IBM

Education Guide

IBM

IBM 3270 Operation and Design

Education Guide

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INTRODUCTION

This Education Guide consists of the following sections:

Section 1 - Introduction

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Section 6 - Solutions to Student Exercises

Both outlines are in a suggested teaching sequence and indicate the daily topics and placement of student exercises and tests. In addition, the Detail Course Outline contains instruction notes, foil references, and foils.

This Education Guide is written for the instructor who is trained and qualified to teach the IBM 3270 Operation and Design Course. At the time this outline was prepared, there were a limited number of manuals available on the IBM 3270 operation; therefore, it is particularly important that the instructor who plans to teach this course attend an IBM 3270 Operation and Design Class.

Conduction

The IBM 3270 O&D Course consists of lecture interspersed with student exercises to reinforce the material. These student exercises are an important part of the class and without exception all students should perform all the exercises. Where possible the exercises should be presented at a time in the class where they coincide with a break. In this manner the break and performing of the exercise overlap to account for the differences in time it takes for various students to perform the exercises.

The student will be expected to read "An Introduction to the IBM 3270 Information Display System" (GA27-2739) However, it should be noted much of the information covered in this class is not contained in that manual. The instructor should also be careful that a student who has read the manual does not draw the instructor into a discussion of a subject before he is ready to cover it in class.

It must be emphasized that this class is <u>not</u> a programming class. The instructor must not become involved in any discussions which hypothesize as to the form of programming support. However, the instructor must realize that there will be students in every class looking for this type of information. Although the class is dealing with output and input data streams, the channel programs generated are not a concern of this class.

Student Exercises

The student exercises are contained in Section 5 of this guide for instructor reference and in Section 2 of the "IBM 3270 Student Materials". Section 2 should be removed from the student materials before handing them out at the start of the class. The exercises build on one another and, therefore, later exercises contain results of earlier exercises. Exercises should be handed out to the students as they are assigned.

Because of the systems design nature of the class exercises, there are several exercises which can have variations to the sample solutions. Where possible some of these differences are discussed in the solutions. The instructor must be qualified in order that he can recognize other acceptable variations of the solutions. Ideally, the instructor should examine every student's solution to each exercise. However, if time does not permit, as a very minimum, students should be selected to present their solutions to the class. Adequate time must then be provided for other class members to take exception to the solution and present their own solutions.

In allowing time for each exercise, the instructor must include time for presentation of the problem and discussion of the solution. The times provided in the outline for class exercises represent only approximate time that should be given for all students to complete working the exercise. Additional time will be required for reviewing the solutions.

Abbreviations for 3270 Class

In the process of teaching this class the instructor and student will encounter many new abbreviations. The following list of abbreviations and their meanings is provided for reference:

AID	Attention ID
ATT	Attribute Code
BPS	Bits Per Second
BSC	Binary Synchronous Communications
BTAM	Basic Teleprocessing Access Method
CBA	Current Buffer Address
CCC	Copy Control Character
CPS	Characters Per Second
CU	Control Unit
DIDOCS	Device Independent Display Operator Console Support
DS	Display Station
DUP	Duplicate **order**
EAU	Erase All Unprotected command
EM	End of Message **order**
EUA	Erase Unprotected to Address order
FM	Field Mark
IC	Insert Cursor order
K/B	Keyboard
MDT	Modified Data Tag
NL	New Line **order**
PA	Program Attention key
PF	Program Function key
PT	Program Tab **order**
RA	Repeat to Address order
SBA	Set Buffer Address order
SDS	Status Display Support
SF	Start Field order
WCC	Write Control Character
ᵇ̸	Blank
ᴺ̸	Null

COURSE DESCRIPTION

IBM 3270 OPERATION AND DESIGN

Course Code -   G3687

Audience -   Personnel performing the function
                        of Systems Analysis, Applications
                        Programming or Systems Program-
                        ming.

Prerequisite -   Given the appropriate reference
                        materials, the student should be
                        able to:

                        1. Match teleprocessing related
                            terms to their definitions.

                        2. Select the data link control
                            sequences required to perform
                            a given teleprocessing appli-
                            cation.

                        3. Select the BSC text framing
                            characters necessary to trans-
                            mit data.

                        4. Using the S/360 Reference
                            Data Card convert between
                            EBCDIC and hexadecimal.

                        5. Discriminate among bits,bytes,
                            and words as used in the S/360
                            and S/370.

                        6. Select the correct channel
                            command to cause a given tele-
                            processing function to be per-
                            formed.

                        The above prerequisites may be
                        learned in Communications System
                        Design and Analysis (D3602) or
                        Communications System Design for
                        Programmers (G3600). The total
                        content of these courses will pro-
                        vide more than the minimum prere-
                        quisite for attendance at this
                        course.

Objectives -   Upon successful completion of this
                    course, given appropriate refer-
                    ence materials, the student should
                    be able to:

1. Select the combination of IBM
    3270 Information Display Sys-
    tem devices and features that
    will meet the input and output
    requirements for a given appli-
    cation at a particular loca-
    tion, either in a remote or
    local environment.

2. Specify the format and char-
    acteristics of information to
    be displayed at a display sta-
    tion or printer, or both, when
    given a specific application
    to be implemented.

3. Identify the fields, field de-
    limiters, and control se-
    quences comprising a message
    transmitted to or from the
    3270 system, and describe the
    functions and effects of the
    control sequences and field
    delimiters when given the for-
    mat and contents of a record.

4. Identify the limits of data
    fields within the record from
    the application program and
    correctly build messages for
    transmission to a 3270 system,
    either local or remote.

5. Identify the source of a mess-
    age received from a 3270 sys-
    tem, either local or remote,
    and extract the text to be
    passed to the application pro-
    gram, if required by the app-
    lication.

6. Select the appropriate command
    to cause a control-unit func-
    tion of a 3270 system, either
    local or remote, to be executed
    as required by a given applica-
    tion.

2.2

7. Describe how to position the
    cursor of the 3275 or 3277
    Display Station, and how to
    Determine its position when
    a message is received from the
    3270 system.

8. List the variables which will
    describe the status of each
    device in the 3270 system to
    the teleprocessing access
    method programmer, when given
    the configuration of devices
    and control units in the sys-
    tem and the application re-
    quirements of the system.

Materials Required:

Student Material (one per student)

TITLE   FORM NO.

An Introduction to the IBM   GA27-2739
3270 Information Display
System.

The IBM 3270 Information   G520-2446
Display System.

General Information-Binary   GA27-3004
Synchronous Communications.

IBM System/360 Reference Data.   GX20-1703

Student Materials   ZR20-4265

Instructor Material (in addition to above)

3270 Preliminary Installation   ZZ77-1056
Aids - TIE Paper

Education Guide   ZR20-4264

IBM 3270 Information Display   GV20-0283
System - Slides

Tests

A prerequisite and final test are available in
the Standard Course Guidelines - see your Edu-
cation Center Manager for the availability of
this manual.

The abstracts for these publications can be found in
BOIS.

GENERAL COURSE OUTLINE

DAY 1

Prerequisite Test (30 min.)

Review Test

TOPIC 1 - INTRODUCTION TO IBM 3270 INFORMATION DISPLAY
SYSTEM.

A.   IBM 3270 System Features

1.   Components

a.   Control Units

b.   Display Station

c.   Printer

d.   Operator ID card reader

2.   Display Station features

a.   Human factors

b.   Size of screen

c.   Character addressable

d.   Field oriented

e.   Selector pen

f.   Keyboards

g.   Audible alarm

h.   Speed of data transfer

i.   Hard copy

j.   Security

k.   Indicator lights

3.   Uses

a.   Terminal

b.   System operator's console

B. Local Hardware Configuration

   1. IBM 3272 Control Unit general information

       a. Attaches to selector, multiplexer, or
           block multiplexer channel.

       b. Speeds up to 650,000 cps.

       c. CU up to 200 feet from channel.

   2. IBM 3272 Control Unit

       a. Functions

       b. Models of CU

       c. Models of DS - 3277

       d. Models of printers - 3284 and 3286.

C. Remote Hardware Considerations

   1. Control Unit - 3271 general information.

       a. Attaches to S/360 or S/370 via communica-
           tion line.

   2. 3271 Control Unit

       a. Functions

   3. 3275 Stand-alone Unit

       a. Attaches on multipoint BSC line

       b. CU and DS contained in single unit.

       c. Models of stand-alone DS

       d. Printer - 3284 Model 3

Class Exercise 1 - Configuration (30 min.)

TOPIC 2 - REMOTE OPERATION

A. BSC Multipoint Data Link Control for 3270.

    1. Features

        a. Supports multiple BSC devices on line.

        b. Line operates in EBCDIC or ASCII.

        c. Improved checking on transmission.

    2. BSC data link control review.

        a. Polling

        b. Selection

    3. I/O operations controlled by BTAM

B. Data Stream Contents

    1. Polling or selection sequence

    2. Output data stream - general.

        a. BSC text framing characters

        b. Command sequence

        c. Set Buffer Address (SBA) sequence.

        d. Start Field (SF) sequence

C. Example of Screen Format

    1. Field oriented concept.

3.3

TOPIC 3 - CREATING SCREEN FORMAT AND BUILDING OUTPUT
          DATA STREAM FOR REMOTE 3270.

A. Components of Data Stream.

    1. General contents

        a. Commands

        b. Orders

        c. Control characters

        d. Text

    2. Start Field sequence

        a. Start Field (SF) order

        b. Attribute (ATT) code

    3. Set Buffer Address (SBA) sequence

        a. SBA order

        b. Address

        c. Occurance

    4. Command Sequence

        a. ESC

        b. Commands

        c. Write Control Character (WCC)

Class Exercise 2 - Building output data stream (20 min.)

DAY 2

B. IBM 3270 Output Data Stream Continued.

    1. Additional orders

        a. Insert Cursor (IC)

        b. Repeat to Address (RA)

    2. Selector pen detectable fields

        a. Optional feature

        b. Entry of data without keyboard operation.

        c. Attribute code indicates field selectable.

        d. On detection Modified Data Tag (MDT) set.

        e. Field format

Class Exercise 3 - Expansion of output data stream.
                    (30 min.)

TOPIC 4 - INPUT DATA STREAM FROM REMOTE 3270.

A. Types of Reads

    1. Read Modified

        a. Read only fields with MDT set.

        b. If unformatted buffer, read entire buffer.

        c. Short read

B. Components of Data Stream for Read Modified.

    1. General contents of data stream.

    2. Source of message

        a. CU and Device address.

        b. Specific poll vs. general poll.

    3. Attention ID (AID) character

        a. Operator request for service.

        b. AID identifies cause of request.

        c. I/O pending set at device.

        d. Resetting of AID

    4. Cursor address

    5. Field data

C. Erasing Under Program Control.

    1. Erase/Write command.

    2. Erase All Unprotected command.

        a. Functions

        b. Data stream

    3. Erase Unprotected to Address (EUA) order.

        a. Include in write data stream.

        b. Operation

        c. Use

D. Additional Read Command Considerations.

    1. Read Modified command - short read.

    2. Read Buffer command.

        a. Entire buffer transferred.

        b. Used primarily for debugging.

Class Exercise 4 - Input data stream and erasing of
                    screen (45 min.)

DAY 3

TOPIC 5 - LOCAL OPERATION

A.   Output Data Stream

    1.   Channel commands

        a.   Effect of CBA

        b.   ERASE/WRITE channel command

        c.   WRITE channel command

        d.   ERASE ALL UNPROTECTED channel command

B.   Input Data Stream

    1.   Channel commands

        a.   Read channel commands

        b.   SELECT channel command

C.   WCC, Orders, Attribute Code, AID

Class Exercise 5 - Local data streams (10 min.)

TOPIC 6 - PRINTER OPERATIONS

A. Hardware Considerations

    1. IBM 3284 or 3286 Printer with 3271 or 3272 CU.

    2. IBM 3284 Model 3 with 3275 DS.

    3. Print positions - 120, 126, or 132 characters per line.

B. Uses for Printer

    1. Hard copy of displayed information.

        a. Processor to printer

        b. DS to printer

    2. Hard copy formatted for printer

C. Output to Printer When Same as DS.

    1. General data stream.

    2. Command sequence

    3. SBA sequence

    4. SF sequence

    5. Other orders and text

D. Output Formatted Specifically for Remote Printer.

    1. Program specifically for hard copy.

    2. WCC - printer specifications (NL & EM)

    3. SBA sequence

E. Copy DS to Printer or DS to DS.

    1. General information - remote cluster only.

    2. Output data stream to perform copy

        a. Select device to receive with BSC selection

        b. Write data stream to initiate copy

        c. Copy DS to DS

F. Output to Local Printer

1. Differences between remote and local.

2. Output data stream to local.

TOPIC 7 - ADDITIONAL FUNCTIONS AND FEATURES OF THE
          3270 SYSTEM.

A. Additional Orders

    1. Program Tab (PT)

    2. Duplicate (DUP)

    3. Field Mark (FM)

B. Operator Identification Card Reader

    1. Enters user information.

    2. Physical characteristics of ID card.

TOPIC 8 - PROGRAMMING SUPPORT OVERVIEW, MAINTAINING
          STATUS, AND SCREEN DESIGN.

A.   IBM 3270 System as a Terminal.

     1.   OS and DOS BTAM

B.   IBM 3270 System as a Display Operator Console.

     1.   DIDOCS - Device Independent Display Operator
          Console Support.

     2.   SDS - Status Display Support.

C.   Determining What Status Information Must Be Main-
     tained For Each Display Station and Printer.

Class Exercise 7 - Determining status information
                   (15 min.)

D.   Screen Design

Class Exercise 8 - Screen design (30 min.)

FINAL TEST (30 min.)

PREQUISITE TEST

REVIEW TEST

NOTE: Based on the results of the prerequisite test,
         it may be necessary to review BSC and par-
         ticularly Multipoint Data Link Control.

TOPIC 1 - INTRODUCTION TO IBM 3270 INFORMATION DISPLAY
          SYSTEM.

A.   IBM 3270 System Features

NOTE: It is suggested IBM 3270 Information Display
         System (GV20-0283) slides be shown at this
         point. With the use of these slides, the in-
         structor can skip portions of Section A.

   1.   Components   (1-V-1)

      a.   Control Units (CU)

         1)   Remote - BSC

         2)   Local

      b.   Display Station (DS)

        CRT
        Keyboards

      c.   Printer

        Two speeds to select from - 40 CPS
        & 66 CPS

      d.   Operator identification card reader at-
         taches to DS.

   2.   Display Station Features   (1-V-2)

      a.   Human factors

         1)   Clarity of image

            a)   Anti-glare design

               High contrast screen

            b)   7X9 dot matrix

            c)   Brightness is operator adjustable

2) No air conditioning required

3) Light and small

   Control unit size of 2 drawer file cabinet.

4) K/B key clicks when character successfully entered.

b. Size of screen

1) 480 - Model 1   (1-V-3)

   12 lines of 40 characters

2) 1920 - Model 2   (1-V-2)

   24 lines of 80 characters

c. Character addressable

1) Every character addressable

2) Program controlled arrangement of data on screen by selective writes to various noncontiguous areas on the screen.

3) Permits changing of selected fields

d. Field oriented

1) Each data field specified by field attribute control code in first position of field.

2) Functions of attribute code

   a) Protected or unprotected

      Permits operator to enter only variable data.

   b) Brightness

      Off/normal/bright

   c) Alphameric or numeric input

   d) Selector pen detectable

e. Selector pen

    1 1) Special feature

    2) Select fields for input with use of pen for speed and accuracy.

    Reduces keystrokes and simplifies operations.

f. Keyboards

NOTE: Three basic keyboards are shown in Chapter 2 of GA27-2739.

    1) Several keyboard layouts depending on application -

      a) Typewriter - 66 or 78 character   (1-V-4)

        Either US ASCII or US EBCDIC

      b) Data Entry - 66 character   (1-V-5)

      c) Operator Console - 66 or 78 character

    2) Keyboard operations

NOTE: Use foils 1-V-5 or 1-V-6 to show cursor movement and keyboard functions.

NOTE: There will always be a cursor on the screen, e.g., power on places the cursor in the upper left hand corner of the screen.

Cursor can be displayed under any position on the screen and does not destroy data as it is moved. It can be moved under both operator and program control.

      a) Cursor movement keys

        UP (↑)
        DOWN (↓)
        LEFT or BACKSPACE (←)
        RIGHT (→)
        TAB or SKIP (→|)
        BACKTAB (|←)
        NEW LINE (↵)

        All typamatic except BACKTAB
        All keys will wrap

NOTE: TAB, SKIP (Data entry keyboard), and BACKTAB
        are all field oriented keys. TAB and SKIP
        will cause cursor movement to the first posi-
        tion of the next unprotected field as defined
        by the attribute code. BACKTAB will cause
        cursor movement to the first position of the
        previously defined unprotected field.

NOTE: Any erase function clears the buffer or por-
        tions of the buffer to null characters. A
        null is a distinct character and will permit
        functions to be performed that are not pos-
        sible with blank characters in the buffer.
        The differences will be discussed throughout
        the course.

        b) **Erasing keys**

           ERASE EOF

                Clears to nulls from cursor
                position to end of field in
                which cursor is located.
                Does not move cursor.

