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DEFENSE ELECTRONICS DIVISION

SPECIAL INFORMATION PRODUCTS DEPARTMENT

Court Street Plant
Building 5, Room M4
Syracuse, New York
November 8, 1967

TO: S. Dunten, MIT, Project MAC
R. Stotz, MIT, Project MAC
J. Ossanna, BTL
G. Ziegler, GE/CISL
A. Letizia, GE/SIPD
T. Beatson, GE/SIPD
I. Popejoy, GE/SIPD
M. Oleyar, GE/SIPD

In advance of our WSA600 meeting we (T. Beatson/M. Tobias) have tried to get together some working papers. The enclosed set represents our current thinking in regard to requirements, and will introduce basic organization.

Sincerely yours,

M J Tobias /TB

M. J. Tobias
Systems Development Engineering
Extension 1822

MJT/dr

Enclosure

CCS: Attendees
DL Bahrs
RG Daniel
WL Estfan
LE Mikus
JF Ossanna - BTL
IJ Popejoy
RE Wengert

TRIP REPORT

TO: MIT Site, Cambridge, Massachusetts

DATE: October 3, 1967

SUBJECT: MIT Requirements for a Word Synchronous Adapter

ATTENDEES: R. H. Stotz - MIT
A. K. Bhushan - MIT
Stan Dunten - MIT
T. J. Beatson, Jr. - General Electric
M. Oleyar - General Electric
Al Letizia - General Electric

The following is the composite trip report of the General Electric attendees.

A GIOC channel that would meet MIT's requirements would provide an interface to Bell System 303-type data sets, and would have the following characteristics:

TRANSMIT MODE

1. character parity - odd, even or no character parity by plug selection.

2. character scrambling - there is no need for bit rearrangement within a character. This could be a desireable feature, from the security aspect, in the future.

3. block parity - block parity, or transmit, would be handled entirely by software.

4. transfer timing error - A transfer timing error should cause transmission of an EOT character, then turn off the Carrier and report a terminate status.

5. Character modulus - The ninth bit of each character could be reserved to identify the last character of a message in the adapter. A second approach is to pad the message with "null" characters to provide an integral number of words.

6. Literals - Although there is no obvious need for literals, it would be a good idea to make the adapter capable of handling 18 bits of literal data.

7. Character length - Although the DCW should specify 36 bit characters, the consequences of specifying either 6 or 9 bit characters should be considered so that a programming error does not hang up the system.

8. Sync Characters - Sync Characters should be generated by software.

9. Speed Range - The channel should have a variable speed range of 40.8 KB to 230 KB with timing supplied by the data set. We (GE) feel that a limited external timing option should be supplied as an advent of our self test mode. A short haul without data sets appears to be an imminent need.

10. Half Duplex Mode - In a half-duplex configuration, resetting the transmit mode should turn off carrier. When transmitting, it would be desireable to detect changes on the "receive data" line as an indication of trouble (head butting). This condition should be stored in the adapter and reported as part of a termination status.

11. Transparent Mode - They see no need for the 8 bit binary mode of communication.

RECEIVE MODE

1. Parity checking - Character parity checking (even or odd) should be enabled or disabled by patchboard.

2. Parity Bit - Retain or strip character parity bit under patchboard control.

3. Parity Errors - When character parity error is detected, set a flag and continue reception. Report the error as part of a terminate status after the EOT has been received.

4. End of transmission - The channel must detect the EOT character. This character should be defined by a patchboard. One code value is sufficient.

5. Block Parity - Block parity checking can be done entirely by software, but the hardware must be transparent to the reception of the parity character (which could be an EOT). This requires detection of ETB and ETX so that detection can be inhibited on the following character. It was noted that the IBM 4-out-of-8 Code requires transparency on two successive cyclic check characters.

6. Special Characters - ACK, NAK, and ENQ can be handled entirely by software.

7. Transparent Mode - There is no planned use of the ASCII transparent mode which is initiated by DLE STX and terminated by DLE ETX or DLE ETB.

All of MIT's planning is based on use of the ASCII character set. Binary data will be imbedded in the ASCII characters (six bit of binary data per 7-bit ASCII character).

Receive
(proposed)

11/10/67

Modes

A = Basic Mode. Previous character not DLE.
B = Basic Mode. Previous character was DLE.
C = Transparent Mode - Previous character not DLE.
D = Transparent Mode - Previous character was DLE.

