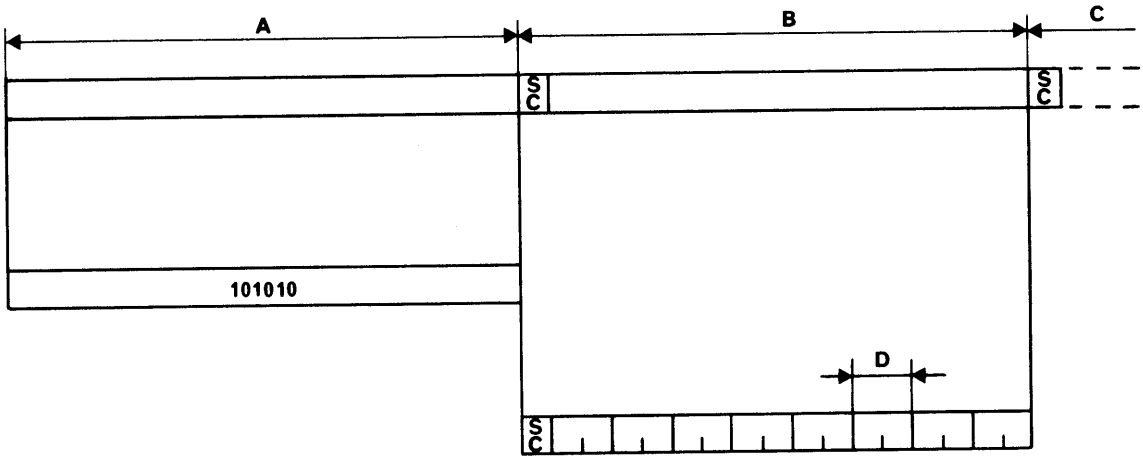

FIGURE 1 – *Signal format*

A: preamble. Duration at least 576 bits = the duration 1 batch + 1 codeword
B: first batch
C: second and subsequent batches
D: one frame = 2 codewords
SC: synchronization codeword

Note. – 1 batch = synchronization codeword + 8 frames = 17 codewords.

D01-sc

1.1 *Preamble*

Each transmission starts with a preamble to aid the pagers to attain bit synchronization and thus help in acquiring word and batch synchronization. The preamble is a pattern of reversals, 101010... repeated for a period of at least 576 bits, i.e. the duration of a batch plus a codeword.

1.2 *Batch structure*

Codewords are structured in batches which comprise a synchronization codeword followed by 8 frames, each containing 2 codewords. The frames are numbered 0 to 7 and the pager population is divided into 8 groups. Thus each pager is allocated to one of the 8 frames according to the 3 least significant bits (1sb) of its 21 bit identity (see § 1.3.2), i.e. 000 = frame 0, 111 = frame 7, and only examines address codewords in that frame. Therefore each pager's address codewords must be transmitted only in the allocated frame.

Message codewords for any receiver may be transmitted in any frame but follow, directly, the associated address codeword. A message may consist of any number of codewords transmitted consecutively and may embrace one or more batches but the synchronization codeword must not be displaced by message codewords. Message termination is indicated by the next address codeword or idle codeword. There is at least one address or idle codeword between the end of one message and the address codeword belonging to the next message.

In any batch, wherever there is no meaningful codeword to be transmitted, an idle codeword is transmitted.

1.3 *Types of codewords*

Codewords contain 32 bits which are transmitted with the most significant bit first.

The structure of a codeword is illustrated in Fig. 2.

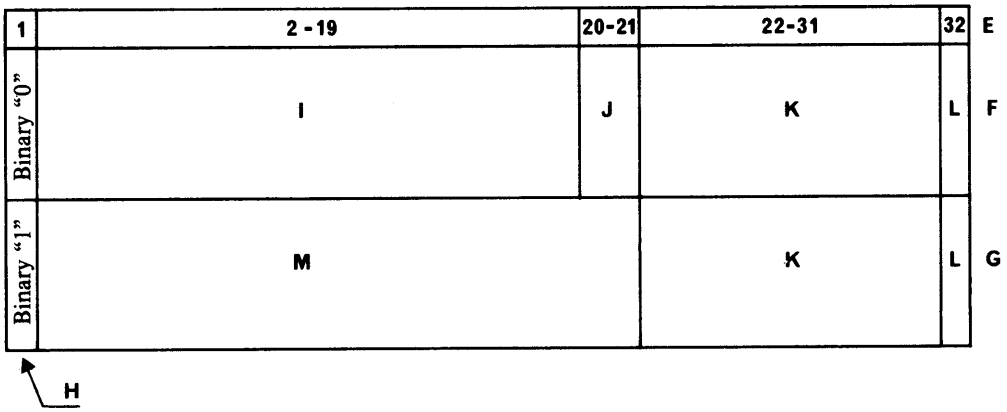

FIGURE 2 – *Form of address and message codewords*

E: bit number
F: address codeword
G: message codeword
H: flag bit
I: address bits (2–19)
J: function bits
K: check bits
L: even parity bit
M: message bits (2–21)

D02-sc

1.3.1 *Synchronization Codeword*

The synchronization codeword is shown in Table I:

TABLE I

Bit No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bit	0	1	1	1	1	1	0	0	1	1	0	1	0	0	1	0
Bit No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Bit	0	0	0	1	0	1	0	1	1	1	0	1	1	0	0	0

1.3.2 *Address Codewords*

The structure of an address codeword is illustrated in Fig. 2.

