1.3 BASIC DATA TRANSMISSION TECHNOLOGY

1.3.1 Networks

Introduction

Modern data processing technics allow more data to be processed nowadays than was previously possible. To meet the requirement of transferring larger quantities of data faster the Public Data Network is added to the Public Telephone Network which is usually used for data transmission.

Public Telephone Network

Data transmitted over the Public Telephone Network is converted into analogue signals by means of modem and in the receiving end converted back to digital signals by another modem.

The maximum permissable transfer rate at present is 2400 bps using the 'switched' Public Telephone Network.

Using 'leased' telephone circuits it may be possible to attain rates upto 9600 bps and may be increased further on leased wideband circuits.

Public Data Network

The Public Data Network is designed for data transmission only. The network is a digital network providing synchronous data transmission, but it is possible to connect asynchronous data terminal equipment for lower transmission rate; 600 - 19.200 bps.

Data terminal equipment with CCITT X21 (X21 bis/X20 bis) interface may be connected to the network.

1.3.2 Transfer Techniques

HDLC Procedure (Protocol)

HDLC (High-level Data Link Control) is the procedure used in data communication systems where a very reliable and high-volume transfer is required. (High-level means here that the procedure is intelligent).

The HDLC procedure synchronises the link and is capable of detecting errors in any kind of sequence and the only way to achieve this is to transmit data in blocks with a Cyclic Redundancy Check (CRC).

Therefore, in HDLC all transmissions are in form of frames as shown in X25 and the **information** can be in any form, length and code. To distinguish between flags and information the transmitter equipment inserts a "0" bit after all sequences of 5 consecutive "1" bits in all the information between the flags. These extra "0" bits are in the receiver removed so as the information is **transparently** (without any changes) transferred from one end to the other.

SDLC Procedure (Protocol)

While HDLC is the ISO's synchronous protocol the SDLC is IBM's bit-oriented synchronous protocol. They are basically the same except when it comes to extending address field or control field and aborting characters.

The SDLC uses address-bytes and max 256 bits while HDLC lets you extend its address and control fields unlimited.

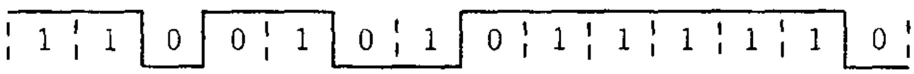
NRZI (Nonreturn-to-Zero Inverted)

The NRZI encoding and decoding lets the SDLC protocol to be used over links that are basically asynchronous.

Under NRZI coding the signals remain steady for transmitting a ONE and change for transmitting a ZERO.

Because of the "0"-bit insertion requirement strings longer than five "1"-bits are broken up. This means that the NRZI coding assures that, when active, the line will have at least one transition every five bit times. So strings of ZEROes are translated into transitions each bit time.

Asynchronous receivers, using either digital or analogue phase-locked loops, can usually extract the "bit-detection clock" from such data streams of NRZI.



NRZI coding, changing on ZEROes

Balanced and Unbalanced Lines

Balanced and unbalanced mean different things to hardware and software:

- Hardware — unbalanced circuits - are shown in V10 (X26)
  balanced circuits - can be seen in V11 (X27)

- Software — unbalanced mode - means that one master station communnicates with on or more slaves, as in PTS Interncom.
  balanced mode - means that any station connected to the line is able to communicate with any other station on the same line

1.3.3 International Standards

General

V and X series standards are recommendations of the CCITT (Consultative Committee for International Telephone and Telegraph) which is located in Switzerland and includes all countries in the world. This committee tries to adapt the V recommendations to other organizations´ standards, i.e. EIA (The Electronic Industries Association) which is the USA´s trade association of electronic equipment manufacturers and IEEE (The Institute of Electrical and Electronic Engineers' Computer Society) concerned with computer and communication standards.

Another well known standard is the one from ISO (The International Organization for Standardization) where the membership is limited to 62 full members and 19 correspondent members. The job of ISO includes standards for communication through all types of telecommunication media.

There are 36 of these V series Recommendations which relate to the transmission of data over the **Public Telephone Network.**

The best known is V24 which specifies the use of interchange circuits at the interface between customer and administration equipment for transporting data in the "analogue" telephone network. Notice, however, that V24 is only a list of signals and the operation conditions of them. All are not used simultaneously by an equipment.

Notice also that V24 is not used by its own but combined with several of the other V recommendations; e.g. V27 telling the transfer baud rate and V28 telling the electrical characteristics for the interface circuits.

The X series Recommendation is applicable for data transmission over the **Public Data Network** which is a "digital" system with superior error performance and fast switching better suited to data transmissions.

Besides the use of different types of transmission networks the transfer procedure differs too, as the terminal equipment provided with a V24 interface uses about 10 separate lines but only 2 balanced lines (with a common return) are used when the equipment is provided with e.g. an X27 interface .

CCITT **V Series Recommendations**

V1 Equivalence between binary notation symbols and the significant conditions of a two-condition code

Digit "0" = Start / Space / Condition A
Digit "1" = Stop / Mark / Condition 2

V2 Power levels for data transmission over telephone lines. Measured in dB.

V3 International Alphabet No.5 (CCITT-5), see Table 1.3-1.

