Symmetric Key Services Markup Language (SKSML) Version 1.0

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Related Work:

This specification replaces or supercedes:

- None

This specification is related to:

- Advanced Encryption Standard (AES) - NIST FIPS 197 - http://csrc.nist.gov/publications/fips/fips197/fips-197.pdf
- Simple Object Access Protocol (SOAP) - W3C Recommendation 08 May 2000. http://www.w3.org/TR/soap/
- XML Encryption - W3C Recommendation 10 Dec 2002. http://www.w3.org/TR/xmlenc-core/
- XML Signature - W3C Recommendation 12 Feb 2002. http://www.w3.org/TR/xmldsig-core/
- Web Services Security - SOAP Message Security 1.0 - OASIS Standard 200401, March 2004 - http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-soap-message-security-1.0.pdf

Declared XML Namespace(s):

http://docs.oasis-open.org/ekmi/2008/01

Abstract:

This normative specification defines the first (1.0) version of the Symmetric Key Services Markup Language (SKSML), an XML-based messaging protocol, by which applications executing on computing devices may request and receive symmetric key-management services from centralized key-management servers, securely, over networks. Applications using SKSML are expected to either implement the SKSML protocol, or use a software library – called the Symmetric Key Client Library (SKCL) – that implements this protocol. SKSML messages are XML messages that can be transported safely between the server and the client either using strong Transport layer security and/or XML encryption or within a SOAP layer, protected by a Web Services Security (WSS) header (can be used over standard HTTP securely).

Status:

This document was last revised or approved by the EKMI TC on the above date. The level of approval is also listed above. Check the "Latest Version" or "Latest Approved Version" location noted above for possible later revisions of this document.

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Table of Contents

166

1 Introduction

This document presents the specification for the Symmetric Key Services Markup Language (SKSML), a protocol by which applications may request and receive symmetric key-management services, securely, over networks or other mechanisms as may be selected by implementers. All text is normative unless otherwise indicated.

1.1 Terminology

The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this specification are to be interpreted as described in IETF RFC 2119.

1.2 Glossary

3DES – Triple Data Encryption Standard

AES – Advanced Encryption Standard

Base64 – An encoding scheme for representing data

Ciphertext – Encrypted data

Cryptographic module – A software library or hardware module dedicated to performing cryptographic operations

DES – Data Encryption Standard

DID *or* ***Domain ID –*** Domain Identifier; the unique ***PEN*** assigned to an implementation of an ***SKMS*** (Symmetric Key Management System) within an enterprise

GKID *or* ***Global Key ID*** – Global Key Identifier; the unique identifier assigned to every symmetric encryption key within an ***SKMS.*** It is the concatenation of the ***DID-SID-KID***

Initialization Vector *or* ***IV*** – A block of bits required to encrypt/decrypt the first block of data when used with a particular mode of cryptographic operations

KeyCachePolicy – The collection of rules that defines how a symmetric encryption key may be cached by a client implementation

KID *or* ***Key ID*** – Key Identifier; the unique integer assigned to every symmetric encryption key generated within a specific ***SKS*** (Symmetric Key Services) server within an ***SKMS*** (Symmetric Key Management System)

KeyUsePolicy – The collection of rules that defines how a symmetric encryption key may be used by an application

PEN – Private Enterprise Number; the unique integer assigned by IANA to any organization that requests such a number

PII – Personally Identifiable Information, such as credit card numbers, social security numbers, bank account numbers, drivers license numbers, etc.

Plaintext – Unencrypted data

SHA – Secure Hashing Algorithm

SHA-1 – Secure Hashing Algorithm with a resultant size of 160-bits

SHA-256 – Secure Hashing Algorithm with a resultant size of 256-bits

SHA-384 – Secure Hashing Algorithm with a resultant size of 384-bits

SHA-512 – Secure Hashing Algorithm with a resultant size of 512-bits

SID or ***Server ID*** – Server Identifier; the unique integer assigned to every ***SKS*** server within an enterprise's *SKMS*

SKCL – Symmetric Key Client Library; a software library that supports the ***SKSML*** protocol

SKMS – Symmetric Key Management System; a collection of hardware and software providing symmetric encryption key-management services

SKS – Symmetric Key Services; a server that provides symmetric key management services over a network or other mechanism selected by implementers

SKSML – Symmetric Key Services Markup Language; an XML-based protocol to request and receive symmetric encryption key-management services

SOAP – Simple Object Access Protocol

SOAP Body – The content part of a SOAP message

SOAP Envelope – The SOAP message consisting of a SOAP Header and a SOAP Body, conforming to the SOAP protocol standard.

SOAP Error – A SOAP error message response to a SOAP request

SOAP Header – The header part of a SOAP message containing meta-information about the message, including security-related objects

Symkey - A symmetric encryption key

unbounded – A parameter used with the “maxOccurs” attribute to indicate an unlimited number

XMLEncryption – Encrypted content represented in eXtensible Markup Language that conforms to the World Wide Web Consortium's XML Encryption standard

XMLSignature – A digital signature represented in eXtensible Markup Language that conforms to the World Wide Web Consortium's XML Signature standard

1.3 Normative References

[AES] Advanced Encryption Standard
NIST FIPS 197. http://csrc.nist.gov/publications/fips/fips197/fips-197.pdf

[RFC 2119] S. Bradner. *Key words for use in RFCs to Indicate Requirement Levels*.
IETF RFC 2119, March 1997. .http://www.ietf.org/rfc/rfc2119.txt

[SOAP] Simple Object Access Protocol 1.2
W3C Recommendation 27 April 2007. http://www.w3.org/TR/soap12/

[XMLEncryption] XML Encryption Syntax and Processing
W3C Recommendation 10 Dec 2002. http://www.w3.org/TR/xmlenc-core/

[XMLSignature] XML Signature Syntax and Processing
W3C Recommendation 12 Feb 2002. http://www.w3.org/TR/xmldsig-core/

[WSS] Web Services Security – SOAP Message Security 1.0
OASIS Standard 200401, January 2004 http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-soap-message-security-1.0.pdf

[RFC 2578] K. McCloghrie, et al. *Structure of Management Information Version 2(SMIv2)*.

IETF RFC 2578, April 1999. http://www.ietf.org/html/rfc2578

2 Background (non-normative)

A confluence of events is causing many companies to consider encrypting sensitive data across many applications and platforms within their IT infrastructure. Some of these events include:

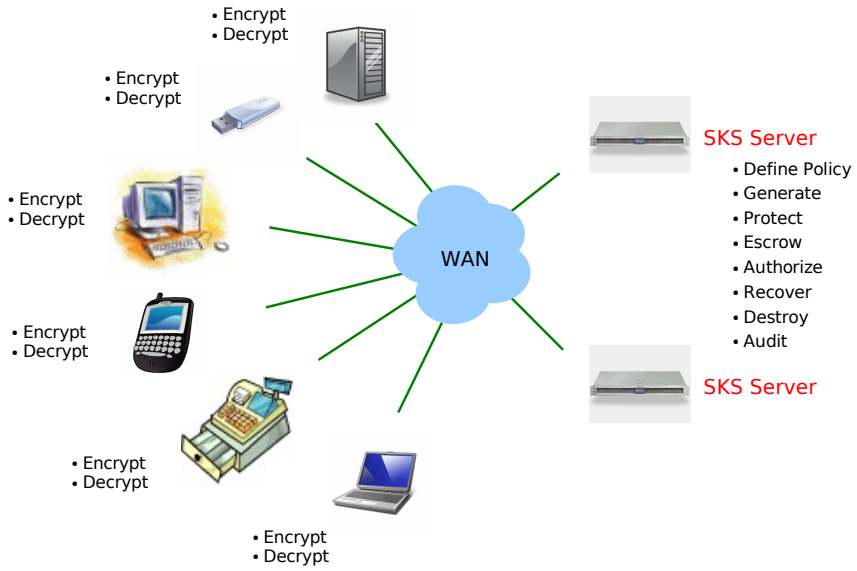
- "Breach Disclosure" laws in nearly 40 states of the USA, requiring companies that have suffered breaches on computers containing Personally Identifiable Information (PII) of their employees or customers, to disclose those breaches to the affected individuals
- Industry-specific regulations such as the credit card industry's Payment Card Industry Data Security Standard, requiring the encryption of credit card numbers accompanied with strong key-management controls
- National laws such as the US' Health Insurance Portability and Accountability Act (HIPAA) and the European Union Directive, requiring the securing of health-related data and PII, respectively
- A significant increase in the number of business applications and e-commerce services on the internet requiring credit card numbers for payment, which in turn becomes a target for attackers
- A significant increase in the number of users connected to the internet with inadequate protection, leading to many attack vectors becoming propagated on these unprotected PC's

In a rush to provide solutions to the market, vendors have created many device-specific, platform-specific, database-specific and application-specific encryption and key-management tools. While these tools may be capable of performing their stated tasks adequately, a typical enterprise would have to deal with many encryption and key-management solutions to adequately protect sensitive data. The following illustration shows how the same key-management tasks need to repeated across every single device, platform, database and/or application where encryption is performed:

Not only does this raise the cost of ownership for implementing companies, but it raises the possibility that with many dissimilar key-management systems, because of the typical complexity of key-management schemes, there is a greater likelihood of human error leading to a vulnerability.

To ensure that encryption policies and designs are specified and used uniformly across applications, a common key-management service capable of supporting enterprise platforms, applications and devices is needed. To enable such applications to communicate with this service, a uniform protocol is needed. The Symmetric Key Services Markup Language (SKSML) is that protocol.

Once an enterprise has implemented an SKMS, and applications have been modified to take advantage of SKSML, they can expect to see their key-management infrastructure to resemble the following diagram:



With an architecture similar to the Domain Name Service (DNS), an SKMS becomes the focal point for all symmetric encryption key-management services.

The Symmetric Key Client Library (SKCL) on client devices is responsible for communicating with the Symmetric Key Services (SKS) server using SKSML. The SKCL handles security, caching, cryptographic operations and ensuring that the use of the key is in conformance to policies specified for the key.

The SKS server is responsible for storing all policies, keys and information about authorized clients and servers within the SKMS, and responds to client requests.

2.1 Requirements (Non-normative)

The requirements of the SKSML protocol are that:

- It must be platform independent;
- It must support the request of new and previously escrowed symmetric encryption keys;
- It must support the unique identification of every symmetric encryption key on the internet;
- It must provide message authenticity, confidentiality and integrity even when used over insecure networks;
- It must support the use of encryption/decryption services by a client even when disconnected from the network;
- It must provide flexibility in defining key-usage policies;

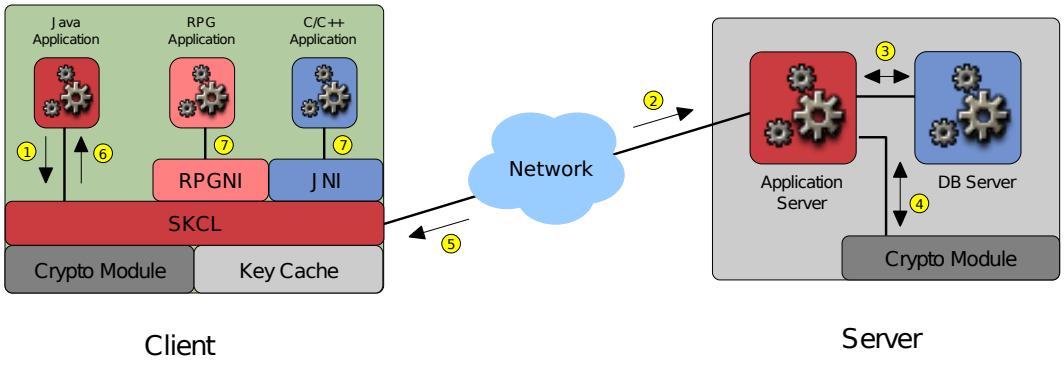
SKSML meets the above requirements in the following manner:

- SKSML uses XML for encapsulating its requests and responses and can thus, be used on any platform that supports this protocol;
- Using a scheme that concatenates unique Domain identifiers (Private Enterprise Numbers issued by the IANA), unique SKS Server identifiers within a domain and unique Key identifiers within an SKS server, SKSML creates Global Key Identifiers (GKID) that can uniquely identify symmetric keys across the internet;
- SKSML relies on RSA crytographic key-pairs and digital certificates enabling XML encryption (confidentiality) and XML signatures (for authenticity and message integrity);
- Using secure key-caching enabled through centrally-defined policies, SKSML supports the request and receipt of ***KeyCachePolicy*** elements by clients for the use of symmetric encryption keys even when the client is disconnected from the network and an SKS server;
- SKSML provides significant flexibility for defining policies on how symmetric encryption keys may be used by client applications. The ***KeyUsePolicy*** element allows Security Officers to define which applications may use a specific key, days and times of use, location of use, purpose of use, key-sizes, encryption algorithms, etc.

SKSML is the first key-management protocol that will do for encryption key-management services what DNS did for name-service protocols: provide a single, standard means of requesting and receiving key-management services from centrally defined servers.

3 Examples of use of SKSML (non-normative)

The following high-level diagram will be used to describe the use of SKSML.



1. Client Application makes a request for a symmetric key
2. SKCL makes a digitally signed request to the SKS
3. SKS verifies SKCL request, generates, encrypts, digitally signs & escrows key in DB
4. Crypto HSM provides security for RSA Signing & Encryption keys of SKS
5. SKS responds to SKCL with signed and encrypted symmetric key
6. SKCL verifies response, decrypts key and hands it to the Client Application
7. Native (non-Java) applications make requests through Java Native Interface

3.1 Request for a new symmetric key

When a client application (that has been linked to the SKCL) needs to encrypt sensitive data, it will call an API method within the SKCL for a new symmetric key. After the SKCL has ensured that the application is authorized to make such a request (by verifying that the configured/passed-in credentials can access the cryptographic key-store module on the client containing the PrivateKey used for signing SKSML requests), the SKCL assembles the following SKSML request:

```
[a01]   <ekmi:SymkeyRequest
[a02]       xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
[a03]       <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
[a04]   </ekmi:SymkeyRequest>
```

[a01] is the start of the ***SymkeyRequest*** element.

[a02] identifies the namespace to which this XML conforms, and the location of its XML Schema Definition (XSD).

[a03] identifies the ***GlobalKeyID*** (GKID) being requested by the client application. The GKID is a concatenation of three distinct identifiers in the following order: the unique Domain Identifier, the unique Server Identifier within the domain and the unique Key Identifier generated on a server. Using a "zero" value for the Server ID and the Key ID indicates a request for a new symmetric key.

[a04] is the closing tag of the ***SymkeyRequest*** element.

While the ***SymkeyRequest*** element is very simple, the Web Service Security (WSS) envelope (if used) – which provides security for all SKSML messages – expands the size of the message. The same request shown above, is displayed below in its entirety, with its WSS envelope. Please note that some content – such as Base64-encoded binary content - has been reformatted for aesthetics and clarity of the XML elements. The actual elements and data-types have been preserved from actual SKSML messages.

For an interpretation of the XML elements shown below, please refer to **[WSS]**.

For the sake of brevity, this specification will dispense with showing the SOAP envelope and the WSS elements in all other examples, when discussing SKSML.

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <wsse:Security xmlns:wsse="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-
1.0.xsd" SOAP-ENV:mustUnderstand="1">
      <wsse:BinarySecurityToken xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-
utility-1.0.xsd"
                  EncodingType="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-soap-message-
security-1.0#Base64Binary"
                  ValueType="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-x509-token-profile-
1.0#X509v3" wsu:Id="XWSSGID-1172790302111-1738806553">


MIIDfDCCAmSgAwIBAgIIAe/AvliGc3AwDQYJKoZIhvcNAQELBQAwZzEmMCQGA1UEAxMdU3Ryb25nab

S2V5IERFTU8gU3Vib3JkaW5hdGUgQ0ExJDAiBgNVBAsTG0ZvciBTdHJvbmdLZXkgREVNTyBVc2Ug1d
  T25seTEXMBUGA1UEChMOU3Ryb25nQXV0aCBJbmMwHhcNMDYwNzI1MTcxMDMwWhcNMDcwNzIa64dd3k
  A1UECxMbRm9yIFN0cm9uZ0tleSBERU1PIFVzZSBPbmx5MRcwFQYDVQQKEw5TdHJvbmdBdXRoIEI2da
  S2V5IERFTU8gU3Vib3JkaW5hdGUgQ0ExJDAiBgNVBAsTG0ZvciBTdHJvbmdLZXkgREVNTyBVc2Ugia
  T25seTEXMBUGA1UEChMOU3Ryb25nQXV0aCBJbmMwHhcNMDYwNzI1MTY0NjEwWhcNMDcwNzI1s34wdd
  NjEwWjBpMREwDwYKCZImiZPyLGQBARMBOTEVMBMGA1UEAxMMU0tTIFNlcnZlci0xMSQwIgYDVQsdw2
  ExtGb3IgU3Ryb25nS2V5IERFTU8gVXNlIE9ubHkxFzAVBgNVBAoTDlN0cm9uZ0F1dGggSW5jMIIBd2

NBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAztppqRoU5A8plxx1Rz1QEUnlAAM1D5g9+isIr3wxa
  hbwjtFSMYilnY4iV77xU/nsMOnMZ7RxsLYKdCzQ1ODVYqQwqmAvaJ5Z6SVy34gZ51YG+rSWE3NjFsd
  bOXW8RJYA/Tn6Lmht/qngrcaqqmtP0cAAiMRZOWtCTmC2K/LEqDabXSyU6Hh8ySNE3njybvmWpresf
  zsYokTdvnWQqT6tKo1OwJsdJ1+hxM7DrnMLvMNq5reINfsKhDdX17wzhrBUx+hiYA/qo8tMXkL6wsd
              4PN5dYugtzpSzIdUO5tIg58Avhzwo7hy5oofBlKFY22CeljQ36u0bMjuyGj6UYHs3rdfdfsds32rda
  YzCBnzANBgkqhkiG9w0BAQEFAAOBjQAwgYkCgYEAyAmxMZhYA8wHJ4UE4b61s51JVWe4Fygj4MCf3a
  hvcNAQELBQADggEBACK05PtvZD4WPglOe=
                  </wsse:BinarySecurityToken>
    <ds:Signature xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
                      <ds:SignedInfo>
                  <ds:CanonicalizationMethod
                                  Algorithm="http://www.w3.org/2001/10/xml-exc-c14n#">
              <InclusiveNamespaces
                                  xmlns="http://www.w3.org/2001/10/xml-exc-c14n#"
                                  PrefixList="wsse SOAP-ENV"/>
          </ds:CanonicalizationMethod>
                              <ds:SignatureMethod
                                  Algorithm="http://www.w3.org/2000/09/xmldsig#rsa-sha1"/>
                              <ds:Reference URI="#XWSSGID-1172790300636-653454040">
              <ds:DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
                                  <ds:DigestValue>IU4m+rp4oebgl9g+t3nRaZYqUlE=</ds:DigestValue>
                              </ds:Reference>
          <ds:Reference URI="#XWSSGID-117279030063770887 1805">
              <ds:DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
                                  <ds:DigestValue>WCpOmTCbffcEHXhGf5rlEYWLrZg=</ds:DigestValue>
                              </ds:Reference>
                      </ds:SignedInfo>
                      <ds:SignatureValue>
```

```
                        svStAvBRRrF+g2biPI7uWHkJTQPII8t4phMbOZQsZIQcn36tcMSj/a4+4LPNfOB3Y8yO2lr1Oa1


fGqCPAWZNuEH34VQEM196rRwV258mgp8uwpXEYJIgPJqg89w8+/NdaODccLQ2Bizu7QM/HSM2ab
                        ogNJwqmbSyIazOsnOcU=
                        </ds:SignatureValue>
        <ds:KeyInfo>
                    <wsse:SecurityTokenReference xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-
200401-wss-wssecurity-utility-1.0.xsd"
                        wsu:Id="XWSSGID-1172790300633-442423344">
                          <wsse:Reference URI="#XWSSGID-1172790302111-1738806553"
                                  ValueType="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-x509-
token-profile-1.0#X509v3"/>
                          </wsse:SecurityTokenReference>
                        </ds:KeyInfo>
                    </ds:Signature>
      <wsu:Timestamp xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-utility-
1.0.xsd" wsu:Id="XWSSGID-1172790300637708871805">
                        <wsu:Created>2007-03-01T23:05:00Z</wsu:Created>
                        <wsu:Expires>2007-03-01T23:05:05Z</wsu:Expires>
                    </wsu:Timestamp>
                </wsse:Security>
    </SOAP-ENV:Header>
    <SOAP-ENV:Body xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-utility-
1.0.xsd" wsu:Id="XWSSGID-1172790300636-653454040">
                    <ekmi:SymkeyRequest
                        xmlns:ekmi=”http://docs.oasis-open.org/ekmi/2008/01">
                        <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
                    </ekmi:SymkeyRequest>
                </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

3.2 Response with a new symmetric key

After an SKS server has performed its operations of authenticating the request, identifying the requester, determining policies that apply to the requester, generating the symmetric encryption key in conformance to the defined policy and finally escrowing a symmetric key securely, it assembles the following response and returns it to the client. (The SOAP message if used, as indicated earlier, is secured using WSS, but only the actual SKSML content is displayed and discussed here).

```
[b01]  <ekmi:SymkeyResponse
[b02]         xmlns:ekmi='http://docs.oasis-open.org/ekmi/2008/01'
[b03]            xmlns:xenc='http://www.w3.org/2001/04/xmlenc#'>
[b04]      <ekmi:Symkey>
[b05]         <ekmi:GlobalKeyID>10514-1-235</ekmi:GlobalKeyID>
[b06]         <ekmi:KeyUsePolicy>
[b07]            <ekmi:KeyUsePolicyID>10514-4</ekmi:KeyUsePolicyID>
[b08]            <ekmi:PolicyName>DES-EDE KeyUsePolicy</ekmi:PolicyName>
[b09]            <ekmi:KeyClass>HR-Class</ekmi:KeyClass>
[b10]            <ekmi:KeyAlgorithm>
[b11]               http://www.w3.org/2001/04/xmlenc#tripledes-cbc
[b12]            </ekmi:KeyAlgorithm>
[b13]            <ekmi:KeySize>192</ekmi:KeySize>
[b14]            <ekmi:Status>Active</ekmi:Status>
[b15]            <ekmi:Permissions>
[b16]               <ekmi:PermittedApplications ekmi:any=”false”>
[b17]                     <ekmi:PermittedApplication>
[b18]                     <ekmi:ApplicationID>10514-23</ekmi:ApplicationID>
[b19]                     <ekmi:ApplicationName>
[b20]                           Payroll Application
```

```
[b21]                        </ekmi:ApplicationName>
[b22]                        <ekmi:ApplicationVersion>1.0</ekmi:ApplicationVersion>
[b23]                        <ekmi:ApplicationDigestAlgorithm>
[b24]                           http://www.w3.org/2000/09/xmldsig#sha1
[b25]                        </ekmi:ApplicationDigestAlgorithm>
[b26]                        <ekmi:ApplicationDigestValue>
[b27]                           NIG4bKkt4cziEqFFuOoBTM81efU=
[b28]                        </ekmi:ApplicationDigestValue>
[b29]                     </ekmi:PermittedApplication>
[b30]                  </ekmi:PermittedApplications>
[b31]                  <ekmi:PermittedDates ekmi:any=”false”>
[b32]                     <ekmi:PermittedDate>
[b33]                        <ekmi:StartDate>2008-01-01</ekmi:StartDate>
[b34]                        <ekmi:EndDate>2008-12-31</ekmi:EndDate>
[b35]                     </ekmi:PermittedDate>
[b36]                  </ekmi:PermittedDates>
[b37]                  <ekmi:PermittedDays ekmi:any=”true” xsi:nil=”true”/>
[b38]                  <ekmi:PermittedDuration ekmi:any=”true” xsi:nil=”true”/>
[b39]                  <ekmi:PermittedLevels ekmi:any=”true” xsi:nil=”true”/>
[b40]                  <ekmi:PermittedLocations ekmi:any=”true” xsi:nil=”true”/>
[b41]                  <ekmi:PermittedNumberOfTransactions ekmi:any=”true”
xsi:nil=”true”/>
[b42]                  <ekmi:PermittedTimes ekmi:any=”false”>
[b43]                     <ekmi:PermittedTime>
[b44]                        <ekmi:StartTime>07:00:00</ekmi:StartTime>
[b45]                        <ekmi:EndTime>19:00:00</ekmi:EndTime>
[b46]                     </ekmi:PermittedTime>
[b47]                  </ekmi:PermittedTimes>
[b48]                  <ekmi:PermittedUses ekmi:any=”true” xsi:nil=”true”/>
[b49]               </ekmi:Permissions>
[b50]            </ekmi:KeyUsePolicy>
[b51]               <ekmi:EncryptionMethod
[b52]                     Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-1_5"/>
[b53]               <xenc:CipherData>
[b54]                  <xenc:CipherValue>
[b55]                  E9zWB/y93hVSzeTLiDcQoDxmlNxTuxSffMNwCJmt1dIqzQHBnpdQ81g6DKdkCFjJM
[b56]                  hQhywCx9sfYjv9h5FDqUiQXGOca8EU871zBoXBjDxjfg1pU8tGFbpWZcd/ATpJD/2fw
[b57]                  UJow/qimxi8+huUYJMtaGHtXuLlWtx27STRcRpIsY=
[b58]                  </xenc:CipherValue>
[b59]               </xenc:CipherData>
[b60]        </ekmi:Symkey>
[b61]  </ekmi:SymkeyResponse>
```

[b01] is the start of the ***SymkeyResponse*** element.

[b02] and **[b03]** identify the namespaces to which this XML conforms, and the location of their XML Schema Definitions (XSD).

[b04] is the start tag of the ***Symkey*** element which contains the symmetric encryption key and related elements.

[b05] identifies the ***GlobalKeyID*** (GKID) assigned by the SKS server for the new symmetric key being returned. In this example, the concatenated values of the Domain ID, Server ID and Key ID indicate that the key belongs to the organization represented by the PEN, 10514; it was generated on an SKS server with a Server ID of 1 and is the 235th unique key generated on that SKS server.

[b06] is the start of the ***KeyUsePolicy*** element. This element contains details of the policy to which SKCL implementations must conform when using the symmetric key.

[b07] identifies the unique ***KeyUsePolicyID*** *(KUPID)* which identifies this policy within the SKMS.

[b08] provides a descriptive name for this key-use policy, which is helpful to human readers when identifying this policy.

