ROCm

Release Notes v3.1.1

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Advanced Micro Devices, Inc.

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As of Jun 19, 2019. Radeon Instinct™ MI50 and MI60 "Vega 7nm" technology-based accelerators support PCIe® Gen 4.0* providing up to 64 GB/s peak theoretical transport data bandwidth from CPU to GPU per card. Previous Gen Radeon Instinct compute GPU cards are based on PCIe Gen 3.0 providing up to 32 GB/s peak theoretical transport rate bandwidth performance. Peak theoretical transport rate performance is calculated by Baud Rate * width in bytes *# directions = GB/s per card. PCIe Gen3: 8 * 2 * 2 = 32 GB/s. PCIe Gen4: 16 * 2 * 2 = 64 GB/s.
Radeon Instinct™ MI50 and MI60 "Vega 7nm" technology-based accelerators include dual Infinity Fabric™ Links providing up to 184 GB/s peak theoretical GPU to GPU or Peer-to-Peer (P2P) transport rate bandwidth performance per GPU card. Combined with PCIe Gen 4 compatibility providing an aggregate GPU card I/O peak bandwidth of up to 248 GB/s. Performance guidelines are estimated only and may vary. Previous Gen Radeon Instinct compute GPU cards provide up to 32 GB/s peak PCIe Gen 3.0 bandwidth performance. Infinity Fabric Link technology peak theoretical transport rate performance is calculated by Baud Rate * width in bytes *# directions *# links = GB/s per card. Infinity Fabric Link: 23 * 2 * 2 = 92 GB/s. MI50 | MI60 each have two links: 92 GB/s * 2 links per GPU = 184 GB/s. Refer to server manufacture PCIe Gen 4.0 compatibility and performance guidelines for potential peak performance of the specified server model numbers. Server manufacturers may vary configuration offerings yielding different results. https://pcisig.com/ , https://www.chipestimate.com/PCI-Ex- press-Gen-4-a-Big-Pipe-for-Big-Data/Cadence/Technical-Article/2014/04/15 , https://www.tomshardware.com/news/pcie-4.0-power-speed-express,32525.html AMD has not independently tested or verified external/third party results/data and bears no responsibility for any errors or omissions therein. RIV-18

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Chapter 1 Introduction

This document describes the features, fixed issues, and information about downloading and installing the ROCm software.

It also covers fixed issues, known issues, and deprecated features in the ROCm v3.1.1 release.

1.1 What Is ROCm?

The Radeon Open Compute platform (ROCm) is designed to be a universal platform for GPU-accelerated computing. This modular design allows hardware vendors to build drivers that support the ROCm framework. ROCm is also designed to integrate multiple programming languages and makes it easy to add support for other languages.

ROCm is built from open source software. Subject to the applicable license, you can download the source code, modify and rebuild the ROCm components. To ensure you are downloading the correct source code versions, the ROCm repository provides a repo manifest file called *default.xml*.

Note: You can also clone the source code for individual ROCm components from the GitHub repositories.

1.1.1 ROCm Components

The following components for the ROCm platform are released and available for the v3.1.1 release:

- Drivers
- ToolChains
- Libraries
- Source Code

You can access the latest supported version of drivers, tools, libraries, and source code for the ROCm platform at the following location:

https://github.com/RadeonOpenCompute/ROCm

1.1.2 Supported Operating Systems

The ROCm v3.1.x platform is designed to support the following operating systems:

- Ubuntu v16.04.6(Kernel 4.15) and 18.04.3 support (5.3 kernel)
- CentOS v7.7 (Using devtoolset-7 runtime support)
- RHEL v7.7 (Using devtoolset-7 runtime support)
- SLES 15 Service Pack 1

For details about deploying the ROCm v3.1.x on these operating systems, see *https://rocm-documentation.readthedocs.io/en/latest/Installation_Guide/Installation-Guide.html#installation-guide*

1.1.3 Important ROCm Links

Access the following links for more information on:

- ROCm QuickStart Installation Guide – for installation instructions on all platforms

  https://github.com/RadeonOpenCompute/ROCm/blob/master/AMD_ROCm_QuickStart_Installation_Guide_v3.1.pdf

