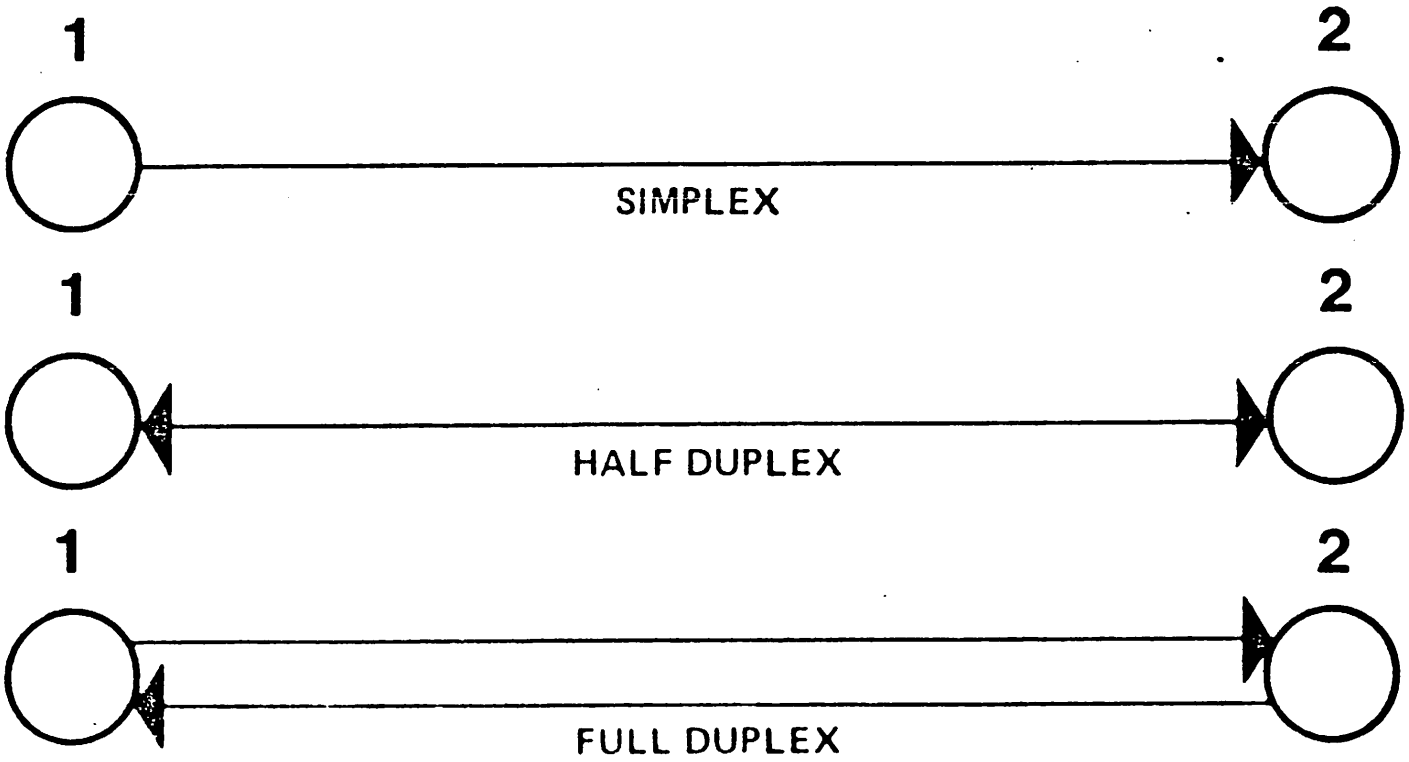
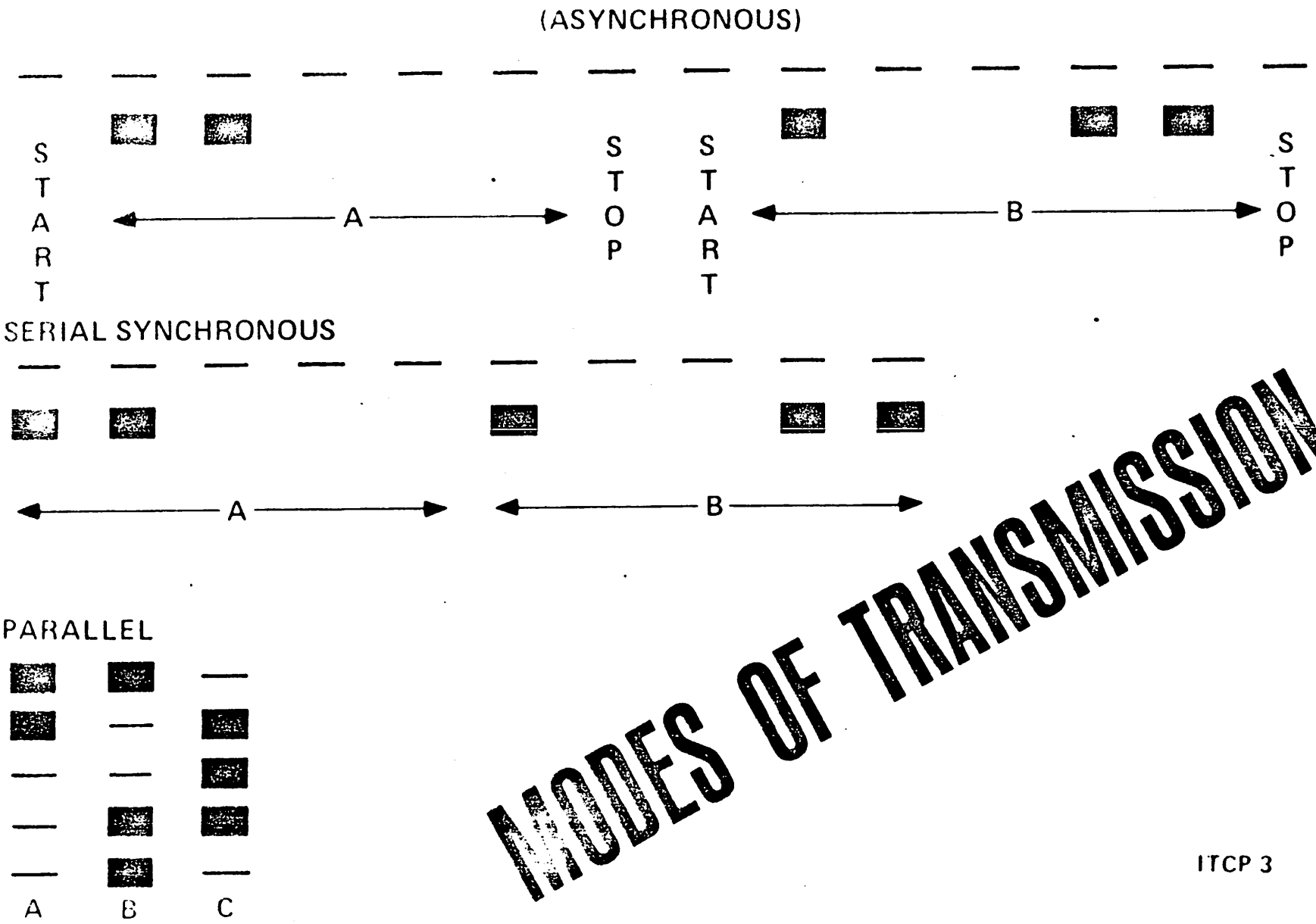
DATA COMMUNICATIONS

CHANNELS



ITCP-2



MODES OF TRANSMISSION

ITCP 3

PARALLEL

HARDWIRED

- **ADVANTAGES**
  - DIRECT DIGITAL TRANSMISSION
  - MAXIMUM DATA RATE
  - TOTAL CONTROL OF MEDIA (CABLE)
  - LOW COST
- **DISADVANTAGES**
  - VERY LIMITED DISTANCE

SYNCHRONOUS (HARDWIRED)