           ERASE INPUT

                Clears all unprotected char-
                acters to nulls.
                Position cursor in first posi-
                tion of first unprotected
                field.

           CLEAR

                Clears entire buffer to nulls.
                Cursor positioned at location
                0.

        c) Edit keys

           Insert mode (INS MODE key)
           Delete (DEL key)

NOTE: To use insert mode must have nulls in the
        field being modified to permit addition of new
        data. If at end of line or field and no nulls
        left for insertion, K/B locks. Operator leaves
        insert mode or resets K/B when locked by de-
        pressing reset key.

        Delete causes removal of character, compression
        of data in the field, and addition of nulls at
        the end of the field.

d) Program function and program at-
            tention keys.

            Depression of any of these keys
            permit uniquely coded input to
            application program.

NOTE: PF and PA keys will be discussed in greater
        detail when considering content of input data
        streams.

        e) Reset key

            Enables operator to recover from
            a locked keyboard, e.g., after
            attempting to key data into a
            protected field.

        f) Enter key

            One of the keys used to request
            servicing of the terminal after
            the operator has entered data.

NOTE: See Chapter 3 of GA27-2739 for further des-
        cription of keyboard functions. Certain
        other keys, e.g., DUP and FIELD MARK, will
        be discussed when covering input data streams.

        3) Movable

            2 1/2 feet of cable

            Keyboards can be interchanged for
            different applications.

            Can remove keyboard and lock it up
            for security.

    g. Audible alarm

        1) Special feature

        2) Obtains operator's attention

            Duration 3 seconds

            Volume operator adjustable

    h. Speed of data transfer.

        1) Speed of CRT

        2) Speed of data transfer

3) Techniques to reduce volume of data transfer.

i. Hard copy

Two models of printers

j. Security

1) Lock

Special feature

2) Non-display feature

Permits operator to key security code without being displayed.

3) Operator identification via an operator ID card reader.

k. Indicator lights

1) Located on right hand side of screen

2) Three lights

a) Insert mode

Turned on by depression of insert key when operator wants to go into insert mode.

b) Input inhibited

Manual input or selector pen input inhibited.

c) System available

Successful completion with CPU. Ready for another operation.

3. Uses

a. As a terminal

1) Data entry

2) Inquiry

NOTE: Data entry and inquiry applications include many different types. Reference Chapter 4 of GA27-2739 for types.

b. System operator's console

    1) Display operator console

       Includes keyboard

    2) Output only display console

       Keyboard not necessary

B. Local Hardware Configuration   (1-V-7)

  1. IBM 3272 Control Unit general information

    a. Attaches to selector, multiplexer, or block multiplexer channel.

    b. Speeds up to 650,000 character per second.

    c. CU can be up to 200 feet from channel.

       Distance from channel has same limits as other types of control units on S/360 or S/370.

NOTE: Speed varies depending on model of S/360 or S/370. When significant volumes of data being transferred, block multiplexer channel would be preferred if system has one.

  2. 3272 Control Unit

    a. Functions

       1) Interfaces with channel.   (1-V-8)

       2) Interprets and performs operations specified by:

          Channel commands
          Data stream

       3) Buffers I/O to and from DS's and printer buffers.

       4) Interfaces with displays and printers.

          Up to 32 of them.
          Must have at least 1 DS.
          Can have 0 printers.

    b. Models of CU   (1-V-9)

       1) Model 1

a) 480 character buffer

b) Can have only DS and printers with 480 character buffers connected to it.

2) Model 2

a) 1920 character buffer

b) Can have any size DS or printer connected to it.

c. Models of DS - 3277

1) Model 1

a) 480 character display image

b) Contains 480 character regenerative buffer.

c) Keyboards

None
Typewriter
Data entry
Operator console keyboard

NOTE: All keyboards can have variations. See Chapter 2 of GA27-2739 and sales manual pages. Do not get involved with a detailed discussion of keyboards.

2) Model 2

a) 1920 character display image

b) Contains 1920 regen buffer

NOTE: Keyboards for Model 2 same as for Model 1.

NOTE: Actual screen size varies between Model 1 and 2. See 1-V-2 and 1-V-3.

d. Models of printers - 3284 and 3286

1) 3284 - 40 CPS print rate

a) Model 1

480 character buffer
Attaches only to Model 2 of 3272.

b) Model 2

1920 character buffer
Attaches only to model 2 of 3272

NOTE: There is a Model 3 for the 3284 but only for
remote stand-alone. Do not discuss at this
point.

2) 3286 - 66 CPS print rate

a) Model 1

480 character buffer
Attaches to 3272 Model 1 or 2

b) Model 2

1920 character buffer
Attaches to only Model 2 of 3272

NOTE: The DS's and printers attached to the 3271 and
3272 CU units can be up to 2000' away from the
CU. If the user has 2260 cables, they can be
used for installation. The only cable required
for this installation is a single coaxial cable.
The cable is limited to 2000' because of signal
distortion above that distance.

C. Remote Hardware Considerations

1. Control Unit - (3271) general information   (1-V-10)

a. Attaches to S/360 or S/370 via communica-
tions line.

1) Data set at CPU attaches to:

a) TCU-2701 or 2703

b) Integrated Communications Adapter
(ICA)

S/370 Model 135 only.

NOTE: TCU will normally be attached to multiplexer
channel. The 2701 can be attached to block
multiplexer channel on Model 135 and selector
channels on other S/360 and S/370's. The 2703
can be connected only to multiplexer channel.

2) Communications line speeds - leased line.

   1200 bps
   2000 bps
   2400 bps
   4800 bps

3) Binary synchronous multipoint data link control.

NOTE: Even if only one remote CU on line it will be multipoint line control.

a) Up to 32 remote 3270 display systems.

b) Can have 3270 system intermixed on same line with other BSC devices.

c) BSC transmission code can be either EBCDIC or ASCII.

2. 3271 Control Unit

a. Functions   (1-V-11)

1) Interfaces with data set

NOTE: Since CU is remote it will not receive channel commands. All control unit commands and device orders will be in data stream. Data stream including commands and orders will be covered later.

NOTE: The strategy of the course is to emphasize remote terminal operations. Then cover the differences in local operations.

3. 3275 Stand-alone Unit

a. Attaches remotely in the same manner as the 3271 multipoint on BSC line.

b. CU and display station are contained in a single unit.

c. Models of DS

1) Model 1

   480 character display image and buffer

2) Model 2

1920 character display image and buffer.

d. Printer - Only 3284 Model 3

1) Attaches to 3275 Model 1 and 2

2) Shares buffer in 3275

3) Prints at 40 CPS

4) Printer up to 10 feet from display

NOTE: Appendix A and Appendix B of GA27-2739 are good references for the hardware configuration.

Class Exercise 1 - Configuration of a system (30 min.)
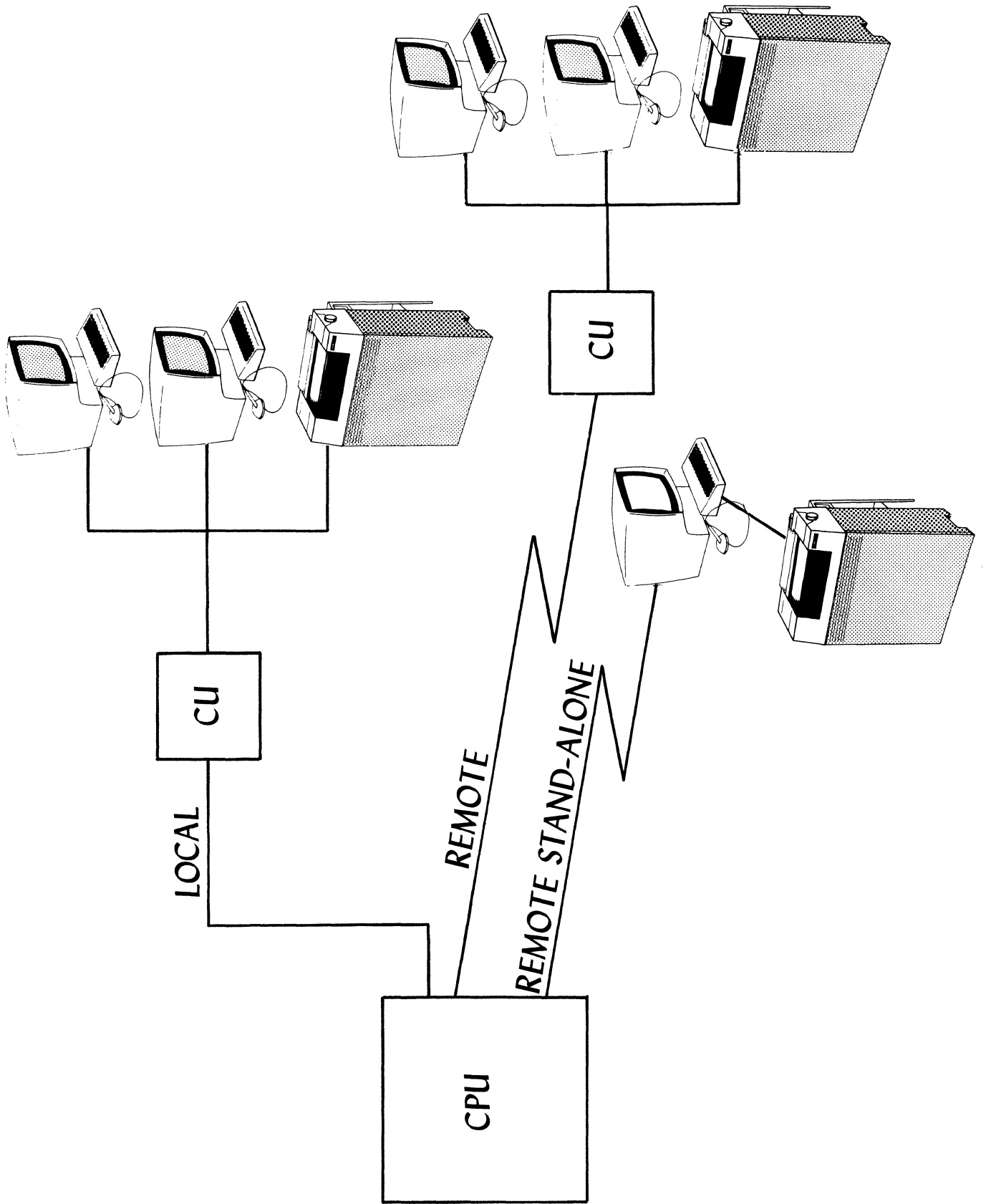
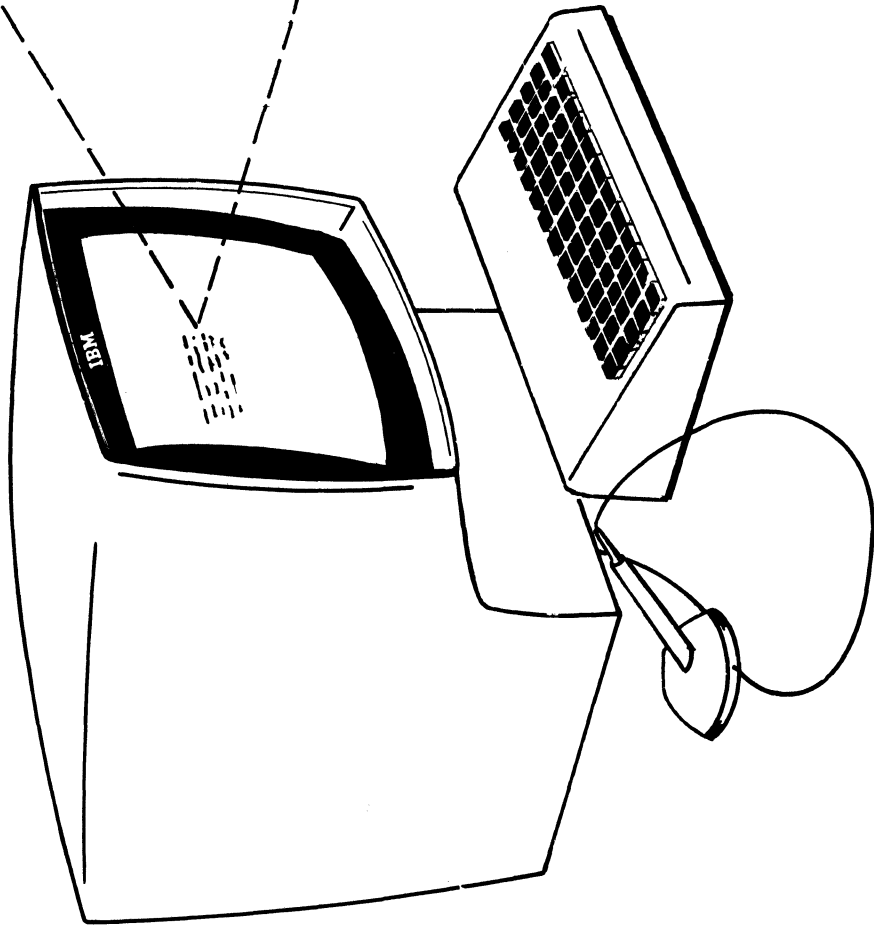LOCAL

CU

REMOTE

REMOTE STAND-ALONE

CPU

PF3 PF6 PF9 PF12

PF2 PF5 PF8 PF11

PF1 PF4 PF7 PF10

FIELD MARK PA2   DEL   →   ↑

DUP PA1   INS MODE   ←   ↓

CLEAR   ERASE INPUT   ERASE EOF   TEST REQ

SHIFT   LOCK   SHIFT   RESET   ENTER

|0|1|2|3|4|5|6|7|8|9|10|11|12|13|14|15|16|17|18|19|20|21|22|23|24|25|26|27|28|29|30|31|32|33|34|35|36|37|38|39|

Row labels:
0
40
80
120
160
200
240
280
320
360
400
440

Keyboard layout:

CLEAR | PA3 | @ | # | ' * | . $ | FIELD MARK | DUP | : . | 0 / | PF1 | PF2 | PF3 | ← | PA1 | PA2

ERASE INPUT | →| | + Q | − W | ! E | : R | ; T | = Y | 1 U | 2 I | 3 O | & P | PF4 | |← | INS MODE | DEL

ERASE EOF | NUM LOCK | < A | > S | D | | F | ⌐ G | ¢ H | 4 J | 5 K | 6 L | SKIP | PF5 | ↵ | ↑ | ↓

TEST REQ | NUMERIC | % Z | ? X | ' C | " V | (B |) N | 7 M | 8 , | 9 . | ALPHA | ← | →

RESET | | ENTER

LOCALLY ATTACHED 3270 DISPLAY SYSTEM

S/360 OR S/370	BLOCK-MULTI-PLEXER
	SELECTOR
	BYTE MULTI-PLEXER

3272 CU

3277

3284

3277

3286

FUNCTIONS OF 3272 CONTROL UNIT

CHANNEL —————

INTERFACE

WITH

CHANNEL

BUFFERS DATA

TO & FROM DS

AND PRINTER

BUFFERS

INTERPRETS

AND PERFORMS

SPECIFIED

OPERATIONS

DEVICE

ADAPTER

INTERFACES

WITH

DISPLAYS

AND

PRINTERS

DISPLAY

STATIONS

AND

PRINTERS

LOCALLY ATTACHED 3270 DISPLAY SYSTEM

```
┌─────────────────┐         ┌──────────┐         ┌──────────┐
│   │ BLOCK       │         │   3272   │         │   3277   │
│   │ MULTI-      │         │          │         │    DS    │
│   │ PLEXER      │─────────│ CONTROL  │──────   │          │
│S/360          │         │   UNIT   │   └──── └──────────┘
│   │             │         │          │          Model 1 - 480
│OR │ SELECTOR    │         └──────────┘
│   │             │                               ┌──────────┐
│S/370          │          Model 1 - 480        │   3284   │
│   │             │                               │ PRINTER  │
│   │ BYTE        │          Model 2 - 1920       │          │
│   │ MULTI-      │                               └──────────┘
│   │ PLEXER      │                                Model 1 - 480 - 40-cps
└─────────────────┘                                Model 2 - 1920 - 40-cps *

                                                  ┌──────────┐
                                                  │   3277   │
                                                  │    DS    │
                                                  └──────────┘
                                                   Model 2 - 1920 *

                                                  ┌──────────┐
                                                  │   3286   │
                                                  │ PRINTER  │
                                                  └──────────┘
```

