The GNU Taler tutorial for PHP Web shops

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This tutorial is about implementing a merchant frontend to run against a GNU Taler merchant backend (version 0.2.0, 11 November 2016),

Short Contents

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1 Introduction

1.1 About GNU Taler

GNU Taler is an open protocol for an electronic payment system with a free software reference implementation. GNU Taler offers secure, fast and easy payment processing using well understood cryptographic techniques. GNU Taler allows customers to remain anonymous, while ensuring that merchants can be held accountable by governments. Hence, GNU Taler is compatible with anti-money-laundering (AML) and know-your-customer (KYC) regulation, as well as data protection regulation (such as GDPR).

1.2 About this tutorial

This tutorial is for Web developers and addresses how to integrate GNU Taler with Web shops. It describes how to create a Web shop that processes payments with the help of a GNU Taler merchant *backend*. In the second chapter, you will learn how to trigger the payment process from the Web site, how to communicate with the backend, how to generate a order and process the payment. The third chapter covers the integration of a back office with the backend, which includes tracking payments for orders, matching payments to orders, and persisting and retrieving contracts.

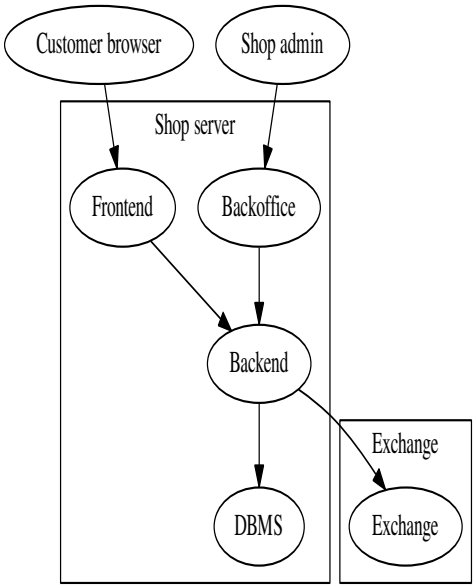
You can download all of the code examples given in this tutorial from `https://git.taler.net/merchant-frontend-examples.git/tree/php/`.

1.3 Architecture overview

The Taler software stack for a merchant consists of the following main components:

- A frontend which interacts with the customer's browser. The frontend enables the customer to build a shopping cart and place an order. Upon payment, it triggers the respective business logic to satisfy the order. This component is not included with Taler, but rather assumed to exist at the merchant. This tutorial describes how to develop a Taler frontend.
- A back office application that enables the shop operators to view customer orders, match them to financial transfers, and possibly approve refunds if an order cannot be satisfied. This component is again not included with Taler, but rather assumed to exist at the merchant. This tutorial will describe how to integrate such a component to handle payments managed by Taler. Such integration is shown by adding the back office functionality to the frontend implemented in the second part of this tutorial.
- A Taler-specific payment backend which makes it easy for the frontend to process financial transactions with Taler. For this tutorial, you will use a public backend, but for a production deployment a merchant-specific backend will need to be setup by a system administrator.

The following image illustrates the various interactions of these key components:



Basically, the backend provides the cryptographic protocol support, stores Taler-specific financial information and communicates with the GNU Taler exchange over the Internet. The frontend accesses the backend via a RESTful API. As a result, the frontend never has to directly communicate with the exchange, and also does not deal with sensitive data. In particular, the merchant's signing keys and bank account information are encapsulated within the Taler backend.

2 Setting up a simple donation page

This section describes how to setup a simple shop, which exposes a button to get donations via Taler. The expected behaviour is that once the "donate" button is clicked, the customer will receive a Taler *proposal* offering him the opportunity to make a fixed donation, for example to donate 1 KUDOS to the charity operating the shop.

All the code samples shown below in the tutorial can be found at `https://git.taler.net/merchant-frontend-examples.git/tree/php`.

Note that if the customer does not have the Taler wallet installed, they should instead be prompted to proceed with a classic dialog for credit card payments.

2.1 Specifying the backend

For many critical operations, the frontend needs to communicate with a Taler backend. Assuming that you do not yet have a backend configured, you can use the public backend provided by the Taler project for testing. This public backend has been set-up at `http://backend.demo.taler.net/` specifically for testing frontends. It uses the currency "KUDOS" and all payments will go into the "Tutorial" account at the Taler "bank" running at `https://bank.demo.taler.net/public-accounts`.

To point the frontend being developed in this tutorial to some backend, it suffices to set the variable `$BACKEND` in `php/config.php` to the desired backend's base URL. You also need to specify the currency used by the backend. For example:

```
// php/config.php
<?php
  // This file is in the public domain.

  // Which backend should we use?  Must end in "/".
  $BACKEND = "http://backend.demo.taler.net/";

  // The currency must match the one used by the backend.
  $CURRENCY = "KUDOS";
?>
```

