GNU Taler Merchant API Tutorial

Release 0.9.0

GNU Taler team

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CONTENTS

CHAPTER

ONE

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 addresses how to process payments using the GNU Taler merchant Backend. The audience for this tutorial are *developers* of merchants (such as Web shops) that are working on integrating GNU Taler with the customer-facing Frontend and the staff-facing Backoffice.

This chapter explains some basic concepts. In the second chapter, you will learn how to do basic payments.

This version of the tutorial has examples for Python3. It uses the `requests` library for HTTP requests. Versions for other languages/environments are available as well.

If you want to look at some simple, running examples, check out these:

- The essay merchant that sells single chapters of a book.
- The donation page that accepts donations for software projects and gives donation receipts.
- The survey that gives users who answer a question a small reward.
- The WooCommerce plugin which is a comprehensive integration into a Web shop including the refund business process.

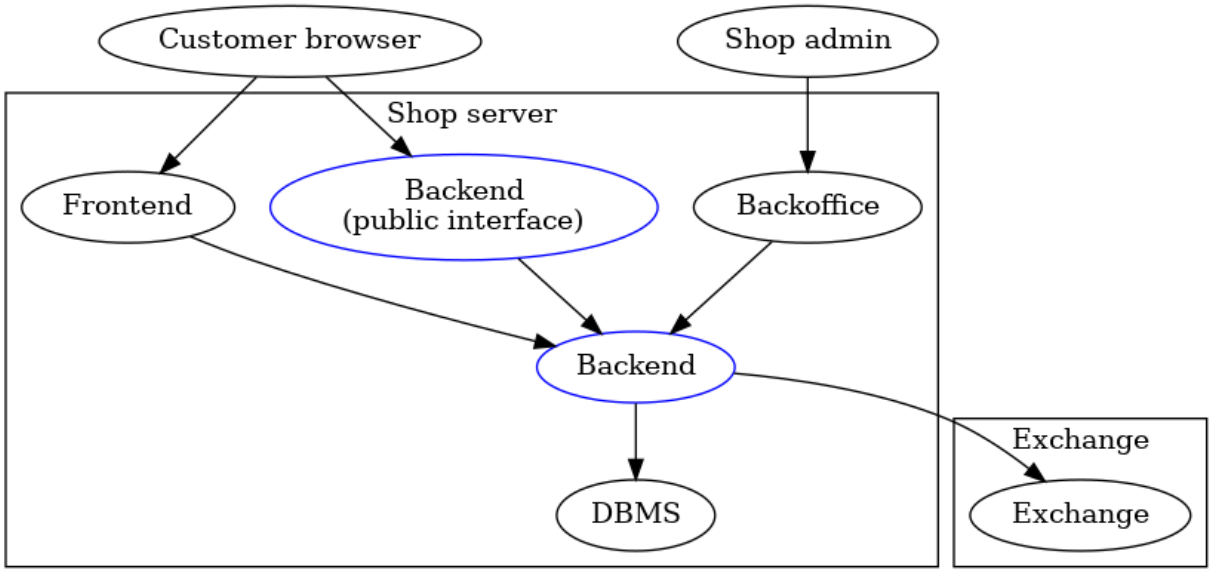
1.3 Architecture overview

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 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 sandbox backend. For production use, you must either set up your own backend or ask another person to do so for you.

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



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.

Some functionality of the backend (the "public interface") is exposed to the customer's browser directly. In the HTTP API, all private endpoints (for the Backoffice) are prefixed with `/private/`. This tutorial focuses on the `/private/` endpoints. The public interface is directly used by the wallet and not relevant for the merchant (other than that the API must be exposed).

1.4 Public Sandbox Backend and Authentication

How the frontend authenticates to the Taler backend depends on the configuration. See taler-merchant-manual.

The public sandbox backend https://backend.demo.taler.net/ uses an API key in the `Authorization` header. The value of this header must be `Bearer secret-token:sandbox` for the public sandbox backend.

```
>>> import requests
>>> requests.get("https://backend.demo.taler.net/private/orders",
...              headers={"Authorization": "Bearer secret-token:sandbox"})
<Response [200]>
```

If an HTTP status code other than 200 is returned, something went wrong. You should figure out what the problem is before continuing with this tutorial.

The sandbox backend https://backend.demo.taler.net/ uses `KUDOS` as an imaginary currency. Coins denominated in `KUDOS` can be withdrawn from https://bank.demo.taler.net/.

