Internet Engineering Task Force (IETF)
Request for Comments: 6818
Updates: 5280
Category: Standards Track
ISSN: 2070-1721

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January 2013

Updates to the Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile

Abstract

This document updates RFC 5280, the "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile". This document changes the set of acceptable encoding methods for the explicitText field of the user notice policy qualifier and clarifies the rules for converting internationalized domain name labels to ASCII. This document also provides some clarifications on the use of self-signed certificates, trust anchors, and some updated security considerations.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc6818.

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1. Introduction

This document updates the "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile" [RFC5280].

This document makes a recommendation that self-signed certificates used to convey trust anchor data be marked as certificate authority (CA) certificates, which is not always current practice.

The use of self-signed certificates as trust anchors in Section 6.2 of [RFC5280] is clarified. While it is optional to use additional information in these certificates in the path validation process, [RFC5937] is noted as providing guidance in that regard.

The acceptable and unacceptable encodings for the explicitText field of the user notice policy qualifier are updated to bring them in line with existing practice.

The rules in Section 7.3 of [RFC5280] for ASCII encoding of Internationalized Domain Names (IDNs) as Distinguished Names are aligned with the rules in Section 7.2 of that document that govern IDN encoding as GeneralNames.

In light of some observed attacks [Prins], the Security Considerations section now gives added depth to the consequences of CA key compromise. This section additionally notes that collision resistance is not a required property of one-way hash functions when used to generate key identifiers.

This document also adds normative and informative references for Trust Anchor formats and how they may be used to initialize the path validation inputs. These are needed as a result of the changes made in Section 4 of this document.

1.1. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

2. Update to RFC 5280, Section 3.2: "Certification Paths and Trust"

Add the following paragraph to the end of RFC 5280, Section 3.2:

| Consistent with Section 3.4.61 of X.509 (11/2008) [X.509], we note
| that use of self-issued certificates and self-signed certificates
| issued by entities other than CAs are outside the scope of this
| specification. Thus, for example, a web server or client might
| generate a self-signed certificate to identify itself. These
| certificates and how a relying party uses them to authenticate
| asserted identities are both outside the scope of RFC 5280.

3. Update to RFC 5280, Section 4.2.1.4: "Certificate Policies"

RFC 5280, Section 4.2.1.4, the tenth paragraph says:

> An explicitText field includes the textual statement directly in the certificate. The explicitText field is a string with a maximum size of 200 characters. Conforming CAs SHOULD use the
| UTF8String encoding for explicitText, but MAY use IA5String.
| Conforming CAs MUST NOT encode explicitText as VisibleString or
| BMPString. The explicitText string SHOULD NOT include any control

| characters (e.g., U+0000 to U+001F and U+007F to U+009F). When
| the UTF8String encoding is used, all character sequences SHOULD be
normalized according to Unicode normalization form C (NFC) [NFC].

This paragraph is replaced with:

An explicitText field includes the textual statement directly in the certificate. The explicitText field is a string with a maximum size of 200 characters. Conforming CAs SHOULD use the
| UTF8String encoding for explicitText. VisibleString or BMPString
| are acceptable but less preferred alternatives. Conforming CAs
| MUST NOT encode explicitText as IA5String. The explicitText string
| SHOULD NOT include any control characters (e.g., U+0000 to U+001F
| and U+007F to U+009F). When the UTF8String or BMPString encoding
is used, all character sequences SHOULD be normalized according to Unicode normalization form C (NFC) [NFC].

4. Update to RFC 5280, Section 6.2: "Using the Path Validation Algorithm"

RFC 5280, Section 6.2, the third paragraph says:

Where a CA distributes self-signed certificates to specify trust anchor information, certificate extensions can be used to specify recommended inputs to path validation. For example, a policy constraints extension could be included in the self-signed certificate to indicate that paths beginning with this trust anchor should be trusted only for the specified policies. Similarly, a name constraints extension could be included to indicate that paths beginning with this trust anchor should be trusted only for the specified name spaces. The path validation algorithm presented in Section 6.1 does not assume that trust anchor information is provided in self-signed certificates and does not specify processing rules for
| additional information included in such certificates.
| Implementations that use self-signed certificates to specify trust
| anchor information are free to process or ignore such information.

This paragraph is replaced with:

Where a CA distributes self-signed certificates to specify trust anchor information, certificate extensions can be used to specify recommended inputs to path validation. For example, a policy constraints extension could be included in the self-signed certificate to indicate that paths beginning with this trust anchor should be trusted only for the specified policies. Similarly, a name constraints extension could be included to indicate that paths beginning with this trust anchor should be trusted only for the specified name spaces. The path validation algorithm presented in

Section 6.1 does not assume that trust anchor information is provided
| in self-signed certificates and does not specify processing rules for
| additional information included in such certificates.
| However, [RFC5914] defines several formats for representing trust
| anchor information, including self-signed certificates, and [RFC5937]
| provides an example of how such information may be used to initialize
| the path validation inputs. Implementations are free to make use of
| any additional information that is included in a trust anchor
| representation, or to ignore such information.

