Exhibit F

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DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 1

ISDN USER-NETWORK INTERFACE-DATA LINK LAYER SPECIFICATION

ITU-T Recommendation Q.921

(Previously “CCITT Recommendation”)

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation Q.921 was revised by the ITU-T Study Group XI (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Recommendation Q.921[1)]

ISDN USER-NETWORK INTERFACE – DATA LINK LAYER SPECIFICATION

(Malaga-Torremolinos, 1984; modified at Helsinki, 1993)

1 General

This Recommendation specifies the frame structure, elements of procedure, format of fields and procedures for the proper operation of the Link Access Procedure on the D-channel, LAPD.

The concepts, terminology, overview description of LAPD functions and procedures, and the relationship with other Recommendations are described in general terms in Recommendation Q.920 [1].

NOTES

1 As stated in Recommendation Q.920 [1], the term "data link layer" is used in the main text of this Recommendation. However, mainly in figures and tables, the terms "layer 2" and "L2" are used as abbreviations. Furthermore, in accordance with Recommendations Q.930 [2] and Q.931 [3], the term "layer 3" is used to indicate the layer above the data link layer.

2 All references within this Recommendation to "layer management entity" and/or "connection management entity" refer to those entities at the data link layer.

The abstract test suites for testing conformance to this Recommendation are contained in Recommendation Q.921 *bis* [4].

2 Frame structure for peer-to-peer communication

2.1 General

All data link layer peer-to-peer exchanges are in frames conforming to one of the formats shown in Figure 1. Two format types are shown in the figure: format A for frames where there is no information field and format B for frames containing an information field.

2.2 Flag sequence

All frames shall start and end with the flag sequence consisting of one 0 bit followed by six contiguous 1 bits and one 0 bit. The flag preceding the address field is defined as the opening flag. The flag following the Frame Check Sequence (FCS) field is defined as the closing flag. The closing flag may also serve as the opening flag of the next frame, in some applications. However, all receivers must be able to accommodate receipt of one or more consecutive flags. See ISDN User-Network Interfaces: Layer 1 Recommendations I.430 [5] and I.431 [6] for applicability.

2.3 Address field

The address field shall consist of two octets as illustrated in Figure 1. The format of the address field is defined in 3.2.

A single octet address field is reserved for LAPB (link access procedure – balanced) operation in order to allow a single LAPB [7] data link connection to be multiplexed along with LAPD data link connections.

NOTE – The support of a LAPB data link connection within the D-channel is optional at both the network and user side.

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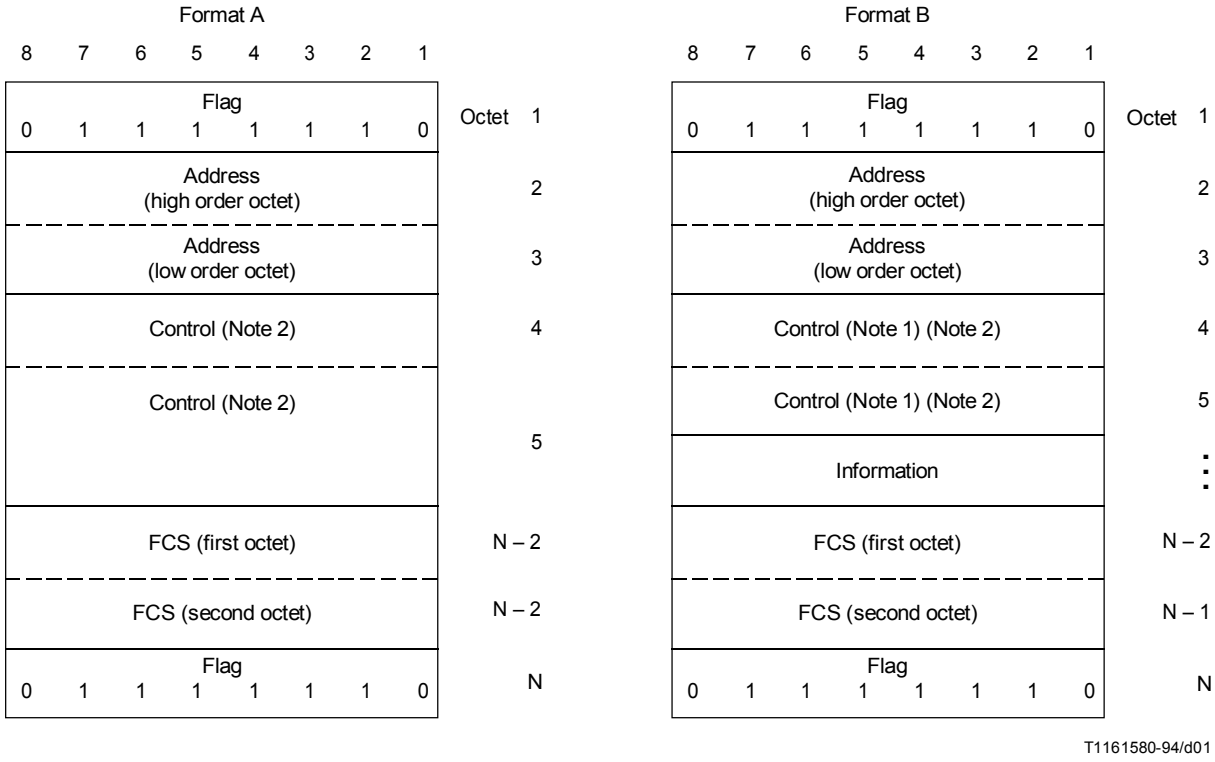
1) This Recommendation will be included in the Series I Recommendations (1993) under the number I.441.

