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Relative Uniform Resource Locators

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Abstract

A Uniform Resource Locator (URL) is a compact representation of the location and access method for a resource available via the Internet. When embedded within a base document, a URL in its absolute form may contain a great deal of information which is already known from the context of that base document's retrieval, including the scheme, network location, and parts of the url-path. In situations where the base URL is well-defined and known to the parser (human or machine), it is useful to be able to embed URL references which inherit that context rather than re-specifying it in every instance. This document defines the syntax and semantics for such Relative Uniform Resource Locators.

1. Introduction

This document describes the syntax and semantics for "relative" Uniform Resource Locators (relative URLs): a compact representation of the location of a resource relative to an absolute base URL. It is a companion to RFC 1738, "Uniform Resource Locators (URL)" [2], which specifies the syntax and semantics of absolute URLs.

A common use for Uniform Resource Locators is to embed them within a document (referred to as the "base" document) for the purpose of identifying other Internet-accessible resources. For example, in hypertext documents, URLs can be used as the identifiers for hypertext link destinations.

Absolute URLs contain a great deal of information which may already be known from the context of the base document's retrieval, including the scheme, network location, and parts of the URL path. In situations where the base URL is well-defined and known, it is useful to be able to embed a URL reference which inherits that context

rather than re-specifying it within each instance. Relative URLs can also be used within data-entry dialogs to decrease the number of characters necessary to describe a location.

In addition, it is often the case that a group or "tree" of documents has been constructed to serve a common purpose; the vast majority of URLs in these documents point to locations within the tree rather than outside of it. Similarly, documents located at a particular Internet site are much more likely to refer to other resources at that site than to resources at remote sites.

Relative addressing of URLs allows document trees to be partially independent of their location and access scheme. For instance, it is possible for a single set of hypertext documents to be simultaneously accessible and traversable via each of the "file", "http", and "ftp" schemes if the documents refer to each other using relative URLs. Furthermore, document trees can be moved, as a whole, without changing any of the embedded URLs. Experience within the World-Wide Web has demonstrated that the ability to perform relative referencing is necessary for the long-term usability of embedded URLs.

2. Relative URL Syntax

The syntax for relative URLs is a shortened form of that for absolute URLs [2], where some prefix of the URL is missing and certain path components ("." and "..") have a special meaning when interpreting a relative path. Because a relative URL may appear in any context that could hold an absolute URL, systems that support relative URLs must be able to recognize them as part of the URL parsing process.

Although this document does not seek to define the overall URL syntax, some discussion of it is necessary in order to describe the parsing of relative URLs. In particular, base documents can only make use of relative URLs when their base URL fits within the generic-RL syntax described below. Although some URL schemes do not require this generic-RL syntax, it is assumed that any document which contains a relative reference does have a base URL that obeys the syntax. In other words, relative URLs cannot be used within documents that have unsuitable base URLs.

2.1. URL Syntactic Components

The URL syntax is dependent upon the scheme. Some schemes use reserved characters like "?" and ";" to indicate special components, while others just consider them to be part of the path. However, there is enough uniformity in the use of URLs to allow a parser to resolve relative URLs based upon a single, generic-RL syntax. This generic-RL syntax consists of six components:

```
   <scheme>://<net_loc>/<path>;<params>?<query>#<fragment>
```

each of which, except <scheme>, may be absent from a particular URL. These components are defined as follows (a complete BNF is provided in Section 2.2):

```
   scheme ":"   ::= scheme name, as per Section 2.1 of RFC 1738 [2].

   "//" net_loc ::= network location and login information, as per
                    Section 3.1 of RFC 1738 [2].

   "/" path     ::= URL path, as per Section 3.1 of RFC 1738 [2].

   ";" params   ::= object parameters (e.g., ";type=a" as in
                    Section 3.2.2 of RFC 1738 [2]).

   "?" query    ::= query information, as per Section 3.3 of
                    RFC 1738 [2].

   "#" fragment ::= fragment identifier.
```

Note that the fragment identifier (and the "#" that precedes it) is not considered part of the URL. However, since it is commonly used within the same string context as a URL, a parser must be able to recognize the fragment when it is present and set it aside as part of the parsing process.

