RECOMMENDATION ITU-R BT.1549*

Data link protocol for interaction channel

(Question ITU-R 16/6)

(2001)

The ITU Radiocommunication Assembly,

considering

a) the progress in information processing and communication technologies;

b) the rapid progress towards enhanced and digital television delivery systems;

c) the need within such systems for interactivity for a variety of purposes;

d) the development of communication methods, over various delivery media, suitable for use in receiving, from viewers, return communications related to the programme material (vision, sound and data);

e) the availability of mass storage media permitting interaction without the requirement of a return channel;

f) the large number of domestic receivers likely to be impacted by the adoption of interactive services;

g) the large number of domestic multimedia systems likely to be impacted by the adoption of interactive services;

h) that return information from viewers can be also provided in a non-automatic way (viewers have to store and then take care of the delivery of the information);

j) the existence of Recommendation ITU-R BT.1369 – Basic principles for a worldwide common family of systems for the provision of interactive television services;

k) the need for simpler protocols than Recommendation ITU-R BT.1434, which supports Internet protocol (IP)-based protocols, such that the introduction of interactive services using a return channel might be more easily achieved;

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* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2002 in accordance with Resolution ITU-R 44.

l) that public switched telephone network (PSTN)/integrated services digital network (ISDN) is one of most generic interaction channels in many countries;

m) the requirement that the simpler protocols should also support a simple level of the security,

recommends

1 that the data link layer protocol for the interaction channel, specified in Annex 1, should be applied when using a low data rate modem and simple data transfer protocols.

ANNEX 1

Data link protocol for interaction channel

1 Scope

This Recommandation specifies the data link layer protocol which can be applied when using a low data rate modem and a simple data transfer protocol for the interaction channel (i.e. non IP-based protocols such as high level data link control (HDLC) (ISO 3309, 4335, 7809), basic mode control procedure for data communication systems (ISO 1745), etc.).

2 Normative references

ITU-T Recommendation X.28 – DTE/DCE interface for a start-stop mode Data Terminal Equipment accessing the Packet Assembly/Disassembly facility (PAD) in a public data network situated in the same country.

3 Reference models

3.1 Assumed connection model for interactive systems

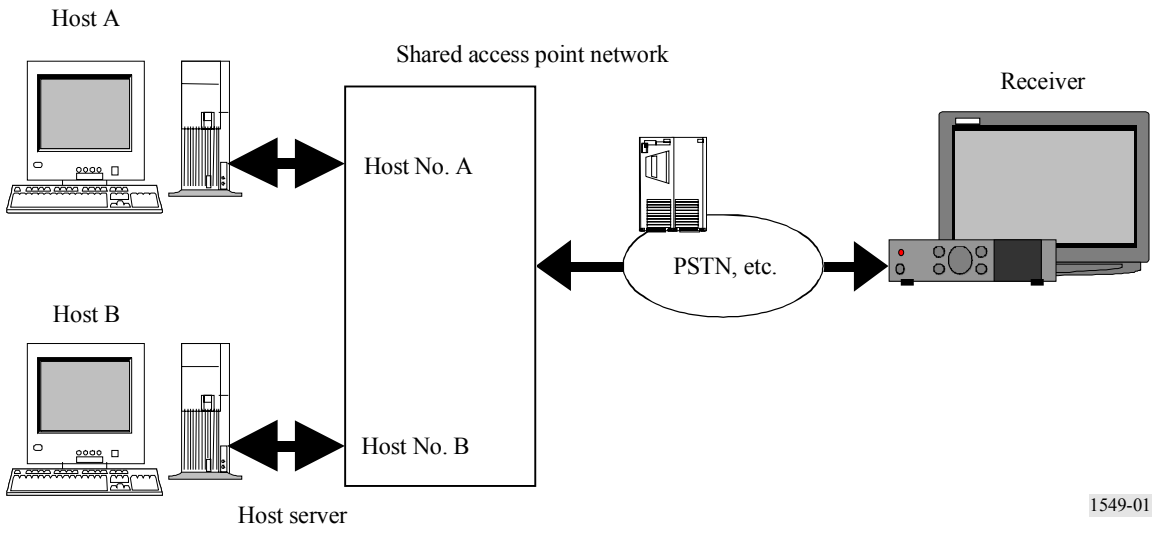
An assumed connection model for interactive systems to which this link layer protocol can be applied is shown below.

NOTE 1 – The model is compliant with the system model of ITU-T Recommendation J.110, and matches the logical model of ITU-T Recommendation J.111 with the exception that the S2 channel for data downloading is not used.

