

Sieve Email Filtering: Detecting Duplicate Deliveries

Abstract

This document defines a new test command, "duplicate", for the Sieve email filtering language. This test adds the ability to detect duplications. The main application for this new test is handling duplicate deliveries commonly caused by mailing list subscriptions or redirected mail addresses. The detection is normally performed by matching the message ID to an internal list of message IDs from previously delivered messages. For more complex applications, the "duplicate" test can also use the content of a specific header field or other parts of the message.

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1. Introduction

This document specifies an extension to the Sieve filtering language defined by RFC 5228 [SIEVE]. It adds a test to track whether or not a text string was seen before by the delivery agent in an earlier execution of the Sieve script. This can be used to detect and handle duplicate message deliveries.

Duplicate deliveries are a common side effect of being subscribed to a mailing list. For example, if a member of the list decides to reply to both the user and the mailing list itself, the user will often get one copy of the message directly and another through the mailing list. Also, if someone crossposts over several mailing lists to which the user is subscribed, the user will likely receive a copy from each of those lists. In another scenario, the user has several redirected mail addresses all pointing to his main mail account. If one of the user's contacts sends the message to more than one of those addresses, the user will likely receive more than a single copy. Using the "duplicate" extension, users have the means to detect and handle such duplicates (e.g., by discarding them, marking them as "seen", or putting them in a special folder).

Duplicate messages are normally detected using the Message-ID header field, which is required to be unique for each message. However, the "duplicate" test is flexible enough to use different criteria for defining what makes a message a duplicate (e.g., using the subject line or parts of the message body). Other applications of this new test command are also possible, as long as the tracked unique value is a string.

2. Conventions Used in This Document

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 [KEYWORDS].

Conventions for notations are as in Section 1.1 of [SIEVE], including use of the "Usage:" label for the definition of action and tagged arguments syntax.

3. Test "duplicate"

```
Usage: "duplicate" [":handle" <handle: string>]
          [":header" <header-name: string> /
           ":uniqueid" <value: string>]
          [":seconds" <timeout: number>] [":last"]
```

The "duplicate" test identifies the message by a "unique ID" and, using that unique ID, keeps track of which messages were seen by a "duplicate" test during an earlier Sieve execution. In its basic form, the test gets the unique ID from the content of the message's Message-ID header field. The "duplicate" test evaluates to "true" if the message was seen before, and it evaluates to "false" if it was not.

As a side effect, the "duplicate" test adds the unique ID to an internal duplicate-tracking list once the Sieve execution finishes successfully. The first time a particular unique ID is seen, the message is not a duplicate, and the unique ID is added to the tracking list. If a future Sieve execution sees a message whose unique ID appears in the tracking list, that test will evaluate to "true", and that message will be considered a duplicate.

Note that this side effect is performed only when the "duplicate" test is actually evaluated. If the "duplicate" test is nested in a control structure or if it is not the first item of an "allof" or "anyof" test list, its evaluation depends on the result of preceding tests, which may produce unexpected results.

Implementations MUST only update the internal duplicate-tracking list when the Sieve script execution finishes successfully. If failing script executions add the unique ID to the duplicate-tracking list, all "duplicate" tests in the Sieve script would erroneously yield "true" for the next delivery attempt of the same message. This can -- depending on the action taken for a duplicate -- easily lead to discarding the message without further notice.

However, deferring the definitive modification of the tracking list to the end of a successful Sieve script execution is not without problems. It can cause a race condition when a duplicate message is delivered in parallel before the tracking list is updated. This way, a duplicate message could be missed by the "duplicate" test. More complex implementations could use a locking mechanism to prevent this problem. But, irrespective of what implementation is chosen, situations in which the "duplicate" test erroneously yields "true" MUST be prevented.

The "duplicate" test MUST only check for duplicates amongst unique ID values encountered in previous executions of the Sieve script; it MUST NOT consider ID values encountered earlier in the current Sieve script execution as potential duplicates. This means that all "duplicate" tests in a Sieve script execution, including those located in scripts included using the "include" [INCLUDE] extension, MUST always yield the same result if the arguments are identical.

The Message-ID header field is assumed to be globally unique as required in Section 3.6.4 of RFC 5322 [IMAIL]. In practice, this assumption may not always prove to be true. The "duplicate" test does not deal with this situation, which means that false duplicates may be detected in this case. However, the user can address such situations by specifying an alternative means of message identification using the ":header" or the ":uniqueid" argument, as described in the next section.

