[MS-WCCE]:
Windows Client Certificate Enrollment Protocol

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1 Introduction

The Windows Client Certificate Enrollment Protocol consists of a set of **DCOM** interfaces (as specified in [MS-DCOM]) that allow clients to request various services from a **certification authority (CA)**. These services enable X.509 (as specified in [X509]) **digital certificate enrollment**, **issuance**, **revocation**, and property retrieval.

Active Directory (AD) can be used to store domain policies for certificate enrollment. An implementation of the protocol that is specified in this document might retrieve Active Directory objects and attributes that define these enrollment policies. Because Active Directory is an independent component with its own protocols, the exact process for Active Directory discovery and objects retrieval is covered in [MS-ADTS].

Familiarity with **public key infrastructure (PKI)** concepts such as asymmetric and symmetric cryptography, digital certificates, and cryptographic **key exchange** is required for a complete understanding of this specification. In addition, a comprehensive understanding of the [X509] standard is required for a complete understanding of the protocol and its usage. For a comprehensive introduction to cryptography and PKI concepts, see [SCHNEIER]. PKI basics and **certificate** concepts are as specified in [X509]. For an introduction to **certificate revocation lists (CRLs)** and revocation concepts, see [MSFT-CRL].

Sections 1.8, 2, and 3 of this specification are normative and can contain the terms MAY, SHOULD, MUST, MUST NOT, and SHOULD NOT as defined in RFC 2119. Sections 1.5 and 1.9 are also normative but cannot contain those terms. All other sections and examples in this specification are informative.

1.1 Glossary

The following terms are defined in [MS-GLOS]:

access control list (ACL)
Active Directory
attestation
Attestation Identity Key (AIK)
attribute
binary large object (BLOB)
certificate
certificate issuance
certification
certificate authority (CA) or certification authority
certificate revocation lists (CRL)
certificate template
client
common name (CN)
container
cross-certification
digital certificate
directory
directory object
directory service (DS)
Distinguished Encoding Rules (DER)
distinguished name (DN)
Distributed Component Object Model (DCOM)

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domain
domain controller (DC)
domain member (member machine)
Domain Name System (DNS)
domain naming service name
EK private key (EKPriv)
EK public key (EKPub)
encryption
end entity (EE)
endorsement certificate (EKCert)
endorsement key (EK)
enhanced key usage (EKU)
enroll/enrollment
exchange certificate
forest(1)
forest(2)
fully qualified domain name (FQDN) (1)
globally unique identifier (GUID)
key
key agreement
key archival
key attestation
key exchange
key recovery agent (KRA)
key recovery certificate
keyholder
little-endian
Message Authentication Code (MAC)
object
object identifier (OID)
objectGuid
object remote procedure call (ORPC)
principal
private key
pseudo-random number generator (PRNG)
public key
public key infrastructure (PKI)
public-private key pair
registration authority (RA)
relative distinguished name (RDN)
relying party (RP)
revocation
Rivest-Shamir-Adleman (RSA)
root CA
root certificate
root domain
sanitized name
security context
server
SHA-1 hash
signing certificates
symmetric algorithm
symmetric key
Triple Data Encryption Standard
trust

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trusted platform module (TPM)
Universal Naming Convention (UNC)
user principal name (UPN)
UTF-8
UTF-16
Windows registry

The following terms are specific to this document:

advanced CA: A **certification authority (CA)** (server role of the Windows Client Certificate Enrollment Protocol) that supports subprotocols 1–6, as specified in section 1.3.1.

asymmetric algorithm: A synonym for **public key algorithm**. For an introduction to these concepts and terminology, see [PUBKEY] and [RSAFAQ]. For more information, also see **public key algorithm**.

autoenrollment: An automated process that performs **certificate enrollment** and **renewal**.

backward cross certificate: Given a set of signing certificates for a specific certificate authority (**CA**), this certificate is a cross certificate created between one of the certificates in the **CA's** set and a certificate that has the following characteristics:

- It precedes the set certificate, based on the value of the **notBefore** field.
- It has a different public-private key pair than the certificate with the set's.

CA exit algorithm: An optional addition to the **CA** (WCCE server role) functionality. The algorithm is invoked whenever a certificate is issued. The algorithm can perform customer-defined, post-processing functionality such as the following:

- Publish the certificate to a predefined path.
- Send an email message to an administrator regarding the issued certificate.

CA policy algorithm: An algorithm that determines whether to issue a certificate for a specified certificate request and defines how that certificate is constructed.

CA role separation: The configuration of a **CA** to disallow an administrator **CA** operator from performing multiple roles on a **CA** simultaneously. Role separation is the concept of configuring a **CA** to enhance security by allowing a user to be assigned only a single role, such as auditor, backup manager, administrator, or **certificate** manager, at one time. Role separation is an optional **Common Criteria** requirement, as specified in [CIMC-PP].

certificate renewal request: An enrollment request for a new certificate where the request is signed using an existing certificate. The renewal request may use the key pair from the existing certificate or a new key pair. After the new certificate has been issued, it is meant (but not required) to replace the older certificate (a **renewed certificate**).

Common Criteria: An international standard process for defining security objectives and for evaluating compliance with those objectives. The Common Criteria has largely replaced the Trusted Computer Security Evaluation Criteria (TCSEC), the Canadian Trusted Computer Product Evaluation Criteria (CTCPEC), and the European Information Technology Security Evaluation Criteria (ITSEC). Details are specified in [CC].

cross certificate: An [X509] **digital certificate** issued between two existing independent **certification authorities (CAs)** for the purpose of extending or constraining **public key infrastructure (PKI) trust** hierarchies. A **cross certificate** is specified in [X509] section

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3.3.21. For an introduction to **cross certificates** and **cross certification**, see [MSFT-CROSSCERT].

Cryptographic Message Syntax (CMS): A public standard that defines how to digitally sign, digest, authenticate, or encrypt arbitrary message content, as specified in [RFC3852].

cryptographic service provider (CSP): A software module that implements cryptographic functionality. Multiple **CSPs** may be installed. A **CSP** is identified by a name represented by a NULL-terminated Unicode string.

digital signature: A **message authenticator** typically derived from a cryptographic operation by using an **asymmetric algorithm** and **private key**. When a **symmetric algorithm** is used for this purpose, the authenticator is typically called a **Message Authentication Code (MAC)**. In some contexts, the term **digital signature** is used to refer to either type of authenticator; however, in this Windows Client Certificate Enrollment Protocol, the term **digital signature** is used only for authenticators created by **asymmetric algorithms**.

enrollment agent (EA): An entity that can request a **certificate** on behalf of other entities. For more information, see **Request On Behalf Of (ROBO)**.

Enroll On Behalf Of (EOBO): See **Request On Behalf Of (ROBO)**.

enterprise certificate authority (CA): A server implementation of the WCCE protocol that uses the certificate template data structure, as specified in [MS-CRTD], in its **CA policy algorithm** implementation.

forward cross certificate: Given a set of signing certificates for a specific certificate authority (**CA**), this certificate is a cross certificate created between one of the certificates in the **CA's** set and a certificate that has the following characteristics:

- It follows the set certificate, based on the value of the **notBefore** field.
- It has a different public-private key pair than the certificate with the set's.

issuance: See **certification**.

key archival certificate: See **key recovery certificate**.

key length: A value specified by a cryptographic module that indicates the length of the **public-private key pair** and **symmetric keys** that are used within the module. The **key length** values are expressed in bits. For more information about cryptographic **key lengths**, see [SP800-56A] section 3.1.

key pair: See **public-private key pair**.

key spec: Specifies how a given **private key** is used within a cryptographic module.

KEYGEN: An HTML tag defined by Netscape to allow HTML communications with a browser to trigger **certificate enrollment**. For more information on the use of <**KEYGEN**>, see [KEYGEN]. Details about how this protocol accommodates **enrollment** triggered by HTML-browser communication are specified in sections 3.2.1.4.2.1 and 3.2.1.4.3.1.

LDAP: In this document, the term LDAP always refers to the Lightweight Directory Access Protocol (LDAP) profile specified in [MS-ADTS] (section 3.1.1.3).

message authenticator: A protocol element that allows the receiver of a message to authenticate the origin and verify the integrity of the message.

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object: When used in the context of **Active Directory**, a set of **attributes**, each with its associated values, as specified in [MS-ADTS]. See also **directory object**.

object ID: See **object identifier (OID)**.

public key algorithm: A cryptographic algorithm that uses two different keys, one for **encryption** and one for decryption, neither of which can be derived from the other. Also, one key is kept secret while the other can be made public. The key that is kept secret is called the **private key**. The key that can be made public is called the **public key**. Examples of **public key algorithms** are specified in various standards, including the **Digital Signature** Algorithm (DSA) standard and the Elliptic Curve Digital Signature Algorithm (ECDSA) standard (as specified in [FIPS186] sections 4 and 6), and RSA (as specified in [PKCS1] section 5). The National Institute of Standards and Technology (NIST) published an introduction to **public key** technology that is specified in [SP800-56A] section 5.6.

renewed certificate: A certificate that has been replaced with a newer certificate, which was obtained via a **certificate renewal request**. Also referred to as a certificate that has been renewed.

Request On Behalf Of (ROBO): A proxy **enrollment** process where one user, typically an administrator, enrolls for a **certificate** for a second user using the administrator credentials.

shadow delta CRL: An empty delta **certificate revocation lists (CRLs)** that are issued to force clients to update to a new base **CRL**.

standalone CA: A minimal server implementation of the WCCE protocol that conforms to functionality specified in section 3.2.1.

standard CA: A **CA** (server role of the Windows Client Certificate Enrollment Protocol) that supports subprotocols 1–5, as specified in section 1.3.1.

subordinate CA: A type of **CA** that is not a **root CA** for a **relying party (RP)** or for a client. A **subordinate CA** is a **CA** whose **certificate** is signed by some other **CA**, as specified in [RFC2510].

trust root: (1) A collection of **root CA** keys trusted by the **RP**. (2) A store that holds that collection of root CA keys and protects it from tampering. In this protocol specification, both meanings apply in each use of the term.

MAY, SHOULD, MUST, SHOULD NOT, MUST NOT: These terms (in all caps) are used as specified in [RFC2119]. All statements of optional behavior use either MAY, SHOULD, or SHOULD NOT.

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References to Microsoft Open Specifications documentation do not include a publishing year because links are to the latest version of the documents, which are updated frequently. References to other documents include a publishing year when one is available.

A reference marked "(Archived)" means that the reference document was either retired and is no longer being maintained or was replaced with a new document that provides current implementation details. We archive our documents online [Windows Protocol].

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We conduct frequent surveys of the normative references to assure their continued availability. If you have any issue with finding a normative reference, please contact dochelp@microsoft.com. We will assist you in finding the relevant information. Please check the archive site, http://msdn2.microsoft.com/en-us/library/E4BD6494-06AD-4aed-9823-445E921C9624, as an additional source.

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[MS-ADTS] Microsoft Corporation, "Active Directory Technical Specification".

[MS-CRTD] Microsoft Corporation, "Certificate Templates Structure".

[MS-CSRA] Microsoft Corporation, "Certificate Services Remote Administration Protocol".

[MS-DCOM] Microsoft Corporation, "Distributed Component Object Model (DCOM) Remote Protocol".

[MS-DSSP] Microsoft Corporation, "Directory Services Setup Remote Protocol".

[MS-DTYP] Microsoft Corporation, "Windows Data Types".

[MS-ERREF] Microsoft Corporation, "Windows Error Codes".

[MS-ICPR] Microsoft Corporation, "ICertPassage Remote Protocol".

[MS-KILE] Microsoft Corporation, "Kerberos Protocol Extensions".

[MS-LSAD] Microsoft Corporation, "Local Security Authority (Domain Policy) Remote Protocol".

[MS-LSAT] Microsoft Corporation, "Local Security Authority (Translation Methods) Remote Protocol".

[MS-NLMP] Microsoft Corporation, "NT LAN Manager (NTLM) Authentication Protocol".

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1.3 Overview

The Windows Client Certificate Enrollment Protocol is built from two DCOM interfaces: ICertRequestD and ICertRequestD2, successive versions. The two DCOM interfaces allow a client to interact with a CA to request a certificate and to obtain certain information about the CA. This document specifies the protocol, the Windows Client Certificate Enrollment Protocol, but also specifies certain elements of the behavior of the client and the CA (the server), because those behaviors are reflected in or influence protocol behavior.

The Windows Client Certificate Enrollment Protocol occurs between one client and one server. However, the client and the server are subject to variation, so the enrollment process can appear very complex. Other machines and services can also interact with the client and/or the server during enrollment, but those interactions depend on the particular variations in use.

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Two elements of a server are subject to variation. These elements are independent of each other and independent of the implementation of the Windows Client Certificate Enrollment Protocol stack. This protocol specification refers to these elements as follows:

- **CA policy algorithm**

  This algorithm determines 1) whether to issue the certificate requested, and 2) how to populate the fields of a certificate that is issued.

- **CA exit algorithm**

  The optional algorithm that is invoked when a certificate is issued. This algorithm might store a copy of that certificate in one or more repositories, or the algorithm might make a log entry or notify some person of the issuance of the certificate.

The variants of interest in the CA policy algorithm are as follows:

- Hard-coded

  A policy algorithm that performs the same operation on certificate requests regardless of the information specified in the request is called a hard-coded policy algorithm. A simple, hard-coded policy algorithm might issue any certificate that is requested.

- Manual

  A policy algorithm that requires human intervention in order to determine whether or not to issue a certificate is called a manual policy algorithm. A simple manual policy algorithm accepts the requester's choice of certificate fields, presents the requested certificate to an administrator, and asks the administrator whether or not to issue the certificate.

- Policy-driven via certificate templates

  A policy algorithm that determines whether or not to issue certificates based on enrollment policies specified in a certificate template [MS-CRTD]. Each certificate template in a collection of certificate templates describes a kind of certificate with its fields. The security descriptor on the certificate template provides an **access control list (ACL)** that can include the Enroll permission for an individual or, more typically, a group of individuals. A policy algorithm that strictly implements a policy stored as certificate templates is described in section 3.2.2.6.2.1.4.

  Note The capability to base certificate policy on user types is not available for a **standalone CA** since standalone CAs do not support the use of **certificate templates**.

One aspect of a client subject to variation is whether certificate templates are used to form certificate requests.

1.3.1 High-Level Protocol Operations

The high-level operations performed by the Windows Client Certificate Enrollment Protocol are the following:

1. Request a new certificate for the client directly from the **CA**. (For more information, see section 3.1.1.4.3.1.) This operation makes one ICertRequestD::Request or ICertRequestD2::Request2 call from the client to the CA.

2. Get a new certificate on behalf of another through a **Request On Behalf Of (ROBO)** process. The **registration authority (RA)** requests a certificate on behalf of a client – a person (usually)

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or machine (potentially). For more information, see section 3.1.1.4.3.3. This operation makes one ICertRequestD::Request or ICertRequestD2::Request2 call from the RA to the CA.

3. Renew a certificate in which the client requests a certificate (presumably with a later expiration date) to replace an old certificate that is reaching its end of life (for more information, see section 3.1.1.4.3.2). This operation makes one ICertRequestD::Request or ICertRequestD2::Request2 call from the client to the CA.

4. Get CA properties in which a client or RA queries the CA for its configuration and state (for more information, see sections 3.1.1.4.4, 3.1.1.4.6, and 3.1.1.4.7). This operation makes one ICertRequestD::GetCACert or ICertRequestD2::GetCAProperty call to the CA.

5. Issue a Ping request against a CA in which an **end entity (EE)** or RA queries the CA to discover availability of the CA service (for more information, see section 3.1.1.4.5). This operation makes one ICertRequestD::Ping or ICertRequestD2::Ping2 call to the CA.

6. Archive a private **key** where a client uses a **public key** belonging to the CA to encrypt a copy of the **private key** corresponding to an **encryption** certificate and sends that encrypted private key to the CA for archiving. This archiving is an optional subprotocol, with security considerations specified in section 5.1.10. (For more information, see section 3.1.1.4.3.5.) This operation makes two calls from the client to the CA: ICertRequestD::GetCACert or ICertRequestD2::GetCAProperty to retrieve the CA **exchange certificate**, followed by ICertRequestD::Request or ICertRequestD2::Request2 to deliver a certificate request including the encrypted private key.

1.3.2 Concepts

The following topics specify concepts and technologies used by the Windows Client Certificate Enrollment Protocol.

1.3.2.1 Key Archival

The Windows Client Certificate Enrollment Protocol allows clients to archive (escrow) a private key with a CA. Enterprise **key archival** policy is communicated by setting the CT_FLAG_REQUIRE_PRIVATE_KEY_ARCHIVAL flag in certificate templates.

The key archival policy serves two functions:

- Backup-Protects the private key from loss for the benefit of the **keyholder**.
- Escrow-Prevents the keyholder from keeping the encrypted data secret from the enterprise.

With respect to the first function, key archival policy is allowed. With respect to the second function, key archival policy is required.

The CA's exchange certificate is used to transport the client's private key for archiving.

It is the responsibility of the CA to protect archived private keys from disclosure to unauthorized parties. How that protection is accomplished is up to the implementer of the CA. For more information on security considerations around key archival, see section 5.1.10. For processing rules concerning key archival, see section 3.2.2.6.2.1.2.2.

1.3.2.2 Key Attestation

The **trusted platform module (TPM)** can be used to create cryptographic public/private **key pairs** in such a way that the private key can never be revealed or used outside the TPM (that is, the key is

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non-migratable). This type of key can be used to guarantee that a certain cryptographic operation occurred in the TPM of a particular computer by virtue of the fact that any operation that uses the private key of such a key pair must occur inside that specific TPM.

It can also be useful to be able to cryptographically prove such a property of a key, so that a relying party can know that any use of the private key must have occurred inside that TPM.

An **Attestation Identity Key (AIK)** is used to provide such a cryptographic proof by signing the properties of the non-migratable key and providing the properties and signature to the CA for verification. Since the signature is created using the AIK private key, which can only be used in the TPM that created it, the CA can trust that the attested key is truly non-migratable and cannot be used outside that TPM.

A CA needs to know that it can trust an AIK, and that it is not being provided just any key that was created outside a TPM and can be used anywhere. This trust is formed by AIK activation, which is a process defined by the TPM that can be used to transfer trust from a TPM **endorsement key (EK)** to an AIK.

A TPM EK is another public/private key pair of which the private portion never leaves the TPM, but the EK is the root of the TPM's identity, and should be assumed to be unchangeable. As the root of the TPM's identity, there must be a way to establish trust in the EK so that CA can have some degree of trust that the private portion of the EK will never be used outside the TPM. Windows server supports the following methods for establishing trust in an EK:

1. **EK public key (EKPub)** validation where a SHA2 hash of the client-provided EKPub is checked against an administrator-managed list. For processing rules, see section 3.2.2.6.2.1.2.5.2.

2. **Endorsement certificate (EKCert)** validation where the chain for the client-provided EK certificate is built and verified to chain up to an administrator-selected list of CAs and root CAs. For processing rules, see section 3.2.2.6.2.1.2.5.1.

3. Trust the client provided EKPub. For processing rules, see section 3.2.2.6.2.1.2.5.

The Windows Client Certificate Enrollment Protocol allows clients and CAs to perform key attestation.<1> Enterprise key attestation is communicated by setting either of the following flags in the certificate template: CT_FLAG_ATTEST_REQUIRED or CT_FLAG_ATTEST_PREFERRED.

1.3.2.3 Netscape KEYGEN Tag

The Netscape browsers implement their own store mechanism for certificates and keys and have their own enrollment request syntax, using HTTP and HTML.

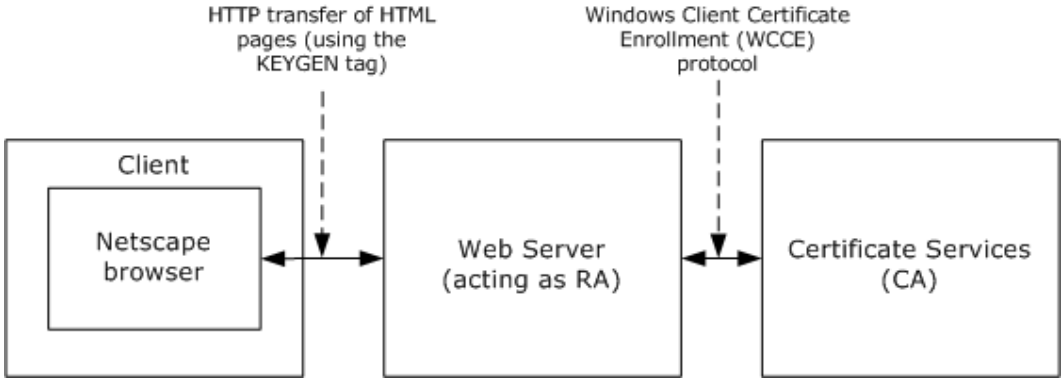

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Figure 1: Netscape enrollment

The Windows Client Certificate Enrollment Protocol supports Netscape enrollment, as shown in the preceding figure. The impact on the protocol defined in this specification is that structures defined in "Netscape Extensions for User Key Generation Communicator 4.0 Version" are supported as certificate requests. For more information, see [KEYGEN].

The process is:

1. The client machine's (Netscape) browser connects to a web page served by a web server that serves as an RA.
2. The web page delivered by the web server to the client includes the <**KEYGEN**> tag. For more information, see [KEYGEN].
3. In response to the KEYGEN tag, the browser generates a **public-private key pair** and builds a certificate enrollment request in a format defined by Netscape.
4. This request is delivered back to the web server with additional parameters.
5. The web server takes those parameters, builds a new request, and sends it to the CA using the WCCE protocol, noting in the call that its parameters are in Netscape format (for more information, see sections 2.2.2.6.4 and 3.1.1.4.3.1.4).
6. The CA returns a certificate in response to that request to the RA (for more information, see section 3.2.2.6.2.1.4).
7. The RA returns the certificate issued in step 6 to the Netscape browser over HTTP.

Note Only steps 5 and 6 are specified in this document.

1.3.2.4 Sanitizing Common Names

Lightweight Directory Access Protocol (LDAP) limits subelements to a maximum of 64 [UNICODE] characters. Because the Windows Client Certificate Enrollment Protocol uses Active Directory [MS-ADTS] to communicate with the **directory** for retrieval and storage of certificates and certificate templates, **objects** with longer names (in excess of 64 [UNICODE] characters) necessitates sanitation.

The algorithm for creating a **sanitized name** is specified in section 3.1.1.4.1.1.

In the following example, the number sign (#) is replaced by !0023 and the percent (%) is replaced by !0025.

```
Original Name: 'LongCAName(WithSpeci@#$%^Characters'
Sanitized Name: 'LongCAName!0028WithSpeci@!0023$!0025!005eCharacters'
```

The algorithm for creating a sanitized name is specified in section 3.1.1.4.1.1.

1.3.3 Information for Certificate Templates

When an enterprise operates its CA with certificate issuance that is controlled through certificate templates, the CA is bound to issue only those certificates that fit a particular template. Each user that requests enrollment must have been granted access to the template that is specified in the enrollment request. In this environment, the Active Directory contains the list of available certificate

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templates. The directory also contains a list of certificate templates for which a given certificate authority can issue certificates.

For information on server processing rules for certificate templates, see section 3.2.2.6.2.1.4.1.

1.3.3.1 Template IDs

Certificate templates are designed to be stored in Active Directory, although any directory accessible by LDAP can hold certificate templates.<2>

Certificate templates constitute data that are shared among multiple computers and that therefore might not be current.

To accommodate nonfreshness of certificate templates, the certificate template data structure, as specified in [MS-CRTD], includes fields that can address freshness. These are:

- **msPKI-Template-Template-OID**: The template's OID
- **revision**: The template's major revision number
- **msPKI-Template-Minor-Revision**: The template's minor revision number

If a customer who modifies a template would like to distinguish the new template from the previous one, that customer either can generate a new **OID** for the modified template, or can give the new template a higher major or minor revision value.<3>

If client software requires a template of a particular revision level or a particular OID, it can request a template by that OID and revision value. The protocol as defined here notifies the client whether the CA with which it is communicating has a template of that OID and at least that revision value; otherwise, the protocol returns an error. For more information, see section 3.1.2.4.2.2 and its subsections.

Note The protocol does not guarantee that the client and server implementations connect to the same Active Directory instance to retrieve templates. In addition, [MS-ADTS] does not guarantee that at any time two instances of Active Directory will be in sync and store the same data. Because of these limitations, the following scenarios are possible:

- Permission changes are available to the client but are not available to the server, and vice versa.
- Template modifications are available to the client but are not available to the server, and vice versa.

Certificate templates were designed to resolve some of the sync issues by allowing the client to identify the version of the certificate template it used when constructing the request. Specifications for the syntax of the template revision can be found in section 2.2.2.7.7.2.

In case of template version mismatch between the client and the server, the server fails a request that refers to a template with a higher version than the server has in its replica. If the server has a higher version than the one requested, the server uses the highest version available.

1.3.3.2 Implementations Without Templates

If a vendor chooses to implement a CA without using templates, as specified in [MS-CRTD], then the "template names" and "template version number and OID" (as they are called in this document) become merely policy identifiers. It is then up to the vendor of the CA to write the code that maps from these policy identifiers to certificate bodies that correspond to those requests.

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1.3.3.3 Modifying Templates

A set of default templates is documented in [MS-CRTD]. However, a customer is free at any time to create new templates, delete existing ones, or modify templates.<4> A template is a normal **directory object** accessed throughLDAP. Any new or existing software capable of modifying LDAP objects can be used. By editing certificate templates, a customer can express custom certificate issuance policy.

1.3.3.4 Permissions on Templates

A template object in Active Directory has an ACL, as does every object in Active Directory. A customer can set those ACLs so that users (or groups of users) have read permission only for templates for certificates (thus, for certificate requests) that are available to those users. In addition, the CA enforces a permission, enroll, which is associated with a template object, by honoring a certificate request from a given user only if that user has enroll permission for the template that corresponds to that request.

If a non-Microsoft implementation of the CA wants to avoid using templates but still wants this kind of access control, then it needs to implement that access control in some other manner.

1.4 Relationship to Other Protocols

The Windows Client Certificate Enrollment Protocol depends on the Distributed Component Object Model (DCOM) Remote Protocol [MS-DCOM]. The DCOM Remote Protocol is built on top of the Remote Procedure Call Protocol Extensions (RPCE) [MS-RPCE], and the Windows Client Certificate Enrollment Protocol accesses RPCE directly to obtain certain security settings for the client-to-server connections. The Windows Client Certificate Enrollment Protocol depends on the Netlogon Remote Protocol Specification [MS-NRPC] for locating the **domain controller**.

The Windows Client Certificate Enrollment Protocol uses the Hypertext Transfer Protocol -- HTTP/1.1 [RFC2616] for retrieving CRLs. When using HTTP, the behavior will be to use HTTP v1.1 (see [RFC2616]) on port 80 unless one of the following cases:

- The URL has a prefix of "https://" in which case it uses port 443.
- A URL explicitly specifies an alternative port, or the processing rule explicitly requests an alternative port.

The HTTP v1.1 behavior is to use persistent connections.

The Windows Client Certificate Enrollment Protocol uses the DCOM Remote Protocol to create and use DCOM object references to server objects, as specified in section 2.1 of this document and [MS-DCOM] section 3.2.4.1. The Windows Client Certificate Enrollment Protocol also uses the DCOM Remote Protocol to select authentication settings. The specific parameters passed from the Windows Client Certificate Enrollment Protocol to the DCOM Remote Protocol are specified in section 2.1.

Using input from a higher-layer protocol or application, the DCOM Remote Protocol negotiates its authentication method and settings by using the Generic Security Service Application Programming Interface (GSS-API) (as specified in [RFC2478]), and these settings are in turn passed to the activation request and **object remote procedure calls (ORPC)** made by the DCOM client to the DCOM server, as specified in [MS-DCOM] sections 3.2.4.1.1.2 and 3.2.4.2. The following figure shows the layering of the protocol stack.

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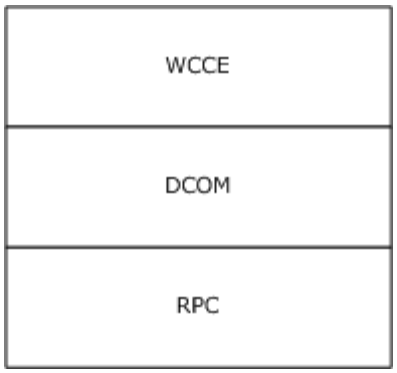

Figure 2: Windows Client Certificate Enrollment protocol stack

Data structures that are defined in the certificate template structure specification (see [MS-CRTD]), can be retrieved over LDAP, as specified in [RFC2559], and used by the Windows Client Certificate Enrollment Protocol.

The Certificate Services Remote Administration Protocol [MS-CSRA] is a management protocol for the Windows Client Certificate Enrollment Protocol server. When implemented together Windows Client Certificate Enrollment Protocol shares ADM with Certificate Services Remote Administration Protocol [MS-CSRA] as specified in sections 3.2.1.1 and 3.2.1.1.3.

The ICertPassage Remote Protocol [MS-ICPR] is another certificate enrollment protocol that is built directly on top of the Remote Procedure Call Protocol Extensions (RPCE) [MS-RPCE]. When implemented together the Windows Client Certificate Enrollment Protocol shares some of its ADM with ICertPassage Remote Protocol [MS-ICPR], as specified in [MS-ICPR] 3.1.1 and 3.2.1.

The Encrypting File System Remote (EFSRPC) Protocol Specification [MS-EFSR] and the Health Certificate Enrollment Protocol [MS-HCEP] depend on the Windows Client Certificate Enrollment Protocol.

Indirectly, as an example, other protocols that rely on certificates for authentication (such as the Transport Layer Security Protocol (TLS), [RFC2246]) can use this protocol for certificate enrollment and issuance.

1.5 Prerequisites/Preconditions

The configuration elements defined in section 3.2.1.1.4 are available. Server implementations that also implement the Certificate Services Remote Administration Protocol, specified in [MS-CSRA], or the ICertPassage Remote Protocol, specified in [MS-ICPR], use the same configuration data elements, defined in section 3.2.1.1.4 as "public", for those implementations.

1.6 Applicability Statement

The Windows Client Certificate Enrollment Protocol is applicable to an environment in which clients benefit from the capability to interact with the CA in order to enroll or manage [X509] certificates.

1.7 Versioning and Capability Negotiation

This document covers versioning issues in the following areas.

- **Interface support**: The Windows Client Certificate Enrollment Protocol uses DCOM [MS-DCOM] to determine interface support, as specified in section 3.1.1.4.

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1.8 Vendor-Extensible Fields

A vendor that implements a customized CA policy algorithm or CA exit algorithm MUST NOT return an implementation description identical to the one implemented by Microsoft: "Windows default". The returned value of the implementation description is specified in section 3.2.1.4.3.2.4 and 3.2.1.4.3.2.5.

1.9 Standards Assignments

Parameter	Value
RPC Interface UUID for ICertRequestD	{d99e6e70-fc88-11d0-b498-00a0c90312f3}
RPC Interface UUID for ICertRequestD2	{5422fd3a-d4b8-4cef-a12e-e87d4ca22e90}
CLSID for CCertRequestD class	{d99e6e74-fc88-11d0-b498-00a0c90312f3}

No standard assignments have been received for the Windows Client Certificate Enrollment Protocol described in this protocol specification.

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2 Messages

The following sections specify how Windows Client Certificate Enrollment Protocol messages are transported and their syntax.

2.1 Transport

The Distributed Component Object Model (DCOM) Remote Protocol [MS-DCOM] is used as the transport protocol.

The Windows Client Certificate Enrollment Protocol uses DCOM to create and use DCOM object references to server objects.

Windows Client Certificate Enrollment Protocol clients initialize a connection to the Windows Client Certificate Enrollment Protocol server by creating and executing a DCOM activation request. As a result of this DCOM activation, the Windows Client Certificate Enrollment Protocol client can use the DCOM client to call the methods specified in this document. The activation process is detailed in [MS-DCOM] section 3.2.4.

The RPC version number for all interfaces MUST be 0.0.

[MS-DCOM] section 3.2.4.1 specifies the various elements that an application using DCOM passes to the DCOM client as part of the initial activation request. Below are the values that the Windows Client Certificate Enrollment Protocol sends to the DCOM layer.

General DCOM settings:

- Remote server name the application-supplied remote server name as specified in [MS-DCOM] section 3.2.4.2. The Windows Client Certificate Enrollment Protocol client sends the name of the CA server.
- Class identifier (CLSID) of the object requested. This value is implementation-specific.
- Interface identifier(s) (IID) of interface(s) requested (see section 1.9).

Security settings ([MS-DCOM] section 3.2.4.1.1.2):

- Security provider: RPC_C_AUTHN_GSS_NEGOTIATE (9).
- Authentication level: SHOULD<5> be set to RPC_C_AUTHN_LEVEL_PKT_PRIVACY (6).

  As a result of the security provider and authentication level used, there is a negotiation between the client and server security providers that results in either NTLM, as specified in [MS-NLMP], or Kerberos, as specified in [RFC4120] and [MS-KILE], being used as the authentication method.
- Impersonation level: RPC_C_IMP_LEVEL_IMPERSONATE (3).

  This means the server can use the client's security context while acting on behalf of the client, to access local resources such as files on the server.
- Authentication identity and credentials: NULL.

Passing NULL authentication identity and credentials for the RPC_C_AUTHN_GSS_NEGOTIATE security provider means that the ORPC call uses the identity and credentials of the higher-layer application.

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Default values, as specified in [MS-DCOM], are used for all DCOM inputs not specified above, such as Security Principal Name (SPN), client and prototype context property buffers, and their context property identifiers.

2.2 Common Data Types

2.2.1 BYTE

A **BYTE** is an 8-bit value. This data type maps to the **byte** base **Interface Definition Language (IDL)** type, as specified in [C706] section 4.2.9.5.

This type is declared as follows:

```
typedef byte BYTE;
```

2.2.2 Common Structures

This section defines the structures used by the Windows Client Certificate Enrollment Protocol. These structures are used when a certificate request is submitted to the server and as part of the server's response. Use of these structures is specified in section 3.2.1.4.

All communications of **binary large objects (BLOBs)** between the client and server use the **CERTTRANSBLOB** data structure (which also takes the acronym BLOB). The **CERTTRANSBLOB** data structure contains a length and a pointer to a byte array. The type of content, stored in the byte array buffer, depends on the particular call context.

A BLOB contains any one of the following:

- CATRANSPROP: A structure used to return information for CA properties, as specified in section 2.2.2.3.
- CAINFO: A structure that contains basic information on the CA, as specified in section 2.2.2.4.
- An ASN.1 (as specified in [X690])-encoded CMS (as specified in [RFC3852]), PKCS #10 (as specified in [RFC2986]), or CMC (as specified in [RFC2797]) request certificate submitted to the CA, as specified in section 2.2.2.6.
- An ASN.1 (as specified in [X690])-encoded CMS with a full certificate chain (as specified in [RFC3852]) or a CMC full PKI response (as specified in [RFC2797]) returned by the CA, as specified in section 2.2.2.8.
- An ASN.1 (as specified in [X690])-encoded X.509 certificate returned by the CA, as specified in section 2.2.2.2.2.
- A Unicode (as specified in [UNICODE4.0]) disposition text message returned by the CA, as specified in section 2.2.2.2.1.

Data type definitions of HRESULT, BOOL, BYTE, LONG, wchar_t, and DWORD, used in the following sections, are as specified in [MS-RPCE], [MS-DTYP], and [MS-ERREF].

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2.2.2.1 CACERTBLOB

The CACERTBLOB construct consists of serialized elements. Each element is a data structure consisting of a header and its value. The element header consists of the following fields.

Field	Data type	Description
Element type	DWORD	Identifies the type of the element.
Encoding type	DWORD	Specifies the encoding used.
Length	DWORD	Specifies the length of the element.

The following table defines the element types that are possible.

Element type	Encoding type	Meaning
FILE_ELEMENT_CERT_TYPE (0x00000020)	X509_ASN_ENCODING (0x00000001)	The element contains ASN.1-encoded X.509 certificates, as defined in [RFC3280].
CERT_FRIENDLY_NAME_PROP_ID (0x0000000d)	X509_ASN_ENCODING (0x00000001)	A friendly name can be associated with the certificate. The friendly name is specified as a null-terminated Unicode character string.
CERT_DESCRIPTION_PROP_ID (0x0000000b)	X509_ASN_ENCODING (0x00000001)	This property allows the user to describe the use for the certificate.
CERT_ENHKEY_USAGE_PROP_ID (0x00000009)	X509_ASN_ENCODING (0x00000001)	A specific set of enhanced key usages can be enabled or disabled for a certificate. The ASN.1 representation for enhanced key usage is described in [RFC3280] section 4.2.1.13.

CERT_CROSS_CERT_DIST_POINTS_PROP_ID (0x00000017)	X509_ASN_ENCODING (0x00000001)	The Cross-Certificate Distribution Points extension can be used to specify the download URL for cross certificates that are associated with a particular certificate.
		The ASN.1 definition for Cross-Certificate Distribution Points is:
		`CrossCertDistPoints ::= SEQUENCE {`
		`  syncDeltaTime INTEGER (0..4294967295) OPTIONAL,`
		`  crossCertDistPointNames CrossCertDistPointNames`
		`}`
		`CrossCertDistPointNames ::= SEQUENCE OF GeneralNames`

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Element type	Encoding type	Meaning
		`GeneralNames ::= AltNames` For the definition of AltNames, see [RFC3280] section 4.2.1.7, the definition of GeneralNames.

2.2.2.2 CERTTRANSBLOB

The **CERTTRANSBLOB** structure defines a byte buffer that is used to store certificates, request certificates, transmit responses, manipulate [UNICODE] strings, and marshal property values.

```
typedef struct _CERTTRANSBLOB {
  ULONG cb;
  [size_is(cb), unique] BYTE* pb;
} CERTTRANSBLOB;
```

cb: Unsigned integer value that MUST contain the length of the buffer pointed to by **pb** in bytes.

pb: Byte buffer that MUST contain the binary contents being transported in this **CERTTRANSBLOB**.

CERTTRANSBLOB is empty when both **cb** and **pb** are set to 0.

The following sections specify marshaling of all supported structures that can be passed in the **pb** Byte buffer of **CERTTRANSBLOB**.

All instances of **CERTTRANSBLOB** used by this protocol MUST use one of the marshaling rules described in the following sections.

2.2.2.2.1 Marshaling Unicode Strings in CERTTRANSBLOB

When a [UNICODE] string is returned in the byte array referenced by the **pb** field of a **CERTTRANSBLOB (section 2.2.2.2)** structure, each [UNICODE] character MUST be marshaled in **little-endian** format.

2.2.2.2.2 Marshaling X.509 Certificates in a CERTTRANSBLOB

The following table specifies how [X509] certificates are to be returned in the byte array referenced by the **pb** field of a **CERTTRANSBLOB (section 2.2.2.2)** structure.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Data (variable)																															
...																															

Data (variable): This field contains the X.509 certificate (as specified in [X509]), which is encoded by using Distinguished Encoding Rules (DER), as specified in [X690].

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2.2.2.2.3 Marshaling an X.509 CRL in a CERTTRANSBLOB

The following table specifies how an X.509 certificate revocation list (CRL), as specified in [RFC3280], is to be returned in the byte array referenced by the **pb** field of a **CERTTRANSBLOB (section 2.2.2.2)** structure.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Data (variable)																															
...																															

Data (variable): This field contains an X.509 CRL (as specified in [RFC3280]), which is encoded by using DER, as specified in [X690].

2.2.2.2.4 Marshaling CMS in a CERTTRANSBLOB

The following table specifies how a **Cryptographic Message Syntax (CMS)**, as specified in [RFC3852], is to be returned in the byte array that is referenced by the **pb** field of a **CERTTRANSBLOB (section 2.2.2.2)** structure.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Data (variable)																															
...																															

Data (variable): This field is CMS (as specified in [RFC3852]), which is encoded by using DER, as specified in [X690].

2.2.2.2.5 Marshaling CAINFO in CERTTRANSBLOB

When a **CAINFO (section 2.2.2.4)** structure is returned within the **pb** field of a **CERTTRANSBLOB (section 2.2.2.2)** structure, **CAINFO** is marshaled by using the same data types and structure as those specified in section 2.2.2.4. All fields MUST be marshaled as little-endian. For more information on supported values of the fields within that structure, see section 2.2.2.4.

2.2.2.2.6 Marshaling Certificate Requests in a CERTTRANSBLOB

The following table specifies how a certificate request is to be returned in the byte array that is referenced by the **pb** field of a **CERTTRANSBLOB** structure.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Data (variable)																															
...																															

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Data (variable): This field is a CMS (as specified in [RFC3852]), Public-Key Cryptography Standards (PKCS) #10 (as specified in [RFC2986]), or CMC (as specified in [RFC2797]) request certificate encoded by using DER, as specified in [X690].

2.2.2.2.7 Marshaling CMC in a CERTTRANSBLOB

The following table specifies how a CMC, as specified in [RFC2797], is to be returned in the byte array referenced by the **pb** field of a **CERTTRANSBLOB (section 2.2.2.2)** structure.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Data (variable)																															
...																															

Data (variable): This field is CMC (as specified in [RFC2797]) encoded by using DER, as specified in [X690].

2.2.2.3 CATRANSPROP

The **CATRANSPROP** structure encapsulates information about a CA property. For a list of CA properties, see section 3.2.1.4.3.2. An array of these structures is carried in a **CERTTRANSBLOB (section 2.2.2.2)** structure, and is returned by GetCAPropertyInfo, as specified in section 3.2.1.4.3.3. Note that this structure does not contain property values themselves; rather, CATRANSPROP contains information about properties.

```
typedef struct {
  LONG lPropID;
  BYTE propType;
  BYTE Reserved;
  USHORT propFlags;
  ULONG obwszDisplayName;
} CATRANSPROP;
```

lPropID: Integer value that MUST contain the property identifier. For the list of supported properties, see section 3.2.1.4.3.2.

propType: Byte value that MUST contain the data type for the property. Must be one of the following values.

Value	Meaning
PROPTYPE_LONG 0x1	Property type is a signed long integer.
PROPTYPE_DATE 0x2	Property type is a date-time value.
PROPTYPE_BINARY 0x3	Property type is binary data.

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Value	Meaning
PROPTYPE_STRING 0x4	Property type is a string.

Reserved: MUST be set to 0 and ignored upon receipt.

propFlags: 16-bit flag field.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I

Where the bits are defined as:

Value	Description
I	This bit provides indication that the property is indexed and has multiple values. If this bit is set to 1, then a property is indexed. If the bit is set to 0, then the property is not indexed.

obwszDisplayName: Integer that MUST contain the offset to the string that contains the display name of this property, where the offset begins at the beginning of the byte array referenced by the **pb** field of the containing **CERTTRANSBLOB** (section 2.2.2.2) structure. The string format MUST be null-terminated [UNICODE]. The offset MUST be **DWORD**-aligned. For marshaling information about this property, see Marshaling CATRANSPROP in a CERTTRANSBLOB (section 2.2.2.3.1).

2.2.2.3.1 Marshaling CATRANSPROP in a CERTTRANSBLOB

A **CERTTRANSBLOB (section 2.2.2.2)** structure MUST be used to return an array of **CATRANSPROP (section 2.2.2.3)** structures, where the count of array elements is returned in a separate output parameter of the remote procedure call. It MUST also contain a null-terminated Unicode string for each **CATRANSPROP** (section 2.2.2.3) structure that represents the display name of the CA property.

The following table shows the sequence of fields in the byte array referenced by the **pb** field of the **CERTTRANSBLOB** (section 2.2.2.2) structure when used to transfer an array of **CATRANSPROP** (section 2.2.2.3) structures and their corresponding data.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
lPropID_1																															
propType_1								Reserved_1								propFlags_1															
obwszDisplayName_1																															
lPropID_N																															

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propType_N	Reserved_N	propFlags_N
obwszDisplayName_N		
Byte Array (variable)		
...		

lPropID_1 (4 bytes): These 4 bytes indicate the value of the **lPropID** field of the first **CATRANSPROP** (section 2.2.2.3) structure that is transferred in the **CERTTRANSBLOB** (section 2.2.2.2) structure. Little-endian encoding format MUST be used.

propType_1 (1 byte): This byte indicates the value of **PropType** field of the first **CATRANSPROP** (section 2.2.2.3) structure that is transferred in the **CERTTRANSBLOB** (section 2.2.2.2) structure.

Reserved_1 (1 byte): MUST be set to 0 and ignored upon receipt.

propFlags_1 (2 bytes): These 2 bytes indicate the value of the **propFlags** field of the first **CATRANSPROP** (section 2.2.2.3) structure that is transferred in the **CERTTRANSBLOB** (section 2.2.2.2) structure. Little-endian encoding format MUST be used.

obwszDisplayName_1 (4 bytes): These 4 bytes indicate the value of the **obwszDisplayName** field of the first **CATRANSPROP** (section 2.2.2.3) structure that transfers in the **CERTTRANSBLOB** (section 2.2.2.2) structure. Little-endian encoding format MUST be used. The value of this field indicates an offset from the beginning of the **pb** field to where the data value for this property can be found in byte array. The value of this field must be DWORD-aligned.

lPropID_N (4 bytes): These 4 bytes indicate the value of the **lPropID** field of the last **CATRANSPROP** (section 2.2.2.3) structure that is transferred in the **CERTTRANSBLOB** (section 2.2.2.2) structure. Little-endian encoding format MUST be used.

propType_N (1 byte): This byte indicates the value of **PropType** of the last **CATRANSPROP** (section 2.2.2.3) structure that is transferred in the **CERTTRANSBLOB** (section 2.2.2.2) structure.

Reserved_N (1 byte): MUST be set to 0 and ignored upon receipt.

propFlags_N (2 bytes): These 2 bytes indicate the value of the **propFlags** field of the last **CATRANSPROP** (section 2.2.2.3) structure that is transferred in the **CERTTRANSBLOB** (section 2.2.2.2) structure. Little-endian encoding format MUST be used.

obwszDisplayName_N (4 bytes): These 4 bytes indicate the value of the **obwszDisplayName** field of the last **CATRANSPROP** (section 2.2.2.3) structure transfers in the **CERTTRANSBLOB** (section 2.2.2.2) structure. Little-endian encoding format MUST be used. The value of this field indicates an offset from the beginning of the **pb** field to where the data value for this property can be found in byte array. The value of this field must be DWORD-aligned.

Byte Array (variable): Contains DisplayName data value for all the properties. The data value for one property MUST not overlap with another property's data value. Arbitrary padding can be added before or after data values. Each data value MUST be encoded as a [UNICODE] null-terminated string in little-endian format.

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2.2.2.4 CAINFO

The **CAINFO** structure defines a basic informational block that describes a CA.

```
typedef struct {
  ULONG cbSize;
  LONG CAType;
  ULONG cCASignatureCerts;
  ULONG cCAExchangeCerts;
  ULONG cExitAlgorithms;
  LONG lPropIDMax;
  LONG lRoleSeparationEnabled;
  ULONG cKRACertUsedCount;
  ULONG cKRACertCount;
  ULONG fAdvancedServer;
} CAINFO;
```

cbSize: Unsigned integer value that MUST contain the size of this structure in bytes.

CAType: Integer value that SHOULD contain a constant describing the CA type. The value SHOULD be one of the values in the following table.

Note The value 0x00000002 MUST NOT be used for this parameter.

Value	Meaning
ENUM_ENTERPRISE_ROOTCA 0x00000000	The CA is an enterprise root (self-signed) CA. For more information, see [MSFT-PKI].
ENUM_ENTERPRISE_SUBCA 0x00000001	The CA is an enterprise **subordinate CA**. For more information, see [MSFT-PKI].
ENUM_STANDALONE_ROOTCA 0x00000003	The CA is a stand-alone root (self-signed) CA. For more information, see [MSFT-PKI].
ENUM_STANDALONE_SUBCA 0x00000004	The CA is a stand-alone subordinate CA. For more information, see [MSFT-PKI].
ENUM_UNKNOWN_CA 0x00000005	The CA type is unknown.

cCASignatureCerts: Unsigned integer value that SHOULD contain the count of CA **signing certificates** in the CA. A CA signing certificate contains a public key that is in turn associated with the private key used to sign certificates that are issued by the CA. For more information on CA signing certificates, see [MSFT-PKI].

cCAExchangeCerts: Unsigned integer value that SHOULD contain the count of CA exchange certificates in the CA. CA exchange certificates contain public keys that are used to encrypt requests sent to a CA. For more information, see [MSFT-ARCHIVE].

cExitAlgorithms: Unsigned integer value that SHOULD contain the number of exit algorithms that are installed and active for the CA.

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lPropIDMax: Integer that SHOULD contain the maximum supported value for the *PropID* parameter in the ICertRequestD2::GetCAProperty method. For more information on CA properties, see section 3.2.1.4.3.2.

lRoleSeparationEnabled: Integer value that SHOULD indicate whether **CA role separation** is enabled on the CA. A value of 0 indicates that CA role separation is disabled; a value of 1 indicates that it is enabled.

cKRACertUsedCount: Unsigned integer value that SHOULD contain the number of **key recovery agent (KRA)** keys used to encrypt each archived private key.

cKRACertCount: Unsigned integer value that SHOULD contain the number of KRA keys available for the CA to encrypt archived private keys.

fAdvancedServer: Unsigned integer value that SHOULD be set to 0 for **standard CA** and 1 for **advanced CA**. This value is a Boolean value. The CA SHOULD return 0 or 1.

2.2.2.5 KeyAttestationStatement

The **KeyAttestationStatement** structure is defined as follows:<6>

```
typedef struct  {
  UINT32 Magic;
  UINT32 Version;
  UINT32 Platform;
  UINT32 HeaderSize;
  UINT32 cbIdBinding;
  UINT32 cbKeyAttestation;
  UINT32 cbAIKOpaque;
  BYTE idBinding[cbIdBinding];
  BYTE keyAttestation[cbKeyAttestation];
  BYTE aikOpaque[cbAIKOpaque];
} KeyAttestationStatement;
```

Magic: The value MUST be 0x5453414B.

Version: The value MUST be 1.

Platform: The value MUST be either 1 or 2 indicating the TPM platform.

HeaderSize: An integer value denoting the size of the header.

cbIdBinding: An integer value denoting the size of the **idBinding** field.

cbKeyAttestation: An integer value denoting the size of the **keyAttestation** field.

cbAIKOpaque: An integer value denoting the size of the **aikOpaque** field.

idBinding: A structure, as defined in [TCG-Struct] section 12.5.

keyAttestation: A structure that is defined as follows:

```
typedef struct {
  UINT32 Magic;
  UINT32 Platform;
  UINT32 HeaderSize;
```


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```
  UINT32 cbKeyAttest;
  UINT32 cbSignature;
  UINT32 cbKeyBlob;
  BYTE keyAttest[cbKeyAttest];
  BYTE signature[cbSignature];
  BYTE keyBlob[cbKeyBlob];
} keyAttestation;
```

Magic: The value MUST be 0x5344414B.

Platform: The value MUST be either 1 or 2 indicating the TPM platform.

HeaderSize: An integer value denoting the size of the header.

cbKeyAttest: An integer value denoting the size of the **keyAttest** array.

cbSignature: An integer value denoting the size of the **signature** array.

cbKeyBlob: An integer value denoting the size of the **keyBlob** array.

keyAttest: MUST be a TPM_CERTIFY_INFO structure if the **Platform** field equals 1, or a TPM_CERTIFY_INFO2 structure if **Platform** equals 2, as defined in [TCG-Struct] sections 11.1 and 11.2.

signature: Contains the signature of the keyAttest array using the AIK private key.

keyBlob: Contains a CSP-specific opaque format of the public portion of the attested key.

aikOpaque: Contains a CSP-specific opaque format of the private portion of the AIK private key.

2.2.2.6 Request Format

The Windows Client Certificate Enrollment Protocol is a simple request-response pattern between the client and the server (CA). The client MUST send the certificate request by using one of the following ASN.1 encoded message formats: PKCS #10, CMS, Netscape, or CMC. Each format contains a set of **attributes** and extensions that describe the request.

This section defines the format for the various client request types. A single ASN.1 encoded request makes up the entire byte buffer of a **CERTTRANSBLOB (section 2.2.2.2)** structure passed to the CA. Detailed processing rules for each of the message formats are specified in section 3.1.1.4.

2.2.2.6.1 PKCS #10 Request Format

Clients use PKCS #10 structures, as specified in [RFC2986], to submit a certificate request to a CA. A PKCS #10 request can be used by itself or encapsulated within a CMC (as specified in [RFC2797]) or a CMS (as specified in [RFC3852]) request.

The following fields are introduced and specified in [RFC2986] section 4 and used by this protocol:

- **CertificationRequest**
- **CertificationRequestInfo**
- **Name**
- **SubjectPublicKeyInfo**

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- **Attributes**
- **AlgorithmIdentifier**

For detailed server processing information, see section 3.1.1.4.3.1.1.

2.2.2.6.2 CMS Request Format

Clients use CMS structures, as specified in [RFC3852], to submit requests to a CA.

The following fields are introduced and specified in [RFC3852] sections 4, 5, 6, and 8, and are used by this protocol:

- **ContentType**
- **Version**
- **DigestAlgorithmIdentifiers**
- **ContentInfo**
- **ExtendedCertificateOrCertificate**
- **RevocationInfoChoices**
- **SignerInfos**
- **IssuerAndSerialNumber**
- **Attributes**
- **DigestAlgorithmIdentifiers**
- **EncryptedContentEnvelopedData**
- **RecipientInfos**
- **EncryptedContentInfo**
- **ContentEncryptionAlgorithmIdentifier**
- **EncryptedContent**
- **UnprotectedAttributes**

For processing rules for these fields, see section 3.1.1.4.3.1.2.

2.2.2.6.3 CMC Request Format

Clients use CMC structures that are documented (as specified in [RFC2797]) for certificate requests. A CMC request consists of a CMS message with CMC content.

The following fields are specified in section 3 and in [RFC2797] (Appendix A) and are used by this protocol:

- **TaggedRequest**
- **TaggedContentInfo**

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- **OtherMsg**
- **BodyPartId**
- **AttributeValue**
- **TaggedCertificationRequest**
- **CertReqMsg**
- **BodyPartId**
- **ContentInfo**

RegInfo: This field is an octet string that is used as follows in this protocol: It MUST contain zero or more request attributes, which MUST take the form of name-value pairs. The name-value pairs MUST be formatted as "Name=Value". An '=' MUST be the separator. An '&' MUST separate adjacent name-value pairs. The string value MUST be encoded as a **UTF-8** string and then converted to an octet string.

For processing rules for these fields, see section 3.2.1.4.2.1.3.

2.2.2.6.4 Netscape KEYGEN Tag Request Format

Certificate requests MAY use the Netscape request format, which MUST be the same format that a Netscape 3.x or Network 4.x browser would send to a web server in response to an HTML KEYGEN tag after a user fills in the information into the request form that it instantiates.

The data sent in the request string is called a Signed Public Key and Challenge (SPKAC) and MUST be encoded as specified in the following ASN.1 structure example.

```
PublicKeyAndChallenge ::= SEQUENCE {
    spki SubjectPublicKeyInfo,
    challenge IA5STRING
}

SignedPublicKeyAndChallenge ::= SEQUENCE {
    publicKeyAndChallenge PublicKeyAndChallenge,
    signatureAlgorithm AlgorithmIdentifier,
    signature BIT STRING
}
```

Two attributes are associated with a request from a Netscape browser: **CertType** and **rdn**. These attributes MUST be passed along with the Netscape certificate request in the pwszAttributes to ICertRequestD::Request or ICertRequestD2::Request2 methods. Method specifications are in sections 3.2.1.4.2.1 and 3.2.1.4.3.1.

2.2.2.6.4.1 CertType

The CertType attribute is used to specify the type of the requested certificate. The only supported value for a KEYGEN certificate request for this attribute is the string "server". For specifications, see section 2.2.2.7.

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2.2.2.6.4.2 Relative Distinguished Name

The **relative distinguished name (RDN)**, as specified in [MS-ADTS] section 3.1.1.1.4, is used to pass the requested values for the **Subject** field in the issued certificate to the CA.

The RDN MUST be one of the following:

- "C" or "Country" or "2.5.4.6".
- "O" or "Org" or "Organization" or "2.5.4.10".
- "OU" or "OrgUnit" or "OrganizationUnit" or "OrganizationalUnit" or "2.5.4.11".
- "CN" or "CommonName" or "2.5.4.3".
- "L" or "Locality" or "2.5.4.7".
- "S" or "ST" or "State" or "2.5.4.8".
- "T" or "Title" or "2.5.4.12".
- "G" or "GivenName" or "2.5.4.42".
- "I" or "Initials" or "2.5.4.43".
- "SN" or "SurName" or "2.5.4.4".
- "DC" or "DomainComponent" or "0.9.2342.19200300.100.1.25".
- "E" or "Email" or "1.2.840.113549.1.9.1".
- "Street" or "StreetAddress" or "2.5.4.9".
- "UnstructuredName" or "1.2.840.113549.1.9.2".
- "UnstructuredAddress" or " 1.2.840.113549.1.9.8".
- "DeviceSerialNumber" or "2.5.4.5".

2.2.2.7 Certificate Request Attributes

A certificate request can contain attributes. The client uses these attributes to pass additional information to the CA, and the CA uses these attributes when issuing the certificate.

There are various locations for these attributes:

- For certificate requests based on the PKCS #10 message format, the attributes SHOULD be passed in the **Attributes** field, as specified in [RFC2986].
- For certificate requests based on the CMS format, the attributes SHOULD be passed in the **Attributes** field of the inner PKCS #10 certificate request that MUST be passed in the CMS. Details are specified in section 3.1.1.4.3.1.2.
- For certificate requests based on the CMC format, attributes SHOULD be passed in the **Attributes** field of the inner PKCS #10 certificate request that MUST be passed in the CMC. Details are specified in section 3.1.1.4.3.1.3. The attributes specified in section 2.2.2.7.10 MAY be passed in the **RegInfo** field of the CMC request. For formatting rules, see section 2.2.2.6.3.

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In addition, the client can pass the attributes specified in section 2.2.2.7.10 in the *pwszAttributes* parameter for **ICertRequestD::Request** and **ICertRequestD2::Request2** methods. The format for this parameter is specified in section 3.2.1.4.2.1.

Because the Netscape KEYGEN tag request format does not support passing additional attributes, any request call that uses a Netscape KEYGEN tag request format MUST pass any additional attributes in the *pwszAttributes* parameter for the **ICertRequestD::Request** and **ICertRequestD2::Request2** methods.

For processing rule specifications, see section 3.

Each attribute has an object identifier (OID) that MUST uniquely identify the attribute and a value. The value MUST be an ASN.1 **DER**-encoded value, as specified in [X690]. The following sections define the various attributes for this protocol and define their formats.

2.2.2.7.1 szOID_OS_VERSION

OID = 1.3.6.1.4.1.311.13.2.3.

Internal Name: szOID_OS_VERSION.

Description: This attribute specifies the client's operating system version.

Format: The following is the ASN.1 structure for this attribute.

```
AnyString ::= CHOICE {
        numericString   NUMERICSTRING,   -- tag 0x12 (18)
        printableString PRINTABLESTRING, -- tag 0x13 (19)
        teletexString   TELETEXSTRING,   -- tag 0x14 (20)
        videotexString  VIDEOTEXSTRING,  -- tag 0x15 (21)
        ia5String       IA5STRING,       -- tag 0x16 (22)
        graphicString   GRAPHICSTRING,   -- tag 0x19 (25)
        visibleString   VISIBLESTRING,   -- tag 0x1A (26)
        generalString   GENERALSTRING,   -- tag 0x1B (27)
        universalString UNIVERSALSTRING, -- tag 0x1C (28)
        bmpString       BMPSTRING,       -- tag 0x1E (30)
    } --#public
```

2.2.2.7.2 szOID_ENROLLMENT_CSP_PROVIDER

OID = 1.3.6.1.4.1.311.13.2.2.

Internal Name: szOID_ENROLLMENT_CSP_PROVIDER.

Description: This attribute MUST specify the **cryptographic service provider (CSP)** used to generate the key pair on the enrollment client.

Format: Following is the ASN.1 format for this attribute.

```
CSPProvider ::= SEQUENCE {
keySpec_INTEGER,
cspName_BMPSTRING,
signature_BITSTRING
}
```


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2.2.2.7.3 szOID_RENEWAL_CERTIFICATE

OID = 1.3.6.1.4.1.311.13.1.

Internal Name: szOID_RENEWAL_CERTIFICATE.

Description: This attribute MUST be the certificate associated with the private key used to sign a request to renew an existing certificate.

Format: The value of the attribute MUST be the DER, as specified in [X690], encoded certificate.

2.2.2.7.4 szOID_REQUEST_CLIENT_INFO

OID = 1.3.6.1.4.1.311.21.20.

Internal Name: szOID_REQUEST_CLIENT_INFO.

The supported request format for this attribute MUST be only PKCS #10.

Description: Provides information about the client.

Client ID: An integer value that identifies the client application that sent the request. The values 0x1, 0x2, 0x3, 0x4, 0x5, 0x6, 0x7, 0x8, 0x9, and 0x3E8 are reserved and SHOULD NOT be used.<7>

Machine Name: A UTF-8 string representing the name of the machine on which this request is generated.

User Name: A UTF-8 string representing the name of the user who is responsible for creating the request.

Process Name: A UTF-8 string representing the application name that generated the request (for example, "certreq").

Format: The following is the ASN.1 format for this attribute.

```
SEQUENCE {
clientId INTEGER,
MachineName UTF8STRING,
UserName UTF8STRING,
ProcessName UTF8STRING
}
```

2.2.2.7.5 szOID_NT_PRINCIPAL_NAME

OID = 1.3.6.1.4.1.311.20.2.3.

Internal Name: szOID_NT_PRINCIPAL_NAME.

Description: Used to encode the **user principal name (UPN)** as **OtherName** in a subject alternative name (SAN) extension, as specified in [RFC3280] section 4.2.1.7.

Format: UTF8String.

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2.2.2.7.6 szOID_NTDS_REPLICATION

OID = 1.3.6.1.4.1.311.25.1.

Internal Name: szOID_NTDS_REPLICATION.

Description: Used to encode the directory **globally unique identifier (GUID)** (see [MS-DTYP] section 2.3.4) as **OtherName** in a subject alternative name (SAN) extension, as specified in [RFC3280] section 4.2.1.7.

Format: Octet string.

2.2.2.7.7 szOID_CERT_EXTENSIONS

OID = 1.3.6.1.4.1.311.2.1.14.

Internal Name: szOID_CERT_EXTENSIONS.

Description: Provides an array of certificate extensions.

Format: Format is specified in [RFC2985] section 5.4.2.

This field MUST contain zero or more extensions as specified in [X509] section 8.2.2.

In addition, clients can pass these certificate extensions:

1. Certificate template information. There are two versions for certificate templates: V1 and V2. Certificate template specifications are in [MS-CRTD]. See sections 2.2.2.7.7.1 and 2.2.2.7.7.2 for specifics on how to encode these extensions.

2. Certificate Application Policies. See section 2.2.2.7.7.3 for specifics on how to encode this extension.

2.2.2.7.7.1 szOID_ENROLL_CERTTYPE

OID = 1.3.6.1.4.1.311.20.2.

Internal Name: szOID_ENROLL_CERTTYPE.

Description: Contains the certificate name template extension.

Name: The value of the **cn** attribute of a certificate template object, as specified in [MS-CRTD] section 2.1. This extension value MUST be DER-encoded. The **critical** field for this extension MUST be set to FALSE.

Format: The following is the ASN.1 format for this attribute.

