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Sieve Email Filtering: Sieves and Display Directives in XML

Abstract

This document describes a way to represent Sieve email filtering language scripts in XML. Representing Sieves in XML is intended not as an alternate storage format for Sieve but rather as a means to facilitate manipulation of scripts using XML tools.

The XML representation also defines additional elements that have no counterparts in the regular Sieve language. These elements are intended for use by graphical user interfaces and provide facilities for labeling or grouping sections of a script so they can be displayed more conveniently. These elements are represented as specially structured comments in regular Sieve format.

Status of This Memo

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1. Introduction

Sieve [RFC5228] is a language for filtering email messages at or around the time of final delivery. It is designed to be implementable on either a mail client or mail server. It is meant to be extensible, simple, and independent of access protocol, mail architecture, and operating system, and it is intended to be manipulated by a variety of different user interfaces.

Some user interface environments have extensive existing facilities for manipulating material represented in XML [XML]. While adding support for alternate data syntaxes may be possible in most if not all of these environments, it may not be particularly convenient to do so. The obvious way to deal with this issue is to map Sieves into XML, possibly on a separate back-end system, manipulate the XML, and convert it back to normal Sieve format.

The fact that conversion into and out of XML may be done as a separate operation on a different system argues strongly for defining a common XML representation for Sieve. This way, different front-end user interfaces can be used with different back-end mapping and storage facilities.

Another issue with the creation and manipulation of Sieve scripts by user interfaces is that the language is strictly focused on describing email filtering operations. The language contains no mechanisms for indicating how a given script should be presented in a user interface. Such information can be represented in XML very easily, so it makes sense to define a framework to do this as part of the XML format. A structured comment convention is then used to retain this information when the script is converted to normal Sieve format.

It should be noted, however, that the ability for different front ends to use the same mapping and storage facilities does not mean that the additional XML information produced by different front ends will interoperate.

Various Sieve extensions have already been defined, e.g., [RFC5183], [RFC5229], [RFC5230], [RFC5231], [RFC5232], [RFC5233], [RFC5235], [RFC5293], and more are planned. The set of extensions available varies from one implementation to the next and may even change as a result of configuration choices. It is therefore essential that the XML representation of Sieve be able to accommodate Sieve extensions without requiring schema changes. It is also desirable that Sieve extensions not require changes to the code that converts to and from the XML representation.

This specification defines an XML representation for Sieve scripts and explains how the conversion process to and from XML works. The XML representation is capable of accommodating any future Sieve extension as long as the underlying Sieve grammar remains unchanged. Furthermore, code that converts from XML to the normal Sieve format requires no changes to accommodate extensions, while code used to convert from normal Sieve format to XML only requires changes when new control commands are added -- a rare event. An XML Schema, Relax NG Schema, and a sample stylesheet to convert from XML format are also provided in the appendices.

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 RFC 2119 [RFC2119].

The term "processor" is used throughout this document to refer to agents that convert Sieve to and from the XML representation. The term "editor" refers to agents that operate on, possibly creating or modifying, Sieves in XML format.

3. Grammatical Structure of Sieve

The Sieve language is designed to be highly extensible without making any changes to the basic language syntax. Accordingly, the syntax of Sieve, defined in Section 8 of [RFC5228], is entirely structural in nature and employs no reserved words of any sort.

Structurally, a Sieve script consists of a series of commands. Each command, in turn, consists of an identifier, zero or more arguments, an optional test or test-list, and finally an optional block containing another series of commands. Commands are further broken down into controls and actions, although this distinction cannot be determined from the grammar.

Some example Sieve controls are:

```
stop;                <-- No arguments, test, or command block
require "fileinto"; <-- Control with a single argument
if true {stop;}     <-- Control with test and command block
```

Some examples of Sieve actions are:

```
discard;            <-- Action with no arguments, test, or command block
fileinto "folder"; <-- Action with an argument
```

At the time of this writing, there are no controls defined that accept both arguments and a test. Similarly, there are currently no defined actions that allow either a test or a command block. Nevertheless, the Sieve grammar allows such constructs to be defined by some future extension.

A test consists of an identifier followed by zero or more arguments, then another test or test-list. Unlike commands, tests cannot be followed by a command block.

Here are some examples of Sieve tests. Note that such tests have to appear as part of a command in order to be syntactically valid:

```
true                <-- Test with no argument or subordinate test
envelope "to" "me@example.com" <-- Test with several arguments
header :is "from" "you@example.com" <-- Test with tagged argument
```

Command or test arguments can be either string lists, whole numbers, or tags. (Tags are simply identifiers preceded by a colon.) Note that although the Sieve grammar treats single strings as a degenerate case of a string list, some tests or actions have arguments that can only be individual strings, not lists.

Here is an example showing the use of both a test-list and a string list:

```
if anyof (not exists ["From", "Date"],
          header :contains "from" "fool@example.edu") {
  discard;
}
```

Extensions can add new controls, actions, tests, or arguments to existing controls or actions. Extensions have also changed how string content is interpreted, although this is not relevant to this specification. However, it is especially important to note that so far, only one of the many defined Sieve extensions -- the `foreverypart` extension [RFC5703] -- has added new controls to the language. It seems safe to assume that, due to their nature, future addition of controls will be relatively rare.

