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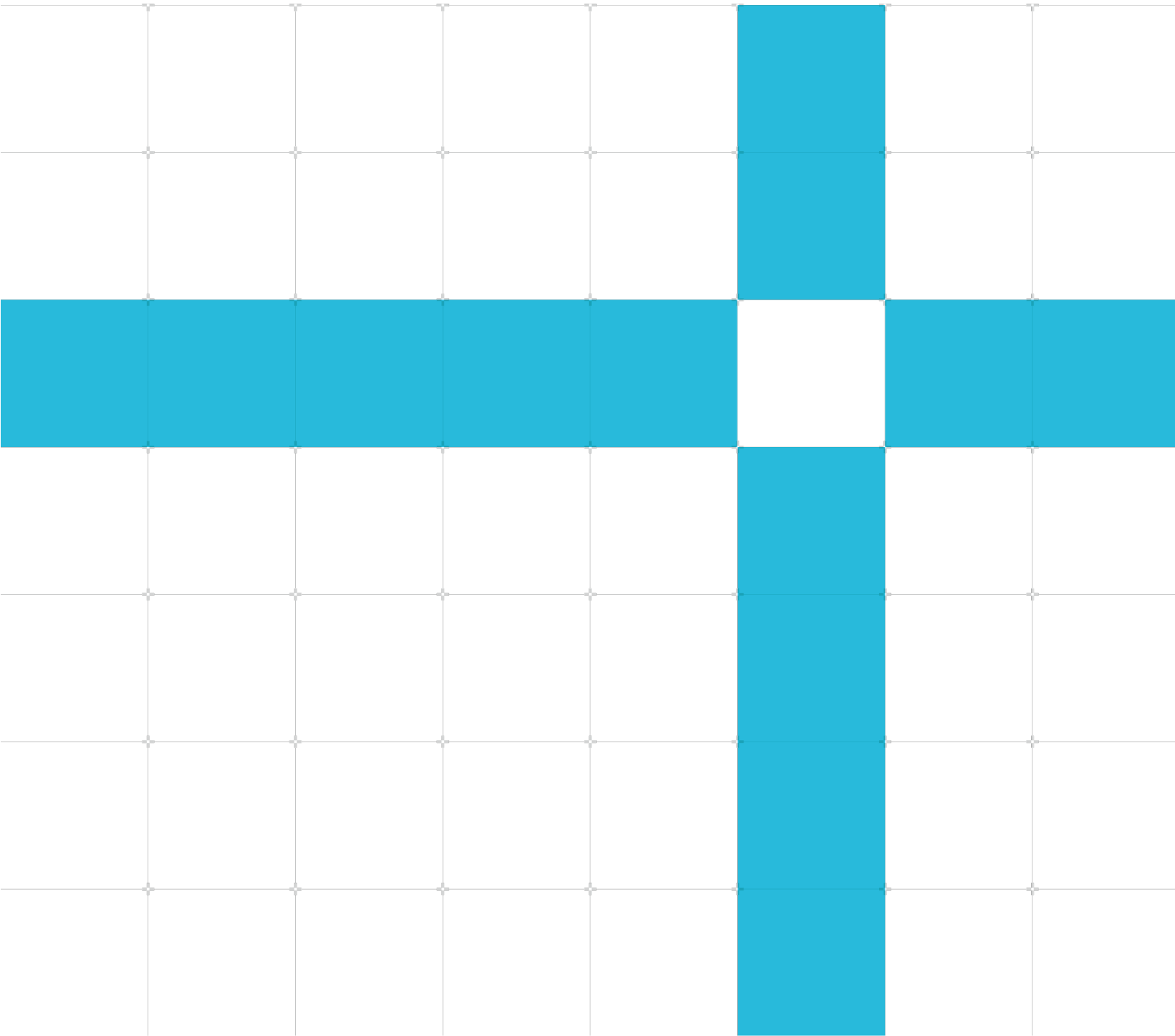
Arm Compiler for Linux

Product revision: 22.1

Release Note

Non-Confidential

Document ID:
107578



Arm Compiler for Linux

Release Note

Non-Confidential Proprietary Notice

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(LES-PRE-20349)

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Product status

The information in this document is Final, that is for a developed product.

Feedback

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To provide feedback on the document, fill the following survey:
https://developer.arm.com/documentation-feedback-survey.

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1 Release overview

The following sections describe the product that this release note describes and its quality status at time of release.

1.1 Product description

The Arm Compiler for Linux 22.1 suite provides a complete compiling environment for natively developing and tuning your server and HPC applications on Arm-based platforms.

