arm

Arm® Authenticated Debug Access Control Test Suite
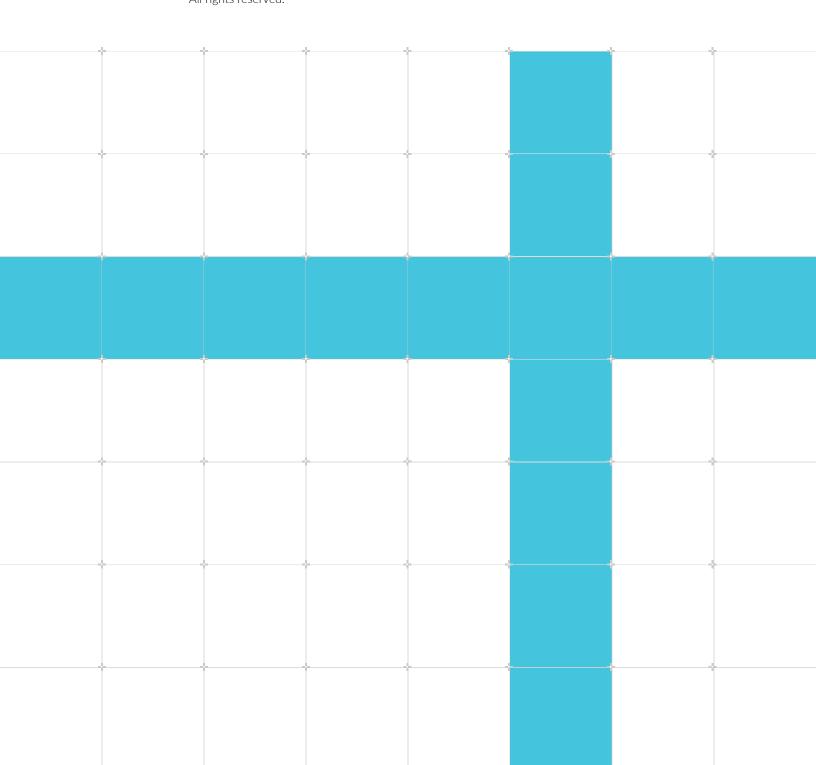
Version 1.1

User Guide

Arm® Authenticated Debug Access Control Test Suite User Guide

Start reading

If you prefer, you can skip to the start of the content.

Intended audience

This book is written for engineers who are specifying, designing, or verifying an implementation of the Arm® Platform Security Architecture Firmware Framework architecture.

Inclusive language commitment

Arm values inclusive communities. Arm recognizes that we and our industry have used language that can be offensive. Arm strives to lead the industry and create change.

This document includes language that can be offensive. We will replace this language in a future issue of this document.

To report offensive language in this document, email terms@arm.com.

Feedback

Arm welcomes feedback on this product and its documentation. To provide feedback on the product, 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.

Contents

1. ADAC overview

This chapter introduces ADAC and its test suite.

1.1 Abbreviations

This section lists the abbreviations used in this document.

Table 1-1: Abbreviations and expansions

Abbreviation	Expansion
ADAC	Authenticated Debug Access Control
PAL	Platform Abstraction Layer
PSA	Platform Security Architecture
RoT	Root of Trust
SPM	Secure Partition Manager
SUT	System Under Test
VAL	Validation Abstraction Layer

1.2 Introduction to ADAC

Authenticated Debug Access Control (ADAC) is a protocol that provides a way to use strong authentication to restrict device debug access to only the authorized entities.

The ADAC specification defines communication between the target debug device and the host debugger. It addresses functional layers that are above the physical debug link. Physical access to the target device is required for debug link operation.

The default mechanism for ADAC authentication relies on a challenge-response protocol where the target challenges the host and verifies the response validity. The response to the challenge is a signed authentication token, also called a debug token. The key used by the host to generate the signature must be trusted by the target through a chain of trusted entities already provisioned on the target. The ADAC specification defines a certificate format to build trust chains and offer the flexibility to deal with complex scenarios.

For more information on ADAC, see the Authenticated Debug Access Control Specification.

1.3 Scope of the ADAC test suite

The scope of the ADAC test suite is to:

- Verify if the tested target implements all ADAC commands.

- Check if the response received for a given ADAC command is one of the expected defined responses.

- Test commands, errors, and success criteria mentioned in the ADAC specification.

1.4 ADAC test suite

The ADAC test suite checks if a device-side implementation conforms to the behavior described in the ADAC specification. For host-side conformance to the ADAC specification, Arm is working directly with partner tool vendors to guarantee compatibility.

