express # guide # proxy

The Proxy Pattern

TCSS 460 — Client/Server Programming

So far, your Express API has returned data that you created — hardcoded objects, in-memory arrays, or values from request parameters. But real-world APIs rarely work in isolation. They call *other* APIs to get data: weather forecasts, movie databases, payment processors, mapping services. This guide teaches you how to build **proxy routes** — endpoints where your server calls a third-party API on behalf of your client, keeping secrets safe and giving you control over the response shape.

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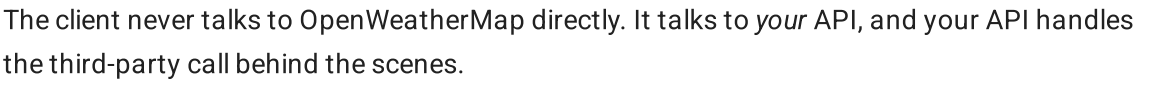
1 What is a Proxy API?

A **proxy** is a middleman. In the context of a web API, a proxy route is an endpoint on *your* server that, instead of returning data it owns, forwards the request to a third-party API, receives the response, and passes it back to your client.



The client never talks to OpenWeatherMap directly. It talks to *your* API, and your API handles the third-party call behind the scenes.

1.1 Why Not Call the Third-Party API Directly?

If the client (a browser, a React app, a mobile app) can make HTTP requests, why not have it call OpenWeatherMap directly? Three reasons:

API key security. Most third-party APIs require an API key. If your front-end JavaScript contains the key, anyone who opens the browser's developer tools can see it — and steal it. Your server holds the key. Your client never sees it.

CORS restrictions. Browsers enforce Cross-Origin Resource Sharing (CORS). A front-end app running on `localhost:3001` may not be allowed to call `api.openweathermap.org` directly. Your Express API can call any URL — servers are not restricted by CORS. The client calls your API (which has CORS configured), and your API calls the third party.

Data reshaping. Third-party APIs often return far more data than your client needs. A proxy lets you filter, rename, and restructure the response before sending it to the client. Your front-end gets exactly the shape it expects, regardless of how the third party formats its data.

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2 Getting a Third-Party API Key

The lecture demo uses the OpenWeatherMap API, a free weather data service. You will need an API key to follow along.

2.1 What is an API Key?

An **API key** is a unique string of characters that identifies your application to a third-party service. Think of it like a library card — it tells the service who you are so it can track your usage, enforce limits, and revoke access if needed.

Why do APIs require keys?

- **Authentication** — The service needs to know *who* is making requests. Without a key, anyone could use the API anonymously, making it impossible to enforce rules or contact abusers.
- **Rate limiting** — Free tiers typically cap how many requests you can make per minute or per day. The key is how the service counts *your* requests separately from everyone else's.
- **Billing** — Paid APIs charge per request. The key ties usage to your account.
- **Abuse prevention** — If someone uses the API maliciously, the service can revoke their key without affecting other users.

When you sign up for a third-party API, the service generates a key for you. You include this key in every request you make — usually as a query parameter (like `appid=YOUR_KEY`) or as an HTTP header. The service checks the key before processing your request.

> ⚠ **API Keys Are Secrets**
>
> An API key is a credential, like a password. Anyone who has your key can make requests as you — burning through your rate limit, running up charges on paid tiers, or getting your account banned. Treat API keys like passwords: never put them in source code, never commit them to git, never expose them to the browser.

2.2 Sign Up for a Key

1. Go to openweathermap.org and create a free account
2. Navigate to **API keys** in your account settings
3. Copy your default API key (it may take a few minutes to activate after sign-up)

2.3 Store the Key in `.env`

Your API key is a secret. It should never appear in your source code or be committed to git.

Create a `.env` file in your project root:

```
PORT=3000
WEATHER_API_KEY=your_openweathermap_api_key_here
```

> **Never Commit `.env` Files**
>
> Your `.gitignore` should include `.env`. If you accidentally commit an API key, the key is in your git history forever — even if you delete the file later. If this happens, revoke the key immediately and generate a new one.