State	Character	Mode	Action		Resulting Mode
1	SOH	A	External signal		A
2	STX	A	External signal		A
	STX	B	External signal	TSTX	C
3	ACK	A	External signal		A
	ACK	D	External signal	TACK	C
4	0-7	B	External signal	ACKi	A
	0-7	D	External signal	TAKi	C
5	EOT	A	Terminate		A
	EOT	B	Terminate	DEOT	A
6	NAK	A	Terminate		A
	NAK	D	External signal	TNAK	C
7	ENQ	A	Terminate		A
	ENQ	D	External signal	TENQ	C
8	?	B	Terminate	WABT	A
	?	D	External signal	TWBT	C
9	ETX	A	Next 2 characters transparent, then terminate		A
	ETX	D	Next 2 characters transparent, then terminate		A
10	ETB	A	Next 2 characters transparent then terminate		A
	ETB	D	Next 2 characters transparent, then terminate		A
11	SYN	A	Delete this character		A
	SYN	D	Delete previous character and this character		C
12	DLE	A	—		B
		C	—		D
		D	Delete this character		C
13-16	Spare				

Transmit (proposed)

11/10/67

Modes

A = Basic Mode. Previous character not DLE.
B = Basic Mode. Previous character was DLE.
C = Transparent Mode. Previous character not DLE.
D = Transparent Mode. Previous character was DLE.

State	Character	Mode	Action	Resulting Mode
1	SOH	A	—	A
2	STX	A	—	A
	STX	B	—	C
3	ACK	A	—	A
	ACK	D	—	C
4	0-7	B	—	A
	0-7	D	—	C
5	EOT	A	Terminate	A
	EOT	B	Terminate	A
6	NAK	A	—	A
	NAK	D	—	C
7	ENQ	A	—	A
	ENQ	D	—	C
8	?	B	—	A
	?	D	—	C
9	ETX	A	Next 2 characters transparent, then terminate	A
	ETX	D	Next 2 characters transparent, then terminate	A
10	ETB	A	Next 2 characters transparent, then terminate	A
	ETB	D	Next 2 characters transparent, then terminate	A
11	SYN	A	~~If TTE, insert this character~~	A
	SYN	D	~~If TTE, insert this character~~	C
12	DLE	A	—	B
	DLE	C	~~If TTE, insert this character~~	D
	DLE	D	—	C
13-16	Spare			
	~~If TTE~~	A	~~insert~~	A

WSA Commands

Bit	
18	Set Receive Mode
19	Reset " "
20	Set Transmit Mode
21	Reset " "
22	
23	
24	
25	
26	Set Data Terminal Ready
27	Reset " " "
28	
29	
30	
31	
32	Set Active Mode
33	Reset " "
34	Status Request
35	Activate List Channel

Write 16 Control Characters
Read 16 Control Characters

Framing and Parity

00	No Change
01	6+1
10	7+1
11	8+0

Status

Line	Status	Status Events: Term.	Status Events: Ext. Sig.
0			
1	Ring Indicator		0-1
2			
3			
4			
5			
6			
7			
8			
9	Receive Mode	1-0	
10	Transmit Mode	1-0	
11	Active Mode		
	Clear To Send	1-0	0-1
	Data Set Ready	1-0	0-1
	AGC Lock or Carrier Detect		Δ
	Character Parity Error		
	Control Character Detected	x	x
	Transparent Mode		
	End Data Transfer	x	

WSA 600 REQUIREMENTS

The following is a list of functional requirements currently seen for the WSA 600, and is intended to serve as a "working paper".

1. The WSA 600 will be designed to interface with Bell System modems 303 and 301B.
2. The need for 7+1 transmission is apparent.
3. An 8-bit code will be considered as very desirable. In this event both 8+0 and 4 out of 8 should be considered, although 4 out of 8 may be implemented simply as 8 bits with even parity (and no parity bit).
4. The speed of the 303 and 301B data sets implies computer-like devices at both ends of the link. Thus, a method for transmitting binary information is considered highly desirable. This need is interpreted here as being a need for 6+1 code - transparent mode.
5. Code recognition - There is need for the adapter to compare and recognize control characters in the receive mode. Present thinking has been influenced by the possibility of using an already developed circuit board with 144 flip-flop devices. This board is a 16 X 9 solid state memory.

