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Use of Hybrid Public-Key Encryption (HPKE) with CBOR Object Signing and
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Abstract

This specification defines hybrid public-key encryption (HPKE) for use with CBOR Object Signing and Encryption (COSE). HPKE offers a variant of public-key encryption of arbitrary-sized plaintexts for a recipient public key.

HPKE is a general encryption framework utilizing an asymmetric key encapsulation mechanism (KEM), a key derivation function (KDF), and an Authenticated Encryption with Associated Data (AEAD) algorithm.

This document defines the use of HPKE with COSE. Authentication for HPKE in COSE is provided by COSE-native security mechanisms or by the pre-shared key authenticated variant of HPKE.

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1. Introduction

Hybrid public-key encryption (HPKE) [RFC9180] is a scheme that provides public key encryption of arbitrary-sized plaintexts given a recipient's public key.

This document defines the use of the HPKE with COSE ([RFC9052], [RFC9053]).

2. Conventions and Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

This specification uses the following abbreviations and terms:

- * Content-encryption key (CEK), a term defined in CMS [RFC2630].
- * Hybrid Public Key Encryption (HPKE) is defined in [RFC9180].
- * pkR is the public key of the recipient, as defined in [RFC9180].
- * skR is the private key of the recipient, as defined in [RFC9180].
- * Key Encapsulation Mechanism (KEM), see [RFC9180].
- * Key Derivation Function (KDF), see [RFC9180].

- * Authenticated Encryption with Associated Data (AEAD), see [RFC9180].
- * Additional Authenticated Data (AAD), see [RFC9180].

3. HPKE for COSE

3.1. Overview

This specification supports two modes of HPKE in COSE, namely

- * HPKE Integrated Encryption mode, where HPKE is used to encrypt the plaintext. This mode can only be used with a single recipient. Section 3.1.1 provides the details.
- * HPKE Key Encryption mode, where HPKE is used to encrypt a content encryption key (CEK) and the CEK is subsequently used to encrypt the plaintext. This mode supports multiple recipients. Section 3.1.2 provides the details.

In both cases, a new COSE header parameter called 'ek' is used to convey the content of the enc structure defined in the HPKE specification. The enc value represents the serialized encapsulated public key.

When used with HPKE, the 'ek' header parameter MUST be present in the unprotected header and MUST contain the encapsulated key, which is the output of the HPKE KEM. The value of 'ek' MUST be a bstr.

For all modes, the HPKE info parameter defaults to the empty string; mutually known private information MAY be used instead. The concept of mutually known private information is defined in [NIST.SP.800-56Ar3] as an input to the key derivation function.

HPKE defines several authentication modes, as described in Table 1 of [RFC9180]. In COSE HPKE, only 'mode_base' and 'mode_psk' are supported. The mode is 'mode_psk' if the 'psk_id' header parameter is present; otherwise, the mode defaults to 'mode_base'. 'mode_base' is described in Section 5.1.1 of [RFC9180], which only enables encryption to the holder of a given KEM private key. 'mode_psk' is described in Section 5.1.2 of [RFC9180], which authenticates using a pre-shared key.

3.1.1. HPKE Integrated Encryption Mode

This mode applies if the COSE_Encrypt0 structure uses a COSE-HPKE algorithm and has no recipient structure(s).

Because COSE-HPKE supports header protection, if the 'alg' parameter is present, it MUST be included in the protected header and MUST be a COSE-HPKE algorithm.

Although the use of the 'kid' parameter in COSE_Encrypt0 is discouraged by RFC 9052, this document RECOMMENDS the use of the 'kid' parameter (or other parameters) to explicitly identify the static recipient public key used by the sender. If the COSE_Encrypt0 structure includes a 'kid' parameter, the recipient MAY use it to select the corresponding private key.

When encrypting, the inputs to the HPKE Seal operation are set as follows:

- * kem_id: Depends on the COSE-HPKE algorithm used.
- * pkR: The recipient public key, converted into an HPKE public key.
- * kdf_id: Depends on the COSE-HPKE algorithm used.
- * aead_id: Depends on the COSE-HPKE algorithm used.
- * info: Defaults to the empty string; mutually known private information MAY be used instead.
- * aad: Canonical encoding of the Recipient_structure.
- * pt: The raw message plaintext.