Finally, comments are allowed between lexical elements in a Sieve script. One important use case for comments is encoding meta-data about the script, a facility that is lacking in the Sieve language. Therefore, comments need to be preserved in the XML representation.

4. XML Representation of Sieve

Sieve controls and actions are represented in XML as "control" or "action" elements, respectively. The command's identifier appears as a name attribute on the element itself. This is the only attribute allowed on controls and actions -- arguments, tests, test-lists, and nested command blocks are all represented as nested elements. While naming the element after the control or action itself may seem like a better choice, doing so would result in extensions requiring frequent corresponding schema changes.

The example Sieve controls shown in the previous section would be represented as these XML fragments:

```
<control name="stop"/>

<control name="require"><str>fileinto</str></control>

<control name="if">
  <test name="true"/><control name="stop"/>
</control>
```

The example Sieve actions shown above would appear in XML as:

```
<action name="discard"/>
<action name="fileinto"><str>folder</str></action>
```

The separation of controls from actions in the XML representation means that conversion from normal Sieve format to XML has to be able to distinguish between controls and actions. This is easily done by maintaining a list of all known controls since experience indicates new controls are rarely added. At the time of this writing, the list of defined controls consists of:

1. if [RFC5228],
2. stop [RFC5228],
3. require [RFC5228],
4. foreverypart [RFC5703], and
5. break [RFC5703].

It should be noted that with this approach unknown controls will simply be treated as actions and can be passed back and forth between the two representations. The treatment of a control as an action is

unlikely to cause other issues since knowledge of a control's language semantics is almost always required to take advantage of it.

Tests are represented in the same basic way as controls and actions, that is, as a "test" element with a name attribute giving the test identifier. For example, the following XML fragments show various types of tests:

```
<test name="true"/>
```

```
<test name="envelope"/>  
  <str>to</str><str>me@example.com</str>  
</test>
```

```
<test name="header"/>  
  <tag>is</tag><str>from</str><str>you@example.com</str>  
</test>
```

String, number, and tag arguments are represented as "str", "num", and "tag" elements, respectively. The actual string, number, or tag identifier appears as text inside the element. None of these elements have any defined attributes. Several examples of arguments have already appeared in the preceding control, action, and test examples. Any whitespace in the str body content MUST be preserved by the processor. Also, note that since strings and tags are represented as element text, any quotes or other syntactic elements required in the regular Sieve representation are dropped rather than being carried over into the XML.

String list arguments are represented as a "list" element, which in turn contains one or more str elements. Note that this allows the distinction between a single string and a string list containing a single string to be preserved. This is not essential since a list containing a single string could simply be mapped to a string, but it seems prudent to maintain the distinction when mapping to and from XML.

Nested command blocks appear as a series of control or action elements inside of an outer control or action element. No block element is needed since an inner command block can only appear once and only after any arguments, tests, or test-lists. For example:

```

<control name="if">
  <test name="anyof">
    <test name="not">
      <test name="exists">
        <list><str>From</str><str>Date</str></list>
      </test>
    </test>
  <test name="header">
    <tag>contains</tag>
    <str>from</str>
    <str>fool@example.edu</str>
  </test>
</test>
<action name="discard"/>
</control>

```

Sieve comments are mapped to a special "comment" element in XML. Both hash and bracketed comments are mapped to the same construct so the distinction between the two is lost in XML. XML comments are not used because some XML tools do not make it convenient to access comment nodes.

Comments are allowed between commands and inside "test" elements. But comments aren't allowed directly inside commands -- due to limitations of XML Schema, special enclosing "preamble" and "postamble" elements are needed:

```

<control name="if">
  <preamble>
    <comment>Check to see if message should be discarded</comment>
  </preamble>
  <test name="anyof">
    <test name="not">
      <test name="exists">
        <list><str>From</str><str>Date</str></list>
      </test>
    </test>
  <test name="header">
    <tag>contains</tag>
    <str>from</str>
    <str>fool@example.edu</str>
  </test>
</test>
<action name="discard"/>
  <postamble>
    <comment>End of discard check</comment>
  </postamble>
</control>

```


4.1. XML Display Directives

Sometimes graphical user interfaces are a convenient way to provide Sieve management functions to users. These interfaces typically summarize/annotate/group/display Sieve script(s) in an intuitive way for end users.

To do this effectively, the graphical user interface may require additional information about the Sieve script itself. That information or "meta-data" might include, but is not limited to, a Sieve name (identifying the current Sieve), whether the Sieve is enabled or disabled, and the order in which the parts of the Sieve are presented to the user. The graphical user interface may also choose to provide mechanisms to allow the user to modify the script.

It is often useful for a graphical user interface to group related Sieve script elements and provide an interface that displays these groups separately so they can be managed as a single object. Some examples include Sieve statements that together provide vacation responders, blacklists/whitelists, and other types of filtering controls.

Some advanced graphical user interfaces may even provide a natural language representation of a Sieve script and/or an advanced interface to present Sieve statements directly to the user.

A graphical user interface may also choose to support only a subset of action commands in the Sieve language (and its extensions), and so a mechanism to indicate the extent of support and characterize the relationships between those supported action commands and the test (with its arguments) is immensely useful and probably required for clients that may not have complete knowledge of Sieve grammar and semantics.

