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The "Payment" HTTP Authentication Scheme

Abstract

This document defines the "Payment" HTTP authentication scheme, enabling HTTP resources to require a payment challenge to be fulfilled before access. The scheme extends HTTP Authentication, using the HTTP 402 "Payment Required" status code.

The protocol is payment-method agnostic, supporting any payment network or currency through registered payment method identifiers. Specific payment methods are defined in separate payment method specifications.

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1. Introduction

HTTP 402 "Payment Required" was reserved in HTTP/one-point-one [RFC9110] but never standardized for common use. This specification defines the "Payment" authentication scheme that gives 402 its semantics, enabling resources to require a payment challenge to be fulfilled before access.

1.1. Relationship to Payment Method Specifications

This specification defines the abstract protocol framework. Concrete payment methods are defined in payment method specifications that:

- Register a payment method identifier
- Define the `request` schema for that method
- Define the `payload` schema for that method
- Specify verification and settlement procedures

2. Requirements Language

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.

3. Terminology

Payment Challenge
: A `WWW-Authenticate` header with scheme "Payment" indicating the payment requirements for accessing a resource.

Payment Credential
: An HTTP header field with scheme "Payment" containing payment authorization data. The default field name is `Authorization`. A Payment challenge **MAY** select `Payment-Authorization` with the `header` parameter (see Section 5.2).

Payment Method
: A mechanism for transferring value, identified by a registered identifier.

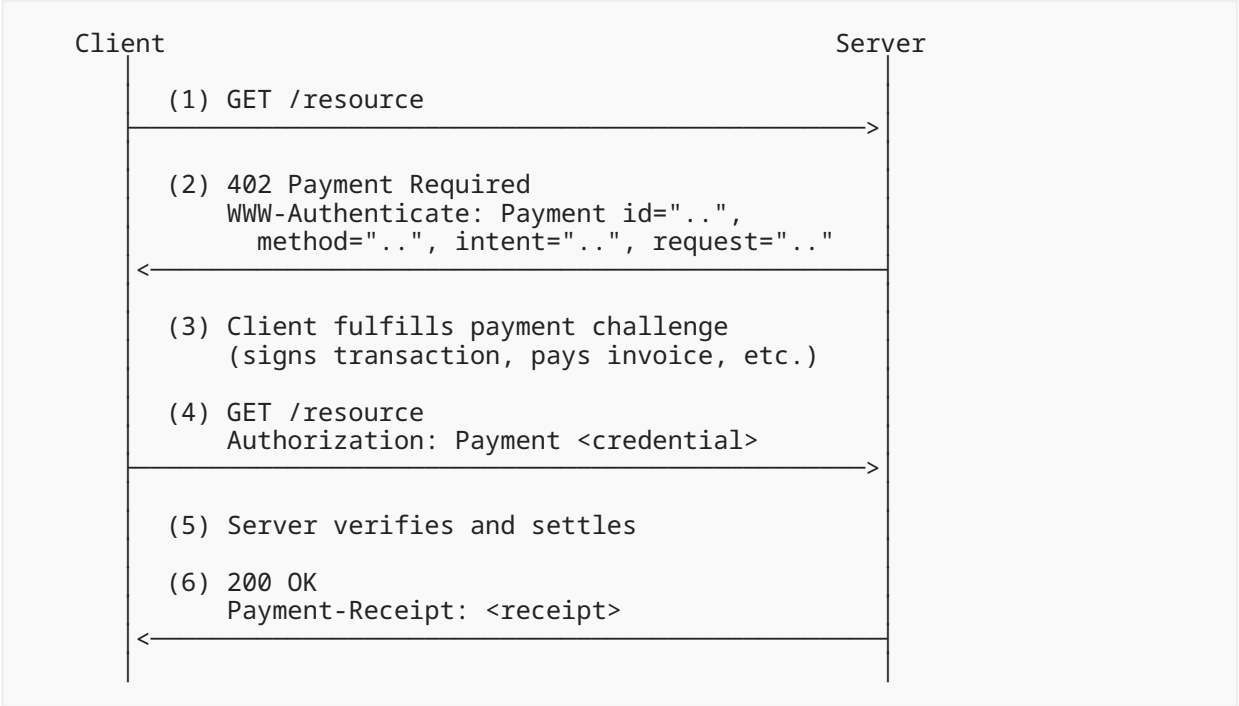
Payment Intent
: The type of payment request, identified by a registered value in the IANA "HTTP Payment Intents" registry. Intents are defined by separate intent specifications.

Request
: Method-specific data in the challenge enabling payment completion. Encoded as base64url JSON in the `request` parameter.

Payload
: Method-specific data in the credential proving payment.

4. Protocol Overview

4.1. Request Flow



Step (4) uses the default `Authorization` header because the challenge did not include a specific header field.

4.2. Status Codes

The following table defines how servers **MUST** respond to payment-related conditions.

Condition	Status	Response
Resource requires payment, no credential provided	402	Fresh challenge in `WWW-Authenticate`
Malformed credential (invalid base64url, bad JSON)	402	Fresh challenge + `malformed-credential` problem
Unknown or already-used challenge `id`	402	Fresh challenge + `invalid-challenge` problem
Expired challenge `id`	402	Fresh challenge + `payment-expired` problem

Condition	Status	Response
Payment proof invalid or verification failed	402	Fresh challenge + `verification-failed` problem
Payment verified, access granted	200	Resource + optional `Payment-Receipt`
Payment verified, but policy denies access	403	No challenge (payment was valid)

Table 1

Servers **MUST** return 402 with a `WWW-Authenticate: Payment` header when payment is required or when a payment credential fails validation (see Section 4.4 for details).

Error details are provided in the response body using Problem Details [RFC9457] rather than in the `WWW-Authenticate` header parameters.

4.3. Relationship to 401 Unauthorized

This specification uses 402 (Payment Required) consistently for all payment-related challenges, including failed credential validation. This diverges from the traditional 401 pattern used by other HTTP authentication schemes. The distinction is intentional:

- **402** indicates a payment barrier (initial challenge or retry needed)
- **401** is reserved for authentication failures unrelated to payment
- **403** indicates the payment succeeded but access is denied by policy

This design ensures clients can distinguish payment requirements from other authentication schemes that use 401.