V4 General structure of signals of International Alphabet No. 5 code for data transmission over the public network order of the bit binary numbering. The low order bit should be transmitted first in serial transfer.

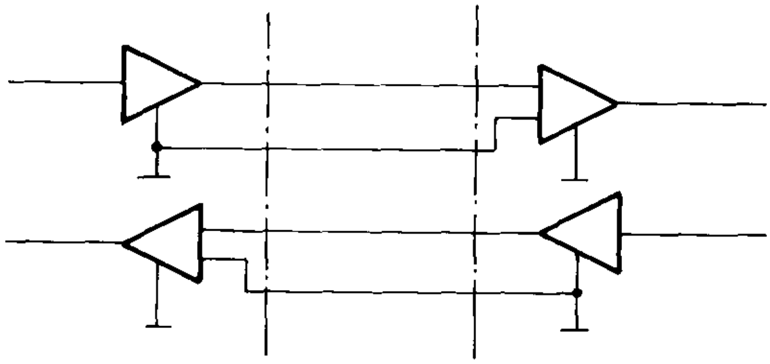
V5 Standardization of data-signalling rates for synchronous data transmission in the general switched telephone network.

V6 Standardization of data-signalling rates for synchronous data transmission of leased telephone-type circuits.

Table 1.3-1 International Alphabet No. 5 (V3)

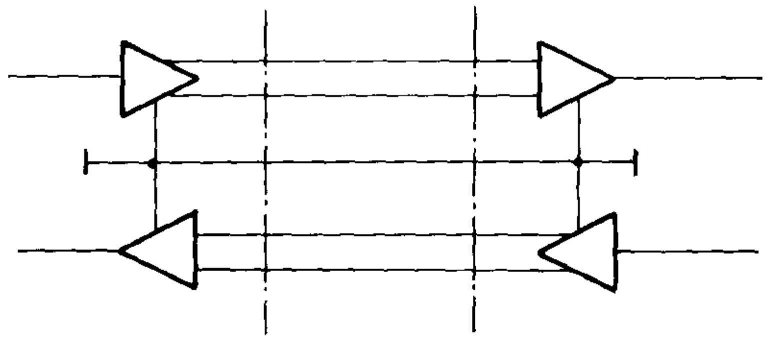
				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
b4	b3	b2	b1		0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	TC7 (DLE)	SP	0	@	P		p
0	0	0	1	1	TC1 (SOH)	DC1	!	1	A	Q	a	q
0	0	1	0	2	TC2 (STX)	DC2	"	2	B	R	b	r
0	0	1	1	3	TC3 (ETX)	DC3	#	3	C	S	c	s
0	1	0	0	4	TC4 (EOT)	DC4	¤	4	D	T	d	t
0	1	0	1	5	TC5 (ENQ)	TC8 (NAK)	%	5	E	U	e	u
0	1	1	0	6	TC6 (ACK)	TC9 (SYN)	&	6	F	V	f	v
0	1	1	1	7	BEL	TC10 (ETB)	'	7	G	W	g	w
1	0	0	0	8	FE0 (BS)	CAN	(	8	H	X	h	x
1	0	0	1	9	FE1 (HT)	EM	)	9	I	Y	i	y
1	0	1	0	10	FE2 (LF)	SUB	*	:	J	Z	j	z
1	0	1	1	11	FE3 (VT)	ESC	+	;	K	[	k	{
1	1	0	0	12	FE4 (FF)	IS4 (FS)	,	<	L	\	l	|
1	1	0	1	13	FE5 (CR)	IS3 (GS)	-	=	M	]	m	}
1	1	1	0	14	SO	IS2 (RS)	.	>	N	^	n	‾
1	1	1	1	15	SI	IS1 (US)	/	?	O	_	o	DEL

V10(X26) Electrical characteristics for **unbalanced** double-current interchange circuits for general use with integrated circuit equipment in the field of data communications (identical to X26).



Interconnection example of signal common return

V11(X27) Electrical characteristics for **balanced** double-current interchange circuits for general use with integrated circuit equipment in the field of data communications (identical to X27).



Interconnection example of balanced interchange circuits

V15 Use of acoustic coupling for data transmission.

V19 Modems for parallel data transmission using telephone signalling frequencies.

V20 Parallel data transmission modems standardized for universal use in the general switched telephone network.

V21 200-baud modem standardized for use in the general switched telephone network.

V23 600/1200 baud modem standardized for use in the general switched telephone network.

V24 List of definitions for interchange circuits between data terminal equipment and data circuit-terminating equipment, see Table 1.3-2.

V25 Automatic calling and/or answering equipment on the general switched telephone network, including disabling of echo suppressors on manually established calls.

V26 2400 bits per second modem standardized for use on four-wire leased circuits.

V26bis 2400/1200 bits per second modem standardized for use in the general switched telephone network.

V27 4800 bits per second modem standardized for use on leased circuits.

V27bis 4800 bits per second modem with **automatic equalizer** standardized for use on leased circuits.

V27ter 4800/2400 bits per second modem standardized for use in the general switched telephone network.

V28 Electrical characteristics for **unbalanced** double-current interchange circuits. Significant levels:

Signal	< -3V	> +3V
Data	1	0
Control & Timing	Off	On

connecting cable, the additional connection considerations are part of Recommendation X24.