FIGURE 1

Symmetric bidirectional connection model

(Direct connection model: using a shared access point network, receivers can easily select connection to any host server (host) directly)



3.2 Data transfer phases

Protocols using PSTN for bidirectional interactive services consist of the following five phases:

– *Phase 1*: Line connection phase

– *Phase 2*: Data link establishment phase

– *Phase 3*: Data transmission phase

– *Phase 4*: Data link termination phase

– *Phase 5*: Line disconnection phase.

4 Data link protocol for interaction channel

4.1 Conditions

4.1.1 Telecommunication conditions

Telecommunication conditions for the modem of the receiver are shown in Table 1.

TABLE 1

Telecommunication conditions for the modem of the receiver

	Parameters	Note
Data length (character length)	8 bits	Communication conditions for line connection
Parity	None	
Stop bit	1 bit	
Transmission code system	Specified by each application	
Local echo back	None (remote echo back may be used)	
CR/LF control	From receiver to host: only CR is sent. From host to receiver: CR and LF are sent	
Code for transmission delimiter	CR (0D H)	
Code for new line	LF (0A H)	
Code for input correction	BS (08 H)	
Data transfer sequence	Specified by each application	Communication conditions for modem
Transmission mode	Asynchronous full duplex transmission	
Transmission speed	Above ITU-T Recommendation V.22*bis* (2 400 bit/s)	
Flow control	RS/CS	
MNP class	Class 4 or above	

CR: transmission mode

LF: code for new line

MNP: Microcom Networking Protocol

4.1.2 Modem

The modem shall support the specifications, listed above, equal to ITU-T Recommendation V.22*bis* or higher (e.g. ITU-T Recommendations V.22*bis*, V.32 and V.32*bis*) and with the error correction scheme equal to MNP4 or higher (e.g. MNP4, MNP5, ITU-T Recommendations V.42 and V.42*bis*).

4.1.3 Line connection and disconnection phase

During the line connection and disconnection phase, the receiver connects to and disconnects from the host using PSTN, etc. The line connection and disconnection are controlled by AT (attention) commands for modems, terminal adapter (TA) and data communication adapters (ADP) of mobile phones.

4.2 Protocol for data link establishment and termination phase

In this phase, which starts after the line connection has been effected, a data transmission is established between the receiver and a host. In addition, after data transmission has been completed, the link between the receiver and the host is terminated. These phases can be applied to data transfer protocols, which do not specify a destination address for each data packet. Therefore, this phase is applicable to various types of protocols for interaction channels.

When basic modems are used, error detection and correction protocols are either performed at the physical layer (MNP4), the data link layer or the network layer, whichever is specified by the operational rule.

Table 2 shows the protocol stack for this phase.

TABLE 2

Protocol stack for data link establishment and termination phase

	Protocol stack	
Application layer	Selected according to service	
Data link layer	Protocol conforming to a part of ITU-T Recommendation X.28 (requires a facility for specifying the number of host servers)	
Physical layer	Receiver	Host
Basic modem	Conforming with ITU-T Recommendation V.22 *bis* and later	

4.3 Host number

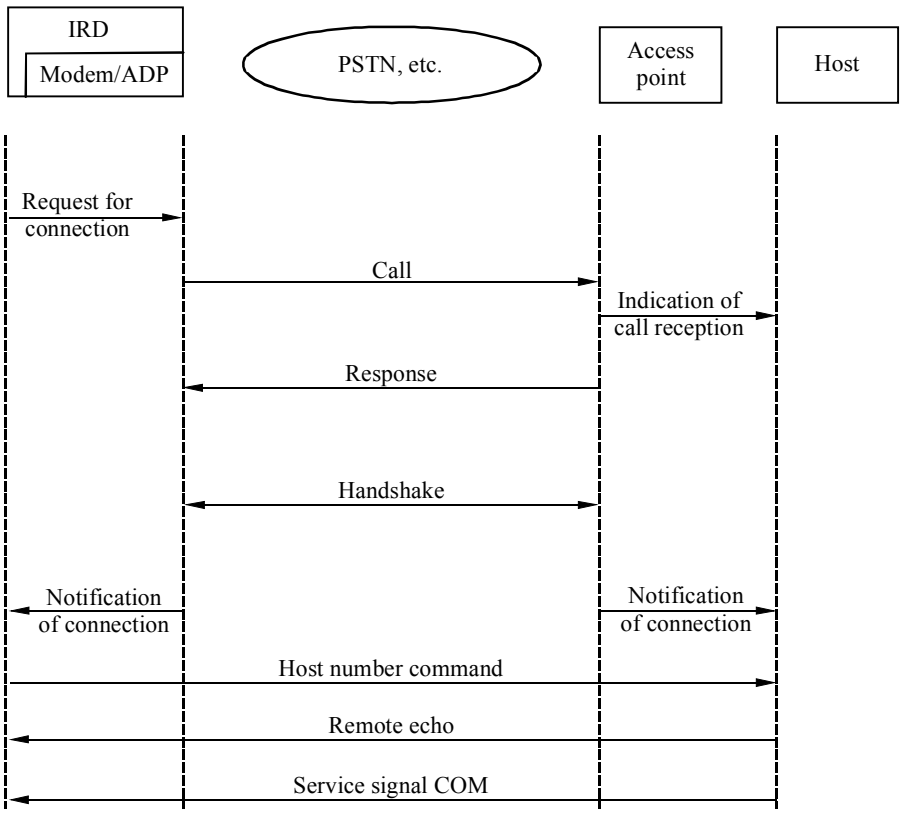
When receivers connect to hosts through telephone networks and so on, they should connect to the shared access point at first and send the host number command to identify host servers.

