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Header Protection for Cryptographically Protected E-mail

Abstract

S/MIME version 3.1 introduced a mechanism to provide end-to-end cryptographic protection of e-mail message headers. However, few implementations generate messages using this mechanism, and several legacy implementations have revealed rendering or security issues when handling such a message.

This document updates the S/MIME specification to offer a different mechanism that provides the same cryptographic protections but with fewer downsides when handled by legacy clients. The header protection schemes described here are also applicable to messages with PGP/MIME cryptographic protections. Furthermore, this document offers more explicit guidance for clients when generating or handling e-mail messages with cryptographic protection of message headers.

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://dkg.gitlab.io/lamps-header-protection/>. Status information for this document may be found at <https://datatracker.ietf.org/doc/draft-ietf-lamps-header-protection/>.

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

Source for this draft and an issue tracker can be found at <https://gitlab.com/dkg/lamps-header-protection>.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

Privacy and security issues regarding email Header Protection in S/MIME and PGP/MIME have been identified for some time. Most current implementations of cryptographically-protected electronic mail protect only the body of the message, which leaves significant room for attacks against otherwise-protected messages. For example, lack of header protection allows an attacker to substitute the message subject and/or author.

This document describes two different structures for how message headers can be cryptographically protected, and provides guidance for implementers of MUAs that generate and interpret such messages. It takes particular care to ensure that messages interact reasonably well with legacy MUAs.

1.1. Two Schemes of Header Protection

This document addresses two different schemes for cryptographically protecting email header sections or fields and provides guidance to implementers.

One scheme is the form specified in S/MIME 3.1 and later, which involves wrapping a message/rfc822 or message/global MIME object with a Cryptographic Envelope around the message to protect. This document calls this scheme "Wrapped Message", and it is documented in more detail in [[RFC8551](#)]. Experience has shown that this form does not interact well with some legacy MUAs (see [Section 1.2](#)).

Consequently, another form of header protection is introduced, where the protected header fields are placed directly on the Cryptographic Payload, without using an intervening message/* MIME object. This document calls this scheme "Injected Headers", and it is documented in more detail in this document, in [Section 2.3.4](#) and [Section 2.5.3](#).

1.2. Problems with Wrapped Messages

Several legacy MUAs have revealed rendering issues when dealing with a message that uses the Wrapped Message header protection scheme.

In the worst cases, some mail user agents cannot render message/rfc822 message subparts at all, in violation of baseline MIME requirements as described on page 5 of [\[RFC2049\]](#). This leaves all wrapped messages unreadable by any recipient using such a MUA.

In other cases, the user sees an attachment suggesting a forwarded email message, which -- in fact -- contains the protected email message that should be rendered directly. In most of these cases, the user can click on the attachment to view the protected message.

However, viewing the protected message as an attachment in isolation may strip it of any security indications, leaving the user unable to assess the cryptographic properties of the message. Worse, for encrypted messages, interacting with the protected message in isolation may leak contents of the cleartext, for example, if the reply is not also encrypted.

1.3. Problems with Injected Headers

A legacy MUA dealing with an encrypted message that has some header fields obscured using the Injected Headers scheme will not render the obscured header fields to the user at all. A workaround "legacy display" mechanism is provided in this document, which most legacy MUAs should render to the user, albeit not in the same location that the header fields would normally be rendered.

1.4. Motivation

Users generally do not understand the distinction between message body and message header. When an e-mail message has cryptographic protections that cover the message body, but not the header fields, several attacks become possible.

For example, a legacy signed message has a signature that covers the body but not the header fields. An attacker can therefore modify the header fields (including the Subject header) without invalidating the signature. Since most readers consider a message body in the context of the message's Subject header, the meaning of the message itself could change drastically (under the attacker's control) while still retaining the same cryptographic indicator of authenticity.

In another example, a legacy encrypted message has its body effectively hidden from an adversary that snoops on the message. But if the header fields are not also encrypted, significant information

about the message (such as the message Subject) will leak to the inspecting adversary.

However, if the sending and receiving MUAs ensure that cryptographic protections cover the message headers as well as the message body, these attacks are defeated.

1.4.1. Backward Compatibility

If the sending MUA is unwilling to generate such a fully-protected message due to the potential for rendering, usability, deliverability, or security issues, these defenses cannot be realized.

The sender cannot know what MUA (or MUAs) the recipient will use to handle the message. Thus, an outbound message format that is backward-compatible with as many legacy implementations as possible is a more effective vehicle for providing the whole-message cryptographic protections described above.

This document aims for backward compatibility with legacy clients to the extent possible. In some cases, like when a user-visible header like the Subject is cryptographically hidden, the message cannot behave entirely identically to a legacy client. But accommodations are described here that ensure a rough semantic equivalence for legacy clients even in these cases.

1.4.2. Deliverability

A message that cannot be delivered is less useful than a message with perfect cryptographic protections. Senders want their messages to reach the intended recipients.

Given the current state of the Internet mail ecosystem, encrypted messages in particular cannot shield all of their header fields from visibility and still be guaranteed delivery to their intended recipient.

This document accounts for this concern by providing a mechanism ([Section 2.3.2](#)) that prioritizes initial deliverability (at the cost of some header leakage) while facilitating future message variants that shield more header metadata from casual inspection.

1.5. Other Protocols to Protect Email Header Fields

A separate pair of protocols also provides some cryptographic protection for the email message header integrity: DomainKeys Identified Mail (DKIM) [[RFC6376](#)], as used in combination with Domain-based Message Authentication, Reporting, and Conformance (DMARC) [[RFC7489](#)]. This pair of protocols provides a domain-based

reputation mechanism that can be used to mitigate some forms of unsolicited email (spam).

However, the DKIM+DMARC suite provides cryptographic protection at a different scope than the mechanisms described here. In particular, the message integrity and authentication signals provided by DKIM+DMARC correspond to the domain name of the sending e-mail address, not the sending address itself, so DKIM+DMARC not provide end-to-end protection. DKIM+DMARC are typically applied to messages by (and interpreted by) mail transfer agents, not mail user agents. The mechanisms in this document are typically applied to messages by (and interpreted by) mail user agents.

Furthermore, DKIM+DMARC only provides cryptographic integrity and authentication, not encryption. So cryptographic confidentiality is not available from that suite.

DKIM+DMARC can be used on any message, including messages formed as described in this document. There should be no conflict between these schemes.

Though not strictly e-mail, similar protections have been in use on Usenet for signing and verification of message headers for years. See ([[PGPCONTROL](#)] and [[PGPVERIFY-FORMAT](#)] for more details. Like DKIM, these Usenet control protections offer only integrity and authentication, not encryption.

1.6. Applicability to PGP/MIME

This document describes end-to-end cryptographic protections for e-mail messages in reference to S/MIME ([[RFC8551](#)]).

Comparable end-to-end cryptographic protections can also be provided by PGP/MIME ([[RFC3156](#)]).

The mechanisms in this document should be applicable in the PGP/MIME protections as well as S/MIME protections, but analysis and implementation in this document focuses on S/MIME.

To the extent that any divergence from the mechanism described here is necessary for PGP/MIME, that divergence is out of scope for this document.

1.7. Requirements Language

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.

1.8. Terms

The following terms are defined for the scope of this document:

*S/MIME: Secure/Multipurpose Internet Mail Extensions (see [\[RFC8551\]](#))

*PGP/MIME: MIME Security with OpenPGP (see [\[RFC3156\]](#))

*Message: An Email Message consisting of Header Fields (collectively called "the Header Section of the message") followed, optionally, by a Body; see [\[RFC5322\]](#).

Note: To avoid ambiguity, this document avoids using the terms "Header" or "Headers" in isolation, but instead always uses "Header Field" to refer to the individual field and "Header Section" to refer to the entire collection.

*Header Field: A Header Field is a line beginning with a field name, followed by a colon (":"), followed by a field body (value), and terminated by CRLF; see [\[RFC5322\]](#).

*Header Section: The Header Section is a sequence of lines of characters with special syntax as defined in [\[RFC5322\]](#). The Header Section of a Message contains the Header Fields associated with the Message itself. The Header Section of a MIME part (that is, a subpart of a message) typically contains Header Fields associated with that particular MIME part.

*Body: The Body is the part of a Message that follows the Header Section and is separated from the Header Section by an empty line (i.e., a line with nothing preceding the CRLF); see [\[RFC5322\]](#). It is the (bottom) section of Message containing the payload of a Message. Typically, the Body consists of a (possibly multipart) MIME [\[RFC2045\]](#) construct.

*Header Protection: cryptographic protection of email Header Sections (or parts of it) for signatures and/or encryption

*Cryptographic Layer, Cryptographic Payload, Cryptographic Envelope, Structural Headers, Main Body Part, User-Facing Headers, and MUA are all used as defined in [\[I-D.ietf-lamps-e2e-mail-guidance\]](#)

*Legacy MUA: a MUA that does not understand header protection as described in this document. A Legacy Non-Crypto MUA is incapable of doing any end-to-end cryptographic operations. A Legacy Crypto MUA is capable of doing cryptographic operations, but does not understand or generate messages with header protection.

*Wrapped Message: The header protection scheme that uses the mechanism described in [[RFC8551](#)], where the Cryptographic Payload is a message/rfc822 or message/global MIME object. (see [Section 2.2](#)).

*Injected Headers: The header protection scheme that uses the mechanism described in this document (see [Section 2.1](#)), where the protected header fields are inserted on the Cryptographic Payload directly.

*Header Confidentiality Policy: a functional specification of which header fields should be obscured when composing an encrypted message with header protection. See [Section 2.3.2](#).

1.9. Document Scope

This document describes sensible, simple behavior for a program that generates an e-mail message with standard end-to-end cryptographic protections, following the guidance in [[I-D.ietf-lamps-e2e-mail-guidance](#)]. An implementation conformant to this draft will produce messages that have cryptographic protection that covers the message's headers as well as its body.

This document also describes sensible, simple behavior for a program that interprets such a message, in a way that can take advantage of these protections covering the header fields as well as the body.

The message generation guidance aims to minimize negative interactions with any legacy receiving client while providing actionable cryptographic properties for modern receiving clients.

In particular, this document focuses on two standard types of cryptographic protection that cover the entire message:

*A cleartext message with a single signature, and

*An encrypted message that contains a single cryptographic signature.

1.9.1. Out of Scope

The message composition guidance in this document (in [Section 2.3.4](#)) aims to provide minimal disruption for any legacy client that receives such a message. However, a legacy client by definition does not implement any of the guidance here. Therefore, the document does not attempt to provide guidance for legacy clients directly.

Furthermore, this document does not explicitly contemplate unusual (and tricky) variants of cryptographic message protections, including any of these:

- *Encrypted-only message (without a cryptographic signature)
- *Triple-wrapped message
- *Signed message with multiple signatures
- *Encrypted message with a cryptographic signature outside the encryption.

All such messages are out of scope of this document.

2. Specification

As mentioned in [Section 1.1](#), this document describes two ways to provide end-to-end cryptographic protection for an e-mail message that includes all header fields known to the sender at message composition time.

A receiving MUA **MUST** be able to handle both header protection schemes, as described in [Section 2.5](#).

A sending MUA **MUST** be able to generate the Injected Headers scheme ([Section 2.3.4](#)), and **MAY** generate the Wrapped Message scheme ([Section 2.3.5](#)).

2.1. Injected Headers Scheme

A message that uses the Injected Headers scheme has protected header fields in the header section of the Cryptographic Payload.

For an encrypted message that has at least one user-visible header field omitted or obscured outside of the Cryptographic Payload, those header fields **MAY** also be duplicated into decorative copies in the Main Body MIME part of the Cryptographic Payload itself. These decorative copies within the message are known as "legacy display elements".

Such a legacy display element can be useful for a legacy receiving MUA that doesn't yet understand how to interpret or display a cryptographically-protected confidential header. See [Section 3.1](#) for more details about how the ecosystem could shift so that a sending MUA could avoid the need to generate any legacy display element.

Composing a message with the Injected Headers scheme is described in [Section 2.3.4](#). Rendering such a message is described in [Section 2.5.3](#).

2.2. Wrapped Message Scheme

A message that uses the Wrapped Message scheme has a Cryptographic payload of a single message/rfc822 (or message/global) MIME object, which itself contains the original message (including the protected header section).

Composing a message with the Wrapped Message scheme is described in [Section 2.3.5](#). Rendering such a message is described in [Section 2.5.4](#).

2.3. Sending Side

This section describes the process an MUA should use to apply cryptographic protection to an e-mail message with header protection. We start by describing the legacy message composition process as a baseline.

2.3.1. Composing a Cryptographically-Protected Message Without Header Protection

[\[I-D.ietf-lamps-e2e-mail-guidance\]](#) describes the typical process for a legacy crypto MUA to apply cryptographic protections to an e-mail message. That guidance and terminology is replicated here for reference:

origbody: the traditional unprotected message body as a well-formed MIME tree (possibly just a single MIME leaf part). As a well-formed MIME tree, origbody already has structural headers (Content-) present.

*origheaders: the intended non-structural headers for the message, represented here as a list of (h,v) pairs, where h is a header field name and v is the associated value. Note that these are header fields that the MUA intends to be visible to the recipient of the message. In particular, if the MUA uses the Bcc header during composition, but plans to omit it from the message (see section 3.6.3 of [\[RFC5322\]](#)), it will not be in origheaders.

*crypto: The series of cryptographic protections to apply (for example, "sign with the secret key corresponding to X.509 certificate X, then encrypt to X.509 certificates X and Y"). This is a routine that accepts a MIME tree as input (the Cryptographic Payload), wraps the input in the appropriate Cryptographic Envelope, and returns the resultant MIME tree as output.

The algorithm returns a MIME object that is ready to be injected into the mail system:

*Apply crypto to origbody, yielding MIME tree output

*For each header name and value (h,v) in origheaders:

-Add header h of output with value v

*Return output

2.3.2. Header Confidentiality Policy

When composing an encrypted message with header protection, the composing MUA needs a Header Confidentiality Policy (HCP). In this document, we represent that Header Confidentiality Policy as a function hcp:

*hcp(name, val_in) --> val_out: this function takes a non-structural header field identified by name with initial value val_in as arguments, and returns a replacement header value val_out. If val_out is the special value null, it mean that the header field in question should be omitted from the set of header fields visible outside the Cryptographic Envelope.

Note that hcp is only applied to non-structural header fields. When composing a message, structural header fields are dealt with separately, as described in [Section 2.3.4](#) and [Section 2.3.5](#).

As an example, an MUA that obscures the Subject header field by replacing it with the literal string [...], hides all Cc'ed recipients, and does not offer confidentiality to any other header fields would be represented as (in pseudocode):

```
hcp_example(name, val_in) → val_out:
  if name is 'Subject':
    return '['...']'
  else if name is 'Cc':
    return null
  else:
    return val_in
```

Note that such a policy is only needed when the end-to-end protections include encryption (confidentiality). No comparable policy is needed for other end-to-end cryptographic protections (integrity and authenticity), as they are simply uniformly applied so that all header fields known by the sender have these protections.

This asymmetry is an unfortunate consequence of complexities in message delivery systems, some of which may reject, drop, or delay messages where all header fields are removed from the top-level MIME object.

This document does not mandate any particular Header Confidentiality Policy, though it offers guidance for MUA implementers in selecting one in [Section 2.4](#). Future documents may recommend or mandate such a policy for an MUA with specific needs. Such a recommendation might be motivated by descriptions of metadata-derived attacks, or stem from research about message deliverability, or describe new signalling mechanisms, but these topics are out of scope for this document.

2.3.3. Definition of HP-Removed and HP-Obscured header fields

This document defines 2 new header fields used for conveying the effect of sender's Header Confidentiality Policy: HP-Removed and HP-Obscured. An implementation that composes encrypted e-mail and hides any of the header fields as described in this document (for example, due to a non-null HCP) **MUST** include the appropriate HP-Removed or HP-Obscured headers in the cryptographic payload. These two MIME header fields should only ever appear directly within the header section of the cryptographic payload of a cryptographic envelope offering confidentiality.

HP-Removed includes a comma separated list of header field names that were omitted from the outer header when the message with header protection was generated. The HP-Removed header field can appear at most once in the header section of a cryptographic payload.

Each instance of HP-Obscured contains a header field name and the value that this header field was modified to in the outer header. The HP-Obscured header field can appear multiple times in the header section of a cryptographic payload.

If a header field name A doesn't appear in an HP-Obscured header field value, then the header field A was either removed (and thus would appear in the HP-Removed header field) or it was copied without any modifications to the outer header.

Syntax of these new header fields is defined using the following ABNF [[RFC5234](#)]:

```
hp-removed      = "HP-Removed:" field-name-list CRLF
field-name-list = [FWS] field-name
                 *([FWS] "," [FWS] field-name) [FWS]
hp-observed     = "HP-Obscured:" [FWS] field-name ": "
                 field-value CRLF
field-value     = unstructured
```

2.3.4. Composing with "Injected Headers" Header Protection

The "Injected Headers" header protection scheme places the header fields to be protected directly on the cryptographic payload. Unlike in the "Wrapped Scheme" (see [compose-wrapped-message](#)), there is no wrapping of the message body in any additional message/* MIME part. This section describes how to generate such a message.

To compose a message using "Injected Headers" header protection, the composing MUA needs one additional input in addition to the Header Confidentiality Policy hcp defined in [Section 2.3.2](#).

*legacy: a boolean value, indicating whether any recipient of the message is believed to have a legacy client. If all recipients are known to implement this draft, legacy should be set to false. (How a MUA determines the value of legacy is out of scope for this document; an initial implementation can simply set it to true)

Enabling visibility of obscured header fields for decryption-capable legacy clients requires transforming a header list into a readable form and including it as a decorative "Legacy Display" element in specially-marked parts of the message. This document recommends two different mechanisms for such a decorative adjustment: one for a text/html Main Body part of the e-mail message, and one for a text/plain Main Body part. This document does not recommend adding a Legacy Display element to any other part.

Please see [[I-D.ietf-lamps-e2e-mail-guidance](#)] for guidance on identifying the parts of a message that are a Main Body Part.

The revised algorithm for applying cryptographic protection to a message is as follows:

```
*if crypto contains encryption, and legacy is true:
  -Create ldlist, an empty list of (header, value) pairs
  -For each header field name and value (h,v) in origheaders:
    oIf h is user-facing (see
      [I-D.ietf-lamps-e2e-mail-guidance]):
      oIf hcp(h,v) is not v:
        oAppend (h,v) to ldlist
```


- If ldlist is not empty:
 - oIdentify each leaf MIME part of payload that represents the "main body" of the message.
 - oFor each "Main Body Part" bodypart of type text/plain or text/html:
 - oInsert Legacy Display element header list ldlist into the content of bodypart (see [Section 2.3.4.1](#) for text/plain and [Section 2.3.4.2](#) for text/html)
 - oAdd Content-Type parameter hp-legacy-display with value 1 to bodypart
- *For each header field name and value (h,v) in origheaders:
 - Add header field h to MIME part payload with value v
- *Set the protected-headers parameter on the Content-Type of payload to v1
- *If crypto contains encryption:
 - Create new empty list of header field names and values newh
 - Let hpr be an empty comma-separated list of header field names
 - For header field name and value (h,v) in origheaders:
 - oLet newval be hcp(h,v)
 - oIf newval is null:
 - oAdd the value h to hpr
 - oElse (if newval is not null):
 - oAdd (h,newval) to newh
 - oIf newval is not v:
 - oLet string record be the concatenation of h, a literal ": " (colon followed by space), and newval
 - oAdd header field "HP-Obscured" to MIME part payload with value record

-If hpr is not empty:

- oAdd header field "HP-Removed" to MIME part payload with value hpr

-Set origheaders to newh

*Apply crypto to payload, producing MIME tree output

*For each header field name and value (h,v) in origheaders:

- Add header field h to output with value v

*Return output

Note that both new parameters (hcp and legacy) are effectively ignored if crypto does not contain encryption. This is by design, because they are irrelevant for signed-only cryptographic protections.

2.3.4.1. Adding a Legacy Display Element to a text/plain Part

For a list of obscured header fields represented as (header, value) pairs, concatenate them as a set of lines, with one newline at the end of each pair. Add an additional trailing newline after the resultant text, and prepend the entire list to the body of the text/plain part.

For example, if the list of obscured header fields was [{"Cc", "alice@example.net"}, {"Subject", "Thursday's meeting"}], then a text/plain part that originally contained:

I think we should skip the meeting.

Would become:

Subject: Thursday's meeting
Cc: alice@example.net

I think we should skip the meeting.

2.3.4.2. Adding a Legacy Display Element to a text/html Part

Adding a Legacy Display Element to a text/html part is similar to how it is added to a text/plain part (see [Section 2.3.4.1](#)). Instead of adding the obscured header fields to a block of text delimited by a blank line, the composing MUA injects them in an HTML <div> element annotated with a class attribute of header-protection-legacy-display.

The content and formatting of this decorative <div> have no strict requirements, but they **SHOULD** represent all the obscured header fields in a readable fashion. A simple approach is to assemble the text in the same way as [Section 2.3.4.1](#), wrap it in a verbatim <pre> element, and put that element in the annotated <div>.

The annotated <div> should be placed as close to the start of the <body> as possible, where it will be visible when viewed with a standard HTML renderer.

For example, if the list of obscured header fields was [{"Cc", "alice@example.net"}, {"Subject", "Thursday's meeting"}], then a text/html part that originally contained:

```
<html><head><title></title></head><body>
<p>I think we should skip the meeting.</p>
</body></html>
```

Would become:

```
<html><head><title></title></head><body>
<div class="header-protection-legacy-display">
<pre>Subject: Thursday's meeting
Cc: alice@example.net</pre></div>
<p>I think we should skip the meeting.</p>
</body></html>
```

2.3.4.2.1. Step-by-step Example for Inserting Legacy Display Element to text/html

A composing MUA **MAY** insert the Legacy Display Element anywhere reasonable within the message as long as it prioritizes visibility for the reader using a legacy decryption-capable MUA. This decision may take into account special message-specific HTML formatting expectations if the MUA is aware of them. However, some MUAs may not have any special insight into the user's preferred HTML formatting, and still want to insert a legacy display element. This section offers a non-normative, simple, and minimal step-by-step approach for a composing MUA that has no other information or preferences to fall back on.

The process below assumes that the MUA already has the full HTML object that it intends to send, including all of the text supplied by the user.

*Assemble the text exactly as specified for text/plain (see [Section 2.3.4.1](#)).

*Wrap that text in a verbatim <pre> element.

*Wrap that <pre> element in a <div> element annotated with the class header-protection-legacy-display.

*Find the <body> element of the full HTML object.

*Insert the <div> element as the first child of the <body> element.

2.3.4.3. Only Add a Legacy Display Element to Main Body Parts

Some messages may contain a text/plain or text/html subpart that is *not* a main body part. For example, an e-mail message might contain an attached text file or a downloaded webpage. Attached documents need to be preserved as intended in the transmission, without modification.

The composing MUA **MUST NOT** add a Legacy Display element to any part of the message that is not a main body part. In particular, if a part is annotated with Content-Disposition: attachment, or if it does not descend via the first child of any of its multipart/mixed or multipart/related ancestors, it is not a main body part, and **MUST NOT** be modified.

See [[I-D.ietf-lamps-e2e-mail-guidance](#)] for more guidance about common ways to distinguish main body parts from other MIME parts in a message.

2.3.4.4. Do Not Add a Legacy Display Element to Other Content-Types

The purpose of injecting a Legacy Display element into each Main Body MIME part is to enable rendering of otherwise obscured header fields in legacy clients that are capable of message decryption, but don't know how to follow the rest of the guidance in this document.

The authors are unaware of any legacy client that would render any MIME part type other than text/plain and text/html as the Main Body. A generating MUA **SHOULD NOT** add a Legacy Display element to any MIME part with any other Content-Type.

2.3.5. Composing with "Wrapped Message" Header Protection

The Wrapped Message header protection scheme is briefly documented in Section 3.1 [[RFC8551](#)]. This section provides a more detailed explanation of how to build such a message, and augments it with the protected-headers parameter with the value wrapped. It also recommends marking such a wrapped message as Content-Disposition: inline to encourage legacy MUAs to render the inner message directly rather than treating it as an attachment.

To compose a message using "Wrapped Message" header protection, we use those inputs described in [Section 2.3.1](#) plus the Header Confidentiality Policy hcp defined in [Section 2.3.2](#). The new algorithm is:

*For header field name and value (h,v) in origheaders:

-Add header field h to origbody with value v

*If crypto contains encryption:

-Create new empty list of header field names and values newh

-Let hpr be an empty comma-separated list of header field names

-For header field name and value (h,v) in origheaders:

oLet newval be hcp(h,v)

oIf newval is null:

oAdd the value h to hpr

oElse (if newval is not null):

oAppend (h,newval) to newh

oIf newval is not v:

oLet string record be the concatenation of h, a literal ": " (colon followed by a space), and newval

oAdd header field HP-Obscured to origbody with value record

-If hpr is not empty:

oAdd header field "HP-Removed" to MIME part payload with value hpr

*If any of the header fields in origbody, including header fields in the nested internal MIME structure, contain any 8-bit UTF-8 characters (see section section 3.7 of [\[RFC6532\]](#)):

-Let payload be a new MIME part with one header field: Content-Type: message/global; protected-headers=wrapped, and whose body is origbody.

*Else:

-Let payload be a new MIME part with one header field: Content-Type: message/rfc822; protected-headers=wrapped, and whose body is origbody.

*Add a Content-Disposition header field to payload with value inline

*Apply crypto to payload, yielding MIME tree output

*If crypto contains encryption:

-Set origheaders to newh

*For header field name and value (h,v) in origheaders:

-Add header field h to output with value v

*Return output

Note that the Header Confidentiality Policy hcp is ignored if crypto does not contain encryption. This is by design.

2.3.6. Choosing Between Wrapped Message and Injected Headers

When composing a message with end-to-end cryptographic protections, an MUA **SHOULD** protect the header fields of that message as well as the body, using one of the formats described here.

A compatible MUA **MUST** be capable of generating a message with header protection using the Injected Headers [Section 2.3.4](#) format.

2.4. Default Header Confidentiality Policy

An MUA **SHOULD** have a sensible default Header Confidentiality Policy, and **SHOULD NOT** require the user to select one. At the time this document was written, a good choice for default HCP is the conservative approach described by hcp_minimal ([Section 2.4.1](#)).

Any default Header Confidentiality Policy **SHOULD** provide confidentiality for the Subject header field by replacing it with the literal string [...]. Most users treat the Subject of a message the same way that they treat the body, and they are surprised to find that the Subject of an encrypted message is visible.

2.4.1. Minimalist Header Confidentiality Policy

The most conservative recommended Header Confidentiality Policy only protects the Subject header field:

```
hcp_minimal(name, val_in) → val_out:
    if name is 'Subject':
        return '[...]'
    else:
        return val_in
```

hcp_minimal is the recommended default HCP for a new implementation, as it provides meaningful confidentiality protections, and is unlikely to cause deliverability or usability problems.

2.4.2. Strong Header Confidentiality Policy

Alternately, a more aggressive (and therefore more privacy-preserving) Header Confidentiality Policy only leaks a handful of fields whose absence is known to increase rates of delivery failure, and simultaneously obscures the Message-ID behind a random new one:

```
hcp_strong(name, val_in) → val_out:
    if name in ['From', 'To', 'Cc', 'Date']:
        return val_in
    else if name is 'Subject':
        return '[...]'
    else if name is 'Message-ID':
        return generate_new_message_id()
    else:
        return null
```

The function generate_new_message_id() represents whatever process the MUA typically uses to generate a Message-ID for a new outbound message.

hcp_strong is known to cause usability problems with message threading for many legacy MUAs, and is not recommended as a default HCP for new implementations.

2.4.3. Null Header Confidentiality Policy

Legacy MUAs can be conceptualized as offering a null Header Confidentiality Policy, which offers no confidentiality protection to any header field:

```
hcp_null(name, val_in) → val_out:
    return val_in
```

A MUA offering header protection **SHOULD NOT** use hcp_null by default.

2.4.4. Offering Stronger Header Confidentiality

A MUA **MAY** offer even stronger confidentiality for header fields of an encrypted message than described in [Section 2.4.2](#). For example,

it might implement an HCP that obfuscates the From field, or omits the Cc field, or ensures Date is represented in UTC (obscuring the local timezone).

The authors of this document hope that implementers with deployment experience will document their chosen Header Confidentiality Policy and the rationale behind their choice.

2.5. Receiving Side

An MUA that receives a cryptographically-protected e-mail will render it for the user.

The receiving MUA will render the message body, a selected subset of header fields, and (as described in [\[I-D.ietf-lamps-e2e-mail-guidance\]](#)) provide a summary of the cryptographic properties of the message.

