



A dramatic nuclear mushroom cloud with a blue and white top and a fiery orange and red base, set against a dark sky.

IPVM

Seamless Services

—For an Open World—

 **Light Cones, User Agency, & Connecting Everything** 

github.com/ipvm-wg
fission.codes

Seamless Services for an Open World

Seamless Services for an Open World

We cannot sow seeds with clenched fists.
To sow we must ***open our hands.***

– **Adolfo Perez Esquivel**

Seamless Services for an Open World

Seamless Services for an Open World

Jesper, I have this idea in which we'll connect all of the worlds Erlang systems to each other, imagine if **every process could talk to every other process**, world-wide!

– **Joe Armstrong**, email to Jesper L. Andersen

Seamless Services for an Open World

Brooklyn Zelenka @expede

Seamless Services for an Open World

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github.com/expede

Seamless Services for an Open World

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- ◆ Cofounder & CTO at Fission Codes 
- ◆ <https://fission.codes>
- ◆ PLT and DSys are my jam 🙌
- ◆ Witchcraft, UCAN, WNFS, Rhizome, Multiformats, EIPs, &c

github.com/expede

Seamless Services for an Open World

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- ◆ PLT and DSys are my jam 🤘
- ◆ Witchcraft, UCAN, WNFS, Rhizome, Multiformats, EIPs, &c
- ◆ 🦀 Rust IPVM implementation (mainly) by *Zeeshan Lakhani*
- ◆ Joint work with Protocol Labs, Expanso, and others



github.com/expede



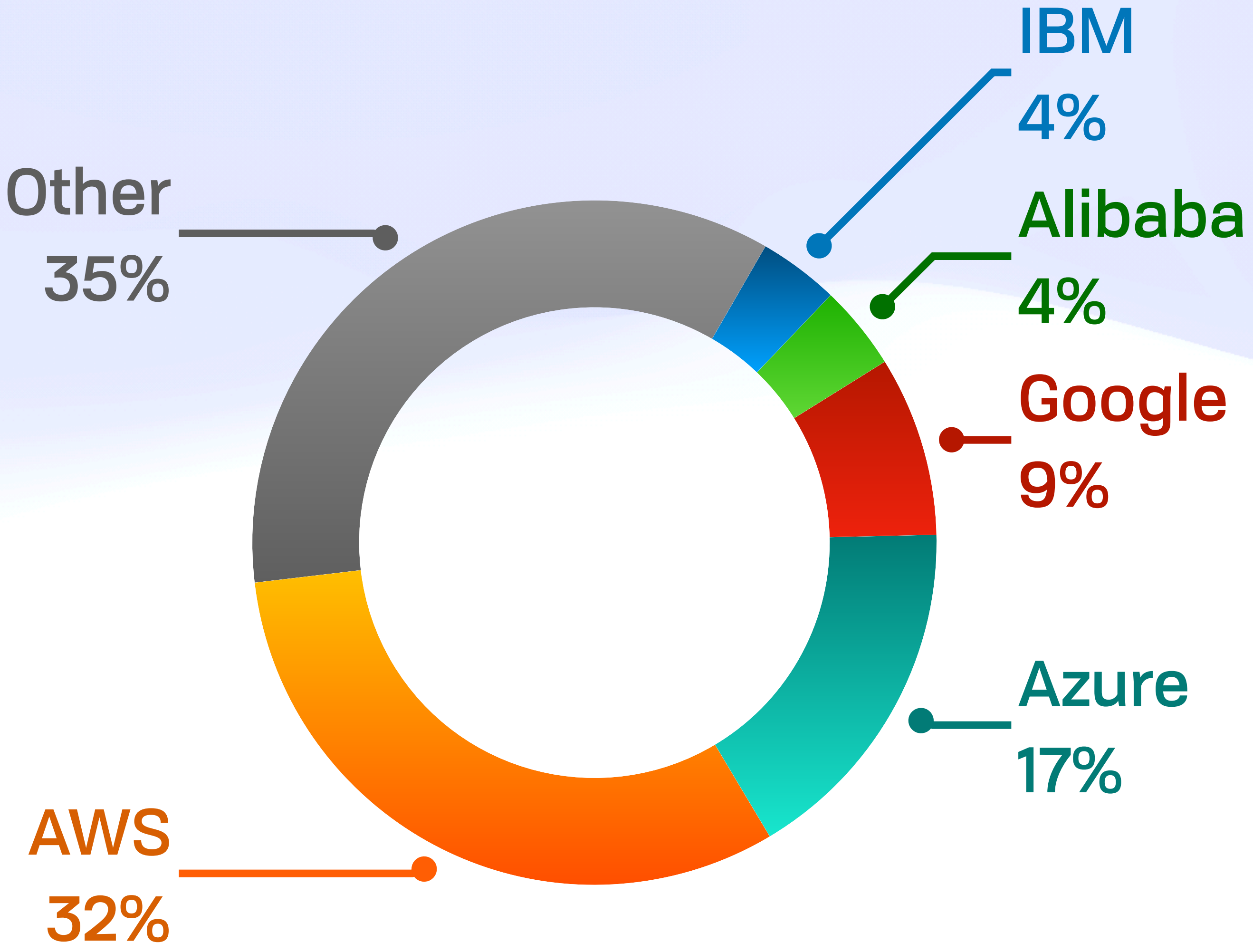
github.com/zeeshanlakhani

Seamless Services for an Open World

Rolling Weight

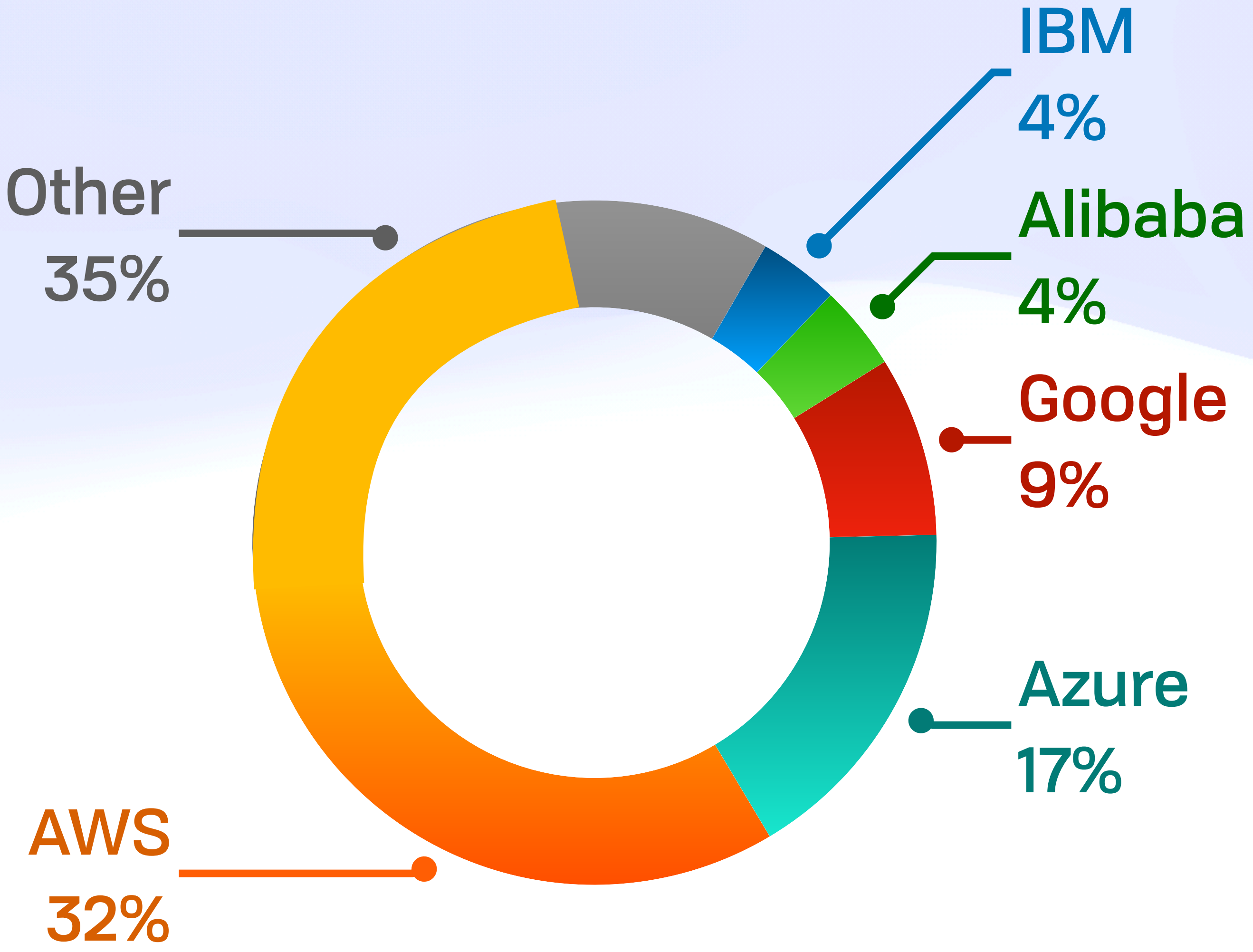
Seamless Services for an Open World

Rolling Weight



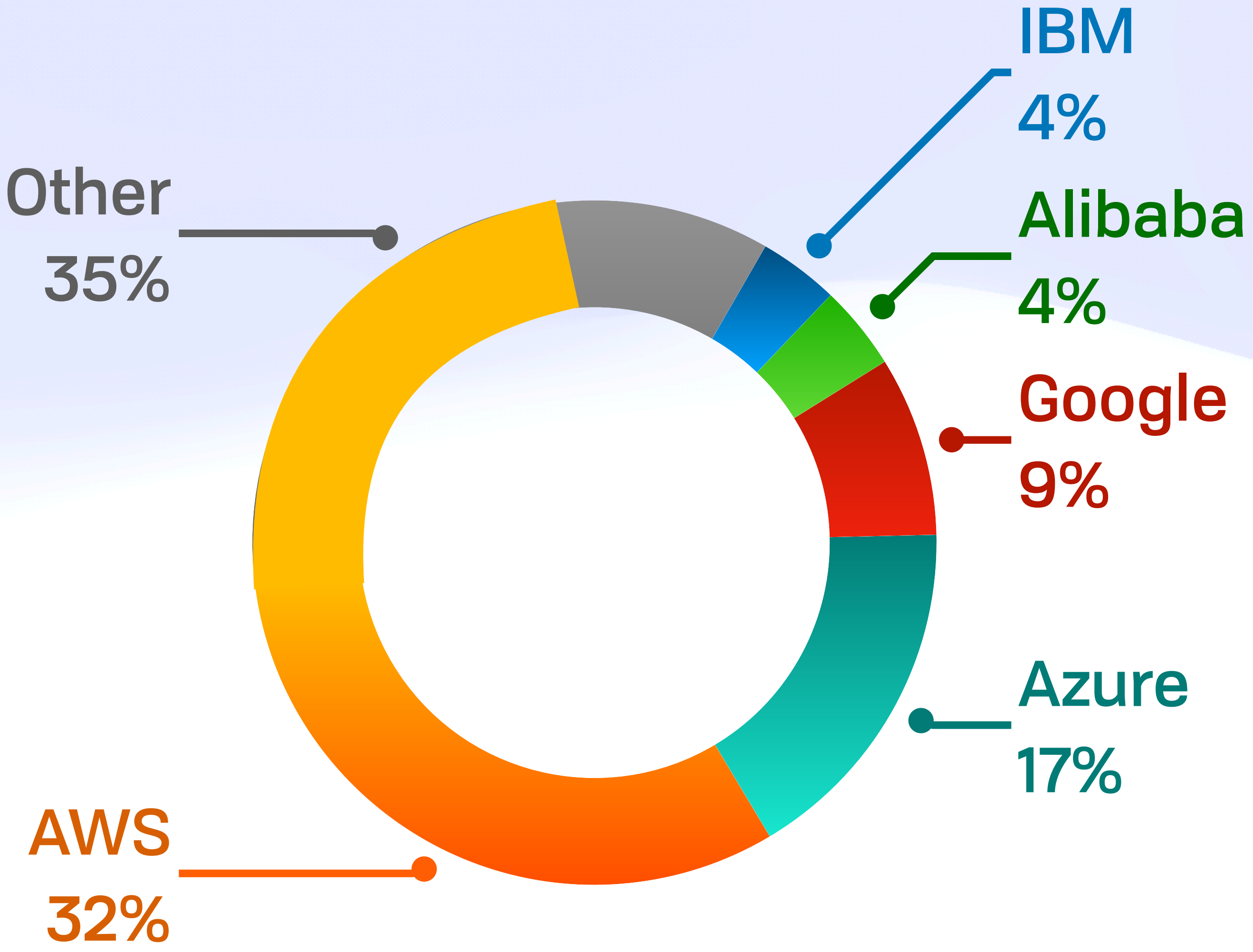
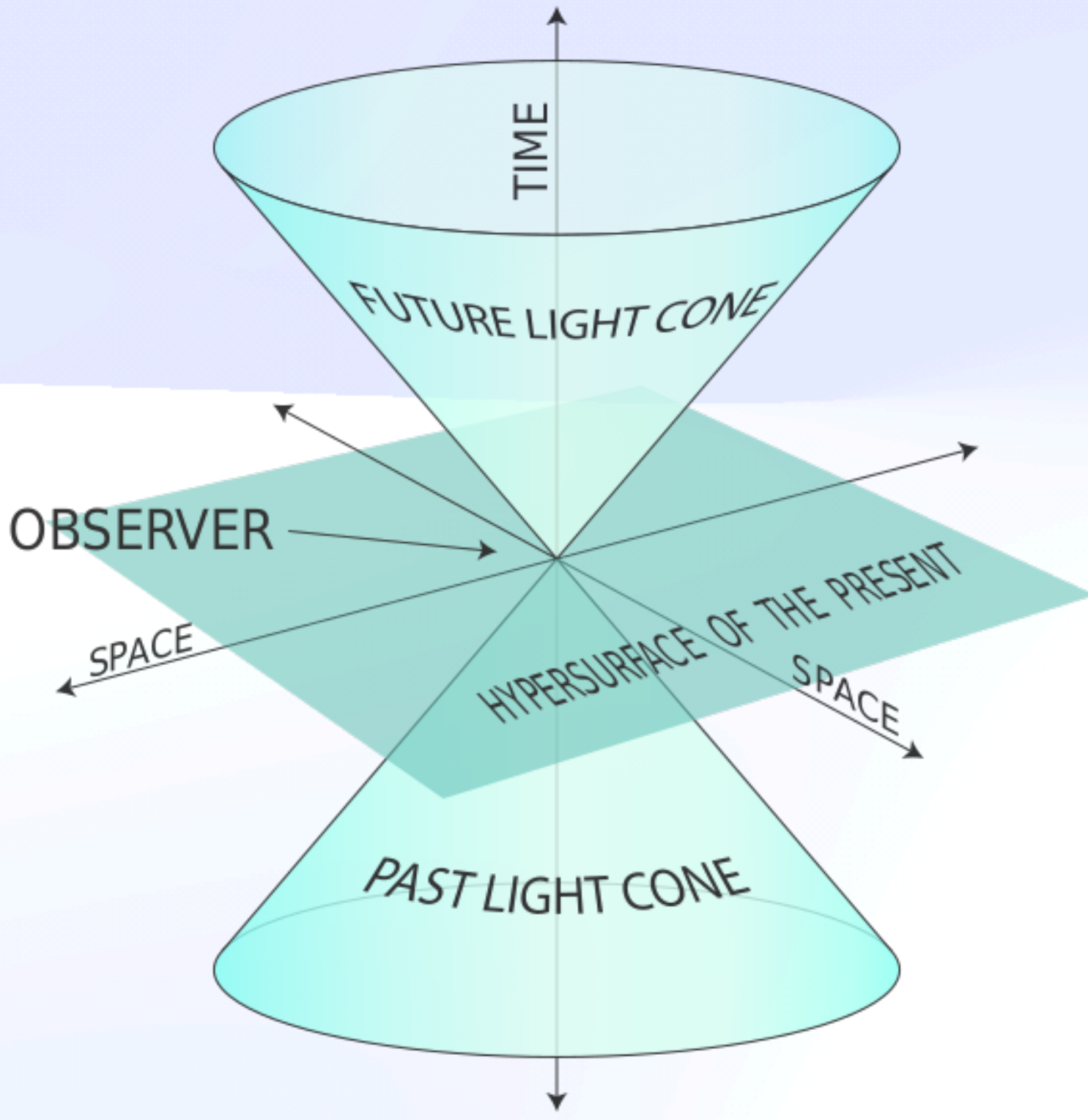
Seamless Services for an Open World

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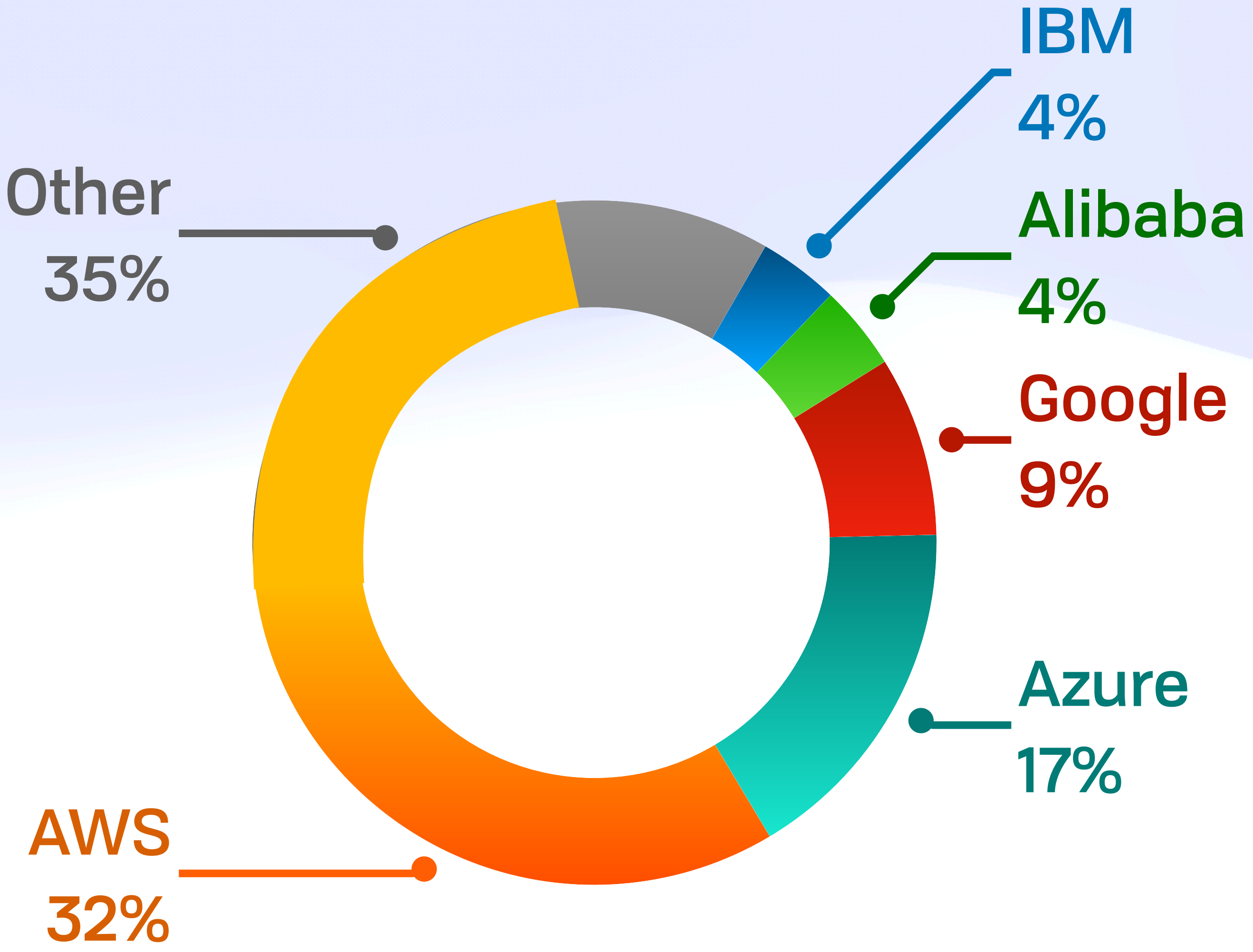
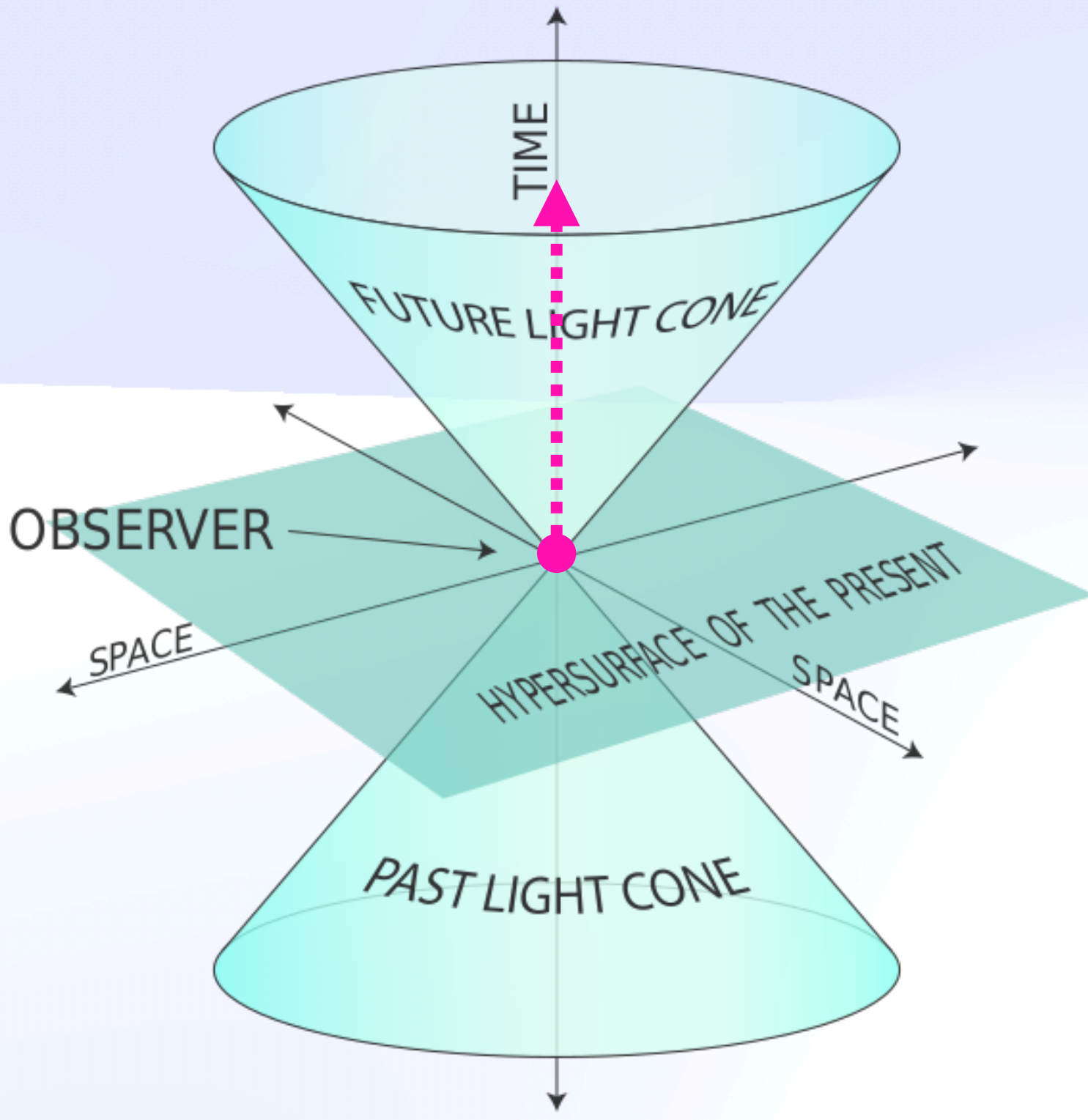
Seamless Services for an Open World

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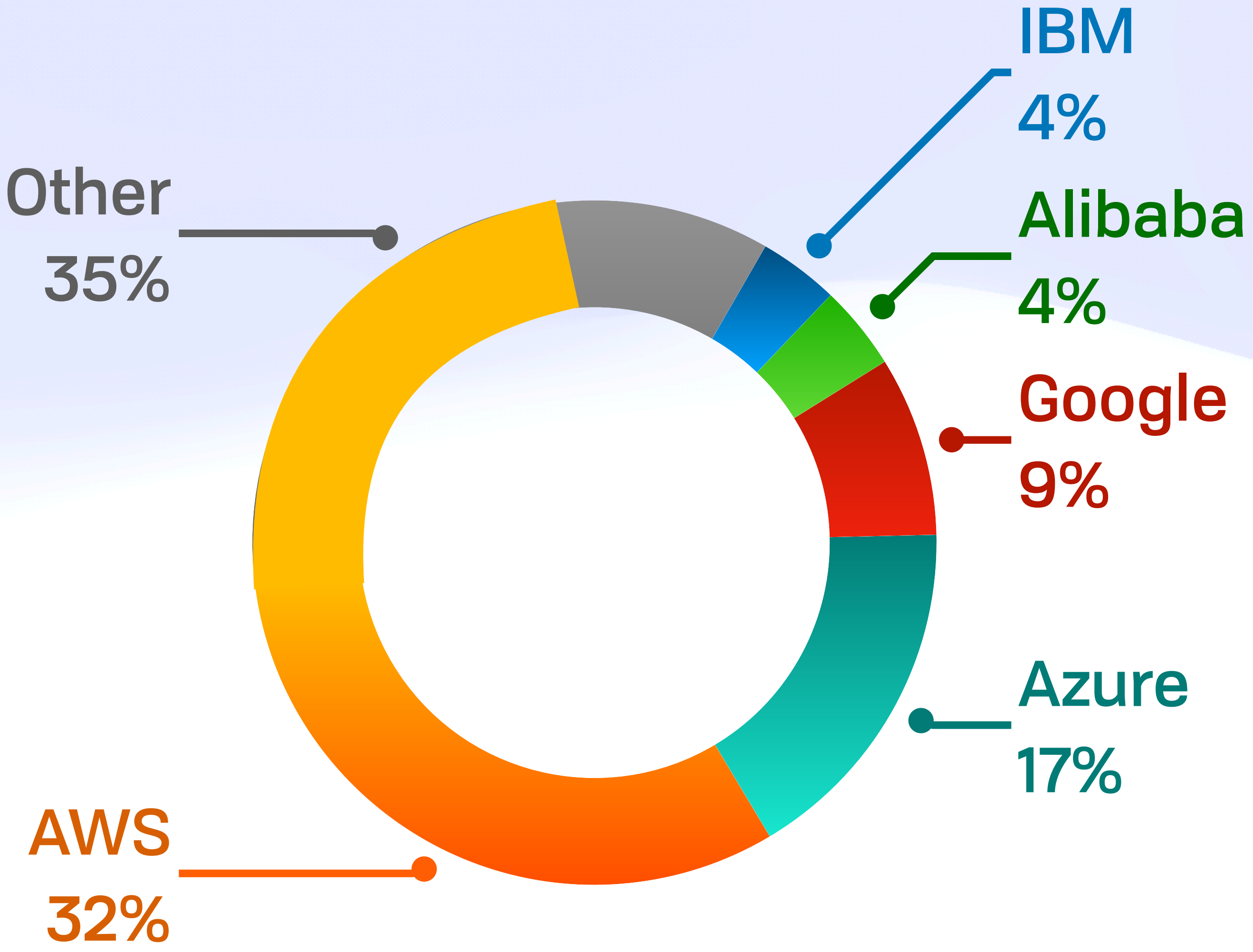
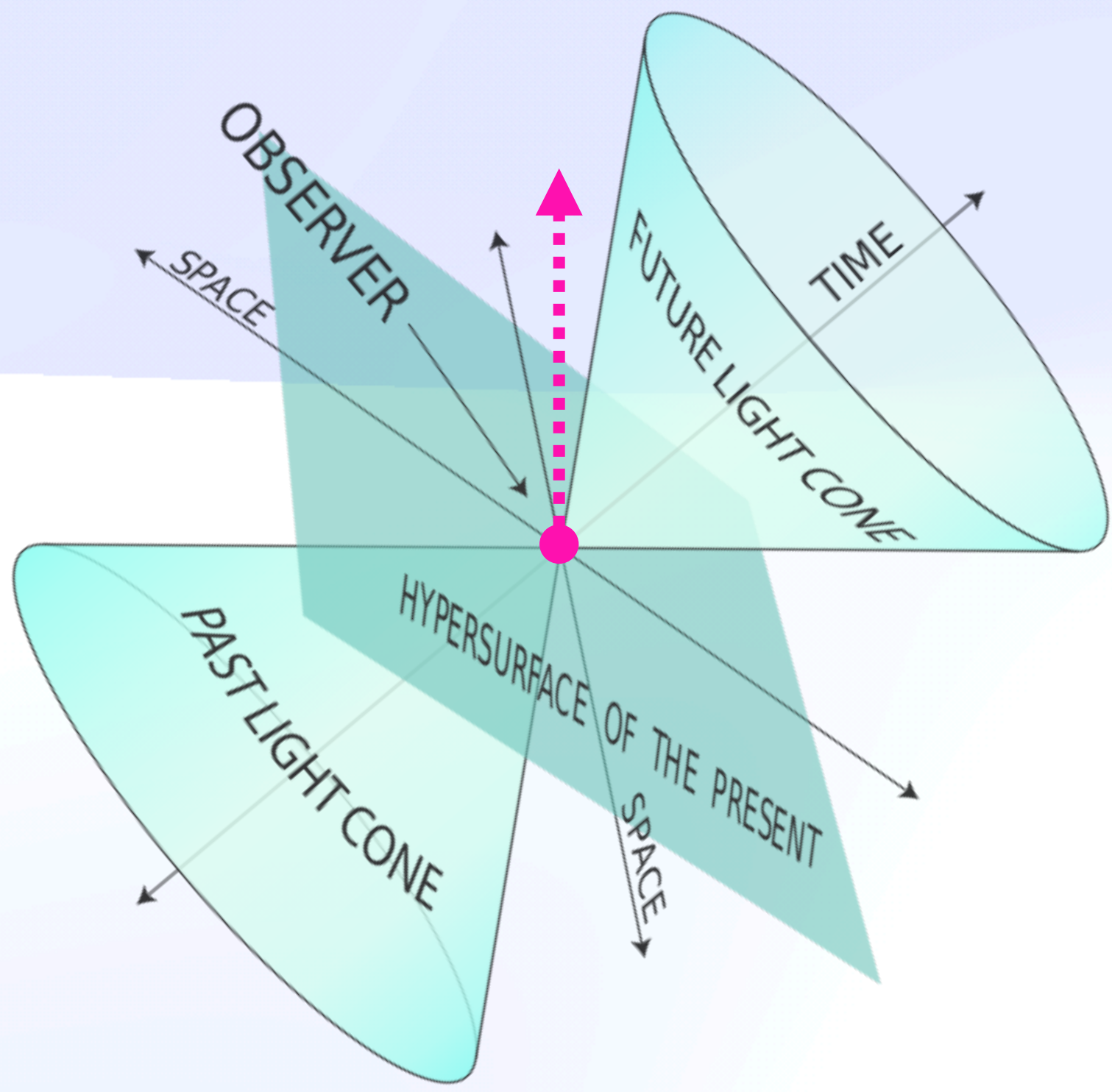
Seamless Services for an Open World

Rolling Weight



Seamless Services for an Open World

Rolling Weight



Seamless Services for an Open World

Everything, Everywhere, All At Once

Seamless Services for an Open World

Everything, Everywhere, All At Once

Nothing less than connecting
all of the world's users & services.

The "HTTP" storage and compute equivalent:
open, interoperable, & everywhere.

Must be ***substantially*** better
than the status quo.

Seamless Services for an Open World

Dependency Stack

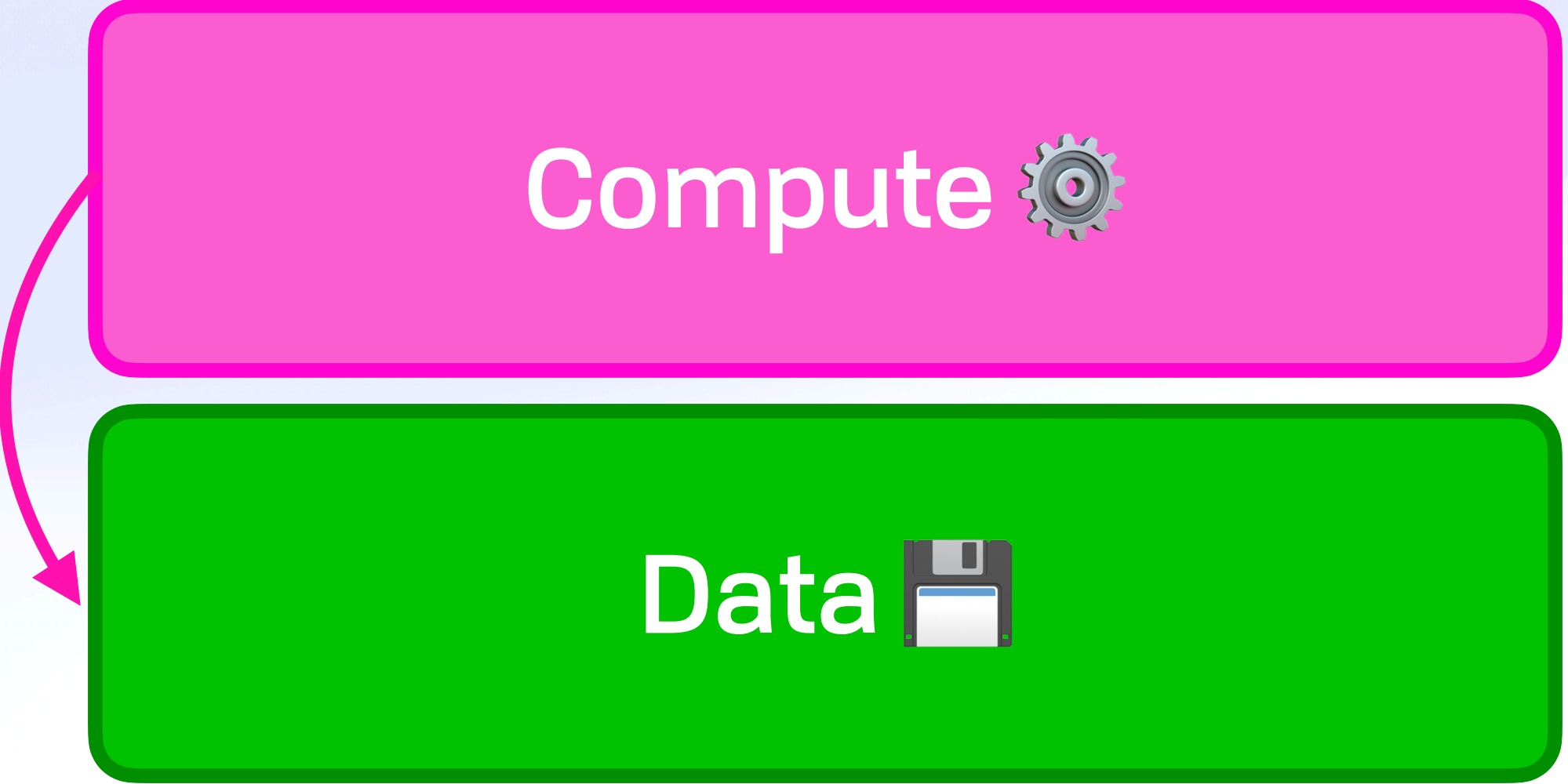
Seamless Services for an Open World

Dependency Stack

Compute 

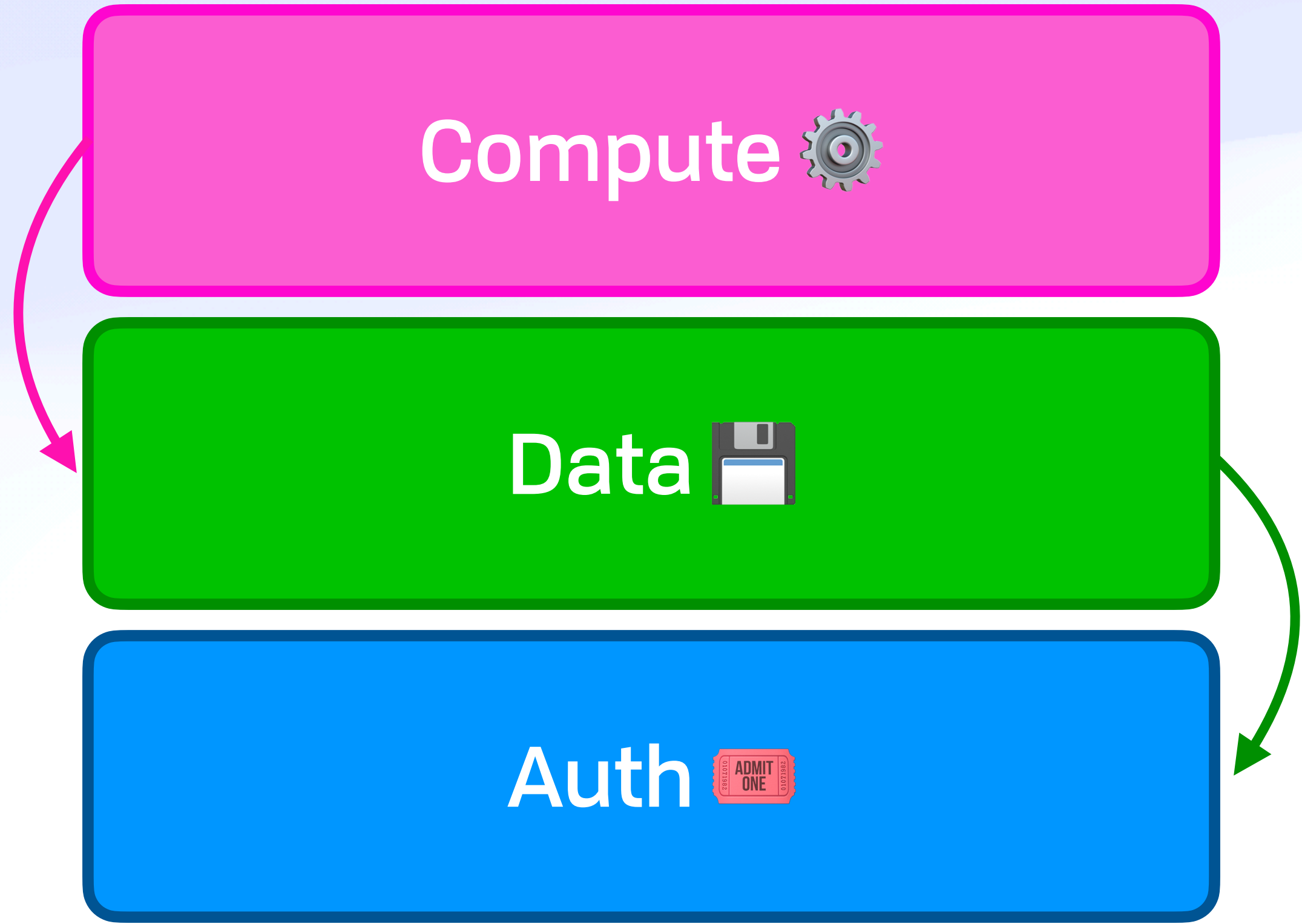
Seamless Services for an Open World

Dependency Stack



Seamless Services for an Open World

Dependency Stack





A person with long dark hair, wearing a green quilted jacket and dark pants, is walking away from the camera down a dirt path in a forest. The path is covered with fallen leaves and branches. The trees are mostly bare, suggesting a late autumn or winter setting. The lighting is soft and diffused, creating a somewhat somber and contemplative atmosphere. The person is centered in the frame, and the path leads towards a brighter area in the distance.