5. Update to RFC 5280, Section 7.3: "Internationalized Domain Names in Distinguished Names"

RFC 5280, Section 7.3, the first paragraph says:

Domain Names may also be represented as distinguished names using
domain components in the subject field, the issuer field, the
subjectAltName extension, or the issuerAltName extension. As with
the dNSName in the GeneralName type, the value of this attribute is
defined as an IA5String. Each domainComponent attribute represents a
single label. To represent a label from an IDN in the distinguished
name, the implementation MUST perform the "ToASCII" label conversion
| specified in Section 4.1 of RFC 3490. The label SHALL be considered
| a "stored string". That is, the AllowUnassigned flag SHALL NOT be
| set.

This paragraph is replaced with:

Domain Names may also be represented as distinguished names using
domain components in the subject field, the issuer field, the
subjectAltName extension, or the issuerAltName extension. As with
the dNSName in the GeneralName type, the value of this attribute is
defined as an IA5String. Each domainComponent attribute represents a
single label. To represent a label from an IDN in the distinguished
name, the implementation MUST perform the "ToASCII" label conversion
| specified in Section 4.1 of RFC 3490 with the UseSTD3ASCIIRules flag
| set. The label SHALL be considered a "stored string". That is, the
| AllowUnassigned flag SHALL NOT be set. The conversion process is the
| same as is performed in step 4 in Section 7.2.

6. Security Considerations

This document modifies the Security Considerations section of RFC
5280 as follows. The fifth paragraph of the Security Considerations
section of RFC 5280 says:

The protection afforded private keys is a critical security factor. On a small scale, failure of users to protect their private keys will permit an attacker to masquerade as them or decrypt their personal information. On a larger scale, compromise of a CA's private signing
| key may have a catastrophic effect. If an attacker obtains the
| private key unnoticed, the attacker may issue bogus certificates and
| CRLs. Existence of bogus certificates and CRLs will undermine
| confidence in the system. If such a compromise is detected, all
| certificates issued to the compromised CA MUST be revoked, preventing
| services between its users and users of other CAs. Rebuilding after
| such a compromise will be problematic, so CAs are advised to
| implement a combination of strong technical measures (e.g., tamper-
| resistant cryptographic modules) and appropriate management
| procedures (e.g., separation of duties) to avoid such an incident.

This paragraph is replaced with:

The protection afforded private keys is a critical security factor. On a small scale, failure of users to protect their private keys will permit an attacker to masquerade as them or decrypt their personal information. On a larger scale, compromise of a CA's private signing key may have a catastrophic effect.
|
| If an attacker obtains the private key of a CA unnoticed, the
| attacker may issue bogus certificates and CRLs. Even if an attacker
| is unable to obtain a copy of a CA's private key, the attacker may be
| able to issue bogus certificates and CRLs by making unauthorized use
| of the CA's workstation or of an RA's workstation. Such an attack
| may be the result of an attacker obtaining unauthorized access to the
| workstation, either locally or remotely, or may be the result of
| inappropriate activity by an insider. Existence of bogus
| certificates and CRLs will undermine confidence in the system. Among
| many other possible attacks, the attacker may issue bogus
| certificates that have the same subject names as legitimate
| certificates in order impersonate legitimate certificate subjects.
| This could include bogus CA certificates in which the subject names
| in the bogus certificates match the names under which legitimate CAs
| issue certificates and CRLs. This would allow the attacker to issue
| bogus certificates and CRLs that have the same issuer names, and
| possibly the same serial numbers, as certificates and CRLs issued by
| legitimate CAs.

The following text is added to the end of the Security Considerations section of 5280:

| One-way hash functions are commonly used to generate key identifier
| values (AKI and SKI), e.g., as described in Sections 4.1.1 and 4.1.2.
| However, none of the security properties of such functions are
| required for this context.

7. Update to RFC 5280, Section 11.1: "Normative References"

[RFC5914] Housley, R., Ashmore, S., and C. Wallace, "Trust Anchor Format", RFC 5914, June 2010.

8. Update to RFC 5280, Section 11.2: "Informative References"

[RFC5937] Ashmore, S. and C. Wallace, "Using Trust Anchor Constraints during Certification Path Processing", RFC 5937, August 2010.

9. References

9.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC5280] Cooper, D., Santesson, S., Farrell, S., Boeyen, S., Housley, R., and W. Polk, "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile", RFC 5280, May 2008.

[RFC5914] Housley, R., Ashmore, S., and C. Wallace, "Trust Anchor Format", RFC 5914, June 2010.

[X.509] ITU-T Recommendation X.509 (2008) | ISO/IEC 9594-8:2008, Information Technology - Open Systems Interconnection - The Directory: Public-key and attribute certificate frameworks.

9.2. Informative References

[RFC5937] Ashmore, S. and C. Wallace, "Using Trust Anchor Constraints during Certification Path Processing", RFC 5937, August 2010.

[Prins] Prins, J. R., "DigiNotar Certificate Authority breach 'Operation Black Tulip'", September 2011, <http://www.rijksoverheid.nl/bestanden/documenten-en-publicaties/rapporten/2011/09/05/diginotar-public-report-version-1/rapport-fox-it-operation-black-tulip-v1-0.pdf>.

[NFC] Davis, M. and M. Duerst, "Unicode Standard Annex #15: Unicode Normalization Forms", October 2006, <http://www.unicode.org/reports/tr15/>.

10. Acknowledgements

David Cooper is acknowledged for his fine work in editing previous versions of this document.

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