Request #: HUTRR29
Title: Repurposing the Alphanumeric Display Page (0x14) as a generic Auxiliary Display Page and adding bitmap and custom segment capabilities
Spec Release: HUT 1.11
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Voting Ends: June 14, 2004
Required Voter: Nathan Sherman (Microsoft) (Chair)
Required Voter: Steve McGowan (Intel)
Required Voter: Mark Lavelle (Logitech)

Summary:
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To augment the Alphanumeric Display Page to include Auxiliary Display, add bitmap enumerating and blitting and respective properties (ie. Resolution, palette format data, display bit depth, etc..), functionality parameters (ie. blit buffer), and custom segment enumeration and usage.

Background:
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In order to use space on a display the controller/processor driving the display must understand the capabilities of a device. This can be easily implemented on a case by case basis, as shown with a VGA display. However, when users can interchange these display devices, the controller needs a way to render information in a way specific to the capabilities of a specific display device. This proposal will allow LCD manufacturers to create displays that can be driven with a standard interface (no new electronics and no hardware (display) specific device drivers). The bandwidth of the USB, functionality provided by these displays are intended to provide still images that include static icons, lines, polygons and text (list not exhaustive and provided to better understand the static nature of the device).

Proposal:
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The objective of this HUT Review Request is to evolve the Alphanumeric Display Page into a more generic display type that will continue to
support the Alphanumeric functionality and in addition support small displays. Making the alphanumeric and bitmap specific types of segments on an Auxiliary Display and creating a Custom Segments Report (CL) will allow display manufacturers to produce displays with different segments. An example of a custom segment is the battery indicator on a mobile phone.

Note: Because the Auxiliary Display Page will continue to have the Usage IDs and Usage Types found in the Alphanumeric Display Page, legacy hardware devices and legacy software will not be affected by the renaming and adding of functionality.

Please refer to http://www.usb.org/developers/hidpage for references into the HID Usage Pages.

The following are the changes and additions to Usage Page 0x14:

Usage Page 0x14 Renamed from Alphanumeric Display Page to Auxiliary Display Page 0x14.

Additions

<table>
<thead>
<tr>
<th>Usage ID</th>
<th>Usage Name</th>
<th>Usage Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>Auxiliary Display</td>
<td>CA</td>
</tr>
<tr>
<td>80</td>
<td>Bitmap Size X</td>
<td>SV</td>
</tr>
<tr>
<td>81</td>
<td>Bitmap Size Y</td>
<td>SV</td>
</tr>
<tr>
<td>82</td>
<td>Max Blit Size</td>
<td>SV</td>
</tr>
<tr>
<td>83</td>
<td>Bit Depth Format</td>
<td>SV</td>
</tr>
<tr>
<td>84</td>
<td>Display Orientation</td>
<td>DV</td>
</tr>
<tr>
<td>85</td>
<td>Palette Report</td>
<td>CL</td>
</tr>
<tr>
<td>86</td>
<td>Palette Data Size</td>
<td>SV</td>
</tr>
<tr>
<td>87</td>
<td>Palette Data Offset</td>
<td>SV</td>
</tr>
<tr>
<td>88</td>
<td>Palette Data</td>
<td>Buffered Bytes</td>
</tr>
<tr>
<td>8A</td>
<td>Blit Report</td>
<td>CL</td>
</tr>
<tr>
<td>8B</td>
<td>Blit Rectangle X1</td>
<td>SV</td>
</tr>
<tr>
<td>8C</td>
<td>Blit Rectangle Y1</td>
<td>SV</td>
</tr>
<tr>
<td>8D</td>
<td>Blit Rectangle X2</td>
<td>SV</td>
</tr>
<tr>
<td>8E</td>
<td>Blit Rectangle Y2</td>
<td>SV</td>
</tr>
<tr>
<td>8F</td>
<td>Blit Data</td>
<td>Buffered Bytes</td>
</tr>
<tr>
<td>90</td>
<td>Soft Button</td>
<td>CL</td>
</tr>
<tr>
<td>91</td>
<td>Soft Button ID</td>
<td>SV</td>
</tr>
<tr>
<td>92</td>
<td>Soft Button Side</td>
<td>SV</td>
</tr>
<tr>
<td>93</td>
<td>Soft Button Offset 1</td>
<td>SV</td>
</tr>
<tr>
<td>94</td>
<td>Soft Button Offset 2</td>
<td>SV</td>
</tr>
<tr>
<td>95</td>
<td>Soft Button Report</td>
<td>SV</td>
</tr>
</tbody>
</table>
1 Alphanumeric Display

