Introduction to AWS EC2 F1

SDx 2018.2

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Objectives

> **After completing this module, you will be able to:**

>> Describe AWS EC2 services
>> List some of the benefits of using AWS EC2 F1 instance
>> State application areas where acceleration is beneficial
>> Describe SDAccel development flow on AWS EC2 F1
>> Explain what are AMI and AFI
>> Create an account on AWS (Appendix)
>> Create and access an instance (Appendix)
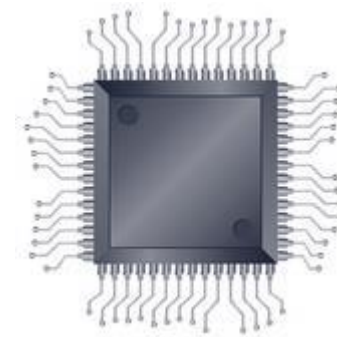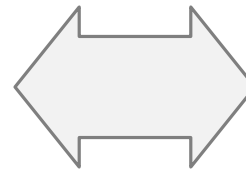
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Outline

Introducing Amazon AWS EC2 F1

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

> **AWS EC2 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**
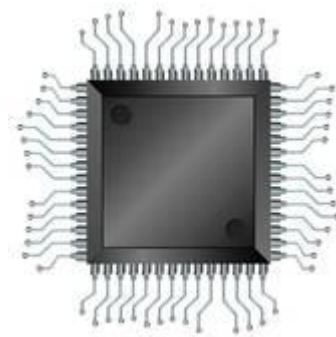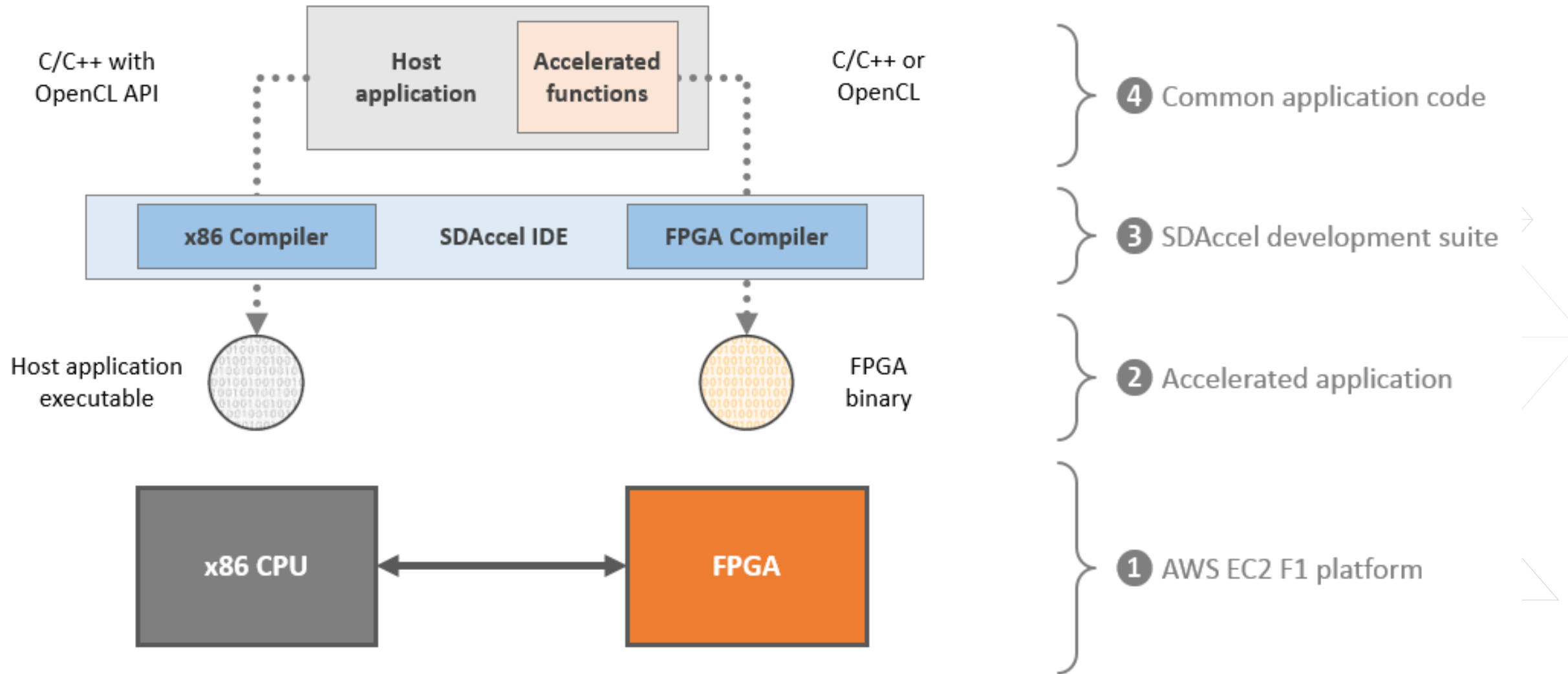
Host CPU   Xilinx FPGA

F1 Instances

> **Up to 8 Xilinx UltraScale+ 16nm VU9P FPGA devices in a single instance**
>> f1.16xlarge size provides:
>>> – 8 FPGAs, each with over 2 million customer-accessible FPGA programmable logic cells and over 5000 programmable DSP blocks
>> Each of the 8 FPGAs has 4 DDR-4 interfaces, with each interface accessing a 16GiB, 72-bit wide, ECC-protected memory

Instance Size	FPGAs	DDR-4 (GiB)	vCPUs	Instance Memory (GiB)	NVMe Instance Storage (GB)	Network Bandwidth
f1.2xlarge	1	4 x 16	8	122	1 x 470	Up to 10 Gbps
f1.16xlarge	8	32 x 16	64	976	4 x 940	25 Gbps

