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TELEPHONE SERVICE, SERVICE OPERATION AND
HUMAN FACTORS

Traffic engineering – ISDN traffic engineering

CONTROL PLANE TRAFFIC MODELS

Reedition of CCITT Recommendation E.713 published in
the Blue Book, Fascicle II.3 (1988)

NOTES

1 CCITT Recommendation E.713 was published in Fascicle II.3 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 E.713

CONTROL PLANE TRAFFIC MODELS

1 Control plane traffic

For the purposes of teletraffic engineering, the control plane traffic load is assumed to be generated by call attempts on the network. These call attempts are part of the call pattern described in Recommendation E.711.

This Recommendation considers traffic loads at the lower three layers of the CCITT 7-layer reference models (Recommendation I.310 and 1.320) described for ISDN in Recommendation Q.931 and in Signalling System No. 7.

The control plane traffic of an ISDN network includes all the control signals sent through the ISDN network. The types of control signals are:

- 1) signals for user call attempts
 - a) to set up the connection paths in the user plane (reservation of time slots for circuit switched connections or control for the virtual calls of packet-switched connections),
 - b) to release the connection paths in the user plane,
 - c) if required, to order additional communication facilities or change of service by the users during the time of user information transfer,
 - d) possibly to send charging information during the time of user information transfer.
- 2) User-to-user information messages¹⁾

Because control plane traffic due to user-to-user messages is left for further study, this Recommendation will consider only signals for user call attempts.

The control plane traffic uses two types of channels in the network:

- a) the 16 kbit/s or 64 kbit/s D-channels in the user access, and
- b) the 64 kbit/s Signalling System No. 7 channels connecting two different signalling points.

2 Signalling traffic

The end-to-end ISDN signalling traffic depends on the call pattern arrival process defined in Recommendation E.711 and on the signalling protocol.

The basis for the estimation of the signalling traffic is the information given in the Recommendations of the I- and Q-Series dealing with the number and structure of the signals in the D- and Signalling System No. 7 channels for any type of attempt. The total signalling traffic is composed of these signals. The number of signals may be different for each different type of attempt.

3 Estimation of the signalling traffic for a single call attempt

In Figure 1/E.713 the network components supporting the control plane of the ISDN reference connection of Figure 1/E.701 are considered. In each section, a significant point is defined:

- | | |
|--|--|
| DA (D-channel, A user side): | S/T interface at an A user side |
| DB (D-channel, B user side): | S/T interface at a B user side |
| CA (S.S. No. 7 channels, A user side): | outgoing side of the local exchange LE(A). |
| CB (S.S. No. 7 channels, B user side): | incoming side of the local exchange LE(B). |

¹⁾ The analysis of user-to-user messages in the control plane is left for further study.