2.2 Talking to the backend

Given the above configuration, we can now implement two simple functions `get_to_backend` and `post_to_backend` to send requests to the backend. The function `get_to_backend` is in charge of performing HTTP GET requests to the backend, while `post_to_backend` will send HTTP POST requests.

```
// php/backend.php
<?php
  // This file is in the public domain.

  include_once 'config.php';
  include_once 'helpers.php';

  /**
   * 'body' is an object, representing the JSON to POST. NOTE: we do NOT
   * rely on a more structured way of doing HTTP, like the one offered by
   * pecl_http, as its installation was NOT always straightforward.
   */
```

```
  function post_to_backend($backend_uri, $body){
    $json = json_encode($body);
    $c = curl_init(url_join ($GLOBALS['BACKEND'], $backend_uri));
    $options = array(CURLOPT_RETURNTRANSFER => true,
                     CURLOPT_CUSTOMREQUEST => "POST",
                     CURLOPT_POSTFIELDS => $json,
                     CURLOPT_HTTPHEADER =>
                       array('Content-Type:  application/json'));
    curl_setopt_array($c, $options);
    $r = curl_exec($c);
    return array("status_code" => curl_getinfo($c, CURLINFO_HTTP_CODE),
                 "body" => $r);
  }

  /**
   * Sends a GET request to the backend.
   */
  function get_to_backend($backend_url, $args){
    $path = sprintf("%s?%s", $backend_url, http_build_query($args));
    $c = curl_init(url_join($GLOBALS['BACKEND'], $path));

    $options = array(CURLOPT_RETURNTRANSFER => true,
                     CURLOPT_CUSTOMREQUEST => "GET");
    curl_setopt_array($c, $options);
    $r = curl_exec($c);
    return array("status_code" => curl_getinfo($c, CURLINFO_HTTP_CODE),
                 "body" => $r);
  }
?>
```

The given `backend.php` code uses a few helper functions from `php/helpers.php`, which should be self-explanatory.

2.3 Prompting for payment

Our goal is to trigger a Taler payment once the customer has clicked on a donation button. We will use a button that issues an HTTP GET to the frontend `/donate.php` URL. For this, the HTML would be as follows:

```
// php/index.html
<!DOCTYPE html>
<html lang="en">
  <!-- This file is in the public domain -->
  <head>
    <title>A donation button</title>
  </head>
  <body>
    <form action='/donate.php' method='GET'>
      <input type='submit' value='Donate!'></input>
    </form>
  </body>
</html>
```

When the server-side handler for `/donate.php` receives the form submission, it will return a HTML page that will take care of:

- showing a credit card paywall to the user if no wallet is found, and
- fetching a Taler proposal and passing it to the wallet if one is found

A minimalistic `donate.php` implementation is shown below (in PHP):

```
// php/donate.php
<?php
  // This file is in the public domain.

  // Next two lines offer Taler payment option for Taler wallets:
  http_response_code(402); // 402:  Payment required
  header ('X-Taler-Contract-Url:  /generate-order.php');
?>
<!DOCTYPE html>
<html lang="en">
  <head>
    <title>Select payment method</title>
  </head>
  <body>
    Here you should put the HTML for the non-Taler (credit card) payment.
  </body>
</html>
```

Given this response, the Taler wallet will fetch the proposal from `/generate-order.php` and display it to the user.

If the wallet is not present, the HTML body will be shown and the Taler headers and the 402 status code ought to be ignored by the browser.

2.4 A helper function to generate the order

We make distinction between *three* different stages of what it informally called "contract".

In a very first stage, we call it the *order*: that occurs when the frontend generates the first JSON that misses some information that the backend is supposed to add. When the backend completes the order and signs it, we have a *proposal*. The proposal is what the user is prompted with, and allows them to confirm the purchase. Once the user confirms the purchase, the wallet makes a signature over the proposal, turning it into a *contract*.

We first define a helper function `make_order` that will generate a complete Taler order as a nested PHP array. The function takes only the order ID and the timestamp as arguments; all of the other details of the order are hardcoded in this simple example.

The following code generate a order about donating 1 KUDOS to the 'Taler charity program':

```
// php/order.php
<?php
  // This file is in the public domain.

  include_once 'config.php';
  include_once 'helpers.php';

  function make_order($nonce,
                      $order_id,
                      $now){
    $order
      = array(
        'nonce' => $nonce,
        'amount' =>
          array('value' => 0,
                'fraction' => 10000000,
```

```
        'currency' => $GLOBALS['CURRENCY']),
  'max_fee' =>
    array('value' => 0,
          'fraction' => 5000000,
          'currency' => $GLOBALS['CURRENCY']),
'products' =>
  array(array('description' =>
                "Donation to charity program",
                'quantity' => 1,
                'price' =>
                   array ('value' => 0,
                          'fraction' => 10000000,
                       'currency' => $GLOBALS['CURRENCY']),
                'product_id' => 0,
                'taxes' =>
                array(),
                'delivery_date' =>
                "/Date(" .  $now->getTimestamp() .  ")/",
                'delivery_location' =>
                'LNAME1'
             )
       ),
'summary' =>
  "Personal donation to charity program",
'order_id' => $order_id,
  'timestamp' =>
  "/Date(" .  $now->getTimestamp() .  ")/",
  'fulfillment_url' =>
  url_rel("/fulfillment.php?order_id=$order_id"),
  'pay_url' =>
  url_rel("/pay.php"),
  'refund_deadline' =>
    "/Date(" .  $now->getTimestamp() .  ")/",
  'pay_deadline' =>
  "/Date(" .  $now->add(new DateInterval('P2W'))->getTimestamp() .  ")/",
  'merchant' =>
    array('address' =>
           'LNAME2',
        'instance' => "tutorial",
           'name' =>
            "Charity donation shop",
           'jurisdiction' =>
            'LNAME2'),
'locations' =>
    array ('LNAME1' =>
               array ('country' => 'Test Country 1',
                        'city' => 'Test City 1',
                        'state' => 'Test State 1',
                        'region' => 'Test Region 1',
                        'province' => 'Test Province 1',
                        'ZIP code' => 49081,
                        'street' => 'test street 1',
                        'street number' => 201),
           'LNAME2' =>
              array ('country' => 'Test Country 2',
                     'city' => 'Test City 2',
                     'state' => 'Test State 2',
                     'region' => 'Test Region 2',
```

```
                                'province' => 'Test Province 2',
                                'ZIP code' => 49082,
                                'street' => 'test street 2',
                                'street number' => 202)
                ));
    return array ('order' => $order);
  }
?>
```