4.4 Sequences

4.4.1 Connection sequence

FIGURE 2

Normal sequence



ADP: adapter
IRD: integrated receiver/decoder

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FIGURE 3

Error sequence
(error caused by host number command)

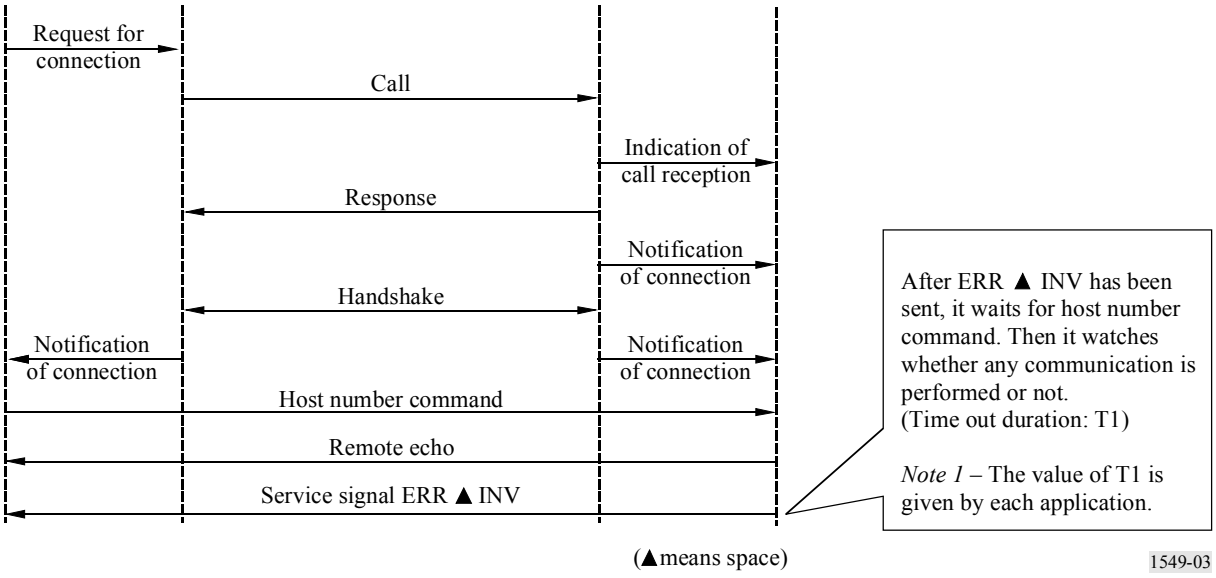


FIGURE 4

Error sequence
(error caused by time out process of host server after waiting for host number command)

