FIDO Authenticator Allowed Restricted Operating Environments List

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Abstract

This document helps support the FIDO Authenticator Security Certification program. The FIDO Security Requirements requires authenticators to run in an Allowed Restricted Operating Environment (AROE) for level 2 and above. Authenticators *not* running in an AROE can qualify for level 1.

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1. Notation

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in [RFC2119].

1.1 Version

This document specifies version 1.1.0 of the allowed restricted operating environments.

2. Introduction

FIDO Authenticators can be implemented in various ways.

The FIDO Authenticator is typically implemented based on some hardware and firmware. For example, this might be a secure element as hardware with the basic secure element firmware in which the Authenticator Trusted Application runs. As another example it might also be a multifunctional device containing some CPUs which are securely shared between the firmware of the restricted operating environment and the high-level operating system.

It is important that by definition, all parts which are relevant for the FIDO Authenticator (e.g. underlying hardware, ...) are part of the Authenticator itself. So the FIDO Authenticator is more than just the Authenticator Application.

We use the term Authenticator Application to refer to the entity that combines the underlying hardware and firmware in a way that results in a FIDO Authenticator.

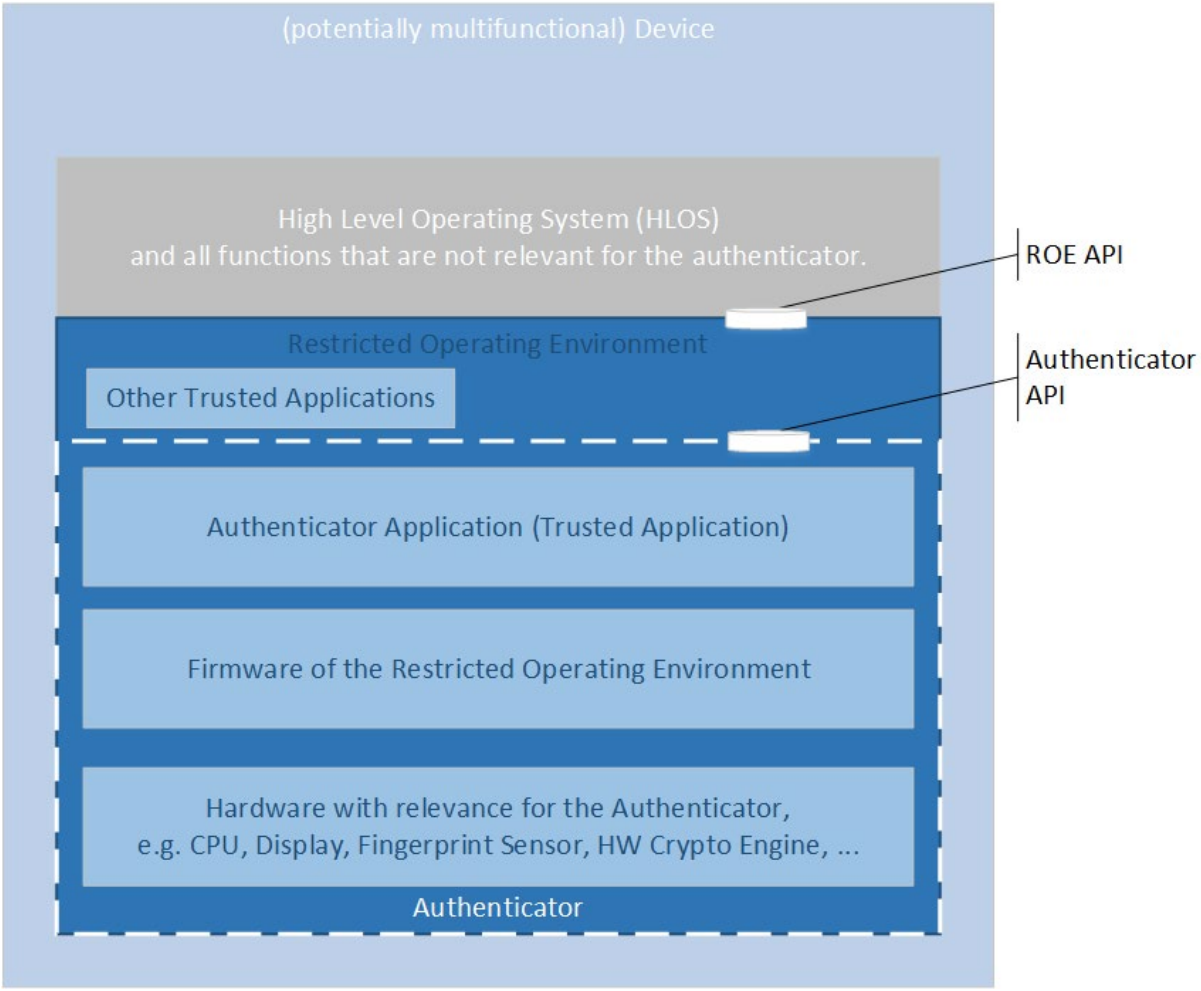

Fig. 1 Restricted Operating Environments Architectural Overview

We distinguish these components as the Restricted Operating Environment can be implemented in a way that it supports more than just the Authenticator Application. Additionally the security of the Restricted Operating Environment (***ROE***) (without the Authenticator Application) can be demonstrated or certified using existing programs (e.g. Common Criteria).

The FIDO Security Certification covers the various components with different depths. At FIDO Security Level 1, we are concenred about the protection against scalable attacks on the server side an on the communication channel. At FIDO Security Levels 2 and 3, we are mostly concerned about the protection against client side scalable attacks (e.g. malware). At FIDO Security Levels 4 and 5 we also require protection against physical attacks.