The outputs are used as follows:

- * enc: MUST be placed raw into the 'ek' (encapsulated key) parameter in the unprotected bucket.
- * ct: MUST be used as layer ciphertext. If not using detached content, this is directly placed as ciphertext in COSE_Encrypt0 structure. Otherwise, it is transported separately and the ciphertext field is nil. See Section 5 of [RFC9052] for a description of detached payloads.

If 'mode_psk' has been selected, then the 'psk_id' parameter MUST be present. If 'mode_base' has been chosen, then the 'psk_id' parameter MUST NOT be present.

When decrypting, the inputs to the HPKE Open operation are set as follows:

- * kem_id: Depends on the COSE-HPKE algorithm used.

- * skR: The recipient private key, converted into an HPKE private key.
- * kdf_id: Depends on the COSE-HPKE algorithm used.
- * aead_id: Depends on the COSE-HPKE algorithm used.
- * info: Defaults to the empty string; mutually known private information MAY be used instead.
- * aad: Canonical encoding of the Recipient_structure.
- * enc: The contents of the layer 'ek' parameter.
- * ct: The contents of the layer ciphertext.

The plaintext output is the raw message plaintext.

The COSE_Encrypt0 MAY be tagged or untagged.

An example is shown in Section 5.1.

3.1.2. HPKE Key Encryption Mode

This mode is selected if the COSE_recipient structure uses a COSE-HPKE algorithm.

In this approach the following layers are involved:

- * Layer 0 (corresponding to the COSE_Encrypt structure) contains the content (plaintext) encrypted with the CEK. This ciphertext may be detached, and if not detached, then it is included in the COSE_Encrypt structure.
- * Layer 1 (corresponding to a recipient structure) contains parameters needed for HPKE to generate a shared secret used to encrypt the CEK. This layer conveys the encrypted CEK in the COSE_recipient structure using a COSE-HPKE algorithm. The unprotected header MAY contain the kid parameter to identify the static recipient public key that the sender has been using with HPKE.

This two-layer structure is used to encrypt content that can also be shared with multiple parties at the expense of a single additional encryption operation. As stated above, the specification uses a CEK to encrypt the content at layer 0.

3.1.2.1. Recipient Encryption

This section describes the `Recipient_structure`. It serves instead of `COSE_KDF_Context` for COSE-HPKE recipients (and possibly other COSE algorithms defined outside this document). It MUST be used for COSE-HPKE recipients as it provides the protection for recipient-protected headers. It is patterned after the `Enc_structure` in [RFC9052], but is specifically for a `COSE_recipient`, never a `COSE_Encrypt`. The `COSE_KDF_Context` MUST NOT be used in COSE-HPKE.

```
Recipient_structure = [  
    context: "Recipient",  
    next_layer_alg: int/tstr,  
    recipient_protected_header: empty_or_serialize_map,  
    recipient_aad: bstr  
]
```

- * "next_layer_alg" is the algorithm ID of the COSE layer for which the `COSE_recipient` is encrypting a key. It is the algorithm that the key MUST be used with. This value MUST match the alg parameter in the next lower COSE layer. (This serves the same purpose as the alg ID in the `COSE_KDF_Context`. It also mitigates attacks where a where the attacker manipulates the content-encryption algorithm identifier. This attack has been demonstrated against CMS and the mitigation can be found in [I-D.ietf-lamps-cms-cek-hkdf-sha256].
- * "recipient_protected_header" contains the protected headers from the `COSE_recipient` CBOR-encoded deterministically with the "Core Deterministic Encoding Requirements", specified in Section 4.2.1 of RFC 8949 [STD94].
- * "recipient_aad" contains any additional context the application wishes to protect. If none, it is a zero-length string. This is distinct from the external_aad for the whole `COSE_Encrypt`. It is per recipient. Since it is not a header, it may be secret data that is not transmitted. It provides a means to convey many of the fields in `COSE_KDF_Context`.

3.1.2.2. COSE-HPKE Recipient Construction

Because COSE-HPKE supports header protection, if the 'alg' parameter is present, it MUST be in the protected header and MUST be a COSE-HPKE algorithm.

The unprotected header MAY contain the kid parameter to identify the static recipient public key that the sender used. Use of the 'kid' parameter is RECOMMENDED to explicitly identify the static recipient public key used by the sender.