The order of the components is important. If both <params> and <query> are present, the <query> information must occur after the <params>.

2.2. BNF for Relative URLs

This is a BNF-like description of the Relative Uniform Resource Locator syntax, using the conventions of RFC 822 [5], except that "|" is used to designate alternatives. Briefly, literals are quoted with "", parentheses "(" and ")" are used to group elements, optional elements are enclosed in [brackets], and elements may be preceded with <n>* to designate n or more repetitions of the following element; n defaults to 0.

This BNF also describes the generic-RL syntax for valid base URLs. Note that this differs from the URL syntax defined in RFC 1738 [2] in that all schemes are required to use a single set of reserved characters and use them consistently within the major URL components.

```
URL         = ( absoluteURL | relativeURL ) [ "#" fragment ]

absoluteURL = generic-RL | ( scheme ":" *( uchar | reserved ) )

generic-RL  = scheme ":" relativeURL

relativeURL = net_path | abs_path | rel_path

net_path    = "//" net_loc [ abs_path ]
abs_path    = "/"  rel_path
rel_path    = [ path ] [ ";" params ] [ "?" query ]

path        = fsegment *( "/" segment )
fsegment    = 1*pchar
segment     =  *pchar

params      = param *( ";" param )
param       = *( pchar | "/" )

scheme      = 1*( alpha | digit | "+" | "-" | "." )
net_loc     =  *( pchar | ";" | "?" )
query       =  *( uchar | reserved )
fragment    =  *( uchar | reserved )

pchar       = uchar | ":" | "@" | "&" | "="
uchar       = unreserved | escape
unreserved  = alpha | digit | safe | extra

escape      = "%" hex hex
hex         = digit | "A" | "B" | "C" | "D" | "E" | "F" |
                      "a" | "b" | "c" | "d" | "e" | "f"

alpha       = lowalpha | hialpha
lowalpha    = "a" | "b" | "c" | "d" | "e" | "f" | "g" | "h" | "i" |
              "j" | "k" | "l" | "m" | "n" | "o" | "p" | "q" | "r" |
              "s" | "t" | "u" | "v" | "w" | "x" | "y" | "z"
hialpha     = "A" | "B" | "C" | "D" | "E" | "F" | "G" | "H" | "I" |
              "J" | "K" | "L" | "M" | "N" | "O" | "P" | "Q" | "R" |
              "S" | "T" | "U" | "V" | "W" | "X" | "Y" | "Z"

digit       = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" |
              "8" | "9"

safe        = "$" | "-" | "_" | "." | "+"
extra       = "!" | "*" | "'" | "(" | ")" | ","
national    = "{" | "}" | "|" | "\" | "^" | "~" | "[" | "]" | "`"
reserved    = ";" | "/" | "?" | ":" | "@" | "&" | "="
punctuation = "<" | ">" | "#" | "%" | <">
```

2.3. Specific Schemes and their Syntactic Categories

Each URL scheme has its own rules regarding the presence or absence of the syntactic components described in Sections 2.1 and 2.2. In addition, some schemes are never appropriate for use with relative URLs. However, since relative URLs will only be used within contexts in which they are useful, these scheme-specific differences can be ignored by the resolution process.

Within this section, we include as examples only those schemes that have a defined URL syntax in RFC 1738 [2]. The following schemes are never used with relative URLs:

```
   mailto     Electronic Mail
   news       USENET news
   telnet     TELNET Protocol for Interactive Sessions
```

Some URL schemes allow the use of reserved characters for purposes outside the generic-RL syntax given above. However, such use is rare. Relative URLs can be used with these schemes whenever the applicable base URL follows the generic-RL syntax.

```
   gopher     Gopher and Gopher+ Protocols
   prospero   Prospero Directory Service
   wais       Wide Area Information Servers Protocol
```

Users of gopher URLs should note that gopher-type information is almost always included at the beginning of what would be the generic-RL path. If present, this type information prevents relative-path references to documents with differing gopher-types.

