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## Header Protection for S/MIME

### Abstract

S/MIME version 3.1 has introduced a feasible standardized option to accomplish Header Protection. However, few implementations generate messages using this structure, and several legacy and non-legacy implementations have revealed rendering issues at the receiving side. Clearer specifications regarding message processing, particularly with respect to header sections, are needed in order to resolve these rendering issues. Some mail user agents are also sending and receiving cryptographically-protected message headers using a different structure.

In order to help implementers to correctly compose and render email messages with Header Protection, this document updates S/MIME Header Protection specifications with additional guidance on MIME format, sender and receiver processing.

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## **1. Introduction**

Privacy and security issues regarding email Header Protection in S/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 Protected Headers**

Unfortunately, there are two different schemes for cryptographically-protected email headers that may be in use on the Internet today. This document addresses them both and provides guidance to implementers.

One scheme is the form specified in S/MIME 3.1 and later, which involves wrapping a message/rfc822 MIME object with a Cryptographic Envelope. 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 produced and consumed by some MUAs, where the protected headers 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 [[I-D.autocrypt-lamps-protected-headers](#)].

### **1.2. Problems with Wrapped Messages**

Several legacy MUAs have revealed rendering issues when dealing with a message with headers protected by the Wrapped Message scheme. In some cases the user sees an attachment suggesting a forwarded email message, which -- in fact -- contains the protected email message that should be rendered directly. For these cases, the user can click on the attachment to view the protected message. However, there have also been reports of email clients displaying garbled

text, or sometimes nothing at all. In those cases the email clients on the receiving side are (most likely) not fully MIME-capable.

The following shortcomings have been identified to cause these issues:

- \*Broken or incomplete implementations
- \*Lack of a simple means to distinguish "forwarded message" and "wrapped message" (for the sake of Header Protection)
- \*Not enough guidance with respect to handling of Header Fields on both the sending and the receiving side

### **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 some legacy MUAs will render to the user, albeit not in the same location that the header fields would normally be rendered. However, some legacy MUAs also fail to render the "legacy display" part, leaving the obscured header fields hidden from users of those MUAs.

### **1.4. Motivation**

Furthermore, the need (technical) Data Minimization, which includes data sparseness and hiding all technically concealable information, has grown in importance over the past several years. In addition, backwards compatibility must be considered when it is possible to do so without compromising privacy and security.

No mechanism for Header Protection has been standardized for PGP/MIME (Pretty Good Privacy) [[RFC3156](#)] yet. PGP/MIME developers have implemented ad-hoc header-protection, and would like to see a specification that is applicable to both S/MIME and PGP/MIME.

This document describes the problem statement ([Section 2](#)), generic use cases ([Section 3](#)) and the specification for Header Protection ([Section 4](#)) with guidance on MIME format, sender and receiver processing .

[[I-D.ietf-lamps-header-protection-requirements](#)] defines the requirements that this specification is based on.

This document is in an early draft state and contains a proposal on which to base future discussions of this topic. In any case, the final mechanism is to be determined by the IETF LAMPS WG.

## 1.5. Other Protocols to Protect Email Headers

A range of protocols for the protection of electronic mail (email) exists, which allows one to assess the authenticity and integrity of the email headers section or selected Header Fields from the domain-level perspective, specifically DomainKeys Identified Mail (DKIM) [[RFC6376](#)], as used by Domain-based Message Authentication, Reporting, and Conformance (DMARC) [[RFC7489](#)]. These protocols provide a domain-based reputation mechanism that can be used to mitigate some forms of unsolicited email (spam). At the same time, these protocols can provide a level of cryptographic integrity and authenticity for some headers, depending on how they are used. However, integrity protection and proof of authenticity are both tied to the domain name of the sending e-mail address, not the sending address itself, so these protocols do not provide end-to-end protection, and are incapable of providing any form of confidentiality.

## 1.6. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC2119](#)].

## 1.7. Terms

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

\*Man-in-the-middle (MITM) attack: cf. [[RFC4949](#)], which states: "A form of active wiretapping attack in which the attacker intercepts and selectively modifies communicated data to masquerade as one or more of the entities involved in a communication association."

Note: Historically, MITM has stood for '*Man*-in-the-middle'. However, to indicate that the entity in the middle is not always a human attacker, MITM can also stand for '*Machine*-in-the-middle' or '*Meddler*-in-the-middle'.

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

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

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

Note: To avoid ambiguity, this document does not use 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; cf. [[RFC5322](#)].

\*Header Field (HF): cf. [[RFC5322](#)] Header Fields are lines beginning with a field name, followed by a colon (":"), followed by a field body (value), and terminated by CRLF.

\*Header Section (HS): The Header Section is a sequence of lines of characters with special syntax as defined in [[RFC5322](#)]. It is the (top) section of a Message containing the Header Fields.

\*Body: The Body is simply a sequence of bytes 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); cf [[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.

\*MIME Header Fields: Header Fields describing content of a MIME entity [[RFC2045](#)], in particular the MIME structure. Each MIME Header Field name starts with "Content-" prefix.

\*MIME Header Section (part): The collection of MIME Header Fields. "MIME Header Section" refers to a Header Sections that contains only MIME Header Fields, whereas "MIME Header Section part" refers to the MIME Header Fields of a Header Section that - in addition to MIME Header Fields - also contains non-MIME Header Fields.

\*Essential Header Fields (EHF): The minimum set of Header Fields an Outer Message Header Section SHOULD contain; cf. [Appendix C. 1.2.5](#).

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

\*Protection Levels (PL): The level of protection applied to a Message, e.g. 'signature and encryption' or 'signature only' (cf. [Section 3.2](#)).

\*Protected: Portions of a message that have had any Protection Levels applied.

\*Protected Message: A Message that has had any Protection Levels applied.

\*Unprotected: Portions of a Message that has had no Protection Levels applied.

\*Unprotected Message: A Message that has had no Protection Levels applied.

\*Submission Entity: The entity which executes further processing of the Message (incl. transport towards the receiver), after protection measures have been applied to the Message.

Note: The Submission Entity varies among implementations, mainly depending on the stage where protection measures are applied: E.g. a Message Submission Agent (MSA) [[RFC6409](#)] or another (proprietary) solution. The latter is particularly relevant, if protection is implemented as a plugin solution. Some implementations may determine the destination recipients by reading the To, Cc and Bcc Header Fields of the Outer Message.

\*Original Message (OrigM): The Message to be protected before any protection-related processing has been applied on the sending side. If the source is not a "message/rfc822" Message, OrigM is defined as the "virtual" Message that would be constructed for sending it as unprotected email.

\*Inner Message (InnerM): The Message to be protected which has had wrapping and protection measures applied on the sending side OR the resulting Message once decryption and unwrapping on the receiving side has been performed. Typically, the Inner Message is in clear text. The Inner Message is a subset of (or the same as) the Original Message. The Inner Message must be the same on the sending and the receiving side.

\*Outer Message (OuterM): The Message as provided to the Submission Entity or received from the last hop respectively. The Outer Message normally differs on the sending and the receiving side (e.g. new Header Fields are added by intermediary nodes).

\*Receiving User Facing Message (RUFM): The Message used for rendering at the receiving side. Typically this is the same as the Inner Message.

\*Data Minimization: Data sparseness and hiding of all technically concealable information whenever possible.

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

\*User-Facing Headers are defined in [[I-D.autocrypt-lamps-protected-headers](#)].

\*Legacy MUA: a MUA that does not understand protected headers 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 protected headers.

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

\*Injected Headers: The protected headers scheme that uses the mechanism described in [[I-D.autocrypt-lamps-protected-headers](#)], where the protected headers are inserted on the Cryptographic Payload directly.

\*Header Confidentiality Policy: documented in [Section 4.1.2.2](#)

## **2. Problem Statement**

The LAMPS charter contains the following Work Item:

Update the specification for the cryptographic protection of email headers -- both for signatures and encryption -- to improve the implementation situation with respect to privacy, security, usability and interoperability in cryptographically-protected electronic mail. 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.

In the following a set of challenges to be addressed:

[[ TODO: Enhance this section, add more items to the following. ]]

### **2.1. Privacy**

\*(Technical) Data Minimization, which includes data sparseness and hiding all technically concealable information whenever possible

### **2.2. Security**

\*Prevent MITM attacks (cf. [[RFC4949](#)])

### **2.3. Usability**

\*Improved User interaction / User experience, in particular at the receiving side

### **2.4. Interoperability**

\*Interoperability with [[RFC8551](#)] implementations

### **3. Use Cases**

In the following, the reader can find a list of the generic use cases that need to be addressed for Messages with Header Protection (HP). These use cases apply regardless of technology (S/MIME, PGP/MIME, etc.) used to achieve HP.

#### **3.1. Interactions**

The following use cases assume that at least the sending side supports Header Protection as specified in this document. Receiving sides that support this specification are expected to be able to distinguish between Messages that use Header Protection as specified in this document, and (legacy) Mail User Agents (MUAs) which do not implement this specification.

[[ TODO: Verify once solution is stable and update last sentence. ]]

##### **3.1.1. Main Use Case**

Both the sending and receiving side (fully) support Header Protection as specified in this document.

The main use case is specified in [Section 4.1](#).

##### **3.1.2. Backward Compatibility Use Cases**

Regarding backward compatibility, the main distinction is based on whether or not the receiving side conforms to MIME according to [\[RFC2046\]](#), ff., which in particular also includes Section 2 of [\[RFC2049\]](#) on "MIME Conformance". The following excerpt is contextually relevant:

A mail user agent that is MIME-conformant MUST:

[...]

- Recognize and display at least the RFC822 message encapsulation (message/rfc822) in such a way as to preserve any recursive structure, that is, displaying or offering to display the encapsulated data in accordance with its media type.

- Treat any unrecognized subtypes as if they were "application/octet-stream".

[...]

An MUA that meets the above conditions is said to be MIME-conformant. A MIME-conformant MUA is assumed to be "safe" to send virtually any kind of properly-marked data to users of such mail systems, because these systems are, at a minimum, capable of treating the data as undifferentiated binary, and will not simply splash it onto the screen of unsuspecting users.

[[ TODO: The compatibility of legacy HP systems with this new solution, and how to handle issues surrounding future maintenance for these legacy systems, will be decided by the LAMPS WG. ]]

#### **3.1.2.1. Receiving Side MIME-Conformant**

The sending side (fully) supports Header Protection as specified in this document, while the receiving side does not support this specification. However, the receiving side is MIME-conformant according to [RFC2045], ff. (cf. [Section 3.1.2](#)).

This use case is specified in [Section 4.2.1](#).

Note: This case should perform as expected if the sending side applies this specification as outlined in [Section 4.1](#).

[[ TODO: Verify once solution is stable and update last sentence. ]]

#### **3.1.2.2. Receiving Side Not MIME-Conformant**

The sending side (fully) supports Header Protection as specified in this document, while the receiving side does not support this specification. Furthermore, the receiving side is **not** MIME-conformant according to [RFC2045], ff. (cf. [Section 3.1.2](#)).

This use case is specified in [Section 4.2.2](#).

## 3.2. Protection Levels

### 3.2.1. In-Scope

The following Protection Levels are in scope for this document:

a) Signature and encryption

Messages containing a cryptographic signature, which are also encrypted.

b) Signature only

Messages containing a cryptographic signature, but which are not encrypted.

### 3.2.2. Out-of-Scope

Legacy implementations, implementations not (fully) compliant with this document or corner-cases may lead to further Protection Levels to appear on the receiving side, such as (list not exhaustive):

\*Triple wrap

\*Encryption only

\*Encryption before signature

\*Signature and encryption, but:

-Signature fails to validate

-Signature validates but the signing certificate revoked

\*Signature only, but:

-with multiple valid signatures, layered atop each other

These Protection Levels, as well as any further Protection Levels not listed in [Section 3.2.1](#) are beyond the scope of this document.

## 4. Specification

This section contains the specification for Header Protection in S/MIME to update and clarify Section 3.1 of [\[RFC8551\]](#) (S/MIME 4.0).

Note: It is likely that PGP/MIME [\[RFC3156\]](#) will also incorporate this specification or parts of it.

This specification applies to the Protection Levels "signature & encryption" and "signature only" (cf. [Section 3.2](#)):

Sending and receiving sides MUST implement the "signature and encryption" Protection Level, which SHOULD be used as default on the sending side.

Certain implementations may decide to send "signature only" Messages, depending on the circumstances and customer requirements. Sending sides MAY and receiving sides MUST implement "signature only" Protection Level.

It generally is NOT RECOMMENDED to send a Message with any other Protection Level. On the other hand, the receiving side must be prepared to receive Messages with other Protection Levels.

[[ TODO: Further study is necessary to determine whether - and if yes to what extent - additional guidance for handling messages with other Protection Levels, e.g. "encryption only" at the receiving side should be included in this document. ]]

#### **4.1. Main Use Case**

This section applies to the main use case, where the sending and receiving side (fully) support Header Protection as specified herein (cf. [Section 3.1.1](#)).

Note: The sending side specification of the main use case is also applicable to the cases where the sending side (fully) supports Header Protection as specified herein, while the receiving side does not, but is MIME-conformant according to [\[RFC2045\]](#), ff. (cf. [Section 3.1.2](#) and [Section 3.1.2.1](#)).

Further backward compatibility cases are defined in [Section 4.2](#).

##### **4.1.1. MIME Format**

###### **4.1.1.1. Introduction**

As per S/MIME version 3.1 and later (cf. [\[RFC8551\]](#)), the sending client MAY wrap a full MIME message in a message/RFC822 wrapper in order to apply S/MIME security services to these header fields.

To help the receiving side to distinguish between a forwarded and a wrapped message, the Content-Type header field parameter "forwarded" is added as defined in [\[I-D.melnikov-iana-reg-forwarded\]](#).

The simplified (cryptographic overhead not shown) MIME structure of such an Email Message looks as follows:

<Outer Message Header Section (unprotected)>

<Outer Message Body (protected)>

    <MIME Header Section (wrapper)>

        <Inner Message Header Section>

        <Inner Message Body>

The following example demonstrates how an Original Message might be protected, i.e., the Original Message is contained as Inner Message in the Protected Body of an Outer Message. It illustrates the first Body part (of the Outer Message) as a "multipart/signed" (application/pkcs7-signature) media type:

Lines are prepended as follows:

    \*"O: " Outer Message Header Section

    \*"I: " Message Header Section

    \*"W: " Wrapper (MIME Header Section)

O: Date: Mon, 25 Sep 2017 17:31:42 +0100 (GMT Daylight Time)  
O: Message-ID: <e4a483cb-1dfb-481d-903b-298c92c21f5e@m.example.net>  
O: Subject: Meeting at my place  
O: From: "Alexey Melnikov" <alexey.melnikov@example.net>  
O: To: somebody@example.net  
O: MIME-Version: 1.0  
O: Content-Type: multipart/signed; charset=us-ascii; micalg=sha1;  
O: protocol="application/pkcs7-signature";  
O: boundary=boundary-AM

This is a multipart message in MIME format.

--boundary-AM

W: Content-Type: message/RFC822; forwarded=no

W:

I: Date: Mon, 25 Sep 2017 17:31:42 +0100 (GMT Daylight Time)  
I: From: "Alexey Melnikov" <alexey.melnikov@example.net>  
I: Message-ID: <e4a483cb-1dfb-481d-903b-298c92c21f5e@m.example.net>  
I: MIME-Version: 1.0  
I: MMHS-Primary-Precedence: 3  
I: Subject: Meeting at my place  
I: To: somebody@example.net  
I: X-Mailer: Isode Harrier Web Server  
I: Content-Type: text/plain; charset=us-ascii

This is an important message that I don't want to be modified.

--boundary-AM

Content-Transfer-Encoding: base64

Content-Type: application/pkcs7-signature

[[base-64 encoded signature]]

--boundary-AM--

The Outer Message Header Section is unprotected, while the remainder (Outer Message Body) is protected. The Outer Message Body consists of the wrapper (MIME Header Section) and the Inner Message (Header Section and Body).

The wrapper is a simple MIME Header Section with media type "message/rfc822" containing a Content-Type header field parameter "forwarded=no" followed by an empty line.

If the source is an Original (message/rfc822) Message, the Inner Message Header Section is typically the same as (or a subset of) the Original Message Header Section, and the Inner Message Body is typically the same as the Original Message Body.

The Inner Message itself may contain any MIME structure.

Note: It is still to be decided by the LAMPS WG whether or not to recommend an alternative MIME format as described in [Appendix C.1.1.1](#) (instead of the currently standardized and above defined format).

#### 4.1.2. 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.

##### 4.1.2.1. Composing a Cryptographically-Protected Message Without Header Protection

[[I-D.dkg-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

#### 4.1.2.2. Header Confidentiality Policy

When composing an encrypted message with protected headers, the composing MUA needs a Header Confidentiality Policy. In this document, we represent that Header Confidentiality Policy as a function `hcp`:

```
*hcp(name, val_in) --> val_out: this function takes a header field
name name and 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 in question should be omitted from
the set of headers visible outside the Cryptographic Envelope.
```

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

```
hcp(name, val_in) --> val_out: if name is 'Subject': return '['...']'
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 headers 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 4.1.3](#). 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.

#### 4.1.2.3. Composing with "Wrapped Message" Header Protection

To compose a message using "Wrapped Message" header protection, we use those inputs described in [Section 4.1.2.1](#) plus the Header

Confidentiality Policy hcp defined in [Section 4.1.2.2](#). The new algorithm is:

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

- Add header h of origbody with value v

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

- Let payload be a new MIME part with one header: Content-Type: message/global; forwarded=no, and whose body is origbody.

- \*Else:

- Let payload be a new MIME part with one header: Content-Type: message/rfc822; forwarded=no, and whose body is origbody.

- \*Apply crypto to payload, yielding MIME tree output

- \*If crypto contains encryption:

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

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

- oLet newval be hcp(h, v)

- oIf newval is not null:

- oAppend (h,newval) to newh

- Set origheaders to newh

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

- Add header h of 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.

#### 4.1.2.4. Composing with "Injected Headers" Header Protection

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 4.1.2.2](#).

\*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)

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

\*Create a new MIME leaf part legacydisplay with header Content-Type: text/plain; protected-headers="v1" and an empty body.

\*if crypto contains encryption, and legacy is true:

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

oIf h is user-facing (see [[I-D.autocrypt-lamps-protected-headers](#)]):

oIf hcp(h,v) is not v:

oAdd h: v to the body of legacydisplay. For example, if h is Subject, and v is lunch plans?, then add the line Subject: lunch plans? to the body of legacydisplay

\*If the body of legacydisplay is empty:

-Let payload be MIME part origbody, discarding legacydisplay

\*Else: (body of legacydisplay is not empty)

-Construct a new MIME part wrapper with Content-Type: multipart/mixed

-Give wrapper exactly two subparts: legacydisplay and origbody, in that order.

-Let payload be MIME part wrapper

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

-Add header h of MIME part payload with value v

\*Set the protected-headers parameter on the Content-Type of payload to v1

\*Apply crypto to payload, producing MIME tree output

\*If crypto contains encryption:

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

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

  - oLet newval be hcp(h, v)

  - oIf newval is not null:

    - oAdd newh[h] to newval

- Set origheaders to newh

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

- Add header h of 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.

#### **4.1.2.5. Choosing Between Wrapped Message and Injected Headers**

When composing a message with end-to-end cryptographic protections, an MUA SHOULD protect the headers of that message as well as the body.

An MUA MAY protect the headers of any outbound message using either the "Wrapped Message" or the "Injected Headers" style of protection. See [Section 4.2](#) for more discussion about reasons to choose one mechanism or another.

[[ TODO: this document should recommend generation of one particular scheme by default for new implementers ]]

#### **4.1.3. Default Header Confidentiality Policy**

An MUA SHOULD have a sensible default Header Confidentiality Policy, and SHOULD NOT require the user to select one.

The 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.

```
[[ TODO: select one of the two policies below the recommended
default ]]
```

#### **4.1.3.1. Minimalist Header Confidentiality Policy**

Accordingly, the most conservative recommended Header Confidentiality Policy only protects the Subject:

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

#### **4.1.3.2. 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.

#### **4.1.3.3. Offering Stronger Header Confidentiality**

A MUA MAY offer even stronger confidentiality for headers of an encrypted message than described in [Section 4.1.3.2](#). 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.

#### **4.1.4. 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.dkg-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 protected headers makes the following two changes to its behavior when rendering a message:

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

- \*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 protected headers does *not* need to render any new header fields that it did not render before.

#### **4.1.4.1. Identifying that a Message has Protected Headers**

An incoming message can be identified as having protected headers based on one of two signals:

- \*The Cryptographic Payload has Content-Type: message/rfc822 or Content-Type: message/global and the parameter forwarded has a value of no. See [Section 4.1.4.3](#) for rendering guidance.

- \*The Cryptographic Payload has some other Content-Type and it has parameter protected-headers set to v1. See [Section 4.1.4.4](#) for rendering guidance.

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

#### **4.1.4.2. Updating the Cryptographic Summary**

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

Each header individually has exactly one the following protections:

- \*unprotected (this is the case for all headers in messages that have no protected headers)
- \*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 was either omitted or obfuscated)
- \*encrypted-and-signed (same as encrypted, but additionally is under a validated signature)

Note that while the message itself may be encrypted-and-signed, some headers may be replicated on the outside of the message (e.g. Date). Those headers would be signed-only, despite the message itself being encrypted-and-signed.

Rendering this information 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.

#### 4.1.4.3. Rendering a Wrapped Message

When the Cryptographic Payload has Content-Type of message/rfc822 or message/global, and the parameter forwarded is set to no, the values of the protected headers are drawn from the headers of the Cryptographic Payload, and the body that is rendered is the body of the Cryptographic Payload.

##### 4.1.4.3.1. Example Signed-Only Wrapped Message

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

```
A └─ application/pkcs7-mime; smime-type="signed-data"
   ↓ (unwraps to)
B └─ message/rfc822 [Cryptographic Payload]
C   └─ multipart/alternative [Rendered Body]
D     └─ text/plain
E       └─ text/html
```

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

```
C └─ multipart/alternative
D   └─ text/plain
E   └─ text/html
```

It should render header fields taken from part C.

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.

#### 4.1.4.3.2. Example Encrypted-and-Signed Wrapped Message

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

```
F └─ application/pkcs7-mime; smime-type="enveloped-data"
   ↓ (decrypts to)
G └─ application/pkcs7-mime; smime-type="signed-data"
   ↓ (unwraps to)
H   └─ message/rfc822 [Cryptographic Payload]
I     └─ multipart/alternative [Rendered Body]
J       └─ text/plain
K       └─ text/html
```

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

```
I └─ multipart/alternative
J   └─ text/plain
K   └─ text/html
```

It should render headers taken from part I.

Its cryptographic summary should indicate that the message was signed and encrypted. Each rendered header field found in I should be compared against the header field of the same name from F. If the value found in F matches the value found in I, the header field should be marked as signed-only. If no matching header field was found in F, or the value found did not match the value from I, the header field should be marked as signed-and-encrypted.

#### 4.1.4.4. 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 headers are drawn from the headers of the Cryptographic Payload, and the body that is rendered is the Cryptographic Payload itself.

#### 4.1.4.4.1. Example Signed-only Message with Injected Headers

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

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

```
M └─ multipart/alternative
N   └─ text/plain
O   └─ text/html
```

It should render header fields taken from part M.

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 L for the purposes of rendering.

#### 4.1.4.4.2. Example Signed-and-Encrypted Message with Injected Headers

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

```
P └─ application/pkcs7-mime; smime-type="enveloped-data"
    ↓ (decrypts to)
Q └─ application/pkcs7-mime; smime-type="signed-data"
    ↓ (unwraps to)
R └─ multipart/alternative [Cryptographic Payload + 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 headers taken from part R.

Its cryptographic summary should indicate that the message was signed and encrypted. As in [Section 4.1.4.3.2](#), each rendered header field found in R should be compared against the header field of the same name from P. If the value found in P matches the value found in R, the header field should be marked as signed-only. If no matching header field was found in P, or the value found did not match the

value from R, the header field should be marked as signed-and-encrypted.

#### **4.1.4.4.3. Do Not Render Legacy Display Part**

As described [[I-D.autocrypt-lamps-protected-headers](#)], a message with cryptographic confidentiality protection MAY include a "Legacy Display" part for backward-compatibility with legacy MUAs

The receiving MUA SHOULD avoid rendering the Legacy Display part to the user at all, since it is aware of and can render the actual Protected Headers.