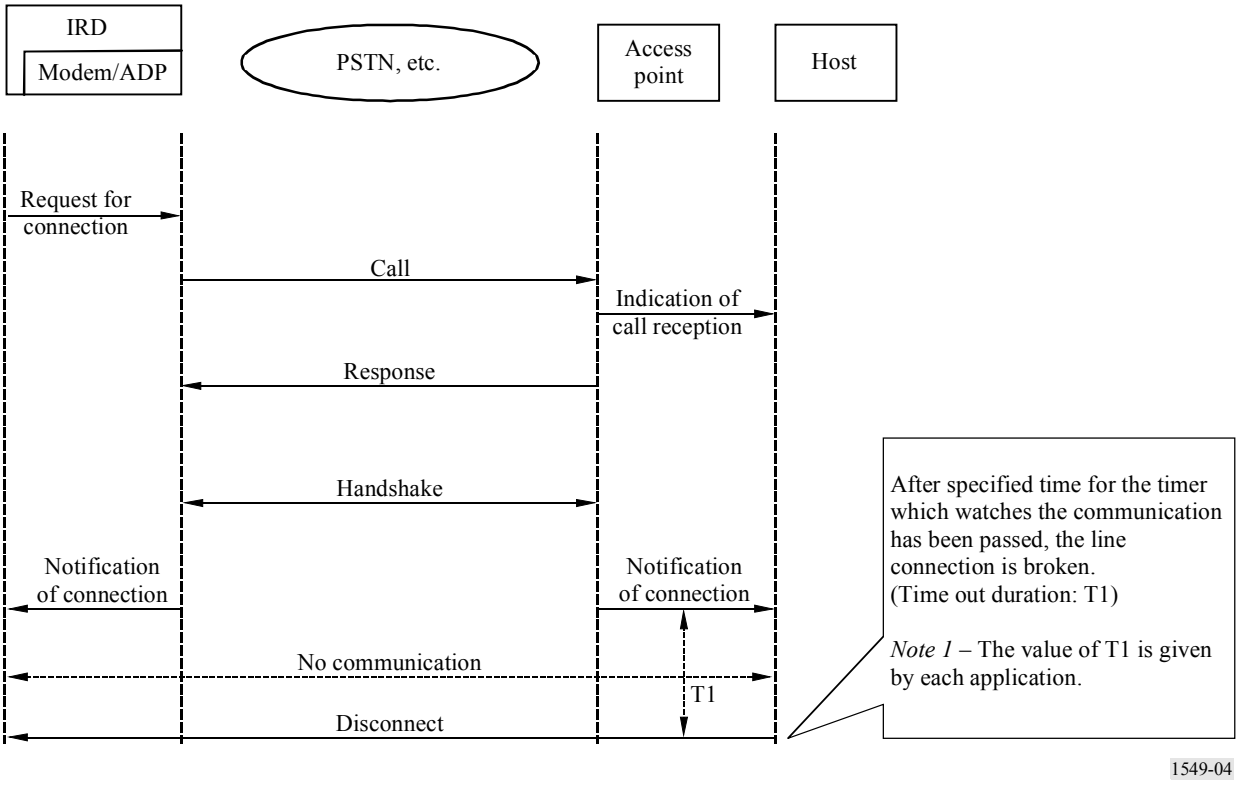


FIGURE 5

Error sequence
(rejection of call reception caused by host)

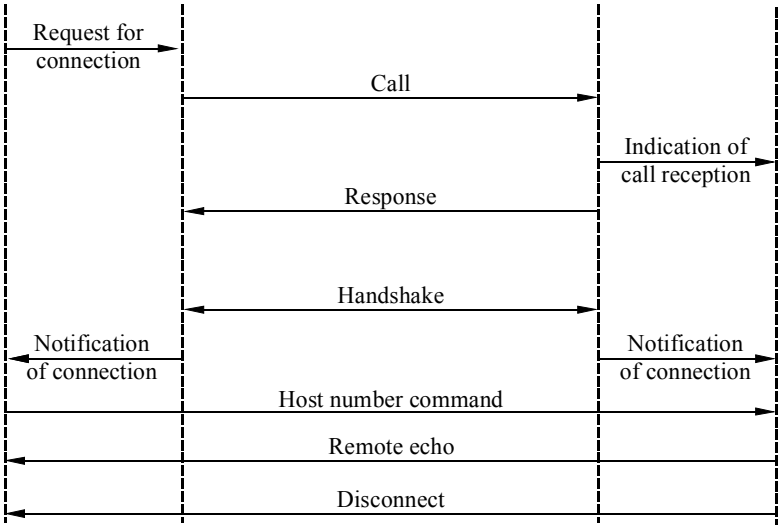


FIGURE 6

Error sequence
(error of remote echo)

