



Team EM076

Real-time HDR video

Independent SP-Team

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Andrey Papushin
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Our project: Real-time HDR video

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TEAM EM076

Vladislav Sharshin



Andrey Papushin



Yelena Kirichenko



Problem definition

The human eye considerably exceeds modern cameras so it's impossible to transmit the image using technical devices just the way a person being would see it



Problem definition

Dynamic range of the human eye and ordinary camera

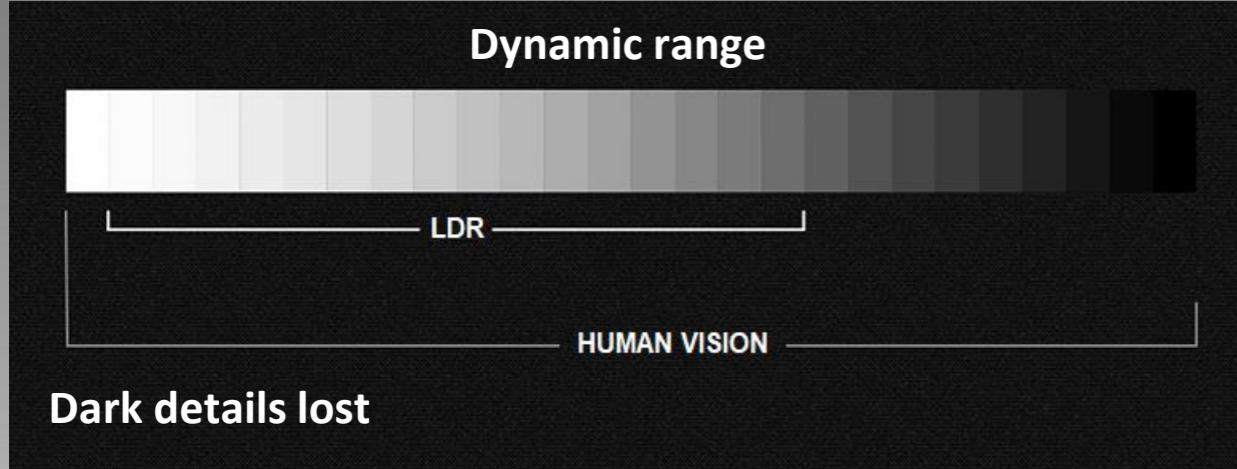
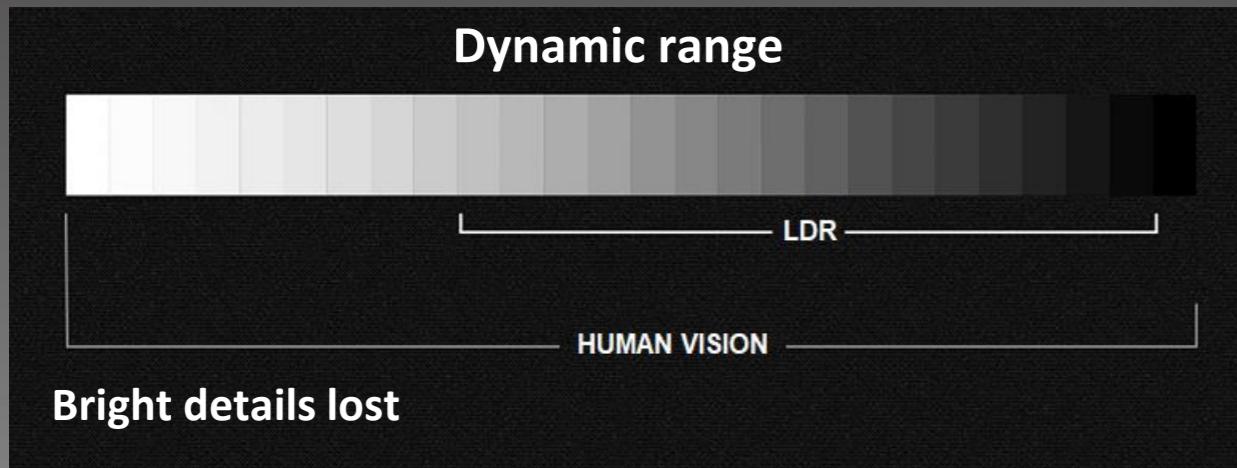
Dynamic range

LDR

HUMAN VISION

Problem definition

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Problem definition

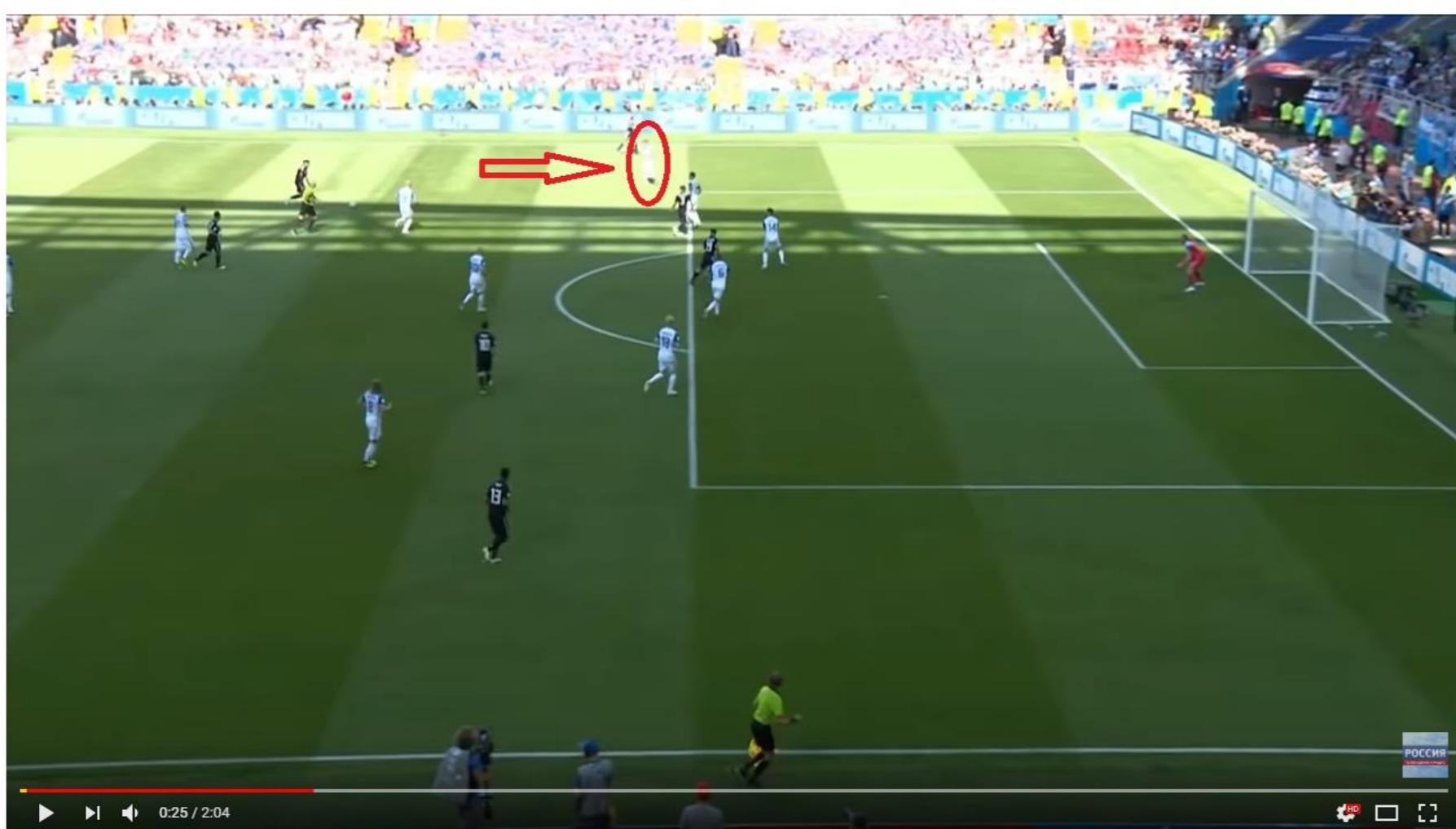
Screenshot of a football match online broadcast between Costa Rica and Serbia, taken on a sunny day



Details
in bright area
are lost
in the frame

Problem definition

Screenshot of a football match online broadcast between Costa Rica and Serbia, taken on a sunny day



