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MONTAGE: FIN DE LA RECOMMANDATION R.102 EN-T | TE DE CETTE PAGE

CODE AND SPEED-DEPENDANT TDM 600 BIT/S SYSTEM FOR USE IN

POINT-TO-POINT OR BRANCH-LINE MULDEX CONFIGURATIONS

(Melbourne, 1988)

The CCITT,

considering

Recommendation R.103

(a) that telex subscribers are often geographically located in small groups;

(b) that TDM multiplexing systems are economical for the transmission of large numbers of channels;

(c) that certain telex switches handle TDM frames in accordance with Series-R Recommendations directly and that frame fill should be optimized;

(d) that telex switches handle channels at 50 bauds and a 7.5 unit code;

(e) that a facility for regenerating start-stop signals is used in new TELEX networks;

(f) that the branch-line multiplexing system should be capable of accepting and regenerating all the signals of the TELEX signalling system;

(g) that the minimum signal transfer delay through TDM systems is achieved by the transmission of interleaved elements,

recommends

that, where banch-line remote or low multiplex capacity TDM systems are to be used for telegraphy, the equipment shall comply with the following standards:

1 System capacity

The system shall be capable of multiplexing up to 8 channels at 50 bauds (7.5 bits including a stop element of 1.5 units).

2 Start-stop channel inputs

2.1 The modulation rate tolerance that shall be accepted on incoming 50 baud start-stop signals with a stop element of 1.4 units shall be at least ± | .4%.

2.2

When receiving characters at 50 bauds having nominally 1.5-unit stop elements, the system shall be capable of transmitting without error isolated incoming characters that have a 1-unit stop element, occurring at a maximum rate of one per second.

2.3 The minimum interval between start elements of undistorted successive continuous characters that may be presented at the channel input when the nominal modulation rate is 50 bauds shall be 145 5/6 ms.

2.4
There shall be no restriction on the continuous transmission of all characters (including combination No. 32 of International Telegraph Alphabet No. 2) when they are presented at the maximum permitted rate.

2.5 The effective net margin on all channel inputs when undistorted signals are received from a transmitter having a nominal character length and rate shall be at least 40%.

2.6 At the nominal modulation rate of 50 bauds, an input character start element shall be rejected if it is less than 0.4 units duration and shall be accepted if it is more than 0.6 units duration.

2.7 Elements corresponding to start polarity (at the distant multiplexer output) shall be inserted in the aggregate stream if the channels are unequipped.

2.8 In the case of an open-circuit line condition at the start-stop channel input, it shall be possible to choose to transmit elements corresponding to a steady start or stop polarity in the aggregate bit stream, according to the availability polarity selected.

3 Start-stop channel outputs

3.1 The maximum degree of gross start-stop distortion, produced by the system on a start-stop channel, shall be 3% for all modulation rates.

3.2 The maximum difference possible between the mean modulation rate of the channel output signals and the nominal modulation rate shall be 0.2%.

3.3 The minimum stop element duration released at the ouptut shall be 1.25 units, whatever the distortion, the length of the stop element or the input rate within the range specified in §§ 2.1 to 2.4 of this Recommendation of the character recognized at the other end, whether this character is in accordance with this Recommendation of Recommendations R.101, R.102 or R.112 (for a rate of 50 bauds and a 7.5 unit code).

3.4 Within 6 ms of the recognition of one of the failures described in §§ 8.3 and 8.4 or carrier loss signalled by the modem, the steady polarity as selected in accordance with § 2.8 shall be applied to the channel outputs of the *TDM system affected* .

3.5 The affected terminal shall signal its synchronization status to the distant terminal over the signalling channel provided (control channel).

4 Multiplexing details

4.1 Channel interleaving shall be on a *bit-by-bit multiplexing basis* .

4.2 Both start and stop elements of each input character shall be transmitted through the aggregate.

4.3 The transfer delay shall not exceed 60 ms.

5 Frame structure

5.1 A unique frame of 12 bits, of duration 20 ms, equivalent to an aggregate signal rate of 600 bit/s shall be used, as shown in Table 1/R.103:

5.2 The frame may be considered as a 600 bit/s *start/stop* character, time slot ‘‘12’’ being the start element of polarity A, slots 10 and 11 forming the stop element of polarity Z, as shown in Figure 1/R.103.

6 Aggregate signal details

6.1 The aggregate signal rate shall be 600 bit/s. The tolerance on the modulation rate of the receive aggregate signals of the TDM system shall be between +2.3% and —0.5%.

6.2 The effective net margin of the aggregate signal receiver of the TDM system shall be at least 40%.

6.3 The maximum degree of isochronous distortion of the send aggregate signals of the TDM system shall be 5%.

H.T. [T1.103]
TABLE 1/R.103
Frame details

Remote muldex slot	Use
1	Data channel 1
2	Data channel 2
3	Data channel 3
4	Data channel 4
5	Data channel 5
6	Data channel 6
7	Data channel 7
8	Data channel 8
9	Control channel
10	Z synchronization
11	Z synchronization
12	A synchronization

Tableau 1/R.103 [T1.103], p. 1

Figure 1/R.103, p. 2

6.4 When the TDM system is operated over an international telephone-type circuit, a modem complying with the appropriate aspects of the Series-V Recommendations (in particular Recommendation V.23) should preferably be employed.

7 Control channel encoding

7.1 The 50 bit/s control channel, the position of which in the frame described in 5 is accurately known, enables all risk of imitation to be eliminated.

7.2 The structure of the control channel shall be in accordance with Figure 2/R.103. It corresponds to an anisochronous character with a recurrence of 240 ms, formed from a one unit start element of polarity Z, five information elements and a six unit stop element of polarity A.

Figure 2/R.103, p.

7.3 The control channel information provides for the transmission of information in accordance with Table 2/R.103.

H.T. [T2.103]

TABLE 2/R.103

Information transmitted by the control channel

5	4	3	2	1	Information elements Function		
0 Without alarm or other informations (default) }	0	0	0	0	{		
0	0	1	0	0	Loss of synchronism		
0 Loop ‘‘d’’ request (Remoteloop 2 on 600 bit/s aggregate) }	0	0	0	1	{		
1	X	X	X	X	National use		
0	1	0	0	0	{		
Remoteloop ‘‘f’’ on TG channel 1							
}	0	1					
0	0	1	2	0	1	0	1
0	3	0	1	0	1	1	4
0	1	1	0	0	5	0	1
1	0	1	6	0	1	1	1
0	7	0	1	1	1	1	8

Note — The least significant bits are sent first.

Tableau 2/R.103 [T2.103], p.

