OpenADR Alliance Certificate Policy

OpenADR-CP-I03-250609 (2025)

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Document Status Sheet

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Key to Document Status Codes:

Work in Progress	An incomplete document, designed to guide discussion and generate feedback that may include several alternative requirements for consideration.
Draft	A document in specification format considered largely complete, but lacking review by Members. Drafts are susceptible to substantial change during the review process.
Issued	A stable document, which has undergone rigorous review and is suitable for publication.
Closed	A static document, reviewed, tested, validated, and closed to further documentation change requests.

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1 Introduction

1.1 Overview

Demand Response (DR) is the temporary modification (e.g., shifting or shedding) of demand on an energy grid triggered by stresses on the grid or market conditions. The Open Automated Demand Response Alliance ("OpenADR" or "OpenADR Alliance") has developed a specification [OpenADR 2.0a & 2.0b] that defines an interface between the Demand Response Automation Server (DRAS) and its client devices. It facilitates the automation of client response to various DR programs and dynamic pricing throughout an electrical grid. The specification also addresses how third parties such as utilities, Independent System Operators (ISOs), energy and facility managers, aggregators, service providers and hardware and software manufacturers communicate with the DRAS.

To provide secure two-way communications between compliant devices, the specification requires embedding X.509 v3 Public Key Infrastructure (PKI) Certificates[1] in devices at the time of manufacture. These Certificates are the basis for a number of security services including authentication, confidentiality, integrity, and non-repudiation. In order for a Certificate to be in compliance with the OpenADR specification, it MUST comply with this Certificate Policy (CP). This CP assumes that the reader is generally familiar with Digital Signatures, PKIs and OpenADR specifications.

The OpenADR Alliance and its members foster the development, adoption and compliance of the OpenADR specifications. OpenADR standardizes a way for electricity providers and system operators to communicate DR signals with each other and with their customers using a common language over any existing IP-based communications network, such as the Internet. The OpenADR Alliance has established the framework for the OpenADR PKI and oversees the OpenADR PKI Policy Authority (PKI-PA), the organization responsible for governing and operating the OpenADR PKI. In particular, this CP was established under the authority of, and with the approval of, the OpenADR Alliance.

This CP comprises the policy framework for the OpenADR PKI and is consistent with the *Internet X.509 PKI Certificate Policy and Certification Practices Framework* [RFC 3647]. It governs the operations of OpenADR PKI components by all individuals and entities within the PKI (collectively, "PKI Participants"). It provides the minimum requirements that PKI Participants are required to meet when issuing and managing Certification Authorities (CAs), digital Certificates, and Private Keys. In addition, it informs potential Relying Parties about what they need to know prior to relying on issued Certificates.

This CP also defines the terms and conditions under which the CAs SHALL operate to issue Certificates. Where "operate" includes Certificate management (i.e., approve, issue, and revoke) of issued Certificates and "issue" in this context refers to the process of digitally signing with the Private Key associated with its authority Certificate a structured digital object conforming to the X.509, version 3 Certificate format.

The CP acts as an umbrella document establishing baseline requirements and applies consistently throughout the entire OpenADR PKI, thereby providing a uniform level of trust throughout the applicable community. The OpenADR PKI accommodates a worldwide, large, public, and widely distributed community of users with diverse needs for communications and information security.

The CP describes the overall business, legal, and technical infrastructure of the OpenADR PKI. More specifically, it describes, among other things:

- Appropriate applications for, and the assurance levels associated with the PKI Certificates;
- Obligations of CAs;

[1] Capitalized words in this document are defined terms in § 11.

- Minimum requirements for audit and related security and practices reviews;
- Methods to confirm the identity of Certificate Applicants;
- Operational procedures for Certificate lifecycle services: Certificate Application, issuance, acceptance, revocation, and renewal;
- Operational security procedures for audit logging, records retention, and disaster recovery;
- Physical, personnel, key management, and logical security; and
- Certificate profile and Certificate Revocation List (CRL) content.

1.1.1 Other Important Documents

Other important documents include:

- **Security Policies**, which describes additional requirements concerning personnel, physical, telecommunications, logical, and cryptographic key management security.
- **Audit Policy**, which describes requirements under which audits will refer to.
- **Compromise Key and Recovery Plan**, which provides procedures for handling a Compromised key and the methods of recovery.
- **Disaster Recovery Plan (DRP)**, which provides procedures for handling a natural disaster or man-made disaster and procedures to retrieve off-site components to get the CA back-on-line.
- ancillary agreements, such as a Digital Certificate Subscriber Agreement (DCSA), Root CA Hosting Agreement, and interoperation agreements.

In many instances, the CP refers to these other documents for specific, detailed requirements, where including the specifics in the CP would Compromise the security of the PKI.

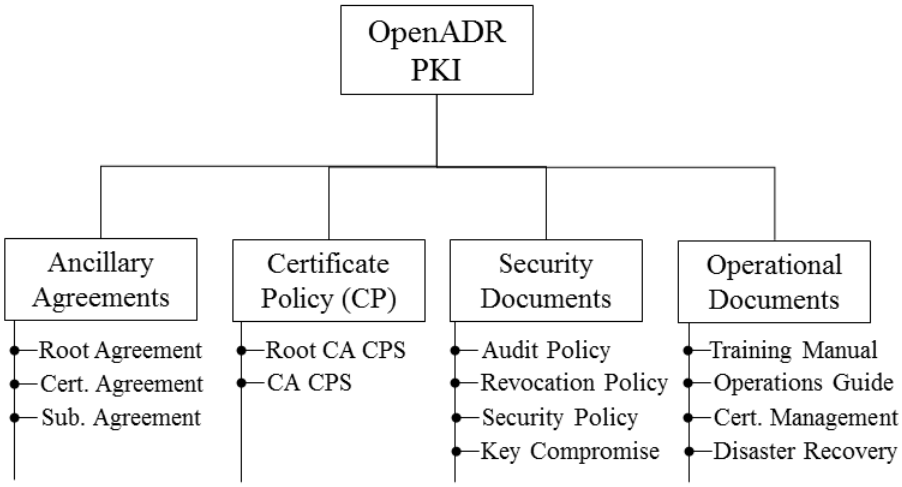

Figure 1: OpenADR PKI Document Architecture

As shown in Figure 1, the CP is an integral part of the OpenADR PKI document architecture and sets the minimum standards for governing, administrating and operating the PKI. Ancillary security and operational documents supplement the CP in setting more detailed requirements. Additionally, each OpenADR PKI CA is governed by a Certification Practice Statement (CPS), which describes how the applicable CP requirements are met by that particular CA. CAs operating in the OpenADR PKI SHALL draft, implement, and maintain a CPS.

Table 1 is a matrix of the various OpenADR PKI practice documents, whether or not they are publicly available, and their locations. The list is not intended to be exhaustive, nor will each

document listed be applicable to every CA. Note that documents not expressly made public are confidential to preserve the security of the OpenADR PKI.

Table 1: Availability of Practice Documents

Documents	Availability	Available From:
OpenADR Certificate Policy (CP)	Public	OpenADR Alliance
Root CA CPS	Confidential	N/A
Sub CA CPS	Confidential	N/A
Ancillary Agreements	Public	the Registration Authority (RA)
Revocation Policy	Confidential	N/A
Audit Policy	Confidential	N/A
Compromise Key and Recovery Plan	Confidential	N/A
Disaster Recovery Plan (DRP)	Confidential	N/A

1.1.2 PKI Architecture

The OpenADR PKI is a two-tier infrastructure with offline Root CAs at tier 1 that issue intermediate CA Certificates (i.e., Subordinate CAs (Sub-CAs)). The online Sub-CAs issue compliant End-Entity Certificates**Error! Reference source not found.**. OpenADR will establish at least one (1) ECC and one (1) RSA Root CA; each Root CA will have at least one (1) pair of Sub-CAs, the VTN Server CA and the VEN Client CA. The VTN CAs will issue VTN server Certificates and the VEN CAs will issue VEN client Certificates to OpenADR Subscribers. OpenADR will make the list of approved Root CAs available to OpenADR Subscribers.

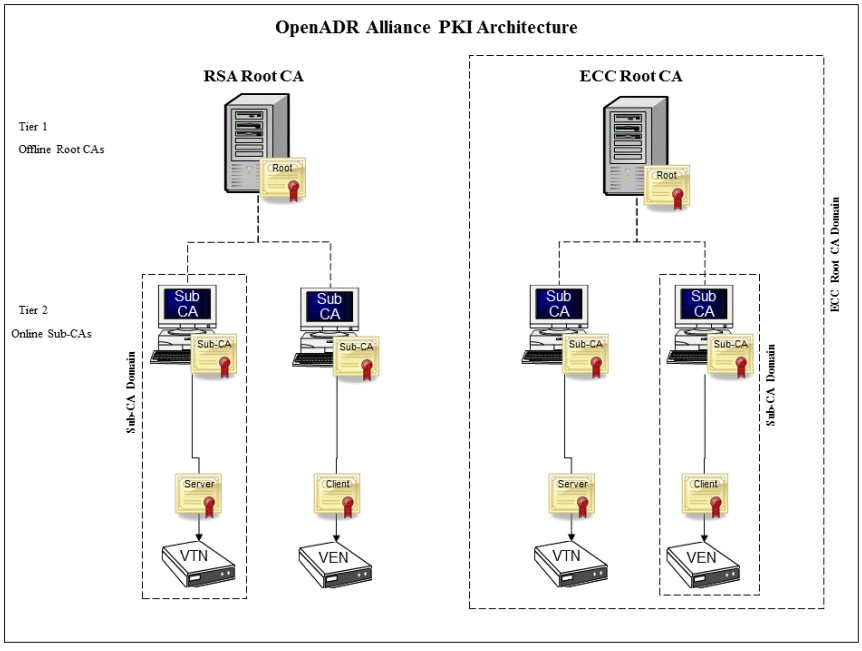

Figure 2: OpenADR PKI Architecture

The Root CA is the apex of its Root CA Domain. The Root CA will issue the Sub-CA Certificates to approved CA service providers. The Sub-CAs will issue the Device Certificates to authorized Subscribers, which will embed the Certificates in OpenADR compliant devices at time of manufacture.

1.1.3 Important Information for Using the CP

Throughout this document, words that are used to define the significance of particular requirements, are all capitalized. The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described here [RFC 2119]:

“MUST”	This word or the adjectives “REQUIRED” or “SHALL” means that the item is an absolute requirement of this CP. “SHALL” will be used when an entity or organization needs to take action. “MUST” will be used otherwise.
“MUST NOT”	This phrase, or the phrase “SHALL NOT” means that the item is an absolute prohibition of this CP.
“SHOULD”	This word or the adjective “RECOMMENDED” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
“SHOULD NOT”	This phrase, or the phrase “NOT RECOMMENDED” means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
“MAY”	This word or the adjective “OPTIONAL” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

This CP uses tables in Section 6: Technical Security Controls and Section 7: Certificate, CRL, and OCSP Profiles. In order to make these tables easier to follow, they are color coded as follows:

	General tables (applying to the document or to all Certificates)
	Root CA
	Sub-CAs
	All CAs
	Device Certificates
	Certificate Status (CRL and OCSP)

This CP uses the following naming convention of *lowerCamelCase*, for x509 extensions and attributes.

1.1.4 Assurance level

OpenADR digital Certificates provide a medium level of assurance that the Certificate Subscriber’s Distinguished Name (DN) is unique and unambiguous within a CA’s domain, and the identity of the Subscriber’s organization is based on a comparison of information submitted by the Subscriber against information in business records or databases. These Certificates can be used for Digital Signatures, encryption, and authentication for proof of identity of components that contain OpenADR Certificates and are compliant with the OpenADR specification [OpenADR 2.0a & 2.0b] and this CP.

1.2 Document Name and Identification

This document is the OpenADR Alliance PKI Certificate Policy. Certificates issued in accordance with this CP SHALL contain the following policy object identifier (OID). The OID SHALL be available in the Sub-CA and Device Certificates, via the *certificatePolicies* extension.

- The OpenADR PKI Certificate Policy (1.3.6.1.4.1.41519.1.1)

1.3 PKI Participants

This section identifies the OADR PKI Participants that are relevant to the administration and operation of the OpenADR PKI.

1.3.1 OpenADR PKI Policy Authority (PKI-PA)

The OpenADR PKI-PA owns this policy and represents the interest of the OpenADR Alliance. The PA oversees the MA, CA, and RA in the implementation and management of the trust infrastructure. The OpenADR PKI-PA responsibilities include:

- Maintaining this CP, ancillary agreements, security, and operational documents referred to by the CP;
- Governing and operating the OpenADR PKI according to this CP;
- Approving the CPS for each CA that issues Certificates under this CP;
- Providing the Registration Authority (RA) with authorized Subscriber information (e.g., certified manufacturers);
- Approving the Compliance Audit report for each CA operating under this policy and the continued conformance of each CA that issues Certificates under this policy with applicable requirements as a condition for allowing continued participation; and
- Performing any Management Authority (MA) activities listed below in the absence of a MA.

1.3.2 Management Authority (MA)

The MA provides trust management services to support OADR in meeting its security goals using the OADR PKI. The PA MAY perform the MA duties itself or designate a trusted third party to act as the MA, on its behalf, to provide operational support and maintain the PKI in accordance with this CP. OADR has assigned Eonti Inc. (“Eonti”) as the MA for the OADR PKI.

The MA’s primary focus is to ensure that policies for secure physical and logical access, data sharing, and communications across the OADR PKI are realized through the execution and management of the CP requirements and its participants. The MA is responsible for the following:

- The maintenance of this CP;
- The process for CAs to submit CPSs;
- The rules/process for the PA to approve CPSs;
- Ensuring that all aspects of the services, operations, and infrastructure related to Certificates issued under this CP are performed in accordance with the requirements of this CP;
- The process for recognizing Certificate Applicants, their authorized representatives, and their agreements;
- The process to approve Subscriber authorizations;
- The approval of Subscriber agreements;
- The process for revocation requests;
- The process for Compliance Audits; and
- The process for the registration of Sub-CAs.

1.3.3 Certification Authorities (CA)

At the heart of the OpenADR PKI are entities called “Certification Authorities” or “CAs.” CA is an umbrella term that refers to the collection of hardware, software, and operating personnel that create, sign, and issue Public Key Certificates to Subscribers or other CAs. OpenADR CAs fall into two categories: (1) Root CAs, which are operated by a PKI-PA designated Root CA service provider and issue Sub-CA Certificates; and (2) the Sub-CAs which are operated by PKI-PA designated CA service providers and issue OpenADR Device Certificates. Within this document, if a requirement only applies to a Root CA, it will denote Root CA and if it only applies to a Sub-CA, it will denote Sub-CA. The CAs are responsible for:

- Developing and maintaining a CPS;

- Issuing compliant Certificates;
- Delivery of Certificates to its Subscribers in accordance with the CP;
- Revocation of CA Certificates;
- Certificate Status Servers (CSS) including OCSP responder and CRL generation and distribution;
- Generation, protection, operation, and destruction of CA Private Keys;
- CA Certificate lifecycle management ensuring that all aspects of the CA services, operations, and infrastructure related to Certificates issued under this CP are performed in accordance with the requirements, representations, and warranties of this CP; and
- CAs act as trusted parties to facilitate the confirmation of the binding between a Public Key and the identity, and/or other attributes, of the "Subject" of the Certificate. In the OpenADR PKI, the Subject of a CA Certificate is the Subscriber (i.e., OpenADR) requesting the CA Certificate and the Subject of a Device Certificate is the Subscriber (i.e., Manufacturer) requesting the Device Certificate.

1.3.4 Registration Authorities (RA)

OpenADR approved Registration Authorities (RAs) are entities that enter into an agreement with a CA to collect and verify each Subscriber's identity and information to be entered into the Subscriber's Device Certificate. The RA performs its function in accordance with this CP and its approved CPS. The RA(s) is responsible for control over the Certificate Application process and:

- Performing front-end functions of confirming the identity of the Certificate Applicant;
- Approving or denying Certificate Applications;
- Onboarding Certificate Applicants to the Certificate issuance process and converting them to a Subscriber;
- Requesting Certificates on behalf of the Subscriber through an online RA account;
- Revocation of Certificates;
- Securing delivery of Public Key Certificates to Subscribers; and
- Approving or denying account renewals.

1.3.5 Subscribers

In the OpenADR PKI, the Subscriber is the organization named in the DCSA, and whose name appears as the Subject in a Device Certificate (also known as a Subscriber Certificate). An authorized representative of the Subscriber, acting as a Certificate Applicant, SHALL complete the Certificate Application process established by the RA. In response, the CA relies on the RA to confirm the identity of the Certificate Applicant and either approves or denies the application. If approved, the Subscriber can then request Certificates.

OpenADR requires that Subscribers adopt the appropriate OpenADR requirements and any additional Certificate management practices to govern the Subscriber's practice for requesting Certificates and handling the corresponding Private Keys. The Subscriber agrees to be bound by its obligations through execution of the DCSA between Subscriber and the RA, and any other applicable agreements.

CAs, technically, are also Subscribers of Certificates within a PKI, either as a Root CA issuing a self-signed Certificate to itself, or as a Sub-CA issued a Certificate by a Root CA. References to "Subscribers" in this CP, however, apply only to the organizations requesting VTN or VEN Certificates. When requirements apply to both VTN and VEN Certificates, Subscriber Certificate will be used. When a requirement applies to only one type of Certificate, the Certificate type will be called out, such as VTN server Certificate.

1.3.6 Relying Parties

The Relying Party is any entity that validates the binding of a Public Key to the Subscriber's name in an OpenADR Device Certificate. The Relying Party is responsible for deciding whether or how to check the validity of the Certificate by checking the appropriate Certificate status information. The Relying Party can use the Certificate to verify the integrity of a digitally signed message, to

identify the initiator of a communication, or to establish confidential communications with the holder of the Certificate. For instance, an OpenADR DRAS can use the Device Certificate embedded in a client device to authenticate the device requesting services from the server.

1.3.7 Other Participants

1.3.7.1 Auditors

The PKI Participants operating under this CP MAY require the services of other security authorities, such as Compliance Auditors. The CA's CPS will identify the parties responsible for providing such services, and the mechanisms used to support these services.

1.3.7.2 Interoperation with Other PKIs

The OpenADR Alliance will consider, in its sole discretion, interoperation with other PKIs on a case-by-case basis. The OpenADR Alliance is responsible for approving or rejecting any requests for such interoperation. The preferred method of interoperation with other PKIs is to incorporate trust of their Root CA Certificate. In addition, cross-certification MAY be used as long as it is with a CA with an established relationship with the OpenADR PKI-PA which includes a history of secure operations. Cross-certification MAY include issuing cross-Certificates or being issued cross-Certificates. OpenADR will consider interoperation with a hierarchy by evaluating factors that include, but are not limited to:

- The degree to which the non-OpenADR PKI provides a substantially similar function and level of assurance and trustworthiness in comparison with OpenADR PKI;
- The degree to which interoperation would enhance the value of OpenADR PKI services to Subscribers and Relying Parties;
- The ability for the interoperating PKIs to support the comprehensive set of robust lifecycle services in a seamless fashion; and
- The relative business need for such interoperation.

Any such interoperation would require the execution of an appropriate interoperation agreement, and is subject to approval by the OpenADR CA service provider.

1.4 Certificate Usage

This CP applies to all OpenADR PKI Participants, including Subscribers and Relying Parties. This CP sets forth policies governing the use of OpenADR PKI Certificates. Each Certificate is generally appropriate for use as set forth in this CP.

1.4.1 Appropriate Certificate Uses

Certificates are suitable for authentication of OpenADR service devices and confidentiality encryption. The use of the Certificates permits message integrity checks, confidentiality of communications, and support for non-repudiation. According to OADR 2.0b profile specification [OpenADR 2.0a & 2.0b], to retain the benefits of both VEN options (ECC or RSA Certificates) and for the purposes of interoperability, the VTNs MUST support both, ECC and RSA Certificates. However, if working in a closed network that only supports ECC or RSA, then the VTN can just obtain the required Certificate.

1.4.2 Prohibited Certificate Uses

OpenADR PKI Certificates are not designed, intended, or authorized for use or resale as control equipment in hazardous circumstances or for uses requiring fail-safe performance such as the operation of nuclear facilities, aircraft navigation systems, aircraft communication systems, air traffic control systems, or weapons control systems, where failure could lead directly to death, personal injury, or severe environmental damage.

1.5 Policy Administration

1.5.1 Organization Administering the Document

The OpenADR PKI-PA is responsible for all aspects of this CP.

1.5.2 Contact Person

Inquiries regarding this CP MUST be directed to the following from the OpenADR PKI-PA:

OpenADR Alliance – certification@openadr.org

1.5.3 Person Determining CPS Suitability for the Policy

The OpenADR PKI-PA SHALL approve the CPS for each CA that issues Certificates under this policy, such approval not to be unreasonably withheld.

1.5.4 CPS Approval Procedures

CAs and RAs operating under this CP are required to meet all facets of the policy. The OpenADR PKI-PA SHALL make the determination that a CPS complies with this policy. The CA and RA SHALL meet all requirements of an approved CPS before commencing operations. In some cases, the PKI-PA MAY require the additional approval of the OpenADR Alliance. The PKI-PA will make this determination based on the nature of the system function, the type of communications, or the operating environment. In each case, the determination of suitability MUST be based on a Compliance Auditor's results and recommendations.

1.6 References, Definitions and Acronyms

See CP § 10, 11 and 12.

2 Publication and Repository Responsibilities

2.1 Repositories

In the OpenADR PKI, there is no separate entity providing repository services. Rather, each CA is responsible for their repository functions. All CAs that issue Certificates under this policy SHALL post all CA Certificates and CRLs issued by the CA in a repository that is publicly accessible on the Internet.

2.2 Publication of Certification Information

The CP, CA Certificates, and CRLs MUST be made publicly available, for example, on the OpenADR Alliance website. The CPS for the Root CAs will not be published; a redacted version of the CPS will be publicly available upon request to the OpenADR PKI-PA. There is no requirement for the publication of CPSs of Sub-CAs that issue Certificates under this policy. The CA SHALL protect information not intended for public dissemination.

2.3 Time or Frequency of Publication

Changes to this CP MUST be made publicly available within thirty (30) business days of approval by the OpenADR PKI-PA. CA information MUST be published promptly after it is made available to the CA.

CA Certificates MUST be made publicly available within three (3) business days after issuance.

Publication requirements for CRLs are provided in CP § 4.9.7.

2.4 Access Controls on Repositories

The CAs SHALL implement controls to prevent unauthorized addition, deletion, or modification of repository entries.

The CPS MUST detail what information in the repository MUST be exempt from automatic availability and to whom, and under which conditions the restricted information MAY be made available.

3 Identification and Authentication

3.1 Naming

3.1.1 Types of Names

Certificates issued under this policy the CA SHALL assign X.500 DNs. The Subject field in Certificates MUST be populated with a non-empty X.500 DN as specified in CP § 7.1.4. The issuer field of Certificates MUST be populated with a non-empty X.500 DN as specified in CP § 7.1.4.

See Appendices A through I for sample Certificate profiles.

3.1.2 Need for Names to be Meaningful

Subscriber Certificates MUST contain meaningful names with commonly understood semantics permitting the determination of the identity of the organization that is the Subject of the Certificate. The RA MUST use the verified company name as the *organizationName* field in the *subjectDN* of the issued Certificate.

The Subject name in CA Certificates MUST match the issuer name in Certificates issued by the CA, as required by [RFC 5280].

3.1.3 Anonymity or Pseudonymity of Subscribers

OpenADR CAs SHALL not issue anonymous or pseudonymous Certificates.

3.1.4 Rules for Interpreting Various Name Forms

Rules for interpreting DN forms are specified in X.500.

3.1.5 Uniqueness of Names

Name uniqueness for Certificates issued by OpenADR CAs MUST be enforced. Each CA SHALL enforce name uniqueness within the X.500 name space within its domain. Name uniqueness is not violated when multiple Certificates are issued to the same Subscriber. Name uniqueness is enforced for the entire *subjectDN* of the Certificate rather than a particular attribute (e.g., the common name). The CA SHALL identify the method for checking uniqueness of *subjectDN*s within its domain.

