Developing Cloud Scale FPGA Accelerations Using AWS F1

H²RC 2017
What is Elastic Compute Cloud (EC2)?
Amazon AWS Cloud

- Agility and speed of innovation
- Cost savings
- Elasticity
  Scale up or down quickly, as needed
- Breadth of functionality
- Go global in minutes
Innovating Faster Requires a New Model

- **Focus** on differentiating your company
- **Innovate** at start-up like speed
- **Reduce** risk
AWS Global Infrastructure

16 Regions – 44 Availability Zones – 100 Points of Presence*

**Region & Number of Availability Zones**

**AWS GovCloud (2)**
- EU
  - Ireland (3)
- Frankfurt (3)
- London (2)

**US West**
- Oregon (3)
- Northern California (3)

**US East**
- N. Virginia (6), Ohio (3)
- Singapore (2)
- Sydney (3), Tokyo (3), Seoul (2), Mumbai (2)

**Canada**
- Central (2)

**China**
- Beijing (2)

**South America**
- São Paulo (3)

**Announced Regions (6)**
- China, France, Hong Kong, Sweden, Bahrain, AWS GovCloud (US-East)

F1 Instance Available in Three Regions

*89 Edge Locations and 11 Regional Edge Caches
## AWS Instance Types

<table>
<thead>
<tr>
<th>General Purpose</th>
<th>Compute Optimized</th>
<th>Storage and IO Optimized</th>
<th>Memory Optimized</th>
<th>GPU Graphics</th>
<th>GPU, FPGA Compute</th>
</tr>
</thead>
<tbody>
<tr>
<td>M4</td>
<td>C5</td>
<td>I3</td>
<td>D2</td>
<td>G3</td>
<td>F1</td>
</tr>
<tr>
<td>T2</td>
<td>C4</td>
<td></td>
<td></td>
<td>G2</td>
<td>P3, P2</td>
</tr>
</tbody>
</table>
FPGA Acceleration Using F1: Goals

- **Make FPGAs available as standard AWS instances** to a large community of developers, and to millions of potential end-customers.

- **Simplify the development process** by providing cloud-based FPGA and C/C++ software development flows.

- **Allow developers to focus on algorithm design**, by abstracting FPGA I/O using well-defined interfaces.

- **Provide a Marketplace for FPGA applications**, providing more choice and easy access for all AWS customers.
F1 FPGA Instance Types on AWS

- Up to 8 Xilinx UltraScale+ 16nm VU9P FPGA devices in a single instance
- The 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

<table>
<thead>
<tr>
<th>Instance Size</th>
<th>FPGAs</th>
<th>DDR-4 (GiB)</th>
<th>vCPUs</th>
<th>Instance Memory (GiB)</th>
<th>NVMe Instance Storage (GB)</th>
<th>Network Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>f1.2xlarge</td>
<td>1</td>
<td>4 x 16</td>
<td>8</td>
<td>122</td>
<td>1 x 470</td>
<td>Up to 10 Gbps</td>
</tr>
<tr>
<td>f1.16xlarge</td>
<td>8</td>
<td>32 x 16</td>
<td>64</td>
<td>976</td>
<td>4 x 940</td>
<td>25 Gbps</td>
</tr>
</tbody>
</table>
FPGA Acceleration Using F1

Amazon Machine Image (AMI)

Amazon FPGA Image (AFI)

An F1 instance can have any number of AFIs

An AFI can be loaded into the FPGA in seconds

Launch F1 Instance and Load AFI

CPU Application

PCIe

DDR Controllers

DDR-4 Attached Memory

FPGA Link
Create the Amazon FPGA Image (AFI)

FPGA Developer AMI
Sold by: Amazon Web Services

The FPGA (field programmable gate array) AMI is a supported and maintained CentOS Linux image provided by Amazon Web Services. The AMI is pre-built with FPGA development tools and run time tools required to develop and use custom FPGAs for hardware acceleration. The FPGA developer AMI includes a pre-packaged tool development environment, with scripts and tools for simulating your FPGA design, compiling code, building and registering your AMI (Amazon FPGA Image). Developers can deploy the FPGA developer AMI on an Amazon EC2 instance and quickly provision the resources they need to write... Read more

Customer Rating ****** (0 Customer Reviews)
Latest Version 1.3.3
Operating System Linux/Unix, CentOS 7.3
Delivery Method 64-bit Amazon Machine Image (AMI) (Read more)
Support See details below
AWS Services Required Amazon EC2, Amazon EBS