```
CertificateTemplateName ::= SEQUENCE {
   Name            UTF8String
}
```

2.2.2.7.7.2 szOID_CERTIFICATE_TEMPLATE

OID = 1.3.6.1.4.1.311.21.7.

Internal Name: szOID_CERTIFICATE_TEMPLATE.

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Description: Contains the information about the template. This extension value MUST be DER-encoded. The **critical** field for this extension SHOULD be set to FALSE.

TemplateID: The value of the msPKI-Template-Cert-Template-OID attribute of a certificate template object, as specified in [MS-CRTD] section 2.20.

TemplateMajorVersion: The value of the revision attribute of a certificate template object, as specified in [MS-CRTD] section 2.6.

TemplateMinorVersion: The value of the msPKI-Template-Minor-Revision attribute of a certificate template object, as specified in [MS-CRTD] section 2.17.

Format: The following is the ASN.1 format for this attribute.

```
CertificateTemplateOID ::= SEQUENCE {
        templateID              OBJECT IDENTIFIER,
        templateMajorVersion    INTEGER (0..4294967295) OPTIONAL,
        templateMinorVersion    INTEGER (0..4294967295) OPTIONAL
    } --#public
```

2.2.2.7.7.3 Encoding a Certificate Application Policy Extension

The OID for the Certificate Application Policy Extension is "1.3.6.1.4.1.311.21.10". The Certificate Application Policy Extension is encoded as a Certificate Policies extension (as specified in [RFC3280] section 4.2.1.5), with an instance of PolicyInformation for each given OID in which the **policyIdentifier** field is set to the OID and the **policyQualifiers** field is not present.

2.2.2.7.8 szOID_ARCHIVED_KEY_ATTR

OID = 1.3.6.1.4.1.311.21.13.

Internal Name: szOID_ARCHIVED_KEY_ATTR.

Description: The value for the attribute MUST be the encrypted private key.

Format: The format MUST be a CMC certificate request (as specified in [RFC2797]), ASN.1 DER encoded, as specified in [X690]. Format for this context is specified in section 3.1.1.4.3.5.1.

2.2.2.7.9 szOID_ENCRYPTED_KEY_HASH

OID = 1.3.6.1.4.1.311.21.21.

Internal Name: szOID_ENCRYPTED_KEY_HASH.

Description: This value MUST be a hash used to identify the client's private key.<8> For specific client processing rules, see section 3.1.1.4.3.5.1.

Format: The hash value. This value MUST be encoded as an octet string.

2.2.2.7.10 szENROLLMENT_NAME_VALUE_PAIR

OID = 1.3.6.1.4.1.311.13.2.1

Internal Name: szOID_ENROLLMENT_NAME_VALUE_PAIR.

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Description: Additional attributes that SHOULD be used.

Format: This attribute MUST be a collection of zero or more name-value pairs. The following is the ASN.1 format.

```
EnrollmentNameValuePairs ::= SEQUENCE OF EnrollmentNameValuePair

EnrollmentNameValuePair ::= SEQUENCE {
        name                BMPSTRING,
        value               BMPSTRING
}  --#public
```

The following table lists all the values that SHOULD be supported by the CA. Processing rules for the supported values for this collection MUST be as specified in section 3.2.1.4.2.1.2.

Note If a value is in quotes, the value must be exactly as the string within the quote. For example, CertType has only a single possible value, "server".

Name	Values	Comments	Value example
CertType	"server"	This attribute MUST be used along with a Netscape KEYGEN request. It MUST define the type of certificate that the client needs.	server
CertificateUsage	Comma-delimited OIDs	The request OIDs for use in the ExtendedKeyUsage extension, as specified in [RFC3280] section 4.2.1.13.	2.5.29.3, 2.5.43.1
ValidityPeriod	"Seconds" or "Minutes" or "Hours" or "Days" or "Weeks" or "Months" or "Years"	The validity period of the request MUST be defined in two values: number and units. For example, number=3 and units=weeks means that the request is for a certificate that will be valid for 3 weeks. This value MUST define the units for the validity period.	Weeks
ValidityPeriodUnits	Unsigned integer	This value MUST define the number units used for the validity period. The units are defined in the ValidityPeriod attribute.	3
ExpirationDate	Date and time	This value MUST define the exact request expiration time of the requested certificate in the format defined in section 3.3 of the [RFC2616].<9>	L"Tue, 21 Nov 2000 01:06:53 GMT"
cdc	**FQDN**	An Active Directory **server** FQDN.	dcmachine.contoso.com
rmd	FQDN	The requesting machine FQDN.	mymachine.contoso.com

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Name	Values	Comments	Value example
CertificateTemplate	The cn attribute on the Active Directory object that contains the certificate template	This value MUST define the certificate template that was used by the client to construct the certificate request.	ContosoAdministrator
SAN	Name-value collection	This value MUST contain a collection of one or more name-value pairs for the SubjectAltName extension. The format for the internal collection MUST be: "name1=value1&name2=value". The supported names for this internal name-value collection are: Guid Email FQDN Dn url ipaddress oid upn spn For all these names, the value MAY be any string. In addition to these names, the name MAY be any OID. If it is an OID, the value MUST be encoded as defined in the following table.	1.2.3.4=user679 &guid=exampleguid &oid=4.3.2.1 &email=user679@contoso.com
challenge	Password	This attribute MUST be passed only with a Netscape KEYGEN request format. The value of the attribute MUST be the challenge (password) string associated with the request. For specifications, see section 3.1.1.4.3.1.4.	mypassword
requestername	**Domain**\account	The identity of the user whose information MUST be used to construct the subject information of an issued certificate. It is used along with a ROBO for a different subject. Note: Unlike the other attributes in this table, this attribute can be passed only within a request format and cannot be passed	Contoso\tester

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Name	Values	Comments	Value example
		using the *pwszAttributes* parameter.	
Other (see section 2.2.2.6.4.2 for possible values)	See section 2.2.2.6.4.2 for possible values	A valid RDN string SHOULD be used to pass subject names for a certificate request generated by using the KEYGEN format on a Netscape browser.	US
certfile	UNC path	The client requests that the server publish the issued certificate to the **Universal Naming Convention (UNC)** path that is specified in the value for this attribute.<10>	c:\mycert.cer
RequestId	ULONG	The request ID of the request that is pending the attestation Challenge Response.<11>	1, 158, etc.

When the SAN value in the preceding table, which is a list of name-value pairs, includes an OID as the name, the value of that OID MUST be encoded in one of the formats in the following table. In the following encoding, the format tag (for example, "{asn}") is a literal string.

Possible SAN values.

Format	Meaning	Example[1]
{asn}Base64String	The value is any valid base64 text string. The base64 text string is decoded into binary data, which is then used as the OtherName value. The decoded binary data is expected to already be a valid ASN.1 encoded BLOB.	{asn}DApzdHJpbmcxMjM0
{utf8}UTF8String	The value is a text string. The string is ASN.1 encoded into a UTF-8 string and used as the OtherName value.	{utf8}string1234
{octet}Base64String	The value is any valid base64 text string. The base64 text string is decoded into binary. The binary is ASN.1 encoded into an octet string and is used as the OtherName value.	{octet}c3RyaW5nMTIzNA==
{octet}{hex}HexadecimalString	The value is a hexadecimal text string with an even number of digits. The hexadecimal text string is decoded into binary. The binary is ASN.1 encoded into an octet string and is used as the OtherName value.	{octet}{hex}12 34 56 78 9a bc de f0
{hex}HexadecimalString	The value is a hexadecimal text string with an even number of digits. The hexadecimal text string is decoded into binary and the binary is used as	{hex}02 02 12 34

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Format	Meaning	Example[1]
	the OtherName value. The decoded binary is expected to already be a valid ASN.1 encoded BLOB.	

The string in the Example column refers to a value equal to "string1234" in any one of the formats supported.

Details about various string encodings are specified in [X690].

2.2.2.7.11 szOID_ISSUED_CERT_HASH

OID = 1.3.6.1.4.1.311.21.17.

Internal Name: szOID_ISSUED_CERT_HASH.

Description: This value MUST be a SHA1 hash of the end entity certificate.

Format: The SHA1 hash value of a certificate. This value MUST be encoded as an octet string.

2.2.2.7.12 szOID_ENROLL_ATTESTATION_STATEMENT

OID = 1.3.6.1.4.1.311.21.33

Internal Name: szOID_ENROLL_ATTESTATION_STATEMENT

Description: This attribute is used to send data BLOBs related to key attestation.

Format: The value MUST include a **KeyAttestationStatement** structure (section 2.2.2.5) encoded as octet string.

2.2.2.7.13 szOID_ENROLL_EK_INFO

OID = 1.3.6.1.4.1.311.21.23.

Internal Name: szOID_ENROLL_EK_INFO

Description: The value of this attribute contains EKCerts and EKPub from the TPM, protected by a certificate. A maximum of 3 EKCerts will be passed. If there is a manufacturer EKCert then it is guaranteed to be supplied at EKCertificates[0] (as shown below).

Format: The value of the property is an enveloped CMS structure with one RecipientInfo ([RFC3852] section 6.2). The RecipientInfo is for the CA exchange certificate. The EncryptedContent field MUST be the encrypted form of the following ASN.1 structure, DER encoded:

```
EndorsementKeyInfo ::= SEQUENCE SIZE (2..5) OF ANY
```

The first element of the sequence must be a SubjectPublicKeyInfo ([RFC2986] section 4) for the EKPub.

The second element of the sequence must be the manufacturer certificate, if available. Otherwise, it must contain the zero length NULL tag: 05 00.

If there are any non-manufacturer EkCertificates available, then element three up to element five contain individual EkCertificates.

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The total number of EkCertificates cannot exceed three.

2.2.2.7.14 szOID_ENROLL_KSP_NAME

OID = "1.3.6.1.4.1.311.21.25"

Internal Name: szOID_ENROLL_KSP_NAME

Description: The value of this attribute contains a cryptographic provider name encoded as a Unicode string. The CA MUST return the cryptographic provider name as an attribute to the full PKCS10 and CMC response used to encrypt the challenge, as specified in section 2.2.2.8.1.1.

Format: The string value of the cryptographic provider name used by the CA to encrypt the challenge. This value MUST be encoded as a Unicode string.

2.2.2.8 Response Format

There are two possible response formats:

- CMS certificate chain format, as specified in [RFC3852].

  The CA uses the CMS structures, as specified in [RFC3852], to generate responses to a client's certificate enrollment requests. When the CA responds to a certificate request, it returns a CMS that MUST include the issued certificate and MAY return all of the CA certificates in the certificate chain of the issued certificate.

  The following fields are specified in [RFC3852] and used by this protocol:

  - **ContentType**
  - **Version**
  - **DigestAlgorithmIdentifiers**
  - **ContentInfo**
  - **ExtendedCertificateOrCertificate**
  - **RevocationInfoChoicesSignerInfos**

- CMC full PKI response, as specified in [RFC2797] section 4.4.

  The response format is requested by the client in the *dwFlags* parameter of the ICertRequestD::Request and ICertRequestD2::Request2 methods, as specified in sections 3.2.1.4.2.1 and 3.2.1.4.3.1.

  The following fields are specified in [RFC2797] section 3.1 and are used by this protocol:

  - **TaggedAttribute**
  - **OtherMsg content**
  - **BodyPartId**
  - **AttributeValue**
  - **ContentInfo**

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Processing rules for these fields are specified in sections 3.2.1.4.2.1.4.7.1 and 3.2.2.6.2.1.4.

2.2.2.8.1 CA Response Attributes

2.2.2.8.1.1 szOID_ENROLL_ATTESTATION_CHALLENGE

OID = 1.3.6.1.4.1.311.21.28

Internal Name: szOID_ENROLL_ATTESTATION_CHALLENGE

Description: The value of this attribute contains a randomly generated secret encrypted by the EKPub received in the request.

Format: This value is encoded as an octet string.

2.2.2.8.1.2 szOID_ENROLL_CAXCHGCERT_HASH

OID = "1.3.6.1.4.1.311.21.29"

Internal Name: szOID_ENROLL_CAXCHGCERT_HASH

Description: The value of this attribute contains a SHA1 hash of the entire encoded content of a CA exchange certificate. The CA returns it in response to an attested key enrollment CMC request for the end entity certificate.

Format: The SHA1 hash value of the entire encoded content of a CA exchange certificate. This value MUST be encoded as an octet string.

2.2.2.8.1.3 szOID_ENROLL_KSP_NAME

See Section 2.2.2.7.14

2.2.2.8.1.4 szOID_ENROLL_ENCRYPTION_ALGORITHM

OID = 1.3.6.1.4.1.311.21.29

Internal Name: szOID_ENROLL_ENCRYPTION_ALGORITHM

Description: The value of this attribute contains an algorithm OID used to encrypt the enveloped data when responding to the CA Challenge message, as specified in section 3.1.1.4.3.4.2. The CA SHOULD set this attribute to the algorithm OID used to encrypt the szOID_ENROLL_EK_INFO value in section 2.2.2.7.13.

Format: The OID identifying the encryption algorithm. This value MUST be encoded as an algorithm identifier.

2.2.2.9 Private Key BLOB

During the archival process, the client sends its private key to the CA encrypted to the CA exchange key. The CA decrypts the encrypted BLOB and retrieves the private key BLOB. More details are specified in section 1.3.2.1.

2.2.2.9.1 RSA Private Key BLOB

The following is the diagram of elements in the RSA private key BLOB that MUST be passed to the CA.

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Type								Version								Reserved															
Key Alg																															
Magic																															
Bitlen																															
PubExp																															
Modulus (variable)																															
...																															
P (variable)																															
...																															
Q (variable)																															
...																															
Dp (variable)																															
...																															
Dq (variable)																															
...																															
Iq (variable)																															
...																															
D (variable)																															
...																															

Type (1 byte): Length MUST be 1 byte.

This field MUST be set to 0x07.

Version (1 byte): Length MUST be 1 byte.

This field MUST be set to 0x02.

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Reserved (2 bytes): Length MUST be 2 bytes.

This field MUST be set to 0 and ignored upon receipt.

Key Alg (4 bytes): Length MUST be 4 bytes.

This field MUST be present as an unsigned integer in little-endian format.

Value MUST be 0x0000A400 (RSA_KEYX).

Magic (4 bytes): Length MUST be 4 bytes.

This field MUST be present as an unsigned integer in little-endian format.

Value MUST be 0x32415352 (RSA2).

Bitlen (4 bytes): Length MUST be 4 bytes.

This field MUST be present as an unsigned integer in little-endian format.

The value of this field MUST indicate the number of bits in the (Rivest-Shamir-Adleman) RSA modules. (This is the RSA key size.)

PubExp (4 bytes): Length MUST be 4 bytes.

This field MUST be present as an unsigned integer in little-endian format.

The value of this field MUST be the RSA public key exponent for this key. The client SHOULD set this value to 65,537.

Modulus (variable): This field MUST be of length ceil(bl/8), where *bl* is the value of the **Bitlen** field defined in the preceding diagram.

This field MUST be present as a byte string in little-endian format.

The value MUST be the RSA key modulus. The modulus is defined as *p***q*.

P (variable): This field MUST be of length ceil(bl/16), where *bl* is the value of the **Bitlen** field defined in the preceding diagram.

This field MUST be present as a byte string in little-endian format.

The value contained in this field MUST be one of the prime number factors of the **modulus** (given in the previous field).

Q (variable): This field MUST be of length ceil(bl/16), where *bl* is the value of the **Bitlen** field defined in the preceding diagram.

This field MUST be present as a byte string in little-endian format.

The value MUST be the other prime number factor of the RSA modulus.

Dp (variable): This field MUST be of length ceil(bl/16), where *bl* is the value of the **Bitlen** field defined in the preceding diagram.

This field MUST be present as a byte string in little-endian format.

The value of this field MUST be *d* mod (*p*-1), where *d* is the private exponent of this RSA private key.

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Dq (variable): This field MUST be of length ceil(bl/16), where *bl* is the value of the **Bitlen** field defined in the preceding diagram.

This field MUST be present as a byte string in little-endian format.

The value of this field MUST be *d* mod (*q*-1), where *d* is the private exponent of this RSA private key.

Iq (variable): This field MUST be of length ceil(bl/16), where *bl* is the value of the **Bitlen** field defined in the preceding diagram.

This field MUST be present as a byte string in little-endian format.

This field MUST contain the inverse of *q* modulus *p*.

D (variable): This field MUST be of length ceil(bl/8), where *bl* is the value of the **Bitlen** field defined in the preceding diagram.

This field MUST be present as a byte string in little-endian format.

The value in this field is the RSA private exponent.

Note Ceil(*x*) is the value of *x* rounded up to the closest integer. For example, ceil(1.2) = 2 and ceil(3) = 3.

2.2.2.9.2 ECDH Private Key BLOB

Following is the table of elements in the Elliptic Curve Diffie-Hellman (ECDH) private key BLOB that MUST be passed to the CA.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Magic																															
Length																															
XParam (variable)																															
...																															
YParam (variable)																															
...																															
PrivateExp (variable)																															
...																															

Magic (4 bytes): The length of this field MUST be 4 bytes.

This field MUST be an unsigned integer in little-endian format.

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Value MUST specify the type of key that this BLOB represents. The possible values for this member MUST be one of the following.

Value	Meaning
0x314B4345	The key is a 256-bit ECDH public key.
0x324B4345	The key is a 256-bit ECDH private key.
0x334B4345	The key is a 384-bit ECDH public key.
0x344B4345	The key is a 384-bit ECDH private key.
0x354B4345	The key is a 521-bit ECDH public key.
0x364B4345	The key is a 521-bit ECDH private key.

Length (4 bytes): The length of this field MUST be 4 bytes.

This field MUST be an unsigned integer in little-endian format.

Value MUST be the length, in bytes, of the ECDH key.

XParam (variable): The length of this field MUST be equal to the **Length** field value.

This field MUST be bytes in little-endian format.

Value MUST be the elliptical curve X parameter.

YParam (variable): The length of this field MUST be equal to the **Length** field value.

This field MUST be bytes in little-endian format.

Value MUST be the elliptical curve Y parameter.

PrivateExp (variable): The length of this field MUST be equal to the **Length** field value.

This field MUST be bytes in little-endian format.

Value MUST be the elliptical curve private exponent.

2.2.2.10 Key Spec

Key spec is a flag that specifies how a given private key MUST be used. Key spec must have one of the values in the following table.

Value	Meaning
1	The key can be used for encryption.
2	The key can be used for signatures.

2.2.2.11 Enterprise PKI Data Structures

This section specifies the structure of the Active Directory **containers** and objects that are related to this protocol. The usage of the data that is stored in these data structures is specified in section 3.

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2.2.2.11.1 Certificate Templates Container

The Certificate Templates container is stored in Active Directory under the following location:

"CN=Public Key Services, CN=Services, CN=Configuration, DC=..."

The container contains objects of type pKICertificateTemplate; each of these objects is referred to in this protocol specification as a certificate template. The structure and the syntax of the object attributes are specified in [MS-CRTD].

2.2.2.11.2 Enrollment Services Container

The Enrollment Services container is stored in Active Directory under the following location:

"CN=Public Key Services, CN=Services, CN=Configuration, DC=..."

The container contains objects of type pKIEnrollmentService. The following attributes of these objects are used by the protocol specified in this protocol specification.

2.2.2.11.2.1 cn Attribute

The cn attribute contains the value of the cn field in the Subject attribute of the CA signing certificate. The value is not sanitized as specified in 3.1.1.4.1.1.

2.2.2.11.2.2 displayName Attribute

The displayName attribute contains the value of the cn field in the Subject attribute of the CA signing certificate. The value is not sanitized.

2.2.2.11.2.3 certificateTemplates Attribute

This attribute contains information for the list of configured certificate templates for the CA identified by the signing certificates stored in the cACertificate attribute. Each string in the attribute identifies a certificate template and is identical to the value of the cn field ([MS-CRTD], section 2.1) of one of the pKICertificateTemplate objects.

In this document, this certificate template is referred to as a configured certificate template.

cn: Certificate-Templates

ldapDisplayName: certificateTemplates

attributeId: 1.2.840.113556.1.4.823

attributeSyntax: 2.5.5.12

omSyntax: 64

isSingleValued: FALSE

schemaIdGuid: 2a39c5b1-8960-11d1-aebc-0000f80367c1

systemOnly: FALSE

searchFlags: 0

isMemberOfPartialAttributeSet: TRUE

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systemFlags: FLAG_SCHEMA_BASE_OBJECT

2.2.2.11.2.4 dNSHostName

This attribute contains the FQDN of the computer that hosts the CA service:

cn: DNS-Host-Name

dapDisplayName: dNSHostName

attributeId: 1.2.840.113556.1.4.619

attributeSyntax: 2.5.5.12

omSyntax: 64

isSingleValued: TRUE

schemaIdGuid: 72e39547-7b18-11d1-adef-00c04fd8d5cd

systemOnly: FALSE

searchFlags: 0

rangeLower: 0

rangeUpper: 2048

attributeSecurityGuid: 72e39547-7b18-11d1-adef-00c04fd8d5cd

isMemberOfPartialAttributeSet: TRUE

systemFlags: FLAG_SCHEMA_BASE_OBJECT

2.2.2.11.2.5 cACertificate Attribute

The cACertificate attribute is a multivalue Octet String attribute that contains the CA signing certificate DER encoded.

Specifications on the syntax of this attribute can be found in [MS-ADA1] section 2.95.

2.2.2.11.3 NTAuthCertificates Object

The NTAuthCertificate Object is as follows:

1. Object of type certificationAuthority
2. Object with cn=NTAuthCertificates
3. Object under the following container.

```
CN=Public Key Services, CN=Services, CN=Configuration, DC=...
```

This object contains a CA Certificate attribute, which is a multivalue Octet String attribute where each one of its value is a DER-encoded CA signing certificate.

Specifications on the syntax of this attribute can be found in [MS-ADA1] section 2.95.

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2.2.2.11.4 Certification Authorities Container

The Certification Authorities container exists under the following container.

