Enhancements to the User Interface in Version 6 of the SAS® System under MVS and VM
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ABSTRACT
This paper describes the enhancements to the user interface in Version 6 of the SAS® System that are specific to the MVS and VM operating systems. Definitions of the various types of 3270 text and graphics terminals lead to a discussion of the device drivers used by the SAS System and the characteristics of each driver. Special device support for the IBM® 3290 and 3179G/3192G terminals with an attached mouse is described. Also presented is a complete list of mainframe-specific SAS system options and global SAS Display Manager commands. Common User Access features in the SAS System are described, and numerous hints are provided for interacting with the SAS full-screen windowing system.

INTRODUCTION
Version 6 of the SAS System provides an extremely powerful, friendly, and attractive interface for interacting with the SAS System. With a highly sophisticated windowing system that includes elements of Common User Access as defined by IBM, the interface provides the "look and feel" of an intelligent workstation on a 3270 terminal. The full-screen interface is used by display manager and SAS/AFF, SAS/FSPT, SAS/GRAFHT and SAS/ASSIST® software.

3270 TERMINALS
In order to understand the structure of the SAS System's full-screen environment and the meaning of the various full-screen options, an introduction to the types of text and graphics 3270 terminals is needed.

Text
3270 Text terminals can be divided into two main types: Extended Data Stream (EDS) and non-Extended Data Stream (non-EDS). An EDS device is one that supports the 3270 extended field attribute, which is used to specify colors and highlighting (reverse-video, underline, and blinking). EDS devices also support the Read Partition Query 3270 data stream order. Examples of EDS devices are the 3279, 3179, 3290, and 3270-PC displays. EDS devices also support the non-EDS data stream, and if a device can do 3270 graphics, then it is an EDS device.

Non-EDS devices do not support the 3270 extended field attribute. Examples of non-EDS devices are the 3277 and 3278 terminals and emulated 3270 devices as provided by protocol converters such as the IBM 7171.

Graphics
3270 graphics terminals can also be divided into two classes: Programmed Symbol Set (PSS) and Vector-to-Raster (Vector). PSS, which is the "old" way of doing graphics (327x and 3290), uses a combination of programmed symbols to produce a graph. A programmed symbol is a character occupying a character cell with certain pixels illuminated to produce a desired shape in a position (cell) on the display. A programmed symbol set is a loadable terminal character set containing these defined programmed symbols.

The newer IBM graphics terminals are Vector; they support graphics drawing orders such as MOVE, DRAW, POLYGON FILL, and so on. The IBM terminals have two planes on the display surface: one for text and one for graphics. Another feature on these devices is Background Transparency, which controls whether or not the graphics plane is visible through the text plane. In addition, the IBM 3179G/3192G terminals have limited support for programmed symbol graphics—specifically, they have two loadable programmed symbol sets (a 3279G has six loadable sets).

SAS 3270 DEVICE DRIVERS
Text
The SAS System has two 3270 device drivers for text: a non-EDS driver (SASVUN) and an EDS driver (SASVUE). The EDS driver is always loaded by default when the full-screen system is initialized. If the device is not queryable or it is determined by inspection of the Read Partition Query that it does not support the 3270 extended data stream, then the EDS driver is deleted and the non-EDS driver is loaded.

The non-EDS driver is distinguished from the EDS driver in that it uses three display positions for a vertical window border: the first position for the field attribute byte, the next position for the border character itself, and the third position for the attribute byte for the following field. Because a window has both left and right vertical borders, six display positions are used by the vertical borders. Therefore, the maximum display/editing area in a window on an 80-column non-EDS device is 74 columns.

The EDS driver uses two display positions for the vertical window borders: the border character and the attribute for the next field (left vertical border), or the attribute and the border character (right vertical border). Therefore, the maximum display/editing area in a window on an 80-column EDS device is 76 columns. The EDS driver takes advantage of 3270 character attributes in order to use only two positions for a vertical border. Character attributes allow the specification of extended highlighting, color, and character set (PSS graphics) on a character by character basis, rather than on a field basis (a 3270 display "field" is preceded by an attribute byte that displays as a blank on the screen). Some PC 3270 emulators such as IRTMAX DFT do not handle character attributes very well. For these devices, there is an EDS driver (SASVUN) that uses three-character borders.

