Host Identity Protocol
Internet-Draft
Intended status: Informational
Expires: October 30, 2010

Heer
Distributed Systems Group, RWTH
Aachen University
Varjonen
Helsinki Institute for Information
Technology

April 28, 2010

HIP Certificates
draft-ietf-hip-cert-03

Abstract

This document specifies a certificate parameter called CERT for the Host Identity Protocol (HIP). The CERT parameter is a container for X.509.v3 certificates and for Simple Public Key Infrastructure (SPKI) certificates. It is used for carrying these certificates in HIP control packets. Additionally, this document specifies the representations of Host Identity Tags in X.509.v3 and in SPKI certificates.

Requirements Language

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].

Status of this Memo

1. Introduction

Digital certificates bind a piece of information to a public key by means of a digital signature, and thus, enable the holder of a private key to generate cryptographically verifiable statements. The Host Identity Protocol (HIP)[RFC5201] defines a new cryptographic namespace based on asymmetric cryptography. Each host's identity is derived from a public key, allowing hosts to digitally sign data with their private key. This document specifies a CERT parameter that is used to transmit digital signatures in HIP. It fills the placeholder specified in Section 5.2 of [RFC5201].

2. CERT Parameter

The CERT parameter is a container for a certain types of digital certificates. It may either carry SPKI certificates or X.509.v3 certificates. It does not specify any certificate semantics. However, it defines some organizational parameters that help HIP hosts to transmit semantically grouped parameters in a more systematic way.

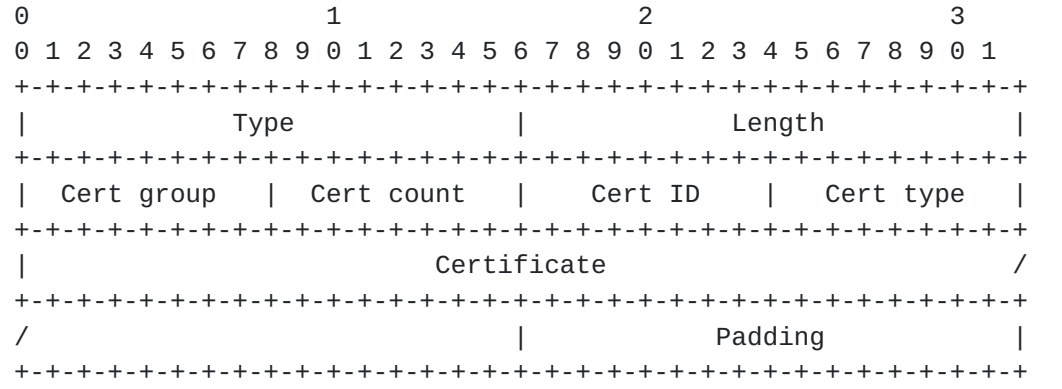
The CERT parameter may be covered by the HIP SIGNATURE field and is a non-critical parameter.

The CERT parameter can be used in all HIP packets but using CERT in I1 is NOT RECOMMENDED. Each allowed HIP control packet may contain multiple CERT parameters. These parameters may be related or unrelated. Related certificates are managed in Cert groups. A Cert group specifies a group of related CERT parameters that should be interpreted in a certain order (e.g. for expressing certificate chains). For grouping CERT parameters, the Cert group and the Cert

count field must be set. Ungrouped certificates exhibit a unique Cert group field and set the Cert count to 1. CERT parameters with the same Cert group number in the group field indicate a logical grouping. The Cert count field indicates the number of CERT parameters in the group.

CERT parameters that belong to the same Cert group may be contained in multiple sequential HIP control packets. This is indicated by a higher Cert count than the amount of CERT parameters with matching Cert group fields in a HIP control packet. The CERT parameters must be placed in ascending order, within a HIP control packet, according to their Cert group field. Cert groups may only span multiple packets if the Cert group does not fit the packet. Only one Cert group may span two subsequent packets.

The Cert ID acts as a sequence number to identify the certificates in a Cert group. The numbers in the Cert ID field must start from 1 up to Cert count.