```
CN=Public Key Services, CN=Services, CN=Configuration, DC=...
```

This container contains an object of type certificationAuthority for each root CA that the enterprise **trusts**.

The following attributes of these objects are used by the protocol.

Specifications on the syntax of this class can be found in [MS-ADSC] section 2.16.

2.2.2.11.4.1 cn Attribute

The cn attribute contains the value of the cn of the subject field of the **root CA** certificate stored in the cACertificate attribute, specified in the following section.

2.2.2.11.4.2 cACertificate Attribute

The cACertificate attribute is a multivalue Octet String attribute that contains the root CA signing certificate DER encoded.

Specifications on the syntax of this attribute can be found in [MS-ADA1] section 2.95.

2.2.3 Certificate Requirements

2.2.3.1 Key Recovery Certificate

A CA MAY use one or more locally configured and specified key recovery keys to encrypt the private key of a client, which is submitted to the CA encapsulated in a certificate enrollment request.

A **key recovery certificate** MUST contain the following fields and extensions identified in [RFC3280] :

- Version
- Serial Number
- Signature
- notBefore
- notAfter
- Subject
- Issuer
- Subject Public Key Info
- Authority Key Identifier
- Subject Key Identifier
- Authority Information Access

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- Key Usage (Key Encipherment = 0x20)
- CDP (CRL Distribution Point)
- Extended Key Usage (Key Recovery OID = szOID_KP_KEY_RECOVERY_AGENT (1.3.6.1.4.1.311.21.6)).<12>

2.2.4 Common Error Codes

The following error codes are used by this protocol to indicate specific error conditions. Other error values might be used and are implementation-specific.

Return value/code	Description
0x80070002 ERROR_FILE_NOT_FOUND	The system cannot find the specified file.
0x80070003 ERROR_PATH_NOT_FOUND	The system cannot find the specified path.
0x80070006 ERROR_INVALID_HANDLE	The handle is not valid.
0x80074003 ERROR_INVALID_POINTER	The pointer is not valid.
0x80074004 CERTSRV_E_PROPERTY_EMPTY	A required property value is empty.
0x80070057 E_INVALIDARG	The parameter is incorrect.
0x80090003 NTE_BAD_KEY	The cryptographic key is not valid.
0x8009000F ERROR_OBJECT_EXISTS	The object already exists.
0x80091004 CRYPT_E_INVALID_MSG_TYPE	The cryptographic message type is not valid.
0x8009200E CRYPT_E_NO_SIGNER	The signed cryptographic message does not have a signer for the specified signer index.
0x8009310B CRYPT_E_ASN1_BADTAG	The value for the ASN1 tag is not valid.
0x80093100 CRYPT_E_ASN1_ERROR	An ASN.1 encoding error exists.

2.3 Directory Service Schema Elements

This protocol accesses the **directory service** schema classes and attributes that are listed in the following table. For the syntactic specifications of the following class or class/attribute pairs, refer to Active Directory Domain Services (AD DS) in [MS-ADA1], [MS-ADA2], [MS-ADA3], and [MS-ADSC].

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Class	Attribute
certificationAuthority	cACertificate cn
Computer	cn distinguishedName dNSHostName objectGuid
msPKI-PrivateKeyRecoveryAgent	cn userCertificate
pKIEnrollmentService	certificateTemplates cn displayName dNSHostName
pKICertificateTemplate	cn flags ntSecurityDescriptor revision pKICriticalExtensions pKIDefaultCSPs pKIDefaultKeySpec pKIEnrollmentAccess pKIExpirationPeriod pKIExtendedKeyUsage pKIKeyUsage pKIMaxIssuingDepth pKIOverlapPeriod msPKI-Template-Schema-Version msPKI-Template-Minor-Revision msPKI-RA-Signature msPKI-Minimal-Key-Size msPKI-Cert-Template-OID msPKI-Supersede-Templates msPKI-RA-Policies msPKI-RA-Application-Policies msPKI-Certificate-Policy msPKI-Certificate-Application-Policy msPKI-Enrollment-Flag msPKI-Private-Key-Flag msPKI-Certificate-Name-Flag
User	cn distinguishedName objectGuid

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Class	Attribute
	mail userCertificate userPrincipalName

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3 Protocol Details

The Windows Client Certificate Enrollment Protocol is a simple request-response protocol. The client sends a certificate request and the server responds with a signed certificate or a detailed disposition message. The primary usage of this protocol is certificate enrollment. In almost all cases, the protocol is a single message followed by a single reply. An overview of subprotocols is specified in section 1.3.1. Many of the DCOM methods that are specified in section 2 are made available for nonprotocol functions, such as diagnostics.

3.1 Client Role

The following sections specify implementation modes of the client role:<13>

- Basic Enrollment: Specifies a client that sends an enrollment request that is not based on certificate templates.
- Enrollment based on certificate templates: Specifies a client that sends an enrollment request, based on enterprise policies published in Active Directory, by using certificate templates.

3.1.1 Client Mode: Basic Enrollment

The Windows Client Certificate Enrollment Protocol constructs a certificate request as specified in section 2.2.2.6, sends the request to the CA, and retrieves the issued certificate. After the client has obtained the certificate, the client SHOULD store the certificate and its associated private key for later use by applications running on the client machine.<14>

This section specifies the behavior of a client to this protocol that does not use the certificate templates.

3.1.1.1 Abstract Data Model

This section describes a conceptual model of data organization that a possible implementation would maintain to participate in this protocol. The described organization is provided to facilitate understanding of how the protocol behaves. This protocol specification does not mandate that implementations adhere to this model as long as their external behavior is consistent with the behavior described in this specification.

The following abstract data model is defined:

Client_EndoresmentKeyInfo: Contains the following DER-encoded ASN.1 structure where EKPub and EkCertificates are initialized from the TPM. EKPub MUST be present. EKCertificates can contain up to 3 certificates.

For syntactical details and semantics, see section 2.2.2.7.13

Client_KeyAttestationStatement: Contains the **KeyAttestationStatement** structure (section 2.2.2.5) that is generated for each TPM key associated with a certificate request.

Returned_Request_ID: A ULONG that contains the request ID created by the CA when it receives a request for a certificate. This value is returned in the *pdwRequestId* parameter of the **ICertRequestD::Request** and **ICertRequestD2::Request2** methods.

3.1.1.2 Timers

None.

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3.1.1.3 Initialization

The Windows Client Certificate Enrollment Protocol depends on DCOM for authentication, as specified in [MS-DCOM].

3.1.1.4 Message Processing Events and Sequencing Rules

The Windows Client Certificate Enrollment Protocol is based on DCOM [MS-DCOM]. DCOM provides the capability to obtain the version of an interface. Clients SHOULD use the **IRemIUnknown.RemQueryInterface** method to determine if the server supports the **ICertRequestD2** interface version. If the server supports the **ICertRequestD2** interface, clients SHOULD use that interface. <15>If the server does not support **ICertRequestD2** interface, clients MUST use the ICertRequestD interface.

The following sections define the processing rules for each of the methods in **ICertRequestD (section 3.2.1.4.2)** and **ICertRequestD2** (section 3.2.1.4.3). For all methods of this protocol, a returned value of 0 indicates a successful invocation. Unless specified otherwise, any returned non-zero value indicates an error and the client SHOULD NOT rely on any specific value for its processing rules.

3.1.1.4.1 Algorithms

The following section specifies subroutines that are used by the Client Mode: Basic Enrollment protocol role.

3.1.1.4.1.1 Sanitizing Common Names

The **CNs** of the Active Directory (as specified in [MS-ADTS]) objects used by the Windows Client Certificate Enrollment Protocol are created by sanitizing the names of other objects and shortening the sanitized name so that it does not exceed 57 characters, including spaces. The sanitized name MUST NOT exceed 57 characters in length. A name is sanitized by replacing disallowed characters with an exclamation point(!) followed by four hexadecimal values that represent the 16-bit character that is being replaced.

The following rules apply to creating a sanitized CN (short name):

- All disallowed characters in the original name MUST be replaced with the appropriate replacements values as specified in section 3.1.1.4.1.1.2.
- The sanitized name MUST be truncated to no more than 51 characters in total length. The truncated name MUST NOT exceed 51 characters. If an incomplete sanitized character sequence remains at the end of the string (for example, !002 instead of !0023), the incomplete sequence MUST be truncated completely.
- The characters that were removed or truncated from the sanitized string in the preceding bulleted item MUST be hashed according to the rules specified in section 3.1.1.4.1.1.1. The resultant hash MUST be converted to a 5-character string. The string MUST be five characters in total length and MUST be padded with leading zeros on the left to ensure a total length of five characters.
- A minus sign (–) MUST be appended to the truncated sanitized name followed by the 5-character string that contains the hash value.

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3.1.1.4.1.1.1 Hashing Processing Rules

The hash to represent truncated characters is computed by rotating a 16-bit value one bit to the left and adding each character truncated from the full CN (original name) until all of the truncated characters have been exhausted, as shown in the following example hash process rule.

If the string length of the full CN is less than 52 characters in total length, the sanitized short name is the same as the full CN. Otherwise, the string base equals the first 51 characters of the full CN.

The string excess equals characters 52 through the end of the full CN. For each character that is in excess of 51, the following algorithm will be applied to hash the excess characters:

- Hash is initialized with 0.

  For each excess character, the following interaction is performed:

  - An unsigned, 16-bit integer (LowBit) is calculated by using the following formula: ((0x8000 & Hash)? 1 : 0).
  - The value of the hash is recalculated by using the following formula: ((Hash << 1) | LowBit) + [excess character].

- Next, the resultant hash equals the decimal representation of the calculated hash. The hash is left-padded with zeros (0) to ensure that it is five characters in total length. The final, short sanitized name equals the concatenation of the string base plus a minus sign (–) plus the 5-character hash.

3.1.1.4.1.1.2 Disallowed Characters

The following characters are disallowed and MUST NOT be used. The disallowed characters and their appropriate replacement values are noted in the table.

Characters that MUST NOT be used in a file name are shown in the following table.

A character whose value is less than 0x20 MUST be replaced with !00xx where xx is the hexadecimal value of the character (for example, the value of 0x10 is replaced with !0010). A character whose value is greater than or equal to 0x7F MUST be replaced with !00xx where xx is the hexadecimal value of the character (for example, the value of 0x80 is replaced with !0080).

Name	Character	Value in !xxxx format
Exclamation point	!	!0021
Inch or quotation mark	"	!0022
Number sign	#	!0023
Percent	%	!0025
Ampersand	&	!0026
Apostrophe	'	!0027
Opening parenthesis	(	!0028
Closing parenthesis	)	!0029
Asterisk	*	!002a

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Name	Character	Value in !xxxx format
Plus sign	+	!002b
Comma	,	!002c
Slash mark	/	!002f
Colon	:	!003a
Semicolon	;	!003b
Less than sign	<	!003c
Equal sign	=	!003d
Greater than sign	>	!003e
Question mark	?	!003f
Opening bracket	[	!005b
Backslash	\	!005c
Closing bracket	]	!005d
Caret or circumflex	^	!005e
Grave accent	`	!0060
Opening brace	{	!007b
Pipe or vertical line	|	!007c
Closing brace	}	!007d

3.1.1.4.2 Processing Rules for the pwszAuthority Parameter

The *pwszAuthority* parameter is a common parameter for each of the methods in this protocol. The following sections describe the client processing rules for this parameter.

The [UNICODE] string in *pwszAuthority* MUST be equal to either the CA common name, the CA sanitized name, or the CA short sanitized name. The algorithm for sanitizing common names is specified in section 3.1.1.4.1.1.

Note Comparing the CA name in the preceding operations MUST NOT be case-sensitive.

CA name specifications are in section 1.3.2.4.

3.1.1.4.3 ICertRequestD::Request and ICertRequestD2::Request2 Processing

The processing for the ICertRequestD::Request method and the ICertRequestD2::Request2 method MUST be identical on the client side, except for the handling of the additional *pwszSerialNumber* parameter.

Rules for each argument passed to ICertRequestD::Request and ICertRequestD2::Request are as follows.

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pwszAuthority: The client MUST follow the processing rules for *pwszAuthority* as specified in section 3.1.1.4.2.

dwFlags: The client MUST set the *dwFlags* parameter as specified in section 3.2.1.4.3.1.1.

pwszSerialNumber: For new requests, clients MUST set this parameter to NULL. To retrieve the status on an issued certificate, clients MUST set this parameter to the serial number of the issued certificate.

pdwRequestId: For new requests, clients MUST set this parameter to 0. To retrieve the status of a pending certificate request, the client MUST set this parameter to the request ID of the pending request.

pwszAttributes: The client MAY set the *pwszAttributes* parameter to a string representing a collection of attributes to be applied to the enrollment request. For specifications on the format of the string, see section 2.2.2.7.

pctbRequest: The pb member of **CERTTRANSBLOB** MUST be the encoded certificate request, and the cb member MUST be the length in bytes of the encoded certificate request. The Windows Client Certificate Enrollment Protocol can be used as the transport for four types of certificate requests, specified as follows.

The following table shows the various request types and request formats that are used when constructing each certificate request.

Certificate request types	CMS with PKCS #10	PKCS #10	CMS with CMC	Netscape KEYGEN
New request	Yes	Yes	Yes	Yes
Renewal request	Yes	No	Yes	No
Enroll On Behalf Of (EOBO) request	Yes	No	Yes	No
Key archival request	No	No	Yes	No
Initial key attestation request	Yes	Yes	Yes	No

"Yes" indicates that this format is supported for this request type. "No" indicates that this format is not supported by this protocol.

The following sections define the requirement for the certificate request types in the table. Fields that are not defined in the following sections MUST be submitted by using the definitions from the relevant RFC as specified in [RFC3852] for CMS, [RFC2797] for CMC requests, [KEYGEN] for Netscape request format, and [RFC2986] for PKCS #10 certificate requests.

pdwDisposition: Upon a successful return from an **ICertRequestD::Request** or **ICertRequestD2::Request2** method invocation, the client receives the *pdwDisposition* parameter as an output value.

If this value is 0x00000005 (CR_DISP_UNDER_SUBMISSION), the CA has not finished processing the enrollment request and the certificate has not been signed. This request is considered to be pending. See section 3.1.1.4.3.6 for information about how to retrieve pending requests from a CA.

If the value is any other nonzero value, the server has encountered an error. Unless otherwise specified in this document, the client SHOULD NOT rely on any specific error for its processing rules.

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pctbDispositionMessage: Upon a successful return from an **ICertRequestD::Request** or **ICertRequestD2::Request2** method invocation, the client receives the *pctbDispositionMessage* parameter as an output value. The client MUST NOT interpret or process this information in any way for anything other than display purposes. If the method encounters an error, the error string associated with the error code is returned. Error codes are specified in [MS-ERREF]. The client SHOULD NOT use the value in this field.

3.1.1.4.3.1 New Certificate Requests

A new certificate request is defined as a certificate request that does not depend upon, and is not associated with, any previous certificate. For new certificate requests, the client MUST use one of the supported request formats when sending the request to the CA. The exact format is specific to the application making the request.

Before creating a new certificate request, the client MUST generate a new public-private key pair. This newly generated public key will be the one that is certified by the CA while its associated private key is used to sign the request. For details, see the following sections.

3.1.1.4.3.1.1 New Certificate Request Using PKCS #10 Request Format

The request MUST be an ASN.1 DER-encoded PKCS #10 request as specified in [RFC2986]. The PKCS #10 ASN.1 structure includes the following fields:

- Attributes: This field SHOULD be used to send additional parameters to the CA.

  Section 2.2.2.7 specifies the required format for each of these attributes. The following OIDs identify the attributes that are supported by the protocol:

  - szOID_OS_VERSION (1.3.6.1.4.1.311.13.2.3): The client SHOULD use this attribute to specify the version information of the client's operating system in the form of a string. <16> The client SHOULD encode the value of this attribute as a IA5String. The format for this attribute is as specified in section 2.2.2.7.

  - szOID_ENROLLMENT_CSP_PROVIDER (1.3.6.1.4.1.311.13.2.2): The client SHOULD use this attribute to specify the CSP that was used to generate a private key. CSP specifications are in section 1.1.

  - szOID_REQUEST_CLIENT_INFO (1.3.6.1.4.1.311.21.20): Clients SHOULD use this value to pass additional client information such as machine name, user name, and application name. For details see section 2.2.2.7.4.

  - szOID_CERT_EXTENSIONS (1.3.6.1.4.1.311.2.1.14): The client SHOULD use this value to pass additional certificate extensions that are to be added to the issued certificate.

  - szOID_ENROLLMENT_NAME_VALUE_PAIR (1.3.6.1.4.1.311.13.2.1): The client SHOULD use this value to pass additional enrollment information as name-value pair collection. Following are the names that are supported by the protocol and their associated client-processing rules:

    - SAN: The client SHOULD use this value to pass a string that defines the requested value for the SubjectAltName extension in the issued certificate. Specifications on possible values for this attribute are in section 3.2.1.4.2.1.2.

    - CertificateUsage: The client SHOULD use this value to pass one or more OIDs that define the requested ExtendedKeyUsage extension for the issued certificate, as specified in [RFC3280] section 4.2.1.13.

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- ValidityPeriod: The client SHOULD use this value to request the CA to issue the certificate for a specific validity time. For example, if the validity period is three weeks, then the client requests that the issued certificate be valid for three weeks after issuance. If ValidityPeriod is used, the client MUST use it with the ValidityPeriodUnits attribute.
- ValidityPeriodUnits: The client SHOULD use this value to send the count of "ValidityPeriod" for the requested validity period for the issued certificate. The client MUST use this attribute with the ValidityPeriod attribute.
- cdc: The client SHOULD use this value to pass an Active Directory server FQDN for the CA to use in case the end entity's information cannot be obtained.
- rmd: The client SHOULD use this value to identify the exact FQDN of the machine object associated with the request.

3.1.1.4.3.1.2 New Certificate Request Using CMS and PKCS #10 Request Formats

The request MUST be an ASN.1 DER encoded CMS request as specified in [RFC3852]. The CMS ASN.1 structure includes the following fields:

- ContentType: This field MUST be the OID szOID_PKCS_7_SIGNED (1.2.840.113549.1.7.2, id-signedData).
- Content: This field MUST be a SignedData with the following values for its fields:
  - encapContentInfo: This field MUST have the following values for its fields:
    - eContentType: This field MUST be OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1, id-data).
    - eContent: This field MUST be a PKCS #10 certificate request as specified in section 3.1.1.4.3.1.1.
  - SignerInfos: The request MUST be signed as specified in [RFC3852].

3.1.1.4.3.1.3 New Certificate Request Using CMS and CMC Request Formats

- The request MUST be an ASN.1 DER encoded CMS request (as specified in [RFC3852]), that includes a CMC request (as specified in [RFC2797]). The ASN.1 structure includes the following fields. The client MUST construct an ASN.1 CMC request structure with the following fields:
  - TaggedRequest: This field MUST contain exactly one certificate request. The certificate request MUST be PKCS #10 as specified in sections 2.2.2.6.1 and 3.1.1.4.3.1.1.
  - TaggedAttributes: The client MAY pass additional enrollment attributes in the RegInfo attribute as specified in [RFC2797] section 5.12. The semantics for the value of this attribute are identical to the ones that are defined for the *pwszAttributes* parameter for **ICertRequestD::Request** and **ICertRequestD2::Request2**. The format of the value is specified in section 2.2.2.6.3.
- Client MUST construct CMS (as specified in [RFC3852]) with the following requirements:
  - ContentType: This field MUST be the OID szOID_PKCS_7_SIGNED (1.2.840.113549.1.7.2, id-signedData).
  - Content: This field MUST be a SignedData with the following values for its fields:

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- encapContentInfo field: This field MUST have the following values for its fields:
  - eContentType: This field MUST be the OID szOID_CT_PKI_DATA (1.3.6.1.5.5.7.12.2, Id-cct-PKIData).
  - eContent: This field MUST be the CMC certificate request constructed in the preceding (first) step.
- SignerInfo fields: The first signerInfo MUST use either the subjectKeyIdentifier form of signerInfo, as specified in [RFC2797] section 4.2, or MUST use the No-Signature Signature Mechanism, as specified in [RFC2797] section 3.3.3.1.

3.1.1.4.3.1.4 New Certificate Request Using Netscape KEYGEN Request Format

The request MUST be compliant with "Netscape Extensions for User Key Generation Communicator 4.0 Version". For specifications see [KEYGEN].

Processing rules for the *pwszAttributes* parameter:

- CertType: Client MUST add the CertType attribute to the *pwszAttributes* parameter. The value for this attribute MUST be the string "server".
- rdn value: Client MUST request the subject name information through the rdn attributes. Supported values and their formats MUST be as specified in section 2.2.2.6.4.2.<17>

3.1.1.4.3.2 Renew Certificate Requests

When sending a **certificate renewal request**, clients MUST use the CMS structure with an embedded PKCS #10 certificate request, as specified in [RFC3852] and [RFC2986], or the CMS structure with an embedded CMC request format, as specified in [RFC3852] and [RFC2797]. The client MUST follow the requirements specified in the following sections.

The renewal request MUST be done either by using an existing public-private key pair associated with the certificate being renewed or by creating a new public-private key pair. See the following sections for details about how those key pairs are used to form a request.

3.1.1.4.3.2.1 Renew Certificate Request Using CMS and PKCS #10 Request Formats

The request MUST be an ASN.1 DER encoded CMS request as specified in [RFC3852]. The CMS ASN.1 structure includes the following fields:

- The client SHOULD construct a request for a new certificate by using the PKCS #10 certificate format as specified in section 3.1.1.4.3.1.1 or section 3.1.1.4.3.4.<18>
- The client MUST add an attribute to the **Attributes** field in the PKCS #10. The attribute is szOID_RENEWAL_CERTIFICATE (1.3.6.1.4.1.311.13.1) as specified in section 2.2.2.7.3. The value for this attribute MUST be an ASN.1 DER encoded certificate to be renewed.
- The client MUST construct a CMS with the following requirements:
  - ContentType: This field MUST be the OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData).
  - Content: This field MUST be a SignedData with the following values for its fields:
    - encapContentInfo: This field MUST have the following values for its fields:

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        - eContentType: This field MUST be the OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1, id-data).
        - eContent: This field MUST be the new PKCS #10 certificate request constructed in the preceding (first) step.
    - Certificates: This field MUST include the certificate to be renewed and that is associated with the private key used to sign the request (the same certificate as the one in the PKCS #10 **Attributes** field specified in the preceding (second) step).
    - SignerInfos: The first SignerInfo in the SignerInfos collection MUST use the key associated with the certificate to be renewed.

3.1.1.4.3.2.2 Renew Certificate Request Using CMS and CMC Request Formats

The request MUST be an ASN.1 DER encoded CMS request (as specified in [RFC3852]) that includes a CMC request (as specified in [RFC2797]). The ASN.1 structure includes the following fields:

- The client SHOULD construct a request for a new certificate by using the PKCS #10 certificate format as specified in section 3.1.1.4.3.1.1 or section 3.1.1.4.3.4.<19>
- The client MUST add an attribute to the **Attributes** field in the PKCS #10. The attribute is szOID_RENEWAL_CERTIFICATE (1.3.6.1.4.1.311.13.1) as specified in section 2.2.2.7.3. The value for this attribute MUST be the ASN.1 DER encoded certificate to be renewed.
- The client MUST construct a CMC request with the following requirements:
    - TaggedRequest: This field MUST contain exactly one certificate request. The certificate request MUST be the PKCS #10 constructed in the first of the preceding steps.
    - TaggedAttributes: The client MAY pass additional enrollment attributes in the RegInfo attribute as specified in [RFC2797] section 5.12. The cosemantics for the value of this attribute are identical to the ones that are defined for the *pwszAttributes* parameter for **ICertRequestD::Request** and **ICertRequestD2::Request2**. To read more on the supported attributes, see section 3.1.1.4.3.1.1. The format of the value is specified in section 2.2.2.6.3.
- The client MUST construct a CMS with the following requirements:
    - ContentType: This field MUST be the OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData).
    - Content: This field MUST be a SignedData with the following values for its fields:
        - encapContentInfo: This field MUST have the following values for its fields:
            - eContentType: This field MUST be the OID szOID_CT_PKI_DATA (1.3.6.1.5.5.7.12.2, Id-cct-PKIData).
            - eContent: This field MUST be the CMC certificate request constructed in the preceding (first) step.
        - SignerInfos: This collection MUST include at least two SignerInfo structures.
            - The first signerInfo MUST either use the subjectKeyIdentifier form of signerInfo, as specified in [RFC2797] section 4.2, or MUST use the No-Signature Signature Mechanism as specified in [RFC2797] section 3.3.3.1.
            - The second SignerInfo MUST use the key associated with the certificate to be renewed.

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3.1.1.4.3.3 Enroll on Behalf of Certificate Requests

The Enroll On Behalf Of (EOBO) proxy process is used when the client that sends a certificate request requests a certificate on behalf of another EE.

When sending a ROBO for another entity, clients MUST use the CMS structure with an embedded PKCS #10 certificate request, as specified in [RFC3852] and [RFC2986], or clients MUST use the CMS structure with an embedded CMC request format, as specified in [RFC3852] and [RFC2797]. Clients MUST follow the specific requirements defined in the following sections.

3.1.1.4.3.3.1 Abstract Data Model

This section describes a conceptual model of data organization that a possible implementation would maintain to participate in this protocol. The described organization is provided to facilitate understanding of how the protocol behaves. This protocol specification does not mandate that implementations adhere to this model so long as their external behavior is consistent with the behavior described in this document.

In addition to the data described in section 3.1.1.1, the client that implements ROBO-requests processing maintains the following data:

- OtherEndEntityRequest

  PKC#10 request constructed as specified in section 3.1.1.4.3.1.1 or section 3.1.1.4.3.4.1, or CMS request constructed as specified in section 3.1.1.4.3.1.3. It is left up to the implementation of the protocol to provide a way for end entities to exchange the requests and store it in this data.<20>

3.1.1.4.3.3.2 Enroll on Behalf of Request Using CMS and PKCS #10 Request Formats

The request MUST be an ASN.1 DER encoded CMS request as specified in [RFC3852]. The CMS ASN.1 structure includes the following fields:

- The client MUST construct a CMS with the following requirements:
  - ContentType: This field MUST be the OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData).
  - Content: This field MUST be a SignedData with the following values for its fields:
    - encapContentInfo: This field MUST have the following values for its fields:
      - eContentType: This field MUST be the OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1, id-data).
      - eContent: This field MUST be the PKCS #10 certificate request constructed as specified in the section 3.1.1.4.3.1.1 or section 3.1.1.4.3.4.1, or retrieved from the OtherEndEntityRequest data.
    - Certificates: This field MUST include the certificate that is associated with the private key used to sign the certificate request.
    - SignerInfo: The signing MUST be done with the key associated to the certificate that is passed in the preceding Certificates field:

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- AuthenticatedAttributes (in the first SignerInfo): This field MUST include the OID szENROLLMENT_NAME_VALUE_PAIR (1.3.6.1.4.1.311.13.2.1) attribute. The value of the attribute MUST include the requestername name-value pair. The value of requestername MUST be the requested value for the **Subject** field in the issued certificate.

3.1.1.4.3.3.3 Enroll on Behalf of Certificate Request Using CMS and CMC Request Formats

The request MUST be an ASN.1 DER encoded CMS message (as specified in [RFC3852]) that includes a CMC request (as specified in [RFC2797]). The ASN.1 structure includes the following fields:

- The client MUST construct a CMC request with the following requirements:
  - TaggedRequest: This field MUST contain exactly one certificate request. The certificate request MUST be the PKCS #10 constructed in the preceding step.
  - TaggedAttributes: The client MAY pass additional enrollment attributes in the RegInfo attribute as specified in [RFC2797] section 5.12. The semantics for the value of this attribute are identical to the ones that are defined for the *pwszAttributes* parameter for **ICertRequestD::Request** and **ICertRequestD2::Request2**. Specifications on the supported attributes are in section 3.1.1.4.3.1.1. The format of the value is specified in section 2.2.2.6.3. The value of the attribute MUST include the requestername name-value pair. The value of requestername MUST be the requested value for the **Subject** field in the Issued certificate.
- The client MUST construct a CMS with the following requirement:
  - ContentType: This field MUST be the OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData).
  - Content: This field MUST be a SignedData with the following values for its fields:
    - encapContentInfo: This field MUST have the following values for its fields:
      - eContentType: This field MUST be the OID szOID_CT_PKI_DATA (1.3.6.1.5.5.7.12.2, Id-cct-PKIData).
      - eContent: This field MUST be the CMC certificate request constructed as specified in the section 3.1.1.4.3.1.3 or retrieved from the OtherEndEntityRequest data.
    - Certificates: This field MUST include the certificate associated with the private key used to sign the certificate request.
    - SignerInfos: This collection MUST include at least two SignerInfo structures.
      - The first signerInfo MUST either use the subjectKeyIdentifier form of signerInfo, as specified in [RFC2797] section 4.2, or MUST use the No-Signature Signature Mechanism as specified in [RFC2797] section 3.3.3.1.
      - The second SignerInfo MUST be done with the key associated to the certificate that is passed in the preceding Certificates field.

3.1.1.4.3.4 Certificate Request with Key Attestation

Note For information on product behavior, see the following product behavior note.<21>

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Before the client can submit the request to the CA for archival purposes, it MUST initialize a secure channel to the CA. To create a secure channel to the CA, the client MUST retrieve the current CA key exchange certificate, either through a call to **ICertRequestD::GetCACert** (providing the GETCERT_CAXCHGCERT 0x00000001 property identifier (ID) in the fchain parameter) or **ICertRequestD2::GetCAProperty** (providing the CR_PROP_CAXCHGCERT 0x0000000F flag in the PropID parameter). Both methods can be used to retrieve the CA exchange certificate with no preference.

The client MUST locally generate a symmetric key and MUST use it to encrypt the Client_EndorsementKeyInfo ADM element in the request. The client MUST then encrypt the symmetric key by using the public key from the retrieved CA exchange certificate. The encrypted symmetric key MUST then be included in a certificate request, as specified in sections 3.1.1.4.3.4.1 and 3.1.1.4.3.4.3.

3.1.1.4.3.4.1 New Certificate Request with Key Attestation Statement

The request MUST be an ASN.1 DER-encoded PKCS10 request [RFC3852] that includes a szOID_ENROLL_EK_INFO attribute. More specifically:

- The client MUST construct an enveloped CMS that complies with the following requirements:
  - RecipientInfos: This field MUST reference the CA exchange certificate that contains the public key that is used to encrypt the client's private key. The exact format of RecipientInfos is specified in [RFC3852] section 6.1.
  - EncryptedContent: This field MUST be the encrypted form of the Client_EndorsementKeyInfo ADM element.
- The client MUST construct a PKCS #10 request, as specified in section 3.1.1.4.3.1.1 with the szOID_ENROLL_EK_INFO attribute set to the enveloped CMS structure constructed in the previous step, the szOID_ENROLL_ATTESTATION_STATEMENT attribute set to the Client_KeyAttestationStatement ADM element, and the szOID_ENROLL_KSP_NAME attribute to CSP name used to create the private/public key pair.

Note All request formats detailed in the following sections MUST be marshaled by using DER-encoding rules, as specified in [X690], for transmission.

3.1.1.4.3.4.2 Responding to a CA Challenge Message

When the CA receives a certificate request with a key attestation statement, it SHOULD return a challenge to the client to prove that the client owns the corresponding EK private key (EKPriv), as specified in section 3.2.2.6.2.1.2.6<22>. Windows Client Certificate Enrollment protocol SHOULD verify and process the challenge as described in this section.<23>

1. The *pctbCertChain* parameter returned by the **ICertRequestD::Request** method MUST be a CMC full PKI response. This parameter contains the **CAChallenge** as described in section 3.2.2.6.2.1.2.6. Message syntax MUST be as specified in section 3.2.2.6.2.1.2.6.
2. The client MUST verify the signature on the **CAChallenge** and MUST validate the CA signing certificate and its chain. The validation MUST be based on chain validation as specified in [RFC3280].
3. The client MUST validate the CA exchange certificate included in the **CAChallenge** and verify that it is a valid exchange certificate (for more information, see [MSFT-ARCHIVE]).

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4. The client MUST decrypt the secret included in the **CAChallenge** using its TPM and use the result as the secret in the next step. This process is CSP-specific.

5. The client generates enveloped data as described in section 3.1.1.4.3.4.3 by setting the encrypted content to the secret obtained in the previous step. The client MUST use the encryption algorithm provided in the szOID_ENROLL_ENCRYPTION_ALGORITHM attribute (section 2.2.2.8.1.4). The client sets the *pctbRequest* parameter in the **ICertRequestD::Request** method to this enveloped data.

6. The client adds the RequestId attribute (section 2.2.2.7.10), constructed from the Returned_Request_ID ADM element, to the *pwszAttributes* parameter of the **ICertRequestD::Request** method.

3.1.1.4.3.4.3 Certificate Request with Challenge Response

The request MUST be an ASN.1 DER-encoded CMS request (as specified in [RFC3852]). The ASN.1 structure includes the following fields:

- RecipientInfos: This field MUST reference the CA exchange certificate that contains the public key that is used to encrypt the client's private key. The exact format of RecipientInfos is specified in [RFC3852] section 6.1.

- EncryptedContent: This field MUST include the secret that the CA has sent (in encrypted format) as described in section 3.2.2.6.2.1.2.6.

3.1.1.4.3.5 Certificate Requests with Private Key Info

Before the client can submit the request to the CA for archival purposes, it MUST initialize a secure channel to the CA. To create a secure channel with the CA, the client MUST retrieve the current CA key exchange certificate either through a call to **ICertRequestD::GetCACert** (providing the GETCERT_CAXCHGCERT 0x00000001 property identifier (ID) in the *fchain* parameter) or **ICertRequestD2::GetCAProperty** (providing the CR_PROP_CAXCHGCERT 0x0000000F flag in the *PropID* parameter). Both methods can be used to retrieve the CA exchange certificate with no preference.

The client MUST locally generate a **symmetric key** and MUST use it to encrypt the private key associated with the certificate to be enrolled. The client MUST then encrypt the symmetric key by using the public key from the retrieved CA exchange certificate. The encrypted symmetric key MUST then be included in a certificate request, as specified in section 3.1.1.4.3.5.1.

For more information about the key archival and recovery process, see [MSFT-ARCHIVE].

When sending a request with an encrypted private key, clients MUST use the CMS structure with an embedded CMC request format, which MUST be as specified in [RFC3852] and [RFC2797]. The client MUST use **ICertRequestD2::Request2** to submit the request and follow the specific requirements specified in the following section.

3.1.1.4.3.5.1 Certificate Request with a Private Key Using CMC Request Format

The request MUST be an ASN.1 DER-encoded CMS request (as specified in [RFC3852]) that includes a CMC request (as specified in [RFC2797]). The ASN.1 structure includes the following fields:

- The client MUST construct a PKCS #10, as specified in section 3.1.1.4.3.1.1.

- The client MUST construct an enveloped CMS that complies with the following requirements:

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- RecipientInfos: This field MUST reference the CA exchange certificate that contains the public key that is used to encrypt the client private key. The exact format of RecipientInfos is specified in [RFC3852] section 6.1.
- EncryptedContent: This field MUST be the encrypted private key (from the public/private key pair that is used in the PKCS #10 of the preceding step).

- The client MUST construct a CMC that complies with the following requirements:
  - TaggedRequest: This field MUST contain exactly one certificate request. The certificate request MUST be the PKCS #10 constructed in the preceding (first) step.
  - TaggedAttributes: This field MUST include the key hash attribute. The OID for this attribute is szOID_ENCRYPTED_KEY_HASH (1.3.6.1.4.1.311.21.21). The value for this attribute MUST be the hash of the ASN.1 DER-encoded value of the enveloped CMS structure that is created in the preceding (second) step. The hash algorithm MUST be the same as the algorithm used to sign the certificate request itself. The hash value MUST be encoded as an octet string. The client MAY pass additional enrollment attributes in the RegInfo attribute as specified in [RFC2797] section 5.12. The format and semantics for the value of this attribute are identical to the values that are defined for the *pwszAttributes* parameter for **ICertRequestD2::Request2**. For more information about the supported attributes, see section 3.1.1.4.3.1.1. The client MUST set the Y flag in the *dwFlags* parameter of **ICertRequestD2::Request2**.
- The client MUST construct a CMS that complies with the following requirements:
  - ContentType: This field MUST be the OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData).
  - Content: This field MUST be a SignedData that uses the following values for its fields:
    - encapContentInfo: This field MUST have the following values for its fields:
      - eContentType: This field MUST be the OID szOID_CT_PKI_DATA (1.3.6.1.5.5.7.12.2, Id-cct-PKIData).
      - eContent: This field MUST be the CMC certificate request that is constructed in the preceding (third) step.
    - SignerInfo: This CMS certificate request MUST be signed with the private key that is associated with the PKCS #10 certificate request that is constructed in the preceding (first) step. The UnauthenticatedAttributes of the SignerInfo field MUST contain the OID szOID_ARCHIVED_KEY_ATTR (1.3.6.1.4.1.311.21.13) attribute. The value of this attribute is the CMS certificate request that is constructed in the preceding (second) step.

Note All the request formats detailed in the following sections MUST be marshaled via DER-encoding rules, as specified in [X690], for transmission.

3.1.1.4.3.6 Certificate Request for Certificate Retrieval

A client retrieves an issued certificate from a CA by calling **ICertRequestD::Request** and **ICertRequestD2::Request2** methods. The call that the client makes does not contain information on a new certificate request; rather, it contains an identifier of the certificate the client wants to retrieve. It has identical semantics for the **ICertRequestD::Request** (section 3.2.1.4.2.1) and **ICertRequestD2::Request2** (section 3.2.1.4.3.1) methods, with the exception of the *pwszSerialNumber* parameter. The client MUST make a call to the same CA that has received the original request.

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The client MUST identify the certificate that it wants to retrieve, either by setting the *pwszSerialNumber* to the requested certificate serial number or by setting *pdwRequestId* to the value of the *pdwRequestId* parameter that was returned in a previous call to this function.

pwszAuthority: The client MUST follow the processing rules for *pwszAuthority* as specified in section 3.1.1.4.2.

dwFlags: The client MUST NOT set the RequestType byte of the *dwFlags* parameter (as specified in section 3.2.1.4.3.1.1). The client SHOULD set the values of the Flags byte in the *dwFlags* parameter (as specified in section 3.2.1.4.3.1.1) as necessary to specify the type of information to be returned.

pwszSerialNumber: If *pdwRequestId* is 0, then the client MUST set this parameter to the serial number of the issued certificate that it requests.

pdwRequestId: If *pwszSerialNumber* is NULL, the client MUST set this parameter to the request ID of the pending request.

pwszAttributes: This parameter MUST be NULL.

pctbRequest: This parameter MUST be NULL.

pdwDisposition: Upon a successful return from an **ICertRequestD::Request** or **ICertRequestD2::Request2** method invocation, the client receives the *pdwDisposition* parameter as an output value.

If this value is 0x00000005 (CR_DISP_UNDER_SUBMISSION), the CA has not completed processing the enrollment request and the certificate has not been signed.

If the value is 0x00000003 (CR_DISP_ISSUED), the CA has issued the certificate.

3.1.1.4.4 ICertRequestD::GetCACert Request Processing

This method returns a CA property.

To invoke this method:

pwszAuthority: This parameter MUST be set according to the processing rules for *pwszAuthority* as specified in section 3.1.1.4.2.

fchain: This parameter MUST be set to indicate the CA property preferred. If the client requests a certificate or property for which it is possible to have multiple instances on the CA, the low-order 16 bits MUST contain the index of the certificate to be returned. Details about the *fchain* parameter are specified in section 3.2.1.4.2.2.

3.1.1.4.5 ICertRequestD::Ping and ICertRequestD2::Ping2 Request Processing

A client invokes either the **ICertRequestD::Ping** or **ICertRequestD2::Ping2** method to determine whether the CA can be contacted.

To invoke one of these methods, use the following parameter:

pwszAuthority (see section 3.1.1.4.2): If the client knows any one of the CA names (common name, sanitized name, or short name) it SHOULD pass it in this parameter. If the client does not know any of the CA names, it MAY pass a NULL string for this parameter.

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Both the **ICertRequestD::Ping** and **ICertRequestD2::Ping2** methods have the same meaning and use. The only difference between the methods is that Ping is a member of the **ICertRequestD** interface, and Ping2 is a member of the **ICertRequestD2** interface.

3.1.1.4.6 ICertRequestD2::GetCAProperty Request Processing

This method returns a CA property.

To invoke this method:

- *pwszAuthority*: The client MUST follow the processing rules for *pwszAuthority*, as specified in section 3.1.1.4.2.
- *PropID*: The client MUST pass the ID of the requested property. A list of optional values is specified in section 3.2.1.4.3.2.
- *PropIndex*: Values and restrictions MUST be as specified in the parameter requirements table in section 3.2.1.4.3.2.
- *PropType*: Values and restrictions MUST be as specified in the parameter requirements table in section 3.2.1.4.3.2.

The value and format of pctbPropertyValue MUST be as specified in section 3.2.1.4.3.2.

3.1.1.4.7 ICertRequestD2::GetCAPropertyInfo Request Processing

This method retrieves an array of structures that provide information about properties available on the CA.

To invoke this method:

pwszAuthority: The client MUST follow the processing rules for *pwszAuthority*, as specified in section 3.1.1.4.2.

On a successful return, the LONG pointed to by pcProperty contains the count of the number of **CATRANSPROP** structures returned in pctbPropInfo. Rules for marshaling multiple **CATRANSPROP** structures in a **CERTTRANSBLOB** are specified in section 2.2.2.3.1.

3.1.1.5 Timer Events

None.

3.1.1.6 Other Local Events

This client can be triggered when an end user starts an application that requires enrollment for an X.509 certificate.<24> The following sections describe local events that capture the processing rules when the WCCE **client** is triggered. Simultaneous invocations of the WCCE client by the higher level code are not supported and the result of such invocations is undefined.

3.1.1.6.1 Retrieving the Pending Certificate Request

This local event allows higher level code to retrieve a certificate for a request that was set to pending by a CA.

Input Parameters:

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CAName: The name of the CA which processed the original request. The type and value of this parameter is the same as the *pwszAuthority* parameter in the **ICertRequestD::Request (section 3.2.1.4.2.1)** method.

ServerName: The FQDN of the server on which the CA specified by the **CAName** is running.

Flags: The flags associated with the request. The type and value of this parameter is the same as the *dwFlags* parameter in the **ICertRequestD::Request** method.

RequestID: The identifier used to identify the original request. The type and value of this parameter is the same as the *pdwRequestID* parameter in the **ICertRequestD::Request** method.

Output Parameters:

Disposition: Possible values are "Issued", "Pending", or "Error".

IssuedCertificate: Contains the requested certificate if it has been issued. The type and value of this parameter is the same as the *pctbEncodedCert* parameter in the **ICertRequestD::Request** method.

Processing:

1. Initialize a DCOM client as specified in section 2.1 by using the value of the **ServerName** input parameter as the remote server name setting of the DCOM client. If initialization did not succeed, then set the **Disposition** output parameter to "Error".

2. Determine the version of the certificate request interface supported by the server by following the processing rules specified in section 3.1.1.4. If errors were encountered, set the **Disposition** output parameter to "Error".

3. If the server supports the **ICertRequestD2 (section 3.2.1.4.3)** interface, then

   1. Retrieve the pending certificate request by invoking **ICertRequestD2::Request2 (section 3.2.1.4.3.1)**, using the following parameters:

      - *pwszAuthority*: set to the value of the **CAName** input parameter.
      - *dwFlags*: set to the value of the **Flags** input parameter.
      - *pdwRequestId*: set to the value of the **RequestID** input parameter.
      - *pwszSerialNumber*: NULL.
      - *pwszAttributes*: NULL.
      - *pctbRequest*: NULL.

   2. If the return value of the **ICertRequestD2::Request2** method is zero and:

      1. If **ICertRequestD2::Request2** returns *pdwDisposition* with value of CR_DISP_ISSUED, set the **Disposition** output parameter to "Issued".

      2. If **ICertRequestD2::Request2** returns *pdwDisposition* with value of CR_DISP_UNDER_SUBMISSION, set the **Disposition** output parameter to "Pending".

      3. Else, set the **Disposition** output parameter to "Error".

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3. If the return value of **ICertRequestD::Request** method is nonzero, set the **Disposition** output parameter to "Error".

4. If **Disposition** equals "Issued", set the **IssuedCertificate** output parameter to the value of the *pctbEncodedCert* returned by **ICertRequestD2::Request2**.

4. If the server does not support the **ICertRequestD2** interface, then

   1. Retrieve the pending certificate request by invoking **ICertRequestD::Request**, using the following parameters:

      - *pwszAuthority*: set to the value of the **CAName** input parameter.
      - *dwFlags*: set to the value of the **Flags** input parameter.
      - *pdwRequestId*: set to the value of the **RequestID** input parameter.
      - *pwszAttributes*: NULL.
      - *pctbRequest*: NULL.

   2. If the return value of the **ICertRequestD::Request** method is zero and:

      1. If **ICertRequestD::Request** returns *pdwDisposition* with value of CR_DISP_ISSUED, set the **Disposition** output parameter to "Issued".
      2. If **ICertRequestD::Request** returns *pdwDisposition* with value of CR_DISP_UNDER_SUBMISSION, set the **Disposition** output parameter to "Pending".
      3. Else, set the **Disposition** output parameter to "Error".

   3. If the return value of the **ICertRequestD::Request** method is nonzero, set the **Disposition** output parameter to "Error".

   4. If **Disposition** equals "Issued", set the **IssuedCertificate** output parameter to the value of the *pctbEncodedCert* returned by **ICertRequestD::Request**.

3.1.1.6.2 Submitting Certificate Request

This local event allows higher level code to submit a certificate request to a CA.

Input Parameters:

CAName: Identical to the *pwszAuthority* parameter in the **ICertRequestD::Request (section 3.2.1.4.2.1)** method.

ServerName: The FQDN of the server on which the CA specified by the **CAName** is running.

Flags: The flags associated with the request. The type and value of this parameter is the same as the *dwFlags* parameter in the **ICertRequestD::Request** method.

Request: A certificate request. The type and value of this parameter is the same as the *pctbRequest* parameter in the **ICertRequestD::Request** method.

Output Parameters:

Disposition: Possible values are "Issued", "Pending", or "Error".

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IssuedCertificate: Contains the requested certificate, if it has been issued. The type and value of this parameter is the same as the *pctbEncodedCert* parameter in the **ICertRequestD::Request** method.

Response: Contains the CA response if a certificate has been issued. The type and value of this parameter is the same as the *pctbCertChain* parameter in the **ICertRequestD::Request** method.

Processing:

1. Initialize a DCOM client as specified in section 2.1 by using the value of the **ServerName** input parameter as the remote server name setting of the DCOM client. If the initialization did not succeed, then set the **Disposition** output parameter to "Error".

2. Determine the version of the certificate request interface supported by the server by following the processing rules specified in section 3.1.1.4. If errors were encountered, set the **Disposition** output parameter to "Error".

3. If the server supports the **ICertRequestD2 (section 3.2.1.4.3)** interface, then

   1. Submit the certificate request by invoking **ICertRequestD2::Request2 (section 3.2.1.4.3.1)**, using the following parameters:

      - *pwszAuthority*: set to the value of the **CAName** input parameter.
      - *dwFlags*: set to the value of the **Flags** input parameter.
      - *pdwRequestId*: set to 0.
      - *pwszSerialNumber*: NULL
      - *pwszAttributes*: NULL
      - *pctbRequest*: set to the value of the **Request** input parameter.

   2. If the return value of the **ICertRequestD2::Request2** method is zero and:

      1. If **ICertRequestD2::Request2** returns *pdwDisposition* with value of CR_DISP_ISSUED, set the **Disposition** output parameter to "Issued".

      2. If **ICertRequestD2::Request2** returns *pdwDisposition* with value of CR_DISP_UNDER_SUBMISSION, and if the CA response is not a challenge message (as described in section 3.2.2.6.2.1.2.6), then set the **Disposition** output parameter to "Pending"; otherwise, the client SHOULD invoke the processing rules in section 3.1.1.4.3.4.2 using the CA response. Perform step 1 again with the Request parameter set to the enveloped data created in section 3.1.1.4.3.4.2.<25>

      3. Else, set the **Disposition** output parameter to "Error".

   3. If the return value of **ICertRequestD::Request** method is nonzero, set the **Disposition** output parameter to "Error".

   4. If **Disposition** equals "Issued", set the **IssuedCertificate** output parameter to the value of the *pctbEncodedCert* and set the **Response** output parameter to the value of the *pctbCertChain* returned by **ICertRequestD2::Request2**.

4. If the server does not support the **ICertRequestD2** interface, then

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1. Submit the certificate request by invoking **ICertRequestD::Request**, using the following parameters:
   - *pwszAuthority*: set to the value of the **CAName** input parameter.
   - *dwFlags*: set to the value of the **Flags** input parameter.
   - *pdwRequestId*: set to 0.
   - *pwszAttributes*: NULL.
   - *pctbRequest*: set to the value of the **Request** input parameter.
2. If the return value of the **ICertRequestD::Request** method is zero and:
   1. If **ICertRequestD::Request** returns *pdwDisposition* with value of CR_DISP_ISSUED, set the **Disposition** output parameter to "Issued".
   2. If **ICertRequestD::Request** returns *pdwDisposition* with value of CR_DISP_UNDER_SUBMISSION, set the **Disposition** output parameter to "Pending".
   3. Else, set the **Disposition** output parameter to "Error".
3. If the return value of the **ICertRequestD::Request** method is nonzero, set the **Disposition** output parameter to "Error".
4. If **Disposition** equals "Issued", set the **IssuedCertificate** output parameter to the value of the *pctbEncodedCert* and set the **Response** output parameter to the value of the *pctbCertChain* returned by **ICertRequestD::Request**.

3.1.2 Client Mode: Enrollment Based on Certificate Templates

This client extends the specification in section 3.1.1 and performs certificate enrollment in an enterprise environment where the enterprise has specified enrollment policies by using certificate templates [MS-CRTD] and other Active Directory objects (see section 2.2.2.11) and where the client enforces those policies. This mode of use of the Windows Client Certificate Enrollment Protocol is invoked by some client processes, such as the **autoenrollment** task [MS-CERSOD], for each enrollment request.

3.1.2.1 Abstract Data Model

This client defines the following abstract elements in addition to those specified in section 3.1.1.1.

Client_Intermediate_CA_Certificates: A collection of **CACERTBLOB** constructs (section 2.2.2.1) that contain intermediate CA certificates that are used by clients and servers to build certificate chains. A client and server should validate and verify certificate path information, as specified in [RFC3280] section 6. Details about the requirements for certificate path validation are specified in [RFC3280] section 9.<26>

Client_Root_CA_Certificates: A collection of **CACERTBLOB** constructs that contain root CA certificates that are used by clients and servers to validate certificate chains. A client and server should validate and verify certificate path information, as specified in [RFC3280] section 6. Details about the requirements for certificate path validation are specified in [RFC3280] section 9.<27>

Client_Current_Version: An unsigned integer with values between 0 and 15. This ADM element is used to determine whether the current template is supported by the client. If

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CT_FLAG_REQUIRE_SAME_KEY_RENEWAL is implemented (see section 3.1.2.4.2.2.2.8 for more details), then this ADM element MUST be set equal to 4. Otherwise, it MUST be set to 15.

The following abstract data represents the subset of values set on a certificate template with which this mode is invoked by a caller. The certificate template data structure is defined in [MS-CRTD]. Each element of the Certificate.Template.* data corresponds to a single attribute of a certificate template and shares its type. For example, the **Certificate.Template.flags** datum corresponds to the flags attribute specified in [MS-CRTD] section 2.4 and is an integer.

Certificate.Template.flags: Corresponds to flags attribute defined in [MS-CRTD] section 2.4.

Certificate.Template.pKIExtendedKeyUsage: Corresponds to the pKIExtendedKeyUsage attribute defined in [MS-CRTD] section 2.12.

Certificate.Template.pKIKeyUsage: Corresponds to the pKIKeyUsage attribute defined in [MS-CRTD] section 2.13.

Certificate.Template.pKIMaxIssuingDepth: Corresponds to the pKIMaxIssuingDepth attribute defined in [MS-CRTD] section 2.14.

Certificate.Template.pKIDefaultKeySpec: Corresponds to the pKIDefaultKeySpec attribute defined in [MS-CRTD] section 2.9.

Certificate.Template.pKIDefaultCSPs: Corresponds to the pKIDefaultCSPs attribute defined in [MS-CRTD] section 2.8.

Certificate.Template.pKICriticalExtensions: Corresponds to the pKICriticalExtensions attribute defined in [MS-CRTD] section 2.7.

Certificate.Template.msPKI-RA-Signature: Corresponds to the msPKI-RA-Signature attribute defined in [MS-CRTD] section 2.18.

Certificate.Template.msPKI-Minimal-Key-Size: Corresponds to the msPKI-Minimal-Key-Size attribute defined in [MS-CRTD] section 2.19.

Certificate.Template.msPKI-Template-Cert-Template-OID: Corresponds to the c attribute defined in [MS-CRTD] section 2.19.

Certificate.Template.msPKI-RA-Policies: Corresponds to the msPKI-RA-Policies attribute defined in [MS-CRTD] section 2.22.

Certificate.Template.msPKI-RA-Application-Policies: Corresponds to the msPKI-RA-Application-Policies attribute defined in [MS-CRTD] section 2.23.

Certificate.Template.msPKI-Certificate-Application-Policy: Corresponds to the msPKI-Certificate-Application-Policy attribute defined in [MS-CRTD] section 2.25.

Certificate.Template.msPKI-Enrollment-Flag: Corresponds to the msPKI-Enrollment-Flag attribute defined in [MS-CRTD] section 2.26.

Certificate.Template.msPKI-Private-Key-Flag: Corresponds to the msPKI-Private-Key-Flag attribute defined in [MS-CRTD] section 2.27.

Certificate.Template.msPKI-Certificate-Policy: Corresponds to the msPKI-Certificate-Policy attribute defined in [MS-CRTD] section 2.24.

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Certificate.Template.msPKI-Certificate-Name-Flag: Corresponds to the msPKI-Certificate-Name-Flag attribute defined in [MS-CRTD] section 2.28.

Certificate.Template.msPKI-Template-Schema-Version: Corresponds to the msPKI-Template-Schema-Version attribute defined in [MS-CRTD] section 2.16.

Certificate.Template.revision: Corresponds to the revision attribute defined in [MS-CRTD] section 2.6.

Certificate.Template.msPKI-Template-Minor-Revision: Corresponds to the msPKI-Template-Minor-Revision attribute defined in [MS-CRTD] section 2.17.

Certificate.Template.cn: Corresponds to the cn attribute specified in [MS-CRTD] section 2.1.

The following ADM elements define data needed to construct a certificate request, but not defined within a certificate template. These elements are set by a caller that invokes this client mode.

IsRenewalRequest: A Boolean flag indicating if a certificate request is a renewal request.

CertificateToBeRenewed: When certificate request is a renewal request, this element contains a certificate that is being renewed as well as its private key.

RACertificates: A list of certificates and their corresponding private keys to co-sign a certificate request.

3.1.2.2 Timers

None.

3.1.2.3 Initialization

Same as specified in section 3.1.1.3.

3.1.2.4 Message Processing Events and Sequencing Rules

The client implemented according to section 3.1.2 differs from the client specified in section 3.1.1 in the usage of the following methods:

- ICertRequestD::Request and ICertRequestD2::Request2
- ICertRequestD::GetCACert and ICertRequestD2::GetCAProperty

The following section specifies the difference between those specifications.

3.1.2.4.1 Algorithms

The Client Mode: Enrollment Based on Certificate Templates protocol role uses the algorithms specified in section 3.1.1.4.1, and its subsections.

3.1.2.4.2 ICertRequestD::Request and ICertRequestD2::Request2 Processing

Certificate Template Based Enrollment adheres to the specification for this method detailed in section 3.1.1.4.3 with the exceptions documented in the following sections. It is required that the abstract data elements defined in section 3.1.2.1 have been initialized using the method specified in section 3.1.2.6.1.

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3.1.2.4.2.1 Choosing Certificate Request Types

This section describes what type of certificate request is used in different situations.

- If the **IsRenewalRequest** datum is set to false:
  - If the **Certificate.Template.msPKI-Template-Schema-Version** datum equals to 1, the client SHOULD create a new certificate request as specified in section 3.1.1.4.3.1.1.
  - If the **Certificate.Template.msPKI-Template-Schema-Version** datum is equal to 2, 3, or 4, the client SHOULD<28> create a certificate request as follows:
    1. If the CT_FLAG_ATTEST_REQUIRED or CT_FLAG_ATTEST_PREFERRED flag under the Certificate.Template.msPKI-Private-Key-Flag datum is set, the client SHOULD create a new certificate request as specified in section 3.1.1.4.3.4.1 <29>; otherwise, if the CT_FLAG_REQUIRE_PRIVATE_KEY_ARCHIVAL flag under the Certificate.Template.msPKI-Private-Key-Flag datum is set, clients MUST create the key archival certificate request as specified in section 3.1.1.4.3.5.1. Otherwise, create a new certificate request as specified in section 3.1.1.4.3.1.3.
    2. If the RACertificates list is not empty, sign the request created in the previous step with each key from the RACertificates list and include each certificate associated with those keys in the **certificates** field of the CMS message.
  - If the **Certificate.Template.msPKI-Template-Schema-Version** datum equals to some other value or has not been set at all, the client SHOULD NOT<30> submit a certificate request.
- If the **IsRenewalRequest** datum is set to true:
  - If the **Certificate.Template.msPKI-Template-Schema-Version** datum equals to 1, the client SHOULD create a new certificate request as specified in section 3.1.1.4.3.2.1.
  - If the **Certificate.Template.msPKI-Template-Schema-Version** datum is equal to 2, 3, or 4, the client SHOULD<31> create a certificate request as follows:
    1. The client MUST create a renewal certificate request as specified in section 3.1.1.4.3.2.2.
    2. The client MUST sign the certificate request with a key from the **CertificateToBeRenewed** datum and include the associated certificate in the **certificates** field of the CMS message.
    3. If the **RACertificates** list is not empty, the request cannot be processed as a renewal request. Instead, the client MUST create a new certificate request as if the **IsRenewalRequest** datum were set to false.
  - If the **Certificate.Template.msPKI-Template-Schema-Version** datum equals to some other value or has not been set at all, the client SHOULD NOT<32> submit a certificate request.

3.1.2.4.2.2 Certificate Template Processing Rules

The client MUST follow the rules identified in this section to create a request based on the abstract data model specified in section 3.1.2.1.

- Clients MUST adhere to the following rules based on the existence or value of the **Certificate.Template.msPKI-Template-Schema-Version** datum:

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- If the **Certificate.Template.msPKI-Template-Schema-Version** datum was not set by the caller, or if the datum has a value of 1, the client MUST adhere to the processing rules as specified in section 3.1.2.4.2.2.1.1.
- If the value of the **Certificate.Template.msPKI-Template-Schema-Version** datum is 2, 3, or 4, the client SHOULD adhere to the processing rules as specified in sections 3.1.2.4.2.2.1.1 and 3.1.2.4.2.2.1.2.<33>

- The client MUST ignore attributes and flags of a certificate template that are not specified in the following sections.

3.1.2.4.2.2.1 Processing Rules for Certificate Template Version 1

The following sections contain the client processing rules for all certificate requests.

3.1.2.4.2.2.1.1 Certificate.Template.flags

The following processing rules are applied to flags in the **Certificate.Template.flags** datum.

Flag	Client processing
0x00000040 - CT_FLAG_MACHINE_TYPE	If this flag is set, an enrollment client MUST NOT send a certificate request based on this template unless the certificate and its associated key are to be used by the hosting machine.
0x00000080 - CT_FLAG_IS_CA	If this flag is set, an enrollment client MUST request a certificate for a CA.
0x00000800 - CT_FLAG_IS_CROSS_CA	If this flag is set, an enrollment client MUST request a certificate for **cross-certifying** a CA. For more information on cross certification, see [MSFT-CROSSCERT].

If the CT_FLAG_IS_CA or CT_FLAG_IS_CROSS_CA flag is set, the client MUST add the Basic Constraints extension (as specified in [RFC3280] section 4.2.1.10) to the certificate request. The **cA** field of the Basic Constraints extension MUST be set to TRUE, and the **pathLenConstraint** field MUST be set as specified in section 3.1.2.4.2.2.1.4. This extension MUST be added as a request attribute to the certificate request, as specified in section 2.2.2.7.7.

3.1.2.4.2.2.1.2 Certificate.Template.pKIExtendedKeyUsage

The client MUST create the extended key usage extension with the keyPurposeId as specified for the **Certificate.Template.pKIExtendedKeyUsage** datum (section 3.1.2.4.2.2.1.2). Specifications on this extension are in [RFC3280] section 4.2.1.13.

This extension MUST be added as a request attribute to the certificate request, as specified in section 2.2.2.7.7.

3.1.2.4.2.2.1.3 Certificate.Template.pKIKeyUsage

The client MUST create the key usage extension with the bits value as specified in the **Certificate.Template.pKIKeyUsage** datum. Specifications on this extension are in [RFC3280] section 4.2.1.3.

This extension MUST be added as a request attribute to the certificate request, as specified in section 2.2.2.7.7.

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3.1.2.4.2.2.1.4 Certificate.Template.pKIMaxIssuingDepth

If a Basic Constraints extension (as specified in [RFC3280] section 4.2.1.10) is being added to the request:

- If the value of the **cA** field of the Basic Constraints extension is TRUE:
  - If the value of the **Certificate.Template.pKIMaxIssuingDepth** datum is not equal 0xFFFFFFFF, the client MUST use the value of the **Certificate.Template.pKIMaxIssuingDepth** datum to populate the **pathLenConstraint** field of the Basic Constraints extension.
  - If the value of the **Certificate.Template.pKIMaxIssuingDepth** datum is equal to 0xFFFFFFFF, the client MUST NOT include the **pathLenConstraint** field in the Basic Constraints extension.
- If the value of the **cA** field of the Basic Constraints extension is FALSE, the client MUST NOT include the **pathLenConstraint** field in the Basic Constraints extension.

The conditions under which the Basic Constraints extension is added to the request are specified in sections 3.1.2.4.2.2.1.1 and 3.1.2.4.2.2.2.7.

3.1.2.4.2.2.1.5 Certificate.Template.pKIDefaultKeySpec

The **Certificate.Template.pKIDefaultKeySpec** datum SHOULD be used to determine the cryptographic key information for generating the cryptographic keys used with the certificate.<34>

Possible values are specified in section 2.2.2.10.

3.1.2.4.2.2.1.6 Certificate.Template.pKIDefaultCSPs

The client SHOULD use the **Certificate.Template.pKIDefaultCSPs** datum to determine the algorithm and the key size to be used to generate the private key as follows. For more details about the definition of the intNum and strCSP strings used in the processing rules below, see [MS-CRTD] section 2.8.

1. Sort the list by using the intNum value in an ascending order.
2. For each item in the list:
   - Map the strCSP string to an algorithm name and key size using the table below:

strCSP	Algorithm, key size when Certificate.Template.pkiDefaultKeySpec Value = 0x1 (AT_KEYEXCHANGE)	Algorithm, key size when Certificate.Template.pkiDefaultKeySpec Value = 0x2 (AT_SIGNATURE)
"Microsoft Base Cryptographic Provider"	RSA, 512 [PKCS1]	RSA, 512 [PKCS1]
"Microsoft Strong Cryptographic Provider"	RSA, 1024 [PKCS1]	RSA, 1024 [PKCS1]
"Microsoft	RSA, 1024 [PKCS1]	RSA, 1024 [PKCS1]

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strCSP	Algorithm, key size when Certificate.Template.pkiDefaultKeySpec Value = 0x1 (AT_KEYEXCHANGE)	Algorithm, key size when Certificate.Template.pkiDefaultKeySpec Value = 0x2 (AT_SIGNATURE)
Enhanced Cryptographic Provider"		
"Microsoft AES Cryptographic Provider"	RSA, 1024 [PKCS1]	RSA, 1024 [PKCS1]
"Microsoft DSS Cryptographic Provider"	Not available	DSA, 1024 [FIPS186]
"Microsoft Base DSS and Diffie-Hellman Cryptographic Provider"	Diffie-Hellman, 512 [PKCS3]	DSA, 1024 [FIPS186]
"Microsoft Enhanced DSS and Diffie-Hellman Cryptographic Provider"	Diffie-Hellman, 1024 [PKCS3]	DSA, 1024 [FIPS186]
"Microsoft DSS and Diffie-Hellman/Schannel Cryptographic Provider"	Diffie-Hellman, 512 [PKCS3]	"Not available"
"Microsoft RSA/Schannel Cryptographic Provider"	RSA, 1024, [PKCS1]	"Not available"

- If the value of the strCSP is not on the list or the value in the table equals "Not available", continue with the next item in the list.
- If the value of the strCSP is on the list, use the mapped algorithm when creating a private key.

3. If no algorithm was selected in step 2, use RSA algorithm and generate a 1024-bit key.

3.1.2.4.2.2.1.7 Certificate.Template.pKICriticalExtensions

The client MUST mark the extensions listed in the **Certificate.Template.pKICriticalExtensions** datum critical when encoding the extensions in the request. Specifications on the extensions format are in section 2.2.2.7.7.

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3.1.2.4.2.2.1.8 Certificate.Template.cn

The client MAY use the value of the **Certificate.Template.cn** datum to encode certificate template name as specified in section 2.2.2.7.7.1.<35>

3.1.2.4.2.2.1.9 Certificate.Template.revision

The value of the **Certificate.Template.revision** datum SHOULD <36> be encoded as a **templateMajorVersion** field of the Certificate Template OID extension specified in section 2.2.2.7.7.2.

3.1.2.4.2.2.2 Processing Rules for Certificate Template Versions 2, 3, and 4

The client MUST adhere to the processing rules as specified in section 3.1.2.4.2.2.1. If the **certificate.Template.msPKI-Template-Schema-Version** datum is set to 2, 3, or 4, the client MUST also adhere to processing rules specified in this section.

3.1.2.4.2.2.2.1 Certificate.Template.msPKI-Minimal-Key-Size

The client MUST create the key pair with a **key length** greater than or equal to the value of the **Certificate.Template.msPKI-Minimal-Key-Size** datum. The client MUST ignore the key length derived by processing the Certificate.Template.pKIDefaultCSPs (section 3.1.2.4.2.2.1.6) datum, as specified in section 3.1.2.4.2.2.1.6.

3.1.2.4.2.2.2.2 Certificate.Template.pKIDefaultCSPs

The client SHOULD use the **Certificate.Template.pKIDefaultCSPs** datum to determine the algorithm and the key size to be used to generate the private key as follows:

- If the **certificate.Template.msPKI-Template-Schema-Version** datum equals 0x2:
  1. Determine the algorithm for the private key, as specified in section 3.1.2.4.2.2.1.6.
  2. Determined the key size, as specified in section 3.1.2.4.2.2.2.1.
- If the **certificate.Template.msPKI-Template-Schema-Version** datum equals 0x3:
  1. Determine the algorithm for the private key by processing the msPKI-Asymmetric-Algorithm property type, as specified in section 3.1.2.4.2.2.2.5.
  2. Determined the key size, as specified in section 3.1.2.4.2.2.2.1.
- If the **certificate.Template.msPKI-Template-Schema-Version** datum equals 0x4 and if CT_FLAG_USE_LEGACY_PROVIDER is set:
  1. Determine the algorithm for the private key, as specified in section 3.1.2.4.2.2.1.6.
  2. Determine the key size, as specified in section 3.1.2.4.2.2.2.1.
  3. If the CT_FLAG_ATTEST_REQUIRED or CT_FLAG_ATTEST_PREFERRED flag under the Certificate.Template.msPKI-Private-Key-Flag datum is set, the client SHOULD initialize the Client_EndoresmentKeyInfo and Client_KeyAttestationStatement ADM elements using CSP-specific methods.<37> If initialization failed and CT_FLAG_ATTEST_REQUIRED is set, the client SHOULD not submit the certificate request based on this template.<38>

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- If the **certificate.Template.msPKI-Template-Schema-Version** datum equals 0x4 and if CT_FLAG_USE_LEGACY_PROVIDER is not set:

  1. Determine the algorithm for the private key by processing the msPKI-Asymmetric-Algorithm property type, as specified in section 3.1.2.4.2.2.2.5.

  2. Determine the key size, as specified in section 3.1.2.4.2.2.2.1.

  3. If the CT_FLAG_ATTEST_REQUIRED or CT_FLAG_ATTEST_PREFERRED flag under the Certificate.Template.msPKI-Private-Key-Flag datum is set, the client SHOULD initialize the Client_EndorsementKeyInfo and Client_KeyAttestationStatement ADM elements using CSP-specific methods.<39> If initialization failed and CT_FLAG_ATTEST_REQUIRED is set, the client SHOULD NOT submit a certificate request based on this template.<40>

3.1.2.4.2.2.2.3 Certificate.Template.msPKI-Template-Cert-Template-OID

The value of the **Certificate.Template.msPKI-Template-Cert-Template-OID** datum MUST be encoded as a **templateID** field of the Certificate Template OID extension, as specified in section 2.2.2.7.7.2.

3.1.2.4.2.2.2.4 Certificate.Template.msPKI-Template-Minor-Revision

The value of the **Certificate.Template.msPKI-Template-Minor-Revision** datum MUST be encoded as a **templateMinorVersion** field of the Certificate Template OID extension as specified in section 2.2.2.7.7.2.

3.1.2.4.2.2.2.5 Certificate.Template.msPKI-RA-Application-Policies

Clients MUST inspect the value of the **Certificate.Template.msPKI-RA-Application-Policies** datum as specified in [MS-CRTD] section 2.23. For each property type, the following client processing rules apply:

- msPKI-Asymmetric-Algorithm: If this property type is present, the client MUST use the algorithm specified in this property to generate the private-public key pair, based on the following table:

Value	Algorithm
DH	The Diffie-Hellman key exchange algorithm [PKCS3]
DS	The digital signature algorithm [FIPS186]
ECDSA_P256	Elliptic Curve Digital Signature Algorithm on p-256 curve [FIPS186]
ECDSA_P384	Elliptic Curve Digital Signature Algorithm on p-384 curve [FIPS186]
ECDSA_P521	Elliptic Curve Digital Signature Algorithm on p-521 curve [FIPS186]
ECDH_P256	Elliptic curve Diffie–Hellman on p-256 curve [SP800-56A]
ECDH_P384	Elliptic curve Diffie–Hellman on p-384 curve [SP800-56A]
ECDH_P521	Elliptic curve Diffie–Hellman on p-521 curve [SP800-56A]
RSA	The RSA **public key algorithm** [PKCS1]

If the property type is not present, clients MAY choose defaults based on local policy.<41>

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- msPKI-SecurityDescriptor: If this property type is present, the client MUST use the security descriptor (as specified in [MS-DTYP]) to set the access permissions on the private key corresponding to the public key in the request. If this property type is not present, clients MAY choose defaults based on local policy.<42>

- msPKI-Symmetric-Algorithm: If this property type is present, the client MUST use the algorithm specified in this property to encrypt the private key corresponding to the public key in the request while generating the key archival enrollment request, as specified in section 1.3.2.1. In addition, the client SHOULD use this algorithm to encrypt the Client_EndorsementKeyInfo ADM element as described in section 3.1.1.4.3.4.1.<43> If this property type is not present, clients MAY choose defaults based on local policy.<44>

- msPKI-Symmetric-Key-Length: If this property type is present, the client MUST use the value specified in this property as the length of the symmetric key used to encrypt the private key while generating the key archival enrollment request, as specified in section 1.3.2.1. If this property type is not present, clients MAY choose defaults based on local policy.<45>

- msPKI-Hash-Algorithm: If this property type is present, the client MUST use the value specified in this property as the hash algorithm while creating the signature of the certificate request. If this property type is not present, clients MAY choose defaults based on local policy.<46>

- msPKI-Key-Usage: This property type MUST<47> be used to determine the cryptographic key information for generating the cryptographic keys that are used with the certificate. If this property type is not present, clients MAY choose defaults based on local policy.<48>

3.1.2.4.2.2.2.6 Certificate.Template.msPKI-Certificate-Application-Policy

The client MUST create the Certificate Application Policy extension as specified in section 2.2.2.7.7.3, and using the OIDs in this abstract datum.

This extension MUST be added as a request attribute to the certificate request. Specifications are in section 2.2.2.7.7.<49>

3.1.2.4.2.2.2.7 Certificate.Template.msPKI-Enrollment-Flag

The following processing rules are applied to flags in the **Certificate.Template.msPKI-Enrollment-Flag** datum.

Flag	Client processing
0x00000001	CT_FLAG_INCLUDE_SYMMETRIC_ALGORITHMS The client MUST include a Secure/Multipurpose Internet Mail Extensions (S/MIME), as specified in [RFC4262], in the request. Note that although the flag contains the words "SYMMETRIC ALGORITHMS" as part of its name, it specifies only S/MIME extensions.
0x00008000	CT_FLAG_INCLUDE_BASIC_CONSTRAINTS_FOR_EE_CERTS If this flag is set, the client SHOULD add a Basic Constraints extension (as specified in [RFC3280], section 4.2.1.10) to the certificate request and set the **cA** field to FALSE. The client SHOULD NOT include the **pathLenConstraint** field in the Basic Constraints extension. <50>

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3.1.2.4.2.2.2.8 Certificate.Template.msPKI-Private-Key-Flag

The following processing rules are applied to flags in the **Certificate.Template.msPKI-Private-Key-Flag** datum.

Flag	Client processing
0x00000001 CT_FLAG_REQUIRE_PRIVATE_KEY_ARCHIVAL	If all of the following conditions are met: ▪ The CT_FLAG_REQUIRE_SAME_KEY_RENEWAL flag (0x00000080) is also set, ▪ The **IsRenewalRequest** datum is set to true, ▪ The CT_FLAG_EXPORTABLE_KEY (0x00000010) is not set, then the client SHOULD ignore this flag<51>; otherwise, clients MUST create the **key archival certificate** request as specified in section 3.1.1.4.3.5.1.
0x00000010 CT_FLAG_EXPORTABLE_KEY	If this flag is set, clients MUST allow other applications to copy the private key to a PFX (as specified in [PKCS12]) file at a later time.
0x00000020 CT_FLAG_STRONG_KEY_PROTECTION_REQUIRED	If this flag is set, clients MUST use a stronger encryption protocol for the private key.<52>
0x00000040 CT_FLAG_REQUIRE_ALTERNATE_SIGNATURE_ALGORITHM	If this flag is set, the client SHOULD sign PKCS#10 request as follows.<53> ▪ For RSA keys, use signature algorithm and ASN structures as specified in section 3 of [RFC4055]. ▪ For ECC keys, follow algorithm and structures specified in [X9.62]. For other algorithms, the client MUST ignore this flag.
0x00000080 CT_FLAG_REQUIRE_SAME_KEY_RENEWAL	If the IsRenewalRequest datum is set, the client SHOULD use the key of the CertificateToBeRenewed ADM datum to generate a certificate request.<54>
0x00000100 CT_FLAG_USE_LEGACY_PROVIDER	This flag instructs the client to generate a public/private key pair as explained in section 3.1.2.4.2.2.1.6.<55> If this flag is not set, the public/private key MUST be generated as explained in section 3.1.2.4.2.2.2.5.
0x000002000 CT_FLAG_ATTEST_REQUIRED *	This flag instructs the client to generate a certificate request as explained in section 3.1.1.4.3.4.1.

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Flag	Client processing
0x000001000 CT_FLAG_ATTEST_PREFERRED *	This flag instructs the client to generate a certificate request as explained in section 3.1.1.4.3.4.1 if the Client_EndorsementKeyInfo andClient_KeyAttestationStatement ADM elements are not empty (as described in section 3.1.2.4.2.2.2.2).

* Support for these flags is specified in the following behavior note.<56>

- If the value of a bitwise AND of **Certificate.Template.msPKI-Private-Key-Flag** and 0x0F000000 is larger than 0x0Y000000, where Y denotes the value of the **Client_Current_Version** ADM element, the client SHOULD NOT enroll for this template.<57>

3.1.2.4.2.2.2.9 Certificate.Template.msPKI-Certificate-Policy

The client MUST construct the "certificate policies" extension as specified in [RFC3280] section 4.2.1.5.

For each value in this multiple-value datum, clients should encode a PolicyInformation object, where the policyIdentifier MUST contain the value stored in this datum and the PolicyQualifier MUST NOT be present.

This extension MUST be added as a request attribute to the certificate request. Specifications are in section 2.2.2.7.7.

3.1.2.4.2.2.2.10 Certificate.Template.msPKI-Certificate-Name-Flag

The following processing rules are applied to flags in the **Certificate.Template.msPKI-Certificate-Name-Flag** datum.

1. If the CT_FLAG_ENROLLEE_SUPPLIES_SUBJECT flag or the CT_FLAG_ENROLLEE_SUPPLIES_SUBJECT_ALT_NAME flag is set, then:

    1. If the CT_FLAG_OLD_CERT_SUPPLIES_SUBJECT_AND_ALT_NAME flag is set and the enrollment client is creating a renewal request, the client SHOULD <58>:

        1. Use the value of the **Subject** field to populate the **Name** filed of the PKCS #10 request (see section 3.1.1.4.3.1.1).

        2. Add a subject alternative name extension to the certificate extensions attribute szOID_CERT_EXTENSIONS (section 2.2.2.7.7) of the PKCS #10 request (see section 3.1.1.4.3.1.1).

    2. Otherwise, the client MUST supply subject information in the certificate request in the **Name** field or the subject alternative name extension in the certificate extensions attribute szOID_CERT_EXTENSIONS of the PKCS #10 request (see section 3.1.1.4.3.1.1).

2. If neither the CT_FLAG_ENROLLEE_SUPPLIES_SUBJECT flag nor the CT_FLAG_ENROLLEE_SUPPLIES_SUBJECT_ALT_NAME flag is set, the client MUST set the **Subject** field to empty and encode it as a 0 length DER-encoded sequence.

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3.1.2.4.2.3 Encoding Certificate Template Identifier in the Request

Clients MUST identify certificate template to the server in one of the following ways:

- The certificate template name as specified in section 3.1.2.4.2.2.1.8.
- The certificate template OID as specified in section 3.1.2.4.2.2.2.3.
- The certificate template name (value of the **Certificate.Template.cn** datum) as an Enrollment-Name-Value pair as specified in section 3.1.1.4.7.
- The certificate template name (value of the **Certificate.Template.cn** datum) in the pwszAttributes parameter of ICertRequestD::Request or ICertRequestD2::Request2 as specified in section 3.2.1.4.3.1.

3.1.2.5 Timer Events

None.

3.1.2.6 Other Local Events

3.1.2.6.1 Creating a Certificate Request Based on a Certificate Template

Input Parameters

Parameter.Certificate.Template.flags: The type and value of this parameter is the same as the **Certificate.Template.flags** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.pKIExtendedKeyUsage: The type and value of this parameter is the same as the **Certificate.Template.pKIExtendedKeyUsage** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.pKIKeyUsage: The type and value of this parameter is the same as the **Certificate.Template.pKIKeyUsage** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.pKIMaxIssuingDepth: The type and value of this parameter is the same as the **Certificate.Template.pKIMaxIssuingDepth** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.pKIDefaultKeySpec: The type and value of this parameter is the same as the **Certificate.Template.pKIDefaultKeySpec** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.pKIDefaultCSPs: The type and value of this parameter is the same as the **Certificate.Template.pKIDefaultCSPs** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.pKICriticalExtensions: The type and value of this parameter is the same as the **Certificate.Template.pKICriticalExtensions** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-RA-Signature: The type and value of this parameter is the same as the **Certificate.Template.msPKI-RA-Signature** ADM element described in section 3.1.2.1.

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Parameter.Certificate.Template.msPKI-Minimal-Key-Size: The type and value of this parameter is the same as the **Certificate.Template.msPKI-Minimal-Key-Size** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-Template-Cert-Template-OID: The type and value of this parameter is the same as the **Certificate.Template.msPKI-Template-Cert-Template-OID** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-RA-Policies: The type and value of this parameter is the same as the **Certificate.Template.msPKI-RA-Policies** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-RA-Application-Policies: The type and value of this parameter is the same as the **Certificate.Template.msPKI-RA-Application-Policies** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-Certificate-Application-Policy: The type and value of this parameter is the same as the **Certificate.Template.msPKI-Certificate-Application-Policy** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-Enrollment-Flag: The type and value of this parameter is the same as the **Certificate.Template.msPKI-Enrollment-Flag** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-Private-Key-Flag: The type and value of this parameter is the same as the **Certificate.Template.msPKI-Private-Key-Flag** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-Certificate-Policy: The type and value of this parameter is the same as the **Certificate.Template.msPKI-Certificate-Policy** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-Certificate-Name-Flag: The type and value of this parameter is the same as the **Certificate.Template.msPKI-Certificate-Name-Flag** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-Template-Schema-Version: The type and value of this parameter is the same as the **Certificate.Template.msPKI-Template-Schema-Version** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.revision: The type and value of this parameter is the same as the **Certificate.Template.revision** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.msPKI-Template-Minor-Revision: The type and value of this parameter is the same as the **Certificate.Template.msPKI-Template-Minor-Revision** ADM element described in section 3.1.2.1.

Parameter.Certificate.Template.cn: The type and value of this parameter is the same as the **Certificate.Template.cn** ADM element described in section 3.1.2.1.

Parameter.IsRenewalRequest: The type and value of this parameter is the same as the **IsRenewalRequest** ADM element described in section 3.1.2.1.

Parameter.CertificateToBeRenewed: The type and value of this parameter is the same as the **CertificateToBeRenewed** ADM element described in section 3.1.2.1.

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Parameter.RACertificates: The type and value of this parameter is the same as the **RACertificates** ADM element described in section 3.1.2.1.

Output Parameter

Request: A certificate request created based on the certificate template settings. The type and value of this parameter is the same as the *pctbRequest* parameter in the **ICertRequestD::Request (section 3.2.1.4.2.1)** method.

Processing

1. Initialize the ADM elements described in section 3.1.2.1 using the input parameters as follows:

Parameter	Initializes ...
Parameter.Certificate.Template.flags	Certificate.Template.flags
Parameter.Certificate.Template.pKIExtendedKeyUsage	Certificate.Template.pKIExtendedKeyUsage
Parameter.Certificate.Template.pKIKeyUsage	Certificate.Template.pKIKeyUsage
Parameter.Certificate.Template.pKIMaxIssuingDepth	Certificate.Template.pKIMaxIssuingDepth
Parameter.Certificate.Template.pKIDefaultKeySpec	Certificate.Template.pKIDefaultKeySpec
Parameter.Certificate.Template.pKIDefaultCSPs	Certificate.Template.pKIDefaultCSPs
Parameter.Certificate.Template.pKICriticalExtensions	Certificate.Template.pKICriticalExtensions
Parameter.Certificate.Template.msPKI-RA-Signature	Certificate.Template.msPKI-RA-Signature
Parameter.Certificate.Template.msPKI-Minimal-Key-Size	Certificate.Template.msPKI-Minimal-Key-Size
Parameter.Certificate.Template.msPKI-Template-Cert-Template-OID	Certificate.Template.msPKI-Template-Cert-Template-OID
Parameter.Certificate.Template.msPKI-RA-Policies	Certificate.Template.msPKI-RA-Policies
Parameter.Certificate.Template.msPKI-RA-Application-Policies	Certificate.Template.msPKI-RA-Application-Policies
Parameter.Certificate.Template.msPKI-Certificate-Application-Policy	Certificate.Template.msPKI-Certificate-Application-Policy
Parameter.Certificate.Template.msPKI-Enrollment-Flag	Certificate.Template.msPKI-Enrollment-Flag
Parameter.Certificate.Template.msPKI-Private-Key-Flag	Certificate.Template.msPKI-Private-Key-Flag
Parameter.Certificate.Template.msPKI-Certificate-Policy	Certificate.Template.msPKI-Certificate-Policy
Parameter.Certificate.Template.msPKI-Certificate-Name-Flag	Certificate.Template.msPKI-Certificate-Name-Flag
Parameter.Certificate.Template.msPKI-Template-Schema-Version	Certificate.Template.msPKI-Template-Schema-Version

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Parameter	Initializes ...
Parameter.Certificate.Template.revision	Certificate.Template.revision
Parameter.Certificate.Template.msPKI-Template-Minor-Revision	Certificate.Template.msPKI-Template-Minor-Revision
Parameter.Certificate.Template.cn	Certificate.Template.cn
Parameter.IsRenewalRequest	IsRenewalRequest
Parameter.CertificateToBeRenewed	CertificateToBeRenewed
Parameter.RACertificates	RACertificates

2. Determine the request type as specified in section 3.1.2.4.2.1.
3. Create a certificate request as specified in section 3.1.2.4.2.2.
4. Set the Request output parameter to the certificate request generated in the previous step.

3.2 Server Role

The server implements the interfaces as specified in sections 3.2.1 and 3.2.2 of this protocol specification.

- The server MUST implement a CA policy algorithm as described in section 3.2.1.4.2.1.4.4 or section 3.2.2.6.2.1.4.
- The server MUST implement the standalone CA mode functionality specified in section 3.2.1 (except for section 3.2.1.4.3).
- The server SHOULD implement the ICertRequestD2 interface as specified in section 3.2.1.4.3.<59> See section 1.7 on how clients determine what interface is supported by the server.
- The server SHOULD implement **enterprise CA** mode functionality. If the server implements multiple CA modes, then it MUST implement customer selection of a mode.<60>
- The server MAY implement one or more CA exit algorithms as described in section 3.2.1.4.2.1.4.8.
- The server MAY implement key archival, making it an advanced CA.<61>
- The server SHOULD return properties on its implementation by implementing ICertRequestD::GetCACert and ICertRequestD2::GetCAProperty methods as specified in sections 3.2.1.4.2.2 and 3.2.1.4.3.2, respectively.

The following sections describe the server modes:

- Server Mode: Standalone CA: This mode is a server to the Windows Client Certificate Enrollment Protocol that implements the minimum required server functionality. This mode is specified in section 3.2.1.
- Server Mode: Enterprise CA: This mode is a server to the Windows Client Certificate Enrollment Protocol that integrates with Active Directory and uses certificate templates [MS-CRTD] for its CA policy algorithm. This mode is specified in section 3.2.2.

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3.2.1 Server Mode: Standalone CA

3.2.1.1 Abstract Data Model

This section describes a conceptual model of data organization that a possible implementation would maintain to participate in this protocol. The described organization is provided to facilitate understanding of how the protocol behaves. This specification does not mandate that implementations adhere to this model, as long as their external behavior is consistent with the behavior described in this specification.

CA_DNS_Domain_Name: The fully qualified domain name (FQDN) (1) for the domain to which the CA belongs. This ADM element is shared with **DomainName.FQDN** ([MS-DISO] section 4.3.1.1).

CA_Client_Name: A string that contains the CA account name. This ADM element is shared with **ClientName** ([MS-DISO] section 4.3.1.1).

CA_Account_Name: A string that contains the security account name under which CA is running. For more information on how this ADM is initialized, see section 3.2.1.3.

CA_SID: Contains the SID of the CA account.

Per_Request: A collection of ADM elements which are initialized per each certificate request and are only valid during the processing of that request. This collection contains two elements:

Per_Request.Caller_Account_Name: A string that contains the caller's account name.

Per_Request.Caller_SID: Contains the SID (section 2.4.2), as specified in [MS-DTYP] section 2.4.2, of the end entity (EE) that requested a certificate from CA.

Note that some of the elements of this section are used by servers implementing the [MS-CSRA] protocol.

Note The abstract interface notation (Public) indicates that this abstract data model element can be directly accessed from outside this protocol.

3.2.1.1.1 Request Table

The Request table is identical to the Request table specified in [MS-CSRA] section 3.1.1.1.

The table columns of the Request table specified in [MS-CSRA] and used by this protocol are as specified in sections 3.2.1.1.1.1 and 3.2.1.1.1.2.

3.2.1.1.1.1 Request Table Required Data Elements

Values for the following elements are required in the Request table:

- Request_Request_ID
- Request_Raw_Request
- Request_Disposition
- Request_Raw_Archived_Key
- Serial_Number

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3.2.1.1.1.2 Request Table Optional Data Elements

Values for the following elements of the Request table SHOULD be maintained by the CA:

- Request_Raw_Old_Certificate
- Request_Request_Attributes
- Request_Request_Type
- Request_Request_Flags
- Request_Status_Code
- Request_Disposition_Message
- Request_Submitted_When
- Request_Resolved_When
- Request_Requester_Name
- Request_Caller_Name
- Request_Signer_Policies
- Request_Signer_Application_Policies
- Request_Officer
- Request_Distinguished_Name
- Request_Raw_Name
- Request_Country
- Request_Organization
- Request_Org_Unit
- Request_Common_Name
- Request_Locality
- Request_State
- Request_Title
- Request_Given_Name
- Request_Initials
- Request_SurName
- Request_Domain_Component
- Request_Email
- Request_Street_Address

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- Request_Unstructured_Name
- Request_Unstructured_Address
- Request_Device_Serial_Number
- Request_Key_Recovery_Hashes
- Request_Attestation_Challenge
- Request_Endorsement_Key_Hash
- Request_Endorsement_Certificate_Hash

3.2.1.1.2 Signing_Cert Table

The Signing_Cert table maintains an ordered list of CA private key and associated other data, including public key certificates. The data is maintained in the following columns.

Column name	Column description
Signing_Cert_Certificate (Public)	Contains the CAcertificate.
Signing_Private_Key (Public)	Contains the private key associated with the CAcertificate stored in the **CA_Signing_Cert** column.
Signing_Cert_Version_ID (Public)	A unique identifier for the CA signing certificate stored in the **CA_Signing_Cert** column.
Signing_Private_Key_Version_ID (Public)	An identifier (not unique) for the private key stored in the **CA_Signing_Private_Key** column.
Signing_Forward_Cross_Certificate (Public)	The **forward cross certificate**. This column does not have a value for the last raw of the table, or when a certificate stored in the Signing_Cert_Certificate column of this raw and next raw have the same associated public-private key pair. For more information, see [MSFT-CROSSCERT].
Signing_Backward_Cross_Certificate (Public)	The **backward cross certificate**. This column does not have a value for the first raw of the table or when a certificate stored in the Signing_Cert_Certificate column of this raw and previous raw have the same associated public-private key pair. For more information, see [MSFT-CROSSCERT].

The Signing_Cert_Certificate in the last row of the Signing_Cert table is the current CA signing certificate.

3.2.1.1.3 CRL Table

The CRL table is identical to the one specified in [MS-CSRA] section 3.1.1.4. The columns used by this protocol are as follows:

- CRL_Row_Id
- CRL_Name_Id
- CRL_Raw_CRL

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- Base_Or_Delta
- CRL_Publish_Status_Code
- Publish_Date

3.2.1.1.4 Configuration List

The following list contains configuration data for the CA. Server implementations that also implement the Certificate Services Remote Administration protocol specified in [MS-CSRA] or the ICertPassage Remote Protocol specified in [MS-ICPR] use the same configuration data elements, defined here as "public", for those implementations. If either Certificate Services Remote Administration Protocol or ICertPassage Remote Protocol or both are also implemented, access to the configuration list from either or both of these protocols SHOULD be serialized.

Data name	Data description
Config_CA_KRA_Cert_List (Public)	An indexed list of KRA certificates.
Config_CA_KRA_Cert_Count (Public)	The minimum amount of valid KRA certificates required to archive a key.
Config_SKU	Data that specifies the operating system SKU. Possible values are Advanced_SKU and Standard_SKU.<62>
Config_Configuration_Directory (Public)	A UNC path that can be used to publish server data.
Config_Max_Property_ID	An integer that defines the greatest number that a client can pass in the PropID parameter of the **GetCAProperty** method.
Config_FQDN	The fully qualified domain name (FQDN) of the machine hosting the CA service.
Config_CA_Role_Separation (Public)	Indicates the role separation state. Possible values are as follows: Role_Separation_Enabled Role_Separation_Disable
Config_CA_Parent_DNS (Public)	The FQDN of the parent CA.
Config_CA_Exchange_Cert (Public)	List of **SHA-1 hash** values of all currently valid CA exchange certificates used to protect private keys in certificate requests.
Current_CA_Exchange_Cert	x.509 certificate that is the current CA exchange certificate.
Store_CA_Exchange_Cert	List of x.509 certificates that is the current set of valid CA exchange certificates.
Config_CA_CDP_Publish_To_Base (Public)	A list of one or more CRL Publishing

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Data name	Data description
	Locations to which the CA is configured to publish base CRLs. This data is used in [MS-CSRA].
Config_CA_CDP_Publish_To_Delta (Public)	A list of one or more CRL Publishing Locations to which the CA is configured to publish delta CRLs. This data is used in [MS-CSRA].
Config_CA_CDP_Include_In_Cert (Public)	The list of strings to be added as UNC paths into the CDP extension of all certificates issued, with the key associated with the certificate in the CASigningCert column. CDP is specified in [RFC3280] section 4.2.1.14.
Config_CA_CDP_Include_In_CRL_Publish_Locations_Extension (Public)	A list of one or more CRL Publishing Locations that will be included in the Published CRL Locations custom extension of CRLs created by the CA. This data is used in [MS-CSRA].
Config_CA_CDP_Include_In_CRL_Freshest_CRL_Extension (Public)	A list of one or more delta CRL Publishing Locations that will be included in the freshest CRL extension of base CRLs created by the CA. This data is used in [MS-CSRA].
Config_CA_CDP_Include_In_CRL_IDP_Extension (Public)	A list of one or more CRL Publishing Locations that will be included in the Issuing Distribution Point CRL extension of CRLs created by the CA. This data is used in [MS-CSRA].
Config_CA_AIA_Include_In_Cert (Public)	The list of strings to be added as UNC paths into the AIA extension of all certificates issued, with the key associated with the certificate in the CASigningCert column. AIA is specified in [RFC3280] section 4.2.2.1.
Config_CA_OCSP_Include_In_Cert (Public)	The list of strings to be added as OCSP paths into the (Authority Information Access) AIA extension of all certificates issued, with the key associated with the certificate in the CASigningCert column. The Online Certificate Status Protocol (OCSP) UNC path is specified in [RFC2560] section 4.2.2.1.
Config_File_Version	Stores information on the CA service file.
Config_Product_Version (Public)	Stores information on the product hosting the CA service.
Config_Database_View_Open (Public)	Indicates whether a caller has opened a view to the database. This data has two possible values: True and False. This data

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Data name	Data description
	is used by methods specified in [MS-CSRA].
Config_Permissions_CA_Security (Public)	A list of administrator-defined rights of designated **principals** to administer the CA. The CA security information is configured with the **SetCASecurity** method and retrieved with the **GetCASecurity** method specified in [MS-CSRA].
Config_Permissions_Officer_Rights (Public)	A list of administrator-defined rights possessed by each CA officer to approve certificate requests associated with a given set of principles. Officer rights are set with the **SetOfficerRights** method and retrieved with the **GetOfficerRights** method specified in [MS-CSRA].
Config_Permissions_Enrollment_Agent_Rights (Public)	A list of administrator-defined rights possessed by each **enrollment agent (EA)** to obtain a certificate, with subject information pertaining to a different principal, from a CA. Enrollment agent is not one of the roles defined in [CIMC-PP]. Like Officer rights, Enrollment Agent rights are set with the **SetOfficerRights** method and retrieved with the **GetOfficerRights** method specified in [MS-CSRA].
Config_Base_CRL_Validity_Period (Public)	Contains the validity period of the base CRL.
Config_Base_CRL_Overlap_Period (Public)	Contains the overlap period of the base CRL.
Config_Delta_CRL_Validity_Period (Public)	Contains the validity period of a delta CRL.
Config_Delta_CRL_Overlap_Period (Public)	Contains the overlap period of a delta CRL.
Config_CA_Policy_Algorithm_Implementation (Public)	Information on the algorithm that implements the CA policy algorithm.
Config_CA_Exit_Algorithm_Implementation_List (Public)	Information on the algorithms that implement the CA exit algorithm.
Config_CA_Exit_Count (Public)	The number of exit algorithms registered on the CA.
Config_CA_Exit_Description_List	An indexed list that contains a description for all registered CA exit algorithms.
Config_CA_Policy_Description	A string that describes the CA policy algorithm.

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Data name	Data description
Config_CA_Accept_Request_Attributes_ValidityTime (Public)	A Boolean value that indicates whether the CA accepts request attributes that specify the validity time for the certificate being requested.
Config_CA_Accept_Request_Attributes_Extensions (Public)	A Boolean value that indicates whether the CA accepts request attributes that specify certificate enhanced key usage (EKU) extensions to be added to the certificate being requested.
Config_CA_Accept_Request_Attributes_SAN (Public)	A Boolean value that indicates whether the CA accepts request attributes that specify the subject alternative name for the certificate being requested.
Config_CA_Accept_Request_Attributes_Other (Public)	A Boolean value that indicates whether the CA accepts 'Other' request attribute specified in section 2.2.2.7.10.
Config_CA_Accept_Request_Attributes_CertPath (Public)	A Boolean value that indicates whether the CA accepts request attributes that specify the subject name for the certificate being requested.
Config_CA_Clock_Skew_Minutes (Public)	Contains the number of minutes used in CA calculations to account for differences in system time across machines.
Config_CA_No_OCSP_Revocation_Check	A Boolean flag that indicates whether the CA honors the CT_FLAG_ADD_OCSP_NOCHECK flag of the certificate template, as specified in section 3.2.2.6.2.1.4.5.6.
Config_CA_Allow_RenewOnBehalfOf_Requests (Public)	A Boolean flag that indicates whether the CA allows requests as specified in section 3.2.2.6.2.1.2.4.
Config_CA_Interface_Flags (Public)	A set of flags which implementers can use to affect server behavior. The defined values are as follows: **IF_NOREMOTEICERTREQUEST**: The CA will not issue any certificates or hold pending any requests for remote users. **IF_NOLOCALICERTREQUEST**: The CA will not issue any certificates or hold pending any requests for local users. **IF_NORPCICERTREQUEST**: The CA will not issue any certificates or hold pending any requests for callers using the ICertPassage interface, as specified in [MS-ICPR] section 3.2.4.1. **IF_NOREMOTEICERTADMIN**: No access to CSRA methods for remote callers.

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Data name	Data description
	IF_NOLOCALICERTADMIN: No access to CSRA methods for local callers. **IF_NOREMOTEICERTADMINBACKUP**: The CA restricts access to the backup-related methods of this protocol for remote callers. **IF_NOLOCALICERTADMINBACKUP**: The CA restricts access to the backup-related methods of this protocol for local callers. **IF_NOSNAPSHOTBACKUP**: The database files cannot be backed up using a mechanism other than the methods of this interface. **IF_ENFORCEENCRYPTICERTREQUEST**: RPC_C_AUTHN_LEVEL_PKT_PRIVACY, as defined in [MS-RPCE] section 2.2.1.1.8, should be defined for all RPC connections to the server for certificate-request operations. **IF_ENFORCEENCRYPTICERTADMIN**: RPC_C_AUTHN_LEVEL_PKT_PRIVACY, as defined in [MS-RPCE] section 2.2.1.1.8, should be defined for all RPC connections to the server for certificate administrative operations (the methods defined in this interface). **IF_ENABLEEXITKEYRETRIEVAL**: Enables an exit algorithm to retrieve the Encrypted private-Key Blob. **IF_ENABLEADMINASAUDITOR**: Only CA administrators can update the CA audit filter settings.
Config_High_Serial_Number (Public)	A 4-byte integer used in generating certificate serial numbers. See section 3.2.1.4.2.1.4.5 about how certificate serial numbers are generated.
Config_High_Serial_String (Public)	A string value used in generating certificate serial numbers. See section 3.2.1.4.2.1.4.5 about how certificate serial numbers are generated.
Config_CA_Requests_Disposition (Public)	A 4-byte integer that indicates whether the CA sets all requests to pending, accepts all requests, or denies all requests. The value is the bitwise OR of the following: ▪ 0x00000100 (REQDISP_PENDINGFIRST): The CA MUST set all certificate requests to pending. ▪ 0x00000001 (REQDISP_ISSUE): The

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Data name	Data description
	CA MUST issue all certificate requests. ▪ 0x00000002 (REQDISP_DENY): The CA MUST deny all certificate requests.
Config_CA_LDAP_Flags	A 1-byte integer that indicates which port is used for connecting to LDAP servers and whether to sign the requests sent to the LDAP server or not. The value is the bitwise OR of the following: ▪ 0x00000001(LDAPF_SSLENABLE): The CA MUST connect to SSL port of the LDAP server. ▪ 0x00000002 (LDAPF_SIGNDISABLE): The CA MUST NOT sign the requests sent to LDAP server.
Config_Disable_LDAP_Sign_Encrypt	A flag that indicates whether LDAP queries for CRL retrievals will be signed and encrypted or not.
Config_Max_Number_Of_AD_Connections	A 4-byte integer that indicates the maximum number of cached **ADConnection** handles.
Config_AD_Connection_Referral	A flag that indicates whether the referral option for **ADConnection** is set to TRUE.
Config_Endorsement_Key_List_Directories (Public)	A list of one or more UNC or local file paths, each pointing to a folder that contains a 0-size file where the name of the file is the SHA2 hash of the EKPub. The CA has read access to this location. See also [MS-CSRA] section 3.1.1.10.

3.2.1.2 Timers

The CA server uses a CRL retrieval timer to ensure that the response time from the server hosting CRLs does not exceed 15 seconds. The CRL retrieval timer is specified per CRL retrieval request and is used in the processing steps for obtaining a CRL, as specified in section 3.2.1.4.1.3.

3.2.1.3 Initialization

- Interface Initialization: DCOM **object** and interface initialization is performed by the DCOM object exporter in response to an activation request from the DCOM client. The Windows Client Certificate Enrollment Protocol client calls the DCOM client to initiate the activation request to the server. As a result, the DCOM server returns an object reference to the DCOM client, and the Windows Client Certificate Enrollment Protocol client can use this client object reference to make calls to the Windows Client Certificate Enrollment Protocol server methods specified in this document. The CA MUST initializes the object exporter as specified in [MS-DCOM] section 3.1.1.3. If Config_CA_Interface_Flags contains the values IF_NOREMOTEICERTREQUEST and IF_NOLOCALICERTREQUEST, the CA MUST NOT initialize the object exporter. The details of

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DCOM object initialization on the server, in response to client activation requests and ORPCs, are specified in [MS-DCOM] sections 3.1.1.5.1 and 3.1.1.5.4.

- Cryptographic Initialization: The CA MUST have access to the signing and exchange private keys. In addition, the CA SHOULD validate the CA signing certificate and its chain. The validation MUST be based on chain validation as specified in [RFC3280].
- Revocation Initialization: The CA SHOULD verify the validity of the last published base and delta CRL and publish new ones if required; the behavior MUST be as specified in [RFC3280].
- Configuration Initialization: The CA SHOULD initialize the Configuration List (section 3.2.1.1.4) as specified in [MS-CSRA] section 3.1.3.
- The CA SHOULD initialize ADM elements **CA_Account_Name** and **CA_SID** by invoking the processing rules in section 3.2.1.4.1.1, setting the **CA_Account_Name** equal to the **OutputAccountName** output parameter, and setting the **CA_SID** equal to the **OutputSID** output parameter.

3.2.1.4 Message Processing Events and Sequencing Rules

The Windows Client Certificate Enrollment Protocol defines the following interfaces for the server role.

Interface	Meaning
ICertRequestD	Defines methods that enable a client to request certificates from a certificate authority.
ICertRequestD2	Inherits and extends the **ICertRequestD** interface.

The return value for each method in these two interfaces is a signed 32-bit value per the definition of HRESULT, as specified in [MS-ERREF]. If the method returns a negative value, the method has failed.

Many of the DCOM methods defined in this section are made available for non-protocol functions, such as diagnostics.

3.2.1.4.1 Algorithms

In addition to the algorithms specified in section 3.1.1.4.1 and its subsections, the Server Mode: StandaloneCA protocol role uses the algorithms in the following sections.

3.2.1.4.1.1 AccountGetInfo Abstract Interface

The AccountGetInfo abstract interface retrieves the name of the user or other security principal associated with the current execution context.

Input Parameters: None.

Output Parameters:

OutputAccountName: A string that contains the security account name under which CA is running.

OutputSID: The SID of the security account name under which CA is running.

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Processing Rules:

In the following steps, the following local variable is used:

CallerToken: A token/authorization context (section 2.5.2). For more information see [MS-DTYP] section 2.5.2.

- If the CA is running on a computer joined to a domain:
  - Set the **OutputAccountName** output parameter equal to a string that contains the name of the user or other security principal associated with the current execution context of the CA. The string is the concatenation of the **CA_DNS_Domain_Name** ADM element, "\", and the **CA_Client_Name** ADM element.
  - Invoke the processing rules specified in [MS-DTYP] section 2.7.3 and store the returned value in **CallerToken**. Set the **OutputSID** output parameter equal to the CallerToken.Sids[CallerToken.UserIndex].
- Else, set the **OutputAccountName** output parameter equal to a legacy account name of the form "Engineering\JSmith" or, in the case of a machine account,"workgroup\ComputerName$". Also, set the **OutputSID** output parameter to NULL.

3.2.1.4.1.2 Retrieving Caller Identity Information

The processing rules in this section return the identity of the caller in the form of {Domain\UserName}, and they also return the SID of the caller.

Input Parameters: None.

Output Parameters:

Output_Account_Name: The caller's account name in the form of <domain netbios name>\<account name> for the caller.

Output_SID: The SID of the caller.

Processing Rules:

The caller identity is in the form {Domain\UserName}. The domain and UserName are found as follows:

1. Call Abstract Interface GetRpcImpersonationAccessToken (section 3.3.3.4.3.1) as specified in [MS-RPCE] section 3.3.3.4.3.1, passing NULL as a parameter to obtain the token of the current thread as specified in [MS-RPCE] section 3.3.3.4.3.1, and use the output parameter *RpcImpersonationAccessToken* in the following steps.
2. Call **LsarOpenPolicy (section 3.1.4.2)** as specified in [MS-LSAT] section 3.1.4.2 with the following as input:
   - SystemName: NULL.
   - DesiredAccess: Contains the bit value 0x00000800 for POLICY_LOOKUP_NAMES.
3. Call **LsarLookupSids (section 3.1.4.11)** as specified in [MS-LSAT] section 3.1.4.11 on the returned PolicyHandle.
   - PolicyHandle: The PolicyHandle returned from the aforementioned **LsarOpenPolicy**.

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- SidEnumBuffer: The **SidInfo** part of this structure contains the SID returned from the element RpcImpersonationAccessToken.Sids[RpcImpersonationAccessToken.UserIndex] as specified in [MS-RPCE] section 3.3.3.4.3. The **Entries** part of this structure is set to 1.
- LookupLevel: Set to LsapLookupWksta.

The return values from the **LsarLookupSids** are as follows:

- ReferencedDomains list: The domain name is found in the **Name** field of the **Domains** structure of the list entry whose index matches the DomainIndex of the **Names** structure of the entry in the TranslatedNames list that corresponds to the SID in question.
- TranslatedNames: Contains the UserName in the **Name** field of the **Names** structure of the entry in the list corresponding to the SID in question (from the SidEnumBuffer input list).

4. Concatenate the Domain name and UserName returned in previous steps using "\" as Domain\UserName, and store it in the output parameter **Output_ Account_Name**.
5. Store the element RpcImpersonationAccessToken.Sids[RpcImpersonationAccessToken.UserIndex] as specified in [MS-RPCE] section 3.3.3.4.3 in the output parameter **Output_SID**.

3.2.1.4.1.3 Retrieving CRLs

The CA uses the cRLDistributionPoints extension (specified in [RFC3280] section 4.2.1.14) of the *ParameterCertificate* parameter to retrieve CRLs. The CA MUST be able to retrieve the CRLs that are published using HTTP [RFC2616] or LDAP [RFC2251]. The CA SHOULD NOT support retrieving CRLs that are published using FTP [RFC959].

Input parameter: None.

ParameterCertificate: The certificate for which the CRL needs to be retrieved.

Output parameter: None.

ParameterCRL: The retrieved CRL

Processing rules:

The CA MUST obtain the CRLs in the following manner:

If the cRLDistributionPoints extension has multiple DistributionPoints, retrieve the CRLs from the cRLDistributionPoints in the order in which they are encoded in the extension. For each DistributionPoint, obtain CRLs by using cRLDistributionPoints extension, as specified in [RFC3280] section 4.2.1.14, of the certificate passed in the *ParameterCertificate* parameter to retrieve CRLs as follows:

1. If the URL in cRLDistributionPoints extension is an LDAP URL:
    1. The CA SHOULD follow the processing rules in section 3.2.1.4.1.3.1 for retrieving CRLs.
    2. If the retrieval attempt is successful from the current DistributionPoint, set the ParameterCRL output parameter to the retrieved CRL and exit.
    3. If the retrieval is not successful, move to the next DistributionPoints.
2. If the URL in cRLDistributionPoints extension is an HTTP URL:
    1. The CA MUST initialize the CRL retrieval timer to 15 seconds.

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2. The CA MUST follow the processing rules in [RFC2616] for retrieval.

3. If the retrieval attempt is successful from the current DistributionPoint, set the **ParameterCRL** output parameter to the retrieved CRL, cancel the CRL retrieval timer, and exit.

4. If the retrieval is not successful, move to the next DistributionPoints component, cancel the CRL retrieval timer, and go to step 1.

5. If the CRL retrieval timer times out before retrieving the CRL from the current DistributionPoint, move to the next DistributionPoint component of the cRLDistributionPoints extension.

3. If all DistributionPoints components in cRLDistributionPoints extension have been examined, return empty as the **ParameterCRL** output parameter and exit.

3.2.1.4.1.3.1 Search Requests for Retrieving CRLs from Active Directory

This type of search request is used to read CRLs from Active Directory using the LDAP URI provided in the DistributionPoint component of the cRLDistributionPoints extension. In the sections that follow, the following local variable is used:

ActiveDirectory_Connection: An ADConnection handle (see [MS-ADSO] section 6.2.2) for more information about ADConnection.

3.2.1.4.1.3.1.1 Search Requests

The CA SHOULD perform a search request as follows:

1. Invoke the "Initialize ADConnection" task ([MS-ADSO] section 6.2.6.1.1) to construct an **ADConnection** handle, with the following parameters:

   - *TaskInputTargetName*: The <host> part of the LDAP URI in DistributionPoint. If <host> part is not present, set it to NULL.

   - *TaskInputPortNumber*: If the port number is provided in the LDAP URI in DistributionPoint, URI, use it; otherwise use 389.

   Store the created **ADConnection** handle in the **ActiveDirectory_Connection** variable.

2. Perform a bind request as specified in section 3.2.1.4.1.3.1.2.

3. Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:

   - *TaskInputADConnection*: **ActiveDirectory_Connection**

   - *TaskInputRequestMessage*: LDAP SearchRequest message ([RFC2251] section 4.5.1), as follows:

     - baseObject: If the baseObject is provided in the LDAP URI in DistributionPoint, use it. If not, set it to EMPTY string.

     - scope: Use the provided scope in URI. If not present in URI, set it to baseObject

     - filter: Use the provided filter in URI. If not present in URI, use (objectClass=*)

     - attributes: Use the provided filter in URI. If not present in URI, set it to NULL

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- derefAliases: neverDerefAliases
- typesOnly: FALSE

- *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search.

4. If the *TaskReturnStatus* returned is not 0, then:

   1. Invoke the "Perform an LDAP Unbind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set equal to **ActiveDirectory_Connection**.

   2. Perform steps 1 and 2 in section 3.2.1.4.1.3.1.2 with the exception that in step 1, use the following parameters:

      - *TaskInputOptionName*: LDAP_OPT_GETDSNAME_FLAGS
      - *TaskInputOptionValue*: Bitwise OR of the bits A, D, and R defined by [MS-NRPC] section 3.5.4.3.1

      If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte HRESULT value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

      - **InputReturnStatus**: *TaskReturnStatus*
      - **InputResultMessage**: NULL

      Return the **OutputHRESULT** output parameter to the client and exit.

   3. Repeat step 3.

   4. If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte HRESULT value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

      - **InputReturnStatus**: *TaskReturnStatus*
      - **InputResultMessage**: *TaskOutputResultMessages*

3.2.1.4.1.3.1.2 Bind Requests

Bind requests are used to connect and to authenticate the user to an LDAP directory. The CA MUST perform bind requests as follows:

1. Invoke the "Setting an LDAP Option on an ADConnection" task ([MS-ADSO] section 6.2.6.1.2) once for each of the following pairs of option and value parameters. For each of these, the TaskInputADConnection parameter is the **ActiveDirectory_Connection**.

TaskInputOptionName	TaskInputOptionValue
LDAP_OPT_GETDSNAME_FLAGS	Bitwise OR of the bits D and R defined by [MS-NRPC] section 3.5.4.3.1
LDAP_OPT_SIGN	If Config_Disable_LDAP_Sign_Encrypt is not set, set to TRUE
LDAP_OPT_REFFERALS	If Config_AD_Connection_Referral ADM element is FALSE, set

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TaskInputOptionName	TaskInputOptionValue
	to FALSE
LDAP_OPT_PROTOCOL_VERSION	3
LDAP_OPT_ ENCRYPT	If Config_Disable_LDAP_Sign_Encrypt is not set, set to TRUE
LDAP_OPT_TIMELIMIT	15

2. Invoke the "Establishing an ADConnection" task ([MS-ADSO] section 6.2.6.1.3) with the following parameters:

   TaskInputADConnection: **ActiveDirectory_Connection**

3. If the *TaskReturnStatus* returned is not 0,

   - Repeat step 1 with the following modification:
     - *TaskInputOptionName*: LDAP_OPT_GETDSNAME_FLAGS
     - *TaskInputOptionValue*: Bitwise OR of the bits A, D and R defined by [MS-NRPC] section 3.5.4.3.1.
   - Repeat step 2.
   - If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte HRESULT value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:
     - **InputReturnStatus**: *TaskReturnStatus*
     - **InputResultMessage**: NULL

     Return the **OutputHRESULT** output parameter to the client and exit.

4. Invoke the "Performing an LDAP Bind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.4) with the following parameter:

   - *TaskInputADConnection*: **ActiveDirectory_Connection**

   If successful, exit.

5. If the *TaskReturnStatus* returned is not 0, repeat step 1 with this additional option:

   - *TaskInputOptionName*: LDAP_OPT_AUTH_INFO
   - *TaskInputOptionValue*:
     - bindMethod: SIMPLE ([MS-ADTS] section 5.1.1.1)
     - name: NULL
     - password: NULL

6. Invoke the "Performing an LDAP Bind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.4) with the following parameters:

   - *TaskInputADConnection*: **ActiveDirectory_Connection**

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If successful, exit.

7. If the *TaskReturnStatus* returned is not 0, repeat step 1 with this additional option:

   - *TaskInputOptionName*: LDAP_OPT_PROTOCOL_VERSION
   - *TaskInputOptionValue*: 2

8. Invoke the "Performing an LDAP Bind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.4) with the following parameters:

   - *TaskInputADConnection*: **ActiveDirectory_Connection**

   If successful, exit.

9. If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte HRESULT value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

   - **InputReturnStatus**: *TaskReturnStatus*
   - **InputResultMessage**: NULL

   Return the **OutputHRESULT** output parameter to the client and exit.

3.2.1.4.2 ICertRequestD

The **ICertRequestD** DCOM interface exposes a set of methods that allow the client to request the services provided by the CA. The **ICertRequestD** interface MUST inherit the IRemUnknown interface. IRemUnknown is specified in [MS-DCOM] section 3.1.1.5.6.

The version number for this interface is "1.0". The UUID for this interface is "D99E6E70-FC88-11D0-B498-00A0C90312F3", as specified in [MS-DCOM].

Methods in RPC Opnum Order

Method	Description
Request	Initiates the certificate issuance process. Opnum: 3
GetCACert	Returns property values on the CA. Opnum: 4
Ping	Performs a request response test (ping) to the CA. Opnum: 5

Note **Opnums** 0, 1, and 2 are reserved for the **IUnknown_QueryInterface**, **AddRef**, and **Release** methods used by the standard COM IUnknown interface, as specified in [MS-DCOM].

3.2.1.4.2.1 ICertRequestD::Request (Opnum 3)

The Request method initiates the **certificate issuance** process.