If a Legacy Display part is detected, it and its enclosing multipart/mixed wrapper should be discarded before rendering.

#### **4.1.4.4.3.1. Legacy Display Detection Algorithm**

A receiving MUA acting on a message SHOULD detect the presence of a Legacy Display part and the corresponding "original body" with the following simple algorithm:

- \*Check that all of the following are true for the message:

- \*The Cryptographic Envelope must contain an encrypting Cryptographic Layer

- \*The Cryptographic Payload must have a Content-Type of multipart/mixed

- \*The Cryptographic Payload must have exactly two subparts

- \*The first subpart of the Cryptographic Payload must have a Content-Type of text/plain or text/rfc822-headers

- \*The first subpart of the Cryptographic Payload's Content-Type must contain a property of protected-headers, and its value must be v1.

- \*If all of the above are true, then the first subpart is the Legacy Display part, and the second subpart is the "original body". Otherwise, the message does not have a Legacy Display part.

#### **4.1.4.4.3.2. Legacy Display Example**

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

```

U └─ application/pkcs7-mime; smime-type="enveloped-data"
    ↓ (decrypts to)
V └─ application/pkcs7-mime; smime-type="signed-data"
    ↓ (unwraps to)
W └─ multipart/mixed [Cryptographic Payload]
X   └─ text/plain [Legacy Display]
Y   └─ multipart/alternative [Rendered Body]
Z     └─ text/plain
A'    └─ text/html

```

The message body should be rendered the same way as this message, effectively hiding the Legacy Display part (X) and its wrapper:

```

Y └─ multipart/alternative
Z  └─ text/plain
A' └─ text/html

```

It should render headers taken from part W, following the same guidance as in [Section 4.1.4.4.2](#) and [Section 4.1.4.3.2](#) about the cryptographic status of each rendered header field.

#### 4.1.4.5. 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 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.

#### 4.1.4.6. Composing a Reply to an Encrypted Message with Protected Headers

When composing a reply to an encrypted message with protected headers, 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.

##### 4.1.4.6.1. Avoid Leaking Encrypted Headers in Reply

As noted in [[I-D.dkg-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 headers.

Values from any header field that was identified as either encrypted 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 Subject field in the cleartext header as described above.

[[ TODO: formally describe how a replying MUA should generate a message-specific Header Protection policy based on the cryptographic status of the headers of the incoming message ]]

#### **4.1.4.6.2. Avoid Misdirected Replies to Encrypted Messages with Protected Headers**

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 headers

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

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

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 header.

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.

#### **4.1.4.7. 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 4.1.4.6.2](#) 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 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 protected headers SHOULD use the value from the protected header, and SHOULD NOT use any value found outside the cryptographic protection.

#### **4.1.4.8. Unprotected Headers Added in Transit**

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

The most common of these headers 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 protected headers.

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

Specific examples appear below.

##### **4.1.4.8.1. Mailing list headers: List-\* and Archived-At**

If the message arrives through a mailing list, the list manager itself may inject headers (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 headers 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 protected headers 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.

FIXME: other examples of unprotected transit headers?

## **4.2. Backward Compatibility Use Cases**

### **4.2.1. Receiving Side MIME-Conformant**

This section applies to the case where the sending side (fully) supports Header Protection as specified in this document, while the receiving side does not support this specification, but is MIME-conformant according to [\[RFC2045\]](#), ff. (cf. [Section 3.1.2](#) and [Section 3.1.2.1](#))

The sending side specification of the main use case (cf. [Section 4.1](#)) MUST ensure that receiving sides can still recognize and display or offer to display the encapsulated data in accordance with its media type (cf. [\[RFC2049\]](#), Section 2). In particular, receiving sides that do not support this specification, but are MIME-conformant according to [\[RFC2045\]](#), ff. can still recognize and display the Message intended for the user.

[[ TODO: Verify once solution is stable and update last sentence. ]]

### **4.2.2. Receiving Side Not MIME-Conformant**

This section applies to cases where the sending side (fully) supports Header Protection as specified in this document, while the receiving side neither supports this specification **nor** is MIME-conformant according to [\[RFC2045\]](#), ff. (cf. [Section 3.1.2](#) and [Section 3.1.2.2](#)).

[\[I-D.autocrypt-lamps-protected-headers\]](#) describes a possible way to achieve backward compatibility with existing S/MIME (and PGP/MIME) implementations that predate this specification and are not MIME-conformant (Legacy Display) either. It mainly focuses on email clients that do not render emails which utilize header protection in a user friendly manner, which may confuse the user. While this has been observed occasionally in PGP/MIME (cf. [\[RFC3156\]](#)), the extent of this problem with S/MIME implementations is still unclear. (Note:

At this time, none of the samples in [[I-D.autocrypt-lamps-protected-headers](#)] apply header protection as specified in Section 3.1 of [[RFC8551](#)], which is wrapping as Media Type "message/RFC822".)

Should serious backward compatibility issues with rendering at the receiving side be discovered, the Legacy Display format described in [[I-D.autocrypt-lamps-protected-headers](#)] may serve as a basis to mitigate those issues (cf. [Section 4.2](#)).

Another variant of backward compatibility has been implemented by pEp [[I-D.pep-email](#)], i.e. pEp Email Format 1.0. At this time pEp has implemented this for PGP/MIME, but not yet S/MIME.

## 5. 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.dkg-lamps-e2e-mail-guidance](#)].

### 5.1. Mixed Protections Within a Message Are Hard To Understand

[[ TODO ]]

### 5.2. Users Should Not Have To Choose a Header Confidentiality Policy

[[ TODO ]]

## 6. Security Considerations

[[ TODO ]]

## 7. Privacy Considerations

[[ TODO ]]

## 8. IANA Considerations

This document requests no action from IANA.

[[ RFC Editor: This section may be removed before publication. ]]

## 9. Acknowledgments

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### 10.1. Normative References

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## **Appendix A. 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.cmrg.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.cmrg.net>.

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

### **A.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.

#### **A.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

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

#### **A.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:

MIILFWyJKoZiIhvcNAQcCoIILCDCCCwQCAQExDTALBgBlghkgBZQMEAgEwggFABGkghkiG9w0BBwGgggExBIIBLU1JTUUtVmVyc2l1bWVjogMS4wDQpDb250ZW50LVR5cGU6IHRleHQvcGxhaW47IGNoYXJzZXQ9InV0Zi04Ig0KQ29udGVudC1UcmFuc2Z1ci1FbmNvZGluZz0gN2JpdA0KDQpUaG1zIG1zIHRoZSBzbWltZS1vbmUtcGFydCBtZXNzYWdlLg0KDQpUaG1zIG1zIGEgc2lnbmVklW9ubHkgUy9NSU1FIG1lc3NhZ2Ugdm1hIFBLQ1MjNyBzaWduZWREYXRhLiAgVGhlDQpwYXlsb2FkIG1zIGEgdGV4dC9wbGFpbiBtZXNzYWdlLiBJdCB1c2VzIG5vIGhlYWRLciBwcm90ZWNoaW9uLg0KDQotLSANCKfSawNlDQphbGljZUBzbWltZS5leGFtcGxldQqgggemMIIDzZCCAREgAwIBAgITDy0lvRE5l0rOQlSHoe49NAaKtDANBgqhkiG9w0BAQ0FAFBVMQ0wCwYDVQQKEwRJRVRGMREwDwYDVQLEWhMQU1QUyBXRzExMC8GA1UEAxMoU2FtcGx1IExBTVBTIFJTQSBDZXJ0aWZpY2F0aW9uIEF1dGhvcml0eTagFw0xOTExMjAwNjU0MThaGA8yMDUyMDkyNzA2NTQxOFowOzENMASGA1UEChMESUVURjERMA8GA1UECXMITEFNUFMGV0cx FzAVBgNVBAMTDkFsaWNIIExvdmVsYWNIIMiIBiJANBgqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAmPUp+ovBouOP6AFQJ+RppwODxxzY60n1lJ53pTeNSiJlWkwtw/cx Qq0t4uD2vWYB8g0UH/CVt2Zp1c+auzPKJ2Zu5mY6kHm+hVB+IthjLeI7Htg6rNeu Xq50/TuTSxx5R1I1EXGt8p6hAQVeA5oZ2afHg4b97enV8gozR0/Nkug4AkXmbk7T HNC8vvjMUJanZ/VmS4TgDqXjWShplcI3lcvvBZMswt41/0HJvmswqpS6oQcAx3We ag0yCNj1V9V9yu/3DjcYbww2lJf5NbMHbm1LY4X5chwFNEbkN6hQury/zxnlsukg n+fHbqvwdhJLAgFpW/jA/EB/WI+whUpqtQIDAQABo4GvMIGsMAWGA1UdEwEB/wQC MAAwFwYDVR0gBBAwDjAMBgpghkgBZQMCATABMB4GA1UdEQQXMBWBE2FsaWNIQHnt aw1lLmV4YW1wbGUwEwYDVR0lBAwwCgYIKwYBBQUHAWQwDgYDVR0PAQH/BAQDAgUg MB0GA1UdDgQWBBSiU0HVRDyAKRV8ASPw546vzfN3DzAFBgNVHSMEGDAWgBSRMI58 BxcMp/EJKGU2GmccaHb0WTANBgqhkiG9w0BAQ0FAAOCAQEAGUl4oJyxMpwWpAyl OvK6NEbm1lgD5H14EC4Muxq1u0q2XgXOSBHI6DfX/4LDsfX7fSIus8gWVY3WqMeu OA7IizkBD+GDEu8uKveERRXZncxGwy2Mfbh1Ib3U8QzTjqB8+dz2AwYeMxODWq9o pwtA/1TOkRg8uuivZfg/m5fFo/QshlHNaatDVEXsU4Ps98Hm/3gznbvhdjFbZbi4 oZ3tAadRlE5K9JiQaJYOnUmGpfB8PPwDR6chMZeegSQAw++OIKqHrg/WEh4yiuPf qmAvX2hZkPpivNJYdTPUXTS07K459CyqbqG+sN0o2kc1nTXl85RHNrVKQK+L0YWy 1Q+hWDCCA88wggK3oAMCAQICEzdBBXntdX9CqaJc0vT4as6aqdcwDQYJKoZIhvcN AQENBQAw/TENMASGA1UEChMESUVURjERMA8GA1UECXMITEFNUFMGV0cxMTAvBgNV BAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2VydgGlmawNhdGlvbiBBdXRob3JpdHkwIBCN MTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcWU0MThaMDsxDTALBgNVBAoTBElFVEYx ETAPBgNVBAsTCExBTvBTIFdHMRcwFQYDVQQDEw5BbGljZSBMb3Z1bGFjZTCCASiW DQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBALT0iehY0BY+TZp/T5K2KNI05Hwr +E3wP6XTvyi6WwyTgBK9LC0wI2juwdRrjFBSXkk7pWpjXwsA3A5G0tz0FpfgyC70 xsVcF7q4WHWZwleYXFKlQHJD73nQwXP968+A/3rBX7Ph00DBbZnfit0LPgPEwjTt dg0VQQ6Wz+CRQ/YbHPKaw7aRphZ063dKvIKp4cQVtkWQH6syTjGsgkLcLNau5LZ DQUdsGV+SAo3nBdWCRYV+I65x8Kf4hCxqqmjV3d/2NKRu0BXnDe/N+iDz3X0zEoj 0fqXgq4SWcC0nsG1llyXt1TL270I6ATKRGJwiQVCCpDtc0NT6vdJ45bCSzsCAwEA Aa0BrzCBrdAMBgNVHRMBaf8EAJAAMBCGA1UdIAQOMA4wDAYKIZIAWUDAgEwATAA

BgNVHREEFzAVgRNhbGljZUBzbWltZS5leGFtcGx1MBMGA1UdJQMMMAoGCCsGAQUF  
BwMEMA4GA1UdDwEB/wQEAwIGwDAdBgNVHQ4EFgQUu/bMsi0dBhIc164papAQ0yBm  
ZnMwHwYDVR0jBBgwFoAUKTC0fAcXDKfxCSH1NhpnHGh29FkwDQYJKoZIhvcNAQEN  
BQADggEBAH0JojanzqmgasN3/ggSQ4cbbmdj/R40BEPr+gXT+xiidfZ2iLNwYyTn  
euK6ACHwKfnNvOFb8lV1iffRTF/KtmVEDMR/sYeqAH83KM5p3e12lVh40HhyI0qN  
uz5oShNaACSioQ23WxHGvy9vsdVfnbhsp1rwg9NQ2WbpCmK+2oMh2oYl0Z/wvXmt  
9cG6jbMvcdH4z0IOvg6mrYkKTM/RCGnumghxwYToj10yD5Gs4D2IJCw+fX50Dxh5  
2MbNRYXTus2ZPRPM8JXNQc4Gwv4km3M4rKnJDd6hnoQ9rNeozIcBVyybQYjfrgg4  
DRvw9Ksk220H4ConlB8f7R7s1LM2cSYxggiAMIIB/AIBATBsMFUXDTALBgNVBAOT  
BELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTewLwYDVQQDEyhTYW1wbGUgTEFNUFMg  
U1NBIEENlcnRpZmljYXRpb24gQXV0aG9yaXR5AhM3QQV57XV/QqmiXDr0+GrOmqnX  
MASGCWCGSAFlAwQCAaBpMBgGCSqGSIB3DQEJAZELBgkqhkiG9w0BBwEwHAYJKoZI  
hvcNAQkFMQ8XDTIxMDIyMDE1MDEwMlowLwYJKoZIhvcNAQkEMSIEIESMi+9/LU1D  
fGjj+6U50VNLfxbzvYVJ0wzwnTS114DyMA0GCSqGSIB3DQEBAQUABIIBACJHeayB  
U1lC4GdcgdojTUjoeIy6UIbrSg/akZgAkCB8Dwq0hdU10qiun6WKI/TxM5izpRvL  
UsNBGmqknPBMFhvwX6KCrwFk0p0j5Y5DZqX30deiQiGTUv3NiwZGTrKJ3JkyyMF0  
HGbe5Thrq3inRLVfilEuIZewaJsnJhKfnEq9fS09icTJ5o1PDAH6mZbW6hpYmU3F  
KBk2qJNqJX6bo60rCogu3wXDj0wxnqEXmeNDH5/+L9UVZur+EWzviUc8Ldd/kP3L  
D007ivs10bAwe8Tbw7NjuP8ZlVvzcvj3nXWzZzxh2ymDIOvyJA+t0LHQvsN/fbdw  
fC6Pm51fEkabbmw=

#### **A.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 4156 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="76c";  
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

--76c  
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

--76c  
Content-Transfer-Encoding: base64  
Content-Type: application/pkcs7-signature; name="smime.p7s"

MIIJ4AYJKoZIhvcNAQcCoIIJ0TCCCC0CAQExDTALBglghkgBZQMEAgEwCwYJKoZI  
hvcNAQcBoIIHjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQGirQwDQYJ  
KoZIhvcNAQENBQAwwVTENMA5GA1UEChMESUVURjERMA8GA1UECzMITEFNUFMgV0cx  
MTAvBgNVBAMTKFNhbXBsZSBMQUU1QUYBSU0EgQ2VydGlmawNhdGlvbiBBdXRob3Jp  
dHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThtaMDsxDTALBgNVBAoT  
BELFVEYxETAPBgNVBAsTCExBTvBTIFdHMRcwFQYDVQQDEw5BbGljZSBMb3ZlbGFi  
ZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAlqVKfqlLwLjJ+gBUCfk  
ackTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfIDlB/wlbdmadXPmrsz  
yidmbuZmOpB5voVQfiLYy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0a  
Gdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6l41koaZXC  
N5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcv9w43GG8FtpSX+TWz  
B2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK  
arUCAwEAAa0BrzCBrdAMBGNVHRMBAf8EAjAAMBcGA1UdIAQQMA4wDAYKYIZIAWUD  
AgEwATAeBgNVHREEFzAvGRNhbGljZUBzbWltZS5leGFtcGx1MBMGA1UdJQQMMAoG  
CCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj  
80e0r83zdW8wHwYDVR0jBBgwFoAukTC0fAcXDKfxCSHlNhpnHGH29FkwDQYJKoZI  
hvcNAQENBQADggEBAIFJeKCsTKcFqQMpTryujRGzJdYA+R9eBAuDLsatbtKt14F  
zkgRy0g31/+Cw7H8e30iLrPIf1WN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMt  
jH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpEYPLror2X4P5uXxaP0LIZR  
zWmkw1RF7F0D7PfB5v94M5274XYxw2W4uKGd7QGnUZROsvSYkGiWdp1JhqXwFdZ8

A0enITGXnoEkAFvvjiCqh64P1hIeMorj36pgL19owZD6YrzSWHUz1F00juyu0fQs  
qm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV5  
7XV/QqmiXDr0+GrOmqnXMA0GCSqGSib3DQEBDQUAMFUXDTALBgNVBAOTBE1FVEYx  
ETAPBgNVBAsTCEsBTBVTIFdHMTewLwYDVQQDEyhTYW1wbGUgTEFNUFMgU1NBIEN1  
cnRpZm1jYXRpb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoYDzIwNTIwOTI3  
MDY1NDE4WjA7MQ0wCwYDVQQKEwRJRVRGMREwDwYDVQLEwhMQU1QUyBXRzEXMBUG  
A1UEAxMQQWxpY2UgTG92ZWxhY2UwggEiMA0GCSqGSib3DQEBAQUAA4IBDwAwggEK  
AoIBAQC09InowDgWPK2af0+StijSN0R8K/hN8D+1078oullsk4ASvSwjsCNo7sHU  
a4xQUl5J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUBYQ+950MFz  
/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2GxzYms02kaYWTut3  
SryCqeHEFbZfKb4urMk4xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWFfi0ucfCn+IQ  
saqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H6l4KuElNAtJ7BtZcs17dUy9u9C0gE  
ykrivokFQgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAX  
BgNVHSAEEDAOMAawGCMCGSAFlAwIBMAEwHgYDVROBBcwFYETYWxpY2VAc21pbWUu  
ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD  
VR00BBYEFLv2zLItHQYSHJeuKwQqENMgZmZzMB8GA1UdIwQYMBaAFJEwjnwHFwyn  
8QkoZTYaZxxodvRZMA0GCSqGSib3DQEBDQUAA4IBAQBziaI2p86poGkjD/4KkkOH  
G25nY/0eNARD6/of0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZl  
RAzEf7GHqgB/Nyj0ad3pdpVYeDh4ciNkjbs+aEoTWgAkoqEnt1sRx1cvb7HVX524  
bKZa1oPTUNlm6QpivtqDIdqGJdGf8L1zLfxBuo2zL3HR+M9CDr40pq2JckzP0Qhp  
7poIccGE6I9Tsg+Rr0A9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz  
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEm  
MYICADCCAFwCAQEwbDBVMQ0wCwYDVQQKEwRJRVRGMREwDwYDVQLEwhMQU1QUyBX  
RzExMC8GA1UEAxMoU2FtcGx1IEsBTBVTIFJTSBDZXJ0awZpY2F0aw9uIEF1dGhv  
cm10eQITN0EFee11f0Kpolw69Phqzppq1zALBglghkgBZQMEAgGgATAYBgkqhkiG  
9w0BCQMxCwYJKoZIhvcNAQcCBMBwGCSqGSib3DQEJBTEPFw0yMTAyMjAxNTAyMDJa  
MC8GCSqGSib3DQEJBDEiBCBBQ1io2vX/u19qayJ1Cm1QL6VZY0fBeGz9o7nEzCR0  
+zANBgkqhkiG9w0BAQEFAASCAQARvWkQYbbPuADZ7Kqy09LuESdEfBxOF80sHKNz  
UXrHZo8JdKaKxr/CTAUzBvoTxsmqvzP3ItCBm+javqX22+tHTpqisz5jkoIWyNVS  
e+F++YX8mXokgQpY26mZ+15Mv8pYYhptn6zdkRU1+Q0wwlDCc6ykkCZeXyc+Hf7c  
xqM6SqPMQ+G7wIF6P2jHCId8Xyl7sdbL0i6PjotesHU+7nQsCjgI/iVR/ubWudFX  
CTg8HVy4p683V3Y9DoRNP4MlUdmon8JasHDvA0240JcXxhJn1zEYa4gOnwgu3kh9  
3Y+NeucYCT0bXCBq2RLVQSpdNZfScXKL9QvZ3FtB0r6Bmtky

--76c--

#### A.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

MIITXAYJKoZIhvcNAQcDoIITTTCCCE0kCAQAxggMQMIIBhAIBADBsmFUXDTALBgNV  
BAoTBELFVEYxETAPBgNVBAsTCExBTvBTIFdHMTewLwYDVQQDEyhTYW1wbGUgTEFN  
UFMgU1NBIENlcnRpZm1jYXRpb24gQXV0aG9yaXR5AhMPLSW9ETmXSs5CVIEh7j00  
Boq0MA0GCSqSIsB3DQEBAQUABIIBAE1K2Qo2Ln506L9qgFn0dVuAuXnh2dLiYWIt  
x7B9W2VMQctrXTipZFue+Y4oV/Rxifp4gChJ2lCgt6A4hHyApD1yNqmR1pCT+ky6  
j0Jlr907Jzy9nIADEjaeKTIHePPWEWpIF30t1rvG25NobNAE/dzcSgaS+SHsfPgu  
vW6gA+lfzdoOKIWNv11AJfbDRw8DeDi5n8ZPLkb/gYteBpY5mC2Iu8TebZ5qstQH  
i8G01K4xb6E7eMdXKx+gyDxox1P79E4q3dCKwYPK/C6B3AaY52WW55js9mb790H5  
6/XvIEez581v4a9d0iY7g+aoARYTPE9Z79miRYT0aagyYhblb14wggGEAgEAMGww  
VTENMASGA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cxMTAvBgNVBAMTKFNh  
bXBsZSBMQU1QUyBSU0EgQ2VydG1maWNhdGlvbiBBdXR0b3JpdHkCEzB8R0APhiY6  
HGLS64MvlsDXhpQwDQYJKoZIhvcNAQEBBQAEggEAWANrcGMnwYd7bg/TA9Wagm3q  
dbiZLg3NxHQZRLRySCFht5wGkq1XcD7bWYwF0hSKiI4AJxJapfGUDEpDk1FYBU4r  
9zS/elrwCnhwp09sLfBJPRVvMTgTZuCOaY25ovZWvWtkS9MRDH+WoM5SNTf4vHHu  
kjcSx5hafbhyiC5pLLTRYIj0bYgKraIMBXix7XKtSR/G7uD+HSIzhYUXqY0q2uQ  
w7XiijbRd4bq9zqBbXriYyhFdo/JsbNyckjmmKcTLP6DfYTEzILKBJOepEiY5X4J  
0JPeFyGxs7WSKDP1JZLZtjbMwvtEuUAWZ+iXDr1x/rQhq7mZIWqIbG6QpxYX6zCC  
EC4GCSqSIsB3DQEHATAdbGlghkgBZQMEAQIEEBDwXZa6LrdPCgLabNCkd3qAghAA  
kaaty8gkFo4+y5iWe0qsbZ9paegmFbiGsTQxrta64sj8znKQfQKz6/g055IcDixI  
STqxPMV+w01jv6+Azoy9qJP29UTL0mXAP0LDionSBTn/4VAwBMSUDRus6jkq045K  
UXxmIpc03Se0npCLksyij6QlnA024SbKsBex7R5EXYXU7W1G/PCoz9SWlYrQuXJ9  
cU50NWldvYE4/WeD1m3pjv3XKLNEWiaUIVo1KFRhR4v+FUedn6dlVYDgfJrH8xDC  
kW9gQvI1ZBbnB0r/zkoDhMMktTgTvmzLIAuDEi2RWKzlvwCattvIkkrjt+Swwpvr  
oc6i58XfCx/d0YHPp5AIU8pslawDtQXe5ecACY9J/K00gX1G51HI+02XMC9S9QYn  
YPxA+CsrXmhKHZqV9au48aQwmLBkhkXZq7FCve8GTnCLdU5AmtP6ff59lga7+hfb  
VSz+jSodBL1Wn1IKw/lrBvXFem/A4mtY/W9y9EVhGyRFuhoZDCiGro/bPsyDNZBS  
WAsjHLI3NJeUgHFFcEn5x0wDmhmJOehzs712pqrzMd0VrT4hALvvhSGB7nybL5dR  
pabbxtPbgqzlwu6eoX1jSh5bF8/RsAJ81dxvn8AWcFc8q81YfY0zjqf7ZnuumT10  
18/rdepv/nfyiYCRhr2Eekj0F3bXj1TG1oeCNTuUPcNHVX6+hQ7FY2CJm9JCqNhL  
7whKhq+kKJuPughb1e5d2rJfKNHrMIJAg8QqKy9eqKct4gW5FFT70wyB15YToJb  
qVxb3BEZ6u1shpZ9IGVzS0Jmvke+Ptze86it00fQIJWfrFqoag83GcCuQEYyEcIc  
HXWFsZiBQ1UD2+YSWBOzRBUUuJ3U66w3J5oDAYfYnieFNPuP0dhaAMsu7QQfLSZa  
T/GbSibQoFXcDx6MaZ5fbZ1iduvoZZfERNMe5vN+q/w9Lx5e8hf1EZmTNMuoRn90  
wft/wuM06Cc8FR2Ft7QLu80jqePQ6tAYwvA5Q0vpBN9A82DUWz0I9eRDl9+S8Z+I  
QgjbPcZ0ACFqLCfbT6uzrKp2vGSrA+IcS89+qBB+sKbtWPgTrK7QlJgc7NpHGyhZ  
BlTAVXv4fPngqn+gSqGuerD/xmvszHMIHq6Q4ADxbxDE4R0yoV2afXUVyAMo85Q  
eNG5WJ83Z12msJqx1+1EUzzoQXxvrZHM0bmMziCjV/P1cu/ChtmuemopRxp1LbJv  
/mChRaKv9TotDy2Dwzf5N5Xy58gb/0ktMXMdGpYts9awYc742TCscrTqutBAXtNM  
dXA00yelkVHBBRCouEWWHUGQKYmK0NQIPxduJYcLLhkMI+2QfyfdkODp1EtXbX9  
LaZhPRI9osmmF0fnSkmt2mtD+W8uxBF7espDkUsidb8NiUtZBrSqTADQUiuAw5xG