4.4. Usage of 402 Payment Required

4.4.1. When to Return 402

Servers **SHOULD** return 402 when:

- The resource requires payment as a precondition for access
- The server can provide a Payment challenge that the client may fulfill
- Payment is the primary barrier to access (not authentication or authorization)

Servers **MAY** return 402 when:

- Offering optional paid features or premium content
- Indicating that a previously-paid resource requires additional payment
- The payment requirement applies to a subset of request methods

4.4.2. When NOT to Return 402

Servers **SHOULD NOT** return 402 when:

- The client lacks authentication credentials (use 401)
- The client is authenticated but lacks authorization (use 403)
- The resource does not exist (use 404)
- No Payment challenge can be constructed for the request

Servers **MUST NOT** return 402 without including a `WWW-Authenticate` header containing at least one Payment challenge.

4.4.3. Interaction with Other Authentication Schemes

When a resource requires both authentication and payment, servers **SHOULD**:

1. First verify authentication credentials
2. Return 401 if authentication fails
3. Return 402 with a Payment challenge only after successful authentication

This ordering prevents information leakage about payment requirements to unauthenticated clients.

When authentication succeeds but the resource also requires payment, the server **MAY** include the `header` parameter in its Payment challenge to select `Payment-Authorization` instead of the default `Authorization` for the Payment credential (see Section 5.2). A challenge that omits `header` defaults to `Authorization`. A challenge that includes `header="Payment-Authorization"` requires the client to send the Payment credential in the `Payment-Authorization` header. This allows the client to retain its ordinary authentication credential in `Authorization`.

For example, the server can issue:

```
HTTP/1.1 402 Payment Required
WWW-Authenticate: Payment id="x7Tg2pLqR9mKvNwY3hBcZa",
    realm="api.example.com",
    method="example",
    intent="charge",
    header="Payment-Authorization",

request="eyJhbW91bnQiOiIxMDAwIiwiY3VycmVuY3kiOiJVU0QiLCJyZWNpcGllbnQiOiJhY2N0
XzEyMyJ9"
```

The subsequent request can then carry both a Bearer credential and a Payment credential:

```
GET /resource HTTP/1.1
Host: api.example.com
Authorization: Bearer mF_9.B5f-4.1JqM
Payment-Authorization: Payment eyJjaGFsbGVuZ2UiOiJ...
```

5. The Payment Authentication Scheme

5.1. Challenge (WWW-Authenticate)

The Payment challenge is sent in the `WWW-Authenticate` header per [RFC9110]. The challenge uses the auth-param syntax defined in Section 11 of [RFC9110]:

```
challenge       = "Payment" [ 1*SP auth-params ]
auth-params     = auth-param *( OWS "," OWS auth-param )
auth-param      = token BWS "=" BWS ( token / quoted-string )
```

5.1.1. Required Parameters

`id`: Unique challenge identifier. This parameter is **REQUIRED** and its value **MUST** be non-empty after `auth-param` parsing and `quoted-string` unescaping. Servers **MUST NOT** emit a Payment challenge with a missing or empty `id`; clients and parsers **MUST** reject challenges whose `id` is missing or empty. Servers **MUST** bind this value to the challenge parameters as described in Section 5.1.2.1. Clients **MUST** include this value unchanged in the credential.

`realm`: Protection space identifier per [RFC9110]. Servers **MUST** include this parameter to define the scope of the payment requirement.

`method`: Payment method identifier (Section 6). **MUST** be a lowercase ASCII string.

`intent`: Payment intent type (Section 7). The value **MUST** be a registered entry in the IANA "HTTP Payment Intents" registry.

`request`: Base64url-encoded [RFC4648] JSON [RFC8259] containing payment-method-specific data needed to complete payment. Structure is defined by the payment method specification. Padding characters ("=") **MUST NOT** be included. The JSON **MUST** be serialized using JSON Canonicalization Scheme (JCS) [RFC8785] to ensure deterministic encoding across implementations. This is critical for challenge binding (Section 5.1.2.1): since the HMAC input includes the base64url-encoded request as it appears on the wire, different JSON serialization orders would produce different HMAC values, breaking cross-implementation interoperability.

5.1.2. Optional Parameters

`digest`: Content digest of the request body, formatted per [RFC9530]. Servers **SHOULD** include this parameter when the payment challenge applies to a request with a body (e.g., POST, PUT, PATCH). When present, clients **MUST** submit the credential with a request body whose digest matches this value. See Section 5.1.3 for body binding requirements.

`expires`: Timestamp indicating when this challenge expires, formatted as an [RFC3339] date-time string (e.g., `"2025-01-15T12:00:00Z"`). Servers **SHOULD** include this parameter. Clients **MUST NOT** submit credentials for expired challenges.

`description`: Human-readable description of the resource or payment purpose. This parameter is for display purposes only and **MUST NOT** be relied upon for payment verification (see Section 11.6).

`header`: Selects the HTTP field for the Payment credential, as specified in Section 5.2. When present, the value **MUST** be `Payment-Authorization` to avoid collision with other HTTP fields. The default field is `Authorization`. A challenge that omits this parameter selects that default: the client **MUST** send the credential in the `Authorization` header. A challenge that includes this parameter selects `Payment-Authorization`; the client **MUST** send the credential in that field. Clients **MUST NOT** send the credential in a different field than the one selected by the challenge. Clients that do not support `Payment-Authorization` **MUST NOT** send a Payment credential for that challenge. Servers **MUST** include this parameter in the challenge binding when it is present. Clients **MUST** echo it unchanged in the credential's `challenge` object. `Payment-Authorization` is **RECOMMENDED** when a resource needs to preserve `Authorization` for ordinary authentication.

`opaque`: Base64url-encoded [RFC4648] JSON [RFC8259] containing server-defined correlation data (e.g., a payment processor intent identifier). The value **MUST** be a JSON object whose values are strings (a flat string-to-string map). Clients **MUST** return this parameter unchanged in the credential and **MUST NOT** modify it. The JSON **MUST** be serialized using JSON Canonicalization Scheme (JCS) [RFC8785] before base64url encoding. Servers **MUST** include `opaque` in the challenge binding (Section 5.1.2.1) to ensure tamper protection.

Unknown parameters **MUST** be ignored by clients.

5.1.2.1. Challenge Binding

Servers **MUST** bind the challenge `id` to `realm`, `method`, `intent`, and `request`, and to `expires`, `digest`, `opaque`, and `header` when present. This prevents request integrity attacks where a client signs or submits a payment different from what the server intended. The `description` parameter is excluded because it is not used for payment verification.

Servers **MUST** verify the binding when processing a credential and **MUST** reject a credential whose echoed challenge parameters do not match the expected binding.

The binding mechanism is implementation-defined. Servers **MAY** use stateful storage (e.g., database lookup) or stateless verification (e.g., HMAC, authenticated encryption) to validate the binding.