The ADAC tests are self-checking and portable C-based tests with directed stimulus. These tests are expected to run on the host platform only. The test suite requires a debug probe connected to the host to communicate between a debugger and a hardware target. The pyOCD project is used for this communication.

The tests send the ADAC commands from the host platform and verify the response obtained from the target. The tests are open source and available with an Apache v2.0 license, allowing for external contribution.

1.5 Tool requirements

The ADAC test suite is developed in C and compiled for the host execution environment.

The following are software prerequisites on the host platform:

- CMake v3.10 or greater
- GNU Arm Embedded Toolchain version 9-2019-q4-major.
- Python 3.7 or later version with pip and virtualenv.

1.6 Prerequisites

The ADAC tests require the following setup for the device to execute the tests on a host platform.

- Credentials must be provisioned in the device and the public key of a root certificate must either be present on the target in hashed form or in its entirety and accessible to the ADAC target code.

- A set of tests for a runtime instance verifies a single cryptosystem algorithm. To test multiple algorithms, target device must be provisioned with required credentials and the tests must be run for each of the algorithm that must be tested.

2. Validation methodology

This chapter describes the validation methodology used for the ADAC test suite.

2.1 Test layering details

The ADAC tests use a layered software stack approach to enable porting across different test platforms.

The constituents of the layered stack are:

Test suite   This layer is a collection of targeted tests. It verifies if the device behavior conforms to the ADAC specification. These tests map to one or more scenarios identified in the scenario document. They use interfaces that are provided by the VAL.

PAL   This layer is the closest to hardware and is aware of underlying hardware details. It must be ported or tailored to a specific host platform. It implements the debug link layer responsible for communication with the target.

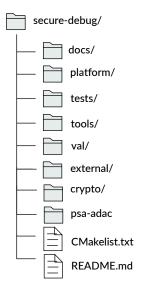**VAL**   This layer contains subdirectories for the VAL libraries. It provides a uniform and consistent view of the available test infrastructure to the tests in the test pool. This layer is not ported when the underlying hardware changes.

2.2 Directory structure

The following figure shows the top-level directory structure of Secure debug within the `psa-arch-tests` git repository.

Figure 2-1: Secure debug

```
secure-debug/
    ├── docs/
    ├── platform/
    ├── tests/
    ├── tools/
    ├── val/
    ├── external/
    ├── crypto/
    ├── psa-adac
    ├── CMakelist.txt
    └── README.md
```

docs	contains the User Guide, Porting Guide and scenarios to be tested.
platform	contains files to form the PAL. It must be ported to specific host platform.
tests	contains the ADAC subsuite tests that verify if the device behavior conforms with the ADAC specification.
tools	contains makefiles and scripts that are used to generate test binaries.
val	contains subdirectories and files to build the VAL libraries. This layer provides a uniform and consistent view of the available test infrastructure to the tests.
CMakeLists.txt	contains information on CMake build support.
README.md	README file for PSA ADAC test suite.
external	contains the mbedtls source code repository that provides crypto services to host platform.
crypto	contains the implementation of crypto API calls used by adac protocol.
psa-adac	contains the implementation of adac protocol.

2.3 Build and execution steps

This section provides steps to build and execute the ADAC test suite for a given host platform.

Build steps

The steps and the dependencies to build the host-side executable are described in detail in the README file. The following steps compile and generate the test image for the ADAC suite:

1. `cd psa-arch-tests/secure-debug`

2. `mkdir <host_build_dir>`

3. `cd <host_build_dir>`

4. `cmake ../ -G"Unix Makefiles" - DTARGET=<target_name> -DSUITE=<suite_name>`

For example,

```
cmake ../ -G"Unix Makefiles" -DTARGET=emulation -DSUITE=ADAC
cmake --build .
```

This generates the `psa_adac_test` executable in the **`<host_build_dir>`** directory.

For more information on building and executing the test suite, see the platform-specific README.

Execution steps

The executable test must be provided with the host-side credentials (key and certificate chain) as command-line arguments. Depending on the debug link layer used, additional command-line parameters must be provided.

```
./psa_adac_test <path_to_key_file> <path_to_certificate> / <optional list to link-
layer details>
```

Note

The details for executing the test suite on a reference hardware platform (`musca-b1`) is described in the README file within the platform directory for the host `musca_b1`.

2.4 Test status report

When the test suite is run on a host platform, each successful test must report either PASS or SKIP.