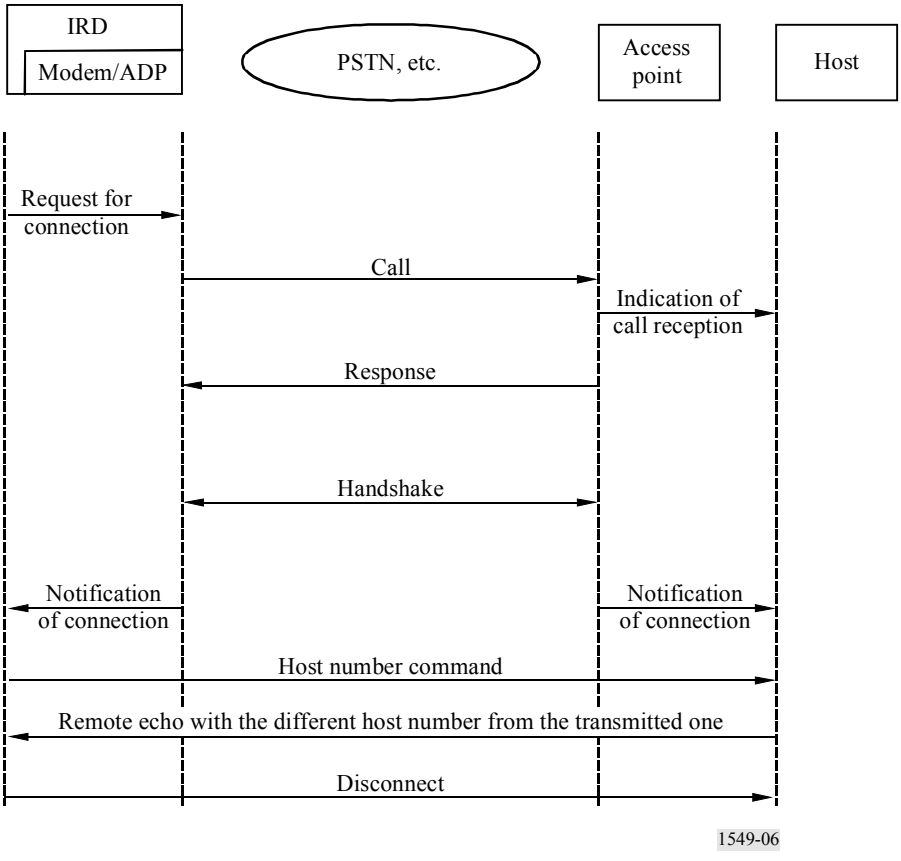


FIGURE 7

Error sequence
(time out occurred at receiver after waiting for remote echo)

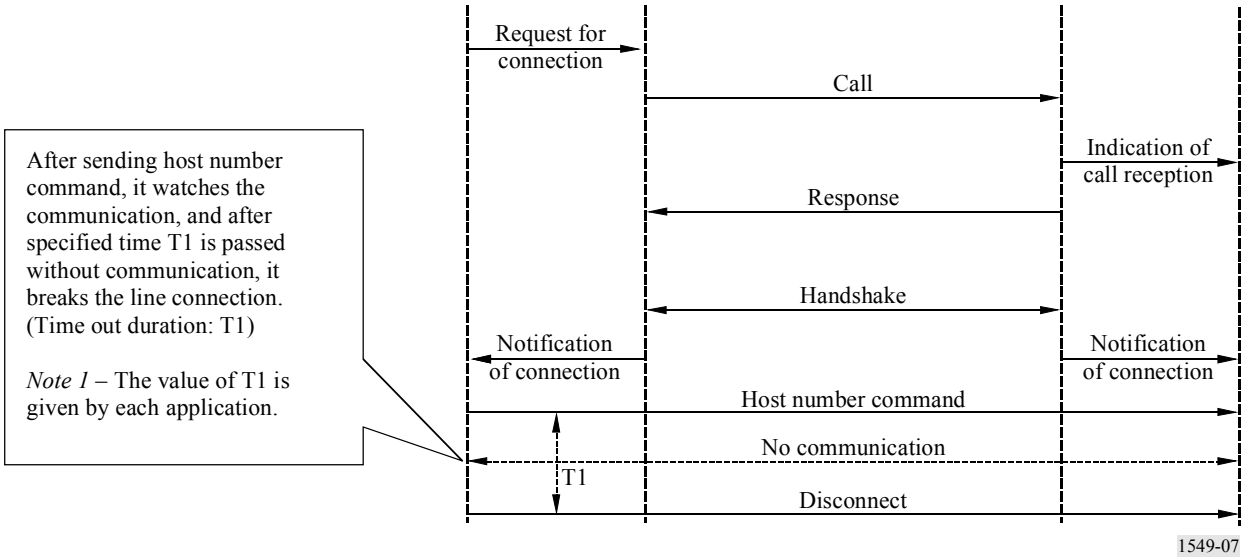


FIGURE 8

Error sequence
(error of service signal)

