GraphQL Documentation

This document goes over Xledger's GraphQL API, first added back in 2017. If you are unfamiliar with the concepts in GraphQL, we suggest checking out the tutorials here. In this document, we'll assume you are familiar with the basics, and cover:

- How to explore the Xledger Schema
- How to connect to the API programmatically
- Querying: Filtering, sorting, pagination
- A few Xledger specific concepts

Note: This document will assume you are trying to connect to www.xledger.net. If you are connecting to a test environment (for example, test.xledger.net), replace the hostname of the URLs in this document accordingly.

Norwegian customers, partners and third parties who use Xledger's GraphQL API must ensure compliance with the guidelines described in "Retningslinjer for bruk av Xledger sitt integrasjonsgrensesnitt."

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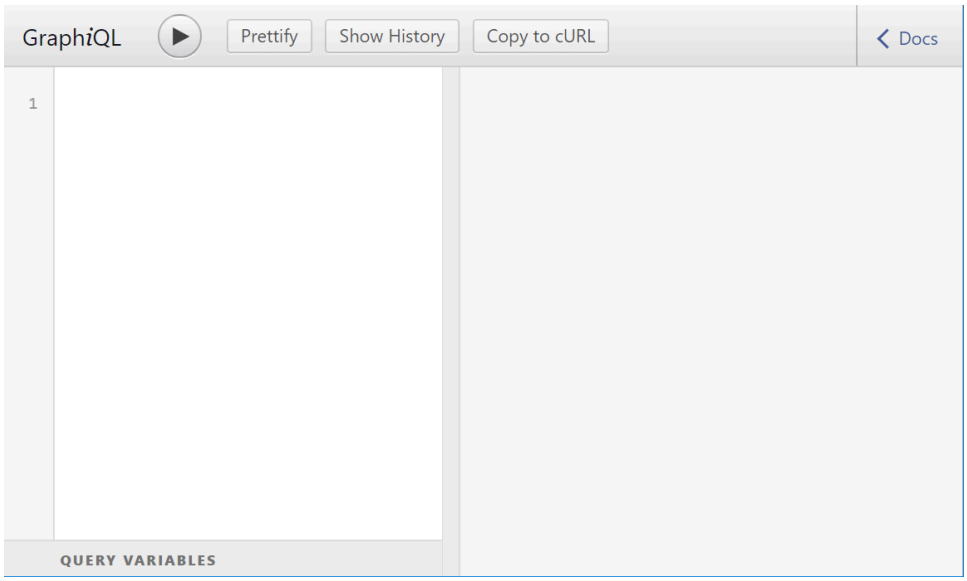
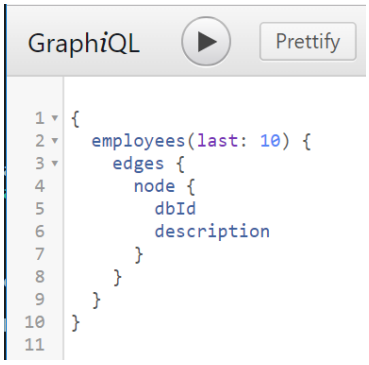
Exploring the Schema

To be able to start exploring the schema, you need to have access to the "Administrator", “Domain Administrator”, or “Implementation Manager” roles in Xledger. After you have logged in and switched to that role, navigate to www.xledger.net/GraphQL to begin. You should then see something like this:



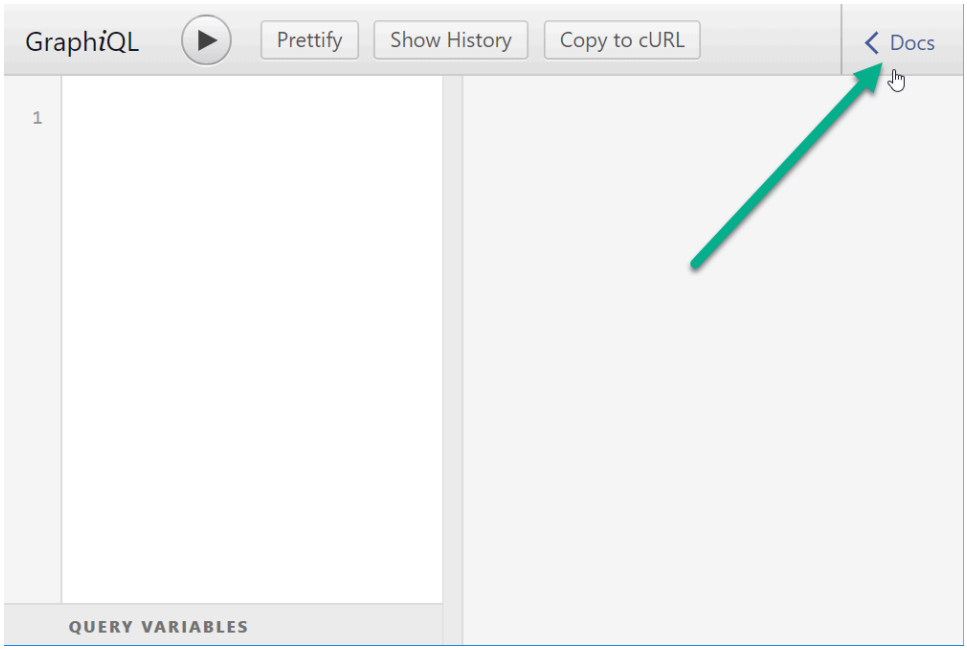
Note: If you have not logged in with the right credentials, you'll get an error saying you do not have access to GraphQL.