Highlights
- Xilinx SDx 2017.1 - Free license for F1 FPGA development
- AWS Integration - includes packages and configurations that provide tight integration with Amazon Web Services

Product Description
The FPGA (field programmable gate array) AMI is a supported and maintained CentOS Linux image provided by Amazon Web Services. The AMI is pre-built with FPGA development tools and run time tools required to develop and use custom FPGAs for...
Create the Amazon FPGA Image (AFI)
Generate an encrypted AFI using the generated DCP

$ aws ec2 create-fpga-image --region <region> --name <afi-name> \ 
  --description <afi-description> \ 
  --input-storage-location Bucket=<dcp-bucket-name>,Key=<path-to-tarball> \ 
  --logs-storage-location Bucket=<logs-bucket-name>,Key=<path-to-logs> \ 
  [ --client-token <value> ] [ --dry-run | --no-dry-run ]

Write your FPGA code with the FPGA Hardware Development Kit and FPGA Developer AMI.

Register compiled code as Amazon FPGA Image (AFI).

Attach your AFI to an F1 Instance.

Attach your AFI with an AMI and offer on the AWS Marketplace.

AWS MARKETPLACE

F1 INSTANCE
F1 Use Cases and Partners

- Financial computing
- Genomics Sequencing
- Test and measurement
- Image and video processing
- Big data and machine learning
- Security, Compression
- …and more
Children’s Hospital of Philadelphia And Edico Genome Achieve Fastest-Ever Analysis Of 1,000 Genomes

ORLANDO, Fla., Oct. 19, 2017 — The Children’s Hospital of Philadelphia (CHOP) and Edico Genome today set a new scientific world standard in rapidly processing whole human genomes into data files useable for researchers aiming to bring precision medicine into mainstream clinical practice. Utilizing Edico Genome’s DRAGEN™ Genome Pipeline, deployed on 1,000 Amazon EC2 F1 Instances on the Amazon Web Services (AWS) Cloud, 1,000 pediatric genomes were processed in two hours and twenty-five minutes.
Connecting FPGA Partners with AWS Users

- edico genome
- DRAGEN on AWS F1
- illumina BaseSpace
- DNAanexus
Reconfigure.io delivers a breakthrough in compute performance, providing accessible hardware acceleration to cloud developers. Program FPGAs with Go!

Our service is built for usability first: familiar tools in a familiar environment, providing acceleration, parallelism and cost savings.

Simple developer-focused workflow: Code in Go, quick compatibility check, hardware simulation then build and deploy, all using our command line tool.

Our compiler digs down into low-level data handling to optimize and convert Go specifically for AWS F1 FPGAs. No hardware skills required!

Get started at Reconfigure.io

Merlin Compiler AMI

⭐⭐⭐⭐⭐ (0) | Version 1.0.1a | Sold by Falcon Computing Solutions, Inc.

14 Day Free Trial Available - The Merlin Compiler AMI is provided by Falcon Computing Solutions, Inc. The AMI is pre-built with Merlin Compiler that provides push-button C/C++...

Linux/Unix, CentOS 7.3 - 64-bit Amazon Machine Image (AMI)

Visual System Integrator for FPGA and Embedded Development

⭐⭐⭐⭐⭐ (0) | Version 2017.1_Autoupdate | Sold by System View

Starting from $0.50/hr or from $2,500.00/yr (43% savings) for software + AWS usage fees

Visual System Integrator is the one-of-a-kind tool for embedded development which, for the first time, makes it possible to develop a full functioning system. Visual System...

Linux/Unix, CentOS 7.3 - 64-bit Amazon Machine Image (AMI)

InTime

⭐⭐⭐⭐⭐ (0) | Version 2.3.0 | Sold by Plunify

InTime is an automated optimization software for FPGA design by Plunify. It optimizes timing and design performance using machine learning to find the best combination of...

Linux/Unix, CentOS 6.9 - 64-bit Amazon Machine Image (AMI)
Connecting FPGA Partners with AWS Users

skreens

Atomic Rules + NGCODEC

Next Generation Video Compression
Connecting FPGA Technology Partners with End customers

NGCodec and Tiledmedia to Show Cloud Hardware-Accelerated Low-Latency HEVC VR360 Streaming Solution at IBC 2017

- World's first implementation of Cloud hardware accelerated low latency HEVC VR360 Video Streaming

- Amazon EC2 FPGA Instances leveraged to reduce encoding costs by 10x compared to current software solutions

- At lower bitrates than legacy VR360 video streaming systems, delivers significantly better quality with lower latency
Bringing the Power of FPGAs to Everyone

