ATIS-1000084.v003

Technical Report on Operational and Management Considerations for SHAKEN STI Certification Authorities and Policy Administrators

TECHNICAL REPORT

As a leading technology and solutions development organization, the Alliance for Telecommunications Industry Solutions (ATIS) brings together the top global ICT companies to advance the industry's most pressing business priorities. ATIS' nearly 200 member companies are currently working to address the All-IP transition, 5G, network functions virtualization, big data analytics, cloud services, device solutions, emergency services, M2M, cyber security, network evolution, quality of service, billing support, operations, and much more. These priorities follow a fast-track development lifecycle — from design and innovation through standards, specifications, requirements, business use cases, software toolkits, open source solutions, and interoperability testing.

ATIS is accredited by the American National Standards Institute (ANSI). The organization is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a founding Partner of the oneM2M global initiative, a member of the International Telecommunication Union (ITU), as well as a member of the Inter-American Telecommunication Commission (CITEL). For more information, visit www.atis.org.

ATIS-1000084.v003, *Technical Report on Operational and Management Considerations for SHAKEN STI Certification Authorities and Policy Administrators*

Published by

Alliance for Telecommunications Industry Solutions
1200 G Street, NW, Suite 500
Washington, DC 20005

ATIS-1000084.v003

ATIS Technical Report on

Technical Report on Operational and Management Considerations for SHAKEN STI Certification Authorities and Policy Administrators

Alliance for Telecommunications Industry Solutions

Approved March 16, 2023

Abstract
This document provides operational and management considerations for the Certification Authorities within the context of the SHAKEN Governance Model and Certificate Management framework. It introduces considerations for the STI Policy Administrator in managing the list of valid STI-CAs and authorized Service Providers, as well as general operational and policy considerations for PKI. This document introduces those aspects which are unique to the SHAKEN use of PKI.

Foreword

The Alliance for Telecommunications Industry Solutions (ATIS) is a global standards development and technical planning organization that develops and promotes worldwide technical and operations standards for information, entertainment, and communications technologies. ATIS' diverse membership includes key stakeholders from the Information and Communications Technologies (ICT) industry – wireless and wireline service providers, equipment manufacturers, broadband providers, software developers, VoIP providers, consumer electronics companies, public safety agencies, and internet service providers. ATIS is also a founding partner and the North American Organizational Partner of the Third Generation Partnership Project (3GPP), the global collaborative effort that has developed the Long-Term Evolution (LTE) and LTE-Advanced wireless specifications.

ATIS' Packet Technologies and Systems Committee (PTSC) develops standards related to services, architectures, signaling, network interfaces, next generation carrier interconnect, cybersecurity, lawful intercept, and government emergency telecommunications service within next generation networks. As networks transition to all-IP, PTSC will evaluate the impact of this transition and develop solutions and recommendations where necessary to facilitate and reflect this evolution.

The SIP Forum is an IP communications industry association that engages in numerous activities that promote and advance SIP-based technology, such as the development of industry recommendations, the SIPit, SIPconnect-IT, and RTCWeb-it interoperability testing events, special workshops, educational seminars, and general promotion of SIP in the industry. The SIP Forum is also the producer of the annual SIP Network Operators Conference (SIPNOC), focused on the technical requirements of the service provider community. One of the Forum's notable technical activities is the development of the SIPconnect Technical Recommendation – a standards-based SIP trunking recommendation for direct IP peering and interoperability between IP Private Branch Exchanges (PBXs) and SIP-based service provider networks. Other important Forum initiatives include work in Video Relay Service (VRS) interoperability, security, Network-to-Network Interoperability (NNI), and SIP and IPv6.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, PTSC, 1200 G Street NW, Suite 500, Washington, DC 20005, and/or to the SIP Forum, 733 Turnpike Street, Suite 192, North Andover, MA, 01845.

The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages. The word *may* denotes an optional capability that could augment the standard. The standard is fully functional without the incorporation of this optional capability.

The **ATIS/SIP Forum IP-NNI Task Force** under the **ATIS Packet Technologies and Systems Committee (PTSC)** and the **SIP Forum Technical Working Group (TWG)** was responsible for the development of this document.

Table of Contents

Table of Figures

ATIS Technical Report on –

Technical Report on Operational and Management Considerations for SHAKEN STI Certification Authorities and Policy Administrators

1 Scope & Purpose

1.1 Scope

This technical report describes operational and management considerations for STI Certification Authorities (STI-CAs) within the context of the SHAKEN framework [ATIS-1000074, *Signature-based Handling of Asserted Information using Tokens (SHAKEN)*], Delegate Certificates [ATIS-1000092, *Signature-based Handling of Asserted Information using Tokens (SHAKEN): Delegate Certificates*] and SHAKEN governance [ATIS-1000080, *SHAKEN Governance Model and Certificate Management framework*]. This document focuses on the operational and management aspects that impact the authentication and verification services, as well as general Certification Authority (CA) practices and policies. The document addresses the STI Policy Administrator (STI-PA) operational aspects of managing the list of STI-CAs and authorization of STI Participants to obtain STI certificates and to issue delegate certificates. This document does not address any additional policy aspects defined by the STI Governance Authority (STI-GA), and applied by the STI-PA, in determining whether or not a CA is qualified to serve as an STI-CA, a service provider is a valid service provider or a service provider is authorized to issue delegate certificates. The guidelines and recommendations provided in this document are based on an STI-PA starting with a list of trusted STI-CAs and a list of authorized STI Participants or the policies set by the STI Governance Authority (STI-GA) to be applied by the STI-PA in authorizing STI Participants to participate in the ecosystem.

1.2 Purpose

The SHAKEN Governance Model and Certificate Management framework uses standard Public Key Infrastructure (PKI) for creating and distributing STI certificates and delegate certificates. As such, PKI Certification Practice Statement (CPS) and Certificate Policy (CP) documents, per RFC 3647, *Internet X.509 Public Key Infrastructure Certificate Policy and Certification Practices Framework*, are an operational requirement for the STI-CAs. This document outlines the role of the STI-PA in defining and administering required certificate policies to support SHAKEN.

The SHAKEN Governance Model and Certificate Management framework introduces a model whereby the STI-PA maintains a list of trusted STI-CAs. This list is distributed to STI Participants and used during the verification process to ensure that the public key certificate associated with a specific PASSporT has been issued by a valid STI-CA. This document specifies the form of the information stored in the list and the mechanism for distributing that list to the STI Participants.

The STI Participant obtains STI certificates from an STI-CA to create signatures authenticating itself as the signing entity and protecting the integrity of the Identity header field. The STI Participant can obtain STI certificates from any approved STI-CA in the list of trusted STI-CAs received from the STI-PA with which it has an established business relationship. An STI Participant can also obtain a CA certificate from an STI-CA to establish a Subordinate CA for issuing delegate certificates to VoIP entities.

