Temporal

Durable MCP

JOIN OUR SLACK CHANNEL

Feel free to ask questions or go there for helpful links!

https://t.mp/nov-18-slack-channel

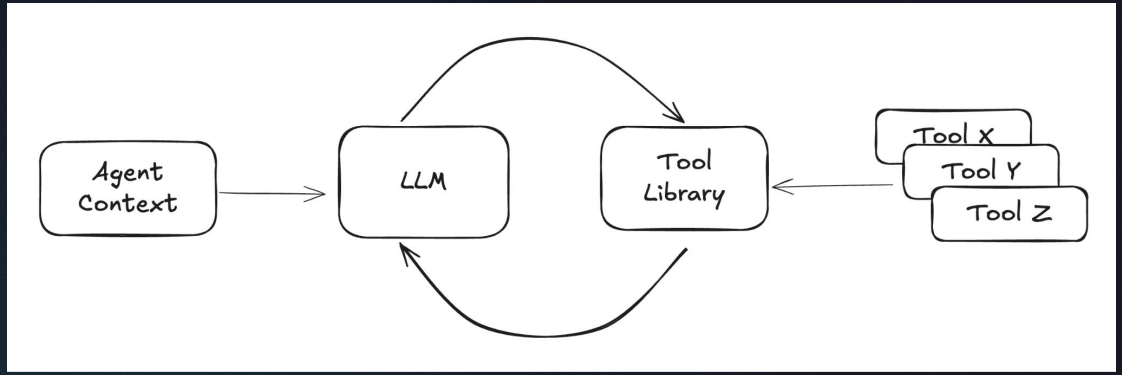
LEARNING OBJECTIVES

- ✅ Explore the role that MCP plays in AI applications
- ✅ Review MCP fundamentals
- ✅ Build durability into your MCP tools with Temporal
- ✅ Debug and monitor MCP tools with Temporal Web UI
- ✅ Implement long running MCP tools with Temporal (queries, signals)

Temporal

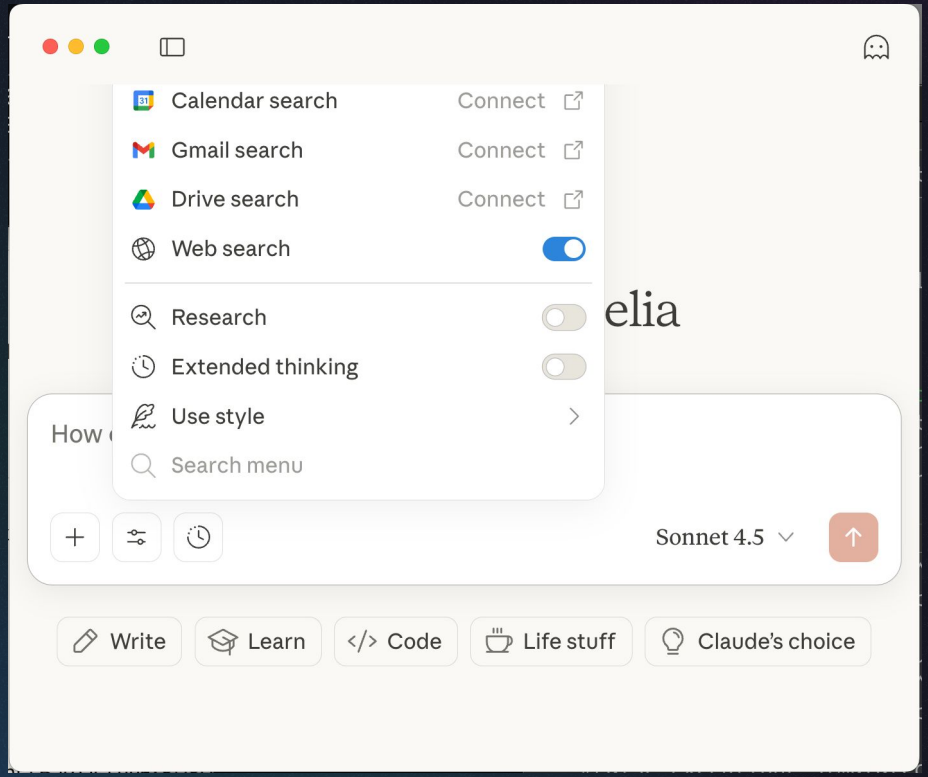
Foundations: Building MCP Servers with Temporal

WHAT ARE WE TRYING TO ACHIEVE?



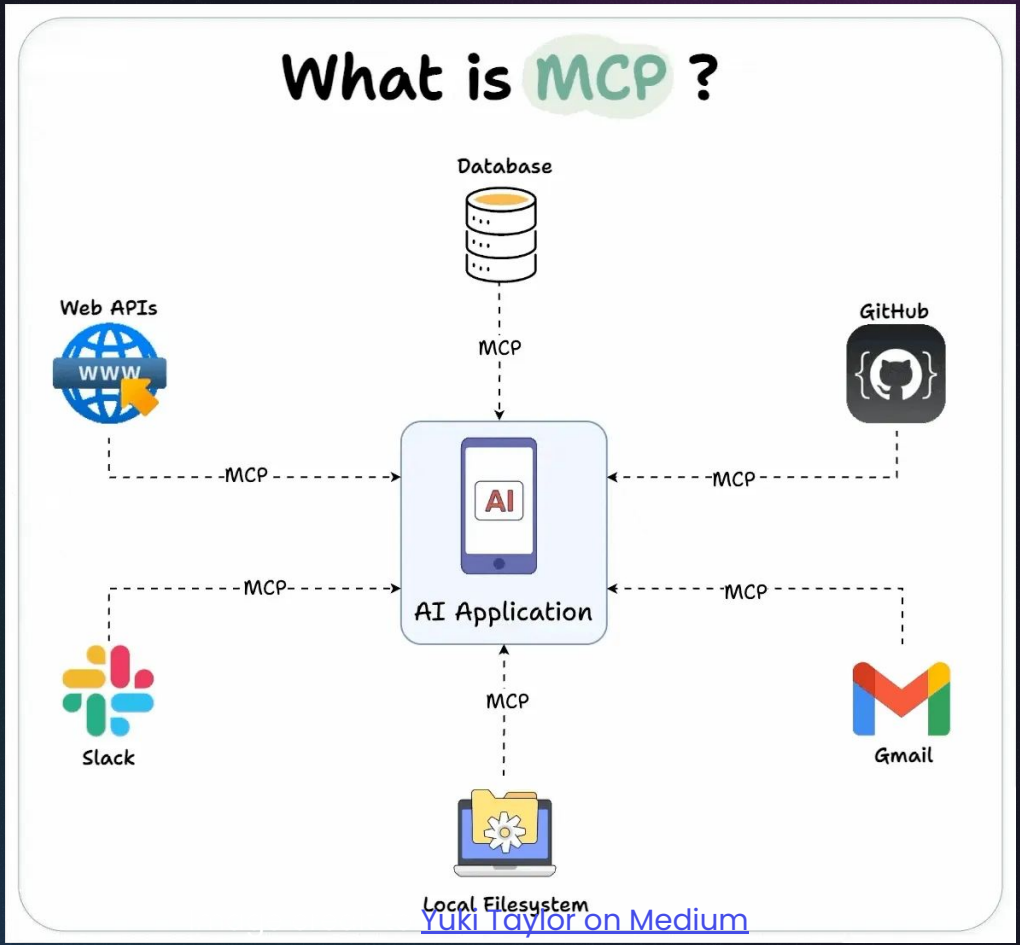
- Instead of building for-purpose agents...
- ... define agents through their instructions and a set of tools they are supplied