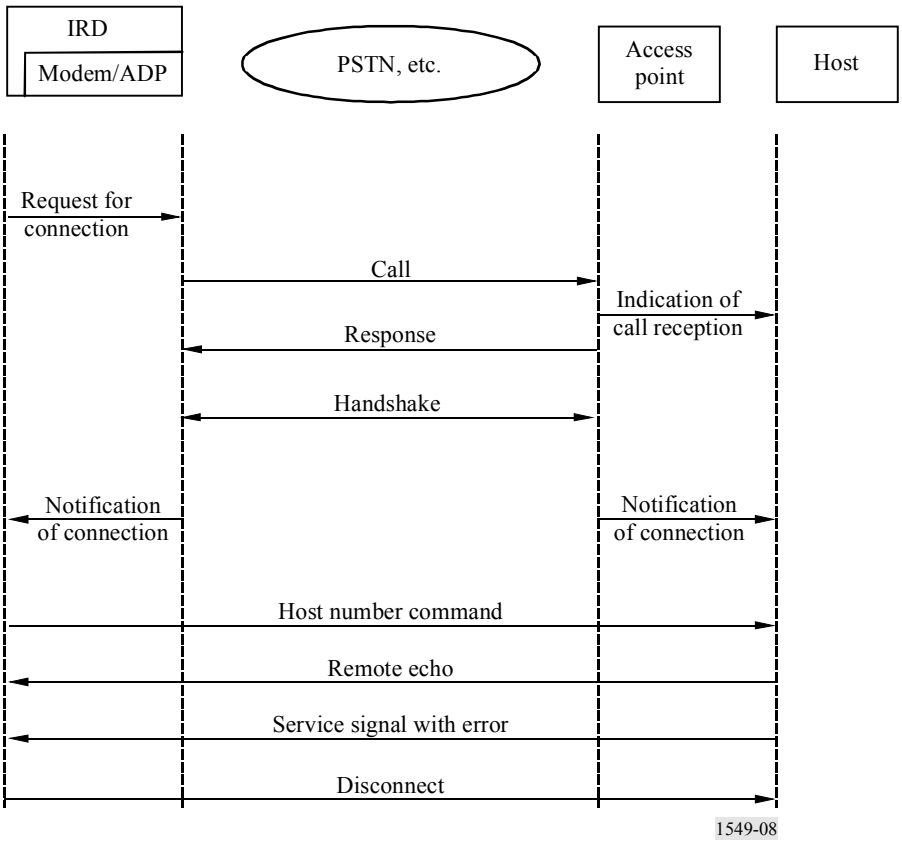
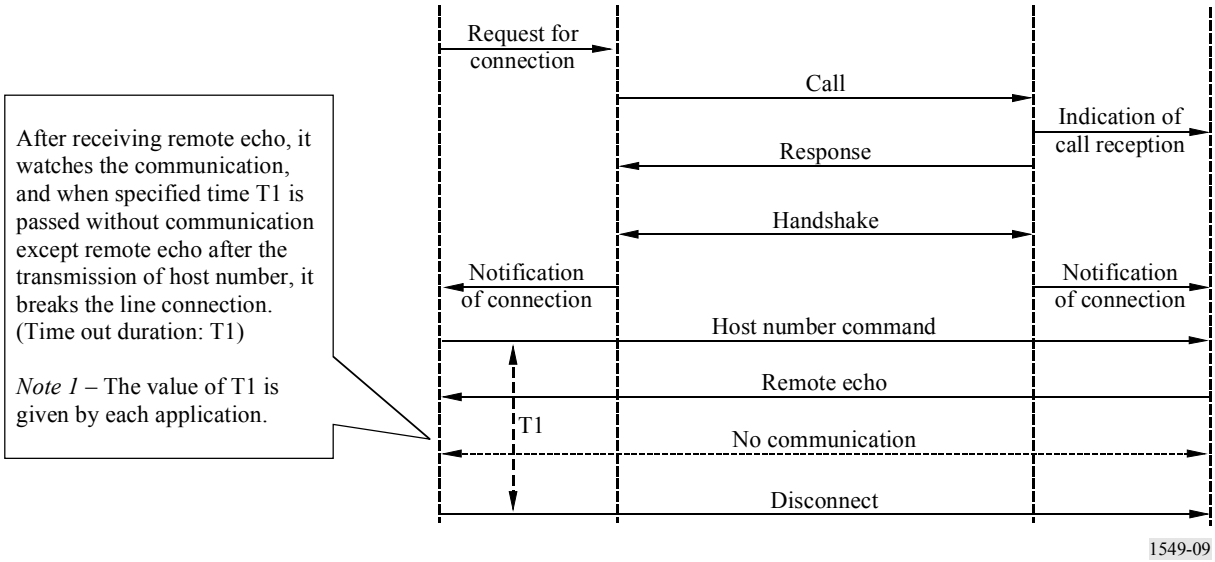


FIGURE 9

Error sequence
(time out occurred at receiver after waiting for service signal)