ADVANTAGES

DIRECT DIGITAL TRANSMISSION

TOTAL CONTROL OF MEDIA (CABLE)

CABLE LENGTH > PARALLEL

DISADVANTAGES

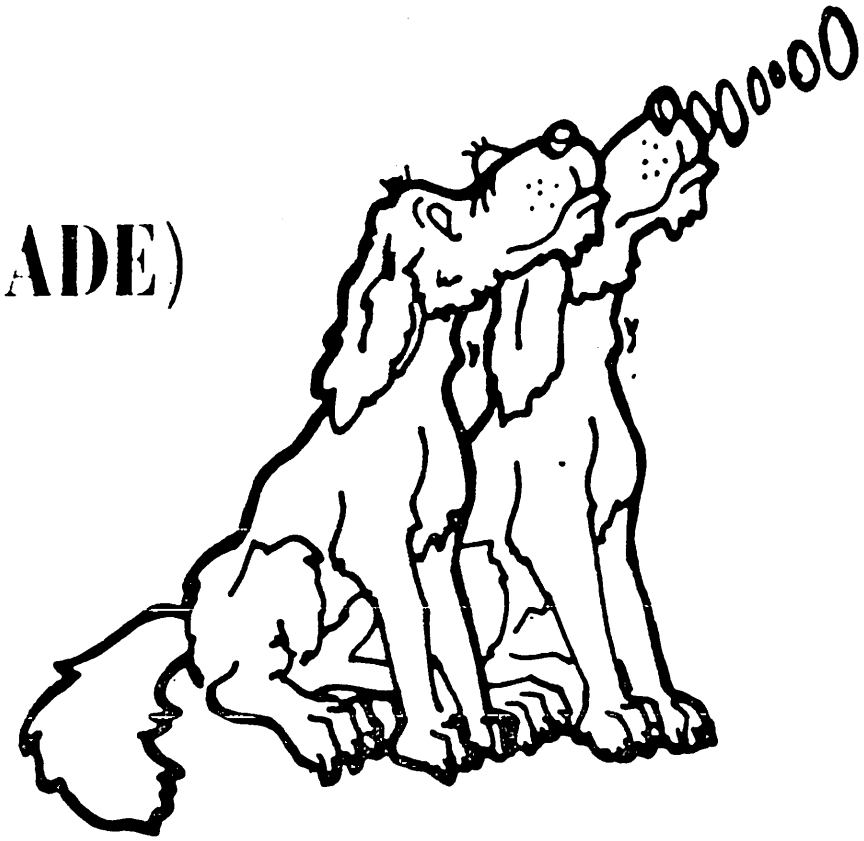
PARALLEL TO SERIAL CONVERSION

DATA RATE < PARALLEL

LIMITED CABLE LENGTH

SYNCHRONOUS

(VOICE GRADE)



- **ADVANTAGES**
  - UNLIMITED DISTANCE
  - SWITCHED OR LEASED CONNECTION
- **DISADVANTAGES**
  - MORE COMPLEX AND COSTLY EQUIPMENT
  - DATA RATE LIMITED BY BANDWIDTH
  - COMMON CARRIER TRANSMISSION MEDIA
  - NOT DIRECT DIGITAL TRANSMISSION

ASYNCHRONOUS (VOICE GRADE)

▲ ADVANTAGES

IRREGULAR INPUT (TERMINALS)

