Porteable Symmeetric Key Container

draft-vassilev-portable-symmetric-key-container-01.txt

Status of this Memo

By submitting this Internet-Draft, each author represents that any applicable patent or other IPR claims of which he or she is aware have been or will be disclosed, and any of which he or she becomes aware will be disclosed, in accordance with Section 6 of BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

The list of current Internet-Drafts can be accessed at http://www.ietf.org/ietf/1id-abstracts.txt.

The list of Internet-Draft Shadow Directories can be accessed at http://www.ietf.org/shadow.html.

This Internet-Draft will expire on February 19, 2007.

Copyright Notice

Copyright (C) The Internet Society (2006).
Abstract

This document specifies a shared secret token format for transport and provisioning of shared secrets (One Time Password (OTP) keys or symmetric cryptographic keys) to different types of strong authentication devices. The standard token format enables enterprises to deploy best-of-breed solutions combining components from different vendors into the same infrastructure.

This work is a joint effort by the members of OATH (Initiative for Open AuTHentication) to specify a format that can be freely distributed to the technical community. The authors believe that a common and shared specification will facilitate adoption of two-factor authentication on the Internet by enabling interoperability between commercial and open-source implementations.

Table of Contents

1. Introduction .............................................. 4
2. Conventions used in this document .................... 5
3. Use Cases ................................................. 6
   3.1. Offline Use Cases .................................. 6
      3.1.1. Credential migration by end-user ............ 6
      3.1.2. Bulk import of new credentials ............. 6
      3.1.3. Bulk migration of existing credentials ...... 6
      3.1.4. Credential upload case ....................... 7
   3.2. Online Use Cases .................................. 7
      3.2.1. Online provisioning a credential to end-user's authentication token ............... 7
      3.2.2. Server to server provisioning of credentials .......... 8
      3.2.3. Online update of an existing authentication token credential .................... 8
4. Requirements ............................................ 9
5. Shared Secret Attributes ................................ 11
   5.1. Common Attributes .................................. 11
      5.1.1. SecretAlgorithm (MANDATORY) ................ 11
      5.1.2. Usage (MANDATORY) ............................. 11
      5.1.3. SecretId (MANDATORY) ........................ 11
      5.1.4. Issuer (MANDATORY) ............................ 11
      5.1.5. AccessRules (OPTIONAL) ....................... 12
      5.1.6. EncryptionMethod (MANDATORY) ............... 12
      5.1.7. DigestMethod (MANDATORY when Digest is present) .................. 12
      5.1.8. OTP and CR specific Attributes ............... 12
      5.1.9. Counter (OPTIONAL) ............................ 12
      5.1.10. Time (OPTIONAL) ................................ 13
      5.1.11. Challenge (MANDATORY) ........................ 13
      5.1.12. Response (MANDATORY) ......................... 14
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.13</td>
<td>AppProfileId (OPTIONAL)</td>
</tr>
<tr>
<td>6.</td>
<td>Secret container XML schema definitions</td>
</tr>
<tr>
<td>6.1</td>
<td>XML Schema Types</td>
</tr>
<tr>
<td>6.1.1</td>
<td>SecretType</td>
</tr>
<tr>
<td>6.1.2</td>
<td>UsageType</td>
</tr>
<tr>
<td>6.1.3</td>
<td>DeviceType</td>
</tr>
<tr>
<td>6.1.4</td>
<td>DeviceIdType</td>
</tr>
<tr>
<td>6.1.5</td>
<td>UserType Type</td>
</tr>
<tr>
<td>6.1.6</td>
<td>SecretContainerType</td>
</tr>
<tr>
<td>6.1.7</td>
<td>EncryptionMethodType</td>
</tr>
<tr>
<td>6.1.8</td>
<td>DigestMethodType</td>
</tr>
<tr>
<td>6.1.9</td>
<td>OtpAlgorithmIdentifierType</td>
</tr>
<tr>
<td>6.2</td>
<td>EncryptionAlgorithmType</td>
</tr>
<tr>
<td>6.3</td>
<td>DigestAlgorithmType</td>
</tr>
<tr>
<td>6.4</td>
<td>SecretAlgorithmType</td>
</tr>
<tr>
<td>6.5</td>
<td>valueFormat</td>
</tr>
<tr>
<td>6.6</td>
<td>Data elements</td>
</tr>
<tr>
<td>6.6.1</td>
<td>SecretContainer</td>
</tr>
<tr>
<td>7.</td>
<td>Formal Syntax</td>
</tr>
<tr>
<td>8.</td>
<td>Security Syntax</td>
</tr>
<tr>
<td>8.1</td>
<td>Payload confidentiality</td>
</tr>
<tr>
<td>8.2</td>
<td>Payload integrity</td>
</tr>
<tr>
<td>8.3</td>
<td>Payload authenticity</td>
</tr>
<tr>
<td>9.</td>
<td>Appendix A - Example Symmetric Key Containers</td>
</tr>
<tr>
<td>9.1</td>
<td>Symmetric Key Container with a single Non-Encrypted HOTP Secret Key</td>
</tr>
<tr>
<td>9.2</td>
<td>Symmetric Key Container with a single Password-based Encrypted HOTP Secret Key</td>
</tr>
<tr>
<td>10.</td>
<td>Normative References</td>
</tr>
<tr>
<td></td>
<td>Authors’ Addresses</td>
</tr>
<tr>
<td></td>
<td>Intellectual Property and Copyright Statements</td>
</tr>
</tbody>
</table>
1. Introduction

With increasing use of symmetric key based authentication systems such as systems based one time password (OTP) and challenge response mechanisms, there is a need for vendor interoperability and a standard format for importing, exporting or provisioning symmetric key based credentials from one system to another. Traditionally authentication server vendors and service providers have used proprietary formats for importing, exporting and provisioning these credentials into their systems making it hard to use tokens from vendor A with a server from vendor B.

This Internet draft describes a standard format for serializing symmetric key based credentials such as OTP shared secrets for system import, export or network/protocol transport, promoted by [OATH]. The goal is that the format will facilitate dynamic provisioning of OTP credentials using an OTP provisioning protocol to different flavors of embedded tokens or allow customers to import new or existing tokens in batch or single instances into a compliant system.

This draft also specifies the token attributes required for interoperability such as the initial event counter used in the HOTP algorithm [HOTP]. It is also applicable for other time-based or proprietary algorithms.