2.5 Signing and returning the proposal

The server-side handler for `/generate-order.php` has to call `make_order` and then POST the result to the backend at `/proposal`. By POSTing the order to the backend we get a cryptographic signature over its contents. The result is then returned to the wallet.

A simple `/generate-order.php` handler may thus look like this:

```
// php/generate-order.php
<?php
  // This file is in the public domain.

  include 'order.php';
  include 'backend.php';
  include 'error.php';

  $order_id = "tutorial-" .  dechex(rand(0,99999999)) .  date("-H_i_s");
  session_start();
  $_SESSION["order_id"] = $order_id;
  if(!isset($_GET["nonce"]))
    return build_error(array("body" => null),
                       "no nonce given",
                       400);
  $order = make_order($_GET["nonce"],
                      strval($order_id),
                      new DateTime('now'));
  // Here the frontend POSTs the proposal to the backend
  $response = post_to_backend("/proposal", $order);
  // We always return verbatim what the backend returned
  http_response_code($response["status_code"]);
  if (200 != $response["status_code"]) {
    echo build_error($response,
                     "Failed to generate proposal",
                     $response['status_code']);
    return;
  }
  echo $response["body"];
?>
```

Note that in practice the frontend might want to generate a monotonically increasing series of order IDs to avoid a chance of collisions. Order IDs must be in the range of $[0 : 2^{51})$.

2.6 Handling errors

In the above example, the helper function `build_error` is used to generate an error response in the case that the backend somehow failed to respond properly to our request.

The function `build_error` is shown below, it returns JSON data matching a particular format for reporting errors, see `http://api.taler.net/api-common.html#errordetail`:

```
// php/error.php
```

```
<?php
  // This file is in the public domain.

  function build_error($response, $hint, $http_code){
    http_response_code($http_code);
    return json_encode(array(
                       'error' => "internal error",
                       'hint' => $hint,
                       'detail' => $response["body"]),
                       JSON_PRETTY_PRINT);
  }
?>
```

2.7 Initiating the payment process

After the browser has fetched the proposal, the user will be given the opportunity to affirm the payment. Assuming the user affirms, the browser will navigate to the "fulfillment_url" that was specified in the proposal.

The fulfillment page can be called by users that have already paid for the item, as well as by users that have not yet paid at all. The fulfillment page must thus use the HTTP session state to detect if the payment has been performed already, and if not request payment from the wallet.

For our example, the fulfillment URL will contain the order id of the donation, like in the following example:

```
https://shop.com/fulfillment.php?order_id=<ORDER_ID>
```

The fulfillment handler at `/fulfillment.php` will use this information to check if the user has already paid, and if so confirm the donation. If the user has not yet paid, it will instead return another "402 Payment Required" header, requesting the wallet to pay:

```
// php/fulfillment.php
<?php
  // This file is in the public domain.

  include 'helpers.php';

  session_start();

  if(pull($_SESSION, 'paid', false)){
    echo sprintf("<p>Thanks for your donation!</p>
                  <br><p>The order ID is:  <b>%s</b>; use it to
                  <a href=\"backoffice.html\">track</a> your money,
                  or make <a href=\"/\">another donation!</a></p>",
                  $_SESSION['order_id']);
    session_destroy();
    return;
  }

  // The user needs to pay, instruct the wallet to send the payment.
  http_response_code(402);
  header('X-Taler-Contract-Url:  '  .  url_rel('/generate-order.php'));
  header('X-Taler-Contract-Query:  '  .  "fulfillment_url");
  header('X-Taler-Offer-Url:  '  .  url_rel('/donate.php'));
  return;
?>
```

Here, this second 402 response contains the following Taler-specific headers:

`X-Taler-Contract-Url`
: The URL that generated the proposal that led to this payment. The wallet may need to reconstruct the proposal.

`X-Taler-Contract-Query`
: The way the wallet should lookup for replayable payments. NOTE that for each payment done, the wallet stores the coins it spent for it in an internal database. And each set of used coins is associated to the fulfillment page where they have been spent. So whenever an already known fulfillment page requests a payment, the wallet will pick those coins it spent on that fulfillment page and resend them (therefore *replaying* the payment). In other words, new coins are used only on unknown fulfillment pages. This header is supposed to be removed in future versions of the wallet though, as it only works with the value `"fulfillment_url"`.

