Signature-Based Handling of Asserted Information using ToKENs (SHAKEN) Certificate Policy

June 6, 2023

Abstract

This document defines the security controls and policies to support the issuance of STI Certificates for the SHAKEN ecosystem. This document was developed for Certification Authorities that desire to be either a trusted STI-CA, STI-SCA, or V-SCA for the issuance of STI Certificates for SHAKEN. This document is based on the outline in ATIS-1000084.v003 and is consistent with the Internet Engineering Task Force (IETF) Public Key Infrastructure X.509 (IETF PKIX) Certificate Policy and Certification Practices Framework (RFC 3647).

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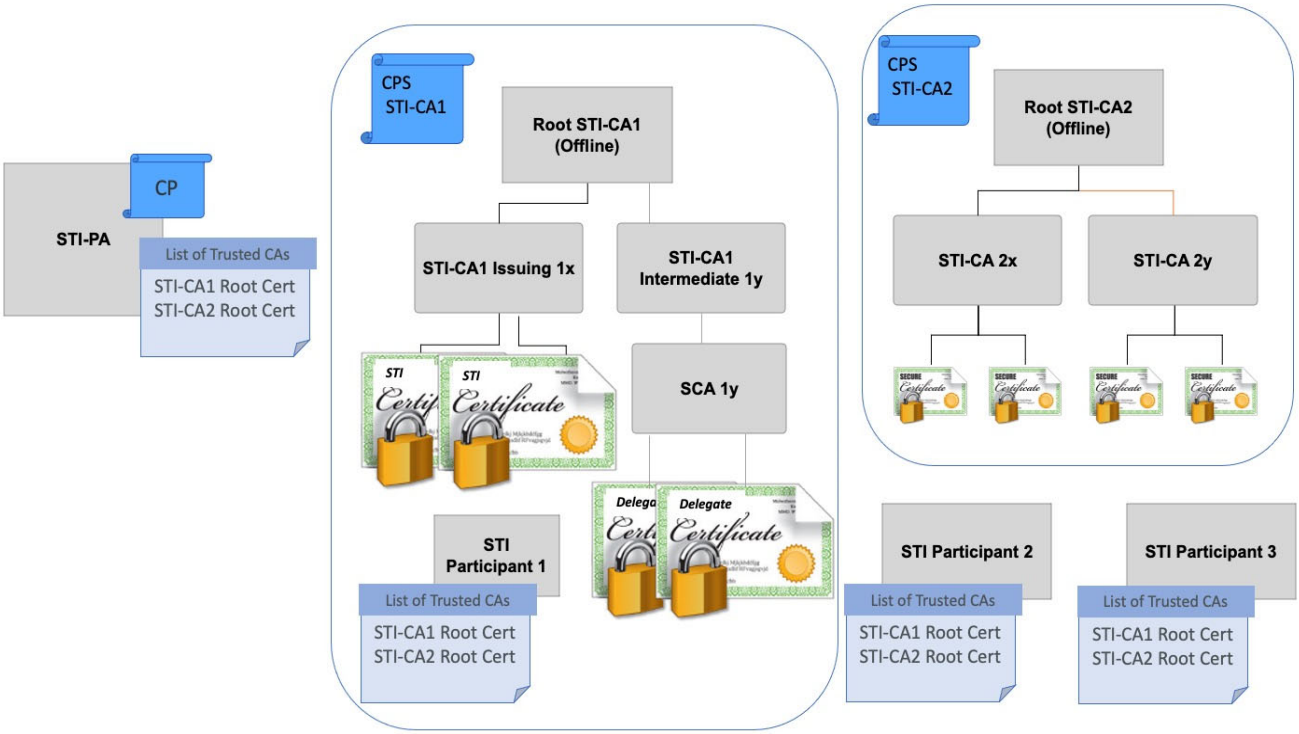
1 Introduction

This document contains the SHAKEN Certificate Policy (CP).

This Certificate Policy (CP) introduces procedural and operational considerations for Secure Telephone Identity Certification Authorities (STI-CAs), Secure Telephone Identity Subordinate Certification Authorities (STI-SCAs), or Virtual Subordinate Certificate Authorities (V-SCAs) [ATIS-1000092.v002], henceforth referred to as STI-CAs in this document unless there is a specific policy difference between them within the context of the *Signature-Based Handling of Asserted Information Using toKENs (SHAKEN)* framework (ATIS-1000074.v003) and the *SHAKEN: Governance Model and Certificate Management* framework (ATIS-1000080.v005). The SHAKEN Public Key Infrastructure (PKI) model is an inter-domain model with the STI Policy Administrator (STI-PA) serving as the Trust Authority for the PKI. The STI-PA maintains a list of the root certificates of the STI-CAs that have been approved to issue certificates in the SHAKEN ecosystem, per the following diagram:



Along with maintaining the list of Trusted STI-CA Root Certificates, the STI-PA also maintains the Certificate Revocation List (CRL).

The centralized trust authority model for SHAKEN allows the STI Governance Authority (STI-GA) and STI-PA to have control of the policies to protect the integrity of the PKI. In order to ensure that each Service Provider (SP) to whom a STI-CA issues STI-certificates is an approved SP in the SHAKEN ecosystem, the STI-PA provides a secure Service Provider Code (SPC) token that signifies approval. The SPs must provide this SPC token to a trusted STI-CA when they request a certificate to prove that they have been authorized by the STI-PA. The STI-CA validates that token using the public key certificate corresponding to the private key that the STI-PA used to sign the token. If the token is not valid, the STI-CA must not issue a certificate to that SP.

As specified in [ATIS-1000080.v005] and [ATIS-1000092.v002], the SPC token contains a CA boolean that provides two levels of authorization:

- CA boolean false authorizes the SP to obtain end entity STI Certificates that it can use to sign SHAKEN-approved PASSporTs as specified in [ATIS-1000074.v003],
- CA boolean true authorizes the SP to obtain intermediate STI Certificates that it can use as the parent certificate to delegate certificates issued to VoIP entities as specified in [RFC9060] and [ATIS-1000092.v002].

The following points summarize the key functions that support the SHAKEN Trust Model and issuance of STI certificates:

1. The STI-PA maintains and makes available the list of Trusted STI-CAs.
2. Local policy determines which issuing STI-CA an SP uses.
3. The STI-PA authorizes SPs to participate in the SHAKEN PKI and issues SPC tokens to obtain either end entity or intermediate level STI Certificate.
4. An SP proves it is authorized to acquire a certificate from an STI-CA by providing the SPC token to the STI-CA:
    a. The STI-CA validates the token using the STI-PA's public key certificate.
    b. The STI-CA verifies that the type of certificate requested (end entity or intermediate) is authorized by the SPC token, based on the value of the token's CA boolean.
5. The STI-PA maintains the CRL:
    a. The URL to the CRL is provided to the SPs when they request an SPC token.
    b. The SP includes the CRL URL as part of the certificate request, and the STI-CA includes the URL to the CRL in the 'cRLDistributionPointName' in the issued end entity or intermediate STI Certificate.
    c. SPs and STI-CAs add revoked certificates to the CRL through an interface to the STI-PA.
6. During verification of the PASSporT [RFC 8588], a certificate is deemed valid if the root CA in the validation path is on the list of Trusted STI-CAs and the certificate is not on the CRL.

1.1 Overview

This document focuses on STI Certification Authority (STI-CA) practices and policies that must be followed in order to be approved by the STI-PA to serve as trusted STI-CAs in the SHAKEN ecosystem. This CP is based on the outline defined in the *Technical Report on Operational and Management Considerations for SHAKEN STI Certification Authorities and Policy Administrators* (ATIS-1000084.v003), and identifies specific functions required to support the SHAKEN Trust Model as described in ATIS-1000080.v005], including SPC token validation and CRL management.

This CP conforms to *Internet X.509 Public Key Infrastructure Certificate Policy and Certification Practices Framework* [Internet Engineering Task Force (IETF) RFC 3647]. To retain the corresponding Section numbers, Sections that are not applicable are annotated as such and Sections left blank identify specific Sections that must be included in the STI-CA's Certification Practice Statement (CPS).

These STI-CA practices and policies are controlled and defined by the SHAKEN Policy Management Authority (PMA) as authorized by the STI-GA.

1.2 Document Name and Identification

This document is the "Signature-Based Handling of Asserted Information using ToKENs (SHAKEN) Certificate Policy".

- Version 1.0 was approved for publication on 22 October 2019.
- Version 1.1 was approved for publication on 07 April 2020.
- Version 1.2 was approved for publication on 26 July 2021
- Version 1.3 was approved for publication on 18 August 2021
- Version 1.4 was approved for publication on 06 June 2023

This policy has been assigned the following Object Identifier [OID]: 2.16.840.1.114569.1.1.4 for SHAKEN CP Version 1.4.

Subsequent revisions to this CP will contain new OID extensions corresponding to the SHAKEN CP version.

1.3 PKI Participants

The participants in the SHAKEN PKI model include STI-CAs, Subscribers, and Relying Parties. The Root CA is recommended to be an offline CA that only issues certificates to intermediate or issuing CAs. In the context of SHAKEN, SPs are the Subscribers and Relying parties.

1.3.1 Certification Authorities

The STI-CAs include the root CAs and any trusted and vetted STI-CA that issue STI Certificates.

1.3.2 Registration Authorities

Not Applicable. Registration Authorities are not part of the SHAKEN PKI model.

1.3.3 Subscribers

The Subscribers, or their designees, are the SPs that request end entity STI Certificates in order to sign a PASSporT (including SHAKEN [RFC 8588]) in the SIP [RFC 3261] Identity header field [RFC 8224], or intermediate STI Certificates to be used as the parent certificate of delegate certificates issued to VoIP Entities as specified in [ATIS-1000092.v002].

1.3.4 Relying Parties

The relying parties are those parties that use a Subscriber's certificate to verify the authenticity of the calling party identity per the procedures defined in [RFC 8224], [ATIS-1000074.v003] and [ATIS-100092.v002].

1.3.5 Other Participants

There are no other active participants in the SHAKEN PKI model.

1.4 Certificate Usage

1.4.1 Appropriate Certificate Usage

The STI-GA recognizes the use of the end entity certificates assigned within the SHAKEN PKI trust model for the SHAKEN PASSporTs, as described in [ATIS-1000074.v003], The end entity certificates issued within the SHAKEN PKI trust model are used by a Relying Party for validating signatures on SHAKEN PASSporTs, as described in [ATIS-1000074.v003]. The end entity certificates are also are used by a Relying Party to determine the authenticity of the calling party in the SP's VoIP network, as described in [ATIS-1000074.v003].

The STI-GA also recognizes the use of the end entity certificates assigned within the SHAKEN PKI trust model for signing other PASSporT extensions defined for use in the SHAKEN ecosystem by ATIS standards, recognized by the STI-GA Board in this CP, and specified in the CPS of the assigning STI-CA.

The following additional PASSporT extensions have been recognized by the STI-GA: "div" [ATIS-1000085.v002], "rph" [ATIS-1000078], and "rcd" [ATIS-1000094].

The end entity certificates issued within the SHAKEN PKI trust model are used by a Relying Party for validating the signatures on the recognized additional PASSporT extensions.

The intermediate STI Certificates issued within the SHAKEN PKI trust model are to be used only for signing the digital signatures of delegate certificates issued by the Subscriber to VoIP Entities, as specified in [ATIS-1000092.v002].

Non-revoked certificates may also be used for processing requests for certificate renewal or rekey.

1.4.2 Prohibited Certificate Uses

Any use other than described in Section 1.4.1, or outside of the SHAKEN eco-system, or not allowed by STI-GA policies are prohibited by this CP.

1.5 Policy Administration

1.5.1 Organization Administering the Document

The CP is administered by the STI-PA PMA, who can be contacted at:

STI-PA PMA Director iconectiv

100 Somerset Corporate Blvd Bridgewater, NJ 08807

Email: PMA@iconectiv.com

Phone: 732-699-6700

Website: https://authenticate.iconectiv.com

1.5.2 Contact Person

STI-CA accounts are hosted by the STI-PA. Administrative support personnel can be contacted at:

STI-PA Support iconectiv

100 Somerset Corporate Blvd Bridgewater, NJ 08807

Email: STI-PA@iconectiv.com

Phone: 732-699-6700

Website: https://authenticate.iconectiv.com

1.5.3 Entity Determining CPS Suitability for the Policy

The PMA determines the suitability and applicability of this CP and the conformance of a CPS, provided by specific STI-CAs, to this CP based on procedures established by the PMA. The suitability and applicability criteria include the results and recommendations received from an independent auditor (see Section 8). The PMA is also responsible for evaluating and acting upon the results of the compliance audit.