The suite contains the following packages:

- Arm C/C++/Fortran Compiler 22.1

  Arm Compiler is a Linux user-space C/C++ and Fortran compiler tailored for scientific computing, HPC, and enterprise workloads.

- Arm Performance Libraries 22.1.0

  Arm Performance Libraries contains optimized math functions, such as linear algebra and Fast Fourier Transforms, for Arm AArch64 implementations, including those with SVE. It is compatible with Arm C/C++/Fortran Compiler 22.1 and GCC 11.2.0.

  Arm Performance Libraries is optimized for a number of microarchitectures. The latest information is available on the Arm Developer website:

  https://developer.arm.com/Tools%20and%20Software/Arm%20Compiler%20for%20Linux#Supported-Devices

- GCC 11.2.0

  For convenience, and to provide the optimal experience of using Arm Performance Libraries and GCC on the latest Arm server and HPC systems, a build of GCC 11.2.0 is provided. The GCC 11.2.0 build is also provided for OpenMP/libgfortran compatibility with Arm Performance Libraries.

  As a GNU tool suite, the GPL-licensed source code can be downloaded separately.

1.2 Release status

This is the 22.1 release of the Arm Compiler for Linux software.

These deliverables are being released under the terms of the agreement between Arm and each licensee (the "Agreement"). All planned verification and validation is complete.

The release is suitable for volume production under the terms of the Agreement.

2 Release contents

The following sections describe:

- Downloading and unpacking the product.
- The contents of this release.
- Any changes since the previous release.
- Any known issues and limitations that exist at the time of this release.

2.1 Licensing information

Use of Arm Compiler for Linux is subject to the terms and conditions of the applicable End User License Agreement (“EULA”). A copy of the EULA can be found in the 'license_terms' folder of your product installation.

You do not require a license to use this Arm Compiler for Linux package.

2.2 Prerequisites

If any of the following tools are not already installed by your Linux distribution, you must install them before installing Arm Compiler for Linux:

- Python (version 2.7 or later)

  To ensure you have the necessary version of Python for your system, install Python using the appropriate package manager for your OS.

- C Libraries:

  SLES and RHEL: glibc-devel

  Ubuntu: libc6-dev

You must have at least 2 GB of free hard disk space to both download and unpack the Arm Compiler for Linux package. You must also have an additional 6 GB of free space to install the package.

2.3 Download the product

Arm delivers the files through the Arm Developer website:

https://developer.arm.com/Tools%20and%20Software/Arm%20Compiler%20for%20Linux#Technical-Specifications

2.4 Unpack the product

To unpack the package, extract the tar file contents using a tar utility:

```
tar -xvf <package_name>.tar
```

2.5 Directory structure

Shows the top-level directory structure of this installer package, which is available after you unpack the bundle:

```
license_terms/
arm-compiler-for-linux-22.1*.sh
RELEASE_NOTES.txt
```

2.6 Install the product

To install Arm Compiler for Linux, navigate into the extracted package directory (<package_name>) and run the installation script as a privileged user. Pass any options to configure the installation:

```
cd path/to/<package_name>/
./arm-compiler-for-linux-22.1*.sh [option]...
```

Some common installation options are:

- For a headless installation and to automatically accept the EULA, use the '--accept' option.

- To install to an alternate location to the default, use the '--install-to <install_location>' option.

For a full list of supported installation options pass the '-h' or '--help' options to the installer script.

To learn more about installing Arm Compiler for Linux, see:

https://developer.arm.com/documentation/102621/latest/

The installer displays the EULA and prompts you to agree to the terms. Type 'yes' at the prompt to continue.

All the packages are unpacked to <install_location>/<package_name> with environment modulefiles available under <install_location>/modulefiles. The default installation location is /opt/arm/. Local installs have the same directory structure starting from your chosen installation root.

2.7 RPM and DEB files

The install packages contain RPM (.rpm) files, for Red Hat-based Linux distributions, or DEB (.deb) files, for Debian-based Linux distributions.

To extract the .rpm or .deb files from the installer, run the installer script with the '-s' or '--save-packages-to <directory_location>' option. If <directory_location> is not an empty directory, you also need to include the '-f' or '--force' option. The installer script requires you to accept the EULA. If you accept the EULA, the .rpm or .deb files extract to <directory_location>.

RPM files are signed by Arm's HPC GPG key. DEB files are not signed. To verify RPM files, you can download and import the Arm's HPC GPG key, and check the signatures:

1. Download the Arm HPC GPG public key from: https://developer.arm.com/-/media/files/keys/GPG-PUB-KEY-ARM-HPC-SW-TOOLS.PUB
2. Import the GPG key, run: rpm --import GPG-PUB-KEY-ARM-HPC-SW-TOOLS.PUB
3. Check the signature of an .rpm file, run: rpm -K <rpm_file>

To install an RPM file, use 'rpm -i <rpm_file>'. To install a DEB file, use 'dpkg -i <deb_file>'.