4.4.2 Break sequence

FIGURE 10

Disconnection initiated by receivers

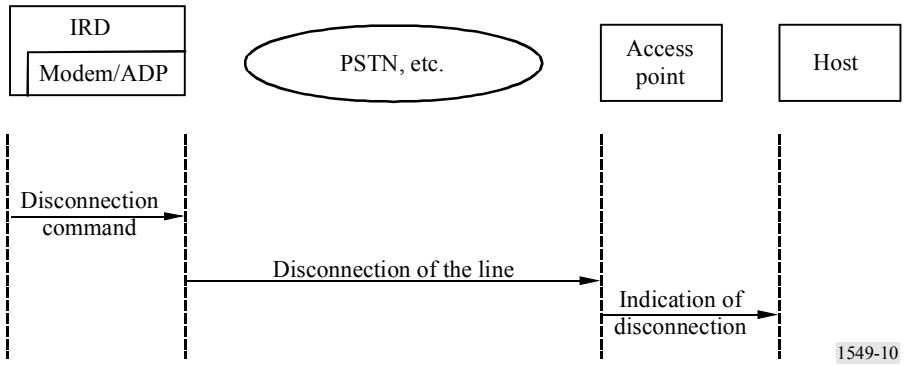
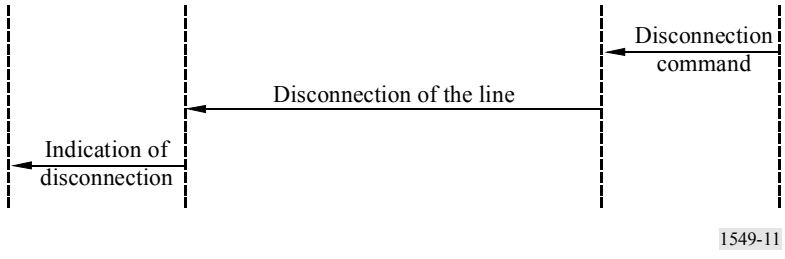


FIGURE 11

Disconnection initiated by host



An example format of the host number command and service signal is shown in Table 3.

TABLE 3

Example format of the host number command and service signal

		Format	Note
Host number command		N_1 N_2 N_3 N_4 N_5 N_6 N_7 N_8 CR Characters which are echoed back N_1 N_2 N_3 N_4 N_5 N_6 N_7 N_8 CR LF	8 alphanumeric characters are echoed back
Service signal	Notification of connection	CR LF COM CR LF	CR LF
	Command error	CR LF ERR▲INV CR LF	▲ means space

4.4.3 Receiver behaviour after transmitting host number command

4.4.3.1 Waiting for remote echo of transmitted host number

After sending the host number, receivers move into the waiting status in order to receive the remote echo. The behaviour of the receivers in this status is shown in Table 4.

TABLE 4

Behaviour of the receivers waiting for the remote echo

Received signal	Behaviour after receiving the signal
Same remote echo as the transmitted host number Reception of N_1 N_2 N_3 N_4 N_5 N_6 N_7 N_8 CR LF (8 characters prior to the CRLF are compared and the other characters are neglected)	Moves into the waiting status for service signal
Different remote echo from the transmitted host number Reception of ■■■■CR LF (■■■■ means code strings with any length larger than 0 byte other than N_1 N_2 N_3 N_4 N_5 N_6 N_7 N_8)	Disconnects the line immediately
After sending host number or re-sending it, it does not receive CR LF within the specified time (time out duration: T1)(1)	Disconnects the line immediately

(1) The timer of the receiver which watches the communication starts from the transmission of host number command or its retransmission. (The value of T1 is specified by each application.)

4.4.3.2 Waiting for service signal

After receiving the same remote echo as the transmitted host number, N_1 N_2 N_3 N_4 N_5 N_6 N_7 N_8 CR LF, receivers move into the waiting status for service signal. The behaviour of the receivers in this status is shown in Table 5.

TABLE 5

Behaviour of the receivers waiting for the service signal

Received signal	Behaviour after receiving the signal
Correct service signal (notification of connection) (1) Reception of CR LF COM CR LF	Moves into data transfer sequence
Correct service signal (command error)(1) Reception of CR LF ERR▲INV CR LF (▲ means space)	Retransmits host number immediately. Number of retransmission: 3 times. (It disconnects when CR LF ERR▲INV CR LF is received four times)
Service signal with errors(1) Reception of CR LF COM◊, CR LF ERR○, or CR LF□□□□CR LF (◊ means codes other than CR. ○ means codes other than space. □□□□ means strings with any length larger than 0 byte other than COM and ERR▲INV)	Disconnects the line immediately
After sending host number or resending it, it does not receive correct service signal within the specified time (time out duration: T1)(2)	Disconnects the line immediately

(1) The data which is received from the transition to the waiting status of service signal to the time when the first CR LF is received are discarded.

(2) The timer of the receiver which watches the communication starts from the transmission of host number command or its retransmission. (The value of T1 is specified by each application.)

4.4.4 Remote echo

When a receiver sends the host number command, the host side echoes back to the receiver. Thus the local echo back in the receiver is not necessary.