1.1 Bitmap Display

There are 3 types of Bit Depth Formats supported:

- Monochrome, where a pixel value is interpreted as a monochrome intensity.
- Indexed, where a pixel value is either used as an index into a palette table to determine the color to be displayed.
- RGB, where each pixel value contains the respective color component values to be displayed.

Some Bit Depth formats support an Alpha channel. The following formula is applied to each color when calculating the resulting displayed pixel value.

Displayed Pixel Component = (Blit Data component * Alpha) + (frame buffer data component * (MaximumPossibleAlphaValue - Alpha))

Where a “component” is the R, G, or B value of the an RGB pixel or the brightness value of a monochromatic display. The MaximumPossibleAlphaValue is 1 for a 1 bit Alpha value or 255 for an 8-bit Alpha value.

Auxiliary Display CA - A collection of auxiliary display related usages.

1.1.1 Display Attributes Report

The usages defined in this section must be contained in a Display Attributes Report feature report, which declares the basic capabilities of the device.

1.1.1.1 Display Specification

Bitmap Size X SV - Specifies the X Resolution -1 of the bitmap segment on the display.

Bitmap Size Y SV - Specifies the Y Resolution -1 of the bitmap segment on the display.

1.1.1.2 Bit Depth Format

Bit Depth Format SV – ID of the bit depth format supported by the device. The format specifies whether the display is Indexed or RGB, Monochrome or Color, and the bit depth and format of the pixel
data. See the Indexed and RGB Formats described below for more details.

**Bit Depth Format**

1.1.1.2.1 Monochrome and Indexed Formats

An Indexed format is specified by ORing it with an RGB BitDepth format value. The resulting value not only specifies the size of the palette table, but the RGB format of its entries. For instance, a BitDepth Format value of 0x13 indicates the palette has 16 entries, where each entry supports a 555 RGB color value.

It is not legal to declare an RGB Format that supports Alpha channels for an Indexed format.

A Palette Report must be declared if an Indexed format is defined. For Indexed formats the system is responsible for initializing all palette entries. For Monochrome formats, a 0 pixel value displays the background color and the maximum pixel value displays the foreground or Active color at maximum intensity.

**0x1 - BitDepth Indexed 1 Bit**

Specifies the display supports a pixel bit depth of 1 bit. If an Indexed format is specified, the palette table will contain 2 entries for specifying two possible colors, where pixel value is the index into the palette table. If a Monochrome format is declared, a 0x0 value displays the Background color for the pixel and a value of 1 displays is the Active color at maximum intensity.

**0x2 - BitDepth Indexed 2 Bits**

Specifies the display supports a bit depth of 2 bits. If an Indexed format is specified, the palette table will contain 4 entries. Not finding a Palette Report indicates a Monochrome format, where a 0x0 value displays the Background color for the pixel and a value of 3 displays is the Active color at maximum intensity.

**0x3 - BitDepth Indexed 4 Bits**

Specifies the display supports a bit depth of 4 bits. If an Indexed format is specified, the palette table will contain 16 entries. If a Monochrome format is declared, a 0x0 value displays the Background color for the pixel and a value of 0xF displays is the Active color at maximum intensity.
0x4 - BitDepth Indexed 8 Bits
   Specifies the display supports a bit depth of 8 bits. If an Indexed format is specified, the palette table will contain 256 entries. If a Monochrome format is declared, a 0x0 value displays the Background color for the pixel and a value of 0xFF displays is the Active color at maximum intensity.

1.1.1.2.2 RGB Formats

Note that bit 8 of the usage value is asserted if an alpha channel is supported.