As we can see,
that football player
wearing a white
uniform can hardly
be seen

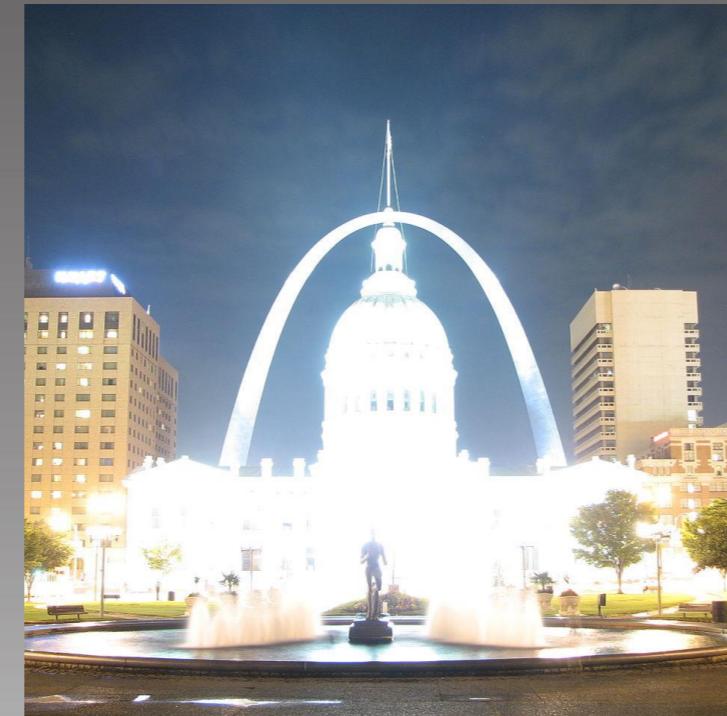
High dynamic range (HDR) technique

Low
exposure



+

High
exposure



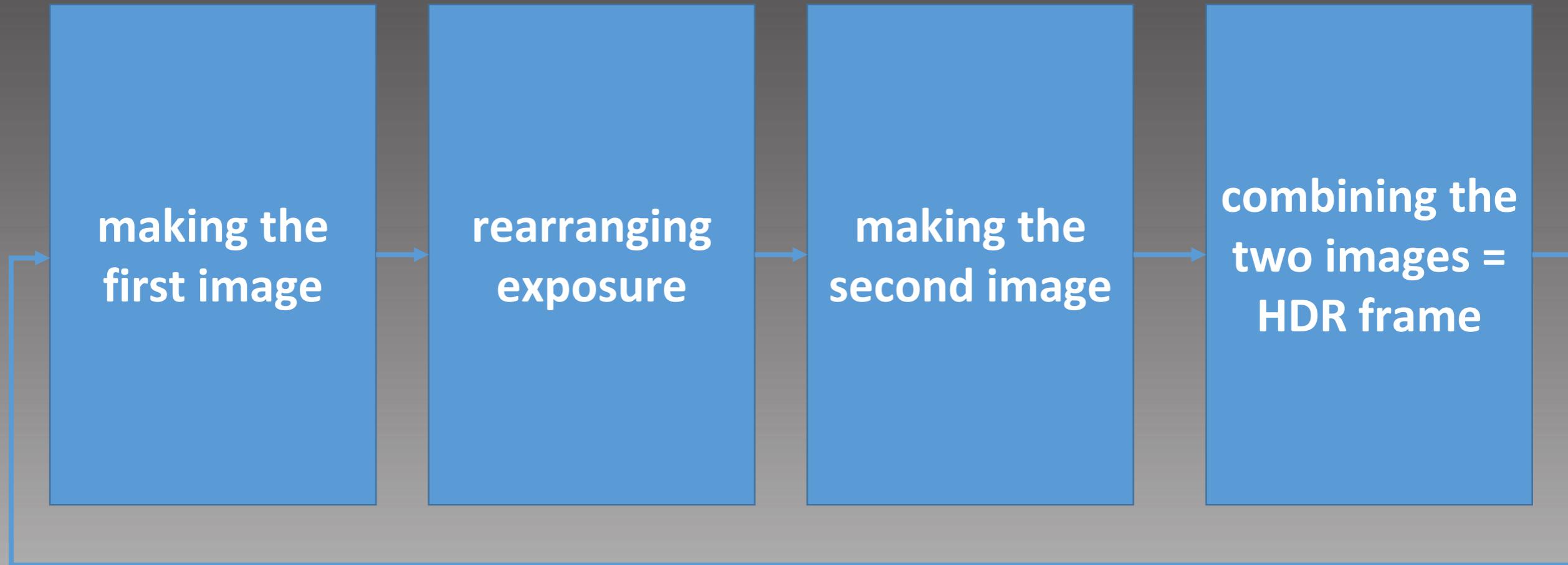
=

HDR



HDR video. Popular algorithm

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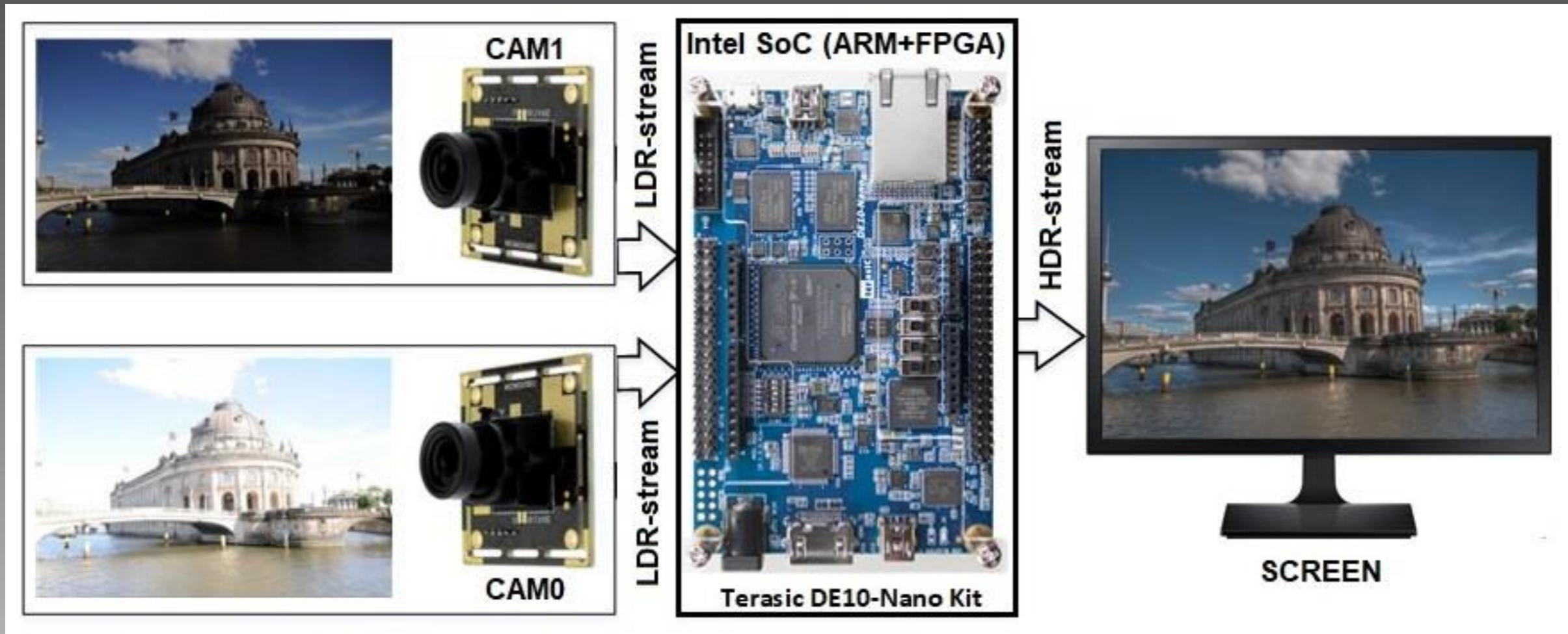
Disadvantages of the popular HDR algorithm

- Reduction of the FPS by at least 2 times
- Doubling of the image

Example of unsuccessful use of HDR while 1 camera is used

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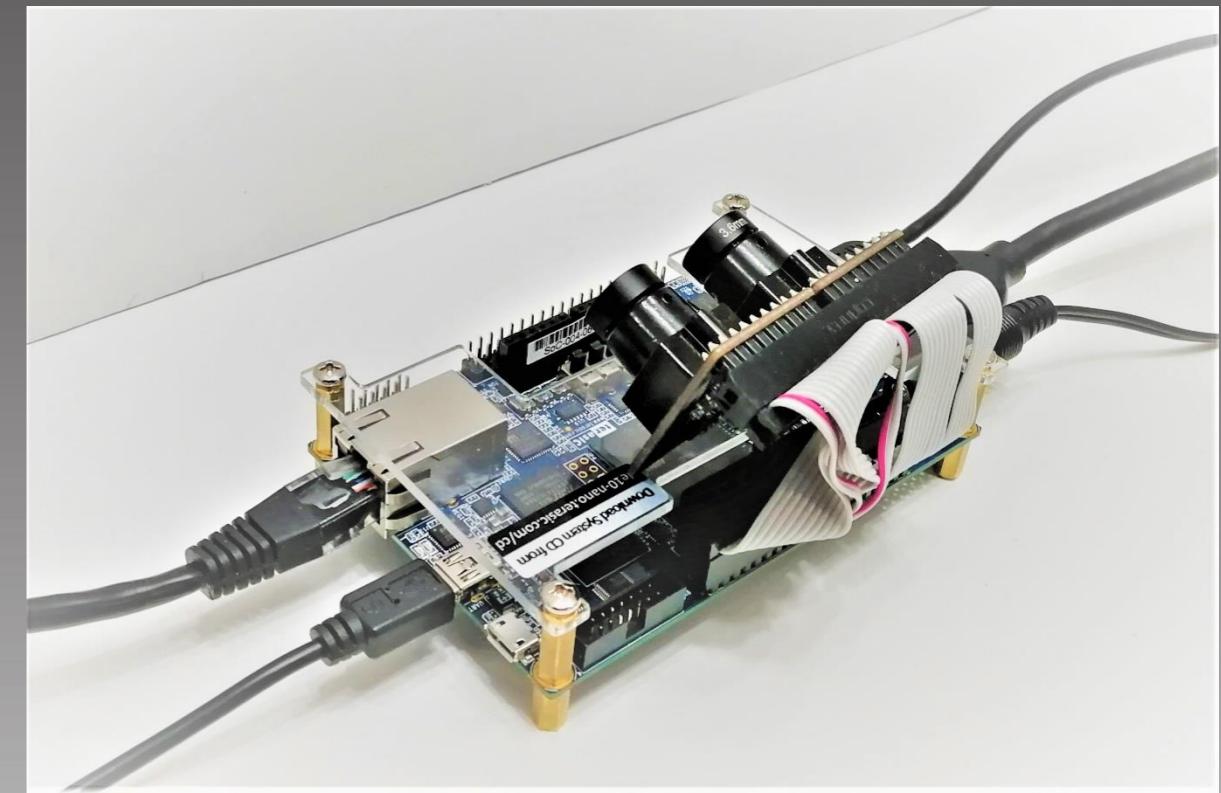
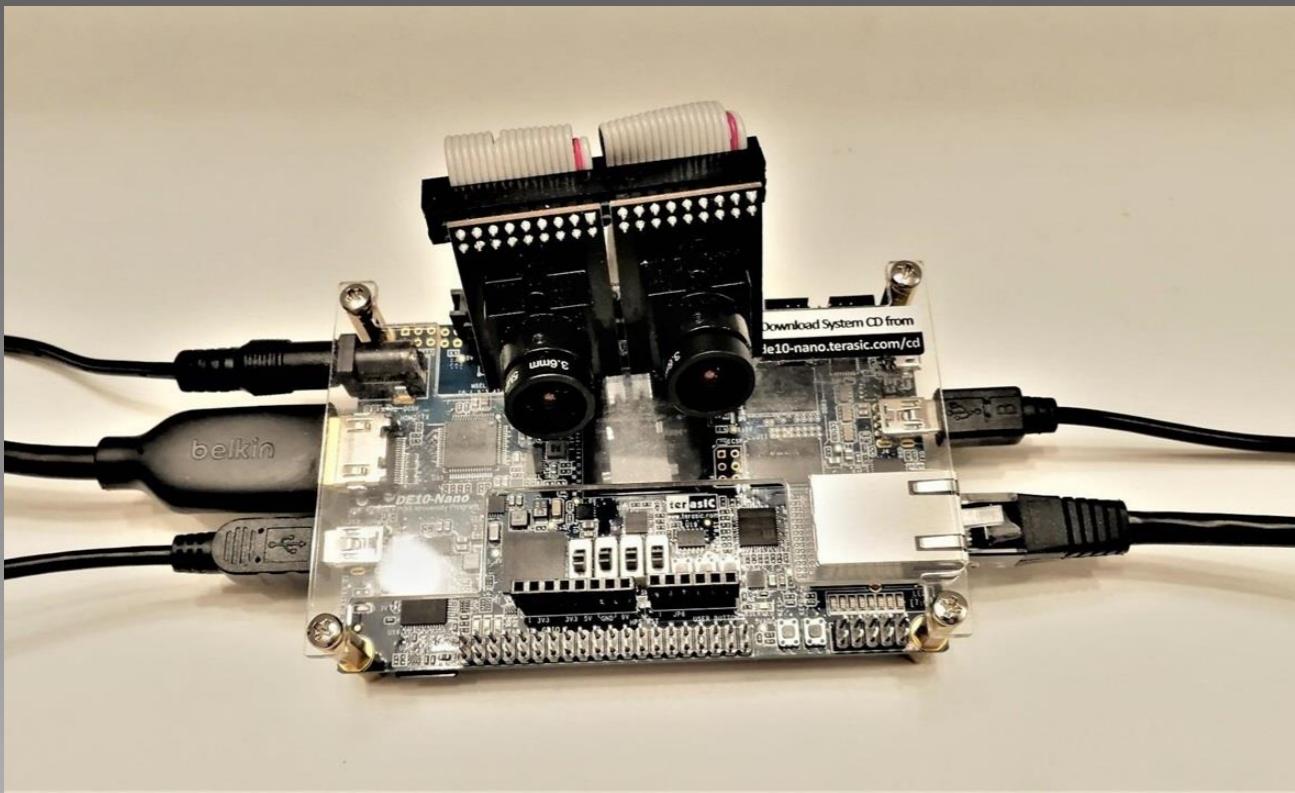
We decided to use two or more cameras to produce HDR algorithm