The lecture demo includes a `.env.example` file that shows which environment variables are needed without including real values. This is a common pattern — commit the example, never commit the real file.

2.4 Checking for the Key at Runtime

What if someone clones your repo but forgets to set up their `.env` file? The server should fail clearly, not crash with a cryptic error from OpenWeatherMap. The lecture demo handles this with middleware:

```
export const requireEnvVar = (key: string) => {
    return (_request: Request, response: Response, next: NextFunction) => {
        if (!process.env[key]) {
            response.status(500).json({ error: `${key} is not configured` });
            return;
        }
        next();
    };
};
```

Applied to the router, this middleware runs before every proxy route:

```
const proxyRouter = Router();
proxyRouter.use(requireEnvVar('WEATHER_API_KEY'));
```

If `WEATHER_API_KEY` is not set, the client gets a clear `500` error and the third-party call never happens.

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3 Making HTTP Requests from Express

Up to this point, your Express server has only *received* requests. Now it needs to *send* them too — your server is both a server (to your client) and a client (to OpenWeatherMap).

3.1 The Fetch API

Node.js 18 and later include the Fetch API as a built-in global — no extra packages needed. If you have used `fetch()` in browser JavaScript, the server-side version works the same way:

```
const result = await fetch('https://api.openweathermap.org/data/2.5/weather?
q=Seattle&appid=YOUR_KEY&units=metric');
```

`fetch()` returns a `Promise` that resolves to a `Response` object. You then call `.json()` on the response to parse the body:

```
const data = await result.json();
```

Because both `fetch()` and `.json()` return Promises, your route handler must be `async`.

3.2 Checking for Errors

`fetch()` does not throw on HTTP errors like `404` or `500`. It only throws on *network failures* (the server is unreachable, DNS fails, etc.). You must check `result.ok` to know whether the request succeeded:

```
const result = await fetch(url);
const data = (await result.json()) as Record<string, unknown>;

if (!result.ok) {
    // The server responded, but with an error status (4xx or 5xx)
    response.status(result.status).json({ error: data.message || 'API request
failed' });
    return;
}
```

```
// If we get here, the request succeeded
response.json(data);
```

This is different from some HTTP libraries (like Axios) that throw on non-2xx responses. With `fetch()`, you always need to check `result.ok` yourself. You will see this `if (!result.ok)` pattern in every proxy controller throughout the lecture demo.

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4 Building a Raw Proxy Route (Pass-Through)

The simplest proxy pattern is a **pass-through** — your server calls the third-party API and forwards the response directly to the client, unchanged. This is useful when the third-party response is already in the shape your client needs.

4.1 The Full Pattern

Here is the `getWeather` controller from the lecture demo:

```
import { Request, Response } from 'express';

const BASE_URL = 'https://api.openweathermap.org/data/2.5';

export const getWeather = async (request: Request, response: Response) => {
    const city = request.query.city || request.params.city;
    const apiKey = process.env.WEATHER_API_KEY;

    try {
        const result = await fetch(
            `${BASE_URL}/weather?
q=${encodeURIComponent(String(city))}&appid=${apiKey}&units=metric`
        );
        const data = (await result.json()) as Record<string, unknown>;

        if (!result.ok) {
            response.status(result.status).json({ error: data.message ||
'Weather API error' });
            return;
        }

        response.json(data);
    } catch (_error) {
        response.status(502).json({ error: 'Failed to reach weather service'
});
    }
};
```

Let's walk through each piece.

4.2 Reading the Client's Input

```
const city = request.query.city || request.params.city;
```

The handler accepts the city from either a query parameter (`/proxy/weather?city=Seattle`) or a route parameter (`/proxy/weather/Seattle`). Supporting both gives clients flexibility.