3.1.6 Recognition, Authentication, and Role of Trademarks

CAs operating under this policy SHALL not issue a Certificate knowing that it infringes the trademark of another. Certificate Applicants SHALL not use names in their Certificate Applications that infringe upon the Intellectual Property Rights of others. Neither OpenADR, the OpenADR PKI-PA, nor any OpenADR CA SHALL be required to determine whether a Certificate Applicant has Intellectual Property Rights in the name appearing in a Certificate Application or to arbitrate, mediate, or otherwise resolve any dispute concerning the ownership of any Intellectual Property Rights, including, without limitation, rights in a domain name, trade name, trademark, or service mark, and OpenADR, the OpenADR PKI-PA, and any OpenADR CA SHALL be entitled, without liability to any Certificate Applicant, to reject or suspend any Certificate Application because of such dispute. The OpenADR PKI-PA SHALL resolve disputes involving names and trademarks.

3.2 Initial Identity Validation

This section provides the requirements for the issuance of medium assurance Certificates under this CP. The word “assurance” means how well a Relying Party can be certain of the identity binding between the Public Key and the entity whose Subject name is cited in the Certificate. In addition, it also reflects how well the Relying Party can be certain that the entity whose name is cited in the Subject of the Certificate is controlling the use of the Private Key that corresponds to the Public Key in the Certificate.

The level of assurance associated with a Public Key Certificate describes the procedures and controls involved in validating a Subscriber's identity and binding that identity to a Public Key. It is the responsibility of the Relying Party to assess that level of assurance and determine if it meets their security requirements for some particular use. The level of assurance depends on the proper generation and management of the Certificate and associated Private Keys, in accordance with the stipulations of this CP. Personnel, physical, procedural, and technical security controls contribute to the assurance level of the Certificates issued.

3.2.1 Method to Prove Possession of Private Key

If the Subscriber generates the Certificate Key Pair, then the CA or RA SHALL prove that the Subscriber possesses the Private Key by verifying the Subscriber's Digital Signature on the PKCS #10 Certificate Signing Request (CSR) with the Public Key in the CSR. The Subscriber will either submit the CSR via their online account, which will employ two-factor authentication, or they can submit the CSR to the RA for the RA to request the Certificate(s) from the CA on behalf of the Subscriber.

If Key Pair is generated by the CA on behalf of a Subscriber; then in this case proof of possession of the Private Key by the Subscriber is not required.

The OpenADR PKI-PA MAY approve other methods to prove possession of a Private Key by a Subscriber.

3.2.2 Authentication of Organization Identity

The RA's Certificate issuance process MUST authenticate the identity of the organization named in the DCSA by confirming that the organization:

- Exists in a business database (e.g., Dun and Bradstreet), or alternatively, has organizational documentation issued by, or filed with, the applicable government (e.g., government issued business credentials) that confirms the existence of the organization, such as articles of incorporation, Certificate of Formation, Charter Documents, or a business license that allow it to conduct business; and
- Conducts business at the address listed in the DCSA; and
- Is not listed on any of the following U.S. Government denied lists: US Department of Commerce' Bureau of Industry and Security Embargoed Countries List, and the US Department of Commerce' Bureau of Industry and Security Denied Entities List.

The RA MUST use the verified organization or trade name in the *organizationName* field of the Certificate as a way for Relying Parties to authenticate the organization name.

3.2.3 Authentication of Individual Identity

The RA's Certificate issuance process MUST authenticate the individual identity by verifying that the:

- Representative submitting the DCSA and Certificate Application, is a duly authorized representative of the organization as an employee, partner, member, agent, etc. and is authorized to act on behalf of the organization;
- Corporate contact listed in the DCSA is an officer in the organization and can act on behalf of the organization; and that the
- Administrator (sometimes referred to as a technical contact) listed in the DCSA and Certificate Application, is a duly authorized representative of the organization as an employee, partner, member, agent, etc. and is authorized to act on behalf of the organization.

Note: The email address of each individual listed in the DCSA MUST be controlled by the organization submitting the DCSA and cannot be a personal email address from another domain.

3.2.4 Non-verified Subscriber Information

Non-verifiable information MAY be included in OpenADR PKI Certificates, such as:

- Organization Unit (OU); or
- Any other information designated as non-verified in the Certificate.

3.2.5 Validation of Authority

The RA's Certificate issuance process MUST confirm that the:

- Corporate contact listed in the DCSA is an officer in the organization who can sign on behalf of the organization and bind the organization to the terms and conditions of the agreement;
- Representative submitting the DCSA and Certificate Application is authorized to act on behalf of the organization;
- Administrators listed on the DCSA and Certificate Application are authorized to act on behalf of the organization; and
- Contacts listed on the DCSA are authorized to act on behalf of the organization.

3.2.6 Criteria for Interoperation

The OpenADR PKI-PA SHALL determine the criteria for interoperation with the OpenADR PKI. See CP § 1.3.7.2.

3.3 Identification and Authentication for Re-key Requests

3.3.1 Identification and Authentication for Routine re-key

CA and Subscriber Certificate re-key shall follow the same procedures as initial Certificate issuance described in CP § 3.2.

3.3.2 Identification and Authentication for Re-key After Revocation

Once a Certificate has been revoked, issuance of a new Certificate is required, and the Subscriber SHALL go through the initial identity validation process per CP § 3.2.

3.4 Identification and Authentication for Revocation Request

After a Certificate has been revoked, other than during a renewal or update action, the Subscriber is required to go through the initial registration process described per CP § 3.2 to obtain a new Certificate.

Revocation requests MUST be authenticated and MAY be authenticated using that Certificate's Public Key, regardless of whether or not the associated Private Key has been Compromised.

4 Certificate Life-Cycle Operational Requirements

4.1 Certificate Application

The Certificate Application is a package consisting of the following:

- The DCSA;
- The Subscriber profile containing contact information;
- The Naming Document, which specifies the content to be bound in the Certificate; and
- Any associated fees.

A CA and RA SHALL include the processes, procedures, and requirements of their Certificate Application process in their CPS.

4.1.1 Who Can Submit a Certificate Application

An application for a CA Certificate MUST be submitted by an authorized representative of the PA.

An application for a Subscriber Certificates MUST be submitted by the Subscriber or an authorized representative of the Subscriber.

4.1.2 Enrollment Process and Responsibilities

The enrollment process, for a Certificate Applicant, MUST include the following:

- Completing the Certificate Application package;
- Providing the requested information;
- Responding to authentication requests in a timely manner; and
- Submitting required payment.

Communication of information MAY be electronic or out-of-band.

4.2 Certificate Application Processing

4.2.1 Performing Identification and Authentication Functions

The identification and authentication functions MUST meet the requirements described in CP § 3.2 and § 3.3.

4.2.2 Approval or Rejection of Certificate Applications

A RA will approve a Certificate Application if all of the following criteria are met:

- A fully executed DCSA;
- A completed and signed Naming Document;
- Successful identification and authentication of all required contact information in the Subscriber profile;
- Receipt of all requested supporting documentation; and
- Payment (if applicable) has been received.

A RA will reject a Certificate Application for any of the following:

- The Subscriber fails to execute the required DCSA;
- An authorized representative fails to sign the Certificate Application;
- Identification and authentication of all required information cannot be completed;
- The Subscriber fails to furnish requested supporting documentation;
- The Subscriber fails to respond to notices within a specified time; and
- Payment (if applicable) has not been received.

The OpenADR PKI-PA MAY approve or reject a Certificate Application.

4.2.3 Time to Process Certificate Applications

RAs SHALL begin processing Certificate Applications within a reasonable time of receipt. There is no time stipulation to complete the processing of an application unless otherwise indicated in the relevant DCSA or CPS.

4.3 Certificate Issuance

4.3.1 CA Actions During Certificate Issuance

A Certificate is created and issued by the CA following the RA's approval of a Certificate Application. Upon receiving this request, CAs SHALL:

- Authenticate the identity of the requestor;
- Verify the integrity of the information in the Certificate request;
- Generate a Certificate using the information in the CSR along with any additional Certificate profile information provided; and
- Make the Certificate available to the Subscriber directly or via the RA, through secure means.

4.3.2 Notification to Subscriber by the CA of Issuance of Certificate

CAs SHALL notify the RA or the Subscriber that they have created the requested Certificate(s), and provide the RA or Subscriber with access to the Certificates by notifying them that their Certificates are available and the means for obtaining them. Verified contact information for the Subscriber, received during the initial enrollment process, will be used to share the issued Certificates.

4.4 Certificate Acceptance

Before a Subscriber can make effective use of its Private Key, a PKI-PA SHALL explain to the Subscriber its responsibilities as defined in CP § 9.6.3.

The CA SHALL obtain acceptance from the RA after Certificates are downloaded by the RA. The RA SHALL obtain acceptance from the Subscriber after Certificates are delivered to the Subscriber. Requested Certificates SHALL be valid immediately after issuance. The Subscribers SHALL check the Certificate and notify the RA if they detect any problems. The Certificates are considered accepted thirty (30) days after the Certificate's issuance.

4.4.1 Conduct Constituting Certificate Acceptance

The following conduct constitutes Certificate acceptance by the Subscriber:

- Downloading a Certificate;
- Installing a Certificate into a device; or
- Failure to object timely to the Certificate or its content.

4.4.2 Publication of the Certificate by the CA

CA Certificates MUST be published in a publicly available repository as specified in CP § 2.1.

This policy makes no stipulation regarding publication of Subscriber Certificates.

4.4.3 Notification of Certificate Issuance by the CA to Other Entities

CAs operating under this CP SHALL notify, through the RA, the OpenADR PKI-PA and MA, whenever a CA Certificate is issued.

RAs MAY receive notification of the issuance of Certificates they approve.

4.5 Key Pair and Certificate Usage

4.5.1 Subscriber Private Key and Certificate Usage

Subscriber Private Key usage MUST be specified through Certificate extensions, including the *keyUsage* and *extendedKeyUsage* extensions, in the associated Certificate. Per the DCSA, Subscribers SHALL protect their Private Keys from unauthorized use and SHALL discontinue use of the Private Key following expiration or revocation of the Certificate.

Certificate use MUST be consistent with the *keyUsage* field extensions included in the Certificate (see § 6.1.7).

4.5.2 Relying Party Public Key and Certificate Usage

Relying Parties SHOULD assess:

- The appropriateness of the use of a Certificate for any given purpose and determine that the Certificate will, in fact, be used for an appropriate purpose that is not prohibited or otherwise restricted by § 1.4;
- The restrictions on key and Certificate usage specified in this CP and which are specified in critical Certificate extensions, including the *basicConstraints* and *keyUsage* extensions; and
- The status of the Certificate and all the CA Certificates in the Certificate Chain. If any of the Certificates in the Certificate Chain have been revoked, the Relying Party is solely responsible to determine whether reliance on a Certificate prior to revocation of a Certificate in the Certificate Chain is reasonable. Any such reliance is made solely at the risk of the Relying Party.

4.6 Certificate Renewal

Certificate renewal is the issuance of a new Certificate for an existing Key Pair without changing any information in the Certificate except the Validity Period and serial number.

4.6.1 Circumstance for Certificate Renewal

Certificate renewal is supported for Certificates where the Private Key associated with the Certificate has not been Compromised. Certificates MAY be renewed to maintain continuity of Certificate usage. Subscribers SHOULD re-key at renewal.

A Certificate MAY be renewed after expiration. The original Certificate MAY or MAY NOT be revoked, but MUST NOT be further re-keyed, renewed, or modified.

4.6.2 Who may Request Renewal

The Subscriber of the Certificate or an authorized representative of the Subscriber MAY request a Certificate renewal.

4.6.3 Processing Certificate Renewal Requests

For a Certificate renewal request, the CA SHALL confirm the identity of the Subscriber in accordance with the requirements specified in CP § 3.2.

4.6.4 Notification of New Certificate Issuance to Subscriber

Notification of issuance of Certificate renewal to the Subscriber MUST be in accordance with CP § 4.3.2.

4.6.5 Conduct Constituting Acceptance of a Renewal Certificate

Conduct constituting Acceptance of a renewed Certificate MUST be in accordance with CP § 4.4.1.

4.6.6 Publication of the Renewal Certificate by the CA

Publication of a renewed Certificate MUST be in accordance with CP § 4.4.2.

4.6.7 Notification of Certificate Issuance by the CA to Other Entities

Notification of the issuance of Certificates MUST be in accordance with CP § 4.4.3.

4.7 Certificate Re-key

Certificate re-key consists of creating a new Certificate for a different Key Pair (and serial number) but can retain the contents of the original Certificate's *subjectName*. Certificate re-key does not violate the requirement for name uniqueness. The new Certificate MAY be assigned a different Validity Period, key identifiers, and/or be signed with a different key.

4.7.1 Circumstance for Certificate Re-key

Re-key of a Certificate MUST include a new Public Key. Re-keys SHALL NOT be processed if the Public Key is the same as the original. Subscribers SHOULD re-key at renewal. Certificates MAY be re-keyed:

- To maintain continuity of Certificate usage;
- For loss or Compromise of original Certificate's Private Key; and
- By a CA during recovery from key Compromise.

A Certificate MAY be re-keyed after expiration. The original Certificate MAY or MAY NOT be revoked, but MUST NOT be further re-keyed, renewed, or modified.

4.7.2 Who May Request Certification of a New Public Key

The following MAY request a Certificate re-key:

- The Subscriber of the Certificate or an authorized representative of the Subscriber;
- The CA MAY request a re-key of its own Certificate;
- The CA MAY re-key its issued Certificates during recovery from a CA key Compromise; or
- The OpenADR PKI-PA MAY request re-key of CA Certificates.

4.7.3 Processing Certificate Re-keying Requests

For Certificate re-key, the RA SHALL confirm the identity of the Subscriber in accordance with the requirements specified in this CP § 3.2 for the authentication of an original Certificate Application.

CA Certificate re-key MUST be approved by the OpenADR PKI-PA.

4.7.4 Notification of New Certificate Issuance to Subscriber

Notification of issuance of a re-keyed Certificate to the Subscriber MUST be in accordance with CP § 4.3.2.

4.7.5 Conduct Constituting Acceptance of a Re-keyed Certificate

Conduct constituting acceptance of a re-keyed Certificate MUST be in accordance with CP § 4.4.1.

4.7.6 Publication of the Re-keyed Certificate by the CA

Publication of a re-keyed Certificate MUST be in accordance with CP § 4.4.2.

4.7.7 Notification of Certificate Issuance by the CA to Other Entities

Notification of the issuance of Certificates MUST be in accordance with CP § 4.4.3.

4.8 Certificate Modification

Modifying a Certificate means creating a new Certificate that contains a different serial number and that differs in one or more other fields from the original Certificate. All requests for Certificate modification SHALL be treated as new Certificate Applications.

4.8.1 Circumstance for Certificate Modification

The RA MAY accept Certificate modification:

- For a Subscriber organization name change or other Subscriber characteristic change;
- To extend the Validity Period to maintain continuity of Certificate usage; or
- By a CA during recovery from key Compromise.

A Certificate MAY be modified after expiration.

The original Certificate MAY or MAY NOT be revoked, but MUST NOT be further re-keyed, renewed, or modified. If not revoked, the CA will flag the Certificate as inactive in its database but will not publish the Certificate on a CRL.

4.8.2 Who May Request Certificate Modification

The following MAY request a Certificate modification:

- The Subscriber of the Certificate or an authorized representative of the Subscriber;
- The CA MAY request a Certificate modification of its own Certificate;
- The CA MAY modify its issued Certificates during recovery from a CA key Compromise; or
- The OpenADR PKI-PA MAY request modification of CA Certificates.

4.8.3 Processing Certificate Modification Requests

For Certificate modification requests, the RA SHALL confirm the identity of the Subscriber in accordance with the requirements specified in this CP § 3.2 for the authentication of an initial Certificate Application.

CA Certificate modification MUST be approved by the OpenADR PKI-PA.

4.8.4 Notification of New Certificate Issuance to Subscriber

Notification of issuance of a new Certificate to the Subscriber MUST be in accordance with CP § 4.3.2.

4.8.5 Conduct Constituting Acceptance of Modified Certificate

Conduct constituting Acceptance of a modified Certificate MUST be in accordance with CP § 4.4.1.

4.8.6 Publication of the Modified Certificate by the CA

Publication of a modified Certificate MUST be in accordance with CP § 4.4.2.

4.8.7 Notification of Certificate Issuance by the CA to Other Entities

Notification of the issuance of Certificates MUST be in accordance with CP § 4.4.3.

4.9 Subscriber Certificate Revocation and Suspension

Revocation of a Certificate permanently ends the operational period of the Certificate prior to the Certificate reaching the end of its stated Validity Period.

CAs SHALL issue CRLs covering all unexpired Certificates issued under this CP, except for OCSP responder Certificates that include the *id-pkix-ocsp-nocheck* extension.

Access to the CAs CRL SHALL make available in the *cRLDistributionPoints* extension of all Device Certificates.

The RA SHALL validate any Revocation requests subject to the requirements in § 3.4 The RA MAY authenticate requests to Revoke a Certificate using that Certificate's associated Public Key, regardless of whether the Private Key has been Compromised.

4.9.1 Circumstances for Revocation

Prior to revoking a Certificate, the RA SHALL verify the authenticity of the revocation request. Subscriber Certificates can be revoked under the following circumstances:

- The Subscriber, or an authorized representative of the Subscriber, asks for the Certificate to be revoked for any reason whatsoever;
- The Subscriber's Private Key corresponding to the Public Key in the Certificate has been lost or Compromised;
- The Subscriber can be shown to have violated the stipulations of its Subscriber agreement;
- The DCSA with the Subscriber has been terminated;
- There is an improper or faulty issuance of a Certificate;
- A prerequisite to the issuance of the Certificate can be shown to be incorrect;
  - information in the Certificate is known, or reasonably believed, to be false;
  - any other circumstance that may reasonably be expected to affect the reliability, security, integrity or trustworthiness of the Certificate or the cryptographic Key Pair associated with the Certificate; or
  - the Subscriber has not submitted payment when due.
- Identifying information of the Subscriber in the Certificate becomes invalid;
- Attributes asserted in the Subscriber's Certificate are incorrect;
- The Certificate was issued:
  - in a manner not in accordance with the procedures required by the applicable CPS;
  - to an organization other than the one named as the Subject of the Certificate; or
  - without the authorization of the organization named as the Subject of such Certificate.
- The Subscriber's organization name changes;
- The CA suspects or determines that any of the information appearing in the Certificate is inaccurate or misleading;
- The continued use of that Certificate is harmful to OpenADR or the CA;
- The CA finds that in the ordinary course of business that the Certificate SHOULD be revoked; or
- In exigent and/or emergency situations.

Whenever any of the above circumstances occur, the associated Certificate MUST be revoked and placed on the CRL. Revoked Certificates MUST be included on all new publications of the Certificate status information until the Certificates expire.

4.9.2 Who can Request Revocation

Within the OpenADR PKI, revocation requests MAY be made by:

- The Subscriber of the Certificate or any authorized representative of the Subscriber;
- The CA, or affiliated RA, for Certificates within its domain; or
- The OpenADR PKI-PA.

4.9.3 Procedure for Revocation Request

A request to revoke a Certificate MUST identify the date of the request, the Certificate to be revoked, the reason for revocation, and allow the requestor to be authenticated. The CA SHALL specify the steps involved in the process of requesting a Certificate revocation in their CPS.

Prior to the revocation of a Subscriber Certificate, the RA SHALL authenticate the request. Acceptable procedures for authenticating revocation requests include:

- Having the Subscriber log in to their account using two-factor authentication and revoking their Certificates via their account portal; or
- Having the RA, after confirming that the representative requesting the revocation is an authenticated individual as described in CP § 3.2.3, log into the RA account using two-factor authentication, to request the revocation.

CAs are entitled to request the revocation of Subscriber Certificates within the CA's Subdomain. CAs SHALL obtain approval from the OpenADR PKI-PA prior to performing the revocation functions except for revocations pursuant to CP § 4.9.1. The CA SHALL send a written notice and brief explanation for the revocation to the Subscriber. Notwithstanding anything to the contrary in this CP, CAs are authorized to take any action they deem necessary, under the circumstances and without liability to any party, to protect the security and integrity of the CA and/or the OpenADR PKI.

The requests from CAs to revoke a CA Certificate MUST be authenticated by the OpenADR PKI-PA.

Upon revocation of a Certificate, the CA that issued the Certificate SHALL publish notice of such revocation in the CA's repository or issue it upon request from the OpenADR PKI-PA.

4.9.4 Revocation Request Grace Period

Revocation requests SHOULD be submitted as promptly as possible within a reasonable time of becoming aware of a revocation circumstance listed in CP § 4.9.1.

4.9.5 Time Within Which CA Must Process the Revocation Request

CAs SHALL begin investigation of a Certificate revocation request within five (5) business days of receipt to decide whether revocation or other appropriate action is warranted based upon the circumstances of the request in CP § 4.9.1.

4.9.6 Revocation Checking Requirement for Relying Parties

Relying Parties SHOULD check the status of Certificates on which they wish to rely on by checking the Certificate status:

- On the most recent CRL from the CA that issued the Certificate;
- On the applicable web-based repository; or
- By using an OCSP responder (if available).

To check the revocation status of Certificates issued by the CA, CAs SHALL provide Relying Parties with information within the Certificate *cRLDistributionPoint* extension on how to find the appropriate CRL or via the *authorityInformationAccess* extension on how to access the OCSP responder (if available).

CA Certificate status MUST be posted by the OpenADR PKI-PA in a CRL or web-based repository.

4.9.7 CRL Issuance Frequency

CRLs MUST be issued periodically, even if there are no changes to be made, to ensure timeliness of information. Certificate status information MAY be issued more frequently than the issuance frequency described below.

OpenADR CAs SHALL update and reissue CRLs at least (i) once every twelve (12) months and (ii) within twenty-four (24) hours after revoking a Certificate, with the value of the *nextUpdate* field not more than twelve (12) months beyond the value of the *thisUpdate* field.

4.9.8 Maximum Latency for CRLs

CRLs SHOULD be published immediately and MUST be published within twenty-four (24) hours of generation.

4.9.9 On-line Revocation/Status Checking Availability

CAs SHALL have a web-based repository that permits Relying Parties to make online inquiries regarding revocation and other Certificate status information. CAs SHALL provide Relying Parties with information on how to find the appropriate repository to check Certificate status and how to find the correct OCSP responder (if available).

4.9.10 On-line Revocation Checking Requirements

A Relying Party SHOULD check the status of a Certificate on which they wish to rely on. If a Relying Party does not check the status of a Certificate by consulting the most recent CRL, the Relying Party SHOULD check the Certificate status by consulting the applicable on-line repository or by requesting Certificate status using the applicable OCSP responder (where available). If the Relying Party does not check the status of the Certificates as described in this paragraph or the CPS, the Relying Party is estopped from asserting any claim against the CA related to or arising out of the Relying Party's reliance on the Certificate.

4.9.11 Other Forms of Revocation Advertisements Available

A CA MAY also use other methods to publicize the Certificates it has revoked. Any alternative method MUST meet the following requirements:

- The alternative method MUST be described in the CA's CPS; and
- The alternative method MUST meet the issuance and latency requirements for CRLs stated in CP § 4.9.7 and § 4.9.8.

4.9.12 Special Requirements Regarding Key Compromise

When a CA Certificate is revoked a CRL MUST be issued within twenty-four (24) hours of notification. The OpenADR PKI-PA SHALL notify OpenADR PKI Participants of a CA Certificate revocation using commercially reasonable efforts.

4.9.13 Circumstances for Suspension

The OpenADR PKI does not offer suspension services for its Certificates.

4.9.14 Who can Request Suspension

No stipulation.

4.9.15 Procedure for Suspension Request

No stipulation.

4.9.16 Limits on Suspension Period

No stipulation.