** Continuous isochronous transmission will be provided.

*** May be provided as an optional additional facility

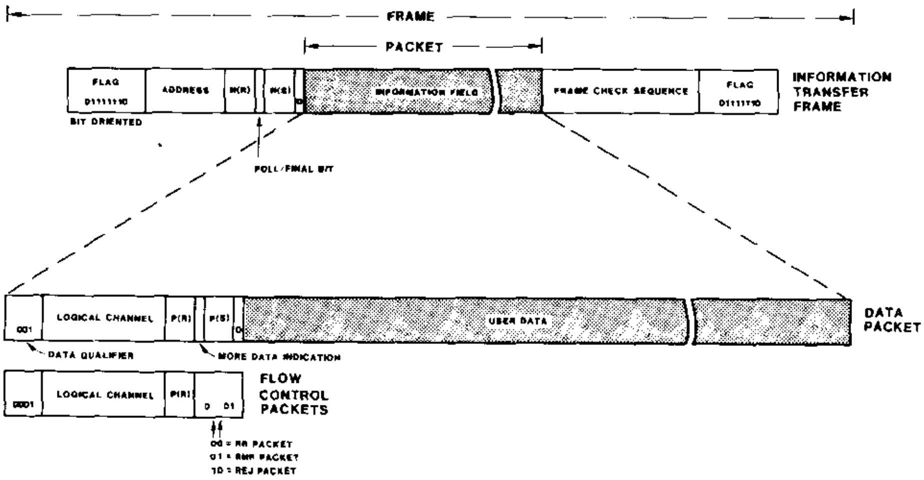
X21bis Use on public data networks of data terminal equipments which are designed for interfacing to synchronous V-series modems.

X24 List of definitions of interchange circuits between data terminal equipment and data circuit-terminating equipment on public data networks (compare V24).

Interchange circuit	Interchange circuit name	Data		Control		Timing	
		to DCE	from DCE	to DCE	from DCE	to DCE	from DCE
G	Signal ground or common return						
Ga	DTE common return			X			
Gb	DCE common return				X		
T	Transmit	X		X			
R	Receive		X		X		
C	Control			X			
I	Indication				X		
S	Signal element timing						X
B	Byte timing						X

X25 Interface between data terminal equipment and data circuit-terminating equipment for terminals operating in the packet mode on public data networks.

All transmissions are in frames conforming to one of the formats of Table 1/X25. The flag preceding the address field is defined as the opening flag.



X26 (V10) Electrical characteristics for **unbalanced** double-current interchange circuits for general use with integrated circuit equipment in the field of data communications (identical to V10).

X27 (V11) Electrical characteristics for **balanced** double-current interchange circuits for general use with integrated circuit equipment in the field of data communications (identical to V11).

X28 DTE/DCE interface for a start/stop mode data terminal equipment accessing the packet assembly/disassembly facility (PAD) on a public data network situated in the same country.

X29 Procedures for exchange of control information and user data between a packet mode DTE and a packet assembly/disassembly facility (PAD).

X92 Hypothetical reference connections for public synchronous data networks.

X95 Network parameters in public data networks.

X96 Call progress signals in public data networks.

ISO Standards for Connector Pin Assignments

This International Standard (ISO 2110-1972E) specifies the assignment of connector pin numbers at the interface between data terminal equipment (DTE) and data communication equipment (DCE) either **modems** or **automatic calling equipment** where CCITT-V24 is applicable.

In general 25 pin connectors are used and the male connector (plug) is associated with the DTE and the female connector (socket) with the DCE (modem). However, a 37 pin connector is standardized for the V24/X26 interfaces.

Pin assignment for the 25 pin connectors is given in Table 1.3-3.

The ISO standard 4903 assigns the pin number of the 15 pin connectors used at X20 and X21 interfaces, see Table 1.3-4.

Table 1.3-3 Pin assignment in 25-pin connectors

Pin number	Interchange circuit numbers and remarks											
	Voice band modems					Public data networks			Telegraph		Automatic calling	
	Asynchronous		Synchronous	Parallel								
	A V21	B V23	C V26, V26 bis V27, V27 bis V27 ter, V29	D V19, V20 Instation	E V20 Outstation	F X20 bis	G X21 bis	H X20	I Telex	J Other	K Telephone V25	L Telex S16
1	101	101	101	101	101	101	101	101	101	101	212	212
2	103	103	103	Note	192-A	103	103	T	103	103	211	211
3	104	104	104	A1	A1	104	104	R	104	104	205	205
4	105	105	105	A2	A2	F	105	F	N	N	202	202
5	106	106	106	A3	A3	106	106	F	106	106	210	210
6	107	107	107	A4	B1	107	107	F	107	107	213	213
7	102	102	102	131	B2	102	102	G	102	102	201	201
8	109	109	109	109	B3	109	109	F	109	109	F	F
9	N	N	N	C1	C1	N	N	N	N	N	N	N
10	N	N	N	C2	C2	N	N	N	N	N	N	N
11	126	N	N	C3	C3	F	N	N	N	N	F	F
12	F	122	122	C4	192-B	F	F	N	F	F	F	F
13	F	121	121	B1	Note	F	F	N	F	F	204	204
14	F	118	118	B2	125-A	F	F	N	F	F	206	205
15	F	114	114	B3	125-B	F	114	N	F	F	207	207
16	F	119	119	B4	105-A	F	F	N	F	F	208	208
17	F	115	115	191-A	105-B	F	115	N	F	F	209	209
18	141	141	141	191-B	129-A	N	N	F	132	F	F	F
19	F	120	120	130	129-B	F	F	F	F	F	F	F
20	108/1 108/2	108/1 108/2	108/1 108/2	105	119-A	108/1 108/2	108/1 108/2	F	108/2	108/2	F	F
21	140	140	140	125	119-B	N	N	F	F	F	F	F
22	125	125	125	108/1 108/2	107-A	125	125	F	125	125	203	203
23	N	111	111	107	107-B	N	N	F	N	N	N	N
24	N	N	113	102	108-A	N	F	F	N	N	N	N
25	142	142	142	124	108-B	N	142	F	F	F	F	F
Electrical characteristics	V28	V28	V28	V28	V31	V28	V28	V28	V28	V28	V28	V28