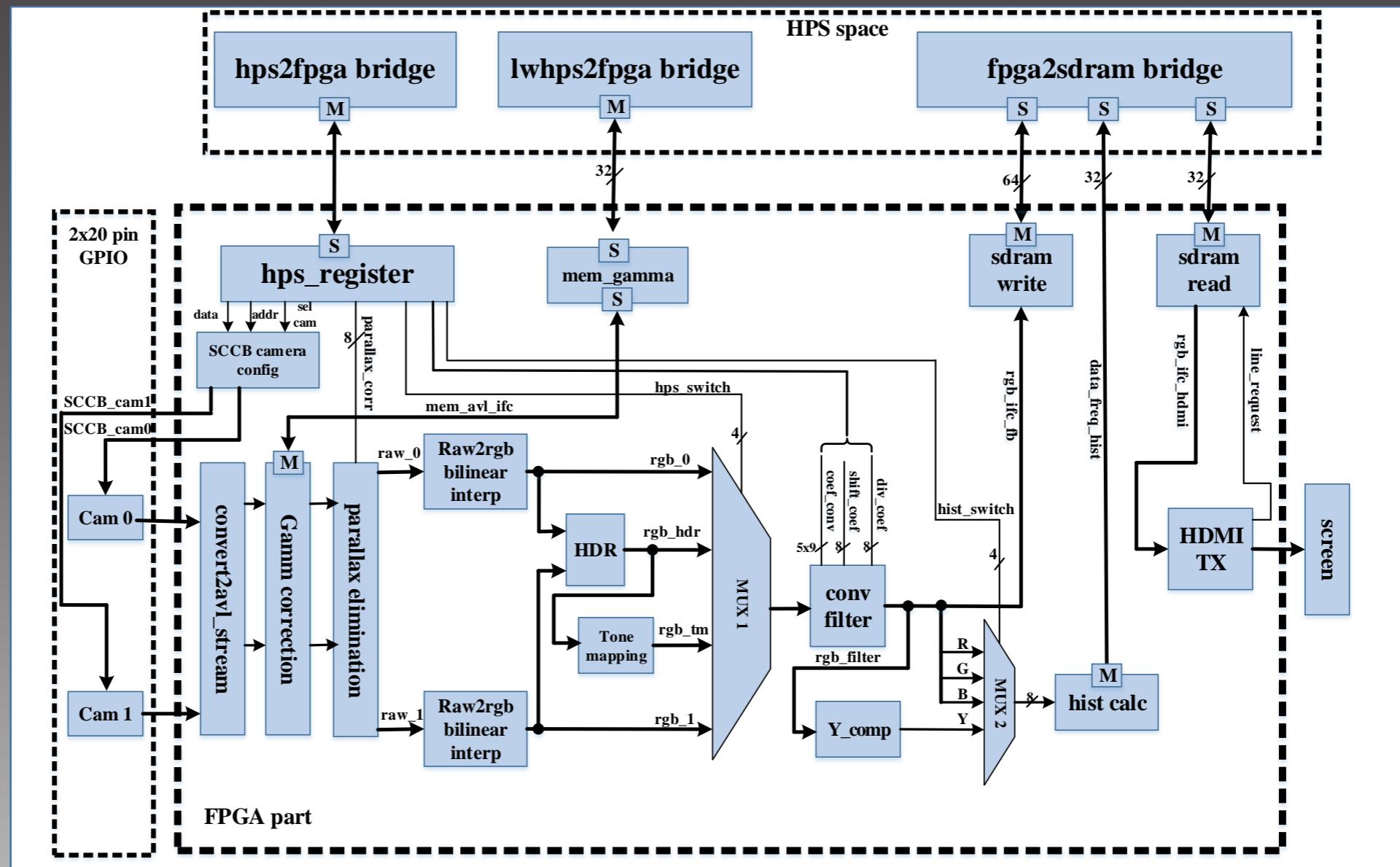
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We decided to use two or more cameras to produce HDR algorithm

