Amlogic

How to add an new resolution

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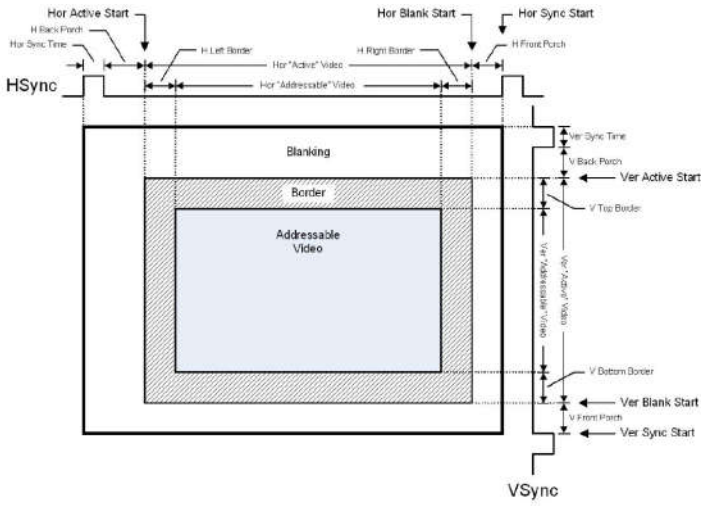
1.添加自定义分辨率

一、核实分辨率参数

要添加自定义分辨率，首先需要核实客户提供的分辨率参数，包括像素时钟(Pixel Clock)，水平可见宽度(H Active)，水平总长(H Total)，水平前沿(H FPorch)，水平同步宽度(H Sync)，水平后沿(H BPorch)，垂直可见高度(V Active)，垂直总长(V Total)，垂直前沿(V FPorch)，垂直同步宽度(V Sync)，垂直后沿(V BPorch)。详细的参数描述如下图，其中 Border 为很久以前的概念，现在的分辨率 Border 全是为 0 的。



上述参数满足如下等式：

H Total = H Active + H FPorch + H Sync + H BPorch

V Total = V Active + V FPorch + V Sync + V BPorch

H Blank = H FPorch + H Sync + H BPorch = H Total - H Active

V Blank = V FPorch + V Sync + V BPorch = V Total - V Active

另外水平和垂直频率的计算方法是：

H Freq = Pixel Clock / H Total

V Freq = Pixel Clock / H Total / V Total = H Freq / V Total

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客户提供的参数必须满足上述条件，如不满足要和客户沟通好。

本文档中我们以客户要求的 3440x1440p60hz 为例，详细说明其配置方法。客户提供的详细参数如下：

H Active：3440，H Total：3600，H FPorch: 48，H Sync: 32，H BPorch: 80

V Active：1440，V Total：1481，V FPorch: 3，V Sync: 10，V BPorch: 28

Pixel Clock: 319750000Hz

二、在 Uboot 里面添加自定义分辨率按如下说明进行：

为了开机后能正常按照关机前的分辨率显示，必须在 Uboot 里面必须添加自定义分辨率相关的代码。

1. 添加 PLL 参数

芯片内部通过 PLL 产生像素时钟，因此需要计算 PLL 参数。参考《g12a_plls_application_note 2.8.1》，设置 PLL 产生像素时钟的方法如下。

$$\text{Target frequency} = 24MHz \bullet \frac{DPLL\_M + \frac{DIV\_FRAC}{2^{17}}}{DPLL\_N} \bullet \frac{1}{OD}$$

其中 $24\ MHz \bullet \frac{DPLL\_M + \frac{DIV\_FRAC}{2^{17}}}{DPLL\_N}$ 为 **DCO 的输出频率**，Target frequency 为像素时钟乘以 10，DPLL_M 为 8bit 无符号整数，DPLL_N 为 5bit 无符号整数，DIV_FRAC 为 19bit 无符号整数。

要确保 **DCO 的输出频率**在 3G 和 6G 之间，当 Target frequency 不足 3G 时可以调节 OD，使之满足条件。DPLL_M，DPLL_N，DIV_FRAC 和 OD 在 HHI_GP0_PLL_CNTL0 和 HHI_GP0_PLL_CNTL1 寄存器中。在实际的计算中，Target frequency 以 KHz 为单位。

