The drawings contained in this Recommendation have been done in Autocad

Recommendation T.71

LINK ACCESS PROTOCOL BALANCED (LAPB) EXTENDED FOR HALF—DUPLEX PHYSICAL LEVEL FACILITY

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

The CCITT,

considering

(a) that the Teletex service will be introduced in different types of networks, i.e. circuit switched public data networks (CSPDN), packet switched public data networks (PSPDN) and public switched telephone networks (PSTN);

(b) that depending on the service provided by the physical level, the link level procedures may have to cater for a half—duplex transmission facility;

(c) that some Administrations are considering the provision of a Teletex service with a half—duplex transmission facility on the PSTN;

(d) that modems according to Recommendation V.26 *bis* are suitable for half—duplex transmission at 2400 bit/s on PSNTs,

unanimously declares

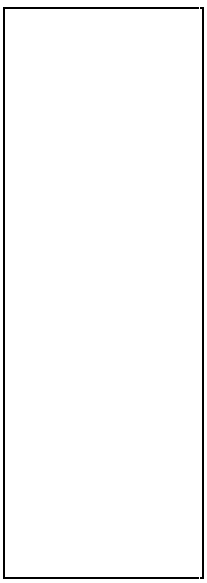
that this Recommendation defines the link level procedure using LAPB extended for half—duplex physical level service.

1 Introduction

1.1 *General*

1.1.1 Figure 1/T.71 shows the half—duplex transmission module (HDTM) for extending the use of LAPB for operation of Teletex terminals connected to the PSTN where use of half—duplex 2400 bit/s modems is planned. This is referred to in Recommendation T.70 as LAPX.

Fig. 1/T.71 /CCITT-54060 = 9 cm



1.1.2 Before the HDTM begins operation the physical circuit must be established by the appropriate PSTN call control procedures. The operation of the HDTM is such that the calling DTE will initially have the right to transmit. For the link addressing conventions refer to Recommendation T.70.

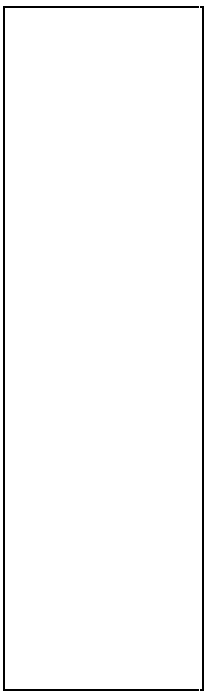
1.2 *Architecture*

1.2.1 *Level relationships*

It is an objective to avoid modification of the definition of LAPB in order to adapt it for half—duplex operation. However, there is a functional requirement that the HDTM inhibit LAPB from sending frames during certain phases of the half—duplex procedure. The means of accomplishing this functional requirement is not defined.

The logical relationships between LAPB, the HDTM and the physical level are as shown in Figure 2/T.71.

Fig. 2/T.71 /CCITT-54070 = 9 cm



1.2.2 *Control (C) and status (S) functions*

The following logical functions are defined to describe the interactions between LAPB and the HDTM:

Control <TERM>

— Revert to the HDTM idle state since LAPB has entered the disconnected phase (equivalent to ADM of HDLC).

Status <OP—T>

— LAPB is enabled to send frames.

Status <INOP—T>

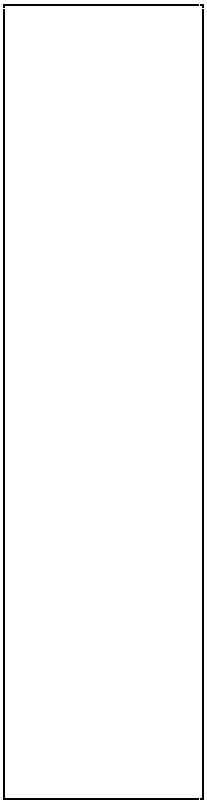
— LAPB is inhibited from sending frames.

2 State diagram and descriptions

2.1 *State diagram*

The state diagram shown in Figure 3/T.71 describes the procedure for controlling the right to transmit. The number in each ellipse is the state reference number.

Fig. 3/T.71 /CCITT-54080 = 15 cm



2.2 *State definitions*

2.2.1 *Idle state (state 0)*

The DTE is in an inactive state. This is the initial state prior to call establishment and the final state after call termination.

2.2.2 *Half—duplex sending state (state 1)*

The DTE is in a half—duplex sending state, so that all signals generated by LAPB are passed to the physical level.

2.2.3 *Wait for receiving state (state 2)*

The DTE is awaiting indication that the remote DTE has entered the half—duplex sending state. No signals generated by LAPB are passed to the physical level.

2.2.4 *Half—duplex receiving state (state 3)*

The DTE is in a half—duplex receiving state, so that no signals generated by LAPB are passed to the physical level. The remote DTE is considered to be in the half—duplex sending state.

2.2.5 *Wait for sending state (state 4)*

The DTE is awaiting indication of the availability of the physical level for transmission of frames to the remote DTE. All signals generated by LAPB are passed to the physical level, but LAPB is inhibited from sending frames.

2.3 *Table of transitions between states*

Table 1/T.71 shows the events that cause transitions from one state to another, along with any resulting actions. This shows a generalized description of the operation of the HDTM.

2.4 *State definitions expressed in terms applicable to a modem interface*

The following definitions apply to the use of the HDTM with the V.26 *bis* modem interface, as an example.

2.4.1 *Idle state (state 0)*

Circuit 107 is OFF.

2.4.2 *Half—duplex sending state (state 1)*

Circuit 105, circuit 106 and circuit 107 are ON. LAPB is connected to circuit 103 and enabled to send frames.