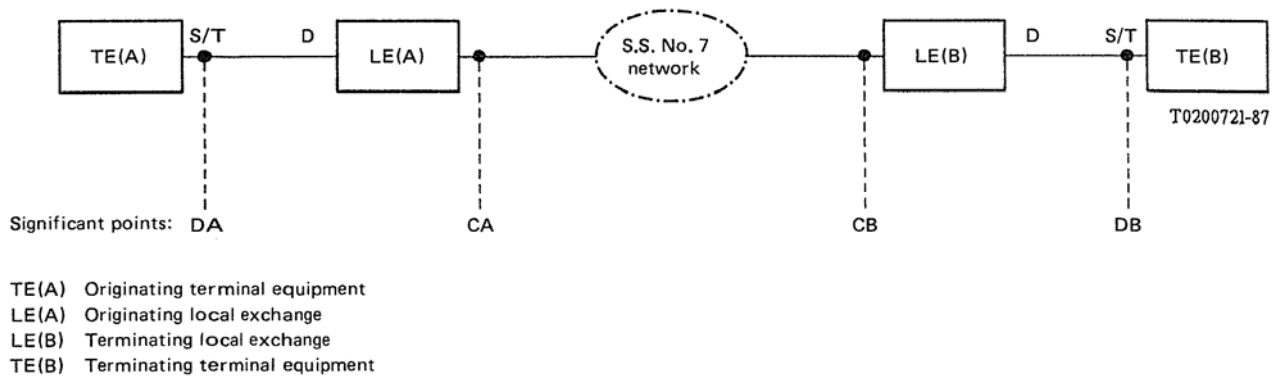


FIGURE 1/E.713

Significant points in the control plane

The signal flow which is necessary to perform the control functions of a particular call attempt may be represented by a signal flow diagram. It contains all the signals passing the significant points in the control plane for the considered attempt. Figure 2/E.713 shows the basic scheme of this signal flow diagram. The arrows represent the layer 2 signals in the three connection phases: call establishment, user information transfer, and call release.

An example of a signal flow diagram for a successful circuit switched call attempt is given in Annex A.

The signal flow diagram is the basis for the estimation of the amount of signalling traffic caused by the considered attempt using the reference connection. The signalling traffic of a single attempt in a given section of the control plane associated with a significant point can be described by two sets of parameters:

- 1) the total number of signals passing the significant point in the three call-connection phases in the A-to-B direction and in the B-to-A direction, as in Figure 2/E.713;
- 2) the length of each signal type passing the significant point in the A-to-B and the B-to-A direction.

4 Estimation of the total signalling traffic

The total number of signals in the control plane over a reference period²⁾ is determined by summing the number of signals caused by call attempts handled in the associated user plane-during the reference period. Therefore the estimation of the number of signals is based on the estimation of the amount and types of attempts in the user plane.

In order to estimate the amount of signals, it is necessary to accept a traffic model for the traffic in the user plane assuming the total number of attempts over the reference period and the breakdown of these attempts into the different types of attempts, such as successful call attempts, unsuccessful call attempts and calls to busy tone.

The total traffic load of a section caused by the signals is expressed by the total amount of bits crossing its significant point.

In order to estimate the amount of this traffic load it is necessary to multiply the length of each particular type of signals by the number of signals of each type occurring during the reference period and summing over all types of signals occurring during the reference period.

Since the number and length of the signals do not vary widely for most types of attempts, initially this traffic model will be adequate by taking into consideration only the most frequently experienced types of attempts.

²⁾ The proper reference period to use for dimensioning is for further study.