1.5.4 CPS Approval Procedures

The PMA approves the CPS based on review procedures established by the PMA to determine compliance to this CP.

Upon formal notice of the publication of a new CP, STI-CAs will have up to 45 days to submit a revised CPS to the PMA.

On approval of an STI-CA's revised CPS, all certificates issued by that STI-CA will conform to the requirements in that CPS within 90 days.

1.6 Definitions and Acronyms

For a list of common communications terms and definitions, please visit the *ATIS Telecom Glossary*, which is located at < http://www.atis.org/glossary >.

1.6.1 Definitions

The following provides some key definitions used in this document. Refer to IETF RFC 4949 for a complete Internet Security Glossary, as well as tutorial material for many of these terms.

(Digital) Certificate: Binds a public key to a Subject (e.g., the end-entity). A certificate document in the form of a digital data object (a data object used by a computer) to which is appended a computed digital signature value that depends on the data object. [RFC 4949]. See also STI Certificate.

Basic Constraints extension: The basic constraints extension identifies whether the subject of the certificate is a CA.

Certification Authority (CA): An entity that issues digital certificates (especially X.509 certificates) and vouches for the binding between the data items in a certificate. [RFC 4949].

Certificate Chain: See Certification Path.

Certification Path: A linked sequence of one or more public-key certificates, or one or more public-key certificates and one attribute certificate, that enables a certificate user to verify the signature on the last certificate in the path, and thus enables the user to obtain (from that last certificate) a certified public key, or certified attributes, of the system entity that is the subject of that last certificate. Synonym for Certificate Chain. [RFC 4949].

Certificate Policy (CP): A named set of rules that indicates the applicability of a certificate to a particular community and/or class of application with common security requirements. [RFC 3647].

Certification Practice Statement (CPS): A statement of the practices that a certification authority employs in issuing, managing, revoking, and renewing or re-keying certificates. [RFC 3647].

Certificate Revocation List (CRL): A data structure that enumerates digital certificates that have been invalidated by their issuer prior to when they were scheduled to expire. [RFC 4949].

CPS Summary (or CPS Abstract) - A subset of the provisions of a complete CPS that is made public by a CA. [RFC 3647].

Certificate Signing Request (CSR): A CSR is sent to a CA to get enrolled. A CSR contains a Public Key of the end-entity that is requesting the certificate.

Certificate Validation: An act or process by which a certificate user established that the assertions made by a certificate can be trusted. [RFC 4949].

Chain of Trust: Deprecated term referring to the chain of certificates to a Trust Anchor. Synonym for Certification Path or Certificate Chain. [RFC 4949].

Company Code: A unique four-character alphanumeric code (NXXX) assigned to all SPs [ATIS-0300251].

Delegate Certificate: A certificate whose parent certificate contains a TNAuthList extension, as defined in [RFC 9060] and [ATIS-1000092.v002].

End-Entity: An entity that participates in the Public Key Infrastructure (PKI). Usually a Server, Service, Router, or a Person. In the context of SHAKEN, it is the SP on behalf of the originating endpoint.

End Entity STI Certificate: An STI Certificate containing a Basic Constraints extension with a CA boolean set to false.

Fingerprint: A hash result ("key fingerprint") used to authenticate a public key or other data [RFC 4949].

Identity: Unless otherwise qualified, an identifier that unambiguously distinguishes an entity for authentication and other security and policy application purposes. In this report, a SPC is an example of the identity of one kind of participant in the certificate management process.

Intermediate STI Certificate: An STI Certificate containing a Basic Constrains extension with a CA boolean set to true.

Issuing CA: A Certification Authority that issues certificates to an End-Entity. In the context of SHAKEN, the Issuing CA must be subordinate to a trusted STI-CA or to an intermediate CA that is subordinate to a trusted STI-CA.

National/Regional Regulatory Authority (NRRA): A governmental entity responsible for the oversight/regulation of the telecommunication networks within a specific country or region.

NOTE: Region is not intended to be a region within a country (e.g., a region is not a state within the US).

National/Regional Regulatory Oversight (NRRO): A governmental entity responsible for the oversight/regulation of the telecommunication networks within a specific country or region. Synonym for NRRA.

Online Certificate Status Protocol (OCSP): An Internet protocol used by a client to obtain the revocation status of a certificate from a server.

Policy Management Authority (PMA): A person, role, or organization within a PKI that is responsible for (a) creating or approving the content of the certificate policies and CPSs that are used in the PKI; (b) ensuring the administration of those policies; and (c) approving any cross-certification or interoperability agreements with STI-CAs external to the PKI and any related policy mappings. The PMA may also be the accreditor for the PKI as a whole or for some of its components or applications.

Private Key: In asymmetric cryptography, the private key is kept secret by the end-entity. The private key can be used for both encryption and decryption. [RFC 4949].

Public Key: The publicly disclosable component of a pair of cryptographic keys used for asymmetric cryptography. [RFC 4949].

Public Key Infrastructure (PKI): The set of hardware, software, personnel, policy, and procedures used by a CA to issue and manage certificates. [RFC 4949].

Relying party: A system entity that depends on the validity of information (such as another entity's public key value) provided by a certificate. [RFC 5217].

Root CA: A CA that is directly trusted by an end-entity. See also Trust Anchor CA and Trusted CA. [RFC 4949].

Secure Telephone Identity (STI) Certificate: A certificate containing a TNAuthList extension as defined in [RFC 8226] and [ATIS-1000080.v005]. The TNAuthList contains a single SPC value that identifies the SHAKEN SP holding the certificate. All STI Certificates include the Basic Constraints extension.

Service Provider Code: In the context of this document, this term refers to any unique identifier that is allocated by a Regulatory and/or administrative entity to a SP. In the US and Canada this would be a Company Code as defined in [ATIS-0300251].

Service Provider Code (SPC) token: An authority token that can be used by a SHAKEN SP during the ACME certificate ordering process to demonstrate authority over the identity information contained in the TN Authorization List extension of the requested STI Certificate. The SPC token complies with the structure of the TNAuthList Authority Token defined by [draft-ietf-acme-authority-token-tnauthlist] and contains a single SPC in the “atc” claim. The SPC token also contains a CA boolean that authorizes the SHAKEN SP to obtain end entity STI Certificates (CA boolean false), or intermediate STI Certificates (CA boolean true).

Signature: Created by signing the message using the private key. It ensures the identity of the sender and the integrity of the data. [RFC 4949].

Subscriber: A SP that requests an end entity STI Certificate in order to sign a PASSporT (including SHAKEN [RFC 8588]) in the SIP [RFC 3261] Identity header field [RFC 8224], or requests an intermediate STI Certificate to be used as the parent certificate to delegate certificates issued to VoIP entities [ATIS-1000092.v002].

Telephone Identity: An identifier associated with an originator of a telephone call. In the context of the SHAKEN framework, this is a SIP identity (e.g., a SIP URI or a TEL URI) from which a telephone number can be derived.

Trust Anchor: An established point of trust (usually based on the authority of some person, office, or organization) from which a certificate user begins the validation of a certification path. The combination of a trusted public key and the name of the entity to which the corresponding private key belongs. [RFC 4949].

Trust Anchor CA: A CA that is the subject of a trust anchor certificate or otherwise establishes a trust anchor key. See also Root CA and Trusted CA. [RFC 4949].

Trust Authority: An entity that manages a Trust List for use by one or more relying parties. [RFC 5217].

Trusted CA: A CA upon which a certificate user relies for issuing valid certificates; especially a CA that is used as a trust anchor CA. [RFC 4949].

Trusted Role: A role performed by a person who can introduce security problems if not carried out properly, whether accidentally or maliciously.

Trust List: A set of one or more trust anchors used by a Relying Party to explicitly trust one or more PKIs. [RFC 5217].

Trust Model: Describes how trust is distributed from Trust Anchors.

VoIP Entity: A non-STI-authorized end user entity or other calling entity that purchases (or otherwise obtains) delegated telephone numbers from a TN Service Provider (e.g., call centers, value added service providers, VoLTE subscriber).

1.6.2 Acronyms

ACME	Automated Certificate Management Environment (Protocol)
ATIS	Alliance for Telecommunications Industry Solutions
CA	Certification Authority
CN	Common Name
CRL	Certificate Revocation List
CP	Certificate Policy
CPS	Certification Practice Statement
CR	Certificate Repository
CSR	Certificate Signing Request
DN	Distinguished Name
ECDSA	Elliptic Curve Digital Signature Algorithm
FCC	Federal Communications Commission
HTTPS	Hypertext Transfer Protocol, Secure
IETF	Internet Engineering Task Force
JSON	JavaScript Object Notation
JWT	JSON Web Token
NNI	Network-to-Network Interface
OCN	Operating Company Number
OCSP	Online Certificate Status Protocol
PKI	Public Key Infrastructure
PKIX	Public Key Infrastructure for X.509 Certificates
PMA	Policy Management Authority
SHAKEN	Signature-based Handling of Asserted information using toKENs
SIP	Session Initiation Protocol
SKS	Secure Key Store

SP	Service Provider
SPC	Service Provider Code
SP-KMS	SP Key Management Server
STI	Secure Telephone Identity
STI-AS	Secure Telephone Identity Authentication Service
STI-CA	Secure Telephone Identity Certification Authority
STI-CR	Secure Telephone Identity Certificate Repository
STI-GA	Secure Telephone Identity Governance Authority
STI-PA	Secure Telephone Identity Policy Administrator
STI-VS	Secure Telephone Identity Verification Service
STIR	Secure Telephone Identity Revisited
TN	Telephone Number
URI	Uniform Resource Identifier
VoIP	Voice over Internet Protocol

1.7 References

At the time of publication, the editions indicated below were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ATIS-1000074.v003, *Signature-based Handling of Asserted Information using Tokens (SHAKEN).*[1]

ATIS-1000080.v005, *Signature-based Handling of Asserted Information using Tokens (SHAKEN): Governance Model and Certificate Management.* ***Error! Bookmark not defined.***

ATIS-1000084.v003, *Operational and Management Considerations for SHAKEN STI Certification Authorities and Policy Administrator.* ***Error! Bookmark not defined.***

ATIS-1000092.v002, *Signature-based Handling of Asserted Information using Tokens (SHAKEN): Delegate Certificates.*[1]

ATIS-0300251.a.2020, *Codes for Identification of Service Providers for Information Exchange.*[1]

draft-ietf-acme-authority-token-tnauthlist, *TNAuthList profile of ACME Authority Token.*[2]

FIPS 140-2, *Security Requirements for Cryptographic Modules.*[3]

FIPS 186-4, *Digital Signature Standard (DSS).*[3]

NIST SP 800-88 Rev. 1, *Guidelines for Media Sanitization.*[3]

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[1] This document is available from the Alliance for Telecommunications Industry Solutions (ATIS) at < https://www.atis.org/docstore/ >.

[2] This document is available from the Internet Engineering Task Force (IETF) at < http://www.ietf.org >.

[3] This document is available from the National Institute of Standards and Technology (NIST) at < https://csrc.nist.gov/publications >.

NIST SP 800-147, *BIOS Protection Guidelines.*[3]

NIST SP 800-147B, *BIOS Protection Guidelines for Servers.*[3]

RFC 3261, *SIP: Session Initiation Protocol.*[2]

RFC 3647, *Internet X.509 Public Key Infrastructure Certificate Policy and Certification Practices Framework.*[2]

RFC 4949, *Internet Security Glossary, Version 2.*2.[2]

RFC 5217, *Memorandum for Multi-Domain Public Key Infrastructure Interoperability.*[2]

RFC 5280, *Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile.*[2]

RFC 5480, *Elliptic Curve Cryptography Subject Public Key Information.*[2]

RFC 5905, *Network Time Protocol Version 4 (NTPv4).*[2]

RFC 7159, *The JavaScript Object Notation (JSON).*[2]

RFC 7231, *Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content.*[2]

RFC 7515, *JSON Web Signatures (JWS).*2 RFC 7516, *JSON Web Algorithms (JWA).*[2]

RFC 7517, *JSON Web Key (JWK).*[2]

RFC 7518, *JSON Web Algorithm (JWA).*[2]

RFC 7519, *JSON Web Token (JWT).*[2]

RFC 8224, *Authenticated Identity Management in the Session Initiation Protocol.*[2]

RFC 8226, *Secure Telephone Identity Credentials: Certificates.*[2]

RFC 8555, *Automatic Certificate Management Environment (ACME).*[2]

RFC 8588, *Personal Assertion Token (PASSporT) Extension for Signature-based Handling of Asserted information using toKENs (SHAKEN).*[2]

RFC 9060, *STIR Certificate Delegation.*[2]

X.501, *ITU-T Recommendation X.501 (2005) | ISO/IEC 9594-2:2005, Information technology - Open Systems Interconnection - The Directory: Models.* [4]

2 Publication and Repository Responsibilities

In the case of SHAKEN, it is expected that the SPs will maintain a repository of the certificates they acquire from trusted STI-CAs. Thus, it is not a requirement that an STI-CA also maintain an STI-CR.

