



Arm RAN Acceleration Library

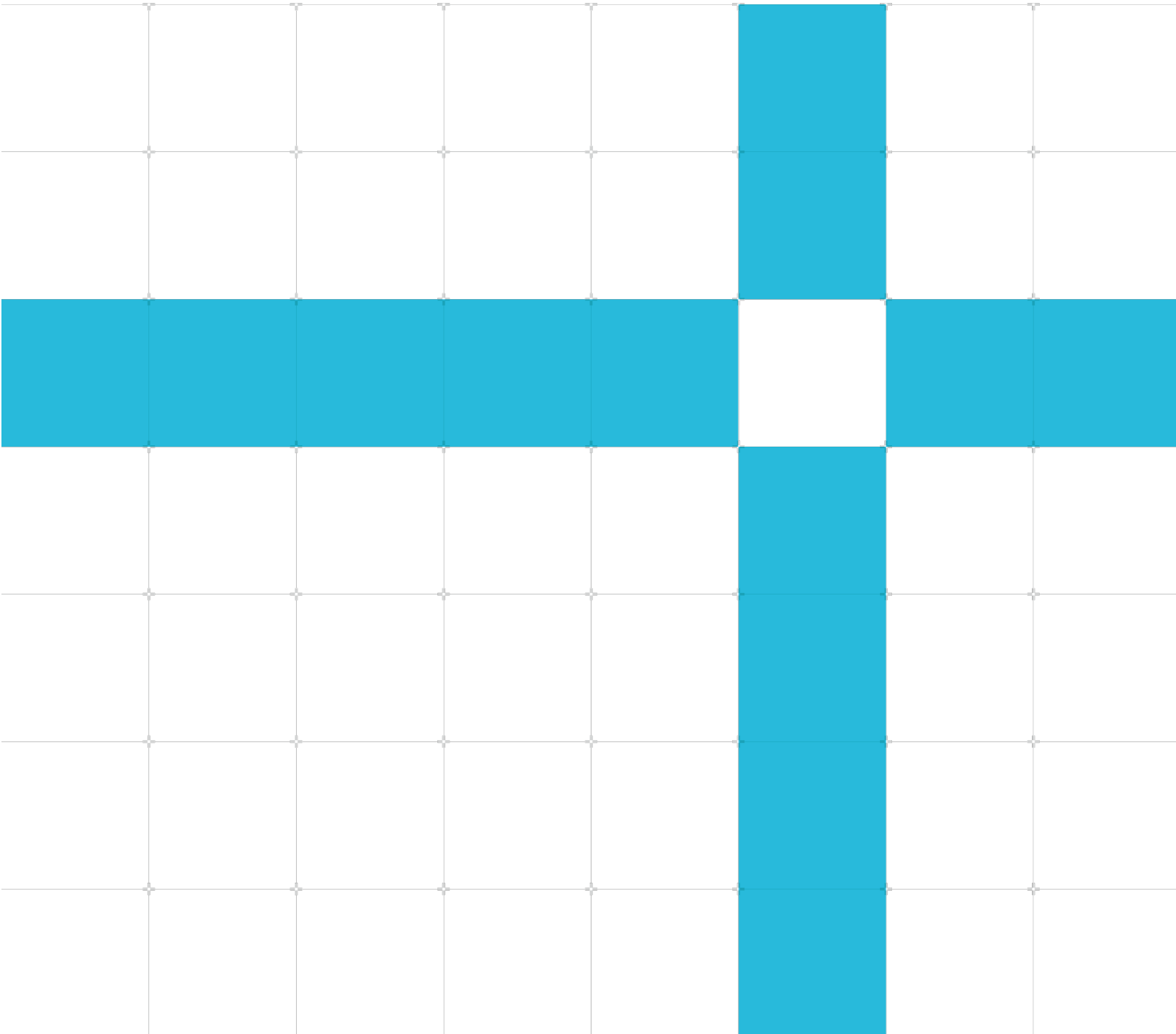
Product revision: 22.07

Release Note

Non-Confidential

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Document ID:
107561



Arm RAN Acceleration Library Release Note

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Product status

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

Feedback

Arm welcomes feedback on this product and its documentation. To provide feedback on Arm RAN Acceleration Library, create a ticket on <https://support.developer.arm.com>.

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.

Use of Arm RAN Acceleration Library 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 RAN Acceleration Library package.

1.1 Product description

The Arm RAN Acceleration Library (ArmRAL) contains a set of functions for accelerating telecommunications applications such as, but not limited to, 5G Radio Access Networks (RANs).

The Arm RAN Acceleration Library 22.07 package provides a library that is optimized for Arm AArch64-based processors, and also provides optimized routines for processors that support the SVE and SVE2 architecture extensions.

Arm RAN Acceleration Library provides:

- Vector functions
- Matrix functions
- Lower PHY support functions
- Upper PHY support functions
- DU-RU Interface support functions

Arm RAN Acceleration Library includes functions that operate on 16-bit signed integers and 32-bit floating-point values.

1.2 Release status

This is the 22.07 release of Arm RAN Acceleration Library.

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

Arm releases can contain documentation and source files such as RTL, testbenches, or software.

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 Downloading and unpacking

You must download the Arm RAN Acceleration Library deliverable from the Arm Developer website, then unpack the contents.

Procedure

1. Go to <https://developer.arm.com/solutions/infrastructure/developer-resources/5g/ran/download>.
2. Complete the form and click **Submit**. The package downloads.
3. Locate the downloaded .tar.gz file.
4. Copy the .tar.gz file to the directory where these files are to be built.
5. Extract the tar file contents using a tar utility, type:

```
tar -zxvf arm-ran-acceleration-library-22.07-aarch64.tar.gz
```

2.2 Deliverables

The downloaded product includes the deliverables listed in this section.

