Use of HPKE with JOSE

draft-rha-jose-hpke-encrypt

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What Does It Do?

- HPKE Direct Encryption mode: A kind of “Direct Encryption” to a single recipient.
- HPKE Key Encryption mode: A kind of “Key Encryption” for symmetric encryption to multiple recipients.

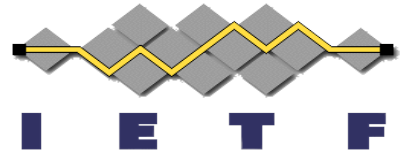
Why Do It?

- The HPKE specification provides a variant of public key encryption of arbitrary-sized plaintexts for a recipient public key.
- HPKE (Hybrid Public Key Encryption) emerged in the IETF as a prominent public key encryption scheme
  - https://www.rfc-editor.org/rfc/rfc9180.html (Developed by CFRG in IRTF)
  - Used by several protocols Oblivious HTTP, Encrypted Client Hello in TLS, MLS
- Use of HPKE with COSE https://datatracker.ietf.org/doc/draft-ietf-cose-hpke/
- HPKE interfaces are friendly to hybrid encryption

Ciphersuite Registration

- The Cipher suite (fully-specified algorithms) approach was finalized for the COSE HPKE draft, rather than the a-la-carte approach
- HPKE-<Mode>-<KEM>-<KDF>-<AEAD>
  - HPKE-Base-P256-SHA256-AES128GCM
- Three authenticated variants including PSK, Auth, and Auth_psk are defined in HPKE
- The "KEM", "KDF", and "AEAD" values are taken from the HPKE IANA registry (Hybrid Public Key Encryption (HPKE) (iana.org))

JOSE HPKE Serializations and Modes

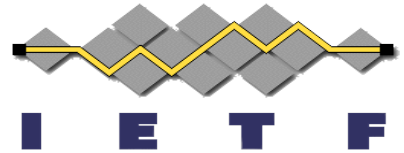


Name	Recipients	Serializations	Content Encryption Key	Similar to
Direct Encryption	1	Compact, JSON	Derived from HPKE	Direct Key Agreement
Key Encryption	1 or More	Compact, JSON	Encrypted by HPKE	Key Agreement with Key Wrapping

HPKE Encryption

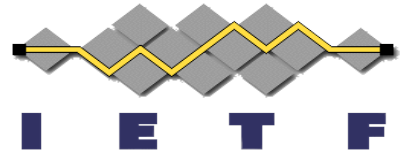
- Invoke SetupBase() to create HPKE context
- In HPKE Direct Encryption mode, the plaintext "pt" passed into Seal() is the content to be encrypted.
- In HPKE Key Encryption mode, the plaintext "pt" passed into Seal() is the CEK.

HPKE Decryption



- Invoke SetupBaseR to create the HPKE context
- Open() to decrypt ciphertext: Output is plaintext or CEK.

HPKE Direct Encryption



Direct Encryption

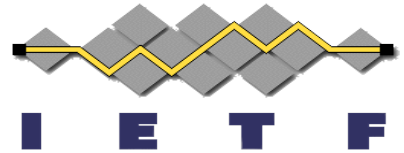
HPKE Cipher Suite

```
{
  "alg": "dir",
  "enc": "HPKE-Base-P256-SHA256-AES128GCM",
  "epk": {
    "kty": "EK",
    "ek": "BGNkj…U9thXA"
  }
}
```

example from draft-steele-jose-cose-hpke-cookbook

Sender's Encapsulated Ephemeral Public Key

HPKE Key Encryption




```
{
  "protected": "eyJlbmMiOiJBMTI4R0NNIn0",
  "ciphertext": "S0qqrM3xXPUavbmL9LQ…M57DX3cXCK3TkHquhZ0rSNduUja",
  "iv": "AzaXpooLg3ZxEASQ",
  "aad": "8J-SgCBhYWQ",
  "tag": "S0omWw35S0H7tyEHsmGLDw",
  "recipients": [
    {
      "encrypted_key": "yDVZLsO7-ecy_GCgEluwn9U723TCHNAzeYRRQPOfpHM",
      "header": {
        "kid": "urn:ietf:params:oauth:jwk-thumbprint:sha-256:adjwW6fyyZ94ZBjGjx_OpDEKHLG",
        "alg": "HPKE-Base-P256-SHA256-AES128GCM",
        "epk": {
          "kty": "EK",
          "ek": "uPpjglnXDh0uQ4kt9tHCs3PUzPxQs"
        }
      }
    }
 ]
}
```

{"enc": "A128GCM"}

Sender's Encapsulated Ephemeral Public Key

HPKE Cipher Suite

Next Steps

- Consider for WG adoption
- Comments and suggestions are welcome