AWS EC2 F1 Instance SDAccel Flow

>> 8

Workloads Dependent Acceleration

Video	Data analytics	Genomics	Machine Learning	& more
10x	90x	100x	40x	

NGCODEC — NEXT GENERATION VIDEO COMPRESSION

RYFT — ACTIONABLE INTELLIGENCE FROM COMPLEX DATA

edico genome

DEEPHi 深 鉴 科 技

XILINX — ALL PROGRAMMABLE

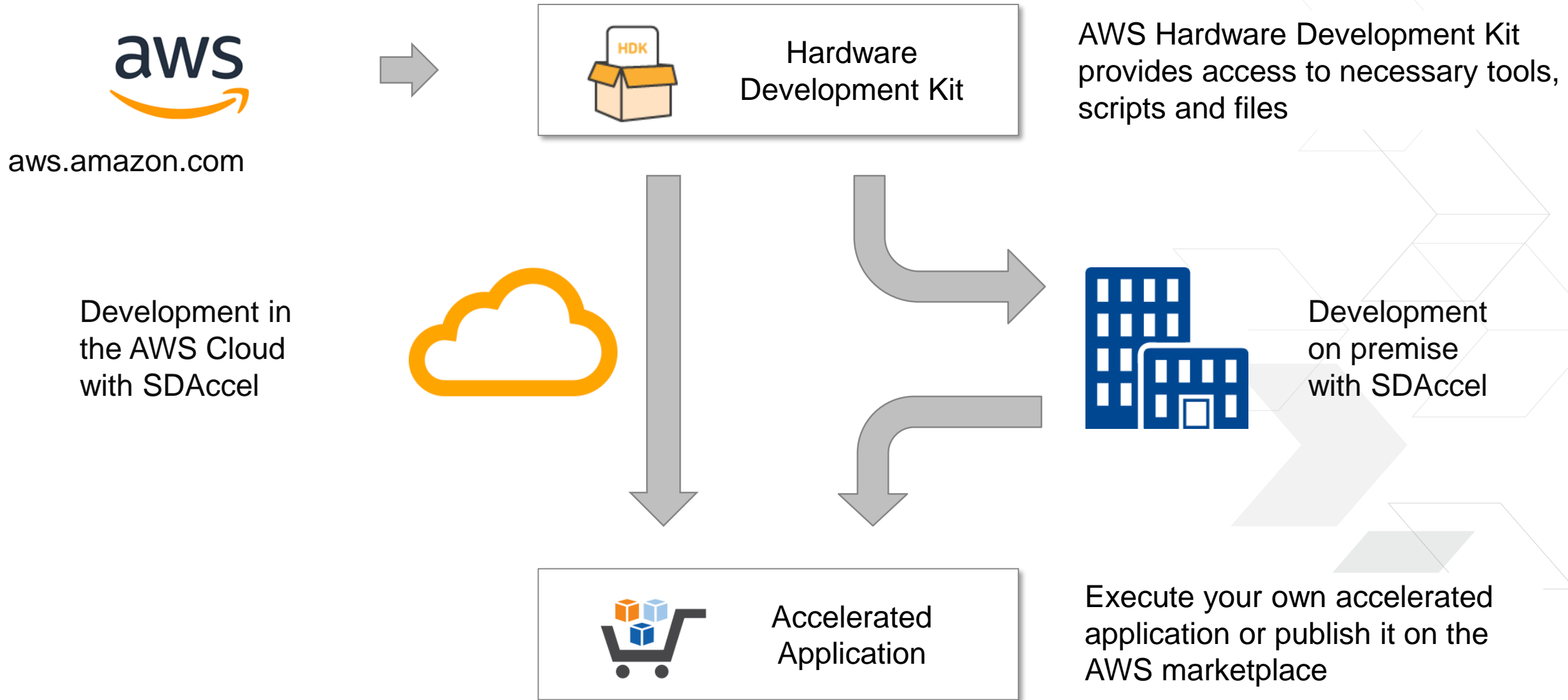Atomic Rules

Reconfigure.io

Titan IC

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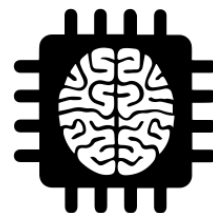
Terminology

> **AMI: An Amazon Machine Image is a template that contains a software configuration (for example, an operating system, an application server, and applications)**
>> Provides the information required to launch an instance, which is a virtual server in the cloud
>> Must specify a source AMI when you create an instance
>> Multiple instances can be launched using the same source AMI

> **AFI: An Amazon FPGA Image is the compiled registered design, securely stored**
>> Secured, encrypted and dynamically loaded in the FPGA - can't be copied or downloaded
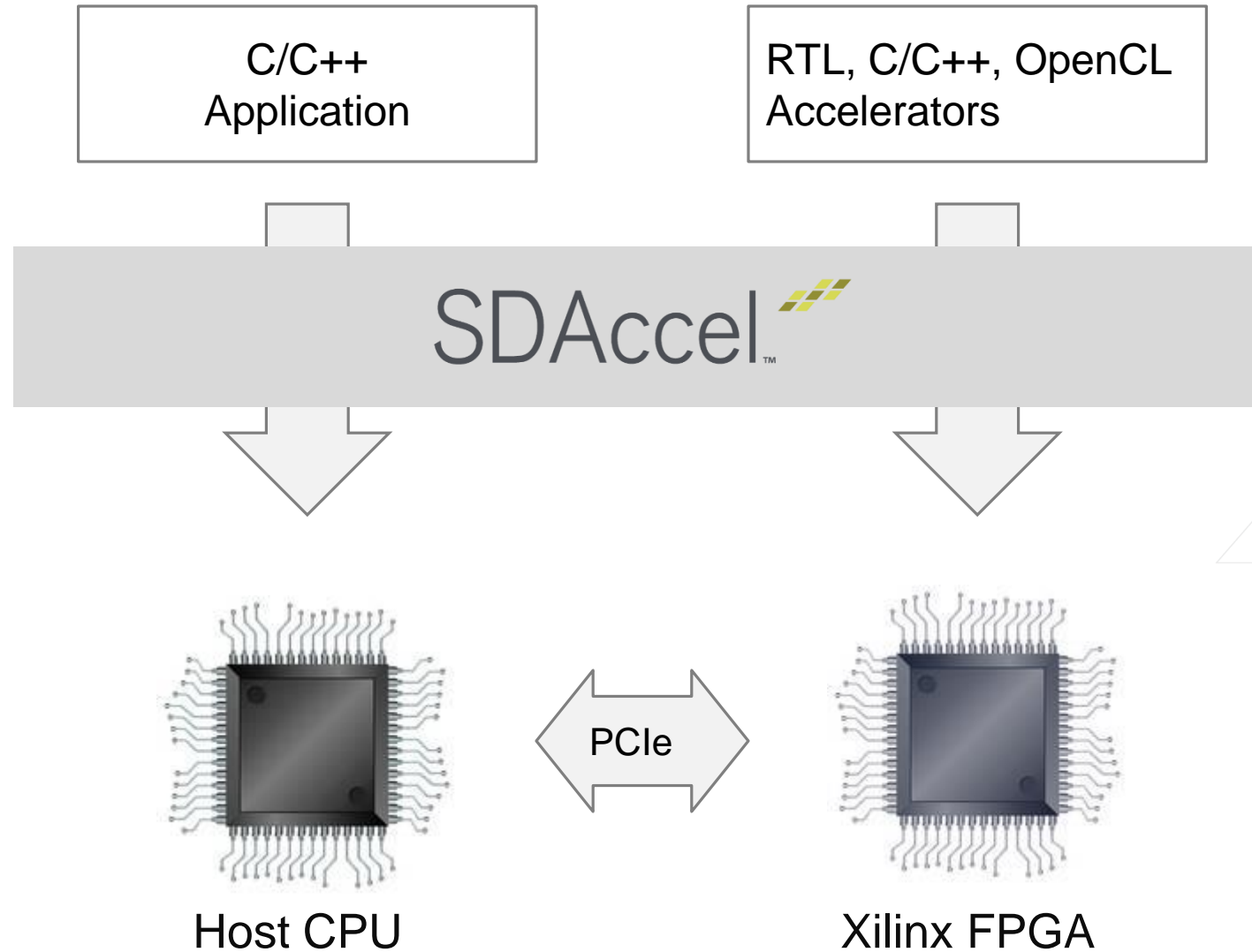>> Can be associated with an AMI and offered on the AWS Marketplace

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SDAccel Development Flow on EC2 F1

