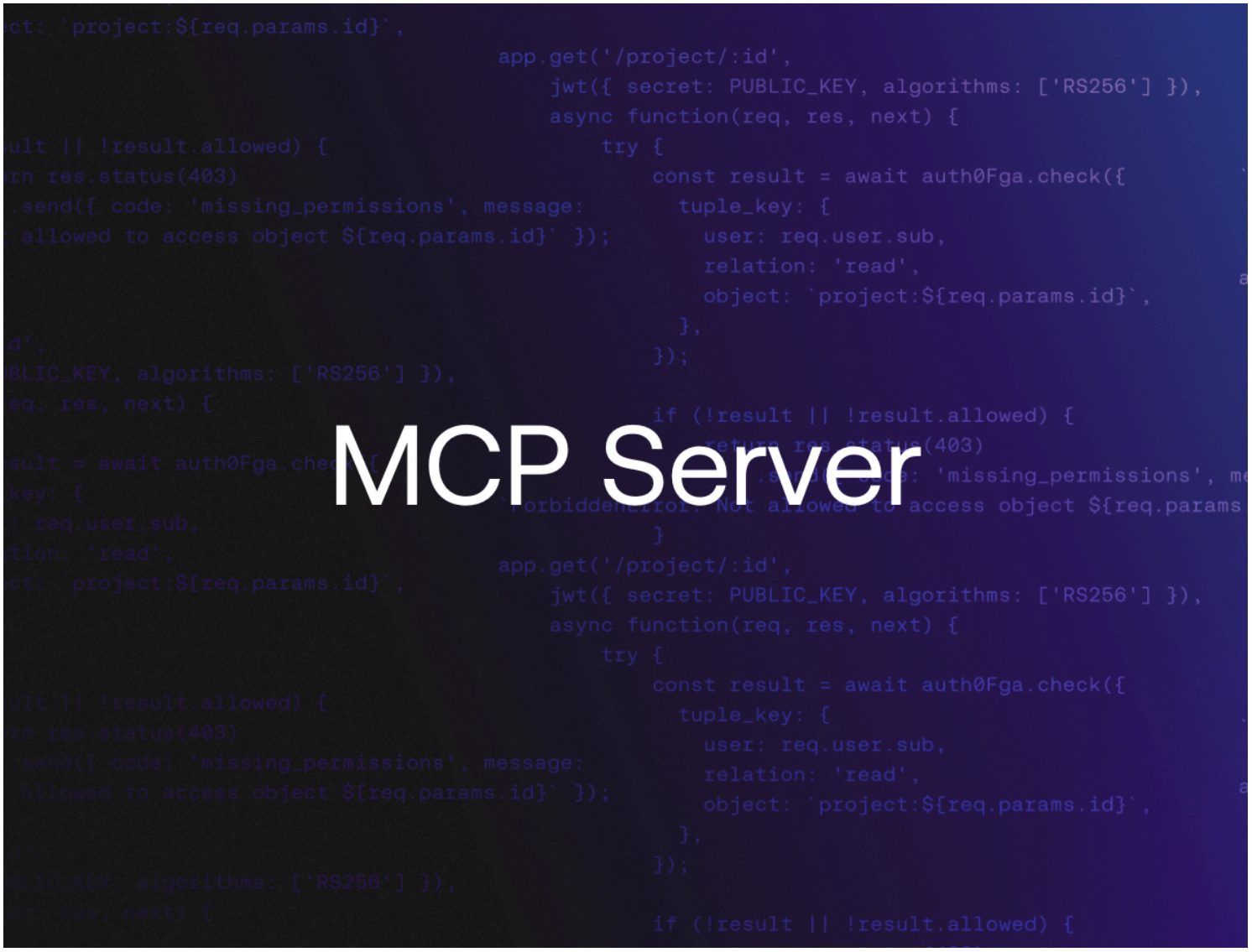

AI English

An Introduction to MCP and Authorization

Discover the Model Context Protocol (MCP) and its authorization mechanisms. Learn how to use API keys, OAuth 2.1 implementation, and best practices for secure LLM API connections.