AND AI “BROWSERS” HAVE AGENTIC BEHAVIOR

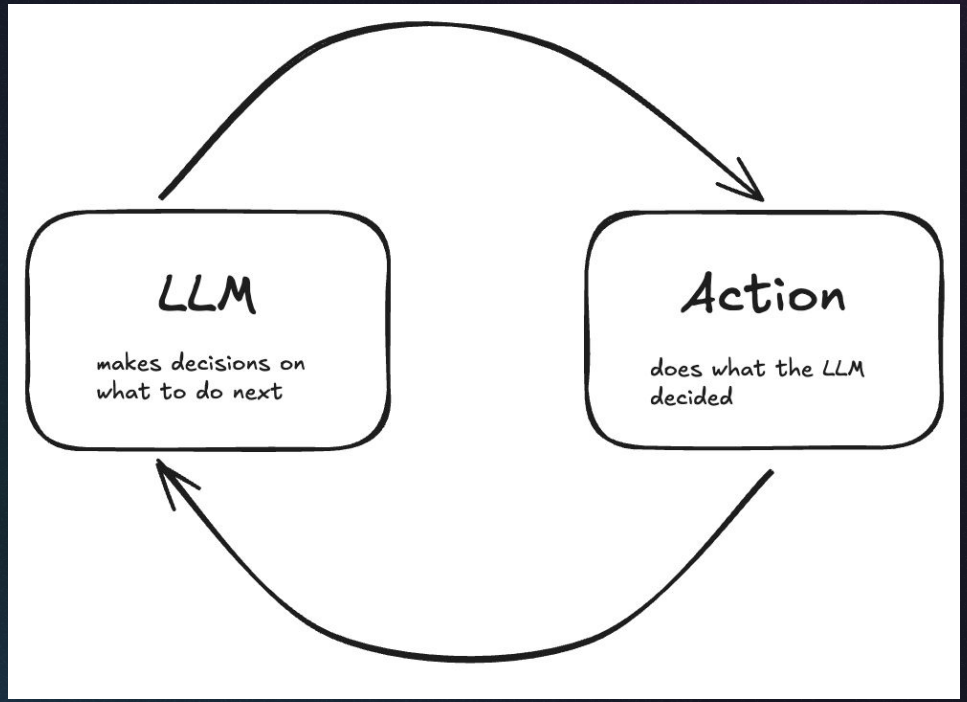


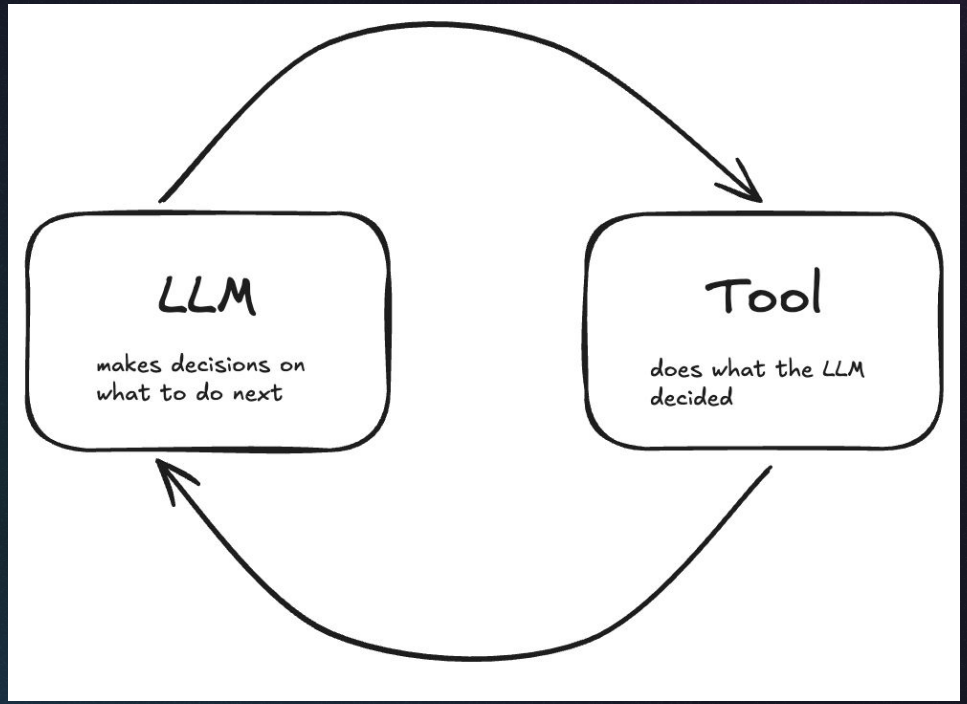
MCP IS THE DEFACTO STANDARD FOR AGENT EXTENSION AND CONFIGURATION

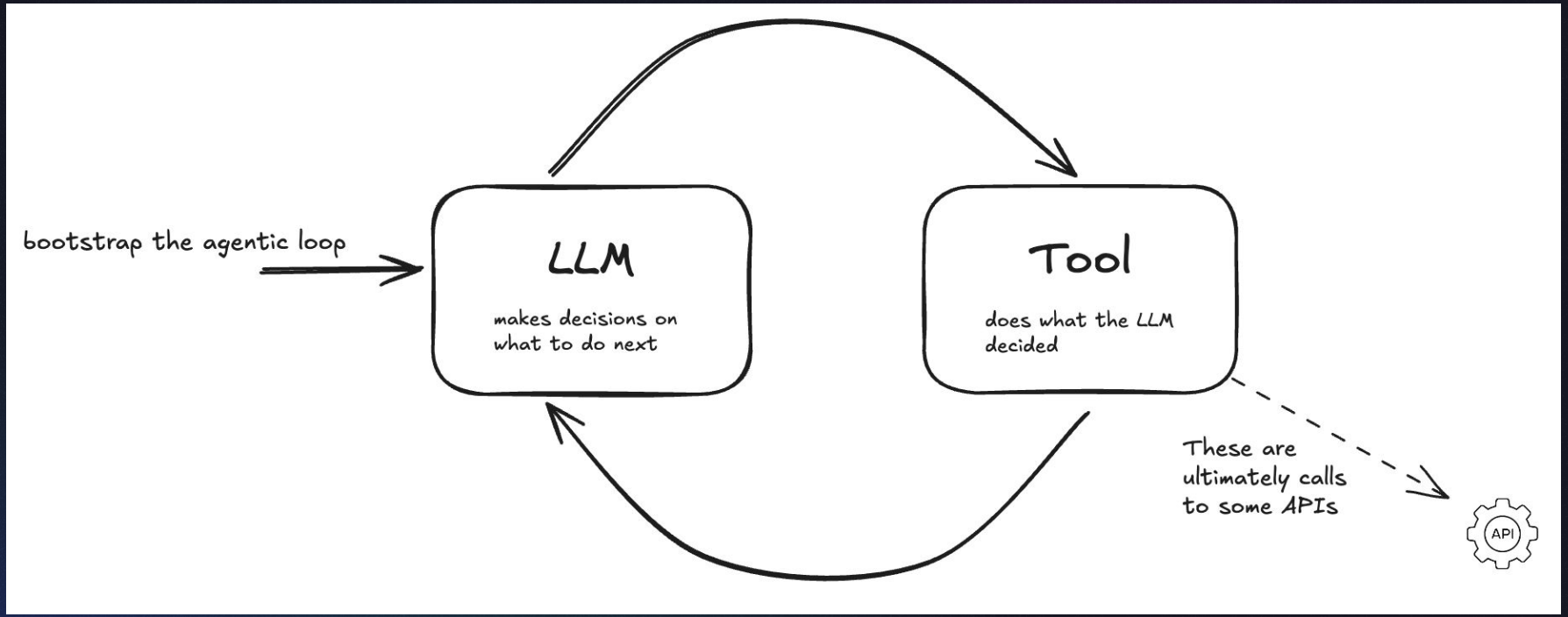
IT ALSO ALLOWS
FOR-PURPOSE AGENTS
TO CONNECT TO EXTERNAL SERVICES



Yuki Taylor on Medium


LLM
makes decisions on what to do next
Action
does what the LLM decided


LLM
makes decisions on what to do next
Tool
does what the LLM decided


bootstrap the agentic loop
LLM
makes decisions on what to do next
Tool
does what the LLM decided
These are ultimately calls to some APIs
API

MCP OVERVIEW

MCP SERVER, IN PRINCIPLE

- Placeholder slide - what I want to do here is establish a way of thinking about an MCP server - what it represents, not just drill into the pieces and parts.
- I.e. ChatGPT applications

(maybe not in the notebooks)

MCP HAS TWO PARTS

Primitives

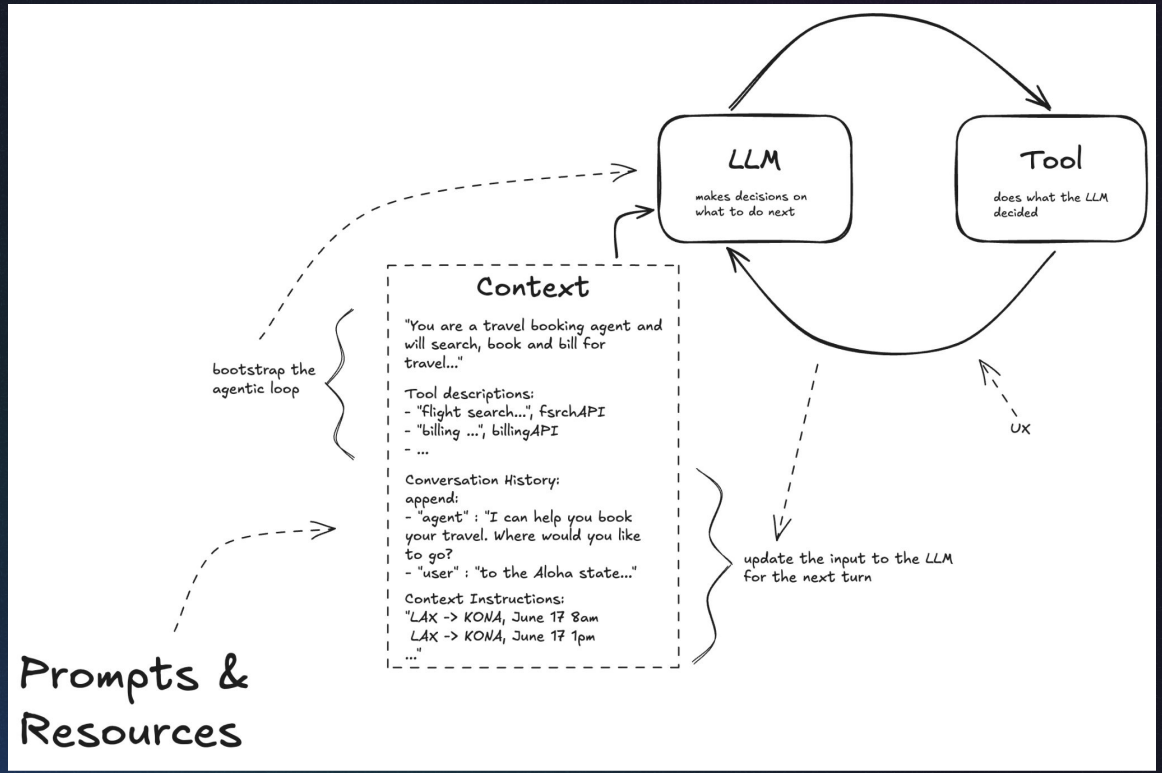
- Prompts
- Resources (i.e. files)
- Tools (i.e. Agent-ready APIs)

Client Server Architecture

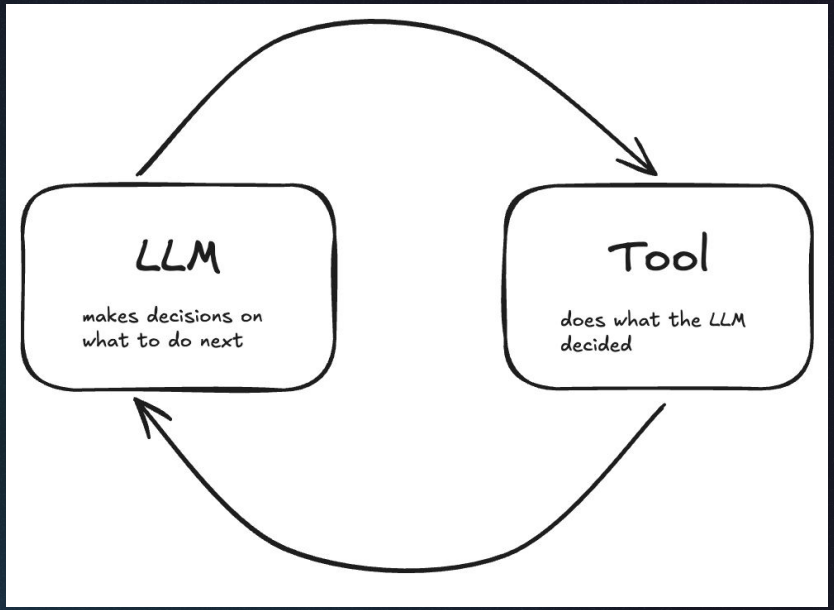
- MCP Clients
- MCP Servers
- A transport protocol between them