On graphics terminals that support programmed symbols, the EDS driver uses a predefined set of programmed symbols to display window borders, scroll bars, and widgets. Four character cell sizes are supported for these programmed symbols: 9 x 12 (3279G, 3179G), 9 x 14 (3270-PC), 9 x 16 (3179G in 24-line mode, 3290), and 6 x 12 (3290).

On 3270 terminals that do not support programmed symbols but support the APL character set, the EDS driver uses APL symbols to display window borders, scroll bars, and widgets. Many 3270 terminals and emulators support the APL character set for output, including all IBM 3279 and 3179 terminals and many vendor compatible ones.

Graphics
The SAS System uses two 3270 graphics terminal device drivers: a PSS driver and a Vector driver. Both drivers must communicate with the EDS text driver that controls the display, and both drivers

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produce output in the graphics window. These two drivers also produce output in "Version 5 Graphics Compatibility Mode" (SAS system option NOGWINDOW). The PSS graphics driver allows only one graphics window to be invoked at a time, while the Vector graphics driver supports multiple graphics windows.

**SPECIAL DEVICE SUPPORT**

Two terminal devices are handled specially by Version 6 of the SAS System on the mainframe. They are the IBM 3290 terminal, because of its variable character cell size, and the IBM 3179G/3192G, when a mouse is attached.

The IBM 3290 terminal supports extended data stream and programmed symbol graphics on one logical terminal only (LT-1). The device also supports variable character cell sizes. The only two cell sizes that produce good graphics are the 6 x 12 and the 9 x 16 cell sizes. Unless overridden by the SAS system option FSFBORDER, the EDS text driver sends a Create Partition structured field to the device, which creates a screen that uses one of these two cell sizes for programmed symbols. The cell size created is based upon the CHARTYPE option (see OPTIONS later in this paper). On a 3290 that is configured as 43 rows by 80 columns, CHARTYPE = 1 gives a 52 x 80 screen size for the full-screen environment of the SAS System. If CHARTYPE = 2 is specified, the screen size will be 48 x 53. Note that if you configure the 3290 as 62 x 150 (the maximum screen size available on the 3290), then CHARTYPE = 2 gives you a screen size of 46 x 106. This gives a very legible and attractive full-screen environment for Version 6 of the SAS System.

There is a caveat, however, in running full-screen in graphics mode on the 3290 in the MVS environment. A 3270 data stream program check (SCREEN ERASURE) may result if full-screen mode is destroyed—for example, if you receive a message. This happens because the partition that was created is destroyed, but the EDS device driver is not aware of this until after it attempts to write the next screen to the terminal. This may be too late if the partition that was created results in more rows or columns on the device than the default partition, thus a PROG 752. The situation corrects itself if you press ENTER a couple of times in response to the SCREEN ERASURE message. There are two reasonable ways to avoid this problem: (1) configure the 3290 into one logical terminal that is 62 x 160, or (2) specify FSFBORDER = APL, in which case programmed symbols will not be used for full-screen, and thus the Create Partition is not issued. Note that with this second alternative, the appearance of graphics with either GWINDOW or NOGWINDOW may be somewhat distorted.

For the IBM 3179G/3192G terminal, the EDS text driver recognizes when a mouse (IBM 5277) is attached and automatically attaches the graphics cursor under control of the mouse (thus there are two cursors on the display: the text cursor and the graphics cursor, which is either a cross-hair cursor or a cross cursor). The mouse has three buttons; the left and center buttons can be controlled by the device driver, while the rightmost button is simply a keyboard unlock (RESET). The SAS System uses the leftmost button as an ENTER key, while the center button can be defined via the KEYS window or KEYDEFS command (by default it is assigned the same value as F15). The normal ENTER key is used to select menu items, grow/shrink/move windows, scroll using scroll bars, and so forth, so having the ENTER key on the mouse is quite desirable. Note that the graphics and text cursors merge to the same position on the display only after graphics input.

The IBM 5277 optical mouse works with the IBM 5550 terminals also.

IBM has a new graphics terminal, the 3472G. It is a high-resolution, multiple-session terminal that supports graphics on one logical terminal. It is basically a replacement for the 3192G, combining some elements of the 3270 PC (multiple host sessions) and the 3194 (record/playback, local screen copying, and printing). IBM claims that graphics output is drawn up to 70% faster on this device than on the 3192G. It uses a PS/2 mouse, which has two buttons and is a mechanical rather than an optical mouse. With the graphics cursor attached, the two buttons function the same as the left and center buttons on the three-button mouse described above. The mouse can also be used in non-graphics mode on this terminal, where it moves the text cursor and by default the left button functions as the ENTER key.