322wFZ0DtpFM6nHpbYBfIGlIR4LyqTzyaSRJtMkMiDFgnMWrNF6pMsToo+4GbAR0  
MWM9mq4XSMrKAinquin7T8UGW0t9bMfMjRTrpfETgQCL4vur9nI1CbgcPWW14U2oBW  
2lT1duS0o2eRpeGA93U6zF7BbCmLEqPK45Qmm78NwMcI9i4GgHSG2ssEn8URmv0L  
qp9+UmkhVLT26dZtkB0wPMEV0Iwx3e+F34eVzno5jAbiJxuUIIdDPDwQg7xtrcLif  
lRsaIGx7MtWsP6paqGBrYdHcXnt8P8k2ywnQRicTSThG0P09CNDWFwNaKa+9Ia7a  
EnWoFmNoNm/IUH+wbRQUnT7oh0qU2mxdgMnygDhEELe1+4tGCTAPTbxSU3gxQyv0  
w686bzZP9uGLoRfivmXKm73Wu0HtUefT1rNdPsJDfqEfo8mEY4EDMh+Fa50S9Yj6  
SGe8X9jDaTEJLd+yL7xEvdEQ7FxHbqo7twj/g4Im00eG2ngEchWLYcuOrlgog4bv  
kWwcMh0CcQ/9242sgCTG/ATAV1ix0Z16/WCzzY60Zxk1eAlP3Ar9NiQHGuVC1R0o  
QxhlP/1KvyVMAQTtuEposNLudXMydq8lVerFuopYej3NJ0PE7eA4BeIXNyrhxqfX  
j23tfb3/C4uHEmgjnfW1LZIJwWrOjoeZa2+lG+Si7YQWLLJWFNqEEH2rpxQMnwvx  
282dIYpyY14PDLLN5nMltY8MeMaNp6Q8rOwTDozmmZ9RONzbKJL3FxSVENKgdJTf  
v+gpLOvXou6qDdidAqxErGM0j68g8Rnsdw7Lj3FQH7JjLZiR3EQgGxRKDWtsV1rW  
ODtsNyKBtHDBOn/zOFTmgTVpYo12x/kv22C1Wn9ZArHfGZDxDyDjjJqxJwHlgVdE  
J+bUZ1C5DatXxvjpFhrTpUz1dvsTsq48cmepEiEnqY0/33uU7KIqjBxY527dagnR  
q01ntVycY4wilKjuJHHHy/b250RyxS/x6nVYJsoRNxsvYCZ1zqHC7uh9eQStAyj6  
zotbPet++u2REXKSwzhI+6mTCrFkfeHxt3BqTPAxHPxsZAmquayksNs8e94G5LnD  
VLAbdtwuIdeuz3rDW0bafna0VXD8vzjoMpiZcYKubb9pdFQIdxpYXPYqWz2f+c8g  
9VnLXajpwqByOPtLT5knKWmbsXJ5Gc8sNIGl1blYnj5ao+z6JNV2qqWA8dukpm5Q  
/KwmBVR9/RijeIEPGoqRcwUi92fuvVJV7oZf2ZCCGMLw8W4pSrzfs/xd0Js1rTgN  
trDrA0KlraCKJQ5zHwZyg+c65KUe+5voj4WTu27g/vWTmPjF70htA+UIYcsNVYU9  
yGuznj6x/2EV7rLSUtPmqMFN0s4dQl4Hhfr4gaoDR0b7b0dkVtWAvwP4c18w1JA9  
08X9kQNPqID0M0N0ruz8J08gyTIxyAmopnEDREvMT7JCGuwPM9YRE64pVPOZ1AZm  
STC7LY11zMHZL+RvhwbWqjKKeKN3hQM4/45BHGFVgg6k5iobcv78LZHw028Swila  
dEgJLSobB9ie0TfrWqBrBBHjpaDwuyjS+QwjSf8SFLdRD5TY1IugUvW5Swnucikh  
X1rK/FaRRQJGzUesrkN06LlpFiiRyW9nuDjdpaKV4P9pkEjHmtN3KF95LjJnXs+Z  
07cF0sX2K7FY4GCFfXGPPSsqbcR/6zAFHVPjgPGDH51y0Te05RWLhgGEWqt7mIeSD  
ppJdnY1LDFK0AFbXAFnjxhNwlfJiLB4vdsFqxGSYXfAjns8vZR62PgSExxUMxr06  
P7oIAYisiu+9XuG40ok8RFCZgN2Qdy5oNdbYow8x3XR4BQu8+2sT9nLvJosjYnHT  
8yHMhhAbJl5VWK1EaB2gMxmAISiCCkQq4YlStMc/Lukl8X0dQmf9SF0L1puuGEpM  
V3BhxNxCReiXA8ulMtnytw++lh13qapALVu50sJBQ2sqrhc7VhZTfiRQHr5s/i97  
OrBb1ZHv48Nblw+tsS0v1+jw/7AMUvQ0+j7wYDI8Q2GplujJ08iHxZw/YDjR+up4  
bmQjK3xySaCi9Ef58KY0j0Y8ITvS61GMn0bCkL23UGNwISo2gPEcStd0ksZtlvGX  
X37skwsFPD3M85DqQeckjv3PFzGQL7ZZLUQmmYqWg43DKrDJSZld7VYHmTY0rrMj  
gNo6iqzI+6Ygi81y14ZWtVe0FIH9t0KvjtuJz+90Qi9vEbDqF43+hiyWvg/a0ke8  
4TGy7BZp5j/+Scr78/LvTko/5gafEymhaQmmsR7hskt3AhjfTyUfq/cAtuIm39U2  
MmXRwPdrzWASgy/lF0QnrgB0T85+ID58J9VaP78mI/BtK020wWMTjbabR7J3Rn+8  
KW4H6eewVWBqghCnsJQuqibbZeFDjFgJ9kIaTvGD0TBehpp9TidmppXM4Dl4J+V/  
u7dSL257Dz1Kkk42gK4Cs0P1dZwe888KIABF38AZ8dnWtD492eYxA9We6NB2ru1o  
K59oloZdn+slcF3DLfvVpyfkZ8o3EVgAPVXiDfHWuVp1g18Cv5ahVlk9BJSd1CgC  
Vwsm01V1E7QeNh3gNdQI88tu4wh5SVFk4U2cYI+dDMFUVDmZrUI3tKvWXNZ0zn4V  
Ce6Eu2JPIcCOYUwDHpsq5aj9BPKBguhQQybDpAAkgSZLwhzAD7rEvo8TU8gzZ2KZ  
ZH506GoFtU4oNinnrvyHX96/bG/Vliz0E9YtQNYefxxS0BsZD9jgd1pG4j/FDF1Z  
Ib+KUUo8Y7GKl0u+l+/WIVcp0nIsyIC4zGdM6DThCT6nGrhKbodutGf5NRH/Hf03  
Vrbj/ZarK0t1gzbzPgxtZiUfCvEuav9AVqxA2Zq5afs6bRfohqyFqWKHiYV19C4  
m00v4HisEFDDG3f5+Zj/x6tnX9QxR81D0omUooh8aYs/iAz0nrKyux6GMHS1j8db  
UbvQ+1VvNE3Fj0xu46HkKzGtFqpgXxzDLkE9e7NJ+Hw4tb0LfINQ0qS7iTcjMbwg  
snexBuL6rf8NF28EdlqQzCPLZVhn0d1+KKJS7V/M8u/R/y22+IXzFSA2TlxhId09  
IduZ3ByCz2HFJfVj7SameC3KANbRnBkdud1hc1IBDS5Hhpqk4M8i3zmZRZWgLyjR

edtSaHuJAlHiKgAtQVeIz1L6I1w3jVoHL0v0dISoQpowWhejB9f47KRmUdbb5Pxb  
0t2ylXJKYFFoCQUs1xkNAaynSJAJ97yEAM7aDmE4bjs33pz4L3nYx0/KUY6EB/E  
eGgPk3Cdvt2JYY5BuFoxXYRKQgZ06c9mXzavJJXXWQUUB5k2QG0uyKPMwNr2sdJQ  
A8ehhmgGws+7qXwZQEcNC3W0vmiG0BDYP3JVJPiNLFVQN9k8C1E7+0emFn2UcNyG  
294h01G0uBPAbCdHAYDnNpVj5RS0EgY647agQHyp/gjSt4XeoacIKaalb4iGpT+C  
4r2BqRcVUCdE3MRQFqiT6ccm+8h8eA7xtMB8c90gUTEIKk/WSc0DUSCJB62Plgtj  
KJ4xXQXTzzUCDMnACFP6mBTd3g2ZbnfHKSyJdAvPigVbA+Qhy2eWUTYpi6yjTIyT  
eaQ2qafGppn85oLFkdgdme3Ty1Ux0pAsqLyN1NAa6YT3D/0Jl3VnfhFKlmywWIG6  
Z2SLd0r07xoBUuAKHkFUuRauGYbVbU/Frmdylv6I9DhCqV/XEDa/tH0a/LWugvb+  
x5A+g+kZiTiWRRLLZYHungyjquAf/zeJsPYRoQEi4KHAQ30xCDk/dhWdhDBnUXT8P  
hzMj8VN3yjQA1vMNA5uefj2/+MIkLkz6+XPl/1JNLFHYi+EERgxJ2mFm/s02h9NF  
NhyWBsBtsEwi+rVbfcRRBPvjR5MwUohNHMGxwgj7rzvUkDe47ueXDP74j+Jc1068  
r4jQ3sob123uSYryDHBZxZSbwjFU2ufE8W+XL/NGwTw04a1HZfKSH4x4ZbGqwunf  
U4lkcoY/ijmuhL5mn2YYUE6w4oywZuLx5WCv2oAvQawMmNP9AeI1jcV9JiKa+8y0  
sAa1LzD78Dg4FK08t3d13Q==

#### A.1.1.5. 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 1357 bytes
  - └ multipart/alternative 780 bytes
    - └ text/plain 206 bytes
    - └ text/html 290 bytes
    - └ image/png inline 232 bytes

Its contents are:

MIME-Version: 1.0  
Content-Type: multipart/mixed; boundary="0f4"  
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

--0f4

MIME-Version: 1.0  
Content-Type: multipart/alternative; boundary="384"

--384

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  
--384

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>  
--384--

--0f4

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

iVBORw0KGgoAAAANSUHEUgAAABQAAAAUCAyAAACNiR0NAAAACe1EQVR42uVT0xbA  
MAgS739n03TpRw20dqpbfARQEj0ywiwYnCtkDKnbcLk66sq1T+zt9cidkE+6KwkZ  
sgrzfcqVMpL2jo0447gYDpeArk+0nJHkIhAfTPRicihAf5YJrw7vjv0ZWRWM/uli  
vdPf1QZ2kDD9xppd8wAAAABJRU5ErkJggg==

--0f4--

#### A.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] 5229 bytes
  ↓ (unwraps to)
  └─ multipart/mixed 1274 bytes
    └─ multipart/alternative 868 bytes
      ├── text/plain 258 bytes
      └─ text/html 339 bytes
    └─ image/png inline 236 bytes
```

Its contents are:

[illegible]

BgNVHRMBAf8EAjAAMBcGA1UdIAQQMA4wDAYKYIZIAWUDAgEwATAeBgNVHREEFzAV  
grNhbGljZUBzbWltZS5leGFtcGx1MBMGA1UdJQQMMAoGCCsGAQUFBwMEMA4GA1Ud  
DWEB/wQEAWIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj80eOr83zdW8wHwYDVR0j  
BBgwFoAUKTC0fAcXDKfxCSH1NhpnHGh29FkwDQYJKoZIhvcNAQENBQADggEBAIFJ  
eKCCsTKcFqQMPTryujRGzJdYA+R9eBAuDLsatbtKt14FzkgRy0g31/+Cw7H8e30i  
LrPIF1WN1qjHrjg0yIs5AQ/hgxLvLir3hEUUV2Z3MRsMtjH2x9SG91PEM046gfPnc  
9gMGHjMTg1qvaKcLQP5UzpEYPLror2X4P5uXxaP0LIZRzWmkw1RF7FOD7PfB5v94  
M5274XYxW2W4uKGd7QGnUZROsVSykGiWDp1JhqXwfDz8A0enITGXnoEkAFvvjiCq  
h64P1hIeMorj36pgl19oWZD6YrzSWHUz1F00juyuOfQsqm6hvrDTqNpHNZ015fOU  
Rza1SkCvi9GFmNUPoVgwgppPMIICt6ADAgECAhM3QQV57XV/QqmiXDr0+GrOmgnX  
MA0GCSqGSIsb3DQEEDQUAMFUXDTALBgNVBAoTBE1FVEYxETAPBgNVBAsTCExBTBVT  
IFdHMTewLwYDVQQDEyhTYW1wbGUgTEFNUFMgU1NBIENlcnRpZmljYXRpb24gQXV0  
aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoYDzIwNTIwOTI3MDY1NDE4WjA7MQ0wCwYD  
VQKKEwRJRVRGMREwDwYDVQQLLEwhMQU1QUyBXRzEXMBUGA1UEAxMOQWxpY2UgTG92  
ZWxhY2UwggEiMA0GCSqGSIsb3DQEBAQUAA4IBDwAwggEKAoIBAQC09InoWDgWPk2a  
f0+StijSNOR8K/hN8D+l078oullsk4ASvSwjsCNo7sHUa4xQUl5J06VqY18LANw0  
Rjrc9BaX4MguzsbFXBe6uFh1mVpXmFSpUByQ+950MFz/evPgP96wV+z4TtAwW2Z  
34rTiz4DXMI07XYNFUE0ls/gkUP2Gxzys02kaYWTut3SryCqeHEFbZfKb4urMk4  
xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWffioUcfCn+IQsaqpo1d3f9jSkbtAV5w3  
vzfog8919MXKI9H6l4KuElnAtJ7BtZcs17dUy9u9C0gEyKriVokFQgqQ7XNDU+r3  
Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAAQH/BAIwADAXBgNVHSAEEDAOAwGCmCG  
SAFlAwIBMAEwHgYDVR0RBBCwFYETyWxpY2VAc21pbWUuZXhhbXBsZTATBgNVHSUE  
DDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYDVR0OBBYEF1v2zLIthQYS  
HJeuKWqQENMgZmZzMB8GA1UdIwQYMBaAFJEwnHFWyn8QkoZTYaZxxodvRZMA0G  
CSqGSIsb3DQEEDQUAA4IBAQBziaI2p86poGkjD/4KkkOHG25nY/0eNARD6/oF0/sY  
onX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZlRAzEf7GHqgB/Nyj0ad3p  
dpVYeDh4ciNkjbs+aEoTWgAkoqEnt1sRx1cvb7HVX524bKZa1oPTUNlm6QpivtqD  
IdqGJdGf8L1zLfXBuo2zL3HR+M9CDR40pq2JCKzP0Qhp7poIccGE6I9Tsg+Rr0A9  
iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz0KypyQ3eoZ6EPazXqMyH  
AVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEmMYICADCCAFwCAQEwbDBV  
MQ0wCwYDVQKKEwRJRVRGMREwDwYDVQQLLEwhMQU1QUyBXRzEXMC8GA1UEAxMoU2Ft  
cGx1IEExBTBVTBIFJTQSDZxJ0awZpY2F0aw9uIEF1dGhvcm10eQITN0EFee11f0Kp  
olw69Phqzppp1zALBg1ghkgBZQMEAgGgaTAYBgkqhkiG9w0BCQMxCwYJKoZIhvcN  
AQcBMbWGCsQGSIsb3DQEJBTEPFw0yMTAyMjAxNzAxMDJhMC8GCSqGSIsb3DQEJBDEi  
BCCBo3TZITs9IUGlq1c1kkamrYq1pC+qA0mbM6mBrJawJDANBgkqhkiG9w0BAQEF  
AASCAQARpmjNRbLD+Z682oraEKCbEbDsym9Mrdu6nkcZ+ivEj+AHTU9rt+LBdvTb  
gHEKrwW8/HJ8C9eybTU4XJlVzbvGLRFhLPrLNz23qygzUH9AJ3n0NY9eGAHLRagc  
Ij3L+IAorjfc3K000s0/rLfb/14EmMLCUDJlShrsqCrFfXQxKi9dwwvVZUzEsGqG  
lhkY58o+No6WN/0SsWTHNNXrg1RKq15PyahFwtySsMZjUOCJr1QDMeKBSE7dpTjX  
wa5N/m9eBDASJyz1xdLOHGfJ1uWn/VR0Lm4xbscAdVJEm5gaH9o4QKf7jXA1709n  
yuP+ZEhRpnjHfJ3XjFKuHiZ36Yon

#### **A.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 5185 bytes
  └─ multipart/mixed 1330 bytes
    └─ multipart/alternative 924 bytes
      └─ text/plain 278 bytes
      └─ text/html 362 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="d66";  
  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

--d66  
MIME-Version: 1.0  
Content-Type: multipart/mixed; boundary="7fe"

--7fe  
MIME-Version: 1.0  
Content-Type: multipart/alternative; boundary="848"

--848  
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  
--848  
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>
--848--
```

--7fe  
Content-Type: image/png  
Content-Transfer-Encoding: base64  
Content-Disposition: inline

iVBORw0KGgoAAAANSUhEUgAAABQAAAAUcAYAAACNiR0NAAAAcE1EQVR42uVTOxbA  
MAgS739n03TPRw20dqpbfARQEj0ywiwYnCTkDKnbcLk66sqlT+zt9cidkE+6KwkZ  
sgrzfcqVMpL2jo0447gYDpeArk+OnJHkIhAfTPRicHaf5YJrw7vjv0ZWRWM/uli  
vdPf1QZ2kDD9xppd8wAAAAABJRU5ErkJggg==

--7fe--

--d66

Content-Transfer-Encoding: base64

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

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hvcNAQcBoIIHjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQGirQwDQYJ  
KoZIhvcNAQENBQAwwVTENMASGA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cx  
MTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2VydGlmawNhdGlvbiBBdXRob3Jp  
dHkwIBcNMtKxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDsxDALBgNVBAoT  
BELFVEYxETAPBgNVBAsTCExBTBTIFdHMRcwFQYDVQQDEw5BbGljZSBMb3Z1bGFiZ  
ZTCCASiWdQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAJqVKfQLwaLjj+gBUCfk  
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Gdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6l41koaZXC  
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CCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj  
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A0enITGXnoEkaFvVjCqH64P1hIeMorj36pgL19oWZD6YrzSWHUz1F00juyu0fQs  
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cnRpZm1lYXRpb24gQXV0aG9yaXR5MCAxdTE5MTEyMDA2NTQxOfoYDzIwNTIwOTI3  
MDY1NDE4WjA7MQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLEWhMQU1QUyBXRzEXMBUG  
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AoIBAQC09InoWdgWPK2af0+StijSN0R8K/hN8D+1078oullsk4ASvSwjsCNo7sHU  
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ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD  
VR00BBYEFLv2zLiTHQYSHJeuKwQqENMgZmZzMB8GA1UdIwQYMBaAFJEwjnwHFwyn  
8QkoZTYaZxxodvRZMA0GCSqGSIb3DQEBAQUAA4IBAQBziaI2p86poGkjD/4KkkOH  
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RAZef7GHqgB/Nyj0ad3pdpVYeDh4ciNKjbs+aEoTWgAkoqENT1sRxlcvb7HVX524  
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7poIccGE6I9Tsg+RrOA9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz  
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEm  
MYICADCCAfWCAQEwbDBVMQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLEwhMQU1QUyBX  
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cm10eQITN0EFee11f0Kpolw69Phqzpp1zALBglghkgBZQMEAgGgaTAYBgkqhkiG  
9w0BCQMxCwYJKoZIhvcNAQcCBMBwGCSqGSIb3DQEJBTEPFw0yMTAyMjAxNzAyMDJa  
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AxIADVfW6YVG3SWVAaTHUM0QmvG9AyV4d0dce+p4aoZfhUfjAF6nWIRLcrfu18z5  
FBxL02+VfWaY0g0d3TgScxQgE2vjAgdz+TqDbQpPriQXf/h7

--d66--

#### A.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] 8670 bytes
  └─ (decrypts to)
    └─ application/pkcs7-mime [smime.p7m] 5408 bytes
      └─ (unwraps to)
        └─ multipart/mixed 1342 bytes
          └─ multipart/alternative 936 bytes
            └─ text/plain 293 bytes
              └─ text/html 374 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