When encrypting, the inputs to the HPKE Seal operation are set as follows:

- * kem_id: Depends on the COSE-HPKE algorithm used.
- * pkR: The recipient public key, converted into HPKE public key.
- * kdf_id: Depends on the COSE-HPKE algorithm used.
- * aead_id: Depends on the COSE-HPKE algorithm used.
- * info: Defaults to the empty string; mutually known private information MAY be used instead.
- * aad: Canonical encoding of the Recipient_structure.
- * pt: The raw key for the next layer down.

The outputs are used as follows:

- * enc: MUST be placed raw into the 'ek' (encapsulated key) parameter in the unprotected bucket.
- * ct: MUST be placed raw in the ciphertext field in the COSE_recipient.

When decrypting, the inputs to the HPKE Open operation are set as follows:

- * kem_id: Depends on the COSE-HPKE algorithm used.
- * skR: The recipient private key, converted into HPKE private key.
- * kdf_id: Depends on the COSE-HPKE algorithm used.
- * aead_id: Depends on the COSE-HPKE algorithm used.
- * info: Defaults to the empty string; mutually known private information MAY be used instead.
- * aad: Canonical encoding of the Recipient_structure.
- * enc: The contents of the layer 'ek' parameter.

- * `ct`: The contents of the layer ciphertext field.

The plaintext output is the raw key for the next layer down.

It is not necessary to fill in `recipient_aad` as HPKE itself covers the attacks that `recipient_aad` (and `COSE_KDF_Context` (and `SP800-56A`)) are used to mitigate. COSE-HPKE use cases may use it for any purpose they wish, but it should generally be for small identifiers, context or secrets, not to protect bulk external data. Bulk external data should be protected at layer 0 with `external_aad`.

The `COSE_recipient` structure is repeated for each recipient.

When encrypting the content at layer 0, the instructions in Section 5.3 of [RFC9052] MUST be followed, including the calculation of the authenticated data structure.

An example is shown in Section 5.2.

3.2. Key Representation

The `COSE_Key` with the existing key types can be used to represent KEM private or public keys. When using a `COSE_Key` for COSE-HPKE, the following checks are made:

- * If the `"kty"` field is `"AKP"`, then the public and private keys SHALL be the raw HPKE public and private keys (respectively) for the KEM used by the algorithm.
- * Otherwise, the key MUST be suitable for the KEM used by the algorithm. In case the `"kty"` parameter is `"EC2"` or `"OKP"`, this means the value of `"crv"` parameter is suitable. The valid combinations of KEM, `"kty"` and `"crv"` for the algorithms defined in this document are shown in Figure 1.
- * If the `"key_ops"` field is present, it MUST include only `"derive bits"` for the private key and MUST be empty for the public key.

Examples of the `COSE_Key` for COSE-HPKE are shown in Section 5.3.

4. Ciphersuite Registration

A ciphersuite is a group of algorithms, often sharing component algorithms such as hash functions, targeting a security level. A COSE-HPKE algorithm is composed of the following choices:

- * HPKE Mode

- * KEM Algorithm
- * KDF Algorithm
- * AEAD Algorithm

The "KEM", "KDF", and "AEAD" values are chosen from the HPKE IANA registry [HPKE-IANA].

The HPKE mode is determined by the presence or absence of the 'psk_id' parameter and is therefore not explicitly indicated in the ciphersuite.

For a list of ciphersuite registrations, please see Section 7. The following table summarizes the relationship between the ciphersuites registered in this document and the values registered in the HPKE IANA registry [HPKE-IANA].

COSE-HPKE Ciphersuite Label	HPKE		
	KEM	KDF	AEAD
HPKE-0	0x10	0x1	0x1
HPKE-1	0x11	0x2	0x2
HPKE-2	0x12	0x3	0x2
HPKE-3	0x20	0x1	0x1
HPKE-4	0x20	0x1	0x3
HPKE-5	0x21	0x3	0x2
HPKE-6	0x21	0x3	0x3

The following list maps the ciphersuite labels to their textual description.