   Thus, consideration is being given to possibility of control character definition by software. That is, the GE645 software may define the control characters to be used by loading the 16X9 memory in the WSA 600.

There are three types of action which may be taken following receipt of a control character.

(a) Action taken by the WSA - - to change its operating characteristics.

(b) Reporting of termination status (and re-setting).

(c) Reporting of external signal status.

These three "types" of actions are not "independent." A character which causes some change in WSA characteristics may well report external signal status.

6. The WSA 600 will have no memory of previous characters except the DLE character. This is the only event which is to be "remembered". This memory will only exist for one additional character time.

7. Character parity will be a hardware function but under program control. That is, in receive mode no-parity check may be selected by software.

A summary of direct software controlled features:

(a) 6+1, 7+1, and 8-bit code transmission.

(b) Control characters - - 16 in number, 9-bits in length loaded into the WSA by software.

8. Block parity will be considered a software function. Thus, WSA 600 will neither generate nor check it. However, to facilitate this checking, the hardware will be required to be completely transparent to <u>two</u> characters following an ETX or ETB.

9. Use of SYN. In receive mode the hardware will strip SYN (or DLE SYN in transparent) so that this character will not be passed on to memory.

In transmit, the SYN (or DLE SYN) will be used as protection against the transfer timing error - - thus making the WSA a "soft-failing" device. When a transfer timing error impends, the hardware will insert SYN (or DLE SYN) as "fill" until another data service from the memory is available.

10. Error Recovery. Basically, error recovery is viewed as a software responsibility. The WSA, then, will be required to detect errors, where possible, and report.

    (a) The occurrence of a parity error will cause an immediate terminate status.

    (b) Failure to achieve sync also constitutes an error. WSA 600 will have to detect this and cause termination status.

11. There is a requirement for "literals" in transmit mode.

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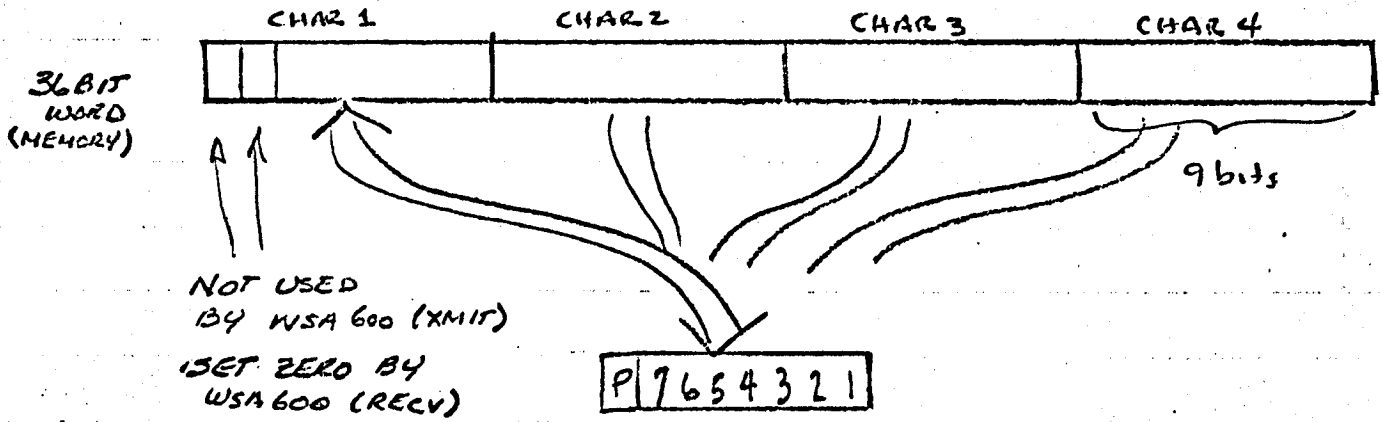
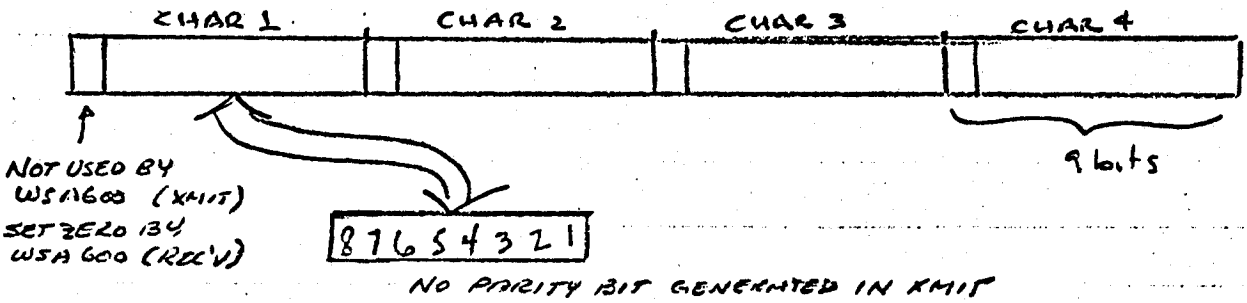
WSA 600 FORMATS