To provide an analogy, in public key environments the PKCS#12 format [PKCS12] is commonly used for importing and exporting private keys and certificates between systems. In the environments outlined in this document where OTP credentials may be transported directly down to smartcards or devices with limited computing capabilities, a small (size in bytes) and more shared secret oriented format is desirable, avoiding the complexity in PKCS#12. One example of PKCS#12 limits is that to carry the shared secret attributes used for OTP calculations one would use the opaque data within PKCS#12, whereas a more explicit attribute schema definition is desirable.
2. Conventions used in this document

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

In examples, "C:" and "S:" indicate lines sent by the client and server respectively.

In the text below, OTP refers to one time password.
3. Use Cases

This section describes a comprehensive list of use cases that inspired the development of this specification. These requirements were used to derive the primary requirement that drove the design. These requirements are covered in the next section.

These use cases also help in understanding the applicability of this specification to real world situations.

3.1. Offline Use Cases

This section describes the use cases relating to offline transport of credentials from one system to another, using some form of export and import model.

3.1.1. Credential migration by end-user

A user wants to migrate a credential from one authentication token (container) to a different authentication token. For example, the authentication token may be soft tokens on two different systems (computers or mobile phones). User can export the credential in a standard format for import into the other authentication token.

The key protection mechanism may rely on password-based encryption for soft tokens, or a pre-placed hardware-protected transfer key shared between the two systems if available.

3.1.2. Bulk import of new credentials

Tokens are manufactured in bulk and associated credentials (key records) need to be loaded into the validation system through a file on portable media. The manufacturer provides the credentials in the form of a file containing records in standard format, typically on a CD. Note that the token manufacturer and the vendor for the validation system may be the same or different.

In this case the file usually is protected by a symmetric transport key which was communicated separately outside of the file between the two parties.

3.1.3. Bulk migration of existing credentials

An enterprise wants to port credentials from an existing validation system A into a different validation system B. The existing validation system provides the enterprise with a functionality that enables export of credentials (OTP tokens) in a standard format. Since the OTP tokens are in the standard format, the enterprise can
import the token records into the new validation system B and start using the existing tokens. Note that the vendors for the two validation systems may be the same or different.

In this case the file usually is protected by a symmetric transport key which was communicated separately outside of the file between the two validation systems.

3.1.4. Credential upload case

User wants to activate and use a new credential against a validation system that is not aware of this credential. This credential may be embedded in the authentication token (e.g., SD card, USB drive) that the user has purchased at the local electronics retailer. Along with the authentication token, the user may get the credential on a CD or a floppy in a standard format. The user can now upload via a secure online channel or import this credential into the new validation system and start using the credential.

The key protection mechanism may rely on password-based encryption, or a pre-placed hardware-protected transfer key shared between the token manufacturer and the validation system(s) if available.

3.2. Online Use Cases

This section describes the use cases related to provisioning the credentials using some form of an online provisioning protocol.

3.2.1. Online provisioning a credential to end-user’s authentication token

A mobile device user wants to obtain an HOTP credential (shared secret) for use with an OTP soft token on the device. The soft token client from vendor A initiates the provisioning process against a provisioning system from vendor B using a standards-based provisioning protocol as described in the OATH Reference Architecture [OATHRefArch]. The provisioning system delivers an OTP credential in a standard format that can be processed by the mobile device. The user can download more than one credential in a single session if the provisioning server holds multiple credentials for that user.

In a variation of the above, instead of the user’s mobile phone, a credential is provisioned in the user’s soft token application on a laptop using a network-based online protocol. As before, the provisioning system delivers an OTP credential in a standard format that can be processed by the soft token on the PC.
3.2.2. Server to server provisioning of credentials

Sometimes, instead of importing token information from manufacturer using a file, an OTP validation server may download the credential seed records using an online protocol. The credentials can be downloaded in a standard format that can be processed by a validation system.

In another scenario, an OTA (over-the-air) credential provisioning gateway that provisions credentials to mobile phones may obtain credentials from the credential issuer using an online protocol. The credentials are delivered in a standard format that can be processed by the OTA credential provisioning gateway and subsequently sent to the end-user’s mobile phone.

3.2.3. Online update of an existing authentication token credential

The end-user or the credential issuer wants to update or configure an existing credential in the authentication token and requests a replacement credential container. The container may or may not include a new secret key and may include new or updated secret key attributes such as a new counter value in HOTP credential case, a new logo, a modified response format or length, a new friendly name, etc.
4. Requirements

This section outlines the most relevant requirements that are the basis of this work. Several of the requirements were derived from use cases described above.

R1: The format MUST support transport of multiple types of symmetric key credentials including HOTP, other OTP, challenge-response, etc.

R2: The format MUST handle the symmetric key itself as well of attributes that are typically associated with symmetric keys. Some of these attributes may be

* Unique Key Identifier
* Issuer information
* Algorithm ID
* Algorithm mode
* Issuer Name
* Issuer logo
* Credential friendly name
* Initial event counter value

R3: The format SHOULD support both offline and online scenarios. That is it should be serializable to a file as well as it should be possible to use this format in online provisioning protocols

R4: The format SHOULD allow bulk representation of symmetric key credentials.

R5: The format SHOULD be portable to various platforms. Furthermore, it SHOULD be computationally efficient to process.

R6: The format MUST provide appropriate level of security in terms of data encryption and data integrity.

R7: For online scenarios the format SHOULD NOT rely on transport level security (e.g., SSL/TLS) for core security requirements.
R8: The format SHOULD be extensible. It SHOULD enable extension points allowing vendors to specify additional attributes in the future.

R9: The format SHOULD allow for distribution of key derivation data without the actual symmetric key itself. This is to support symmetric key management schemes that rely on key derivation algorithms based on a pre-placed master key. The key derivation data typically consists of a reference to the key, rather than the key value itself.

R10: The format SHOULD allow for additional lifecycle management operations such as counter resynchronization. Such processes require confidentiality between client and server, thus could use a common secure container format, without the transfer of key material.

R11: The format MUST support the use of pre-shared symmetric keys to ensure confidentiality of sensitive data elements.

R12: The format MUST support a password-based encryption (PBE) [PKCS5] scheme to ensure security of sensitive data elements. This is a widely used method for various provisioning scenarios.

R13: The format SHOULD support asymmetric encryption algorithms such as RSA to ensure end-to-end security of sensitive data elements. This is to support scenarios where a pre-set shared encryption key is difficult to use.
5. Shared Secret Attributes

The shared secret includes a number of data attributes that define the type of the secret, its usage and associated meta-information required during the provisioning, configuration, access or usage in the host device.