- * HPKE-0: DHKEM(P-256, HKDF-SHA256) KEM, HKDF-SHA256 KDF and AES-128-GCM AEAD.
- * HPKE-1: DHKEM(P-384, HKDF-SHA384) KEM, HKDF-SHA384 KDF, and AES-256-GCM AEAD.
- * HPKE-2: DHKEM(P-521, HKDF-SHA512) KEM, HKDF-SHA512 KDF, and AES-256-GCM AEAD.
- * HPKE-3: DHKEM(X25519, HKDF-SHA256) KEM, HKDF-SHA256 KDF, and AES-128-GCM AEAD.
- * HPKE-4: DHKEM(X25519, HKDF-SHA256) KEM, HKDF-SHA256 KDF, and ChaCha20Poly1305 AEAD.

- * HPKE-5: DHKEM(X448, HKDF-SHA512) KEM, HKDF-SHA512 KDF, and AES-256-GCM AEAD.
- * HPKE-6: DHKEM(X448, HKDF-SHA512) KEM, HKDF-SHA512 KDF, and ChaCha20Poly1305 AEAD.

As the list indicates, the ciphersuite labels have been abbreviated at least to some extent to strike a balance between readability and length.

The ciphersuite list above is a minimal starting point. Additional ciphersuites can be registered into the already existing registry. For example, once post-quantum cryptographic algorithms have been standardized it might be beneficial to register ciphersuites for use with COSE-HPKE. Additionally, ciphersuites utilizing the compact encoding of the public keys, as defined in [I-D.irtf-cfrg-dnhpke], may be standardized for use in constrained environments.

As a guideline for ciphersuite submissions to the IANA COSE algorithm registry, the designated experts must only register combinations of (KEM, KDF, AEAD) triple that constitute valid combinations for use with HPKE, the KDF used should (if possible) match one internally used by the KEM, and components should not be mixed between global and national standards.

4.1. COSE_Key for COSE-HPKE Ciphersuites

The COSE-HPKE algorithm uniquely determines the KEM for which a COSE_Key is used. The following mapping table shows the valid combinations of the KEM used, COSE_Key type, and its curve/key subtype.

HPKE KEM id	COSE_Key	
	kty	crv
0x0010, 0x0013	EC2	P-256
0x0011, 0x0014	EC2	P-384
0x0012, 0x0015	EC2	P-521
0x0020	OKP	X25519
0x0021	OKP	X448

Figure 1: COSE_Key Types and Curves for COSE-HPKE Ciphersuites

5. Examples

This section provides a set of examples that show all COSE message types (COSE_Encrypt0, COSE_Encrypt and COSE_Mac) to which the COSE-HPKE can be applied, and also provides some examples of key representation for HPKE KEM.

Each example of the COSE message includes the following information that can be used to check the interoperability of COSE-HPKE implementations:

- * plaintext: Original data of the encrypted payload.
- * external_aad: Externally supplied AAD.
- * skR: A recipient private key.
- * skE: An ephemeral sender private key paired with the encapsulated key.

5.1. HPKE Integrated Encryption Mode

This example assumes that a sender wants to communicate an encrypted payload to a single recipient in the most efficient way.

An example of the HPKE Integrated Encryption Mode is shown in Figure 2. Line breaks and comments have been inserted for better readability.

This example uses the following:

- * alg: HPKE-0
- * plaintext: "This is the content."
- * external_aad: "COSE-HPKE app"
- * skR: h'57c92077664146e876760c9520d054aa93c3afb04e306705db6090308507b4d3'
- * skE: h'42dd125eefc409c3b57366e721a40043fb5a58e346d51c133128a77237160218'

```

16([
  / alg = HPKE-0 (Assumed: 35) /
  h'a1011823',
  {
    / kid /
    4: h'3031',
    / ek /
    -4: h'045df24272faf43849530db6be01f42708b3c3a9
        df8e268513f0a996ed09ba7840894a3fb946cb28
        23f609c59463093d8815a7400233b75ca8ecb177
        54d241973e',
  },
  / encrypted plaintext /
  h'35aa3d98739289b83751125abe44e3b977e4b9abbf2c8cfaade
    b15f7681eef76df88f096',
])

```

Figure 2: COSE_Encrypt0 Example for HPKE

5.2. HPKE Key Encryption Mode

In this example we assume that a sender wants to transmit a payload to two recipients using the HPKE Key Encryption mode. Note that it is possible to send two single-layer payloads, although it will be less efficient.

5.2.1. COSE_Encrypt

An example of the COSE_Encrypt structure using the HPKE scheme is shown in Figure 3. Line breaks and comments have been inserted for better readability.

