Proposal of buffer cropping for V4L2 API

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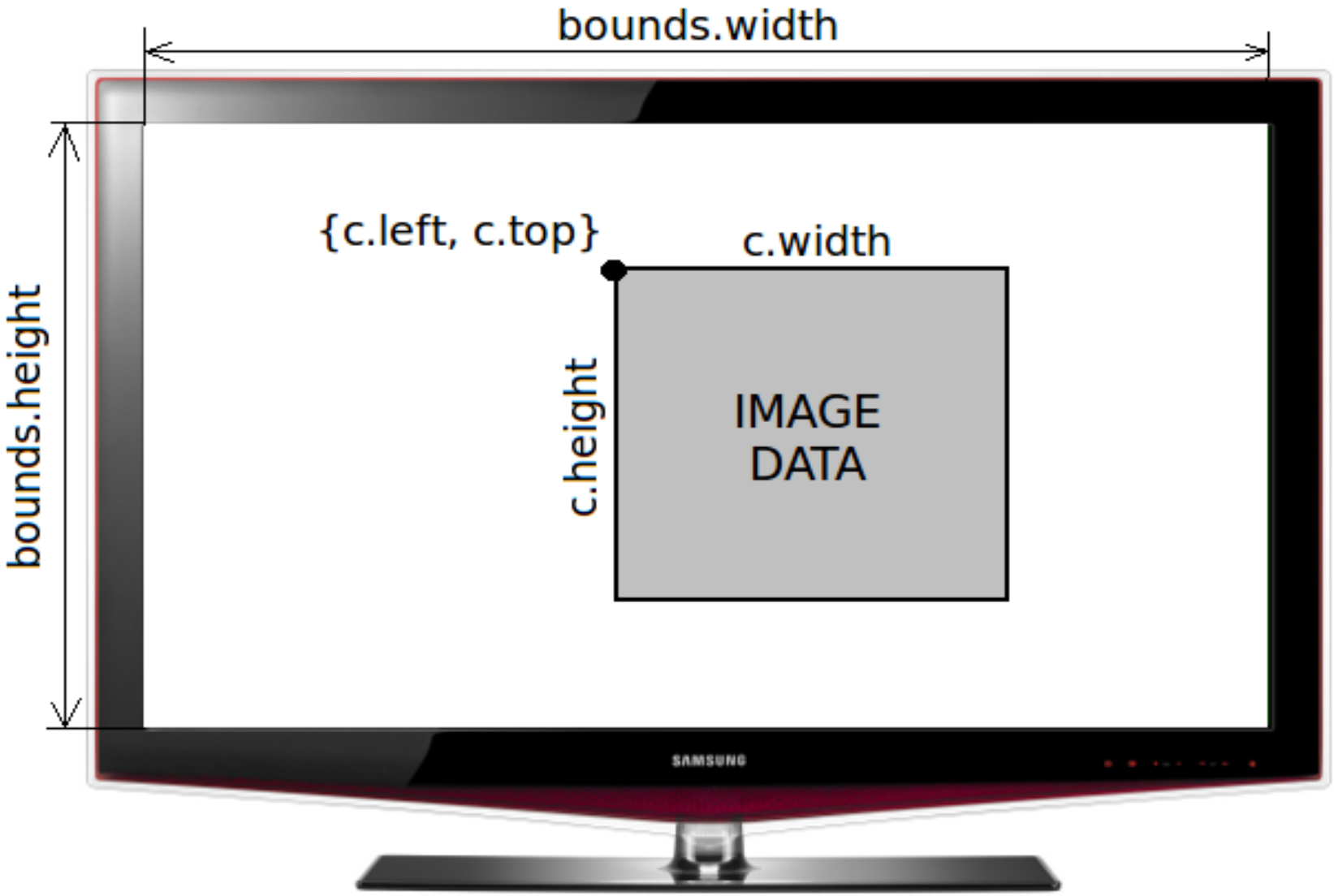
Agenda

1. Introduction
   - Cropping in V4L2
2. Problem description
   - Environment
   - Macroblock formats
   - Workflow Comparison
3. Solution proposals
   - Buffer crop description
   - Existing API
   - Extended API