`X-Taler-Offer-Url`
: In case that the wallet does not know about this payment already, i.e. because a user shared the URL with another user, this tells the wallet where to go to retrieve a fresh offer.

2.8 Receiving payments via Taler

The final next step for the frontend is to accept the payment from the wallet. For this, the frontend must implement a payment handler at the URI specified in the `pay_url` proposal field, as explained above.

The role of the `/pay.php` handler is to receive the payment from the wallet and forward it to the backend. If the backend reports that the payment was successful, the handler needs to update the session state with the browser to remember that the user paid.

The following code implements this in PHP:

```
// php/pay.php
<?php
  // This file is in the public domain.

  include "backend.php";
  include "error.php";

  session_start();
  if(!isset($_SESSION["paid"])){
    echo "<p>No session active.  Aborting.</p>";
    return;
  }
  // Get coins.
  $body = json_decode(file_get_contents("php://input"));

  $response = post_to_backend("/pay", $body);
  $proposal_data = json_decode($response["body"])->proposal_data;
  /**
   * NOTE: the order id is fetched from the data returned by the
   * backend.  This information is then shown in the final page from
   * the fulfillment URL. This way, if a malicious wallet sends a
   * old deposit permission for a new donation, then the user can
```

```
   * still detect that, since the old order id would be shown on
   * the fulfillment page.
   */
  $_SESSION["order_id"] = $proposal_data->order_id;
  http_response_code($response["status_code"]);

  if (200 != $response["status_code"]){
    echo build_error($response,
                     "Could not send payment to backend",
                     $response["status_code"]);
    return;
  }
  // Payment went through!
  $_SESSION["paid"] = true;
  return;
?>
```

Do not be confused by the `isset` test for the session state. In our simple example, it will be set to "false" by the fulfillment URL which the browser actually always visits first.

After the `pay.php` handler has affirmed that the payment was successful, the wallet will refresh the fulfillment page, this time receiving the message that the donation was successful. If anything goes wrong, the wallet will handle the respective error.

3 Integration with the back office

This chapter shows how to implement the back office Web interface.

We will use the term *transaction* to refer to the business transaction that a merchant has with a customer (and the related communication with the Taler exchange for payment), and the term *wire transfer* to refer to the exchange settling its accounts with the merchant.

However, from the frontend's perspective, any transaction is denoted by the *order id* contained in the proposal that led to the transaction.

Given that Taler deals with microtransactions, not every customer payment processed with Taler will necessarily correspond to a wire transfer. The Taler exchange may aggregate multiple payments from transactions into one larger wire transfer. The *refund_deadline* and the *pay_deadline* values in the contract specify the timeframes within which the exchange is permitted to perform such aggregations, see ⟨undefined⟩ [Taler contracts], page ⟨undefined⟩.

In this chapter, we will see how a merchant can obtain the mapping from transactions to wire transfers and vice versa. Additionally, we will describe how to obtain a list of all transactions known to the backend.

3.1 Entry page

Given this charge, the back office's main tasks are:

- Allow the back office operator to specify a order id, and display the corresponding wire transfer identifiers.
- Allow the back office operator to specify a wire transfer ID, and display all of the corresponding order ids.
- Allow the back office operator to obtain a list of all transactions.

We implement these with a simple HTML form. For simplicity, we have one single page for gathering input data for both tracking directions:

```
// php/backoffice.html
<!DOCTYPE html>
<html lang="en">
  <!-- This file is in the public domain -->
  <head>
    <title>Minimal merchant back office</title>
    <script src="/history.js" type="application/javascript"></script>
  </head>
  <body>
    <form action='/track-transaction.php' method='GET'>
      <input type='text' name='order_id' placeholder='Order ID'></input>
      <input type='text' name='instance' value='tutorial' hidden></input>
      <input type='submit' value='Track transaction'></input>
    </form>
    <form action='/track-transfer.php' method='GET'>
      <input type='text' name='wtid' placeholder='Wire transfer ID'></input>
      <input type='text' name='exchange' placeholder='Exchange URL'></input>
      <input type='text' name='instance' value="tutorial" hidden></input>
      <input type='submit' value='Track transfer'></input>
    </form>
    <form id="history_form" action="" method="GET">
      <a href="#" onclick="submit_history()">Get transactions list</a>
```

```
      <br>
      <small>Works only if JavaScript enabled</small>
    </form>
    <br/>
    <table id="history" style="visibility:  hidden;">
      <tr>
        <th>Order ID</th>
        <th>Date</th>
        <th>Amount</th>
      </tr>
    </table>
  </body>
</html>
```

The imported script `history.js` is responsible for dynamically get the list of known transactions. See below.