3277 DS — Model 1 - 480

3284 PRINTER — Model 1 - 480 - 40-cps / Model 2 - 1920 - 40-cps *

3277 DS — Model 2 - 1920 *

3286 PRINTER — Model 1 - 480 - 66-cps / Model 2 - 1920 - 66-cps *

3272 CONTROL UNIT — Model 1 - 480 / Model 2 - 1920

*   REQUIRES MODEL 2 CONTROL UNIT

REMOTELY ATTACHED 3270 DISPLAY SYSTEM
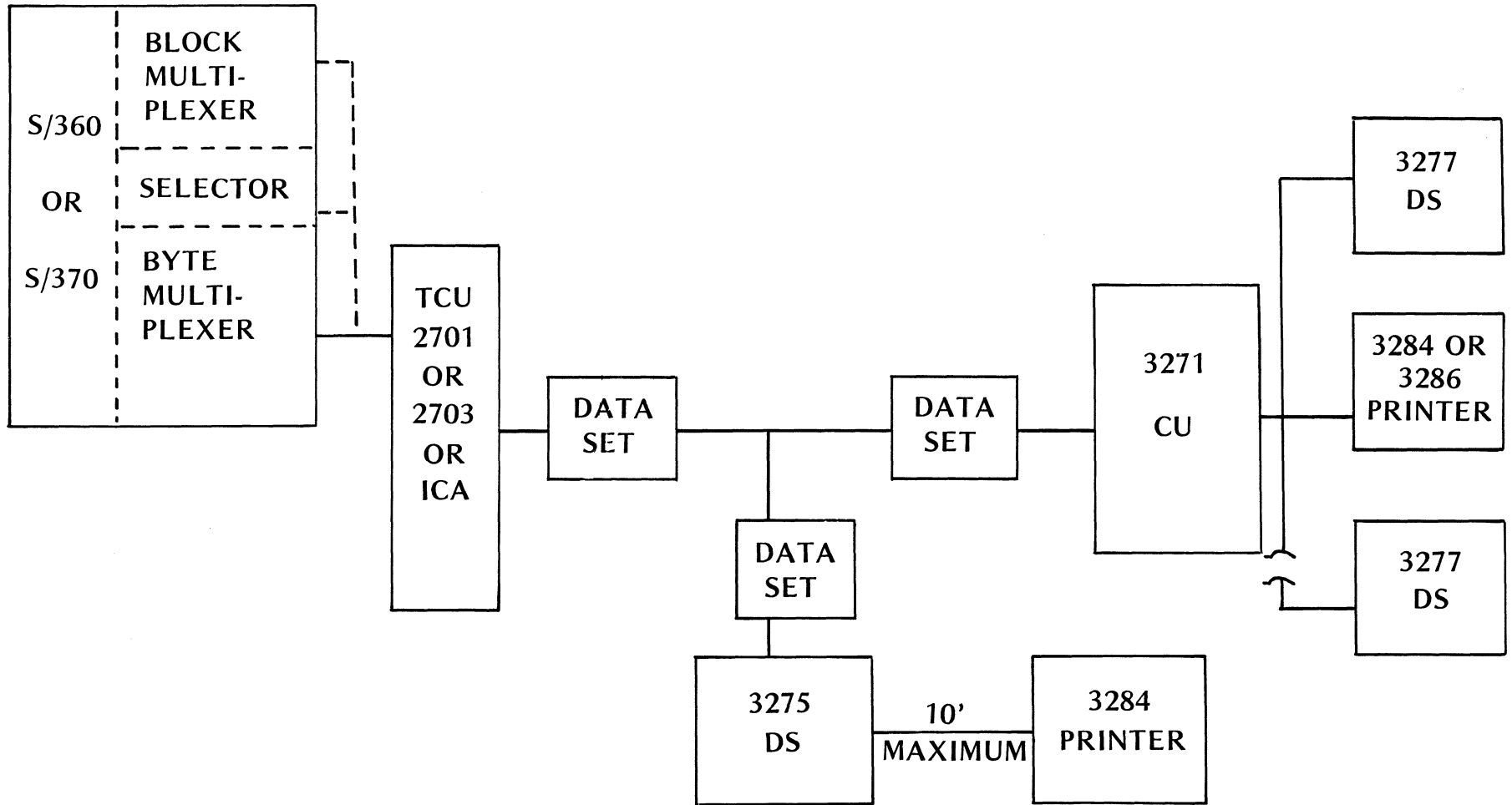
FUNCTIONS OF 3271 CONTROL UNIT

LINE

DATA
SET

INTERFACE
WITH
DATA SET

BUFFERS DATA
TO AND FROM
DIAPLAY
STATION
AND TO
PRINTER
BUFFERS

DEVICE
ADAPTER

INTERPRETS
AND PERFORMS
SPECIFIED
OPERATIONS

INTERFACES
WITH
DISPLAYS
AND
PRINTERS

DISPLAY
STATIONS
AND
PRINTERS
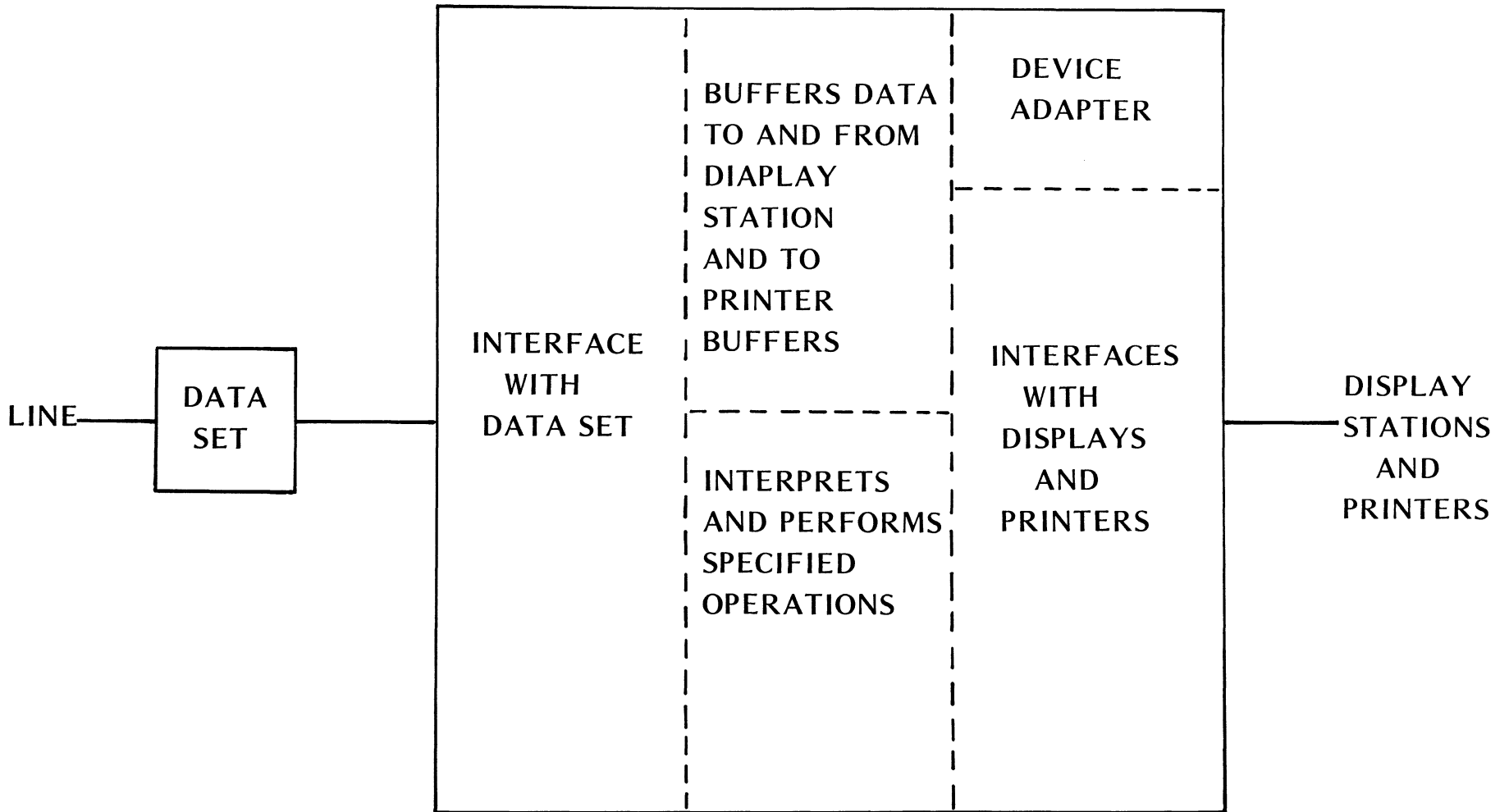
TOPIC 2 - REMOTE OPERATION

NOTE: In examining the operation of the 3270 Display
         System, including screen design and data
         stream formats, most of the time will be spent
         on the remotely attached system. Except for
         commands and BSC control characters this data
         stream will be the same as the local data
         stream.

A. BSC Multipoint Data Link Control for 3270

NOTE: BSC is a prerequisite and may have been re-
         viewed after the prerequisite test, therefore,
         the instructor may not need to spend much time
         on this subject.

    1. Features

        a. Supports multiple BSC device on line.

            1)   3271 CU

            2)   3275 Stand-alone

            3)   Other BSC terminals

                 2770, System 3, Mod 20, 2780, 3735,
                 1130

        b. A line can operate in EBCDIC or ASCII

        c. Improved checking on transmission

    2. BSC data link control review

        a. Polling example   (2-V-1)

        b. Selection example   (2-V-3)

NOTE: Foils 2-V-2 and 2-V-4 are provided as another
         way to illustrate the exchange of control and
         data between the CPU and remote 3270.

    3. I/O operations on line controlled by BTAM
        channel programs.

NOTE: This is not a programming course; therefore,
         do not get involved with a discussion of BTAM
         channel programs. The main point to be made
         here is that the normal READ and WRITE channel
         commands used in most BTAM channel programs
         are employed. When the topic of local support
         comes up the channel commands will be consid-
         erably different.

B. Data Stream Contents

    1. Polling or selection sequence

        a. EOT establishes control mode

        b. CU and DS address

NOTE: These addresses will take the place of "AA11" and "aa99" on foils (2-V-1) and (2-V-3).

    2. Output data stream - general format   (2-V-5)

        a. BSC text framing characters

            1) STX - start of text

            2) ETB or ETX

                ETB indicates another block to be transmitted from 3270. ETX indicates last block.

NOTE: On polling 3270, CPU can receive multiple blocks since remote 3270 will break long data streams into shorter blocks for transmission. For transmission to the remote 3270, all blocks will end in ETX since it does not recognize an ETB.

        b. Command sequence

            1) Indicates function to be performed at specified remote 3270.

NOTE: When working with locally attached 3270's there would not be a command sequence in the data stream. Instead the channel command would specify the function to be performed. This will be covered in detail under local operation.

        c. Set Buffer Address (SBA) sequence

            1) Indicates the address in the buffer where the following text is to be stored. This determines the screen or printer image.

d.   Start Field (SF) sequence

             1)   Specified beginning of a field and the
                  characteristics of the field, e.g.,

                  Protected or unprotected, selector pen
                  detectable, brightness, etc.

C.   Example of Screen Format   (2-V-6)

NOTE: Either 1-V-5 or 1-V-6 may be used by the in-
         structor if he wishes to write his own example
         on the screen.

NOTE: Instructor must start emphasizing the import-
         ant concept of field oriented display.

     1. Field oriented concept

         a.   Each field positioned on screen by SBA se-
              quence.

         b.   Characteristic of field determined by at-
              tribute code.

              1)   SF precedes attribute code.

              2)   Attribute code

                   a)   Takes position in buffer.

                   b)   Not displayed on screen.

                   c)   Field separator for visual pur-
                        poses attribute code automatically
                        gives blank.

NOTE: In foil 2-V-6 [_] represents attribute code.
         The fields shown in the foil are protected and
         normal intensity. Fields to be entered are
         unprotected and the salary field is also non-
         displayed (brightness off).

BSC DATA LINK CONTROL
(POLLING)

CPU

E		E		A	A
O	AA11	N		C 1	C 0
T		Q		K	K

3270

S		E b		S	E b	E
T TEXT	T c		T TEXT	T c	O
X		B c		X	X c	T

NOTE: "AA11" POLLING CHARACTERS ARE EXAMPLES AND NOT
INTENDED TO BE ACTUAL 3270 CHARACTERS.

BSC DATA LINK CONTROL
(POLLING)

CPU   3270

EOT
POLL ADDR. CHAR.
ENQ

```
                                    STX
                                     T
                                     E
                                     X
                                     T
                                    ETB
                                    bcc
```

ACK1

```
                                    STX
                                     T
                                     E
                                     X
                                     T
                                    ETX
                                    bcc
```
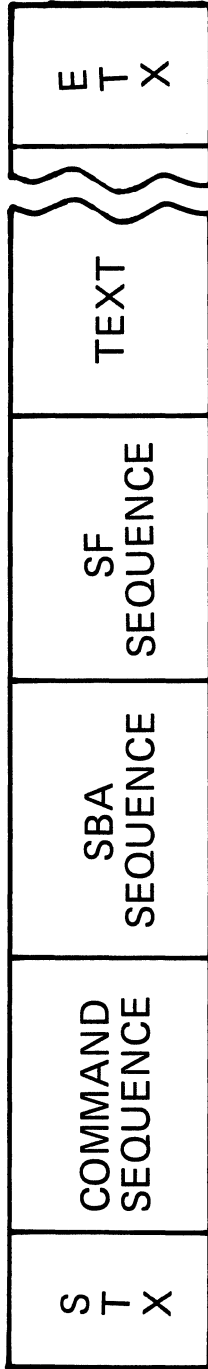
ACK0

```
                                    EOT
```
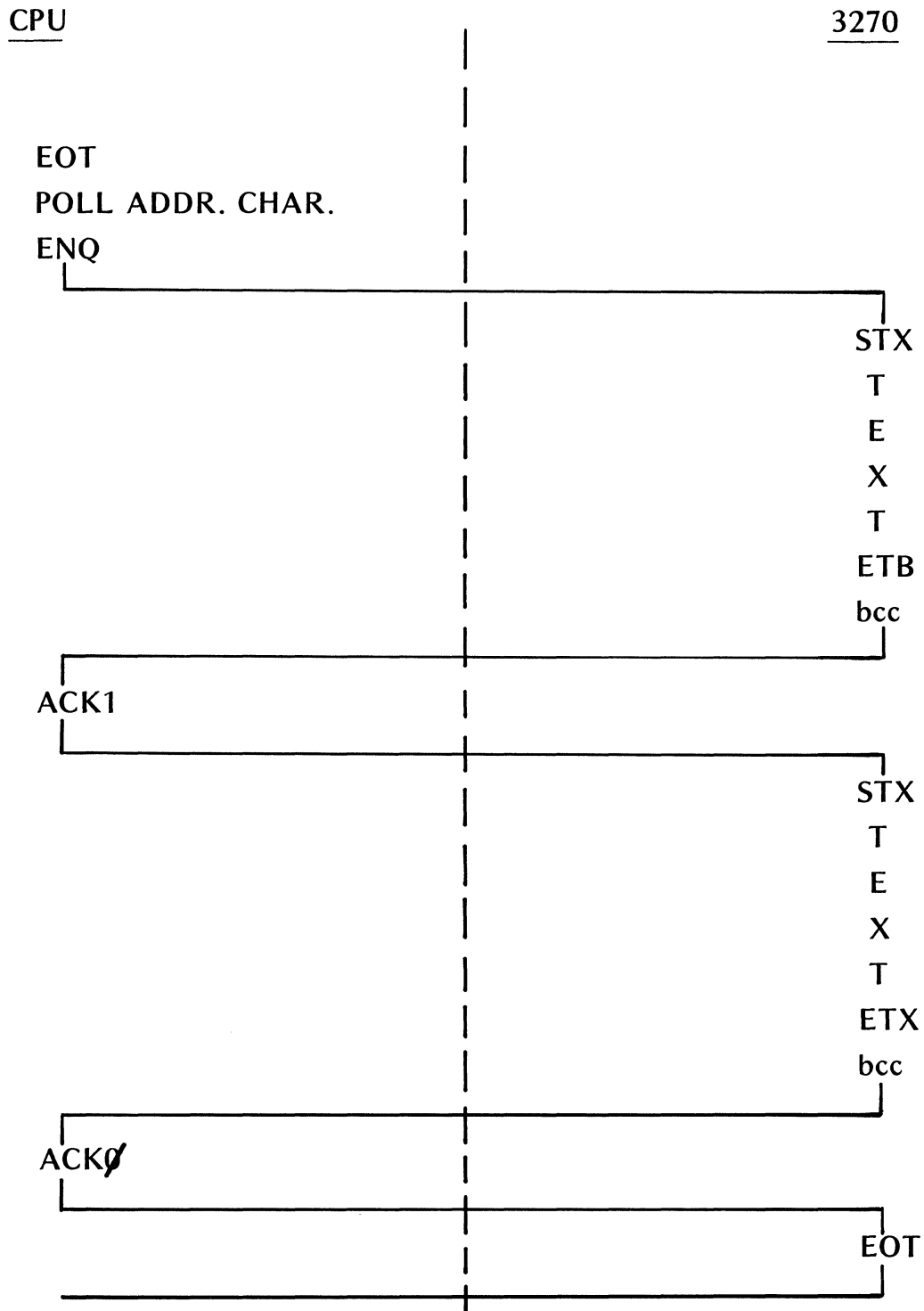
BSC DATA LINK CONTROL
(SELECTION)

CPU

```
E              E          S          E b              E
O    aa99      N          T  TEXT  T c              O
T              Q          X          X c              T
```

3270

```
                    A                        A
                    C ø                      C 1
                    K                        K
```

NOTE: "aa99" SELECTION CHARACTERS ARE EXAMPLES
       AND NOT INTENDED TO BE ACTUAL 3270
       CHARACTERS.

