NVIDIA DOCA with OpenSSL

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This guide provides instructions on using DOCA SHA for OpenSSL implementations.

Introduction

The `doca_sha_offload_engine` is an OpenSSL dynamic engine with the ability of offloading SHA calculation. It can offload the OpenSSL one-shot SHA-1, SHA-256, and SHA-512. It supports synchronous mode and asynchronous mode by leveraging the OpenSSL `async_jobs` library. For more information on the `async_jobs` library, please refer to official OpenSSL documentation.

This engine is based on the `doca_sha` library and the OpenSSL dynamic engine interface API. For more information on the OpenSSL dynamic engine, please refer to official OpenSSL documentation.

This engine can be called by an OpenSSL application through the OpenSSL high-level algorithm call interface, `EVP_Digest`. For more information on the `EVP_Digest`, please refer to official OpenSSL documentation.

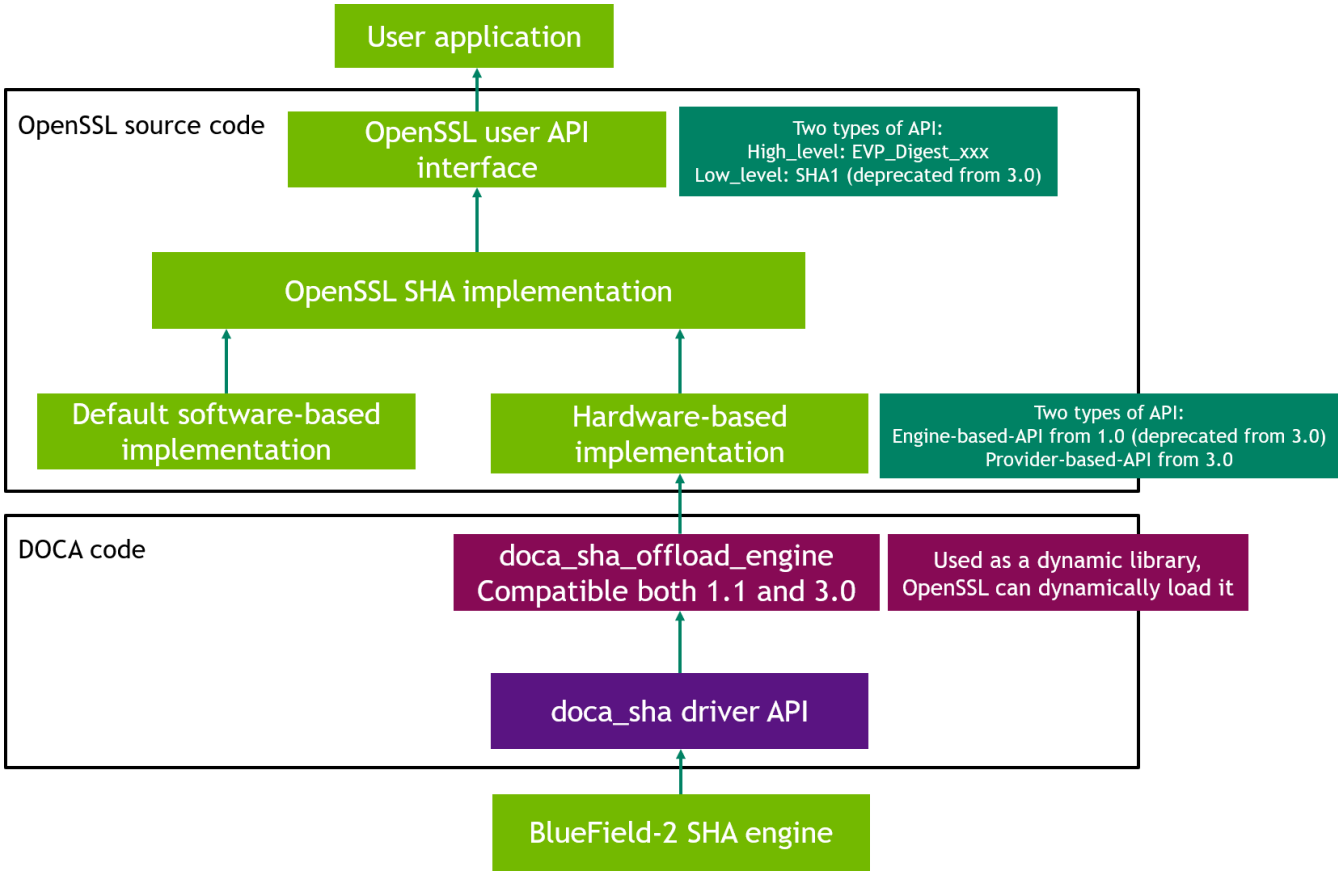
Prerequisites

- Hardware-based `doca_sha` engine which can be verified by calling `doca_sha_get_hardware_supported()`
- Installed OpenSSL version $\geqslant$ 1.1.1

Architecture

The following diagram shows the software hierarchy of `doca_sha_offload_engine` and its location in the whole DOCA repository.