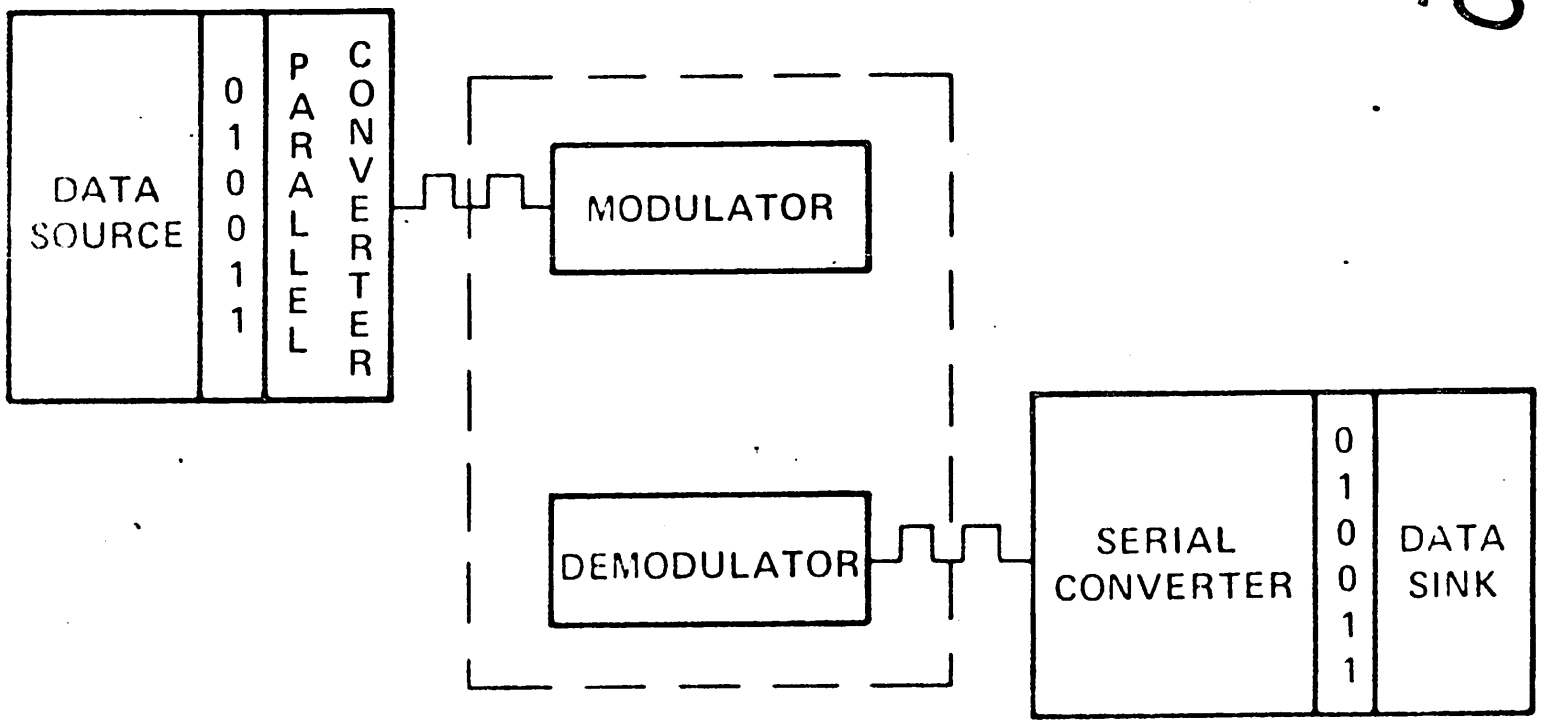
LOW COST

▲ DISADVANTAGES

SLOW DATA RATE

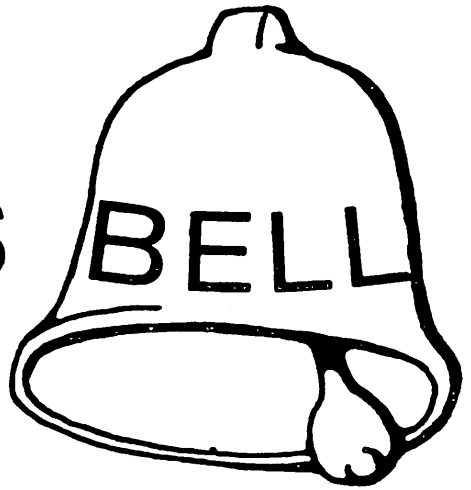
MINIMAL ERROR CHECKING

MODEMS



ITCP 3

SYNCHRONOUS MODEMS

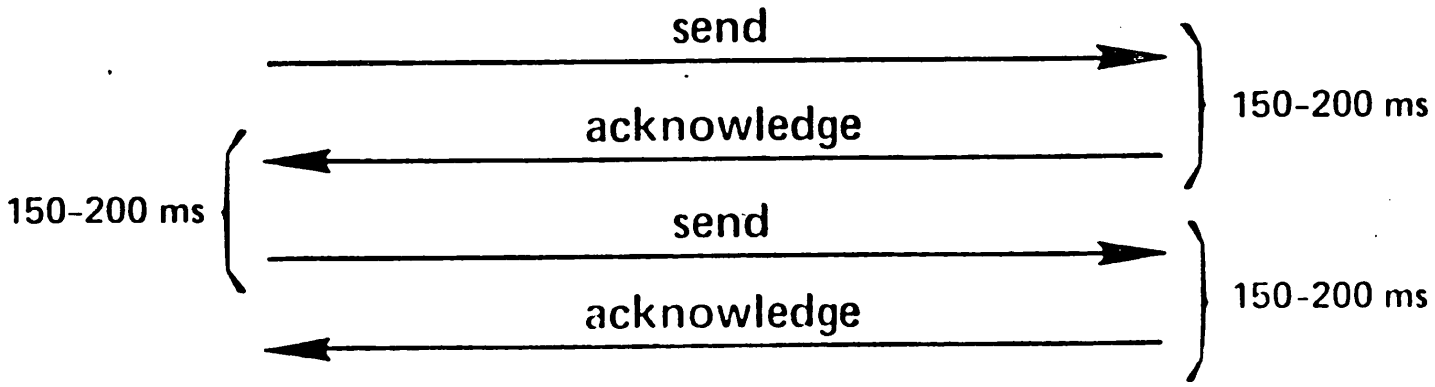


201A	2000 BPS HALF-DUPLEX ON SWITCHED LINE
201B	2400 BPS HALF DUPLEX ON 2-WIRE PRIVATE LINE
201C	2400 BPS HALF DUPLEX ON SWITCHED OR 2-WIRE PRIVATE LINE
208A	4800 BPS HALF DUPLEX 4-WIRE PRIVATE LINE
208B	4800 BPS HALF DUPLEX ON SWITCHED LINES

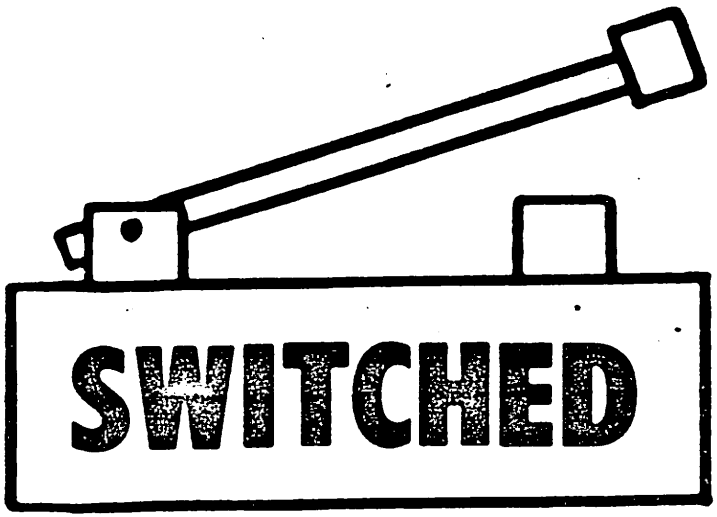
MODEM TURNAROUND

(HALF DUPLEX)

TIME REQUIRED TO REVERSE THE DIRECTION OF TRANSMISSION FROM SEND TO RECEIVE OR VICE VERSA.



ITCP 10



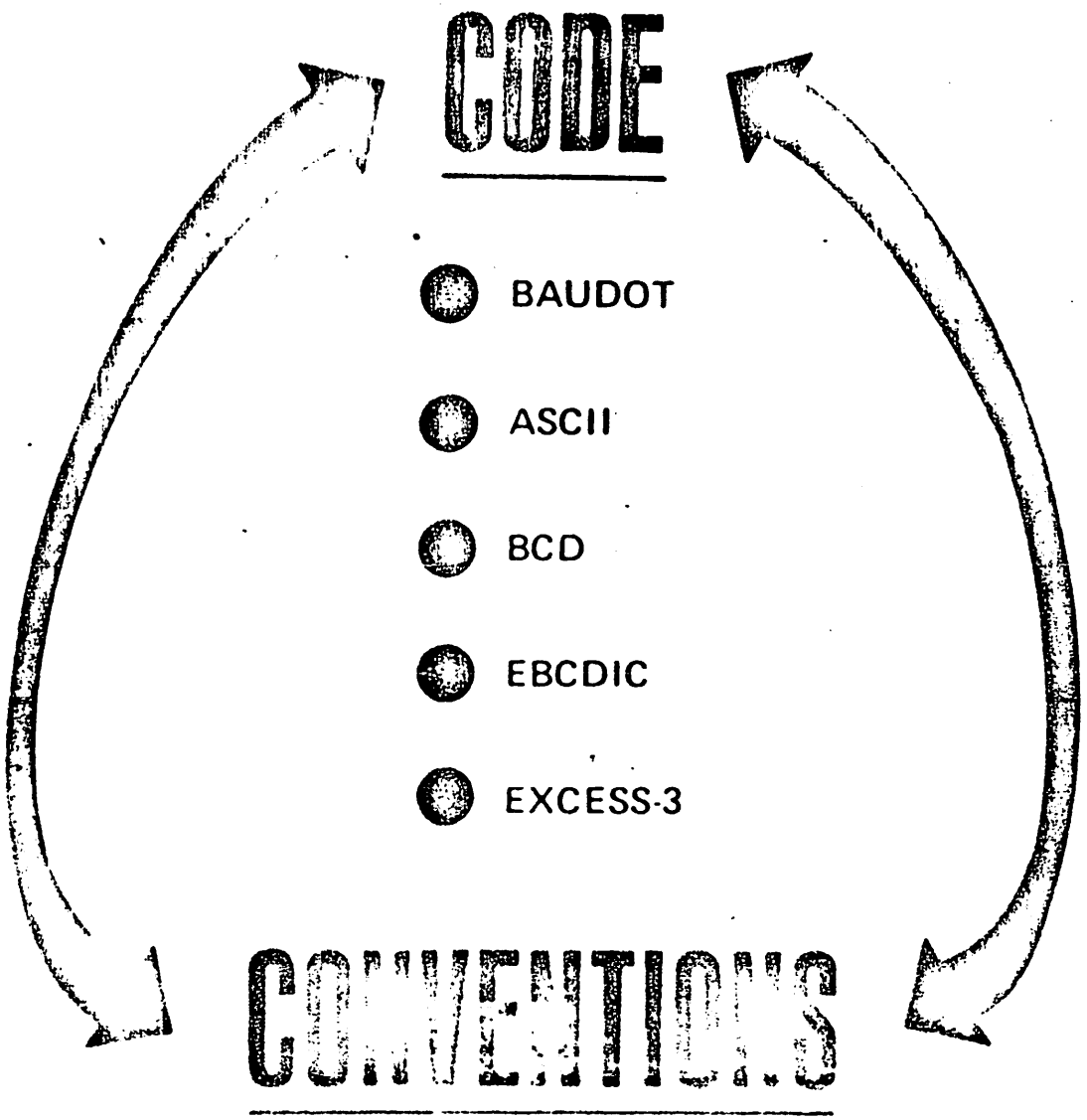
vs LEASED

SWITCHED

- LINE CONNECTED BY PUBLIC EXCHANGE
- LESS EXPENSIVE FOR SHORTER PERIODS
- MOBILITY

LEASED

- CONNECTED PERMANENTLY OR SEMI-PERMANENTLY BETWEEN MACHINES (NON-SWITCHED)
- HIGHER TRANSMISSION SPEED CAN BE OBTAINED
- LESS EXPENSIVE FOR LONG PERIODS OF TIME
- CAN BE TREATED FOR DISTORTION (CONDITIONING)
- WIDEBAND FACILITIES ARE AVAILABLE