2.1 Public Repositories

In the SHAKEN ecosystem, the STI-CA Subscriber (i.e., SP) is responsible for the publication of public certificates into a certificate repository (STI-CR) that shall be publicly accessible to all relying parties.

2.2 Publication of Certification Information

Each Subscriber shall publish the end entity certificate that it obtains from the STI-CA via a certificate repository system (STI-CR) that is publicly accessible within the VoIP network. The Subscriber shall ensure the certificates are published in a repository accessible to all relying parties for the validity period of the end entity certificate.

[4] This document is available from the ITU-T at: < http://www.itu.org >.

The Subscriber shall notify and provide the STI-PA with any revoked certificates that shall be placed on the CRL via the STI-PA UI. It is required that certificate being revoked be uploaded as part of the revocation process.

2.3 Time or Frequency of Publication

The Subscriber shall publish any issued certificate, within 24 hours after issuance.

Root STI-CAs shall provide their root certificate once they have been approved by the PMA. Each Root STI-CA shall provide the STI-PA a revised root certificate at least one (1) week prior to expiration of the current root certificate being stored by the STI-PA for distribution to the SPs.

2.4 Access Controls on Repositories

Information published in a repository is public information. Subscribers shall provide unrestricted access to its repositories and shall implement logical and physical controls to prevent unauthorized *write* access to those repositories.

3 Identification and Authentication

The CPS shall describe the procedures used to authenticate the identity and other attributes of an SP prior to issuing certificates to the SP. This shall include whether the STI-CA supports the Automated Certificate Management Environment (ACME) [RFC 8555] protocol, as well as the ACME extension for token authorization using the SPC as described in [ATIS-1000080.v005], [ATIS-1000092.v002] and[draft-ietf-acme-authority-token-tnauthlist]. The fingerprint in the SPC token is based on the public key associated with the SP's account ACME credentials.

If the Issuing STI-CA does not support the ACME protocol, the Issuing STI-CA is still required to validate that the SP requesting issuance of a certificate has been assigned a valid SPC token by the STI-PA, following the procedures as described in [ATIS-1000080.v005] and [ATIS-1000092.v002]. The value to be used for the fingerprint in the SPC token should be based on a similar mechanism as that used ACME (i.e., the fingerprint of a public key used by the SP to interface with the STI-CA). The STI-CA shall describe the mechanism in the CPS.

3.1 Naming

3.1.1 Types of Names

The STI-CA shall assign an X.501 Distinguished Name (DN) [X.501] to each Subscriber. Issuer and subject DNs, shall include single country name (C) which shall be "US" for all certificates produced under this policy, single organization name (O), and single common name (CN) naming attributes. See [ATIS-100080.v005] and [ATIS-100092.v002] for additional restrictions on the values placed in the organization name and common name naming attributes. To distinguish among successive instances of certificates associated with the same entity, the 'serialNumber' naming attribute may also be included in the DN.

3.1.2 Need for Names to be Meaningful

Names used in the STI Certificates shall represent an unambiguous identifier for the SP Subject. The names should be meaningful enough to represent the SP to whom the certificate is being issued, in a manner similar to that used to identify SP's equipment in the network.

3.1.3 Anonymity or Pseudonymity of Subscribers

Anonymity is not a function of this PKI; thus, no explicit support for this feature is provided.

3.1.4 Rules for Interpreting Various Name Form

No specific rules are required.

3.1.5 Uniqueness of Name

Subject names need not be globally unique in this PKI. However, each STI-CA shall certify that subject names are unique among the certificates it issues and must describe the process for creating unique names in the CPS.

3.1.6 Recognition, Authentication, and Role of Trademarks

No additional stipulations.

3.2 Initial Identity Validation

The SHAKEN model for identification requires that an SP shall first register with the STI-PA and have a valid SPC token issued by the STI-PA in order to obtain certificates.

3.2.1 Method to Prove Possession of Private Key

Each STI-CA operating within the context of this PKI shall require each Subscriber to demonstrate proof of possession (PoP) of the private key corresponding to the public key in the certificate, prior to issuing the certificate. The means by which PoP is achieved is determined by each STI-CA and shall be described in the CPS of that STI-CA.

In the case of a STI-CA that supports the ACME protocol, the SP is authenticated by means of an "account key pair." The SP uses the private key of this key pair to sign all messages sent to the server. The server uses the SP's public key to verify the authenticity and integrity of messages from the SP.

3.2.2 Authentication of Organization Identity

The certificate subject DN shall contain the Country (C) naming attribute and other Subject Identity Information. The STI-CA shall verify the identity of the SP and the authenticity of the SP Applicant Representative's certificate request using a verification process that must be described in the STI-CA's CPS. At a minimum, the STI-CA shall validate the SP and ensure that the SP has a valid SPC token.

3.2.3 Authentication of Individual Identity

Each STI-CA operating within the context of the SHAKEN PKI shall employ procedures to identify at least one individual as a representative of each SP. The specific means by which each STI-CA authenticates individuals as representatives for the SP shall be described by the CPS for each STI-CA.

3.2.4 Non-verified Subscriber Information

Information that is not verified shall not be included in certificates.

3.2.5 Validation of Authority

Each STI-CA operating within the context of the SHAKEN PKI shall employ procedures to verify that an individual claiming to represent an SP to which a certificate is issued is authorized to represent that SP in this context. The procedures shall be described by the CPS for the STI-CA.

3.2.6 Criteria for Interoperation

This PKI is neither intended nor designed to interoperate with any other PKI.

3.3 Identification and Authentication for Re-key Requests

The CPS shall describe the procedures required for identification and authentication for re-key requests. In the context of SHAKEN, a re-key request shall require issuance of a new certificate.

3.3.1 Identification and Authentication for Routine Re-key

For re-key of any Subscriber certificate issued under this Certificate Policy, credentials may be established through use of current a signature key unless the certificate has been revoked (see Section 3.3.2). The credentials shall be established following the same procedures as the initial registration at least once every three (3) years from the time of the initial registration.

3.3.2 Identification and Authentication for Re-key after Revocation

In the context of SHAKEN, certificate re-key requests after revocation shall follow the same process as initial identity verification and certificate issuance.

3.4 Identification and Authentication for Revocation Requests

Revocation requests shall be performed by STI-CA subscribers directly to the STI-PA via their STI-PA account. The specific certificate to be revoked needs to be identified, and the reason for revocation and invalidity date need to be documented. STI-CA subscribers shall notify the STI-PA as soon as possible in the case that a certificate is required to be revoked. This should be performed via the STI-PA UI, which requires the actual certificate being revoked to be uploaded as part of the revocation process. Section 4.9. provides details of other revocation scenarios.

4 Certificate Life-Cycle Operational Requirements

This component of the CP specifies requirements imposed upon Issuing STI-CAs and Subscribers with respect to the life cycle of a certificate.

4.1 Certificate Application

4.1.1 Who Can Submit a Certificate Application

The only entities that can submit an application for a certificate are SPs that have provided their STI-CA with an SPC Token. The SPC Token will serve as the means for verification. The SPs must have previously set up an account with the STI-PA and must provide a valid SPC token, as defined in [ATIS-1000080.v005] and [ATIS-1000092.v002], to prove that it is authorized to obtain STI Certificates.

4.1.2 Enrollment Process and Responsibilities

In the case of an Issuing STI-CA that supports the ACME protocol, the procedures outlined in [ATIS-1000080.v005] and [ATIS-1000092.v002] shall be followed in order to create an account with the Issuing STI-CA.

For STI-CAs that do not support the ACME protocol, the mechanism shall be described in the CPS.

Prior to the issuance of a certificate, the STI-CA shall obtain the following documentation from the Applicant:

1. A certificate request, which may be electronic; and
2. An executed Subscriber Agreement or Terms of Use, which may be electronic.

The STI-CA shall obtain any additional documentation the STI-CA determines necessary to meet these requirements.

The STI-CA CPS shall provide and describe the means by which the SPC token associated with the certificate request can be transmitted to the STI-CA.

4.2 Certificate Application Processing

This Section describes the procedure for processing certificate applications.

4.2.1 Performing Identification and Authentication Functions

In the case of STI-CAs that support the ACME protocol the procedures for authentication and association of a certificate application shall follow the procedures for authenticating each ACME protocol request. If the STI-CA does not implement the ACME protocol, the CPS must describe the procedure for authenticating and identifying the SP customer.

4.2.2 Approval or Rejection of Certificate Applications

The Issuer STI-CA shall reject any certificate application that cannot be verified. Issuer STI-CAs shall provide a reason for rejecting a certificate application.

4.2.3 Time to Process Certificate Applications

As part of its CPS, each STI-CA shall declare its expected time frame to process a certificate application (i.e., the time between receiving the order for a new certificate from the SP and delivering the new certificate to the SP). Certificate applications shall be processed within a maximum of 24 hours.

4.3 Certificate Issuance

In the case of STI-CAs that support the ACME protocol, the procedures for certificate issuance depend on the type of STI Certificate as follows:

- For issuing end entity STI Certificates, the procedures described in [ATIS- 1000080.v005] and [RFC 8555] shall be followed.
- For issuing intermediate STI Certificates, the procedures in [ATIS-1000092.v002] shall be followed.

For CP revisions that place new requirements on end-entity certificates, STI-CAs shall comply with the new requirements for all newly assigned certificates within 90 days of the approval of their revised CPS.

For certificates issued under a previous version of the CP, the new requirements will not need to be applied until 90-days after the effective date of the new CP and until those certificates are renewed or re-keyed.

4.3.1 STI-CA Actions During Certificate Issuance

If a STI-CA determines that the request is acceptable, it shall issue the requested certificate. If the STI-CA maintains a public repository it shall publish the certificate in the repository as described in Section 2.

4.3.2 Notification to Subscriber by the STI-CA of Issuance of Certificate

If the STI-CA publishes the certificate on behalf of the SP, the STI-CA shall notify the Subscriber when the certificate is published. If the ACME protocol is not supported, the means by which a Subscriber is notified shall be defined by each STI-CA in its CPS.

4.4 Certificate Acceptance

If the STI-CA publishes the certificate on behalf of the SP, the CPS shall document the process for an SP applicant acceptance of a certificate, publication of the certificate by the STI-CA, and notification of certificate issuance to other entities.

4.4.1 Conduct Constituting Certificate Acceptance

If the STI-CA publishes the certificate on behalf of the SP, within the timeframe specified in its CPS, the STI-CA shall place the certificate in the repository and notify the Subscriber. Each STI-CA shall state in its CPS the procedures it follows for publishing of the certificate and notification to the Subscriber.

4.4.2 Publication of the Certificate by the STI-CA

In the case that the STI-CA is publishing the certificates on behalf of the Subscriber, the STI-CA shall publish the certificate in the repository as described on Section 2.

4.4.3 Notification of Certificate Issuance by the STI-CA to Other Entities

No other entities shall be notified of issuance of the STI Certificates.

4.5 Key Pair and Certificate Usage

A summary of the SHAKEN model for the PKI is provided below.

4.5.1 Subscriber Private Key and Certificate Usage

All Subscribers shall protect their Private keys from unauthorized use or disclosure by third parties and shall use their Private keys only as specified in the key usage extension of the corresponding certificate. Each SP that has a valid account with the STI-PA is eligible to request an STI Certificate containing the STIR/SHAKEN extensions.

4.5.2 Relying Party Public Key and Certificate Usage

Any SP that receives a SIP Identity header field with a STI Certificate signed PASSporT must verify the information. Before using the STI public key certificate, the SP shall perform digital signature per procedures defined in [ATIS-1000074.v003] and [ATIS-1000092.v002], as well as ensure that the certificate was issued by a STI-CA that is on the list of Trusted Root CAs, as provided by the STI-PA, and the certificate is not included in the CRL. The Relying Party shall ensure that the list of Trusted Root CAs has not expired; i.e., is up to date. If it has expired, they shall retrieve the current list from the STI-PA.

4.6 Certificate Renewal

In the case of the ACME protocol, the Subscriber initiates a request for a new certificate. STI-CAs shall not initiate the process to renew or issue a new certificate on behalf of the Subscriber. The process for renewal follows that of certificate issuance per Sections 4.2 through 4.4. Those STI-CAs not using ACME shall provide equivalent procedures and shall describe them.