Note: Arm does not recommend that you install directly from the .rpm or .deb files. Only experienced users who are comfortable with this type of installation route should attempt to install the Arm Compiler for Linux package using this method.

2.8 Run the product

1. Load the environment module:

   For Arm C/C++/Fortran Compiler, use:

   ```
   module load acfl/22.1
   ```

   To also use Arm Performance Libraries, include the ``-armpl`` compiler option when linking your executable. You do not need to load the Arm Performance Libraries modulefile.

   For GCC 11.2.0 only, use:

   ```
   module load gnu/11.2.0
   ```

   For GCC 11.2.0 with Arm Performance Libraries, use:

   ```
   module load gnu/11.2.0
   module load armpl/22.1.0
   ```

2. Generate your executable binary.

   To generate an executable binary with Arm Compiler for Linux, compile your program with Arm C/C++/Fortran Compiler and specify any options ([options]), the output binary name (-o <binary>), and the input file (<input>):

   {armclang|armclang++|armflang} [options] -o <binary> <input>

Refer to the GCC documentation to see the equivalent command syntax for the GCC compiler.

2.9 Examples

Example code is included in this suite as part of Arm Performance Libraries. This code can be found at:

<install_location>/<ARMPL_Name>*<ARMPL_Version>*/examples*

Examples that use, and do not use, SVE are included for each of Arm C/C++/Fortran Compiler and GCC.

Multiple examples directories are provided in the installation. The suffix of the directory name indicates whether the examples inside link to the 32-bit ('_lp64') or 64-bit ('_ilp64') integer variants, and sequential (no suffix indicator) or OpenMP ('_mp') multi-threaded variants, of Arm Performance Libraries.

The default set of examples in the 'examples' directory link to the sequential, 32-bit integers variant of Arm Performance Libraries.

To build the default set of examples:

* For Arm Compiler for Linux:

1. Copy the 'examples' directory somewhere writeable:
   cp -r <install_location>/armpl-22.1.0_AArch64_*arm-linux-compiler*/examples ./cd examples
2. Load the Arm Compiler for Linux environment module:
   module load acfl/22.1
3. Build the examples:
   make

* For GCC:

1. Copy the 'examples' directory somewhere writeable:
   cp -r <install_location>/armpl-22.1.0_AArch64_*gcc*/examples ./cd examples
2. Load the GCC environment modules:
   module load gnu/11.2.0
   module load armpl/22.1.0
3. Build the examples:
   Make

For more information about the Arm Performance Libraries examples, see:

https://developer.arm.com/documentation/102574/0100/compile-an-example

2.10 Uninstall

For convenience, this package includes an "uninstall.sh" script at:

<install_location>/arm-compiler-for-linux-22.1*/uninstall.sh

This script attempts to uninstall all the components supplied as part of Arm Compiler for Linux. However, if other packages outside of this product depend on the GCC component, GCC will not be uninstalled.

2.11 Deliverables

The downloaded product includes the deliverables listed in this section.

- Arm C/C+/Fortran Compiler 22.1

- Arm Performance Libraries 22.1.0

- GCC 11.2.0

- Release Notes (this document)

- Documentation

Arm Compiler for Linux reference guides are available in <install_location>/<package_name>/share. The guides that are in the '/share' location are also available on the Arm Developer website:

https://developer.arm.com/Tools%20and%20Software/Arm%20Compiler%20for%20Linux#Resources

The same Arm Developer web page also contains links to tutorials, installation guides, and application porting guides.

Documentation and release notes might change between product releases. For the latest documentation bundle, check the product download page.

Arm tests its PDFs only in Adobe Acrobat and Acrobat Reader. Arm cannot guarantee the quality of this document when used with any other PDF reader.
A suitable PDF reader can be downloaded from Adobe at **http://www.adobe.com**.

2.12 Differences from previous release

Arm Compiler for Linux 22.1 includes various internal changes that resolve defects and improve performance.

The following subsections describe the significant differences from the previous release of Arm Compiler for Linux.

2.12.1 Additions and changes

This section describes the new features or components added, or any significant technical changes to features or components, in the 22.1 release.