This example uses the following:

TODO: recompute this for Recipient_structure

```

* Encryption alg: AES-128-GCM
* plaintext: "This is the content."
* detached ciphertext: h'cc168c4e148c52a83010a75250935a47ccb8682deeb
  cef8fce5d60c161e849f53a2dc664'
* kid:"01"
  - alg: HPKE-0
  - external_aad: "COSE-HPKE app"

```

- skR: h'57c92077664146e876760c9520d054aa93c3afb04e306705db6090308507b4d3'
- skE: h'97ad883f949f4cdcb1301b9446950efd4eb519e16c4a3d78304eec832692f9f6'
- * kid: "02"
- alg: HPKE-4
- external_aad: "COSE-HPKE app"
- skR: h'bec275a17e4d362d0819dc0695d89a73be6bf94b66ab726ae0b1afe3c43f41ce'
- skE: h'b8ed3f4df56c230e36fa6620a47f24d08856d242ea547c5521ff7bd69af8fd6f'

```

96_0([
  / alg = AES-128-GCM (1) /
  h'a10101',
  {
    / iv /
    5: h'b3fb95dde18c6f90a9f0ae55',
  },
  / detached ciphertext /
  null,
  [
    [
      / alg = HPKE-0 (Assumed: 35) /
      h'a1011823',
      {
        / kid /
        4: h'3031',
        / ek /
        -4: h'04d97b79486fe2e7b98fb1bd43
            c4faee316ff38d28609a1cf568
            40a809298a91e601f1cc0c2ba4
            6cb67b41f4651b769cafd9df78
            e58aa7f5771291bd4f0f420ba6',
      },
      / ciphertext containing encrypted CEK /
      h'24450f54ae93375351467d17aa7a795cfede2
        c03ecedlad21fcb7e7c2fe64397',
    ],
    [
      / alg = HPKE-4 (Assumed: 42) /
      h'a101182a',
      {
        / kid /
        4: h'3032',
        / ek /
        -4: h'd1afbdc95b0e735676f6bca34f
            be50f2822259ac09bfc3c500f1
            4a05de9b2833',
      },
      / ciphertext containing encrypted CEK /
      h'079b443ec6dfcda6a5f8748aff3875146a8ed
        40359e1279b545166385d8d9b59',
    ],
  ],
])

```

Figure 3: COSE_Encrypt Example for HPKE

To offer authentication of the sender the payload in Figure 3 is signed with a COSE_Sign1 wrapper, which is outlined in Figure 4. The payload in Figure 4 is meant to contain the content of Figure 3.

```
18(
  [
    / protected / h'a10126' / {
      \ alg \ 1:-7 \ ECDSA 256 \
    } / ,
    / unprotected / {
      / kid / 4: 'sender@example.com'
    },
    / payload /      h'AA19...B80C',
    / signature /    h'E3B8...25B8'
  ]
)
```

Figure 4: COSE_Encrypt Example for HPKE

5.2.2. COSE_Mac

An example of the COSE_Mac structure using the HPKE scheme is shown in Figure 5.

This example uses the following:

- * MAC alg: HMAC 256/256
- * payload: "This is the content."
- * kid: "01"
 - alg: HPKE-0
 - external_aad: "COSE-HPKE app"
 - skR: h'57c92077664146e876760c9520d054aa93c3afb04e306705db6090308507b4d3'
 - skE: h'e5dd9472b5807636c95be0ba2575020ba91cbb3561b52be141da89678c664307'
- * kid: "02"
 - alg: HPKE-4
 - external_aad: "COSE-HPKE app"