4.6.1 Circumstance for Certificate Renewal

A Subscriber must request issuance of a new certificate prior to the expiration date of the certificate currently in use. It is recommended that the Subscriber request issuance of the new certification at least 24 hours prior to expiration.

The request for a new certificate renewal must incorporate the same public key as the previous certificate, unless the private key has been reported as compromised.

4.6.2 Who May Request Renewal

Only the Subscriber that is the holder of the expiring certificate can request a new certificate.

4.6.3 Processing Certificate Renewal Requests

The process for renewing a certificate follows the procedures for initial issuance per the previous Sections. Only the certificate Subscriber may request the renewal of their certificate.

4.6.4 Notification of New Certificate Issuance to Subscriber

The process shall follow that described in Section 4.3.2.

4.6.5 Conduct Constituting Acceptance of a Renewal Certificate

The process follows that described in Section 4.4.1.

4.6.6 Publication of the Renewal Certificate by the STI-CA

The process follows that described in Section 4.4.2.

4.6.7 Notification of Certificate Issuance by the STI-CA to Other Entities

The process follows that described in Section 4.4.3; no other entities shall be notified of certificate issuance.

4.7 Certificate Re-key

This Section describes the requirements for certificate re-key. Certificate re-key is the issuance of a new certificate to replace an old one for the reasons given in Section 4.7.1. Unlike with certificate renewal, the public key must be changed.

4.7.1 Circumstance for Certificate Re-key

Re-key of a certificate must only be performed when required, based on:

1. Knowledge or suspicion of compromise or loss of the associated private key; or
2. The expiration of the cryptographic lifetime of the associated key pair.

A STI-CA or SP may perform the certificate re-key operation for other reasons (e.g., an SP could choose to always re-key its short-lived certificates).

Information on maximum key lifetimes can be found in Section 6.3.2. A STI-CA re-key operation requires the reissuance of all certificates issued by the re-keyed entity. It must be performed only when necessary and in a way that preserves the capability of Relying Parties to validate certificates whose validation path includes the re-keyed entity.

If the re-key is based on a suspected compromise, then the previous certificates shall be revoked per the procedures in Section 4.9.

4.7.2 Who May Request Certification of a New Public Key

A certificate re-key may be requested only by the Subscriber.

4.7.3 Processing Certificate Re-keying Request

The process for re-keying a certificate follows the procedures for initial issuance per the previous Sections.

4.7.4 Notification of New Certificate Issuance to Subscriber

The STI-CA shall describe how the subscriber is informed of the re-key of its certificate and the contents of the certificate.

4.7.5 Conduct Constituting Acceptance of a Re-keyed Certificate

The process follows that described in Section 4.4.1.

4.7.6 Publication of the Re-keyed Certificate by the STI-CA

The process follows that described in Section 4.4.2.

4.7.7 Notification of Certificate Issuance by the STI-CA to Other Entities

The process follows that described in Section 4.4.3; no other entities shall be notified of certificate issuance.

4.8 Certificate Modification

Subscriber certificates must not be modified. If certificate information is not correct, then a new certificate must be requested. For example, if the Subscriber name changes, then the Subscriber shall undergo the initial registration process again with the STI-CA and then follow the procedures described in Sections 4.2 through 4.4. The previous certificate must be revoked and follow the procedures in Section 4.9.

4.8.1 Circumstance for Certificate Modification

Not applicable.

4.8.2 Who May Request Certificate Modification

Not applicable.

4.8.3 Processing Certificate Modification Requests

Not applicable.

4.8.4 Notification of New Certificate Issuance to Subscriber

Not applicable.

4.8.5 Conduct Constituting Acceptance of Modified Certificate

Not applicable.

4.8.6 Publication of the Modified Certificate by the STI-CA

Not applicable.

4.8.7 Notification of Certificate Issuance by the STI-CA to Other Entities

Not applicable.

4.9 Certificate Revocation and Suspension

The model for managing and communicating the status of revoked certificates is in the form of a distributed Certificate Revocation List (CRL) that is maintained by the STI-PA as described in [ATIS-1000080.v005]. The STI-PA authenticates all revocation requests. Certificates that can be included on the STI-PA managed CRL include end-entity or intermediate certificates that were authorized to be created via SPC tokens or intermediate STI Certificates of approved STI-CAs. Delegate Certificates created by the procedures as defined in [ATIS-1000092.v002] shall not be placed on the CRL managed by the STI-PA.

Once a certificate is revoked, the CRL entry shall be included in all subsequent CRLs for one edition beyond the expiration of the certificate. This process ensures that all revoked certificates appear on at least one CRL, even when the revocation occurs shortly before the certificate expiration.

4.9.1 Circumstances for Revocation

An intermediate STI Certificate or STI End Entity Certificate shall be revoked if there is reason to be believe there has been a compromise of a STI-CA's or Subscriber's private key. Other reasons for certificate revocation include:

- Affiliation Changed, where, due to an organizational name change, the certificate's Subject Name field no longer identifies the certificate holder.
- Superseded, where the certificate has been replaced with a new certificate.
- Cessation of operation, where the Subscriber holding the certificate is ceasing operation.
- Privilege Withdrawn, where the Subscriber holding the certificate is no longer authorized to obtain STI Certificates.

Note, when a STI-CA ceases operation or loses its authority to issue STI Certificates, the STI-CA's intermediate certificates are not revoked. Instead, relying parties will discover that the STI-CA's certificates are no longer valid based on the fact that the STI-CA is no longer listed on the Trusted STI-CA List.

There is also an STI-GA revocation policy that provides other reasons a certificate may be revoked, generally more for policy violation reasons than the organizational change or security compromises listed above.

4.9.2 Who Can Request Revocation

A Subscriber can request revocation of a certificate over which it has authority. In addition, a third party (i.e., STI-GA, STI-PA, FCC, or other regulatory bodies as identified in the policies) could also revoke a certificate. If the STI-CA receives a request for revocation from a Subscriber of a certificate that it issued to the Subscriber, then the request shall be sent to the STI-PA.

4.9.3 Procedure for Revocation Request

An entity requesting a certificate revocation (see Section 4.9.2 for the list of such requestors) must submit a request for revocation of an end entity or intermediate certificate to the STI-PA by providing a certificate to be placed on the CRL.

4.9.4 Revocation Request Grace Period

There is no grace period for a revocation request. Once a certificate has been identified and the revocation requestor has been verified, the STI-PA shall revoke the certificate immediately by adding it to the CRL.

4.9.5 Time within which the Revocation Request must be Processed

The expected revocation timing is guided by the process per Section 4.9.4 and the revocation requestor. The timing shall consider the process of notifying the STI-PA.

4.9.6 Revocation Checking Requirement for Relying Parties

A Relying Party shall acquire and check the CRL, which is managed by the STI-PA, when the Relying Party validates a certificate.

4.9.7 CRL Issuance Frequency (If Applicable)

The STI-PA maintains the CRL and updates the CRL and makes it available within a 24-hour timeframe.

4.9.8 Maximum Latency for CRLs (If Applicable)

Not applicable.

4.9.9 Online Revocation/Status Checking Availability

The URL to the CRL maintained by the STI-PA is included in the ‘cRLDistributionPointName’ field in the issued certificate. The Relying Party accesses the list via an HTTPS interface as described in [ATIS-1000080.v005].

4.9.10 Online Revocation Checking Requirements

The SHAKEN PKI does not make provisions for the support of certificate status services such as Online Certificate Status Protocol (OCSP). The SHAKEN PKI defines an indirect CRL model in which the Subscribers can provide any revoked end-entity or intermediate certificates and STI-CAs provide any revoked intermediate certificates to the STI-PA for inclusion in the CRL. The URL to the CRL is included in the SPC token provided by the STI-PA. The STI-CA includes the URL from the token in the ‘cRLDistributionPointName’ field in the end entity certificate so that during path validation, the Relying Party can check whether the end entity certificate or any intermediate certificate in the certification path have been revoked.

4.9.11 Other Forms of Revocation Advertisements Available

Not applicable.

4.9.12 Special Requirements Re-key Compromise

Not applicable.

4.9.13 Circumstances for Suspension

The SHAKEN PKI model does not support suspension of certificates.

4.9.14 Who Can Request Suspension

Not applicable.

4.9.15 Procedure for Suspension Request

Not applicable.

4.9.16 Limits on Suspension Period

Not applicable.

4.10 Certificate Status Services

The SHAKEN PKI does not support certificate status services such as OCSP.

4.10.1 Operational Characteristics

Not applicable.

4.10.2 Service Availability

Not applicable.

4.10.3 Optional Features

Not applicable.

4.11 End of Subscription

The subscription ends when the certificate is revoked or expires. The CPS shall describe the procedure to handle the end of subscription.

4.12 Key Escrow and Recovery

4.12.1 Key Escrow and Recovery Policy and Practices

STI-CA private keys shall never be escrowed. Under no circumstances shall a Subscriber's signature key be held in trust by a third party.

Subscriber key management keys may be escrowed to provide key recovery. Escrowed keys shall be protected at no less than the level of security in which they are generated, delivered, and protected by the Subscriber. STI-CAs that support private key escrow for key management keys shall document their specific practices in their CPS and key escrow documentation.

4.12.2 Session Key Encapsulation and Recovery Policy and Practices

STI-CAs that support session key encapsulation and recovery shall identify the document describing the practices in the applicable CPS. Components that support session key recovery shall meet the security requirements for the STI-CAs stated in Section 6.

5 Management, Operational, and Physical Controls

This Section describes the technical and administrative security controls used by the STI-CA for key generation, subject authentication, certificate issuance, certificate revocation, auditing, and archiving. The CPS shall describe the controls and procedures for all the areas identified in this Section.

5.1 Physical Security Controls

For directly operated physical systems, the STI-CA shall maintain security controls for its facilities hosting the STI-CA operation. For physical systems that are not under the direct control of the STI-CA, an equivalent description of security guarantees and/or highly available, geo-redundant operation shall be provided. The controls employed for the STI-CA operation shall be specified in its CPS. The following items shall be documented:

5.1.1 Site Location and Construction

The location and construction of the facility housing the STI-CA equipment, as well as sites housing remote workstations used to administer the STI-CAs, shall be consistent with facilities used to house sensitive information. The site whether directly operated or operated by an external party shall provide protection against unauthorized access to STI-CA equipment and records. STI-CAs in the SHAKEN ecosystem shall be located in the US.

5.1.2 Physical Access

Physical access to equipment hosting the STI-CA shall be limited to authorized personnel. The security mechanisms shall be commensurate with the level of threat in the equipment environment. The CPS shall describe the physical access controls for relevant facility rooms to the extent relevant to directly operated physical systems. The CPS shall describe the security mechanisms in place to prohibit unauthorized access to equipment hosting the STI-CA.

5.1.3 Power and Air Conditioning

For directly operated physical systems, the STI-CA shall have backup power capability sufficient to lock out input, finish any pending actions, and record the state of the equipment automatically before lack of power or air conditioning causes a shutdown.

5.1.4 Water Exposures

For directly operated physical systems, the STI-CA equipment shall be installed such that it is not in danger of exposure to water (e.g., on tables or elevated floors). Potential water damage from fire prevention and protection measures (i.e., sprinkler systems) are excluded from this requirement.

5.1.5 Fire Prevention and Protection

For directly operated physical systems, the physical systems hosting the STI-CA shall comply with local commercial building codes for fire prevention and protection.

5.1.6 Media Storage

For directly operated physical systems, media shall be stored so as to protect it from accidental damage (water, fire, electromagnetic) and unauthorized physical access.

Media containing private key material shall be handled, packaged, and stored in a manner compliant with the requirements for the sensitivity level of the information it protects or to which it provides access. Storage protection of STI-CA private key material shall be offline and at the high levels of sensitivity.

5.1.7 Waste Disposal

For directly operated physical systems, STI-CA and Operations Staff shall remove and destroy normal office waste in accordance with local policy. Media used to collect or transmit privacy information shall be destroyed such that the information is unrecoverable at any time prior to disposal of the physical medium itself. Sensitive media and paper shall be destroyed in a manner that renders the information printed on it unrecoverable by any means, Destruction of media and documentation containing sensitive information, such as private key material, shall employ methods commensurate with those in SP 800-88.

5.1.8 Off-site Backup

A system backup shall be made when a STI-CA system is activated. STI-CA operational system backups shall be made at least once per week. Backups shall be stored offsite. Only the latest backup needs to be retained. The backup shall be stored at a site with physical and procedural controls commensurate to that of the operational STI-CA system.