5.1. Common Attributes

5.1.1. SecretAlgorithm (MANDATORY)

Defines the type of algorithm of the secret key and MUST be set to one of the values defined in Section 6.4

5.1.2. Usage (MANDATORY)

Defines the intended usage of the shared secret and is a combination of one or more of the following (set to true):

- OTP, the shared secret will be used for OTP generation
- CR, the shared secret will be used for Challenge/Response purposes
- ENCRYPT, the shared secret will be used for data encryption purposes
- SIGN, the shared secret will be used to generate a signature or keyed hashing for data integrity or authentication purposes.
- UNLOCK, the shared secret will be used for an inverse challenge response in the case a user has locked the device by entering a wrong PIN too many times (for devices with PIN-input capability)

Additional attributes that are specific to the usage type MAY be required. Section 6.1 describes OTP and CR specific attributes.

5.1.3. SecretId (MANDATORY)

A unique and global identifier of the shared secret. The identifier is defined as a string of alphanumeric characters.

5.1.4. Issuer (MANDATORY)

The shared secret issuer name. The Issuer is defined as a String.
5.1.5. AccessRules (OPTIONAL)

Defines a set of access rules and policies for the protection of the shared secret on the host Device. Currently only the userPIN policy is defined. The userPIN policy specifies whether the user MUST enter a PIN (for devices with PIN input capability) in order to unlock or authenticate to the device hosting the secret container. The userPIN is defined as a Boolean (TRUE or FALSE). When the user PIN is required, the policy MUST be set to TRUE. If the userPIN is NOT provided, implementations SHALL default the value to FALSE.

5.1.6. EncryptionMethod (MANDATORY)

Identifies the encryption algorithm and possible parameters used to protect the Secret Key data in the container and MUST be set to one of the values defined in Section 6.2

When the value is set to NONE, implementations SHALL ensure the privacy of the shared secret data through other standard mechanisms e.g. transport level encryption.

When the SecretContainer contains more than one shared secret and EncryptionMethod is different from NONE, the same encryption key MUST be used to encrypt all the secret data elements in the container.

5.1.7. DigestMethod (MANDATORY when Digest is present)

Identifies the algorithm and possible parameters used to generate a digest of the the Secret Key data. The digest guarantees the integrity and the authenticity of the shared secret data. The Digest algorithm MUST be set to one of the values defined in Section 6.3

See Section 6.1.8 for more information on Digest data value type.

5.1.8. OTP and CR specific Attributes

When the shared secret usage is set to OTP or CR, additional attributes MUST be provided to support the OTP and/or the response computation as required by the underlying algorithm and to customize or configure the outcome of the computation (format, length and usage modes).

5.1.9. Counter (OPTIONAL)

Defines the initial event counter value for OTP generation in counter based OTP generation algorithm [HOTP] computation. When the Counter attribute is specified, the value MUST be of type long integer and MAY be set to any number that is greater than or equal to 0. When
the Counter is NOT specified, implementations of HOTP algorithm SHALL default the value to 0.

5.1.10. Time (OPTIONAL)

Defines the value of the time attribute used for a time based algorithm. The attribute value MUST be:

Unsigned long (Number of seconds since 1970)

Implementation MAY use the Time attribute value to reset the clock on the Device.

5.1.11. Challenge (MANDATORY)

The Challenge attribute defines the characteristics of the challenge in a CR usage scenario. The Challenge attribute is defined by the following sub-attributes:

1. Format (MANDATORY)

Defines the format of the challenge accepted by the device and MUST be one of the values defined in Section 6.5

2. CheckDigit (OPTIONAL)

Defines if the device needs to check the appended Luhn check digit contained in a provided challenge. Value MUST be:

TRUE device will check the appended Luhn check digit in a provided challenge

FALSE device will not check appended Luhn check digit in challenge

3. Min (MANDATORY)

Defines the minimum size of the challenge accepted by the device for CR mode. Value MUST be:

Unsigned integer.

4. Max (MANDATORY)

Defines the maximum size of the challenge accepted by the device for CR mode. Value MUST be:
5.1.12. Response (MANDATORY)

The Response attribute defines the characteristics of the result of a computation. The Response attribute is defined by the following sub-attributes:

1. Format (MANDATORY)

   Defines the format of the response generated by the device and MUST be one of the values defined in Section 6.5

2. CheckDigit (OPTIONAL)

   Defines if the device needs to append a Luhn check digit to the response. Value MUST be:

   TRUE device will append a Luhn check digit to the response.
   FALSE device will not append a Luhn check digit to the response.

3. Length (MANDATORY)

   Defines the length of the response generated by the device. Value MUST be:

   Unsigned integer.

5.1.13. AppProfileId (OPTIONAL)

Defines the application profile id related to attributes present on a smart card that have influence when computing a response. An example could be an EMV MasterCard CAP [CAP] application on a card that contains attributes or uses fixed data for a specific batch of cards such as:

IAF Internet authentication flag

CVN Cryptogram version number, for example (MCHIP2, MCHIP4, VISA 13, VISA14)

AIP (Application Interchange Profile), 2 bytes
TVR Terminal Verification Result, 5 bytes
CVR The card verification result
AmountOther
TransactionDate
TerminalCountryCode
TransactionCurrencyCode
AmountAuthorised

IIPB

These values are not contained within attributes in the container but are shared between the manufacturing and the validation service through this unique AppProfileId.
6. Secret container XML schema definitions

The portable shared secret container is defined by the following entities:

1. SecretContainer entity
2. Device entity
3. Secret entity
4. User entity

A SecretContainer MAY contain one or more Device entities. A Device MAY contain one or more Secret entities and may be associated to one or more User entities.

6.1. XML Schema Types

The following types are defined to represent the portable shared secret container entities and associated attributes.

6.1.1. SecretType

The SecretType represents the shared Secret entity in the SecretContainer. The SecretType is defined as follows:
<complexType name="SecretType">
  <sequence>
    <element name="Issuer" type="string"/>
    <element name="Usage" type="oath-pskc:UsageType"/>
    <element name="FriendlyName" type="string" minOccurs="0"/>
    <element name="Data" type="oath-pskc:DataType" minOccurs="0"/>
    <element name="AccessRules" minOccurs="0">
      <complexType>
        <simpleContent>
          <extension base="string">
            <attribute name="userPIN" type="boolean" use="optional" default="false"/>
          </extension>
        </simpleContent>
      </complexType>
    </element>
    <element name="Logo" type="oath-logo:LogoType" minOccurs="0"/>
    <element name="Expiry" type="string" minOccurs="0"/>
  </sequence>
  <attribute name="SecretId" type="string" use="required"/>
  <attribute name="SecretAlgorithm" type="oath-pskc:SecretAlgorithmType" use="required"/>
</complexType>

The components of the SecretType have the following meanings (see Section 5 for further information):