**OPTIONS**

The following mainframe-specific system options apply to the SAS System's full-screen environment and are invocation options only:

- **FSDEVICE**
  - is used to specify the name of the full-screen device driver or the name of the device itself. The SAS System can determine the characteristics of a device and use the appropriate device driver, so you would not normally need to use this option. However, some device names are recognized by the EDS device driver and are used either to override device characteristics or to compensate for non-standard 3270 implementation on a particular device. The following are some values recognized in specific ways by the SAS System:
    - A name specified that begins with SAS is considered to be the name of a device driver and is therefore loaded and initialized. Thus, any of the current device drivers could be specified (that is, SASVUE, SASVUI, and SASVUN). **NOTE**: These module names are not guaranteed to be the same in subsequent releases of the SAS System.
    - **FSDEVICE** = IRMA causes the SAS System to use the SASVUI device driver, which is an EDS driver that uses three-character borders instead of two-character borders. You might specify this when running the IRMAX DFT 3270 emulator on a PC, since this emulator does not handle well character attributes for extended color, highlighting, or the APL character set.
    - **FSDEVICE** = PCXxxx (where xxxx can be any characters) prevents the EDS device driver from issuing a Read Partition Query List since the PCX software rejects this data stream. Specify it when running the PCX 3179 emulator on a PC.
    - **FSDEVICE** = XTR3179 or **FSDEVICE** = TEK3179 prevents the EDS device driver from using the Background Transparency extended field and character attributes that are rejected by these devices (but erroneously reported by these devices as supported). Specify one of these when using the graphics window with either a coax attached TEKTRONIX 3179-type terminal (certain firmware levels) or Attachmate's Extra 3179 emulator.
    - **FSDEVICE** = IBM3278 causes the EDS device to make a multi-color IBM 3179 or 3279 terminal behave as a single-color 3278.
    - **FSDEVICE** = IBM327x causes a 3179G terminal to appear to the SAS System as a 327x (that is, PSS
There are a number of display manager commands that are either unique to the mainframe or operate a little differently there than on other terminals. An incorrect setting of this option may cause a 3270 data stream program check or a SAS System abend.

CHARTYPE—
on the IBM 3290 (LT-1) specifies which character cell size is to be used as follows: CHARTYPE=0 (the default) or CHARTYPE=1 gives the 5 x 12 cell size; CHARTYPE=2 gives the 9 x 16 cell size. On other EDS terminals, it specifies if the primary or alternate screen size is to be used; for example, CHARTYPE=0 means to use the current screen size (as defined to VTAM), CHARTYPE=1 means to use the primary screen size, and CHARTYPE=2 means to use the alternate screen size.

PFKEY—
specifies which set of 12 programmed function keys is to be considered primary or if the terminal only has 12 function keys. The PRIMARY set of function keys is F13-F24, and the ALTERNATE set is F1-F12. The SAS System provided default function key definitions contain many of the new functions in display manager commands: F1-F12, and the Version 5 definitions (where appropriate) on keys F13-F24. When PFKEY=ALTERNATE is specified, the Version 5 settings appear on F1-F12 and the newer settings on F13-F24. When PFKEY=12 is specified, the Version 5 settings appear on F1-F12, and only these 12 keys will be shown in a KEYS window.

FSBORDER—
specifies which character set is to be used for window borders and other widgets. Valid values are PS (Programmed Symbols), APL, BEST (the default), and NONE. BEST means to use Programmed Symbols if the device has them, and if not, then use APL characters if the device has them, and if not, then use neither (NONE). (You might want to specify FSBORDER=APL on a 3279G to cause APL characters to be used instead of Programmed Symbols. This will give the PSS graphics driver more programmed symbol slots since they are not being used for full-screen text.)

COMMON USER ACCESS FEATURES

Common User Access (CUA) is the user-interface component of IBM’s Systems Application Architecture. It defines how a user should interact with an application and how information is presented to the user. CUA is complicated by the differences in display technologies across the IBM platforms. For instance, the PC (intelligent workstation or IWS in the CUA vernacular) allows programs to use graphics and to respond to each individual keystroke, while the IBM 3270 terminal (non-programmable terminal or NPT) has limited graphics capabilities and cannot respond to each keystroke. IBM has defined somewhat similar models of CUA: the Graphical Model for the NPT and the Entry Model and the Text Subset of the Graphical Model for the IWS.