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需要修改的文件、函数或变量如下表：

文件	函数或变量
arch/arm/cpu/armv8/g12a/hdmitx20/enc_clk_config.c	修改 set_hpll_clk_out
arch/arm/cpu/armv8/g12a/hdmitx20/enc_clk_config.c	修改 setting_enc_clk_val_24
arch/arm/cpu/armv8/g12b/hdmitx20/enc_clk_config.c	修改 set_hpll_clk_out
arch/arm/cpu/armv8/g12b/hdmitx20/enc_clk_config.c	修改 setting_enc_clk_val_24
arch/arm/cpu/armv8/tm2/hdmitx20/enc_clk_config.c	修改 set_hpll_clk_out
arch/arm/cpu/armv8/tm2/hdmitx20/enc_clk_config.c	修改 setting_enc_clk_val_24

set_hpll_clk_out 函数中添加配置 P_HHI_HDMI_PLL_CNTL0/1/2/3/4/5/6 的代码，相关寄存器说明可参考《G12A-HIU-Registers.docx》，至于非 DPLL_M，DPLL_N，DIV_FRAC，OD 的字段，不知道准确的理论根据，按照最接近的 Target frequency Copy 即可。set_hpll_clk_out 函数中并没有对 OD 进行配置，后面的代码会配置的。示例代码如下，注意 3197500 是 **DCO 的输出频率**，只有当 OD 等于 1 时，它才等于像素时钟。

```
case 3197500:
    hd_write_reg(P_HHI_HDMI_PLL_CNTL0, 0x3b000485);  0x85就是DPLL_M,
    hd_write_reg(P_HHI_HDMI_PLL_CNTL1, 0x00007555);  0x04>>2后就是
    hd_write_reg(P_HHI_HDMI_PLL_CNTL2, 0x00000000);
    hd_write_reg(P_HHI_HDMI_PLL_CNTL3, 0x0a691c00);  DPLL_N,
    hd_write_reg(P_HHI_HDMI_PLL_CNTL4, 0x33771290);  0x7555就是DIV_FRAC
    hd_write_reg(P_HHI_HDMI_PLL_CNTL5, 0x39270000);
    hd_write_reg(P_HHI_HDMI_PLL_CNTL6, 0x50540000);
    hd_set_reg_bits(P_HHI_HDMI_PLL_CNTL0, 0x0, 29, 1);
    WAIT_FOR_PLL_LOCKED(P_HHI_HDMI_PLL_CNTL0);
    pr_info("HPLL: 0x%lx\n", hd_read_reg(P_HHI_HDMI_PLL_CNTL0));
    break;
```


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24*1000*(133+30037/(2^17))=3197499，与需要的 3197500 相差无几。

在 setting_enc_clk_val_24 结构体数组中添加一个元素，该结构体的 hpll_clk_out 变量为 $24MHz \bullet \frac{DPLL\_M + \frac{DIV\_FRAC}{2^{17}}}{DPLL\_N}$，od1/2/3 的乘积为 OD 值。示例代码如下：

```
{
    {
        HDMIV_3440x1440p60hz, GROUP_END
    },
    1, VIU_ENCP, 3197500, 1, 1, 1, CLK_UTIL_VID_PLL_DIV_5, 2, 1, 1, -1
},
```

2. 添加支持模式

需要修改的文件、函数或变量如下表：

文件	函数或变量
arch/arm/cpu/armv8/g12a/hdmitx20/hdmitx_set.c	修改 gxbb_modes
arch/arm/cpu/armv8/g12b/hdmitx20/hdmitx_set.c	修改 gxbb_modes
arch/arm/cpu/armv8/tm2/hdmitx20/hdmitx_set.c	修改 gxbb_modes

在 gxbb_modes 结构体数组中添加 VIC 宏定义和模式名称字符串。示例代码如下：

```
{HDMIV_3440x1440p60hz, "3440x1440p60hz", 0},
```