Try typing in a query like this, and then hit the Play button:

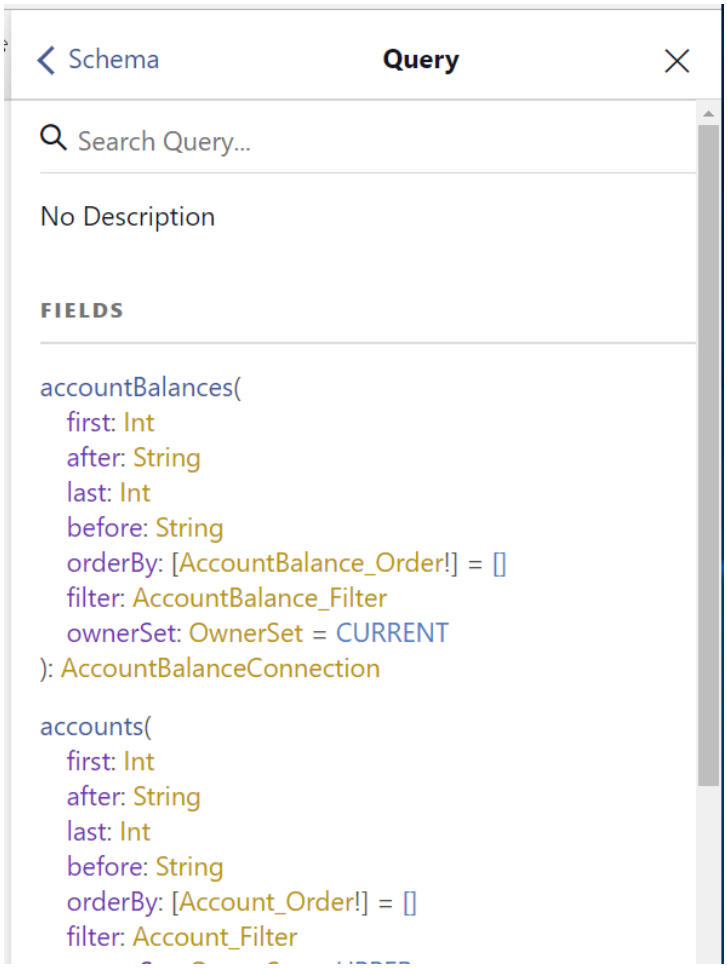


You should see a JSON response of employees to the right.

To view the schema, click on the "Docs" button in the top right:



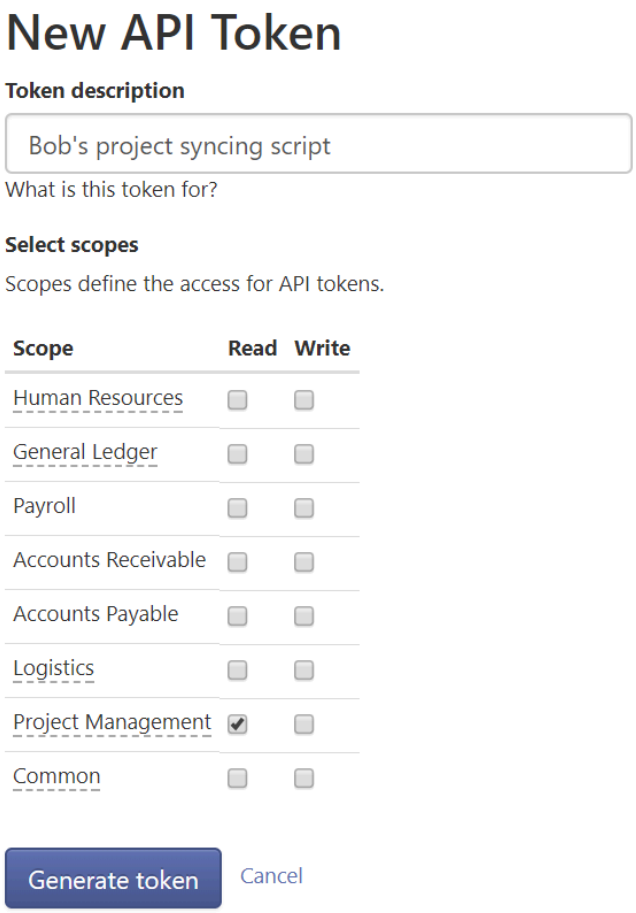
If you then click on query, you'll see a list of the top-level fields that are available:



Connecting to the API Programmatically

To connect to the API programmatically, first go to this screen to create an API token:

https://www.xledger.net/f/api-tokens



You will be able to create a token, give it a name, and select what type of information it has access to. Once you have a token, you can make a request like this:

Uri	`https://www.xledger.net/graphql`	
HTTP Method	POST	
Header: Authorization	`token <your-token-here>`	
Body	`{ "query": "<your-query-string>", "variables": <variables object or null>, "operationName": <operation name or null>}`	JSON

Example using cURL:

```
curl -H "Authorization: token <your-token-here>"
      https://master.xlabs.com/graphql --data-binary '{"query": "{
```

```
employees(last: 10) { edges { node { dbId description } } }
}","variables":null,"operationName":null}'
```

Here is a basic example that shows how to connect to the API, and loop through a list of employees in C# (open in LINQPad).

Querying: Sorting and Filtering

GraphQL queries in Xledger come in two forms: one for fetching a single record, and one for fetching multiple. For example, the type "Employee" has both top level fields, "employee(…)" for fetching 1 by id, and "employees(…)" to fetch many.