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The Model Context Protocol (MCP) is gaining traction as a mechanism to connect Large Language Models (LLMs), like GPT, Gemini, or Claude

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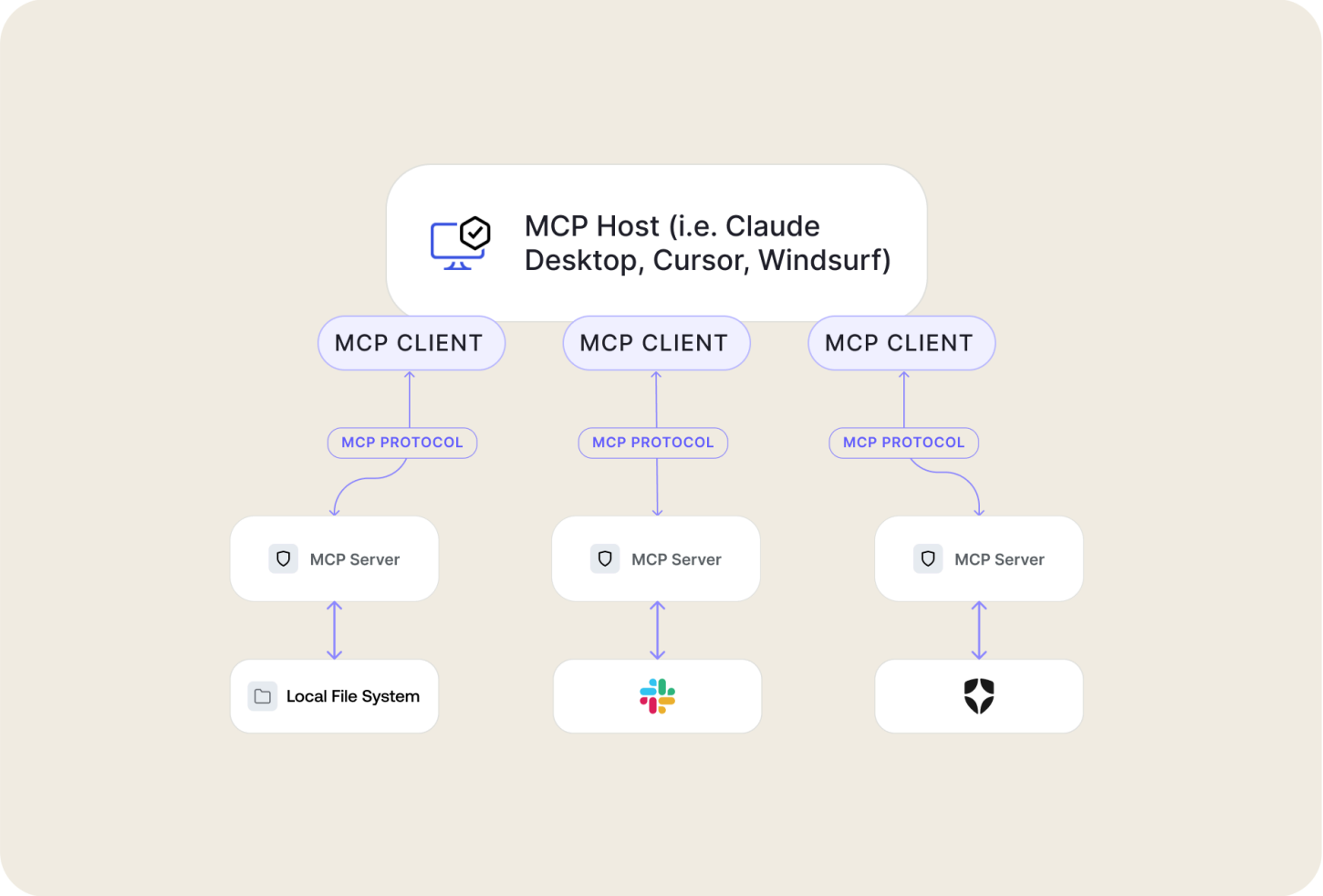
To better understand how MCP works, let's understand its components and how they interact with each other:

- **MCP Host**: These are programs like Claude Desktop, Cursor IDE, or any other AI tool that requires access to data through MCP.
- **MCP Client**: Your MCP host will run one or multiple MCP clients. Each client will maintain a 1:1 relationship with an MCP server. For example, When Cursor starts, it will connect to each MCP server you've provided.
- **MCP Servers**: This is the server that's going to be running the tools your host wants to call. These servers can either run locally or hosted on a remote server.
- **Local Data Sources**: The MCP server, if running locally, can access local resources in the host computer, such as files, databases, and locally running services and applications.
- **Remote Services**: External systems available through the internet, e.g., Auth0 APIs, Google Calendar APIs, GitHub APIs, etc.



How Does MCP Work?

Now that we understand the basic idea of MCP and its components, let's look at how MCP works, going from the host, to the underlying services, and back.

```
    }
  }
}
```

With this setup, the host will initialize a client that will give the host access to the user's Desktop and Downloads folder through the `server-filesystem` MCP server. It's common for MCP servers to provide details about their setup and multiple configurations through their documentation.