- ROCm documentation, see *https://rocm-documentation.readthedocs.io/en/latest/index.html*

- ROCm binary structure, see *https://github.com/RadeonOpenCompute/ROCm/blob/master/README.md#rocm-binary-package-structure*

- Instructions to install PyTorch after ROCm is installed – *https://rocm-documentation.readthedocs.io/en/latest/Deep_learning/Deep-learning.html#pytorch*

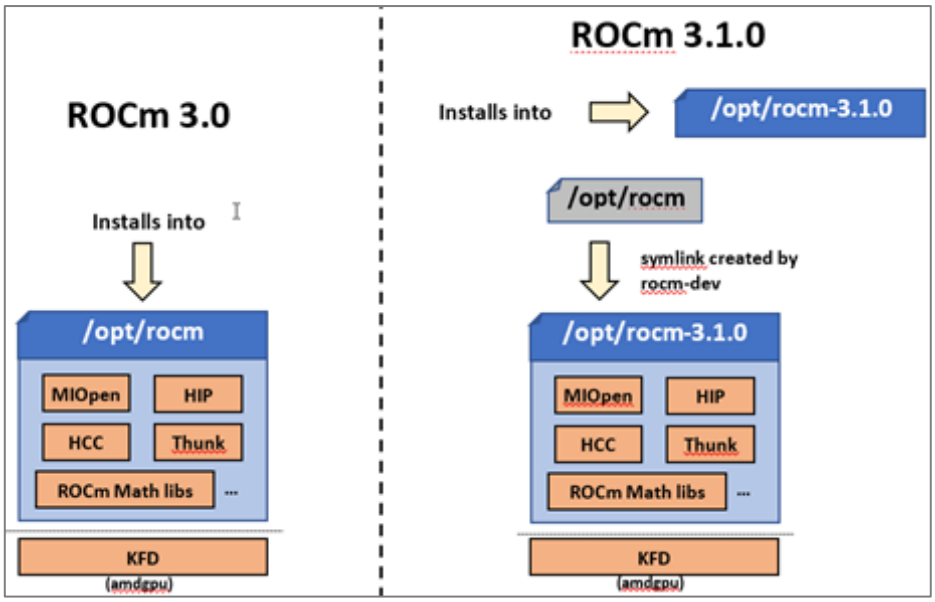
  Note: These instructions reference the rocm/pytorch:rocm3.1_ubuntu16.04_py2.7_pytorch image. However, you can substitute the Ubuntu 18.04.x image listed at *https://hub.docker.com/r/rocm/pytorch/tags*

Chapter 2 What's New in This Release

2.1 Change in ROCm Installation Directory Structure

A fresh installation of the ROCm toolkit installs the packages in the */opt/rocm-<version>* folder.

Previously, ROCm toolkit packages were installed in the */opt/rocm* folder.



2.2 Reliability, Accessibility, and Serviceability Support for Vega 7nm

The Reliability, Accessibility, and Serviceability (RAS) support for Vega7nm is now available. The support includes:

- UMC RAS – HBM ECC (uncorrectable error injection), page retirement, RAS recovery via GPU (BACO) reset
- GFX RAS – GFX, MMHUB ECC (uncorrectable error injection), RAS recovery via GPU (BACO) reset
- PCIE RAS – PCIE_BIF ECC (uncorrectable error injection), RAS recovery via GPU (BACO) reset

2.3 SLURM Support for AMD GPU

SLURM (Simple Linux Utility for Resource Management) is an open source, fault-tolerant, and highly scalable cluster management and job scheduling system for large and small Linux clusters. The latest version 20.02.0 of SLURM includes AMD plugins that enable SLURM to detect and configure AMD GPU automatically. It also collects and reports the energy consumption of AMD GPU.

Chapter 3 Fixed Issues

3.1 Fixed Issues in the v3.1.1 Release

The following issue is fixed in this release:

3.1.1 Failing PyTorch c10d Unit Tests

Issue: PyTorch c10d unit tests failed due to incorrect treatment of an edge case condition in HIP.

Resolution: This issue is fixed and the PyTorch c10d unit tests no longer fail.