— A Series of Very Reasonable Steps —

How We Got Here

How We Got Here

One-to-One

How We Got Here

One-to-One



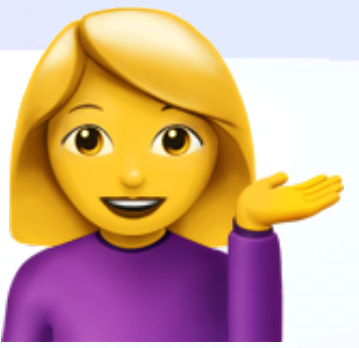
How We Got Here

One-to-One



How We Got Here

One-to-One



How We Got Here

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How We Got Here

One-to-One



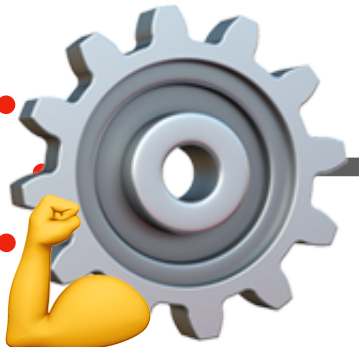
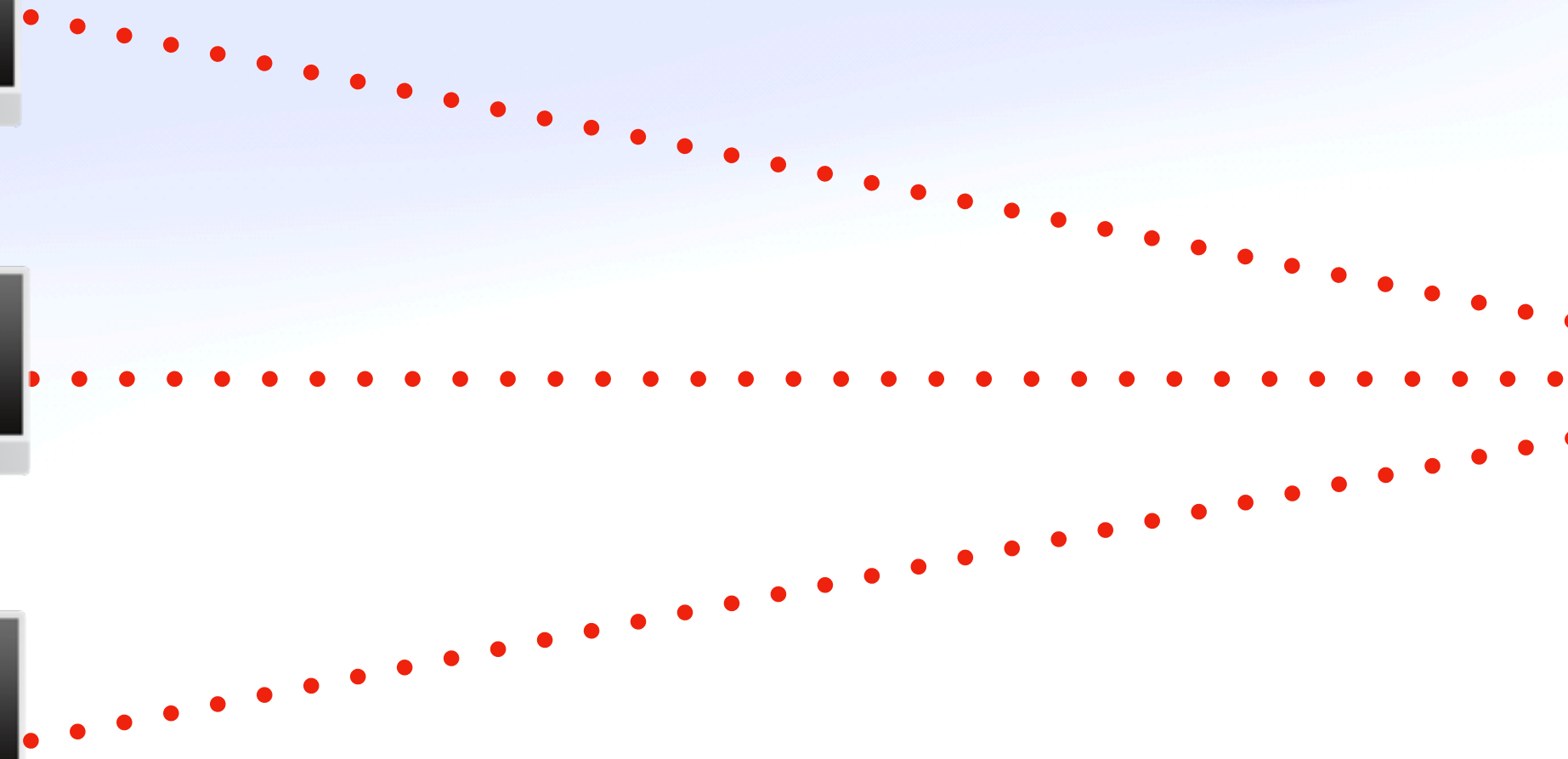
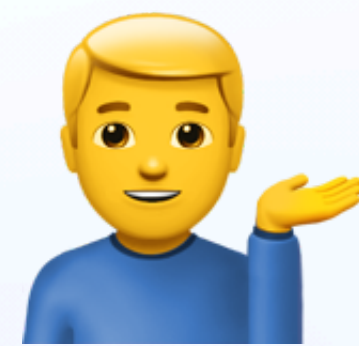
How We Got Here

One-to-One



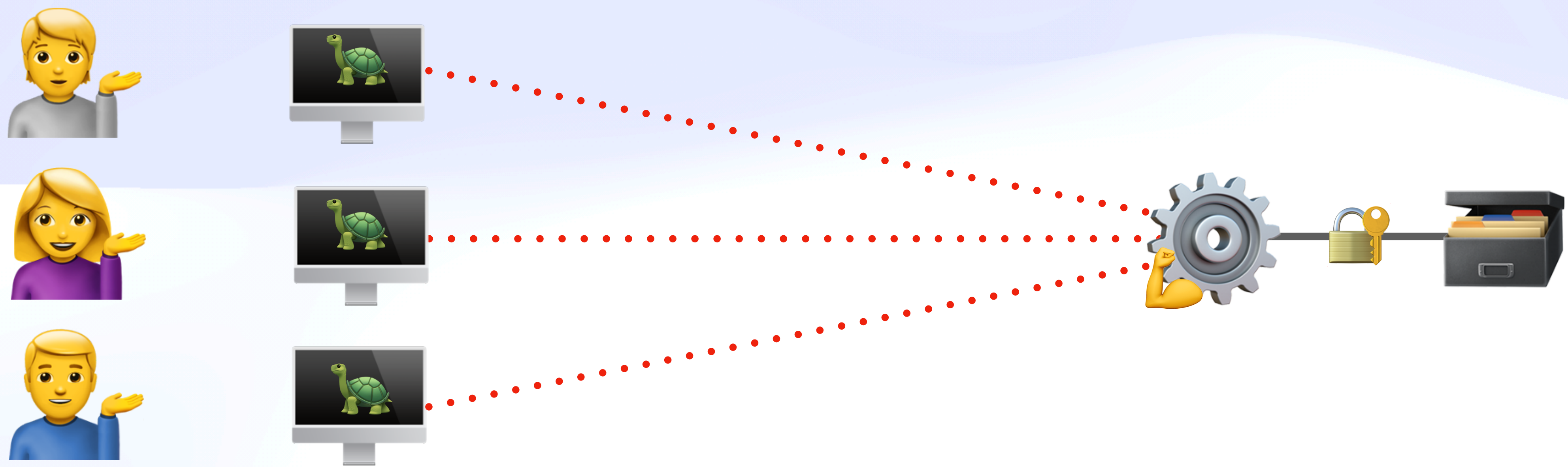
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One-to-One



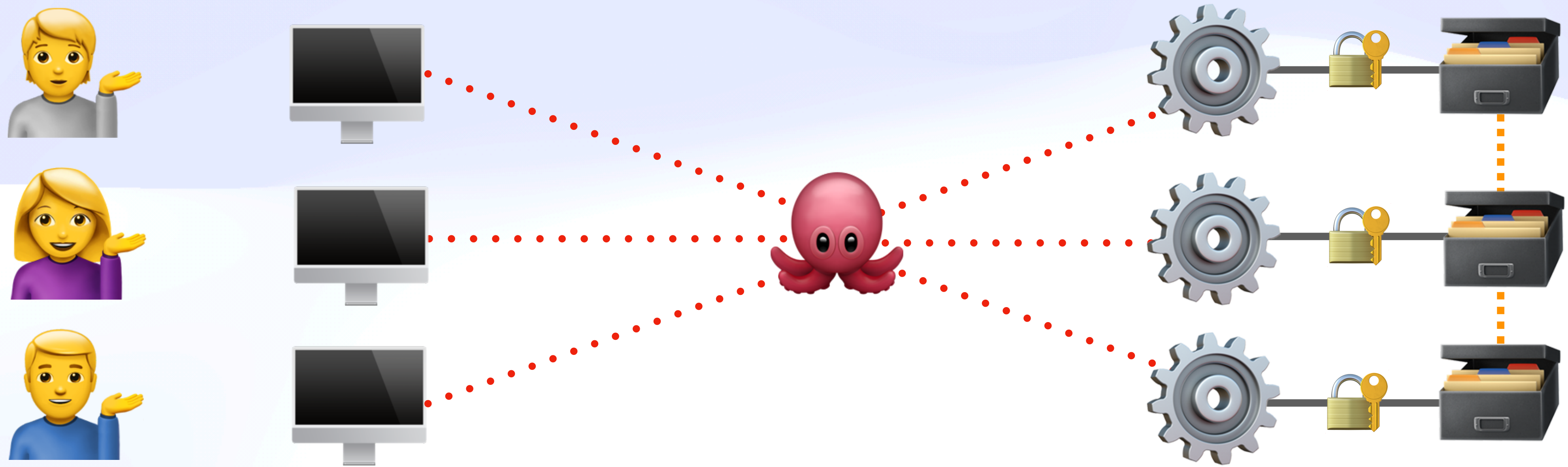
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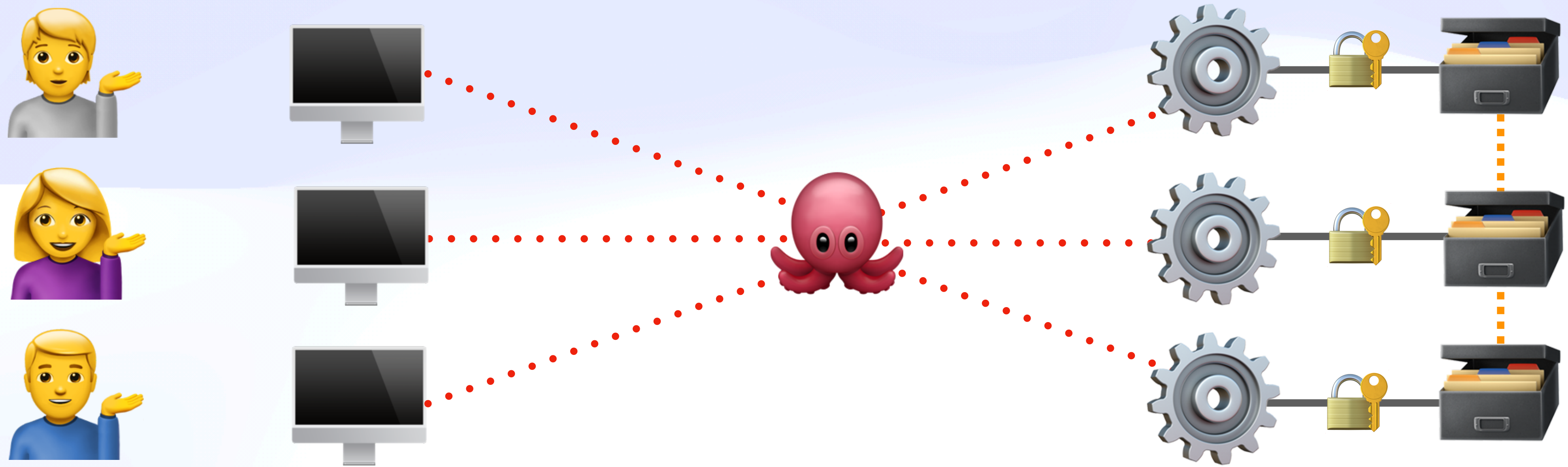
How We Got Here

Hidden Many-to-Many



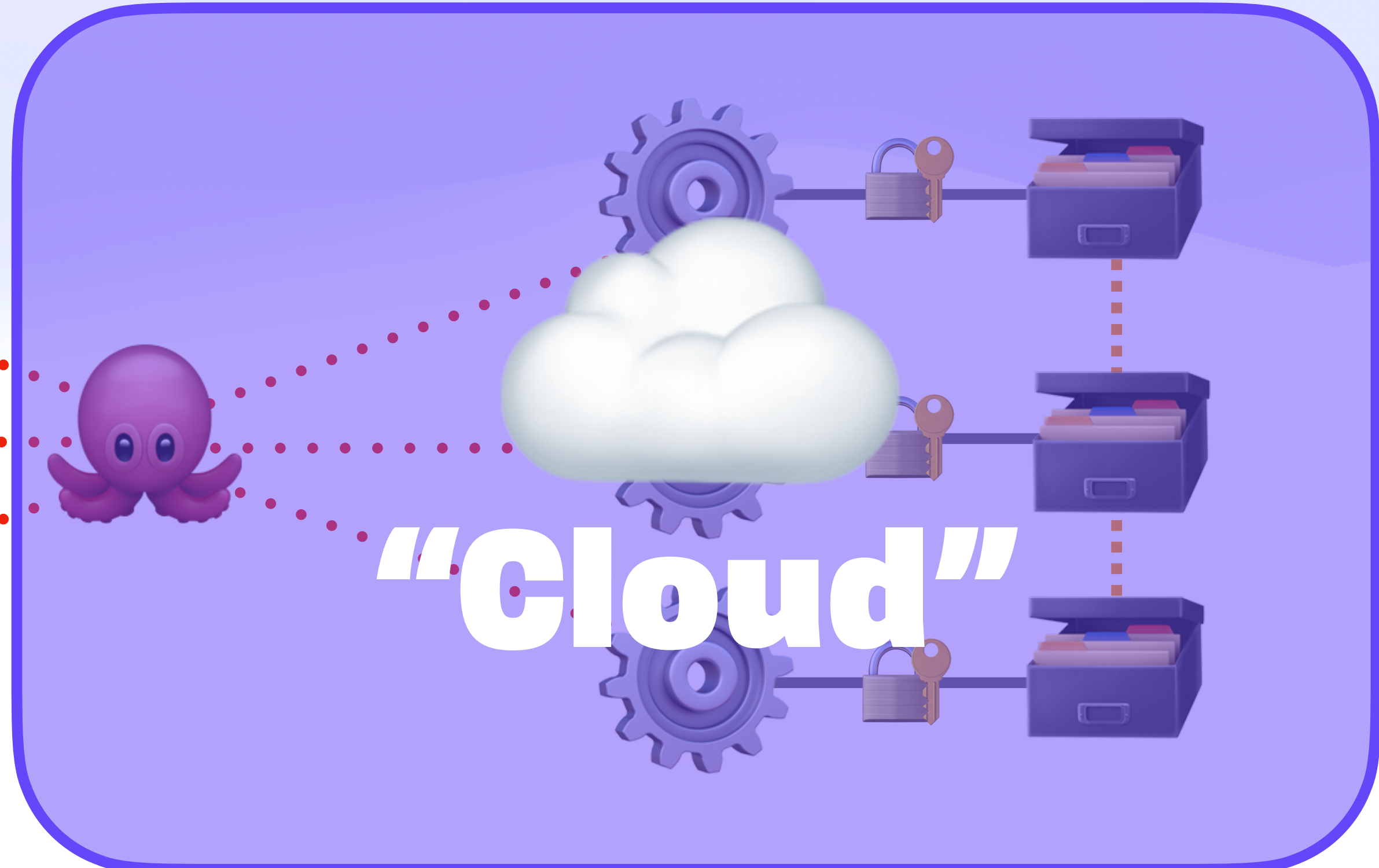
How We Got Here

Invisible Many-to-Many



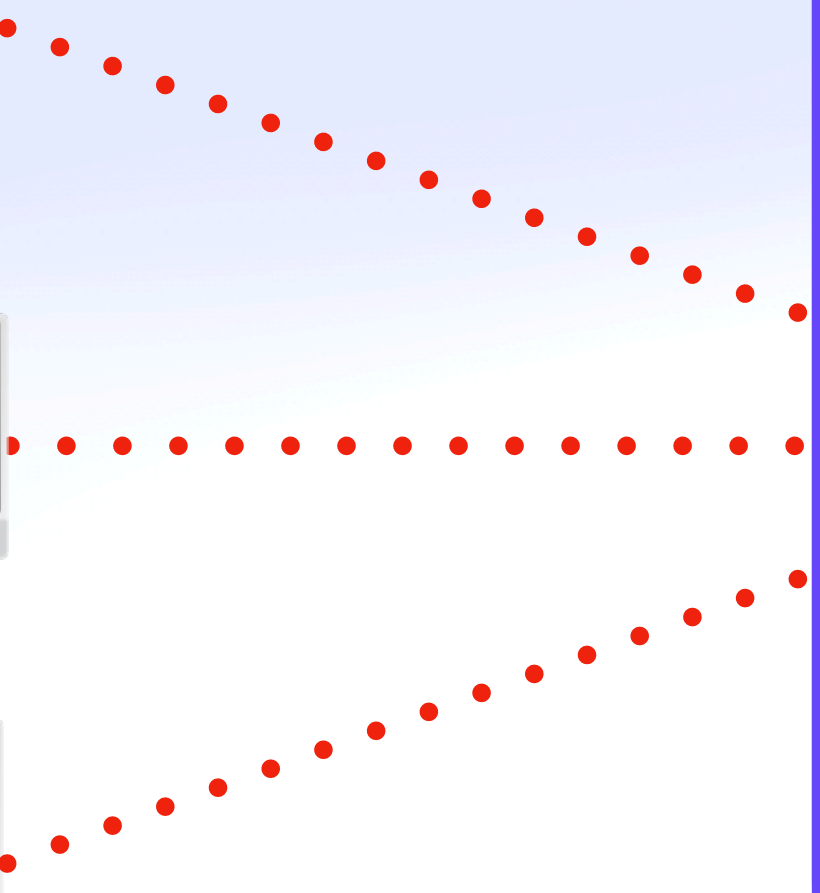
How We Got Here

Invisible Many-to-Many



How We Got Here

Abstract Many-to-Many



A purple rounded rectangle containing a white cloud with a yellow lightning bolt, a purple octopus, a gear, a padlock with a key, and a filing cabinet. Red dotted lines connect the octopus to the cloud and the cloud to the server icons. The text "Serverless" and "(AKA more servers)" is written in white at the bottom.

How We Got Here

...and so it was for many years...

How We Got Here

...and so it was for many years...



How We Got Here

Consequences 

How We Got Here

Consequences

- Single source of truth ("**the**" database)

How We Got Here

Consequences

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- Server-centric



- "Full stack development"
- DevOps, Docker, k8s, IaC
- How to train enough engineers?

How We Got Here

Consequences 🍂

- Single source of truth ("**the**" database)
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- DevOps, Docker, k8s, IaC
- How to train enough engineers?

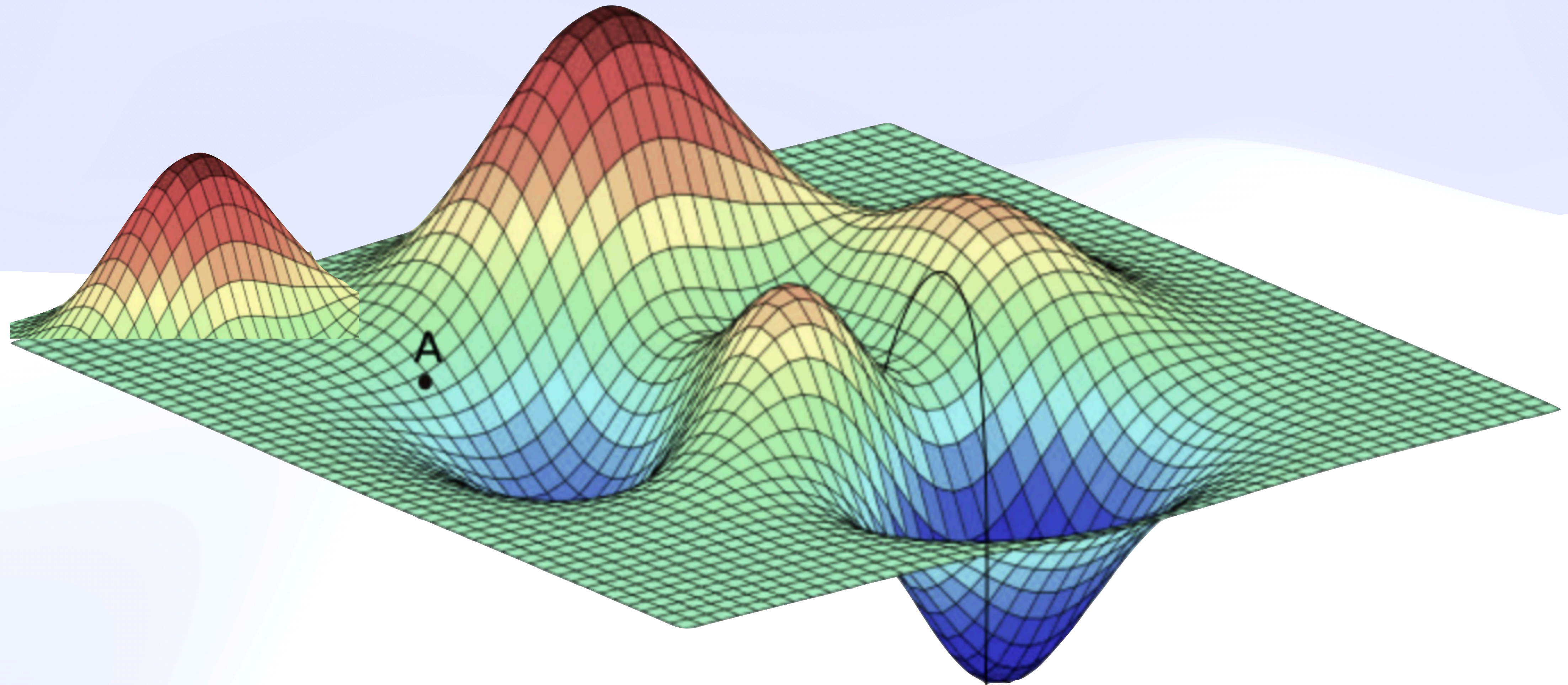


How We Got Here

Random Walk

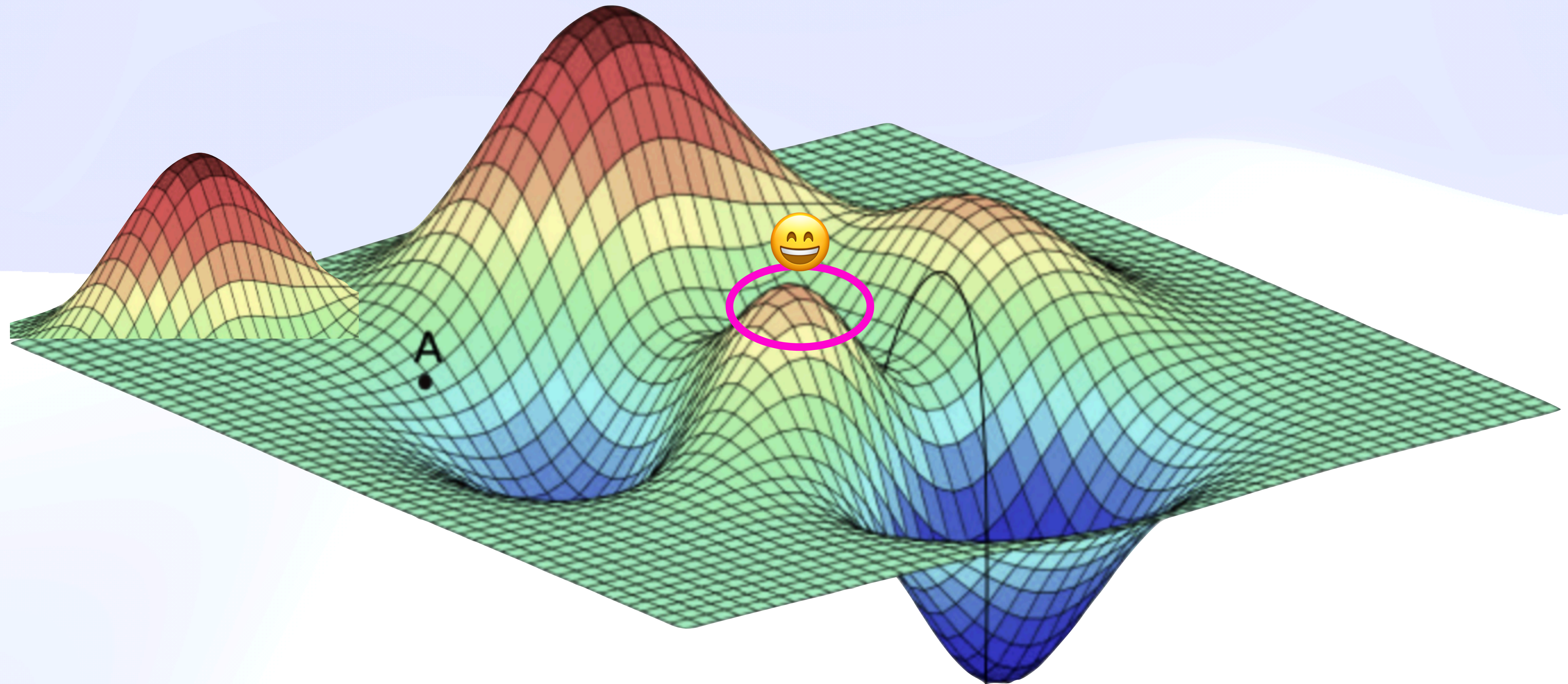
How We Got Here

Random Walk



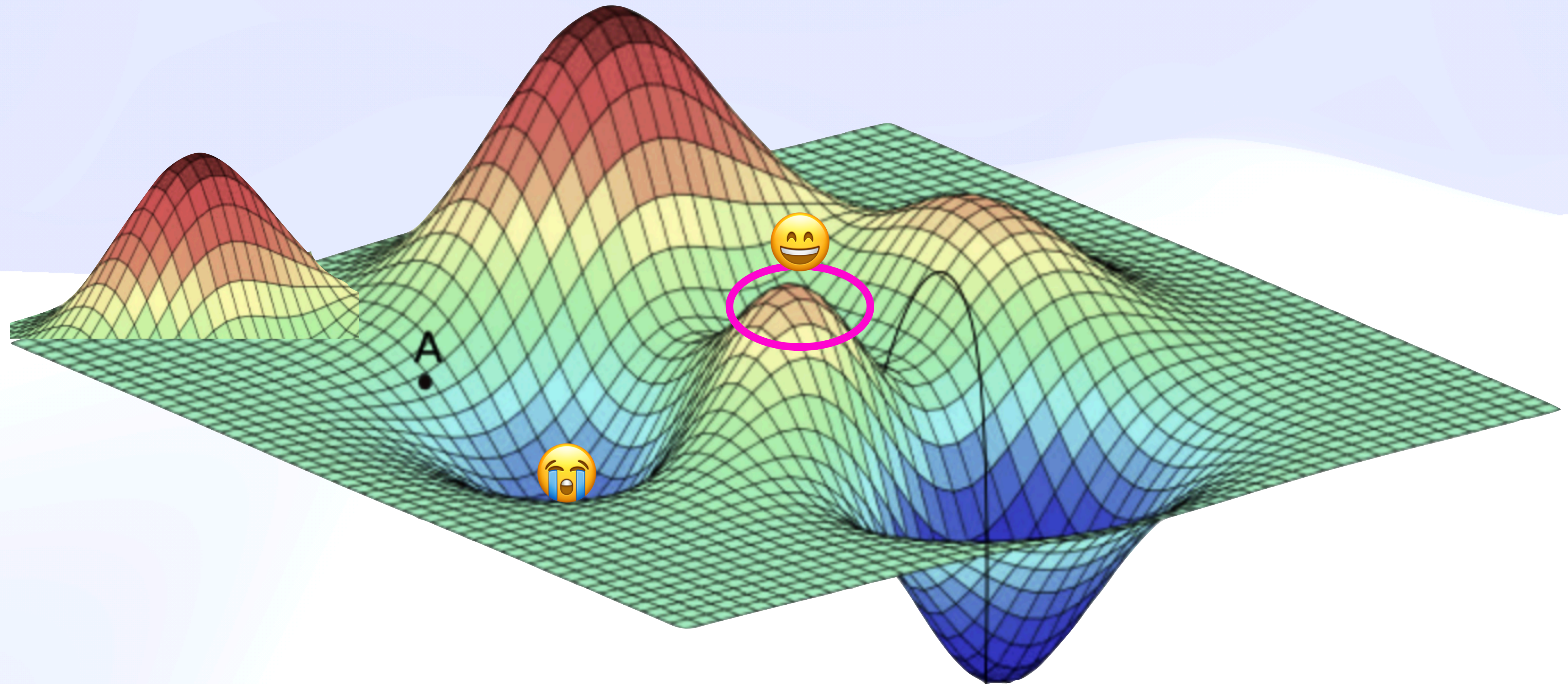
How We Got Here

Random Walk



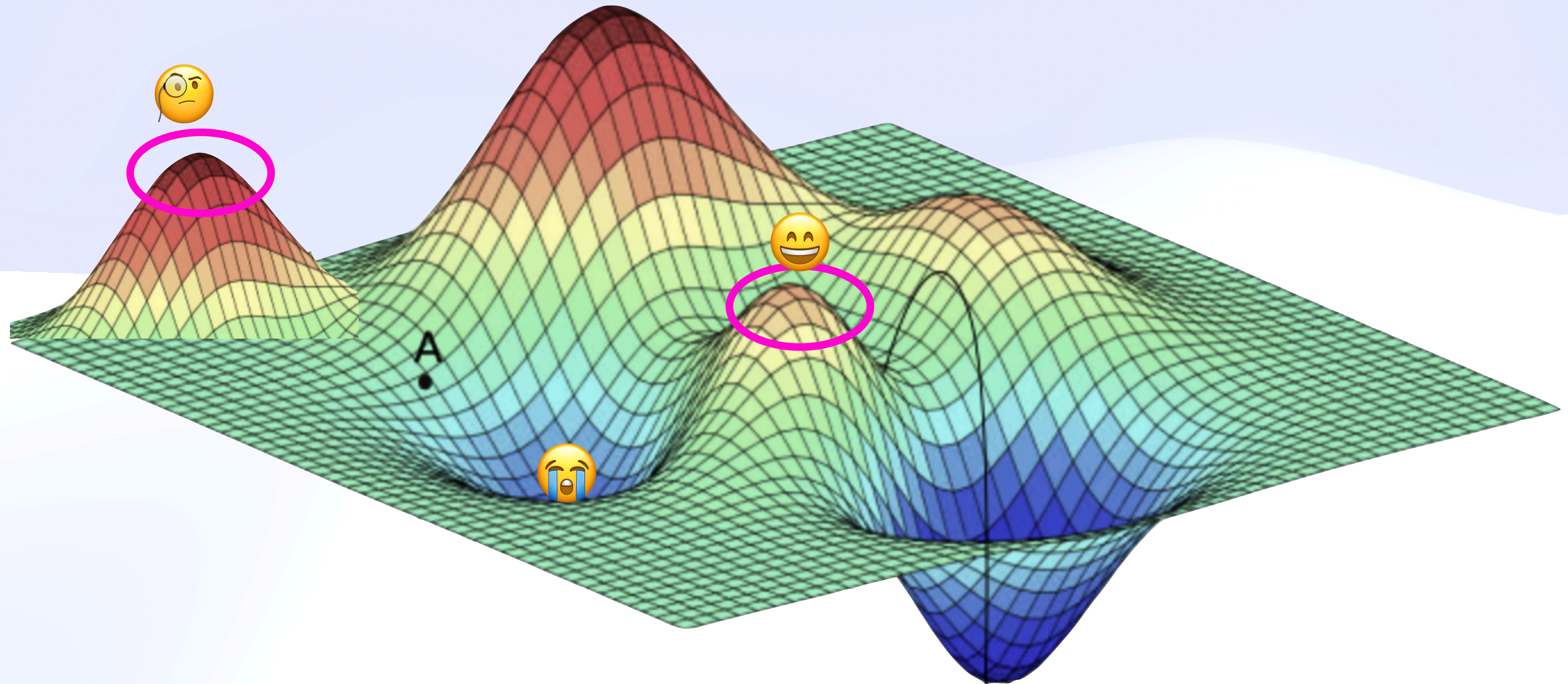
How We Got Here

Random Walk



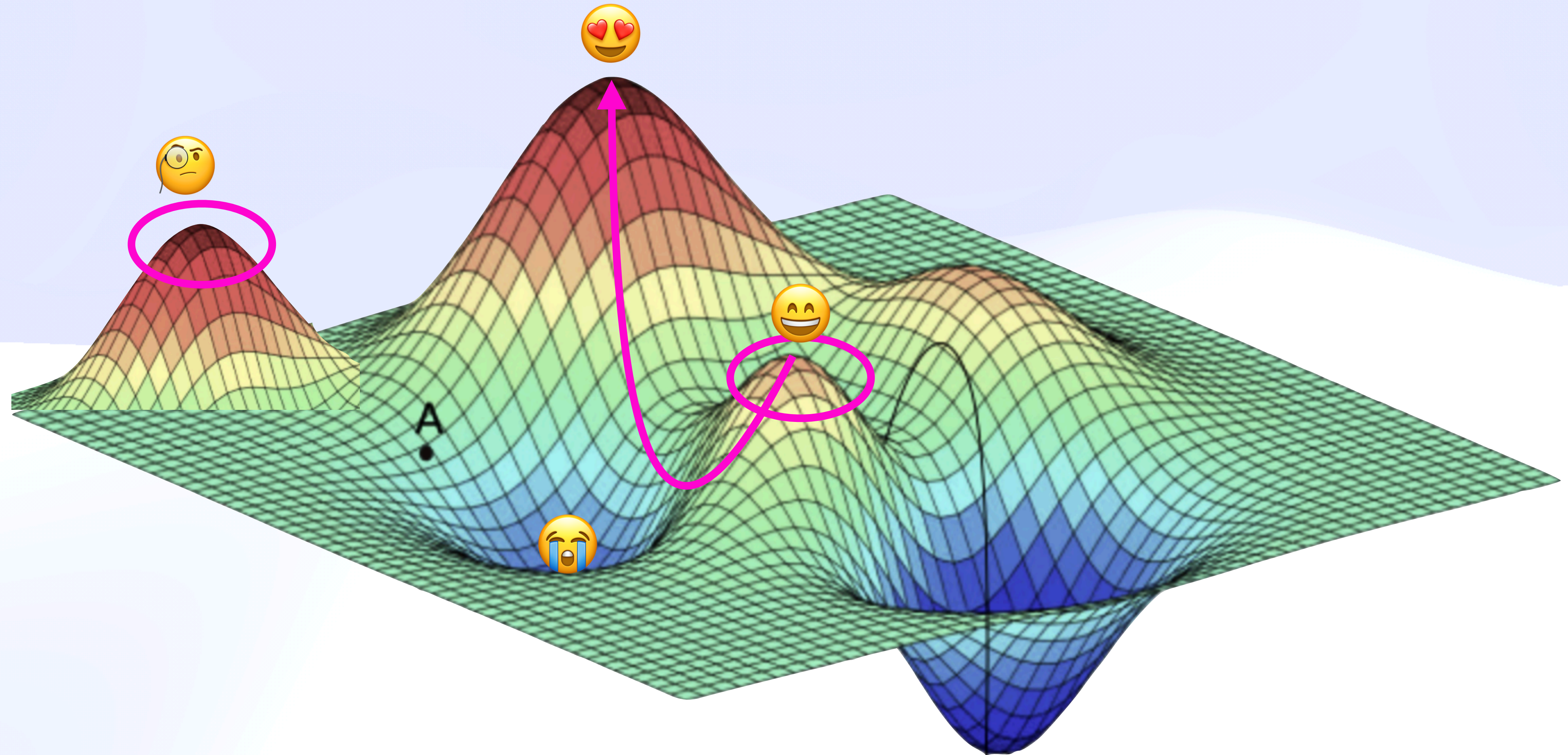
How We Got Here

Random Walk



How We Got Here

Random Walk



How We Got Here

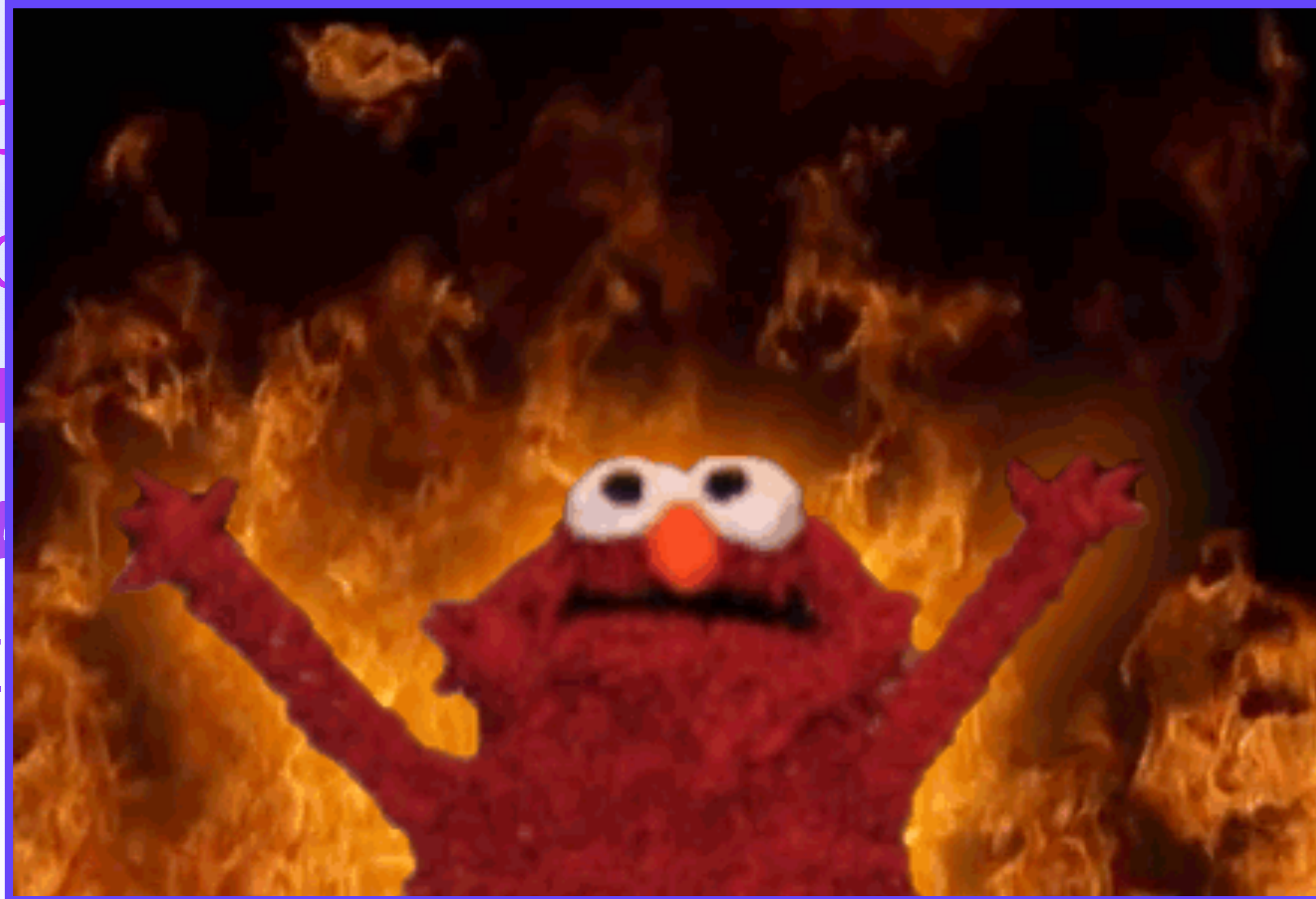
How We Got Here

Not to be bound by certain 'obvious' methodological rules [...] is both reasonable and ***absolutely necessary for the growth of knowledge.*** [...] There are always circumstances when it is advisable not only to ignore the rule, but to ***adopt its opposite.***