- Arm Compiler for Linux suite 22.1:

    - No changes

- Arm C/C++/Fortran Compiler 22.1:

    - In previous releases, Arm Compiler for Linux supported custom extensions to the OpenMP pragma "declare variant". These extensions are deprecated in Arm Compiler for Linux 22.1. Support will be removed from Arm Compiler for Linux in version 23.0. As a result users won't be able to define custom vector equivalents of scalar functions. Arm Compiler for Linux 22.1 issues a warning message when such a construct is encountered. The deprecated features are:
      - The "scalable" extension to the #pragma omp declare variant,
      - Specifying context properties for the context set 'construct' in the context selector 'simd', in certain constructs. See documentation for more details: https://developer.arm.com/documentation/101458/2202/Optimize/Vector-routines-support/How-to-declare-custom-vector-routines-in-Arm-C-C---Compiler

    - Improved the vectorization of loops that include the 'omp parallel for' or 'omp parallel for simd' constructs.

- Arm Performance Libraries 22.1.0:

    - Increased performance for:
        - BLAS level 1 and level 2 routines in serial and parallel.
        - BLAS DGEMM scaling for high numbers of cores.
        - FFT functions.

- LAPACK SVD routines *GESVD, *GESDD, involving:

- *ORGQR, *ORMQR, *UNGQR, *UNMQR, *ORGLQ, *ORMLQ, *UNGLQ, *UNMLQ, *BDSQR, *GEBRD, *GEQRF.

- Performance improvements in libamath, for:

- asinh (scalar), asinhf (scalar & vector)

- exp, expf (vector)

- log10, log10f (vector)

- log1p (scalar), log1pf (scalar & vector)

- Support for LAPACK version 3.10.1.

2.12.2 Resolved issues

Describes any technical issues that are resolved in the 22.1 release.

- Arm Compiler for Linux suite 22.1:

- The Arm Compiler for Linux installer no longer requires a python2 installation.

- Arm C/C++/Fortran Compiler 22.1:

- Fixed an internal compiler error in armflang when the move_alloc Fortran intrinsic procedure is called on a field value of a deeply nested derived type.

- Fixed an internal compiler error in armclang that caused the error "fatal error: error in backend: Cannot select" when compiling code using a bfcvt instruction in an inline assembly block at -O1 and above.

- Fixed a code generation bug affecting functions that contain SVE state and allocate variable length arrays

- Fixed an issue where the ACLE feature macros for the BFloat16 extension were not correctly defined on targets where the extension is supported.

- Fixed a compilation failure when including the arm_sve.h header with the POSIX netdb.h header.

- Arm Performance Libraries 22.1.0:

- Bug fixes for cblas_*gemmt and cblas_*axpby (OpenMP) functions.

2.13 Known limitations

The following subsection describes any issues that are known at the time of this release.

Open technical issues:

Describes any technical issues that are open in the 22.1 release.

- Arm C/C++/Fortran Compiler 22.1:

  - In November 2021, two general source code vulnerabilities in compilers were disclosed - CVE-2021-42574 and CVE-2021-42694. Both exploits use Unicode characters to make source code look different when viewed in a text editor to what is processed by the compiler. This exploit could be used by a malicious programmer to inject malicious code into software that looks non-malicious when reviewed or inspected by programmers responsible for the integrity of said software. Arm Compiler for Linux does not have any mitigation for source code containing these attacks. Arm recommends using static analysis tools to detect such vulnerabilities in source code before compilation. For more information see https://developer.arm.com/documentation/ka005002

3 Support

The documentation that is available for Arm Compiler for Linux can be found on the product resources page on the Arm Developer website:

https://developer.arm.com/Tools%20and%20Software/Arm%20Compiler%20for%20Linux#Resources

You can also find a subset of that documentation, available in <install_location>/<package_name>/share.

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3.1 OS

This suite is supported on the following Linux platforms:

- AArch64 RHEL 7 and 8
- AArch64 SLES 15
- AArch64 Ubuntu 18.04 and 20.04
- Amazon Linux 2022 (AL 2022)

Full information about the platforms supported by Arm Compiler for Linux is available on the Arm Developer website:

https://developer.arm.com/Tools%20and%20Software/Arm%20Compiler%20for%20Linux#Supported-Devices

4 Release history

A full release history (with release notes) for Arm Compiler for Linux is available on the Arm Developer website:

https://developer.arm.com/documentation/107578/latest

5 Conventions

The following subsections describe conventions used in Arm documents.

5.1 Glossary

The Arm Glossary is a list of terms that are used in Arm documentation, together with definitions for those terms. The Arm Glossary does not contain terms that are industry standard unless the Arm meaning differs from the generally accepted meaning.

See the Arm Glossary for more information: **https://developer.arm.com/glossary**.