Leverage Xilinx FPGA-based performance with CPU-like ease-of-use for lightning-fast insight from all your data and business analytics applications on AWS cloud.
- All our customers are interested in capabilities in the Cloud
- Instead of leading with our on-premises equipment we are leading with Cloud based solutions
- Create your own listing in AWS Marketplace via the self service listing mechanism
- Use “private” listing mode to validate documentation URLs and single & cluster instance creation
Amazon EC2 FPGA Deployment via Marketplace

Amazon Machine Image (AMI)

AWS Marketplace

Amazon FPGA Image (AFI)

Customers

AFI is secured, encrypted, dynamically loaded into the FPGA - can’t be copied or downloaded

Delivering FPGA Partner Solutions via AWS Marketplace

Amazon EC2 FPGA Deployment via Marketplace
AWS Marketplace
Discover, Procure, Deploy, and Manage Software in the Cloud

FPGA Developer AMI

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Linux/Unix, CentOS 7.3 - 64-bit Amazon Machine Image (AMI)

Mipsology

ZEBA on 1 FPGA (image classification)

Zebra offers users FPGA-based class-leading acceleration for neural network inference. The user-defined neural network works on Zebra just as it would on GPU or CPU. Zebra...

Linux/Unix, CentOS 7.3 - 64-bit Amazon Machine Image (AMI)

DRAGEN Genome Pipeline (Germline)

The DRAGEN Genome Pipeline** enables ultra-rapid analysis of Next Generation Sequencing (NGS) data, reducing the time required for analyzing a whole genome at 30x coverage...

Linux/Unix, CentOS 7.2 - 64-bit Amazon Machine Image (AMI)

Free Trial

Merlin Compiler AMI

14 Day Free Trial Available - The Merlin Compiler AMI is provided by Falcon Computing Solutions, Inc. The AMI is pre-built with Merlin Compiler that provides push-button C/C++...

Linux/Unix, CentOS 7.3 - 64-bit Amazon Machine Image (AMI)

Visual System Integrator for FPGA and Embedded Development

Starting from $2,000/hr or from $5,000/yr (43% savings) for software + AWS usage fees

Visual System Integrator is the one-of-a-kind tool for embedded development which, for the first time, makes it possible to develop a full functioning system. Visual System...

Linux/Unix, CentOS 7.3 - 64-bit Amazon Machine Image (AMI)

NGCodec HEVC Encoder C02

Using an F1 instance, offload HEVC encoding to an FPGA. This version of the NGCodec Encoder features low latency, I&F Frame encoding at up to 1080p60 resolution/frame rate.

Linux/Unix, Amazon Linux 5.1 - 64-bit Amazon Machine Image (AMI)

PLUNIFY

InTime

InTime is an automated optimization software for FPGA design by Plunify. It optimizes timing and design performance using machine learning to find the best combination of...

Linux/Unix, CentOS 6.9 - 64-bit Amazon Machine Image (AMI)

FireSim Demo v1.0

FireSim is an FPGA-accelerated hardware simulation tool that cycle-accurately simulates RISC-V RocketChip-based clusters, with peripherals like disks and network interface...

Linux/Unix, CentOS 7.3 - 64-bit Amazon Machine Image (AMI)

Toolkit Powered by RTF X86 Computing

Starting from $1.00 to $1.00/hr for software + AWS usage fees

Ryft’s Toolkit is a pre-configured, ready to run image for instantly integrating smarter, more sophisticated FPGA-accelerated search & analysis capabilities into existing data analytics interfaces...

Linux/Unix, Ubuntu 16.04 - 64-bit Amazon Machine Image (AMI)

Toolkit Powered by RTF Heterogeneous Computing

Starting from $1.00 to $1.00/hr for software + AWS usage fees

Ryft’s Toolkit is a pre-configured, ready to run image for instantly integrating smarter, more sophisticated FPGA-accelerated search & analysis capabilities into existing...

Linux/Unix, Ubuntu 16.05 - 64-bit Amazon Machine Image (AMI)
Interested in Becoming an AWS EC2 F1 Instance Partner?

AWS EC2 F1 Instance participates in the AWS Service Delivery Program. The Service Delivery Program recognizes APN Partners with a verified track record of delivering specific AWS services and workloads to AWS customers, including AWS EC2 F1 Instance. To apply to become a AWS Service Delivery Partner, apply online through the APN Portal today.

https://aws.amazon.com/partners/
Thank you!
duff@amazon.com