8 Synchronizing

8.1 The maximum average synchronization time in the absence of error and imitation shal be 600 ms.

8.2 Synchronism shall be considered acheived after recognition of the frame positioning pattern (sequence of two elements of polarity Z followed by an element of polarity A) as described in 5 and at least two successive recognitions of the control channel (6 elements of polarity A followed by one element of polarity Z modulo 12) in compliance witn 7.

8.3 The maximum time loss of synchronization due to a steady polarity signal shall be 120 ms.

8.4 The maximum time loss of synchronization for repeated error on the synchronization pattern in the control channel shall be 380 ms.

9 Telex signalling

9.1 Specifications for the signals used to establish, to clear and to control telex calls are laid down in Recommendation U.1 (types A and B), U.11 (type C) and U.12 (type D). Recommendation U.25 lists the modes of both-way telex signalling on a single circuit and the signalling combinations on a given aggregate that a TDM terminal shall be capable of handling.

9.2 Recommendation U.25 also lays down the tolerances on the control signals from a TDM terminal to telex and vice versa.

10 Maintenance

The branch looping facilities shall remain in accordance with Recommendation R.115.

11 Numbering of channels

The numbering of channels for the branch line telegraph muldex is given in Tables 1/R.114 and 4/R.114 in accordance with the numbering scheme concerning Recommendations R.101 and R.102.

12 Channel selection

Remote channels shall be grouped so as to provide maximum ease of use of heterogeneous frames, a time slot allocation involving little variation in the sampling rate being retained.

The selection of channel grouping and the method used shall be based on bilateral agreement, particularly when the channels of an existing system have to be branched without there being any possibility of a reconfiguration of the whole.

Tables 3/R.103 and 4/R.103 give an example of remote channel grouping on the basis of muldexes in conformity with Recommendation R.101 or R.102.

Blanc

H.T. [T3.103]
TABLE 3/R.103
Example of grouping of remote channels for an R.101 muldex

	200 baud channels eliminated	50 baud channels extended
Remote channel 1 0501, 0513, 0525, 0536 | 504, 0516(2), 0528, 0539 }	2001 2004	{
Remote channel 2 0505, 0529, 0517, 0540 0509, 0532, 0521, 0544 }	2005 2009	{
Remote channel 3 0502, 0526, 0514, 0537 0506, 0530, 0518, 0541 }	2002 2006	{
Remote channel 4 0503, 0527, 0515, 0538 0501, 0533, 0522, 0545 }	2003 2010	{
Remote channel 5 0507, 0531, 0519, 0542 0511, 0534, 0523, 0546 }	2007 2011	{
0508, 0512, 0520, 0524, 0535, 0543(1)**512, 0520, 0524, 0535** }		{

Note 1 — Although incomplete, a sixth remote channel could be implemented with the remaining 50 baud channels.

Note 2 — Channel 0516 may not be remoted when the corresponding TS is used to transmit the maintenance channel in the R.101 multiplexer.

Tableau 3/R.103 [T3.103], p. 5

H.T. [T4.103]
TABLE 4/R.103
Example of grouping of remote channels for an R.102 muldex

{	200 baud channels eliminated 2004 and 2016 2012 and 2020

{
channel
3
channel
4
 	
channel
5
}
2001 and 2013
2005 and 2017
2009 and 2021
}
	{

{
channel
6
channel
7
 	
channel
8
}
2002 and 2014
2006 and 2018
2010 and 2022
}
	{

{
channel
9
channel
10
 	
channel
11
}
2003 and 2015
2007 and 2019
2011 and 2023
}
	{

Tableau 4/R.103 [T4.103], p. 6

Recommendation R.105

DUPLEX MULDEX CONCENTRATOR , CONNECTING A GROUP OF GENTEX AND TELEX SUBSCRIBERS TO A TELEGRAPH EXCHANGE BY ASSIGNING

VIRTUAL CHANNELS TO TIME SLOTS OF A BIT-INTERLEAVED TDM SYSTEM

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

(a) that the specifications of code and speed dependent TDM muldexes are already given in Recommendation R.101;

(b) that code and speed dependent TDM muldexes can be successfully used for connecting a group of gentex and telex subscribers to an exchange;

(c) that a considerable increase in the efficiency of muldex channel utilization may be achieved by concentration, i.e. allocating time slots to subscribers only while they are operating;

(d) that the busy-hour load generated by gentex and telex subscribers averages from 0.05 to 0.2 erlang;

(e) that both the virtual and assigned (fixed) telegraph channels can be set up on the same aggregate channel using the TDM method;

unanimously declares the view

that, when a bit-interleaved TDM system is used on gentex and telex subscriber lines for concentrating telegraph signals by assigning virtual channels to time slots in the 2400 bit/s aggregate bit stream, the equipment should meet the following requirements:

1 Channel types

1.1 The duplex muldex/concentrator should ensure that virtual channels are only allocated time slots in the 2400 bit/s aggregate bit stream for the duration of their seizure.

1.2 The duplex muldex/concentrator should also ensure that assigned (fixed) channels are permanently allocated specific time slots in the 2400 bit/s aggregate bit stream.

1.3 Virtual channels should ensure the connection of gentex and telex subscribers operating at 50 bauds and using the International Telegraph Alphabet No. 2 (ITA2) code who have an average load of 0.05 to 0.2 erlang. The use of other rates requires further study.

1.4 Assigned (fixed) channels should ensure data and telegraph signal transmission in compliance with Recommendation R.101, alternative B.

2 System capacity

2.1 The duplex muldex/concentrator should ensure the setting-up of virtual and assigned channels in any combination within the range of the 2400 bit/s aggregate rate.

2.2 When a system has only virtual channels, the number of connected subscribers with an average load of 0.05 to 0.1 erlang each should not exceed 256 and with an average load of 0.1 to 0.2 erlang each should not exceed 128. In either case, the percentage value of the failures to connect is not more than 0.1%.

2.3 When a system has only assigned (fixed) channels, their number, depending on the types and rates of the channels, should comply with Recommendation R.101, alternative B.

3 Multiplexing system specifications

Multiplexing scheme, frame structure, frame synchronization, aggregate signal parameters, interfaces, telegraph signal parameters at input-output and telegraph signal delay time should conform to Recommendation R.101, alternative B.

4 Virtual channel parameters

4.1 Virtual channels are intended for use on the telex network subscriber section with type A and type B signalling (Recommendation U.1).

4.2 Seizure of virtual channels may be from either end. In order to decrease the probability of call collisions it is necessary:

— to perform blocking of the backward path immediately after the first calling signal stop element polarity appearing in a receiver vacant channel position;

— to establish the following order for seizure of time slots in the opposite muldexes;

— for a muldex installed at the exchange seizure should start with the first in a frame-free channel time slot while for the opposite muldex seizure begins with the last free channel time slot.

When encountering a call collision, a through-connection should be given to a call coming from the telegraph exchange, and a busy signal should be sent to the calling subscriber.