4.3 Building the Third-Party URL

```
const result = await fetch(
    `${BASE_URL}/weather?
q=${encodeURIComponent(String(city))}&appid=${apiKey}&units=metric`
);
```

Four things to notice:

1. **`BASE_URL`** — The OpenWeatherMap base URL is extracted into a constant at the top of the file. Every handler reuses it, so if the API version changes (e.g., from `2.5` to `3.0`), you update one line.
2. **`encodeURIComponent()`** — User input goes into a URL, so it must be URL-encoded. A city like "New York" becomes `New%20York`. Without encoding, spaces and special characters break the URL.
3. **`appid=${apiKey}`** — The API key is injected from `process.env`. The client never sent it and never sees it.
4. **`units=metric`** — A server-side decision. Your API always returns Celsius. The client does not need to know or care about OpenWeatherMap's unit options.

4.4 Forwarding the Response

```
response.json(data);
```

In a pass-through proxy, you send the entire third-party response to the client as-is. The client gets exactly what OpenWeatherMap returned.

Try It Yourself

1. Clone the lecture demo repo and run `npm install`
2. Copy `.env.example` to `.env` and add your OpenWeatherMap API key
3. Start the server: `npm run dev`
4. In Postman or your browser, visit `http://localhost:3000/proxy/weather?city=Seattle`
5. Compare the response to what you see at `https://api.openweathermap.org/data/2.5/weather?q=Seattle&appid=YOUR_KEY&units=metric` — they should be identical

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5 Passing Client Parameters Through

Your proxy routes need to accept parameters from the client and forward them to the third-party API. Before looking at how, let's start with an important rule: **validate before forwarding**.

5.1 Validating Before Forwarding

Never blindly forward client input to a third-party API. If the client sends a bad request, you should reject it immediately — before your server wastes an API call on input that will fail anyway. The lecture demo uses `requireCity` middleware to enforce this:

```
export const requireCity = (request: Request, response: Response, next:
NextFunction) => {
    const city = request.query.city || request.params.city;
    if (!city) {
        response.status(400).json({ error: 'City is required (query param or
route param)' });
        return;
    }
    next();
};
```

If the client forgets the city parameter, they get a `400` error immediately. The request never reaches OpenWeatherMap. This is the same route-level middleware pattern from the Routing & Middleware guide — the middleware runs before the handler, and if validation fails, the handler never executes.

With validation in place, the lecture demo offers two ways for clients to pass the city parameter.

5.2 Query Parameters

```
proxyRouter.get('/weather', requireCity, getWeather);
```

The client sends: `GET /proxy/weather?city=Seattle`

The route definition reads left to right: when a GET request hits `/weather`, run `requireCity` first (reject if no city), then run `getWeather`. Inside the handler, `request.query.city` contains `"Seattle"`, which gets forwarded to OpenWeatherMap as the `q` parameter.

5.3 Route Parameters

```
proxyRouter.get('/weather/:city', requireCity, getWeather);
```

The client sends: `GET /proxy/weather/Seattle`

Here the city is part of the URL path itself. Inside the handler, `request.params.city` contains `"Seattle"`. The same `getWeather` controller handles both styles because it checks both sources: `request.query.city || request.params.city`.

The same `requireCity` middleware works for both — it checks `request.query.city || request.params.city` too, so it validates regardless of how the client passes the value.

5.4 Different Endpoints, Same Pattern

The lecture demo also proxies the 5-day forecast endpoint, using a different OpenWeatherMap path but the same pattern:

```
proxyRouter.get('/forecast', requireCityQuery, getForecast);
```

```
export const getForecast = async (request: Request, response: Response) => {
    const city = request.query.city;
    const apiKey = process.env.WEATHER_API_KEY;

    try {
        const result = await fetch(
            `${BASE_URL}/forecast?
q=${encodeURIComponent(String(city))}&appid=${apiKey}&units=metric`
        );
        const data = (await result.json()) as Record<string, unknown>;
```

```
        if (!result.ok) {
            response.status(result.status).json({ error: data.message ||
'Weather API error' });
            return;
        }

        response.json(data);
    } catch (_error) {
        response.status(502).json({ error: 'Failed to reach weather service'
});
    }
};
```

The only difference: the URL path is `/forecast` instead of `/weather`. The error handling, key injection, and response forwarding are identical. Once you understand the proxy pattern, adding new proxy routes is mechanical.