– **Paul Feyerabend**, Against Method

How We Got Here

No
methodo
absolu
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when it



us'
able and
rowth of
instances
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– **Paul Feyerabend**, Against Method



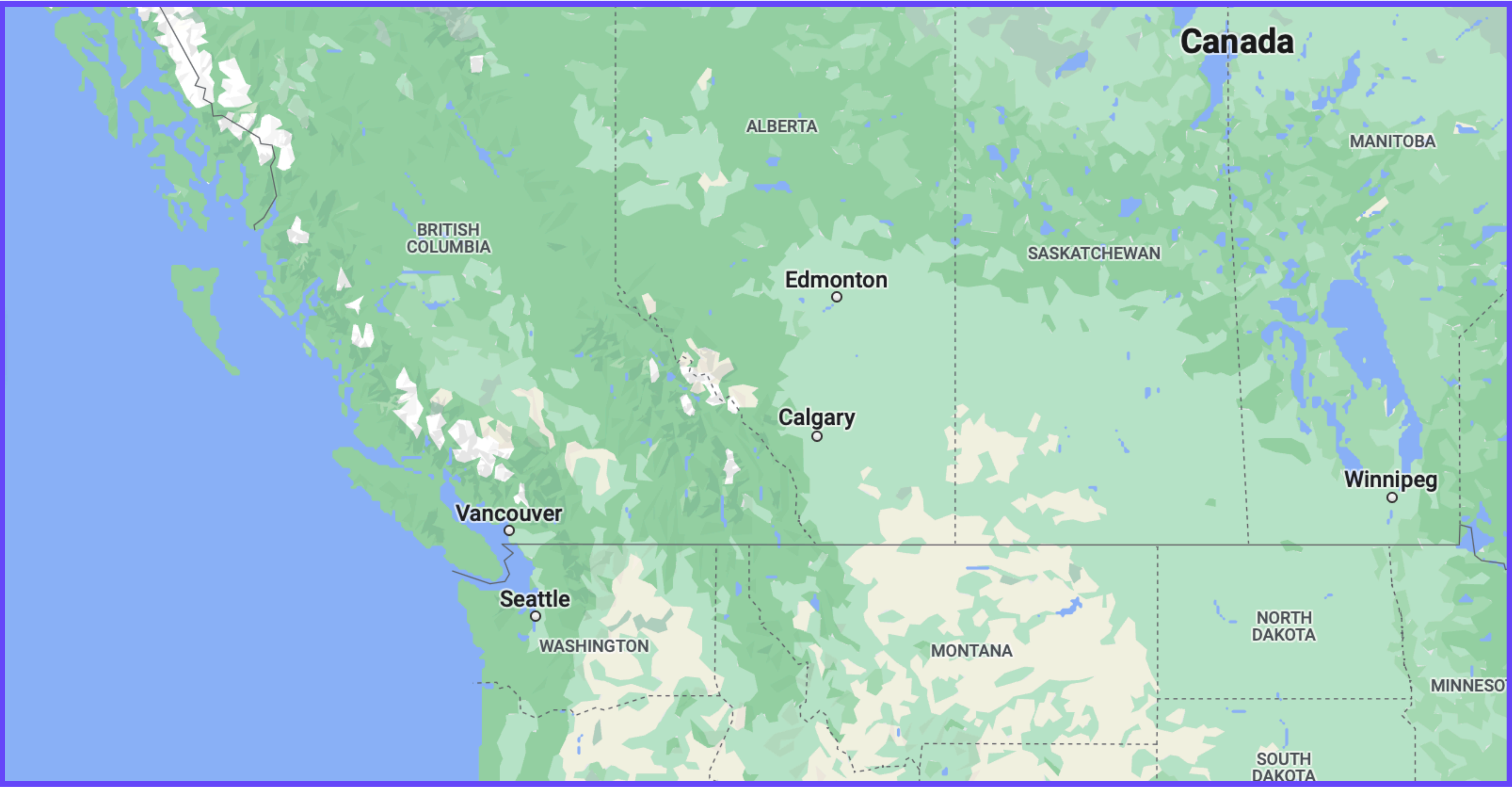
A vibrant, futuristic landscape. In the center, a large, dome-shaped structure with intricate patterns is partially obscured by a massive, stylized tree with a thick, metallic-looking trunk and dense, green foliage. The scene is set against a warm, golden-orange sky, suggesting a sunset or sunrise. In the background, there are tall, thin, vertical structures and distant mountains. Several flying vehicles, including a large one at the top and smaller ones, are visible in the sky. The overall atmosphere is one of advanced technology and a lush, controlled environment.

— We're Not On Dial-Up Anymore —

A New Environment

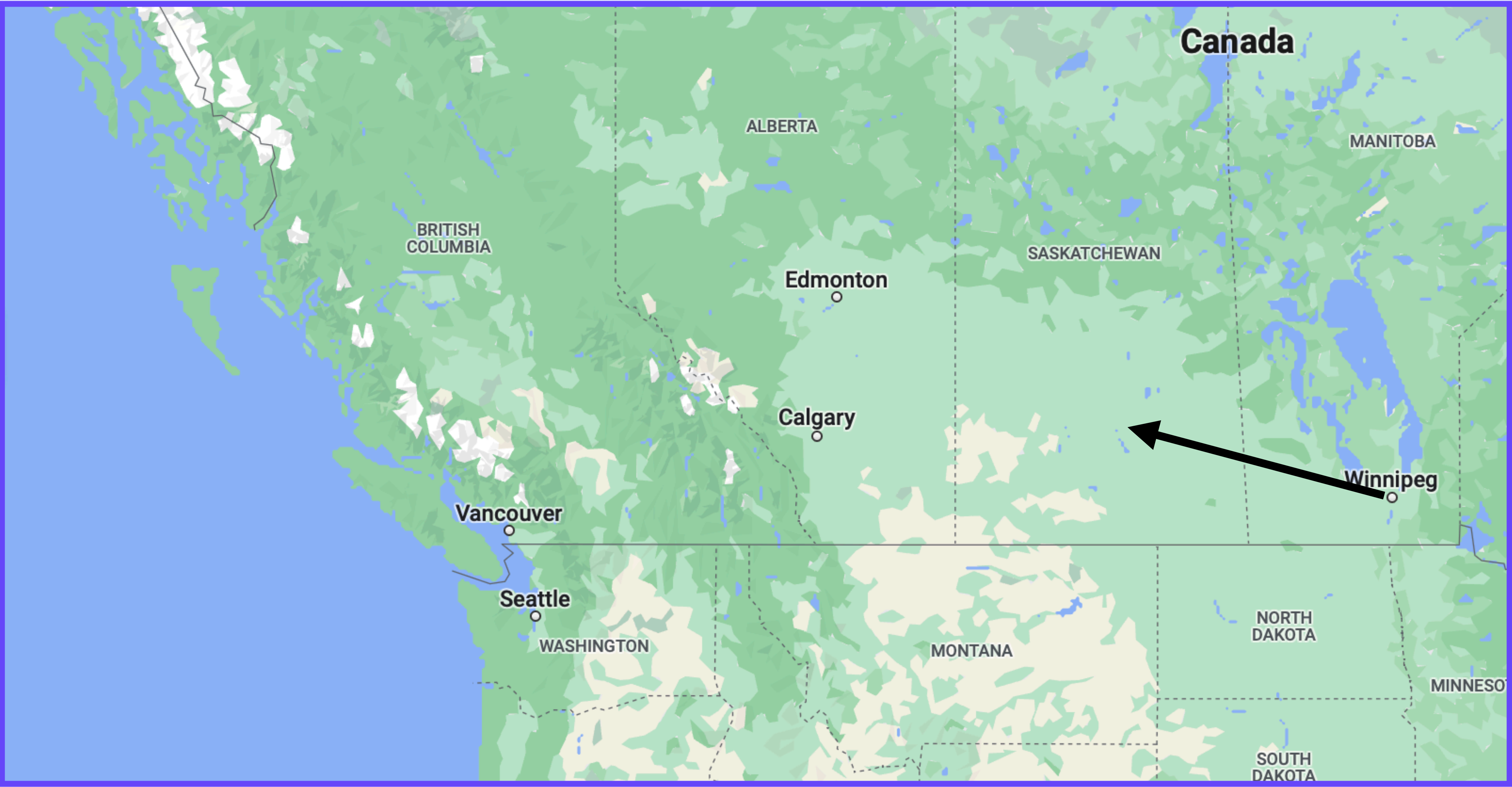
A New Environment

Sending a "Direct" Message



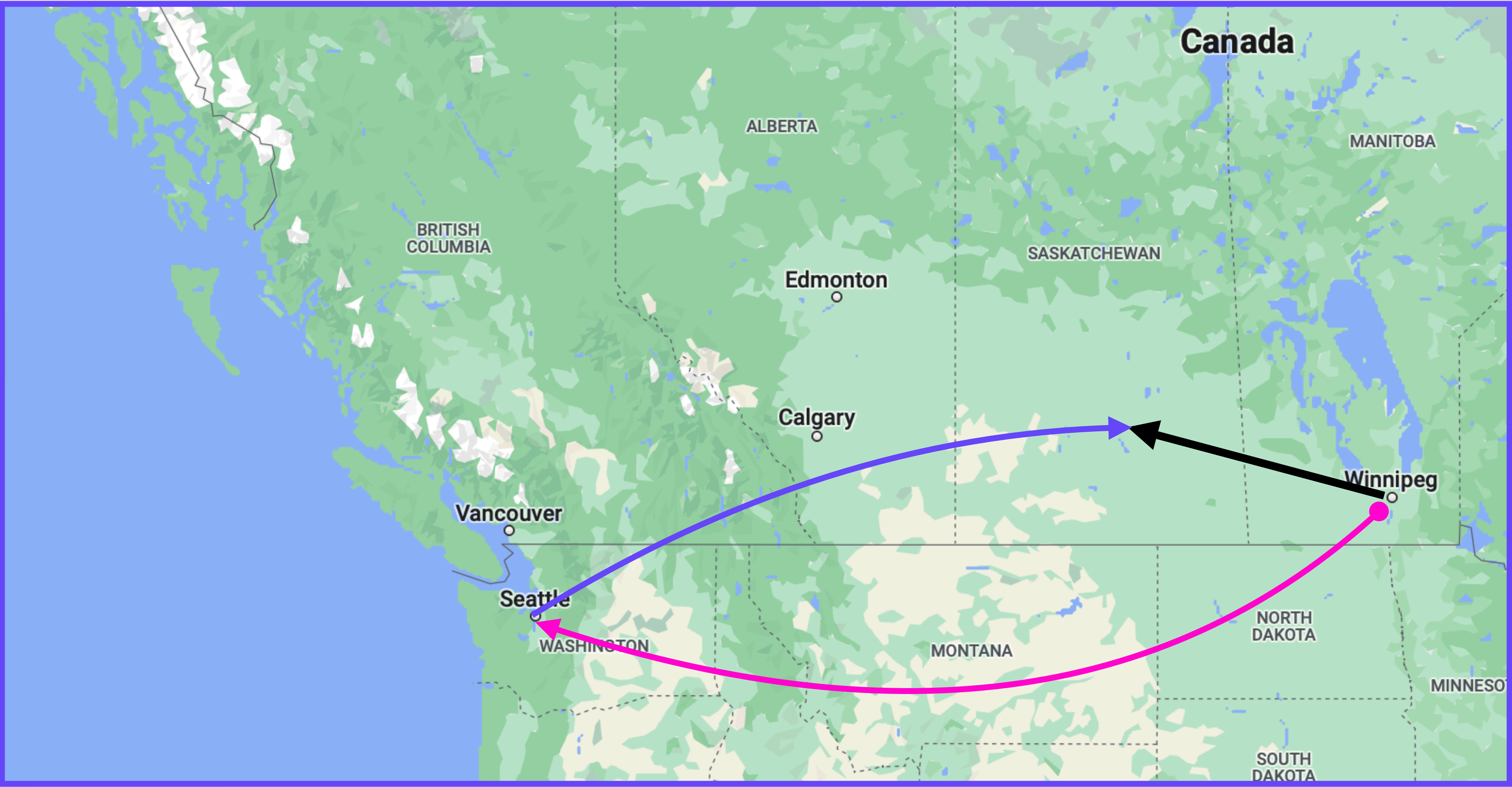
A New Environment

Sending a "Direct" Message



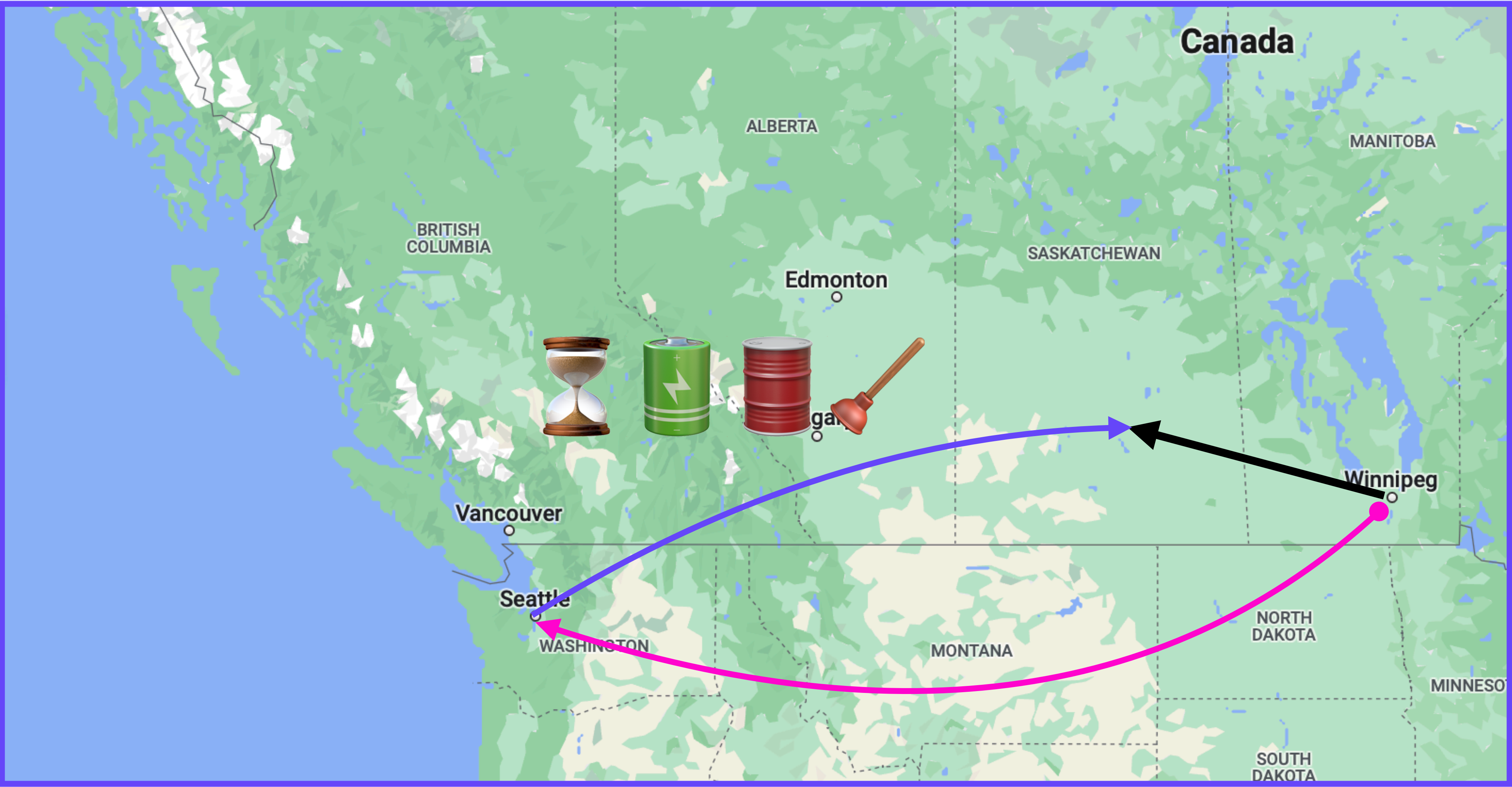
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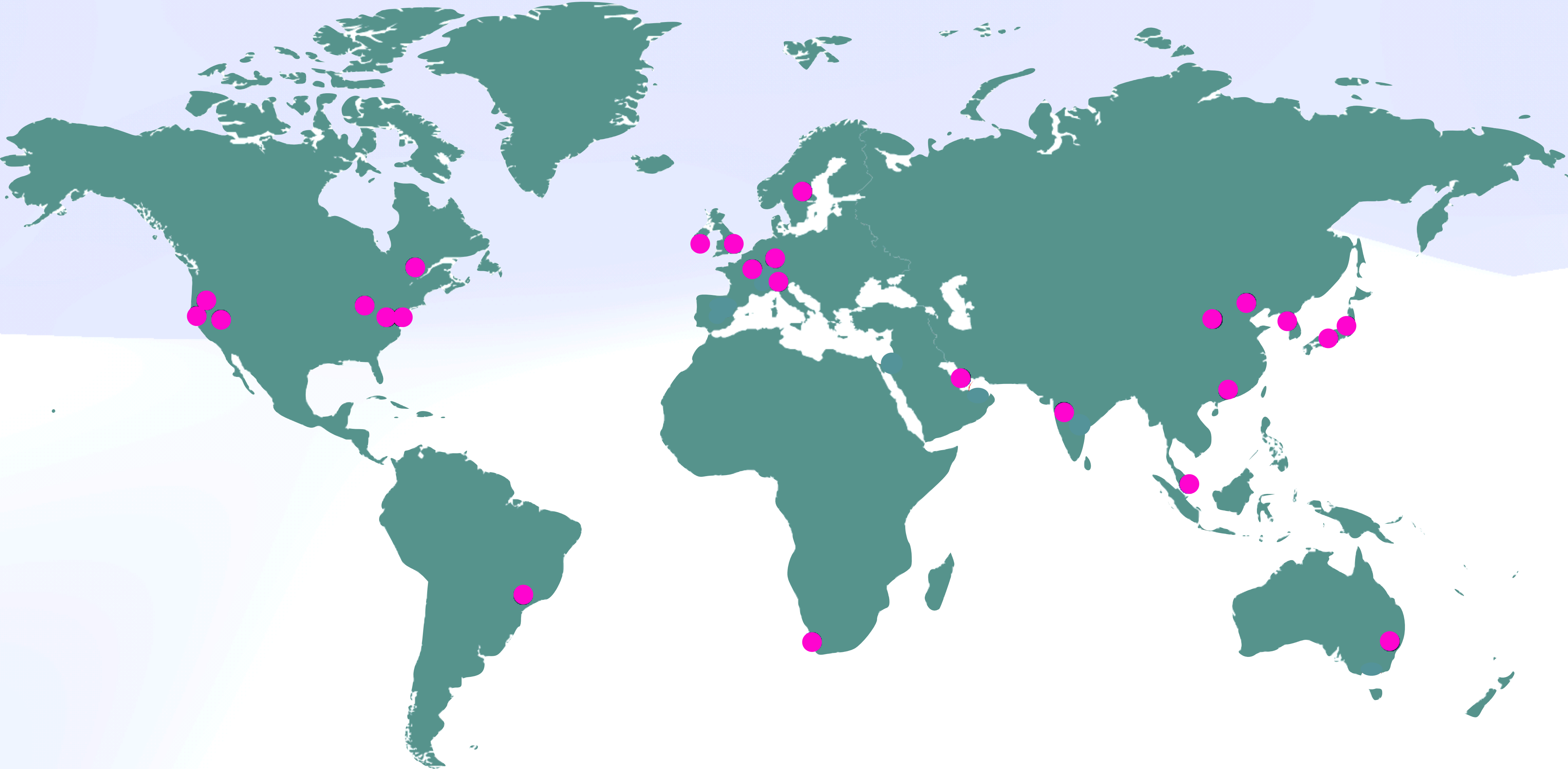
A New Environment

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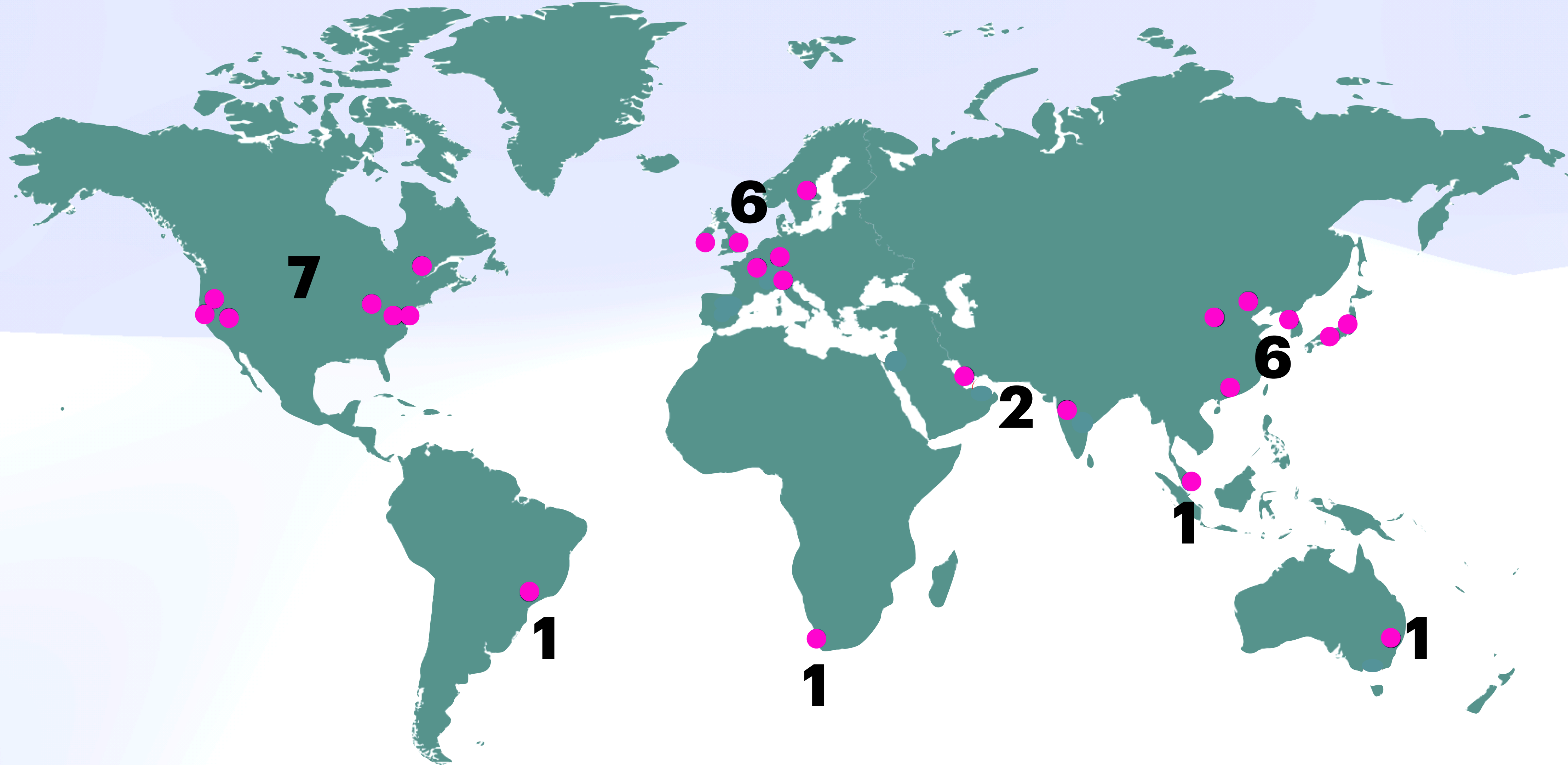
A New Environment

Users vs Cloud Infra



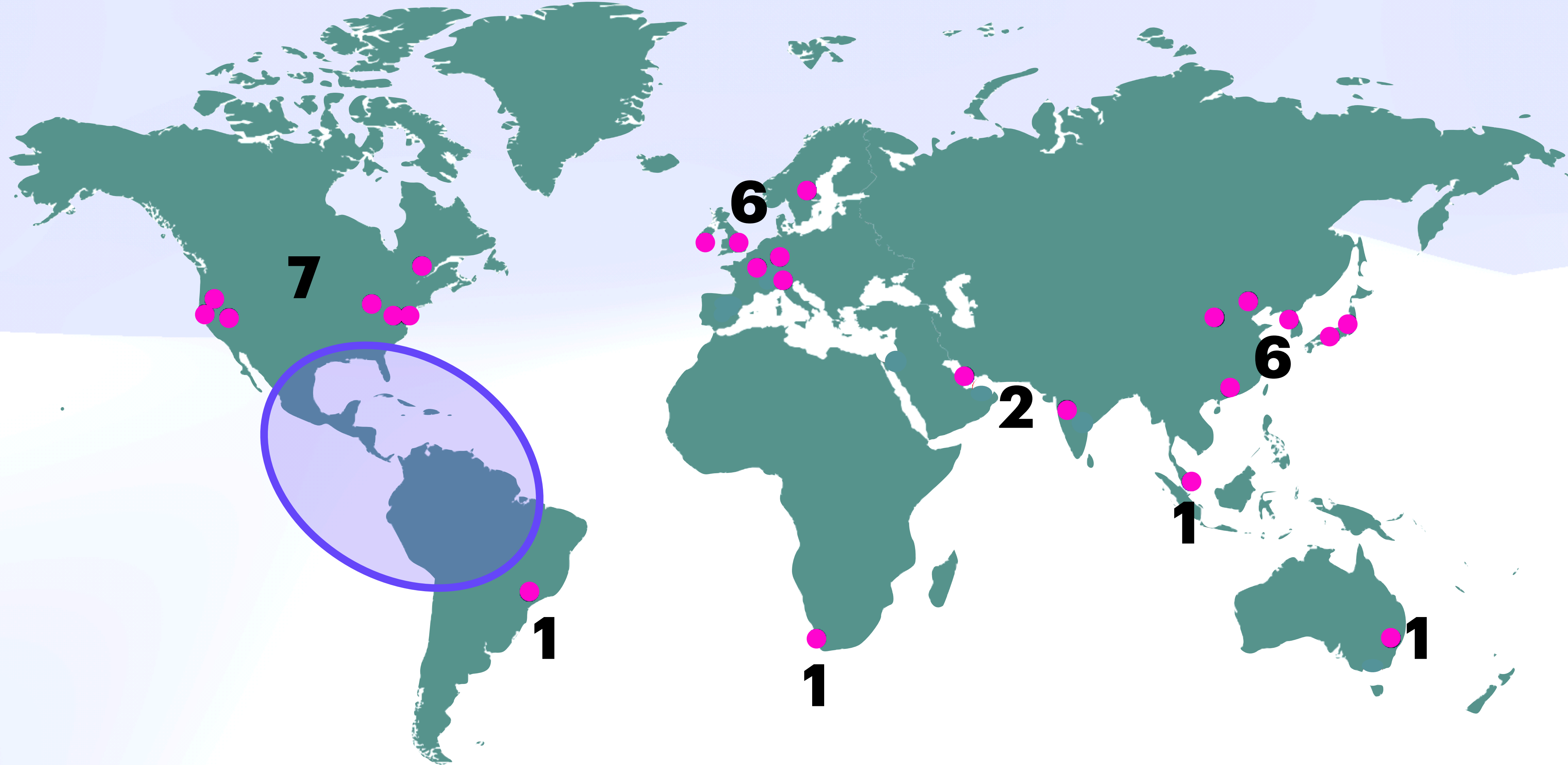
A New Environment

Users vs Cloud Infra



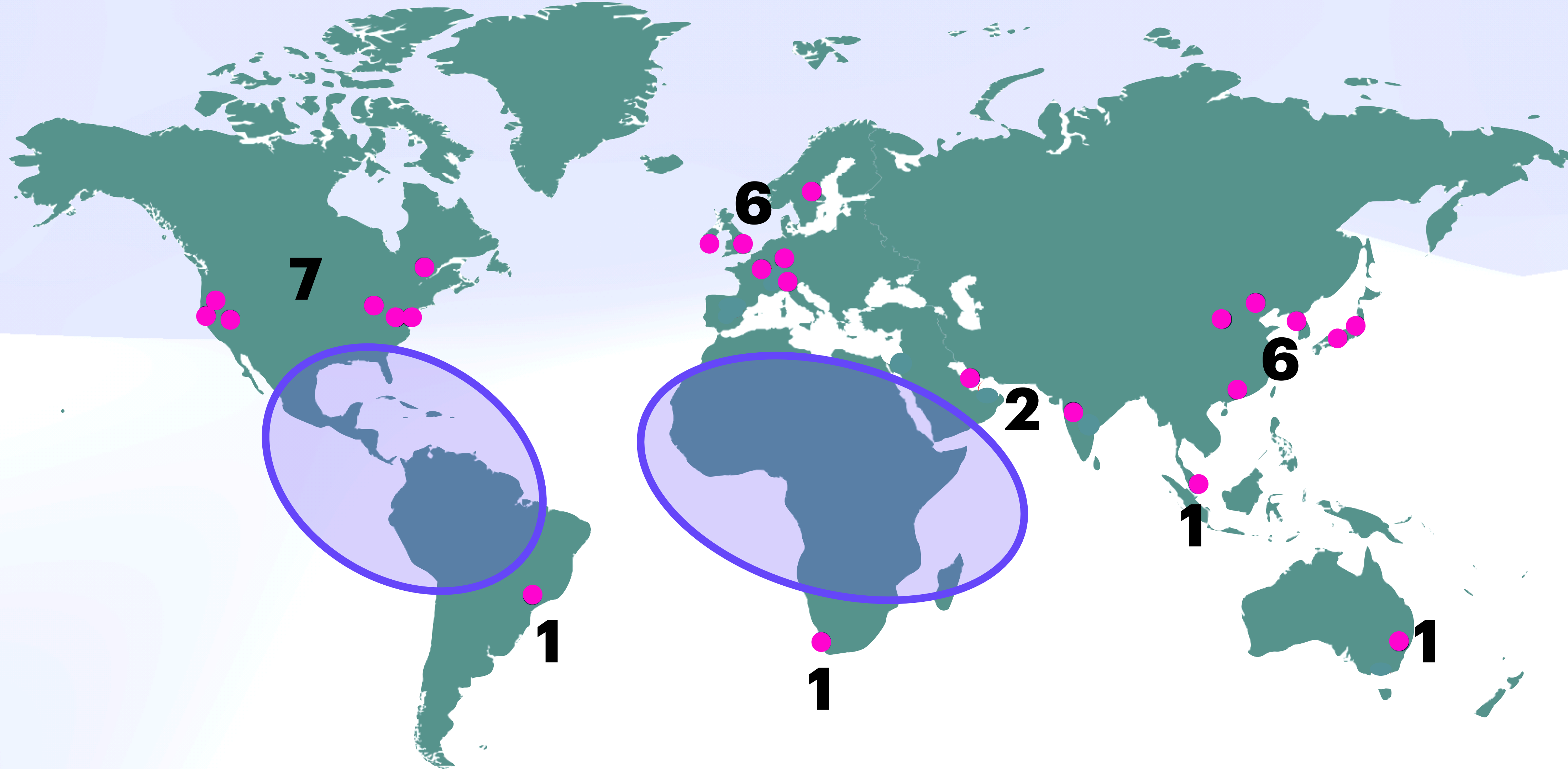
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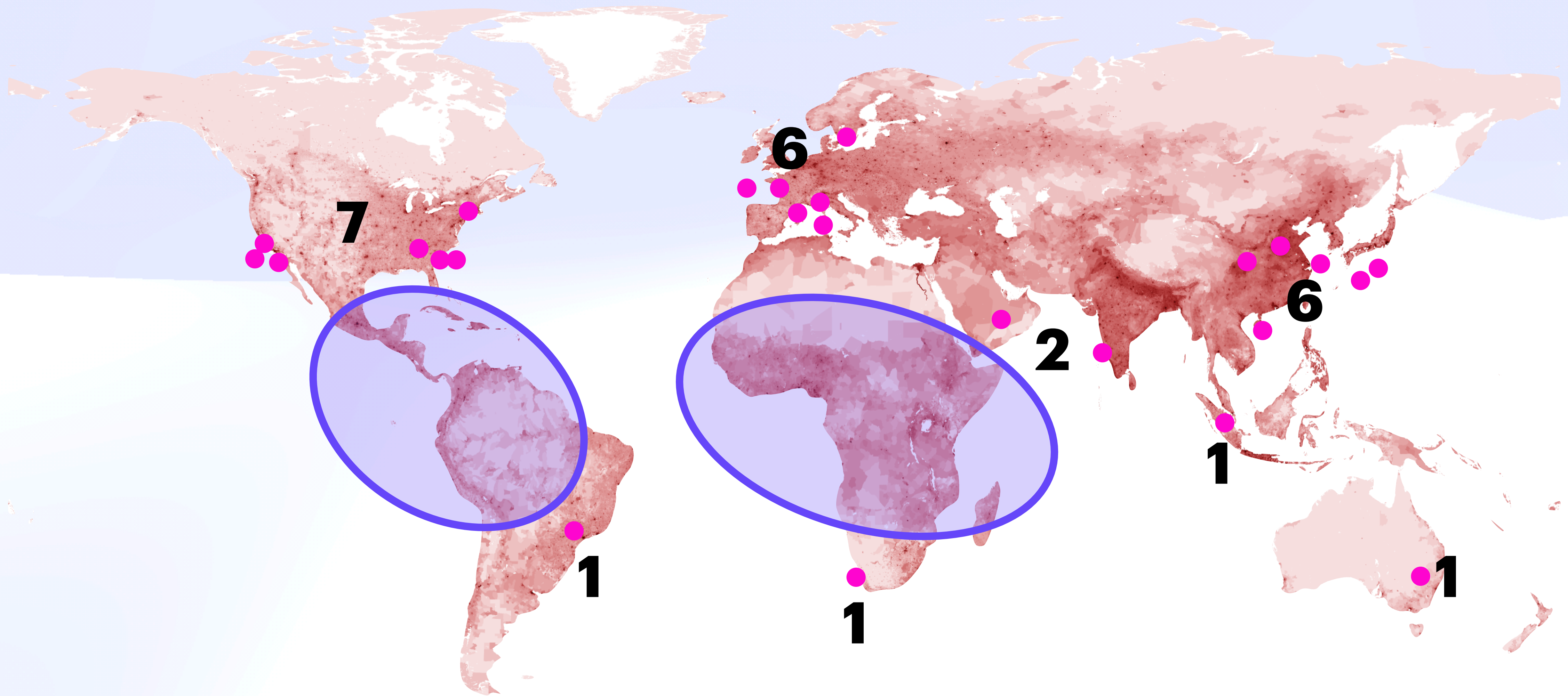
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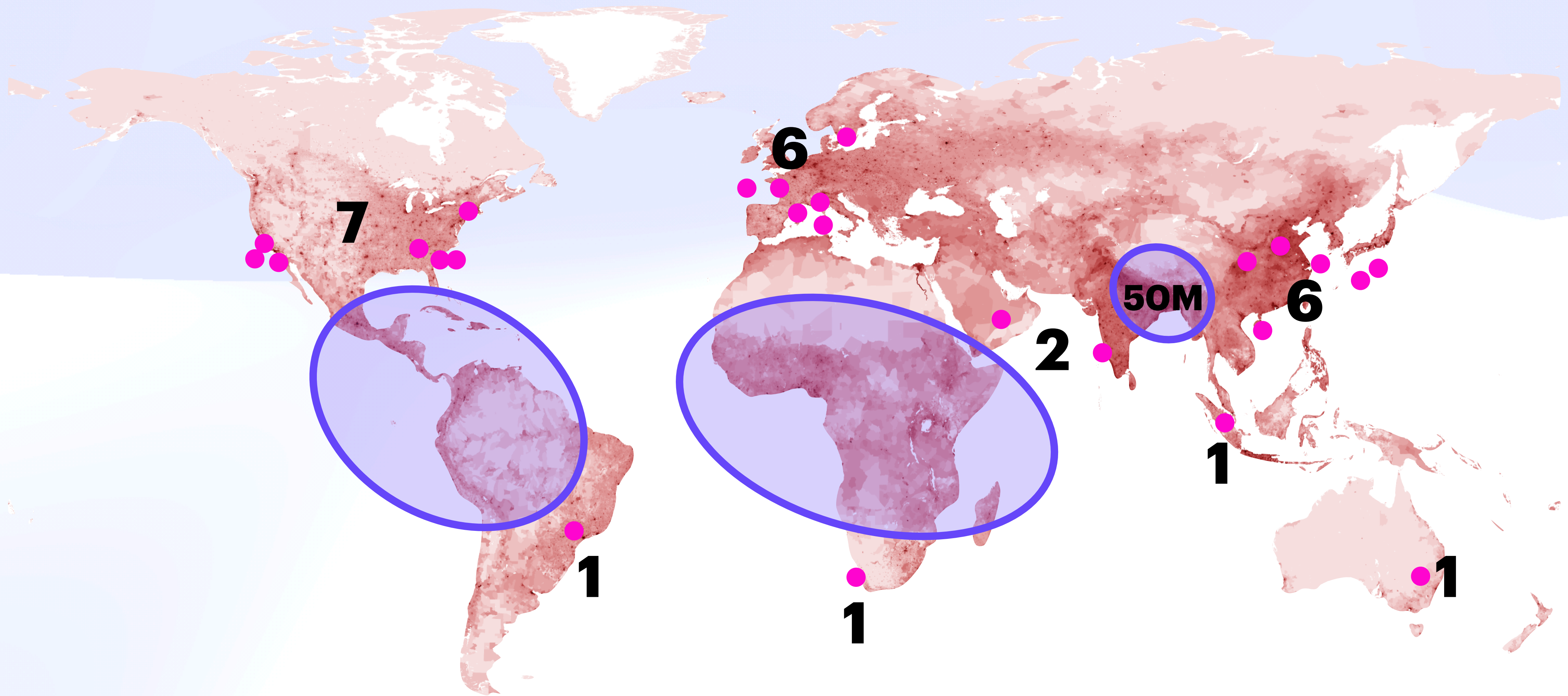
A New Environment