[b09] identifies the ***KeyClass*** to which this symmetric key belongs. Key-classes are useful to applications that wish to encrypt plaintext with a key that has specific characteristics. The requesting application is expected to know what ***KeyClass*** it needs before it asks for a key corresponding to that class.

[b10] is the start tag of the ***KeyAlgorithm*** element.

[b11] identifies the cryptographic algorithm that this symmetric key must be used with to for cryptographic operations.

[b12] is the closing tag of the ***KeyAlgorithm*** element.

[b13] specifies the size of the symmetric encryption key in bits. While it is possible for application developers to determine this programmatically from the key-object, this element provides this information as a convenience.

[b14] indicates the **Status** of this ***KeyUsePolicy*** and whether it is an active policy or not. This is useful in situations where an application may wish to re-use a symmetric key to encrypt related data to the data originally encrypted with the symmetric key. While it is possible for the symmetric key object to be active in the database, it is conceivable that the ***KeyUsePolicy*** used by the key has changed and the application technically needs to use a new symmetric key to encrypt new data.

[b15] is the start of the ***Permissions*** element. This element provides a sophisticated mechanism for controlling how, where, when and by which applications symmetric keys be used. While there are many sub-elements within a ***Permissions*** element, not all ***KeyUsePolicy*** objects might use all ***Permissions*** sub-elements. The example shown in this section only uses three of the possible ***Permissions*** sub-elements.

[b16] is the start of the ***PermittedApplications*** element. This element allows SKMS policies to be defined that allow only specific applications to use symmetric encryption keys associated with this policy. The **ekmi:any="true"** attribute of the ***PermittedApplications*** element indicates that not just any application on the client machine is permitted to use this symmetric key; only the specified applications within the sub-elements of this element are permitted to use the symmetric key in question..

[b17] is the start of the first ***PermittedApplication*** element. This element identifies a specific application within a list of ***PermittedApplications*** that is allowed to use the symmetric key. There can be any number of ***PermittedApplication*** elements with ***PermittedApplications***.

[b18] identifies the unique ***ApplicationID*** (as identified within the SKMS) of the ***PermittedApplication***.

[b19] is the start of the ***ApplicationName*** element.

[b20] identifies the ***ApplicationName*** of the ***PermittedApplication*** (as identified within the SKMS).

[b21] is the closing tag of the ***ApplicationName*** element.

[b22] identifies the specific ***ApplicationVersion*** of the ***PermittedApplication***. This is helpful when there are multiple versions of a specific application, and the policy-makers need to distinguish between the symmetric keys in use by a specific version of the application.

[b23] is the start of the ***ApplicationDigestAlgorithm*** element. This element permits enterprises to ensure that only a cryptographically-verified application is authorized to use the symmetric encryption key. This assumes that the implementation has an infrastructure where the SKCL is capable of determining a cryptographic value to uniquely identify an application within the run-time environment.

[b24] identifies the W3C-specified URL of the cryptographic algorithm used to calculate the message digest of the application's image.

[b25] is the closing tag of the ***ApplicationDigestAlgorithm*** element.

[b26] is the start of the ***ApplicationDigestValue*** element. This element permits enterprises to ensure that only a cryptographically-verified application is authorized to use the symmetric encryption key. This assumes that the implementation has an infrastructure where the SKCL is capable of determining a cryptographic value to uniquely identify an application within the run-time environment.

[b27] identifies the Base64-encoded message digest of the ***PermittedApplication's*** image, based on the algorithm specified in the ***ApplicationDigestAlgorithm*** element.

[b28] is the closing tag of the ***ApplicationDigestValue*** element.

[b29] is the closing tag of the ***PermittedApplication*** element.

[b30] is the closing tag of the ***PermittedApplications*** element.

[b31] is the start of the ***PermittedDates*** element. This element permits enterprises to ensure that the symmetric encryption key can be used only during a specified date period. This assumes that the implementation has an infrastructure where the SKCL is capable of accurately determining the current date within the run-time environment.

[b32] is the start of the first ***PermittedDate*** element. There can be any number of ***PermittedDate*** elements within a ***PermittedDates*** element.

[b33] identifies the ***StartDate*** of the duration period during which the symmetric encryption key can be used by authorized applications.

[b34] identifies the ***EndDate*** of the duration period during which the symmetric encryption key can be used by authorized applications.

[b35] is the closing tag of the ***PermittedDate*** element.

[b36] is the closing tag of the ***PermittedDates*** element.

[b37] is an empty (null) ***PermittedDays*** element. This element permits enterprises to ensure that the symmetric encryption key can be used only on specific days of the week. This assumes that the implementation has an infrastructure where the SKCL is capable of accurately determining the current day-of-week within the run-time environment. In this specific instance, the null element indicates that this permission does not apply to this symmetric key, and therefore, there are no constraints on its use. However, the key is still subject to all non-null permission clauses.

[b38] is an empty (null) ***PermittedDuration*** element. This element permits enterprises to ensure that the symmetric encryption key can be used only for a specific duration of time once the symmetric key has been used for the first time on the client. This assumes that the implementation has an infrastructure where the SKCL is capable of accurately determining the current time within the run-time environment. In this specific instance, the null element indicates that this permission does not apply to this symmetric key, and therefore, there are no constraints on its use. However, the key is still subject to all non-null permission clauses.

[b39] is an empty (null) ***PermittedLevels*** element. This element permits enterprises to ensure that the symmetric encryption key can be used only by applications that are classified at a given level within the Multi-Level Security (MLS) system as defined in the Bell-LaPadula model. In this specific instance, the null element indicates that this permission does not apply to this symmetric key, and therefore, there are no constraints on its use. However, the key is still subject to all non-null permission clauses.

[b40] is an empty (null) ***PermittedLocations*** element. This element permits enterprises to ensure that the symmetric encryption key can be used only by applications at specified geographic locations on the planet. This assumes that the implementation has an infrastructure where the SKCL is capable of accurately determining the current GPS location of the client within the run-time environment. In this specific instance, the null element indicates that this permission does not apply to this symmetric key, and therefore, there are no constraints on its use. However, the key is still subject to all non-null permission clauses.

[b41] is an empty (null) ***PermittedNumberOfTransactions*** element. This element permits enterprises to ensure that the symmetric encryption key can be used by applications only for a specified number of encryption transactions. In this specific instance, the null element indicates that this permission does not apply to this symmetric key, and therefore, there are no constraints on its use. However, the key is still subject to all non-null permission clauses.

[b42] is the start of the ***PermittedTimes*** element. This element permits enterprises to ensure that the symmetric encryption key can be used only during a specified time period within any date. This assumes that the implementation has an infrastructure where the SKCL is capable of accurately determining the current time within the run-time environment.

[b43] is the start of the first ***PermittedTime*** element. There can be any number of ***PermittedTime*** elements within a ***PermittedTimes*** element.

[b44] identifies the ***StartTime*** of the duration period during which the symmetric encryption key can be used by authorized applications.

[b45] identifies the ***EndTime*** of the duration period during which the symmetric encryption key can be used by authorized applications.

[b46] is the closing tag of the ***PermittedTime*** element.

[b47] is the closing tag of the ***PermittedTimes*** element.

[b48] is an empty (null) ***PermittedUses*** element. This element permits enterprises to ensure that the symmetric encryption key can be used by applications for specific uses. In this specific instance, the null element indicates that this permission does not apply to this symmetric key, and therefore, there are no constraints on its use. However, the key is still subject to all non-null permission clauses.

[b49] is the closing tag of the ***Permissions*** element.

[b50] is the closing tag of the ***KeyUsePolicy*** element.

[b51]-[b52] identifies the encryption algorithm used in the ***EncryptionMethod*** element to encrypt the symmetric encryption key itself, to transport to the requesting client. The symmetric key is encrypted using the PublicKey or the requesting client. The ***Algorithm*** attribute uses the W3C-specified URLs for identifying the encryption and padding algorithms.

[b53] is the start of the ***CipherData*** element. This element is from the W3C XML Encryption namespace (as identified by the “xenc” qualifier in the element name).

[b54] is the start of the ***CipherValue*** element. This element contains the Base64-encoded ciphertext of the symmetric encryption key.

[b55] – [b57] is the Base64-encoded ciphertext of the symmetric encryption key.

[b58] is the closing tag of the ***CipherValue*** element.

[b59] is the closing tag of the ***CipherData*** element.

[b60] is the closing tag of the ***Symkey*** element.

[b61] is the closing tag of the ***SymkeyResponse*** element.

3.3 Request for an existing symmetric key

Typically, when a client application encrypts data, it must make accommodations to store the ***GlobalKeyID*** of the symmetric encryption key it uses to encrypt the plaintext, along with the ciphertext. Without the ***GlobalKeyID***, neither the client application nor the SKS server can determine which key was used to encrypt specific ciphertext. When the client application needs to decrypt such ciphertext, it must request the symmetric key with the appropriate ***GlobalKeyID*** from the SKS server if it does not already have the key cached within its key-cache.

The client application (linked to the call SKCL) will an API method within the SKCL for the appropriate symmetric key. After the SKCL has ensured that the application is authorized to make such a request, and assuming that the client application needs the key with the ***GlobalKeyID*** value of 10514-1-235, the SKCL assembles the following SKSML request. (The SOAP message is secured using WSS, but only the actual SKSML content is displayed and discussed here).

```
[c01]  <ekmi:SymkeyRequest
[c02]     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
[c03]     <ekmi:GlobalKeyID>10514-1-235</ekmi:GlobalKeyID>
[c04]  </ekmi:SymkeyRequest>
```

[c01] is the start of the ***SymkeyRequest*** element.

[c02] identifies the namespace to which this XML conforms, and the location of its XML Schema Definition (XSD).

[c03] identifies the ***GlobalKeyID*** (GKID) of the specific symmetric encryption key being requested by the client application.

[c04] is the closing tag of the ***SymkeyRequest*** element.

Note that the request for an existing symmetric key is no different from a request for a new symmetric key other than that the ***GlobalKeyID*** being requested has non-zero values for the Server ID and Key ID parts of the ***GlobalKeyID***.

3.4 Response with an existing symmetric key

After an SKS server has performed its operations of authenticating the request, identifying the requester and determining whether the requester is authorized to receive the symmetric key, the SKS server sends back the symmetric key using a ***SymkeyResponse*** message secured within a WSS envelope. This ***SymkeyResponse*** is identical to the message described in Section 3.2 (since the ***SymkeyRequest*** was for the same symmetric key identified there) and is therefore, not repeated here for brevity.

3.5 Request for a new symmetric key of a specific *KeyClass*

There are business situations where an application might need a symmetric key that conforms to a ***KeyUsePolicy*** that has a specific ***KeyClass*** attribute within the policy. This is useful in situations where there may be many encryption policies within a company that apply to different type of data, geographical zones, applications, level of access to sensitive data, etc., and the requesting application needs a symmetric key which satisfies its business rules.

In those situations, a client application (that has been linked to the SKCL) will call an API method within the SKCL for a new symmetric key of a specific ***KeyClass***. After the SKCL has ensured that the application is authorized to make such a request the SKCL assembles the following SKSML request:

```
[e01]  <ekmi:SymkeyRequest
[e02]     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
[e03]     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
[e04]     <ekmi:KeyClasses>
```

```
[e05]         <ekmi:KeyClass>HR-Class</ekmi:KeyClass>
[e06]     </ekmi:KeyClasses>
[e07]  </ekmi:SymkeyRequest>
```

[e01] is the start of the ***SymkeyRequest*** element.

[e02] identifies the namespace to which this XML conforms, and the location of its XML Schema Definition (XSD).

[e03] identifies the ***GlobalKeyID*** (GKID) being requested by the client application. The "zero" value for the Server ID and the Key ID indicates a request for a new symmetric key.

[e04] is the start of the ***KeyClasses*** element.

[e05] identifies the specific ***KeyClass*** being requested by the client application.

[e06] is the closing tag of the ***KeyClasses*** element.

[e07] is the closing tag of the ***SymkeyRequest*** element.

3.6 Response with a new symmetric key of a specific *KeyClass*

After an SKS server has performed its operations of authenticating the request, identifying the requester and determining whether the requester is authorized to receive a symmetric key of the requested ***KeyClass***, the SKS server generates, escrows, encrypts and sends back the symmetric key using a *SymkeyResponse* message secured within a WSS envelope. This *SymkeyResponse* is identical to the message described in Section 3.2 (since the symmetric key identified there is of the ***KeyClass*** requested here) and is therefore, not repeated here for brevity.

3.7 Request for multiple new symmetric keys

There are business situations where an application needs many symmetric keys to encrypt different parts of a single record. This is useful in applications where many entities might have access to the same "master" record, but only some entities have access to sensitive data within "detail" records. In these situations, the use of multiple symmetric keys addresses this business requirement, while allowing the entire record to freely move to any system without fear of loss of confidentiality.

For example, within an Electronic Health Record (EHR) application, the application might store a Patient's medical data as a single logical EHR within a database (even though they may be physically represented by many hundreds of detail records). This has the benefit of presenting a single view of a Patient's EHR to all actors within the use-case. However, the information necessary to a Physician treating the patient is quite different from the information necessary to an insurance company processing a claim, a government agency tracks diseases, a pharmacy filling out a prescription or a nurse administering treatment to the patient.

While there is a clear business advantage to maintaining all patient data as a single logical EHR, security and privacy requirements dictate that appropriate sensitive data must be made visible only to authorized entities.

In these situations, a client application (that has been linked to the SKCL) will call an API method within the SKCL for multiple new symmetric keys. In order to request multiple symmetric keys, the SKSML request must contain a ***KeyClass*** element within the ***KeyClasses*** element for every key the client application needs. Thus, if the EHR application were to request nine symmetric keys to encrypt different parts of the EHR, the client application would make the following SKSML ***SymkeyRequest***:

```
[g01]  <ekmi:SymkeyRequest
[g02]     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
[g03]     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
[g04]     <ekmi:KeyClasses>
[g05]        <ekmi:KeyClass>EHR-CDC</ekmi:KeyClass>
[g06]        <ekmi:KeyClass>EHR-CRO</ekmi:KeyClass>
[g07]        <ekmi:KeyClass>EHR-DEF</ekmi:KeyClass>
[g08]        <ekmi:KeyClass>EHR-EMT</ekmi:KeyClass>
[g09]        <ekmi:KeyClass>EHR-HOS</ekmi:KeyClass>
[g10]        <ekmi:KeyClass>EHR-INS</ekmi:KeyClass>
[g11]        <ekmi:KeyClass>EHR-NUR</ekmi:KeyClass>
[g12]        <ekmi:KeyClass>EHR-PAT</ekmi:KeyClass>
[g13]        <ekmi:KeyClass>EHR-PHY</ekmi:KeyClass>
[g14]     </ekmi:KeyClasses>
[g15]  </ekmi:SymkeyRequest>
```

[g01] is the start of the ***SymkeyRequest*** element.

[g02] identifies the namespace to which this XML conforms, and the location of its XML Schema Definition (XSD).

[g03] identifies the ***GlobalKeyID*** (GKID) being requested by the client application. The "zero" value for the Server ID and the Key ID indicates a request for a new symmetric key.

[g04] is the start of the ***KeyClasses*** element.

[g05] identifies a ***KeyClass*** for a symmetric encryption key being requested by the client application, ostensibly for encrypting data that can later be decrypted by an authorized application at the Center for Disease Control (CDC) and any other application that has been granted access to keys of the EHR-CDC ***KeyClass***.

[g06] identifies a ***KeyClass*** for a symmetric encryption key being requested by the client application, for encrypting data that can later be decrypted only by an authorized application at Clinical Research Organizations (CRO) and any other application that has been granted access to keys of the EHR-CRO ***KeyClass***.

[g07] identifies a default ***KeyClass*** (EHR-DEF) for a symmetric encryption key for encrypting data that can later be decrypted by any authorized application within the EHR system.

[g08] identifies a ***KeyClass*** for a symmetric encryption key for encrypting data that was collected by an Emergency Medical Technician (EMT), and which can later be decrypted only by authorized applications at the hospital that have access to keys of the EHR-EMT ***KeyClass***.

[g09] identifies a ***KeyClass*** for a symmetric encryption key for encrypting data collected by a hospital where the patient might have used for treatment. Data encrypted by keys of this EHR-HOS ***KeyClass*** can later be decrypted only by authorized application that has access to keys of this ***KeyClass***.

[g10] identifies a ***KeyClass*** (EHR-INS) for a symmetric encryption key that might be used for encrypting data which will be submitted to an insurance company for claims processing.

[g11] identifies a ***KeyClass*** for a symmetric encryption key for encrypting data that can later be decrypted by any authorized application used by nurses and/or other authorized entities in providing treatment to a patient at the hospital (EHR-NUR).

[g12] identifies a ***KeyClass*** for a symmetric encryption key for encrypting patient related data (EHR-PAT) that may not be medical in nature, but nevertheless sensitive.

[g13] identifies a ***KeyClass*** for a symmetric encryption key for encrypting data that can later be decrypted by authorized physicians and other entities that have access to keys of the EHR-PHY ***KeyClass***.

[g14] is the closing tag of the ***KeyClasses*** element.

[g15] is the closing tag of the ***SymkeyRequest*** element.

3.8 Response with multiple new symmetric keys

After an SKS server has performed its operations of authenticating the request, identifying the requester, determining policies that apply to the requester, generating the symmetric encryption keys in conformance to the defined policies and ***KeyClasses*** and finally escrowing the symmetric keys securely, it assembles the following response and returns it to the client.

To reduce the verbosity of the response that includes nine symmetric encryption keys, the SKSML shows only the details of two symmetric keys and the encapsulating element tags for the remaining seven keys. Regardless of what the KeyUsePolicy and/or Permissions elements state in those seven keys, the schema for each response conforms to the specification described in this document. Additionally, the SOAP message, as indicated earlier, is secured using WSS, but only the actual SKSML content is displayed and discussed here.

```
[h01]  <ekmi:SymkeyResponse
[h02]         xmlns:ekmi='http://docs.oasis-open.org/ekmi/2008/01'
[h03]          xmlns:xenc='http://www.w3.org/2001/04/xmlenc#'>
[h04]      <ekmi:Symkey>
[h05]         <ekmi:GlobalKeyID>10514-4-3792</ekmi:GlobalKeyID>
[h06]         <ekmi:KeyUsePolicy>
[h07]            <ekmi:KeyUsePolicyID>10514-9</ekmi:KeyUsePolicyID>
[h08]            <ekmi:PolicyName>DES-EDE KeyUsePolicy for EHR-CDC</ekmi:PolicyName>
[h09]            <ekmi:KeyClass>EHR-CDC</ekmi:KeyClass>
[h10]            <ekmi:KeyAlgorithm>
[h11]               http://www.w3.org/2001/04/xmlenc#tripledes-cbc
[h12]            </ekmi:KeyAlgorithm>
[h13]            <ekmi:KeySize>192</ekmi:KeySize>
[h14]            <ekmi:Status>Active</ekmi:Status>
[h15]            <ekmi:Permissions>
[h16]               <ekmi:PermittedApplications ekmi:any="true" xsi:nil="true"/>
[h17]               <ekmi:PermittedDates ekmi:any="true" xsi:nil="true"/>
[h18]               <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
[h19]               <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
[h20]               <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
[h21]               <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
[h22]               <ekmi:PermittedNumberOfTransactions
[h23]                        ekmi:any="true" xsi:nil="true"/>
[h24]               <ekmi:PermittedTimes ekmi:any="true" xsi:nil="true"/>
[h25]               <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
[h26]            </ekmi:Permissions>
[h27]       </ekmi:KeyUsePolicy>
[h28]       <ekmi:EncryptionMethod
[h29]              Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-1_5"/>
[h30]       <xenc:CipherData>
[h31]           <xenc:CipherValue>
[h32]           E9zWB/y93hVSzeTLiDcQoDxmlNxTuxSffMNwCJmt1dIqzQHBnpdQ81g6DKdkCFjJMa1w
[h33]           hQhywCx9sfYjv9h5FDqUiQXGOca8EU871zBoXBjDxjfg1pU8tlWtx27STRcR/2fw2ava
[h34]           UlWtx27STRcRJMtaGHtXuLlWtx27STRcRpIsY=
[h35]           </xenc:CipherValue>
[h36]        </xenc:CipherData>
[h37]     </ekmi:Symkey>
[h38]     <ekmi:Symkey>
[h39]        <ekmi:GlobalKeyID>10514-4-3793</ekmi:GlobalKeyID>
[h40]        <ekmi:KeyUsePolicy>
[h41]           <ekmi:KeyUsePolicyID>10514-12</ekmi:KeyUsePolicyID>
[h42]           <ekmi:PolicyName>DES-EDE KeyUsePolicy for EHR-CRO</ekmi:PolicyName>
[h43]               <ekmi:KeyClass>EHR-CRO</ekmi:KeyClass>
```

```
[h44]                <ekmi:KeyAlgorithm>
[h45]                   http://www.w3.org/2001/04/xmlenc#tripledes-cbc
[h46]                </ekmi:KeyAlgorithm>
[h47]             <ekmi:KeySize>192</ekmi:KeySize>
[h48]             <ekmi:Status>Active</ekmi:Status>
[h49]             <ekmi:Permissions>
[h50]                <ekmi:PermittedApplications ekmi:any="true" xsi:nil="true"/>
[h51]                <ekmi:PermittedDates ekmi:any="true" xsi:nil="true"/>
[h52]                    <ekmi:PermittedDate>
[h53]                        <ekmi:StartDate>2008-01-01</ekmi:StartDate>
[h54]                        <ekmi:EndDate>2009-12-31</ekmi:EndDate>
[h55]                    </ekmi:PermittedDate>
[h56]                </ekmi:PermittedDates>
[h57]                <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
[h58]                <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
[h59]                <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
[h60]                <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
[h61]                <ekmi:PermittedNumberOfTransactions
[h62]                          ekmi:any="true" xsi:nil="true"/>
[h63]                <ekmi:PermittedTimes ekmi:any="true" xsi:nil="true"/>
[h64]                <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
[h65]             </ekmi:Permissions>
[h66]          </ekmi:KeyUsePolicy>
[h67]          <ekmi:EncryptionMethod
[h68]                  Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-1_5"/>
[h69]          <xenc:CipherData>
[h70]              <xenc:CipherValue>
[h71]              qUiQXGOca8EU871zBoXBjDoDxmlNxTuxSffMNwCJmt1dIqzQHBnpdQ81g6DKdkCFjJM1
[h72]              hQhywCx9sfYjv9h5FDqUiQXGOca8EU871zBoXBjDxjfg1pU8tGFbpWZcd/ATpJD/2fw1
[h73]              UJow/qimxi8+ huUYJMtaGHtXuLlWtx27STRcRpIsY=
[h74]              </xenc:CipherValue>
[h75]           </xenc:CipherData>
[h76]       </ekmi:Symkey>
[h77]       <ekmi:Symkey>
[h78]          <ekmi:GlobalKeyID>10514-4-3795</ekmi:GlobalKeyID>
                   ...
[h79]                <ekmi:KeyClass>EHR-DEF</ekmi:KeyClass>
                   ...
[h80]       </ekmi:Symkey>
[h81]       <ekmi:Symkey>
[h82]          <ekmi:GlobalKeyID>10514-4-3797</ekmi:GlobalKeyID>
                   ...
[h83]                <ekmi:KeyClass>EHR-EMT</ekmi:KeyClass>
                   ...
[h84]       </ekmi:Symkey>
[h85]       <ekmi:Symkey>
[h86]          <ekmi:GlobalKeyID>10514-4-3798</ekmi:GlobalKeyID>
                   ...
[h87]                <ekmi:KeyClass>EHR-HOS</ekmi:KeyClass>
                   ...
[h88]       </ekmi:Symkey>
[h89]       <ekmi:Symkey>
[h90]          <ekmi:GlobalKeyID>10514-4-3799</ekmi:GlobalKeyID>
                   ...
[h91]                <ekmi:KeyClass>EHR-INS</ekmi:KeyClass>
                   ...
[h92]       </ekmi:Symkey>
[h93]       <ekmi:Symkey>
[h94]          <ekmi:GlobalKeyID>10514-4-3801</ekmi:GlobalKeyID>
                   ...
```

```
[h95]                <ekmi:KeyClass>EHR-NUR</ekmi:KeyClass>
                  ...
[h96]          </ekmi:Symkey>
[h97]          <ekmi:Symkey>
[h98]            <ekmi:GlobalKeyID>10514-4-3803</ekmi:GlobalKeyID>
                    ...
[h99]                <ekmi:KeyClass>EHR-PAT</ekmi:KeyClass>
                  ...
[h100]         </ekmi:Symkey>
[h101]         <ekmi:Symkey>
[h102]           <ekmi:GlobalKeyID>10514-4-3805</ekmi:GlobalKeyID>
                 ...
[h103]               <ekmi:KeyClass>EHR-PHY</ekmi:KeyClass>
                  ...
[h104]         </ekmi:Symkey>
[h105]     </ekmi:SymkeyResponse>
```

[h01] is the start of the ***SymkeyResponse*** element.

[h02] and **[h03]** identify the namespaces to which this XML conforms, and the location of their XML Schema Definitions (XSD).

[h04] is the start tag of the first ***Symkey*** element which contains the symmetric encryption key and related elements.

[h05] identifies the ***GlobalKeyID*** (GKID) assigned by the SKS server of this first symmetric key. In this example, the concatenated values of the Domain ID, Server ID and Key ID indicate that the key belongs to the organization represented by the PEN, 10514; it was generated on an SKS server with a Server ID of 4 and is the 3792nd unique key generated on that SKS server.

[h06] is the start of the ***KeyUsePolicy*** element that applies just to this symmetric key. This element contains details of the policy to which SKCL implementations must conform when using the symmetric key.

[h07] identifies the unique ***KeyUsePolicyID*** *(KUPID)* which identifies this policy within the SKMS.

[h08] provides a descriptive name for this key-use policy, which is helpful to human readers when identifying this policy.

[h09] identifies the ***KeyClass*** to which this symmetric key belongs. In the case of this example, the first symmetric key in the response conforms to the **EHR-CDC** class which, presumably, might be a key that covers data encrypted for/by the Center for Disease Control (CDC) within an Electronic Health Record (EHR) system. Key-classes are useful to applications that wish to encrypt plaintext with a key that has specific characteristics. The requesting application is expected to know what ***KeyClass*** it needs before it asks for a key corresponding to that class.

[h10] is the start tag of the ***KeyAlgorithm*** element.