3.1. Arguments ":header" and ":uniqueid"

Duplicate tracking involves determining the unique ID for a given message and checking whether that unique ID is in the duplicate-tracking list. The unique ID for a message is determined as follows:

- o When neither the ":header" argument nor the ":uniqueid" argument is used, the unique ID is the content of the message's Message-ID header field.
- o When the ":header" argument is used, the unique ID is the content of the specified header field in the message. The header field name is not part of the resulting unique ID; it consists only of the field value.
- o When the ":uniqueid" argument is used, the unique ID is the string parameter that is specified with the argument.

The ":header" and ":uniqueid" arguments are mutually exclusive; specifying both for a single "duplicate" test command MUST trigger an error.

The syntax rules for the header name parameter of the ":header" argument are specified in Section 2.4.2.2 of RFC 5228 [SIEVE]. Note that implementations MUST NOT trigger an error for an invalid header name. Instead, the "duplicate" test MUST yield "false" unconditionally in this case. The parameter of the ":uniqueid" argument can be any string.

If the tracked unique ID value is extracted directly from a message header field (i.e., when the ":uniqueid" argument is not used), the following operations MUST be performed before the actual duplicate verification:

- o Unfold the header line as described in Section 2.2.3 of RFC 5322 [IMAIL] (see also Section 2.4.2.2 of RFC 5228 [SIEVE]).
- o If possible, convert the header value to Unicode, encoded as UTF-8 (see Section 2.7.2 of RFC 5228 [SIEVE]). If conversion is not possible, the value is left unchanged.
- o Trim leading and trailing whitespace from the header value (see Section 2.2 of RFC 5228 [SIEVE]).

Note that these rules also apply to the Message-ID header field used by the basic "duplicate" test without a ":header" or ":uniqueid" argument. When the ":uniqueid" argument is used, any normalization needs to be done in the Sieve script itself as the unique ID is created.

If the header field specified using the ":header" argument exists multiple times in the message, extraction of the unique ID MUST use only the first occurrence. This is true whether or not multiple occurrences are allowed by Section 3.6 of RFC 5322 [IMAIL]. If the specified header field is not present in the message, the "duplicate" test MUST yield "false" unconditionally. In that case, the duplicate-tracking list is left unmodified by this test, since no unique ID value is available. The same rules apply with respect to the Message-ID header field for the basic "duplicate" test without a ":header" or ":uniqueid" argument, since that header field could also be missing or occur multiple times.

The string parameter of the ":uniqueid" argument can be composed from arbitrary text extracted from the message using the "variables" [VARIABLES] extension. To extract text from the message body, the "foreverypart" and "extracttext" [SIEVE-MIME] extensions need to be used as well. This provides the user with detailed control over how the message's unique ID is created.

The unique ID MUST be matched case-sensitively with the contents of the duplicate-tracking list, irrespective of how the unique ID was determined. To achieve case-insensitive behavior when the ":uniqueid" argument is used, the "set" command added by the "variables" [VARIABLES] extension can be used to normalize the unique ID value to upper or lower case.

3.2. Argument ":handle"

The "duplicate" test MUST track a unique ID value independent of its source. This means that all values in the duplicate-tracking list should be used for duplicate testing, regardless of whether they were obtained from the Message-ID header field, from an arbitrary header specified using the ":header" argument, or explicitly from the ":uniqueid" argument. The following three examples are equivalent and match the same entry in the duplicate-tracking list:

```
require "duplicate";
if duplicate {
  discard;
}

require "duplicate";
if duplicate :header "message-id" {
  discard;
}

require ["duplicate", "variables"];
if header :matches "message-id" "*" {
  if duplicate :uniqueid "${0}" {
    discard;
  }
}
```

The ":handle" argument can be used to override this default behavior. The ":handle" argument separates a "duplicate" test from other "duplicate" tests with a different or omitted ":handle" argument. Using the ":handle" argument, unrelated "duplicate" tests can be prevented from interfering with each other: a message is only recognized as a duplicate when the tracked unique ID was seen before in an earlier script execution by a "duplicate" test with the same ":handle" argument.

NOTE: The necessary mechanism to track duplicate messages is very similar to the mechanism that is needed for tracking duplicate responses for the "vacation" action [VACATION]. One way to implement the necessary mechanism for the "duplicate" test is therefore to store a hash of the tracked unique ID and, if provided, the ":handle" argument.