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6 Reshaping the Response (Transformed Proxy)

A pass-through proxy is simple, but it forces your client to deal with whatever structure the third-party API returns. A **transformed proxy** fetches the same data but reshapes it into a cleaner format before sending it to the client. This is where the proxy pattern really adds value.

6.1 The Problem: Raw Third-Party Responses

Here is what OpenWeatherMap returns for a current weather request (abbreviated):

```
{
    "coord": { "lon": -122.33, "lat": 47.61 },
    "weather": [
        {
            "id": 800,
            "main": "Clear",
            "description": "clear sky",
            "icon": "01d"
        }
    ],
    "base": "stations",
    "main": {
        "temp": 18.5,
        "feels_like": 17.9,
        "temp_min": 16.2,
        "temp_max": 20.1,
        "pressure": 1023,
        "humidity": 62
    },
```

```
    "visibility": 10000,
    "wind": { "speed": 3.6, "deg": 200 },
    "clouds": { "all": 0 },
    "dt": 1560350645,
    "sys": {
        "type": 1,
        "id": 5169,
        "country": "US",
        "sunrise": 1560343627,
        "sunset": 1560396563
    },
    "timezone": -25200,
    "id": 5809844,
    "name": "Seattle",
    "cod": 200
}
```

This response has deeply nested objects (`main.temp` , `weather[0].description` , `sys.country`), internal fields the client does not care about (`base` , `cod` , `dt` , `visibility`), and a structure that does not match what a simple weather widget needs.

6.2 The Solution: Reshape Before Sending

The lecture demo's `getWeatherSummary` controller fetches the same data but transforms it into a flat, clean shape:

```
export const getWeatherSummary = async (request: Request, response: Response)
=> {
    const city = request.query.city || request.params.city;
    const apiKey = process.env.WEATHER_API_KEY;

    try {
        const result = await fetch(
            `${BASE_URL}/weather?
q=${encodeURIComponent(String(city))}&appid=${apiKey}&units=metric`
        );
        const data = (await result.json()) as Record<string, unknown>;

        if (!result.ok) {
            response.status(result.status).json({ error: data.message ||
'Weather API error' });
            return;
        }

        // Transform the raw response into a clean, simplified shape
        const main = data.main as Record<string, unknown>;
        const weather = (data.weather as Record<string, unknown>[])?.[0];
        const wind = data.wind as Record<string, unknown>;

        response.json({
            city: data.name,
            country: (data.sys as Record<string, unknown>)?.country,
            temperature: {
```

```
                current: main?.temp,
                feelsLike: main?.feels_like,
                min: main?.temp_min,
                max: main?.temp_max,
            },
            conditions: weather?.description,
            humidity: main?.humidity,
            windSpeed: wind?.speed,
        });
    } catch (_error) {
        response.status(502).json({ error: 'Failed to reach weather service'
});
    }
};
```

The client receives:

```
{
    "city": "Seattle",
    "country": "US",
    "temperature": {
        "current": 18.5,
        "feelsLike": 17.9,
        "min": 16.2,
        "max": 20.1
    },
    "conditions": "clear sky",
    "humidity": 62,
    "windSpeed": 3.6
}
```

6.3 Walking Through the Transformation

The transformation happens in three steps:

Step 1: Extract nested objects. The raw response buries useful data inside `main`, `weather[0]`, `wind`, and `sys`. Pull these out into local variables:

```
const main = data.main as Record<string, unknown>;
const weather = (data.weather as Record<string, unknown>[])?.[0];
const wind = data.wind as Record<string, unknown>;
```

The `as Record<string, unknown>` casts tell TypeScript "I know this is an object with string keys." The `?.[0]` safely accesses the first element of the `weather` array — if the array is missing or empty, you get `undefined` instead of a crash.

Step 2: Pick the fields you want. From the 20+ fields in the raw response, select only what your client needs. In this case: city name, country, temperature values, conditions, humidity, and wind speed.

