FPGA-based Accelerated Cloud Computing with AWS EC2 F1 and SDAccel

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Tutorial Objectives

- Overview on cloud computing and Xilinx FPGA-based acceleration using Amazon AWS EC2 F1 instance

- Introduction to FPGA acceleration using high level languages via Xilinx SDAccel

- Provide hands-on experience on using AWS EC2 F1 and Xilinx SDAccel

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Agenda

- Overview of AWS EC2 F1 and SDAccel

- Get started on AWS EC2 F1

  - Lab 1

  - Lab 2

  - Lab 3

- Wrap-up

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Introducing AWS EC2 F1

- Amazon AWS EC2 F1 is a compute instance with Xilinx FPGAs which can be programmed to create custom hardware accelerated applications

- F1 instances are easy to program and come with everything needed to develop, simulate, debug, and compile hardware accelerators

- Once a FPGA design is complete, it can be registered as an Amazon FPGA Image (AFI), and deployed to F1 instance in just a few clicks
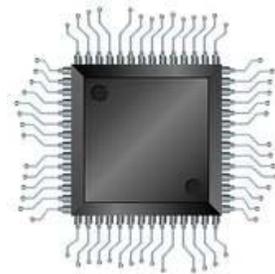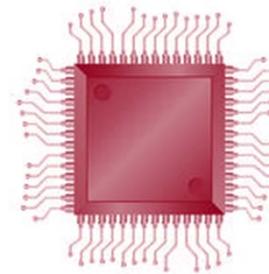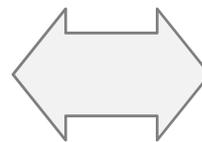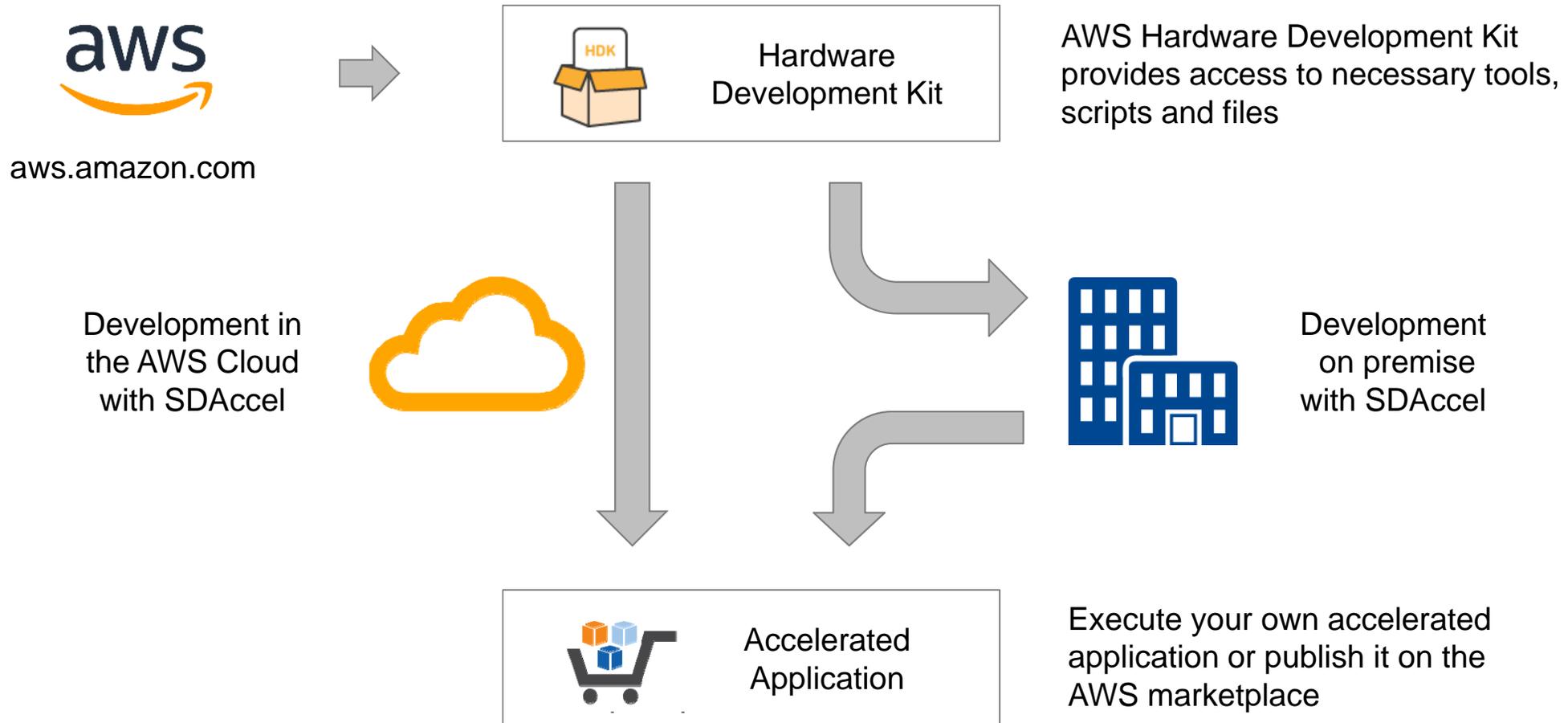
Host CPU   Xilinx FPGA