The client will communicate with the MCP server through transports, which we will review in the next section.

Transport

Transports in MCP provide a way for communication between client and server. The transport handles all the communication mechanisms and is responsible for sending and receiving messages between the parties.

When developing MCP servers, the developer will opt for a specific transport type depending on the MCP requirements.

The specification currently allows for three different transport types:

1. **Stdio (standard input/output)**: This transport enables communication through the input and output streams. It's useful for local integrations and command-line tools.

```
const server = new Server({
  name: "my-mcp-server",
  version: "1.0.0"
});

const transport = new StdioServerTransport();
await server.connect(transport);
```

2. **SSE (server-sent events):** This transport enables communication through HTTP POST streaming requests.

```
const app = express();

const server = new Server({
  name: "my-mcp-server",
  version: "1.0.0"
});

let transport: SSEServerTransport | null = null;

app.get("/sse", (req, res) => {
  transport = new SSEServerTransport("/messages", res);
  server.connect(transport);
```

3. **Custom Transports**: MCP allows developers to easily define new custom transports for their unique requirements, whether you need to support a specific network protocol, or integrate with existing systems, you can create a custom transport by implementing a simple interface.

```
// Callbacks
```

MCP server

Finally, we define the MCP server, which will receive and process the messages sent by the client on behalf of the LLM's requests, and will stream/output the results.

The MCP server can serve the host with three capabilities:

- **Resources**: Allow for MCP servers to expose data and content that can be read by the clients and be used as context for the LLM interactions. Resources can be any kind of data, like file contents, database records, API responses, etc.
- **Prompts**: Allow for MCP servers to define reusable prompt templates and workflows that clients can use to guide users or LLMs.
- **Tools**: Perhaps what MCP are most famous for, tools allow for servers to expose executable functionality to clients. Thanks to tools, LLMs can directly interact with external systems, perform computations and access the real world.

Your first MCP server

Now that we know what MCP servers are and how they work let's build our first server.

The first thing we need to think about is, what type of transport do we want to use? We will get started with an SSE server. Our MCP server will allow clients to retrieve random dog images, so let's give it a proper name.

```
import { McpServer } from "@modelcontextprotocol/sdk/server/mcp";
import { SSEServerTransport } from "@modelcontextprotocol/sdk/server/sse";
import express from "express";

const server = new McpServer({
  name: "MCP for Dog Lovers",
  version: "1.0.0",
});
const app = express();
let transport: SSEServerTransport | null = null;

app.get("/sse", async (_req, res) => {
```

Next, we are going to define a tool that will retrieve a dog image from a third-party service and return it back to the client:

```
server.tool("getRandomDogImage", {}, async () => {
  const response = await fetch(`https://dog.ceo/api/breeds/image/random`);
  const data = await response.json();
  return {
    content: [
      { type: "text", text: `Your dog image is here: ${data.message}` },
    ],
  };
});
```

```
  const data = await response.json();
  return {
    content: [
      { type: "text", text: `Your dog image is here: ${data.message}` },
    ],
  };
});
```

> WARNING
> In the example above the user input is not sanitized and that could lead into injection attacks. Always make sure to sanitize and validate user input securely..

In the same way, we can specify arguments for tool calling for LLMs, we can specify arguments for MCP tools. Pretty cool, right? Let's see the complete code sample, and this server in action:

```
import { McpServer } from "@modelcontextprotocol/sdk/server/mcp";
import { SSEServerTransport } from "@modelcontextprotocol/sdk/server/sse";
import express from "express";
import { z } from "zod";

const server = new McpServer({
  name: "My Super Cool Thursday MCP Demo Server",
  version: "1.0.0",
});

server.tool("getRandomDogImage", { breed: z.string() }, async ({ breed }) => {
  const response = await fetch(
```

Steps to run the server:

1. Create a new directory to save the project and run `npm init`
2. Save all the code in a `main.ts` file.
3. Install the project dependencies: `npm i @modelcontextprotocol/sdk express zod`
4. Run the server with `npx tsx main.ts`
5. Finally, set up the MCP in a client of your choice, using the following URL for the server: `http://localhost:3000/sse`

Let's see it in action:

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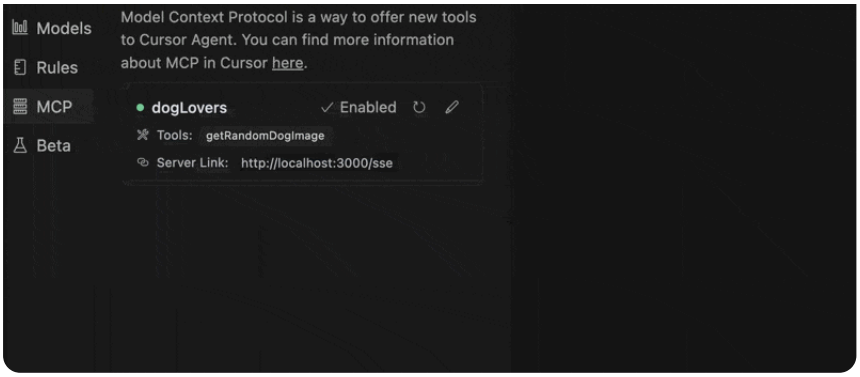

The MCP Lifecycle

We now understand how MCP works, we even built a MCP server ourselves, but in all the magic, there's a sequence of steps from prompt to response.

The lifecycle is divided into two different flows.

Connection lifecycle

1. The MCP host, in our case, Cursor, reads the MCP configuration file, determines the MCP servers it needs to connect to, and sends an `initialize` request with protocol version and capabilities to the MCP server.
2. The MCP server responds with its own protocol version and capabilities (e.g., available tools).
3. The client sends `initialized` notification as acknowledgment.
4. The connection is ready for use.

Messaging lifecycle

1. When the user sends a prompt through the MCP Host, the host will run an LLM model, which will determine if it's interested in requesting a tool call. In our case, when we prompt "Generate a random image of a labrador", the LLM detects we are talking about a dog, that there's a tool available for that task (that happens to be through our MCP server), and then it chooses to invoke that tool.
2. In this process, the MCP client sends a message to the MCP server indicating the tool's execution and parameters.
3. The MCP server receives the request, calls the Dog API, and returns the image URL to the client.
4. The MCP Host merges the response from the tool with the LLM context, processes a new response, and displays that back to the user.

Authorization in the World of MCPs

So far, the MCP server knows nothing about who's requesting information, or calling tools. This situation may work for MCP servers accessing public services that require no form of authorization or for getting access to local resources the MCP server has access to.

But what if we need to access remote services that require authorization?

Let's explore that next.

```
    "mcpServers": {
      "github": {
        "command": "npx",
        "args": ["-y", "@modelcontextprotocol/server-github"],
        "env": {
          "GITHUB_PERSONAL_ACCESS_TOKEN": "<YOUR_TOKEN>"
        }
      }
    }
}
```

This method is only recommended for MCP servers using the stdio transport.

Alternatively, since these are servers running locally, like a CLI application, the server could make use of device flow to authenticate the user, and retrieve an access token. The necessary client credentials needed for device flow, would be stored as disclaimed before, as environment variables or secrets.

OAuth 2.1

In March 2025, the MCP specification took a major leap forward with the release of a new specification that standardizes **Authorization using OAuth 2.1**.

The new specification enables MCP clients and servers to make use of OAuth 2.1, to delegate authorization. MCP servers implementing the new spec can authorize users to perform specific tasks and actions on existing services built on top of OAuth such as Auth0, Google APIs, GitHub, etc.

Here are some of the features that the new spec enables:

1. **Built-in Security Baseline (PKCE):** Mandating PKCE for all clients significantly raises the bar for security, protecting against common attacks right out of the box.