BSC DATA LINK CONTROL
(SELECTION)

CPU   3270

EOT
SELECTION ADDR. CHAR.
ENQ

                                                             ACK∅

STX
 T
 E
 X
 T
ETX
bcc

                                                             ACK1

EOT

REMOTE 3270 OUTPUT DATA STREAM

S T X	COMMAND SEQUENCE	SBA SEQUENCE	SF SEQUENCE	TEXT	E T X

Screen layout grid (columns 0–39, rows 0–440):

```
 NAME: 
 SALARY: 
 JOB  TITLE: 
 PHONE  #: 
```

Keyboard:

CLEAR	PA3	@	#	' *	. $	FIELD MARK	DUP	: .	0 /	PF1	PF2	PF3	←		PA1	PA2
ERASE INPUT	→|	+ Q	– W	! E	: R	; T	= Y	1 U	2 I	3 O	& P	PF4	|←		INS MODE	DEL
ERASE EOF	NUM LOCK	< A	> S	D		F	⌐ G	¢ H	4 J	5 K	6 L	SKIP	PF5	↵		↑	↓
TEST REQ	NUMERIC	% Z	? X	' C	" V	(B	) N	7 M	8 ,	9 .	.	ALPHA		←	→
RESET												ENTER		

TOPIC 3 - CREATING SCREEN FORMAT AND BUILDING OUTPUT
            DATA STREAM FOR REMOTE 3270.

NOTE: Instructor may find it useful to see foil
          3-V-1 to illustrate what happens on screen
          when discussing some of the concepts in this
          topic.

NOTE: The hex codes for all commands, addresses, or-
          ders, attribute code, and AID bytes are un-
          available for release at the time this Educa-
          tion Guide is being written. Therefore, these
          bytes will be represented symbolically.

A.   Components of Data Stream

     1.   General Contents of data stream

          a.   Commands

               Cause CU to perform specified function.
               For example, erase screen and write mess-
               age.

          b.   Orders

               1)   Causes certain device related opera-
                    tions to be performed.

                    For example, position cursor.

          c.   Control characters

               BSC characters
               Attribute code

          d.   Text

     2.   Start Field sequence   (3-V-2)

          a.   Start Field (SF) order.

               1)   Indicates beginning of a field.

               2)   Precedes attribute code in output data
                    stream.

NOTE: The other orders will be covered as they are
          needed for student exercises.

          b.   Attribute (ATT) code

               1)   General considerations

a) Occupies displayable position

b) Controls characteristics of field until another attribute code in data stream.

c) Can be entered only under program control as part of data stream.

d) Once an attribute code is given, it pertains to all following buffer locations until another attribute code is encountered. This also pertains in a wraparound situation.

e) Presence of an attribute code implies formatted buffer.

NOTE: The unformatted buffer is similar to 2260; therefore, may be first step in conversion of 2260 applications to 3270.

There would be no attribute character in any location of the buffer. The entire screen would be unprotected, alphameric, and normal brightness.

f) Attribute code's position in buffer is protected from operator keying over it.

2) Characteristics

NOTE: Attribute code is a one byte character which has various combinations of bits set on indicate characteristics of a field.

a) Protected or unprotected field.

Protected prevents operator from keying data into that field. Keyboard remains locked until operator depresses RESET.

Also provides a means of erasing variable data (unprotected) from the screen, while retaining headings (protected), etc.

b) Alphameric and numeric.

Indicate whether field is to contain alphameric or numeric data.

c) Brightness

Allows a field to be displayed at one of three intensities - normal, bright, or off.
Bright is used to highlight specific fields and off prevents the field from being displayed.

d) Modified Data Tag (MDT)

Indicates whether a field has been modified either under program control or from the keyboard.

Normally, the MDT will be set by K/B entry as opposed to program control.

e) Selector pen detectable

Allows a field to be selected for input by using a selector pen.

3) Relationship between ATT code and operator functions.

a) ATT codes act as tab stop.

When TAB key depressed cursor moves to next unprotected field.

BACKTAB causes following cursor movement:

If cursor in protected field, ATT character, or first alphameric character location of unprotected field, it moves to first position of preceding unprotected data field.

If cursor located in any other position in unprotected field, it moves to first position in that field.

b)   Autoshift - Data entry K/B only.

Numeric in ATT code causes autoshift.
If numeric lock feature on DS, entry
of any other character than 0-9,".",
"-", and DUP will cause K/B to lock
(autolock).
Can override autoshift with ALPHA key.
If no numeric lock can enter any character and not cause autolock.

NOTE: When autolock occurs depress RESET to restore K/B.

c)   Numeric ATT code with typewriter K/B.

No autoshift on numeric ATT code.
If numeric ATT code and numeric lock
feature, entry of any character other
than 0-9,".","-", and DUP will cause
autolock.
If no numeric lock can enter any character.

d)   Autoskip - All K/B's.

When keying into last position of a
field and the next field is defined as
protected and numeric, cursor will autoskip to the next unprotected field
when that last operation is filled.
If next field is protected alphameric,
the cursor will move into that field
and autolock will occur if entry is attempted.

3.   Set Buffer Address (SBA) sequence   (3-V-3)

NOTE: The concept of the DS's CBA must be discussed and
understood by the student during the presentation
of the SBA sequence.

a)   SBA order

1)   Used in WRITE and ERASE/WRITE command data
stream.

2)   Resets CBA to a specified location.

Any write will cause data to be read into
the buffer location specified by the DS's
CBA. As each character is moved into the
buffer the address is incremented by one.

The value in the CBA can be reset at
any time by the data stream with an
SBA.

b. Address

Following SBA order will be the two byte
address to be used as the CBA.

c. Occurance

1) Establish position of first field.

Will normally occur early in the data
stream for the first field.

2) Prior to new field

Will normally have SBA sequence coded
prior to any new field to be displayed
or defined.

4. Command Sequence   (3-V-4)

NOTE: There will be only one command sequence in an
output data stream. This can be an area con-
fusion to the student since there can be many
SBA and SF sequences in a single output data
stream.

a. ESC

BSC escape control character required
prior to command.
This alerts CU that command follows.

b. Commands

NOTE: Only the commands which may be used to perform
class exercises 2 and 3 will be discussed at
this time.

1) Writes

a) Erase/Write

Clears entire buffer to nulls
Reset CBA to 0.
Places cursor at position 0.
Writes data into buffer as speci-
fied by rest of data stream.
Does not restore K/B.
Does RESET MDT.

4.3.5

NOTE: Nulls need not be transmitted when reading
from the 3270. Blank characters would be
transmitted on all reads.

    b) WRITE

       Write data as specified by rest of
       data stream.

       CBA not reset until SBA sequence en-
       countered in data stream.

NOTE: When using a WRITE command, the inclusion of
an SBA sequence in the data stream is recom-
mended to assure proper positioning of a mes-
sage on the screen.

    c. Write Control Character (WCC)

      1) Function

        a) First character in data stream
          following every ERASE/WRITE and
          WRITE command.

        b) Further defines write operation.

          Indicates whether output is for
          printer or DS.
          Printer format information.
          Sound audible alarm.
          Restore K/B.
          Reset MDT in attribute code.

NOTE: Show class how to use forms for exercise. Two
foils are provided, 3-V-5 and 3-V-1. The in-
structor may choose to use the example or
write his own example on 3-V-1.

Class Exercise 2 - Building of output data stream.
                (20 min.)

DAY 2

B. 3270 Remote Output Data Stream Continued.

NOTE: This portion of the class is directed at ex-
       panding on the last class exercise to use ad-
       ditional functions of the 3270. In effect it
       is a continuation of the data stream developed
       in Class Exercise 2.

    1. Additional orders

        a. Insert Cursor (IC)   (3-V-6)

NOTE: This is the only order which will cause the
       cursor to be repositioned.

            1) Included in ERASE/WRITE or WRITE data
                stream.

            2) Cursor will be positioned at location
                specified by the CBA.

                a) Therefore, IC must be given in
                    data stream when CBA is set at de-
                    sired value, or

                b) SBA sequence can be issued prior
                    to IC.

            3) IC itself does not cause CBA to be in-
                cremented.

            4) Will normally set cursor at beginning
                of first unprotected field into which
                operator is to key data.

            5) Once operator entry of variable data
                is initiated, the CBA will be the same
                as the cursor's position.

NOTE: Other than when entering data, there is no re-
       lationship between cursor position and CBA.
       For example, the IC order can be followed by
       additional data which will keep incrementing
       the CBA. However, as soon as the operator
       enters data into the cursor position, the CBA
       is changed to reflect that location.

        b. Repeat to Address (RA)   (3-V-7)

            1) Included in ERASE/WRITE or WRITE data
                stream.

2) Inserts a specified character (alpha-
meric or null) in all locations begin-
ning at CBA up to but not including
address specified in data stream.

   a) User must be sure of CBA prior to
   coding this character in data
   stream.

3) CBA incremented every time character
is repeated.

4) Specified character can be followed by
regular text which will start follow-
ing last repeated character.

2. Selector pen detectable fields

   a. Optional feature

   b. Provides operator with means of identify-
   ing a portion of a displayed message for
   entry into the processor without using the
   keyboard.

   c. Attribute code indicates whether field is
   selector pen detectable.

   d. Modified data tag (MDT) is set in attri-
   bute code when detection is accomplished
   with pen.

   e. Field format for detectable field.   (3-V-8)

   1) Attribute code must indicate field is
   selector pen detectable.

   2) Designator character.

NOTE: Foils 3-V-9 and 3-V-10 are provided for addi-
tional examples of selector pen detectable
fields.

   a) ? or)

   Normally a "?" would be sent in
   output data stream. When detec-
   tion is made on that field, the
   "?" is changed to ") " and the
   MDT is set on.

If detection should then be made
on a field with " ", it is
changed to "?" and the MDT is set
off, thus providing a means of ne-
gating a previous selection.

b) Nulls or blanks

If the designator character is
null or blank, the selector pen
detection:

Will not change display.
Will set MDT on.
Requests service and locks
K/B;
therefore, selection is irre-
versible.

NOTE: No other graphic can be used for a designator
character.

3) At least one character in addition to
designator character must be displayed.

NOTE: A blank is frequently left between the designa-
tor character and displayed character for
clarity; however, it is not necessary.

NOTE: Actual detection can be made on the displayed
alphameric character or the designator char-
acter when "?" or " ⟩ " is present.

4) Concluding nulls or blanks

a) At least three nulls or blanks at
end of field to provide buffer
zone to next detectable field.

b) If last field on line, 3 nulls or
blanks not required.

NOTE: If when creating a selector pen detectable
field, the program knows nulls already exist
in the field (e.g., ERASE/WRITE command has
been issued), it would not be necessary to
transmit nulls in the output data stream.

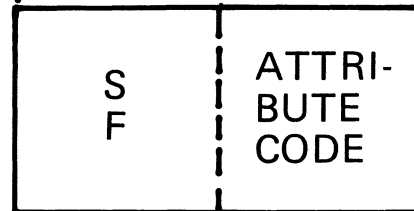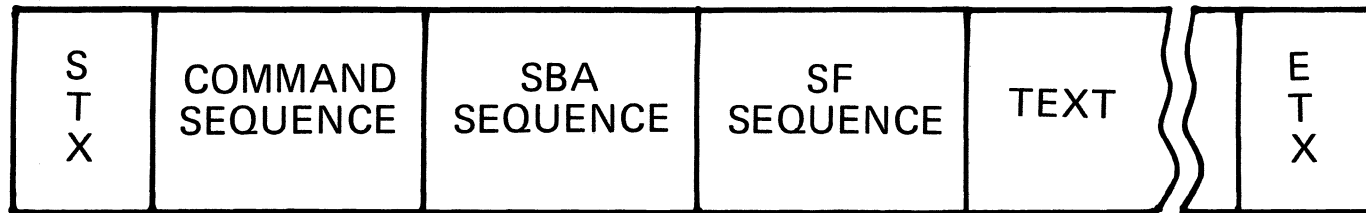Class Exercise 3 - Expansion of output data stream.
(30 min.)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40																																								
80																																								
120																																								
160																																								
200																																								
240																																								
280																																								
320																																								
360																																								
400																																								
440																																								

REMOTE 3270 OUTPUT DATA STREAM

SF SEQUENCE

S T X	COMMAND SEQUENCE	SBA SEQUENCE	SF SEQUENCE	TEXT	}	E T X

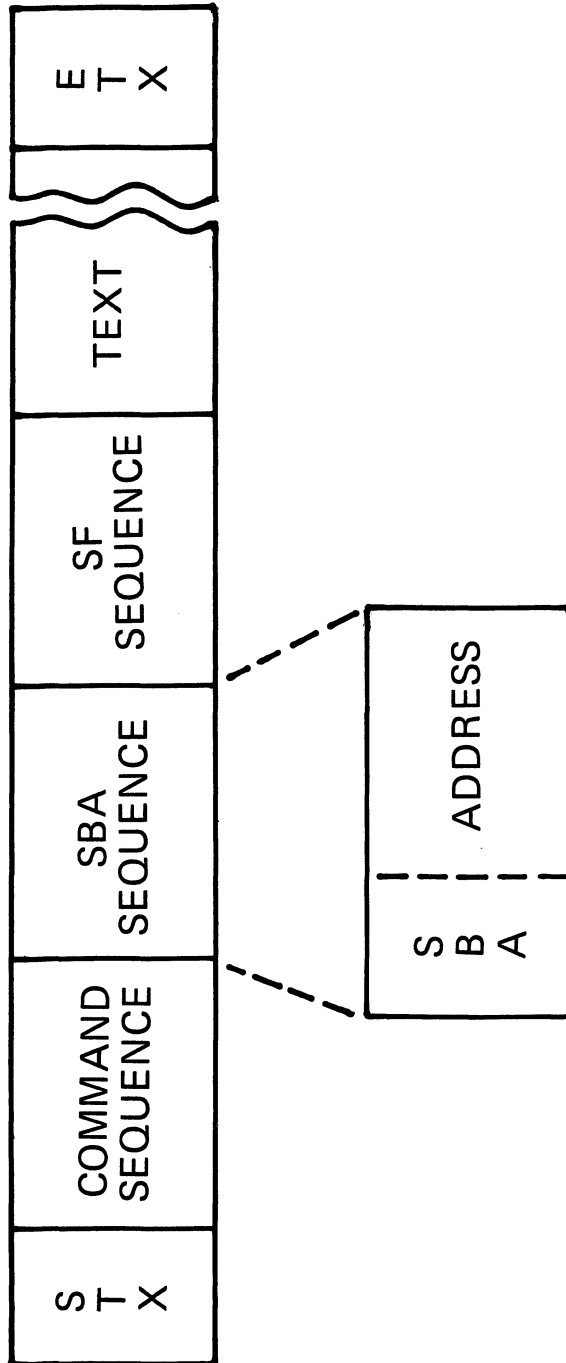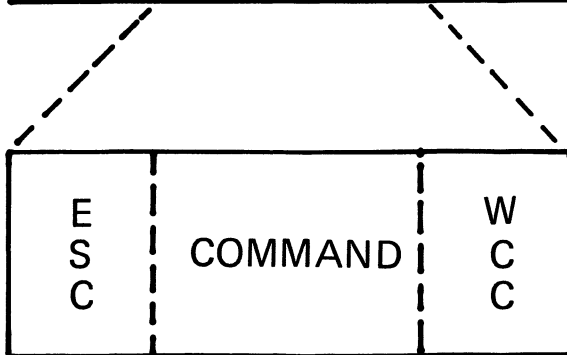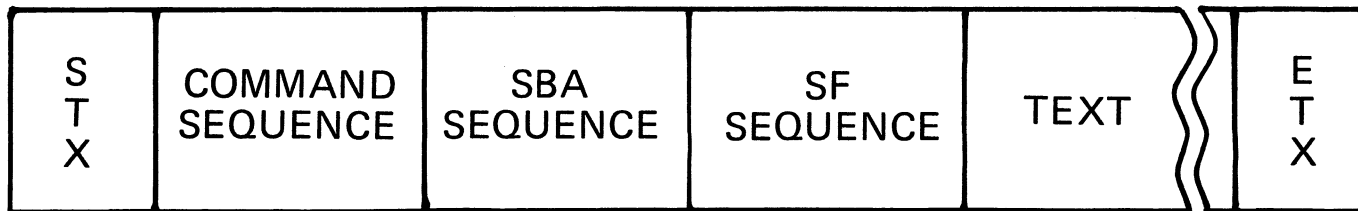| S F	ATTRI- BUTE CODE

CHARACTERISTICS

PROTECTED
UNPROTECTED
BRIGHTNESS
NUMERIC
SELECTOR PEN DETECT
MODIFIED DATA

REMOTE 3270 OUTPUT DATA STREAM

SBA SEQUENCE

REMOTE 3270 OUTPUT DATA STREAM

COMMAND SEQUENCE

S T X	COMMAND SEQUENCE	SBA SEQUENCE	SF SEQUENCE	TEXT	E T X

E S C	COMMAND	W C C

COMMANDS

ERASE/WRITE
WRITE

WCC

KEYBOARD RESTORE

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40																																								
80																																								
120																																								
160										□A	C	C	O	U	N	T		#□																						
200																																								
240																																								
280																																								
320																																								
360																																								
400																																								
440																																								

STX	ESC	WR	WK,WM	SBA	170	SF	P,R	ACCOUNT ∅#	SF	U,H	SBA	⟩⟩ ⟩⟩	ETX

3270 OUTPUT DATA STREAM

INSERT CURSOR SEQUENCE

SBA SEQUENCE	SF SEQUENCE	TEXT	...	I C

OR

SBA SEQUENCE	I C	...