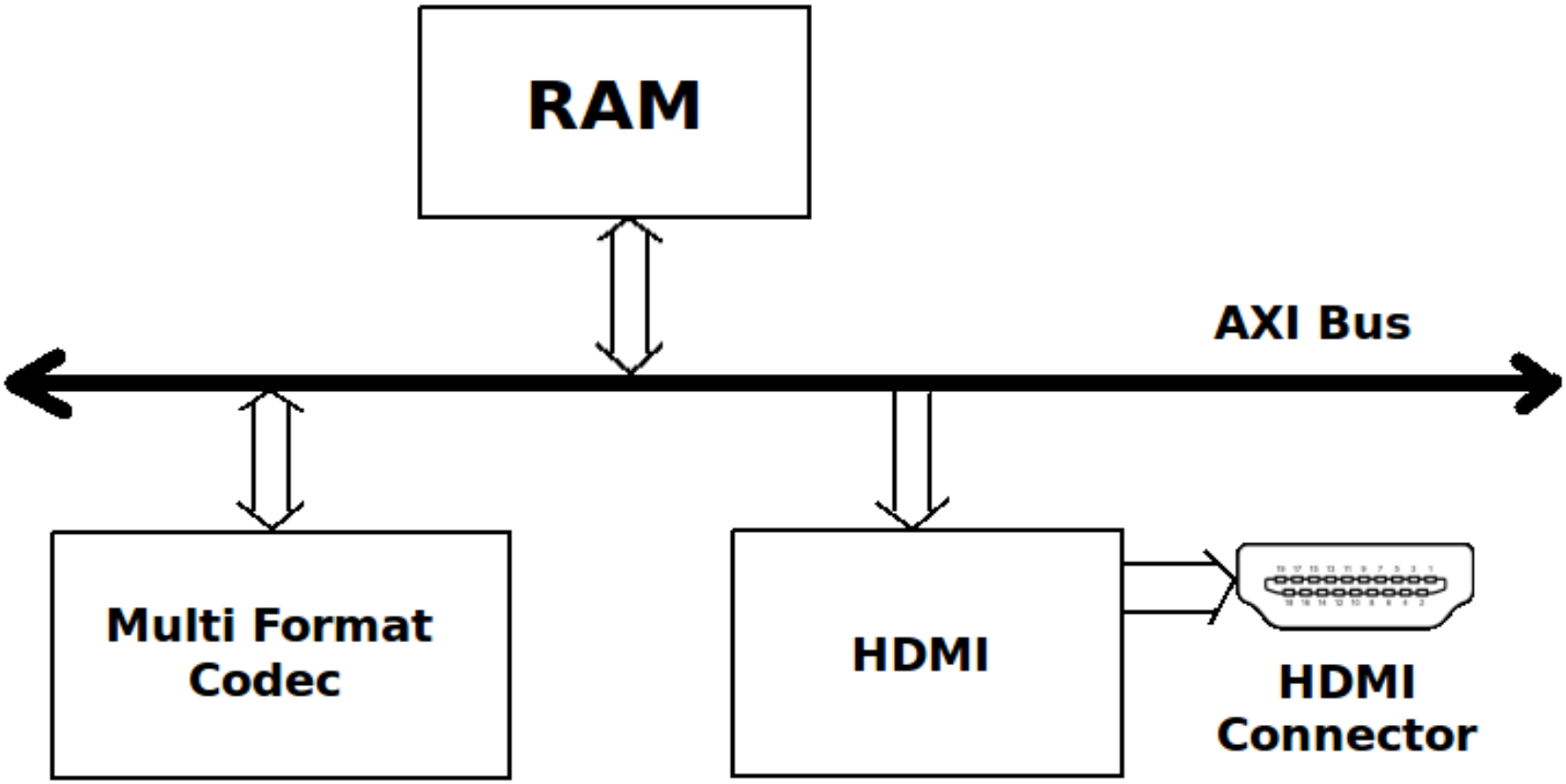
Cropping in V4L2

1. Buffer is defined using VIDIOC_S_FMT ioctl
   - format by FourCC
   - width and height
   - bytesperline
   - size
2. Crop in output/capture buffer is defined using VIDIOC_S_CROP
   - position of cropping rectangle in left/top fields
   - size of crop in fields width/height
   - cropping bounds are obtained with ioctl VIDIOC_S_CROPCAP