MIIY/AYJKoZIhvcNAQcDoIIY7TCCG0kCAQAxggMQMIIBhAIBADBsmFUXDTALBgNV  
BAoTBELFVEYxETAPBgNVBAsTCExBTBTIFdHMTewLwYDVQQDEyhTYW1wbGUgTEFN  
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s0gYC34/x1zwZ0DWIvrVq5yPslY4Qd5KkFEo8ACTFJFFInL3KaHg7SMHY0bg60cT  
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UTqWptWwsOQD7MGC5bmGDFj4sq0/D4F1HoAwHDjZ/t/BSYXv8JsahPT1L6ymNJ2J  
QpYkqkUTFoAcPGGdRY7V3LDFnprFHQf329krDizoHx8zXkSWX1RPW/SB8jcxkbKT  
5nN06+GIJI+CmO+YJbT10Q8a5bLDAE8rrS5K6d8LAS2b1zX1tnYSqFWIyb84iEG5  
sy6NM1VU14rWIZeVnr0iJmAn3PLDGxVtVKJmLzp5m4EZBESadPFUwdLKvXQQUFeK  
bmUo1BAcLxaemP0S8LJ7AS7mfQSHTRQGI1UCAU0LTuEQg75kQtEPdic71NjorMEZ  
a3oBk72PFLq0AMF3KZOSih8PQisd1UJckiUqlppbgoxTJBbHwd7Cb5GykRb1Sy3X  
hLCfuvxZ4ima8SCu1HGfDF4StdJMdppqtfdn0ttKbcRkMsIVHrNhwwdIwLKR+JXUW  
UotEh3clhvEkuMvzBtkJLG2eEbmCQ7tS0kZB6+fqCJ8rwjFYr1LxzsrJZMmN6+Wk  
uIFRnM5GAwdr/y3cNcUA01HliXhYjZ+aux5QqM3hnqiXwRyjtDbqjZIAZdfphdYf  
6kIuJIsmfvT2vV8IWkzoWeNswd+n+u6qqVWGSvIG2u1+F1WhKS+35kVcppVawtA0  
BG4wMhkqEBJg0CIL3RE3AMEMvswp6i6xwuk+hIO1fk2hhenTed8T2Y8vnAZiTxxk6  
rmArxR9BCXWBi10JryL4Yr9eHc6e/e0hhxk+QrKC2nJs+QTcArXdLJvbsYXdVNum  
Cf8xLegWrkMRsK/FbarFPHzESH2Chy7Q1DbY5ICyfluSvFF1Fh91FGycMRGgd3rr  
ITLV57i20S9b1JVGZNoF3bmRjeJxCCHgl5A+Qz5JxsZsi6HIEeg07IrHE/CCtike  
Bfq1JvR3rm8XSZYX6Neo0aqbX0FAMP9YrevJrZ1hIPT5BfBvElbyaJYGX/jWeqx9  
7nJ2Mh5MxNTnzz//xTdQCrU9gCk5bBe2ZvDwnZ7nCwXRbcNd97+x30EAdHirss/5  
kZyJwrWwuDGUFvinUYf1i1Wo2a2dEHlfYymNr8Uwe31wRMJKqy0bUhb/Rez2I2t  
7U05g0svEnAz/SPbgGk1TUvqcXmQc2GmpPq6Tfk27sDfUCqYKgrDfE44Q9IszBpR  
fAdMTIQLtUWmLCq7ZM2yFkl2mx+ymmEaqKA+3SzC2A32nZ4IKqebD3vIYA6c8aFn  
V80Huub1VAvFsGjviVitZmXL9wTvTLCFzYlRoZJWqmgH+oZZJ36o1tYaEobaTvCU  
MfpKuuqQ01ifjFtdn05Wjtd4Usw90ngspR3V2EoTiUC4+oGJYQ1ux8ACWjNJ9vEB  
pH7DBV1IGyiAXSuql+W77PRI2I6xnhA5eWR+jUXRnr0v4DGjdsQ8LWeyS1APmCHh  
Wbf5p/Z6k3mcMF+vJz3DkQ5BI/horJK0/1LGGgi2j4kl nus2H5200h+f+4Vn7Ky  
vYby8jm50o6RXgAgc/rFoUinUo3//syk/+xExYZYt37hL6PlewkeG8vhXoFvuJAJ  
gi0d7rnqWYuse+UrzUrbp5z/UpJQp/PyY6rdDlScWQp3WJYSNgEe62EmnMShGf+q  
TboTsuXy8MfKltJsV9ybuJGZdtA6yIrlKwj8YYfbPX2neXmZrDnDMGkOSfdGi3lU  
/yXCBPW0nMCR+MVWVXUpf3wFXlH04nZfNtyVb/v7e4lRCylyayXo7g2rkmR+LrH3  
dEnczDF/LZLbDnkizNpzlgLU5BA1k9rDW6uwyMywrLIYl1ttVnRrHwjAo16US+mjF  
sZib126lo8EIEHyccGZIQfyTHld03m32IzMnDn16dVeX5TAuBmDuNGbXHP4h20SG  
m6tUHSFI9fMx02pBT1Tts1kjYBU+jMenqI8GxpP6DD/Y8PUbxBN0PoP8aVR3rkBk  
GONb4ksn6zWoRXT4XyaPvmImvFX5nkHHnvkThvL0DaWcwuIOrj1tq0JwmPBT0ywjA  
KYPPCK7qVCwVAssJxx7adE1W+F15UoTyyyjpe6pVtg090lGRcprYQnBasw03kATd  
k8GFN7Ej370iXiVrmsJ1toHzlhungW5uYedaTMBNmw8iU63r36sMhj46i9nML2jP  
mUjfxMeMvQGMImmjDBN0j10+5tANXtQY8CdC3pSJLe0lmIIHMB7gT1f4Quyu2LP9  
5NRz07fwamd09k3N3dIeAB0I+YJyeE1069772qnqpiGnx10uq5lnhEyytJCyH1tS  
vWUvX0tyAFfuIBkdyCKMFP6zhHVxZCCa+r3W/qrfON6GH/tJ3aLdilvjwC2zQy29  
iuNYYJoyAS3PCjC7CL41U0kA0BNJPka6Vqn6PwxpnxGaZZyFCSU2fpAvNyT2au0h  
CmLz/P0tNE7z7l1JXqao62CoPa1d0QJ27NbEjsoR3GobhcGQqkYb3Zsss/y1QZaa  
9lkTdk02ZDXfPPyaIUy46+VA3VcHlmWxChZiiFpQ0dV21aAt+f4PJLtsPE2/OTEG  
GqHngtafmmV75z+M08ExXvy5YrI5N+S2eArIteQxBjNs5DjXnsPjE3CGwb7GPx8T  
XMsEmWDQ77TdtqFSuZHAIB8EieTziP0LL2L0d9dpE8xDH1X0gDC82whSxUrZ0a15Z  
iJ1sZkS1VRI/iq9/5zc8BX+218FfdN+rBHWZZAM02ge1IMy0sLF9qaaIR1K9ZQPJ  
LYDLcCmnS6Q1oKA2JvD0iB8sbrpKLsLk31lcqCrVJ9e0IqnA4yAijsCNiUjI1DSC  
TefQo1PVS8qAGhfkcA/4nw==

## A.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.

### A.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] 4213 bytes
  ↓ (unwraps to)
  └─ message/rfc822 566 bytes
    └─ text/plain 228 bytes
```

Its contents are:

MIIMIIWYJKoZiHvcNAQcCoIIMFDCCDBACAQExDTALBg1ghkgBZQMEAgEwggJMBGgk  
hkiG9w0BBWGgggI9BIICOU1JTUUtVmVyc2l1bWVjogMS4wDQpDb250ZW50LVR5cGU6  
IG1lc3NhZ2UvcmljaW90IyYyYXNjaW90Im5vIG0KDQpNSU1FLVZlcnNpb246  
IDEuMApDb250ZW50LVR5cGU6IHRleHQvcGxhaW47IGNoYXJzZXQ9InV0Zi04IgpD  
b250ZW50LVRyYW5zMVYUUVY29kaw5n0iA3Yml0C1N1YmplY3Q6IHntaw1lLW9u  
ZS1wYXJ0LXdyYXBwZWQKTWVzc2FnZS1JRDOGPHntaw1lLW9uZS1wYXJ0LXdyYXBw  
ZWRAbGhwLmV4YW1wbGU+ckZyb206IEFsaWNLIDxhbG1jZUBzbWltZS5leGFtcGxl  
PgpUbzogQm9iIDxib2JAc21pbWUuZXh1bXBsZT4KRGF0ZTogU2F0LCAyMCGZWIg  
MjAyMSAxMDowNDowMiAtMDUwMAoKVghpcyBpcyB0aGUgc21pbWUtb251LXBhcnQt  
d3JhcHB1ZCBtZXNzYWdlLgoKVghpcyBpcyBhIHNpZ251ZC1vbmx5IFMvTU1NRSBt  
ZXNzYWdlIHZpYSBQS0NTIzcg21nbmVkrGF0YS4gIFRoZQpwYXlsb2FkIGlzIGEg  
dGV4dC9wbGFpb1BtZXNzYWdlLiBjdB1c2VzIHRoZSBXcmFwcGVkIE1lc3NhZ2Ug  
aGVhZGVyCnByb3RlY3Rpb24gc2NoZW1lLgoKLS0gCkFsaWNLcmFsaWNLQHntaw1l  
LmV4YW1wbGUkOIIHpjCCA88wggK3oAMCAQICEw8tJb0ROZDkzkJU6HuPTQGirQw  
DQYJKoZIhvcNAQENBQAwVTENMA5GA1UEChMESAUVURjERMA8GA1UECzMITEFNUFMg  
V0cxMTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2Vydg1maWNhdGlvbiBBdXRo  
b3JpdHkwIBcNMTEwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MTAmdSxDTALBgNV  
BAoTBElFVEYxETAPBgNVBASCEXBTBTIFdHMRcwFQYDVQDEw5BbG1jZSBMb3Z1  
bGFjZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAJqVKfqLwaLjj+gB  
UCfkacKTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfID1B/wlbmadXR  
mrszyidmbuZmOpB5voVQfiLYy3i0x7Y0qzXr16udP07k0sV+UdSNRFXrfKeoQEF  
Xg0aGdmnx40G/e3p1fIKM0dPZZLo0AJF5m500xzxPL74zFCWp2f1ZkuE4A6l41ko  
aZXCN5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgY9VfVfcrv9w43GG8FtpSX  
+TwzB2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iP  
sIVKarUCAwEAAa0BrzCBrdAMBgNVHRMBAf8EAjAAMBCGA1UdIAQQMA4wDAYKYIZI  
AWUDAgEwATAeBgNVHREEFzAVgRNhbG1jZUBzbWltZS5leGFtcGxlMBMGA1UdJQQM  
MAoGCCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkv  
fAEj80eOr83zdW8wHwYDVR0jBBgwFoAUKTC0fAcXDKfxcSh1NhpnhGH29FkwDQYJ  
KoZIhvcNAQENBQADggEBAIFJeKCCsTKcFqQMPTryujRGzJdYA+R9eBAuDLsatbtK  
tl4FzkRyOg31/+Cw7H8e30iLrPIfLWN1qjHrjg0yIs5AQ/hgxLvLir3hEUVZ23M  
RsMjtH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpEYPLror2X4P5uXxaP0  
LIZRzWmkw1RF7FOD7PfB5v94M5274XYxw2W4uKgd7QGnUZROsvSYKgiWdp1JhqXw  
fDz8A0enITGXnoEkaFvVjCqh64P1hIeMorj36pgL19owZD6YrZSWHuZ1F00juyu  
OfQsqm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3  
QQV57XV/QqmiXDr0+GrOmqnXMA0GCSqGSIb3DQEEDQUAMFUDALBgNVBAoTBElF  
VEYxETAPBgNVBASCEXBTBTIFdHMTewLwYDVQQDEyY1w1bGUgTEFNUFMgU1NB  
IEN1cnRpb246QXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoYDzIwNTIw  
OTI3MDY1NDE4WjA7MQ0wCwYDVQQKEwRJRVRGRmREwDwYDVQQLEwhMQU1QUyBXRzEX  
MBUGA1UEAxMOQWxpY2UgTG92ZWxhY2UwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAw  
ggEKAoIBAQC09InowDgWpK2af0+StijsN0R8K/hN8D+l078oullsk4ASvSwjsCN

7sHUa4xQUl5J06VqY18LANw0Rjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+95  
0MFz/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2Gxzys02kaYW  
Tut3SryCqeHEFbZfKb4urMk4xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWFFi0ucfC  
n+IQsaqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H6l4KuElnAtJ7BtZcs17dUy9u9  
C0gEyKriVokFqgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIw  
ADAXBgNVHSAEEDAOMAAGCmCGSAFlAwIBMAEwHgYDVR0RBBCwFYETYWxpY2VAc21p  
bWUuZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAw  
HQYDVR00BBYEFV2zLItHQYSHJeuKwQqENMgZmZzMB8GA1UdIwQYMBaAFJEwjnW  
Fwyn8QkoZTYaZxxodvRZMA0GCSqGSIB3DQEBDQUAA4IBAQBziaI2p86poGkjD/4K  
kkOHG25nY/0eNARD6/oF0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30Uxf  
yrZlRAZef7GHqgB/Nyj0ad3pdpVYeDh4ciNKjbs+aEoTWgAkoqEnt1sRxlcvb7HV  
X524bKZa1oPTUNlm6QpivtqDIdqGJdGf8L1zLFXBuo2zL3HR+M9CDr40pq2JCKzP  
0Qhp7poIccGE6I9Tsg+RrOA9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+  
JJtz0KypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSz  
NnEmMYICADCCAFwCAQEwBDBVMQ0wCwYDVQKKEwRJRVRGMREwDwYDVQQLewhMQU1Q  
UyBXRzExMC8GA1UEAxMoU2FtcGx1IExBTVBTIFJTQSBDZXJ0aWZpY2F0aW9uIEF1  
dGhvcml0eQITN0EFee11f0Kpolw69Phqzppp1zALBglghkgBZQMEAgGgaTAYBgkq  
hkiG9w0BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIB3DQEJBTEPFw0yMTAyMjAxNTA0  
MDJhMC8GCSqGSIB3DQEJBDEiBCct+Ik56mZTd2mpSg0XM38dS7jm5a1U2FDX9/58  
cga1szANBgkqhkiG9w0BAQEFAASCAQCxKLkx5li140IOcH2tcwQcsQilPLgQ30ck  
qhJL2X9/Cl22ib0GNwL8w3qSEBeG1a+WtHw3bSqJx1ciRYcLs16ms23no5QoZ0pU  
fRLmQuTEg0bCf+syiTGNwLj8e+2aRVP1L9yEiBin6+hFyp4s393zYhdMOPAP2ruI  
lg+BxowXUjXso+8lPgqLawA+9KMI6tQZMnwI9LpGJmZfoSXdHWqWtjdotzZpqsKm  
Ihr8DBKtUetqgZ2zqD03zo3W2L6EmNM05BJUmqwAt/cN+X9kws5dAqtHDQhPNTa1  
WUX0oTTkMzn1RA10xfowEStSnfD00ziqg+L7LgiMw9jhIgP4/uB2

#### A.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 4451 bytes
  - └ message/rfc822 596 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="20c";  
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

--20c  
MIME-Version: 1.0  
Content-Type: message/rfc822; forwarded="no"

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

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

--20c  
Content-Transfer-Encoding: base64  
Content-Type: application/pkcs7-signature; name="smime.p7s"

MIIJ4AYJKoZIhvcNAQcCoIIJ0TCCCC0CAQExDTALBgIghkgBZQMEAgEwCwYJKoZI  
hvcNAQcBoIIHjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQGirQwDQYJ  
KoZIhvcNAQENBQAwVTENMA5GA1UEChMESUVURjERMA8GA1UECzMITEFNUFMgV0cx  
MTAvBgNVBAMTKFNhbXBsZSBMQUU1QUYBSU0EgQ2VydGlmawNhdGlvbiBBdXRob3Jp  
dHkwIBcNMTkxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDsxDTALBgNVBAoT  
BELFVEYxETAPBgNVBASTCExBTvBTIFdHMRcwFQYDVQQDEw5BbG1jZSBMb3Z1bGFj  
ZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAJqVKfqLwaLjj+gBUCfk  
acKTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfIDlB/wlbdmadXPmrsz  
yidmbuZmOpB5voVQfiLYy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0a  
Gdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6l41koaZXC  
N5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcrv9w43GG8FtpSX+Twz  
B2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK

arUCAwEAAa0BrzCBrdAMBgNVHRMBAf8EAjAAMBcGA1UdIAQQMA4wDAYKYIZIAWUD  
AgEwATAeBgNVHREEFzAVgRNhbG1jZUBzbWltZS5leGFtcGx1MBMGA1UdJQQMMAoG  
CCsGAQUFBwMEMA4GA1UdDwEB/wQEAWIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCKvFAEj  
80e0r83zdw8wHwYDVR0jBBgwFoAUKTC0fAcXDKfxCSH1NhpnHGh29FkwDQYJKoZI  
hvcNAQENBQADggEBAIFJeKCCsTKcFqQMPTryujRGzJdYA+R9eBAuDLsatbtKt14F  
zkgRy0g31/+Cw7H8e30iLrPIFlWN1qjHrjg0yIs5AQ/hgxLvLir3hEUv2Z3MRsMt  
jH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpEYPLror2X4P5uXxaP0LIZR  
zWmkw1RF7FOD7PfB5v94M5274XYxw2W4uKgd7QGnUZROsvSYkGiWdp1JhqXwfDz8  
A0enITGXnoEkAFvjjCqh64P1hIeMorj36pgL19owZD6YrzSWHUz1F00juyu0fQs  
qm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAHm3QQV5  
7XV/QqmiXDr0+Gr0mqnXMA0GCSqGSIB3DQEBDQUAMFUXDTALBgNVBAoTBELFVEYx  
ETAPBgNVBAStCEExBTBTVBTIFdHMTewLWYDVQQDEyhTYW1wbGUgTEFNUFMgU1NBIEI  
cnRpZm1jYXRpb24gQXV0aG9yaXR5MCAxdTE5MTEyMDA2NTQxOFoYDzIwNTIwOTI3  
MDY1NDE4WjA7MQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLewhMQU1QUyBXRzEXMBUG  
A1UEAxMOQWxpY2UgTG92ZWxhY2UwgGElMA0GCSqGSIB3DQEBAQUAA4IBDwAwggEK  
AoIBAQC09InowDgWPk2af0+StijSNOR8K/hN8D+1078oullsk4ASvSwjsCNo7sSHU  
a4xQUl5J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+950MFz  
/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2GxzYms02kaYWTut3  
SryCqeHEFbZFKB4urMk4xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWFFi0ucfCn+IQ  
saqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H614KuElnAtJ7BtZcs17dUy9u9C0gE  
yKriVokFgqQ7XNDU+r3Se0Wwks7AgMBAAAGjga8wgawWDAYDVR0TAQH/BAIwADAX  
BgNVHSAEEDAOMAawGCMCGSAFlawIBMAEWHgYDVR0RBBcwFYETyWxpY2VAc21pbWUu  
ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD  
VR00BBYEFLv2zLiThQYSHJeuKWqQENMgZmZzMB8GA1UdIwQYMBaAFJewjnwHFwyn  
8QkoZTYaZxxodvRZMA0GCSqGSIB3DQEBDQUAA4IBAQBziaI2p86poGkjD/4KkkOH  
G25nY/0eNARD6/oF0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZl  
RAZef7GHqgB/Nyjoad3pdpVYeDh4ciNkjbs+aEoTwgAkoqEnt1sRx1cvb7HVX524  
bKZa1oPTUNlm6QpivtqDIdqGJdGf8L1zLFXBuo2zL3HR+M9CDr40pq2JckzP0Qhp  
7poIccGE6I9Tsg+RrOA9iCqsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz  
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEm  
MYICADCCAFwCAQEwbDBVMQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLewhMQU1QUyBX  
RzExMC8GA1UEAxMoU2FtcGx1IEExBTBTVBTIFJTQSBdZXJ0awZpY2F0aw9uIEF1dGhv  
cm10eQITN0EFee11f0Kpolw69Phqzppq1zALBg1ghkgBZQMEAgGgaTAYBgkqhkiG  
9w0BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIB3DQEJBTEPFw0yMTAyMjAxNTA1MDJa  
MC8GCSqGSIB3DQEJBDEiBCAFer0UUFydTkv9BzCYqvcfCJJbB+VZNk+SH9uv1/MN  
fDANBgkqhkiG9w0BAQEFAASCAQA9qySzpCRsqdnJMDIP1oTsPBkHnSpqQ0/wm6/v  
Cstc02Xzew0q1D0JHlYp1FHdz1fdJuEhpYdfGwoEPme/bItTYrXQWARZKdAMgZNg  
TRVS5iBkSRqRD+Wai9rk87rKQmdVv4kMtWHoaA4AVecyAnACYUS7B+gjQmpxhCXb  
rmM0507xLdX0ScFyXPzz2NU77yHeu2AhWbLteuSWh07jGP6gOnD4uzYcoF2kH0Eh  
4nvEd6KZLwefp9jRxI6u1GWstrdUk0SYDr6nLFNZuUa82pRLBclGz/OvHnbY2Xv1  
1K3AE0rZvnudTwhf/1m+Rn16pSyab6Ph1fwJref3UbQnY3CK

### **A.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] 4185 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

MIIMDgYJKoZIhvcNAQcCoIIL/zCCC/sCAQExDTALBglghkgBZQMEAgEwggI3BgkqhkiG9w0BBWGgggIoBIICJE1JTUUtVmVyc2lrbjogMS4wDQpDb250ZW50LVRyYW5zMmVYLUVuY29kaW50Ia3Yml0DQpTdWJqZWNo0iBzbWltZS1vbmUtcGFydC1pbmp1Y3RlZA0KTWVzc2FnZS1JRdogPHNtaW1lLW9uZS1wYXJ0LWluamVjdGVkQGxocC5leGFtcGxlPg0KRnJvbTogQWxpY2UgPGFsaWNlQHNTaW1lLmV4YW1wbGU+DQpUbzogQm9iIDxib2JAc21pbWUuZXhhbXBsZT4NckRhdGU6IFNhdCwgMjAgRmViIDlwMjEgMTA6MDY6MDIgLTA1MDANckNvbRlbnQtVHlwZTogdGV4dC9wbGFpbjsyY2hhcnNldD0idXRmLTgiOyBwcm90ZWNoZWQtaGVhZGVyc20idjEiDQoNClRoaxMgaXMgdGhlIHNTaW1lLW9uZS1wYXJ0LWluamVjdGVkIG1lc3NhZ2UuDQoNClRoaxMgaXMGYSBzaWduZWQtb25seSBTL01JTUUGbWVzc2FnZSB2aWEgUEtDUyM3IHNPZ25lZERhdGEuICBUaGUNCnBheWxvYWQgaXMgYSB0ZXh0L3BsYWluIG1lc3NhZ2UuIEl0IHVzZXMGdGhlIEluamVjdGVkIEh1YWRIcnMgaGVhZGVyDQpwc90ZWNoaW9uIHnjaGVtZS4NCg0KLS0gdQpBbGljZQ0KYWxpY2VAc21pbWUuZXhhbXBsZQ0KoIIHpjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQGirQwDQYJKoZIhvcNAQENBQAuVTENMAAGA1UEChMESUVURjERMA8GA1UECXMITEFNUFNGV0cxMTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2VydGlmawNhdGlvbiBBdXRob3JpdHkwIBcNMTEwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThaMDsxDTALBgNVBAoTBElFVEYxETAPBgNVBAsTCExBTVBTIFdHMRcwFQYDVQDEw5BbGljZSBmb3Z1bGFjZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBBAJqVKfqlLwLjj+gBUCfkacKTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfIDlB/wlbdmadXPmrszyidmbuZmOpB5voVQfiliYYy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0aGdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6l41koaZXC5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMggjY9VfVfcrv9w43GG8FtpSX+TwzB2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVKarUCAwEAAa0BrzCBrdAMBgNVHRMBAf8EAjAAMBcGA1UdIAQQMA4wDAYKYIZIAWUDAgEwATAeBgNVHREEFzAVgRNhbGljZUBzbWltZS5leGFtcGxlMBMGA1UdJQMMAoGCCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj80e0r83zdw8wHwYDVR0jBBgwFoAUKTC0fAcXDKfxCSHlNhpnHGh29FkWDQYJKoZIhvcNAQENBQADggEBAIFJeKCCsTKcFqQMPTryujRGzJdYA+R9eBAuDLsatbtKt14FzkgRy0g31/+Cw7H8e30iLrPIFlWN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMtjH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpEYPLror2X4P5uXxaP0LIZRzWmkw1RF7FOD7PfB5v94M5274XYxw2W4uKGd7QGNuzR0SvSYkGiWdp1JhqXwfDz8A0enITGXnoEkAFvvjiCqh64P1hIeMorj36pgL19owZD6YrzSWHUz1F00juyu0fQsqm6hvrDTqNpHNZ015f0URza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV57XV/QqmiXDr0+GrOmgnXMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQC09InoWDgWpK2af0+S tijSNOR8K/hN8D+1078oullsk4ASvSwjsCNo7sHUa4xQU15J06VqY18LANw0Rjrc

9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+950MFz/evPgP96wV+z4TtAwW2Z34rT  
iz4DxMI07XYNFUE0ls/gkUP2GxzYms02kaYWTut3SryCqeHEFbZfKb4urMk4xrIJ  
C3CzWruS2Q0FHbBlfkgKN5wXVgkWfFi0ucfCn+IQsaqpo1d3f9jSkbtAV5w3vzfo  
g8919MxKI9H6l4KuElNAtJ7BtZcsl7dUy9u9C0gEyKriVokFQgqQ7XNDU+r3Se0W  
wks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAXBgNVHSAEEDAOAwGCMGSAF1  
AwIBMAEwHgYDVR0RBBCwFYETyWxpY2VAc21pbWUuZXhhbXBsZTATBgNVHSUEDDAK  
BggrBgEFBQcDBDAOBgNVHQ8BAf8EBAMCBsAwHQYDVR00BBYEFLv2zLIthQYSHJeu  
KWqQENMgZmZzMB8GA1UdIwQYMBaAFJEWjnwHFWyn8QkoZTYaZxxodvRZMA0GCSqG  
SIb3DQEEDQUAA4IBAQBziaI2p86poGkjD/4Kkk0HG25nY/0eNARD6/oF0/sYonX2  
doizcGMk53riugAocCn5zbzhW/JVdYn30UxfyrZlRAzEf7GHqgB/Nyj0ad3pdpVY  
eDh4ciNKjbs+aEoTWgAkoqENT1sRx1cvb7HVX524bKZa1oPTUNlm6QpivtqDIdqG  
JdGf8L1zLFXBuo2zL3HR+M9CDr40pq2JCkzP0Qhp7poIccGE6I9Tsg+Rr0A9iCQs  
Pn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz0KypyQ3eoZ6EPazXqMyHAVcs  
m0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEmMYICADCCAFwCAQEwDBVMQ0w  
CwYDVQKKEwRJRVRGMREwDwYDVQQLEwhMQU1QUyBXRzExMC8GA1UEAxMoU2FtcGx1  
IExBTvBTIFJTQSBdZXJ0aWZpY2F0aW9uIEF1dGhvcml0eQITN0EFee11f0Kpolw6  
9Phqzppp1zALBg1ghkgBZQMEAgGgATAYBgkqhkiG9w0BCQMxCwYJKoZIhvcNAQcB  
MBWGCsQGSIB3DQEBTEPFw0yMTAyMjAxNTA2MDJhMC8GCSqGSIB3DQEBDEiBCA7  
4grfze+Y7DQEGFAYHyvRpnkuuZFR0V+RvSTvu4FGDANBgkqhkiG9w0BAQEFAASC  
AQB1KYVvQNzpe3EKEM0XhJr1JNxeVmZWFCe15YFeRs08FeIwJkV65YtFJKj0Vvy  
qYUzBGz4MsKaddXxAOXI/Q7cJ+70d9i0c1mL3PD2/U6D0wwhNfJoNSK7miYfMASV  
42TMJWtT0T10RJnvBitjkTuZDus1tp3xwxbrZTa4pyGaXehBW/Fc4z6L+z8hpQv/  
+6dw3+ORgfc67VTHVnsVvfb0UPrWvdxFdL5xYdqXxlhDsLMems2ttHHzvJC003Kq  
As0xMHEmMpfdL5M69MAjvro0Uv0SXETfQaxca7IKd+9xUNNRretZ9xz2kn2uD+k7  
unTEyVGeHrwmQMw/8MdvEac/

#### A.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 4417 bytes
  - └ text/plain 258 bytes
  - └ application/pkcs7-signature [smime.p7s] 3429 bytes

Its contents are:

```
--12b
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
Content-Type: text/plain; charset="utf-8"; protected-headers="v1"
```

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.