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
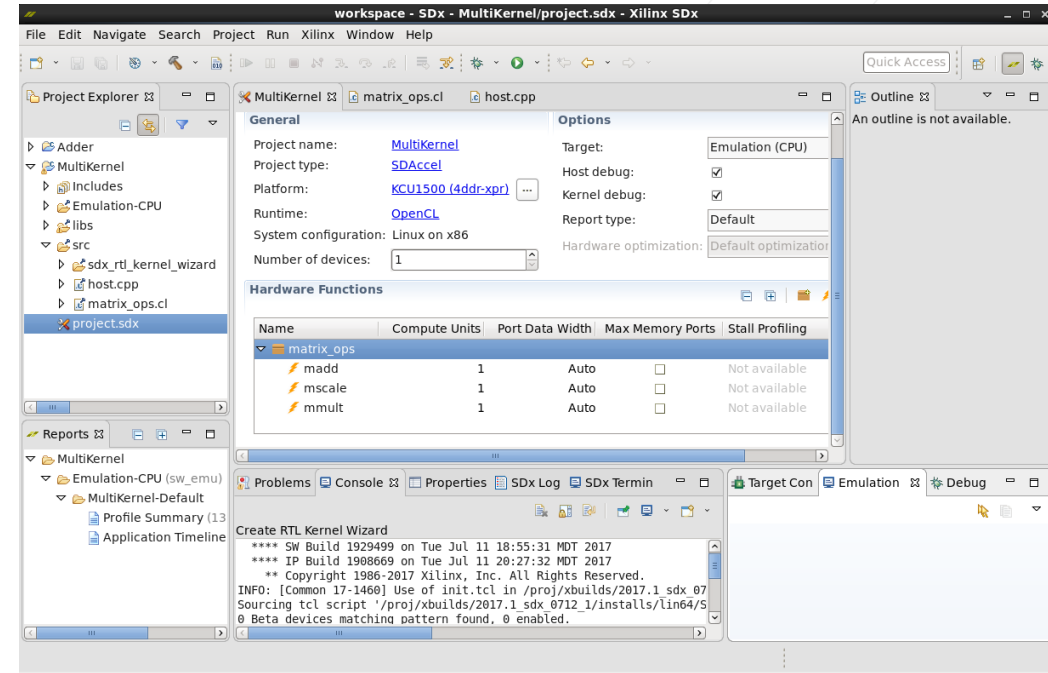
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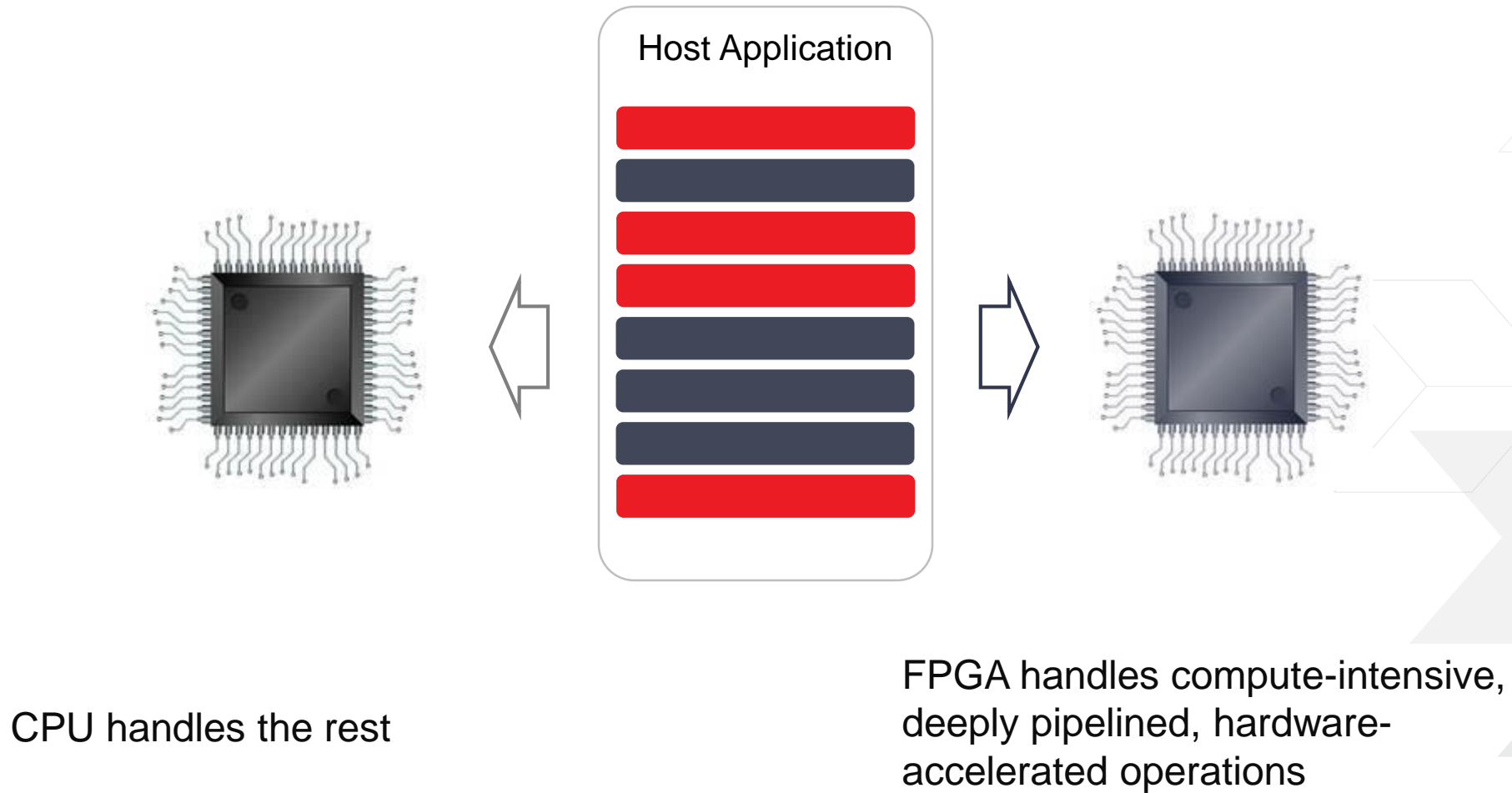# The SDAccel Development Environment
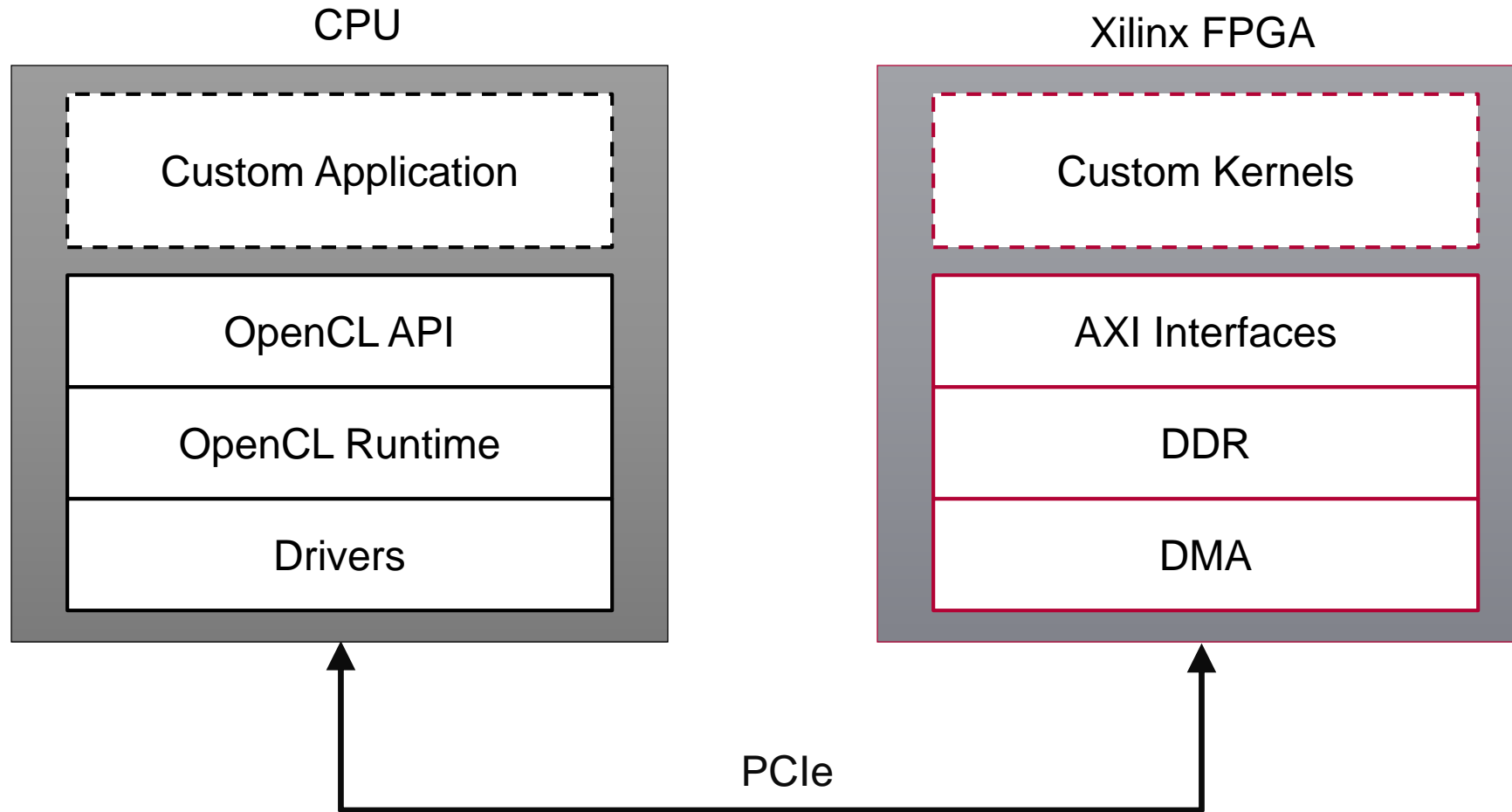
The SDAccel Development Environment

