The Samsung S5P/Exynos4 FIMC driver

The FIMC (Fully Interactive Mobile Camera) device available in Samsung SoC Application Processors is an integrated camera host interface, color space converter, image resizer and rotator. It's also capable of capturing data from LCD controller (FIMD) through the SoC internal writeback data path. There are multiple FIMC instances in the SoCs (up to 4), having slightly different capabilities, like pixel alignment constraints, rotator availability, LCD writeback support, etc. The driver is located at drivers/media/platform/samsung/exynos4-is directory.

Supported SoCs

S5PC100 (mem-to-mem only), S5PV210, Exynos4210

Supported features

- camera parallel interface capture (ITU-R.BT601/565);
- camera serial interface capture (MIPI-CSI2);
- memory-to-memory processing (color space conversion, scaling, mirror and rotation);
- dynamic pipeline re-configuration at runtime (re-attachment of any FIMC instance to any parallel video input or any MIPI-CSI front-end);
- runtime PM and system wide suspend/resume

Not currently supported

- LCD writeback input
- per frame clock gating (mem-to-mem)

User space interfaces

Media device interface

The driver supports Media Controller API as defined at :ref:`media_controller`. The media device driver name is "Samsung S5P FIMC".

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The purpose of this interface is to allow changing assignment of FIMC instances to the SoC peripheral camera input at runtime and optionally to control internal connections of the MIPI-CSIS device(s) to the FIMC entities.

The media device interface allows to configure the SoC for capturing image data from the sensor through more than one FIMC instance (e.g. for simultaneous viewfinder and still capture setup).

Reconfiguration is done by enabling/disabling media links created by the driver during initialization. The internal device topology can be easily discovered through media entity and links enumeration.

Memory-to-memory video node

V4L2 memory-to-memory interface at /dev/video? device node. This is standalone video device, it has no media pads. However please note the mem-to-mem and capture video node operation on same FIMC instance is not allowed. The driver detects such cases but the applications should prevent them to avoid an undefined behaviour.

Capture video node

The driver supports V4L2 Video Capture Interface as defined at :ref:`devices`.

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At the capture and mem-to-mem video nodes only the multi-planar API is supported. For more details see: :ref:`planar-apis`.

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Camera capture subdevs

Each FIMC instance exports a sub-device node (/dev/v4l-subdev?), a sub-device node is also created per each available and enabled at the platform level MIPI-CSI receiver device (currently up to two).

sysfs

In order to enable more precise camera pipeline control through the sub-device API the driver creates a sysfs entry associated with "s5p-fimc-md" platform device. The entry path is: /sys/platform/devices/s5p-fimc-md/subdev_conf_mode.

In typical use case there could be a following capture pipeline configuration: sensor subdev -> mipi-csi subdev -> fimc subdev -> video node

When we configure these devices through sub-device API at user space, the configuration flow must be from left to right, and the video node is configured as last one.

When we don't use sub-device user space API the whole configuration of all devices belonging to the pipeline is done at the video node driver. The sysfs entry allows to instruct the capture node driver not to configure the sub-devices (format, crop), to avoid resetting the subdevs' configuration when the last configuration steps at the video node is performed.

For full sub-device control support (subdevs configured at user space before starting streaming):

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```
.. code-block:: none

        # echo "sub-dev" > /sys/platform/devices/s5p-fimc-md/subdev_conf_mode
```

For V4L2 video node control only (subdevs configured internally by the host driver):

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        # echo "vid-dev" > /sys/platform/devices/s5p-fimc-md/subdev_conf_mode
```

This is a default option.

5. Device mapping to video and subdev device nodes

There are associated two video device nodes with each device instance in hardware - video capture and mem-to-mem and additionally a subdev node for more precise FIMC capture subsystem control. In addition a separate v4l2 sub-device node is created per each MIPI-CSIS device.

How to find out which /dev/video? or /dev/v4l-subdev? is assigned to which device?

You can either grep through the kernel log to find relevant information, i.e.

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```

```
        # dmesg | grep -i fimc
```

(note that udev, if present, might still have rearranged the video nodes),

or retrieve the information from /dev/media? with help of the media-ctl tool:

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        # media-ctl -p
```

7. Build

If the driver is built as a loadable kernel module (CONFIG_VIDEO_SAMSUNG_S5P_FIMC=m) two modules are created (in addition to the core v4l2 modules): s5p-fimc.ko and optional s5p-csis.ko (MIPI-CSI receiver subdev).