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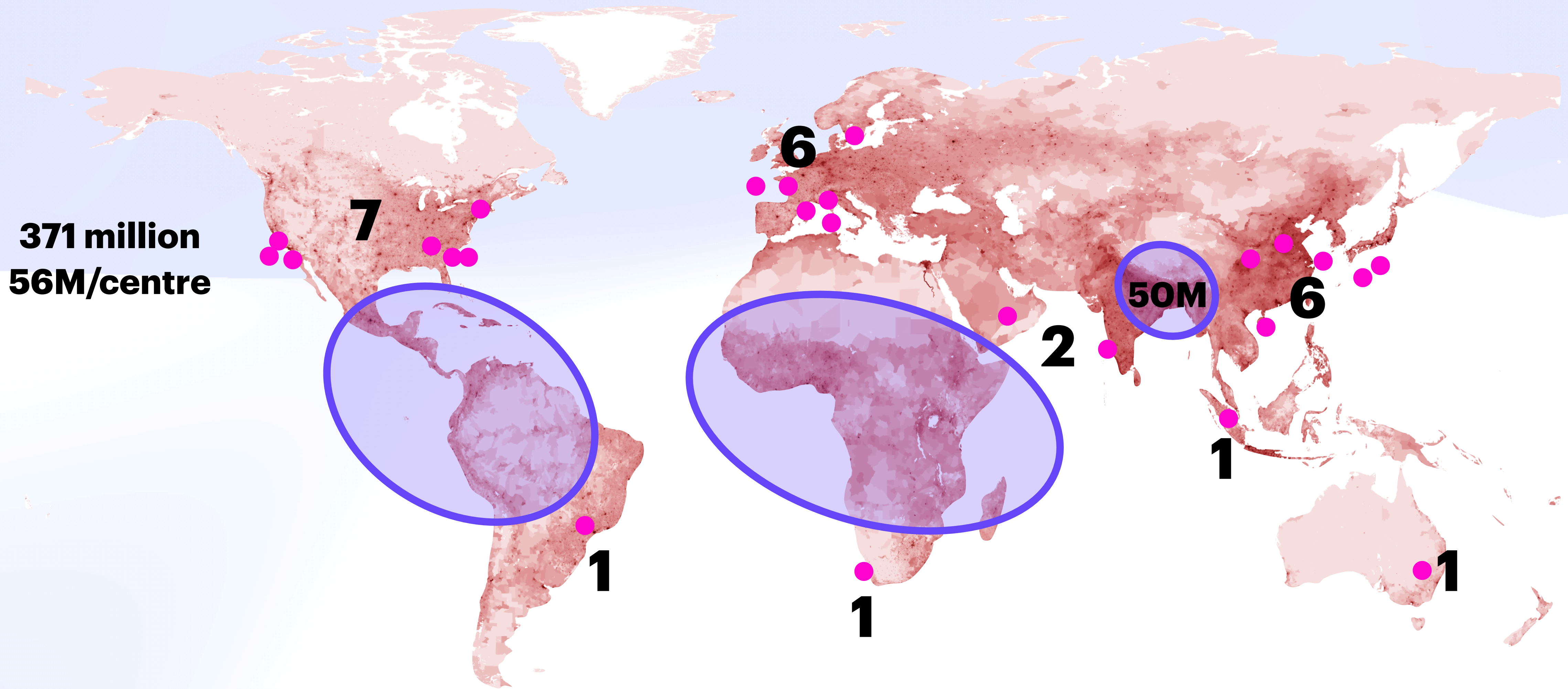
A New Environment

Users vs Cloud Infra



A New Environment

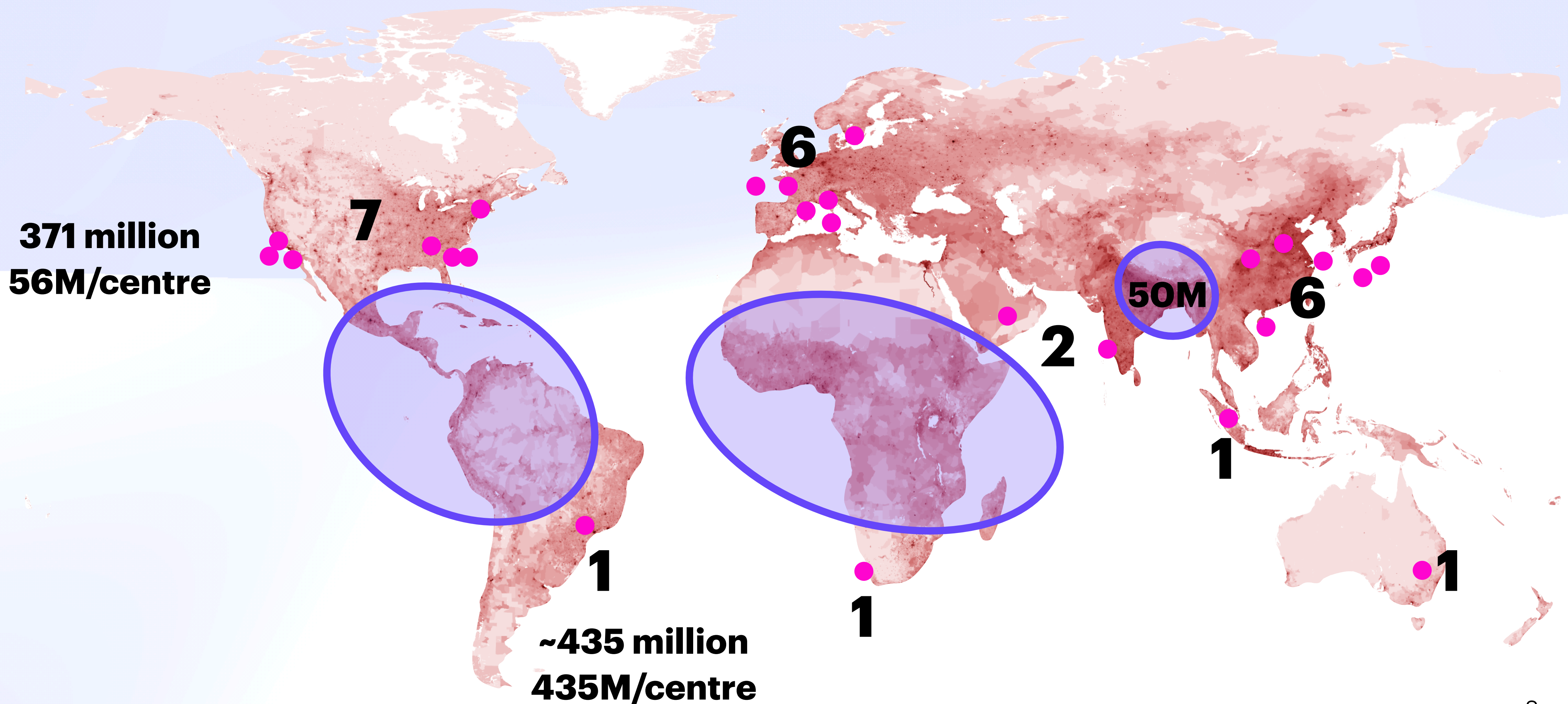
Users vs Cloud Infra



371 million
56M/centre

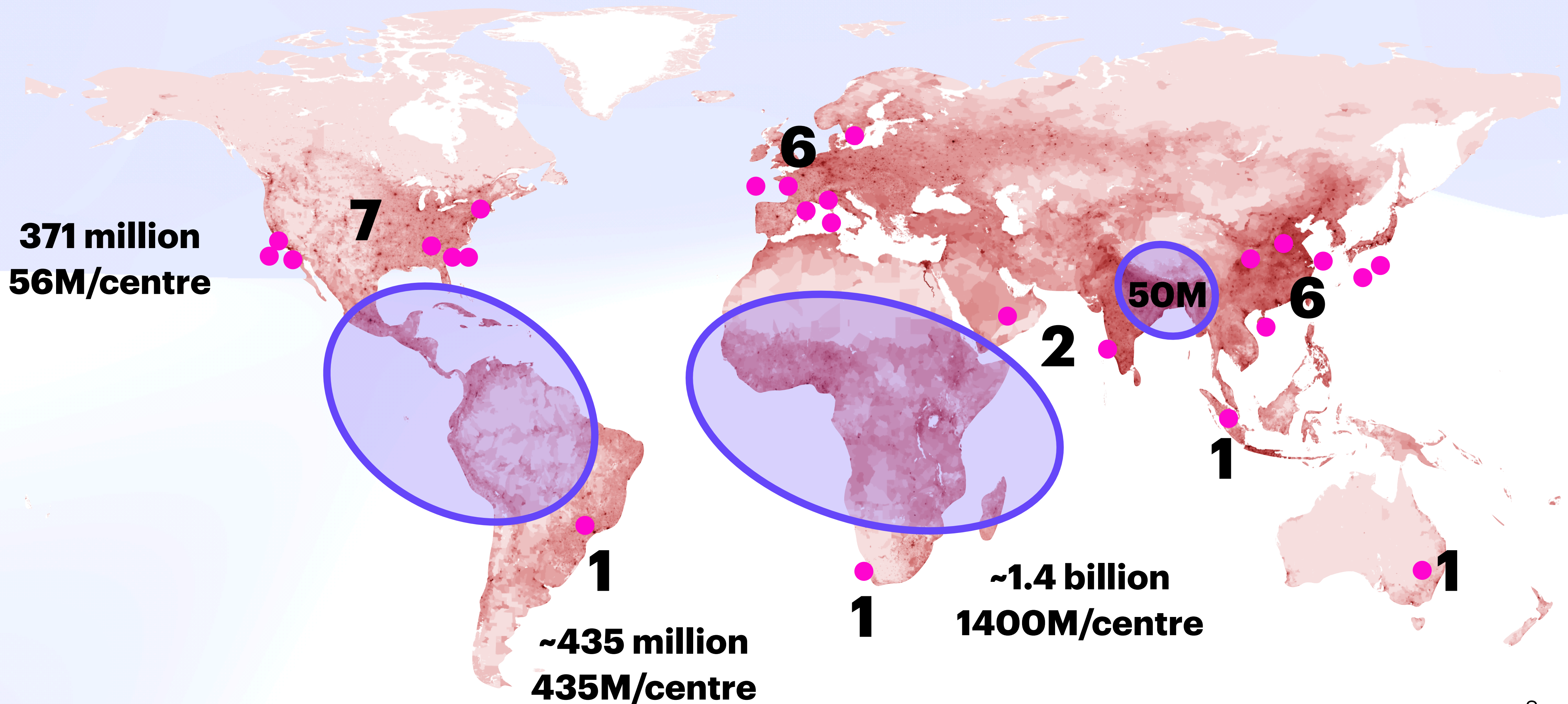
A New Environment

Users vs Cloud Infra



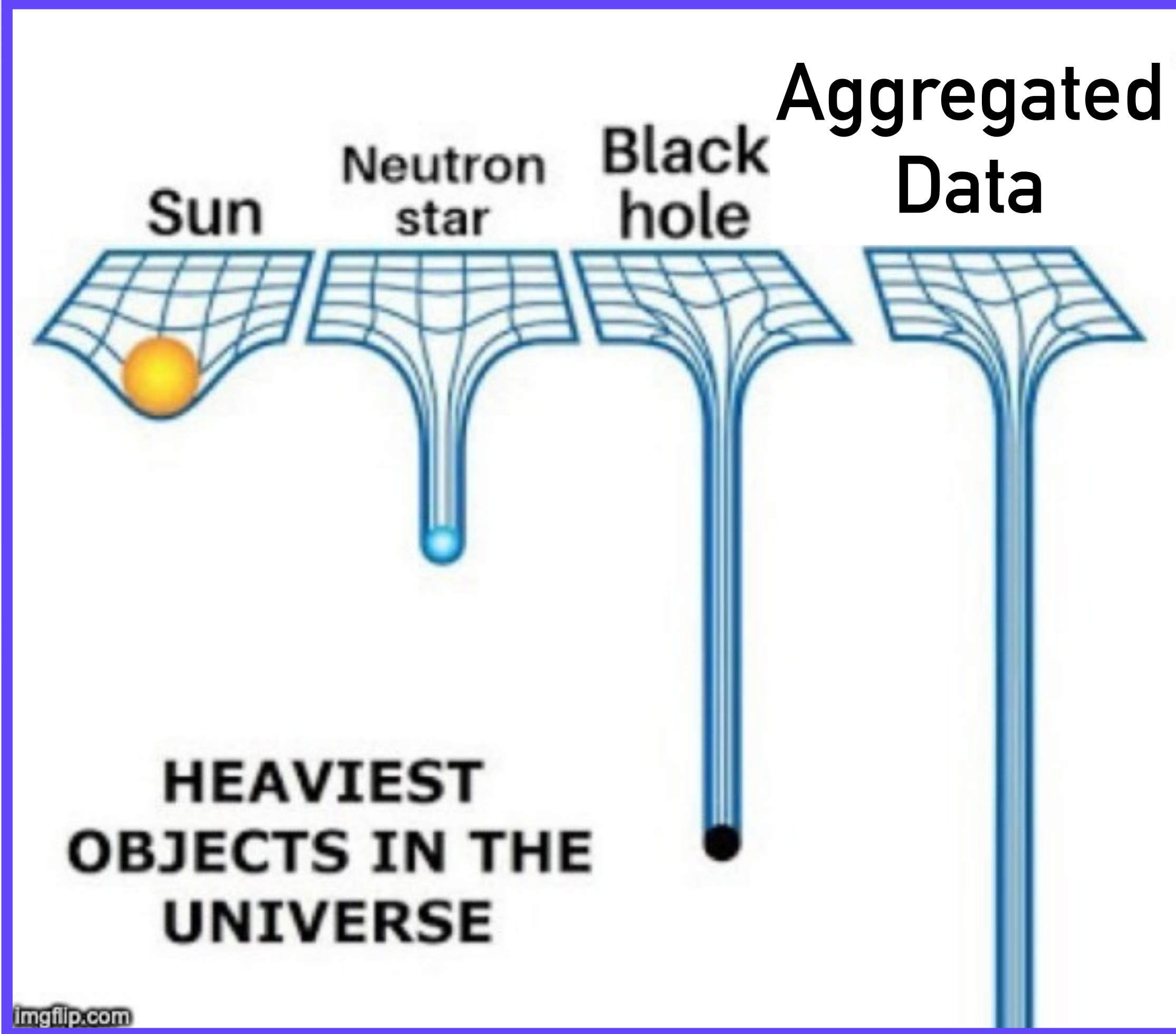
A New Environment

Users vs Cloud Infra



A New Environment

Data Gravity



A New Environment

What 8ms Looks Like

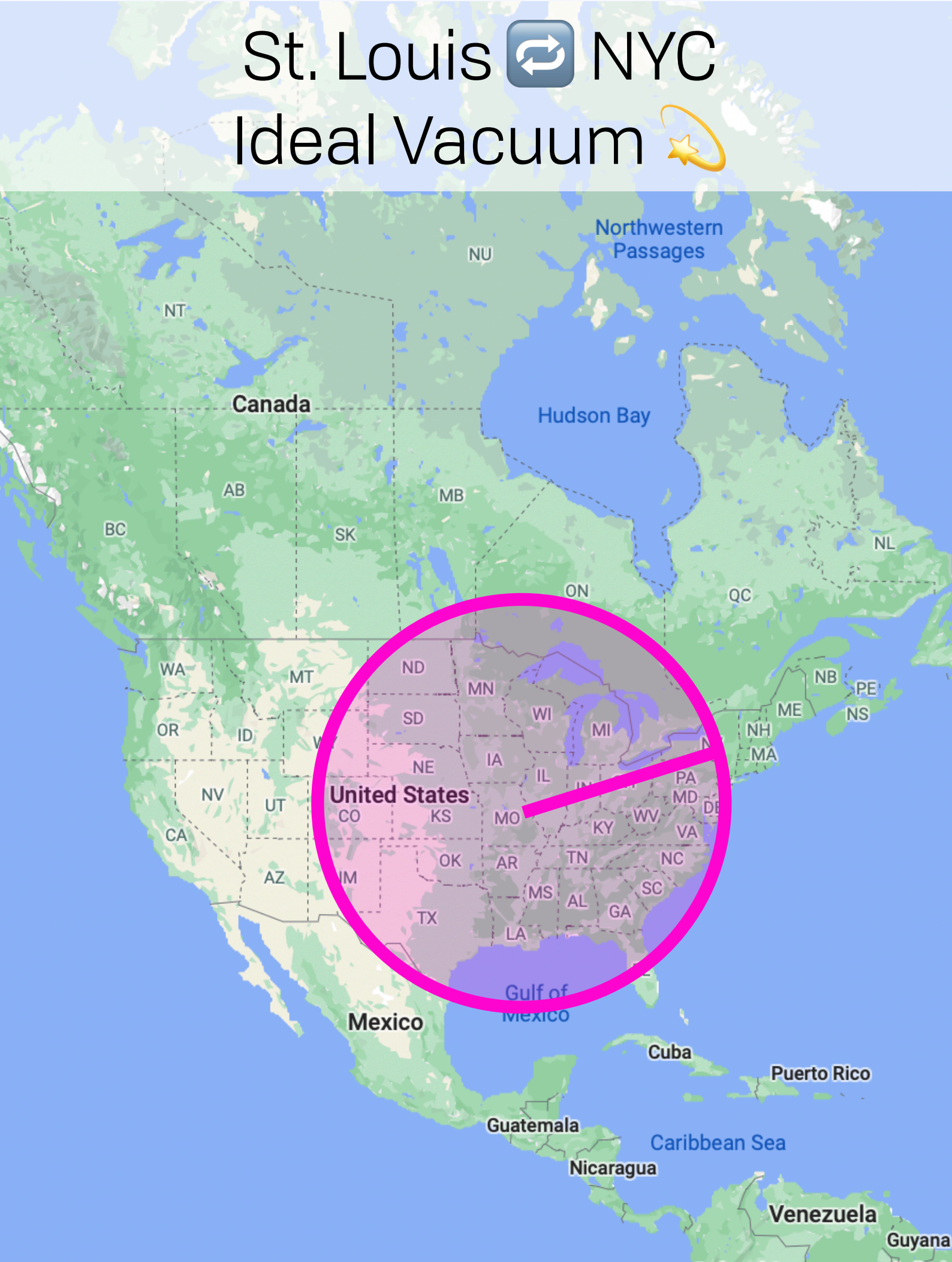
A New Environment

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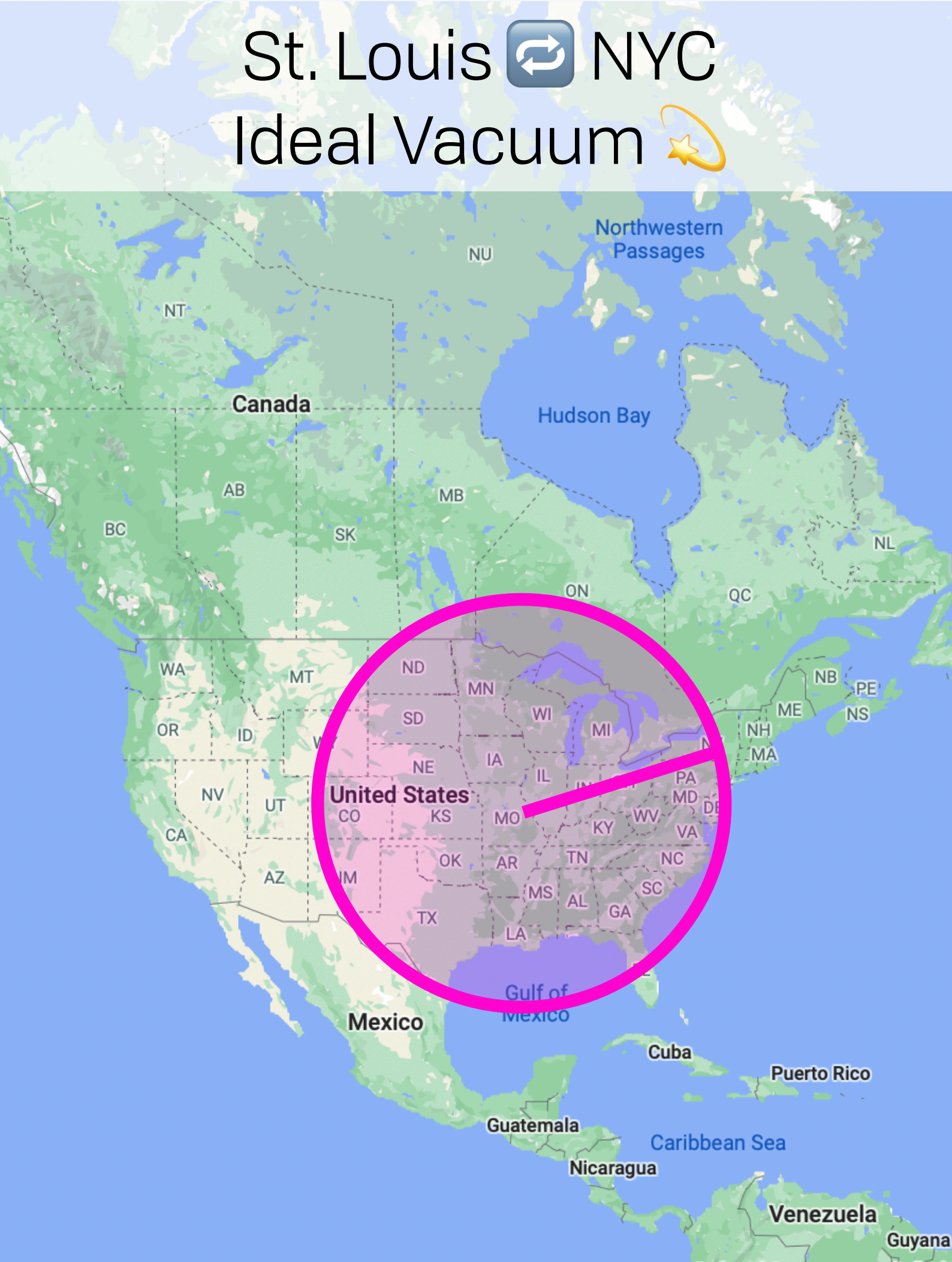
A New Environment

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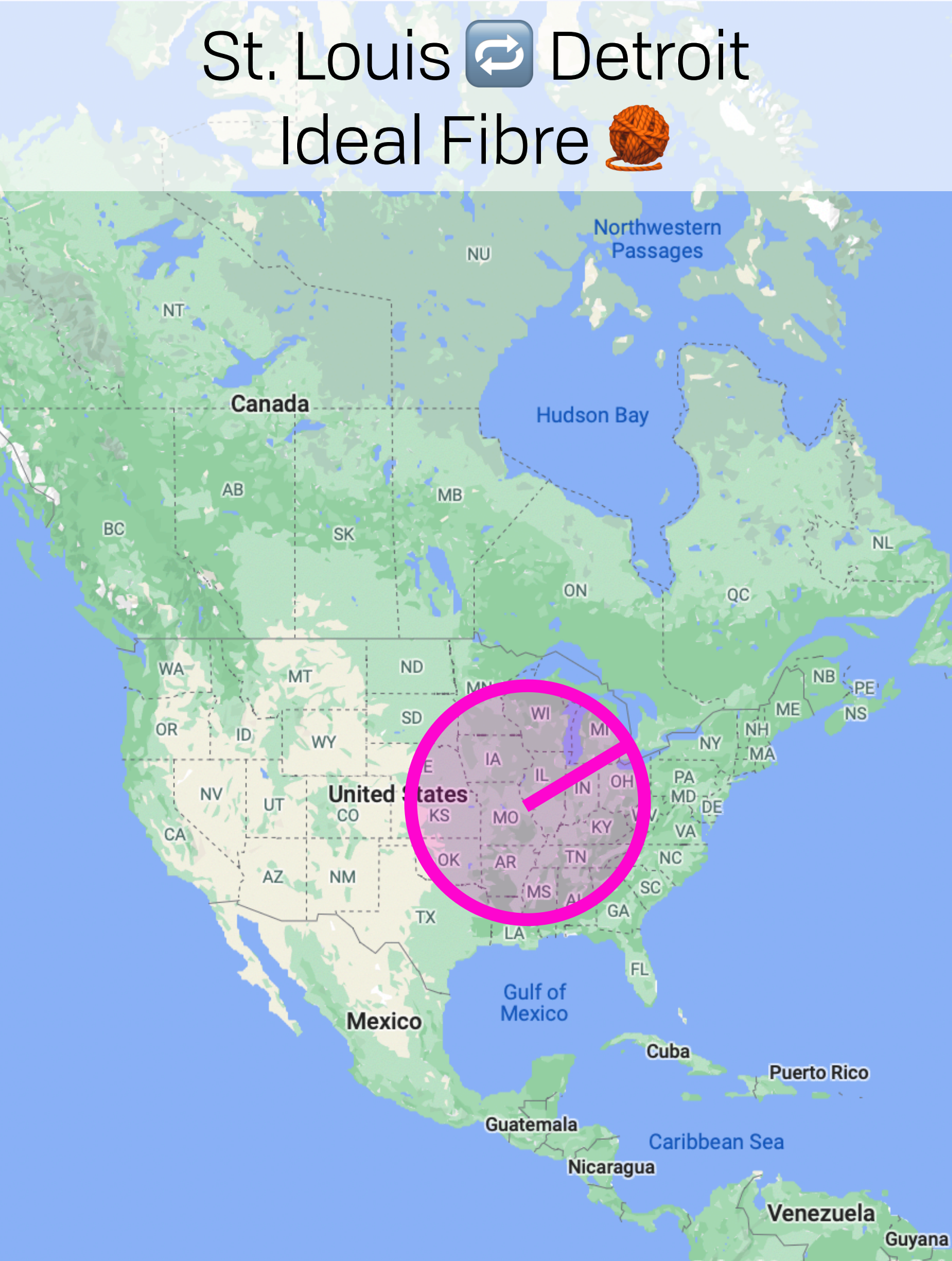
St. Louis → Havana
Ideal Vacuum 🌟



St. Louis ↔ NYC
Ideal Vacuum 🌟

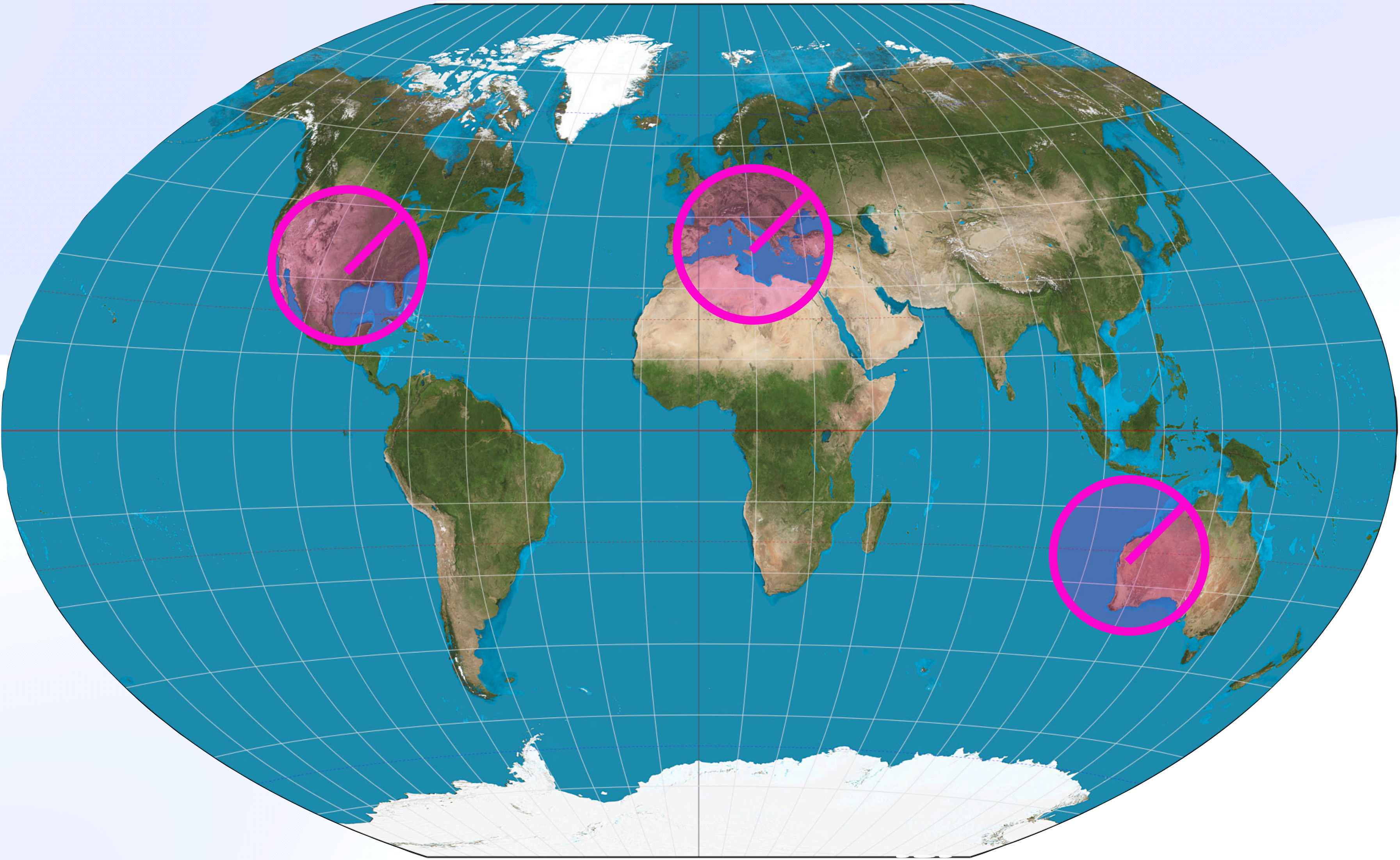


St. Louis ↔ Detroit
Ideal Fibre 🧶



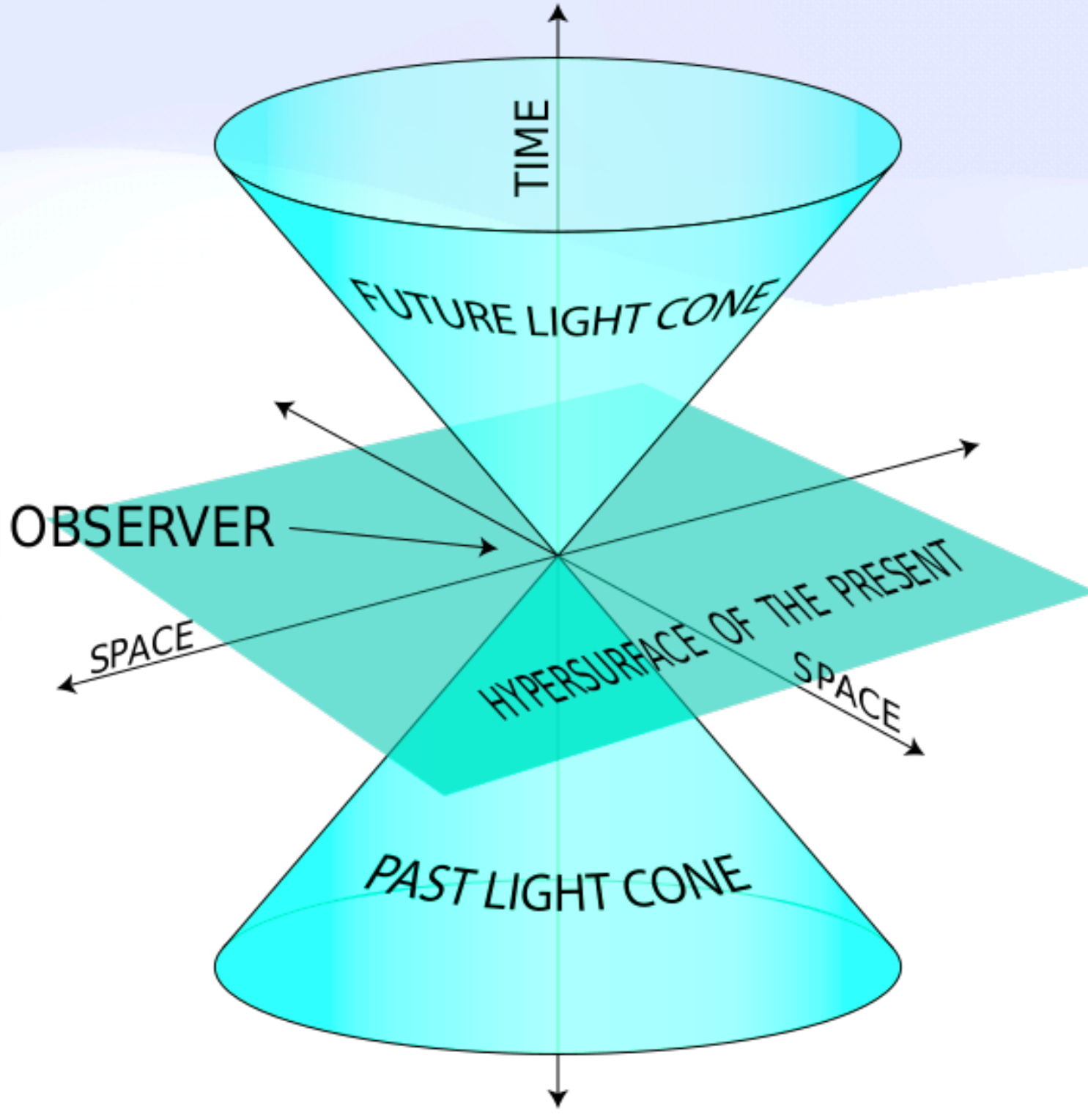
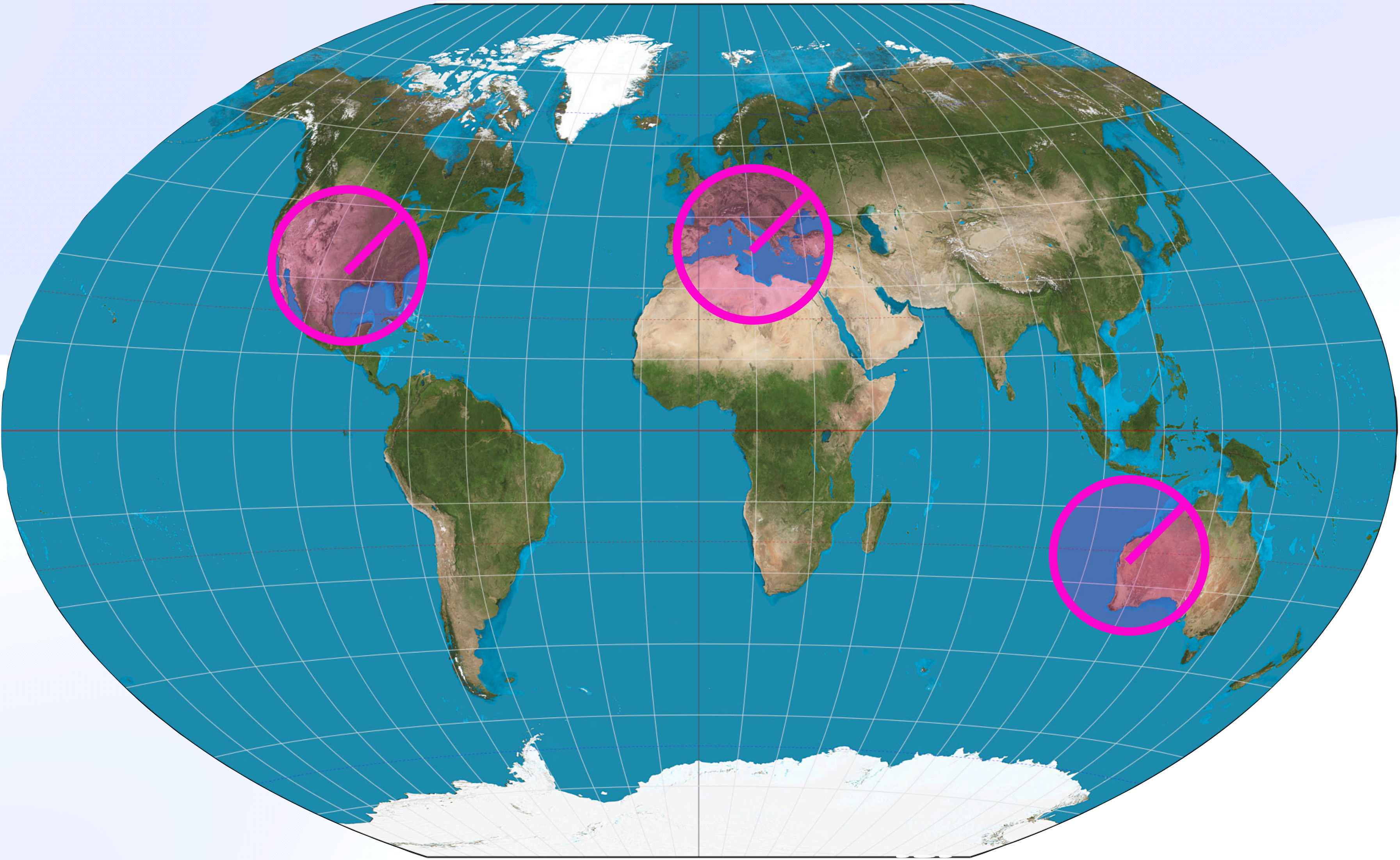
A New Environment