Most MUAs only render a subset of header fields by default. For example, few MUAs typically render Message-Id or Received header fields for the user, but most do render From, To, Cc, Date, and Subject.

A MUA that knows how to handle a message with header protection makes the following two changes to its behavior when rendering a message:

- *If it detects that an incoming message had protected header fields, it renders header fields for the message from the protected header fields, ignoring the external (unprotected) header fields.

- *It includes information in the message's cryptographic summary to indicate the types of protection that applied to each rendered header field (if any).

A MUA that handles a message with header protection does *not* need to render any new header fields that it did not render before.

2.5.1. Identifying that a Message has Header Protection

An incoming message can be identified as having header protection based on one of two signals:

- *The Cryptographic Payload has Content-Type: message/rfc822 or Content-Type: message/global and the parameter protected-headers has a value of wrapped. See [Section 2.5.4](#) for rendering guidance.

*The Cryptographic Payload has some other Content-Type and it has parameter protected-headers set to v1. See [Section 2.5.3](#) for rendering guidance.

Messages of both types exist in the wild, and a compliant MUA **MUST** be able to handle them both. They provide the same semantics and the same meaning.

2.5.2. Updating the Cryptographic Summary

Regardless of whether a cryptographically-protected message has protected header fields, the cryptographic summary of the message should be modified to indicate what protections the header fields have.

Each header field individually has exactly one the following protections:

- *unprotected (this is the case for all header fields in messages that have no header protection)
- *signed-only (bound into the same validated signature as the enclosing message, but also visible in transit)
- *encrypted-only (only appears within the cryptographic payload; the corresponding external header field was either omitted or obfuscated)
- *signed-and-encrypted (same as encrypted-only, but additionally is under a validated signature)

Note that while the message itself may be signed-and-encrypted, some header fields may be replicated on the outside of the message (e.g. Date). Those header fields would be signed-only, despite the message itself being signed-and-encrypted. Additionally, the data from some encrypted or signed-and-encrypted header fields may not be fully private (see [Section 6.1](#) for more details).

Rendering the cryptographic status of each header field is likely to be complex and messy --- users may not understand it. It is beyond the scope of this document to suggest any specific graphical affordances or user experience. Future work should include examples of successful rendering of this information.

2.5.3. Rendering a Message with Injected Headers

When the Cryptographic Payload does not have a Content-Type of message/rfc822 or message/global, and the parameter protected-headers is set to v1, the values of the protected header fields are

drawn from the header fields of the Cryptographic Payload, and the body that is rendered is the Cryptographic Payload itself.

2.5.3.1. Example Signed-only Message with Injected Headers

```
A └─ application/pkcs7-mime; smime-type="signed-data"
    ↓ (unwraps to)
B └─ multipart/alternative [Cryptographic Payload + Rendered Body]
   └─ text/plain
D └─ text/html
```

The message body should be rendered the same way as this message:

```
B └─ multipart/alternative
   └─ text/plain
D └─ text/html
```

It should render header fields taken from part B.

Its cryptographic summary should indicate that the message was signed and all rendered header fields were included in the signature.

The MUA **SHOULD** ignore header fields from part A for the purposes of rendering.

2.5.3.2. Example Signed-and-Encrypted Message with Injected Headers

Consider a message with this structure, where the MUA is able to validate the cryptographic signature:

```
E └─ application/pkcs7-mime; smime-type="enveloped-data"
    ↓ (decrypts to)
F └─ application/pkcs7-mime; smime-type="signed-data"
    ↓ (unwraps to)
G └─ multipart/alternative [Cryptographic Payload + Rendered Body]
   └─ text/plain
I └─ text/html
```

The message body should be rendered the same way as this message:

```
G └─ multipart/alternative
   └─ text/plain
I └─ text/html
```

It should render header fields taken from part G.

Its cryptographic summary should indicate that the message was signed and encrypted. Each rendered header field found in G should be considered against any HP-Removed header field found in G and all HP-Obscured header fields found in G. If the field's name is found

in the list of header field names in HP-Removed, or if one of the HP-Obscured fields refers to the field name, then the header field should be marked as signed-and-encrypted. Otherwise, the header field should be marked as signed-only.

2.5.3.3. Do Not Render Legacy Display Elements

As described in [Section 2.1](#), a message with cryptographic confidentiality protection **MAY** include "Legacy Display" elements for backward-compatibility with legacy MUAs. These Legacy Display elements are strictly decorative, unambiguously identifiable, and will be discarded by compliant implementations.

The receiving MUA **SHOULD** avoid rendering the identified Legacy Display elements to the user at all, since it is aware of header protection and can render the actual protected header fields.

If a text/html or text/plain part within the cryptographic envelope is identified as containing Legacy Display elements, those elements **SHOULD** be hidden when rendering and **SHOULD** be dropped when generating a draft reply or inline forwarded message. Whenever a Message or MIME subtree is exported, downloaded or otherwise further processed, implementers should consider whether or not to drop the Legacy Display elements.

2.5.3.3.1. Identifying a Part with Legacy Display Elements

A receiving MUA acting on a message that contains an encrypting Cryptographic Layer identifies a MIME subpart within the Cryptographic Payload as containing Legacy Display elements based on the Content-Type of the subpart.

*The subpart's Content-Type contains a parameter hp-legacy-display with value set to 1

*The subpart's Content-Type is either text/html (see [Section 2.5.3.3.3](#)) or text/plain (see [Section 2.5.3.3.2](#))

Note that the term "subpart" above is used in the general sense: if the Cryptographic Payload is a single part, that part itself may contain a Legacy Display element if it is marked with the hp-legacy-display=1 parameter.

2.5.3.3.2. Omitting Legacy Display Elements from text/plain

If a text/plain part within the Cryptographic Payload has the Content-Type parameter `hp-legacy-display="1"`, it should be processed before rendering in the following fashion:

*Discard the leading lines of the body of the part up to and including the first entirely blank line.

Note that implementing this strategy is dependent on the charset used by the MIME part.

See [Appendix D.1](#) for an example.

2.5.3.3.3. Omitting Legacy Display Elements from text/html

If a text/html part within the Cryptographic Payload has the Content-Type parameter `hp-legacy-display="1"`, it should be processed before rendering in the following fashion:

*If any element of the HTML `<body>` is a `<div>` with class attribute `header-protection-legacy-display`, that entire element should be omitted.

A straightforward way for an HTML-capable MUA to do this is to add an entry to the [\[CSS\]](#) stylesheet for such a part:

```
body div.header-protection-legacy-display { display: none; }
```

2.5.4. Rendering a Wrapped Message

Some MUAs may compose and send a message with end-to-end cryptographic protections that offer header protection using the Wrapped Message scheme described in Section 3.1 of [\[RFC8551\]](#). This section describes how a receiving MUA should identify and render such a message.

When the Cryptographic Payload has Content-Type of `message/rfc822` or `message/global`, and the parameter `protected-headers` is set to `wrapped`, the values of the protected header fields are drawn from the header fields of the Cryptographic Payload, and the body that is rendered is the body of the Cryptographic Payload.

2.5.4.1. Example Signed-Only Wrapped Message

Consider a message with this structure, where the MUA is able to validate the cryptographic signature:

```

J └─ application/pkcs7-mime; smime-type="signed-data"
  ↓ (unwraps to)
K └─ message/rfc822 [Cryptographic Payload]
L └─ multipart/alternative [Rendered Body]
M └─ text/plain
N └─ text/html

```

The message body should be rendered the same way as this message:

```

L └─ multipart/alternative
M └─ text/plain
N └─ text/html

```

It should render header fields taken from part K.

Its cryptographic summary should indicate that the message was signed and all rendered header fields were included in the signature.

The MUA **SHOULD** ignore header fields from part J for the purposes of rendering.

2.5.4.2. Example Signed-and-Encrypted Wrapped Message

Consider a message with this structure, where the MUA is able to validate the cryptographic signature:

```

O └─ application/pkcs7-mime; smime-type="enveloped-data"
  ↓ (decrypts to)
P └─ application/pkcs7-mime; smime-type="signed-data"
  ↓ (unwraps to)
Q └─ message/rfc822 [Cryptographic Payload]
R └─ multipart/alternative [Rendered Body]
S └─ text/plain
T └─ text/html

```

The message body should be rendered the same way as this message:

```

R └─ multipart/alternative
S └─ text/plain
T └─ text/html

```

It should render header fields taken from part Q.

Its cryptographic summary should indicate that the message was signed and encrypted. As in [Section 2.5.3.2](#), each rendered header field found in Q should be considered against any HP-Removed header field found in Q and all HP-Obscured header fields found in Q. If the field's name is found in the list of header field names in HP-Removed, or if one of the HP-Obscured fields refers to the field name, then the header field should be marked as signed-and-

encrypted. Otherwise, the header field should be marked as signed-only.

2.5.5. Guidance for Automated Message Handling

Some automated systems have a control channel that is operated by e-mail. For example, an incoming e-mail message could subscribe someone to a mailing list, initiate the purchase of a specific product, approve another message for redistribution, or adjust the state of some shared object.

To the extent that such a system depends on end-to-end cryptographic guarantees about the e-mail control message, header protection as described in this document should improve the system's security. This section provides some specific guidance for systems that use e-mail messages as a control channel that want to benefit from these security improvements.

2.5.5.1. Interpret Only Protected Header Fields

Consider the situation where an e-mail-based control channel depends on the message's cryptographic signature and the action taken depends on some header field of the message.

In this case, the automated system **MUST** rely on information from the header field that is protected by the mechanism described in this document. It **MUST NOT** rely on any header field found outside the cryptographic payload.

For example, consider an administrative interface for a mailing list manager that only accepts control messages that are signed by one of its administrators. When an inbound message for the list arrives, it is queued (waiting for administrative approval) and the system generates and listens for two distinct e-mail addresses related to the queued message -- one that approves the message, and one that rejects it. If an administrator sends a signed control message to the approval address, the mailing list verifies that the protected To: header field of the signed control message contains the approval address before approving the queued message for redistribution. If the protected To: header field does not contain that address, or there is no protected To: header field, then the mailing list logs or reports the error, and does not act on that control message.

2.5.5.2. Ignore Legacy Display Elements

Consider the situation where an e-mail based control channel expects to receive an end-to-end encrypted message -- for example, where the control messages need confidentiality guarantees -- and where the action taken depends on the contents of some MIME part within message body.

In this case, the automated system that decrypts the incoming messages and scans the relevant MIME part **SHOULD** identify when the MIME part contains a legacy display element (see [Section 2.5.3.3.1](#)), and it **SHOULD** parse the relevant MIME part with the legacy display element removed.

For example, consider an administrative interface of a confidential issue tracking software. An authorized user can confidentially adjust the status of a tracked issue by a specially-formatted first line of the message body (for example, severity #183 serious). When the user's MUA encrypts a plain text control message to this issue tracker, depending on the MUA's HCP and its choice of legacy value, it may add a legacy display element. If it does so, then the first line of the message body will contain a decorative copy of the confidential Subject: header field. The issue tracking software decrypts the incoming control message, identifies that there is a legacy display element in the part (see [Section 2.5.3.3.1](#)), strips the legacy display lines (including the first blank line), and only then parses the remaining top line to look for the expected special formatting.

2.5.6. Affordances for Debugging and Troubleshooting

Note that advanced users of an MUA may need access to the original message, for example to troubleshoot problems with the rendering MUA itself, or problems with the SMTP transport path taken by the message.

A MUA that applies these rendering guidelines **SHOULD** ensure that the full original source of the message as it was received remains available to such a user for debugging and troubleshooting.

If a troubleshooting scenario demands information about the cryptographically-protected values of headers, and the message is encrypted, the debugging interface **SHOULD** also provide a "source" view of the Cryptographic Payload itself, alongside the full original source of the message as received.

2.5.7. Rendering Other Schemes

Other MUAs may have generated different structures of messages that aim to offer end-to-end cryptographic protections that include header protection.

While this document is not normative for those schemes, it offers guidance for how to identify and handle these other formats. In the following a list of systems that are known to generate email messages with end-to-end cryptographic protections that include header protection using a different MIME scheme.

2.5.7.1. Pretty Easy Privacy (pEp)

The pEp (pretty Easy privacy) [[I-D.pep-general](#)] project specifies MIME schemes for Signed-and-Encrypted email messages that also provide header protection [[I-D.pep-email](#)]. Similar to the "Wrapped Messages" scheme described in [Section 2.3.5](#) and [Section 2.5.4](#), pEp email messages are fully encapsulated in the Cryptographic Payload.

More information can be found in [[I-D.pep-email](#)].

2.5.8. Composing a Reply to an Encrypted Message with Header Protection

When composing a reply to an encrypted message with header protection, the MUA is acting both as a receiving MUA and as a sending MUA. Special guidance applies here, as things can go wrong in at least two ways: leaking previously-confidential information, and replying to the wrong party.

2.5.8.1. Avoid Leaking Encrypted Header Fields in Reply

As noted in [[I-D.ietf-lamps-e2e-mail-guidance](#)], an MUA in this position **MUST NOT** leak previously-encrypted content in the clear in a followup message. The same is true for protected header fields.

Values from any header field that was identified as either encrypted-only or signed-and-encrypted based on the steps outlined above **MUST NOT** be placed in cleartext output when generating a message.

In particular, if Subject was encrypted, and it is copied into the draft encrypted reply, the replying MUA **MUST** obfuscate the unprotected (cleartext) Subject header field as described above.

When crafting the headers for a reply message, the composing MUA can make use of the HP-Removed and HP-Obscured headers from within the cryptographic envelope of the reference message to ensure that headers derived from the reference message do not leak in the reply.

Consider a header field in a reply message that is generated by derivation from a header field in the reference message. For example, the To header field is typically derived from the reference message's Reply-To or From header fields. When generating the outer copy of the header field, the composing MUA first applies its own header confidentiality policy. If the header field's value is changed by the HCP, then it is applied to the outside header and noted in the protected header section using HP-Removed or HP-Obscured as appropriate, as described in [Section 2.3.3](#). Otherwise, if the header field's value is unchanged, the composing MUA re-generates the header field using the source header fields from the

values within the cryptographic payload of the reference message, as modified by the HP-Obscured or HP-Removed headers. If that value is itself different than the protected value, then it is applied to the outside header and noted in the protected header section using HP-Obscured. If the value is the same as the protected value, then it is simply copied to the outside header directly.

See [Appendix C.2](#) for a simple worked example of this process.

2.5.8.2. Avoid Misdirected Replies to Encrypted Messages with Header Protection

When replying to a message, the Composing MUA typically decides who to send the reply to based on:

- *the Reply-To, Mail-Followup-To, or From header fields

- *optionally, the other To or Cc header fields (if the user chose to "reply all")

When a message has header protection, the replying MUA **MUST** populate the destination fields of the draft message using the protected header fields, and ignore any unprotected header fields.

This mitigates against an attack where Mallory gets a copy of an encrypted message from Alice to Bob, and then replays the message to Bob with an additional Cc to Mallory's own e-mail address in the message's outer (unprotected) header section.

If Bob knows Mallory's certificate already, and he replies to such a message without following the guidance in this section, it's likely that his MUA will encrypt the cleartext of the message directly to Mallory.

2.5.9. Implicitly-rendered Header Fields

While From and To and Cc and Subject and Date are often explicitly rendered to the user, some header fields do affect message display, without being explicitly rendered.

For example, Message-Id, References, and In-Reply-To header fields may collectively be used to place a message in a "thread" or series of messages.

In another example, [Section 2.5.8.2](#) observes that the value of the Reply-To field can influence the draft reply message. So while the user may never see the Reply-To header field directly, it is implicitly "rendered" when the user interacts with the message by replying to it.

An MUA that depends on any implicitly-rendered header field in a message with header protection **SHOULD** use the value from the protected header field, and **SHOULD NOT** use any value found outside the cryptographic protection.

2.5.10. Unprotected Header Fields Added in Transit

Some header fields are legitimately added in transit, and could not have been known to the sender at message composition time.

The most common of these header fields are Received and DKIM-Signature, neither of which are typically rendered, either explicitly or implicitly.

If a receiving MUA has specific knowledge about a given header field, including that:

- *the header field would not have been known to the original sender, and

- *the header field might be rendered explicitly or implicitly,

then the MUA **MAY** decide to operate on the value of that header field from the unprotected header section, even though the message has header protection.

The MUA **MAY** prefer to verify that the header fields in question have additional transit-derived cryptographic protections (e.g., to test whether they are covered by a valid DKIM-Signature, see [[RFC6376](#)]) before rendering or acting on them.

Specific examples appear below.

2.5.10.1. Mailing list header fields: List-* and Archived-At

If the message arrives through a mailing list, the list manager itself may inject header fields (most of which start with List-) in the message:

- *List-Archive

- *List-Subscribe

- *List-Unsubscribe

- *List-Id

- *List-Help

- *List-Post

*Archived-At

For some MUAs, these header fields are implicitly rendered, by providing buttons for actions like "Subscribe", "View Archived Version", "Reply List", "List Info", etc.

An MUA that receives a message with header protection that contains these header fields in the unprotected section, and that has reason to believe the message is coming through a mailing list **MAY** decide to render them to the user (explicitly or implicitly) even though they are not protected.

3. E-mail Ecosystem Evolution

This document is intended to offer tooling needed to improve the state of the e-mail ecosystem in a way that can be deployed without significant disruption. Some elements of this specification are present for transitional purposes, but would not exist if the system were designed from scratch.

This section describes these transitional mechanisms, as well as some suggestions for how they might eventually be phased out.

3.1. Dropping Legacy Display Elements

Any decorative Legacy Display element added to an encrypted message that uses the Injected Header scheme is present strictly for enabling header field visibility (most importantly, the Subject header field) when the message is viewed with a decryption-capable legacy client.

Eventually, the hope is that most decryption-capable MUAs will conform to this specification, and there will be no need for injection of Legacy Display elements in the message body. A survey of widely-used decryption-capable MUAs might be able to establish when most of them do support this specification.

At that point, a composing MUA could make the legacy parameter described in {#compose-injected-headers} to false by default, or could even hard-code it to false, yielding a much simpler message construction set.

Until that point, an end user might want to signal that their receiving MUAs are conformant to this draft so that a peer composing a message to them can set legacy to false. A signal indicating capability of handling messages with header protection might be placed in the user's cryptographic certificate, or in outbound messages.

This draft doesn't attempt to define the syntax or semantics of such a signal.

3.2. Stronger Default Header Confidentiality Policy

This draft defines two different forms of Header Confidentiality Policy. A MUA implementing an HCP for the first time **SHOULD** deploy `hcp_minimal` as recommended in [Section 2.4](#). This HCP offers the most commonly-expected protection (obscuring the Subject header field) without risking deliverability or rendering issues.

The HCPs proposed in this draft are relatively conservative and still leak a significant amount of metadata for encrypted messages. This is largely done to ensure deliverability (see [Section 1.4.2](#)) and usability, as messages without some critical header fields are more likely to not reach their intended recipient.

In the future, some mail transport systems may accept and deliver messages with even less publicly-visible metadata. Many MTA operators today would ask for additional guarantees about such a message to limit the risks associated with abusive or spammy mail.

This specification offers the HCP formalism itself as a way for MUA developers and MTA operators to describe their expectations around message deliverability. MUA developers can propose a stronger default HCP, and ask MTA operators (or simply test) whether their MTAs would be likely to deliver or reject encrypted mail with that HCP applied. Proponents of a stronger HCP should explicitly document the HCP, and name it clearly and unambiguously to facilitate this kind of interoperability discussion.

Reaching widespread consensus around a stronger global default HCP is a challenging problem of coordinating many different actors. A piecemeal approach might be more feasible, where some signalling mechanism allows a message recipient, MTA operator, or third-party clearinghouse to announce what kinds of HCPs are likely to be deliverable for a given recipient. In such a situation, the default HCP for a MUA might involve consulting the signalled acceptable HCPs for all recipients, and combining them (along with a default for when no signal is present) in some way.

If such a signal were to reach widespread use, it could also be used to guide reasonable statistical default HCP choices for recipients with no signal.

This draft doesn't attempt to define the syntax or semantics of such a signal.

3.3. Deprecation of Messages Without Header Protection

At some point, when the majority of MUA clients that can generate cryptographically protected messages with header protection, it should be possible to deprecate any cryptographically protected message that does not have header protection.

For example, as noted in [Section 4.1](#), it's possible for a MUA to decline to render a signed-only message that has no header protection the same as an unsigned message. And a signed-and-encrypted message without header protection could likewise be marked as not fully protected.

These stricter rules could be adopted immediately for all messages. Or a MUA developer could roll them out immediately for any new message, but still treat an old message (based on the Date header field and cryptographic signature timestamp) more leniently.

A decision like this by any popular receiving MUA could drive adoption of this standard for sending MUAs.

4. Usability Considerations

This section describes concerns for MUAs that are interested in easy adoption of header protection by normal users.

While they are not protocol-level artifacts, these concerns motivate the protocol features described in this document.

See also the Usability section in [\[I-D.ietf-lamps-e2e-mail-guidance\]](#).

4.1. Mixed Protections Within a Message Are Hard To Understand

When rendering a message to the user, the ideal circumstance is to present a single cryptographic status for any given message. However, when message headers are present, some message headers do not have the same cryptographic protections as the main message.

Representing such a mixed set of protection statuses is very difficult to do in a way that a normal user can understand without training. There are at least three scenarios that are likely to be common, and poorly understood:

- *A signed message with no header protection.

- *A signed-and-encrypted message with no header protection.

*An signed-and-encrypted message with header protection as described in this document, where some user-facing headers have confidentiality but some do not.

A MUA should have a reasonable strategy for clearly communicating each of these scenarios to the user. For example, a MUA operating in an environment where it expects most cryptographically-protected messages to have header protection could use the following rendering strategy:

*When rendering a message with signed-only cryptographic status but no header protection, decline to indicate to the user that the message was signed at all. That is, the message would appear identical to an unsigned message.

*When rendering a message with signed-and-encrypted or encrypted-only cryptographic status but no header protection, overlay a warning flag on the typical cryptographic status indicator. That is, if a typical signed-and-encrypted message displays a lock icon, display a lock icon with a warning sign (e.g., an exclamation point in a triangle) overlaid. See, for example, the graphics in [[chrome-indicators](#)].

*When rendering a message with signed-and-encrypted or encrypted-only cryptographic status, with header protection, but where the Subject header field has not been removed or obscured, place a warning sign on the on the Subject line.

Other simple rendering strategies could also be reasonable.

4.2. Users Should Not Have To Choose a Header Confidentiality Policy

This document defines the abstraction of a Header Confidentiality Policy object for the sake of communication between implementers and deployments.

Most e-mail users are unlikely to understand the tradeoffs between different policies. In particular, the potential negative side effects (e.g. poor deliverability) may not be easily attributable by a normal user to a particular HCP.

Therefore, MUA implementers should be conservative in their choice of default HCP, and should not require the ordinary user to make an incomprehensible choice that could cause unfixable, undiagnosable problems. The safest option is for the MUA developer to select a known, stable HCP (this document recommends `hcp_minimal` in [Section 2.4](#)) on the user's behalf. A MUA should not not expose the ordinary user to a configuration option where they are expected to manually select (let alone define) an HCP.

In the event that a MUA implementer gets user complaints about problems with removed or obscured header fields due to the MUA's defined HCP, the implementer may offer the user an option to drop header confidentiality altogether for freshly composed messages (thereby reverting to `hcp_null`). But when handling such a scenario for a reply to a message with some header confidentiality policy in place, note the guidance in [Section 2.5.8.1](#) to avoid accidental leakage.

4.3. Users Should Not Have To Choose a Header Protection Scheme

This document also describes two different header protection schemes: Wrapped Messages in [Section 2.2](#) and Injected Headers in [Section 2.1](#).

These distinct schemes are described for the sake of implementers who may have to deal with messages found in the wild, but their intended semantics are identical. They represent different tradeoffs in terms of rendering and user experience on the recipient's side, things that a given user writing a message is not prepared to select.

When composing a message with cryptographic protections, the ordinary user should not be confronted with any choices about which header protection scheme to use. Rather, the MUA developer should use a single scheme for all outbound cryptographically-protected messages.

This document recommends the Injected Headers scheme for generating messages with cryptographic protections, as described in [Section 2](#). A MUA should not expose the ordinary user to any configuration option where they are expected to manually select, enable, or disable header protections for new cryptographically-protected messages.

5. Security Considerations

This document describes a mechanism for improving the security of cryptographically-protected e-mail messages. Following the guidance in this document should improve security for users of these technologies by more directly aligning the underlying messages with user expectations about confidentiality, authenticity, and integrity.

However, many existing messages with cryptographic protections will not have these protections, and MUAs encountering these messages will need to handle older forms (without header protection) for quite some time. An implementation that deals with legacy message archives will need to deal with all the various formats forever.

Helping the user distinguish between cryptographic protections of various messages is a difficult job for message renderers.

However, on the message generation side, the situation is much clearer: there is a standard form that a protected message can take, and an implementer can always generate the standard form. Generating the standard form also makes it more likely that any receiving implementation will be able to handle the generated message appropriately.

5.1. Caution about Composing with Legacy Display Elements

When composing a message, it's possible for a Legacy Display Element to contain risky data that a rendering client could trigger errors in a rendering client.

For example, if the value for a header field to be included in a Legacy Display Element within a given body part contains folding whitespace, it should be "unfolded" before generating the Legacy Display Element: all contiguous folding whitespace should be replaced with a single space character. Likewise, if the header value was originally encoded with [\[RFC2047\]](#), it should be decoded first to a standard string and re-encoded using the charset appropriate to the target part.

When including a Legacy Display Element in a text/plain part (see [Section 2.3.4.1](#)), if the decoded Subject header field contains a pair of newlines (e.g., if it is broken across multiple lines by encoded newlines), any newline **MUST** be stripped from the Legacy Display Element. If the pair of newlines is not stripped, a receiving MUA that follows the guidance in [Section 2.5.3.3.2](#) might leave the later part of the Legacy Display Element in the rendered message.

When including a Legacy Display Element in a text/html part (see [Section 2.3.4.2](#)), any material in the header values should be explicitly HTML escaped to avoid being rendered as part of the HTML. At a minimum, the characters <, >, and & should be escaped to <;, >;, and &;, respectively (see for example [\[HTML-ESCAPES\]](#)). If unescaped characters from removed or obscured header values end up in the Legacy Display element, a receiving MUA that follows the guidance in [Section 2.5.3.3.3](#) might fail to identify the boundaries of the Legacy Display Element, cutting out more than it should, or leaving remnants visible. And a legacy client parsing such a message might misrender the entire HTML stream, depending on the content of the removed or obscured header values.

The Legacy Display Element is a decorative addition solely to enable visibility of obscured or removed header fields in legacy,

decryption-capable MUAs. When it is produced, it should be generated conservatively and narrowly, to avoid damaging the rest of the message.

6. Privacy Considerations

6.1. Encrypted Header Fields Are Not Always Private

For encrypted messages, depending on the sender's HCP, some header fields may appear both within the Cryptographic Envelope and on the outside of the message. [Section 2.5.2](#) identifies those messages as signed-only. These header fields are clearly *not* private at all, despite a copy being inside the Cryptographic Envelope.

A header field whose name can be found in the HP-Removed or in any HP-Obscured header field from the same part will have encrypted-only or signed-and-encrypted status. But even header fields with these stronger levels of cryptographic confidentiality protection might not be as private as the user would like.

6.2. Header Fields Can Leak Unwanted Information to the Recipient

For encrypted messages, even with a powerful HCP that successfully obscures most header fields from all transport agents, header fields will be ultimately visible to all intended recipients. This can be especially problematic for header fields that are not user-facing, which the sender may not expect to be injected by their MUA. Consider the three following examples:

- *The MUA may inject a User-Agent header field that describes itself to every recipient, even though the sender may not want the recipient to know the exact version of their OS, hardware platform, or MUA.
- *The MUA may have an idiosyncratic way of generating a Message-ID header, which could embed the choice of MUA, a timezone, a hostname, or other subtle information to a knowledgeable recipient.
- *The MUA may erroneously include a Bcc header field in the origheaders of a copy of a message sent to the named recipient, defeating the purpose of using Bcc instead of Cc (see [Section 6.3](#) for more details about risks related to Bcc).

Clearly, no end-to-end cryptographic protection of any header field as described in this document will hide such a sensitive field from the intended recipient. Instead, the composing MUA **MUST** judiciously populate the origheaders list for any outbound message with only information that the user reasonably intends the recipient to have access to. This is true for messages without any cryptographic

protection as well, of course, and it is even worse there: such a leak is exposed to the transport agents as well as the recipient. An encrypted message with header protection and a strong header confidentiality policy avoid these leaks exposing information to the transport agents, but cannot defend against such a leak to the recipient.