```
--12b
Content-Transfer-Encoding: base64
Content-Type: application/pkcs7-signature; name="smime.p7s"
```

MIIJ4AYJKoZiHvcNAQcCoIIJ0TCCcC0CAQExDTALBg1ghkgBZQMEAgEWcWYJKoZiHvcNAQcBoIIHpjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQGirQwDQYJKoZiHvcNAQENBQAwwTENMASGA1UEChMESUVURjERMA8GA1UECxMITEFNUFMgV0cyMTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2VydgGlmawNhdGlvbiBBdXRob3JpdHkwIBcNMtKxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MTThaMDsxDTALBgNVBAOTBE1FVEYxETAPBgNVBASTCExBTvBTIFdHMRcwFQYDVQQDEw5BbG1jZSBMb3Z1bGFjZTCCASiWdQYJKoZiHvcNAQEBBQADggEPADCCAQoCggEBAJqVKfqLwaLjj+gBUCfkacKTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfID1B/wlbdmadXPMrszyidmbuZmOpB5voVQfiLYyy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0aGdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCwp2f1ZkuE4A6141koaZXCN5XL7wwTLMLeNf9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcrv9w43GG8FtpSX+TWzB2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK arUCAwEAAa0BrzCBrdAMBgNVHRMBAf8EAjAAMBCGA1UdIAQQMA4wDAYKYIZIAWUDAgEwATAeBgNVHREEFzAVgrNhbG1jZUBzbWltZS5leGftcGx1MBMGA1UdJQqMMAoGCCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIFIDAdBqNVHQ4EFgQUo1NB1U08gCkVfAEj

80e0r83zdw8wHwYDVR0jBBgwFoAukTC0fAcXDKfxCSHlNhpnHGh29FkwDQYJKoZI  
hvcNAQENBQADggEBAIFJeKCcsTKcFqQMPTryujRGzJdYA+R9eBAuDLsatbtKt14F  
zkgRy0g31/+Cw7H8e30iLrPIFlWN1qjHrjg0yIs5AQ/hgxLvLir3hEUUV2Z3MRsMt  
jH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpeYPLror2X4P5uXxaP0LIZR  
zWmkw1RF7FOD7PFb5v94M5274XYxw2W4uKGd7QGnUZROsvSYkGiWDp1JhqXwfDz8  
A0enITGXnoEkAFvvjiCqh64P1hIeMorj36pgL19owZD6YrzSWHUz1F00juyu0fQs  
qm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV5  
7XV/QqmiXDr0+Gr0mqnXMA0GCSqGSIB3DQEBDQUAMFuxDTALBgNVBAoTBElFVEYx  
ETAPBgNVBAStCEXBTBtIFdHMTewLWYDVQQLDEYhTYW1wbGUgTEFNUFMgu1NBIEl  
cnRpZm1jYXRpb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoYDzIwNTIwOTI3  
MDY1NDE4WjA7MQ0wCwYDVQQKEWJRVRGMREwDwYDVQQLLEwhMQU1QUyBXRzEXMBUG  
A1UEAxMOQWxpY2UgTG92ZWxhY2UwgGEiMA0GCSqGSIB3DQEBAQUAA4IBDwAwggEK  
AoIBAQC09InowDgWPk2af0+StijSNOR8K/hN8D+1078oullsk4ASvSwjsCNo7sSHU  
a4xQUl5J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+950MFz  
/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2Gxzys02kaYWTut3  
SryCqeHEFbZfKB4urMk4xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWFFi0ucfCn+IQ  
saqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H614KuElnAtJ7BtZcs17dUy9u9C0gE  
yKriVokFgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAX  
BgNVHSAEEDAOMAawGCMGSAFlAwIBMAEwHgYDVR0RBBCwFYETyWxpY2VAc21pbWUu  
ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD  
VR00BBYEFLv2zLiThQYSHJeuKWqQENMgZmZzMB8GA1UdIwQYMBaAFJEwjnwHFWyn  
8QkoZTYaZxxodvRZMA0GCSqGSIB3DQEBDQUAA4IBAQBziaI2p86poGkjD/4KkkOH  
G25nY/0eNARD6/oF0/sYonX2doizcGMk53riuGAocCn5zbzhw/JVdYn30UxfyrZl  
RAZef7GHqgB/Nyj0ad3pdpVYeDh4ciNkjbs+aEoTWgAkoqEnt1sRxlcvb7HVX524  
bKZa1oPTUNlm6QpivtqDIdqGJdGf8L1zLfxBuo2zL3HR+M9CDr40pq2JCkzP0Qhp  
7poIccGE6I9Tsg+RrOA9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz  
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEm  
MYICADCCAFwCAQEwbDBVMQ0wCwYDVQQLKEWJRVRGMREwDwYDVQQLLEwhMQU1QUyBX  
RzExMC8GA1UEAxMoU2FtcGx1IEExBTBtIFJTSBDZlXJ0aWZpY2F0aw9uIEF1dGhv  
cm10eQITN0EFee11f0Kpolw69Phqzppq1zALBg1ghkgBZQMEAgGgATAYBgkqhkiG  
9w0BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIB3DQEJBTEPFw0yMTAyMjAxNTA3MDJa  
MC8GCSqGSIB3DQEJBDEiBCCXR0Udgr7J+TnI6kw8MpGtWVJPCnoAB+XfkDf78dWi  
cTANBgkqhkiG9w0BAQEFAASCAQCitU3JsEMd9FhqUu87UxYScDI1pDfZnX1vjges  
xBmmSy5lq5vvs+axKK/hTOR7YLSuLJLNwxJgDCPEmHi1hV5Tpj5mLH8qEXu4c+kK  
s9is53v0NvibhIvDEpnqNvL/kMVDak2gTqYHCE2Ij7qcWWNhnGdweMJZsBvLy/Xi  
BLad2t4qHY9lPaeMugDrxThNWEhjoDioI5f7NpBPYvJgB7b1cJhXqil5weYrJiGr  
hyTr56lff+Xjs8qjgrrzdJ8HHeUsxDJulrX8auo+pIKudcu41U8Ben2M9nCiVbEG  
aqbbPK7xip5c/YZEaZWYAs8w+dif68J8Eo7Q0/kkr45Tt5pf

--12b--

#### A.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] 5615 bytes
  ↓ (unwraps to)
  └─ message/rfc822 1599 bytes
    └─ multipart/mixed 1535 bytes
      └─ multipart/alternative 932 bytes
        ├── text/plain 282 bytes
        ├── text/html 366 bytes
        └─ image/png inline 232 bytes
```

Its contents are:

MIIQLAYJkoZiHvcvNAQcCoIIQHTCCBkCAQExDTALBg1ghkgBZQMEAgEwggZVBGk  
 hkiG9w0BBwGgggZGBIIGQk1JTUUtVmVyc2l1bWVjogMS4wDQpDb250ZW50LVR5cGU6  
 IG1lc3NhZ2UvcmljaW90Iy0yBmB3J3YXJkZWQ9Im5vIG0KDQpNSU1FLVZlcnNpb246  
 IDEuMAPDb250ZW50LVR5cGU6IG11bHRpcGFydC9taXhlZDsgYm91bmRhcnk9IjNm  
 YyIKU3ViamVjdDogc21pbWUtb251LXBhcnQtY29tcGxleC13cmFwcGVkCk1lc3Nh  
 Z2UtSUQ6IDxbWltZS1vbmUtcGFydC1jb21wbGV4LXdyYXBwZWRAbGhwLmV4YW1w  
 bGU+CkZyb206IEFsaWNIIDxhbG1jZUBzbWltZS5leGFtcGxlPgpUbzogQm9iIDxi  
 b2JAc21pbWUuZXhhbXBsZT4KRGF0ZTogU2F0LCAyMCGZWIGMjAyMSAxMjowNDow  
 MiAtMDUwMAoKLS0zZmMKTU1NRS1WZXJzaW9u0iAxLjAKQ29udGVudC1UeXB10iBt  
 dwx0aXBhcnQvYXw0ZXJuYXRpdml1IGJvdW5kYXJ5PSJjMGUICgotLWMwZQpDb250  
 ZW50LVR5cGU6IHRleHQCvcGxhaw47IGNoYXJzZXQ9InVzLWFzY21pIgpNSU1FLVZl  
 cnNpb246IDEuMAPDb250ZW50LVRyYW5zZmVyLUVuY29kaw5n0iA3Yml0CgpUaGlz  
 IGlzIHRoZSBzbWltZS1vbmUtcGFydC1jb21wbGV4LXdyYXBwZWQgbWVzc2FnZS4K  
 ClRoaxMgaXMgYSBzaWduZWQtb25seSBTL01JTUugbWVzc2FnZSB2aWEgUETDUyM3  
 IHNPZ251ZERhdGEuICBUaGUKcGF5bG9hZCBpcyBhIG11bHRpcGFydC9hbHRlcml5h  
 dG12ZSBtZXNzYwdlIHdpdGggYW4gaw5saW5lIGltYwdlL3BuZwphdHRhY2htZW50  
 LiBJdCB1c2VzIHRoZSBXcmFwcGVkIE1lc3NhZ2UgaGVhZGVyIHByb3RlY3Rpb24g  
 c2NoZW11LGoKLS0gCkFsaWNIcmFsaWNIQHNTaW11LmV4YW1wbGUkLS1jMGUKQ29u  
 dGVudC1UeXB10iB0ZXh0L2h0bWw7IGNoYXJzZXQ9InVzLWFzY21pIgpNSU1FLVZl  
 cnNpb246IDEuMAPDb250ZW50LVRyYW5zZmVyLUVuY29kaw5n0iA3Yml0Cgo8aHRT  
 bD48aGVhZD48dG10bGU+PC90aXRST48L2hlYWQ+PGJvZHK+CjxwPlRoaxMgaXMg  
 dGhlIDxiPnNtaW11LW9uZS1wYXJ0LWNvbXBsZXgtZ3JhcHB1ZDwvYj4gbWVzc2Fn  
 ZS48L3A+CjxwPlRoaxMgaXMgYSBzaWduZWQtb25seSBTL01JTUugbWVzc2FnZSB2  
 aWEgUETDUyM3IHNPZ251ZERhdGEuICBUaGUKcGF5bG9hZCBpcyBhIG11bHRpcGFy  
 dC9hbHRlcml5hdG12ZSBtZXNzYwdlIHdpdGggYW4gaw5saW5lIGltYwdlL3BuZwph  
 dHRhY2htZW50LiBJdCB1c2VzIHRoZSBXcmFwcGVkIE1lc3NhZ2UgaGVhZGVyIHBy  
 b3RlY3Rpb24gc2NoZW11LjwvcD4KPHA+PHR0Pi0tIDxicl8+QWxpY2U8YnIvPmFs  
 aWNIQHNTaW11LmV4YW1wbGU8L3R0PjwvcD4KLS1jMGUtlQoKLS0zZmMkQ29udGVu  
 dC1UeXB10iBpbWFnZS9wbmckQ29udGVudC1UcmFuc2Zlci1FbmNvZGluZzogYmFz  
 ZTY0CkNvbnRlbnQtRGlzcG9zaXRpb246IGlubGluZQoKaVZCT1J3METHz29BQUFB  
 TlNvaEVVZ0FBQUJRQUFBQVVDQV1BQUFDtmLSME5BQUFBY0VsRVFWUjYyYVZUT3hi  
 QQpNQWdTNzM5bk8zVHBSdzIwZHFwYmZBULFFak95d2l3Ww5DdGtES25iY0xrNjZz  
 cwXUK3p0WNPZGtFKZLd2taCnNncnpmY3FWTXBMMmpvMDQ0N2dZRHBlQXJrK09u  
 SkhrSWbZL1RQUmljaWhBZjVZSnJ3N3ZqdjBaV1JXTS91bGkKdmRQZjFRWjJrREQ5  
 eHBwZDh3QUFBQUJKU1U1RXJrSmdnZz09CgotLTNmYy0tCqCCB6YwggPPMIICt6AD  
 AgECAhMPLSW9ETmXSs5CVIEh7j00Boq0MA0GCSqSISb3DQEBDQUAMFUxDTALBgNV  
 BAoTBELFVEYxETAPBgNVBASCEXBTBTIFdHMTewLWYDVQkQDEYhTYW1wbGUgTEFN  
 UFMgu1NBIEN1cnRpZm1jYXRpb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoY  
 DzIwNTIwOTI3MDY1NDE4WjA7MQ0wCwYDVQkQEWRRJRVGRGMREwDwYDVQQLEwhMQU1Q  
 UyBXRzEXEMBUGA1UEAxMQWxpY2UgTG92ZWxhY2UwggEiMA0GCSqSISb3DQEBAAQU

A4IBDwAwggEKAoIBAQCAlSn6i8Gi44/oAVAn5GnChk4PHHNjrSfWUnne1N41KImVa  
TC3D9zFCrS3i4Pa9ZgHyA5Qf8JW3ZmnVz5q7M8onZm7mZjqQeb6FUH4i2Gmt4jse  
2Dqs165ernT905NLFf1HUjURca3ynqEBBV4DmhnZp8eDhv3t6dXyCjNHT82S6DgC  
ReZuTtMc1zy++MxQlqdn9WZLh0A0peNZKGmVwjeVy+8FkyzC3jX/Qcm+ZLCq1LqH  
BwDHDZ5qDTII2PVX1X3K7/c0NxbvBbaU1/k1swdszUtjhflYfZ80RuQ3qFC6vL/P  
Gwy6SCf58duq/A0EksCAW1b+MD8QH9Yj7CFsmq1AgMBAAGjga8wgawwDAYDVR0T  
AQH/BAIwADAXBgNVHSAEEDA0MAwGCmCGSAFlAwIBMAEwHgYDVR0RBBCwFYETyWxp  
Y2VAc21pbWUuZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8E  
BAMCBSAwHQYDVR00BBYEFKJTQdVEPIApFXwBI/Dnjq/N83cPMB8GA1UdIwQYMBaA  
FJEwjnhWFwyn8QkoZTYaZxxodvRZMA0GCSqGSIB3DQEBDQUAA4IBAQCBSXignLEy  
nBakDKU68ro0RsyXWAPkfXgQLgy7GrW7SrZeBc5IEcjoN9f/gsoX/Ht9Ii6zyBVZ  
jdaox644DsiLOQEP4YMS7y4q94RFFdmdzEbDLYx9sfUhvdTXDN00oHz53PYDBh4z  
E4Nar2inc0D+VM6RGDy66K9l+D+bl8Wj9CyGUc1ppMNURexTg+z3web/eD0du+F2  
MvtluLihne0Bp1GUTkr0mJBolg6dSYal8Hw8/ANHpyExl56BJABb744gqoeuD9YS  
HjKK49+qYC9faFmQ+mK80lh1M9RdNI7srjn0LKpuob6w06jaRzWdNeXzlEc2tUpA  
r4vRhZjVD6FYMIIDzzCCAreAwIBAgITN0EFee11f0Kpolw69Phqzppq1zANBgkq  
hkiG9w0BAQ0FADBVMQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLEwhMQU1QUyBXRzEx  
MC8GA1UEAxMoU2FtcGx1IExBTVBTIFJTSBDZXJ0aWZpY2F0aW9uIEF1dGhvcml0  
eTAqFw0x0TEXMjAwNjU0MThaGA8yMDUyMDkyNzA2NTQxOFowOzENMASGA1UEChME  
SUVURjERMA8GA1UECxMITEFNUFMgV0cxZAVBgNVBAMTDkFsaWN1IExvdmVsYWw1  
MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAtPSJ6Fg4Fj5Nmn9PkrYo  
0jTkcV4TfA/pd0/KLpZbJOAER0sI7Aja07B1GuMUFJeSTulamNfCwDcDkY63PQW  
l+DILs7GxVwXurhYdZlaV5hcUqVackPvedDBc/3rz4D/esFfs+E7QMftmd+K04s+  
A8TCN012DRVBDpbP4JFD9hsc8prDtpGmFk7rd0q8gqnhxBW2RZAeLqzJ0MayCQtw  
s1q7ktkNBR2wZX5ICjecF1YJFhX4jrnHwp/iELGqqaNXd3/Y0pG7QFecN7836IPP  
dftMSiPR+peCrhJZwLSewbWXLJe3VMvbvQjoBMpEYlaJBUIKk01zQ1Pq90njlsJL  
OwIDAQAB04GvMIGsMAwGA1UdEwEB/wQCMAAFwYDVR0gBBAwDjAMBgpghkgBZQMC  
ATABMB4GA1UdEQQXMBWBE2FsaWN1QHNTaW11LmV4YW1wbGUwEwYDVR0lBAwwCgYI  
KwYBBQUHAWQwDgYDVR0PAQH/BAQDAgBAMB0GA1UdDgQWBBS79syyLR0GEhyXrilq  
kBDTIGZmczAfBgNVHSMEGDAWgBSRMI58BxcMp/EJKGU2GmccaHb0WTANBgkqhkiG  
9w0BAQ0FAA0CAQEAc4miNqf0qaBpI3f+CPJDhxtuZ2P9HjQEQ+v6BdP7GKJ19naI  
s3BjJ0d64roAKHAp+c284VvyVXWJ99FMX8q2ZUQMxH+xh6oAfzcozmnd6XaVWHg4  
eHIjSo27PmhKE1oAJKKhDbdbEcZXL2+x1V+duGymWtaD01DZZukKYr7agyHahIXR  
n/C9cy31wbqNsy9x0fjPQg6+DqatiQpMz9EIAe6aCHHBh0iPU7IPkazgPYgkLD59  
fk4PGHnYxs1Fhd06zZk9E8zwlc1ALgZa/iSbczisqckN3qGehD2s16jMhwFXLJtB  
iN+uCDgNG/D0qyTbY4fGkieUHx/tHuzUszZxJjGCAgAwggH8AgEBMGwwVTENMASG  
A1UEChMESUVURjERMA8GA1UECxMITEFNUFMgV0cxMTAvBgNVBAMTKFNhbXBsZSBM  
QU1QUyBSU0EgQ2VydGlmawNhdGlvbiBBdXRob3JpdHkCEzdBBXntdX9CqaJc0vT4  
as6aqdcwCwYJYIZIAWUDBAIBoGkwGAYJKoZIhvcNAQkDMQsGCSqGSIB3DQEHATAc  
BgkqhkiG9w0BCQUxXcNMjEwMjIwNDYwYjAvBgkqhkiG9w0BCQqxIgQgGiss  
3bBs4a2FSojj2NVcmGx+Y2J2N13x7iIwXuaypk0wDQYJKoZIhvcNAQEBBQAEggEA  
hu0PBptjY2fcRzq9DPryHFCFCpa75LnQ12zLijpFMW7qyswoyR6BguvTEzV4kBPV  
D2Sbh86FibwmvNdggzXc2PJzcj6jtYE0R58td0/ks7q0eIbtZUgpZT3W/wlEpnmd  
Pr7Df40VEV9qS+vJh0iNASJspYwccPwIf5fKCPJf5H+xhQlSJ1rLIhw6Cu2ogkWB  
bQDijNyjP5jM1X7Xo3mP4ReuauS4e0DnnRMH3pDGUAkAN5dnEVqdXG1C76+y0Bwr  
/foPN5vjE8RMtte3Dt0KqGwWsoEcjinU77z6d0kIWQqNYUNmqDHJ70/y1a0xG14  
IPJnl/JphEWK13Fji6iL4A==

#### A.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 5528 bytes
  └─ message/rfc822 1657 bytes
    └─ multipart/mixed 1593 bytes
      └─ multipart/alternative 988 bytes
        ├── text/plain 310 bytes
        ├── text/html 394 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="932";  
  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

--932

MIME-Version: 1.0  
Content-Type: message/rfc822; forwarded="no"

MIME-Version: 1.0  
Content-Type: multipart/mixed; boundary="c35"  
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

--c35

MIME-Version: 1.0  
Content-Type: multipart/alternative; boundary="645"

--645

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

--645

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

```
<p><tt>-- <br/>Alice<br/>alice@smime.example</tt></p>
--645--
```

- - c35

Content-Type: image/png

Content-Transfer-Encoding: base64

Content-Disposition: inline

iVBORw0KGgoAAAANSUhEUGAAABQAAAAUCAYAAACNiR0NAAAAcE1EQVR42uVT0xbA  
MAgS739nO3TpRw20dqpbfARQEj0ywiwYnCtkDKnbcLk66sqlT+zt9cidkE+6KwZ  
sgrzfcqVmpL2jo0447gYDpeArk+OnJHkIhAfTPRicIhAf5YJrw7vjv0ZWRWM/uli  
vdPf1QZ2kDD9xppd8wAAAABJRU5ErkJggg==