Causal Islands 🏖️ 🌴



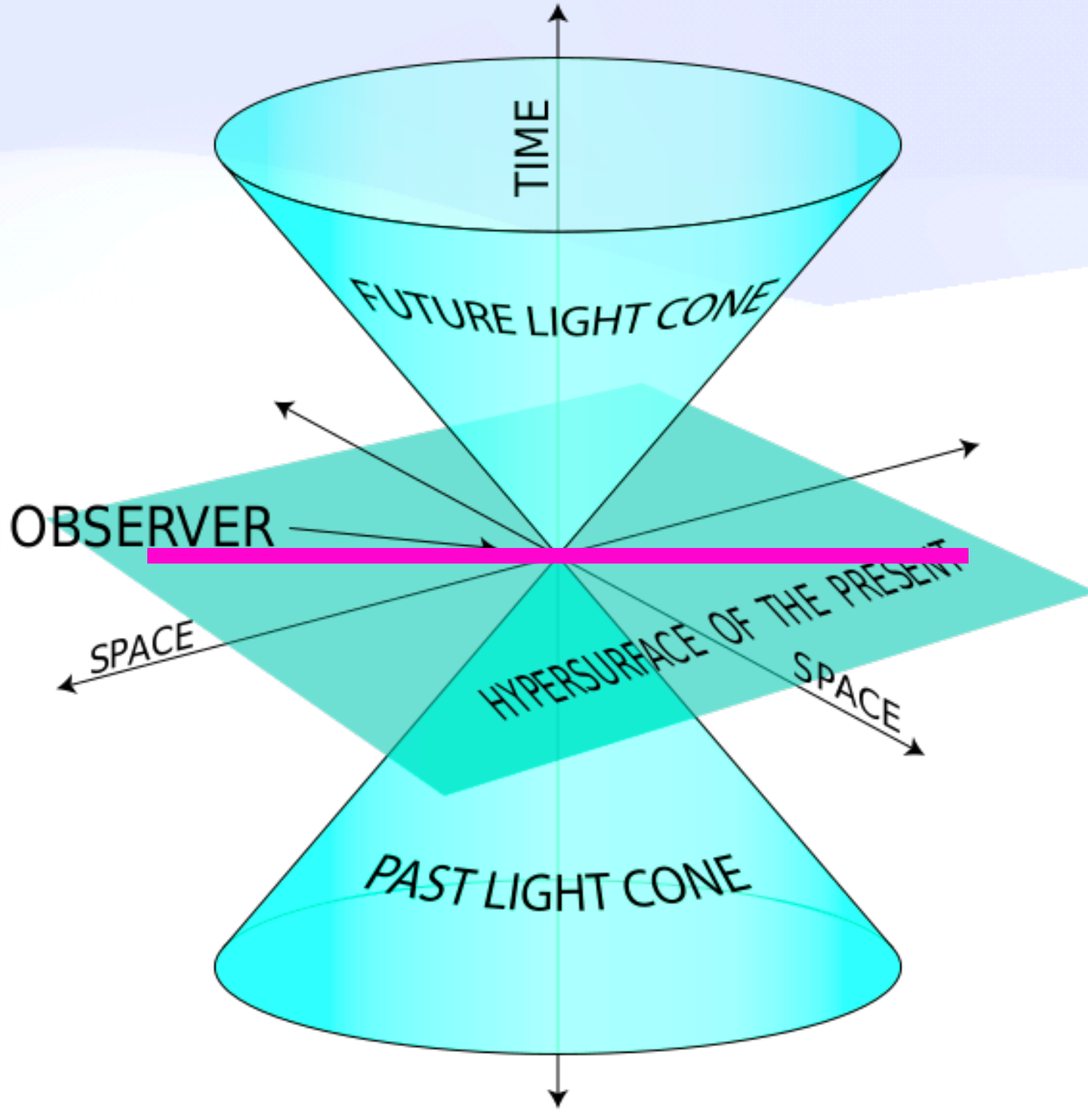
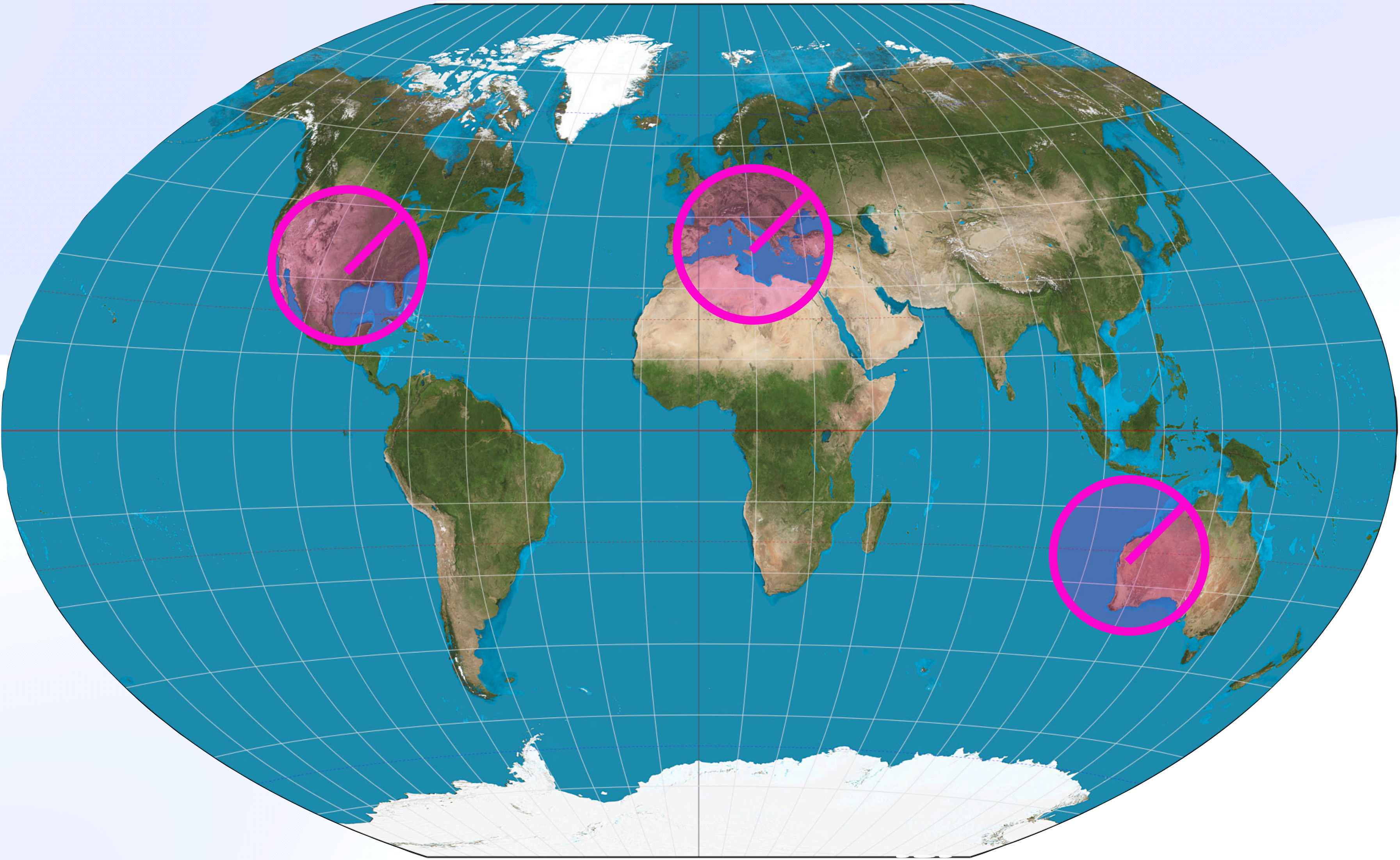
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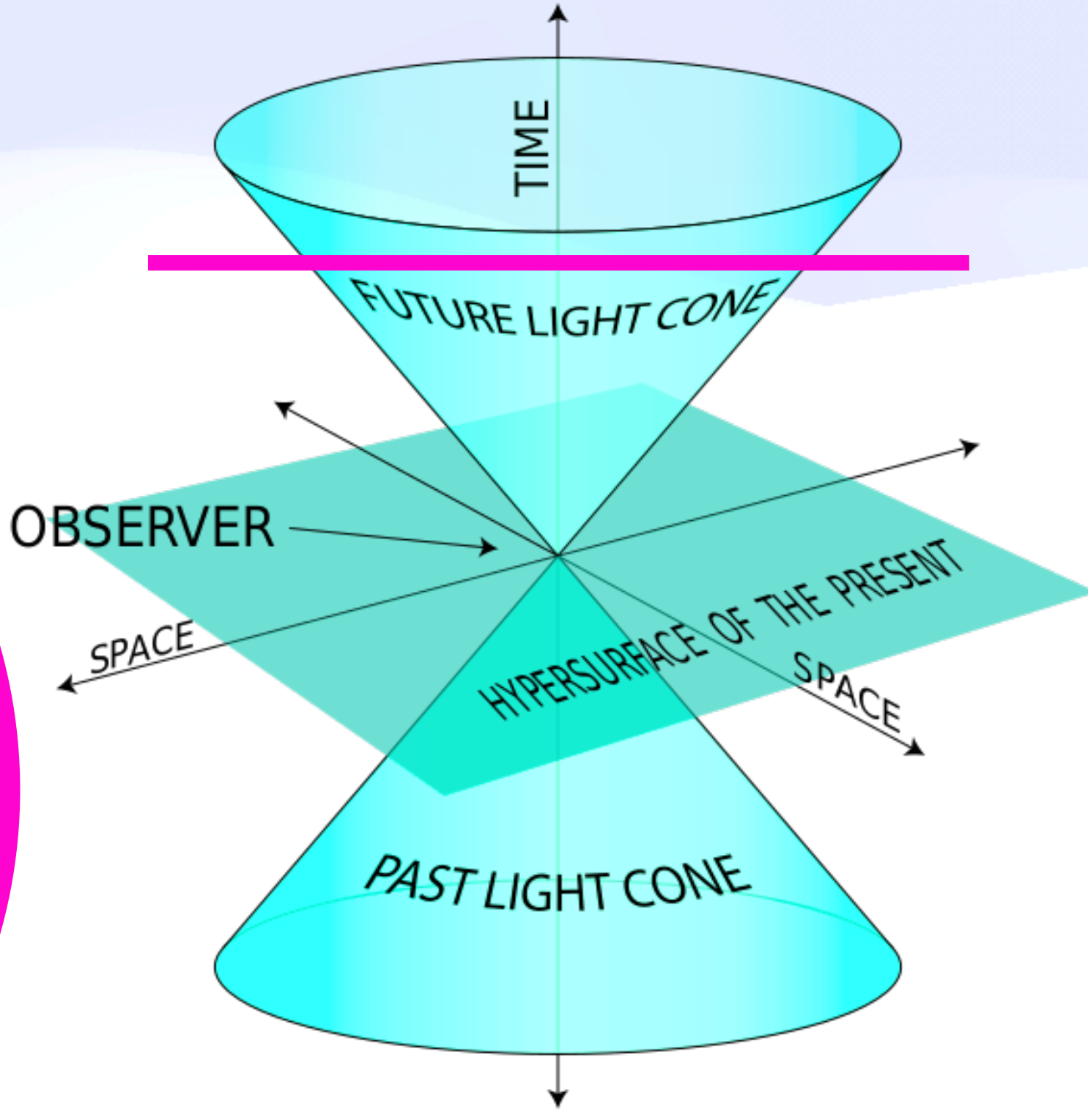
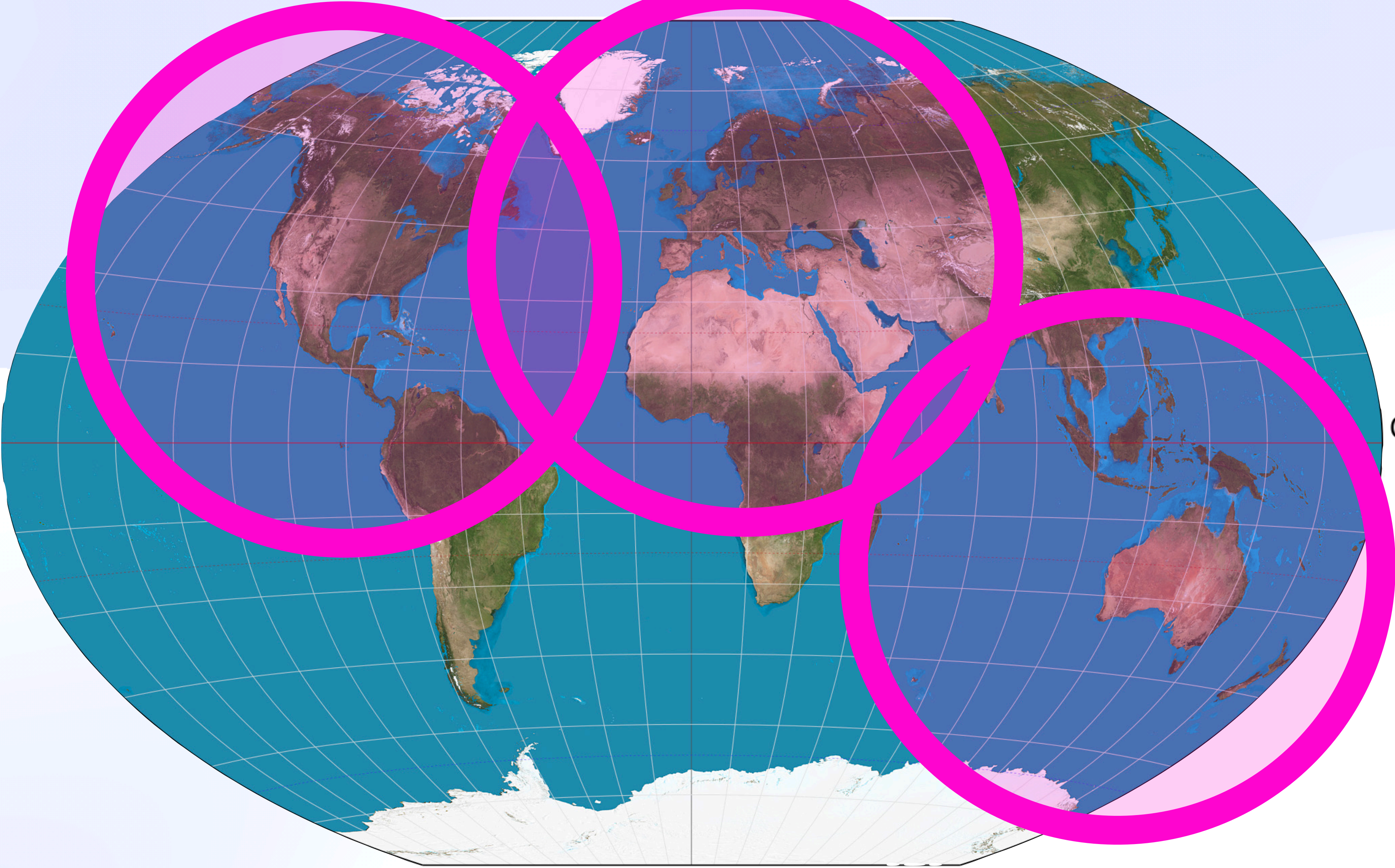
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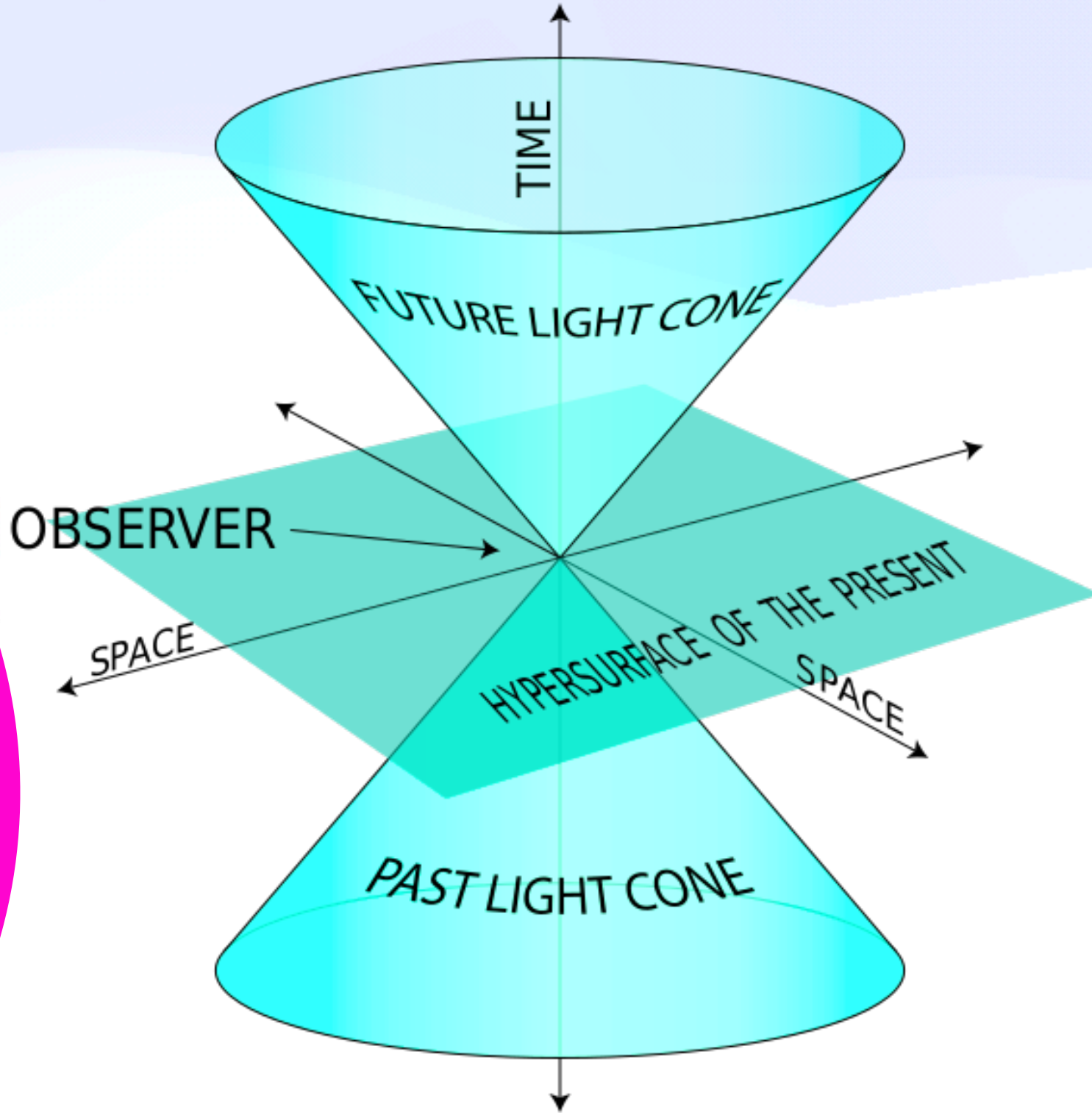
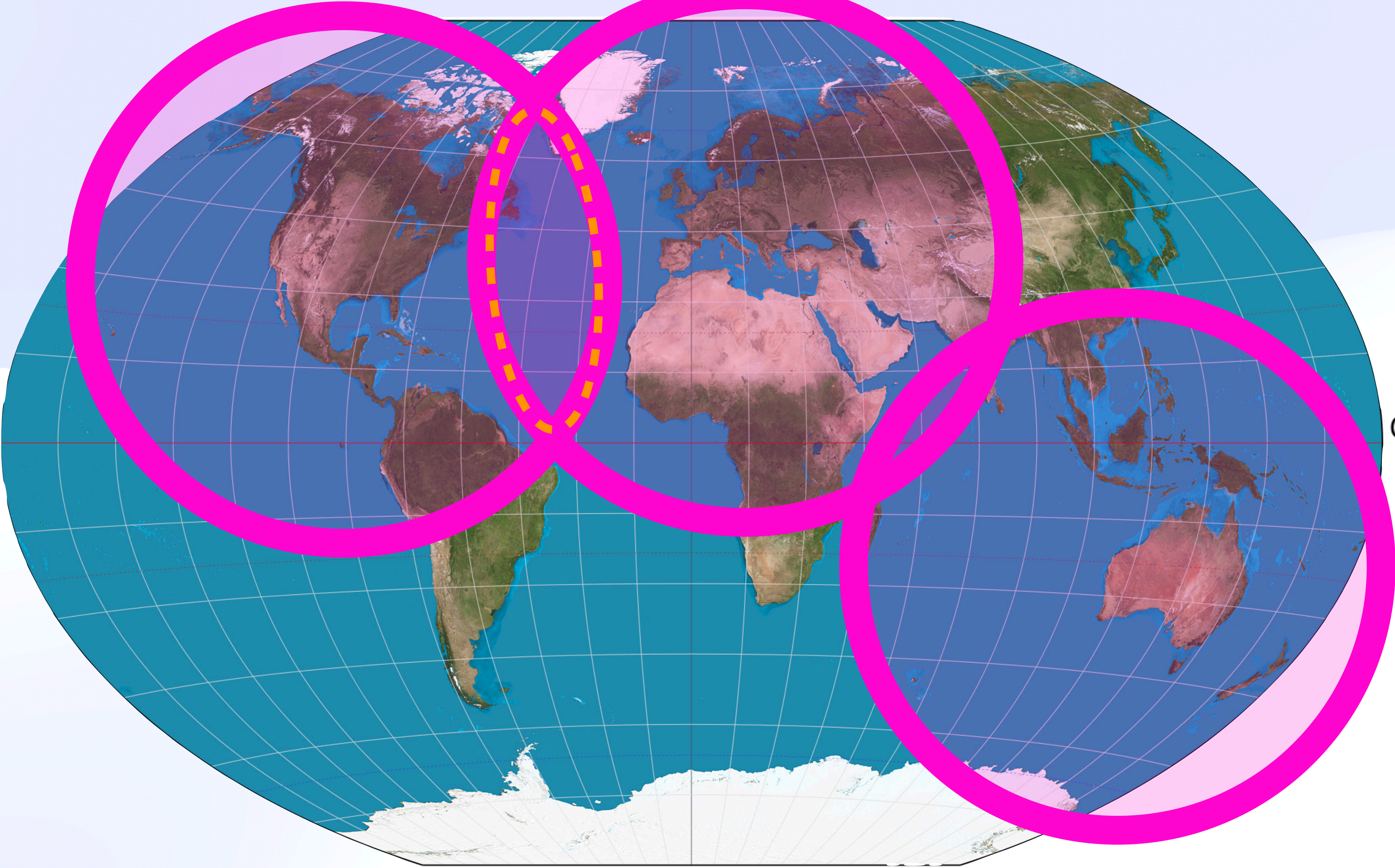
A New Environment

Causal Islands



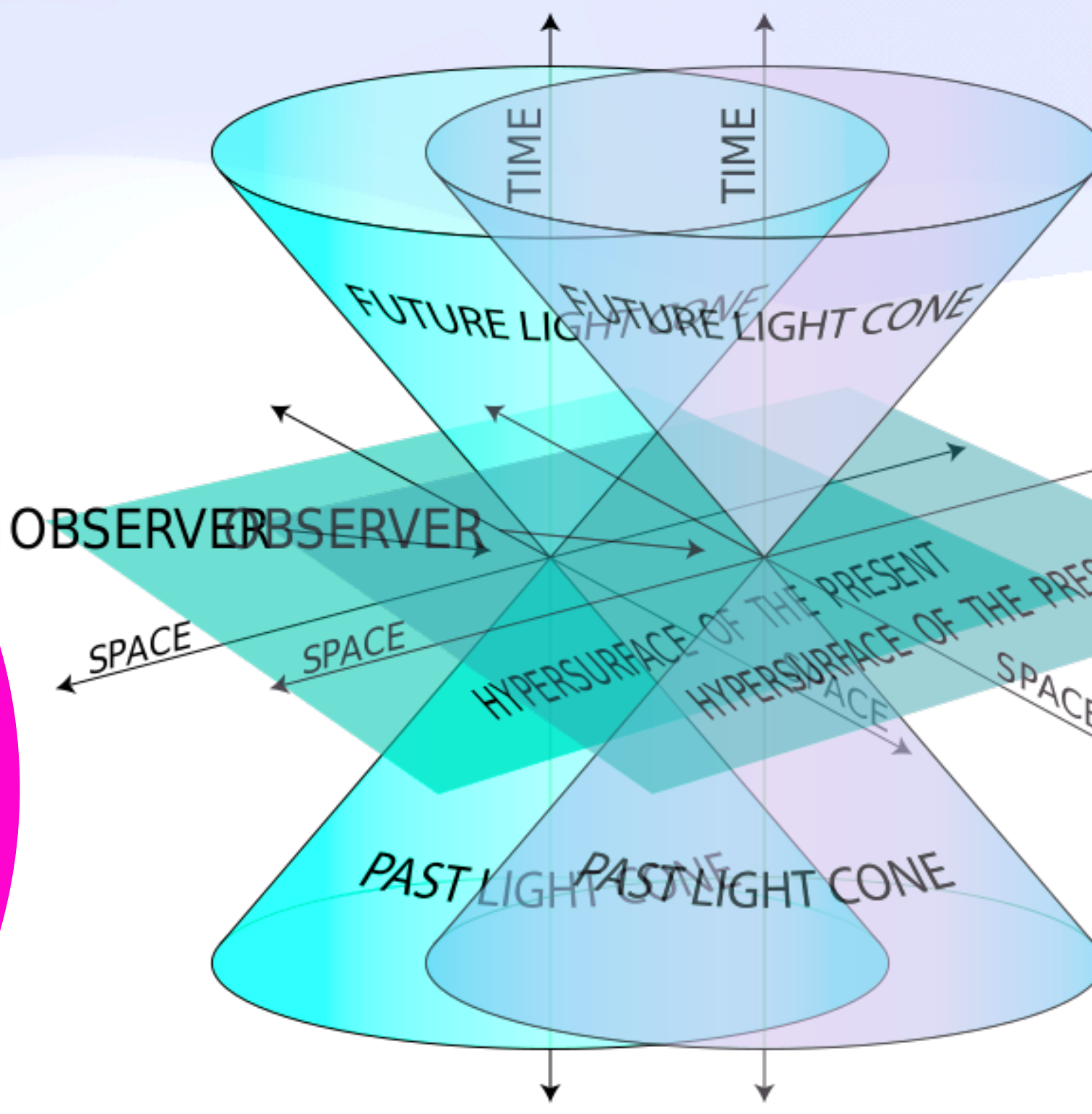
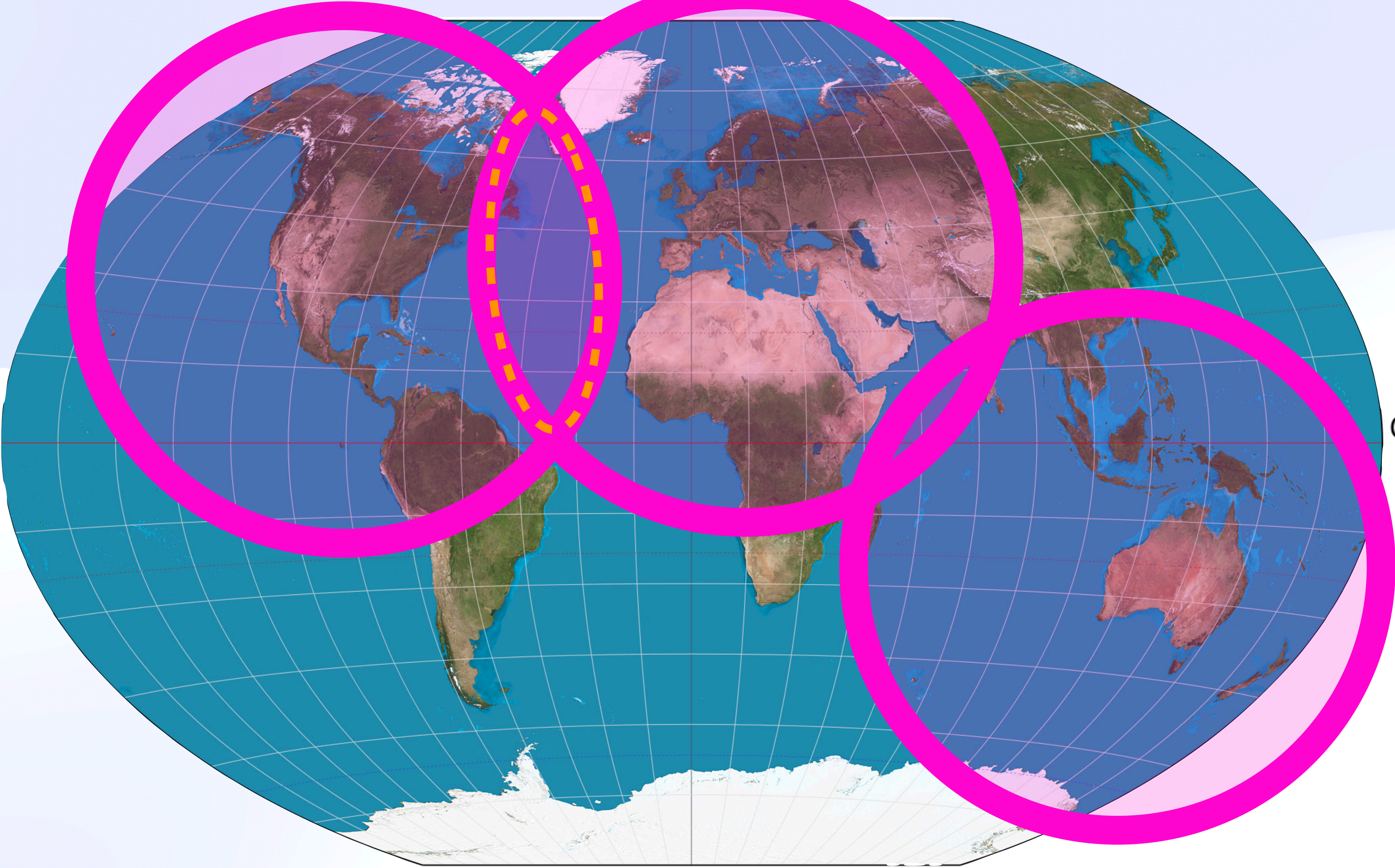
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Causal Islands



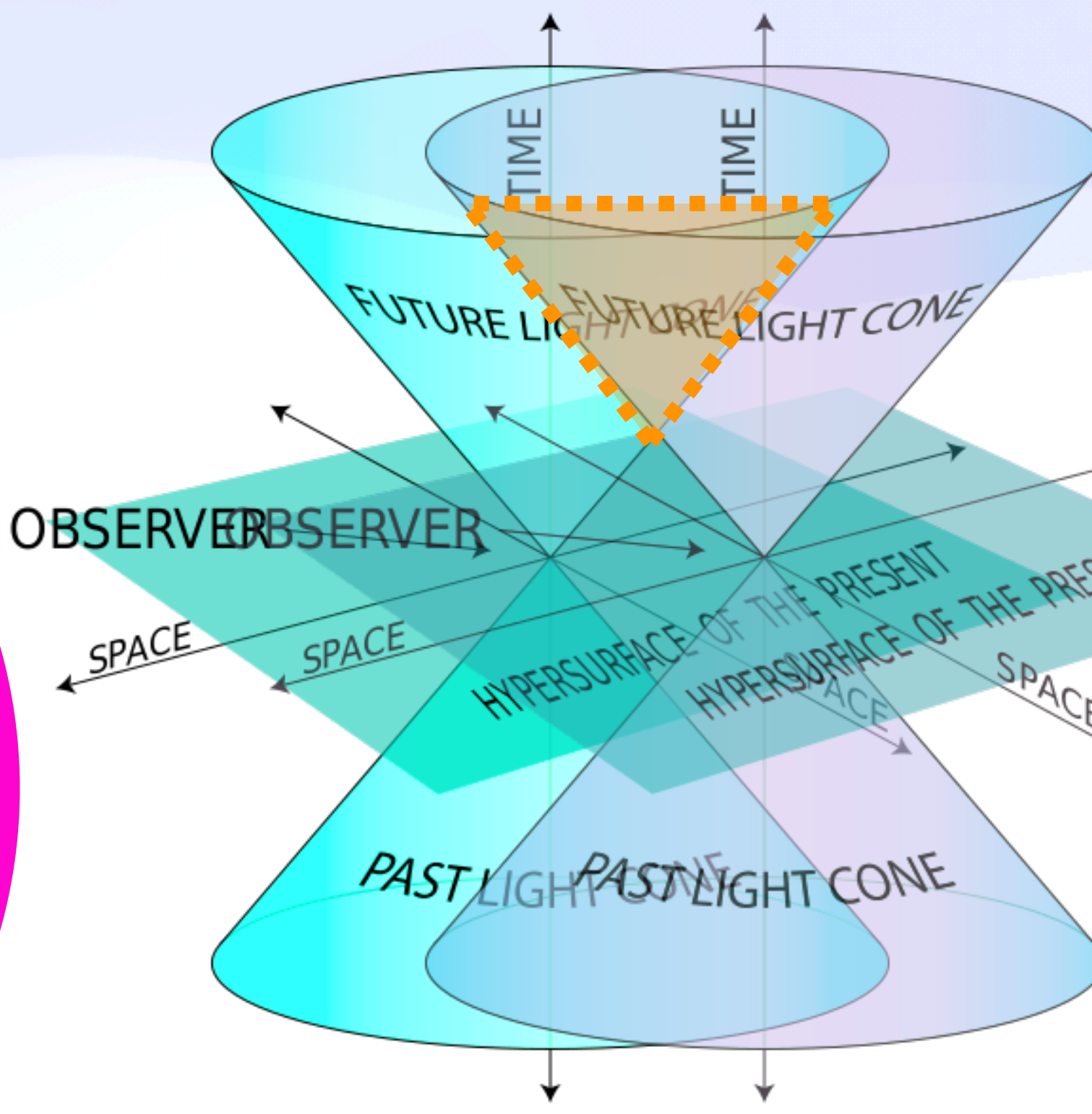
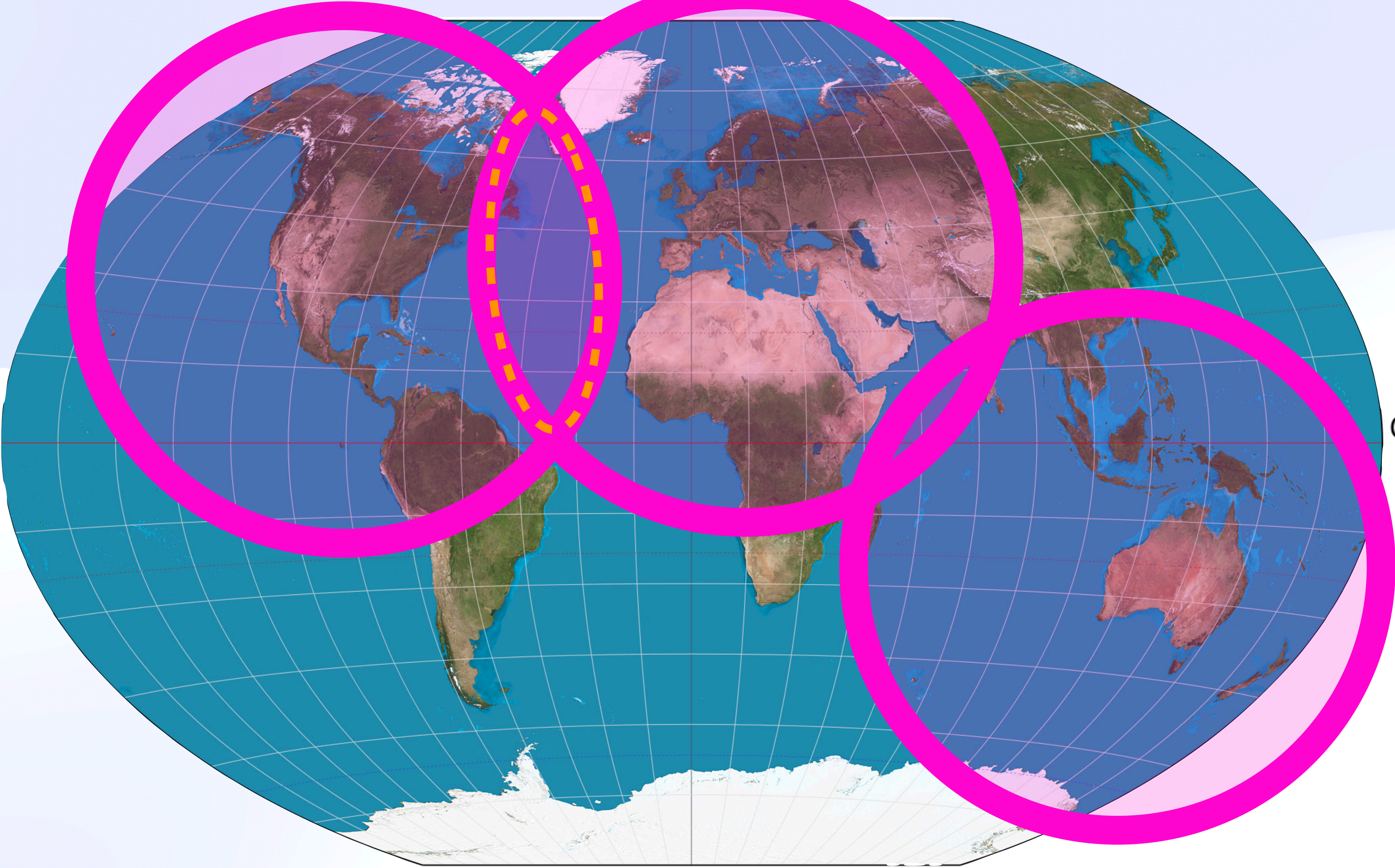
A New Environment

Causal Islands



A New Environment

Causal Islands



A New Environment

A New Environment

As we continue to increase the number of globally connected devices, we **must embrace a design that considers every single member in the system as the primary site** for the data that it is generates.

It is **completely impractical** that we can look at a single, or a small number, of globally distributed data centers as the **primary site for all global information** that we desire to perform computations with.

