Remote attestation

Peng Xu

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SGX Application - Attestation

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2. Why we need attestation?
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3. How can we implement attestation by Intel SGX?
    - Local (Intra-platform) attestation
        - a mechanism for creating a basic assertion between enclaves running on the same platform
    - Remote (Inter-platform) attestation
        - a mechanism that provides the foundation for attestation between an enclave and a remote third party

SGX Application - Remote Attestation

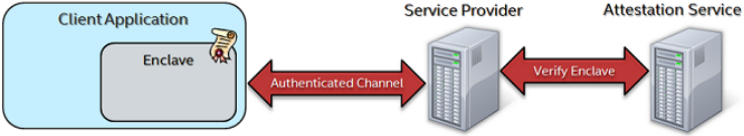


Figure: remote_attestation

https://software.intel.com/en-us/node/702987
https://software.intel.com/en-us/articles/code-sample-intel-software-guard-extensions-remote-attestation-end-to-end-example

SGX Application - Remote Attestation

1. A client's enclave can attest to a remote entity that it is trusted
2. establishes an authenticated communication channel with that entity
3. the client's enclave proves the following:
   - Its identity
   - That it has not been tampered with
   - That it is running on a genuine platform with Intel SGX enabled
4. the remote server can safely provision secrets to the enclave

Basic Concepts

1. Cryptography
   - Private key/symmetric cryptography

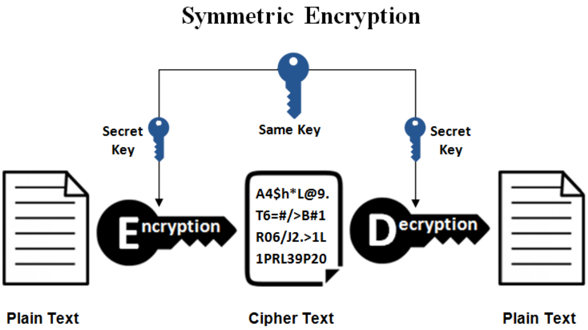


Figure: Symmetric_key_encryption

Basic Concepts

1. Cryptography
   - Public key/asymmetric cryptography

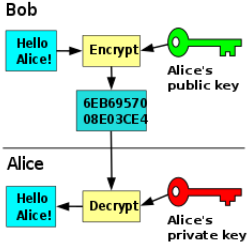


Figure: Asymmetric_key_encryption

Basic Concepts

1. Signature
   - Public key/asymmetric cryptography

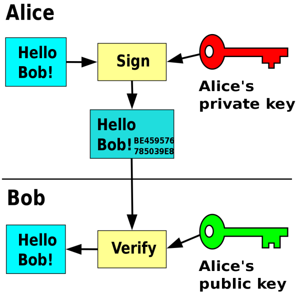


Figure: Private_key_signing

Basic Concepts

1. Client-Server protocol - Sigma protocol
   - Commitment, challenge and response

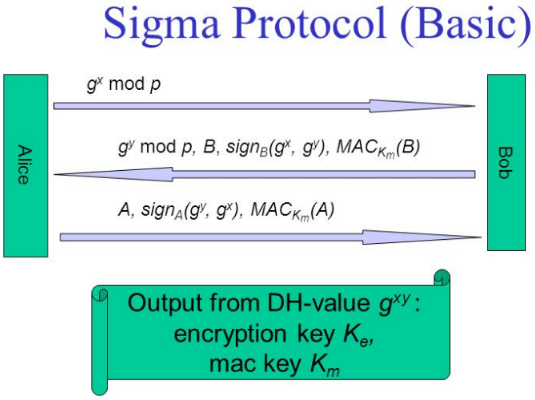
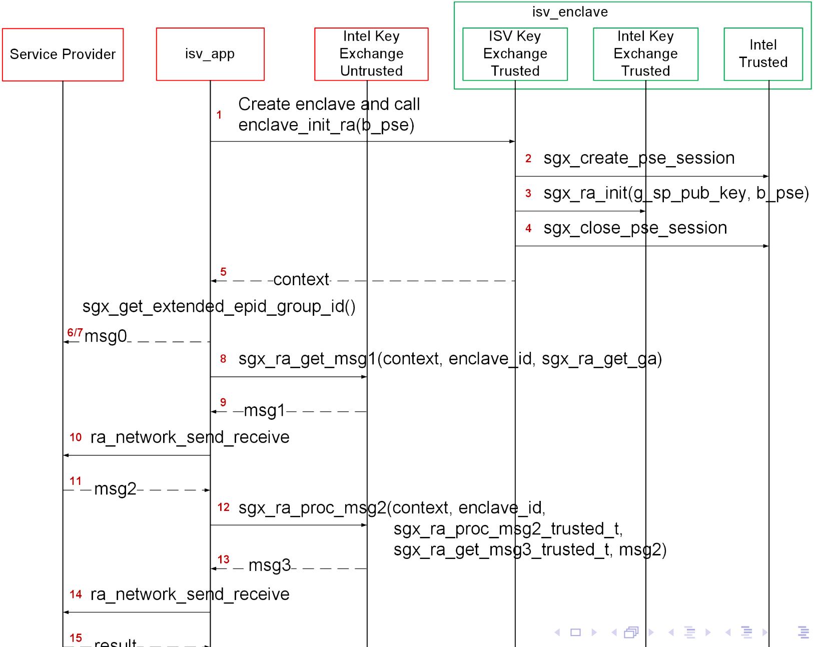