The SAS System, however, uses many elements of the Graphical Model on the 3270 terminal (this is permitted under CUA). In addition, the SAS System has extended or modified the CUA definition in order to fit SAS applications such as display manager that are more complex than the typical application that CUA addresses. Nevertheless, the SAS System complies with the CUA definition in most instances.

Some of the CUA components that the SAS System employs include action bars, action bar pull-downs, pop-ups (dialog boxes), scrolling indicators (scroll bars), single-choice selection fields (radio buttons), multiple-choice selection fields (check boxes), and cursor select fields (push buttons).

With the exception of scroll bars, all of these elements are contained in the menu system of display manager and in other applications, such as SAS/ASSIST software. You can choose to use the menu system by specifying the PMENU global display manager command.
The normal command-line field of every window is replaced with an action bar. Many of the items on the action bars are CUA standards, such as FILE, EDIT, VIEW, HELP, and so forth. Selecting an item invokes an action bar pull-down menu, and many of the items in these pull-downs are standard in CUA. A pull-down or series of pull-downs may lead to a dialog box. Dialog boxes contain push-buttons to terminate the dialog box, and may contain radio buttons, check boxes, and entry fields.

Scroll bars provide methods for scrolling horizontally or vertically. The SCROLLBAR, or simply SBAR, command activates the scroll bars. You can select anywhere on the scroll bar for a relative scroll position on the single arrow and select for a scroll of one position (horizontal or vertical), or position on the double arrow and select for a scroll equal to the current horizontal or vertical scroll amount.

**Hints**

**Activating Windows**
In the SAS System's full-screen windowing environment on the mainframe, you can only enter input into the current active window (window can also mean pull-down menu or dialog box in this context). All other windows are protected, which means that you cannot simply move the cursor into a different window and start typing in what appears to be an input field (such as a command line). You must first activate a window. There are three ways to activate a window that has already been invoked:

- If all or part of the window is visible, you can cursor into it and press the ENTER or a function key (the function key is also executed in addition to the window being activated).
- You can invoke the window by its name.
- You can issue the NEXT or PREVWIND commands.

If a window is an icon, you "un-icon" it by activating the window (as described above) and pressing the ENTER key. If you press a function key instead of the ENTER key, the function key is executed, but the window is not "un-iconed" unless the ICON command is assigned to the function key that you used.

**Using the Menu System**
Action bar items, pull-down menu items, and the other widgets are input fields, so you can tab to them. You can also modify these fields, but the input is ignored, and the original text is redisplayed. In addition, you must select a check box item; that is, you cannot modify multiple check boxes in order to make multiple selections in one interaction with the application.

**Cancelling a Pull-Down Menu**
To cancel a menu pull-down or menu dialog box, you can either move the cursor out of the box and press ENTER, or press any function key. The pull-down or dialog box is cancelled, and the ENTER or function key is processed. This means that you can also cursor to a different action bar item within the same window or to a visible action bar in another window, press ENTER, and have the old pull-down dialog cancelled and a new pull-down sequence started.

**Growing/Shrinking/Moving Windows**
To grow or shrink a window, you move the cursor to the desired window border (or corner) and press ENTER. You are now in GROW/SHRINK mode, as indicated on the status line. The window border (or two borders if a corner was selected) is highlighted for verification. (Highlighted in this context simply means changed. On a non-EDS device, if the border was highlighted, it is changed to normal intensity; otherwise, it is really highlighted. On an EDS device, it is changed to reverse-video unless the border was already reverse-video, in which case it is changed to have no extended attributes.) Move the cursor to the new position and press ENTER again. The window is resized, and you are out of GROW/SHRINK mode.

Moving a window is done similarly, except that you must position the cursor on the window title (or on the first three upper left positions if the window has no title) and press ENTER to get into MOVE mode. The entire window border is highlighted. Move the cursor to the new position and press ENTER to move the window. (Note that the window is moved relative to where the cursor was placed in the title.)

**Conclusion**
Through the use of highly specialized device drivers, the SAS System is able to use the features and functions of each type of 3270 terminal. But regardless of device capability, the full function of the SAS user interface is consistently provided. Various SAS system options can be used to tailor the full-screen environment, and there are global display manager commands that are unique to the mainframe SAS System.

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