(1) 7+1 TRANSMISSION



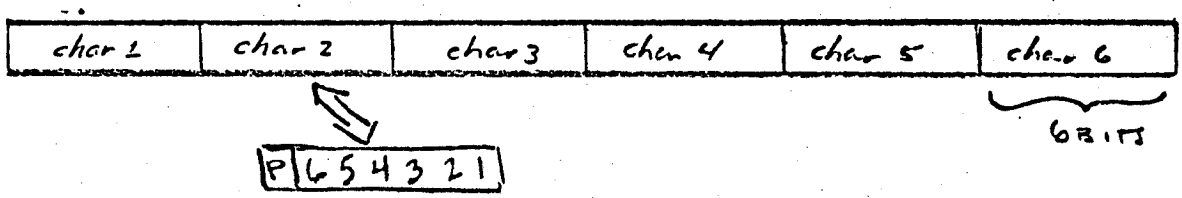
characters transmitted in order 1,2,3 4 ; bits transmitted 1,2...7,P

(2) 8 BIT TRANSMISSION

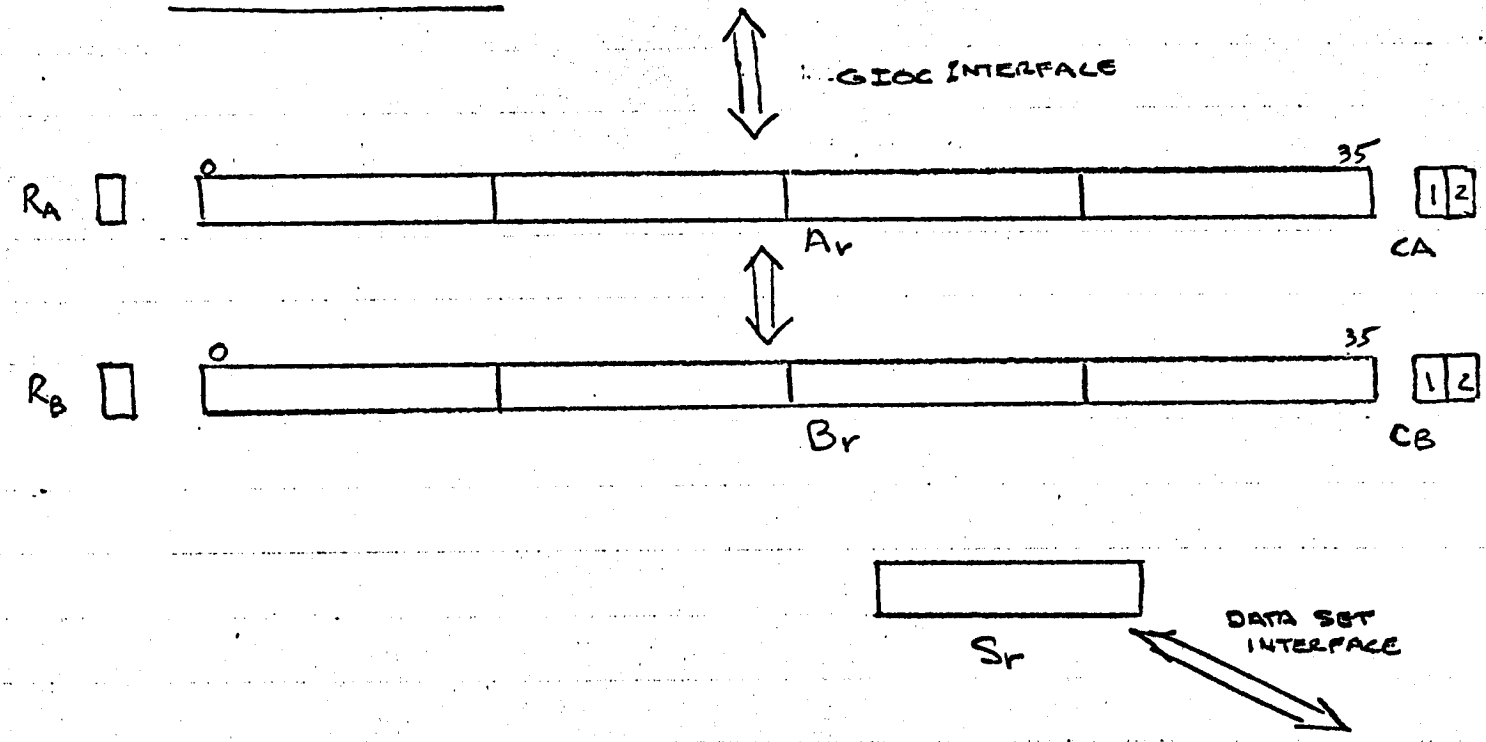


same character and bit sequence

(3) 6+1 TRANSMISSION



WSA 600
ORGANIZATION



A_r, B_r ... Buffer storage -- 2 36-bit words -- within WSA

S_r ... A comparison register .. temporary (8-bit) storage accumulated from data set for comparis to control characters

R_A ... Indicates: (1) XMIT MODE: Initiate data service to refill A_r (2) RECV MODE: Initiate data service to transfer A_r to memory

R_B ... Indicates (1) XMIT MODE: request $A_r \rightarrow B_r$
(2) RECV MODE: request $B_r \rightarrow A_r$

CA_1, CB_1 ... (1) XMIT: TERMINATION UPON XFR of this word to data set
(2) RECV TERMINATION upon xfr of this word to mem

FN-205 (1-54)

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COMPANY

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November 3, 1967

TO: S. Dunten, MIT, Project MAC
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A meeting concerning the WSA600 communication adapter is being scheduled for November 13, 1967 at 10:00 A.M. in Cambridge, Massachusetts, 7th floor conference room, 545 Technology Square.

The meeting agenda will include discussion of WSA600 spec requirements and how these requirements are initially being handled by preliminary flow charts and state diagrams. These preliminary charts are being prepared by M. Tobias and T. J. Beatson. If at all possible, they will be distributed before the 13th meeting date.

