Abstract:

Describes additional (optional) message encodings as an alternative to the (mandatory) raw TTLV encoding including:

- HTTP
• JSON
• XML

Status:
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[kmip-addtl-msg-enc-v1.0]
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1 Introduction

For normative definition of the elements of KMIP see the KMIP Specification [KMIP-SPEC] and the KMIP Profiles [KMIP-PROF].

Illustrative guidance for the implementation of KMIP clients and servers is provided in the KMIP Usage Guide [KMIP-UG].

This profile defines the necessary encoding rules for the transport of KMIP TTLV messages encoded in:
- Hypertext Transfer Protocol [RFC2616] over TLS as specified in HTTP over TLS [RFC2818]
- JavaScript Object Notification [RFC4627]
- Extensible Markup Language [XML]

1.1 Terminology

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

1.2 Normative References


[KMIP-SPEC] One or more of [KMIP-SPEC-1_0], [KMIP-SPEC-1_1], [KMIP-SPEC-1_2]


URL Candidate OASIS Standard 01. DD MMM YYYY.

[KMIP-PROF] One or more of [KMIP-PROF-1_0], [KMIP-PROF-1_1], [KMIP-PROF-1_2]


OASIS Standard. 1 October 2010.
1.3 Non-Normative References

- **[KMIP-PROF-1_1]** *Key Management Interoperability Protocol Usage Guide Version 1.1.*
  - OASIS Standard 01. 24 January 2013.

  - URL
  - Candidate OASIS Standard 01. DD MMM YYYY.

- **[KMIP-UG-1_0]** *Key Management Interoperability Protocol Usage Guide Version 1.0.*
  - http://docs.oasis-open.org/kmip/ug/v1.1/kmip-ug-v1.1-cnd01.doc
  - Committee Note Draft, 1 December 2011

- **[KMIP-UG-1_1]** *Key Management Interoperability Protocol Usage Guide Version 1.1.*
  - http://docs.oasis-open.org/kmip/ug/v1.1/cn01/kmip-ug-v1.1-cn01.doc
  - Committee Note 01, 27 July 2012

  - URL
  - Committee Note Draft, DD MMM YYYY

- **[KMIP-TC-1_1]** *Key Management Interoperability Protocol Test Cases Version 1.1.*

- **[KMIP-TC-1_2]** *Key Management Interoperability Protocol Test Cases Version 1.2.*
  - URL, Committee Note Draft, DD MMM YYYY.

- **[KMIP-UC]** *Key Management Interoperability Protocol Use Cases Version 1.0.*
2 HTTPS Profile

The Hypertext Transfer Protocol over Transport Layer Security (HTTPS) is simply the use of HTTP over TLS in the same manner that HTTP is used over TCP.

KMIP over HTTPS is simply the use of KMIP messages over HTTPS in the same manner that KMIP is used over TLS.

2.1 Authentication Suite

Implementations conformant to this profile SHALL support one or more of the Authentication Suites defined within section 3 of [KMIP-PROF]. The establishment of the trust relationship between the KMIP client and the KMIP server is the same as the defined base profiles.

2.2 KMIP Port Number

KMIP servers conformant to this profile MAY use TCP port number 5696, as assigned by IANA, to receive and send KMIP messages provided that both HTTP and non-HTTP encoded messages are supported.

KMIP clients SHALL enable end user configuration of the TCP port number used, as a KMIP server may specify a different TCP port number.

2.3 Request URI

KMIP servers conformant to this profile SHOULD support the value /kmip as the target URI.

KMIP clients SHALL enable end user configuration of the target URI used as a KMIP server may specify a different target URI.

2.4 HTTP Encoding

KMIP client implementations conformant to this profile:

1. SHALL support HTTP/1.0 and/or HTTP/1.1 over TLS conformant to [RFC2818]
2. SHALL use the POST request method
3. SHALL specify a Content-Type of “application/octet-stream”
4. SHALL specify a Content-Length
5. SHALL specify a Cache-Control of “no-cache”
6. SHALL send KMIP TTLV message in binary format as the body of the HTTP request

KMIP server implementations conformant to this profile:

1. SHALL support HTTP/1.0 and HTTP/1.1 over TLS conformant to [RFC2818]
2. SHALL return HTTP response code 200 if a KMIP response is available
3. SHALL specify a Content-Type of “application/octet-stream”
4. SHALL specify a Content-Length
5. SHALL specify a Cache-Control of “no-cache”
6. SHALL send KMIP TTLV message in binary format as the body of the HTTP request

KMIP servers that support server to client operations SHALL behave as an HTTPS client. KMIP clients that support responding to server to client operations SHALL behave as a HTTPS server.
3 HTTPS Profile Test Cases

This section contains a test case that demonstrates the HTTPS profile encoding using test case 12.1 from [KMIP-TC] using protocol version 1.0 which exercises the Query operation and the Maximum Response Size header field.

3.1.1 MSGENC-HTTPS-1-10 - Query, Maximum Response Size

Perform a Query operation, querying the Operations and Objects supported by the server, with a restriction on the Maximum Response Size set in the request header. Since the resulting Query response is too big, an error is returned. Increase the Maximum Response Size, resubmit the Query request, and get a successful response.

The specific list of operations and object types returned in the response MAY vary.