R
A | ADDRESS | X

OR

SBA
SEQUENCE | R
A | ADDRESS | X
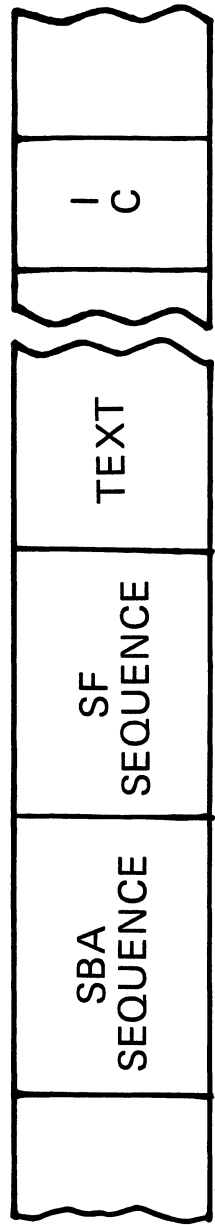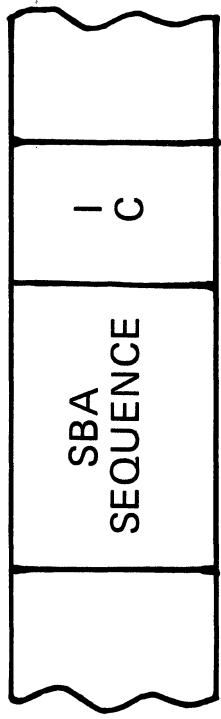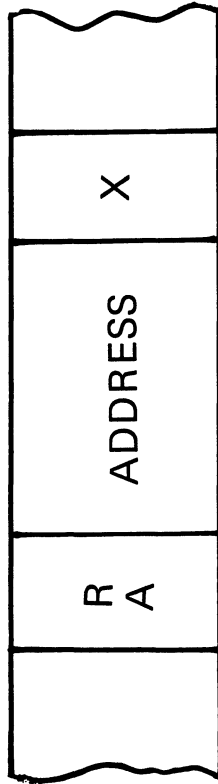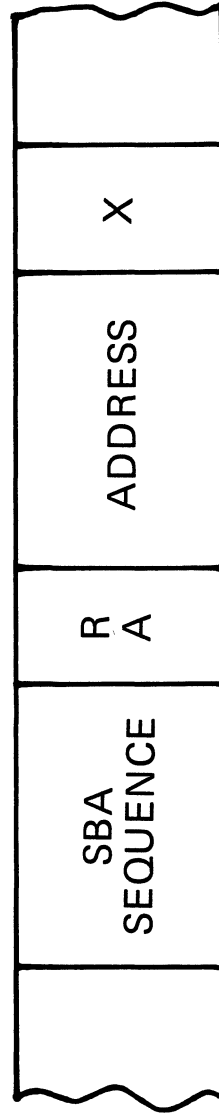
FIELD FORMAT FOR SELECTOR PEN DETECTION

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0
40				▫	?	⊬	Y	⊬	⊬	⊬											▫	?	N
80
120
160				▫	⊬	D	O	N	E	⊬	⊬	⊬									▫	⊉	N	E	X	T	⊉	S	C	R	E	E	N
200
240
280
320
360
400
440

S F	ATT CODE	DESIGNATOR	1 OR MORE DISPLAYED ALPHAMERIC	3 ⊬ OR ⊉ (IF NOT LAST FIELD ON LINE)
		? ⊬ ⊉		

3 V-8

SELECTOR PEN EXAMPLE

TP CLASS ENROLLMENT

NAME:

ADDRESS:

? CUSTOMER

? IBM

CLASS

? CSD & A

? BTAM

? TCAM

? 3270

DONE   SCHEDULE

R. JONES   2/22/71   HOSPITAL VISIT   CARE-NORMAL   FOOD-SAME

DRUGS   — ASPIRIN

STRENGTH   —   ? FULL   ? 1/2   ? BABY
DOSE   ? 20 MG   ? 50 MG   ? 100 MG
DAILY SCHED   ? 1 TIME   ? 2 TIMES   ? 3 TIMES

                       ? 4 TIMES   ? 6 TIMES   ? 8 TIMES

                       ? 12 TIMES   ? 24 TIMES

                       ? AS REQUIRED

DRUG A   DRUG B   DRUG C   DRUG D

        EXIT   FOOD   HISTORY

TOPIC 4 - INPUT DATA STREAM FROM REMOTE 3270.

A. Types of Reads

    1. Read Modified

NOTE: This will be the customary read employed when
        polling a remote 3270. The remote CU actually
        generates the Read Modified command when
        polled.

        The BTAM channel programs are unavailable for
        release at the time this Education Guide is
        being written. Therefore, use foil 2-V-1 for
        general review purposes. Do not attempt to
        get into detail of this operation since that
        is not the intent of the course.

        a. Reads only fields which have been modified,
            e.g., MDT set on for _protected_ and unpro-
            tected.

NOTE: MDT could have been set on for protected
        fields under program control.

        b. If unformatted buffer, will read entire
            buffer, e.g., 480 or 1920 positions.

        c. Short read

            Under certain circumstances no data read,
            just certain control information.

NOTE: This occurs when PA key depressed. Short read
        will be discussed further in following lecture.

B. Components of Data Stream for Read Modified.

    1. General contents of data stream.

        a. BSC control characters

        b. Source of message

        c. Identifies cause of response to poll

        d. Cursor location

        e. Field data

    2. Source of Message   (4-V-1)

        a. CU and Device address or originating
            device.

4.4.1

b.   Specific poll vs. general poll

   1)   Specific poll

        Specific poll is used when checking to
        see if a specified device has anything
        to send.

        Still will receive source address even
        though program knows who was polled.

   2)   General poll

        a)   When a 3270 CU has more than one
             DS connected to it, this poll will
             take message from whichever one is
             requesting service.

        b)   Significance of source

             In the general poll it is essen-
             tial that the responding device's
             address be included in the input
             data stream to know who was read.

3.   Attention ID (AID) character   (4-V-2)

   a.   Operator causes request for service - I/O
        pending and setting of AID.

        1)   Enter

        2)   Clear

             Causes short read.
             Indicates to program that operator has
             cleared buffer.

        3)   Program Attention (PA) keys

             Allows code to be transmitted to the
             program to identify which key was de-
             pressed, without transmitting text.

             Example of use would be to instruct
             program to cancel last input received.

        4)   Program Function (PF) keys

             Allows any input data on the screen to
             be transmitted to the program together
             with a code that identifies which pro-
             gram function key was pressed.

Example of use would be to request a
certain application program to process
the data just entered.

NOTE: PF keys do cause I/O pending and setting of
AID. Therefore, if operator wishes to send
both data and PF indication, he must depress
the specified PF key after keying in the data.

    5) Selector pen detect

        With blank or null causes I/O pending
        and setting of AID.

        With "?" causes only setting of MDT.

    6) Cancel

        For operator console K/B - replaces a
        PA key.
        Short read

    7) Test Request

        Used for device testing purpose. Per-
        mits initiation of on-line test prog-
        ram.

b. AID identifies which of these operations
    were performed by the operator.

c. I/O pending also set at device.

    I/O pending causes remote device to send a
    message when polled.

    Device inoperative as long as I/O pending.

d. Resetting of AID.

    1) Erase All Unprotected command.

NOTE: This command will be covered shortly.

    2) WCC in output data stream.

        Restore K/B
        Resets AID
        Resets MDT

NOTE: RESET key can reset an existing I/O pending
condition and the AID character as long as I/O
is not in progress. This type of usage should
seldom occur.

4.   Cursor address

Indicates location of cursor at time Read
Modified was issued.

5.   Field data   (4-V-3)

   a.   Field data received for every field modi-
        fied, i.e., MDT set on.

        1)   SBA

        2)   Buffer address of first character
             position in modified field.

             Will be as many field data sequences
             as fields modified (MDT set on).

        3)   Text

             Alphameric data of each field
             Null characters not included in data
             stream.

NOTE: Under certain circumstances, e.g., long input
        streams, the input may consist of more than
        one transmission block.   In this case all
        blocks will end with ETB except the last which
        ends with ETX.   After the first block all
        other blocks start with STX which is imme-
        diately followed by next field data.

        It is recommended that the instructor does not
        get involved with the concept of multiple
        blocks since most transmissions will only be
        one block due to transmission of only modified
        fields.   Also, at the time this Education
        Guide was prepared the block length was not
        available.

C.   Erasing Under Program Control

NOTE: Besides the ERASE/WRITE command the user has
        two other methods available to erase, all or
        portions of the screen.   One involves the use
        of a command (EAU) while the other is done by
        use of an order (EUA) in the data stream.
        Either may be employed by the student in stu-
        dent exercise 4; however, the EUA order will
        offer the best solution.

1.   Erase/Write Command - already discussed.

2. Erase All Unprotected (EAU) command

   a. Functions

      1) Clears all unprotected alphameric characters to nulls.

      2) Resets MDT in attribute code for all unprotected fields.

      3) Unlocks K/B

      4) Reset AID

      5) Repositions cursor to first character location in first unprotected field in buffer.

      6) CBA unchanged

   b. Data stream   (4-V-4)

      No text transmitted

NOTE: The EUA command or EUA order will not cause ") " to be changed back to "?" in a protected selector pen detectable field. Therefore, if it is necessary to reset the screen image to display "?" once it has been changed to ") ", the "?" must be written out in the data stream.

This information may be used by the student to perform part of exercise 4.

3. Erase unprotected To address (EUA)   (4-V-5)

   a. Can be included in Write or Erase/Write data stream.

   b. Operation

      1) Erases (sets to nulls) all unprotected character locations in buffer storage, beginning with CBA and continuing to, but not including, address in order sequence.

      2) If CBA equal to address in sequence, all unprotected character locations erased.

      3) Operation may wrap

      4) No effect on cursor location

5) CBA is modified to reflect address associated with EUA order.

6) K/B is not restored.

7) AID is not reset

8) MDT's for fields effected are not reset.

NOTE: Can erase all unprotected fields, an entire field, portion of a field, or a single character depending on CBA and address in the order sequence.

    c. Use

Provides a means of erasing variable data on a screen after a read without erasing the protected image format.

Screen would then be ready for new variable information to be entered.

D. Additional Read Command Considerations

    1. Read Modified command - short read

       a. Only brings in   (4-V-6)

          1) Source

          2) AID

To indicate reason for requesting service.

          3) No field data since no MDT bits set on.

       b. Occurs when

          1) Clear

          2) Program Attention (PA) keys

          3) Cancel - replace PA key on operator console K/B.

    2. Read Buffer command   (4-V-7)

       a. The contents of the entire buffer transferred.

Protected and Unprotected fields.

Attributes codes preceded by SF.
Alphameric characters.
Nulls and blanks.

b. Used primarily for debugging

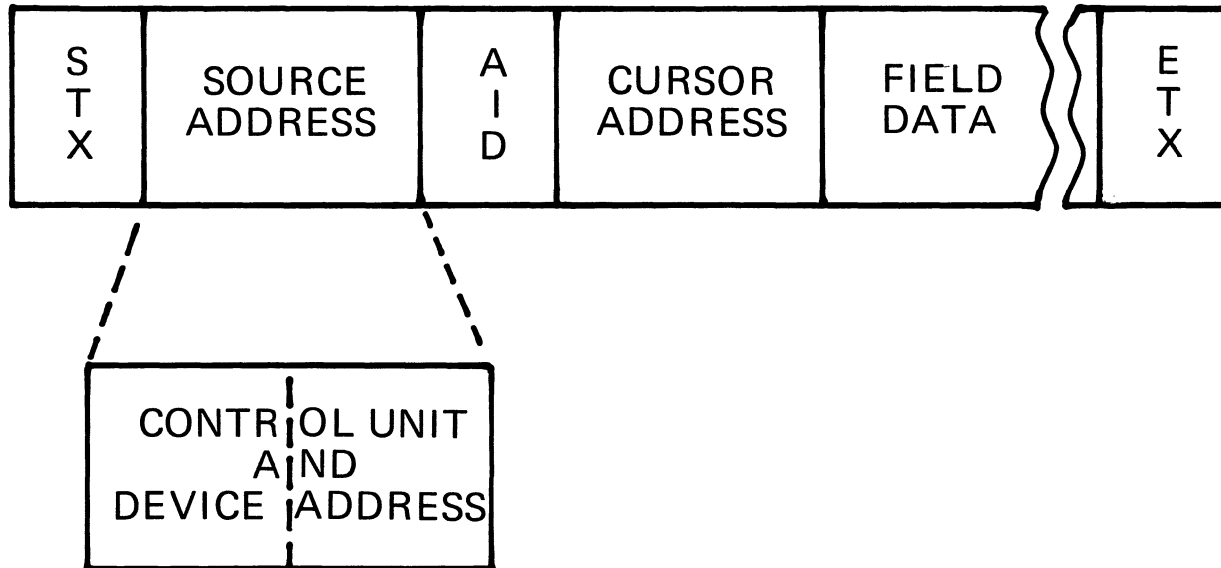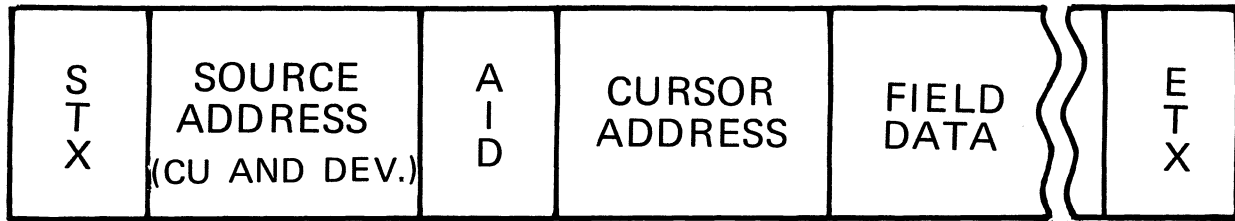Class Exercise 4 - Input data stream and erasing of
screen. (45 min.)

REMOTE 3270 INPUT DATA STREAM

SOURCE OF MESSAGE

| S T X | SOURCE ADDRESS | A I D | CURSOR ADDRESS | FIELD DATA | ⟨⟨ | E T X |

CONTROL UNIT
AND
DEVICE ADDRESS

REMOTE 3270 INPUT DATA STREAM

ATTENTION ID

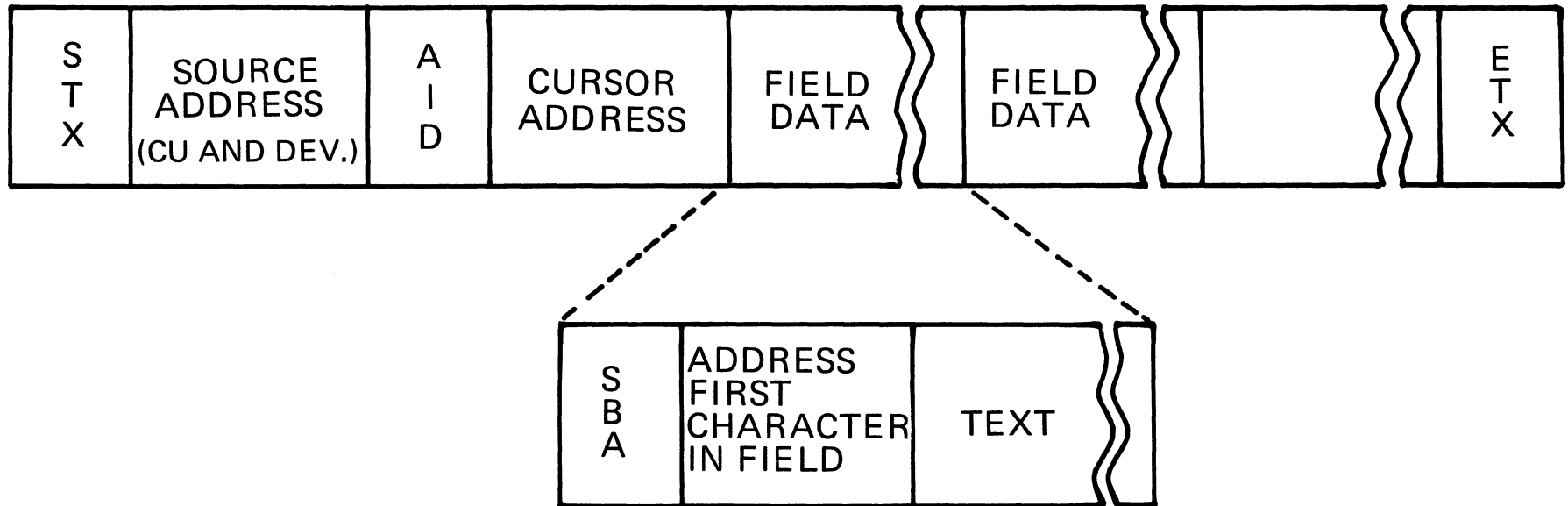| S T X	SOURCE ADDRESS (CU AND DEV.)	A I D	CURSOR ADDRESS	FIELD DATA	⌇⌇	E T X