6.2.1. Encrypted Header Fields Can Be Inferred From External Metadata

For example, if the To: and Cc: header fields are omitted from the unprotected header section, the values in those fields might still be inferred with high probability by an adversary who looks at the message either in transit or at rest. If the message is found in, or being delivered to a mailbox for bob@example.org, it's likely that Bob was in either To: or Cc:. Additionally, an MTA that handles the message may add a Received: header field (or some other custom header field) that leaks some information about the nature of the delivery.

6.2.2. HCP May Not Mask All Data in an Encrypted Header Field

In another example, if the HCP modifies the Date: header to mask out high-resolution time stamps (e.g. rounding to the most recent hour) and to convert the local timezone to UTC, some information about the date of delivery will still be attached to the e-mail. At the very least, the low resolution, global version of the date will be present on the message. Additionally, headers like Received that are added during message delivery might include higher-resolution timestamps. And if the message lands in a mailbox that is ordered by time of receipt, even its placement in the mailbox and the non-obscured Date: header fields of the surrounding messages could leak this information.

Some fields like From: may be impossible to fully obscure, as many modern message delivery systems depend on at least domain information in the From: field for determining whether a message is coming from a domain with "good reputation" (that is, from a domain that is not known for leaking spam). So even if an aggressive HCP opts to remove the human-readable part from any From: header field, and to standardize/genericize the local part of the From: address, the domain will still leak.

6.2.3. An Intermediary Can Trick a Recipient into Overestimating the Cryptographic Status of a Header Field in an Encrypted Message

When an encrypted (or signed-and-encrypted) message is in transit, an active intermediary can strip or tamper with any header field that appears outside the Cryptographic Envelope.

For example, if the original sender's HCP passes through the Cc: header field unchanged, a cleanly-delivered message would indicate that the Cc: header field has a cryptographic status of signed. But if an intermediary attacker simply removes the header field from the unprotected header section before forwarding the message, then the recipient would believe that the field has a cryptographic status of signed-and-encrypted.

An attacker can thus induce a false sense of confidentiality in a recipient whose MUA actually did not provide that level of privacy.

This draft offers protection against such an attack by way of the HP-Obscured and HP-Removed header fields that can be found on the cryptographic payload. If a header field appears to have been obscured, but no HP-Obscured header matches it; or if the header field appears to have been removed, but the HP-Removed header does not include its field name, the receiving MUA can indicate to the user that the header field in question may not have been confidential.

However, in such a case, a conservative MUA may still decide to treat the header field in question as signed-and-encrypted during reply, to avoid accidental leakage of the cleartext value in the reply message, as described in [Section 2.5.8.1](#).

6.2.4. Summary and Implementation Guidance

In the abstract sense, the above concerns are of course also true for any encrypted data, including the body of the message: if the sender isn't careful, the message contents or session keys could leak in many different ways that are beyond the scope of this draft. The message recipient has no way in principle to tell whether the apparent confidentiality of any given piece of encrypted content has been broken via channels that they cannot perceive. And an active intermediary aware of the recipient's public key can always encrypt a cleartext message in transit to give the recipient a false sense of security.

A receiving MUA should be cautious about how it represents the cryptographic status of encrypted-only and signed-and-encrypted header fields to the user, to avoid overpromising. However, the MUA should also strive to avoid additional leakage of these header fields, as described in [Section 2.5.8.1](#).

6.3. Privacy and Deliverability Risks with Bcc and Encrypted Messages

As noted in [[I-D.ietf-lamps-e2e-mail-guidance](#)], handling Bcc when generating an encrypted e-mail message can be particularly tricky. With header protection, there is an additional wrinkle. When an encrypted e-mail message with header protection has a Bcc'ed

recipient, and the composing MUA explicitly includes the Bcc'ed recipient's address in their copy of the message (see the "second method" in [Section 3.6.3](#) of [\[RFC5322\]](#)), that Bcc header field will always be visible to the Bcc'ed recipient.

In this scenario, though, the composing MUA has one additional choice: whether to hide the Bcc header field from intervening message transport agents, by returning null when the HCP is invoked for Bcc . If the composing MUA's rationale for including an explicit Bcc in the copy of the message sent to the Bcc recipient is to ensure deliverability via a message transport agent that inspects message headers, then stripping the Bcc field during encryption may cause the intervening transport agent to drop the message entirely. This is why Bcc is not explicitly stripped in `hcp_minimal`.

If, on the other hand, deliverability to a Bcced recipient is not a concern, the most privacy-preserving option is to simply omit the Bcc header field from the protected header section in the first place. A MUA that is capable of receiving and processing such a message can infer that since their user's address was not mentioned in any To or Cc header field, they were likely a Bcc recipient.

Please also see [\[I-D.ietf-lamps-e2e-mail-guidance\]](#) for more discussion about Bcc and encrypted messages.

7. IANA Considerations

This document request IANA to register the following header fields in the "Permanent Message Header Field Names" Registry in accordance with [\[RFC3864\]](#).

*Header field name: HP-Removed

*Applicable protocol: mail [\[RFC5322\]](#)

*Status: standard

*Author/change controller: IETF

*Specification document(s): [Section 2.3.3](#) of RFCXXX

*Header field name: HP-Obscured

*Applicable protocol: mail [\[RFC5322\]](#)

*Status: standard

*Author/change controller: IETF

*Specification document(s): [Section 2.3.3](#) of RFCXXX

This document also defines a parameter protected-headers for the Content-Type header field, which is used to identify cryptographic payloads that use this form of header protection.

The possible values of the protected-headers parameter are v1 (meaning Injected Headers, see [Section 2.1](#)) and wrapped (meaning Wrapped Message, see [Section 2.2](#)).

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Appendix A. Possible Problems with some Legacy Clients

When an e-mail message with end-to-end cryptographic protection is received by a mail user agent, the user might experience many different possible problematic interactions. A message with header protection may introduce new forms of user experience failure.

In this section, the authors enumerate different kinds of failures we have observed when reviewing, rendering, and replying to messages with different forms of header protection in different legacy MUAs.

Different legacy MUAs demonstrate different subsets of these problems.

Hopefully, a non-legacy MUA would not exhibit any of these problems. An implementer updating their legacy MUA to be compliant with this specification should consider these concerns and try to avoid them.

A.1. Problems Reviewing signed-and-encrypted Messages in List View

- *Unprotected Subject, Date, From, To are visible

- *Threading is not visible

A.2. Problems when Rendering a signed-and-encrypted Message

- *Unprotected Subject is visible

- *Protected subject (on its own) is visible in the body

- *Protected subject, date, from, to visible in the body

- *User interaction needed to view whole message

- *User interaction needed to view message body

- *User interaction needed to view protected subject

- *Impossible to view protected subject

- *Nuisance alarms during user interaction

- *Impossible to view message body

- *Appears as a forwarded message

- *Appears as an attachment

- *Security indicators not visible

- *User has multiple different methods to Reply: (e.g. reply to outer, reply to inner)

- *User sees English "Subject:" in body despite message itself being in non-English

- *Security indicators do not identify protection status of header fields

- *Header fields in body render with local header field names (e.g. showing "Betreff" instead of "Subject") and dates (TZ, locale)

A.3. Problems when Replying to a signed-and-encrypted Message

Note that the use case here is:

- *User views message, to the point where they can read it.
- *User then replies to message, and they are shown a message composition window, which has some UI elements
- *If the MUA has multiple different methods to Reply: to a message, each way may need to be evaluated separately

This section also uses the shorthand UI:x to mean "the UI element that the user can edit that they think of as x."

- *protected subject is in UI:subject (and will leak)
- *protected subject is quoted in UI:body
- *protected subject is not anywhere in UI
- *message body is *not* visible/quoted in UI:body
- *user cannot reply while viewing protected message
- *reply is not encrypted by default (but is for normal S/MIME sign+enc messages)
- *unprotected From: is in UI:To
- *User's locale (lang, TZ) leaks in quoted body
- *Header fields not protected (and in particular, Subject is not obscured) by default

A.4. Problems Reviewing signed-only Messages in List View

- *Unprotected Subject, Date, From, To are visible
- *Threading is not visible

A.5. Problems when Rendering a signed-only Message

- *Unprotected Subject is visible
- *Protected subject (on its own) is visible in the body
- *Protected subject, date, from, to visible in the body
- *User interaction needed to view whole message

- *User interaction needed to view message body
- *User interaction needed to view protected subject
- *Impossible to view protected subject
- *Nuisance alarms during user interaction
- *Impossible to view message body
- *Appears as a forwarded message
- *Appears as an attachment
- *Security indicators not visible
- *Security indicators do not identify protection status of header fields
- *User has multiple different methods to Reply: (e.g. reply to outer, reply to inner)
- *Header fields in body render with local header fields (e.g. showing "Betreff" instead of "Subject") and dates (TZ, locale)

A.6. Problems when Replying to a signed-only Message

This uses the same use case(s) and shorthand as [Appendix A.3](#).

- *Unprotected Subject: is in UI:subject
- *Protected Subject: is quoted in UI:body
- *Protected Subject: is not anywhere in UI
- *Message body is not visible/quoted in UI:body
- *User cannot reply while viewing protected message
- *Unprotected From: is in UI:To
- *User's locale (lang, TZ) leaks in quoted body

Appendix B. Test Vectors

This section contains sample messages using the different schemes described in this document. Each sample contains a MIME object, a textual and diagrammatic view of its structure, and examples of how an MUA might render it.

The cryptographic protections used in this document use the S/MIME standard, and keying material and certificates come from [\[I-D.ietf-lamps-samples\]](#).

These messages should be accessible to any IMAP client at `imap://bob@header-protection.cmrq.net/` (any password should authenticate to this read-only IMAP mailbox).

You can also download copies of these test vectors separately at `https://header-protection.cmrq.net`.

If any of the messages downloaded differ from those offered here, this document is the canonical source.

B.1. Baseline Messages

These messages offer no header protection at all, and can be used as a baseline. They are provided in this document as a counterexample. An MUA implementer can use these messages to verify that the reported cryptographic summary of the message indicates no header protection.

B.1.1. No cryptographic protections over a simple message

This message uses no cryptographic protection at all. Its body is a text/plain message.

It has the following structure:

└ text/plain 152 bytes

Its contents are:

MIME-Version: 1.0
Content-Type: text/plain; charset="utf-8"
Content-Transfer-Encoding: 7bit
Subject: no-crypto
Message-ID: <no-crypto@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:00:02 -0500
User-Agent: Sample MUA Version 1.0

This is the no-crypto message.

This message uses no cryptographic protection at all. Its body is a text/plain message.

--

Alice
alice@smime.example

B.1.2. S/MIME signed-only signedData over a simple message, No Header Protection

This is a signed-only S/MIME message via PKCS#7 signedData. The payload is a text/plain message. It uses no header protection.

It has the following structure:

└ application/pkcs7-mime [smime.p7m] 3852 bytes
 ┆ (unwraps to)
 └ text/plain 204 bytes

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="signed-data"
Subject: smime-one-part
Message-ID: <smime-one-part@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:01:02 -0500
User-Agent: Sample MUA Version 1.0

MIILFwYJKoZIhvcNAQcCoIILCDECCwQCAQEExDTALBglghkgBZQMEAgEwggFABgkq
hkiG9w0BBWGGggExBIIBLU1JTUUtVmVyc2ljbjogMS4wDQpDb250ZW50LVR5cGU6
IHRleHhQvcGxhaw47IGNoYXJzZXQ9InV0Zi04IG0KQ29udGVudC1UcmFuc2Zlci1F
bmNvZGluZz0gN2JpdA0KDQpUaGlzIGlzIHRoZSBzbWltZS1vbmUtcGFydCBtZXNz
YwdlLg0KDQpUaGlzIGlzIGEgc2lnbmVklW9ubHkgUy9NSU1FIG1lc3NhZ2Ugdm1h
IFBLQ1MjNyBzawduZWR5YXRhLiAgVGVhZDQpYX1sb2FkIGlzIGEgdGV4dC9wbgFp
biBtZXNzYwdlLiBjdB1c2VzIG5vIGhlyYWRlciBwcm90ZWN0aW9uLg0KDQotLSAN
CkFsawNlDQpUaGlzIGlzIG5leGFtcGxlDQpUaGlzIGlzIG5leGFtcGxlDQpUaGlz
Dy0lvRE5l0rOQ1SHoe49NAaKtDANBkgqhkig9w0BAQ0FADBVMQ0wCwYDVQKQEW
RVRGMREwDwYDVQQLLEwhMQU1QUyBXRzExMC8GA1UEAxMoU2FtcGx1IEExBTBTIFJT
QSBZDZXJ0aWZpY2F0aW9uIEF1dGhvcml0eTAGFw0x0TEwMjAwNjU0MThaGA8yMDUy
MDkyNzA2NTQxOFowOzENMASGA1UEChMESUVURjERMA8GA1UECzMITEFNUFMgV0cx
FzAVBgNVBAMTDkFsawNlIEExvdmVsYWNlMlIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8A
MIIBCgKCAQEAmP+ovBou0P6AFQJ+Rpw0DxxzY60n1lJ53pTeNSiJlWkwtw/cx
Qq0t4u2vWYB8g0UH/Cvt2Zp1c+auzPKJ2Zu5mY6kHm+hVB+IthjLeI7Htg6rNeu
Xq50/TuTSxX5R1I1EXGt8p6hAQVeA5oZ2afHg4b97enV8gozR0/Nkug4AKXmbk7T
HNc8vvjMUJanZ/VmS4TgDqXjWShplcI3lcvvBZMswt41/0HJvmswqpS6oQcAx3We
ag0yCNj1V9V9yu/3DjcYbWw2lJf5NBmHbM1LY4X5chwFNEbkN6hQury/zxnlsukg
n+fHbqvwDhJLAgFpw/jA/EB/WI+whUpqtQIDAQAB04GvMIGSMaWGA1UdEwEB/wQC
MAAwFwYDVR0gBBAwDjAMBgpghkgBZQMCATAMB4GA1UdEQQXMBWBE2FsaWNlQHNT
aw1lLmV4YW1wbGUwEwYDVR0lBAwwCgYIKwYBBQUHAWQwDgYDVR0PAQH/BAQDAgUg
MB0GA1UdDgQWBBSiU0HVRdyAKRV8ASPw546vzfn3DzAfBgNVHSMEGDAWgBSRMI58
BxcMp/EJKGU2GmccaHb0WTANBgkqhkiG9w0BAQ0FAAOCAQEAgUl4oJyxMpwWpAy1
0vK6NEbM1lgD5H14EC4Muxq1u0q2XgX0SBHI6DFX/4LDsfx7fSIus8gwVY3WqMeu
0A7IizkBD+GDEu8uKveERRXZncxGwy2MfbH1Ib3U8QzTjqB8+dz2AwYeMx0Dwq9o
pwtA/1T0kRg8uuivZfg/m5fFo/QshlHNaatDVEXsU4Ps98Hm/3gznbvhdjFbZbi4
oZ3tAadR1E5K9JiQaJYOnUmGpfb8PPwDR6chMZeegSQAw++0IKqHrg/WEh4yiuPf
qmAvX2hZkPpivNjYdTPUXTS07K459CyqbqG+sN0o2kc1nTXl85RHnrVKQK+L0YWY
1Q+hWDCCA88wggK3oAMCAQICEzdBBXntdX9CqaJc0vT4as6aqdcwDQYJKoZIhvcN
AQENBQAwwVTENMASGA1UEChMESUVURjERMA8GA1UECzMITEFNUFMgV0cxMTAvBgNV
BAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2VydG1maWNhdG1vb1BBdXR0b3JpdHkwIBcN
MTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDsxDTALBgNVBAoTBElFVEYx
ETAPBgNVBAsTCEXBTBTIFdHMRcwFQYDVQKQDEw5BbG1jZSBMb3ZlbgFjZTCCASIw
DQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBALTOiehY0BY+TZp/T5K2KNI05Hwr
+E3wP6XTvyi6WwYtgbK9LC0wI2juwdrRjFBSXkk7pWpjXwsA3A5G0tz0FpfgyC70
xsVcF7q4WHWZwleYXFKlQHJD73nQwXP968+A/3rBX7Ph00DBbZnfitOLPgPEwjTt
dg0VQq6Wz+CRQ/YbHPKaw7aRphZ063dKvIKp4cQvtkWQH16syTjGsgkLcLNau5LZ
DQUdsGV+SA03nBdWCRYV+I65x8Kf4hCxxqmqjV3d/2NKRu0BXnDe/N+iDz3X0zEoj
0fqXgq4SWcc0nsG1lyyXt1TL270I6ATKRgJwiQVCCpDtc0NT6vdJ45bCSzsCAwEA

Aa0BrzCBrdAMBgNVHRMBAf8EAjAAMBcGA1UdIAQQMA4wDAYKYIZIAWUDAgEwATAe
BgNVHREEFzAVgRNhbGljZUBzbWltZS5leGFtcGx1MBMGA1UdJQQMMAoGCCsGAQUF
BwMEMA4GA1UdDwEB/wQEAwIGwDAdBgNVHQ4EFgQUu/bMsi0dBhIc164papAQ0yBm
ZnMwHwYDVR0jBBgwFoAUKTCOfAcXDKfxCSH1NhpnHGh29FkwDQYJKoZIhvcNAQEN
BQADggEBAH0JojanzqmgasN3/ggSQ4cbbmdj/R40BEPr+gXT+xiidfZ2iLNwYyTn
euK6AChwKfnNvOFb81V1iffRTF/KtmVEDMR/sYeqAH83KM5p3e121Vh40HhyI0qN
uz5oShNaACSioQ23WxHGvy9vsdVfnbhsp1rWg9NQ2WbpCmK+2oMh2oY10Z/wvXMT
9cG6jbMvcdH4z0I0vg6mrYkKTM/RCGnumghxwYToj10yD5Gs4D2IJCw+fX50Dxh5
2MbNRYXTus2ZPRPM8JXNQ4Gwv4km3M4rKnJDD6hnoQ9rNeozIcBVyybQYjfrgg4
DRvW9Ksk220H4Con1B8f7R7s1LM2cSYxggIAMIIB/AIBATBsMFUXDTALBgNVBAoT
BELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTEwLWYDVQQDEyhTYW1wbGUgTEFNUFMg
U1NBIENlcnRpZmljYXRpb24gQXV0aG9yaXR5AhM3QV57XV/QqmiXDr0+Gr0mqnX
MAsGCWCGSAFlAwQCAaBpMBGCSqGSIb3DQEJAZELBgkqhkiG9w0BBwEwHAYJKoZI
hvcNAQkFMQ8XDTIxMDIyMDE1MDEwMlowLWYJKoZIhvcNAQkEMSIEIESMi+9/LU1D
fGjj+6U50VNLfxbzvyVJ0wzwnTS114DyMA0GCSqGSIb3DQEBAQUABIIBACJHeayB
UllC4GdcgdojTUjoeIy6UIbrSg/aKZgAkCB8Dwq0hdU10qiun6WKI/TxM5izpRvL
UsNBGmqknPBMFhvWx6KCrwFk0p0j5Y5DZqX30deiQiGTUv3NiwZGTrKJ3JkyyMFO
HGbe5Thrq3inRLVfilEuIZewaJsnJhKfnEq9fS09icTJ5o1PDAH6mZbw6hpYmU3F
KBk2qJNqJX6bo60rCogu3wXDj0wxnqEXmeNDH5/+L9UVZur+EWzviUc8Ldd/kP3L
D007ivs10bAwe8Tbw7NjuP8Z1VvzcVj3nXWzZzxh2ymDIOvyJA+t0LHQvsN/fbdW
fC6Pm51fEkabmw=

B.1.3. S/MIME signed-only multipart/signed over a simple message, No Header Protection

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a text/plain message. It uses no header protection.

It has the following structure:

- └ multipart/signed 4191 bytes
 - └ text/plain 224 bytes
 - └ application/pkcs7-signature [smime.p7s] 3429 bytes

Its contents are:

MIME-Version: 1.0
Content-Type: multipart/signed;
protocol="application/pkcs7-signature"; boundary="052";
micalg="sha-256"
Subject: smime-multipart
Message-ID: <smime-multipart@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:02:02 -0500
User-Agent: Sample MUA Version 1.0

--052

MIME-Version: 1.0
Content-Type: text/plain; charset="utf-8"
Content-Transfer-Encoding: 7bit

This is the smime-multipart message.

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a text/plain message. It uses no header protection.

--

Alice
alice@smime.example

--052

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-signature; name="smime.p7s"

MIIJ4AYJKoZIhvcNAQcCoIIJ0TCCc0CAQExDTALBgIghkgBZQMEAgEwCwYJKoZI
hvcNAQcBoIIHjCCA88wggK3oAMCAQICEw8tJb0ROZdKzkJU6HuPTQGirQwDQYJ
KoZIhvcNAQENBQAwVTENMA8GA1UEChMESUVURjERMA8GA1UECxMITEFNUFMgV0cx
MTAvBgNVBAMTKFNhbXBsZSBMQUU1QUYBSU0EgQ2VydGlmawNhdGlvbiBBdXRob3Jp
dHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDSxDTALBgNVBAoT
BELFVEYxETAPBgNVBAsTCExBTvBTIFdHMRcwFQYDVQQDEw5BbG1jZSBMb3Z1bGFj
ZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAJqVKfqLwaLjj+gBUCfk
acKTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfIDlB/wlbdmadXPmrsz
yidmbuZm0pB5voVQfiLYyy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0a
Gdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6l41koaZXC
N5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcrv9w43GG8FtpSX+Twz
B2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK
arUCAwEAAoBrzCBrDAMBGNVHRMBAf8EAJAAMBcGA1UdIAQQMA4wDAYKYIZIAWUD
AgEwATAeBgNVHREEFzAVgRNhbG1jZUBzbWltZS5leGFtcGx1MBMGA1UdJQQMMAoG
CCsGAQUFBwMEMA4GA1UdDwEB/wQEAWIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj
80e0r83zdW8wHwYDVR0jBBgwFoAUKTC0fAcXDKfxCSH1NhpnHGh29FkwDQYJKoZI
hvcNAQENBQADggEBAIFJeKCCsTKcFqQMpTryujRGzJdYA+R9eBAuDLsatbtKt14F
zkgrY0g31/+Cw7H8e30iLrPIfLWN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMt
jH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpeYPLror2X4P5uXxaP0LIZR

zWmkw1RF7FOD7PfB5v94M5274XYxw2W4uKGD7QGnUZROsvSYkGiWdp1JhqXwfDz8
A0enITGXnoEkAFvjjcQh64P1hIeMorj36pgL19oWZD6YrzSWHUz1F00juyu0fQs
qm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV5
7XV/QqmiXDr0+Gr0mqnXMA0GCSqGSIB3DQEBDQUAMFUxDTALBgnVBAoTBE1FVEYx
ETAPBgNVBAStCEXBTBTFIFdHMTEwLWYDVQDEYhTYW1wbGUgTEFNUFMgU1NBIENl
cnRpZm1jYXRpb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoYDzIwNTIwOTI3
MDY1NDE4WjA7MQ0wCwYDVQKwRJRVRGMREwDwYDVQLEwhMQU1QUyBXRzEXMBUG
A1UEAxMQWxpY2UgTG92ZWxhY2UwgGEmA0GCSqGSIB3DQEBAQUAA4IBDwAwggEK
AoIBAQC09InowDgWPk2af0+StijSN0R8K/hN8D+1078oullsk4ASvSwjsCNo7shU
a4xQU15J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+950MFz
/evPpG96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2GxzYms02kaYWTut3
SryCqeHEFBzFk4urMk4xrIJC3CzWruS2Q0FHbB1fkgKN5wXVgkWFFi0ucfCn+IQ
saqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H614KuElnAtJ7BtZcs17dUy9u9C0gE
ykrivokFgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAX
BgNVHSAEEDAOMAawGCMCGSAFlAwIBMAEwHgyDVR0RBBcwFYETyWxpY2VAc21pbWUu
ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD
VR00BBYEFvL2zLItHQYSHJeuKwQENMgZmZzMB8GA1UdIwQYMBaAFJEwjnHFwyn
8QkoZTYaZxxodvRZMA0GCSqGSIB3DQEBDQUAA4IBAQBziaI2p86poGkjD/4Kkk0H
G25nY/0eNARD6/oF0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZL
RAZef7GHqgB/NyjOad3pdpVYeDh4ciNkjbs+aEoTWgAkoqEnt1sRx1cvb7HVX524
bKZa1oPTUNlm6QpivtqDIIdqGJdGf8L1zLFXBuo2zL3HR+M9CDr40pq2JckzP0Qhp
7poIccGE6I9Tsg+RrOA9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJntjh+AqJ5QfH+0e7NSzNnEm
MYICADCCAFwCAQEwbDBVMQ0wCwYDVQKwRJRVRGMREwDwYDVQLEwhMQU1QUyBX
RzExMC8GA1UEAxMoU2FtcGx1IEExBTBTFIFJTQSBdZXJ0awZpY2F0aw9uIEF1dGhv
cm10eQITN0EFee11f0Kpolw69Phqzppq1zALBglghkgBZQMEAgGgaTAYBgkqhkiG
9w0BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIB3DQEJBTEPFw0yMTAyMjAxNTAyMDJa
MC8GCSqGSIB3DQEJBDEiBCDAkYJYhqvAHhprkzEWP6PweksoYhj5ULTLbcfQ9Tu3C
zDANBgkqhkiG9w0BAQEFAASCAQcJe818Stb4M4utvQsdCQEHOZCR7I38uL5TSZF3
llKmD9PuCDuV3GIkfdmZISKRuffBlE1xANc2av/0Qogr70aFF485DAONVAEQ7ah
t94pwgAE4yvXXWkmFqkKid1tnMXbnHADKWU0YC+BQkgd/5J3zg4ESeMwOUm0+b3C
GDaUBTIJhHfu9sqt7jXa7PbzQEfemYZORPI14/uZSs86SLkPvNGUpWb4mN6o1C0
2h/U4SCpq80y390oNM0VNpoo+nsTu5y0Fc34pMIvjwCJyIOYPaDnvw9FYgr2o0p7
cd0gFcSJ8q7I+Tx2yg60VW8tAT7UBkifc37UUuVbn0sqeVB3

--052--

B.1.4. S/MIME encrypted and signed over a simple message, No Header Protection

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses no header protection.