- - c35 - -

- - 932

Content-Transfer-Encoding: base64

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

MIJ4AYJKoZiHvcNAQcCoIIJ0TCCCC0CAQExDTALBg1ghkgBZQMEAgEwCwYJKoZI  
hvcNAQcBoIIHpjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQGirQwDQYJ  
KoZiHvcNAQENBQAwwVTENMASGA1UEChMESUVURjERMA8GA1UECzMITEFNUFMgV0cx  
MTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2Vydg1maWNhdGlvbiBBdXRob3Jp  
dHkwIBcNMtKxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MThtaMDsxDTALBgNVBAO  
tBELFVEYxETAPBgNVBAsTCEExBTBTIFdHMRCwFQYDVQDEw5BbG1jZSBMb3Z1bGFj  
ZTCCASiWdQYJKoZiHvcNAQEBBQADggEPADCCAQoCggEBAJqVKfqLwaLjj+gBUCfk  
ackTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfID1B/wlbmadXPmrsz  
yidmbuZmOpB5voVQfiliYYy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0a  
Gdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6141koaZXC  
N5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcrv9w43GG8FtpSX+Twz  
B2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK  
arUCAwEAAaOBrzCBrdAMBgNVHRMBAf8EAjAAMBCGA1UdIAQQA4wDAYKYIZIAWUD  
AgEwATAeBgNVHREEFzAVgRNhbG1jZUBzbWltZS5leGFtcGxlMBMGA1UdJQQMMAOG  
CCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj  
80eOr83zdW8wHwYDVR0jBBgwFoAUKTCOfAcXDKfxCSH1NhpnHGh29FkwDQYJKoZI  
hvcNAQENBQADggEBAIFJeKCCsTKcFqQMPTryujRGzJdYA+R9eBAuDLsatbtKt14F  
zkgRyOg31/+Cw7H8e30iLrPIfLWN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMt  
jH2x9SG91PEM046gfPnc9gMGHjMTg1qvaKcLQP5UzpEYPLror2X4P5uXxaP0LIZR  
zWmkw1RF7FOD7PfB5v94M5274XYxw2W4uKgd7QGnUZROsvSYKgiWdp1JhqXwFdZ8  
A0enITGXnoEkaFvVjCqh64P1hIeMorj36pgL19owZD6YrzSWHuZ1F00juyuOfQs  
qm6hvrDTqNpHNZ015fOURza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV5  
7XV/QqmiXDr0+GrOmqnXMA0GCSqGSiB3DQEBDQUAMFuxDTALBgNVBAOtBELFVEYx  
ETAPBgNVBAsTCEExBTBTIFdHMTEwLWYDVQDEYhTYW1wbGUgTEFNUFMgU1NBIE  
N1cnRpZmljYXRpb24gQXV0aG9yaXR5MCAXDTE5MTEyMDA2NTQxOFoYDzIwNTIwOTI3  
MDY1NDE4WjA7MQ0wCwYDVQKKEwRJRVRGMREwDwYDVQQLewhMQU1QUyBXRzEXMBUG  
A1UEAxMOQWxpY2UgTG92ZWxhY2UwgGEMMA0GCSqGSiB3DQEBAQUAA4IBDwAwggEK  
AoIBAQC09InowDqWpk2af0+StijSN0R8K/hN8D+l078oullsk4ASvSwjsCNo7shU

a4xQUl5J06VqY18LANw0Rjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+950MFz  
/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2GxzYms02kaYWTut3  
SryCqeHEFbZFkB4urMk4xrIJC3CzWruS2Q0FHbBlfkgKN5wXVgkWFFiOucfCn+IQ  
saqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H614KuElnAtJ7BtZcs17dUy9u9C0gE  
yKriVokFQgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAX  
BgNVHSAEEDAOMAawGCMGSAFlAwIBMAEwHgYDVR0RBBCwFYETyWxpY2VAc21pbWUu  
ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD  
VR00BBYEFLv2zLIthQYSHJeuKwQqENMgZmZzMB8GA1UdIwQYMBaAFJEwjnWHFwyn  
8QkoZTYaZxxodvRZMA0GCSqGSIb3DQEBDQUAA4IBAQBziaI2p86poGkjD/4KkkOH  
G25nY/0eNARD6/oF0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZl  
RAZef7GHqgB/Nyjoad3pdpVYeDh4ciNkjbs+aEoTWgAkoqEnt1sRxlcvb7HVX524  
bKZa1oPTUNlm6QpivtqDIdqGJdGf8L1zLFXBuo2zL3HR+M9CDr40pq2JCkzP0Qhp  
7poIccGE6I9Tsg+RrOA9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz  
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEm  
MYICADCCAFwCAQEwbDBVMQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLEWhMQU1QUyBX  
RzExMC8GA1UEAxMoU2FtcGx1IExBTVBTIFJTQSBDZXJ0aWZpY2F0aW9uIEF1dGhv  
cm10eQITN0EFee11f0Kpolw69Phqzppq1zALBglghkgBZQMEAgGgaTAYBgkqhkiG  
9w0BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIb3DQEJBTEPFw0yMTAyMjAxNzA1MDJa  
MC8GCSqGSIb3DQEJBDEiBCCV9xSB/IVw/tBS3A32iIL4hLUX22Ane+7Zjas34KM6  
yzANBgkqhkiG9w0BAQEFAASCAQB7m9+tvuIXlRpTmHv+V9XCZbYbMFSE9YU9DBZA  
GYf9GYckf113Nwwg75oi7MA/VHSDMhVkd1mBIN/Te+3mcnhda+KkoDICHZPJ3k7N  
4baRLQi8S+a+JEQxj8/lUp2Dd0giw09J8E7uHAzYu9MEAXKRS0Z9F8BudabXg+tr  
8K7fQ/0WpjAs4HkSRZaX5eve9U1Qf99+oCyYvRmv+BZhTCbaic/8ZJuN0e1YjbB/  
IRmin0dV401L4EpNacsFUyLpWqWUsMgRIJ4+b/xwqEUKmLnh41XKh1/0Bp1natYs  
3PP7EUNBBJebAPyo1ifT3LFR4qsa5QRu20X0Jhajvn1Qkws9