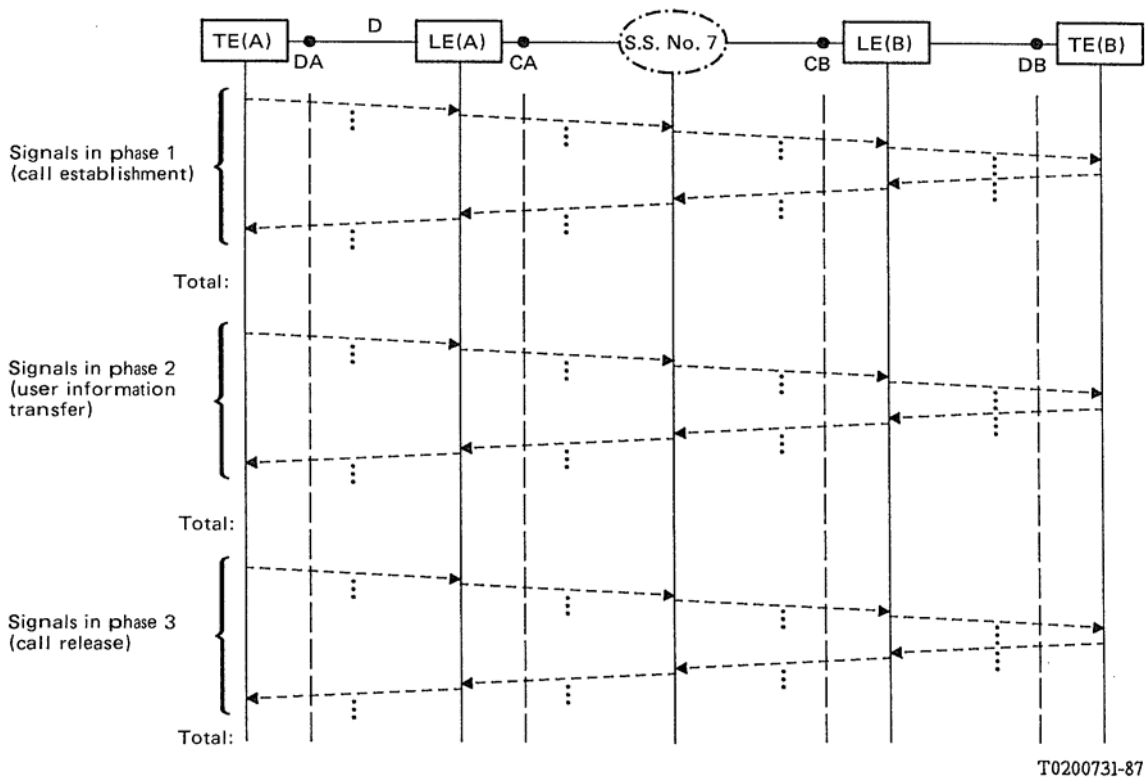


FIGURE 2/E.713

Basic scheme of a signal flow diagram of a call attempt for the reference connection

The characteristic of the signalling traffic in a particular section of the control plane will depend on such factors as:

- a) the total traffic load caused by layer 2 and 3 signals for the attempts.
- b) the distribution of call attempts and release arrivals.

The impact on teletraffic engineering caused by a full characterization of the arrival process is left for further study.

Using Figure 2/E.713, the signalling traffic load at a significant point can be estimated.

If, over the reference period:

i is the call phase,

j is the signal type,

$n_{ij}(u)$ is the average number of signals of type j in call phase i in the A-to-B direction,

$n_{ij}(d)$ is the average number of signals of type j in call phase i in the B-to-A direction,

l_j is the length of signal of type j ,

T is the total number of signals types,

$L(u)$ is the total load in the A-to-B direction,

$L(d)$ is the total load in the B-to-A direction,

then:

$$L(u) = \sum_{i=1}^3 \sum_{j=1}^T l_j \times n_{ij}(u)$$

$$L(d) = \sum_{i=1}^3 \sum_{j=1}^T l_j \times n_{ij}(d)$$

Each $n_{ij}(u)$ and $n_{ij}(d)$ must be estimated from the number of call attempts and the call attributes in the user plane over the reference period. An example of this procedure is given in Annex A.

ANNEX A

(to Recommendation E.713)

Example of procedure for estimating the total signalling traffic in a D-channel

A.1 *Signalling traffic for one call attempt*

A call attempt of the following type is considered:

- effective call attempt,
- circuit switched connection,
- en-bloc sending of dialled information,
- call to an appointed terminal,
- no additional control signals during the information transfer phase,
- installation of data link in the D-channels required for establishment and release of the connection,
- manual answering terminal.