It has the following structure:


```
└─ application/pkcs7-mime [smime.p7m] 6720 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 3960 bytes
    ↓ (unwraps to)
    └─ text/plain 239 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: smime-enc-signed
Message-ID: <smime-enc-signed@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:03:02 -0500
User-Agent: Sample MUA Version 1.0

MIITXAYJKoZIhvcNAQcDoIITTTCCCE0kCAQAxggMQMIIBhAIBADBsmFUxDTALBgNV
BAoTBELFVEYxETAPBgNVBAsTCExBTBVTIFdHMTEwLWYDVQQDEYhTYW1wbGUgTEFN
UFMgU1NBIENlcnRpZm1jYXRpb24gQXV0aG9yaXR5AhMPLSW9ETmXSs5CVIeh7j00
Boq0MA0GCSqGSIb3DQEBAQUABIIBAHmns02IdHZqhpStR4Kwdgv3WQtCaxYUhtXJ
AmWV0NBvy5u7gilyKnpGy7CcJ4T5bA68lWNos4i4D2bsiLDGtMAuEynCKejeKp+r
rS6BU+iI3QArUw8v4xxFHmYtOdge1tV1uws7atc8fXnUlgcfpnOD+IvL0dwkrJBs
o0AePTxqKmi3pUkSoZ4FVkfXJNkM3KKlXsqf5VFJV21r/AY+3w5V5sFkengnXv6e
kAZWUVMZ5GiiLzCk5412rG03Wi5oC1cYqkbnmKndm2MvceEos048N6XTvW9geENp
y9stPxxv9pAp9HD4miuwWA2KLUPBVLh7l7XwjDwA08MGsRCzHP64wggGEAgEAMGww
VTENMASGA1UEChMESUVURjERMA8GA1UECxMITEFNUFMgV0cxMTAvBgNVBAMTKFNh
bXBsZSBMQUU1QUYBSU0EgQ2VydG1maWNhdGlvbiBBdXRob3JpdHkCEzB8R0APhiY6
HGSL64MvlsDXhpQwDQYJKoZIhvcNAQEBBQAEggEAd0njKorhe+/7PA3sZPAMGBA6
bQlRDw3HF8/5y4ld+ZCHw02YeGKvc40T1T04SsY8zd0hNBhJRaQqRkK+5HK00PqV
ADA6a90U36FAyNI0Zn8veG4rH1b/vWHVdxWb0W69Liyimia3fBz65o/6E1yX/GAb8
m+KPtKx9cvsFCazv95M4C3Girn8LkAswtmWR+deEp7tYPdjHky7T0kdXpV/z0Ee9
HtjilLeqUD+mvV3CJkIbywsUBRsZ0iLA8B9WoIsvcpYDU1biaxMko0rwlUfH2Vsd
j6+Tj1w90dSZM7xUF1YefRDd9XnF+HcRNb058ucu8iIMxVJq+LNBey4N70XmfjCC
EC4GCSqGSIb3DQEHATAdBg1ghkgBZQMEAAQIEEMyuzbDBN6TV2WSNq2aSZ5WAghAA
nq1HKlEGkfDdd9BKbpZgRqgsSUEEBdGSgAC4v0Ugu6eD+ukLBk+TZZGuLHFj1vB3
/Nk6mjv4xakp/x23yGk7zc6bzmHduR27avvu9zZf8fdeNMkwBeuB47WIXEnQKmlt
y6I7vVEJJE4CEVF0VDIFH7B2wpo5pogs0N3vJt/Gr2vA02NjRosgGuHTRDXybQ1Y
KZK0Cw2G0+vB1CYCP9YeM5gG7vQnirjQdVPJ0K+4NOEHy8JZHQZvu7dR2P02/QiS
5p8wcYPSRLSWRdaPaBDnfkDTwaaQYUcm909iydoYUI5Xg33LzjGh0UMDg0vouQ/1
Aqj7zwHXfHJVk38lSQc8fL88/TaCkouGMAw/dHCUQY0B5v4JlsSaYBo8ojaPIIk
T6PYuFu001ghi56h21sKNsuhnYSR8c8rZMq3jIKDkmdjOpNpn6kevu1BHeNnH1wK
WPBiMx4CAapizFjeVmbgnFbjNBdw2k055bPqXrHMoG5/hHC85JV/IgCF0uvQgOY/
kg2eTl80pJ3dF3/iJnHsn6wB50UDPYAQxt9bpAgtNND0iCyd5Gd3guQOCAfvpB00
IkMPH2K8xsvqk6cUncEtrbSc0lrldEpnQhiTiwyAmJevan++mvjUuBRPN1grXH4v
AeCR28K+ht0xC/5SaONcLX6FhppX0MR09j4nlwlvvXfmm0Bo3eyaYqLAatmId1/
ig17gk0JQBw2zzZHqEm1URQh50r/6DvStMj2ASjGgtSPPhBQK0+CaITceLhuRNyw
cH3tSLEgmhMj0lDT6gmB/d3PFcLjUx8DwCwYsshDY3Z15GrzIq1jgZvmzjBxaCuA
VPGA3jwM0wBdJtXhAP7uYCe5qjbTL9L6EqIo8RQ17zrXxP7etwSjBAFbTUKBxxik
AZKPAgoTFs03cVhUBmSzoMupgiUAieT00S43iP9JeXLFH0nN+cAlo7iJx/gEcL68
1ENpSawRV00NBtF6vjPnIEh7eN0MCA/fTipRR7Pz+g2oKQLUZPNkvXUTi7PjoSPb
bfKpK0xbHqao40mJdNvX6lNg73PsQnJGadYu6DnMvVG7oTibcsA3aoh3jreb1vLO
mzpATxg4b1QFC0Cjxqd8FKRrXZlync5c05E3EhYlVXW0pi17wW/a2Ca7S8iT3+Rw
bVNd2A01JgS6r+NsvgIXQTjxA6RNzP3K1Iorkuhg6nNbqgJffskHz5uD72AXQc9J
OfxGIFAgNIBnr9u+pvj3WvQJLZTHFdDvVXPGza5/D3tnoWb83j8Z9T8px1TGK3m2
GVFm4CyJxdzDr0cfXznR031YkNeTA01SySF0yhTHAZIOU81YaUT/2P4y28Fc/79w

ofFZSqVz+J2QCoGbZfbWsj8RbrcaPYzPj0cBwtUxPyCni0Mf/4if+GxLv1F8a7DI
onHVJg5w+Lo1RKcvPpRiRq/w7wrwF0hEehyQr6a/8WbiAOSMMRsQj3+9atQViPfb
QChAtGHq1TMWysVVGod4S30hki0sp1s6t0FCJb8QIL2DY1DSbg/wtnNbWA0BXYtf
tR1bhQRI0ytm7mhN01kfw+dWXOPqzofRG/zvaKIGoufnmqJpbk4RR4r+KHUZ3xDP
2URkSh5Qrf9yZ7wE791QKomGSZygvX1Tp8TzicUWpeTQB0IHXSg2JBtykU3q3m/
SV1NY16oP6oC1vVAzRNxQgs6TQ8PEgGqPsE323VDCpgAnqsA5zq5zeZjjEK8p+Zy
HWjcaWf1top6+l9Tt/5chnAmCk4wS120Lkisu7f0zB9M8UzQC0yVrJ4L1A/MD73Q
KE1zP92o87ZfJnnNjpBb4A/EcBTmhVxbjSlC4cT6UR08pv0cfhSqFni9eMhImQmS
0XST/0NkVeqBmC6b72fATGQb09Iv02pyV/2w5W04gCNCvWBN8kmQQLEEHkDaOmZD
0YxGkgfbT00RxsC2fa8VnRuc8FyRjWf09qWn80TNhnVHbd3DPfsoTHN15v7dsGDz
0a0nVMmwSmAFfzQstA9qC+0PeBPXBCKNXd1Y7/7ru00GpUW9hSHKk0c227QtbtAH
LdUAUw1bBIPA3gNJQDkmGQaefVFJDV8xn9v/1RuVxegh4N8QIK1U9IPz7+wec81S/
4cXz/JT01u/oGpcSE86jzarGMh/ik3ovckGLvH7q7Tdt5Bd0YyZZa6PcinfkT1Tj
rj/SMsHH3a1XNipnSnb+50dEIQUJksSgQYE1nFgV2M9PB0Ny3YA07Z2ArF/f0sEf
hRKQw9YH9grv0berA0C5182tvvKrZ5j0q6gttYZ8PacoD9DnaXJjNGKJ01jwNsmV
v1Px7G8yOuxx2qUuTBbqr8jHg7XR9/UaYEuvmds1QZpnuDM0rxuRPufI1nWVZvd7
wxWd588fI3X0XmE9ZA2/kq5uq57xpoRL1Ph/sVqVysj9ruYTU7uHz629jFeq5mF4
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8ydpnyZVV/bu+Py7MYq8YtkcEVvIk70b9gBI3UhKEL1Pfrj/t/q0XM2C63a+c93j
YpMSCnb/w01py9ws5VMCISksDYQLdKwNjj/aYWiHfgyghXGSY8/KDL18Yyzfqz2n
za0UaFMS7TMvHSjTe6Cv0zIYvht8P6gQmXVvE0LJ1VWUh+q3ccXnW5EHg4CgIbCI
dm5iN3a+01IejFQSzVfW4kB/RWns0iyBextm0xxyAmu7xGayLZul/bzBFT5XrQwv
sb524bG0Ys6zcka5zjnkQY215aGztAXFuMki2nRiUsve5ARm/KQhb12NGthQu++2
r807AnZGdjhG1z4h5XfR/VvmjuMF/LxdgIJG31VC37u/343lgNbI0WybUorzFaeg
rVnSDvMrfzMdZ/KRLTBhVUC9KFj1hn4L7FdfpWz3Lbcw5Kn+uIU6EsRkbd0wdRPN
mEPHgjT/+PD+msMoxTC0kaPtgRgB39I5jnIgpBA08iKt0bHttmZoZeqD5+N2uTyK
WB+tC1CctNGGYfCR+YAUMTojhou1FSwiJIBTTE7QmSueuLmrEuCYvxUdEuA7RtD
L01Abt0S05WURWu0pNDFroYbYPEjX5vEoFbU5jHhzEZF5WQ3cy+/EqMkxk7/47dh
ux/J9UXXJTYt4Sh8KNZOPh381cVliqI0/Ms4Nn859zwaFCAKBZxn6ZqfQbBmxZwu
D8ejB8KfXUIUp9H6wSPWvxJ2XW8By01UuZFIE6vvZunm55eYvotkhjQFIag6Cz0H
CaUZfwJ6bEWreih41WFghnRL1ZhRptnfQhnsKKVUqJW0jiaGZNZC+4jVC0r+36bo
W9e6LYfkemtKEMer/nrdgvw9LXo2CaL4BNgReK+T4ZkQbyob/2/ADN3mYe+ETBF8
m71bfEix73e87xNY2mWhvNMA1/hZ041IjQdPysNwi5V9YE2/cs+6UulfoVIyxiNG
DpixonTJroJ6GeKotBn/K5eCqxKoF3gKiH98DnH9NV1otBej74998NG6ATN5jpaZ
C46LiTjPmZpTx91EyasuT6eDw+1EGa6EwylC7x7zjjjwanlqD2mM1NpnSm8L1oB3
vvcwP60GoLgyu50+M0C+hYxrNuyCG2aoX6bvzdFrh9DyL18LEErVdOPj9r/hOMtB
PJzmiDqHIYaZv6+uyarrjFRG6d0+kCZDtzuAy/HEU+UXCuv27i99gkEyeMcasQSp
DkrjvnVJQ101fMx/ttIGyyUbTH/jlBmLQ0cc+hrBeGGTYyKM5N6eB5WCukYskfva
6p7zGiKUER1py0Zmc04BN3UqPR6P9pJbJ0cNhpCTx7/pKa90gDpT8+Ma1RxaNOLK
mskKwQpnkJf+2ays9Rv0oYtbnFvZJJPrT8iVg1D3aFwmCop0M1/kW5sYFdPpFGsH
byzTzq3Fjw0AQ5U0G5Qq8EpsAlAJ3hy/5Vv40aVizAoJz2fZXnQ9Bw00lud/outL
ZbRUEC72vJewbIAS1lzdJ7RLlpSMvB48/cA2dgeXqqfnvnAsMzgO1laF1VID9H4m
/KtMJfKPKagrka91wFwLECu207zihtHmRbkkW1rswqA4SyumWfR5AEGW/sZ8g9LA
rugrt/sE6SpyYi5zzYL9/vNT61kQVy7UhUqcasQU+1CLVuaplAk4uvRso88wXYKn
SSQXesmy5m6eY0IevOmyUMQzzfwKswT49j/7hrHsECTzpyCOP0/8zBgGH8f/wg1r
/sZ/0+sZnu819qUaJhHSFIEx/CQKuHYv5ez6aT3BAtmPn0iWrFVzna30go8XAL68
eDwN69Qm82ikD02LFkKZrBzn/1dyZs/dT61QYpsmhxJzoluZzW/sYFeOCX6fWs7n
fcrz9yMIDKvj70JrZp5jPRghFKHmq05xh39TmeTsQFp2B8U1GD9YK6YfgSEaGbyL
3BpujZN/713jmWYHzGvEQfx7vP3SaZBMZ4GSCoeBT2grQoUDe575H7UDJsmRVJ04

b07iTWPZ1LdIC+oifedAhGhCoum+tApUYj+3BHZ1xIAZJMCGARqgyKcnvjw5WVu3
fDna+4xJdNs0YK1uBkr6N9FBDfmQIuneIsQHAM7lZfucd1FenZhy1zNreqgls9Q0
NncRNl1tqmT2qmERXw8/HwcwNjR8FwrwbCCApSmgAZ0xWaRxpEct5lnGNbBpp1En
BrMafVecUlQgwa1jchA5Zi0uaZxizi1Pr9/eoaX93aa2u+60psyPqdadxwDev1Do
4dg2NrDqQMFo3I1IcADeZEcEqPx8PV0tYjEeFZYsE0k3Qmcti+RuRj/rNTaXQ2Xw
VkgL1BG8P0kxw0pVIKvYevcPtUD5tSlTxfp4qBF1EY/yrGCHy36q2mboBcRyYQry
oBnsvoEfrIE8FEz1rOJVM+HN2udrKVJZzEPySf1ZvbDzxINcqDu09r3U0+L+ymW5
9/nchCMYoa0KbQ08q9i8VsGchL2FF5Q66g7I8U9u7R7V4Fz8RvL0zs6bB/Oh7+Z9
0dTWreRYp9/82pQ0VSuvkwyiSPwiy37spaE8uALD5MvZOS3Cq0wGI+o45uLBP/a6
dga1Pv1kThe8/a25+FqiQP6boCsN9wgA+T3v3kRFibzFEtyqX8C6Vu795PpycZ14
/RGFTm2Df/U38DN/mlNhGgM6gMQr1YuSPieFJ+0/ctzGpSaS835d+DkQVvS3zT3/
5Epybk0Zrqf6erhNTVa80nr3Zndt9QyNUCmwxpYVvV2exwoVfcIjQgCxwehySLW5
UprvrRNgHo00BMH+UmSggBfT7/omejxHgAJz5WCl/P+DiQ/dZcBK10CRh1ZkocLB
WVpunKTMuLyqSqNG87nzXAgFCLYQRWeCQNcItSbJ4aed+sJIYxmEm2UzyKak9eXI
dCZ/5fH0tmMD1645r/v9eSjeZd7Ed6MhGladuVlNm9Dl29sIzKcUu3zfZAqBlzFK
1RzPS3IUeM2VEJbK9AowEQ==

B.1.5. No cryptographic protections over a complex message

This message uses no cryptographic protection at all. Its body is a multipart/alternative message with an inline image/png attachment.

It has the following structure:

- └ multipart/mixed 1406 bytes
 - └ multipart/alternative 794 bytes
 - └ text/plain 206 bytes
 - └ text/html 304 bytes
 - └ image/png inline 232 bytes

Its contents are:

MIME-Version: 1.0
Content-Type: multipart/mixed; boundary="c39"
Subject: no-crypto-complex
Message-ID: <no-crypto-complex@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:00:02 -0500
User-Agent: Sample MUA Version 1.0

--c39

MIME-Version: 1.0
Content-Type: multipart/alternative; boundary="05a"

--05a

Content-Type: text/plain; charset="us-ascii"
MIME-Version: 1.0
Content-Transfer-Encoding: 7bit

This is the no-crypto-complex message.

This message uses no cryptographic protection at all. Its body is a multipart/alternative message with an inline image/png attachment.

--

Alice
alice@smime.example

--05a

Content-Type: text/html; charset="us-ascii"
MIME-Version: 1.0
Content-Transfer-Encoding: 7bit

```
<html><head><title></title></head><body>  
<p>This is the <b>no-crypto-complex</b> message.</p>  
<p>This message uses no cryptographic protection at all. Its body  
is a multipart/alternative message with an inline image/png  
attachment.</p>  
<p><tt>-- <br/>Alice<br/>alice@smime.example</tt></p></body></html>
```

--05a--

--c39

Content-Type: image/png
Content-Transfer-Encoding: base64
Content-Disposition: inline

iVBORw0KGgoAAAANSUHEUgAAABQAAAAUCAyAAACNiR0NAAAACe1EQVR42uVT0xbA
MAGs739n03TpRw20dqpbFARQej0ywiwYnCtkDKnbcLk66sqlT+zt9cidkE+6KwkZ
sgrzfcqVMpL2jo0447gYDpeArk+0nJHkIhAfTPRicihAf5YJrw7vjv0ZWRWM/uli
vdPf1QZ2kDD9xppd8wAAAABJRU5ErkJggg==

--c39--

B.1.6. S/MIME signed-only signedData over a complex message, No Header Protection

This is a signed-only S/MIME message via PKCS#7 signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses no header protection.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 5249 bytes
  ↓ (unwraps to)
  └─ multipart/mixed 1288 bytes
    └─ multipart/alternative 882 bytes
      └─ text/plain 258 bytes
        └─ text/html 353 bytes
          └─ image/png inline 236 bytes
```

Its contents are:

bM1LY4X5chwfNEbkN6hQury/zxnlsukgn+fHbqvDhJLAgFpw/jA/EB/WI+whUpq
tQIDAQABo4GvMIGsMAwGA1UdEwEB/wQCMAAwFwYDVR0gBBADjAMBgpghkgBZQMC
ATABMB4GA1UdEQQXMBWBE2FsawNlQHNTaW1lLmV4YW1wbGUwEwYDVR0lBAwwCgYI
KwYBBQUHAWQwDgYDVR0PAQH/BAQDAgUGMB0GA1UdDgQWBBSiU0HVRDyAKRV8ASpw
546vzfN3DzAfBgNVHSMEGDAwGBSRMI58BxcMp/EJKGU2GmccaHb0WTANBgkqhkiG
9w0BAQ0FAAOCAQEAgU14oJyxMpwWpAy10vK6NEbM1gD5H14EC4Muxq1u0q2XgXO
SBHI6DFX/4LDsfX7fSIus8gWVY3WqMeu0A7IizkBD+GDEu8uKveERRXZncxGwy2M
fbH1Ib3U8QzTjqB8+dz2AwYeMx0Dwq9opwtA/1T0kRg8uuivZfg/m5fFo/QshlHN
aaTDVEXsU4Ps98Hm/3gznbvhdjFbZbi4oZ3tAadRlE5K9JiQaJYOnUmGpfb8PPwD
R6chMZeeqSAW++OIKqHrg/WEh4yiuPfqmAvX2hZkPpivNjYdTPUXTS07K459Cyq
bqG+sN0o2kc1nTXl85RHNrVKQK+L0YwY1Q+hWDCCA88wgGK3oAMCAQICEzdBBXnt
dX9CqaJc0vT4as6aqdcwDQYJKoZIhvcNAQENBQAwVTENMASGA1UEChMESUVURjER
MA8GA1UECxMITEFNUFMgV0cxMTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2Vy
dGlmawNhdGlvbiBBdXR0b3JpdHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5Mjcw
NjU0MThaMDsxDALBgNVBAoTBELFVEYxETAPBgNVBAsTCExBTvBTIFdHMRcwFQYD
VQQDEw5BbG1jZSBmb3Z1bGfjZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoC
ggEBALT0iehYOBY+TZp/T5K2KNI05Hwr+E3wP6XTvyi6WwyTgBK9LCOWI2juwdRr
jFBSXkk7pwpjXwsA3A5G0tz0PpfgYc70xsVcF7q4WHWZwleYXFKlQHJD73nQwXP9
68+A/3rBX7Ph00DBBznfitOLPgPEwjTtdg0VQq6Wz+CRQ/YbHPKaw7aRphZ063dK
vIKp4cQvtkwQHih6syTjGsgkLcLNau5LZDQUdsGV+SAo3nBdWCRYV+I65x8Kf4hCx
qqmjV3d/2NKRu0BxNDe/N+iDz3X0zEoj0fqXgq4SwcC0nsG1llyXt1TL270I6ATK
RGJwiQVCCpDtc0NT6vdJ45bCSzsCAwEAA0BrzCBrDAMBGNVHRMBAf8EAjAAMBcG
A1UdIAQQMA4wDAYKYZIAWUDAgEwATAeBgNVHREEFzAVgRNhbG1jZUBzbWltZS5l
eGFtcGxlMBMGA1UdJQQMMAoGCCsGAQUFBwMEMA4GA1UdDwEB/wQEAWIGwDAdBgNV
HQ4EFgQUu/bMsi0dBhIc164papAQ0yBmZnMwHwYDVR0jBBgwFoAUKTC0fAcXDKfx
CShlnhpnHGh29FkwDQYJKoZIhvcNAQENBQADggEBAH0JoJanzqmgasN3/gqSQ4cb
bmdj/R40BEPr+gXT+xiidfZ2iLNwYyTneuK6AChwKfnNv0Fb81V1iffRTF/KtmVE
DMR/sYeqAH83KM5p3e12lVh40HhyI0qNuz5oShNaACSioQ23WxHGvY9vsdVfnbhs
plRwG9NQ2WbpCmK+2oMh2oYl0Z/wvXmt9cG6jbMvcdH4z0I0vg6mrYkKTM/RCGnu
mghxwYToj10yD5Gs4D2IJCw+fx50Dxh52MbNRYXTus2ZPRPM8JXNQc4Gwv4km3M4
rKnJDD6hnoQ9rNeozIcBVyybQYjfrgg4DRvw9Ksk220H4ConlB8f7R7s1LM2cSYx
ggIAMiIB/AIBATBsMFUXDTALBgNVBAoTBELFVEYxETAPBgNVBAsTCExBTvBTIFdH
MTEwLWYDVR0QDEyhTYW1wbGUgTEFNUFMgUlnBIENlcnRpZmljYXRpb24gQXV0aG9y
aXR5AhM3QV57XV/QqmiXDr0+Gr0mqnXMASGCWCGSAFlAwQCAaBpMBGCSqGSIb3
DQEJAZELBgkqhkiG9w0BBwEwHAYJKoZIhvcNAQkFMQ8XDTIxMDIyMDE3MDEwMlow
LwYJKoZIhvcNAQkEMSIEIhGVzAx/S4dUwqko0cb+oa+gXfmEqw2Iz+svSKpWzC+
MA0GCSqGSIb3DQEBAQUABIIBAGtNM3MMhWZVJdN1nlfSk3mhNk6E+LFo0qG4aiHz
e+HEQjN6bKft5zu1MCqh7NKRpRmDcEE9RXDGKGY9BKBf60d/041o1BY/xpPu9G5
XnUTHN3MmqubrTSP3xxU5AozL8i7XmkB68VxKBQ2YpfcXBFGBuvlc6FXkbh2QtRX
UgBZEp+GSxG7o0UVJRa97t6wb1UdMwaQ10NrtBsmr046bThv4cgrlGBvz8tGfHwR
4HbS/Rp+6jNAS0K9fZ0PQxy2b4M4braYg3f1n4q3dDH8N0XiUcwG8FiB9XQo18+D
fdkZwTVUoDHWjSvdIREobdPI2wdpnGxS/AB1VuiYpcebi4o=

B.1.7. S/MIME signed-only multipart/signed over a complex message, No Header Protection

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a multipart/alternative message with an inline image/png attachment. It uses no header protection.

It has the following structure:

```
└─ multipart/signed 5234 bytes
  └─ multipart/mixed 1344 bytes
    └─ multipart/alternative 938 bytes
      └─ text/plain 278 bytes
      └─ text/html 376 bytes
      └─ image/png inline 232 bytes
      └─ application/pkcs7-signature [smime.p7s] 3429 bytes
```

Its contents are:

MIME-Version: 1.0
Content-Type: multipart/signed;
 protocol="application/pkcs7-signature"; boundary="452";
 micalg="sha-256"
Subject: smime-multipart-complex
Message-ID: <smime-multipart-complex@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:02:02 -0500
User-Agent: Sample MUA Version 1.0

--452
MIME-Version: 1.0
Content-Type: multipart/mixed; boundary="ac5"

--ac5
MIME-Version: 1.0
Content-Type: multipart/alternative; boundary="813"

--813
Content-Type: text/plain; charset="us-ascii"
MIME-Version: 1.0
Content-Transfer-Encoding: 7bit

This is the smime-multipart-complex message.

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a multipart/alternative message with an inline image/png attachment. It uses no header protection.

--
Alice
alice@smime.example
--813
Content-Type: text/html; charset="us-ascii"
MIME-Version: 1.0
Content-Transfer-Encoding: 7bit

```
<html><head><title></title></head><body>  
<p>This is the <b>smime-multipart-complex</b> message.</p>  
<p>This is a signed-only S/MIME message via PKCS#7 detached  
signature (multipart/signed). The payload is a  
multipart/alternative message with an inline image/png  
attachment. It uses no header protection.</p>  
<p><tt>-- <br/>Alice<br/>alice@smime.example</tt></p></body></html>  
--813--
```

--ac5
Content-Type: image/png

Content-Transfer-Encoding: base64

Content-Disposition: inline

iVBORw0KGgoAAAANSUgAAABQAAAAUCAYAAACNiR0NAAAACe1EQVR42uVT0xbAMAgS739n03TPRw20dqpbFARQEj0ywiwYnCTkDKnbcLk66sq1T+zt9cidkE+6KwkZsgrzfcvMpl2jo0447gYDpeArk+0nJHkIhAfTPRicihAf5YJrw7vjv0ZWRWM/ulivdPf1QZ2kDD9xppd8wAAAABJRU5ErkJggg==

--ac5--

--452

Content-Transfer-Encoding: base64

Content-Type: application/pkcs7-signature; name="smime.p7s"

MIIJ4AYJKoZIhvcNAQcCoIIJ0TCCCc0CAQEXDTALBglghkgBZQMEAgEwCwYJKoZIhvcNAQcBoIIHpjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQgirQwDQYJKoZIhvcNAQENBQAwVTENMASGA1UECHMESUVURjERMA8GA1UECXMITEFNUFMgV0cxMTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2VydGlmawNhdGlvbiBBdXR0b3JpdHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDsxDTALBgNVBAoTBE1FVEYxETAPBgNVBAsTCExBTBTIFdHMRCwFQYDVQDEw5BbGljZSBMb3ZlbGFjZTCCASIdQYJKoZIhvcNAQEBBQADgGEPADCCAQoCggEBAJqVKfqLwLjj+gBUCfkacKTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfID1B/wlbdmadXPmrszyidmbuZm0pB5voVQfiLYyy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0aGdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6141koaZXCN5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcrv9w43GG8FtpSX+TWzB2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK arUCAwEAAa0BrzCBRDAMBGNVHRMBAf8EAjAAMBcGA1UdIAQQMA4wDAYKYIZIAWUDAgEwATAeBgNVHREEFzAVgRNhbGljZUBzbWltZS5leGFtcGxlMBMGA1UdJQQMMAoGCCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj80e0r83zdw8wHwYDVR0jBBgwFoAukTC0fAcXDKfxCSHlnhpnHGh29FkwDQYJKoZIhvcNAQENBQADggEBAIFJeKcCsTKcFqQMpTryujRGzJdYA+R9eBAuDLsatbtKt14FzkgRy0g31/+Cw7H8e30iLrPIFlWN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMtjH2x9SG91PEM046gfPnc9gMGHjMtG1qvaKcLQP5UzpeYPLror2X4P5uXxaP0LIZRzWmkw1RF7FOD7PFB5v94M5274XYxw2W4uKGD7QGnUZROsvSykGiWdp1JhqXwfDz8A0enITGXnoEkaFvjjcQh64P1hIeMorj36pgL19oWZD6YrzSWHUz1F00juyu0fQsqm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV57XV/QqmiXDr0+Gr0mqnXMA0GCSqGSIb3DQEBAQUAMFUDTALBgNVBAoTBE1FVEYxETAPBgNVBAsTCExBTBTIFdHMTEwLWYDVQDEYhTYW1wbGUgTEFNUFMgU1NB1EN1cnRpZm1jYXRpb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOjY0YDZlWNTIwOTI3MDY1NDE4WjA7MQ0wCwYDVQKQERJRVRGMREwDwYDVQQLZWhMQU1QUyBXRzEXMBUGA1UEAxMOQWxpY2UgTG92ZWxhY2UwgGElMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEK AoIBAQC09InoWdGwPk2af0+StijSN0R8K/hN8D+l078oullsk4ASvSwjScNo7sSHUa4xQUl5J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFvSpUBByQ+950MFz/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2GxzYms02kaYWTut3SryCqeHEFbZfKB4urMk4xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWFfi0ucfCn+IQsaqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H614KuElNAtJ7BtZcs17dUy9u9C0gEyKriVokFgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAAQH/BAIwADAXBgNVHSAEEDAOMAAGCmCGSAFlAwIBMAEwHgYDVR0RBBCwFYETyWxpY2VAc21pbWUuZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD

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8QkoZTYaZxxodvRZMA0GCSqGSIB3DQEBDQUAA4IBAQBziaI2p86poGkjd/4KkkOH
G25nY/0eNARD6/oF0/sYonX2doizcGMk53riugAocCn5zbzhW/JVdYn30UxfyrZl
RAzEf7GHqgB/Nyj0ad3pdpVYeDh4ciNKjbs+aEoTWgAkoqEnt1sRx1cvb7HVX524
bKZa1oPTUNlm6QpivtqDIIdqGJdGf8L1zLfxBuo2zL3HR+M9CDr40pq2JckzP0Qhp
7poIccGE6I9Tsg+RrOA9iCqsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEm
MYICADCCAFwCAQEwDBVMQ0wCwYDVQKQEWJRVRGMREwDwYDVQQLewhMQU1QUyBX
RzExMC8GA1UEAxMoU2FtcGx1IEExBTBVTIFJTQSBDZXJ0awZpY2F0aw9uIEF1dGhv
cm10eQITN0EFee11f0Kpolw69Phqzpp1zALBglghkgBZQMEAgGgaTAYBgkqhkiG
9w0BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIB3DQEJBTPEFw0yMTAyMjAxNzAyMDJa
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fdcdNerDq15+CKaf8R/JDW+hiLyvD0KCpXucWLBh1okt1Jpld4kkaA4wu9Idh9fK
G1N20s+dBXoytH/G6K8Nh0h3Qaf3lMP1R60gkvJVJ3j9jIs3/ZG4qH5qWQJHLvi2
WLSxDhkYmZ+dYSCyfIauNkq7a0wauSpZj82elFA7HdyZmNp0

--452--

B.1.8. S/MIME encrypted and signed over a complex message, No Header Protection

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses no header protection.