Benefits of the AWS EC2 F1 Cloud Compute Platform

❯ Makes FPGA acceleration available to a large community of developers, and to millions of potential AWS users

❯ Provides dedicated and large amounts of FPGA logic with elasticity to scale to multiple FPGAs

❯ Simplifies the development process by providing cloud-based FPGA development tools

❯ Provides a Marketplace for FPGA applications, giving more choice, secure and easy access to millions of AWS users

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Amazon F1 Development Flow

aws.amazon.com

Hardware Development Kit

AWS Hardware Development Kit provides access to necessary tools, scripts and files

Development in the AWS Cloud with SDAccel

Development on premise with SDAccel

Accelerated Application

Execute your own accelerated application or publish it on the AWS marketplace

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The SDAccel Development Environment

C/C++
Application

RTL, C/C++, OpenCL
Accelerators

SDAccel™

PCIe

Host CPU

Xilinx FPGA
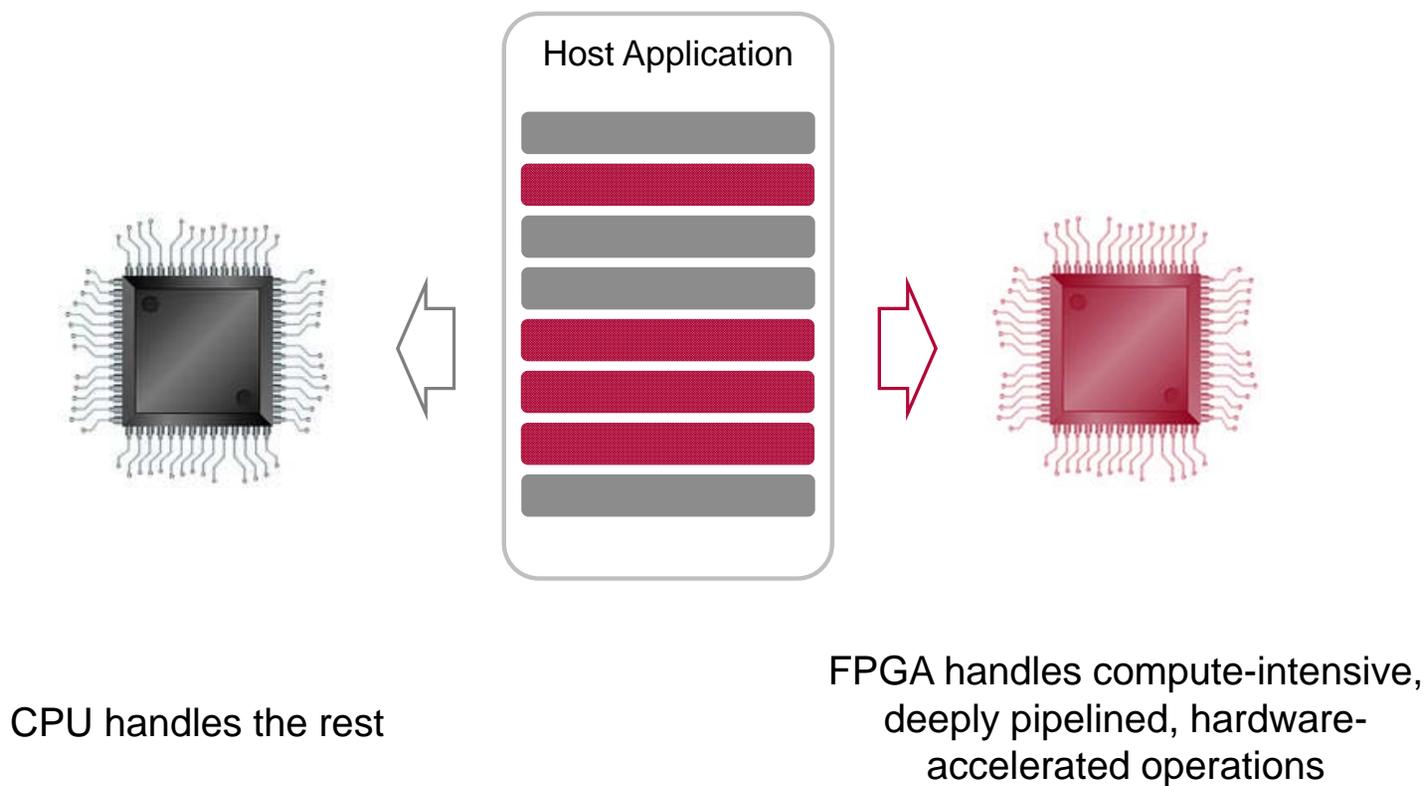
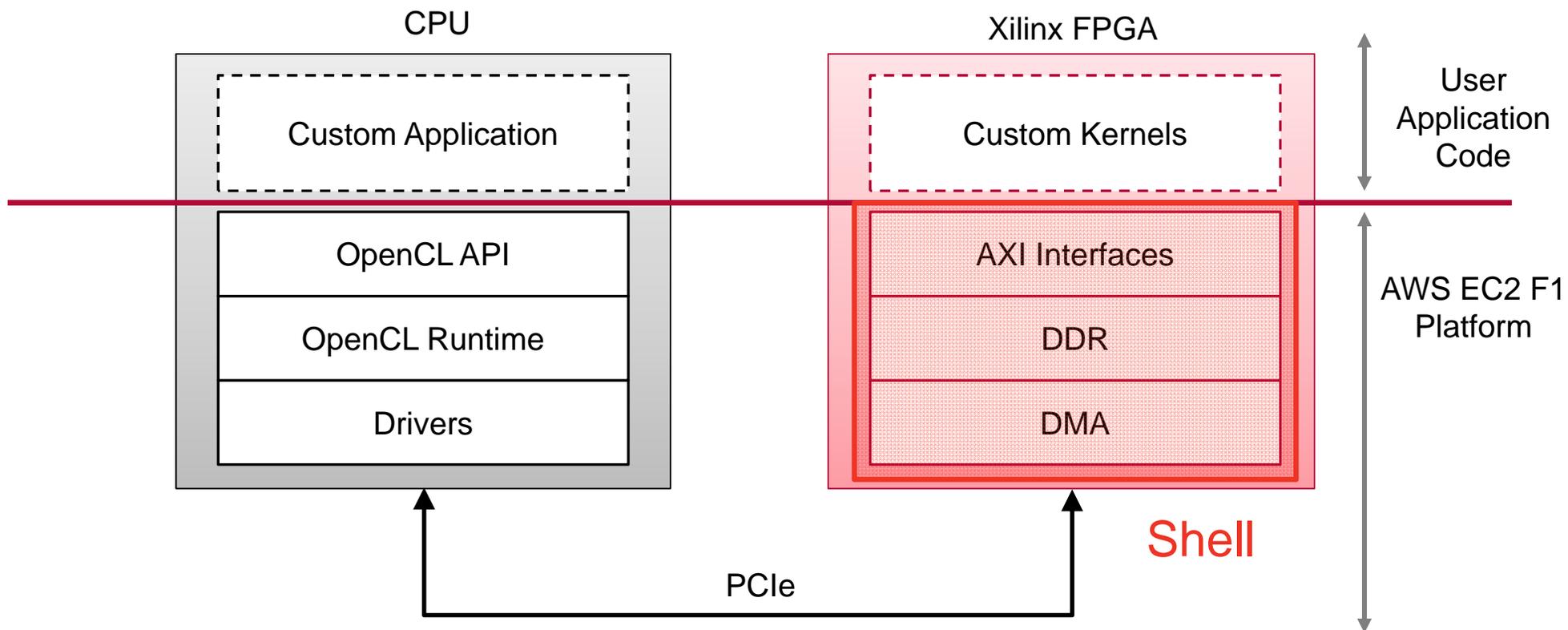XILINX ➤ ALL PROGRAMMABLE™
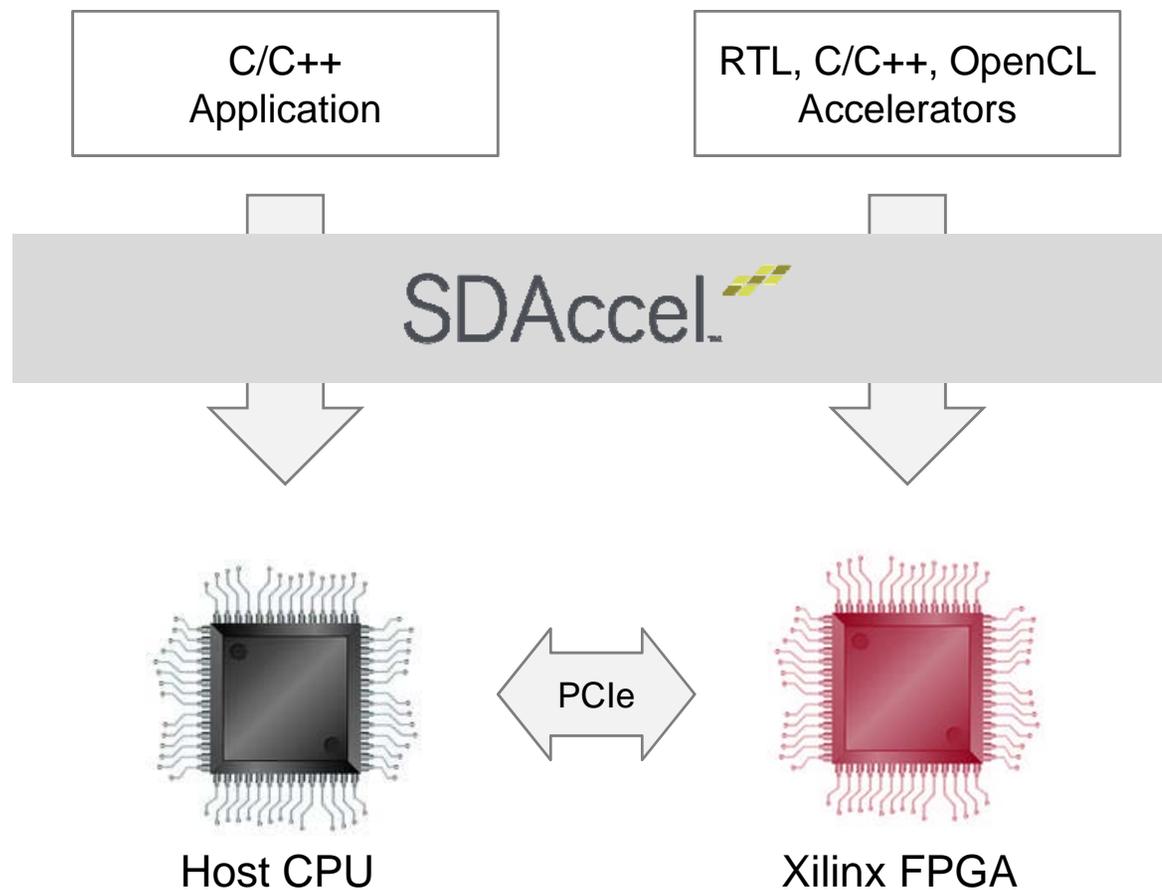
The SDAccel Development Environment