Type	768
Length	Length in octets, excluding Type, Length, and Padding
Cert group	Group ID grouping multiple related CERT parameters
Cert count	Total count of certificates that are sent, possibly in several consecutive HIP control packets.
Cert ID	The sequence number for this certificate
Cert Type	Describes the type of the certificate
Padding	Any Padding, if necessary, to make the TLV a multiple of 8 bytes.

The following certificate types are defined:

Cert format	Type number
X.509.v3	1
SPKI	2
URL of X.509.v3	3
URL of SPKI	4
Hash of X.509.v3	5
Hash of SPKI	6
LDAP URL of X.509.v3	7
LDAP URL of SPKI	8
Distinguished Name of X.509.v3	9
Distinguished Name of SPKI	10

Next sections outline the use of HITs in X.509.v3 and in SPKI certificates. X.509.v3 certificates are defined in [RFC3280]. The Wire format for X.509.v3 is Distinguished Encoding Rules format as defined in [X.690]. The SPKI and its formats are defined in [RFC2693].

Hash and URL encodings (3 to 6) are used as defined in [RFC4306]. Using hash and URL encodings results in smaller HIP control packets, but requires the receiver to resolve the URL or check local cache against the hash.

LDAP URL encoding (7 and 8) is used as defined in [RFC2255]. Using LDAP URL encoding results in smaller HIP control packets, but requires the receiver to retrieve the certificate or check local cache against the URL.

Distinguished name (DN) encoding (9 and 10) is used as defined in [RFC1779]. Using LDAP URL encoding results in smaller HIP control packets, but requires the receiver to retrieve the certificate or check local cache against the DN.

3. X.509.v3 Certificate Object and Host Identities

HITs need to be enclosed within the certificates, when using X.509.v3 certificates to transmit information related to HIP hosts. HITs can represent an issuer, a subject, or both. In X.509.v3 HITs are represented as issuer and subject alternative name extensions as defined in [RFC2459]. If only HIP information is presented as either the issuer or the subject the HIT is also placed into the respective entity's DNs Common Name (CN) section in a colon delimited presentation format. Inclusion of CN is not necessary if DN contains any other information. It is RECOMMENDED to use FQDN/NAI from the

hosts HOST_ID parameter in DN if one exists. Full HIs are presented in the public key entries of X.509.v3 certificates.

As an example, in a case where the issuer and the subject are both HIP enabled, the HITs are expressed as follows:

```
Format:
    Issuer: CN=hit-of-host
    Subject: CN=hit-of-host

    X509v3 extensions:
        X509v3 Issuer Alternative Name:
            IP Address:HIT-OF-HOST
        X509v3 Subject Alternative Name:
            IP Address:HIT-OF-HOST

Example:
    Issuer: CN=2001:14:6cf:fae7:bb79:bf78:7d64:c056
    Subject: CN=2001:14:6cf:fae7:bb79:bf78:7d64:c056

    X509v3 extensions:
        X509v3 Issuer Alternative Name:
            IP Address:2001:14:6CF:FAE7:BB79:BF78:7D64:C056
        X509v3 Subject Alternative Name:
            IP Address:2001:14:6CF:FAE7:BB79:BF78:7D64:C056
```

Appendix B shows a full example X.509.v3 certificate with HIP content.

4. SPKI Cert Object and Host Identities

HITs need to be enclosed within the certificates, when using SPKI certificates to transmit information related to HIP hosts. HITs can represent an issuer, a subject, or both. In the following we define the representation of those identifiers for SPKI given as S-expressions. Note that the S-expressions are only the human-readable representation of SPKI certificates. Full HIs are presented in the public key sequences of SPKI certificates.

As an example the Host Identity Tag of a host is expressed as follows:

```
Format:  (hash hit hit-of-host)
Example: (hash hit 2001:13:724d:f3c0:6ff0:33c2:15d8:5f50)
```

Appendix A shows a full example SPKI certificate with HIP content.

5. Revocation of Certificates

Revocation of SPKI certificates is handled as defined in Section 5. in [RFC2693] Revocation of X.509.v3 certificates is handled as defined in Section 5 in [RFC2459].