N = Pin number permanently reserved for national use.
F = Pin number reserved for future International Standard and should not be used for national use.

The V24 signals 140, 141 and 142 are assigned to the pins 21, 18 and 25 in the columns A, B and C.

Table 1.3-4 Pin assignment in 15-pin connectors

Pin number	Interchange circuit assignment			
	X20		X21	
	X26	X27	X28	X27
1	*)	*)	*)	*)
2	T	T	T	T
3	-	-	C	C
4	R	R	R	R
5	-	-	I	I
6	-	-	S	S
7	-	-	S	S
8	G	G	G	G
9	Ga	T	Ga	T
10	-	-	Ga	C
11	Gb	R	R	R
12	-	-	I	I
13	-	-	S	S
14	-	-	B	B
15	Reserved for future use			

*) Pin 1 is assigned for connecting the shields between tandem sections of shielded interface cable. The shield may be connected either to protective ground or to signal ground at either the DTE or DCE or both in accordance with national regulations.

1.4 LWSI/RWSI COMMUNICATION METHODS

1.4.1 Introduction

HDLC Protocol

The data communication is full duplex and data is serially transferred at a speed of 96 kbit/sec. for LWSI and 600-19200 bit/sec. for RWSI.

The way of transferring data is decided by a procedure described in a protocol called HDLC (High-level Data Link Control). A Data Link is not only the hardware of the LWSI line but as well the procedure needed to establish the communication channel between a primary and a secondary unit.

Philips is not using the whole international standardized HDLC protocol but a real subset. The HDLC procedure synchronises the data link to the work stations and is capable of detecting errors in any kind of sequences.

The only way to achieve this is to transmit data in blocks, called frames, with a Cyclic Redundancy Check (CRC). The HDLC procedure provides the information block, called a data packet, with the necessary sync characters (flags) and control characters. The procedure also calculates the CRC-sum and inserts extra "zeroes" when transmitting data and removes them again in the receiving end. "Zero" insertion is done to allow data equal to flags to be sent in the data field without any effect.

The HDLC procedure permits any form of data to be transparently (without any changes) transferred from one end to the other. The frame structure is defined in the ISO 3309-1976(E) standard.

Polling

The communication between the TC and the work stations is performed by a polling procedure governed by the primary unit. This means that a work station cannot send anything until it is polled by the primary unit (TC or Work Station Controller). The poll frequency can be upto 35 Hz/WS.

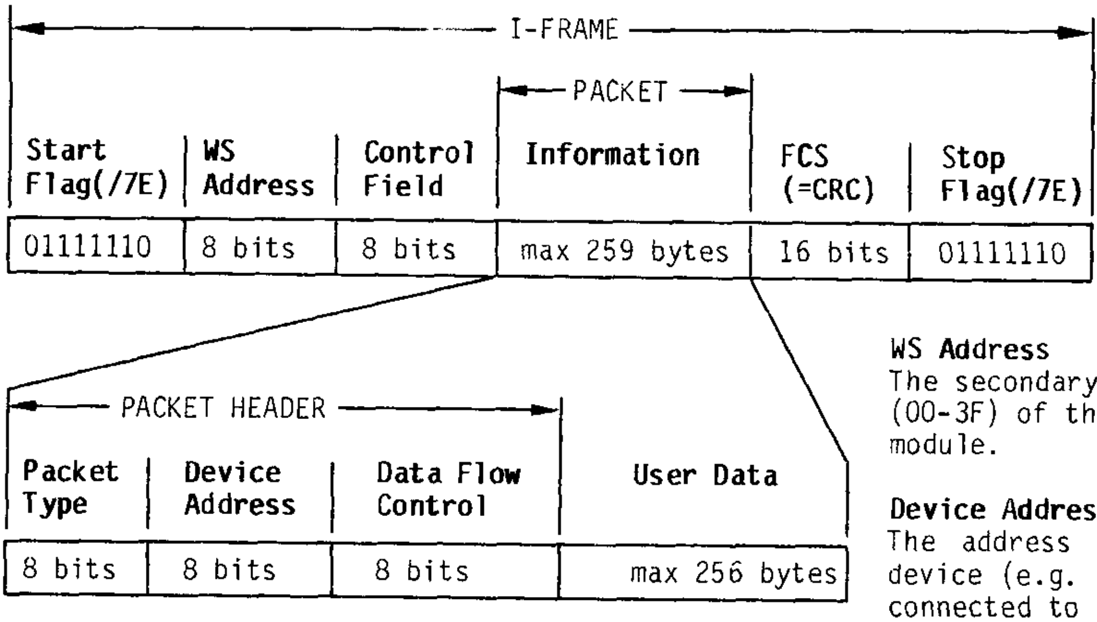
1.4.2 Frames

Figure 1.4-1

Structure

The frames can be of any length upto 265 bytes. A frame begins and ends with one or more flag bytes (01111110) and contains always a workstation address byte, a control byte and two FCS bytes.