--932--

#### A.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] 5631 bytes
  ↓ (unwraps to)
  └─ multipart/mixed 1565 bytes
    └─ multipart/alternative 936 bytes
      └─ text/plain 292 bytes
      └─ text/html 373 bytes
      └─ image/png inline 236 bytes
```

Its contents are:

MIIQOYQYJkZiIhvcNAQcCoIIQKJCCCECYCAQExDTALBgIghkgBZQMEAgEwggZiBgk  
 hkiG9w0BBwGgggZTBIIGT01JTUUtVmVyc2l2bWVjogMS4wDQpTdWJqZWNO0iBzbWlt  
 ZS1vbmUtcGFydC1jb21wbGV4LWluamVjdGVkDQpNZXNzYWdlLUL1E0iA8c21pbWUt  
 b25lLXBhcnQtY29tcGxleC1pbmpleY3RlZEBsaHAuZXhhbXBsZT4NckZyb206IEFs  
 aWNLIDxhbGJjZUBzbWltZS5leGFtcGxlpG0KVG86IEJvYiA8Ym9iQHntaW1lLmV4  
 YW1wbGU+DQpEYXRlOiBTYXQsIDIwIEZlYiAyMDIxIDEyOjA2OjAyIC0wNTAwDQpD  
 b250ZW50LVR5cGU6IG11bHRpcGFydC9taXhlZDsgYm91bmRhcnc9ImNmZiI7IHBY  
 b3RlY3RlZC1oZWFKZXJzPSJ2MSINCgOKLS1jZmYNck1JTUUtVmVyc2l2bWVjogMS4w  
 DQpDb250ZW50LVR5cGU6IG11bHRpcGFydC9hbHRlcm5hdG12ZTsgYm91bmRhcnc9  
 IjdiZSINCgOKLS03YmUNCkNvbnRlbnQtVHlwZTogdGV4dC9wbGFbjsgY2hhcnNl  
 dD0idXMtYXNjaWkiDQpNSU1FLVZlcnNpb246IDEuMA0KQ29udGVudC1UcmFuc2Zl  
 ci1FbmNvZGluZz0gN2JpdA0KDQpUaGlzIGlzIHROZSBzbWltZS1vbmUtcGFydC1j  
 b21wbGV4LWluamVjdGVkIG1lc3NhZ2UuDQoNClRoXMGaXMGYSBzaWduZWQtY25s  
 eSBTL01JTUUbWVzc2FnZSB2aWEgUeTUyM3IHNPZ25lZERhdGEuICBUaGUNCnBh  
 ewxvYWQgaXMGYSBtdWx0aXBhcnQvYXw0ZXJuYXRpdmgUgBWVzc2FnZSB3aXR0IGFu  
 IGlubGluZSBpbWFnZS9wbmcNCmF0dGFjaG1lbnQuIEl0IHVzZXMGdGhlIEluamVj  
 dGVkIEhlYWRIcnMgaGVhZGVyIHByb3RlY3Rpb24gc2NoZW1lLg0KDQotLSANCkFs  
 aWNLIDQpPhbGJjZUBzbWltZS5leGFtcGxldQotLTdiZQ0KQ29udGVudC1UeXB0iB0  
 ZXh0L2h0bWw7IGNoYXJzZXQ9InVzLWFzY21pIg0KTUlnRS1WZXJzaW9uOiAxLjAN  
 CkNvbnRlbnQtVHJhbnNmZXItRW5jb2Rpbmc6IDdiaXQNCgOKPGH0bWw+PGhlYWQ+  
 PHRpdGxlpjwvZG10bGU+PC9oZWFKPjxib2R5Pg0KPHA+VGhpcyBpcyB0aGUgPGI+  
 c21pbWUtY25lLXBhcnQtY29tcGxleC1pbmpleY3RlZDwvYj4gbWVzc2FnZS48L3A+  
 DQo8cD5UaGlzIGlzIGEGc2lnbmVklW9ubHkgUy9NSU1FIG1lc3NhZ2UgdmlhIFBL  
 Q1MjNyBzaWduZWREYXRhLiAgVGhlDQpwYXlsb2FkIGlzIGEGbXVsdG1wYXJ0L2Fs  
 dGVybWFOaXZlIG1lc3NhZ2Ugd2l0aCBhbiBpbmxbpbmUgaW1hZ2UvcG5nDQphdHRh  
 Y2htZW50LiBJdCB1c2VzIHROZSBjbmpleY3RlZCBIZWFKZXJzIGhlYWRIciBwcm90  
 ZWN0aW9uIHJnJaGVtZS48L3A+DQo8cD44dHQ+LS0gPGJyLz5BbGJjZTxicici8+Ywxp  
 Y2VAc21pbWUuZXhhbXBsZTwwdHQ+PC9wPg0KLS03YmUtLQ0KDQotLWNmZg0KQ29u  
 dGVudC1UeXB0iBpbWFnZS9wbmcNCkNvbnRlbnQtVHJhbnNmZXItRW5jb2Rpbmc6  
 IGJhc2U2NA0KQ29udGVudC1EaXNwb3NpdG1vbjogaw5saW5lDQoNClwQk9SdzBL  
 R2dvQUFBQU5TVWhFVWdBUQFUCUFBQUFVQ0FZQUFBQ05pUjB0QUFBQWNfbEVyVlI0  
 MnVWE94YkENCk1BZ1M3MzluTzNUcFJ3MjBkXBiZkFSUUVqT3l3aXdZbkN0a0RL  
 bmJjTGs2NnNxbFQrenQ5Y2lka0UrNkt3a1oNCnNncnpyY3FWTXBMMmpvMDQ0N2dZ  
 RHBLQXJrK09uSkhrSWbZLRQumljawhBZjVZSnJ3N3ZqdjBaV1JXTS91bGkNCnZk  
 UGYxUVoya0REOXhwcGQ4d0FBQUFCSlJVNuvYa0pnZ2c9PQ0KDQotLWNmZi0tdQqg  
 ggemMIIDzzCCAreAwIBAgITDy0lvRE5l0rOQ1SHoe49NAaKtDANBgkqhkiG9w0B  
 AQ0FADBMVQ0wCwYDVQKKEwRJRVRGMREwDwYDVQQLLEwhMQU1QUyBXRzExMC8GA1UE  
 AxMoU2FtcGxleIEExBTBTIFJTSBDZXJ0aWZpY2F0aW9uIEF1dGhvcml0eTAwFw0x  
 OTEYXjAwNjU0MThaGA8yMDUyMDkyNzA2NTQxOFowOZENMASGA1UEChMESUVURjER  
 MA8GA1UECXMITEFNUFmV0cxFzAVBqNVBAMTDkFsaWNLIEExvdmVsYWNlMIIIBjAN

BgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAmPUp+ovBouOP6AFQJ+RpwP0DxxzY  
60n1lJ53pTeNSiJlWkwtw/cxQq0t4uD2vWYB8g0UH/CVt2Zp1c+auzPKJ2Zu5mY6  
kHm+hVB+IthjLeI7Htg6rNeuXq50/TuTSxX5R1I1EXGt8p6hAQVeA5oZ2afHg4b9  
7enV8gozR0/Nkug4AkXmbk7THNc8vvjMUJanZ/VmS4TgDqXjWShplcI3lcvvBZMs  
wt41/0HJvmswqpS6oQcAx3Weag0yCnj1V9V9yu/3DjcYbww2lJf5NbMHbM1LY4X5  
chWfNEbkN6hQury/zxnlsukgn+fHbqvWdhJlAgFpW/jA/EB/WI+whUpqtQIDAQAB  
o4GvMIGsMAwGA1UdEwEB/wQCMAAwFwYDVR0gBBawDjAMBgpghkgBZQMCAATABMB4G  
A1UdEQQXMBWBE2FsawNlQHNTaw1lLmV4Yw1wbGUwEwYDVR0lBAwwCgYIKwYBBQUH  
AwQwDgYDVR0PAQH/BAQDAgUGMB0GA1UdDgQWBBSiU0HVRDyAKRV8ASPw546vzfN3  
DzAfBgNVHSMEGDAwGBSRMI58BxcMp/EJKGU2GmccaHb0WTANBgkqhkiG9w0BAQ0F  
AAOCAQEAgUl4oJyxMpwWpAy10vK6NEbM1lgD5H14EC4Muxq1u0q2XgX0SBHI6DfX  
/4LDsfxf7fSIus8gWVY3WqMeu0A7IizkBD+GDEu8uKveERRXZncxGwy2MfbH1Ib3U  
8QzTjqB8+dz2AwYeMXODWq9opwtA/lT0kRg8uuivZfg/m5fFo/QshlHNaaTDVEXs  
U4Ps98Hm/3gznbvhdjFbZbi4oZ3tAadRlE5K9JiQaJY0nUmGpfb8PPwDR6chMZee  
gSQAw++0IKqHrg/WEh4yiuPfqmAvX2hZkPpivNJYdTPUXTS07K459CyqbqG+sN0o  
2kc1nTXl85RHNrVKQK+L0YwY1Q+hWDCCA88wggK3oAMCAQICEzdBBXntdX9CqaJc  
OvT4as6aqdcwDQYJKoZIhvcNAQENBQAwVTENMAsgA1UEChMESUVURjERMA8GA1UE  
CxMITEFNUFMgV0cMTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EgQ2VydGlmawNh  
dGlvbiBBdXRob3JpdHkwIBcNMtKxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MTha  
MDsxDTALBgNVBAoTBElFVEYxETAPBgNVBAstCExBTVBTIFdHMRcwFQYDQVQDEw5B  
bGljZSBMb3ZlbgFjZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBALT0  
iehY0BY+TZp/T5K2KNI05Hwr+E3wP6XTvyi6WwyTgBK9LC0wI2juwdRrjFBSXkk7  
pWpjXwsA3A5G0tz0FpfgyC70xsVcF7q4WHWZWleYXFKlQHJD73nQwXP968+A/3rB  
X7Ph00DBbZnfit0LPgPEWjTtdg0VQq6Wz+CRQ/YbHPKaw7aRphZ063dKvIKp4cQV  
tkWQH16syTjGsgkLcLNaU5LZDQUdsGV+SAo3nBdWCRYV+I65x8Kf4hCxqqmjV3d/  
2NKRu0BXnDe/N+iDz3X0zEoj0fqXgq4SWcC0nsG1lyXt1TL270I6ATKR6JWiQVC  
CpDtc0NT6vdJ45bCSzsCAwEAAa0BrzCBrdAMBgnVHRMBAf8EAJAAMBcGA1UdIAQQ  
MA4wDAYKYZIAWUDAgEwATAeBgNVHREEFzAVgRNhbGljZUBzbWltZS5leGFtcGxl  
MBMGA1UdJQMMaOGCCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIGwDAdBgNVHQ4EFgQU  
u/bMsi0dBhIcl64papAQ0yBmZnMwHwYDVR0jBBgwFoAUKTC0fAcXDKfxCSHlNhpn  
HGh29FkwDQYJKoZIhvcNAQENBQADggEBAH0JojanzqmgasN3/gqSQ4cbbmdj/R40  
BEPr+gXT+xiidfZ2iLnWYyTneuK6AChwKfnNv0Fb8lV1iffRTF/KtmVEDMR/sYeq  
AH83KM5p3el2lVh40HhyI0qNuz5oShNaACSioQ23WxHGvy9vsdVfnbhsp1rwg9NQ  
2WbpCmK+2oMh2oYl0Z/wvXMT9cG6jbmVcdH4z0IOvg6mrYkKTM/RCGnumghxwYTo  
j10yD5Gs4D2IJCw+fx50Dxh52MbNRYXTus2ZPRPM8JXNQC4Gwv4km3M4rKnJdd6h  
noQ9rNeozIcBVyybQYjfrgg4DRvw9Ksk220H4ConlB8f7R7s1LM2cSYxggIAMIIB  
/AIBATBsMFUXDTALBgNVBAoTBElFVEYxETAPBgNVBAstCExBTVBTIFdHMTewLwYD  
VQQDEyhTYw1wbGUgTEFNUFMgUlNBIENlcnRpZmljYXRpb24gQXV0aG9yaXR5AhM3  
QQV57XV/QqmiXDr0+GrOmqnXMAsgCWCGSAFlAwQCAaBpMBgGCSqGSib3DQEJAzel  
BgkqhkiG9w0BBwEwHAYJKoZIhvcNAQkFMQ8XDTIxMDIyMDE3MDYwMlowLwYJKoZI  
hvcNAQkEMSIEIEZJTcpCQRTwXEI88+n1LqN3b7JQ6wZ3y/JlosQRxxY4MA0GCSqG  
Sib3DQEBAQUABIIEAEj1f7sJy7g9/S/3wXfUqyyg/3Sr/4H7n/Wyxg+FP74Bi0Km  
Z01zoauH8fpjs0g0fS/1l14j69FckaFUqHYotT6kojdodBRM36IGMIHEPPYH6pAL  
4K4CPk62J9PWRw1X+6HYPr+WDfSjzGAL5mDTzYVAuu2aUn46SmTUVNDv3UBaxQCS  
sghtVe1snSHpJYz3LciIWyKrE+Kpw+g6cb9hVY/a4p9jHu11x7MfCQddVg2qjZs0  
9TH1X9hfSzv6bmFRZ39+MU/m0V2pxVYXyDnk6BX48PVx7C5tFWDtr+hB5dEQ93i  
sQt3VRgv6NwEiYxqfxyQhHgPJY2+DqhoFgwbhki=

#### **A.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 5496 bytes
  └─ multipart/mixed 1623 bytes
    └─ multipart/alternative 992 bytes
      └─ text/plain 312 bytes
      └─ text/html 396 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="a23";  
  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

--a23

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  
Content-Type: multipart/mixed; boundary="d03"; protected-headers="v1"

--d03

MIME-Version: 1.0  
Content-Type: multipart/alternative; boundary="8d8"

--8d8

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  
--8d8  
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>-- <br/>Alice<br/>alice@smime.example</tt></p>  
--8d8--

--d03

Content-Type: image/png

Content-Transfer-Encoding: base64

Content-Disposition: inline

iVBORw0KGgoAAAANSUhEUgAAABQAAAAUcAYAAACNiR0NAAAAcE1EQVR42uVT0xbA  
MAgS739nO3TPRw20dqpbfARQEj0ywiwYnCTkDKnbcLk66sqLT+zt9cidkE+6KwkZ  
sgrzfcqVMpL2jo0447gYDpeArk+OnJHkIhAftPRicHaf5YJrw7vjv0ZWRWM/uli  
vdPf1QZ2kDD9xppd8wAAAAABJRUErkJggg==

--d03--

--a23

Content-Transfer-Encoding: base64

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

MIIJ4AYJKoZIhvcNAQcCoIIJ0TCCCC0CAQExDtALBgIghkgBZQMEAgEwCwYJKoZI  
hvcNAQcBoIIHpjCCA88wggK3oAMCAQICEw8tJb0R0ZdKzkJU6HuPTQGirQwDQYJ  
KoZIhvcNAQENBQAwwVTENMAsgA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cx  
MTAvBgNVBAMTKFNhbXBsZSBMQU1QUyBSU0EGQ2VydGlmawNhdGlvbiBBdXRob3Jp  
dHkwIBcNMtKxMTIwMDY1NDE4WhgPMjA1MjA5MjcwNjU0MTAmdSxDtALBgNVBAOT  
BELFVEYxETAPBgNVBAsTCExBTBVBtIFdHMRCwFQYDVQQDEw5BbGljZSBMb3Z1bGFi  
ZTCCASiWdQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAlJqVKfLwLjJ+gBUCfk  
ackTg8cc20tJ9ZSed6U3jUoiZVpMLcP3MUKtLeLg9r1mAfID1B/wlbdmadXPmrsz  
yidmbuZm0pB5voVQfiLYy3i0x7Y0qzXr16udP07k0sV+UdSNRFxrfKeoQEFXg0a  
Gdmnx40G/e3p1fIKM0dPzZLo0AJF5m500xzXPL74zFCWp2f1ZkuE4A6141koaZXC  
N5XL7wWTLMLenF9Byb5ksKqUuqEHAMd1nmoNMgjY9VfVfcrv9w43GG8FtpSX+TWz  
B2zNS20F+XIVnzRG5DeoULq8v88Z5bLpIJ/nx26r8A4SSwIBaVv4wPxAf1iPsIVK  
arUCAwEAAa0BrzCBRDAMBGNVHRMBAf8EAjAAMBcGA1UdIAQQMA4wDAYKYIZIAWUD  
AgEwATAeBgNVHREEFzAVgRNhbGljZUBzbWltZS5leGFtcGxlMBMGA1UdJQQMMAoG  
CCsGAQUFBwMEMA4GA1UdDwEB/wQEAwIFIDAdBgNVHQ4EFgQUo1NB1UQ8gCkVfAEj  
80e0r83zdw8wHwYDVR0jBBgwFoAukTCOfAcXDKfxCSh1NhpnHGh29FkwDQYJKoZI  
hvcNAQENBQADggEBAIFJeKCCsTKcFqQMpTryujRGzJdYA+R9eBAuDLsatbtKt14F  
zkgRy0g31/+Cw7H8e30iLrPIfLWN1qjHrjg0yIs5AQ/hgxLvLir3hEUV2Z3MRsMt  
jH2x9SG91PEM046gfpnc9gMGHjMTg1qvaKcLQP5UzpEYPLror2X4P5uXxaP0LIZR  
zWmkw1RF7F0D7PfB5v94M5274XYxw2W4uKGd7QGnUZROsvSYkGiWdp1JhqXwfDz8  
A0enITGXnoEkAFvvjiCqh64P1hIeMorj36pgL19oWZD6YrzSWHUz1F00juyu0fQs  
qm6hvrDTqNpHNZ015f0URza1SkCvi9GFmNUPoVgwgGPPMIICt6ADAgECAhM3QQV5  
7XV/QqmiXDr0+GrOmgnXMA0GCSqGSIb3DQEBAQUAMFUDtALBgNVBAOTBELFVEYx  
ETAPBgNVBAsTCExBTBVBtIFdHMTExLWYDVQQDEyhTYW1wbGUgTEFNUFMgU1NBIE  
N1cnRpZm1jYXRpb24gQXV0aG9yaXR5MCAxdTE5MTEyMDA2NTQxOjY0ZDZlWNTIwOTI3  
MDY1NDE4WjA7MQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLEwhMQU1QUyBXRzEXMBUG  
A1UEAxMQQWxpY2UgTG92ZWxhY2UwgGEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEK  
AoIBAQC09InoWdGwPk2af0+StijSN0R8K/hN8D+1078oullsk4ASvSwjsCNo7sSHU  
a4xQU15J06VqY18LANwORjrc9BaX4MguzsbFXBe6uFh1mVpXmFxSpUByQ+950MFz  
/evPgP96wV+z4TtAwW2Z34rTiz4DxMI07XYNFUE0ls/gkUP2GxzYms02kaYWTut3

SryCqeHEFbZFkB4urMk4xrIJC3CzWruS2Q0FHB1fkgKN5wXVgkWFFi0ucfCn+IQ  
saqpo1d3f9jSkbtAV5w3vzfog8919MxKI9H6L4KuElNAtJ7BtZcs17dUy9u9C0gE  
yKriVokFQgqQ7XNDU+r3Se0Wwks7AgMBAAGjga8wgawwDAYDVR0TAQH/BAIwADAX  
BgNVHSAEEDAOMAawGCMCGSAFlAwIBMAEwHgYDVR0RBBcwFYETYWxpY2VAc21pbWUu  
ZXhhbXBsZTATBgNVHSUEDDAKBggrBgEFBQcDBDA0BgNVHQ8BAf8EBAMCBsAwHQYD  
VR00BBYEFLv2zLlthQYSHJeuKwqQENMgZmZzMB8GA1UdIwQYMBaAFJEwnHFWyn  
8QkoZTYaZxxodvRZMA0GCSqGSIb3DQEBAQUAA4IBAQBziaI2p86poGkjd/4KkkOH  
G25nY/0eNARD6/oF0/sYonX2doizcGMk53riugAocCn5zbzhw/JVdYn30UxfyrZl  
RAZef7GHqgB/Nyj0ad3pdpVYeDh4ciNkjs+aEoTWgAkoqEnt1sRxlcvb7HVX524  
bKZa1oPTUNlm6QpivtqDIdqGJdGf8L1zLfXBuo2zL3HR+M9CDr40pq2JckzP0Qhp  
7poIccGE6I9Tsg+Rr0A9iCQsPn1+Tg8YedjGzUWF07rNmT0TzPCVzUAuBlr+JJtz  
OKypyQ3eoZ6EPazXqMyHAVcsm0GI364IOA0b8PSrJNtjh+AqJ5QfH+0e7NSzNnEm  
MYICADCCAFwCAQEwbDBVMQ0wCwYDVQQKEwRJRVRGMREwDwYDVQQLEWhMQU1QUyBX  
RzExMC8GA1UEAxMoU2FtcGx1IEExBTBVTIFJTQSBDZXJ0awZpY2F0aw9uIEF1dGhv  
cm10eQITN0EFee11f0Kpolw69Phqzpq1zALBg1ghkgBZQMEAgGgaTAYBgkqhkiG  
9w0BCQMxCwYJKoZIhvcNAQcBMBwGCSqGSIb3DQEJBTEPFw0yMTAyMjAxNzA3MDJa  
MC8GCSqGSIb3DQEJBDEiBCA4lK0x9a084fB6gb7XvsxC6U70hV0Xe3FjeF9sS6mN  
qDANBgkqhkiG9w0BAQEFAASCAQAFMFJgqp9Vb8dS34Kz4fZfKGA1SMbqun/XqC6S  
9/+EpIiDL54Mw3qug01eU/ms0YoBlu8aV/9CbC2Dl0dPrFCRuHTWyFC1Wgi2X5Mj  
fg57SXgGd1KJmhWAtcNuI1111k6TeoI/pmU/R9tNkrF349tDVHZU/4GWUfuyiorK  
t6TQK0/Vf+JUySQVCUqnx+Zb+bhvWmKfKuX0CJDE0yD+kH21ar0HMNLK9S9R3MJ  
dfL9+1PmXCXsTP7TihmnwCJSpBJpmzzq345uu3N52/3SsJYrahIukbPLnYxTAKDD  
N1k0ijGbEofDEC9RtdwnoGPfv1UG95LK22Ys3tLqApQqkByY

--a23--

### A.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.

#### A.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] 7345 bytes
  - └ (decrypts to)
    - └ application/pkcs7-mime [smime.p7m] 4436 bytes
      - └ (unwraps to)
        - └ message/rfc822 679 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

MIIVLAYJKoZIhvcNAQcDoIIVHTCCFRkCAQAxggMQMIIBhAIBADBsmFUXDTALBgNV  
BAoTBELFVEYxETAPBgNVBAsTCExBTVBTIFdHMTewLwYDVQQDEyhTYW1wbGUgTEFN  
UFGU1NBIENlcnRpZm1jYXRpb24gQXV0aG9yaXR5AhMPLSW9ETmXSs5CVIeh7j00  
Boq0MA0GCSqGSIb3DQEBAQUABIIBAFHb+aM8bhyJ1nFFuBDyyBVQf2IplykrvvYb  
mKqBk08i2gecPSOMTKw5e2oQ4+Wt4rtU4E0JXfMSA2KukKc+QUA3ycVCoL5zhetX  
GsEx74S5P4JMY/uAoyBIEogGNI2lvagvg0GkqHJCZAJKjPNmqyTfafyv1Y4BQRQ+  
WJi7mURDIbgrc0xfcc/y7UwXFlfUhm6n7rTvRKhe4D0E00B8yKupUgcDzBMTw5F  
P9HEY0vFij12+LNKSsOPhVp0PbPKMCV+ERTxEgV7C7BRVVYBiprpYJxJry09t3E  
jmIupqHZMgXxlAKFpBsdlPwfI1mrMVZTBpRgy8Bds7C0RgWbs0MwggGEAgEAMGww  
VTENMASGA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cxMTAvBgNVBAMTKFNh  
bXBsZSBMQU1QUyBSU0EgQ2VydG1maWNhdGlvbiBBdXR0b3JpdHkCEzB8R0APhiY6  
HGLS64MvlsDXhpQwDQYJKoZIhvcNAQEBBQAEggEAX1PxPDD1V2Wo766+MhR82lw8  
pD0GWAM1ScYPggh4t50FmSjFtyiqawhMcQhoRsAkGV387oXupYXH/1kaD7nIdZW+  
pZK1/RZUU0txvlsRIpJduXcWm/Dsu0lQtQSfcg5FaslSMjBpMI41BD2KC9M5meDP  
NqHnzNMFv0ZiP06x+bTCXhds8WTi/B2DDyXGjEa6RUFw6rKNXwbXoR0DJCMosF5  
55gQuo1k040YMqYRwdsJGETr/r/JaEPwNekogAfuXBkNE3JQB7aVgePp8mIZNIIU  
0nP6eXp95UwLsoA/zwb0v9XSYgQDCcQ0MwycXmmn4ysbewi1p7P+6CLwgx/TNTCC  
Ef4GCSqGSIb3DQEHAAdBg1ghkgBZQMEAAQIEEN9EoELWqIPQUHcQvENM3K+AghHQ  
7MaGZ6VZ5f9fpYjTHCbQSjcBtsF3qd7/z94CkYE+Fdt4Xtm91GLDSRONaVuT9yV6  
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### A.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] 7305 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 4406 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

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### A.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] 7865 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 4810 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 923 bytes
      └─ text/plain 51 bytes
        └─ text/plain 370 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

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MxP6C0t4ZQ4d/Khd3ZlVpDClsHX5oLy438m/4pjHEEVUrq8IwR2iE2N4oVqP8BuB  
yj6jswjjEu1uxahEYUqagASBAZU/uoue4B/hPrMgx3vVLs18UYPSivJ2cawRFtEo  
PgFoTvS5uMDl0TcCvcw6pRksNQb0vkwgFa2DnpXAOkwy4o+6zhWcAzzE4o58m+hm  
54sURdkwq9hodKwv61Yw/01I1DMSfoZyccoQ1r54PE0+rDcru4IPrPVsK65TMBHM  
utS8DatppiLRuuryLd6YtRNih1ELM6V64vPlbZi/i7all004RQvHjy/vgZTHrCKF  
lHZLa0AmoyGTPVAugi0VsLGc6SE/7P71QxfmfW4nEAekD5bDTLNXKrgSXN+26An9  
pjAg/Kv7VzqkNvPeu41Y8dLE0A4LzUx00W4TtoJaGy0FY9jr0ISPkyi7v9c70nih  
Qay38UcMyaHNrJ3ln45GrH4d6SyY3MFF9pCzYzhrYgMrrJoF12VGRl0CVfWEL7Co  
lWmMQ5sg5vYAVEZmdZA/BjApb5/yByVwYdVEc04YlyZ4IKXutyPDs0tHn2f1YM6M  
eC0mZq3Wlwac4h8oGh+bb5uyDtrXux20x/mFB03clrt2Xlxg3Kz+30dz0rwBcJNg  
gb0McWbNuvqkrqbtCjrSsgIYSyc3+8jXBZTF+Gzb0lcQocDCH6c5EVhgkvJ0ZK1q  
xotnpJ5KkmUtQcEaxWyzl5CZZJvUatas0H+Hq4742stnIjtgec5S7Zz6YyzWL/uA  
PbskoDQW1FBEgzMBwREQ4M+UjPKSs08CAIVSreGTeSYYS9JAmfe5iGSTx7HkFRft  
cP5KgEr1sm47epBnV7C9qAf6XVUWPpQMR0mbkn+1b+BYNE84NG3CCEDRl3JTs5fA  
7yLCnNJ13+jmqjtyCtcbYfGVFiZ3xnPMTB2fb016oTShsTx6jDr7bC+a959XBxWn  
WSwc47R27JurX3+t7BkP0IYiED6yydVbQ0Q41E0p3o2Kec9VXh0fjIEu6Ttctgk  
JyAEwUylj/APoa//GN4qqHQFXIMALaxfwj/1IvyqXWEE5E6WCihUdV3GFkMhztu1  
d/X6IOqUgQyas/1WakdhSpRiHZC6MXI5WUA1Fj7DqwlckxWDar3Poy9VsvtmP47w  
zh5cgHDbi1Kz65mGK0AajVH1D9UYb0gkW6nAU8y05Bm0AhS8bDceC6GaQzhhs6a5m

#### **A.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] 7345 bytes
  ↳ (decrypts to)
    └─ application/pkcs7-mime [smime.p7m] 4432 bytes
      ↳ (unwraps to)
        └─ message/rfc822 675 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

MIIVLAYJKoZIhvcNAQcDoIIIVHTCCFRkCAQAxggMQMIIBhAIBADBsmFUXDTALBgNV  
BAoTBELFVEYxETAPBgNVBAsTCExBTBTIFdHMTewLwYDVQQDEyhTYW1wbGUgTEFN  
UFMgU1NBIENlcnRpZm1jYXRpb24gQXV0aG9yaXR5AhMPLSW9ETmXSs5CVIeh7j00  
Boq0MA0GCSqSIsB3DQEBAQUABIIBAHMG7sjRDCJDMqgvQrFh4sk9MkaJJY7q6B3r  
hY87n3jm6UYk/ZaBi9uzcB1pDAF0hJkFLmo+PRUbFLUrmeYfQI60uvVElpwIDWmp  
cMtfz1XgKA06fh/On6aoVhpfv9EmaG1rCU5ezDPPbaXW8caNi2/yvL0ustpqK0Tj  
cOLgMK45tPcHeIaSD+8A4P0uf/GLzEFhDPdJrt3mVq76UbAoIGasA/sDhhg0xygq  
ZH3IPQoYShFEUmsK+RC9Sc9dmXtVYPByCEsPdhTieJyJw695dde8x17ZewS+JZai  
QK8pXZUDRL8E182+001HTXZYybfF05sFmJHQZ3L1ftF2Dqs800cwggGEAgEAMGww  
VTENMASGA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cxMTAvBgNVBAMTKFNh  
bXBsZSBMQU1QUyBSU0EgQ2VydG1maWNhdGlvbiBBdXR0b3JpdHkCEzB8R0APhiY6  
HGLS64MvlsDXhpQwDQYJKoZIhvcNAQEBBQAEggEALvjSc3y8/+aA+Mk2+8tup051  
fsr8cR8BV0+aR/CYDXaeAFg6CPk12PnLcpFRZDdqitxfe7SpMgk0oT3IsBxvu0sr  
0QckRlRLOwlv43Y9jJfMc7VInrB7bJ/cPHHgB07tPtB69/Qf252gsUs3UbWko8JU  
JXBkymfUAe5+x8/gGQYNJdvNC+v9cmnwTORFF/IJ/WcGsyHPhxguR+JZqIJkSI8T  
xjawV40qcahz5G/03vLI8kxW96lSSmVE9WIuPafsMbP1KZN/6i1gaUOPFcsh1jln  
fdnk3fToayCGwOAQvh/UYv1GTA06Rtnmz44YLZiGbVFLGLvcXFfwL1JLdl25DCC  
Ef4GCSqSIsB3DQEHATAdBg1ghkgBZQMEAAIEEJo6k0dMHnCo9aCxbG8k8qSAGhHQ  
oifxeGRuuDaxdcCKEYnhsAq0P92jEteuI38u48FqaDfBniUs9wmW/EiEaTmXWvdB  
f7df3Xe0K8yGqyR4pcSYSK8iGfLezceiIwABbXRS8eLcNT9NPc5MPopD/h4q1Vq  
+L1iuvm8P00Ih561cmKglrAmTebH1bnyjYLw6GH82/dscgRu4mihqvJTYQC3uaLY  
H0dJnqyYV124/K0QyAPKcm3gR9gniHVlejlQKIVwOT649mTdZ6FVeMk9eaLQtKf3  
mkx0trUzXduJnBj4cASKSovC8yySEuGwWu4kROF1g650ledfeU4SC9lwPwzvHPD/  
lk4R/gUA0UAoIij7GaNDZ4CqpZqDYOG2wJvCQjfk7MU9TgoPsSRXhlmZPCam4eck  
gdybUd0A4UTQ901ZiCrS0pDyKQyatn0u04SfKU/b97P9VwNageENErZTERoUx1T8  
Vq9yBTKZIwoQe/2wsVvVJaR2+SXunrla9HDwpHqDtZHhR6i9Ttnp08KMOCWLZbb+  
lVrxswrexUtGPCJRl62TBchhy01dIyz8eWMIUvHhLUkFnSUGh81MdQKIc0qJ9g3  
iu3tSd05AEHxNf+2hKrrTZzWCClatSvyfRbW6/Om1Izh9+JUyJLcCywJbxQUuWRA  
5pc3bHrd6/Ff1dqgw1dbH9x0Q/r0lbKrwK98B+7/KIAfvy/XTW3NAJNd1zpyhl4  
Ko4ujuBiRJz0xRKIPSMOH4w76YejowDi405Ea/F44hlTop5N/lyNVkPIVnGYrEHD  
7s05/cjQTX+A98PpoFVKHxphV+jRiwDz7uUYlW6ClYrC7/H7VkdztPk07Eyy+zXs  
uThq5Js+uwgsbNqnA613vTEF0p8f8k5fLi+HSgL/TYz/UtW7JknTl6k7TvLXuQWT  
UwmrWrD/UKADkkehGkZHPmZe+RaImwRd/x10M9+ZBovlbf1DigfhrVimwTppKE2k  
/S+GSXDs5r5ESN70gIZv8swYTk6N18yoFijBD+wwWU4u6JNL15R1JZZbki00Hhse  
40f2qogvmNfTpHbAU5DL4UWdehoK1fmPu4KaSpL2sRnTpqzyZEdAwG1JI0B0YAqE  
ztszmcxi1s9KWQ/XdNJBG2QHvSMf4QTCuY2e+335Y9/ZC5WBphpAazRp9xfXc3de  
Pl93N6ydfn09wT5k7TMeL0JrqPa84H06oRAYXqFYwi0VWRvyfrsInUv6AJfhrJBN  
dA3ebIVCwrfG1w80HerzDBo5yPc1ASLRmuPjaQ42CDrHqzfnMw9tHq5ZajoCGF60  
4mzqu9/99upVaaToFRsA40lUpRN2Qo0YUB0l3Ck34mWGwg8vf6akYADy1m0SrpR0  
yM+/8WeERonQcc3YqrmVjzM/yh4RLpl89owWhHIHAAP1YyuwCj+kji0q2HNhvyuq

9acwfjQ7mKBfK1i7PAYdvWb9dt95VnY5LF+MvevJ0df1lEt6rISePs+AhoQCA1u1  
B92MpDynfPUFoeRMx3do/zhVmY64qN7r1V0XxuuZXUW3WoopjdUzTmHycYBn7sM4  
3U0d02yJgy+IqiT0usRaQGC3/IJiZmXoTL94wBs0B1++cP59GPvym6qgm7i09fUW  
V04ik8lTEs1WegTez1Lr96dwkPv6mfFJQIDlxVoZ4LVRf3FbQa9cZS7wxSe6hgpI  
0Y6YB/s21v13GpCX8RtHEkEkW4Zc/9CrpUv+1/R3QXRvY0nQaWxc96w0/lVkoXcd  
SRrlglhl6yY0QYv0mTbusUdC0QtrcQBRVcVeqqbfLhip9Nxe8vabPkoGQro+15s0  
xk08Yw1Pt6oa0hh5NjqZaBpMhD0xAqHT0826xj7R5wp49KKtR90K4wuUy00AWpFY  
NdihipP1jGuCio13PPc+Vah0+ACMMDvEWjYk2qEy2TRbWoonB9szzUoQ7P0kKJx  
LfMS07ecJ6sSsjcprskZg0sJQxtIcAgRMnxFFaCfeg2zjW1I5HC+jbiNtqda0aQQ  
L0RZ1a3KWIIPNBq18u+cXXjfaBy4HQh1XmQEnStkLrx1JuAI1wxhXWYdsrjJ2xEW  
hQBjBwcnTAc5i/vU8H+oI1Pnc32DF8qfa51w1uLdoYl37PUMlerpXq+mPvL9cX/l  
w2zd7Nc+UUezq0YPrBbwnrW0vG1msrjBPqKnJGHZJhlZ0fLdmLa6inlsQBpX6kXb  
K+8mpshqf472H0fje8/hrdLn0e9Qxdf8eNyioDHS2MzxkYRktNJFIEK6JHo62NSG  
/aM1VJbKudK1V7FFd/hr0AVg+uLbrsaFBdI6EE868qQpDThpd3WnyX8HztTkm7Up  
zpPujeRarCgEk4RPLl3erYa7d+8lpD0hzZ0lQkEALbSlCV0uTW3RSd60fNp4gvXu  
GCzrJ/gsevJrJNggz3QojIXW9RFaU1Wwy80yIwdTguCswGBjMdUBRghKQlM6LlHU  
qqXGdRL742XbYU76RVNlTnjUvAFvumey5cylAck7Lm68hV8rhTBsWMAJCP6VYhY9  
i2AiW440gsN0Wu/uCLBNpxPlfA5UFYNx3fo5XriyTPumhkhksaF1N/jnWeXm8eUz  
/ylnM5K6sD0gOX0ThLWvg90IC+qbMPNu5d0pCznI9DIup6dIhx8L2j+JoeqdsCBY  
6Xt6KE8silLZAKYFFe5A57q1Tq/z1s/p/6TlhmRP/2IC+2sSX9EBqXGDD98gy66h  
rBapI4n5N6Rnt1N5fnWJPVSnvFYIDQ145EmqPd/gUmMBF/AalgyLEdxc3xK0T+Gd  
G0BcwQJdvMup8rPGWgP5oy/qNIAdB3dnlfAde0eeeiGhaSpcwVhEaW0fYS+IXUM  
kgWNDccjDIZHvGyLYNSihyAP6v0xZWzj2EWwUEAhtGodCQ74qm6JxRMGyVuBvyFD  
MtZxMQE/AU/bPQMNBNCkn69NXyYW9Uk7p//Ef0EvZG4WYgQvaZ1u4E/P8x0L6au0  
pDcB5UWRoqkyU7jguMb7f167iCgkRTTfSLULD+lJv/4zf1Fv4F6cQhv+NaEAF48l  
fCUFjEMtGLCp99xxnu3M6CdiabZNCyuGEVkhzL/fq1JpVlgKRFeDFU/wfTe8D4QT  
9tranwYyAVj3gd2f0ijr1Q5/9Ch0s83/X2CpSk8fHF0z3oBS7Gfyz45BugIhDqml  
NkX8J2vKlCB0x2Xo/3waf/Wf3aj0EFXKR9fC+TS06DrSS6XGBSQXn95SsWrzuA9I  
RuemiW8+wYbygiW4auucs+V60BRWg0wxAzn+0lX7zac+WHjerZui+E/7ehmFc8NP  
ZW/FVfTcyi6oc26dysKTzhp0Umh0WX4TvFHEX4KCL9QXTC/Ya1jrZTBFF+0tsJ0i  
oRDK2/yjrgU67Q1zK5escKJg0YdorZjMkfb0nNdjN0eJ1fLNL5eB8em/LEpaF+vK  
aCWLa8tVvuq8ggUZ6PHQNkqeIssJoSxrmCfSP0DEtjk2ZDGsHaH0J8KUBLR+wiSs  
g+NRIG3Uvch6kARJqN3Agw1BySV42A+C6x+BPUEbcwDv3qz0DLmfNob4WArd+jyk  
42Gnk9VL/bbddnhCyzYyHCr1D0XMIzewqzFR9ppDbgCLMxb7Q7a+8Umlkddd/aC5  
wFUAVB88JT1gj+NqxHZs4BISTd91ElFslmx9yXD/dEUPGfqy15tbTrbGQpfv393U  
Q6L6cwZS11Rg+b7E777ZSu0WxJL92ATouJmzCYLjafI0jBN9BpGIymvi2QvUYgB9  
9Bia2X/SRc1fc00VRK77c1GtW6Nj9L37eiXMKseQEWY3i94vY2Z61ytosB2BccS0  
R0QRJSWzXCXTJ6btCnFhZUuGhrnG6ibGKYmrTJTzNcrN4yJ/eByDq0c0YBUR10S2  
uGMqxbW0adJ9ci+r76ZLzdo70vTIb+WGb0P3IIYeSjIsymkc+Shb04mAEcodrYX0  
n3wYsjrhRYf4WIDxQhWJRudBpty2LG140GU0TP0QPDaKwnGIiBUiT554NJMvv6WW  
KLEBxtJlJQ8LhN/jo9ZwxwI/FZ68pd0h4r5Mh1atVxJHbLmnWmdd0L2b8w9UyBwM  
ts/zY9bdjfnDbgU3zmDsJkZgZdgGtZL9KbUwHDInvCKtODM+X7QQKHu482dRb/vo  
uIkQDy6meuxdj8e/xzdSua2aSqhYaRXuZlE7uq4EyN30cJB/re30R1sgKh5k+7hm  
kSibtsFYMYMwvBzh/Mata98kYHs6Bf+Rgx/FdA8989koFmkAb/B41NFKuTuS0DmK1  
2SDKgHb6rmn+cftv1M0zfgJdnG0bqa3NCEYnICWitPw6NAbqllvRwDKj2A91oM09  
YU1P/ZNox2vKWdH6rkpGfKJYVwdtVEwu1Nhaobu6p2c71RyCzJSYuAMshOyLXxgE  
1mCup6EU6+IqLryA4WkD2IdpYbVP/t0dFLKY1fBcGJtSVdgJCXiC/krDLdKhREkm  
RCiIcf6ghGlEn0Jpk0xU30WMh+kD01M02IJuwk4TlT0kBRqZatYWQQYQv0xecZ/K  
DvOXZNUQQSzxFSpnGo7w0LoUh9gB5G0IbDqtAShYsCXbU3fuXl8/6Lojv+f0YBBN

capJh5oWbmJAmowJU3pL1JyABd5+R//cj1hQFApBKrs+cbP6Z02cDabDWavBPPQ/  
QQCPjbMENRsGrU5bdWRoG13qP8+FV+k+aNHf0xtn+mc18scGhwfem6/hFgKyBCAZh  
H7RmYuWoRZP73XPLYAM3sfwb1hLZSFNhbKHS00/Fg2b5MkFy3DwtMbqH+2vDLBv  
6CJ8s0VTULjSk9b+ddvk6rgUy+Nce4l3s8Gq1ZfUUDV/AfYeovwoUhCIkKYj2DFS  
jBB6Zvoo8Z7zQpqN0HIiz+02zoYKtLconQWBGHVhn/A5ytYh05JZ72725AjitaE/  
9iRvigf0u4hQrowNuR+5t6bjA+5nfpKimd/3G6JdvY+QcN3BizQ39ZyUrUr3pmY5  
KkyHTZolsazk9ZKQY8LU1/nM2IraTuFzLhP6Mttj8DR+zXDjoPX5xxsr9VVWlcTG  
Y1NPHo1SYvqScQ7K3LVVsiqAzbr7SH0ABDF8ZtfwVqIDDMk7cubaTlUEdGA/tXTu  
iQMYNv8iJ4MmE0tte0sRrPKKbnEPlf+UiSI2LDEYPuvXooGoroNFHzqPUX+6BswB  
8GSEpsQDPzSJlYTugYrX+2PlM75c89dhfuidAHdubHMqurOUawtTKTl57rd9en4e  
HF0ZHQpXBgGQyQ7fT51WsXBZjxhwjHM4uDmc3WiST9DQX+blihwoOGx3moRbbAR4  
UsUJ8lopNmbY+Pf5XGvp92PtxzIBJyJ1Wfp0nCX3g4LhuwHpi5J0Gu2nfKD2LZR9  
l9OehrIncV0oF5rcJWwKnRZbTBjgozaxKwkUUFp/qEateGYxEeAJC0wy4ZD3N2cS  
r3I2871gQAni/LsF8CEAPaXE6swdSsfC0GWTi5W+jnDh2oeAweU0qb10+vwLicC+  
Xm4VabpnHPZPiozLRL6TaVEqvmBpvUXGzffUIXpXHsWbVpJuPsIzMlmgEEdwUvD  
Efcmds0p3V5B4ZaXLfR6aHdtrDT+B8eNb1bB2wOP/IA7Up4NzVf9BtEzq2JKj18  
mtSbNmSuhSGqYP3fKWV4inAgRQiDDw3bnazMh/mI17qMLa251zP9IJ5RNDRRWCjf  
+mljnLpyYhb5RyZ4nqD4+w59YM9Q/v72C2cyL6WygYE4JVXIwdnrHPSTkjBBjoxD  
P1WbthMP6DJcM5v9t8Rv8Mc8bPiUrKzMDCbXNcPJm1HDCnYrWXYqOvUpKvWn6zt  
Q39rPppCdrHKnzFS20MsvWiw9Kswg2rb/ph+qh418ac8VdyXNcETVgkLeYHnue61  
Rbb04HvCvu3bBNjy8D6yRlFVIVxH3Zy7+iz3fJ70VwlqqpmInMsidx3v1ykAeK1t  
uo42n/3t82Dx/5s3p9rZnhWXUD00etjL88GpyzvdwtkYy3Nj/8afvB62iUwZ1fR5  
rcnklWkphSq9HL6brXQsS3l0DDHsy8xIJlu5RrGD2M0IOy/rbMxNT5WnGoZ6j/RJ  
Spn1f944h2LkyVFFNgIlq1W6MLfTNBrZZ6kMpJ8X39iL5KmkRQ1me1rgJTTm4heK

#### A.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] 7305 bytes
  - ┆ (decrypts to)
  - └ application/pkcs7-mime [smime.p7m] 4402 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

MIIVDAYJKoZIhvcNAQcDoIIU/TCCFPkCAQAxggMQMIIBhAIBADBsmFUXDTALBgNV  
BAoTBELFVEYxETAPBgNVBAsTCExBTBVTIFdHMTewLwYDVQQDEyhTYW1wbGUgTEFN  
UFMgU1NBIENlcnRpZm1jYXRpb24gQXV0aG9yaXR5AhMPLSW9ETmXSs5CVIeh7j00  
Boq0MA0GCSqSIsB3DQEBAQUABIIBAFemxt6IIoOR5Kq2Jiucu85qezrNEQcYm6sV  
Cuo2f+/3Qcmr85ho7PNGXSmj0LkmkvIAh4RYf2fH6jqYSYgsxQjT3j0cx70hhTms  
zQV8e/UjVWRvxQHhPbntDFketPi2CA++Y8zqvb13L/dBeL+ltiQqcQprqy9RY5pH  
FibcQ50kxPIzBZQUL5NrjwRf16gujq+nGVrhphjwjWsCX+ypt6ZrrBPtje3Iudw6  
/0Mkmj21JPEkgwvFEFNL/FkcNRzH1H3dQxqjaf28Jp7eY/3tF4NVHcirE9DSc6hV  
7v5zV1VEtthdFE9shnbPxf+Sbww+M3ZTV0xJwGNwPwhM7ehf8wMwggGEAgEAMGww  
VTENMASGA1UEChMESUVURjERMA8GA1UECXMITEFNUFMgV0cxMTAvBgNVBAMTKFNh  
bXBsZSBMQU1QUyBSU0EgQ2VydG1maWNhdGlvbiBBdXR0b3JpdHkCEzB8R0APhiY6  
HGLS64MvlsDXhpQwDQYJKoZIhvcNAQEBBQAEggEAAZ8MBsyH2Tp59sokhPP1DnTLh  
iblpxfhKGR1N86t0QjQcmsND8MB4aM7BtgsymR3IcdKrchClmkt6ATp9anhFwz  
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#### A.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] 4802 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 918 bytes
      └─ text/plain 50 bytes
      └─ text/plain 367 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 10:13:02 -0500

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#### **A.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] 7605 bytes
  ↳ (decrypts to)
    └─ application/pkcs7-mime [smime.p7m] 4626 bytes
      ↳ (unwraps to)
        └─ message/rfc822 816 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  
In-Reply-To: <smime-enc-signed-wrapped-minimal@lhp.example>  
References: <smime-enc-signed-wrapped-minimal@lhp.example>

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DAU/W4DYjv9cN2BoAT0xWkWKyI9IbGyN00b6E8LFPXoCswXAtuW/MdphWUHWlKED  
v/WYC1ZYL8oRIZdAvNQGJxp7CI9iGaQCEcsbwzoGw7AGsb7pt0lfLJfVTNC28qSG  
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09sicjpgeFcIoZBDz26njP0gLM15o0xtKDsJ1tKl0M2g9NpA2kjXy/4uW1iru69E  
c592xssBoY3eEzoKdAOE20HUBVnmA2v+kJc51y1Bky3YYi9LICEDPZvR0PTD172o  
cJY2hGykCCDvfrTBjTuvIB5KeKgMfJRJDMtGAfzPESCX0ZcDr4pXX4im1japeGUX

#### A.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] 7585 bytes
  - ┆ (decrypts to)
  - └ application/pkcs7-mime [smime.p7m] 4600 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  
In-Reply-To: <smime-enc-signed-injected-minimal@lhp.example>  
References: <smime-enc-signed-injected-minimal@lhp.example>

MIIV3AYJKoZIhvcNAQcDoIIVzTCCFckCAQAxggMQMIIBhAIBADBsmFUXDTALBgNV  
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#### **A.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] 8170 bytes
  ↳ (decrypts to)
    └─ application/pkcs7-mime [smime.p7m] 5034 bytes
      ↳ (unwraps to)
        └─ multipart/mixed 1082 bytes
          ├── text/plain 57 bytes
          └─ text/plain 376 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  
In-Reply-To:  
<smime-enc-signed-injected-minimal-legacy@lhp.example>  
References:  
<smime-enc-signed-injected-minimal-legacy@lhp.example>

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#### **A.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] 7605 bytes
  - ↓ (decrypts to)
  - └ application/pkcs7-mime [smime.p7m] 4616 bytes
    - ↓ (unwraps to)
    - └ message/rfc822 810 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: <fdccb76a-49ed-50c5-9030-e4aeb83d7f04@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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#### **A.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] 7565 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 4592 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: <0e210732-9184-5855-9a95-2a635560d3a6@lhp.example>  
From: Alice <alice@smime.example>  
To: Bob <bob@smime.example>  
Date: Sat, 20 Feb 2021 10:18:02 -0500

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#### A.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] 8150 bytes
  - └ (decrypts to)
    - └ application/pkcs7-mime [smime.p7m] 5022 bytes
      - └ (unwraps to)
        - └ multipart/mixed 1075 bytes
          - └ text/plain 56 bytes
          - └ text/plain 373 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 10:19:02 -0500

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#### A.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] 9450 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 5982 bytes
    ↓ (unwraps to)
    └─ message/rfc822 1805 bytes
      └─ multipart/mixed 1741 bytes
        ├── multipart/alternative 1118 bytes
        │   ├── text/plain 375 bytes
        │   └─ text/html 459 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

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#### **A.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] 9470 bytes
  ↳ (decrypts to)
    └─ application/pkcs7-mime [smime.p7m] 6006 bytes
      ↳ (unwraps to)
        └─ multipart/mixed 1771 bytes
          ├── multipart/alternative 1122 bytes
          │   ├── text/plain 387 bytes
          │   └─ text/html 468 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

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#### **A.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] 10120 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6474 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 2095 bytes
      └─ text/plain 59 bytes
      └─ multipart/mixed 1600 bytes
        └─ multipart/alternative 1194 bytes
          └─ text/plain 424 bytes
          └─ text/html 505 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

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#### A.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] 9425 bytes
  - ┆ (decrypts to)
    - └ application/pkcs7-mime [smime.p7m] 5974 bytes
      - ┆ (unwraps to)
        - └ message/rfc822 1799 bytes
          - └ multipart/mixed 1735 bytes
            - ┆ multipart/alternative 1114 bytes
              - ┆ ┆ text/plain 373 bytes
              - ┆ ┆ text/html 457 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: <0b3ea6dd-0e91-5a91-9bc0-3d553f892983@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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#### **A.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] 9470 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 5998 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 1765 bytes
      └─ multipart/alternative 1118 bytes
        ├── text/plain 385 bytes
        │ └─ text/html 466 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: <b10dcc75-cf43-5fd7-9e48-f932a9d68fb5@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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#### **A.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] 10100 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6460 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 2088 bytes
      └─ text/plain 58 bytes
        └─ multipart/mixed 1596 bytes
          └─ multipart/alternative 1190 bytes
            └─ text/plain 421 bytes
              └─ text/html 502 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: <fdccb76a-49ed-50c5-9030-e4aeb83d7f04@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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#### A.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] 9750 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6200 bytes
    ↓ (unwraps to)
    └─ message/rfc822 1964 bytes
      └─ multipart/mixed 1900 bytes
        └─ multipart/alternative 1130 bytes
          └─ text/plain 381 bytes
            └─ text/html 465 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  
In-Reply-To:  
<smime-enc-signed-complex-wrapped-minimal@lhp.example>  
References:  
<smime-enc-signed-complex-wrapped-minimal@lhp.example>

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#### **A.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] 9775 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6230 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 1932 bytes
      └─ multipart/alternative 1134 bytes
        ├── text/plain 393 bytes
        ├── text/html 474 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  
In-Reply-To:  
<smime-enc-signed-complex-injected-minimal@lhp.example>  
References:  
<smime-enc-signed-complex-injected-minimal@lhp.example>

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#### A.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] 10465 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6728 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 2278 bytes
      └─ text/plain 65 bytes
        └─ multipart/mixed 1612 bytes
          └─ multipart/alternative 1206 bytes
            └─ text/plain 430 bytes
              └─ text/html 511 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-reply@lhp.example>  
From: Alice <alice@smime.example>  
To: Bob <bob@smime.example>  
Date: Sat, 20 Feb 2021 12:16:02 -0500  
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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#### **A.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] 9730 bytes
  ↳ (decrypts to)
    └─ application/pkcs7-mime [smime.p7m] 6192 bytes
      ↳ (unwraps to)
        └─ message/rfc822 1956 bytes
          └─ multipart/mixed 1892 bytes
            ├── multipart/alternative 1126 bytes
            │   ├── text/plain 379 bytes
            │   └── text/html 463 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 12:17:02 -0500

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#### **A.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] 9775 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6222 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 1924 bytes
      └─ multipart/alternative 1130 bytes
        ├── text/plain 391 bytes
        ├── text/html 472 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 12:18:02 -0500

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#### **A.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] 10445 bytes
  ↓ (decrypts to)
  └─ application/pkcs7-mime [smime.p7m] 6712 bytes
    ↓ (unwraps to)
    └─ multipart/mixed 2269 bytes
      └─ text/plain 64 bytes
      └─ multipart/mixed 1608 bytes
        └─ multipart/alternative 1202 bytes
          └─ text/plain 427 bytes
          └─ text/html 508 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: <0e210732-9184-5855-9a95-2a635560d3a6@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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OC2cH0uJ4wCTCq1RKVvlpZBYRGmQZzfgtZNUFPXkGMfgJ/nMtKasqPNdqTglFubI  
jyUq8xdFzYuIeydv7m6Tf2jBawV8zHbQ/2ZkL18WUPU=

## **Appendix B. Additional information**

### **B.1. Stored Variants of Messages with Bcc**

Messages containing at least one recipient address in the Bcc header field may appear in up to three different variants:

1. The Message for the recipient addresses listed in To or Cc header fields, which must not include the Bcc header field neither for signature calculation nor for encryption.
2. The Message(s) sent to the recipient addresses in the Bcc header field, which depends on the implementation:
  - a) One Message for each recipient in the Bcc header field separately, with a Bcc header field containing only the address of the recipient it is sent to.
  - b) The same Message for each recipient in the Bcc header field with a Bcc header field containing an indication such as "Undisclosed recipients", but no addresses.

c) The same Message for each recipient in the Bcc header field which does not include a Bcc header field (this Message is identical to 1. / cf. above).

3. The Message stored in the 'Sent'-Folder of the sender, which usually contains the Bcc unchanged from the original Message, i.e., with all recipient addresses.

The most privacy preserving method of the alternatives (2a, 2b, and 2c) is to standardize 2a, as in the other cases (2b and 2c), information about hidden recipients is revealed via keys. In any case, the Message has to be cloned and adjusted depending on the recipient.

## **Appendix C. Text Moved from Above**

Note: Per an explicit request by the chair of the LAMPS WG to only present one option for the specification, the following text has been stripped from the main body of the draft. It is preserved in an Appendix for the time being and may be moved back to the main body or deleted, depending on the decision of the LAMPS WG.

### **C.1. MIME Format**

Currently there are two options in discussion:

1. The option according to the current S/MIME specification (cf. [\[RFC8551\]](#))
2. An alternative option that is based on the former "memory hole" approach (cf. [\[I-D.autocrypt-lamps-protected-headers\]](#))

#### **C.1.1. S/MIME Specification**

Note: This is currently described in the main part of this document.

##### **C.1.1.1. Alternative Option Autocrypt "Protected Headers" (Ex-"Memory Hole")**

An alternative option (based on the former autocrypt "Memory Hole" approach) to be considered, is described in [\[I-D.autocrypt-lamps-protected-headers\]](#).

Unlike the option described in [Appendix C.1.1](#), this option does not use a "message/RFC822" wrapper to unambiguously delimit the Inner Message.

Before choosing this option, the following two issues must be assessed to ensure no interoperability issues result from it:

1. How current MIME parser implementations treat non-MIME Header Fields, which are not part of the outermost MIME entity and not part of a Message wrapped into a MIME entity of media type "message/rfc822", and how such Messages are rendered to the user.

[\[I-D.autocrypt-lamps-protected-headers\]](#) provides some examples for testing this.

2. MIME-conformance, i.e. whether or not this option is (fully) MIME-conformant [\[RFC2045\]](#) ff., in particular also Section 5.1. of [\[RFC2046\]](#) on "Multipart Media Type). In the following an excerpt of paragraphs that may be relevant in this context:

The only header fields that have defined meaning for body parts are those the names of which begin with "Content-". All other header fields may be ignored in body parts. Although they should generally be retained if at all possible, they may be discarded by gateways if necessary. Such other fields are permitted to appear in body parts but must not be depended on. "X-" fields may be created for experimental or private purposes, with the recognition that the information they contain may be lost at some gateways.

NOTE: The distinction between an RFC 822 Message and a body part is subtle, but important. A gateway between Internet and X.400 mail, for example, must be able to tell the difference between a body part that contains an image and a body part that contains an encapsulated Message, the body of which is a JPEG image. In order to represent the latter, the body part must have "Content-Type: message/rfc822", and its body (after the blank line) must be the encapsulated Message, with its own "Content-Type: image/jpeg" header field. The use of similar syntax facilitates the conversion of Messages to body parts, and vice versa, but the distinction between the two must be understood by implementors. (For the special case in which parts actually are Messages, a "digest" subtype is also defined.)

The MIME structure of an Email Message looks as follows:

<Outer Message Header Section (unprotected)>

<Outer Message Body (protected)>

<Inner Message Header Section>

<Inner Message Body>

The following example demonstrates how an Original Message might be protected, i.e., the Original Message is contained as Inner Message in the Protected Body of an Outer Message. It illustrates the first Body part (of the Outer Message) as a "multipart/signed" (application/pkcs7-signature) media type:

Lines are prepended as follows:

\*"O: " Outer Message Header Section

\*"I: " Message Header Section

O: Date: Mon, 25 Sep 2017 17:31:42 +0100 (GMT Daylight Time)  
O: Message-ID: <e4a483cb-1dfb-481d-903b-298c92c21f5e@m.example.net>  
O: Subject: Meeting at my place  
O: From: "Alexey Melnikov" <alexey.melnikov@example.net>  
O: MIME-Version: 1.0  
O: Content-Type: multipart/signed; charset=us-ascii; micalg=sha1;  
O: protocol="application/pkcs7-signature";  
O: boundary=boundary-AM

This is a multipart message in MIME format.

--boundary-AM

I: Date: Mon, 25 Sep 2017 17:31:42 +0100 (GMT Daylight Time)  
I: From: "Alexey Melnikov" <alexey.melnikov@example.net>  
I: Message-ID: <e4a483cb-1dfb-481d-903b-298c92c21f5e@m.example.net>  
I: MIME-Version: 1.0  
I: MMHS-Primary-Precedence: 3  
I: Subject: Meeting at my place  
I: To: somebody@example.net  
I: X-Mailer: Isode Harrier Web Server  
I: Content-Type: text/plain; charset=us-ascii

This is an important message that I don't want to be modified.

--boundary-AM

Content-Transfer-Encoding: base64

Content-Type: application/pkcs7-signature

[[base-64 encoded signature]]

--boundary-AM--

The Outer Message Header Section is unprotected, while the remainder (Outer Message Body) is protected. The Outer Message Body consists of the Inner Message (Header Section and Body).

The Inner Message Header Section is the same as (or a subset of) the Original Message Header Section.

The Inner Message Body is the same as the Original Message Body.

The Original Message itself may contain any MIME structure.

### C.1.2. Sending Side

To ease explanation, the following describes the case where an Original (message/rfc822) Message to be protected is present. If this is not the case, Original Message means the (virtual) Message that would be constructed for sending it as unprotected email.

#### **C.1.2.1. Inner Message Header Fields**

It is RECOMMENDED that the Inner Message contains all Header Fields of the Original Message with the exception of the following Header Field, which MUST NOT be included within the Inner Message nor within any other protected part of the Message:

\*Bcc

[[ TODO: Bcc handling needs to be further specified (see also [Appendix B.1](#)). Certain MUAs cannot properly decrypt Messages with Bcc recipients. ]]

#### **C.1.2.2. Wrapper**

The wrapper is a simple MIME Header Section followed by an empty line preceding the Inner Message (inside the Outer Message Body). The media type of the wrapper MUST be "message/RFC822" and MUST contain the Content-Type header field parameter "forwarded=no" as defined in [[I-D.melnikov-iana-reg-forwarded](#)]. The wrapper unambiguously delimits the Inner Message from the rest of the Message.

#### **C.1.2.3. Cryptographic Layers / Envelope**

[[ TODO: Basically refer to S/MIME standards ]]

#### **C.1.2.4. Sending Side Message Processing**

For a protected Message the following steps are applied before a Message is handed over to the Submission Entity:

##### **C.1.2.4.1. Step 1: Decide on Protection Level and Information Disclosure**

The implementation which applies protection to a Message must decide:

\*Which Protection Level (signature and/or encryption) shall be applied to the Message? This depends on user request and/or local policy as well as availability of cryptographic keys.

\*Which Header Fields of the Original Message shall be part of the Outer Message Header Section? This typically depends on local policy. By default, the Essential Header Fields are part of the Outer Message Header Section; cf. [Appendix C.1.2.5](#).

\*Which of these Header Fields are to be obfuscated? This depends on local policy and/or specific Privacy requirements of the user.

By default only the Subject Header Field is obfuscated; cf. [Appendix C.1.2.5](#).

#### **C.1.2.4.2. Step 2: Compose the Outer Message Header Section**

Depending on the decision in [Appendix C.1.2.4.1](#), the implementation shall compose the Outer Message Header Section. (Note that this also includes the necessary MIME Header Section part for the following protection layer.)

Outer Header Fields that are not obfuscated should contain the same values as in the Original Message (except for MIME Header Section part, which depends on the Protection Level selected in [Appendix C.1.2.4.1](#)).

#### **C.1.2.4.3. Step 3: Apply Protection to the Original Message**

Depending on the Protection Level selected in [Appendix C.1.2.4.1](#), the implementation applies signature and/or encryption to the Original Message, including the wrapper (as per [[RFC8551](#)]), and sets the resulting package as the Outer Message Body.

The resulting (Outer) Message is then typically handed over to the Submission Entity.

[[ TODO: Example ]]

### **C.1.2.5. Outer Message Header Fields**

#### **C.1.2.5.1. Encrypted Messages**

To maximize Privacy, it is strongly RECOMMENDED to follow the principle of Data Minimization (cf. [Section 2.1](#)).

However, the Outer Message Header Section SHOULD contain the Essential Header Fields and, in addition, MUST contain the Header Fields of the MIME Header Section part to describe Cryptographic Layer of the protected MIME subtree as per [[RFC8551](#)].

The following Header Fields are defined as the Essential Header Fields:

\*From

\*To (if present in the Original Message)

\*Cc (if present in the Original Message)

\*Bcc (if present in the Original Message, see also [Appendix B.1](#))

\*Date

\*Message-ID

\*Subject

Further processing by the Submission Entity normally depends on part of these Header Fields, e.g. From and Date HFs are required by [\[RFC5322\]](#). Furthermore, not including certain Header Fields may trigger spam detection to flag the Message, and/or lead to user experience (UX) issues.

For further Data Minimization, the value of the Subject Header Field SHOULD be obfuscated as follows:

\* Subject: [...]

and it is RECOMMENDED to replace the Message-ID by a new randomly generated Message-ID.

In addition, the value of other Essential Header Fields MAY be obfuscated.

Non-Essential Header Fields SHOULD be omitted from the Outer Message Header Section where possible. If Non-essential Header Fields are included in the Outer Message Header Section, those MAY be obfuscated too.

Header Fields that are not obfuscated should contain the same values as in the Original Message.

If an implementation obfuscates the From, To, and/or Cc Header Fields, it may need to provide access to the clear text content of these Header Fields to the Submission Entity for processing purposes. This is particularly relevant, if proprietary Submission Entities are used. Obfuscation of Header Fields may adversely impact spam filtering.

(A use case for obfuscation of all Outer Message Header Fields is routing email through the use of onion routing or mix networks, e.g. [\[pEp.mixnet\]](#).)

The MIME Header Section part is the collection of MIME Header Fields describing the following MIME structure as defined in [\[RFC2045\]](#). A MIME Header Section part typically includes the following Header Fields:

\*Content-Type

\*Content-Transfer-Encoding

\*Content-Disposition

The following example shows the MIME Header Section part of an S/MIME signed Message (using application/pkcs7-mime with SignedData):