3.3. Arguments ":seconds" and ":last"

Implementations SHOULD let entries in the tracking list expire after a short period of time. The user can explicitly control the length of this expiration time by means of the ":seconds" argument, which accepts an integer value specifying the timeout value in seconds. If the ":seconds" argument is omitted, an appropriate default value MUST be used. A default expiration time of around 7 days is usually appropriate. Sites SHOULD impose a maximum limit on the expiration time. If that limit is exceeded by the ":seconds" argument, the maximum value MUST be silently substituted; exceeding the limit MUST NOT produce an error. If the ":seconds" argument is zero, the "duplicate" test MUST yield "false" unconditionally.

When the ":last" argument is omitted, the expiration time for entries in the duplicate-tracking list MUST be measured relative to the moment at which the entry was first created (i.e., at the end of the successful script execution during which the "duplicate" test returned "false" for a message with that particular unique ID value). This means that subsequent duplicate messages have no influence on the time at which the entry in the duplicate-tracking list finally expires.

In contrast, when the ":last" argument is specified, the expiration time MUST be measured relative to the last script execution during which the "duplicate" test was used to check the entry's unique ID value. This effectively means that the entry in the duplicate-tracking list will not expire while duplicate messages with the corresponding unique ID keep being delivered within intervals smaller than the expiration time.

It is possible to write Sieve scripts where, during a single execution, more than one "duplicate" test is evaluated with the same unique ID value and ":handle" argument but different ":seconds" or ":last" arguments. The resulting behavior is left undefined by this specification, so such constructs should be avoided. Implementations MAY choose to use the ":seconds" and ":last" arguments from the "duplicate" test that was evaluated last.

3.4. Interaction with Other Sieve Extensions

The "duplicate" test does not support either the "index" [DATE-INDEX] or "mime" [SIEVE-MIME] extensions directly, meaning that none of the ":index", ":mime", or associated arguments are added to the "duplicate" test when these extensions are active. The ":uniqueid" argument can be used in combination with the "variables" [VARIABLES] extension to achieve the same result indirectly.

Normally, Sieve scripts are executed at final delivery. However, with the "imapsieve" [IMAPSIEVE] extension, Sieve scripts are invoked when the IMAP [IMAP] server performs operations on the message store (e.g., when messages are uploaded, flagged, or moved to another location). The "duplicate" test is devised for use at final delivery, and the semantics in the "imapsieve" context are left undefined. Therefore, implementations SHOULD NOT allow the "duplicate" test to be used in the context of "imapsieve".

4. Sieve Capability Strings

A Sieve implementation that defines the "duplicate" test command will advertise the capability string "duplicate".

5. Examples

5.1. Example 1

In this basic example, message duplicates are detected by tracking the Message-ID header field. Duplicate deliveries are stored in a special folder contained in the user's Trash folder. If the folder does not exist, it is created automatically using the "mailbox" [MAILBOX] extension. This way, the user has a chance to recover messages when necessary. Messages that are not recognized as duplicates are stored in the user's inbox as normal.

```
require ["duplicate", "fileinto", "mailbox"];

if duplicate {
    fileinto :create "Trash/Duplicate";
}
```

5.2. Example 2

This example shows a more complex use of the "duplicate" test. The user gets network alerts from a set of remote automated monitoring systems. Several notifications can be received about the same event from different monitoring systems. The Message-ID header field of these messages is different, because these are all distinct messages from different senders. To avoid being notified more than a single time about the same event, the user writes the following script:

```
require ["duplicate", "variables", "imap4flags",
        "fileinto"];

if header :matches "subject" "ALERT: *" {
    if duplicate :seconds 60 :uniqueid "${1}" {
        setflag "\\seen";
    }
    fileinto "Alerts";
}
```

The subjects of the notification message are structured with a predictable pattern that includes a description of the event. In the script above, the "duplicate" test is used to detect duplicate alert events. The message subject is matched against a pattern, and the event description is extracted using the "variables" [VARIABLES] extension. If a message with that event in the subject was received before, but more than a minute ago, it is not detected as a duplicate due to the specified ":seconds" argument. In the event of a duplicate, the message is marked as "seen" using the "imap4flags" [IMAP4FLAGS] extension. All alert messages are put into the "Alerts" mailbox, irrespective of whether those messages are duplicates or not.