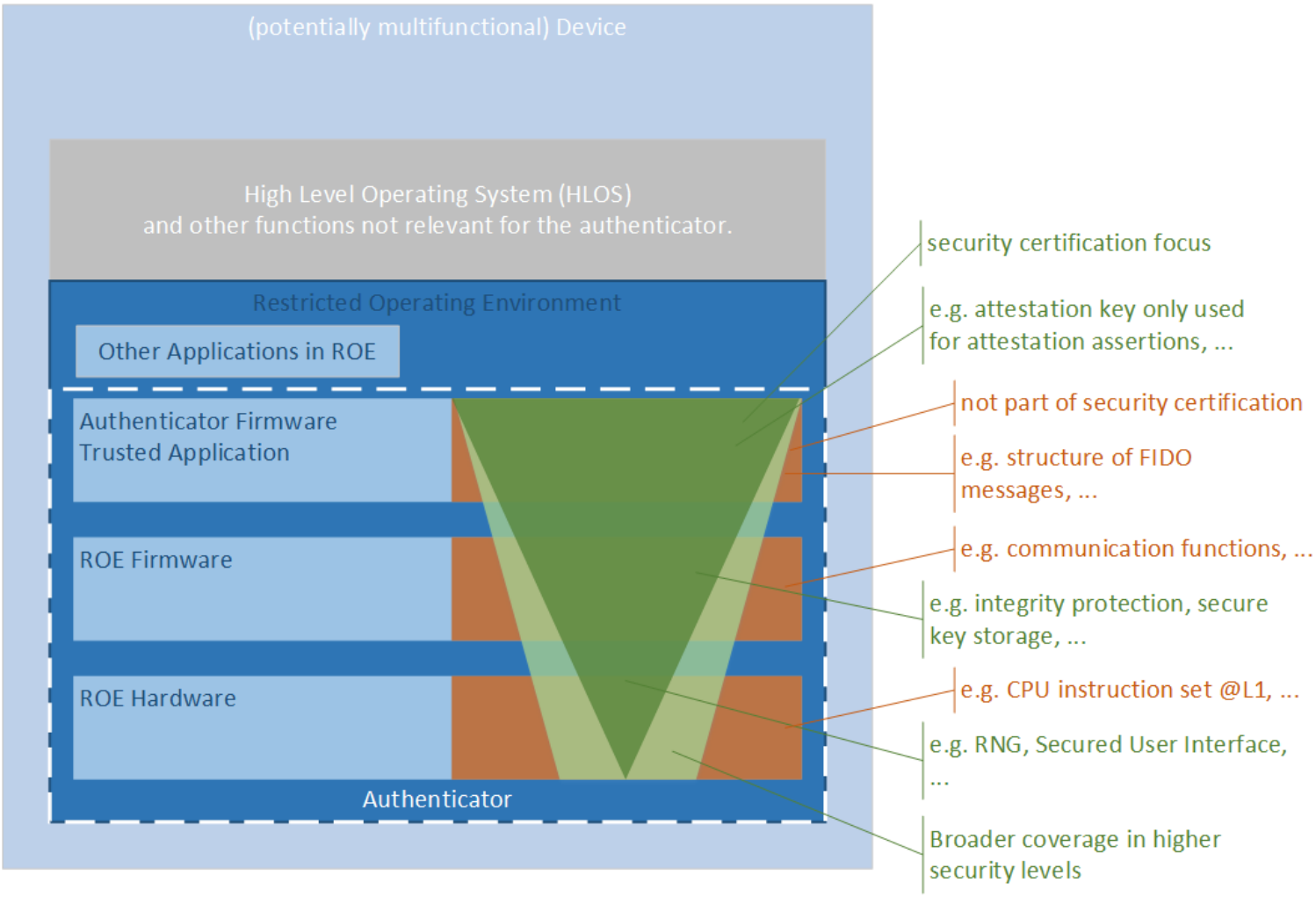

Fig. 2 Restricted Operating Environments Security Certification Focus

The following aspects of the AROE are relevant for the FIDO Security Certification:

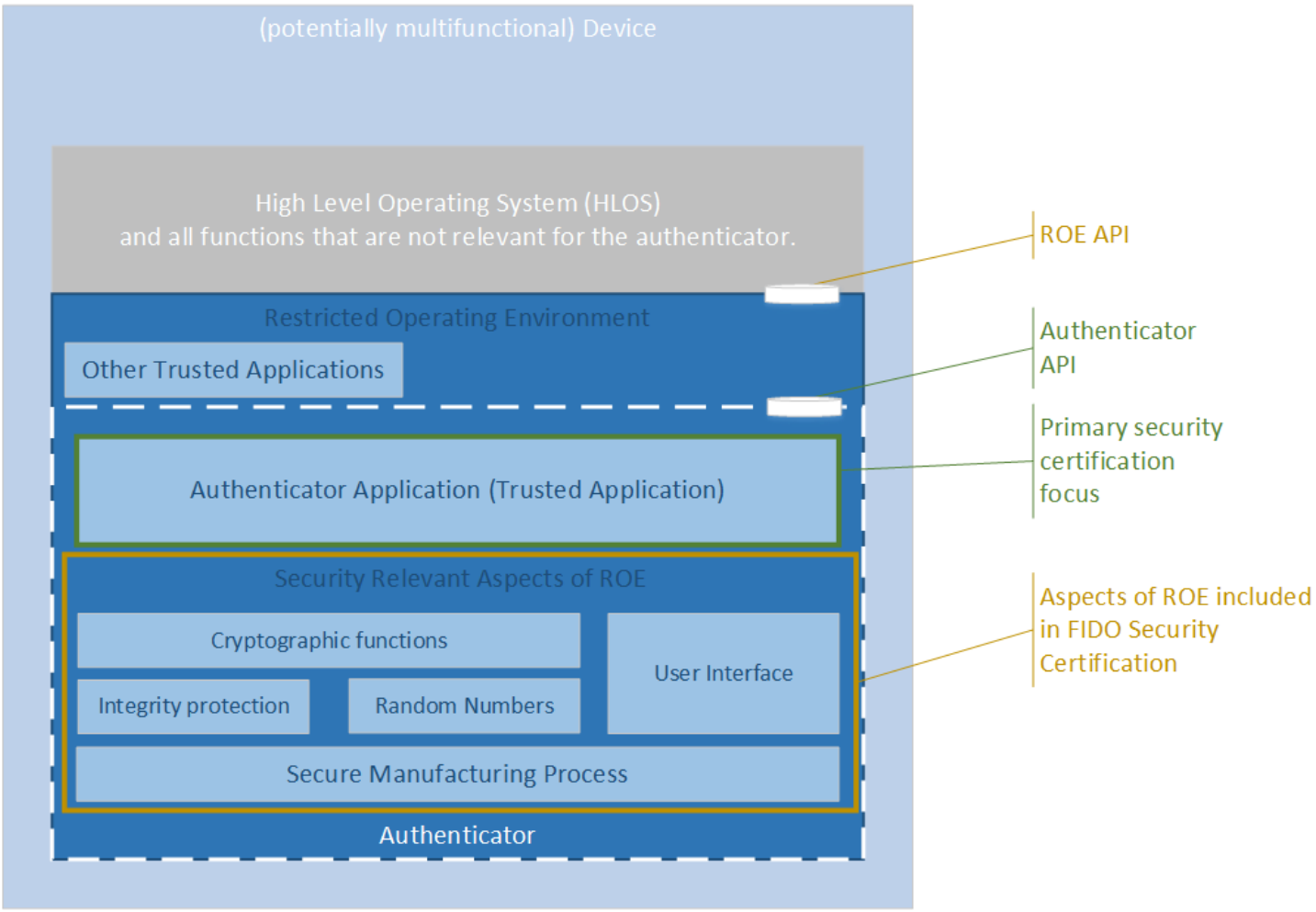

Fig. 3 AROE Aspects Relevant for FIDO Security Certification

3. Allowed Restricted Operating Environments

The following table outlines the Allowed Restricted Operating Environments (***AROE***s) for FIDO Security Certification.