The SHAKEN certificate management framework is based on using a signed Service Provider Code (SPC) token for validation when requesting a certificate. Prior to requesting a certificate, the STI Participant requests a Service Provider Code token from the STI-PA as described in ATIS-1000080 [Ref 2] for an STI certificate or ATIS-1000092 [Ref 3] for a CA certificate to support delegate certificates. When an STI Participant initiates a Certificate Signing Request (CSR), the STI Participant proves to the STI-CA that it has been validated and is eligible to receive a certificate via the use of the SPC token. This document describes the STI-PA management of the SPC tokens.

2 References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated 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.

2.1 Normative References

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

[Ref 2] ATIS-1000080, *Signature-based Handling of Asserted Information using Tokens (SHAKEN): Governance Model and Certificate Management.*[1]

[Ref 3] ATIS-1000092, *Signature-based Handling of Asserted Information using Tokens (SHAKEN): Delegate Certificates.*[1]

[Ref 4] draft-ietf-acme-authority-token-tnauthlist, *TNAuthList profile of ACME Authority Token.*[2]

[Ref 5] RFC 3261, *SIP: Session Initiation Protocol.*[2]

[Ref 6] RFC 3647, *Internet X.509 Public Key Infrastructure Certificate Policy and Certification Practices Framework.*[2]

[Ref 7] RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax.*[2]

[Ref 8] RFC 4648, *The Base16, Base32, and Base64 Encodings.*[2]

[Ref 9] RFC 4949, *Internet Security Glossary, Version 2.*[2]

[Ref 10] RFC 5217, *Memorandum for Multi-Domain Public Key Infrastructure Interoperability.*[2]

[Ref 11] RFC 5280, *Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile.*[2]

[Ref 12] RFC 5905, *Network Time Protocol Version 4 (NTPv4).*[2]

[Ref 13] RFC 6890, *Special-Purpose IP Address Registries).*[2]

[Ref 14] RFC 7159, *The JavaScript Object Notation (JSON).*[2]

[Ref 15] RFC 7231, *Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content.*[2]

[Ref 16] RFC 7468, *Textual Encodings of PKIX, PKCS, and CMS Structure.*[2]

[Ref 17] RFC 7519, *JSON Web Token (JWT).*[2]

[Ref 18] RFC 8226, *Secure Telephone Identity Credentials: Certificates.*[2]

2.2 Informative References

[Ref 100] NIST SP 800-57, *Recommendation for Key Management.*[3]

[Ref 101] FIPS PUB 140-2, *Security Requirements for Cryptographic Modules.*[3]

[Ref 102] ATIS-1000093, *ATIS Standard on Toll-Free Numbers in the SHAKEN Framework.*[1]

---

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

[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/ >.

3 Definitions, Acronyms & Abbreviations

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

3.1 Definitions

The following provides some key definitions used in this document. Refer to IETF RFC 4949, *Internet Security Glossary, Version 2* [Ref 9] 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 [Ref 9]. See also STI Certificate.

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 [Ref 9].

Certification Authority (CA) Certificate: A public key certificate, containing a Basic Constraints extension with a CA Boolean set to "TRUE". A CA Certificate is used by an STI Participant to establish an STI-SCA to issue delegate certificates to VoIP entities.

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 [Ref 9]. Synonym for Certificate Chain.

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 [Ref 6].

Certification Practice Statement (CPS): A statement of the practices that a certification authority employs in issuing, managing, revoking, and renewing or re-keying certificates [Ref 6].

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 [Ref 9].

CPS Summary (or CPS Abstract): A subset of the provisions of a complete CPS that is made public by a CA [Ref 6].

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 [Ref 9].

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 STI Participant 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". An End-Entity STI Certificate is used by a service provider to sign and verify a PASSporT.

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

Issuing Certification Authority (CA): A CA that creates STI certificates.

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 United States).

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 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 [Ref 9].

Public Key: The publicly disclosable component of a pair of cryptographic keys used for asymmetric cryptography [Ref 9].

Public Key Infrastructure (PKI): The set of hardware, software, personnel, policy, and procedures used by a CA to issue and manage certificates [Ref 9].

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, *Memorandum for Multi-Domain Public Key Infrastructure Interoperability*].

Responsible Organization (RespOrg): An STI Participant designated as the agent for the Toll-Free subscriber to obtain, manage and administer Toll-Free Numbers and provide routing reference information in the Toll-Free Number Registry (TFNR). RespOrgs are the only parties who assign, manage and administer Toll-Free numbers in the Toll-Free Number Registry [ATIS-1000093, *ATIS Standard on Toll-Free Numbers in the SHAKEN Framework*].

Root CA: A CA that is directly trusted by an end-entity. See also Trust Anchor CA and Trusted CA [RFC 4648, *The Base16, Base32, and Base64 Encodings*].

Secure Telephone Identity (STI) Certificate: A public key certificate used by an STI Participant to sign and verify the PASSporT.

Secure Telephone Identity Subordinate CA (STI-SCA): An SCA that gets its certificate directly from an STI-CA.

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 an STI Participant.

Service Provider Code (SPC) Token: An authority token that can be used by a SHAKEN STI Participant 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 [Ref 4], but with the restriction for SHAKEN where the TNAuthList value contained in the token's "atc" claim identifies a single Service Provider Code.

Signature: Created by signing the message using the private key. It ensures the identity of the sender and the integrity of the data [Ref 9].

STI Participant: Service Providers, RespOrgs, and other parties that the STI-GA authorizes to obtain SPC Tokens.

Subordinate CA (SCA): A CA whose public-key certificate is issued by another (superior) CA.

Subscriber: A user that is registered in a PKI and, therefore, can be named in the "subject" field of a certificate issued by a CA in that PKI [Ref 9].

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 [Ref 9].

Trust Anchor CA: A CA that is the subject of a trust anchor certificate or otherwise establishes a trust anchor key [Ref 9]. See also Root CA and Trusted CA.

Trust Authority: An entity that manages a Trust List for use by one or more relying parties [Ref 10].

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 [Ref 9].

Trust List: A set of one or more trust anchors used by a relying party to explicitly trust one or more PKIs [Ref 10].

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

3.2 Acronyms & Abbreviations

ACME	Automated Certificate Management Environment (Protocol)
ATIS	Alliance for Telecommunications Industry Solutions
CA	Certification Authority
CRL	Certificate Revocation List
CP	Certificate Policy
CPS	Certification Practice Statement
CSR	Certificate Signing Request
HTTPS	Hypertext Transfer Protocol Secure
IETF	Internet Engineering Task Force
JSON	JavaScript Object Notation
JWT	JSON Web Token
NIST	National Institute of Standards and Technology
NNI	Network-to-Network Interface
NTP	Network Time Protocol
NRRA	National/Regional Regulatory Authority
NRRO	National/Regional Regulatory Oversight
OCSP	Online Certificate Status Protocol
OID	Object Identifier
PKI	Public Key Infrastructure
PMA	Policy Management Authority
PTSC	ATIS Packet Technologies and Systems Committee
SHAKEN	Signature-based Handling of Asserted information using toKENs
SIP	Session Initiation Protocol
SP	Service Provider
SPC	Service Provider Code
STI	Secure Telephone Identity
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-SCA	Secure Telephone Identity Subordinate Certification Authority
STI-VS	Secure Telephone Identity Verification Service
TFNR	Toll-Free Number Registry
TN	Telephone Number
URI	Uniform Resource Identifier
VoIP	Voice over Internet Protocol
V-SCA	VoIP Entity Subordinate Certification Authority