5.1.2.1.1. Recommended: HMAC-SHA256 Binding

Servers using HMAC-SHA256 for stateless challenge binding **SHOULD** compute the challenge `id` as follows:

The HMAC input consists of six fixed prefix slots, an optional `header` slot, and a final `opaque` slot. Required fields supply their string value; optional fields use an empty string (`""`) when absent. The `header` slot is omitted when `header` is absent. When `header` is present, its slot is inserted immediately before `opaque`. Thus the two layouts are:

```
realm|method|intent|request|expires|digest|opaque
realm|method|intent|request|expires|digest|header|opaque
```

This preserves the HMAC input for challenges that predate `header`. The slots are:

Slot	Field	Value
0	`realm`	Required. String value.
1	`method`	Required. String value.
2	`intent`	Required. String value.
3	`request`	Required. JCS-serialized per [RFC8785], then base64url-encoded.
4	`expires`	Optional. String value if present; empty string if absent.
5	`digest`	Optional. String value if present; empty string if absent.
6	`header`	Present only when the `header` parameter is present. The value `Payment-Authorization`.
last	`opaque`	Optional. JCS-serialized per [RFC8785], then base64url-encoded if present; empty string if absent.

Table 2

The computation proceeds as follows:

1. Populate the six prefix slots as described above. If `header` is present, append its value. Append the `opaque` value last, using an empty string when it is absent.
2. Join the populated slots with the pipe character (`|`) as delimiter. Every slot other than `header` is always present in the joined string; absent optional fields appear as empty segments (e.g., `...|expires||opaque_b64url` when `digest` is absent and `header` is omitted). The `header` slot is omitted entirely when the parameter is absent.
3. Compute HMAC-SHA256 over the resulting string using a server secret.
4. Encode the HMAC output as base64url without padding ([RFC4648] Section 5).

```
values = [
    realm,
    method,
    intent,
    request_b64url,
    expires or "",
    digest or "",
]
if header is present:
    values.append(header)
values.append(opaque_b64url or "")
input = "|".join(values)
id = base64url(HMAC-SHA256(server_secret, input))
```

The base optional fields use fixed positional slots with empty strings when absent, rather than being omitted. This avoids ambiguity between combinations of optional fields — for example, `(expires set, no digest)` and `(no expires, digest set)` produce distinct inputs. Clients echo the challenge `id` and bound fields; they do not know the server secret and do not recompute this HMAC. A deterministic construction nevertheless allows different server components and implementations to issue and verify the same challenge.

5.1.2.1.1.1. HMAC-SHA256 Test Vectors

The following vectors use the UTF-8 server secret `test-vector-secret` and this request object:

```
{"amount":"1000000"}
```

Its JCS serialization has the base64url encoding `eyJhbW91bnQiOiIxMDAwMDAwIn0`. All vectors omit `expires` and `digest`.

In the following inputs, adjacent quoted strings are concatenated without whitespace. The legacy layout, with neither `header` nor `opaque`, is:

```
input = "api.example.com|tempo|charge|"
        "eyJhbW91bnQiOiIxMDAwMDAwIn0|||"
```

Its challenge `id` is:

```
X6v1eo7fJ76gAxqY0xN9Jd__4lUyDDYmriryOM-5FO4
```

With `header="Payment-Authorization"` and no `opaque`, the input is:

```
input = "api.example.com|tempo|charge|"
        "eyJhbW91bnQiOiIxMDAwMDAwIn0|||"
        "Payment-Authorization|"
```

Its challenge `id` is:

```
S91xi-OFGZPMs-j7GsX0FDpIkmCcZT1P9XyV58WNy_U
```

Finally, with `header="Payment-Authorization"` and the following opaque object:

```
{"pi":"pi_123"}
```

the base64url-encoded `opaque` value is `eyJwaSI6InBpXzEyMyJ9`, and the input is:

```
input = "api.example.com|tempo|charge|"
        "eyJhbW91bnQiOiIxMDAwMDAwIn0|||"
        "Payment-Authorization|eyJwaSI6InBpXzEyMyJ9"
```

Its challenge `id` is:

```
CJ4X1O4aTDmS59hfdhnhBtxIQjWDOf0bcrhsswwMOW8
```

5.1.2.2. Example Challenge

This challenge omits `header` and therefore selects the default credential field `Authorization` (see Section 5.2).

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
WWW-Authenticate: Payment id="x7Tg2pLqR9mKvNwY3hBcZa",
    realm="api.example.com",
    method="example",
    intent="charge",
    expires="2025-01-15T12:05:00Z",

request="eyJhbW91bnQiOiIxMDAwIiwiY3VycmVuY3kiOiJVU0QiLCJyZWNpcGllbnQiOiJhY2N0
XzEyMyJ9"
```

Decoded `request` example:

```
{
  "amount": "1000",
  "currency": "usd",
  "recipient": "acct_123"
}
```

5.1.2.3. Example Challenge Selecting an Alternate Header

This challenge includes `header="Payment-Authorization"`. The client **MUST** send the corresponding Payment credential in the `Payment-Authorization` header, not in `Authorization`.

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
WWW-Authenticate: Payment id="x7Tg2pLqR9mKvNwY3hBcZa",
    realm="api.example.com",
    method="example",
    intent="charge",
    header="Payment-Authorization",
    expires="2025-01-15T12:05:00Z",

request="eyJhbW91bnQiOiIxMDAwIiwiY3VycmVuY3kiOiJVU0QiLCJyZWNpcGllbnQiOiJhY2N0
XzEyMyJ9"
```

5.1.3. Request Body Digest Binding

Servers **SHOULD** include the `digest` parameter when issuing challenges for requests with bodies. The digest value is computed per [RFC9530]:

```
WWW-Authenticate: Payment id="...",
    realm="api.example.com",
    method="example",
    intent="charge",
    digest="sha-256=:X48E9qOokqqrvdts8nOJRJN3OWDUoyWxBf7kbu9DBPE=:",
    expires="2025-01-15T12:05:00Z",
    request="..."
```

When verifying a credential with a `digest` parameter, servers **MUST**:

1. Compute the digest of the current request body per [RFC9530]
2. Compare it with the `digest` value from the challenge
3. Reject the credential if the digests do not match

5.2. Credentials

The default HTTP field for the Payment credential is `Authorization`.

A challenge that omits the `header` parameter selects this default. Clients receiving such a challenge **MUST** send the Payment credential in the `Authorization` header.

A challenge that includes the `header` parameter selects `Payment-Authorization` instead of the default. The value **MUST** be `Payment-Authorization`; this specification does not allow any other field name, to avoid collision with other HTTP fields. Servers **MUST NOT** emit a `header` parameter with any other value. Clients receiving such a challenge **MUST** send the Payment credential in the

`Payment-Authorization` header. Clients **MUST NOT** send the credential in a different field than the one selected by the challenge. Clients **MUST** treat any other `header` value as an unrecognized challenge and **MUST NOT** send a Payment credential for it.