> **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**

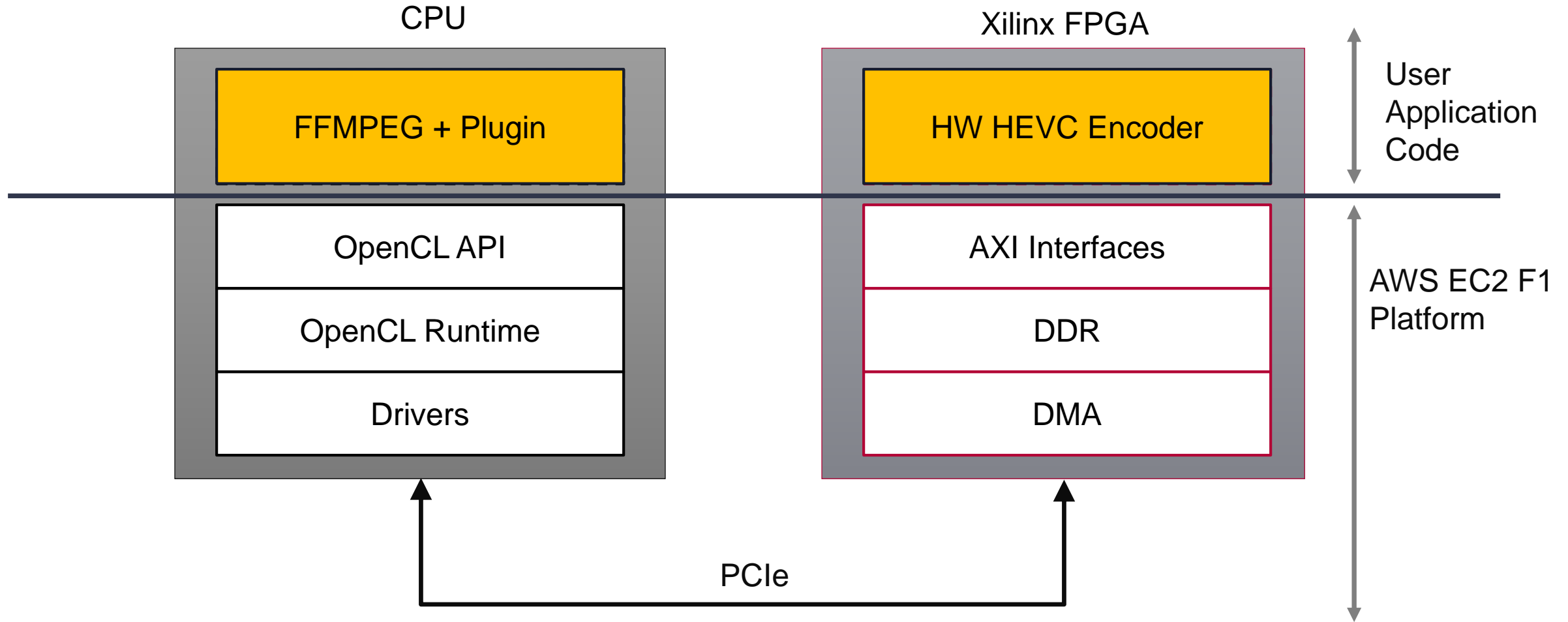> **Built-in debug, profiling and performance analysis tools**

How FPGA Acceleration Works 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 |

OpenCL API	AXI Interfaces
OpenCL Runtime	DDR
Drivers	DMA

PCIe

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Example of a Custom Video Encoding Application

CPU

Xilinx FPGA

| FFMPEG + Plugin | HW HEVC Encoder |

User Application Code

OpenCL API	AXI Interfaces
OpenCL Runtime	DDR
Drivers	DMA

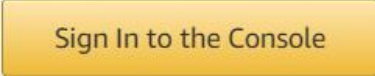AWS EC2 F1 Platform

PCIe

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Accessing an AWS EC2 Instance

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Login Procedure using Provided Instance

> **Click on the provided link to your preconfigured instance**
>> Otherwise go to **aws.amazon.com**, click on [Sign In to the Console]

> **Use the provided Account ID**
>> xilinx-aws-f1-developer-labs

> **Enter provided user name**
>> user*n*

> **Enter the following password**
>> *Given by instructor*
>> For *centos* user on RDP*: Given by instructor*

> ***Precompiled FPGA binaries***

aws

Account ID or alias

xilinx-aws-f1-developer-labs

IAM user name

user31

Password

•••••••••••

[Sign In]

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Starting an Instance on EC2 F1

> Make sure that you have selected *N. Virginia* as a region

> Click on the instances in the left pane

> Select your instance and then start it

>> Since the AMI used already has an instance available, filter your instance by typing your username in the Search field under the Launch Instance button

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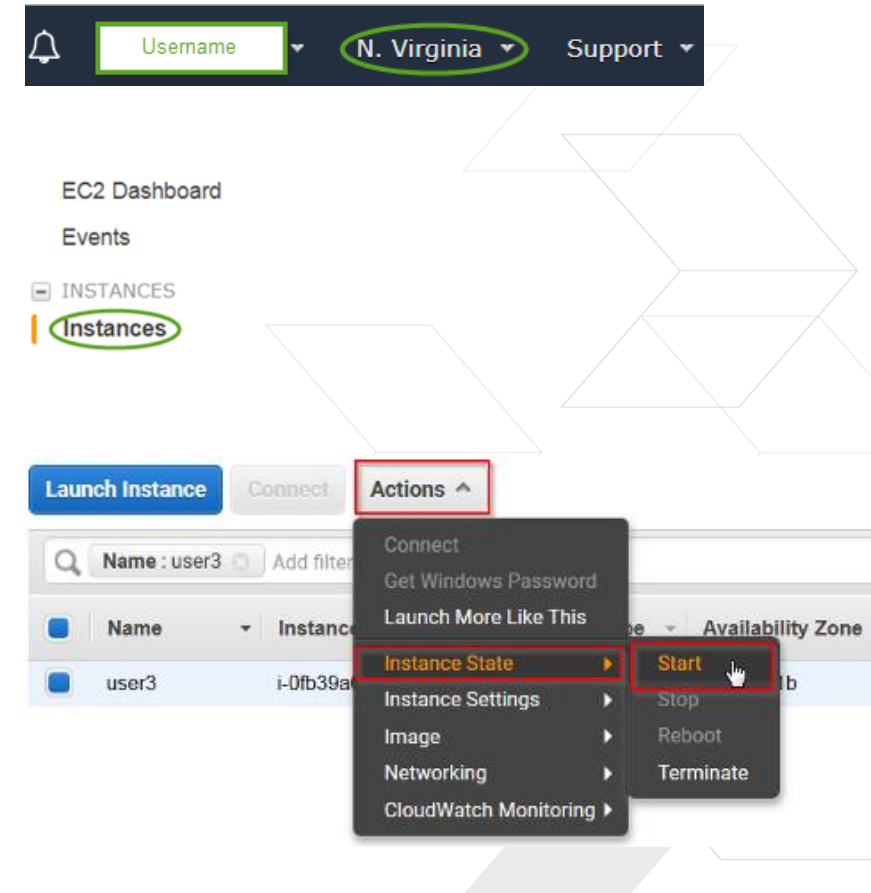
Connecting to an Instance

