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CDNI Metadata for Delegated Credentials
draft-cdni-https-delegation-subcerts-00

Abstract

The delivery of content over HTTPS involving multiple CDNs raises credential management issues. This document defines metadata in CDNI Control and Metadata interface to setup HTTPS delegation using Delegated Credentials from an Upstream CDN (uCDN) to a Downstream CDN (dCDN).

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on 30 July 2022.

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1 Introduction

Content delivery over HTTPS using one or more CDNs along the path requires credential management. This specifically applies when an entity delegates to another trusted entity delivery of content via HTTPS.

Several delegation methods are currently proposed within different IETF working groups. They specify different methods for provisioning HTTPS delivery credentials.

This document defines the CDNI Metadata interface to setup HTTPS delegation using Delegated Credentials between an upstream CDN (uCDN) and downstream CDN (dCDN). Furthermore, it includes a proposal of IANA registry to enable adding of new methods.

Section 2 is about terminology used in this document. Section 3 presents delegation methods specified at the IETF. Section 4 specifies the CDNI Footprint and Capabilities Advertisement interface (FCI) for delegated credentials. Section 5 specifies the CDNI Metadata interface (MI) for delegated credentials. Section 6 provides overall call-flows for delegated credentials. Section 7 addresses IANA registry for delegation methods. Section 8 discusses Security Considerations. Section 9 discusses Privacy Considerations.

2. Terminology

This document uses terminology from CDNI framework documents: CDNI framework document [RFC7336], CDNI requirements [RFC7337] and CDNI interface specifications documents: CDNI Metadata interface [RFC8006] and CDNI Control interface / Triggers [RFC8007].

2.1. Change Log

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* Added object FCI.DelegatedCredentials allowing to announce the number of credentials needed

* Removed object MI.ConfDelegatedCredentials

* MI.DelegatedCredentials changed: private key is now optional, arrays used to embed multiple delegated credentials within the object.

* Added sections on privacy and security considerations

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* added section CDNI Footprint and Capabilities Advertisement interface (FCI) that describes how to announce support of delegated credentials

* moved to two different MI objects: MI.ConfDelegatedCredentials and MI.DelegatedCredentials. The former provides an URI that allows to download a MI.DelegatedCredentials object that contains the delegated credential and a private key.

* Added precision on the cryptographic material required by the dCDN in order to be able to use delegated credentials

* Added precision on the expected behavior when fetching a delegated credential using credentials-location-uri

* completed and simplified call-flow figure (figure 1) and moved it to a separate section and added descriptive text

* Minor text improvements

3. Known delegation methods

The TLS and ACME working groups specified a set of RFCs and Internet drafts to handle delegation of HTTPS delivery between entities. [RFC8739] specifies the Support for Short-Term, Automatically Renewed (STAR) Certificates in the Automated Certificate Management Environment (ACME). [RFC9115] specifies the automatic generation of delegated certificates in ACME. Together these two RFCs allow managing short term delegated certificates with ACME. [I-D.ietf-cdni-interfaces-https-delegation] specifies the HTTPS delegation between the CDN entities using CDNI interfaces using the STAR/ACME delegation method.

Instead of working with actual certificates, [I-D.ietf-tls-subcerts] proposes the use of delegated credentials. This Internet Draft (I-D) specifies the HTTPS delegation between the CDN entities using CDNI interfaces by relying on the use of delegated credentials as a delegation method as defined in [I-D.ietf-tls-subcerts].

4. CDNI Footprint and Capabilities Advertisement interface (FCI) for delegated credentials

A dCDN should advertise its supported delegation methods using the Footprint and Capabilities interface (FCI) as defined in RFC8008. With FCI, the dCDN informs the uCDN about its capabilities and the MI objects supported by the dCDN. Accordingly, to announce the support

for delegated credentials, the dCDN should announce the support of MI.DelegatedCredentials .

There is also a need to announce parameters, i.e., the number of delegated credentials needed by the dCDN in order to work properly. For that purpose we introduce the FCI object FCI.DelegationCredentials.

4.1 FCI.DelegatedCredentials

The FCI.DelegationCredentials object allows to announce support for delegated credentials and to announce the number of delegated credentials needed.

Property: number-delegated-certs-needed

Description: Number of delegated credentials needed by the dCDN.

