INTERNATIONAL TELECOMMUNICATION UNION

CCITT

E.713

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

(10/92)

TELEPHONE NETWORK AND ISDN

QUALITY OF SERVICE, NETWORK MANAGEMENT AND TRAFFIC ENGINEERING

CONTROL PLANE TRAFFIC MODELLING

Recommendation E.713

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT 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 Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation E.713 was revised by Study Group II and was approved under the Resolution No. 2 procedure on the 30th of October 1992.

CCITT NOTES

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

2) A list of abbreviations used in this Recommendation can be found in Annex B.

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Recommendation E.713

CONTROL PLANE TRAFFIC MODELLING

(revised 1992)

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 (see Recommendations I.310 and I.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 messages[1].

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.

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

3 Estimation of the signalling traffic for a single call attempt

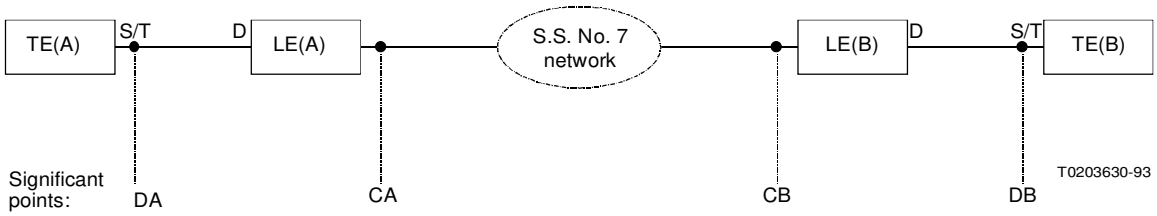
In Figure 1/E.713 the network components supporting the control plane of the ISDN reference connection of Figure 1/E.701 are considered. In each section, a significant point is defined:

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).



TE(A) Originating terminal equipment
LE(A) Originating local exchange
LE(B) Terminating local exchange
TE(B) Terminating terminal equipment

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.