Servers **MUST** accept a Payment credential for a given challenge only from the field selected by that challenge. A Payment credential received in any other field **MUST NOT** satisfy the challenge.

The field value uses base64url encoding without padding per [RFC4648] Section 5:

```
credentials     = "Payment" 1*SP base64url-nopad
base64url-nopad = 1*( ALPHA / DIGIT / "-" / "_" )
```

The base64url-nopad value is a base64url-encoded JSON object (without padding) containing:

Field	Type	Required	Description
`challenge`	object	Yes	Echoed challenge parameters
`source`	string	No	Payer identifier (**RECOMMENDED**: DID format per [W3C-DID])
`payload`	object	Yes	Method-specific payment proof

Table 3

The `challenge` object contains the parameters from the original challenge:

Field	Type	Description
`id`	string	Challenge identifier
`realm`	string	Protection space
`method`	string	Payment method identifier
`intent`	string	Payment intent type
`request`	string	Base64url-encoded payment request
`description`	string	Human-readable payment purpose (if present in challenge)
`opaque`	string	Base64url-encoded server correlation data (if present in challenge)
`digest`	string	Content digest
`expires`	string	Challenge expiration timestamp

Field	Type	Description
`header`	string	`Payment-Authorization` when the challenge selected that field (included only when the challenge contained `header`)

Table 4

The `payload` field contains the payment-method-specific data needed to complete the payment challenge. Payment method specifications define the exact structure.

When the original challenge omitted `header`, clients **MUST NOT** include a `header` field in the credential's `challenge` object.

5.2.1. Example Credential

This credential corresponds to a challenge that omitted `header`, so it is sent in the default `Authorization` field:

```
GET /api/data HTTP/1.1
Host: api.example.com
Authorization: Payment
eyJjaGFsbGVuZ2UiOnsiaWQiOiJ4N1RnMnBMcVI5bUt2TndZM2hCY1phIiwicmVhbG0iOiJhcGkuZ
XhhbXBsZS5jb20iLCJtZXRob2QiOiJleGFtcGxlIiwiaW50ZW50IjoiY2hhcmdlIiwicmVxdWVzdC
I6ImV5SmhiVzkxYm5RaU9pSXhNREF3SWl3aVkzVnljbVZ1WTNraU9pSlZVMFFpTENKeVpXTnBjR2x
sYm5RaU9pSmhZMk4wWHpFeU15SjkiLCJleHBpcmVzIjoiMjAyNS0wMS0xNVQxMjowNTowMFoifSwi
cGF5bG9hZCI6eyJwcm9vZiI6IjB4YWJjMTIzLi4uIn19
```

Decoded credential:

```
{
  "challenge": {
    "id": "x7Tg2pLqR9mKvNwY3hBcZa",
    "realm": "api.example.com",
    "method": "example",
    "intent": "charge",
    "request":
"eyJhbW91bnQiOiIxMDAwIiwiY3VycmVuY3kiOiJVU0QiLCJyZWNpcGllbnQiOiJhY2N0XzEyMyJ9
",
    "expires": "2025-01-15T12:05:00Z"
  },
  "payload": {
    "proof": "0xabc123..."
  }
}
```

5.2.2. Example Credential with Alternate Header

This credential corresponds to a challenge that included `header="Payment-Authorization"`. The client **MUST** send it in `Payment-Authorization`, and **MUST** echo `header` in the credential's `challenge` object:

```
GET /api/data HTTP/1.1
Host: api.example.com
Authorization: Bearer mF_9.B5f-4.1JqM
Payment-Authorization: Payment
eyJjaGFsbGVuZ2UiOnsiaWQiOiJ4N1RnMnBMcVI5bUt2TndZM2hCY1phIiwicmVhbG0iOiJhcGkuZ
XhhbXBsZS5jb20iLCJtZXRob2QiOiJleGFtcGxlIiwiaW50ZW50IjoiY2hhcmdlIiwicmVxdWVzdC
I6ImV5SmhiVzkxYm5RaU9pSXhNREF3SWl3aVkzVnljbVZ1WTNraU9pSlZVMFFpTENKeVpXTnBjR2x
sYm5RaU9pSmhZMk4wWHpFeU15SjkiLCJoZWFkZXIiOiJQYXltZW50LUF1dGhvcml6YXRpb24iLCJl
eHBpcmVzIjoiMjAyNS0wMS0xNVQxMjowNTowMFoifSwicGF5bG9hZCI6eyJwcm9vZiI6IjB4YWJjM
TIzLi4uIn19
```

Decoded credential:

```
{
  "challenge": {
    "id": "x7Tg2pLqR9mKvNwY3hBcZa",
    "realm": "api.example.com",
    "method": "example",
    "intent": "charge",
    "request":
"eyJhbW91bnQiOiIxMDAwIiwiY3VycmVuY3kiOiJVU0QiLCJyZWNpcGllbnQiOiJhY2N0XzEyMyJ9
",
    "header": "Payment-Authorization",
    "expires": "2025-01-15T12:05:00Z"
  },
  "payload": {
    "proof": "0xabc123..."
  }
}
```

5.3. Payment-Receipt Header

Servers **SHOULD** include a `Payment-Receipt` header on successful responses:

```
Payment-Receipt = base64url-nopad
```

The decoded JSON object contains:

Field	Type	Description
`status`	string	`"success"` — receipts are only issued on successful payment
`method`	string	Payment method used
`timestamp`	string	[RFC3339] settlement timestamp
`reference`	string	Method-specific reference (tx hash, invoice id, etc.)

Table 5

Payment method specifications **MAY** define additional fields for receipts.

5.3.1. Receipt Status Semantics

The `status` field **MUST** be `"success"`, indicating the payment was verified and settled successfully. Receipts are only issued on successful payment responses (2xx status codes).

Servers **MUST NOT** return a `Payment-Receipt` header on error responses. Payment failures are communicated via HTTP status codes and Problem Details [RFC9457]. Servers **MUST** return 402 with a fresh challenge and appropriate problem type when payment verification fails.

6. Payment Methods

6.1. Method Identifier Format

Payment methods are identified by lowercase ASCII letters:

```
payment-method-id = 1*LOWERALPHA
```

Method identifiers are case-sensitive and **MUST** be lowercase.

6.2. Method Registry

Payment methods are registered in the HTTP Payment Methods registry (Section 12.3). Each registered method has an associated specification that defines the `request` and `payload` schemas.