Type: integer

Mandatory-to-Specify: Yes.

The following is an example of the FCI.DelegatedCredentials.

```
{
  "capabilities": [
    {
     "capability-type": "FCI.DelegatedCredentials",
     "capability-value": {
        "number-delegated-certs-needed": 10
      }
     "footprints": [
        <Footprint objects>
      ]
    }
  ]
}
```

4.2 Expected usage of FCI.DelegatedCredentials

At the first announcement of FCI.DelegatedCredentials to an uCDN, the dCDN may announce the number of endpoints as the number of required delegated credentials. When configuring the dCDN, the uCDN may decide to provide only a subset of the requested delegated credentials. Note that, within a dCDN different deployment possibilities of the delegated credentials on the endpoints exist. The dCDN may use one

single delegated credential and deploy it on multiple endpoints. Alternatively, the dCDN may deploy a different delegated credential for each endpoint. (provided that the uCDN delivers enough different delegated credentials). This choice depends of course on the number of delegated credentials provided by the uCDN.

Once the dCDN has been configured with delegated credentials and a set of delegated credentials have been deployed on endpoints, the dCDN monitors the number of credentials that are about to expires (e.g. within one day), and ask for new ones by announcing this number of required delegated credentials via the FCI.DelegatedCredentials object.

When uCDN queries and retrieves the FCI object it can push the required number of delegated credentials to the dCDN.

5. CDNI Metadata interface (MI) for delegated credentials

As expressed in [I-D.ietf-tls-subcerts], when an origin has set a delegation to a downstream entity such as a downstream CDN (i.e. dCDN), the dCDN should present the "delegated_credential" during the TLS handshake [RFC8446] to the end-user client application, instead of its own certificate. The dCDN must further be in the possession of the private key corresponding to the public key in DelegatedCredential.cred [I-D.ietf-tls-subcerts]. This allows the end user client to verify the signature in CertificateVerify message sent and signed by the dCDN.

This section defines the object, MI.DelegatedCredentials containing an array of delegated credentials and optionally the corresponding private keys. The CDNI Metadata Interface [RFC8006] describes the CDNI metadata distribution mechanisms according to which a dCDN can retrieve the MI.DelegatedCredentials object from the uCDN.

The properties of the MI.DelegatedCredentials object are as follows.

Property: delegated-credentials

Description: Array of delegated credentials.

Type: array

Mandatory-to-Specify: Yes

Each item of the array of the property delegated-credentials is composed of the following two properties:

Property: delegated-credential

Description: Hex-encoded delegated credential structure DelegatedCredential as defined in [I-D.ietf-tls-subcerts].

Mandatory-to-Specify: Yes

Property: private-key

Description: private key corresponding to the public key contained in the DelegatedCredential.

Mandatory-to-Specify: No

The private-key property is not mandatory. If not used we suppose that the dCDN generated the public-private key pair for the delegated credential itself and provided the public key information with a mechanism outside of this specification to the uCDN.

Find below an example MI.DelegatedCredential object.

```
{
  "generic-metadata-type": "MI.DelegatedCredentials",
  "generic-metadata-value": {
    "delegated-credentials": [
         {"delegated-credential":
             "70105f9bc28aea93f3fed7602b279dc0...
              8970822009b330cd11f052c8dc16b451"},
         {"delegated-credential":
             "e29c881ad8c5772b35fbdcbfe2c4bf16...
              27e87d967458ff18268bae512c62a847"},
         {"delegated-credential":
             "e8f5853b4836017bd46942d72ce6dc54...
              1d7a25753fea698082344c8273c24cd8"}
    ]
  }
}
```

6. Delegated credentials call flows

An example call-flow using delegated credentials in CDNI is depicted in Figure 1.

1. We suppose that the uCDN has been provisioned and configured with a certificate. Note that it is out of scope of CDNI and the present document how and from where (e.g. CSP) the uCDN acquired its certificate.

2. The uCDN generates a set of delegated credentials (here we suppose that public keys of the dCDN are known). Note, that the uCDN may

generate this material at different points in time, e.g. in advance to have a pool of delegated credentials or on-demand when dCDN request new delegated credentials.