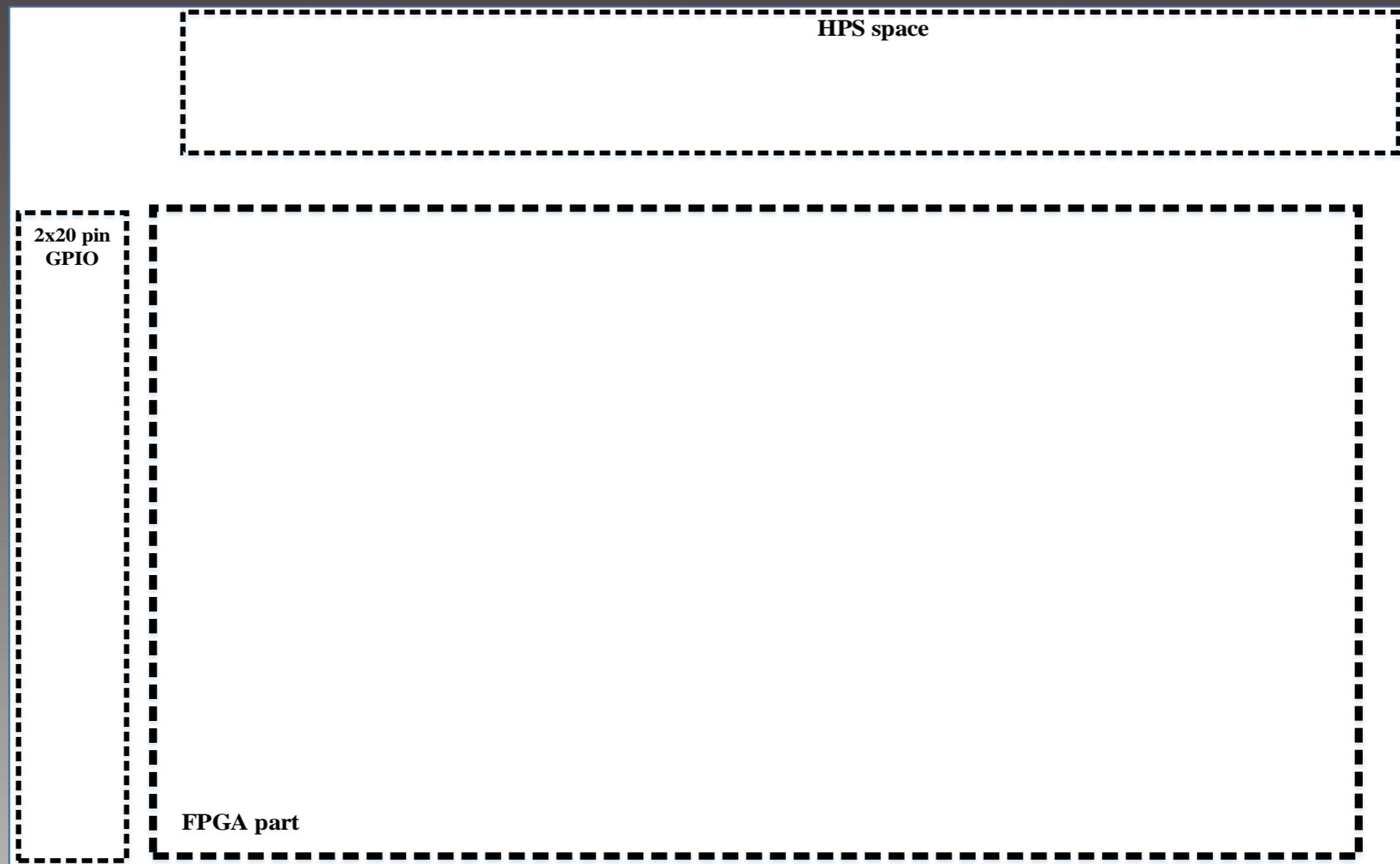
Device prototype



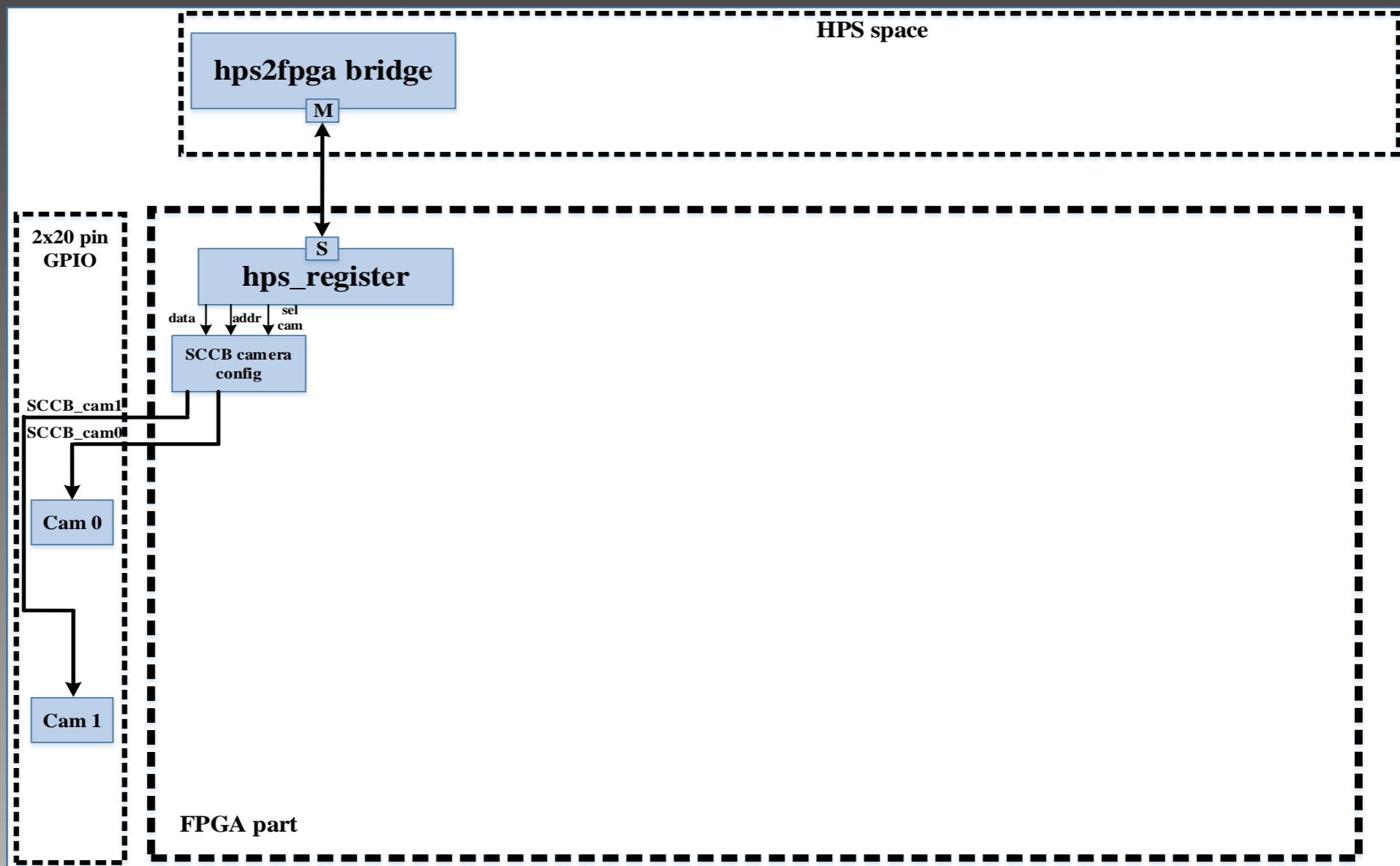
Implementation in the Intel SoC



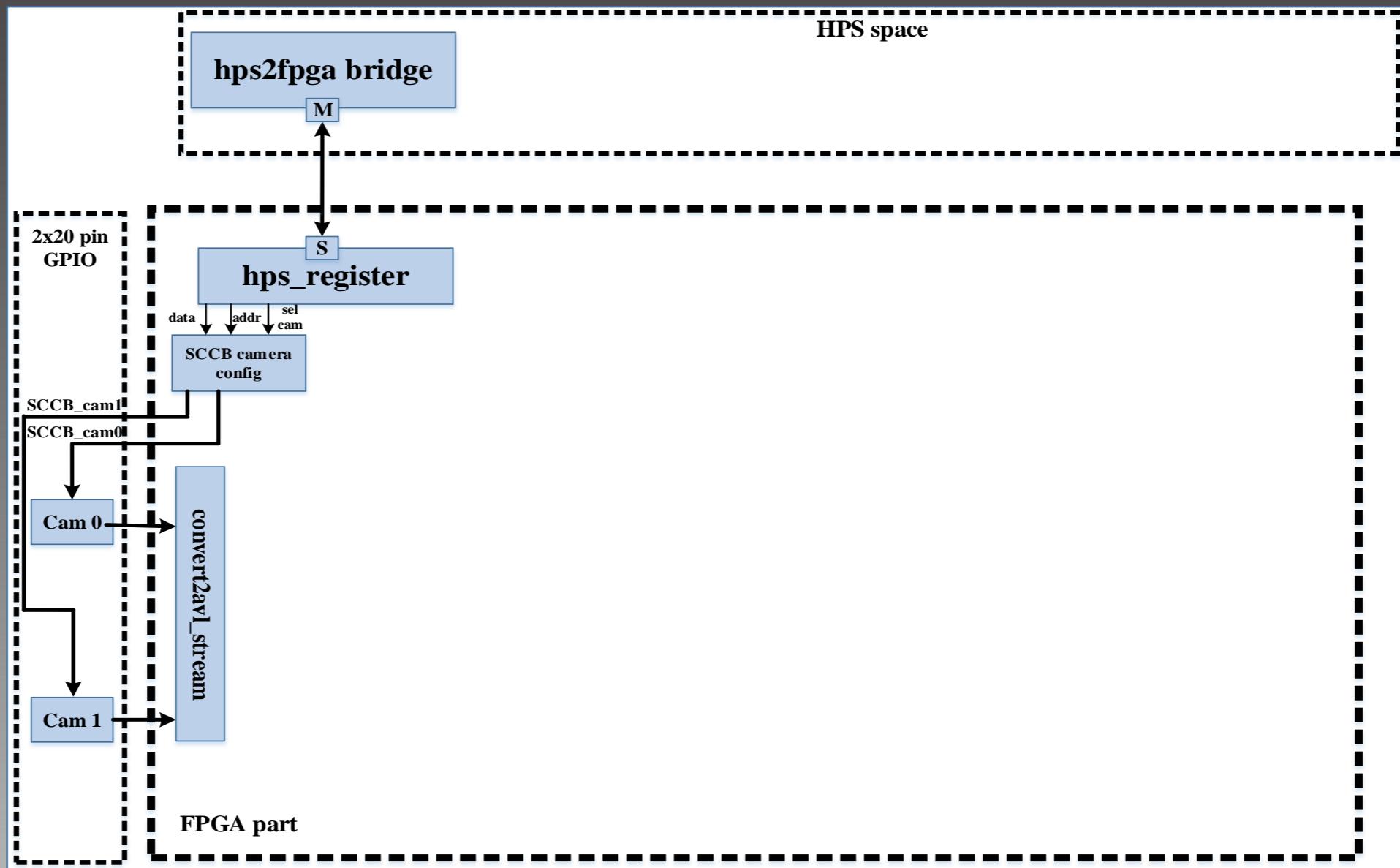
Implementation in the Intel SoC



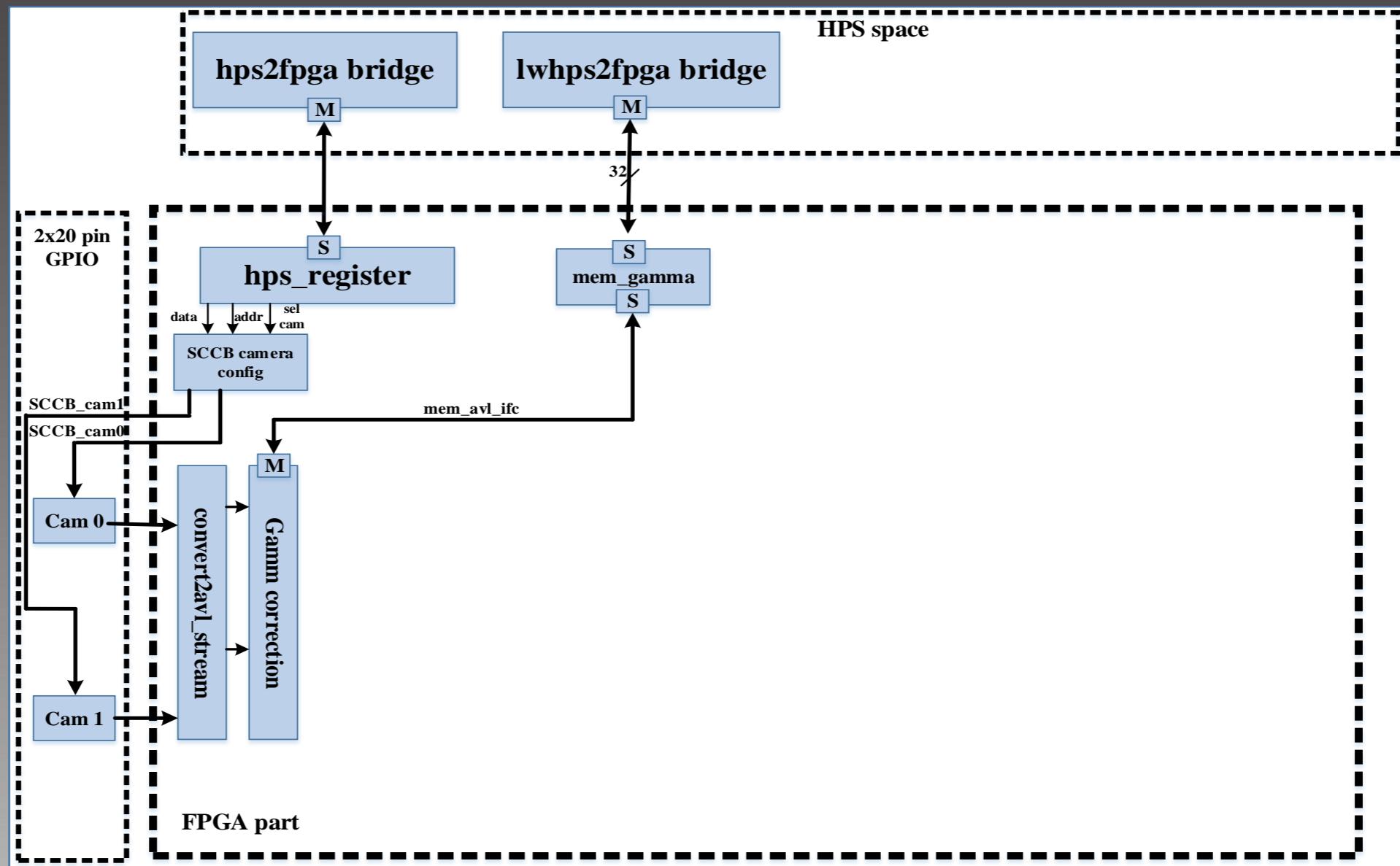
Implementation in the Intel SoC



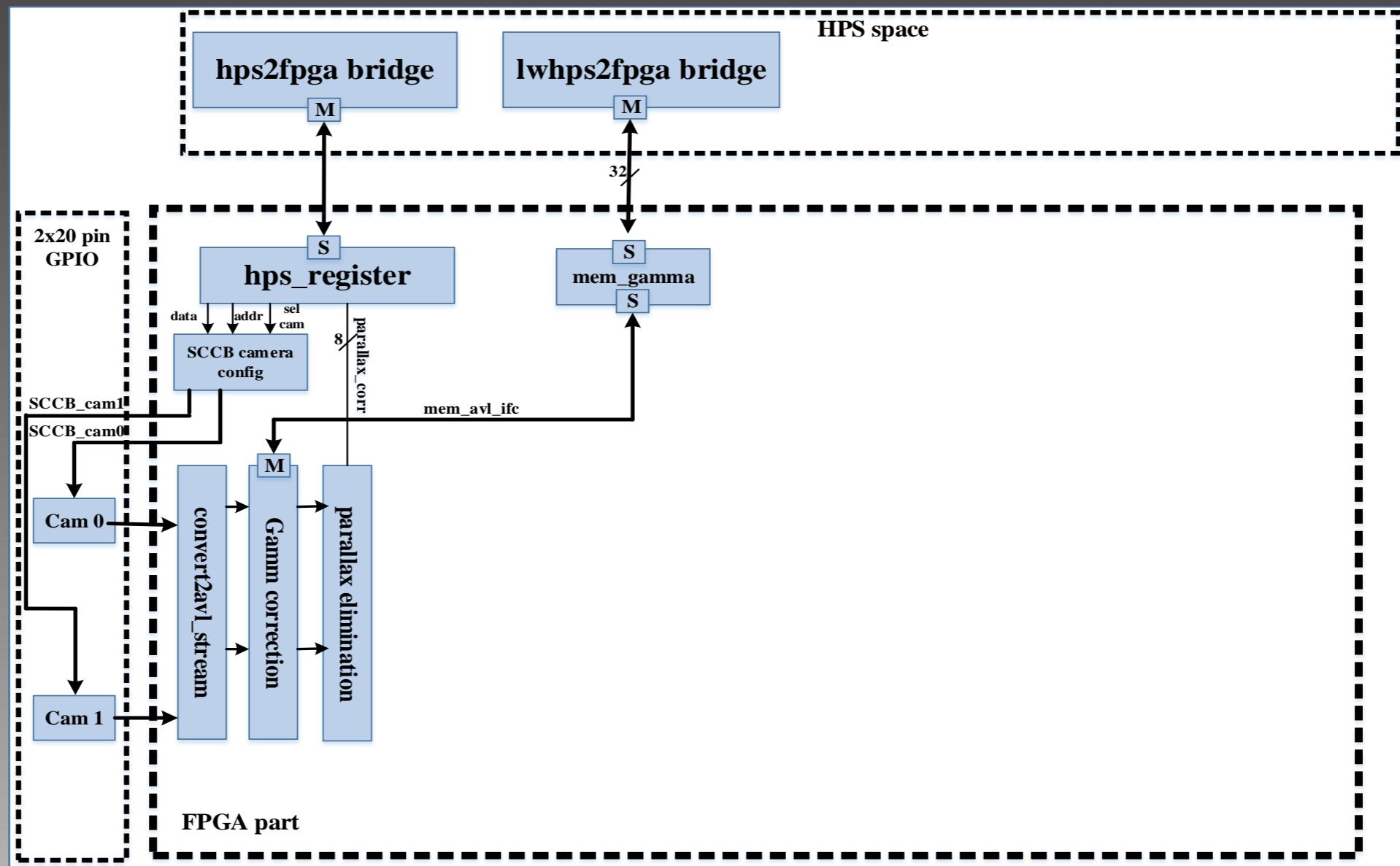