7. Payment Intents

Payment intents describe the type of payment being requested.

7.1. Intent Identifiers

```
intent = 1*( ALPHA / DIGIT / "-" )
```

7.2. Intent Specifications

Payment intents are defined in separate intent specifications that:

- Define the semantic meaning of the intent
- Specify required and optional `request` fields
- Specify `payload` requirements
- Define verification and settlement semantics
- Register the intent in the Payment Intent Registry (Section 12.4)

See the Payment Intent Registry for registered intents.

7.3. Intent Negotiation

If a server supports multiple intents, it **MAY** issue multiple challenges:

```
WWW-Authenticate: Payment id="abc", realm="api.example.com",
method="example", intent="charge", request="..."
WWW-Authenticate: Payment id="def", realm="api.example.com",
method="example", intent="authorize", request="..."
```

Clients choose which challenge to respond to. Clients that do not recognize an intent **SHOULD** treat the challenge as unsupported.

7.4. Client Payment Preferences

Clients **MAY** send an `Accept-Payment` request header to declare which payment method and intent combinations they support.

The header uses the same weighted-preference model as other HTTP negotiation fields: omitted `q` values are equivalent to `q=1`, and `q=0` means "do not use".

```
Accept-Payment = #payment-range
payment-range  = payment-token [ weight ]
payment-token  = payment-method-or-wildcard "/" intent-or-wildcard
payment-method-or-wildcard = payment-method-id / "*"
intent-or-wildcard         = intent-token / "*"
```

Examples:

```
Accept-Payment: tempo/charge, tempo/session, stripe/charge;q=0.5, solana/
charge;q=0.3
Accept-Payment: tempo/*, solana/*;q=0.6, */session;q=0.3
Accept-Payment: tempo/charge, tempo/session;q=0, solana/charge
```

When `Accept-Payment` is present, servers **SHOULD** consider it when choosing which Payment challenges to return.

Specifically, servers **SHOULD**:

- Filter challenges to those matching at least one declared range with `q>0`
- Order matching challenges by descending client `q` value
- Preserve server preference order when multiple matches have the same `q`
- Prefer the most specific matching range when multiple ranges match the same challenge

If `Accept-Payment` is absent, servers **MUST** behave as though the client accepts any method and intent combination.

If `Accept-Payment` is malformed, servers **MAY** ignore it.

If `Accept-Payment` is present but no available challenge matches a declared range with `q>0`, servers **MAY** ignore the header and return their normal set of challenges.

The `WWW-Authenticate: Payment` challenge remains authoritative even when `Accept-Payment` is used. Clients **MUST** validate the returned challenge before authorizing payment.

8. Error Handling

8.1. Error Response Format

Servers **SHOULD** return Problem Details [RFC9457] error bodies for payment-related errors, using the HTTP status defined below. For example:

```
{
  "type": "https://paymentauth.org/problems/payment-required",
  "title": "Payment Required",
  "status": 402,
  "detail": "Human-readable description"
}
```

The `type` URI **SHOULD** correspond to one of the problem types defined below, and the canonical base URI for problem types is `https://paymentauth.org/problems/`.

8.2. Error Codes

Code	HTTP	Description
`payment-required`	402	Resource requires payment
`payment-insufficient`	402	Amount too low
`payment-expired`	402	Challenge or authorization expired
`verification-failed`	402	Proof invalid
`method-unsupported`	400	Method not accepted
`malformed-credential`	402	Invalid credential format
`invalid-challenge`	402	Challenge ID unknown or already used
`bad-request`	400	Malformed request or invalid parameters
`invalid-payload`	402	Credential payload does not match schema
`internal-payment-error`	500	Unexpected payment processing error

Code	HTTP	Description
`payment-action-required`	402	Payment requires additional action

Table 6

8.3. Retry Behavior

Servers **SHOULD** use the `Retry-After` HTTP header [RFC9110] to indicate when clients may retry:

```
HTTP/1.1 402 Payment Required
Retry-After: 60
WWW-Authenticate: Payment ...
```

9. Extensibility

9.1. Payment Method Specifications

Payment method specifications **MUST** define:

1. **Method Identifier**: Unique lowercase string
2. **Request Schema**: JSON structure for the `request` parameter
3. **Payload Schema**: JSON structure for credential payloads
4. **Verification Procedure**: How servers validate proofs
5. **Settlement Procedure**: How payment is finalized
6. **Security Considerations**: Method-specific threats and mitigations

9.2. Versioning

The Payment scheme uses a layered versioning strategy:

9.2.1. Core Protocol

The `Payment` scheme name is the stable identifier. The core protocol does NOT carry a version on the wire, consistent with all deployed HTTP authentication schemes (`Basic`, `Bearer`, `Digest`). Evolution happens through adding optional parameters and fields; implementations **MUST** ignore unknown parameters and fields. If a future change is truly incompatible, a new scheme name (e.g., `Payment2`) would be registered.

9.2.2. Payment Methods

Payment method specifications **MAY** include a `version` field in their `methodDetails`. The absence of a `version` field is implicitly version 1. When a breaking change is needed, the method specification adds a `version` field starting at `2`. Compatible changes (adding optional fields, defining defaults) do not require a version change. Methods **MAY** also register a new identifier for changes fundamental enough to warrant a distinct name.

9.2.3. Payment Intents

Payment intents do not carry a version. They evolve through the same compatibility rules as the core: adding optional fields with defined defaults is compatible, and breaking changes require a new intent identifier (e.g., `charge-v2`).

9.3. Custom Parameters

Implementations **MAY** define additional parameters in challenges:

- Parameters **MUST** use lowercase names
- Unknown parameters **MUST** be ignored by clients

9.4. Size Considerations

Servers **SHOULD** keep challenges under 8KB. Clients **MUST** be able to handle challenges of at least 4KB. Servers **MUST** be able to handle credentials of at least 4KB.

10. Internationalization Considerations

10.1. Character Encoding

All string values use UTF-8 encoding [RFC3629]:

- The `request` and credential payloads are JSON [RFC8259]
- Payment method identifiers are restricted to ASCII lowercase
- The `realm` parameter **SHOULD** use ASCII-only values per [RFC9110]

10.2. Human-Readable Text

The `description` parameter may contain localized text. Servers **SHOULD** use the `Accept-Language` request header [RFC9110] to determine the appropriate language.

11. Security Considerations

11.1. Threat Model

This specification assumes:

- Attackers can observe all network traffic
- Attackers can inject, modify, or replay messages
- Attackers may control malicious servers or clients

11.2. Transport Security

This specification REQUIRES TLS 1.2 [RFC5246] or later for all Payment authentication flows. TLS 1.3 [RFC8446] is **RECOMMENDED**.