Chapter 4 Known Issues

4.1 Known Issues in the v3.1.1 Release

4.1.1 MIVision/MIGraphX Installation

- Install and use the latest version of the MIVision/MIGraphX code.
- Ensure the */opt/rocm* symbolic link for the new version of ROCm is present and points to the right version of the ROCm toolkit.

4.1.2 Using TensorFlow

The TensorFlow build system requires the following additional changes to support the new installation path:

- Ensure the */opt/rocm* symbolic link is preset and points to the right version of the ROCm toolkit.
- Modify the build configure file to include the header files from the respective ROCm version-specific folder

4.1.3 HIP Compiler Dependency Issue

If the HIP compiler has a dependency on */opt/rocm*, use the following workaround:

- Ensure the */opt/rocm* symbolic link points to the right version of the ROCm software
- Use the *ROCM_PATH* environment variable that points to the version of the ROCm software installed on the system.
- Use the *rocm-dkms* package to install required ROCm components.

4.1.4 Error Running ROC Profiler

Issue: Running ROC profiler results in the following error -

“: hip / hsa trace due to "ImportError: No module named sqlite3" error”

Workaround: Export the Python version before running ROC profiler:

```
export ROCP_PYTHON_VERSION=<python version>

ex: export ROCP_PYTHON_VERSION=python3
```

Chapter 5 Hardware and Software Support

5.1 Hardware Support

ROCm is focused on using AMD GPUs to accelerate computational tasks such as machine learning, engineering workloads, and scientific computing. In order to focus our development efforts on these domains of interest, ROCm supports the following targeted set of hardware configurations.

5.1.1 Supported Graphics Processing Units

As the AMD ROCm platform has a focus on specific computational domains, AMD offers official support for a selection of GPUs that are designed to offer good performance and price in these domains.

ROCm officially supports AMD GPUs that use the following chips:

- GFX8 GPUs
  "Fiji" chips, such as on the AMD Radeon R9 Fury X and Radeon Instinct MI8
  "Polaris 10" chips, such as on the AMD Radeon RX 580 and Radeon Instinct MI6

- GFX9 GPUs
  "Vega 10" chips, such as on the AMD Radeon RX Vega 64 and Radeon Instinct MI25
  "Vega 7nm" chips, such as on the Radeon Instinct MI50, Radeon Instinct MI60 or AMD Radeon VII

ROCm is a collection of software ranging from drivers and runtimes to libraries and developer tools. Some of this software may work with more GPUs than the "officially supported" list above, though AMD does not make any official claims of support for these devices on the ROCm software platform. The following list of GPUs is enabled in the ROCm software. However, full support is not guaranteed:

- GFX8 GPUs
  "Polaris 11" chips, such as on the AMD Radeon RX 570 and Radeon Pro WX 4100
  "Polaris 12" chips, such as on the AMD Radeon RX 550 and Radeon RX 540

- GFX7 GPUs
  "Hawaii" chips, such as the AMD Radeon R9 390X and FirePro W9100

As described in the next section, GFX8 GPUs require PCI Express 3.1 (PCIe 3.1) with support for PCIe atomics. This requires both CPU and motherboard support. GFX9 GPUs require PCIe 3.1 with support for PCIe atomics by default, but they can operate in most cases without this capability.

The integrated GPUs in AMD APUs are not officially supported targets for ROCm. As described below, "Carrizo", "Bristol Ridge", and "Raven Ridge" APUs are enabled in AMD upstream drivers and the ROCm OpenCL runtime. However, they are not enabled in AMD HCC or HIP runtimes, and may not work due to motherboard or OEM hardware limitations. Note, they are not yet officially supported targets for ROCm.

5.1.1.1 GFX8 GPUs

ROCm offers support for the following microprocessors from AMD's "gfx8" generation of GPUs.

Note: The GPUs require a host CPU and platform with PCIe 3.1 with support for PCIe atomics.