Implementation in the Intel SoC



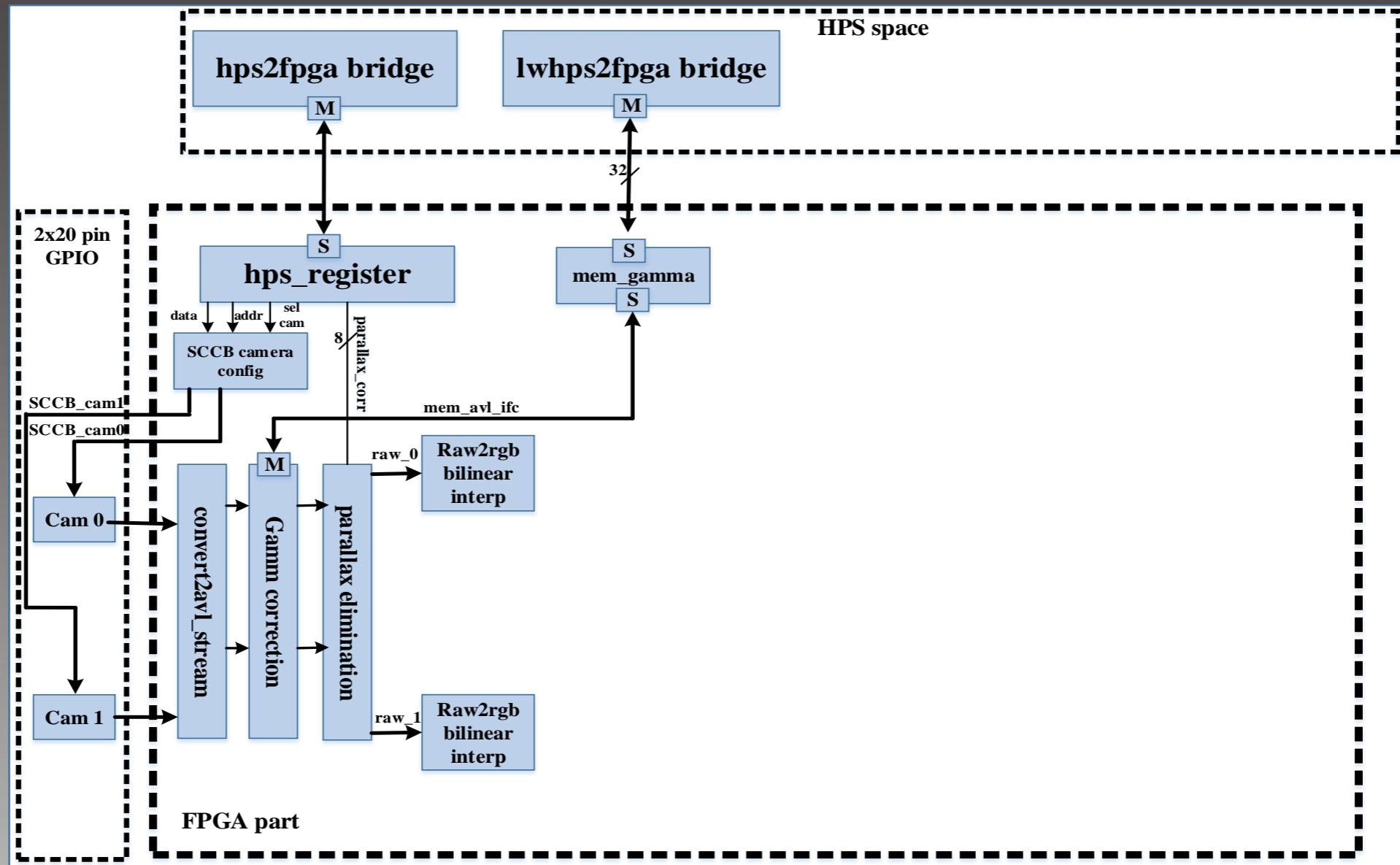
Implementation in the Intel SoC



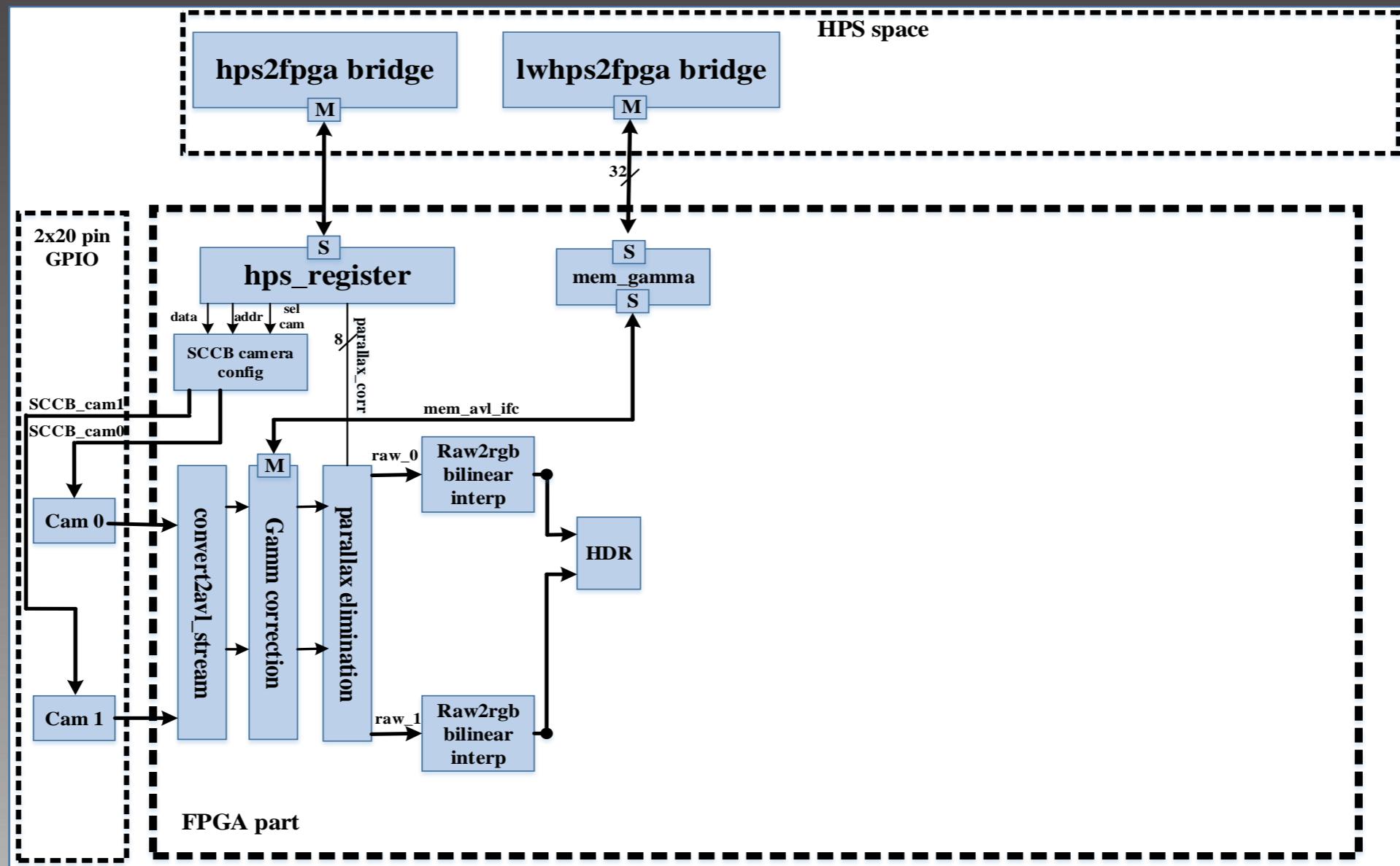
Implementation in the Intel SoC



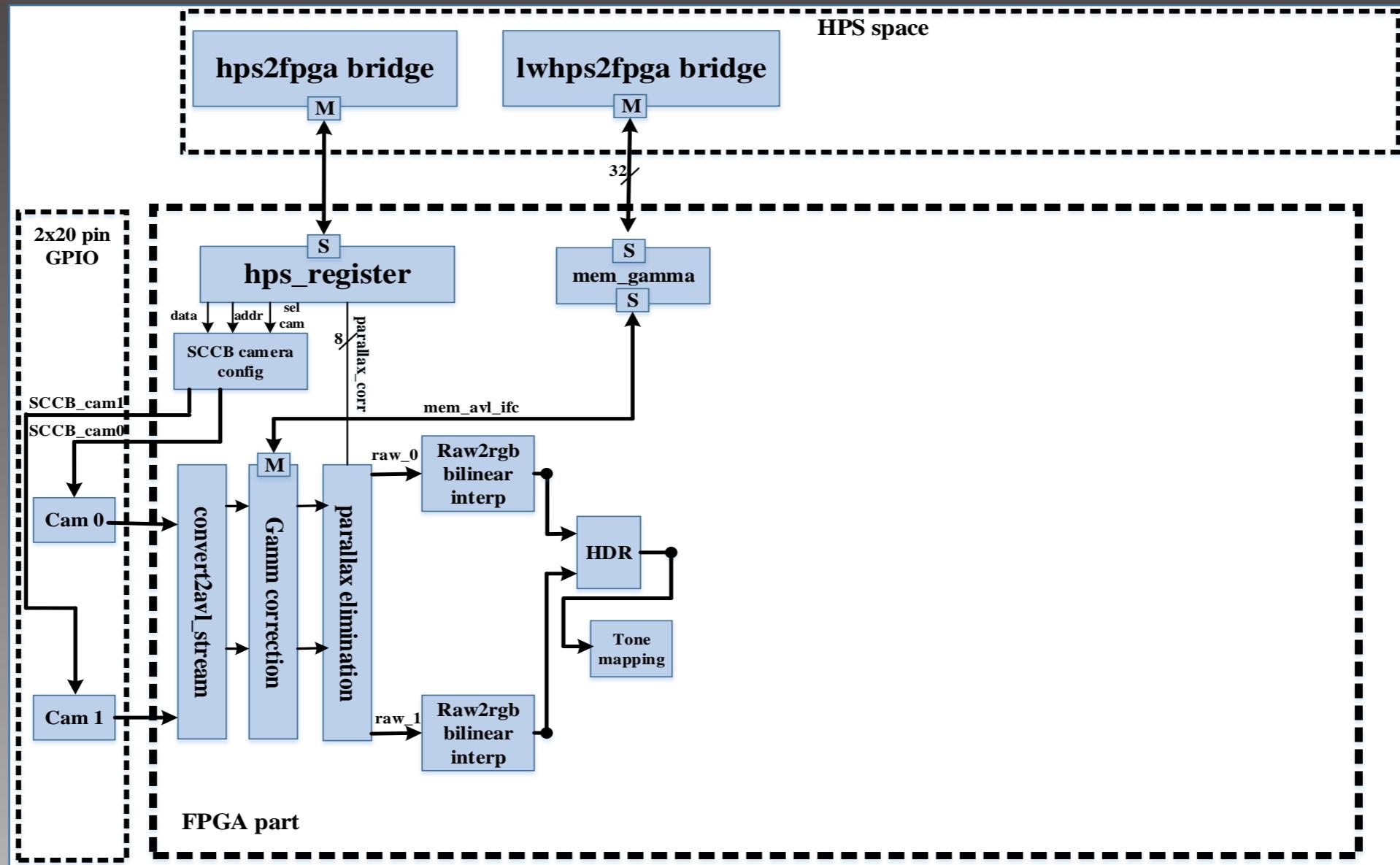
Implementation in the Intel SoC



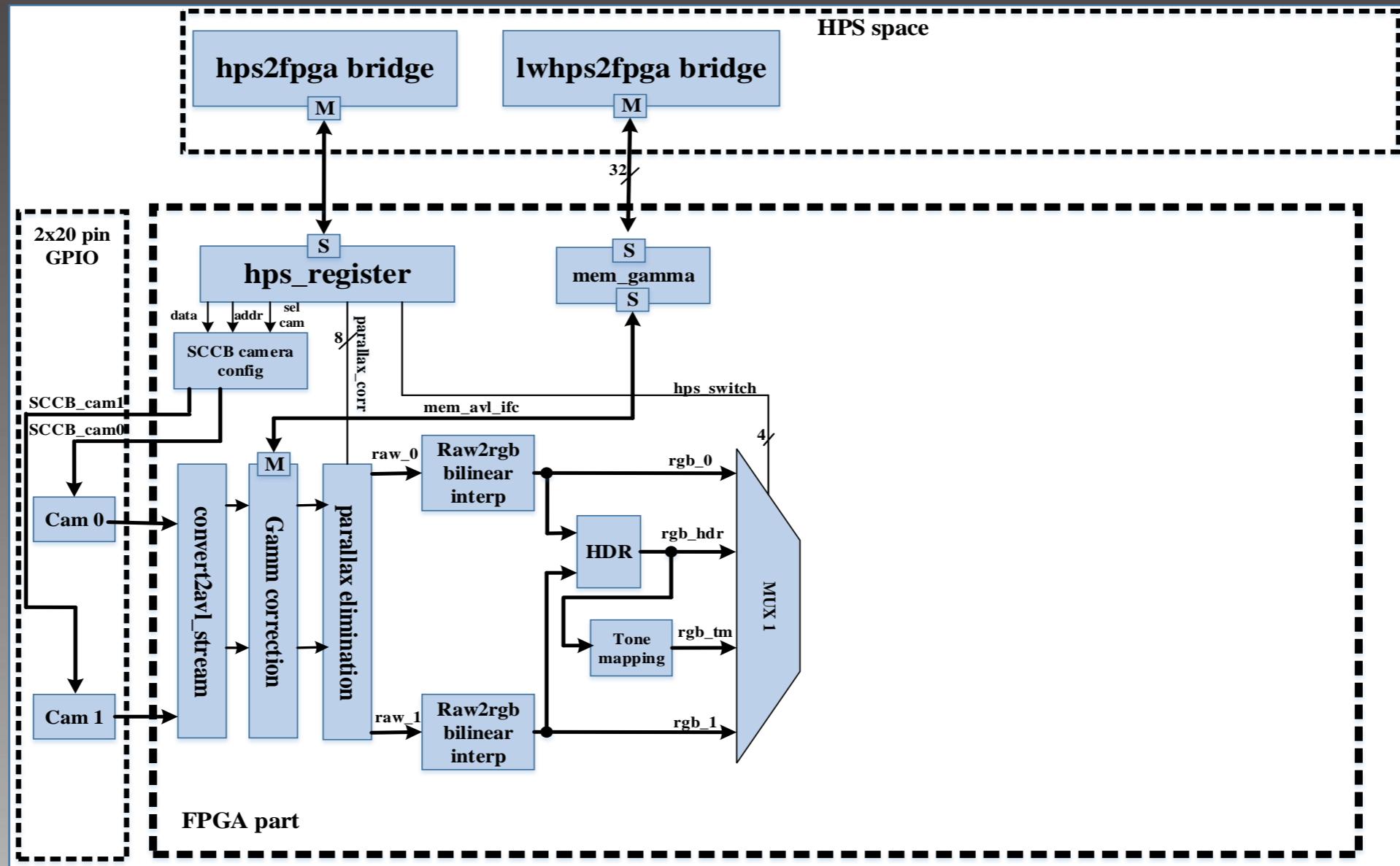