<table>
<thead>
<tr>
<th># TIME 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
</tr>
<tr>
<td>0002</td>
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<tr>
<td>0003</td>
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</tr>
<tr>
<td>0016</td>
</tr>
<tr>
<td>0017</td>
</tr>
</tbody>
</table>

```
<RequestMessage>
  <RequestHeader>
    <ProtocolVersion>
      <ProtocolVersionMajor type="Integer" value="1"/>
      <ProtocolVersionMinor type="Integer" value="0"/>
    </ProtocolVersion>
    <MaximumResponseSize type="Integer" value="256"/>
    <BatchCount type="Integer" value="1"/>
  </RequestHeader>
  <BatchItem>
    <Operation type="Enumeration" value="Query"/>
    <RequestPayload>
      <QueryFunction type="Enumeration" value="QueryOperations"/>
      <QueryFunction type="Enumeration" value="QueryObjects"/>
    </RequestPayload>
  </BatchItem>
</RequestMessage>
```

```
<ResponseMessage>
  <ResponseHeader>
    42007801000000904200770100000048420069010000002042006a00000000100000000000000000
    0000000000: 50 4f 53 54 20 2f 6b 6d 69 70 20 48 54 54 50 2f   POST /kmip HTTP/
    0000000100: 31 2e 30 0d 0a 50 72 67 6d 61 3a 20 6e 6f 2d   1.0..Pragma: no-
    0000000200: 63 61 63 68 65 0d 0a 43 61 63 68 65 2d 43 6f 6e   cache..Cache-
    0000000300: 74 72 6f 6c 3a 20 6e 6f 2d 63 61 63 68 65 0d   trol: no-cache..
    0000000400: 43 6f 6e 74 65 6e 74 2d 4c 65 6e 74 68 3a 20   Content-Length:
    0000000500: 31 35 2f 20 20 20 20 20 20 0d 0a 0d 0a 42 00   15/......B.
    0000000600: 15 32 78 01 00 00 00 90 00 00 00 00 00 00 38   .2x.....B.w....8
    0000000700: 42 00 5c 05 00 00 00 00 00 00 00 00 00 00 00   B.\............
    0000000800: 42 00 79 01 00 00 00 00 00 00 00 00 00 00 00   B.y.....
    0000000900: 30 00 00 00 00 00 00 00 00 00 00 00 00 00 00   0...00000000
    0000000a00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   000000000000
    0000000b00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   000000000000
    0000000c00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   000000000000
    0000000d00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   000000000000
    0000000e00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   000000000000
    0000000f00: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   000000000000
    0000001000: 42 00 5c 05 05 00 00 00 00 00 00 00 00 00 00   B.\............
    0000001100: 42 00 79 01 00 00 00 00 00 00 00 00 00 00 00   B.y.....
    0000001200: 30 00 00 00 00 00 00 00 00 00 00 00 00 00 00   0...00000000
    0000001300: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   000000000000
    <ResponseMessage>
    <ResponseHeader>
<ProtocolVersion>
  <ProtocolVersionMajor type="Integer" value="1"/>
  <ProtocolVersionMinor type="Integer" value="0"/>
</ProtocolVersion>

<TimeStamp type="DateTime" value="2013-06-26T09:09:17+00:00"/>

<ResponseHeader>
  <BatchItem>
    <Operation type="Enumeration" value="Query"/>
    <ResultStatus type="Enumeration" value="OperationFailed"/>
    <ResultReason type="Enumeration" value="ResponseTooLarge"/>
    <ResultMessage type="TextString" value="TOO_LARGE"/>
  </BatchItem>
</ResponseMessage>
<ResponseMessage>
  <ResponseHeader>
    <ProtocolVersion>
      <ProtocolVersionMajor type="Integer" value="1"/>
      <ProtocolVersionMinor type="Integer" value="0"/>
    </ProtocolVersion>
    <TimeStamp type="DateTime" value="2013-06-26T09:09:17+00:00"/>
    <BatchCount type="Integer" value="1"/>
  </ResponseHeader>
  <BatchItem>
    <Operation type="Enumeration" value="Query"/>
  </BatchItem>
  <ResponseStatus type="Enumeration" value="Success"/>
  <ResponsePayload>
    <Operation type="Enumeration" value="Query"/>
    <Operation type="Enumeration" value="Locate"/>
    <Operation type="Enumeration" value="Destroy"/>
    <Operation type="Enumeration" value="Get"/>
    <Operation type="Enumeration" value="Create"/>
    <Operation type="Enumeration" value="Register"/>
    <Operation type="Enumeration" value="GetAttributes"/>
    <Operation type="Enumeration" value="GetAttributeList"/>
    <Operation type="Enumeration" value="AddAttribute"/>
    <Operation type="Enumeration" value="ModifyAttribute"/>
    <Operation type="Enumeration" value="DeleteAttribute"/>
    <Operation type="Enumeration" value="Activate"/>
    <Operation type="Enumeration" value="Revoke"/>
    <Operation type="Enumeration" value="Poll"/>
    <Operation type="Enumeration" value="Cancel"/>
    <Operation type="Enumeration" value="Check"/>
    <Operation type="Enumeration" value="GetUsageAllocation"/>
    <Operation type="Enumeration" value="CreateKeyPair"/>
    <Operation type="Enumeration" value="ReKey"/>
    <Operation type="Enumeration" value="Archive"/>