2.4 Control field

The control field shall consist of one or two octets. Figure 1 illustrates the two frame formats (A and B), each with a control field of one or two octets, depending upon the type of frame.

The format of the control field is defined in 3.4.



NOTES

1 For an acknowledged operation format B applies and one octet control field is used.

2 For multiple frame operation frames with sequence numbers contain a two octet control field and frames without sequence numbers contain a one octet control field. Connection management information transfer frames contain a one octet control field.

FIGURE 1/Q.921

Frame formats

2.5 Information field

The information field of a frame, when present, follows the control field (see 2.4 above) and precedes the frame check sequence (see 2.7 below). The contents of the information field shall consist of an integer number of octets.

The maximum number of octets in the information field is defined in 5.9.3.

2.6 Transparency

A transmitting data link layer entity shall examine the frame content between the opening and closing flag sequences, (address, control, information and FCS fields) and shall insert a 0 bit after all sequences of five contiguous 1 bits (including the last five bits of the FCS) to ensure that a flag or an abort sequence is not simulated within the frame. A receiving data link layer entity shall examine the frame contents between the opening and closing flag sequences and shall discard any 0 bit which directly follows five contiguous 1 bits.

2.7 Frame check sequence (FCS) field

The FCS field shall be a 16-bit sequence. It shall be the ones complement of the sum (modulo 2) of:

a) the remainder of x^k $(x^{15} + x^{14} + x^{13} + x^{12} + x^{11} + x^{10} + x^9 + x^8 + x^7 + x^6 + x^5 + x^4 + x^3 + x^2 + x + 1)$ divided (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, where k is the number of bits in the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency, and

b) the remainder of the division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, of the product of x^{16} by the content of the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency.

As a typical implementation at the transmitter, the initial content of the register of the device computing the remainder of the division is preset to all 1s and is then modified by division by the generator polynomial (as described above) on the address, control and information fields; the ones complement of the resulting remainder is transmitted as the 16-bit FCS.

As a typical implementation at the receiver, the initial content of the register of the device computing the remainder is preset to all 1s. The final remainder, after multiplication by x^{16} and then division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$ of the serial incoming protected bits and the FCS, will be 0001110100001111 (x^{15} through x^0, respectively) in the absence of transmission errors.

2.8 Format convention

2.8.1 Numbering convention

The basic convention used in this Recommendation is illustrated in Figure 2. The bits are grouped into octets. The bits of an octet are shown horizontally and are numbered from 1 to 8. Multiple octets are shown vertically and are numbered from 1 to n.

2.8.2 Order of bit transmission

The octets are transmitted in ascending numerical order; inside an octet bit 1 is the first bit to be transmitted.

2.8.3 Field mapping convention

When a field is contained within a single octet, the lowest bit number of the field represents the lowest order value.

When a field spans more than one octet, the order of bit values within each octet progressively decreases as the octet number increases. The lowest bit number associated with the field represents the lowest order value.

For example, a bit number can be identified as a couple (o, b) where o is the octet number and b is the relative bit number within the octet. Figure 3 illustrates a field that spans from bit (1, 3) to bit (2, 7). The high order bit of the field is mapped on bit (1, 3) and the low order bit is mapped on bit (2, 7).

An exception to the preceding field mapping convention is the data link layer FCS field, which spans two octets. In this case, bit 1 of the first octet is the high order bit and bit 8 of the second octet is the low order bit (see Figure 4).