The Sieve language contains no mechanisms for indicating how a given script should be presented in a user interface. The language also does not contain any specific mechanisms to represent other sorts of meta-data about the script. Providing support for such meta-data as part of a Sieve script is currently totally implementation specific and is usually done by imposing some type of structure on comments.

However, such information can be represented in XML very easily, so it makes sense to define a framework to do this as part of the XML format. Implementations MAY choose to use structured comments to retain this information when the script is converted to normal Sieve format.

The sample schemata for the XML representation of Sieve allows XML in foreign namespaces to be inserted in the same places "comment" elements can appear in Sieve scripts. This is the preferred means of including additional information. Alternately, the schema defines two display directives -- `displayblock` and `displaydata` -- as containers for meta-data needed by graphical user interfaces.

Editors MAY use `displayblock`, `displaydata`, and foreign namespaces to associate meta-data. Some editors find it inconvenient to preserve this additional data during an editing session. Editors MAY preserve this data during an editing session for compatibility with other editors.

The `displayblock` element can be used to enclose any number of Sieve statements at any level. It is semantically meaningless to the Sieve script itself. It allows an arbitrary set of attributes. Implementations MAY use this to provide many simple, display-related meta-data for the Sieve such as Sieve identifier, group identifier, order of processing, etc.

The `displaydata` element supports any number of arbitrary child elements. Implementations MAY use this to represent complex data about that Sieve such as a natural language representation of Sieve or a way to provide the Sieve script directly.

4.2. Structured Comments

Since the XML representation is not intended as a storage format, there needs to be a way to preserve the additional information that can be included in the XML representation in the normal Sieve syntax. This is done through the use of three structured comment conventions:

1. XML content in other namespaces is placed in Sieve bracketed comments beginning with the string `/* [/"` and ending with the string `"/] */`.
2. The content of `displaydata` elements is placed in Sieve bracketed comments beginning with the string `/* [|"` and ending with the string `"|] */`.
3. The beginning of a `displayblock` element is mapped to a bracketed Sieve comment beginning with the string `/* [*"`, which then lists any `displayblock` attribute names and values in XML format. The end of a `displayblock` element is mapped to a comment of the form `**] */`.

Processors MUST preserve the additional information allowed in the XML format and SHOULD use the structured comment format shown above.

Note: If "*" is found in the XML content, when mapped into a comment, it would prematurely terminate that comment. Escaping this sequence would often be inconvenient for processors. Editors SHALL NOT include "*" within displayblock, displaydata, or foreign markup. Processors MAY regard documents containing "*" in foreign markup, displayblock, or displaydata as invalid.

4.3. Validation

A processor MAY validate documents against a schema, and it MAY reject any that do not conform. For any document that a processor does not reject as invalid, any markup that the processor cannot understand by reference to this specification MAY be discarded.

Note that example Relax NG and XML Schema are given in the appendices below.

5. Security Considerations

Any syntactically valid Sieve script can be represented in XML. Accordingly, all security considerations applicable to Sieve and any extensions used also apply to the XML representation.

The use of XML carries its own security risks. Section 7 of RFC 3470 [RFC3470] discusses these risks.

It is axiomatic that a Sieve editor must be trusted to do what the user specifies. If XML formats are used, this trust necessarily must extend to the components involved in converting to and from XML format.

Arbitrary data can be included using other namespaces or placed in the extensible displayblock and displaydata constructs defined in this specification, possibly including entire scripts and other executable content in languages other than Sieve. Such material will necessarily have its own security considerations, which are beyond the scope of this document.

6. IANA Considerations

This section registers a new XML namespace per the procedures in RFC 3688 [RFC3688].

URI: urn:ietf:params:xml:ns:sieve

Registrant Contact: IETF Sieve working group
<ietf-mta-filters@imc.org>

XML:

```
BEGIN
<?xml version="1.0"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML Basic 1.0//EN"
  "http://www.w3.org/TR/xhtml-basic/xhtml-basic10.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
  <meta http-equiv="content-type"
    content="text/html;charset=iso-8859-1"/>
  <title>Sieve Namespace</title>
</head>
<body>
  <h1>Namespace for Sieve Language objects expressed in XML</h1>
  <h2>urn:ietf:params:xml:ns:sieve</h2>
  <p>See <a href="http://www.rfc-editor.org/rfc/rfc5784.txt">
    RFC 5784</a>.
  </p>
</body>
</html>
END
```

7. References

7.1. Normative References

- [OASISRNC] Clark, J., "RELAX NG Compact Syntax", OASIS Committee Specification rnc, November 2002.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
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- [RFC5228] Guenther, P. and T. Showalter, "Sieve: An Email Filtering Language", RFC 5228, January 2008.

[XML] Bray, T., Paoli, J., Sperberg-McQueen, C., Maler, E., and F. Yergeau, "Extensible Markup Language (XML) 1.0 (Fifth Edition)", W3C REC-xml-20081126, November 2008, <<http://www.w3.org/TR/2008/REC-xml-20081126/>>.