> Fully integrated Eclipse-based environment

> Develop, profile and deploy applications accelerated with Xilinx FPGAs

> Concurrent programming of the host application and FPGA kernels

> Automatic hardware execution flows

> Built-in debug, profiling and performance analysis tools
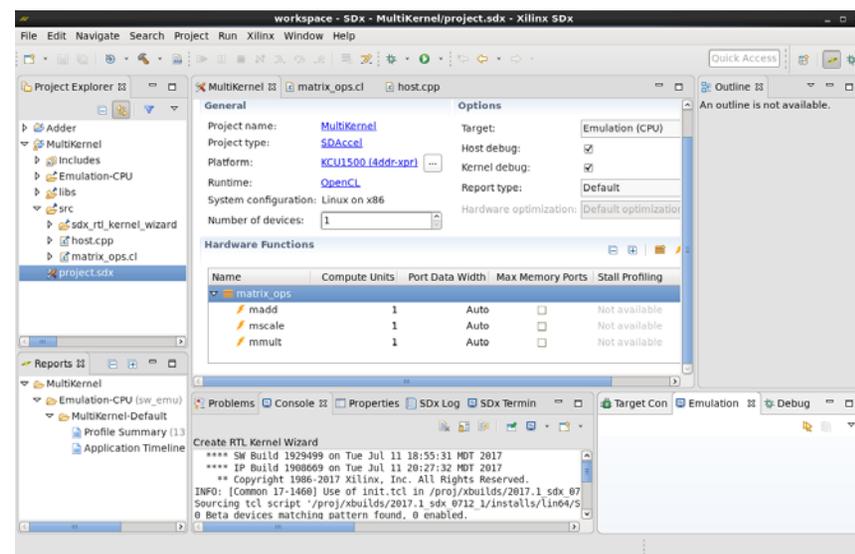
How does FPGA Acceleration Work on AWS?

Host Application

CPU handles the rest

FPGA handles compute-intensive, deeply pipelined, hardware-accelerated operations

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AWS EC2 F1 Platform Model

CPU

Xilinx FPGA

Custom Application

Custom Kernels

User Application Code

OpenCL API

AXI Interfaces

OpenCL Runtime

DDR

AWS EC2 F1 Platform

Drivers

DMA

Shell

PCIe

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It's Time to Get started on AWS EC2 F1

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Labs

➤ Instructions at

https://github.com/Xilinx/AWS-F1-Developer-Labs/blob/master/README.md

➤ Timeline

– Connecting to your F1 instance (~10 minutes)
– Experiencing F1 acceleration (~15 minutes)
– Developing and optimizing F1 application with SDAccel (~30 minutes, may be a stretch goal)
– Wrap-up (10:15 – 10:25 AM)

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Lab 1: Logging In on AWS EC2 F1

› Click on the provided link to your preconfigured instance

› Use the provided Account ID
  – Xilinx-aws-f1-developer-labs

› Enter provided user name
  – user*n*

› Enter the following password
  – *<will be provided> (*same for *centos* user on RDP*)*

› You will run "hello world" application

› *Precompiled FPGA binaries*

aws

Account ID or alias

Xilinx-aws-f1-developer-labs

IAM user name

user1

Password

••••••••••••

Sign In

Sign-in using root account credentials

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Setting up RDP Screen Color Depth And Other Tips

➤ You can copy and paste commands between the instructions window and terminal window of RDP using Ctrl+C (copy) and Ctrl+Shift+V (paste)