- skR: h'bec275a17e4d362d0819dc0695d89a73be6bf94b66ab726ae0b1afe3c43f41ce'
- skE: h'78a49d7af71b5244498e943f361aa0250184afc48b8098a68ae97ccd2cd7e56f'

```

97_0([
  / alg = HMAC 256/256 (5) /
  h'a10105',
  {},
  / payload = 'This is the content.' /
  h'546869732069732074686520636f6e74656e742e',
  / tag /
  h'5cdcf6055fcbdb53b4001d8fb88b2a46b200ed28e1e
    d77e16ddf43fb3cac3a98',
  [
    [
      / alg = HPKE-0 (Assumed: 35) /
      h'a1011823',
      {
        / kid = '01' /
        4: h'3031',
        / ek /
        -4: h'043ac21632e45e1fbd733f002a
          621aa4f3d94737adc395d5a7cb
          6e9554bd1ad273aec991493786
          d72616d9759bf8526e6e20c1ed
          c41ba5739f2b2e441781aa0eb4',
      },
      / ciphertext containing encrypted MAC key /
      h'5cee2b4235a7ff695164f7a8d1e79ccf3ca3d
        e8b22f3592626020a95b2a8d3fb4d7aa7fe37
        432426ee70073a368f29d1',
    ],
    [
      / alg = HPKE-4 (Assumed: 42) /
      h'a101182a',
      {
        / kid = '02' /
        4: h'3032',
        / ek /
        -4: h'02cfffacc60def3bb3d0a1c3661
          227c9de8dc2b1d3939dd2c07d4
          49ebb0bba324',
      },
      / ciphertext containing encrypted MAC key /
      h'3f5b8b60271d5234dbea554dc1461d0239e9f
        4589f6415e8563b061dbcb37795a616111b78
        2b4c589b534309327ffadc',
    ],
  ],
],
])

```

Figure 5: COSE_Mac Example for HPKE

5.3. Key Representation

Examples of private and public KEM key representation are shown below.

5.3.1. KEM Public Key for HPKE-0

```
{
  / kty = 'EC2' /
  1: 2,
  / kid = '01' /
  2: h'3031',
  / alg = HPKE-0 (Assumed: 35) /
  3: 35,
  / crv = 'P-256' /
  -1: 1,
  / x /
  -2: h'65eda5a12577c2bae829437fe338701a10aaa375
      e1bb5b5de108de439c08551d',
  / y /
  -3: h'1e52ed75701163f7f9e40ddf9f341b3dc9ba860af
      7e0ca7ca7e9eecd0084d19c'
}
```

Figure 6: Key Representation Example for HPKE-0

5.3.2. KEM Private Key for HPKE-0

```
{
  / kty = 'EC2' /
  1: 2,
  / kid = '01' /
  2: h'3031',
  / alg = HPKE-0 (Assumed: 35) /
  3: 35,
  / key_ops = ['derive_bits'] /
  4: [8],
  / crv = 'P-256' /
  -1: 1,
  / x /
  -2: h'bac5b11cad8f99f9c72b05cf4b9e26d244dc189f7
      45228255a219a86d6a09eff',
  / y /
  -3: h'20138bf82dc1b6d562be0fa54ab7804a3a64b6d72
      ccfed6b6fb6ed28bbfc117e',
  / d /
  -4: h'57c92077664146e876760c9520d054aa93c3afb04
      e306705db6090308507b4d3',
}
```

Figure 7: Key Representation Example for HPKE-0

5.3.3. KEM Public Key for HPKE-4

```
{
  / kty = 'OKP' /
  1: 1,
  / kid = '11' /
  2: h'3131',
  / alg = HPKE-4 (Assumed: 42) /
  3: 42,
  / crv = 'X25519' /
  -1: 4,
  / x /
  -2: h'cb7c09ab7b973c77a808ee05b9bbd373b55c06eaa
      9bd4ad2bd4e9931b1c34c22',
}
```

Figure 8: Key Representation Example for HPKE-4

6. Security Considerations

This specification is based on HPKE and the security considerations of [RFC9180] are therefore applicable also to this specification.

Both HPKE and HPKE COSE assume that the sender possesses the recipient's public key. Therefore, some form of public key distribution mechanism is assumed to exist, but this is outside the scope of this document.

HPKE relies on a source of randomness to be available on the device. Additionally, with the two layer structure the CEK is randomly generated and it MUST be ensured that the guidelines in [RFC8937] for random number generation are followed.

HPKE in Base mode does not offer authentication as part of the HPKE KEM. In this case COSE constructs like COSE_Sign, COSE_Sign1, COSE_Mac, or COSE_Mac0 can be used to add authentication.

If COSE_Encrypt or COSE_Encrypt0 is used with a detached ciphertext then the subsequently applied integrity protection via COSE_Sign, COSE_Sign1, COSE_Mac, or COSE_Mac0 does not cover this detached ciphertext. Implementers MUST ensure that the detached ciphertext also experiences integrity protection. This is, for example, the case when an AEAD cipher is used to produce the detached ciphertext but may not be guaranteed by non-AEAD ciphers.