7.2. Informative References

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- [RFC5229] Homme, K., "Sieve Email Filtering: Variables Extension", RFC 5229, January 2008.
- [RFC5230] Showalter, T. and N. Freed, "Sieve Email Filtering: Vacation Extension", RFC 5230, January 2008.
- [RFC5231] Segmuller, W. and B. Leiba, "Sieve Email Filtering: Relational Extension", RFC 5231, January 2008.
- [RFC5232] Melnikov, A., "Sieve Email Filtering: Imap4flags Extension", RFC 5232, January 2008.
- [RFC5233] Murchison, K., "Sieve Email Filtering: Subaddress Extension", RFC 5233, January 2008.
- [RFC5235] Daboo, C., "Sieve Email Filtering: Spamtest and Virustest Extensions", RFC 5235, January 2008.
- [RFC5293] Degener, J. and P. Guenther, "Sieve Email Filtering: Edithheader Extension", RFC 5293, August 2008.
- [RFC5703] Hansen, T. and C. Daboo, "Sieve Email Filtering: MIME Part Tests, Iteration, Extraction, Replacement, and Enclosure", RFC 5703, October 2009.

Appendix A. Extended Example

The example Sieve script given in Section 9 of [RFC5228] would be represented in XML as the following code component:

```
<sieve xmlns="urn:ietf:params:xml:ns:sieve">
  <comment>
    Example Sieve Filter
    Declare any optional features or extensions used by the script
  </comment>

  <control name="require">
    <str>fileinto</str>
  </control>
  <comment>
    Handle messages from known mailing lists.
    Move messages from IETF filter discussion list to filter mailbox.
  </comment>
  <control name="if">
    <test name="header">
      <tag>is</tag>
      <str>Sender</str>
      <str>owner-ietf-mta-filters@imc.org</str>
    </test>
    <action name="fileinto">
      <str>filter</str>
    </action>
    <postamble>
      <comment>move to "filter" mailbox</comment>
    </postamble>
  </control>

  <comment>
    Keep all messages to or from people in my company.
  </comment>
  <control name="elsif">
    <test name="address">
      <tag>domain</tag>
      <tag>is</tag>
      <list>
        <str>From</str>
        <str>To</str>
      </list>
      <str>example.com</str>
    </test>
    <action name="keep"/>
  </control>
```

```
<comment>
  Try and catch unsolicited email.  If a message is not to me,
  or it contains a subject known to be spam, file it away.
</comment>
<control name="elsif">
  <test name="anyof">
    <test name="not">
      <test name="address">
        <tag>all</tag>
        <tag>contains</tag>
        <list>
          <str>To</str>
          <str>Cc</str>
          <str>Bcc</str>
        </list>
        <str>me@example.com</str>
      </test>
    </test>
    <test name="header">
      <tag>matches</tag>
      <str>subject</str>
      <list>
        <str>*make*money*fast*</str>
        <str>*university*dipl*mas*</str>
      </list>
    </test>
  </test>
  <action name="fileinto">
    <str>spam</str>
  </action>
</control>
<control name="else">
  <preamble>
    <comment>
      Move all other (non-company) mail to "personal"
      mailbox.
    </comment>
  </preamble>
  <action name="fileinto">
    <str>personal</str>
  </action>
</control>
</sieve>
```

The same script could be annotated with graphical display hints in a variety of ways. Three possible code components that do this are:

```
<sieve xmlns="urn:ietf:params:xml:ns:sieve">

  <control name="require">
    <str>fileinto</str>
  </control>

  <displayblock name="File filter list mail" order="1"
    group="FILE_TO_FOLDER" enable="true">
    <control name="if">
      <test name="header">
        <tag>is</tag>
        <str>Sender</str>
        <str>owner-ietf-mta-filters@imc.org</str>
      </test>
      <action name="fileinto">
        <str>filter</str>
      </action>
    </control>
  </displayblock>

  <displayblock name="Keep all company mail" order="2"
    group="KEEP_MESSAGE" enable="true">
    <control name="elsif">
      <test name="address">
        <tag>domain</tag>
        <tag>is</tag>
        <list>
          <str>From</str>
          <str>To</str>
        </list>
        <str>example.com</str>
      </test>
      <action name="keep" />
    </control>
  </displayblock>

  <displayblock name="File suspected spam" order="3"
    group="FILE_TO_FOLDER" enable="true">
    <control name="elsif">
      <test name="anyof">
        <test name="not">
          <test name="address">
            <tag>all</tag>
            <tag>contains</tag>
          </test>
        </test>
      </test>
    </control>
  </displayblock>
</sieve>
```



```
        <str>To</str>
        <str>Cc</str>
        <str>Bcc</str>
    </list>
    <str>me@example.com</str>
</test>
</test>
<test name="header">
  <tag>matches</tag>
  <str>subject</str>
  <list>
    <str>*make*money*fast*</str>
    <str>*university*dipl*mas*</str>
  </list>
</test>
</test>
<action name="fileinto">
  <str>spam</str>
</action>
</control>
</displayblock>

<displayblock name="File noncompany mail as personal" order="4"
  group="FILE_TO_FOLDER" enable="true">
  <control name="else">
    <action name="fileinto">
      <str>personal</str>
    </action>
  </control>
</displayblock>

</sieve>
```

Note that since displayblock elements are semantically null as far as the script itself is concerned, they can be used to group structures like elsif and else that are tied to statements in other groups.