Implementations **MUST** use TLS when transmitting Payment challenges and credentials. Payment credentials contain sensitive authorization data that could result in financial loss if intercepted.

Servers **MUST NOT** issue Payment challenges over unencrypted HTTP. Clients **MUST NOT** send Payment credentials over unencrypted HTTP. Implementations **SHOULD** reject Payment protocol messages received over non-TLS connections.

11.2.1. Credential Handling

Payment credentials are bearer tokens that authorize financial transactions. Servers and intermediaries **MUST NOT** log Payment credentials or include them in error messages, debugging output, or analytics. Credential exposure could enable replay attacks or unauthorized payments.

Implementations **MUST** treat Payment credentials with the same care as authentication passwords or session tokens. Credentials **SHOULD** be stored only in memory and cleared after use.

11.2.2. Challenge-Binding Secret Management

Implementations that use a shared secret for stateless challenge binding (for example, HMAC) **MUST** keep that secret on trusted server-side systems only and **MUST NOT** disclose it to clients. Servers **MUST NOT** log the secret or include it in error messages, debugging output, or analytics.

If a server rotates a challenge-binding secret, it **SHOULD** continue verifying challenges issued under the previous secret until those challenges expire, or use an equivalent migration strategy that avoids invalidating unexpired challenges.

11.3. Replay Protection

Payment methods used with this specification **MUST** provide single-use proof semantics. A payment proof **MUST** be usable exactly once; subsequent attempts to use the same proof **MUST** be rejected by the payment method infrastructure.

11.4. Idempotency and Side Effects

Servers **MUST NOT** perform side effects (database writes, external API calls, resource creation) for requests that have not been paid. The unpaid request that triggers a 402 challenge **MUST NOT** modify server state beyond recording the challenge itself.

For non-idempotent methods (POST, PUT, DELETE), servers **SHOULD** accept an `Idempotency-Key` header to enable safe client retries. When a client retries a request with the same `Idempotency-Key` and a valid Payment credential, the server **SHOULD** return the same response as the original successful request without re-executing the operation.

11.5. Concurrent Request Handling

Servers **MUST** ensure that concurrent requests with the same Payment credential result in at most one successful payment settlement and one resource delivery. Race conditions between parallel requests could otherwise cause double-payment or double-delivery.

Implementations **SHOULD** use atomic operations or distributed locks when verifying and consuming Payment credentials. The credential verification and resource delivery **SHOULD** be performed as an atomic operation where possible.

11.6. Amount Verification

Clients **MUST** verify before authorizing payment:

1. Requested amount is reasonable for the resource
2. Recipient/address is expected
3. Currency/asset is as expected
4. Validity window is appropriate

Clients **MUST NOT** rely on the `description` parameter for payment verification. Malicious servers could provide a misleading description while the actual `request` payload requests a different amount.

11.7. Privacy

- Servers **MUST NOT** require user accounts for payment.
- Payment methods **SHOULD** support pseudonymous options where possible.
- Servers **SHOULD NOT** log Payment credentials in plaintext

11.8. Credential Storage

Implementations **MUST** treat any header carrying a Payment credential and `Payment-Receipt` headers as sensitive data.

11.9. Intermediary Handling of 402

HTTP intermediaries (proxies, caches, CDNs) may not recognize 402 as an authentication challenge in the same way they handle 401. While this specification uses `WWW-Authenticate` headers with 402 responses following the same syntax as [RFC9110], intermediaries that perform special processing for 401 (such as stripping credentials or triggering authentication prompts) may not apply the same behavior to 402.

Servers **SHOULD NOT** rely on intermediary-specific handling of 402 responses. Clients **MUST** be prepared to receive 402 responses through any intermediary.

11.10. Caching

Payment challenges contain unique identifiers and time-sensitive payment data that **MUST NOT** be cached or reused. To prevent challenge replay and stale payment information:

Servers **MUST** send `Cache-Control: no-store` [RFC9111] with 402 responses; this ensures no shared cache reuse.

Responses containing `Payment-Receipt` headers **MUST** include `Cache-Control: private` to prevent shared caches from storing payment receipts.

When a request carries a Payment credential in a field other than `Authorization`, every corresponding response **MUST** include `Cache-Control: private` or `Cache-Control: no-store`. [RFC9111] Section 3.5 restricts shared caching of responses to requests that contain `Authorization`; that protection does not apply to `Payment-Authorization`. `Payment-Receipt` is optional and does not by itself prevent shared caches from storing those responses.

11.11. Cross-Origin Considerations

Clients (particularly browser-based wallets) **SHOULD**:

- Clearly display the origin requesting payment
- Require explicit user confirmation before authorizing payments
- Not automatically respond to Payment challenges

11.12. Denial of Service

Servers **SHOULD** implement rate limiting on challenges issued and credential verification attempts.

12. IANA Considerations

12.1. Authentication Scheme Registration

This document registers the "Payment" authentication scheme in the "Hypertext Transfer Protocol (HTTP) Authentication Scheme Registry" established by [RFC9110]:

- **Authentication Scheme Name**: Payment
- **Reference**: This document, Section 5
- **Notes**: Used with HTTP 402 status code for proof-of-payment flows

12.2. Header Field Registration

This document registers the following header fields:

Field Name	Status	Reference
Accept-Payment	permanent	This document, Section 7.4
Payment-Authorization	permanent	This document, Section 5.2
Payment-Receipt	permanent	This document, Section 5.3

Table 7

12.3. Payment Method Registry

This document establishes the "HTTP Payment Methods" registry. This registry uses the "Specification Required" policy defined in [RFC8126].

Registration requests must include:

- **Method Identifier**: Unique lowercase ASCII letters (`a-z`)
- **Description**: Brief payment-method description
- **Specification pointer**: Reference to the specification document
- **Registrant Contact**: Contact information for the registrant

12.4. Payment Intent Registry

This document establishes the "HTTP Payment Intents" registry. This registry uses the "Specification Required" policy defined in [RFC8126].

Registration requests must include:

- **Intent Identifier**: Unique lowercase ASCII string
- **Description**: Brief description of the intent semantics
- **Specification pointer**: Reference to the specification document
- **Registrant Contact**: Contact information for the registrant

The registry is initially empty. Intent specifications register their identifiers upon publication.

13. References

13.1. Normative References

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[RFC4648] Josefsson, S., "The Base16, Base32, and Base64 Data Encodings", RFC 4648, DOI 10.17487/RFC4648, October 2006, <https://www.rfc-editor.org/info/rfc4648>.