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3. 添加 timing 参数

需要修改的文件、函数或变量如下表：

文件	函数或变量
arch/arm/cpu/armv8/g12a/hdmitx20/hdmitx_tvenc.c	新增 tvregs_vesa_3440x1440p60hz
arch/arm/cpu/armv8/g12a/hdmitx20/hdmitx_tvenc.c	修改 tvregsTab
arch/arm/cpu/armv8/g12b/hdmitx20/hdmitx_tvenc.c	新增 tvregs_vesa_3440x1440p60hz
arch/arm/cpu/armv8/g12b/hdmitx20/hdmitx_tvenc.c	修改 tvregsTab
arch/arm/cpu/armv8/tm2/hdmitx20/hdmitx_tvenc.c	新增 tvregs_vesa_3440x1440p60hz
arch/arm/cpu/armv8/tm2/hdmitx20/hdmitx_tvenc.c	修改 tvregsTab

新增类型为 static const struct reg_t 结构体的全局变量，同时在 tvregsTab 数组中添加刚定义的变量。

static const struct reg_t 结构体全局变量的值可以通过_ENC_g9tv_4k1k_4k05k.xls 计算，使用说明如下图。 

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					ok		debug				
ENCP_VIDEO_MODE	0x1b8d	0x4040	红色方框内的最右列就是计算出的数据						Hacitve	3440	3440
ENCP_VIDEO_MODE_ADV	0x1b8e	0x18							Vactive	1440	1440
ENCP_VIDEO_MAX_PXCNT	0x1b97	0xE0F	3599	**2200** - 1	3599	E0F	3599	0	Htotal	3600	3599
ENCP_VIDEO_MAX_LNCNT	0x1bae	0x5C8	1480	**1125** – 1	1480	5C8	1480	0	Hblank	160	
ENCP_VIDEO_HAVON_BEGIN	0x1ba4	0x70	112	**148**	192	C0	192	E0F	Vtotal	1481	1480
ENCP_VIDEO_HAVON_END	0x1ba3	0xDDF	3551	2067 – 148 = **1920** – 1	2111	83F	2111	5C8	Vblank	41	
ENCP_VIDEO_VAVON_BLINE	0x1ba6	0x26	38	**41**	41	29	41	C0	Hfront	48	48
ENCP_VIDEO_VAVON_ELINE	0x1baf	0x5C5	1477	1120 – 41 = **1080** – 1	1120	460	1120	83F	Hsync	32	32
ENCP_VIDEO_HSO_BEGIN	0x1ba7	0x0	0		0	0	0	29	Hback	80	80
ENCP_VIDEO_HSO_END	0x1ba8	0x20	32		44	2C	44	460	Vfront	3	3
ENCP_VIDEO_VSO_BEGIN	0x1ba9	0x1E	30		0	0	0		Vsync	10	10
ENCP_VIDEO_VSO_END	0x1baa	0x32	50		2199	897	2199	0	Vback	28	28
ENCP_VIDEO_VSO_BLINE	0x1bab	0x0	0	**0**	0	0	0	2C			
ENCP_VIDEO_VSO_ELINE	0x1bac	0xA	10	**5**	5	5	5	0			
ENCP_DVI_HSO_BEGIN	0x1c30	0x2	2	2200 – 2158 + 2 = **44**	2	2	2	897	根据客户的参数		
ENCP_DVI_HSO_END	0x1c31	0x22	34		46	2E	46	0	填写上面绿色方		
ENCP_DVI_VSO_BLINE_EVN	0x1c32	0x0	0		0	0	0	5			
ENCP_DVI_VSO_BLINE_ODD	0x1c33	0x0	0	1125 – 1124 + 4 = **5**					框内的数值		
ENCP_DVI_VSO_ELINE_EVN	0x1c34	0xA	10		5	5	5	2			
ENCP_DVI_VSO_ELINE_ODD	0x1c35	0x0	0					2E			
ENCP_DVI_VSO_BEGIN_EVN	0x1c36	0x2	2		2	2	2	0			
ENCP_DVI_VSO_BEGIN_ODD	0x1c37	0x0	0								
ENCP_DVI_VSO_END_EVN	0x1c38	0x2	2		2	2	2	5			
ENCP_DVI_VSO_END_ODD	0x1c39	0x0	0								
ENCP_DE_H_BEGIN	0x1c3a	0x72	114	2070 – 150 = **1920**	194	C2	194	2			
ENCP_DE_H_END	0x1c3b	0xDE2	3554		2114	842	2114				
ENCP_DE_V_BEGIN_EVEN	0x1c3c	0x26	38	1121 – 41 = **1080**	41	29	41	2			
ENCP_DE_V_END_EVEN	0x1c3d	0x5C6	1478		1121	461	1121				
ENCP_DE_V_BEGIN_ODD	0x1c3e	0x0	0					C2			
ENCP_DE_V_END_ODD	0x1c3f	0x0	0					842			
VPU_HDMI_SETTING	0x271b							461			
VPP_POSTBLEND_H_SIZE	0x1d21	0xD70	3439								