```
MIME-Version: 1.0
Content-Type: application/pkcs7-mime; smime-type=signed-data;
             name=smime.p7m
Content-Transfer-Encoding: base64
Content-Disposition: attachment; filename=smime.p7m
```

Depending on the scenario, further Header Fields MAY be exposed in the Outer Message Header Section, which is NOT RECOMMENDED unless justified. Such Header Fields may include e.g.:

\*References

\*Reply-To

\*In-Reply-To

#### **C.1.2.5.2. Unencrypted Messages**

The Outer Message Header Section of unencrypted Messages SHOULD contain at least the Essential Header Fields and, in addition, MUST contain the Header Fields of the MIME Header Section part to describe Cryptographic Layer of the protected MIME subtree as per [RFC8551]. It may contain further Header Fields, in particular those also present in the Inner Message Header Section.

#### **Appendix D. Document Considerations**

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

This draft is built from markdown source, and its development is tracked in [a git repository](#).

While minor editorial suggestions and nit-picks can be made as [merge requests](#), please direct all substantive discussion to [the LAMPS mailing list](#) at [spasm@ietf.org](mailto:spasm@ietf.org).

#### **Appendix E. Document Changelog**

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

\*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.dkg-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](#)])

## Appendix F. Open Issues

[[ RFC Editor: This section should be empty and is to be removed before publication. ]]

\*Ensure "protected header" (Ex-Memory-Hole) option is (fully) compliant with the MIME standard, in particular also [[RFC2046](#)], Section 5.1. (Multipart Media Type) [Appendix C.1.1.1](#).

\*Test Vectors! We can point to the relevant test vector in the main text by reference. We should also include in the test vectors an encrypted message that references another message, so we can observe the effect of the HCP on threading.

\*Should Outer Message Header Section (as received) be preserved for the user? ([Section 4.1.4.5](#))

\*Decide on whether or not merge requirements from [[I-D.ietf-lamps-header-protection-requirements](#)] into this document.

\*Decide what parts of [[I-D.autocrypt-lamps-protected-headers](#)] to merge into this document.

\*Enhance Introduction [Section 1](#) and Problem Statement ([Section 2](#)).

\*Decide on whether or not specification for more legacy HP requirements should be added to this document ([Section 3.1.2](#)).

\*Verify simple backward compatibility case (Receiving Side MIME-Conformant) is working; once solution is stable and update paragraphs in [Section 4.1](#), [Section 3.1.2.1](#) and [Section 4.2.1](#) accordingly.

\*Verify ability to distinguish between Messages with Header Protection as specified in this document and legacy clients and update [Section 3.1](#) accordingly.

\*Improve definitions of Protection Levels and enhance list of Protection Levels ([Section 3.2](#), [Section 4](#)).

\*Privacy Considerations [Section 7](#)

\*Security Considerations [Section 6](#)

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