    <Operation type="Enumeration" value="Recover"/>
    <Operation type="Enumeration" value="ObtainLease"/>
    <Operation type="Enumeration" value="Certify"/>
    <Operation type="Enumeration" value="ReCertify"/>
    <Operation type="Enumeration" value="Notify"/>
    <Operation type="Enumeration" value="Put"/>
    <ObjectType type="Enumeration" value="Certificate"/>
    <ObjectType type="Enumeration" value="SymmetricKey"/>
    <ObjectType type="Enumeration" value="SecretData"/>
    <ObjectType type="Enumeration" value="PublicKey"/>
    <ObjectType type="Enumeration" value="PrivateKey"/>
    <ObjectType type="Enumeration" value="Template"/>
  </ResponsePayload>
</ResponseMessage>
4 JSON Profile

The JSON profile specifies the use of KMIP replacing the TTLV message encoding with a JSON message encoding.

4.1 JSON Encoding

4.1.1 Hex representations

Hex representations of numbers must always begin with ‘0x’ and must not include any spaces. They may use either upper or lower case ‘a’-‘f’. The hex representation must include all leading zeros or sign extension bits when representing a value of a fixed width such as Tags (3 bytes), Integer (32-bit signed big-endian), Long Integer (64-bit signed big-endian) and Big Integer (big-endian multiple of 8 bytes). The Integer values for -1, 0, 1 are represented as “0xffffffff”, “0x00000000”, “0x00000001”. Hex representation for Byte Strings are similar to numbers, but do not include the ‘0x’ prefix, and can be of any length.

4.1.2 Tags

Tags are a String that may contain either:

- The 3-byte tag hex value prefixed with ‘0x’
- The normalised text of a Tag as specified in the KMIP Specification

Other text values may be used such as published names of Extension tags, or names of new tags added in future KMIP versions. Producers may however choose to use hex values for these tags to ensure they are understood by all consumers.

4.1.3 Normalizing Names

KMIP text values of Tags, Types and Enumerations SHALL be normalized to create a ‘CamelCase’ format that would be suitable to be used as a variable name in C/Java or an JSON name.

The basic approach to converting from KMIP text to CamelCase is to separate the text into individual word tokens (rules 1-4), capitalize the first letter of each word (rule 5) and then join with spaces removed (rule 6). The tokenizing splits on whitespace and on dashes where the token following is a valid word. The tokenizing also removes round brackets and shifts decimals from the front to the back of the first word in each string. The following rules SHALL be applied to create the normalized CamelCase form:

1. Replace round brackets (‘(‘, ’)’) with spaces
2. If a non-word char (not alpha, digit or underscore) is followed by a letter (either upper or lower case) then a lower case letter, replace the non-word char with space
3. Replace remaining non-word chars (except whitespace) with underscore.
4. If the first word begins with a digit, move all digits at start of first word to end of first word
5. Capitalize the first letter of each word
6. Concatenate all words with spaces removed
# 1. Replace brackets with space
noBrackets = re.sub('[(\)]', ' ', enumName)

# 2. replace \W with space if followed by letter, lower
nonWordToSpace = re.sub('\W([A-Za-z][a-z])', r'\1', noBrackets)

# 3. non-word to underscore
words = [re.sub('\W', '_', s) for s in nonWordToSpace.split()]

# 4. move numbers to end of first word
words[0] = re.sub('^\d+', r'2\1', words[0])

# 5. capitalize first letter of each word
words = [re.sub('\W(.*)', r'\1', s[0].upper(), s) for s in words]

# 6. concatenate
enumanNameCamel = ''.join(words)

Example python name normalization code

# 1. Replace brackets with space
$enumName=~s/[[]]/ /g;
# 2. replace \W with space if followed by letter, lower
$enumName=~s/\W([A-Za-z][a-z])/ \1/g;
# 3. non-word to underscore
@words=split(/ /,$enumName);
for($i=0;$i<=$#words;$i++) { $words[$i]=~s/\W/_/g; }
# 4. move numbers to end of first word
$words[0] =~ s/^\d+/.*/2\1/;
# 5. capitalize first letter of each word
for($i=0;$i<=$#words;$i++) { 
  substr($words[$i],0,1)=~tr/a-z/A-Z/;
 }
# 6. concatenate
$enumNameCamel  = join('',$words);

Example perl name normalization code

## 4.1.4 Type
Type must be a String containing one of the normalized CamelCase values as defined in the KMIP specification.

- Structure
- Integer
- LongInteger
- BigInteger
- Enumeration
- Boolean
- TextString
- ByteString
- DateTime
- Interval

If type is not included, the default type of Structure SHALL be used.

## 4.1.5 Value
The specification of a value is represented differently for each TTLV type.
### 4.1.6 JSON Object

For JSON encoding, each TTLV is represented as a JSON Object with properties `tag`, optional `name`, `type` and `value`.