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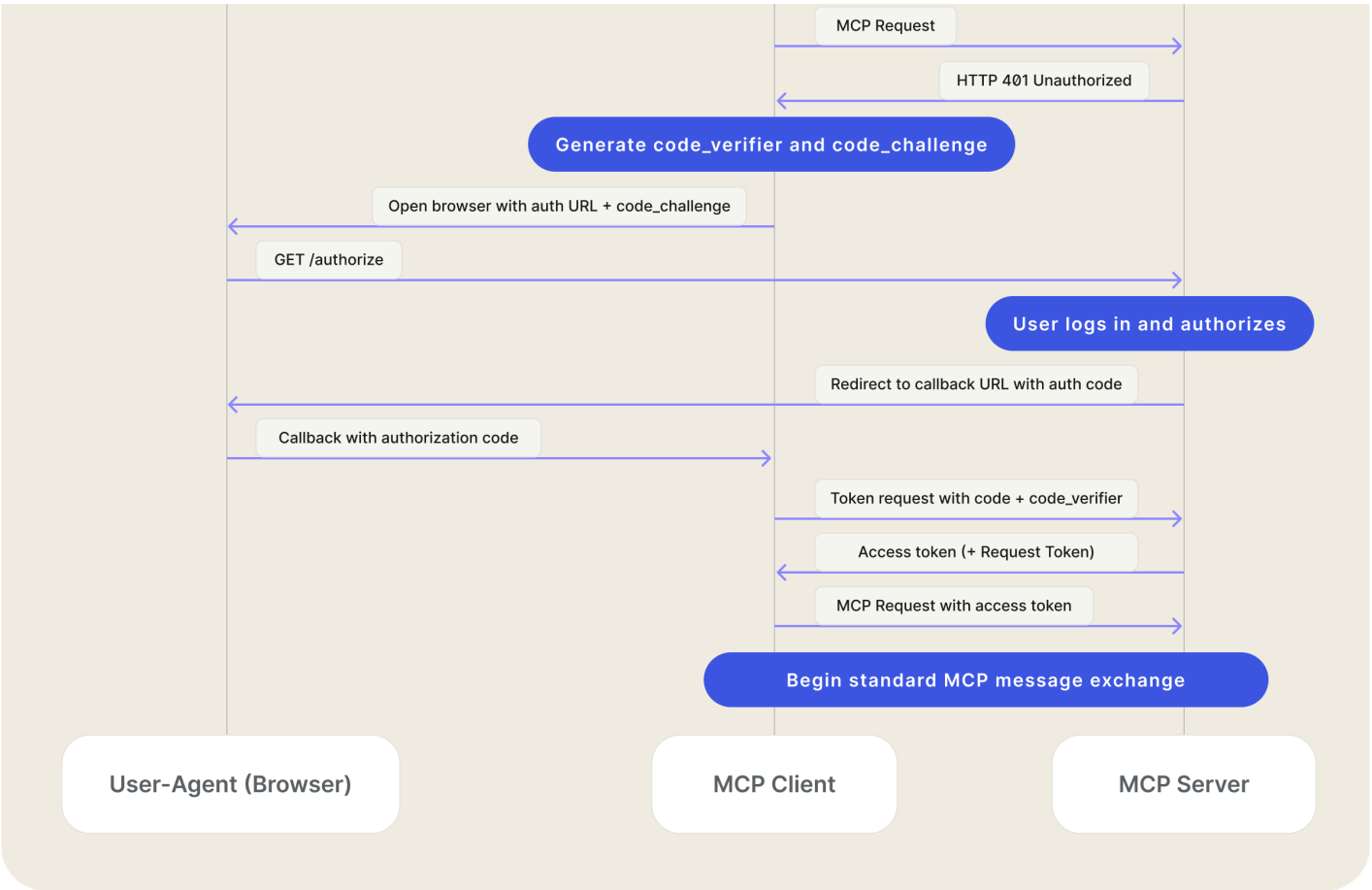