– **Meiklejohn**, A Certain Tendency Of The Database Community

A New Environment

Everything, Everywhere

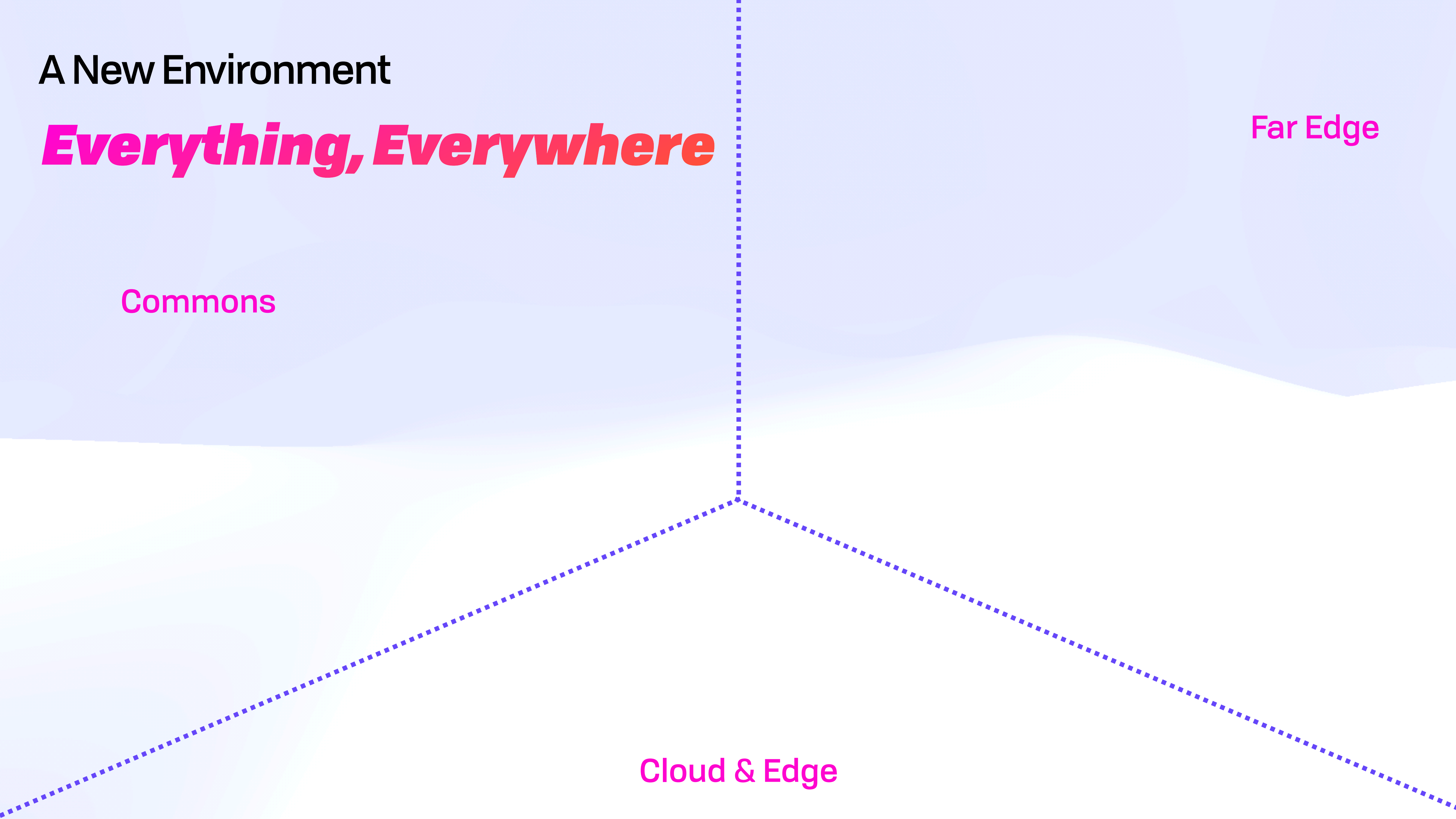
A New Environment

Everything, Everywhere

Far Edge

Commons

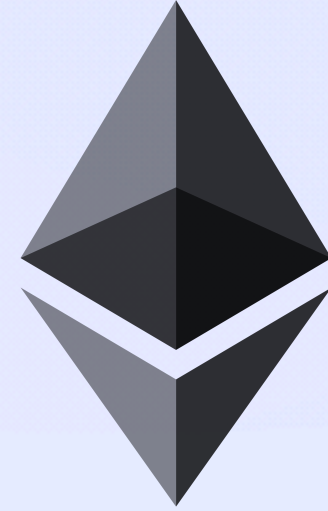
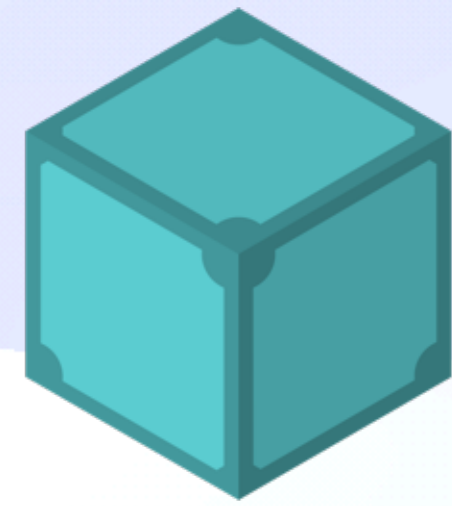
Cloud & Edge



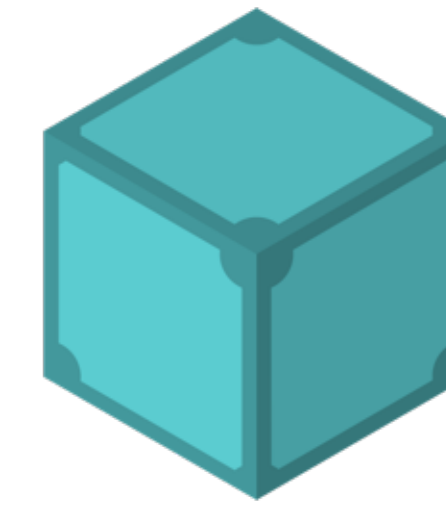
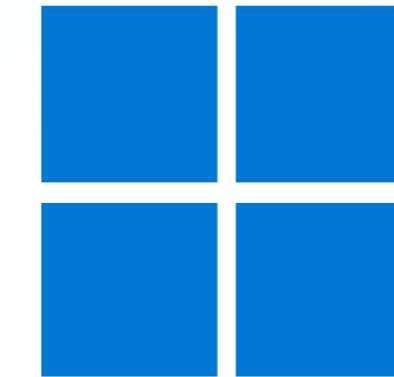
A New Environment

Everything, Everywhere

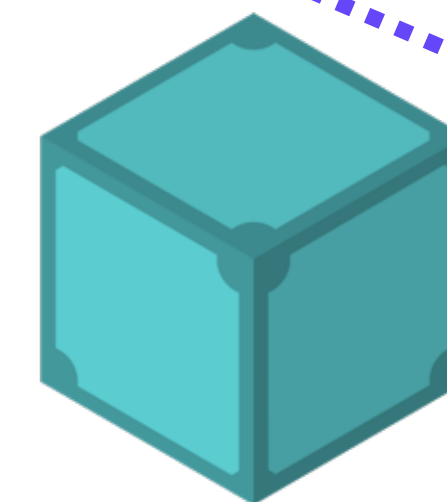
Commons



Far Edge



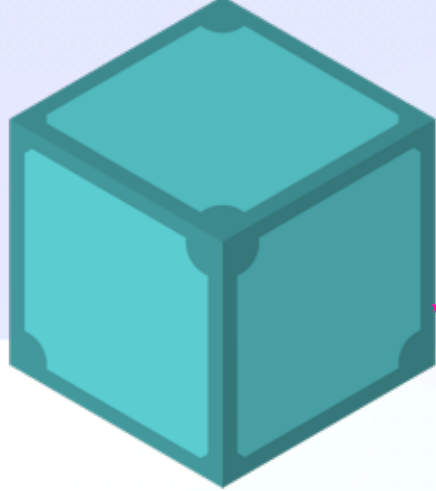
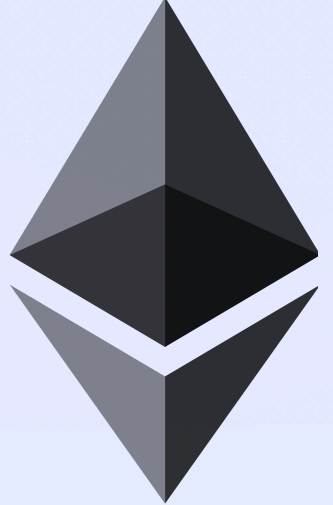
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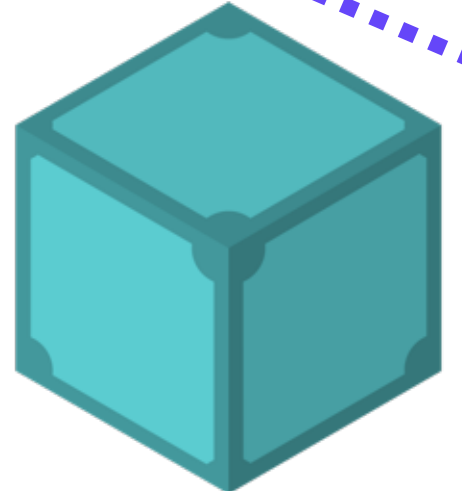
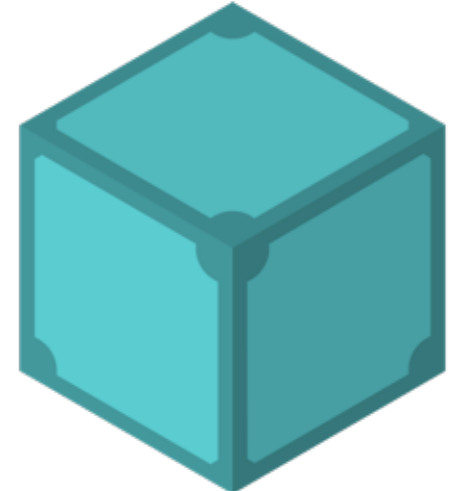
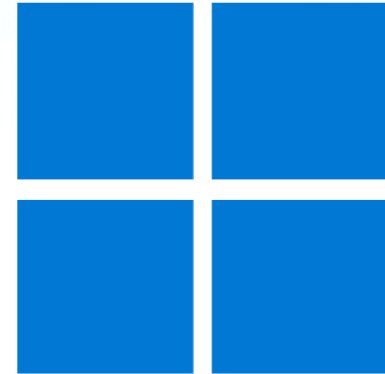
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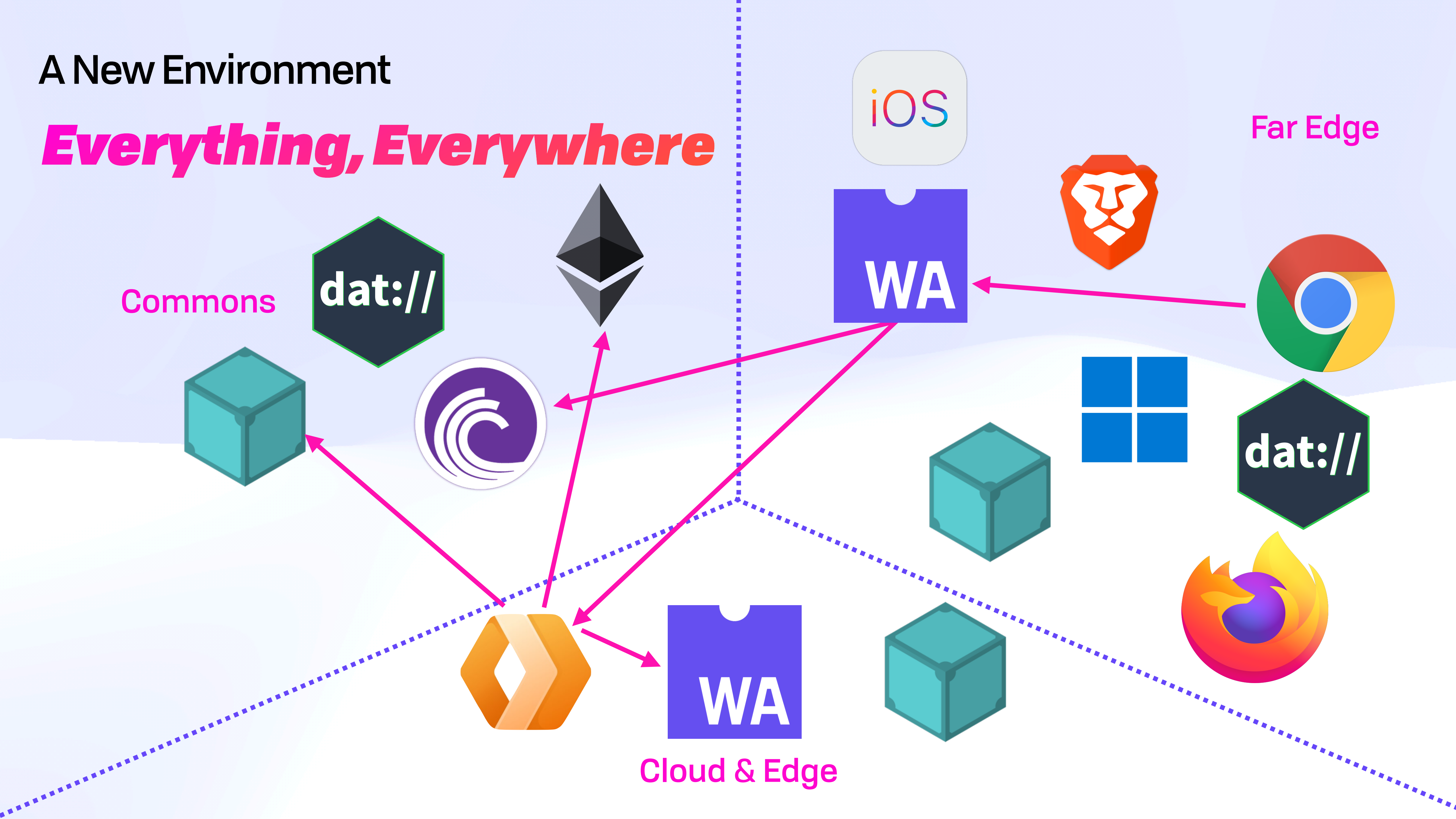
Commons



Far Edge



Cloud & Edge



A New Environment







— Getting Back to Our Roots —

Networks for Good

Networks for Good

Back to Our Roots

Networks for Good

Back to Our Roots

1. Decentralisation

2. Non-discrimination

3. Bottom-up Design

4. Universality

5. Consensus

– **The Web Foundation**, History of the Web

Networks for Good

Back to Our Roots

- 1. Decentralisation**
- 2. Non-discrimination**
- 3. Bottom-up Design**
- 4. Universality**
- 5. Consensus**

Layer		Protocol data unit (PDU)	
Host layers	7	Application	Data
	6	Presentation	
	5	Session	
	4	Transport	Segment, Datagram
Media layers	3	Network	Packet
	2	Data link	Frame
	1	Physical	Bit, Symbol

en.wikipedia.org/wiki/OSI_model

– **The Web Foundation**, History of the Web

Networks for Good

Back to Our Roots

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Networks for Good

Back to Our Roots

- 1. Decentralisation**
- 2. Non-discrimination**
- 3. Bottom-up Design**
- 4. Universality**
- 5. Consensus**

Layer		Protocol data unit (PDU)	
Host layers	7	Application	Data
	6	Presentation	
	5	Session	
	4	Transport	Segment, Datagram
Media layers	3	Network	Packet
	2	Data link	Frame
	1	Physical	Bit, Symbol

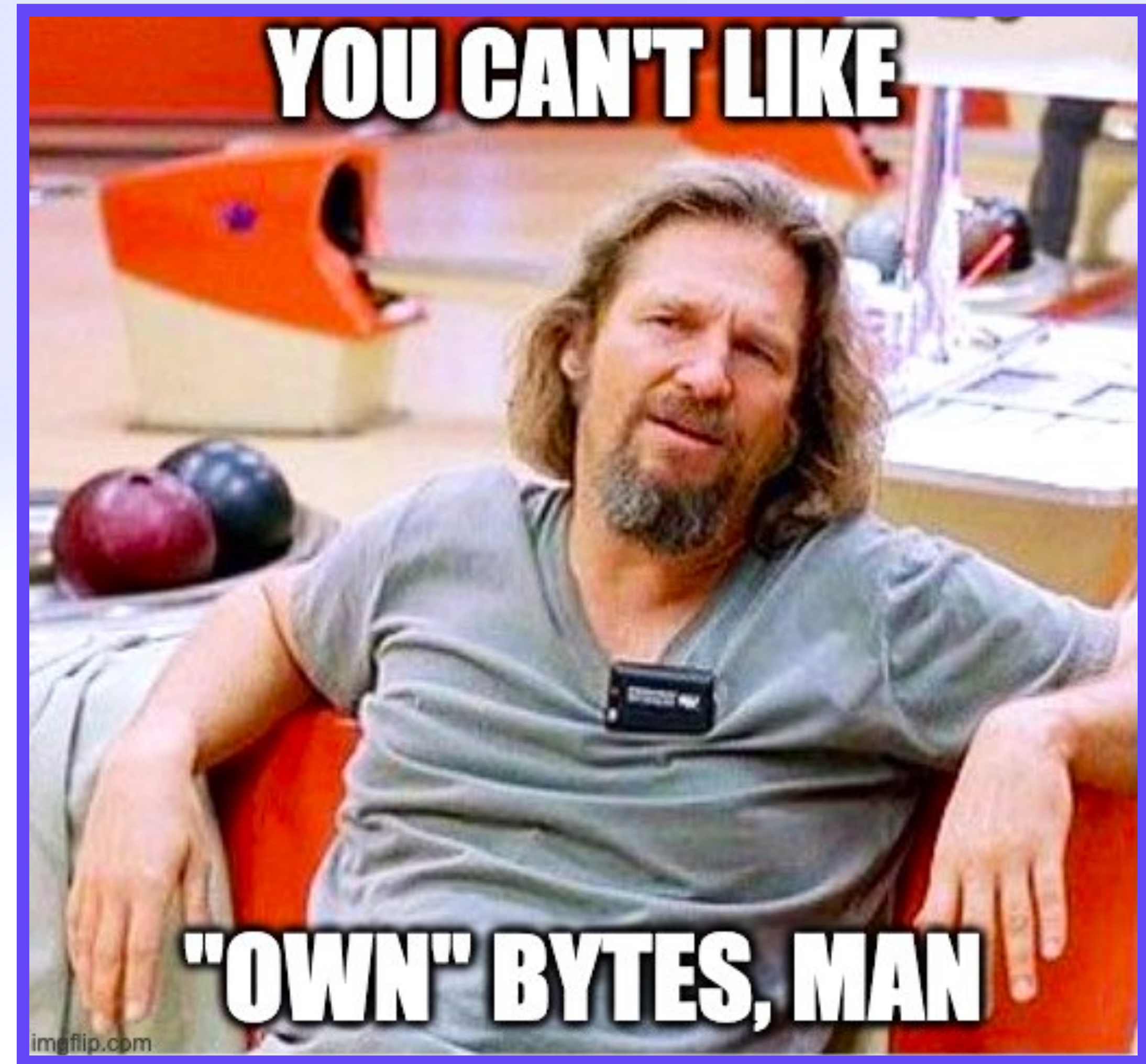
en.wikipedia.org/wiki/OSI_model

– **The Web Foundation**, History of the Web

Networks for Good


User Agency

- **Entry:** Empower users to participate
- **Exit:** Option to move or leave
- **Safety:** Control access to *your* data
- **Serve:** Provide capacity to others



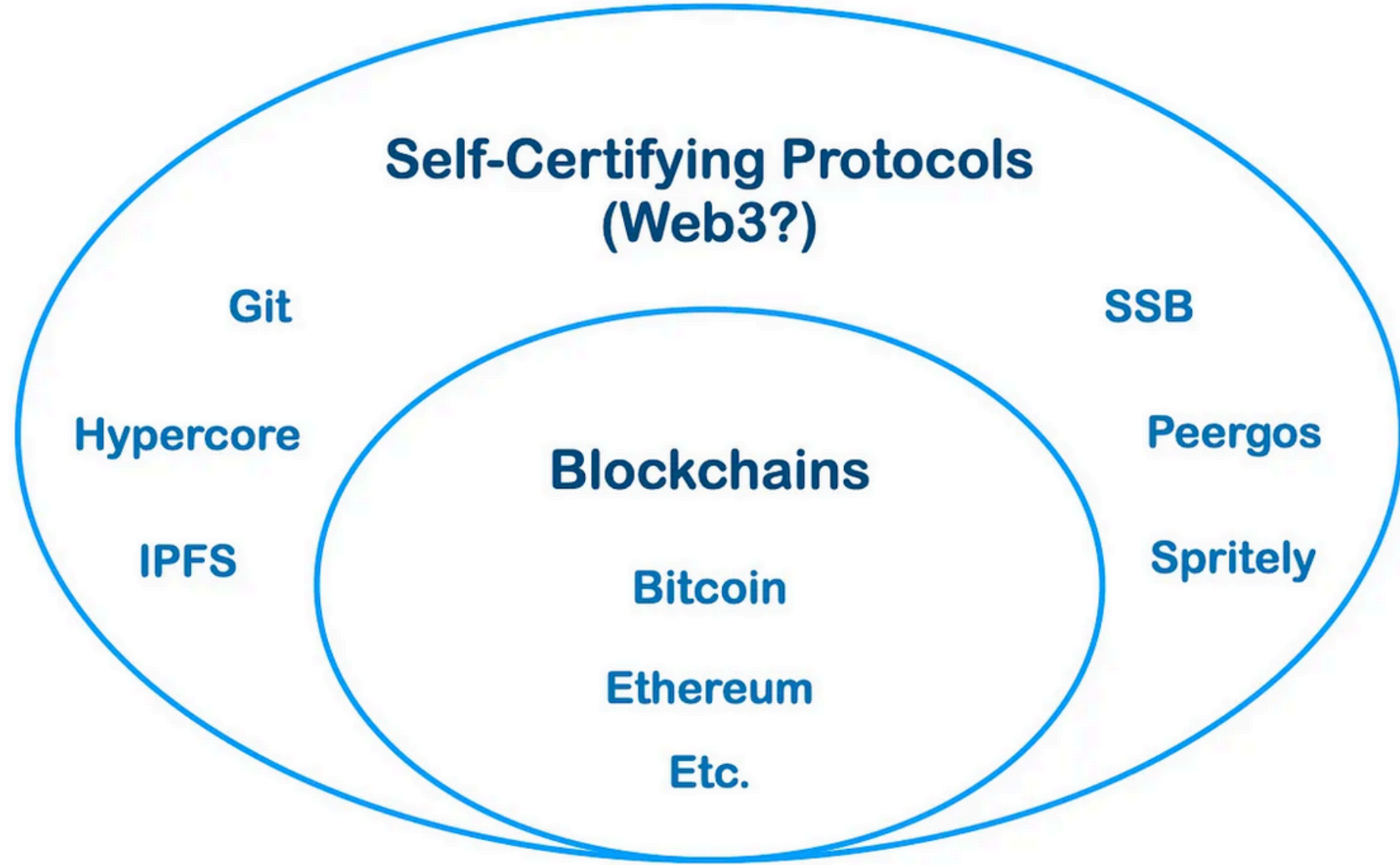
Signs of a Way Out

Emerging Definitions

 Jay Graber
Dec 23, 2021 · 5 min read · [Listen](#)

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Web3 is Self-Certifying



Self-Certifying Protocols (Web3?)

- Git
- Hypercore
- IPFS
- Blockchains**
 - Bitcoin
 - Ethereum
 - Etc.
- SSB
- Peergos
- Spritely

1. Cryptographic user keys
2. Content-addressed data

Signs of a Way Out

ACL Redux

Signs of a Way Out

ACL Redux



Signs of a Way Out

ACL Redux



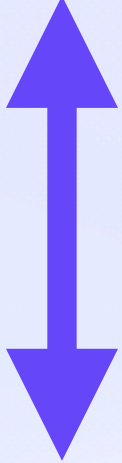
Signs of a Way Out

ACL Redux



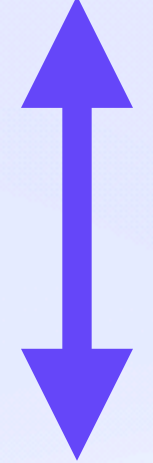
Signs of a Way Out

ACL Redux



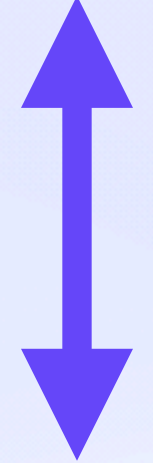
Signs of a Way Out

ACL Redux



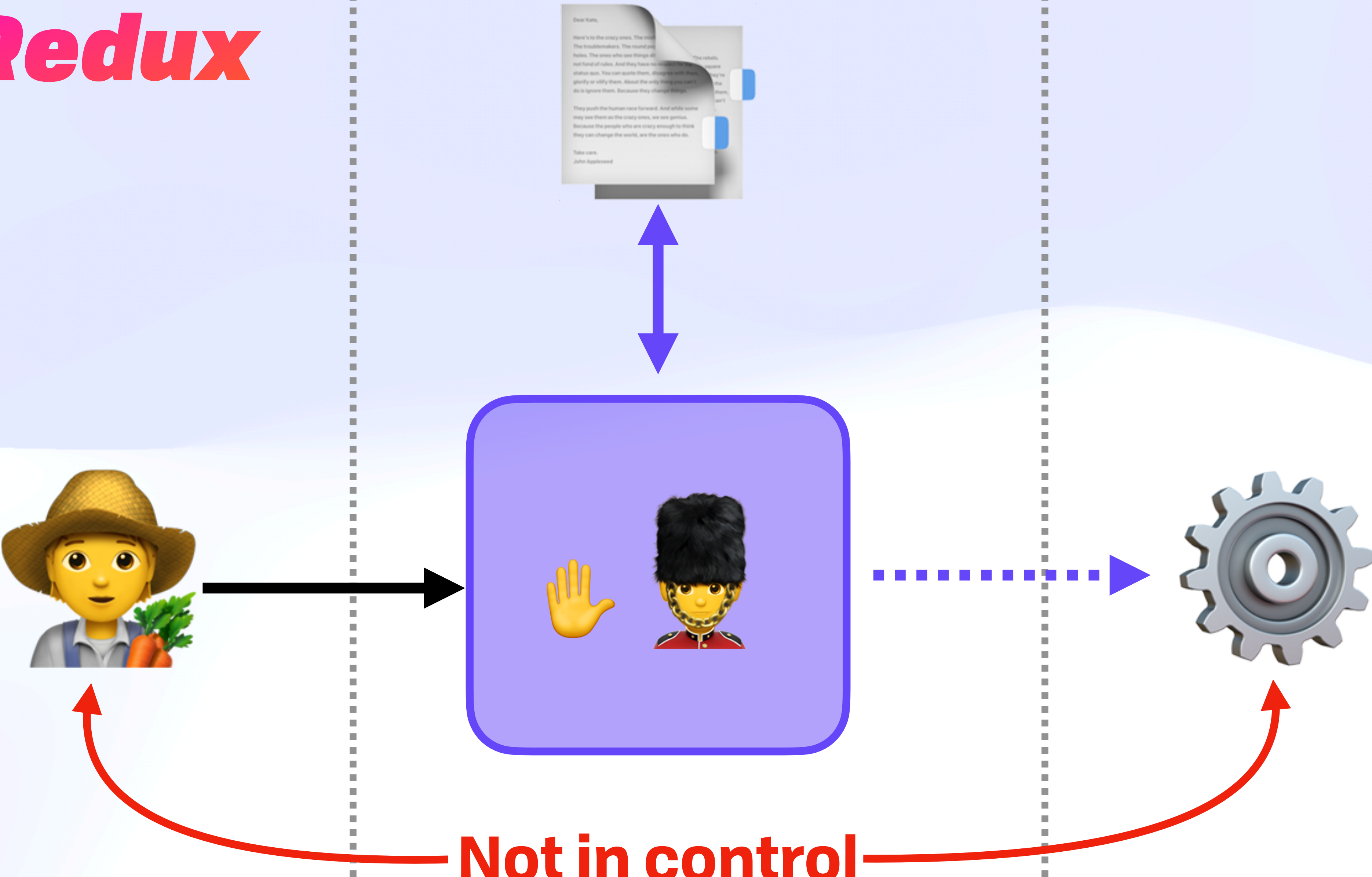
Signs of a Way Out

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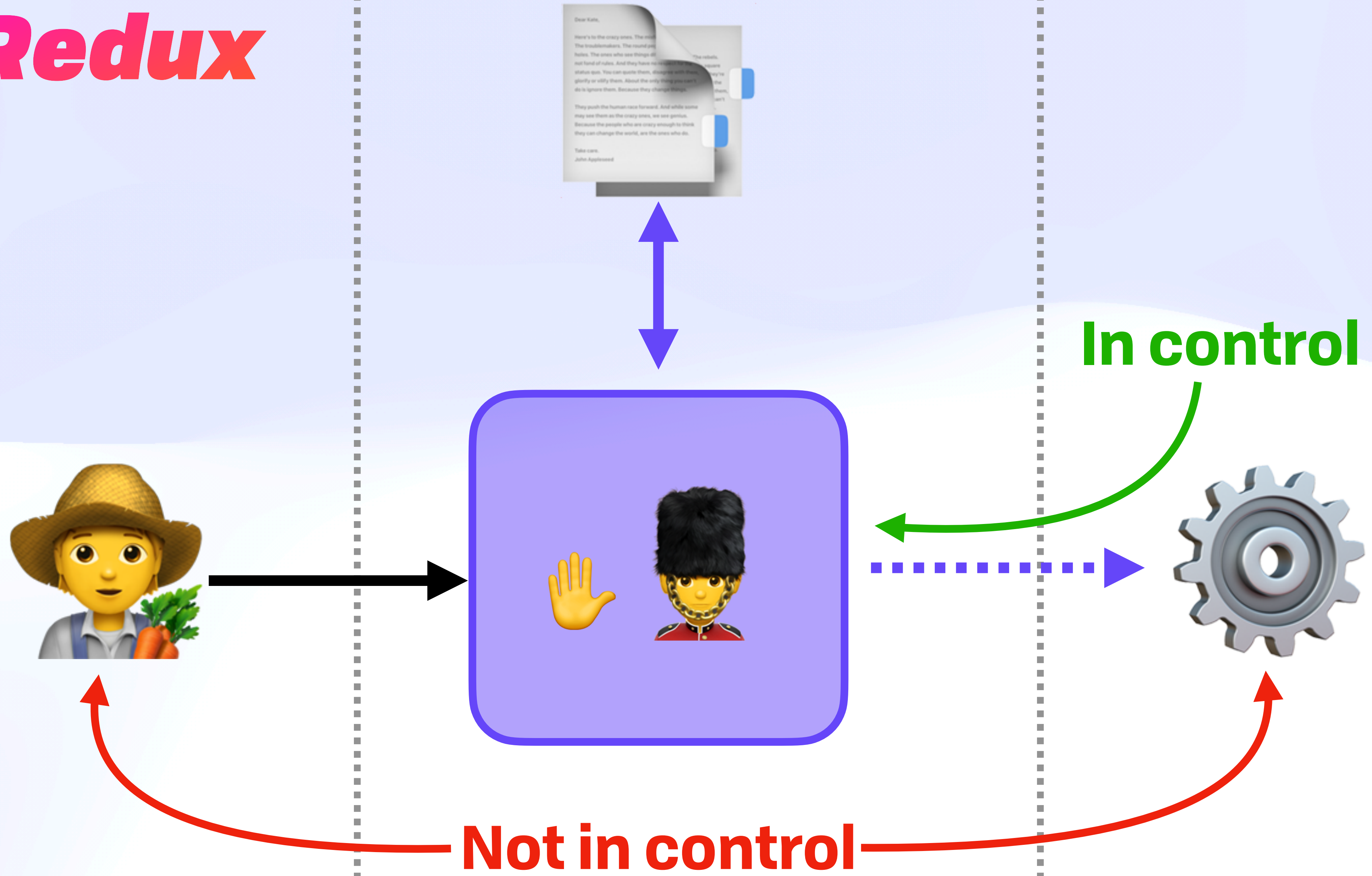
Signs of a Way Out

ACL Redux



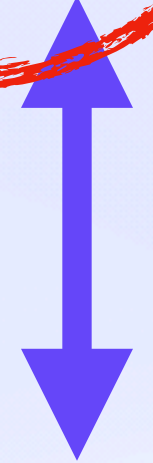
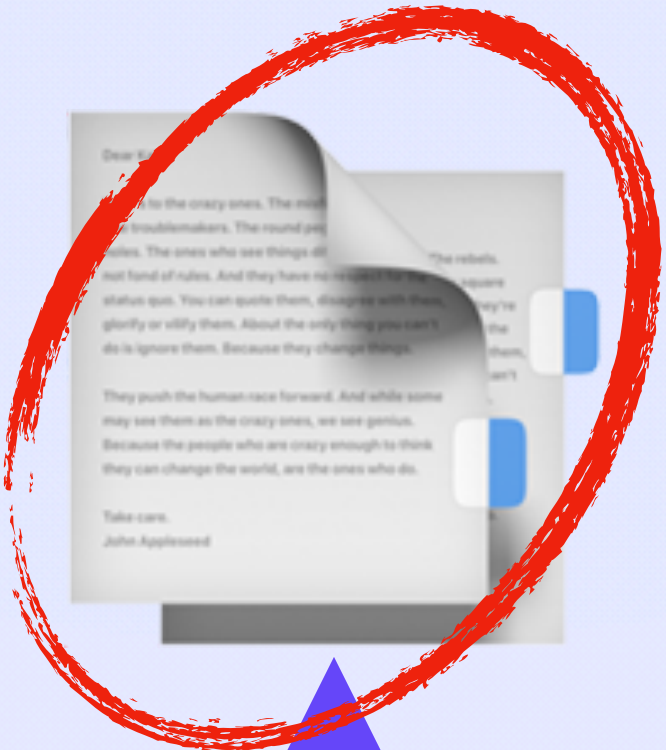
Signs of a Way Out

ACL Redux

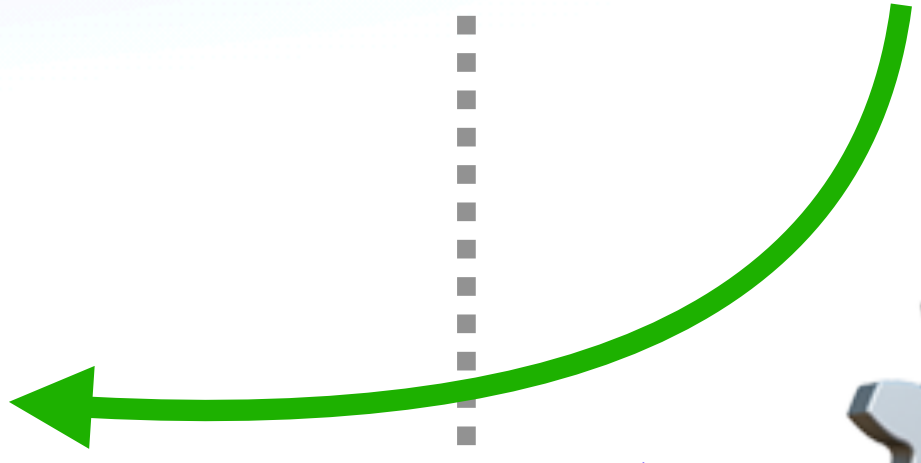


Signs of a Way Out

ACL Redux



In control



Not in control

Signs of a Way Out

Capabilities

Signs of a Way Out

Capabilities



Signs of a Way Out

Capabilities



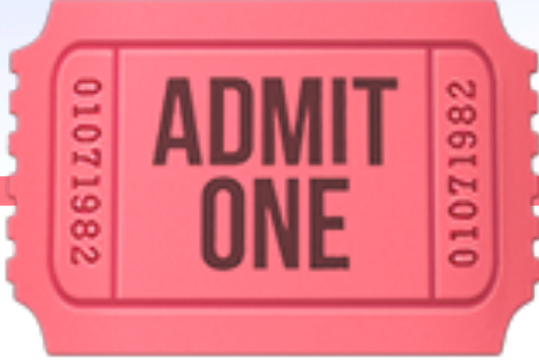
Signs of a Way Out

Capabilities



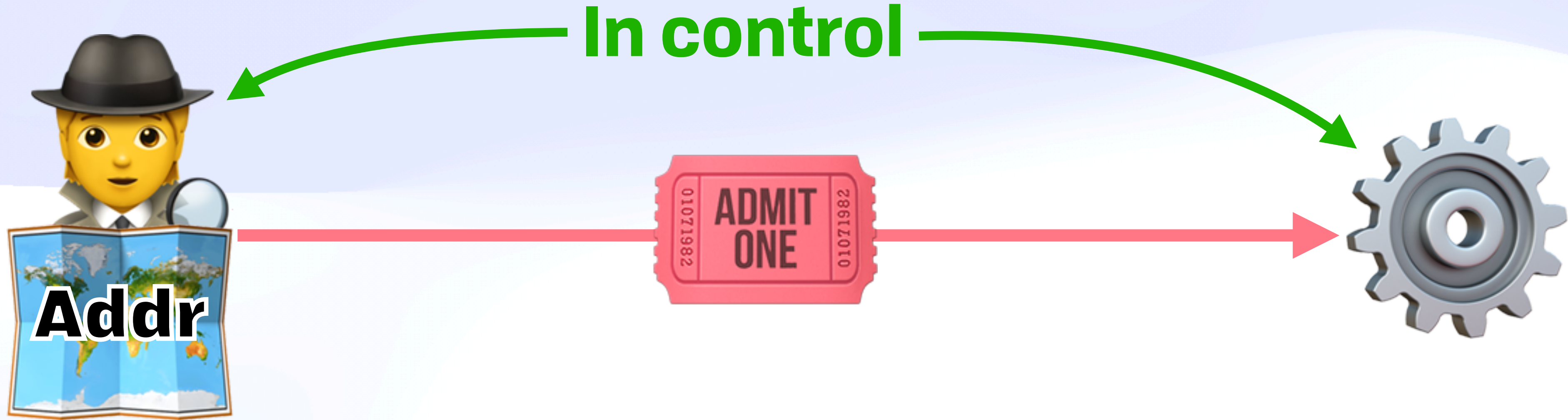
Signs of a Way Out

Capabilities



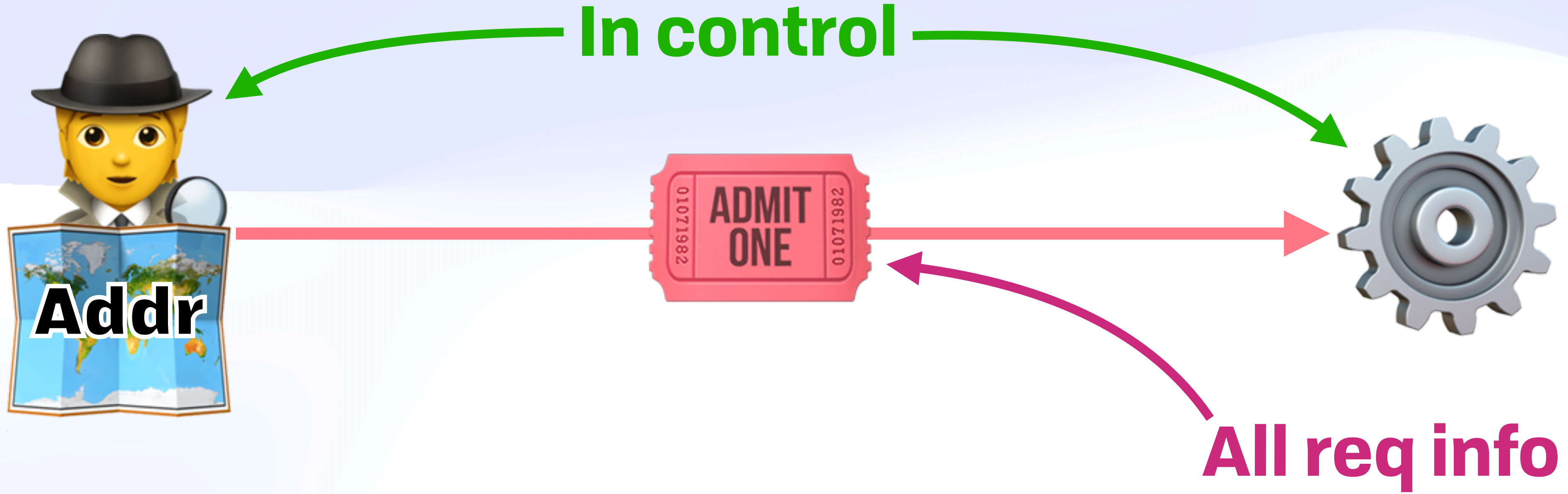
Signs of a Way Out

Capabilities



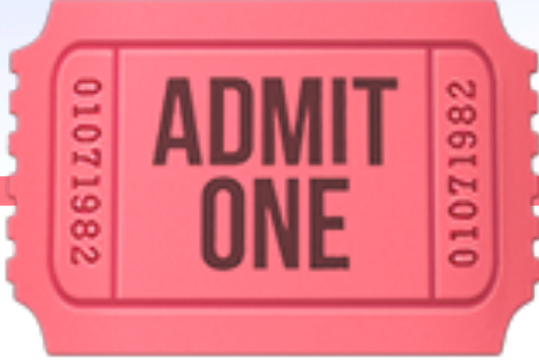
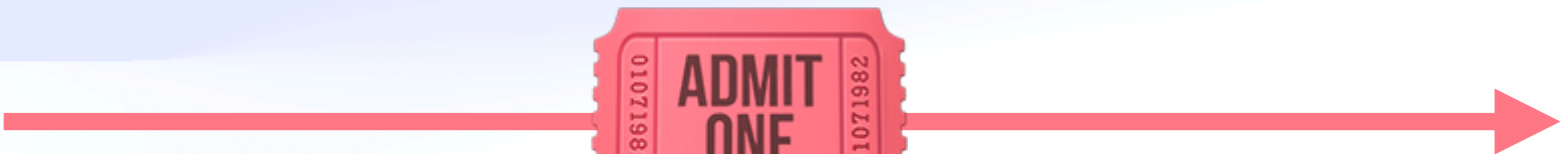
Signs of a Way Out

