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Semi-Private Messages in the Messaging Layer Security (MLS) Protocol  
draft-mahy-mls-semiprivatemessage-05

## Abstract

This document defines a `SemiPrivateMessage` for the Messaging Layer Security (MLS) protocol. It allows members to share otherwise private commits and proposals with a designated list of external receivers rather than send these handshakes in a `PublicMessage`.

## About This Document

This note is to be removed before publishing as an RFC.

The latest revision of this draft can be found at <https://rohanmahy.github.io/mls-semiprivatemessage/draft-mahy-mls-semiprivatemessage.html>. Status information for this document may be found at <https://datatracker.ietf.org/doc/draft-mahy-mls-semiprivatemessage/>.

Discussion of this document takes place on the Messaging Layer Security Working Group mailing list (<mailto:mls@ietf.org>), which is archived at <https://mailarchive.ietf.org/arch/browse/mls/>. Subscribe at <https://www.ietf.org/mailman/listinfo/mls/>.

Source for this draft and an issue tracker can be found at <https://github.com/rohanmahy/mls-semiprivatemessage>.

## Status of This Memo

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## 1. Introduction

This document defines two extensions of MLS [RFC9420]. The first is the SemiPrivateMessage wire format, which allows an otherwise PrivateMessage to be shared with a predefined list of external receivers. It is restricted for use only with commits or proposals. The second is the external\_receivers GroupContext extension that contains the list of external receivers and allows members to agree

on that list.

SemiPrivateMessages are expected to be useful in federated environments where messages routinely cross multiple administrative domains, but the MLS Distribution Service needs to see the content of commits and proposals where group members would otherwise send handshakes using PublicMessage.

## 2. Conventions and Definitions

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 document uses terminology extensively from MLS [RFC9420] and the Safe Extensions framework, defined in Section 2 of [I-D.ietf-mls-extensions].

Whenever a hash function is mentioned, it refers to the hash function defined in the cipher suite in use for the relevant MLS group.

## 3. Syntax and Usage

The external\_receivers GroupContext extension is used for all members to agree on the list of external receivers in the current epoch. Its construction mirrors the syntax of the external\_senders extension in [RFC9420].

```
struct {  
    HPKEPublicKey external_receiver_public_key;  
    Credential credential;  
} ExternalReceiver;
```

The mls\_semiprivate\_message wire format is advertised in the supported\_wire\_formats list in LeafNode.capabilities.extensions, (defined in Section 5 of [I-D.ietf-mls-extensions]). For SemiPrivateMessage to be used in a group, mls\_semiprivate\_message needs to be in the required\_wire\_formats list in the GroupContext.extension\_types of that group, and there needs to be at least one entry in the external\_receivers GroupContext extension.

SemiPrivateMessage substantially reuses the construction of PrivateMessage, but like a Welcome message also contains information (key\_and\_nonces) necessary to identify the sender leaf node and decrypt the SemiPrivateMessage struct's ciphertext. Note that the encrypted\_sender\_data cannot be decrypted by an external receiver,

but the `sender_leaf_index` is included with `key_and_nonces` and is verified in another step. `key_and_nonces` is encrypted once for each external receiver in the `external_receivers` extension.

### 3.1. Encryption of a SemiPrivateMessage

As with a `PrivateMessage`, the sending client chooses an unused generation in its own handshake ratchet and derives a key and nonce. It also generates a fresh random four-byte `reuse_guard`. The snippet below shows the syntax and encryption and decryption construction of `keys_and_nonces` into `encrypted_keys_and_nonces` for each external receiver.

```
struct {
    opaque key<V>;
    opaque nonce<V>;
    opaque reuse_guard[4];
    uint32 sender_leaf_index;
} PerMessageKeyAndNonces;

partial_context_hash = hash(sender_leaf_index || nonce)

struct {
    opaque group_id<V>;
    uint64 epoch;
    opaque partial_context_hash<V>;
} SemiPrivateMessageContext;

PerMessageKeyAndNonces key_and_nonces;
SemiPrivateMessageContext semi_private_message_context;

encrypted_key_and_nonces = EncryptWithLabel(
    external_receiver_public_key,
    "SemiPrivateMessageReceiver",
    semi_private_message_context, /* context */
    keys_and_nonces)

key_and_nonces = DecryptWithLabel(
    external_receiver_private_key,
    "SemiPrivateMessageReceiver",
    semi_private_message_context, /* context */
    encrypted_keys_and_nonces.kem_output,
    encrypted_keys_and_nonces.ciphertext)
```

The `KeyForExternalReceiver` structure contains a hash of the `ExternalReceiver` as a reference and the `encrypted_key_and_nonces`.

```
ExternalReceiverRef = hash(ExternalReceiver)
```

```
struct {  
    ExternalReceiverRef external_receiver_ref;  
    HPKECiphertext encrypted_keys_and_nonces;  
} KeyForExternalReceiver;
```

The SemiPrivateMessage struct extends the PrivateMessage struct, adding the keys\_for\_external\_receivers list, the partial\_context\_hash needed for its decryption context, and the hash of the FramedContentTBS to insure that the sender cannot encrypt content to the external receivers that is different from the other members, without detection.

The SemiPrivateContentAAD struct likewise extends the PrivateContentAAD struct, adding the keys\_for\_external\_receivers list, the partial\_context\_hash and the framed\_content\_tbs\_hash.