Step 3: Rename and restructure. OpenWeatherMap uses `feels_like` (snake_case). Your API uses `feelsLike` (camelCase). The raw response scatters temperature data across `main.temp`, `main.temp_min`, `main.temp_max` — your API groups them under a `temperature` object. These are design decisions *you* control.

6.4 Defining a TypeScript Interface for the Response

For a production codebase, you would define an interface for your reshaped response. This gives you type safety and documents your API's contract:

```
interface WeatherSummary {
    city: string;
    country: string;
    temperature: {
        current: number;
        feelsLike: number;
        min: number;
        max: number;
    };
    conditions: string;
    humidity: number;
    windSpeed: number;
}
```

Now anyone reading your code (or building a front-end against your API) knows exactly what shape to expect.

6.5 When to Reshape vs. Pass Through

Both approaches are valid. Choose based on your needs:

Pass-Through	Transformed
Quick to implement	More work up front
Client gets all available data	Client gets only what it needs
Your API contract = third-party contract	Your API contract = your design
If the third party changes their response, your client breaks	If the third party changes their response, you update the proxy — client is unaffected

The Key Insight

A transformed proxy **decouples** your API from the third party. Your client depends on *your* response shape, not OpenWeatherMap's. If OpenWeatherMap renames `feels_like` to `apparent_temperature` next year, you update one line in your proxy controller and your client never notices.

Gen AI & Learning: Generating Transformation Code

Writing transformation code is tedious but mechanical — you are mapping fields from one shape to another. This is exactly the kind of task where an AI coding agent excels. Paste the raw third-party JSON response and your desired output shape, and ask the agent to write the transformation. The agent is fast at this because the task is well-defined: input shape, output shape, write the mapping. The hard part — *deciding* what your API's response shape should look like — is still your job. Define the contract first, then let the agent write the plumbing.

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7 Error Handling in Proxy Routes

Proxy routes have an extra source of errors that normal routes do not: the third-party API can fail. Your error handling needs to cover both client mistakes and upstream failures.

7.1 Upstream API Errors

When the third-party API returns an error (invalid city, expired key, rate limited), check `result.ok` and translate the error:

```
if (!result.ok) {
    response.status(result.status).json({ error: data.message || 'Weather API
error' });
    return;
}
```

The lecture demo forwards the upstream status code (`result.status`). Common cases:

Upstream Status	Meaning	What the Client Sees
`401`	Your API key is invalid or expired	`{ "error": "Invalid API key..." }`
`404`	The city was not found	`{ "error": "city not found" }`
`429`	You exceeded the rate limit	`{ "error": "API rate limit exceeded" }`

> ⚠ **Don't Leak Internal Details**
>
> The error message `data.message` comes from OpenWeatherMap. For a production API, you might want to replace it with your own message rather than forwarding the third party's exact wording. This prevents leaking information about which upstream service you use.

7.2 Network Failures

If OpenWeatherMap is down, DNS fails, or the network times out, `fetch()` throws an exception. The `try/catch` around the entire block handles this:

```
try {
    const result = await fetch(url);
    // ... handle response
} catch (_error) {
    response.status(502).json({ error: 'Failed to reach weather service' });
}
```

A `502 Bad Gateway` is the correct status code here — it means "I (your server) tried to reach an upstream service, and it failed." This tells the client that the problem is not with their request but with a service your server depends on.

7.3 Validation Errors

Client input errors are caught by middleware before the proxy call happens:

```
Client sends: GET /proxy/weather
                  ↓
        requireCity middleware
        → city parameter is missing
        → 400 { "error": "City is required" }
```

```
        → handler never runs
        → fetch() never called
```

This is important for two reasons: you do not waste a third-party API call on bad input, and the client gets a fast, clear error message.

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8 Organizing Proxy Routes

The lecture demo organizes proxy routes using the same Router pattern covered in the Routing & Middleware guide.