➤ If RDP crashes/freezes, you may have to reboot the instance

  – Go to the local web browser where you started the instance, select it, click on Actions, and select **Instance State**, and then click **Reboot**
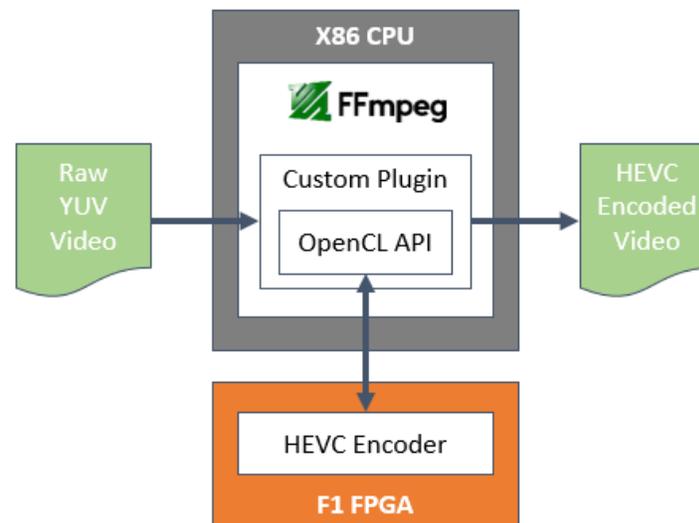
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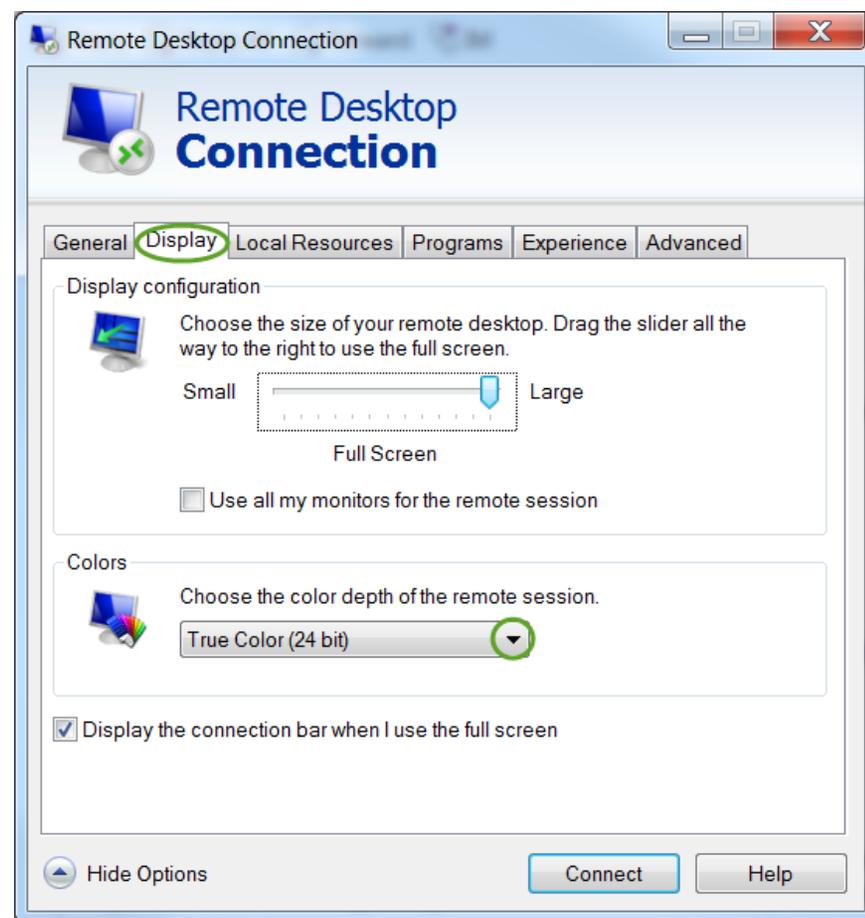
Lab 2: Experiencing F1 Acceleration