AID SETTINGS

ENTER
CLEAR
PA KEYS
PF KEYS
SELECTOR PEN DETECT
CANCEL
TEST REQUEST

REMOTE 3270 INPUT DATA STREAM

FIELD DATA

S T X	SOURCE ADDRESS (CU AND DEV.)	A I D	CURSOR ADDRESS	FIELD DATA	FIELD DATA		E T X

S B A	ADDRESS FIRST CHARACTER IN FIELD	TEXT

REMOTE 3270 OUTPUT DATA STREAM
ERASE ALL UNPROTECTED

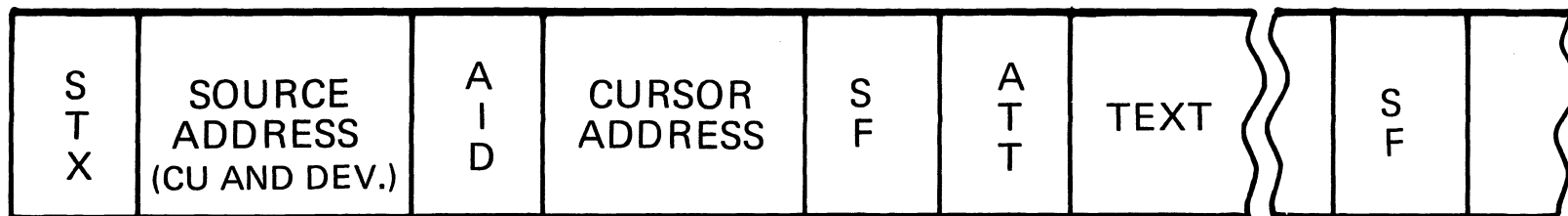| S T X	E S C	EAU	E T X

REMOTE 3270 INPUT DATA STREAM FOR SHORT READ

(READ MODIFIED ON CLEAR OR PA/CANCEL)

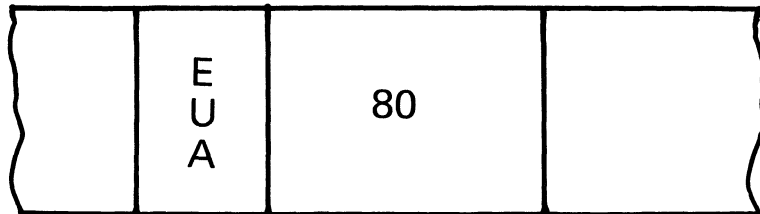| S T X	SOURCE ADDRESS (CU AND DEV.)	A I D	E T X

REMOTE 3270 INPUT DATA STREAM FOR READ BUFFER

S T X	SOURCE ADDRESS (CU AND DEV.)	A I D	CURSOR ADDRESS	S F	A T T	TEXT	S F	

ERASE UNPROTECTED ORDER SEQUENCE

(EUA)

CBA ALREADY SET AT 40

	E U A	80	

CBA UNKOWN

	S B A	40	E U A	80	
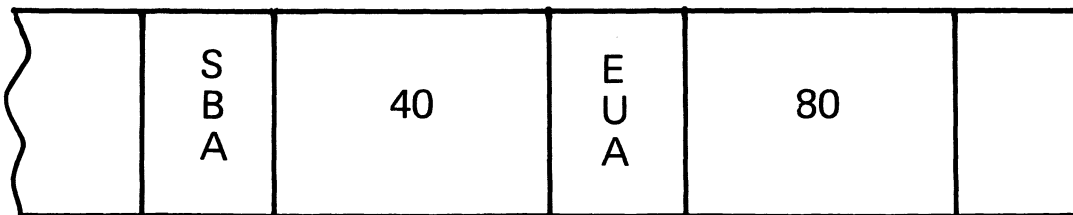
IN BOTH CASES ERASE ALL UNPROTECTED POSITIONS FROM LOCATION 40 TO 79.

DAY 3

TOPIC 5 - LOCAL OPERATION

NOTE: Much of the information covered in the remote
         operation will pertain to the local operation.
         Two of the most significant points to be made
         are that:

              Commands will not be in the data stream.
              Instead there are channel commands to pre-
              form the specified function.

              There is no need for BSC data link con-
              trol; therefore, all of those control
              characters are eliminated.

A.   Output Data Stream

     1.   Channel commands

          a.   Writes

               1)   Effect of current buffer address (CBA)

                    Same significance as with remote,
                    e.g., will indicate where field is to
                    be displayed.
                    SBA sequence resets the address.

               2)   ERASE/WRITE channel command

                    a)   Functions

                         Same as remote, e.g.;
                         Clears entire buffer to nulls.
                         Sets CBA to 0.
                         Places cursor in position 0.
                         Writes text as specified by rest
                         of data stream.
                         Does not restore K/B.
                         Does reset MDT.

                    b)   Data stream format   (5-V-1)

                         WCC - same meaning as remote

                         Orders and text - same as remote

               3)   WRITE channel command

                    Same as remote.
                    Write data as specified by rest of
                    data stream.

CBA remains unchanged until SBA se-
quence encountered in data stream.

4) ERASE ALL UNPROTECTED channel command

Functions same as remote command.
No data stream - only issue command.
Clears all unprotected alphameric
fields to nulls.
Resets AID.
Resets MDT for all unprotected fields.
Restores K/B.
Positions cursor to first character lo-
cation in first unprotected field in
buffer.
CBA unchanged.

B. Input Data Stream

1. Channel commands

a. Reads

1) READ MODIFIED channel command

a) Function

Same as remote

b) Data stream   (5-V-2)

NOTE: Will read entire modified data stream with a
single read. No blocking as might occur in
remote.

c) Short read format   (5-V-3)

Caused by same operations as in
remote.

NOTE: Source address is not included in any of the
local input data streams. At this point the
instructor may have to briefly review channel
operations. That is, the local 3270 will gen-
erate an interrupt and the device causing the
interrupt will be specified in the old PSW.
Therefore, the supervisor or access method
will obtain the source address for the reads
from the old PSW interruption code.

This is probably a good point to make since it
will reemphasize that the local operation is
completely under the control of channel com-
mands while the remote operation is under con-
trol of commands in the data stream.

2) READ BUFFER channel command

    a) Function - same as remote

    b) Format

       Same as remote except no BSC character or source address.

b. SELECT channel command

NOTE: To appreciate the usefulness of this command the instructor must describe one aspect of the 3270 operation. The display station regen buffer must be brought into the CU buffer when commands are issued to the CU. This operation may take up to 70 MS. Rather than have a delay of this sort in a read or write operation, the Select Command is available for use.

    1) Function

       a) Used only with local operation.

       b) Usefulness realized when display system attached to block multiplexer channel.

       c) Select command sent to CU to initiate buffer transfer. Channel would be available then for other functions.

       d) On completion of the DS buffer to CU buffer transfer would then read buffer with a read command.

NOTE: Without the block multiplexer channel the SELECT channel command would require special programming by the user to effectively utilize it.

    2) Data stream for Select command

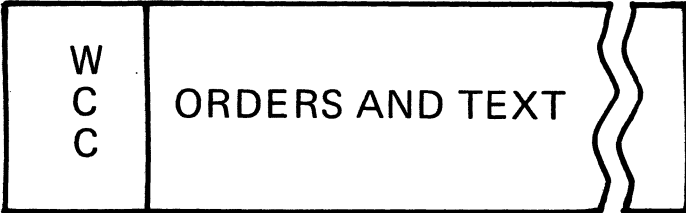   No data stream

C. WCC, Orders, Attribute Code, AID

NOTE: This portion of data stream and its function is same as described for remote operation.

Class Exercise 5 - Local data streams (10 min.)

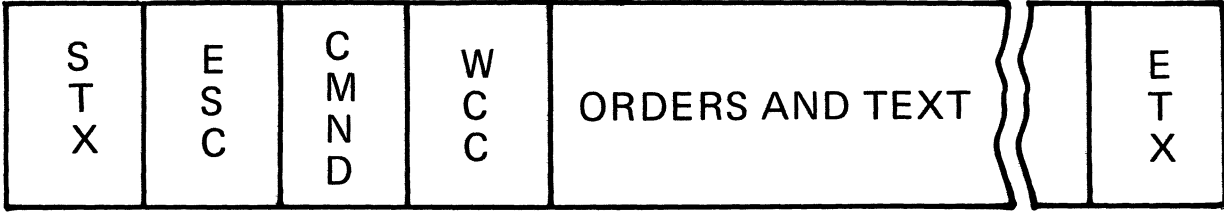# 3270 OUTPUT DATA STREAM
ERASE/WRITE
WRITE

LOCAL

W C C	ORDERS AND TEXT

REMOTE

S T X	E S C	C M N D	W C C	ORDERS AND TEXT	E T X

3270 INPUT DATA STREAM

READ MODIFIED

LOCAL

A I D	CURSOR ADDRESS	FIELD DATA	

REMOTE

S T X	ADDRESS OF SOURCE (CU AND DEV.)	A I D	CURSOR ADDRESS	FIELD DATA		E T X
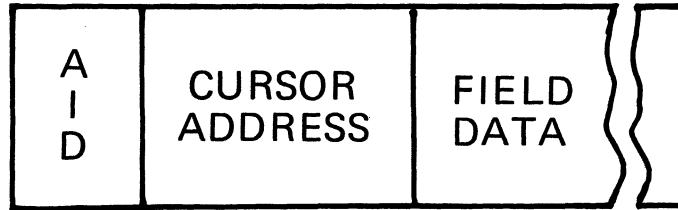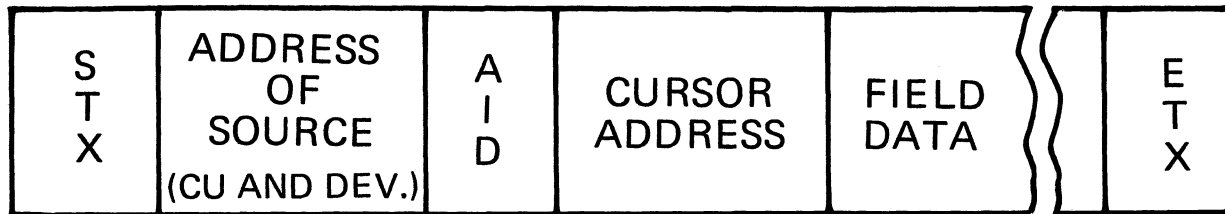
3270 INPUT DATA STREAM (SHORT READ)
READ MODIFIED

LOCAL

A I D
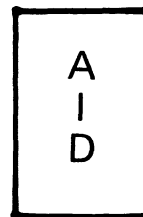
REMOTE

S T X	ADDRESS OF SOURCE (CU AND DEV.)	A I D	E T X

5-V-3

TOPIC 6 - PRINTER OPERATIONS

A. Hardware Considerations

   1. 3284 or 3286 Printer associated with 3271 or 3272 CU.

      a. Each printer in cluster will have its own buffer, as DS's have.

      b. Will have a unique address.

   2. Only Model 3 3284 printer with 3275 DS.

      a. Single buffer services DS and printer.

         Referred to as a dedicated printer.

      b. Will not have unique address.

         WCC in data stream causes printing.

   3. Print positions - must specify when ordered.

      a. 120, 126, or 132 characters per line.

      b. 6 lines per inch.

      c. 10 characters per inch.

B. Uses for Printer

   1. To obtain hard copy of displayed information.

      a. Processor to printer when information same as sent to DS.

      b. DS directly to printer - remote only.

         1) This must be done under program control, e.g., operator depresses a specific function key which tells program to copy DS image on printer.

   2. To obtain hard copy of text which is formatted specifically for printer output and not necessarily to be displayed at a DS, e.g., invoices.

C. Output to Remote Printer When Same as for DS, e.g., not especially formatted for printer

   1. General data stream   (6-V-1)

      a. BSC characters

b. Command sequence

c. Set buffer address sequence. Will indicate location in printer, buffer.

d. Text

2. Command sequence

a. Command

1) ERASE/WRITE

Clears printer buffer to nulls.

2) WRITE

Write text into buffer location specified by CBA.

3) ERASE ALL UNPROTECTED

Operates same as with DS.

NOTE: Can issue Read Modified to printer which will read modified fields. In this case the MDT's would have to be set under program control for any fields to be read. The use of this command for the printer operation is unlikely; however, it does serve to illustrate the similarity between the printer buffer and DS buffer operation.

NOTE: Printing will always start with first position of buffer.

b. WCC

1) Start printer

2) Format - line length coincides with line lengths for DS.

a) 40 characters/line

b) 80 characters/line

NOTE: Line length has meaning only on buffered printer, e.g., printer connected to 3271 CU. If no line length specified, it will print to end of line (120, 126, 132) and start at the beginning of the next line.

3. SBA sequence

   Sets CBA in printer buffer.

4. SF sequence

   a. Defines field

      1) Attribute code

         a) If attribute code has brightness off following field will not print. Will be blanks.

         b) Attribute character treated as a blank.

5. Other orders and text

   a. Orders - Most orders function in same manner as with DS.

      1) IC is ignored

         Cursor not a printable character.

      2) RA

         Will repeat characters as with DS.

      3) EUA

         Erases unprotected to address as with DS.

   b. Text

      1) Prints what would appear on screen.

      2) A line of all nulls and non-displayable characters - no line advance, no horizontal printing.

      3) A line containing one or more blanks and rest of line is nulls and non-displayable characters - line advance and carriage return to cause blank line.

NOTE: With dedicated printer what is printed is also displayed since it is a common buffer.

D. Output Formatted Specifically for Remote Printer.   (6-V-3)

4.6.3

1. Program specifically for hard copy.

    a. Reports and pre-printed form.

    b. Will eliminate certain orders that really do not pertain to print out.

2. WCC

    a. Additional printer specifications

        1) New Line (NL)

            Enables insertion of NL character (order) in data stream which will be detected by CU and cause line feed and carriage return.

        2) End of Message (EM)

            Enables program to insert EM (order) to prevent printing of entire buffer. Printing stops on encountering EM.

        3) NL and EM not honored when in non-displayable field.

            Treated as blanks.

NOTE: When operating with NL and EM, 3270 does not recognize line length format in WCC.

NOTE: Dedicated printer honors NL and EM regardless of WCC setting.

3. SBA sequence

    This **sequence will** still be valuable to establish start of print positions.

E. Copy DS to Printer or DS to DS.

1. General Information

    a. Use at remote cluster only (not for dedicated) - 3271 CU.

        Devices must be on the same control unit.

    b. <u>Performed only under program control</u>,e.g., operator depresses PF or PA key to inform program of copy requirement.

c. On recognizing request for copy, the processor must send out a data stream with appropriate command.

2. Output data stream to perform copy   (6-V-4)

   a. Select device to receive copied information with BSC selection sequence.

   b. Write data stream to initiate copy. (DS to Printer)

      1) Command

         Copy command

      2) Copy Control Character (CCC)

         a) Starts printer

         b) Indicates length of print line.

         c) Specifies -

            Copy only unprotected fields.
            Copy only protected fields.
            Copy all of screen.

      3) Indicate address of device from which information is to be copied.

   c. Copy DS to DS

      1) Use -

         Efficient means of repeating same information on more than one DS in the cluster.

      2) CCC

         Indicates only what is to be copied.

         Copy only unprotected.
         Copy only protected.
         Copy all of screen.

NOTE: Copying under program control assures that with successive copies the next copy is not started until the previous one is completed.

F. Output of Local Printer

    1. Differences between remote and local. (6-V-5)

        a. Local has no BSC characters.

        b. Local has no command sequence.

        c. Local has no copy function.

        d. All local writes to printer performed with
           channel commands.

    2. Output data stream to local - formatted for (6-V-6)
       printer.

          Same as for remote except there are no BSC
          characters or command sequence.