It has the following structure:

```
└ application/pkcs7-mime [smime.p7m] 8690 bytes
  ↓ (decrypts to)
  └ application/pkcs7-mime [smime.p7m] 5426 bytes
    ↓ (unwraps to)
    └ multipart/mixed 1356 bytes
      └ multipart/alternative 950 bytes
        └ text/plain 293 bytes
          └ text/html 388 bytes
            └ image/png inline 236 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: smime-enc-signed-complex
Message-ID: <smime-enc-signed-complex@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:03:02 -0500
User-Agent: Sample MUA Version 1.0

MIIZDAYJKoZIhvcNAQcDoIIY/TCCGPKCAQAxggMQMIIBhAIBADBsmFUxDTALBgNV
BAoTBELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTEwLWYDVQQDEYhTYW1wbGUgTEFN
UFMgU1NBIENlcnRpZm1jYXRpb24gQXV0aG9yaXR5AhMPLSW9ETmXSs5CVIeh7j00
Boq0MA0GCSqGSIb3DQEBAQUABIIBAB5TXoiCIIIIxehywh5/tdFM72iw946N60zE
mkIj1x+ShPweKrmTgPxaZbNgZpMdyNetqSXTn5H1ZwUAX0kE+EPp301kveWwxBAM
/Umzr/ODGiYLHWORWh+cPwj00IHo8IJzmF9FWMr7CKYhvbSZn3AFuERRfEccwH9
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+paj8dFQb3W9AG0uCdW8r5CoawAZdYMvZ/v0ixYIkQid7fs0E+AwggGEAgEAMGww
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bXBsZSBMQUU1QUYBSU0EgQ2VydG1maWNhdGlvbiBBdXRob3JpdHkCEzB8R0APhiY6
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5NQs0DVNjxjCAOXWm9zsyhH8tYGdNVvzktXkn0JV4g19TEu4MisuhcIhqJyrSsh
4epi0ZxbyM/YTnhHvi4wttaZq07tNVF6eafyuecDKLV8/WF+AGSVWe0xPumEni3w
GADVkwmc02mDZO/ad/u7Jv14jF//Id/IG/A0y/yBgrWq4pH7BPwp1W/rXbnw1EEem
8an56+5f/m8teqqXaiRMVQgMaKGCmXHyD3Ud21Rqc4jwsN0VCpzabK9DSDPcxwV1
H+PPutza/Ux7yNgJ1gm816e85lu0jvpf+H1iioHpNKCQ+eh6mH0BqLJKJkktjCC
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6c8Ad/SQUfk84wns2/+pKocqa69tVTIok3Y4+1nDcvg8jzkdPD0cednWdYjh0vQz
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ZbQgka+Csxk/S/lBiJ5hfdsU6t0k7JZwSNQXHgGrCp7lboSljx0EfiKQVjo+ynnyE
LmUM0zoZz2eUdsUILLQtmFs9r0AvBrW8PcF79II0QR+X4QEJ6Ztz3zAgj409q0Fmm
fCrhJTUMcVZyeqLUTpyLWDBKqV+jm5dA7WR8CL5NqEsmtYQRTabkPv8a0DNpgM17
fCN3bIs6VdsiQXdhwwH8U8pcdZSINvNb2nNbUrFWlU6Z0x160DGQKm5KxuUd0Uzi
xKe2v0DM15TyjRekBPhoZC3Mwqf7Ud6vDoBk4Evhlxjv8MAKA5L0ghtfvv4xP/eP
L5i4V3EnZtRy4hnW060tcD0odWw2PXPYPfXN0z7UEdKk1hj0mBGF1Wt1QrPzM05x
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GVD+PUBULWxEIPHQU58y7KwBeXtNX/o9rPu13Nt2H0INyYhhLNgX5AyTpG10NrFJ
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7cgM9UHRjLY8y0IEl3fME/JF1pR3NMG3LQ9dohsgvl8Z11JABY8+Zz8103g5ZjBy
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pELaOPDJIGYrEPO2d3TunL2qJwAJEY0asa0NMvvA3eSdC8kzM+NP5gYHl6gRFvDQ
WbU2LRsCKwu4TtHRR920qKw1r9x4ZgyZH7UvVnIZVGz2buta7ssQ+PLDwIXemtFh
3laYmNYrSSJ7lnd3WwXvS5MxWa/OBwPpDS20IRw00GmAYKwPQzgfJb/gWf4/rSiK
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JUUBS0Z7qF/2AljMgrTjkiQGNuVLhLxexaQJr0GLAWlK2ij0xXK6bGh+JUW12HcT
Ms71ef811J1fHrS7mTzqAAreAsUrUs30WBBYmWsvRyMMqNuWRJr4Ax1jF/5HBNPI
bdx9X6Dz51azBBQb78S2hxLwrGLffbheyYJ06CwMeM1epsV/VvCuKfakVGINS4yg
i7DHBQrHXekU6XzCgCRARC288zwDpRSxqubQYGchpewg9ZBK/Syu1FRw/AjQowNS
ONatikKD5N8UZAaf/iLznBzG+bXF4esrMpUm8MY1acow7A6IyQBioGEaAh6U05Ww
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Yy2ez/q7sb1l2P7YFY6TXRc4FIIEVooK6LbsHggzwcibhc80Ue7bq+T6ouFYEBCW
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clB4eYdp1ZZJ7s3hkPwq678LBRXT3Fs4a9BpqEnvUot6Wfg0sP/zsszS247EjWra
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qAeV4HIRBg3/jU+8PRHTyUz1Qf7vRXKiDM1nrT1belccJTWxUtybEKECersUX+zv
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y5cqIjJJj0SES2VoyP0cu/rJ06+gg7v+0HHehmhkehuQNsLnXldAgGJyiFKcvw4C
+NrQ2II8uJ54Q+ytrAMr8GDV7F6cHb9BuyTT1ubQEP1L5EwcEFWUESEV3A4quit9
t1r3jEuPbc3fqyIcmDNKP58qS0ZP03m/fJEW1LX6yR0IEkrSxZD6PbUYgNT+qZD+
Rh1NUJ6dIpd+xxA837NxU0nkrJQ3uv0vURBKVv20o0XzDVkRtAIEy8aVic6ZAxIX
ZHqkikEiFxnCMxi04agsE7qwCKvpq6l1M+xxXFs5Puqoj7vL1ihzCjoABqne5SE
yBkYqU20U7uoIvWSwVdtwqX1Ih/adN5t01n1HWcMHBooh04nfpMrhci80i/XYTA0
new3jLMwZXEBZhlkZ62ZZt1PA68K9f6XkSTaJ+bx+s3iV0K4RmLt7VC88+1Kspsn
/pnDEBFBCQhGD07YeKUBbJ3RPdRi6rsj54PRsZk0Ai2MoQZJ6PnzfI6EHsQXNad
PnYFB6ZGrse1ayA9QqibkRFMKGRSakkB+fq12M36RB8Ce0766iMoc5qc8n5qz0oH
BB1ftiAHTGU+6AhEGU5kifLZaehBcp5yDl2I5I5lc0X786Zjdm4oGbGq4q6Ieyu1
0Lx8vkb9L3ZvkLgZAvn1r2dZK0xyNewjQwFG05ErbK7ppqD6TC5VZCiTLJKs1N+B
l3/UjwSwc0Lt3P7dep8oDySMgxKYDQJ0qNBFA6kwdZzTlaXRfQUFHukwn6fn10kX
1p/2K+oYUsA40E9qL0cWEMwcnMYRQyk0qpgWWIykrMl4efXkQxSddTqP0WfW/uxs
pQB4rVeZStpz09cie1E0tVcoipItpNvvQTENdC/p4Eg2bw2dw+Vd6NB/HwobsPY3
YRox1LGrfj0LH7Rg0qg3pI0D2u9qo3A7ZZ95vkGutTtF0BYkIf9/SFoEwNSJARNp
BOBA5lMrq3S9qwJEOYoA4KuFqLmpbmQg1K3bdi9M9aDK3hgQgLqWsgB4TF00WuaG
lkkQSPVZH0dZgtYxcJnNDth5Bp1MhVmS05mlr/uRKdVjdSg3MKj/20/Nm7P28dRt
0+w7rvRINTp5fWbstkwtBnhe0kyX9usXU1qigTIUsAlXqlaG5g5qrDpG9Ijyqa1i
ShQJ7cL0tGFIJlkZgG/fT+jbJNSNke5uvMLF9/chmmR2SZEhou1tahe8J2/97H+H
L6epMyb4QYeH9JTLdlebyz8bvouA8ydh0HbMj6Vr80x9af+Uu1FhDtJs57goehgS
/SBljJGQMw10kHhLpK8q0k9i+NZ005N+GiBlVgushDyjsUHnxk3mM8hoRqqpkxAW
7mqZagmE09qk7PEct11oAgrwdTSIB9WHIudg9cV1yFi1kkI2ktjEZPD/i8uZq05n
pd6v4w/XJuPopVn5nwJx0wQy1RKDNS0UaWRasZc3l+16D4eywDgDesSLaBmXU1Ui
dbbtK0i40nAEWQ1iyE+Q7JABtILJ8aDSejBvP5gUvKPBliDLwAXMR98ruJeMdbE
/6qCA6YAc5v/UxREKCBzBqSYs0aEqD1YKZEIMhn64NDqpdicX4gwe/sCawTcX1E5r
XLgnSSpflbIexggQ46Ma1BLGp9CbiG02bw1IZmlGG0XqpQmKN6FP00sSnwwq9D2J
nquPar04ILWbL9awBCA6EIkcer/C0fwGidtazmTj5MXkd83lY3cozRuC9dYLO+4R
FXswzvqQeXiaulZ8iQsgxKUj2DcPT2k6j/qzSXz/M5xapj13Bk6VH9KoR194/smT
gjGjVw0nYdzjv5J3i3oQ0wCL9T/ZgdqIFW82jfmGvoe2zu/00XnV9FP4Lbr4rtv6
if54Hr/h8jqJoRnBGAh3doQIGdGLiZZDpt+GWMxreYAk16mbXpuqn49bP8G75ZKq
5Azp5xgNcm/rPGYE+9iQJSGgoz+dqGiQ0u37lK+i0/A00zJ845NW82hoUye0C+X
DB60kbbYcGmPou7bBVaUJNQqdRUTnGd/Yr1Ea0QVScMZ09FN2hjx6V1zjdMuvTe
XXpJ2C5R14kxHY6pw8mInAg9ja7jmY2e7xana4cwrntjbH7J5uZFNEC2kSf4Z07V
k7MOX+zDe285FVBS2+97yAlL3xalj1E4DZVF0w+3dKD+W2bg4r0Yhds/wxYH+M5
GU9zLrHEbw0GsPwUr50w9isSu+o9Ske0CfWrzhz1fJnH26woP00bWby+kkG2cunPN
T5e+0Pw9K3MgBKNZ9YG6Ce9ULqh065f4LISdwDSsMG13eNhgZMPLtCJZAP8K7dEt
80c3P0Y0NSB8lq1oyxDwHKJz0S/HMwranU05V9abkZuYhs0Gw+1Kjswd+cPh5Y8
HoL3GF+0AopbYYesvIWgzH0/MtYYUoI3kPvUd4vdWNHEbtHlfsALDs5pukAE9ny8
0GhntdoH04cV1vDmpyflCdTWi+UJ5tT1VQMGLuFo/CxDV9vWjXhJd7kSt+7+K1L
YPzrT6ggMfrLA0kYRIa5K/n99wp2aYab7/DkwfpejZI=

B.2. Signed-only Messages

These messages are signed-only, using different schemes of header protection and different S/MIME structure. They use no Header Confidentiality Policy because the hcp is only relevant when a message is encrypted.

B.2.1. S/MIME signed-only signedData over a simple message, Wrapped Message

This is a signed-only S/MIME message via PKCS#7 signedData. The payload is a text/plain message. It uses the Wrapped Message header protection scheme.

It has the following structure:

```
└ application/pkcs7-mime [smime.p7m] 4319 bytes
  ↓ (unwraps to)
  └ message/rfc822 inline 642 bytes
    └ text/plain 228 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="signed-data"
Subject: smime-one-part-wrapped
Message-ID: <smime-one-part-wrapped@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:04:02 -0500
User-Agent: Sample MUA Version 1.0

MIIMcAYJKoZIhvcNAQcCoIIMYTCCDF0CAQExDTALBgIghkgBZQMEAgEwggKZBgkq
hkiG9w0BBWgGgggKKBIIChk1JTUUtVmVyc2ljbjogMS4wDQpDb250ZW50LVR5cGU6
IG1lc3NhZ2UvcmlkLWVudC9zaXRpb246IGlubGluZQ0KDQpNSU1FLVZlcnNpb246IDEuMApD
b250ZW50LVR5cGU6IHRleHQvcGxhaW47IGNoYXJzZXQ9InV0Zi04IgpDb250ZW50
LVRyYW5zZmVyLUVuY29kaW5n0iA3Yml0C1N1YmplY3Q6IHNTaW1lLW9uZS1wYXJ0
LXdyYXBwZWQKTWVzc2FnZS1JRDogPHNTaW1lLW9uZS1wYXJ0LXdyYXBwZWRAbGhw
LmV4YW1wbGU+ckZyb206IEFsaWNIIDxhbG1jZUBzbWltZS5leGFtcGxlPgpUzbzog
Qm9iIDxib2JAc21pbWUuZXhhbXBsZT4KRGF0ZTogU2F0LCAyMCGZWIgMjAyMSAx
MDowNDowMiAtMDUwMApVc2VyLUFnZW500iBTYw1wbGUgTVVBIkZlcnNpb246MS4w
CgpUaGlzIGlzIHRoZSBzbWltZS1vbWUtcGFydC13cmFwcGVkIG1lc3NhZ2UuCgpU
aGlzIGlzIGlEgc2lnbmVklW9ubHkgUy9NSU1FIG1lc3NhZ2UgdmlhIFBLQ1MjNyBz
aWduZWREYXRhLiAgVGHlCnBheWxvYQgaXMGYSB0ZXh0L3BsYWluIG1lc3NhZ2Uu
IEl0IHVzZXMGdGh1IFdyYXBwZWQgTWVzc2FnZQpoZWFKZXIgcHJvdGJvbiBz
Y2h1bWUuCGotLSAKQWxpY2UKYwXpY2VAc21pbWUuZXhhbXBsZQqgggemMIIDzzCC
AregAwIBAgITDy01vRE510rOQ1Shoe49NAaKtDANBgkqhkiG9w0BAQ0FADBMQ0w
CwYDVQQKEwRJRVRGMREwDwYDVQQLEWhMQU1QUyBXRzExMC8GA1UEAxMoU2FtcGxl
IEBTBTBIFJTQSBZDZXJ0awZpY2F0aw9uIEF1dGhvcml0eTAGFw0xOTExMjAwNjU0
MThaGA8yMDUyMDkyNzA2NTQxOQ0Fow0ZENMASGA1UEChMESUVURjERMA8GA1UECxMI
TEFNUFMGV0cxZAVBgNVBAMTDkFsaWNIIEExvdmVsYWNlMIIBIjANBgkqhkiG9w0B
AQEFAA0CAQ8AMIIBCgKCAQEAmPUp+ovBouOP6AFQJ+RpwpODxxzY60n1lJ53pTeN
SiJlWkwtw/cxQq0t4uD2vWYB8g0UH/Cvt2Zp1c+auzPKJ2Zu5mY6kHm+hVB+Ithj
LeI7Htg6rNeuXq50/TuTSxX5R1I1EXGt8p6hAQVeA5oZ2afHg4b97enV8gozR0/N
kug4AkXmbk7THNc8vvjMUJanZ/VmS4TgDqXjWShplcI3lcvvBZMswt41/0HJvmsw
qpS6oQcAx3weag0yCnj1V9V9yu/3DjcYbww21Jf5NbMHbM1LY4X5chWfNEbkN6hQ
ury/zxnlsukgn+fHbqvwDhJLAgFpW/jA/EB/WI+whUpqtQIDAQAB04GvMIGsMAwG
A1UdEwEB/wQCAAwFwYDVR0gBBAwDjAMBgpghkgBZQMCAATABMB4GA1UdEQQXMBWB
E2FsaWNIQHNTaW1lLmV4YW1wbGUwEwYDVR0lBAwwCgYIKwYBBQUHAWQwDgYDVR0P
AQH/BAQDAgUGMB0GA1UdDgQWBBSiU0HVRDyAKRV8ASPw546vzfN3DzAfBgNVHSME
GDAwGSRMI58BxcMp/EJKGU2GmccaHb0WTANBgkqhkiG9w0BAQ0FAA0CAQEAgU14
oJyxMpwWpAy10vK6NEbM1lgD5H14EC4Muxq1u0q2XgX0SBHI6DfX/4LDsfx7fSiU
s8gWVY3WqMeu0A7IizkBD+GDEu8uKveERRXZncxGwy2MfbH1Ib3U8QzTjqB8+dz2
AwYeMxODWq9opwtA/lT0kRg8uuiVzfg/m5fFo/QshlHNaaTDVEXsU4Ps98Hm/3gz
nbvhdjFbZbi4oZ3tAadRlE5K9JiQaJY0nUmGpFb8PPwDR6chMZeegSQAW++0IKqH
rg/WEh4yiuPfqmAvX2hZkPpivNJYdTPUXTS07K459CyqbqG+sN0o2kc1nTX185RH
NrVKQK+L0YwY1Q+hWDCCA88wggK3oAMCAQICEzdBBXntdX9CqaJc0vT4as6aqdcw
DQYJKoZIhvcNAQENBQAwwTENMASGA1UEChMESUVURjERMA8GA1UECxMITEFNUFMG
V0cxMTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2Vydg1maWNoZGlvdjBBdXRo
b3JpdHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDsxDALBgNV

BAoTBELFVEYxETAPBgNVBAsTCExBTVBTIFdHMRCwFQYDVQQDEw5BbGljZSBMb3Zl
bGFjZTCCASiWdQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBALTOiehY0BY+TZp/
T5K2KNI05Hwr+E3wP6XTvyi6WwyTgBK9LC0wI2juwdRrjFBSXkk7pwpjXwsA3A5G
0tz0FpfgyC70xsVcF7q4WHWZwleYXFKlQHJD73nQwXP968+A/3rBX7Ph00DBbZnf
it0LPgPEWjttdg0VQQ6Wz+CRQ/YbHPKaw7aRphZ063dKvIKp4cQVtkWQH6syTjG
sgkLcLNau5LZDQUdsGV+SAo3nBdWCRYV+I65x8Kf4hCxqqmjV3d/2NKRu0BXnDe/
N+iDz3X0zEoj0fqXgq4SWcC0nsG1lyyXt1TL270I6ATKRGJwiQVCCpDtc0NT6vdJ
45bCSzsCAwEAAa0BrzCBrDAMBgNVHRMBAf8EAJAAMBcGA1UdIAQQMA4wDAYKYIZI
AWUDAgEwATAeBgNVHREEFzAVgRNhbGljZUBzbWltZS5leGFtcGx1MBMGA1UdJQQM
MAoGCCsGAQUFBwMEMA4GA1UdDwEB/wQEAWIGwDAdBgNVHQ4EFgQUu/bMsi0dBhIc
l64papAQ0yBmZnMwHwYDVR0jBBgwFoAUKTC0fAcXDKfxCShlNhpnHGh29FkwDQYJ
KoZIhvcNAQENBQADggEBAH0JojanzqmgasN3/gqSQ4cbbmdj/R40BEPr+gXT+xi
dfZ2iLNwYyTneuK6AchwkFnNv0Fb81V1iffRFT/KtmVEDMR/sYeqAH83KM5p3e12
lVh40HhyI0qNuz5oShNaACSioQ23WxHGvY9vsvdfnbhsp1rwg9NQ2WbpCmK+2oMh
2oYl0Z/wvXmt9cG6jbmVcdH4z0I0vg6mrYkKTM/RCGnumghxwYToj10yD5Gs4D2I
JCw+fx50Dxh52MbNRYXTus2ZPRPM8JXNQc4Gwv4km3M4rKnJDD6hnoQ9rNeozIcB
VyybQYjfrgg4DRvw9Ksk220H4ConlB8f7R7s1LM2cSYxggIAMIIB/AIBATBsMFUX
DTALBgNVBAoTBELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTewLwYDVQQDEyhTYW1w
bGUgTEFNUFMgU1NBIENlcnRpZmljYXRpb24gQXV0aG9yaXR5AhM3QQV57XV/Qqmi
XDr0+Gr0mqnXMASGCWGSaFlAwQCAaBpMBGGSqGSiB3DQEJAzELBgkqhkiG9w0B
BwEwHAYJKoZIhvcNAQkFMQ8XDTIxMDIYMDE1MDQwMlowLwYJKoZIhvcNAQkEMSIE
IPno+5X5nFLPT0q5vegHgVP40V2/uzd4xPnLWkqhYIvMA0GCSqGSiB3DQEBAQUA
BIIBAKG7Nq53TFMHU6ciIcQ9Tqq987YPEVAIJJ23U+60DXrXSrrmcZCqd2ZTyhJn
f5Wc8vBoC9tzRBoQp10WMS3wyQQkkWYY+ovPyDqcEt3iixC0aVRWIZoDiq5SiWR8
lB9CUcsKueu0IG1xmdvCmI/wr0DKDEgISV0Z+d2cs/I+0S1FSNVosffsd4JhkTx
i2d5BMCfa0zaS96GPadv47p3oizmS09u2TIBCceD94k6iIhG0jl9rdeUmOunTKl
bOdz6Y1TlVrb+s+nYGQUt0WwGu10854oCYjWuTi2Twz1BI9NrrMM6XR+T8JAXIkX
xvKwJA1ETt2Nvp00qVR9izIeei00=

B.2.2. S/MIME signed-only multipart/signed over a simple message, Wrapped Message

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a text/plain message. It uses the Wrapped Message header protection scheme.

It has the following structure:

- └ multipart/signed 4562 bytes
 - └ message/rfc822 inline 672 bytes
 - └ text/plain 256 bytes
 - └ application/pkcs7-signature [smime.p7s] 3429 bytes

Its contents are:

MIME-Version: 1.0
Content-Type: multipart/signed;
 protocol="application/pkcs7-signature"; boundary="8a8";
 micalg="sha-256"
Subject: smime-multipart-wrapped
Message-ID: <smime-multipart-wrapped@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:05:02 -0500
User-Agent: Sample MUA Version 1.0

--8a8
MIME-Version: 1.0
Content-Type: message/rfc822; protected-headers="wrapped"
Content-Disposition: inline

MIME-Version: 1.0
Content-Type: text/plain; charset="utf-8"
Content-Transfer-Encoding: 7bit
Subject: smime-multipart-wrapped
Message-ID: <smime-multipart-wrapped@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:05:02 -0500
User-Agent: Sample MUA Version 1.0

This is the smime-multipart-wrapped message.

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a text/plain message. It uses the Wrapped Message header protection scheme.

--
Alice
alice@smime.example

--8a8
Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-signature; name="smime.p7s"

MIIJ4AYJKoZIhvcNAQcCoIIJ0TCCCc0CAQExDALBglghkgBZQMEEAgEwCwYJKoZI
hvcNAQcBoIIHpjCCA88wggK3oAMCAQICEw8tJb0ROZdKzkJU6HuPTQGirQwDQYJ
KoZIhvcNAQENBQAwwVTENMASGA1UEChMESUVURjERMA8GA1UECxMITEFNUFMgV0cx
MTAvBgNVBAMTKFNhbXBsZSBMQUU1QUYBSU0EgQ2VydGlmawNhdGlvbiBBdXRob3Jp
dHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDSxDTALBGNVBAoT
BE1FVEYxETAPBgNVBAsTCExBTkVBTIFdHMRcwFQYDVQQDEw5BbG1jZSBMb3Z1bGFj
ZTCCASIdQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAJqVKfLwLjj+gBUCfk
acKTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfID1B/wlbdmadXPmrsz
yidmbuZmOpB5voVQfiliYYy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0a

Gdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6l41koaZXC
N5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcrv9w43GG8FtpSX+Twz
B2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK
arUCAwEAAa0BrzCBrdAMBgNVHRMBAf8EAJAAMBcGA1UdIAQQMA4wDAYKYIZIAWUD
AgEwATAeBgNVHREEFzAVgRNhbG1jZUBzbwltZS5leGFtcGx1MBMGA1UdJQQMMAoG
CCsGAQUFBwMEMA4GA1UdDwEB/wQEAWIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCKvFAEj
80e0r83zdw8wHwYDVR0jBBgwFoAukTC0fAcXDKfxCSH1NhpnHGh29FkwDQYJKoZI
hvcNAQENBQADggEBAIFJeKCCsTKcFqQMPTryujRGzJdYA+R9eBAuDLsatbtk14F
zkgRy0g31/+Cw7H8e30iLrPIFlWN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMt
jH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpeYPLror2X4P5uXxaP0LIZR
zWmkw1RF7F0D7PFb5v94M5274XYxw2W4uKGD7QGnUZROsvSYkGiWdp1JhqXwfDz8
A0enITGXnoEkaFvVjicQh64P1hIeMorj36pgL19oWZD6YrzSWHUz1F00juyu0fQs
qm6hvrDTqNPHNZ015fOURza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV5
7XV/QqmiXDr0+Gr0mqnXMA0GCSqGSIb3DQEBDQUAMFUxDALBgNVBAoTBELFVEYX
ETAPBgNVBAStCEXBTBVTBIFdHMTEwLWYDVQQLDEYhTlYw1wbGUgTEFNUFMgU1NBIENl
cnRpZm1jYXRrb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoYDzIwNTIwOTI3
MDY1NDE4WjA7MQ0wCwYDVQKKEwRJRVRGMREwDwYDVQQLLEwhMQU1QUyBXRzEXMBUG
A1UEAxMQ0WxpY2UgTG92ZWxhY2UwgGEMa0GCSqGSIb3DQEBAQUAA4IBDwAwggEK
AoIBAQC09InowDgWPK2af0+StijSN0R8K/hN8D+l078oullsk4ASvSwjsCNo7sHU
a4xQU15J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+950MFz
/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2GxzYms02kaYWTut3
SryCqeHEFbZfKB4urMk4xrIJC3CzWruS2Q0FHbB1fkgKN5wXVgkWFfi0ucfCn+IQ
saqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H614KuElnAtJ7BtZcsl7dUy9u9C0gE
ykrivokFgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAX
BgNVHSAEEDAOMAawGCMCGSAFlAwIBMAEwHgYDVR0RBBCwFYETyWxpY2VAc21pbWUu
ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD
VR00BBYEFLv2zLiThQYSHJeuKwQqENMgZmZzMB8GA1UdIwQYMBaAFJEwjnHFwYn
8QkoZTYaZxxodvRZMA0GCSqGSIb3DQEBDQUAA4IBAQBziaI2p86poGkjD/4KkkOH
G25nY/0eNARD6/of0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZl
RAZef7GHqgB/Nyj0ad3pdpVYeDh4ciNkjbs+aEoTgAkoqEnt1sRx1cvb7HVX524
bKZa1oPTUN1m6QpivtqDIdqGJdGf8L1zLFXBuo2zL3HR+M9CDr40pq2JckzP0Qhp
7poIccGE6I9Tsg+RrOA9iCqsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz
0KypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEm
MYICADCCAFwCAQEwBDBVMQ0wCwYDVQKKEwRJRVRGMREwDwYDVQQLLEwhMQU1QUyBX
RzExMC8GA1UEAxMoU2FtcGx1IEExBTBVTBIFJTQSBDZXJ0awZpY2F0aw9uIEF1dGhv
cm10eQITN0EFee11f0Kpolw69Phqzppq1zALBglghkgBZQMEAgGgaTAYBgkqhkiG
9w0BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIb3DQEJBTEPFw0yMTAyMjAxNTA1MDJa
MC8GCSqGSIb3DQEJBDEiBCAL0MrQogvVsAh7w8dZ49veRaAFhTQ49VmGVz+1eTbz
tjANBgkqhkiG9w0BAQEFAASCAQA/IjhMNkM+NpI3wGfQyDC1EMkiUG5SQ88JC0zc
Xaz46K27ncQh+PW9TChvi9V9VR9EvKx7sh0dBnjhogrMTH3V1mZPgyL2HdsfLvXa
WHmHQmbTnsZH8+kq0LdOZG/zbQMGr3sSv992f6ShxZNdazwGSf5s7Hs6+an6yy24
VtJqhT5xHHvMFDLUVW4sXwRugWKohiw+cjZ16SQ5zP14KJBprIMWv8A/4sJv5aC2
ImraEATJ1gIse53X6XPd/+9BsX0rvbIvXRIbgMJBK8gIz6a072n/dvm1fHjdBXv
9t75zqN+0821RiUiSbBoaB3FP0s13prsZ4QRr3Yv7vpv/HoR