The data between the control and the FCS bytes is called a Packet consisting of a 3 byte Packet Header (device address and two more control bytes) and a variable length (max 256) of information to/from a device.



WS Address
The secondary address (00-3F) of the main module.

Device Address
The address (0-7) of a device (e.g. keyboard=1) connected to the work-station module.

Figure 1.4-1 Frame structure

- **Flag** — The flag is used for frame synchronization and all stations hunt for this bit sequence. (The only byte which contains more than 5 ONEs in a sequence.)

- **WS Address** — identifies the work station address to/from which the frame is transferred. The address is calculated in the following way:
  2 x WS number - 1 = WS Address
  Example 1: WS number 11 has the address 2x11 - 1 = 21_{10} = 15_{16}
  Example 2: WS number 5 has the address 2x5 - 1 = 9_{10} = 09_{16}

- **Control** — This field contains commands/responses. The primary unit, the TC, uses this field to command the secondary unit, a work station, to perform a particular operation. The work station uses this field to respond to the TC.

- **Information** — This field, called packet, contains information to/from the WS. This field is in some frames not included and in others it only contains the packet header.

- **FCS** — means Frame Checking Sequence and is a type of CRC control to detect transmission errors.

Note: All bytes are transmitted on the line with low order bit (2^0) first. However, when looking at the data stream on the line by means of the LWSI Datascope this unit converts the bytes in the opposite order. Because of this, the bits within the bytes are in this manual presented with the least significant bit, 2^0, most to the right.

To ensure data bytes not being interpreted as flags the HDLC procedure at transmission inserts a "0" bit after all sequences of 5 continous "1" bits for all data between the flags.

At reception of a frame the HDLC procedure removes this extra "0" bits.

Types

There are three formats of frames used and they are defined by the HDLC control byte:

- I-Frames — numbered information frames, contains data to/from a device and the number of sent and received frames.

- S-Frames — numbered supervisory frames used to perform data link supervisory functions as:
  - acknowledge I-Frames (wnen it cannot be done in an I-Frame)
  - Polling
  - requesting retransmission of I-Frames
  - indicating "temporary not ready" to receive I-Frames

- U-Frames — unnumbered control frames. This format contains no sequence number of the frames. U-Frames are additional data link control functions such as:
  - open a data link by means of the SNRM* command
  - disconnect a work station
  - reject a frame
  - unnumbered acknowledge is the response to one of the other U-Frames.

*SNRM = Set Normal Response Mode, is a command sent from TC to open a data link between TC and a work station.

"Numbered frames" means that they in the control field contain a sequence number of messages sent, N(S), waiting to be acknowledged and a sequence number for next message to be received, N(R). The highest sequence number is 7, which means that max 7 frames could await to be acknowledged. However, there is a practical limit of 4 frames waiting for ACK and if this number is exceeded the next frame is rejected.

Packets

The information, "the Packet", is of two types:

- Type 1: (/11): Transmitted data, to which no acknowledgement is expected e.g. "Echo" to display. No flow control is implemented.

- Type 2 (/10): Transmitted data that must be acknowledged by the receiver when executed; e.g. a string of characters printed on the printer. These messages include a flow control byte.

Five different Type-2 messages can be sent:

1. Data packet
2. Receive Ready packet (RR)
3. Receive Not/Ready packet (RNR)
4. Reset packet (RES)
5. Reset Confirmation packet (RESC)

The packet header (the three first bytes of the packet) contains information for the PLSP (Philips Link Sharing Protocol = SLSP, Simple Link Sharing Protocol).

The meaning of these three bytes is shown in some examples below:

Packet Header			Meaning		
Byte 1	**Byte 2**	**Byte 3**	**Byte 1**	**Byte 2**	**Byte 3**
10	02	64	Type 2 data	Dev. Addr 2 (Printer)	Counters + Data pack.
10	01	81	Type 2 data	Dev. Addr 1 (Keyboard)	Counters + Flow Contr.
11	01	C0	Type 1 data	Dev. Addr 1	Counter

Byte 1 (↑): always "1"

Byte 3 (↑):
even = Data packet
odd = Flow Control (e g. RR)

The HDLC control byte, the one after the WS address byte, determines which type of frame that is transferred.