GFX8 GPUs			
Fiji (AMD)	**Polaris 10 (AMD)**	**Polaris 11 (AMD)**	**Polaris 12 (Lexa) (AMD)**
• Radeon R9 Fury • Radeon R9 Nano • Radeon R9 Fury X • Radeon Pro Duo (Fiji) • FirePro S9300 X2 • Radeon Instinct MI8	• Radeon RX 470 • Radeon RX 480 • Radeon RX 570 • Radeon RX	• Radeon RX 460 • Radeon RX 560 • Radeon Pro WX 4100	• Radeon RX 540 • Radeon RX 550 • Radeon Pro WX 2100 • Radeon Pro

	580 • Radeon Pro Duo (Polaris) • Radeon Pro WX 5100 • Radeon Pro WX 7100 • Radeon Instinct MI6		WX 3100

5.1.1.2 GFX9 GPUs

ROCm offers support for two chips from AMD's most recent "gfx9" generation of GPUs.

GFX9 GPUs	
Vega 10 (AMD)	**Vega 7nm (AMD)**
• Radeon RX Vega 56 • Radeon RX Vega 64 • Radeon Vega Frontier Edition • Radeon Pro WX 8200 • Radeon Pro WX 9100 • Radeon Pro V340 • Radeon Pro V340 MxGPU • Radeon Instinct MI25 **Note:** ROCm does not support Radeon Pro SSG.	• Radeon VII • Radeon Instinct MI50 • Radeon Instinct MI60

5.1.2 Supported CPUs

As described above, GFX8 GPUs require PCIe 3.1 with PCIe atomics to run ROCm. In particular, the CPU and every active PCIe point between the CPU and GPU require support for PCIe 3.1 and PCIe atomics. The CPU root must indicate PCIe AtomicOp Completion capabilities and any intermediate switch must indicate PCIe AtomicOp Routing capabilities.

The current CPUs which support PCIe Gen3 + PCIe Atomics are:

- AMD Ryzen CPUs
- CPUs in AMD Ryzen APUs
- AMD Ryzen Threadripper CPUs
- AMD EPYC CPUs
- Intel Xeon E7 v3 or newer CPUs

- Intel Xeon E5 v3 or newer CPUs
- Intel Xeon E3 v3 or newer CPUs
- Intel Core i7 v4, Core i5 v4, Core i3 v4 or newer CPUs (i.e. Haswell family or newer)
- Some Ivy Bridge-E systems

Beginning with ROCm 1.8, GFX9 GPUs (such as Vega 10) no longer require PCIe atomics. We have similarly made more options available for many PCIe lanes. GFX9 GPUs can now be run on CPUs without PCIe atomics and on older PCIe generations, such as PCIe 2.0. This is not supported on GPUs below GFX9, e.g. GFX8 cards in the Fiji and Polaris families.

If you are using any PCIe switches in your system, please note that PCIe Atomics are only supported on some switches, such as Broadcom PLX. When you install your GPUs, make sure you install them in a PCIe 3.1 x16, x8, x4, or x1 slot attached either directly to the CPU's Root I/O controller or via a PCIe switch directly attached to the CPU's Root I/O controller.

In our experience, many issues stem from trying to use consumer motherboards which provide physical x16 connectors that are electrically connected as e.g. PCIe 2.0 x4, PCIe slots connected via the Southbridge PCIe I/O controller, or PCIe slots connected through a PCIe switch that does not support PCIe atomics.

If you attempt to run ROCm on a system without proper PCIe atomic support, you may see an error in the kernel log (`dmesg`):

kfd: skipped device 1002:7300, PCI rejects atomics

Experimental support for our Hawaii (GFX7) GPUs (Radeon R9 290, R9 390, FirePro W9100, S9150, S9170) does not require or take advantage of PCIe Atomics. However, AMD recommends that you use a CPU from the list provided above for compatibility purposes.

5.1.2.1 Not supported or limited support under ROCm

5.1.2.1.1 Limited support

- ROCm 3.1.x should support PCIe 2.0 enabled CPUs such as the AMD Opteron, Phenom, Phenom II, Athlon, Athlon X2, Athlon II and older Intel Xeon and Intel Core Architecture and Pentium CPUs. However, we have done very limited testing on these configurations, since our test farm has been catering to CPUs listed above. This is where we need community support. *If you find problems on such setups, please report these issues*.
- Thunderbolt 1, 2, and 3 enabled breakout boxes should now be able to work with ROCm. Thunderbolt 1 and 2 are PCIe 2.0 based, and thus are only supported with GPUs that do not require PCIe 3.1 atomics (e.g. Vega 10). However, we have done no testing on this configuration and would need community support due to limited access to this type of equipment.
- AMD "Carrizo" and "Bristol Ridge" APUs are enabled to run OpenCL, but do not yet support HCC, HIP, or our libraries built on top of these compilers and runtimes.