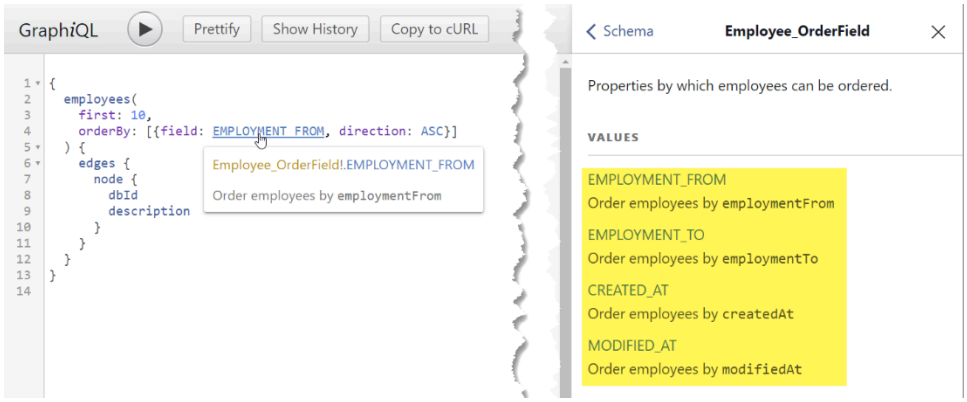
Fetching one by Id	Fetch many

`employee(dbId: 130482) {`
`  dbId`
`  description`
`  dateFrom`
`  dateTo`
`}`
	`employees(last: 10) {`
	`  edges {`
	`  node {`
	`  dbId`
	`  description`
	`  }`
	`  }`
	`}`

When fetching many, for some types you can specify the order to get them back in. For example, if you wanted to fetch the 10 employees with the earliest start date, you would issue this query:

```
{
  employees(
    first: 10,
    orderBy: [{field: EMPLOYMENT_FROM, direction: ASC}]
  ) {
    edges {
      node {
        dbId
        description
      }
    }
  }
}
```

If you click on the "EMPLOYMENT_FROM" field, you can see a list of other fields you can sort on:



To filter the results, you can specify the "filter" argument. For example, to only return results modified since January 1, 2017, issue this query:

```
{
  employees(
    first: 10,
    orderBy: [{field: EMPLOYMENT_FROM, direction: ASC}],
    filter: { modifiedAt_gte: "2017-01-01"}
  ) {
    edges {
      node {
        dbId
        description
      }
    }
  }
}
```

Filters can be combined with other filters by using "AND" or "OR" and then specifying a list of conditions. For example, this query will get rows that either have been modified since January 1, 2017, or where the `dateTo` is less than December 31, 2017:

```
{
  employees(
    first: 10,
    orderBy: [{field: EMPLOYMENT_FROM, direction: ASC}],
    filter:
     { OR: [{ modifiedAt_gte: "2017-01-01" }
            { dateTo_lt: "2017-12-31" }]}
  ) {
    edges {
      node {
        dbId
        description
      }
    }
  }
}
```

Querying: OwnerSet and Object Status

Many concepts in Xledger are defined in a hierarchical fashion, so that a company can see rows defined above or below them in the owner hierarchy. For types where this makes sense, we add an argument for "ownerSet". For example, is a query for products that only looks at the current level (instead of UPPER, which is the default in this case):

```
{
  products(
    first: 10
    ownerSet: CURRENT
  ) {
    edges {
      node {
        id
        description
      }
    }
  }
}
```

Similarly, many concepts in Xledger have the notion of an "object status", where objects can be closed or opened at will. For types where this applies, we add an "objectStatus" field which can be either OPEN (the default), CLOSED, or ALL.

Querying: Pagination

For pagination, Xledger supports the Relay pagination specification. To give this a try, modify the earlier employee query, adding these parts:

```
{
  employees(first: 10) {
    pageInfo {
      hasNextPage
    }
    edges {
      cursor
      node {
        dbId
        description
      }
    }
  }
}
```

When you hit play, you will then get a field indicating whether there is a next page of results, as well as a cursor. If there is a next page, and you want to get the next one, specify the "after" field, and use one of the cursors (for example, the last one) to get the first N records after that one. For example:

```
{
  employees(first: 10, after: "124813.124929.124998") {
    pageInfo {
      hasNextPage
    }
    edges {
      cursor
      node {
        dbId
        description
      }
    }
  }
}
```

If you want to go backwards instead, you can the "last" and "before" fields instead of "first" and "after".

Querying: History

Some resources in Xledger are audit friendly, in that changes made to them get logged. For these, you can access the changes by using the `_changes` meta field:

```
{
  subledgers(last: 1000) {
    edges {
      node {
        id
        _changes(last: 10) {
          edges {
            node {
              description
              code
              modifiedAt
              changeType
              changedByUser { description }
            }
          }
        }
      }
    }
  }
}
```

The results will be sorted chronologically, and will have a non-null value for the fields you fetch (e.g., `description`) if that field was inserted or updated. If it did not change in an update, it will be `null`. The `changeType` special field will always have a value.

Alternatively, if you want to see all changes to a resource, not starting from an individual instance, you can use the appropriate connection field, e.g., `subledger_changes`.

Rate Limiting

The Xledger GraphQL API has 3 kinds of rate limits, each with a different purpose.

1. Burst request limit

There is a limit on how many requests you can start in a 5 second window. If you start more than 20 requests in that window, you will start getting errors (code = 'BAD_REQUEST.BURST_LIMIT_REACHED').

This rate limit is based on the owner of the API token being used.

2. Concurrent request limit

As of March 8, 2024, Xledger enforces a limit of how many outstanding requests you can have. After you get above this new limit of 6 outstanding requests, you should wait until one of them completes before starting a new one. If you don't, you will start getting errors (code = bad_request.concurrency_limit_reached).

If you can't easily track how many outstanding requests you have, the simplest way to handle this rate limit is to just add something like this to your code that is sending requests:

```
if error.code = 'BAD_REQUEST.CONCURRENCY_LIMIT_REACHED':
   sleep(1000)
   retry()
```

In order to be effective against programs controlling multiple API keys for different owners, this one is based on the user that created the API token being used.