4.3 *In the initial state* , a virtual channel should be free and a start polarity should be transmitted over it between statistical muldex/concentrator assemblies.

4.4 *When a call arrives* , i.e. stop polarity with an interval of more than 150 ms, either from the subscriber side or from the exchange side, a virtual channel should be seized, and a stop polarity having a duration of 140-160 ms should be transmitted over it to the remote side followed by the transmission of two start-stop characters having a length of 8 units each in accordance with Figure 1/R.105.

The signal elements indicated as 1 to 8 are used for the transmission of an 8-digit conventional number indicating which subscriber (maximum 2^8 = 256; see also § 2.2 above) is/should be connected to the equipment.

4.5 For error protection of a conventional number, transmitted over a channel, the following should be carried out:

— a parity check;

— a check for anticoincidence of a convention number with any of the numbers of a circuit already seized.

In the case of an error or coincidence of a conventional number a service signal (a busy pulse signal or ‘‘OCC’’) should be transmitted to the connection initiator side (a customer or exchange), returning a customer or exchange to initial state.

4.6 The element ‘‘C’’ of the second start-stop character (see Figure 1/R.105) is used for parity check.

Figure 1/R.105, p.

A parity check element should correspond to the even number of elements in Z condition.

Element ‘‘C’’ of the first start-stop character remains vacant and may be used for service purposes.

4.7 When the setting up of a virtual channel fails because all time slots are engaged by other virtual or assigned (fixed) channels, a busy signal, the structure of which is specified by current CCITT Recommendations should be returned to the calling subscriber side.

Recommendation R.111

CODE AND SPEED INDEPENDENT TDM SYSTEM
FOR ANISOCHRONOUS TELEGRAPH AND DATA TRANSMISSION

(Geneva, 1976; amended at Geneva, 1980 and Malaga-Torremolinos, 1984)

The CCITT,

considering

(a) that the use of voice-frequency telegraph (VFT) equipment on voice channels provided by frequency division multiplexing of a primary group or by time slots in a pulse code modulation (PCM) transmission system may not always be the optimum solution for telegraph and low-speed data transmission, if aspects of transmission quality, equipment complexity, technological progress, miniaturization, power consumption and overall cost are globally considered;

(b) that the economic transmission of telegraph and low-speed anisochronous data signals requiring code- and speed-independent channels may be achieved by using time division techniques;

(c) that a relatively simple TDM (time division multiplex) system, even if less efficient in bandwidth utilization, might be preferred in some (e.g. short-haul) applications;

(d) that Administrations might be interested in conserving code and speed independence inherent in VFT systems when replacing them by TDM systems;

(e) that code and speed independent transmission systems are capable of transmitting any type of digital signal (anisochronous, isochronous, telegraph, data, signalling for switching purposes);

(f) that a code and speed independent TDM system can adapt its inherent telegraph distortion to the needs of a network, depending on the number of circuits connected in tandem;

(g) that a code and speed independent TDM system can adapt to a number of different types of channels (each being defined by its maximum modulation rate and inherent distortion);

(h) that a basic 64 kbit/s telegraph multiplexer may provide interfaces for remote submultiplexers if required. The submultiplexers may be associated in some applications with Recommendations X.50 [1] and X.51 [2] data multiplexers and with telephone channel modems and/or baseband modems;

unanimously declares the following views

1 64 kbit/s aggregate

1.1 *General*

1.1.1 Where code and speed independent TDM systems for transmission of telegraph and low-speed anisochronous data signals utilize the whole 64 kbit/s capacity (e.g. provided by a PCM time slot or a primary group), the equipment shall be manufactured to comply with the following standards.

1.2 *Aggregate bearer channel*

1.2.1 The aggregate bearer channel may be a 64 kbit/s PCM time slot or a 64 kbit/s synchronous data modem in accordance with the Recommendation cited in [3]. The nominal data signalling rate is 64 | 00 bit/s with a tolerance of ± | bit/s.

1.3 *Frame structure*

1.3.1 The frame consists of 240 bits for information plus 16 symmetrically distributed service bits for framing and other purposes. The 16th bit of the frame is the first service bit. The frame synchronization pattern comprises the first 12 service bits in the sequence 101001010101.

1.3.2 The 13th service bit is used to inform the opposite multiplexer terminal of bearer failure as follows: 1 = no bearer failure; 0 = bearer failure. A minimum of three consecutive 0 conditions is the criterion for an alarm indication.

1.3.3 The 14th service bit is used to inform the opposite multiplexer terminal of frame alignment loss as follows: 1 = no loss of frame alignment; 0 = frame alignment loss (this may be accompanied by bearer failure). A minimum of three consecutive 0 conditions is the criterion for an alarm indication.

1.3.4 The time delay between detection of a bearer failure or frame alignment loss and the sending of the 0 condition is for further study.

1.3.5 The 15th service bit is provisionally fixed to 1 and its use is left for further study.

1.3.6 The 16th service bit (last bit of the frame) may be used for possible justification and is fixed to 1. However, the justification strategy, if used, must be agreed bilaterally.

1.3.7 The channel numbering scheme is specified in Recommendation R.114.

1.4 *Type of multiplexing*

1.4.1 Channel interleaving shall be on a bit basis.

1.4.2 The coding method shall be the transition coding process in accordance with Annex A below.

1.5 *Allocation of information bits*

1.5.1 The data signalling rate on the bearer for each multiplexed channel should be 250, 500, 1000, 2000 or 4000 bit/s corresponding to one, two, four, eight or sixteen bits per frame (symmetrically distributed) respectively.

1.5.2 The 64 kbit/s aggregate stream is divided into 60 kbit/s for information and 4 kbit/s for framing and other purposes.

1.5.3 The 60 kbit/s information bit stream may be subdivided into five bit streams of 12 kbit/s or, for national use or by bilateral agreement, into twenty bit streams of 3 kbit/s.

1.6 *Telegraph and data channels*

1.6.1 The nominal modulation rates are 50, 100, 200, 300, 600 and 1200 bauds. A mixture of these rates should be possible.

1.6.2 The maximum degree of inherent isochronous distortion due to the sampling process is 2.5, 5 or 7.5% according to the application as shown in Table 1/R.111, which gives the channel characteristics and full system capacity for various telegraph channel rates and for aggregate signalling rates of 64 kbit/s and below (see § 2 below).

1.6.3 Where applicable, spurious elements with duration of 1.6 ms (= 8%) or less shall be rejected and elements longer than 2 ms shall be accepted at the 50 baud channel input. The element lengths to be rejected or accepted at higher channel modulation rates is for further study.