From the perspective of OpenSSL, this engine is an instantiation of the OpenSSL dynamic engine interface API by leveraging the `doca_sha` library.



Capabilities and Limitations

- Only one-shot OpenSSL SHA is supported
- The maximum message length ⩽ 2GB, the same as `doca_sha` library

OpenSSL Command Line Verification

Verify that the engine can be loaded:

```
$ openssl engine dynamic -pre NO_VCHECK:1 -pre
SO_PATH:${DOCA_DIR}/infrastructure/doca_sha_offload_engine/libdoca
-pre LOAD -vvv -t -c
(dynamic) Dynamic engine loading support
[Success]:
SO_PATH:${DOCA_DIR}/infrastructure/doca_sha_offload_engine/libdoca
[Success]: LOAD
```

```
Loaded: (doca_sha_offload_engine) Openssl SHA offloading engine
based on doca_sha
 [SHA1, SHA256, SHA512]
     [ available ]
     set_pci_addr: set the pci address of the doca_sha_engine
          (input flags): STRING
```

- For SHA-1:

```
$ echo "hello world" | openssl dgst -sha1 -engine
{DOCA_DIR}/infrastructure/doca_sha_offload_engine/libdoca_sha_
-engine_impl
```

- For SHA-256:

```
$ echo "hello world" | openssl dgst -sha256 -engine
{DOCA_DIR}/infrastructure/doca_sha_offload_engine/libdoca_sha_
-engine_impl
```

- For SHA-512:

```
$ echo "hello world" | openssl dgst -sha512 -engine
{DOCA_DIR}/infrastructure/doca_sha_offload_engine/libdoca_sha_
-engine_impl
```

OpenSSL Throughput Test

`openssl-speed` is the OpenSSL throughput benchmark tool. For more information, consult official OpenSSL documentation. `doca_sha_offload_engine` throughput can also be measured using `openssl-speed`.

- SHA-1, each job 10000 bytes, using engine:

```
$ openssl speed -evp sha1 -bytes 10000 -elapsed --engine
{DOCA_DIR}/infrastructure/doca_sha_offload_engine/libdoca_sha_
```

- SHA-256, each job 10000 bytes, using engine, `async_jobs=256`:

```
$ openssl speed -evp sha256 -bytes 10000 -elapsed --engine
{DOCA_DIR}/infrastructure/doca_sha_offload_engine/libdoca_sha_
-async_jobs 256
```

- SHA-512, each job 10000 bytes, using engine, `async_jobs=256`, `threads=8`:

```
$ openssl speed -evp sha512 -bytes 10000 -elapsed --engine
{DOCA_DIR}/infrastructure/doca_sha_offload_engine/libdoca_sha_
-async_jobs 256 -multi 8
```

Using DOCA SHA Offload Engine in OpenSSL Application

More information on the dynamic engine usage can be found in the official OpenSSL documentation.

1. To load the `doca_sha_offload_engine` (optionally, set engine PCIe address):

```
ENGINE *e;
const char *doca_engine_path =
"${DOCA_DIR}/infrastructure/doca_sha_offload_engine/libdoca_sha_offload_engine.so";
const char *default_doca_pci_addr = "03:00.0";
ENGINE_load_dynamic();
e = ENGINE_by_id(doca_engine_path);
```

```
ENGINE_ctrl_cmd_string(e, "set_pci_addr", doca_engine_pci_addr,
0);
ENGINE_init(e);
ENGINE_set_default_digests(e);
```

2. To perform SHA calculation by calling the OpenSSL high-level function EVP_XXX:

```
const EVP_MD *evp_md = EVP_sha1();
EVP_MD_CTX *mdctx = EVP_MD_CTX_create();
EVP_DigestInit_ex(mdctx, evp_md, e);
EVP_DigestUpdate(mdctx, msg, msg_len);
EVP_DigestFinal_ex(mdctx, digest, digest_len);
EVP_MD_CTX_destroy(mdctx);
```

3. To unload the engine:

```
ENGINE_unregister_digests(e);
ENGINE_finish(e);
ENGINE_free(e);
```