- <Usage> of type UsageType defines the usage of the Secret Key. The Usage attribute is described in Section 5.1.2.
- <Issuer> identifies the issuer of the Secret Key. The Issuer attribute is described in Section 5.1.4.
- <FriendlyName> is a user friendly name that is assigned to the Secret Key for easy reference.
- <Data> conveys the Secret Key octet data in encrypted or non-encrypted format and a digest of the non-encrypted secret key octet. The <Data> component is further described below.
- <AccessRules> Defines the rules for accessing the credential on the device e.g. a password must be provided by the user to view credential info or use the credential to generate an OTP response.
- SecretId is a global identifier of the Secret Key. See Section 5.1.3.
o SecretAlgorithm defines the algorithm used with the Secret Key. The type values are defined in Section 6.4.

o Logo of type LogoType associates display logos with this Secret Key

o Expiry defines the expiry date of the Secret Key in format DD/MM/YYYY

The <Data> element is of type <DataType> and is defined as follows:

```xml
<complexType name="DataType">
  <sequence>
    <element name="Value" type="base64Binary"/>
    <element name="ValueDigest" type="base64Binary" minOccurs="0"/>
  </sequence>
</complexType>
```

The <Value> element in the SecretType conveys the secret key octets in base 64 encoding. The secret data MAY be encrypted or in clear text as per the EncryptionMethod data element in the SecretContainer (see Section 6.1.6 for details about SecretContainerType). When the secret data is encrypted, the Digest value MUST be provided. The digest MUST be calculated on the unencrypted secret data and MUST use one of the Digest algorithms specified in DigestMethodType element of the SecretContainer. When the secret data is in clear text, the SecretContainer payload signature MAY be used to check the integrity of the secret octets.

6.1.2. UsageType

The UsageType defines the usage attribute of the shared secret entity. The UsageType is defined as follows:
<complexType name="UsageType">
  <sequence>
    <element name="AI" type="oath-pskc:OtpAlgorithmIdentifierType" minOccurs="0"/>
    <element name="Counter" type="integer" default="0" minOccurs="0"/>
    <element name="Response">
      <complexType>
        <attribute name="format" type="oath-pskc:valueFormat" use="required"/>
        <attribute name="length" type="unsignedInt" use="required"/>
        <attribute name="checkDigits" type="boolean" use="optional" default="false"/>
      </complexType>
    </element>
    <element name="Challenge" minOccurs="0">
      <complexType>
        <attribute name="format" type="oath-pskc:valueFormat" use="required"/>
        <attribute name="min" type="unsignedInt" use="required"/>
        <attribute name="max" type="unsignedInt" use="required"/>
        <attribute name="checkDigits" type="boolean" use="optional" default="false"/>
      </complexType>
    </element>
    <element name="Time" type="unsignedLong" minOccurs="0"/>
    <element name="AppProfileId" type="string" minOccurs="0"/>
  </sequence>
  <attribute name="otp" type="boolean" use="optional" default="false"/>
  <attribute name="cr" type="boolean" use="optional" default="false"/>
  <attribute name="sign" type="boolean" use="optional" default="false"/>
  <attribute name="encrypt" type="boolean" use="optional" default="false"/>
  <attribute name="unlock" type="boolean" use="optional" default="false"/>
</complexType>

The UsageType components have the following meanings:

- <Usage> defines the way the Secret key is used.
- <AI> the AI bit string in [MutualAuth].
<Counter> sets the initial moving factor in HOTP or other event based algorithms computation.

<Time> sets the moving factor in time based OTP or other time based algorithms computation. Unsigned long (Number of seconds since 1970)

<Challenge> sets the challenge attributes in CR based algorithm computations.

<Response> sets the algorithm response attributes.

<AccessRules> defines a set of access rules and policies for the shared secret once provisioned on the Device. Currently only the userPIN attribute is defined. The userPIN indicates weather the user MUST provide a PIN to unlock the secret.

<AppProfileId> Is the unique shared identifier for out of band shared common parameters.

6.1.3. DeviceType

The DeviceType type represents the Device entity in the Container. A shared secret MUST be bound to one Device only. A Device MAY be bound to a user and MAY contain more than one shared secrets.

The DeviceType is defined as follows:

<complexType name="DeviceType">
  <sequence>
    <element name="DeviceId" type="oath-pskc:DeviceIdType" minOccurs="0"/>
    <element name="Secret" type="oath-pskc:SecretType" maxOccurs="unbounded"/>
    <element name="User" type="oath-pskc:UserType" minOccurs="0"/>
  </sequence>
</complexType>

The components of the DeviceType have the following meanings:

<DeviceId>, a unique identifier for the device, defined by the DeviceId type.

<Secret>, represents the shared secret entity defined by the SecretType.
o <User>, optionally identifies the owner or the user of the Device, as defined by the UserType.

6.1.4. DeviceIdType

The DeviceId type represents the identifying criteria to uniquely identify the device that contains the associated shared secrets. Since OATH devices can come in different form factors such as hardware tokens, smartcards, soft tokens in a mobile phone or PC etc this type allows different criteria to be used. Combined though the criteria MUST identify uniquely the device.

The DeviceIdType is defined as follows:

```
<complexType name="DeviceIdType">
  <sequence>
    <element name="Manufacturer" type="string"/>
    <element name="SerialNo" type="string"/>
    <element name="Model" type="string" minOccurs="0"/>
    <element name="IssueNo" type="string" minOccurs="0"/>
    <element name="Expiry" type="string" minOccurs="0"/>
  </sequence>
</complexType>
```

The components of the DeviceId type have the following meanings:

o <Manufacturer>, the manufacturer of the device.

o <Model>, the model of the device (e.g. one-button-OATH-token-V1)

o <SerialNo>, the serial number of the device or the PAN (primary account number) in case of EMV (Europay-MasterCard-Visa) smart cards.

o <IssueNo>, the issue number in case of smart cards with the same PAN, equivalent to a PSN (PAN Sequence Number).

o <ExpiryDate>, the expiry date of a device (such as the one on an EMV card, used when issue numbers are not printed on cards). In format DD/MM/YYYY

6.1.5. UserType Type

The UserType represents the identifying criteria to uniquely identify the user who is bound to this device.

The UserType is defined as follows:
<complexType name="UserType">
  <sequence>
    <sequence>
      <element name="UserId" type="string" minOccurs="0"/>
      <element name="FirstName" type="string" minOccurs="0"/>
      <element name="LastName" minOccurs="0"/>
    </sequence>
    <element name="Org" type="string" minOccurs="0"/>
  </sequence>
</complexType>

The components of the UserType type have the following meanings:

- <FirstName>, user first name.
- <LastName>, user last name.
- <UserId>, user id (UID) or user name.
- <Org>, user organization name.