1.7 *Frame alignment*

1.7.1 Frame realignment is ensured within three correct consecutive frame synchronization patterns, i.e. within 12 to 16 ms. In the absence of frame realignment, the telegraph channel outputs of the demultiplexer should be locked in their start polarity state for switched applications.

Note — Stop polarity might be required by some Administrations on a per channel basis for leased applications.

H.T. [T1.111]
TABLE 1/R.111
Channel characteristics and system capacities

{								
					64 kbit/s	9.6 kbit/s	4.8 kbit/s	2.4 kbit/s
{ 50 | **fR↑a↑)** }	5.**5** 2.5	83 167	250 500	{				
4.**25** 2.**25** }	240 120	32 16	16 8	8 4				
{ 100 | **fR↑a↑)** }	5.**5** 2.5	167 333	500 1000	{				
2.**25** 1.**25** }	120 60	16 8	8 4	4 2				
{ 200 | **fR↑a↑)** }	5.**5**	333	1000	1.**25**	60	8	4	2
{ 300 | **fR↑a↑)** }	7.5	333	1000	1.**25**	60	8	4	2
600 | ua)	7.5	666	2000	0.5**2**	30	4	2	—
1200 | ua)	7.5	1333	4000	0.25	15	2	—	—

a) The number of channels indicated for modulation rates of 600 and 1200 bauds is for information only (homogeneous aggregates at these rates are not contemplated).

TABLE 1/R.111 [T1.111], p.

1.7.2 Three consecutive erroneous frame synchronization patterns should be regarded as the criterion for loss of frame alignment.

1.8 *Loss of telegraph input*

1.8.1 In the absence of any signal at a telegraph channel input, the multiplexer system should reproduce start polarity at the corresponding output.

Note — Stop polarity might be required by some Administrations on a per channel basis for leased applications.

1.9 *Bearer interface*

1.9.1 For the interface between the aggregate bearer and a PCM time slot, either a codirectional or contradirectional 64 kbit/s interface with the PCM equipment could be accepted. Even for a codirectional interface no stuffing device would be provided in the telegraph multiplexer, which would loop back the 64 kHz clock.

1.9.2 For the interface to a 64 kbit/s modem the interchange circuits of Table 2/R.111 should be provided (see the Recommendation cited in [4]).

1.10 *Telegraph interface*

1.10.1 The interface between the multiplexer and the telegraph circuits should be in accordance with national requirements.

H.T. [T2.111]
TABLE 2/R.111

{ Circuit number (cf. Recommendation V.24 | 5]) }	Function
102 | ua)**b** Signal ground or common return }	{
102b | ub)	DCE common return
103 | uc)**b**	Transmitted data
104 | uc)**b**	Received data
{ 109**b | fR↑b↑)** } Data channel received line signal detector }	{
| 13 | uc) | ud) Transmitter signal element timing (DTE source) }	{
| 14 | uc) | ud) Transmitter signal element timing (DCE source) }	{
115 | uc)**b** Receiver signal element timing }	{

a) The provision of this conductor is optional.

b) This conductor is used in conjunction with interchange circuit 109.

c) The electrical characteristics of the interchange circuits marked with a c) should be in accordance with Recommendation X.27 | 6]. The circuits not so marked should be in accord ance with Recommendation X.26 | 7].

d) Either circuit 113 or 114 is to be used.

Table 2/R.111 [T2.111], p.

2 Aggregate bearer rates lower than 64 kbit/s

2.1 *General*

2.1.1 Where code and speed independent TDM systems for transmission of telegraph and low speed anisochronous data signals make use of capacities lower than 64 kbit/s, the equipment shall be manufactured to comply with the following standards:

2.2 *Aggregate bearer channels*

2.2.1 Aggregate rates of 2.4, 4.8 and 9.6 kbit/s shall be used. These rates can be provided either using modems in accordance with the Series V Recommendations or using data multiplexers in accordance with Recommendations X.50 [1] or X.51 [2].

2.3 *Frame structure*

2.3.1 The frame structure is independent of the frame structure of the 64 kbit/s data multiplexer or of the 64 kbit/s telegraph multiplexer. However, it must be designed to allow easy insertion of the carried telegraph channels on to the multiplexer defined in § 1 above (see also § 3 below).

2.3.2 For that purpose, one bit out of every six bits will carry framing information and other functions, which will result in effective binary rates of 2, 4 or 8 kbit/s with actual aggregate rates of 2.4, 4.8 and 9.6 kbit/s respectively.

2.3.3 The frame consists of 160 information bits plus 32 symmetrically distributed service bits for framing and other purposes. The sixth bit of the frame is the first service bit.

2.3.4 This frame is subdivided into two subframes each consisting of 80 information bits plus 16 symmetrically distributed service bits.

2.3.5 The subframe synchronization pattern comprises the first 12 service bits in the sequence 101001010101.

2.3.6 For the allocation of the 13th, 14th and 15th service bits, see §§ 1.3.2 to 1.3.5 above. The 16th service bit is set at 0 for the first subframe and at 1 for the second subframe.

2.4 *Type of multiplexing*

2.4.1 See § 1.4 above.

2.5 *Allocation of information bits*

2.5.1 The same data signalling rates as defined in § 1.5 should be used (250, 500 and 1000 bit/s and, where applicable, 2000 and 4000 bit/s).

2.5.2 Table 3/R.111 shows the number of information bits per frame for the different data signalling rates on the bearer channel. These information bits are symmetrically distributed among the 160 information bits of the frame.

H.T. [T3.111]

TABLE 3/R.111

Number of information bits per frame

{	{		
	9.6 kbit/s	4.8 kbit/s	2.4 kbit/s
250	5	10	20
500	10	20	40
1000	20	40	80
2000	40	80	—
4000	80	—	—

TABLE 3/R.111 [T3.111], p.

2.6 *Telegraph and data channels*

2.6.1 See § 1.6 above.

2.7 *Frame alignment*

2.7.1 Frame realignment time is ensured within three correct consecutive subframe synchronization patterns. This frame realignment will be ensured within 40, 80 and 160 ms for aggregate rates of 9.6, 4.8 and 2.4 kbit/s respectively. In the absence of frame realignment the telegraph channel outputs of the demultiplexer should be locked in their start polarity state for switched applications.

Note — Stop polarity might be required by some Administrations on a per channel basis for leased applications.

2.7.2 See § 1.7.2 above.

2.8 *Loss of telegraph input*

2.8.1 See § 1.8 above.

2.9 *Bearer interface*

2.9.1 The interface between the telegraph aggregate and higher aggregate bearer channels should be as laid down in the relevant Recommendations for modems and data multiplexers.

2.10 *Telegraph interface*

2.10.1 See § 1.10 above.

3 Compatibility

3.1 For the different subrates of 2, 4 and 8 kbit/s, there should be 8, 16 and 32 information bits respectively distributed symmetrically within the 64 kbit/s aggregate frame.