0x10 - BitDepth RGB 555
   Specifies the display supports a bit depth of 15 bits in a 16-bit value. Finding this usage specifies that a Palette Report is invalid. Bits 0-4 indicate the red aspect of a specific pixel. Bits 5-9 indicate the green aspect of the specific pixel. Bits 10-14 indicate the blue aspect of the indexed pixel. Bit 15 is unused in this pixel bit depth.

0x90 - BitDepth ARGB 1555
   Specifies the display supports a bit depth of 16 bits. Finding this usage specifies that a Palette Report is invalid. Bits 0-4 indicate the red aspect of a specific pixel. Bits 5-9 indicate the green aspect of the specific pixel. Bits 10-14 indicate the blue aspect of the indexed pixel. Bit 15 is the alpha value of the pixel.

0x20 - BitDepth RGB 565
   Specifies the display supports a bit depth of 16 bits. Finding this usage specifies that a Palette Report is invalid. Bits 0-4 indicate the red aspect of a specific pixel. Bits 5-10 indicate the green aspect of the specific pixel. Bits 11-15 indicate the blue aspect of the indexed pixel.

0x30 - BitDepth RGB 888
   Specifies the display supports a bit depth of 24 bits. Finding this usage specifies that a Palette Report is invalid. Bits 0-7 indicate the red aspect of a specific pixel. Bits 8-15 indicate the green aspect of the specific pixel. Bits 16-23 indicate the blue aspect of the indexed pixel.

0xC0 - BitDepth ARGB 8888
   Specifies the display supports a bit depth of 32 bits. Finding this usage specifies that a Palette Report is invalid. Bits 0-7 indicate the red aspect of a specific pixel. Bits 8-15 indicate the green aspect of the specific pixel. Bits 16-24 indicate the blue aspect of the indexed pixel. Bits 25-31 indicate the alpha value of the pixel.
0xA - BitDepth PARGB 8888

Specifies the display supports a bit depth of 32 bits. Finding this usage specifies that a Palette Report is invalid. The first 8 bit is the alpha value of the pixel. Note that the alpha value should be calculated into the following 24 bits of the pixel data. The second 8 bits indicate the red aspect of a specific pixel. The third 8 bits indicate the green aspect of the specific pixel. The fourth 8 bits indicate the blue aspect of the indexed pixel.

0x40 - BitDepth 8880

Specifies the display supports a bit depth of 32 bits. Finding this usage specifies that a Palette Report is invalid. Bits 0-7 indicate the red aspect of a specific pixel. Bits 8-15 indicate the green aspect of the specific pixel. Bits 16-23 indicate the blue aspect of the indexed pixel. Bits 24-31 of the pixel data should be set to 0 and are ignored by the display.

1.1.1.3 Soft Buttons

Soft (unlabeled) Buttons can be positioned around the edges of the display. Knowing the position of the button, an application can render text or an icon close to the button that has the associated function, defining its purpose.

The existence of a Soft Button collection in a Report descriptor indicates that the device supports Soft Buttons. A Soft Button collection defines the position of soft button. This information is normally retrieved at initialization time. During run time, input reports are generated to indicate changes in the state of a button.

Note: The button collection will include usages from the functional Button Usage Page (0x09) in order to represent hardware buttons with an associated function.

<table>
<thead>
<tr>
<th>Soft Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft Button ID</td>
<td>SV – This usage specifies the usage value from the Button Usage table (0x09) that will be used to identify this button.</td>
</tr>
<tr>
<td>Soft Button Side</td>
<td>SV – This usage specifies the side of the display where the button resides. Where, 0 = top, 1 = bottom, 2 = left side. 3 = right side.</td>
</tr>
</tbody>
</table>
Soft Button Offset 1 SV – A static value that specifies the offset in pixels of the top or left edge of the button. If the Soft Button Side usage equals top or bottom then the offset is in the column position of the side of the button nearest the origin. If the Soft Button Side usage equals right or left then the offset is in the row position of the side of the button nearest the origin.

Soft Button Offset 2 SV – A static value that specifies the offset in pixels of the bottom or right edge of the button. If the Soft Button Side usage equals top or bottom then the offset is in the column position of the side of the button farthest from the origin. If the Soft Button Side usage equals right or left then the offset is in the row position of the side of the button farthest from the origin.