Operating Environment	Notes
TEEs based on ARM TrustZone HW	All operating systems (ROE firmware) running on ARM TrustZone HW are accepted as AROE as required for Level 2 FIDO Authenticator Certification. See ARM TrustZone Security Whitepaper and ARM Architecture Reference Manual.
TEE Based on Intel VT HW	All operating systems (ROE firmware) running on Intel VT HW are accepted as AROE as required for Level 2 FIDO Authenticator Certification. See Intel Vanderpool Technology for IA-32 Processors (VT-x) Preliminary Specification.
TEE Based on Intel SGX HW	All operating systems (ROE firmware) running on Intel SGX HW are accepted as AROE as required for Level 2 FIDO Authenticator Certification. See Innovative Instructions and Software Model for Isolated Execution and Innovative Technology for CPU based Attestation and Sealing.
TEE Based on Intel ME/TXE HW	All operating systems (ROE firmware) running on Intel ME/TXE HW are accepted as AROE as required for Level 2 FIDO Authenticator Certification. See Intel's Embedded Solutions: from Management to Security
TEE with GlobalPlatform TEE Protection Profile Certification	GlobalPlatform TEE Protection Profile Certification is NOT required for Level 2 FIDO Authenticator Certification, but it is sufficient for any TEE to be qualified as an Allowed Restricted Operating Environment. See TEE Protection Profile v1.2.1
Windows 10 Virtualization-based Security.	Security apps and services that are running at Virtual Trust Level 1 are accepted as AROE as required for Level 2 FIDO Authenticator Certification See Moore Defeating - Pass the Hash Separation of Powers.
Secure World of AMD PSP (Platform Security coProcessor).	All operating environments running on the secure world side of the TrustZone in the AMD PSP. See AMD Secure Technology.
Trusted Platform Modules (TPMs) Complying to Trusted Computing Group specifications.	For example, TPM Main Specification Version 1.2 [TPM] or TPM Library Specification Version 2.0 [TPMv2] are accepted as AROE as required for Level 2 FIDO Authenticator Certification.
Secure Element (SE)	Secure Operating Systems (ROE firmware) running on a secure tamper-resistant microcontroller are accepted as AROE as required for Level 2 FIDO Authenticator Certification.

4. Requirements for Restricted Operating Environment to be Allowed

- The AROE security configuration MUST be controlled by the vendor of the commercial device or its delegates or its suppliers.
- The AROE MUST protect itself from modifications degrading its security. This includes modifications when powered-off. It hence requires a secure boot process of the AROE.

The AROE MUST provide full isolation from any rich OS or external devices or operating environments it connects with except for conveyance of protocol messages intended for communication with the rich OS and external devices or operating environments. As a consequence, it MUST NOT be possible for SW or HW on the same device but outside the AROE to modify any state, registers, memory or storage inside the operating environment.

- The AROE SHOULD be security-oriented with the bulk of the functionality it hosts and provides being focused primarily on security (e.g., not large graphics engines, signal processors, general purpose app hosting, network stacks and such).
- The apps hosted by the AROE SHOULD be primarily security-oriented (e.g., does not host thousands of downloadable games, complex productivity apps like word processors, or large scale network apps like web browsers).
- A security oriented SW engineering practice SHOULD be followed
  - Code is reviewed by security experts
  - A security patch system is in place
  - Security incidents are tracked
  - Security coding practice is followed
  - System documentation is produced

A. References

A.1 Normative references

[RFC2119]
S. Bradner. *Key words for use in RFCs to Indicate Requirement Levels*. March 1997. Best Current Practice. URL: https://tools.ietf.org/html/rfc2119

A.2 Informative references

[TPM]
TPM Main Specification. URL: http://www.trustedcomputinggroup.org/resources/tpm_main_specification

[TPMv2]
TPM Library Specification. February 2017. URL: https://trustedcomputinggroup.org/tpm-library-specification/