

H4Z

AMD FPGA and HAILO ASIC
Communication Library

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Software product



Software product

H4Z is a software integration library for AMD FPGAs and HAILO ASIC

Useful for:

- ▶ Work unloading for AI tasks
- ▶ Enabling AI tasks implementation on FPGAs that don't support DPU
- ▶ Rapid prototyping / fast development
- ▶ Complex or heterogeneous architectures





Technical brief

Toolchain used:

- Vivado 2021.1
- Petalinux 2021.1
- Yocto project version Gatesgrath 3.2
- Linux kernel 5.10
- FSBL 2021.1
- U-Boot 2021.01

HAILO Drivers

- hailo firmware 4.8.1
- hailo pci 4.8.1
- hailo post processes 3.19.1
- hailortcli 4.8.1
- libgsthailo 4.8.1
- libgsthailotools 3.19.1
- libhailort 4.8.1
- Tappas app 3.19.1

VCU Drivers

- Kernel-module-vcu 1.0.0
- libvcu-xlnx 1.0.0
- libomxil-xlnx 1.0.0
- vcu firmware 1.0.0

AV Utilities

- gstreamer 1.0-omx-1.16.3
- openCV 4



<https://hailo.ai/products/hailo-8-starter-kit/>

- High Performance
26 TOPS
- Automotive Grade
ASIL-B (D)
AEC-Q100 Grade-2
- Flexible
Fully Programmable
Comprehensive SDK

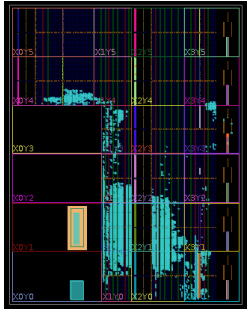
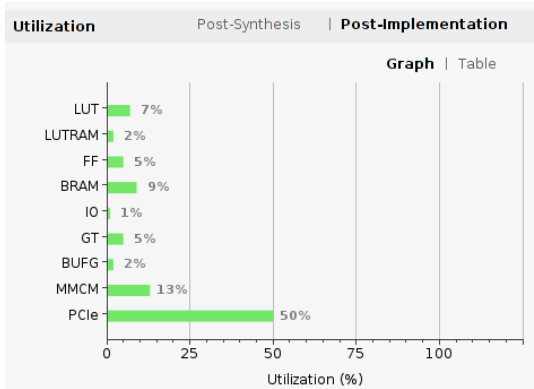
- High Efficiency
Typical Power
Consumption: 2.5W
- Single Chip Solution
No External DRAM
required
- Configuration
- Standalone
- Co-processor

<https://opsero.com/product/fpga-drive-fmc-dual/>

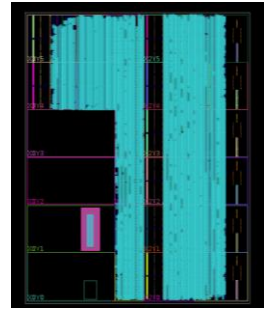
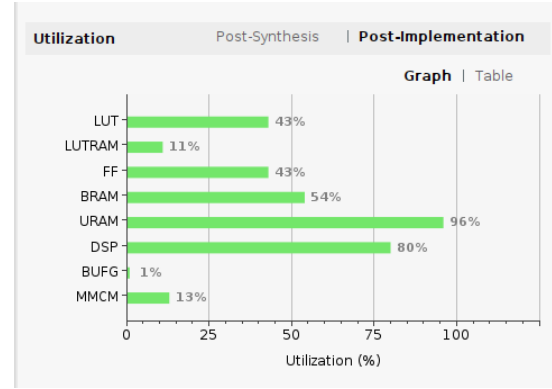


Resources usage

FPGA usage with FMC + VCU decoder on ZCU104
(distribute workload! The FPGA is quite free!)