The host side echoes back after receiving the host number command, and sends a service signal in succession.

4.4.5 Start timing of the timer at the server side

The timer at the host side which watches the communication starts count-up from the completion of the line connection (end of the modem negotiation). The value of time out T1 is specified according to this start time. The timer resets after sending CR LF ERR▲INV CR LF.

APPENDIX 1

TO ANNEX 1

Example protocols used for direct connections (data transmission phase) together with the specified data link protocol (data link establishment and termination phase)

In the following protocols, error detection and correction protocols are either performed at the physical layer (MNP4), the data link layer or the network layer, whichever is specified by the operational rule.

NOTE 1 – Protocols at the physical layer in this Recommendation mean those of the physical layer and transport layer in ITU-T Recommendation J.111 (or Recommendation ITU-R BT.1434) and ITU-T Recommendation J.113 (or Recommendation ITU-R BT.1435), and, Protocols at the data link and higher layers mean the network independent protocols in ITU-T Recommendation J.111. These differences come from the IP protocol layer. In this specification IP is stated at the network layer, which is stated at the higher medium layer in ITU-T Recommendation J.111.

TABLE 6

Text communications protocol stack

<table>
<tr><th colspan="2"></th><th colspan="2">Protocol stack</th></tr>
<tr><td colspan="2">Application layer</td><td colspan="2">Selected according to service</td></tr>
<tr><td colspan="2">Data link layer</td><td colspan="2">Non procedure (tele-typewriter (TTY) protocol)</td></tr>
<tr><td colspan="2">Physical layer</td><td>Receiver</td><td>Host</td></tr>
<tr><td colspan="2">Basic modem</td><td colspan="2">ITU-T Recommendation V.22 bis and later</td></tr>
<tr><td colspan="4">Examples of optional modem</td></tr>
<tr><td rowspan="3"></td><td>Advanced modem</td><td colspan="2">ITU-T Recommendation V.34 and later + V.42 bis</td></tr>
<tr><td>Mobile phone (circuit switched service)</td><td>PDC(1): 9 600 bit/s</td><td>PDC: 9 600 bit/s or ITU-T Recommendation V.32 bis + V.42 bis(2)</td></tr>
<tr><td>PHS(3)</td><td colspan="2">PIAFS(4): 32 kbit/s or more.</td></tr>
</table>

(1) Personal digital cellular: PDC of Recommendation ITU-R M.1073 – Digital cellular land mobile telecommunication systems.

(2) Converted to analogue data by mobile phone network (same hereinafter).

(3) Personal handy-phone system: System 6 of Recommendation ITU-R M.1033 – Technical and operational characteristics of cordless telephones and cordless telecommunication systems.

(4) PHS Internet access forum standard.

NOTE 1 – This protocol stack would be possible for extension of other mobile phone networks including International Mobile Telecommunications-2000 (IMT-2000). Support for these networks may be considered for creation of the Recommendation.

TABLE 7a

Communications protocol stacks for binary transmissions

		Protocol stack	
Application layer		Selected according to service	
Data link layer		Basic mode control procedure for data communication systems (ISO 1745) (only required functions implemented) Code-independent mode	
Physical layer		Receiver	Host
Basic modem		ITU-T Recommendation V.22 *bis* and later	
Examples of optional modem			
	Advanced modem	ITU-T Recommendation V.34 and later + V.42 *bis*	
	Mobile phone (circuit switched service)	PDC(1): 9 600 bit/s	PDC: 9 600 bit/s or ITU-T Recommendation V.32 *bis* + V.42 *bis*(2)
	PHS(3)	PIAFS(4): 32 kbit/s or more.	

(1), (2), (3) and (4) see footnotes (1), (2), (3) and (4) to Table 6.

NOTE 1 – This protocol stack would be possible for extension of other mobile phone networks including International Mobile Telecommunications-2000 (IMT-2000). Support for these networks may be considered for creation of the Recommendation.

TABLE 7b

Communications protocol stacks for binary transmissions

		Protocol stack	
Application layer		Selected according to service	
Data link layer		Basic mode control procedure for data communication systems (ISO 1745) Code-independent mode	
Physical layer		Receiver	Host
Basic modem		ITU-T Recommendation V.22 *bis* and later	
Examples of optional modem			
	Advanced modem	ITU-T Recommendation V.34 and later + V.42 *bis*	
	Mobile phone (circuit switched service)	PDC(1): 9 600 bit/s	PDC: 9 600 bit/s or ITU-T Recommendation V.32 *bis* + V.42 *bis*(2)
	PHS(3)	PIAFS(4): 32 kbit/s or more.	

(1), (2), (3) and (4) see footnotes (1), (2), (3) and (4) to Table 6.

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