2.4.3 *Wait for receiving state (state 2)*

Circuit 107 is ON, circuit 105 is OFF. LAPB is inhibited from sending frames and disconnected from circuit 103, which is held in the binary 1 condition. Timer T is running.

2.4.4 *Half—duplex receiving state (state 3)*

Circuit 107 is ON, circuit 105 is OFF. LAPB is inhibited from sending frames and disconnected from circuit 103, which is held in the binary 1 condition.

2.4.5 *Wait for sending state (state 4)*

Circuit 105 and circuit 107 are ON, and circuit 106 is OFF. LAPB is connected to circuit 103 but is inhibited from sending frames.

2.5 *Table of transitions between states expressed in terms applicable to a modem interface*

Table 2/T.71 shows, in terms of the V.26 *bis* modem interface, the events that cause a state transition and the resulting action(s).

2.6 *Timer T*

This timer is used to recover from an apparent failure of the remote DTE to take the right to transmit. To avoid a contention condition during this recovery process, different values of timer T are to be used by the called and calling DTE. A calling DTE uses the value T_a, and a called DTE uses the value T_b.

The values of T_a and T_b are system parameters and must be studied further in relationship to interworking requirements and other system parameters in Recommendation T.70.

TABLE 1/T.71

Description of state transitions

Present state	Event	Action	New state
0	Calling DTE: Data circuit established (e.g. data set ready, ready for data)	---------->	4
0	Called DTE: Data circuit established (e.g. data set ready, ready for data)	Start timer T	2
4	Indication of availability of the physical level for transmission	Send indication to the remote DTE that the half—duplex sending state has been entered Status <OP—T> (see Note 1)	1
1	Conclusion of transmission	Send request that remote DTE enter the half—duplex sending state Start timer T (see Note 4) Status <INOP—T> (see Note 2)	2
2	Reception of indication that the remote DTE has entered the half—duplex sending state	Stop timer T	3
2	Expiry of timer T	---------->	4
3	Reception of notification that the remote DTE is requesting a change in the direction of transmission	---------->	4
1	LAPB has entered a disconnected phase (i.e. Conrol <TERM>, see Note 3)	---------->	0
3	LAPB has entered a disconnected phase (i.e. Conrol <TERM>, see Note 3)	---------->	0
Any	Physical level has no circuit to a remote DTE	---------->	0

Note 1 — Status <OP—T> indicates to LAPB that the sending of frames is enabled.

Note 2 — Status <INOP—T> indicates to LAPB that the sending of frames is inhibited.

Note 3 — Control <TERM> indicates that LPAB has entered the disconnected phase (equivalent to ADM of HDLC).

Note 4 — HDTM uses the idle data link channel state indication (at least 15 contiguous 1's) for requesting that the remote DTE enter the half—duplex sending state.

TABLE 2/T.71

Description of state transitions in terms of the V.26 *bis* modem interface

Present state	Event	Action	New state
0	Calling DTE: Circuit 107 ON	Turn circuit 105 0N Connect LAPB to circuit 103	4
0	Called DTE: Circuit 107 ON	Start timer T	2
4	Circuit 106 ON	Enable sending of LAPB frames (see Note 1)	1
1	Transmission concluded (see Note 2)	Inhibit sending of LAPB frames Disconnect LAPB from circuit 103 Hold circuit 103 in the binary 1 condition Turn circuit 105 OFF (see Note 3) Start timer T	2
2	Reception of a flag	Stop timer T	3
2	Expiry of timer T	Turn circuit 105 ON Release circuit 103 from binary 1 condition Connect LAPB to circuit 103	4
3	Reception of 15 contiguous 1 bits (see Notes 4 and 5)	Turn circuit 105 ON Release circuit 103 from binary 1 condition Connect LAPB to circuit 103	4
1	LAPB has entered a disconnected phase	Turn circuit 105 0FF	0
3	LAPB has entered a disconnected phase	---------->	0
Any	Circuit 107 OFF	Turn circuit 105 OFF	0

Note 1 — It is necessary to ensure that at least one full flag is transmitted after circuit 106 comes ON. This flag may be the opening flag of the first frame.

Note 2 — The HDTM may determine that a transmission by the LAPB module has been concluded by either of the following:

— counting a sequence of contiguous flags on circuit 103 while in state 1,

— a time—out, T,

— a signal from another source, e.g., from a higher level.

However, if no frame is transmitted while in state 1, not less than five contiguous flags shall be sent in state 1 before entry into state 2.

Note 3 — It is recommended that circuit 105 not be turned OFF until 15 bit times after the binary 1 condition is established on circuit 103. This will assure transmission of an idle sequence to the remote DTE.

Note 4 — It is recognized that whether or not an idle sequence is sent by the remote DTE, the DTE will detect an idle sequence after circuit 109 goes OFF, since according to Recommendation V.26 *bis*, this will hold circuit 104 in the binary 1 condition.

Note 5 — It is understood that circuit 109 will go OFF. Entry into state 4 may be made dependent on this OFF condition, as an implementation option.

ANNEX A

(to Recommendation T.71)

ADDITIONAL RULES MAKING FOR GREATER EFFICIENCY IN HALF—DUPLEX TRANSMISSION

A.1 *General considerations*

— Greater efficiency is obtained in recovery situations.

— The application of these rules is optional.

— The application of these rules does not imply any incompatibility or entail any amendment of DTEs (or DCEs) which observe the procedures described in Recommendation T.71.

A.2 *Rules of operation*

1) Before the DTE (or DCE) gives the turn back, it ensures that it has acknowledged all the frames received and accepted before it received the turn.

2) If the DTE (or DCE) receives or takes the turn, it will always first retransmit all the I—frames which have not been acknowledged.

3) The DTE (or DCE) must replace the last RR frame in each turn, if any, by an REJ frame carrying the appropriate N(R).