4 Overview

The governance model in ATIS-1000080 [Ref 2] introduces an STI-Policy Administrator that bridges the governance aspects of STI with the protocol requirements to support digital certificates [RFC 5280, *Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile*] which are used by the SHAKEN framework [Ref 1] to authenticate and verify telephone identities. Per the governance model and certificate management framework, the STI-PA maintains a list of trusted STI-CAs to be provided to Verification services. The STI-PA also provides for management of the STI Participants authorized to obtain certificates and provide STI functionality within the VoIP network. This document effectively extends the roles and functions of the STI-PA beyond those defined in ATIS-1000080 [Ref 2] per the following diagram:

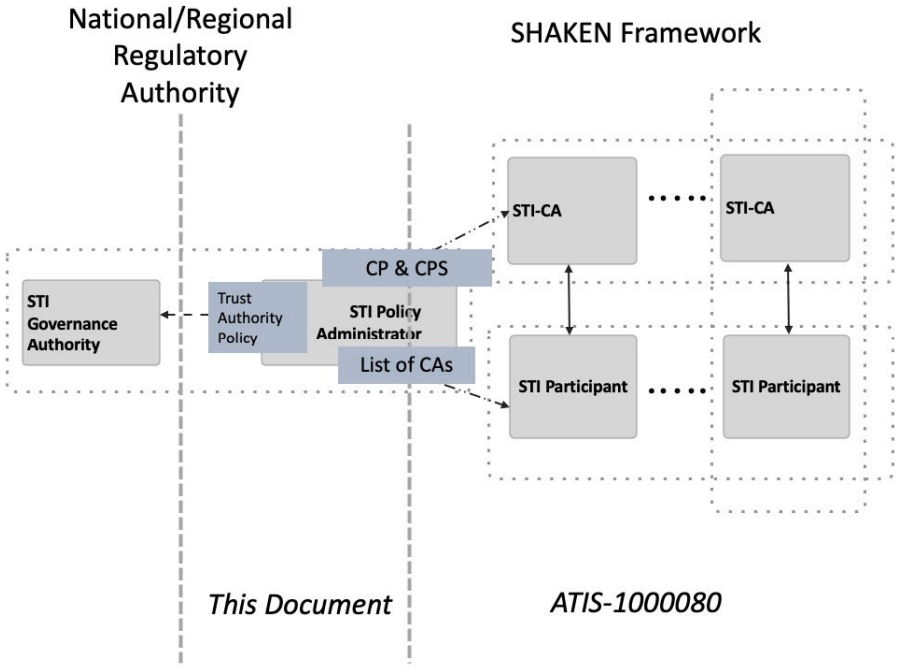


Figure 4.1: Governance Model for Certificate Management

Clause 5 of this document describes a Trust Authority Policy that establishes the relationship between the STI Governance Authority (STI-GA) and the STI-PA's operational responsibilities.

In the context of SHAKEN, the approval of STI-CAs follows standard PKI practices, as outlined in RFC 3647 [Ref 6], including the definition of Certificate Policies as described in Clause 6. The STI-PA defines a CP and the STI-CAs provide a CPS describing their adherence to the CP during the approval process.

Details on the management of the list of STI-CAs are provided in Clause 7 and the management of the authorized STI Participants in Clause 8.

5 STI-PA as Trust Authority

As described in ATIS-1000080 [Ref 2], the STI-GA is responsible for:

- Establishing policies governing which entities can manage the PKI and issue STI certificates.
- Defining the policies and procedures governing which entities can acquire STI certificates.

The STI-PA applies and enforces any policies established by the STI-GA in its role as the Trust Authority. In this role, the STI-PA serves as the Trust Authority to the relying parties in the PKI. The STI-PA maintains the Trust List of authorized STI-CAs which each establish their own PKI for issuing certificates, per the following diagram:

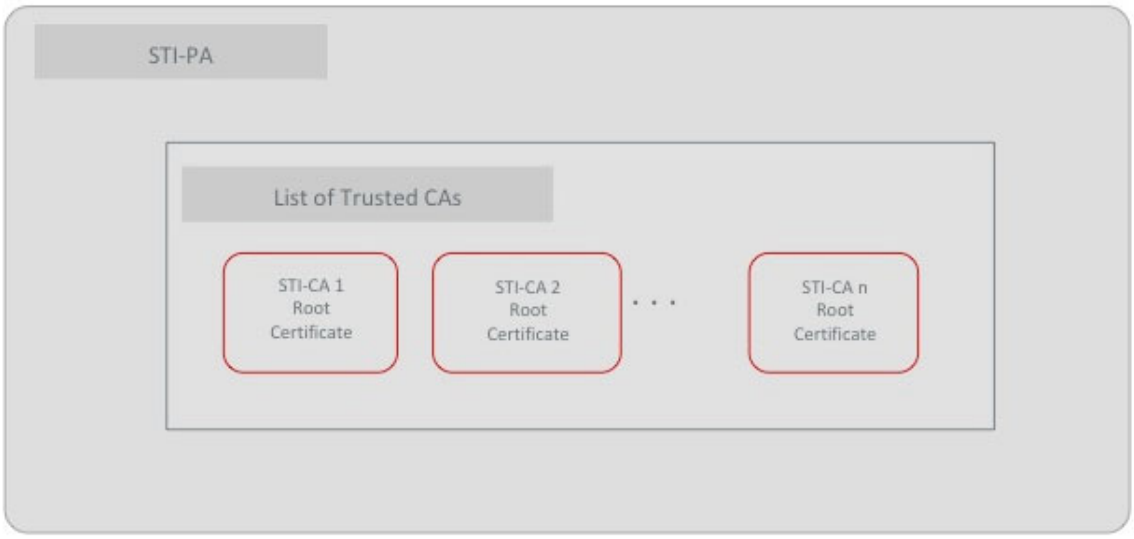


Figure 5.1: Trust Model

Each of the STI-CAs operates its own Root CA, Issuing CAs, Intermediate CAs, and Subordinate CAs in the case of support of Delegate Certificates with a PKI infrastructure similar to the following diagram:

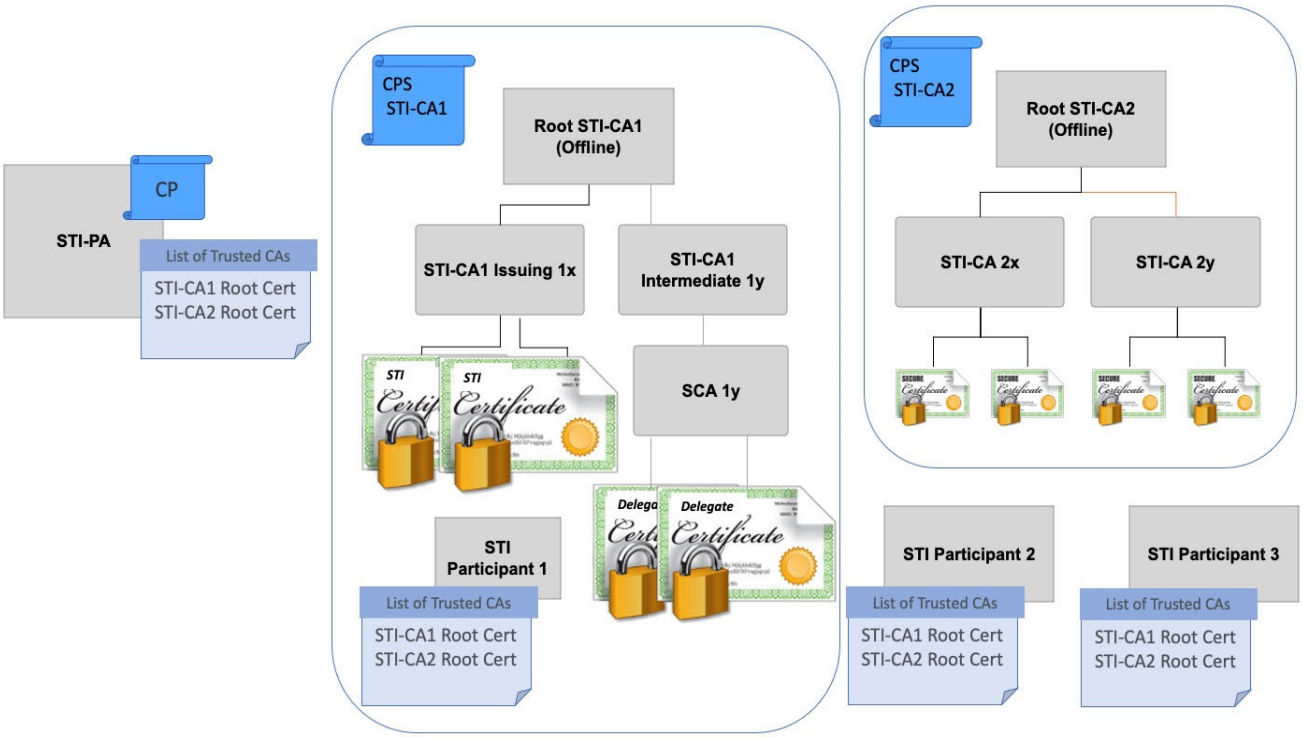


Figure 5.2: PKI Model

In a multi-stakeholder PKI model, typically a Policy Management Authority (PMA) is established, comprising a set of people responsible for ensuring that the established policies are being adhered to. The set is typically comprised of the stakeholders (e.g., service providers in the case of SHAKEN).

The PMA defines a CP to be supported by the approved STI-CAs. The STI-CAs provide a CPS describing their adherence to the CP during the approval process. An outline of the CP to be supported by the STI-CAs is provided in Clause 6.1.

The STI-PA defines a Trust Authority Policy, including the following:

- STI-CAs shall not inherit trust from other STI-CAs in the deployment of the SHAKEN framework (i.e., the STI-PA is the only trust authority). To preclude this, policy mapping shall be inhibited.
- An STI-PA may remove an STI-CA from the list of trusted STI-CAs based on specific criteria such as a failure to comply with the CP established by the STI-PA or other criteria as defined by the STI-GA. Typically, compliance is audited by the PMA and thus guidelines must be established for the timeframe in which an identified problem must be resolved.
- Other policies established by the STI-GA for operation of the STI-PA.

Beyond the role of managing the list of trusted STI-CAs, the STI-PA also serves as a Trust Anchor to the relying parties in the PKI by providing service providers with the SPC token that is used by the STI-CA in determining whether the service provider requesting issuance of certificates is authorized.

As described in ATIS-1000080 [Ref 2], whether an entity is or is not authorized to acquire STI certificates is based on the service provider being assigned a Service Provider Code by a Regulatory and/or administrative entity. Per ATIS-1000080 [Ref 2], the STI-GA can define other policies and procedures governing which entities can acquire STI certificates.

The following diagram summarizes the roles and responsibilities associated with the STI-PA to support issuance of STI certificates, including the interfaces to other functional elements:

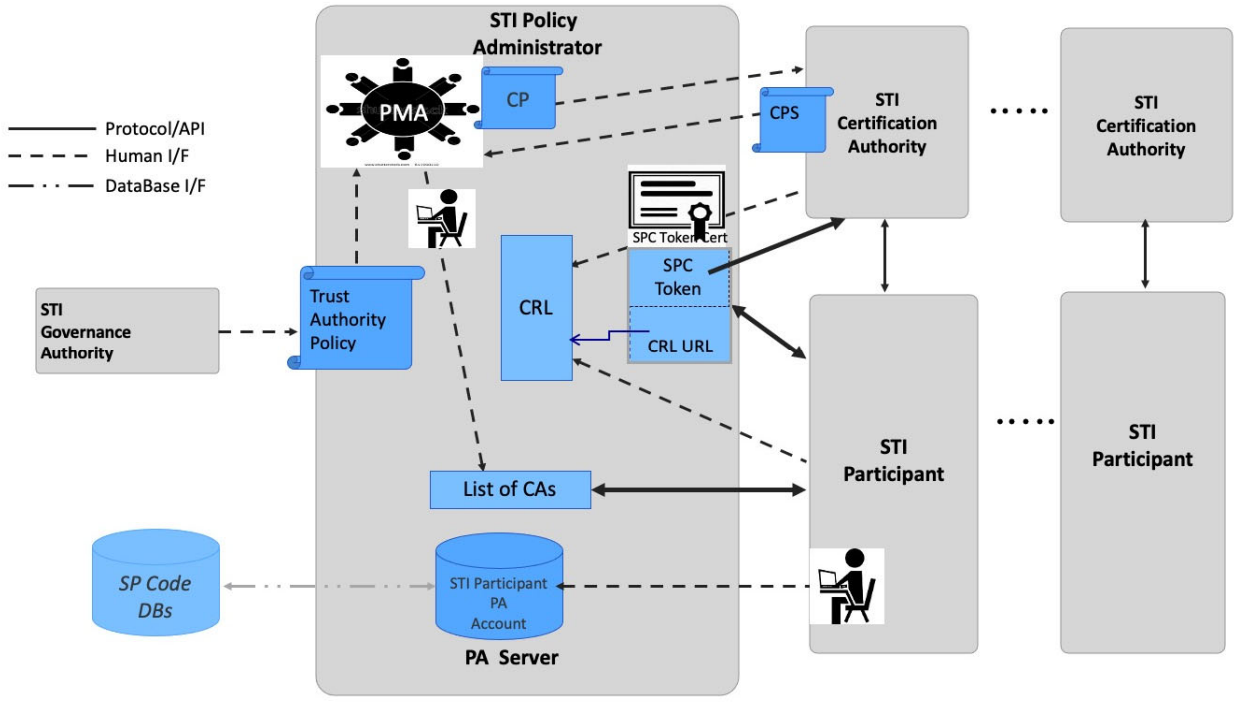
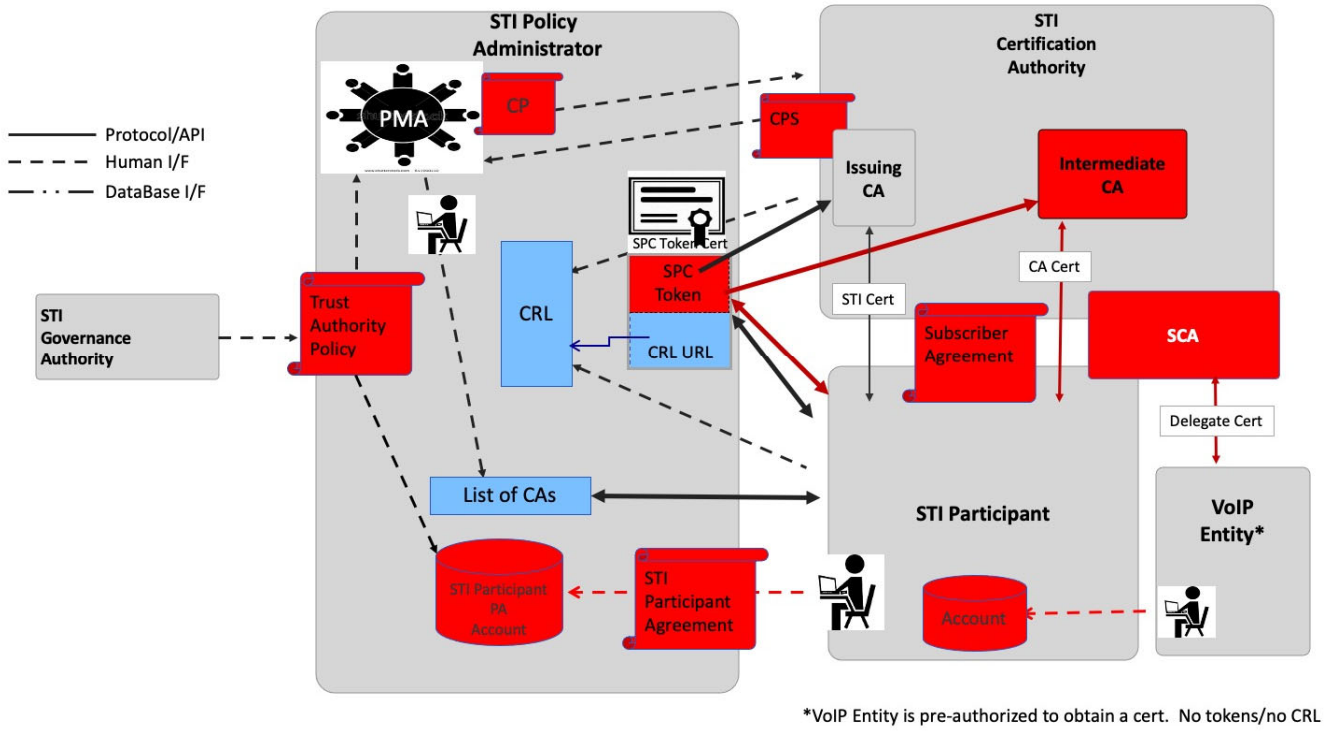


Figure 5.3: STI-PA Roles and Functional Interfaces

ATIS-1000092 [Ref 3] extends the SHAKEN PKI framework and Trust model to include Subordinate CAs (STI-SCAs) that issue delegate certificates to VoIP entities. An SPC token with the CA boolean equal to "TRUE" is required in order to obtain a certificate for an STI Participant to use an STI-SCA to issue delegate certificates. As with the STI-GA policy applied by the STI-PA in determining who is qualified to obtain an SPC token authorizing the STI Participant to obtain STI certificates, the STI-PA will apply and enforce any policies set by the STI-GA for authorizing an STI Participant to obtain an SPC token authorizing the STI Participant to establish an STI-SCA to issue delegate certificates.

The addition of an SCA extends the SHAKEN PKI and Trust model per the following diagram:



As described in ATIS-1000092 [Ref 3], the delegate end entity certificates issued by the STI-SCA contain TNAuthLists that include TNs and not an SPC as is the case for STI certificates. The use of the TNs by the VoIP entity is vetted by the TNSP and the authorization for the VoIP entity to be issued delegate end entity certificates is implicit based on this vetting. Whether additional criteria for authorization is imposed by the STI-GA is outside the scope of this document. However, such policies should consider that with this model, the STI-PA is effectively delegating authorization of the entities who can obtain certificates in the SHAKEN ecosystem to the STI Participant that has been approved to participate in the ecosystem.

As well as issuing delegate end entity certificates, an STI-SCA can also issue a delegate CA certificate that establishes a VoIP Entity Subordinate Certificate Authority (V-SCA) on behalf of the VoIP entity (referred to as a V-SCA delegate certificate). The V-SCA can also establish a subordinate delegate V-SCA.

6 Certificate Policy & Certification Practice Statements

The STI-PA defines a CP that prescribes the policies to be followed by an STI-CA within the SHAKEN framework. The CP also defines policies with regards to the operation of Subordinate CAs (STI-SCAs) to support delegate certificates. Within the SHAKEN framework, the STI-PA imposes some of these policies based on its role as the Trust Authority. The STI-CAs shall produce Certification Practice Statements defining the manner in which they abide by the Certificate Policy, aligning with their role as a CA issuing STI certificates. In the case that a CA also supports issuance of CA certificates, the CPS shall address the manner in which they abide by the CP in their role

as a CA issuing CA certificates, an STI SCA issuing delegate CA certificates and delegate end entity certificates and a VoIP SCA issuing delegate CA certificates and delegate end entity certificates, as applicable.

6.1 Certificate Policy

A CP provides a set of rules that indicates the applicability of a certificate to a particular community and/or class of application with common security requirements [Ref 6]. It contains the business, legal, and technical requirements for certificate approval, management, use, revocation, and renewal.

The following reference documents provide additional information about writing the CP and CPS:

- NIST SP 800-57, *Recommendation for Key Management* [Ref 100]
  - Part 1 Revision 4: *General*
  - Part 2: *Best Practices for Key Management Organization*
  - Part 3 Revision 1: *Application-Specific Key Management Guidance*, section 2 on PKI.
- FIPS PUB 140-2, *Security Requirements for Cryptographic Modules* [Ref 101]

The CP contains policies for the STI-PA, STI-CA, STI-SCA, STI Certificate Repository (STI-CR), subscribers, and relying parties. RFC 3647 [Ref 6] contains the following outline for the contents of the Certificate Policy. The STI-PA shall address the following 9 topics:

1. Introduction
2. Publication and Repository
3. Identification and Authentication
4. Certificate Life-Cycle Operational Requirements
5. Facilities, Management, and Operational Controls
6. Technical Security Controls
7. Certificate, CRL, and OCSP Profile
8. Compliance Audit
9. Other Business and Legal Matters.

6.1.1 Introduction

This component of the CP provides the set of provisions, and the entities and application (SHAKEN) for which the CP is targeted.

6.1.1.1 Overview

The CP shall provide an overview of the relationship between the CP and CPS, and the target audience. This section shall include the following statement: “This CP conforms to Internet X.509 Public Key Infrastructure Certificate Policy and Certification Practices Framework [Internet Engineering Task Force (IETF) RFC 3647 [Ref 6]].”