3.2 The 160 information bits of the 2.4, 4.8 and 9.6 kbit/s aggregate rates should correspond to 20 groups of 8 bits, 10 groups of 16 and 5 groups of 32 bits respectively. These 8, 16 and 32 information bits should be made to correspond to the 8, 16 and 32 information bits of the 64 kbit/s frame by means of a special padding/depadding unit.

3.3 Some examples of possible implementations are given in Figures 1/R.111, 2/R.111 and 3/R.111 for illustration purposes only.

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Figure 1/R.111, p.

Figure 2/R.111, p.

Figure 3/R.111, p.

ANNEX A

(to Recommendation R.111)

Transition coding process

FIGURE A-1/R.111, p.

A.1 The sampling pulses are divided into groups of four and each transition of the anisochronous signal causes a code character of 3 bits to be generated at the rate of one bit for a group of 4 samples. The first T bit of this code character indicates the sense of transition while the two bits C_1 and C_2 translate into binary code the position of the transition in the relevant group.

A.2 Following the acceptance of a transition into the coding system, a ‘‘data transition lockout condition’’ which inhibits entry of further transitions shall persist until code characters T, C_1 and C_2 have been transmitted. Any transition which has been locked out in this manner shall enter the coder as soon as the lockout condition is removed and will be coded as if it had occurred in the first quarter of the next transmission period.

A.3 The code characters are transmitted over the digital channel at a rate of 1 bit per group of 4 sampling pulses and the subsequent bits P between the code characters confirm the polarity of the anisochronous signal at the relevant instant. The minimum number of P bits may be zero, so the maximum code character rate equals 1/3 of the maximum modulation rate allowed.

A.4 When the anisochronous signal has a permanent polarity, an error of one bit will never entail a continuous inversion of the decoded signal, but will cause a mutilation of this signal during a limited time. The duration of these mutilations is reduced to a minimum when the code characters are formed as shown in Table A-1/R.111.

H.T. [T4.111]

TABLE A-1/R.111

{ Code character for a transition from 1 to 0 in the anisochronous signal }	{ Code character for a transition from 0 to 1 in the anisochronous signal }		{ Position of the transition in a group of four sampling pulses }			
T	C 1	C 2	T	C 1	C 2	
0	0	0	1	1	1	first quarter
0	0	1	1	1	0	second quarter
0	1	0	1	0	1	third quarter
0	1	1	1	0	0	fourth quarter

TABLE A-1/R.111 [T4.111], p.

References

[1] CCITT Recommendation *Fundamental parameters of a multiplexing scheme for the international interface between synchronous data networks* , Rec. X.50.

[2] CCITT Recommendation *Fundamental parameters of a multiplexing scheme for the international interface between synchronous data networks using 10-bit envelope structure* , Rec. X.51.

[3] CCITT Recommendation *Modems for synchronous data transmission using 60-108 kHz group band circuits* , Rec. V.36, § 1 f).

[4] *Ibid.* , § 10.

[5] CCITT Recommendation *List of definitions for interchange circuits between data terminal equipment and data circuit terminating equipment* , Rec. V.24.

[6] CCITT Recommendation *Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications* , Rec. X.27.

[7] CCITT Recommendation *Electrical characteristics for unbalanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications* , Rec. X.26.

Recommendation R.112

TDM HYBRID SYSTEM FOR ANISOCHRONOUS TELEGRAPH AND DATA TRANSMISSION USING BIT INTERLEAVING

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

(a) that there is a limited requirement on certain routes to provide for rates and codes not included in Table 1/R.101 which may be achieved by using time-division multiplexing (TDM) techniques;

(b) that wherever possible the rates and codes given in Table 1/R.101 should not be expanded in the future;

(c) that Administrations may be asked to provide code and speed independent channels for cryptography, for telemetry, for rates outside the Recommendation R.101 tolerance of ± 1.4%, where the rate and code may be changed frequently, and for maintenance purposes;

(d) that the aggregate bit rate may be limited to 2400 bit/s and TDM equipment may be required to pass code independent and code dependent traffic;

(e) that the bearer may not be suitable for using the backward channel as defined by Recommendation V.26, § 5 [1], or in the provision of telegraph channels above the Recommendation V.26 aggregate by the technique of subdivision of the frequency band as given in Recommendation H.34 [2],

unanimously declares the view

that where bit-interleaved TDM systems are used for code dependent and code independent anisochronous telegraph and data transmission with an aggregate rate of 2400 bit/s, carried either by analogue telephone-type circuit or by higher order TDM system, the equipment should be constructed to comply with the following standards:

1 System capacity

1.1 The TDM system will be capable of multiplexing the rates shown in Table 1/R.101 for code dependent channels to alternative B.

1.2 Each code and rate independent channel should replace three, six or twelve 50 baud code dependent channels.

1.3 The characteristics of the code independent channels should follow the limits shown in Table 1/R.112.

H.T. [T1.112]

TABLE 1/R.112

Characteristics of code independent channels and system capacity

{ 50 8.3 51.06 153.2 6.5 15 100 8.3 102.12 306.4 3.25 7 200 8.3 204.24 612.8 1.625 3 }					

Table 1/R.112 [T1.112], p.

2 Channel inputs

2.1 The nominal modulation rate will be 50, 100 or 200 bauds; the theoretical maximum modulation rate shall be 51.06, 102.12 or 204.24 bauds.

2.2 The transition coding process of telegraph signals is in accordance with Recommendation R.111.

2.3 Each channel provides its individual coding intervals starting within the allocated time slots: each coding interval is subdivided into four quarters. In that coding interval where the skipping bit occurs in the subframe, the forth quarter is shortened by one time slot length.

For a 50 baud channel, transmission of the code character starts with the next corresponding time slot. For channels with higher modulation rates the transmission of the code characters should be delayed by the number of the allocated time slots in the subframe minus 3.

2.4 Where applicable, spurious elements with duration of 1.6 ms (= 8%) or less shall be rejected and elements longer than 2 ms shall be accepted at the 50 baud channel input. The element lengths to be rejected or accepted at higher channel modulation rates is for further study.

3 Channel outputs

3.1 The maximum degree of inherent isochronous distortion due to the sampling process shall be 8.3%.

Note — The long-term system distortion on a tandem connection of transition encoded channels of an independent TDM system approximates in the worst case to the arithmetic summation of the individual link distortions.

3.2 After a TDM link failure, actions described in §§ 3.5 and 3.6 of Recommendation R.101, should be taken on the derived channel output.

4 Multiplexing details

4.1 The multiplexing details are in accordance with Recommendation R.101, alternative B on a bit basis.

4.2 The maximum transfer delay (excluding the modem) for 50, 100 and 200 baud code and rate independent channels for back-to-back terminals shall not exceed 50 ms for the rate 50 bauds and 35 ms for rates 100 and 200 bauds. The values of the delay are subject to further study.