8.1 The Router File

All proxy routes live in their own file with a dedicated router:

```
// routes/protected/proxy.ts
import { Router } from 'express';
import { getWeather, getWeatherSummary, getForecast } from
'../../controllers/proxy';
import { requireEnvVar, requireCity, requireCityQuery } from
'../../middleware/validation';

const proxyRouter = Router();

// All proxy routes require the API key to be configured
proxyRouter.use(requireEnvVar('WEATHER_API_KEY'));

// Raw pass-through
proxyRouter.get('/weather', requireCity, getWeather);
proxyRouter.get('/weather/:city', requireCity, getWeather);
proxyRouter.get('/forecast', requireCityQuery, getForecast);

// Transformed response — curates the raw data into a simplified shape
proxyRouter.get('/summary', requireCity, getWeatherSummary);
proxyRouter.get('/summary/:city', requireCity, getWeatherSummary);

export { proxyRouter };
```

Notice the structure:

- `requireEnvVar('WEATHER_API_KEY')` is applied to the entire router with `.use()` — it runs before every proxy route
- `requireCity` and `requireCityQuery` are applied to individual routes — different routes have different validation needs
- **Controllers** are imported from a separate file — the router file only wires things together

8.2 Mounting Under a Protected Namespace

The proxy router is mounted inside a `protectedRoutes` parent router:

```
// routes/protected/index.ts
import { Router } from 'express';
import { proxyRouter } from './proxy';

const protectedRoutes = Router();

// Week 5: add JWT middleware here
// protectedRoutes.use(verifyJwt);
protectedRoutes.use('/proxy', proxyRouter);

export { protectedRoutes };
```

This gives the proxy routes a `/proxy` prefix and sets up a place to add authentication middleware later (Week 5). When you add JWT verification, every proxy route will automatically require a valid token — no changes to the proxy router itself.

8.3 Extracting Configuration

The controller extracts the base URL into a constant:

```
const BASE_URL = 'https://api.openweathermap.org/data/2.5';
```

This avoids repeating the full URL in every handler. If OpenWeatherMap changes their API version (e.g., from `2.5` to `3.0`), you update one line.

Try It Yourself

1. In the lecture demo, add a new proxy route: `GET /proxy/air-quality?city=Seattle`
2. Create a new controller that calls OpenWeatherMap's Air Pollution API
3. Add the route to `proxyRouter` with `requireCity` middleware
4. Test it in Postman — does the middleware catch missing cities? Does the error handling catch bad responses?

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9 Summary

Concept	Key Point
Proxy pattern	Your server calls a third-party API on behalf of your client
API key security	Keys stay in `.env` on the server — the client never sees them
`fetch()`	Built into Node.js 18+ — no extra packages needed
`result.ok`	`fetch()` does not throw on HTTP errors — you must check `result.ok`
`encodeURIComponent()`	Always encode user input before putting it in a URL
Pass-through proxy	Forwards the third-party response unchanged
Transformed proxy	Reshapes the response — selects fields, renames, restructures
Decoupling	A transformed proxy isolates your client from third-party API changes
Error handling	Check `result.ok` for upstream errors, `try/catch` for network failures
`502 Bad Gateway`	The correct status when an upstream service is unreachable
Validation middleware	Reject bad input before making third-party API calls

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10 References

Official Documentation:

- OpenWeatherMap — Current Weather Data — API endpoints, parameters, and response format
- MDN — Fetch API — Using `fetch()` for HTTP requests
- MDN — `encodeURIComponent()` — URL-encoding user input
- Node.js — Fetch API — Built-in `fetch()` in Node.js

- Express.js — Routing — Route organization with `express.Router()`

TCSS 460 Lecture Demo

github.com/UWT-SET-TCSS460-LECTURE-MATERIALS/TCSS-460-Backend-1 — proxy routes with OpenWeatherMap

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11 Further Reading

External Resources

- What is a Web API? — Section 6: API Consumers and Providers — concept reading on why the proxy pattern exists
- Routing & Middleware Guide — middleware chain, Router, and route organization
- Error Handling & Validation Guide — centralized error handling and input validation patterns
- OpenWeatherMap — 5 Day Forecast — forecast endpoint used in the `getForecast` example

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This guide is part of TCSS 460 — Client/Server Programming, School of Engineering and Technology, University of Washington Tacoma.