1.1.2 Orientation

Pixels are addressed in row and columns. The origin or 0,0 position is always in the upper left hand corner of the display. Below is an example of a 128x64 bitmapped display.

![Display Orientation and Writing Order](image)

Display Orientation DV – This usage is declared if the orientation of the display can be changed during usage. It identifies the location of the origin as viewed by the user.

Note: the application must perform the translations necessary to correctly display the screen to the user given the Orientation information.

0 – Origin at top left (default)
1 – Origin at top right (rotated 90 degrees clockwise)
2 – Origin at bottom right (rotated 180 degrees clockwise)
3 – Origin at bottom left (rotated 270 degrees clockwise)
1.1.3 Palette Report

Palette Report CL – Finding this usage in a display application descriptor indicates the Auxiliary Display supports loadable Palettes. This usages applies to a logical collection that defines the palette download report.

Palette Data Size SV - Specifies the number of palette table entries contained in the Palette Data buffered bytes field.

Palette Data Offset SV - Specifies the offset into the palette table of the first entry contained in the Palette Data buffered bytes field. This field can be optional if the Palette Data Size is large enough to initialize the complete Palette table at once. If not declared, then the all Palette table entries must be included in a Palette Rptr report

Palette Data Buffer Bytes – A collection of buffered bytes data that contains the palette data. The size of the individual palette entries are determined by the Bit Depth Format, see the descriptions above. If a Palette Data Offset is declared then the palette entries are loaded into the palette table starting at the offset declared by the Palette Data Offset. If a Palette Data Offset is not declared then the palette entries are loaded into the palette table starting at offset 0.

1.1.4 Blit Report

Blit Report CL – This usage is required for moving data to or from a Bitmapped Display Device.

The maximum size of a blit (in bytes) that is supported by the display, is defined by the size of the buffered bytes field in the Blit Report.

The following Blit Rectangle coordinates specify the bounding rectangle X1, Y1, X2, Y2 where the Blit Data buffer will be moved. The coordinate values assume the default Orientation of the display. See section 1.1.2 for more information on the default orientation.

If no Blit Rectangle usages are declared, then the client should assume that the data provided in the Blit Data is for the entire display buffer. i.e. the blit rectangle is (0,0, Bitmap Size X – 1, Bitmap Size Y – 1).

If a coordinate of the bounding rectangle is outside the boundaries of the display, the display will ignore data for this part of the Blit Data Buffer.

Blit Rectangle X1 DV – Specifies the X component of the top left corner of the rectangle for the blit.
Blit Rectangle Y1  DV - Specifies the Y component of the top left corner of the rectangle for the blit.

Blit Rectangle X2  DV - Specifies the X component of the bottom right corner of the rectangle for the blit.

Blit Rectangle Y2  DV - Specifies the X component of the bottom right corner of the rectangle for the blit.

Blit Data         Buffered Bytes – The buffer that contains the pixel data for each pixel in a blit to a display. The number of pixels contained in the Blit Data buffer equals

\[(\text{Blit Rectangle X1} - \text{Blit Rectangle X2})\]
\[\times (\text{Blit Rectangle Y1} - \text{Blit Rectangle Y2}).\]

The format of the pixel data is a function of the Bit Depth Format, see section 18.2.1.

1.1.5 Soft Button Report

Soft Button Report  CL - The Soft Button Report collection will include usages from the Button Usage page (0x09), which provides usages for generic non-function based button usages. The IDs of these buttons are defined in a Soft Button collection.

1.2 Sample Aux Display Device

The following example of a 128 x 64 bitmap display device with a 256 color 555 palette and 4 soft buttons on the bottom edge of the display. The Soft Buttons are 24 pixels wide, on 32 pixel centers, where the left-most button is offset 4 pixels from the edge of the display.