1.5 Merchant Instances

A single Taler merchant backend server can be used by multiple merchants that are separate business entities. Each of these separate business entities is assigned a *merchant instance* which is identified by an alphanumeric *instance id*. If the instance is omitted, the instance id `default` is assumed.

The following merchant instances are configured on https://backend.demo.taler.net/:

- `GNUnet` (The GNUnet project), reachable at https://backend.demo.taler.net/instances/gnunet/
- `FSF` (The Free Software Foundation), reachable at https://backend.demo.taler.net/instances/fsf/
- `Tor` (The Tor Project), reachable at https://backend.demo.taler.net/instances/tor/
- `default` (Kudos Inc.), reachable at https://backend.demo.taler.net/

Note: These are fictional merchants used for our demonstrators and not affiliated with or officially approved by the respective projects.

All endpoints for instances offer the same API. Thus, which instance to be used is simply included in the base URL of the merchant backend.

CHAPTER

TWO

MERCHANT PAYMENT PROCESSING

2.1 Creating an Order for a Payment

Payments in Taler revolve around an *order*, which is a machine-readable description of the business transaction for which the payment is to be made. Before accepting a Taler payment as a merchant you must create such an order.

This is done by POSTing a JSON object to the backend's `/private/orders` API endpoint. At least the following fields must be given inside the `order` field:

- `amount`: The amount to be paid, as a string in the format `CURRENCY:DECIMAL_VALUE`, for example `EUR:10` for 10 Euros or `KUDOS:1.5` for 1.5 KUDOS.
- `summary`: A human-readable summary for what the payment is about. The summary should be short enough to fit into titles, though no hard limit is enforced.
- `fulfillment_url`: A URL that will be displayed once the payment is completed. For digital goods, this should be a page that displays the product that was purchased. On successful payment, the wallet automatically appends the `order_id` as a query parameter, as well as the `session_sig` for session-bound payments (discussed below).

Orders can have many more fields, see *The Taler Order Format*. When POSTing an order, you can also specify additional details such as an override for the refund duration and instructions for inventory management. These are rarely needed and not covered in this tutorial; please see the core/api-merchant reference manual for details.

A minimal Python snippet for creating an order would look like this:

```
>>> import requests
>>> body = dict(order=dict(amount="KUDOS:10",
...                        summary="Donation",
...                        fulfillment_url="https://example.com/thanks.html"),
...             create_token=False)
>>> response = requests.post("https://backend.demo.taler.net/private/orders",
...                json=body,
...                headers={"Authorization": "Bearer secret-token:sandbox"})
<Response [200]>
```

The backend will fill in some details missing in the order, such as the address of the merchant instance. The full details are called the *contract terms*.

Note: The above request disables the use of claim tokens by setting the `create_token` option to `false`. If you need claim tokens, you must adjust the code to construct the `taler://pay/` URI given below to include the claim token.

After successfully `POST`ing to `/private/orders`, a JSON with just an `order_id` field with a string representing the order ID will be returned. If you also get a claim token, please double-check that you used the request as described

above.

Together with the merchant `instance`, the order id uniquely identifies the order within a merchant backend. Using the order ID, you can trivially construct the respective `taler://pay/` URI that must be provided to the wallet. Let `example.com` be the domain name where the public endpoints of the instance are reachable. The Taler pay URI is then simply `taler://pay/example.com/$ORDER_ID/` where `$ORDER_ID` must be replaced with the ID of the order that was returned.

You can put the `taler://` URI as the target of a link to open the Taler wallet via the `taler://` schema, or put it into a QR code. However, for a Web shop, the easiest way is to simply redirect the browser to `https://example.com/orders/$ORDER_ID`. That page will then trigger the Taler wallet. Here the backend generates the right logic to trigger the wallet, supporting the various types of Taler wallets in existence. Instead of constructing the above URL by hand, it is best to obtain it by checking for the payment status as described in the next section.

2.2 Checking Payment Status and Prompting for Payment

Given the order ID, the status of a payment can be checked with the `/private/orders/$ORDER_ID` endpoint. If the payment is yet to be completed by the customer, `/private/orders/$ORDER_ID` will give the frontend a URL (under the name `payment_redirect_url`) that will trigger the customer's wallet to execute the payment. This is basically the `https://example.com/orders/$ORDER_ID` URL we discussed above.