4.10 Certificate Status Services

4.10.1 Operational Characteristics

Certificate status MUST be available via CRL through a URL specified in a CA's CPS, and MAY be available via a Lightweight Directory Access Protocol (LDAP) directory or OCSP responder.

4.10.2 Service Availability

Certificate status services MUST be available twenty-four (24) hours a day and seven (7) days per week. CRL and OCSP capability SHOULD provide a response time of ten (10) seconds or less under normal operating conditions.

4.10.3 Optional Features

OCSP is an optional Certificate status feature that is not available for all products and MUST be specifically enabled for other products.

4.11 End of Subscription

End of subscription MUST be stipulated in the DCSA.

4.12 Key Escrow and Recovery

4.12.1 Key Escrow and Recovery Policy and Practices

No stipulation.

4.12.2 Session Key Encapsulation and Recovery Policy and Practices

No stipulation.

5 Facility, Management, and Operational Controls

All entities performing CA functions SHALL implement and enforce the following physical, procedural, logical, and personnel security controls for a CA.

5.1 Physical Controls

CA equipment MUST be protected from unauthorized access while the Cryptographic Module is installed and activated. The CA SHALL implement physical access controls to reduce the risk of equipment tampering even when the Cryptographic Module is not installed and activated. CA cryptographic tokens MUST be protected against theft, loss, and unauthorized use.

All the physical control requirements specified below apply equally to the Root CA and Sub-CAs, and any remote workstations used to administer the CAs except where specifically noted.

5.1.1 Site Location and Construction

All CA operations MUST be conducted within a physically protected environment that deters, prevents, and detects unauthorized use of, access to, or disclosure of sensitive information and systems. The location and construction of the facility housing the CA equipment, as well as sites housing remote workstations used to administer the CAs, MUST be consistent with facilities used to house high-value, sensitive information. The site location and construction, when combined with other physical security protection mechanisms such as guards, high security locks, and intrusion sensors, MUST provide robust protection against unauthorized access to the CA equipment and records.

Such requirements are based in part on the establishment of physical security tiers. A tier is a barrier such as a locked door, a closed gate, or an alarm system that provides mandatory access control for individuals and requires a positive response (e.g., door unlocks, gate opens, or alarm system is disarmed) for each individual to proceed to the next area. Each successive tier provides more restricted access and greater physical security against intrusion or unauthorized access. Moreover, each physical security tier encapsulates the next inner tier, such that an inner tier MUST be fully contained in an outside tier and cannot have a common outside wall with the outside tier, the outermost tier being the outside barrier of the building (e.g., a perimeter fence or outside wall).

CAs SHALL construct the facilities housing their CA functions with at least four (4) physical security tiers. CAs SHALL perform all validation operations within Tier 2 or higher. CAs SHALL place Information Services systems necessary to support CA functions in Tier 3 or higher. Online and offline Cryptographic Modules MUST be placed in Tier 4 or higher when not in use.

CAs SHALL describe their Site Location and Construction in more detail in their CPS.

5.1.2 Physical Access

Access to each tier of physical security, constructed in accordance with CP § 5.1.1, MUST be auditable and controlled so that only authorized personnel can access each tier.

CAs SHALL control access to their CA facilities including:

- Minimizing exposure of privileged functions through definition of function-specific roles or authorization groups;
- Access control enforcement of these roles or groups;
- Use of proximity card identification badges;
- Logging of access into and out of the facility;
- The use of tamper resistant physical intrusion alarm systems to detect break-ins or unauthorized access to physical security tiers within the facility;
- Automated notification to outside alarm monitoring agency of a potential security breach when facility-based guards are not present; and
- Video surveillance [optional].

Although not required, the use of biometric readers (e.g., hand geometry or iris scan) that provide two-factor authentication is recommended.

At a minimum, the physical access controls for CA equipment, as well as remote workstations used to administer the CAs, MUST:

- Ensure that no unauthorized access to the hardware is permitted;
- Ensure that all removable media and paper containing sensitive plain-text information is stored in secure containers;
- Be manually or electronically monitored for unauthorized intrusion at all times;
- Ensure an access log is maintained and inspected periodically; and
- Require two-person physical access control to both the Cryptographic Module and computer systems.

When not in use, removable Cryptographic Modules, activation information used to access or enable Cryptographic Modules MUST be placed in secure containers. Activation data MUST be either memorized or recorded and stored in a manner commensurate with the security afforded the Cryptographic Module, and MUST NOT be stored with the Cryptographic Module or removable hardware associated with remote workstations used to administer the CA.

A security check of the facility housing the CA equipment or remote workstations used to administer the CAs MUST occur if the facility is to be left unattended. At a minimum, the check MUST verify the following:

- The equipment is in a state appropriate to the current mode of operation (e.g., that Cryptographic Modules are in place when ”open”, and secured when ”closed”, and for the CA, that all equipment other than the repository is shut down);
- Any security containers are properly secured;
- Physical security systems (e.g., door locks, vent covers) are functioning properly; and
- The area is secured against unauthorized access.

A person or group of persons SHALL be made explicitly responsible for making such checks. When a group of persons is responsible, a log identifying the person performing a check at each instance MUST be maintained. If the facility is not continuously attended, the last person to depart SHALL initial a sign-out sheet that indicates the date and time and asserts that all necessary physical protection mechanisms are in place and activated.

5.1.3 Power and Air Conditioning

CA facilities MUST be equipped with primary and backup power systems to ensure continuous, uninterrupted access to electric power. Also, these facilities MUST be equipped with primary and backup heating/ventilation/air conditioning systems to control temperature and relative humidity.

The CA SHALL have backup 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

CA facilities MUST be constructed, equipped and installed, and procedures MUST be implemented, to prevent floods or other damaging exposure to water. Potential water damage from fire prevention and protection measures (e.g., sprinkler systems) are excluded from this requirement.

5.1.5 Fire Prevention and Protection

CA facilities MUST be constructed and equipped, and procedures MUST be implemented, to prevent and extinguish fires or other damaging exposure to flame or smoke. These measures MUST meet all local applicable safety regulations.

5.1.6 Media Storage

CAs SHALL protect the media holding back ups of critical system data or any other sensitive information from water, fire, or other environmental hazards, and SHALL use protective measures to deter, detect, and prevent the unauthorized use of, access to, or disclosure of such media.

5.1.7 Waste Disposal

CAs SHALL implement procedures for the disposal of waste (paper, media, or any other waste) to prevent the unauthorized use of, access to, or disclosure of waste containing confidential/private information.

CA media and documentation that are no longer needed for operations MUST be destroyed in a secure manner. For example, paper documentation MUST be shredded, burned, or otherwise rendered unrecoverable.

5.1.8 Off-site Backup

CAs SHALL maintain backups of critical system data or any other sensitive information, including audit data, in a secure off-site facility. Full system backups sufficient to recover from system failure MUST be made on a periodic schedule, and described in a CA's CPS. Backups are to be performed and stored off-site not less than once per week. At least one full backup copy MUST be stored at an off-site location (separate from CA equipment). Only the latest full backup need be retained. The backup MUST be stored at a site with physical and procedural controls commensurate to that of the operational CA. An active/active infrastructure, whereby data are synchronized between two sites and one site alone is capable of hosting the OpenADR PKI in the event of a disaster at the other site, will meet the requirements of off-site backup.

Requirements for CA Private Key backup are specified in CP § 6.2.4.

5.2 Procedural Controls

Procedural controls are requirements on roles that perform functions that can introduce security problems if not carried out properly, whether accidentally or maliciously. The people selected to fill these roles SHALL be extraordinarily responsible, or the integrity of the CA will be weakened. The functions performed in these roles form the basis of trust for the entire PKI. Two approaches are taken to increase the likelihood that these roles can be successfully carried out. The first ensures that the person filling the role is trustworthy and properly trained. The second distributes the functions among more than one person, so that any malicious activity would require collusion.

5.2.1 Trusted Roles

Employees, contractors, and consultants that are designated to manage the CA's trustworthiness SHALL be considered to be "Trusted Persons" serving in "Trusted Roles." Persons seeking to become Trusted Persons SHALL meet the screening requirements of CP § 5.3.

CAs SHALL consider the categories of their personnel identified in this section as Trusted Persons having a Trusted Role. Trusted Persons include all employees, contractors, and consultants that have access to or control authentication or cryptographic operations that may materially affect:

- The validation of information in Certificate Applications;
- The acceptance, rejection, or other processing of Certificate Applications, revocation requests, or renewal requests, or enrollment information;
- The issuance, or revocation of Certificates, including (in the case of Processing Centers) personnel having access to restricted portions of its repository; and
- The handling of Subscriber information or requests.

Trusted Persons include, but are not limited to, customer service personnel, CA system administrators, designated engineering personnel, CA operators, auditors, and executives that are designated to manage infrastructural trustworthiness.

5.2.2 Number of Persons Required per Task

Multiparty control procedures are designed to ensure that at a minimum, two (2) Trusted Persons are required to have either physical or logical access to the CA. Access to CA cryptographic hardware MUST be strictly enforced by multiple Trusted Persons throughout its lifecycle, from incoming receipt and inspection to final logical and/or physical destruction. Once a CA device is activated with operational keys, further access controls MUST be invoked to maintain split control over both physical and logical access to the device. Persons with physical access to CA modules do not hold “Secret Shares” to activate the CA and vice versa.

Two (2) or more persons are required for the following tasks:

- Access to CA hardware;
- Management of CA cryptographic hardware;
- CA key generation;
- CA signing key activation; and
- CA Private Key backup.

Where multiparty control is required, at least one of the participants SHALL be an administrator. All participants SHALL serve in a Trusted Role as defined in CP § 5.2.1. Multiparty control MUST NOT be achieved using personnel that serve in the Auditor Trusted Role. CAs SHALL establish, maintain, and enforce rigorous control procedures to ensure the segregation of duties based on job responsibility and to ensure that multiple Trusted Persons are required to perform sensitive tasks.

Other manual operations such as the validation and issuance of Certificates, not issued by an automated validation and issuance system, require the participation of at least two (2) Trusted Persons, or a combination of at least one Trusted Person and an automated validation and issuance process. Manual operations for Key Recovery MAY optionally require the validation of two (2) authorized administrators.

5.2.3 Identification and Authentication for Each Role

CAs SHALL confirm the identity and authorization of all personnel seeking to become Trusted Persons before such personnel are:

- Issued access devices and granted access to the required facilities; and
- Given electronic credentials to access and perform specific functions on CA systems.

Authentication of identity MUST include the personal (physical) presence of such personnel before Trusted Persons performing Human Resources (HR) or security functions within an entity and a check of well-recognized forms of identification, such as passports and driver’s licenses. Identity MUST be further confirmed through background checking procedures in CP § 5.3.

5.2.4 Roles Requiring Separation of Duties

Roles requiring separation of duties include (but are not limited to) the:

- Validation of information in Certificate Applications;
- Acceptance, rejection, or other processing of Certificate Applications, revocation requests, key recovery requests or renewal requests, or enrollment information;
- Issuance, or revocation of Certificates, including personnel having access to restricted portions of the repository;
- handling of Subscriber information or request;
- generation or destruction of a CA Certificate; or
- Loading of a CA to a production environment.

No individual SHALL have more than one (1) Trusted Role. The CA SHALL have in place a procedure to identify and authenticate its users and SHALL ensure that no user identity can assume multiple roles.

5.3 Personnel Controls

5.3.1 Qualifications, Experience, and Clearance Requirements

CAs SHALL require that personnel assigned to Trusted Roles have the requisite background, qualifications, and experience or are provided the training needed to perform their prospective job responsibilities competently and satisfactorily. The requirements governing the qualifications, selection and oversight of individuals who operate, manage, oversee, and audit the CA MUST be set forth in the CPS.

5.3.2 Background Check Procedures

CAs SHALL conduct background check procedures for personnel tasked become Trusted Persons. These procedures MUST be subject to any limitations on background checks imposed by local law. To the extent one of the requirements imposed by this section cannot be met due to a prohibition or limitation in local law, the investigating entity SHALL utilize a substitute investigative technique permitted by law that provides substantially similar information, including but not limited to obtaining a background check performed by an applicable agency. Background investigations MAY include a:

- Confirmation of previous employment;
- Check of one or more 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; and
- Search of driver's license records.

Factors revealed in a background check that MAY be considered grounds for rejecting candidates for Trusted Roles or for taking action against an existing Trusted Person (all subject to and in accordance with applicable law) MAY include, but is not limited to, the following:

- Misrepresentations made by the candidate or Trusted Person;
- Highly unfavorable or unreliable personal references;
- Certain criminal convictions; and
- Indications of a lack of financial responsibility.

Background checks MUST be repeated for personnel holding Trusted Roles at least every five (5) years.

5.3.3 Training Requirements

CAs SHALL provide their personnel with the requisite on-the-job training needed for their personnel to perform their job responsibilities relating to CA operations competently and satisfactorily. The CA SHALL also periodically review their training programs, and their training MUST address the elements relevant to functions performed by their personnel.

Training programs MUST address the elements relevant to the particular environment of the person being trained, including, without limitation:

- Security principles and mechanisms of the CA and the its environment;
- Hardware and software versions in use;
- All duties the person is expected to perform;
- Incident and Compromise reporting and handling;
- Disaster recovery and business continuity procedures; and
- The stipulations of this policy.

5.3.4 Retraining Frequency and Requirements

CAs SHALL provide refresher training and updates to their personnel to the extent and frequency required to ensure that such personnel maintain the required level of proficiency to perform their job responsibilities competently and satisfactorily.

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

Documentation MUST 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

CAs SHALL establish, maintain, and enforce policies for the discipline of personnel following unauthorized actions. Disciplinary actions MAY include measures up to and including termination and MUST be commensurate with the frequency and severity of the unauthorized actions.

5.3.7 Independent Contractor Requirements

CAs SHALL permit independent contractors or consultants to become Trusted Persons only to the extent necessary to accommodate clearly defined outsourcing relationships. CAs SHOULD only use contractors or consultants as Trusted Persons if the CA does not have suitable employees available to fill the roles of Trusted Persons. Otherwise, independent contractors and consultants SHALL be escorted and directly supervised by Trusted Persons when they are given access to the CA and its secure facility.

Contractors fulfilling Trusted Roles are subject to all personnel requirements stipulated in this policy and SHALL establish procedures to ensure that any subcontractors perform in accordance with this policy.

5.3.8 Documentation Supplied to Personnel

CAs SHALL give their personnel the requisite training and documentation needed to perform their job responsibilities competently and satisfactorily.

5.4 Audit Logging Procedures

Audit log files MUST be generated for all events relating to the security of the CA. Where possible, the audit logs MUST be automatically collected. Where this is not possible, a logbook, paper form, or other physical mechanism MUST be used. All CA audit logs, both electronic and non-electronic, MUST be retained and made available during Compliance Audits.

5.4.1 Types of Events Recorded

All auditing capabilities of the CA operating system and applications MUST be enabled during installation. All audit logs, whether recorded automatically or manually, MUST contain the date and time, the type of event, and the identity of the entity that caused the event.

CAs SHALL record in audit log files all events relating to the security of the CA system, including, without limitation:

Table 2: Auditable Events Recorded

Auditable Event	CA	RA
Physical Access to CA Facility:		
Personnel Access to room housing CA	X	
Access to the CA server	X	
Known or suspected violations of physical security	X	
Any removal or addition of equipment to the CA enclosure	X	
CA System Configuration:		

Auditable Event	CA	RA
Installation of the operating system	X	
Installation of the CA software	X	
Installation and removal of hardware Cryptographic Modules	X	
Any security-relevant changes to the configuration of the CA	X	
CA hardware configuration	X	
System configuration changes and maintenance	X	
Cryptographic Module life cycle management-related events (e.g., receipt, use, de-installation, and retirement)	X	
Account Administration:		
Roles and users are added or deleted	X	
Access control privileges of a user account or a role are modified	X	
Appointment of an individual to a Trusted Role	X	
Designation of personnel for multi-person control	X	
System administrator accounts	X	
Attempts to delete or modify Audit logs	X	
Changes to the value of maximum Authentication attempts	X	
Resetting operating system clock	X	
CA Operational Events:		
Key generation	X	
Start-up and shutdown of CA systems and applications	X	
Changes to CA details or keys	X	
Records of the destruction of media containing key material, activation data, or personal Subscriber information	X	
Successful and unsuccessful attempts to log into the CA system	X	
The value of maximum Authentication attempts is changed	X	
Maximum unsuccessful Authentication attempts occur during user login	X	
A CA Administrator unlocks an account that has been locked as a result of unsuccessful Authentication attempts	X	
End-Entity Certificate Life Cycle Events:		
Certificate Application requests		X
Certificate requests	X	X
Issuance	X	
Re-Key	X	
Renewal	X	
Certificate Revocation requests	X	X
Revocation	X	
Trusted Person Events:		
Logon and logoff to the CA system	X	
Attempts to create, remove, set passwords or change the system privileges of the privileged users	X	
Unauthorized attempts to access the CA system	X	
Unauthorized attempts to access system files	X	
Failed read and write operations on the Certificate	X	
Personnel changes	X	

5.4.2 Frequency of Processing Log

CAs SHALL review their audit logs in response to alerts based on irregularities and incidents within their CA systems. Review of the audit log MUST be required at least once every three (3) months. CAs SHALL compare their audit logs with supporting manual and electronic logs when any action is deemed suspicious.

Audit log processing MUST consist of a review of the audit logs and documenting the reason for all significant events in an audit log summary. Audit log reviews MUST include a verification that the log has not been tampered with, a brief inspection of all log entries, and a more thorough investigation of any alerts or irregularities in the logs. Actions taken based on audit log reviews MUST be documented.

5.4.3 Retention Period for Audit Log

Audit logs MUST be retained onsite at least two (2) months after processing and thereafter archived in accordance with CP § 5.5. The individual who removes audit logs from the CA system SHALL be different from the individuals who, in combination, command the CA signature key.

5.4.4 Protection of Audit Log

Audit logs MUST be protected from unauthorized viewing, modification, deletion, or other tampering. CA system configuration and procedures MUST be implemented together to ensure that only authorized people archive or delete security audit data. Procedures MUST 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

Incremental backups of audit logs MUST be created frequently, at least monthly.

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 MUST be invoked at system or application startup and cease only at system or application shutdown. Audit collection systems MUST 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, and the integrity of the system or confidentiality of the information protected by the system is at risk, operations MUST be suspended until the problem has been remedied.

5.4.7 Notification to Event-Causing Subject

Where an event is logged by the audit collection system, no notice is required to be given to the individual, organization, device, or application that caused the event.

5.4.8 Vulnerability Assessments

The CA SHALL perform routine self-assessments of security controls for vulnerabilities. Events in the audit process are logged, in part, to monitor system vulnerabilities. The assessments MUST be performed following an examination of these monitored events. The assessments MUST be based on real-time automated logging data and MUST be performed at least on an annual basis as input into an entity's annual Compliance Audit.

The audit data SHOULD be reviewed by the security auditor for events such as repeated failed actions, requests for privileged information, attempted access of system files, and unauthenticated responses. Security auditors SHOULD check for continuity of the audit data.

5.5 Records Archival

CA archive records MUST 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. Records MAY

be kept in the form of either computer-based messages or paper-based documents, provided their indexing, storage, preservation, and reproduction are accurate, reliable, and complete.

5.5.1 Types of Records Archived

OpenADR CA records MUST include all relevant evidence in the recording entity's possession, including, without limitation:

- Time stamps
- Certificate Policy (CP)
- Certification Practice Statement (CPS)
- Contractual obligations and other agreements concerning operations of the CA System and equipment configuration
- Modifications and updates to system or configuration
- Certificate request documentation
- Records of all actions taken on Certificates issued and/or published
- Record of re-key
- Revocation request information
- Records of all CRLs issued and/or published
- Compliance Auditor reports
- Appointment of an individual to a Trusted Role
- Destruction of Cryptographic Modules
- All Certificate Compromise notifications

OpenADR PKI-PA and RA records MUST include all relevant evidence in the recording entity's possession, including, without limitation:

- Executed DCSAs
- All CRLs issued and/or published
- Compliance Auditor reports
- Destruction of Cryptographic Modules
- All Certificate Compromise notifications

5.5.2 Retention Period for Archive

Archive records MUST be kept for a minimum of ten (10) years without any loss of data.

5.5.3 Protection of Archive

An entity maintaining an archive of records SHALL protect the archive so that only the entity's authorized Trusted Persons are able to obtain access to the archive. The archive MUST be protected against unauthorized viewing, modification, deletion, or other tampering. The archive media and the applications required to process the archive data MUST be maintained to ensure that the archive data can be accessed for the time period set forth in CP § 5.5.2.

5.5.4 Archive Backup Procedures

Entities compiling electronic information SHALL incrementally back up system archives of such information on a daily basis and perform full backups on a weekly basis. Copies of paper-based records MUST be maintained in an off-site secure facility.

5.5.5 Requirements for Time-Stamping of Records

CA archive records MUST be automatically time-stamped as they are created. System clocks used for time-stamping MUST be maintained in synchrony with an authoritative time standard.

5.5.6 Archive Collection System (Internal or External)

Archive data MAY be collected in any expedient manner.

5.5.7 Procedures to Obtain and Verify Archive Information

Only authorized Trusted Personnel are able to obtain access to the archive. The integrity of the information is verified as usable when it is restored.

5.6 Key Changeover

To minimize risk from Compromise of a CA's Private Key, that key MAY be changed often. From that time on, the CA will only use the new key will to sign Certificates. If the old Private Key is used to sign OCSP responder Certificates or CRLs that cover Certificates signed with that key, the old key MUST be retained and protected.

A CA Certificate MAY be renewed if the CA's Superior Entity reconfirms the identity of the CA. Following such reconfirmation, the Superior Entity SHALL either approve or reject the renewal application.

When a CA updates its Private Key and thus generates a new Public Key, the CA SHALL notify all CAs, RAs, and Subscribers that rely on the CA's Certificate that it has been changed.

5.7 Compromise and disaster recovery

5.7.1 Incident and Compromise Handling Procedures

The OpenADR PKI-PA SHALL be notified if any CAs operating under this policy experience the following:

- Suspected or detected Compromise of the CA systems;
- Physical penetration of the site housing the CA systems; or
- Successful denial of service attacks on CA components.

The OpenADR PKI-PA will take appropriate steps to protect the integrity of the OpenADR PKI.

The CA's Management Authority SHALL reestablish operational capabilities as quickly as possible in accordance with procedures set forth in the CA's CPS.

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

When computing resources, software, and/or data are corrupted, CAs operating under this policy SHALL respond as follows:

- Before returning to operation, ensure that the system's integrity has been restored;
- The OpenADR PKI-PA SHALL be notified as soon as possible; and
- A report of the incident and a response to the event, MUST be promptly made by the affected CA or RA in accordance with the documented incident and Compromise reporting and handling procedures in the applicable CPS.

5.7.3 Entity Private Key Compromise Procedures

In the event of a CA Private Key Compromise, the following operations MUST be performed.

- The OpenADR PKI-PA SHALL be immediately informed;
- If the CA signature keys are not destroyed, CA operation MUST be reestablished, giving priority to the ability to generate Certificate status information;
- If the CA signature keys are destroyed, CA operation MUST be reestablished as quickly as possible, giving priority to the generation of a new CA Key Pair;
- The CA SHALL generate new keys in accordance with CP § 6.1.1;
- Initiate procedures to notify Subscribers of the Compromise; and
- Subscriber Certificates MAY be renewed automatically by the CA under the new Key Pair (see CP §4.6), or the CA MAY require Subscribers to repeat the initial Certificate Application process.

5.7.4 Business continuity capabilities after a disaster

Entities operating CAs SHALL develop, test, and maintain a DRP designed to mitigate the effects of any kind of natural or man-made disaster. The DRP MUST identify conditions for activating the recovery and what constitutes an acceptable system outage and recovery time for the restoration of information systems services and key business functions within a defined recovery time objective.