Five reports are defined:

- A Display Attributes feature report is declared for identifying fixed features of the display. This report defines the size of the display, the bit depth and format, and the positions of the soft buttons. All of the Feature report’s fields are constant.
- A Display Status input report that identifies state changes in the display.
- A Palette output report for loading the palette. Note that up to 256 bytes of palette data can be sent to the display in a single Palette report. Given 16-bits per palette entry, 2 reports are required to load the complete palette. One report with a Palette Data Offset = 0 and a second report with a Palette Data Offset = 128.
- A Blit output report for loading pixel data to the display. Note that up to 256 bytes of pixel data can be sent to the display in a single Blit report. Given 8-bits per pixel, 32 reports are required to completely refresh the screen.
And a Soft Button input report for notifying the client of any buttons pressed by the user.

**Figure 2: Example Display Layout**

### 1.2.1 Example Auxiliary Display Report Descriptor

```plaintext
USAGE_PAGE (Alphanumeric Display) 05 14
USAGE (Auxiliary Display) 09 02
COLLECTION (Application) A1 01
USAGE (Display Attributes Report) 09 20
COLLECTION (Logical) A1 02
REPORT_ID (1) 85 01
USAGE (Bitmap Size X) Constant = 128-1 09 80
USAGE (Bitmap Size Y) Constant = 64-1 09 81
USAGE (Bit Depth Format) Constant = 0x14 09 83
(Blit Format = 8 bit-Indexed with 555 palette)
LOGICAL_MINIMUM (0) 15 00
LOGICAL_MAXIMUM (255) 26 FF 00
REPORT_SIZE (8) 75 08
REPORT_COUNT (3) 95 03
FEATURE (Cnst,Var,Abs) B1 03
USAGE (Soft Button) 09 90
COLLECTION (Logical) A1 02
USAGE (Soft Button ID) Constant = 1 (Button 1) 09 91
USAGE (Soft Button Side) Constant = 1 (Bottom) 09 92
REPORT_SIZE (4) 75 04
REPORT_COUNT (2) 95 02
LOGICAL_MAXIMUM (15) 25 0F
FEATURE (Cnst,Var,Abs) B1 03
USAGE (Soft Button Offset 1) Constant = 4 (left side of button) 09 93
USAGE (Soft Button Offset 2) Constant = 28 (right side of button) 09 94
REPORT_SIZE (8) 75 08
LOGICAL_MAXIMUM (255) 26 FF 00
FEATURE (Cnst,Var,Abs) B1 03
END_COLLECTION C0
USAGE (Soft Button) 09 90
COLLECTION (Logical) A1 02
USAGE (Soft Button ID) Constant = 2 (Button 2) 09 91
USAGE (Soft Button Side) Constant = 1 (Bottom) 09 92
REPORT_SIZE (4) 75 04
LOGICAL_MAXIMUM (15) 25 0F
FEATURE (Cnst,Var,Abs) B1 03
USAGE (Soft Button Offset 1) Constant = 36 (left side of button) 09 93
USAGE (Soft Button Offset 2) Constant = 60 (right side of button) 09 94
REPORT_SIZE (8) 75 08
```
LOGICAL_MAXIMUM (255)  26 FF 00
FEATURE (Const,Var,Abs)  B1 03
END_COLLECTION  C0
USAGE (Soft Button)  09 90
COLLECTION (Logical)  A1 02
USAGE (Soft Button ID) Constant = 3 (Button 3)  09 91
USAGE (Soft Button Side) Constant = 1 (Bottom)  09 92
REPORT_SIZE (4)  75 04
LOGICAL_MAXIMUM (15)  25 0F
FEATURE (Const,Var,Abs)  B1 03
USAGE (Soft Button Offset 1) Constant = 68  (left side of button)  09 93
USAGE (Soft Button Offset 2) Constant = 82 (right side of button)  09 94
REPORT_SIZE (8)  75 08
LOGICAL_MAXIMUM (255)  26 FF 00
FEATURE (Const,Var,Abs)  B1 03
END_COLLECTION  C0
USAGE (Soft Button)  09 90
COLLECTION (Logical)  A1 02
USAGE (Soft Button ID) Constant = 4 (Button 4)  09 91
USAGE (Soft Button Side) Constant = 1 (Bottom)  09 92
REPORT_SIZE (4)  75 04
LOGICAL_MAXIMUM (15)  25 0F
FEATURE (Const,Var,Abs)  B1 03
USAGE (Soft Button Offset 1) Constant = 90  (left side of button)  09 93
USAGE (Soft Button Offset 2) Constant = 114 (right side of button)  09 94
REPORT_SIZE (8)  75 08
LOGICAL_MAXIMUM (255)  26 FF 00
FEATURE (Const,Var,Abs)  B1 03
END_COLLECTION  C0
END_COLLECTION  C0
USAGE (Display Status)  09 2D
COLLECTION (Logical)  A1 02
USAGE (Stat Not Ready)  09 2E
USAGE (Stat Ready)  09 2F
REPORT_SIZE (8)  75 08
REPORT_COUNT (1)  95 01
LOGICAL_MAXIMUM (1)  25 01
INPUT (Data,Ary,Abs,Null)  81 40
END_COLLECTION  C0
USAGE (Palette Report)  09 85
COLLECTION (Logical)  A1 02
USAGE (Palette Data Size)  09 86
Number of Palette table entries in the buffered bytes Palette Data field
USAGE (Palette Data Offset)  09 87
Start offset in palette table for palette entries in Palette Data
REPORT_SIZE (8)  75 08
REPORT_COUNT (2)  95 02
OUTPUT (Data,Var,Abs,Null)  91 42
USAGE (Palette Data)  Palette Data buffer  09 88
REPORT_SIZE (8)  75 08
REPORT_COUNT (256)  96 00 01
OUTPUT (Data,Var,Abs,Buf)  92 02 01
END_COLLECTION  C0
USAGE (Blit Report)  09 8A
COLLECTION (Logical)  A1 02
REPORT_ID (2)
USAGE (Blit Rectangle X1) Blit rectangle definition  09 8B
USAGE (Blit Rectangle Y1)  09 8C
USAGE (Blit Rectangle X2)  09 8D
USAGE (Blit Rectangle Y2)  09 8E
REPORT_SIZE (8)  75 08
REPORT_COUNT (4)  95 04
LOGICAL_MAXIMUM (127)  25 7F
OUTPUT (Data,Var,Abs)  91 02
USAGE (Blit Data)  Blit Data buffer  09 8F
REPORT_SIZE (8)  75 08
REPORT_COUNT (256)  96 00 01
OUTPUT (Data,Var,Abs,Buf)  92 02 01
END_COLLECTION  C0
Response:
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<sam> I dropped the Custom Segment usage because that’s what Vendor Defined Usages are for.
nathans@microsoft.com Minor edit to sample descriptor comment field clarifying that Bitmap Size X and Bitmap Size Y are 0-based.