Note that the best way to obtain the `payment_redirect_url` is to check the status of the payment, even if you know that the user did not pay yet. There are a few corner cases to consider when constructing this URL, so asking the backend to do it is the safest method.

```
>>> import requests
>>> r = requests.get("https://backend.demo.taler.net/private/orders/" + order_id,
...                  headers={"Authorization": "Bearer secret-token:sandbox"})
>>> print(r.json())
```

If the `order_status` field in the response is `paid`, you will not get a `payment_redirect_url` and instead information about the payment status, including:

- `contract_terms`: The full contract terms of the order.
- `refunded`: `true` if a (possibly partial) refund was granted for this purchase.
- `refunded_amount`: Amount that was refunded

Once the frontend has confirmed that the payment was successful, it usually needs to trigger the business logic for the merchant to fulfill the merchant's obligations under the contract.

Note: You do not need to keep querying to notice changes to the order's transaction status. The endpoints support long polling, simply specify a `timeout_ms` query parameter with how long you want to wait at most for the order status to change to `paid`.

CHAPTER

THREE

GIVING REFUNDS

A refund in GNU Taler is a way to "undo" a payment. It needs to be authorized by the merchant. Refunds can be for any fraction of the original amount paid, but they cannot exceed the original payment. Refunds are time-limited and can only happen while the exchange holds funds for a particular payment in escrow. The time during which a refund is possible can be controlled by setting the `refund_deadline` in an order. The default value for this refund deadline is specified in the configuration of the merchant's backend.

The frontend can instruct the merchant backend to authorize a refund by `POST`ing to the `/private/orders/$ORDER_ID/refund` endpoint.

The refund request JSON object has only two fields:

- `refund`: Amount to be refunded. If a previous refund was authorized for the same order, the new amount must be higher, otherwise the operation has no effect. The value indicates the total amount to be refunded, *not* an increase in the refund.
- `reason`: Human-readable justification for the refund. The reason is only used by the Back Office and is not exposed to the customer.

If the request is successful (indicated by HTTP status code 200), the response includes a `taler_refund_uri`. The frontend must redirect the customer's browser to that URL to allow the refund to be processed by the wallet.

This code snipped illustrates giving a refund:

```
>>> import requests
>>> refund_req = dict(refund="KUDOS:10",
...                   reason="Customer did not like the product")
>>> requests.post("https://backend.demo.taler.net/private/orders/"
...               + order_id + "/refund", json=refund_req,
...               headers={"Authorization": "Bearer secret-token:sandbox"})
<Response [200]>
```

Note: After granting a refund, the public `https://example.com/orders/$ORDER_ID` endpoint will change its wallet interaction from requesting payment to offering a refund. Thus, frontends may again redirect browsers to this endpoint. However, to do so, a `h_contract` field must be appended (`?h_contract=$H_CONTRACT`) as the public endpoint requires it to authenticate the client. The required `$H_CONTRACT` value is returned in the refund response under the `h_contract` field.

CHAPTER

FOUR

REPURCHASE DETECTION AND FULFILLMENT URLS

A possible problem for merchants selling access to digital articles is that a customer may have paid for an article on one device, but may then want to read it on a different device, possibly one that does not even have a Taler wallet installed.

Naturally, at this point the customer would at first still be prompted to pay for the article again. If the customer then opens the `taler://` link in the wallet that did previously pay for the article (for example by scanning the QR code on the desktop with the Android App), the wallet will claim the contract, detect that the fulfillment URL is identical to one that it already has made a payment for in the past, and initiate **repurchase redirection**: Here, the wallet will contact the merchant and replay the previous payment, except this time using the (current) session ID of the browser (it learns the session ID from the QR code).

The merchant backend then updates the session ID of the existing order to the current session ID of the browser. When the payment status for the "new" unpaid order is checked (or already in long-polling), the backend detects that for the browser's *session ID* and *fulfillment URL* there is an existing paid contract. It then tells the browser to immediately redirect to the fulfillment URL where the already paid article is available.

To ensure this mechanism works as designed, merchants must make sure to not use the same fulfillment URL for different products or for physical products where customers may be expected to buy the article repeatedly. Similarly, it is crucial that merchants consistently use the same fulfillment URL for the same digital product where repurchase detection is desired.