Implementation in the Intel SoC



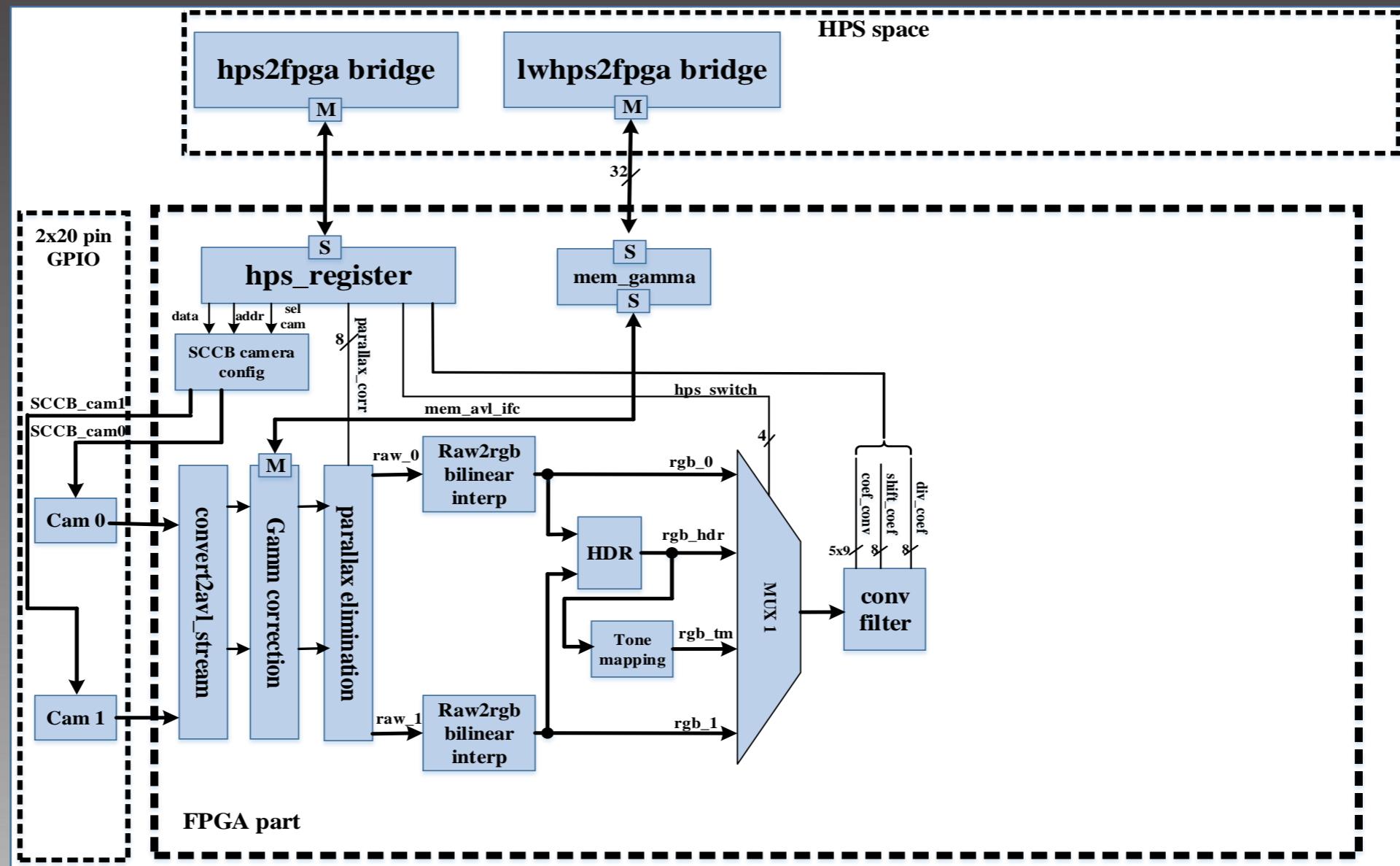
Implementation in the Intel SoC



Implementation in the Intel SoC

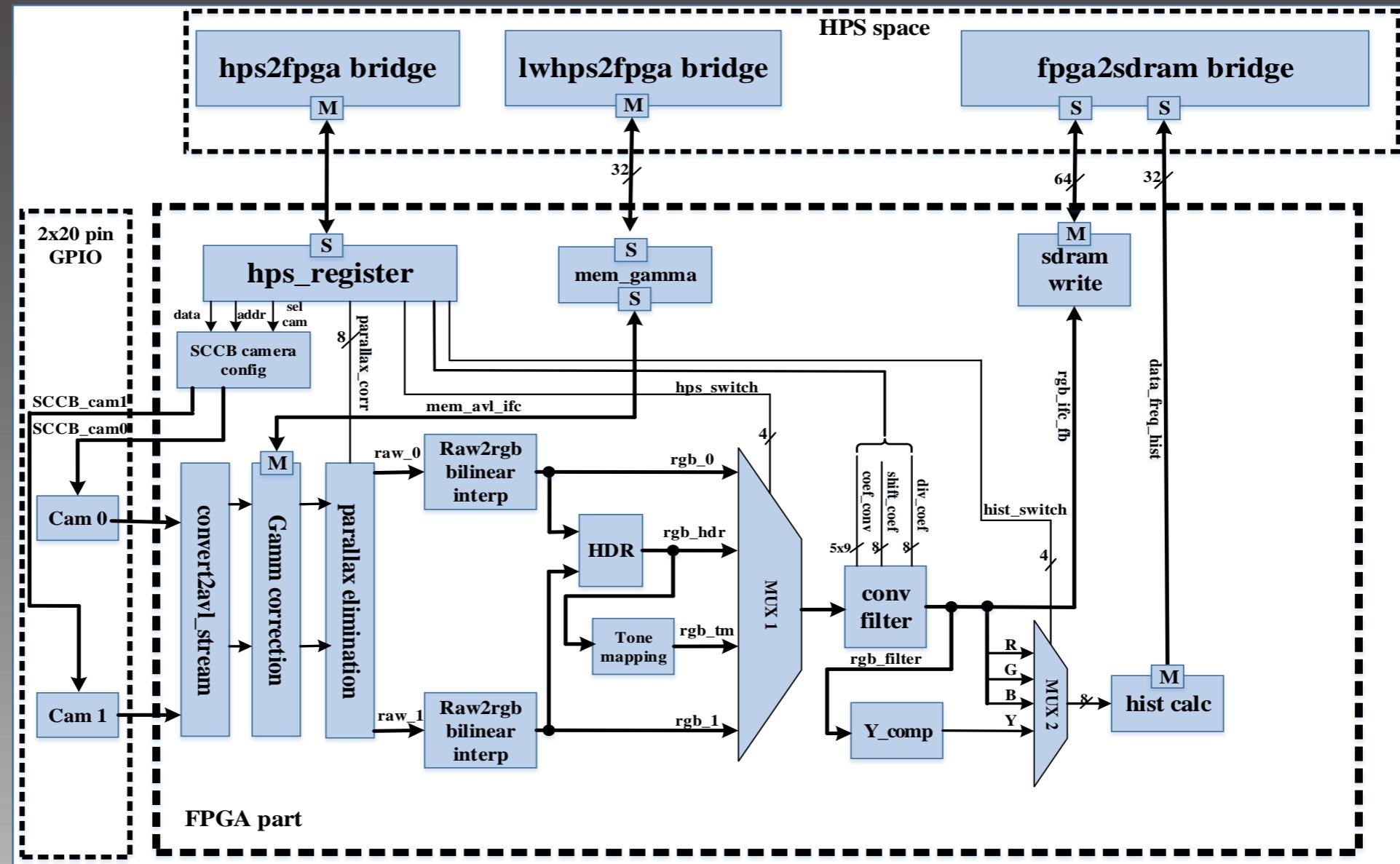


Implementation in the Intel SoC

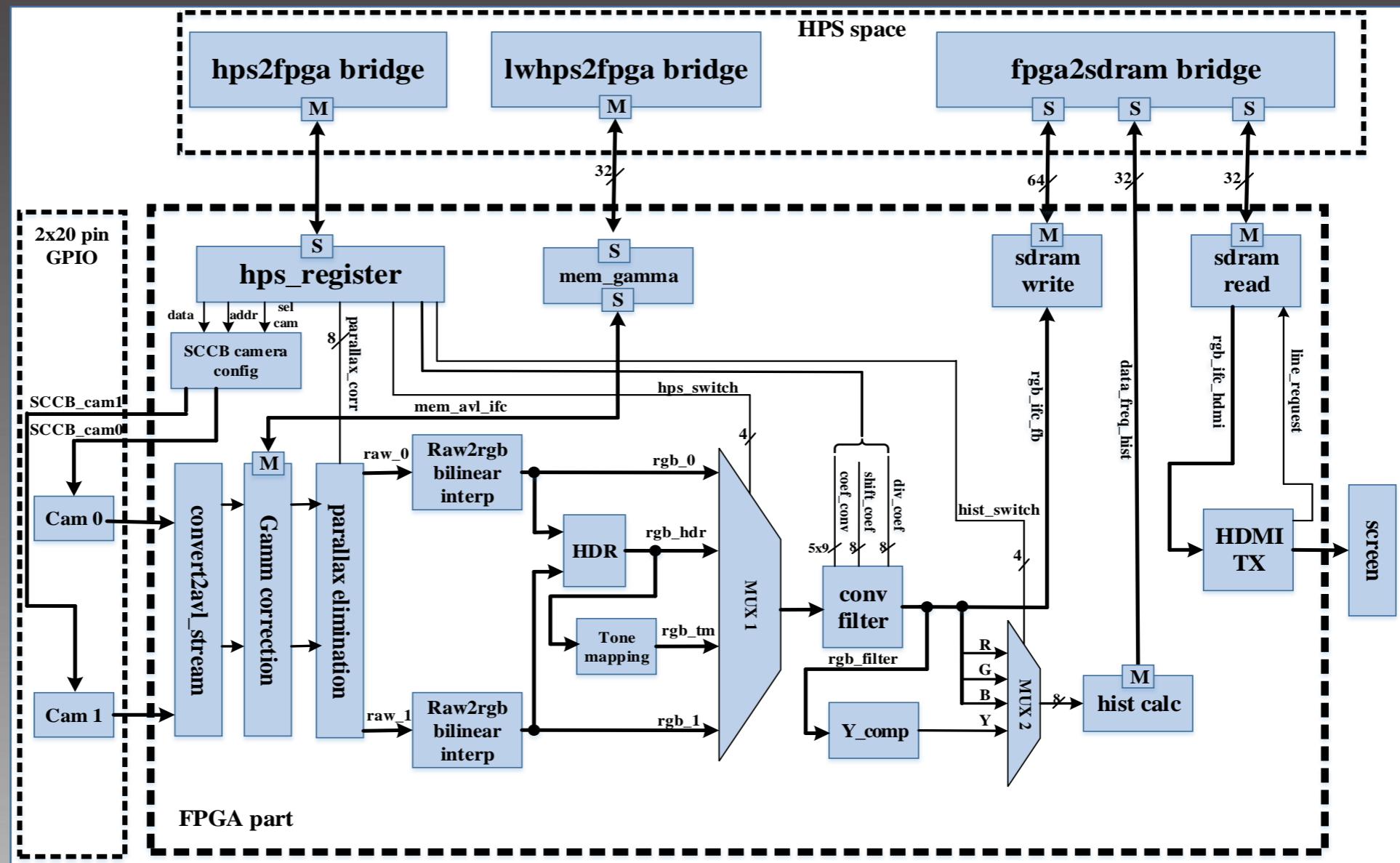


Implementation in the Intel SoC