5 Frame structure

This is as defined in Recommendation R.101 alternative B.

6 Synchronizing

This is defined in Recommendation R.101, alternative B.

7 Aggregate signals and interface, system clock arrangements and system control and alarms

These are defined in Recommendation R.101.

8 Channel numbering scheme of code independent channels

Channel numbers used in the given Recommendation represent two last digits of the four-digit numbering scheme in respect to the Figure 1/R.112, first two digits are shown in Recommendation R.114.

Figure 1/R.112, p.

References

[1] CCITT Recommendation *2400 bit per second modem standardized for use on 4-wire leased telephone-type circuits* , Rec. V.26.

[2] CCITT Recommendation *Sub-division of the frequency band of a telephone-type circuit between telegraph and other services* , Rec. H.34.

Recommendation R.114

NUMBERING OF INTERNATIONAL TDM CHANNELS

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

(a) that in view of the introduction in the international service of time division multiplex (TDM) channels with different characteristics, configured for various nominal modulation rates and for different character structures, it has become necessary to evolve a method of numbering TDM channels;

(b) that this numbering method must make it possible to recognize:

— the type of TDM (code-dependent or code-independent);

— the nominal modulation rate and (in the case of code-dependent TDM) the character length;

— the position of the channel in the frame,

unanimously declares the view

1 The channels in an international TDM system conforming to Recommendation R.101 should be numbered as shown in Table 1/R.114.

2 The number assigned to a channel should be selected from the series applicable to the type of channel and should correspond to its position in the multiplex tables in Recommendation R.101.

3 The channels in an international TDM system conforming to Table 1/R.111 should be numbered as shown in Table 2/R.114.

4 The channels in systems conforming to Table 1/R.111 should be numbered in the same way as their positions in the frame; i.e. in the sequence from 1 to 255 excluding the channel numbers that are multiples of 16. In establishing a channel having a rate of more than 50 bauds, the number assigned coincides with the number of the first 50 baud channel taking part in the integration.

5 International TDM channels to Recommendation R.112 should have the numbering scheme shown in Table 3/R.114.

6 The numbers assigned to the channels should be selected from the series applicable to the type of channel and should correspond to its position in the Figure 1/R.112 to Recommendation R.112.

7 International code independent and code dependent channels to Recommendation R.102 should have the numbering schemes shown in Tables 3/R.114 and 4/R.114, respectively.

8 The numbers assigned to the channels should be selected from the series applicable to the type of channel and should correspond to its position in Tables 2/R.102 to 4/R.102 to Recommendation R.102.

9 Channel numbering of 50 baud channels for branch-line muldexes conforming to Recommendation R.103 should be in accordance with the numbering scheme in Tables 1/R.114 and 4/R.114.

Blanc

H.T. [T1.114]

TABLE 1/R.114

Numbering scheme for TDM systems conforming to Recommendation R.101

{
50 |
0501 | (hy | 546
75 |
0701 | (hy | 742 (for alternative A). See Table 3/R.101 for numbers not used
0701 | (hy | 731 (for alternative B, 0716 not used)
100 |
1001 | (hy | 023 (for 10 unit, 1008 not used)
1701 | (hy | 723 (for 7½ unit, 1708 not used)
110 |
1101 | (hy | 123 (1108 not used)
134.5
1301 | (hy | 315
150 |
1501 | (hy | 515
200 |
2001 | (hy | 011 (for 10 unit, 2008 not used)
2101 | (hy | 111 (for 11 unit, 2108 not used)
2701 | (hy | 711 (for 7½ unit, 2708 not used)
300 |
3001 | (hy | 007 (for 10 unit)
3101 | (hy | 107 (for 11 unit)
}	

Tableau 1/R.114 [T1.114], p. 18

H.T. [T2.114]

TABLE 2/R.114

Numbering scheme for TDM systems conforming to Table 1/R.111

{ 50 (300) 5 (7.5) 5001 | (hy | 255 (The numbers 16, 32, 48, 64, 80, 96, 112, 128, 144, 160, 176, 192, 208, 224 and 240 are not used) 100 (300) 5 (7.5) 6001 | (hy | 127 (The numbers 16, 32, 48, 64, 80, 96 and 112 are not used) 200 (300) 5 (7.5) 7001 | (hy | 063 (The numbers 16, 32 and 48 are not used) 600 (300) 7.5 (5) 8001 | (hy | 031 (The number 16 is not used) 1200 (300) 7.5 (5) 8101 | (hy | 115 }		

Tableau 2/R.114 [T2.114], p. 19

H.T. [T3.114]

TABLE 3/R.114

Numbering scheme of code independent channels for TDM

systems

conforming to Recommendations R.112 and R.102

{		R.112 (2400 bit/s)	R.102 (4800 bit/s)
50 5801 | (hy | 831 (5816 not used) }	8.3	5801 | (hy | 815	{
100	8.3	6801 | (hy | 807	6801 | (hy | 815
200	8.3	7801 | (hy | 803	7801 | (hy | 807

Tableau 3/R.114 [T3.114], p. 20

H.T. [T4.114]

TABLE 4/R.114

Numbering scheme of code dependent channels for TDM

systems

conforming to Recommendation R.102

{ Nominal modulation rate (bauds) }	Channel numbers
50 |	0501 | (hy | 592
75 |	0701 | (hy | 746
100 | 1001 | (hy | 046 (for 10 unit) 1701 | (hy | 746 (for 7.5 unit) }	{
110 |	1101 | (hy | 146
134.5 1301 | (hy | 331 (1316 not used) }	{
150 | 1501 | (hy | 531 (1516 not used) }	{
200 | 2001 | (hy | 023 (for 10 unit, 2008 not used) 2101 | (hy | 123 (for 11 unit, 2108 not used) 2701 | (hy | 723 (for 7.5 unit, 2708 not used) }	{
300 | 3001 | (hy | 015 (for 10 unit) 3101 | (hy | 115 (for 11 unit) }	{

Tableau 4/R.114 [T4.114], p. 21

Recommendation R.115

MAINTENANCE LOOPS FOR TDM-SYSTEMS

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

The CCITT,

considering

(a) the increasing use of TDM transmission systems;

(b) the volume of information circulating on data and telegraph transmmission networks;

(c) the savings to be made by reducing interruption time on such links;

(d) the importance of being able to determine responsibilities between the several parties who, of necessity, are involved in maintenance questions for the networks;

(e) the advantages of standardization regarding maintenance,

unanimously declares the following:

1 The locating of faults can be facilitated in many cases by looping and other maintenance procedures in the TDM equipments. These maintenance facilities allow local or remote measurements to be carried out optionally by the Administrations and/or users concerned.