Additionally, the Plan MUST include:

- Frequency for taking backup copies of essential business information and software;
- Requirement to store critical cryptographic materials (i.e., secure cryptographic device and activation materials) at an alternate location;
- Separation distance of the disaster recovery site to the CA's main site; and
- Procedures for securing the disaster facility during the period of time following a disaster and prior to restoring a secure environment either at the original or a remote site.

The DRP MUST include administrative requirements including:

- Maintenance schedule for the plan;
- Awareness and education requirements;
- Responsibilities of the individuals; and
- Regular testing of contingency plans.

CAs SHALL have the capability of restoring or recovering essential operations within twenty-four (24) hours following a disaster with, at a minimum, support for the following functions: Certificate issuance, Certificate revocation, and publication of revocation information. The disaster recovery equipment MUST have physical security protections comparable to the production CA system, which includes the enforcement of physical security tiers.

A CA's DRP MUST make provisions for full recovery within one week following a disaster at the primary site.

5.8 CA or RA Termination

When a CA operating under this policy terminates operations before all Certificates have expired, the CA signing keys MUST be surrendered to the OpenADR PKI-PA. Prior to CA termination, the CA SHALL provide archived data to an archive facility as specified in the CPS. As soon as possible, the CA will advise all other organizations to which it has issued Certificates of its termination, using an agreed-upon method of communication specified in the CPS.

CAs that have ceased issuing new Certificates but are continuing to issue CRLs until all Certificates have expired are required to continue to conform with all relevant aspects of this policy (e.g., audit logging and archives).

The termination of an OpenADR CA MUST be subject to the contract between the terminating CA and its Superior Entity. A terminating CA and its Superior Entity SHALL, in good faith, use commercially reasonable effort to agree on a termination plan that minimizes disruption to Subscribers and Relying Parties. The termination plan MAY cover issues such as:

- Providing notice to parties affected by the termination, such as Subscribers and Relying Parties;
- Who bears the cost of such notice, the terminating CA or the Superior Entity;
- The revocation of the Certificate issued to the CA by the Superior Entity;
- The preservation of the CA's archives and records for the time periods required in CP § 5.4.6;
- The continuation of Subscriber and customer support services;
- The continuation of revocation services, such as the issuance of CRLs or the maintenance of online status checking services;

- The revocation of unexpired unrevoked Certificates of Subscribers and Sub-CAs, if necessary;
- The payment of compensation (if necessary) to Subscribers whose unexpired unrevoked Certificates are revoked under the termination plan or provision, for the issuance of substitute Certificates by a successor CA;
- Disposition of the CA's Private Key and the hardware token containing such Private Key; and/or
- Provisions needed for the transition of the CA's services to a successor CA.

6 Technical Security Controls

6.1 Key Pair Generation and Installation

6.1.1 Key Pair Generation

Key Pair generation MUST be performed using FIPS 140 validated Cryptographic Modules and processes that provide the required cryptographic strength of the generated keys and prevent the loss, disclosure, modification, or unauthorized use of Private Keys. Any pseudo-random numbers use and parameters for key generation material MUST be generated by a FIPS-approved method.

CA keys MUST be generated in a Key Generation Ceremony using multi-person control for CA Key Pair generation, as specified in CP § 6.2.2.

CA Key Pair generation MUST create a verifiable audit trail showing that the security requirements for procedures were followed. The documentation of the procedure MUST be detailed enough to show that appropriate role separation was used. An independent third party SHALL validate the execution of the key generation procedures either by witnessing the key generation or by examining the signed and documented record of the key generation.

6.1.2 Private Key Delivery to Subscriber

Subscriber Key Pair generation MUST be performed by the Subscriber or CA. If the Subscribers themselves generate Private Keys, then Private Key delivery to a Subscriber is unnecessary.

When CAs generate Key Pairs on behalf of the Subscriber, the Private Key MUST be delivered securely to the Subscriber. Private Keys MUST be delivered electronically or on a hardware Cryptographic Module. In all cases, the following requirements MUST be met:

- The CA SHALL not retain any copy of the key for more than two (2) weeks after delivery of the Private Key to the Subscriber.
- CAs SHALL use FIPS 140-2 Level 3 systems and deliver Private Keys to Subscribers via SSL/TLS and SHALL secure such delivery through the use of a PKCS#8 package or, at the CAs sole discretion, any other comparably equivalent means (e.g., PKCS#12 package) in order to prevent the loss, disclosure, modification, or unauthorized use of such Private Keys.
- Where Key Pairs are pre-generated on hardware tokens, the entities distributing such tokens SHALL use best efforts to provide physical security of the tokens to prevent the loss, disclosure, modification, or unauthorized use of the Private Keys on them. The RA SHALL maintain a record of the Subscriber acknowledgment of receipt of the token.
- The Subscriber SHALL acknowledge receipt of the Private Key(s).
- Delivery MUST be accomplished in a way that ensures that the correct tokens and activation data are provided to the correct Subscribers.
    - For hardware modules, accountability for the location and state of the module MUST be maintained until the Subscriber accepts possession of it.
    - For electronic delivery of Private Keys, the key material MUST be encrypted using a cryptographic algorithm and key size at least as strong as the Private Key. Activation data MUST be delivered using a separate secure channel.

6.1.3 Public Key Delivery to Certificate Issuer

When a Public Key is transferred to the issuing CA to be certified, it MUST be delivered through a mechanism validating the identity of the Subscriber and ensuring that the Public Key has not been altered during transit and that the Certificate Applicant possesses the Private Key corresponding to the transferred Public Key. The Certificate Applicant SHALL deliver the Public Key in a PKCS#10 CSR or an equivalent method ensuring that the Public Key has not been altered during transit; and the Certificate Applicant possesses the Private Key corresponding to the transferred Public Key. The Certificate Applicant will submit the CSR to the RA to request a Certificate on behalf of the Subscriber.

6.1.4 CA Public Key Delivery to Relying Parties

The Root CA Public Key Certificate MUST be delivered to Relying Parties in a secure fashion to preclude substitution attacks. Acceptable methods for Certificate delivery are:

- The Root CA Certificate is delivered as part of a Subscriber's Certificate request;
- Secure distribution of Root CA Certificates through secure out-of-band mechanisms; and/or
- Downloading the Root CA Certificates from trusted websites (e.g., OpenADR PKI-PA website). The Root CA SHALL calculate the hash of the Certificate before posting it on a website so that it can be made available via out-of-band to Relying Parties to validate the posted Root CA Certificate.

6.1.5 Key Sizes

Key Pairs MUST be of sufficient length to prevent others from determining the Key Pair's Private Key using cryptanalysis during the period of expected utilization of such Key Pairs.

OpenADR Certificates MUST meet the requirements in Table 3 for algorithm type and key size.

Table 3: Algorithm Type and Key Size

	Root CA	Sub-CA	Device Certificates
Digest Algorithm	SHA-256	SHA-256	SHA-256
Minimum RSA modulus size (bits)	4096	2048	2048
Elliptic Curve Cryptography (ECC)	NIST P-256	NIST P-256	NIST P-256

6.1.6 Public Key Parameters Generation and Quality Checking

Elliptic Curve Cryptography (ECC) Public Key parameters MUST be selected from the set specified in CP § 7.1.3.

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

The use of a specific key is constrained by the *keyUsage* extension in the X.509 Certificate.

Extended key usage SHALL meet the requirements stated in § 7.x.x.x. Extended key usage OIDs SHALL be consistent with the *keyUsage* bits asserted.

6.1.7.1 keyUsage Extension for CA Certificates

Table 4 shows the specific *keyUsage* extension settings for OpenADR CA Certificates and specifies that all OpenADR CA Certificates (i.e., Root CAs or Sub-CAs, with RSA or ECC Public Keys):

- MUST include a *keyUsage* extension;
- MUST set the criticality of the *keyUsage* extension to TRUE; and
- MUST assert the *keyCertSign* bit and the *cRLSign* bit in the key usage extension.

Table 4: *keyUsage* Extension for all CA Certificates

Field	Format	Criticality	Value	Comment
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	Included in all CA Certificates
digitalSignature	(0)		0	Not Set
nonRepudiation	(1)		0	Not Set
keyEncipherment	(2)		0	Not Set
dataEncipherment	(3)		0	Not Set

keyAgreement	(4)		0	Not Set
keyCertSign	(5)		1	Set
cRLSign	(6)		1	Set
encipherOnly	(7)		0	Not Set
decipherOnly	(8)		0	Not Set

6.1.7.2 keyUsage Extension for RSA Subscriber Certificates

Table 5 shows the specific *keyUsage* extension settings for OpenADR Subscriber Certificates that contain RSA Public Keys and specifies that all OpenADR Subscriber Certificates that contain RSA Public Keys:

- MUST include a *keyUsage* extension;
- MUST set the criticality of the *keyUsage* extension to TRUE;
- MUST assert the *digitalSignature* bit;
- MUST assert the *keyEncipherment* bit; and
- MAY assert the *dataEncipherment* bit.

Table 5: *keyUsage* Extension for Subscriber Certificates with RSA Public Keys

Field	Format	Criticality	Value	Comment
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	Included in all Subscriber Certificates
digitalSignature	(0)		1	Set
nonRepudiation	(1)		0	Not Set
keyEncipherment	(2)		1	Set
dataEncipherment	(3)		0 / 1	Optional
keyAgreement	(4)		0	Not Set
keyCertSign	(5)		0	Not Set
cRLSign	(6)		0	Not Set
encipherOnly	(7)		0	Not Set
decipherOnly	(8)		0	Not Set

6.1.7.3 keyUsage Extension for ECC Subscriber Certificates

Table 6 shows the specific *keyUsage* extension settings for OpenADR Subscriber Certificates that contain ECC Public Keys and specifies that all OpenADR Subscriber Certificates that contain ECC Public Keys:

- MUST include a *keyUsage* extension;
- MUST set the criticality of the *keyUsage* extension to TRUE;
- MUST assert the *digitalSignature* bit; and
- MAY assert the *keyAgreement* bit.

Table 6: *keyUsage* Extension for Subscriber Certificates with ECC Public Keys

Field	Format	Criticality	Value	Comment
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	Included in all Subscriber Certificates
digitalSignature	(0)		1	Set
nonRepudiation	(1)		0	Not Set

keyEncipherment	(2)		0	Not Set
dataEncipherment	(3)		0	Not Set
keyAgreement	(4)		0 / 1	Optional
keyCertSign	(5)		0	Not Set
cRLSign	(6)		0	Not Set
encipherOnly	(7)		0	Not Set
decipherOnly	(8)		0	Not Set

6.1.7.4 keyUsage Extension for OCSP Responder Certificates

Table 7 shows the specific *keyUsage* extension settings for OpenADR OCSP responder Certificates and specifies that all OpenADR OCSP responder Certificates:

- SHALL include a *keyUsage* extension;
- SHALL set the criticality of the *keyUsage* extension to FALSE; and
- SHALL assert the *digitalSignature* bit.

Table 7: *keyUsage* Extension for OCSP Responder Certificates

Field	Format	Criticality	Value	Comment
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	Included in all OCSP Responder Certificates
digitalSignature	(0)		1	Set
nonRepudiation	(1)		0	Not Set
keyEncipherment	(2)		0	Not Set
dataEncipherment	(3)		0	Not Set
keyAgreement	(4)		0	Not Set
keyCertSign	(5)		0	Not Set
cRLSign	(6)		0	Not Set
encipherOnly	(7)		0	Not Set
decipherOnly	(8)		0	Not Set

6.2 Private Key Protection and Cryptographic Module Engineering Controls

6.2.1 Cryptographic Module Standards and Controls

CA Private Keys within the OpenADR PKI MUST be protected using FIPS 140-2 Level 3 systems. Private Key holders SHALL take necessary precautions to prevent the loss, disclosure, modification, or unauthorized use of such Private Keys in accordance with this CP and contractual obligations specified in the appropriate OpenADR Agreement.

The relevant standard for Cryptographic Modules is Security Requirements for Cryptographic Modules [FIPS 140-2].

- Root CAs SHALL perform all CA cryptographic operations on Cryptographic Modules rated at a minimum of FIPS 140-2 level 3 or higher.
- Sub-CAs SHALL use a FIPS 140-2 Level 3 or higher validated hardware Cryptographic Module.

- Subscribers SHOULD use a FIPS 140-2 Level 1 or higher validated Cryptographic Module for their cryptographic operations.

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

Multi-person control is enforced to protect the activation data needed to activate CA Private Keys so that a single person SHALL not be permitted to activate or access any Cryptographic Module that contains the complete CA Private Key.

CA signature keys SHOULD be backed up only under multi-person control. Access to CA signing keys backed up for disaster recovery MUST be under multi-person control. The names of the parties used for multi-person control MUST be maintained on a list that MUST be made available for inspection during Compliance Audits.

CAs MAY use “Secret Sharing” to split the Private Key or activation data needed to operate the Private Key into separate parts called “Secret Shares” held by individuals called “Shareholders.” Some threshold number of Secret Shares (m) out of the total number of Secret Shares (n) MUST be required to operate the Private Key. The minimum threshold number of shares (m) needed to sign a CA Certificate MUST be three (3). The total number of shares (n) used MUST be greater than the minimum threshold number of shares (m).

CAs MAY also use Secret Sharing to protect the activation data needed to activate Private Keys located at their respective disaster recovery sites. The minimum threshold number of shares (m) needed to sign a CA Certificate at a disaster recovery site MUST be three (3). The total number of shares (n) used MUST be greater than the minimum threshold number of shares (m).

6.2.3 Private Key Escrow

CA Private Keys and Subscriber Private Keys MUST NOT be escrowed.

6.2.4 Private Key Backup

CAs SHALL back up their Private Keys, under the same multi-person control as the original signature key. The backups allow the CA to be able to recover from disasters and equipment malfunction. At least one (1) copy of the Private Key MUST be stored off-site. Private Keys that are backed up MUST be protected from unauthorized modification or disclosure through physical or cryptographic means. Backups, including all activation data needed to activate the cryptographic token containing the Private Key, MUST be protected with a level of physical and cryptographic protection equal to or exceeding that for Cryptographic Modules within the CA site, such as at a disaster recovery site or at another secure off-site facility, such as a bank safe. All copies of the CA Private Key MUST be accounted for and protected in the same manner as the original.

Device Private Keys MAY be backed up or copied, but MUST be held under the control of the Subscriber or other authorized administrator. Backed up device Private Keys MUST NOT be stored in plaintext form and storage MUST ensure security controls consistent with the OpenADR security specifications the device is compliant with. Subscribers MAY have the option of using enhanced Private Key protection mechanisms available today including the use of smart cards, biometric access devices, and other hardware tokens to store Private Keys.

6.2.5 Private Key Archival

CA Private Keys and Subscriber Private Keys MUST NOT be archived. Upon expiration of a CA Certificate, the Key Pair associated with the Certificate will be securely retained for a period of at least five (5) years using hardware Cryptographic Modules that meet the requirements of this CP. These CA Key Pairs MUST NOT be used for any signing events after the expiration date of the corresponding CA Certificate, unless the CA Certificate has been renewed in terms of this CP.

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 CP § 6.2.4. At no time shall the CA Private Key exist in plaintext outside the Cryptographic Module.

All other keys MUST be generated by and in a Cryptographic Module. In the event that 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.

Private or symmetric keys used to encrypt other Private Keys for transport MUST be protected from disclosure.

Entry of a Private Key into a Cryptographic Module MUST use mechanisms to prevent loss, theft, modification, unauthorized disclosure, or unauthorized use of such Private Key.

Processing Centers generating CA or RA Private Keys on one hardware Cryptographic Module and transferring them into another shall securely transfer such Private Keys into the second Cryptographic Module to the extent necessary to prevent loss, theft, modification, unauthorized disclosure, or unauthorized use of such Private Keys. Such transfers shall be limited to making backup copies of the Private Keys on tokens.

CAs pre-generating Private Keys and transferring them into a hardware token, for example transferring generated end-user Subscriber Private Keys into a smart card, SHALL securely transfer such Private Keys into the token to the extent necessary to prevent loss, theft, modification, unauthorized disclosure, or unauthorized use of such Private Keys.

6.2.7 Private Key Storage on Cryptographic Module

No stipulation beyond that specified in FIPS 140-2.

6.2.8 Method of Activating Private Key

All CAs SHALL protect the activation data for their Private Keys against loss, theft, modification, disclosure, or unauthorized use.

CA administrators SHALL be authenticated to 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 MUST be protected from disclosure (i.e., the data SHOULD NOT be displayed while it is entered).

For Device Certificates, the device MAY be configured to activate its Private Key, provided that appropriate physical and logical access controls are implemented for the device. The strength of the security controls MUST be commensurate with the level of threat in the device's environment, and MUST protect the device's hardware, software, Private Keys and its activation data from Compromise.

6.2.8.1 CA Administrator Activation

Method of activating the CA system by a CA administrator MUST require:

- Use a smart card, biometric access device, password in accordance with CP § 6.4.1, or security of equivalent strength to authenticate the administrator before the activation of the Private Key, which includes, for instance, a password to operate the Private Key, a Windows logon or screen saver password, or a network logon password; and
- Take commercially reasonable measures for the physical protection of the administrator's workstation to prevent use of the workstation and its associated Private Key without the administrator's authorization.

6.2.8.2 Offline Root CAs Private Key

Once the CA system has been activated, a threshold number of Shareholders MUST be required to supply their activation data in order to activate an offline CA's Private Key, as defined in CP § 6.2.2. Once the Private Key is activated, it MUST be active until termination of the session.

6.2.8.3 Online Subordinate CAs Private Keys

An online CA's Private Key MUST be activated by a threshold number of Shareholders, as defined in CP § 6.2.2, supplying their activation data (stored on secure media). Once the Private Key is

activated, the Private Key MAY be active for an indefinite period until it is deactivated when the CA goes offline.

6.2.8.4 Subscriber Private Keys

The OpenADR standards for protecting activation data for Subscribers' Private Keys MUST be in accordance with the specific obligations appearing in this CP and the DCSA.

6.2.9 Method of Deactivating Private Key

Cryptographic Modules that have been activated MUST NOT be available to unauthorized access. After use, the Cryptographic Module MUST be deactivated, e.g., via a manual logout procedure or automatically after a period of inactivity. CA Cryptographic Modules MUST be stored securely when not in use.

When an online CA is taken offline, the CA SHALL remove the token containing the Private Key from the reader in order to deactivate it, or take similar action based upon the type of hardware used to store the Private Key.

With respect to the Private Keys of offline CAs, after the completion of a Key Generation Ceremony, in which such Private Keys are used for Private Key operations, the CA SHALL remove the token containing the Private Keys from the reader in order to deactivate them, or take similar action based upon the type of hardware used to store the Private Key. Once removed from the reader, tokens MUST be securely stored.

When an online CA is taken offline, the CA SHALL remove the token containing such CA's Private Key from the reader in order to deactivate it.

When deactivated, Private Keys MUST be kept in encrypted form only.

6.2.10 Method of Destroying Private Key

Private Keys MUST be destroyed in a way that prevents their theft, disclosure, or unauthorized use.

Upon termination of the operations of a CA, individuals in Trusted Roles SHALL decommission the CA Private Keys by deleting it using functionality of the token containing such CA's Private Key so as to prevent its recovery following deletion, or the loss, theft, modification, disclosure, or unauthorized use of such Private Key. CA Private Keys MUST be destroyed in a manner that reasonably ensures that there are no residuals remains of the key that could lead to the reconstruction of the key.

For Root CAs, OpenADR PKI-PA security personnel SHALL witness this process.

Subscribers MAY destroy their Private Keys when they are no longer needed or when the Certificates to which they correspond expire or are revoked. Physical destruction of hardware is not required.

6.2.11 Cryptographic Module Rating

See CP § 6.2.1.

6.3 Other Aspects of Key Pair Management

6.3.1 Public Key Archival

CAs MAY archive their Public Keys in accordance with CP § 5.5.1.

6.3.2 Certificate Operational Periods and Key Pair Usage Periods

The Certificate Validity Period (i.e., Certificate operational period and Key Pair usage period) MUST be set to the time limits set forth in Table 8.

Table 8: Certifcate Validity Periods

Certificate	Certificate Validity
Root CA Certificates	up to 40 years
Sub-CA Certificates	up to 30 years*
Subscriber VTN Certificates	2 years
Subscriber VEN Certificates	up to 20 years

*Up to, and including, the validity end date of the Root CA.

Validity Periods MUST be nested such that the Validity Periods of issued Certificates MUST be contained within the Validity Period of the issuing CA.

As necessary to ensure the continuity and security of the OpenADR PKI, OpenADR SHALL commission new CAs.

OpenADR PKI Participants SHALL cease all use of their Key Pairs after their usage periods have expired.

6.4 Activation data

6.4.1 Activation Data Generation and Installation

CAs SHALL generate and installing activation data for their Private Keys and SHALL use methods that protect the activation data to the extent necessary to prevent the loss, theft, modification, disclosure, or unauthorized use of such activation data.

To the extent passwords are used as activation data, CAs activation participants SHALL generate passwords that cannot easily be guessed or cracked by dictionary attacks. Participants may not need to generate activation data, for example if they use biometric access devices.

6.4.2 Activation Data Protection

CAs SHALL protect the activation data for their Private Keys using methods that protect against the loss, theft, modification, unauthorized disclosure, or unauthorized use of such Private Keys.

CAs SHALL use multi-party control in accordance with CP § 6.2.2. CAs SHALL provide the procedures and means to enable Shareholders to take the precautions necessary to prevent the loss, theft, modification, disclosure, or unauthorized use of the Secret Shares that they possess. Shareholders SHALL not:

- Copy, disclose, or make the Secret Share available to a third party, or make any unauthorized use of it whatsoever; or
- Disclose their or any other person’s status as a Shareholder to any third party.

The Secret Shares and any information disclosed to the Shareholder in connection with their duties as a Shareholder SHALL constitute confidential/private information.

CAs SHALL include in their DRP provisions for making Secret Shares available at a disaster recovery site after a disaster (note the important aspect of disaster recovery vis-à-vis shares is that a process exists for making the necessary number of shares available, even if the requisite shareholders are not available). CAs SHALL maintain an audit trail of Secret Shares, and Shareholders SHALL participate in the maintenance of an audit trail.

6.4.3 Other Aspects of Activation Data

6.4.3.1 Activation Data Transmission

To the extent activation data for their Private Keys are transmitted, Activation Data Participants SHALL protect the transmission using methods that protect against the loss, theft, modification, unauthorized disclosure, or unauthorized use of such Private Keys. To the extent desktop computer

or network logon user name/password combination is used as activation data for an end-user Subscriber, the passwords transferred across a network MUST be protected against access by unauthorized users.

6.4.3.2 Activation Data Destruction

Activation data for CA Private Keys MUST be decommissioned using methods that protect against the loss, theft, modification, unauthorized disclosure, or unauthorized use of the Private Keys protected by such activation data. After the record retention periods in CP § 5.5.2 lapses, CAs SHALL decommission activation data by overwriting and/or physical destruction.

6.5 Computer Security Controls

6.5.1 Specific Computer Security Technical Requirements

CAs SHALL ensure that the systems maintaining CA software and data files are Trustworthy Systems secure from unauthorized access, which can be demonstrated by compliance with audit criteria applicable under CP § 5.4.1. In addition, CAs SHALL limit access to production servers to those individuals with a valid business reason for access. General application users SHALL not have accounts on the production servers.

CAs SHALL have production networks logically separated from other components. This separation prevents network access except through defined application processes. CAs SHALL use firewalls to protect the production network from internal and external intrusion and limit the nature and source of network activities that may access production systems.

To the extent that passwords are used, CAs SHALL require the use of passwords with a minimum character length and a combination of alphanumeric and special characters, and SHALL require that passwords be changed on a periodic basis and whenever necessary. Direct access to a CA's database maintaining the CA's repository MUST be limited to Trusted Persons having a valid business reason for such access.