[h11] identifies the cryptographic algorithm that this symmetric key must be used with. For this symmetric key example, the algorithm is the Triple Data Encryption Standard (3DES) with Cipher Block Chaining (CBC) padding. The URL is a standard notation for this algorithm and padding as defined within **[XMLEncryption]**..

[h12] is the closing tag of the ***KeyAlgorithm*** element.

[h13] specifies the size of the symmetric encryption key in bits. For this Triple-DES key, it is 192-bits.

[h14] indicates the **Status** of this ***KeyUsePolicy*** and whether it is an active policy or not. This is useful in situations where an application may wish to re-use a symmetric key to encrypt related data to the data originally encrypted with the symmetric key. While it is possible for the symmetric key object to be active

in the database, it is conceivable that the ***KeyUsePolicy*** used by the key has changed and the application technically needs to use a new symmetric key to encrypt new data.

[h15] is the start of the ***Permissions*** element. This element provides a sophisticated mechanism for controlling how, where, when and by which applications symmetric keys be used. While there are many sub-elements within a ***Permissions*** element, not all ***KeyUsePolicy*** objects might use all ***Permissions*** sub-elements<ekmi:RequestedKeyClass>Payroll-Tax-Class</ekmi:RequestedKeyClass>. The example shown for this symmetric key indicates that there are no other specific restrictions on the use of this symmetric key by authorized client applications; i.e. any authorized client application may use it at any time, on any date, in any location for any purpose.

[h16] is the start and end of the null ***PermittedApplications*** element. This implies that there are no restrictions on which application can use this symmetric key.

[h17] is the start and end of the null ***PermittedDates*** element. This implies that there are no date restrictions on when this symmetric key can be used.

[h18] is the start and end of the null ***PermittedDays*** element. This implies that there are no day-of-week restrictions on when this symmetric key can be used.

[h19] is the start and end of the null ***PermittedDuration*** element. This implies that there are no restrictions to how long this symmetric key may be used.

[h20] is the start and end of the null ***PermittedLevels*** element. This implies that there are no restrictions on the MLS security level in which this symmetric key can be used.

[h21] is the start and end of the null ***PermittedLocations*** element. This implies that there are no geophysical restrictions where this symmetric key can be used.

[h22] - [h23] is the start and end of the null ***PermittedNumberOfTransactions*** element. This implies that there are no restrictions on how many encryption transactions that can be performed by this symmetric key.

[h24] is the start and end of the null ***PermittedTimes*** element. This implies that there are no time-of-day restrictions when this symmetric key can be used.

[h25] is the start and end of the null *PermittedUses* element. This implies that there are no restrictions how this symmetric key can be used by applications.

[h26] is the closing tag of the ***Permissions*** element.

[h27] is the closing tag of the ***KeyUsePolicy*** element.

[h28] and **[h29]** identify the encryption algorithm used in the ***EncryptionMethod*** element to encrypt the symmetric encryption key itself, to transport to the requesting client. The symmetric key is encrypted using the PublicKey or the requesting client. The ***Algorithm*** attribute uses the W3C-specified URLs for identifying the encryption and padding algorithms.

[h30] is the start of the ***CipherData*** element. This element is from the W3C XML Encryption namespace (as identified by the “xenc” qualifier in the element name).

[h31] is the start of the ***CipherValue*** element. This element contains the Base64-encoded ciphertext of the symmetric encryption key.

[h32] – [h34] is the Base64-encoded ciphertext of the symmetric encryption key.

[h35] is the closing tag of the ***CipherValue*** element.

[h36] is the closing tag of the ***CipherData*** element.

[h37] is the closing tag of the first ***Symkey*** element within this ***SymkeyResponse***.

[h38] - **[h76]** represents the **second** ***Symkey*** element in this ***SymkeyResponse***. The differences in this symmetric key element from the first, can be summarized as follows:

- **[h39]** identifies a different ***GlobalKeyID*** (10514-4-3793) for this symmetric key;
- **[h41]** identifies a different ***KeyUsePolicy*** (10514-12) for this symmetric key;
- **[h43]** identifies a different ***KeyClass*** (EHR-CRO) for this symmetric key;
- **[h49] - [h65]** defines a different ***Permissions*** element for this symmetric key;
- **[h71] - [h73]** contains a different ***CipherValue*** for this symmetric key;

[h78] – [**h80]** is the container for the **third** ***Symkey*** element in this response. For the sake of brevity, all the usual ***Symkey*** elements have been dispensed with, but the unique ***GlobalKeyID*** and ***KeyClass*** are shown to indicate the SKS server's response to the request. In this example, they are 10514-4-3795 and EHR-DEF respectively.

[h81] – [h104] contain the remaining ***Symkey*** elements of this ***SymkeyResponse***. Once again, for brevity, all the details of the *Symkey* elements are dispensed with, except for the unique GKIDs and KeyClasses.

[h105] is the closing tag of the ***SymkeyResponse*** element.

Note that it is possible for a request to contain the same ***KeyClass*** multiple times; there is no requirement that they need to be unique within a request if an application has a legitimate business need for multiple symmetric keys of the same ***KeyClass***. The SKS server will respond with unique symmetric keys, all belonging to the ***KeyClass*** requested by the client application.

3.9 Response with an SKS error

While one hopes that all authorized requesters will get favorable responses from the SKS server, there are situations in which the client application can receive an error to a request for a symmetric key. The following XML shows one example of such an error response. Depending on the type of error, the actual message content might be different.

```
[i01]    <ekmi:SymkeyResponse
[i02]           xmlns:ekmi='http://docs.oasis-open.org/ekmi/2008/01'
[i03]           xmlns:xenc='http://www.w3.org/2001/04/xmlenc#'>
[i04]        <ekmi:SymkeyError>
[i05]           <ekmi:RequestedGlobalKeyID>10514-2-22</ekmi:RequestedGlobalKeyID>
[i06]           <ekmi:RequestedKeyClass>Payroll</ekmi:RequestedKeyClass>
[i07]           <ekmi:ErrorCode>SKS-100004</ekmi:ErrorCode>
[i08]           <ekmi:ErrorMessage>Unauthorized request for key</ekmi:ErrorMessage>
[i09]        </ekmi:SymkeyError>
[i10]    </ekmi:SymkeyResponse>
```

[i01] is the start of the ***SymkeyResponse*** element.

[i02] and **[i03]** identify the namespaces to which this XML conforms, and the location of their XML Schema Definitions (XSD).

[i04] is the start of the ***SymkeyError*** element, which tells the Symmetric Key Client Library (SKCL) that the request for a symmetric key resulted in an error.

[i05] indicates the ***RequestedGlobalKeyID*** the client requested. Returning the GKID in the error response allows the SKCL to associate the error message with the requesting application on the client machine.

[i06] indicates the *RequestedKeyClass* the client requested. Returning the key-class in the error response allows the SKCL to associate the error message with the requesting application on the client machine.

[i07] is an ***ErrorCode*** returned by the SKS server. The code may be one of the standard error codes defined in this specification, or may be a vendor-specific error code.

[i08] is the text of the ***ErrorMessage***, localized to the region and language of the requesting client application.

[i09] is the closing tag of the ***SymkeyError*** tag.

[i10] is the closing tag of the ***SymkeyResponse*** tag.

3.10 Response with symmetric keys and errors

When a client application requests multiple symmetric keys, the SKS server may respond in one of three ways. The SKS server may:

i. Return all symmetric keys as requested;

ii. Return no symmetric keys – i.e. it returns all errors;

iii. Return some symmetric keys and some errors.

The following SKSML shows the third case, where the server returns some symmetric keys and errors in response to a request for multiple keys (such as the one shown in ***Section 3.7 Request for multiple new symmetric keys***).

In a response that contains a mix of symmetric keys and errors, all symmetric keys precede all errors – i.e. the ***SymkeyResponse*** element will not consist of ***Symkey***s interspersed with ***SymkeyError***s in between; all ***Symkey***s (if any) will start from the top of the response till the first ***SymkeyError*** element.

```
[j01]      <ekmi:SymkeyResponse
[j02]           xmlns:ekmi='http://docs.oasis-open.org/ekmi/2008/01'
[j03]           xmlns:xenc='http://www.w3.org/2001/04/xmlenc#'>
[j04]        <ekmi:Symkey>
[j05]              <ekmi:GlobalKeyID>10514-4-3792</ekmi:GlobalKeyID>
[j06]             <ekmi:KeyUsePolicy>
[j07]               <ekmi:KeyUsePolicyID>10514-9</ekmi:KeyUsePolicyID>
[j08]                  <ekmi:PolicyName>DES-EDE Policy for EHR-CDC</ekmi:PolicyName>
[j09]                  <ekmi:KeyClass>EHR-CDC</ekmi:KeyClass>
[j10]                  <ekmi:KeyAlgorithm>
[j11]                      http://www.w3.org/2001/04/xmlenc#tripledes-cbc
[j12]                  </ekmi:KeyAlgorithm>
[j13]               <ekmi:KeySize>192</ekmi:KeySize>
[j14]               <ekmi:Status>Active</ekmi:Status>
[j15]               <ekmi:Permissions>
[j16]                  <ekmi:PermittedApplications ekmi:any="true" xsi:nil="true"/>
[j17]                  <ekmi:PermittedDates ekmi:any="true" xsi:nil="true"/>
[j18]                  <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
[j19]                  <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
[j20]                  <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
[j21]                  <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
[j22]                  <ekmi:PermittedNumberOfTransactions
[j23]                            ekmi:any="true" xsi:nil="true"/>
[j24]                  <ekmi:PermittedTimes ekmi:any="true" xsi:nil="true"/>
[j25]                  <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
```

```
[j26]              </ekmi:Permissions>
[j27]            </ekmi:KeyUsePolicy>
[j28]            <ekmi:EncryptionMethod
[j29]                   Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-1_5"/>
[j30]            <xenc:CipherData>
[j31]                <xenc:CipherValue>
[j32]                E9zWB/y93hVSzeTLiDcQoDxmlNxTuxSffMNwCJmt1dIqzQHBnpdQ81g6DKdkCFjJ
[j33]                hQhywCx9sfYjv9h5FDqUiQXGOca8EU871zBoXBjDxjfg1pU8tlWtx27STRcR/2fw
[j34]                UlWtx27STRcRJMtaGHtXuLlWtx27STRcRpIsY=
[j35]                </xenc:CipherValue>
[j36]             </xenc:CipherData>
[j37]          </ekmi:Symkey>
[j38]          <ekmi:Symkey>
[j39]                <ekmi:GlobalKeyID>10514-4-3793</ekmi:GlobalKeyID>
[j40]              <ekmi:KeyUsePolicy>
[j41]                <ekmi:KeyUsePolicyID>10514-12</ekmi:KeyUsePolicyID>
[j42]                   <ekmi:PolicyName>DES-EDE Policy for EHR-CRO</ekmi:PolicyName>
[j43]                   <ekmi:KeyClass>EHR-CRO</ekmi:KeyClass>
[j44]                   <ekmi:KeyAlgorithm>
[j45]                       http://www.w3.org/2001/04/xmlenc#tripledes-cbc
[j46]                   </ekmi:KeyAlgorithm>
[j47]                <ekmi:KeySize>192</ekmi:KeySize>
[j48]                <ekmi:Status>Active</ekmi:Status>
[j49]                <ekmi:Permissions>
[j50]                   <ekmi:PermittedApplications ekmi:any="true" xsi:nil="true"/>
[j51]                   <ekmi:PermittedDates ekmi:any="true" xsi:nil="true"/>
[j52]                       <ekmi:PermittedDate>
[j53]                           <ekmi:StartDate>2008-01-01</ekmi:StartDate>
[j54]                           <ekmi:EndDate>2009-12-31</ekmi:EndDate>
[j55]                       </ekmi:PermittedDate>
[j56]                    </ekmi:PermittedDates>
[j57]                   <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
[j58]                   <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
[j59]                   <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
[j60]                   <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
[j61]                   <ekmi:PermittedNumberOfTransactions
[j62]                            ekmi:any="true" xsi:nil="true"/>
[j63]                   <ekmi:PermittedTimes ekmi:any="true" xsi:nil="true"/>
[j64]                   <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
[j65]                </ekmi:Permissions>
[j66]            </ekmi:KeyUsePolicy>
[j67]            <ekmi:EncryptionMethod
[j68]                   Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-1_5"/>
[j69]            <xenc:CipherData>
[j70]                <xenc:CipherValue>
[j71]                qUiQXGOca8EU871zBoXBjDoDxmlNxTuxSffMNwCJmt1dIqzQHBnpdQ81g6DKdkCF
[j72]                hQhywCx9sfYjv9h5FDqUiQXGOca8EU871zBoXBjDxjfg1pU8tGFbpWZcd/ATpJD/
[j73]                UJow/qimxi8+ huUYJMtaGHtXuLlWtx27STRcRpIsY=
[j74]                </xenc:CipherValue>
[j75]             </xenc:CipherData>
[j76]          </ekmi:Symkey>
[j77]          <ekmi:Symkey>
[j78]            <ekmi:GlobalKeyID>10514-4-3795</ekmi:GlobalKeyID>
                       ...
[j79]                    <ekmi:KeyClass>EHR-DEF</ekmi:KeyClass>
                       ...
[j80]          </ekmi:Symkey>
[j81]          <ekmi:Symkey>
[j82]            <ekmi:GlobalKeyID>10514-4-3797</ekmi:GlobalKeyID>
                       ...
```

```
[j83]                    <ekmi:KeyClass>EHR-EMT</ekmi:KeyClass>
                       ...
[j84]           </ekmi:Symkey>
[j85]           <ekmi:Symkey>
[j86]             <ekmi:GlobalKeyID>10514-4-3798</ekmi:GlobalKeyID>
                       ...
[j87]                    <ekmi:KeyClass>EHR-HOS</ekmi:KeyClass>
                       ...
[j88]           </ekmi:Symkey>
[j89]           <ekmi:Symkey>
[j90]             <ekmi:GlobalKeyID>10514-4-3799</ekmi:GlobalKeyID>
                       ...
[j91]                    <ekmi:KeyClass>EHR-INS</ekmi:KeyClass>
                       ...
[j92]           </ekmi:Symkey>
[j93]           <ekmi:Symkey>
[j94]             <ekmi:GlobalKeyID>10514-4-3801</ekmi:GlobalKeyID>
                       ...
[j95]                    <ekmi:KeyClass>EHR-NUR</ekmi:KeyClass>
                       ...
[j96]           </ekmi:Symkey>
[j97]           <ekmi:SymkeyError>
[j98]             <ekmi:RequestedGlobalKeyID>10514-0-0</ekmi:RequestedGlobalKeyID>
[j99]             <ekmi:RequestedKeyClass>EHR-PAT</ekmi:RequestedKeyClass>
[j100]            <ekmi:ErrorCode>SKS-100004</ekmi:ErrorCode>
[j101]            <ekmi:ErrorMessage>Unauthorized request for key</ekmi:ErrorMessage>
[j102]          </ekmi:SymkeyError>
[j103]          <ekmi:SymkeyError>
[j104]            <ekmi:RequestedGlobalKeyID>10514-0-0</ekmi:RequestedGlobalKeyID>
[j105]            <ekmi:RequestedKeyClass>EHR-PHY</ekmi:RequestedKeyClass>
[j106]            <ekmi:ErrorCode>SKS-100004</ekmi:ErrorCode>
[j107]            <ekmi:ErrorMessage>Unauthorized request for key</ekmi:ErrorMessage>
[j108]          </ekmi:SymkeyError>
[j109]    </ekmi:SymkeyResponse>
```

[j01] – [j96] is no different from the response shown in ***Section 3.8 Response with multiple new symmetric keys***.

[j97] - [j102] identifies the first ***SymkeyError*** returned by the SKS server. It is not unlike the error described in ***Section 3.9 Response with an SKS error***. However, there is one difference in this element on line [j79]. This element includes the ***RequestedKeyClass*** of the request.

[j103] - [j108] identifies the second ***SymkeyError*** returned by the SKS server. It is similar to the error described in lines [j77] through [j82] including the ***RequestedKeyClass*** of the request.

[j109] is the closing tag of the ***SymkeyResponse*** tag.

3.11 Request for a symmetric key-caching policy

When a client application (that has been linked to the SKCL) needs to encrypt sensitive data, it will call an API method within the SKCL for a new symmetric key. After the SKCL has ensured that the application is authorized to make such a request (by verifying that the configured/passed-in credentials can access the cryptographic key-store module on the client containing the PrivateKey used for signing SKSML requests), the SKCL assembles the following SKSML request:

```
[k01]  <ekmi:KeyCachePolicyRequest
[k02]     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01"/>
```

[k01] is the start of the ***KeyCachePolicyRequest*** element.

[k02] identifies the namespace to which this XML conforms, and the location of its XML Schema Definition (XSD).

The ***KeyCachePolicyRequest*** is an "empty" request. It does not need to specify any requesting parameter or element, since the SKS server only needs to know who requested the policy. The server derives this information from the SOAP Header and consequently has everything it needs to know – the digital signature to establish the identity of the requester, as well as to to ensure message integrity in the request.

While the ***KeyCachePolicyRequest*** element is very simple, the Web Service Security (WSS) envelope – which provides security for all SKSML messages – expands the size of the message. The same request shown above, is displayed below in its entirety, with its WSS envelope. Please note that some content – such as Base64-encoded binary content - has been reformatted for aesthetics and clarity of the XML elements. The actual elements and data-types have been preserved from actual SKSML messages.

For an interpretation of the XML elements shown below, please refer to **[WSS]**.

For the sake of brevity, this specification will dispense with showing the SOAP envelope and the WSS elements in all other examples, when discussing SKSML.

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
   <SOAP-ENV:Header>
      <wsse:Security xmlns:wsse="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-
1.0.xsd" SOAP-ENV:mustUnderstand="1">
      <wsse:BinarySecurityToken xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-
utility-1.0.xsd"
            EncodingType="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-soap-message-security-
1.0#Base64Binary"
            ValueType="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-x509-token-profile-1.0#X509v3"
wsu:Id="XWSSGID-1172790302111-1738806553">
            MIIDfDCCAmSgAwIBAgIIAe/AvliGc3AwDQYJKoZIhvcNAQELBQAwZzEmMCQGA1UEAxMdU3Ryb25nab
      S2V5IERFTU8gU3Vib3JkaW5hdGUgQ0ExJDAiBgNVBAsTG0ZvciBTdHJvbmdLZXkgREVNTyBVc2Ug1d
      T25seTEXMBUGA1UEChMOU3Ryb25nQXV0aCBJbmMwHhcNMDYwNzI1MTcxMDMwWhcNMDcwNzIa64dd3k
      A1UECxMbRm9yIFN0cm9uZ0tleSBERU1PIFVzZSBPbmx5MRcwFQYDVQQKEw5TdHJvbmdBdXRoIEl2da
      S2V5IERFTU8gU3Vib3JkaW5hdGUgQ0ExJDAiBgNVBAsTG0ZvciBTdHJvbmdLZXkgREVNTyBVc2Ugia
      T25seTEXMBUGA1UEChMOU3Ryb25nQXV0aCBJbmMwHhcNMDYwNzI1MTY0NjEwWhcNMDcwNzI1s34wdd
      NjEwWjBpMREwDwYKCZImiZPyLGQBARMBOTEVMBMGA1UEAxMMU0tTIFNlcnZlci0xMSQwIgYDVQsdw2
      ExtGb3IgU3Ryb25nS2V5IERFTU8gVXNlIE9ubHkxFzAVBgNVBAoTDlN0cm9uZ0F1dGggSW5jMIIBd2
            NBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAztppqRoU5A8plxx1Rz1QEUnlAAM1D5g9+isIr3wxa
      hbwjtFSMYilnY4iV77xU/nsMOnMZ7RxsLYKdCzQ1ODVYqQwqmAvaJ5Z6SVy34gZ51YG+rSWE3NjFsd
      bOXW8RJYA/Tn6Lmht/qngrcaqqmtP0cAAiMRZOWtCTmC2K/LEqDabXSyU6Hh8ySNE3njybvmWpresf
      zsYokTdvnWQqT6tKo1OwJsdJ1+hxM7DrnMLvMNq5reINfsKhDdX17wzhrBUx+hiYA/qo8tMXkL6wsd
         4PN5dYugtzpSzIdUO5tIg58Avhzwo7hy5oofBlKFY22CeljQ36u0bMjuyGj6UYHs3rdfdfsds32rda
      YzCBnzANBgkqhkiG9w0BAQEFAAOBjQAwgYkCgYEAyAmxMZhYA8wHJ4UE4b61s51JVWe4Fygj4MCf3a
      hvcNAQELBQADggEBACK05PtvZD4WPglOe=
            </wsse:BinarySecurityToken>
       <ds:Signature xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
                  <ds:SignedInfo>
                  <ds:CanonicalizationMethod
                              Algorithm="http://www.w3.org/2001/10/xml-exc-c14n#">
            <InclusiveNamespaces
                              xmlns="http://www.w3.org/2001/10/xml-exc-c14n#"
                              PrefixList="wsse SOAP-ENV"/>
            </ds:CanonicalizationMethod>
                        <ds:SignatureMethod
                              Algorithm="http://www.w3.org/2000/09/xmldsig#rsa-sha1"/>
                        <ds:Reference URI="#XWSSGID-1172790300636-653454040">
            <ds:DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
                              <ds:DigestValue>lU4m+rp4oebgl9g+t3nRaZYqUlE=</ds:DigestValue>
                        </ds:Reference>
            <ds:Reference URI="#XWSSGID-11727903006377088718O5">
            <ds:DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
```

```
                        <ds:DigestValue>WCpOmTCbffcEHXhGf5rlEYWLrZg=</ds:DigestValue>
                    </ds:Reference>
                </ds:SignedInfo>
                <ds:SignatureValue>
                svStAvBRRrF+g2biPl7uWHkJTQPIl8t4phMbOZQsZlQcn36tcMSj/a4+4LPNfOB3Y8yO2lr1Oa1
                fGqCPAWZNuEH34VQEM196rRwV258mgp8uwpXEYJlgPJqg89w8+/NdaODccLQ2Bizu7QM/HSM2ab
                ogNJwqmbSylazOsnOcU=
                </ds:SignatureValue>
        <ds:KeyInfo>
                <wsse:SecurityTokenReference xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-
wss-wssecurity-utility-1.0.xsd"
                    wsu:Id="XWSSGID-1172790300633-442423344">
                    <wsse:Reference URI="#XWSSGID-1172790302111-1738806553"
                            ValueType="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-x509-token-
profile-1.0#X509v3"/>
                    </wsse:SecurityTokenReference>
                </ds:KeyInfo>
            </ds:Signature>
        <wsu:Timestamp xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-utility-
1.0.xsd" wsu:Id="XWSSGID-1172790300637708871805">
                <wsu:Created>2007-03-01T23:05:00Z</wsu:Created>
                <wsu:Expires>2007-03-01T23:05:05Z</wsu:Expires>
            </wsu:Timestamp>
        </wsse:Security>
    </SOAP-ENV:Header>
    <SOAP-ENV:Body xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-utility-
1.0.xsd" wsu:Id="XWSSGID-1172790300636-653454040">
        <ekmi:KeyCachePolicyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01"/>
        </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

3.12 Response with a symmetric key-caching policy (1)

After an SKS server has performed its operations of authenticating a ***KeyCachePolicyRequest***, identifying the requester, determining policies that apply to the requester, it assembles the following response and returns it to the client. (The SOAP message, as indicated earlier, is secured using WSS, but only the actual SKSML content is displayed and discussed here).

```
[m01]  <ekmi:KeyCachePolicyResponse
[m02]         xmlns:ekmi='http://docs.oasis-open.org/ekmi/2008/01'
[m03]            xmlns:xenc='http://www.w3.org/2001/04/xmlenc#'>
[m04]         <ekmi:KeyCachePolicy>
[m05]            <ekmi:KeyCachePolicyID>10514-1</ekmi:KeyCachePolicyID>
[m06]            <ekmi:PolicyName>No Caching Policy</ekmi:PolicyName>
[m07]            <ekmi:Description>
[m08]               This policy is for high-risk, always-connected machines on the
[m09]               network, which will never cache symmetric keys locally.  This
[m10]               policy never expires (but checks monthly for any updates).
[m11]            </ekmi:Description>
[m12]            <ekmi:KeyClass>NoCachingClass</ekmi:KeyClass>
[m13]            <ekmi:StartDate>2008-01-01T00:00:01.0</ekmi:StartDate>
[m14]            <ekmi:EndDate>1969-01-01T00:00:00.0</ekmi:EndDate>
[m15]            <ekmi:PolicyCheckInterval>2592000</ekmi:PolicyCheckInterval>
[m16]            <ekmi:Status>Active</ekmi:Status>
[m17]         </ekmi:KeyCachePolicy>
[m18]  </ekmi:KeyCachePolicyResponse>
```

[m01] is the start of the ***KeyCachePolicyResponse*** element.

[m02] and **[m03]** identify the namespaces to which this XML conforms, and the location of their XML Schema Definitions (XSD).

[m04] is the start of the first – and only - ***KeyCachePolicy*** element.

[m05] identifies the ***KeyCachePolicyID*** (KCPID) assigned to this policy by the SKS server. In this example, the concatenated values of the Domain ID and Policy ID indicate that the key belongs to the organization represented by the PEN, 10514; and is the first key-caching policy within the SKMS.

[m06] provides a descriptive name for this key-cache policy through the ***PolicyName*** element, which is helpful to human readers when identifying this policy.

[m07] is the start tag of the ***Description*** element.

[m08] - [m10] provides a human-readable description about this key-cache policy.

[m11] is the closing tag of the ***Description*** element.

[m12] specifies the ***KeyClass*** to which this policy applies. Only keys that belong to this key-class are subject to this caching policy.

[m13] specifies the date and time that this ***KeyCachePolicy*** is effective. This is accomplished through a ***StartDate*** element. In this example, the policy is effective as of January 01, 2008.

[m14] specifies the date and time that this ***KeyCachePolicy*** becomes invalid. This is accomplished through a ***EndDate*** element. In this example, the use of the UNIX "epoch" date (January 01, 1969) indicates that this policy never expires.

[m15] specifies the frequency at which this client must check with the SKS server for updates to the key-caching policy. This is specified in seconds in the ***PolicyCheckInterval*** element; in this example it is a monthly interval.

[m16] indicates the **Status** of this ***KeyCachePolicy*** and whether it is an active policy or not.

[m17] is the closing tag of the ***KeyCachePolicy*** element.