Cropping in V4L2



Environment : S5PC210 board



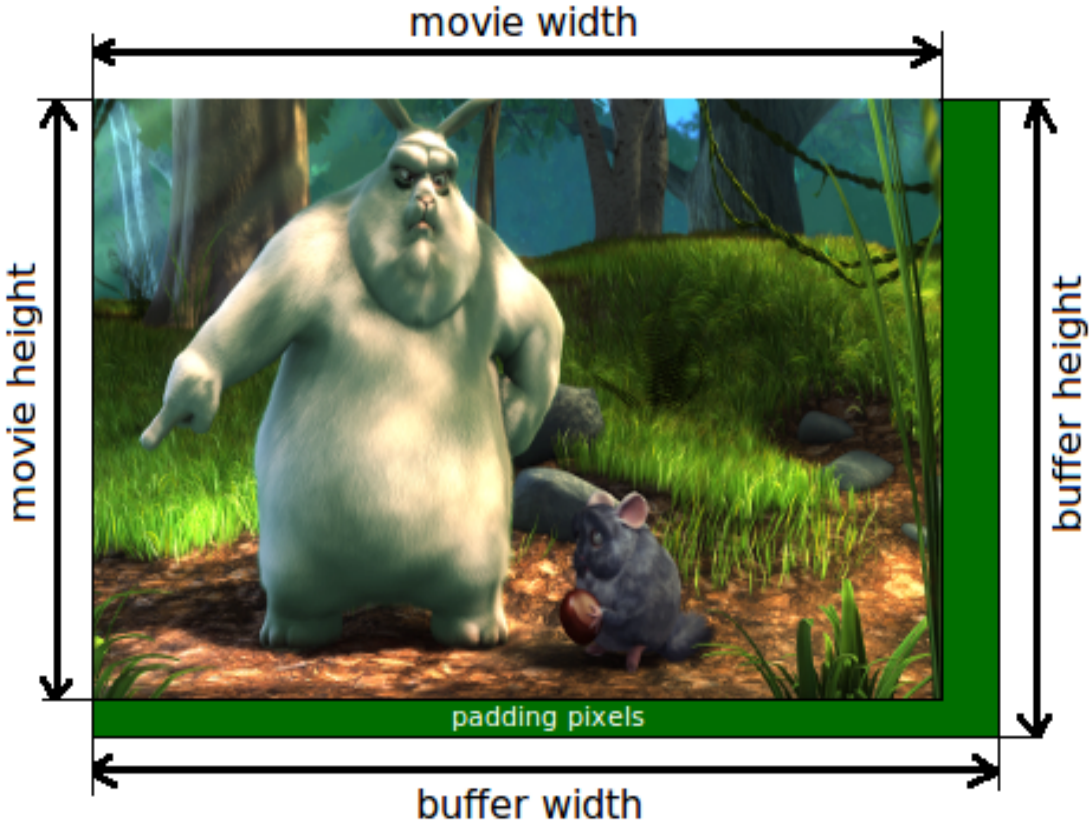
MFC decode compressed movie to buffers in NV12T format