Computer security controls are required to ensure CA operations are performed as specified in this policy. The following computer security functions MAY be provided by the operating system, or through a combination of operating system, software, and physical safeguards:

- Require authenticated logins;
- Provide discretionary access control;
- Provide a security audit capability;
- Enforce access control for CA services and PKI roles;
- Enforce separation of duties for PKI roles;
- Require identification and authentication of PKI roles and associated identities;
- Prohibit object reuse or require separation for CA random access memory;
- Require use of cryptography for session communication and database security;
- Archive CA history and audit data;
- Require self-test security-related CA services;
- Require a trusted path for identification of PKI roles and associated identities;
- Require a recovery mechanism for keys and the CA system; and/or
- Enforce domain integrity boundaries for security-critical processes.

For other CAs operating under this policy, the computer security functions listed below are required. These functions MAY be provided by the operating system, or through a combination of operating system, software, and physical safeguards. The CA and its ancillary parts SHALL include the following functionality:

- Authenticate the identity of users before permitting access to the system or applications;
- Manage privileges of users to limit users to their assigned roles;
- Generate and archive audit records for all transactions; (see CP § 5.4)
- Enforce domain integrity boundaries for security critical processes; and

- Support recovery from key or system failure.

For Certificate status servers operating under this policy, the computer security functions listed below are required:

- Authenticate the identity of users before permitting access to the system or applications;
- Manage privileges of users to limit users to their assigned roles;
- Enforce domain integrity boundaries for security critical processes; and
- Support recovery from key or system failure.

For remote workstations used to administer the CAs, the computer security functions listed below are required:

- Authenticate the identity of users before permitting access to the system or applications;
- Manage privileges of users to limit users to their assigned roles;
- Generate and archive audit records for all transactions; (see CP § 5.4)
- Enforce domain integrity boundaries for security critical processes; and
- Support recovery from key or system failure.

All communications between any PKI Trusted Role and the CA MUST be authenticated and protected from modification.

6.5.2 Computer Security Rating

No Stipulation.

6.6 Life Cycle Technical Controls

6.6.1 System Development Controls

The system development controls for the CA are as follows:

- The CA SHALL use software that has been designed and developed under a formal, documented development methodology.
- Hardware and software procured to operate the CA MUST be purchased 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).
- Hardware and software developed specifically for the CA MUST be developed in a controlled environment, and the development process MUST be defined and documented. This requirement does not apply to commercial off-the-shelf hardware or software.
- The CA hardware and software MUST be dedicated to performing one task: the CA. There shall be no other applications, hardware devices, network connections, or component software installed that are not parts of the CA operation. Where the CA operation supports multiple CAs, the hardware platform MAY support multiple CAs.
- Proper care MUST be taken to prevent malicious software from being loaded onto the CA equipment. All applications required to perform the operation of the CA MUST be obtained from documented sources.
- Hardware and software updates MUST be purchased or developed in the same manner as the corresponding original equipment, and MUST be installed by trusted and trained personnel in a defined manner.

6.6.2 Security Management Controls

The configuration of the CA system, in addition to any modifications and upgrades, MUST be documented and controlled. There MUST be a mechanism for detecting unauthorized modification to the software or configuration. The CA software, when first loaded, MUST be verified as being that supplied from the vendor, with no modifications, and be the version intended for use.

6.6.3 Life Cycle Security Controls

No Stipulation.

6.7 Network Security Controls

A network guard, firewall, or filtering router MUST protect network access to CA equipment. The network guard, firewall, or filtering router MUST limit services allowed to and from the CA equipment to those required to perform CA functions.

Protection of CA equipment MUST be provided against known network attacks. All unused network ports and services MUST be turned off. Any network software present on the CA equipment MUST be necessary to the functioning of the CA application.

Any boundary control devices used to protect the network on which PKI equipment is hosted MUST deny all but the necessary services to the PKI equipment.

Repositories, Certificate status servers, and remote workstations used to administer the CAs MUST employ appropriate network security controls. Networking equipment MUST turn off unused network ports and services. Any network software present MUST be necessary to the functioning of the equipment.

The CA SHALL establish connection with a remote workstation used to administer the CA only after successful authentication of the remote workstation at a level of assurance commensurate with that of the CA.

6.8 Time-Stamping

Certificates, CRLs, and other revocation database entries MUST contain time and date information. Such time information need not be cryptographic-based. Asserted times MUST be accurate to within three minutes. Electronic or manual procedures MAY be used to maintain system time. Clock adjustments are auditable events (see CP § 5.4.1).

7 Certificate, CRL, and OCSP Profiles

7.1 Certificate Profile

OpenADR Certificates MUST conform to [RFC 5280]: Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile, May 2008.

OpenADR Certificates MUST contain the identity and attribute data of a Subject using the base Certificate with applicable extensions. The base Certificate MUST contain the version number of the Certificate, the Certificate's identifying serial number, the signature algorithm used to sign the Certificate, the issuer's DN, the Validity Period of the Certificate, the Subject's DN, information about the Subject's Public Key, and extensions (See Table 9).

Table 9: Certificate Profile Basic Fields

Field	[RFC5280] Section	Requirement or Recommendation
tbsCertificate	4.1.1.1	Follows [RFC 5280] guidance
version	4.1.2.1	See CP § 7.1.1
serialNumber	4.1.2.2	MUST be a unique positive integer assigned by the CA and MUST NOT be longer than 20 octets.
signature	4.1.2.3	See CP § 7.1.3
issuer	4.1.2.4	See CP § 7.1.4
validity	4.1.2.5	See CP § 6.3.2
subject	4.1.2.6	See CP § 7.1.4
subjectPublicKeyInfo	4.1.2.7	See Table 32and Table 33
extensions	4.1.2.9	See CP § 7.1.2
signatureAlgorithm	4.1.1.2	Follows [RFC 5280] guidance
algorithmIdentifier	4.1.1.2	
algorithm	4.1.1.2	See CP § 7.1.3
parameters	4.1.1.2	See CP § 7.1.3
signatureValue	4.1.1.3	Follows [RFC 5280] guidance

7.1.1 Version Number(s)

OpenADR Certificates MUST be X.509 v3 Certificates. The Certificate version number MUST be set to the integer value of "2" for Version 3 Certificate.

7.1.2 Certificate Extensions

OpenADR Certificate extensions provide methods for associating additional attributes with Public Keys and for managing relationships between CAs. OpenADR Certificates MUST follow the guidance in [RFC 5280] and MUST contain the standard extensions shown in the tables below, unless they are denoted as optional.

Table 10 shows the Certificate extensions for all OpenADR Root CA Certificates (i.e., Root CAs with RSA or ECC Public Keys).

Table 10: RSA and ECC Root CA Certificate Standard Extensions

Field	Referenced Standard	Section	Requirement or Recommendation
basicConstraints	[RFC 5280]	4.2.1.9	See Table 17
keyUsage	[RFC 5280]	4.2.1.3	See Table 4
subjectAltName	[RFC 5280]	4.2.1.6	(Optional Extension) See Table 25
subjectKeyIdentifier	[RFC 5280]	4.2.1.2	See Table 28

Table 11 shows the Certificate extensions for all OpenADR Sub-CA Certificates (i.e., Sub-CAs with RSA or ECC Public Keys).

Table 11: RSA and ECC Sub-CA Certificate Standard Extensions

Field	Referenced Standard	Section	Requirement or Recommendation
authorityKeyIdentifier	[RFC 5280]	4.2.1.1	See Table 15
basicConstraints	[RFC 5280]	4.2.1.9	See Table 18
certificatePolicies	[RFC 5280]	4.2.1.4	See CP § 7.1.6
cRLDistributionPoints	[RFC 5280]	4.2.1.13	(Optional Extension) MAY be included in Sub-CA Certificates. Criticality MUST be set to FALSE.
keyUsage	[RFC 5280]	4.2.1.3	See CP § 6.1.7
subjectAlternativeName	[RFC 5280]	4.2.1.6	(Optional Extension) MAY be included in Sub-CA Certificates. Criticality MUST be set to FALSE.
subjectKeyIdentifier	[RFC 5280]	4.2.1.2	See Table 28

Table 12 shows the Certificate extensions for all OpenADR Subscriber Certificates (i.e., Device Certificates with RSA or ECC Public Keys).

Table 12: RSA and ECC Subscriber Certificate Standard Extensions

Field	Referenced Standard	Section	Requirement or Recommendation
authorityInformationAccess	[RFC 5280]	4.2.2.1	(Optional Extension)
authorityKeyIdentifier	[RFC 5280]	4.2.1.1	See Table 16
certificatePolicies	[RFC 5280]	4.2.1.4	See CP § 7.1.6
cRLDistributionPoint	[RFC 5280]	4.2.1.14	(Optional Extension)
extKeyUsage	[RFC 5280]	4.2.1.12	(Optional Extension) See Table 22 for server (VTN) Certificates. See Table 23 for client (VEN) Certificates.
keyUsage	[RFC 5280]	4.2.1.3	See CP § 6.1.7
subjectAltName	[RFC 5280]	4.2.1.6	SHALL be included in VTN Subscriber Certificates. See Table 27

7.1.2.1 Standard Extensions for OCSP Responder Certificates

Table 13 shows the Certificate extensions for all A3SA OCSP responder Certificates.

Table 13: OCSP Responder Certificate Standard Extensions

Field	Referenced Standard	Section	Requirement or Recommendation
authorityKeyIdentifier	[RFC 5280]	4.2.1.1	MAY be included in OCSP responder Certificates. Criticality SHALL be set to FALSE.
basicConstraints	[RFC 5280]	4.2.1.9	SHALL be included in OCSP responder Certificates. Criticality SHALL be set to TRUE.
certificatePolicies	[RFC 5280]	4.2.1.4	MAY be included in OCSP responder Certificates. Criticality SHALL be set to FALSE.
extendedKeyUsage	[RFC 5280]	4.2.1.12	MAY be included in OCSP responder Certificates. Criticality SHALL be set to FALSE.
keyUsage	[RFC 5280]	4.2.1.3	SHALL be included in OCSP responder Certificates. Criticality SHALL be set to TRUE.
noCheck	[RFC 5280]	4.2.2.2.1	SHALL be included in OCSP responder Certificates. Criticality SHALL be set to FALSE.
subjectKeyIdentifier	[RFC 5280]	4.2.1.2	MAY be included in OCSP responder Certificates. Criticality SHALL be set to FALSE.

7.1.2.2 Authority Information Access (AIA) Extension

The *authorityInformationAccess* (also known as the *AuthorityInfoAccess* or AIA) extension indicates how to Access OCSP information for the Certificate issuer.

Table 14 shows the *authorityInformationAccess* extension settings for RSA and ECC Subscriber Certificates and specifies that all Subscriber Certificates:

- MAY include the *authorityInformationAccess* extension;
- If included, SHALL set the criticality of the *authorityInformationAccess* extension to FALSE;
- If included, SHALL set the *accessMethod* OID; and
- If included, SHALL set the *accessLocation* to the URL of the OCSP responder.

Table 14: *authorityInformationAccess* Extension for RSA and ECC Subscriber Certificates

Field	Format	Criticality	Value	Comment
authorityInformationAccess		FALSE	{ id-pe 1 }	MAY include in Subscriber Certificates
accessMethod	OID		1.3.6.1.5.5.7.48.1	OCSP {id-pkix-ocsp}
accessLocation	GeneralName		URL	Address of the OCSP responder

7.1.2.3 Authority Key Identifier Extension

Table 15 shows the *authorityKeyIdentifier* extension settings and specifies that all OpenADR RSA and ECC Sub-CA Certificates:

- MUST include the *authorityKeyIdentifier* extension;
- MUST set the criticality of the *authorityKeyIdentifier* extension to FALSE; and
- MUST calculate the *keyIdentifier* of the authority*KeyIdentifier* per Method 1.

Table 15: *authoritytKeyIdentifier* Extension for RSA and ECC Sub-CA Certificates

Field	Format	Criticality	Value	Comment
authorityKeyIdentifier		FALSE	{ id-ce 35 }	Included in all Sub-CA Certificates
keyIdentifier	OCTET STRING		*<key Identifier>*	Calculated per Method 1

Table 16 shows the *authorityKeyIdentifier* extension settings and specifies that all OpenADR RSA and ECC Subscriber Certificates:

- MUST include the *authorityKeyIdentifier* extension;
- MUST set the criticality of the *authorityKeyIdentifier* extension to FALSE; and
- MUST calculate the *keyIdentifier* of the authority*KeyIdentifier* per Method 1.

Table 16: *authoritytKeyIdentifier* Extension for RSA and ECC Subscriber Certificates

Field	Format	Criticality	Value	Comment
authorityKeyIdentifier		FALSE	{ id-ce 35 }	Included in all Subscriber Certificates
keyIdentifier	OCTET STRING		*<key Identifier>*	Calculated per Method 1

7.1.2.4 Basic Constraints Extension

The *basicConstraints* extension identifies whether the Subject of a Certificate is a CA and the maximum depth of valid certification paths that include the Certificate.

NOTE: The pathLenConstraint field gives the maximum number of Sub-CA Certificates that MAY follow this Certificate in the certification path. A value of "0" indicates that only an End-Entity Certificate MAY follow in the path. If the pathLenConstraint value is set, it MUST be greater than or equal to "0". If it is not set, then the certification path MAY be of any length.

Subscriber Certificates MUST NOT include the *basicConstraints* extension.

Table 17 shows the *basicConstraints* extension settings for OpenADR RSA and ECC Root CA Certificates and specifies that all OpenADR Root CA Certificates:

- MUST include the *basicConstraints* extension;
- MUST set the criticality of the *basicConstraints* extension to TRUE;
- MUST set the cA field of the *basicConstraints* extension to TRUE; and
- MUST set the *pathLenConstraint* field of the *basicConstraints* to NONE.

Table 17: *basicConstraints* Extension for RSA and ECC Root CA Certificates

Field	Format	Criticality	Value	Comment
basicConstraints		TRUE	{ id-ce 19 }	Included in all Root Certificates
cA	BOOLEAN		TRUE	Set
pathLenConstraint	INTEGER			NONE

Table 18 shows the *basicConstraints* extension settings for OpenADR RSA and ECC Sub-CA Certificates and specifies that all OpenADR Sub-CA Certificates:

- MUST include the *basicConstraints* extension;
- MUST set the criticality of the *basicConstraints* extension to TRUE;
- MUST set the cA field of the *basicConstraints* extension set to TRUE; and

- MUST set the *pathLenConstraint* field of the *basicConstraints* to “0” (zero).

Table 18: *basicConstraints* Extension for RSA and ECC Sub-CA Certificates

Field	Format	Criticality	Value	Comment
basicConstraints		TRUE	{ id-ce 19 }	Included in all Sub-CA Certificates
cA	BOOLEAN		TRUE	Set
pathLenConstraint	INTEGER		0	Set to “0” (Zero) or Not Set

.Table 19 shows the *basicConstraints* extension settings for OpenADR OCSP responder Certificates and specifies that all OpenADR OCSP responder Certificates:

- MAY include the *basicConstraints* extension;
- SHALL set the criticality of the *basicConstraints* extension to TRUE;
- SHALL set the *cA* to FALSE; and
- SHALL set the *pathLenConstraint* field of the *basicContraints* to “None”.

Table 19: *basicConstraints* Extension for OCSP Responder Certificates

Field	Format	Criticality	Value	Comment
basicConstraints		TRUE	{ id-ce 19 }	Included in all OCSP responder Certificates
cA	BOOLEAN		FALSE	Default
pathLenConstraint	INTEGER		None	Not Set

7.1.2.5 Certificate Policies Extension

See CP § 7.1.6.

7.1.2.6 CRL Distribution Points Extension

The *cRLDistributionPoints* extension identifies how CRL information is obtained.

Non-Root Certificates MAY use the CRL Distribution Point extension. Table 20 shows the *cRLDistributionPoints* extension settings for OpenADR RSA and ECC Sub-CA Certificates and specifies that OpenADR Sub-CA Certificates:

- MAY be included the *cRLDistributionPoints* extension;
- If included, it MUST set the criticality of the *cRLDistributionPoints* extension to FALSE; and
- If included, it SHALL set the *distributionPointName* to the URL of the CRL.

Table 20: *cRLDistributionPoints* Extension for RSA and ECC Sub-CA Certificates

Field	Format	Criticality	Value	Comment
cRLDistributionPoints	SEQUENCE	FALSE	{ id-ce 31 }	MAY be included in all OpenADR Sub-CA Certificates
distributionPoint	SEQUENCE			
distributionPointName	CHOICE		URL	Complete URI string to CRL file

Table 21 shows the *cRLDistributionPoints* extension settings for OpenADR RSA and ECC Subscriber Certificates and specifies that all Subscriber Certificates:

- MAY include the *cRLDistributionPoints* extension;
- If included, SHALL set the criticality of the *cRLDistributionPoints* extension to FALSE; and
- If included, SHALL set the *distributionPointName* to the URL of the CRL.

Table 21: *cRLDistributionPoints* Extension for RSA and ECC Subscriber Certificates

Field	Format	Criticality	Value	Comment
cRLDistributionPoints		FALSE	{ id-ce 31 }	MAY be included in Subscriber Certificates
distributionPoint				
distributionPointName	*generalNames*		URL	Address of the CRL location

7.1.2.7 Extended Key Usage (EKU) Extension

The *extendedKeyUsage* (or *extKeyUsage,* or *EKU*) extension indicates one or more purposes for which the Public Key MAY be used, in addition to, or in place of, the purposes indicated in the *keyUsage* extension.

CA Certificates MUST NOT include the *extKeyUsage* extension.

Table 22 shows the *extKeyUsage* extension settings for OpenADR Subscriber server Certificates (e.g., VTN Certificates) and specifies that all OpenADR VTN Certificates:

- MAY include the *extKeyUsage* extension;
- If included, MUST set the criticality of the *extKeyUsage* extension to FALSE;
- MUST set the *keyPurposeId* field of the *extKeyUsage* to id-kp-serverAuth; and
- MAY set the *keyPurposeId* field of the *extKeyUsage* to id-kp-clientAuth.

Table 22: *extKeyUsage* Extension for Server (VTN) Certificates

Field	Format	Criticality	Value	Comment
extKeyUsage		FALSE	{ id-ce 37 }	MAY be included in Subscriber VTN (server) Certificates
keyPurposeID	OID		1.3.6.1.5.5.7.3.1	id-kp-serverAuth
keyPurposeID	OID		1.3.6.1.5.5.7.3.2	id-kp-clientAuth (optional)

Table 23 shows the *extKeyUsage* extension settings for OpenADR Subscriber client Certificates (e.g., VEN Certificate) and specifies that all OpenADR client Certificates:

- MAY include the *extKeyUsage* extension;
- If included, MUST set the criticality of the *extKeyUsage* extension to FALSE;
- MUST set the *keyPurposeId* field of the *extKeyUsage* to id-kp-clientAuth; and
- MAY set an additional *keyPurposeId* field fo the *extKeyUsage* to id-kp-serverAuth.

Table 23: *extKeyUsage* Extension for Client (VEN) Certificates

Field	Format	Criticality	Value	Comment
extKeyUsage		FALSE	{ id-ce 37 }	MAY be included in Subscriber VEN (client) Certificates
keyPurposeID	OID		1.3.6.1.5.5.7.3.2	id-kp-clientAuth
keyPurposeID	OID		1.3.6.1.5.5.7.3.1	id-kp-serverAuth (optional)

7.1.2.8 Key Usage Extension

See CP § 6.1.7.

7.1.2.9 OCSP noCheck Extension

Table 24 shows the OCSP *noCheck* extension for OpenADR OCSP responder Certificates and specifies that all OCSP responder Certificates:

- SHALL include a *noCheck* extension;
- SHALL set the criticality of the *noCheck* extension to FALSE; and
- SHALL set the *value* to NULL.

Table 24: OCSP *noCheck* Extension

Field	Format	Criticality	Value	Comment
id-pkix-ocsp-nocheck		FALSE	NULL	{id-pkix-ocsp 5}

7.1.2.10 Subject Alternative Name (SAN) Extension

The *subjectAlternativeName* (or *subjectAltName* or SAN) extension allows identities to be bound to the Subject of the Certificate.

Table 25 shows the *subjectAltName* extension settings for all Root Certificates and specifies that all Root Certificates:

- SHALL include the *subjectAltName* extension;
- SHALL set the criticality of the *subjectAltName* extension to FALSE; and
- SHALL set the *directoryName* with the appropriate information.

Table 25: *subjectAlternative* Name Extension for Root Certificates

Field	Format	Criticality	Value	Comment
subjectAltName		FALSE	{ id-ce 17 }	SHALL be included in all Root Certificates.
directoryName	OCTET STRING			Directory Address

Table 26 shows the *subjectAltName* extension settings for all Sub-CA Certificates and specifies that all Sub-CA Certificates:

- MAY include the *subjectAltName* extension;
- If included, SHALL set the criticality of the *subjectAltName* extension to FALSE; and
- If included, SHALL set the *directoryName* with the appropriate information.

Table 26: *subjectAlternative* Name Extension for Sub-CA Certificates

Field	Format	Criticality	Value	Comment
subjectAltName		FALSE	{ id-ce 17 }	MAY be included in all Sub-CA Certificates.
directoryName	OCTET STRING			Directory Address

Table 27 shows the *subjectAltName* extension settings for VTN Subscriber Certificates and specifies that VTN Subscriber Certificates:

- SHALL include the *subjectAltName* extension;
- SHALL set the criticality of the *subjectAltName* extension to FALSE; and
- SHALL set the *dNSName* with the appropriate information.

Table 27: *subjectAlternative* Name Extension for VTN Subscriber Certificates

Field	Format	Criticality	Value	Comment
subjectAltName		FALSE	{ id-ce 17 }	SHALL be included in all VTN Subscriber Certificates
dNSName	IA5String			DNS Name (same as the *cn*= field in the *subjectDN* of the VTN Certificate

VEN Subscriber Certificates SHALL NOT include the *subjectAltName* extension.

7.1.2.11 Subject Key Identifier Extension

The *subjectKeyIdentifier* extension provides a means of identifying Certificates that contain a particular Public Key.

Subscriber Certificates MUST NOT include the *subjectKeyIdentifier* extension.Table 28 shows the *subjectKeyIdentifier* extension settings for OpenADR CA Certificates and specifies that all OpenADR Root and Sub-CA Certificates:

- MUST include the *subjectKeyIdentifier* extension;
- MUST set the criticality of the *subjectKeyIdentifier* extension to FALSE; and
- MUST calculate the *keyIdentifier* of the *subjectKeyIdentifier* per Method 1.

Table 28: *subjectKeyIdentifier* Extension for CA Certificates

Field	Format	Criticality	Value	Comment
subjectKeyIdentifier		FALSE	{ id-ce 14 }	Included in all CA Certificates
keyIdentifier	OCTET STRING		*<keyIdentifier>*	Calculated per Method 1

Table 29 shows the *subjectKeyIdentifier* extension settings for OCSP responder Certificates, and specifies that all OCSP responder Certificates:

- MAY include the *subjectKeyIdentifier* extension;
- SHALL set the criticality of the *subjectKeyIdentifier* extension to FALSE; and
- SHALL calculate the *keyIdentifier* of the *subjectKeyIdentifier* per Method 1.

Table 29: *subjectKeyIdentifier* Extension for OCSP Responder Certificates

Field	Format	Criticality	Value	Comment
subjectKeyIdentifier		FALSE	{ id-ce 14 }	MAY be included in all OCSP responder Certificates
keyIdentifier	OCTET STRING		*<keyIdentifier>*	Calculated per Method 1

7.1.3 Algorithm Object Identifiers (OIDs)

This CP requires use of RSA or ECDSA signatures. Certificates issued under this policy MUST contain RSA or elliptic curve Public Keys and MUST use the following RSA (see Table 30) and ECC (see Table 31) OIDs for signatures.

Table 30: Signature OIDS for Certificates Using SHA-256 with RSA Encryption

Field	Format	Criticality	Value	Comment
signature				
algorithmIdentifier				
algorithm	OID		1.2.840.113549.1.1.11	*sha256WithRSAEncryption*
parameters	ANY		NULL	

Table 31: Signature OIDS for Certificates with ECC Public Keys

Field	Format	Criticality	Value	Comment
signature				

algorithmIdentifier				
algorithm	OID		1.2.840.10045.4.3.2	*ecdsaWithSHA256*
parameters	ANY			Absent

Certificates issued under this CP MUST use the following OIDs to identify the algorithm associated with the Subject Public Key in Certificates with RSA (see Table 32) and ECC (Table 33) Public Keys.