```json
{ "tag": "ActivationDate", "type": "DateTime", "value": "2001-01-01T10:00:00+10:00" }
{ "tag": "IVCounterNonce", "type": "ByteString", "value": "a1b2c3d4" }
{ "tag": "WELL_KNOWN_EXTENSION", "type": "TextString", "value": "This is an extension" }
```

The `type` property / attribute SHALL have a default value of `Structure` and may be omitted for Structures.

#### 4.1.6.1 Tags

Tags are a String that may contain either:

- The 3-byte tag hex value prefixed with '0x'
- The normalised text of a Tag as specified in the KMIP Specification

Other text values may be used such as published names of Extension tags, or names of new tags added in future KMIP versions. Producers may however choose to use hex values for these tags to ensure they are understood by all consumers.

```json
{ "tag": "0x420001", "type": "DateTime", "value": "2001-01-01T10:00:00+10:00" }
{ "tag": "IVCounterNonce", "type": "ByteString", "value": "a1b2c3d4" }
{ "tag": "WELL_KNOWN_EXTENSION", "type": "TextString", "value": "This is an extension" }
```

#### 4.1.6.2 Structure

For JSON, value is an Array containing sub-items, or may be null.

```json
{ "tag": "ProtocolVersion", "type": "Structure", "value": 
  { "tag": "ProtocolVersionMajor", "type": "Integer", "value": 0 },
  { "tag": "ProtocolVersionMajor", "type": "Integer", "value": 1 },
}
```

The `type` property / attribute is optional for a Structure.

#### 4.1.6.3 Integer

For JSON, value is either a Number or a hex string.

```json
{ "tag": "BatchCount", "type": "Integer", "value": 10 }
{ "tag": "BatchCount", "type": "Integer", "value": "0x0000000A" }
```

#### 4.1.6.4 Integer - Special case for Masks

(Cryptographic Usage Mask, Storage Status Mask):

Integer mask values can also be encoded as a String containing mask components. JSON uses `|` as the separator. Components may be either the text of the enumeration value as defined in the KMIP Specification or a 32-bit unsigned big-endian hex string.

```json
{ "tag": "CryptographicUsageMask", "type": "Integer", "value": "0x0000000c" }
{ "tag": "CryptographicUsageMask", "type": "Integer", "value": "Encrypt|Decrypt|CertificateSign" }
{ "tag": "CryptographicUsageMask", "type": "Integer", "value": "0x00000001" }
{ "tag": "CryptographicUsageMask|0x00000004|0x00000008" }
{ "tag": "CryptographicUsageMask|0x00000004|0x00000008", "type": "Integer", "value": "CertificateSign|0x0000000c" }
```
4.1.6.5 Long Integer
For JSON, value is either a Number or a hex string. Note that JS Numbers are 64-bit floating point and
4.1.6.6 Big Integer
For JSON, value is either a Number or a hex string. Note that Big Integers must be sign extended to
4.1.6.7 Enumeration
For JSON, value may contain:
• Number representing the enumeration 32-bit unsigned big-endian value
• Hex string representation of 32-bit unsigned big-endian value
• CamelCase enum text as defined in KMIP 9.1.3.2.x
4.1.6.8 Boolean
For JSON, value must be either a hex string, or a JSON Boolean 'true' or 'false'.
4.1.6.9 Text String
For JSON, value must be a String
4.1.6.10 Byte String
For JSON, value must be a hex string. Note Byte Strings do not include the '0x' prefix, and do not have
4.1.6.11 Date-Time
For JSON, value must be either a hex string, or an ISO8601 DateTime as used in XSD using format:
4.1.6.12 Interval
For JSON, value is either a Number or a hex string. Note that intervals are 32-bit unsigned big-endian
values.
5 JSON Profile Test Cases

This section contains a test case that demonstrates the JSON profile encoding using test case 12.1 from [KMIP-TC] using protocol version 1.0 which exercises the Query operation and the Maximum Response Size header field.

5.1.1 MSGENC-JSOn-1-10 - Query, Maximum Response Size

Perform a Query operation, querying the Operations and Objects supported by the server, with a restriction on the Maximum Response Size set in the request header. Since the resulting Query response is too big, an error is returned. Increase the Maximum Response Size, resubmit the Query request, and get a successful response.

The specific list of operations and object types returned in the response MAY vary.

```
# TIME 0
0001  <RequestMessage>
0002   <RequestHeader>
0003     <ProtocolVersion>
0004       <ProtocolVersionMajor type="Integer" value="1"/>
0005       <ProtocolVersionMinor type="Integer" value="0"/>
0006     </ProtocolVersion>
0007     <MaximumResponseSize type="Integer" value="256"/>
0008     <BatchCount type="Integer" value="1"/>
0009   </RequestHeader>
0010   <BatchItem>
0011     <Operation type="Enumeration" value="Query"/>
0012     <RequestPayload>
0013       <QueryFunction type="Enumeration" value="QueryOperations"/>
0014       <QueryFunction type="Enumeration" value="QueryObjects"/>
0015     </RequestPayload>
0016   </BatchItem>
0017 <ResponseMessage>

420078010000000904200770100000048420069010000020420060a020000020400000100000000  
42006b020000000400000000000000004200500200000004000001000000000042000d0200000004  
000000100000000000000a0f0100000000000000000000000000000000000000000000000000000  
42007405000000040000000000000000042007050000000000000000002000000000000000000000  

{"tag":"RequestMessage", "value":{
   "tag":"RequestHeader", "value":{
   "tag":"ProtocolVersion", "value":{
   ["tag":"ProtocolVersionMajor", "type":"Integer", "value":"0x00000001"],
   ["tag":"ProtocolVersionMinor", "type":"Integer", "value":"0x00000000"]
   },
   ["tag":"MaximumResponseSize", "type":"Integer", "value":"0x00000001"],
   ["tag":"BatchCount", "type":"Integer", "value":"0x00000001"]
   },
   ["tag":"BatchItem", "value":{
   ["tag":"Operation", "type":"Enumeration", "value":"Query"],
   ["tag":"RequestPayload", "value":{
   ["tag":"QueryFunction", "type":"Enumeration", "value":"QueryOperations"],
   ["tag":"QueryFunction", "type":"Enumeration", "value":"QueryObjects"]
   ]
   }
   ]
}]}