6. Signaling

HIP end-hosts and HIP-aware middleboxes need to inform, the initiator or the responder, of the need for a certificate or need for a chain of certificates. They also need a way to inform about failing to meet required conditions. HIP services [HIP.service] describes the signaling. Signaling for the requirements and failures with certificates is described in Section 4.1 of [HIP.service].

7. IANA Considerations

This document defines the CERT parameter for the Host Identity Protocol [RFC5201]. This parameter is defined in Section 2 with type 768. The parameter type number is also defined in [RFC5201]. The Cert Group and Cert ID namespaces are managed locally by each host that sends CERT parameters in HIP control packets.

8. Security Considerations

Certificate grouping allows the certificates to be sent in multiple consecutive packets. This might allow similar attacks as IP-layer fragmentation allows, i.e. sending of fragments in wrong order and skipping some fragments to delay or stall packet processing by the victim in order to use resources (e.g. CPU or memory).

It is not recommended to use grouping or hash and URL encodings when HIP-aware middleboxes are anticipated to be present on the communication path between peers because fetching remote certificates require the middlebox to buffer the packets and to request remote data. This makes these devices prone to denial of service (DoS) attacks. Moreover, middleboxes and responders that request remote certificates can be used as deflectors for distributed denial of service attacks.

9. Acknowledgements

The authors would like to thank M. Komu and T. Henderson of fruitful conversations on the subject.

10. References

10.1. Normative References

[HIP.service] Heer, T., Wirtz, H., and S. Varjonen, "Service Identifiers for HIP", <draft-heer-hip-service-00.txt>.

[RFC1779] Kille, S., "A String Representation of Distinguished Names", RFC 1779, March 1995.

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

[RFC2255] Howes, T. and M. Smith, "The LDAP URL Format", RFC 2255, December 1997.

[RFC2459] Housley, R., Ford, W., Polk, T., and D. Solo, "Internet X.509 Public Key Infrastructure Certificate and CRL Profile", RFC 2459, January 1999.

[RFC2693] Ellison, C., Frantz, B., Lampson, B., Rivest, R., Thomas, B., and T. Ylonen, "SPKI Certificate Theory", RFC 2693, September 1999.

[RFC3280] Housley, R., Polk, W., Ford, W., and D. Solo, "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile", RFC 3280, April 2002.

[RFC4306] Kaufman, C., "Internet Key Exchange (IKEv2) Protocol", RFC 4306, December 2005.

[RFC5201] Moskowitz, R., Nikander, P., Jokela, P., and T. Henderson, "Host Identity Protocol", RFC 5201, April 2008.

10.2. Informative References

[X.690] ITU-T, "Recommendation X.690 Information Technology - ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)", July 2002, <http://

www.itu.int/ITU-T/studygroups/com17/languages/
X.690-0207.pdf>.

Appendix A. SPKI certificate example

This section shows a self-signed SPKI certificate of HIT 2001:14:6cf:fae7:bb79:bf78:7d64:c056. The example has been indented for readability.

```
(sequence
  (public_key
    (rsa-pkcs1-sha1
      (e #010001#)
      (n |n1CheoELqYRSkHYMQddub2TpILl+6H9wC/as6zFCZqOY43hsZgAjG0F
          GoQwtyOyQjzO2Ykb2TmUCZemTYui/sR0zIbdwg1xafKl7ggZDkhk5an
          PtGDxJxFalTYo6/A5ZQv8uatbaJgB/G7VM8G+O9HLucadad2zQUXpQf
          gbK3S8=|
      )
    )
  )
  (cert
    (issuer
      (hash hit 2001:0014:06cf:fae7:bb79:bf78:7d64:c056)
    )
    (subject
      (hash hit 2001:0014:06cf:fae7:bb79:bf78:7d64:c056)
    )
    (not-before "2008-07-12_22:11:07")
    (not-after "2008-07-22_22:11:07")
  )
  (signature
    (hash sha1 |kfElDhagiK0Bsqtj32Gq3t/1mxgA|)
    |HiIqjjZIUzypvoxQyO0UovPm5uC4Xte0scEcBnENDIfn2DNy/bAtxGEdKq4O
     dW80vTCmkF8/HXclgXLLVch3DxRNdSbYiiks000HpQt/OKqlTH+uUHBcHOAo
     E42LmDskM9T5KQJoC/CH7871zfvojPnpkl2dUngOWv4q0r/wSJ0=|
  )
)
```