6.1.1.2 Document Name and Identification

The CP shall provide an official title. The CP shall identify certificate policies, levels of assurance, and object identifier (OID) values that will be included in certificates issued by the STI-CAs. The CP shall contain the TNAuthList OID as defined in RFC 8226, *Secure Telephone Identity Credentials: Certificates* [Ref 18].

6.1.1.3 PKI Participants

The CP provides information on the PKI participants. This shall include Certification Authorities (STI-CAs, STI-SCAs and V-SCAs), Subscribers, and Relying Parties. The Root CA is recommended to be an offline CA that only issues certificates to intermediate CAs. An intermediate CA issues STI certificates and/or CA certificates to allow operation of an STI-SCA. An STI-SCA and a V-SCA issue delegate end entity certificates and/or delegate CA certificates that allow operation of V-SCA. In the context of SHAKEN, service providers and VoIP entities are the subscribers and relying parties.

6.1.1.4 Certificate Usage

The CP shall include the appropriate certificate uses and prohibited certificate uses. The CP shall specify that the certificates are used for SHAKEN.

6.1.1.5 Policy Administration

The STI-PA administers the CP. The CP shall provide contact information for STI-CAs writing their CPSs. The CP shall include additional information for reviewing the CPS compliance with the CP. The CP shall document the CP approval procedures.

6.1.1.6 Definitions and Acronyms

The CP shall include the definitions and acronyms used in the CP. This section can also reference an appendix with the information.

6.1.2 Publication and Repository Responsibilities

The CP shall include information on any certificate repositories. It shall include information on the entity that operates the STI-CR and its responsibility to publish practices, certificates, and certificate status. The CP shall include the frequency of publication and access controls. Note that in the case of SHAKEN, it is anticipated that the service providers will maintain a repository of their certificates. Thus, it is not a requirement that an STI-CA also maintain an STI-CR.

6.1.3 Identification and Authentication

The CP shall describe the procedures used to authenticate the identity and/or other attributes of a certificate applicant prior to issuing the certificate. This shall include whether the CA supports the Automated Certificate Management Environment (ACME) protocol, as well as the ACME extension for token authorization using the Service Provider Code as described in ATIS-1000080 [Ref 2] and draft-ietf-acme-authority-token-tnauthlist [Ref 4].

6.1.3.1 Naming

The CP shall provide information on the naming standards used in the certificates. Naming conventions used shall be standardized to avoid collisions. The Subject name in STI-CA root certificates shall match the Issuer name as required by RFC 5280 [Ref 11]. The Issuer name in the certificates shall match the Subject name of the Issuing CA certificate.

6.1.3.2 Initial Identity Validation

The CP shall include the procedures required for identification and authentication for the initial registration of certificates.

6.1.3.3 Identification and Authentication for Re-key Requests

The CP shall include 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.

6.1.3.4 Identification and Authentication for Revocation Requests

The CP shall include the procedures required for identification and authentication for revocation requests. In the context of SHAKEN, certificate re-key requests after revocation shall follow the same process as initial certificate issuance.

6.1.4 Certificate Life-Cycle Operational Requirements.

This component of the CP specifies requirements imposed upon issuing CAs (STI-CAs, STI-SCAs and V-SCAs) and subscribers with respect to the life-cycle of a certificate.

6.1.4.1 Certificate Application

The CP shall provide information on who can submit a certificate application and the enrollment process. The CP shall specify that the only entities to apply for certificates are valid STI Participants and VoIP entities. The CP shall specify that STI end entity certificates and certificates for STI-SCAs are not issued if an entity does not have a valid SPC token. The CP shall specify that delegate end entity certificates are only issued to VoIP entities when the entity has been authorized to use the TNs that are included in the TNAuthList in the CSR.

6.1.4.2 Certificate Application Processing

The CP shall describe the procedure for processing certificate applications.

6.1.4.3 Certificate Issuance

The CP shall include information on actions performed by the issuing CAs, during the issuance of the certificate and notification mechanisms.

6.1.4.4 Certificate Acceptance

The CP shall document the process for an applicant accepting a certificate, publication of the certificate by the STI-CA, and notification of certificate issuance to other entities.

6.1.4.5 Key Pair and Certificate Usage

The CP shall provide responsibilities for the use of keys and certificates. This includes subscriber's responsibilities for using the private key and the relying party responsibilities for using the public key and certificate.

6.1.4.6 Certificate Renewal

The CP shall document the process for renewing a certificate.

6.1.4.7 Certificate Re-key

The CP shall document the process for issuing a new certificate with a new public key.

6.1.4.8 Certificate Modification

The CP shall document the process for modifying certificate information, using the existing public key.

6.1.4.9 Certificate Revocation and Suspension

The CP shall document the policy for certificate revocation and suspension. The CP shall include information on reasons for certificate revocation, who can request certificate revocation, procedures for revoking the certificate, publishing certificate revocation, and mechanisms a relying party uses to check for certificate revocation. The required mechanisms shall align with the Certificate Lifecycle Management procedures described in ATIS-1000080 [Ref 2] and ATIS-1000092 [Ref 3].

6.1.4.10 Certificate Status Services

The CP shall provide information on the certificate status services supported and availability of the services.

6.1.4.11 End of Subscription

The CP shall document the process for a subscriber to end the subscription services of the CA.

6.1.4.12 Key Escrow and Recovery

The CP shall document the policies and practices of key escrow of the subject's private key by the CA and the recovery process used by the subscriber.

6.1.5 Facility, Management, and Operational Controls

The CP shall describe the non-technical security controls used by the STI-CA for key generation, subject authentication, certificate issuance, certificate revocation, auditing, and archiving. The CP shall define the non-technical security controls on the STI-CR, STI-CAs, subscribers, and other participants.

6.1.5.1 Physical Security Controls

The CP shall describe the physical security controls on the facilities housing the STI-CA and any STI-CR systems.

6.1.5.2 Procedural Controls

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

6.1.5.3 Personnel Security Controls

The CP shall provide the policies related to personnel that perform trusted roles in the STI-PA and STI-CA and STI-SCA and V-SCAs, as applicable. This includes qualifications, experience, background checks, clearances, training, and auditing.

6.1.5.4 Audit Logging Procedures

The CP shall provide the policies related to event logging and audit systems. The CP shall include the types of events recorded, the frequency the audit logs are processed, protection of the audit log files, and vulnerability assessments.

6.1.5.5 Records Archival

The CP shall document the requirements for records archival, including the types of records that are archived, retention period, time-stamping, backup, and protection.

6.1.5.6 Key Changeover

The CP shall document the procedure to provide a new CA public key to users following a re-key by the CA.

6.1.5.7 Compromise and Disaster Recovery

The CP shall provide the requirements for notification and recovery procedures in the event of compromise or disaster.

6.1.5.8 CA Termination

The CP shall document the requirements for termination of a CA.

6.1.6 Technical Security Controls

The document FIPS PUB 140-2 [Ref 101], provides technical information needed for this section.