* Note: there are a few other concepts, but these are the core ones

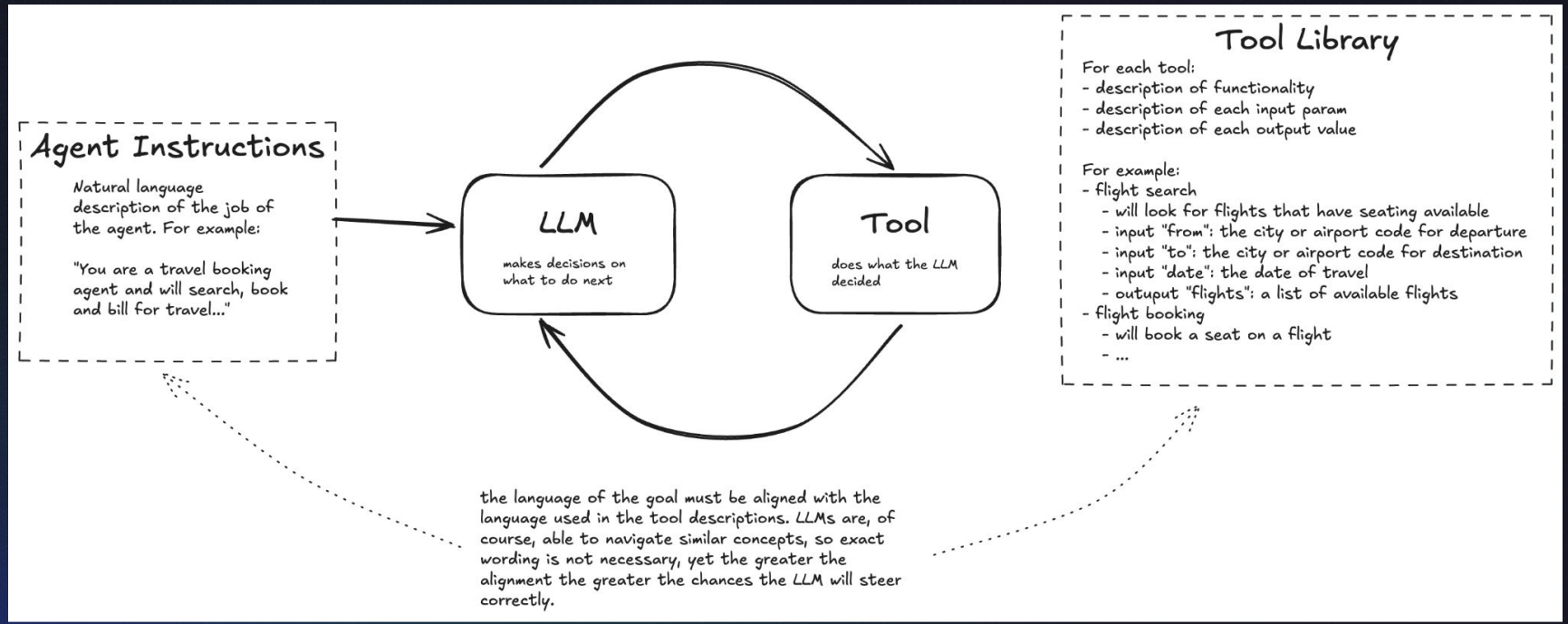
PROMPTS AND RESOURCES → CONTEXT WINDOW



TOOLS = AGENT-READY APIS



"AGENT-READY" APIS MEANS LANGUAGE ALIGNED



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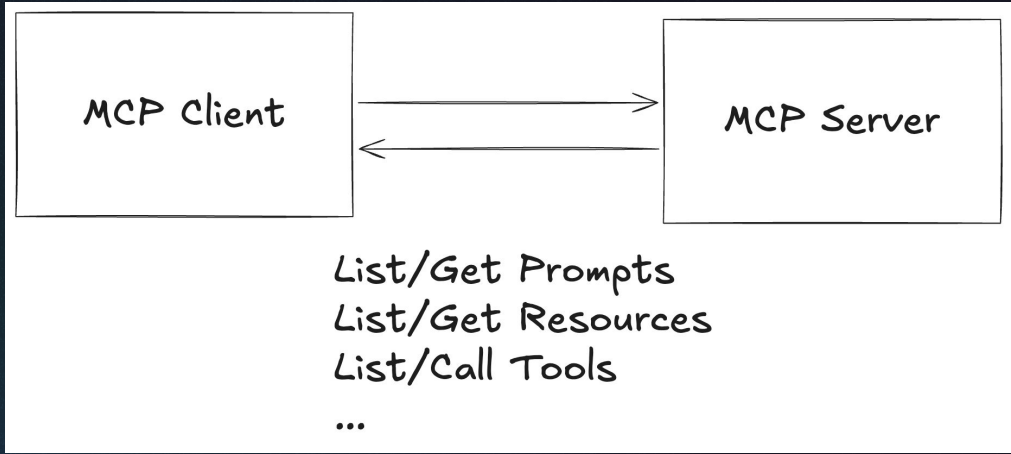
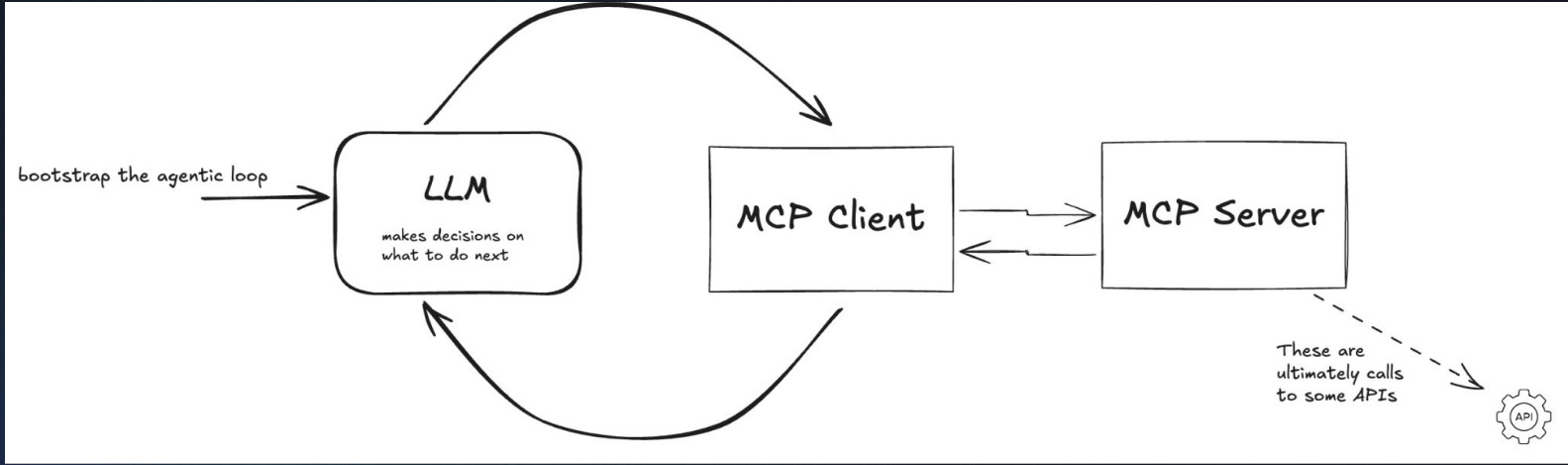
MCP CLIENT/SERVER ARCHITECTURE

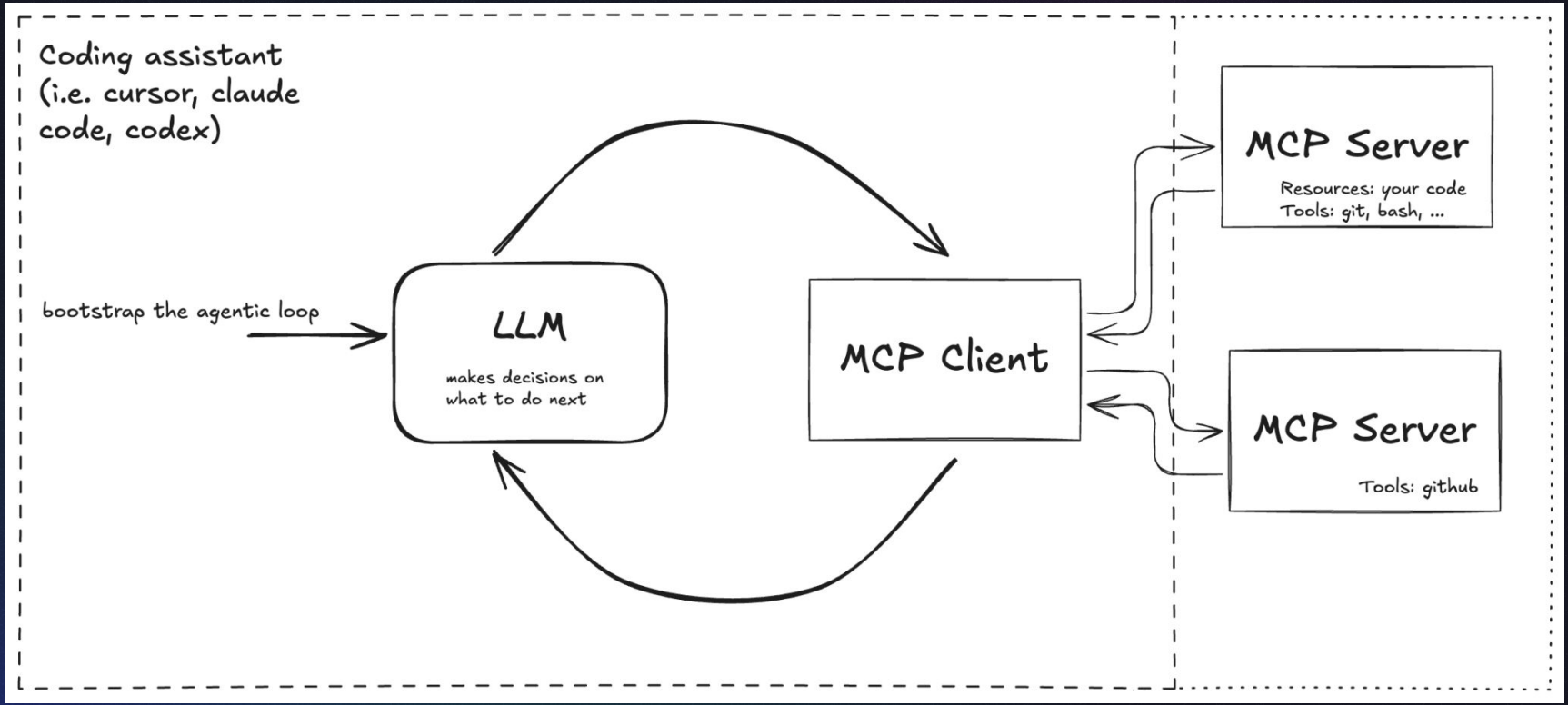


* Note: there are additional operations including notifications (one way), and sampling (Request/Response in the other direction).

MCP CLIENTS ARE EMBEDDED IN THE AGENT



MANY APPLICATIONS EMBED MCP CLIENTS



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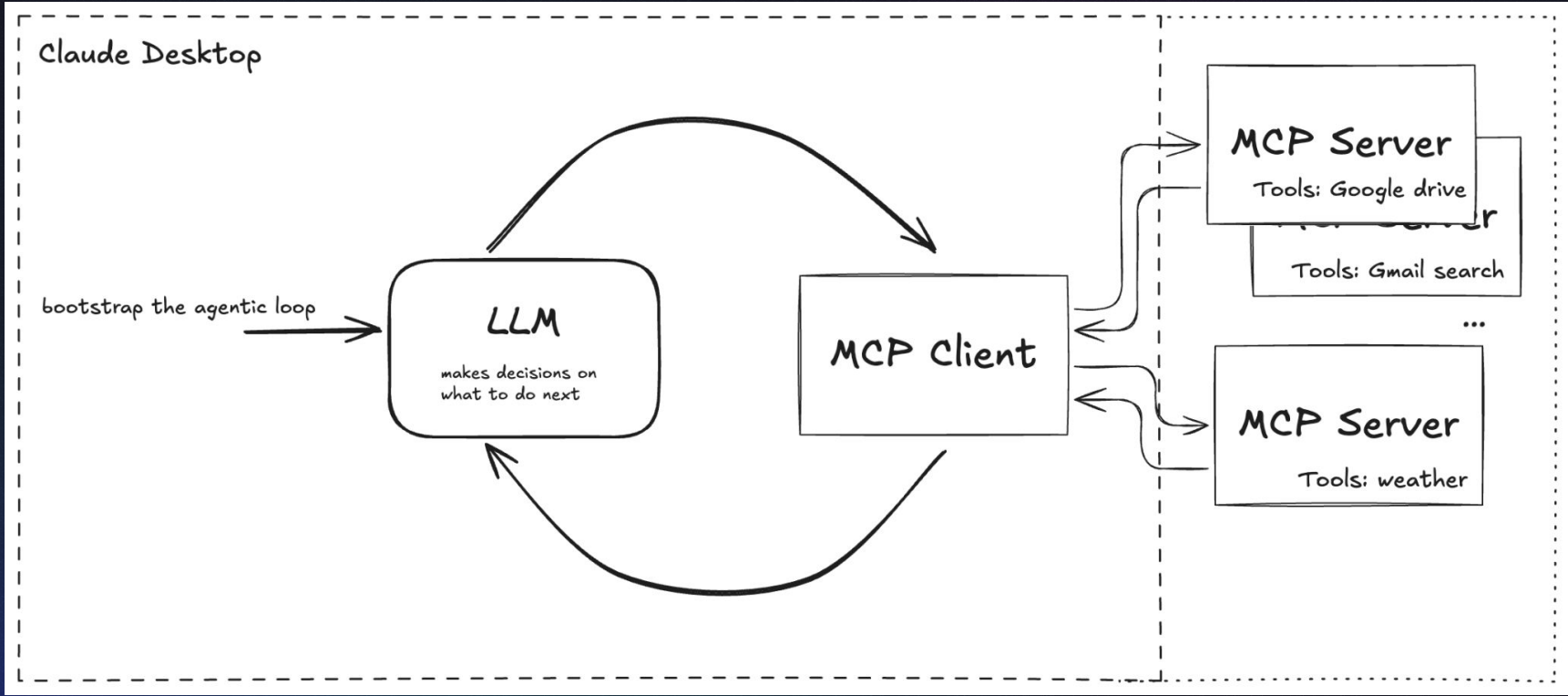
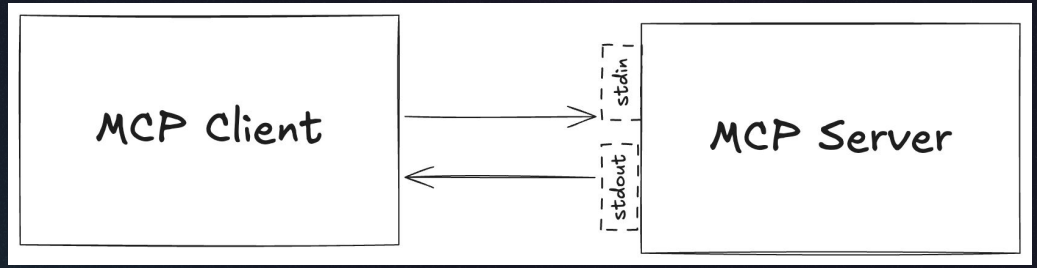
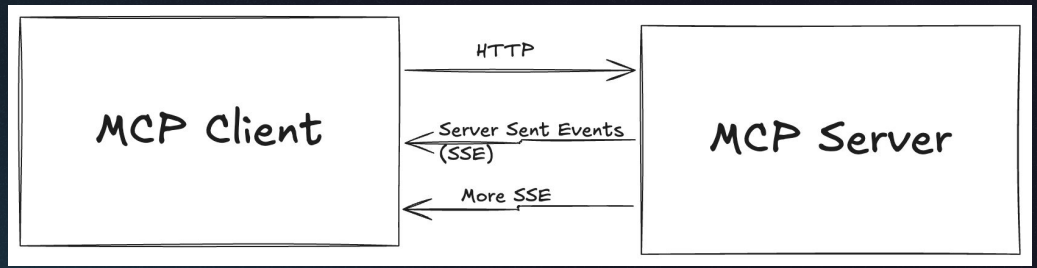


SUPPORTS MULTIPLE TRANSPORT PROTOCOLS

Transport: stdio



Transport:
streamable-http



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OKAY, THEN WHAT MAKES A GOOD MCP SERVER

“An API built for a human will poison your AI agent.”