Class Exercise 6 - Format data stream to perform
                printer operations. (30 min)

OUTPUT DATA STREAM TO REMOTE PRINTER
(SAME AS FOR DS)

S T X	COMMAND SEQUENCE	SBA SEQUENCE	SF SEQUENCE	TEXT	E T X

OUTPUT DATA STREAM TO REMOTE PRINTER

(SAME AS FOR DS)

S T X	COMMAND SEQUENCE	SBA SEQUENCE	SF SEQUENCE	TEXT	E T X
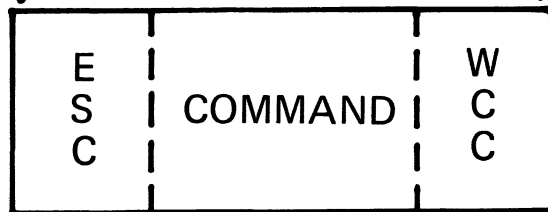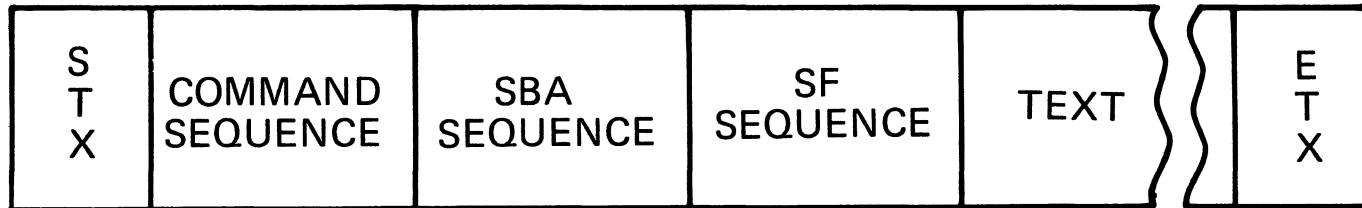
E S C	COMMAND	W C C

COMMANDS

ERASE/WRITE
WRITE

WCC

START PRINTER
LINE LENGTH
NEW LINE
END OF MESSAGE

OUTPUT DATA STREAM TO REMOTE PRINTER

(FORMATTED FOR PRINTER)

S T X	COMMAND SEQUENCE	SBA SEQUENCE	TE┆XT	SBA SEQUENCE	TE┆XT	E M	E T X
			N L		N L		
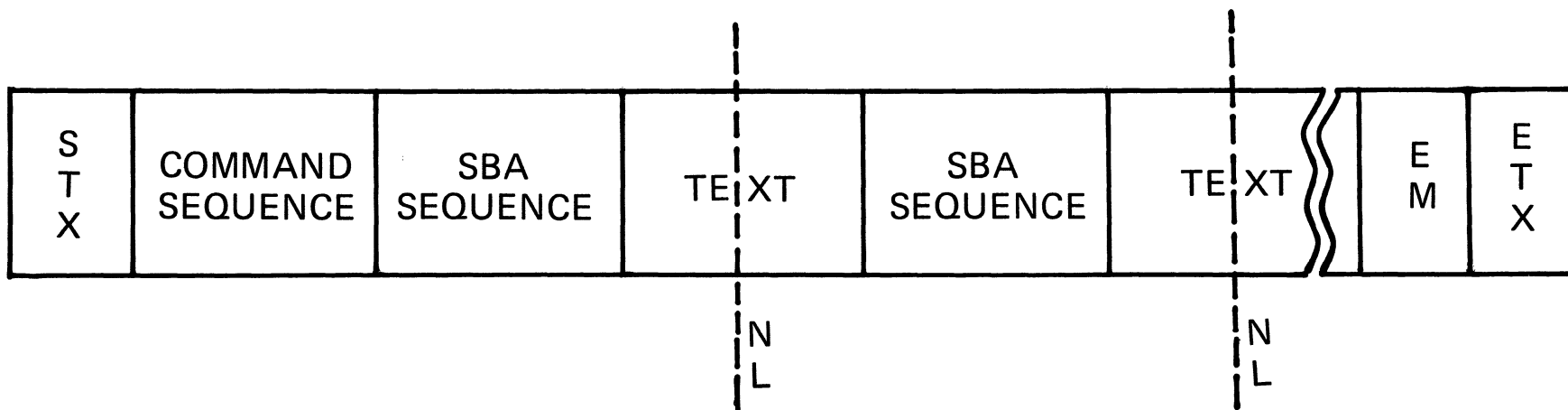
DATA FLOW TO INIATE COPY

CPU   3270

E   E   A

O a a 99 N   C Ø

T   Q   K

    ↑

   TO

S T X	E S C	COPY	C C C	DEVICE ADDRESS (FROM)	E T X

OUTPUT DATA STREAM TO LOCAL PRINTER
(SAME AS DS)

W C C	SBA SEQUENCE	SF SEQUENCE	TEXT
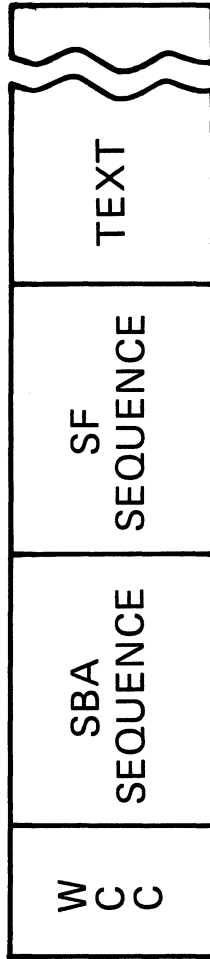
OUTPUT DATA STREAM TO LOCAL PRINTER

(FORMATTED FOR PRINTER)

W C C	SBA SEQUENCE	TE XT	SBA SEQUENCE	TE XT	E M

N L

N L
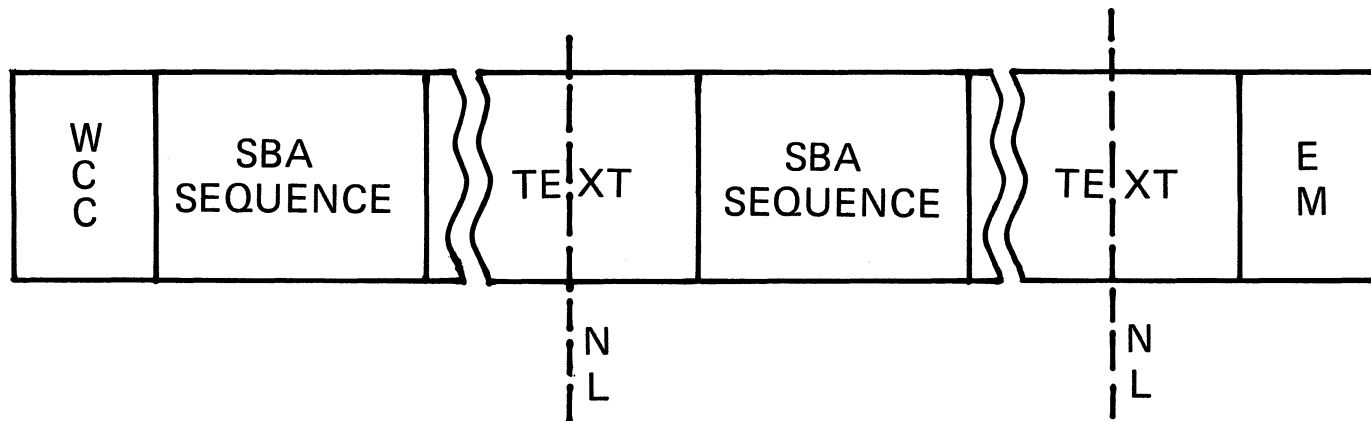
TOPIC 7 - ADDITIONAL FUNCTIONS AND FEATURES OF THE
            3270 SYSTEM.

NOTE: There are additional features and functions of
         the 3270 which should be brought to the atten-
         tion of the student. This is the purpose of
         this topic. Do not spend much time on any of
         the items.

A. Additional Orders

    1. Program Tab (PT)

        a. Used in Write or Erase/Write data stream.

        b. Operation

            1) When inserted in data stream after al-
                phameric or null character will clear
                all remaining characters in existing
                field to nulls.

            2) Advances buffer address to first al-
                phameric character location of next
                unprotected field.

        c. Use

            Use for writing into successive data
            fields defined by a protected image format.
            This provides a means of cutting down on
            the amount of data which must be trans-
            mitted, especially, control characters
            such as the SBA sequence.

    2. Duplicate (DUP)

        a. An order received in the input data stream.

        b. Operation

            1) Generated by operator from K/B.

            2) Displayed as '*'.

        c. Use

            Informs program to use information re-
            ceived in the previous record for this
            field. Saves the operator of keying in
            information which he may entered in the
            previous data entry operation.

3. Field Mark (FM)

    a. An order received in the input data
       stream.

    b. Operation

       1) Generated by operator from K/B.

       2) Displayed as ";".

    c. Use

       Used as a field separator where keying in
       a series of variable length fields with-
       out a fixed format.

B. Operator Identification Card Reader.

1. Used to enter system user information.

    a. Security

    b. Account numbers

2. ID Card is 2 1/8" X 3 3/8" with a magnetically
    encoded stripe containing 15 characters.

TOPIC 8 - PROGRAMMING SUPPORT OVERVIEW, MAINTAINING
         STATUS, AND SCREEN DESIGN.

NOTE: Programming information is in Chapter 5 of
         GA27-2739.

A.   3270 System as a Terminal

     1.   OS and DOS BTAM

          a.   Functions Provided

               1)   Handles both remote and local systems.

                    a)   Remote - part of the BTAM Support
                         for BSC multipoint.

                    b)   Local - Similar to DOS/BTAM 2260
                         local support.

               2)   Generates Channel programs

               3)   Starts I/O operations

               4)   Handles attentions for local and line
                    interrupts for remote.

               5)   Provides error recovery procedures and
                    posts error conditions.

NOTE: OS and DOS BTAM will be available with first
         customer shipments of the 3270 in May, 1972.

B.   3270 System as a Display Operator Console.

     1.   DIDOCS - Device Independent Display Operator
          Console Support.

          a.   Provided under multiple console support
               option of S/360 OS-MFT & MVT.

          b.   Supports locally attached display stations
               and printers (3272 control unit).

               1)   3277 DS Model 2 as a full capability
                    console.

               2)   3277 DS Model 1 as an output-only con-
                    sole.

               3)   3284 and 3286 Models 1 and 2 printers
                    as hardcopy consoles.

c. Provides rapid entry of operator commands by support of 3270 System Program Function Keys and Selector Pen.

2. SDS-Status Display Support.

a. Provided under OS/360 MVT and MFT.

b. Provides status of system devices and allows operator to monitor system activity on both DS and printers.

C. Determining what status information must be maintained for each display station and printer.

NOTE: This subject should be covered by means of Student Exercise 7. Students should be placed in teams to work on the exercise and then the results should be reviewed in an interactive discussion between class and instructor. The major point here is that applications require the programmer to keep accurate status information on each device.

Class Exercise 7 - Determining status information (15 min.)

D. Screen Design

NOTE: Based on the information given the students in this class, they should be able to take a particular application and format a screen or sequence of screens for that application. This is the purpose of Class Exercise 8. After the students have been given time to work on this exercise, the instructor should be able to generate a good interactive discussion on the important considerations for screen design.

Class Exercise 8 - Screen Design (30 min.)

FINAL TEST

NOTE: Time should be allowed to review the final test after all students have finished.

REFERENCES FOR STUDENT EXERCISES

Use of Codes in Data Stream

The student should use the attached list of codes to
indicate what information is contained in the command,
order, AID, ATTRIBUTE, WCC, and CCC codes. When a
code has more than one characteristic associated with
it then all of them should be indicated separated by
commas. For example, if specifying an attribute byte
for normal intensity and numeric, it would be written
as follows:

```
{                           }
{        |         |        }
{        |  R,N    |        }
{        |         |        }
{                           }
```
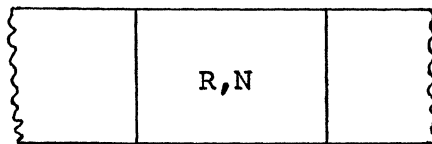
Use of Addresses in Data Stream

When an address is to be specified in the data stream,
the student should use the decimal address of that lo-
cation on the screen. For example, if the student
wishes something to start in location 224 of the
screen image it would be stated as:

```
{                           }
{       |  224   |          }
{                           }
```
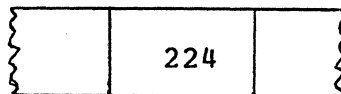
Text in Data Stream

For those fields containing text, either alphameric or
numeric, simply write the characters desired, e.g.,

```
{                                       }
{  |                                 |  }
{  |   1616b MICHIGAN b AVE.         |  }
{  |                                 |  }
{                                       }
```

5.1.1
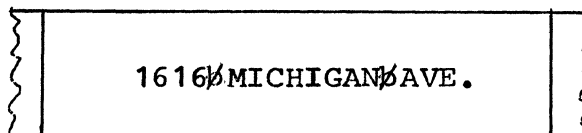
If it is necessary to specify a null in the data stream,
it can be shown in the following manner:

GREEN𝑛𝑥𝑥
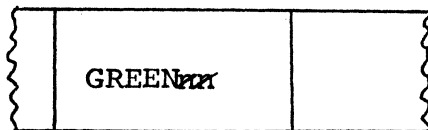
If it is necessary to specify a blank in a data stream,
it can be shown as follows:

ENTER∅ID∅∅
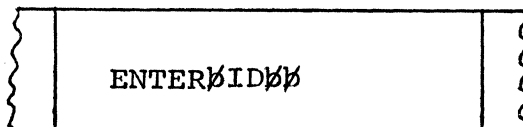
BSC Control Characters

For remote data streams indicate in the data stream
where the proper binary synchronous control character
would occur, e.g.:

```
E
S
C
```
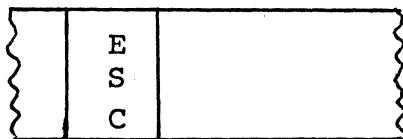
COMMANDS

CODE	COMMAND
EW	ERASE/WRITE
WR	WRITE
EAU	ERASE ALL UNPROTECTED
RM	READ MODIFIED
RB	READ BUFFER
CPY	COPY

ORDERS

CODE	ORDER
SF	START FIELD
SBA	SET BUFFER ADDRESS
IC	INSERT CURSOR
RA	REPEAT TO ADDRESS
EUA	ERASE UNPROTECTED TO ADDRESS
PT	PROGRAM TAB
NL	NEW LINE
EM	END OF MESSAGE

ATTRIBUTE CODE

CODE	CHARACTERISTICS
U	UNPROTECTED DATA
P	PROTECTED DATA
N	NUMERIC DATA
R	NORMAL INTENSITY
H	HIGH INTENSITY
O	OFF INTENSITY
S	SELECTOR PEN DETECTABLE
M	FIELD DATA TAGGED AS MODIFIED

WRITE CONTROL CHARACTER (WCC)

CODE	DEVICE OPERATIONS
WP	START PRINTER
WK	RESTORE KEYBOARD AND RESET AID
WM	RESET MODIFIED DATA TAG
WA	SOUND ALARM
WN	HONOR NL & EM CODES
WF	PRINT 40 CHARACTER LINE
WE	PRINT 80 CHARACTER LINE

COPY CONTROL CHARACTER (CCC)

CODE	DEVICE OPERATION
CP	START PRINTER
CS	COPY ENTIRE SCREEN
CX	COPY PROTECTED
CU	COPY UNPROTECTED
CA	SOUND AUDIBLE ALARM
CF	PRINT 40 CHARACTER LINE
CE	PRINT 80 CHARACTER LINE
CN	HONOR NL & EM CODES

ATTENTION ID (AID) CHARACTER

CODE	SETTING
E	ENTER KEY
C	CLEAR KEY
F	PF KEY
A	PA KEY
P	SELECTOR PEN

5.1.4

Student Exercise 1

The Cobra Company has its headquarters in New York City. It has offices in Philadelphia and Boston. A 3270 Information Display System is to be installed to handle data entry and inquiry applications. Display stations with 480 character image will be used for data entry and stations with 1920 character image will be used for inquiry.

New York City is the site of the CPU and requires:

      10 - Display Stations - 480 character image
      35 - Display Stations - 1920 character image
       1 - 40 CPS Printer on each Control Unit

      The control units in NYC will be no more than
      100 feet from the CPU and all display stations
      and printers will be located within 750 feet
      of their control unit.

Philadelphia requires:

      6 - Display Stations - 480 character image
      4 - Display Stations - 1920 character image
      2 - Printers @ 66 CPS each

      These devices will all be located within 1500
      feet of each other in Philadelphia.

Boston requires:

      1 - Display Station - 480 character image
      1 - Printer @ 40 CPS

      These devices will be located within 10 feet
      of each other in Boston.

Using Appendix A and Chapter 2 in An Introduction to the IBM 3270 Information Display System (GA27-2739), list the configuration of control units, device adapters, display stations and printers at each location.

STUDENT EXERCISE 2

Remote 3270 System

A format is on the display screen for another applica-
tion. Create an output data stream that will clear
the screen and reset the keyboard and write out the
format shown on the screen format sheet. The fields
written out should be protected and normal intensity.
Fields should be defined for the operator to key in
name at high intensity and an ID of numerics only.
ID is not to be displayed.

STUDENT EXERCISE 2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40					E	N	T	E	R		N	A	M	E	:																									
80																																								
120													I	D	:																									
160																																								
200																																								
240																																								
280																																								
320																																								
360																																								
400																																								
440																																								

STUDENT EXERCISE 3

Remote 3270 System

Add to the output data stream created in Student Exer-
cise 2 so that the display will have the information
shown on the display screen format for this exercise.
The cursor should be located in the first position of
the first unprotected field. The additional fields
should be protected and displayed at normal intensity.
Cause 'CSDA', 'BTAM WORKSHOP' and '3270 O&D' to be
displayed as selector pen detectable fields so that
the operator may select one, several, or none of these
before entering the data by means of the ENTER key.