3. Credit limit

Each GraphQL query gets a cost associated with it based on the number of fields selected, number of sub-selections, number of rows requested, etc. Credits usage is stored in 1 hour windows are stored in 1 hour windows. After you run out of credits, you will get errors with the code BAD_REQUEST.INSUFFICIENT_CREDITS until the next 1 hour window. To see how much a query costs, how many credits your company has remaining, and when the credits will reset, query for the special field `rateLimit`:

```
{
  rateLimit {
    cost
    limit
    resetAt
    remaining
  }

  employees(first: 10) {
    edges {
      cursor
      node {
        dbId
        description
      }
    }
  }
}
```

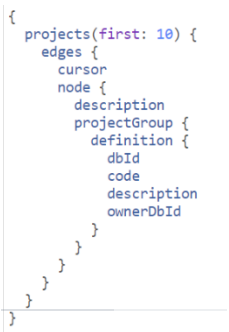
Mutations also have a cost, but unfortunately, you cannot query this field in a mutation, since one request cannot mix queries and mutations in GraphQL.

Conserving Credits

To conserve credits, be tactical with the kind of queries you make.

If you need to sync data, instead of querying for and updating every record, consider asking for only the records that have been modified in the last N (hours/days).

When asking for data in related registers, make sure you are not repeating information. For example, instead of writing queries like Figure 1, write a query that just fetches the projects and the dbId of the projectGroups, and then fetch the projectGroups in the next query.



In some cases, you can also start from “header” rows, and then get the details for each (like SalesOrder and SalesOrderDetail), which would achieve the same result.

When asking for a lot of data, (e.g., downloading all your transactions), make sure you are using the biggest page size you can (10 000). The query cost does not scale linearly with the number of rows, so this will be much more efficient credits-wise.

When in doubt, keep asking for the rateLimit field, and pay attention to the “cost” in the response as you make changes to the query.

Example Application A

Here is an example application that randomly generates and inserts contacts, all while respecting the credit and burst limit, and firing requests as quickly as possible:

http://share.linqpad.net/cbcexe.linq

Note how this program doesn't hardcode all the delays - it just keeps making requests until it gets told to wait, and then it adds a delay before continuing. As you can see, this is simple to do by just reacting to the error messages. The benefit of this approach is that it will keep acting optimally if the GraphQL rate limits are relaxed(*).

* They are relaxed for credits at night time CET - see 'slackPeriods' in the schema documentation.

Note: This example is not yet up to date with the newest rate limit (the concurrency limit).

Example Application B

Here is an example application that synchronizes project to a Sqlite Database in C#. Notice how it works in three phases:

https://github.com/xledger/graphql-samples/tree/master/Webhooks-CSharp

1) Full Sync
2) Incremental Sync
3) Maintaining sync via webhooks.

This example is up to date as of 6/24/2024, and respects the newest rate limit (the concurrency limit).

Mutations

Mutations in Xledger are fairly self-explanatory, but here are a couple of examples.

Adding a new supplier:

```
mutation {
  addSupplier(code: "WATTO", description: "Watto's Emporium") {
    dbId
  }
}
```

Updating a supplier by Id:

```
mutation {
  updateSupplier(dbId: 23538892, code: "WATTOS" ) {
    dbId
  }
}
```

File Attachments

For some mutations, you may want to attach a file with the request. Examples of this would be `InvoiceBase` and `ExpenseBase`. To do this:

1. Instead of sending a pure JSON request, change to sending a Multipart request.
2. Add one or more file content parts
3. Add a final part (with `Content-Type: “application/json”`). This part can refer to filenames you provided in step 2.

Here is an example in C#: (LINQPad link)

```
async Task<string> MakeRequest() {
    var image_path = @"C:\Users\Bob\Desktop\obi.jpg";

    using (var client = new HttpClient())
    using (var content = new MultipartFormDataContent()) {
        if (!client.DefaultRequestHeaders.TryAddWithoutValidation("Authorization", $"token {TOKEN}")) {
            throw new Exception("Could not add header");
        }

        content.Add(new StreamContent(new FileStream(image_path, FileMode.Open)), "obi", "obi.jpg");

        var json = new Dictionary<string, object> {
            ["query"] = @"mutation {
  addExpenseBase(attachment: ""obi.jpg"", employeeId: 129796) {
    dbId
  }
}"
        };

        var json_str = Newtonsoft.Json.JsonConvert.SerializeObject(json);

        content.Add(new StringContent(json_str, Encoding.UTF8, "application/json"), "content", "content2");

        using (var message = await client.PostAsync("https://www.xledger.net/graphql", content)) {
            var input = await message.Content.ReadAsStringAsync();
            return input;
        }
    }
}
```

If you have done everything correctly, the raw request will look something like this:

```
POST http://[illegible]/graphql HTTP/1.1
Authorization: token AAAAEAAEKgAAAAAAAN[illegible]
Content-Type: multipart/form-data; boundary="d75531ae-5f1c-484a-b87f-ab877acc5683"
Host: [illegible]
Content-Length: 58719
Expect: 100-continue
Connection: Keep-Alive

--d75531ae-5f1c-484a-b87f-ab877acc5683
Content-Disposition: form-data; name=obi; filename=obi.jpg; filename*=utf-8''obi.jpg

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```

Figur 1 - The beginning of the request

```
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□□c□□X□□%□UbJ□□□O□vI□L□□b□□K+□9□6□'□<□□T□'□□□□□n7□□□□□=□hF□□□ □o□□U□□□6□□□.□□y□□□|□
□□□m□6□8□□z□□□M□□□□□B□4`□□□□□□□□□□GJ(□□□□□□□-1Ih□□;□□P□□□%□?□□
--d75531ae-5f1c-484a-b87f-ab877acc5683
Content-Type: application/json; charset=utf-8
Content-Disposition: form-data; name=content; filename=content2; filename*=utf-8''content2