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Implementation in the Intel SoC

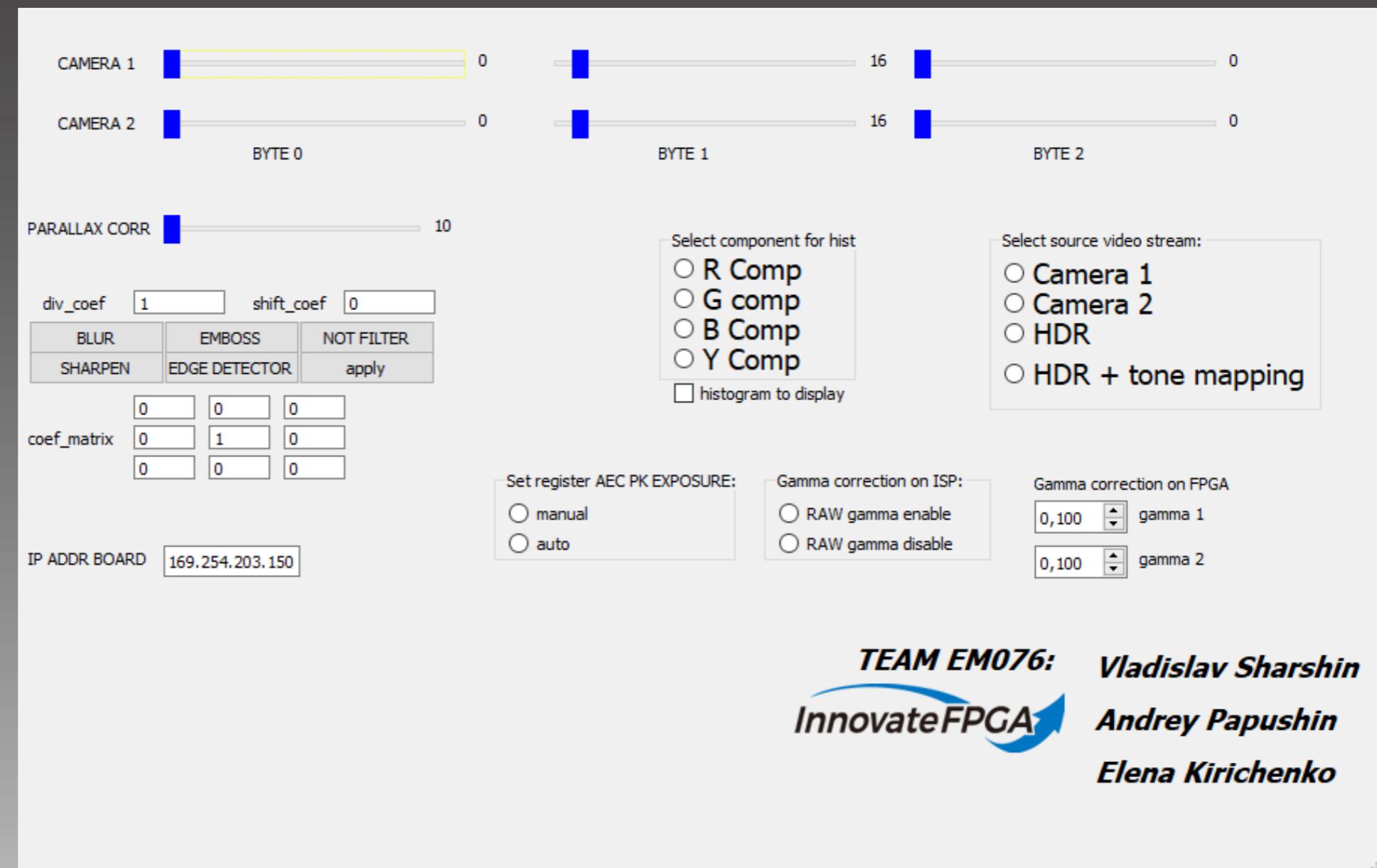


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FEATURES

- Cameras choosing
- Exposure changing
- Parallax fixing
- Gamma correction
- HDR mode activating
- Filters choosing
- Histograming mode activating
- Tone mapping