The representation of this script in regular Sieve syntax uses structured comments:

```
require "fileinto";
/* [* name="File filter list mail" order="1"
   group="FILE_TO_FOLDER" enable="true" */
if header :is "Sender" "owner-ietf-mta-filters@imc.org"
{
  fileinto "filter";
}
/* *] */
/* [* name="Keep all company mail" order="2"
   group="KEEP_MESSAGE" enable="true" */
elsif address :domain :is [ "From", "To" ] "example.com"
{
  keep;
}
/* *] */
/* [* name="File suspected spam" order="3"
   group="FILE_TO_FOLDER" enable="true" */
elsif anyof ( not ( address :all :contains [ "To", "Cc", "Bcc" ]
           "me@example.com" ),
             header :matches "subject" [ "*make*money*fast*",
           "*university*dipl*mas*" ] )
{
  fileinto "spam";
}
/* *] */
/* [* name="File noncompany mail as personal" order="4"
   group="FILE_TO_FOLDER" enable="true" */
else
{
  fileinto "personal";
}
/* *] */
```

A separate namespace can be used to embed text or structured information:

```
<sieve xmlns="urn:ietf:params:xml:ns:sieve"
  xmlns:nls="http://example.com/nls">

  <nls:interpretation>
    If the email header "Sender" is owner-ietf-mta-filters@imc.org,
    then file it into the "filter" folder.

    Otherwise, if the address in the "From" or "To" has a domain
    that is "example.com", then keep it.

    Otherwise, messages meeting with any of these conditions:

    (1) None of the addresses in "To", "Cc", or "Bcc" contain
        the domain "example.com".

    (2) The "Subject" field matches the pattern *make*money*fast*
        or *university*dipl*mas*, then file it into the "spam"
        folder.

    If all else fails, then file the message in the "personal"
    folder.
  </nls:interpretation>

  ... the actual Sieve script ...

</sieve>
```

Alternately, `displaydata` elements can be used to accomplish the same thing:

```
<sieve xmlns="urn:ietf:params:xml:ns:sieve">
  <displaydata>
    <nls-interpretation>
      If the email header "Sender" is owner-ietf-mta-filters@imc.org,
      then file it into the "filter" folder.

      Otherwise, if the address in the "From" or "To" has a domain
      that is "example.com", then keep it.

      Otherwise, messages meeting with any of these conditions:

      (1) None of the addresses in "To", "Cc", or "Bcc" contain
          the domain "example.com".

      (2) The "Subject" field matches the pattern *make*money*fast*
          or *university*dipl*mas*, then file it into the "spam"
          folder.

      If all else fails, then file the message in the "personal"
      folder.
    </nls-interpretation>
  </displaydata>

  ... the actual Sieve script ...
</sieve>
```

Again, structured comments are used to represent this in regular Sieve syntax:

```
/* [|
  <nls-interpretation>
    If the email header "Sender" is owner-ietf-mta-filters@imc.org,
    then file it into the "filter" folder.

    Otherwise, if the address in the "From" or "To" has a domain
    that is "example.com", then keep it.

    Otherwise, messages meeting with any of these conditions:

    (1) None of the addresses in "To", "Cc", or "Bcc" contain
        the domain "example.com".

    (2) The "Subject" field matches the pattern *make*money*fast*
        or *university*dipl*mas*, then file it into the "spam"
        folder.

    If all else fails, then file the message in the "personal"
    folder.
  </nls-interpretation>
|] */

... the actual Sieve script ...
```

Appendix B. XML Schema for Sieves in XML

This appendix is informative. The following code component is an XML Schema for the XML representation of Sieve scripts. Most of the elements employing a complex content model allow use of elements in other namespaces, subject to lax XML Schema validation rules. Additionally, `displaydata` elements can be used to encapsulate arbitrary XML content. Finally, `displayblock` elements can be used as a general-purpose grouping mechanism -- arbitrary attributes are allowed on `displayblock` elements.

```
<?xml version="1.0" encoding="UTF-8"?>

<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns="urn:ietf:params:xml:ns:sieve"
  targetNamespace="urn:ietf:params:xml:ns:sieve">

  <xsd:element name="sieve">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:choice maxOccurs="unbounded" minOccurs="0">
```

```

    <xsd:element ref="control"/>
    <xsd:element ref="action"/>
    <xsd:element ref="displayblock"/>
    <xsd:element ref="displaydata"/>
    <xsd:element ref="comment"/>
    <xsd:any namespace="##other" processContents="lax"/>
  </xsd:choice>
</xsd:sequence>
</xsd:complexType>
</xsd:element>

<xsd:element name="comment" type="xsd:string"/>

<xsd:complexType name="ambles">
  <xsd:choice minOccurs="0" maxOccurs="unbounded">
    <xsd:element ref="displaydata"/>
    <xsd:element ref="comment"/>
    <xsd:any namespace="##other" processContents="lax"/>
  </xsd:choice>
</xsd:complexType>

<xsd:element name="preamble" type="ambles"/>
<xsd:element name="postamble" type="ambles"/>

<xsd:complexType name="command">
  <xsd:sequence>
    <xsd:element ref="preamble" minOccurs="0" maxOccurs="1"/>
    <xsd:choice minOccurs="0" maxOccurs="unbounded">
      <xsd:element ref="str"/>
      <xsd:element ref="num"/>
      <xsd:element ref="list"/>
      <xsd:element ref="tag"/>
    </xsd:choice>
    <xsd:element ref="test" minOccurs="0" maxOccurs="1"/>
    <xsd:choice minOccurs="0" maxOccurs="unbounded">
      <xsd:element ref="control"/>
      <xsd:element ref="action"/>
      <xsd:element ref="displayblock"/>
    </xsd:choice>
    <xsd:element ref="postamble" minOccurs="0" maxOccurs="1"/>
  </xsd:sequence>
  <xsd:attribute use="required" name="name" type="identifier"/>
</xsd:complexType>

<xsd:element name="control" type="command"/>
<xsd:element name="action" type="command"/>

<xsd:element name="test">

