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A method for describing changes made to an email
draft-gondwana-dkim2-modification-alegebra-03

Abstract

This memo describes a method for describing the changes made to an email during common email modifications, for example those caused by mailing lists and forwarders.

While this is general enough to be used for any changes, it is anticipated that this method will normally be used for removing added data rather than large complex changes.

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1. Background and motivations

Currently, when an email is sent with a DKIM signature, the message can go through multiple forwarders and still be authenticated, however if a single change is made to a header which is covered by the signature, or to the body, then the signature no longer validates - and it's impossible for the receiver to know what was changed, or even if the entire message was replaced.

By producing a way to describe changes, the recipient can examine the sections which were changed and determine whether the change was malicious. Because each step signs its own changes in DKIM2, this also allows the recipient to identify exactly which intermediary introduced each change, and adjust their reputation accordingly.

2. Delta format - headers

For headers, the format is to completely replace all headers with a particular name. For example if you replace the subject and from address in an email, then you need to include the complete old headers for each of those:

Header: "DKIM2-Delta-Header:"

Tag	Value
i	DKIM2 matching header number
a.header.n	prepend named header with base64 octet value
b.header.n	replace named header with base64 octet value (remove and prepend)
d.header.n	remove first instance of named header (value: 't')
r.header.n	replace named header with raw text characters value (remove and prepend)
t.header.n	prepend named header with raw text characters value

Table 1

Example for a message which has had Subject and From replaced, and Reply-To added.

```
From: brong@fastmailteam.com.dmarc.fail
To: dkim2@lists.ietf.org
Reply-To: dkim2@lists.ietf.org
DKIM2-Delta-Header: i=3;
  r.Subject.0=A replacement for DKIM;
  b.From.0=YnJvbmdAZmFzdG1haWx0ZWftLmNvbQo=;
  d.Reply-To.0=t
```

Notice that each of these is .0. If there is more than one edit of the same header name then they will be .1, .2, etc.

While key names are case insensitive, implementations SHOULD create the header with the same case as the key.

3. Delta format - body

This difference format for the body was originally going to be an octet-based change format, however this is incompatible with "relaxed" signature checks as line ending normalisation could change the octet lengths, so this format was changed to be line based.

Since the transport for the delta is a 7-bit mime header, this format has been made simple and human readable. It is a simple program describing ranges of data to copy from the output to recreate the input.

Header: "DKIM2-Delta-Body:"

Tag	Value
i	DKIM2 matching header number
d.n	Insert lines by the formula in the value into the output
z	If present (value 't') then the program in d.0-N is declared to not recreate a passing hash (e.g. if an attachment has been deleted)

Table 2

Formulas:

Command	Input
b.b64val	decode the value as base64 and insert the resulting octets as a line
c.a-b	insert the numbered lines from a to b inclusive (starting at 1)
t.value	insert the text of the value as a line

Table 3

Example:

DKIM2-Delta-Body: i=2; d.0=c.1-500; d.1=c.520-520

Example - a URL was substituted in the content of the body (complex, but still easily doable!)

```
DKIM2-Delta-Body: i=3;  
d.0=c.1-500;  
d.1=b.PGEgaHJlZj0iaHR0cHM6Ly93d3cuZXhhbXBsZS5jb20iPkv4YW1wbGU8L2E+Cg==;  
d.2=c.501-702
```

The decision whether to use 'b' or 't' is up to the system creating the diff, however 't' has a limited set of characters that are safe to use in headers.

Likewise, it is expected that 'c' will normally be used to copy lines directly from the new message, however in cases where a message needs to transit 7 bits systems cleanly, the email modifier may need to re-encode the octets of the original message, and this allows for doing so.

4. Signature coverage.

Each DKIM2-Signature implicitly covers all DKIM2-Delta-Body and DKIM2-Delta-Header headers with an i=N value for the same and lower N values as the i= on the DKIM2 header.

5. Iterative application

To get back to the original message and confirm that it was unchanged, it is necessary to apply this algorithm iteratively.

For example if you receive a message at i=7 for which there is a modification to the headers at i=5 and a modification to both headers and body at i=3, to recreate the original message you would first apply the header changes from i=5, then apply the header and body changes for i=3. If this doesn't create a message which validates with the initial i=1 signature, then some hop has corrupted the message, and you can check every single DKIM signature in reverse to find the first one where the message no longer validates.

6. Security

TBA

7. IANA Considerations

TBA

8. Informative References

- [RFC2046] Freed, N. and N. Borenstein, "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types", RFC 2046, DOI 10.17487/RFC2046, November 1996, <<https://www.rfc-editor.org/rfc/rfc2046>>.
- [RFC3284] Korn, D., MacDonald, J., Mogul, J., and K. Vo, "The VCDIFF Generic Differencing and Compression Data Format", RFC 3284, DOI 10.17487/RFC3284, June 2002, <<https://www.rfc-editor.org/rfc/rfc3284>>.

Appendix A. Changes from Earlier Versions

A.1. draft-gondwana-dkim2-modification-algebra-02

- * change the header format to have unique keys, making it fit the ABNF for these types of headers.
- * allow easier editing of multi-value headers by always popping the first header and always prepending newly added headers.
- * change body to use d.0, d.1, etc with the program in the value, so that the program ordering is reliable regardless of the parser used to read the header.

A.2. draft-gondwana-dkim2-modification-algebra-02

- * change to using line numbers rather than octet offsets
- * remove d= base64 decoding capability
- * for multiple lines; require a separate b= or t= for each line

A.3. draft-gondwana-dkim2-modification-algebra-01

- * rename 'DKIM2-Diff' headers to 'DKIM2-Delta'
- * add 'z=y' option to DKIM2-Delta-Body for "complete replacement"
- * add d= base64 decoding option to DKIM2-Delta-Body

A.4. draft-gondwana-dkim2-modification-algebra-00

- * original version

[[This section to be removed by RFC Editor]]

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