0018 <ResponseMessage>
0019   <ResponseHeader>
0020   <ProtocolVersion>
```
<ProtocolVersionMajor type="Integer" value="1"/>
<ProtocolVersionMinor type="Integer" value="0"/>
</ProtocolVersion>
<TimeStamp type="DateTime" value="2013-06-26T09:09:17+00:00"/>
<BatchCount type="Integer" value="1"/>
</ResponseHeader>
<BatchItem>
<Operation type="Enumeration" value="Query"/>
<ResultStatus type="Enumeration" value="OperationFailed"/>
<ResultReason type="Enumeration" value="ResponseTooLarge"/>
<ResultMessage type="TextString" value="TOO_LARGE"/>
</BatchItem>
</ResponseMessage>
<ResponseMessage>
  <ResponseHeader>
    <ProtocolVersion>
      <ProtocolVersionMajor type="Integer" value="1"/>
      <ProtocolVersionMinor type="Integer" value="0"/>
    </ProtocolVersion>
    <TimeStamp type="DateTime" value="2013-06-26T09:17+00:00"/>
    <BatchItemCount type="Integer" value="1"/>
  </ResponseHeader>
  <BatchItem>
    <Operation type="Enumeration" value="Query"/>
    <RequestPayload>
      <Operation type="Enumeration" value="Query/
      <Operation type="Enumeration" value="QueryFunction">
        <Value type="Template"/>
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        <Value type="PublicKey"/>
        <Value type="SecretData"/>
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        <Value type="ModifyAttribute"/>
        <Value type="DeleteAttribute"/>
        <Value type="Activate"/>
        <Value type="Revoke"/>
        <Value type="Poll"/>
        <Value type="Cancel"/>
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        <Value type="CreateUsageAllocation"/>
        <Value type="GetAttribute"/>
        <Value type="GetAttributes"/>
        <Value type="Register"/>
        <Value type="Create"/>
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        <Value type="GetAttributes"/>
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        <Value type="Get"/>
        <Value type="Locate"/>
        <Value type="Destroy"/>
        <Value type="Register"/>
        <Value type="GetAttributes"/>
        <Value type="GetAttributeList"/>
        <Value type="AddAttribute"/>
        <Value type="ModifyAttribute"/>
        <Value type="DeleteAttribute"/>
        <Value type="Activate"/>
        <Value type="Revoke"/>
        <Value type="Poll"/>
        <Value type="Cancel"/>
<ArrayOfObject type="Enumeration" value="OpaqueObject"/>
<ArrayOfObject type="Enumeration" value="SplitKey"/>
</ArrayOfObject>
</ArrayOfObject>
6 XML Profile

The XML profile specifies the use of KMIP replacing the TTLV message encoding with an XML message encoding.

6.1 XML Encoding

6.1.1 Hex representations

Hex representations of numbers must always begin with '0x' and must not include any spaces. They may use either upper or lower case 'a'-’f’. The hex representation must include all leading zeros or sign extension bits when representing a value of a fixed width such as Tags (3 bytes), Integer (32-bit signed big-endian), Long Integer (64-bit signed big-endian) and Big Integer (big-endian multiple of 8 bytes). The Integer values for -1, 0, 1 are represented as “0xffffffff”, “0x00000000”, “0x00000001”. Hex representation for Byte Strings are similar to numbers, but do not include the ‘0x’ prefix, and can be of any length.

6.1.2 Tags

Tags are a String that may contain either:

- The 3-byte tag hex value prefixed with '0x'
- The normalised text of a Tag as specified in the KMIP Specification

Other text values may be used such as published names of Extension tags, or names of new tags added in future KMIP versions. Producers may however choose to use hex values for these tags to ensure they are understood by all consumers.

6.1.3 Normalizing Names

KMIP text values of Tags, Types and Enumerations SHALL be normalized to create a ‘CamelCase’ format that would be suitable to be used as a variable name in C/Java or an XML element name.

The basic approach to converting from KMIP text to CamelCase is to separate the text into individual word tokens (rules 1-4), capitalize the first letter of each word (rule 5) and then join with spaces removed (rule 6). The tokenizing splits on whitespace and on dashes where the token following is a valid word. The tokenizing also removes round brackets and shifts decimals from the front to the back of the first word in each string. The following rules SHALL be applied to create the normalized CamelCase form:

1. Replace round brackets ‘(’, ’)’ with spaces
2. If a non-word char (not alpha, digit or underscore) is followed by a letter (either upper or lower case) then a lower case letter, replace the non-word char with space
3. Replace remaining non-word chars (except whitespace) with underscore.
4. If the first word begins with a digit, move all digits at start of first word to end of first word
5. Capitalize the first letter of each word
6. Concatenate all words with spaces removed
# 1. Replace brackets with space
noBrackets = re.sub('([()])', ' ', enumName)

# 2. replace \W with space if followed by letter, lower
nonWordToSpace = re.sub('\\W([A-Za-z][a-z])', r' \1', noBrackets)

# 3. non-word to underscore
words = [re.sub('\\W', '_', s) for s in nonWordToSpace.split()]

# 4. move numbers to end of first word
words[0] = re.sub('^\d+(.*')', r'\2\1', words[0])

# 5. capitalize first letter of each word
words = [re.sub('^\.', s[0].upper(), s) for s in words]

# 6. concatenate
enumeNameCamel = ''.join(words)

---

# 1. Replace brackets with space
$enumName=~s/\[(\)]/ /g;

# 2. replace \W with space if followed by letter, lower
$enumName=~s/\\W([A-Za-z][a-z])/ /g;

# 3. non-word to underscore
@words=split(/ /,$enumName);
for($i=0;$i<=$#words;$i++) { $words[$i]=~s/\\W/_/g; } 

# 4. move numbers to end of first word
$words[0] =~ s/^\d+\(.*\)/2\1/;

# 5. capitalize first letter of each word
for($i=0;$i<=$#words;$i++) {
    substr($words[$i],0,1)=~tr/a-zA-Z/a-Z/;
}

# 6. concatenate
$enumNameCamel = join('','@words);

---

### 6.1.4 Type

Type must be a String containing one of the normalized CamelCase values as defined in the KMIP specification.

- Structure
- Integer
- LongInteger
- BigInteger
- Enumeration
- Boolean
- TextString
- ByteString
- DateTime
- Interval

If type is not included, the default type of Structure SHALL be used.

### 6.1.5 Value

The specification of a value is represented differently for each TTLV type.
6.1.6 XML Element Encoding

For XML, each TTLV is represented as an XML element with attributes. The general form uses a single element named 'TTLV' with 'tag', optional 'name' and 'type' attributes. This form allows any TTLV including extensions to be encoded. For tags defined in the KMIP Specification or other well-known extensions, a more specific form can be used where each tag is encoded as an element with the same name and includes a 'type' attribute. For either form, structure values are encoded as nested XML elements, and non-structure values are encoded using the 'value' attribute.