6.1.6.  SecretContainerType

The SecretContainerType represents the shared secret container entity. A Container MAY contain more than one Device entity; each Device entity MAY contain more than one Shared Secret entity.

The SecretContainerType is defined as follows:
<complexType name="SecretContainerType">
  <sequence>
  
    <element name="EncryptionMethod">
      <complexType>
        <complexContent>
          <extension base="oath-pskc:EncryptionMethodType"/>
        </complexContent>
      </complexType>
    </element>
  
    <element name="DigestMethod">
      <complexType>
        <complexContent>
          <extension base="oath-pskc:DigestMethodType"/>
        </complexContent>
      </complexType>
    </element>
  
    <element name="Device" type="oath-pskc:DeviceType" maxOccurs="unbounded"/>
    <element name="Signature" type="ds:SignatureType" minOccurs="0"/>
  </sequence>
  
  <attribute name="version" type="oath-pskc:VersionType" use="required"/>
</complexType>

The components of the SecretContainer have the following meanings:

- **Version**, the version number for the portable shared secret container format (the XML schema defined in this document).
- **EncryptionMethod**, the encryption method used to protect the Secret Key data
- **DigestMethod**, the digest method used to sign the unencrypted the Secret Key data
- **Device**, the host Device for one or more Shared Secrets.
- **Signature**, contains the signature value of the Container. When the signature is applied to the entire container, it MUST use XML Signature methods as defined in [XMLSIG]. The signature is enveloped.

### 6.1.7. EncryptionMethodType

The EncryptionMethodType defines the algorithm and parameters used to encrypt the Secret Key data in the Container. The encryption is applied on each individual Secret Key data in the Container. The
encryption method MUST be the same for all Secret Key data in the container.

The EncryptionMethodType is defined as follows:

```xml
c<complexType name="EncryptionMethodType">
  <sequence>
    <element name="EncKeyLabel" minOccurs="0"/>
    <choice>
      <element name="KeyInfo" type="ds:KeyInfoType" minOccurs="0"/>
      <sequence>
        <element name="PBESalt" type="base64Binary" minOccurs="0"/>
        <element name="PBEIterationCount" type="int" minOccurs="0"/>
      </sequence>
    </choice>
  </sequence>
  <attribute name="algorithm" type="oath-pskc:EncryptionAlgorithmType" use="required"/>
</complexType>
```

The components of the EncryptionMethodType have the following meanings:

- **algorithm**, identifies the encryption algorithm used to protect the Secret Key data. When NONE is specified, implementations MUST guarantee the privacy of the Secret Key Data through other mechanisms e.g. through transport level security. Please see EncryptionAlgorithmType for more information on supported algorithms.

- **<PBESalt>**, conveys the Salt when [PKCS5] password-based encryption is applied.

- **<PBEIterationsCount>**: conveys the iteration count value in [PKCS5] password-based encryption if it is different from the default value.

- **<EncKeyLabel>**: identifies a unique label for a pre-shared encryption key.

- **<KeyInfo>**: conveys the information of the key if an RSA algorithm has been used.
6.1.8. DigestMethodType

The DigestMethodType defines the algorithm and parameters used to create the digest on the unencrypted Secret Key data in the Container. The digest is applied on each individual Secret Key data in the Container before encryption. The digest method MUST be the same for all Secret Key data in the container. Unless a different digest key is specified it is assumed that keyed digest algorithms will use the same key as for encryption.

The DigestMethodType is defined as follows:

```
<complexType name="DigestMethodType">
  <sequence>
    <element name="DigestKeyLabel" minOccurs="0"/>
  </sequence>
  <attribute name="algorithm" type="oath-pskc:DigestAlgorithmType" use="required"/>
</complexType>
```

The components of the DigestMethodType have the following meanings:

- **algorithm**, identifies the digest algorithm used to protect the Secret Key data. Please see DigestAlgorithmType for more information on supported algorithms.
- **<DigestKeyLabel>**: identifies a unique label for a pre-shared digest key.

6.1.9. OtpAlgorithmIdentifierType

The OtpAlgorithmIdentifierType defines the OTP Algorithm identifier (AI) specified in [MutualAuth].

The OtpAlgorithmIdentifierType is defined as follows:
See [MutualAuth] for a full description of the components of the OtpAlgorithmIdentifierType.

6.2. EncryptionAlgorithmType

The EncryptionAlgorithmType defines the allowed algorithms for encrypting the Secret Key data in the Container.

The EncryptionAlgorithmType is defined as follows:
<simpleType name="EncryptionAlgorithmType">
  <restriction base="string">
    <enumeration value="NONE"/>
    <enumeration value="PBE-3DES112-CBC"/>
    <enumeration value="PBE-3DES168-CBC"/>
    <enumeration value="PBE-AES128-CBC"/>
    <enumeration value="PBE-AES256-CBC"/>
    <enumeration value="PBE-AES192-CBC"/>
    <enumeration value="3DES112-CBC"/>
    <enumeration value="3DES168-CBC"/>
    <enumeration value="AES128-CBC"/>
    <enumeration value="AES192-CBC"/>
    <enumeration value="AES256-CBC"/>
    <enumeration value="RSA1024"/>
    <enumeration value="RSA2048"/>
  </restriction>
</simpleType>

NONE when no encryption is applied on the shared secret

PBE-3DES112-CBC when password-based encryption is applied using a 112-bit 3DES key in CBC mode

PBE-3DES168-CBC when password-based encryption is applied using a 168-bit 3DES key in CBC mode

PBE-AES128-CBC when password-based encryption is applied using a 128-bit AES key in CBC mode

PBE-AES192-CBC when password-based encryption is applied using a 192-bit AES key in CBC mode is applied.

PBE-AES256-CBC password-based encryption is applied using a 256-bit AES key in CBC mode is applied.

3DES112-CBC encryption using a pre-shared 112-bit 3DES key in CBC mode is applied.

3DES168-CBC encryption using a pre-shared 168-bit 3DES key in CBC mode is applied.

AES128-CBC encryption using a pre-shared 128-bit AES key in CBC mode is applied.

AES192-CBC encryption using a pre-shared 192-bit AES key in CBC mode is applied.
AES256-CBC encryption using a pre-shared 256-bit AES key in CBC mode is applied.

6.3. DigestAlgorithmType

The DigestAlgorithmType defines the allowed algorithms for generating a digest on the unencrypted Secret Key data in the Container.