```

```

<xsd:complexType>
  <xsd:sequence>
    <xsd:choice minOccurs="0" maxOccurs="unbounded">
      <xsd:element ref="str"/>
      <xsd:element ref="num"/>
      <xsd:element ref="list"/>
      <xsd:element ref="tag"/>
      <xsd:element ref="displaydata"/>
      <xsd:element ref="comment"/>
      <xsd:any namespace="##other" processContents="lax"/>
    </xsd:choice>
    <xsd:element ref="test" minOccurs="0"
      maxOccurs="unbounded"/>
  </xsd:sequence>
  <xsd:attribute use="required" name="name" type="identifier"/>
</xsd:complexType>
</xsd:element>

<xsd:element name="list">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:element ref="str" minOccurs="1"
        maxOccurs="unbounded"/>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>

<xsd:element name="tag" type="identifier"/>

<xsd:element name="str" type="xsd:string"/>

<xsd:element name="num" type="xsd:nonNegativeInteger"/>

<xsd:simpleType name="identifier">
  <xsd:restriction base="xsd:token">
    <xsd:pattern value="[A-Za-z_][A-Za-z0-9_]*"/>
  </xsd:restriction>
</xsd:simpleType>

<xsd:element name="displayblock">
  <xsd:complexType>
    <xsd:sequence>
      <xsd:choice minOccurs="0" maxOccurs="unbounded">
        <xsd:element ref="control"/>
        <xsd:element ref="action"/>
        <xsd:element ref="displayblock"/>
        <xsd:element ref="displaydata"/>
        <xsd:element ref="comment"/>
      </xsd:choice>
    </xsd:sequence>
  </xsd:complexType>
</xsd:element>

```

```

        <xsd:any namespace="##other" processContents="lax"/>
    </xsd:choice>
</xsd:sequence>
    <xsd:anyAttribute processContents="skip"/>
</xsd:complexType>
</xsd:element>

<xsd:element name="displaydata">
    <xsd:complexType>
        <xsd:sequence minOccurs="0" maxOccurs="unbounded">
            <xsd:any processContents="skip"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>

</xsd:schema>

```

Appendix C. Relax NG Schema for Sieves in XML

This appendix is informative. The following code component defines a Relax NG Schema using compact notation OASISRNC [OASISRNC] for the XML representation of Sieve scripts. Most of the elements employing a complex content model allow unrestricted use of elements in other namespaces. Additionally, `displaydata` elements can be used to encapsulate arbitrary XML content. Finally, `displayblock` elements can be used as a general-purpose grouping mechanism -- arbitrary attributes are allowed on `displayblock` elements.

```

namespace sieve = "urn:ietf:params:xml:ns:sieve"

start = element sieve:sieve { ( control | action | displayblock |
                                displaydata | comment | ext )* }

comment = element sieve:comment { xsd:string }

ambles =
    (
        ( displaydata | comment | ext )*
    ),
    empty

preamble = element sieve:preamble { ambles }
postamble = element sieve:postamble { ambles }

command =
    (
        attribute name {
            xsd:token {

```



```

        pattern = "[A-Za-z_][A-Za-z0-9_]*" } },
    preamble?,
    ( str | num | \list | tag )*,
    test?,
    ( control | action | displayblock)*,
    postamble?
),
empty

control = element sieve:control { command }
action = element sieve:action { command }

test =
    element sieve:test
    {
        attribute name {
            xsd:token {
                pattern = "[A-Za-z_][A-Za-z0-9_]*" } },
        ( str | num | \list | tag | comment | ext )*,
        test*
    }

\list = element sieve:list { str+ }

tag = element sieve:tag {
    xsd:token {
        pattern = "[A-Za-z_][A-Za-z0-9_]*" } }

str = element sieve:str { xsd:string }

num = element sieve:num { xsd:nonNegativeInteger }

any = ( element * { any } | attribute * { text } | text )*

ext = element * - sieve:* { any }*

displayblock =
    element sieve:displayblock
    {
        ( control | action | displayblock |
          displaydata | comment | ext )*,
        attribute * { text }*
    }

displaydata = element sieve:displaydata { any* }