- Jeremiah Lowin,
  Creator of FastMCP

https://www.jlowin.dev/blog/stop-converting-rest-apis-to-mcp

Commerce

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Get sales data for a Square seller, itemize payments, push orders to POS, and more.

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Apple pay
Apple Pay support APIs

Customers

Securely manage customer data and integrate engagement features to increase repeat business and attract new customers.

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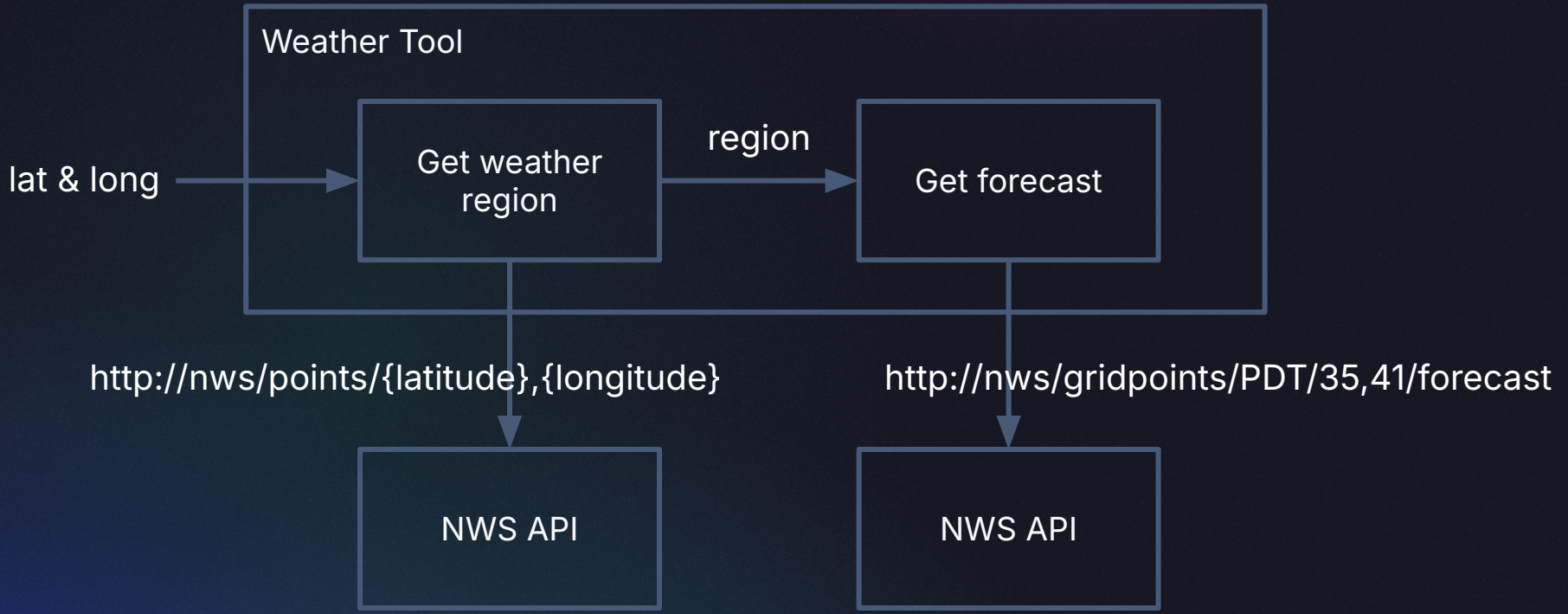
SQUARE APIS

WE NEED COARSER GRAINED APIS FOR LLMS

AND WE BUILD THOSE BY ORCHESTRATING
LOWER LEVEL APIS
INTO MCP SERVERS

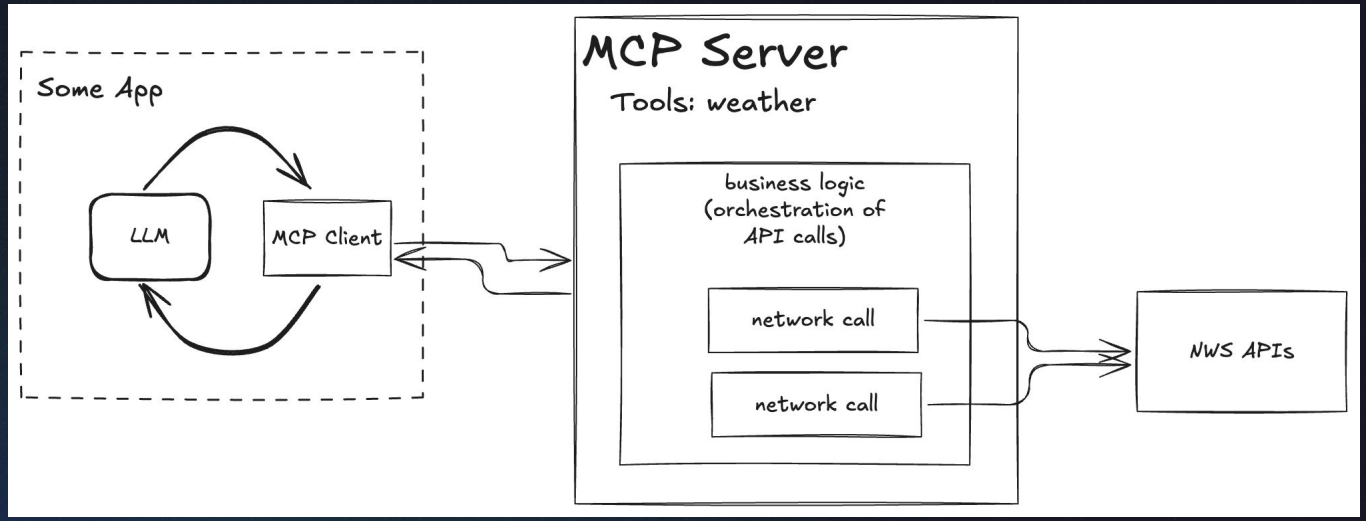
LET'S LOOK AT AN EXAMPLE



This is the example in the MCP spec

DEMO TIME!

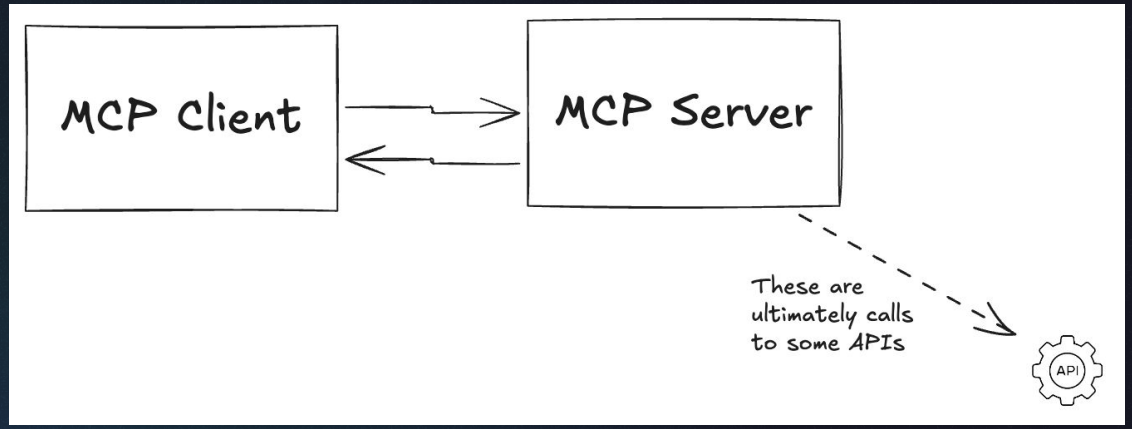
NON-DURABLE MCP ARCHITECTURE



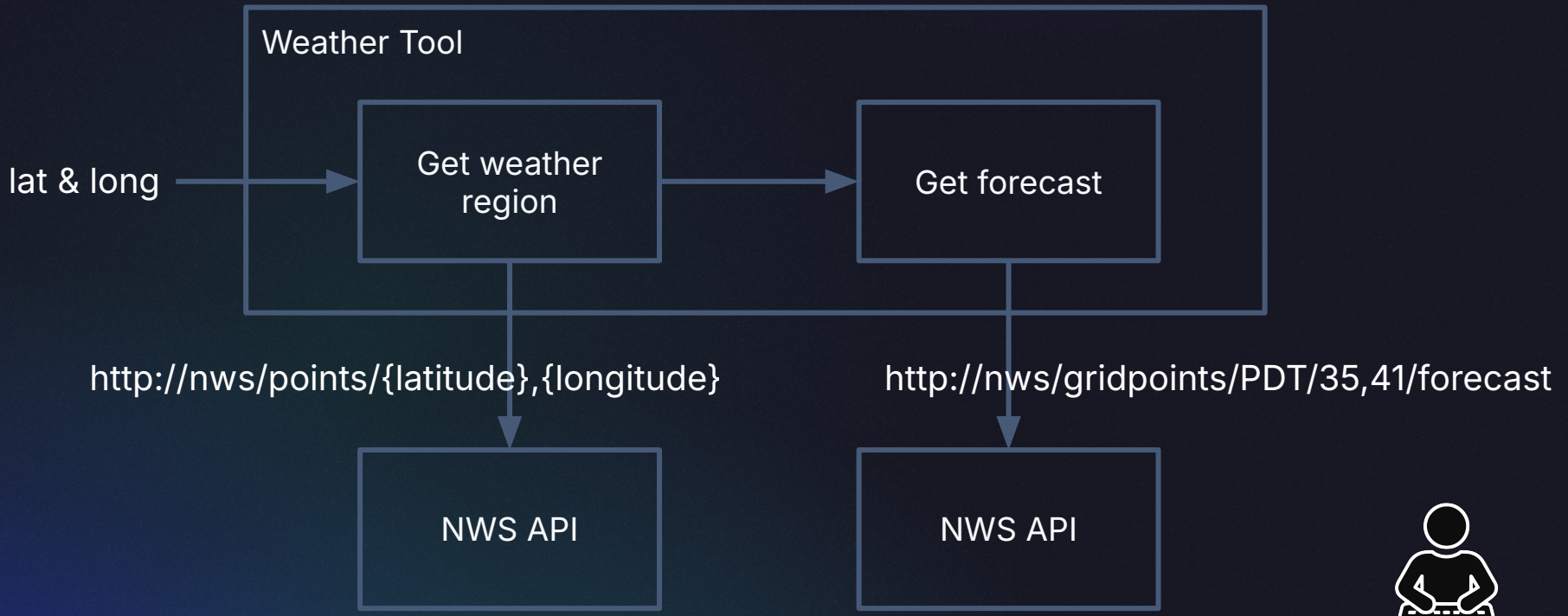
NOW, TEMPORAL

MCP SERVERS

Temporal is the ideal technology for building MCP Servers!