M. Tobias

M. J. Tobias
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SIPD - Ext. 1822

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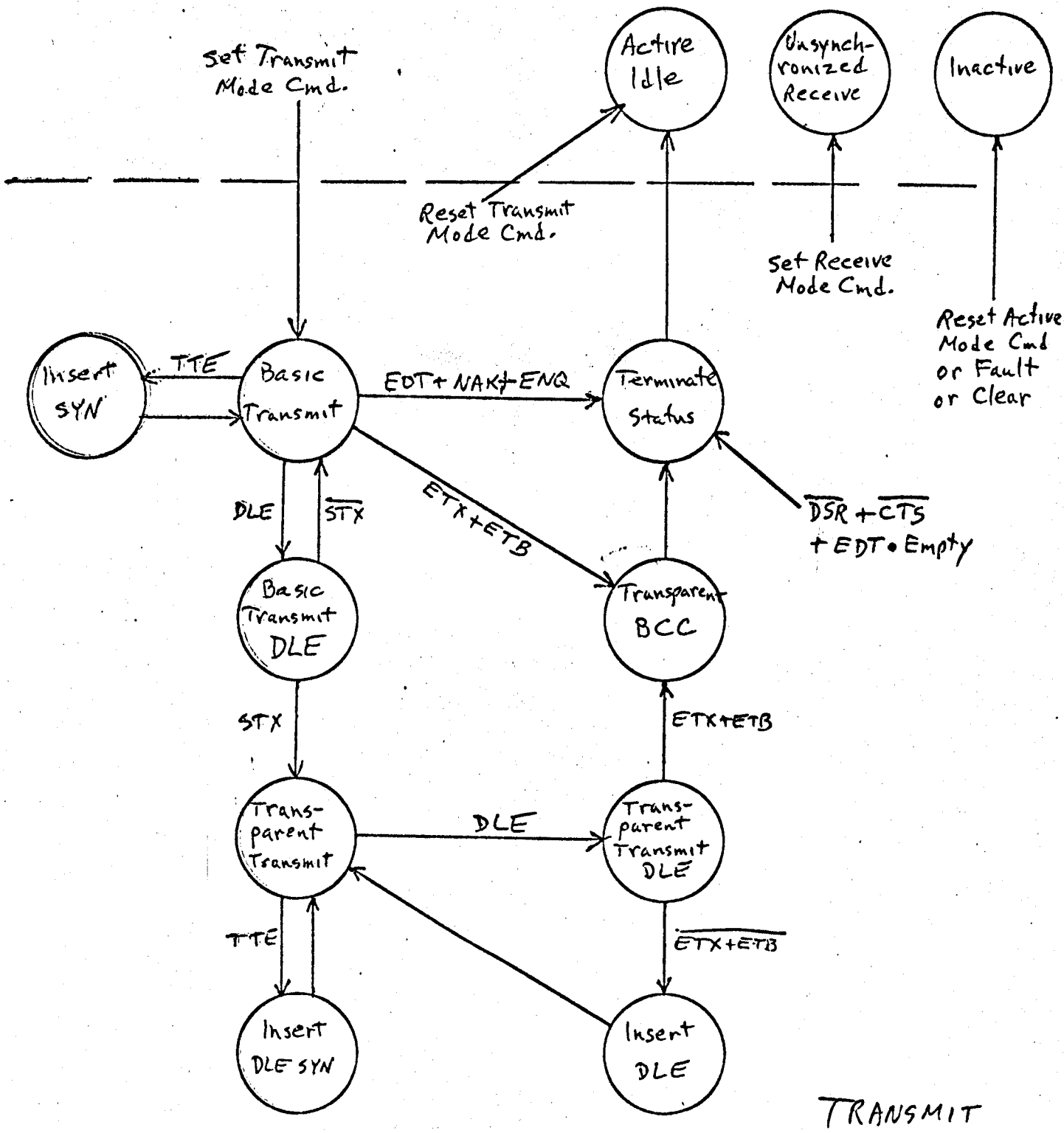
WSA CONTROL CHARACTERS