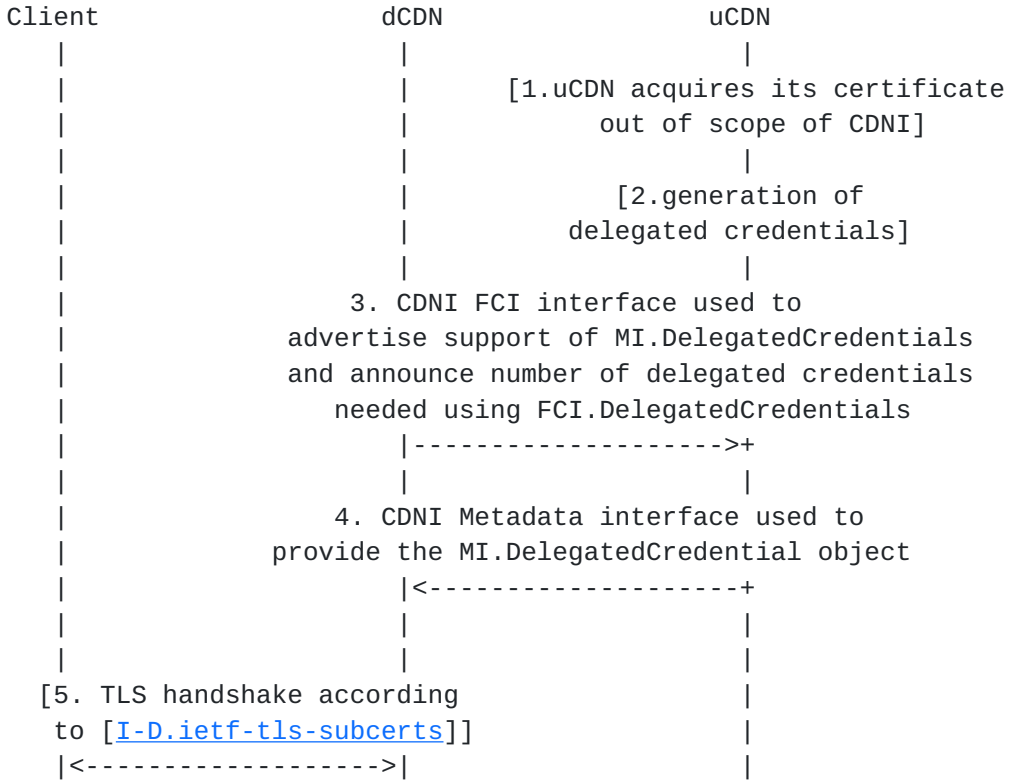
3. Using CDNI Footprint and Capabilities interface [RFC8008], the dCDN advertises MI.DelegatedCredentials capabilities to the uCDN. The dCDN further uses FCI.DelegatedCredentials to ask for a certain number of delegated credentials.

4. Using CDNI the Metadata interface [RFC8006], the dCDN acquires the MI.DelegatedCredentials, therefore retrieving an array of delegated credentials.

5. The client establishes a TLS connection with an endpoint of the dCDN according to [I-D.ietf-tls-subcerts] using the delegated credentials retrieved in step 4.

6. Some delegated credentials are about to expire. The dCDN uses FCI.DelegatedCredentials to announce the number of delegated credentials needed.

7. Using CDNI the Metadata interface [RFC8006], the dCDN acquires the MI.DelegatedCredentials, therefore retrieving an new array of delegated credentials.



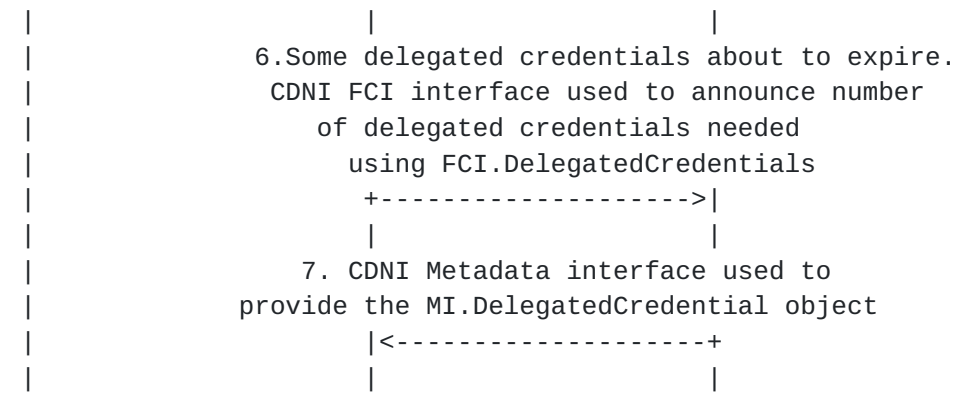


Figure 1: Example call-flow of Delegated credentials in CDNI

7. IANA Considerations

This document requests the registration of the following entries under the "CDNI Payload Types" registry hosted by IANA regarding "CDNI delegation":