Capabilities



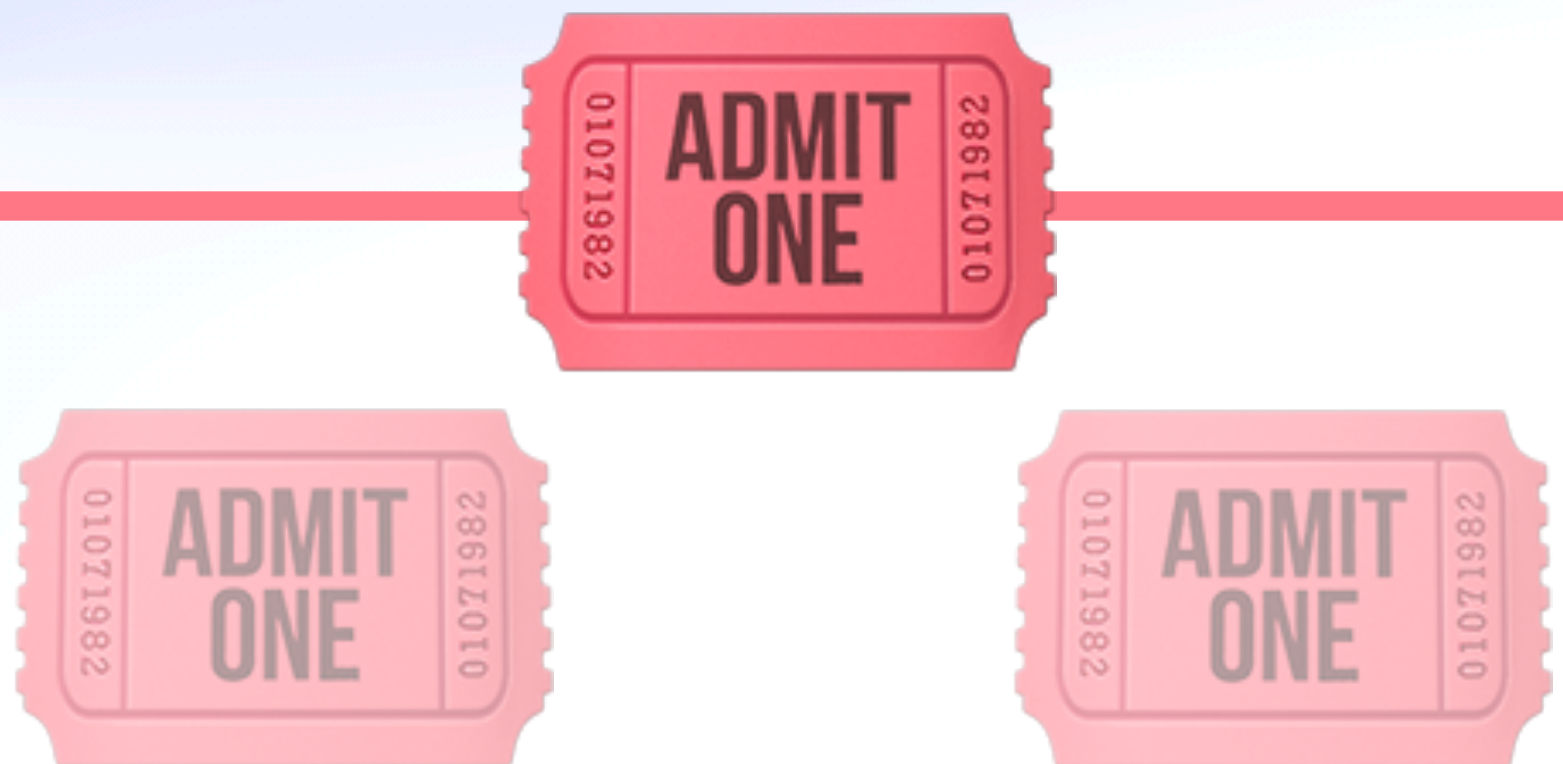
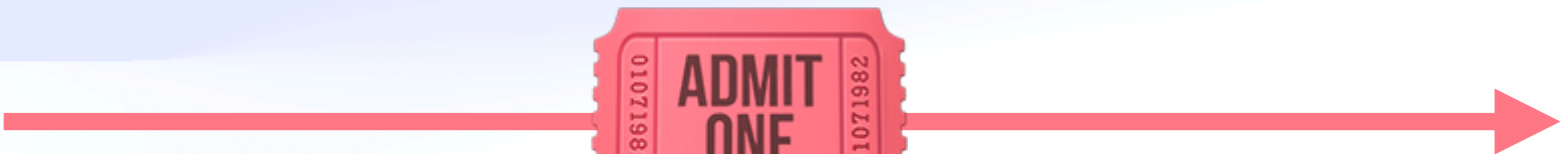
Signs of a Way Out

Capabilities



Signs of a Way Out

Capabilities



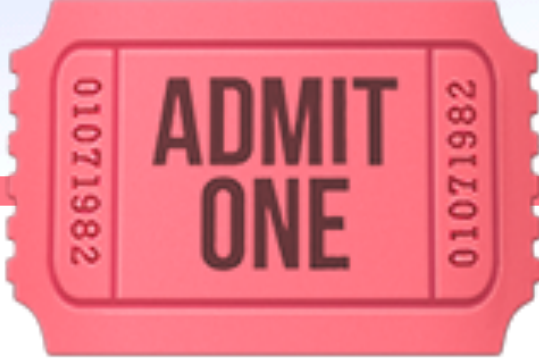
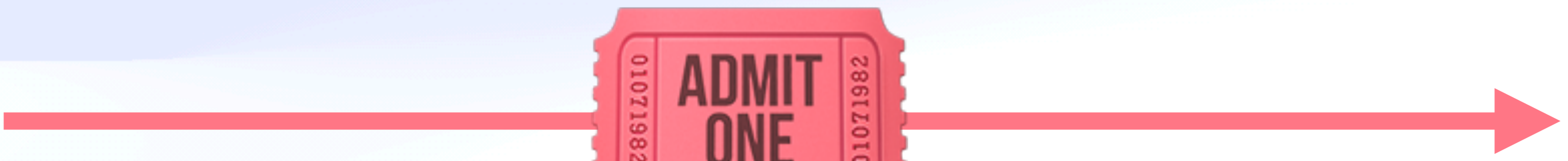
Signs of a Way Out