CODE
BAUDOT
ASCII
BCD
EBCDIC
EXCESS-3
CONVENTIONS

BAUDOT CODE

First 2 Digits 2^0 2^1 \ Last 3 Digits 2^3 2^4 2^5		000	001	010	011	100	101	110	111
0 0	UC	blank	5	c r	9	space	#	'	·
0 0	LC	blank	T	c r	O	space	H	N	M
0 1	UC	LF	)	4	&	8	zero	;	;
0 1	LC	LF	L	R	G	1	P	C	V
1 0	UC	3	"	$	?	bell	6	!	/
1 0	LC	E	Z	D	B	S	Y	F	X
1 1	UC	-	-	'	figures	7	1	(	letters
1 1	LC	A	W	J	figures	U	Q	K	letters

ITCP-13

ASCII

BIT POSITIONS 0, 1, 2, 3

BIT POSITIONS 4, 5, 6, 7	HEX	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0000	0	NULL	DLE	SP	0	@	P		p								
0001	1	SOH	DC1	!	1	A	Q	a	q								
0010	2	STX	DC2	"	2	B	R	b	r								
0011	3	ETX	DC3	=	3	C	S	c	s								
0100	4	EOT	DC4	$	4	D	T	d	t								
0101	5	ENQ	NAK	%	5	E	U	e	u								
0110	6	ACK	SYN	&	6	F	V	f	v								
0111	7	BEL	ETB		7	G	W	g	w								
1000	8	BS	CAN	↑	8	H	X	h	x								
1001	9	HT	EM	)	9	I	Y	i	y								
1010	A	LF	SUB	■	:	J	Z	j	z								
1011	B	VT	ESC	+	;	K	[	k									
1100	C	FF	FS	'	<	L		l									
1101	D	CR	GS	-	=	M	]	m									
1110	E	SO	RS	.	>	N		n									
1111	F	SI	US	/	?	O	_	o	DEL								

BCD

CHARACTER	BCD CODE	CHARACTER	BCD CODE	CHARACTER	BCD CODE
0	00	F	26	Q	50
1	01	G	27	R	51
2	02	H	30	$	53
3	03	I	31	*	54
4	04	.	33	(blank)	60
5	05	)	34	/	61
6	06	=	35	S	62
7	07	”	36	T	63
8	10	–	40	U	64
9	11	J	41	V	65
+	20	K	42	W	66
A	21	L	43	X	67
B	22	M	44	Y	70
C	23	N	45	Z	71
D	24	Ø	46	,	73
E	25	P	47	(	74

EBCDIC

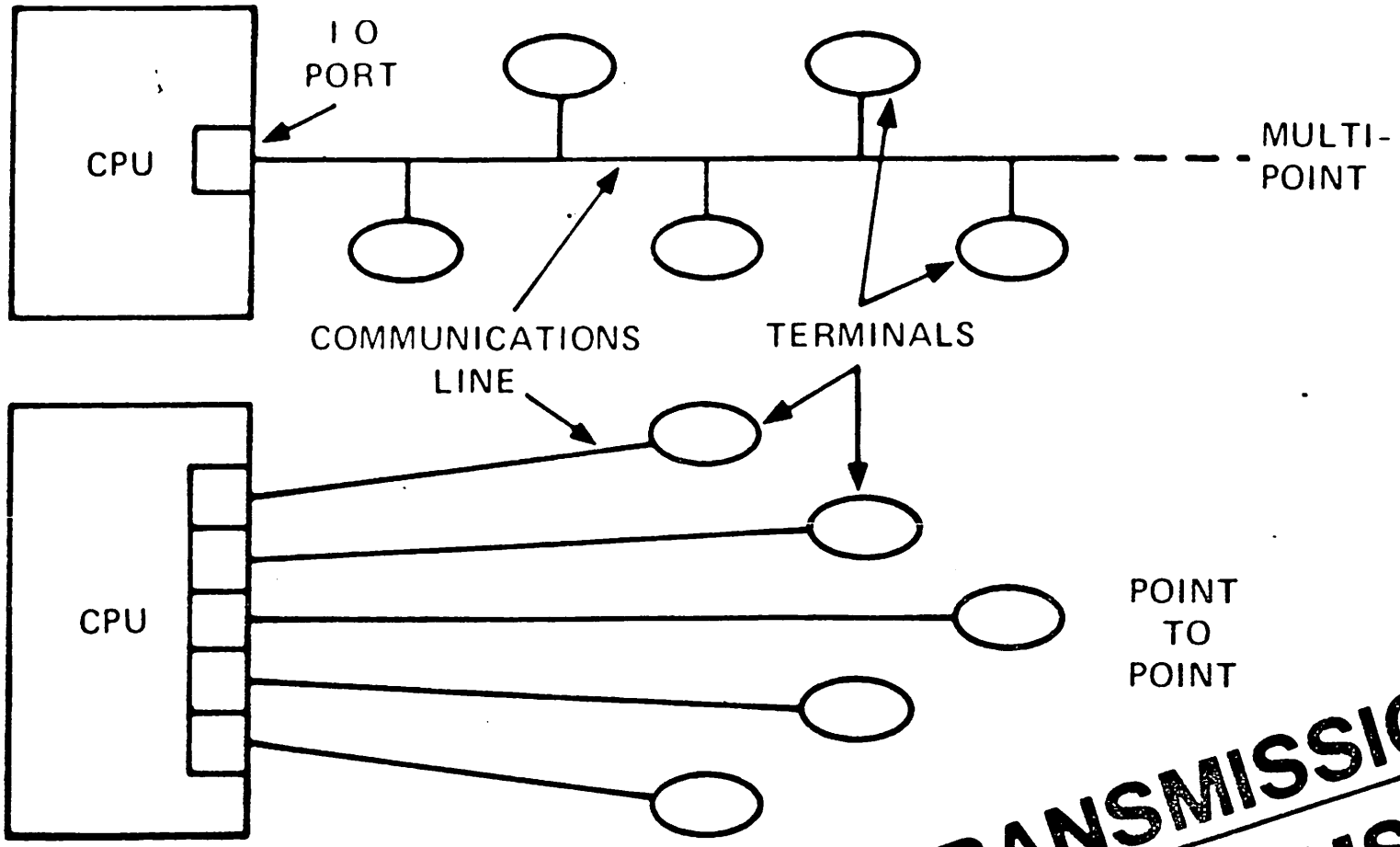
BIT POSITIONS 0, 1, 2, 3

BIT POSITIONS 4, 5, 6, 7	HEX	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0000	0	NUL	DLE	DS		SP	&									\	0
0001	1	SOH	DC1	SOS						a	j	~		A	J		1
0010	2	STX	DC2	FS	SYN					b	k	s		B	K	S	2
0011	3	FTX	DC3							c	l	t		C	L	T	3
0100	4	PF	RES	BYP	PN					d	m	u		D	M	U	4
0101	5	HT	NL	LF	RS					e	n	v		E	N	V	5
0110	6	LC	BS	EOB / ETB	UC					f	o	w		F	O	W	6
0111	7	DEL	IL	PRE / ESC	EOT					g	p	x		G	P	X	7
1000	8		CAN							h	q	y		H	Q	Y	8
1001	9	RLF	EM						\	i	r	z		I	R	Z	9
1010	A	SMM	CC	SM		¢	!		:								
1011	B	VT				.	$	,									
1100	C	FF	IFS		DC4	<	*	%									
1101	D	CR	ICS	ENQ	NAK	(	)	–									
1110	E	SO	IRS	ACK		+	;	>									
1111	F	SI	IUS	BEL	SUB			?	"								