Payload Type	Specification
FCI.DelegatedCredentials	RFCthis
MI.DelegatedCredentials	RFCthis

[RFC Editor: Please replace RFCthis with the published RFC number for this document.]

7.1 CDNI MI DelegatedCredentials Payload Type

Purpose: The purpose of this Payload Type is to distinguish Delegated Credentials MI objects (and any associated capability advertisement)

Interface: MI/FCI

Encoding: see corresponding section

7.1 CDNI FCI DelegatedCredentials Payload Type

Purpose: The purpose of this Payload Type is to advertise the number of delegated credentials needed (and any associated capability advertisement)

Interface: FCI

Encoding: see corresponding section

8. Security Considerations

The extensions defined in the present document allow to provide delegated credentials to dCDNs. The delegated credentials themselves are short-lived and as such a single leaked delegated credential represents a limited security risk. However, it is important to ensure that an attacker is not able to systematically retrieve a more important number of delegated credentials. Such an attack would allow the attacker to systematically impersonate dCDN nodes.

The FCI and MI objects defined in the present document are transferred via the interfaces defined in CDNI [RFC8006]. [RFC8006] describes how to secure these interfaces, protecting the integrity, confidentiality and ensuring the authenticity of the dCDN and uCDN. The security provide by [RFC8006] should therefore address the above security concerns.

9. Privacy Considerations

The information, FCI and MI objects defined in the present document do not contain any personally identifiable information (PII). As such this document does not change or alter the Confidentiality and Privacy Consideration outlined in the CDNI Metadata and Footprint and Capabilities RFCs [RFC8006].

10 References

10.1 Normative References

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[RFC9115] Sheffer, Y., Lopez, D., Pastor Perales, A., and T. Fossati, "An Automatic Certificate Management Environment (ACME) Profile for Generating Delegated Certificates", RFC 9115, DOI 10.17487/RFC9115, September 2021, <https://www.rfc-editor.org/info/rfc9115>.

[RFC8739] Sheffer, Y., Lopez, D., Gonzalez de Dios, O., Pastor Perales, A., and T. Fossati, "Support for Short-Term, Automatically Renewed (STAR) Certificates in the Automated Certificate Management Environment (ACME)", RFC 8739, DOI 10.17487/RFC8739, March 2020, <https://www.rfc-

editor.org/info/rfc9115>.

[RFC8006] Niven-Jenkins, B., Murray, R., Caulfield, M., and K. Ma, "Content Delivery Network Interconnection (CDNI) Metadata", RFC 8006, DOI 10.17487/RFC8006, December 2016, <https://www.rfc-editor.org/info/rfc8006>.

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[RFC8008] Seedorf, J., Peterson, J., Previdi, S., van Brandenburg, R., and K. Ma, "Content Delivery Network Interconnection (CDNI) Request Routing: Footprint and Capabilities Semantics", RFC 8008, DOI 10.17487/RFC8008, December 2016, <https://www.rfc-editor.org/info/rfc8008>.

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10.2 Informative References

[RFC7336] Peterson, L., Davie, B., and R. van Brandenburg, Ed., "Framework for Content Distribution Network Interconnection (CDNI)", RFC 7336, DOI 10.17487/RFC7336, August 2014, <https://www.rfc-editor.org/info/rfc7336>.

[RFC7337] Leung, K., Ed. and Y. Lee, Ed., "Content Distribution Network Interconnection (CDNI) Requirements", RFC 7337, DOI 10.17487/RFC7337, August 2014, <https://www.rfc-editor.org/info/rfc7337>.

[RFC8446] Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.3", RFC 8446, DOI 10.17487/RFC8446, August 2018, <https://www.rfc-editor.org/info/rfc8446>.

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