3.2 Tracking a transaction

The `track-transaction.php` script is now responsible for taking all the URL query parameter and use them on the `/track/transaction` request to the backend, see `http://api.taler.net/api-merchant.html#get--track-transaction`. The parameters are the *order_id* and the *instance* (see Section 4.5 [Instances], page 22) of this merchant. Note that the backend may then request this information from the exchange, or retrieve it from its own cache if it has already obtained it. The backend will also check signatures from the exchange, persist the information obtained, and complain if the exchange ever changes its facts in an inconsistent manner.

```
// php/track-transaction.php
<?php
  // This file is in the public domain.

  include 'error.php';
  include 'backend.php';


  $response = get_to_backend("/track/transaction", $_GET);

  if (!in_array($response["status_code"], array(200, 202, 424))){
    echo build_error($response,
                     "Backend error",
                     $response["status_code"]);
    return;
  }

  // Report conflict
  if (424 == $response["status_code"]){
    $body = json_decode($response["body"]);
    echo sprintf("<p>Exchange provided conflicting information about
                  transaction '%s':  what claimed by the exchange does
                  not match what stored in our DB.</p>",
                  $_GET["order_id"]);
    return;
  }

  // Render HTML
  http_response_code($response["status_code"]);
```

```
  $decoded = json_decode($response["body"]);
  if (202 == $response["status_code"]){
    $pretty_date = get_pretty_date($decoded->details->execution_time);
    echo "<p>The exchange accepted the transaction.
          The estimated time for when the related wire transfer
          is to be performed is:  $pretty_date</p>";
    return;
  }

  echo "<ul>";
  foreach ($decoded as $entry){
    $pretty_date = get_pretty_date($entry->execution_time);
    echo sprintf("<li>Wire transfer ID: %s, date:  %s</li>",
                 $entry->wtid,
                 $pretty_date);
  }
  echo "</ul>";
?>
```

If the backend returned an HTTP status code `202` (Accepted), this means that the exchange simply did not yet perform the wire transfer. This is usually the case before *pay_deadline*, as the exchange is waiting for additional opportunities to aggregate transactions. In this case, we tell the user when to retry this operation later.

In the `foreach` loop, we construct the list of all the wire transfers which paid back transaction *order_id*. For simplicity, the list will report only two values: the wire transfer identifier and the date when the transfer occurred. Nonetheless, the data returned by the backend contains more information that can be shown to the user.

3.3 Tracking a wire transfer

To track a wire transfer, the frontend just needs to forward the request it got from the Web form, to the backend. Again, the backend may request missing information from the exchange, verify signatures, persist the result and complain if there are inconsistencies.

In the case that the backend detects inconsistencies, an HTTP status code of `402` is returned. In this case, we report this situation to the user, who should now report this situation to the exchange's auditors as the exchange is misbehaving.

In the usual case where everything went fine, we first output the amount that was supposed to have been transfered under the given `wtid`, and when it was performed (according to the exchange). Finally, in the `foreach` loop, we construct the list of the order ids paid by the wire transfer:

```
<?php
  // This file is in the public domain.

  include 'error.php';
  include 'backend.php';


  $response = get_to_backend("/track/transfer", $_GET);

  if (!in_array($response["status_code"], array(200, 424))){
    echo build_error($response,
                     "Backend error",
                     $response["status_code"]);
```

```
    return;
  }

  // Render HTML
  http_response_code($response["status_code"]);
  if (424 == $response["status_code"]){
    $body = json_decode($response["body"]);
    echo sprintf("<p>The backend detected that the amount wire
                  transferred by the exchange for coin '%s', differs
                  from the coin's original amount.</p>",
                  $body->coin_pub);
    return;
  }

  $json_response = json_decode($response["body"]);
  $pretty_date = get_pretty_date($json_response->execution_time);
  $amount = get_amount($json_response->total);
  echo "<p>$amount transferred on $pretty_date.  The list of involved
       transactions is shown below:</p>";
  echo "<ul>";

  foreach ($json_response->deposits_sums as $entry){
    echo sprintf("<li>Order id:  %s", $entry->order_id);
  }
  echo "</ul>";
?>
```

3.4 Listing all transactions

In order to track transactions, order ids are needed as input. To that purpose, the frontend needs to make a HTTP GET request to `/history`, which is offered by the backend.

The returned data lists the transactions from the youngest back to the oldest.

The `/history` API is actually more rich, as it offers the way to skim results based on time or on index, but that goes beyond the scope of this tutorial.

Our example frontend implements this feature by orchestrating two parts:

- A JavaScript function, imported within `backoffice.html`, that issues the HTTP GET to `/history.php?instance=tutorial` and modifies the current page by adding a table showing the result.
- The `history.php` script, which is in charge of serving the request coming from the JavaScript. Its task is to relay that request to the backend, and echo the result back.