```

Appendix D. Stylesheet for Conversion from XML

This appendix is informative. The following code component is a stylesheet that can be used to convert the Sieve in XML representation to regular Sieve format. Content in other namespaces, `displaydata`, and `displayblock` elements are converted to structured comments as appropriate.

```
<?xml version="1.0" encoding="UTF-8"?>

<!-- Convert Sieve in XML to standard Sieve syntax -->

<xsl:stylesheet version="1.0"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
  xmlns:sieve="urn:ietf:params:xml:ns:sieve">

  <xsl:output method="text" encoding="UTF-8"
    media-type="application/sieve"/>

  <!-- Only preserve whitespace in str elements -->
  <xsl:strip-space elements="*" />
  <xsl:preserve-space elements="sieve:str" />

  <!-- Match top level sieve node,
    start processing in sieve mode -->

  <xsl:template match="sieve:sieve">
    <xsl:apply-templates select="*" mode="sieve">
      <xsl:with-param name="prefix" select="'" />
    </xsl:apply-templates>
  </xsl:template>

  <!-- Routine to properly literalize quotes in Sieve strings -->

  <xsl:template name="quote-string">
    <xsl:param name="str" />
    <xsl:choose>
      <xsl:when test="not($str)" />
      <xsl:when test="contains($str, '&quot;')">
        <xsl:call-template name="quote-string">
          <xsl:with-param name="str"
            select="substring-before($str, '&quot;')"/>
        </xsl:call-template>
        <xsl:text>\&quot;</xsl:text>
        <xsl:call-template name="quote-string">
          <xsl:with-param name="str"
            select="substring-after($str, '&quot;')"/>
        </xsl:call-template>
      </xsl:choose>
  </xsl:template>
```

```

</xsl:when>
<xsl:when test="contains($str, '\')">
  <xsl:call-template name="quote-string">
    <xsl:with-param name="str"
      select="substring-before($str, '\')"/>
  </xsl:call-template>
  <xsl:text>\\</xsl:text>
  <xsl:call-template name="quote-string">
    <xsl:with-param name="str"
      select="substring-after($str, '\')"/>
  </xsl:call-template>
</xsl:when>
<xsl:otherwise>
  <xsl:value-of select="$str"/>
</xsl:otherwise>
</xsl:choose>
</xsl:template>

<!-- Sieve mode processing templates -->

<xsl:template match="sieve:control|sieve:action" mode="sieve">
  <xsl:param name="prefix"/>
  <xsl:text xml:space="preserve">
</xsl:text>
  <xsl:value-of select="$prefix"/>
  <xsl:value-of select="@name"/>
  <xsl:variable name="blockbegin"
    select="generate-id(sieve:control|sieve:action)"/>
  <xsl:for-each select="*">
    <xsl:choose>
      <xsl:when test="self::sieve:str|self::sieve:num|
        self::sieve:list|self::sieve:tag|
        self::sieve:test">
        <xsl:apply-templates select="." mode="sieve"/>
      </xsl:when>
      <xsl:when test="generate-id(.) = $blockbegin">
        <xsl:text xml:space="preserve">
</xsl:text>
        <xsl:value-of select="$prefix"/>
        <xsl:text>{</xsl:text>
        <xsl:apply-templates select="." mode="sieve">
          <xsl:with-param name="prefix"
            select="concat($prefix, ' ' )"/>
        </xsl:apply-templates>
        </xsl:when>
      <xsl:otherwise>
        <xsl:apply-templates select="." mode="sieve">
          <xsl:with-param name="prefix"

```

```

        select="concat($prefix, ' ')" />
      </xsl:apply-templates>
    </xsl:otherwise>
  </xsl:choose>
</xsl:for-each>
<xsl:choose>
  <xsl:when test="count(sieve:control|sieve:action) > 0">
    <xsl:text xml:space="preserve">
</xsl:text>
    <xsl:value-of select="$prefix" />
    <xsl:text>}</xsl:text>
  </xsl:when>
  <xsl:otherwise>
    <xsl:text>;</xsl:text>
  </xsl:otherwise>
</xsl:choose>
</xsl:template>

<xsl:template match="sieve:preamble|sieve:postamble" mode="sieve">
  <xsl:param name="prefix" />
  <xsl:apply-templates mode="sieve">
    <xsl:with-param name="prefix" select="$prefix" />
  </xsl:apply-templates>
</xsl:template>

<xsl:template match="sieve:test" mode="sieve">
  <xsl:text xml:space="preserve"> </xsl:text>
  <xsl:value-of select="@name" />
  <xsl:apply-templates select="*[not(self::sieve:test)]"
    mode="sieve" />
  <xsl:if test="count(descendant::sieve:test) > 0">
    <xsl:text> (</xsl:text>
    <xsl:for-each select="sieve:test">
      <xsl:apply-templates select="." mode="sieve" />
      <xsl:if test="count(following-sibling::sieve:test) > 0">
        <xsl:text>,</xsl:text>
      </xsl:if>
    </xsl:for-each>
    <xsl:text> )</xsl:text>
  </xsl:if>
</xsl:template>

<xsl:template match="sieve:str" mode="sieve">
  <xsl:text> &quot;</xsl:text>
  <xsl:call-template name="quote-string">
    <xsl:with-param name="str" select="text()" />
  </xsl:call-template>
  <xsl:text>&quot;</xsl:text>