6.1.6.1 Key Pair Generation and Installation

The CP shall provide the requirements for key pair generation and installation for the STI-CA and subscribers.

6.1.6.2 Private Key Protection and Cryptographic Module Engineering Controls

The CP shall document the requirements for private key protection and the use of cryptographic modules for STI-CAs and subscribers.

6.1.6.3 Other Aspects of Key Pair Management

The CP shall document other aspects of key pair management including public key archival and operational period of the certificates issued to the subscriber.

6.1.6.4 Activation Data

The CP shall provide the policies for protecting the activation data required to operate private keys or cryptographic modules containing private keys.

6.1.6.5 Computer Security Controls

The CP shall describe computer security controls used, including access control, audit, identification, authentication, trusted path, security testing, and penetration testing.

6.1.6.6 Life Cycle Security Controls

The CP shall describe the security controls for system development, including development environment, configuration management, software engineering practices, and software development methodology. The CP shall describe security management controls, including the tools and procedures.

6.1.6.7 Network Security Controls

The CP shall document network security controls, including firewalls.

6.1.6.8 Time-Stamping

The CP 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, *Network Time Protocol Version 4 (NTPv4)*].

6.1.7 Certificate Profile Requirements

The CP shall provide a profile of the certificates that are issued along with the lifecycle management of the issued certificates.

6.1.7.1 Certificate Profile

Certificates issued by the STI-CA shall adhere to the X.509 v3 certificate profile, documented in RFC 5280 [Ref 11]. The CP shall provide information on the certificate profile(s), including certificate extensions, algorithm object identifiers, and name constraints.

6.1.7.2 Certificate Lifecycle Management

The CP shall provide a description of the mechanism for lifecycle management, including the use of Certificate Revocation Lists (CRLs), as defined in ATIS-1000080 [Ref 2] and ATIS-1000092 [Ref 3].

6.1.8 Compliance Audit and Other Assessment

The CP shall provide information on compliance audits, including methodology, frequency, personnel qualifications, independence of assessor, and who is entitled to see assessment results.

6.1.9 Other Business and Legal Matters

The CP should include the details for the following business and legal aspects:

1. Financial Responsibility
2. Confidentiality of Business Information
3. Privacy of Personal Information
4. Intellectual Property Rights
5. Representations and Warranties
6. Disclaimers of Warranties
7. Limitations of Liability
8. Indemnities
9. Term and Termination
10. Individual notices and communications with participants
11. Amendments
12. Dispute Resolution Procedures
13. Governing Law
14. Compliance with Applicable Law
15. Miscellaneous Provisions
16. Other Provisions.

It is important that this section is written and/or reviewed by the legal department of the STI-PA for the CP and the STI-CA for the CPS.

6.2 Certification Practice Statement

The CPS contains the practices a CA follows when issuing digital certificates. It provides detailed information on how the policy requirements documented in the CP are implemented for the CA.

The CPS is written by the STI-CA. To ensure the Certificate Policy requirements are followed, the CPS shall use the same format as the CP. RFC 3647 [Ref 6] contains the recommended contents of a CP and CPS, which is shown in Clause 6.1. The following clauses would differ from the CP.

6.2.1 Introduction

The introduction shall provide information on the CPS, instead of the CP.

6.2.2 Policy Administration

The CPS shall include the CPS approval procedures, instead of CP approval procedures.

7 Managing List of STI-CAs

Per the SHAKEN Governance and Certificate Management Framework, the STI-PA shall manage a list of valid STI-CAs. This list shall be distributed to each of the STI Participants for use in verifying that the STI-CA that issued the certificate has been authorized by the STI-PA.

Managing the list of STI-CAs introduces an additional interface from the STI-PA to the STI Verification Service (STI-VS):

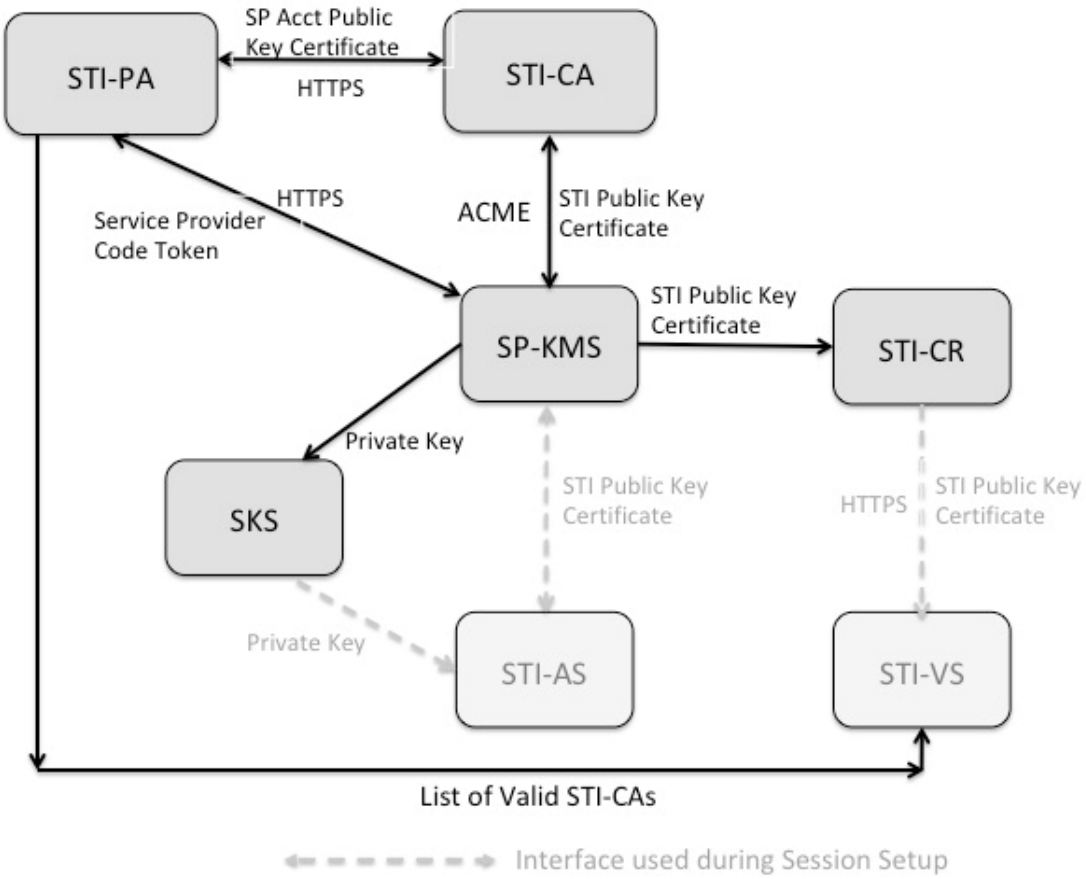


Figure 7.1: SHAKEN Certificate Management Architecture

The STI-PA is responsible for the following prior to including an STI-CA in the Trust List. The STI-PA shall only add an STI-CA to the list of Trusted STI-CAs based upon the following:

- Reviewing the Certification Practice Statement of the STI-CA to determine that the PKI in which it resides is operated to an acceptable level of assurance.
- Ensuring that the policies as identified in Clause 6 are supported.