2 Location of the loops

The maintenance loops are positioned in order to make it possible for the Administrations to locate faults to the following function blocks:

— aggregate modem;

— TDM central logic;

— tributary interface unit;

— aggregate line;

— subscriber line.

The loops necessary to fulfil the above listed demands are shown in Figure 1/R.115. Additional loops may be used for the location of faulty boards but these loops are relevant to each particular manufacturer’s implementation and are not included here. The number of maintenance loops may be extended to include the subscriber terminal equipment. These loops are left for further study.

3 Names, types and definitions of the loops

See Figure 1/R.115.

3.1 *Loop a — digital multiplexer aggregate loop*

This loop is a one-way or optionally an echo-back loop (see Figures 2/R.115 and 3/R.115) that shall connect the aggregate data output to the aggregate data input of the TDM central logic. This loop shall be accomplished as close as possible to the digital aggregate interface.

3.2 *Loop b — analogue aggregate modem loop*

This loop is a one-way loop or optionally an echo-back loop (see Figures 2/R.115 and 3/R.115). With this loop, the line signal from the output of the aggregate modem is looped back to the input of the aggregate modem. The loop should include the maximum number of aggregate modem components used in normal working.

Figure 1/R.115, p.

3.3 *Loop c — analogue line loop*

This loop is a one-way loop or optionally an echo-back loop (see Figures 2/R.115 and 3/R.115). With this loop, the incoming line signal at the receiver input of the aggregate modem is looped back to the outgoing direction of the line. It is noted that it may not be possible to correctly receive data that has been sent over the looped circuit.

3.4 *Loop d — digital aggregate modem loop*

This loop is a one-way loop or optionally an echo-back loop (see Figures 2/R.115 and 3/R.115). In this loop the received aggregate digital data from the modem is looped back to the originating side. This loop shall be located as close as possible to the digital aggregate interface.

3.5 *Loop f — tributary analogue loop*

This loop is a one-way loop (see Figure 2/R.115). With this loop, the tributary signal to be sent to the subscriber is looped back towards the multiplex system. This loop shall be accomplished at the subscriber line interface and shall include as many parts of the tributary interface unit as possible. As long as the loop is set the subscriber connection is interrupted.

3.6 *Loop g — tributary digital loop towards the Muldex*

This loop is a one-way loop (see Figure 2/R.115) with the output polarity towards the tributary interface unit strapable to A or Z polarity. Through this loop the channel data as received from the aggregate is looped back to the aggregate towards the distant TDM equipment. This loop shall be accomplished as close as possible to the internal tributary interface which can be located on the tributary interface unit or in the TDM central logic.

3.7 *Loop h — tributary digital loop towards the tributary interface unit*

This loop is a one-way loop with the output polarity towards the muldex-part of the given channel strapable to A or Z polarity. Through this loop the channel data at the tributary input is looped back to the channel output through the tributary interface unit. This loop shall be accomplished as close as possible to the TDM central logic.

Figures 2/R.115, 3/R.115, 4/R.115, p.

4 Use of the loops

Loops c and d may be used under remote control on international links after bilateral agreements only.

5 Methods of control

5.1 Two types of control might be possible:

a) *Local control of a loop*

A loop is locally controlled when the loop request originates at the location of the equipment to be looped.

b) *Remote control of a loop*

A loop is remotely controlled when the loop request originates at a location other than that of the equipment to be looped.

5.2 When the aggregate modem is using a standard interface to the TDM-equipment, the implementation of the echo-back function and the controls through the digital aggregate interface of loops b, c and d are left for further study.

5.3 The control of loops a, b, c and d should be supervised by a time-out function. The time-out function shall automatically open the loop after a specified time period, measured from the closing of the loop. The length of the time period should be chosen from time intervals 5, 20 or 40 seconds by bilateral agreement between Administrations.

The operation and test procedure for loop f to h is a national matter.

6 Control signalling

6.1 *Alternative A*

When the maintenance facilities are controlled by the software within an exchange, a maintenance centre or a TDM terminal, a control signalling code (CSC) is used where the control signalling characters on the selected maintenance channel shall be in accordance with Table 1/R.115 (see also Recommendation U.12, Table 8/U.12).

H.T. [T1.115]
TABLE 1/R.115
lw(66p) | lw(30p) | lw(18p) | lw(12p) | lw(18p) | lw(12p) | lw(72p) .

Table 1/R.115 [T1.115], p.

A complete control signalling code character consists of one start element (Start), followed by four information elements (b_0, b_1, b_2, b_3) one parity element (b_4),and a stop element (Stop) of nominally one and a half unit element, see Figure 5/R.115.

Figure 5/R.115, p.

Bit b_0 is the least significant bit (LSB) and b_3 is the most significant bit (MSB). For the transmission of decimal numbers from 0 up to 99 the binary code should be used. The 8 binary bits should be split into two characters, No. 1 and No. 2, character No. 1 holding the least significant bits and character No. 2 the most significant bits.

6.2 *Alternative B*

When maintenance facilities do not use control signal according to Recommendation U.12, the signalling characters on the maintenance channel selected must conform to International Alphabet No. 5 (IA5), with an even parity check (see Figure 6/R.115).

Figure 6/R.115, p.

6.3 *Maintenance channel signalling*

Standardization of signalling on the maintenance channel is left for further study.

7 Routing of the maintenance control signals

One 50 baud channel, or a channel of more than 50 bauds may be allocated (on an optional basis) for maintenance purposes, where possible on a separate system using a parallel route. Where this option is exercised the allocation of the maintenance channel is specified within the respective CCITT Recommendation or bilaterally between Administrations.

The selected maintenance channel should only be used for the transmission of alarms, supervision and remote control signals.

When there is no possibility to use a separate system on a parallel route the control of the loops c and d is left for further study.

8 Application

It may be possible to apply the described maintenance technique to multiplexors conforming to Recommendations R.101, R.111 and other standardized multiplexors.

9 Use of the maintenance channel

Use of the maintenance channel for purposes other than loop control is left for further study.

Recommendation R.116

MAINTENANCE TESTS TO BE CARRIED OUT ON INTERNATIONAL TDM SYSTEMS

(Melbourne, 1988)

The CCITT,

considering

(a) the savings to be made by reducing interruption time on TDM links;

(b) the importance of being able to determine responsibilities between the several parties who, of necessity are involved in maintenance questions for the networks;

(c) the advantages of standardization regarding maintenance;

(d) maintenance loops are standardized in Recommendation R.115,

unanimously declares the following:

that when the quality of the TDM-link has deteriorated beyond the alarm limit or if the local muldex gives an alarm, supplementary measurement should be performed. The following test and supervision methods can be used.