The DigestAlgorithmType is defined as follows:

```xml
<simpleType name="DigestAlgorithmType">
    <restriction base="string">
        <enumeration value="HMAC-SHA1"/>
        <enumeration value="HMAC-SHA256"/>
        <enumeration value="HMAC-SHA512"/>
    </restriction>
</simpleType>
```

HMAC-SHA1
HMAC-SHA192
HMAC-SHA256

6.4. SecretAlgorithmType

The SecretAlgorithmType defines the algorithms in which the Secret Key data is used.

The SecretAlgorithmType is defined as follows:

```xml
<simpleType name="SecretAlgorithmType">
    <restriction base="string">
        <enumeration value="DES"/>
        <enumeration value="3DES112"/>
        <enumeration value="3DES168"/>
        <enumeration value="AES128"/>
        <enumeration value="AES192"/>
        <enumeration value="AES256"/>
        <enumeration value="HOTP"/>
        <enumeration value="MKEYLABEL"/>
    </restriction>
</simpleType>
```
HOTP, as defined in [HOTP]

MKEYNAME, master key name or label when an embedded device key is used to derive the Shared Secret

DES, a standard DES key

3DES112, a 112-bit 3DES key (a.k.a. two-key 3DES)

3DES168, a 168-bit parity-checked 3DES key

AES128, a 128-bit AES key

AES192, a 192-bit AES key

AES256, a 256-bit AES key

6.5. valueFormat

The valueFormat defines allowed formats for challenges or responses in the OTP algorithms.

The valueFormat is defined as follows:

<simpleType name="valueFormat">
  <restriction base="string">
    <enumeration value="DECIMAL"/>
    <enumeration value="HEXADECIMAL"/>
    <enumeration value="ALPHANUMERIC"/>
    <enumeration value="BASE64"/>
    <enumeration value="BINARY"/>
  </restriction>
</simpleType>

DECIMAL Only numerical digits

HEXADECIMAL Hexadecimal response

ALPHANUMERIC All letters and numbers (case sensitive)

BASE64 Base 64 encoded

BINARY Binary data, this is mainly used in case of connected devices
6.6. Data elements

6.6.1. SecretContainer

The SecretContainer data element is defined as:

```
<element name="SecretContainer" type="oath-pskc:SecretContainerType"/>
```

The SecretContainer data element is of type SecretContainerType defined in Section 6.1.6.

The EncryptionMethod data element in the SecretContainer defines the encryption algorithm used to protect the Shared Secret data. In a multi-secret SecretContainer, the same encryption method and the same encryption key MUST be used for all secret data elements.

The SecretContainer data element MAY contain multiple Device data elements, allowing for bulk provisioning of shared secrets.

The Signature data element is of type <ds:Signature> as defined in [XMLSIG] and MAY be omitted in the SecretContainer data element when application layer provisioning or transport layer provisioning protocols provide the integrity and authenticity of the payload between the sender and the recipient of the container. When required, this specification recommends using a symmetric key based signature with the same key used in the encryption of the secret data. The signature is enveloped.
7. Formal Syntax

The following syntax specification uses the widely adopted XML schema format as defined by a W3C recommendation (http://www.w3.org/TR/xmlschema-0/). It is a complete syntax definition in the XML Schema Definition format (XSD).