[m18] is the closing tag of the ***KeyCachePolicyResponse*** element.

3.13 Response with a symmetric key-caching policy (2)

This is a second example of a key-caching policy response that has additional elements in the policy permitting caching and specify the number of unused and used (for encryption) symmetric keys that may be cached by the client machine.

```
[m01]  <ekmi:KeyCachePolicyResponse
[m02]            xmlns:ekmi='http://docs.oasis-open.org/ekmi/2008/01'
[m03]            xmlns:xenc='http://www.w3.org/2001/04/xmlenc#'>
[m04]     <ekmi:KeyCachePolicy>
[m05]        <ekmi:KeyCachePolicyID>10514-17</ekmi:KeyCachePolicyID>
[m06]        <ekmi:PolicyName>Corporate Laptop Key Caching Policy</ekmi:PolicyName>
[m07]        <ekmi:Description>
[m08]           This policy defines how company-issued laptops will manage symmetric
[m09]           keys used for file/disk encryption in their local cache.  This
[m10]           policy must be used by all laptops that use the company EKMI.
[m11]        </ekmi:Description>
[m12]        <ekmi:KeyClass>LaptopKeysCachingClass</ekmi:KeyClass>
[m13]        <ekmi:StartDate>2008-01-01T00:00:01.0</ekmi:StartDate>
[m14]        <ekmi:EndDate>2008-12-31T00:00:01.0</ekmi:EndDate>
[m15]        <ekmi:PolicyCheckInterval>2592000</ekmi:PolicyCheckInterval>
[m16]        <ekmi:Status>Active</ekmi:Status>
```

```
[m17]         <ekmi:NewKeysCacheDetail>
[m18]            <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
[m19]            <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
[m20]         </ekmi:NewKeysCacheDetail>
[m21]         <ekmi:UsedKeysCacheDetail>
[m22]            <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
[m23]            <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
[m24]         </ekmi:UsedKeysCacheDetail>
[m25]      </ekmi:KeyCachePolicy>
[m26]  </ekmi:KeyCachePolicyResponse>
```

[m01] is the start of the ***KeyCachePolicyResponse*** element.

[m02] and **[m03]** identify the namespaces to which this XML conforms, and the location of their XML Schema Definitions (XSD).

[m04] is the start of the first – and only - ***KeyCachePolicy*** element.

[m05] identifies the ***KeyCachePolicyID*** (KCPID) assigned by the SKS server for the key-caching policy being returned.

[m06] provides a descriptive name for this key-cache policy through the ***PolicyName*** element, which is helpful to human readers when identifying this policy.

[m07] is the start tag of the ***Description*** element.

[m08] - [m10] provides a human-readable description about this key-cache policy.

[m11] is the closing tag of the ***Description*** element.

[m12] specifies the ***KeyClass*** to which this policy applies. Only keys that belong to this key-class are subject to this caching policy.

[m13] specifies the date and time that this ***KeyCachePolicy*** is effective. This is accomplished through a ***StartDate*** element. In this example, the policy is effective as of January 01, 2008.

[m14] specifies the date and time that this ***KeyCachePolicy*** becomes invalid. This is accomplished through a ***EndDate*** element. In this example, the policy expires on December 31, 2008.

[m15] specifies the frequency at which this client must check with the SKS server for updates to the key-caching policy. This is specified in seconds in the ***PolicyCheckInterval*** element; in this example it is a monthly interval.

[m16] indicates the **Status** of this ***KeyCachePolicy*** and whether it is an active policy or not.

[m17] is the start of the ***NewKeysCacheDetail*** element, which provides details about how many new symmetric keys – that haven't been used for any encryption transactions – may be cached by the client and for how long.

[m18] indicates the maximum number of new (unused) symmetric keys that may be cached by the client. This is specified through the ***MaximumKeys*** element. When the client uses a symmetric key, this reduces the number of new symmetric keys. In this case, the SKCL connects to the SKS server (if it is on the network) and requests a new symmetric key to add to its new-key cache.

[m19] indicates the maximum duration that new (unused) symmetric keys may be cached by the client. This is specified through the ***MaximumDuration*** element in seconds. If there are any new keys that exceed this duration limit, the SKCL deletes the specific symmetric key and replaces it with a new symmetric key from the SKS server.

[m20] is the closing tag of the ***NewKeysCacheDetail*** element.

[m21] is the start of the ***UsedKeysCacheDetail*** element, which provides details about how many used symmetric keys – those that HAVE been used for any encryption transactions – may be cached by the client and for how long.

[m22] indicates the maximum number of used symmetric keys that may be cached by the client through the ***MaximumKeys*** element. If the client already has the maximum number of used-keys in its cache, using the First-In-First-Out (FIFO) method, it deletes the oldest symmetric key in the cache to replace with the key that transitioned from the "new" to "used" status.

[m23] indicates the maximum duration that used symmetric keys may be cached by the clien through the ***MaximumDuration*** element in seconds. If there are any used keys that exceed this duration limit, the SKCL deletes the specific symmetric key. While this may temporarily reduce the number of used symmetric keys in the cache, the SKCL takes the most conservative position when making this decision.

[m24] is the closing tag of the ***UsedKeysCacheDetail*** element.

[m25] is the closing tag of the ***KeyCachePolicy*** element.

[m26] is the closing tag of the ***KeyCachePolicyResponse*** element.

3.14 Response with multiple symmetric key-caching policies (3)

This is a third example of a key-caching policy response that has multiple key-cache policies that apply to different classes of symmetric keys.

```
[m01]  <ekmi:KeyCachePolicyResponse
[m02]           xmlns:ekmi='http://docs.oasis-open.org/ekmi/2008/01'
[m03]           xmlns:xenc='http://www.w3.org/2001/04/xmlenc#'>
[m04]     <ekmi:KeyCachePolicy>
[m05]           <ekmi:KeyCachePolicyID>10514-1</ekmi:KeyCachePolicyID>
[m06]           <ekmi:PolicyName>No Caching Policy</ekmi:PolicyName>
[m07]           <ekmi:Description>
[m08]              This policy is for high-risk, always-connected machines on the
[m09]              network, which will never cache symmetric keys locally.  This
[m10]              policy never expires (but checks monthly for any updates).
[m11]           </ekmi:Description>
[m12]           <ekmi:KeyClass>NoCachingClass</ekmi:KeyClass>
[m13]           <ekmi:StartDate>2008-01-01T00:00:01.0</ekmi:StartDate>
[m14]           <ekmi:EndDate>1969-01-01T00:00:00.0</ekmi:EndDate>
[m15]           <ekmi:PolicyCheckInterval>2592000</ekmi:PolicyCheckInterval>
[m16]           <ekmi:Status>Active</ekmi:Status>
[m17]     </ekmi:KeyCachePolicy>
[m18]     <ekmi:KeyCachePolicy>
[m19]        <ekmi:KeyCachePolicyID>10514-17</ekmi:KeyCachePolicyID>
[m20]        <ekmi:PolicyName>Corporate Laptop Key Caching Policy</ekmi:PolicyName>
[m21]        <ekmi:Description>
[m22]           This policy defines how company-issued laptops will manage symmetric
[m23]           keys used for file/disk encryption in their local cache.  This
[m24]           policy must be used by all laptops that use the company EKMI.
[m25]        </ekmi:Description>
[m26]        <ekmi:KeyClass>LaptopKeysCachingClass</ekmi:KeyClass>
[m27]        <ekmi:StartDate>2008-01-01T00:00:01.0</ekmi:StartDate>
[m28]        <ekmi:EndDate>2008-12-31T00:00:01.0</ekmi:EndDate>
[m29]        <ekmi:PolicyCheckInterval>2592000</ekmi:PolicyCheckInterval>
[m30]        <ekmi:Status>Active</ekmi:Status>
[m31]        <ekmi:NewKeysCacheDetail>
[m32]           <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
[m33]           <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
```

```
[m34]         </ekmi:NewKeysCacheDetail>
[m35]         <ekmi:UsedKeysCacheDetail>
[m36]            <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
[m37]            <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
[m38]         </ekmi:UsedKeysCacheDetail>
[m39]      </ekmi:KeyCachePolicy>
[m40]      <ekmi:KeyCachePolicy>
[m41]         <ekmi:KeyCachePolicyID>10514-17</ekmi:KeyCachePolicyID>
[m42]         <ekmi:PolicyName>Corporate Laptop Key Caching Policy</ekmi:PolicyName>
[m43]         <ekmi:Description>
[m44]            This policy defines how company-issued laptops will manage
[m45]           symmetric keys used for file/disk encryption in their local
[m46]           cache.  This policy must be used by all laptops.
[m47]         </ekmi:Description>
[m48]         <ekmi:KeyClass>LaptopKeysCachingClass</ekmi:KeyClass>
[m49]         <ekmi:StartDate>2008-01-01T00:00:01.0</ekmi:StartDate>
[m50]         <ekmi:EndDate>2008-12-31T00:00:01.0</ekmi:EndDate>
[m51]         <ekmi:PolicyCheckInterval>2592000</ekmi:PolicyCheckInterval>
[m52]         <ekmi:Status>Active</ekmi:Status>
[m53]         <ekmi:NewKeysCacheDetail>
[m54]            <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
[m55]            <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
[m56]         </ekmi:NewKeysCacheDetail>
[m57]         <ekmi:UsedKeysCacheDetail>
[m58]            <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
[m59]            <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
[m60]         </ekmi:UsedKeysCacheDetail>
[m61]      <ekmi:KeyCachePolicy>
[m62]  </ekmi:KeyCachePolicyResponse>
```

[m01] is the start of the ***KeyCachePolicyResponse*** element.

[m02] and **[m03]** identify the namespaces to which this XML conforms, and the location of their XML Schema Definitions (XSD).

[m04] is the start of the first of three ***KeyCachePolicy*** elements in this response.

[m05] identifies the ***KeyCachePolicyID*** (KCPID) assigned to this policy by the SKS server. In this example, the concatenated values of the Domain ID and Policy ID indicate that the key belongs to the organization represented by the PEN, 10514; and is the first key-caching policy within the SKMS.

[m06] provides a descriptive name for this key-cache policy through the ***PolicyName*** element, which is helpful to human readers when identifying this policy.

[m07] is the start tag of the ***Description*** element.

[m08] - [m10] provides a human-readable description about this key-cache policy.

[m11] is the closing tag of the ***Description*** element.

[m12] specifies the ***KeyClass*** to which this policy applies. Only keys that belong to this key-class are subject to this caching policy.

[m13] specifies the date and time that this ***KeyCachePolicy*** is effective. This is accomplished through a ***StartDate*** element. In this example, the policy is effective as of January 01, 2008.

[m14] specifies the date and time that this ***KeyCachePolicy*** becomes invalid. This is accomplished through a ***EndDate*** element. In this example, the use of the UNIX “epoch” date (January 01, 1969) indicates that this policy never expires.

[m15] specifies the frequency at which this client must check with the SKS server for updates to the key-caching policy. This is specified in seconds in the ***PolicyCheckInterval*** element; in this example it is a monthly interval.

[m16] indicates the **Status** of this ***KeyCachePolicy*** and whether it is an active policy or not.

[m17] is the closing tag of the first ***KeyCachePolicy*** element.

[m18] is the start of the second of three ***KeyCachePolicy*** elements in this response.

[m19] identifies the ***KeyCachePolicyID*** (KCPID) assigned by the SKS server for the key-caching policy being returned.

[m20] provides the descriptive name for this key-cache policy through the ***PolicyName*** element.

[m21] is the start tag of the ***Description*** element.

[m22] - [m24] provides a human-readable description about this key-cache policy.

[m25] is the closing tag of the ***Description*** element.

[m26] specifies the ***KeyClass*** to which this policy applies. Only keys that belong to this key-class are subject to this caching policy.

[m27] specifies the date and time that this ***KeyCachePolicy*** is effective. This is accomplished through a ***StartDate*** element. In this example, the policy is effective as of January 01, 2008.

[m28] specifies the date and time that this ***KeyCachePolicy*** becomes invalid. This is accomplished through a ***EndDate*** element. In this example, the policy expires on December 31, 2008.

[m29] specifies the frequency at which this client must check with the SKS server for updates to the key-caching policy. This is specified in seconds in the ***PolicyCheckInterval*** element; in this example it is a monthly interval.

[m30] indicates the **Status** of this ***KeyCachePolicy*** and whether it is an active policy or not.

[m31] is the start of the ***NewKeysCacheDetail*** element, which provides details about how many new symmetric keys – that haven't been used for any encryption transactions – may be cached by the client and for how long.

[m32] indicates the maximum number of new (unused) symmetric keys that may be cached by the client. This is specified through the ***MaximumKeys*** element. When the client uses a symmetric key, this reduces the number of new symmetric keys. In this case, the SKCL connects to the SKS server (if it is on the network) and requests a new symmetric key to add to its new-key cache.

[m33] indicates the maximum duration that new (unused) symmetric keys may be cached by the client. This is specified through the ***MaximumDuration*** element in seconds. If there are any new keys that exceed this duration limit, the SKCL deletes the specific symmetric key and replaces it with a new symmetric key from the SKS server.

[m34] is the closing tag of the ***NewKeysCacheDetail*** element.

[m35] is the start of the ***UsedKeysCacheDetail*** element, which provides details about how many used symmetric keys – those that HAVE been used for any encryption transactions – may be cached by the client and for how long.

[m36] indicates the maximum number of used symmetric keys that may be cached by the client through the ***MaximumKeys*** element. If the client already has the maximum number of used-keys in its cache, using the First-In-First-Out (FIFO) method, it deletes the oldest symmetric key in the cache to replace with the key that transitioned from the “new” to “used” status.

[m37] indicates the maximum duration that used symmetric keys may be cached by the clien through the ***MaximumDuration*** element in seconds. If there are any used keys that exceed this duration limit, the SKCL deletes the specific symmetric key. While this may temporarily reduce the number of used symmetric keys in the cache, the SKCL takes the most conservative position when making this decision.

[m38] is the closing tag of the ***UsedKeysCacheDetail*** element.

[m39] is the closing tag of the second ***KeyCachePolicy*** element.

[m40] is the start of the third ***KeyCachePolicy*** element in this response.

[m41] identifies the ***KeyCachePolicyID*** (KCPID) assigned by the SKS server for the key-caching policy being returned.

[m42] provides the descriptive name for this key-cache policy through the ***PolicyName*** element.

[m43] is the start tag of the ***Description*** element.

[m44] - [m46] provides a human-readable description about this key-cache policy.

[m47] is the closing tag of the ***Description*** element.

[m48] specifies the ***KeyClass*** to which this policy applies. Only keys that belong to this key-class are subject to this caching policy.

[m49] specifies the date and time that this ***KeyCachePolicy*** is effective.

[m50] specifies the date and time that this ***KeyCachePolicy*** becomes invalid.

[m51] specifies the frequency at which this client must check with the SKS server for updates to the key-caching policy.

[m52] indicates the **Status** of this ***KeyCachePolicy*** and whether it is an active policy or not.

[m53] is the start of the ***NewKeysCacheDetail*** element, which provides details about how many new symmetric keys may be cached by the client and for how long.

[m54] indicates the maximum number of new (unused) symmetric keys that may be cached by the client. This is specified through the ***MaximumKeys*** element. When the client uses a symmetric key, this reduces the number of new symmetric keys. In this case, the SKCL connects to the SKS server (if it is on the network) and requests a new symmetric key to add to its new-key cache.

[m55] indicates the maximum duration that new (unused) symmetric keys may be cached by the client. This is specified through the ***MaximumDuration*** element in seconds. If there are any new keys that exceed this duration limit, the SKCL deletes the specific symmetric key and replaces it with a new symmetric key from the SKS server.

[m56] is the closing tag of the ***NewKeysCacheDetail*** element.

[m57] is the start of the ***UsedKeysCacheDetail*** element, which provides details about how many used symmetric keys – those that HAVE been used for any encryption transactions – may be cached by the client and for how long.

[m58] indicates the maximum number of used symmetric keys that may be cached by the client through the ***MaximumKeys*** element. If the client already has the maximum number of used-keys in its cache, using the First-In-First-Out (FIFO) method, it deletes the oldest symmetric key in the cache to replace with the key that transitioned from the “new” to “used” status.

[m59] indicates the maximum duration that used symmetric keys may be cached by the clien through the ***MaximumDuration*** element in seconds. If there are any used keys that exceed this duration limit, the SKCL deletes the specific symmetric key. While this may temporarily reduce the number of used symmetric keys in the cache, the SKCL takes the most conservative position when making this decision.

1610 **[m60]** is the closing tag of the ***UsedKeysCacheDetail*** element.

1611 **[m61]** is the closing tag of the third and final ***KeyCachePolicy*** element in this response.

1612 **[m62]** is the closing tag of the ***KeyCachePolicyResponse*** element.

4 Specification

4.1 Element <SymkeyRequest>

The <SymkeyRequest> element identifies one or more ***GlobalKeyID***'s of symmetric encryption keys needed by the client application. The request may also specify one or more ***KeyClass*** elements for the requested key when the request is for a new symmetric key.

While it is a top-level element within this specification, a <SymkeyRequest> element MAY be enclosed within a ***SOAP Body*** element of a ***SOAP Envelope*** to conform to the security requirements of this specification. The ***SOAP Header*** of the ***SOAP Envelope*** MUST enclose a ***Security*** element conforming to **[WSS]** with a ***ValueType*** attribute containing the value http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-x509-token-profile-1.0#X509v3. The ***Security*** element must conform to all other requirements of the specified security profile in **[WSS]** to form a well-formed, secure message.

Schema Definition:

```
    <xsd:element name="SymkeyRequest">
        <xsd:complexType>
            <xsd:sequence>
                <xsd:element
                    name="GlobalKeyID"
                    type="ekmi:GlobalKeyIDType"
                    minOccurs="1"
                    maxOccurs="unbounded">
                </xsd:element>
                <xsd:element
                    name="KeyClasses"
                    type="ekmi:KeyClassesType"
                    minOccurs="0">
                </xsd:element>
            </xsd:sequence>
        </xsd:complexType>
    </xsd:element>
```

The <SymkeyRequest> element consists of a sequence of two child elements:

1. <GlobalKeyID> [Required]

   This element of type ***GlobalKeyIDType,*** identifies the unique global key identifier of the requested symmetric key within the target Symmetric Key Management System (SKMS) the client is communicating with. There MUST be at least one <GlobalKeyID> element in a <SymkeyRequest>, but there may be an unbounded (unlimited) number of <GlobalKeyID> elements specified.

   The <GlobalKeyID> element is specified in Section 4.2.

2. <KeyClasses> [Optional]

   This element of type ***KeyClassesType***, when specified, identifies at least one <KeyClass> element, but may specify an unbounded (unlimited) number of <KeyClass> elements within the <KeyClasses> set. Client applications may request one or more symmetric keys conforming to one or more key classes required by the application. If the client application is authorized to receive keys conforming to such key classes, the **SKS** server will generate and supply them.

When more than one <GlobalKeyID> for a new symmetric key is specified in the request, there MAY be only one <KeyClass> element within the <KeyClasses> set.

When the client requires more than one new symmetric key, and each key is required to be of a different key class, there MUST be only one <GlobalKeyID> element followed by as many <KeyClass> elements inside the <KeyClasses> set, as needed by the client application.

When a client requires multiple symmetric keys of two or more key classes, the client MUST send multiple requests to the **SKS** server. See examples 4 and 5 below in this section.

The <KeyClasses> and <KeyClass> elements are specified in Section 4.3.

Some examples of the <SymkeyRequest> element are as follows:

Example 1 – A single new symmetric key request of a default key class:

```
<ekmi:SymkeyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
</ekmi:SymkeyRequest>
```

Example 2 – A request for three new symmetric keys of a default key class for each symmetric key:

```
<ekmi:SymkeyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
</ekmi:SymkeyRequest>
```

Example 3 – A request for a single new symmetric key of a specific key class:

```
<ekmi:SymkeyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
     <ekmi:KeyClasses>
          <ekmi:KeyClass>HR-Class</ekmi:KeyClass>
     </ekmi:KeyClasses>
</ekmi:SymkeyRequest>
```

Example 4 – A request for a two new symmetric keys with the same key class for each symmetric key:

```
<ekmi:SymkeyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
     <ekmi:KeyClasses>
          <ekmi:KeyClass>FIN-FX</ekmi:KeyClass>
     </ekmi:KeyClasses>
</ekmi:SymkeyRequest>
```

Example 5 – A request for a nine new symmetric keys of different key classes:

```
<ekmi:SymkeyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
  <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
  <ekmi:KeyClasses>
       <ekmi:KeyClass>EHR-CDC</ekmi:KeyClass>
       <ekmi:KeyClass>EHR-CRO</ekmi:KeyClass>
       <ekmi:KeyClass>EHR-DEF</ekmi:KeyClass>
       <ekmi:KeyClass>EHR-EMT</ekmi:KeyClass>
       <ekmi:KeyClass>EHR-HOS</ekmi:KeyClass>
       <ekmi:KeyClass>EHR-INS</ekmi:KeyClass>
       <ekmi:KeyClass>EHR-NUR</ekmi:KeyClass>
```

```
            <ekmi:KeyClass>EHR-PAT</ekmi:KeyClass>
            <ekmi:KeyClass>EHR-PHY</ekmi:KeyClass>
       </ekmi:KeyClasses>
    </ekmi:SymkeyRequest>
```

4.2 Element <GlobalKeyID>

The <GlobalKeyID> element is the unique identifier of a symmetric encryption key within an SKMS. Every symmetric key generated by the **SKS** server MUST be assigned a unique <GlobalKeyID> as specified in this section.

Schema Definition:

```
   <xsd:simpleType name="GlobalKeyIDType">
        <xsd:restriction base="xsd:string">
            <xsd:minLength value="5"/>
            <xsd:maxLength value="62"/>
            <xsd:pattern value="[0-9]{1,20}-[0-9]{1,20}-[0-9]{1,20}"/>
            <xsd:whiteSpace value="collapse"/>
        </xsd:restriction>
    </xsd:simpleType>
```

The <GlobalKeyID> element is of the ***GlobalKeyIDType***, and is a string identifier of a symmetric key consisting of five parts concatenated together:

1. A positive integer identifying the ***Domain ID***. The ***DomainID*** identifies the IANA-issued Private Enterprise Number (PEN) as published at http://www.iana.org/assignments/enterprise-numbers and is used by the **SKS** server to constrain the ownership of objects within the SKMS:
2. A literal hyphen ("-") without surrounding spaces;
3. A positive integer identifying the Server ID of the server that originally generated the key;
4. Another literal hyphen ("-") without surrounding spaces;
5. A positive integer identifying the Key ID;

Combined, the five components of this element make up a unique identifier for a symmetric key within the SKMS. Since all enterprise are expected to use only the PENs assigned to them, technically the <GlobalKeyID> is unique across the internet.

The ***DomainID*** part of the <GlobalKeyID> element MUST be a positive integer in the range of 0 (zero) to 18446744073709551615 (20-byte ASCII decimal).

When an SKMS manages the symmetric keys for a single enterprise, the ***DomainID*** part of the <GlobalKeyID> element in a <SymkeyRequest> MAY be zero (“0”). When an SKMS manages symmetric keys for multiple enterprises, the ***DomainID*** in the <GlobalKeyID> of a <SymkeyRequest> MUST be positive and non-zero. In such a situation, the client application will request a symmetric key for the domain in which it is authorized to request and receive keys.

The ***DomainID*** in the <GlobalKeyID> element of a <SymkeyResponse> MUST always be positive and non-zero. It will typically contain the PEN of the domain to which the symmetric key belongs.

The ***ServerID*** part of the <GlobalKeyID> element MUST be a positive integer in the range of 0 (zero) to 18446744073709551615 (20-byte ASCII decimal).

The ***ServerID*** part of the <GlobalKeyID> element of a <SymkeyRequest> MUST always be zero (“0”).

The ***ServerID*** part of the <GlobalKeyID> element of a <SymkeyResponse> MUST always be positive and non-zero. It will typically contain the unique server identifier of the **SKS** server where the symmetric key was generated.

The ***KeyD*** part of the <GlobalKeyID> element MUST be a positive integer in the range of 0 (zero) to 18446744073709551615 (20-byte ASCII decimal).

The ***KeyID*** part of the <GlobalKeyID> element of a <SymkeyRequest> MUST always be zero ("0").

The ***KeyID*** part of the <GlobalKeyID> element of a <SymkeyResponse> MUST always be positive and non-zero. It will typically contain the unique key identifier of the symmetric key within the **SKS** server where the key was generated.

Example 1 – A <GlobalKeyID> value for a new symmetric key from an SKMS that serves a single domain:

```
<ekmi:GlobalKeyID>0-0-0</ekmi:GlobalKeyID>
```

Example 2 – A <GlobalKeyID> value for a new symmetric key for the domain with the PEN 10514, from an SKMS that serves multiple domains:

```
<ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
```

Example 3 – A <GlobalKeyID> value for the 16,777,215th symmetric key generated on 2nd SKS server for an enterprise with the PEN 10514, in either a <SymkeyRequest> or a <SymkeyResponse>:

```
<ekmi:GlobalKeyID>10514-2-16777215</ekmi:GlobalKeyID>
```

Example 4 – The maximum <GlobalKeyID> value possible (a 62-byte ASCII decimal), in a <SymkeyRequest> or <SymkeyResponse>:

```
<ekmi:GlobalKeyID>
    18446744073709551615-18446744073709551615-18446744073709551615
</ekmi:GlobalKeyID>
```

4.3 Element <KeyClasses> and <KeyClass>

The <KeyClasses> element of type ***KeyClassesType***, when specified, identifies at least one <KeyClass> element, but may specify an unbounded (unlimited) number of <KeyClass> elements within the <KeyClasses> set.

Schema Definition:

```
<xsd:complexType name="KeyClassesType">
   <xsd:sequence>
      <xsd:element
         name="KeyClass"
         type="tns:KeyClassType"
         minOccurs="1"
         maxOccurs="unbounded"/>
   </xsd:sequence>
</xsd:complexType>


<xsd:simpleType name="KeyClassType">
   <xsd:restriction base="xsd:string">
      <xsd:maxLength value="255"/>
   </xsd:restriction>
</xsd:simpleType>
```

Client applications may request one or more symmetric keys conforming to one or more key classes required by the application. If the client application is authorized to receive keys conforming to such key classes, the SKS server will generate and supply them.