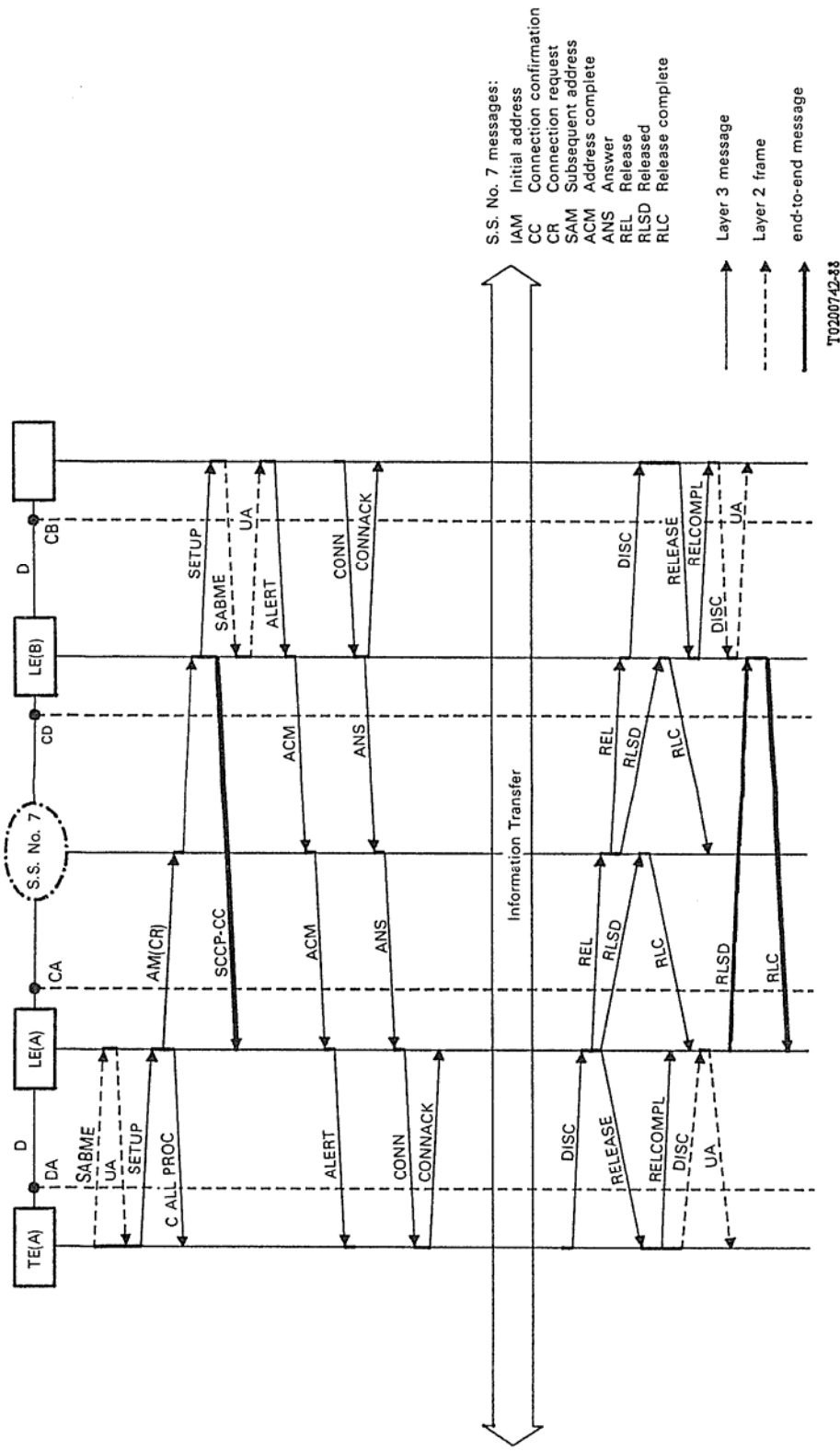
The signal flow diagram for this type of call attempt is given in Figure A-1/E.713 and Figure A-2/E.713. Three kinds of signals are indicated in Figure A-1/E.713:

- layer 3 signals,
- layer 2 signals for the activation and deactivation of the data links,
- end-to-end signals via the S.S. No. 7 network.

Figure A-2/E.713 presents the breakdown of the D-channel signals into layer 2 for the case of multiple terminals on the terminating side. The breakdown of the S.S. No. 7 messages and the total length of signal in the considered call attempt is for further study.