HDMI process image buffers and pass them to HDMI output

Macroblock formats : NV12T

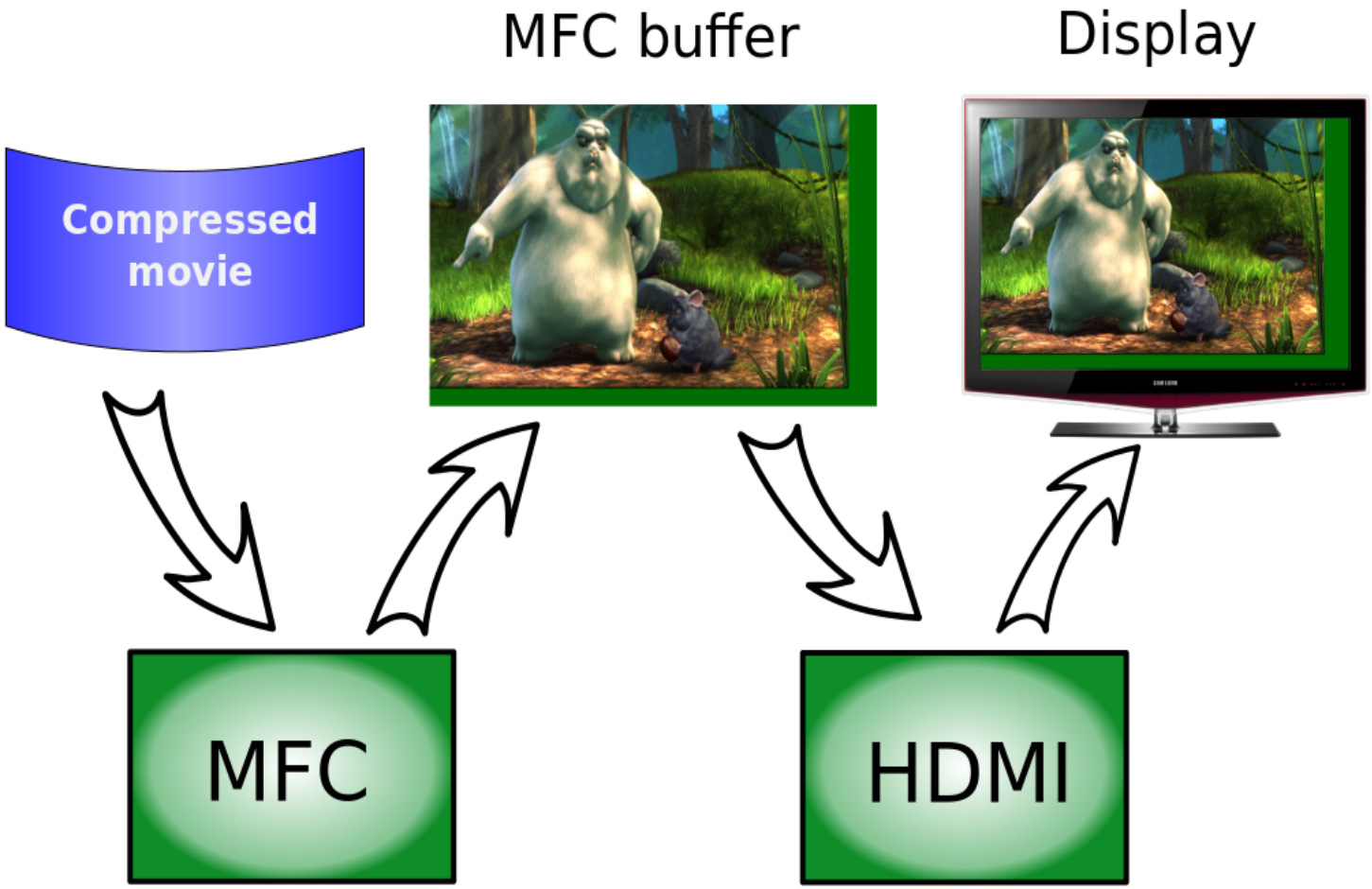
1. MFC (movie coded on Samsung SoC) hardware produces images in NV12T
2. NV12T is planar YCbCr format
3. NV12T is a macroblock format with block size 64×32 pixels
4. Complex ordering of macroblocks
   - Z-ordering in cells 4×2 macroblocks
   - cells are ordered linearly
5. hardware limitation forces buffer size to be multiple of 128×32