The data backup media shall be stored in a manner appropriate for storage of information of the same value of the information that will be protected by the certificates and associated private keys issued or managed using the equipment with a minimum requirement of transferring, handling, packaging, and storage of the information in a manner compliant with requirements for sensitive material identified in Section 6.5.1.6.

5.2 Procedural Controls

The CPS shall provide information on the trusted roles (e.g., system administrator). For each role, the CPS shall provide the responsibilities, and the identification and authentication requirements. The CPS shall include separation of duties and the number of individuals required to perform a task.

5.2.1 Trusted Roles

A trusted role--if performed by person versus a secure, autonomous computer program or process--is one in which the person acting in that role performs functions that can introduce security problems if not carried out properly, whether accidentally or maliciously. The only trusted roles defined by this policy are CA Administrators, CA Operations Staff, and Security Auditors. Trusted role operations include:

- The validation, authentication, and handling of information in certificate applications;
- The acceptance, rejection, or other processing of certificate applications, revocation requests, renewal requests, or enrollment information;
- The issuance, or revocation of certificates, including personnel having access to restricted portions of its repository;
- Access to safe combinations and/or keys to security containers that contain materials supporting production services;
- Access to hardware security modules (HSMs), their associated keying material, and the secret share splits of the PINs that protect access to the HSMs;
- Installation, configuration, and maintenance of the CA;
- Access to restricted portions of the certificate repository; or
- The ability to grant physical and/or logical access to the CA equipment.

The STI-CA shall maintain lists, including names, organizations, contact information, and organizational affiliation for those who act in CA Administrator, CA Operations Staff, and Security Auditor trusted roles, and shall make them available during compliance audits.

If applicable, the CPS shall define the roles and responsibilities for the CA Administrator, CA Operations Staff, and Security Auditor, noting that some staff may serve in multiple roles.

5.2.2 Number of Persons Required Per Task

If processes are not performed by a secure, autonomous computer program or process, and where multi-party control is required, all participants shall hold a trusted role. Multi-party control shall not be performed by personnel who serve in a Security Auditor role with the exception of audit functions. If not being performed by a secure, autonomous computer program or process, and physical access is required, the following tasks shall require two or more persons:

- Generation, activation, and backup of CA keys;
- Performance of CA administration or maintenance tasks;
- Archiving or deleting CA audit logs. At least one of the participants in this task shall serve in a Security Auditor role.
- Physical access to CA equipment;
- Access to any copy of the CA cryptographic module.

5.2.3 Identification and Authentication for Each Role

Individuals holding trusted roles shall identify themselves and be authenticated by the STI-CA systems before being permitted to perform any actions set forth above for that role or identity. CA Operations Staff and shall authenticate themselves using a unique credential that is distinct from any credential they use to perform non- trusted role functions. This credential shall be generated and stored in a system that is protected to the same level as the CA system.

CA equipment and systems shall require, at a minimum, strong authenticated access control for remote access using multi-factor authentication. CA equipment and systems shall require, at a minimum, authenticated access control (e.g., strong passwords) for local multi-party access.

Individuals holding trusted roles shall be appointed to the trusted role by an appropriate approving authority. These appointments shall be periodically reviewed for continued need and renewed as appropriate. The approval shall be recorded in a secure and auditable fashion. Individuals holding trusted roles shall accept the responsibilities of the trusted role, and this acceptance shall be recorded in a secure and auditable fashion.

Users requiring access to a sensitive resource shall authenticate themselves to all aspects of the network (servers, operating systems, applications, databases, processes, etc.) before they can access that resource.

5.2.4 Roles Requiring Separation of Duties

Individuals serving as Security Auditors shall not perform or hold any other trusted role. Only an individual serving in a Security Auditor role may perform internal auditing functions, with the exception of those security audit functions (e.g., configuring, archiving, deleting) that require multi-person control. An individual that who performs any trusted role shall only have one identity when accessing CA equipment or systems.

5.3 Personnel Security Controls

Each STI-CA shall maintain personnel security controls for its operation. The personnel controls employed for CA operation shall be specified in its CPS.

5.3.1 Qualifications, Experience, and Clearance Requirements

Personnel seeking to become Trusted Persons shall present proof of the requisite background, qualifications and experience needed to perform their prospective job responsibilities competently and satisfactorily.

Individuals appointed to any trusted role shall meet the following:

- Be employees of or contractor/vendor of the CA and bound by terms of employment or contract;
- Have successfully completed an appropriate training program;
- Have demonstrated the ability to perform their duties;

- Have no other duties that would interfere or conflict with their responsibilities as defined in Section 5.2.1; and
- Have never been previously relieved of trusted role duties for reasons of negligence or non- performance of duties.

5.3.2 Background Check Procedures

If persons fulfilling Trusted Roles require direct access to information related to secrets (i.e., private keys) that may compromise the integrity of the security of the CA system, they shall pass a background check prior to commencement of employment. The STI-CA shall conduct background checks (in accordance with local privacy laws) which may include the following:

- Confirmation of previous employment;
- Checks of professional references;
- Confirmation of the highest or most relevant educational degree obtained;
- Search of criminal records (local, state or provincial, and national);
- Check of credit/financial records;
- Search of driver's license records;
- Identification verification via National Identity Check (e.g., Social Security Administration records), as applicable.

5.3.3 Training Requirements

All personnel performing duties with respect to the operation of the STI-CA shall receive comprehensive training. Training shall be conducted in the following areas:

- CA security principles and mechanisms;
- All PKI software versions in use on the CA system;
- All PKI duties they are expected to perform;
- Certificate lifecycle management;
- Subscriber vetting and identification and validation procedures;
- Disaster recovery and business continuity procedures;
- Stipulations of this policy.

5.3.4 Retraining Frequency and Requirements

All individuals responsible for PKI Trusted Roles shall be made aware of changes in the CA operation. Any significant change to the operations shall have a training (awareness) plan, and the execution of such plan shall be documented. Examples of such changes are CA software or hardware upgrades, changes in CA operational procedures, changes in automated security systems, and relocation of equipment.

Documentation shall be maintained identifying all personnel who received training and the level of training completed.

5.3.5 Job Rotation Frequency and Sequence

No Stipulation.

5.3.6 Sanctions for Unauthorized Actions

Appropriate administrative and disciplinary actions, as documented in organization policy, shall be taken against personnel who perform unauthorized actions (i.e., actions not permitted by this CP or other CA security policies) involving the CA's systems, operational processes, security controls the certificate status verification systems, and the certificate repository. Disciplinary actions may include measures up to and including termination and shall be commensurate with the frequency and severity of the unauthorized actions.

5.3.7 Independent Contractor Requirements

Contractor personnel filling trusted roles shall be subject to all requirements stipulated in this document. Independent contractors and consultants who have not completed or passed the background check procedures specified above shall be permitted access to the CA's secure facilities unless they are escorted and directly supervised by people holding trusted roles at all times.

5.3.8 Documentation Supplied to Personnel

Documentation sufficient to define duties and procedures for each role shall be provided to the personnel filling that role.

5.4 Audit Logging Procedures

The STI-CA shall generate audit log files for all events relating to the security of the CA operation. The log information shall be automatically collected. Where this is not possible, the CA shall use a logbook, paper forms or other physical mechanisms to capture the information. Details of how a CA implements the audit logging shall be addressed in its CPS.

The PMA shall have procedures to review the logs on a request basis.

5.4.1 Types of Events Recorded

Audit records shall be generated for the basic operations of the Certification Authority computing equipment.

Audit records shall include the date, time, responsible user or process, success or failure indicators, and summary content data relating to the event.

Auditable events include:

- Access to CA computing equipment (e.g., logon, logout);
- Messages received requesting CA actions (e.g., certificate requests, certificate revocation requests, compromise notifications);
- Subscriber identification information;
- Certificate creation, modification, revocation, or renewal actions;
- Posting of any material to a repository;
- Adding a revoked certificate to the CRL maintained by the STI-PA;
- Any attempts to change or delete audit data;
- Key generation;
- Software and/or configuration updates to the CA; or
- Clock adjustments.

5.4.2 Frequency of Processing Log

The audit log shall be reviewed periodically and before being archived. All significant events shall be explained in an audit log summary. Actions taken as a result of these reviews shall be documented.

Such reviews involve verifying that the log has not been tampered with and performing a thorough examination of any alerts or irregularities in the logs. A statistically significant portion of the security audit data generated by the STI-CA since the last review shall be examined. This amount will be described in the CPS.

Real-time automated analysis tools should be used. All alerts generated by such systems shall be analyzed by CA operations staff on a daily basis.

5.4.3 Retention Period for Audit Log

Audit logs shall be retained for at least ninety (90) days in addition to being archived as described in Section 5.5. The individual who removes audit logs from the CA system, if performed manually by a person, shall be an official different from the individuals who, in combination, command the CA signature key.

5.4.4 Protection of Audit Log

The security audit data shall not be open for reading by any human, or by any automated process, other than those that perform security audit processing. The log shall not be writable except by the logging mechanism itself. Once written, the log shall not be modifiable by machine or human.

Electronic logs shall be protected to prevent alteration and detect tampering. Examples include digitally signing audit records or the use of a data diode to transfer logs to a separate system to prevent modification after the log is written to media.

Physical logbooks shall implement controls to allow for the detection of the removal of pages or deletion of entries.

Security audit data shall be moved to a safe, secure storage location separate from the location where the data was generated.

CA system configuration and procedures shall be implemented together to ensure that only authorized people archive or delete security audit data. Procedures shall be implemented to protect archived data from deletion or destruction before the end of the security audit data retention period (note that deletion requires modification access).

5.4.5 Audit Log Backup Procedures

Audit logs and audit summaries shall be backed up at least every thirty (30) days. The backup of the audit logs shall be stored securely in an alternate location.

5.4.6 Audit Collection System (Internal vs. External)

The audit log collection system may or may not be external to the CA system. Automated audit processes shall be invoked at system or application startup and cease only at system or application shutdown. Audit collection systems shall be configured such that security audit data is protected against loss (e.g., overwriting or overflow of automated log files). Should it become apparent that an automated audit system has failed; CA operations shall be suspended until the security audit capability can be restored, except for revocation processing and in the situation where a certificate needed for real-time authentication has expired or is soon to expire.

5.4.7 Notification to Event-Causing Subject

Not Applicable.

5.4.8 Vulnerability Assessments

The CA operations staff shall routinely test, at least annually, and assess the CA systems to determine if they have any vulnerabilities. Each identified vulnerability shall be prioritized based on its risk level and a remediation plan shall be created. There shall be a patch management process to remediate critical and high rated vulnerabilities as soon as it is feasible or when a vendor patch is released.

5.5 Records Archival

5.5.1 Types of Records Archived

CA archive records shall be sufficiently detailed to determine the proper operation of the CA and the validity of any certificate (including those revoked or expired) issued by the CA. At a minimum, if applicable the following data shall be recorded for archive:

- CP
- CPS
- Contractual obligations
- Other agreements concerning operations of the CA
- System and equipment configuration
- Subscriber identity authentication data as per Section 3.2.3
- Documentation of receipt and acceptance of certificates (if applicable)
- Subscriber agreements
- Documentation of receipt of tokens
- All certificate requests for which the authorization failed
- All certificates issued
- All certificates revoked
- All Audit logs
- Other data or applications to verify archive contents
- Compliance Auditor reports
- Any changes to the Audit parameters, e.g. audit frequency, type of event audited
- Any attempt to delete or modify the Audit logs
- All access to any certificate subject private keys retained within the CA for key recovery purposes
- All changes to the trusted public keys, including additions and deletions
- Remedial action taken as a result of violations of physical security
- Violations of CP
- Violations of CPS

5.5.2 Retention Period for Archive

Archive records must be kept for a minimum of seven (7) years and six (6) months without any loss of data.

5.5.3 Protection of Archive

The CPS shall describe the archiving process and how the archive is protected. No unauthorized user shall be permitted to write to, modify, or delete the archive.

The archived records may be moved to another offline medium. The contents of the archive shall not be released. Records of individual transactions may be released upon request of any Subscribers involved in the transaction or their legally recognized agents.

Archive media shall be stored in a safe, secure storage system separate from the CA systems with physical and procedural security controls equivalent to or better than those of the STI-CA. If the original media cannot retain the data for the required period, a mechanism to periodically transfer the archived data to new media shall be defined by the archive site.

5.5.4 Archive Backup Procedures

The CPS shall describe how archive records are backed up and how the archive backups are managed.

5.5.5 Requirements for Time-Stamping of Records

The CA archive records shall be automatically time-stamped as they are created. The CPS shall describe how system clocks used for time-stamping are maintained in synchrony with an authoritative time source.