```
HRESULT Request(
  [in] DWORD dwFlags,
```


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```
    [in, string, unique] const wchar_t* pwszAuthority,
    [in, out, ref] DWORD* pdwRequestId,
    [out] DWORD* pdwDisposition,
    [in, string, unique] const wchar_t* pwszAttributes,
    [in, ref] const CERTTRANSBLOB* pctbRequest,
    [out, ref] CERTTRANSBLOB* pctbCertChain,
    [out, ref] CERTTRANSBLOB* pctbEncodedCert,
    [out, ref] CERTTRANSBLOB* pctbDispositionMessage
  );
```

dwFlags: This field MUST contain packed data as specified in section 3.2.1.4.3.1.1. The data in this field MUST define the structure of the *pctbRequest* parameter and the expected content in *pctbCertChain*.

pwszAuthority: A null-terminated [UNICODE] string that contains the name of the CA.

pdwRequestId: A 32-bit integer value that contains the identifier used to identify the request. Details about processing information are specified in section 3.1.1.4.3.

pdwDisposition: An unsigned integer that identifies the request status for this invocation. The value MUST be one of the following:

- CR_DISP_ISSUED, 0x00000003: The requested certificate was issued.
- CR_DISP_UNDER_SUBMISSION, 0x00000005: The requested certificate was not issued and is now in a pending state waiting for additional processing before it can be issued.
- A nonzero value, excluding 0x00000003 and 0x00000005, indicating an error.

pwszAttributes: A null-terminated [UNICODE] string that contains a set of request attributes. The parameter contains zero or more request attributes, which MUST be empty or take the form of name/value pairs. The name/value pairs MUST be formatted as "Name:Value". A colon MUST be the separator, and a new line ('\n') MUST separate name/value pairs.

pctbRequest: A **CERTTRANSBLOB** structure that contains a certificate request as a raw binary object. This request binary object can be in one of a number of formats. The format used is specified in the *dwFlags* parameter. The syntax of that structure is provided in section 2.2.2.8.

pctbCertChain: A **CERTTRANSBLOB** structure that is empty or contains a simple CMS or a CMC full PKI response for the certificate chain issued by the CA based on the request (in the *pctbRequest* parameter) supplied by the caller. The parameter format is as requested by the client in the *dwFlags* parameter. Message syntax MUST be as specified in section 2.2.2.2.

pctbEncodedCert: A **CERTTRANSBLOB** structure that is empty or contains the issued certificate. The returned value MUST be an X509 cert encoded by using DER, as specified in [X660]. Message syntax MUST be as specified in section 2.2.2.2.

pctbDispositionMessage: A **CERTTRANSBLOB** structure that contains a null-terminated [UNICODE] string with a message that identifies the status of the request. Message syntax MUST be as specified in section 2.2.2.2.

Return Values: The method MUST return zero unless otherwise explicitly stated in this section. The server MUST return errors through the *pdwDisposition* parameter.

This section, and the following sections, describe the processing rules for **ICertRequestD::Request** and **ICertRequestD2::Request2**.

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The following is an overview of the CA processing rules for these methods:

The CA MUST obtain the end entity account name and SID by performing the processing rules in section 3.2.1.4.1.2 and storing the returned **Output_Account_Name** in the **Per_Request.Caller_Account_Name** ADM element and the returned **Output_SID** in **Per_Request.Caller_SID**.

If Config_CA_Interface_Flags contains the value IF_NOREMOTEICERTREQUEST, the server SHOULD return 0x80094011 (CERTSRV_E_ENROLL_DENIED) to the client.<63>

If Config_CA_Interface_Flags contains the value IF_ENFORCEENCRYPTICERTREQUEST and the RPC_C_AUTHN_LEVEL_PKT_PRIVACY authentication level, as defined in [MS-RPCE] section 2.2.1.1.8, is not specified on the RPC connection from the client, the CA MUST refuse to establish a connection with the client by returning a nonzero error.

1. The CA MUST verify the CA name passed in the *pwszAuthority* attribute by invoking the processing rules in section 3.2.1.4.2.1.1 with the *CANameString* input parameter set to the CA name passed in the *pwszAuthority* parameter and the *EmptyNameAllowed* input parameter set to false. If false is returned, the CA MUST return the E_INVALIDARG (0x80070057) error code to the client.

2. The CA MUST parse attributes passed in *pwszAttributes* parameter as specified in section 3.2.1.4.2.1.2.

3. The CA MUST check if the request is a status inspection as specified in section 3.2.1.4.2.1.3 and process it accordingly if it is. If it is not, it is a new or renewal request and the CA MUST proceed to the following steps.

4. If the value of the *pdwRequestId* parameter is 0, the CA MUST process the request BLOB as specified in section 3.2.1.4.2.1.4.

5. The CA MUST store the request fields in the Request table as specified in sections 3.2.1.4.2.1.4.3 and 3.2.1.4.2.1.4.4.

6. The CA MUST call its CA policy algorithm implementation as specified in section 3.2.1.4.2.1.4.4.

7. If the CA policy algorithm implementation decided to issue a certificate, then the CA MUST sign the certificate as specified in section 3.2.1.4.2.1.3.

8. If the CA policy algorithm implementation decided to issue a certificate, then the CA MUST follow the post processing rules as specified in section 3.2.1.4.2.1.4 and construct the certificate as specified in section 3.2.1.4.2.1.4.6.

9. The CA MUST set the following values for the out parameters:

   - pdwDisposition: If a certificate was issued, then the CA MUST return 0x00000003; if a certificate issuance requires manager approval, then the CA MUST return 0x00000005. If an error was encountered, the CA MUST set the value of this parameter to a non-zero value.

   - pctbCertChain: If a certificate was issued, then the CA MUST return the issued certificate and its full chain as constructed in section 3.2.1.4.2.1.4.7 in this parameter.

   - pctbEncodedCert: If a certificate was issued, then the CA MUST return the issued certificate in this parameter.

   - pctbDispositionMessage: In this parameter, the CA SHOULD send additional information in the form of a Unicode string that can be used to troubleshoot the server response.<64>

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3.2.1.4.2.1.1 Verifying the CA Name

Input Parameter: None.

CANameString: A null terminated [UNICODE] string.

EmptyNameAllowed: BOOLEAN (true or false).

Output Parameter: BOOLEAN (true or false).

Processing Rules:

1. Return true if the *CANameString* parameter equals one of the following:
   - The CN attribute of the **Subject** field in the latest CA signing certificate stored in the Signing_Cert_Certificate column in the Signing_Cert datum.
   - The sanitized value (as specified in section 3.1.1.4.1.1) of the CN attribute of the **Subject** field in the latest CA signing certificate stored in the Signing_Cert_Certificate column in the Signing_Cert datum.
   - The short sanitized value (as specified in section 3.1.1.4.1.1) of the CN attribute of the **Subject** field in the latest CA signing certificate stored in the Signing_Cert_Certificate column in the Signing_Cert datum. The algorithm for shortening names is specified in section 3.1.1.4.1.1.1.
2. Return true if the *EmptyNameAllowed* is set to true and if the *CANameString* equals one of the following:
   - NULL
   - L'\0'
3. Otherwise, return false.

3.2.1.4.2.1.2 Parsing and Verifying pwszAttributes

The CA MUST parse the [UNICODE] string that is passed in the *pwszAttributes* parameter. The string MUST be a combination of one or more lines separated by '\n'. Each line MUST have the attribute name token, a ':' separator, and the value token.

A line that contains invalid syntax or a missing token MUST be ignored by the CA. Blanks and minus signs before the separator on each line MUST be removed by the receiving CA, even if they appear before or within the name string. Blanks that occur before or after the value string MUST be removed; however, blanks within the value string can remain.

A list of actions follows, which the CA MUST perform for each of the supported attributes. This list contains supported attributes and sample values:

- SAN:type_1=value1[&type_N=value_N]
  - Processing: If the Config_CA_Accept_Request_Attributes_SAN data is set to false, the CA MUST ignore this attribute. If the Config_CA_Accept_Request_Attributes_SAN data is set to true, the CA MUST use the values that are defined in this attribute to construct the **SubjectAltName** in the issued certificate. **SubjectAltName** MUST be constructed with one or more values specified in the GeneralName structure in [RFC3280] section 4.2.1.7. The CA MUST map the attribute value to a supported type in the GeneralName structure. This

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attribute supports multiple values separated by the '&' character and prepended by their type and '=' character. The mapping MUST be as illustrated in the following examples:

- Email=sample@contoso.com is mapped to the **rfc822Name** that has the sample@contoso.com value.
- Dns=contoso.com is mapped to a FQDN that has the contoso.com value.
- dn=CN=xxx,OU=xxx,DC=xxx is mapped to a **directoryName** that has a value of CN=xxx,OU=xxx,DC=xxx.
- url=http://adatum.com/default.html is mapped to a **uniformResourceIdentifier** that has a value of http://adatum.com/default.html.
- ipaddress=172.134.10.134 is mapped to the IPAddress that has the 172.134.10.134 value.
- upn=sample@cpandl.com is mapped to the **otherName** that has an OID szOID_NT_PRINCIPAL_NAME (1.3.6.1.4.1.311.20.2.3) and a value of sample@cpandl.com that is encoded as a UTF-8 string.
- oid=2.1.3.3.2 is mapped to the **registeredID** that has the 2.1.3.3.2 value.
- guid=f7c3ac41-b8ce-4fb4-aa58-3d1dc0e36b39 is mapped to the **otherName** that has an OID szOID_NTDS_REPLICATION (1.3.6.1.4.1.311.25.1) and a value of f7c3ac41-b8ce-4fb4-aa58-3d1dc0e36b39 that is encoded as an octet string.
- 1.2.3.4=contoso. The name of this token can be any OID (in this example 1.2.3.4). It is mapped to an **otherName** structure that has the OID 1.2.3.4. The format for the value uses an octet string for the OID and contoso for the value that is encoded as an octet string.

Note The **otherName** structure is as specified in [RFC3280] section 4.2.1.7. The **otherName** structure includes an OID and a value.

- CertificateUsage:OID,OID
  - Processing: If the Config_CA_Accept_Request_Attributes_Extensions data is set to true, the CA MUST use the OIDs that are passed with this value to construct the ExtendedKeyUsage extension in the issued certificate. The ExtendedKeyUsage extension is specified in [RFC3280] section 4.2.1.13. If the Config_CA_Accept_Request_Attributes_Extensions data is set to false, the CA MUST ignore this attribute.
- ValidityPeriod:Weeks\nValidityPeriodUnits:3
  - Processing: If the Config_CA_Accept_Request_Attributes_ValidityTime data is set to true and the ExpirationDate attribute is not present, the CA MUST set the **NotAfter** field of the issued certificate equal to the value of the **NotBefore** field plus the value of the **ValidityPeriod**.<65> In this sample, the client requests a validity period of three weeks. If the Config_CA_Accept_Request_Attributes_ValidityTime datum is set to false, the CA MUST ignore this attribute.
- ExpirationDate:Tue, 21 Nov 2000 01:06:53 GMT
  - Processing: If the Config_CA_Accept_Request_Attributes_ValidityTime data is set to true, the CA MUST set the **NotAfter** field of the issued certificate to this value and MUST ignore the **ValidityPeriod**.<66> If the Config_CA_Accept_Request_Attributes_ValidityTime data is set to false, the CA MUST ignore this attribute.

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- certfile:c:\mycert.cer
  - Processing: If the Config_CA_Accept_Request_Attributes_CertPath data is set to true, the CA MAY<67> publish the issued certificate to the path that is specified in this attribute. If the Config_CA_Accept_Request_Attributes_CertPath datum is set to false, the CA MUST ignore this attribute.
- CertType:server
  - Processing: If this attribute is present and the value is "server", the CA MUST add an extension 2.16.840.1.113730.1.1 with a bit string value of 0x01100000 (SSL server). If this attribute is present and the value is not "server", the CA MUST add an extension 2.16.840.1.113730.1.1 by using a bit string value of 0x01000000 (SSL client). If the request is a KEYGEN request and this attribute is not present, the CA MUST add an extension 2.16.840.1.113730.1.1 by using a bit string value of 0x01000000 (SSL client). The Netscape KEYGEN Tag Format is specified in section 2.2.2.6.4.
- Other:...
  - Processing: If the Config_CA_Accept_Request_Attributes_Other data is set to true and the request is a KEYGEN type, the CA MUST process the string to construct the subject name based on the rdn attribute, as specified in section 3.2.1.4.2.1.4.1.4. Otherwise, the CA MUST ignore this attribute.

3.2.1.4.2.1.3 Requesting Status Inspection

If the **pb** field of the pctbRequest parameter is NULL, the client has requested a status inspection of a certificate request. This section describes the rules for processing certificate status requests. If the **pb** field of the pctbRequest parameter is not NULL, the CA MUST process the request as a new request as specified in section 3.2.1.4.2.1.4.

The rules for processing the status inspection are as follows:

1. If the **pdwRequestId* is 0, the CA MUST fail the request with a non-zero error.
2. If *pwszAttributes* is not NULL, the CA MUST look up the record in the request table defined in the section 3.2.1.1.1 by matching the serial number of the certificate in *pwszAttributes* parameter with the values in the Serial_Number column. If the lookup failed, the function MUST return the error 0x80094004 (CERTSRV_E_PROPERTY_EMPTY).
3. The CA MUST set the value of the *pdwDisposition* parameter by mapping the value of the Request_Disposition column for the located record as described in the table below. The values of the Request_Disposition column are defined in MS-CSRA section 3.1.1.1.1.

Request_Disposition column value	pdwDisposition value
foreign certificate	0
request denied	2
certificate issued	3
request pending	5
certificate revoked	6

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Request_Disposition column value	pdwDisposition value
request failed	Non-zero value indicating an error that is not one of the values already defined in this table

4. If the value of the Request_Disposition column is "certificate issued", the CA MUST return the previously issued certificate through the *pctbEncodedCert* parameter as specified in section 3.2.1.4.2.1.4.7.

5. If the value of the Request_Disposition column is "request denied", the CA SHOULD set the return value to the 0x80094014 (CERTSRV_E_ADMIN_DENIED_REQUEST).<68>

3.2.1.4.2.1.4 Processing a Request

The CA MUST inspect the format of certificate requests. If the requestor sets the RequestType byte of the *dwFlags* parameter to a nonzero value, the RequestType specifies the format of the request (see section 3.2.1.4.3.1.1 for more details). The request can be a PKCS #10, CMS, KEYGEN, or CMC structured request. If the RequestType byte of the *dwFlags* is set to zero, the client relies on CA to determine the request type.

There are two scenarios for requests:

- New certificate request
- Request to renew an existing certificate

The following table describes the different request types and request formats that are used when constructing each certificate request, as indicated in the column heading.

Request type	CMS with PKCS #10	PKCS #10	CMS with CMC	Netscape KeyGen
New request	Yes	Yes	Yes	Yes
Renewal request	Yes	No	Yes	No

"Yes" indicates that this format is supported for this request type. "No" indicates that this format is not supported by this protocol.

If a certificate request is submitted by using a certificate format that is not supported, or if the type of the request does not match the format denoted by the RequestType byte of the *dwFlags* parameter (see section 3.2.1.4.3.1.1 for more details), the CA MUST return an error code. The error code SHOULD be CRYPT_E_INVALID_MSG_TYPE.

The server MUST apply the rules specified in the following subsections for each one of these request types. To determine the type of the request, the CA MUST perform the following processing rules:

1. The received request with a "CMS with PKCS #10" format is a renewal request if it meets all of the requirements specified in section 3.2.1.4.2.1.4.2.1. Otherwise, it is a new request.

2. The received request with a "CMS with CMC" format is a renewal request if it meets all of the requirements specified in section 3.2.1.4.2.1.4.2.2. Otherwise, it is a new request.

3. In all other cases, the received request is a new request.

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3.2.1.4.2.1.4.1 Processing Rules for New Certificate Request

A new certificate request MUST use one of the following certificate request formats as specified in section 2.2.2.6:

- PKCS #10
- CMS with embedded PKCS #10
- CMS with embedded CMC
- KEYGEN

The following sections specify the specific CA processing rules for a new certificate request for each one of the preceding formats.

3.2.1.4.2.1.4.1.1 New Certificate Request Using PKCS #10 Request Format

In general, the request MUST be compliant with the information in [RFC2986]. The processing rules listed with the following fields MUST be adhered to by the CA. These are not explicitly specified by [RFC2986]:

- Subject: The CA MUST use the information supplied in this field to construct the **Subject** field, as specified in [RFC3280], in the issued certificate.
- SubjectPublicKeyInfo: This field MUST contain the required information on the public key associated with the certificate request. The CA MUST copy this field to the **SubjectPublicKeyInfo** field, as specified in [RFC3280], in the issued certificate. The CA MUST validate the requester possession of the key by verifying that the signature on the request was computed by using a private key corresponding to the public key info in this field. See section 4.2 in [RFC2986] for more information on certificate request signatures. If the **SubjectPublicKeyInfo** field is not present in the request or signature validation fails, the CA MUST return a nonzero error to the client.
- Attribute: This field MAY be used to send additional parameters to the CA. The CA MUST parse it and use it to construct the issued certificate. The following rules MUST be followed for each one of the supported attributes:
  - OID = szOID_OS_VERSION (1.3.6.1.4.1.311.13.2.3)
    - Description: This attribute MUST define the client's operating system version.
    - CA Semantics: The CA MUST ignore the value of this attribute. The CA MUST NOT assume any specific values or value ranges that it receives in this attribute. If this field contains more than one value the CA MUST return 0x8007000D (ERROR_INVALID_DATA) to the client. If the format is not compliant with the requirement specified in section 2.2.2.7, the CA MUST return a nonzero error to the client.
  - OID = szOID_ENROLLMENT_CSP_PROVIDER (1.3.6.1.4.1.311.13.2.2) attribute
    - Description: This attribute MUST define the CSP used to generate the key pair on the enrollment client.
    - CA Semantics: The CA MUST ignore the value of this attribute. The CA MUST NOT assume any specific values or value ranges that it receives in this attribute. If this field contains more than one value, the CA MUST return 0x8007000D (ERROR_INVALID_DATA) to the

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client. If the format is not compliant with the requirement specified in section 2.2.2.7, the CA MUST return a nonzero error to the client.

- OID = szOID_REQUEST_CLIENT_INFO (1.3.6.1.4.1.311.21.20)
  - Description: Provides information on the client. For details, see section 2.2.2.7.4.
  - CA Semantics: CA MUST ignore the value of this attribute. The CA MUST NOT assume any specific values or value ranges that it receives in this attribute.
- OID = szOID_CERT_EXTENSIONS (1.3.6.1.4.1.311.2.1.14)
  - Description: This OID MUST be used to encode an array of extensions into an attribute so that extensions can be included in a PKCS10. CA Semantics are as follows:
  - The CA SHOULD add the requested extensions as specified in this value to the issued certificate.<69>
- OID = szOID_ENROLLMENT_NAME_VALUE_PAIR (1.3.6.1.4.1.311.13.2.1)
  - Description: Additional attributes that MAY be used for the certificate request. The attributes are identical to the attributes that are defined for the pwszAttributes parameter.
  - CA Semantics: The CA behavior for this attribute is identical to the behavior for attributes in the *pwszAttributes* parameter as specified in section 3.2.1.4.2.1.2.

3.2.1.4.2.1.4.1.2 New Certificate Request Using CMS and PKCS #10 Request Format

The request MUST be compliant with the information that is specified in [RFC3852], otherwise the CA MUST return a non-zero error. The processing rules listed with the following fields MUST be adhered to by the CA. These are not explicitly specified by [RFC3852]:

- contentType: This field ([RFC3852] section 3) MUST be OID szOID_PKCS_7_SIGNED (1.2.840.113549.1.7.2, id-signedData). If it is not, the CA MUST return a non-zero error.
- content: This field is a SignedData structure (as specified in [RFC3852] section 5.1) and has the following requirements for its fields:
  - encapContentInfo: This field has the **eContentType** field set to OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1, id-data) and the **eContent** field contains a PKCS#10 certificate request. If the **eContentType** field is not set to OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1, id-data) or the **eContent** field does not contain a PKCS#10 certificate request conforming to rules specified in section 3.2.1.4.2.1.4.1.1, the CA MUST return 0x8007000D (ERROR_INVALID_DATA) to the client.
- signerInfos: The request MUST be signed. If the request is not signed, the CA MUST return 0x8009200E (CRYPT_E_NO_SIGNER) to the client.

3.2.1.4.2.1.4.1.3 New Certificate Request Using CMS and CMC Request Format

The request MUST be compliant with the information that is specified in [RFC2797], otherwise the CA MUST return a non-zero error. The processing rules listed with the following fields MUST be adhered to by the CA. These are not explicitly specified by [RFC2797]:

- contentType: This field ([RFC3852] section 3) MUST be OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData). If it is not, the CA MUST return a non-zero error.

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- content: The content structure MUST be a **SignedData** structure ([RFC3852] section 5.1). The **SignedData** structure MUST adhere to the following requirements:
  - encapContentInfo: This field MUST have the following values for its fields:
    - eContentType: This field ([RFC3852] section 5.2) MUST be OID szOID_CT_PKI_DATA (1.3.6.1.5.5.7.12.2, id-cct-PKIData). If not, the CA MUST return a non-zero error.
    - eContent: This field MUST be a **PKIData** structure, as specified in [RFC2797] section 3.1. The **PKIData** structure MUST adhere to the following requirements:
      - TaggedRequest: This field MUST contain exactly one certificate request. If the contents of this field is not exactly one PKCS #10 certificate request conforming to rules specified in section 3.2.1.4.2.1.4.1.1, the CA MUST return 0x8007000D (ERROR_INVALID_DATA) to the client.
      - TaggedAttribute: This field MAY contain additional enrollment attributes. If the field contains the RegInfo attribute (as specified in [RFC2797] section 5.12), processing rules for its value are identical to the ones for the *pwszAttributes* parameter (as specified in section 3.2.1.4.2.1.2).
    - signerInfos: The request MUST be signed. If the request is not signed, the CA MUST return 0x8009200E (CRYPT_E_NO_SIGNER) to the client.

3.2.1.4.2.1.4.1.4 New Certificate Request Using KEYGEN Request Format

The certificate request MUST be compliant with "Netscape Extensions for User Key Generation Communicator 4.0 Version", otherwise the CA MUST return a non-zero error. For specifications, see [KEYGEN].

The request MUST contain the following attributes in the *pwszAttributes* parameter:

- challenge ([KEYGEN] section 4.10.14): If the challenge string is supplied in the certificate request, the CA MUST verify that the same string (case-sensitive comparison) is supplied in the *pwszAttributes* parameter. The syntax for this attribute is specified in section 2.2.2.7. If this is not the case, the CA MUST return a non-zero error.
- CertType: The processing rules for this attribute are specified in section 3.2.1.4.2.1.2.
- rdn ([KEYGEN] section 4.10.14): This attribute MUST be added to this parameter. If the attribute is not added, the CA MUST return a non-zero error code. If the attribute is present in this parameter, the CA MUST use the value to construct the **Subject** field in the issued certificate. Optional values are specified in section 2.2.2.6.4.2.

3.2.1.4.2.1.4.2 Processing Rules for Renewing a Certificate Request

A request to renew an existing certificate MUST use one of the following formats, as specified in section 2.2.2.6:

- CMS with embedded PKCS #10.
- CMS with embedded CMC.

Rules specified in the following sections MUST be used by the CA to process the certificate request for each of the preceding formats.

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3.2.1.4.2.1.4.2.1 Renewing a Certificate Request Using CMS and PKCS #10 Request Formats

The request MUST be compliant with the information that is specified in [RFC3852], otherwise the CA MUST return a nonzero error. The processing rules for the following fields MUST be adhered to the CA, but are not specified by [RFC3852].

- ContentType: This field ([RFC3852] section 3) MUST be OID szOID_PKCS_7_SIGNED (1.2.840.113549.1.7.2, id-signedData). If not, the CA MUST return a nonzero error.
- Content: MUST have a SignedData structure ([RFC3852] section 5.1). If not, the CA MUST return a nonzero error.
  - encapContentInfo: In the **SignedData** field. This field MUST have the following values for its fields:
    - eContentType: This field MUST be OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1, id-data). If not, the CA MUST return a nonzero error.
    - eContent: This field MUST be the PKCS #10 certificate request. Processing rules are identical to the ones specified in section 3.2.1.4.2.1.4.1.1. In addition, the **Attributes** field MUST include the szOID_RENEWAL_CERTIFICATE (1.3.6.1.4.1.311.13.1) attribute. If this attribute is not included, the CA assumes that this is a new certificate request and follows the processing rules in section 3.2.1.4.2.1.4.1.1.The value for this attribute MUST be the already issued certificate DER encoded. If the issued certificate is not included in the value of this attribute, the CA MUST return 0x8009400E (CERTSRV_E_BAD_RENEWAL_CERT_ATTRIBUTE) to the client.
  - Certificates: This field MUST include the already-issued certificate that is associated with the private key used to sign the request (the same certificate as the one in the PKCS #10 Attributes that MUST be included in the PKCS #10 attribute specified in the preceding requirement). If this field does not contain the already-issued certificate, the CA MUST return 0x8009400E (CERTSRV_E_BAD_RENEWAL_CERT_ATTRIBUTE) to the client.
  - SignerInfo: The signing MUST use the key associated with the already-issued certificate that is passed in the **Certificates** field, otherwise the CA MUST return a nonzero error to the client.

3.2.1.4.2.1.4.2.2 Renewing a Certificate Request Using CMS and CMC Request Format

The request MUST be compliant with the information specified in [RFC2797], otherwise the CA MUST return a non-zero error. The processing rules for the following fields MUST be adhered to by the CA but are not specified by [RFC2797]:

- ContentType: This field MUST be OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData). If not, the CA MUST return a non-zero error.
- Content: The content structure MUST be SignedData. The SignedData structure MUST adhere to the following requirements:
  - encapContentInfo: This field MUST have the following values for its fields:
    - eContentType: This field MUST be szOID_CT_PKI_DATA (1.3.6.1.5.5.7.12.2, Id-cct-PKIData). If not, the CA MUST return a non-zero error.
    - eContent: This field MUST be a PKIData. The PKIData structure MUST adhere to the following requirements:

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- TaggedRequest: This field contains a single PKCS #10 certificate request. If the content of this field is not exactly one PKCS #10 certificate request conforming to the rules specified in section 3.2.1.4.2.1.4.1.1, the CA MUST return 0x80007000D (ERROR_INVALID_DATA) to the client. In addition, the **Attributes** field in the PKCS #10 certificate request MUST include the szOID_RENEWAL_CERTIFICATE (1.3.6.1.4.1.311.13.1) attribute. If this attribute is not included, the CA assumes that this is a new certificate request and follows the processing rules in section 3.2.1.4.2.1.4.1.1. The value for this attribute MUST be the already issued certificate DER encoded. If the issued certificate is not included in the value of this attribute, the CA MUST return 0x8009400E (CERTSRV_E_BAD_RENEWAL_CERT_ATTRIBUTE) to the client.

- TaggedAttribute: This field MAY contain additional enrollment attributes. If the field contains the RegInfo attribute (as specified in [RFC2797] section 5.12), processing rules for its value are identical to the ones for the *pwszAttributes* parameter (as specified in section 3.2.1.4.2.1.2).

- Certificates: This field MUST include the already issued certificate associated with the private key used to sign the request (the same certificate as the one in the PKCS #10 Attributes that MUST be included in the PKCS #10 attribute). If this field does not contain the already issued certificate, the CA MUST return 0x8009400E (CERTSRV_E_BAD_RENEWAL_CERT_ATTRIBUTE) to the client

- SignerInfo: The signing MUST be done with the key associated to the already issued certificate that is passed in the **Certificates** field.

3.2.1.4.2.1.4.3 Storing Request Parameters in the Request Table

The CA MUST create a new row in the Request table and set the following values:

- Request_Request_ID: Assign a unique value in this column.

- Request_Disposition: Assign the value "request pending".

- Request_Raw_Request: Assign the value of the **pb** field of the **CERTTRANSBLOB** structure contained in the *pctbRequest* parameter.

In addition, the CA MAY store request parameters in the Request table. If the CA decides to store the additional parameters, it MUST follow the processing rules specified in the following table. If the CA fails to store the request parameters in the Request table, the CA MUST return a nonzero error to the client. <70>

Column name	Processing rules
Request_Raw_Old_Certificate	If the request is a renewal request, the CA MUST store the X.509 certificate passed in the Certificates field of the CMS request as specified in [RFC3852] section 5.1.
Request_Request_Attributes	The CA MUST store all the request attributes as specified in 2.2.2.7.
Request_Request_Type	The CA MUST store the type of the request as passed in the dwFlags parameter. See section 3.2.1.4.3.1.1
Request_Request_Flags	The CA MUST store additional information on the request process in this column. Specified values are documented in [MS-CSRA] section 3.1.1.1.2.

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Column name	Processing rules
Request_Status_Code	The CA MUST store the returned value from the call to ICertRequestD::Request or ICertD2::Request2 methods.
Request_Submitted_When	The CA MUST store the time the request was received by the CA.
Request_Resolved_When	The CA MUST store the time the CA completed the request processing.
Request_Requester_Name	The CA MUST store the value of the requestername attribute that is passed in the request.
Request_Caller_Name	The value of the **Per_Request.Caller_Account_Name** ADM element.
Request_Signer_Policies	The CA MUST store the value of all the OIDs stored in the Policy extension of the certificate stored in the Certificate field in the CMS request as specified in [RFC3852] section 5.1.
Request_Signer_Application_Policies	The CA MUST store the value of all the OIDs stored in the EKU extension of the certificate stored in the Certificate field in the CMS request as specified in [RFC3852] section 5.1.
Request_Officer	The CA MUST store True if the caller name stored in the Request_Requester_Name column is an Officer_Rights as specified in [MS-CSRA].
Request_Distinguished_Name	The CA MUST store the **distinguished name (DN)** from the Subject field of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Raw_Name	The CA MUST store the Subject field of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Country	The CA MUST store the Country attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Organization	The CA MUST store the Organization attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Org_Unit	The CA MUST store the Organizational-Unit attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Common_Name	The CA MUST store the common name (CN) attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Locality	The CA MUST store the Locality attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_State	The CA MUST store the Province name attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.

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Column name	Processing rules
Request_Title	The CA MUST store the Title attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Given_Name	The CA MUST store the Given Name attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Initials	The CA MUST store the Initials attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_SurName	The CA MUST store the Surname attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Domain_Component	The CA MUST store the Domain Component attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Email	The CA MUST store the Email Address attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Street_Address	The CA MUST store the Street Address attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Unstructured_Name	The CA MUST store the Unstructured Name attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Unstructured_Address	The CA MUST store the Unstructured Address attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Device_Serial_Number	The CA MUST store the Device Serial Number attribute from the DN from the Subject of the certificate request as specified in [RFC3280] section 4.1.2.4.
Request_Attestation_Challenge	The CA MUST store the AttestationChallenge attribute from the certificate request.
Request_Endorsement_Key_Hash	The CA MUST store the EndorsementKeyHash from the certificate request.
Request_Endorsement_Certificate_Hash	The CA MUST store the EndorsementCertificateHash from the certificate request.

3.2.1.4.2.1.4.4 CA Policy Algorithm

The CA SHOULD use Config_CA_Policy_Algorithm_Implementation data to obtain the CA policy algorithm. The policy algorithm MUST determine if the certificate should be issued, set to pending, or denied, using the following processing rules:

1. If the value of the Config_CA_Requests_Disposition datum has 0x00000100 (REQDISP_PENDINGFIRST) bit set, set the request to pending.

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2. Else, if the value of the Config_CA_Requests_Disposition datum equals 0x00000001 (REQDISP_ISSUE), issue the certificate.

3. Else, if the value of the Config_CA_Requests_Disposition datum equals 0x00000002 (REQDISP_DENY), deny the request.

4. Else, set the request to pending.

In the Request table row for the current certificate request, the CA MUST set the following values to the values that are returned from the policy algorithm:

- Request_Disposition: If the policy algorithm resulted in the certificate being issued, the CA MUST set the value to "certificate issued". If the policy algorithm resulted in the certificate being pended, the CA MUST set the value to "request pending". If the policy algorithm encountered an error, the CA MUST set the value to "request failed".

- Request_Disposition_Message: The CA SHOULD populate this element with additional information that the licensee considers informative to a human.<71>

Certificates constructed by the policy algorithm MUST satisfy all the processing rules specified in section 3.2.1.4.2.1.

The CA SHOULD store some description of the policy algorithm in the Config_CA_Policy_Description data of the Abstract Data Model that can be requested by clients as described in section 3.2.1.4.3.2.5.

3.2.1.4.2.1.4.5 Generating a Serial Number

The CA SHOULD follow these steps to generate a serial number for a certificate. The CA MAY use an alternative algorithm to generate serial numbers. Note that the following steps do not conform to [RFC3280] section 4.1.2.2.

The following numbers are used in processing rules in this section:

C: A 4-byte arbitrary integer generated with any pseudo random number generator.

R: An 8-byte arbitrary integer generated with any pseudo random number generator.

1. If Config_High_Serial_String is not empty, the CA SHOULD<72>:

   1. Generate a serial number as specified in section 3.2.1.4.2.1.4.5.3.

   2. Continue with step 5.

2. If Config_High_Serial_Number equals 0xFFFFFFFF, the CA SHOULD<73>:

   1. Generate a serial number as specified in section 3.2.1.4.2.1.4.5.4.

   2. Generate a serial number as specified in section 3.2.1.4.2.1.4.5.3.

   3. Continue with step 5.

3. If Config_High_Serial_Number is not zero, the CA MUST:

   1. Generate a serial number as specified in section 3.2.1.4.2.1.4.5.2.

   2. Continue with step 5.

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4. The CA MUST generate a serial number as specified in section 3.2.1.4.2.1.4.5.1.
5. Zero the high bit of the high byte of the serial number generated in the preceding steps.
6. If the high byte is zero, set it to 0x61. Otherwise, if the high nibble of the high byte is zero XOR the high byte with 0x10.

3.2.1.4.2.1.4.5.1 Default Serial Numbers

1. Generate a number **C** defined in section 3.2.1.4.2.1.4.5 using any pseudo random number generator.
2. Construct a serial number that consists of these parts (from low byte to high):
   - Bytes 0-3: The 4-byte little-endian value of the request ID (the value of the Request_Request_ID column in the Request table generated in section 3.2.1.4.2.1.4.3).
   - Bytes 4-5: The 2-byte little-endian value of the zero-based index of the last row of the Signing_Cert table.
   - Bytes 6-9: The value of **C** generated at step 1.

3.2.1.4.2.1.4.5.2 Serial Numbers Based on Config_High_Serial_Number

1. Generate a number **R** defined in section 3.2.1.4.2.1.4.5 using any pseudo random number generator.
2. Construct a serial number that consists of these parts (from low byte to high):
   - Bytes 0-3: The 4-byte little-endian value of the request ID (the value of the Request_Request_ID column in the Request table generated in section 3.2.1.4.2.1.4.3).
   - Bytes 4-5: The 2-byte little-endian value of the index of the last row of the Signing_Cert table.
   - Bytes 6-13: The value of **R** generated at step 1.
   - Bytes 14-17: The 4-byte little-endian value of the request ID (the value of the Request_Request_ID column in the Request table generated in section 3.2.1.4.2.1.4.3).
   - Byte 18: The low byte of the value in Config_High_Serial_Number datum.

3.2.1.4.2.1.4.5.3 Serial Numbers Based on Config_High_Serial_String

Construct a serial number that consists of these parts (from low byte to high):

- Bytes 0-3: The 4-byte little-endian value of the request ID (the value of the Request_Request_ID column in the Request table generated in section 3.2.1.4.2.1.4.3).
- Bytes 4-5: The 2-byte little-endian value of the index of the last row of the Signing_Cert table.
- Bytes 6-18: Up to 13 initial bytes of the numeric value of Config_High_Serial_String. To obtain a numeric value, convert the string to a multi-byte integer by interpreting each pair of characters as hexadecimal string representation of a single byte while ignoring any spaces or tabs. The order of bytes in the string is high to low.

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3.2.1.4.2.1.4.5.4 Creating a Serial Number String

Follow these steps to create a serial number string:

1. Generate a number **R** defined in section 3.2.1.4.2.1.4.5 using any pseudo random number generator.
2. Convert the number to a string form where each byte is represented in a hexadecimal form by two characters starting from high byte to low. For example, "1f2cd56a8293f8a0".
3. Set the value of the Config_High_Serial_String to the string generated in the previous step.
4. If the CA implements the Certificate Services Remote Administration Protocol [MS-CSRA] protocol, write the value generated in step 2 to the OnNextRestart_Config_High_Serial_String persisted datum. If the CA does not implement Certificate Services Remote Administration Protocol [MS-CSRA], write the value to the implementation specific storage.

3.2.1.4.2.1.4.6 Constructing Certificate

The CA SHOULD add required certificate fields to the certificate as specified in [RFC3280]. This specification does not guarantee serial number uniqueness and that deviates from [RFC3280] section 4.1.2.2. The serial number SHOULD be generated as specified in section 3.2.1.4.2.1.4.5.

The CA MUST NOT issue a certificate that does not have at least subject name or SAN extension. If after processing the certificate request the CA does not have information to be encoded in subject name or SAN extension, the CA MUST return 0x80094001 (CERTSRV_E_BAD_REQUESTSUBJECT) to the client.

The **CA** MUST set the **NotBefore** field equal to the current time minus the value of the *Config_CA_Clock_Skew_Minutes* data.

The CA also MUST add the following extensions:

- CRL Distribution Point (CDP) Extension

  This extension is described in [RFC3280], section 4.2.1.14. The CA MUST construct this extension in the following manner:

  - The cRLDistributionPoint MUST consist of a single instance of the DistributionPoint.
  - The DistributionPoint MUST have distributionPoint field set with the fullName containing all entries from the Config_CA_CDP_Include_In_Cert data.

- If Config_CA_AIA_Include_In_Cert or Config_CA_OCSP_Include_In_Cert lists are not empty, the CA MUST add the AIA Extension.

  This extension is described in [RFC3280], section 4.2.2.1. The CA MUST construct this extension in the following manner:

  - The AuthorityInfoAccessSyntax MUST consist of a sequence of AccessDescription elements corresponding to each item in the Config_CA_AIA_Include_In_Cert and Config_CA_OCSP_Include_In_Cert lists.
  - For the items from the Config_CA_AIA_Include_In_Cert list, the **accessMethod** field of the **AccessDescription** structure MUST be set to the OID szOID_PKIX_CA_ISSUERS (1.3.6.1.5.5.7.48.2, id-ad-caIssuers).

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- For the items from the Config_CA_OCSP_Include_In_Cert list, the **accessMethod** field of the **AccessDescription** structure MUST be set to the OID szOID_PKIX_OCSP (1.3.6.1.5.5.7.48.1, id-ad-ocsp).

3.2.1.4.2.1.4.7 Signing and Returning the Issued Certificate

After constructing the certificate, the CA MUST sign the certificate with its signing key stored in the Signing_Private_Key data. Then the CA MUST save the certificate's serial number in the Serial_Number column of the Request table and MUST construct the response defined in the following sections. Note that the response MUST consist only of fields and content specified in the following subsections.

3.2.1.4.2.1.4.7.1 Returning the Certificate as a CMS Certificate Response

If the client did not set the Y flag in the *dwFlags* parameter of **ICertRequestD::Request** or **ICertRequestD2::Request2**, the CA MUST use the CMS structures that are specified in [RFC3852] for constructing the response structure. If no end entity certificate is to be returned to the client (due to a failed, pending, or denied request), the CA MUST NOT build a CMS response and MUST return NULL in the *pctbCertChain* parameter. The following are the values for specific fields that the CA MUST set:

- ContentType: szOID_PKCS_7_SIGNED (1.2.840.113549.1.7.2, id-signedData).
- Content: SignedData (as specified in [RFC3852], section 5.1) with the following requirements:
  - version: See section [RFC3852], section 5.1.
  - digestAlgorithms: Not used.
  - encapContentInfo: EncapsulatedContentInfo structure (as specified in [RFC3852], section 5.2) with the **eContentType** set to the OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1, id-data) and the **eContent** field not used.
  - certificates: Contains the end entity certificate that has been issued or retrieved, as well as all CA certificates in its chain.
  - crls: If the client passed the X flag in the *dwFlag* parameter, this field MUST contain all current CRLs and delta CRLs for the CAs whose certificates were added to the certificates field. For each certificate in the certificates field, the CA SHOULD retrieve the CRL using the processing rules in section 3.2.1.4.1.3 by setting the ParameterCertificate equal to the current certificate and add the returned ParameterCRL output parameter to the crls field.
  - signerInfos: Not used.

3.2.1.4.2.1.4.7.2 Returning the Certificate as CMC Full PKI Response

When the client sets the Y flag in the *dwFlags* parameter of **ICertRequestD2::Request2**, the CA MUST return a CMC structure wrapped in the CMS message. CMS and CMC are specified in [RFC3852] and [RFC2797] respectively.

The format of the response is a signed CMS message. The following are the values for specific fields that the CA MUST set:

- ContentType: szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData).

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- Content: szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData) with the following requirements:
  - version: See [RFC3852], section 5.1.
  - digestAlgorithms: See [RFC3852], section 5.1.
  - encapContentInfo: See section 3.2.1.4.2.1.4.7.2.1.
  - certificates:
    - If an end entity certificate is being returned to the client, the content of this field MUST include the **certificates** field in section 3.2.1.4.2.1.4.7.1.
    - This field MUST include the signing certificate that was used to sign the CMS message.
    - This field SHOULD include the CA certificates in the chain of the certificate that was used to sign the CMS message.
  - crls: If an end entity certificate is being returned to the client, the content of this field is the same as **crls** field in section 3.2.1.4.2.1.4.7.1. Otherwise this field is not used.
  - signerInfos: See section 3.2.1.4.2.1.4.7.2.2.

3.2.1.4.2.1.4.7.2.1 encapContentInfo

The **encapContentInfo** field is of type EncapsulatedContentInfo, as specified in [RFC3852], section 5.2. The fields of it are populated as follows:

- eContentType: szOID_CT_PKI_RESPONSE (1.3.6.1.5.5.7.12.3, id-cct-PKIResponse).
- eContent: ResponseBody, as specified in [RFC2797], section 3.2.
  - controlSequence: Contains the following attributes of type TaggedAttribute (as specified in [RFC2797], section 3.5):
    - attribute[0]:
      - bodyPartID: 0x1.
      - attrType: szOID_CMC_STATUS_INFO (1.3.6.1.5.5.7.7.1, id-cmc-cMCStatusInfo).
      - attrValues:
        - value[0]: Set to the CMCStatusInfo structure specified in [RFC2797], section 5.1.
          - cMCStatus: If the value of the Request_Disposition column for this certificate is "certificate issued", "certificate revoked", or "foreign certificate", this field MUST be set to 0x0. If the value of the Request_Disposition column for this certificate is "request denied" or "request failed", this field MUST be set to 0x2. If the value of the Request_Disposition column for this certificate is "request pending", this field MUST be set to 0x3.
          - bodyList: 0x1.
          - statusString: A human readable string representing the status of the certificate request, as specified in [RFC2797], section 5.1.

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        - otherInfo: If cMCStatus equals to 0x3 (pending), this field MUST be set to the structure of type PendInfo (as specified in [RFC2797], section 5.1) with pendToken set to the request ID and pendTime set to the time when CA received the request. For all other values, the **otherInfo** field MUST NOT be included.

    - attribute[1]:
        - bodyPartID: 0x2.
        - attrType: szOID_CMC_ADD_ATTRIBUTES (1.3.6.1.4.1.311.10.10.1). The structure of the CMC Attributes type is identical to the Attributes type specified in [RFC2986], section 4.1.
        - attrValues:
            - value[0]: The attributes are as specified below.
                - attribute[0]: This attribute is included only if an end entity certificate is being returned as a part of this response.
                - type: szOID_ISSUED_CERT_HASH (1.3.6.1.4.1.311.21.17) see section 2.2.2.7.10.
                - values: A single value containing the SHA1 hash of the certificate being issued or retrieved.
                - attribute[1]: This attribute is included only if an end entity certificate is being returned as a part of this response and client's key is being (or has been) archived.
                - type: szOID_ENCRYPTED_KEY_HASH (1.3.6.1.4.1.311.21.21) see section 2.2.2.7.9.
                - values: A single value containing the hash of the archived private key. The CA MUST calculate the hash using the same algorithm that client has used when submitting the request. See section 3.2.2.6.2.1.2.2 for details.

- cmsSequence: Not used.
- otherMsgSequence: Not used.

3.2.1.4.2.1.4.7.2.2 signerInfos

The signerInfos field MUST be populated with a single SignerInfo structure (as specified in [RFC3852], section 5.3). The fields MUST be populated as follows:

- version: See [RFC3852], section 5.3.
- sid: A IssuerAndSerialNumber type (as specified in [RFC3852], section 10.2.4), with its fields set as follows:
    - issuer: The subject name of the CA's signing certificate.
    - serialNumber: The serial number of the CA's signing certificate.
- digestAlgorithm: A DigestAlgorithmIdentifier type (as specified in [RFC3852], section 10.1.1). The algorithm MUST be the same as used by the CA for signing end entity certificate.

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- signedAttrs: The attributes are as follows.
  - attribute[0]:
    - attrType: szOID_PKCS_9_CONTENT_TYPE (1.2.840.113549.1.9.3, id-contentType).
    - attrVales: A single value set to the OID szOID_CT_PKI_RESPONSE (1.3.6.1.5.5.7.12.3, id-cct-PKIResponse).
  - attribute[1]:
    - attrType: szOID_PKCS_9_MESSAGE_DIGEST (1.2.840.113549.1.9.4, id-messageDigest).
    - attrVales: A hash of the CMS payload.
- signatureAlgorithm: Depends on the algorithm of the CA's signing certificate.
- signature: The message signature. The CA MUST use the same key as it used to sign the end entity certificate.
- unsignedAttrs: Not used.

3.2.1.4.2.1.4.8 CA Exit Algorithm

The CA MAY implement one or more CA exit algorithms. In a Microsoft CA implementation, the CA exit algorithm is implemented via exit modules. Exit modules do not affect the Windows Client Certificate Enrollment Protocol in any way. The exit modules can perform the following tasks:

- If the certificate request contained the **certFile** attribute (specified in section 2.2.2.7.10), the default exit module publishes the issued certificate to the UNC path as specified in section 2.2.2.7.10.
- If the CA administrator configured the exit module to send email notifications on certificate issuance as specified in [MSFT-EXITMAIL], then the exit module sends email notifications.

The exit module can be configured as described in [MSFT-MODULES]. It can also be replaced as described in [MSDN-ICERTEXIT2].

If the CA implements exit algorithms, these algorithms SHOULD be stored in the **Config_CA_Exit_Algorithm_Implementation_List** data field, and MUST be triggered by the issuance of a certificate.

The CA SHOULD store the information about the number of CA exit algorithms it implements and their description in Config_CA_Exit_Count and Config_CA_Exit_Description_List respectively. This information can be requested by a client as described in sections 3.2.1.4.3.2.3 and 3.2.1.4.3.2.4.