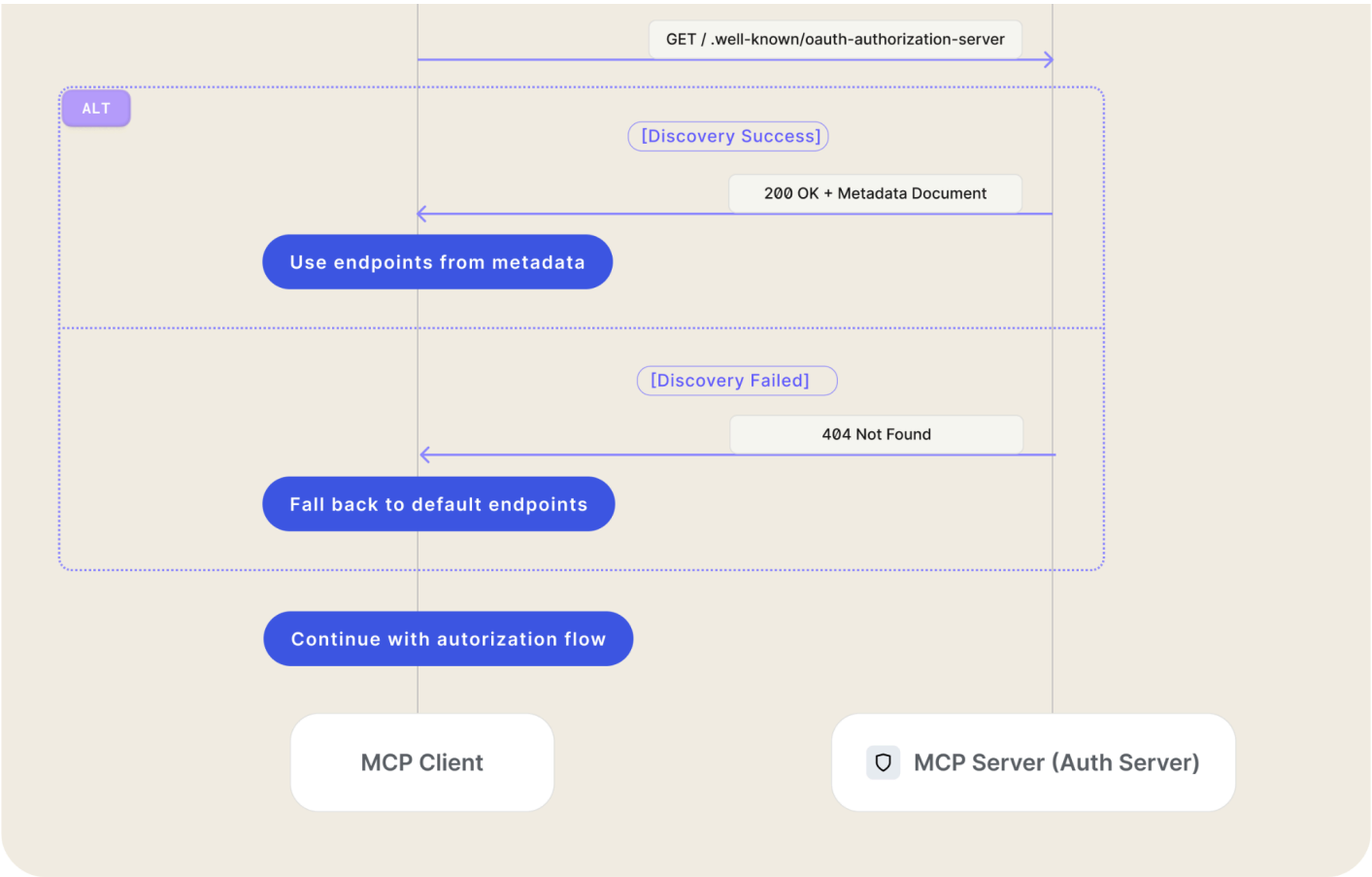
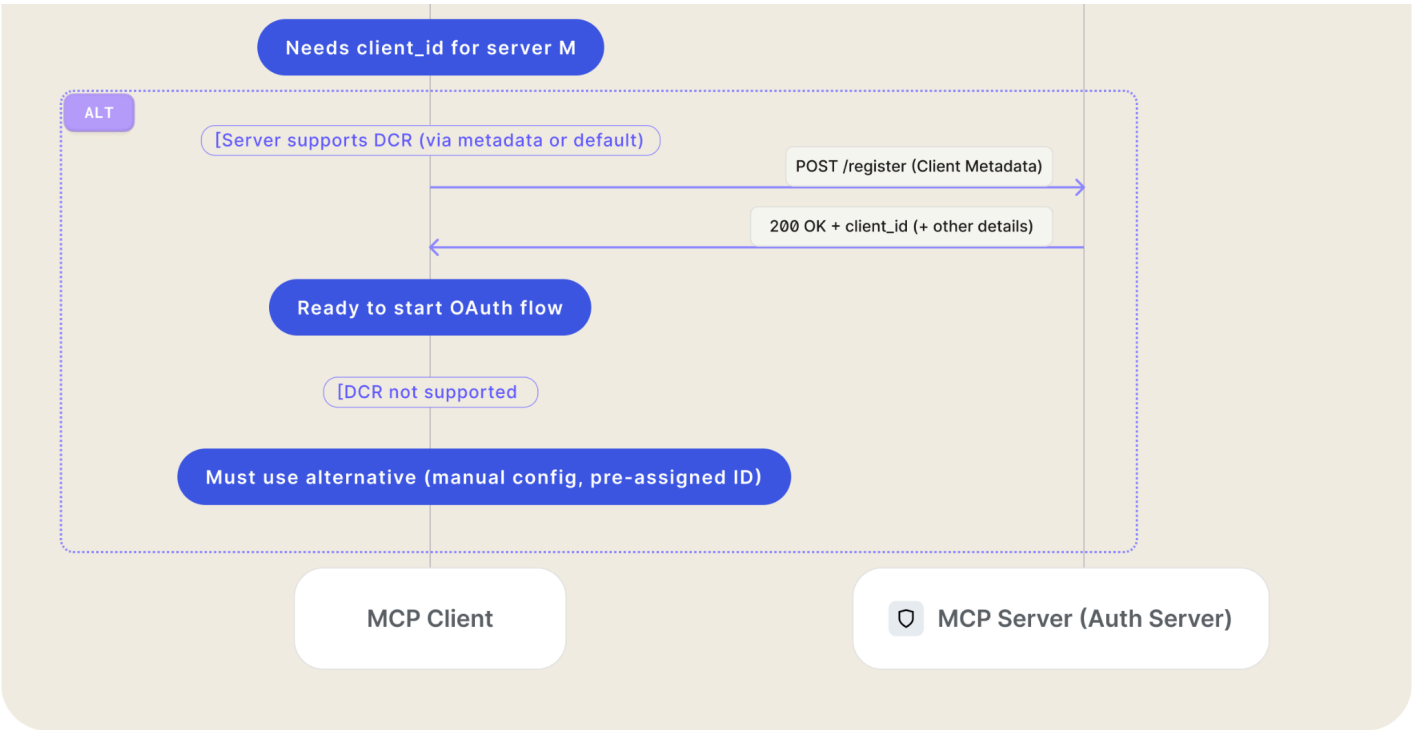