The following is an example code of a successful test pass.

```
***** PSA ADAC Architecture Test Suite - Version 1.0 *****

Running.. Secure Debug Suite
*****************************

TEST: 801 | DESCRIPTION: Testing ADAC Protocol Host API| UT: psa_challenge
psa_adac_issue_command        :  169 : info  : host  : Sending challenge request
psa_adac_parse_response       :  217 : debug : host  : status = 0x0000, data_count =
 9
psa_adac_parse_response       :  232 : info  : host  : Receiving challenge..
psa_adac_issue_command        :  169 : info  : host  : Sending challenge request
psa_adac_parse_response       :  217 : debug : host  : status = 0x0000, data_count =
 9
psa_adac_parse_response       :  232 : info  : host  : Receiving challenge..
Challenge response obtained is unique
```

```
Closing debug session
psa_adac_issue_command        : 178  : info  : host  : Sending close session command
psa_adac_parse_response       : 220  : debug : host : status = 0x0000, data_count = 0
TEST RESULT: PASSED
```

The following code displays the status of all the tests scheduled in a single execution run.

```
************ Secure Debug Suite Report **********
TOTAL TESTS     : 12
TOTAL PASSED    : 11
TOTAL SIM ERROR : 0
TOTAL FAILED    : 1
TOTAL SKIPPED   : 0
****************************************
```

2.5 Additional notes

The following are a few additional points to consider:

- The data structures and the packet format described in the specification are defined in the `psa_adac.h` header file within the `psa-adac` repository.
- The `val_adac.h` defines the API for the following tasks:
  - Managing the host credentials (uses mbedtls services).
  - Building and constructing ADAC commands.
  - Parsing the response obtained from the debug target.
- The PAL API which is responsible for implementing the debug link layer is defined in `pal_interfaces.h`. These APIs must be ported for your host platform. For more information on API porting, see the Porting Guide.

Proprietary Notice

This document is protected by copyright and other related rights and the use or implementation of the information contained in this document may be protected by one or more patents or pending patent applications. No part of this document may be reproduced in any form by any means without the express prior written permission of Arm Limited ("Arm"). No license, express or implied, by estoppel or otherwise to any intellectual property rights is granted by this document unless specifically stated.

Your access to the information in this document is conditional upon your acceptance that you will not use or permit others to use the information for the purposes of determining whether the subject matter of this document infringes any third party patents.

The content of this document is informational only. Any solutions presented herein are subject to changing conditions, information, scope, and data. This document was produced using reasonable efforts based on information available as of the date of issue of this document. The scope of information in this document may exceed that which Arm is required to provide, and such additional information is merely intended to further assist the recipient and does not represent Arm's view of the scope of its obligations. You acknowledge and agree that you possess the necessary expertise in system security and functional safety and that you shall be solely responsible for compliance with all legal, regulatory, safety and security related requirements concerning your products, notwithstanding any information or support that may be provided by Arm herein. In addition, you are responsible for any applications which are used in conjunction with any Arm technology described in this document, and to minimize risks, adequate design and operating safeguards should be provided for by you.

This document may include technical inaccuracies or typographical errors. THIS DOCUMENT IS PROVIDED "AS IS". ARM PROVIDES NO REPRESENTATIONS AND NO WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY, SATISFACTORY QUALITY, NON-INFRINGEMENT OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE DOCUMENT. For the avoidance of doubt, Arm makes no representation with respect to, and has undertaken no analysis to identify or understand the scope and content of, any patents, copyrights, trade secrets, trademarks, or other rights.

TO THE EXTENT NOT PROHIBITED BY LAW, IN NO EVENT WILL ARM BE LIABLE FOR ANY DAMAGES, INCLUDING WITHOUT LIMITATION ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF ANY USE OF THIS DOCUMENT, EVEN IF ARM HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Reference by Arm to any third party's products or services within this document is not an express or implied approval or endorsement of the use thereof.

This document consists solely of commercial items. You shall be responsible for ensuring that any permitted use, duplication, or disclosure of this document complies fully with any relevant

export laws and regulations to assure that this document or any portion thereof is not exported, directly or indirectly, in violation of such export laws. Use of the word "partner" in reference to Arm's customers is not intended to create or refer to any partnership relationship with any other company. Arm may make changes to this document at any time and without notice.

This document may be translated into other languages for convenience, and you agree that if there is any conflict between the English version of this document and any translation, the terms of the English version of this document shall prevail.

The validity, construction and performance of this notice shall be governed by English Law.

The Arm corporate logo and words marked with ® or ™ are registered trademarks or trademarks of Arm Limited (or its affiliates) in the US and/or elsewhere. Please follow Arm's trademark usage guidelines at https://www.arm.com/company/policies/trademarks. All rights reserved. Other brands and names mentioned in this document may be the trademarks of their respective owners.