Excess-3

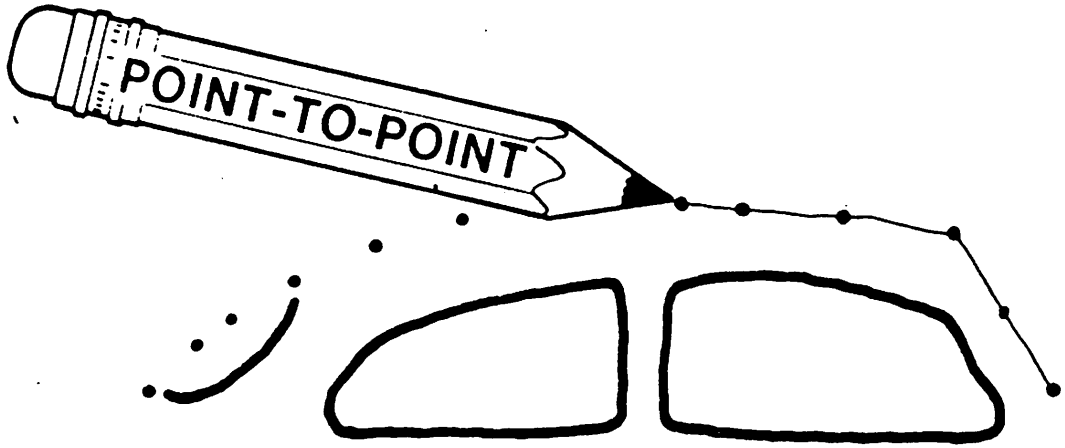
OCTAL CODE	CHARACTER	OCTAL CODE	CHARACTER	OCTAL CODE	CHARACTER
00	~	26	C	53	Q
01	SPACE	27	D	54	R
02	-	30	E	55	$
03	Ø	31	F	56	*
04	1	32	G	57	~
05	2	33	H	60	~
06	3	34	[	61	~
07	4	35	#	62	:
10	5	36	~	63	
11	6	37	~	64	/
12	7	40	~	65	S
13	8	41	~	66	T
14	9	42	~	67	U
15	'	43	)	70	V
16	&	44	J	71	W
17	(	45	K	72	X
20	~	46	L	73	Y
21	,	47	M	74	Z
22	.	50	N	75	%
23	;	51	O	76	~
24	A	52	P	77	~
25	B				

ITCP-17



TRANSMISSION SYSTEMS

ITCP-18



- INVOLVED ONLY 2 DEVICES.
- DEVICE ADDRESSING NOT REQUIRED
- COST PER TERMINAL CONSTANT
- SIMPLE LINE CONNECTION.
- GUARANTEED ACCESS
- TYPICALLY USED IN CONTENTION MODE