3.2.1.4.2.2 ICertRequestD::GetCACert (Opnum 4)

The **GetCACert** method returns property values on the CA. The main use of this method is to enable clients to diagnose issues and the state of the server. In addition, one of the properties returned by this method is required to support the advanced CA functionality (GETCERT_CAXCHGCERT).

```
HRESULT GetCACert(
  [in] DWORD fchain,
  [in, unique, string] const wchar_t* pwszAuthority,
  [out, ref] CERTTRANSBLOB* pctbOut
```


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```
);
```

fchain: Specifies the type of information to include in the output parameter.

pwszAuthority: Contains the name of the CA.

pctbOut: If the function returns success (0) this parameter is a pointer to a **CERTTRANSBLOB** structure containing the returned value.

Return Values: For successful invocation, the CA MUST return 0; otherwise, the CA MUST return a nonzero value.

The processing rules for this method are as follows.

If the server implements the advanced CA functionality, it MUST implement the GETCERT_CAXCHGCERT property specified as follows.

If Config_CA_Interface_Flags contains the value IF_NOREMOTEICERTREQUEST, the server SHOULD return 0x80094011 (CERTSRV_E_ENROLL_DENIED) to the client.<74>

If Config_CA_Interface_Flags contains the value IF_ENFORCEENCRYPTICERTREQUEST and the RPC_C_AUTHN_LEVEL_PKT_PRIVACY authentication level, as defined in [MS-RPCE] section 2.2.1.1.8, is not specified on the RPC connection from the client, the CA MUST refuse to establish a connection with the client by returning a nonzero error.

1. The *fchain* parameter MUST be one of the values in the first table that follows, or the two most significant bytes of fchain MUST be one of the values in the second table that follows.

Value	Meaning
GETCERT_CASIGCERT 0x00000000	The request is for a CA signing certificate.
GETCERT_CAXCHGCERT 0x00000001	The request is for a CA exchange certificate.
GETCERT_CURRENTCRL 0x6363726C	The request is for the current CRL in ASN.1 format encoded by using DER for the latest CA signing certificates.
GETCERT_FILEVERSION 0x66696C65	The request is for a string value containing the version number of the CA implementation.
GETCERT_CAINFO 0x696E666F	The request is for a specific CA informational block, marshaled as a **CAINFO** structure.
GETCERT_CANAME 0x6E616D65	The request is for the CA name. The CA name is a [UNICODE] string that contains the CN of the CA.
GETCERT_PARENTCONFIG 0x70617265	The request is for the name of the parent CA to the current CA.
GETCERT_POLICYVERSION 0x706F6C69	The request is for the policy algorithm description.
GETCERT_PRODUCTVERSION 0x70726F64	The request is for a string value that contains the product version (build number) of the CA.
GETCERT_SANITIZEDCANAME	The request is for the CA sanitized name. The sanitized name

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Value	Meaning
0x73616E69	algorithm is specified in section 3.1.1.4.1.1.
GETCERT_SHAREDFOLDER 0x73686172	The request is for a common shared folder location. The shared folder is a UNC path name. This property was implemented for CAs deployed in a network without Active Directory. For more information on Windows implementation and usage for shared folders, see [MSFT-SHAREDFOLDER].
GETCERT_CATYPE 0x74797065	The request is for the CA type.

The values in the following table define the indexed properties for the *fchain* parameter. The two most significant bytes of *fchain* define the property type, and the two least significant bytes of *fchain* define the index required for these properties.

For example, a property with the value 0x636C0002 is the GETCERT_CRLBYINDEX value with the index value of 0x0002.

Value	Meaning
GETCERT_CRLBYINDEX 0x636C	The request is for the CRL at the specified index. The index of the CRL MUST represent the CA certificate that is associated with the CRL. Because each CRL has an index, this method provides the means to retrieve a specific CRL based on its index. The CA Abstract Data Model is specified in section 3.1.1.1.
GETCERT_CACERTBYINDEX 0x6374	The request is for the CA certificate at the specified index. The index MUST refer to the number of the certificate of the CA. Because each CA certificate has an index, this method provides the means to retrieve a specific certificate based on its index.
GETCERT_EXITVERSIONBYINDEX 0x6578	The request is for the exit algorithm description at the specified index.
GETCERT_CRLSTATEBYINDEX 0x736C	The request is for the CRL state at the specified index.
GETCERT_CACERTSTATEBYINDEX 0x7374	The request is for the CA certificate state at the specified index.

If the value is not one of the preceding specified values, the server MUST return an error, which SHOULD be 0x80070057.

2. If *fchain* doesn't equal GETCERT_SANITIZEDCANAME (0x73616E69) or GETCERT_CANAME (0x6E616D65), the server MUST invoke the processing rules in section 3.2.1.4.2.1.1 with the *CANameString* input parameter set to the CA name passed in the *pwszAuthority* parameter and the *EmptyNameAllowed* input parameter set to false. If false is returned, the CA MUST return the E_INVALIDARG (0x80070057) error code to the client.

3. Returned data type:

   The data type of the value returned depends on the value specified in the *fchain* parameter:

   - A [UNICODE] null-terminated string: A [UNICODE] string MUST be returned if *fchain* is equal to one of the following values:

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- GETCERT_FILEVERSION
- GETCERT_CANAME
- GETCERT_PARENTCONFIG
- GETCERT_POLICYVERSION
- GETCERT_PRODUCTVERSION
- GETCERT_SANITIZEDCANAME
- GETCERT_SHAREDFOLDER
- GETCERT_EXITVERSIONBYINDEX

Marshaling rules for [UNICODE] strings MUST be as specified in section 2.2.2.2.1.

- A **CAINFO** structure: A **CAINFO** structure MUST be returned if *fchain* is equal to the following:

  GETCERT_CAINFO

  Marshaling rules for **CAINFO** MUST be as specified in section 2.2.2.2.5.

- A CRL: A CRL MUST be returned if *fchain* is equal to the following:

  GETCERT_CURRENTCRL

  GETCERT_CRLBYINDEX

  Marshaling rules for a CRL MUST be as specified in section 2.2.2.2.3.

- [X509] Certificate: A certificate MUST be returned if *fchain* is equal to the following:

  GETCERT_CASIGCERT

  GETCERT_CAXCHGCERT

  GETCERT_CACERTBYINDEX

  Marshaling rules for [X509] certificates MUST be as specified in section 2.2.2.2.2.

- Byte array: A byte array MUST be returned if *fchain* is equal to the following:

  GETCERT_CRLSTATEBYINDEX

  GETCERT_CACERTSTATEBYINDEX

  Marshaling: pctbOut MUST be a pointer to a **CERTTRANSBLOB** structure. The pb member of the structure MUST point to the byte array.

- An unsigned integer: An unsigned integer MUST be returned if *fchain* is equal to the following:

  GETCERT_CATYPE

  Marshaling: pctbOut MUST be a pointer to a **CERTTRANSBLOB** structure. The pb member of the structure MUST point to an unsigned integer in little-endian format.

Note The numeric values for these constants are defined in the preceding table.

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4. Computing the returned values:

   - Sections 3.2.1.4.2.2.1 to 3.2.1.4.2.2.12 define the possible values for the *fchain* parameter.
   - Sections 3.2.1.4.2.2.13 to 3.2.1.4.2.2.17 define the possible values for the most significant two bytes of the *fchain* parameter.

3.2.1.4.2.2.1 GETCERT_CASIGCERT - 0x00000000

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_CASIGCERT property ID identified in the *PropID* parameter and the number of rows in the Signing_Cert table in the *PropIndex* parameter.

3.2.1.4.2.2.2 GETCERT_CAXCHGCERT - 0x00000001

The CA SHOULD process this client request identically to one specified in section 3.2.1.4.3.2 for the CR_PROP_CAXCHGCERT property ID identified in the *PropID* parameter.<75>

3.2.1.4.2.2.3 GETCERT_CURRENTCRL - 0x6363726C

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_BASECRL property ID identified in the *PropID* parameter and the number of rows in the Signing_Cert table in the *PropIndex* parameter.

3.2.1.4.2.2.4 GETCERT_FILEVERSION - 0x66696C65

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_FILEVERSION property ID identified in the *PropID* parameter.

3.2.1.4.2.2.5 GETCERT_CAINFO - 0x696E666F

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_CATYPE property ID identified in the *PropID* parameter.

3.2.1.4.2.2.6 GETCERT_CANAME - 0x6E616D65

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_CANAME property ID identified in the *PropID* parameter.

3.2.1.4.2.2.7 GETCERT_PARENTCONFIG - 0x70617265

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_PARENTCA property ID identified in the *PropID* parameter.

3.2.1.4.2.2.8 GETCERT_POLICYVERSION - 0x706F6C69

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_POLICYDESCRIPTION property ID identified in the *PropID* parameter.

3.2.1.4.2.2.9 GETCERT_PRODUCTVERSION - 0x70726F64

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_PRODUCTVERSION property ID identified in the *PropID* parameter.

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3.2.1.4.2.2.10 GETCERT_SANITIZEDCANAME - 0x73616E69

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_SANITIZEDCANAME property ID identified in the *PropID* parameter.

3.2.1.4.2.2.11 GETCERT_SHAREDFOLDER - 0x73686172

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_SHAREDFOLDER property ID identified in the *PropID* parameter.

3.2.1.4.2.2.12 GETCERT_CATYPE - 0x74797065

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_CATYPE property ID identified in the *PropID* parameter.

3.2.1.4.2.2.13 GETCERT_CRLBYINDEX - 0x636C

The index for this property MUST be passed in the least significant two bytes of the property value.

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_BASECRL property ID identified in the *PropID* parameter.

3.2.1.4.2.2.14 GETCERT_CACERTBYINDEX - 0x6374

The index for this property MUST be passed in the least significant two bytes of the property value.

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_CASIGCERT property ID identified in the *PropID* parameter.

3.2.1.4.2.2.15 GETCERT_EXITVERSIONBYINDEX - 0x6578

The index for this property MUST be passed in the least significant two bytes of the property value.

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_EXITDESCRIPTION property ID identified in the *PropID* parameter.

3.2.1.4.2.2.16 GETCERT_CRLSTATEBYINDEX - 0x736C

The index for this property MUST be passed in the least significant two bytes of the property value.

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_CRLSTATE property ID identified in the *PropID* parameter.

3.2.1.4.2.2.17 GETCERT_CACERTSTATEBYINDEX - 0x7374

The index for this property MUST be passed in the least significant two bytes of the property value.

Processing rules MUST be identical to the ones specified in section 3.2.1.4.3.2 for the CR_PROP_CACERTSTATE property ID identified in the *PropID* parameter.

3.2.1.4.2.3 ICertRequestD::Ping (Opnum 5)

The **Ping** method performs a request response test (ping) to the CA.

```
HRESULT Ping(
```


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```
    [in, unique, string] const wchar_t* pwszAuthority
  );
```

pwszAuthority: A null-terminated [UNICODE] string that MUST contain the name of the CA. The CA name MUST be the CN value in the **Subject** field of the CA signing certificates or its sanitized name. The sanitized names algorithm is specified in section 3.1.1.4.1.1.

Return Values: For successful invocation, the CA MUST return 0; otherwise, the CA MUST return a nonzero value.

The processing rules for this method are as follows.

If Config_CA_Interface_Flags contains the value IF_NOREMOTEICERTREQUEST, the server SHOULD return 0x80094011 (CERTSRV_E_ENROLL_DENIED) to the client.<76>

If Config_CA_Interface_Flags contains the value IF_ENFORCEENCRYPTICERTREQUEST and the RPC_C_AUTHN_LEVEL_PKT_PRIVACY authentication level, as defined in [MS-RPCE] section 2.2.1.1.8, is not specified on the RPC connection from the client, the CA MUST refuse to establish a connection with the client by returning a nonzero error.

Upon receiving this invocation, the CA MUST verify the CA name that is passed in the *pwszAuthority* parameter parameter by invoking the processing rules in section 3.2.1.4.2.1.1 with the *CANameString* input parameter set to the CA name passed in the *pwszAuthority* parameter and the *EmptyNameAllowed* input parameter set to true. If false is returned, the CA MUST return the E_INVALIDARG (0x80070057) error code to the client.

3.2.1.4.3 ICertRequestD2

The **ICertRequestD2** interface MUST extend (derive from) the **ICertRequestD** interface specified in this protocol specification. The additional functionality provided by **ICertRequestD2** includes the following:

- Additional CA properties MAY be retrieved from GetCAProperty.
- CA property syntax MAY be retrieved from GetCAPropertyInfo.

The version number for this interface MUST be "1.0". The UUID for this interface MUST be "5422FD3A-D4B8-4CEF-A12E-E87D4CA22E90".

Methods in RPC Opnum Order

Method	Description
Request	Initiates the certificate issuance process. Opnum: 3
GetCACert	Returns property values on the CA. Opnum: 4
Ping	Performs a request response test (ping) to the CA. Opnum: 5
Request2	The **Request2** method requests a certificate from the CA. Opnum: 6

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Method	Description
GetCAProperty	The **GetCAProperty** method retrieves a property value from the CA. Opnum: 7
GetCAPropertyInfo	The **GetCAPropertyInfo** method retrieves a set of property structures from the CA. Opnum: 8
Ping2	The **Ping2** method pings the CA. Opnum: 9

Note Opnums 0, 1, and 2 are reserved for the **IUnknown_QueryInterface**, **AddRef**, and **Release** methods used by the standard COM IUnknown interface, as specified in [MS-DCOM].

3.2.1.4.3.1 ICertRequestD2::Request2 (Opnum 6)

The **Request2** method requests a certificate from the CA. It is similar to the **ICertRequestD::Request** method, but it has an additional parameter, *pwszSerialNumber*, which is specified as follows.

```
HRESULT Request2(
  [in, string, unique] const wchar_t* pwszAuthority,
  [in] DWORD dwFlags,
  [in, string, unique] const wchar_t* pwszSerialNumber,
  [in, out, ref] DWORD* pdwRequestId,
  [out] DWORD* pdwDisposition,
  [in, string, unique] const wchar_t* pwszAttributes,
  [in, ref] const CERTTRANSBLOB* pctbRequest,
  [out, ref] CERTTRANSBLOB* pctbFullResponse,
  [out, ref] CERTTRANSBLOB* pctbEncodedCert,
  [out, ref] CERTTRANSBLOB* pctbDispositionMessage
);
```

pwszAuthority: Identical to the *pwszAuthority* parameter in the **ICertRequestD::Request** method.

dwFlags: Identical to the *dwFlags* parameter in the **ICertRequestD::Request** method.

pwszSerialNumber: A null-terminated [UNICODE] string that specifies a serial number that identifies a certificate. The string MUST specify the serial number as an even number of hexadecimal digits. If necessary, a zero can be prefixed to the number to produce an even number of digits. The string MUST NOT contain more than one leading zero. Information on the serial number is specified in [RFC3280] section 4.1.2.2.

pdwRequestId: Identical to the *pdwRequestId* parameter in the **ICertRequestD::Request** method.

pdwDisposition: Identical to the *pdwDisposition* parameter in the **ICertRequestD::Request** method.

pwszAttributes: Identical to the *pwszAttributes* parameter in the **ICertRequestD::Request** method.

pctbRequest: Identical to the *pctbRequest* parameter in the **ICertRequestD::Request** method.

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pctbFullResponse: Identical to the *pctbCertChain* parameter in the **ICertRequestD::Request** method.

pctbEncodedCert: Identical to the *pctbEncodedCert* parameter in the **ICertRequestD::Request** method.

pctbDispositionMessage: Identical to the *pctbDispositionMessage* parameter in the **ICertRequestD::Request** method.

Return Values: Identical to the return value of the **ICertRequestD::Request** method.

The processing rules for this message MUST be the same as for the information that is specified in 3.2.1.4.2.1.

3.2.1.4.3.1.1 dwFlags Packed Data Requirements

The dwFlags field consists of a set of flags and values that MUST define the *pctbRequest* parameter BLOB and the expected content of the *pctbCertChain* parameter. This field MUST contain packed data specified as follows.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Padding1								Flags								RequestType								Padding2							

Padding1 (1 byte): This field MUST be set to 0 and ignored upon receipt.

Flags (1 byte): This bit-field MUST define options for the server's request processing and the response.

0	1	2	3	4	5	6	7
0	0	Z	0	X	Y	0	0

Where the bits are defined as:

Value	Description
X	If this bit is set, the response MUST include the CRLs for all the certificates returned in the *pctbCertChain* and *pctbEncodedCert* parameters.
Y	If this bit is set, then the response MUST be a CMC full PKI response. If it is not set, the response MUST be a CMS. This bit supported by the ICertRequestD2::Request2 method only.
Z	If this bit is set, this is a renewal request on behalf of another user. The processing rules for this type of request are specified in section 3.2.2.6.2.1.2.4.

RequestType (1 byte): RequestType MUST define the possible formats of the certificate request submitted in the *pctbRequest* parameter (format types are specified in [RFC2797]).

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Value	Meaning
0x00	The client relies on CA to determine the request type. See section 3.2.1.4.2.1.4 for more details.
0x01	The request format MUST be a PKCS #10 request structure.
0x02	The request format MUST be a Netscape KEYGEN request structure.
0x03	The request format MUST be a CMS request structure.
0x04	The request format MUST be a Certificate Management Messages over a CMS (CMC) request structure.

Padding2 (1 byte): This field MUST be set to 0 and ignored upon receipt.

3.2.1.4.3.1.2 Requesting Status Inspection

The caller of the **ICertRequestD2::Request2** can request a status inspection of a certificate request similar to how it is defined in section 3.2.1.4.2.1.4.1.3. If the **pb** field of the *pctbRequest* parameter is NULL, the client has requested a status inspection of a certificate request and the CA MUST follow the rules defined in this section to respond to the request. The rules for processing a status inspection are as follows:

1. If the **pdwRequestId* is 0 and *pwszSerialNumber* is NULL, the CA MUST fail the request with a nonzero error.

2. If the **pdwRequestId* is nonzero and *pwszSerialNumber* is not NULL, the CA MUST fail the request with a nonzero error.

3. If the **pdwRequestId* is nonzero, the CA MUST look up the record in the Request table that is defined in section 3.2.1.1.1 by matching the request ID passed in the *pdwRequestId parameter with the values in the Request_RequestID column. If the lookup failed, the function MUST return the error 0x80094004 (CERTSRV_E_PROPERTY_EMPTY).

4. If *pwszSerialNumber* is not NULL, the CA MUST look up the record in the Request table that is defined in section 3.2.1.1.1 by matching the serial number of the certificate in the *pwszSerialNumber* parameter with the values in the Serial_Number column. If the lookup failed, the function MUST return the error 0x80094004 (CERTSRV_E_PROPERTY_EMPTY).

5. The CA MUST set the value of the *pdwDisposition* parameter by mapping the value of the Request_Disposition column for the located record as described in the table below. The values of the Request_Disposition column are defined in [MS-CSRA] section 3.1.1.1.1.

Request_Disposition column value	pdwDisposition value
foreign certificate	0
request denied	2
certificate issued	3
request pending	5
certificate revoked	6

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Request_Disposition column value	pdwDisposition value
request failed	A nonzero value indicating an error that is not one of the values already defined in this table.

6. If the value of the Request_Disposition column is "certificate issued", the CA MUST return the previously issued certificate through the *pctbEncodedCert* parameter as specified in section 3.2.1.4.2.1.4.7.

7. If the value of the Request_Disposition column is "request denied", the CA SHOULD set the return value to the 0x80094014 (CERTSRV_E_ADMIN_DENIED_REQUEST).<77>

3.2.1.4.3.2 ICertRequestD2::GetCAProperty (Opnum 7)

The **GetCAProperty** method retrieves a property value from the CA.

```
HRESULT GetCAProperty(
  [in, unique, string] const wchar_t* pwszAuthority,
  [in] long PropID,
  [in] long PropIndex,
  [in] long PropType,
  [out, ref] CERTTRANSBLOB* pctbPropertyValue
);
```

pwszAuthority: Contains the name of the CA.

PropID: An integer value that specifies the property to be returned.

Property name	Numerical value	Type/Index	Meaning
CR_PROP_FILEVERSION	0x00000001	String	A string that MUST contain the CA version information.
CR_PROP_PRODUCTVERSION	0x00000002	String	A string that MUST contain the build number of the CA.
CR_PROP_EXITCOUNT	0x00000003	Long	MUST be the number of exit algorithms registered on the CA.
CR_PROP_EXITDESCRIPTION	0x00000004	String indexed	A string that MUST contain the name of the exit algorithm identified by the *PropIndex* parameter.
CR_PROP_POLICYDESCRIPTION	0x00000005	String	A string that MUST contain the description of the policy algorithm on the CA.
CR_PROP_CANAME	0x00000006	String	A string that MUST contain the CN, as specified in

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Property name	Numerical value	Type/Index	Meaning
			[RFC3280], of a CA.
CR_PROP_SANITIZEDCANAME	0x00000007	String	A string that MUST contain the sanitized name of the CA. More information about sanitized name is specified in section 3.1.1.4.1.1.
CR_PROP_SHAREDFOLDER	0x00000008	String	A string that MUST contain the UNC path of a folder that contains the CA information and signature certificates.
CR_PROP_PARENTCA	0x00000009	String	A string that MUST contain the name of the parent CA to the current CA.
CR_PROP_CATYPE	0x0000000A	Long	MUST be a **CAINFO** structure that MUST contain the CA type. More information is specified in section 3.2.1.4.3.2.10.
CR_PROP_CASIGCERTCOUNT	0x0000000B	Long	MUST be the number of signing certificates on the CA.
CR_PROP_CASIGCERT	0x0000000C	Binary, indexed	MUST be a binary object that contains a signing certificate identified by the *PropIndex* parameter.
CR_PROP_CASIGCERTCHAIN	0x0000000D	Binary, indexed	MUST be a binary object that contains the certificate chain for a signing certificate identified by the *PropIndex* parameter.
CR_PROP_CAXCHGCERTCOUNT	0x0000000E	Long	MUST be 0x1.
CR_PROP_CAXCHGCERT	0x0000000F	Binary, indexed	MUST be a binary object that contains the CA's current exchange certificate from the Current_CA_Exchange_Cert datum. The *PropIndex* parameter MUST be 0x0 or 0xFFFFFFFF.
CR_PROP_CAXCHGCERTCHAIN	0x00000010	Binary, indexed	MUST be a binary object that contains the certificate chain for the CA's current exchange

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Property name	Numerical value	Type/Index	Meaning
			certificate from the Current_CA_Exchange_Cert datum. The *PropIndex* parameter MUST be 0x0 or 0xFFFFFFFF.
CR_PROP_BASECRL	0x00000011	Binary, indexed	MUST be a CRL, for a CA signing certificate identified by the *PropIndex* parameter.
CR_PROP_DELTACRL	0x00000012	Binary, indexed	MUST be a delta CRL, for a CA signing certificate identified by the *PropIndex* parameter. For more information about delta CRLs, see [MSFT-CRL]. Additional information is specified in [RFC3280] section 5.2.
CR_PROP_CACERTSTATE	0x00000013	Long indexed	MUST be a byte array that contains the disposition status of all CA signing certificates. Disposition status is specified in section 3.2.1.4.3.2.19.
CR_PROP_CRLSTATE	0x00000014	Long indexed	MUST be a byte array that contains the status for all the CRLs of the CA.
CR_PROP_CAPROPIDMAX	0x00000015	Long	MUST be the maximum property identifier supported by the CA.
CR_PROP_DNSNAME	0x00000016	String	MUST be the fully qualified domain name of the computer on which the CA is installed.
CR_PROP_ROLESEPARATIONENABLED	0x00000017	Long	Indicates whether administrative role separation has been enabled on the CA. A nonzero return value means that role separation has been enabled. Zero means that role separation has not been enabled.
CR_PROP_KRACERTUSEDCOUNT	0x00000018	Long	MUST be the minimum number of KRAs to use when archiving a private key. For more information about KRA usage, see

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Property name	Numerical value	Type/Index	Meaning
			[MSFT-ARCHIVE].
CR_PROP_KRACERTCOUNT	0x00000019	Long	MUST be the maximum number of KRA certificates available on the CA.
CR_PROP_KRACERT	0x0000001A	Binary, indexed	A KRA certificate identified by the *PropIndex* parameter.
CR_PROP_KRACERTSTATE	0x0000001B	Long, indexed	MUST be a byte array that contains the status of the KRA certificates registered with the CA.
CR_PROP_ADVANCEDSERVER	0x0000001C	Long	MUST identify whether the CA operating system is an advanced server platform.
CR_PROP_TEMPLATES	0x0000001D	String	MUST be a collection of name and OID pairs that identify the templates supported by a CA.
CR_PROP_BASECRLPUBLISHSTATUS	0x0000001E	Long, indexed	MUST be the publishing status of a signing certificate base CRL identified by the *PropIndex* parameter.
CR_PROP_DELTACRLPUBLISHSTATUS	0x0000001F	Long, indexed	MUST be the publishing status of a signing certificate delta CRL identified by the *PropIndex* parameter.
CR_PROP_CASIGCERTCRLCHAIN	0x00000020	Binary, indexed	MUST be a binary object that contains the certificate chain for a signing certificate and the CRL for the certificates in the chain identified by the *PropIndex* parameter.
CR_PROP_CAXCHGCERTCRLCHAIN	0x00000021	Binary, indexed	MUST be a binary object for a chain containing CRLs for the CA's current exchange certificate from the Current_CA_Exchange_Cert datum. The *PropIndex* parameter MUST be 0x00000000 or 0xFFFFFFFF.
CR_PROP_CACERTSTATUSCODE	0x00000022	Long, indexed	MUST be an **HRESULT** that identifies the result of

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Property name	Numerical value	Type/Index	Meaning
			certificate validation, as specified in [RFC3280], by the CA for the CA signing certificates identified by the *PropIndex* parameter.
CR_PROP_CAFORWARDCROSSCERT	0x00000023	Binary, indexed	MUST be a forward cross certificate, by index, from a CA. For more information about cross certificates, see [MSFT-CROSSCERT].
CR_PROP_CABACKWARDCROSSCERT	0x00000024	Binary, indexed	MUST be a backward cross certificate, by index, from a CA. For more information about cross certificates, see [MSFT-CROSSCERT].
CR_PROP_CAFORWARDCROSSCERTSTATE	0x00000025	Long, indexed	MUST be a byte array that identifies the status of all backward cross certificates for a CA.
CR_PROP_CABACKWARDCROSSCERTSTATE	0x00000026	Long, indexed	MUST be a byte array that identifies the disposition status of all forward cross certificates for a CA.
CR_PROP_CACERTVERSION	0x00000027	Long, indexed	MUST be an indexed 32-bit integer that contains the version number of a CA signing certificate.
CR_PROP_SANITIZEDCASHORTNAME	0x00000028	String	The property MUST return the sanitized shortened name of the CA. More information about the sanitized name is specified in section 3.1.1.4.1.1.
CR_PROP_CERTCDPURLS	0x00000029	String, indexed	MUST be a null-terminated [UNICODE] string of the format "String1\nString2\n", where each string (separated by '\n') MUST represent a URI to be part of a CRL Distribution Point (CDP) extension, as specified in [RFC3280] section 4.2.1.14.
CR_PROP_CERTAIAURLS	0x0000002A	String, indexed	MUST be a null-terminated [UNICODE] string of the format

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Property name	Numerical value	Type/Index	Meaning
			"String1\nString2\n", where each string (separated by '\n') MUST represent a URI to be part of Authority Information Access extension, as specified in [RFC3280] section 4.2.2.1.
CR_PROP_CERTAIAOCSPRLS	0x0000002B	String, indexed	MUST be a null-terminated [UNICODE] string of the format "String1\nString2\n", where each string (separated by '\n') MUST represent the OCSP URLs configured on the CA, as specified in [RFC3280] section 4.2.2.1.
CR_PROP_LOCALENAME	0x0000002C	String	MUST be a null-terminated [UNICODE] string in the 'Language-Region' format (as specified in [RFC4646]) that represents the locale of the CA.

PropIndex: This parameter is used as the index to a property that can contain multiple values.

PropType: An integer value that specifies the property data type.

Value	Meaning
PROPTYPE_LONG 0x00000001	The property type is a signed long integer or a byte array.
PROPTYPE_BINARY 0x00000003	The property type is binary data.
PROPTYPE_STRING 0x00000004	The property type is a string.

pctbPropertyValue: If the function succeeds, this method returns a **CERTTRANSBLOB** structure in this parameter that contains the property value. If the function fails, the content of this parameter is undefined.

The data type of the value returned depends on the value specified in the *PropType* parameter and the property specified in the *PropID* parameter.

Return Values: For successful invocation, the CA MUST return 0; otherwise, the CA MUST return a nonzero value.

The processing rules for this method are as follows:

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If Config_CA_Interface_Flags contains the value IF_NOREMOTEICERTREQUEST, the server SHOULD return 0x80094011 (CERTSRV_E_ENROLL_DENIED) to the client.<78>

If Config_CA_Interface_Flags contains the value IF_ENFORCEENCRYPTICERTREQUEST and the RPC_C_AUTHN_LEVEL_PKT_PRIVACY authentication level, as defined in [MS-RPCE] section 2.2.1.1.8, is not specified on the RPC connection from the client, the CA MUST refuse to establish a connection with the client by returning a non-zero error.

If the server implements advanced CA functionality, it MUST implement the CR_PROP_CAXCHGCERT property that is specified in section 3.2.1.4.3.2.15.

To return server properties to the client using this method, the server implementation MUST follow the processing rules specified as follows.

1. Validate arguments: The server MUST invoke the processing rules in section 3.2.1.4.2.1.1 with the *CANameString* input parameter set to the CA name passed in the *pwszAuthority* parameter and the *EmptyNameAllowed* input parameter set to false. If false is returned, the CA MUST return the E_INVALIDARG (0x80070057) error code to the client.

2. Returned server property: The server MUST follow the steps that are specified in section 3.2.1.4.3.2.2.

The following table defines the values that MUST be set for the *PropIndex* and *PropType* parameters for each property value passed via the *PropID* parameter.

PropID value	PropIndex MUST be	PropType MUST be
0x01	0x00000000	0x00000004
0x02	0x00000000	0x00000004
0x03	0x00000000	0x00000001
0x04	The minimum index is 0. The maximum value is one less than the value stored in the Config_CA_Exit_Count datum.	0x00000004
0x05	0x00000000	0x00000004
0x06	0x00000000	0x00000004
0x07	0x00000000	0x00000004
0x08	0x00000000	0x00000004
0x09	0x00000000	0x00000004
0x0a	0x00000000	0x00000001
0x0b	0x00000000	0x00000001
0x0c	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table. An index of 0xFFFFFFFF is allowed and indicates the maximum valid index.	0x00000003
0x0d	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table. An index of 0xFFFFFFFF is allowed and indicates the maximum valid index.	0x00000003

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PropID value	PropIndex MUST be	PropType MUST be
0x0e	0x00000000	0x00000001
0x0f	0x00000000. An index of 0xFFFFFFFF is also valid and implies an index of 0x00000000.	0x00000003
0x10	0x00000000. An index of 0xFFFFFFFF is also valid and implies an index of 0x00000000.	0x00000003
0x11	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table. An index of 0xFFFFFFFF is allowed and indicates the maximum valid index.	0x00000003
0x12	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table.	0x00000003
0x13	ANY	0x00000001
0x14	ANY	0x00000001
0x15	0x00000000	0x00000001
0x16	0x00000000	0x00000004
0x17	0x00000000	0x00000001
0x18	0x00000000	0x00000001
0x19	0x00000000	0x00000001
0x1a	The minimum index is 0. The maximum index is one less than value of the Config_CA_KRA_Cert_Count datum.	0x00000003
0x1b	ANY	0x00000001
0x1c	0x00000000	0x00000001
0x1d	0x00000000	0x00000004
0x1e	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table. An index of 0xFFFFFFFF is allowed and indicates the maximum valid index.	0x00000001
0x1f	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table.	0x00000001
0x20	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table.	0x00000003
0x21	0x00000000	0x00000003
0x22	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table. An index of 0xFFFFFFFF is allowed and indicates the maximum valid index.	0x00000001
0x23	The index corresponds to a particular CA signing certificate. Since the last CA signing certificate cannot have a forward cross certificate, the minimum index is 0 and the maximum index is two less than the count of rows in the	0x00000003

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PropID value	PropIndex MUST be	PropType MUST be
	Signing_Cert table.	
0x24	The index corresponds to a particular CA signing certificate. Since the first CA signing certificate cannot have a backward cross certificate, the minimum index is 1 and the maximum index is one less than the count of rows in the Signing_Cert table.	0x00000003
0x25	ANY	0x00000001
0x26	ANY	0x00000001
0x27	ANY	0x00000001
0x28	0x00000000	0x00000004
0x29	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table. An index of 0xFFFFFFFF is allowed and indicates the maximum valid index.	0x00000004
0x2A	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table. An index of 0xFFFFFFFF is allowed and indicates the maximum valid index.	0x00000004
0x2B	The minimum index is 0. The maximum index is one less than the count of rows in the Signing_Cert table.	0x00000004
0x2C	0x00000000	0x00000004

When processing the **GetCAProperty** method, the server MUST determine its behavior based on the requested property ID (*PropID* parameter). All valid property IDs are listed in the preceding table.

The CA MUST return a nonzero error if either of the following conditions is met.

- The value of *PropID* is not listed in the preceding table.
- For a specific *PropID* value, the *PropType* value does not match the required values that are defined in the preceding table.

  For a specific non-indexed *PropID* value, the *PropIndex* value does not match the required values that are defined in the preceding table.

For a specific indexed *PropID* value, if the PropIndex value does not match the required values that are defined in the preceding table, the CA MUST return a nonzero error.

The following sections specify the CA behavior of the method for each requested property ID. The returned property MUST be returned to the caller in the *pctbPropertyValue* parameter as a **CERTTRANSBLOB** structure. The message format for this structure MUST be as specified in section 2.2.2.2 and its subsections.

3.2.1.4.3.2.1 PropID = 0x00000001 (CR_PROP_FILEVERSION) "CA File Version"

The client has requested the CA file version property. If the CA implements the Config_File_Version datum, the CA SHOULD construct a [UNICODE] string of the form "w.x.y.z", where w, x, y, and z MUST be numeric values indicating the version of the CA. The CA MAY construct a [UNICODE] string

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of the form "w.x:y.z".<79> If the CA does not implement the Config_File_Version datum, it MUST return a NULL string. The [UNICODE] string MUST be returned through the **CERTTRANSBLOB (section 2.2.2.2)** structure.<80>

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.2 PropID = 0x00000002 (CR_PROP_PRODUCTVERSION) "CA Product Version"

The client has requested the CA product version property. If the CA implements the Config_Product_Version datum, the CA SHOULD construct a [UNICODE] string of the form "w.x.y.z", where w, x, y, and z MUST be numeric values indicating the version of the server hosting the CA, which might or might not match the version of the CA returned for the previous property. The CA MAY construct a [UNICODE] string of the form "w.x:y.z". <81> If the CA does not implement the Config_Product_Version datum, it MUST return a NULL string. The [UNICODE] string MUST be returned through the **CERTTRANSBLOB (section 2.2.2.2)** structure.<82>

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.3 PropID = 0x00000003 (CR_PROP_EXITCOUNT) "Exit Count"

The client has requested the count of exit algorithms installed on the CA. The CA MUST return the number stored in the Config_CA_Exit_Count datum. The returned value is returned through the **cExitAlgorithms** field of a **CAINFO** structure in the returned **CERTTRANSBLOB (section 2.2.2.2)** structure.<83>

If the CA does not implement the Config_CA_Exit_Count datum or does not implement any exit algorithms, the CA MUST return 0.

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.4 PropID = 0x00000004 (CR_PROP_EXITDESCRIPTION) "Exit Description"

The client has requested the text description for a particular exit algorithm. The client has indicated the particular algorithm by using the PropIndex parameter.

The CA MUST return a value that is stored in the Config_CA_Exit_Description_List at the position that is specified by the PropIndex parameter. The value is passed as a [UNICODE] string through a **CERTTRANSBLOB (section 2.2.2.2)** structure. If the index provided by the client is out of range for the Config_CA_Exit_Description_List, the CA MUST return a nonzero error code. The error code SHOULD be ERROR_FILE_NOT_FOUND (0x80070002).

If the CA does not implement the Config_CA_Exit_Description_List, the CA MUST return a null-terminated [UNICODE] string through a **CERTTRANSBLOB** structure.

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.<84>

3.2.1.4.3.2.5 PropID = 0x00000005 (CR_PROP_POLICYDESCRIPTION) "Policy Description"

The client has requested the text description of the policy algorithm.

The CA MUST return the value of the Config_CA_Policy_Description datum. The returned value MUST be returned as a [UNICODE] string through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

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If the CA does not implement the Config_CA_Policy_Description datum, it MUST return a NULL [UNICODE] string through a **CERTTRANSBLOB** structure.

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.1.<85>

3.2.1.4.3.2.6 PropID = 0x00000006 (CR_PROP_CANAME) "Certification Authority Name"

The client has requested the common name of the CA.

The CA MUST return the value of the CN attribute of the **Subject** field in the CA signing certificate found in the Signing_Cert_Certificate column in the indexed row of the Signing_Cert table specified by the *PropIndex* parameter as a [UNICODE] string, through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

Marshaling rules for the **CERTTRANSBLOB** structure are specified in section 2.2.2.2.

3.2.1.4.3.2.7 PropID = 0x00000007 (CR_PROP_SANITIZEDCANAME) "Sanitized CA Name"

The client has requested the common name of the certification authority (CA) in the sanitized form. The name of the CA returned in this property is taken from the CN attribute of the **Subject** field in the CA signing certificate, and is then sanitized. More information about the Windows sanitizing name algorithm is specified in section 1.3.2.4.

The CA MUST return a sanitized value (as specified in section 3.1.1.4.1.1) of the CN attribute of the **Subject** field in the CA signing certificate found in the Signing_Cert_Certificate column in the indexed row of the Signing_Cert table specified by the *PropIndex* parameter as a [UNICODE] string, through a **CERTTRANSBLOB** structure.

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.8 PropID = 0x00000008 (CR_PROP_SHAREDFOLDER) "Shared Folder Path"

The client has requested the UNC path that is used as a shared folder for the CA. If the CA implements the Config_Configuration_Directory data, the CA MUST return its value as a [UNICODE] string, through a **CERTTRANSBLOB (section 2.2.2.2)** structure. If the CA does not implement the Config_Configuration_Directory data, the CA MUST return a nonzero error. The error SHOULD be 0x80070002. For more information about Windows implementation and usage for shared folders, see [MSFT-SHAREDFOLDER].<86>

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.9 PropID = 0x00000009 (CR_PROP_PARENTCA) "Parent CA Name"

The client has requested the name of the parent of the CA.

If the CA is a root CA, it has no parent and the server MUST return a non-zero error code.

If the CA implements the Config_CA_Parent_DNS datum, then the CA MUST return this name as a [UNICODE] string, through a **CERTTRANSBLOB (section 2.2.2.2)** structure. The format of the name SHOULD be Parent-FQDN + "\" + Parent-CommonName. Otherwise, the CA MUST return an empty string.

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

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3.2.1.4.3.2.10 PropID = 0x0000000A (CR_PROP_CATYPE) "CA Type"

The client requested the type of the CA.

- If the CA signing certificate that is stored in the Signing_Cert_Certificate column is a **root certificate**, the CA MUST return 0x00000003. Otherwise, the CA MUST return 0x00000004.

The CA MUST return its type through the **CAType** field of a **CAINFO (section 2.2.2.4)** structure. The server MUST return the **CAINFO** structure through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

Marshaling rules for the **CERTTRANSBLOB** structure are specified in section 2.2.2.2.

3.2.1.4.3.2.11 PropID = 0x0000000B (CR_PROP_CASIGCERTCOUNT) "CA Signature Certificate Count"

The client has requested the count of signature certificates on the CA. The CA SHOULD return the count of rows in the Signing_Cert Table. The CA MUST return the count through the **cCASignatureCerts** field of a **CAINFO (section 2.2.2.4)** structure. The CA MUST return the **CAINFO** (section 2.2.2.4) structure through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.12 PropID = 0x0000000C (CR_PROP_CASIGCERT) "CA Signature Certificate"

The client has requested a particular signing certificate.

The CA SHOULD retrieve the CA certificate from the Signing_Cert_Certificate column in the row indexed by the value of the *PropIndex* parameter. The CA MUST return the signature certificate in X509 format, as specified in [X660]. The CA MUST return the value through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

Marshaling rules for the **CERTTRANSBLOB** structure are specified in section 2.2.2.2.

3.2.1.4.3.2.13 PropID = 0x0000000D (CR_PROP_CASIGCERTCHAIN) "CA signing certificate Chain"

The client has requested a particular signing certificate and its complete chain. The CA SHOULD retrieve the CA certificate from the Signing_Cert_Certificate column in the row indexed by the value of the *PropIndex* parameter. The CA SHOULD return the chain of this certificate as specified in [RFC3280] section 3.2. The CA MUST return the certificate chain through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

Marshaling rules for the **CERTTRANSBLOB** structure are specified in section 2.2.2.2.

3.2.1.4.3.2.14 PropID = 0x0000000E (CR_PROP_CAXCHGCERTCOUNT) "CA Exchange Certificate Count"

The client has requested the count of exchange certificates on the CA. The CA MUST return 0x1 through the **cCAExchangeCerts** field of a **CAINFO** structure. The CA MUST return the **CAINFO** structure through a **CERTTRANSBLOB (section 2.2.2.2)** structure. For more information, see [MSFT-ARCHIVE].

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

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3.2.1.4.3.2.15 PropID = 0x0000000F (CR_PROP_CAXCHGCERT) "CA Exchange Certificate"

The client has requested the CA exchange certificate. The CA MUST follow these processing rules to process the client's request:

1. If the *PropIndex* parameter is not equal to 0x0 or 0xFFFFFFFF, return the E_INVALIDARG (0x80070057) error to the client.
2. If Current_CA_Exchange_Cert element is NULL, load exchange certificate as follows:
   - Clear all contents from the Store_CA_Exchange_Cert list and set it back to NULL
   - Read each entry from the Config_CA_Exchange_Cert list. For each entry:
     - Retrieve the certificate from the request database by finding the row with Certificate_Hash equal to the Config_CA_Exchange_Cert entry value.
     - If the certificate is found and it meets the following criteria, add it to the Store_CA_Exchange_Cert element.
       - The certificate is within its validity period.
       - The issuer name of the certificate matches the subject name of the current CA signing certificate.
       - The public key that signed the certificate matches the public key of the current CA signing certificate.
   - Populate the Current_CA_Exchange_Cert element with the certificate from Store_CA_Exchange_Cert with the latest NotAfter date.
3. If no entries were found in Config_CA_Exchange_Cert above, or if no certificates met the criteria to be added to Store_CA_Exchange_Cert above, or if Current_CA_Exchange_Cert is not NULL and any of the following is true:
   - Current_CA_Exchange_Cert is not within its validity period.
   - Current_CA_Exchange_Cert is revoked.

   Create a new exchange certificate as specified in section 3.2.1.4.3.2.15.1. Then go through the list Store_CA_Exchange_Cert and add the hash value of each certificate, including the new exchange certificate, to the Config_CA_Exchange_Cert list.
4. By this point there should be a valid exchange certificate in Current_CA_Exchange_Cert. Return the contents of this datum by marshaling it in a **CERTTRANSBLOB (section 2.2.2.2)** structure as specified in section 2.2.2.2.2. Marshaling rules for the **CERTTRANSBLOB** structure are specified in section 2.2.2.2.

3.2.1.4.3.2.15.1 Creating a CA Exchange Certificate

The CA MUST perform the following steps to create an exchange certificate.

1. Determine the role of the machine that the CA is running on by performing external behavior consistent with locally invoking DsRolerGetPrimaryDomainInformation (specified in [MS-DSSP] section 3.2.5.1), using the following parameters:
   - Set the *hBinding* parameter to NULL.

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- Set the *InfoLevel* parameter to DsRolePrimaryDomainInfoBasic.

If the MachineRole field of the returned DomainInfo structure is not equal to DsRole_RoleStandaloneWorkstation or DsRole_RoleStandaloneServer, then perform the following steps.

1. Invoke the "Initialize ADConnection" task ([MS-ADSO] section 6.2.6.1.1) to construct an **ADConnection** with the following parameters:

   - *TaskInputTargetName*: NULL.

   - *TaskInputPortNumber*: If the value of the Config_CA_LDAP_Flags datum has 0x0000001 (LDAPF_SSLENABLE) bit set, use port 636 Otherwise use port 389.

2. Invoke the "Setting an LDAP Option on an ADConnection" task ([MS-ADSO] section 6.2.6.1.2) once for each of the pairs of option and value parameters in the following table. For each of these, the *TaskInputADConnection* parameter is the **ADConnection** handle created in the previous step.

TaskInputOptionName	TaskInputOptionValue
LDAP_OPT_GETDSNAME_FLAGS	Bitwise OR of the bits D and R, as defined in [MS-NRPC] section 3.5.4.3.1
LDAP_OPT_REFFERALS	If Config_AD_Connection_Referral ADM element is FALSE, set to FALSE
LDAP_OPT_PROTOCOL_VERSION	2

3. If the value of the Config_CA_LDAP_Flags datum does not have the 0x0000002 (LDAPF_SIGNDISABLE) bit set and:

   - If after invoking the processing rules that are specified in section 3.2.2.1.6 with input parameter **InputADConnectionHandle** set equal to **ActiveDirectory_Connection**, the returned value is TRUE (that is, DC supports signing) set LDAP_OPT_SIGN to TRUE.

   - Else, if the Config_CA_LDAP_Flags datum does not have the 0x0000001 (LDAPF_SSLENABLE) bit set, return 0x80094013 (CERTSRV_E_DOWNLEVEL_DC_SSL_OR_UPGRADE) to the client and exit.

4. Invoke the "Performing an LDAP Bind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.4) with the following parameter:

   TaskInputADConnection: The **ADConnection** handle generated in the previous step

   If the *TaskReturnStatus* returned is not 0:

   - Repeat step 1.2 with the following modification:

     - *TaskInputOptionName*: LDAP_OPT_GETDSNAME_FLAGS

     - *TaskInputOptionValue*: Bitwise OR of the bits A, D, and R, as defined in [MS-NRPC] section 3.5.4.3.1

   - Repeat this step (1.4). If the *TaskReturnStatus* returned is not 0, go to step 2.

5. Obtain the distinguished name for the Certificate Templates Container (section 2.2.2.11.1), as specified in the following steps:

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- Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:
  - TaskInputADConnection: The **ADConnection** handle generated in the previous step
  - *TaskInputRequestMessage*: LDAP SearchRequest message (see [RFC2251] section 4.5.1), as follows:
    - baseObject: distinguished name of the rootDSE object as specified in [MS-ADTS] section 3.1.1.3.2.1
    - scope: baseObject
    - filter: (objectCategory=*)
    - attributes: The CA SHOULD use the following attributes:
      - configurationNamingContext
      - defaultNamingContext
    - sizeLimit: 10000
    - timeLimit: 120
    - derefAliases: neverDerefAliases
    - typesOnly: FALSE
  - *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search.

  If the *TaskReturnStatus* returned is not 0, go to step 2.
- Build the distinguished name by concatenating the "CN=Certificate Templates,CN=Public Key Services,CN=Services, CN=Configuration" path and the value for **configurationNamingContext** attribute from the previous step.

6. Read all objects under the Certificate Templates Container as follows:

   Repeat the previous step with the following modifications:

   - baseObject: distinguished name of the Certificate Templates Container obtained in the previous step.
   - scope: wholeSubtree
   - filter: (objectCategory=pKICertificateTemplate)
   - attributes: The CA SHOULD use the following attributes:
     - cn
     - flags
     - ntSecurityDescriptor
     - revision

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- pKICriticalExtensions
- pKIDefaultCSPs
- pKIDefaultKeySpec
- pKIEnrollmentAccess
- pKIExpirationPeriod
- pKIExtendedKeyUsage
- pKIKeyUsage
- pKIMaxIssuingDepth
- pKIOverlapPeriod
- msPKI-Template-Schema-Version
- msPKI-Template-Minor-Revision
- msPKI-RA-Signature
- msPKI-Minimal-Key-Size
- msPKI-Cert-Template-OID
- msPKI-Supersede-Templates
- msPKI-RA-Policies
- msPKI-RA-Application-Policies
- msPKI-Certificate-Policy
- msPKI-Certificate-Application-Policy
- msPKI-Enrollment-Flag
- msPKI-Private-Key-Flag
- msPKI-Certificate-Name-Flag

If the *TaskReturnStatus* returned is not 0, go to step 2.

7. If a certificate template with a **commonName** attribute equal to "CAExchange" (case-insensitive comparison) was read in the previous step and CA has the permission to enroll for that template (by invoking the processing rules in Verify End Entity Permissions (section 3.2.2.6.2.1.4.3) with input parameter **Input_ntSecurityDescriptor** set equal to the **ntSecurityDescriptor** attribute of the CAExchange certificate template and **Input_SID** set equal to **CA_SID** ADM element), create the exchange certificate based on the attribute value processing specified in sections 3.2.2.6.2.1.4.4 and 3.2.2.6.2.1.4.5.

2. If an exchange certificate wasn't created in previous steps, create it by adding the following fields and extensions:

   1. For the Subject of the exchange certificate, a common name attribute is used with a value the same as the value of the common name attribute in the subject information of the CA signing

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certificate (Signing_Cert_Certificate datum) and appending "-Xchg" to the value. The Issuer field is filled with the same value as the Subject field.

2. Key Usage extension with KeyEncipherment bit enabled. Key Usage extension is specified in [RFC3280] section 4.2.1.3.

3. Extended Key Usage extension containing the OID szOID_KP_CA_EXCHANGE (1.3.6.1.4.1.311.21.5) as the KeyPurposeId. Extended Key Usage extension is specified in [RFC3280] section 4.2.1.13.

4. Application Policies extension containing the OID szOID_KP_CA_EXCHANGE (1.3.6.1.4.1.311.21.5) as the Application Policy OID. Application Policies extension is specified in section 2.2.2.7.7.3.

5. Certificate Template Common Name extension with the value of Name as "CAExchange". Encoding a Certificate Template Common Name Extension is specified in section 2.2.2.7.7.1.

6. If the CA signing certificate contains a Certificate Policies extension, add this extension with the same value as in the CA signing certificate (Signing_Cert_Certificate datum). Certificate Policies extension is specified in [RFC3280] section 4.2.1.5.

7. If the CA signing certificate contains an Authority Key Identifier extension, add this extension with the same value as in the CA signing certificate (Signing_Cert_Certificate datum). Authority Key Identifier extension is specified in [RFC3280] section 4.2.1.1.

8. If the CA signing certificate contains a Subject Key Identifier extension, add this extension with the same value as in the CA signing certificate (Signing_Cert_Certificate datum). Subject Key Identifier extension is specified in [RFC3280] section 4.2.1.2.

9. If the CA signing certificate contains an Authority Information Access extension, add this extension with the same value as in the CA signing certificate (Signing_Cert_Certificate datum). Authority Information Access extension is specified in [RFC3280] section 4.2.2.1.

10. If the CA signing certificate contains a CRL Distribution Point extension, add this extension with the same value as in the CA signing certificate (Signing_Cert_Certificate datum). CRL Distribution Point extension is specified in [RFC3280] section 4.2.1.14.

11. The value for Valid From field is the date and time when the request for CA exchange certificate was received minus the value of the Config_CA_Clock_Skew_Minutes data. The Valid To field is set to one week later. Valid From and Valid To are specified in [RFC3280] section 4.1.2.5.

12. The serial number SHOULD be generated as specified in section 3.2.1.4.2.1.4.5 and stored in the Serial Number field. The Serial Number field is specified in [RFC3280] section 4.1.2.2.

13. The value for the Signature Algorithm field is the name of the CA signing algorithm. The Signature Algorithm field is specified in [RFC3280] section 4.1.1.2.

14. The value for the Subject Public Key field is the public key associated with the exchange certificate. The Subject Public Key field is specified in [RFC3280] section 4.1.

3. Store the created certificate as follows:

   - Store the certificate as an entry in the request table.

   - Add the x.509 certificate to the Store_CA_Exchange_Cert list of certificates and set it as the Current_CA_Exchange_Cert data element value.

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- Delete the list of hash values from the Config_CA_Exchange_Cert datum.

4. The CA MUST create a new row in the Request table and set the following values:
   - Request_Request_ID: Assign a unique value in this column.
   - Request_Disposition: Assign the value "certificate issued".
   - Request_Raw_Request: Set to empty.

   In addition, the CA SHOULD store the following request parameters in the Request table.

Column name	Value
Request_Raw_Old_Certificate	Empty
Request_Request_Attributes	Empty
Request_Request_Type	Empty
Request_Request_Flags	0x0000000C (The bitwise OR of CR_FLG_CAXCHGCERT flag and CR_FLG_FORCEUTF8 flag. For more details see [MS-CSRA] section 3.1.1.1.2.)
Request_Status_Code	0x00000000 (The operation completed successfully.)
Request_Submitted_When	The time the request for CA exchange server was received by the CA.
Request_Resolved_When	The time the CA completed the processing for the CA exchange certificate.
Request_Requester_Name	The value of **CA_Account_Name** ADM element.
Request_Caller_Name	The value of **Per_Request.Caller_Account_Name** ADM element.
Request_Signer_Policies	Empty
Request_Signer_Application_Policies	Empty
Request_Officer	Empty
Request_Distinguished_Name	The distinguished name (DN) from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Raw_Name	The Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Country	The Country attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Organization	The Organization attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Org_Unit	The Organizational-Unit attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).

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Column name	Value
Request_Common_Name	The Common Name attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Locality	The Locality attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_State	The Province name attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Title	The Title attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Given_Name	The Given Name attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Initials	The Initials attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_SurName	The Surname attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Domain_Component	The Domain Component attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Email	The Email Address attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Street_Address	The Street Address attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Unstructured_Name	The Unstructured Name attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Unstructured_Address	The Unstructured Address attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).
Request_Device_Serial_Number	The Device Serial Number attribute from the DN from the Subject field of the CA exchange certificate (Config_CA_Exchange_Cert datum).

3.2.1.4.3.2.16 PropID = 0x00000010 (CR_PROP_CAXCHGCERTCHAIN) "CA Exchange Certificate Chain"

The client has requested the CA exchange certificate and its complete chain. The CA MUST follow these processing rules to process the client's request:

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1. If *PropIndex* parameter is not equal to 0x0 or 0xFFFFFFFF, return the E_INVALIDARG (0x80070057) error to the client.

2. Validate that the Current_CA_Exchange_Cert datum contains a current, valid CA exchange certificate by executing steps 2 and 3 in section 3.2.1.4.3.2.15.

3. Construct a signed CMS message with the following fields:

   - ContentType: szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData).

   - Content: SignedData (as specified in [RFC3852], section 5.1) with the following requirements:

     - version: See section [RFC3852], section 5.1.

     - digestAlgorithms: Same digest algorithm as was used to sign current CA's certificate stored in Signing_Cert_Certificate datum.

     - encapContentInfo: EncapsulatedContentInfo structure (as specified in [RFC3852], section 5.2) with the **eContentType** set to the OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1, id-data) and the **eContent** field set to the CA's exchange certificate from the Current_CA_Exchange_Cert datum.

     - certificates: Contains CA's certificate stored in the Signing_Cert_Certificate datum and its parent certificates excluding the root certificate. To obtain parent certificates, the CA SHOULD use Authority Information Access (AIA) extension of its certificate and its parent certificates. The AIA extension is specified in [RFC3280] section 4.2.2.1.

     - crls: Not used.

     - signerInfos: Not used.

4. Return the CMS message through a CERTTRANSBLOB structure (as specified in section 2.2.2.2). Marshaling rules for the **CERTTRANSBLOB** structure are specified in section 2.2.2.2.

3.2.1.4.3.2.17 PropID = 0x00000011 (CR_PROP_BASECRL) "Base CRL"

The client has requested a particular base CRL. If the CA implements the CRL table, then it MUST return the value of the CRL_Raw_CRL datum from the following row:

- The value of the Base_Or_Delta column is equal to Base.

- The value of the CRL_Name_Id is equal to the value of the PropIndex parameter.

- The value of the Publish_Date column is the newest among the rows that meet the preceding criteria.

Otherwise, the CA MUST return an empty **CERTTRANSBLOB (section 2.2.2.2)** structure. The CA MUST return the base CRL in X.509 format, as specified in [X660]. The CA MUST return the value through a **CERTTRANSBLOB** (section 2.2.2.2) structure.

Marshaling rules for the **CERTTRANSBLOB** structure are specified in section 2.2.2.2.4.

3.2.1.4.3.2.18 PropID = 0x00000012 (CR_PROP_DELTACRL) "Delta CRL"

The client has requested a particular delta CRL. If the CA implements the CRL table, then it MUST return the value of the CRL_Raw_CRL datum from the following row:

- The value of the Base_Or_Delta column is equal to Delta.

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- The value of the CRL_Name_Id is equal to the value of the PropIndex parameter.
- The value of the Publish_Date column is the newest among the rows that meet the aforementioned criteria.

Otherwise, the CA MUST return an empty **CERTTRANSBLOB (section 2.2.2.2)** structure. The CA MUST return the delta CRL in X.509 format, as specified in [X660]. The CA MUST return the delta CRL through a **CERTTRANSBLOB** (section 2.2.2.2) structure.

Marshaling rules for the **CERTTRANSBLOB** structure are specified in section 2.2.2.2.

3.2.1.4.3.2.19 PropID = 0x00000013 (CR_PROP_CACERTSTATE) "CA Signing Certificates State"

The client has requested the disposition status of all CA signing certificates.

If the server implements the Signing_Cert Table, it MUST validate all the signing certificates stored in the Signing_Cert_Certificate column.

The server MUST return a byte array that contains the status. The value used MUST be one of the following.

Value	Meaning
CA_DISP_INCOMPLETE (0x00)	The signing certificate is incomplete.
CA_DISP_ERROR (0x01)	The signing certificate is unavailable.
CA_DISP_REVOKED (0x02)	The signing certificate has been revoked.
CA_DISP_VALID (0x03)	The signing certificate is valid.
CA_DISP_INVALID (0x04)	The signing certificate has expired.

The CA MUST return the byte array in a **CERTTRANSBLOB (section 2.2.2.2)** structure. The first byte MUST identify the status of the signing certificate in row 1 of the Signing_Cert table, and the second byte MUST identify the status of the signing certificate in the second row of the Signing_Cert table. Subsequent bytes MUST repeat this pattern so that byte *n* MUST contain the disposition of the signing certificate in row *n*.

3.2.1.4.3.2.20 PropID = 0x00000014 (CR_PROP_CRLSTATE) "CA CRL State"

The client has requested to identify which signing certificate is associated with the key used to publish CRLs.

The CA MUST do the following for each one of the rows in Signing_Cert table:

- The CA MUST evaluate the certificate status stored in the Signing_Cert_Certificate column by building its chain based on the specification defined in [RFC3280].
- If the certificate is not valid the CA should use one of the status codes in the following table as the status for this signing certificate.
- If the signing certificate is valid, the CA MUST evaluate the base CRL stored in the CRL_Raw_CRL column of the CRL table row where the value of CRL_Name_Id is equal to the row of the preceding signing certificate and verify that it was signed by the key associated with the signing certificate stored in the Signing_Cert_Certificate column. If the signature does not match to the

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public key of the signing certificate, then the CA MUST return the status 0x01 as specified in the following table.

- If the signing certificate is valid and its associated key was used to sign the base CRL stored in the same row, the CA MUST return 0x00 as the status for this signing certificate.

The CA MUST return a byte array that identifies whether a certificate has been used to publish a CRL. Each byte in the array MUST have one of the values in the following table.

Value	Meaning
CA_DISP_ERROR (0x01)	This indexed signing certificate is not associated with the key used to generate the CRL.
CA_DISP_REVOKED (0x02)	This indexed signing certificate was revoked and its associated key MUST NOT be used to sign CRLs.
CA_DISP_VALID (0x03)	This indexed signing certificate is associated with the key used to sign the last CRL.
CA_DISP_INVALID (0x04)	The indexed signing certificate has expired and the associated key MUST NOT be used to sign CRLs.

The CA MUST return the byte array in a **CERTTRANSBLOB (section 2.2.2.2)** structure. The first byte MUST specify the status of the first signing certificate, and the second byte MUST specify the status of the second signing certificate. Subsequent bytes MUST repeat this pattern.

3.2.1.4.3.2.21 PropID = 0x00000015 (CR_PROP_CAPROPIDMAX) "Maximum Property ID"

The client has requested to know the maximum value for the *PropID* parameter. If the CA implements the Config_Max_Property_ID data, the CA MUST return the value of this data. Otherwise, the CA MUST return the value 0.

The CA MUST return the number through the **lPropIDMax** field of a **CAINFO (section 2.2.2.4)** structure. The CA MUST return the **CAINFO** (section 2.2.2.4) through a **CERTTRANSBLOB (section 2.2.2.2)** structure.<87>

3.2.1.4.3.2.22 PropID = 0x00000016 (CR_PROP_DNSNAME) "CA Fully Qualified DNS"

The client has requested to know the FQDN of the server that hosts the CA. If the CA implements the Config_FQDN data, then the CA MUST return the value of this data. Otherwise, the CA MUST return an empty string. The CA MUST return the FQDN as a [UNICODE] string through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.23 PropID = 0x00000017 (CR_PROP_ROLESEPARATIONENABLED) "Role Separated Enabled"

The client requested to know whether the role separation feature is enabled on the CA.

If the CA implements the Config_CA_Role_Separation data, the CA must return a value listed in the following table.

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Stored value	CA MUST return
Role_Separation_Enabled	1
Role_Separation_Disabled	0

If the CA does not implement this data, the CA MUST return a nonzero error code. The error code SHOULD be E_INVALIDARG (0x80070057).<88>

The CA MUST return the value through the **lRoleSeparationEnabled** field of a **CAINFO (section 2.2.2.4)** structure. The CA MUST return the **CAINFO** (section 2.2.2.4) through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.24 PropID = 0x00000018 (CR_PROP_KRACERTUSEDCOUNT) "Count Of Required KRAs For Archival"

The client has requested to know how many KRAs are required to be used when archiving a private key on the CA.

If the CA implements the Config_CA_KRA_Cert_Count data, then the CA MUST return the value of this data; otherwise, the CA MUST return 0.

The CA MUST return the count through the **cKRACertUsedCount** field of a **CAINFO (section 2.2.2.4)** structure. The CA MUST return the **CAINFO** (section 2.2.2.4) through a **CERTTRANSBLOB (section 2.2.2.2)** structure.<89>

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.25 PropID = 0x00000019 (CR_PROP_KRACERTCOUNT) "Count Of Registered KRAs"

The client has sent a request for the number of KRAs registered and available for the CA.

If the CA implements the Config_CA_KRA_Cert_List datum, then the CA MUST return the count of items in this list; otherwise, the CA MUST return 0.

The CA MUST return the count through the **cKRACertCount** field of a **CAINFO (section 2.2.2.4)** structure. The CA MUST return the **CAINFO** (section 2.2.2.4) through a **CERTTRANSBLOB (section 2.2.2.2)** structure. For more information, see [MSFT-ARCHIVE].

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.26 PropID = 0x0000001A (CR_PROP_KRACERT) "KRA Certificate"

The client has requested a particular KRA certificate. The client MUST specify the required index for the certificate in the Config_CA_KRA_Cert_List through the *PropIndex* parameter. The CA SHOULD retrieve the KRA certificate from the Config_CA_KRA_Cert_List list at the specified index. Otherwise, the CA MUST return an empty **CERTTRANSBLOB (section 2.2.2.2)** structure.

The CA MUST return the KRA certificate in X.509 format, as specified in [X660]. The CA MUST return the certificate through a **CERTTRANSBLOB** structure.

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Marshaling rules for the **CERTTRANSBLOB** structure are specified in section 2.2.2.2. If the index provided by the client is out of range for the Config_CA_KRA_Cert_List, the CA MUST return a nonzero error code. The error code SHOULD be 0x80070002 (ERROR_FILE_NOT_FOUND).

3.2.1.4.3.2.27 PropID = 0x0000001B (CR_PROP_KRACERTSTATE) "KRA Certificates State"

The client has sent a request for the state of all registered KRA certificates. If the CA implements the Config_CA_KRA_Cert_List data, then the CA MUST return a byte array that contains the status for each of the KRAs in the Config_CA_KRA_Cert_List data. The value used MUST be one of the following.

Value	Meaning
KRA_DISP_EXPIRED (0x00)	The certificate has expired.
KRA_DISP_NOTFOUND (0x01)	The certificate was not found.
KRA_DISP_REVOKED (0x02)	The certificate has been revoked.
KRA_DISP_VALID (0x03)	The certificate is valid.
KRA_DISP_NOTLOADED (0x04)	The certificate is not loaded.
KRA_DISP_INVALID (0x05)	The certificate is invalid.
KRA_DISP_UNTRUSTED (0x06)	The certificate is not trusted.

The CA MUST return the byte array in a **CERTTRANSBLOB (section 2.2.2.2)** structure. The first byte MUST identify the status for the first KRA certificate in the list, and the second byte MUST identify the same for the second KRA certificate. Subsequent bytes MUST repeat this pattern. For more information, see [MSFT-ARCHIVE].

If the CA does not implement the Config_CA_KRA_Cert_List data, the CA MUST return a non-zero error.

3.2.1.4.3.2.28 PropID = 0x0000001C (CR_PROP_ADVANCEDSERVER) "Advanced Server"

The client requested to know whether the operating system that hosts the CA is an advanced server. If the CA implements the Config_SKU data, then it MUST inspect its value: If the value is Advanced_SKU, the CA MUST return 1; if the value is Standard_SKU or if the data is not implemented, the CA MUST return 0.

The CA MUST return this information through the **fAdvancedServer** field of a **CAINFO (section 2.2.2.4)** structure. The CA MUST return the **CAINFO** (section 2.2.2.4) structure through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

Marshaling rules for the **CERTTRANSBLOB** (section 2.2.2.2) structure are specified in section 2.2.2.2.

3.2.1.4.3.2.29 PropID = 0x0000001D (CR_PROP_TEMPLATES) "Configured Certificate Templates"

The client requested to know the list of certificate templates that are configured for this CA.

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The server MUST return an empty **CERTTRANSBLOB (section 2.2.2.2)** structure.

3.2.1.4.3.2.30 PropID = 0x0000001E (CR_PROP_BASECRLPUBLISHSTATUS) "Base CRL Publishing Status"

The client requested the publishing status of a particular base CRL.

If the CA does not implement the CRL_Publish_Flags column in the CRL table data, it MUST return 0. If the CA implements the CRL_Publish_Flags column, it MUST identify the publishing status by specifying a ULONG value that is a bitwise OR of the CPF_BASE flag and one or more of the other values specified in the table in [MS-CSRA] section 3.1.1.4.1 for the CRL_Publish_Flags element, except for the CPF_DELTA flag, which is never set for this call.

The CA MUST return the publishing status in a **CERTTRANSBLOB (section 2.2.2.2)** structure. The **pb** member of the structure MUST point to a ULONG in little-endian format that contains the publishing status as defined earlier. The **cb** member MUST contain the length of a ULONG.

3.2.1.4.3.2.31 PropID = 0x0000001F (CR_PROP_DELTACRLPUBLISHSTATUS) "Delta CRL Publishing State"

The client requested the publishing status of a particular delta CRL.