Table 32: *subjectPublicKeyInfo* for Certificate with RSA Public Keys

Field	Format	Criticality	Value	Comment
subjectPublicKeyInfo				
algorithm				
algorithmIdentifier				
algorithm	OID		1.2.840.113549.1.1.1	*rsaEncryption*
parameters	ANY		NULL	
subjectPublicKey	BIT STRING		<Subject Public Key>	Modulus length. See CP § 6.1.5

Table 33: *subjectPublicKeyInfo* for Certificate with ECC Public Keys

Field	Format	Criticality	Value	Comment
subjectPublicKeyInfo				
algorithm				
algorithmIdentifier				
algorithm	OID		1.2.840.10045.2.1	*ecPublicKey*
parameters	ANY		1.2.840.10045.3.1.7	*prime256v1*
subjectPublicKey	BIT STRING		<Subject Public Key>	Modulus length. See CP § 6.1.5

7.1.4 Name Forms

7.1.4.1 Root CAs

The following naming attributes MUST be used to populate the issuer and Subject fields in Root CA Certificates issued under this CP:

Table 34: RSA and ECC Root CA Certificate Issuer and Subject Fields

Name	Field	Value	Requirement
countryName	(C=)	US	MUST be the two-letter ISO 3166-1 country code for the country in which the Root CA's service provider's place of business is located.
organizationName	(O=)	OpenADR Alliance	MUST contain the Subscriber organization name.
organizationalUnitName	(OU=)	<Root-CA Type> Root CA<Id#>	MUST contain a name that accurately identifies the "<Root-CA Type>", either RSA or ECC. The "<Id#>"

			indicates the ID number of the Root and is populated when the Root CA Certificate is issued. For Example, “RSA Root CA0001.”
commonName	(CN=)	OpenADR Alliance <Root-CA Type> Root CA	MUST contain the common name that identifies the OpenADR Alliance Root CAs. For Example, “OpenADR Alliance RSA Root CA.”

7.1.4.2 Sub-CAs

The following naming attributes MUST be used to populate the Sub-CA Certificate Subject fields issued under this CP:

Table 35: Sub-CA Certificate Subject Fields

Name	Field	Value	Requirement
countryName	(C=)	US	MUST be the two-letter ISO 3166-1 country code for the country in which the CA’s service provider’s place of business is located.
organizationName	(O=)	OpenADR Alliance	MUST contain the Subscriber organization name.
organizationalUnitName	(OU=)	<Root-CA Type> <Sub-CA Type> CA<Id#>	MUST contain additional CA identifying information. The “<Root-CA Type>”, either RSA or ECC, the <Sub-CA Type>, either VTN or VEN. The “<Id#>” indicates the ID number of the Sub CA and is populated when the Sub CA Certificate is issued. For example, “RSA VTN CA0001.”
commonName	(CN=)	OpenADR Alliance <Root-CA Type> <Sub-CA Type> CA	MUST contain a name that accurately identifies the Sub CA, including the “<Root-CA Type>”, either RSA or ECC, the <Sub-CA Type>, either VTN or VEN. For example, “OpenADR Alliance RSA VTN CA.”

7.1.4.3 RSA and ECC VTN Subscriber Certificates

The following naming attributes MUST be used to populate the Subject in all VTN Subscriber Certificates issued under this CP:

Table 36: VTN Subscriber Certificate Subject Fields

Name	Field	Value	Requirement
countryName	(C=)	<Country Name>	MUST be the two-letter ISO 3166-1 country code for the country in which the Subscriber’s place of business is located.

organizationName	(O=)	<Organization Name>	MUST contain the Subscriber organization name (or abbreviation thereof), trademark, or other meaningful identifier.
organizationalUnitName	(OU=)	<Additional Information>	MUST contain: “OpenADR Alliance RSA VTN Certificate”
commonName	(CN=)	<Identity Information>	MUST contain identity information (e.g. DNS Name) that is bound into the Certificate that will bind the Certificate’s Public Key to the VTN server.

7.1.4.4 RSA and ECC VEN Subscriber Certificates

The following naming attributes MUST be used to populate the Subject in VEN Subscriber Certificates issued under this CP:

Table 37: VEN Subscriber Certificate Subject Fields

Name	Field	Value	Requirement
countryName	(C=)	<Country Name>	MUST be the two-letter ISO 3166-1 country code for the country in which the Subscriber’s place of business is located.
organizationName	(O=)	<Organization Name>	MUST contain the Subscriber organization name (or abbreviation thereof), trademark, or other meaningful identifier.
organizationalUnitName	(OU=)	<Addition Information>	MUST contain: “OpenADR Alliance RSA VEN Certificate.”
commonName	(CN=)	<Identity Information>	MUST contain identity information (e.g. MAC Address or ID number) that is bound into the Certificate that will bind the Certificate’s Public Key to the VEN client.

7.1.5 Name Constraints

The CAs SHALL not assert name constraints in OpenADR Certificates.

7.1.6 Certificate Policy Object Identifier

Table 38 shows the *certificatePolicies* extension settings for OpenADR RSA and ECC Sub-CA ertificates and specifies that all OpenADR Sub-CA Certificates:

- MUST include the *certificatePolicies* extension;
- MUST set the criticality of the *certificatePolicies* extension to FALSE; and
- SHALL set the *policyIdentifier* to the policy OID in CP § 1.2.

Table 38: *certificatePolicies* Extension for RSA and ECC Sub-CA Certificates

Field	Format	Criticality	Value	Comment
certificatePolicies		FALSE	{ id-ce 32 }	MUST be included in all OpenADR Sub-CA Certificates.
policyIdentifier	OID			See CP § 1.2

Table 39 shows the *certificatePolicies* extension settings for OpenADR RSA and ECC Subscriber Certificates and specifies that all OpenADR Subscriber Certificates:

- MUST include the *certificatePolicies* extension;
- MUST set the criticality of the *certificatePolicies* extension to FALSE; and
- SHALL set the *policyIdentifier* to the policy OID in CP § 1.2.

Table 39: *certificatePolicies* Extension for RSA and ECC Subscriber Certificates

Field	Format	Criticality	Value	Comment
certificatePolicies		FALSE	{ id-ce 32 }	MUST be included in all OpenADR Subscriber Certificates.
policyIdentifier	OID			See CP § 1.2

7.1.7 Usage of Policy Constraints Extension

The CAs SHALL not assert policy constraints in CA Certificates.

7.1.8 Policy Qualifiers Syntax and Semantics

Certificates issued under this CP SHALL NOT contain policy qualifiers.

7.1.9 Processing Semantics for the Critical Certificate Policies Extension

Certificates issued under this policy MUST NOT contain a critical *certificatePolicies* extension.

7.2 CRL Profile

CRLs MUST conform to [RFC 5280] and contain the basic fields and contents specified in the table below:

Table 40: CRL Profile Basic Fields

Field	Referenced Standard	Section	Requirement or Recommendation
version	[RFC 5280]	5.1.2.1	See CP § 7.2.1
signature	[RFC 5280]	5.1.2.2	Algorithm used to sign the CRL.
issuer	[RFC 5280]	5.1.2.3	Entity that has signed and issued the CRL.
thisUpdate	[RFC 5280]	5.1.2.4	Indicates the issue date of the CRL. CRLs are effective upon issuance.
nextUpdate	[RFC 5280]	5.1.2.5	Indicates the date by which the next CRL will be issued.

revokedCertificates	[RFC 5280]	5.1.2.6	Listing of revoked Certificates, including the Serial Number of the revoked Certificate and the Revocation Date.
authoritKeyIdentifier	[RFC 5280]	5.2.1	Follows the guidance in RFC 5280. Criticality is FALSE.
cRLNumber	[RFC 5280]	5.2.3	A monotonically increasing sequence number for a given CRL scope and issuer. Criticality is FALSE.
signatureAlgorithm	[RFC 5280]	5.1.1.2	Follows the guidance in RFC 5280.
signatureValue	[RFC 5280]	5.1.1.3	Follows the guidance in RFC 5280.

7.2.1 Version Number(s)

The CAs SHALL support the issuance of X.509 Version two (2) CRLs. The CRL version number MUST be set to the integer value of "1" for Version 2 [RFC 5280, Section 5.1.2.1].

7.2.2 CRL and CRL entry extensions

Critical CRL extensions MUST NOT be used.

7.3 OCSP Profile

OCSP (Online Certificate Status Protocol) is optional but is a way to obtain timely information about the revocation status of a particular Certificate. OCSP Responses MUST conform to [RFC 5019] and MUST either be:

- Signed by the CA that issued the Certificates whose revocation status is being checked; or
- Signed by an OCSP Responder whose Certificate is signed by the CA that issued the Certificate whose revocation status is being checked. Such OCSP Responder signing Certificate MUST contain the extension *id-pkix-ocsp-nocheck* as defined by [RFC 6960].

7.3.1 Version Number(s)

OCSP responses MUST support use of OCSP version 1 as defined by [RFC 6960] and [RFC 5019].

7.3.2 OCSP Extensions

Critical OCSP extensions MUST NOT be used.

8 Compliance Audit and Other Assessments

8.1 Frequency or Circumstances of Assessment

CAs operating under this policy SHALL be subject to a periodic Compliance Audit at least once per year. Compliance Audits are conducted at the sole expense of the audited entity. The OpenADR PKI-PA MAY require a periodic Compliance Audit of CAs operating under this policy as stated in CP § 8.4.

8.2 Identity/Qualifications of Assessor

The CA MAY select an auditor, subject to the qualifications described herein. The auditor SHALL demonstrate competence in the field of Compliance Audits, and SHALL be thoroughly familiar with the CA's CPS and this CP. The auditor SHALL be a certified information system auditor (CISA), or IT security specialist, and a PKI subject matter specialist who can offer input regarding acceptable risks, mitigation strategies, and industry best practices.

Audits performed by an independent third-party audit firm MUST be performed by a certified public accounting firm with demonstrated expertise in computer security or by accredited computer security professionals employed by a competent security consultancy. Such firm SHALL also have demonstrated expertise in the performance of IT security and PKI Compliance Audits and the selected Audit Scheme.

The qualified audit firm SHALL be bound by law, government regulation, or professional code of ethics and SHALL maintain Professional Liability/Errors & Omissions insurance with policy limits of at least one million US dollars in coverage.

8.3 Assessor's Relationship to Assessed Entity

The Compliance Auditor either SHALL be a private firm that is independent from the CA being audited, or it SHALL be sufficiently organizationally separated from those entities to provide an unbiased, independent evaluation. Compliance Auditors SHALL not have a conflict of interest that hinders their ability to perform auditing services. To insure independence and objectivity, the Compliance Auditor may not have served the entity in developing or maintaining the entity's CA Facility or CPS. The OpenADR PKI-PA SHALL determine whether a Compliance Auditor meets this requirement.

8.4 Topics Covered by Assessment

CA's SHALL perform an annual Compliance Audit that MUST be a WebTrust for Certification Authorities or an equivalent audit standard approved by OpenADR PKI-PA which includes: A Report of Policies and Procedures in Operation and Test of Operational Effectiveness. The purpose of the annual Compliance Audit shall be to verify that a CA complies with all the requirements of the current versions of this CP and the CA's CPS.

All aspects of the CA operation MUST be subject to the Compliance Audit and SHOULD address the items listed below. A WebTrust for Certification Authorities or equivalent will satisfy this requirement.

- Identify foreseeable internal and external threats that could result in unauthorized access, disclosure, misuse, alteration, or destruction of any Certificate Data or Certificate Management Processes;
- Assess the likelihood and potential damage of these threats, taking into consideration the sensitivity of the Certificate Data and Certificate Management Processes; and
- Assess the sufficiency of the policies, procedures, information systems, technology, and other arrangements that the CA has in place to counter such threats.

In addition to Compliance Audits, if the OpenADR PKI-PA has a reasonable belief that a CA is not operating in conformance with this CP, the OpenADR PKI-PA SHALL be entitled, to perform other reviews and investigations, which include, but are not limited to:

- A “Security and Practices Review,” which consists of a review of a CA’s secure facility, security documentation, CPS, and any other appropriate material to ensure that the CA meets the CP.
- An “Exigent Audit/Investigation” on CAs, including, for example, in the event the OpenADR PKI-PA has reason to believe that the audited entity has failed to meet the CP Standards, has experienced an incident or Compromise, or has acted or failed to act, such that the audited entity’s failure, the incident or Compromise, or the act or failure to act poses an actual or potential threat to the security or integrity of the OpenADR PKI.
- A “Supplemental Risk Management Reviews” on CAs following incomplete or exceptional findings in a Compliance Audit.

The OpenADR PKI-PA SHALL be entitled to delegate the performance of these audits, reviews, and investigations to (a) the Superior Entity of the entity being audited, reviewed, or investigated or (b) a third-party audit firm. Entities that are subject to an audit, review, or investigation SHALL provide cooperation with OpenADR PKI-PA and the personnel performing the audit, review, or investigation.

8.5 Actions Taken as a Result of Deficiency

When the Compliance Auditor finds a discrepancy between the requirements of this CP or the stipulations in the CPS and the design, operation, or maintenance of the PKI Authorities, the following actions MUST be performed:

- The Compliance Auditor SHALL note the discrepancy;
- The Compliance Auditor SHALL notify the parties identified in CP § 8.6 of the discrepancy; and
- The party responsible for correcting the discrepancy will propose a remedy, including expected time for completion, to the parties identified in CP § 8.6.

In the event the audited entity fails to develop a corrective action plan or implement it, or if the report reveals exceptions or deficiencies that the OpenADR PKI-PA reasonably believes poses an immediate threat to the security or integrity of the OpenADR PKI, then OpenADR PKI-PA:

- SHALL determine whether revocation and Compromise reporting are necessary;
- SHALL be entitled to suspend services to the audited entity; and
- If necessary, MAY terminate such services subject to this CP and the terms of the audited entity’s contract.

8.6 Communication of Results

Following any Compliance Audit, the audited entity SHALL provide the OpenADR PKI-PA with the Audit Compliance Report and identification of corrective measures within 30 days of completion. A special Compliance Audit MAY be required to confirm the implementation and effectiveness of the remedy.

9 Other Business and Legal Matters

9.1 Fees

9.1.1 Certificate Issuance or Renewal Fees

Subscribers MAY be charged a fee for the issuance, management, and renewal of Certificates.

9.1.2 Certificate Access Fees

CAs SHALL not charge a fee as a condition of making a Certificate available in a repository or otherwise making Certificates available to Relying Parties.

9.1.3 Revocation or Status Information Access Fees

CAs SHALL not charge a fee as a condition of making CRLs available in a repository or otherwise available to Relying Parties.

9.1.4 Fees for Other Services

No stipulation.

9.1.5 Refund Policy

Refund policies SHOULD be stipulated in the DCSA.

9.2 Financial Responsibility

9.2.1 Insurance Coverage

OpenADR PKI Participants SHOULD maintain a commercially reasonable level of insurance coverage for errors and omissions, either through an errors and omissions insurance program with an insurance carrier or a self-insured retention.

9.2.2 Other Assets

CAs SHALL have sufficient financial resources to maintain their operations and perform their duties, and they SHALL be reasonably able to bear the risk of liability to Subscribers and Relying Parties.

9.2.3 Insurance or Warranty Coverage for End-Entities

No stipulation.

9.3 Confidentiality of business information

9.3.1 Scope of Confidential Information

The following Subscriber information MUST be kept confidential and private:

- Certificate Application records;
- CA application status, whether approved or disapproved;
- Transactional records (both full records and the audit trail of transactions);
- Audit trail records;
- Audit reports;
- Contingency planning and DRPs; and
- Security measures controlling the operations of CA hardware and software.

9.3.2 Information not Within the Scope of Confidential Information

OpenADR PKI Participants acknowledge that Certificates, Certificate revocation and other status information, OpenADR repositories, and information contained within them are not considered confidential/private information. Information not expressly deemed confidential/private information under CP § 9.3.1 MUST be considered neither confidential nor private.

9.3.3 Responsibility to Protect Confidential Information

OpenADR PKI Participants receiving private information SHALL secure it from Compromise and disclosure to third parties.

9.4 Privacy of Personal Information

9.4.1 Privacy Plan

CAs SHALL have a privacy plan to protect personally identifying information from unauthorized disclosure.

9.4.2 Information Treated as Private

CAs acquiring services under this policy SHALL protect all Subscriber personally identifying information from unauthorized disclosure. Records of individual transactions MAY be released upon request of any Subscribers involved in the transaction or their legally recognized agents. The contents of the archives maintained by CAs operating under this policy SHALL not be released except as required by law.

9.4.3 Information not Deemed Private

Information included in Certificates is deemed pubic information and is not subject to protections outlined in § 9.4.2.

9.4.4 Responsibility to Protect Private Information

Sensitive information MUST be stored securely, and MAY be released only in accordance with other stipulations in § 9.4.

9.4.5 Notice and Consent to Use Private Information

The OpenADR PKI-PA or OpenADR CAs are not required to provide any notice or obtain the consent of the Subscriber in order to release private information in accordance with other stipulations in § 9.4.

9.4.6 Disclosure Pursuant to Judicial or Administrative Process

The OpenADR PKI-PA or OpenADR CAs SHALL not disclose private information to any third party unless authorized by this policy, required by law, government rule or regulation, or order of a court of competent jurisdiction.

9.4.7 Other Information Disclosure Circumstances

No stipulations.

9.5 Intellectual Property Rights

The OpenADR PKI-PA retains all Intellectual Property Rights in and to this CP.

CAs retain all Intellectual Property Rights in and to the Certificates and revocation information that they issue.

A Certificate Applicant retains all rights it has (if any) in any trademark, service mark, or trade name contained in any Certificate Application and DN within any Certificate issued to such Certificate Applicant.

Private Keys corresponding to Certificates of CAs and Subscribers are the property of the CAs and Subscribers that are the respective Subjects of these Certificates. Secret Shares of a CA's Private Key are the property of the CA, and the CA retains all Intellectual Property Right in and to such Secret Shares.

Without limiting the generality of the foregoing, OpenADR's Root Public Keys and Certificates containing them, including all CA and Subscriber Public Keys and Certificates containing them, are

the property of OpenADR. OpenADR licenses software and hardware manufacturers to reproduce such Public Key Certificates to place copies in OpenADR compliant hardware devices or software.

9.6 Representations and Warranties

The OpenADR PKI-PA SHALL:

- Approve the CPS for each CA that issues Certificates under this policy;
- Review periodic Compliance Audits to ensure that CAs are operating in compliance with their approved CPSs;
- Review name space control procedures to ensure that DNs are uniquely assigned for all Certificates issued under this CP;
- Revise this CP to maintain the level of assurance and operational practicality;
- Publicly distribute this CP; and
- Coordinate modifications to this CP to ensure continued compliance by CAs operating under approved CPSs.

9.6.1 CA Representations and Warranties

CAs operating under this CP SHALL warrant that:

- The CA procedures are implemented in accordance with this CP;
- The CA will provide their CPS to the OpenADR PKI-PA, as well as any subsequent changes, for conformance assessment;
- The CA operations are maintained in conformance to the stipulations of the approved CPS;
- Any Certificate issued is in accordance with the stipulations of this CP;
- There are no material misrepresentations of fact in the Certificate known to or originating from the entities approving the Certificate Application or issuing the Certificate;
- There are no errors in the information in the Certificate that were introduced by the entities approving the Certificate Application as a result of a failure to exercise reasonable care in managing the Certificate Application;
- Their Certificates meet all material requirements of this CP and the applicable CPS;
- The revocation of Certificates in accordance with the stipulations in this CP; and
- Revocation services (when applicable) and use of a repository conform to all material requirements of this CP and the applicable CPS in all material aspects.

Subscriber Agreements MAY include additional representations and warranties.

9.6.2 RA Representations and Warranties

RAs that perform registration functions under this CP SHALL warrant that:

- The RA complies with the stipulations of this CP;
- The RA complies with and maintains its operations in conformance to the stipulations of the approved CPS;
- There are no material misrepresentations of fact in the Certificate known to or originating from the entities approving the Certificate Application or issuing the Certificate;
- There are no errors in the information in the Certificate that were introduced by the entities approving the Certificate Application as a result of a failure to exercise reasonable care in managing the Certificate Application;
- Their Certificates meet all material requirements of this CP and the applicable CPS; and
- Revocation services (when applicable) and use of a repository conform to all material requirements of this CP and the applicable CPS in all material aspects.

Subscriber Agreements MAY include additional representations and warranties.

9.6.3 Subscriber representations and warranties

Subscribers SHALL sign a DCSA containing the requirements the Subscriber SHALL meet, including protection of their Private Keys and use of the Certificates, before being issued the Certificates. In addition, Subscribers SHALL warrant that:

- The Subscriber SHALL abide by all the terms, conditions, and restrictions levied on the use of their Private Keys and Certificates.
- Each Digital Signature created using the Private Key corresponding to the Public Key listed in the Certificate is the Digital Signature of the Subscriber and the Certificate has been accepted and is operational (not expired or revoked) at the time the Digital Signature is created.
- Subscriber's Private Keys are protected from unauthorized use or disclosure.
- All representations made by the Subscriber in the Certificate Application the Subscriber submitted are true.
- All information supplied by the Subscriber and contained in the Certificate is true.
- The Certificate is being used exclusively for authorized and legal purposes, consistent with all material requirements of this CP.
- The Subscriber will promptly notify the appropriate CA upon suspicion of loss or Compromise of their Private Key(s).
- The Subscriber is an end-user Subscriber and not a CA, and is not using the Private Key corresponding to any Public Key listed in the Certificate for purposes of digitally signing any Certificate (or any other format of certified Public Key) or CRL, as a CA or otherwise.

Subscriber Agreements MAY include additional representations and warranties.

9.6.4 Relying Party Representations and Warranties

This CP does not specify the steps a Relying Party SHOULD take to determine whether to rely upon a Certificate. The Relying Party decides, pursuant to its own policies, what steps to take. The CA merely provides the tools (i.e., Certificates and CRLs) needed to perform the trust path creation, validation, and CP mappings that the Relying Party MAY wish to employ in its determination. Relying Parties acknowledge that they have sufficient information to make an informed decision as to the extent to which they choose to rely on the information in a Certificate, that they are solely responsible for deciding whether or not to rely on such information, and that they SHALL bear the legal consequences of their failure to perform the Relying Party obligations in terms of this CP.

9.6.5 Representations and Warranties of Other Participants

No stipulations.

9.7 Disclaimers of warranties

To the extent permitted by applicable law, Subscriber Agreements MUST disclaim OpenADR's and the applicable Affiliate's possible warranties, including any warranty of merchantability or fitness for a particular purpose.

9.8 Limitations of liability

The liability (and/or limitation thereof) of Subscribers MUST be as set forth in the applicable Subscriber Agreements.

9.9 Indemnities

To the extent permitted by applicable law, Subscribers are required to indemnify CAs for:

- Falsehood or misrepresentation of fact by the Subscriber on the its Certificate Application;
- Failure by the Subscriber to disclose a material fact on the Certificate Application, if the misrepresentation or omission was made negligently or with intent to deceive any party;

- The Subscriber's failure to take the precautions necessary to prevent the Compromise, loss, disclosure, modification, or unauthorized use of the Subscriber's Private Key(s); and
- The Subscriber's use of a name (including that infringes upon the Intellectual Property Rights of a third party.

9.10 Term and termination

9.10.1 Term

The CP becomes effective when approved by the OpenADR PKI-PA. Amendments to this CP become effective upon publication. This CP has no specified term.

9.10.2 Termination

This CP as amended from time to time MUST remain in force until it is replaced by a new version. Termination of this CP is at the discretion of the OpenADR PKI-PA.