Note that changing the session ID to a different device requires the involvement of the wallet that made the payment, thus reasonably limiting the possibility of broadly sharing the digital purchases. Repurchase detection is also *only* done for HTTP(S) fulfillment URLs. In particular, this means fulfillment URIs like `taler://fulfillment-success/$MESSAGE` are not considered to identify a resource you can pay for and thus do not have to be unique.

CHAPTER

FIVE

GIVING CUSTOMERS REWARDS

GNU Taler allows Web sites to grant digital cash directly to a visitor. The idea is that some sites may want incentivize actions such as filling out a survey or trying a new feature. It is important to note that receiving rewards is not enforceable for the visitor, as there is no contract. It is simply a voluntary gesture of appreciation of the site to its visitor. However, once a reward has been granted, the visitor obtains full control over the funds provided by the site.

The merchant backend of the site must be properly configured for rewards, and sufficient funds must be made available for rewards. See the Taler User Guide for details.

To check if rewards are configured properly and if there are sufficient funds available for granting rewards, query the `/private/reserves` endpoint:

```
>>> import requests
>>> requests.get("https://backend.demo.taler.net/private/reserves",
...              headers={"Authorization": "Bearer secret-token:sandbox"})
<Response [200]>
```

Check that a reserve exists where the `merchant_initial_amount` is below the `committed_amount` and that the reserve is `active`.

To authorize a reward, `POST` to `/private/rewards`. The following fields are recognized in the JSON request object:

- `amount`: Amount that should be given to the visitor as a reward.
- `justification`: Description of why the reward was granted. Human-readable text not exposed to the customer, but used by the Back Office.
- `next_url`: The URL that the user's browser should be redirected to by the wallet, once the reward has been processed.

The response from the backend contains a `taler_reward_url`. The customer's browser must be redirected to this URL for the wallet to pick up the reward.

This code snipped illustrates giving a reward:

```
>>> import requests
>>> reward_req = dict(amount="KUDOS:0.5",
...                   justification="User filled out survey",
...                   next_url="https://merchant.com/thanks.html")
>>> requests.post("https://backend.demo.taler.net/private/rewards", json=reward_req,
...              headers={"Authorization": "Bearer secret-token:sandbox"})
<Response [200]>
```

CHAPTER

SIX

ADVANCED TOPICS

6.1 Session-Bound Payments

Sometimes checking if an order has been paid for is not enough. For example, when selling access to online media, the publisher may want to be paid for exactly the same product by each customer. Taler supports this model by allowing the mechant to check whether the "payment receipt" is available on the user's current device. This prevents users from easily sharing media access by transmitting a link to the fulfillment page. Of course, sophisticated users could share payment receipts as well, but this is not as easy as sharing a link, and in this case they are more likely to just share the media directly.

To use this feature, the merchant must first assign the user's current browser an ephemeral `session_id`, usually via a session cookie. When executing or re-playing a payment, the wallet will receive an additional signature (`session_sig`). This signature certifies that the wallet showed a payment receipt for the respective order in the current session.

Session-bound payments are triggered by passing the `session_id` parameter to the `/check-payment` endpoint. The wallet will then redirect to the fulfillment page, but include an additional `session_sig` parameter. The frontend can query `/check-payment` with both the `session_id` and the `session_sig` to verify that the signature is correct.

The last session ID that was successfully used to prove that the payment receipt is in the user's wallet is also available as `last_session_id` in the response to `/check-payment`.

6.2 Product Identification

In some situations the user may have paid for some digital good, but the frontend does not know the exact order ID, and thus cannot instruct the wallet to reveal the existing payment receipt. This is common for simple shops without a login system. In this case, the user would be prompted for payment again, even though they already purchased the product.

To allow the wallet to instead find the existing payment receipt, the shop must use a unique fulfillment URL for each product. Then, the frontend must provide an additional `resource_url` parameter to to `/check-payment`. It should identify this unique fulfillment URL for the product. The wallet will then check whether it has paid for a contract with the same `resource_url` before, and if so replay the previous payment.

6.3 The Taler Order Format

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

Financial amounts are always specified as a string in the format `"CURRENCY:DECIMAL_VALUE"`.

amount
: Specifies the total amount to be paid to the merchant by the customer.

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 format 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. Zero 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 (e.g. `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:

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

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

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

Note: Locations are not required to specify all of these fields, and they 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.

APPENDIX

A

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A.1 0. PREAMBLE

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INDEX