7. IANA Considerations

This document requests IANA to add new values to the 'COSE Algorithms' and to the 'COSE Header Parameters' registries.

7.1. COSE Algorithms Registry

7.1.1. HPKE-0

- * Name: HPKE-0
- * Value: TBD1 (Assumed: 35)
- * Description: Cipher suite for COSE-HPKE in Base Mode that uses the DHKEM(P-256, HKDF-SHA256) KEM, the HKDF-SHA256 KDF and the AES-128-GCM AEAD.
- * Capabilities: [kty]
- * Change Controller: IESG
- * Reference: [[TBD: This RFC]]
- * Recommended: Yes

7.1.2. HPKE-1

- * Name: HPKE-1
- * Value: TBD3 (Assumed: 37)
- * Description: Cipher suite for COSE-HPKE in Base Mode that uses the DHKEM(P-384, HKDF-SHA384) KEM, the HKDF-SHA384 KDF, and the AES-256-GCM AEAD.
- * Capabilities: [kty]
- * Change Controller: IESG
- * Reference: [[TBD: This RFC]]
- * Recommended: Yes

7.1.3. HPKE-2

- * Name: HPKE-2
- * Value: TBD5 (Assumed: 39)
- * Description: Cipher suite for COSE-HPKE in Base Mode that uses the DHKEM(P-521, HKDF-SHA512) KEM, the HKDF-SHA512 KDF, and the AES-256-GCM AEAD.
- * Capabilities: [kty]
- * Change Controller: IESG
- * Reference: [[TBD: This RFC]]
- * Recommended: Yes

7.1.4. HPKE-3

- * Name: HPKE-3
- * Value: TBD7 (Assumed: 41)
- * Description: Cipher suite for COSE-HPKE in Base Mode that uses the DHKEM(X25519, HKDF-SHA256) KEM, the HKDF-SHA256 KDF, and the AES-128-GCM AEAD.
- * Capabilities: [kty]

- * Change Controller: IESG
- * Reference: [[TBD: This RFC]]
- * Recommended: Yes

7.1.5. HPKE-4

- * Name: HPKE-4
- * Value: TBD8 (Assumed: 42)
- * Description: Cipher suite for COSE-HPKE in Base Mode that uses the DHKEM(X25519, HKDF-SHA256) KEM, the HKDF-SHA256 KDF, and the ChaCha20Poly1305 AEAD.
- * Capabilities: [kty]
- * Change Controller: IESG
- * Reference: [[TBD: This RFC]]
- * Recommended: Yes

7.1.6. HPKE-5

- * Name: HPKE-5
- * Value: TBD9 (Assumed: 43)
- * Description: Cipher suite for COSE-HPKE in Base Mode that uses the DHKEM(X448, HKDF-SHA512) KEM, the HKDF-SHA512 KDF, and the AES-256-GCM AEAD.
- * Capabilities: [kty]
- * Change Controller: IESG
- * Reference: [[TBD: This RFC]]
- * Recommended: Yes

7.1.7. HPKE-6

- * Name: HPKE-6
- * Value: TBD10 (Assumed: 44)

- * Description: Cipher suite for COSE-HPKE in Base Mode that uses the DHKEM(X448, HKDF-SHA512) KEM, the HKDF-SHA512 KDF, and the ChaCha20Poly1305 AEAD.
- * Capabilities: [kty]
- * Change Controller: IESG
- * Reference: [[TBD: This RFC]]
- * Recommended: Yes

7.2. COSE Header Parameters

7.2.1. ek Header Parameter

- * Name: ek
- * Label: TBDX (Assumed: -4)
- * Value type: bstr
- * Value Registry: N/A
- * Description: HPKE encapsulated key
- * Reference: [[TBD: This RFC]]

7.2.2. psk_id Header Parameter

- * Name: psk_id
- * Label: TBDX (Assumed: -5)
- * Value type: bstr
- * Value Registry: N/A
- * Description: A key identifier (kid) for the pre-shared key as defined in Section 5.1.2 of [RFC9180]
- * Reference: [[TBD: This RFC]]

8. References

8.1. Normative References

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Appendix A. Contributors

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* Ilari Liusvaara

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