			← PACKET →		
FLAG	WS ADDR.	CONTROL	Variable (0-259)	FCS	FLAG

	8 (MSB)	7	6	5	4	3	2	1 (LSB)	
I-Frames	N(R)			P/F	N(S)			0	I, Information
S-Frames	N(R)			P/F	0	0	0	1	RR, Receiver Ready
	N(R)			P/F	0	1	0	1	RNR, Receiver Not Ready
	N(R)			P/F	1	0	0	1	REJ, Reject
U-Frames	1	0	0	P	0	0	1	1	SNRM, Set Normal Response Mode
	0	1	1	F	0	0	1	1	UA, Unnumbered Acknowledge
	1	0	1	F	0	1	1	1	FRMR*, Frame Reject
	0	1	0	F	0	1	1	1	DISC, Disconnect
	0	0	0	F	1	1	1	1	DM, Disconnect Mode

* The FRMR contains three more information bytes

← Byte 1 →	← Byte 2			→	← Byte 3							→
Rejected Frame control byte	V(R)	C/R	V(S)	0	0	0	0	0	X	Y	Z	W

Figure 1.4-2 All Frame-types used at HDLC level (Level 2)

- Bit number 1 is "0" in an I-Frame and "1" in S- and U-Frames.
- Bit number 2 is "0" in an S-Frame and "1" in an U-Frame.
- Bits number 3 and 4 indicate in an S-Frame RR (00), RNR (10) and REJ (01).

BIT 4	BIT 3		Definition
0	0	RR	"Receive Ready Command and Response" used to indicate that the originating station is ready to receive an I-Frame and to acknowledge previously received I-Frames numbered upto N(R)-1.
0	1	RNR	"Received Not Ready Command and Response" used to indicate busy; i.e. temporary inability to accept additional incoming I-Frames. I-Frames upto N(R)-1 are acknowledged.
1	0	REJ	"Reject Command and Response" used to request retransmission of I-Frames starting with the frame N(R). I-Frames N(R)-1 and below are acknowledged.

In a U-Frame these bits together with the bits 6, 7, 8 are called modifier (M) bits.

- Bit number 5 in the control field is called P/F, Poll or Final.

  The Poll bit is used in a command, from the TC to a WS, to request a response. This means that a work station cannot transmit until a command with the P bit set to ONE is received.

  The Final bit is set in responses from a WS to TC. However, if there are several frames to be transmitted from the same work station, the bit is set to ONE only in the last frame of its response.

- N(S) is the sequence number of the last frame that is sent.
- N(R) is the number of the next frame to be received. The previous frames are acknowledged.

	CONTROL FIELD BIT ORDER							
Type of Frame	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
I-Frame		N(R)		P/F		N(S)		0
S-Frame		N(R)		P/F	S	S	0	1
U-Frame	M	M	M	P/F	M	M	1	1

Figure 1.4-3 Control Field Formats summary

Important Sequences in HDLC

In the table below is shown the direction of commands and responses. There is also the type of frame indicated.

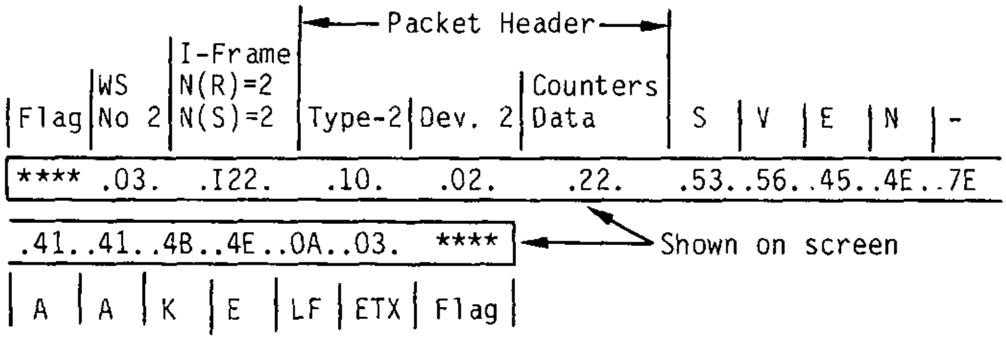
P=1	means polling
F=1	means the final bit in one or more frames from one WS.
I, 1, 3	means that N(R) = 1 and N(S) = 3
X	means any number of frames.