5.5.6 Archive Collection System (Internal or External)

Archive data shall be collected in an expedient manner and on a regular schedule as described in the CPS.

5.5.7 Procedures to Obtain and Verify Archive Information

Procedures, detailing how to create, verify, package, transmit, and store the CA archive information, shall be published in the CPS.

5.6 Key Changeover

STI-CAs shall not issue Subscriber certificates that extend beyond the expiration date of their own certificates and public keys. Each CA certificate validity period shall extend one user certificate validity period past the last use of the CA private key. To minimize the risk from compromise of a CA's private signing key, the private signing key will change more frequently. When the private signing key changes, the CA shall use only the new key for certificate signing.

The CPS shall describe the procedure to provide a new STI-CA public key to users following a re-key by the STI-CA.

5.7 Compromise and Disaster Recovery

5.7.1 Incident and Compromise Handling Procedures

STI-CA organizations shall have an Incident Response Plan and a Disaster Recovery Plan.

If compromise of a STI-CA occurs, certificate issuance by that STI-CA shall be stopped immediately. An independent, third-party investigation shall be performed in order to determine the nature and the degree of damage. The scope of potential damage shall be assessed in order to determine appropriate remediation procedures. If a STI-CA private signing key is suspected of compromise, the procedures outlined in Section 5.7.3 shall be followed.

The STI-CA shall immediately notify the PMA if any of the following occur:

- Actual or detected compromise of any CA system or subsystem;
- Physical or electronic penetration of any CA system or subsystem;
- Successful denial of service attacks on any CA system or subsystem; or
- Any incident preventing a STI-CA from notifying the STI-PA of a revoked certificate (e.g., compromised credentials).

5.7.2 Computing Resources, Software, and/or Data are Corrupted

When computing resources, software, and/or data are corrupted, STI-CAs operating under this CP shall respond as follows:

- Notify the PMA director as soon as possible using the PMA contact information provided in this CP.
- Ensure that the system's integrity has been restored prior to returning to operation and determine the extent of loss of data since the last point of backup.
- Reestablish CA operations.
- If the CA signing keys are destroyed, reestablish CA operations as quickly as possible, giving priority to the generation of a new CA signing key pair.

- If the integrity of the system cannot be restored, or if the risk is deemed substantial, reestablish system integrity before returning to operation.

5.7.3 Entity Private Key Compromise Procedures

5.7.3.1 Root CA Compromise Procedures

In the case of the Root CA compromise, the STI-CA shall immediately notify the PMA. The STI-CA shall also notify all Subscribers. The PMA shall update the list of trusted STI-CAs and make it available to all Subscribers and Relying Parties to obtain the new list of Trusted STI-CAs. The caList has an expiration period, configured to 24 hours, and the SPs periodically retrieve it via REST API. Therefore, such an update will only reflect the next time the SPs can retrieve the caList.

Initiation of notification shall be made at the earliest feasible time and shall not exceed twenty-four (24) hours beyond determination of the actual compromise or loss unless otherwise required by law enforcement. If the cause of the compromise can be adequately addressed, and it is determined that the PKI can be securely re-established, the CA shall then generate a new Root CA certificate and update its account with the STI-PA per the established CPS procedures.

CP changes that place new requirements on an existing root (or issuing) CA will be limited to those that have been evaluated and required to address a security issue within the SHAKEN ecosystem. For such changes, the PMA will coordinate with individual STI-CAs on a practical implementation approach and schedule.

5.7.3.2 Intermediate CA Compromise Procedures

In the event of an Intermediate CA key compromise, the CA shall notify the PMA and the Root CA. The STI-PA shall revoke that CA's intermediate STI-CA certificate, and the revocation information shall be published immediately via the distributed CRL model described in section 4.9. The Compromised CA shall also investigate and report to the PMA and Superior CA what caused the compromise or loss, and what measures have been taken to preclude recurrence. If the cause of the compromise can be adequately addressed and it is determined that the CA can be securely re-established, then the CA shall be re-established. Upon re-establishment of the CA, new Subscriber certificates shall be requested and issued.

CP changes that place new requirements on an existing intermediate (or issuing) CA will be limited to those that have been evaluated and required to address a security issue within the SHAKEN ecosystem. For such changes, the PMA will coordinate with individual STI-CAs on a practical implementation approach and schedule.

5.7.4 Business Continuity Capabilities After a Disaster

STI-CAs shall be required to maintain a Disaster Recovery Plan. The CA Disaster Recovery Plan shall be coordinated with any overarching Enterprise Disaster Recovery Plan that the broader organization may have. The Disaster Recovery Plan shall identify what management and operations procedures are in place to mitigate risks to facilities, systems, networks, and application controls. It shall also identify procedures for annual testing of processes to restore service, individuals on call for management, response and recovery activities, and the order of restoral of equipment and services.

In the case of a disaster in which the CA equipment is damaged and inoperative, the CA operations shall be re-established as quickly as possible. If the CA cannot re-establish operational capabilities within eighteen (18) hours, then the inoperative status of the CA shall be reported to the PMA and Superior CA. The PMA shall decide whether to declare the CA private signing key as compromised and the CA keys and certificates need to be reissued, or allow additional time for reestablishment of the CA's revocation capability.

In the case of a disaster in which a CA installation is physically damaged and all copies of the Intermediate CA signature key are destroyed as a result, the CA shall request that its intermediate certificates be revoked. If the Root CA is physically damaged such that all copies of the Root CA signature keys are destroyed, then the root certificate(s) shall be removed from the Trusted STI-CA List. The CA installation shall then be completely rebuilt by re-establishing the CA's equipment, generating new private and public keys and being re-certified. Finally, all Subscribers will be notified that certificates need to be re-issued.

5.8 STI-CA Termination

When a STI-CA operating under this CP terminates operations before all certificates have expired, entities shall be given as much advance notice as circumstances permit. The STI-CA shall notify the PMA using documented contact information, and the STI-PA shall remove the STI-CA from the Trusted STI-CA List.

The STI-CA shall archive all audit logs and other records prior to termination. The STI-CA shall destroy all private keys upon termination. The STI-CA archive records shall be transferred to the PMA. If a Root CA is terminated, the Root CA shall be removed from the list of trusted STI-CAs. In that case, any certificates that have not been revoked will be invalid once the relying parties receive the updated list.

5.9 STI-CA Authority to Issue STI Certificates is Withdrawn

When a STI-CA loses its authority to issue STI Certificates, the STI-PA shall remove the STI-CA from the Trusted STI-CA List.

6 Technical Security Controls

6.1 Key Pair Generation and Installation

6.1.1 Key Pair Generation

Cryptographic keying material used by STI-CAs to sign certificates should be generated by cryptographic modules validated to FIPS 140-2 Level 3, or equivalent.

CA key pair generation shall create a verifiable audit trail demonstrating that the security requirements for the documented procedures were followed. The CPS description of the procedure shall be detailed enough to show that appropriate role separation was used.

Subscriber key pair generation shall be performed by the Subscriber or a delegate with written authorization from Subscriber.

6.1.2 Private Key Delivery to Subscriber

This is not applicable in the case that only the Subscriber generates the key pair.

6.1.3 Public Key Delivery to Certificate Issuer

When the Subscriber generates the key pair, the public key and the Subscriber's identity need to be delivered securely to the CA for certificate issuance. In the case that the ACME protocol is supported, this is provided to the CA during account creation.

6.1.4 CA Public Key Delivery to Relying Parties

The list of Trusted STI-CA Root Certificates is maintained by the STI-PA. Relying Parties shall obtain this list in a secure manner so that it is not vulnerable to modification or substitution.

When a CA updates its signature key pair, the key rollover certificates may be signed with the CA's current private key; in this case, secure out-of-band mechanisms are not required.

6.1.5 Key Sizes

CAs that issue STI Certificates under this CP shall generate digital signatures with the Elliptic Curve Digital Signature Algorithm (ECDSA) with Curve P-256 and SHA-256 or ECDSA with Curve P-384 and SHA-384.

CAs that issue STI Certificates under this CP shall generate digital signatures with a NIST-approved hash function that offer the same security as the elliptic curve used by the CA. For example, the NIST P-256 curve and SHA-256 offer the same security.

6.1.6 Public Key Parameters Generation and Quality Checking

Public key parameters shall always be generated and validated in accordance with [FIPS 186-4] and [RFC 5480]. For example, the AlgorithmIdentifier, including the parameters field, for an ECDSA public key using the NIST P-256 curve consists of the following hexadecimal-encoded octets: 301306072a8648ce3d020106082a8648ce3d030107.

6.1.7 Key Usage Purposes (as per X.509 v3 Key Usage Field)

The use of a specific public key is constrained by the key usage extension, and all certificates shall include a critical key usage extension.

The private key associated with a CA certificate shall be used only for signing certificates. CA certificates whose subject public key is to be used to verify other certificates shall assert only the *keyCertSign* bit in the key usage extension.

The *dataEncipherment*, *encipherOnly*, and *decipherOnly* bits shall not be asserted in certificates issued under this CP. In addition, *anyExtendedKeyUsage* shall not be asserted in extended key usage extension.

6.2 Private Key Protection and Cryptographic Module Engineering Controls

6.2.1 Cryptographic Module Standards and Controls

STI-CAs should use cryptographic modules validated to [FIPS 140-2] Level 3 (or higher), or equivalent for signing operations.

6.2.2 Private Key (n out of m) Multi-person Control

STI-CAs may employ multi-person controls to constrain access to their private keys, but this is not a requirement all STI-CAs in the PKI. The CPS for each STI-CA shall describe which, if any, multi-person controls it employs.

6.2.3 Private Key Escrow

CA private keys shall never be escrowed.

6.2.4 Private Key Backup

The CA private signature keys shall be backed up under the same control as the original signature key. All copies of the CA private signature key shall be accounted for and protected in the same manner as the original. Backup procedures shall be included in the CA's CPS.

6.2.5 Private Key Archival

CA private signature keys and Subscriber private signature keys shall not be archived. STI-CAs that retain Subscriber private encryption keys for business continuity purposes shall archive such Subscriber private keys in accordance with Section 5.5.

6.2.6 Private Key Transfer Into or From a Cryptographic Module

CA private keys may be exported from the cryptographic module only to perform CA key backup procedures as described in Section 6.2.4. At no time shall the CA private key exist in plaintext outside the cryptographic module.

All other keys shall be generated by a cryptographic module. In the event a private key is to be transported from one cryptographic module to another, the private key must be encrypted during transport; private keys must never exist in plaintext form outside the cryptographic module boundary.

Transport keys used to encrypt private keys shall be at least as strong as the private key being protected, and the encryption algorithm used with the transport key shall provide both confidentiality and integrity.

6.2.7 Private Key Storage on Cryptographic Module

No stipulation beyond that specified in FIPS 140-2 (or other generally accepted secure storage methods).

6.2.8 Method of Activating Private Key

If private key activation is applicable to the CA use of a cryptographic module, the people holding the trusted roles must be authenticated with the cryptographic token before the activation of the associated private key(s). Acceptable means of authentication include but are not limited to passphrases, PINs or biometrics. Entry of activation data shall be protected from disclosure (i.e., the data should not be displayed while it is entered).

6.2.9 Method of Deactivating Private Key

If private key activation is applicable to the CA use of a cryptographic module, cryptographic modules that have been activated shall not be available to unauthorized access. After use, the cryptographic module shall be deactivated, e.g., via a manual logout procedure or automatically after a period of inactivity as defined in the applicable CPS. CA cryptographic modules shall be removed and stored in a secure container when not in use.

6.2.10 Method of Destroying Private Key

Individuals in trusted roles or automated computer processes shall destroy CA private signature keys when they are no longer needed. If applicable, subscribers shall either surrender their cryptographic module to CA personnel for destruction or subscribers shall destroy their private signature keys when they are no longer needed or when the certificates to which they correspond expire or are revoked. Physical destruction of any hardware is not required.

6.2.11 Cryptographic Module Rating

See Section 6.2.1.

6.3 Other Aspects of Key Pair Management

6.3.1 Public Key Archival

The public key is archived as part of the certificate archival described in Section 5.5.

6.3.2 Certificate Operational Periods and Key Pair Usage Periods

The usage period for the Root CA STI Certificate key pair is a maximum of twenty-five (25) years. The Root CA STI Certificate private key may be used to sign STI-CA CA certificates for at most sixteen (16) years.

For all other STI-CAs operating under this policy, the usage period for a CA STI Certificate key pair is a maximum of twelve (12) years. The STI-CA CA STI Certificate private key may be used to sign certificates for at most (9) years. All certificates signed by a specific STI-CA CA STI Certificate key pair must expire before the end of that key pair's usage period.

