HTTP Transport Authentication
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Abstract

The most common existing authentication mechanisms for HTTP are sent with each HTTP request, and authenticate that request instead of the underlying HTTP connection, or transport. While these mechanisms work well for existing uses of HTTP, they are not suitable for emerging applications that multiplex non-HTTP traffic inside an HTTP connection. This document describes the HTTP Transport Authentication Framework, a method of authenticating not only an HTTP request, but also its underlying transport.

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1. Introduction

The most common existing authentication mechanisms for HTTP are sent
with each HTTP request, and authenticate that request instead of the
underlying HTTP connection, or transport. While these mechanisms
work well for existing uses of HTTP, they are not suitable for
emerging applications that multiplex non-HTTP traffic inside an HTTP
connection. This document describes the HTTP Transport
Authentication Framework, a method of authenticating not only an HTTP
request, but also its underlying transport.

Traditional HTTP semantics specify that HTTP is a stateless protocol
where each request can be understood in isolation [RFC7230].
However, the emergence of QUIC [I-D.ietf-quic-transport] as a new
transport protocol that can carry HTTP [I-D.ietf-quic-http] and the
existence of QUIC extensions such as the DATAGRAM frame
[I-D.pauly-quic-datagram] enable new uses of HTTP such as
[I-D.vvv-webtransport-http3] and [I-D.schinazi-masque] where some
traffic is exchanged that is distinct from HTTP requests and
responses. In order to authenticate this traffic, it is necessary to authenticate the underlying transport (e.g., QUIC or TLS [RFC8446]) instead of authenticate each request individually. This mechanism aims to supplement the HTTP Authentication Framework [RFC7235], not replace it.

Note that there is currently no mechanism for origin servers to request that user agents authenticate themselves using Transport Authentication, this is left as future work.

1.1. Conventions and Definitions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

This document uses the Augmented BNF defined in [RFC5234] and updated by [RFC7405] along with the "#rule" extension defined in Section 7 of [RFC7230]. The rules below are defined in [RFC3061], [RFC5234], [RFC7230], and [RFC7235]:

\[
\begin{align*}
\text{OWS} & = \text{<OWS, see {{RFC7230}}, Section 3.2.3>}
\text{quoted-string} & = \text{<quoted-string, see {{RFC7230}}, Section 3.2.6>}
\text{token} & = \text{<token, see {{RFC7230}}, Section 3.2.6>}
\text{token68} & = \text{<token, see {{RFC7235}}, Section 2.1>}
\text{oid} & = \text{<oid, see {{RFC3061}}, Section 2>}
\end{align*}
\]

2. Computing the Authentication Proof

This document only defines Transport Authentication for uses of HTTP with TLS. This includes any use of HTTP over TLS as typically used for HTTP/2, or HTTP/3 where the transport protocol uses TLS as its authentication and key exchange mechanism [I-D.ietf-quic-tls].

The user agent leverages a TLS keying material exporter [RFC5705] to generate a nonce which can be signed using the user-id’s key. The keying material exporter uses a label that starts with the characters "EXPORTER-HTTP-Transport-Authentication-" (see Section 4 for the labels and contexts used by each scheme). The TLS keying material exporter is used to generate a 32-byte key which is then used as a nonce.
3. Header Field Definition

The "Transport-Authentication" header allows a user agent to authenticate its transport connection with an origin server.

\[
\text{Transport-Authentication} = \text{transp-auth-scheme} *( \text{OWS }";" \text{ OWS parameter} )
\]

\[
\text{transp-auth-scheme} = \text{token}
\]

\[
\text{parameter} = \text{token }"=\text{" ( text / quoted-string )}
\]

3.1. The u Directive

The OPTIONAL "u" (user-id) directive specifies the user-id that the user agent wishes to authenticate. It is encoded using Base64 (Section 4 of [RFC4648]).

\[
u = \text{token68}
\]

3.2. The p Directive

The OPTIONAL "p" (proof) directive specifies the proof that the user agent provides to attest to possessing the credential that matches its user-id. It is encoded using Base64 (Section 4 of [RFC4648]).

\[
p = \text{token68}
\]

3.3. The a Directive

The OPTIONAL "a" (algorithm) directive specifies the algorithm used to compute the proof transmitted in the "p" directive.

\[
a = \text{oid}
\]

4. Transport Authentication Schemes

The Transport Authentication Framework allows defining Transport Authentication Schemes, which specify how to authenticate user-ids. This documents defined the "Signature" and "HMAC" schemes.