2. **Simplified Connections (Metadata Discovery):** How does your tool know where to send you to log in for a specific MCP server? The spec encourages **Metadata Discovery**, allowing servers to advertise their OAuth endpoints automatically. This means less manual configuration and fewer errors.



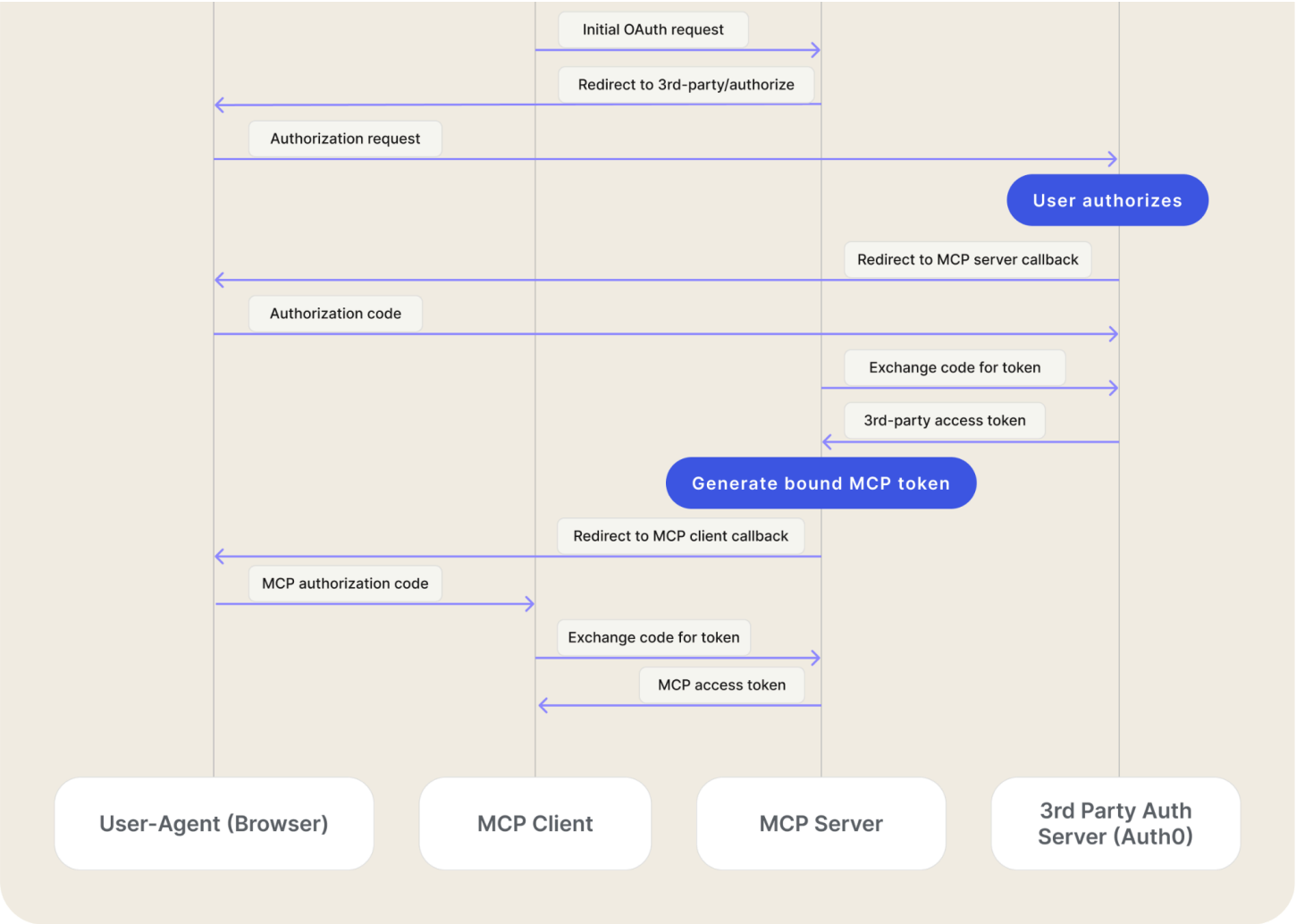
3. **Seamless Onboarding (Dynamic Client Registration - DCR):** Perhaps one of the most impactful features for usability. DCR allows MCP clients (like a generic AI workbench) to *programmatically register themselves* with a new MCP server they've never seen before. This avoids forcing users through tedious manual setup processes for every new connection, which is critical in a potentially vast landscape of model servers.