MFC buffers

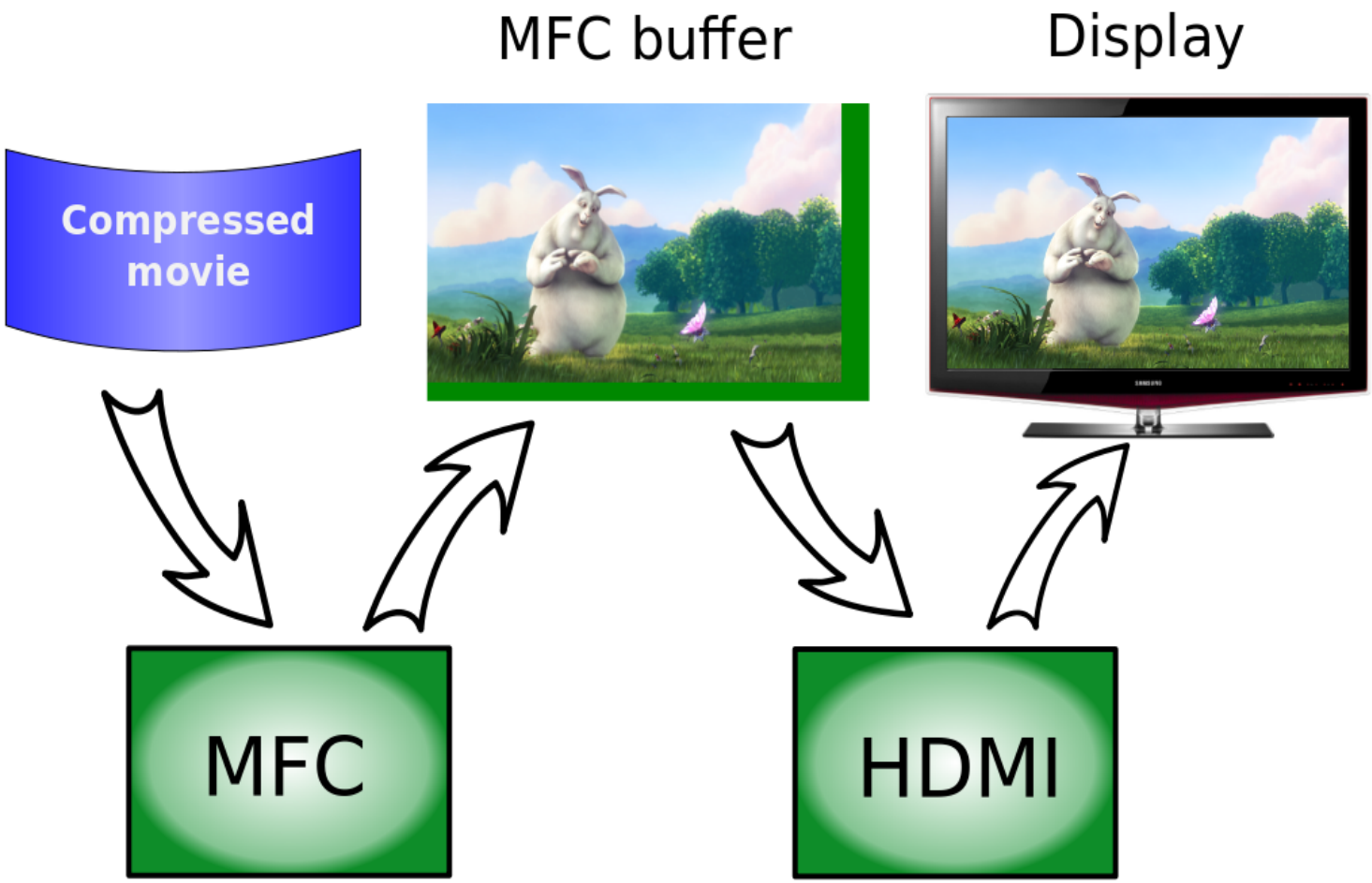


1. padding pixels are added if size of a movie is not a multiple of 128×32
2. padding pixel are filled with zeros, ugly green color in YCbCr colorspace