Finally, the following schemes can always be parsed using the generic-RL syntax. This does not necessarily imply that relative URLs will be useful with these schemes -- that decision is left to the system implementation and the author of the base document.

```
   file       Host-specific Files
   ftp        File Transfer Protocol
   http       Hypertext Transfer Protocol
   nntp       USENET news using NNTP access
```

NOTE: Section 5 of RFC 1738 specifies that the question-mark character ("?") is allowed in an ftp or file path segment. However, this is not true in practice and is believed to be an error in the RFC. Similarly, RFC *1738* allows the reserved character semicolon (";") within an http path segment, but does not define its semantics; the correct semantics are as defined by this document for <params>.

We recommend that new schemes be designed to be parsable via the generic-RL syntax if they are intended to be used with relative URLs. A description of the allowed relative forms should be included when a new scheme is registered, as per Section 4 of RFC 1738 [2].

2.4. Parsing a URL

An accepted method for parsing URLs is useful to clarify the generic-RL syntax of Section 2.2 and to describe the algorithm for resolving relative URLs presented in Section 4. This section describes the parsing rules for breaking down a URL (relative or absolute) into the component parts described in Section 2.1. The rules assume that the URL has already been separated from any surrounding text and copied to a "parse string". The rules are listed in the order in which they would be applied by the parser.

2.4.1. Parsing the Fragment Identifier

If the parse string contains a crosshatch "#" character, then the substring after the first (left-most) crosshatch "#" and up to the end of the parse string is the <fragment> identifier. If the crosshatch is the last character, or no crosshatch is present, then the fragment identifier is empty. The matched substring, including the crosshatch character, is removed from the parse string before continuing.

Note that the fragment identifier is not considered part of the URL. However, since it is often attached to the URL, parsers must be able to recognize and set aside fragment identifiers as part of the process.

2.4.2. Parsing the Scheme

If the parse string contains a colon ":" after the first character and before any characters not allowed as part of a scheme name (i.e., any not an alphanumeric, plus "+", period ".", or hyphen "-"), the <scheme> of the URL is the substring of characters up to but not including the first colon. These characters and the colon are then removed from the parse string before continuing.

2.4.3. Parsing the Network Location/Login

If the parse string begins with a double-slash "//", then the substring of characters after the double-slash and up to, but not including, the next slash "/" character is the network location/login (<net_loc>) of the URL. If no trailing slash "/" is present, the entire remaining parse string is assigned to <net_loc>. The double-slash and <net_loc> are removed from the parse string before

continuing.

2.4.4. Parsing the Query Information

If the parse string contains a question mark "?" character, then the substring after the first (left-most) question mark "?" and up to the end of the parse string is the <query> information. If the question mark is the last character, or no question mark is present, then the query information is empty. The matched substring, including the question mark character, is removed from the parse string before continuing.

2.4.5. Parsing the Parameters

If the parse string contains a semicolon ";" character, then the substring after the first (left-most) semicolon ";" and up to the end of the parse string is the parameters (<params>). If the semicolon is the last character, or no semicolon is present, then <params> is empty. The matched substring, including the semicolon character, is removed from the parse string before continuing.

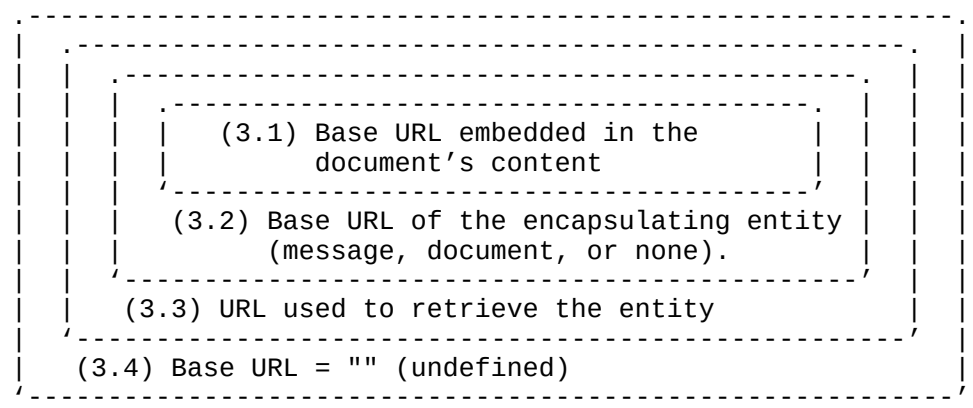
2.4.6. Parsing the Path

After the above steps, all that is left of the parse string is the URL <path> and the slash "/" that may precede it. Even though the initial slash is not part of the URL path, the parser must remember whether or not it was present so that later processes can differentiate between relative and absolute paths. Often this is done by simply storing the preceding slash along with the path.