9.10.3 Effect of termination and survival

Upon termination of this CP, OpenADR PKI Participants are nevertheless bound by its terms for all Certificates issued for the remainder of the Validity Periods of such Certificates.

9.11 Individual notices and communications with participants

Unless otherwise specified by agreement between the parties, OpenADR participants SHALL use commercially reasonable methods to communicate with each other, taking into account the criticality and subject matter of the communication.

9.12 Amendments

9.12.1 Procedure for Amendment

The OpenADR PKI-PA SHALL review this CP at least once every year. Corrections, updates, or changes to this CP MUST be made available as per CP § 9.12.2. Suggested changes to this CP MUST be communicated to the contact in CP §1.5.2; such communication MUST include a description of the change, a change justification, and contact information for the person requesting the change.

9.12.2 Notification Mechanism and Period

The OpenADR PKI-PA reserves the right to amend the CP without notification for amendments that are not material, including without limitation corrections of typographical errors, changes to URLs, and changes to contact information. The PKI-PA's decision to designate amendments as material or non-material SHALL be within the PKI-PA's sole discretion.

Change notices to this CP MUST be distributed electronically to OpenADR PKI Participants and observers in accordance with the OpenADR PKI-PA document change procedures.

9.12.3 Circumstances Under Which OID Must be Changed

Object Identifiers (OIDs) will be changed if the OpenADR PKI-PA determines that a change in the CP reduces the level of assurance provided. If the OpenADR PKI-PA determines that a change is necessary in the OID corresponding to a Certificate Policy, the amendment MUST contain new object identifiers for the Certificate Policies corresponding to each Class of Certificate. Otherwise, amendments shall not require a change in Certificate Policy object identifier.

9.13 Dispute Resolution Provisions

The OpenADR PKI-PA SHALL facilitate the resolution between entities when conflicts arise as a result of the use of Certificates issued under this policy.

9.14 Governing Law

Subject to any limits appearing in applicable law, the laws of the State of Colorado, U.S.A., SHALL govern the enforceability, construction, interpretation, and validity of this CP, irrespective of contract or other choice of law provisions and without the requirement to establish a commercial nexus in Colorado, USA. This choice of law is made to ensure uniform procedures and interpretation for all OpenADR Participants, no matter where they are located.

This governing law provision applies only to this CP. Agreements incorporating the CP by reference MAY have their own governing law provisions, provided that this CP § 9.14 governs the enforceability, construction, interpretation, and validity of the terms of the CP separate and apart from the remaining provisions of any such agreements, subject to any limitations appearing in applicable law.

9.15 Compliance with Applicable Law

This CP is subject to applicable national, state, local, and foreign laws, rules, regulations, ordinances, decrees, and orders including, but not limited to, restrictions on exporting or importing software, hardware, or technical information. All 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

No stipulation.

9.16.3 Severability

Should it be determined that one section of this CP is incorrect or invalid, the other sections of this CP shall remain in effect until the CP is updated. The process for updating this CP is described in CP § 9.12.

In the event that a clause or provision of this CP is held to be unenforceable by a court of law or other tribunal having authority, the remainder of the CP shall remain valid.

9.16.4 Enforcement (Attorneys' fees and waiver of rights)

No Stipulation.

9.16.5 Force Majeure

To the extent permitted by applicable law, OpenADR PKI agreement (e.g., DCSAs) shall include a force majeure clause protecting OpenADR and the applicable Affiliate.

9.17 Other Provisions

No Stipulation.

10 References

FIPS 140-2	Security Requirements for Cryptographic Modules, FIPS 140-2, May 25, 2001. http://csrc.nist.gov/publications/fips/fips140-2/fips1402.pdf
OpenADR 2.0a & 2.0b	OpenADR 2.0 Profile Specifications https://www.openadr.org/specification
RFC 2119	Key Words for use in RFCs to Indicate Requirement Level, IETF (Bradner), March 1997. http://www.ietf.org/rfc/rfc2119.txt
RFC 3647	Internet X.509 PKI Certificate Policy and Certification Practices Framework, IETF (Chokhani, Ford, Sabett, Merrill, and Wu), November 2003. http://www.ietf.org/rfc/rfc3647.txt
RFC 5019	The Lightweight Online Certificate Status Protocol (OCSP) Profile for High-Volume Environments, IETF (Deacon, Hurst), September 2007. http://www.ietf.org/rfc/rfc5019.txt
RFC 5280	Internet X.509 PKI Certificate and Certification Revocation List (CRL) Profile, IETF (Cooper, Santesson, Farrell, Boeyen, Housley, and Polk), May 2008. http://www.ietf.org/rfc/rfc5280.txt
RFC 6960	X.509 Internet Public Key Infrastructure Online Certificate Status Protocol – OCSP, June 2013. https://www.ietf.org/rfc/rfc6960.txt
X.500	ITU-T Recommendation X.500 Series (2019) – Information technology – Open Systems Interconnection – The Directory: Overview of concepts, models and services

11 Glossary

This document uses the following terms, which are Capitalized within the document:

Certificate	A message that, at least, states a name or identifies the CA, identifies the Subscriber, contains the Subscriber's Public Key, identifies the Certificate's Validity Period, contains a Certificate serial number, and is digitally signed by the CA that issued the Certificate. Also known as a digital Certificate.
Certificate Applicant	An individual or organization that requests the issuance of a Certificate by a CA. Once the Certificate issuance procedure is completed (e.g., when the Certificate has been issued) the Applicant becomes a Subscriber.
Certificate Application	A request from a Certificate Applicant (or authorized agent of the Certificate Applicant) to a CA for the issuance of a Certificate.
Certificate Chain	An ordered list of Certificates containing a Subscriber Certificate and one or more CA Certificates, which terminates in a Root Certificate.
Certificate Policy (CP)	The principal statement of policy governing the OpenADR PKI.
Certificate Revocation List (CRL)	A periodically (or exigently) issued list, digitally signed by a CA, of identified Certificates that have been revoked prior to their expiration dates. The list generally indicates the CRL issuer's name, the date of issue, the date of the next scheduled CRL issue, the revoked Certificates' serial numbers, and the specific times and reasons for revocation.
Certificate Signing Request (CSR)	A message conveying a request to have a Certificate issued.
Certification Authority (CA)	An entity authorized to issue, manage, revoke, and renew Certificates in the OpenADR PKI.
Certification Practice Statement (CPS)	A statement of the practices that a CA employs in approving or rejecting Certificate Applications and issuing, managing, and revoking Certificates.
Compliance Audit	A periodic audit that a CA system undergoes to determine its conformance with OpenADR PKI requirements that apply to it. The Compliance Audit is completed by a Compliance Auditor.
Compromise	A violation of a Security Policy, in which an unauthorized disclosure of, or loss of control over, sensitive information has occurred. With respect to Private Keys, a Compromise is a loss, theft, disclosure, modification, unauthorized use, or other Compromise of the security of such Private Key.
Cryptographic Module	The set of hardware, software, firmware, or some combination thereof that implements cryptographic logic or processes, including cryptographic algorithms, and is contained within the cryptographic boundary of the module. [FIPS 140-2]
Device Certificate	A Certificate in which the Subject is not a CA (also known as an end-entity or Subscriber Certificate).

Digital Certificate Subscriber Agreement (DCSA)	An agreement used by a CA setting forth the terms and conditions under which an individual or organization acts as a Subscriber.
Digital Signatures	The result of a transformation of a message by means of a cryptographic system using keys such that a Relying Party can determine (1) whether the transformation was created using the Private Key that corresponds to the Public Key in the signer's digital Certificate; and (2) whether the message has been altered since the transformation was made.
Disaster Recovery Plan (DRP)	A documented process or set of procedures to recover and protect an infrastructure in the event of a disaster.
Distinguished Name (DN)	Identification fields in a Certificate that are input by the CA when issuing Certificates. The information is obtained from the Subscriber's Naming Document.
Elliptic Curve Cryptography (ECC)	A public-key cryptography system based on the algebraic structure of elliptic curves over finite fields.
Exigent Audit/Investigation	An audit or investigation by OpenADR where OpenADR has reason to believe that an entity's failure to meet PKI Standards, an incident or Compromise relating to the entity, or an actual or potential threat to the security of the PKI posed by the entity has occurred.
Intellectual Property Rights	Rights under one or more of the following: copyright, patent, trade secret, trademark, or any other Intellectual Property ights.
Key Generation Ceremony	A procedure whereby a CA's Key Pair is generated, its Private Key is backed up, and/or its Public Key is certified.
Key Pair	Two mathematically related keys having the properties that (1) one (Public) Key can be used to encrypt a message that can only be decrypted using the other (Private) Key; and (2) even knowing the Public Key, it is computationally infeasible to discover the Private Key.
Naming Document (or Naming Application)	A form, included in the Certificate Application, that is completed by the Certificate Applicant and contains the information to be loaded into the Certificate subjectDN which will set the Certificate profile.
PKCS #10	Public-Key Cryptography Standard #10, developed by RSA Security Inc., which defines a structure for a Certificate Signing Request.
PKCS #8	Public-Key Cryptography Standard #8, developed by RSA Security Inc., which defines a secure means for the transfer of Private Keys.
PKI Participant	An individual or organization that is one or more of the following within the OpenADR PKI: OpenADR, a CA, a Subscriber, or a Relying Party.
Private Key	The key of a signature Key Pair used to create a Digital Signature. This key MUST be kept secret.

Processing Center	A secure facility created by an appropriate organization (e.g., Symantec) that houses, among other things, the Cryptographic Modules used for the issuance of Certificates.
Public Key	The key of a signature Key Pair used to validate a Digital Signature. This key is normally made publicly available in the form of a digital Certificate.
Public Key Infrastructure (PKI)	The architecture, organization, techniques, practices, and procedures that collectively support the implementation and operation of a Certificate-based Private Key cryptographic system.
Relying Party	An individual or organization that acts in reliance on a certificateCertificate and/or a dDigital sSignature.
Root CA	A Root Certification Authority (CA) is the highest level CA of a PKI. It generates a self-signed Certificate, which means that the Root CA validates itself (self-validating). A Root CA can issue Sub-CAs that effectively trust it. The Sub-CAs receive a Certificate signed by the Root CA, so the Sub-CAs can issue Certificates that are validated by the Root CA. This establishes a CA hierarchy and chain of trust.
RSA (Algorithm)	A Private Key cryptographic system invented by Rivest, Shamir, and Adelman.
Secret Share	A portion of the activation data needed to operate the Private Key, held by individuals called “Shareholders.” Some threshold number of Secret Shares (n) out of the total number of Secret Shares (m) shall be required to operate the Private Key.
Secret Sharing	The practice of splitting a CA Private Key or the activation data to operate a CA Private Key in order to enforce multi-person control over CA Private Key operations.
Security Repository	OpenADR’ database of relevant security information accessible on-line.
Subdomain	The portion of the OpenADR PKI under control of an entity and all entities subordinate to it within the OpenADR hierarchy.
Subordinate (Sub-) CA	A Subordinate CA issued directly from the Root CA that allows for more specific policy implementations and protects the Root CA from unnecessary exposure.
Subscriber	An entity that (1) is the Subject named or identified in a Certificate issued to that entity, (2) holds a Private Key that corresponds to the Public Key listed in the Certificate, and (3) does not itself issue Certificates to another party.The entity who requests a Certificate (e.g., a manufacturer). The Subscriber is capable of using, and is authorized to use, the Private Key that corresponds to the Private Key listed in the Certificate.
Trusted Person	An employee, contractor, or consultant of an entity within the OpenADR PKI responsible for managing infrastructural trustworthiness of the entity, its products, its services, its facilities, and/or its practices.

Trusted Role	The positions within the OpenADR manufacuring entity that MUST be held by a Trusted Person.
Trustworthy System	Computer hardware, software, and procedures that are reasonably secure from intrusion and misuse; provide a reasonable level of availability, reliability, and correct operation; are reasonably suited to performing their intended functions; and enforce the applicable security Security policyPolicy.
Validity Period	The period starting with the date and time a Certificate is issued (or on a later date and time certain if stated in the Certificate) and ending with the date and time on which the Certificate expires or is earlier revoked.

12 Abbreviations and Acronyms

This specification uses the following abbreviations:

CA	Certification Authority
CP	Certificate Policy
CPS	Certification Practice Statement
CRL	Certificate Revocation List
CSR	Certificate Signing Request
DN	Distinguished Name
DR	Demand Response
DRAS	Demand Response Automation Server
DRP	Disaster Recovery Plan
ECC	Elliptic Curve Cryptography
FIPS	Federal Information Processing Standards
id-at	X.500 attribute types. (OID value: 2.5.4)
id-ce	Object Identifier for Version 3 Certificate extensions (OID value: 2.5.29)
IETF	Internet Engineering Task Force
ISO	Independent System Operators
MFG	Manufacturer
OID	Object Identifier
OpenADR	Open Automated Demand Response
PA	Policy Authority
PKCS	Public-Key Cryptography Standard
PKI	Public Key Infrastructure
RFC	Request for comment
RSA	Rivest, Shamir, Adelman
VEN	Virtual End Node
VTN	Virtual Top Node

Appendix A - (Informative) Document Control Number History

Table 41 shows the Document Control Numbers that have been incorporated into this CP.

Table 41: Document Control Number (DCN)

DCN	Author	Approval Date	Summary
I01	Kyrio	2017	Kyrio edits
I02	Eonti	2021	Minor edits to allow for multiple RAs
I03	Eonti	2025	Review and update of all requirements to account for any PKI changes. Major formatting edits and clarifications made for clearer requirement understanding.

Appendix B - RSA Root CA Certificate Profile

Table 42 shows an EXAMPLE of the OpenADR Root CA Certificate profile for Root CAs that contain RSA Public Keys.

Table 42: OpenADR RSA Root CA Certificate Profile

Field	Format	Value	Comments
Certificate			
tbsCertificate			Fields to be signed
version	INTEGER	2	See CP § 7.1.1
serialNumber			See Table 9
certificateSerialNumber	INTEGER	<Unique positive integer>	Assigned by issuing CA
signature			See CP § 7.1.3, Table 30
algorithmIdentifier			
algorithm	OID	1.2.840.113549.1.1.11	*sha256WithRSAEncryption*
parameters	ANY	NULL	
issuer			See CP § 7.1.4.1
RDNSequence	Name		X.500 Distinguished Name
relativeDistinguishedName	SET OF		
attributeTypeAndValue	SEQUENCE		
attributeType	OID	{id-at 6}	*countryName* (size = 2)
atttributeValue	*printableString*	**US**	C= US
attributeTypeAndValue			
attributeType	OID	{id-at 10}	*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**	O= OpenADR Alliance
attributeTypeAndValue			
attributeType	OID	{id-at 11}	*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**RSA Root CA<*ID#*>**	OU= RSA Root CA<ID#>
attributeTypeAndValue			
attributeType	OID	{id-at 3)	*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance RSA Root CA**	CN= OpenADR Alliance RSA Root CA
validity			See Table 8
notBefore			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Key ceremony date	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Key ceremony date	Use for dates after 2049
notAfter			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Up to 40 years	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Up to 40 years	Use for dates after 2049
subject			See CP § 7.1.4.1

Name			X.500 Distinguished Name
RDNSequence			
relativeDistinguishedName	SET OF		
attributeTypeAndValue	SEQUENCE		
attributeType	OID	{id-at 6}	*countryName* (size = 2)
atttributeValue	*printableString*	**US**	C= US
attributeTypeAndValue			
attributeType	OID	{id-at 10}	*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**	O= OpenADR Alliance
attributeTypeAndValue			
attributeType	OID	{id-at 11}	*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**RSA Root CA<*Id#*>**	OU= RSA Root CA<Id#>
attributeTypeAndValue			
attributeType	OID	{id-at 3)	*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance RSA Root CA**	CN= OpenADR Alliance RSA Root CA
subjectPublicKeyInfo			See Table 32
algorithm			
algorithmIdentifier			
algorithm	OID	1.2.840.113549.1.1.1	*rsaEncryption*
parameters	ANY	NULL	
subjectPublicKey	BIT STRING	<4096 bits>	Modulus length

Field	Format	Criticality	Value	Comments
extensions				See CP § 7.1.2, Table 10
basicConstraints		TRUE	{ id-ce 19 }	Table 17
cA	BOOLEAN		TRUE	Set
pathLenConstraint	INTEGER			Not Set (None)
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	Table 4
keyCertSign	(5)		1	Set
cRLSign	(6)		1	Set
subjectAltName		FALSE	{ id-ce 17 }	Table 25
generalNames				
generalName				
directoryName	Name		<Name>	Directory Address
subjectKeyIdentifier		FALSE	{ id-ce 14 }	Table 28
keyIdentifier	OCTET STRING		<*keyIdentifier*>	Calculated per Method 1

----- End Of Fields To Be Signed (*tbsCertificate*) -----

Field	Format	Value	Comments
signatureAlgorithm			See CP § 7.1.3, Table 30
algorithmIdentifier			
algorithm	OID	1.2.840.113549.1.1.11	*sha256WithRSAEncryption*
parameters	ANY	NULL	
signatureValue			See CP § 7.1

Appendix C - RSA Sub-CA Certificate Profile

Table 43 shows an EXAMPLE of the OpenADR Sub-CA Certificate profile for VEN or VTN Sub-CAs that contain RSA Public Keys.

Table 43: OpenADR RSA Sub-CA Certificate Profile

Field	Format	Value	Comments
Certificate			
tbsCertificate			Fields to be signed
version	INTEGER	2	See CP § 7.1.1
serialNumber			See Table 9
certificateSerialNumber	INTEGER	<Unique positive integer>	Assigned by issuing CA
signature			See CP § 7.1.3, Table 30
algorithmIdentifier			
algorithm	OID	1.2.840.113549.1.1.11	*sha256WithRSAEncryption*
parameters	ANY	NULL	
issuer			See CP § 7.1.4.1
Name			X.500 Distinguished Name
RDNSequence			
relativeDistinguishedName	SET OF		
attributeTypeAndValue	SEQUENCE		
attributeType	OID	{id-at 6}	*countryName* (size = 2)
atttributeValue	*printableString*	**US**	C= US
attributeTypeAndValue			
attributeType	OID	{id-at 10}	*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**	O= OpenADR Alliance
attributeTypeAndValue			
attributeType	OID	{id-at 11}	*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**RSA Root CA<*ID#*>**	OU= RSA Root CA<ID#>
attributeTypeAndValue			
attributeType	OID	{id-at 3)	*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance RSA Root CA**	CN= OpenADR Alliance RSA Root CA
validity			See Table 8
notBefore			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Key ceremony date	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Key ceremony date	Use for dates after 2049
notAfter			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Up to 30 years	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Up to 30 years	Use for dates after 2049

subject				See CP § 7.1.4.2
Name				X.500 Distinguished Name
RDNSequence				
relativeDistinguishedName	SET OF			
attributeTypeAndValue	SEQUENCE			
attributeType	OID	{id-at 6}		*countryName* (size = 2)
atttributeValue	*printableString*	**US**		C= US
attributeTypeAndValue				
attributeType	OID	{id-at 10}		*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**		O= OpenADR Alliance
attributeTypeAndValue				
attributeType	OID	{id-at 11}		*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**RSA <*Sub-CA Type*> CA<*ID#*>**		OU= RSA <Sub-CA Type> CA<ID#>
attributeTypeAndValue				
attributeType	OID	{id-at 3)		*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance RSA <*Sub-CA Type*> CA**		CN= OpenADR Alliance RSA <Sub-CA Type> CA
subjectPublicKeyInfo				See Table 32
algorithm				
algorithmIdentifier				
algorithm	OID	1.2.840.113549.1.1.1		*rsaEncryption*
parameters	ANY	NULL		
subjectPublicKey	BIT STRING	<3072 bits>		Modulus length
Field	**Format**	**Criticality**	**Value**	**Comments**
extensions				See CP § 7.1.2, Table 11
authorityKeyIdentifier		FALSE	{ id-ce 35 }	Table 15
keyIdentifier	OCTET STRING		<*keyIdentifier*>	Calculated per Method 1
basicConstraints		TRUE	{ id-ce 19 }	Table 18
cA	BOOLEAN		TRUE	Set
pathLenConstraint	INTEGER		0	Set
certificatePolicies		FALSE	{ id-ce 32 }	See CP § 1.2, Table 38
policyInformation				
policyIdentifier				
certPolicyId	OID		1.3.6.1.4.1.41519.1.1	Certificate Policy OID
policyQualifiers	SEQUENCE			Not Set
cRLDistributionPoint				(Optional), Table 20
distributionPoint				
distributionPointName	*generalNames*		URL	Address of CRL location
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	Table 4
keyCertSign	(5)		1	Set
cRLSign	(6)		1	Set
subjectAltName		FALSE	{ id-ce 17 }	(Optional), Table 26
generalNames				
generalName				

directoryName	Name		<Name>	Directory Address
subjectKeyIdentifier		FALSE	{ id-ce 14 }	Table 28
keyIdentifier	OCTET STRING		*<keyIdentifier>*	Calculated per Method 1
----- End Of Fields To Be Signed (*tbsCertificate*) -----				
Field	**Format**	**Value**		**Comments**
signatureAlgorithm				See CP § 7.1.3, Table 30
algorithmIdentifier				
algorithm	OID	1.2.840.113549.1.1.11		*sha256WithRSAEncryption*
parameters	ANY	NULL		
signatureValue				See CP § 7.1

Appendix D - RSA VEN Client Certificate Profile

Table 44 shows an EXAMPLE OpenADR VEN client Certificate profile for client Certificates that contain RSA Public Keys.

Table 44: OpenADR RSA VEN Client Certificate Profile

Field	Format	Value	Comments
Certificate			
tbsCertificate			Fields to be signed
version	INTEGER	2	See CP § 7.1.1
serialNumber			See Table 9
certificateSerialNumber	INTEGER	<Unique positive integer>	Assigned by issuing CA
signature			See CP § 7.1.3, Table 30
algorithmIdentifier			
algorithm	OID	1.2.840.113549.1.1.11	*sha256WithRSAEncryption*
parameters	ANY	NULL	
issuer			See CP § 7.1.4.2
Name			X.500 Distinguished Name
RDNSequence			
relativeDistinguishedName	SET OF		
attributeTypeAndValue	SEQUENCE		
attributeType	OID	{id-at 6}	*countryName* (size = 2)
atttributeValue	*printableString*	**US**	C= US
attributeTypeAndValue			
attributeType	OID	{id-at 10}	*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**	O= OpenADR Alliance
attributeTypeAndValue			
attributeType	OID	{id-at 11}	*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**RSA VEN CA<ID#>**	OU= RSA VEN CA<ID#>
attributeTypeAndValue			
attributeType	OID	{id-at 3)	*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance RSA VEN CA**	CN= OpenADR Alliance RSA VEN CA
validity			See Table 8
notBefore			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Key ceremony date	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Key ceremony date	Use for dates after 2049
notAfter			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Up to 20 years	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Up to 20 years	Use for dates after 2049

subject				See CP § 7.1.4.4
Name				X.500 Distinguished Name
RDNSequence				
relativeDistinguishedName	SET OF			
attributeTypeAndValue	SEQUENCE			
attributeType	OID	{id-at 6}		*countryName* (size = 2)
atttributeValue	*printableString*	***<Country Code>***		C= <Country Code>
attributeTypeAndValue				
attributeType	OID	{id-at 10}		*organizationName* (size = 64)
atttributeValue	*printableString*	***<Subscriber Org. Name>***		O= <Subscriber Org. Name>
attributeTypeAndValue				
attributeType	OID	{id-at 11}		*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance RSA VEN Certificate**		OU= <Additional Identifying Information>
attributeTypeAndValue				
attributeType	OID	{id-at 3)		*commonName* (size = 64)
atttributeValue	*printableString*	***<Unique Id>***		CN= <Unique Id>
subjectPublicKeyInfo				See Table 32
algorithm				
algorithmIdentifier				
algorithm	OID	1.2.840.113549.1.1.1		*rsaEncryption*
parameters	ANY	NULL		
subjectPublicKey	BIT STRING	at least 2048 bits		Modulus length
Field	**Format**	**Criticality**	**Value**	**Comments**
extensions				See CP § 7.1.2, Table 12
authorityInfoAccess		FALSE	{ id-pe 1 }	CP § 7.1.2.2
accessMethod	OID		1.3.6.1.5.5.7.48.1	OCSP {*id-pkix-ocsp*}
accessLocation	*GeneralName*		URL	OCSP responder location
authorityKeyIdentifier		FALSE	{ id-ce 35 }	Table 16
keyIdentifier	OCTET STRING		*<keyIdentifier>*	Calculated per Method 1
certificatePolicies		FALSE	{ id-ce 32 }	See CP § 1.2, Table 39
policyInformation				
policyIdentifier				
certPolicyId	OID		1.3.6.1.4.1.41519.1.1	Certifificate Policy OID
policyQualifiers	SEQUENCE			Not Set
cRLDistributionPoint		FALSE	{ id-ce 31 }	(Optional), Table 21
distributionPoint				
distributionPointName	*generalNames*		URL	Address of CRL location
extKeyUsage		FALSE	{ id-ce 37 }	Table 23
keyPurposeID	OID		1.3.6.1.5.5.7.3.2	id-kp-clientAuth
keyPurposeID	OID		1.3.6.1.5.5.7.3.1	id-kp-serverAuth (optional)
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	CP § 6.1.7.2
digitalSignature	(0)		1	Set

keyEncipherment	(2)		1	Set
dataEncipherment	(3)		0 / 1	Optional
----- End Of Fields To Be Signed (*tbsCertificate*) -----				
Field	**Format**	**Value**		**Comments**
signatureAlgorithm				See CP § 7.1.3, Table 30
algorithmIdentifier				
algorithm	OID	1.2.840.113549.1.1.11		*sha256WithRSAEncryption*
parameters	ANY	NULL		
signatureValue				See CP § 7.1

Appendix E - RSA VTN Server Certificate Profile

Table 45 shows an EXAMPLE OpenADR VTN Certificate profile for CAs that contain RSA Public Keys.