B.2.3. S/MIME signed-only signedData over a simple message, Injected Headers

This is a signed-only S/MIME message via PKCS#7 signedData. The payload is a text/plain message. It uses the Injected Headers header protection scheme.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 4234 bytes
  ↓ (unwraps to)
  └─ text/plain 239 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
 smime-type="signed-data"
Subject: smime-one-part-injected
Message-ID: <smime-one-part-injected@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:06:02 -0500
User-Agent: Sample MUA Version 1.0

MIIMMgYJKoZIhvcNAQcCoIIMIZCCDB8CAQEExDTALBgIghkgBZQMEAgEwggJbBgkq
hkiG9w0BBWGgggJMBIICSE1JTUUtVmVyc2lvbjogMS4wDQpDb250ZW50LVRyYW5z
ZmVyLUVuY29kaw5nOia3Yml0DQpTdWJqZWN0OibZbWltZS1vbmUtcGFydC1pbmp1
Y3RlZA0KTWVzc2FnZS1JRDogPHNtaW1lLW9uZS1wYXJ0LWluamVjdGVkQGxocC5l
eGFtcGxlpG0KRnJvbTogQWxpY2UgPGFsaWNlQHNtaW1lLmV4YW1wbGU+DQpUbzog
Qm9iIDxib2JAc21pbWUuZXhhbXBsZT4NCrRhdGU6IFNhdCwgMjAgRmViIDlwMjEg
MTA6MDY6MDIglTA1MDANC1VzZXItQWdlbnQ6IFNhbXBsZSBNVUEgVmVyc2lvbiAx
LjANCknvbnRlbnQtVHlwZTogdGV4dC9wbGFpbjsyY2hhcnNldD0idXRmLTgiOyBw
cm90ZWN0ZWQtaGVhZGVyc20idjEidQoNClRoXMGaXMGdGh1IHntaW1lLW9uZS1w
YXJ0LWluamVjdGVkIG1lc3NhZ2UuDUQoNClRoXMGaXMGYSBzaWduZWQtb25seSBT
L01JTUUgWVzc2FnZSB2aWEgUeTduYm3IHNPZ25lZERhdGEuICBUaGUNCnBheWxv
YWQgaXMGYSB0ZXh0L3BsYWluIG1lc3NhZ2UuIEl0IHVzZXMGdGh1IEluamVjdGVk
IEh1YWRlcncmMh1YWRlc1Bwcm90ZWN0aW9uIHNTaW1lLW9uZS1wYXJ0LWluamVjdGVk
ZQ0KYWxpY2VAc21pbWUuZXhhbXBsZQ0KoIIPjCCA88wggK3oAMCAQICEw8tJb0R
OZDkzkJU6HuPTQgRiR0QWQYJKoZIhvcNAQENBQAwVTENMASGA1UEChMESUVURjER
MA8GA1UECxMITEFNUFNgV0cxMTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2Vy
dGlmawNhdGlvbiBBdXR0b3JpdHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5Mjcw
NjU0MTAmdsxDTALBgNVBAoTBE1FEYExETAPBgNVBAStCEExBTvBTIFdHMRcwFQYD
VQQDEw5BbG1jZSBMb3ZlbgFjZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoC
ggEBAJqVkfQlWALjj+gBUCfkackTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg
9r1mAfIDlB/wlbdmadXPmrszyidmbuZm0pB5voVQfiliYYy3i0x7Y0qzXr16udP07
k0sv+UdSNRfXrfKeoQEFXg0aGdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74
zFCWp2f1ZkuE4A6l41koaZXC5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY
9VfVfcrv9w43GG8FtpSX+TwzB2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r
8A4SSwIBaVv4wPxAf1iPsIVKarUCAwEAA0BrzCBrDAMBGNVHRMBAf8EAjAAMBcG
A1UdIAQQMA4wDAYKIZIAWUDAgEwATAeBgNVHREEFzAVgRNhbG1jZUBzbWltZS5l
eGFtcGx1MBMGA1UdJQQMMAoGCCsGAQUFBwMEMA4GA1UdDwEB/wQEAWIFIDAdBgNV
HQ4EFgQUo1NB1UQ8gCkVfAEj80e0r83zdW8wHwYDVR0jBBgwFoAUKTCOfAcXDKfx
CSh1NhpnhGH29FkwDQYJKoZIhvcNAQENBQADggEBAlFJeKcCsTKcFqQMpTryujRG
zJdYA+R9eBAuDLsatbtKt14FzkgRyOg31/+Cw7H8e30iLrPIF1WN1qjHrjgOyIs5
AQ/hgxLvLir3hEUVZ2Z3MRsMtjH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5U
zpEYPLror2X4P5uXxaP0LIZRzWmkw1RF7FOD7PFB5v94M5274XYxw2W4uKgd7QGn
UZROsvSYkGiWdp1JhqXwfdz8A0enITGXnoEkAFvVjicqH64P1hIeMorj36pgL19o
WZD6YrZSHWUz1F00juyuOfQsqm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgw
ggPPMIICt6ADAgECAhM3QQV57XV/QqmiXDr0+GrOmqnXMA0GCSqGSib3DQEBDQUA
MFUxDTALBgNVBAoTBE1FEYExETAPBgNVBAStCEExBTvBTIFdHMTewLwYDQQDEyhT
YW1wbGUgTEFNUFNgU1NB1ENlcnRpZm1lYXJ0LWluamVjdGVkIG1lc3NhZ2UuIEl0IHVz
MDA2NTQxOFoYDzIwNTIwOTI3MDY1NDE4WjA7MQ0wCwYDVQQKEWRJRVRGMREwDwYD
VQQLewhMQU1QUyBXRzEXMBUGA1UEAxMQ0WxpY2UgTG92ZWxhY2UwggEiMA0GCSqG

SIB3DQEBAQUAA4IBDwAwggEKAoIBAQC09InowDgWPK2af0+StijSNOR8K/hN8D+1078oullsk4ASvSwjsCNo7sHUa4xQU15J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFxFSpUByQ+950MFz/evPgP96wV+z4TtAwW2Z34rTiz4DXMI07XYNFUE0ls/gkUP2Gxzyms02kaYWTut3SryCqeHEFbZFKB4urMk4xrIJC3CzWruS2Q0FHbBlfkgn5wXVgkWFFi0ucfCn+IQsaqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H6l4KuElnAtJ7BtZcs17dUy9u9C0gEyKRiVokFQggQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAXBgNVHSAEEDA0MAwGCmCGSAFlAwIBMAEwHgYDVR0RBBCwFYETYWxpY2Vac21pbWUuZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBAwHQYDVR00BBYEFV2zLIThQYSHJeuKWqQENMgZmZzMB8GA1UdIwQYMBaAFJEwjnWHFwyn8QkoZTYaZxxodvRZMA0GCSqGSIb3DQEBDQUAA4IBAQBziaI2p86poGkjD/4Kkk0HG25nY/0eNARD6/oF0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZlRAZef7GHqgB/NyjOad3pdpVYeDh4ciNKjbs+aEoTWgAkoqEnt1sRxlcvb7HVX524bKZa1oPTUNlm6QpivtqDIdqGJdGf8L1zLfxBuo2zL3HR+M9CDr40pq2JCkzP0Qhp7poIccGE6I9Tsg+Rr0A9iCQsPn1+Tg8YedjGzUWF07rNmT0tZPCVzUAuBlr+JJtz0KypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJntjh+AqJ5QfH+0e7NSzNnEmMYICADCCAfwCAQEwbDBVMQ0wCwYDVQKKEwRJRVRGMREwDwYDVQQLLEwhMQU1QUyBXRzExMC8GA1UEAxMoU2FtcGx1IExBTVBTIFJTQSBDZXJ0awZpY2F0aw9uIEF1dGhvcml0eQITN0EFee11f0Kpolw69Phqzppp1zALBgIghkgBZQMEAgGgATAYBgkqhkiG9w0BCQMxCwYJKoZIhvcNAQcBMBwGCsGSIb3DQEJBTPEFw0yMTAyMjAxNTA2MDJhMC8GCSqGSIb3DQEJBDEiBCBwJ1HsKaiXvrMR26xS/wrb+5CS85FLWuHRuK85dkUFTANBkgkqhkiG9w0BAQEFAASCAQBE/g/trAYogNeF9oD6esBshX+oPQp8AhmTNr5mdEi+YCHauI04z94lPIGHwPGGI220cly1C68bMsjTHPLaumv6zhotJym50tJH1nD0c0xeqMSP+/htEgb/Ym0Ts1tGL5W6MRDE2Qpk+ZT+skuKKBt98a/VQGEmyIZSTJV9SmiapvYDb9BA+KpuFZ0Yd/vMtTjq1dRBzadE9byX010GDNMBiq0eDeVcfU2j/rb3UELfJqSpiTqEST/JIq1PvZHR+En2Z0PfMA7BKjTmsl/sczGLB0bDAJzt0OG7oU83zowcKn0JNse2cKU2eQMAENTuahfaXzVrmbfsw665Mrfom9Z/

B.2.4. S/MIME signed-only multipart/signed over a simple message, Injected Headers

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a text/plain message. It uses the Injected Headers header protection scheme.

It has the following structure:

- └ multipart/signed 4487 bytes
 - └ text/plain 258 bytes
 - └ application/pkcs7-signature [smime.p7s] 3429 bytes

Its contents are:

MIME-Version: 1.0
Content-Type: multipart/signed;
 protocol="application/pkcs7-signature"; boundary="f1e";
 micalg="sha-256"
Subject: smime-multipart-injected
Message-ID: <smime-multipart-injected@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:07:02 -0500
User-Agent: Sample MUA Version 1.0

--f1e

MIME-Version: 1.0
Content-Transfer-Encoding: 7bit
Subject: smime-multipart-injected
Message-ID: <smime-multipart-injected@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:07:02 -0500
User-Agent: Sample MUA Version 1.0
Content-Type: text/plain; charset="utf-8"; protected-headers="v1"

This is the smime-multipart-injected message.

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a text/plain message. It uses the Injected Headers header protection scheme.

--

Alice
alice@smime.example

--f1e

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-signature; name="smime.p7s"

MIIJ4AYJKoZIhvcNAQcCoIIJ0TCCc0CAQExDTALBgIghkgBZQMEAgEwCwYJKoZI
hvcNAQcBoIIHjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJUh6HuPTQGirQwDQYJ
KoZIhvcNAQENBQAwVTENMASGA1UEChMESUVURjERMA8GA1UECxMITEFNUFMgV0cx
MTAvBgNVBAMTKFNhbXBsZSBMQUU1QUYBSU0EgQ2VydGlmawNhdGlvbiBBdXRob3Jp
dHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDSxDTALBgNVBAoT
BELVEYxETAPBgNVBAsTCExBTvBTIFdHMRcwFQYDVQQDEw5BbG1jZSBMb3Z1bGFj
ZTCCASiWdQYJKoZIhvcNAQEBBQADgGEPADCCAQoCggEBAJqVKfqLwaLjj+gBUCfk
ackTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfIDlB/wlbdmadXPmrsz
yidmbuZmOpB5voVQfiliYYy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXgOa
Gdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6l41koaZXC
N5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcrv9w43GG8FtpSX+Twz
B2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK
arUCAwEAAoBrzCBrDAMBGNVHRMBAf8EAJAAMBcGA1UdIAQQMA4wDAYKYIZIAWUD

AgEwATAeBgNVHREEFzAVgRNhbG1jZUBzbWltZS5leGFtcGx1MBMGA1UdJQQMMAoG
CCsGAQUFBwMEMA4GA1UdDwEB/wQEAWIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj
80e0r83zdw8wHwYDVR0jBBgwFoAUKTC0fAcXDKfxCSH1NhpNHGh29FkwDQYJKoZI
hvcNAQENBQADggEBAIFJeKCcsTKcFqQMpTryujRGzJdYA+R9eBAuDLsatbtKt14F
zkgrY0g31/+Cw7H8e30iLrPIFLWN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMt
jH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpEYPLror2X4P5uXxaP0LIZR
zWmkw1RF7FOD7Pfb5v94M5274XYxw2W4uKGd7QGnUZROsvSYkGiWdp1JhqXwfdz8
A0enITGXnoEkAFvviCqh64P1hIeMorj36pgL19oWZD6YrzSWHUz1F00juyuoFQs
qm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV5
7XV/QqmiXDr0+GrOmqnXMA0GCSqGSIb3DQEBDQUAMFUxDTALBgnVBAoTBE1FVEYx
ETAPBgNVBAStCEXBTBVTIFdHMTEwLWYDVQDEYhTYW1wbGUgTEFNUFMgU1NBIEN1
cnRpZm1jYXRpb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoYDzIwNTIwOTI3
MDY1NDE4WjA7MQ0wCwYDVQKKEwRJRVRGMREwDwYDVQLEwhMQU1QUyBXRzEXMBUG
A1UEAxMOQWxpyY2UgTG92ZWxhY2UwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEK
AoIBAQC09InowDgWPK2af0+StijSN0R8K/hN8D+1078oullsk4ASvSwjsCNo7sHU
a4xQU15J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+950MFz
/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE01s/gkUP2GxzYms02kaYWTut3
SryCqeHEFBzFKB4urMk4xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWFfi0ucfCn+IQ
saqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H614KuElnAtJ7BtZcs17dUy9u9C0gE
yKriVokFgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAX
BgNVHSAEEDAOMAAGCmCGSAFlAwIBMAEwHgYDVR0RBBCwFYETYWxpyY2VAc21pbWUu
ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD
VR00BBYEF1v2zLiThQYSHJeuKwQqENMgZmZzMB8GA1UdIwQYMBaAFJewjnwHFwyn
8QkoZTYaZxxodvRZMA0GCSqGSIb3DQEBDQUAA4IBAQBziaI2p86poGkjD/4Kkk0H
G25nY/0eNARD6/oF0/sYonX2doizcGMk53riuGocCn5zbzhw/JVdYn30UxfyrZL
RAzEf7GHqgB/NyjOad3pdpVYeDh4ciNkjbs+aEoTWgAkoqEnt1sRx1cvb7HVX524
bKZa1oPTUN1m6QpivtqDIdqGJdGf8L1zLfxBuo2zL3HR+M9CDr40ppq2JckzP0Qhp
7poIccGE6I9Tsg+Rr0A9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJntjh+AqJ5QfH+0e7NsZnEm
MYICADCCAFwCAQEwBDBVMQ0wCwYDVQKKEwRJRVRGMREwDwYDVQLEwhMQU1QUyBX
RzExMC8GA1UEAxMoU2FtcGx1IEExBTBVTBVTIFJTSBDZlXJ0aWZpY2F0aW9uIEF1dGhv
cm10eQITN0EFee11f0Kpolw69Phqzppq1zALBglghkgBZQMEAgGgATAYBgkqhkiG
9w00BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIb3DQEJBTBTEPFw0yMTAyMjAxNTA3MDJa
MC8GCSqGSIb3DQEJBTBTEiBCA6Rhu8s2iPcywQk+TNKhP9ZHJ9+wu1WjsMpaF1NXCE
jDANBgkqhkiG9w00BAQEFAASCAQB4QMAYf42dnAelBRb2NotiixNgdjdSpVK75af6
oND3UjdCwcd4bPbrfTzMQKp0FBPoft91w2fwNgXwKbhd1cL3RWUmUq0zcNbI3XI
86vWp79p+KwM/+SyDdfgudIRGjbs/tmKaBvaH89a8SvuxhNxq/pxgDzpy/JWC8Er
AUDTbKrnVsYD+MfzMy9B0TlK2YLkoQ6rV0N1n2nXbw0e+Ztv0a/getNKAEAP+5hE
OQkq50RxUP9pI5kQ1NdU6zqCNhRjmd1wnMxn45K+hfy8cxwwemFn94PgDGpPG4mB
yRXQPj+5oyduWiHRMLXG1+fs4tqxHZXN+waUHvSIDqNXK3rj

--f1e--

B.2.5. S/MIME signed-only signedData over a complex message, Wrapped Message

This is a signed-only S/MIME message via PKCS#7 signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Wrapped Message header protection scheme.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 5737 bytes
  ↓ (unwraps to)
  └─ message/rfc822 inline 1689 bytes
    └─ multipart/mixed 1584 bytes
      └─ multipart/alternative 946 bytes
        ├── text/plain 282 bytes
        └── text/html 380 bytes
          └─ image/png inline 232 bytes
```

Its contents are:

QSBZXJ0awZpY2F0aw9uIEF1dGhvcml0eTAgFw0x0TExmJAwNjU0MThaGA8yMDUy
MDkyNzA2NTQx0Fow0zENMA8GA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cx
FzAVBgNVBAMTDkFsaWNlIExvdmVsYWNIIEIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8A
MIIBCgKCAQEAmPUp+ovBouOP6AFQJ+Rpw0DxxzY60n1lJ53pTeNSiJlWkwtw/cx
Qq0t4u2vWYB8gOUH/Cvt2Zp1c+auzPKJ2Zu5mY6kHm+hVB+IthjLeI7Htg6rNeu
Xq50/TuTSxX5R1I1EXGt8p6hAQVeA5oZ2afHg4b97enV8gozR0/Nkug4AkXmbk7T
HNc8vvjMUJanZ/VmS4TgDqXjWShplcI3lcvvBZMswt41/0HJvmSwqpS6oQcAx3We
ag0yCNj1V9V9yu/3DjcYbwW2lJf5NBmHbM1LY4X5chwFNEbkn6hQury/zxnlsukg
n+fHbqvWdhJLAgFpw/jA/EB/WI+whUpqtQIDAQAB04GvMIGsMAwGA1UdEwEB/wQC
MAAwFwYDVR0gBBAwDjAMBgpghkgBZQMCAATABMB4GA1UdEQQXMBWBE2FsaWNlQHNT
aw1lLmV4YW1wbGUwEwYDVR0lBAwwCgYIKwYBBQUHAWQwDgYDVR0PAQH/BAQDAgUg
MB0GA1UdDgQWBBSiU0HVRdyAKRV8ASPw546vzfn3DzAfBgNVHSMEGDAWgBSRMI58
BxcMp/EJKGU2GmccaHb0WTANBgkqhkiG9w0BAQ0FAAOCAQEAgUl4oJyxMpwWpAy1
0vK6NEbM1lgD5H14EC4Muxq1u0q2XgX0SBHI6DFX/4LDsfx7fSIus8gwVY3WqMeu
0A7IizkBD+GDEu8uKveERRXZncxGwy2MfbH1Ib3U8QzTjqB8+dz2AwYeMxODWq9o
pwtA/lT0Krg8uuivZfg/m5fFo/QshlHNaatDVEXsU4Ps98Hm/3gznbvhdjFbZbi4
oZ3tAadR1E5K9JiQaJYOnUmGpfb8PPwDR6chMZeegSQAw++0IKqHrg/wEh4yiuPf
qmAvX2hZkPpivNjYdTPUXTS07K459CyqbqG+sN0o2kc1nTXl85RHNrVKQK+L0YWY
1Q+hWDCCA88wggK3oAMCAQICEzdBBXntdX9CqaJcOvT4as6aqdcwDQYJKoZIhvcN
AQENBQAwwVTENMA8GA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cxMTAvBgNV
BAMTKFNhbXBsZSBMU1QUyBSU0EgQ2VydGlmawNhdGlvbiBBdXR0b3JpdHkwIBcN
MTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDsxDALBgNVBAoTBELFVEYx
ETAPBgNVBAsTCExBTVBTIFdHMRCwFQYDVQQDEw5BbGljZSBmb3Z1bGFjZTCCASIw
DQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBALTOiehYOBY+TZp/T5K2KNI05Hwr
+E3wP6XTvyi6wWytgBK9LC0wI2juwdrRjFBSXkk7pWpjXwsA3A5G0tz0Fpfgyc70
xsVcF7q4WHWZwleYXFKlQHJD73nQwXP968+A/3rBX7Ph00DBbZnfitOLPgPEwjTt
dg0VQq6Wz+CRQ/YbHPKaw7aRphZ063dKvIKp4cQvtkWQH16syTjGsgkLcLNau5LZ
DQUdsGV+SA03nBdWCRYV+I65x8Kf4hCxxqmqjV3d/2NKRu0BXnDe/N+iDz3X0zEoj
0fqXgq4SwwC0nsG1llyXt1TL270I6ATKRgJwiQVCCpDtc0NT6vdJ45bCSzsCAwEA
Aa0BrzCBrdAMBgNVHRMBAf8EAjAAMBcGA1UdIAQQMA4wDAYKYIZIAWUDAgEwATAe
BgNVHREEFzAVGRNhbGljZUBzbWltZS5leGFtcGxlMBMGA1UdJQQMMAoGCCsGAQUF
BwMEMA4GA1UdDwEB/wQEAWIGwDAdBgNVHQ4EFgQUu/bMsi0dBhIcl64papAQ0yBm
ZnMwHwYDVR0jBBgwFoAUKTC0fAcXDKfXcShlNhpnHGh29FkwDQYJKoZIhvcNAQEN
BQADggEBAH0JojanzqmgasN3/gqSQ4cbbmdj/R40BEPr+gXT+xiidfZ2iLNwYyTn
euK6AChwKfnNvOfb8lV1iffRtF/KtmVEDMR/sYeqAH83KM5p3e12lVh40HhyI0qN
uz5oShNaACSioQ23WxHGvy9vsdVfnbhsplrwg9NQ2WbpCmK+2oMh2oYl0Z/wvXmt
9cG6jbmVcdH4z0I0vg6mrYkKTM/RCGnumghxwYToj10yD5Gs4D2IJCw+fx50Dxh5
2MbNRYXTus2ZPRPM8JXNQc4Gwv4km3M4rKnJDd6hnoQ9rNeozIcBVyybQYjfrgg4
DRvw9Ksk220H4ConlB8f7R7s1LM2cSYxggIAMIIB/AIBATBSMFUXDTALBgNVBAoT
BELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTEwLWYDVQQDEyhTYW1wbGUgTEFNUFMg
UlNBIENlcnRpZmljYXRpb24gQXV0aG9yaXR5A5hM3QQV57XV/QqmiXDr0+GrOmqnX
MASGCWCGSAlAwQCAaBpMBGCSqGSIb3DQEJAZELBgkqhkiG9w0BBWewHAYJKoZI
hvcNAQkFMQ8XDTIxMDIyMDE3MDQwMlowLWYJKoZIhvcNAQkEMSIeICsRogMUJrtS
GAERSFiPMhqwk+9misiJV48XcSNJBKuj5MA0GCSqGSIb3DQEBAQUABIIBALJCpFEK
FQ+M1YQIuTcVEHr/K/w/8ht4p0y4BmEE+q3yZUBATHt37DxdZUXRZjUB52FdsWed
agkt3DjtFzJwRiDSteChrjrA/0jbfV0uV/9VBm0VGGfodRTovS+6wH+yJNAXHSW9
p1GXmPcDFatN5wr69zBNCX5mKU6bwcaVX41S7/fmcDlBNSQ45fx+RrXRhMX/vG2A
tgu01LuRSCvGgz719968R5D3obEtZwUi8uS0pv13XqThZC5Q4NMg68UNgNb//OT

Puaq1M0vhWhSkTNKjbtv2P/MifHWXj9TYHkRc9l5k707LqWj3yWNFR7tpV007n0+hTEzoJRFKuxJlQ4=

B.2.6. S/MIME signed-only multipart/signed over a complex message, Wrapped Message

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a multipart/alternative message with an inline image/png attachment. It uses the Wrapped Message header protection scheme.

It has the following structure:

```
└─ multipart/signed 5653 bytes
  └─ message/rfc822 inline 1747 bytes
    └─ multipart/mixed 1642 bytes
      └─ multipart/alternative 1002 bytes
        └─ text/plain 310 bytes
          └─ text/html 408 bytes
            └─ image/png inline 232 bytes
              └─ application/pkcs7-signature [smime.p7s] 3429 bytes
```

Its contents are:

MIME-Version: 1.0
Content-Type: multipart/signed;
 protocol="application/pkcs7-signature"; boundary="aa9";
 micalg="sha-256"
Subject: smime-multipart-complex-wrapped
Message-ID: <smime-multipart-complex-wrapped@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:05:02 -0500
User-Agent: Sample MUA Version 1.0

--aa9

MIME-Version: 1.0
Content-Type: message/rfc822; protected-headers="wrapped"
Content-Disposition: inline

MIME-Version: 1.0
Content-Type: multipart/mixed; boundary="a30"
Subject: smime-multipart-complex-wrapped
Message-ID: <smime-multipart-complex-wrapped@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:05:02 -0500
User-Agent: Sample MUA Version 1.0

--a30

MIME-Version: 1.0
Content-Type: multipart/alternative; boundary="844"

--844

Content-Type: text/plain; charset="us-ascii"
MIME-Version: 1.0
Content-Transfer-Encoding: 7bit

This is the smime-multipart-complex-wrapped message.

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a multipart/alternative message with an inline image/png attachment. It uses the Wrapped Message header protection scheme.

--

Alice
alice@smime.example

--844

Content-Type: text/html; charset="us-ascii"
MIME-Version: 1.0
Content-Transfer-Encoding: 7bit

```
<html><head><title></title></head><body>
<p>This is the <b>smime-multipart-complex-wrapped</b> message.</p>
<p>This is a signed-only S/MIME message via PKCS#7 detached
signature (multipart/signed). The payload is a
multipart/alternative message with an inline image/png
attachment. It uses the Wrapped Message header protection
scheme.</p>
<p><tt>-- <br/>Alice<br/>alice@smime.example</tt></p></body></html>
--844--
```

```
--a30
Content-Type: image/png
Content-Transfer-Encoding: base64
Content-Disposition: inline
```

```
iVBORw0KGgoAAAANSUHEUgAAABQAAAAUCAyAAACNiR0NAAAACe1EQVR42uVT0xbA
MAGs739nO3TpRw20dqpbfARQEj0ywiwYnCTkDKnbcLk66sq1T+zt9cidkE+6KwkZ
sgrzfcqVMpL2jo0447gYDpeArk+OnJHkIhAftPRicihAf5YJrw7vjv0ZWRWM/uli
vdPf1QZ2kDD9xppd8wAAAABJRu5ErkJggg==
```

```
--a30--
```

```
--aa9
Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-signature; name="smime.p7s"
```