```xml
<TTLV tag="0x420001" name="ActivationDate" type="DateTime" value="2001-01-01T10:00:00+10:00"/>
```

The 'type' property / attribute SHALL have a default value of 'Structure' and may be omitted for Structures.

If namespaces are required, XML elements SHALL use the following namespace:

`urn:oasis:tc:kmip:xmlns`

6.1.6.1 Tags

Tags are a String that may contain either:

- The 3-byte tag hex value prefixed with '0x'
- The normalised text of a Tag as specified in the KMIP Specification

Other text values may be used such as published names of Extension tags, or names of new tags added in future KMIP versions. Producers may however choose to use hex values for these tags to ensure they are understood by all consumers.

```xml
<ActivationDate xmlns="urn:oasis:tc:kmip:xmlns" type="DateTime" value="2001-01-01T10:00:00+10:00"/>
```

6.1.6.2 Structure

For XML, sub-items are nested elements.

```xml
<ProtocolVersion type="Structure">
    <ProtocolVersionMajor type="Integer" value="1"/>
    <ProtocolVersionMinor type="Integer" value="0"/>
</ProtocolVersion>
```

The 'type' property / attribute is optional for a Structure.

6.1.6.3 Integer

For XML, value is a decimal and uses XML schema type xsd:int

```xml
<BatchCount type="Integer" value="10"/>
```

6.1.6.4 Integer - Special case for Masks

(Cryptographic Usage Mask, Storage Status Mask):
Integer mask values can also be encoded as a String containing mask components. XML uses an attribute with XML type xsd:list which uses a space separator. Components may be either the text of the enumeration value as defined in KMIP 9.1.3.3.1 / KMIP 9.1.3.3.2, or a 32-bit unsigned big-endian hex string.

6.1.6.5 Long Integer

For XML, value uses XML schema type xsd:long

6.1.6.6 Big Integer

For XML, value uses XML schema type xsd:hexBinary

6.1.6.7 Enumeration

For XML, value uses XML schema type xsd:string and is either a hex string or the CamelCase enum text. If an XSD with xsd:enumeration restriction is used to define valid values (as is the case with the XSD included as an appendix), parsers should also accept any hex string in addition to defined enum values.

6.1.6.8 Boolean

For XML, value uses XML schema type xsd:Boolean

6.1.6.9 Text String

XML uses schema type xsd:string

6.1.6.10 Byte String

XML uses schema type xsd:hexBinary

6.1.6.11 Date-Time

For XML, value uses schema type xsd:dateTime

6.1.6.12 Interval

XML uses schema type xsd:unsignedInt

<Offset type="Interval" value="27"/>
7 XML Profile Test Cases

This section contains a test case that demonstrates the XML profile encoding using test case 12.1 from [KMIP-TC] using protocol version 1.0 which exercises the Query operation and the Maximum Response Size header field.

7.1.1 MSGENC-XML-1-10 - Query, Maximum Response Size

Perform a Query operation, querying the Operations and Objects supported by the server, with a restriction on the Maximum Response Size set in the request header. Since the resulting Query response is too big, an error is returned. Increase the Maximum Response Size, resubmit the Query request, and get a successful response.

The specific list of operations and object types returned in the response MAY vary.