5.3. Example 3

This example shows how the "duplicate" test can be used to limit the frequency of notifications sent using the "enotify" [NOTIFY] extension. Consider the following scenario: a mail user receives Extensible Messaging and Presence Protocol (XMPP) notifications [NOTIFY-XMPP] about new mail through Sieve, but sometimes a single contact sends many messages in a short period of time. Now the user wants to prevent being notified of all of those messages. The user wants to be notified about messages from each person at most once per 30 minutes and writes the following script:

```
require ["variables", "envelope", "enotify", "duplicate"];

if envelope :matches "from" "*" { set "sender" "${1}"; }
if header :matches "subject" "*" { set "subject" "${1}"; }

if not duplicate :seconds 1800 :uniqueid "${sender}"
{
  notify :message "[SIEVE] ${sender}: ${subject}"
    "xmpp:user@im.example.com";
}
```

The example shown above uses the message envelope sender rather than the Message-ID header field as the unique ID for duplicate tracking.

The example can be extended to allow more messages from the same sender in close succession as long as the discussed subject is different. This can be achieved as follows:

```
require ["variables", "envelope", "enotify", "duplicate"];

if envelope :matches "from" "*" { set "sender" "${1}"; }
if header :matches "subject" "*" { set "subject" "${1}"; }

# account for 'Re:' prefix
if string :comparator "i;ascii-casemap"
  :matches "${subject}" "Re:*"
{
  set "subject" "${1}";
}
if not duplicate :seconds 1800
  :uniqueid "${sender} ${subject}"
{
  notify :message "[SIEVE] ${sender}: ${subject}"
    "xmpp:user@im.example.com";
}
```

This uses a combination of the message envelope sender and the subject of the message as the unique ID for duplicate tracking.

5.4. Example 4

For this example, the mail user uses the "duplicate" test for two separate applications: for discarding duplicate events from a notification system and for marking certain follow-up messages in a software support mailing as "seen" using the "imap4flags" [IMAP4FLAGS] extension.

The two "duplicate" tests in the following example each use a different header to identify messages. However, these "X-Event-ID" and "X-Ticket-ID" headers can have similar values in this case (e.g., both based on a time stamp), meaning that one "duplicate" test can erroneously detect duplicates based on ID values tracked by the other. Therefore, the user wants to prevent the second "duplicate" test from matching ID values tracked by the first "duplicate" test and vice versa. This is achieved by specifying different ":handle" arguments for these tests.

```
require ["duplicate", "imap4flags"];

if duplicate :header "X-Event-ID" :handle "notifier" {
  discard;
}
if allof (
  duplicate :header "X-Ticket-ID" :handle "support",
  address "to" "support@example.com",
  header :contains "subject" "fileserver")
{
  setflag "\\seen";
}
```

6. Security Considerations

A flood of unique messages could cause the duplicate-tracking list to grow indefinitely. Therefore, implementations SHOULD limit the number of entries in the duplicate-tracking list. When limiting the number of entries, implementations SHOULD discard the oldest ones first.

Scripts using the "duplicate" test evaluation should be aware that message IDs are not necessarily unique, either through the fault of benign generators or attackers injecting a message with the properties used by the duplicate Sieve filter at some point prior to

the Sieve filter. Therefore, scripts are well advised to be conservative with respect to actions taken when duplicate messages are identified only by message ID.

The list of unique IDs used for duplicate tracking can include privacy-sensitive information, such as message ID values, content of subject lines, and content extracted from message bodies. Implementations SHOULD protect that information by obscuring it through hashing (see the note at the end of Section 3.2) and/or by storing it with a level of access control equivalent to that of the messages themselves.

These measures will not prevent an entity that has access to the duplicate-tracking list from querying whether messages with certain unique ID values were received. As this operation is the essence of the "duplicate" test, this cannot be prevented and may violate the expectations of the user. For example, a user who deletes a message from the server may expect that no record of it remains on the server, but that will not be true if its message ID is persisted on the server in the duplicate-tracking list.

It's notable, however, that server logs will often store the information present on the duplicate-tracking list anyway and probably would expose plaintext message IDs for a much longer period than this mechanism would. Users of email services that intentionally delete such logs with the intent of limiting traceability should be made aware that use of the duplicate-tracking mechanism re-exposes this information for the duration of the expiry interval. Therefore, a shorter default expiry interval may be appropriate in those situations.

7. IANA Considerations

The following template specifies the IANA registration of the Sieve extension specified in this document:

```
To: iana@iana.org
Subject: Registration of new Sieve extension

Capability name: duplicate
Description:     Adds test 'duplicate' that can be used to test
                 whether a particular message is a duplicate,
                 i.e., whether a copy of it was seen before by
                 the delivery agent that is executing the Sieve
                 script.
RFC number:     RFC 7352
Contact address: Sieve mailing list <sieve@ietf.org>
```

This information has been added to the list of Sieve extensions given on <http://www.iana.org/assignments/sieve-extensions>.

8. Acknowledgements

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