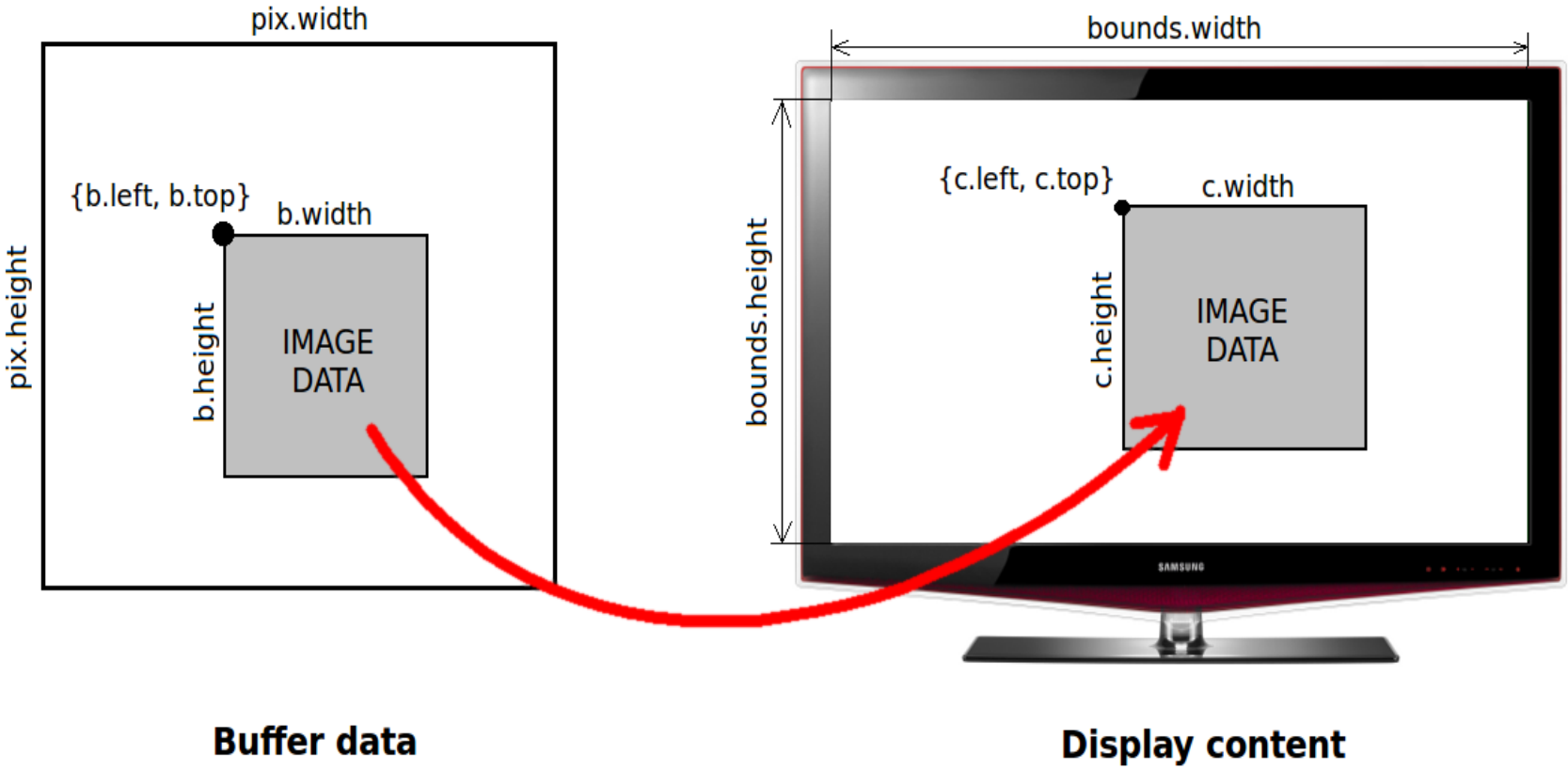
Incorrect workflow



Expected workflow



Buffer Crop



1. Only part of pixels in buffer is passed to active area on output device
2. supported by most of IPs on S5PC210 board

Solution 1 : VIDIOC_S_FMT and VIDIOC_QBUF

1. Overload fields in existing structures.
   - Use v4l2_pix_format.bytesperline field to configure real width.
   - Use v4l2_buffer.m.userptr to simulate left/top offsets.
2. Disadvantages
   - Field bytesperline is not defined for macroblock and compressed formats.
   - Computing proper pointer is possible only for small set of coordinates (multiples of 64×32).
   - Such a pointer may not exists (JPEG)

Solution 2 : VIDIOC_S_CROP

1. Use other buffer types in structure v4l2_crop.type. V4L2 nodes often supports only single buffer type. For output node:
   - Using V4L2_BUF_TYPE_VIDEO_OUTPUT would indicate normal cropping.
   - Using V4L2_BUF_TYPE_VIDEO_OVERLAY would indicate buffer cropping.
2. Already supported for mem2mem drivers, where cropping is configured both for OUTPUT and CAPTURE buffers.
3. Disadvantages
   - Workaround/hack solution.
   - May not be applicable if node supports more than one type of buffer.

Solution 3 : VIDIOC_S_BUFCROP

1. Introduce new ioctls VIDIOC_{S, G, TRY}_BUFCROP
2. Analogs of VIDIOC_{S, G, TRY}_CROP family
3. If buffer cropping is not supported then VIDIOC_G_BUFCROP whould return rectangle:
   - top = 0, left = 0
   - width = original width, height = original height

Solution 4 : VIDIOC_S_CROP2

```
struct v4l2_crop2 {
    u32 type;
    struct v4l2_rect c;
    struct v4l2_rect b;
    u32 hint;
    u32 reserved[?];
};
```

- type - buffer type: OUTPUT, CAPTURE, etc.
- c - cropping rectangle in hardware (display/sensor)
- b - cropping rectangle in data buffer
- hint - bit flags used to control crop adjustments done by driver
- reserved - extra place for future extensions

VIDIOC_S_CROP2

1. Buffer and normal crop are configured simultaneously
   - better control over scaling
2. Hints provides better control over cropping adjustments. Not defined yet but here are some proposals:

   V4L2_CROP_HINT_B_WIDTH_UP - prevent driver from lowering width of buffer cropping

   V4L2_CROP_HINT_C_HEIGHT_FIXED - keep height of normal cropping fixed, equal to (V4L2_CROP_HINT_C_HEIGHT_UP | V4L2_CROP_HINT_C_HEIGHT_DOWN)

   V4L2_CROP_HINT_FMT_FIXED - imply keeping width and height of buffer fixed

Questions?

Questions?

Thank you for attention!

Bibliography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Screenshots from Big Buck Bunny movie, Blender Foundation, (c) copyright 2008
http://www.bigbuckbunny.org