Sigma Protocol (Basic)
Alice
Bob
$g^x \bmod p$
$g^y \bmod p$, B, $sign_B(g^x, g^y)$, $MAC_{K_m}(B)$
A, $sign_A(g^y, g^x)$, $MAC_{K_m}(A)$
Output from DH-value g^{xy}:
encryption key K_e,
mac key K_m

Figure: Sigma Protocol

SGX Application - Remote Attestation


isv_enclave
Service Provider
isv_app
Intel Key Exchange Untrusted
ISV Key Exchange Trusted
Intel Key Exchange Trusted
Intel Trusted
1 Create enclave and call enclave_init_ra(b_pse)
2 sgx_create_pse_session
3 sgx_ra_init(g_sp_pub_key, b_pse)
4 sgx_close_pse_session
5 context
sgx_get_extended_epid_group_id()
6/7 msg0
8 sgx_ra_get_msg1(context, enclave_id, sgx_ra_get_ga)
9 msg1
10 ra_network_send_receive
11 msg2
12 sgx_ra_proc_msg2(context, enclave_id, sgx_ra_proc_msg2_trusted_t, sgx_ra_get_msg3_trusted_t, msg2)
13 msg3
14 ra_network_send_receive
15 result

SGX Application - Attestation

1. Attestation application structure
    - ISV_Enclave(secure_world)
    - ISV_App(Non-secure_world)
    - Service Provider
    - Makefile
    - Include

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1. Attestation application structure
    - ISV_Enclave(secure_world)
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2. Basic concepts
    - Public key/Private key
    - Signature
    - Service provider
    - etc.

Logical functionalities - Preparing msg2

1. Checks the values in the request
2. Generates its own DHKE parameter,
3. Sends a query to the IAS to retrieve the Signature Revocation List (SigRL) for the Intel EPID GID sent by the client.

Logical functionalities - Processing msg2

1. Generate a random EC key using the P-256 curve. This key will become Gb.
2. Derive the key derivation key (KDK) from Ga and Gb:
    - Compute the shared secret using the client's public session key, Ga, and the service provider's private session key (obtained from Step 1), Gb. The result of this operation will be the x coordinate of Gab, denoted as Gabx.
    - Convert Gabx to little-endian byte order by reversing its bytes. Perform an AES-128 CMAC on the little-endian form of Gabx using a block of 0x00 bytes for the key.
    - The result of 2.3 is the KDK.
3. Derive the SMK from the KDK by performing an AES-128 CMAC on the byte sequence:
    - *sgx_ra_msg2_t* p_msg2_body = (sgx_ra_msg2_t*)((uint8_t*)p_msg2_full + sizeof(ra_samp_response_header_t))*;
    - PRINT_ATTESTATION_SERVICE_RESPONSE()

Logical functionalities - Processing msg2

1. Verifies the service provider signature.
2. Checks the SigRL.
3. Returns msg3, which contains the quote used to attest that particular enclave.
   - sgx_ra_proc_msg2(context, enclave_id, sgx_ra_proc_msg2_trusted, sgx_ra_get_msg3_trusted, p_msg2_body, p_msg2_full-¿size, &p_msg3, &msg3_size);
   - sgx_status_t sgx_ra_proc_msg2_trusted();
   - sgx_status_t sgx_ra_get_msg3_trusted();

from ”sgx_tkey_exchange.edl” import *;

enclave {

from ”sgx_tae_service.edl” import *;

trusted {

- public sgx_status_t sgx_ra_get_ga();
- public sgx_status_t sgx_ra_proc_msg2_trusted();
- public sgx_status_t sgx_ra_get_msg3_trusted();

};

};

Question?

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