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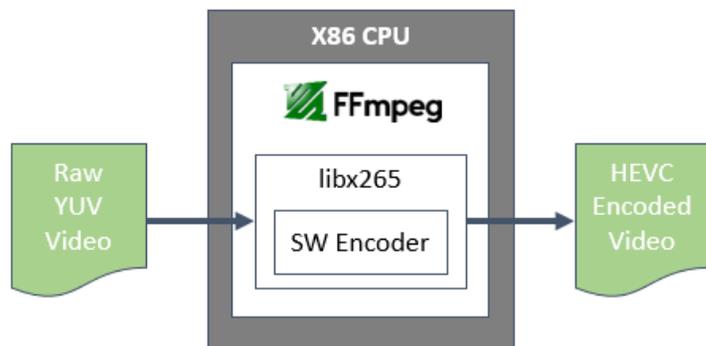
Lab 3:

▶ **Understanding software and hardware emulation flows**
  – Kernel calls
  – Application timeline

▶ **Profiling performance and identifying how to optimize host**

▶ **Kernel code**
  – Inverse Discrete Cosine Transform (IDCT)

▶ **Kernel optimization**
  – HLS reports

▶ **Use pre-compiled AFI to run on the F1 instance**

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Summary

It's Time to Wrap-Up (10:15 AM)

▶ **Please close RDP, stop instance, and logout**
- Click the '**X**' icon to close your *RDP* client
- In your local browser, return to the tab showing the **EC2 Console**
- In the **EC2 Console**, make sure you have selected your instance
- Click the **Actions** button, select **Instance State**, and then click **Stop**
- Make sure to **Sign Out**
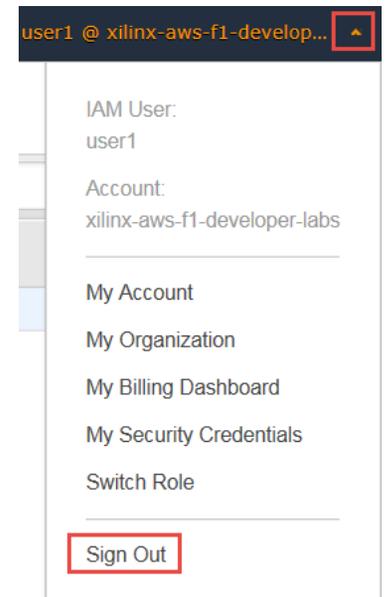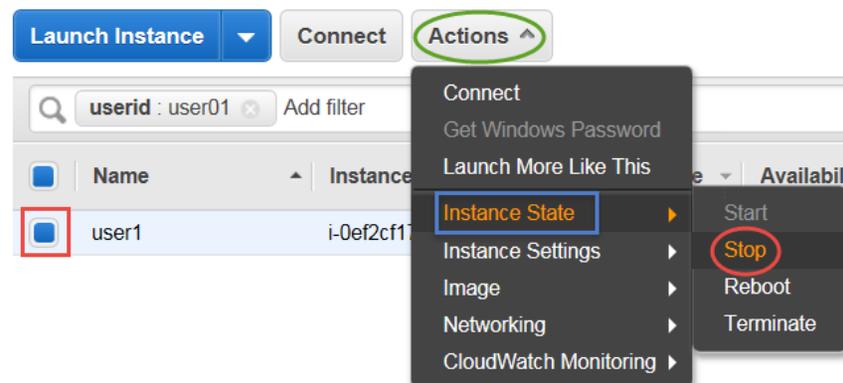
▶ **PLEASE RETURN THE EVALUATION FORM**

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Summary

➤ F1-optimized *HEVC* encoder showed acceleration over pure software driven *ffmpeg* encoder

➤ SDAccel environment enabled application profiling and optimization

➤ Hardware acceleration on VU9P FPGA using pre-built AFI

➤ Labs conducted using pre-generated AMI and pre-configured EC2 F1 instance

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Create Your Amazon Web Services (AWS) Account

https://aws.amazon.com/

Want Support to Continue to Work on AWS F1?

➤ Submit academic research proposal that justifies F1 usage
- – Please submit a one page proposal by March 12, 2018 to parimal.patel@Xilinx.com with subject "Research Proposal for AWS F1 Work" stating what you propose to work on

➤ A team will evaluate your proposal

➤ Ten proposals will be selected and each will be awarded $250 research credit (~150 hours of compute time on F1.2x or ~625 hours on C4.2x)

➤ Outstanding follow on research may entitle additional research credit

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Thank You

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