```
# TIME 0
0001 <RequestMessage>
0002 <RequestHeader>
0003 <ProtocolVersion>
0004   <ProtocolVersionMajor type="Integer" value="1"/>
0005   <ProtocolVersionMinor type="Integer" value="0"/>
0006 </ProtocolVersion>
0007 <MaximumResponseSize type="Integer" value="256"/>
0008 <BatchCount type="Integer" value="1"/>
0009 </RequestHeader>
0010 <BatchItem>
0011   <Operation type="Enumeration" value="Query"/>
0012 <RequestPayload>
0013     <QueryFunction type="Enumeration" value="QueryOperations"/>
0014     <QueryFunction type="Enumeration" value="QueryObjects"/>
0015   </RequestPayload>
0016 </BatchItem>
0017 </RequestMessage>

42007801000000094200770100000004420069010000002042006a02000000040000000010000000
42006b0200000004000000000000000042005002000000040000001000000000000000042000d20000000
00000001000000042000f010000000000000018000000004200790100000020
420074050000004000000100000000000000004200740500000040000000000

0018 <ResponseMessage>
0019 <ResponseHeader>
0020 <ProtocolVersion>
0021   <ProtocolVersionMajor type="Integer" value="1"/>
0022   <ProtocolVersionMinor type="Integer" value="0"/>
0023 </ProtocolVersion>
0024 <TimeStamp type="DateTime" value="2013-06-26T09:09:17+00:00"/>
0025 <BatchCount type="Integer" value="1"/>
0026 </ResponseHeader> <BatchItem>
0027   <Operation type="Enumeration" value="Query"/>
0028   <ResultStatus type="Enumeration" value="OperationFailed"/>
0029   <ResultReason type="Enumeration" value="ResponseTooLarge"/>
0030   <ResultMessage type="TextString" value="TOO_LARGE"/>
0031 </BatchItem>
0032 </ResponseMessage>
```
<RequestMessage>
  <RequestHeader>
    <ProtocolVersion>
      <ProtocolVersionMajor type="Integer" value="1"/>
      <ProtocolVersionMinor type="Integer" value="0"/>
    </ProtocolVersion>
    <MaximumResponseSize type="Integer" value="2048"/>
    <BatchCount type="Integer" value="1"/>
  </RequestHeader>
  <BatchItem>
    <Operation type="Enumeration" value="Query"/>
    <RequestPayload>
      <QueryFunction type="Enumeration" value="QueryOperations"/>
      <QueryFunction type="Enumeration" value="QueryObjects"/>
    </RequestPayload>
  </BatchItem>
</RequestMessage>

<ResponseMessage>
  <ResponseHeader>
    <ProtocolVersion>
      <ProtocolVersionMajor type="Integer" value="1"/>
      <ProtocolVersionMinor type="Integer" value="0"/>
    </ProtocolVersion>
    <TimeStamp type="DateTime" value="2013-06-26T09:09:17+00:00"/>
    <BatchCount type="Integer" value="1"/>
  </ResponseHeader>
  <BatchItem>
    <Operation type="Enumeration" value="Query"/>
    <ResultStatus type="Enumeration" value="Success"/>
    <ResponsePayload>
      <Operation type="Enumeration" value="Query"/>
      <Operation type="Enumeration" value="Locate"/>
      <Operation type="Enumeration" value="Destroy"/>
      <Operation type="Enumeration" value="Get"/>
      <Operation type="Enumeration" value="Create"/>
      <Operation type="Enumeration" value="Register"/>
      <Operation type="Enumeration" value="GetAttributes"/>
      <Operation type="Enumeration" value="GetAttributeList"/>
      <Operation type="Enumeration" value="AddAttribute"/>
      <Operation type="Enumeration" value="ModifyAttribute"/>
      <Operation type="Enumeration" value="DeleteAttribute"/>
      <Operation type="Enumeration" value="Activate"/>
      <Operation type="Enumeration" value="Revoke"/>
      <Operation type="Enumeration" value="Poll"/>
      <Operation type="Enumeration" value="Cancel"/>
      <Operation type="Enumeration" value="Check"/>
      <Operation type="Enumeration" value="GetUsageAllocation"/>
    </ResponsePayload>
  </BatchItem>
</ResponseMessage>
```xml
<Operation type="Enumeration" value="CreateKeyPair"/>
<Operation type="Enumeration" value="ReKey"/>
<Operation type="Enumeration" value="Archive"/>
<Operation type="Enumeration" value="Recover"/>
<Operation type="Enumeration" value="ObtainLease"/>
<Operation type="Enumeration" value="Certify"/>
<Operation type="Enumeration" value="ReCertify"/>
<Operation type="Enumeration" value="Notify"/>
<Operation type="Enumeration" value="Put"/>
<ObjectType type="Enumeration" value="Certificate"/>
<ObjectType type="Enumeration" value="SymmetricKey"/>
<ObjectType type="Enumeration" value="SecretData"/>
<ObjectType type="Enumeration" value="PublicKey"/>
<ObjectType type="Enumeration" value="PrivateKey"/>
<ObjectType type="Enumeration" value="Template"/>
<ObjectType type="Enumeration" value="OpaqueObject"/>
<ObjectType type="Enumeration" value="SplitKey"/>
</ResponsePayload>
</BatchItem>
</ResponseMessage>
```

8 Conformance

8.1 HTTPS Profile Conformance

KMIP client and server implementations conformant to this profile:
1. SHALL support the Authentication Suite conditions as specified in Section 2.1 of this profile.
2. SHALL support the KMIP Port Number conditions as specified in Section 2.2 of this profile.
3. SHALL support the Request URL conditions as specified in Section 2.3 of this profile.
4. SHALL support the HTTP Encoding conditions as specified in Section 2.4 of this profile.
5. SHALL support mapping of all TTLV tags and enumerations specified within each version of the [KMIP-SPEC] that is supported.
6. SHALL support user defined extensions containing additional tags and enumerations not specified within [KMIP-SPEC].

8.2 JSON Profile Conformance

KMIP client and server implementations conformant to this profile:
1. SHALL support JSON message encoding for request and response messages as specified in Section 4.1 of this profile.
2. SHALL support mapping of all TTLV tags and enumerations specified within each version of the [KMIP-SPEC] that is supported.
3. SHALL support user defined extensions containing additional tags and enumerations not specified within [KMIP-SPEC].

8.3 XML Profile Conformance

KMIP client and server implementations conformant to this profile:
1. SHALL support XML message encoding for request and response messages as specified in Section 6.1 of this profile.
2. SHALL support mapping of all TTLV tags and enumerations specified within each version of the [KMIP-SPEC] that is supported.
3. SHALL support user defined extensions containing additional tags and enumerations not specified within [KMIP-SPEC].

