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**Internet X.509 Public Key Infrastructure -- HTTP Transport for CMP
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Abstract

This document describes how to layer the Certificate Management Protocol over HTTP. It is the "CMPtrans" document referenced in [RFC 4210](#) and therefore updates the reference given therein.

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1. Introduction

The Certificate Management Protocol (CMP) [[RFC4210](#)] requires well defined transport mechanisms to enable End Entities, RAs and CAs to pass PKIMessage sequences between them. This document defines the transport mechanisms which were removed from the main CMP specification with the second release and referred to be in a separate document.

The first version of the CMP specification [[RFC2510](#)] included a brief description of a simple transport protocol layer on top of TCP. Its features was simple transport level error-handling and a mechanism to poll for outstanding PKI messages. Additionally it was mentioned that PKI messages could also be conveyed using file-, E-mail- and HTTP-based transport, but those were not specified in detail.

The current version of the CMP specification incorporated an own polling mechanism and thus the need for a transport protocol providing this functionality vanished. The remaining features CMP requires from its transport protocols are connection- and error-handling.

During the long time it existed as draft, this RFC was undergoing drastic changes. The TCP-based transport protocol was enhanced and a TCP-Messages-over-HTTP transport specification appeared. As both proved to be needless and cumbersome, implementers preferred to use plain HTTP transport. This document now reflects that by exclusively describing HTTP as transport protocol for CMP.

HTTP transport is generally easy to implement, traverses network borders utilizing ubiquitous proxies and is already commonly found in existing implementations.

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2. Requirements

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 [[RFC2119](#)].

3. HTTP-Based Protocol

For direct interaction between two entities, where a reliable transport protocol like TCP is available, HTTP SHOULD be utilized for conveying CMP messages.

With its status codes HTTP provides needed error reporting capabilities. General problems on the server side as well as those directly caused by the respective request can be reported to the client.

As CMP implements a transaction ID, identifying transactions spanning over more than just a single request/response pair, the statelessness of HTTP is not blocking its usage as transport protocol for CMP messages.

3.1. HTTP Versions

Either HTTP/1.0 as described in [[RFC1945](#)] or HTTP/1.1 as in [[RFC2616](#)] MAY be used. Both server and client SHOULD be able to interact with counterparts utilizing either HTTP protocol version.

3.2. Persistent Connections

HTTP permits to reuse a connection for subsequent requests. Implementations may use this functionality for messages within the same transaction but MUST NOT rely on that, as e.g. intermediate HTTP proxies might terminate the connection after each request/response pair.

3.3. General Form

An ASN.1 DER-encoded PKIMessage is sent as the entity-body of an HTTP POST request. If this HTTP request is successful, the server returns the CMP reply in the body of the HTTP response. The response status code in this case MUST be 200; other 2xx codes MUST NOT be used for this purpose. HTTP responses with empty message body to pushed CMP Announcement messages utilize the status codes 201, 202 and 204 to identify whether the received information was processed.

All applicable 4xx or 5xx status codes may be used to inform the client about errors.

3.4. Media Type

The Internet Media Type "application/pkixcmp" MUST be set in the HTTP header when conveying a PKIMessage.

3.5. Communication Workflow

In CMP most communication is initiated by the end entities where every CMP request triggers a CMP response message from the CA or RA.

The CMP Announcement messages described in [Section 3.7](#) are an exception. Their creation may be triggered by certain events or done on a regular basis by a CA. The recipient of the Announcement only replies with an HTTP status code acknowledging the receipt or indicating an error but not with a CMP response.

If the receipt of an HTTP request is not confirmed by receiving an HTTP response, it MUST be assumed that the transported CMP message was not successfully delivered to its destination.

3.6. HTTP Request-URI

The Request-URI is formed as specified in [[RFC3986](#)].

Client requests containing a PKI message MUST be directed to an Request-URI depicting a directory. A server implementation MUST handle Request-URIs with or without a trailing slash as identical. The following list contains all such CMP message types. The prefixed numbers reflect the ASN.1 numbering of the respective element.