程序中的示例代码如下，其中 P_ENCP_VIDEO_EN，P_ENCI_VIDEO_EN，MREG_END_MARKER 的数据来源不清楚，Copy 其它逐行扫描的分辨率都是 0。

```
static const struct reg_t tvregs_vesa_3440x1440p60hz[] = {
    {P_ENCP_VIDEO_EN, 0,},
    {P_ENCI_VIDEO_EN, 0,},

    {P_ENCP_VIDEO_MODE, 0x4040,},
    {P_ENCP_VIDEO_MODE_ADV, 0x18,},
    {P_ENCP_VIDEO_MAX_PXCNT, 0xE0F,},
    {P_ENCP_VIDEO_MAX_LNCNT, 0x5C8,},
    {P_ENCP_VIDEO_HAVON_BEGIN, 0x70,},
    {P_ENCP_VIDEO_HAVON_END, 0xDDF,},
    {P_ENCP_VIDEO_VAVON_BLINE, 0x26,},
    {P_ENCP_VIDEO_VAVON_ELINE, 0x5C5,},
    {P_ENCP_VIDEO_HSO_BEGIN, 0x0,},
    {P_ENCP_VIDEO_HSO_END, 0x20,},
    {P_ENCP_VIDEO_VSO_BEGIN, 0x1E,},
    {P_ENCP_VIDEO_VSO_END, 0x32,},
    {P_ENCP_VIDEO_VSO_BLINE, 0x0,},
    {P_ENCP_VIDEO_VSO_ELINE, 0xA,},

    {P_ENCI_VIDEO_EN, 0},
    {MREG_END_MARKER, 0}
};



  {HDMIV_3440x1440p60hz, tvregs_vesa_3440x1440p60hz},
```

4. 添加 mode 的详细信息

需要修改的文件、函数或变量如下表：

文件	函数或变量
common/hdmi_parameters.c	新增 fmt_para_vesa_3440x1440p60_43x18
common/hdmi_parameters.c	修改 all_fmt_paras

在 common/hdmi_parameters.c 文件中添加类型为 static struct hdmi_format_para 结构体的全局变量，同时在 all_fmt_paras 数组中添加刚定义的变量。示例代码如下：

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```
static struct hdmi_format_para fmt_para_vesa_3440x1440p60_43x18 = {
    .vic = HDMIV_3440x1440p60hz,
    .name = "3440x1440p60hz",
    .sname = "3440x1440p60hz",
    .pixel_repetition_factor = 0,
    .progress_mode = 1,
    .scrambler_en = 0,
    .tmds_clk_div40 = 0,
    .tmds_clk = 319750,
    .timing = {
        .pixel_freq = 319750,
        .h_freq = 88819,
        .v_freq = 59973,
        .vsync_polarity = 1, /* +VSync */
        .hsync_polarity = 1, /* +HSync */
        .h_active = 3440,
        .h_total = 3600,
        .h_blank = 160,
        .h_front = 48,
        .h_sync = 32,
        .h_back = 80,
        .v_active = 1440,
        .v_total = 1481,
        .v_blank = 41,
        .v_front = 3,
        .v_sync = 10,
        .v_back = 28,
        .v_sync_ln = 1,
    },
};
```