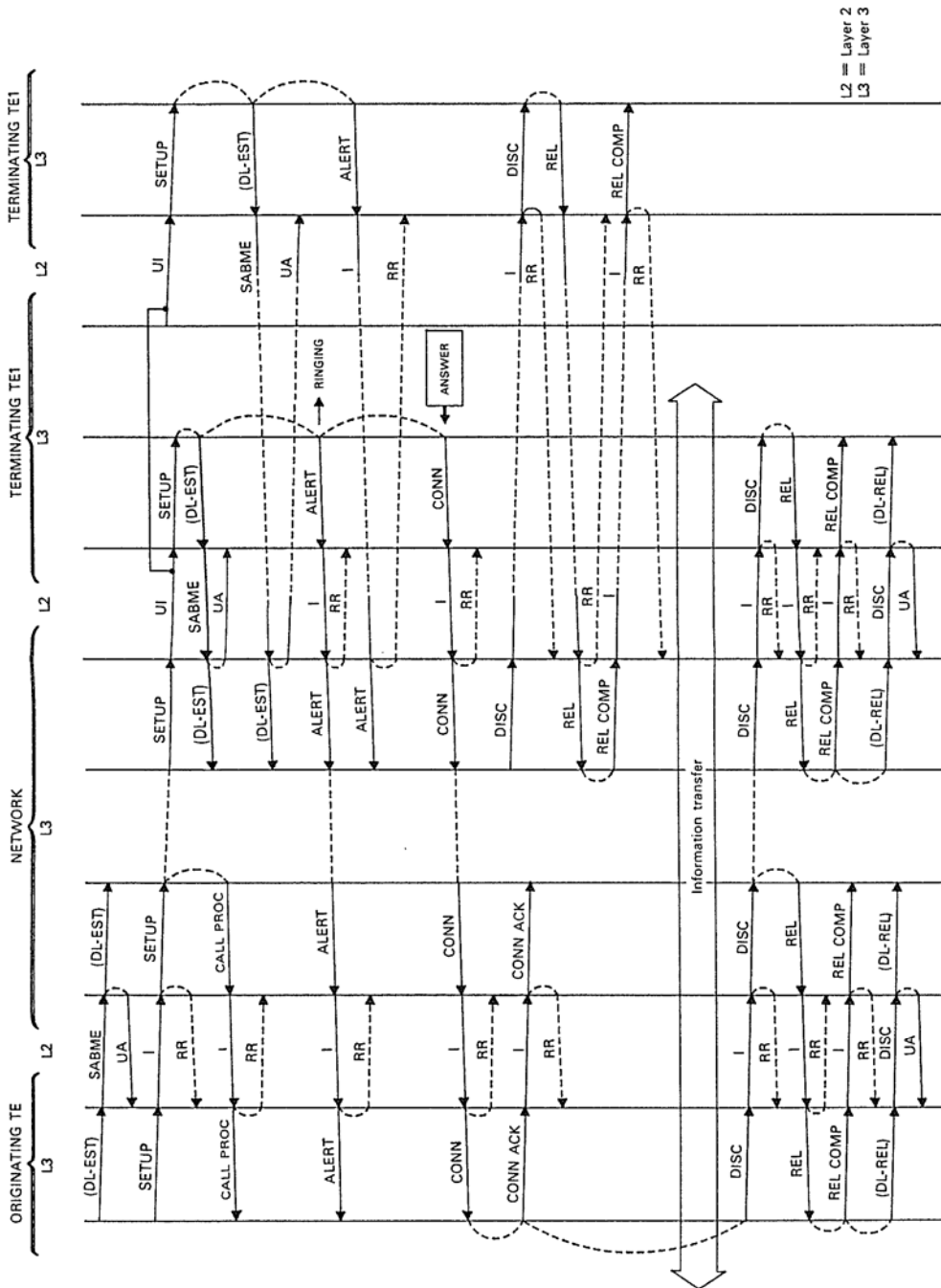
A.2 *Signalling traffic for additional types of call attempts*

For further study.



Note - See Recommendations I.441 and I.451 for the abbreviations of layer 2 frames and layer 3 messages. In this Recommendation, these are referred to as signals.

FIGURE A-1/E.713
Signal flow diagram for a circuit switched connection with en-bloc sending of dialled information (to appointed terminal)



Note — See Recommendations I.441 and I.451 for the abbreviations of layer 2 frames and layer 3 messages. In this Recommendation, these are referred to as signals.

FIGURE A-2/E.713
Signal flow diagram
Example of Figure A-1/E.713 with layer 2 signals on the D-channels and with multiple terminals
on the terminating side for an effective call attempt

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