3. Establishing a Base URL

The term "relative URL" implies that there exists some absolute "base URL" against which the relative reference is applied. Indeed, the base URL is necessary to define the semantics of any embedded relative URLs; without it, a relative reference is meaningless. In order for relative URLs to be usable within a document, the base URL of that document must be known to the parser.

The base URL of a document can be established in one of four ways, listed below in order of precedence. The order of precedence can be thought of in terms of layers, where the innermost defined base URL has the highest precedence. This can be visualized graphically as:



3.1. Base URL within Document Content

Within certain document media types, the base URL of the document can be embedded within the content itself such that it can be readily obtained by a parser. This can be useful for descriptive documents, such as tables of content, which may be transmitted to others through protocols other than their usual retrieval context (e.g., E-Mail or USENET news).

It is beyond the scope of this document to specify how, for each media type, the base URL can be embedded. It is assumed that user agents manipulating such media types will be able to obtain the appropriate syntax from that media type's specification. An example of how the base URL can be embedded in the Hypertext Markup Language (HTML) [3] is provided in an Appendix (Section 10).

Messages are considered to be composite documents. The base URL of a message can be specified within the message headers (or equivalent tagged metainformation) of the message. For protocols that make use of message headers like those described in RFC 822 [5], we recommend that the format of this header be:

```
base-header  = "Base" ":" "<URL:" absoluteURL ">"
```

where "Base" is case-insensitive and any whitespace (including that used for line folding) inside the angle brackets is ignored. For example, the header field

```
   Base: <URL:http://www.ics.uci.edu/Test/a/b/c>
```

would indicate that the base URL for that message is the string "http://www.ics.uci.edu/Test/a/b/c". The base URL for a message serves as both the base for any relative URLs within the message headers and the default base URL for documents enclosed within the message, as described in the next section.

Protocols which do not use the RFC 822 message header syntax, but which do allow some form of tagged metainformation to be included within messages, may define their own syntax for defining the base URL as part of a message.

3.2. Base URL from the Encapsulating Entity

If no base URL is embedded, the base URL of a document is defined by the document's retrieval context. For a document that is enclosed within another entity (such as a message or another document), the retrieval context is that entity; thus, the default base URL of the document is the base URL of the entity in which the document is encapsulated.

Composite media types, such as the "multipart/*" and "message/*" media types defined by MIME (RFC 1521, [4]), define a hierarchy of retrieval context for their enclosed documents. In other words, the retrieval context of a component part is the base URL of the composite entity of which it is a part. Thus, a composite entity can redefine the retrieval context of its component parts via the inclusion of a base-header, and this redefinition applies recursively for a hierarchy of composite parts. Note that this might not change the base URL of the components, since each component may include an embedded base URL or base-header that takes precedence over the retrieval context.

3.3. Base URL from the Retrieval URL

If no base URL is embedded and the document is not encapsulated within some other entity (e.g., the top level of a composite entity), then, if a URL was used to retrieve the base document, that URL shall be considered the base URL. Note that if the retrieval was the result of a redirected request, the last URL used (i.e., that which resulted in the actual retrieval of the document) is the base URL.

3.4. Default Base URL

If none of the conditions described in Sections 3.1 -- 3.3 apply, then the base URL is considered to be the empty string and all embedded URLs within that document are assumed to be absolute URLs.

It is the responsibility of the distributor(s) of a document containing relative URLs to ensure that the base URL for that document can be established. It must be emphasized that relative URLs cannot be used reliably in situations where the document's base URL is not well-defined.

4. Resolving Relative URLs

This section describes an example algorithm for resolving URLs within a context in which the URLs may be relative, such that the result is always a URL in absolute form. Although this algorithm cannot guarantee that the resulting URL will equal that intended by the original author, it does guarantee that any valid URL (relative or absolute) can be consistently transformed to an absolute form given a valid base URL.