TEMPORAL IS THE BEST ORCHESTRATOR



NOTEBOOK SETUP

Follow along and play with our samples by accessing our Jupyter Notebooks here:

t.mp/temporal-mcp-workshop

Activity

```python
@activity.defn
async def make_nws_request(url: str) -> dict[str, Any] | None:
    """Make a request to the NWS API with proper error handling."""
    headers = {
        "User-Agent": USER_AGENT,
        "Accept": "application/geo+json"
    }
    async with httpx.AsyncClient() as client:
        try:
            response = await client.get(url, headers=headers, timeout=30.0)
            response.raise_for_status()
            return response.json()
        except Exception:
            return None
```

Workflow

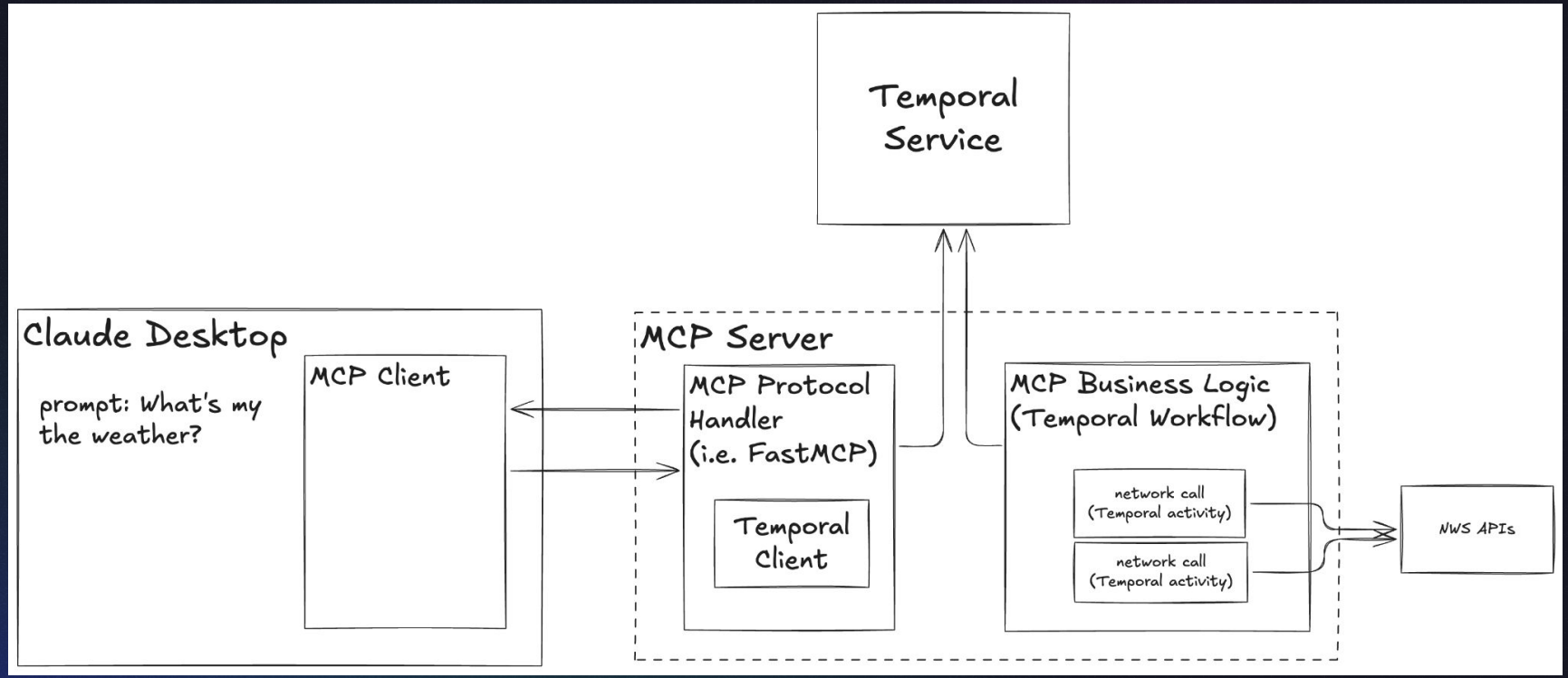
```python
@workflow.defn
class GetForecast:
    @workflow.run
    async def get_forecast(self, latitude: float, longitude: float) -> str:

        # First get the forecast grid endpoint
        points_url = f"{NWS_API_BASE}/points/{latitude},{longitude}"
        points_data = await workflow.execute_activity(
            make_nws_request,
            points_url,
            schedule_to_close_timeout=timedelta(seconds=40),
            retry_policy=retry_policy,
        )

        await workflow.sleep(10)

        # Get the forecast URL from the points response
        forecast_url = points_data["properties"]["forecast"]
        forecast_data = await workflow.execute_activity(
            make_nws_request,
            forecast_url,
            schedule_to_close_timeout=timedelta(seconds=40),
            retry_policy=retry_policy,
        )
```

MCP Protocol Handler and Workflow Client

```python
@mcp.tool
async def get_forecast(latitude: float, longitude: float) -> str:
    """Get weather forecast for a location.

    Args:
        latitude: Latitude of the location
        longitude: Longitude of the location
    """
    # The business logic has been moved into the temporal workflow, the mcp tool kicks off the workflow
    client = await get_temporal_client()
    handle = await client.start_workflow(
        workflow="GetForecast",
        args=[latitude, longitude],
        id=f"forecast-{latitude}-{longitude}",
        task_queue="weather-task-queue",
    )
    return await handle.result()
```

The Durable Architecture



DEMO TIME!

WHEN ERROR HANDLING IS A BUG

Activity (corrected)

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    async with httpx.AsyncClient() as client:

        response = await client.get(url, headers=headers, timeout=20.0)
        response.raise_for_status()
        return response.json()
```

Summarizing

- MCP is the defacto standard
- What we are seeing in our customer base → you are building MCP servers.
  - Platform Engineering orchestration from slack
  - Extensions to your coding agents
  - ...
- Still early days - an abundance of trickiness (security, scaling, observability, ..)

But some things are clear...

- MCP servers are distributed systems
- They need durability
- The durability needs compound because... Agents!
- Temporal is committed!

Challenge	Without Temporal	With Temporal
Failures	Tool execution lost on crash	Automatic recovery and retry
Long operations	Timeout limitations	Unlimited execution time
State Management	Complex manual handling	Built-in durable state
Network Issues	Manual retry logic needed	Automatic retry with backoff
Multi-step Processes	Difficult coordination	Natural workflow orchestration

LET'S CODE AND BUILD SOME DURABLE MCP TOOLS.

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SQUARE APIS

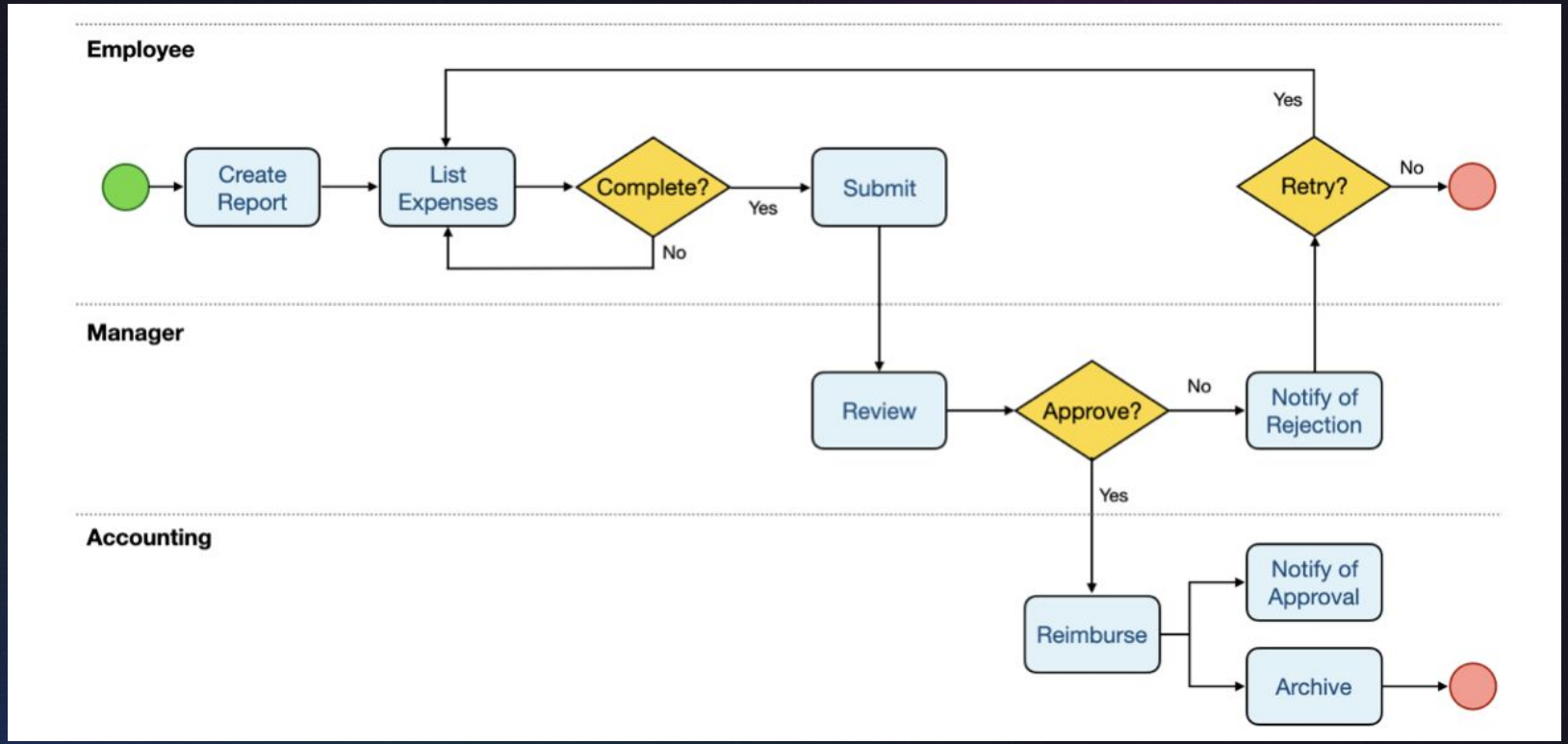
Temporal

Long-running MCP tools and HITL

Temporal