8.4 Permitted Test Case Variations

Whilst the test cases provided in this Profile define the allowed request and response content, some inherent variations MAY occur and are permitted within a successfully completed test case.

Each test case MAY include allowed variations in the description of the test case in addition to the variations noted in this section.
Other variations not explicitly noted in this Profile SHALL be deemed non-conformant.

8.4.1 Variable Items

An implementation conformant to this Profile MAY vary the following values:
1. UniqueIdentifier
2. PrivateKeyUniqueIdentifier
3. PublicKeyUniqueIdentifier
4. UniqueBatchItemIdentifier
5. AsynchronousCorrelationValue
6. TimeStamp
7. KeyValue / KeyMaterial including:
   a. key material content returned for managed cryptographic objects which are generated by
      the server
   b. wrapped versions of keys where the wrapping key is dynamic or the wrapping contains
      variable output for each wrap operation
8. For response containing the output of cryptographic operation in Data / SignatureData/ MACData
    / IVCounterNonce where:
    a. the managed object is generated by the server; or
    b. the operation inherently contains variable output
9. For the following DateTime attributes where the value is not specified in the request as a fixed
   DateTime value:
   a. ActivationDate
   b. ArchiveDate
   c. CompromiseDate
   d. CompromiseOccurrenceDate
   e. DeactivationDate
   f. DestroyDate
   g. InitialDate
   h. LastChangeDate
   i. ProtectStartDate
   j. ProcessStopDate
   k. ValidityDate
   l. OriginalCreationDate
10. LinkedObjectIdentifier
11. DigestValue
    a. For those managed cryptographic objects which are dynamically generated
12. KeyFormatType
    a. The key format type selected by the server when it creates managed objects
13. Digest
    a. The HashingAlgorithm selected by the server when it calculates the digest for a managed
       object for which it has access to the key material
    b. The Digest Value
14. Extensions reported in Query for ExtensionList and ExtensionMap
15. Application Namespaces reported in Query
16. Object Types reported in Query other than those noted as required in this profile
17. Operation Types reported in Query other than those noted as required in this profile (or any
    referenced profile documents)
18. For TextString attribute values containing test identifiers:
    a. Additional vendor or application prefixes
19. Additional attributes beyond those noted in the response
An implementation conformant to this Profile MAY allow the following response variations:

1. Object Group values – May or may not return one or more Object Group values not included in the requests
2. y-CustomAttributes – May or may not include additional server-specific associated attributes not included in requests
3. Message Extensions – May or may not include additional (non-critical) vendor extensions
4. TemplateAttribute – May or may not be included in responses where the Template Attribute response is noted as optional in [KMIP-SPEC]
5. AttributeIndex – May or may not include Attribute Index value where the Attribute Index value is 0 for Protocol Versions 1.1 and above.
6. ResultMessage – May or may not be included in responses and the value (if included) may vary from the text contained within the test case.
7. The list of Protocol Versions returned in a DiscoverVersion response may include additional protocol versions if the request has not specified a list of client supported Protocol Versions.
8. VendorIdentification - The value (if included) may vary from the text contained within the test case.

8.4.2 Variable behavior

An implementation conformant to this Profile SHALL allow variation of the following behavior:

1. A test may omit the clean-up requests and responses (containing Revoke and/or Destroy) at the end of the test provided there is a separate mechanism to remove the created objects during testing.
2. A test may omit the test identifiers if the client is unable to include them in requests. This includes the following attributes:
   a. Name; and
   b. x-ID
Appendix A. Acknowledgments

The following individuals have participated in the creation of this specification and are gratefully acknowledged:

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Sairam Manidi, Freescale
Luther Martin, Voltage Security
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Michael Yoder, Vormetric, Inc.
Magda Zdunkiewicz, Cryptsoft
Peter Zelechoski, Election Systems & Software
# Appendix B. KMIP Specification Cross Reference

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### 4 Client-to-Server Operations

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## 5 Server-to-Client Operations

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## 6 Message Contents

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## Reference Term

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### 10 Transport

| Transport                                  | 10               | 10               | 10               |

### 12 KMIP Server and Client Implementation Conformance

| Conformance clauses for a KMIP Server      | 12.1.            | -                | -                |
| KMIP Client Implementation Conformance    | -                | 12.2.            | 12.2.            |
| KMIP Server Implementation Conformance    | -                | 12.1.            | 12.1.            |
## Appendix C. Revision History

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<td>wd01</td>
<td>26-June-2013</td>
<td>Tim Hudson</td>
<td>Merged version of the three committee draft documents. Updated conformance wording style. Updated test case style. Applied new OASIS template.</td>
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<td>wd02</td>
<td>6-August-2013</td>
<td>Tim Hudson</td>
<td>Updated to include Permitted Test Case Variations</td>
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<tr>
<td>wd03</td>
<td>10-August-2013</td>
<td>Tim Hudson</td>
<td>Updated Permitted Test Case Variations</td>
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