The following steps are performed in order:

Step 1: The base URL is established according to the rules of Section 3. If the base URL is the empty string (unknown), the embedded URL is interpreted as an absolute URL and we are done.

Step 2: Both the base and embedded URLs are parsed into their component parts as described in Section 2.4.

a) If the embedded URL is entirely empty, it inherits the entire base URL (i.e., is set equal to the base URL) and we are done.

b) If the embedded URL starts with a scheme name, it is interpreted as an absolute URL and we are done.

c) Otherwise, the embedded URL inherits the scheme of the base URL.

Step 3: If the embedded URL's <net_loc> is non-empty, we skip to Step 7. Otherwise, the embedded URL inherits the <net_loc> (if any) of the base URL.

Step 4: If the embedded URL path is preceded by a slash "/", the path is not relative and we skip to Step 7.

Step 5: If the embedded URL path is empty (and not preceded by a slash), then the embedded URL inherits the base URL path, and

a) if the embedded URL's <params> is non-empty, we skip to step 7; otherwise, it inherits the <params> of the base URL (if any) and

b) if the embedded URL's <query> is non-empty, we skip to step 7; otherwise, it inherits the <query> of the base URL (if any) and we skip to step 7.

Step 6: The last segment of the base URL's path (anything following the rightmost slash "/", or the entire path if no slash is present) is removed and the embedded URL's path is appended in its place. The following operations are then applied, in order, to the new path:

a) All occurrences of "./", where "." is a complete path segment, are removed.

b) If the path ends with "." as a complete path segment, that "." is removed.

c) All occurrences of "/../", where is a complete path segment not equal to "..", are removed. Removal of these path segments is performed iteratively, removing the leftmost matching pattern on each iteration, until no matching pattern remains.

d) If the path ends with "/..", where is a complete path segment not equal to "..", that "/.." is removed.

Step 7: The resulting URL components, including any inherited from the base URL, are recombined to give the absolute form of the embedded URL.

Parameters, regardless of their purpose, do not form a part of the URL path and thus do not affect the resolving of relative paths. In particular, the presence or absence of the ";type=d" parameter on an ftp URL does not affect the interpretation of paths relative to that URL. Fragment identifiers are only inherited from the base URL when the entire embedded URL is empty.

The above algorithm is intended to provide an example by which the output of implementations can be tested -- implementation of the algorithm itself is not required. For example, some systems may find it more efficient to implement Step 6 as a pair of segment stacks being merged, rather than as a series of string pattern matches.

5. Examples and Recommended Practice

Within an object with a well-defined base URL of

Base: <URL:http://a/b/c/d;p?q#f>

the relative URLs would be resolved as follows:

5.1. Normal Examples

```
g:h        = <URL:g:h>
g          = <URL:http://a/b/c/g>
./g        = <URL:http://a/b/c/g>
g/         = <URL:http://a/b/c/g/>
/g         = <URL:http://a/g>
//g        = <URL:http://g>
?y         = <URL:http://a/b/c/d;p?y>
g?y        = <URL:http://a/b/c/g?y>
g?y/./x    = <URL:http://a/b/c/g?y/./x>
#s         = <URL:http://a/b/c/d;p?q#s>
g#s        = <URL:http://a/b/c/g#s>
g#s/./x    = <URL:http://a/b/c/g#s/./x>
g?y#s      = <URL:http://a/b/c/g?y#s>
;x         = <URL:http://a/b/c/d;x>
g;x        = <URL:http://a/b/c/g;x>
g;x?y#s    = <URL:http://a/b/c/g;x?y#s>
.          = <URL:http://a/b/c/>
./         = <URL:http://a/b/c/>
..         = <URL:http://a/b/>
../        = <URL:http://a/b/>
../g       = <URL:http://a/b/g>
../..      = <URL:http://a/>
../../     = <URL:http://a/>
../../g    = <URL:http://a/g>
```

5.2. Abnormal Examples

Although the following abnormal examples are unlikely to occur in normal practice, all URL parsers should be capable of resolving them consistently. Each example uses the same base as above.