Graphic User Interface



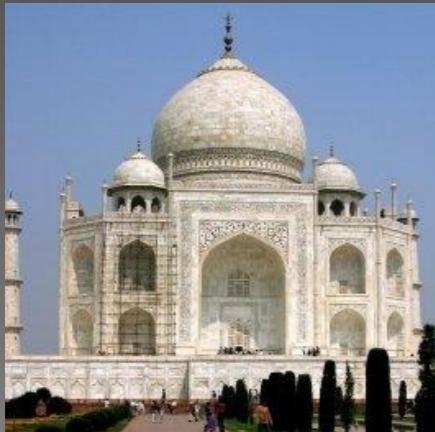
TEAM EM076:
InnovateFPGA

Vladislav Sharshin
Andrey Papushin
Elena Kirichenko

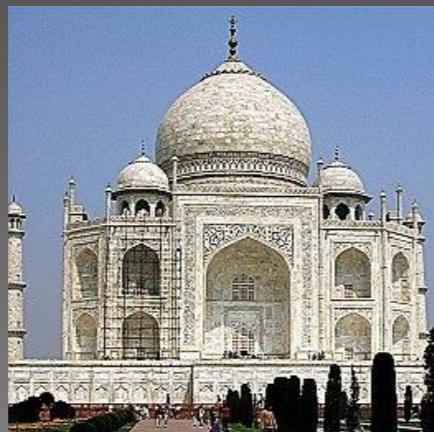
Additional features

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Filters implementation



Real image



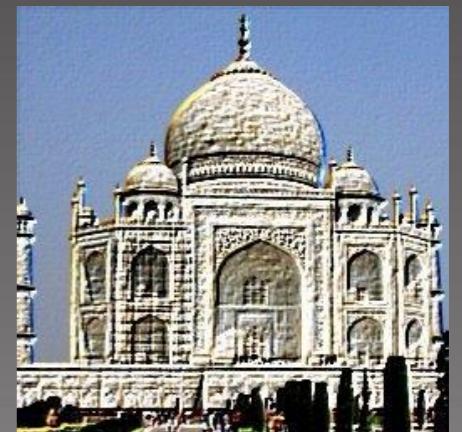
SHARPEN



EDGE DETECTOR



BLUR



EMBOSS



Our
realization



Real-time HDR video

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Additional features

HISTOGRAM PLOTTING



Advantages of FPGA

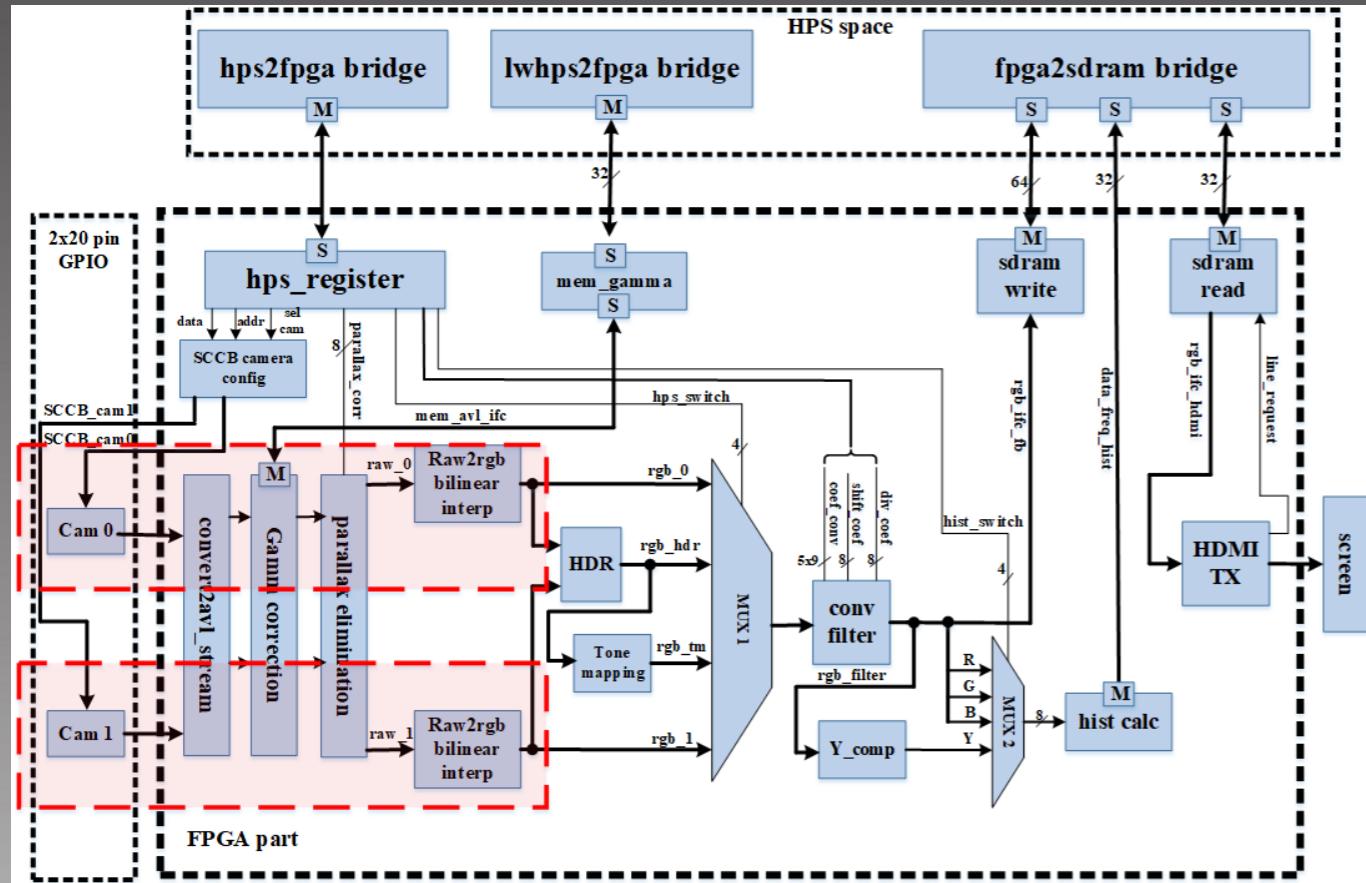
Why is FPGA the best option for this project?

1. **FPGA allows us to make the necessary calculations parallel, which is impossible to do on CPU.** If required, we can connect 3, 4, 10 cameras, while RAW streams from all the cameras will be simultaneously converted to RGB
2. **FPGA allows us to use pipeline method for data flow processing, which is impossible to do on CPU.** Module calculations occur one by one with no feedback. The data stream gets into the input and is transferred to the output (upon a certain latency) with no breakups.
3. **FPGA design reconfiguration.** We can replace the cameras with others; change output interface from HDMI to VGA, DVI, etc.; to reassign input and output pins and voltage standards, and so on.

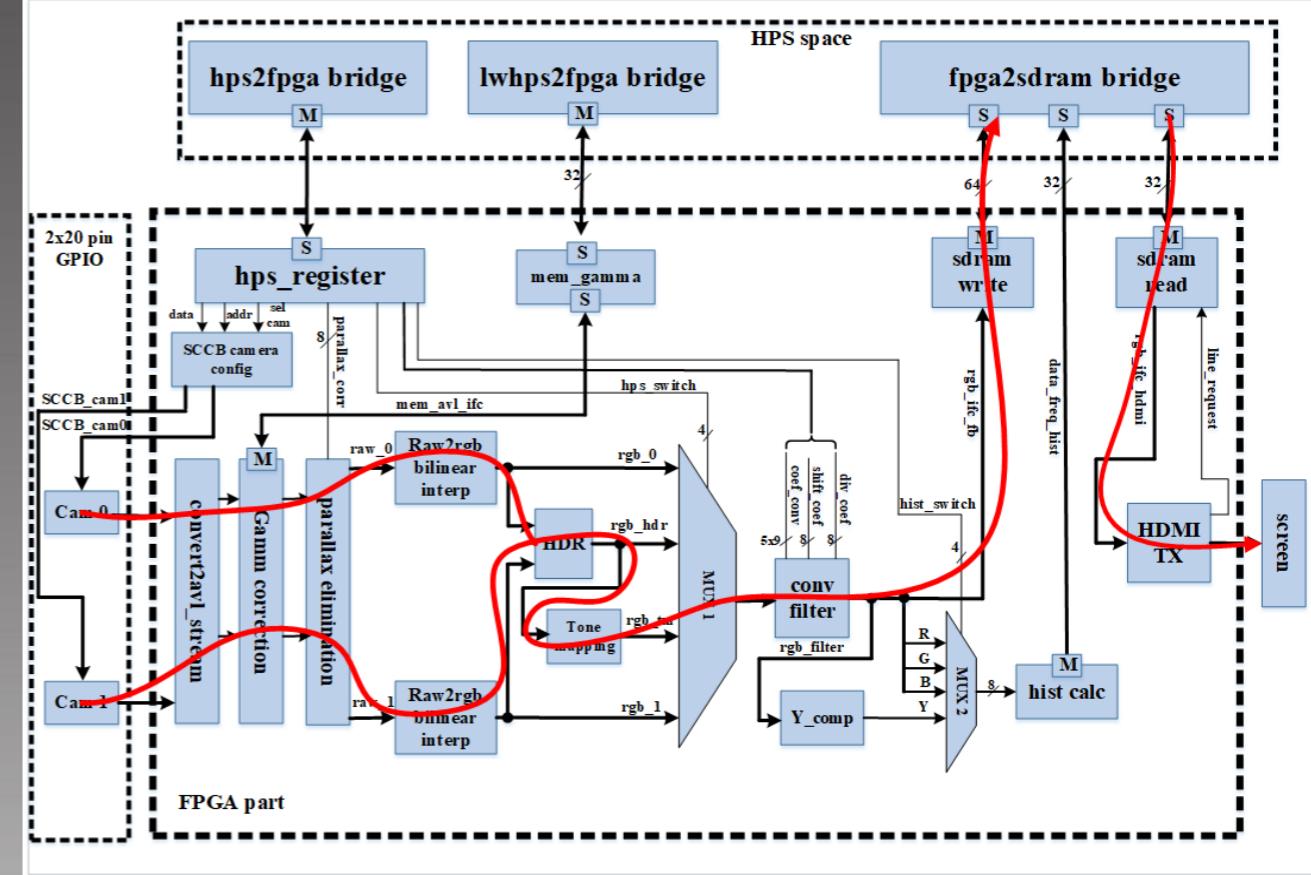
Advantages of FPGA

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Parallel data processing



Pipelining



Opportunities to apply

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Our work on the HDR real-time HD video implementation can be successfully used for

- security systems,
- dashcams,
- traffic control cameras, or in cases of streaming objects, moving with a different speed
- located against the light or in different shadows,
- live broadcasting from sport events by professional cameras

RESULTS

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The main aim of the project is to realize HDR real-time HD video via Terasic DE10-Nano KIT with Intel SoC (FPGA Cyclone V + ARM A9), that is succeed.

We have realized some features

- Additional filters as well as real-time video;
- Tone-mapping;
- PC remote control by “Ethernet”;
- Gamma-correction;
- Real-time color histogram for each color channel, brightness histogram for each camera’s data-stream and output stream.



Thank you for your attention

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