- Arm RAN Acceleration Library 22.07
- Release Notes (this document)
- Documentation

Product documentation is available on the Arm Developer website at:

<https://developer.arm.com/documentation/102249/2204>



Documentation, errata 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>.

2.3 Differences from previous release

The following subsections describe differences from the previous release of Arm RAN Acceleration Library.

2.3.1 Additions and changes

Describes new features or components added, or any technical changes to features or components, in this release.

- Renamed the Polar encoding and decoding routines to ``armral_polar_encode_block`` and ``armral_polar_decode_block``. This ensures the naming is consistent with the LDPC and Turbo coding implementations. This naming scheme makes it clear that the encoding and decoding routines operate on a single code block.

- Improved the performance of the following implementations:

- SVE2 mu law compression and decompression (``armral_mu_law_compr_*` and ``armral_mu_law_decompr_*`).
- SVE2 block float compression and decompression (``armral_block_float_compr_*` and ``armral_block_float_decompr_*`).
- SVE2 8-bit block scaling compression (``armral_block_scaling_compr_8bit``).
- Neon and SVE2 16-QAM modulation (``armral_modulation`` with ``armral_modulation_type`` set to ``ARMRAL_MOD_16QAM``).
- 32-bit floating-point and 16-bit fixed-point complex valued FFTs (``armral_fft_execute_cf32``, ``armral_fft_execute_cs16``) with large prime factors.

- Added SVE2 optimized implementations of the following routines:

- Equalization with four subcarriers (``armral_solve_*x*_4sc_f32``).

- Added matrix-vector multiplication functions for batches of 32-bit complex floating-point matrices and vectors. There are two versions of this routine:

``armral_cmplx_mat_vec_mult_batch_f32`` and ``armral_cmplx_mat_vec_mult_batch_f32_pa``. These assume that the batches are organized differently in memory. For a description of the batched layout, see the comments for these functions in ``armral.h``.

- Added routine for LTE Turbo encoding (``armral_turbo_encode_block``) that implements the encoding scheme defined in section 5.1.3.2 of the 3GPP Technical Specification (TS) 36.212 "Multiplexing and channel coding".

- Added routine for LTE Turbo decoding (``armral_turbo_decode_block``) that implements a maximum a posteriori (MAP) algorithm to return a hard decision (either 0 or 1) for each output bit. The routine takes a parameter that specifies the maximum number of iterations that the decoder will perform. The algorithm will terminate in fewer iterations if there is no change in the computed log-likelihood ratios between consecutive iterations. The routine does not implement CRC checking and so does not ascertain whether or not the chosen output is valid.

- Added routine to perform rate matching for Polar coding. This implements the specification in section 5.4.1 of the 3GPP Technical Specification (TS) 38.212.

- Added routine to perform rate recovery for Polar coding. This implements the inverse operations of rate matching. Rate matching is described in section 5.4.1 of the 3GPP Technical Specification (TS) 38.212.

- Added utilities to simulate the error correction performance for Polar coding over a noisy channel. More information can be found in the simulation/README.md file.

- Added routine to perform rate matching for LDPC coding. This implements the specification in section 5.4.2 of the 3GPP Technical Specification (TS) 38.212.

- Added routine to perform rate recovery for LDPC coding. This implements the inverse operations of rate matching. Rate matching is described in section 5.4.2 of the 3GPP Technical Specification (TS) 38.212.

- Added utilities to simulate the error correction performance for LDPC coding over a noisy channel. More information can be found in the simulation/README.md file.

- Added utilities to simulate the error correction performance for Turbo coding over a noisy channel. More information can be found in the simulation/README.md file.

2.3.2 Resolved issues

There are no resolved issues in this release.

2.4 Known limitations

There are no known issues with this release.

3 Support

If you have any issues with the installation, content or use of this release, create a ticket on <https://support.developer.arm.com>. Arm will respond as soon as possible.



Support for this release of the product is only provided by Arm to partners who have a current support and maintenance contract for the product.

3.1 Tools

The following points list the tools that are required to build or run Arm RAN Acceleration Library:

- A recent version of a C/C++ compiler, such as GCC. Arm RAN Acceleration Library has been tested with GCC 7.5.0, 8.2.0, 9.3.0, 10.2.0, and 11.1.0.



If you are cross-compiling, you need a cross-toolchain compiler that targets AArch64. You can download open-source cross-toolchain builds of the GCC compiler on the Arm Developer website:

<https://developer.arm.com/tools-and-software/open-source-software/developer-tools/gnu-toolchain/gnu-a/downloads>

The variant to use for an AArch64 GNU/Linux target is ``aarch64-none-linux-gnu``.

- A recent version of CMake (version 3.3.0, or higher).

In addition to the preceding requirements:

- To run the benchmarks, you must have the Linux utility tool ``perf`` installed and a recent version of Python 3. Arm RAN Acceleration Library has been tested with Python 3.8.5.
- To build a local version of the documentation, you must have Doxygen installed. Arm RAN Acceleration Library has been tested with Doxygen version 1.8.13.
- To generate code coverage HTML pages, you must have ``gcovr`` installed. The library has been tested with ``gcovr`` version 4.2.



Arm RAN Acceleration Library runs on AArch64 cores, however to use the CRC functions, you must run on a core that supports the AArch64 PMULL extension. If your machine supports the PMULL extension, `pmull` is listed under the "Features" list given in the `/proc/cpuinfo` file.

4 Release history

A full release history (with release notes) for Arm RAN Acceleration Library is available on the Arm Developer website:

<https://developer.arm.com/solutions/infrastructure/developer-resources/5g/ran/release-history>

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>.