```
    &fmt_para_vesa_3440x1440p60_43x18,
```

5. 添加 VIC 编号

需要修改的文件、函数或变量如下表：

文件	函数或变量
include/amlogic/hdmi.h	修改 enum hdmi_vic

在 enum hdmi_vic 枚举中添加一个成员。示例代码如下：

```
    HDMIV_3440x1440p60hz,
```

三、在 Kernel 里面添加自定义分辨率按如下说明进行：

1. 添加 PLL 参数

需要修改的文件、函数或变量如下表：

文件	函数或变量
drivers/amlogic/media/vout/hdmitx/hdmi_tx_20/hw/hw_g12a.c	修改 set_g12a_hpll_clk_out
drivers/amlogic/media/vout/hdmitx/hdmi_tx_20/hw/hw_clk.c	修改 setting_enc_clk_val_24

计算 PLL 参数的方法与 uboot 里面相同，在 set_g12a_hpll_clk_out 函数中做与 uboot 相同的添加即可。示例代码如下：

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```
case 3197500:
    hd_write_reg(P_HHI_HDMI_PLL_CNTL0, 0x3b000485);
    hd_write_reg(P_HHI_HDMI_PLL_CNTL1, 0x00007555);
    hd_write_reg(P_HHI_HDMI_PLL_CNTL2, 0x00000000);
    hd_write_reg(P_HHI_HDMI_PLL_CNTL3, 0x0a691c00);
    hd_write_reg(P_HHI_HDMI_PLL_CNTL4, 0x33771290);
    hd_write_reg(P_HHI_HDMI_PLL_CNTL5, 0x39270000);
    hd_write_reg(P_HHI_HDMI_PLL_CNTL6, 0x50540000);
    hd_set_reg_bits(P_HHI_HDMI_PLL_CNTL0, 0x0, 29, 1);
    WAIT_FOR_PLL_LOCKED(P_HHI_HDMI_PLL_CNTL0);
    pr_info("HPLL: 0x%lx\n", hd_read_reg(P_HHI_HDMI_PLL_CNTL0));
    break;
```

0x85就是DPLL_M,
0x04>>2后就是
DPLL_N,
0x7555就是DIV_FRAC

在 setting_enc_clk_val_24 结构体数组中添加一个元素，与 uboot 中的添加相同。示例代码如下：

```
{{HDMIV_3440x1440p60hz,
  HDMI_VIC_END},
    3197500, 1, 1, 1, VID_PLL_DIV_5, 2, 1, 1, -1},
```

2. 添加色域，色深，色彩空间等信息

需要修改的文件、函数或变量如下表：

文件	函数或变量
drivers/amlogic/media/vout/hdmitx/hdmi_tx_20/hdmi_tx_video.c	修改 hdmi_tx_video_params

在文件的 hdmi_tx_video_params 结构体数组中添加一个元素。示例代码如下：

```
{
    .VIC        = HDMIV_3440x1440p60hz,
    .color_prefer    = COLORSPACE_RGB444,
    .color_depth     = COLORDEPTH_24B,
    .bar_info    = B_UNVALID,
    .repeat_time     = NO_REPEAT,
    .aspect_ratio    = ASPECT_RATIO_SAME_AS_SOURCE,
    .cc      = CC_NO_DATA,
    .ss      = SS_NO_DATA,
    .sc      = SC_NO_UINFORM,
},
```

3. 添加 timing 参数

需要修改的文件、函数或变量如下表：

文件	函数或变量
drivers/amlogic/media/vout/hdmitx/hdmi_tx_20/hw/enc_cfg_hw.c	新增 tvregs_vesa_3440x1440p60hz
drivers/amlogic/media/vout/hdmitx/hdmi_tx_20/hw/enc_cfg_hw.c	修改 tvregsTab