Appendix B. X.509.v3 certificate example

This section shows a self-signed X.509.v3 certificate of HIT 2001:14:6cf:fae7:bb79:bf78:7d64:c056.

```
   Certificate:
       Data:
           Version: 3 (0x2)
           Serial Number: 0 (0x0)
           Signature Algorithm: sha1WithRSAEncryption
           Issuer: CN=2001:14:6cf:fae7:bb79:bf78:7d64:c056
           Validity
               Not Before: Jul 12 18:58:38 2008 GMT
               Not After : Jul 22 18:58:38 2008 GMT
           Subject: CN=2001:14:6cf:fae7:bb79:bf78:7d64:c056
           Subject Public Key Info:
               Public Key Algorithm: rsaEncryption
               RSA Public Key: (1024 bit)
                   Modulus (1024 bit):
                       00:9f:50:a1:7a:81:0b:a9:84:52:90:76:0c:41:d7:
                       6e:6f:64:e9:20:b9:7e:e8:7f:70:0b:f6:ac:eb:31:
                       42:66:a3:98:e3:78:6c:66:00:23:1b:41:46:a1:0c:
                       2d:c8:ec:90:8f:33:b6:62:46:f6:4e:65:02:65:e9:
                       93:62:e8:bf:b1:1d:33:21:b7:70:83:5c:5a:7c:a9:
                       7b:82:06:43:92:19:39:6a:73:ed:18:3c:49:c4:56:
                       a5:4d:8a:3a:fc:0e:59:42:ff:2e:6a:d6:da:26:00:
                       7f:1b:b5:4c:f0:6f:8e:f4:72:ee:71:a7:5a:77:6c:
                       d0:51:7a:50:7e:06:ca:dd:2f
                   Exponent: 65537 (0x10001)
           X509v3 extensions:
               X509v3 Basic Constraints:
                   CA:TRUE
               X509v3 Issuer Alternative Name:
                   IP Address:2001:14:6CF:FAE7:BB79:BF78:7D64:C056
               X509v3 Subject Alternative Name:
                   IP Address:2001:14:6CF:FAE7:BB79:BF78:7D64:C056
       Signature Algorithm: sha1WithRSAEncryption
           19:32:0b:72:a8:6c:f9:65:20:5b:1d:9a:e1:c7:39:97:c7:8a:
           4d:d1:01:f9:7d:0b:0d:6f:61:a2:e3:2c:62:30:28:f6:36:db:
           62:bc:7f:d1:9b:6d:cc:da:e3:9b:90:e7:53:9e:55:28:51:7e:
           39:de:23:24:f5:a9:97:7a:ba:ce:54:3e:cf:8b:68:04:f6:be:
           78:94:9f:d3:20:62:96:14:84:51:af:c7:ba:30:ae:b1:d6:7e:
           7f:32:42:9c:f6:f5:76:27:0a:28:58:8b:b5:85:e7:e9:5a:ff:
           aa:4c:57:55:95:09:33:ac:0b:8c:fd:05:4a:5e:60:e7:7f:d7:
           42:f0
```

Appendix C. Change log

Changes from version 00 to 01:

- Revised text about DN usage.

- Revised text about Cert group usage.

Changes from version 01 to 02:

- Revised the type numbers.
- Added a section about signaling.

Changes from version 02 to 03:

- Revised text about CERT use in control packets.

Authors' Addresses

Tobias Heer
Distributed Systems Group, RWTH Aachen University
Ahornstrasse 55
Aachen
Germany

Phone: +49 241 80 214 36
Email: heer@cs.rwth-aachen.de
URI: http://ds.cs.rwth-aachen.de/members/heer

Samu Varjonen
Helsinki Institute for Information Technology
Metsnneidonkuja 4
Helsinki
Finland

Fax: +35896949768
Email: samu.varjonen@hiit.fi
URI: http://www.hiit.fi