See below both parts:

```
// ../history.js
var FRACTION = 100000000;

// Stringify amounts.  Take a {value:  x, fraction:  y, currency:  "Z"}
// and return a "a.b Z" form.
function parse_amount(amount){
  var v = amount.value + (amount.fraction/FRACTION);
  return v + " " + amount.currency;
}

// Parse Taler date ("/Date(TIMESTAMP)/") string and
// return a JavaScript Date object.
```

```
function get_date(date){
  var split = date.match(/Date\((.*)\)/);
  var seconds;
  if(isNaN(seconds = Number(split[1]))){
    console.error("Malformed date gotten from backend");
    return;
  }
  console.log("Extracting timestamp", split[1]);
  var d = new Date(seconds * 1000);
  return d;
}


// Perform the call to /history.php?instance=tutorial.
// It also takes care of cleaning/filling the table showing
// the results.
function submit_history(){

  // Clean the table showing old results
  var table = document.getElementById("history");
  /* We don't want to kill the first child */
  for (var i = 2; i < table.childNodes.length; i++)
    table.removeChild(table.childNodes[i]);
  var req = new XMLHttpRequest();
  var get_column = function(value){
    var column = document.createElement("td");
    column.textContent = value;
    return column;
  };
  var on_error = function(){
    table.innerHTML = "<p>Could not get transactions list from server</p>"
  };
  req.open("GET", "/history.php?instance=tutorial", true);
  req.onload = function(){
    if(req.readyState == 4 && req.status == 200){
      console.log("Got history:", req.responseText);
      var history = JSON.parse(req.responseText);
      if(!history)
        console.log("Got invalid JSON");
      if(0 == history.length){
        table.innerHTML = "<p>No transaction was that young!</p>";
      }
      // Fill the table with fresh results
      for (var i=0; i<history.length; i++){
          var entry = history[i];
        var tr = document.createElement("tr");
        tr.appendChild(get_column(entry.order_id));
          var date = get_date(entry.timestamp);
          tr.appendChild(get_column(date.toLocaleDateString()));
          tr.appendChild(get_column(parse_amount(entry.amount)))
          table.appendChild(tr);
      }
      table.style.visibility = "";
    }
    else{
      on_error();
    }
  };
```

```
  req.send();
}
// ../history.php
<?php

  include "helpers.php";
  include "backend.php";
  include "error.php";

  // Just relay the request we got from the JavaScript
  $response = get_to_backend("/history", $_GET);

  if (200 != $response["status_code"]){
    echo build_error($response,
                     "Backend error",
                     $response["status_code"]);
    return;
  }

  // Give the response "verbatim" back.
  echo $response["body"];
?>
```

4 Advanced topics

4.1 Reacting to the presence of a Taler wallet

Taler offers the way to the frontend developer to detect whether a user has the wallet installed in their browser, and take actions accordingly.

4.1.1 The no-JavaScript way

The follwing example shows all that is needed to perform the detection without using JavaScript:

```
<!DOCTYPE html>
<html lang="en" data-taler-nojs="true">
  <head>
    <title>Tutorial</title>
    <link rel="stylesheet"
          type="text/css"
          href="/web-common/taler-fallback.css"
          id="taler-presence-stylesheet" />
  </head>
  <body>
    <p class="taler-installed-hide">
      No wallet found.
    </p>
    <p class="taler-installed-show">
      Wallet found!
    </p>
  </body>
</html>
```

The `taler-fallback.css` is part of the Taler's *web-common* repository, available at `https://git.taler.net/web-common.git`. Please adjust the `href` attribute in order to make it work with your Web site.

The detection works by `taler-fallback.css` hiding any tag from the `taler-installed-show` class, in case no wallet is installed. If otherwise the wallet is installed, the wallet takes action by hiding any tag from the `taler-installed-hide` class and overriding `taler-fallback.css` logic by showing any tag from the `taler-installed-show` class.

4.1.2 The JavaScript way

`taler-wallet-lib.js` helps the frontend, by providing the way to register two callbacks: one to be executed if a wallet is present, the other if it is not. See the example below:

```
<html lang="en">
  <head>
    <script src="/web-common/taler-wallet-lib.js" type="application/javascript">
    </script>
  </head>
  <body>
    <div id="content">
    </div>
    <script type="application/javascript">

      content = document.getElementById("content");
```

```
        p = document.createElement("p");

        function walletInstalled()
          p.textContent = "Wallet installed!";
          content.appendChild(p);

        function walletNotInstalled()
          p.textContent = "Wallet not found.";
          content.appendChild(p);

        taler.onPresent(wallerInstalled);
        taler.onAbsent(wallerNotInstalled);
      </script>
    </body>
  </html>
```

`taler-wallet-lib.js` exports the `taler` object that exposes the `onPresent` and the `onAbsent` functions needed to register the frontend's callbacks. Thus the function `walletInstalled` will be executed whenever a wallet is installed, and `walletNotInstalled` if not. Note that since now we can use JavaScript we can register callbacks that do more than just showing and hiding elements.

4.2 Building Taler proposals

A Taler proposal can specify many details about the transaction. This section describes each of the fields in depth.

amount Specifies the total amount to be paid to the merchant by the customer. The amount is broken up into a *value*, a *fraction* (100.000.000 *fraction* units correspond to one *value*) and the *currency*. For example, `EUR 1.50` would be represented as the tuple `value = 1, fraction = 50000000, currency = "EUR"`.

max_fee This is the maximum total amount of deposit fees that the merchant is willing to pay. If the deposit fees for the coins exceed this amount, the customer has to include it in the payment total. The fee is specified using the same triplet used for *amount*.

max_wire_fee
Maximum wire fee accepted by the merchant (customer share to be divided by the 'wire_fee_amortization' factor, and further reduced if deposit fees are below 'max_fee'). Default if missing is zero.

wire_fee_amortization
Over how many customer transactions does the merchant expect to amortize wire fees on average? If the exchange's wire fee is above 'max_wire_fee', the difference is divided by this number to compute the expected customer's contribution to the wire fee. The customer's contribution may further be reduced by the difference between the 'max_fee' and the sum of the actual deposit fees. Optional, default value if missing is 1. 0 and negative values are invalid and also interpreted as 1.