4.1. Signature

The "Signature" Transport Authentication Scheme uses asymmetric cryptography. User agents possess a user-id and a public/private key pair, and origin servers maintain a mapping of authorized user-ids to their associated public keys. When using this scheme, the "u", "p", and "a" directives are REQUIRED. The TLS keying material export label for this scheme is "EXPORTER-HTTP-Transport-Authentication-Signature" and the associated context is empty. The nonce is then
signed using the selected asymmetric signature algorithm and
transmitted as the proof directive.

For example, the user-id "john.doe" authenticating using Ed25519
[RFC8410] could produce the following header (lines are folded to fit):

Transport-Authentication: Signature u="am9obi5kb2U=";a=1.3.101.112;
p="SW5zZXJ0IHNpZ25hdHVyZSBvZiBub25jZSB0aWNoIHRha2VzIDUxMiBiaXRzIGZvcnIBZDI1NTE5IQ=="

4.2. HMAC

The "HMAC" Transport Authentication Scheme uses symmetric
cryptography. User agents possess a user-id and a secret key, and
origin servers maintain a mapping of authorized user-ids to their
associated secret key. When using this scheme, the "u", "p", and "a"
directives are REQUIRED. The TLS keying material export label for
this scheme is "EXPORTER-HTTP-Transport-Authentication-HMAC" and the
associated context is empty. The nonce is then HMACed using the
selected HMAC algorithm and transmitted as the proof directive.

For example, the user-id "john.doe" authenticating using HMAC-SHA-512
[RFC6234] could produce the following header (lines are folded to fit):

Transport-Authentication: HMAC u="am9obi5kb2U=";a=2.16.840.1.101.3.4.2.3;
p="SW5zZXJ0IEdHNQUWhmb2Ygbm9uY2UgaGVyZSB3aGljaCB0YWtlcyA1MTIgYml0cyBmb3IgU0hBLTUxMiEhISEhIQ=="

5. Proxy Considerations

Since Transport Authentication authenticates the underlying transport
by leveraging TLS keying material exporters, it cannot be
transparently forwarded by proxies that terminate TLS. However it
can be sent over proxied connections when TLS is performed end-to-end
(e.g., when using HTTP CONNECT proxies).

6. Security Considerations

Transport Authentication allows a user-agent to authenticate to an
origin server while guaranteeing freshness and without the need for
the server to transmit a nonce to the user agent. This allows the
server to accept authenticated clients without revealing that it
supports or expects authentication for some resources. It also
allows authentication without the user agent leaking the presence of
authentication to observers due to clear-text TLS Client Hello
extensions.
7. IANA Considerations

7.1. Transport-Authentication Header Field

This document, if approved, requests IANA to register the "Transport-Authentication" header in the "Permanent Message Header Field Names" registry maintained at https://www.iana.org/assignments/message-headers/ [1].

+--------------------------+----------+--------------+---------------+
|    Header Field Name     | Protocol |    Status    |   Reference   |
+--------------------------+----------+--------------+---------------+
| Transport-Authentication |   http   | experimental | This document |
+--------------------------+----------+--------------+---------------+

7.2. Transport Authentication Schemes Registry

This document, if approved, requests IANA to create a new HTTP Transport Authentication Schemes Registry with the following entries:

+---------------------------------+---------------+
| Transport Authentication Scheme |   Reference   |
+---------------------------------+---------------+
|            Signature            | This document |
+---------------------------------+---------------+
|              HMAC               | This document |
+---------------------------------+---------------+

7.3. TLS Keying Material Exporter Labels

This document, if approved, requests IANA to register the following entries in the "TLS Exporter Labels" registry maintained at https://www.iana.org/assignments/tls-parameters/tls-parameters.xhtml#exporter-labels [2]

+--------------------------------------------------+
|                       Value                      |
+--------------------------------------------------+
| EXPORTER-HTTP-Transport-Authentication-Signature |
+--------------------------------------------------+
| EXPORTER-HTTP-Transport-Authentication-HMAC       |
+--------------------------------------------------+

Both of these entries are listed with the following qualifiers:
8. References

8.1. Normative References


8.2. Informative References

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8.3. URIs

[1] https://www.iana.org/assignments/message-headers/


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