Table 45: OpenADR RSA VTN Certificate Profile

Field	Format	Value	Comments
Certificate			
tbsCertificate			Fields to be signed
version	INTEGER	2	See CP § 7.1.1
serialNumber			See Table 9
certificateSerialNumber	INTEGER	<Unique positive integer>	Assigned by issuing CA
signature			See CP § 7.1.3, Table 30
algorithmIdentifier			
algorithm	OID	1.2.840.113549.1.1.11	*sha256WithRSAEncryption*
parameters	ANY	NULL	
issuer			See CP § 7.1.4.2
Name			X.500 Distinguished Name
RDNSequence			
relativeDistinguishedName	SET OF		
attributeTypeAndValue	SEQUENCE		
attributeType	OID	{id-at 6}	*countryName* (size = 2)
atttributeValue	*printableString*	**US**	C= US
attributeTypeAndValue			
attributeType	OID	{id-at 10}	*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**	O= OpenADR Alliance
attributeTypeAndValue			
attributeType	OID	{id-at 11}	*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**RSA CA-<ID#>**	OU= RSA CA-<ID#>
attributeTypeAndValue			
attributeType	OID	{id-at 3)	*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance RSA VTN CA**	CN= OpenADR Alliance RSA VTN CA
validity			See Table 8
notBefore			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Key ceremony date	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Key ceremony date	Use for dates after 2049
notAfter			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Up to 2 years	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Up to 2 years	Use for dates after 2049

subject				See CP § 7.1.4.3
Name				X.500 Distinguished Name
RDNSequence				
relativeDistinguishedName	SET OF			
attributeTypeAndValue	SEQUENCE			
attributeType	OID	{id-at 6}		*countryName* (size = 2)
atttributeValue	*printableString*	**<Country Code>**		C= <Country Code>
attributeTypeAndValue				
attributeType	OID	{id-at 10}		*organizationName* (size = 64)
atttributeValue	*printableString*	**<Subscriber Org. Name>**		O= <Subscriber Org. Name>
attributeTypeAndValue				
attributeType	OID	{id-at 11}		*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance RSA VTN Certificate**		OU= <Additional Identifying Information>
attributeTypeAndValue				
attributeType	OID	{id-at 3)		*commonName* (size = 64)
atttributeValue	*printableString*	**<DNS Name>**		CN= <DNS Name>
subjectPublicKeyInfo				See Table 32.
algorithm				
algorithmIdentifier				
algorithm	OID	1.2.840.113549.1.1.1		*rsaEncryption*
parameters	ANY	NULL		
subjectPublicKey	BIT STRING	at least 2048 bits		Modulus length
Field	**Format**	**Criticality**	**Value**	**Comments**
extensions				See CP § 7.1.2, Table 12
authorityInfoAccess		FALSE	{ id-pe 1 }	CP § 7.1.2.2
accessMethod	OID		1.3.6.1.5.5.7.48.1	OCSP {*id-pkix-ocsp*}
accessLocation	*GeneralName*		URL	OCSP responder location
authorityKeyIdentifier		FALSE	{ id-ce 35 }	Table 16
keyIdentifier	OCTET STRING		*<keyIdentifier>*	Calculated per Method 1
certificatePolicies		FALSE	{ id-ce 32 }	See CP § 1.2, Table 39
policyInformation				
policyIdentifier				
certPolicyId	OID		1.3.6.1.4.1.41519.1.1	Certifificate Policy OID
policyQualifiers	SEQUENCE			Not Set
cRLDistributionPoint		FALSE	{ id-ce 31 }	(Optional), Table 21
distributionPoint				
distributionPointName	*generalNames*		URL	Address of CRL location
extKeyUsage		FALSE	{ id-ce 37 }	Table 23
keyPurposeID	OID		1.3.6.1.5.5.7.3.1	id-kp-serverAuth
keyPurposeID	OID		1.3.6.1.5.5.7.3.2	id-kp-clientAuth (optional)
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	CP § 6.1.7.2

digitalSignature	(0)		1	Set
keyEnchiperment	(2)		1	Set
dataEnchiperment	(3)		0 / 1	Optional
subjectAltName		FALSE	{ id-ce 17 }	Table 27
generalNames				
generalName				
dNSName	IA5String		*<dNSName>*	DNS Name
----- End Of Fields To Be Signed (*tbsCertificate*) -----				
Field	**Format**	**Value**		**Comments**
signatureAlgorithm				See CP § 7.1, Table 30
algorithmIdentifier				
algorithm	OID	1.2.840.113549.1.1.11		*sha256WithRSAEncryption*
parameters	ANY	NULL		
signatureValue				See CP § 7.1

Appendix F - ECC Root CA Certificate Profile

Table 46 shows an EXAMPLE of the OpenADR Root CA Certificate profile for Root CAs that contain ECC Public Keys.

Table 46: OpenADR ECC Root CA Certificate Profile

Field	Format	Value	Comments
Certificate			
tbsCertificate			Fields to be signed
version	INTEGER	2	See CP § 7.1.1
serialNumber			See Table 9
certificateSerialNumber	INTEGER	<Unique positive integer>	Assigned by issuing CA
signature			See CP § 7.1.3, Table 31
algorithmIdentifier			
algorithm	OID	1.2.840.10045.4.3.2	*ecdsaWithSHA256*
parameters	ANY		Absent
issuer			See CP § 7.1.4.1
Name			X.500 Distinguished Name
RDNSequence			
relativeDistinguishedName	SET OF		
attributeTypeAndValue	SEQUENCE		
attributeType	OID	{id-at 6}	*countryName* (size = 2)
atttributeValue	*printableString*	**US**	C= US
attributeTypeAndValue			
attributeType	OID	{id-at 10}	*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**	O= OpenADR Alliance
attributeTypeAndValue			
attributeType	OID	{id-at 11}	*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**ECC Root CA<ID#>**	OU= ECC Root CA<ID#>
attributeTypeAndValue			
attributeType	OID	{id-at 3)	*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance ECC Root CA**	CN= OpenADR Alliance ECC Root CA
validity			See Table 8
notBefore			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Key ceremony date	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Key ceremony date	Use for dates after 2049
notAfter			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Up to 40 years	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Up to 40 years	Use for dates after 2049

subject				See CP § 7.1.4.1
Name				X.500 Distinguished Name
RDNSequence				
relativeDistinguishedName	SET OF			
attributeTypeAndValue	SEQUENCE			
attributeType	OID	{id-at 6}		*countryName* (size = 2)
atttributeValue	*printableString*	**US**		C= US
attributeTypeAndValue				
attributeType	OID	{id-at 10}		*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**		O= OpenADR Alliance
attributeTypeAndValue				
attributeType	OID	{id-at 11}		*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**ECC Root CA<ID#>**		OU= ECC Root CA<ID#>
attributeTypeAndValue				
attributeType	OID	{id-at 3)		*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance ECC Root CA**		CN= OpenADR Alliance ECC Root CA
subjectPublicKeyInfo				See Table 33
algorithm				
algorithmIdentifier				
algorithm	OID	1.2.840.10045.2.1		*ecPublicKey*
parameters	ANY	1.2.840.10045.3.1.7		*prime256v1*
subjectPublicKey	BIT STRING	<ECC P-256>		Modulus length
Field	**Format**	**Criticality**	**Value**	**Comments**
extensions				See CP § 7.1.2, Table 10
basicConstraints		TRUE	{ id-ce 19 }	Table 17
cA	BOOLEAN		TRUE	Set
pathLenConstraint	INTEGER			Not Set
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	Table 4
keyCertSign	(5)		1	Set
cRLSign	(6)		1	Set
subjectAltName		FALSE	{ id-ce 17 }	Table 25
generalNames				
generalName				
directoryName	Name		<Name>	Directory Address
subjectKeyIdentifier		FALSE	{ id-ce 14 }	Table 28
keyIdentifier	OCTET STRING		*<keyIdentifier>*	Calculated per Method 1
----- End Of Fields To Be Signed (*tbsCertificate*) -----				
Field	Format	Value		Comments
signatureAlgorithm				See CP § 7.1.3, Table 31
algorithmIdentifier				
Algorithm	OID	1.2.840.10045.4.3.2		*ecdsaWithSHA256*
Parameters	ANY			Absent
signatureValue				See CP § 7.1

Appendix G - ECC Sub-CA Certificate Profile

Table 47 shows an EXAMPLE of the OpenADR Sub-CA Certificate profile for CAs that contain ECC Public Keys.

Table 47: OpenADR ECC Sub-CA Certificate Profile

Field	Format	Value	Comments
Certificate			
tbsCertificate			Fields to be signed
version	INTEGER	2	See CP § 7.1.1
serialNumber			See Table 9
certificateSerialNumber	INTEGER	<Unique positive integer>	Assigned by issuing CA
signature			See CP § 7.1.3, Table 31
algorithmIdentifier			
algorithm	OID	1.2.840.10045.4.3.2	ecdsa-with-Sha256
parameters	ANY		Absent
issuer			See CP § 7.1.4.1
Name			X.500 Distinguished Name
RDNSequence			
relativeDistinguishedName	SET OF		
attributeTypeAndValue	SEQUENCE		
attributeType	OID	{id-at 6}	*countryName* (size = 2)
atttributeValue	*printableString*	**US**	C= US
attributeTypeAndValue			
attributeType	OID	{id-at 10}	*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**	O= OpenADR Alliance
attributeTypeAndValue			
attributeType	OID	{id-at 11}	*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**ECC Root CA<ID#>**	OU= ECC Root CA<ID#>
attributeTypeAndValue			
attributeType	OID	{id-at 3)	*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance ECC Root CA**	CN= OpenADR Alliance ECC Root CA
validity			See Table 8
notBefore			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Key ceremony date	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Key ceremony date	Use for dates after 2049
notAfter			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Up to 40 years	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Up to 40 years	Use for dates after 2049

subject				See CP § 7.1.4.2
Name				X.500 Distinguished Name
RDNSequence				
relativeDistinguishedName	SET OF			
attributeTypeAndValue	SEQUENCE			
attributeType	OID	{id-at 6}		*countryName* (size = 2)
atttributeValue	*printableString*	**US**		C= US
attributeTypeAndValue				
attributeType	OID	{id-at 10}		*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**		O= OpenADR Alliance
attributeTypeAndValue				
attributeType	OID	{id-at 11}		*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**ECC <Sub-CA Type> CA<ID#>**		OU= ECC <Sub-CA type> CA<ID#>
attributeTypeAndValue				
attributeType	OID	{id-at 3)		*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance ECC <Sub-CA Type> CA**		CN= OpenADR Alliance ECC <Sub-CA type> CA
subjectPublicKeyInfo				See Table 33
algorithm				
algorithmIdentifier				
algorithm	OID	1.2.840.10045.2.1		*ecPublicKey*
parameters	ANY	1.2.840.10045.3.1.7		*prime256v1*
subjectPublicKey	BIT STRING	<ECC P-256>		Modulus length
Field	**Format**	**Criticality**	**Value**	**Comments**
extensions				See CP § 7.1.2, Table 11
authorityKeyIdentifier		FALSE	{ id-ce 35 }	Table 15
keyIdentifier	OCTET STRING		*<keyIdentifier>*	Calculated per Method 1
basicConstraints		TRUE	{ id-ce 19 }	Table 18
cA	BOOLEAN		TRUE	Set
pathLenConstraint	INTEGER		0	Set to “0” (Zero)
certificatePolicies		FALSE	{ id-ce 32 }	See CP § 1.2, Table 38
policyInformation				
policyIdentifier				
certPolicyId	OID		1.3.6.1.4.1.41519.1.1	Certifificate Policy OID
policyQualifiers	SEQUENCE			Not Set
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	Table 4
keyCertSign	(5)		1	Set
cRLSign	(6)		1	Set
subjectAltName		FALSE	{ id-ce 17 }	(Optional), Table 26
generalNames				
generalName				
directoryName	Name		<Name>	Directory Name
subjectKeyIdentifier		FALSE	{ id-ce 14 }	Table 28
keyIdentifier	OCTET STRING		*<keyIdentifier>*	Calculated per Method 1

----- End Of Fields To Be Signed (*tbsCertificate*) -----			
Field	**Format**	**Value**	**Comments**
signatureAlgorithm			See CP § 7.1.3, Table 31
algorithmIdentifier			
algorithm	OID	1.2.840.10045.4.3.2	*ecdsaWithSHA256*
parameters	ANY		Absent
signatureValue			See CP § 7.1

Appendix H - ECC VEN Client Certificate Profile

Table 48 shows an EXAMPLE of the OpenADR VEN Certificate profile for CAs that contain ECC Public Keys.

Table 48: OpenADR ECC VEN Client Certificate Profile

Field	Format	Value	Comments
Certificate			
tbsCertificate			Fields to be signed
version	INTEGER	2	See CP § 7.1.1
serialNumber			See Table 9
certificateSerialNumber	INTEGER	<Unique positive integer>	Assigned by issuing CA
signature			See CP § 7.1.3, Table 31
algorithmIdentifier			
algorithm	OID	1.2.840.10045.4.3.2	*ecdsaWithSHA256*
parameters	ANY		Absent
issuer			See CP § 7.1.4.2
Name			X.500 Distinguished Name
RDNSequence			
relativeDistinguishedName	SET OF		
attributeTypeAndValue	SEQUENCE		
attributeType	OID	{id-at 6}	*countryName* (size = 2)
atttributeValue	*printableString*	**US**	C= US
attributeTypeAndValue			
attributeType	OID	{id-at 10}	*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**	O= OpenADR Alliance
attributeTypeAndValue			
attributeType	OID	{id-at 11}	*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**ECC VEN CA<ID#>**	OU= ECC VEN CA<ID#>
attributeTypeAndValue			
attributeType	OID	{id-at 3)	*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance ECC VEN CA**	CN= OpenADR Alliance ECC VEN CA
validity			See Table 8
notBefore			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Key ceremony date	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Key ceremony date	Use for dates after 2049
notAfter			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Up to 20 years	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Up to 20 years	Use for dates after 2049

subject				See CP § 7.1.4.4
Name				X.500 Distinguished Name
RDNSequence				
relativeDistinguishedName	SET OF			
attributeTypeAndValue	SEQUENCE			
attributeType	OID	{id-at 6}		*countryName* (size = 2)
atttributeValue	*printableString*	**<Country Code>**		C= <Country Code>
attributeTypeAndValue				
attributeType	OID	{id-at 10}		*organizationName* (size = 64)
atttributeValue	*printableString*	**<Subscriber Org. Name>**		O= <Subscriber Org. Name>
attributeTypeAndValue				
attributeType	OID	{id-at 11}		*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance ECC VEN Certificate**		OU= <Additional Identifying Information>
attributeTypeAndValue				
attributeType	OID	{id-at 3)		*commonName* (size = 64)
atttributeValue	*printableString*	**<Unique Id>**		CN= <Unique Id>
subjectPublicKeyInfo				See CP § Table 33
algorithm				
algorithmIdentifier				
algorithm	OID	1.2.840.10045.2.1		*ecPublicKey*
parameters	ANY	1.2.840.10045.3.1.7		*prime256v1*
subjectPublicKey	BIT STRING	<ECC P-256>		Modulus length
Field	**Format**	**Criticality**	**Value**	**Comments**
extensions				See CP § 7.1.2, Table 12
authorityInforAccess		FALSE	{ id-pe 1 }	CP § 7.1.2.2
accessMethod	OID		1.3.6.1.5.5.7.48.1	OCSP {*id-pkix-ocsp*}
accessLocation	*GeneralName*		URL	OCSP responder location
authorityKeyIdentifier		FALSE	{ id-ce 35 }	Table 16
keyIdentifier	OCTET STRING		*<keyIdentifier>*	Calculated per Method 1
certificatePolicies		FALSE	{ id-ce 32 }	See CP § 1.2, Table 39
policyInformation				
policyIdentifier				
certPolicyId	OID		1.3.6.1.4.1.41519.1.1	Certificate Policy OID
policyQualifiers	SEQUENCE			Not Set
cRLDistributionPoint		FALSE	{ id-ce 31 }	(Optional), Table 21
distributionPoint				
distributionPointName	*generalNames*		URL	Address of CRL location
extKeyUsage		FALSE	{ id-ce 37 }	Table 23
keyPurposeID	OID		1.3.6.1.5.5.7.3.2	id-kp-clientAuth
keyPurposeID	OID		1.3.6.1.5.5.7.3.1	id-kp-serverAuth (optional)
keyUsage	BIT STRING	TRUE	{ id-ce 15 }	CP § 6.1.7.3

digitalSignature	(0)		1	Set
keyAgreement	(4)		1	Set
----- End Of Fields To Be Signed (*tbsCertificate*) -----				
Field	Format	Value		Comments
signatureAlgorithm				See CP § 7.1.3, Table 31
algorithmIdentifier				
algorithm	OID	1.2.840.10045.4.3.2		*ecdsaWithSHA256*
parameters	ANY			Absent
signatureValue				See CP § 7.1

Appendix I - ECC VTN Server Certificate Profile

Table 49 shows an EXAMPLE of the OpenADR VTN Certificate profile for Subscriber VTN Certificates that contain ECC Public Keys.

Table 49: OpenADR ECC VTN Server Certificate Profile

Field	Format	Value	Comments
Certificate			
tbsCertificate			Fields to be signed
version	INTEGER	2	See CP § 7.1.1
serialNumber			See Table 9
certificateSerialNumber	INTEGER	<Unique positive integer>	Assigned by issuing CA
signature			See CP § 7.1.3, Table 31
algorithmIdentifier			
algorithm	OID	1.2.840.10045.4.3.2	*ecdsaWithSHA256*
parameters	ANY		Absent
issuer			See CP § 7.1.4.2
Name			X.500 Distinguished Name
RDNSequence			
relativeDistinguishedName	SET OF		
attributeTypeAndValue	SEQUENCE		
attributeType	OID	{id-at 6}	*countryName* (size = 2)
atttributeValue	*printableString*	**US**	C= US
attributeTypeAndValue			
attributeType	OID	{id-at 10}	*organizationName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance**	O= OpenADR Alliance
attributeTypeAndValue			
attributeType	OID	{id-at 11}	*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**ECC VTN CA<ID#>**	OU= ECC VTN CA<ID#>
attributeTypeAndValue			
attributeType	OID	{id-at 3)	*commonName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance ECC VTN CA**	CN= OpenADR Alliance ECC VTN CA
validity			See Table 8
notBefore			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Key ceremony date	Use for dates ≤ 2049
generalTime			
GeneralizedTime	YYYYMMDDHHMMSSZ	Key ceremony date	Use for dates after 2049
notAfter			
Time	CHOICE		Choose time format:
utcTime			
UTCTime	YYMMDDHHMMSSZ	Up to 20 years	Use for dates ≤ 2049
generalTime			

GeneralizedTime	YYYYMMDDHHMMSSZ	Up to 20 years		Use for dates after 2049
subject				See CP § 7.1.4.3
Name				X.500 Distinguished Name
RDNSequence				
relativeDistinguishedName	SET OF			
attributeTypeAndValue	SEQUENCE			
attributeType	OID	{id-at 6}		*countryName* (size = 2)
atttributeValue	*printableString*	**<Country Code>**		C= <Country Code>
attributeTypeAndValue				
attributeType	OID	{id-at 10}		*organizationName* (size = 64)
atttributeValue	*printableString*	**<Subscriber Org. Name>**		O= <Subscriber Org Name>
attributeTypeAndValue				
attributeType	OID	{id-at 11}		*organizationalUnitName* (size = 64)
atttributeValue	*printableString*	**OpenADR Alliance ECC VTN Certificate**		OU= <Additional Identifying Information>
attributeTypeAndValue				
attributeType	OID	{id-at 3)		*commonName* (size = 64)
atttributeValue	*printableString*	***<dNSName>***		CN= <DNS Name>
subjectPublicKeyInfo				See Table 33
algorithm				
algorithmIdentifier				
algorithm	OID	1.2.840.10045.2.1		*ecPublicKey*
parameters	ANY	1.2.840.10045.3.1.7		*prime256v1*
subjectPublicKey	BIT STRING	<ECC P-256>		Modulus length
Field	**Format**	**Criticality**	**Value**	**Comments**
extensions				See CP § 7.1.2, Table 12
authorityInfoAccess		FALSE	{ id-pe 1 }	CP § 7.1.2.2
accessMethod	OID		1.3.6.1.5.5.7.48.1	OCSP {*id-pkix-ocsp*}
accessLocation	*GeneralName*		URL	OCSP responder location
authorityKeyIdentifier		FALSE	{ id-ce 35 }	Table 16
keyIdentifier	OCTET STRING		<*keyIdentifier* >	Calculated per Method 1
certificatePolicies		FALSE	{ id-ce 32 }	See CP § 1.2, Table 39
policyInformation				
policyIdentifier				
certPolicyId	OID		1.3.6.1.4.1.41519.1.1	Certifificate Policy OID
policyQualifiers	SEQUENCE			Not Set
cRLDistributionPoint		FALSE	{ id-ce 31 }	(Optional), Table 21
distributionPoint				
distributionPointName	*generalNames*		URL	Address of CRL location
extKeyUsage		FALSE	{ id-ce 37 }	Table 22
keyPurposeID	OID		1.3.6.1.5.5.7.3.1	id-kp-serverAuth
keyPurposeID	OID		1.3.6.1.5.5.7.3.2	id-kp-clientAuth (optional)

keyUsage	BIT STRING	TRUE	{ id-ce 15 }	See CP § 6.1.7.3
digitalSignature	(0)		1	Set
keyAgreement	(4)		1	Set
subjectAltName		FALSE	{ id-ce 17 }	Table 27
generalNames				
generalName				
dNSName	IA5String		<*dNSName*>	DNS Name
----- End Of Fields To Be Signed (*tbsCertificate*) -----				
Field	Format	Value		Comments
signatureAlgorithm				See CP § 7.1.3, Table 31
algorithmIdentifier				
algorithm	OID	1.2.840.10045.4.3.2		*ecdsaWithSHA256*
parameters	ANY			Absent
signatureValue				See CP § 7.1.