The SemiPrivateMessageContent struct is the same as PrivateMessageContent except application messages are not included.

```
framed_content_tbs_hash = hash(FramedContentTBS)
```

```
struct {  
    opaque group_id<V>;  
    uint64 epoch;  
    ContentType content_type;  
    opaque authenticated_data<V>;  
    opaque partial_context_hash<V>;  
    KeyForExternalReceiver keys_for_external_receivers<V>;  
    opaque framed_content_tbs_hash<V>;  
    opaque encrypted_sender_data<V>;  
    opaque ciphertext<V>;  
} SemiPrivateMessage;
```

```
struct {  
    select (SemiPrivateMessage.content_type) {  
        case proposal:  
            Proposal proposal;  
        case commit:  
            Commit commit;  
    };  
    FramedContentAuthData auth;  
    opaque padding[length_of_padding];  
} SemiPrivateMessageContent;
```

```
struct {  
    opaque group_id<V>;
```

```

    uint64 epoch;
    ContentType content_type;
    opaque authenticated_data<V>;
    opaque partial_context_hash<V>;
    KeyForExternalReceiver keys_for_external_receivers<V>;
    opaque framed_content_tbs_hash<V>;
} SemiPrivateContentAAD;

struct {
    ProtocolVersion version = mls10;
    WireFormat wire_format;
    select (MLSMessage.wire_format) {
        case mls_public_message:
            PublicMessage public_message;
        case mls_private_message:
            PrivateMessage private_message;
        ...
        case mls_semiprivate_message:
            SemiPrivateMessage semiprivate_message;
    };
} MLSMessage;

```

Encryption of the ciphertext uses the cipher suite's AEAD algorithm using the key, nonce xored with the reuse\_guard, the SemiPrivateMessageContent as the plaintext, and the SemiPrivateContentAAD as the authenticated data.

Encryption of the encrypted\_sender\_data proceeds in the same way for SemiPrivateMessage as for PrivateMessage.

### 3.2. Decryption of SemiPrivateMessage as a member

When receiving a SemiPrivateMessage, a member receiver derives the sender\_data\_key and sender\_data\_nonce and decrypts the encrypted\_sender\_data, just as for a PrivateMessage.

The receiver uses the SenderData to lookup the key and nonce for the correct generation in the (non-blank) sender's handshake ratchet. The receiver verifies the partial\_context\_hash.

After xoring the nonce with the reuse\_guard, the member decrypts the ciphertext. It verifies the padding consists of the appropriate number of zero bytes, and verifies that the framed\_content\_tbs\_hash is correct. Finally, it verifies that the signature in the FramedContentAuthData is valid.

### 3.3. Decryption of SemiPrivateMessage as an external receiver

When receiving a SemiPrivateMessage, an external receiver looks in the `keys_for_external_receivers` field for its `external_receiver_ref`. It calculates the `semi_private_message_context` and uses HPKE to decrypt the `encrypted_keys_and_nonces`. Using the nonce and `sender_leaf_node` it verifies the `partial_context_hash`.

After xoring the nonce with the `reuse_guard`, the member decrypts the ciphertext. It verifies the padding consists of the appropriate number of zero bytes, and verifies that the `framed_content_tbs_hash` is correct. If the external receiver has a copy of the `GroupContext`, it verifies that the signature in the `FramedContentAuthData` is valid.

## 4. Security Considerations

These two extensions provide a privacy improvement over sending handshake messages using `PublicMessage`. The handshake is shared with a specific list of receivers, and that list is visible as part of the `GroupContext`.

TODO More Security.

## 5. IANA Considerations

### 5.1. SemiPrivateMessage Wire Format

- \* Value: TBD1 (to be assigned by IANA)
- \* Name: `mls_semiprivate_message`
- \* Recommended: Y
- \* Reference: RFC XXXX

### 5.2. External Receivers Extension Type

The `external_receivers` extension contains a list of external receivers targeted in a `SemiPrivateMessage`.

- \* Value: TBD2 (to be assigned by IANA)
- \* Name: `external_receivers`
- \* Message(s): GC. This extension may appear in `GroupContext` objects.
- \* Recommended: Y

- \* Reference: RFC XXXX

### 5.3. SemiPrivateMessageReceiver Public Key Encryption Label

- \* Label: "SemiPrivateMessageReceiver"
- \* Recommended: Y
- \* Reference: RFC XXXX

## 6. Normative References

### [I-D.ietf-mls-extensions]

Robert, R., "The Messaging Layer Security (MLS) Extensions", Work in Progress, Internet-Draft, draft-ietf-mls-extensions-06, 19 February 2025, <<https://datatracker.ietf.org/doc/html/draft-ietf-mls-extensions-06>>.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/rfc/rfc2119>>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/rfc/rfc8174>>.

[RFC9420] Barnes, R., Beurdouche, B., Robert, R., Millican, J., Omara, E., and K. Cohn-Gordon, "The Messaging Layer Security (MLS) Protocol", RFC 9420, DOI 10.17487/RFC9420, July 2023, <<https://www.rfc-editor.org/rfc/rfc9420>>.

## Appendix A. Change log

### A.1. Changes from draft-mahy-mls-semiprivatemessage-04 to -05

- \* remove the "safe extension" wire format
- \* use the supported/required\_wire\_formats extensions in mls-extensions
- \* register SemiPrivateMessageReceiver Public Key Encryption Label

### A.2. Changes from draft-mahy-mls-semiprivatemessage-03 to -04

- \* corrected a typo in SemiPrivateMessageContent



## A.3. Changes from draft-mahy-mls-semiprivatemessage-02 to -03

- \* do not attempt to decrypt SenderData for external receivers; instead also encrypt the sender\_leaf\_index and reuse\_guard.
- \* make the encrypted\_key\_and\_nonces context include the group\_id, epoch, and a the hash of the sender\_leaf\_index and nonce. include that partial\_context\_hash in the AAD.
- \* add a hash of the FramedContentTBS to the AAD to make sure the content encrypted to the external receiver is the same as that sent to members.
- \* add explicit instructions about encryption and decryption.

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