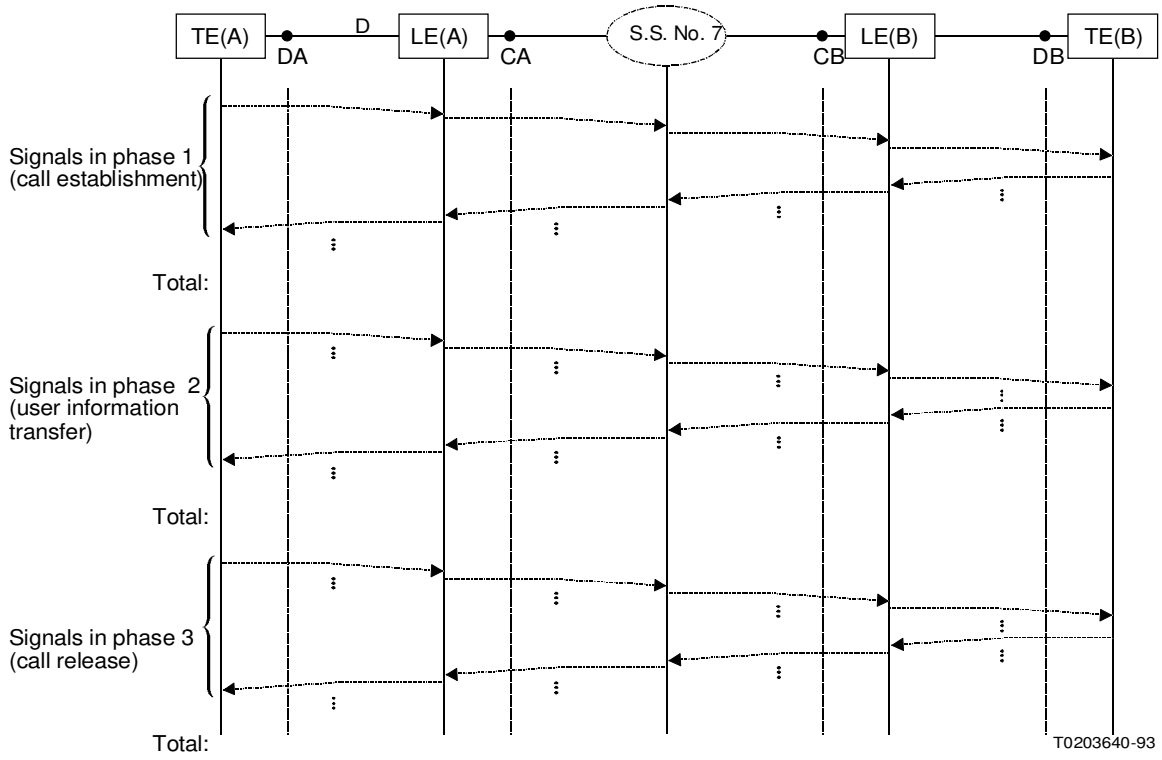


FIGURE 2/E.713

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

4 Estimation of the total signalling traffic

The total number of signals in the control plane over a reference period[2)] 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 occuring during the reference period and summing over all types of signals occuring 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.

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

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.

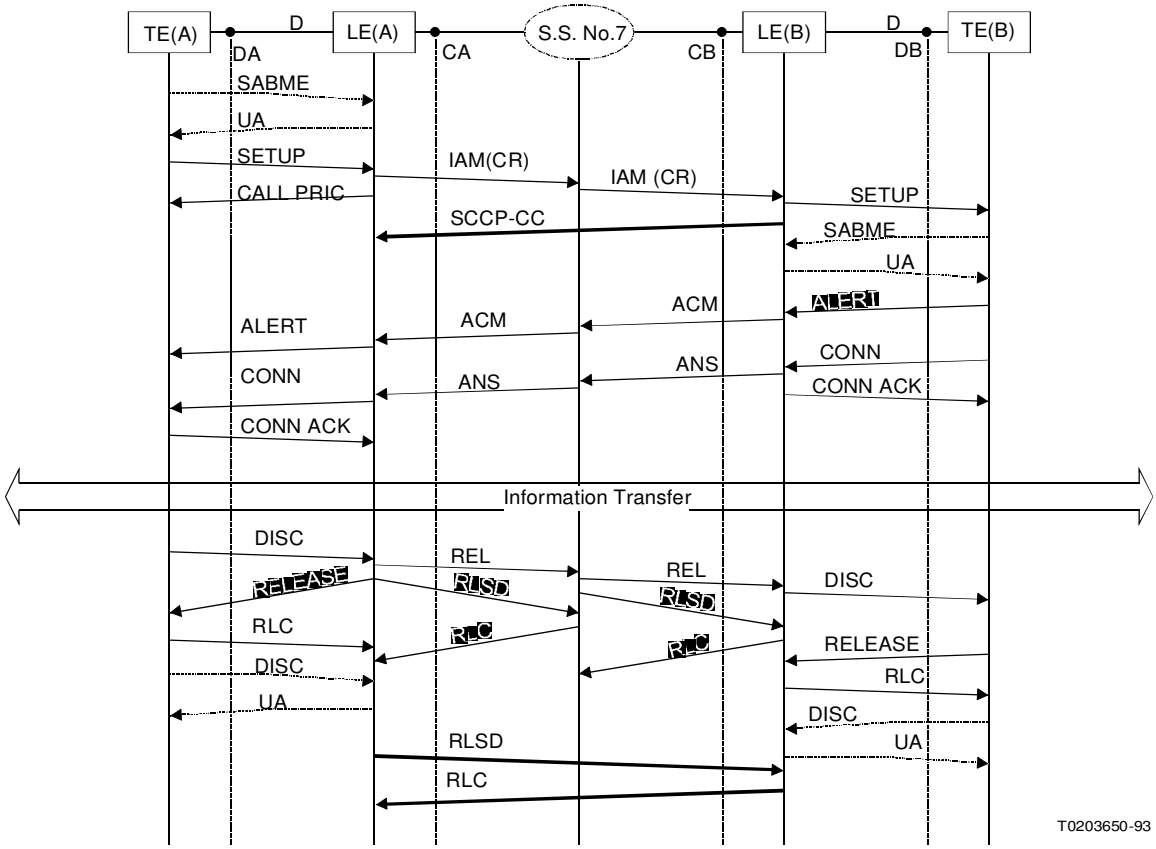
The signal flow diagram for this type of call attempt is given in Figure A-1/E.713 and Figure A-2/E.713. Three kinds of signals are indicated in Figure A-1/E.713:

- 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.