- Any other criteria that may be specified by the STI-GA.

7.1 Distributing Trusted STI-CA List

This document recommends the use of HTTPS [RFC 7231, *Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content*] for the distribution of the list of trusted STI-CAs. Clause 7.2 provides details on the format and contents of the list in the form of a JSON Web Token (JWT) [RFC 7519, *JSON Web Token (JWT)*]. Access to the list does not require an account with the STI-PA, but the STI-PA shall publish the URL to the list of STI-CAs. Any entity that receives a SIP INVITE with a SIP Identity header field requires the list be publicly accessible in order to perform the verification function per ATIS-1000074 [Ref 1].

7.2 Format of Trusted STI-CA List

The Trusted STI-CA List shall contain the key as well as the algorithm used for the signature. The trust list is distributed in the form of a standard JWT with the following fields in the protected header:

- alg: Algorithm used in the signature of the STI-CA list. Shall use “ES256”.
- typ: Set to the standard “jwt” value.
- x5u: Contains the URL of the STI-PA certificate associated with the signature of the JWT. The URL shall have a protocol of “https”. The URL shall either not contain a port or contain a port of “443”. The URL shall not contain a userinfo subcomponent, query component, or fragment identifier component as described in RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax*. The URL path shall end with “.pem”.

The payload contains the following fields:

- version (required, string): Version number for this list format. The version number shall be changed if the format/contents of the STI-CA list is modified or extended.
- exp: The timestamp after which the service provider considers this list of STI-CAs no longer valid. This field shall be a number containing a NumericDate value, which is recommended to be updated daily. The STI Participant shall request an updated list at some short interval before the current list expires (an interval of one hour is recommended).
- sequence (required, int): The sequence number is incremented by one each time a new list is provided by the STI-PA. A 64-bit integer is recommended.
- trustList (required, array of strings): The trustList is represented as a JSON [RFC 7159, *The JavaScript Object Notation (JSON)*] array of root certificate strings. Each string in the array is a base64-encoded (Section 4 of RFC 4648 [Ref 8]) DER X.509 root certificate for an approved STI-CA.
- extensions (optional, string).

The following provides an example, noting that the trustList is not shown in the encoded form for the purposes of the example:

```
GET /sti-pa/ca-list HTTP/1.1
HOST: sti-pa.com

 HTTP/1.1 200 OK
 Content-Type: application/jose+json
{
"protected": base64url({
    "alg": "ES256",
    "typ": "JWT",
    "x5u": "https://sti-pa.com/sti-pa/cert.pem"
 })
```

```
"payload": base64url({
     "version": "1.0",
     "sequence": 1,
     "exp": 1300819380,

      "trustList": [
     "-----BEGIN CERTIFICATE-----
        STI-CA 1 Root certificate contents
        -----END CERTIFICATE-----",
       "-----BEGIN CERTIFICATE-----
        STI-CA 2 Root certificate contents
        -----END CERTIFICATE-----",
       "-----BEGIN CERTIFICATE-----
         STI-CA 3 Root certificate contents
       -----END CERTIFICATE-----"
     ],
   }) "signature": "RZPOnYoPs1PhjszF...-nh6X1qtOFPB519I"
```

Upon receipt of the Trusted STI-CA List, the entity requiring the list to perform verification (a relying party) shall retrieve the certificate referenced by the “x5u" URL. The relying party shall not dereference URLs that use a scheme other than “https” or a port other than 443. The relying party shall not dereference URLs that contain a userinfo subcomponent, query component, or fragment identifier component as described in RFC 3986 [Ref 7]. The relying party shall not dereference URLs if the host resolves to a special-purpose IP address described in RFC 6890, *Special-Purpose IP Address Registries*. The relying party shall not dereference URLs that appear to be part of a Server-Side Request Forgery (SSRF) attack. The relying party may make an HTTP HEAD request to check the Content-Type or other headers before making an HTTP GET request to dereference the URL.

The HTTPS response to a query to obtain the certificate referenced by the “x5u” URL of the Trusted STI-CA List shall contain a Content-Type header field with a media type of application/pem-certificate-chain, and a message body containing the signing STI-PA certificate plus the additional certificates in the certification path. The end-entity certificate shall be listed first followed by all intermediate certificates. The certificates shall be listed in order such that each certificate is followed by the certificate that issued it. The root certificate shall not be included. Each certificate shall be encoded with the PEM textual encoding according to RFC 7468, *Textual Encodings of PKIX, PKCS, and CMS Structure*.

The relying party shall ensure that the certificate is valid.

7.3 Lifecycle of Trusted STI-CA List

This clause discusses considerations and management of the lifecycle of the trusted STI-CA list.

The Trusted STI-CA List is updated by the STI-PA to remove an STI-CA from the list, to add a new STI-CA to the list, or when a new root certificate is generated as part of STI-CA root certificate lifecycle management. Criteria by which a STI-CA would be removed from the Trusted STI-CA List are described in Clause 5 and are subject to policy considerations. In order to allow the relying party to determine the validity of an issued certificate, it is important that relying parties poll the Trusted STI-CA List on a regular basis (e.g., daily). The STI-PA shall enforce the polling interval using the payload "exp" field defined in Clause 7.2.

The STI-GA is responsible for establishing policies governing the lifetimes of STI-CA root certificates. Since changes to the Trusted STI-CA List are dynamically distributed to relying parties within the relatively short polling interval, it is possible to configure STI-CA root certificates with lifetimes that are shorter than typical root certificate

lifetimes[4] (e.g., STI-CA root certificate lifetimes in the range of 6 months to a year would be feasible). During root certificate rollover, the new root certificate must be listed on the Trusted STI-CA List for at least one polling interval before being used as the trust anchor for new certificates issued to relying parties. This will ensure that relying parties are in possession of the new STI-CA root certificate before it is needed for certification path validation. The STI-PA shall remove root certificates from the Trusted STI-CA List when they expire.

8 STI-PA Administration of STI Participants

The STI-PA shall maintain a list of valid STI Participants who hold tokens, as represented by Service Provider Codes. The assignment of Service Provider Codes is outside the scope of this document. The assumption is that the STI-GA indicates the entity that should be the source for these identifiers.

The trust model for SHAKEN defines the STI-PA as the Trust Anchor for the token-based mechanism for validation of STI Participants within a national/regional administrative domain. Per ATIS-1000080 [Ref 2], the STI-PA issues SPC tokens to STI Participants authorizing an STI Participant to obtain STI certificates. These SPC tokens include the SPC value and a “ca” = “FALSE” boolean in the TNAuthList field. Per ATIS-1000092 [Ref 3], the STI-PA also issues SPC tokens with an SPC value and “ca”=”TRUE” in the TNAuthList. These SPC tokens authorize an STI Participant to obtain a CA certificate from an approved STI-CA in order to establish a Subordinate CA (SCA) to issue delegate certificates. The STI-PA shall also provide guidelines for the renewal and revocation of SPC tokens.

[4] X.509 root certificates typically have lifetimes in the range of one or two decades.