Connection setup

> **You can communicate with the instance using**
>> Command line through PuTTY or Git Bash
>> GUI through remote desktop connection

> **Select the running instance and you will see the console window with various information**

Starting a Remote Desktop Session

> **Start *Remote Desktop Connection* program**

> **Enter *IPv4 Public IP* address available in the console**

> **Click Connect**

> **Click Yes**

> **In the desktop session**
>> Enter **centos** in the *username* field
>> Enter <user password> as you had set that in PuTTY session
>> Click **OK** to run the session

> **You can now execute GUI/Windows based tasks**

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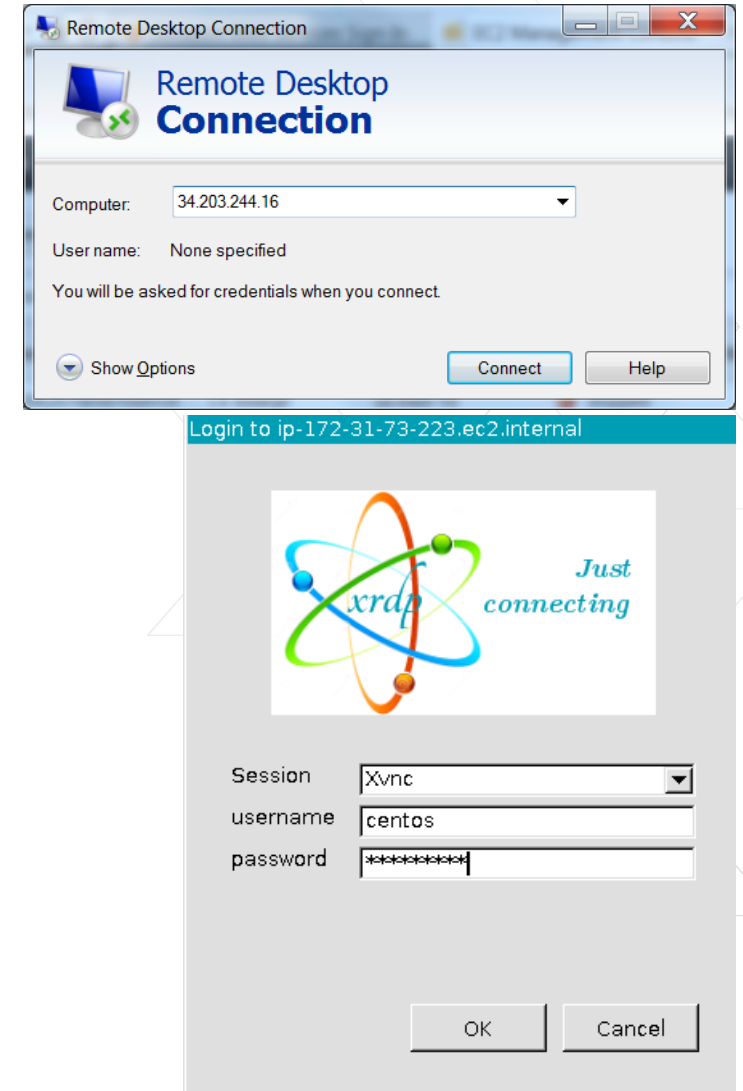
Remote Desktop Client

> **Before connecting, set your remote desktop client to use 24-bit for color depth**
>> Windows client: In the bottom-left corner of connection prompt, click Options, select the Display tab and set Colors to True Colors (24 bit)

> **On Windows: press the Windows key and type "remote desktop"**
>> You should see the "Remote Desktop Connection" in the list of programs
>> Alternatively you can also simply type mstsc.exe in the Windows run prompt

> **On Linux: RDP clients such a Remmina or Vinagre are suitable**

> **On MacOS: use the Microsoft Remote Desktop v8.0.43 (that version offers color depth settings) from the Mac App Store**

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Summary

Summary

> **AWS EC2 F1 is an elastic cloud computing instance that uses Xilinx FPGAs for custom hardware accelerated applications**

> **AWS EC2 F1 development flow options**
>> Develop in the AWS cloud with the SDAccel development environment
>> Develop on-premise in the SDAccel environment and execute the application on AWS

> **Accelerated applications can easily be put on the AWS Marketplace, offering a rapid path to monetization**
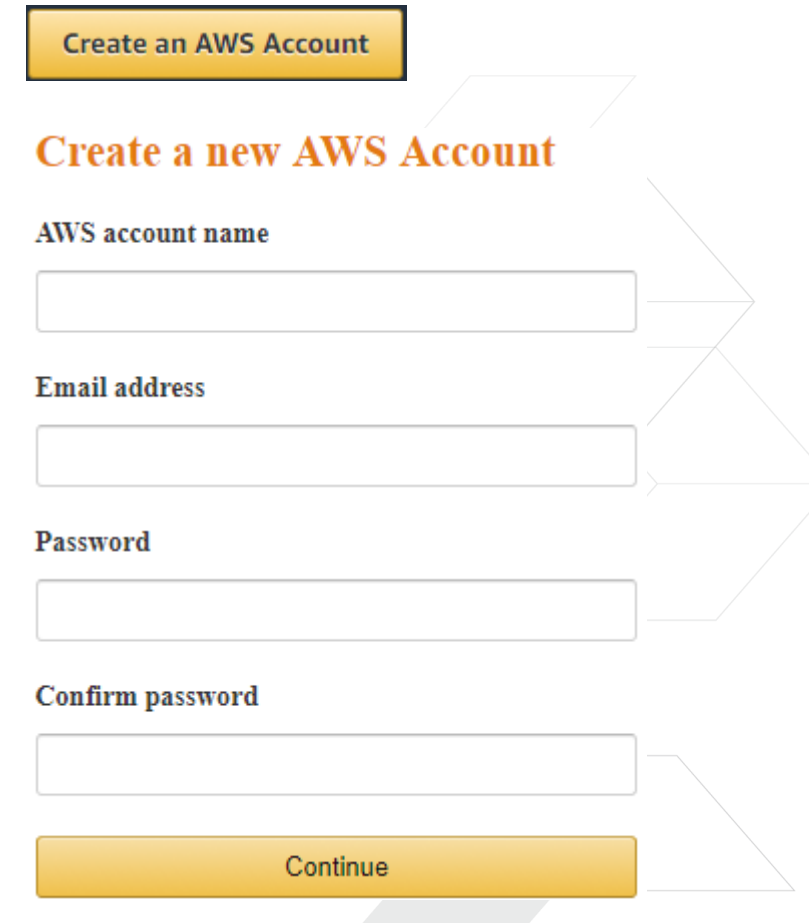
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Lab Intro

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Lab Intro

> **In this lab you will start an EC2 F1 instance using the preconfigured FPGA Developer AMI and connect to it using a remote desktop client. Once connected, you will open a terminal window on the RDP client and source the environment variables.**

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Appendix: Account Creation on AWS

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Creating an AWS Account

> **Go to https://aws.amazon.com and then click on**
>> Free account is really for non-FPGA services

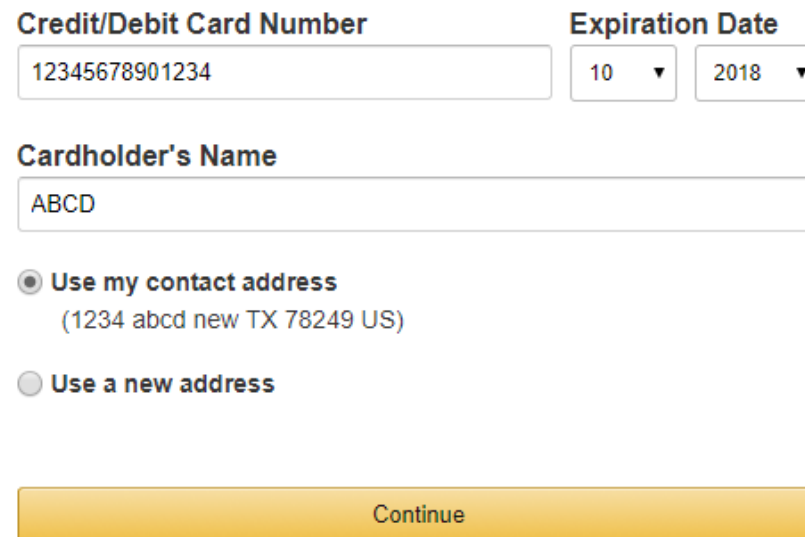> **Enter your choice of account name, email address password and click on Continue**