Bit 1 (the flag bit) of an address codeword is always a zero. This distinguishes it from a message codeword.

Bits 2-19 are address bits corresponding to the 18 most significant bits of a 21 bit identity assigned to the pager.

For information regarding the least significant bits see § 1.2.

Bits 20 and 21 are the two function bits which are used to select the required address from the four assigned to the pager. Hence the total number of addresses is 2^{23} (over 8 million).

Bits 22 to 31 are the parity check bits (see § 1.4) and the final bit (bit 32) is chosen to give even parity.

1.3.3 *Message Codewords*

The structure of a message codeword is shown in Fig. 2. A message codeword always starts with a 1 (the flag bit) and the whole message always follows directly after the address codeword. The framing rules of the code format do not apply to a message and message codewords continue until terminated by the transmission of the next address codeword or idle codeword. Each message displaces at least one address codeword or idle codeword and the displaced address codewords are delayed and transmitted in the next available appropriate frame. Although message codewords may continue into the next batch, the normal batch structure is maintained, i.e., the batch will consist of 16 codewords, preceded by a synchronization codeword. At the conclusion of a message any waiting address codewords are transmitted, starting with the first appropriate to the first free frame or half frame.

Message codewords have 20 message bits, viz bit 2 to bit 21 inclusive and these are followed by the parity check bits obtained according to the procedure outlined in § 1.4 below.

1.3.4 *Idle Codeword*

In the absence of an address codeword or message codeword, an idle codeword is transmitted. The idle codeword is a valid address codeword, which must not be allocated to pagers and has the following structure as shown in Table II:

TABLE II

Bit No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bit	0	1	1	1	1	0	1	0	1	1	0	0	1	0	0	1
Bit No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Bit	1	1	0	0	0	0	0	1	1	0	0	1	0	1	1	1

1.4 *Codeword Generation (31: 21 BCH + Parity)*

Each codeword has 21 information bits, which correspond to the coefficients of a polynomial having terms from x^{30} down to x^{10}. This polynomial is divided, modulo-2, by the generating polynomial $x^{10} + x^9 + x^8 + x^6 + x^5 + x^3 + 1$. The check bits correspond to the coefficients of the terms from x^9 to x^0 in the remainder polynominal found at the completion of this division. The complete block, consisting of the information bits followed by the check bits, corresponds to the coefficients of a polynomial which is integrally divisible in modulo-2 fashion by the generating polynomial.

To the 31 bits of the block is added one additional bit to provide an even bit parity check of the whole codeword.

2. Message formats

Although in principle, any message format can be inserted into message codewords, the following formats are regarded as standard. Adherence to these standards will enable a greater measure of interworking to be possible. The formats are not mixed within any one message.

2.1 *"Numeric-only" message format*

The "numeric-only" format is provided for the transmission of messages which may be represented solely in decimal numerals together with spaces, hyphens, opening and closing brackets, an urgency symbol "U" and one other symbol. There are 4 bits per character in this format and its use will save air-time compared to the other format.

The address which introduces a message (or segment of a message) using this format has its function bits set to 00. The character-set used for the message is as shown in Table III which is based on Binary Coded Decimal (BCD). The bits of each character are transmitted in numerical order starting with bit No. 1. Characters are transmitted in the same order as they are to be read and are packed 5 per message codeword. Any unwanted part of the last codeword of the message is filled with space characters.

TABLE III – *"Numeric-only" character set*

4-bit Combination	Displayed character
Bit No.: 4 3 2 1	
0 0 0 0	0
0 0 0 1	1
0 0 1 0	2
0 0 1 1	3
0 1 0 0	4
0 1 0 1	5
0 1 1 0	6
0 1 1 1	7
1 0 0 0	8
1 0 0 1	9
1 0 1 0	Spare
1 0 1 1	U (urgency indicator)
1 1 0 0	Space
1 1 0 1	Hyphen
1 1 1 0	⊐
1 1 1 1	⊏

2.2 *Alpha-numeric or general data format*

This format can be used for the transmission of messages requiring a greater range of characters than that provided within the "numeric-only" format but it may also be used to replace the latter when circumstances make this essential or desirable. There are 7 bits per character in this format.

The pager address which introduces a message (or segment of a message) using this format has its function bits set to 11.

The CCITT Alphabet No. 5 (7 bits per character) is used in this format. As in the case of the "numeric-only" format, bit order starting with bit No. 1 of each character, and character reading order are preserved in transmission. The complete message is partitioned into contiguous 20 bit blocks for the purpose of filling consecutive message codewords. Thus a character may be split between one message codeword and the next. Any unwanted part of the last codeword of the message is filled with appropriate non-printing characters such as "End of Message", "end of Text", Null, etc. All characters, except Null, are complete.