```
MIIJ4AYJKoZIhvcNAQcCoIIJ0TCCCc0CAQExDTALBg1ghkgBZQMEAgEwCwYJKoZI
hvcNAQcBoIIHjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQGirQwDQYJ
KoZIhvcNAQENBQAwVTENMA5GA1UEChMESUVURjERMA8GA1UECxMITEFNUFmgV0cx
MTAvBgNVBAMTKFNhbXBzS291YyBSU0EgQ2Vydg1mawNhdG1vbiBBdXR0b3Jp
dHkwIBcNMTkxMTIwMDY1NDE4WHgPMjA1MjA1MjcwNjU0MTA0MDEsDTALBgNVBAoT
BELFVEYxETAPBgNVBAsTCEExBTBVTIFdHMRCwFQYDVQQDEw5BbG1jZSBMb3Z1bGZj
ZTCCASIdQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAJqVKfLwLj+gBUCfk
acKTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfID1B/w1bdmadXPmrsz
yidmbuZm0pB5voVQfiLYy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0a
Gdmnx40G/e3p1fIKM0dPzZLoAJF5m500xzXPL74zFCWp2f1ZkuE4A6141koaZXC
N5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcrv9w43GG8FtpSX+Twz
B2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK
arUCAwEAAa0BrzCBrdAMBGNVHRMBAf8EAJAAMBcGA1UdIAQQMA4wDAYKYZIAWUD
AgEwATAeBgNVHREEFzAVgRNhbG1jZUBzbWltZS51eGFtcGx1MBMGA1UdJQQMMAoG
CCsGAQUFBwMEMA4GA1UdDwEB/wQEAWIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj
80e0r83zdW8wHwYDVR0jBBGwFoAUKTC0fAcXDKfxCSH1NhpNHGh29FkwDQYJKoZI
hvcNAQENBQADggEBAIFJeKcCsTKcFqQMpTryujRGzJdYA+R9eBAuDLsatbtKt14F
zkgRy0g31/+Cw7H8e30iLrPIFlWN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMt
jH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpEYPLror2X4P5uXxaP0LIZR
zWmkw1RF7FOD7PFB5v94M5274XYxw2W4uKGd7QGnUZROsvSYkGiWdp1JhqXwfDz8
A0enITGXnoEkAFvviCqh64P1hIeMorj36pgL19oWZD6YrzSWHUz1F00juyufQs
qm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgwgppPMIICt6ADAgECAHM3QQV5
7XV/QqmiXDr0+GrOmqnXMA0GCSqGSIb3DQEBDQUAMFUxDTALBgNVBAoTBELFVEYx
```

ETAPBgNVBAsTCEXBTvBTIFdHMTEwLwYDVQDEyhTYW1wbGUgTEFNUFMgU1NBIENl
cnRpZm1jYXRpb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoYDzIwNTIwOTI3
MDY1NDE4WjA7MQ0wCwYDVQKQEWJRVRGMREwDwYDVQQLLEwhMQU1QUyBXRzEXMBUG
A1UEAxMQQWxpY2UgTG92ZWxhY2UwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEK
AoIBAQC09InowDgWPK2af0+StijSN0R8K/hN8D+l078oullsk4ASvSwjsCNo7sHU
a4xQUl5J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+950MFz
/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2Gxyzms02kaYWTut3
SryCqeHEFbZfkb4urMk4xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWFfi0ucfCn+IQ
saqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H6l4KuElnAtJ7BtZcs17dUy9u9C0gE
ykrivokFgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAX
BgNVHSAEEDAOMAAGCmCGSAFlAwIBMAEwHgYDVR0RBBCwFYETYWxpY2VAc21pbWUu
ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBSAwHQYD
VR00BBYEFLv2zLIthQYSHJeuKwQqENMgZmZzMB8GA1UdIwQYMBAAFJEwjnHFwyn
8QkoZTYaZxxodvRZMA0GCSqGSIb3DQEBDQUAA4IBAQBziaI2p86poGkjD/4Kkk0H
G25nY/0eNARD6/oF0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZl
RAZef7GHqgB/Nyj0ad3pdpVYeDh4ciNkjbs+aEoTWgAkoqEnt1sRxlcvb7HVX524
bkZa1oPTUNlm6QpivtqDIdqGJdGf8L1zLfxBuo2zL3HR+M9CDr40pp2JckzP0Qhp
7poIccGE6I9Tsg+Rr0A9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEm
MYICADCCAfwCAQEwbDBVMQ0wCwYDVQKQEWJRVRGMREwDwYDVQQLLEwhMQU1QUyBX
RzExMC8GA1UEAxMoU2FtcGx1IEExBTvBTIFJTQSBDZXJ0awZpY2F0aw9uIEF1dGhv
cm10eQITN0EFee11f0Kpolw69Phqzppq1zALBglghkgBZQMEAgGgaTAYBgkqhkiG
9w00BQCMxCwYJKoZIhvcNAQcBMBwGCSqGSIb3DQEJBTEPFw0yMTAyMjAxNzA1MDJa
MC8GCSqGSIb3DQEJBDEiBCDvCB0ZJKngosmsBz3B3if2ErlyiRyR1KnTpWbe6AN0
fzANBgkqhkiG9w00BAQEFAASCAQB6Xc+YUIEUCqF3vqlZTP41u/jEG330+bc5jw7D
VLUbKQ+AI6c6602LAGMwX17VuBdbgHecf59trY2F47Wr8NlcbTcAq0jN54tqrhri
8cL4YzS8YGH0vLrDdwilChjs0N1+t5nQ8Rya+rdGqseE0TK38P/K28cnU3udgTjb
6E/QcopIlnLaaji+x5qjRHq10Yt9tbA5F1L9vgqgu7Zf9w55tZie9cESnVZpud/1
+zqsKdfj4ndnMDFzrUtXztY2e1f/Y8EVjSIVtY+ZeYuIdtGhPpvk/N3koxZ1yL2Z
mrPQemZ0C2bIet7T1vv7lFCUtU0bdyHoHBvXI70hbCmGmak3

--aa9--

B.2.7. S/MIME signed-only signedData over a complex message, Injected Headers

This is a signed-only S/MIME message via PKCS#7 signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme.

It has the following structure:

```
└ application/pkcs7-mime [smime.p7m] 5700 bytes
  ↓ (unwraps to)
  └ multipart/mixed 1614 bytes
    └ multipart/alternative 950 bytes
      └ text/plain 293 bytes
        └ text/html 388 bytes
          └ image/png inline 236 bytes
```


Its contents are:

IBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDsxDTALBgNVBAoTBE1FVEYxETAPBgNVBAsTCExBTVBTIFdHMRCwFQYDVQQDEw5BbGljZSBMb3Z1bGFjZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAJqVKfqlWALjj+gBUCfkacKTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfID1B/wlbdmadXPmrszyidmbuZm0pB5voVqfiLYYy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEEXgOaGdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6141koaZXC5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMggjY9VfVfcrv9w43GG8FtpSX+TWzB2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVKarUCAwEAAa0BrzCBrdAMBgNVHRMBAf8EAjAAMBcGA1UdIAQQMA4wDAYKYIZIAWUDAgEwATAeBgNVHREEFzAVgRNhbGljZUBzbWltZS5leGFtcGxlMBMGA1UdJQQMMAoGCCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj80e0r83zdw8wHwYDVR0jBBgwFoAUKTCOfAcXDKfxCSh1NhpnHGh29FkwDQYJKoZIhvcNAQENBQADggEBAlFJeKcCsTKcFqQMpTryujRGzJdYA+R9eBAuDLsatbtKt14FzkgRy0g31/+Cw7H8e30iLrPIFlWN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMtjH2x9SG91PEM046gfPnc9gMGHjMtG1qvaKcLQP5UzpeYPLror2X4P5uXxaP0LIZRzWmkw1RF7FOD7Pfb5v94M5274XYxw2W4uKgd7QGNUZROsvSYkGiWdp1JhqXwfDz8A0enITGXnoEkaFvVjicqH64P1hIeMorj36pgL19owZD6YrzSWHUz1F00juyufQsqm6hvrDTqNpHNZ015f0URza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV57XV/QqmiXDr0+GrOmqnXMA0GCSqGSib3DQEBDQUAMFUxDTALBgNVBAoTBE1FVEYxETAPBgNVBAsTCExBTVBTIFdHMTEwLWYDVQQDEYhTYW1wbGUgTEFNUFMgU1NBIEIcnRpmZmljYXRpb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOjY0ZDZlWNTIwOTI3MDY1NDE4WjA7MQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLEWhMQU1QUyBXRzEXMBUGA1UEAxMOQWxpY2UgTG92ZWxhY2UwggEiMA0GCSqGSib3DQEBAQUAA4IBDwAwggEKAoIBAQc09InowDgWpk2af0+StijSN0R8K/hN8D+1078oullsk4ASvSwjScNo7sHUa4xQU15J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFvSpUBYQ+950MFz/evPgp96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE01s/gkUP2GxzYms02kaYWTut3SryCqeHEFbZfKb4urMk4xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWFfi0ucfCn+IQsaqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H614KuElnAtJ7BtZcs17dUy9u9C0gEyKriVokFQgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAXBgNVHSAEEDA0MAwGCmCGSAFlAwIBMAEwHgYDVR0RBBCwFYETyWxpY2VAc21pbWUuZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYDVR00BBYEFLv2zLItHQYSHJeuKWqQENMgZmZzMB8GA1UdIwQYMBaAFJEwjnwHFwYn8QkoZTYaZxxodvRZMA0GCSqGSib3DQEBDQUAA4IBAQBziaI2p86poGkjD/4KkkOHG25nY/0eNARD6/of0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZlRAZef7GHqgB/Nyj0ad3pdpVYeDh4ciNkjbs+aEoTWgAkoqEnt1sRx1cvb7HVX524bKZa1oPTUNlm6QpivtqDIdqGJdGf8L1zLfxBuo2zL3HR+M9CDr40pq2JckzP0Qhp7poIccGE6I9Tsg+Rr0A9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz0KypYQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEmMYICADCCafwCAQEwbDBVMQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLEWhMQU1QUyBXRzEXMC8GA1UEAxMoU2FtcGx1IExBTVBTIFJTSBDZlJ0awZpY2F0aw9uIEF1dGhvcml0eQITN0EFee11f0Kp0lw69Phqzppq1zALBg1ghkgBZQMEAgGgaTAYBgkqhkiG9w00BQCMxwYJKoZIhvcNAQcBMBwGCSqGSib3DQEJBTEPFw0yMTAyMjAxNzA2MDJhMC8GCSqGSib3DQEJBDEiBCC84gf/+no5va6ErXhHIk1xELMQNWg9BUh8E1M78W5u5TANBgkqhkiG9w00BAQEFAASCAQB+q8buLwucKfPrBoXxKP7ZaJ/ifg8Y4Axf84AhNJXC+NwzThUSgq12Fn9cdSV0858oDrWDSndd/zwgab0TgQZ+64atwiQ7bVTDkG8qgeT+I/R1I8jGOCUTpkKcK34t0Ybmhkc7/2BLITc3q0AxuN+lrswVL2NF8LFGH9RbfzRuWFVqAMyFAo9DRr1PeFD0DqnjAgTi37M8/wvftXixx0AevVmFUwbpnFiwvSwdrt0CKquQ1NYbFAvx0awxLU0jFqhIgw10+fU4jqQDUKUVSKFiw1/dK+7jLZC6sCXf3YsoHRhxqY/bSsgXn1DUWSDjhae3Hn1ZuoVXLJDHGCD6oSR

B.2.8. S/MIME signed-only multipart/signed over a complex message, Injected Headers

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme.

It has the following structure:

```
└─ multipart/signed 5580 bytes
  └─ multipart/mixed 1672 bytes
    └─ multipart/alternative 1006 bytes
      └─ text/plain 312 bytes
      └─ text/html 410 bytes
      └─ image/png inline 232 bytes
      └─ application/pkcs7-signature [smime.p7s] 3429 bytes
```

Its contents are:

MIME-Version: 1.0
Content-Type: multipart/signed;
 protocol="application/pkcs7-signature"; boundary="f91";
 micalg="sha-256"
Subject: smime-multipart-complex-injected
Message-ID: <smime-multipart-complex-injected@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:07:02 -0500
User-Agent: Sample MUA Version 1.0

--f91

MIME-Version: 1.0
Subject: smime-multipart-complex-injected
Message-ID: <smime-multipart-complex-injected@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:07:02 -0500
User-Agent: Sample MUA Version 1.0
Content-Type: multipart/mixed; boundary="099"; protected-headers="v1"

--099

MIME-Version: 1.0
Content-Type: multipart/alternative; boundary="9a5"

--9a5

Content-Type: text/plain; charset="us-ascii"
MIME-Version: 1.0
Content-Transfer-Encoding: 7bit

This is the smime-multipart-complex-injected message.

This is a signed-only S/MIME message via PKCS#7 detached signature (multipart/signed). The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme.

--

Alice
alice@smime.example
--9a5
Content-Type: text/html; charset="us-ascii"
MIME-Version: 1.0
Content-Transfer-Encoding: 7bit

```
<html><head><title></title></head><body>  
<p>This is the <b>smime-multipart-complex-injected</b> message.</p>  
<p>This is a signed-only S/MIME message via PKCS#7 detached
```

signature (multipart/signed). The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme.</p><p><tt>--
Alice
alice@smime.example</tt></p></body></html>--9a5--

--099
Content-Type: image/png
Content-Transfer-Encoding: base64
Content-Disposition: inline

iVBORw0KGgoAAAANSUHEUgAAABQAAAAUCAyAAACNiR0NAAAACe1EQVR42uVTOxBA
MAGS739n03TpRw20dqpbfARQEj0ywiwYnCtkDKnbcLk66sqlT+zt9cidkE+6KwkZ
sgrzfcqVMpL2jo0447gYDpeArk+OnJHkIhAfTPRicihAf5YJrw7vjv0ZWRWM/uli
vdPf1QZ2kDD9xppd8wAAAABJRu5ErkJggg==

--099--

--f91
Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-signature; name="smime.p7s"

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hvcNAQcBoIIHjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQGirQwDQYJ
KoZIhvcNAQENBQAwVTENMA5GA1UEChMESUVURjERMA8GA1UECxMITEFNUFMgV0cx
MTAvBgNVBAMTKFNhbXBsZSBMU1QUyBSU0EgQ2VydGlmawNhdGlvbiBBdXR0b3Jp
dHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDSxDTALBgNVBAoT
BELFVEYxETAPBgNVBAsTCExBTVBTIFdHMrcwFQYDVQDEw5BbG1jZSBMb3Z1bGFj
ZTCCASiWdQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAJqVKfqLwaLjj+gBUCfk
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bKZa1oPTUNlm6QpivtqDIIdqGJdGf8L1zLFXBuo2zL3HR+M9CDr40pq2JckzP0Qhp
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9w0BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIB3DQEJBTEPFw0yMTAyMjAxNzA3MDJa
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--f91--

B.3. Encrypted-and-signed Messages

These messages are encrypted and signed. They use PKCS#7 signedData inside envelopedData, with different header protection schemes and different Header Confidentiality Policies.

B.3.1. S/MIME encrypted and signed over a simple message, Wrapped Message with hcp_minimal

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Wrapped Message header protection scheme with the hcp_minimal Header Confidentiality Policy.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 7540 bytes
  ↳ (decrypts to)
    └─ application/pkcs7-mime [smime.p7m] 4580 bytes
      ↳ (unwraps to)
        └─ message/rfc822 inline 783 bytes
          └─ text/plain 321 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <smime-enc-signed-wrapped-minimal@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:08:02 -0500
User-Agent: Sample MUA Version 1.0

MIIVvAYJKoZIhvcNAQcDoIIIVrTCCFakCAQAxggMQMIIBhAIBADBsmFUxDTALBgNV
BAoTBELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTEwLWYDVQQDEYhTYW1wbGUgTEFN
UFMgU1NBIENlcnRpZm1jYXRpb24gQXV0aG9yaXR5AhMPLSW9ETmXSs5CVIeh7j00
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z0jg0m/DYvPz5/AMk8Z/jRF8PQEffb0Jcfe40ksKQyja8lNlTJsQJslvYQdITz1f
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8sw3ecNwoFsCd9fucBGtmqPEiWr9nrIVj6I4mPd7tCXZQEhaN7sLz9hX6lTd9Ybg
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+iaVQ0+g9XDTVytovy4xr7302goBJcUK35kDlz/2E2CLEFBxEqu/PmYj0oSvpv3f
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L66GdRK9zc8G4dcr1tjaxAp6/LW+taetP04yRNhBlXAjd10/6ldyaEkyLRk23dWN
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a1zNXHzltqSPV5202s2DPGkjQy9ZCIjX85WRW6KZ1e6aT9TXE3jzDJdtsAnp/jf7
0S0DZMAx0hh7ELKqrG0xP92IYh1sf+0hpubGIjuBAPo8L0JaQ0SmSWKUwfF8XrzX
HCzu+MtnQ+6Lf7ctJ15XQJNEspEwshPFpXGL2IRFd1/EgvIk750C4JQ1kW3D1/s
R93ikylnwBWF7PDqWREq9Buo53ENUx/lBdsXxJ/AxF5hz8tFe5QnK5fZ+iYHbhPV

B.3.2. S/MIME encrypted and signed over a simple message, Injected Headers with hcp_minimal

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Injected Headers header protection scheme with the hcp_minimal Header Confidentiality Policy.

It has the following structure:

- └ application/pkcs7-mime [smime.p7m] 7435 bytes
 - ┆ (decrypts to)
 - └ application/pkcs7-mime [smime.p7m] 4498 bytes
 - ┆ (unwraps to)
 - └ text/plain 333 bytes

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <smime-enc-signed-injected-minimal@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:09:02 -0500
User-Agent: Sample MUA Version 1.0

MIIVbAYJKoZIhvcNAQcDoIIIVXTCCFVvCAQAxggMQMIIBhAIBADBsmFUxDTALBgNV
BAoTBELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTEwLWYDVQQDEYhTYW1wbGUgTEFN
UFMgU1NBIENlcnRpZm1jYXRpb24gQXV0aG9yaXR5AhMPLSW9ETmXSs5CVIeh7j00
Boq0MA0GCSqGSIb3DQEBAQUABIIBAE4jHFjgvcL+vJbAAHC/TgYKD0lhFKLlWZh
gSxqq1gj4wiewoJudnfk5t9F091LxUqqrqFC0oR7MTdQMjhgmcSB9G8ncJoWns0
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VTENMASGA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cxMTAvBgNVBAMTKFNh
bXBsZSBMQU1QUyBSU0EgQ2VydG1maWNhdG1vbiBBdXR0b3JpdHkCEzB8R0APhiY6
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+vBLwEHtHYgB0eZRdIeQwA==

B.3.3. S/MIME encrypted and signed over a simple message, Injected Headers with hcp_minimal (+ Legacy Display)

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Injected Headers header protection scheme with the hcp_minimal Header Confidentiality Policy with a "Legacy Display" part.

It has the following structure:

- └ application/pkcs7-mime [smime.p7m] 7670 bytes
- ┆ (decrypts to)
- └ application/pkcs7-mime [smime.p7m] 4674 bytes
- ┆ (unwraps to)
- └ text/plain 423 bytes

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID:
<smime-enc-signed-injected-minimal-legacy@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:10:02 -0500
User-Agent: Sample MUA Version 1.0

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B.3.4. S/MIME encrypted and signed over a simple message, Wrapped Message with hcp_strong

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Wrapped Message header protection scheme with the hcp_strong Header Confidentiality Policy.

It has the following structure:

```
└ application/pkcs7-mime [smime.p7m] 7735 bytes
  ↓ (decrypts to)
  └ application/pkcs7-mime [smime.p7m] 4712 bytes
    ↓ (unwraps to)
    └ message/rfc822 inline 878 bytes
      └ text/plain 319 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <73a42f8e-8f5a-5c62-b982-82ace766fd32@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:11:02 -0500

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B.3.5. S/MIME encrypted and signed over a simple message, Injected Headers with hcp_strong

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Injected Headers header protection scheme with the hcp_strong Header Confidentiality Policy.

It has the following structure:

- └ application/pkcs7-mime [smime.p7m] 7605 bytes
 - ┆ (decrypts to)
 - └ application/pkcs7-mime [smime.p7m] 4630 bytes
 - ┆ (unwraps to)
 - └ text/plain 331 bytes

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <27139e00-e05f-581d-a339-d2bd43bd0f42@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:12:02 -0500

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v1jG18AQn3MgDjK1gz2EoRfPv/lDputJj9AE/6HNJIJ+EA53GttHHmTITkaMpfR
RPRihuaXChirqsUj1o0/7/xSch/N3YZqpfQjqsxVIUtY0aVvWXRRlKkZUByuc5dg
rZ0xjkkZaZKEfvwfffsIl/bjUeR0kAPPRrRDN90k0uRSa6jMqwEp2rUtqbJLiNrE
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2gqq5FU4XpaCtcP6u8/dDRkdXyhXy828ccNWJ376U3MGp0f2yv69hQxHZPoHH2Yf
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lmLZUewYYGrqFER375gyRnCGPDAircopx0XiEh5ZGox3m17/QdkHXvV8kx55NLGz
dNVerNDadBm/10IBkWpeQ2CMnuJHsIGDlFYtC6N4k9cBBIHfh8dItE6BYuDCzcas

B.3.6. S/MIME encrypted and signed over a simple message, Injected Headers with hcp_strong (+ Legacy Display)

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Injected Headers header protection scheme with the hcp_strong Header Confidentiality Policy with a "Legacy Display" part.

It has the following structure:

- └ application/pkcs7-mime [smime.p7m] 7845 bytes
 - ┆ (decrypts to)
 - └ application/pkcs7-mime [smime.p7m] 4806 bytes
 - ┆ (unwraps to)
 - └ text/plain 420 bytes

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <fdccb76a-49ed-50c5-9030-e4aeb83d7f04@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:13:02 -0500

MIIWnAYJKoZIhvcNAQcDoIIWjTCCFokCAQAxggMQMIIBhAIBADBsmFUxDALBgNV
BAoTBELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTEwLWYDVQQDEyhTYW1wbGUgTEFN
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v53RWDv4IhiylEv0KDaVOKDVJ80p0Ic0I7SCiZDcn5c=

B.3.7. S/MIME encrypted and signed reply over a simple message, Wrapped Message with hcp_minimal

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Wrapped Message header protection scheme with the hcp_minimal Header Confidentiality Policy.

It has the following structure:

- └ application/pkcs7-mime [smime.p7m] 7800 bytes
 - ┆ (decrypts to)
 - └ application/pkcs7-mime [smime.p7m] 4770 bytes
 - ┆ (unwraps to)
 - └ message/rfc822 inline 920 bytes
 - └ text/plain 327 bytes

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <smime-enc-signed-wrapped-minimal-reply@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:14:02 -0500
User-Agent: Sample MUA Version 1.0
In-Reply-To: <smime-enc-signed-wrapped-minimal@lhp.example>
References: <smime-enc-signed-wrapped-minimal@lhp.example>

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B.3.8. S/MIME encrypted and signed reply over a simple message, Injected Headers with hcp_minimal

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Injected Headers header protection scheme with the hcp_minimal Header Confidentiality Policy.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 7695 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 4692 bytes
    ↓ (unwraps to)
    └─ text/plain 339 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID:
<smime-enc-signed-injected-minimal-reply@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:15:02 -0500
User-Agent: Sample MUA Version 1.0
In-Reply-To: <smime-enc-signed-injected-minimal@lhp.example>
References: <smime-enc-signed-injected-minimal@lhp.example>

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B.3.9. S/MIME encrypted and signed reply over a simple message, Injected Headers with hcp_minimal (+ Legacy Display)

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Injected Headers header protection scheme with the hcp_minimal Header Confidentiality Policy with a "Legacy Display" part.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 7975 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 4898 bytes
    ↓ (unwraps to)
    └─ text/plain 435 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID:

<smime-enc-signed-injected-minimal-legacy-reply@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:16:02 -0500
User-Agent: Sample MUA Version 1.0
In-Reply-To:

<smime-enc-signed-injected-minimal-legacy@lhp.example>
References:
<smime-enc-signed-injected-minimal-legacy@lhp.example>

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B.3.10. S/MIME encrypted and signed reply over a simple message, Wrapped Message with hcp_strong

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Wrapped Message header protection scheme with the hcp_strong Header Confidentiality Policy.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 8020 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 4930 bytes
    ↓ (unwraps to)
    └─ message/rfc822 inline 1038 bytes
      └─ text/plain 325 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <0e210732-9184-5855-9a95-2a635560d3a6@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:17:02 -0500

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M7F30MyDGT440BAHTEbPBhG0B5gZ0j0mIyoBhoxPi/257AfLXXY72bZKm0swqmok
PwMhH4J9/MfLnJ9uDN03dIgcJ1k0kCx8XF/BSs4Fda2mfwmauTMRtk3BBoqfIYkB
eAW2DADrliZEKL+SsapvFsN+9HmnVICsIB6gk0tZLCKyVwkIThwidhNBkNqj93EW
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P+4DPjHkptGetlTf4t4cQe05ZQesVrt3Bis3nmKpVPV6jv22EumjmsEbRESsiddQ
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I62JN4S2vyMPuKIwXsUXoraWwIg67iK4rmK8Phi02I6bfb1GayDw924X+xTUw9d/
nW09+xuSQHZIk2ykPb4cjvPKxv5Zlzmfi+b5WmdTF32SKR0tPci8hcYsBgrfTv3+
UME/HraCoC0eHV3mzRff0puWyEu3v5Vrbip7Nz8QbYGkm2JRdfIip4ZD4ZBUizJY
qyAJHhkpx0rdGanzV8kkfjdEAF3Ji6+RKNgrGHcKq6gyE6G1797Vzof7MgzJy6en
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Dy2R1536+eeRmguF0XC1G9wd82w/0adV2yWmo0MpxAB8Ase+iU1WYz7YtVwLKGye
LWfbtQqVSLfzQr+MWOMi1BT9+TPj+8EIqodap1PjmU8RLebZs0EcNaPv37djsIFn
SycK9UBlEai7T0/1Yr5h3f2/04XsLqtjGwq553nnnk56WpIc5Muo1SSljiz5OX5F
lpIdOuLXNQLG/+emf1GTbcsPta38GX5VAwe9kF3vVjswryw1SNPXyoOKAJVkBq/
C0nuJ05Lu+dbA+wkaMCEBw==

B.3.11. S/MIME encrypted and signed reply over a simple message, Injected Headers with hcp_strong

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Injected Headers header protection scheme with the hcp_strong Header Confidentiality Policy.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 7930 bytes
  ↳ (decrypts to)
    └─ application/pkcs7-mime [smime.p7m] 4856 bytes
      ↳ (unwraps to)
        └─ text/plain 337 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <0b3ea6dd-0e91-5a91-9bc0-3d553f892983@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:18:02 -0500

MIIW3AYJKoZIhvcNAQcDoIIwzTCCFskCAQAxggMQMIIBhAIBADBsmFUxDTALBgNV
BAoTBELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTEwLwYDVQQDEyhTYW1wbGUgTEFN
UFGU1NBIENlcncRZm1jYXRpb24gQXV0aG9yaXR5AhMPLSW9ETmXSs5CVIEh7j00
Boq0MA0GCSqSgSIb3DQEBAQUABIIBAJcdIoUSpo1n7vGpkIbII5F90QJDgjFBWqN8
mrP3eorKcd/HmE614/YrIqI4MD0rcJBkd6xNbUeBl2z3wU9w0tyThZKAXZH8XkNw
ZZu1aA3MRM+wqwCnxfJTSaZjkIMhsMe8U9R0Y7InwRXqH200QRqRU4iJpIe5/DUH
dn/70Yq05g0HOGjzWS+6IoQdiHf3eSU40AlqNyg0QQT5CP10M7aRXxt006GWvqLW
Lq52uimRL8AanDUkrEs0h1DggpFwsn/kTk0q9eBrjgNA8wHDA1BYfoLBHJQvn9yd
ivkXnsjIqoaBcx/61TLrP97dn2v4STbiZd3LDe/8yBCdn0v08qkwggGEAgEAMGww
VTENMASGA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cxMTAvBgNVBAMTKFNh
bXBsZSBMQU1QUyBSU0EgQ2VydG1maWNhdGlvbiBBdXR0b3JpdHkCEzB8R0APhiY6
HGLS64Mv1sDXhpQwDQYJKoZIhvcNAQEBBQAEEgEAZ09H8ZLL02dMDjR2ysuZrqi
j3KqVh8Rq7uzjB+IKkzFfun3FxFVZLUAiVw1Pwrt3lFx20ekpF4PzC7x9sdbxWJ4
ZJKftmD6sMz7DVeV5GABH3C10+aY1Mws10Lq82S1TBzwcJZpKf5srR0QCuxaQq76
47owb3Dd9Ecn03AIPeJDy05EMNGLRJFqc8md08ykQEJwHFXeZ0otDWDm3lBAmqn+
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X+vrFmPwm8EJUHPEx6I0V8ylyDXBt5qp1Jgku+51eH1BJtF7WMMVVI/1RSE+zCC
E64GCSqSgSIb3DQEHATAAdBg1ghkgBZQMEAAQIEEPmUUHGHIyJ8IXE0zUFiAKOAgH0A
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+2S/Lj6qM5B7Lk+B0qrJqhfquyUaNsmyvXfGbzcdjmaYt0LEpaZ+QtdPBjaZGdd
J1v5hErhQW9At52gt35iZP1kKMHmWfKc09VBQw0QHf9hv8p1t3ugvYpmln4fzKhe

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lUIeqHTqGxluMEL8yKs872P81rnPAYVZK50TW7ie7aLlXTD2TP0fx/pATDVyHLb
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Y2YFrtz9AXeuEwpvM/DOZgmYXIQeHv4VPv/CSped5JZMMQ2ZnXrG0ptqNgI78Tdi