Creating an AWS Account (2)

> **Provide required credentials**
>> Enter correct phone number as it will be used to verify credentials
>> You will be required to enter credit card related information
>> Your identity will be verified using a telephone number

> **If everything is successful then you will be assigned a 12-digit account number**
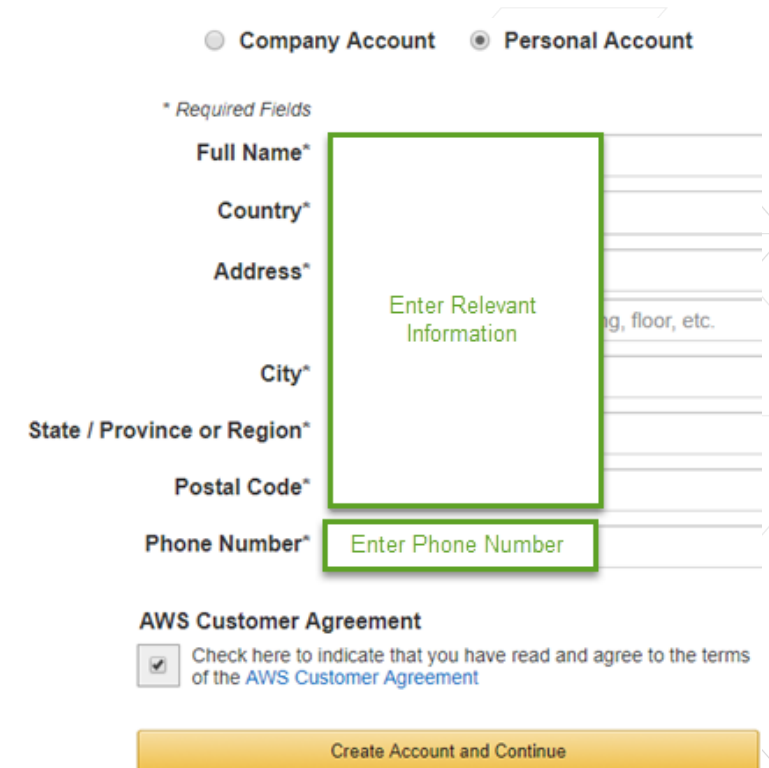
Signing Up for the Services

> **Open https://aws.amazon.com/education/awseducate/ and then click Apply for AWS Educate for Educators link under the Educators section**

>> Non-academic customers may create an account visiting https://aws.amazon.com/, and then choose **Create an AWS Account**

> **Select the appropriate role (Educators or Students)**

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Signing Up for the Services (2)

> Fill out Institution Name (you may be able to select), Country, etc. fields

> Enter the AWS account number that you created in the previous step

Institution Name
Start typing the name of your school and select from the list. If you don't see your school, enter the full name, example: Harvard University

Country ▾

City

--None-- ▾

First Name

Last Name

Department ▾

Email
Please provide a valid, current email issued by your institution. Example: your_name@your_school.edu

Title
Please specify your official title at the institution (eg Assistant Professor)

AWS Account ID
Your AWS Account ID is a 12-digit number.

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Appendix: Accessing an AWS EC2 instance through your own account

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Login Procedure using Your Own Account

> **Open a web browser and enter https://signin.aws.amazon.com/console**

> **Enter email address of your AWS account or account ID and click Next**

> **Enter password and click on Sign-In**

> **Select N. Virginia farm using the drop-down button**

Starting an Instance on EC2

> **You can use an available AMI to start an instance or you can use a provided AMI to start an instance**

> **Click on the EC2 icon**
>> EC2 dashboard will be displayed

> **Click on the Instances option under the INSTANCES group**

> **Click on the Launch Instance > Launch Instance**
>> The seven-steps wizard will open
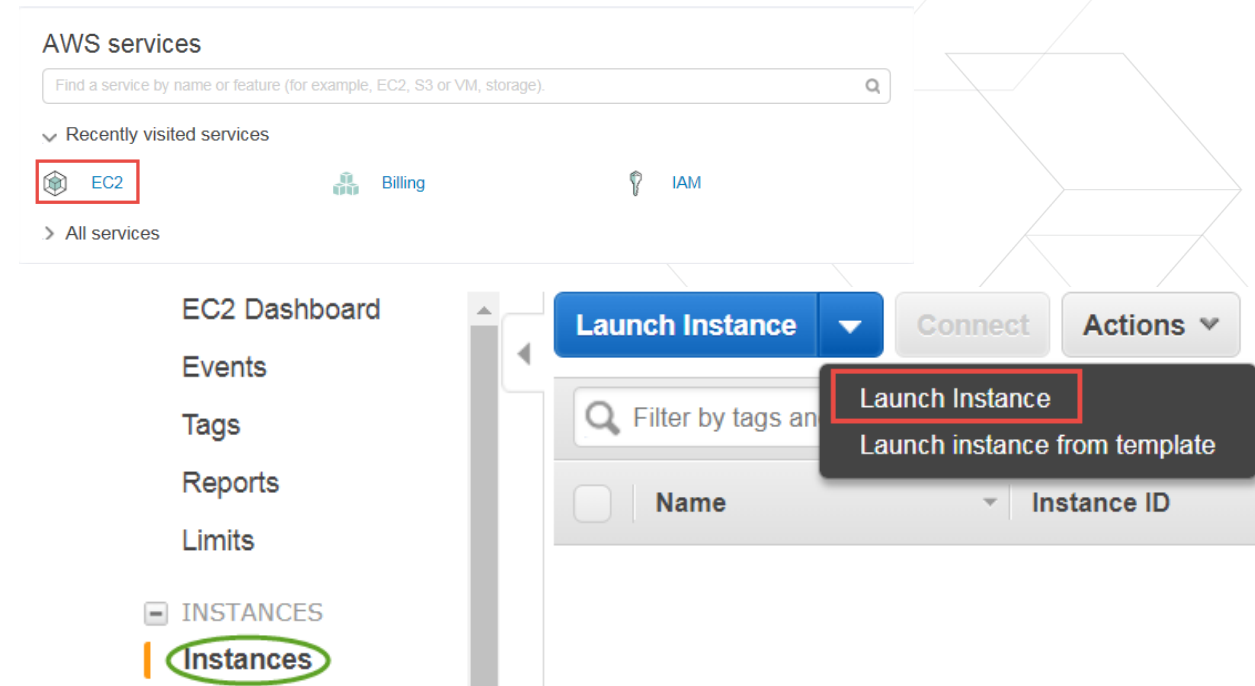
Choosing AMI

> **Step 1: Select AWS Marketplace**

> **In the search field enter *FPGA* and hit enter**
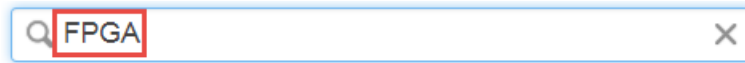
> **Click on the Select button of the FPGA Developer AMI**
>> List of instance types with cost be displayed (see next slide)