If the CA does not implement the CRL_Publish_Flags column or has not published any Delta CRLs, it MUST return a non-zero error.

If the CA implements the CRL_Publish_Flags column, it MUST identify the publishing status by using a ULONG value that is a bitwise OR of the CPF_DELTA flag and one or more of the other values that are specified in the table in [MS-CSRA] section 3.1.1.4.1 for the CRL_Publish_Flags element, except for the CPF_BASE flag, which is never set for this call.

The CA MUST return the publishing status in a **CERTTRANSBLOB** structure. The pb member of the structure MUST point to a ULONG in a little-endian format that contains the publishing status as defined earlier. The cb member MUST contain the length of a ULONG.

The revocation process is specified in [RFC3280].

3.2.1.4.3.2.32 PropID = 0x00000020 (CR_PROP_CASIGCERTCRLCHAIN) "CA Signing Certificate Chain and CRL"

The client has requested a particular signing certificate, its complete chain, and all relevant CRLs. The CA MUST retrieve the CA certificate from the Signing_Cert_Certificate column in the row indexed by the value of the *PropIndex* parameter. The CA MUST return the chain of this certificate and all associated CRLs in a CMS format, as specified in [X660]. The CA MUST return the certificate chain through a **CERTTRANSBLOB** structure (as specified in section 2.2.2.2.3).

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

3.2.1.4.3.2.33 PropID = 0x00000021 (CR_PROP_CAXCHGCERTCRLCHAIN) "CA Exchange Certificate Chain and CRL"

The client has requested the CA exchange certificate, its complete chain, and all relevant CRLs. The CA MUST follow these processing rules to process a client's request:

1. If the *PropIndex* parameter is not equal to 0x0 or 0xFFFFFFFF, return the E_INVALIDARG (0x80070057) error to the client.

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2. Validate that the Current_CA_Exchange_Cert datum contains a current, valid CA exchange certificate by executing steps 2 and 3 in section 3.2.1.4.3.2.15.

3. Construct a signed CMS message with the following fields:

   - ContentType: szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData).

   - Content: SignedData (as specified in [RFC3852] section 5.1) with the following requirements:

     - version: See [RFC3852] section 5.1.

     - digestAlgorithms: Same digest algorithm as was used to sign current CA's certificate stored in Signing_Cert_Certificate datum.

     - encapContentInfo: EncapsulatedContentInfo structure (as specified in [RFC3852] section 5.2) with the eContentType set to the OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1) and the eContent field set to the CA's exchange certificate from the Current_CA_Exchange_Cert datum.

     - certificates: Contains the CA's certificate stored in the Signing_Cert_Certificate datum and its parent certificates excluding the root certificate. To obtain parent certificates, the CA SHOULD use Authority Information Access (AIA) extension of its certificate and its parent certificates. The AIA extension is specified in [RFC3280] section 4.2.2.1.

     - crls: Contains all current CRLs and delta CRLs for the CAs whose certificates were added to the certificates field. For each certificate in the certificates field, the CA SHOULD retrieve the CRL using the processing rules in section 3.2.1.4.1.3 by setting the *ParameterCertificate* to be equal to the current certificate.

     - signerInfos: Not used.

4. Return the CMS message through a CERTTRANSBLOB structure (as specified in section 2.2.2.2). Marshaling rules for CERTTRANSBLOB are specified in section 2.2.2.2.4.

3.2.1.4.3.2.34 PropID = 0x00000022 (CR_PROP_CACERTSTATUSCODE) "CA Signing Certificate Status"

The client has requested the status of a particular CA signing certificate. If the PropIndex value of the request is (-1), the client has requested the status of the certificate that has the highest index in the Signing_Cert_Certificate column.

If the CA implements the Signing_Cert_Certificate column, it MUST validate the status of the requested signing certificate that is pointed to by the *PropIndex* parameter. It MUST also return an **HRESULT** value that identifies the status of the signing certificate. Otherwise, it MUST return an empty **CERTTRANSBLOB (section 2.2.2.2)**.

If the certificate validation succeeded, the property value SHOULD be S_OK. If the certificate validation failed, the returned **HRESULT** value SHOULD indicate the error. Certificate validation SHOULD follow the requirements as specified in [RFC3280].

The CA MUST return the status in a **CERTTRANSBLOB** structure. The pb member of the structure MUST point to the returned **HRESULT** value in little-endian format. The cb member MUST contain the length of a **LONG**.

Possible values include but are not limited to those in the following table. Other common error codes are specified in [MS-ERREF].

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Value	Meaning	Section in RFC 3280
CRYPT_E_REVOCATION_OFFLINE (0x80092013)_	The revocation status cannot be checked because the revocation server is offline.	An operational error occurred as specified in sections 3.3, 5.3.1, and 9.
CERT_E_EXPIRED (0x800B0101)	A required certificate is not within its validity period.	A time validity check failed as specified in section 4.1.2.5.
CERT_E_REVOKED (0x800B010C)	A certificate was explicitly revoked by its issuer.	Revocation of certificates by a CA are uniquely tracked as specified in section 5.1.2.6.
CERT_E_CHAINING (0x800B010B)	A certificate chain cannot be built to a trusted root authority.	An error occurred while building name chaining, as specified in sections 4.1.2.4 and 6.
CERT_E_UNTRUSTEDROOT (0x800B010A)	A certificate chain was processed but terminated in a root certificate, which is not trusted by the trust provider.	An invalid path validation results in this error as specified in section 6.2.
CRYPT_E_NO_REVOCATION_DLL (0x80092011)	No DLL or exported function was found to verify revocation.	An operational error occurred as specified in sections 3.3, 5.3.1, and 9. Specifically, this error code is included to indicate that the revocation library is missing.
CRYPT_E_NO_REVOCATION_CHECK (0x80092012)	The revocation status for the certificate cannot be verified.	An operational error occurred as specified in sections 3.3, 5.3.1, and 9.

3.2.1.4.3.2.35 PropID = 0x00000023 (CR_PROP_CAFORWARDCROSSCERT) "CA Forward Cross Certificate"

The client has requested a particular forward cross certificate. The client MUST specify the required index through the *PropIndex* parameter.

If the CA is a root CA, the CA MUST return a non-zero error.

If the server implements the Signing_Forward_Cross_Certificate column, it MUST return the value of this column in the row identified by the value of the *PropIndex* parameter. The CA MUST return the forward cross certificate in X.509 format (as specified in [X660]) marshaled in a CERTTRANSBLOB structure (as specified in section 2.2.2.2.2).

If there is no value stored in the table (see section 3.2.1.1), the CA MUST return a non-zero error.

If the index provided by the client is out of range as defined in the table in section 3.2.1.4.3.2, the CA MUST return a nonzero error code.

If the server does not implement the Signing_Forward_Cross_Certificate column, the server MUST return an empty CERTTRANSBLOB (as specified in section 2.2.2.2). Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

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3.2.1.4.3.2.36 PropID = 0x00000024 (CR_PROP_CABACKWARDCROSSCERT) "CA Backward Cross Certificate"

The client has requested a particular backward cross certificate. The client MUST specify the required index through the *PropIndex* parameter.

If the CA is a root CA, the CA MUST return a non-zero error code.

If the server implements the Signing_Backward_Cross_Certificate column, it MUST return the value of this column in the row that is identified by the value of the *PropIndex* parameter. The CA MUST return the backward cross certificate in the X.509 format (as specified in [X660]) marshaled in a CERTTRANSBLOB structure (as specified in section 2.2.2.2.2).

If there is no value stored in the table (see section 3.2.1.1), the CA MUST return a non-zero error.

If the index provided by the client is out of range as defined in the table in section 3.2.1.4.3.2, the CA MUST return a non-zero error.

If the server does not implement the Signing_Backward_Cross_Certificate column, the server MUST return an empty **CERTTRANSBLOB**. Marshaling rules for CERTTRANSBLOB are specified in section 2.2.2.2.

3.2.1.4.3.2.37 PropID = 0x00000025 (CR_PROP_CAFORWARDCROSSCERTSTATE) "CA Forward Cross Certificate State"

The client requested the state of all forward cross certificates. If the server implements the Signing_Forward_Cross_Certificate column, it MUST return a byte array that MUST contain the status for each one of the forward cross certificates. Otherwise, the server MUST return an empty **CERTTRANSBLOB (section 2.2.2.2)** structure.

The disposition's value SHOULD be one of the following.

Value	Meaning
CA_DISP_INCOMPLETE (0x00)	The certificate is incomplete.
CA_DISP_ERROR (0x01)	The certificate is unavailable.
CA_DISP_REVOKED (0x02)	The certificate has been revoked.
CA_DISP_VALID (0x03)	The certificate is valid.
CA_DISP_INVALID (0x04)	The certificate has expired.

The CA MUST return the byte array in a **CERTTRANSBLOB** (section 2.2.2.2) structure. The first byte MUST identify the status for the first forward cross certificate, and the second byte MUST identify the same for the second forward cross certificate. Subsequent bytes MUST repeat this pattern.

The content of the byte array returned in the **CERTTRANSBLOB** (section 2.2.2.2) structure is best explained by an example. Assume that the client has renewed its CA certificates in the following manner.

CA certificate 0 contains the original key.

CA certificate 1 is created by renewing CA certificate 0 with a new key.

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CA certificate 2 is created by renewing CA certificate 1 with the key used to create CA certificate 1. A new key is not used.

CA certificate 3 is created by renewing CA certificate 2 with a new key.

Two forward cross certificates exist, the first from certificate 0 to 1 and the second from certificate 2 to 3. The following table identifies the values of the byte array returned by this property.

Byte	Value	Meaning
0	Any	Contains the status of the forward cross certificate from CA certificate 0 to CA certificate 1. This can be any value from the preceding disposition table.
1	0x01	Because the CA was renewed by using the same key, there is no forward cross certificate, and the status is unavailable.
2	Any	Contains the status of the forward cross certificate from CA certificate 2 to CA certificate 3. This can be any value from the preceding disposition table.
3	0x01	The last CA certificate cannot have a forward cross certificate.

3.2.1.4.3.2.38 PropID = 0x00000026 (CR_PROP_CABACKWARDCROSSCERTSTATE) "CA Backward Cross Certificate State"

The client requested the state of all backward cross certificates. If the server implements the Signing_Backward_Cross_Certificate column, it MUST return a byte array that contains the status for each of the backward cross certificates. Otherwise, the server MUST return an empty **CERTTRANSBLOB (section 2.2.2.2)** structure.

The possible disposition's values SHOULD be a set of values in the following table.

Value	Meaning
CA_DISP_INCOMPLETE (0x00)	The certificate is incomplete.
CA_DISP_ERROR (0x01)	The certificate is unavailable.
CA_DISP_REVOKED (0x02)	The certificate has been revoked.
CA_DISP_VALID (0x03)	The certificate is valid.
CA_DISP_INVALID (0x04)	The certificate has expired.

The CA MUST return the byte array in a **CERTTRANSBLOB** structure. The first byte MUST identify the status for the first backward cross certificate, and the second byte MUST identify the same for the second backward cross certificate. Subsequent bytes MUST repeat this pattern.

3.2.1.4.3.2.39 PropID = 0x00000027 (CR_PROP_CACERTVERSION) "CA Signing Certificates Revisions"

The client has requested the revisions on the CA signing certificate. If the server implements the Signing_Cert table, it MUST return a ULONG array that identifies the revisions to its signing certificates as specified as follows. Otherwise, the server MUST return an empty CERTTRANSBLOB structure.

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The CA MUST return the array in a **CERTTRANSBLOB (section 2.2.2.2)** structure. Each ULONG value in the returned array MUST contain version information for a signing certificate in little-endian format. The upper 16 bits MUST contain a zero-based key index, and the lower 16 MUST contain a zero-based certificate index.

Example: The CA has renewed its certificates in the following manner:

- Certificate_0 contains the original key.
- Certificate_1 is created by renewing Certificate_0 with a new key.
- Certificate_2 is created by renewing Certificate_1 with the key used to create Certificate_1.
- Certificate_3 is created by renewing Certificate_2 with the key used to create Certificate_1.
- Certificate_4 is created by renewing Certificate_3 with the key used to create Certificate_1.
- Certificate_5 is created by renewing Certificate_4 with a new key.
- Certificate_6 is created by renewing Certificate_5 with the key used to create Certificate_5.
- Certificate_7 is created by renewing Certificate_6 with the key used to create Certificate_5.
- Certificate_8 is created by renewing Certificate_7 with a new key.

This renewal pattern leads to the following ULONG array.

Index	ULONG	Key index	Certificate index
0	0x00000000	0000	0000
1	0x00010001	0001	0001
2	0x00010002	0001	0002
3	0x00010003	0001	0003
4	0x00010004	0001	0004
5	0x00050005	0005	0005
6	0x00050006	0005	0006
7	0x00050007	0005	0007
8	0x00080008	0008	0008

3.2.1.4.3.2.40 PropID = 0x00000028 (CR_PROP_SANITIZEDCASHORTNAME) "CA Sanitized Short Name"

The client has requested the CN of the CA in the short sanitized form.

The CA MUST return the short sanitized form of the common name for the CA (cn field of the CA signing certificate) as a [UNICODE] string, through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

Marshaling rules for **CERTTRANSBLOB** are specified in section 2.2.2.2.

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3.2.1.4.3.2.41 PropID = 0x00000029 (CR_PROP_CERTCDPURLS) "CRL Distribution Points"

The client has requested the list of CRL distribution points (CDPs), as specified in [RFC3280] section 4.2.1.14, for a particular CA certificate. The client MUST specify the required CA certificate through the *PropIndex* parameter.

If the CA does not implement the Config_CA_CDP_Include_In_Cert column, the CA SHOULD return an empty string. If the CA implements the Config_CA_CDP_Include_In_Cert column, the CA MUST construct a string that has a format of "String1\nString2\n" by using the strings that are stored in the CDP data.<90>

The CA MUST return the string as a [UNICODE] string through a **CERTTRANSBLOB (section 2.2.2.2)** structure.

3.2.1.4.3.2.42 PropID = 0x0000002A (CR_PROP_CERTAIAURLS) "Authority Information Access"

The client has requested the authority information access (AIA) list for a particular CA certificate. (AIA is specified in [RFC3280] section 4.2.2.1.) The client MUST specify the required CA certificate through the *PropIndex* parameter.

If the CA does not implement the Config_CA_AIA_Include_In_Cert column, the CA MUST return an empty string. If the CA implements the AIA column, the CA SHOULD construct a string that has a format of "String1\nString2\n" by using the strings stored in the AIA data.<91>

3.2.1.4.3.2.43 PropID = 0x0000002B (CR_PROP_CERTAIAOCSPRLS) "OCSP URLs"

The client has requested the list of Online Certificate Status Protocol (OCSP) URLs, as specified in [RFC2560] section 4.2.2.2.1. OCSP URLs are configured for a particular CA certificate. The client MUST specify the required CA certificate through the *PropIndex* parameter.

If the CA does not implement the Config_CA_OCSP_Include_In_Cert column, the CA MUST return an empty string. If the CA implements the OCSP column, the CA MUST construct a string that has a format of "String1\nString2\n" by using the strings that are stored in OCSP data.

The CA MUST return the list as a [UNICODE] string through a **CERTTRANSBLOB (section 2.2.2.2)** structure.<92>

3.2.1.4.3.2.44 PropID = 0x0000002C (CR_PROP_LOCALENAME) "CA Locale Name"

The client has request the locale of the CA. The CA SHOULD return its locale in the "Language-Region" format as specified in the [RFC4646]. The CA MUST return it as a [UNICODE] string, through a CERTTRANSBLOB (section 2.2.2.2) structure.<93>

3.2.1.4.3.2.45 PropID = 0x0000002D (CR_PROP_SUBJECTTEMPLATE_OIDS) "Subject Template"

The client has requested the **CR_PROP_SUBJECTTEMPLATE_OIDS** property from the CA to order the relative **DistiniguishedName** in the subject. If the CA does not implement **Config_CA_DN_Order_String**, then CA MUST return an empty string. If the CA implements **Config_CA_DN_Order_String**, the CA MUST construct a string that has a format of "String1\nString2\n" by converting the strings that are stored in **Config_CA_DN_Order_String** into their respective OIDs ([MS-ADTS] section 3.1.1.4) in string representation.

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The CA MUST return the string as a Unicode string through a **CERTTRANSBLOB** (section 2.2.2.2) structure.<94>

3.2.1.4.3.3 ICertRequestD2::GetCAPropertyInfo (Opnum 8)

The **GetCAPropertyInfo** method retrieves a set of property structures from the CA. The list of properties is specified in section 3.2.1.4.3.2.

```
HRESULT GetCAPropertyInfo(
  [in, unique, string] const wchar_t* pwszAuthority,
  [out] long* pcProperty,
  [out, ref] CERTTRANSBLOB* pctbPropInfo
);
```

pwszAuthority: Contains the name of the CA.

pcProperty: An integer value that contains the number of property structures returned.

pctbPropInfo: A **CERTTRANSBLOB** structure that contains zero or more **CATRANSPROP** structures. For more information about the **CERTTRANSBLOB** and **CATRANSPROP** structures, see Common Structures.

Return Values: For successful invocation, the CA MUST return 0. Otherwise, the CA MUST return a nonzero value.

The processing rules for this method are as follows.

If Config_CA_Interface_Flags contains the value IF_NOREMOTEICERTREQUEST, the server SHOULD return 0x80094011 (CERTSRV_E_ENROLL_DENIED) to the client. <95>

If Config_CA_Interface_Flags contains the value IF_ENFORCEENCRYPTICERTREQUEST and the RPC_C_AUTHN_LEVEL_PKT_PRIVACY authentication level, as defined in [MS-RPCE] section 2.2.1.1.8, is not specified on the RPC connection from the client, the CA MUST refuse to establish a connection with the client by returning a nonzero error.

When the CA receives this invocation, it MUST verify the CA name that is passed in *pwszAuthority* by invoking the processing rules in section 3.2.1.4.2.1.1 with the *CANameString* input parameter set to the CA name passed in the *pwszAuthority* parameter and the *EmptyNameAllowed* input parameter set to false. If false is returned, the CA MUST return the E_INVALIDARG (0x80070057) error code to the client.

If the CA name validation succeeded, the CA MUST return success (0), MUST construct the returned CA properties information in the *pctbPropInfo* field (as specified in section 2.2.2.3.1), and MUST return the number of CA properties in the *pcProperty* parameter.

3.2.1.4.3.4 ICertRequestD2::Ping2 (Opnum 9)

The **Ping2** method pings the CA.

```
HRESULT Ping2(
  [in, unique, string] const wchar_t* pwszAuthority
);
```

pwszAuthority: Contains the name of the CA.

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Return Values: For successful invocation, the CA MUST return 0; otherwise, the CA MUST return a nonzero value.

The processing rules for this request MUST be the same as those specified in section 3.2.1.4.2.3.

3.2.1.5 Timer Events

None.

3.2.1.6 Other Local Events

None.

3.2.2 Server Mode: Enterprise CA

The CA is an implementation of the server mode specified in section 3.2.1 with a different implementation for its CA policy algorithm implementation. The CA policy algorithm of this server mode uses the certificate template data structure as specified in [MS-CRTD] for its certificate issuance policies. Note that unless specified otherwise in the following sections, this server mode is compliant with the specifications documented in 3.2.1.

3.2.2.1 Interaction with Active Directory

This section provides a recommendation for the Enterprise CA on how to access Active Directory. Server implementations can use an alternative method to read or write the information to the Active Directory that is required for the server processing rules in 3.2.2.

The CA SHOULD use LDAP search and modify operations, as specified in [RFC2251] sections 4.5 and 4.6, to read and write to the Active Directory. The profile of LDAP as implemented by the Active Directory servers (DCs) as described in [MS-ADTS] section 3.1.1.3.

3.2.2.1.1 Search Requests for Reading Objects under Enrollment Services or Certificate Templates Container

This type of search request is used to read objects under Enrollment Services Container (section 2.2.2.11.2) or Certificate Templates Container (section 2.2.2.11.1) from the LDAP directory.

Input Parameters:

InputContainer: Determines which container is being queried. The possible values are Enrollment Services Container and Certificate Templates Container.

Output Parameters:

CertificateTemplatesandEnrollmentServicesObjects: The set of objects under Enrollment Services Container or Certificate Templates Container in Active Directory.

Processing Rules:

The CA MUST perform the processing rules in section 3.2.2.1.1.1.

In the following sections, the following local variable is used:

ActiveDirectory_Connection: An ADConnection handle. For more information, see [MS-ADSO] section 6.2.2.

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ContainerDistinguishedName: A distinguished name.

3.2.2.1.1.1 Search Requests

The CA SHOULD perform search requests demonstrated in the following figure.

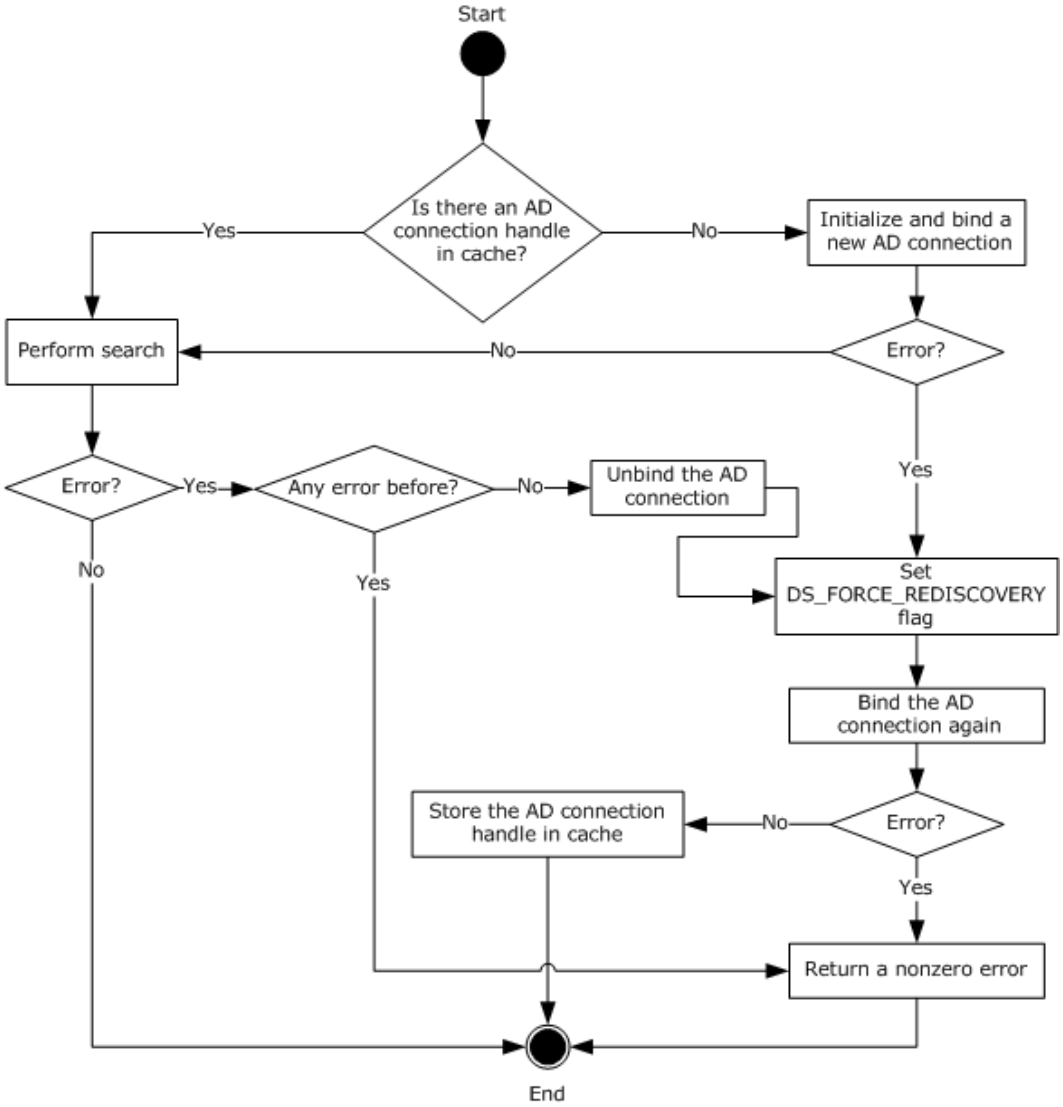

Figure 3: Retrieving ADConnection handle for reading objects under certificate templates and enrollment services containers.

The preceding figure describes the algorithm used for retrieving an **ADConnection** handle for reading objects under certificate templates and enrollment services containers.

The following steps describe the flow of the preceding figure:

1. If the **CertificateTemplatesAndEnrollmentServices_AD_Connection** ADM element is NULL:

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1. Invoke the "Initialize ADConnection" task ([MS-ADSO] section 6.2.6.1.1) to construct an **ADConnection** with the following parameters:

   - *TaskInputTargetName*: NULL
   - *TaskInputPortNumber*: If the value of the Config_CA_LDAP_Flags datum has 0x0000001 (LDAPF_SSLENABLE) bit set, use port 636. Otherwise use port 389.

   Store the returned **ADConnection** handle in the **ActiveDirectory_Connection** variable.

2. Perform a bind request as specified in section 3.2.2.1.1.2. Store the returned **ADConnection** handle in the **CertificateTemplatesAndEnrollmentServices_AD_Connection** ADM element.

2. Obtain the distinguished name for the Certificate Templates Container (section 2.2.2.11.1) or Enrollment Services Container (section 2.2.2.11.2) as specified in the following steps:

   1. Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:

      - *TaskInputADConnection*: **CertificateTemplatesAndEnrollmentServices_AD_Connection**
      - *TaskInputRequestMessage*: LDAP SearchRequest message (see [RFC2251] section 4.5.1) as follows:
        - baseObject: distinguished name of the rootDSE object, as specified in [MS-ADTS] section 3.1.1.3.2.1
        - scope: baseObject
        - filter: (objectCategory=*)
        - attributes: The CA SHOULD use the following attributes:
          - **configurationNamingContext**
          - **defaultNamingContext**
        - sizeLimit: 10000
        - timeLimit: 120
        - derefAliases: neverDerefAliases
        - typesOnly: FALSE
      - *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search.

   2. If the *TaskReturnStatus* returned in the previous step is not 0, go to step 4.

   3. If **InputContainer** is equal to Certificate Templates Container, set **ContainerDistinguishedName** equal to the concatenation of "CN=Certificate Templates,CN=Public Key Services,CN=Services, CN=Configuration" path and the value for **configurationNamingContext** attribute from step 2..

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If **InputContainer** is equal to Enrollment Services Container, set **ContainerDistinguishedName** equal to the concatenation of "CN=Enrollment Services,CN=Public Key Services,CN=Services, CN=Configuration" path and the value for **configurationNamingContext** attribute from step 2.1.

3. Read all objects under the Certificate Templates Container or Enrollment Services Container as follows: Repeat step 2.1 with the following modifications:
   - baseObject: **ContainerDistinguishedName**
   - scope: wholeSubtree
   - filter: The CA SHOULD use the following filters:
     - If **InputContainer** is equal to Certificate Templates Container: (objectCategory=pKICertificateTemplate).
     - If **InputContainer** is equal to Enrollment Services Container: (&(objectCategory=pKIEnrollmentServce)(cn=SomeCA)), where SomeCA is a sanitized name, as specified in section 3.1.1.4.1.1, of the CA.
   - attributes: The CA SHOULD use the following attributes:
     - If **InputContainer** is equal to Certificate Templates Container:
       - cn
       - flags
       - ntSecurityDescriptor
       - revision
       - pKICriticalExtensions
       - pKIDefaultCSPs
       - pKIDefaultKeySpec
       - pKIEnrollmentAccess
       - pKIExpirationPeriod
       - pKIExtendedKeyUsage
       - pKIKeyUsage
       - pKIMaxIssuingDepth
       - pKIOverlapPeriod
       - msPKI-Template-Schema-Version
       - msPKI-Template-Minor-Revision
       - msPKI-RA-Signature
       - msPKI-Minimal-Key-Size

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        - msPKI-Cert-Template-OID
        - msPKI-Supersede-Templates
        - msPKI-RA-Policies
        - msPKI-RA-Application-Policies
        - msPKI-Certificate-Policy
        - msPKI-Certificate-Application-Policy
        - msPKI-Enrollment-Flag
        - msPKI-Private-Key-Flag
        - msPKI-Certificate-Name-Flag
    - If **InputContainer** is equal to Enrollment Services Container:
        - certificateTemplates
        - cn
        - displayName
        - dNSHostName
- controls: Sequence of two Control structures, as follows:
    - Control
        - controlType: LDAP_SERVER_SD_FLAGS_OID_W (see [MS-ADTS] section 3.1.1.3.4.1.11)
        - criticality: TRUE
        - controlValue:

          Flags: DACL_SECURITY_INFORMATION | OWNER_SECURITY_INFORMATION | GROUP_SECURITY_INFORMATION
    - Control
        - controlType: LDAP_SERVER_PERMISSIVE_MODIFY_OID_W (see [MS-ADTS] section 3.1.1.3.4.1.8)
        - criticality: FALSE
- *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAPsearch. Set **CertificateTemplatesandEnrollmentServicesObjects** equal to *TaskOutputResultMessage*

4. If the *TaskReturnStatus* returned in step 2 is not 0, then,
    1. Invoke the "Perform an LDAP Unbind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set to **CertificateTemplatesAndEnrollmentServices_AD_Connection**.
    2. Repeat step 1.1

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3. Perform steps 1 and 2 in section 3.2.2.1.1.2 with the exception that in step 1, use the following parameters:

   - *TaskInputOptionName*: LDAP_OPT_GETDSNAME_FLAGS
   - *TaskInputOptionValue*: Bitwise OR of the bits A, D, and R, as defined in [MS-NRPC] section 3.5.4.3.1.

   If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

   - **InputReturnStatus**: *TaskReturnStatus*
   - **InputResultMessage**: *TaskOutputResultMessages*

   Return the **OutputHRESULT** output parameter to the client and exit.

4. Repeat step 3. If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

   - **InputReturnStatus**: *TaskReturnStatus*
   - **InputResultMessage**: *TaskOutputResultMessages*

   Return the **OutputHRESULT** output parameter to the client and exit.

3.2.2.1.1.2 Bind Requests

Bind requests are used to connect and to authenticate the user to an LDAP directory. The CA MUST perform bind requests as follows:

1. Invoke the "Setting an LDAP Option on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.2) once for each of the pairs of option and value parameters in the following table. For each of these, the *TaskInputADConnection* parameter is the **ActiveDirectory_Connection**.

TaskInputOptionName	TaskInputOptionValue
LDAP_OPT_GETDSNAME_FLAGS	Bitwise OR of the bits J and R, as defined in [MS-NRPC] section 3.5.4.3.1.
LDAP_OPT_REFFERALS	If the **Config_AD_Connection_Referral** ADM element is FALSE, set to FALSE.
LDAP_OPT_PROTOCOL_VERSION	0
LDAP_OPT_TCP_KEEPALIVE	TRUE
LDAP_OPT_AUTO_RECONNECT	TRUE

2. If the value of the Config_CA_LDAP_Flags datum does not have the 0x0000002 (LDAPF_SIGNDISABLE) bit set and:

   - If after invoking the processing rules that are specified in section 3.2.2.1.6 with input parameter **InputADConnectionHandle** set equal to **ActiveDirectory_Connection**, the returned value is TRUE (that is, DC supports signing) set LDAP_OPT_SIGN to TRUE.

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- Else, if the Config_CA_LDAP_Flags datum does not have the 0x0000001 (LDAPF_SSLENABLE) bit set, return 0x80094013 (CERTSRV_E_DOWNLEVEL_DC_SSL_OR_UPGRADE) to the client and exit.

3. Invoke the "Performing an LDAP Bind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.4) with the following parameter:

   TaskInputADConnection: **ActiveDirectory_Connection**

4. If the *TaskReturnStatus* returned is not 0:

   - Repeat step 1 with the following modification:

     - *TaskInputOptionName*: LDAP_OPT_GETDSNAME_FLAGS

     - *TaskInputOptionValue*: Bitwise OR of the bits A, J, and R, as defined in [MS-NRPC] section 3.5.4.3.1.

   - Repeat step 3.

   - If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

     - **InputReturnStatus**: *TaskReturnStatus*

     - **InputResultMessage**: NULL

     Return the **OutputHRESULT** output parameter to the client and exit.

3.2.2.1.2 Search Requests for Querying End Entity Object Attributes

This type of search request is used to read attributes from user or computer object from the LDAP directory.

Input Parameters:

EndEntityDistinguishedName: The distinguished name of the user or computer object in Active Directory.

Output Parameters:

EndEntityAttributes: The set of values of the user object attributes in Active Directory.

Processing Rules:

The CA MUST perform the processing rules in section 3.2.2.1.2.1.

In the following sections, the following local variable is used:

ActiveDirectory_Connection: An **ADConnection** handle. For more information, see [MS-ADSO] section 6.2.2.

3.2.2.1.2.1 Search Requests

The CA SHOULD perform search requests demonstrated in the following figure.

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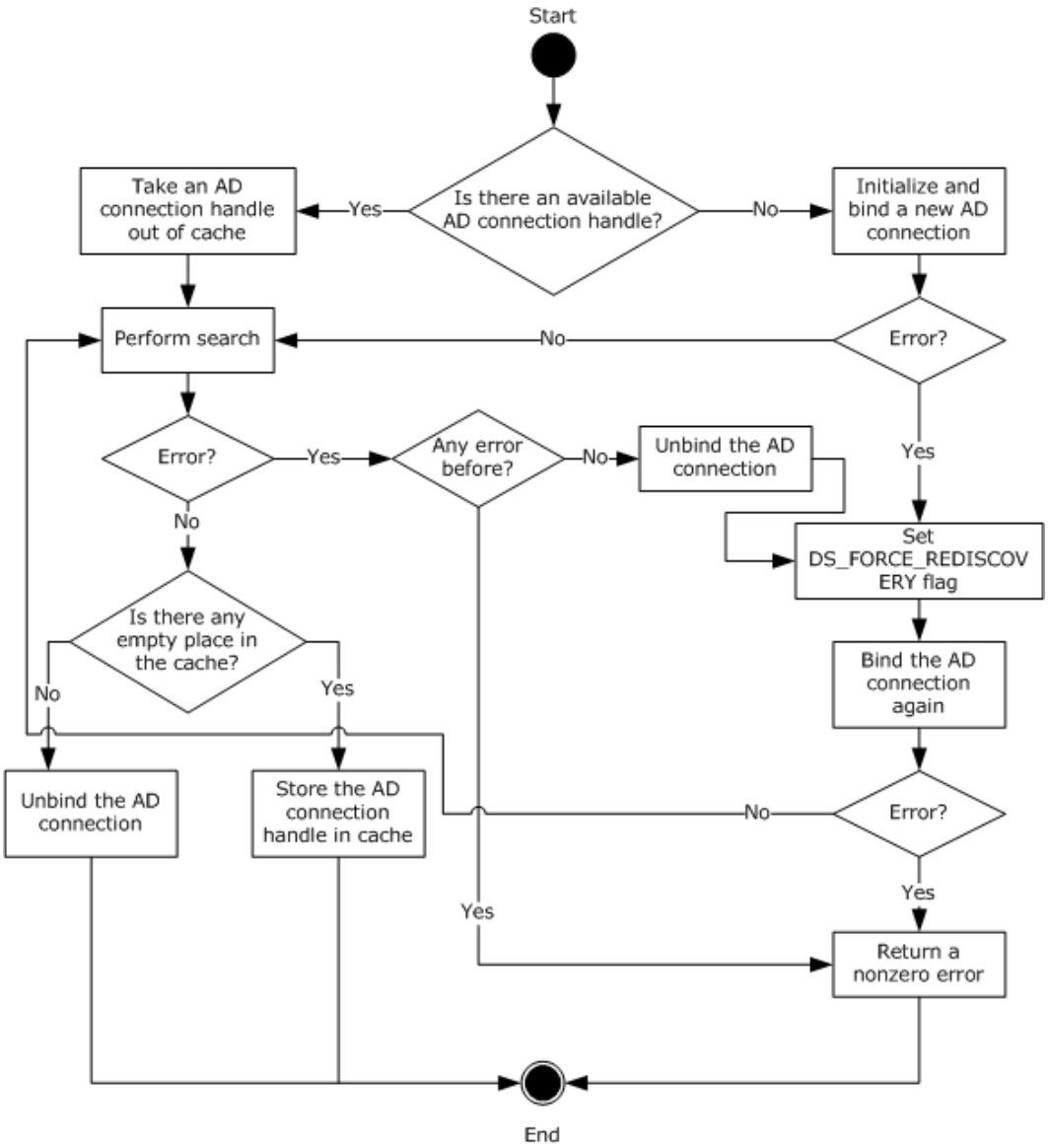

Figure 4: Retrieving an ADConnection handle for reading user or computer object.

The following steps describe the flow of the preceding figure.

1. If the **Collection_Of_End_Entity_Object_Query_AD_Connections** ADM has no **ADConnection** handle:

    1. Invoke the "Initialize ADConnection" task ([MS-ADSO] section 6.2.6.1.1) to construct an **ADConnection**, with the following parameter:

        - *TaskInputTargetName*: NULL
        - *TaskInputPortNumber*: 3268

        Store the generated **ADConnection** handle in the **ActiveDirectory_Connection** variable.

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2. Perform a bind request as specified in section 3.2.2.1.2.2. Go to step 3.

2. Remove from the **Collection_Of_End_Entity_Object_Query_AD_Connections** ADM element the **ADConnection** handle that was added the last, and use it as the **ADConnection** handle in the following steps.

3. Invoke the "Perform an LDAP Operation on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.6) with the following parameters:

   - *TaskInputADConnection*: ActiveDirectory_Connection
   - *TaskInputRequestMessage*: LDAP SearchRequest message (see [RFC2251] section 4.5.1), as follows:
     - baseObject: **EndEntityDistinguishedName**
     - scope: baseObject
     - filter: (|(objectCategory=user)(objectCategory=computer))
     - attributes: The CA SHOULD use the following attributes:
       - objectClass
       - cn
       - dNSHostName
       - mail
       - objectGUID
       - userPrincipalName
     - sizeLimit: 10000
     - timeLimit: 120 <96>
     - derefAliases: neverDerefAliases
     - typesOnly: FALSE
   - *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search. Set the output parameter **EndEntityAttributes** equal to *TaskOutputResultMessage*.

4. If the *TaskReturnStatus* returned from LDAP search operation in step 3 is not 0, then:

   - Invoke the "Perform an LDAP Unbind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set to the **ActiveDirectory_Connection**.
   - Repeat step 1.1
   - Perform steps 1 and 2 in section 3.2.2.1.2.2 with the exception that in step 1, use the following parameters:
     - *TaskInputOptionName*: LDAP_OPT_GETDSNAME_FLAGS

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- *TaskInputOptionValue*: Bitwise OR of the bits A, D, J, and R, as defined in [MS-NRPC] section 3.5.4.3.1

- If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

  - **InputReturnStatus**: *TaskReturnStatus*

  - **InputResultMessage**: NULL

  Return the **OutputHRESULT** output parameter to the client and exit.

- Repeat step 3. If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

  - **InputReturnStatus**: *TaskReturnStatus*

  - **InputResultMessage**: *TaskOutputResultMessages*

  Return the **OutputHRESULT** output parameter to the client and exit.

5. If the number of **ADConnection** handles in the **Collection_Of_End_Entity_Object_Query_AD_Connections** ADM element is less than **Config_Max_Number_Of_AD_Connections**, add the **ActiveDirectory_Connection** variable to the **Collection_Of_End_Entity_Object_Query_AD_Connections** ADM element.

6. Otherwise, invoke the "Perform an LDAP Unbind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set to **ActiveDirectory_Connection**.

3.2.2.1.2.2 Bind Requests

Bind requests are used to connect and to authenticate the user to an LDAP directory. The CA MUST perform bind requests as follows:

1. Invoke the "Setting an LDAP Option on an ADConnection" task ([MS-ADSO] section 6.2.6.1.2) once for each of the pairs of option and value parameters in the following table. For each of these, the *TaskInputADConnection* parameter is the **ActiveDirectory_Connection**.

TaskInputOptionName	TaskInputOptionValue
LDAP_OPT_GETDSNAME_FLAGS	Bitwise OR of the bits D, J and R as defined in [MS-NRPC] section 3.5.4.3.1
LDAP_OPT_SIGN	TRUE
LDAP_OPT_REFFERALS	If the **Config_AD_Connection_Referral** ADM element is FALSE, set to FALSE
LDAP_OPT_PROTOCOL_VERSION	2

2. Invoke the "Performing an LDAP Bind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.4) with the following parameter:

   TaskInputADConnection: **ActiveDirectory_Connection**

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3. If the *TaskReturnStatus* returned is not 0:

   - Repeat step 1 with the following modification:

     - *TaskInputOptionName*: LDAP_OPT_GETDSNAME_FLAGS

     - *TaskInputOptionValue*: Bitwise OR of the bits A, D, J, and R, as defined by [MS-NRPC] section 3.5.4.3.1.

   - Repeat step 2.

   - If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

     - **InputReturnStatus**: *TaskReturnStatus*

     - **InputResultMessage**: NULL

     Return the **OutputHRESULT** output parameter to the client and exit.

3.2.2.1.3 Search Requests for Querying End Entity Object Attributes with an End Entity Provided DC Name

This section specifies how to perform a search request against a domain controller (DC) specified by the client, as specified in section 3.2.2.6.2.1.1.

Input Parameters:

DCName: The name of the domain controller (DC) that the client provided to the CA. This is a null-terminated **UTF-16** string that contains a fully qualified domain name (FQDN) (1) of the domain controller, prefixed with "\\".

EndEntityDistinguishedName: The distinguished name of the user or computer object in Active Directory.

Output Parameters:

EndEntityAttributes: The set of values of the user object attributes in Active Directory.

Processing Rules:

The CA MUST perform the processing rules in section 3.2.2.1.3.1.

In the following sections, the following local variable is used:

ActiveDirectory_Connection: An **ADConnection** handle. For more information about **ADConnection** see [MS-ADSO] section 6.2.2.

3.2.2.1.3.1 Search Requests

The CA SHOULD perform search requests demonstrated in the following figure.<97>

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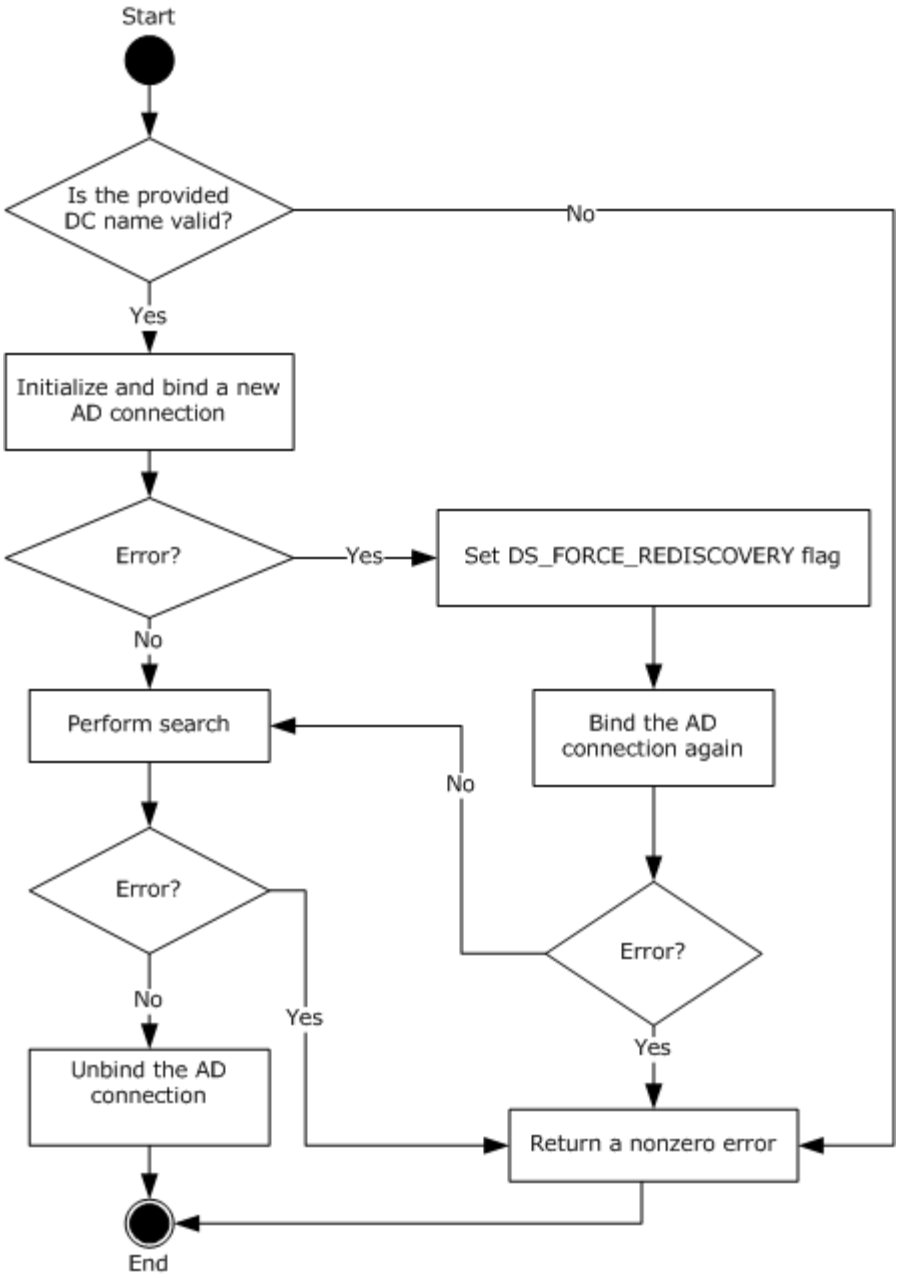

Figure 5: Retrieving an ADConnection handle for reading user or computer object with provided DC name.

The following steps describe the flow of the preceding figure:

1. The CA MUST validate the provided DC name by performing the following processing rules:

    1. Perform the processing rules in section 3.2.2.1.2 with the following modification: in step 3 of the processing rules in section 3.2.2.1.2.1 use the following parameters:

        - baseObject: NULL

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- scope: wholeSubtree
- filter: (&(objectCategory=computer)(servicePrincipalName=HOST/**DCName**)) where **DCName** is the input parameter.
- attributes: The CA SHOULD use the following attributes:
  - **dNSHostName**
  - **serverReferenceBL**
  - **servicePrincipalName**

The rest of the parameters and processing rules are the same as in section 3.2.2.1.2.

2. Perform the processing rules in section 3.2.2.1.2 with the following modification: in step 3 of the processing rules in section 3.2.2.1.2.1, use the following parameters:
   - baseObject: serverReferenceBL attribute value from the previous step
   - scope: wholeSubtree
   - filter: (objectCategory=nTDSDSA)
   - attributes: NULL

   The rest of parameters and processing rules are the same as in section 3.2.2.1.2.

3. If the previous search request returned exactly one entry, proceed with the rest of the processing rules. Otherwise, return a nonzero error to the client and exit.

2. Invoke the "Initialize ADConnection" task ([MS-ADSO] section 6.2.6.1.1) to construct an **ADConnection** with the following parameters:
   - *TaskInputTargetName*: **DCName**
   - *TaskInputPortNumber*: 389
   - Store the generated **ADConnection** handle in **ActiveDirectory_Connection** variable.
3. Perform a bind request as specified in section 3.2.2.1.3.2.
4. Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:
   - *TaskInputADConnection*: **ActiveDirectory_Connection**
   - *TaskInputRequestMessage*: LDAP SearchRequest message (see [RFC2251] section 4.5.1), as follows:
     - baseObject: **EndEntityDistinguishedName**
     - scope: baseObject
     - filter: (|(objectCategory=user)(objectCategory=computer))
     - attributes: The CA SHOULD use the following attributes
       - objectClass

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        - cn
        - dNSHostName
        - mail
        - objectGUID
        - userPrincipalName
    - sizeLimit: 10000
    - timeLimit: 120
    - derefAliases: neverDerefAliases
    - typesOnly: FALSE
  - *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search. Set the output parameter **EndEntityAttributes** equal to *TaskOutputResultMessage*.

5. If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

   - **InputReturnStatus**: *TaskReturnStatus*
   - **InputResultMessage**: *TaskOutputResultMessages*

   Return the **OutputHRESULT** output parameter to the client and exit.

6. Invoke the "Perform an LDAP Unbind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set to be equal to **ActiveDirectory_Connection**.

3.2.2.1.3.2 Bind Requests

Bind requests are used to connect and to authenticate the user to an LDAP directory. The CA MUST perform bind requests as follows:

1. Invoke the "Setting an LDAP Option on an ADConnection" task ([MS-ADSO] section 6.2.6.1.2) once for each of the pairs of option and value parameters in the following table. For each of these, the *TaskInputADConnection* parameter is the **ActiveDirectory_Connection**.

TaskInputOptionName	TaskInputOptionValue
LDAP_OPT_GETDSNAME_FLAGS	Bitwise OR of the bits J and R, as defined by [MS-NRPC] section 3.5.4.3.1
LDAP_OPT_SIGN	TRUE
LDAP_OPT_REFFERALS	FALSE

2. Invoke the "Performing an LDAP Bind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.4) with the following parameters:

   TaskInputADConnection: **ActiveDirectory_Connection**

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3. If the *TaskReturnStatus* returned is not 0:

   - Repeat steps 1 and 2.
   - If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:
     - **InputReturnStatus**: *TaskReturnStatus*
     - **InputResultMessage**: NULL

     Return the **OutputHRESULT** output parameter to the client and exit.

3.2.2.1.4 Publishing KRA Certificates

Modify requests are used to write information to the LDAP directory. The CA SHOULD perform modify requests to publish KRA certificates to user objects in the Active Directory.

Input Parameters:

IssuedCertificate: The issued certificate to be published to Active Directory.

Output Parameters: None

Processing Rules:

The CA MUST perform the processing rules that are specified in section 3.2.2.1.4.1.

In the following sections, the following local variables are used:

ActiveDirectory_Connection: An **ADConnection** handle. See [MS-ADSO] section 6.2.2 for more information about **ADConnection**.

Set_Of_Certificates: A set of certificates.

3.2.2.1.4.1 Search Requests

The CA SHOULD perform modify requests as demonstrated in the following figure.

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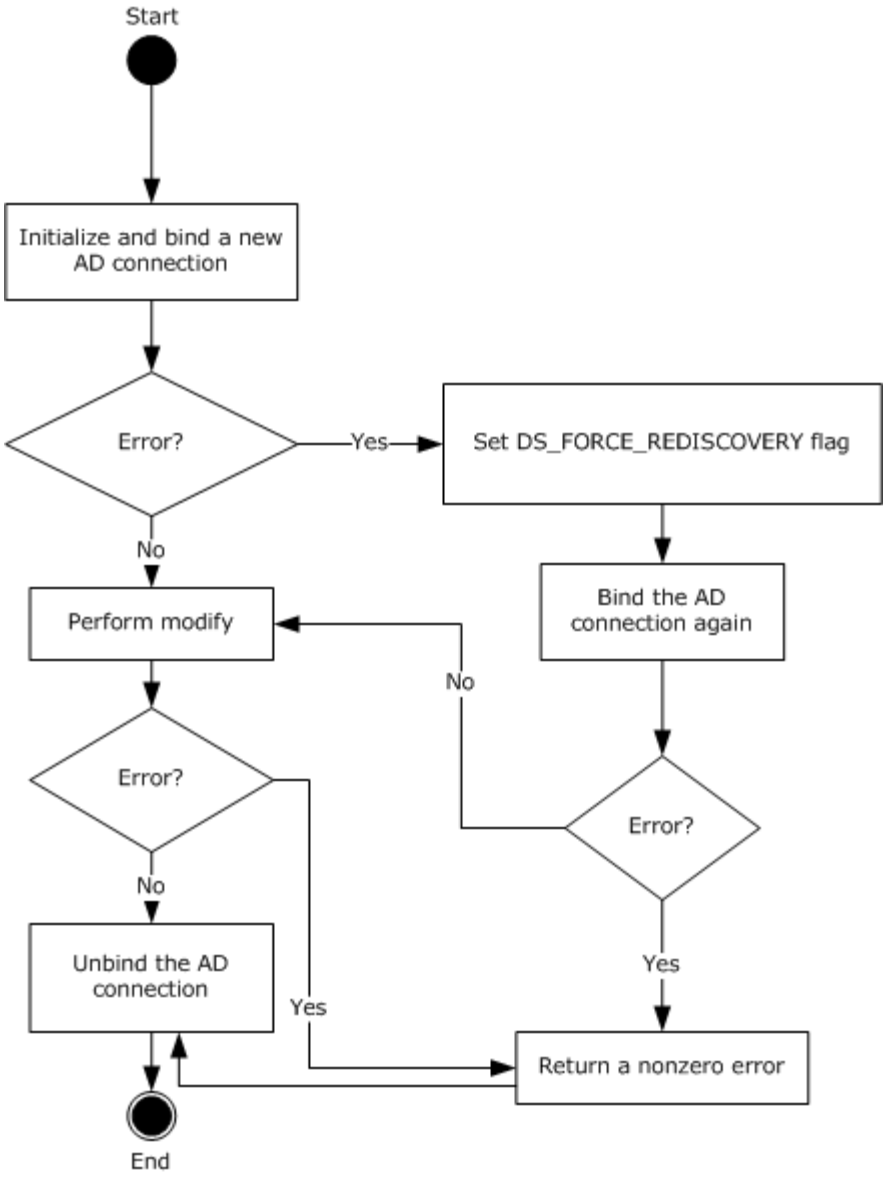

Figure 6: Retrieving an ADConnection handle for publishing KRA certificates to AD

The following steps describe the flow of the preceding figure:

1. Invoke the "Initialize ADConnection" task ([MS-ADSO] section 6.2.6.1.1) to construct an **ADConnection** with the following parameters:

   - *TaskInputTargetName*: NULL
   - *TaskInputPortNumber*: If the value of the Config_CA_LDAP_Flags datum has 0x0000001 (LDAPF_SSLENABLE) bit set, use port 636. Otherwise use port 389.

   Store the returned **ADConnection** handle in the **ActiveDirectory_Connection** variable.

2. Perform a bind request, as specified in section 3.2.2.1.4.2.

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3. Obtain the distinguished name for the KRA container as specified in the following steps:

   1. Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:

      - *TaskInputADConnection*: **ActiveDirectory_Connection**
      - *TaskInputRequestMessage*: LDAP SearchRequest message (see [RFC2251] section 4.5.1) as follows:
        - baseObject: distinguished name (DN) of the rootDSE object, as specified in [MS-ADTS] section 3.1.1.3.2.1
        - scope: baseObject
        - filter: (objectCategory=*)
        - attributes: The CA SHOULD use the following attributes:
          - **configurationNamingContext**
          - **defaultNamingContext**
        - sizeLimit: 10000
        - timeLimit: 120
        - derefAliases: neverDerefAliases
        - typesOnly: FALSE
      - *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search.

   2. If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

      - **InputReturnStatus**: *TaskReturnStatus*
      - **InputResultMessage**: *TaskOutputResultMessages*

      Return the **OutputHRESULT** output parameter to the client and exit. Also, invoke the "Perform an LDAP Unbind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set equal to **ActiveDirectory_Connection**.

   3. Build the distinguished name by combining the "CN=KRA, CN=Public Key Services,CN=Services, CN=Configuration" path and the value from step 3.1.

4. Verify that the issued certificate, passed in as input parameter **IssuedCertificate**, does not already exist under the KRA container as specified in the following steps.

   1. Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:

      - *TaskInputADConnection*: **ActiveDirectory_Connection**
      - *TaskInputRequestMessage*: LDAP SearchRequest message ([RFC2251] section 4.5.1) as follows:

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- baseObject: distinguished name (DN) of the object of the class msPKI-Private-Key-Recovery-Agent stored in the KRA container in the working directory. DN of the KRA container is obtained in step 3.
- scope: baseObject
- filter: NULL
- attributes: **userCertificate**
- sizeLimit: 10000
- timeLimit: 120
- derefAliases: neverDerefAliases
- typesOnly: FALSE

- *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search.

Store the returned value for **userCertificate** attribute in the **Set_Of_Certificates** variable.

2. If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

   - **InputReturnStatus**: *TaskReturnStatus*
   - **InputResultMessage**: *TaskOutputResultMessages*

   Return the **OutputHRESULT** output parameter to the client and exit. Also invoke the "Perform an LDAP Unbind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set equal to **ActiveDirectory_Connection** and then exit.

3. If the certificate in input parameter **IssuedCertificate** does not exist in the **Set_Of_Certificates** variable, add it to this set.

4. If any of the certificates in **Set_Of_Certificates** variable has expired for more than 24 hours, remove it from **Set_Of_Certificates**.

5. If **Set_Of_Certificates** is not changed as part of step 4.3 and 4.4, go to step 7.

5. Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:

   - *TaskInputADConnection*: **ActiveDirectory_Connection**
   - *TaskInputRequestMessage*: An LDAP ModifyRequest (see [RFC2251] section 4.6) as follows:
     - object: distinguished name of the object of the class msPKI-Private-Key-Recovery-Agent stored in the KRA container in the working directory. distinguished name of the KRA container is obtained in step 3.
     - The modification sequence has one entry, as follows:
       - operation: replace
       - modification:

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- type: **userCertificate**
- vals: **Set_Of_Certificates**

- *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP operation.

6. If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

   - **InputReturnStatus**: *TaskReturnStatus*
   - **InputResultMessage**: *TaskOutputResultMessages*

   Return the **OutputHRESULT** output parameter to the client and exit.

7. Invoke the "Perform an LDAP Unbind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set equal to **ActiveDirectory_Connection**.

3.2.2.1.4.2 Bind Requests

Bind requests are used to connect and to authenticate the user to an LDAP directory. The CA MUST perform bind requests as follows:

1. Invoke the "Setting an LDAP Option on an ADConnection" task ([MS-ADSO] section 6.2.6.1.2) once for each of the pairs of option and value parameters in the following table. For each of these, the *TaskInputADConnection* parameter is the **ActiveDirectory_Connection**.

TaskInputOptionName	TaskInputOptionValue
LDAP_OPT_GETDSNAME_FLAGS	Bitwise OR of the bits J and R, as defined in [MS-NRPC] section 3.5.4.3.1.
LDAP_OPT_REFFERALS	If the **Config_AD_Connection_Referral** ADM element is FALSE, set to FALSE.

2. If the value of the Config_CA_LDAP_Flags datum does not have the 0x0000002 (LDAPF_SIGNDISABLE) bit set and:

   - If after invoking the processing rules that are specified in section 3.2.2.1.6 with input parameter **InputADConnectionHandle** set equal to **ActiveDirectory_Connection**, the returned value is TRUE (that is, DC supports signing) set LDAP_OPT_SIGN to TRUE.
   - Else, if the Config_CA_LDAP_Flags datum does not have the 0x0000001 (LDAPF_SSLENABLE) bit set, return 0x80094013 (CERTSRV_E_DOWNLEVEL_DC_SSL_OR_UPGRADE) to the client and exit.

3. Invoke the "Performing an LDAP Bind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.4) with the following parameter:

   TaskInputADConnection: **ActiveDirectory_Connection**.

4. If the *TaskReturnStatus* returned is not 0:

   - Repeat step 1 with the following modification:

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- *TaskInputOptionName*: LDAP_OPT_GETDSNAME_FLAGS.
- *TaskInputOptionValue*: Bitwise OR of the bits A, J, and R, as defined in [MS-NRPC] section 3.5.4.3.1.

- Repeat step 3.
- If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:
  - **InputReturnStatus**: *TaskReturnStatus*
  - **InputResultMessage**: NULL

  Return the **OutputHRESULT** output parameter to the client and exit.

3.2.2.1.5 Publishing Issued Certificates

Modify requests are used to write information from the LDAP directory. The CA SHOULD perform modify requests to publish issued certificates to end entity object in the Active Directory.

Input Parameters:

EndEntityDistinguishedName: The distinguished name of the user or computer object in Active Directory.

IssuedCertificate: The issued certificate to be published to Active Directory.

Output Parameters: None

Processing Rules:

The CA MUST perform the processing rules that are specified in section 3.2.2.1.5.1.

In the following sections, we use the following local variables:

ActiveDirectory_Connection: An **ADConnection** handle (see [MS-ADSO] section 6.2.2 for more information about **ADConnection**).

Set_Of_Certificates: A set of certificates.

3.2.2.1.5.1 Search Requests

The CA SHOULD perform modify requests as demonstrated in the following figure.

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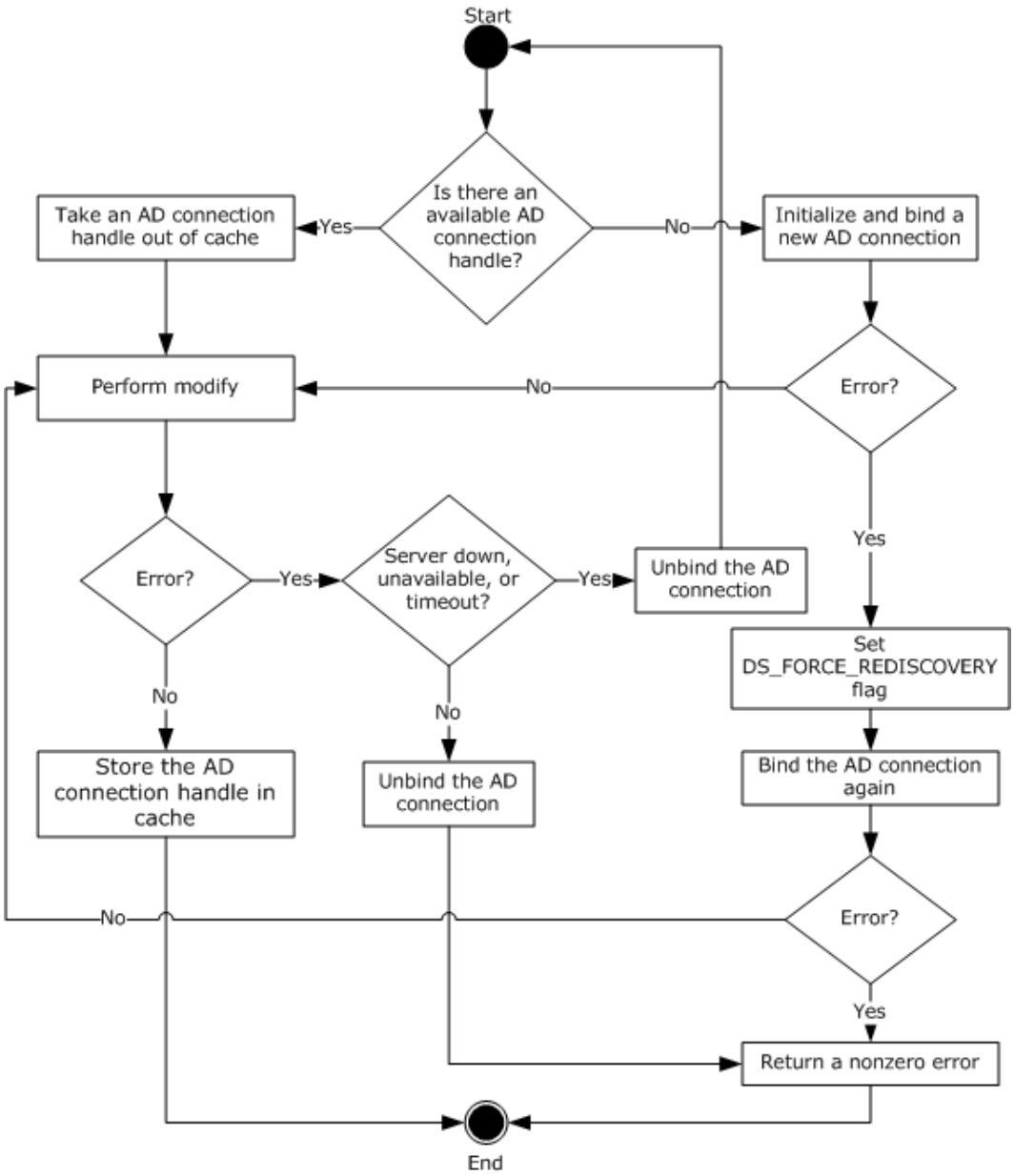

Figure 7: Retrieving an ADConnection handle for publishing issued certificates to a user or computer object

The following steps describe the flow of the preceding figure:

1. If the **Collection_of_Certificates_Publication_AD_Connections** ADM has no **ADConnection** element:

    1. Invoke the "Initialize ADConnection" task ([MS-ADSO] section 6.2.6.1.1) to construct an **ADConnection** with the following parameters:

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- *TaskInputTargetName*: **Domain Name System (DNS)** of the end entity obtained from the distinguished name of the end entity passed in as input parameter **EndEntityDistinguishedName**.
- *TaskInputPortNumber*: If the value of the Config_CA_LDAP_Flags datum has 0x0000001 (LDAPF_SSLENABLE) bit set, use port 636, otherwise use port 389.