4. **Leveraging Your Existing Identity Infrastructure (Third-Party Auth):** The specification explicitly supports flows where the MCP server delegates the actual user login process to a trusted **Third-Party Identity Provider** – like Auth0.

Here's what the authorization flow looks like:

1. MCP client initiates standard OAuth flow with MCP server
2. The MCP server redirects the user to a third-party authorization server
3. User authorizes with the third-party server
4. The third-party server redirects back to the MCP server with the authorization code
5. MCP server exchanges code for the third-party access token
6. MCP server generates its own access token bound to the third-party session
7. MCP server completes original OAuth flow with MCP client



The Road Ahead

While the new spec introduces OAuth 2.1 support to the MCP standard, the specification as it currently stands defines the MCP server as both **a resource server and an authorization server**. This design, though a step forward, also introduces some challenges for developers of MCP servers, as they would have to be responsible for implementing discovery, registration, and token endpoints rather than leveraging existing identity providers.

But the limitations are beyond just lines of code, as incorrect implementations can lead to security vulnerabilities and scaling challenges.

Of course, not all is lost, and there are already conversations about the future of authorization in the world of MCPs, and identity experts are sharing their views, and knowledge to find a solution to some of these limitations.

But before going any further, let's see what the current state is.

Current limitations

- issuer
- authorization_endpoint
- token_endpoint
- registration_endpoint
- userinfo_endpoint

For example, you can query your Auth0 tenant metadata by using the following URL:

`https://<your-tenant>.auth0.com/.well-known/openid-configuration`

Here's what that may look like:

```
{
  "issuer": "https://<your-tenant>.auth0.com/",
  "authorization_endpoint": "https://<your-tenant>.auth0.com/authorize",
  "token_endpoint": "https://<your-tenant>.auth0.com/oauth/token",
  "device_authorization_endpoint": "https://<your-tenant>.auth0.com/oauth/device/code",
  "userinfo_endpoint": "https://<your-tenant>.auth0.com/userinfo",
  "mfa_challenge_endpoint": "https://<your-tenant>.auth0.com/mfa/challenge",
  "jwks_uri": "https://<your-tenant>.auth0.com/.well-known/jwks.json",
  "registration_endpoint": "https://<your-tenant>.auth0.com/oidc/register",
  "revocation_endpoint": "https://<your-tenant>.auth0.com/oauth/revoke",
  ...
}
```

As you can see, the metadata information contains information about your Auth0 tenant (or identity provider). But if we are to implement that on the MCP server, then do we also need to implement each of those endpoints?

This is not a great practice, and it introduces a lot of burden and limitations on the MCP server. For example:

- The MCP server would require storage for token handling.
- The MCP server would be a part of critical infrastructure and will have to comply with all the corresponding security requirements, audits, logging, and certifications.
- The MCP server would be responsible for validating the third-party token, and that's unnecessary and not a recommended practice.

Alternatively, we could "proxy" the metadata endpoint to that of our identity provider; that way, the MCP server would, in a way, delegate the authorization to the authorization server.

But, according to the MCP spec, that raises new issues. In section 2.9.2, the spec states that the MCP server authorizes with the third-party authorization server, and then it generates its own access token bound to the third-party session.

The issue here is that if we delegate authorization, as explained before, we would not be able to comply with this part of the spec.

So, what's the alternative?

With identity experts weighing in the spec, we have to consider the possibility of releasing a new specification that addresses the issues above, and provides the MCP standard with a best-in-class take on OAuth2.

Conclusion

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I stream, blog, and make youtube videos about tech stuff. I love coding, I love AI, and I love building stuff!

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