Pricing Details

Hourly Fees

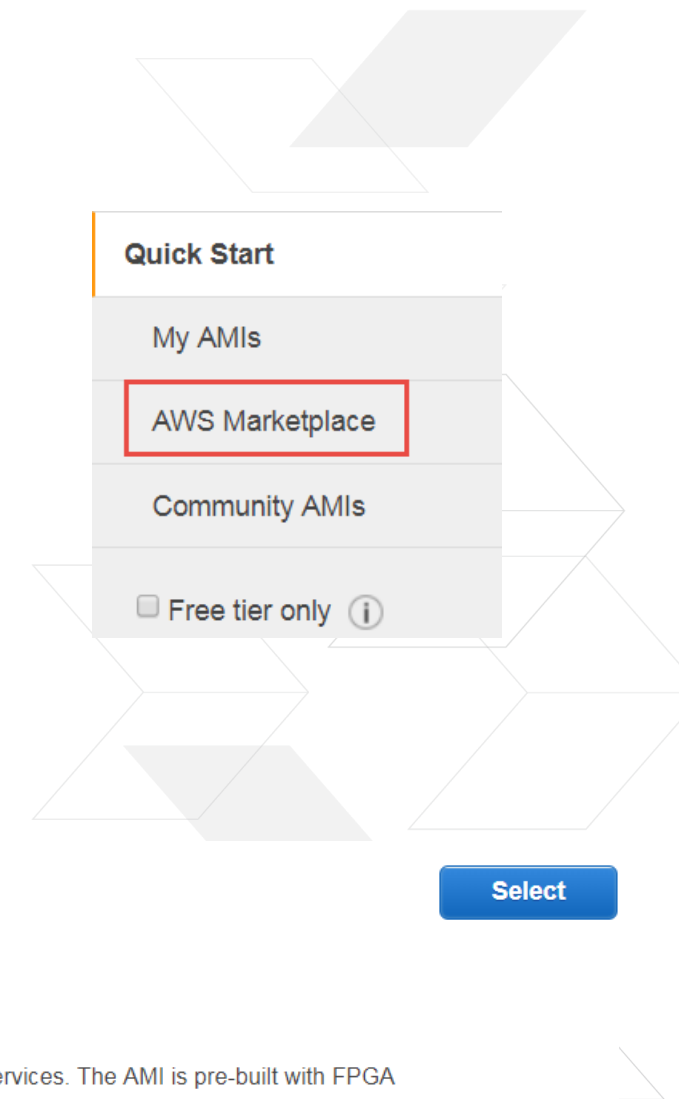| Instance Type	Software	EC2	Total
T2 Nano	$0.00	$0.006	$0.006/hr
R4 16 Extra Large	$0.00	$4.256	$4.256/hr
M5 Extra Large	$0.00	$0.192	$0.192/hr
M4 Extra Large	$0.00	$0.20	$0.20/hr
H1 2 Extra Large	$0.00	$0.55	$0.55/hr
High I/O Quadruple Extra Large	$0.00	$1.248	$1.248/hr
T2 Large	$0.00	$0.093	$0.093/hr
C4 Double Extra Large	$0.00	$0.398	$0.398/hr
M5 Large	$0.00	$0.096	$0.096/hr
FPGA Accelerated Compute 16 Extra Large	$0.00	$13.20	$13.20/hr
C5 Large	$0.00	$0.085	$0.085/hr
M5 Double Extra Large	$0.00	$0.384	$0.384/hr
T2 Double Extra Large	$0.00	$0.371	$0.371/hr
T2 Extra Large	$0.00	$0.186	$0.186/hr
C4 Eight Extra Large	$0.00	$1.591	$1.591/hr
M4 Quadruple Extra Large	$0.00	$0.80	$0.80/hr
M5 12 Extra Large	$0.00	$2.304	$2.304/hr
T2 Medium	$0.00	$0.046	$0.046/hr
C4 Large	$0.00	$0.10	$0.10/hr

T2 Small	$0.00	$0.023	$0.023/hr
R4 Extra Large	$0.00	$0.266	$0.266/hr
C4 Quadruple Extra Large	$0.00	$0.796	$0.796/hr
C4 Extra Large	$0.00	$0.199	$0.199/hr
R4 Eight Extra Large	$0.00	$2.128	$2.128/hr
C5 Double Extra Large	$0.00	$0.34	$0.34/hr
R4 Double Extra Large	$0.00	$0.532	$0.532/hr
High I/O Double Extra Large	$0.00	$0.624	$0.624/hr
D2 Extra Large	$0.00	$0.69	$0.69/hr
D2 Eight Extra Large	$0.00	$5.52	$5.52/hr
T2 Micro	$0.00	$0.012	$0.012/hr
C5 Extra Large	$0.00	$0.17	$0.17/hr
C5 Eighteen Extra Large	$0.00	$3.06	$3.06/hr
C5 Nine Extra Large	$0.00	$1.53	$1.53/hr
R4 Quadruple Extra Large	$0.00	$1.064	$1.064/hr
D2 Double Extra Large	$0.00	$1.38	$1.38/hr
M4 Large	$0.00	$0.10	$0.10/hr
FPGA Accelerated Compute Double Extra Large	$0.00	$1.65	$1.65/hr
M5 24 Extra Large	$0.00	$4.608	$4.608/hr
H1 4 Extra Large	$0.00	$1.10	$1.10/hr

Red-boxed are FPGA based

Green-boxed are compute optimized

Perform development on compute-optimized instances, perform final verification in hardware on FPGA based instances
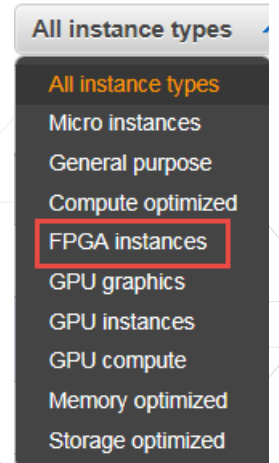
Instance Configuration

> **In Step 2. Click *All instance type* filter and select FPGA instances**
>> Two entries will be displayed

> **Select c4.4xlarge or f1.2xlarge type and click Next: Configure Instance Details**

Instance Configuration (2)

> **Step 3:** *Configure Instance Details* **will be displayed**

> **Click Next: Add Storage**

> **Step 4:** *Add Storage* **will be displayed**

> **Click Next: Add Tags**

> **Step 5:** *Add Tags* **will be displayed**

> **Click Next: Configure Security Group**

Type ⓘ	Protocol ⓘ	Port Range ⓘ	Source ⓘ	Description ⓘ
HTTP	TCP	80	0.0.0.0/0	
Custom TCP Rule	TCP	8080	0.0.0.0/0	
SSH	TCP	22	0.0.0.0/0	
RDP	TCP	3389	0.0.0.0/0	

Cancel   Previous   **Review and Launch**

Step 6: Configure Security Group
A security group is a set of firewall rules that control the traffic for your instance. On this page, you can add rules to allow specific traffic to reach your instance. For example, if you want to set up a web server and allow Internet traffic to reach your instance, add rules that allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select from an existing one below. Learn more about Amazon EC2 security groups.

Assign a security group: ○ Create a **new** security group

⦿ Select an **existing** security group

Security	Name	Description
☐ sg-9798a3e9	default	default VPC security group
☐ sg-f8473a8a	FPGA Developer AMI-1-3-3-AutogenByAWSMP-3	This security group was generated by AWS Marketplace
☑ sg-68570c1a	ICCD_Tutorial	For ICCD Tutorial

> **Step 6:** *Configure Security Group* **will be displayed**
>> Select *Create a new security group* if this is first time you are creating an instance on AWS
>> Select *Select an existing security group* if you already have created earlier

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Instance Configuration (3)

> **Click on Add Rule and then add desired ports and type of connections**
>> Add 3389 port for the RDP (Remote Desktop)

Type ⓘ	Protocol ⓘ	Port Range ⓘ	Source ⓘ	Description ⓘ
HTTP	TCP	80	0.0.0.0/0	
Custom TCP Rule	TCP	8080	0.0.0.0/0	
SSH	TCP	22	0.0.0.0/0	
RDP	TCP	3389	0.0.0.0/0	

Cancel   Previous   **Review and Launch**

> **Click on Review and Launch**

> **Step 7:** *Review Instance Launch* **will be displayed**
>> This summarizes the AMI details, Instance type, Security Group etc.
>> Ignore warnings of non-free usage tier and security group