STUDENT EXERCISE 3

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40				E	N	T	E	R		N	A	M	E	:		_																								
80																																								
120																																								
160																																								
200	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
240																																								
280				S	E	L	E	C	T		C	L	A	S	S																									
320					C	S	D	A														B	T	A	M		W	O	R	K	S	H	O	P						
360					3	2	7	0		O	&	D																												
400																																								
440																																								

5.1.9

STUDENT EXERCISE 4

Remote 3270 System

The display screen format and output data stream for
this exercise show one possible result of Student Ex-
ercise 3. Enter data on the format including selector
pen detection, to reflect what you would enter as an
operator. Show the input data stream that would re-
sult from a read modified command being executed when
the ENTER key is depressed at the display station.
Show on the format sheet the position of the cursor at
the time the ENTER key is depressed. Assume the input
is a single block and the source address of the input
is 'B1'. Then create the output data stream that
would be required to clear the variable input fields
and set up the display for another enrollment trans-
action.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40					E	N	T	E	R		N	A	M	E	:			_																						
80																																								
120									I	D	:																													
160																																								
200																																								
240																																								
280					S	E	L	E	C	T		C	L	A	S	S																								
320					?		C	S	D	A														?		B	T	A	M		W	O	R	K	S	H	O	P		
360					?		3	2	7	0		O	&	D																										
400																																								
440																																								

STX	ESC	EW	WK	SBA	44	SF	P,R	ENTER ⌷NAME:	SF	U,H	IC	SBA	132	SF	P,R	ID:	SF	U,O,N	SBA	199

SF	P,R	RA	240	–	SBA	284	SF	P,R	SELECT ⌷CLASS	SBA	325	SF	P,R,S	? ⌷CSDA⌷⌷⌷	SBA	342	SF	P,R,S

? ⌷ BTAM ⌷WORKSHOP	SBA	365	SF	P,R,S	? ⌷ 3270 ⌷ O&D	ETX	

STUDENT EXERCISE 4 — WORKSHEET

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40					E	N	T	E	R		N	A	M	E	:		_																							
80																																								
120											I	D	:																											
160																																								
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
240																																								
280					S	E	L	E	C	T		C	L	A	S	S																								
320						?		C	S	D	A											?		B	T	A	M		W	O	R	K	S	H	O	P				
360						?		3	2	7	0		O	&	D																									
400																																								
440																																								

STUDENT EXERCISE 5

Local 3270 System

The display screen format and input and output data
streams for this exercise show the results of Student
Exercises 2, 3, and 4. Make the changes necessary to
the input and output data streams so that they will be
correct for <u>local</u> attachment of the display.

5.1.14

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |

```
  0 |
 40 |     E N T E R   N A M E :   _
 80 |
120 |               I D :
160 |
200 | - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
240 |
280 |     S E L E C T   C L A S S
320 |       ?   C S D A                              ?   B T A M   W O R K S H O P
360 |       ?   3 2 7 0   O & D
400 |
440 |
```

STX ESC	EW	WK	SBA	44	SF	P,R	ENTER ⌿ NAME:	SF	U,H	IC	SBA	132	SF	P,R	ID:	SF	U,O,N	SBA	199

SF	P,R	RA	240	—	SBA	284	SF	P,R	SELECT ⌿ CLASS	SBA	325	SF	P,R,S	? ⌿ CSDA ⌿⌿⌿	SBA	342	SF	P,R,S

? ⌿ BTAM ⌿ WORKSHOP	SBA	365	SF	P,R,S	? ⌿ 3270 ⌿ O&D	ETX	

SOLUTION TO EXERCISE 4 FOR USE IN EXERCISE 5

```
        ENTER NAME: J. SMITH

                 ID: 23456_
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

        SELECT CLASS
           ? CSDA                    ? BTAM WORKSHOP
           ? 3270 O&D
```

INPUT DATA STREAM

S T X	B1	É	142	S B A	57	J. ∅ SMITH	S B A	137	23456	S B A	366	>∅3270∅O&D	E T X	

OUTPUT DATA STREAM

S T X	E S C	WR	WK,WM	S B A	57	I C	E U A	142	S B A	366	?	E T X	

STUDENT EXERCISE 6

Configuration:

		Address
Remote -	Control Unit	0
	Display Station	2
	Printer	9
Local -	Control Unit	1
	Display Station	1
	Printer	6

A protected display screen format for this exercise
has been sent to both the local and remote displays.
The operator has entered a name and an ID into unpro-
tected fields.

Construct output data streams that will produce a
hard-copy of all the displayed fields for:

a) Remote 3270 (assume BSC selection sequence has
    already taken place)

b) Local 3270

STUDENT EXERCISE 6

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40					E	N	T	E	R		N	A	M	E	:		J	.		S	M	I	T	H																
80																																								
120										I	D	:		2	3	4	5	6	_																					
160																																								
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
240																																								
280																																								
320																																								
360																																								
400																																								
440																																								

5.1.17

STUDENT EXERCISE 7

The Cobra Company in Student Exercise 1 has expanded its system and added applications.

Boston is handling inquiry, source recording, and invoicing applications.

New York City and Philadelphia are handling inquiry, source recording, and data entry applications.

<u>NYC</u>

1 - 3272 Model 2 CU

    20 - 3277 Model 2 Display Stations
     5 - 3277 Model 1 Display Stations
     3 - 3286 Model 2 Printers

1 - 3272 Model 2 CU

    18 - 3277 Model 2 Display Stations
    10 - 3277 Model 1 Display Stations
     1 - 3286 Model 2 Printer

15 of the display stations have selector pens.

All the 3277 Model 2 Display Stations have data entry keyboards and all the 3277 Model 1 Display Stations have EBCDIC typewriter keyboards.

<u>Philadelphia</u>

1 - 3271 Model 1 CU

    15 - 3277 Model 1 Display Stations
     2 - 3284 Model 1 Printers

1 - 3271 Model 2 CU

     5 - 3277 Model 1 Display Stations
    15 - 3277 Model 2 Display Stations
     2 - 3284 Model 2 Printers
     1 - 3286 Model 2 Printer

All the display stations on the 3271 Model 1 CU have selector pens and EBCDIC keyboards.

All the display stations on the 3271 Model 2 CU have data entry keyboards.

Boston

1 - 3275 Model 2 Display Station
1 - 3284 Model 3 Printer

    EBCDIC typewriter keyboard
    Selector pen

List the variables which the programmer must
consider when keeping track of the status of
each device in the system. Take into account
the requirement to handle multiple applications
and device types.

STUDENT EXERCISE 8

The Slippery Rock Police Department is planning to install an IBM 3270 Information Display System. One of the applications they wish to implement is a stolen car inquiry system. The Police dispatcher will have a Display Station for entry to the system.

You have been asked to design one of the screen formats for this application. It is the initial screen image which will request the following detailed information to be entered by the dispatcher:

Car description including color, model, make and year.

License number and state.

The following should be considered in formatting the screen:

Display screen size.

Type of keyboard, if any.

Optional features, e.g., selector pen, audible alarm and security lock.

You should indicate the following:

Screen image format.

Characteristics of fields (attribute codes).

Means of operator entry of information, e.g., keying variable data, use of PF or PA keys, use of selector pen and ENTER key.

Without going into detail give consideration to ways for the dispatcher to obtain additional information (e.g., he may need to know the makes and models of cars that are acceptable to the system) from the system.

STUDENT EXERCISE 8

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40																																								
80																																								
120																																								
160																																								
200																																								
240																																								
280																																								
320																																								
360																																								
400																																								
440																																								

STUDENT EXERCISE 8

Student Exercise 1 Solution

The main objective of the exercise is to familiarize
the student with the different Models of 3270 Control
Units, display stations, and printers. There are no
volume or performance considerations so the student
can configure the 3270 systems in many different ways.
The instructor should check the following points in
particular:

1.   New York City is local with at least two CU
      (3272).
      Philadelphia is remote with at least one CU
      (3271).
      Boston's requirements can be satisfied with
      a single 3275 Stand-alone display station.

2.   Model 2 CU's are necessary if both Model 1
      (480 character) and Model 2 (1920 character)
      DS's are to be attached.

3.   The printer Model selected for a CU should
      be capable of handling the maximum size dis-
      play also associated with that CU.

4.   Printer speeds are specified, thus predeter-
      mining whether 3284 or 3286 printers are to
      be connected to the CU.

5.   There must be a device adapter specified for
      every combination of four DS's or printers.
      They should realize that one device adapter
      comes with each control unit.

6.   Some students will also show that a TCU
      (2701 or 2703) is required at NYC.

Following is an example of a typical configuration
which the student might select.

New York City

NO.	HARDWARE
2	3272 Model 2 Control Units 5 additional Device Adapters on each (assuming DS's and printers split be- tween the two CU's).
35	3277 Model 2 Display Stations with K/B (most students will probably split be- tween CU's).

6

NO.	HARDWARE
10	3277 Model 1 Display Stations with K/B (will probably split between CU's).
2	3284 Model 2 Printers (assuming both size DS's on each CU).

Philadelphia

1	3271 Model 2 Control Unit 2 additional Device Adapters
6	3277 Model 1 Display Stations with K/B
4	3277 Model 2 Display Stations with K/B
2	3286 Model 2 Printers (assuming printer must service both 480 and 1920 DS's)

Boston

1	3275 Model 1 Stand-alone Display Station with K/B and printer adapter.
1	3284 Model 3 Printer.

SOLUTION TO EXERCISE 2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40					E	N	T	E	R		N	A	M	E	:																									
80																																								
120														I	D	:																								
160																																								
200																																								
240																																								
280																																								
320																																								
360																																								
400																																								
440																																								

STX	ESC	EW	WK	SBA	44	SF	P,R	ENTER ∅ NAME:	SF	U,H	SBA	132	SF	P,R	ID:	SF	U,O,N	ETX

Student Exercise 3 Solution

The Start Field sequence for "SELECT∅CLASS" is not
necessary since the sequence for the "-" is the same
and will carry over until a new Start Field sequence
is specified. There must be a Start Field sequence
for the "-" since the previous sequence for the ID
specifies non-display.

The blank character between the "?" and the selector
pen detectable fields is optional and is present only
for readability on the screen.

The three nulls following "CSDA" are not required
since the ERASE/WRITE command clears the entire dis-
play buffer to nulls.

The final Start Field sequence controls the remainder
of the screen and wraps around to control the begin-
ning of the screen up to the first Start Field sequence.

SOLUTION TO EXERCISE 3

A screen layout grid (columns 0–39, rows 0, 40, 80, 120, 160, 200, 240, 280, 320, 360, 400, 440):

```
ENTER NAME: _

            ID:

- - - - - - - - - - - - - - - - - - - - - - - - - - -

SELECT CLASS
   ?  CSDA                      ?  BTAM WORKSHOP
   ?  3270 O&D
```

Data stream (left to right):

STX	ESC	EW	WK	SBA	44	SF	P,R	ENTER ⌀NAME:	SF	U,H	IC	SBA	132	SF	P,R	ID:	SF	U,O,N	SBA	199

SF	P,R	RA	240	–	SBA	284	SF	P,R	SELECT ⌀CLASS	SBA	325	SF	P,R,S	? ⌀CSDA⌀⌀⌀	SBA	342	SF	P,R,S

? ⌀BTAM ⌀WORKSHOP	SBA	365	SF	P,R,S	? ⌀3270 ⌀O&D	ETX

Student Exercise 4 Solution

The student may choose to write out the "?" for all
three selector pen detectable fields to account for
the operator selecting more than one course or to a-
void checking which specific course was selected be-
fore restoring the screen format.

SOLUTION TO EXERCISE 4

Screen layout (columns 0–39, rows 0–440):

```
          0    5    10   15   20   25   30   35
 40       ENTER NAME:  J.  SMITH
 80
120                   ID:  23456_
160
200  ----------------------------------------
240
280       SELECT CLASS
320       ?  CSDA                 ?  BTAM WORKSHOP
360       ?  3270 O&D
400
440
```

INPUT DATA STREAM

STX	B1	E	142	SBA	57	J. b̷SMITH	SBA	137	23456	SBA	366	>b̷3270b̷O&D	ETX

OUTPUT DATA STREAM

STX	ESC	WR	WK,WM	SBA	57	IC	EUA	142	SBA	366	?	ETX

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40					E	N	T	E	R		N	A	M	E	:		_																							
80																																								
120										I	D	:																												
160																																								
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
240																																								
280					S	E	L	E	C	T		C	L	A	S	S																								
320					?		C	S	D	A											?			B	T	A	M		W	O	R	K	S	H	O	P				
360					?		3	2	7	0		O	&	D																										
400																																								
440																																								

STX	ESC	EW ⊠	WK	SBA	44	SF	P,R	ENTER ▷NAME:	SF	U,H	IC	SBA	132	SF	P,R	ID:	SF	U,O,N	SBA	199

SF	P,R	RA	240	–	SBA	284	SF	P,R	SELECT ▷CLASS	SBA	325	SF	P,R,S	? ▷CSDA▷▷▷	SBA	342	SF	P,R,S

? ▷BTAM ▷WORKSHOP	SBA	365	SF	P,R,S	? ▷3270 ▷O&D	ETX ⊠

SOLUTION TO EXERCISE 5

Column headers: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39

Row labels: 0, 40, 80, 120, 160, 200, 240, 280, 320, 360, 400, 440

```
        ENTER  NAME:  J.   SMITH

                      ID:    23456_

------------------------------------------------

        SELECT  CLASS
          ?  CSDA                    ?  BTAM  WORKSHOP
          ?  3270  O&D
```

INPUT DATA STREAM

S T X	B1	E	142	S B A	57	J. ⌀SMITH	S B A	137	23456	S B A	366	>⌀3270⌀O&D	E X

OUTPUT DATA STREAM

S T X	E S C	WR	WK,WM	S B A	57	I C	E U A	142	S B A	366	?	E X

Student Exercise 6 Solution

For remote the preferred solution is the use of the
COPY command. This does not negate the possibility
of a student using a WRITE or ERASE/WRITE to the print-
er with a data stream for the printer.

For the local solution there may be several variations.
The sample solution assumes the program sends an exact
copy of the DS data stream to the printer. Some stu-
dents will format the output specifically for the
printer using NL and EM and eliminating none essential
orders and attribute characters from the data stream.
This later approach is also acceptable.

SOLUTION TO EXERCISE 6

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0																																								
40					E	N	T	E	R		N	A	M	E	:		J	.		S	M	I	T	H																
80																																								
120											I	D	:			2	3	4	5	6	_																			
160																																								
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
240																																								
280																																								
320																																								
360																																								
400																																								
440																																								

REMOTE

STX	ESC	CPY	CP,CS,CF	2	ETX	

LOCAL

WP,WF	SBA	44	SF	P,R	ENTER ∅ NAME	SF	U,H	IC	SBA	132	SF	P,R	ID:	SF	U,O,N	SBA	199	SF	P,R	RA	240	−

Student Exercise 7   Solution

The following are some typical considerations that a
team may list in the time allowed for this exercise:

Buffer size
Device type (Printer of DS)
Address
Unit Status - On line/off line/terminating
Number Errors in
Number Errors out
Line assignment for each unit
I/O operation in progress
Device model number
Local or remote
If printer - line width
If DS - screen size
Application program unit is linked to
Security level
Link to output queue for device
If 3275 - whether has printer attached
Type of keyboard
Terminal priority for polling & selecting
Ratio of polls to selects desired
Master or slave terminal
Flag indicating procedure to follow is a terminal has
        more than a maximum number of errors.

        1.   Automatic removal from system
        2.   Operator notification
Maximum number of allowable errors

Student Exercise 8 Solution

The following are two possible student solutions to
this exercise. There are many variations possible.
The key areas to watch for are -

     Use of selector pen
     Use of PA and PF keys
     Split screen format for operator inquiry

SOLUTION TO STUDENT EXERCISE 8

6.1.14

```
     0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39

  0                     S T O L E N   V E H I C L E     I N Q U I R Y

 40

 80    []  ƀ C O L O R     []              []  ƀ M O D E L        []

120    []  ƀ M A K E       []              []  Y E A R            []

160    []  S T A T E       []              []  L I C E N S E      []

200                                                                                                             []

240  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

280    S E L E C T     C O L O R / M A K E / M O D E L     F O R     C O D E S

320

360

400

440
```

PA1 ASKS FOR INQUIRY FORMAT

COLOR, MAKE, AND MODEL ARE SELECTOR PEN DETECTABLE
FOR LIST OF ACCEPTABLE CODES WHICH APPEAR ON BOTTOM
HALF OF SCREEN.

TOTAL TRANSACTION ENTERED VIA ENTER KEY.

SOLUTION TO STUDENT EXERCISE 8

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0											S	T	O	L	E	N		A	U	T	O		D	E	S	C	R	I	P	T	I	O	N								
40							M	A	K	E	:																													
80							M	O	D	E	L	:																													
120							C	O	L	O	R	:																													
160								Y	E	A	R	:																													
200							S	T	A	T	E	:																													
240						L	I	C	E	N	S	E	:																												
280	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
320	O	P	E	R	A	T	O	R			R	E	Q	U	E	S	T	:																						
360																																								
400																																								
440																																								

ALL FIELDS PROTECTED AND NORMAL INTENSITY
OPERATOR ENTRY IS UNPROTECTED AND HIGH INTENSITY
OPERATOR REQUESTS THROUGH PA KEYS
    PA1 = MAKES OF CARS
    PA2 = MODELS
    PA3 = COLORS
RESPONSE WILL PRINT OUT IN OPERATOR REQUEST AREA OF
SCREEN.

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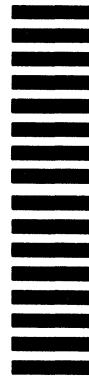
FOLD   FOLD

FOLD   FOLD