pay_url Which URL accepts payments. This is the URL where the wallet will POST coins.

fulfillment_url
: Which URL should the wallet go to for obtaining the fulfillment, for example the HTML or PDF of an article that was bought, or an order tracking system for shipments, or a simple human-readable Web page indicating the status of the contract.

order_id
: Alphanumeric identifier, freely definable by the merchant. Used by the merchant to uniquely identify the transaction.

summary
: Short, human-readable summary of the contract. To be used when displaying the contract in just one line, for example in the transaction history of the customer.

timestamp
: Time at which the offer was generated.

pay_deadline
: Timestamp of the time by which the merchant wants the exchange to definitively wire the money due from this contract. Once this deadline expires, the exchange will aggregate all deposits where the contracts are past the *refund_deadline* and execute one large wire payment for them. Amounts will be rounded down to the wire transfer unit; if the total amount is still below the wire transfer unit, it will not be disbursed.

refund_deadline
: Timestamp until which the merchant willing (and able) to give refunds for the contract using Taler. Note that the Taler exchange will hold the payment in escrow at least until this deadline. Until this time, the merchant will be able to sign a message to trigger a refund to the customer. After this time, it will no longer be possible to refund the customer. Must be smaller than the *pay_deadline*.

products
: Array of products that are being sold to the customer. Each entry contains a tuple with the following values:

  description
  : Description of the product.

  quantity
  : Quantity of the items to be shipped. May specify a unit (`1 kg`) or just the count.

  price
  : Price for *quantity* units of this product shipped to the given *delivery_location*. Note that usually the sum of all of the prices should add up to the total amount of the contract, but it may be different due to discounts or because individual prices are unavailable.

  product_id
  : Unique ID of the product in the merchant's catalog. Can generally be chosen freely as it only has meaning for the merchant, but should be a number in the range $[0, 2^{51})$.

  taxes
  : Map of applicable taxes to be paid by the merchant. The label is the name of the tax, i.e. *VAT*, *sales tax* or *income tax*, and the

value is the applicable tax amount. Note that arbitrary labels are permitted, as long as they are used to identify the applicable tax regime. Details may be specified by the regulator. This is used to declare to the customer which taxes the merchant intends to pay, and can be used by the customer as a receipt. The information is also likely to be used by tax audits of the merchant.

delivery_date
: Time by which the product is to be delivered to the *delivery_location*.

delivery_location
: This should give a label in the *locations* map, specifying where the item is to be delivered.

Values can be omitted if they are not applicable. For example, if a purchase is about a bundle of products that have no individual prices or product IDs, the *product_id* or *price* may not be specified in the contract. Similarly, for virtual products delivered directly via the fulfillment URI, there is no delivery location.

merchant

address
: This should give a label in the *locations* map, specifying where the merchant is located.

name
: This should give a human-readable name for the merchant's business.

jurisdiction
: This should give a label in the *locations* map, specifying the jurisdiction under which this contract is to be arbitrated.

locations
: Associative map of locations used in the contract. Labels for locations in this map can be freely chosen and used whenever a location is required in other parts of the contract. This way, if the same location is required many times (such as the business address of the customer or the merchant), it only needs to be listed (and transmitted) once, and can otherwise be referred to via the label. A non-exhaustive list of location attributes is the following:

  country
  : Name of the country for delivery, as found on a postal package, i.e. "France".

  state
  : Name of the state for delivery, as found on a postal package, i.e. "NY".

  region
  : Name of the region for delivery, as found on a postal package.

  province
  : Name of the province for delivery, as found on a postal package.

  city
  : Name of the city for delivery, as found on a postal package.

  ZIP code
  : ZIP code for delivery, as found on a postal package.

  street
  : Street name for delivery, as found on a postal package.

street number
: Street number (number of the house) for delivery, as found on a postal package.

name receiver name for delivery, either business or person name.

Note that locations are not required to specify all of these fields, and it is also allowed to have additional fields. Contract renderers must render at least the fields listed above, and should render fields that they do not understand as a key-value list.

4.3 Inlining proposals in HTTP headers

In the example in Section 2.3 [Prompting for payment], page 4, we told the wallet the URL from where it should fetch the proposal. Instead of specifying the proposal via an URL, it is also possible to inline short proposals directly.

That may be accomplished by the frontend including the `X-Taler-Proposal` HTTP header, whenever the requested page is meant to trigger a payment. The example shown below may be an alternative version of `/donate.php`, which implements inline contracts.

```
// ../inline.php
<?php
  // This file is in the public domain.

  include "order.php";

  $order_id = rand(1,90000); // simplified, do not do this!
  $order = make_order($order_id, new DateTime("now"));

  $response = post_to_backend("/proposal", $order);
  $ret = $response["body"];

  if (200 != $response["status_code"]) {
    $ret =  build_error($response,
                        "Failed to generate proposal",
                        $response["status_code"]);
  }

  http_response_code(402); // Payment required
  header ("X-Taler-Proposal:  $ret"); // Inline proposal
?>
<!DOCTYPE html>
<html lang="en">
  <head>
    <title>Select payment method</title>
  </head>
  <body>
    Here you should put the HTML for the non-Taler (credit card) payment.
  </body>
</html>
```

The wallet will then look for the `X-Taler-Proposal` header, and fetch the inlined contract if this header is found. Please note that this feature is not yet implemented in the wallet.