> **Click Launch**
>> A form will be displayed to either create or select a key pair

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Instance Configuration (4)
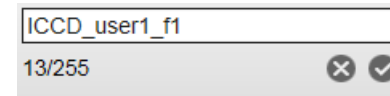
> **Click the acknowledgement check box, and click Launch Instances**
>> A Launch Status be displayed

> **Click on the link and it will take you to the instance filtering all other instances**
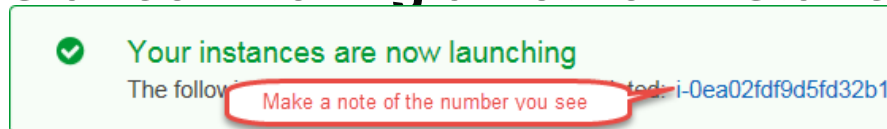
Naming the Instance

> You can name the instance by moving the mouse under the Name column until you see a pencil tool

> Click on the pencil tool and a field will open

> Enter a meaningful name and hit enter

Appendix: Other Ways to Communicate

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Connecting using PuTTY (Windows)

> **Start PuTTY program**

> **Enter centos@\<public_dns entry> in the *Host Name* field and 22 in the *Port* field**

> **Make sure SSH is selected as the *Connection Type***

> **Expand *SSH* under the *Connection* and click Auth**

> **Click on the Browse button and browse to the location where you were provided the private key**

> **Click Open**

> **Click Yes**
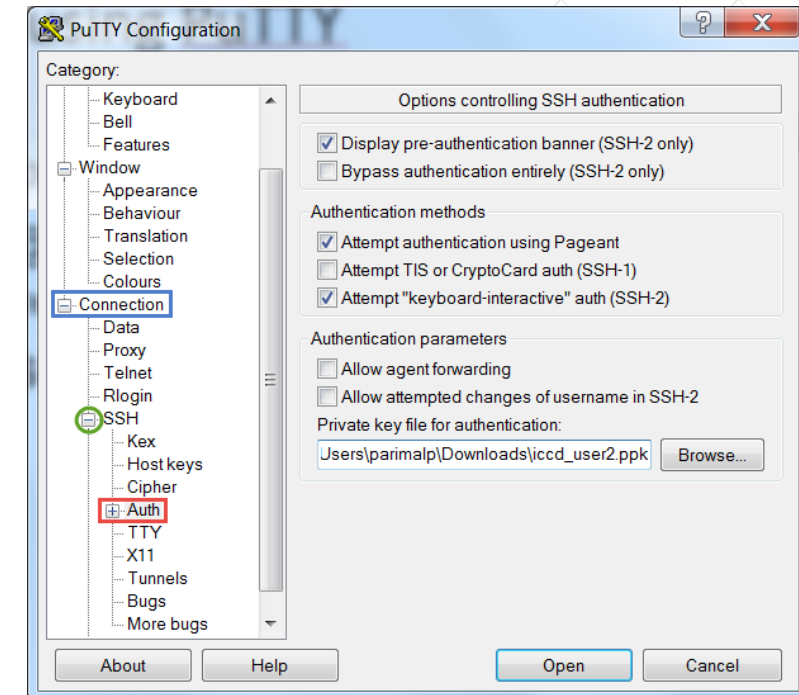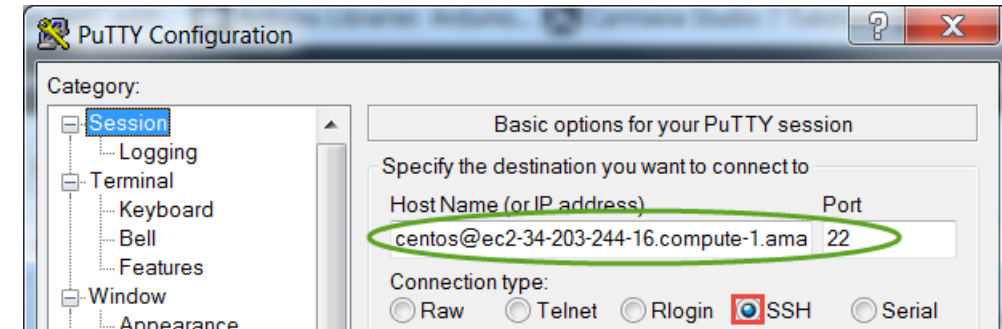
Connecting using PuTTY on VPN (Windows)

> **Start PuTTY program**

> **Enter centos@<public_dns entry> in
> the *Host Name* field and 22 in the *Port* field**

> **Make sure SSH is selected as the *Connection Type***

> **Select Proxy under the Connection**

> **Select HTTP as the *Proxy type*, proxy as the *Proxy hostname* and 80 as the *Port*
> number**

> **Expand *SSH* under the *Connection* and click Auth**

> **Click on the Browse button and browse to the location of the private key**

> **Click Open and then click Yes**

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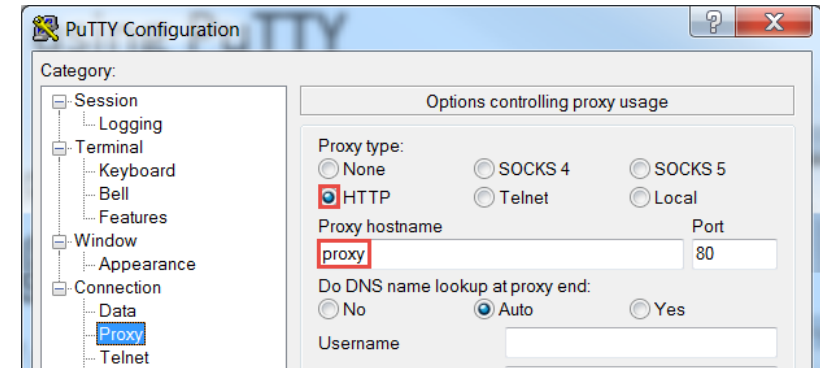
Connecting using Terminal (MAC)

> **Start a Terminal program**
>> Click on Finder, select Applications on left
>> Enter Terminal in the Search bar and double-click on the entry

> **Make sure that the access mode to the *.pem file is 400**

> **Enter the ssh command**

  `ssh -i <pem file> centos@<public_dns entry>`

> **At the centos prompt set the password if not already done**
>> This is needed to enable remote desktop connection: `sudo passwd centos`
>> Enter user password as the centos password

> **At this stage you can execute command line tasks**

```
-r--------  1 parimalp  staff  1696 Oct 25 12:23 iccd_user2.pem
[PATELs-MacBook-Pro:Documents parimalp$ ssh -i iccd_user2.pem centos@ec2-54-167-7]
2-110.compute-1.amazonaws.com
The authenticity of host 'ec2-54-167-72-110.compute-1.amazonaws.com (54.167.72.1
10)' can't be established.
ECDSA key fingerprint is SHA256:o9cPJGGL2iT5mNLdokPxt+XgywKzmibpo6rAC5Pj+rc.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'ec2-54-167-72-110.compute-1.amazonaws.com,54.167.72.
110' (ECDSA) to the list of known hosts.
Last login: Wed Oct 25 19:38:53 2017 from 108-93-8-67.lightspeed.snantx.sbcgloba
l.net

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   |  |  \/  | |  | \ |  __\ \/ /  /_\ |  |  |__|
   |  ||   _/ (_ | _ \ |  | ) | _ \ \ / /  / _ \ |\/| | | |
   |_| |_| \___/\_\ |___/|___| \/   /_/ \_\| |_|__|

AMI Version:          1.3.3
Readme:               /home/centos/src/README.md
GUI Setup Steps:      /home/centos/src/GUI_README.md
AMI Release Notes:    /home/centos/src/RELEASE_NOTES.md
Xilinx Tools:         /opt/Xilinx/
Developer Support:    https://github.com/aws/aws-fpga/blob/master/README.md#develo
per-support
Centos Common code: /srv/git/centos-git-common
[centos@ip-172-31-79-239 ~]$
```

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