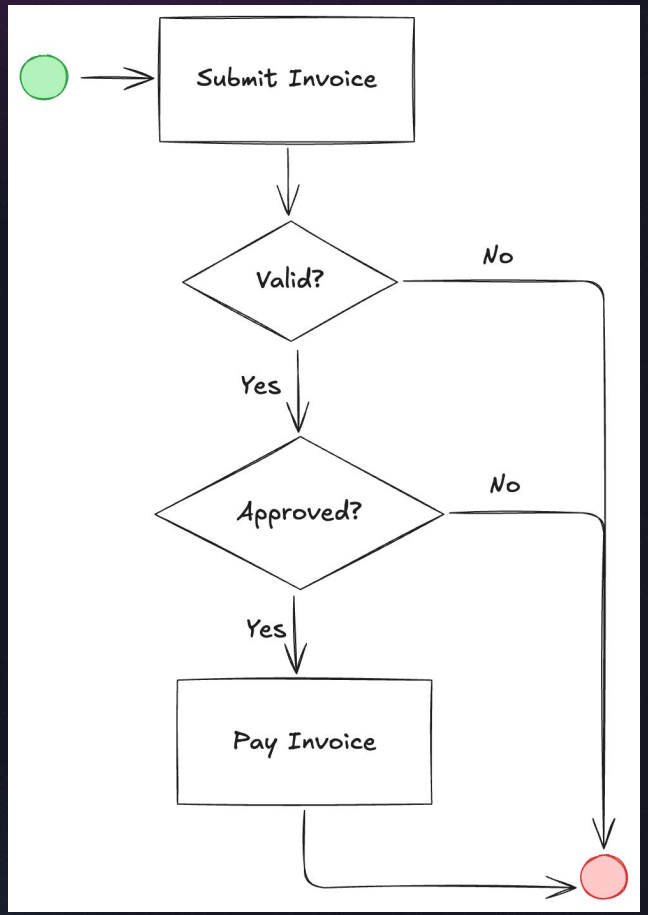
Processes

Long-running ~~MCP tools~~ and HITL


Employee
Create Report
List Expenses
Complete?
Yes
No
Submit
Retry?
Yes
No
Manager
Review
Approve?
No
Notify of Rejection
Yes
Accounting
Reimburse
Notify of Approval
Archive

FOR TODAY: INVOICE PROCESSING

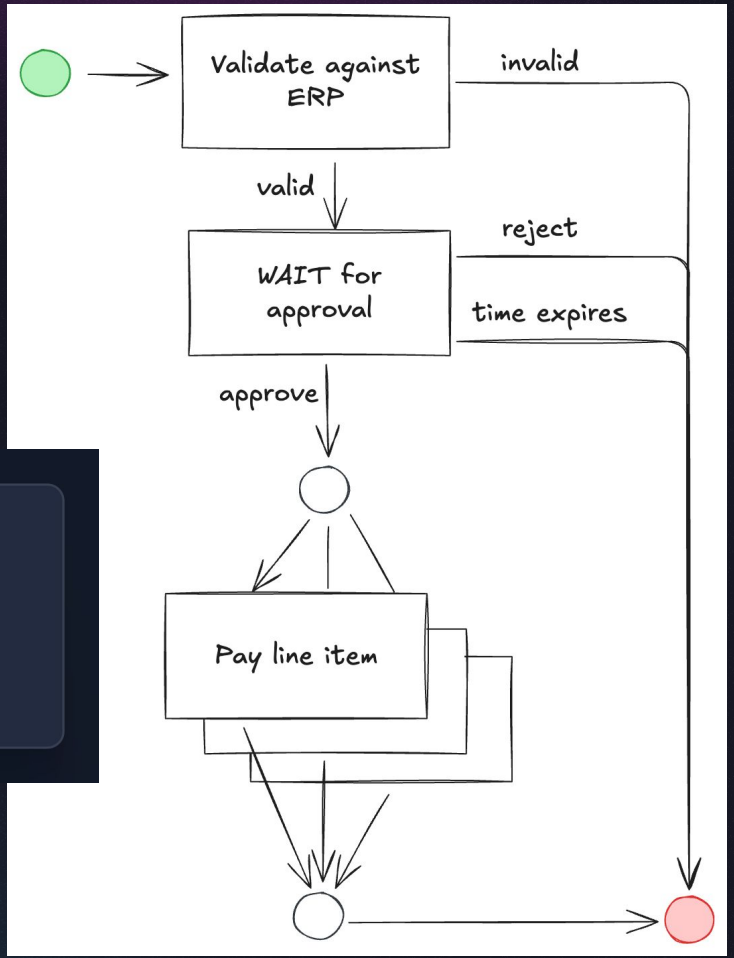
- Submit invoice
- Apply policies to determine whether an invoice can be auto approved (i.e. <$100)
- Allow for approval (HITL)
- When approved, process the invoice (i.e. issue a payment)
- Implement policies for invoices that go unapproved



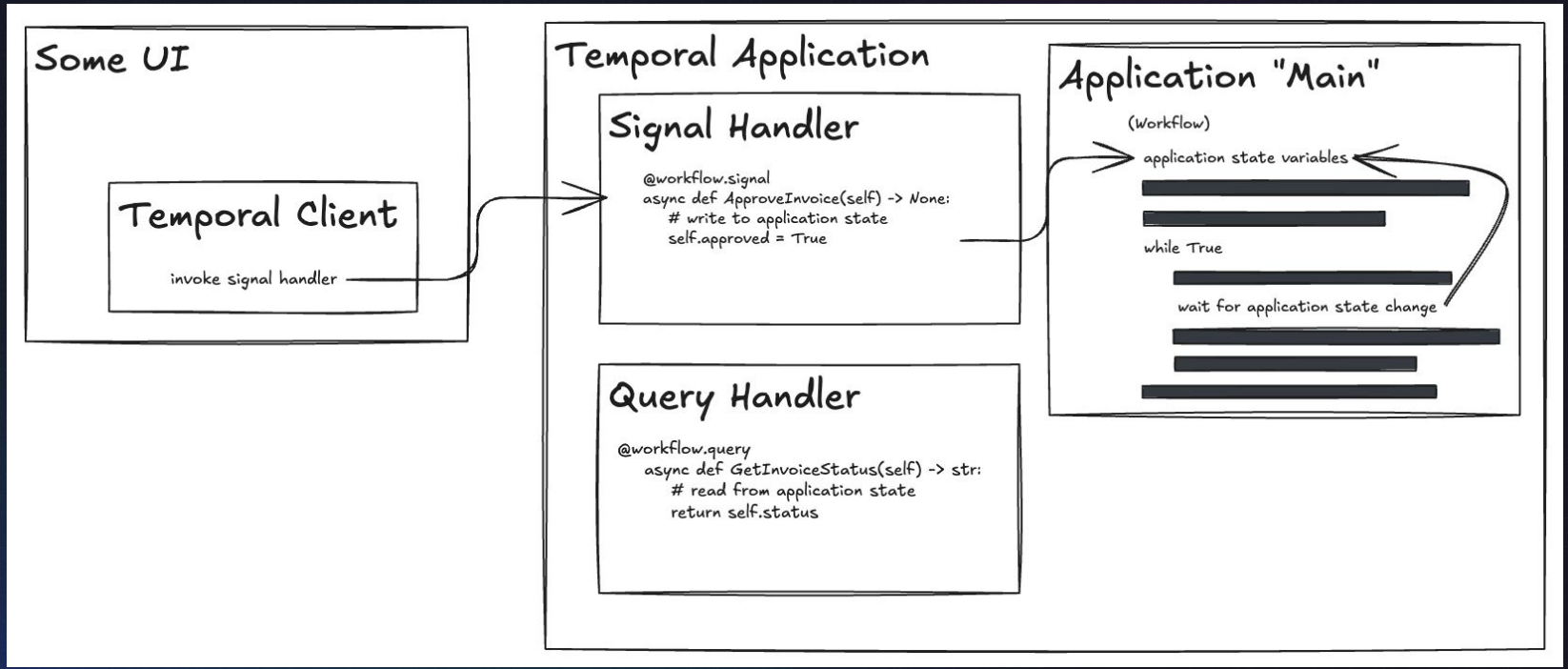
THE WORKFLOW

Durable Timers!!

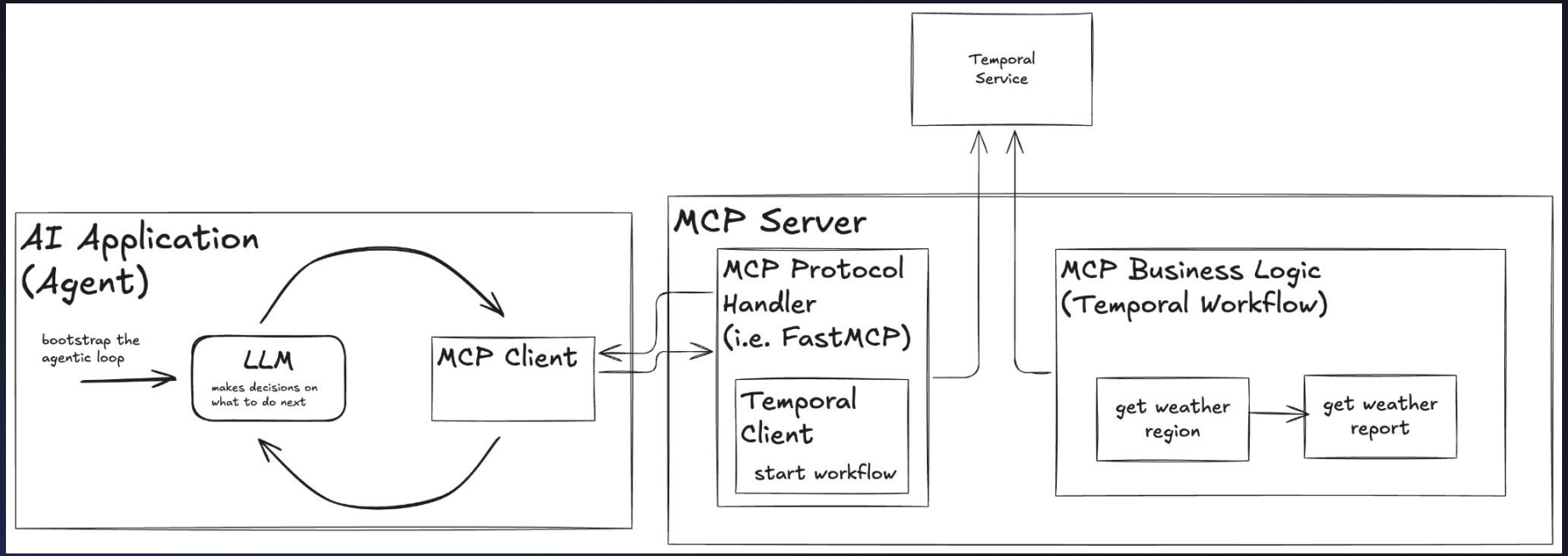
```python
await workflow.wait_condition(
    lambda: self.approved is not None,
    timeout=timedelta(days=5),
)
```



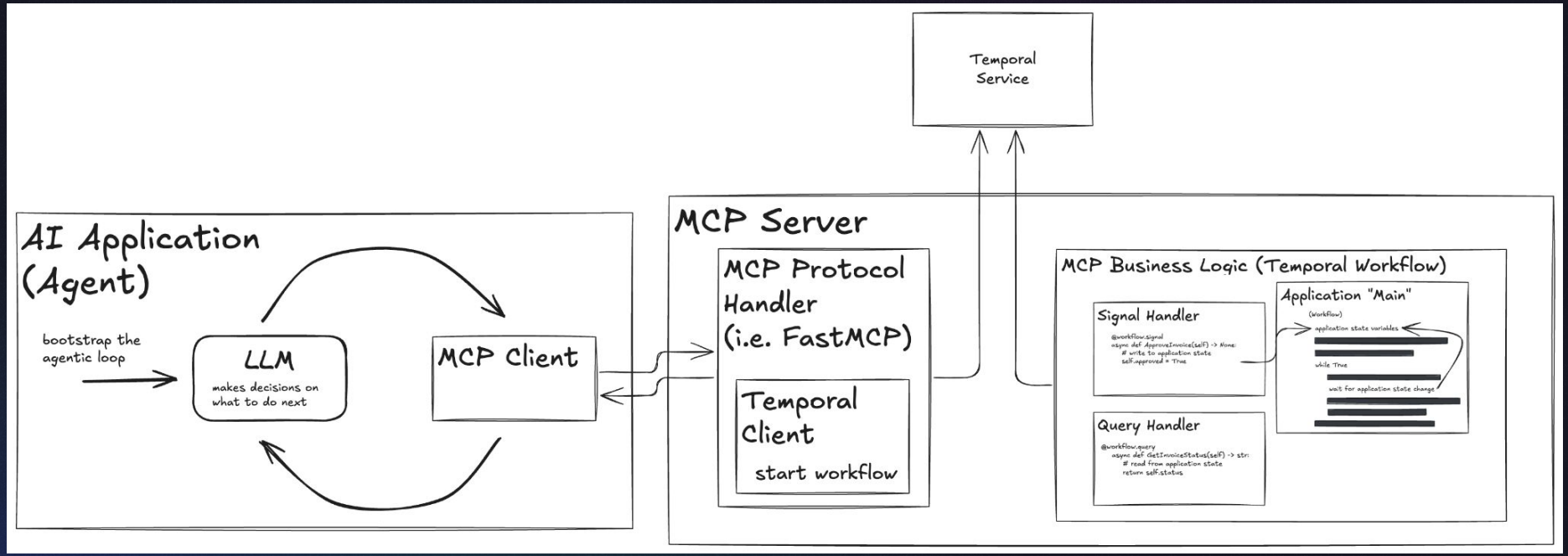
WELL SUITED TO TEMPORAL!



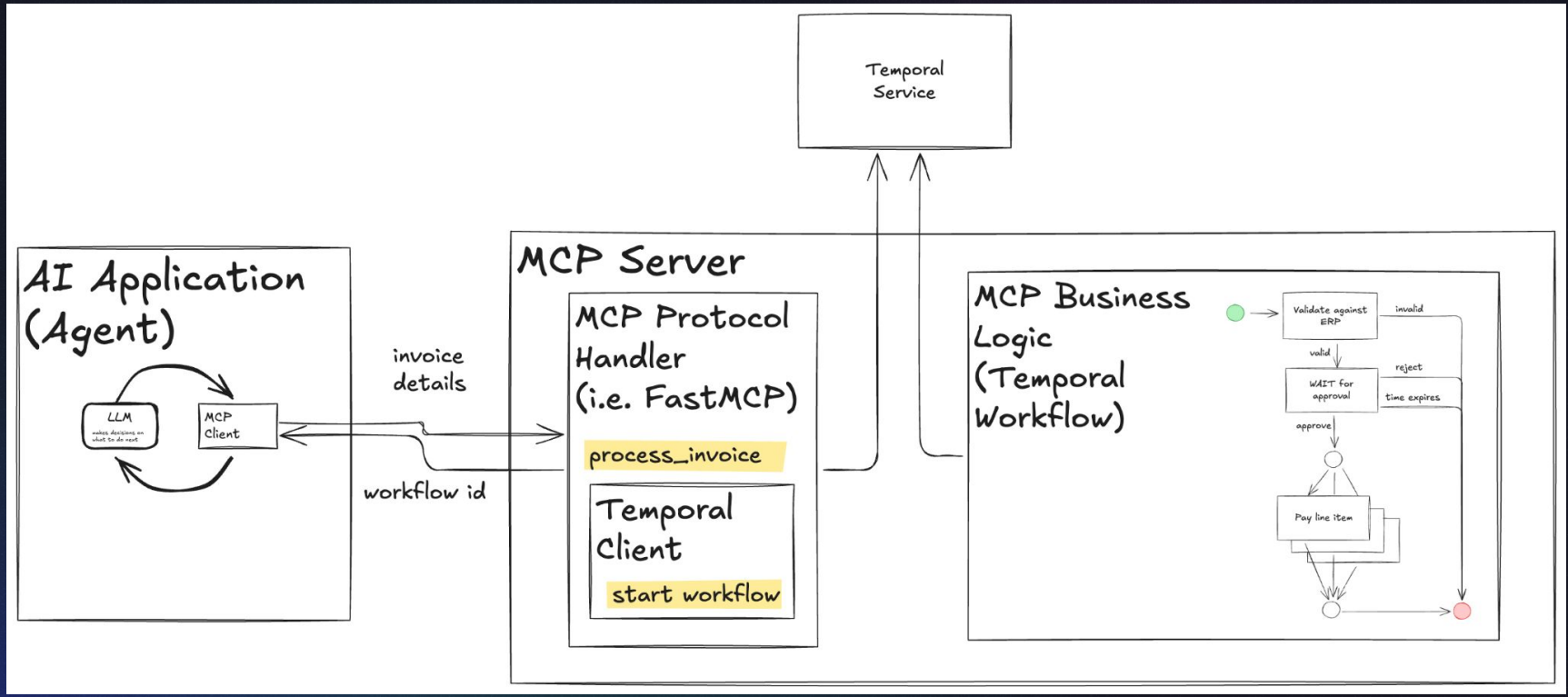
REMEMBER THIS? - FROM OUR FIRST EXAMPLE



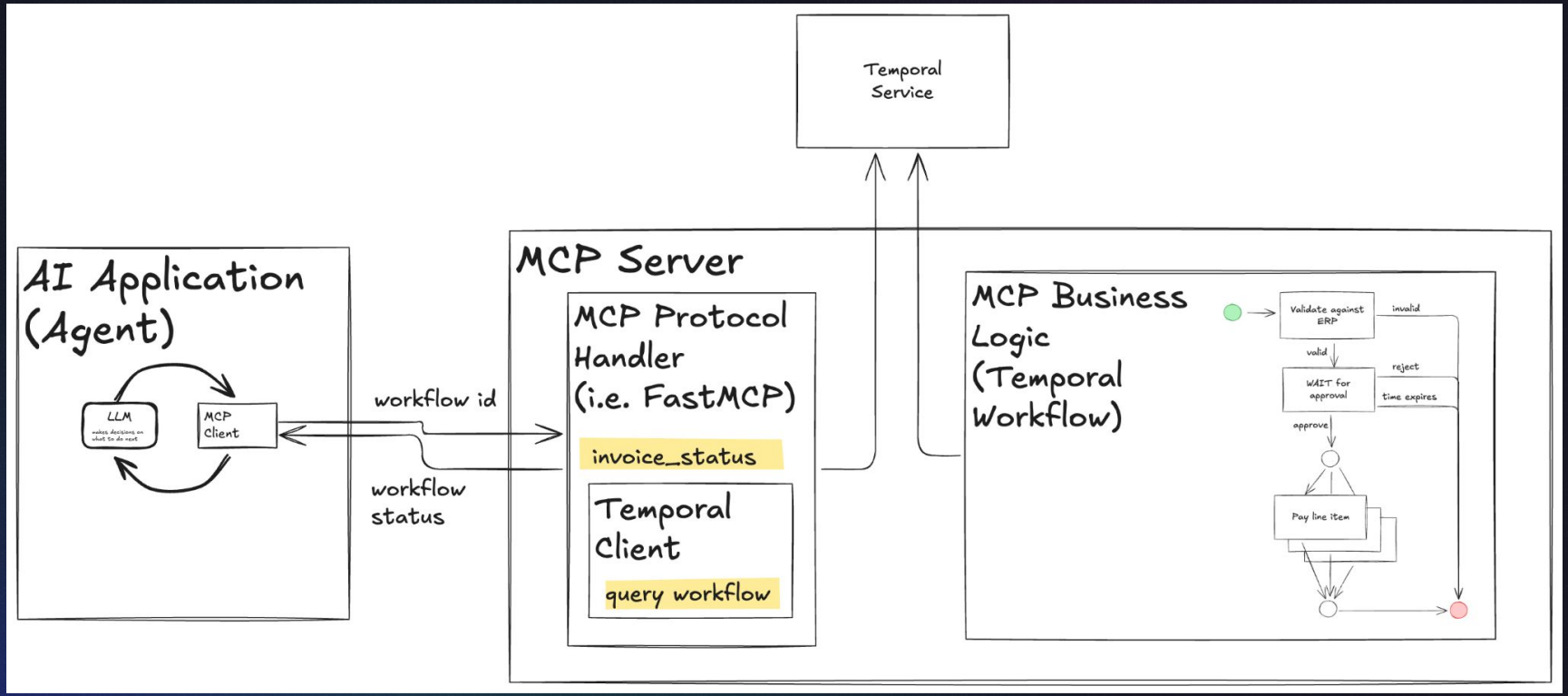
FRONT WITH THE MCP PROTOCOL



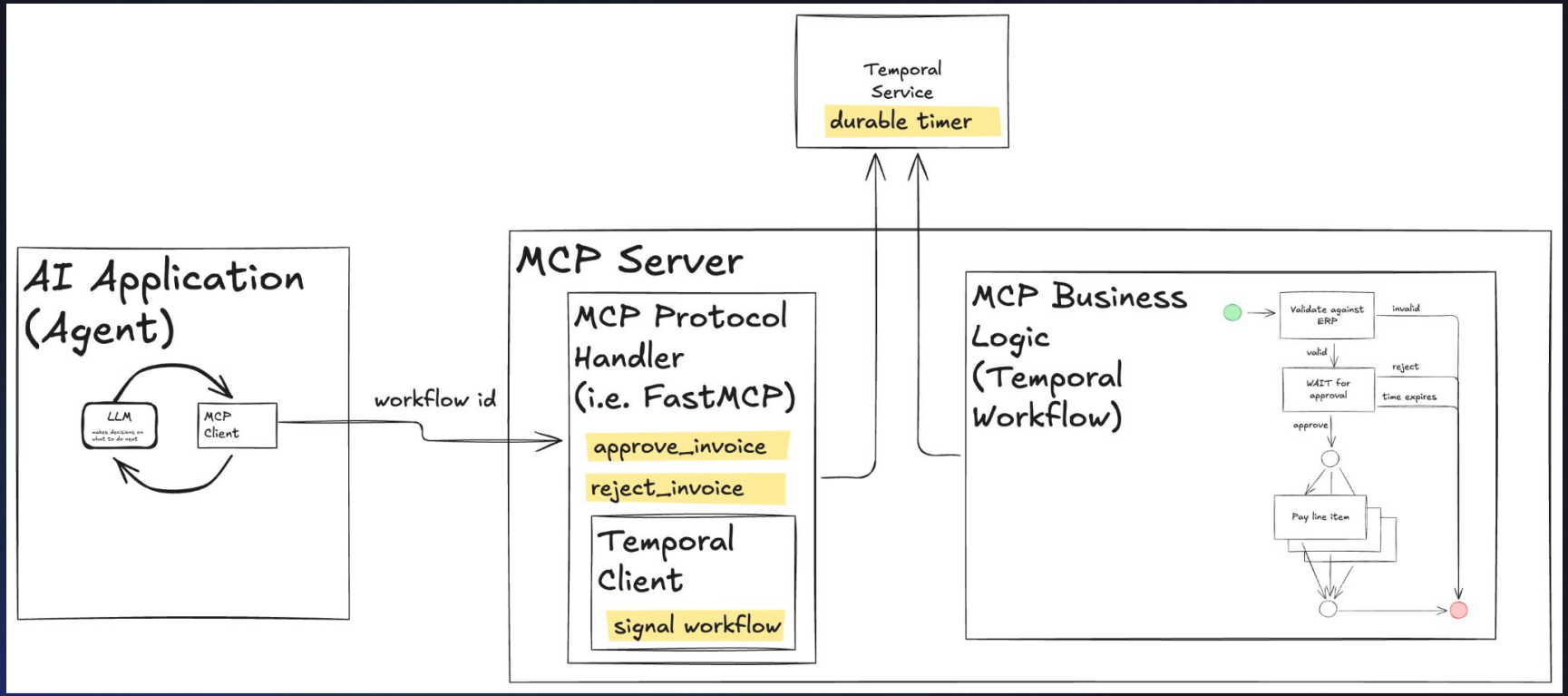
SUBMIT INVOICE



INVOICE STATUS



APPROVE/REJECT INVOICE (AND TIMERS)



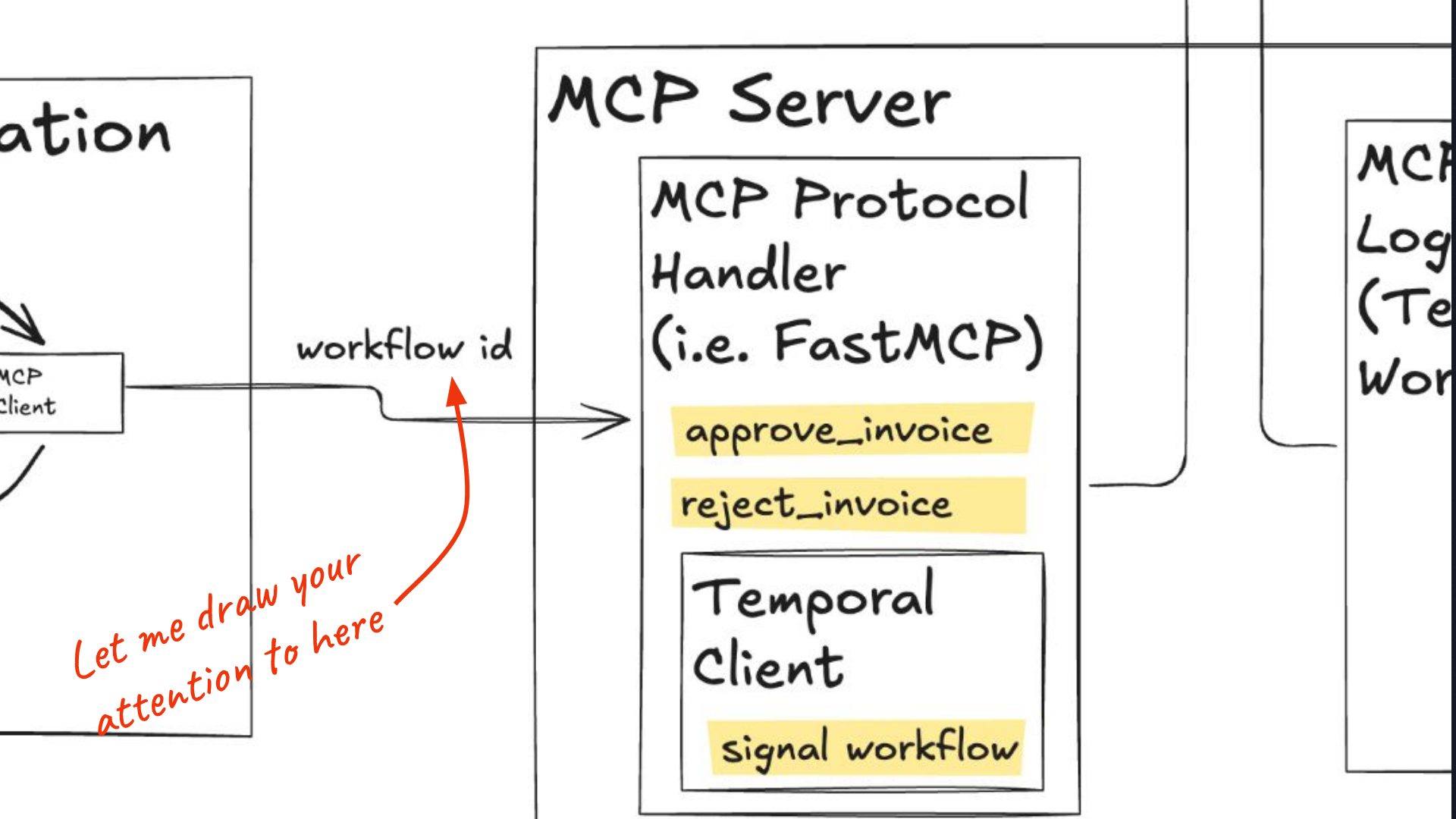
MCP Protocol Layer