All implementations of this standard must comply with the schema below.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSpy v2006 rel. 3 sp1 (http://www.altova.com) by Philip Hoyer (ActivIdentity) -->
<schema xmlns="http://www.w3.org/2001/XMLSchema"
  xmlns:oath-pskc="http://www.openauthentication.org/OATH/2006/08/PSKC"
  xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
  xmlns:oath-logo="http://www.openauthentication.org/OATH/2006/08/Logo"
  targetNamespace="http://www.openauthentication.org/OATH/2006/08/PSKC"
  elementFormDefault="qualified" attributeFormDefault="unqualified">
<import namespace="http://www.w3.org/2000/09/xmldsig#"
<import namespace="http://www.openauthentication.org/OATH/2006/08/Logo"
  schemaLocation="oath_logotype_v1.0.xsd"/>
<complexType name="SecretContainerType">
  <sequence>
    <element name="EncryptionMethod">
      <complexType>
        <extension base="oath-pskc:EncryptionMethodType"/>
      </complexType>
    </element>
    <element name="DigestMethod">
      <complexType>
        <extension base="oath-pskc:DigestMethodType"/>
      </complexType>
    </element>
    <element name="Device" type="oath-pskc:DeviceType" maxOccurs="unbounded"/>
    <element name="Signature" type="ds:SignatureType" minOccurs="0"/>
  </sequence>
  <attribute name="version" type="oath-pskc:VersionType" use="required"/>
</complexType>
```

<complexType name="OtpAlgorithmIdentifierType">
<attribute name="type" use="required">
<simpleType>
<restriction base="string">
<enumeration value="HMAC-SHA1-NO-TRUNC"/>
<enumeration value="HMAC-SHA1-TRUNC-6DIGITS"/>
<enumeration value="HMAC-SHA1-TRUNC-7DIGITS"/>
<enumeration value="HMAC-SHA1-TRUNC-8DIGITS"/>
</restriction>
</simpleType>
</attribute>
<attribute name="pinHash" type="boolean" use="optional" default="false"/>
<attribute name="counter" type="boolean" use="optional" default="false"/>
<attribute name="time" type="boolean" use="optional" default="false"/>
<attribute name="random" type="boolean" use="optional" default="false"/>
<attribute name="mode" use="required">
<simpleType>
<restriction base="string">
<enumeration value="PLAIN-SINGLE"/>
<enumeration value="PLAIN-DUAL"/>
<enumeration value="CHAINED-SINGLE"/>
<enumeration value="CHAINED-DUAL"/>
</restriction>
</simpleType>
</attribute>
</complexType>
<complexType name="SecretType">
<sequence>
<element name="Issuer" type="string"/>
<element name="Usage" type="oath-pskc:UsageType"/>
<element name="FriendlyName" type="string" minOccurs="0"/>
<element name="Data" type="oath-pskc:DataType" minOccurs="0"/>
<complexType name="AccessRules" minOccurs="0">
<extension base="string">
<attribute name="userPIN" type="boolean" use="optional" default="false"/>
</extension>
</complexType>
</sequence>
</complexType>
<complexType name="DeviceIdType">
  <sequence>
    <element name="Manufacturer" type="string"/>
    <element name="SerialNo" type="string"/>
    <element name="Model" type="string" minOccurs="0"/>
    <element name="IssueNo" type="string" minOccurs="0"/>
    <element name="Expiry" type="string" minOccurs="0"/>
  </sequence>
</complexType>

<complexType name="DeviceType">
  <sequence>
    <element name="DeviceId" type="oath-pskc:DeviceIdType" minOccurs="0"/>
    <element name="Secret" type="oath-pskc:SecretType" maxOccurs="unbounded"/>
    <element name="User" type="oath-pskc:UserType" minOccurs="0"/>
  </sequence>
</complexType>

<complexType name="UserType">
  <sequence>
    <sequence>
      <element name="UserId" type="string" minOccurs="0"/>
      <element name="FirstName" type="string" minOccurs="0"/>
      <element name="LastName" minOccurs="0"/>
    </sequence>
    <element name="Org" type="string" minOccurs="0"/>
  </sequence>
</complexType>

<complexType name="UsageType">
  <sequence>
    <element name="AI" type="oath-pskc:OtpAlgorithmIdentifierType" minOccurs="0"/>
    <element name="Counter" type="integer" default="0" minOccurs="0"/>
    <element name="Response">
      <complexType>
        <attribute name="format" type="oath-pskc:valueFormat" use="required"/>
        <attribute name="length" type="unsignedInt" use="required"/>
      </complexType>
    </element>
  </sequence>
</complexType>
<attribute name="checkDigits" type="boolean" use="optional" default="false"/>
</complexType>
</element>
<element name="Challenge" minOccurs="0">
<complexType>
<attribute name="format" type="oath-pskc:valueFormat" use="required"/>
<attribute name="min" type="unsignedInt" use="required"/>
<attribute name="max" type="unsignedInt" use="required"/>
<attribute name="checkDigits" type="boolean" use="optional" default="false"/>
</complexType>
</element>
<element name="Time" type="unsignedLong" minOccurs="0"/>
<element name="AppProfileId" type="string" minOccurs="0"/>
</sequence>
<attribute name="otp" type="boolean" use="optional" default="false"/>
<attribute name="cr" type="boolean" use="optional" default="false"/>
<attribute name="sign" type="boolean" use="optional" default="false"/>
<attribute name="encrypt" type="boolean" use="optional" default="false"/>
<attribute name="unlock" type="boolean" use="optional" default="false"/>
</complexType>
<complexType name="AttributeType">
<simpleContent>
<extension base="string">
<attribute name="name" type="string" use="required"/>
</extension>
</simpleContent>
</complexType>
<complexType name="EncryptionMethodType">
<sequence>
<element name="EncKeyLabel" minOccurs="0"/>
<choice>
<element name="KeyInfo" type="ds:KeyInfoType" minOccurs="0"/>
<sequence>
<element name="PBESalt" type="base64Binary" minOccurs="0"/>
<element name="PBEIterationCount" type="int" minOccurs="0"/>
</sequence>
</choice>
</sequence>
</complexType>
<element name="algorithm" type="oath-pskc:EncryptionAlgorithmType" use="required"/>
</complexType>
<complexType name="DigestMethodType">
  <sequence>
    <element name="DigestKeyLabel" minOccurs="0"/>
  </sequence>
  <attribute name="algorithm" type="oath-pskc:DigestAlgorithmType" use="required"/>
</complexType>
<complexType name="EncryptionAlgorithmType">
  <restriction base="string">
    <enumeration value="NONE"/>
    <enumeration value="PBE-3DES112-CBC"/>
    <enumeration value="PBE-3DES168-CBC"/>
    <enumeration value="PBE-AES128-CBC"/>
    <enumeration value="PBE-AES256-CBC"/>
    <enumeration value="PBE-AES192-CBC"/>
    <enumeration value="3DES112-CBC"/>
    <enumeration value="3DES168-CBC"/>
    <enumeration value="AES128-CBC"/>
    <enumeration value="AES192-CBC"/>
    <enumeration value="AES256-CBC"/>
    <enumeration value="RSA1024"/>
    <enumeration value="RSA2048"/>
  </restriction>
</complexType>
<complexType name="DigestAlgorithmType">
  <restriction base="string">
    <enumeration value="HMAC-SHA1"/>
    <enumeration value="HMAC-SHA256"/>
    <enumeration value="HMAC-SHA512"/>
  </restriction>
</complexType>
<complexType name="SecretAlgorithmType">
  <restriction base="string">
    <enumeration value="DES"/>
    <enumeration value="DES"/>
    <enumeration value="3DES112"/>
    <enumeration value="3DES168"/>
    <enumeration value="AES128"/>
    <enumeration value="AES192"/>
    <enumeration value="AES256"/>
    <enumeration value="HOTP"/>
    <enumeration value="MKEYLABEL"/>
  </restriction>
</complexType>
<complexType name="valueFormat">
  <restriction base="string">
    <enumeration value="NONE"/>
    <enumeration value="PBE-3DES112-CBC"/>
    <enumeration value="PBE-3DES168-CBC"/>
    <enumeration value="PBE-AES128-CBC"/>
    <enumeration value="PBE-AES256-CBC"/>
    <enumeration value="PBE-AES192-CBC"/>
    <enumeration value="3DES112-CBC"/>
    <enumeration value="3DES168-CBC"/>
    <enumeration value="AES128-CBC"/>
    <enumeration value="AES192-CBC"/>
    <enumeration value="AES256-CBC"/>
    <enumeration value="RSA1024"/>
    <enumeration value="RSA2048"/>
  </restriction>
</complexType>
<restriction base="string">
<enumeration value="DECIMAL"/>
<enumeration value="HEXADECIMAL"/>
<enumeration value="ALPHANUMERIC"/>
<enumeration value="BASE64"/>
<enumeration value="BINARY"/>
</restriction>
</simpleType>
<simpleType name="VersionType" final="restriction">
<restriction base="string">
<pattern value="\d{1,9}\..\d{0,9}"/>
</restriction>
</simpleType>
<element name="SecretContainer" type="oath-pskc:SecretContainerType"/>
<complexType name="DataType">
<sequence>
<element name="Value" type="base64Binary"/>
<element name="ValueDigest" type="base64Binary" minOccurs="0" minOccurs="0"/>
</sequence>
</complexType>
</schema>
8. Security Considerations

The portable shared secret container carries sensitive information (e.g., cryptographic keys) and may be transported across the boundaries of one secure perimeter to another. For example, a container residing within the secure perimeter of a back-end provisioning server in a secure room may be transported across the internet to an end-user device attached to a personal computer. This means that special care must be taken to ensure the confidentiality, integrity, and authenticity of the information contained within.

8.1. Payload confidentiality

By design, the container allows two main approaches to guaranteeing the confidentiality of the information it contains while transported.

First, the container shared secret key payload may be encrypted. In this version of the specification, only shared secret key data is encrypted. Other credential attributes such as event counter are not encrypted.

In this case no transport layer security is required. If an application requires those attributes transmitted in confidential manner, the application should add such protection in the communication channel (see below). However, standard security best practices apply when selecting the strength of the cryptographic algorithm for payload encryption. Symmetric cryptographic cipher should be used - the longer the cryptographic key, the stronger the protection. At the time of this writing both 3DES and AES are recommended algorithms but 3DES may be dropped in the relatively near future. Applications concerned with algorithm longevity are advised to use AES. In cases where the exchange of encryption keys between the sender and the receiver is not possible, asymmetric encryption of the secret key payload may be employed. Similarly to symmetric key cryptography, the stronger the asymmetric key, the more secure the protection is.

If the payload is encrypted with a method that uses one of the password-based encryption methods provided above, the payload may be subjected to password dictionary attacks to break the encryption password and recover the information. Standard security best practices for selection of strong encryption passwords apply [Schneier].

Practical implementations should use PBESalt and PBEIterationCount when PBE encryption is used. Different PBESalt value per credential record should be used for best protection.
The second approach to protecting the confidentiality of the payload is based on using transport layer security. The secure channel established between the source secure perimeter (the provisioning server from the example above) and the target perimeter (the device attached to the end-user computer) utilizes encryption to transport the messages that travel across. No payload encryption is required in this mode. Secure channels that encrypt and digest each message provide an extra measure of security, especially when the signature of the payload does not encompass the entire payload.

Because of the fact that the plain text payload is protected only by the transport layer security, practical implementation must ensure protection against man-in-the-middle attacks [Schneier]. Validating the secure channel end-points is critically important for eliminating intruders that may compromise the confidentiality of the payload.

8.2. Payload integrity

The portable symmetric key container provides means for guaranteeing the integrity of the information it contains through digital signatures. For best security practices, the digital signature of the container should encompass the entire payload. This provides assurances for the integrity of all attributes. It also allows verification of the integrity of a given payload even after the container is delivered through the communication channel to the target perimeter and channel message integrity check is no longer possible.

8.3. Payload authenticity

The digital signature of the payload is the primary way of showing its authenticity. The recipient of the container may use the public key associated with the signature to assert the authenticity of the sender by tracing it back to a preloaded public key or certificate. Note that the digital signature of the payload can be checked even after the container has been delivered through the secure channel of communication.

A weaker payload authenticity guarantee may be provided by the transport layer if it is configured to digest each message it transports. However, no authenticity verification is possible once the container is delivered at the recipient end. This approach may be useful in cases where the digital signature of the container does not encompass the entire payload.
9. Appendix A - Example Symmetric Key Containers

All examples are syntactically correct and compatible with the XML schema in section 7. However, <Signature>, Secret <Value> and Secret <ValueDigest> data values are fictitious.

9.1. Symmetric Key Container with a single Non-Encrypted HOTP Secret Key