An empty reference resolves to the complete base URL:

```
   <>            = <URL:http://a/b/c/d;p?q#f>
```

Parsers must be careful in handling the case where there are more relative path ".." segments than there are hierarchical levels in the base URL's path. Note that the ".." syntax cannot be used to change the <net_loc> of a URL.

```
   ../../../g    = <URL:http://a/../g>
   ../../../../g = <URL:http://a/../../g>
```

Similarly, parsers must avoid treating "." and ".." as special when they are not complete components of a relative path.

```
   /./g          = <URL:http://a/./g>
   /../g         = <URL:http://a/../g>
   g.            = <URL:http://a/b/c/g.>
   .g            = <URL:http://a/b/c/.g>
   g..           = <URL:http://a/b/c/g..>
   ..g           = <URL:http://a/b/c/..g>
```

Less likely are cases where the relative URL uses unnecessary or nonsensical forms of the "." and ".." complete path segments.

```
   ./../g        = <URL:http://a/b/g>
   ./g/.         = <URL:http://a/b/c/g/>
   g/./h         = <URL:http://a/b/c/g/h>
   g/../h        = <URL:http://a/b/c/h>
```

Finally, some older parsers allow the scheme name to be present in a relative URL if it is the same as the base URL scheme. This is considered to be a loophole in prior specifications of partial URLs [1] and should be avoided by future parsers.

```
   http:g        = <URL:http:g>
   http:         = <URL:http:>
```

5.3. Recommended Practice

Authors should be aware that path names which contain a colon ":" character cannot be used as the first component of a relative URL path (e.g., "this:that") because they will likely be mistaken for a scheme name. It is therefore necessary to precede such cases with other components (e.g., "./this:that"), or to escape the colon character (e.g., "this%3Athat"), in order for them to be correctly parsed. The former solution is preferred because it does not affect the absolute form of the URL.

There is an ambiguity in the semantics for the ftp URL scheme regarding the use of a trailing slash ("/") character and/or a parameter ";type=d" to indicate a resource that is an ftp directory. If the result of retrieving that directory includes embedded relative URLs, it is necessary that the base URL path for that result include a trailing slash. For this reason, we recommend that the ";type=d" parameter value not be used within contexts that allow relative URLs.

6. Security Considerations

There are no security considerations in the use or parsing of relative URLs. However, once a relative URL has been resolved to its absolute form, the same security considerations apply as those described in RFC 1738 [2].

7. Acknowledgements

This work is derived from concepts introduced by Tim Berners-Lee and the World-Wide Web global information initiative. Relative URLs are described as "Partial URLs" in RFC 1630 [1]. That description was expanded for inclusion as an appendix for an early draft of RFC 1738, "Uniform Resource Locators (URL)" [2]. However, after further discussion, the URI-WG decided to specify Relative URLs separately from the primary URL draft.

This document is intended to fulfill the recommendations for Internet Resource Locators as stated in [6]. It has benefited greatly from the comments of all those participating in the URI-WG. Particular thanks go to Larry Masinter, Michael A. Dolan, Guido van Rossum, Dave Kristol, David Robinson, and Brad Barber for identifying problems/deficiencies in earlier drafts.

8. References

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<URL:http://www.ics.uci.edu/pub/ietf/html/>

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10. Appendix - Embedding the Base URL in HTML documents

It is useful to consider an example of how the base URL of a document can be embedded within the document's content. In this appendix, we describe how documents written in the Hypertext Markup Language (HTML) [3] can include an embedded base URL. This appendix does not form a part of the relative URL specification and should not be considered as anything more than a descriptive example.

HTML defines a special element "BASE" which, when present in the "HEAD" portion of a document, signals that the parser should use the BASE element's "HREF" attribute as the base URL for resolving any relative URLs. The "HREF" attribute must be an absolute URL. Note that, in HTML, element and attribute names are case-insensitive. For example:

```
<!doctype html public "-//IETF//DTD HTML//EN">
<HTML><HEAD>
<TITLE>An example HTML document</TITLE>
<BASE href="http://www.ics.uci.edu/Test/a/b/c">
</HEAD><BODY>
... <A href="../x">a hypertext anchor</A> ...
</BODY></HTML>
```

A parser reading the example document should interpret the given relative URL "../x" as representing the absolute URL

<URL:http://www.ics.uci.edu/Test/a/x>

regardless of the context in which the example document was obtained.