FPGA usage with 2 DPU on ZCU104
(all stuffed! There is very little space for custom design)





Installer

You will receive only 1 installer file, with a one-tap wizard

```
*****
* HAILO Installer *
*****
Copyright @ MakarenaLabs srl
-----
Rel v1.0.0
-----
This installer will install Hailo required software and drivers. Do you agree? [Y/n]
Ok. Bye!
root@xilinx-zcu104-2021_1:~# ./hailo_installer.sh

*****
* HAILO Installer *
*****
Copyright @ MakarenaLabs srl
-----
Rel v1.0.0
-----
This installer will install Hailo required software and drivers. Do you agree? [Y/n]
hailo_installer/
```

```
Complete!
Installation complete. Restart your board!
```

Easy deploy on your current working petalinux image

- ▶ based on RPM package
- ▶ No Petalinux and Vivado skills required
- ▶ No Petalinux rebuild image required
- ▶ No Vivado design required
- ▶ Possible Vivado integration on request



Drivers

- VCU Decoder (FPGA enabling + petalinux Drivers), just specify if you need H264 or H265 for your application
- HAILO driver (FPGA bindings + petalinux Drivers)

```
root@xilinx-zcu104-2021_1:~# lsmod
Module                Size  Used by
dmaproxy              16384  0
al5d                  16384  0
allegro               36864  1 al5d
hailo_pci             61440  0
xlnx_vcu              20480  1 allegro
mali                  233472  0
regmap_mmio          16384  1 xlnx_vcu
uio_pdrv_genirq      16384  0
```

```
root@xilinx-zcu104-2021_1:~# ls /dev/all*
/dev/allegroDecodeIP
```

```
root@xilinx-zcu104-2021_1:~# ls /dev/hailo*
/dev/hailo0
root@xilinx-zcu104-2021_1:~# hailortcli scan
Hailo PCIe Devices:
[-] Device BDF: 0000:01:00.0
```



TAPPAS HAILO

- Integration with [TAPPAS HAILO](#) (below the cascade face detection + landmark example)

```
gst-launch-1.0 v4l2src device=/dev/video0 name=src_0 \  
! decodebin \  
! videoflip video-direction=horiz \  
! videoconvert qos=false n-threads=4 \  
! queue \  
! tee name=t hailomuxer name=hmux t. \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! hmux. t. \  
! videoscale qos=false n-threads=3 \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! hailonet net-name=joined_lightface_slim_tddfa_mobilenet_v1/lightface_slim hef-path=/home/root/apps/cascading_networks/resources/joined_lightface_slim_tddfa_mobilenet_v1.hef is-active=true vdevice-key=1 \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! hailofilter so-path=/usr/lib/hailo-post-processes/libface_detection_post.so function-name=lightface qos=false \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! hmux. hmux. \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! hailocropper so-path=/usr/lib/hailo-post-processes/cropping_algorithms/lib3ddfa.so function-name=create_crops internal-offset=false name=cropper hailoaggregator name=agg cropper. \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! agg. cropper. \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! hailonet net-name=joined_lightface_slim_tddfa_mobilenet_v1/tddfa_mobilenet_v1 hef-path=/home/root/apps/cascading_networks/resources/joined_lightface_slim_tddfa_mobilenet_v1.hef is-active=true vdevice-key=1 \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! hailofilter function-name=facial_landmarks_merged so-path=/usr/lib/hailo-post-processes/libfacial_landmarks_post.so qos=false \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! agg. agg. \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! hailooverlay qos=false \  
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \  
! videoconvert \  
! kmssink bus-id=fd4a0000.display fullscreen-overlay=1
```