4.4 Design considerations for the fulfillment page

The fulfillment page mechanism is designed to provide the following two properties:

1. Taler payments *can* be implemented in DB-less frontends.
2. Taler payments are replayable, meaning that each purchase is associated with a URL (the fulfillment URL) that shows the product each time it gets visited (and of course, only the first time takes the user's money).

Both properties are gotten "for free" by the way replayable payments are implemented. Since `pay.php` simply relays payments to the backend, if the latter returns "200 OK", then the frontend delivers what is mentioned in the backend's response. Note that along with the "200 OK" response, the backend returns the whole proposal associated with the fulfillment URL that triggered the payment, so the frontend has all the information useful to pick the right product to deliver. The "payment" relayed to the backend contains the *order id*, that allows the backend to perform all the integrity checks on the payment. This way, the frontend doesn't need any database to replay payments.

4.5 Instances

Taler's design allows a single backend to manage multiple frontends. In other words, we might have multiple shops relying on the same backend. As of terminology, we call *instance* any of the frontends accounted by the same backend.

The backend's RESTful API allows frontends to specify which instance they are. However, this specification is optional, and a "default" instance will be used whenever the frontend does not specify one.

Please note that in this stage of development, the backend's REST call `/history` returns records for *any* instance. The rationale behind is to allow grouping "public" business entities under the same backend.

This way, a single frontend can expose multiple donation buttons for multiple receivers, and still operate against one backend. So in this scenario, there is no harm if the operator of instance 'a' sees history entries related to instance 'b'.

See `https://donations.demo.taler.net/`, which uses this functionality.

4.6 Normalized base URLs

Exchanges and merchants have a base URL for their service. This URL **must** be in a canonical form when it is stored (e.g. in the wallet's database) or transmitted (e.g. to a bank page).

- The URL must be absolute. This implies that the URL has a schema.
- The path component of the URL must end with a slash.
- The URL must not contain a fragment or query.

When a user enters a URL that is, technically, relative (such as "alice.example.com/exchange"), wallets *may* transform it into a canonical base URL ("http://alice.example.com/exchange/"). Other components *should not* accept URLs that are not canonical.

Rationale: Joining non-canonical URLs with relative URLs (e.g. "exchange.example.com" with "reserve/status") results in different and slightly unexpected behavior in some URL handling libraries. Canonical URLs give more predictable results with standard URL joining.

5 Reference

5.1 Headers for HTTP 402

The HTTP status code `402 Payment Required` can be used by the merchant frontend to trigger operations related to payments in the user agent. The user agent associates at most one proposal with every URL via the proposal's `fulfillment_url` field. The associated proposal is either missing (in case it doesn't exist), paid (in case the payment for it was successfully sent to the merchant) or unpaid. If the associated proposal is unpaid, `402 Payment Required` will cause the user agent to pay for the associated proposal.

The following headers for `402 Payment Required` are recognized by Taler and further influence the processing:

`X-Taler-Refund-Url`
: If this header present, the value of this header must be a URL that the user agent can use to request and process refunds.

`X-Taler-Contract-Url`
: If there is no associated proposal, the user agent will fetch a proposal from this URL and process it. This typically prompts the user to agree to pay.

`X-Taler-Offer-Url`
: If there is no associated proposal and `X-Taler-Contract-Url` is not specified, the browser will navigate to this URL.

5.2 JavaScript API

The following functions are defined in the `taler` namespace of the `taler-wallet-lib` helper library available at `https://git.taler.net/web-common.git/tree/taler-wallet-lib.js`.

`onPresent(callback: () => void)`
: Add a callback to be called when support for Taler payments is detected.

`onAbsent(callback: () => void)`
: Add a callback to be called when support for Taler payments is disabled.

`pay({contract_url: string, offer_url: string})`
: Results in the same action as a `402 Payment Required` with `contract_url` in the `X-Taler-Contract-Url` header and `offer_url` in the `X-Taler-Payment-Url` header.

`refund(refund_url: string)`
: Results in the same action as a `402 Payment Required` with `refund_url` in the `X-Taler-Refund-Url` header.

5.3 Stylesheet-based presence detection

Stylesheet-based presence detection will be applied on all pages that have the `data-taler-nojs` attribute of the `html` element set `true`. The default/fallback stylesheet, that will be

taken over by the wallet once installed, must be included with the id `taler-presence-stylesheet`, like this:

The following CSS classes can be used:

`taler-installed-hide`
: A CSS rule will set the `display` property for this class to `none` once the Taler wallet is installed and enabled. If the wallet is not installed, `display` will be `inherit`.

`taler-installed-show`
: A CSS rule will set the `display` property for this class to `inherit` once the Taler wallet is installed and enabled. If the wallet is not installed, `display` will be `none`.

GNU-LGPL

Version 2.1, February 1999

[This is the first released version of the Lesser GPL. It also counts
as the successor of the GNU Library Public License, version 2, hence the
version number 2.1.]

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