{"query":"mutation {\r\n  addExpenseBase(attachment: \"obi.jpg\", employeeId: 129796) {\r\n\tdbId\r\n  }\r\n}"}
--d75531ae-5f1c-484a-b87f-ab877acc5683--
```
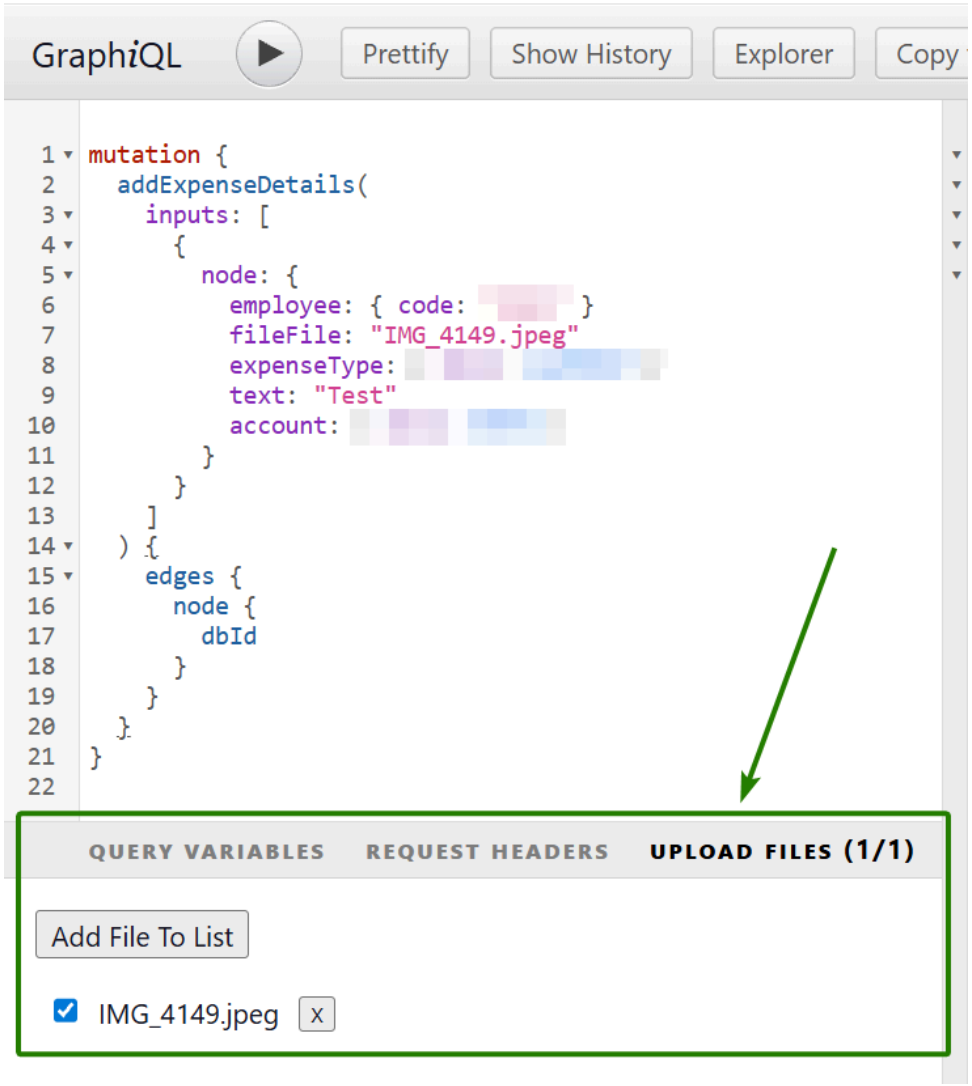

Figur 2 - The end of the request

This can be tested within the GraphiQL interface via the Uploaded Files tab at the bottom of the screen. Add a file to the list, then refer to it in your mutation:



Updating multiple records in one request

To create or update multiple records in one request, use the bulk mutation fields (e.g., addProjects, updateProjects) and send multiple inputs. For example:

```graphql
mutation ($newProjects: [AddProjectsInput!]!) {
  addProjects(inputs: $newProjects) {
    edges {
      node {
        dbId
      }
    }
  }
}
```

QUERY VARIABLES REQUEST HEADERS

```json
{
  "newProjects": [
    {
      "clientId": "project1",
      "node": {
        "description": "Community Park Renovation",
        "subledger": { "code": "CPR-2025" }
      }
    },
    {
      "clientId": "project2",
      "node": {
        "description": "Water Sanitization",
        "subledger": { "code": "FLINTMI" }
      }
    },
    {
      "clientId": "project3",
      "node": {
        "description": "Public Library Expansion",
        "subledger": { "code": "LIB-EXP-03" }
      }
    }
  ]
}
```

You can use what you pass for clientId to correlate the results in the response.

Idempotent Mutations

For sensitive operations (for example, mutating records that will cause money to be moved), it is important that they only happen one time. Something that makes this hard is that when more than one computer is involved, there is no way to guarantee that a request won't be interrupted in transit.

How does one ensure that an operation only happens once under these conditions? This is where idempotency keys come in. To use this feature, first generate a unique value (for example, a random uuid) up to 64 characters long. When you are sending this request, add the header '`X-XL-Idempotency-Key`' with that value. When you add that header, here is what will happen:

1. Mutation with Idempotency Key "Foo123" sent
2. Xledger checks - Have we seen a request with idempotency key "Foo123" before(*)?
    a. If yes:
        i. Validate that the request matches the last one we saw (this helps ensure you are writing correct programs)
        ii. Send the cached response to the client
    b. If not:
        i. Mark idempotency key "Foo123" as processing
        ii. Process the request
        iii. Save the result
        iv. Send the result back to the client

* - Idempotency key responses are kept for 24 hours.

Here is an example of how you might write your code to take advantage of this feature (in pseudocode):

```
let completed = false;
let idempotencyKey = randomUUID();
let request = createRequest();

do {
  let response = send(request, idempotencyKey);
  let stillProcessing = false;
  let badIdempotencyKey = false;

  for err in response.errors {
        case err.code
        | "BAD_REQUEST.IDEMPOTENCY_KEY_MISMATCH":
          badIdempotencyKey = true
        | "STILL_PROCESSING":
          stillProcessing = true;
        | _ :
```