The <KeyClasses> element is useful only when requesting new symmetric keys, i.e. symmetric encryption keys that have previously NOT been used for encrypting data. There is little reason for a client application to specify the <KeyClasses> element when requesting an existing (escrowed) symmetric key, since the SKS server will return the requested key to authorized clients with whatever key class is associated with the key regardless of what key class is specified in the request. The key class will have been associated with the symmetric key at the time of its generation and cannot be changed once associated with a key.

When more than one <GlobalKeyID> is specified in the request, there MAY be only one <KeyClass> element within the <KeyClasses> set. When a key class is not specified in a request, it implies a request for symmetric key(s) of a default key class configured at the **SKS** server. The default key class for a site is site-specific.

When the client requires more than one symmetric key, and each key needs to be of a different key class, there MUST be only one <GlobalKeyID> element followed by as many <KeyClass> elements insides the <KeyClasses> set as needed by the client application. (Example 5 in this section).

When a client requires many symmetric keys – say five keys – and two or more keys belong to the same key class, the client MUST send multiple requests to the **SKS** server. One request will contain multiple <GlobalKeyID> elements with one <KeyClass> element in the <KeyClasses> set, and the other request will contain one <GlobalKeyID> element and multiple <KeyClass> elements within the <KeyClasses> set. (Examples 4 and 5 in this section).

Example 1 – A symmetric key request of a default key class (when no KeyClass is specified):

```
<ekmi:SymkeyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
</ekmi:SymkeyRequest>
```

Example 2 – A request for multiple new symmetric keys, each of a default key class:

```
<ekmi:SymkeyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
</ekmi:SymkeyRequest>
```

Example 3 – A request for a new symmetric key of a specific key class:

```
<ekmi:SymkeyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
     <ekmi:KeyClasses>
          <ekmi:KeyClass>256-Bit-Class</ekmi:KeyClass>
     </ekmi:KeyClasses>
</ekmi:SymkeyRequest>
```

Example 4 – A request for two new symmetric keys of the same key class for each symmetric key. Note that if the FIN-FX key class was the default key class, a request as shown in Example 2 of this section would result in the same response:

```
<ekmi:SymkeyRequest xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
     <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
     <ekmi:KeyClasses>
          <ekmi:KeyClass>FIN-FX</ekmi:KeyClass>
     </ekmi:KeyClasses>
</ekmi:SymkeyRequest>
```

Example 5 – A request for a four new symmetric keys of different key classes:

```
<ekmi:SymkeyRequest xmlns:ekmi=”http://docs.oasis-open.org/ekmi/2008/01">
  <ekmi:GlobalKeyID>10514-0-0</ekmi:GlobalKeyID>
  <ekmi:KeyClasses>
       <ekmi:KeyClass>EHR-DEF</ekmi:KeyClass>
       <ekmi:KeyClass>EHR-HOS</ekmi:KeyClass>
       <ekmi:KeyClass>EHR-INS</ekmi:KeyClass>
       <ekmi:KeyClass>EHR-PAT</ekmi:KeyClass>
  </ekmi:KeyClasses>
</ekmi:SymkeyRequest>
```

4.4 Element <SymkeyResponse>

The <SymkeyResponse> element is one of two results returned by an **SKS** server upon being sent a valid and authorized <SymkeyRequest> by a client application. The other result is a <SymkeyError> which will be discussed in the next section.

While <SymkeyResponse> is a top-level element within this specification, it MAY be enclosed within a ***SOAP Body*** element of a ***SOAP Envelope*** to conform to the security requirements of this specification. The ***SOAP Header*** of the ***SOAP Envelope*** MUST enclose a ***Security*** element conforming to **[WSS]** with a ***ValueType*** attribute containing the value http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-x509-token-profile-1.0#X509v3. The ***Security*** element must conform to all other requirements of the specified security profile in **[WSS]** to form a well-formed, secure message.

Schema Definition:

```
<xsd:element name="SymkeyResponse">
    <xsd:complexType>
        <xsd:sequence>
            <xsd:element
                name="Symkey"
                type="tns:SymkeyType"
                minOccurs="0"
                maxOccurs="unbounded"/>
            <xsd:element
                name="SymkeyError"
                type="tns:SymkeyErrorType"
                minOccurs="0"
                maxOccurs="unbounded"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>
```

The <SymkeyResponse> element consists of a sequence of two types of child elements - <Symkey> or <SymkeyError> . The <SymkeyResponse> element MAY consist of either type of element or both types of elements. When both elements are contained in a <SymkeyResponse>, all <Symkey> elements MUST precede the first <SymkeyError> element.

1. <Symkey> [Optional]

   This element of type ***SymkeyType***, is returned by the **SKS** server in response to a successful processing of a <SymkeyRequest>. There MAY be more than one <Symkey> element in the <SymkeyResponse> if the client application made a request for multiple symmetric keys.

   The <Symkey> element and the ***SymkeyType*** are specified in Section 4.5.

2. <SymkeyError> [Optional]

This element of type ***SymkeyErrorType***, contains a response to a failed attempt in processing a request for one or more symmetric keys. There MAY be more than one <SymkeyError> element in the <SymkeyResponse> if the client application made a request for multiple symmetric keys and the request resulted in multiple errors.

The <SymkeyError> element is specified in Section 4.6.

Some high-level examples of the <SymkeyResponse> element are as follows:

Example 1 – A response with a single symmetric key:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:Symkey>.....</ekmi:Symkey>
</ekmi:SymkeyResponse>
```

Example 2 – A response with three symmetric keys:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:Symkey>.....</ekmi:Symkey>
     <ekmi:Symkey>.....</ekmi:Symkey>
     <ekmi:Symkey>.....</ekmi:Symkey>
</ekmi:SymkeyResponse>
```

Example 3 – A response with an error:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:SymkeyError>.....</ekmi:SymkeyError>
</ekmi:SymkeyResponse>
```

Example 4 – A response with multiple errors:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:SymkeyError>.....</ekmi:SymkeyError>
     <ekmi:SymkeyError>.....</ekmi:SymkeyError>
</ekmi:SymkeyResponse>
```

Example 5 – A response with one symmetric key and one error:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:Symkey>.....</ekmi:Symkey>
     <ekmi:SymkeyError>.....</ekmi:SymkeyError>
</ekmi:SymkeyResponse>
```

Example 6 – A response with multiple symmetric keys and multiple error:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:Symkey>.....</ekmi:Symkey>
     <ekmi:Symkey>.....</ekmi:Symkey>
     <ekmi:Symkey>.....</ekmi:Symkey>
     <ekmi:SymkeyError>.....</ekmi:SymkeyError>
     <ekmi:SymkeyError>.....</ekmi:SymkeyError>
</ekmi:SymkeyResponse>
```

4.5 Element <Symkey>

The <Symkey> element is the *raison d'etre* of the **SKSML** protocol. The element of type ***SymkeyType***, contains the symmetric key returned by the **SKS** server, in response to a successful processing of a <SymkeyRequest> from a client application.

Schema Definition:

```
    <xsd:complexType name="SymkeyType">
        <xsd:sequence>
            <xsd:element name="GlobalKeyID" type="ekmi:GlobalKeyIDType"/>
            <xsd:element name="KeyUsePolicy" type="ekmi:KeyUsePolicyType"/>
            <xsd:element name="EncryptionMethod" type="xenc:EncryptionMethodType"/>
            <xsd:element ref="xenc:CipherData"/>
        </xsd:sequence>
    </xsd:complexType>
```

When a request for a symmetric key is successful, there MUST be at least one <Symkey> element in a <SymkeyResponse> element. There MAY be more than one <Symkey> element in the response if the client application made a request for multiple symmetric keys and the **SKS** server processed the request successfully.

In the event of an error in processing the request, there SHALL be no <Symkey> element in the response; there SHALL be a <SymkeyError> element, instead. The <SymkeyError> element is specified in Section 4.6.

The <Symkey> element consists of a sequence of the following child elements:

1. <GlobalKeyID> [Required]

   This element of type ***GlobalKeyIDType*** identifies the unique identifier of the symmetric key within an SKMS. There SHALL be only one <GlobalKeyID> within a <Symkey> element.

   The ***GlobalKeyIDType*** is specified in Section 4.2.

2. <KeyUsePolicy> [Required]

   This element of type ***KeyUsePolicyType***, defines how the symmetric key in this <Symkey> element may be used by applications. There SHALL be only one <KeyUsePolicy> element within a <Symkey> element.

   The <KeyUsePolicy> element is specified in Section 4.7.

3. <EncryptionMethod> [Required]

   This element of type ***EncryptionMethodType*** from **[XMLEncryption]** describes how the symmetric key in this <Symkey> element is encrypted for transport between the **SKS** Server and the client application.

   The <EncryptionMethod> MUST specify one of the following two transport algorithms in the ***Algorithm*** attribute of the element:

   - http://www.w3.org/2001/04/xmlenc#rsa-1_5
   - http://www.w3.org/2001/04/xmlenc#rsa-oaep-mgf1p

4. <CipherData> [Required]

   This element of ***CipherDataType*** from **[XMLEncryption]** contains the encrypted symmetric-key.

As specified in **[XMLEncryption]**, the content of this element is Base-64 encoded and is of the XML Schema ***base64Binary*** type.

Some high-level examples of the <Symkey> element are as follows. Details about the <KeyUsePolicy> element have been elided for brevity:

Example 1 – A response with a symmetric key:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:Symkey>
        <ekmi:GlobalKeyID>10514-1-235</ekmi:GlobalKeyID>
        <ekmi:KeyUsePolicy>.....</ekmi:KeyUsePolicy>
        <ekmi:EncryptionMethod
             Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-1_5"/>
        <xenc:CipherData>
             <xenc:CipherValue>
                E9zWB/y93hVSzeTLiDcQoDxmlNxTux+SffMNwCJmt1dIqzQHBnpdQ8
                1g6DKdkCFjJMhQhywCx9sfYjv9h5FDqUiQXGOca8EU871zBoXBjDxj
                fg1pU8tGFbpWZcd/ATpJD/UJow/qimxi8+huUYJMtaGH=
           </xenc:CipherValue>
        </xenc:CipherData>
    </ekmi:Symkey>
</ekmi:SymkeyResponse>
```

Example 2 – A response with multiple symmetric keys:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:Symkey>
        <ekmi:GlobalKeyID>10514-1-235</ekmi:GlobalKeyID>
        <ekmi:KeyUsePolicy>.....</ekmi:KeyUsePolicy>
        <ekmi:EncryptionMethod
             Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-oaep-mgf1p"/>
        <xenc:CipherData>
             <xenc:CipherValue>
                E9zWB/y93hVSzeTLiDcQoDxmlNxTux+SffMNwCJmt1dIqzQHBnpdQ8
                1g6DKdkCFjJMhQhywCx9sfYjv9h5FDqUiQXGOca8EU871zBoXBjDxj
                fg1pU8tGFbpWZcd/ATpJD/UJow/qimxi8+huUYJMtaGH=
           </xenc:CipherValue>
        </xenc:CipherData>
    </ekmi:Symkey>
    <ekmi:Symkey>
        <ekmi:GlobalKeyID>10514-1-236</ekmi:GlobalKeyID>
        <ekmi:KeyUsePolicy>.....</ekmi:KeyUsePolicy>
        <ekmi:EncryptionMethod
             Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-oaep-mgf1p"/>
        <xenc:CipherData>
             <xenc:CipherValue>
                Qbg65cy93hVSzeTLiDcQoDxmlNxTux+SffMNwCJmt1dIqzQHBnpdQ8
                7k6DKdkCFjJMhQhywCx9sfYjv9h5FDqUiQXGOca8EU871zBoXBjDxj
                uyecU8tGFbpWZcd/ATpJD/UJow/qimxi8+huUYJMtaGH=
             </xenc:CipherValue>
        </xenc:CipherData>
    </ekmi:Symkey>
</ekmi:SymkeyResponse>
```

4.6 Element <SymkeyError>

The <SymkeyError> element of type ***SymkeyErrorType***, contains the error returned by the **SKS** server, in response to a failure in processing of a <SymkeyRequest> from a client application.

Schema Definition:

```
<xsd:complexType name="SymkeyErrorType">
   <xsd:sequence>
      <xsd:element name="RequestedGlobalKeyID" type="ekmi:GlobalKeyIDType"/>
      <xsd:element
            name="RequestedKeyClass"
            type="ekmi:KeyClassType"
            minOccurs="0"/>
      <xsd:element name="ErrorCode">
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:maxLength value="255"/>
            </xsd:restriction>
          </xsd:simpleType>
      </xsd:element>
      <xsd:element name="ErrorMessage">
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:maxLength value="1024"/>
            </xsd:restriction>
         </xsd:simpleType>
      </xsd:element>
   </xsd:sequence>
</xsd:complexType>
```

When a request for a symmetric key fails despite successfully being processed by the SOAP layer, there MUST be at least one <SymkeyError> element in a <SymkeyResponse> element. When a <SymkeyRequest> fails at the SOAP layer, the response SHALL consist of a ***SOAPFault***.

There MAY be more than one <SymkeyError> element in the response if the client application made a request for multiple symmetric keys and the **SKS** server failed in processing the request for more than one symmetric key.

The <SymkeyError> element consists of a sequence of the following child elements:

1. <RequestedGlobalKeyID> [Required]

   This element of type ***GlobalKeyIDType*** identifies the unique identifier of the symmetric key requested by the client application. There SHALL be only one <RequestedGlobalKeyID> within a <SymkeyError> element.

   The ***GlobalKeyIDType*** is specified in Section 4.2.

2. <RequestedKeyClass> [Optional]

   This element of type ***KeyClassType*** identifies the key-class of the symmetric key requested by the client application. If the <RequestedKeyClass> element is not embedded in the <SymkeyError> element, this implies that the requested symmetric key was for the default key-class of the SKMS.

   The ***KeyClassType*** is specified in Section 4.3.

3. <ErrorCode> [Required]

This element of type ***String*** identifies a mnemonic code identifying the error the **SKS** Server experienced in processing the client's symmetric key request.

The <ErrorCode> element SHALL return one of the codes identified in Appendix D of this specification.

4. <ErrorMessage> [Required]

   This element of type ***String*** identifies a localized message describing the error the **SKS** Server experienced in processing the client's symmetric key request.

   The <ErrorMessage> element SHALL return the appropriate localized version of the message corresponding to the <ErrorCode> element from Appendix D of this specification.

Some high-level examples of the <SymkeyError> element are as follows.

Example 1 – An error within a response:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:SymkeyError>
        <ekmi:RequestedGlobalKeyID>10514-2-22</ekmi:RequestedGlobalKeyID>
        <ekmi:ErrorCode>SKS-100004</ekmi:ErrorCode>
        <ekmi:ErrorMessage>Unauthorized request for key</ekmi:ErrorMessage>
    </ekmi:SymkeyError>
</ekmi:SymkeyResponse>
```

Example 2 – Multiple errors within a response:

```
<ekmi:SymkeyResponse
     xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01">
     <ekmi:SymkeyError>
        <ekmi:RequestedGlobalKeyID>10514-1-0</ekmi:RequestedGlobalKeyID>
        <ekmi:ErrorCode>SKS-100001</ekmi:ErrorCode>
        <ekmi:ErrorMessage>Invalid GlobalKeyID</ekmi:ErrorMessage>
    </ekmi:SymkeyError>
    <ekmi:SymkeyError>
        <ekmi:RequestedGlobalKeyID>10514-2-22</ekmi:RequestedGlobalKeyID>
        <ekmi:ErrorCode>SKS-100004</ekmi:ErrorCode>
        <ekmi:ErrorMessage>Unauthorized request for key</ekmi:ErrorMessage>
    </ekmi:SymkeyError>
</ekmi:SymkeyResponse>
```

4.7 Element <KeyUsePolicy>

The <KeyUsePolicy> element defines rules that conforming implementations of the **SKCL** MUST adhere to when using the symmetric key sent by the **SKS** Server. It is an integral part of the <Symkey> element .

Schema Definition:

```
<xsd:complexType name="KeyUsePolicyType" mixed="true">

     <xsd:sequence>
         <xsd:element name="KeyUsePolicyID" type="tns:TwoPartIDType"/>
         <xsd:element name="PolicyName">
             <xsd:simpleType>
```

```
                    <xsd:restriction base="xsd:string">
                        <xsd:maxLength value="255"/>
                    </xsd:restriction>
                </xsd:simpleType>
            </xsd:element>
            <xsd:element name="KeyClass" type="tns:KeyClassType"/>
            <xsd:element name="KeyAlgorithm" type="tns:EncryptionAlgorithmType"/>
            <xsd:element name="KeySize" type="tns:KeySizeType"/>
            <xsd:element name="Status" type="tns:StatusType"/>
            <xsd:element name="Permissions" type="tns:PermissionsType"/>
        </xsd:sequence>
    </xsd:complexType>
```

The <KeyUsePolicy> element is of the ***KeyUsePolicyType*** and consists of the following child elements:

1. <KeyUsePolicyID> [Required]

   The < KeyUsePolicyID> element, of type ***TwoPartIDType*** , identifies the unique policy object within the SKMS. There SHALL be only one <KeyUsePolicyID> element within a <KeyUsePolicy> element.

   The ***TwoPartIDType*** is specified in Section 4.8.

2. <PolicyName> [Required]

   The <PolicyName> element, of type XSD ***String,*** with a maximum length of 255 characters, identifies a unique name given to this <KeyUsePolicy>. There SHALL be only one <PolicyName> element within a <KeyUsePolicy> element.

3. <KeyClass> [Required]

   The <KeyClass> element ,of type ***KeyClassType*** , identifies a key-class assigned to this <KeyUsePolicy>. There SHALL be only one <KeyUsePolicyID> element within a <KeyUsePolicy> element.

   The ***KeyClassType*** is specified in Section 4.3.

4. <KeyAlgorithm> [Required]

   The <KeyAlgorithm> element , of type ***EncryptionAlgorithmType*** , identifies encryption algorithm to be used by applications when using this symmetric key. There SHALL be only one <KeyAlgorithm> element within a <KeyUsePolicy> element.

   The <KeyAlgorithm> element is specified in Section 4.9.

5. <KeySize> [Required]

   The <KeySize> element , of type ***KeySizeType***, defines the size of the symmetric key, in bits (binary digits). There SHALL be only one <KeySize> element within a <KeyUsePolicy> element.

   Note: It is possible to determine the size of a symmetric key in an **SKCL** implementation without having to send the size in the response. So, why include it? It is our belief that while network bandwidth and compute performance of devices are increasing steadily, encryption is desired in many small and portable devices. Consequently, it will speed up applications in cryptographic processing if they do not have to determine the size of each key they use. While “protocol purity” demands that implementation issues do not show up in protocol design, we believe it is justified in this case.

   The ***KeySizeType*** is specified in Section 4.10.

6. <Status> [Required]

   The <Status> element, of type ***StatusType***, identifies the current status of the symmetric key. There SHALL be only one <Status> element within a <KeyUsePolicy> element.

   The ***StatusType*** is specified in Section 4.11.

7. <Permissions> [Required]

   The <Permissions> element, of type ***PermissionsType***, defines what is permissible to client applications with the symmetric key this element is associated with. It is the responsibility of the conforming **SKCL** implementation to enforce these rules.

   An important distinction of this element – unlike most access control rules – is that the absence of sub-elements in the <Permissions> element implies that all permissions are allowed. The presence of sub-elements in this element provide rules to the **SKCL** about what actions are permitted.

   There SHALL be only one <Permissions> element in a <KeyUsePolicy> element.

   The ***PermissionsType*** is specified in Section 4.12.

Some examples of the <KeyUsePolicy> element are as follows.

Example 1 – A <KeyUsePolicy> with some permission restrictions:

```
<ekmi:KeyUsePolicy>
   <ekmi:KeyUsePolicyID>10514-4</ekmi:KeyUsePolicyID>
   <ekmi:PolicyName>DES-EDE KeyUsePolicy</ekmi:PolicyName>
   <ekmi:KeyClass>HR-Class</ekmi:KeyClass>
   <ekmi:KeyAlgorithm>
      http://www.w3.org/2001/04/xmlenc#tripledes-cbc
   </ekmi:KeyAlgorithm>
   <ekmi:KeySize>192</ekmi:KeySize>
   <ekmi:Status>Active</ekmi:Status>
   <ekmi:Permissions>
      <ekmi:PermittedApplications ekmi:any="false">
         <ekmi:PermittedApplication>
            <ekmi:ApplicationID>10514-23</ekmi:ApplicationID>
            <ekmi:ApplicationName>Payroll Application</ekmi:ApplicationName>
            <ekmi:Version>1.0</ekmi:Version>
            <ekmi:DigestAlgorithm>
               http://www.w3.org/2000/09/xmldsig#sha1
            </ekmi:DigestAlgorithm>
            <ekmi:DigestValue>
               229ea73a5e76eabd183663d332b283948a9202a1
            </ekmi:DigestValue>
         </ekmi:PermittedApplication>
      </ekmi:PermittedApplications>
      <ekmi:PermittedDates ekmi:any="false">
         <ekmi:PermittedDate>
            <ekmi:StartDate>2008-01-01</ekmi:StartDate>
            <ekmi:EndDate>2008-12-31</ekmi:EndDate>
         </ekmi:PermittedDate>
      </ekmi:PermittedDates>
      <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedNumberOfTransactions ekmi:any="true" xsi:nil="true"/>
```

```
            <ekmi:PermittedTimes ekmi:any="false">
               <ekmi:PermittedTime>
                  <ekmi:StartTime>07:00:00</ekmi:StartTime>
                  <ekmi:EndTime>19:00:00</ekmi:EndTime>
               </ekmi:PermittedTime>
            </ekmi:PermittedTimes>
            <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
         </ekmi:Permissions>
      </ekmi:KeyUsePolicy>
```

Example 2 – A <KeyUsePolicy> with no restrictions on the key:

```
      <ekmi:KeyUsePolicy>
          <ekmi:KeyUsePolicyID>10514-2</ekmi:KeyUsePolicyID>
        <ekmi:PolicyName>Laptop KeyUsePolicy</ekmi:PolicyName>
          <ekmi:KeyClass>HR-Class</ekmi:KeyClass>
          <ekmi:KeyAlgorithm>
              http://www.w3.org/2001/04/xmlenc#aes256-cbc
          </ekmi:KeyAlgorithm>
          <ekmi:KeySize>256</ekmi:KeySize>
          <ekmi:Status>Active</ekmi:Status>
          <ekmi:Permissions>
              <ekmi:PermittedApplications ekmi:any="true" xsi:nil="true"/>
              <ekmi:PermittedDates ekmi:any="true" xsi:nil="true"/>
              <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
              <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
              <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
              <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
              <ekmi:PermittedNumberOfTransactions ekmi:any="true" xsi:nil="true"/>
              <ekmi:PermittedTimes ekmi:any="true" xsi:nil="true"/>
              <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
          </ekmi:Permissions>
      </ekmi:KeyUsePolicy>
```

4.8 Type *TwoPartIDType*

The ***TwoPartIDType*** is used to create identifiers for many elements within the **SKSML**. It is a simple concatenation of two integers with a hyphen between them (“-”) to create an XML Schema ***String*** type.

The ***TwoPartIDType*** has a minimum length of three (3) characters, and a maximum length of 41 characters.

Schema Definition:

```
   <xsd:simpleType name="TwoPartIDType">
        <xsd:restriction base="xsd:string">
            <xsd:minLength value="3"/>
            <xsd:maxLength value="41"/>
            <xsd:pattern value="[1-9][0-9]{0,19}-[1-9][0-9]{0,19}"/>
            <xsd:whiteSpace value="collapse"/>
        </xsd:restriction>
   </xsd:simpleType>
```

The ***TwoPartIDType*** is used in the <ApplicationID>, the <KeyCachePolicyID> and the <KeyUsePolicyID> elements within the **SKSML**.

Some examples of the <KeyUsePolicy> element are as follows.

Example 1 – A *TwoPartIDType* used to identify an ApplicationID:

```
<ekmi:ApplicationID>10514-23</ekmi:ApplicationID>
```

Example 2 – A *TwoPartIDType* used to identify a KeyUsePolicyID:

```
<ekmi:KeyUsePolicyID>10514-4</ekmi:KeyUsePolicyID>
```

Example 3 – A minimum-length *TwoPartIDType* :

```
<ekmi:KeyCachePolicyID>5-4</ekmi:KeyCachePolicyID>
```

Example 4 – A maximum-length *TwoPartIDType* :

```
<ekmi:ApplicationID>
   18446744073709551615-18446744073709551615
</ekmi:ApplicationID>
```

4.9 Element <KeyAlgorithm>

The element <KeyAlgorithm> , of type ***EncryptionAlgorithmType***, is used to identify the cryptographic algorithm to be used with the symmetric keys in the <SymkeyResponse>.

Schema Definition:

```
<xsd:simpleType name="EncryptionAlgorithmType">
     <xsd:restriction base="xsd:anyURI">
        <xsd:enumeration value="http://www.w3.org/2001/04/xmlenc#tripledes-cbc"/>
        <xsd:enumeration value="http://www.w3.org/2001/04/xmlenc#aes128-cbc"/>
        <xsd:enumeration value="http://www.w3.org/2001/04/xmlenc#aes192-cbc"/>
        <xsd:enumeration value="http://www.w3.org/2001/04/xmlenc#aes256-cbc"/>
     </xsd:restriction>
 </xsd:simpleType>
```

The algorithms currently supported by this specification are the algorithms defined in **[XMLEncryption]**. As new algorithms are added to **[XMLEncryption]**, they will be added to the enumerated list in this element. Currently, the following four algorithms are supported:

1. Triple Data Encryption Standard (3DES)

   Within the context of this specification, and as specified in **[XMLEncryption]**, the form of 3DES supported within **SKSML** is a 192-bit key with a 64-bit Initialization Vector. Of the key bits, the first 64 are used in the first DES operation, the second 64 bits in the second (middle) DES operation, and the third 64 bits in the third (last) DES operation. Each of these 64 bits of key contain 56 effective bits and 8 parity bits.

   The algorithm standard is denoted by the URL: http://www.w3.org/2001/04/xmlenc#tripledes-cbc.

2. Advanced Encryption Standard (AES) – 128-bit

   Within the context of this specification, and as specified in **[AES]**, this is a 128-bit symmetric key used in the Cipher Block Chaining (CBC) mode.

   The algorithm standard is denoted by the URL: http://www.w3.org/2001/04/xmlenc#aes128-cbc.

3. Advanced Encryption Standard (AES) – 192-bit

Within the context of this specification, and as specified in **[AES]**, this is a 192-bit symmetric key used in the Cipher Block Chaining (CBC) mode.

The algorithm standard is denoted by the URL: http://www.w3.org/2001/04/xmlenc#aes192-cbc.

4. Advanced Encryption Standard (AES) – 256-bit

Within the context of this specification, and as specified in **[AES]**, this is a 256-bit symmetric key used in the Cipher Block Chaining (CBC) mode.

The algorithm standard is denoted by the URL: http://www.w3.org/2001/04/xmlenc#aes256-cbc.

There SHALL be only one <KeyAlgorithm> element within a <KeyUsePolicy> element.

Some examples of the <KeyAlgorithm> element are as follows; other elements of the <KeyUsePolicy> element are not displayed for brevity:

Example 1 – An example using the Triple-DES key algorithm:

```
<ekmi:KeyUsePolicy>
    ...
    <ekmi:KeyAlgorithm>
        http://www.w3.org/2001/04/xmlenc#tripledes-cbc
    </ekmi:KeyAlgorithm>
    ...
</ekmi:KeyUsePolicy>
```

Example 2 – An example using the AES-128 key algorithm:

```
<ekmi:KeyUsePolicy>
    ...
    <ekmi:KeyAlgorithm>
        http://www.w3.org/2001/04/xmlenc#aes128-cbc
    </ekmi:KeyAlgorithm>
    ...
</ekmi:KeyUsePolicy>
```

4.10 Element <KeySize>

The element <KeySize> , of type ***KeySizeType***, is used to identify the size of the symmetric key, in binary digits (bits) in the <SymkeyResponse>.

Schema Definition:

```
<xsd:simpleType name="KeySizeType">
     <xsd:restriction base="xsd:unsignedShort">
         <xsd:totalDigits value="3"/>
         <xsd:fractionDigits value="0"/>
         <xsd:enumeration value="128"/>
         <xsd:enumeration value="192"/>
         <xsd:enumeration value="256"/>
     </xsd:restriction>
 </xsd:simpleType>
```

There SHALL be only one <KeySize> element within a <KeyUsePolicy> element.

Currently, the following three key-sizes are supported:

1. 128-bits when used with the ***AES-192*** algorithm
2. 192-bits when used with the ***AES-192*** or the ***3DES*** algorithms
3. 256-bits when used with the ***AES-256*** algorithm

Some examples of the <KeySize> element are as follows; other elements of the <KeyUsePolicy> element are not displayed for brevity:

Example 1 – An example using a 128-bit key size:

```
<ekmi:KeyUsePolicy>
    ...
    <ekmi:KeySize>128</ekmi:KeySize>
    ...
</ekmi:KeyUsePolicy>
```

Example 2 – An example using a 192-bit key size:

```
<ekmi:KeyUsePolicy>
    ...
    <ekmi:KeySize>192</ekmi:KeySize>
    ...
</ekmi:KeyUsePolicy>
```

Example 3 – An example using a 256-bit key size:

```
<ekmi:KeyUsePolicy>
    ...
    <ekmi:KeySize>256</ekmi:KeySize>
    ...
</ekmi:KeyUsePolicy>
```

4.11 Element <Status>

The element <Status>, of type ***StatusType***, is used to identify the current status of an object . It is used in almost every element within the SKMS.

Schema Definition:

```
<xsd:simpleType name="StatusType">
     <xsd:restriction base="xsd:string">
         <xsd:enumeration value="Active"/>
         <xsd:enumeration value="Default"/>
         <xsd:enumeration value="Inactive"/>
         <xsd:enumeration value="Other"/>
     </xsd:restriction>
 </xsd:simpleType>
```

Where it exists within an element, there SHALL be only one <Status> element within the enclosing element.

The <Status> element can contain one of four ***String*** type values:

1. The **Active** value indicates that the element that makes up the document-root is currently active in the SKMS and conforming **SKCL** implementations may use it within applications.

2. The **Default** value indicates that the element that makes up the document root is the default element in the SKMS, is also active, and conforming **SKCL** implementations may use it within applications.

3. The **Inactive** value indicates that the element that makes up the document root is not active in the SKMS, and conforming **SKCL** implementations may NOT use it within applications.

4. The **Other** value indicates that the element that makes up the document root has a meaning that is application-specific. However, conforming **SKCL** implementations may NOT use it within applications.

Some examples of the <Status> element are shown below; other parts of their enclosing elements are not shown for brevity:

Example 1 – An example with an Active status within a <KeyUsePolicy> element:

```
<ekmi:KeyUsePolicy>
   ...
   <ekmi:Status>Active</ekmi:Status>
   ...
</ekmi:KeyUsePolicy>
```

Example 2 – An example with an Inactive status within a <KeyUsePolicy> element:

```
<ekmi:KeyUsePolicy>
   ...
   <ekmi:Status>Inactive</ekmi:Status>
   ...
</ekmi:KeyUsePolicy>
```

Example 3 – An example with a Default status within a <KeyUsePolicy> element:

```
<ekmi:KeyUsePolicy>
   ...
   <ekmi:Status>Default</ekmi:Status>
   ...
</ekmi:KeyUsePolicy>
```

4.12 Element <Permissions>

The <Permissions> element, of the type ***PermissionsType*** is at the heart of the <KeyUsePolicy> element. It provides guidance to conforming **SKCL** implementations on who may use the symmetric key, when they may use it, for what purposes, for how long and in which locations. For applications that conform to the Multi-Level Security (MLS) model, there is a provision for specifying which levels are permitted use of the key. There is also an element that allows for extending the <Permissions> element to accommodate rules that have not been envisioned in the current specification.

There SHALL be only one <Permissions> element within a <KeyUsePolicy> element.

Schema Definition:

```
<xsd:complexType name="PermissionsType">
<xsd:sequence>
   <xsd:element
```

```
                name="PermittedApplications"
                type="tns:PermittedApplicationsType"
                minOccurs="1"
                nillable="true"/>
        <xsd:element
                name="PermittedDates"
                type="tns:PermittedDatesType"
                minOccurs="1"
                nillable="true"/>
        <xsd:element
                name="PermittedDays"
                type="tns:PermittedDaysType"
                minOccurs="1"
                nillable="true"/>
        <xsd:element
                name="PermittedDuration"
                type="tns:PermittedDurationType"
                minOccurs="1"
                nillable="true"/>
        <xsd:element
                name="PermittedLevels"
                type="tns:PermittedLevelsType"
                minOccurs="1"
                nillable="true"/>
        <xsd:element
                name="PermittedLocations"
                type="tns:PermittedLocationsType"
                minOccurs="1"
                nillable="true"/>
        <xsd:element
                name="PermittedNumberOfTransactions"
                type="tns:PermittedNumberOfTransactionsType"
                minOccurs="1"
                nillable="true"/>
        <xsd:element
                name="PermittedTimes"
                type="tns:PermittedTimesType"
                minOccurs="1"
                nillable="true"/>
        <xsd:element
                name="PermittedUses"
                type="tns:PermittedUsesType"
                minOccurs="1"
                nillable="true"/>
        <xsd:element
                name="Other"
                type="xsd:anyType"
                minOccurs="0"/>
    </xsd:sequence>
</xsd:complexType>
```

The <Permissions> element consists of the following sub-elements:

1. A required <PermittedApplications> element which identifies applications that are permitted use of the symmetric key in question. While the <PermittedApplications> element is required, it may be empty (NULL). The absence of sub-elements in the <PermittedApplications> element implies that all applications are permitted to use the key. Identifying a specific application restricts the use of the key to only the identified applications.

The <PermittedApplications> element is specified in Section 4.13.

2. A required <PermittedDates> element which identifies the date ranges during which applications are permitted use of the symmetric key in question. While the <PermittedDates> element is required, it may be empty (NULL). The absence of sub-elements in the <PermittedDates> element implies that applications are permitted to use the key on any date. Identifying specific date ranges restricts the use of the key to only the duration between the identified dates.

   The <PermittedDates> element is specified in Section 4.12.

3. A required <PermittedDays> element which identifies the days of week during which applications are permitted use of the symmetric key in question. While the <PermittedDays> element is required, it may be empty (NULL). The absence of sub-elements in the <PermittedDays> element implies that applications are permitted to use the key on any day of the week. Identifying specific days restricts the use of the key to only the identified days.

   The <PermittedDays> element is specified in Section 4.15.

4. A required <PermittedDuration> element which identifies the duration (in seconds) in which applications are permitted use of the symmetric key in question *once the **SKCL** starts using the symmetric key*. While the <PermittedDuration> element is required, it may be empty (NULL). The absence of any content – the duration time - in the <PermittedDuration> element implies that applications are permitted to use the key for any duration after it has been used. Identifying a non-zero, positive duration value restricts the use of the key to only the period after the start of the use of the key.

   A distinction between <PermittedDates> and <PermittedDuration> is that the former has fixed start and end-dates for the use of the key, whereas the latter has a fixed end-date-and-time after the key has begun to be used without a fixed start-date-and-time. Thus, an application with a <PermittedDuration> can begin the use of a symmetric key at any time, but must stop its use at the end of the <PermittedDuration> once it has begun. With <PermittedDates>, an application can continue using the symmetric key until the fixed date-and-time have been reached.

   The <PermittedDuration> element is specified in Section 4.16

5. Within a Multi-Level Security (MLS) system, the required <PermittedLevels> element identifies the security levels at which applications are permitted use of the symmetric key in question. While the <PermittedLevels> element is required, it may be empty (NULL). The absence of sub-elements in the <PermittedLevels> element implies that applications are permitted to use the key at any level of security. Identifying specific MLS level(s) restricts the use of the key to only the identified security level(s).

   The <PermittedLevels> element is specified in Section 4.17

6. A required <PermittedLocations> element which identifies physical geographic locations where applications are permitted use of the symmetric key in question. While the <PermittedLocations> element is required, it may be empty (NULL). The absence of sub-elements in the <PermittedLocations> element implies that applications are permitted to use the key at any physical location. Identifying specific locations restricts the use of the key to only the identified locations.

   The <PermittedLocations> element is specified in Section 4.18.

7. A required <PermittedNumberOfTransactions> element which identifies the number of encryption transactions that applications are permitted, with the use of the symmetric key in question. While the <PermittedNumberOfTransactions> element is required, it may be empty

(NULL). The absence of content – the number of transactions – in the <PermittedNumberOfTransactions> element implies that applications are permitted to use the key for as many encryption transactions as necessary. Identifying a specific, non-zero, positive number of transactions in this element restricts the use of the key to only the limit identified in the element.

The <PermittedNumberOfTransactions> element is specified in Section 4.19.

8. A required <PermittedTimes> element which identifies the times of day during which applications are permitted the use of the symmetric key in question. While the <PermittedTimes> element is required, it may be empty (NULL). The absence of sub-elements in the <PermittedTimes> element implies that applications are permitted to use the key at any time of day. Identifying specific times restricts the use of the key to only the duration of the identified times.

   The <PermittedTimes> element is specified in Section 4.20.

9. A required <PermittedUses> element which identifies application-uses that applications are permitted with the symmetric key in question. While the <PermittedUses> element is required, it may be empty (NULL). The absence of sub-elements in the <PermittedUses> element implies that applications are permitted to use the key for any purpose. Identifying specific uses restricts the use of the key to only the identified uses.

   The <PermittedUses> element is specified in Section 4.21.

10. The optional <Other> element allows implementers to specify permissions that cannot be addressed with the above-mentioned categories, for restricting the use of the symmetric key in question.

    While the <Other> element provides flexibility for implementations, the disadvantage of the element is that it may render a specific implementation incompatible with other **SKMS** implementations that use the **SKSML** standard.

    It is strongly recommended that implementers avoid the use of the <Other> element unless they definitely do not expect to inter-operate with other SKCL implementations. If there is a strong need for capability that does not exist within the current specification of the <Permissions> element, implementers are encouraged to contact the OASIS EKMI TC with their requirements.

When all sub-elements of the <Permissions> element are empty, there are no restrictions on the use of the symmetric key other than that the application calling on the **SKCL** be authorized to access the key in question. However, when there are elements defined within the sub-elements of the <Permissions> element, conforming **SKCL** implementations must comply with all the permission elements, evaluating the most restrictive permissions first and in decreasing order of restriction, before allowing the use of the key.

For example, if a <Permissions> element specifies that a key may be used on Weekdays, between the hours of 0900 and 1700 Hours, then a request for a symmetric key on a Saturday at 1105 would deny use of the key in question, since it violates the more restrictive permission of being allowed for use only on weekdays.

It should be noted that it is the primary responsibility of a conforming SKCL to enforce the <Permission> elements' rules. The SKS server will generate the key – or return an existing key - when an authorized client with appropriate access requests it. However, it is up to the SKCL implementation to comply with the rules in the <Permissions> element.

In another example, if a <Permissions> element specifies a <PermittedDuration> of 600 seconds from the start of use of the key, and there is also present a <PermittedNumberOfTransactions> element with a value of 10 (encryption transactions), conforming **SKCL** implementations must evaluate both permissions before each transaction and determine if they are both within the specified thresholds before using the key. If the 600 seconds expire before the 10 encryption transactions have been completed, or if

the 10 encryption transactions are completed before 600 seconds have expired, conforming **SKCL** implementations MUST not use the key in question anymore.

Some examples of the <Permissions> element are as shown below; the enclosing <KeyUsePolicy> element, <Symkey> element and <SymkeyResponse> elements are not displayed for brevity:

Example 1 – A <Permissions> element that permits a single application the use of the symmetric key in question, between January 01, 2008 and December 31, 2008 and between the hours of 0700 and 1900. There are, however, no restrictions on what days of the week the key may be used, the locations where it may be used, at which MLS level it may be used (if it applies), the number of data files/transactions that may be encrypted with the key or the uses of the key within that application:

```
<ekmi:Permissions>
   <ekmi:PermittedApplications ekmi:any="false">
      <ekmi:PermittedApplication>
         <ekmi:ApplicationID>10514-23</ekmi:ApplicationID>
         <ekmi:ApplicationName>Payroll Application</ekmi:ApplicationName>
         <ekmi:Version>1.0</ekmi:Version>
         <ekmi:DigestAlgorithm>
            http://www.w3.org/2000/09/xmldsig#sha1
         </ekmi:DigestAlgorithm>
         <ekmi:DigestValue>
            229ea73a5e76eabd183663d332b283948a9202a1
         </ekmi:DigestValue>
      </ekmi:PermittedApplication>
   </ekmi:PermittedApplications>
   <ekmi:PermittedDates ekmi:any="false">
      <ekmi:PermittedDate>
         <ekmi:StartDate>2008-01-01</ekmi:StartDate>
         <ekmi:EndDate>2008-12-31</ekmi:EndDate>
      </ekmi:PermittedDate>
   </ekmi:PermittedDates>
   <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
   <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
   <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
   <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
   <ekmi:PermittedNumberOfTransactions ekmi:any="true" xsi:nil="true"/>
   <ekmi:PermittedTimes ekmi:any="false">
      <ekmi:PermittedTime>
         <ekmi:StartTime>07:00:00</ekmi:StartTime>
         <ekmi:EndTime>19:00:00</ekmi:EndTime>
      </ekmi:PermittedTime>
   </ekmi:PermittedTimes>
   <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
</ekmi:Permissions>
```

Example 2 – A <Permissions> element that permits two specific applications the use of the symmetric key in question, between January 01, 2009 and January 31, 2009.

```
<ekmi:Permissions>
   <ekmi:PermittedApplications ekmi:any="false">
      <ekmi:PermittedApplication>
         <ekmi:ApplicationID>10514-24</ekmi:ApplicationID>
         <ekmi:ApplicationName>
            Employee Tax Reporting Application
         </ekmi:ApplicationName>
         <ekmi:Version>3.3</ekmi:Version>
         <ekmi:DigestAlgorithm>
            http://www.w3.org/2000/09/xmldsig#sha1
         </ekmi:DigestAlgorithm>
```

```
            <ekmi:DigestValue>
               af96d65a7a2415239c8eb8be1347f704322957a4
            </ekmi:DigestValue>
         </ekmi:PermittedApplication>
         <ekmi:PermittedApplication>
               <ekmi:ApplicationID>10514-25</ekmi:ApplicationID>
               <ekmi:ApplicationName>
                  IRS Tax Reporting Application
               </ekmi:ApplicationName>
               <ekmi:Version>2.1</ekmi:Version>
               <ekmi:DigestAlgorithm>
                  http://www.w3.org/2000/09/xmldsig#sha1
               </ekmi:DigestAlgorithm>
               <ekmi:DigestValue>
                  a4f5925185ffe12c1a91ea3de90fc086b34b34b2
               </ekmi:DigestValue>
         </ekmi:PermittedApplication>
      </ekmi:PermittedApplications>
      <ekmi:PermittedDates ekmi:any="false">
         <ekmi:PermittedDate>
            <ekmi:StartDate>2009-01-01</ekmi:StartDate>
            <ekmi:EndDate>2009-12-31</ekmi:EndDate>
         </ekmi:PermittedDate>
      </ekmi:PermittedDates>
      <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedNumberOfTransactions ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedTimes ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
   </ekmi:Permissions>
```

Example 3 – A <Permissions> element that permits all applications the use of the symmetric key in question, for 100 transactions for encrypting credit card numbers.

```
   <ekmi:Permissions>
      <ekmi:PermittedApplications ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedDates ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedNumberOfTransactions ekmi:any="false">
         100
      </ekmi:PermittedNumberOfTransactions>
      <ekmi:PermittedTimes ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedUses ekmi:any="false">
         <ekmi:PermittedUse>CCN</ekmi:PermittedUse>
      </ekmi:PermittedUses>
   </ekmi:Permissions>
```

Example 4 – A <Permissions> element that permits all applications the use of the symmetric key in question, for 600 seconds once the SKCL starts using the key.

```
   <ekmi:Permissions>
      <ekmi:PermittedApplications ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedDates ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedDays ekmi:any="true" xsi:nil="true"/>
      <ekmi:PermittedDuration ekmi:any="false">600</ekmi:PermittedDuration>
      <ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
```

```
        <ekmi:PermittedLocations ekmi:any="true" xsi:nil="true"/>
        <ekmi:PermittedNumberOfTransactions ekmi:any="true" xsi:nil="true"/>
        <ekmi:PermittedTimes ekmi:any="true" xsi:nil="true"/>
        <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
    </ekmi:Permissions>
```

Example 5 – A <Permissions> element that permits a specific application the use of the symmetric key in question, at specific geographic locations only on weekdays between the hours of 0800 and 1700, and only when the application is operating at the Secret security level within an MLS system.

```
    <ekmi:Permissions>
        <ekmi:PermittedApplications ekmi:any="true" xsi:nil="true"/>
        <ekmi:PermittedDates ekmi:any="true" xsi:nil="true"/>
        <ekmi:PermittedDays ekmi:any="false”>
              <ekmi:PermittedDay>Weekday</ekmi:PermittedDay>
        </ekmi:PermittedDays>
        <ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
        <ekmi:PermittedLevels ekmi:any="false">
            <ekmi:PermittedLevel>Secret</ekmi:PermittedLevel>
        </ekmi:PermittedLevels>
        <ekmi:PermittedLocations ekmi:any="false”>
            <ekmi:PermittedLocation>
                <ekmi:LocationName>Facility A51</ekmi:LocationName>
                <ekmi:Latitude>37.385562</ekmi:Latitude>
                <ekmi:Longitude>-121.993387</ekmi:Latitude>
            </ekmi:PermittedLocation>
            <ekmi:PermittedLocation>
                <ekmi:LocationName>Facility DC-VA01</ekmi:LocationName>
                <ekmi:Latitude>88.485362</ekmi:Latitude>
                <ekmi:Longitude>-21.453648</ekmi:Latitude>
            </ekmi:PermittedLocation>
        </ekmi:PermittedLocations>
        <ekmi:PermittedNumberOfTransactions ekmi:any="true" xsi:nil="true"/>
        <ekmi:PermittedTimes ekmi:any="false”>
            <ekmi:PermittedTime>
        <ekmi:StartTime>08:00:00</ekmi:StartTime>
        <ekmi:EndTime>17:00:00</ekmi:EndTime>
            </ekmi:PermittedTime>
        </ekmi:PermittedTimes>
        <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
    </ekmi:Permissions>
```

4.13 Element <PermittedApplications> and <PermittedApplication>

The element <PermittedApplications>, of type ***PermittedApplicationsType*** and its only child-element <PermittedApplication> of type ***ApplicationsType*** are used to define the list of applications that are permitted to use a symmetric key within a specific <Symkey> element.

Schema Definition:

```
    <xsd:complexType name="PermittedApplicationsType">
        <xsd:sequence>
             <xsd:element
                  name="PermittedApplication"
```

```
                type="tns:ApplicationsType"
                minOccurs="0"
                maxOccurs="unbounded"/>
      </xsd:sequence>
      <xsd:attribute ref="tns:any" use="required"/>
   </xsd:complexType>
```

Schema Definition:

```
    <xsd:complexType name="ApplicationsType">
        <xsd:sequence>
            <xsd:element name="ApplicationID" type="tns:TwoPartIDType"/>
            <xsd:element name="ApplicationName">
                <xsd:simpleType>
                    <xsd:restriction base="xsd:string">
                        <xsd:maxLength value="256"/>
                        <xsd:whiteSpace value="preserve"/>
                    </xsd:restriction>
                </xsd:simpleType>
            </xsd:element>
            <xsd:element name="Version" minOccurs="0">
                <xsd:simpleType>
                    <xsd:restriction base="xsd:string">
                        <xsd:maxLength value="32"/>
                        <xsd:whiteSpace value="preserve"/>
                    </xsd:restriction>
                </xsd:simpleType>
            </xsd:element>
            <xsd:group ref="tns:MessageDigestGroup" minOccurs="0"/>
            <xsd:element name="Other" type="xsd:anyType" minOccurs="0"/>
        </xsd:sequence>
    </xsd:complexType>
```

Schema Definition:

```
   <xsd:group name="MessageDigestGroup">
      <xsd:sequence>
         <xsd:element name="DigestAlgorithm">
            <xsd:simpleType>
               <xsd:restriction base="xsd:anyURI">
                 <xsd:enumeration value="http://www.w3.org/2000/09/xmldsig#sha1"/>
                 <xsd:enumeration value="http://www.w3.org/2001/04/xmlenc#sha256"/>
                 <xsd:enumeration value="http://www.w3.org/2001/04/xmlenc#sha512"/>
               </xsd:restriction>
            </xsd:simpleType>
         </xsd:element>
         <xsd:element name="DigestValue">
            <xsd:simpleType>
               <xsd:restriction base="xsd:base64Binary">
                  <xsd:maxLength value="1024"/>
               </xsd:restriction>
            </xsd:simpleType>
         </xsd:element>
      </xsd:sequence>
   </xsd:group>
```

Schema Definition:

```
    <xsd:attribute name="any">
        <xsd:simpleType>
            <xsd:restriction base="xsd:string">
```

```
                <xsd:enumeration value="false"/>
                <xsd:enumeration value="true"/>
            </xsd:restriction>
        </xsd:simpleType>
    </xsd:attribute>
```

There SHALL be only one <PermittedApplications> element within the <Permissions> element. However, there MAY be an unbounded (unlimited) number of <PermittedApplication> elements within a <PermittedApplications> element.

The <PermittedApplications> element SHALL have one attribute named “any”, that will have a “false” or “true” value, based on the following:

- When the <PermittedApplications> element is null (i.e. it does not have a single <PermittedApplication> sub-element in it), the value of the “any” attribute SHALL be set to “true” AND the XML Schema Instance (XSI) “nil” attribute SHALL be set to “true”.
- When the <PermittedApplications> element is not-null (i.e. it has at least one <PermittedApplication> sub-element in it), the value of the “any” attribute SHALL be set to “false” AND the XML Schema Instance (XSI) “nil” attribute SHALL NOT be present.

A null <PermittedApplications> element specifies that ALL applications are permitted use of the symmetric key, subject to complying with all other permission clauses in the <KeyUsePolicy> element.

The <PermittedApplication> sub-element of type ***ApplicationsType***, provides details of the application which is permitted use of the symmetric key in question. The <PermittedApplication> element consists of the following sub-elements:

1. The <ApplicationID> element identifies the unique identifier assigned to this application within the SKMS. It is a ***TwoPartIDType*** as specified in Section 4.8. There SHALL be only one <ApplicationID> element within a <PermittedApplication> element.
2. The <ApplicationName> element identifies the name assigned to this application within the SKMS. It is an XSD ***String*** with a maximum length of 256 characters. There SHALL be only one <ApplicationName> element within a <PermittedApplication> element.
3. An optional <Version> element identifying the version number of this application within the **SKMS**. It is an XSD ***String*** with a maximum length of 32 characters. There MAY be only one <Version> element within a <PermittedApplication> element.
4. The <MessageDigestGroup> group which identifies the message digest value of the application's binary image, along with the message digest algorithm used to calculate the digest value. The <MessageDigestGroup> consists of the following elements:
    a) The <DigestAlgorithm> element of the XSD type ***anyURI***, which supports one of the following three digest algorithms:
        i. http://www.w3.org/2000/09/xmldsig#sha1
        ii. http://www.w3.org/2001/04/xmlenc#sha256
        iii. http://www.w3.org/2001/04/xmlenc#sha512
    b) The <DigestValue> element of the XSD type ***base64Binary***.

    There SHALL be only one <MessageDigestGroup> group within a <PermittedApplication> element.
5. An optional <Other> element that provides implementers the ability to carry other information about the application that may be relevant to their **SKMS**. Implementers are cautioned that the use of the <Other> element may not be supported by other **SKCL** implementations, and may break interoperability between two **SKMS** implementations. Should there be a strong need for

additional features in the <PermittedApplication> element, implementers are encouraged to contact the OASIS EKMI TC with their requirements.

NOTE: The **SKSML** specification does not specify how an **SKCL** implementation will determine the message digest of an application that needs to use the symmetric key in question. It is left to the implementers of the **SKCL** to determine the message digest of the calling application using the specified algorithm, and verify that the digest values match before the **SKCL** uses the symmetric key on behalf of the application.

Some examples of the <PermittedApplications> element are shown below; other parts of their enclosing elements are not shown for brevity:

Example 1 – An example of a <PermittedApplications> element with two child <PermittedApplication> elements with specific version numbers and message digest values:

```
<ekmi:PermittedApplications ekmi:any="false">
   <ekmi:PermittedApplication>
            <ekmi:ApplicationID>10514-24</ekmi:ApplicationID>
         <ekmi:ApplicationName>Employee Tax
Reporting</ekmi:ApplicationName>
      <ekmi:Version>3.3</ekmi:Version>
         <ekmi:DigestAlgorithm>
            http://www.w3.org/2000/09/xmldsig#sha1
      </ekmi:DigestAlgorithm>
       <ekmi:DigestValue>G4bsdfKkt4cziEqFFuOoBTM81efU=</ekmi:DigestValue>
   </ekmi:PermittedApplication>
   <ekmi:PermittedApplication>
            <ekmi:ApplicationID>10514-25</ekmi:ApplicationID>
        <ekmi:ApplicationName>IRS Tax Reporting
Application</ekmi:ApplicationName>
       <ekmi:Version>2.1</ekmi:Version>
       <ekmi:DigestAlgorithm>
            http://www.w3.org/2001/04/xmlenc#sha256
      </ekmi:DigestAlgorithm>
       <ekmi:DigestValue>

   ab7b85c9410d48c54fc7939c391be4028e7305085191c56e7b3740f2cbdbbc79
      </ekmi:DigestValue>
   </ekmi:PermittedApplication>
</ekmi:PermittedApplications>
```

Example 2 – An example of a <PermittedApplications> element with one child <PermittedApplication> element that applies to all versions of the application; the message digest value and algorithm are not used in this example:

```
<ekmi:PermittedApplications ekmi:any="false">
   <ekmi:PermittedApplication>
            <ekmi:ApplicationID>10514-14</ekmi:ApplicationID>
         <ekmi:ApplicationName>E-Commerce Payment</ekmi:ApplicationName>
   </ekmi:PermittedApplication>
</ekmi:PermittedApplications>
```

Example 3 – An example of a null <PermittedApplications> element specifying that ALL applications are permitted the use of the symmetric key:

```
<ekmi:PermittedApplications ekmi:any="true" xsi:nil="true"/>
```

4.14 Element <PermittedDates> and <PermittedDate>

The element <PermittedDates>, of type ***PermittedDatesType*** and its only child-element <PermittedDate>, which is an anonymous XSD ***ComplexType***, are used to define ranges of dates between which applications are permitted to use the symmetric key within a specific <Symkey> element.

Schema Definition:

```
<xsd:complexType name="PermittedDatesType">
   <xsd:sequence>
      <xsd:element name="PermittedDate" minOccurs="0" maxOccurs="unbounded">
         <xsd:complexType>
            <xsd:sequence>
               <xsd:element name="StartDate">
                  <xsd:simpleType>
                  <xsd:restriction base="xsd:date">
                        <xsd:pattern value="\p{Nd}{4}-\p{Nd}{2}-\p{Nd}{2}"/>
                     </xsd:restriction>
                  </xsd:simpleType>
               </xsd:element>
               <xsd:element name="EndDate">
                  <xsd:simpleType>
                  <xsd:restriction base="xsd:date">
                        <xsd:pattern value="\p{Nd}{4}-\p{Nd}{2}-\p{Nd}{2}"/>
                     </xsd:restriction>
                  </xsd:simpleType>
               </xsd:element>
            </xsd:sequence>
         </xsd:complexType>
      </xsd:element>
   </xsd:sequence>
   <xsd:attribute ref="tns:any" use="required"/>
 </xsd:complexType>
```

There SHALL be only one <PermittedDates> element within the <Permissions> element. However, there MAY be an unbounded number of <PermittedDate> elements within a <PermittedDates> element.

The <PermittedDates> element SHALL have one attribute named “any”, that will have a “false” or “true” value, based on the following:

- When the <PermittedDates> element is null (i.e. it does not have a single <PermittedDate> sub-element in it), the value of the “any” attribute SHALL be set to “true” AND the XML Schema Instance (XSI) “nil” attribute SHALL be set to “true”.
- When the <PermittedDates> element is not-null (i.e. it has at least one <PermittedDate> sub-element in it), the value of the “any” attribute SHALL be set to “false” AND the XML Schema Instance (XSI) “nil” attribute SHALL NOT be present.

A null <PermittedDates> element specifies that applications are permitted use of the symmetric key on any calendar date of the year, subject to complying with all other permission clauses in the <Permissions> element.

The <PermittedDate> sub-element identifies an individual set of dates between which application are permitted use of the symmetric key in question. The <PermittedDate> element consists of the following sub-elements:

1. The <StartDate> element identifies the date from which applications MAY start using the symmetric key in question. It is an XSD ***Date*** type that MUST be specified in a specific pattern (see examples) where the first four digits specify the year, the second two digits specify the

calendar month in the year, and the last two digits specify the calendar date of the month.

There SHALL be only one <StartDate> element within a <PermittedDate> element.

Conforming **SKCL** implementations SHALL NOT start using the symmetric before the onset of the <StartDate> on the client machine. Unless further constrained by the <PermittedTimes> element, the onset of the <StartDate> is specified to be the first second of the day – 00:00:01 Hours – on the client machine.

2. The <EndDate> element identifies the date until which applications may use the symmetric key in question. It is an XSD ***Date*** type that MUST be specified in a specific pattern (see examples) where the first four digits specify the year, the second two digits specify the calendar month in the year, and the last two digits specify the calendar date of the month.

   There SHALL be only one <EndDate> element within a <PermittedDate> element.

   Conforming **SKCL** implementations SHALL NOT use the symmetric after the end of the <EndDate> on the client machine. Unless further constrained by the <PermittedTimes> element, the end of the <EndDate> is specified to be the last second of the day – 23:59:59 Hours – on the client machine.

Examples of the <PermittedDates> element are shown below; other required parts of their enclosing elements are not shown for brevity:

Example 1 – An example of a <PermittedDates> element with a single<PermittedDate> element. The <StartDate> specifies January 01, 2009 while the <EndDate> specifies January 31, 2009:

```
<ekmi:PermittedDates ekmi:any=”false”>
   <ekmi:PermittedDate>
            <ekmi:StartDate>2009-01-01</ekmi:StartDate>
        <ekmi:EndDate>2009-01-31</ekmi:EndDate>
   </ekmi:PermittedDate>
</ekmi:PermittedDates>
```

Example 2 – An example of a <PermittedDates> element with two <PermittedDate> elements. For the first <PermittedDate> element , the <StartDate> element specifies July 01, 2008 while the <EndDate> element specifies July 03, 2008. For the second <PermittedDate> element, the <StartDate> element specifies July 07, 2008 while the <EndDate> element specifies July 12, 2008. This policy would restrict a symmetric key with this <PermittedDates> element so it cannot be used on the July 4th weekend of 2008:

```
<ekmi:PermittedDates ekmi:any=”false”>
   <ekmi:PermittedDate>
            <ekmi:StartDate>2008-07-01</ekmi:StartDate>
        <ekmi:EndDate>2008-07-03</ekmi:EndDate>
   </ekmi:PermittedDate>
   <ekmi:PermittedDate>
            <ekmi:StartDate>2008-07-07</ekmi:StartDate>
        <ekmi:EndDate>2009-07-12</ekmi:EndDate>
   </ekmi:PermittedDate>
</ekmi:PermittedDates>
```

Example 3 – An example of a null <PermittedDates> element, specifying that applications are permitted use of the symmetric key on any date:

```
<ekmi:PermittedDates ekmi:any=”true” xsi:nil=”true”/>
```

4.15 Element <PermittedDays> and <PermittedDay>

The element <PermittedDays> , of the type ***PermittedDaysType*** and its only child-element <PermittedDay> of the ***PermittedDayType***, are used to define days of the week on which applications are permitted to use a symmetric key within a specific <Symkey> element.

Schema Definition:

```
   <xsd:complexType name="PermittedDaysType">
      <xsd:sequence>
         <xsd:element
                name="PermittedDay"
                type="tns:PermittedDayType"
                minOccurs="0"
                maxOccurs="unbounded">
         </xsd:element>
      </xsd:sequence>
      <xsd:attribute ref="tns:any" use="required"/>
    </xsd:complexType>
```

Schema Definition:

```
   <xsd:simpleType name="PermittedDayType">
      <xsd:restriction base="xsd:string">
         <xsd:enumeration value="Sunday"/>
         <xsd:enumeration value="Monday"/>
         <xsd:enumeration value="Tuesday"/>
         <xsd:enumeration value="Wednesday"/>
         <xsd:enumeration value="Thursday"/>
         <xsd:enumeration value="Friday"/>
         <xsd:enumeration value="Saturday"/>
         <xsd:enumeration value="Weekday"/>
         <xsd:enumeration value="Weekend"/>
         </xsd:restriction>
   </xsd:simpleType>
```

There SHALL be only one <PermittedDays> element within the <Permissions> element. However, there MAY be an unbounded (unlimited) number of <PermittedDay> elements within a <PermittedDays> element.

The <PermittedDays> element SHALL have one attribute named “any”, that will have a “false” or “true” value, based on the following:

- When the <PermittedDays> element is null (i.e. it does not have a single <PermittedDay> sub-element in it), the value of the “any” attribute SHALL be set to “true” AND the XML Schema Instance (XSI) “nil” attribute SHALL be set to “true”.
- When the <PermittedDays> element is not-null (i.e. it has at least one <PermittedDay> sub-element in it), the value of the “any” attribute SHALL be set to “false” AND the XML Schema Instance (XSI) “nil” attribute SHALL NOT be present.

A null <PermittedDays> element specifies that applications are permitted use of the symmetric key on all days of the week, subject to complying with all other permission clauses in the <Permissions> element.

The <PermittedDay> element, of the XSD ***String*** type, identifies individual days of the week from an enumerated list on which application are permitted to use the symmetric key in question.

Examples of the <PermittedDays> element are shown below; other parts of their enclosing elements are not shown for brevity:

Example 1 – An example of a <PermittedDays> element with a single<PermittedDay> child element, specifying that the symmetric key may be used only on weekdays:

```
<ekmi:PermittedDays ekmi:any=”false”>
   <ekmi:PermittedDay>Weekday </ekmi:PermittedDay>
</ekmi:PermittedDays>
```

Example 2 – An example of a <PermittedDays> element with three <PermittedDay> child elements, specifying that the symmetric key may be used only on Mondays, Wednesdays and Fridays:

```
<ekmi:PermittedDays ekmi:any=”false”>
   <ekmi:PermittedDay>Monday</ekmi:PermittedDay>
   <ekmi:PermittedDay>Wednesday</ekmi:PermittedDay>
   <ekmi:PermittedDay>Friday</ekmi:PermittedDay>
</ekmi:PermittedDays>
```

Example 3 – An example of a null <PermittedDays> element, specifying that the symmetric key may be used on any day of the week:

```
<ekmi:PermittedDays ekmi:any=”true” xsi:nil=”true”/>
```

4.16 Element <PermittedDuration>

The element <PermittedDuration>, of the type ***PermittedDurationType*** is used to define the number of seconds, applications are permitted to use a symmetric key, once the **SKCL** has started using the symmetric key in question.

Schema Definition:

```
<xsd:complexType name="PermittedDurationType">
   <xsd:simpleContent>
      <xsd:extension base="tns:DurationType">
         <xsd:attribute ref="tns:any" use="required"/>
      </xsd:extension>
   </xsd:simpleContent>
</xsd:complexType>
```

Schema Definition:

```
<xsd:simpleType name="DurationType">
   <xsd:restriction base="xsd:positiveInteger">
      <xsd:minInclusive value="1"/>
      <xsd:maxInclusive value="18446744073709551615"/>
   </xsd:restriction>
</xsd:simpleType>
```

There SHALL be only one <PermittedDuration> element within the <Permissions> element.

The <PermittedDuration> element SHALL have one attribute, named “any” that will have a “false” or “true” value, based on the following:

- When the <PermittedDuration> element is null (i.e. it does not have any content in it), the value of the “any” attribute SHALL be set to “true” AND the XML Schema Instance (XSI) “nil” attribute SHALL be set to “true”.

- When the <PermittedDuration> element is not-null (i.e. it has content in it), the value of the "any" attribute SHALL be set to "false" AND the XML Schema Instance (XSI) "nil" attribute SHALL NOT be present.

A null <PermittedDuration> element specifies that applications are permitted use of the symmetric key indefinitely, subject to complying with all other permission clauses in the <Permissions> element.

The <PermittedDuration> element, of the XSD ***positiveInteger*** type, identifies the number of seconds for which the symmetric key in question may be used, ONCE the key has been used by conforming **SKCL** implementations for the first time. The values for <PermittedDuration> may range between 1 and 18446744073709551615.

As long as the symmetric has not been used by an **SKCL** on a client device (it might be cached for many days/weeks/months depending on the <KeyCachePolicy> in effect within the SKMS for that device) the effective lifetime of the symmetric key may be well past the number of seconds specified in <PermittedDuration> when calculated from the time of the key's generation time on the **SKS** server. It is the responsibility of the **SKCL** implementation, when presented with a <PermittedDuration> element in a <KeyUsePolicy> of a symmetric key, to keep track of the date/time when the symmetric key in question was first used on the client device, and how long the key will last after that.

Examples of the <PermittedDuration> element are shown below; other parts of their enclosing elements are not shown for brevity:

Example 1 – An example of a <PermittedDuration> element specifying that the symmetric key may be used only for a single 24-hour period from the moment it is first used by an SKCL:

```
<ekmi:PermittedDuration ekmi:any="false">86400</ekmi:PermittedDuration>
```

Example 2 – An example of a <PermittedDuration> element specifying that the symmetric key may be used only for week from the moment it is first used by an SKCL:

```
<ekmi:PermittedDuration ekmi:any="false">604800</ekmi:PermittedDuration>
```

Example 3 – An example of a <PermittedDuration> element specifying that the symmetric key may be used only 5 minutes from the moment it is first used by an SKCL:

```
<ekmi:PermittedDuration ekmi:any="false">300</ekmi:PermittedDuration>
```

Example 4 – An example of a null <PermittedDuration> element specifying that the symmetric key may be used indefinitely by an SKCL:

```
<ekmi:PermittedDuration ekmi:any="true" xsi:nil="true"/>
```

4.17 Element <PermittedLevels> and <PermittedLevel>

The element <PermittedLevels>, of the type ***LevelClassificationType,*** is used to define the security level at which applications are permitted use of a symmetric key. This element is useful only to applications and systems that conform to the multi-level security (MLS) system as defined in the Bell-LaPadula model.

Schema Definition:

```
<xsd:complexType name="PermittedLevelsType">
   <xsd:sequence>
      <xsd:element
```

```
                    name="PermittedLevel"
                    type="tns:LevelClassificationType"
                    minOccurs="0"
                    maxOccurs="unbounded">
          </xsd:element>
          <xsd:element name="Other" type="xsd:anyType" minOccurs="0"/>
       </xsd:sequence>
       <xsd:attribute ref="tns:any" use="required"/>
   </xsd:complexType>
```

Schema Definition:

```
   <xsd:simpleType name="LevelClassificationType">
        <xsd:restriction base="xsd:string">
            <xsd:enumeration value="Unclassified"/>
            <xsd:enumeration value="Confidential"/>
            <xsd:enumeration value="Secret"/>
            <xsd:enumeration value="Top-Secret"/>
        </xsd:restriction>
    </xsd:simpleType>
```

There SHALL be only one <PermittedLevels> element within the <Permissions> element. However, there MAY be an unbounded (unlimited) number of <PermittedLevel> elements within the <PermittedLevels> element. (Practically, it makes no sense to have more than the known levels; however, this specification leaves itself open to the possibility that other levels may be defined).

The <PermittedLevels> element SHALL have one attribute named “any”, that will have a “false” or “true” value, based on the following:

- When the <PermittedLevels> element is null (i.e. it does not have a single <PermittedLevel> sub-element in it), the value of the “any” attribute SHALL be set to “true” AND the XML Schema Instance (XSI) “nil” attribute SHALL be set to “true”.
- When the <PermittedLevels> element is not-null (i.e. it has at least one <PermittedLevel> sub-element in it), the value of the “any” attribute SHALL be set to “false” AND the XML Schema Instance (XSI) “nil” attribute SHALL NOT be present.

A null <PermittedLevels> element specifies that applications at ANY level are permitted use of the symmetric key, subject to complying with all other permission clauses in the <Permissions> element.

The <PermittedLevel> sub-element, of the ***LevelClassificationType*** , identifies the precise MLS level at which the symmetric key in question may be used. The <PermittedLevel> SHALL contain one of the following four (4) enumerated values:

1. Unclassified
2. Confidential
3. Secret
4. Top-Secret

Examples of the <PermittedLevels> element are shown below; other parts of their enclosing elements are not shown for brevity:

Example 1 – An example of a <PermittedLevels> element specifying that the symmetric key may be used only by applications at the Confidential level:

```
   <ekmi:PermittedLevels ekmi:any=”false”>
      <ekmi:PermittedLevel>Confidential</ekmi:PermittedLevel>
   </ekmi:PermittedLevels>
```

Example 2 – An example of a <PermittedLevels> element specifying that the symmetric key may be used only by applications at the Secret or Top-Secret level:

```
<ekmi:PermittedLevels ekmi:any="false">
   <ekmi:PermittedLevel>Secret</ekmi:PermittedLevel>
   <ekmi:PermittedLevel>Top-Secret</ekmi:PermittedLevel>
</ekmi:PermittedLevels>
```

Example 3 – An example of a null <PermittedLevels> element specifying that the symmetric key may be used at any level:

```
<ekmi:PermittedLevels ekmi:any="true" xsi:nil="true"/>
```

4.18 Element <PermittedLocations> and <PermittedLocation>

The element <PermittedLocations>, of the type ***PermittedLocationsType,*** is used to define the geographically physical locations where applications are permitted use of a symmetric key. This element is useful only to applications that have the ability to determine the Global Positioning System (GPS) location of the client device intending to use the symmetric key.

Schema Definition:

```
<xsd:complexType name="PermittedLocationsType">
   <xsd:sequence>
      <xsd:element name="PermittedLocation" minOccurs="1" maxOccurs="unbounded">
         <xsd:complexType>
            <xsd:sequence>
               <xsd:element name="LocationName">
                  <xsd:simpleType>
                  <xsd:restriction base="xsd:string">
                        <xsd:maxLength value="256"/>
                       <xsd:whiteSpace value="preserve"/>
                    </xsd:restriction>
                  </xsd:simpleType>
               </xsd:element>
               <xsd:group
                     ref="tns:LocationCoordinateGroup"
                     minOccurs="0"
                     maxOccurs="unbounded"/>
               <xsd:element name="Other" type="xsd:anyType" minOccurs="0"/>
            </xsd:sequence>
         </xsd:complexType>
      </xsd:element>
   </xsd:sequence>
<xsd:attribute ref="tns:any" use="required"/>
</xsd:complexType>
```

Schema Definition:

```
<xsd:group name="LocationCoordinateGroup">
    <xsd:sequence>
        <xsd:element name="Latitude">
           <xsd:simpleType>
               <xsd:restriction base="xsd:decimal">
```

```
                        <xsd:totalDigits value="10"/>
                        <xsd:fractionDigits value="7"/>
                    </xsd:restriction>
                </xsd:simpleType>
            </xsd:element>
            <xsd:element name="Longitude">
                <xsd:simpleType>
                    <xsd:restriction base="xsd:decimal">
                        <xsd:totalDigits value="10"/>
                        <xsd:fractionDigits value="7"/>
                    </xsd:restriction>
                </xsd:simpleType>
            </xsd:element>
        </xsd:sequence>
    </xsd:group>
```

There SHALL be only one <PermittedLocations> element within the <Permissions> element. However, there MAY be an unbounded (unlimited) number of <PermittedLocation> sub-elements within the <PermittedLocations> element.

The <PermittedLocations> element SHALL have one attribute named “any”, that will have a “false” or “true” value, based on the following:

- When the <PermittedLocations> element is null (i.e. it does not have a single <PermittedLocation> sub-element in it), the value of the “any” attribute SHALL be set to “true” AND the XML Schema Instance (XSI) “nil” attribute SHALL be set to “true”.
- When the <PermittedLocations> element is not-null (i.e. it has at least one <PermittedLocation> sub-element in it), the value of the “any” attribute SHALL be set to “false” AND the XML Schema Instance (XSI) “nil” attribute SHALL NOT be present.

A null <PermittedLocations> element specifies that applications are permitted use of the symmetric key at ANY physical location, subject to complying with all other permission clauses in the <Permissions> element.

The <PermittedLocation> element, of the ***PermittedLocationType***, identifies the precise geographical location where the symmetric key in question may be used. The <PermittedLocation> SHALL contain the following elements:

1. The <LocationName> element identifies a human-readable name of the physical location. It is an XSD ***String*** type element, with a maximum length of 256 characters.

   There SHALL be only one <LocationName> element within a <PermittedLocation> element.

2. An optional **LocationCoordinateGroup** which, when present, SHALL contain the following two elements:

   a) The <Latitude> element of XSD ***Decimal*** type, that identifies the horizontal coordinate location of the client device on the Earth, measured in *degrees* and expressed as a decimal with the *minutes* and *seconds* part of the measurement expressed as a single fraction.

      When used, there SHALL be only one <Latitude> element within the <PermittedLocation> element.

   b) The <Longitude> element of XSD ***Decimal*** type, that identifies the vertical coordinate location of the client device on the Earth, measured in *degrees* and expressed as a decimal with the *minutes* and *seconds* part of the measurement expressed as a single fraction.

When used, there SHALL be only one <Longitude> element within the <PermittedLocation> element.

Some examples of the <PermittedLocations> element are shown below; other parts of their enclosing elements are not shown for brevity:

Example 1 – An example of a <PermittedLocations> element specifying that the symmetric key may be used only by applications at a single named location:

```
<ekmi:PermittedLocations ekmi:any=”false”>
   <ekmi:PermittedLocation>
      <ekmi:LocationName>StrongAuth Server Room</ekmi:LocationName>
   </ekmi:PermittedLocation>
</ekmi:PermittedLocations>
```

Example 2 – An example of a <PermittedLocations> element specifying that the symmetric key may be used only by applications at a single location at the given GPS coordinates:

```
<ekmi:PermittedLocations ekmi:any=”false”>
   <ekmi:PermittedLocation>
      <ekmi:LocationName>StrongAuth Server Room</ekmi:LocationName>
      <ekmi:Latitude>37.385653 </ekmi:Latitude>
      <ekmi:Longitude>-121.993192 </ekmi:Longitude>
   </ekmi:PermittedLocation>
</ekmi:PermittedLocations>
```

Example 3 – An example of a <PermittedLocations> element specifying that the symmetric key may be used only by applications at multiple locations:

```
<ekmi:PermittedLocations ekmi:any=”false”>
   <ekmi:PermittedLocation>
      <ekmi:LocationName>Humongous Headquarters</ekmi:LocationName>
   </ekmi:PermittedLocation>
   <ekmi:PermittedLocation>
      <ekmi:LocationName> Humongous Primary Data Center</ekmi:LocationName>
      <ekmi:Latitude>37.385653 </ekmi:Latitude>
      <ekmi:Longitude>-121.993192 </ekmi:Longitude>
   </ekmi:PermittedLocation>
   <ekmi:PermittedLocation>
      <ekmi:LocationName>Humongous DR Data Center</ekmi:LocationName>
      <ekmi:Latitude>68.845901 </ekmi:Latitude>
      <ekmi:Longitude>11.393385 </ekmi:Longitude>
   </ekmi:PermittedLocation>
</ekmi:PermittedLocations>
```

Example 4 – An example of a null <PermittedLocations> element specifying that the symmetric key may be used at any location on the planet:

```
<ekmi:PermittedLocations ekmi:any=”true” xsi:nil=”true”/>
```

4.19 Element <PermittedNumberOfTransactions>

The element <PermittedNumberOfTransactions>, of type ***PermittedNumberOfTransactionsType*** is used to define the number of ***encryption*** transactions that applications are permitted with a symmetric key within a specific <Symkey> element, once the **SKCL** has started using the symmetric key in question. It does not limit the number of ***decryption*** transactions with the same symmetric key.

Schema Definition:

```
   <xsd:complexType name="PermittedNumberOfTransactionsType">
      <xsd:simpleContent>
         <xsd:extension base="tns:NumberOfTransactionsType">
            <xsd:attribute ref="tns:any" use="required"/>
         </xsd:extension>
      </xsd:simpleContent>
   </xsd:complexType>
```

Schema Definition:

```
   <xsd:simpleType name="NumberOfTransactionsType">
      <xsd:restriction base="xsd:positiveInteger">
         <xsd:minInclusive value="1"/>
         <xsd:maxInclusive value="18446744073709551615"/>
      </xsd:restriction>
   </xsd:simpleType>
```

There SHALL be only one <PermittedNumberOfTransactions> element within the <Permissions> element.

The <PermittedNumberOfTransactions> element SHALL have one attribute named “any”, that will have a “false” or “true” value, based on the following:

- When the <PermittedNumberOfTransactions> element is null (i.e. it does not have any content in it), the value of the “any” attribute SHALL be set to “true” AND the XML Schema Instance (XSI) “nil” attribute SHALL be set to “true”.
- When the <PermittedNumberOfTransactions> element is not-null (i.e. it has a positive integer content in it), the value of the “any” attribute SHALL be set to “false” AND the XML Schema Instance (XSI) “nil” attribute SHALL NOT be present.

A null <PermittedNumberOfTransactions> element specifies that applications are permitted use of the symmetric key for an unlimited number of encryption transactions, subject to complying with all other permission clauses in the <Permissions> element.

The value of <PermittedNumberOfTransactions> element, of the XSD ***positiveInteger*** type, MAY range between 1 and 18446744073709551615.

Some examples of the <PermittedNumberOfTransactions> element are shown below; other parts of their enclosing elements are not shown for brevity:

Example 1 – An example of a <PermittedNumberOfTransactions> element specifying that the symmetric key may be used only for a single encryption transaction by an SKCL:

```
   <ekmi:PermittedNumberOfTransactions ekmi:any=”false”>
      1
   </ekmi:PermittedNumberOfTransactions>
```

Example 2 – An example of a <PermittedNumberOfTransactions> element specifying that the symmetric key may be used only for 100 transactions by an SKCL:

```
   <ekmi:PermittedNumberOfTransactions ekmi:any=”false”>
      100
   </ekmi:PermittedNumberOfTransactions>
```

Example 3 – An example of a null <PermittedNumberOfTransactions> element specifying that the symmetric key may be used for an unlimited number of encryption transactions by an SKCL:

```
   <ekmi:PermittedNumberOfTransactions ekmi:any=”true” xsi:nil=”true”/>
```

4.20 Element <PermittedTimes> and <PermittedTime>

The element <PermittedTimes>, of the type ***PermittedTimesType*** and its only child-element <PermittedTime>, which is an anonymous XSD ***ComplexType***, are used to define sets of times during the day between which applications are permitted to use a symmetric key within a specific <Symkey> element.

Schema Definition:

```
<xsd:complexType name="PermittedTimesType">
   <xsd:sequence>
      <xsd:element name="PermittedTime" minOccurs="0" maxOccurs="unbounded">
         <xsd:complexType>
            <xsd:sequence>
               <xsd:element name="StartTime">
                  <xsd:simpleType>
                     <xsd:restriction base="xsd:time">
                        <xsd:pattern value="\p{Nd}{2}:\p{Nd}{2}:\p{Nd}{2}"/>
                     </xsd:restriction>
                  </xsd:simpleType>
               </xsd:element>
               <xsd:element name="EndTime">
                  <xsd:simpleType>
                     <xsd:restriction base="xsd:time">
                        <xsd:pattern value="\p{Nd}{2}:\p{Nd}{2}:\p{Nd}{2}"/>
                     </xsd:restriction>
                  </xsd:simpleType>
               </xsd:element>
            </xsd:sequence>
         </xsd:complexType>
      </xsd:element>
   </xsd:sequence>
   <xsd:attribute ref="tns:any" use="required"/>
</xsd:complexType>
```

There SHALL be only one <PermittedTimes> element within the <Permissions> element. However, there MAY be an unbounded (unlimited) number of <PermittedTime> sub-elements within a <PermittedTimes> element.

The <PermittedTimes> element SHALL have one attribute named “any”, that will have a “false” or “true” value, based on the following:

- When the <PermittedTimes> element is null (i.e. it does not have a single <PermittedTime> sub-element in it), the value of the “any” attribute SHALL be set to “true” AND the XML Schema Instance (XSI) “nil” attribute SHALL be set to “true”.
- When the <PermittedTimes> element is not-null (i.e. it has at least one <PermittedTime> sub-element in it), the value of the “any” attribute SHALL be set to “false” AND the XML Schema Instance (XSI) “nil” attribute SHALL NOT be present.

A null <PermittedTimes> element specifies that applications are permitted use of the symmetric key at ANY time of the day or night, subject to complying with all other permission clauses in the <Permissions> element.

The <PermittedTime> sub-element identifies an individual set of times between which application are permitted to use the symmetric key in question. The <PermittedTime> element consists of the following sub-elements:

1. The <StartTime> element identifies the date from which applications may start using the symmetric key in question. It is an XSD ***Time*** type that MUST be specified in a specific pattern (see examples) where the first two digits specify the hour, the second two digits specify the minutes and the last two digits specify the seconds in a 24 hour format.

   There SHALL be only one <StartTime> element within a <PermittedTime> element.

   Conforming **SKCL** implementations SHALL NOT start using the symmetric before the onset of the <StartTime> on the client machine.

2. The <EndTime> element identifies the time until which applications may use the symmetric key in question. It is an XSD ***Time*** type that MUST be specified in a specific pattern (see examples) where the first two digits specify the hour, the second two digits specify the minutes and the last two digits specify the seconds in a 24 hour format.

   There SHALL be only one <EndTime> element within a <PermittedTime> element.

   Conforming **SKCL** implementations SHALL NOT use the symmetric after the end of the <EndTime> on the client machine.

Some examples of the <PermittedTimes> element are shown below; other parts of their enclosing elements are not shown for brevity:

Example 1 – An example of a <PermittedTimes> element with a single<PermittedTime> element. The <StartTime> specifies 9:00AM on the client machine while the <EndTime> specifies 5:00PM:

```
<ekmi:PermittedTimes ekmi:any=”false”>
   <ekmi:PermittedTime>
            <ekmi:StartTime>09:00:00</ekmi:StartTime>
       <ekmi:EndTime>17:00:00</ekmi:EndTime>
   </ekmi:PermittedTime>
</ekmi:PermittedTimes>
```

Example 2 – An example of a <PermittedTimes> element with two <PermittedTime> elements. For the first <PermittedTime> element , the <StartTime> element specifies 6:00AM while the <EndTime> element specifies 12:00 Noon. For the second <PermittedTime> element, the <StartTime> element specifies 3:00 PM in the afternoon, while the <EndTime> element specifies 7:00PM in the evening. This policy might imply that a symmetric key with this <PermittedTimes> element cannot be used during a lunch break of 12:00 Noon to 3:00PM:

```
<ekmi:PermittedTimes ekmi:any=”false”>
   <ekmi:PermittedTime>
            <ekmi:StartTime>06:00:00</ekmi:StartTime>
       <ekmi:EndTime>12:00:00</ekmi:EndTime>
   </ekmi:PermittedTime>
   <ekmi:PermittedTime>
            <ekmi:StartTime>15:00:00</ekmi:StartTime>
       <ekmi:EndTime>19:00:00</ekmi:EndTime>
   </ekmi:PermittedTime>
</ekmi:PermittedTimes>
```

Example 3 – An example of a null <PermittedTimes> element, specifying that the key may be used at any time:

```
<ekmi:PermittedTimes ekmi:any=”true” xsi:nil=”true”/>
```

4.21 Element <PermittedUses> and <PermittedUse>

The element <PermittedUses>, of the type ***PermittedUsesType,*** is used to define the specific ways in which applications are permitted to use a symmetric key within a specific <Symkey> element.

Schema Definition:

```
<xsd:complexType name="PermittedUsesType" mixed="true">
   <xsd:sequence>
      <xsd:element name="PermittedUse" minOccurs="0" maxOccurs="unbounded">
         <xsd:simpleType>
            <xsd:restriction base="xsd:string">
               <xsd:maxLength value="256"/>
               <xsd:whiteSpace value="preserve"/>
            </xsd:restriction>
         </xsd:simpleType>
      </xsd:element>
      <xsd:element name="Other" type="xsd:anyType" minOccurs="0"/>
   </xsd:sequence>
   <xsd:attribute ref="tns:any" use="required"/>
</xsd:complexType>
```

There SHALL be only one <PermittedUses> element within the <Permissions> element. However, there MAY be an unbounded (unlimited) number of <PermittedUse> sub-elements within the <PermittedUses> element.

The <PermittedUses> element SHALL have one attribute named “any”, that will have a “false” or “true” value, based on the following:

- When the <PermittedUses> element is null (i.e. it does not have a single <PermittedUse> sub-element in it), the value of the “any” attribute SHALL be set to “true” AND the XML Schema Instance (XSI) “nil” attribute SHALL be set to “true”.
- When the <PermittedUses> element is not-null (i.e. it has at least one <PermittedUse> sub-element in it), the value of the “any” attribute SHALL be set to “false” AND the XML Schema Instance (XSI) “nil” attribute SHALL NOT be present.

A null <PermittedUses> element specifies that applications are permitted use of the symmetric key for ANY purpose, subject to complying with all other permission clauses in the <Permissions> element.

Examples of the <PermittedUses> element are shown below; other parts of their enclosing elements are not shown for brevity:

Example 1 – An example of a <PermittedUses> element specifying that the symmetric key may be used only by VPN applications for session encryption keys:

```
<ekmi:PermittedUses ekmi:any=”false”>
   <ekmi:PermittedUse>VPN</ekmi:PermittedUse>
</ekmi:PermittedUses>
```

Example 2 – An example of a <PermittedUses> element specifying that the symmetric key may be used only by applications on laptops and Personal Digital Assistants (PDA):

```
<ekmi:PermittedUses ekmi:any=”false”>
   <ekmi:PermittedUse>Laptop</ekmi:PermittedUse>
```

```
        <ekmi:PermittedUse>PDA</ekmi:PermittedUse>
    </ekmi:PermittedUses>
```

Example 3 – An example of a null <PermittedUses> element specifying that the symmetric key may be used for any purpose:

```
    <ekmi:PermittedUses ekmi:any="true" xsi:nil="true"/>
```

4.22 Element <KeyCachePolicyRequest>

The <KeyCachePolicyRequest> element is used to request a key-cache policy from the **SKS** server , so the client may know if and how to cache symmetric keys locally.

While it is a top-level element within this specification, a <SymkeyRequest> element MUST be enclosed within a ***SOAP Body*** element of a ***SOAP Envelope*** to conform to the security requirements of this specification. The ***SOAP Header*** of the ***SOAP Envelope*** MUST enclose a ***Security*** element conforming to **[WSS]** with a ***ValueType*** attribute containing the value http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-x509-token-profile-1.0#X509v3. The ***Security*** element must conform to all other requirements of the specified security profile in **[WSS]** to form a well-formed, secure message.

Schema Definition:

```
    <xsd:element name="KeyCachePolicyRequest">
        <xsd:complexType>
            <xsd:annotation>
                <xsd:documentation>
                    No elements/attributes are defined for KeyCachePolicyRequest.
                </xsd:documentation>
            </xsd:annotation>
        </xsd:complexType>
    </xsd:element>
```

The <KeyCachePolicyRequest> has no child elements. The SOAP Header of the signed request provides the **SKS** server with all the information it needs to process the request: the identity of the requester, strong authentication and message integrity of the request.

Some examples of the use of the <SymkeyRequest> element are as follows:

Example 1 – An example of a <KeyCachePolicyRequest>; the surrounding SOAP envelope is not displayed here for brevity:

```
    <ekmi:KeyCachePolicyRequest
      xmlns:ekmi="http://docs.oasis-open.org/ekmi/2008/01"/>
```

4.23 Element <KeyCachePolicyResponse>

The <KeyCachePolicyResponse> element is the response sent by an **SKS** Server to a client that requested a key-cache policy through a <KeyCachePolicyRequest>. The <KeyCachePolicyResponse> contains policy elements, which define rules that conforming implementations of the **SKCL** MUST adhere to when caching symmetric keys sent by the **SKS** Server.

Schema Definition:

```
    <xsd:element name="KeyCachePolicyResponse">
        <xsd:complexType>
            <xsd:sequence>
                <xsd:element
```

```
                    name="KeyCachePolicy"
                    type="ekmi:KeyCachePolicyType"
                    minOccurs="1" maxOccurs="unbounded"/>
            </xsd:sequence>
        </xsd:complexType>
    </xsd:element>
```

The <KeyCachePolicyResponse> element consists of a minimum of one, but an unbounded (unlimited) number of <KeyCachePolicy> children elements.

4.24 Element <KeyCachePolicy>

The <KeyCachePolicy> element contains policy elements, which define rules that conforming implementations of the **SKCL** MUST adhere to when caching symmetric keys sent by the **SKS** Server.

Schema Definition:

```
   <xsd:element name="KeyCachePolicyResponse">
        <xsd:complexType>
            <xsd:sequence>
                <xsd:element
                    name="KeyCachePolicy"
                    type="ekmi:KeyCachePolicyType"
                    minOccurs="1" maxOccurs="unbounded"/>
            </xsd:sequence>
        </xsd:complexType>
    </xsd:element>

   <xsd:complexType name="KeyCachePolicyType" mixed="true">
        <xsd:sequence>
            <xsd:element name="KeyCachePolicyID" type="tns:TwoPartIDType"/>
            <xsd:element name="PolicyName">
                <xsd:simpleType>
                    <xsd:restriction base="xsd:string">
                        <xsd:maxLength value="255"/>
                        <xsd:whiteSpace value="preserve"/>
                    </xsd:restriction>
                </xsd:simpleType>
            </xsd:element>
            <xsd:element name="Description" nillable="true">
                <xsd:simpleType>
                    <xsd:restriction base="xsd:string">
                        <xsd:maxLength value="2048"/>
                        <xsd:whiteSpace value="preserve"/>
                    </xsd:restriction>
                </xsd:simpleType>
            </xsd:element>
            <xsd:element name="KeyClass" type="tns:KeyClassType"/>
            <xsd:element name="StartDate" type="xsd:dateTime"/>
            <xsd:element name="EndDate" type="xsd:dateTime" nillable="true"/>
            <xsd:element name="PolicyCheckInterval">
                <xsd:simpleType>
                    <xsd:restriction base="xsd:nonNegativeInteger">
                        <xsd:minInclusive value="0"/>
                        <xsd:maxInclusive value="2592000"/>
                    </xsd:restriction>
                </xsd:simpleType>
            </xsd:element>
```

```
            <xsd:element name="Status" type="tns:StatusType"/>
            <xsd:element
                 name="NewKeysCacheDetail"
                 type="tns:KeyCacheDetailType"
                 minOccurs="0"/>
            <xsd:element
                 name="UsedKeysCacheDetail"
                 type="tns:KeyCacheDetailType"
                 minOccurs="0"/>
        </xsd:sequence>
    </xsd:complexType>
```

The <KeyCachePolicy> element is of the ***KeyCachePolicyType*** and consists of the following child elements:

1. <KeyCachePolicyID> [Required]

   The <KeyCachePolicyID> element, of type ***TwoPartIDType*** , identifies the unique policy object within the **SKMS**. There SHALL be only one <KeyCachePolicyID> element within a <KeyCachePolicy> element.

   The ***TwoPartIDType*** is specified in Section 4.8.

2. <PolicyName> [Required]

   The <PolicyName> element ,of type XSD ***String***, with a maximum length of 255 characters, identifies a unique name given to this <KeyCachePolicy>. There SHALL be only one <PolicyName> element within a <KeyCachePolicy> element.

3. <Description> [Required]

   The <Description> element , of type XSD ***String*** , with a maximum length of 2048 characters, provides a human-readable description of this policy. There SHALL be only one <Description> element within a <KeyCachePolicy> element.

   The <Description> MAY be an empty element, but MUST exist within the <KeyCachePolicy> element.

4. <KeyClass> [Required]

   This element of type ***KeyClassType*** identifies the key-class of the symmetric key to which this policy applies.

5. <StartDate> [Required]

   The <StartDate> element , of type XSD ***dateTime***, specifies the date and time at which this policy becomes effective. There SHALL be only one <StartDate> element within a <KeyCachePolicy> element.

6. <EndDate> [Required]

   The <EndDate> element , of type XSD ***dateTime***, specifies the date and time at which this policy expires. There SHALL be only one <EndDate> element within a <KeyCachePolicy> element.

   The <EndDate> MAY be an empty element, but MUST exist within the <KeyCachePolicy> element.

7. <PolicyCheckInterval> [Required]

The <PolicyCheckInterval> element , of type XSD ***nonNegativeInteger***, specifies the frequency at which the client SHALL check the **SKS** server for updates to this policy. This frequency is specified in seconds and SHALL NOT exceed 2592000 seconds (30 calendar days). There SHALL be only one <PolicyCheckInterval> element within a <KeyCachePolicy> element.

8. <Status> [Required]

   The <Status> element, of type ***StatusType***, identifies the current status of this policy within the SKMS. There SHALL be only one <Status> element within a <KeyCachePolicy> element.

   The ***StatusType*** is specified in Section 4.11.

9. <NewKeysCacheDetail> [Required]

   The <NewKeysCacheDetail> element, of type ***KeyCacheDetailType***, defines how many new (as yet unused for any encryption transaction) symmetric keys a client may cache, and for how long. It is the responsibility of the conforming **SKCL** implementation to enforce these rules.

   The absence of the <NewKeysCacheDetail> element implies that new symmetric keys SHALL NEVER be cached on the client. New keys may be cached only when this element exists, and SHALL conform to the rules specified in this element.

   When it exists, there SHALL be only one <NewKeysCacheDetail> element in a <KeyCachePolicy> element.

   The ***KeyCacheDetailType*** is specified in Section 4.22.

10. <UsedKeysCacheDetail> [Required]

    The <UsedKeysCacheDetail> element, of type ***KeyCacheDetailType***, defines how many used symmetric keys a client may cache, and for how long. It is the responsibility of the conforming **SKCL** implementation to enforce these rules.

    The absence of the <UsedKeysCacheDetail> element implies that used symmetric keys SHALL NEVER be cached on the client. Used keys may be cached only when this element exists, and SHALL conform to the rules specified in this element.

    When it exists, there SHALL be only one <UsedKeysCacheDetail> element in a <KeyCachePolicy> element.

    The ***KeyCacheDetailType*** is specified in Section 4.22.

Some examples of the <KeyUsePolicy> element are as follows.

Example 1 – A <KeyCachePolicy> that is valid between January 01, 2008 and December 31, 2008. It requires the client to check for policy updates every day and allows 3 new and 3 used keys to be cached for up to 90 days:

```
<ekmi:KeyCachePolicy>
    <ekmi:KeyCachePolicyID>10514-17</ekmi:KeyCachePolicyID>
    <ekmi:PolicyName>
        Corporate Laptop Symmetric Key Caching Policy
    </ekmi:PolicyName>
    <ekmi:Description>
        This policy defines how company-issued laptops will manage
        symmetric keys used for file/disk encryption in each laptop's
        local cache.  This policy must be used by all laptops that
        use the company EKMI.
```

```
        </ekmi:Description>
        <ekmi:StartDate>2008-01-01T00:00:01.0</ekmi:StartDate>
        <ekmi:EndDate>2008-12-31T24:00:00.0</ekmi:EndDate>
        <ekmi:PolicyCheckInterval>86400</ekmi:PolicyCheckInterval>
        <ekmi:Status>Active</ekmi:Status>
        <ekmi:NewKeysCacheDetail>
            <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
            <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
        </ekmi:NewKeysCacheDetail>
        <ekmi:UsedKeysCacheDetail>
            <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
            <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
        </ekmi:UsedKeysCacheDetail>
    </ekmi:KeyCachePolicy>
```

Example 2 – A <KeyCachePolicy> that is effective starting January 01, 2008 and never expires. It does NOT permit any caching of symmetric keys through the absence of the detail elements on caching:

```
    <ekmi:KeyCachePolicy>
      <ekmi:KeyCachePolicyID>10514-1</ekmi:KeyCachePolicyID>
      <ekmi:PolicyName>
        No Caching Policy
      </ekmi:PolicyName>
      <ekmi:Description>
        This policy is for high-risk, always-connected machines on the
        network, which will never cache symmetric keys locally.  This
        policy never expires (but checks monthly for any updates).
      </ekmi:Description>
      <ekmi:StartDate>2008-01-01T00:00:01.0</ekmi:StartDate>
      <ekmi:EndDate>1969-01-01T00:00:00.0</ekmi:EndDate>
      <ekmi:PolicyCheckInterval>2592000</ekmi:PolicyCheckInterval>
      <ekmi:Status>Active</ekmi:Status>
    </ekmi:KeyCachePolicy>
```

4.25 Type *KeyCacheDetailType*

The ***KeyCacheDetailType*** type allows **SKS** servers to specify precisely how many symmetric keys MAY be cached on the client machine, and for how long.

Schema Definition:

```
   <xsd:complexType name="KeyCacheDetailType">
        <xsd:sequence>
            <xsd:element name="MaximumKeys" minOccurs="1">
                <xsd:simpleType>
                    <xsd:restriction base="xsd:integer">
                        <xsd:minInclusive value="0"/>
                        <xsd:maxInclusive value="18446744073709551615"/>
                    </xsd:restriction>
                </xsd:simpleType>
            </xsd:element>
            <xsd:element name="MaximumDuration" minOccurs="1">
                <xsd:simpleType>
                    <xsd:restriction base="xsd:integer">
                        <xsd:minInclusive value="0"/>
                        <xsd:maxInclusive value="18446744073709551615"/>
                    </xsd:restriction>
```

```
                </xsd:simpleType>
            </xsd:element>
        </xsd:sequence>
    </xsd:complexType>
```

The ***KeyCacheDetailType*** consists of the following child elements:

1. <MaximumKeys> [Required]

   The <MaximumKeys> element, of type XSD ***Integer*** ,specifies the maximum number of symmetric keys that MAY be cached on a client machine. It SHALL be a positive number between the values 0 and 18446744073709551615. There SHALL be only one <MaximumKeys> element within an element that uses the ***KeyCacheDetailType.***

2. <MaximumDuration> [Required]

   The <MaximumDuration> element, of type XSD ***Integer*** ,specifies the maximum number of seconds that symmetric keys MAY be cached on a client machine. It SHALL be a positive number between the values 0 and 18446744073709551615. There SHALL be only one <MaximumDuration> element within an element that uses the ***KeyCacheDetailType.***

Examples of the ***KeyCacheDetailType*** when used in the <KeyCachePolicy> element are as follows.

Example 1 – A <KeyCachePolicy> that is valid between January 01, 2008 and December 31, 2008. It requires the client to check for policy updates every day and allows 3 new and 3 used keys to be cached for up to 90 days:

```
<ekmi:KeyCachePolicy>
    <ekmi:KeyCachePolicyID>10514-17</ekmi:KeyCachePolicyID>
    <ekmi:PolicyName>
        Corporate Laptop Symmetric Key Caching Policy
    </ekmi:PolicyName>
    <ekmi:Description>
        This policy defines how company-issued laptops will manage
        symmetric keys used for file/disk encryption in their local
        cache.  This policy must be used by all laptops that use
        the company EKMI.
    </ekmi:Description>
    <ekmi:StartDate>2008-01-01T00:00:01.0</ekmi:StartDate>
    <ekmi:EndDate>2008-12-31T24:00:00.0</ekmi:EndDate>
    <ekmi:PolicyCheckInterval>86400</ekmi:PolicyCheckInterval>
    <ekmi:Status>Active</ekmi:Status>
    <ekmi:NewKeysCacheDetail>
        <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
        <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
    </ekmi:NewKeysCacheDetail>
    <ekmi:UsedKeysCacheDetail>
        <ekmi:MaximumKeys>3</ekmi:MaximumKeys>
        <ekmi:MaximumDuration>7776000</ekmi:MaximumDuration>
    </ekmi:UsedKeysCacheDetail>
</ekmi:KeyCachePolicy>
```

Example 1 – A <KeyCachePolicy> that is valid between January 01, 2008 and December 31, 2008. It requires the client to check for policy updates every day and allows 1 new and 0 used keys to be cached for upto 15 days:

```
<ekmi:KeyCachePolicy>
  <ekmi:KeyCachePolicyID>10514-17</ekmi:KeyCachePolicyID>
  <ekmi:PolicyName>
    Corporate Laptop Symmetric Key Caching Policy
  </ekmi:PolicyName>
```

```
        <ekmi:Description>
           This policy defines how company-issued laptops will manage
           symmetric keys used for file/disk encryption in each laptop's
           local cache.  This policy must be used by all laptops that
           use the company EKMI.
        </ekmi:Description>
        <ekmi:StartDate>2008-01-01T00:00:01.0</ekmi:StartDate>
        <ekmi:EndDate>2008-12-31T24:00:00.0</ekmi:EndDate>
        <ekmi:PolicyCheckInterval>86400</ekmi:PolicyCheckInterval>
        <ekmi:Status>Active</ekmi:Status>
        <ekmi:NewKeysCacheDetail>
           <ekmi:MaximumKeys>1</ekmi:MaximumKeys>
           <ekmi:MaximumDuration>1296000</ekmi:MaximumDuration>
        </ekmi:NewKeysCacheDetail>
        <ekmi:UsedKeysCacheDetail>
           <ekmi:MaximumKeys>0</ekmi:MaximumKeys>
           <ekmi:MaximumDuration>1296000</ekmi:MaximumDuration>
        </ekmi:UsedKeysCacheDetail>
     </ekmi:KeyCachePolicy>
```

5 Bindings

An SKSML implementation can provide symmetric key services over a wide variety of transport mechanisms. This is referred to as “Bindings” of this specification. To maintain compliance with the specification, implementations must support the bindings that are REQUIRED.

5.1 W3C Security Binding

An SKSML implementation is REQUIRED to provide a binding that transports SKSML messages with support for XML Signatures and XML Encryption.

5.2 Mutually Authenticated TLS Binding

An SKSML implementation is REQUIRED to provide a binding that transports SKSML messages over a TLS connection that is mutually authenticated.

5.3 SOAP-WSS Binding

An SKSML implementation MAY provide SOAP and Web Services Security [WSS] support for transporting SKSML messages.

6 Conformance

An implementation conforms to this specification if it satisfies all of the MUST or REQUIRED level requirements defined within this specification. An SKSML Node MUST NOT use the XML namespace identifier for this specification (listed in the Title section under Declared Namespace(s)) within SOAP Envelopes unless it is compliant with this specification.

This specification references a number of other specifications (see the table above). In order to comply with this specification, an implementation MUST implement the portions of referenced specifications necessary to comply with the required provisions of this specification. Additionally, the implementation of the portions of the referenced specifications that are specifically cited in this specification MUST comply with the rules for those portions as established in the referenced specification.

Additionally normative text within this specification takes precedence over normative outlines, which in turn take precedence over the XML Schema [XML Schema Part 1, Part 2] descriptions. That is, the normative text in this specification further constrains the schema part of this specification; and this specification contains further constraints on the elements defined in referenced schemas.

If an OPTIONAL message is not supported, then the implementation SHOULD Fault just as it would for any other unrecognized/unsupported message. If an OPTIONAL message is supported, then the implementation MUST satisfy all of the MUST and REQUIRED sections of the message.

Appendix A. Acknowledgments

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

Participants:

- Arshad Noor, StrongAuth (Former Chair of EKMI TC)
- Anil Saldhana, Red Hat
- Tomas Gustavsson, PrimeKey
- Tim Bruce, CA
- Eric Lengvenis, Wells Fargo
- Upendra Mardikar, Paypal Inc.
- Ken Adler, Individual
- Davi Ottenheimer, Individual
- Benjamin Tomhave, Individual
- Shahid Sharif, Individual
- Marc Massar, Individual
- Shaheen N Abdul Jabbar - Individual

Appendix B. Non-Normative Text

Appendix C. SKSML Error Codes and Error Messages

Appendix D. Revision History

Version	Date	Author	Notes
DRAFT 4	June 08, 2008	Arshad Noor	Initial version
DRAFT 5	June 17, 2008	Arshad Noor	Moved non-normative sections to their own document. KeyClass element was added to KeyCachePolicy. KeyCachePolicy is now embedded inside a KeyCachePolicyResponse.
DRAFT 6	July 7, 2008	Arshad Noor	Modified Permissions object to include all sub-elements on a mandatory basis. Modified all abbreviations in elements to expand to full names.
PR 1	July 22, 2008	Arshad Noor	Modified Title page information to conform with OASIS standards. Brought some Background information into this document from the information document, into Section 2. Added a Conformance section to Section 4.
PR2	10/19/09	Anil Saldhana	Updated the document to the August 2008 template. Added a Profile section