添加类型为 static const struct reg_s 结构体的全局变量，同时在 tvregsTab 数组中添加刚定义的变量。相关的数值与 uboot 里面相同。示例代码如下：

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```
static const struct reg_s tvregs_vesa_3440x1440p60hz[] = {
    {P_ENCP_VIDEO_EN, 0,},
    {P_ENCI_VIDEO_EN, 0,},
    {P_VENC_VDAC_SETTING, 0xff,},

    {P_ENCP_VIDEO_MODE, 0x4040,},
    {P_ENCP_VIDEO_MODE_ADV, 0x18,},
    {P_ENCP_VIDEO_MAX_PXCNT, 0xE0F,},
    {P_ENCP_VIDEO_MAX_LNCNT, 0x5C5,},
    {P_ENCP_VIDEO_HAVON_BEGIN, 0x70,},
    {P_ENCP_VIDEO_HAVON_END, 0xDDF,},
    {P_ENCP_VIDEO_VAVON_BLINE, 0x26,},
    {P_ENCP_VIDEO_VAVON_ELINE, 0x5C5,},
    {P_ENCP_VIDEO_HSO_BEGIN, 0x0,},
    {P_ENCP_VIDEO_HSO_END, 0x20,},
    {P_ENCP_VIDEO_VSO_BEGIN, 0x1E,},
    {P_ENCP_VIDEO_VSO_END, 0x32,},
    {P_ENCP_VIDEO_VSO_BLINE, 0x0,},
    {P_ENCP_VIDEO_VSO_ELINE, 0xA,},

    {P_VPU_VIU_VENC_MUX_CTRL, 0xA},
    {P_ENCI_VIDEO_EN, 0},
    {MREG_END_MARKER, 0}
};


{HDMIV_3440x1440p60hz, tvregs_vesa_3440x1440p60hz},
```

4. 添加 mode 的详细信息

需要修改的文件、函数或变量如下表：

文件	函数或变量
drivers/amlogic/media/vout/hdmitx/hdmi_common/hdmi_parameters.c	新增 fmt_para_vesa_3440x1440p60_43x18
drivers/amlogic/media/vout/hdmitx/hdmi_common/hdmi_parameters.c	修改 all_fmt_paras

添加类型为 static struct hdmi_format_para 结构体的全局变量，同时在 all_fmt_paras 数组中添加刚定义的变量。示例代码如下：

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```
static struct hdmi_format_para fmt_para_vesa_3440x1440p60_43x18 = {
    .vic = HDMIV_3440x1440p60hz,
    .name = "3440x1440p60hz",
    .pixel_repetition_factor = 0,
    .progress_mode = 1,
    .scrambler_en = 0,
    .tmds_clk_div40 = 0,
    .tmds_clk = 319750,
    .timing = {
        .pixel_freq = 319750,
        .h_freq = 88819,
        .v_freq = 59973,
        .vsync_polarity = 1, /* +VSync */
        .hsync_polarity = 1, /* +HSync */
        .h_active = 3440,
        .h_total = 3600,
        .h_blank = 160,
        .h_front = 48,
        .h_sync = 32,
        .h_back = 80,
        .v_active = 1440,
        .v_total = 1481,
        .v_blank = 41,
        .v_front = 3,
        .v_sync = 10,
        .v_back = 28,
        .v_sync_ln = 1,
    },
    .hdmitx_vinfo = {
        .name               = "3440x1440p60hz",
        .mode               = VMODE_HDMI,
        .width              = 3440,
        .height             = 1440,
        .field_height       = 1440,
        .aspect_ratio_num   = 43,
        .aspect_ratio_den   = 18,
        .sync_duration_num  = 60,
        .sync_duration_den  = 1,
        .video_clk          = 319750000,
        .htotal             = 3600,
        .vtotal             = 1481,
        .fr_adj_type        = VOUT_FR_ADJ_HDMI,
        .viu_color_fmt      = COLOR_FMT_YUV444,
        .viu_mux            = VIU_MUX_ENCP,
    },
};
```


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