```

```

</xsl:template>

<xsl:template match="sieve:num" mode="sieve">
  <xsl:text xml:space="preserve"> </xsl:text>
  <!-- Use numeric suffixes when possible -->
  <xsl:choose>
    <xsl:when test="(number(text()) mod 1073741824) = 0">
      <xsl:value-of select="number(text()) div 1073741824"/>
      <xsl:text>G</xsl:text>
    </xsl:when>
    <xsl:when test="(number(text()) mod 1048576) = 0">
      <xsl:value-of select="number(text()) div 1048576"/>
      <xsl:text>M</xsl:text>
    </xsl:when>
    <xsl:when test="(number(text()) mod 1024) = 0">
      <xsl:value-of select="number(text()) div 1024"/>
      <xsl:text>K</xsl:text>
    </xsl:when>
    <xsl:otherwise>
      <xsl:value-of select="text()"/>
    </xsl:otherwise>
  </xsl:choose>
</xsl:template>

<xsl:template match="sieve:list" mode="sieve">
  <xsl:text> [</xsl:text>
  <xsl:for-each select="sieve:str">
    <xsl:apply-templates select="." mode="sieve"/>
    <xsl:if test="count(following-sibling::sieve:str) > 0">
      <xsl:text>,</xsl:text>
    </xsl:if>
  </xsl:for-each>
  <xsl:text> ]</xsl:text>
</xsl:template>

<xsl:template match="sieve:tag" mode="sieve">
  <xsl:text> :</xsl:text>
  <xsl:value-of select="text()"/>
</xsl:template>

<xsl:template match="sieve:comment" mode="sieve">
  <xsl:param name="prefix"/>
  <xsl:text xml:space="preserve">
</xsl:text>
  <xsl:value-of select="$prefix"/>
  <xsl:text>/*</xsl:text>
  <xsl:value-of select="."/>
  <xsl:value-of select="$prefix"/>

```

```

    <xsl:text>*/</xsl:text>
  </xsl:template>

  <!-- Convert display information into structured comments -->

  <xsl:template match="sieve:displayblock" mode="sieve">
    <xsl:param name="prefix"/>
    <xsl:text xml:space="preserve">
  </xsl:text>
    <xsl:value-of select="$prefix"/>
    <xsl:text>/* [*/</xsl:text>
    <xsl:apply-templates select="@*" mode="copy"/>
    <xsl:text> */</xsl:text>
    <xsl:apply-templates select="*" mode="sieve">
      <xsl:with-param name="prefix" select="$prefix"/>
    </xsl:apply-templates>
    <xsl:text xml:space="preserve">
  </xsl:text>
    <xsl:value-of select="$prefix"/>
    <xsl:text>/* *] */</xsl:text>
  </xsl:template>

  <xsl:template match="sieve:displaydata" mode="sieve">
    <xsl:param name="prefix"/>
    <xsl:text xml:space="preserve">
  </xsl:text>
    <xsl:value-of select="$prefix"/>
    <xsl:text>/* [|</xsl:text>
    <xsl:apply-templates mode="copy">
      <xsl:with-param name="prefix"
        select="concat($prefix, ' ')" />
    </xsl:apply-templates>
    <xsl:text xml:space="preserve">
  </xsl:text>
    <xsl:value-of select="$prefix"/>
    <xsl:text> |] */</xsl:text>
  </xsl:template>

  <!-- Copy unrecognized nodes and their descendants -->

  <xsl:template match="*" mode="sieve">
    <xsl:param name="prefix"/>
    <xsl:text xml:space="preserve">
  </xsl:text>
    <xsl:value-of select="$prefix"/>
    <xsl:text>/* [*/</xsl:text>
    <xsl:apply-templates select="." mode="copy">
      <xsl:with-param name="prefix"

```

```

                select="concat($prefix, ' ')" />
    </xsl:apply-templates>
    <xsl:text xml:space="preserve">
</xsl:text>
    <xsl:value-of select="$prefix" />
    <xsl:text> /] */</xsl:text>
</xsl:template>

<!-- Copy mode processing templates -->

<xsl:template match="*[not(node())]" mode="copy">
    <xsl:param name="prefix" />
    <xsl:text xml:space="preserve">
</xsl:text>
    <xsl:value-of select="$prefix" />
    <xsl:text>&lt;</xsl:text>
    <xsl:value-of select="name()" />
    <xsl:apply-templates select="@*" mode="copy" />
    <xsl:text>/&gt;</xsl:text>
</xsl:template>

<xsl:template match="*[node()]" mode="copy">
    <xsl:param name="prefix" />
    <xsl:text xml:space="preserve">
</xsl:text>
    <xsl:value-of select="$prefix" />
    <xsl:text>&lt;</xsl:text>
    <xsl:value-of select="name()" />
    <xsl:apply-templates select="@*" mode="copy" />
    <xsl:text>&gt;</xsl:text>
    <xsl:apply-templates mode="copy">
        <xsl:with-param name="prefix"
            select="concat($prefix, ' ')" />
    </xsl:apply-templates>
    <xsl:if test="*[last()][not(text())]">
        <xsl:text xml:space="preserve">
</xsl:text>
        <xsl:value-of select="$prefix" />
    </xsl:if>
    <xsl:text>&lt;</xsl:text>
    <xsl:value-of select="name()" />
    <xsl:text>&gt;</xsl:text>
</xsl:template>

<xsl:template match="@*" mode="copy">
    <xsl:text> </xsl:text>
    <xsl:value-of select="name()" />
    <xsl:text>="</xsl:text>

```

```
<xsl:value-of select="."/>
<xsl:text>"</xsl:text>
</xsl:template>
```

```
</xsl:stylesheet>
```

Appendix E. Acknowledgements

The stylesheet copy mode code is loosely based on a sample code posted to the xsl-list list by Americo Albuquerque. Jari Arkko, Robert Burrell Donkin, Andrew McKeon, Alexey Melnikov, and Aaron Stone provided useful comments on the document.

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