Layer 3 message

Layer 2 frame

End-to-end message

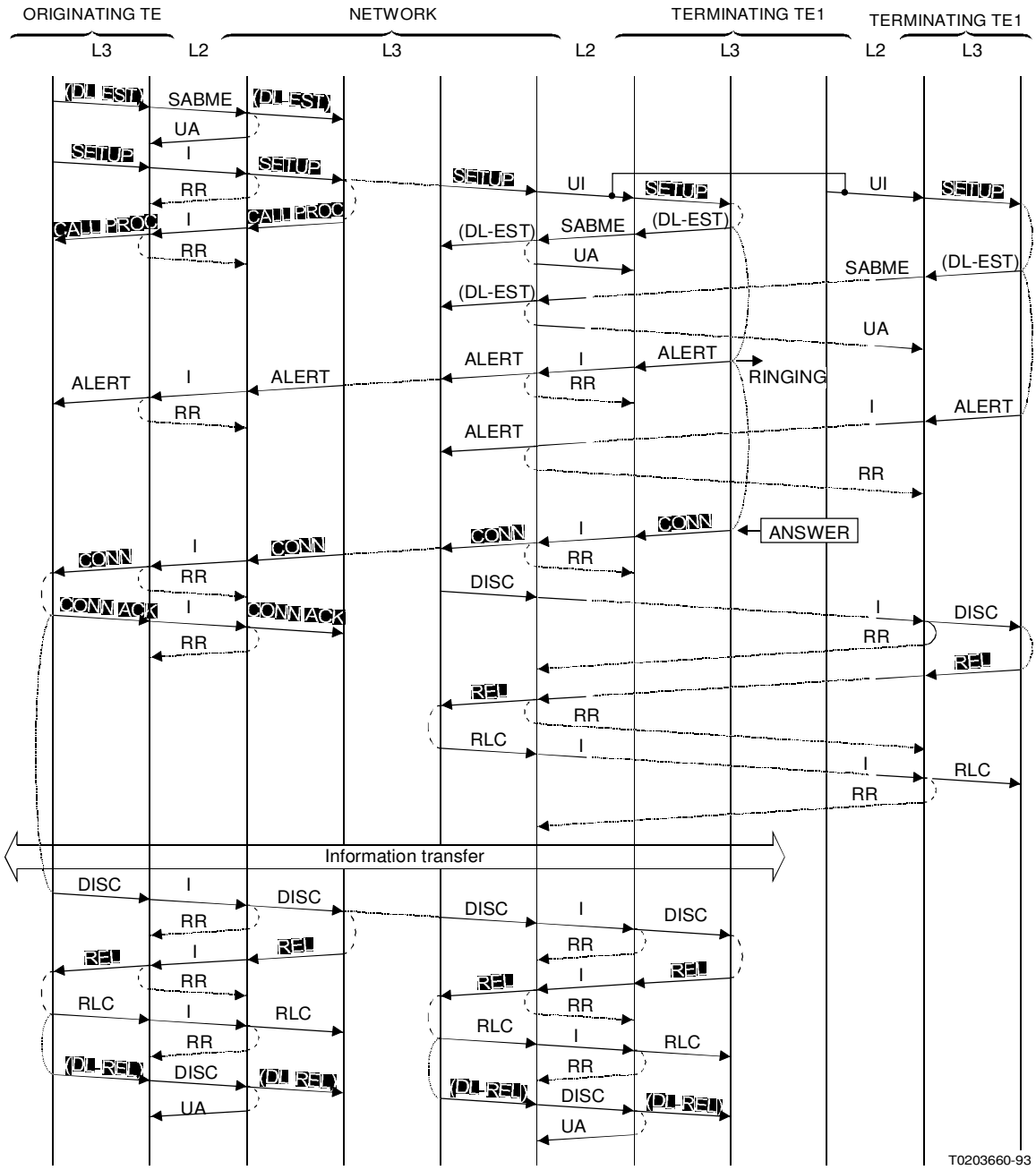
S.S. No. 7 messages:

IAM	Initial address message
CC	Connection confirmation
CR	Connection request
ACM	Address complete message
ANS	Answer
REL	Release
RLSD	Released
RLC	Release complete

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)



L2 Layer 2
L3 Layer 3

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

ANNEX B

(to Recommendation E.713)

Alphabetical list of abbreviations used in this Recommendation

ACM	Address complete message
ANS	Answer
CC	Connection confirmation
CR	Connection request
IAM	Initial address message
ISDN	Integrated services digital network
LE	Local exchange
REL	Release
RLC	Release complete
RLSD	Released
S.S. No. 7	Signalling System No. 7
TE	Terminal equipment