```python
@mcp.tool()
async def approve_invoice(workflow_id: str, run_id: str) -> str:
    """Signal approval for the invoice workflow."""
    client = await _client()
    ...

@mcp.tool()
async def reject_invoice(workflow_id: str, run_id: str) -> str:
    """Signal rejection for the invoice workflow."""
    client = await _client()
    ...

@mcp.tool()
async def invoice_status(workflow_id: str, run_id: str) -> str:
    """Return current status of the workflow."""
    client = await _client()
    ...

@mcp.tool()
async def process_invoice(invoice: Dict) -> Dict[str, str]:
    """Start the InvoiceWorkflow with the given invoice JSON."""
    client = await _client()
    ...
```

MCP Business Logic

```python
@workflow.defn
class InvoiceWorkflow:
    def __init__(self) -> None:
        self.approved: bool | None = None
        self.status: str = "INITIALIZING"

    @workflow.signal
    async def ApproveInvoice(self) -> None:
        self.approved = True

    @workflow.signal
    async def RejectInvoice(self) -> None:
        self.approved = False

    @workflow.query
    async def GetInvoiceStatus(self) -> str:
        return self.status

    @workflow.run
    async def run(self, invoice: dict) -> str:
      ...
```

DEMO TIME!


ation
MCP
Client
workflow id
Let me draw your attention to here
MCP Server
MCP Protocol Handler (i.e. FastMCP)
approve_invoice
reject_invoice
Temporal Client
signal workflow
MCP
Log
(Te
Wor

LET'S TALK ABOUT DIGITAL TWINS

*“A **digital twin** is a digital model of an intended or actual real-world physical product, system, or process (a physical twin) that serves as a digital counterpart of it for purposes such as simulation, integration, testing, monitoring, and maintenance.”*

https://en.wikipedia.org/wiki/Digital_twin

INVOICE = LONG RUNNING WORKFLOW

Physical twin

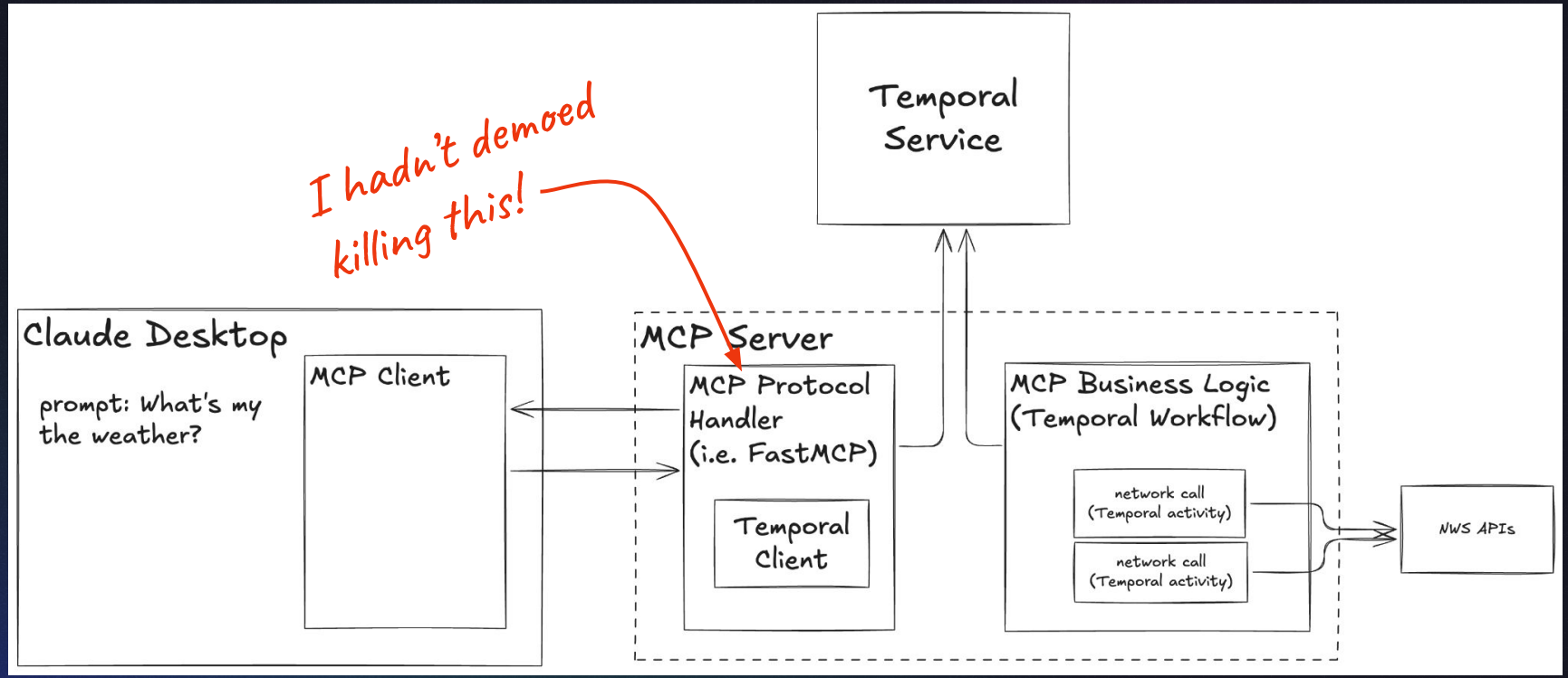
Digital twin

We also refer to these as
Entity Workflows

DEMO TIME!

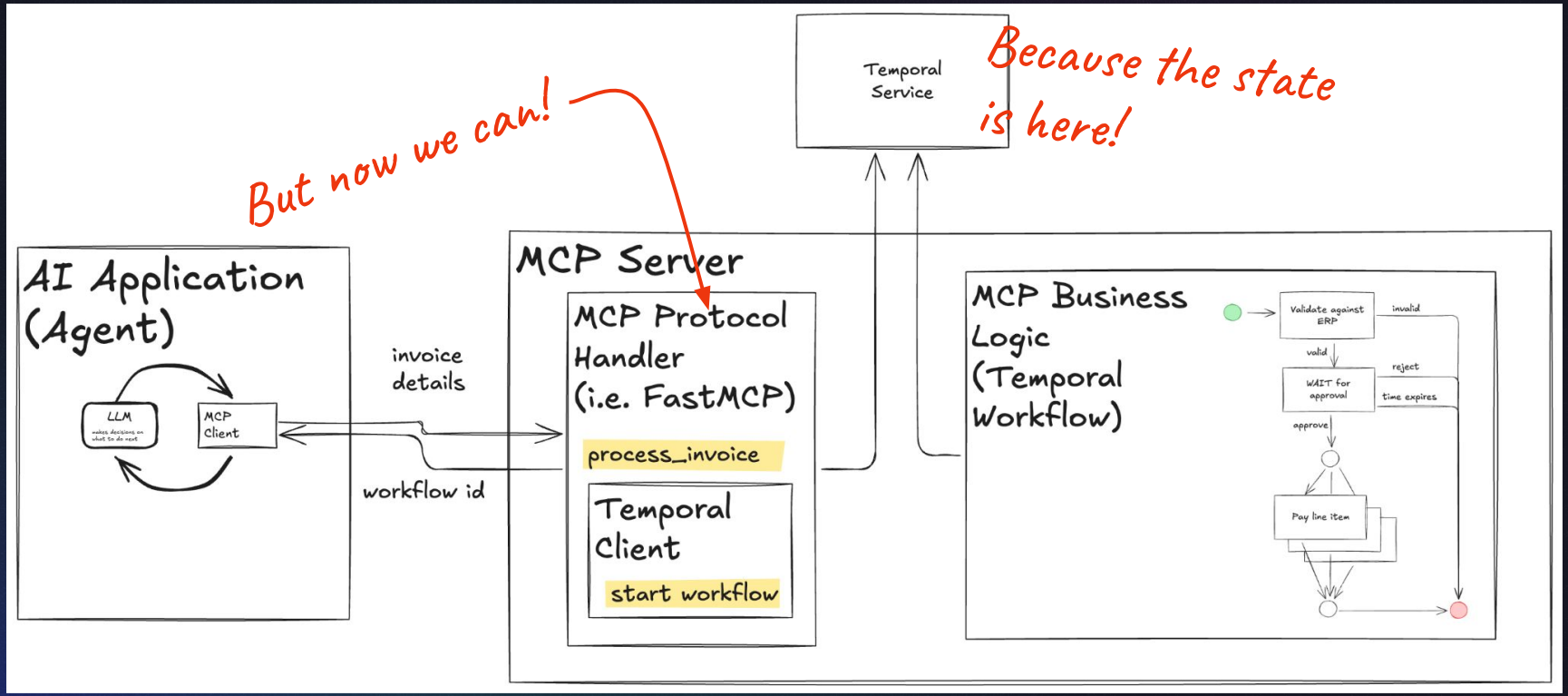
ONE MORE THING TO NOTE...

THE DURABLE ARCHITECTURE



THE CONNECTION BETWEEN THE MCP CLIENT AND THE MCP SERVER IS STATEFUL

THE DURABLE ARCHITECTURE



THIS IS A GAP IN THE MCP PROTOCOL

[notes] Long running tools/ async tools/ resumability #982

THAT IS ADDRESSED - TODAY - IF YOU IMPLEMENT YOUR MCP SERVERS USING TEMPORAL

DEMO TIME!

IF YOU DON'T...

We're working on it with some of you.

LEARNING OBJECTIVES

- ✅ Explore the role that MCP plays in AI applications
- ✅ Review MCP fundamentals
- ✅ Build durability into your MCP tools with Temporal
- ✅ Debug and monitor MCP tools with Temporal Web UI
- ✅ Implement long running MCP tools with Temporal (queries, signals)

WE WELCOME YOUR FEEDBACK!

T.MP/AI-WORKSHOP-FEEDBACK

WANT TO WATCH MORE ABOUT TEMPORAL AND MCP?

GET STARTED WITH TEMPORAL!

- Join the community!
- Read the documentation
- Follow a tutorial
- Take a free course online and more

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// JUST ANNOUNCED

01 TEMPORAL

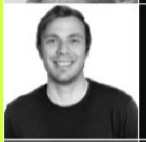
SAMAR ABBAS

02 TEMPORAL

MAXIM FATEEV

03 REPLIT

AMJAD MASAD



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