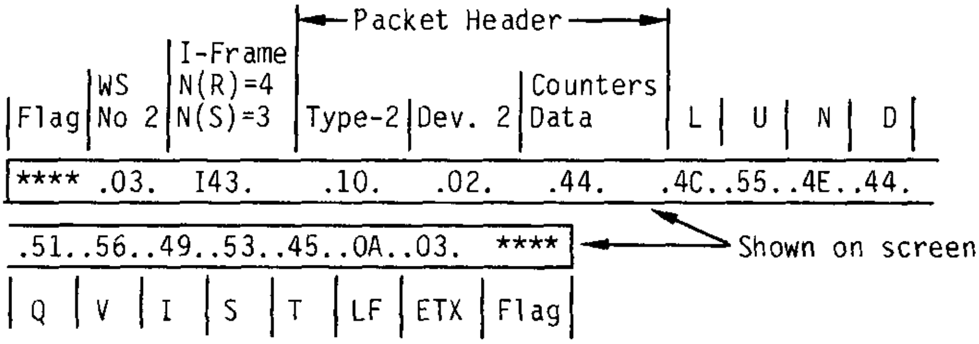
	TC or WSC (Primary)	FRAME TYPE	WORK STATION, DLH (Secondary)	COMMENTS
Ex. 1	SNRM, P(=1)	U-		Data link opened and WS polled and reset.
		U-	UA, F(=1)	Unnumbered Acknowledge.
	RR, N(R)=0, P(=1)	S-		WS polled.
		S-	RR, N(R)=0, F(=1)	WS ready, but has nothing to send.
	3 possible answers	I-	I,0,0, + 0,1 + 0,2, F(=1)	3 I-Frames are sent as example.
		S-	RNR, 0, F(=1)	WS not ready and has nothing to send.
	I,X,0 P(=0)	I-		Answer in next I- or RR-Frame from WS.
Ex. 2	RR, N(R)=3, P(=1)	S-		WS polled.
		I-	I,1,3 + 1,4, F(=1)	2 I-Frames.
	REJ, 3. P(=1)	S-		Frame 3 is not received by TC so it is rejected.
		I-	I,1,3 + 1,4, F(=1)	Retransmission of I-Frames as from N(R)=3
Ex. 3	I,0,X+0,X+1 P(=0)	I-		I-Frame, no polling.
	RR N(R)=0 P(=1)	S-		WS polled.
		S-	REJ, X, F(=1)	Frame X is not received (but X+1 is).
	I,0,X+0,X+1 P(=0)	I-		Retransmission of the I-Frame X and X+1.
Ex. 4	RNR,X P(=1)	S-		The primary is not ready for more I-Frames, but can receive S-Frames.
		S-	RR, X, F(=1)	
		S-	RNR, X, F(=1)	
		S-	REJ, X, F(=1)	
Ex. 5	SNRM, P(=1)	U-		
		U-	FRMR, F(=1)	The frame is not correctly received so it is rejected.
	RR, N(R=6), P(=1)	S-		Upto frame 5 are acknowledged, polled
		U-	DM, F(=1)	WS in disconnect mode.
	DISC	U-		TC disconnects the WS.
		U-	UA, F(=1)	Frame acknowledged.

Figure 1.4-4 Transfer Sequences

Monitoring LWSI Transmit Line

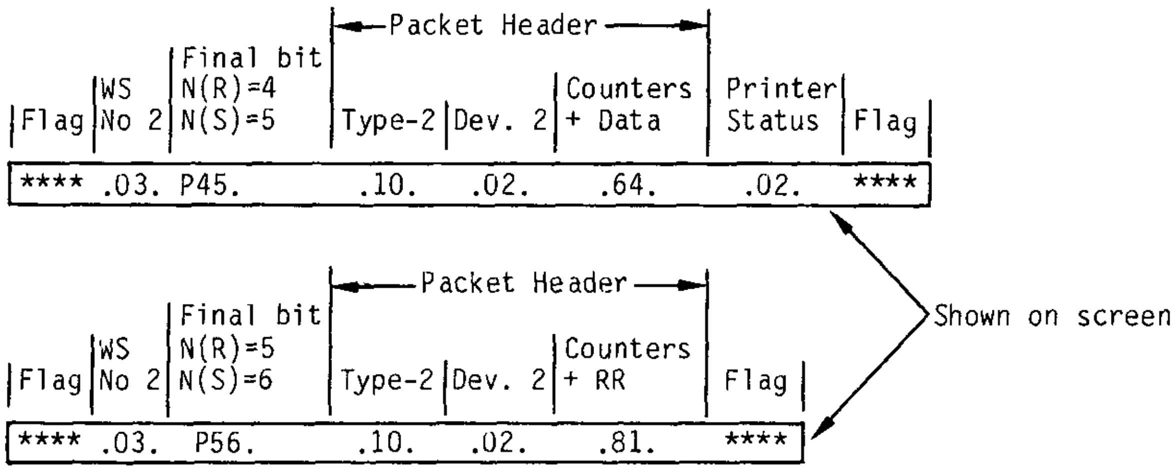
When using the LWSI Datascope to monitor the communication on an LWSI transmit line, the following picture may be seen. The example shows strings of characters to a printer (device address 2).





Monitoring LWSI Receive Line

When monitoring an LWSI receive line you may see the following examples of replies to strings sent to the printer.



1.4.4 Hierarchy of Control Protocols

Levels in LWSI/RWSI Figure 1.4-5

When a message is transferred between a primary and a secondary station the different parts of the frame is handled at different levels by hardware and program modules. To understand the use of levels we can make a comparison with a message sent from one boss to another.

LEVEL	Definition	Comparison
Level 3 (Highest)	Controls the traffic (PLSP), provides the message with device address (logical channel No.). Based on the CCITT rec. X25.	A boss which decides the contents of a message and to whom it will be sent.
Level 2	Transmission procedure (the HDLC) and Data Link Control provide the message with WS address, add flags, perform failure checks, i.e. format the frame.	The secretary who puts the message in an envelope, writes the address, puts on the stamp.
Level 1	The physical interconnection, the hardware characteristics of the line and interface circuits defined by X27 (V11).	The postal service which transports the envelope.