  - As of ROCm 2.1, "Carrizo" and "Bristol Ridge" require the use of upstream kernel drivers.
  - In addition, various "Carrizo" and "Bristol Ridge" platforms may not work due to OEM and ODM choices when it comes to key configurations parameters such as inclusion of the required CRAT tables and IOMMU configuration parameters in the system BIOS.
  - Before purchasing such a system for ROCm, please verify that the BIOS provides an option for enabling IOMMUv2 and that the system BIOS properly exposes the correct CRAT table. Inquire with your vendor about the latter.

- AMD "Raven Ridge" APUs are enabled to run OpenCL, but do not yet support HCC, HIP, or our libraries built on top of these compilers and runtimes.
  - As of ROCm 2.1, "Raven Ridge" requires the use of upstream kernel drivers.
  - In addition, various "Raven Ridge" platforms may not work due to OEM and ODM choices when it comes to key configurations parameters such as inclusion of the required CRAT tables and IOMMU configuration parameters in the system BIOS.
  - Before purchasing such a system for ROCm, please verify that the BIOS provides an option for enabling IOMMUv2 and that the system BIOS properly exposes the correct CRAT table. Inquire with your vendor about the latter.

5.1.2.1.2 Not supported

- "Tonga", "Iceland", "Vega M", and "Vega 12" GPUs are not supported.
- AMD does not support GFX8-class GPUs (Fiji, Polaris, etc.) on CPUs that do not have PCIe3.1 with PCIe atomics.
  - AMD Carrizo and Kaveri APUs as hosts for such GPUs are not supported
  - Thunderbolt 1 and 2 enabled GPUs are not supported by GFX8 GPUs on ROCm. Thunderbolt 1 & 2 are based on PCIe 2.0.

In the default ROCm configuration, GFX8 and GFX9 GPUs require PCI Express 3.1 with PCIe atomics. The ROCm platform leverages these advanced capabilities to allow features such as user-level submission of work from the host to the GPU. This includes PCIe atomic Fetch and Add, Compare and Swap, Unconditional Swap, and AtomicOp Completion.

Current CPUs which support PCIe 3.1 + PCIe Atomics:

AMD	INTEL
Ryzen CPUs (Family 17h Model 01h-0Fh) • Ryzen 3 1300X • Ryzen 3 2300X • Ryzen 5 1600X • Ryzen 5 2600X • Ryzen 7 1800X	Intel Core i3, i5, and i7 CPUs from Haswell and beyond. This includes: • Haswell CPUs such as the Core i7 4790K

• Ryzen 7 2700X	• Broadwell CPUs such as the Core i7 5775C • Skylake CPUs such as the Core i7 6700K • Kaby Lake CPUs such as the Core i7 7740X • Coffee Lake CPUs such as the Core i7 8700K • Xeon CPUs from "v3" and newer • Some models of "Ivy Bridge-E" processors
Ryzen APUs (Family 17h Model 10h-1Fh – previously code-named Raven Ridge) such as: • Athlon 200GE • Ryzen 5 2400G **Note:** The integrated GPU in these devices is not guaranteed to work with ROCm.	
Ryzen Threadripper Workstation CPUs (Family 17h Model 01h-0Fh) such as: • Ryzen Threadripper 1950X • Ryzen Threadripper 2990WX	
EPYC Server CPUs (Family 17h Model 01h-0Fh) such as: • Epyc 7551P • Epyc 7601	

5.2 Software Support

As of AMD ROCm v1.9.0, the ROCm user-level software is compatible with the AMD drivers in certain upstream Linux kernels. You have the following options:

- Use the ROCk kernel driver that is a part of AMD's ROCm repositories
  or
- Use the upstream driver and only install ROCm user-level utilities from AMD's ROCm repositories

The releases of the upstream Linux kernel support the following GPUs in ROCm:

- Fiji, Polaris 10, Polaris 11
- Fiji, Polaris 10, Polaris 11, Vega10
- Fiji, Polaris 10, Polaris 11, Vega10, Vega 7nm