```xml
<?xml version="1.0" encoding="UTF-8"?>
<SecretContainer
  xmlns="http://www.openauthentication.org/OATH/2006/08/PSKC"
  xmlns:oath-logo="http://www.openauthentication.org/OATH/2006/08/Logo"
  xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.openauthentication.org/OATH/2006/08/PSKC
  .\oauth_pskc_schema_v1.1.xsd" version="1.1">
  <EncryptionMethod algorithm="NONE"/>
  <DigestMethod algorithm="HMAC-SHA1"></DigestMethod>
  <Device>
    <DeviceId>
      <Manufacturer>Token Manufacturer</Manufacturer>
      <SerialNo>98765432187</SerialNo>
      <Expiry>01/01/2008</Expiry>
    </DeviceId>
    <Secret SecretAlgorithm="HOTP" SecretId="98765432187">
      <Issuer>Credential Issuer</Issuer>
      <Usage>
        <Counter>101</Counter>
        <Response format="DECIMAL" length="6"/>
      </Usage>
      <FriendlyName>MyFirstToken</FriendlyName>
      <Data>
        <Value>WldjTHZwRm9YTkhBRytseDMrUnc=</Value>
        <ValueDigest>WldjTHZwRm9YTkhBRytseDM=</ValueDigest>
      </Data>
    </Secret>
  </Device>
</SecretContainer>
```

9.2. Symmetric Key Container with a single Password-based Encrypted HOTP Secret Key
<?xml version="1.0" encoding="UTF-8"?>
<SecretContainer
xmlns="http://www.openauthentication.org/OATH/2006/08/PSKC"
xmloath-logo="http://www.openauthentication.org/OATH/2006/08/Logo"
xmldsig#="http://www.w3.org/2000/09/xmldsig#"
xmlixsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.openauthentication.org/OATH/2006/08/PSKC/oath_pskc_schema_v1.1" version="1.1">
<EncryptionMethod algorithm="PBE-3DES112-CBC">
  <PBESalt>y6TzckelRQw=</PBESalt>
  <PBEIterationCount>999</PBEIterationCount>
</EncryptionMethod>
<DigestMethod algorithm="HMAC-SHA1"></DigestMethod>
<Device>
  <DeviceId>
    <Manufacturer>Token Manufacturer</Manufacturer>
    <SerialNo>98765432187</SerialNo>
    <Expiry>01/01/2008</Expiry>
  </DeviceId>
  <Secret SecretAlgorithm="HOTP" SecretId="77654321870">
    <Issuer>Credential Issuer</Issuer>
    <Usage>
      <Counter>101</Counter>
      <Response format="DECIMAL" length="6"/>
    </Usage>
    <FriendlyName>MySecondToken</FriendlyName>
    <Data>
      <Value>7JHUyp3azOkqJENSsh6b2vxXzwGBYypzJxEr+ikQAa229KV/Bg2hGA==</Value>
      <ValueDigest>WldjTHZwRm9YTkhBrytseDMrUnc=</ValueDigest>
    </Data>
  </Secret>
</Device>
</SecretContainer>
10. Normative References


Authors’ Addresses

Apostol T. Vassilev
Axalto Inc.
8311 N. FM 620
Austin, TX  78726
USA

Phone: +1 512 331 3723
Email: vassilev@axalto.com

Jon Martinsson
PortWise AB
Fånögatan 33 / Kista Science Tower
Kista, SE  164 21
Sweden

Phone: +46 8 562 914 55
Email: jon.martinsson@portwise.com

Mingliang Pei
VeriSign, Inc.
487 E. Middlefield Road
Mountain View, CA  94043
USA

Phone: +1 650 426 5173
Email: mpei@verisign.com

Philip Hoyer
ActivIdentity, Inc.
109 Borough High Street
London, SE1  1NL
UK

Phone: +44 (0) 20 7744 6455
Email: Philip.Hoyer@actividentity.com