> Note: the requirements in the previous paragraph apply to the STI-CA only, and not to the STI-SCA or V-SCA.

Subscriber public keys in end-entity STI Certificates and in STI-SCA CA STI Certificates have a maximum usage period of three (3) years. Subscriber signature private keys have the same usage period as their corresponding public key. The usage period for subscriber key management private keys is not restricted.

6.4 Activation Data

6.4.1 Activation Data Generation and Installation

If applicable to CA, CA activation data may be user-selected (by each of the multiple parties holding that activation data). If the activation data must be transmitted, it shall be via an appropriately protected channel, and distinct in time and place from the associated cryptographic module.

Subscriber activation data may be user-selected. The strength of the activation data shall meet or exceed the requirements for authentication mechanisms stipulated for Level 3 in FIPS 140-2, or some other equivalent standard. If the activation data must be transmitted, it shall be via an appropriately protected channel, and distinct in time and place from the associated cryptographic module.

6.4.2 Activation Data Protection

Data used to unlock private keys shall be protected from disclosure by a combination of cryptographic and physical access control mechanisms. Activation data shall be either:

- memorized;
- biometric in nature; or
- recorded and secured at the level of assurance associated with the activation of the cryptographic module and shall not be stored with the cryptographic module.

6.4.3 Other Aspects of Activation Data

No additional stipulations.

6.5 Computer Security Controls

6.5.1 Specific Computer Security Technical Requirements

The CPS shall document the technical controls covering all the of the areas identified in this Section of the CP.

6.5.1.1 Access Control

Access to information such as sensitive details about customer accounts, passwords, and ultimately, CA-related private keys should be carefully guarded, along with the machines housing such information.

6.5.1.1.1 Access Control Policy and Procedures

The STI-CA shall create and document roles and responsibilities for each trusted role employee job function in the CPS. The STI-CA shall create and maintain a mapping of these trusted roles and their associated responsibilities to specific employees and their accounts on the CA system.

6.5.1.1.2 Account Management

Information system account management features shall ensure that users access only that functionality permitted by their role or function. All account types with access to information systems shall be documented along with the

conditions and procedures to follow in creating new accounts. Groups and roles shall have a documented relationship to the business or mission roles involved in operating the CA.

Section 5.2.1 of this document defines roles and job functions for personnel that the STI-CA shall use when defining access control mechanisms. The STI-CA shall employ the principle of least privilege when creating users and assigning them to groups and roles; membership to a group or role shall be justified based upon business need. The STI-CA shall take appropriate action when a user no longer requires an account, their business role changes, or the user is terminated or transferred. The STI-CA shall annually review all active accounts to match active authorized users with accounts and disable or remove any accounts no longer associated with an active authorized user.

Automated systems shall be employed to maintain access for only those users who are still authorized to use the information system. After thirty (30) days of inactivity, an account shall be automatically disabled and attempts to access any deactivated account shall be logged.

All account administration activities shall be logged and made available for inspection by appropriate security personnel. Account administration activities that shall be audited include account creation, modification, enabling, disabling, group or role changes, and removal actions. See Section 5.4 for detailed requirements for these logs.

Guest/anonymous and defaults accounts for logon to CA operations systems shall be prohibited. Accounts shall be assigned to a single user and shall not be shared.

6.5.1.1.3 Least Privilege

In granting rights to accounts and groups, the STI-CA shall employ the principle of least privilege, allowing only authorized access for users (and processes acting on behalf of users) which are necessary to accomplish assigned tasks in accordance with organizational missions and business functions. The STI-CA shall explicitly authorize access to accounts and groups for controlling security functions and security-relevant information. The STI-CA shall authorize access to privileged commands and features of information systems only for specific, organization-defined compelling operational needs and documents the rationale for such access. The STI-CA shall require that users of information systems with access to administrative privileges to utilize non-privileged accounts or roles when accessing non-privileged functions (such as reading email).

6.5.1.1.4 Access Control Best Practices

The following are best practices for access control:

- Unique User IDs is associated with each individual user.
- All user activity shall be traceable to an individual.
- No shared or default accounts shall be used.
- There is a process to track the assignment and configurations of administrative privileges to CA operations systems. The principle of least privilege shall be followed.
- There is an authorization process to approve users and their associated privileges.
- There is a process to establish, change, deactivate and remove UserIDs and privileges.
- Passwords shall be at least 8 characters with associated complexity and usage rules.
- Passwords are never stored or transmitted in cleartext.
- There are defined session timeouts (15 minutes) during periods of user inactivity.
- There shall be a limit on failed login attempts (5). If there is a lockout, an administrator needs to reset the password.
- For remote access from external public networks, multi-factor authentication shall be used.
- There shall be logging of all failed login attempts and changes in administrative privileges.

6.5.1.1.5 Authentication: Passwords and Accounts

When the authentication mechanism uses user selectable passwords, strong passwords shall be employed, as defined in the CA password policy referenced in the CPS. Passwords for CA authentication operational systems shall be different from CA enterprise systems.

The STI-CA shall have the minimum number of user accounts that are necessary to its operation. Account access shall be locked after five (5) unsuccessful login attempts. Restoration of access shall be performed by a different person who holds a trusted role, or restore access after a timeout period.

6.5.1.1.6 Permitted Actions without Identification or Authentication

The STI-CA shall document in the CPS a specific list of actions that can be performed on specifically enumerated information systems without identification or authentication, such as accessing a publicly available website. Furthermore, the STI-CA shall document and provide supporting rationale in its security policy and procedures an enumerated list of user actions and systems not requiring identification or authentication (i.e., anonymous access to a public website) and not related to the CA operation.

6.5.1.2 System Integrity

6.5.1.2.1 System Isolation and Partitioning

CA systems shall be configured, operated, and maintained so as to ensure the continuous logical separation of CA operations processes and their assigned resources. This separation shall be enforced by:

- Physical and/or logical isolation mechanisms, such as dedicated systems or virtualization;
- Protecting an active process and any assigned resources from access by or interference from another process;
- Protecting an inactive process and any assigned resources from access by or interference from an active process; and
- Ensuring that any exception condition raised by one process will have no lasting detrimental effect on the operation or assigned resources of another process.

All trusted components should be logically separated from each other and shall be logically separated from any untrusted components of the CA system. The CPS shall document how this logical isolation of components is accomplished.

Security critical processes shall be isolated from processes that have external interfaces. For example, the CA signing processes shall be isolated from registration processes. The CPS shall outline how security critical processes are protected from interference by externally facing processes and applications.

If there are system resources shared amongst trusted and/or untrusted processes, the underlying system(s) shall prevent any unauthorized and unintended information transfer between processes via those shared system resources.

The STI-CA shall develop and document controlled procedures for transferring software updates configuration files, certificate requests, and other data files between trusted components.

6.5.1.2.2 Malicious Code Protection

The CA system shall employ malicious code protection mechanisms to mitigate the risk of malicious code on CA system components. Malicious code on trusted CA components could allow an attacker to issue fraudulent certificates, create a rogue intermediate or signing CA server, or compromise the availability of the system.

CA system components running standard operating systems that are not air-gapped from the Internet shall employ host-based anti-malware tools to detect and prevent the execution of known malicious code. These tools shall be configured to automatically scan removable media when it is inserted, as well as files received over the network. Introduction of removable media shall not cause automatic execution of any software residing on the media.

Anti-malware tools employed by a STI-CA shall be properly maintained and updated by the CA. Anti-malware tools on networked systems shall be updated automatically as updates become available, or CA Administrators shall push updates to system components on a weekly basis. Anti-malware tools may be employed on air-gapped systems. If anti-malware tools are employed on air-gapped systems, the STI-CA shall document in the CPS how

these tools will be updated, including mitigations intended to reduce the risks of spreading malware and exfiltration of data off of compromised CA systems.

Anti-malware tools shall alert CA Administrators of any malware detected by the tools.

On system components that do not implement host-based anti-malware tools, the STI-CA shall identify and employ other malicious code protection mechanisms to prevent the execution of malicious code, detect infected files or executables, and remediate infected systems. These mechanisms could include, but are not limited to, compensating physical protection on hosts, network-based malware detection tools at boundary points, application whitelisting, and manually scanning removable media by trusted CA personnel. The STI-CA shall document all malware protection mechanisms in the CPS.

6.5.1.2.3 Software and Firmware Integrity

The STI-CA shall employ technical and procedural controls to prevent and detect unauthorized changes to firmware and software on CA systems. Access control mechanisms and documented configuration management processes (see Sections 6.5.1.1 and 6.6.2) shall ensure that only authorized CA Administrators are capable of installing or modifying firmware and software on CA systems.

Root and subordinate CA servers shall implement automated technical controls to prevent and detect unauthorized changes to firmware and software. Example technical controls include signature verification prior to firmware/software installation or execution (such as firmware protections that comply with SP800-147 or SP800-147B), or hash-based white-listing of executables. Unauthorized software or firmware detected by these mechanisms should be blocked from executing. Any instances of unauthorized firmware or software detected by the system shall be logged, and CA Administrators shall be notified of these events.

6.5.1.2.4 Information Protection

The STI-CA shall protect the confidentiality and integrity of sensitive information stored or processed on CA systems that could lead to abuse or fraud. For example, the STI-CA shall protect customer data that could allow an attacker to impersonate a customer. The STI-CA shall employ technical mechanisms to prevent unauthorized changes or accesses to this information, such as access control mechanisms that limit which users are authorized to view or modify files. Sensitive information stored on devices that are not physically protected from potential attackers shall be stored in an encrypted format.

6.5.2 Computer Security Rating

No specific stipulation. The CPS should indicate any rating applicable to their CA.

6.6 *Life Cycle Security Controls*

6.6.1 System Development Controls

The system development controls must address all aspects related to the development and change of the CA system through aspects of its life cycle.

The CA system shall be implemented and tested in a non-production environment prior to implementation in a production environment. No change shall be made to the production environment unless the change has gone through the documented change control process.

In order to prevent incorrect or improper changes to the CA system, the CA system shall require multi-party control for access to the CA system when changes are made.

For any software developed by the STI-CA, evidence shall be produced relating to the use of a defined software development methodology setting out the various phases of development, as well as implementation techniques intended to avoid common errors to reduce the number of vulnerabilities. Automated software assurance (e.g., static code analysis, dynamic code analysis) tools shall be used to catch common error conditions within developed

code. For compiled code, all compiler warnings shall be enabled and addressed or acknowledged to be acceptable. Input validation shall be performed for all inputs into the system.

Hardware and software procured to operate the CA shall be purchased from authorized vendors in a fashion to reduce the likelihood that any particular component was tampered with (e.g., by ensuring the vendor cannot identify the PKI component that will be installed on a particular device). The hardware and software shall be verified as being that supplied from the vendor, with no modifications, and be the version intended for use.

Hardware and software updates shall be purchased or developed in the same manner as original equipment, and shall be installed by trusted and trained personnel in a defined manner.

All data input to CA system components from users or other system components shall be validated prior to consumption by the receiving entity. Validating the syntax and semantics of system inputs (e.g., character set, length, numerical range, and acceptable values) verifies that inputs match the expected definitions for format and content.

6.6.2 Security Management Controls

A list of acceptable products and their versions for each individual CA system component shall be maintained and kept up to date within a configuration management system. Mechanisms and/or procedures shall be in operation designed to prevent the installation and execution of unauthorized software. A signed whitelist of the acceptable software for the system should be one of the ways to control the allowed software. A CA system shall have automated mechanisms to inventory on, at least, a daily basis software installed on a system and alert operators if invalid software is found.

To reduce the available attack surface of a CA system, only those ports, protocols, and services that are necessary to the CA system architecture are permitted to be installed or operating. The CA system shall maintain a list of ports, protocols, and services that are necessary for the correct function of each component within the CA system. There shall be automated mechanisms to monitor the running processes and open ports against the permitted list.

To validate the integrity of the CA system, automated tools that validate all static files on a component shall be in operation to notify operators when a protected file has changed.

The CA system shall establish and document mandatory configuration settings for all information technology components, which comprise the CA system. All configuration settings capable of automated assessment shall be validated to be set according to the guidance contained within a documented security configuration checklist on at least daily basis for powered on systems or next power-on for systems, which are not left powered-on.

6.6.3 Life Cycle Security Controls

The STI-CA shall scan all online CA operations systems for vulnerabilities using commercially available security vulnerability testing and analysis tool on a regular basis (i.e., monthly). The use of multiple vulnerability testing tools for testing the most sensitive systems is strongly encouraged.