- [0] Initialization Request
- [2] Certification Request
- [4] PKCS-10 Request
- [6] pop Response
- [7] Key Update Request
- [9] Key Recovery Request
- [11] Revocation Request
- [13] Cross-Certification Request
- [[15](#)] CA Key Update Announcement
- [16] Certificate Announcement
- [17] Revocation Announcement
- [18] CRL Announcement
- [20] Nested Message
- [21] General Message
- [23] Error Message
- [24] Certificate Confirmation
- [25] Polling Request

An example of a Request-Line and a Host header field in an HTTP/1.1 header, sending a CMP request to a server, located in the "/cmp" directory of the host example.com, would be

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```
POST /cmp HTTP/1.1
Host: example.com
```

or in the absoluteURI form

```
POST http://example.com/cmp/ HTTP/1.1
Host: example.com
```

A CMP server may be logically located either inside the root- or within subdirectories of an HTTP server domain.

3.7. Pushing of Announcements

A CMP server may create event-triggered announcements or generate them on a regular basis. It MAY also utilize HTTP transport to convey them to a suitable recipient. No request message for is specified, so they can only be pushed to the recipient. If an EE wants to poll for a potential CA Key Update Announcement or the current CRL, a PKI Information Request using a General Message as described in E.5 of [[RFC4210](#)] can be used.

When pushing Annocements, ASN.1 encoded structures are sent as the entity-body of an HTTP POST request.

Suitable recipients for CMP announcements might e.g. be repositories storing the announced information such as directory services. Those listen for incoming messages, utilizing the same HTTP Request-URI scheme as defined in [Section 3.6](#).

The following PKIMessages are announcements that may be pushed by a CA. The prefixed numbers reflect ASN.1 numbering of the respective element.

- [15] CA Key Update Announcement
- [16] Certificate Announcement
- [17] Revocation Announcement
- [18] CRL Announcement

CMP Announcement messages do not require any CMP response. However, the recipient MUST acknowledge receipt with a HTTP response having an

appropriate status code and an empty body. When not receiving such response it MUST be assumed that the delivery was not successful and if applicable the sending side may retry sending the Announcement after waiting for an appropriate time span.

If the announced issue was successfully stored in a database or was already present, the answer MUST be an HTTP response with a "201 Created" or "204 No Content" status code and empty message body.

In case the announced information was only accepted for further processing, the status code of the returned HTTP response MAY also be

"202 Accepted". After an appropriate delay, the server may then try to send the Announcement again and may repeat this until it receives a confirmation that it had been successfully stored. The appropriate

duration of the delay and the option to increase it between consecutive attempts should be carefully considered.

A receiver MUST answer with a suitable 4xx or 5xx HTTP error code when a problem occurs.

3.8. HTTP Considerations

In general CMP messages are not cachable. HTTP headers of requests and responses MUST include "Cache-Control: no-cache" and, in case of HTTP/1.0, additionally "Pragma: no-cache" to protect the client from getting cached responses.

Connection management is based on the HTTP provided mechanisms ("Connection" and "Proxy-Connection" header fields).

While an implementation MAY make use of all defined features of the HTTP protocol, it SHOULD keep the protocol utilization as simple as possible.

There is no need for the clients to send an "Expect" request-header field with the "100-continue" expectation and wait for a "100 Continue" status as described in chapter 8.2.3 of [[RFC2616](#)]. The

CMP payload sent by a client is relatively small, so having extra messages exchanged is more inefficient as the server will anyway only seldomly reject a message without evaluating the body.

Content codings MAY be applied.

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4. Compatibility Issues with Legacy Implementations

As this document was subject of multiple changes during the long period of time it was created in, implementations using a different approach for HTTP transport may exist. While only those implementations according to this specification are compliant, implementers should to be aware that there might be existing ones which behave differently.

Legacy implementations might also use an unregistered "application/pkixcmp-poll" MIME type as it was specified in earlier drafts of this document. Here, the entity-body of an HTTP POST request contains the DER-encoded PKIMessage prefixed by an additional "TCP-Messaging" protocol. TCP-Messaging was described in draft versions of this document but was removed.