Notes on Approval Procedure:
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HID WG On Line Voting Procedures

1. Votes are on a per company basis.

2. Each Review Request shall have attached a Required Voter List that is the result of recruiting by the HID Chair and submitter of members of the USB IF. Required Voter List must include the HID Chair plus 2 companies (other than the submitter) plus any others designated by the HID Chair at the Chair’s discretion. The Required Voter List ensures that a quorum is available to approve the Request.

3. Impose a 7-calendar-day posting time limit for new Review Requests. HID Chair or designate must post the RR within 7 calendar days. HID Chair or designate must work with the submitter to make sure the request is valid prior to posting. Valid review request must include all fields marked as required in the template. A new template will be adopted that requires at least the following fields: Change Text, Required Voter List, Review Period End Date and Voting End Date, Submittal Date, Submitter, Review Request Title and RR Number.

4. If a RR approval process stalls, the HID Chair may call a face-to-face meeting or conference call to decide the issue. Submitter may request that this take place.

5. Impose a minimum 15-calendar-day review period on a posted RR prior to the voting period. At HID Chair discretion, changes to the RR may require this review period to restart.
6. The Chair will accept votes via documentable means such as mail or e-mail during the 7 calendar days after the close of the review period. If a Required Voter does not vote during the period, then there is no quorum and the Chair may pursue the absent required voter and extend the voting period. The Chair may designate a substitute for the absent voter and extend the voting period if necessary.