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mWrqhx56HHzLIJ6RxW2ChEkZyMsjzYK9eXQ3duSAd7Ye12/dVQEKQVqmk06UdQJB
76kbQum/jgm0Ii2mHiFwChEW76kzfnIqzxd0Wu8nwQj20R9WH07KoiI+/T6ur4s6
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WDVDFDdjZUuIonv0rm1z9i9fsK0tsDYcS4TDkimaD0KrGctnxbxBzzUhEm8jN3W
qoVoAWCnE3TgIbo4Vw1gkFMP37obVrw9ocSMk1X3+Lrp1B+Rod2Ps1n6LbuyFXr5
lZsfJr6eT1DFQ3JBIhm47uGURZRKAucCK63kh3Y1zjLlL4mVDrARMnHYZw+2hIA
lFpuTp7Cu9DNSASMTIykm0UGNU1Xs0GRPo1HkmfXFLCHb8G9N9SAwGggAT4yg0n4
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3RWW2cmL1ew4DzG4auZ0OpAPxk0kPq9g0j6Nj1PbAz3g67v820bv/Y0zLwxa69jU
MofBs5itg8XQf23gUVN8tC2zbJL8letTIKKnKGvxe1QHM96R83PxT4gUjfnKR63rs
cyrtlqfU2+PKa4SBYfb9NgaS/v4h2R95j6JGGtSW1Ua9rp3aFLVf1fACHiMz9EJP
pbPFxUnT5Gwx0RbP5Y0vVU8RFgR0ArKRZhn1Mmyk9vRaJSrT+6K1c3igKdpDvcZJ
AF8NHDUL65szSSwVc0b50w1wBfAIW5MgI55uqDrhTleip4lbbWNwxcd3a6yba9qv
lu0ZAD6E+drFKgZu5B86BRnvcCYGaK90WaHA72ptEQcSKbAAe90x3Ij5C15aCr1m
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9Ve8V2DvgTdgLrc3SHZn1BgtWwISf1jLRx3IWmB6kIRTkoqUND+Mh/bgb1fnKy4o
OTPmg2hFLvY64mJEnWC5ATZUX8IN71dsKa18CyDCVWjaq99H+DMbBB+Dwk15nbke
ZPwTyUM7CiHILnpoMBu5Xc9H/2EtLSesnZ90tNbyQH1eCU/OaBM/5iveZWE3VCnT
7VRke7s3JYbcBAkWM01oRGj/s0HrPFR6ju7LHjZvWIjeZap1Zf4ldJpTyC6yRcs9
DjJIu9BUU1QE/t4uLOCPsCLlcmTzXtZpD+jV7+9wH8s+LZ0AE1GH+3FZyL9p3UA7

B.3.12. S/MIME encrypted and signed reply over a simple message, Injected Headers with hcp_strong (+ Legacy Display)

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a text/plain message. It uses the Injected Headers header protection scheme with the hcp_strong Header Confidentiality Policy with a "Legacy Display" part.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 8190 bytes
  ↳ (decrypts to)
    └─ application/pkcs7-mime [smime.p7m] 5058 bytes
      ↳ (unwraps to)
        └─ text/plain 432 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <b10dcc75-cf43-5fd7-9e48-f932a9d68fb5@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 10:19:02 -0500

MIIIXnAYJKoZIhvcNAQcDoIIXjTCCF4kCAQAxggMQMIIBhAIBADBsmFUXDTALBgNV
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Boq0MA0GCSqSIB3DQEBAQUABIIBACIQq5gYVgJxS7N/umioYQqABDzYuvtrP0wn
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B.3.13. S/MIME encrypted and signed over a complex message, wrapped Message with hcp_minimal

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Wrapped Message header protection scheme with the hcp_minimal Header Confidentiality Policy.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 9665 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6148 bytes
    ↓ (unwraps to)
    └─ message/rfc822 inline 1923 bytes
      └─ multipart/mixed 1818 bytes
        └─ multipart/alternative 1132 bytes
          └─ text/plain 375 bytes
            └─ text/html 473 bytes
              └─ image/png inline 232 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID:
<smime-enc-signed-complex-wrapped-minimal@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:08:02 -0500
User-Agent: Sample MUA Version 1.0

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B.3.14. S/MIME encrypted and signed over a complex message, Injected Headers with hcp_minimal

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme with the hcp_minimal Header Confidentiality Policy.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 9620 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6114 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 1848 bytes
      └─ multipart/alternative 1136 bytes
        ├── text/plain 387 bytes
        ├── text/html 482 bytes
        └─ image/png inline 236 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID:
<smime-enc-signed-complex-injected-minimal@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:09:02 -0500
User-Agent: Sample MUA Version 1.0

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B.3.15. S/MIME encrypted and signed over a complex message, Injected Headers with hcp_minimal (+ Legacy Display)

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme with the hcp_minimal Header Confidentiality Policy with a "Legacy Display" part.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 10205 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6548 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 2157 bytes
      └─ multipart/alternative 1431 bytes
        └─ text/plain 485 bytes
          └─ text/html 637 bytes
            └─ image/png inline 236 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID:
<smime-enc-signed-complex-injected-minimal-legacy@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:10:02 -0500
User-Agent: Sample MUA Version 1.0

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B.3.16. S/MIME encrypted and signed over a complex message, Wrapped Message with hcp_strong

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Wrapped Message header protection scheme with the hcp_strong Header Confidentiality Policy.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 9840 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6276 bytes
    ↓ (unwraps to)
    └─ message/rfc822 inline 2016 bytes
      └─ multipart/mixed 1911 bytes
        ├── multipart/alternative 1128 bytes
        │   ├── text/plain 373 bytes
        │   └── text/html 471 bytes
        └─ image/png inline 232 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <95b9bb39-c028-5ff4-99b1-f179cb5d7585@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:11:02 -0500

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B.3.17. S/MIME encrypted and signed over a complex message, Injected Headers with hcp_strong

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme with the hcp_strong Header Confidentiality Policy.

It has the following structure:

- └ application/pkcs7-mime [smime.p7m] 9795 bytes
 - ┆ (decrypts to)
 - └ application/pkcs7-mime [smime.p7m] 6246 bytes
 - ┆ (unwraps to)
 - └ multipart/mixed 1941 bytes
 - ┆ multipart/alternative 1132 bytes
 - ┆┆ text/plain 385 bytes
 - ┆┆ text/html 480 bytes
 - ┆┆ image/png inline 236 bytes

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <23abef5f-8781-5c95-a46c-61e3a4464d58@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:12:02 -0500

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B.3.18. S/MIME encrypted and signed over a complex message, Injected Headers with hcp_strong (+ Legacy Display)

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme with the hcp_strong Header Confidentiality Policy with a "Legacy Display" part.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 10380 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6676 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 2248 bytes
      └─ multipart/alternative 1425 bytes
        ├── text/plain 482 bytes
        ├── text/html 634 bytes
        └─ image/png inline 236 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <9cfcaae2-9fec-5aca-9a29-c98da35b262d@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:13:02 -0500

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B.3.19. S/MIME encrypted and signed reply over a complex message, Wrapped Message with hcp_minimal

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Wrapped Message header protection scheme with the hcp_minimal Header Confidentiality Policy.

It has the following structure:

```
└ application/pkcs7-mime [smime.p7m] 9970 bytes
  ↓ (decrypts to)
  └ application/pkcs7-mime [smime.p7m] 6366 bytes
    ↓ (unwraps to)
    └ message/rfc822 inline 2082 bytes
      └ multipart/mixed 1977 bytes
        └ multipart/alternative 1144 bytes
          └ text/plain 381 bytes
            └ text/html 479 bytes
              └ image/png inline 232 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID:

<smime-enc-signed-complex-wrapped-minimal-reply@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:14:02 -0500
User-Agent: Sample MUA Version 1.0
In-Reply-To:

<smime-enc-signed-complex-wrapped-minimal@lhp.example>
References:
<smime-enc-signed-complex-wrapped-minimal@lhp.example>

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B.3.20. S/MIME encrypted and signed reply over a complex message, Injected Headers with hcp_minimal

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme with the hcp_minimal Header Confidentiality Policy.

It has the following structure:

```
└ application/pkcs7-mime [smime.p7m] 9925 bytes
  ↓ (decrypts to)
  └ application/pkcs7-mime [smime.p7m] 6342 bytes
    ↓ (unwraps to)
    └ multipart/mixed 2009 bytes
      └ multipart/alternative 1148 bytes
        ├── text/plain 393 bytes
        ├── text/html 488 bytes
        └ image/png inline 236 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID:
<smime-enc-signed-complex-injected-minimal-reply@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:15:02 -0500
User-Agent: Sample MUA Version 1.0
In-Reply-To:
<smime-enc-signed-complex-injected-minimal@lhp.example>
References:
<smime-enc-signed-complex-injected-minimal@lhp.example>

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B.3.21. S/MIME encrypted and signed reply over a complex message, Injected Headers with hcp_minimal (+ Legacy Display)

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme with the hcp_minimal Header Confidentiality Policy with a "Legacy Display" part.

It has the following structure:

- └ application/pkcs7-mime [smime.p7m] 10510 bytes
 - ┆ (decrypts to)
 - └ application/pkcs7-mime [smime.p7m] 6766 bytes
 - ┆ (unwraps to)
 - └ multipart/mixed 2314 bytes
 - ┆ multipart/alternative 1435 bytes
 - ┆┆ text/plain 487 bytes
 - ┆┆ text/html 639 bytes
 - ┆┆ image/png inline 236 bytes

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID:
<smime-enc-signed-complex-injected-minimal-lgc-rpl@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:16:02 -0500
User-Agent: Sample MUA Version 1.0
In-Reply-To:
<smime-enc-signed-complex-injected-minimal-legacy@lhp.example>
References:
<smime-enc-signed-complex-injected-minimal-legacy@lhp.example>

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B.3.22. S/MIME encrypted and signed reply over a complex message, Wrapped Message with hcp_strong

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Wrapped Message header protection scheme with the hcp_strong Header Confidentiality Policy.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 10185 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6526 bytes
    ↓ (unwraps to)
    └─ message/rfc822 inline 2198 bytes
      └─ multipart/mixed 2093 bytes
        ├── multipart/alternative 1140 bytes
        │   ├── text/plain 379 bytes
        │   └── text/html 477 bytes
        └─ image/png inline 232 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <38a0b7ba-76e0-5351-93e9-f44877e20e6e@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:17:02 -0500

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B.3.23. S/MIME encrypted and signed reply over a complex message, Injected Headers with hcp_strong

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme with the hcp_strong Header Confidentiality Policy.

It has the following structure:

```
└─ application/pkcs7-mime [smime.p7m] 10140 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6502 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 2125 bytes
      └─ multipart/alternative 1144 bytes
        └─ text/plain 391 bytes
          └─ text/html 486 bytes
            └─ image/png inline 236 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <c6774fdb-3ef5-5293-ab2d-eca8b66b4bbf@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:18:02 -0500

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B.3.24. S/MIME encrypted and signed reply over a complex message, Injected Headers with hcp_strong (+ Legacy Display)

This is a encrypted and signed S/MIME message using PKCS#7 envelopedData around signedData. The payload is a multipart/alternative message with an inline image/png attachment. It uses the Injected Headers header protection scheme with the hcp_strong Header Confidentiality Policy with a "Legacy Display" part.

It has the following structure:

```
└ application/pkcs7-mime [smime.p7m] 10790 bytes
  ↓ (decrypts to)
  └ application/pkcs7-mime [smime.p7m] 6968 bytes
    ↓ (unwraps to)
    └ multipart/mixed 2460 bytes
      └ multipart/alternative 1449 bytes
        └ text/plain 494 bytes
          └ text/html 646 bytes
            └ image/png inline 236 bytes
```

Its contents are:

Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
smime-type="enveloped-data"
Subject: [...]
Message-ID: <acced3c9-111b-5a4f-bd80-34558da32b4d@lhp.example>
From: Alice <alice@smime.example>
To: Bob <bob@smime.example>
Date: Sat, 20 Feb 2021 12:19:02 -0500

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zjRBS0UeHXzv2N5LnYLaArADFGbhm4bhZvmgdQeHiPW5EaUF9PbaiWxs1E2dz710
DIgZaaz5ij3mWgRdu2uqBio7Abibsfhd0D3ImyEoB1AwiisV3x8ucrTLjlm0Lt4f
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cS9GYERRszavcaAQqYv/SF8Zi9VcuJA3ymyIHT1MaAghJYYzVcrr7NHWrU6+qf/S
zL3zJj30G1uftX70tN41cJG9THfciWkiIFgn5AdKiq0hqR2r0Wffwy4E3/A2tKBe
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hi4Q0gs3yNSbV3V0DnCj+VIpLFnwo0D1Qy0H2GrEnREjJKSjqzCGbgBkXcvP03oE
dSioL/OvppL4c5FbQY135rQ6YtN8Ibww4QgCt3BEgPjUL820Pod0u/Fs5n0m0d0Y
/TAP1SUASRNoX3huZXPvPws4wHXtymYobUeiTz709iJGN1htySDhq6hHNBboIdh
OBSI7/j1Uw0FLE6gAGIkxqxBRCKur/xUEia5MLfwsIDkd+MiAqRdtyHLZuVx4J5K
SgF08VucGPJNSkxMWpx30M65CBMc9t7HR2EaMD230L5iF/maNyMH5X530Hib1Zg4
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/3tE8jye4VDUYwHmCiIs08mnyFGNq7qBb/Iq4AXegXMHTN/loDVWqlKaPoq2t23X
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fgBmxL2+DylgC21hg5X/OFA0KsA5iyJa84lq2k5F/KlGhwkyPgpRSbrEtTWWQ1KM
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taPBG5IM5jRqxHntADcWQRXg5UBB/ssj2ziyd8xSpIZnikMcJQUZA10WprCXm1kC
LBYanEAhce71K/o79v13de+Ynox5v0smvsMF9RU7+90Yzx/2dwzbMSwh4+IDoAZ3
fYUFootr14wPHVA4z34Vuyc30BR7UMv3JvIXmU8awdENHUF9yVG0TbMhu2M0kp50
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Appendix C. Composition Examples

This section offers step-by-step examples of message composition.

C.1. New message composition

A typical MUA composition interface offers the user a place to indicate the message recipients, the subject, and the body. Consider a composition window filled out by the user like so:

Composing New Message

To: Alice <alice@example.net> Send

Subject: Handling the Jones contract

Please review and approve or decline by Thursday, it's critical!

Thanks,
Bob

--
Bob Gonzalez
ACME, Inc.

Figure 1: Example Message Composition Interface

When Bob clicks "Send", his MUA generates values for Message-ID, From, and Date header fields, and converts the message body into the appropriate format.

C.1.1.1. Unprotected message

The resulting message would look something like this if it was sent without cryptographic protections:

```
Date: Wed, 11 Jan 2023 16:08:43 -0500
From: Bob <bob@example.net>
To: Alice <alice@example.net>
Subject: Handling the Jones contract
Message-ID: <20230111T210843Z.1234@lhp.example>
Content-Type: text/plain; charset="us-ascii"
MIME-Version: 1.0
```

Please review and approve or decline by Thursday, it's critical!

Thanks,
Bob

--
Bob Gonzalez
ACME, Inc.

C.1.2. Encrypted with hcp_minimal and Legacy Display

Now consider the message to be generated if it is to be cryptographically signed and encrypted, using HCP `hcp_minimal`, and the legacy variable is set.

For each header field, Bob's MUA passes its name and value through `hcp_minimal`. This returns the same value for every header field, except that:

```
hcp_minimal("Subject", "Handling the Jones contract") yields "[...]"
```

C.1.2.1. Cryptographic Payload

The cryptographic payload that will be signed and then encrypted is very similar to the unprotected message in [Appendix C.1.1](#). Note the addition of:

- *the `protected-headers="v1"` parameter for the Content-Type

- *the appropriate HP-Obscured header for Subject,

- *the `hp-legacy-display="1"` parameter for the Content-Type

- *the Legacy Display Element (the simple pseudo-header and its trailing newline) in the main body part.

```
Date: Wed, 11 Jan 2023 16:08:43 -0500
From: Bob <bob@example.net>
To: Alice <alice@example.net>
Subject: Handling the Jones contract
Message-ID: <20230111T210843Z.1234@lhp.example>
Content-Type: text/plain; charset="us-ascii"; hp-legacy-display="1";
  protected-headers="v1"
MIME-Version: 1.0
HP-Obscured: Subject: [...]
```

Subject: Handling the Jones contract

Please review and approve or decline by Thursday, it's critical!

Thanks,
Bob

--

Bob Gonzalez
ACME, Inc.

C.1.2.2. External header section

The cryptographic payload from [Appendix C.1.2.1](#) is then wrapped in the appropriate cryptographic layers. For this example, using S/MIME, it is wrapped in an application/pkcs7-mime; smime-type="signed-data" layer, which is in turn wrapped in a application/pkcs7-mime; smime-type="enveloped-data" layer.

Then an external header section is applied to the outer MIME object, which looks like this:

```
Date: Wed, 11 Jan 2023 16:08:43 -0500
From: Bob <bob@example.net>
To: Alice <alice@example.net>
Subject: [...]
Message-ID: <20230111T210843Z.1234@lhp.example>
Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
  smime-type="enveloped-data"
MIME-Version: 1.0
```

Note that the Subject header field has been obscured appropriately by hcp_minimal. The output of the CMS enveloping operation is base64-encoded and forms the body of the message.

C.2. Composing a Reply

Next we consider a typical MUA reply interface, where we see Alice replying to Bob's message from [Appendix C.1](#).

When Alice clicks "Reply" to Bob's signed-and-encrypted message with header protection, she might see something like this:

Replying to Bob ("Handling the Jones Contract")

To:

Subject:

On Wed, 11 Jan 2023 16:08:43 -0500, Bob wrote:

> Please review and approve or decline by Thursday,
> it's critical!
>
> Thanks,
> Bob
>
> --
> Bob Gonzalez
> ACME, Inc.

--
Alice Jenkins
ACME, Inc.

Figure 2: Example Message Reply Interface (unedited)

Note that because Alice's MUA is aware of header protection, it knows what the correct Subject header is, even though it was obscured. It also knows to avoid including the Legacy Display Element in the quoted/attributed text that it includes in the draft reply.

Once Alice has edited the reply message, it might look something like this:

Replying to Bob ("Handling the Jones Contract")

To: Bob <bob@example.net>

Subject: Re: Handling the Jones contract

On Wed, 11 Jan 2023 16:08:43 -0500, Bob wrote:

> Please review and approve or decline by Thursday,
> it's critical!

I'll get right on it, Bob!

Regards,
Alice

--
Alice Jenkins
ACME, Inc.

Figure 3: Example Message Reply Interface (edited)

When Alice clicks "Send", the MUA generates values for Message-ID, From, and Date header fields, populates the In-Reply-To, and References header fields, and also converts the reply body into the appropriate format.

C.2.1. Unprotected message

The resulting message would look something like this if it were to be sent without any cryptographic protections:

Date: Wed, 11 Jan 2023 16:48:22 -0500
From: Alice <alice@example.net>
To: Bob <bob@example.net>
Subject: Re: Handling the Jones contract
Message-ID: <20230111T214822Z.5678@lhp.example>
In-Reply-To: <20230111T210843Z.1234@lhp.example>
References: <20230111T210843Z.1234@lhp.example>
Content-Type: text/plain; charset="us-ascii"
MIME-Version: 1.0

On Wed, 11 Jan 2023 16:08:43 -0500, Bob wrote:

> Please review and approve or decline by Thursday,
> it's critical!

I'll get right on it, Bob!

Regards,
Alice

--

Alice Jenkins
ACME, Inc.

Of course, this would leak not only the contents of Alice's message, but also the contents of Bob's initial message, as well as the Subject header field! So Alice's MUA won't do that; it is going to create a signed-and-encrypted message to submit to the network.

C.2.2. Encrypted with hcp_null and Legacy Display

This example assumes that Alice's MUA uses hcp_null, not hcp_minimal. That is, by default, it does not obscure or remove any header fields, even when encrypting.

However, it follows the guidance in [Section 2.5.8.1](#), and will make use of the HP-Obscured field in the cryptographic payload of Bob's original message ([Appendix C.1.2.1](#)) to determine what to obscure.

When crafting the cryptographic payload, its baseline HCP (hcp_null) leaves each field untouched. But it also knows that In-Reply-To, References, To, and Subject are all derived from headers in Bob's original message.

For each of these header fields, it observes whether the origin header field was signed-and-encrypted or merely signed in Bob's original message.

In-Reply-To and References derive from Bob's original message's Message-ID field, which was merely signed. The To header field is

derived from Bob's original message's From field, which was also merely signed. So these three header fields are passed through untouched.

But the Subject header field is derived from Bob's original message's Subject field (by prefixing Re: to it), and that header field is signed-and-encrypted, which the MUA can tell because the HP-Obscured: Subject entry in the cryptographic payload of Bob's message.

So Alice's MUA generates a new external Subject header by applying its derivation rules to the HP-Obscured: Subject value from Bob's message, yielding the value Re: [...].

C.2.2.1. Cryptographic Payload

Consequently, the cryptographic payload for Alice's reply looks like this:

```
Date: Wed, 11 Jan 2023 16:48:22 -0500
From: Alice <alice@example.net>
To: Bob <bob@example.net>
Subject: Re: Handling the Jones contract
Message-ID: <20230111T214822Z.5678@lhp.example>
In-Reply-To: <20230111T210843Z.1234@lhp.example>
References: <20230111T210843Z.1234@lhp.example>
Content-Type: text/plain; charset="us-ascii"; hp-legacy-display="1";
  protected-headers="v1"
MIME-Version: 1.0
HP-Obscured: Subject: Re: [...]
```

Subject: Re: Handling the Jones contract

On Wed, 11 Jan 2023 16:08:43 -0500, Bob wrote:

```
> Please review and approve or decline by Thursday,
> it's critical!
```

I'll get right on it, Bob!

Regards,
Alice

--

Alice Jenkins
ACME, Inc.

Note the following features:

- *the protected-header="v1" parameter to Content-Type

- *the appropriate HP-Obscured header for Subject,
- *the hp-legacy-display="1" parameter for the Content-Type
- *the Legacy Display Element (the simple pseudo-header and its trailing newline) in the main body part.

C.2.2.2. External header section

The cryptographic payload from [Appendix C.2.2.1](#) is then wrapped in the appropriate cryptographic layers. For this example, using S/MIME, it is wrapped in an application/pkcs7-mime; smime-type="signed-data" layer, which is in turn wrapped in a application/pkcs7-mime; smime-type="enveloped-data" layer.

Then an external header section is applied to the outer MIME object, which looks like this:

```
Date: Wed, 11 Jan 2023 16:48:22 -0500
From: Alice <alice@example.net>
To: Bob <bob@example.net>
Subject: Re: [...]
Message-ID: <20230111T214822Z.5678@lhp.example>
In-Reply-To: <20230111T210843Z.1234@lhp.example>
References: <20230111T210843Z.1234@lhp.example>
Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-mime; name="smime.p7m";
  smime-type="enveloped-data"
MIME-Version: 1.0
```

Note that the Subject header field has been obscured appropriately even though hcp_null would not have touched it by default. The output of the CMS enveloping operation is base64-encoded and forms the body of the message.

Appendix D. Rendering Examples

This section offers example cryptographic payloads (the content within the cryptographic envelope) that contain Legacy Display elements.

D.1. Example text/plain Cryptographic Payload with Legacy Display Elements

Here is a simple one-part Cryptographic Payload (headers and body) of a message that includes Legacy Display elements:

Date: Fri, 21 Jan 2022 20:40:48 -0500
From: Alice <alice@example.net>
To: Bob <bob@example.net>
Subject: Dinner plans
Message-ID: <text-plain-legacy-display@lhp.example>
MIME-Version: 1.0
Content-Type: text/plain; charset="us-ascii"; hp-legacy-display="1";
protected-headers="v1"

Subject: Dinner plans

Let's meet at Rama's Roti Shop at 8pm and go to the park
from there.

A compatible MUA will recognize the hp-legacy-display="1" parameter
and render the body of the message as:

Let's meet at Rama's Roti Shop at 8pm and go to the park
from there.

A legacy decryption-capable MUA that is unaware of this mechanism
will ignore the hp-legacy-display="1" parameter and instead render
the body including the Legacy Display elements:

Subject: Dinner plans

Let's meet at Rama's Roti Shop at 8pm and go to the park
from there.

D.2. Example text/html Cryptographic Payload with Legacy Display Elements

Here is a modern one-part Cryptographic Payload (headers and body)
of a message that includes Legacy Display elements:

Date: Fri, 21 Jan 2022 20:40:48 -0500
From: Alice <alice@example.net>
To: Bob <bob@example.net>
Subject: Dinner plans
Message-ID: <text-html-legacy-display@lhp.example>
MIME-Version: 1.0
Content-Type: text/html; charset="us-ascii"; hp-legacy-display="1";
protected-headers="v1"

```
<html><head><title></title></head><body>  
<div class="header-protection-legacy-display">  
<pre>Subject: Dinner plans</pre>  
</div>  
<p>  
Let's meet at Rama's Roti Shop at 8pm and go to the park  
from there.  
</p>  
</body>  
</html>
```

A compatible MUA will recognize the hp-legacy-display="1" parameter and mask out the Legacy Display div, rendering the body of the message as a simple paragraph:

Let's meet at Rama's Roti Shop at 8pm and go to the park from there.

A legacy decryption-capable MUA that is unaware of this mechanism will ignore the hp-legacy-display="1" parameter and instead render the body including the Legacy Display elements:

Subject: Dinner plans

Let's meet at Rama's Roti Shop at 8pm and go to the park from there.

Appendix E. Document Changelog

[[RFC Editor: This section is to be removed before publication]]

*draft-ietf-lamps-header-protection-13

-Retitle from "Header Protection for S/MIME" to "Header Protection for Cryptographically Protected E-mail"

*draft-ietf-lamps-header-protection-12

-**MUST** produce HP-Obscured and HP-Removed when generating encrypted messages with non-null HCP

- Wrapped Message: move from forwarded=no to protected-headers=wrapped

- Wrapped Message: recommend Content-Disposition: inline

*draft-ietf-lamps-header-protection-11

- Remove most of the Bcc text (transferred general discussion to e2e-mail-guidance)

- Fix bug in algorithm for generating HP-Obscured and HP-Removed

- More detail about handling Reply messages

- Considerations around handling risky Legacy Display Elements

- Narrative descriptions of some worked examples

- Describe potential leaks to recipients

- Clarify debugging/troubleshooting UX affordances

*draft-ietf-lamps-header-protection-10

- Clarify that HCP doesn't apply to structural header fields

- Drop out-of-date "Open Issues" section

- Brief commentary on UI of messages with intermediate/mixed protections

- Deprecation prospects for messages without protected headers

- Describe generating replies to encrypted messages with stronger HCP

*draft-ietf-lamps-header-protection-09

- clarify terminology

- add privacy and security considerations

- clarify HCP examples and baselines

- recommend hcp_minimal as default HCP

- add HP-Obscured and HP-Removed (avoids reasoning about differences between outside and inside the cryptographic envelope)

- regenerated test vectors

*draft-ietf-lamps-header-protection-08

- MUST** compose injected headers, **MAY** compose wrapped messages
- MUST** parse both schemes
- cleanup and restructure document

*draft-ietf-lamps-header-protection-07

- move from legacy display MIME part to legacy display elements within main body part

*draft-ietf-lamps-header-protection-06

- document observed problems with legacy MUAs
- avoid duplicated outer Message-IDs in hcp_strong test vectors

*draft-ietf-lamps-header-protection-05

- fix multipart/signed wrapped test vectors

*draft-ietf-lamps-header-protection-04

- add test vectors
- add "problems with Injected Messages" subsection

*draft-ietf-lamps-header-protection-03

- dkg takes over from Bernie as primary author
- Add Usability section
- describe two distinct formats "Wrapped Message" and "Injected Headers"
- Introduce Header Confidentiality Policy model
- Overhaul message composition guidance
- Simplify document creation workflow, move public face to gitlab

*draft-ietf-lamps-header-protection-02

- editorial changes / improve language

*draft-ietf-lamps-header-protection-01

- Add DKG as co-author
- Partial Rewrite of Abstract and Introduction [HB/AM/DKG]
- Adding definitions for Cryptographic Layer, Cryptographic Payload, and Cryptographic Envelope (reference to [[I-D.ietf-lamps-e2e-mail-guidance](#)]) [DKG]
- Enhanced MITM Definition to include Machine- / Meddler-in-the-middle [HB]
- Relaxed definition of Original message, which may not be of type "message/rfc822" [HB]
- Move "memory hole" option to the Appendix (on request by Chair to only maintain one option in the specification) [HB]
- Updated Scope of Protection Levels according to WG discussion during IETF-108 [HB]
- Obfuscation recommendation only for Subject and Message-Id and distinguish between Encrypted and Unencrypted Messages [HB]
- Removed (commented out) Header Field Flow Figure (it appeared to be confusing as is was) [HB]

*draft-ietf-lamps-header-protection-00

- Initial version (text partially taken over from [[I-D.ietf-lamps-header-protection-requirements](#)])

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