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[RFC8785] Rundgren, A., Jordan, B., and S. Erdtman, "JSON Canonicalization Scheme (JCS)", RFC 8785, DOI 10.17487/RFC8785, June 2020, <https://www.rfc-editor.org/info/rfc8785>.

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[RFC9111] Fielding, R., Ed., Nottingham, M., Ed., and J. Reschke, Ed., "HTTP Caching", STD 98, RFC 9111, DOI 10.17487/RFC9111, June 2022, <https://www.rfc-editor.org/info/rfc9111>.

[RFC9457] Nottingham, M., Wilde, E., and S. Dalal, "Problem Details for HTTP APIs", RFC 9457, DOI 10.17487/RFC9457, July 2023, <https://www.rfc-editor.org/info/rfc9457>.

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13.2. Informative References

[W3C-DID] W3C, "Decentralized Identifiers (DIDs) v1.0", n.d., <https://www.w3.org/TR/did-core/>.

[W3C-PMI] W3C, "Payment Method Identifiers", n.d., <https://www.w3.org/TR/payment-method-id/>.

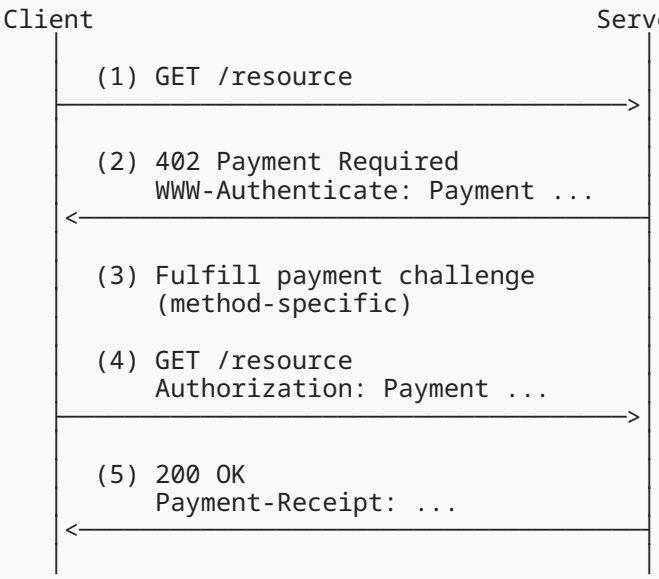
Appendix A. ABNF Collected

```
; HTTP Authentication Challenge (following RFC 7235 Section 2.1)
payment-challenge = "Payment" [ 1*SP auth-params ]
auth-params       = auth-param *( OWS "," OWS auth-param )
auth-param        = token BWS "=" BWS ( token / quoted-string )

; Required parameters: id, realm, method, intent, request
; The id parameter is required by prose to be non-empty after parsing.
; Optional parameters: expires, digest, description, header, opaque

; Payment credential field value (Authorization by default;
; Payment-Authorization when the challenge includes header)
payment-credentials = "Payment" 1*SP base64url-nopad
Payment-Authorization = payment-credentials

; Client payment preferences
Accept-Payment = #payment-range
payment-range = payment-token [ weight ]
payment-token = payment-method-or-wildcard "/" intent-or-wildcard
payment-method-or-wildcard = payment-method-id / "*"
intent-or-wildcard = intent-token / "*"

; Payment-Receipt header field value
Payment-Receipt = base64url-nopad

; Base64url encoding without padding per RFC 4648 Section 5
base64url-nopad = 1*( ALPHA / DIGIT / "-" / "_" )

; Payment method identifier (lowercase only)
payment-method-id   = 1*LOWERALPHA
LOWERALPHA          = %x61-7A  ; a-z

; Payment intent
intent-token = 1*( ALPHA / DIGIT / "-" )
```

Appendix B. Examples

B.1. One-Time Charge

A client requests a resource, receives a payment challenge, fulfills the payment, and receives the resource with a receipt.



Challenge:

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
Content-Type: application/problem+json
WWW-Authenticate: Payment id="qB3wErTyU7iOpAsD9fGhJk",
    realm="api.example.com",
    method="invoice",
    intent="charge",
    expires="2025-01-15T12:05:00Z",

request="eyJhbW91bnQiOiIxMDAwIiwiY3VycmVuY3kiOiJVU0QiLCJpbnZvaWNlIjoiaW52XzEy
MzQ1In0"

{
  "type": "https://paymentauth.org/problems/payment-required",
  "title": "Payment Required",
  "status": 402,
  "detail": "Payment required for access.",
  "challengeId": "qB3wErTyU7iOpAsD9fGhJk"
}
```

Decoded `request`:

```
{
  "amount": "1000",
  "currency": "usd",
  "invoice": "inv_12345"
}
```

Credential:

```
GET /resource HTTP/1.1
Host: api.example.com
Authorization: Payment
eyJpZCI6InFCM3dFclR5VTdpT3BBc0Q5ZkdoSmsiLCJwYXlsb2FkIjp7InByZWltYWdlIjoiMHhhY
mMxMjMuLi4ifX0
```

Decoded credential:

```
{
  "challenge": {
    "id": "qB3wErTyU7iOpAsD9fGhJk",
    "realm": "api.example.com",
    "method": "invoice",
    "intent": "charge",
    "request":
"eyJhbW91bnQiOiIxMDAwIiwiY3VycmVuY3kiOiJVU0QiLCJpbnZvaWNlIjoiaW52XzEyMzQ1In0"
,
    "expires": "2025-01-15T12:05:00Z"
  },
  "payload": {
    "preimage": "0xabc123..."
  }
}
```

Success:

```
HTTP/1.1 200 OK
Cache-Control: private
Payment-Receipt:
eyJzdGF0dXMiOiJzdWNjZXNzIiwibWV0aG9kIjoiaW52b2ljZSIsInRpbWVzdGFtcCI6IjIwMjUtM
DEtMTVUMTI6MDA6MDBaIiwicmVmZXJlbmNlIjoiaW52XzEyMzQ1In0
Content-Type: application/json

{"data": "..."}
```

B.2. Challenge Negotiation with Accept-Payment

The client can pre-declare its supported payment capabilities and let the server tailor the 402 response:

```
GET /resource HTTP/1.1
Host: api.example.com
Accept-Payment: tempo/charge, tempo/session, stripe/charge;q=0.5, solana/
charge;q=0.3
```

If the server supports all four combinations, it **SHOULD** prefer the higher-ranked `tempo` challenges, then `stripe/charge`, then `solana/charge`:

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
WWW-Authenticate: Payment id="pT7yHnKmQ2wErXsZ5vCbNl",
realm="api.example.com", method="tempo", intent="charge", request="..."
WWW-Authenticate: Payment id="nH6xJkLpO3qRtYsA6wDcVb",
realm="api.example.com", method="tempo", intent="session", request="..."
WWW-Authenticate: Payment id="mF8uJkLpO3qRtYsA6wDcVb",
realm="api.example.com", method="stripe", intent="charge", request="..."
WWW-Authenticate: Payment id="kD4vLmNpQ2rStUwX5yAbCe",
realm="api.example.com", method="solana", intent="charge", request="..."
```

When multiple entries omit `q`, they are equally preferred. In that case, the server **MAY** order the returned challenges according to its own policy:

```
GET /resource HTTP/1.1
Host: api.example.com
Accept-Payment: tempo/charge, solana/charge
```

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
WWW-Authenticate: Payment id="sK9vLmQwErTyUiOpA2dFgH",
realm="api.example.com", method="solana", intent="charge", request="..."
WWW-Authenticate: Payment id="rJ8uKnLpO3qWtYsA6wDcVb",
realm="api.example.com", method="tempo", intent="charge", request="..."
```

Clients can also use wildcards to express broader support. In the following example, the client prefers any `tempo` payment method, then any `solana` method, and least prefers `stripe/charge`:

```
GET /stream HTTP/1.1
Host: api.example.com
Accept-Payment: tempo/*, solana/*;q=0.6, stripe/charge;q=0.2
```

If the server can offer `tempo/session`, `tempo/charge`, `solana/charge`, and `stripe/charge`, it **SHOULD** rank the `tempo` offers first, then `solana/charge`, then `stripe/charge`:

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
WWW-Authenticate: Payment id="tM4nOpQrS5uVwXyZ6aBcDe",
realm="api.example.com", method="tempo", intent="session", request="..."
WWW-Authenticate: Payment id="uN5oPqRsT6vWxYzA7bCdEf",
realm="api.example.com", method="tempo", intent="charge", request="..."
WWW-Authenticate: Payment id="qE3rFgHiJ4kLmNpO5sAtBu",
realm="api.example.com", method="solana", intent="charge", request="..."
WWW-Authenticate: Payment id="vP6qRtSuV7wXyZaB8cDeFg",
realm="api.example.com", method="stripe", intent="charge", request="..."
```

Clients can set `q=0` to declare that a capability is not acceptable. In this example, the client is able to use `tempo/session`, but does not wish to receive that challenge for this request:

```
GET /download HTTP/1.1
Host: api.example.com
Accept-Payment: tempo/charge, tempo/session;q=0, solana/charge;q=0.8, stripe/
charge;q=0.4
```

If the server would otherwise offer `tempo/charge`, `tempo/session`, `solana/charge`, and `stripe/charge`, it **SHOULD** omit `tempo/session` from the ranked set:

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
WWW-Authenticate: Payment id="wQ7rStTuV8xYzAbC9dEfGh",
realm="api.example.com", method="tempo", intent="charge", request="..."
WWW-Authenticate: Payment id="yR5tUvWxY6zAbCdE7fGhIj",
realm="api.example.com", method="solana", intent="charge", request="..."
WWW-Authenticate: Payment id="xR8sTuUvW9yZaBcD0eFgHi",
realm="api.example.com", method="stripe", intent="charge", request="..."
```

B.3. Signed Authorization

A payment method using cryptographic signatures:

Challenge:

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
WWW-Authenticate: Payment id="zL4xCvBnM6kJhGfD8sAaWe",
    realm="api.example.com",
    method="signed",
    intent="charge",
    expires="2025-01-15T12:05:00Z",

request="eyJhbW91bnQiOiI1MDAwIiwiYXNzZXQiOiJVU0QiLCJyZWNpcGllbnQiOiIweDc0MmQz
NUNjNjYzNEMwNTMyOTI1YTNiODQ0QmM5ZTc1OTVmOGZFMDAiLCJub25jZSI6IjB4MTIzNDU2Nzg5M
CJ9"
```

Decoded `request`:

```
{
  "amount": "5000",
  "currency": "usd",
  "recipient": "0x742d35Cc6634C0532925a3b844Bc9e7595f8fE00",
  "methodDetails": {
    "nonce": "0x1234567890"
  }
}
```

Credential:

```
{
  "challenge": {
    "id": "zL4xCvBnM6kJhGfD8sAaWe",
    "realm": "api.example.com",
    "method": "signed",
    "intent": "charge",
    "request":
"eyJhbW91bnQiOiI1MDAwIiwiYXNzZXQiOiJVU0QiLCJyZWNpcGllbnQiOiIweDc0MmQzNUNjNjYz
NEMwNTMyOTI1YTNiODQ0QmM5ZTc1OTVmOGZFMDAiLCJub25jZSI6IjB4MTIzNDU2Nzg5MCJ9",
    "expires": "2025-01-15T12:05:00Z"
  },
  "source": "did:key:z6MkhaXgBZDvotDkL5257faiztiGiC2QtKLGpbnnEGta2doK",
  "payload": {
    "signature": "0x1b2c3d4e5f..."
  }
}
```

B.4. Multiple Payment Options

Servers **MAY** return multiple Payment challenges in a single 402 response, each with a different payment method or configuration:

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
WWW-Authenticate: Payment id="pT7yHnKmQ2wErXsZ5vCbNl",
realm="api.example.com", method="invoice", intent="charge", request="..."
WWW-Authenticate: Payment id="mF8uJkLpO3qRtYsA6wDcVb",
realm="api.example.com", method="signed", intent="charge", request="..."
```

When a server returns multiple challenges, clients **SHOULD** select one based on their capabilities and user preferences. Clients **MUST** send only one Payment credential in the subsequent request, in the field selected by that challenge (Section 5.2). A selected challenge that omits `header` uses `Authorization`; a selected challenge that includes `header` requires the credential in `Payment-Authorization`.

Servers receiving multiple Payment credentials in a single request **SHOULD** reject with 400 (Bad Request).

B.5. Failed Payment Verification

```
HTTP/1.1 402 Payment Required
Cache-Control: no-store
Content-Type: application/problem+json
WWW-Authenticate: Payment id="aB1cDeF2gHiJ3kLmN4oPqR",
realm="api.example.com", method="invoice", intent="charge", request="..."

{
  "type": "https://paymentauth.org/problems/verification-failed",
  "title": "Payment Verification Failed",
  "status": 402,
  "detail": "Invalid payment proof."
}
```

The server returns 402 with a fresh challenge, allowing the client to retry with a new payment credential.

Appendix C. Acknowledgements

TBD

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