H264 compressed USB camera



TAPPAS HAILO

```
gst-launch-1.0 v4l2src device=/dev/video0 name=src_0 \
! decodebin \
! videoflip video-direction=horiz \
! videorevert qos=false n-threads=4 \
! queue \
! tee name=t hailomixer name=hmux t. \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! max. t. \
! videoscale qos=false n-threads=3 \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! hailonet net-name=joined_lightface_slim_tddfa_mobilenet_v1 hef-path=/home/root/apps/cascading_networks/resources/joined_lightface_slim_tddfa_mobilenet_v1.hef is-active=true vdevice=key1 \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! hailofilter so-path=/usr/lib/hailo-post-processes/libface_detection_post.so function-name=lightface qos=false \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! max. hmux. \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! hailocropper so-path=/usr/lib/hailo-post-processes/cropping_algorithms/libtddfa.so function-name=create_crops internal-offset=false name=cropper hailoagggregator name=agg cropper. \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! max. cropper. \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! hailonet net-name=joined_lightface_slim_tddfa_mobilenet_v1/tddfa_mobilenet_v1 hef-path=/home/root/apps/cascading_networks/resources/joined_lightface_slim_tddfa_mobilenet_v1.hef is-active=true vdevice=key1 \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! hailofilter function-name=facial_landmarks_merged so-path=/usr/lib/hailo-post-processes/libfacial_landmarks_post.so qos=false \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! agg. agg. \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! hailooverlay qos=false \
! queue leaky=no max-size-buffers=3 max-size-bytes=0 max-size-time=0 \
! videorevert \
! videocovercvt \
! vaapi_v4l2sink bus-id=fd4a0000.display full-screen-overlay=1
```



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Roadmap



H4Z releases



	2023			
	Q1	Q2	Q3	Q4
1.0.0	Petalinux 2021.1– Hailo RT 4.8			
1.5.0		Petalinux 2022.2 – Hailo RT 4.8		
2.0.0			Petalinux 2023.1 – Hailo RT 4.13	
HAILO RT	4.12	4.13	4.14	4.15
AMD Tools	2022.2 – Yocto Honister	2023.1 – Yocto Honister / Kirkstone		2023.2



Z4H releases



Release 1.0.0

- Petalinux 2021.1
- ZynqMP (tested on zcu104)
- TAPPAS tested (h264 camera and MP4 file):
 - Cascade (face detection + face landmark)
 - Detection (object detection)
 - Landmark (face landmark)

Next releases

- Petalinux > 2021.1
 - Support for Zynq7000 (zc702)
 - Support for KRIA K26
 - Support for different development board (ZU1 – ZU9)
 - Full TAPPAS support

What is the «best» desiderata?

3

Business model & Pricing



Pricing (Hardware not included)



Make License



- One-tap installer*
- 1 month online support** (Mon-Fri 9 AM – 6PM)
- No recurrent fee
- No device royalties
- Incremental discount 5% for new major release***

Manufacturer's Suggested Retail Price

15'000 € + VAT (if applicable)

* On-site test only with MakarenaLabs staff

** Installer support, no custom hardware/software support included

*** maximum discount 25% for consecutive purchases

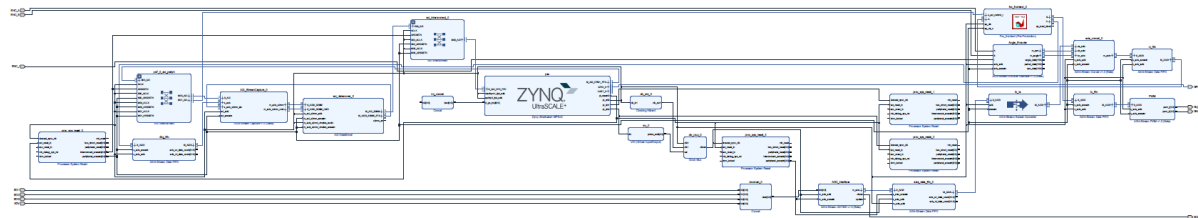
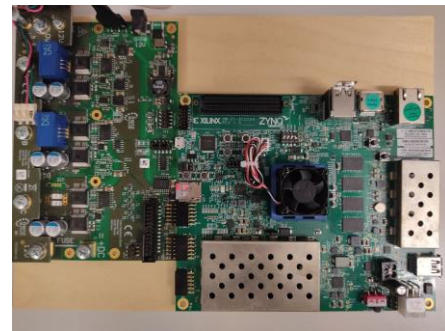