11-8-67

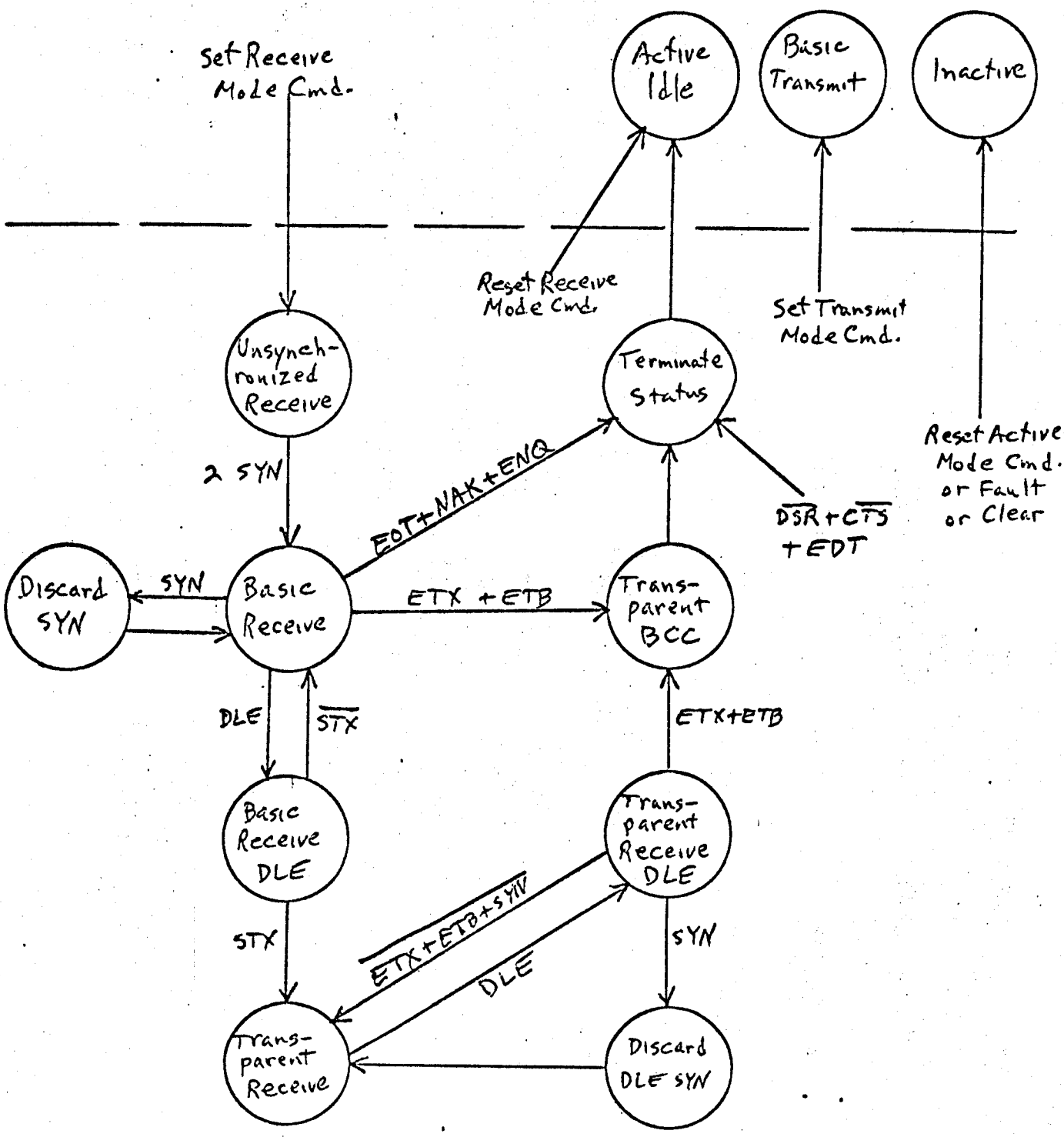
CONTROL CHARACTER ADDRESS	CURRENT MODE	WAS PREVIOUS CHARACTER DLE?	ACTION
0, 1	BASIC	—	RESET RECEIVE OR TRANSMIT MODE AND REPORT TERMINATION STATUS. (EOT)
2, 3	BASIC	YES	ENTER TRANSPARENT MODE. (STX)
4–7	BASIC	NO	REPORT EXTERNAL SIGNAL STATUS. (ACK, SOH, STX)
	TRANSP.	YES	
8–11	BASIC	NO	RESET RECEIVE OR TRANSMIT MODE AND REPORT TERMINATION STATUS. (NAK, ENQ)
	TRANSP.	YES	
12, 13	BASIC	NO	RESET TRANSPARENT MODE. THE NEXT TWO CHARACTERS (BCC) ARE TRANSPARENT. AFTER THEY ARE RECEIVED OR TRANSMITTED, RESET THE RECEIVE OR TRANSMIT MODE AND REPORT TERMINATION STATUS. (ETX, ETB)
	TRANSP.	YES	
14	BASIC	NO	DELETE THIS CHARACTER FROM RECEIVED MESSAGE. INSERT THIS CHARACTER IN TRANSMITTED MESSAGE TO AVOID TRANSFER TIMING ERROR. (SYN)
	TRANSP.	YES	DELETE THIS CHARACTER AND PREVIOUS CHARACTER FROM RECEIVED MESSAGE. INSERT "DLE" FOLLOWED BY THIS CHARACTER IN TRANSMITTED MESSAGE TO AVOID TRANSFER TIMING ERROR. (SYN)
15	—	NO	THIS IS "DLE". INTERPRETATION OF NEXT CHARACTER IS AFFECTED. (DLE)
	TRANSP.	YES	DELETE THIS CHARACTER FROM RECEIVED MESSAGE. INSERT AN ADDITIONAL "DLE" IN TRANSMITTED MESSAGE IF "DLE" IS NOT FOLLOWED BY ONE OF THE CHARACTERS DEFINED IN 4–14 ABOVE. (DLE)



External Signal Status Events Not Shown

TRANSMIT MODE

11-8-67



External Signal Status Events Not Shown

RECEIVE MODE

11-8-67