Store the returned **ADConnection** handle in the **ActiveDirectory_Connection** variable.

2. Perform a bind request, as specified in section 3.2.2.1.5.2. Go to step 3.

2. If the **Collection_of_Certificates_Publication_AD_Connections** ADM has an **ADConnection** handle, remove it from the **Collection_of_Certificates_Publication_AD_Connections** ADM and use it as **ActiveDirectory_Connection** in the following steps.

3. Verify that the issued certificate, passed in as input parameter **IssuedCertificate**, does not already exist under the user object as specified in the following steps.

   1. Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:

      - *TaskInputADConnection*: **ActiveDirectory_Connection**
      - *TaskInputRequestMessage*: LDAP SearchRequest message (see [RFC2251] section 4.5.1) as follows:
        - baseObject: **EndEntityDistinguishedName**
        - scope: baseObject
        - filter: NULL
        - attributes: **userCertificate**
        - sizeLimit: 10000
        - timeLimit: 120
        - derefAliases: neverDerefAliases
        - typesOnly: FALSE
      - *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search.

      Store the returned value for **userCertificate** attribute in the **Set_Of_Certificates** variable.

   2. If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

      - **InputReturnStatus**: *TaskReturnStatus*
      - **InputResultMessage**: *TaskOutputResultMessages*

      Return the **OutputHRESULT** output parameter to the client and exit. Also, invoke the "Perform an LDAP Unbind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.5) with

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the *TaskInputADConnection* parameter set equal **ActiveDirectory_Connection** and then exit.

3. If the certificate in input parameter **IssuedCertificate** does not exist in the **Set_Of_Certificates** variable, add it to this set.

4. If any of the certificates in **Set_Of_Certificates** variable has expired for more than 24 hours, remove it from **Set_Of_Certificates**.

5. If **Set_Of_Certificates** is not changed as part of step 3.3 and 3.4, add the **ActiveDirectory_Connection** to the **Collection_of_Certificates_Publication_AD_Connections** ADM and then exit.

4. Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:

   - *TaskInputADConnection*: **ActiveDirectory_Connection**
   - *TaskInputRequestMessage*: An LDAP ModifyRequest (see [RFC2251] section 4.6) as follows:
     - Object: **EndEntityDistinguishedName**
     - The modification sequence has one entry, as follows:
       - operation: replace
       - modification:
         - type: **userCertificate**
         - vals: **Set_Of_Certificates**
   - *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search.

5. If the LDAP modify is successful, add the **ActiveDirectory_Connection** to the **Collection_of_Certificates_Publication_AD_Connections** ADM and exit.

6. If an error is returned from the LDAP modify indicating that the LDAP server is down, unavailable, or that there is a timeout (that is, the error code LDAP_SERVER_DOWN, indicating the directory server is unreachable), the CA MUST do the following:

   1. Invoke the "Perform an LDAP Unbind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set to **ActiveDirectory_Connection**.

   2. Go to step 1.

7. If an error is returned from the LDAP modify for reasons not covered in step 6, the CA MUST do the following:

   1. Invoke the "Perform an LDAP Unbind on an ADConnection" task (see [MS-ADSO] section 6.2.6.1.5) with the *TaskInputADConnection* parameter set to **ActiveDirectory_Connection**.

   2. Return a nonzero error to the client and then exit.

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3.2.2.1.5.2 Bind Requests

Bind requests are used to connect and to authenticate the user to an LDAP directory. The CA MUST perform bind requests as follows:

1. Invoke the "Setting an LDAP Option on an ADConnection" task ([MS-ADSO] section 6.2.6.1.2) once for each of the pairs of option and value parameters in the following table. For each of these, the *TaskInputADConnection* parameter is the **ActiveDirectory_Connection**.

TaskInputOptionName	TaskInputOptionValue
LDAP_OPT_GETDSNAME_FLAGS	Bitwise OR of the bits J and R, as defined in [MS-NRPC] section 3.5.4.3.1.
LDAP_OPT_REFFERALS	If the **Config_AD_Connection_Referral** ADM element is FALSE, set to FALSE.

2. If the value of the Config_CA_LDAP_Flags datum does not have the 0x0000002 (LDAPF_SIGNDISABLE) bit set and:

   - If after invoking the processing rules that are specified in section 3.2.2.1.6 with input parameter **InputADConnectionHandle** set equal to **ActiveDirectory_Connection**, the returned value is TRUE (that is, DC supports signing) set LDAP_OPT_SIGN to TRUE.

   - Else, if the Config_CA_LDAP_Flags datum does not have the 0x0000001 (LDAPF_SSLENABLE) bit set, return 0x80094013 (CERTSRV_E_DOWNLEVEL_DC_SSL_OR_UPGRADE) to the client and exit.

3. Invoke the "Performing an LDAP Bind on an ADConnection" task ([MS-ADSO] section 6.2.6.1.4) with the following parameter:

   TaskInputADConnection: **ActiveDirectory_Connection**.

4. If not successful:

   - Repeat step 1 with the following modification:

     - *TaskInputOptionName*: LDAP_OPT_GETDSNAME_FLAGS.

     - *TaskInputOptionValue*: Bitwise OR of the bits A, J, and R, as defined in [MS-NRPC] section 3.5.4.3.1.

   - Repeat step 3.

   - If the *TaskReturnStatus* returned is not 0, convert it to a 4-byte **HRESULT** value (errors are specified in [MS-ERREF] section 2.1) by performing the processing rules in section 3.2.2.1.7 with the following input parameters:

     - **InputReturnStatus**: *TaskReturnStatus*

     - **InputResultMessage**: NULL

     Return the **OutputHRESULT** output parameter to the client and exit.

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3.2.2.1.6 Determining DC Support for Signing

The processing rules in this section are used to determine whether the domain controller (DC) supports signing or not.

Input Parameters:

InputADConnectionHandle: An **ADConnection** handle (see [MS-ADSO] section 6.2.2 for more information about **ADConnection**).

Output Parameters:

True or False, depending on whether the DC supports signing or not.

Processing Rules:

1. Invoke the "Establishing an ADConnection" task ([MS-ADSO] section 6.2.6.1.3) with the following parameter:

   TaskInputADConnection: **InputADConnectionHandle**

2. If the *TaskReturnStatus* returned is FALSE, return FALSE.

3. Invoke the "Perform an LDAP Operation on an ADConnection" task ([MS-ADSO] section 6.2.6.1.6) with the following parameters:

   - *TaskInputADConnection*: **InputADConnectionHandle**
   - *TaskInputRequestMessage*: LDAP SearchRequest message ([RFC2251] section 4.5.1) as follows:
     - baseObject: NULL
     - scope: baseObject
     - filter: (objectClass=*)
     - attributes: The CA SHOULD use the following attributes:
       - supportedCapabilities
     - sizeLimit: 10000
     - timeLimit: 120
     - derefAliases: neverDerefAliases
     - typesOnly: FALSE
   - *TaskOutputResultMessage*: Upon successful return from the task, this parameter will contain the results of the LDAP search.

4. If the *TaskReturnStatus* returned is not 0, return FALSE.

5. If *TaskOutputResultMessage* contains 1.2.840.113556.1.4.1791 (LDAP_CAP_ACTIVE_DIRECTORY_LDAP_INTEG_OID_W), then return TRUE, else return FALSE.

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3.2.2.1.7 Converting the LDAP results to HRESULT

The processing rules in this section are used to convert the returned LDAP result into an **HRESULT (section 2.2.18)**, as specified in [MS-DTYP] section 2.2.18.

Input Parameters:

InputReturnStatus: An LDAP resultCode ([RFC2251] section 4.1.10) returned from the directory server in response to the request or an error indicating that the directory server could not be contacted or a timeout has occurred.

InputResultMessage: A list of LDAPMessage values ([RFC2251] section 4.1.1) which contains the response from the directory server.

Output Parameters:

OutputHRESULT: The returned **HRESULT** value.

Processing Rules:

1. If the input parameter **InputResultMessages** is set to NULL (as in the case of the Bind task), use the **InputReturnStatus** input parameter. Convert this value to a Win32 error using the conversion specified in [MS-ERREF] section 2.4, and then convert the Win32 error to **HRESULT** using the conversion specified in [MS-ERREF] section 2.1.2. Set the output parameter **OutputHRESULT** equal to the returned **HRESULT** and exit.

2. If the input parameter **InputResultMessages.errorMessage** is at least 8 bytes long:

    1. If each of the first 8 bytes is between '0' and '9' inclusive, or between 'a' and 'f' inclusive, or between 'A' and 'F' inclusive, then use this value as the hexadecimal representation of a Win32 error and then convert the Win32 error to **HRESULT** using the conversion specified in [MS-ERREF] section 2.1.2. Set output parameter **OutputHRESULT** equal to the returned **HRESULT** and exit.

    2. If each of the first 8 bytes is 0, use ERROR_DS_GENERIC_ERROR, as specified in [MS-ERREF] section 2.4, as the Win32 error and then convert the Win32 error to **HRESULT** using the conversion specified in [MS-ERREF] section 2.1.2. Set the output parameter **OutputHRESULT** equal to the returned **HRESULT** and exit.

3. Otherwise, use the input **InputResultMessages.resultCode**. Convert it to a Win32 error using the conversion specified in [MS-ERREF] section 2.4, and then convert the Win32 error to **HRESULT** using the conversion specified in [MS-ERREF] section 2.1.2. Set the output parameter **OutputHRESULT** equal to the returned **HRESULT** and exit.

3.2.2.2 CA Information in the Active Directory

This section specifies the information that is required to exist in the Active Directory of the client's domain for Enterprise CA.

Attributes and certificates in the Enrollment service object:

1. The object of type pKIEnrollmentService under the following container where "CN=Configuration, DC=..." is replaced with the value of the **configurationNamingContext** attribute (specified in [MS-ADTS] section 3.1.1.3.2.1) of the rootDSE object.

```
"CN=Enrollment Services,CN=Public Key Services,CN=Services,CN=Configuration,DC=..."
```


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2. The CN attribute of this object is set to the CN value of the **Subject** field of the CA signing certificate. The value is bold sanitized as specified in 3.1.1.4.1.1.

3. The **displayName** attribute of this object is set to the CN value of the **Subject** field of the CA signing certificate. The value is not sanitized.

4. The **dNSHostName** attribute of this object is set to the fully qualified domain name (FQDN) of the machine that the CA is running on.

5. The **certificateTemplates** attribute of this object is set with the list of names of the certificate templates that this CA issues as specified in section 2.2.2.11.2.3.

6. The CA signing certificate is added to the **cACertificate** attribute of that object.

CA signing certificates in the NTAuthCertificates object:

1. The object of type certificationAuthority under the following container where "CN=Configuration, DC=..." is replaced with the value of the **configurationNamingContext** attribute (specified in [MS-ADTS] section 3.1.1.3.2.1) of the rootDSE object.

```
"CN=Public Key Services,CN=Services,CN=Configuration,DC=..."
```

2. The CN of this object is set to NTAuthCertificates.

3. All the CA signing certificates are added to the **cACertificate** attribute of that object.

For root enterprise CAs only, the CA signing certificates in the CA object:

1. The object of type certificationAuthority under the following container where "CN=Configuration, DC=..." is replaced with the value of the **configurationNamingContext** attribute (specified in [MS-ADTS] section 3.1.1.3.2.1) of the rootDSE object.

```
"CN=Certification Authorities,CN=Public Key
Services,CN=Services,CN=Configuration,DC=..."
```

2. The CN attribute of this object is set to the CN value of the **Subject** field of the CA signing certificate.

3. All the CA signing certificates are added to the **cACertificate** attribute of that object.

3.2.2.3 Abstract Data Model

In addition to the tables specified in section 3.2.1 and maintained by the server, the enterprise CA maintains the data detailed in the following sections.

Server_Current_Version: An unsigned integer with values between 0 and 15. This ADM element is used to determine whether the current template is supported by the server. If CT_FLAG_REQUIRE_SAME_KEY_RENEWAL is implemented (see section 3.2.2.6.2.1.4.5.7 for more details), then this ADM element MUST be set to 4; otherwise, it MUST be set to 15.

Collection_Of_End_Entity_Object_Query_AD_Connections: A collection of **ADConnection** handles whose maximum size SHOULD be set to Config_Max_Number_Of_AD_Connections.<98> Each element of this collection can be used each time the CA establishes an Active Directory connection. This collection is initialized with

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no element. In order to support multiple simultaneous requests, the CA SHOULD enforce mutual exclusion on read and write operations on the elements of this ADM.

CertificateTemplatesAndEnrollmentServices_AD_Connection: An **ADConnection** handle initialized to NULL. In order to support multiple simultaneous requests, the CA SHOULD serialize the access to this ADM element. All Windows Client Certificate Enrollment server implementations serialize access to the ADconnection handle. Other implementations are not required to do this.

Collection_of_Certificates_Publication_AD_Connections: A collection of **ADConnection** handles. Each element of this collection can be used each time the CA establishes an Active Directory connection to publish issued certificates. This collection is initialized with no element.

See [MS-ADSO] section 6.2.2 for more information about **ADConnection**.

3.2.2.3.1 Certificate Templates Replica Table

The server maintains the following table.

Column name	Column description
Certificate_Template_Data	Contains the certificate template attributes that are documented in [MS-CRTD].
Certificate_Template_IsConfigured	Instructs the CA whether it can issue certificates, based on this certificate template. Possible values are True and False.

3.2.2.4 Timers

There are no timers for this protocol.

3.2.2.5 Initialization

In addition to the initialization steps documented in section 3.2.1.3, the server MUST perform the following initialization steps:

1. Reads the list of objects under the certificate templates container in the working directory, by performing the processing rules specified in section 3.2.2.1.1 with input parameter **InputContainer** set to Certificate Templates Container.

2. For each certificate template in **CertificateTemplatesandEnrollmentServicesObjects** returned in step 1 that does not have a msPKI-Template-Schema-Version attribute or has msPKI-Template-Schema-Version value of 0x1, 0x2, 0x3, or 0x4, the CA SHOULD create a new row in the Certificate Templates Replica table, store each certificate template object in a Certificate_Template_Data column, and set the value of the Certificate_Template_Is_Configured to False.<99>

3. Reads the list of objects under the enrollment services container in the working directory by performing the processing rules specified in section 3.2.2.1.1 with input parameter **InputContainer** set to Enrollment Services Container.

   For each object in **CertificateTemplatesandEnrollmentServicesObjects** returned from section 3.2.2.1.1, the CA MUST look for the object that has the following characteristics:

   1. The object is of type pKIEnrollmentService as specified in section 2.2.2.11.2.

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2. The value of the cn field is equal to the sanitized value of cn in the subject field of the CA signing certificate.

4. Looks at the certificateTemplates attribute of the object identified in step 3. This is a multiple-value string and each value of this attribute is a configured certificate template. For each value of this string, the server performs the following steps:

   1. Compares the value of the string to the value of the cn field for each certificate template that is stored in the Certificate_Template_Data column in the certificate template replica.

   2. If the values are equal, sets the value of the Certificate_Template_Is_Configured of the same row to True.

If the CA fails to complete any of the initialization steps in this section, the CA MUST continue to receive requests from clients. When the CA receives a request from a client, it MUST reattempt all the initialization steps, and if it still fails to initialize, it MUST return a nonzero error to the client.

3.2.2.6 Message Processing Events and Sequencing Rules

The following sections specify processing rules that the server implements, in addition to those specified in section 3.2.1.4, or rules where the Enterprise CA deviates from those specified in section 3.2.1.4. If an interface or method is specified in section 3.2.1.4, but is omitted in this section, the Enterprise CA implements that method or that interface exactly as specified in section 3.2.1.4.

3.2.2.6.1 Algorithms

The Server Mode: Enterprise CA protocol role uses the algorithms specified in 3.1.1.4.1, and its subsections, in addition to the algorithms specified in 3.2.1.4.1.

3.2.2.6.2 ICertRequestD

3.2.2.6.2.1 ICertRequestD::Request (Opnum 3)

The server follows the specifications documented in section 3.2.1.4.2.1, with the following exceptions:

- The server MUST support the additional request attributes as specified in section 3.2.2.6.2.1.1.
- The server MUST support the additional request scenarios and their supporting structures as documented in 3.2.2.6.2.1.2.
- The server MUST replace the CA policy algorithm specified in section 3.2.1.4.2.1.4.4 with the one specified in section 3.2.2.6.2.1.4.

3.2.2.6.2.1.1 Parsing and Verifying pwszAttributes

In addition to the processing rules specified in section 3.2.1.4.2.1.2, the server MUST support the following attributes:

- CertificateTemplate:
  - Processing: The server MUST use this attribute when processing the request. Specifications are in section 3.2.2.6.2.1.4.1.
- cdc:

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- Processing: If for any reason the CA fails to read information on the requesting end entity from the working directory and the client provided this attribute in the request, it MUST try to read that information from the Active Directory server by invoking the processing rules in section 3.2.2.1.3 (and its subsections) with input parameters **DCName** set to the value of the **cdc** attribute and **EndEntityDistinguishedName** set equal to the requester's distinguished name.

- Rmd:
  - Processing: The CA SHOULD verify the value of this attribute with the FQDN for the requestor obtained from the **dNSHostName** attribute of the requester's object in the working directory. The CA MUST obtain the **dNSHostName** attribute by invoking the processing rules in section 3.2.2.1.2 with input parameter **EndEntityDistinguishedName** set equal to the requester distinguished name and then retrieving the **dNSHostName** from the returned **EndEntityAttributes** output parameter.

3.2.2.6.2.1.2 Processing a Request

In addition to the request types specified in section 3.2.1.4.2.1.4, the server MUST support the following types of certificate requests:

- A Request On Behalf Of (ROBO) a different subject.
- A request that includes private key materials.
- A request that includes key attestation materials.
- A request that includes challenge response materials.

The following table describes the different request formats for these additional scenarios.

Request type	CMS with PKCS #10	PKCS #10	CMS with CMC	Netscape KEYGEN
ROBO	Yes	No	Yes	No
Key archival request	No	No	Yes	No
Initial Key Attestation Request	Yes	Yes	Yes	No
Challenge Response	Yes	No	Yes	No

"Yes" indicates that this format is supported for this request type. "No" indicates that this format is not supported by this protocol.

If a certificate request is submitted using a certificate format that is not supported, the CA MUST return an error code. The error code SHOULD be CRYPT_E_INVALID_MSG_TYPE.

The server MUST apply the rules specified in the following sections for each of these request types.

3.2.2.6.2.1.2.1 Processing Rules for Request on Behalf of a Different Subject

A ROBO certificate request MUST use one of the following formats as specified in section 3.2.1.4.2.1.4:

- CMS with embedded PKCS #10.

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- CMS with embedded CMC.

The following are the specific CA processing rules for the certificate request for each one of the preceding formats.

If the CA implements Config_Permissions_Enrollment_Agent_Rights data,<100> the CA MUST verify that the EA that has permissions to request a certificate for the specific end-entity (subject of the certificate being requested) based on the specific template. If the EA does not have the permissions to make a request, the CA MUST return a nonzero error. The error SHOULD be 0x80094009 (CERTSRV_E_RESTRICTEDOFFICER).

3.2.2.6.2.1.2.1.1 Request on Behalf of Using CMS and PKCS #10 Request Formats

The request MUST be compliant with the information that is specified in [RFC3852]. The processing rules for the following fields MUST be adhered to by the CA but are not specified by [RFC3852]:

- contentType: This field MUST be set to the OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData). If it is not, the CA MUST return a non-zero error.
- content: This field is a **SignedData** structure (as specified in [RFC3852] section 5.1) and has the following requirements for its fields:
  - encapContentInfo: This field MUST have the following values for its fields:
    - eContentType: This field MUST be set to the OID szOID_PKCS_7_DATA (1.2.840.113549.1.7.1, id-data). If it is not, the CA MUST return a non-zero error.
    - eContent: this field MUST be the PKCS #10 certificate request. Processing rules MUST be identical to the ones specified in section 3.2.1.4.2.1.4.1.1.
  - certificates: This field MUST include all the certificates that are associated with the private keys used to sign the certificate request. The certificates MUST have the certificate request agent EKU (1.3.6.1.4.1.311.20.2.1).
  - signerInfos: The signing MUST be done with the key (or keys) associated with the certificate or certificates that are passed in the **certificates** field.
    - AuthenticatedAttributes (in the first SignerInfo instance): This field MUST include the OID szENROLLMENT_NAME_VALUE_PAIR (1.3.6.1.4.1.311.13.2.1) attribute. The value of the attribute MUST include the requestername name-value pair. The value of the requestername name-value pair MUST be used to construct the Subject field in the issued certificate.

3.2.2.6.2.1.2.1.2 Request on Behalf of Using CMS and CMC Request Format

The request MUST be compliant with the information that is specified in [RFC2797]. The processing rules for the following fields MUST be adhered to by the CA but are not specified by [RFC2797]:

- contentType: This field MUST be set to the OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData). If it is not, the CA MUST return a non-zero error.
- content: This field is a SignedData structure. If it is not, the CA MUST return a non-zero error.
  - encapContentInfo: This field MUST have the following values for its fields:
    - eContentType: This field MUST be set to the OID szOID_CT_PKI_DATA (1.3.6.1.5.5.7.12.2, Id-cct-PKIData). If it is not, the CA MUST return a non-zero error.

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- eContent: This field MUST be a **PKIData** structure, as specified in [RFC2797] section 3.1. The **PKIData** structure MUST adhere to the following requirements:
  - TaggedRequest: This field MUST contain exactly one certificate request. The certificate request MUST be PKCS #10 conforming to rules specified in section 3.2.1.4.2.1.4.1.1. If it is not, the CA MUST return a non-zero error.
  - TaggedAttribute: This field MUST include the RegInfo attribute (as specified in [RFC2797] section 5.12). The RegInfo value MUST include the OID szENROLLMENT_NAME_VALUE_PAIR (1.3.6.1.4.1.311.13.2.1) attribute. The value of the attribute MUST include the requestername name-value pair. The value of the requestername name-value pair MUST be used to construct the Subject field in the issued certificate.

- certificates: This field MUST include all the certificates that are associated with the private keys used to sign the certificate request. The certificates MUST have the certificate request agent EKU (1.3.6.1.4.1.311.20.2.1).
- signerInfos: The signing MUST be done with the key (or keys) associated with the already issued certificate (or certificates) that are passed in the **certificates** field.

3.2.2.6.2.1.2.2 Processing Rules for Requests That Include Private Key Information

A certificate request that includes its associated private key MUST use a CMS certificate request with an embedded CMC structure.

The request MUST be compliant with the information that is specified in [RFC3852]. The processing rules for the following fields MUST be adhered to by the CA, but are not specified by [RFC3852].

- contentType: This field MUST be set to the OID szOID_RSA_signedData (1.2.840.113549.1.7.2, id-signedData). If it is not, the CA MUST return a non-zero error.
- content: The content structure MUST be SignedData. The SignedData structure MUST adhere to the following requirements:
  - encapContentInfo: This field MUST have the following values for its fields:
    - eContentType: This field MUST be set to the OID szOID_CT_PKI_DATA (1.3.6.1.5.5.7.12.2, Id-cct-PKIData). If it is not, the CA MUST return a non-zero error.
    - eContent: This field MUST be a **PKIData** structure, as specified in [RFC2797] section 3.1. The **PKIData** structure MUST adhere to the following requirements:
      - TaggedRequest: This field MUST contain exactly one certificate request. The certificate request MUST be PKCS #10 conforming to rules specified in section 3.2.1.4.2.1.4.1.1. If it does not, the CA MUST return a non-zero error.
      - TaggedAttribute: This field MUST include the key hash attribute. The OID for this attribute is the OID szOID_ENCRYPTED_KEY_HASH (1.3.6.1.4.1.311.21.21), as specified in section 2.2.2.7.9. The value for this attribute MUST be the hash of the value of the OID szOID_ARCHIVED_KEY_ATTR (1.3.6.1.4.1.311.21.13) attribute, specified in the subsequent steps. The hash algorithm could be either algorithm used to sign certificate request or SHA1. <101> The hash value MUST be encoded as an octet string. The CA MUST calculate its own hash of the enveloped private key using the same hash algorithm and confirm it matches to the value in this field. If it doesn't, the CA MUST fail the request with a non-zero error.

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This field MAY also contain additional enrollment attributes. If the field contains the RegInfo attribute (as specified in [RFC2797] section 5.12), processing rules for its value are identical to the ones for the *pwszAttributes* parameter (as specified in section 3.2.1.4.2.1.2).

- signerInfos: The **SignerInfo** structure MUST adhere to the following requirements:
  - unauthenticatedAttributes: One of the attributes in this field MUST be the OID szOID_ARCHIVED_KEY_ATTR (1.3.6.1.4.1.311.21.13). The value for this attribute MUST be ASN.1 DER encoded CMS. This CMS MUST have the following structure:
    - contentType: This field MUST be the OID szOID_PKCS_7_ENVELOPED (1.2.840.113549.1.7.3, id-envelopedData). If it is not, the CA MUST return a non-zero error.
    - content: This field MUST be an **EnvelopedData** structure with the following requirements:
      - recipientInfos: This field MUST reference the CA exchange certificate that contains the public key used for encrypting the private key. Other certificates in this collection SHOULD be ignored.
      - encryptedContentInfo: The **encryptedContent** field of the **EncryptedContentInfo** structure includes the private key that is to be sent to the CA encrypted to the public key of the certificate in the Current_CA_Exchange_Cert datum. The format of this private key is specified in section 2.2.2.9. If this private key does not correspond to the public key in the encapsulated PKCS #10 request, the CA MUST return a non-zero error.

3.2.2.6.2.1.2.3 Processing Rules for Renewal Request

In addition to the processing rules defined in section 3.2.1.4.2.1.4.2, Enterprise CA MUST validate that the renewal request is based on the same certificate template as the certificate being renewed. If certificate templates do not match, the CA MUST return a non-zero error.

3.2.2.6.2.1.2.4 Processing Renewal Request on Behalf of a Different Subject

The CA SHOULD accept renewal requests submitted on behalf of other end entities.<102> The client indicates this type of request by setting 0x00200000 bit of the dwFlags parameter of the Request method.

The following are the rules for processing these types of requests:

1. The CA MUST validate the format of the certificate request as specified in sections 3.2.1.4.2.1.4.2 and 3.2.2.6.2.1.2.3.
2. If the CA implements the Config_CA_Allow_RenewOnBehalfOf_Requests datum and it is set to false, the CA MUST return a nonzero error.
3. For a renewal request on behalf of others, the key that signed the request MUST be treated as the authentication of the renewal request, overriding any authentication applied to the message that carries this request. If the CA fails to identify the end entity, it MUST return a nonzero error.
4. Once the end entity has been identified in step 3, the CA MUST process the request as if that end-entity has made the call to the Request method and follow the all of the method's applicable processing rules as specified in section 3.2.2.6.2.1.

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3.2.2.6.2.1.2.5 Processing Rules for an Initial Key Attestation Request

Note For information on product behavior, see the following product behavior note.<103>

In addition to the processing rules defined in section 3.2.1.4.2.1.4, the CA MUST perform the following processing on the certificate request, which is formatted as explained in section 3.1.1.4.3.4.1.

1. The CA MUST decrypt the encrypted szOID_ENROLL_EK_INFO attribute that contains the EKPub and up to 3 optional EKCerts using the current CA exchange certificate private key. The encryption algorithm will be sent back to the client as the szOID_ENROLL_ENCRYPTION_ALGORITHM attribute defined in section 2.2.2.8.1.4. If these szOID_ENROLL_EK_INFO constraints are not met, the CA returns error CERTSRV_E_INVALID_EK.

2. The CA MUST extract the EKPub, verify it can be loaded, and record its SHA-2 hash in the EndorsementKeyHash column of the database ([MS-CSRA] section 3.1.1.1.2).

3. The CA performs the following processing.

   1. The CA SHOULD set the CR_FLG_TRUSTONUSE flag in the Request_Request_Flags column of the Request table ([MS-CSRA] section 3.1.1.1.2).

   2. The CA SHOULD verify all EKCerts obtained in step 1 according to the processing rules in section 3.2.2.6.2.1.2.5.1 and the CA MUST set the CR_FLG_TRUSTEKCERT in the Request_Request_Flags column of the Request table ([MS-CSRA] section 3.1.1.1.2).

   3. The CA SHOULD verify that the EKPub exists in one of the locations listed under the Config_Endorsement_Key_List_Directories ADM element according to the processing rules in section 3.2.2.6.2.1.2.5.2; if it exists, the CA MUST set the CR_FLG_TRUSTEKKEY in the Request_Request_Flags column of the Request table ([MS-CSRA] section 3.1.1.1.2).

4. The CA MUST verify that the requestor of the certificate is in ownership of the AIK by verifying the KeyAttestationStatement data stored under the szOID_ENROLL_ATTESTATION_STATEMENT attribute as specified in [TCG-Architect]; otherwise, fail with an HRESULT indicating that the CA failed to validate the KeyAttestationStatement data.

5. The CA MUST verify that the value of the szOID_ENROLL_KSP_NAME attribute is a Unicode string that contains the name of a valid TPM provider.<104>

Once the request has been processed as described earlier in this section, the CA creates a Challenge message as described in section 3.2.2.6.2.1.2.6 and sends it to the client.

3.2.2.6.2.1.2.5.1 Processing Rules for Key Attestation Based on Trusted Endorsement Certificates

The CA MUST follow the processing rules for key attestation as outlined in section 3.2.2.6.2.1.2.5 and below in order to perform key attestation based on trusted endorsement certificates (EKCerts).

1. The server SHOULD verify that there are a maximum of 3 EKCerts in the Request.

2. The CA MUST verify that the public key in each EKCert matches the EKPub in the request.

3. The CA SHOULD verify that any one of the EKCerts in the Request is valid and chains up to a trusted root [RFC5280] in the Endorsement Root store or Endorsement CA store for intermediate CA certificates.

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- If successful the CA MUST store the SHA2 hash of the EKPub in the EndorsementCertificateHash column of the Request table ([MS-CSRA] section 3.1.1.1.2) and the CA MUST set the CR_FLG_TRUSTEKCERT flag in the Request_Request_Flags column to indicate that key attestation succeeded while processing a trusted EKCert.

3.2.2.6.2.1.2.5.2 Processing Rules for Key Attestation Based on a Trusted Endorsement Key

The CA MUST following the processing rules outlined below to perform key attestation based on a trusted endorsement key.

1. The CA MUST create a SHA2 hash of the EKPub with spaces removed.
2. If the Config_Endorsement_Key_List_Directories ADM element contains a location or multiple locations, the CA MUST perform the following processing:
   - For each folder location defined, the CA MUST search for a file with a name matching the SHA2 hash of the EKPub created in step 1.

     Note This search SHOULD be case-insensitive.
3. If a file is found with the SHA2 hash of the EKPub in step 2, the CA MUST set the CR_FLG_TRUSTEKKEY flag in the Request_Request_Flags column of the Request table ([MS-CSRA] section 3.1.1.1.2) to indicate that key attestation succeeded on a trusted endorsement key.

3.2.2.6.2.1.2.6 Processing Rules for Providing a Challenge Response to an Initial Key Attestation Request

If processing for initial key attestation request, as specified in section 3.2.2.6.2.1.2.5, is successful, the CA MUST create the response as show below:

1. The CA MUST generate a random secret of 32 bytes and encrypt the secret into a challenge using the szOID_ENROLL_ATTESTATION_STATEMENT attribute.
2. The CA MUST encrypt the secret with a current CA exchange certificate private key and store it in the AttestationChallenge column of the Request table ([MS-CSRA] section 3.1.1.1.2).
3. The CA MUST set the Request_Request_Flags column to CR_FLG_CHALLENGEPENDING as specified in [MS-CSRA] section 3.1.1.1.2.
4. The CA MUST send a CMC full PKI response including a CA exchange certificate and its full chain.
5. The CA MUST also include additional attributes as specified in section 2.2.2.8.1 where pdwDisposition is set to request pending (5).

3.2.2.6.2.1.2.7 Processing Rules for a Challenge Response Request

If a request of type Challenge Response is received the CA MUST adhere to the following processing rules:

1. The CA MUST look up the relevant Request row in the Request Table using the RequestId attribute (section 2.2.2.7.10) specified in the pwszAttributes parameter of **ICertRequestD::Request** or **ICertRequestD2::Request2**.

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2. The CA MUST verify that the Request_Disposition column in the Request table ([MS-CSRA] section 3.1.1.1.1) is set to "request pending".

3. The CA MUST verify that the original requester or caller of the request is the caller for this request.

4. The CA MUST verify that the Request_Request_Flags column in the Request Table is set to CR_FLG_CHALLENGEPENDING as specified in [MS-CSRA] section 3.1.1.1.2.

5. The CA MUST verify that the KeyAttestationChallenge column still has a challenge and is not set to a single zero byte. If this is true, then after these processing rules are complete (regardless of eventual success or failure), the contents of the KeyAttestationChallenge column MUST be set to a single zero byte to indicate a challenge response has been attempted.

6. The CA MUST decrypt the challenge in the response with the current CA exchange private key.

7. The CA MUST decrypt the challenge in the KeyAttestationChallenge column of the Request table.

8. The CA MUST verify that the decrypted challenge from the response matches the decrypted challenge in the database.

9. If the above processing is successful, the CA MUST set the Request_Request_Flags column in the Request table to CR_FLG_CHALLENGESATISFIED indicating that challenge verification is satisfied as specified in [MS-CSRA] section 3.1.1.1.2.

10. The CA MUST call the CA Policy Algorithm to process the request according to section 3.2.2.6.2.1.4.

3.2.2.6.2.1.3 Storing Request Parameters in the Request Table

Unless specified otherwise in this section, the CA MUST store the request parameters as specified in section 3.2.1.4.2.1.4.3.

If a request is a key archival request as specified in section 3.2.2.6.2.1.2.2:

- The CA MUST remove the unauthenticated attribute szOID_ARCHIVED_KEY_ATTR (1.3.6.1.4.1.311.21.13) from the outer CMS message before saving the request to the Request_Raw_Request column as specified in section 3.2.1.4.2.1.4.3.

- If the CA implements the ICertAdminD2 interface specified in [MS-CSRA], it MUST follow these steps to archive the client's private key from the szOID_ARCHIVED_KEY_ATTR (1.3.6.1.4.1.311.21.13) attribute:

  1. If the Config_CA_KRA_Cert_List is empty, return a non-zero error to the client.

  2. If the Config_CA_KRA_Cert_Count is less than a number of certificates in the Config_CA_KRA_Cert_List, return a non-zero error to the client.

  3. From the Config_CA_KRA_Cert_List select Config_CA_KRA_Cert_Count number of certificates. These certificates will be used in steps 4 and 6.

  4. Construct an enveloped CMS message as specified in section 6 of [RFC3852] with the following requirements:

     - RecipientInfos: Use certificates selected in step 3.

     - EncryptedContent: Encrypt the private key from the szOID_ARCHIVED_KEY_ATTR (1.3.6.1.4.1.311.21.13) attribute of the certificate request.

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5. Save the message from the previous step in the Request_Raw_Archived_Key column.

6. Save the SHA1 hashes of the certificates selected in step 3 by following these steps:

    1. Convert each hash into a string form by using hexadecimal digits and separating each byte with a space. Use lower case for letters 'a' through 'f'. For example, "01 23 fe dc".

    2. Concatenate each hash into a single string separating them with a '\n' character.

    3. Save the resultant string in the Request_Key_Recovery_Hashes column.

- If the CA doesn't implement the ICertAdminD2 interface specified in [MS-CSRA], it MAY archive the client's private key by implementation specific means.

If the request is an initial key attestation request as specified in section 3.2.2.6.2.1.2.5, the CA MUST store the request parameters as specified in section 3.2.1.4.2.1.4.3:

- Save the start bit in the Request_Request_Flags column when key attestation begins and the completion bit when key attestation is completed.

- Save the SHA2 hash of the Endorsement Public Key in the Request_Endorsement_Certificate_Hash column.

- If the attestation is successful, indicate in the Request_Request_Flags column that attestation is performed based on valid user credentials and store the hash in the Request_Endorsement_Key_Hash column.

- If attestation processing happened according to section 3.2.2.6.2.1.2.5.1, indicate in the Request_Request_Flags column that attestation is based on EKCert and store the hash of the certificate in the Request_Endorsement_Certificate_Hash column.

- If attestation processing happened according to section 3.2.2.6.2.1.2.5.2, indicate in the Request_Request_Flags column ([MS-CSRA] section 3.1.1.1.2) that attestation is based on EKPub and store the hash of the public key in the Request_Endorsement_Key_Hash column.

- Save the secret that was encrypted with the CA exchange key in the Request_Attestation_Challenge column.

3.2.2.6.2.1.4 CA Policy Algorithm

In addition to the rules specified in section 3.2.1.4.2.1.4.1.3, the server MUST adhere to the processing rules described in this section and subsections that describe how the CA policy algorithm has to be implemented using certificate templates:

1. The server MUST verify that the request contains an identifier to a configured certificate template and is for a template configured to be issued by this CA. See section 3.2.2.6.2.1.4.1.

2. The server MUST compare the version of the requested certificate template to the version of the certificate template stored in its certificate template table. See section 3.2.2.6.2.1.4.2.

3. The server MUST verify that the requester has enroll permission on the requested certificate template, by invoking the processing rules in section Verify End Entity Permissions (section 3.2.2.6.2.1.4.3) with input parameter **Input_ntSecurityDescriptor** set to the **ntSecurityDescriptor** attribute of the certificate template, and **Input_SID** set equal to the **Per_Request.Caller_SID** ADM element.

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4. The server MUST construct the issued certificate. It MUST adhere to the processing rules on the certificate template attributes as specified in section 3.2.2.6.2.1.4.1. If the certificate template object has an msPKI-Template-Schema-Version attribute and it is set to 2, 3, or 4, the CA MUST also adhere to processing rules specified in section 3.2.2.6.2.1.4.2.

The certificate templates data structure is specified in [MS-CRTD].

3.2.2.6.2.1.4.1 Verify Configured Certificate Template

After it receives a request, the server MUST first verify that the request is for a certificate that is based on a configured certificate template by performing the following steps:

1. The CA MUST retrieve the certificate template identifier from the following four optional locations:
   - Name: From the CertificateTemplateName structure as specified in section 2.2.2.7.7.1.
   - Name: From the Enrollment-Name-Value pair as specified in section 2.2.2.7.10.
   - Name: From the pwszAttributes parameter of ICertRequestD::Request or ICertRequestD2::Request2 as specified in section 3.2.1.4.2.1.2.
   - OID: From the CertificateTemplateOID structure as specified in section 2.2.2.7.7.2.
2. The CA MUST map each of these identifiers to one of the certificate templates in its certificate template table in the following way:
   - A name identifier is mapped to the value of the cn attribute of a certificate template object that is stored in the Certificate_Template_Data column.
   - An OID identifier is mapped to the value of the msPKI-Template-Cert-Template-OID attribute of a certificate template object that is stored in the Certificate_Template_Data column.
3. The CA MUST validate that all the certificate template identifiers that are passed in the request are mapped to a single certificate template object. This certificate template is referred to as the certificate template for this request. If there are no certificate template identifiers, the CA MUST return a nonzero error. The error SHOULD be 0x80094800 (CERTSRV_E_UNSUPPORTED_CERT_TYPE). If the certificate template identifiers are mapped to more than one certificate template, the CA MUST return a nonzero error. The error code SHOULD be 0x80094802 (CERTSRV_E_TEMPLATE_CONFLICT).
4. The CA MUST verify that the value of the Certificate_Template_Is_Configured column of the identified certificate template is True. If the value is False, the CA MUST fail the request. The error code SHOULD be 0x80094800 (CERTSRV_E_UNSUPPORTED_CERT_TYPE).

3.2.2.6.2.1.4.2 Verify Certificate Template Version

The server MUST verify that the version of the certificate template that is submitted in the request is not newer than the certificate template that the server stores in its certificate template table. The server MUST perform the following steps:

1. If the certificate template does not have the msPKI-Template-Schema-Version attribute or if the attribute exists and its value is 1, the certificate template version is correct and the server MUST continue processing according to the rules specified in section 3.2.2.6.2.1.4.
2. If the attribute exists and its value is 2 or 3, the server MUST perform the following steps:

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1. The server MUST inspect the version information specified in the V2 template extension OID_CERTIFICATE_TEMPLATE "1.3.6.1.4.1.311.21.7" (as specified in section 2.2.2.7.7.2). If this extension is not specified in the request, the request is assumed to have (0, 0) as the (major, minor) version for the template.

2. If the V2 template extension exists in the request and the specified major version is greater than the value of the revision attribute of the certificate template that is stored in the Certificate_Template_Data column, the request MUST be rejected with a disposition of error code CERTSRV_E_BAD_TEMPLATE_VERSION.

3. If the V2 template extension exists in the request and the specified minor version is greater than the value of the msPKI-Template-Minor-Revision attribute of the certificate template that is stored in the Certificate_Template_Data column, the request MUST be rejected with a disposition of error code as CERTSRV_E_BAD_TEMPLATE_VERSION.

3.2.2.6.2.1.4.3 Verify End Entity Permissions

Input Parameters:

Input_ntSecurityDescriptor: The **ntSecurityDescriptor** attribute of the input template.

Input_SID: Contains the SID of the end entity requesting the certificate based on the input template.

Output Parameters:

TRUE or FALSE

Processing Rules:

The server MUST verify that the requester is allowed to enroll for the identified certificate template by following these steps:

1. Invoke the processing rules in Determining enrollment permission of an end entity for a template (section 2.5.1) as specified in [MS-CRTD] section 2.5.1, by setting **Template_ntSecurityDescriptor** equal to **Input_ntSecurityDescriptor**, and **Requester_SID** equal to **Input_SID**.

2. If the enrolling entity does not have the Enroll permission, as determined in the previous step, the CA MUST reject the request. The returned error code MUST be 0x80094012 (CERTSRV_E_TEMPLATE_DENIED).

3.2.2.6.2.1.4.4 Version 1 Certificate Template Server Processing

The following sections describe the required server processing rules for attributes for certificate template version 1.

3.2.2.6.2.1.4.4.1 Flags

The following processing rules are applied to flags in this attribute.

Flag	Server processing
0x00000040 CT_FLAG_MACHINE_TYPE	If this flag is set and CT_FLAG_ENROLLEE_SUPPLIES_SUBJECT is not set in msPKI-Certificate-Name-Flag (section 3.2.2.6.2.1.4.5.9), and either CT_FLAG_SUBJECT_REQUIRE_COMMON_NAME,

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Flag	Server processing
	CT_FLAG_SUBJECT_REQUIRE_DNS_AS_CN, or CT_FLAG_SUBJECT _ALT_REQUIRE_DNS is set in msPKI-Certificate-Name-Flag, the CA MUST require a nonempty value for the **dNSHostName** attribute of the requestor's computer object in the working directory. For this, the CA MUST invoke the processing rules in section 3.2.2.1.2 with input parameter **EndEntityDistinguishedName** set equal to the requester's computer object distinguished name and retrieve the **dNSHostName** attribute from the returned **EndEntityAttributes** output parameter. Also, the CA MUST use the value to construct the Subject field of the issued certificate. If the value is empty or if the computer object is not found, the CA MUST reject the request. The returned code SHOULD be 0x8009480F (CERTSRV_E_SUBJECT_DNS_REQUIRED).
0x00000080 CT_FLAG_IS_CA	If this flag is set, a CA MUST set the basic constraint extension and key usage extension in the certificate to be issued for the request. Specifications are in [RFC3280] sections 4.2.1.3 and 4.2.1.10. The CA MUST set the **cA** field of the Basic Constraints extension to TRUE, and set the **pathLenConstraint** field as specified in section 3.2.2.6.2.1.4.4.5.
0x00000800 CT_FLAG_IS_CROSS_CA	If this flag is set, a CA MUST set the basic constraint extension and key usage extension in the certificate to be issued for the request. Specifications are in [RFC3280] sections 4.2.1.3 and 4.2.1.10. The CA MUST set the **cA** field of the Basic Constraints extension to TRUE, and the **pathLenConstraint** field MUST be set as specified in section 3.2.2.6.2.1.4.4.5.
0x00000400 CT_FLAG_DONOTPERSISTINDB	If this flag is set and if the certificate has been issued, the CA SHOULD NOT persist the information about the request in the Request table that is specified in section 3.2.1.1.1.<105>

3.2.2.6.2.1.4.4.2 pKIExpirationPeriod

The CA MUST issue a certificate with a validity period that does not exceed the period defined by this attribute's value. Additional information on certificate validity period is specified in [RFC3280] section 4.1.2.5.

3.2.2.6.2.1.4.4.3 pKIExtendedKeyUsage

The server MUST add the extended key usage extension with the OID as specified by this attribute to the issued certificate. Specifications on this extension are in [RFC3280] section 4.2.1.13.

3.2.2.6.2.1.4.4.4 pKIKeyUsage

The server SHOULD use this attribute from the certificate template, and use the public key algorithm sent in the certificate request, to construct the key usage extension in the issued certificate. Specifications on this extension are in [RFC3280] section 4.2.1.3.

3.2.2.6.2.1.4.4.5 pKIMaxIssuingDepth

If a Basic Constraints extension (as specified in [RFC3280] section 4.2.1.10) is being added to the certificate:

- If the value of the **cA** field of the Basic Constraints extension is TRUE:

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- If the value of the pKIMaxIssuingDepth attribute is not equal to 0xFFFFFFFF, the CA MUST use the value of the pKIMaxIssuingDepth attribute to populate the **pathLenConstraint** field of the Basic Constraints extension.
- If the value of the pKIMaxIssuingDepth attribute is equal to 0xFFFFFFFF, the CA MUST NOT include the **pathLenConstraint** field in the Basic Constraints extension.

- If the value of the **cA** field of the Basic Constraints extension is FALSE, the CA MUST NOT include the **pathLenConstraint** field in the Basic Constraints extension.

The conditions under which a Basic Constraints extension is added to the certificate are specified in sections 3.2.2.6.2.1.4.4.1 and 3.2.2.6.2.1.4.5.6.

3.2.2.6.2.1.4.4.6 pKICriticalExtensions

CAs MUST use this attribute to determine which extension should be marked critical in the certificate for the request that is being processed. Specifications on certificates format and extensions are in [RFC3280] section 4.2.

3.2.2.6.2.1.4.5 Version 2, 3, and 4 Certificate Template Server Processing

The following sections describe the required server processing rules for attributes for certificate templates, versions 2, 3, and 4.

Specifications on certificate template versions are in [MS-CRTD] section 2.16.

3.2.2.6.2.1.4.5.1 msPKI-RA-Signature

CAs that receive a certificate request referring to a template where the msPKI-RA-Signature is nonzero MUST require that the private keys used to sign the request are associated with certificates that meet the requirements of the msPKI-RA-Policies and msPKI-RA-Application-Policies attributes.

If the value of this property is non-zero and there are no (additional) signatures in the request, the CA SHOULD return a non-zero error. The error Should be 0x80094809 (CERTSRV_E_SIGNATURE_POLICY_REQUIRED).

If the number of signatures on the certificate request is less than the number defined by this property, the CA SHOULD return a non-zero error. The error SHOULD be 0x8009480A (CERTSRV_E_SIGNATURE_COUNT).

3.2.2.6.2.1.4.5.2 msPKI-Minimal-Key-Size

When receiving a certificate request, a CA MUST require that the length of the specified public key be greater than or equal to the value of this property.

If the key length is less than this value, the CA SHOULD return the disposition as CERTSRV_E_KEY_LENGTH.

3.2.2.6.2.1.4.5.3 msPKI-RA-Policies

If any OID present in this attribute doesn't exist in Certificate Policies extension(defined in section 4.2.1.5 of the [RFC3280]) of at least one certificate whose private key was used to sign the certificate request, the CA MUST reject the request and return a non-zero error. The error SHOULD be 0x8009480B (CERTSRV_E_SIGNATURE_REJECTED).

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3.2.2.6.2.1.4.5.4 msPKI-RA-Application-Policies

If any OID in this attribute doesn't exist as a KeyPurposeID in Extended Key Usage extension (defined in section 4.2.1.13 of the [RFC3280]) of at least one certificate whose private key was used to sign the certificate request, the CA MUST reject the request and return a non-zero error. The error SHOULD be 0x8009480B (CERTSRV_E_SIGNATURE_REJECTED).

3.2.2.6.2.1.4.5.5 msPKI-Certificate-Application-Policy

A CA that processes the request MUST add the OIDs specified in this property to the Certificate Application Policy extension, as specified in section 2.2.2.7.7.3.

3.2.2.6.2.1.4.5.6 msPKI-Enrollment-Flag

The following processing rules are applied to flags in this attribute.

Flag	Client processing
0x00000001 CT_FLAG_INCLUDE_SYMMETRIC_ALGORITHMS	The CA MUST include an S/MIME extension, as specified in [RFC4262], in the issued certificate.
0x00000002 CT_FLAG_PEND_ALL_REQUESTS	If this flag is included in the template, the CA MUST return a pending state response for the certificate request and require a CA manager to approve the request before issuing the certificate.
0x00000004 CT_FLAG_PUBLISH_TO_KRA_CONTAINER	If this flag is included in the template, the CA MUST publish the certificate to the userCertificate attribute of an object of the class msPKI-Private-Key-Recovery-Agent stored in the "CN=KRA, CN=Public Key Services,CN=Services, CN=Configuration" container in the working directory by invoking the processing rules in section 3.2.2.1.4 with input parameter **IssuedCertificate** set equal to the issued certificate. The CN of that object MUST be equal to the sanitized short name of the CA. The algorithm for sanitizing names is described in section 3.1.1.4.1.1.
0x00000008 CT_FLAG_PUBLISH_TO_DS	If this flag is included in the template, the CA MUST append the issued certificate to the userCertificate attribute, as specified in [RFC4523], of the user object in the working directory by invoking the processing rules in section 3.2.2.1.5 with input parameter **IssuedCertificate** set equal to the issued certificate and input parameter **EndEntityDistinguishedName** set equal to the requester's user object distinguished name.
0x00000040 CT_FLAG_PREVIOUS_APPROVAL_VALIDATE_REENROLLMENT	The CA MUST enforce this flag only for certificate renewal requests.

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Flag	Client processing
	If this flag is set in the template: ▪ The CA MUST NOT enforce the signature processing rules specified for the following attributes: msPKI-RA-Signature, msPKI-RA-Policies, and msPKI-Application-Policy. ▪ The CA MUST ignore the CT_FLAG_PEND_ALL_REQUESTS flag.
0x00001000 CT_FLAG_ADD_OCSP_NOCHECK	If this flag is set and the following are all true: ▪ The CA implements Config_CA_No_OCSP_Revocation_Check datum and it is set to true or the CA doesn't implement this datum. ▪ Certificate template's msPKI-Certificate-Application-Policy attribute contains the OID szOID_PKIX_KP_OCSP_SIGNING (1.3.6.1.5.5.7.3.9, id-kp-OCSPSigning). The CA SHOULD NOT include the OIDs szOID_AUTHORITY_INFO_ACCESS (1.3.6.1.5.5.7.1.1, id-pe-authorityInfoAccess) and szOID_CRL_DIST_POINTS (2.5.29.31, id-ce-cRLDistributionPoints) extensions and SHOULD add a NULL value extension with the OID szOID_PKIX_OCSP_NOCHECK (1.3.6.1.5.5.7.48.1.5, id-pkix-ocsp-nocheck) to the issued certificate.<106>
0x00004000 CT_FLAG_NOREVOCATIONINFOINISSUEDCERTS	If this flag is set the CA SHOULD NOT include entries from the Config_CA_OCSP_Include_In_Cert list in the OID szOID_AUTHORITY_INFO_ACCESS (1.3.6.1.5.5.7.1.1, id-pe-authorityInfoAccess) extension of the issued certificate and SHOULD NOT include the OID szOID_CRL_DIST_POINTS (2.5.29.31, id-ce-cRLDistributionPoints) extension in the issued certificate.<107>
0x00008000 CT_FLAG_INCLUDE_BASIC_CONSTRAINTS_FOR_EE_CERTS	If this flag is set, the CA SHOULD add a Basic Constraints extension (as specified in [RFC3280] section 4.2.1.10) to the certificate and set the **cA** field to FALSE. The CA SHOULD NOT include the **pathLenConstraint** field in the Basic Constraints extension.<108>
0x00010000 CT_FLAG_ALLOW_PREVIOUS_APPROVAL_KEYBASEDRENEWAL_	The CA MUST enforce this flag only for certificate renewal requests when the

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Flag	Client processing
VALIDATE_REENROLLMENT	CT_FLAG_ENROLLEE_SUPPLIES_SUBJECT and CT_FLAG_PREVIOUS_APPROVAL_VALIDATE_REENROLLMENT flags are also set. If this flag is set on the template, the CA SHOULD NOT enforce the processing rules specified in section 3.2.2.6.2.1.4.3.<109>
0x00020000 CT_FLAG_ISSUANCE_POLICIES_FROM_REQUEST	If this flag is set the CA SHOULD apply special processing rules to the **msPKI-Certificate-Policy** attribute as specified in section 3.2.2.6.2.1.4.5.8.<110>

3.2.2.6.2.1.4.5.7 msPKI-Private-Key-Flag

The following processing rules are applied to flags in this attribute.

Flag	Client processing
0x00000001 CT_FLAG_REQUIRE_PRIVATE_KEY_ARCHIVAL	If this flag is set, the CA MUST verify that the certificate request is a key archival request as specified in section 3.2.2.6.2.1.2.2. If this is a renewal request and CT_FLAG_REQUIRE_SAME_KEY_RENEWAL is set, the CA SHOULD ignore this flag.<111> If the request does not comply with the specifications of the key archival request, the CA SHOULD return the following error code: 0x80094804 CERTSRV_E_ARCHIVED_KEY_REQUIRED.
0x00000080 CT_FLAG_REQUIRE_SAME_KEY_RENEWAL	If this flag is set and the request is a renewal request, the CA MUST verify that the key used in the request matches one of the certificates being renewed. If it does not match, the CA SHOULD return error CERTSRV_E_RENEWAL_BAD_PUBLIC_KEY (0x80094816) to the client.<112>
0x000002000 CT_FLAG_ATTEST_REQUIRED *	If this flag is set and the request contains the attestation data, the CA MUST invoke the key Attestation processing rules specified in section 3.2.2.6.2.1.2.5 and its subsections. The CA SHOULD return error CERTSRV_E_KEY_ATTESTATION_(0x8009481AL) to the client if none of the key attestation is performed. If flag CT_FLAG_ATTESTATION_WITHOUT_POLICY is not set, the CA MUST add at least one of the OIDs in the msPKI-Certificate-Policy attribute indicating key attestation. The CA MUST add OIDs as specified below to the msPKI-CertificatePolicy attribute if key attestation processing rules are performed according to the corresponding processing sections. ▪ Processing rules section: 3.2.2.6.2.1.2.5 Add OID: szOID_ENROLL_EKVERIFYCREDS (1.3.6.1.4.1.311.21.32) ▪ Processing rules section: 3.2.2.6.2.1.2.5.1

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Flag	Client processing
	Add OID: szOID_ENROLL_EKVERIFYCERT (1.3.6.1.4.1.311.21.31) ▪ Processing rules section: 3.2.2.6.2.1.2.5.2 Add OID: szOID_ENROLL_EKVERIFYKEY (1.3.6.1.4.1.311.21.30)
0x000001000 CT_FLAG_ATTEST_PREFERRED *	If this flag is set and the request contains the attestation data, the CA MUST invoke the key attestation processing rules specified in section 3.2.2.6.2.1.2.5 and its subsections. The CA SHOULD not return an error to the client, if none of the key attestation is performed. If flag CT_FLAG_ATTESTATION_WITHOUT_POLICY is not set, the CA MUST add OIDs in the msPKI-Certificate-Policy attribute indicating key attestation. The CA MUST add OIDs as specified below to the msPKI-CertificatePolicy attribute if key attestation processing rules are performed according to the corresponding processing sections. ▪ Processing rules section: 3.2.2.6.2.1.2.5 Add OID: szOID_ENROLL_EKVERIFYCREDS (1.3.6.1.4.1.311.21.32) ▪ Processing rules section: 3.2.2.6.2.1.2.5.1 Add OID: szOID_ENROLL_EKVERIFYCERT (1.3.6.1.4.1.311.21.31) ▪ Processing rules section: 3.2.2.6.2.1.2.5.2 Add OID: szOID_ENROLL_EKVERIFYKEY (1.3.6.1.4.1.311.21.30)
0x00000000 CT_FLAG_ATTEST_NONE *	If this flag is set, the CA MUST NOT add certificate policy OIDs to the msPKI-Certificate-Policy attribute to indicate attestation occurred, and the CA MUST NOT return an error if key attestation failed, even if the request contained key attestation data as specified in section 3.2.2.6.2.1.2.5 and the CA invoked key attestation processing rules.
0x000004000 CT_FLAG_ATTESTATION_WITHOUT_POLICY *	If this flag is set, the CA MUST NOT add the certificate policy OIDs as specified in the CT_FLAG_ATTEST_REQUIRED or CT_FLAG_ATTEST_PREFERRED flags to the msPKI-Certificate-Policy attribute, but the CA SHOULD follow the processing rules specified in section 3.2.2.6.2.1.2.5.
0x000000200 CT_FLAG_EK_TRUST_ON_USE *	If this flag is set the CA MUST invoke the key attestation processing rules in section 3.2.2.6.2.1.2.5 and the CA MUST base the attestation on valid user credentials. If the CT_FLAG_ATTESTATION_WITHOUT_POLICY flag is not set, the CA MUST add OID szOID_ENROLL_EKVERIFYCREDS "1.3.6.1.4.1.311.21.32"

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Flag	Client processing
	to the msPKI-Certificate-Policy attribute indicating that key attestation has occurred.
0x000000400 CT_FLAG_EK_VALIDATE_CERT *	If this flag is set the CA MUST invoke the key attestation processing rules in section 3.2.2.6.2.1.2.5 and the CA MUST validate the EK certificate according to section 3.2.2.6.2.1.2.5.1. The CA SHOULD return CERTSRV_E_INVALID_EK (0x80094817L) if an error occurs. If the CT_FLAG_ATTESTATION_WITHOUT_POLICY flag is not set, the CA MUST add OID szOID_ENROLL_EKVERIFYCERT "1.3.6.1.4.1.311.21.31" to the msPKI-Certificate-Policy attribute indicating that key attestation has occurred.
0x000000800 CT_FLAG_EK_VALIDATE_KEY *	If this flag is set the CA MUST invoke the key attestation processing rules in section 3.2.2.6.2.1.2.5 and the CA MUST check the EKPub in the request against the EKPub list located using Config_Endorsement_Key_List_Directories. The entire processing is described in section 3.2.2.6.2.1.2.5.2. If the CT_FLAG_ATTESTATION_WITHOUT_POLICY flag is not set, the CA MUST add OID szOID_ENROLL_EKVERIFYKEY "1.3.6.1.4.1.311.21.30" to the msPKI-Certificate-Policy attribute indicating that key attestation has occurred.

* Support for these flags is specified in the following behavior note.<113>

- If the value of a bitwise AND of **Certificate.Template.msPKI-Private-Key-Flag** and 0x000F0000 is larger than 0x000Z0000, where Z denotes the value of the **Server_Current_Version** ADM element, the server SHOULD NOT enroll for this template.<114>

3.2.2.6.2.1.4.5.8 msPKI-Certificate-Policy

The CA MUST construct a certificate policies extension as specified in [RFC3280] section 4.2.1.5, and the CA MUST use the OIDs specified in this attribute in the certificate request as the OIDs in the certificate policy extension of the certificate.

- Let **CurrentCertificateRequestPolicies** be a list of OIDs identifying each certificate policy requested by the client via the szOID_CERT_EXTENSIONS attribute (1.3.6.1.4.1.311.2.1.14) containing a certificate policy extension as defined in [RFC3280] section 4.2.1.5.
- Let KeyAttestationPolicies be a list of OIDs identifying each certificate policy verified by the CA according to section 3.2.2.6.2.1.4.5.7.

Processing occurs as defined in the following sections.

3.2.2.6.2.1.4.5.8.1 Processing for CurrentCertificateRequestPolicies

- If CT_FLAG_ISSUANCE_POLICIES_FROM_REQUEST flag of the **msPKI-Enrollment-Flag** attribute is set AND the msPKI-Certificate-Policy attribute is empty AND the **CurrentCertificateRequestCertPolicies** list is not empty, the CA SHOULD return the CERTSRV_E_TEMPLATE_CONFLICT error (0x80094802) to the client.<115>
- For each OID in the msPKI-Certificate-Policy attribute:

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- If the CT_FLAG_ISSUANCE_POLICIES_FROM_REQUEST flag of the **msPKI-Enrollment-Flag** attribute is set and the **CurrentCertificateRequestCertPolicies** list does not contain the current OID, the CA SHOULD continue with the next OID.<116>

- Add a certificate policy identified by the current OID to the certificate policy extension of the certificate to be issued.

3.2.2.6.2.1.4.5.8.2 Processing When KeyAttestationPolicies Is Not Empty

- If the KeyAttestationPolicies list is not empty, the CA MUST obtain a union between KeyAttestationPolicies OIDs and the OIDs in the msPKI-Certificate-Policy attribute. If there are any duplicates, the CA MUST preserve the OID in msPKI-Certificate-Policy and discard the one from KeyAttestationPolicies.

- If the CT_FLAG_ISSUANCE_POLICIES_FROM_REQUEST flag of the msPKI-Enrollment-Flag attribute is set and both KeyAttestationPolicies and CurrentCertificateRequestCertPolicies are not empty, the CA MUST follow the processing rules in section 3.2.2.6.2.1.4.5.8.1. The CA MUST then obtain a union between KeyAttestationPolicies OIDs and the OIDs in the msPKI-Certificate-Policy attribute. If there are any duplicates, the CA MUST preserve the OID in msPKI-Certificate-Policy and discard the one from KeyAttestationPolicies.