```
            throw "Unknown error {err.code}"
    }

    if badIdempotencyKey {
            idempotencyKey = randomUUID();
            continue;
    }

    if stillProcessing {
            sleep(seconds: 5);
            continue;
    }
    processReponse(response);
    completed = true;
} while (!completed);
```

Subscriptions

Subscriptions is a feature of GraphQL that allows you to get notifications in real time in response to events (such as records being inserted, updated or deleted). The GraphQL specification does not specify which transport mechanism one should use for subscriptions, but we decided on starting with websockets, since that is the easiest to implement robustly - we think both for us, and for our customers.

Getting started with subscriptions

Here are the steps you need to take to start using subscriptions:

1. Send a WebSocket handshake request (GET /graphql) to the endpoint you want to connect to (for example: www.xledger.net)
    a. This request should have the `Authorization : "token {apiToken}"` header, like normal GraphQL query/mutation requests.
2. After connecting, you have 30 seconds to start a subscription before your inactive connection will be closed by the server. To start a subscription, send a message in the following form:

```
{
        "type":"start",
        "id":1,
        "payload":{
            "query":"subscription { projectsMutated { edges { node {
description } } } }",
            "variables":null
        }
}
```

The **query** above should of course be the subscription query that you want to get notifications for. The **id** above is unique in the context of a connection, and allows a client to start many concurrent subscriptions on a single socket, and then identify which subscription they get a message for, as well as stopping it at

any time. After starting a subscription like the above, you will get messages like this when the relevant events occur:

```
{
    "type":"data",
    "id":1,
    "payload":{
        "data":{
            "projectsMutated":{
                "edges":[
                    {"node":{"description":"Acme Company"}}
                ]
            }
        }
    }
}
```

3. If you want to stop a subscription, you can send a message like this with the **id** of the subscription you want to stop:

```
{
    "type":"stop",
    "id":1
}
```

Note: If your websocket connection is closed, all subscriptions are stopped automatically.

Special messages

If an error occurs, you will get a message in this form:

```
{
    "type":"error",
    "payload":{
        "errors":[
            {
                "message":"Something went awry."
            }
        ]
    }
}
```

Another message you may get is a 'keep-alive' message, which we may send periodically to prevent the websocket connection from closing. It will look like this:

```
{ “type”: “ka” }
```

You may safely ignore it.

Subscriptions and API Credits

API Credits are charged with subscriptions in three different ways:

1. A client is charged when a web socket is opened (5 credits).

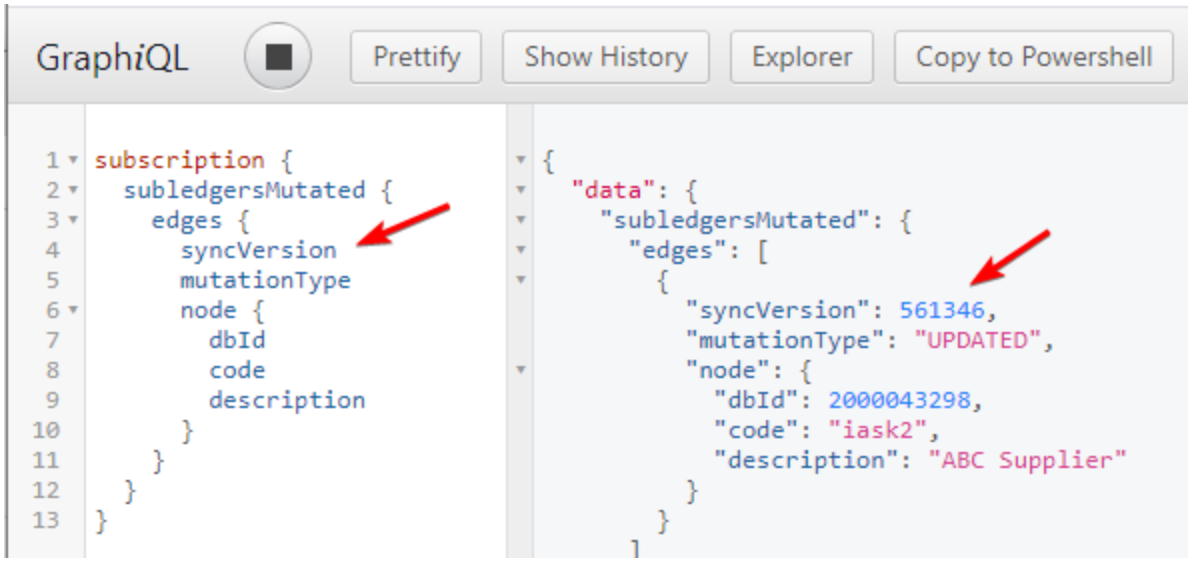
2. A client is charged for each minute a subscription is active (0.5 credits).

3. A client is charged by the complexity of the query when returning data for a subscription (as though the subscription were a regular query).

If the server's attempt to charge a client one of those credit costs would take that client beyond their hourly limit, the server will report an error and close the connection.

Surviving disconnects

To make you get all messages, and can process all notifications in case you get disconnected, ask for the syncVersion field:



If you keep track of the latest syncVersion you have seen, you can provide it when starting the subscription (via the “lastSyncVersion” argument), and we will send you all the notifications that have happened since then. You have up to 3 days to reconnect and get

caught up. After that, the notifications will not be available anymore.

Example subscription program

Here is a link to an example program that listens for changes in subledgers and prints the messages to the console. It is runnable with Linqpad version **5**.

http://share.linqpad.net/n84q4b.linq

Try running this program, then making changes to suppliers via the UI. You will see notifications in the console about the changes.

Webhooks

The webhook feature, added in 2023 R2, builds on the subscription feature above. To use it, first add a webhook with the `addWebhooks` mutation:

Above, `serializedPayload` is the same JSON payload you would send to a websocket when starting a subscription. I.e., it is a serialized JSON object with these properties:

> **query**: A string that is your GraphQL query that would normally start a websocket subscription. (Required)
>
> **variables**: An object with variables needed for your query. (Optional)

After you have added your webhook, it becomes active within 60 seconds, and we will start sending you JSON payloads when the mutations you subscribed to occur.

For the webhook created above, a webhook payload that we would send to your URL might look like this:

```
{
  "data": {
    "projectsMutated": {
      "edges": [
        {
          "dbId": 123,
          "mutationType": "ADDED",
          "node": {
            "code": "Alpha",
            "description": "Project Alpha",
            "text": "Promising new innovation that can boost revenue."
          }
        }
      ]
    }
  }
}
```

To verify that the webhook came from us, ensure that the X-XL-Webhook-Signature header of the webhook request matches the SHA256 HMAC hash of the following canonical utf-8 string:

```
Request.Date.ToUnixTimeSeconds() + "." + Request.Body
```

To prevent replay attacks, also ensure that the Date on the request is within 15 minutes of the current time.

To signal that you have processed the webhook request we send you successfully, respond with a 2xx status code. If your webhook fails to respond successfully, or we cannot reach it, we will try again 4 times: first with a 1 minute delay, then 10 minutes, then 1 hour, and then 24 hours. If your webhook continues to fail after those attempts, it will be marked as faulted, and we will not try it again without manual intervention.

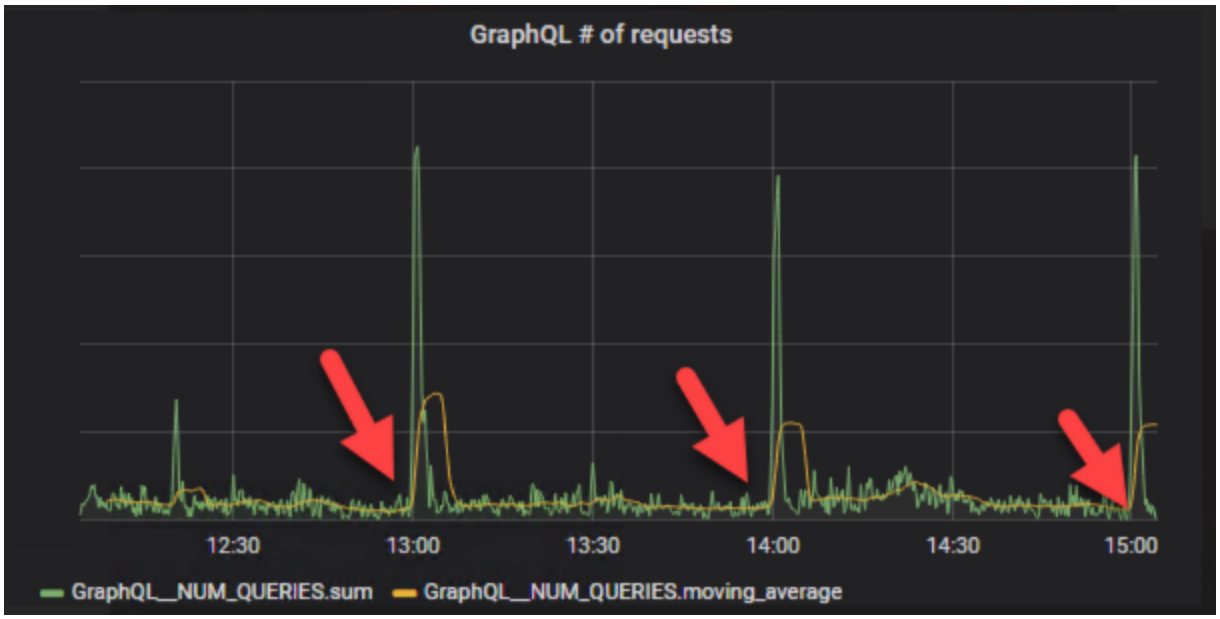
To see a complete code example that uses queries, webhooks and Sqlite to keep an up-to-date register of Xledger projects in a database, check out this project on github:

https://github.com/xledger/graphql-samples/tree/master/Webhooks-CSharp

Integration Tips

If you are writing an integration that needs to poll GraphQL periodically, avoid scheduling your queries to run near hour changes (like 1:00, 2:00, 3:00, etc). The reason to avoid those times is that is what everyone else has done, and it creates a big spike in traffic that can lead to timeouts. If you instead schedule it 2-30 minutes before or after the hour change, you will minimize the number of retries you will have to do.

Here is a screenshot of our query traffic that shows why scheduling your queries near the hour change isn't the best idea.



Special Headers

If you are running a single API token to handle multiple sub entities (our preference), Xledger has some special headers you can add to your HTTP request to make this easier.

Header	Value	Description
`X-XL-Owner-To-Charge`	Owner DbId	Owner to charge for api credits (instead of the current API tokens owner). Must be an owner below you. If some of your queries are executed because of a single entity, you can use this header to instruct us to charge that owner for the API credits.
`X-XL-Owner-To-Run-As`	Owner DbId	Owner to run the request on behalf of. Must be an owner below you. This one is useful if you need to see things from a lower perspective, usually for taking object status into account. For example, setup values that were hidden for a sub entity.

Request Limits

The maximum GraphQL request size is 64 MB.

Recent Changes

Note: This section only covers general changes, not changes to specific fields or mutations.For the latter, see the "Schema Changelog" button in the top menu in GraphiQL.

2026 January 13

A new tab has been added in the GraphiQL interface, allowing you to upload files and have selected files' blob data sent to the /graphql endpoint as a multiform request. This means that mutations with file uploads can now be tested within the GraphiQL interface itself.

2024 August 9

Previously, the __typename GraphQL introspection field was not respected for queries that returned data. (I.e., pure introspection queries.) This shortcoming has been fixed, which should allow GraphQL clients that always ask for this field to work. For example, StrawberryShake for C#.

2024 June 15

We are adding support for the special header `X-XL-Owner-To-Run-As`. Please see the documentation here.

2024 March 8 (planned start of concurrency limit enforcement)

On March 8, 2024, we plan on enforcing a new rate limit on the number of concurrent requests. Please see the new concurrency limit part of this document. Most customers have had good API etiquette and should be unaffected. We have contacted customers and partners who will probably need to make changes to respect the limit.

2023 R2

Delta Fields

This release, we added delta query fields. For example:

- transaction_deltas
- supplier_deltas
- project_deltas
- user_deltas
- and 11 more

These fields provide access to changes that have occurred in the last 3 days, and are ideally suited for people who need to keep an external system in sync with the data in Xledger. Each delta represents the

mutation type (whether the record was added, updated, or deleted), and the complete value of the record at that point in time, without any derived values.

After you make a change to a record in Xledger, the corresponding delta record should be available to query within about 30 seconds.

Webhook support

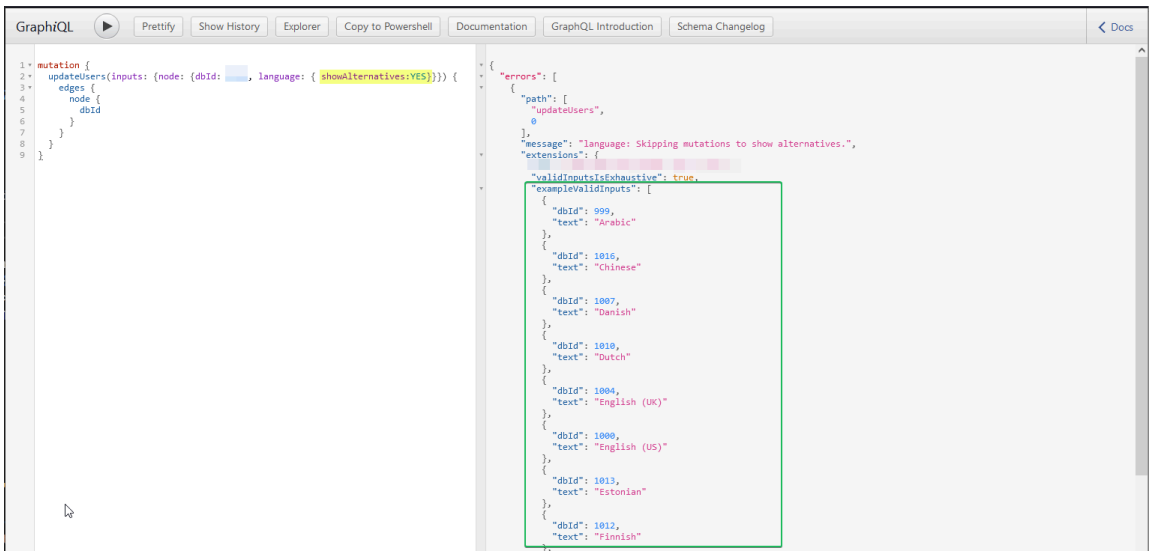
Building on the above and the existing websocket subscription support, we added websocket support. Please see the new webhook section of the documentation.

2022-08-22

For subscriptions, we have deprecated the "connection_init" message for authenticating. (See the updated "Getting started with subscriptions" section for the supported method. This old method will stop working on `Thu, 01 Jun 2023 00:00:00 GMT`. We will have a brownout period (starting `Mon, 01 May 2023 00:00:00 GMT` lasting 24 hours) before shutting it off completely, and will do our best to communicate this with everyone via email. If you have any questions or concerns, please let us know (via support) as soon as possible.

2022 R1 - May 15th 2022

- Request Idempotency Keys (see new section Mutations > Idempotent Mutations)
- When doing mutations, and you are unsure about the valid values for an input field, you can now pass `"showAlternatives": YES`, and instead of your request being run normally, it will return an error that has a list of the valid inputs for that field. For example:



2021 R2 - Nov 20th 2021

This release, we added a way to redirect which owner to charge for query credits. You can redirect credits that would otherwise be charged to the owner of the API key you are querying with by adding a header called `X-XL-Owner-To-Charge`, with the value being the `dbId` of the owner that should be charged instead.

2021 R1 - June 12th 2021

New bulk mutation support

This release, we added fields such as "addProjects", which allows you to insert many records at once. The limit on the number is usually 500, but is lower (5) for some fields such as "addUsers".