1 Testing and supervision of TDM systems

1.1 *Bit error rate*

The synchronization bits are supervised and an error rate alarm is issued when the error rate exceeds a preset limit, 10^{D}lF261^{3}, 10^{D}lF261^{4} or 10^{D}lF261^{5}.

1.2 *Bit error counter*

All synchronization bit errors shall be registered in a cyclic counter and it shall be possible to read the value of this counter by command.

1.3 *Routine supervision*

The operation of the TDM equipment and maintenance channel should continuously be supervised by a repetitive test signal. An alarm is issued when a correct acknowledgement is not received for a specified number of test signals. The alarm is reset automatically when the fault situation ceases.

1.4 *Alarm reset*

It shall be possible to reset all alarms from the local side. The command shall also be able to reset the error rate value.

1.5 *System alarms*

Failures that affect operation of the whole or a major part of the TDM equipment are classified as one category. The supervised functions are:

— Carrier:

Loss of carrier is detected by the data modem through CCITT circuit 109 or the corresponding circuit.

— Synchronization:

Loss of synchronization is detected by the TDM multiplexer in accordance with the respective CCITT Recommendation.

— Multiplexing logic:

Failure of the TDM central logic is detected by internal supervision facilities within the multiplexer.

— Power:

Failure of the power supply is detected when the telegraph power supply exceeds tolerance limits.

1.6 *Changing of active side*

When the TDM equipment is duplicated the active side can be changed by command or manually.

When the remote or local side is changed automatically or manually, information about what side is executive must be sent when the change has been executed.

1.7 *Looptest on standby side*

When the TDM equipment is duplicated the standby modem can be tested by the setting of loop b by command. The test result is sent over the active maintenance channel.

1.8 *Automatic restart*

When the remote TDM is automatically restarted, information shall be sent informing about the restart and alarm status.

1.9 *Acknowledgement*

The acknowledgement consists of one character and should have the following values:

5 acknowledgement;

0 not acknowledgement.

2 Format of the messages

The messages which will be sent over the 50 baud maintenance channel shall have the following structure:

$C_1C_2M_1M_2$. | | | M_n

C_1C_2: Message category (two characters)

M_1—M_n: Information (number of characters unlimited)

After the reception of a message at the receiving end, the receiving end shall send one character to the originating end as an acknowledgement of the reception.

2.1 *Message categories*

The purpose of the message categories (called MC) is to give a direct command or to inform the control equipment in an exchange, a maintenance centre or a TDM about what type of information the following message contains.

The MC consist of two characters, and each character is a decimal number from 0 to 9. The numbers are coded according to alternative A (CSC) in Recommendation R.115.

2.2 *Information*

The information characters are a part of an order to the remote TDM equipment or information from the remote TDM-equipment, depending on the Message Category Signal.

The number of information characters in a message is not limited.

The characters are decimal numbers from 0 to 9, coded according to alternative A (CSC) in Recommendation R.115.

3 Maintenance messages

Using the format described in § 2 the maintenance messages shall have a message category and information as given in the table below:

Blanc

H.T. [1T1.116]

TABLE 1

Maintenance messages

Types of messages	Message category	Information
	C 1 C 2	M 1-M n
Routine supervision	01	—
System alarm reset	02	—
Setting of loop a	03	—
Setting of loop b	04	—
Setting of loop c	05	—
Setting of loop d	06	—
Setting of loop g	07	M 1-M 3: Channel No.
Setting of loop h	09	M 1-M 3: Channel No.
Setting of loop f	10	M 1-M 3: Channel No.
{		
Connection of automatic test eq.		
}	11	{
M		
1-M		
3:		
Channel No.		
M		
4-M		
2		
3:		
Answer back (See Note)		
}		
{		
Disconnection of automatic test eq.		
}	12	—
{		
Distortion measurement on sub. line		
}	13	M 1-M 3: Channel No.
Line measurements	14	{
M		
1-M		
3:		
Channel No.		
M		
4:		
Type of line		
0 =		
SC		
1 =		
DC		
2 =		
FS		
M		
5:		
Type of measurement		
0 =		
Current		
1 =		
Voltage		
2 =		
Leakage to earth		
3 =		
Leakage betw. conductors		
4 =		
Level FS		
5 =		
Interface test		
}		
Change side	15	{
M		

1: Side b 0 = 0 A side executive b 0 = 1 B side executive b 1 = 0 Standby side halted b 1 = 1 Standby side working }			
Restart of control unit	16	—	
Read bit error counter	17	—	

{
Set loop b on remote standby side modem
}
	18	—	

Open line alarm M 1-M 3: Channel no. M 4: Alarm b 0 = 1 Alarm b 0 = 0 No alarm }	26	{	

Tableau 1/R.116 [1T1.116], p. 29

H.T. [2T1.116]

TABLE 1 *(continued)*

Types of messages	Message category	Information
Distortion alarm	27	M 1-M 3: Channel No.
Bit error rate	28	{

M
1:
Failure rate
3 =
10^{D}lF261^{3}
4 =
10^{D}lF261^{4}
5 =
10^{D}lF261^{5}
}
{
Results of distortion measurement sub. line		

}	29	{
M 1 | 2: Number of measured transitions M 3 | 4: Maximum distortion }		
Result of line measurement	30	{
M 1-M 1 0: Test result M 1 = 0 Level FS OK M 1 = 1 Level FS not OK M 2 = 0 Interf. OK M 2 = 1 Interf. not OK M 3 | 4: Voltage or current on wire 1 and resistance between wire 1 and 2. Resistance to earth, w.1 M 5 | 6: Voltage or current on wire 2 or resistance between wire 3 and 4. Resistance to earth, w.2 M 7 | 8: Voltage or current on wire 3. Resistance to earth, w.3 M 9 | 1		

0:
Voltage or current on wire 4.
Resistance to earth, w.4
}
System alarms 31 {
M
1:
Type of alarm
b
0 =
1 Carrier alarm
b
0 =
0 No carrier alarm
b
1 =
1 Synchronization alarm
b
1 =
0 No synchronization alarm
b
2 =
1 Power alarm
b
2 =
0 No power alarm
b
3 =
1 Mux logic alarm
b
3 =
0 No Mux logic alarm
}
{
Manually initiated change side
} 32 {
M
1:
Side
b
0 =
0 A side executive
b
0 =
1 B side executive
b
1 =
0 Standby side halted
b
1 =
1 Standby side working
}
{
Looptest result from standby side
} 33 {
M
1:
Result
0
Test OK
1
Test not OK
}

Automatic restart	34	
Bit error counter	35	M

1-M 3: Result *Note* — The answer back message shall be sent using International Alphabet No. 2.

Tableau 1/R.116 [2T1.116], p. 30