3.2.2.6.2.1.4.5.9 msPKI-Certificate-Name-Flag

The following processing rules are applied to flags in this attribute. If the CA fails to obtain any data that is required by this section to be stored in the certificate, the CA MUST return a nonzero error to the client.

1. The CA MUST ignore the CT_FLAG_ENROLLEE_SUPPLIES_SUBJECT_ALT_NAME flag.

2. If the CT_FLAG_ENROLLEE_SUPPLIES_SUBJECT flag is not set, then:

   1. The CA MUST ignore any subject name information provided in the certificate request.

   2. If the CT_FLAG_SUBJECT_REQUIRE_DIRECTORY_PATH flag is set, then the CA MUST set the **Subject** field of the issued certificate to the requestor's DN from the working directory

   3. If the CT_FLAG_SUBJECT_REQUIRE_DIRECTORY_PATH flag is not set and either the CT_FLAG_SUBJECT_REQUIRE_COMMON_NAME or CT_FLAG_SUBJECT_REQUIRE_DNS_AS_CN flag is set, do the following:

      1. If the request is for a machine certificate, the CA MUST set the CN of the **Subject** field of the issued certificate with the **dNSHostName** attribute of the requestor's computer object in the working directory. For this, the CA MUST invoke the processing rules in section 3.2.2.1.2 with input parameter **EndEntityDistinguishedName** set equal to the requester's computer object distinguished name and retrieve the **dNSHostName** attribute from the returned **EndEntityAttributes** output parameter.

      2. If the request is for a user certificate, the CA MUST set the **Subject** field of the issued certificate as a DN whose CN component value is attribute obtained from the User **cn** attribute in the working directory. For this, the CA MUST invoke the processing rules in section 3.2.2.1.2 with input parameter **EndEntityDistinguishedName** set equal to the requester's user object distinguished name and retrieve the **cn** attribute from the returned **EndEntityAttributes** output parameter.

   4. If CT_FLAG_SUBJECT_REQUIRE_EMAIL is set, the CA MUST set the **Subject** field of the issued certificate as a DN whose E component value is obtained from the value of the **mail** attribute

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of the requestor's user object in the working directory. For this, the CA MUST invoke the processing rules in section 3.2.2.1.2 with input parameter **EndEntityDistinguishedName** set equal to the requester's user object distinguished name and retrieve the **mail** attribute from the returned **EndEntityAttributes** output parameter.

3. If CT_FLAG_ENROLLEE_SUPPLIES_SUBJECT is set, then the CA MUST use the subject and subject alternative name information provided in the certificate request. If no subject name is provided in the request, the CA MUST reject the request.

4. If the CT_FLAG_SUBJECT_ALT_REQUIRE_UPN or CT_FLAG_SUBJECT_ALT_REQUIRE_SPN flag is set, the CA MUST add the value of the **userPrincipalName** attribute from the requestor's user object in the working directory to the subject alternative name extension of the issued certificate. For this, the CA MUST invoke the processing rules in section 3.2.2.1.2 with input parameter **EndEntityDistinguishedName** set equal to the requester's user object distinguished name and retrieve the **userPrincipalName** attribute from the returned **EndEntityAttributes** output parameter.

5. If the CT_FLAG_SUBJECT_ALT_REQUIRE_EMAIL flag is set, the CA MUST add the value of the **mail** attribute from the requestor's user object in the working directory to the subject alternative name extension of the issued certificate. For this, the CA MUST invoke the processing rules in section 3.2.2.1.2 with input parameter **EndEntityDistinguishedName** set equal to the requester's user object distinguished name and retrieve the **mail** attribute from the returned **EndEntityAttributes** output parameter.

6. If the CT_FLAG_SUBJECT_ALT_REQUIRE_DIRECTORY_GUID flag is set, the CA MUST add the value of the **objectGuid** attribute from the requestor's user object in the working directory to the subject alternative name extension of the issued certificate. For this, the CA MUST invoke the processing rules in section 3.2.2.1.2 with input parameter **EndEntityDistinguishedName** set equal to the requester's user object distinguished name and retrieve the **objectGuid** attribute from the returned **EndEntityAttributes** output parameter.

7. If the CT_FLAG_SUBJECT_ALT_REQUIRE_DOMAIN_DNS flag is set, the CA SHOULD<117>:

   1. The CA SHOULD retrieve a handle for the information policy using the **LsarOpenPolicy** method ([MS-LSAD] section 3.1.4.4.2), with the *SystemName* parameter set as the **dNSHostName** attribute from the requestor's computer object, all fields of the *ObjectAttributes* set to NULL, and the *DesiredAccess* parameter set to POLICY_VIEW_LOCAL_INFORMATION.

   2. The CA SHOULD obtain the requester's computer DNS Domain Information by using the **LsarQueryInformationPolicy** method ([MS-LSAD] section 3.1.4.4.4), with the *PolicyHandle* parameter set to the value obtained in the previous step, and the *InformationClass* parameter set to *PolicyDnsDomainInformation*.

   3. The CA MUST add the value of the **Name** and **DNSDomainName** field in the returned DNS Domain Information from the previous step, to the subject alternative name extension of the issued certificate.

8. If the CT_FLAG_SUBJECT_ALT_REQUIRE_DNS flag is set, the CA MUST add the value of the **dNSHostName** attribute from the requestor's computer object in the working directory to the subject alternative name extension of the issued certificate. For this, the CA MUST invoke the processing rules in section 3.2.2.1.2 with input parameter **EndEntityDistinguishedName** set equal to the requester's computer object distinguished name and retrieve the **dNSHostName** attribute from the returned **EndEntityAttributes** output parameter.

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3.2.2.6.2.1.4.6 Additional Processing Rules for Certificate Requests

Upon receiving a certificate request, based on the specific value of either a certificate template extension (as specified in 2.2.2.7.7) in the certificate request or the value of "CertificateTemplate" attribute 1.3.3, the CA MUST apply following processing rules:

- If the value is the same as "SubCA", "CA", or "CrossCA" (case-insensitive comparison), the CA MUST add a basic constraint extension in the certificate (to be issued corresponding to the request) with a Boolean value set to true, as specified in [RFC3280] section 4.2.1.10.
- If the value is the same as "ExchangeUser" or "ExchangeUserSignature" (case-insensitive comparison), and the Subject Alternative Name extension (SubjectAltName) is present in the certificate (to be issued corresponding to the request), and if SubjectAltName contains an rfc822Name, then the CA MUST remove any directoryName with only X520CommonName as the RelativeDistinguishedName, as specified in [RFC3280] section 4.2.1.7.

3.2.2.6.2.1.4.7 Enforcing Configured Certificate Templates Issuance

If the CA uses the certificate template identifiers that are supplied in the request to enforce its issuance and enrollment policies, the CA MUST require that the identified certificate template is listed as a configured certificate template under the enrollment services container, as specified in section 2.2.2.11.2. The CA MUST adhere to the following rules:

- Locate a pKIEnrollmentService object that has a cn value that is identical to the sanitized cn value of the **Subject** field in the CA certificate.
- The certificateTemplates attributes of the object that is located in the preceding step MUST contain a string with a value that is identical to the value of the cn attribute of the certificate templates identified in the request.
- If one or both of these steps fail, the enterprise CA MUST reject the request.

3.2.2.6.3 ICertRequestD2

3.2.2.6.3.1 ICertRequestD2::GetCAProperty (Opnum 7)

The server MUST comply with the requirements specified in section 3.2.1.4.3.2, with the following exceptions:

- If *PropID* is equal to 0x0000001D (CR_PROP_TEMPLATES), the server MUST follow the processing rules as specified in section 3.2.2.6.3.1.1.
- If *PropID* is equal to 0x0000000A (CR_PROP_CATYPE), the server MUST follow the processing rules as specified in section 3.2.2.6.3.1.2.

3.2.2.6.3.1.1 PropID=0x0000001D (CR_PROP_TEMPLATES) "Configured Certificate Templates"

The client requested to know the list of certificate templates that are configured for this CA.

The CA MUST return the name and OID of each certificate templates in its certificate template table, where the value of the Certificate_Template_IsConfigured is True.

The returned string MUST have the following format:

"TemplateName1\nTemplateOID1\nTemplateName2\nTemplateOID2\... " where

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- TemplateName1 is one of the values of the cn attribute of the certificate template object that is stored in the Certificate_Template column.
- TemplateOID1 is the value of the msPKI-Template-Cert-Template-OID attribute of the certificate template stored in the Certificate_Template column.<118>

  Note If the certificate template does not have the msPKI-Template-Cert-Template-OID attribute, then the value of TemplateOID1 is empty. The CA MUST return the configured certificate template as a [UNICODE] string through a CERTTRANSBLOB (section 2.2.2.2) structure.

  Marshaling rules for CERTTRANSBLOB are specified in section 2.2.2.2.

3.2.2.6.3.1.2 PropID=0x0000000A (CR_PROP_CATYPE) "CA Type"

The client has requested the type of the CA:

- If the CA signing certificate that is stored in the Signing_Cert_Certificate column is a root certificate, the CA MUST return 0x00000000. Otherwise, the CA SHOULD return 0x00000001.
- The CA MUST return its type through the **CAType** field of a **CAINFO (section 2.2.2.4)** structure. The server MUST return the **CAINFO** structure through a **CERTTRANSBLOB** structure.

Marshaling rules for the **CERTTRANSBLOB** structure are specified in 2.2.2.2.

3.2.2.7 Timer Events

None.

3.2.2.8 Other Local Events

The server SHOULD monitor whether a change was made to the certificate template container or to its enrollment service object, as identified in section 3.2.2.5 steps 1 and 3 respectively by using the LDAP_SERVER_NOTIFICATION_OID control specified in [MS-ADTS] section 3.1.1.3.4.1.9. A change in one of these objects SHOULD trigger the initialization steps documented in section 3.2.2.5.

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4 Protocol Examples

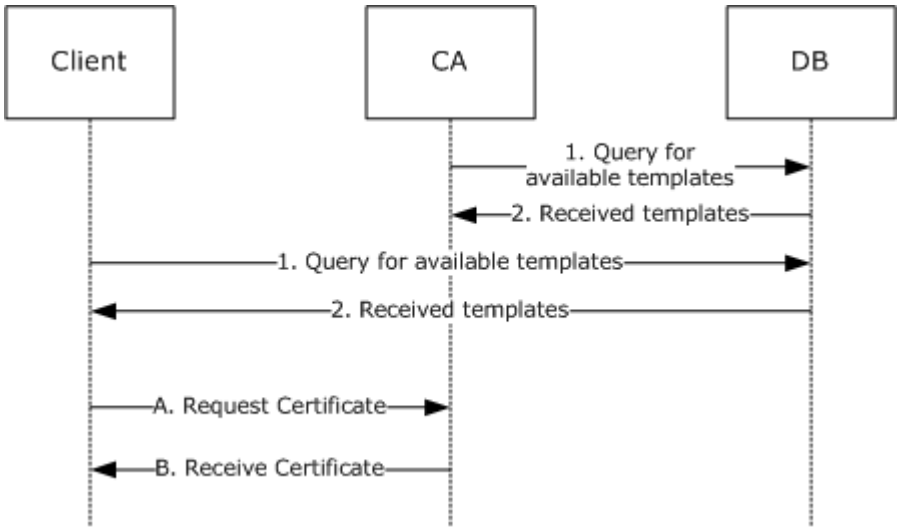

Figure 8: Certificate enrollment

The process of requesting a certificate by citing certificate templates is shown in the preceding figure. The certificate request process has two separate phases. The first phase, numbered 1 and 2, occurs for both the client and the server (CA), in any order and at any time. In this first step, each asks the DB that holds templates for a list of available templates. The second phase of the process is the request for a certificate, identified A and B in the preceding figure based on a certificate templates that was retrieved from the DB. Because templates are optional, this describes Microsoft code behavior and the behavior of any client and server code that chooses to implement templates as Microsoft does.

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5 Security Considerations

Any cryptographic protocol has security considerations dealing with key handling during cryptographic operations and key distribution. A public-key certificate, although it is not by itself a protocol, has most of the same security considerations that a cryptographic protocol has—in the sense that a public key certificate is a "message" from the CA to the **relying parties (RPs)**. This "message" is addressed, in effect, to "to whom it may concern". A cryptographic protocol that deals with the transmission, issuance, or other use of a public key certificate therefore has security considerations in two areas: around the protocol itself and around the certificate and its use.

In addition, a certificate binds two or more pieces of information together. In the most common case, that would be a public key and a name. The name in such a certificate has security relevance, and there are security considerations around the use and provisioning of those names. In some certificate forms, there are attributes bound to either a name or a key, and there are security considerations around the use and provisioning of those attributes.

5.1 Security Considerations for Implementers

5.1.1 Keeping Information Secret

Any cryptographic key must be kept secret. Additionally, any function of a secret (such as a key schedule) that an attacker could use to decipher the secret more easily must also be kept secret.

When a secret must be in the normal memory of a general-purpose computer in order to be used, that secret should be erased (for example, replaced with a constant value, such as 0) as soon as possible after it is used.

A secret might be kept in a specially protected memory where it can be used without being erased. Typically, such memory is found in a hardware security module (HSM). If an HSM is used, it should be as specified in [FIPS140], or the equivalent, at a level consistent with the security requirements of the customer deploying the cryptographic protocol or CA that uses the HSM.

5.1.2 Generating Keys

Generation of a cryptographic key requires randomness so that the generated key cannot be guessed by an attacker. Randomness is expressed in terms of entropy, in units of bits. A symmetric key should have as many bits of entropy as there are bits in the key. A public key pair should have as many bits of entropy as there are bits in the key minus a small number of bits.

5.1.3 Entropy Sources

How entropy is acquired is up to the implementer of any protocol. The literature on measurement of entropy and on methods of harvesting entropy in computer systems is extensive and well known to anyone skilled in the cryptographic art. The best entropy source is probably a properly verified hardware random-bit generator that has circuitry attached to monitor all bits produced and to verify the entropy of the bits, raising an error condition if the hardware starts to malfunction. Such a hardware source of entropy can be used to drive a conditioning function (sometimes called "a whitening function") and might be used to drive a **pseudo-random number generator (PRNG)**. If a PRNG is used, it should be compliant with recognized standards, such as FIPS 140-2 Annex C, as specified in [FIPS140].

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5.1.4 Name Selection

Human beings use names from an ID certificate to refer to end entities. When the relying party (RP) is a human being and that human makes a security decision based on the name from an ID certificate, that name should be clear and unambiguous to the human RP. It is the responsibility of the CA (or the human administering the CA or associated RA) to choose (or approve) the name for an ID certificate.

5.1.5 Name Binding

A CA has the responsibility to bind a name to a key within an ID certificate and to do so with a proper level of care. In commercial CAs, this is called "**certification** practices". The actual certification practices required in any deployment of a CA depend on the security requirements of the various RPs that will use these certificates. However, each deployment of a CA should establish the security requirements of its RPs and the appropriate certification practices. The **trust root** on an RP should list only those CA root keys (root certificates) that meet the RP's security requirements.

5.1.6 Attribute Definition

When a certificate binds an attribute to either a key or a name, if that attribute is to be used by a human RP in making a security decision, the presentation of that attribute to the human should be clear and unambiguous.

5.1.7 Attribute Binding

When attributes are bound to either a key or a name, some authority is responsible for making that assignment of attributes. In any given deployment, it is important that the authority empowered to assign the attributes be consistent with the security requirements of the RPs that will use these attribute assignments. Because this varies on a per-deployment basis, this document cannot specify either these security requirements or the selection of attribute authorities. However, each deployment should establish security requirements of RPs and, for each attribute, should establish the list of authorities empowered to assign that attribute.

Different attributes frequently have different lists of authorities. When the attribute is carried in a certificate, the issuer of the certificate carrying that attribute should be on the list of authorities for that attribute. This might imply the use of multiple certificates for carrying attributes. Alternatively, when attributes are held in a directory (such as Active Directory), the list of authorities for an attribute should be reflected in the ACL for that directory entry.

5.1.8 Coding Practices

Any implementation of a protocol exposes code to inputs from attackers. Such code must be developed according to secure coding and development practices to avoid buffer overflows, denial-of-service (DOS) attacks, escalation of privilege, and disclosure of information. For an introduction to these concepts, secure development best practices, and common errors, see [HOWARD].

5.1.9 Security Consideration Citations

Implementers of this protocol should be aware of the following security considerations:

- A secure communications channel should exist between the client and server that might require an out-of-band trust initialization process, such as DCOM (as specified in [MS-DCOM]) or TLS (as specified in [RFC2246]).

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- A client or server should follow generally accepted principles of secure key management, as specified in [RFC3280] section 9. For an introduction to these generally accepted principles, see [SCHNEIER] and [HOWARD].
- A client or server should not archive or escrow a signing key. Details are specified in [RFC2797] section 9.
- Clients should verify the public key of the server prior to submission of a private key for archival or escrow. Details are specified in [RFC2797] section 9.
- Certificate enrollment clients and CAs that support the Diffie-Hellman algorithm for the certificate's key pair should validate cryptographic parameters prior to issuing or accepting certificates. Details are specified in [RFC2785]. Windows enrollment clients and CAs do not support Diffie-Hellman in the certificate requests.
- A CA and RA should take care to validate the binding of a client identity to a public key. Details are specified in [RFC3280] section 9. An introduction on CA practices of binding an identity to a public key is specified in [RFC2527].
- A client and server should validate and verify certificate path information, as specified in [RFC3280] section 6. Details about the requirement for certificate path validation are specified in [RFC3280] section 9.
- A client and server should validate and verify the freshness of revocation information of all digital certificates prior to usage, trust, or encryption, as specified in [RFC3280] section 6.3. Details about the requirement for revocation freshness are specified in [RFC3280] section 9.
- A CA must encode the DN in the subject field of a CA certificate identically to the DN in the issuer field in certificates issued by that CA. Details are specified in [RFC3280] section 9.
- A client or server should follow all security considerations discussed throughout [RFC3852] and [RFC2986], as neither normative reference has a specific security section.
- A client and server should use an authentication session between client and server to mitigate DOS attacks, as specified in [MS-DCOM]. For more information on generic DOS mitigation techniques, see [HOWARD].
- A client and server should consider security issues regarding PKI or certificate repositories. For example, security considerations regarding LDAP repositories are as specified in [RFC2559] section 10.

5.1.10 Key Archival Security Considerations

Key archival is for decryption keys only. The purpose of key archival is the prevention of loss of data. Just as backup preserves the bits of a file, key archival permits recovery of decryption keys. Because a decryption key inherits the security value of everything it can decrypt, this key must be protected from disclosure strongly enough to withstand an attack by an attacker motivated by that accumulated value.

In the protocol specified here, a private decryption key is protected in transit by being encrypted with a key (the exchange key) belonging to the CA. The CA must then (through any manner deemed appropriate by the vendor and/or customer of that CA) do the following:

- Protect its own decryption key from disclosure (because the exchange key acquires the sum of value of all of the keys transmitted by using it).
- Protect any archived private keys from disclosure.

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- Protect any archived private keys from loss or destruction.
- Make some process available by which a private key can be restored to its owner (including some human-to-human process by which the proper owner of the private key is authenticated).

How the CA chooses to meet these requirements is not addressed in this document. In the Microsoft CA implementation, a private key offered for archival, is decrypted on receipt and then re-encrypted in multiple KRA keys. The resulting encrypted key BLOBs are then stored in multiple backup copies. This redundancy meets the third requirement listed above. The recovery process is entirely manual and is a function of the enterprise within which the CA is deployed.

5.1.11 Data Consistency for Certificate Templates

It is not possible to achieve all three of the desirable properties of a distributed system:

- Data consistency.
- Application availability.
- Tolerance of network partitions.

Because network partitions are unavoidable, the implementer must sacrifice either data consistency or application availability in the system design.

The Microsoft CA and the client code that requests certificates have chosen to provide application availability and sacrifice data consistency, if a conflict arises. This shows up in a variety of design decisions—including, in particular, the caching of certificate templates.

The design of these systems places data consistency after network partitions are healed. The amount of time needed to reach consistency can be significant (perhaps several hours or days).

If the use of an old certificate template would create a security flaw for the user of this system, methods exist that let the user identify whether the template is up-to-date and, if necessary, retrieve the current template.

When making a request for a certificate to match a particular template, the user can request that template not only by CN but also by OID and by revision number.

The user can, in critical cases, define a new OID for the new template, and retire certificates that were built according to the previous OID. In less-critical cases, the user can wait for Active Directory propagation, as is normal for anything else stored in Active Directory, and can expect changes to become fully distributed sometime during that wait period.

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6 Appendix A: Full IDL

For ease of implementation, the full interface definition language (IDL) is provided here, where "ms-dcom.idl" is the IDL as specified in [MS-DCOM] section 6.

```
import "ms-dcom.idl";
typedef byte BYTE;

typedef struct _CERTTRANSBLOB {
    ULONG                       cb;
    [size_is(cb), unique] BYTE *pb;
} CERTTRANSBLOB;

typedef struct _CATRANSPROP {
    LONG   lPropID;
    BYTE   propType;
    BYTE   Reserved;
    USHORT propFlags;
    ULONG  obwszDisplayName;
} CATRANSPROP;

typedef struct _CAINFO {
    DWORD               cbSize;
    long                CAType;
    DWORD               cCASignatureCerts;
    DWORD               cCAExchangeCerts;
    DWORD               cExitAlgorithms;
    long                lPropIDMax;
    long                lRoleSeparationEnabled;
    DWORD               cKRACertUsedCount;
    DWORD               cKRACertCount;
    DWORD               fAdvancedServer;
} CAINFO;


[
    object,
    uuid(d99e6e70-fc88-11d0-b498-00a0c90312f3),
    helpstring("ICertRequest DCOM Interface"),
    pointer_default(unique)
]
interface ICertRequestD: IUnknown
{
    HRESULT Request(
        [in]                DWORD                dwFlags,
        [in, string, unique, range(1, 1536)] wchar_t const       *pwszAuthority,
        [in, out, ref]      DWORD               *pdwRequestId,
        [out]               DWORD               *pdwDisposition,
        [in, string, unique, range(1, 1536)] wchar_t const       *pwszAttributes,
        [in, ref]           CERTTRANSBLOB const *pctbRequest,
        [out, ref]          CERTTRANSBLOB       *pctbCertChain,
        [out, ref]          CERTTRANSBLOB       *pctbEncodedCert,
        [out, ref]          CERTTRANSBLOB       *pctbDispositionMessage
    );

    HRESULT GetCACert(
        [in]                DWORD          fchain,
```


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```
        [in, string, unique, range(1, 1536)] wchar_t const *pwszAuthority,
        [out, ref]           CERTTRANSBLOB *pctbOut
    );

    HRESULT Ping(
        [in, string, unique, range(1, 1536)] wchar_t const *pwszAuthority
    );
};


[
    object,
    uuid(5422fd3a-d4b8-4cef-a12e-e87d4ca22e90),
    helpstring("ICertRequest2 DCOM Interface"),
    pointer_default(unique)
]
interface ICertRequestD2: ICertRequestD
{
    HRESULT Request2(
        [in, string, unique, range(1, 1536)] wchar_t const       *pwszAuthority,
        [in]                 DWORD                dwFlags,
        [in, string, unique, range(1, 64)] wchar_t const       *pwszSerialNumber,
        [in, out, ref]       DWORD               *pdwRequestId,
        [out]                DWORD               *pdwDisposition,
        [in, string, unique, range(1, 1536)] wchar_t const       *pwszAttributes,
        [in, ref]            CERTTRANSBLOB const *pctbRequest,
        [out, ref]           CERTTRANSBLOB       *pctbFullResponse,
        [out, ref]           CERTTRANSBLOB       *pctbEncodedCert,
        [out, ref]           CERTTRANSBLOB       *pctbDispositionMessage
    );

    HRESULT GetCAProperty(
        [in, string, unique, range(1, 1536)] wchar_t const *pwszAuthority,
        [in]                 long           PropID,
        [in]                 long           PropIndex,
        [in]                 long           PropType,
        [out, ref]           CERTTRANSBLOB *pctbPropertyValue
    );

    HRESULT GetCAPropertyInfo(
        [in, string, unique, range(1, 1536)] wchar_t const *pwszAuthority,
        [out]                long          *pcProperty,
        [out, ref]           CERTTRANSBLOB *pctbPropInfo
    );

    HRESULT Ping2(
        [in, string, unique, range(1, 1536)] wchar_t const *pwszAuthority
    );
};
```


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7 Appendix B: Product Behavior

The information in this specification is applicable to the following Microsoft products or supplemental software. References to product versions include released service packs:

- Windows 2000 Server operating system
- Windows XP operating system
- Windows Server 2003 operating system
- Windows Vista operating system
- Windows Server 2008 operating system
- Windows 7 operating system
- Windows Server 2008 R2 operating system
- Windows 8 operating system
- Windows Server 2012 operating system
- Windows 8.1 operating system
- Windows Server 2012 R2 operating system

Exceptions, if any, are noted below. If a service pack or Quick Fix Engineering (QFE) number appears with the product version, behavior changed in that service pack or QFE. The new behavior also applies to subsequent service packs of the product unless otherwise specified. If a product edition appears with the product version, behavior is different in that product edition.

Unless otherwise specified, any statement of optional behavior in this specification that is prescribed using the terms SHOULD or SHOULD NOT implies product behavior in accordance with the SHOULD or SHOULD NOT prescription. Unless otherwise specified, the term MAY implies that the product does not follow the prescription.

<1> Section 1.3.2.2: Only Windows 8.1 and Windows Server 2012 R2 support key attestation.

<2> Section 1.3.3.1: Certificate templates were first introduced with the release of Windows 2000 Server. The Active Directory schema for this release defined a new class named **pKICertificateTemplate** (as specified in [MS-ADSC] section 2.216) and the unique attributes for this class. It was technically possible to modify the attributes of these pKICertificateTemplate objects, but such modifications were not supported by Microsoft. The attributes were not documented.

One of the requirements for the release of Windows Server 2003 was to support attribute modifications. To meet this requirement, a schema change was introduced that defined the following new attributes for the **pKICertificateTemplate** class.

- **msPKI-Template-Schema-Version**: This attribute defines the **pKICertificateTemplate** class version and instructs the client and server as to those processing rules that apply to the object. For example, certificate template version 2 is a **pKICertificateTemplate** object where the value of **msPKI-Template-Schema-Version** is 2.

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- **msPKI-Template-Minor-Version**: With this attribute, the certificate template revision number has two parts (revision and **msPKI-Template-Minor-Version**). It can be used to identify the minimum revision required in an Windows Client Certificate Enrollment Protocol request.

In addition to the schema change, a new certificate template extension was introduced that can be added to a certificate request and can be used by clients to request a specific revision of a certificate template. For more information, see 2.2.2.7.7.2.

<3> Section 1.3.3.1: The MMC Certificate Templates snap-in that ships with Windows Server automatically increments the minor revision value with each modification of a certificate template.

<4> Section 1.3.3.3: Microsoft offers an MMC snap-in to allow a customer to modify templates. However, the customer is not prohibited from using any other application to modify templates.

<5> Section 2.1: All Windows clients set the authentication level to RPC_C_AUTHN_LEVEL_PKT_PRIVACY. On the server side, if IF_ENFORCEENCRYPTICERTREQUEST or IF_ENFORCEENCRYPTICERTADMIN are set (see section 3.2.1.1.4) and the RPC_C_AUTHN_LEVEL_PKT_PRIVACY authentication level is not specified from the client, the CA MUST refuse to establish a connection with the client by returning a nonzero error. By default, however, Windows CAs do not require the RPC_C_AUTHN_LEVEL_PKT_PRIVACY authentication level. That is, neither IF_ENFORCEENCRYPTICERTREQUEST nor IF_ENFORCEENCRYPTICERTADMIN are set.

<6> Section 2.2.2.5: Only Windows 8.1 and Windows Server 2012 R2 support key attestation.

<7> Section 2.2.2.7.4: Windows implementations set the value of the Client ID as follows:

Values for client application sending the request		
Value	**Internal name**	**Meaning**
0	ClientIdNone	No information about the client application.
1	ClientIdXEnroll2003	The client application in XEnroll.dll shipped with Windows Server 2003.
2	ClientIdAutoEnroll2003	The client application in the Windows autoenrollment service shipped with Windows Server 2003.
3	ClientIdWizard2003	The client application in the enrollment wizard shipped with Windows Server 2003.
4	ClientIdCertReq2003	The client application in certreq.exe shipped with Windows Server 2003.
5	ClientIdDefaultRequest	The client application that uses Windows Vista, Windows 7, Windows 8, and Windows 8.1 enrollment classes.
6	ClientIdAutoEnroll	The client application in the Windows autoenrollment service shipped with Windows Vista, Windows 7, Windows 8, and Windows 8.1.
7	ClientIdRequestWizard	The client application in the enrollment wizard shipped with Windows Vista, Windows 7, Windows 8, and Windows 8.1.
8	ClientIdEOBO	The client application that makes Enroll On Behalf Of (EOBO) requests.
9	ClientIdCertReq	The client application in certreq.exe shipped with Windows Vista, Windows 7, Windows 8, and Windows 8.1.

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Values for client application sending the request		
1000	ClientIdUserStart	The client application is not adequately described by the preceding entries.

<8> Section 2.2.2.7.9: In Windows versions except Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2, the hash algorithm used is always set to SHA1. In Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2, the hash algorithm is defined by the certificate template that is used for enrollment. For more information, see section 3.2.2.6.2.1.4.5.4.

<9> Section 2.2.2.7.10: The "ExpirationDate" value for the OID szENROLLMENT_NAME_VALUE_PAIR (1.3.6.1.4.1.311.13.2.1) is supported by Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 only.

<10> Section 2.2.2.7.10: To enable this feature for the Microsoft CA, follow the instructions as specified in [MSFT-EXIT].

Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 ignore the value of this attribute and instead copy the certificate to the following location:"%system%\certsrv\certenroll". The file name is the request ID with a '.cer' extension.

<11> Section 2.2.2.7.10: The RequestId attribute is available only in Windows Server 2012 R2.

<12> Section 2.2.3.1: A Windows–based server will use key recovery certificates that contain the following X.509v3 extensions specific to Windows:

- Application Policies (Policy Identifier = Key Recovery Agent)
- Certificate Template Name
- Certificate Template Information

Key recovery certificates, when issued by a Windows enterprise CA, are automatically written to the configuration container of Active Directory. The actual certificates are published to the userCertificate attribute (as specified in [RFC4523]) of the KRA object when issued to a member of the domain administrators group in Active Directory.

<13> Section 3.1: Microsoft implements multiple clients of this protocol, including:

- Certificates snap-in for the Microsoft Management Console (MMC)
- Certreq.exe tool (see [MSFT-ADVCERT] for more information)
- Certificate Autoenrollment (see [MSFT-AUTOENROLLMENT] for more information).

<14> Section 3.1.1: A Windows-based client implements an abstraction layer on top of the interfaces specified in this document. Windows Server 2003, Windows 2000, Windows XP, and Windows NT support the interfaces documented in [MSDN-XEnroll]. Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 support the interfaces documented in [MSDN-CertEnroll].

<15> Section 3.1.1.4: Windows 2000 clients do not obtain a supported interface version from the server and always use the **ICertRequestD** interface.

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<16> Section 3.1.1.4.3.1.1: Windows clients use the OS version structure defined in [MSDN-OSVERSIONINFO] to create a string in the format "A.B.C.D", where the A is the value of the **dwMajorVersion** field, B is the value of the **dwMinorVersion** field, C is the value of the **dwBuildNumber** field, and D is the value of the **dwPlatformId**. All numbers are represented in the decimal format. For example, the string "6.1.7600.2" represents Windows Server 2008 R2.

<17> Section 3.1.1.4.3.1.4: This format was designed by Netscape, and there are no Microsoft tools to create a request in this format. To construct a certificate request using this format, the SPKAC tool can be used (for more information, see [OPENSSL]).

<18> Section 3.1.1.4.3.2.1: Only Windows 8.1 and Windows Server 2012 R2 support processing rules in section 3.1.1.4.3.4.

<19> Section 3.1.1.4.3.2.2: Only Windows 8.1 and Windows Server 2012 R2 support processing rules in section 3.1.1.4.3.4.

<20> Section 3.1.1.4.3.3.1: The Microsoft client allows importing a request file during the enrollment implemented in the certificates snap-in for the MMC in Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2; and during the web enrollment for Windows 2000, Windows Server 2003, and Windows XP.

<21> Section 3.1.1.4.3.4: Only Windows 8.1 and Windows Server 2012 R2 support key attestation.

<22> Section 3.1.1.4.3.4.2: Only Windows Server 2012 R2 supports this behavior.

<23> Section 3.1.1.4.3.4.2: Only Windows 8.1 and Windows Server 2012 R2 support these processing rules.

<24> Section 3.1.1.6: Windows Certificate MMC snap-in has a command to trigger this client.

<25> Section 3.1.1.6.2: Only Windows 8.1 and Windows Server 2012 R2 support this behavior.

<26> Section 3.1.2.1: In the Windows implementation, the **Client_Intermediate_CA_Certificates** collection is stored in the **Windows registry** using the following registry path:

HKEY_LOCAL_MACHINE\Software\Microsoft\SystemCertificates\CA\Certificates\

A unique registry key for each intermediate CA certificate is added using the thumbprint of the certificate as the key name. Each element in **Client_Intermediate_CA_Certificates** is the BLOB value under the corresponding key (stored as a binary type).

<27> Section 3.1.2.1: In the Windows implementation, the **Client_Root_CA_Certificates** collection is stored in the Windows registry using the following registry path:

HKEY_LOCAL_MACHINE\Software\Microsoft\SystemCertificates\Root\Certificates\

A unique registry key for each root CA certificate is added using the thumbprint of the certificate as the key name. Each element in **Client_Root_CA_Certificates** is the BLOB value under the corresponding key (stored as a binary type).

<28> Section 3.1.2.4.2.1: Windows 2000 does not support certificate templates with these versions. Windows XP and Windows Server 2003 do not support certificate templates that have the **Certificate.Template.msPKI-Template-Schema-Version** datum equal to 3. Windows Vista, Windows Server 2008, Windows 7, and Windows Server 2008 R2 do not support certificate

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templates that have the **Certificate.Template.msPKI-Template-Schema-Version** datum equal to 4.

<29> Section 3.1.2.4.2.1: Only Windows 8.1 and Windows Server 2012 R2 support this flag.

<30> Section 3.1.2.4.2.1: Windows 2000 does not process the **Certificate.Template.msPKI-Template-Schema-Version** datum and treats all templates with a **Certificate.Template.msPKI-Template-Schema-Version** datum less than 100 as templates that have the **Certificate.Template.msPKI-Template-Schema-Version** datum set to 1. Windows XP treats templates with the **Certificate.Template.msPKI-Template-Schema-Version** datum set to 0 the same as templates with **Certificate.Template.msPKI-Template-Schema-Version** datum set to 1.

<31> Section 3.1.2.4.2.1: Windows 2000 does not support certificate templates with these versions. Windows XP and Windows Server 2003 do not support certificate templates that have the **Certificate.Template.msPKI-Template-Schema-Version** datum equal to 3. Windows Vista, Windows Server 2008, Windows 7, and Windows Server 2008 R2 do not support certificate templates that have the **Certificate.Template.msPKI-Template-Schema-Version** datum equal to 4.

<32> Section 3.1.2.4.2.1: Windows 2000 does not process the **Certificate.Template.msPKI-Template-Schema-Version** datum and treats all templates with a **Certificate.Template.revision** datum less than 100 as templates that have the **Certificate.Template.msPKI-Template-Schema-Version** datum set to 1. Windows XP treats templates with the **Certificate.Template.msPKI-Template-Schema-Version** datum set to 0 the same as templates with **Certificate.Template.msPKI-Template-Schema-Version** datum set to 1.

<33> Section 3.1.2.4.2.2: The Microsoft **Certificate Services** client uses the following values for the **Certificate.Template.msPKI-Template-Schema-Version** datum:

- When the datum does not exist: Windows can use this certificate template.
- When the value = 1: Windows can use this certificate template.
- When the value = 2: Windows XP, Windows Server 2003, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 can use this certificate template.
- When the value = 3: Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 can use this certificate template.
- When the value = 4: Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 can use this certificate template.
- For other values, existing Windows clients ignore the certificate template.

<34> Section 3.1.2.4.2.2.1.5: The Microsoft Certificate Services client uses this flag with the cryptographic service provider (CSP) when creating the cryptographic keys.

<35> Section 3.1.2.4.2.2.1.8: Windows XP, Windows Server 2003, Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 create this extension only if the **Certificate.Template.msPKI-Template-Schema-Version** datum equals 1 or is not initialized with any value.

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<36> Section 3.1.2.4.2.2.1.9: Windows 2000 does not add certificate template OID extension as an attribute of the request.

<37> Section 3.1.2.4.2.2.2.2: Only Windows 8.1 and Windows Server 2012 R2 support these flags.

<38> Section 3.1.2.4.2.2.2.2: Only Windows 8.1 and Windows Server 2012 R2 support this behavior.

<39> Section 3.1.2.4.2.2.2.2: Only Windows 8.1 and Windows Server 2012 R2 support these flags.

<40> Section 3.1.2.4.2.2.2.2: Only Windows 8.1 and Windows Server 2012 R2 support this behavior.

<41> Section 3.1.2.4.2.2.2.5: Windows clients default to RSA.

<42> Section 3.1.2.4.2.2.2.5: Windows clients default to set Read permissions on the key associated with the certificate request for the entity sending the certificate request.

<43> Section 3.1.2.4.2.2.2.5: Only Windows 8.1 and Windows Server 2012 R2 support this behavior.

<44> Section 3.1.2.4.2.2.2.5: Windows client defaults to **Triple Data Encryption Standard**.

<45> Section 3.1.2.4.2.2.2.5: Windows clients default to 168.

<46> Section 3.1.2.4.2.2.2.5: Windows client defaults to SHA1.

<47> Section 3.1.2.4.2.2.2.5: The Microsoft client uses the msPKI-Key-Usage value with the cryptographic service provider (CSP) when creating the cryptographic keys.

<48> Section 3.1.2.4.2.2.2.5: Windows clients default to all key usages.

<49> Section 3.1.2.4.2.2.2.6: CryptoAPI, a Windows cryptographic application programming interface, creates a union of the values in the Extended Key Usage and Application Policy extensions. The combined union will be used as the extended key usages for the certificate as specified in [RFC3280] section 4.2.1.5.

<50> Section 3.1.2.4.2.2.2.7: Only Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 support this flag.

<51> Section 3.1.2.4.2.2.2.8: Only Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 ignore this flag.

<52> Section 3.1.2.4.2.2.2.8: Windows uses Data Protection API (DPAPI) to protect private keys. For more information, see [MSDN-DPAPI].

<53> Section 3.1.2.4.2.2.2.8: Only Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 support this flag.

<54> Section 3.1.2.4.2.2.2.8: This flag is supported only by Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2.

<55> Section 3.1.2.4.2.2.2.8: This flag is supported only by Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2.

<56> Section 3.1.2.4.2.2.2.8: These flags are supported only in Windows 8.1 and Windows Server 2012 R2.

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<57> Section 3.1.2.4.2.2.2.8: Only Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 implement the **Client_Current_Version** ADM element.

<58> Section 3.1.2.4.2.2.2.10: Windows 2000, Windows XP, Windows Server 2003, Windows Vista, and Windows Server 2008 ignore the CT_FLAG_OLD_CERT_SUPPLIES_SUBJECT_AND_ALT_NAME flag.

<59> Section 3.2: Windows 2000 Server doesn't implement ICertRequestD2 interface.

<60> Section 3.2: All Microsoft CAs implement selection among the CA modes during setup.

<61> Section 3.2: CAs that run on Windows Server 2003 Datacenter Edition, Windows Server 2003 Enterprise Edition, Windows Server 2008 Datacenter, and Windows Server 2008 Enterprise implement key archival. CAs that run on Windows Server 2003 Standard Edition, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 do not implement key archival.

<62> Section 3.2.1.1.4: Windows clients use this CA property for diagnostics information only on the operating system that hosts the CA. The Windows Client Certificate Enrollment Protocol does not depend on the value of this property.

CAs running on Windows Server 2003 Enterprise Edition, Windows Server 2003 Datacenter Edition, Windows Server 2008 Enterprise, and Windows Server 2008 Datacenter support key archival and are considered "advanced server". Windows Server 2003 Standard Edition, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 CAs are considered "standard server".

<63> Section 3.2.1.4.2.1: Windows 2000 does not return an error.

<64> Section 3.2.1.4.2.1: If pdwDisposition was request failed (1, or an error code from [MS-ERREF]), the disposition messages include the following:

- Error archiving private key.
- Error parsing request.
- Error verifying request signature or signing certificate.
- Resubmitted by {domain\name}, where {domain\name} is replaced with the user name of the caller if the request was submitted by using the ResubmitRequest method of [MS-CSRA].

If pdwDisposition was request denied (2), the disposition messages include the following:

- Denied by {domain\name}, where {domain\name} is replaced with the user name of the caller if the request was submitted by using the DenyRequest method of [MS-CSRA].
- Denied by policy module.
- Denied by policy module, combined with a descriptive error message such as: "Renewing a certificate with the 'xyz' Certificate Template failed because the renewal overlap period is longer than the certificate validity period."
- Requested by {domain\name}, where {domain\name} is replaced with the user name of the caller if the request was formerly in a pending state and was issued by using the ResubmitRequest method of [MS-CSRA].

If pdwDisposition was certificate issued (3), the disposition messages include the following:

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- Requested by {domain\name} where {domain\name} is replaced with the user name of the caller.
- Issued.
- Issued, combined with a descriptive informational message from the policy algorithm.
- Resubmitted by {domain\name}, where {domain\name} is replaced with the user name of the caller if the request was formerly in a pending state and was issued by using the ResubmitRequest method of [MS-CSRA].

If pdwDisposition was request pending (5), the disposition messages include the following:

- Taken under submission.
- Taken under submission, combined with an informational message from the policy algorithm.
- The disposition message contains text in the system language of the server.

<65> Section 3.2.1.4.2.1.2: The **ExpirationDate** value of the OID szENROLLMENT_NAME_VALUE_PAIR (1.3.6.1.4.1.311.13.2.1) is supported in Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2.

<66> Section 3.2.1.4.2.1.2: The **ExpirationDate** value of *the OID szENROLLMENT_NAME_VALUE_PAIR* (1.3.6.1.4.1.311.13.2.1) is supported in Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2.

<67> Section 3.2.1.4.2.1.2: Only a Windows 2000 CA publishes the certificate to the location that is provided by the requestor through this attribute.

<68> Section 3.2.1.4.2.1.3: Windows 2000, Windows Server 2003, and Windows Server 2008 CAs will set this value to 0 in this case.

<69> Section 3.2.1.4.2.1.4.1.1: Microsoft standalone CAs will not add a requested extension to the certificate unless it is configured as allowed locally by the administrator. By default when the CA is installed, the following extensions are allowed:

- 1.2.840.113549.1.9.15 - SMIME Capabilities
- 1.3.6.1.4.1.311.21.1 - CA Version
- 1.3.6.1.4.1.311.21.2 - Previous CA Certificate Hash
- 2.5.29.15 - Key Usage
- 1.3.6.1.4.1.311.10.9.1 - Cross-Certificate Distribution Points
- 1.3.6.1.4.1.311.20.2 - Certificate Template Name (Certificate Type)
- 1.3.6.1.4.1.311.21.7 - Certificate Template Information
- 1.3.6.1.4.1.311.21.10 - Application Policies
- 1.3.6.1.4.1.311.21.11 - Application Policy Mappings
- 1.3.6.1.4.1.311.21.12 - Application Policy Constraints

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- 2.5.29.17 - Subject Alternative Name
- 2.5.29.30 - Name Constraints
- 2.5.29.32 - Certificate Policies
- 2.5.29.33 - Policy Mappings
- 2.5.29.36 - Policy Constraints
- 2.5.29.37 - Enhanced Key Usage

<70> Section 3.2.1.4.2.1.4.3: A Windows CA stores these additional values in the Request table.

<71> Section 3.2.1.4.2.1.4.4: If the disposition was Error (30), the disposition messages include the following:

- Error archiving private key.
- Error parsing request.
- Error verifying request signature or signing certificate.
- Resubmitted by {domain\name}, where {domain\name} is replaced with the user name of the caller if the request was submitted by using the ResubmitRequest method of [MS-CSRA].

If the disposition was Denied (31), the disposition messages include the following:

- Denied by {domain\name}, where {domain\name} is replaced with the user name of the caller if the request was submitted by using the DenyRequest method of [MS-CSRA].
- Denied by policy module.
- Denied by policy module, combined with a descriptive error message such as "Renewing a certificate with the 'xyz' Certificate Template failed because the renewal overlap period is longer than the certificate validity period."
- Requested by {domain\name}, where {domain\name} is replaced with the user name of the caller if the request was formerly in a pending state and was issued by using the ResubmitRequest method of [MS-CSRA].

If the disposition was Issued (20), the disposition messages include the following:

- Requested by {domain\name} where {domain\name} is replaced with the user name of the caller.
- Issued.
- Issued, combined with a descriptive informational message from the policy algorithm.
- Resubmitted by {domain\name}, where {domain\name} is replaced with the user name of the caller if the request was formerly in a pending state and was issued by using the ResubmitRequest method of [MS-CSRA].

If the disposition was Pending (9), the disposition messages include the following:

- Taken under submission.
- Taken under submission, combined with an informational message from the policy algorithm.

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- The disposition message will contain text in the system language of the server.

<72> Section 3.2.1.4.2.1.4.5: Only Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 support this behavior.

<73> Section 3.2.1.4.2.1.4.5: Only Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 support this behavior.

<74> Section 3.2.1.4.2.2: Windows 2000 does not return an error.

<75> Section 3.2.1.4.2.2.2: Only Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 implement this property.

<76> Section 3.2.1.4.2.3: Windows 2000 does not return an error.

<77> Section 3.2.1.4.3.1.2: Windows 2000, Windows Server 2003, and Windows Server 2008 CAs will set this value to 0 in this case.

<78> Section 3.2.1.4.3.2: Windows 2000 does not return an error.

<79> Section 3.2.1.4.3.2.1: In Windows Server 2003 and Windows 2000 Server, the format of the string is "w.x:y.z".

<80> Section 3.2.1.4.3.2.1: This string is based on the file version attribute of the certsrv.exe file. In Windows Server 2003, the string is "5.2:3790.0". In Windows Server 2003 with SP1, the string is "5.2:3790.1830". The string might change to represent servicing changes to the CA binaries.

<81> Section 3.2.1.4.3.2.2: In Windows Server 2003 and Windows 2000 Server, the format of the string is "w.x:y.z".

<82> Section 3.2.1.4.3.2.2: This string is based on the product version attribute of the certsrv.exe file. In Windows Server 2003, the string is "5.2:3790.0". In Windows Server 2003 with SP1, the string is "5.2:3790.1830". The string might change to represent servicing changes to the server product.

<83> Section 3.2.1.4.3.2.3: By default, the Microsoft CA returns the value 1 for this CA property.

<84> Section 3.2.1.4.3.2.4: By default, if the requested index is 0, a Microsoft CA returns the value "Windows default".

<85> Section 3.2.1.4.3.2.5: By default, a Windows CA returns the value "Windows default".

<86> Section 3.2.1.4.3.2.8: In Windows 2000 Server and Windows Server 2003 CAs, the Shared Folder feature is disabled and can be enabled through the CA setup wizard. If the feature is enabled, the folder contains a file named "certsrv.txt".

In Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2, the Shared Folder feature is also disabled, but it cannot be enabled through the CA setup wizard. If Windows Server 2003 CA has the shared folder enabled and is upgraded to the Windows Server 2008 CA, the folder remains shared.

The "Certsrv.txt" file provides limited ability to publish information about CAs. With the introduction of Active Directory in Windows 2000 Server, the benefit of storing CA information in a shared folder was minimized and use of the technique became rare.

The "Certsrv.txt" file contains one or more lines of text that identifies the location of CAs. Each line has the following form.

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Note Line breaks have been added to improve readability. They do not exist in the file.

```
CASanitizedCN,
  CASanitizedOU,
    CASanitizedO,
      CASanitizedL,
        CASanitizedS,
          CASanitizedC,
            CAFullDNSMachineName\CASanitizedCommonName,
              ExchangeCertName,
                SignatureCertName,
                  Description
```

Each field in the preceding string is described in the following table. Optional fields that are not populated contain quotation marks ("""). All but the first and seventh fields are optional.

Field	Description
CASanitizedCN	The sanitized CN from the CA certificate subject.
CASanitizedOU	Optional. The sanitized OU from the CA certificate subject.
CASanitizedO	Optional. The sanitized O from the CA certificate subject.
CASanitizedL	Optional. The sanitized L from the CA certificate subject.
CASanitizedS	Optional. The sanitized S from the CA certificate subject.
CASanitizedC	Optional. The sanitized C from the CA certificate subject.
CAFullDNSMachineName\ CASanitizedCommonName	A configuration string that contains the CA Domain Name System (DNS) name and the sanitized common name.
ExchangeCertName	Optional. The file name of the CA exchange certificate. This field is never used and the value is empty.
SignatureCertName	Optional. The file name of the CA signing certificate. For the first CA signing certificate only, this is stored in the %windir%\System32\CertSrv\CertEnroll directory.
Description	Optional. This is the CA description. If specified, this is the sanitized CN from the CA certificate subject.

For more information about sanitized names, see section 1.3.2.4.

The shared folder can also contain the additional files specified as follows:

- CA signing certificates: The certificate files are encoded by using DER, and the naming convention is "CAComputerDNSName_CASanitizedName(CertIndex).crt". Because the CertIndex value is based on CA certificate renewal, no index value is present for the first certificate.
- Certificate request files: Subordinate CAs copy the certificate request file to this folder. This file contains data on the certificate that the subordinate CA requests from its parent CA. The file is encoded by using DER, and the naming convention is

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"CAComputerDNSName_CASanitizedName(CertIndex).req". Because the CertIndex value is based on CA certificate renewal, no index value is present for the first certificate.

Note No Windows-based clients depend on these certificates being stored in the shared folder.

<87> Section 3.2.1.4.3.2.21: Windows Server 2003 returns the value 40. Windows Server 2008 returns the value 43, Windows Server 2008 R2 returns the value 44, Windows Server 2012 returns the value 45, and Windows Server 2012 R2 returns the value 45.

<88> Section 3.2.1.4.3.2.23: Microsoft Windows 2000, Windows Server 2003, and Windows Server 2008 CAs do not implement **CR_PROP_ROLESEPARATIONENABLED** property and always return E_INVALIDARG (0x80070057).

<89> Section 3.2.1.4.3.2.24: For more information on Windows implementation for KRAs and key archival, see [MSFT-ARCHIVE].

<90> Section 3.2.1.4.3.2.41: Windows 2000 and Windows Server 2003 CAs do not implement this property and always return 0x80070057 (E_INVALIDARG).

<91> Section 3.2.1.4.3.2.42: Windows 2000 and Windows Server 2003 CAs do not implement this property and always return 0x80070057 (E_INVALIDARG).

<92> Section 3.2.1.4.3.2.43: Windows 2000 and Windows Server 2003 CAs do not implement this property and always return 0x80070057 (E_INVALIDARG).

<93> Section 3.2.1.4.3.2.44: This property is supported by Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2.

<94> Section 3.2.1.4.3.2.45: The CT_FLAG_ISSUANCE_POLICIES_FROM_REQUEST flag is supported by Windows 8 and Windows 8.1 only.

<95> Section 3.2.1.4.3.3: In Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2, the error is E_ACCESSDENIED (0x80000009). Windows 2000 does not return an error.

<96> Section 3.2.2.1.2.1: Windows 2000 SP1 and Windows 2000 SP2 set timeLimit to 300.

<97> Section 3.2.2.1.3.1: Windows 2000 does not support this feature.

<98> Section 3.2.2.3: In Windows 2000, the maximum size of Collection_Of_End_Entity_Object_Query_AD_Connections is always one.

<99> Section 3.2.2.5: Windows 2000 Server only supports templates that do not have msPKI-Template-Schema-Version, or that have msPKI-Template-Schema-Version set to 0x1. Windows Server 2003 only supports templates that do not have msPKI-Template-Schema-Version, or that have msPKI-Template-Schema-Version set to 0x1 or 0x2. Windows Server 2008 and Windows Server 2008 R2 CAs only support templates that do not have msPKI-Template-Schema-Version or that have msPKI-Template-Schema-Version set to 0x1, 0x2, or 0x3.

<100> Section 3.2.2.6.2.1.2.1: Only Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 CAs implement this data.

<101> Section 3.2.2.6.2.1.2.2: Windows 2000 and Windows Server 2003 CAs only attempt to calculate the SHA1 hash.

<102> Section 3.2.2.6.2.1.2.4: These types of requests are supported by Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 only.

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<103> Section 3.2.2.6.2.1.2.5: Only Windows 8.1 and Windows Server 2012 R2 support key attestation.

<104> Section 3.2.2.6.2.1.2.5: In the Windows implementation, the value of this string is "Microsoft Platform Crypto Provider".

<105> Section 3.2.2.6.2.1.4.4.1: Only Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 support this flag.

<106> Section 3.2.2.6.2.1.4.5.6: Only Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 support this flag.

<107> Section 3.2.2.6.2.1.4.5.6: Only Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 support this flag.

<108> Section 3.2.2.6.2.1.4.5.6: Only Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 support this flag.

<109> Section 3.2.2.6.2.1.4.5.6: Only Windows Server 2012 and Windows Server 2012 R2 support this flag.

<110> Section 3.2.2.6.2.1.4.5.6: Only Windows Server 2012 and Windows Server 2012 R2 support this flag.

<111> Section 3.2.2.6.2.1.4.5.7: Flag CT_FLAG_REQUIRE_SAME_KEY_RENEWAL is supported only by Windows Server 2012 and Windows Server 2012 R2.

<112> Section 3.2.2.6.2.1.4.5.7: This flag is supported only by Windows Server 2012 and Windows Server 2012 R2.

<113> Section 3.2.2.6.2.1.4.5.7: These flags are supported only in Windows Server 2012 R2.

<114> Section 3.2.2.6.2.1.4.5.7: Only Windows Server 2012 and Windows Server 2012 R2 implement the **Server_Current_Version** ADM element.

<115> Section 3.2.2.6.2.1.4.5.8.1: The CT_FLAG_ISSUANCE_POLICIES_FROM_REQUEST flag is supported by Windows Server 2012 and Windows Server 2012 R2 only.

<116> Section 3.2.2.6.2.1.4.5.8.1: The CT_FLAG_ISSUANCE_POLICIES_FROM_REQUEST flag is supported by Windows Server 2012 and Windows Server 2012 R2 only.

<117> Section 3.2.2.6.2.1.4.5.9: Only Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 support CT_FLAG_SUBJECT_ALT_REQUIRE_DOMAIN_DNS flag.

<118> Section 3.2.2.6.3.1.1: The format of the returned value depends on the Active Directory schema.

For a DC running with a Windows Server 2003 Active Directory schema or a Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, or Windows Server 2012 R2 Active Directory Domain Services (AD DS) schema:

If the DC is running with a Windows Server 2003 Active Directory schema and at least one Windows Server 2003, Enterprise Edition CA has been installed in the forest, the string returned in the pctbPropertyValue parameter contains the name (cn attribute of the certificate template) and OID (msPKI-Template-Cert-Template-OID) attribute of the certificate template of each configured certificate template and has the following format:

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TemplateName1\nTemplateOID1\nTemplateName2\nTemplateOID2\...

Note All certificate templates are represented with their OID and name regardless of the certificate template version.

For a DC running with a Windows 2000 Server Active Directory schema:

If the DC is running with a Windows 2000 Server Active Directory schema or if no Windows Server 2003, Enterprise Edition CA has been installed in the forest, the string returned in the pctbPropertyValue parameter contains the names (cn attribute of the certificate template) of the configured certificate template and has the following format:

TemplateName1\n\nTemplateName2\n\nTemplateName3\n\...

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8 Change Tracking

This section identifies changes that were made to the [MS-WCCE] protocol document between the January 2013 and August 2013 releases. Changes are classified as New, Major, Minor, Editorial, or No change.

The revision class **New** means that a new document is being released.

The revision class **Major** means that the technical content in the document was significantly revised. Major changes affect protocol interoperability or implementation. Examples of major changes are:

- A document revision that incorporates changes to interoperability requirements or functionality.
- An extensive rewrite, addition, or deletion of major portions of content.
- The removal of a document from the documentation set.
- Changes made for template compliance.

The revision class **Minor** means that the meaning of the technical content was clarified. Minor changes do not affect protocol interoperability or implementation. Examples of minor changes are updates to clarify ambiguity at the sentence, paragraph, or table level.

The revision class **Editorial** means that the language and formatting in the technical content was changed. Editorial changes apply to grammatical, formatting, and style issues.

The revision class **No change** means that no new technical or language changes were introduced. The technical content of the document is identical to the last released version, but minor editorial and formatting changes, as well as updates to the header and footer information, and to the revision summary, may have been made.

Major and minor changes can be described further using the following change types:

- New content added.
- Content updated.
- Content removed.
- New product behavior note added.
- Product behavior note updated.
- Product behavior note removed.
- New protocol syntax added.
- Protocol syntax updated.
- Protocol syntax removed.
- New content added due to protocol revision.
- Content updated due to protocol revision.
- Content removed due to protocol revision.
- New protocol syntax added due to protocol revision.

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- Protocol syntax updated due to protocol revision.
- Protocol syntax removed due to protocol revision.
- New content added for template compliance.
- Content updated for template compliance.
- Content removed for template compliance.
- Obsolete document removed.

Editorial changes are always classified with the change type **Editorially updated.**

Some important terms used in the change type descriptions are defined as follows:

- **Protocol syntax** refers to data elements (such as packets, structures, enumerations, and methods) as well as interfaces.
- **Protocol revision** refers to changes made to a protocol that affect the bits that are sent over the wire.

The changes made to this document are listed in the following table. For more information, please contact protocol@microsoft.com.

Section	Tracking number (if applicable) and description	Major change (Y or N)	Change type
1.2.1 Normative References	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
1.2.2 Informative References	Replaced reference for [MS-CAESO] with reference for [MS-CERSOD].	N	Content updated.
1.2.2 Informative References	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
1.3.2.2 Key Attestation	Added section with content for Windows 8.1 operating system and Windows Server 2012 R2 operating system.	Y	New content added.
2.2.2.1 CACERTBLOB	65830 Added section with CACERTBLOB data structure.	Y	New content added.
2.2.2.5 KeyAttestationStatement	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
2.2.2.7.10 szENROLLMENT_NAME_VALUE_PAIR	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.

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Section	Tracking number (if applicable) and description	Major change (Y or N)	Change type
2.2.2.7.12 szOID_ENROLL_ATTESTATION_STATEMENT	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
2.2.2.7.13 szOID_ENROLL_EK_INFO	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
2.2.2.7.14 szOID_ENROLL_KSP_NAME	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
2.2.2.8.1.1 szOID_ENROLL_ATTESTATION_CHALLENGE	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
2.2.2.8.1.2 szOID_ENROLL_CAXCHGCERT_HASH	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
2.2.2.8.1.3 szOID_ENROLL_KSP_NAME	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
2.2.2.8.1.4 szOID_ENROLL_ENCRYPTION_ALGORITHM	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.1.1.1 Abstract Data Model	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.1.1.4.3 ICertRequestD::Request and ICertRequestD2::Request2 Processing	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.1.1.4.3.1 New Certificate Requests	66993 Removed implementation-specific information from the section body.	N	Content updated.
3.1.1.4.3.2.1 Renew Certificate Request Using CMS and PKCS #10 Request Formats	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.1.1.4.3.2.2 Renew Certificate Request Using CMS and CMC Request Formats	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.1.1.4.3.3.1 Abstract Data Model	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.1.1.4.3.3.2 Enroll on Behalf of Request Using CMS and PKCS	Updated content for Windows 8.1 and Windows	Y	Content updated.

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Section	Tracking number (if applicable) and description	Major change (Y or N)	Change type
#10 Request Formats	Server 2012 R2.		
3.1.1.4.3.4 Certificate Request with Key Attestation	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.1.1.4.3.4.1 New Certificate Request with Key Attestation Statement	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.1.1.4.3.4.2 Responding to a CA Challenge Message	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.1.1.4.3.4.3 Certificate Request with Challenge Response	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.1.1.4.3.5 Certificate Requests with Private Key Info	66993 Removed implementation-specific information from the section body.	N	Content updated.
3.1.1.6.2 Submitting Certificate Request	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.1.2 Client Mode: Enrollment Based on Certificate Templates	Replaced reference to [MS-CAESO] with reference to [MS-CERSOD].	N	Content updated.
3.1.2.1 Abstract Data Model	65830 Added abstract data model elements.	Y	Content updated.
3.1.2.4.2.1 Choosing Certificate Request Types	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.1.2.4.2.2.2.2 Certificate.Template.pKIDefaultCSPs	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.1.2.4.2.2.2.5 Certificate.Template.msPKI-RA-Application-Policies	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.1.2.4.2.2.2.8 Certificate.Template.msPKI-Private-Key-Flag	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.2.1.1.1.2 Request Table Optional Data Elements	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.

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Section	Tracking number (if applicable) and description	Major change (Y or N)	Change type
3.2.1.1.4 Configuration List	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.2.1.4.2.1 ICertRequestD::Request (Opnum 3)	67974 Revised the name of the pdwDisposition parameter.	N	Content updated.
3.2.1.4.2.1.4.3 Storing Request Parameters in the Request Table	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.2.1.4.3.1 ICertRequestD2::Request2 (Opnum 6)	Revised the spelling of pctbCertChain.	N	Content updated.
3.2.1.4.3.2.36 PropID = 0x00000024 (CR_PROP_CABACKWARDCROSSCERT) "CA Backward Cross Certificate"	66993 Removed unused reference.	N	Content updated.
3.2.2.6.2.1.2 Processing a Request	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.2.2.6.2.1.2.5 Processing Rules for an Initial Key Attestation Request	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.2.2.6.2.1.2.5.1 Processing Rules for Key Attestation Based on Trusted Endorsement Certificates	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.2.2.6.2.1.2.5.2 Processing Rules for Key Attestation Based on a Trusted Endorsement Key	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.2.2.6.2.1.2.6 Processing Rules for Providing a Challenge Response to an Initial Key Attestation Request	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.2.2.6.2.1.2.7 Processing Rules for a Challenge Response Request	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
3.2.2.6.2.1.3 Storing Request Parameters in the Request Table	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.2.2.6.2.1.4.5.7 msPKI-Private-Key-Flag	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.
3.2.2.6.2.1.4.5.8 msPKI-Certificate-Policy	Updated content for Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.

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Section	Tracking number (if applicable) and description	Major change (Y or N)	Change type
3.2.2.6.2.1.4.5.8.2 Processing When KeyAttestationPolicies Is Not Empty	Added section with content for Windows 8.1 and Windows Server 2012 R2.	Y	New content added.
6 Appendix A: Full IDL	67987 Modified the CATRANSPROP structure to be consistent with other definitions.	N	Content updated.
7 Appendix B: Product Behavior	Modified this section to include references to Windows 8.1 and Windows Server 2012 R2.	Y	Content updated.

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