```
mutation {
  addProjects(inputs: [
    {clientId: "1", node: {code: "GH", description: "Integrate with Github" }}
    {clientId: "2", node: {code: "EP2021", description: "End of year party for 2021" }}
  ]) {
    edges {
      clientId
      node { dbId }
    }
  }
}
```

These new bulk mutation fields are more efficient, run in a transaction (i.e., all of the updates succeed, or none), cost you less credits per item, and should be easier to use.

Improved error messages for reference input arguments

When using our mutation fields and you provided an invalid value, up until this release, we could only provide error messages such as "The value 456 is not valid or allowed" for a reference input argument like "projectDbId". With this release, we either provide an explanation for the failure, or give a few examples of values that are valid.


```
{
  "errors": [
    {
      "path": [
        "addEmployee"
      ],
      "message": "Argument: \"glObject1DbId\" - the value 1 is not valid or allowed.",
      "extensions": {
        "exampleValidInputs": [
          {
            "dbId": 4024082,
            "text": "Consulting and Support"
          },
```

Alternative input methods for reference input arguments

You can now refer to other types of objects (e.g., Project, Employee) when doing a mutation without necessarily using our dbIds. For example, if you have a code, and that is enough to uniquely identify an object, you can use that:

Old way	`mutation { addProject(code: "Colonize Mars", subledgerDbId: 6237215) { dbId } }`
New way	`mutation { addProjects(inputs: [{node: {description: "Colonize Mars", subledger: {code: "ELON"}}}]) { edges { node { dbId }} } }`