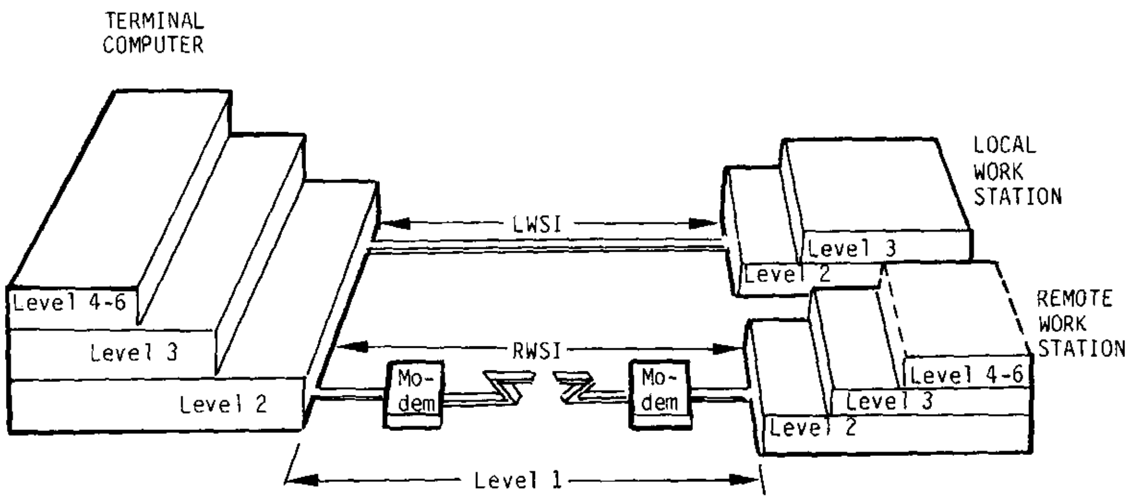


Figure 1.4-5 Data communication levels

Level	Definition	Terminal Computer	Local Work Station	Remote Work Station	Work Station Controller
6	Application	Customer appl.			Customer appl.
5	Device Drivers	Toss			Toss
4	Network Distrib.				
3	Line Driver	PLSP(=DRPL01)X25	PLSP(X25)	PLSP(X25)	
2	Data Link Handler	HDLC	HDLC	HDLC	HDLC
1	Physical Control	X27, V24-V28	X27	V24-V28	V24-V28. X27

Level 3 - PLSP (SLSP)

The Philips Link Sharing Protocol, PLSP, is used on Level 3 and is a real subset based on the CCITT X.25 Recommendations.

The PLSP defines the packet format. data multiplexing to devices, and flow control. All this information is implemented in the three bytes called "Packet Header". This means that the protocol describes how the Link (an established communication channel between a primary and a secondary) is shared between several, so called, "Logical channels".

A Logical Channel is the way for messages between a program module in the terminal computer and a device, and there is one Logical channel per device. The Logical channel is identified by the two first bytes in the packet header.

- the first byte — contains normally the Logical Channel Group Number (LCGN) indicated by 4 bits enabling upto 16 groups. PTS, however, uses only two of these to indicate Type-1 and Type-2 messages.

- the second byte — contains normally the Logical Channel Number (LCN) and by using all the 8 bits upto 256 channels may be addressed.

  LWSI uses this byte for the Device Address, 0-7.
  Device Address 1-7 addresses the devices as usual, i.e. keyboard =1, printer =2, VDU =3 etc. The Device Address 0 is used for commands to the main module itself, e.g. MDA 6411, that controls the communication with the devices.

The third byte in the packet header is used for the "Flow Control"., which means control of messages sent and received to/from a work station.

The byte contains counters for sent and received messages similar to the use of the control byte in the HDLC procedure at level 2. The reason for this flow control is to avoid overloading of the Link, by slowing-down the originator of the messages.

Counting of transferred messages is performed by ring counters counting upto 7 and thereafter starting from 0.

Though the counters can handle upto 7 messages to be sent without being immediately acknowledged, there are limits set by PTS. These limits called "windows" are the space of buffers available in respective primary and secondary unit.

- Windows on Level 3 & 2 Figure 1.4-6

There are different Windows (buffer sizes) used at level 3 and level 2.

- Level 3 windows *) (PLSP)
  1) Primary → Secondary
     The window is 1 message except for output to VDU, where the window size is 2 messages.
  2) Secondary → Primary
     At input to the primary the window size is 7.
- Level 2 (HDLC) windows
  Primary ↔ Secondary
  The window size is 4 messages in both directions.

The PLSP is in the primary unit handled by the program module "line driver DRPL01" and in the secondary units by the Logical Channel Handler, LCH (firmware module).

The DRPL01 supports both type-1 and type-2 packets. There are some limits in DRPL01 and packets that cannot be received by DRPL01 will be considered illegal, even if they are legal according to the SLSP definition.

Note: Toss releases 11 or above must be used.

*) These window sizes might be adapted for new devices.

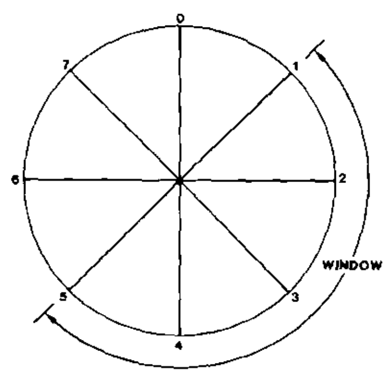


Figure 1.4-6 Message counter with a window of 4 messages