Each vulnerability found shall be entered into a vulnerability tracking database, along with the date and time and the specific system. The vulnerabilities shall be prioritized based on the risk level. A remediation plan shall be created to address at least the critical and high rated vulnerabilities within 72 hours if feasible. If a vendor patch is required, the patch, when released shall be tested before it is deployed into production. Remediation shall be entered into the vulnerability database as well (including date and time).

The STI-CA staff shall monitor relevant product and vendor notification portals on a regular basis for updates to product packages installed on CA systems (including networking hardware). STI-CAs shall subscribe to these notification portals identifying software and firmware updates and patches, and having a patch management and maintenance program that covers obtaining and testing those updates and patches, for deciding when to install them, and finally for installing them without undue disruption. A log shall be kept of the notifications, the decision to apply/not apply including reason, and the application of relevant updates/patches. The CPS shall describe in detail the security lifecycle management activities and procedures.

From time to time, the STI-CA may discover unintentional errors in configuration files, either because of human error, source data error, or changes in the environment, which have made an entry erroneous. The STI-CA shall correct such errors as soon as possible governed by the documented change management procedure.

6.7 Network Security Controls

The CPS shall document network security controls protecting the CA operations systems, including the following key principles:

- Defense-in-depth strategy to protect the network elements and externally facing perimeter, systems, applications and interfaces.
- Security devices that are being used including firewalls, Web application firewalls, intrusion detection and prevention technology and denial-of-service protection.
- Threat intelligence monitoring include procedures to update attack signatures in network security devices.
- Network segmentation to protect the CA operations systems from the enterprise systems.
- Security access controls for accessing network management tools and information.
- Network security monitoring approach.

6.8 Time-Stamping

The CPS shall address the requirements for the use of timestamps. System clocks used for time-stamping shall be maintained in synchrony with an authoritative time standard (e.g., through the use of Network Time Protocol (NTP) [RFC 5905]).

7 Certificate, CRL, and OCSP Profiles

7.1 Certificate Profile

Certificates issued by the STI-CA shall adhere to the X.509 v3 certificate profile documented in RFC 5280. The STI-CA shall support the certificate extensions defined and described for STIR [RFC 8226], SHAKEN [ATIS-1000080.v005] and [ATIS-1000092.v002].

The CPS shall have the following Sections addressing their compliance to the standards:

- Version number(s)
- Certificate extensions
- Algorithm object identifiers
- Name forms
- Name constraints
- Certificate policy object identifier
- Usage of Policy constraints extension
- Policy qualifiers syntax and semantics
- Processing semantics for the critical Certificate Policies extension

When issuing STI Certificates to a Service Provider, the STI-CA shall ensure that the ‘cRLDistributionPointName’ extension of the issued certificate contains a URL reference to the indirect CRL hosted by the STI-PA. The STI-CA shall also ensure that the ‘cRLDistributionPointName’ extension of all STI intermediate certificates in the certification path of the issued certificate contain that same CRL URL value.

7.2 CRL Profile

The CRL for the SHAKEN ecosystem is maintained by the STI-PA as defined in [ATIS-1000080.v005]. The CRL issued by the STI-PA also includes the crlExtensions CRLNumber as per RFC 5280. This extension is updated

when the CRL is updated, or when the CRL expires and a new one is generated. The format required for entries in the CRL provided by the STI-CA is described in the following Sections.

7.2.1 Version Numbers

CRL V2.

7.2.2 CRL and CRL Entry Extensions

When a STI-CA revokes a certificate, the procedures described in Section 4.9 shall be followed. The STI-CA shall notify the STI-PA and provide the following information, which is included in the CRL entries:

- Certificate's Serial Number;
- Revocation Date;
- Reason;
- Certificate Issuer.

7.3 OCSP Profile

Not applicable.

8 Compliance Audit and Other Assessment

The STI-CA policies shall be designed to meet the requirements based on [ATIS-1000080.v005] and [ATIS-1000084.v003], as well as generally accepted and published industry standards. All Issuing STI-CAs shall ensure that audits are conducted for all PKI functions regardless of how or by whom the PKI components are managed and operated. All audit related costs are the responsibility of the STI-CA.

8.1 Frequency or Circumstances of Assessment

The STI-CA shall submit to the PMA a CP Compliance Attestation each year by February 15th based on either an independent auditor's or an independent part of the STI-CA organization's assessment of the policy compliance of the STI-CA.

In addition, if requested by the PMA, the STI-CA shall submit to the PMA a CP Compliance Attestation for a specific period of time. The CP Compliance Attestation shall include the following:

- Confirmation of compliance with the Certificate Policy standards for infrastructure, security, and business process management;
- Identification/notification of any security breach incidents in any environment supporting the STI-CA; and
- Identification/notification of any material changes in technology architecture or business processes supporting the STI-CA.

8.2 Identity/Qualifications of Assessor

The auditor must demonstrate competence in the field of compliance audits, and must be thoroughly familiar with the STI-CA's CPS and this CP. The compliance auditor must perform such compliance audits as a regular ongoing business activity. In addition to the previous requirements, the auditor shall have appropriate professional certifications such as a Certified Information System Auditor (CISA) or IT security specialist, and shall have available a PKI subject matter specialist who can offer input regarding acceptable risks, mitigation strategies, and industry best practices.

8.3 Assessor's Relationship to Assessed Entity

The compliance auditor either shall be a private firm that is independent from the Issuing STI-CA being audited, or shall be sufficiently organizationally separated from the STI-CA to provide an unbiased, independent evaluation. To ensure independence and objectivity, the compliance auditor must not have worked with the STI-CA in developing or maintaining the entity's CA Facility or CPS. The PMA shall determine whether a compliance auditor meets this requirement.

8.4 Topics Covered by Assessment

The audit must conform to industry standards, cover the Issuing STI-CA's compliance with its business practices disclosure, and evaluate the integrity of the Issuing STI-CA's PKI operations in compliance with the SHAKEN PKI model. The audit must verify that each Issuing STI-CA is compliant with this CP.

8.5 Actions Taken as a Result of Deficiency

If an audit reports a material noncompliance with applicable law, this CP, the CPS, or any other contractual obligations related to the Issuing STI-CA's services, then (1) the auditor shall document the discrepancy, (2) the auditor shall promptly notify the Issuing STI-CA and the PMA, and (3) the Issuing STI-CA and the PMA shall develop a plan to rectify the noncompliance. The PMA shall also notify the STI-GA. body. The Issuing STI-CA shall submit the plan to the PMA for approval. The PMA may require additional action, if necessary, to rectify any significant issues created by the non-compliance, including requiring revocation of affected certificates.

8.6 Communication of Results

The Audit Compliance Report and identification of corrective measures shall be provided to the PMA within thirty (30) days of completion.

The results shall also be communicated to any third-party entities entitled by law, regulation, or agreement to receive a copy of the audit results.

9 Other Business and Legal Matters

9.1 Fees

9.1.1 Certificate Issuance or Renewal Fees

Issuing STI-CAs may charge fees for certificate issuance and renewal.

9.1.2 Certificate Access Fees

Issuing STI-CAs may not charge fees for access to their database of certificates.

9.1.3 Revocation Access Fees

Issuing STI-CAs may not charge additional fees for access to CRLs.

9.2 Financial Responsibility

9.2.1 Insurance Coverage

No stipulation.

9.2.2 Other Assets

No stipulation.

9.2.3 Insurance or Warranty Coverage

No stipulation.

9.3 Confidentiality of Business Information

9.3.1 Scope of Confidential Information

Issuing STI-CAs shall specify what constitutes confidential information in their CPS.

9.3.2 Information Not Within the Scope of Confidential Information

Issuing STI-CAs may treat any information not listed as confidential in the CPS as public information.

9.3.3 Responsibility to Protect Confidential Information

Issuing STI-CAs shall contractually obligate anyone with authorized access to confidential information to protect such confidential information (including but not limited to employees, agents, and contractors). Issuing STI-CAs shall provide training to employees on how to handle confidential information.

9.4 Privacy of Personal Information

9.4.1 Privacy Plan

Issuing STI-CAs shall develop, implement and maintain a privacy plan. The privacy plan shall document what personally identifiable information is collected, how it is stored and processed, and under what conditions the information may be disclosed.

9.4.2 Information Treated as Private

Issuing STI-CAs shall identify all personal information as private in the CPS and protect it from unauthorized disclosure. The Issuing STI-CA shall protect personally identifiable information in its possession in accordance with its privacy plan.

9.4.3 Responsibility to Protect Private Information

Issuing STI-CAs are responsible for securely storing and protecting private information.

9.4.4 Disclosure Pursuant to Judicial or Administrative Process

Issuing STI-CAs shall not disclose private information to any third party unless (a) authorized by this policy or the STI-CA's privacy plan or policy or (b) required by law, government rule or regulation, or order of a court of competent jurisdiction.

9.5 Intellectual Property Rights

No stipulation.

9.6 Representations and Warranties

9.6.1 STI-CA Representations and Warranties

By participating in the SHAKEN ecosystem, issuing STI-CAs represent to the PMA, Subscribers, and Relying Parties that they comply, in all material aspects, with this CP, their CPS, and all applicable laws and regulations.

9.6.2 Relying Party Representations and Warranties

No stipulation.

9.6.3 Subscriber Representations and Warranties

No stipulation.

9.7 Disclaimers of Warranties

Issuing STI-CAs may not disclaim any warranties specified in this CP.

9.8 Limitations of Liability

Issuing STI-CAs may limit their liability to any extent not otherwise prohibited by the CP, provided that the Issuing STI-CA remains responsible for complying with this CP and the Issuing STI-CA's CPS.

9.9 Indemnities

9.9.1 Indemnification by an Issuing STI-CA

No stipulation.

9.9.2 Indemnification by Subscribers

Issuing STI-CAs shall include any indemnification requirements for Subscribers in their CPS and in their Subscriber Agreements.

9.9.3 Indemnification by Relying Parties

Issuing STI-CAs shall include any indemnification requirements for Relying Parties in their CPS.

9.10 Term and Termination

9.10.1 Term

This CP and any amendments are effective when published to the Policy Administrator's online repository and remain in effect until replaced with a newer version.

9.10.2 Termination

The CP and any amendments remain in effect until replaced by a newer version.

9.10.3 Effect of Termination and Survival

The STI-PA on behalf of the PMA will specify which provisions survive termination. At a minimum, responsibilities related to protecting confidential information will survive termination.

9.11 Individual Notices and Communications with Participants

The STI-PA and the PMA accept digitally signed or paper notices related to this CP that are addressed to the locations specified in Section 1.5 of this CP. Notices are deemed effective after the sender receives a valid and digitally signed acknowledgment of receipt from the STI-PA/PMA. If an acknowledgement of receipt is not received within five days, the sender must resend the notice in paper form to the street address specified in Section 2.2 using either a courier service that confirms delivery or via certified or registered mail with postage prepaid and return receipt requested.

STI-CAs shall notify the PMA at least two weeks prior to implementation of any planned change to the infrastructure that has the potential to affect the SHAKEN PKI operational environment, and all new artifacts, including CA root certificates, produced as a result of the change will be provided to the PMA within 24 hours following implementation.

CAs shall notify the PMA one month in advance of any updates or changes with the potential to affect compliance with this CP, including:

1. Additions or changes of Root CAs
2. Additional CPs at the Root CA level
3. Changes in certificate issuance procedures
4. Terminations or transition of ownership of Root CAs

9.12 Amendments

9.12.1 Procedure for Amendment

Changes to this CP may be made from time to time by the PMA. The PMA will review this CP annually and when any changes are made to the specifications from which the requirements for this CP are derived.

9.12.2 Notification Mechanism and Period

The PMA will post notice on the PA website of any proposed significant revisions to this CP.

9.12.3 Circumstances Under which OID Must be Changed

If the PMA determines that an amendment necessitates a change in an OID, then the revised version of this CP will identify that a new OID is required and will specify a revised OID.

9.13 Dispute Resolution Procedures

No stipulation.

9.14 Governing Law

No stipulation.

9.15 Compliance with Applicable Law

All STI-CAs operating under this policy are required to comply with applicable law.

9.16 Miscellaneous Provisions

9.16.1 Entire Agreement

No stipulation.

9.16.2 Assignment

Except in the case of a transfer of all or substantially all its assets, any entity operating under this CP may not assign its rights or obligations without the prior written consent of the PMA.

9.16.3 Severability

If a provision of this CP is held invalid or unenforceable by a competent court or tribunal, the remainder of the CP will remain valid and enforceable.

9.16.4 Force Majeure

No stipulation.

9.17 Other Provisions

No stipulation.