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5. Security Considerations

The following aspects need to be considered by server side implementers:

1. There is the risk for denial of service attacks through resource consumption by opening many connections. Therefore idle connections should be terminated after an appropriate timeout, maybe also depending on the available free resources. After sending a CMP Error Message, the server should close the connection even if the CMP transaction is not yet fully completed.
2. There is no security at the HTTP protocol level (unless tunneled via TLS) and thus information from the HTTP protocol SHOULD NOT be used to change state of the transaction. Change of state SHOULD be triggered by signed PKIMessages only. Likewise, the clients SHOULD NOT support the 301 HTTP status code which could otherwise be used by an man-in-the-middle attacker to barr them permanently from contacting the correct server.

6. Information Security Considerations

CMP provides inbuilt integrity protection and authentication. Due to the nature of a PKI, from a security perspective the information communicated unencrypted does not contain sensitive information.

However, it might be possible for an interceptor to utilize the available information to gather confidential technical or business critical information. Therefore users of the HTTP CMP transport might want to use HTTP over TLS according to [\[RFC2818\]](#) or should consider to use virtual private networks created e.g. by utilizing Internet Protocol Security according to [\[RFC4301\]](#).

7. IANA Considerations

The IANA has already registered TCP and UDP port 829 for "PKIX-3 CA/RA" and the MIME media type "application/pkixcmp" for identifying CMP sequences.

No further action by the IANA is necessary for this document or any anticipated updates.

8. References

8.1. Normative References

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Appendix A. Acknowledgments

Until the fifth draft version of this document, released in November 24th 2000, the sole authors were Amit Kapoor and Ronald Tschlaer from

Certicom. Up to this point the now removed TCP-Based transport was described in detail. They are not available for this working on this

document anymore at the time it is entering the "Authors Final Review

state AUTH48". As they therefore cannot approve this document as it would be necessary, their names were moved to this section. Their contact data, as originally stated by them, is as follows:

Amit Kapoor
Certicom
25801 Industrial Blvd
Hayward, CA
US
Email: amit@trustpoint.com

Ronald Tschalaer
Certicom
25801 Industrial Blvd
Hayward, CA
US
Email: ronald@trustpoint.com

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Tomas Gustavsson, Primekey
Peter Gutmann, University of Auckland
Wolf-Dietrich Moeller, Nokia Siemens Networks

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[Appendix B](#). Registration of the application/pkixcmp Media Type

To: ietf-types@iana.org
Subject: Registration of MIME media type application/pkixcmp

MIME media type name: application

MIME subtype name: pkixcmp

Required parameters: -

Optional parameters: -

Encoding considerations:

Content may contain arbitrary octet values (the ASN.1 DER encoding of a PKIMessage sequence, as defined in the IETF PKIX Working Group specifications). base64 encoding is required for MIME e-mail; no encoding is necessary for HTTP.

Security considerations:

This MIME type may be used to transport Public-Key Infrastructure (PKI) messages between PKI entities. These messages are defined by the IETF PKIX Working Group and are used to establish and maintain an Internet X.509 PKI. There is no requirement for specific security mechanisms to be applied at this level if the PKI messages themselves are protected as defined in the PKIX specifications.

Interoperability considerations: -

Published specification: this document

Applications which use this media type: Applications using certificate management, operational, or ancillary protocols (as defined by the IETF PKIX Working Group) to send PKI messages via E-Mail or HTTP.

Additional information:

Magic number (s): -
File extension (s): ".PKI"
Macintosh File Type Code (s): -

Person and email address to contact for further information:
Martin Peylo, martin.peylo@nsn.com

Intended usage: COMMON

Author/Change controller: Martin Peylo

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Authors' Addresses

Tomi Kause
Tectia Corporation
Fredrikinkatu 42
Helsinki 00100
Finland

Email: toka@tectia.com

Martin Peylo
Nokia Siemens Networks
Linnoitustie 6
Espoo 02600
Finland

Email: martin.peylo@nsn.com