MULTI-POINT

INVOLVES 3 OR MORE DEVICES

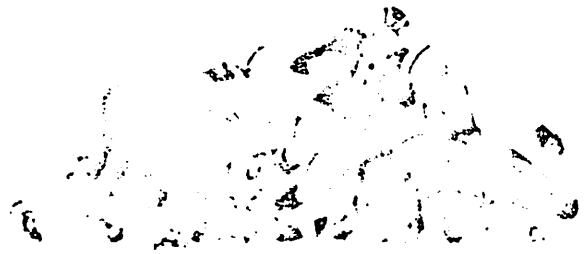
COMPLEX LINE CONNECTION

DEVICE ADDRESSING

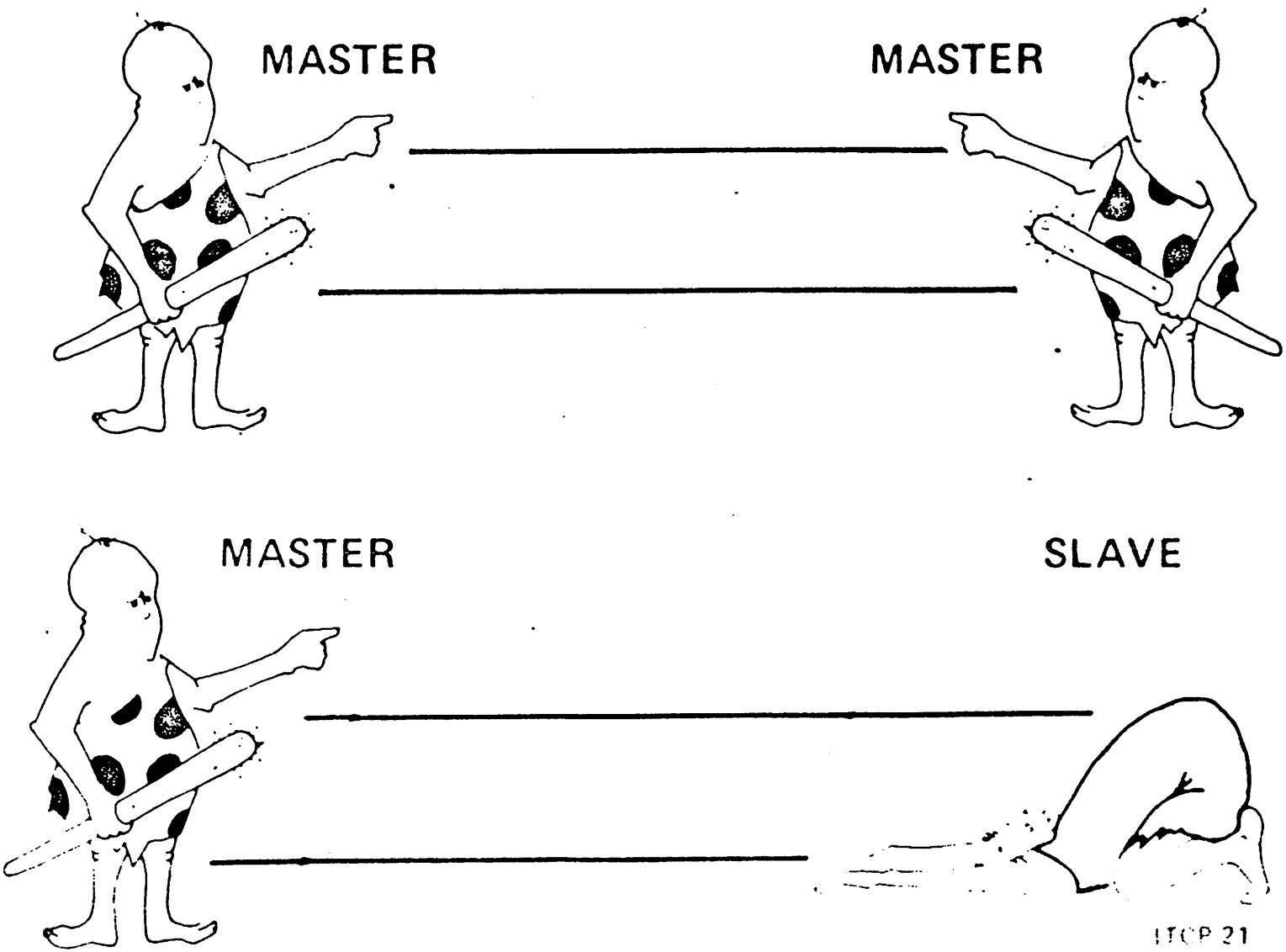
TEMPORARY LOCKOUT MAY OCCUR

COST PER TERMINAL ON SLIDING SCALE

TYPICALLY POLLED

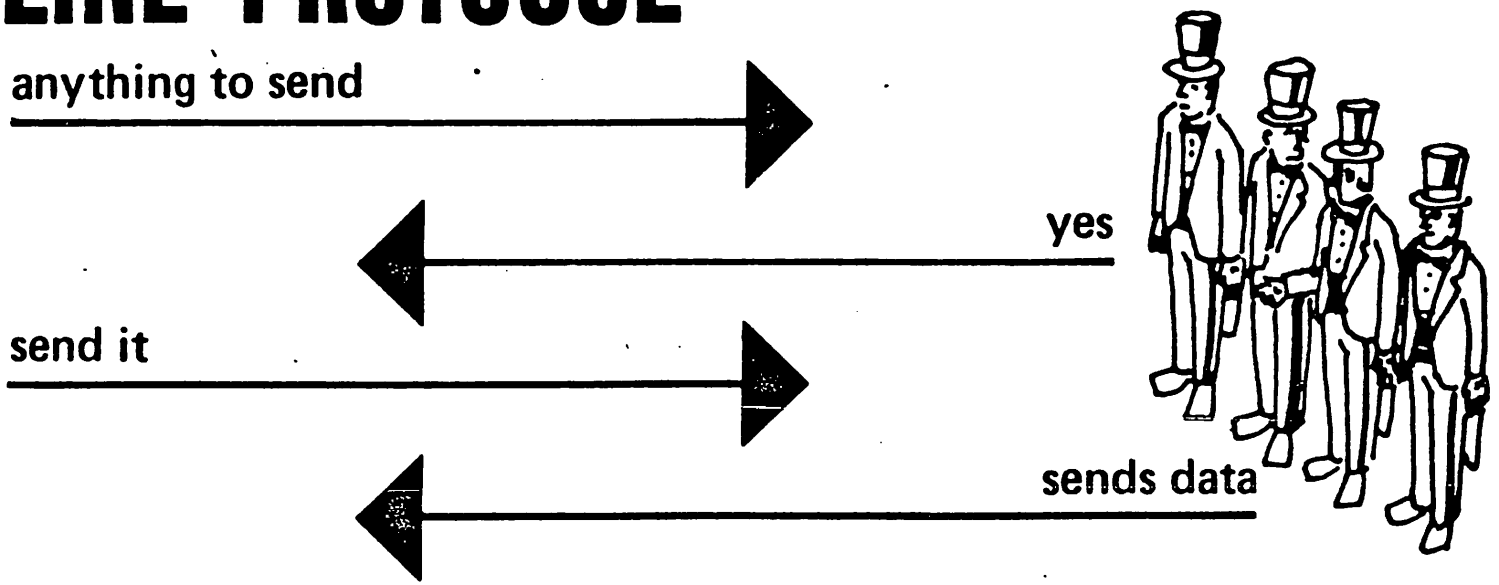


CONTENTION



ITCP 21

LINE PROTOCOL



LINE PROTOCOL USED TO:

DISTINGUISH SENDER FROM RECEIVER

ALLOW ORDERLY TRANSFER OF DATA

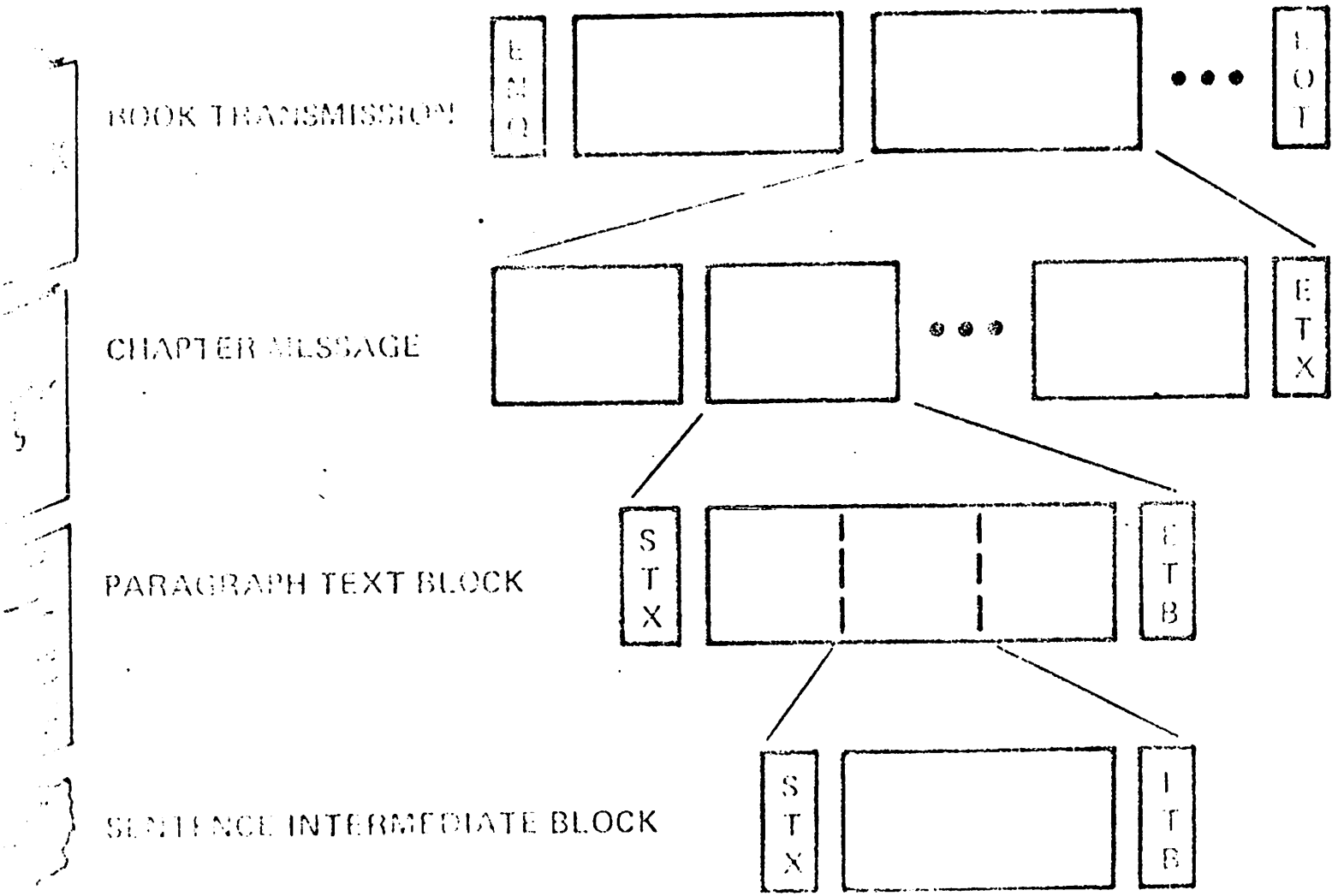
PERMITS ERROR DETECTION AND RETRY

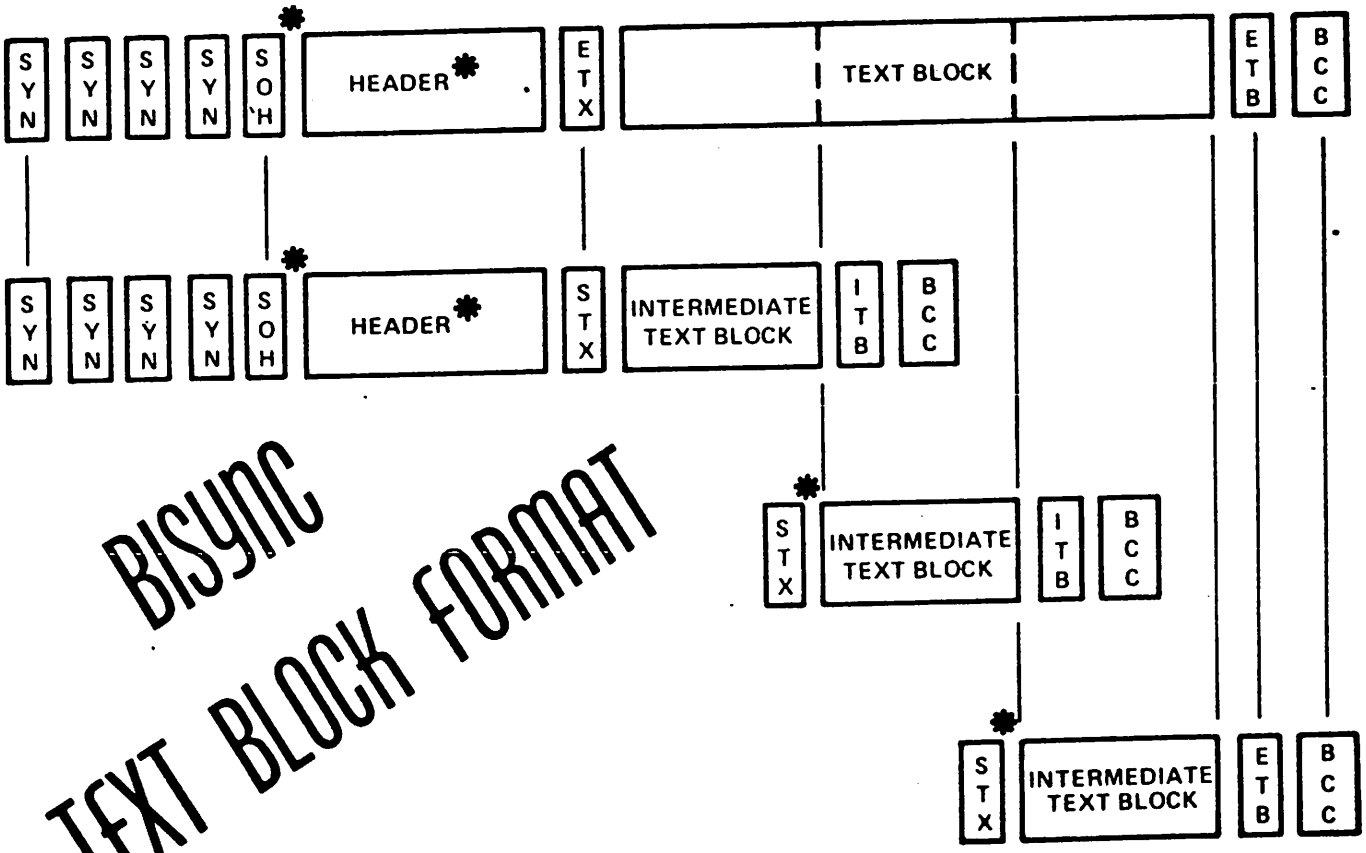
BINARY SYNCHRONOUS COMMUNICATIONS

(BISYNC)

- MESSAGE BLOCKS AND SYNCHRONIZATION
- CONTROL CHARACTERISTICS
- TRANSPARENT-TEXT MODE
- BLOCK CHECK CHARACTER

ITCP-23


BOOK TRANSMISSION
CHAPTER MESSAGE
PARAGRAPH TEXT BLOCK
SENTENCE INTERMEDIATE BLOCK
E N Q
E O T
S T X
E T X
E T B
I T B


SYN
SYN
SYN
SYN
SOH
HEADER
ETX
TEXT BLOCK
ETB
BCC
SYN
SYN
SYN
SYN
SOH
HEADER
STX
INTERMEDIATE TEXT BLOCK
ITB
BCC
STX
INTERMEDIATE TEXT BLOCK
ITB
BCC
STX
INTERMEDIATE TEXT BLOCK
ETB
BCC
BISYNC
TEXT BLOCK FORMAT
marks optional portions
ITCP-25