Consultancy services

Consultancy

- Custom software/firmware design support
 - We have a big expertise on AMD FPGA devices
- Petalinux packages integration (image build or RPM provider)
- Additional hardware integration
- Additional TAPPAS support

The pricing depends on the specific project



Example:

EDDP-SPYN Motor control for ZynqMP with predictive maintenance

<https://tinyurl.com/5n8xbhzv>

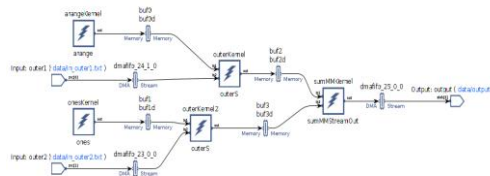


Consultancy services

Consultancy

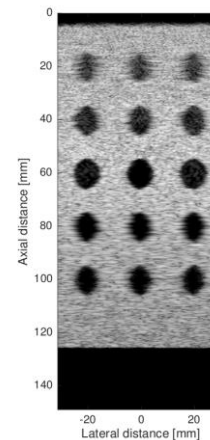
- Custom software/firmware design support
 - We have a big expertise on AMD FPGA devices
- Petalinux packages integration (image build or RPM provider)
- Additional hardware integration
- Additional TAPPAS support

The pricing depends on the specific project



Example:
Medical imaging for Ultrasound
on Versal VCK190

<https://tinyurl.com/s4t4r6sy>

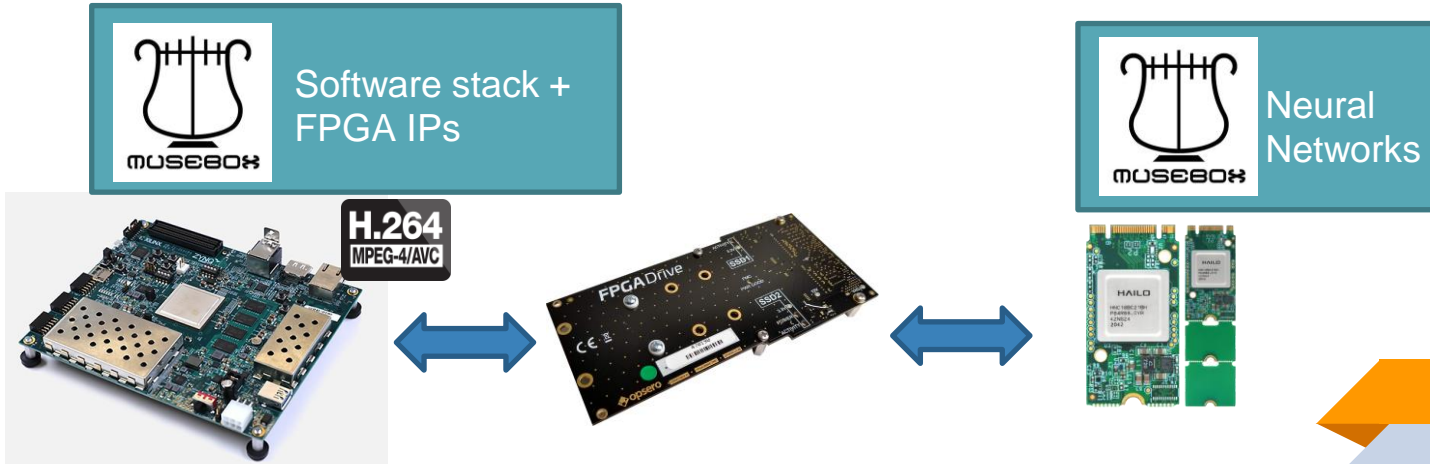




H4Z MuseBox



- MuseBox is a framework for distributed and heterogenous Machine Learning applications
- Every ML tasks is deployable on HAILO chip (<https://musebox.it/solutions/>)
- Useful for developers
- Useful for final product integration (<https://store.musebox.it/>)





THANKS!

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