Arm Limited. Company 02557590 registered in England.

110 Fulbourn Road, Cambridge, England CB1 9NJ.

PRE-1121-V1.0

Product and document information

Read the information in these sections to understand the release status of the product and documentation, and the conventions used in the Arm documents.

Product status

All products and Services provided by Arm require deliverables to be prepared and made available at different levels of completeness. The information in this document indicates the appropriate level of completeness for the associated deliverables.

Product completeness status

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

Revision history

These sections can help you understand how the document has changed over time.

Document release information

The Document history table gives the issue number and the released date for each released issue of this document.

Document history

Issue	Date	Confidentiality	Change
0100-02	30 July 2025	Non-Confidential	EAC release
0100-01	31 May 2023	Non-Confidential	EAC release
0008-01	25 January 2022	Non-Confidential	Beta release
0006-01	8 October 2021	Non-Confidential	Alpha release
0005-01	30 June 2021	Non-Confidential	Alpha release

The Change history tables describe the technical changes between released issues of this document in reverse order. Issue numbers match the revision history in Document release information on page 12.

Table 2: Issue 0005-01

Change	Location
First release.	-

Table 3: Differences between Issue 0005-01 and 0006-01

Change	Location
No technical updates.	-

Table 4: Differences between Issue 0006-01 and 0008-01

Change	Location
Removed RDDI abbreviation.	See 1.1 Abbreviations on page 4.
Updated ADAC test suite section.	See 1.4 ADAC test suite on page 5.
Removed RDDI references in tool requirements section.	See 1.5 Tool requirements on page 5.
Updated the Build and execution steps section.	See 2.3 Build and execution steps on page 7.
Updated the test codes in Test status report section.	See 2.4 Test status report on page 8.

Table 5: Differences between Issue 0008-01 and 0100-01

Change	Location
Updated software prerequisites on the host platform in Tool requirements.	See 1.5 Tool requirements on page 5.
Deleted a note in the Test layering details.	See 2.1 Test layering details on page 6.
Updated the Secure debug directory structure image.	See 2.2 Directory structure on page 6.
Added external and crypto directories description in the Directory structure.	See 2.2 Directory structure on page 6.
Updated the note in Build and execution steps.	See 2.3 Build and execution steps on page 7.
Updated the PSA ADAC Test suit version to 1.0 and updated the test example in test status report.	See 2.4 Test status report on page 8.
Updated Additional notes.	See 2.5 Additional notes on page 9.

Table 6: Differences between Issue 0100-01 and 0100-02

Change	Location
Updated the test example code of a successful test pass in the test status report.	See 2.4 Test status report on page 8.

Conventions

The following subsections describe conventions used in Arm documents.

Glossary

The Arm Glossary is a list of terms 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: developer.arm.com/glossary.

Typographic conventions

Arm documentation uses typographical conventions to convey specific meaning.

Convention	Use
italic	Citations.
bold	Interface elements, such as menu names. Terms in descriptive lists, where appropriate.
`monospace`	Text that you can enter at the keyboard, such as commands, file and program names, and source code.
`monospace` <u>`underline`</u>	A permitted abbreviation for a command or option. You can enter the underlined text instead of the full command or option name.
`<and>`	Encloses replaceable terms for assembler syntax where they appear in code or code fragments. For example: `MRC p15, 0, <Rd>, <CRn>, <CRm>, <Opcode_2>`
SMALL CAPITALS	Terms that have specific technical meanings as defined in the *Arm® Glossary*. For example, **IMPLEMENTATION DEFINED**, **IMPLEMENTATION SPECIFIC**, **UNKNOWN**, and **UNPREDICTABLE**.

We recommend the following. If you do not follow these recommendations your system might not work.

Caution

Your system requires the following. If you do not follow these requirements your system will not work.

Warning

You are at risk of causing permanent damage to your system or your equipment, or of harming yourself.

Danger

This information is important and needs your attention.

Note

This information might help you perform a task in an easier, better, or faster way.

Tip

This information reminds you of something important relating to the current content.

Remember

Useful resources

This document contains information that is specific to this product. See the following resources for other useful information.

Arm documents are available on developer.arm.com/documentation.

Confidential documents are only available to licensees, when logged in. Each document link in the tables below provides direct access to the online version of the document.

Arm product resources	Document ID	Confidentiality
PSA Cryptography API	IHI 0086	Non-Confidential
Authenticated Debug Access Control Specification	DEN0101	Non-Confidential