PARITY OPTIONS

CRC CYCLIC REDUNDANCY CHECKING

Discard Quotient

Constant) *Character*

Constant X Quotient

Remainder + next character

Constant X Quotient

Remainder + next character

Constant X Quotient

Remainder + next character

Constant X Quotient

Check character at any time ETB, ETX, or US is recognized → Remainder

Cyclic Redundancy Checking

used when not ASCII non-transparent

PARITY OPTIONS

VRC/LRC

VERTICAL REDUNDANCY CHECKING

7 BIT ASCII AND ODD PARITY BIT

LONGITUDINAL REDUNDANCY CHECKING

EXCLUSIVE OR OF ALL ASCII CHARACTERS AND OWN ODD PARITY BIT

USED WITH NON-TRANSPARENT ASCII

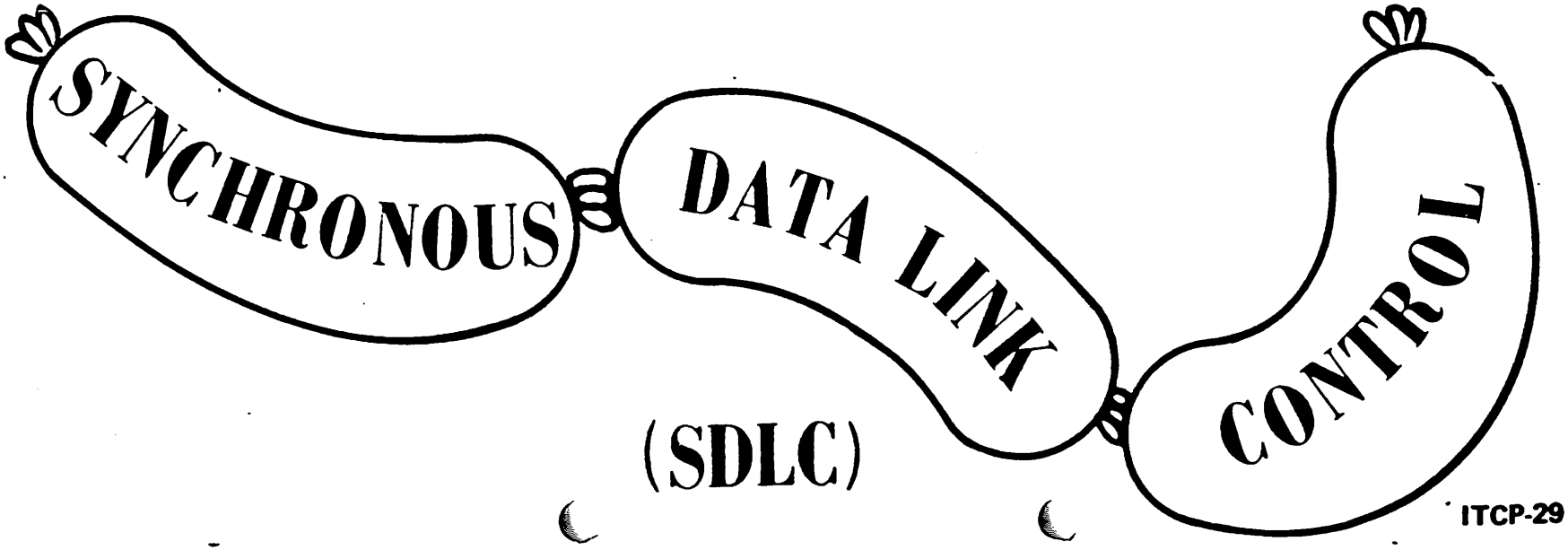
HALF OR FULL DUPLEX

- **POINT-TO-POINT OR MULTI-POINT**

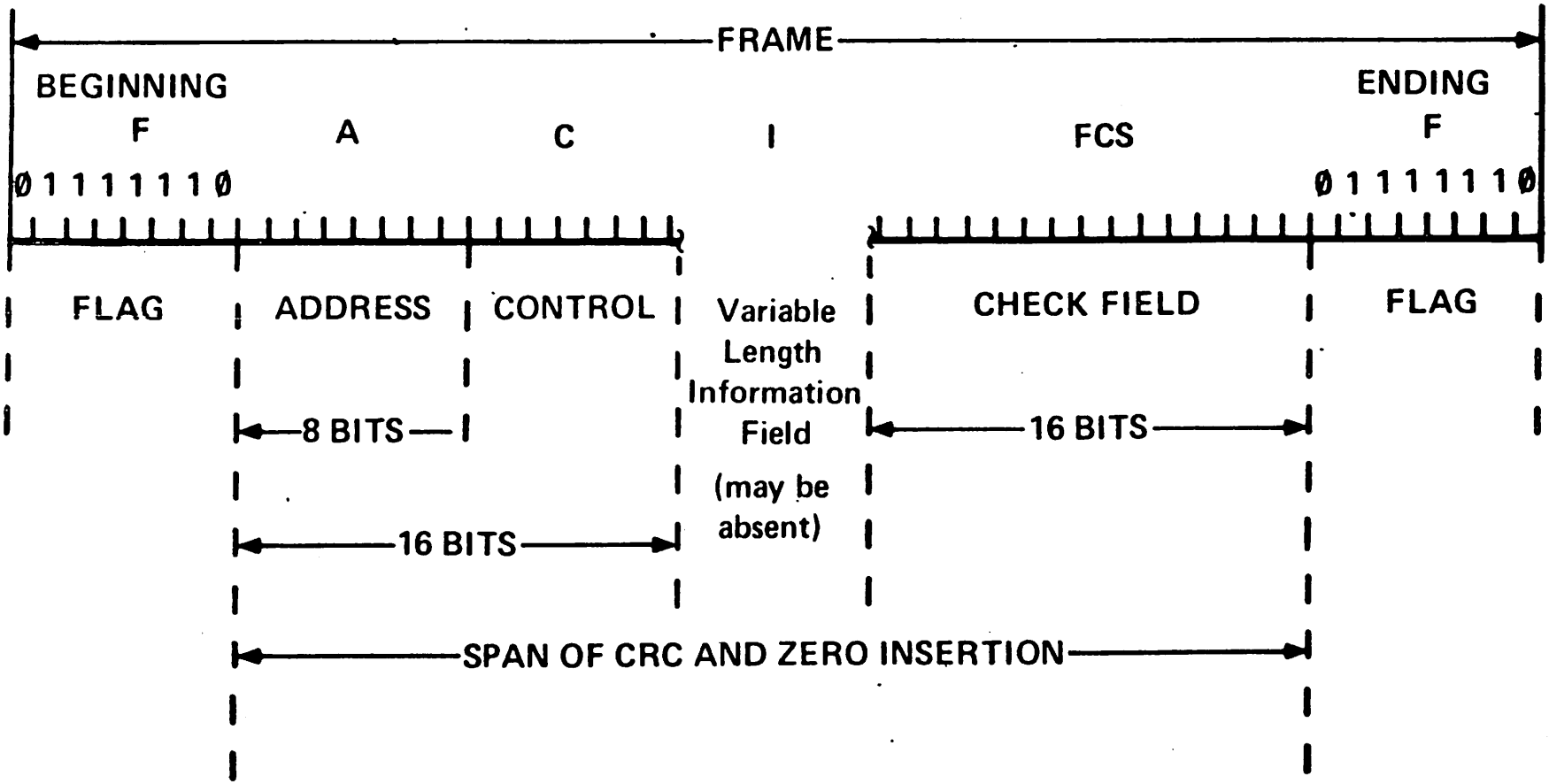
LOOP

- **COMPREHENSIVE ERROR DETECTION/RECOVERY**
- **MINIMIZES LINE DELAYS**
- **TRANSMITS DATA IN BIT STREAM AND IS INDEPENDENT OF CONTROL CHARACTERS**

- **TRANSMITS DATA IN BIT STREAM AND IS INDEPENDENT OF CONTROL CHARACTERS**



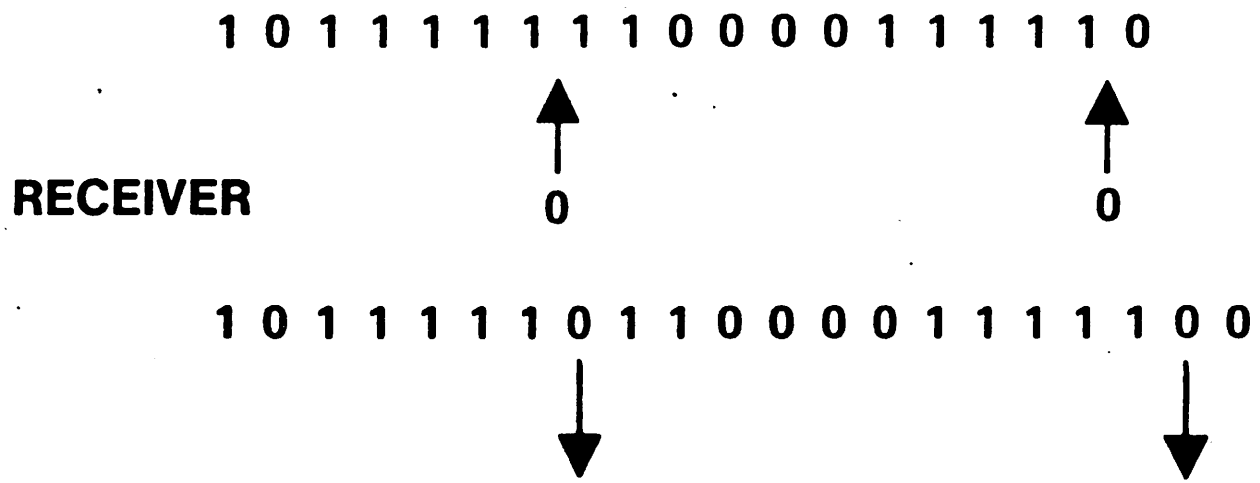
SDLC TRANMISSION FRAME



ZERO INSERTION

SDLC'S METHOD OF ACHIEVING TRANSPARENCY

A BINARY ZERO IS INSERTED AFTER ANY SUCCESSION OF FIVE CONTIGOUS I's

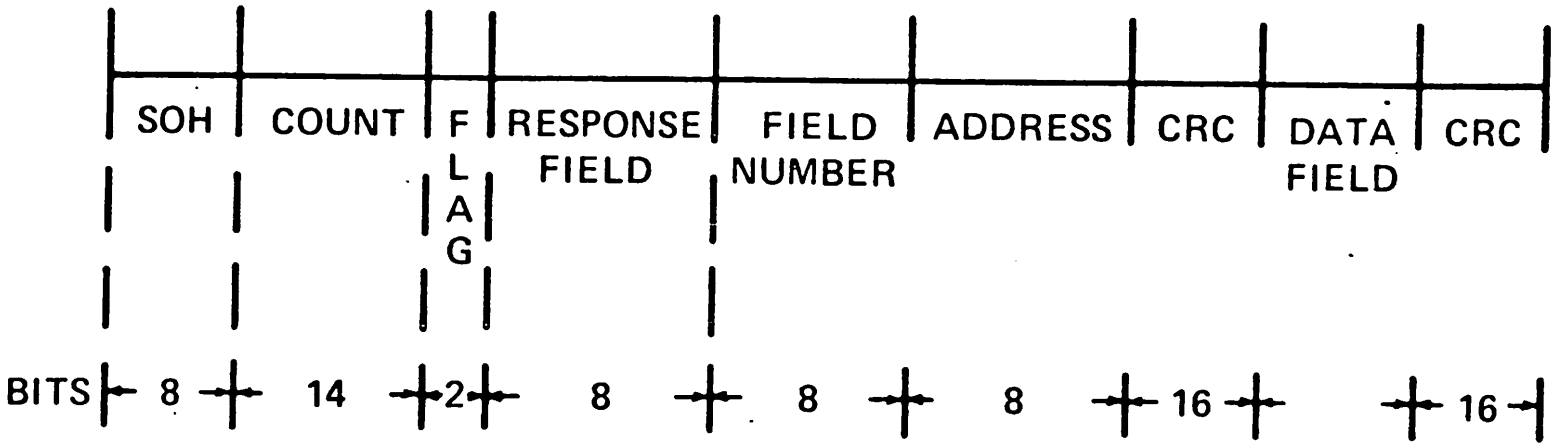


ITCP-31

DIGITAL DATA COMMUNICATIONS MESSAGE PROTOCOL (DDCMP)

- HALF OR FULL DUPLEX
- POINT-TO-POINT OR MULTI-POINT
- SYNCHRONOUS AND ASYNCHRONOUS MODES
- SERIAL OR PARALLEL TRANSMISSION FACILITIES
- REQUIRES NO SPECIAL CHARACTER SCANS
- ALLOWS BOOTSTRAP STARTUP OF REMOTE TERMINALS
- RUNS ON EXISTING HARDWARE

DDCMP



DATA MESSAGE FORMAT