Capabilities



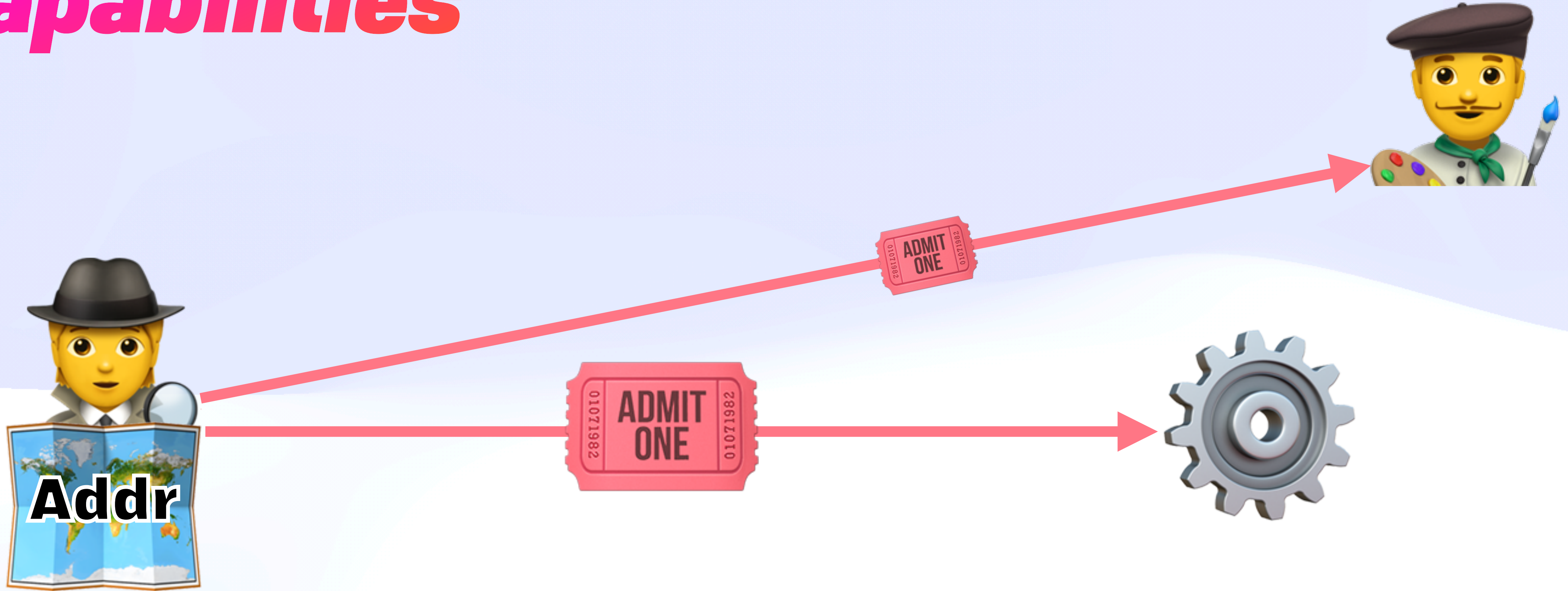
Signs of a Way Out

Capabilities



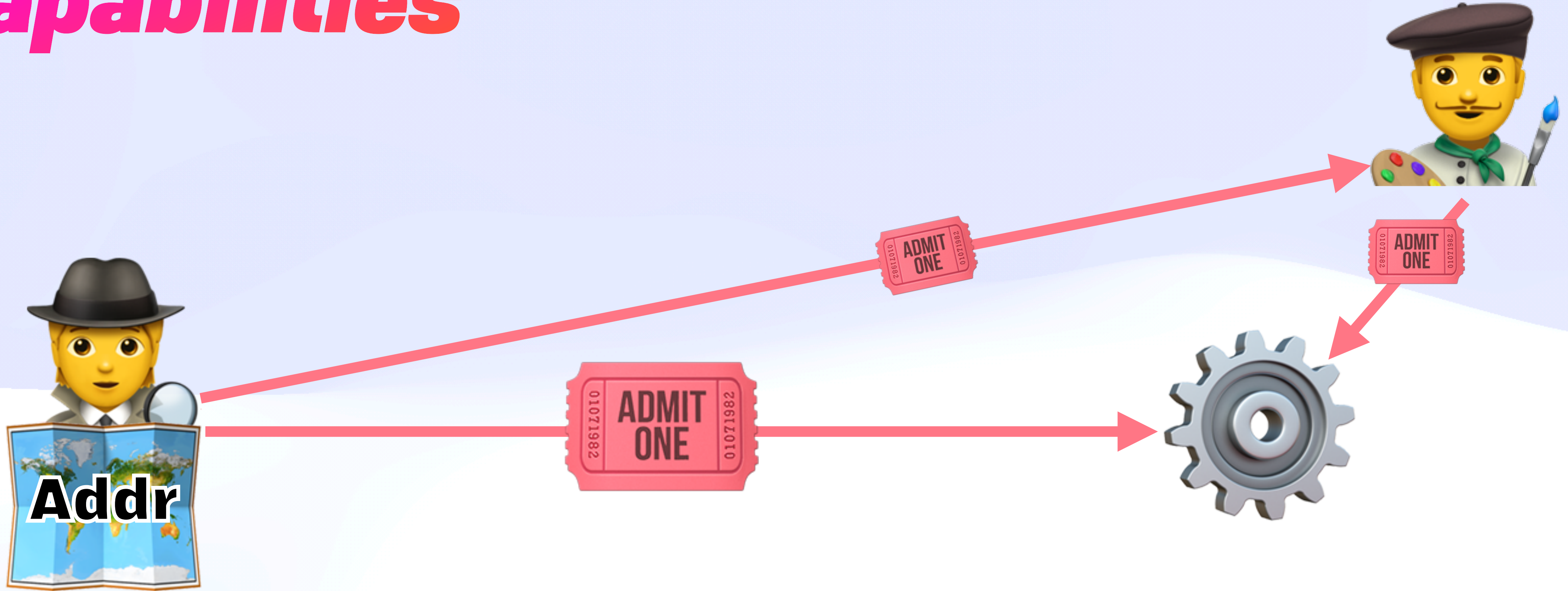
Signs of a Way Out

Capabilities



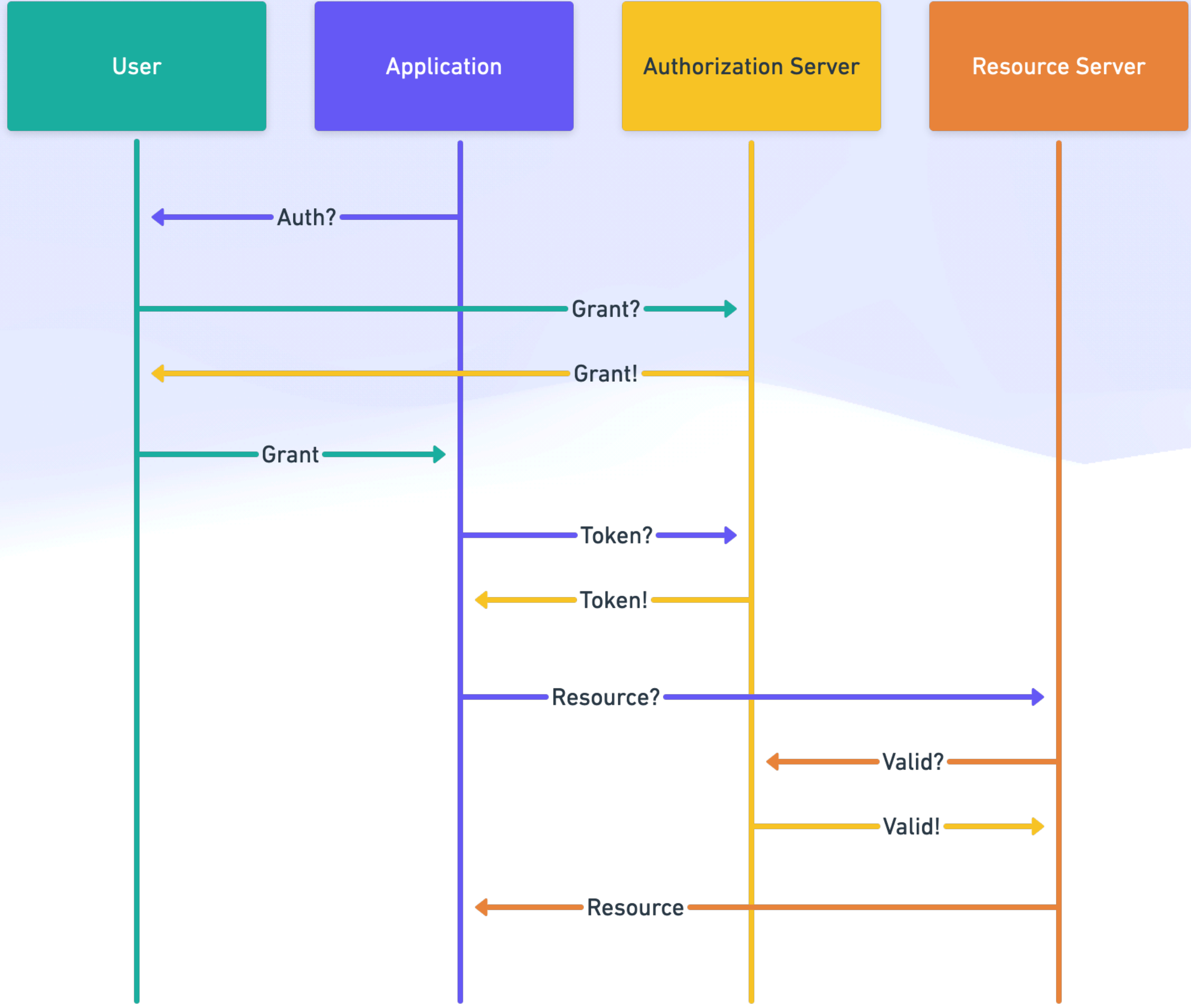
Signs of a Way Out

Capabilities



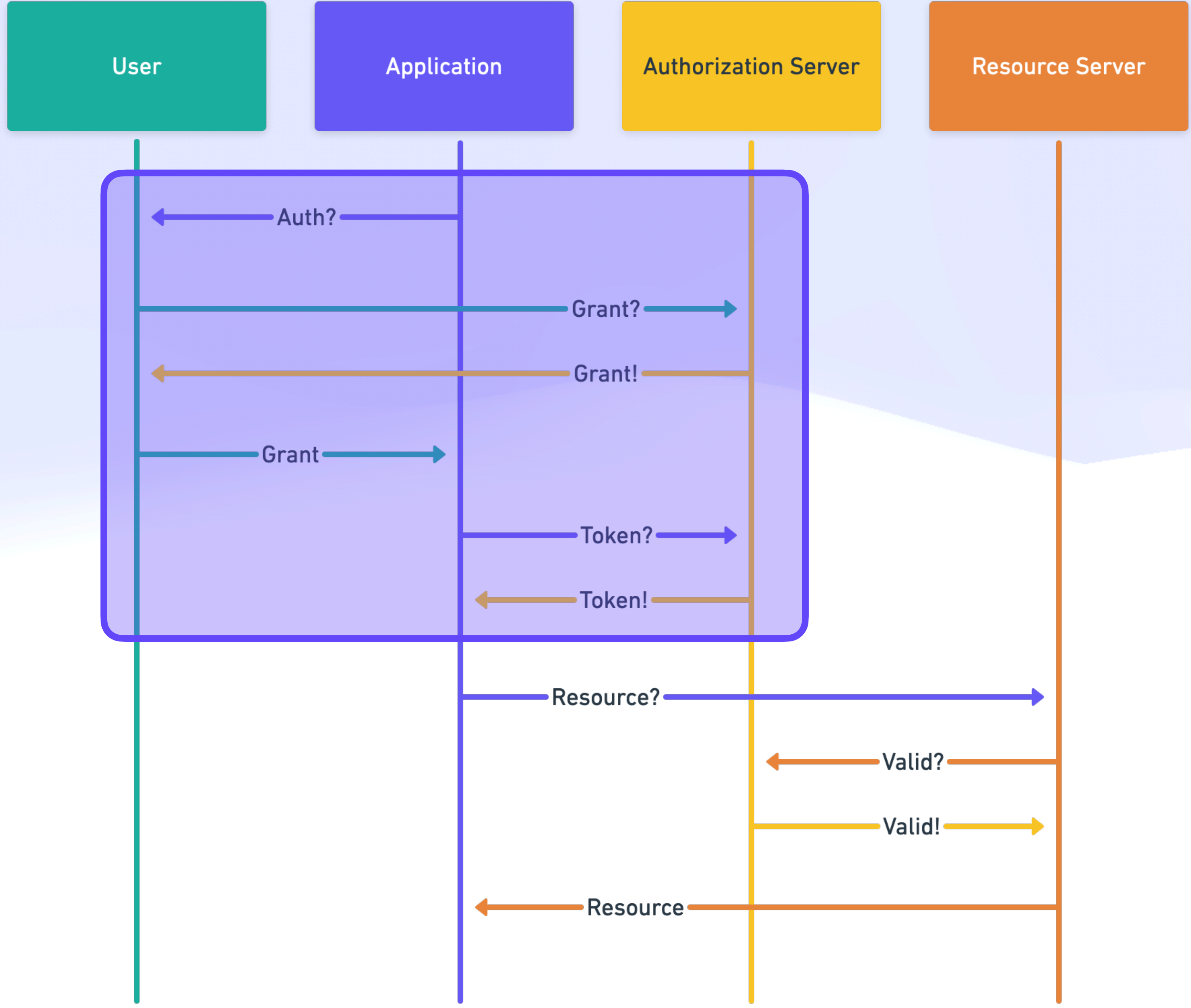
Signs of a Way Out

OAuth Sequence



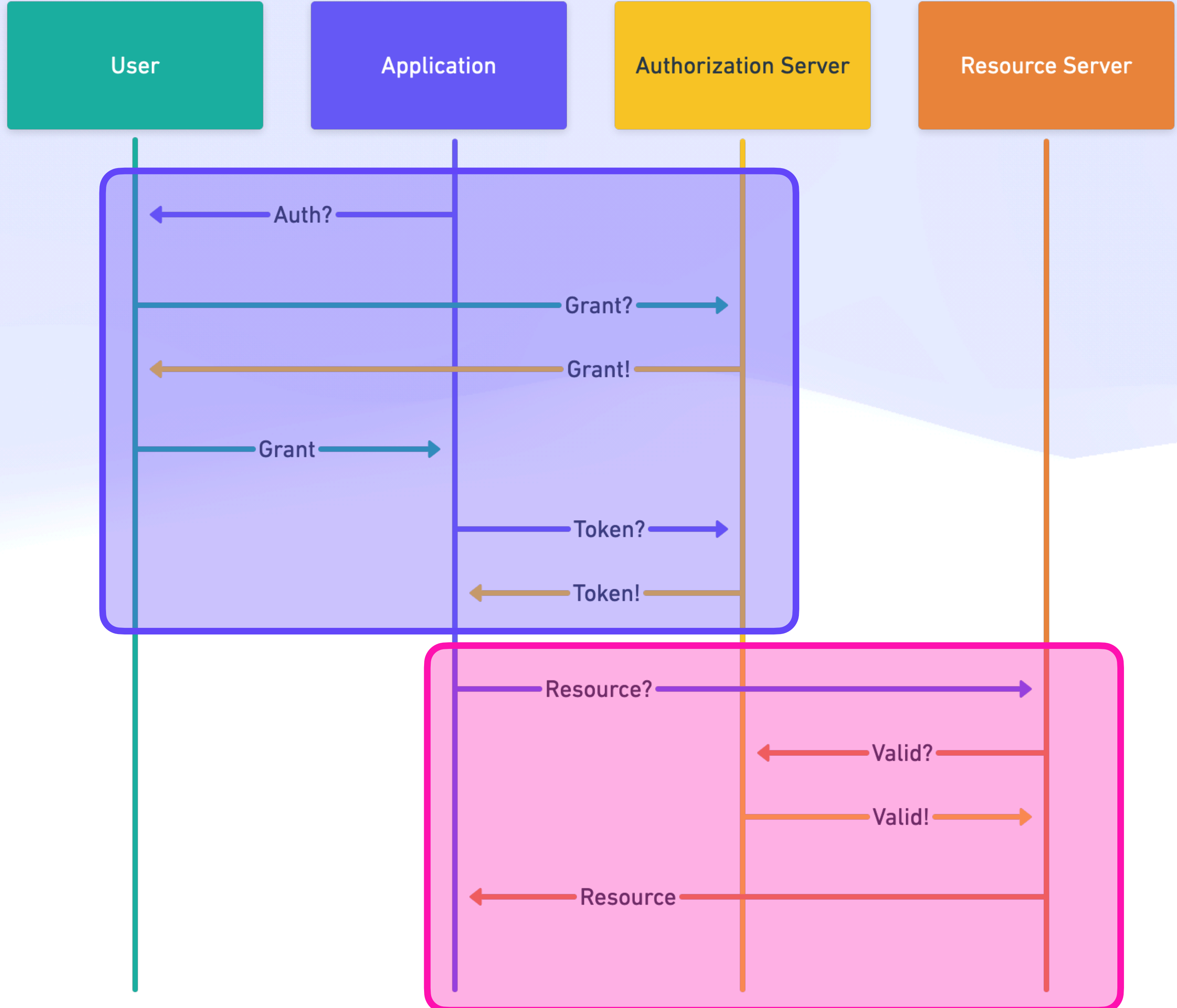
Signs of a Way Out

OAuth Sequence



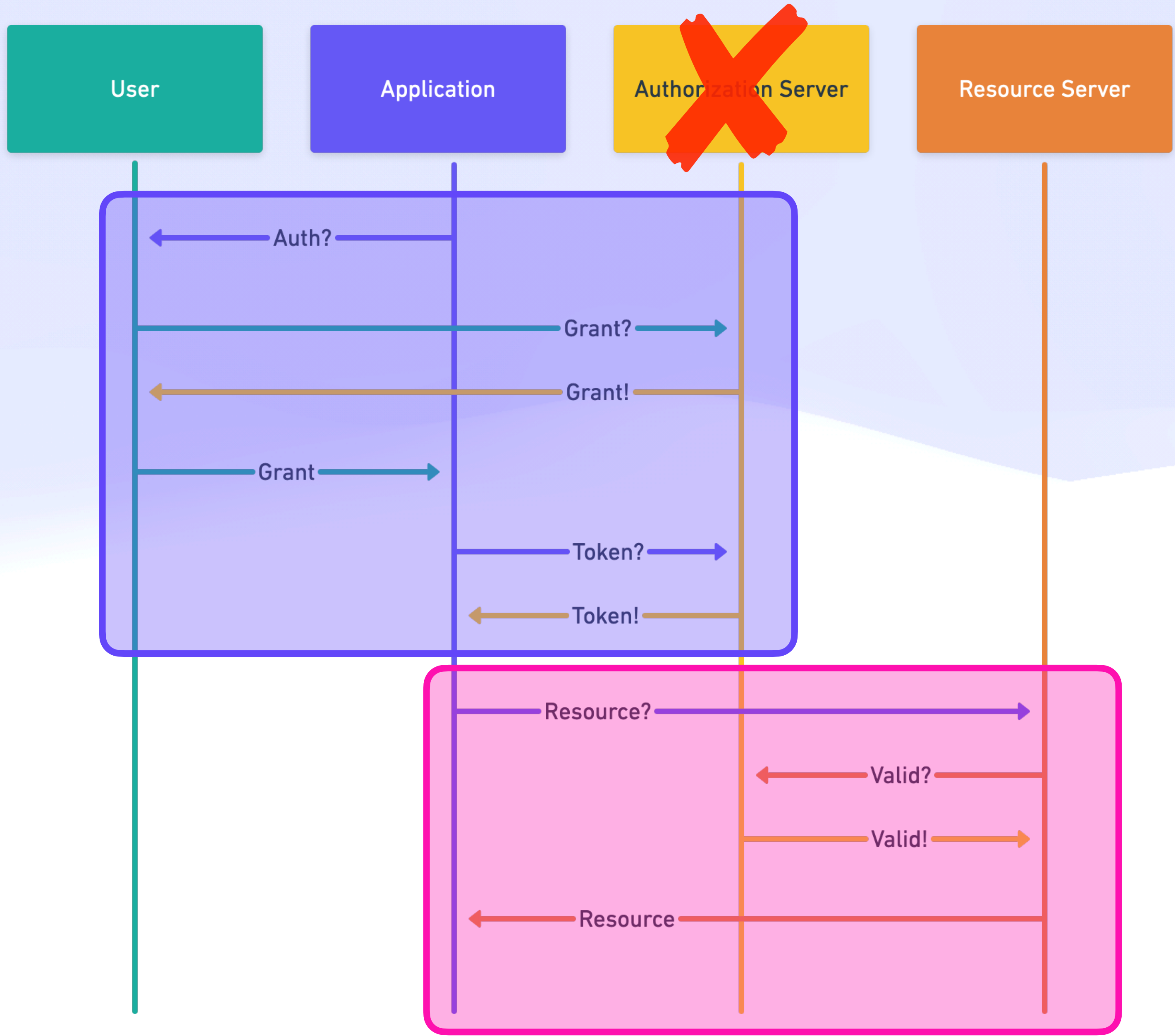
Signs of a Way Out

OAuth Sequence



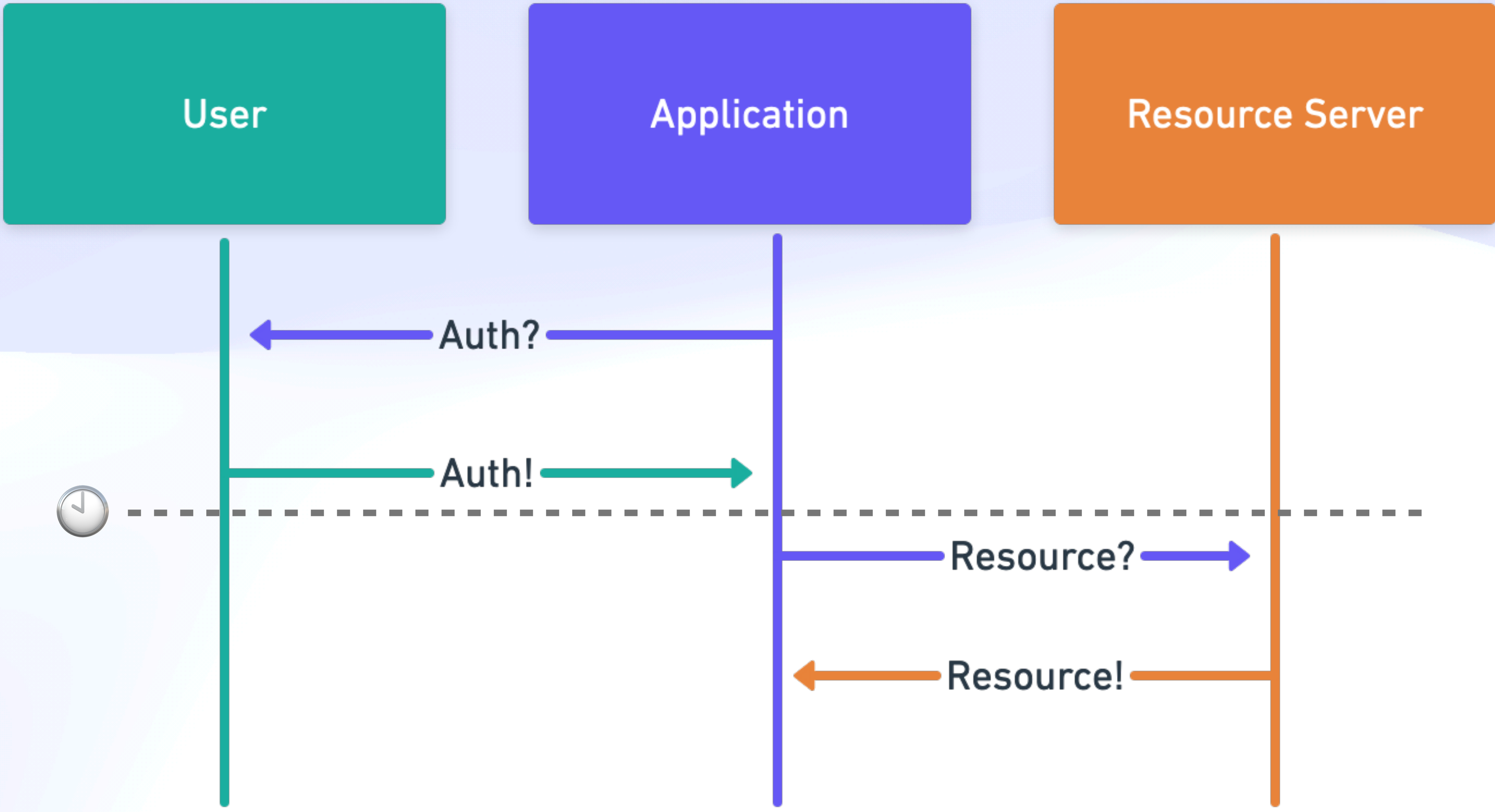
Signs of a Way Out

OAuth Sequence



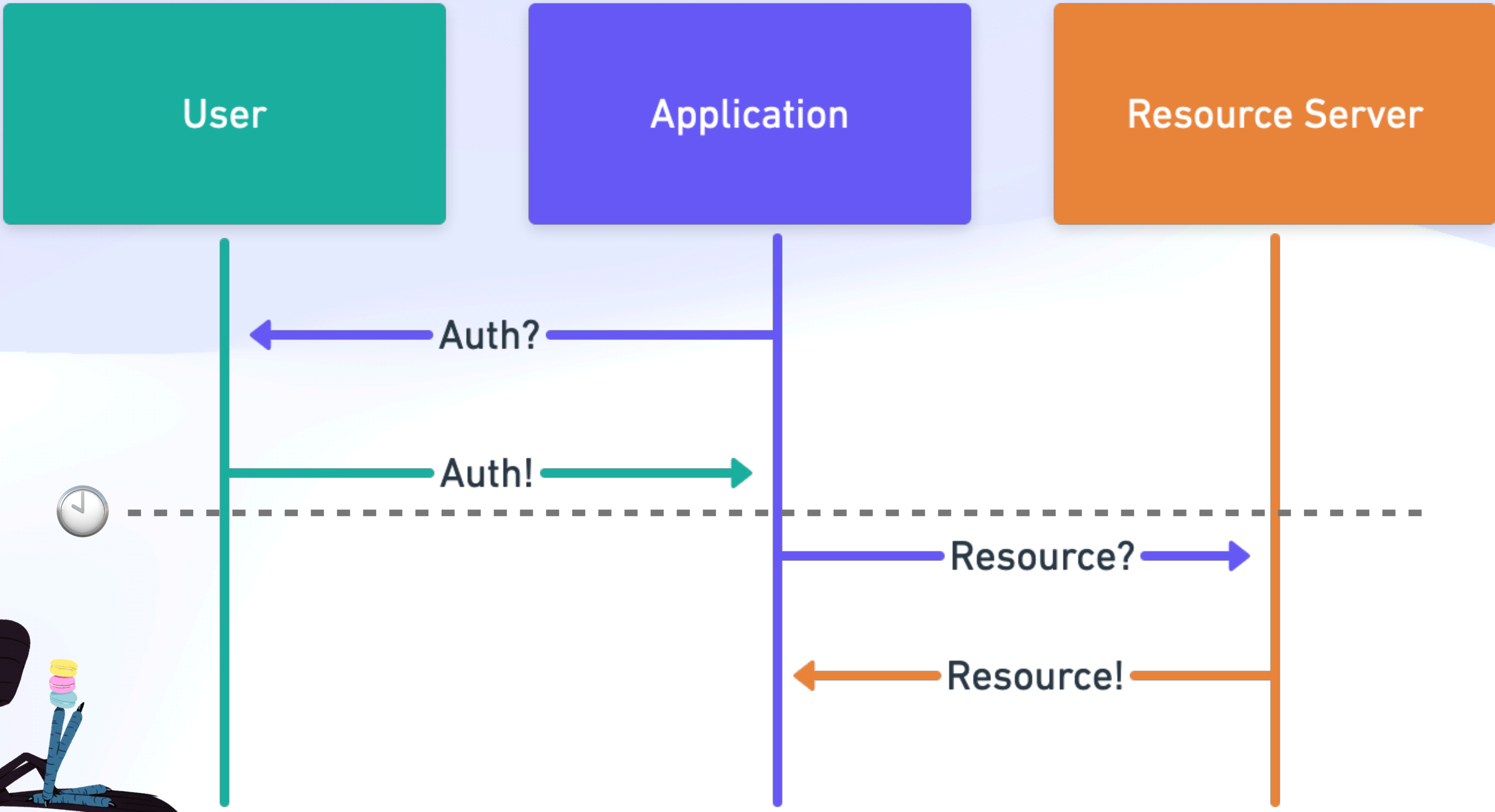
Signs of a Way Out

UCAN Sequence



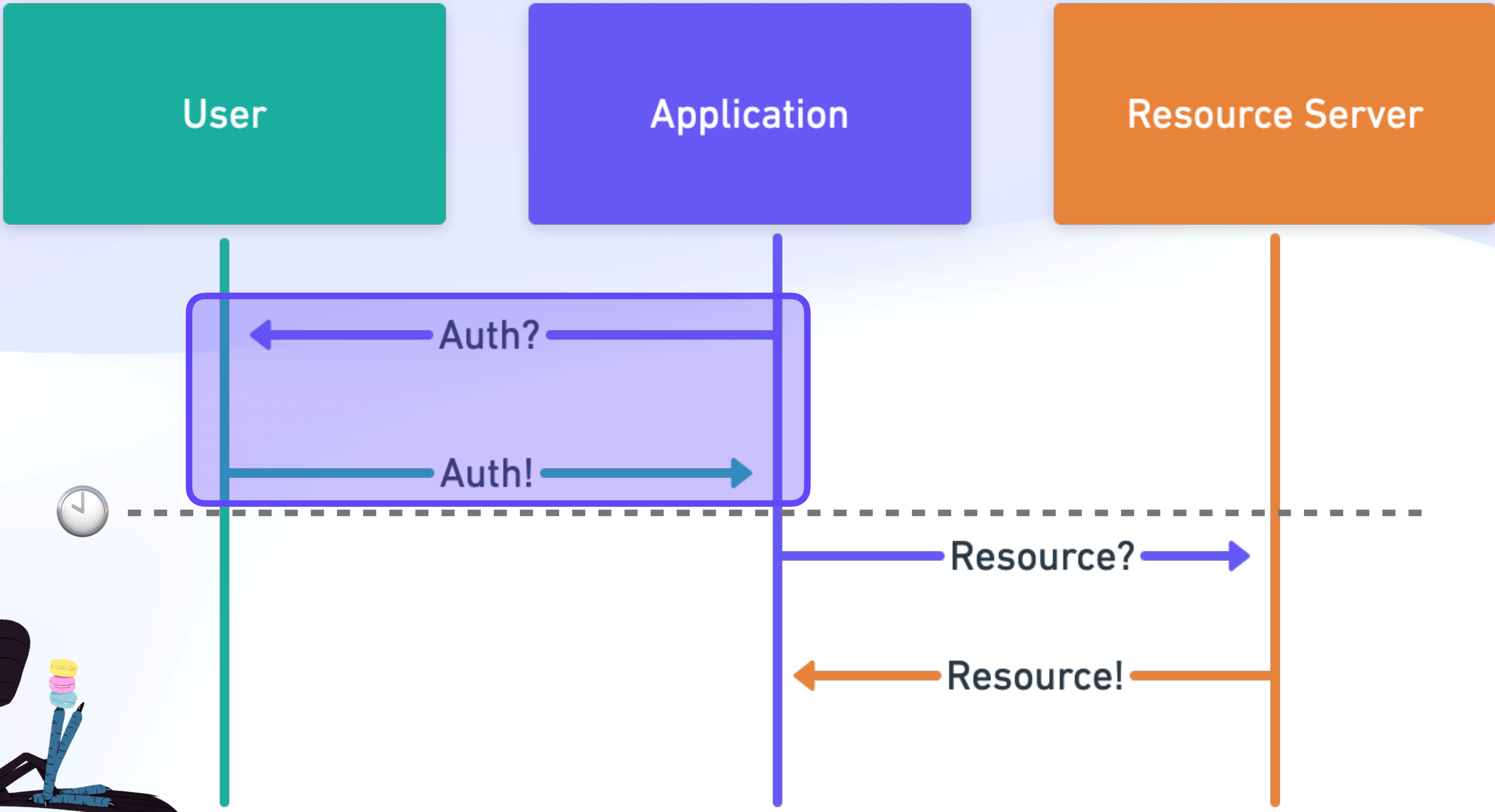
Signs of a Way Out

UCAN Sequence



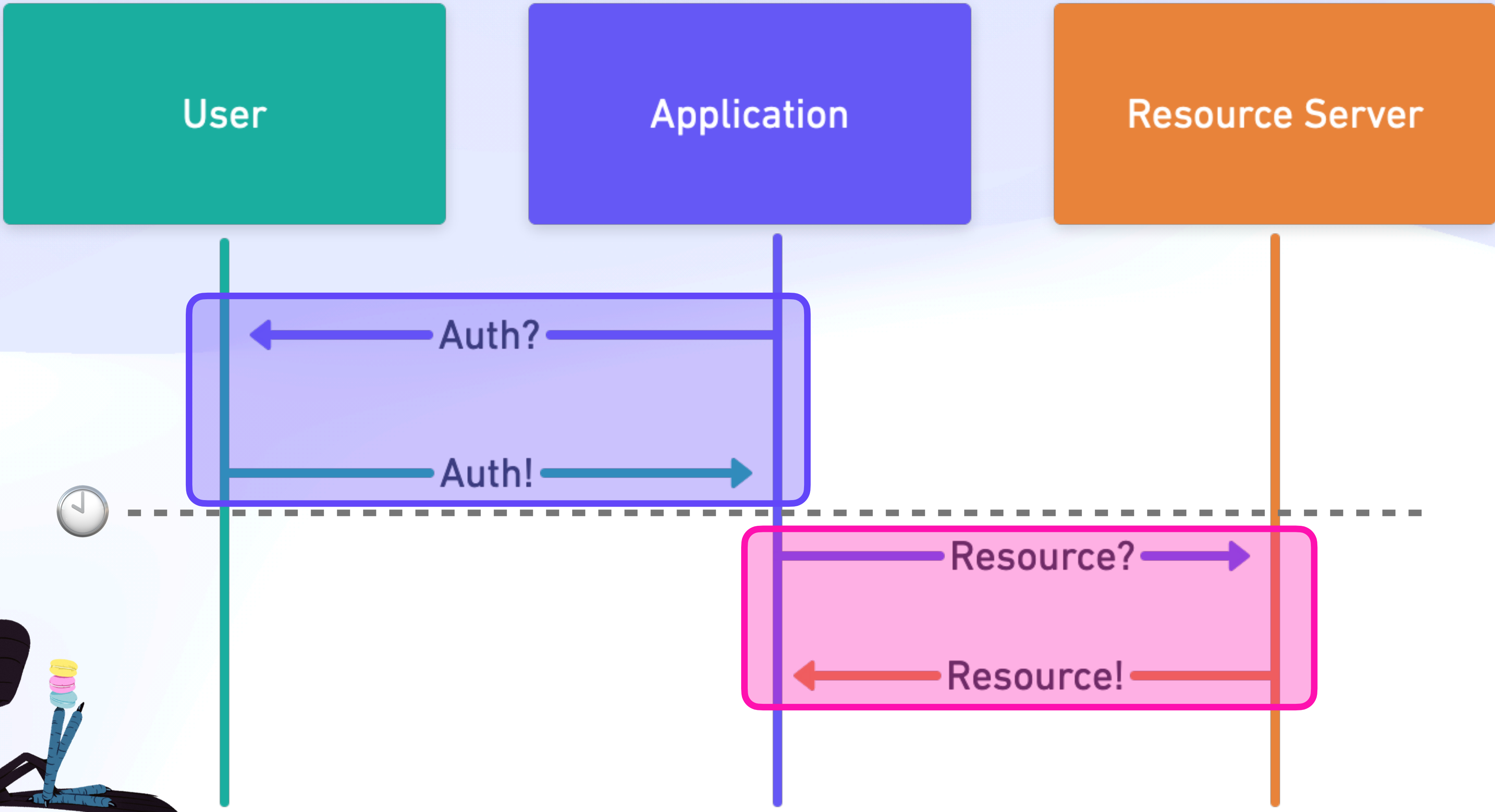
Signs of a Way Out

UCAN Sequence



Signs of a Way Out

UCAN Sequence

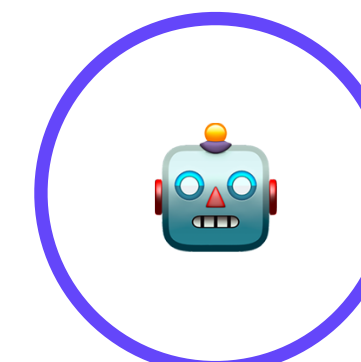
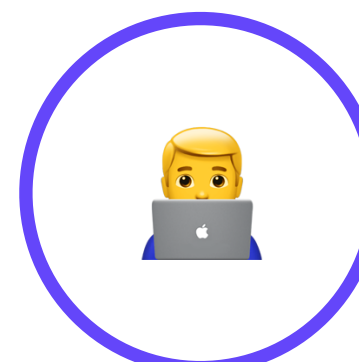
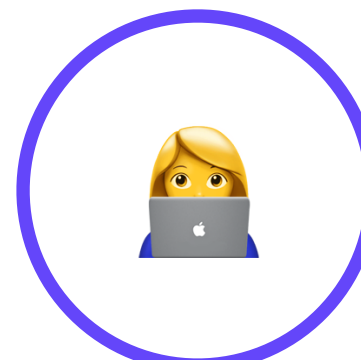
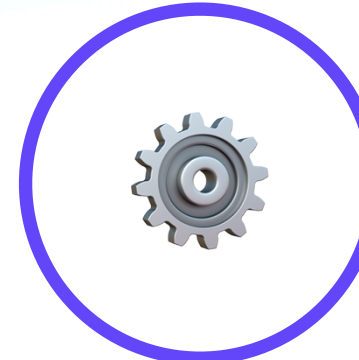
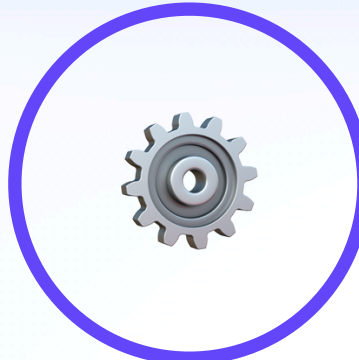
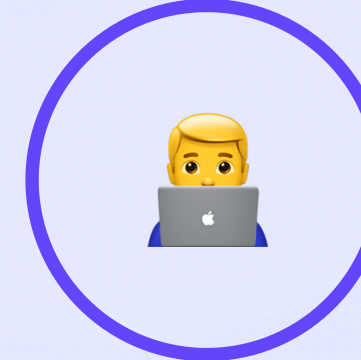
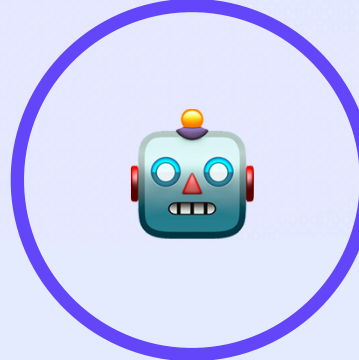


Signs of a Way Out



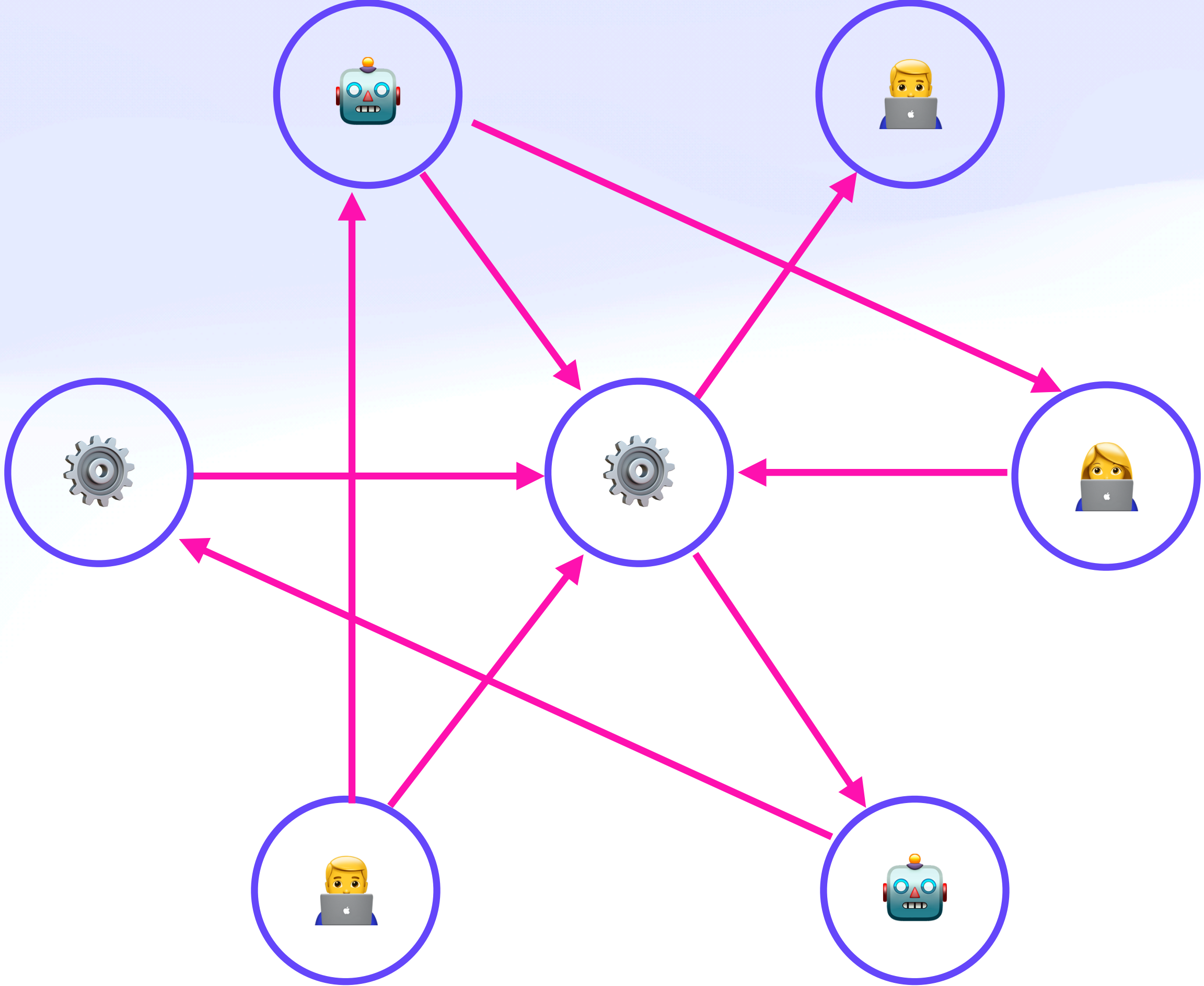
Signs of a Way Out

Disorderly Programming



Signs of a Way Out

Disorderly Programming

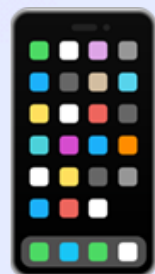


Signs of a Way Out

Don't Make Me Think

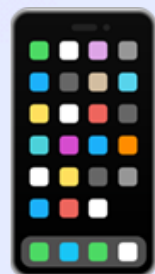
Signs of a Way Out

Don't Make Me Think



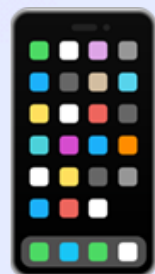
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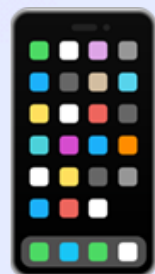
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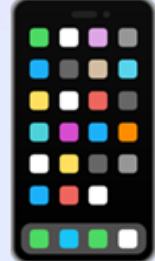
Signs of a Way Out

Don't Make Me Think



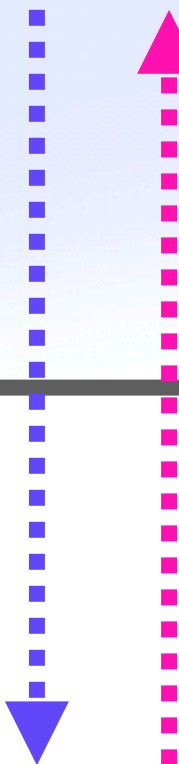
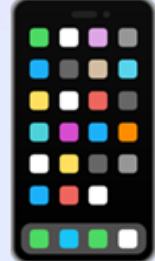
Signs of a Way Out

Don't Make Me Think



Signs of a Way Out

Don't Make Me Think





A computer monitor is shown from a three-quarter perspective, with a large, dynamic splash of multi-colored liquid (pink, orange, teal, and yellow) erupting from its screen. The splash is highly textured and appears to be in motion, with many droplets and splatters extending outwards. The background is a solid, light teal color. The text 'Compute Substrate' is overlaid on the splash, and '— Schedule. Execute. Verify. Reuse —' is below it.

Compute Substrate

— Schedule. Execute. Verify. Reuse —

Compute Substrate

Wasn Eats the World 🤪

Compute Substrate

Wasm Eats the World 🤤



Compute Substrate


With Their Powers Combined!

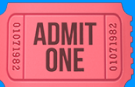


Compute Substrate

With Their Powers Combined!

Compute 

Data 


Auth 




Compute Substrate

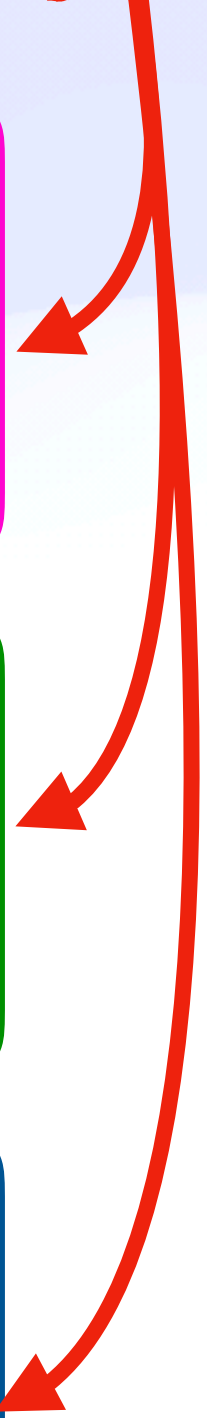
With Their Powers Combined!

Compute 

Data 

Auth 


Everywhere!




Compute Substrate

With Their Powers Combined!

Compute 

Data 

Auth 


Everywhere!




Compute Substrate

With Their Powers Combined!

Compute 

Data 

Auth 


Everywhere!




Compute Substrate

With Their Powers Combined!

Compute 

Data 

Auth 

Everywhere!




Compute Substrate


With Their Powers Combined!

IPVM



Compute 

Data 

Auth 

Everywhere!



Compute Substrate

Code-as-Data

Compute Substrate

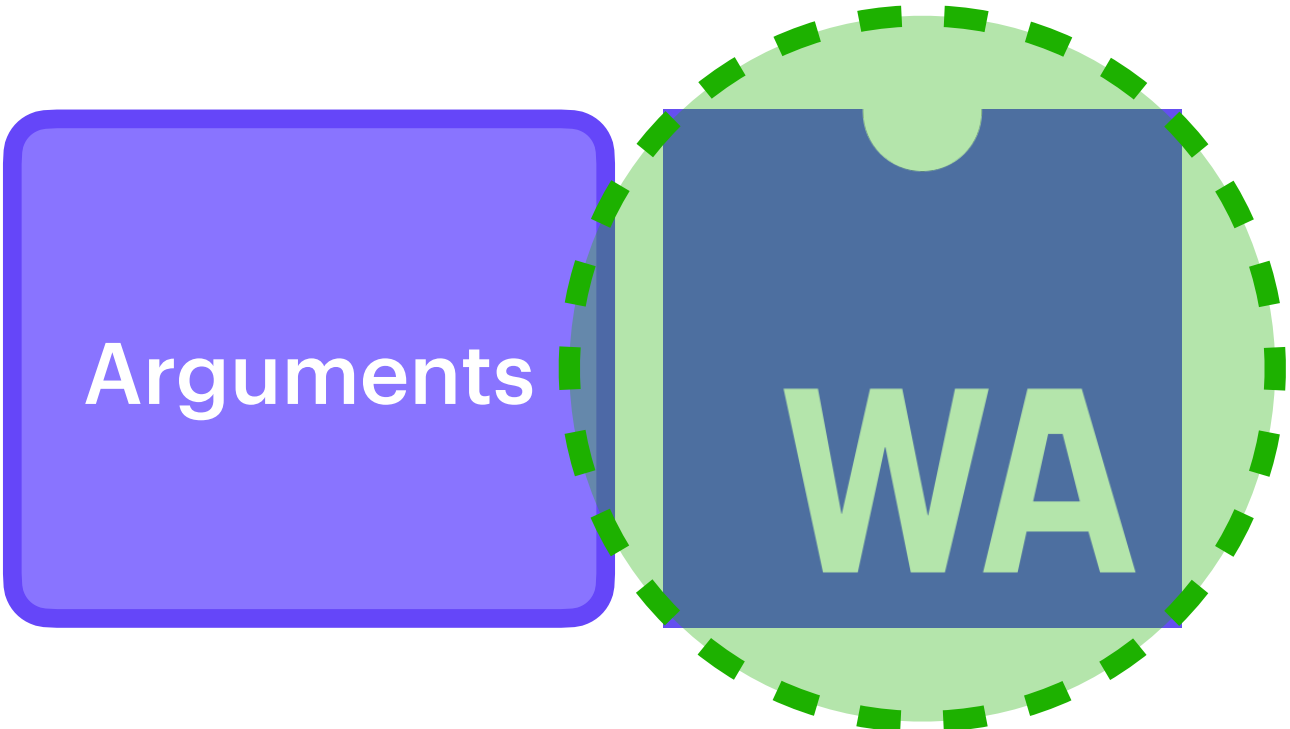
Code-as-Data

Arguments

WA

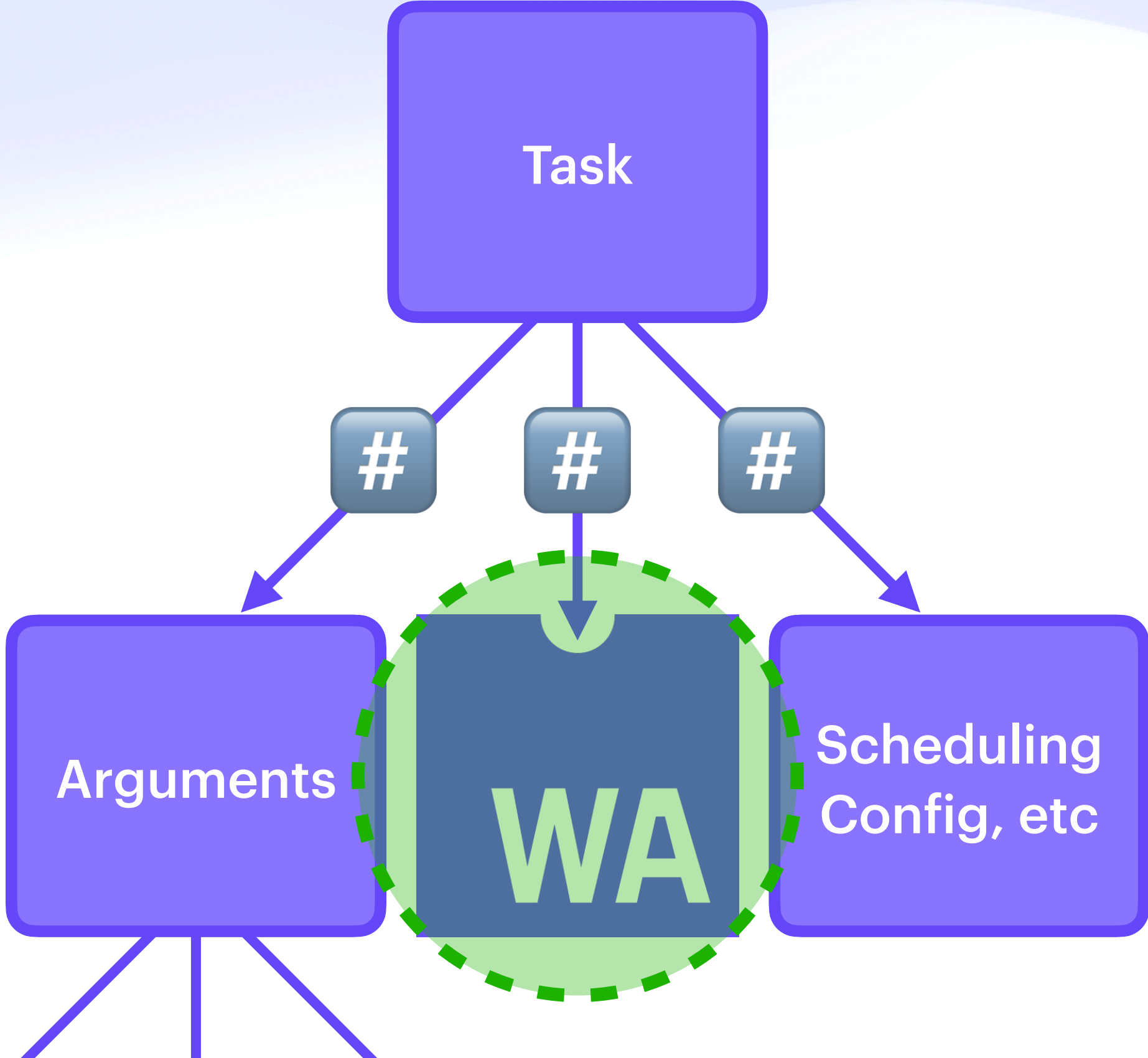
Compute Substrate

Code-as-Data



Compute Substrate

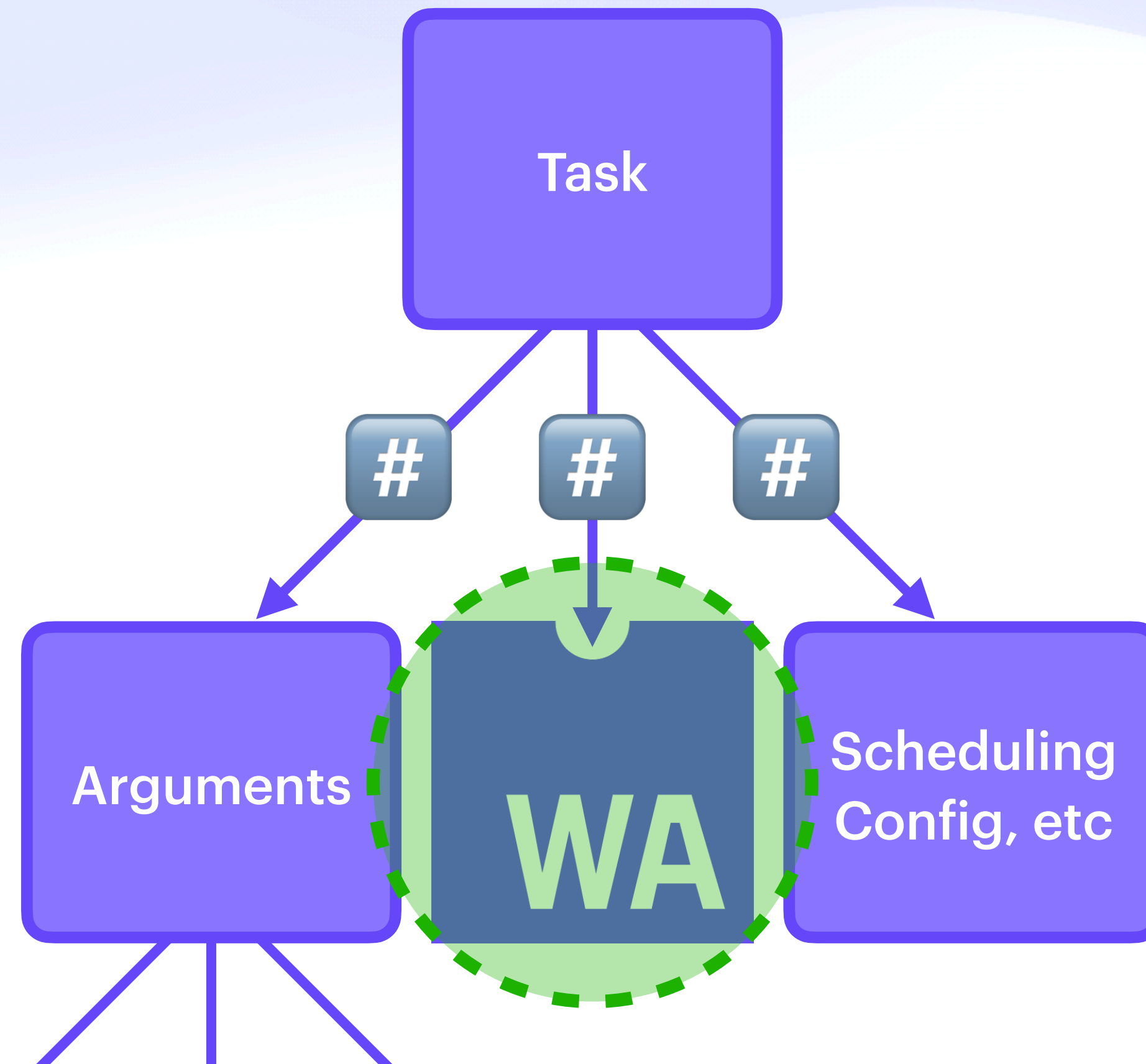
Code-as-Data



Compute Substrate

Code-as-Data

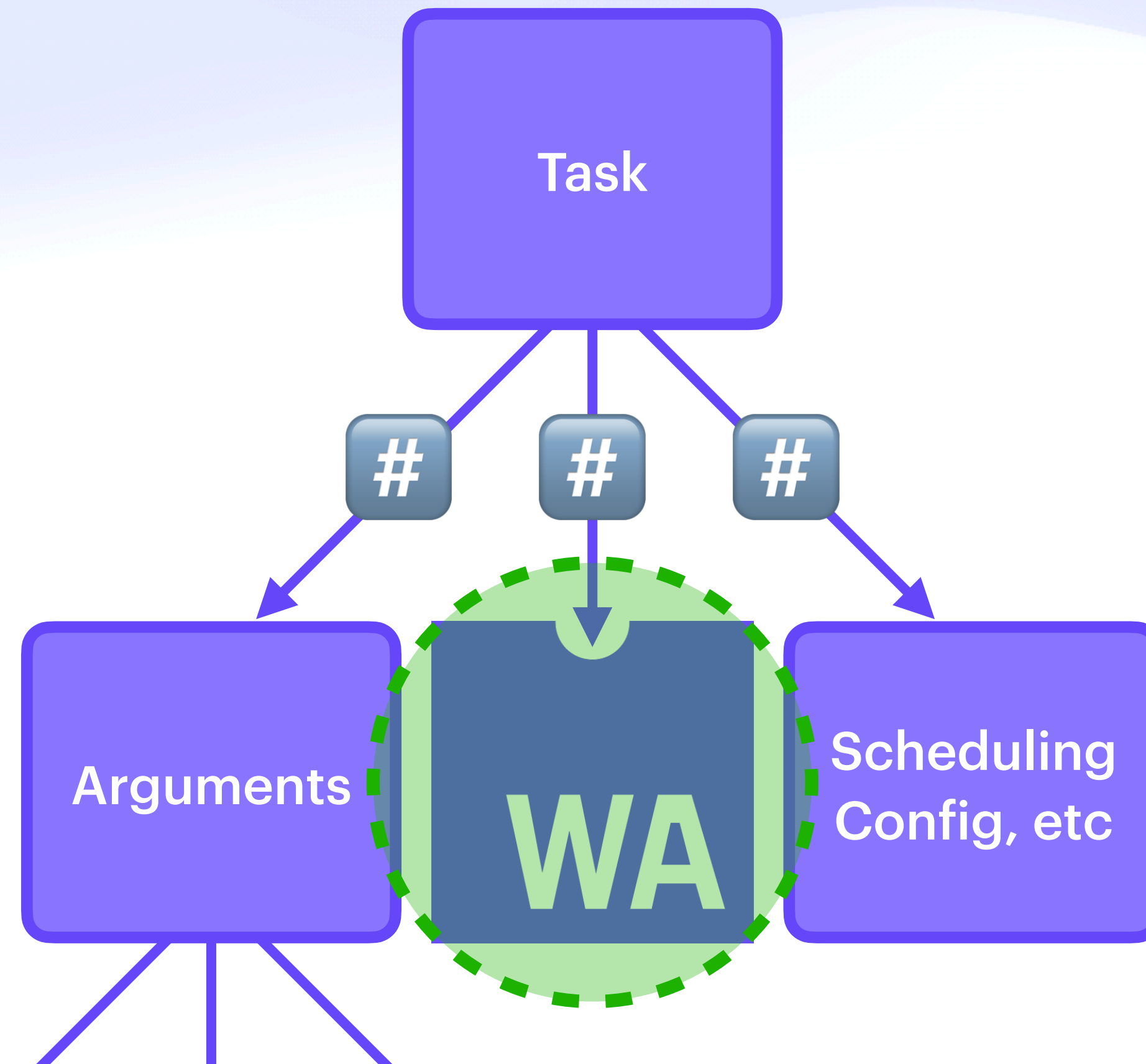
```
const message = () => alert("hello world")
```



Compute Substrate

Code-as-Data

```
const message = () => alert("hello world")  
message // Nothing happens
```



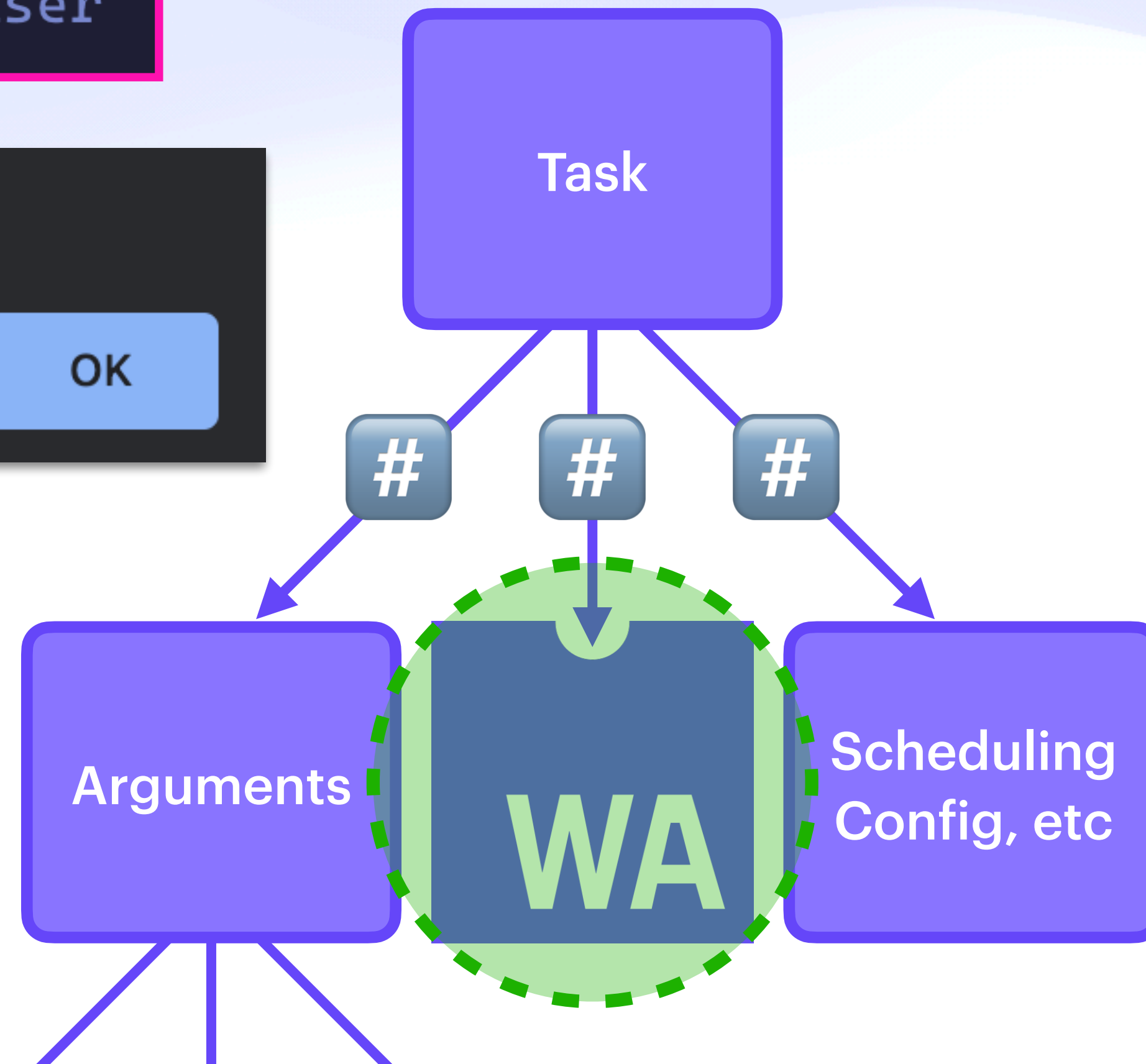
Compute Substrate

Code-as-Data

```
const message = () => alert("hello world")  
message // Nothing happens  
message() // A message interrupts the user
```

hello world

OK



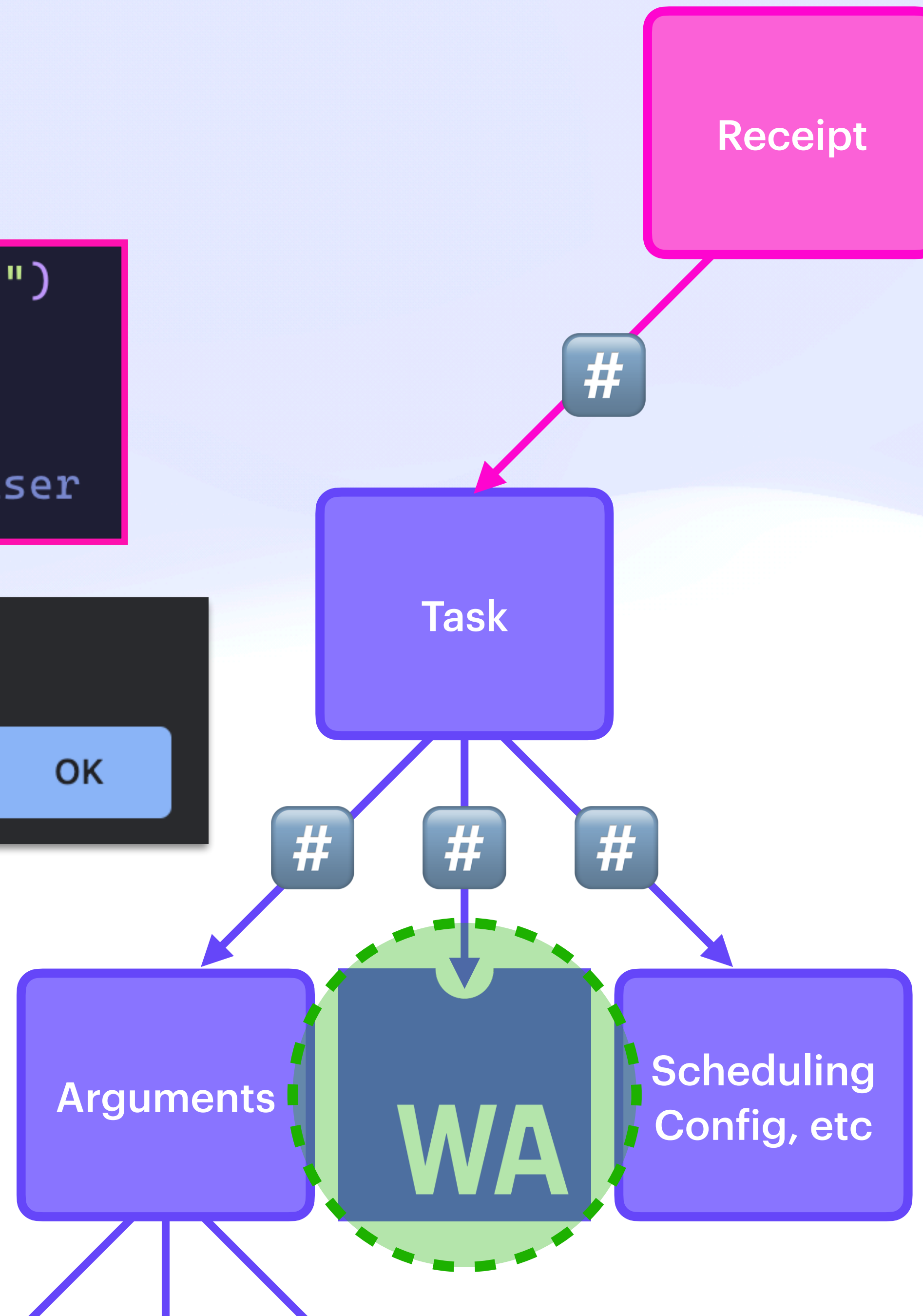
Compute Substrate

Code-as-Data

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const message = () => alert("hello world")  
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hello world

OK



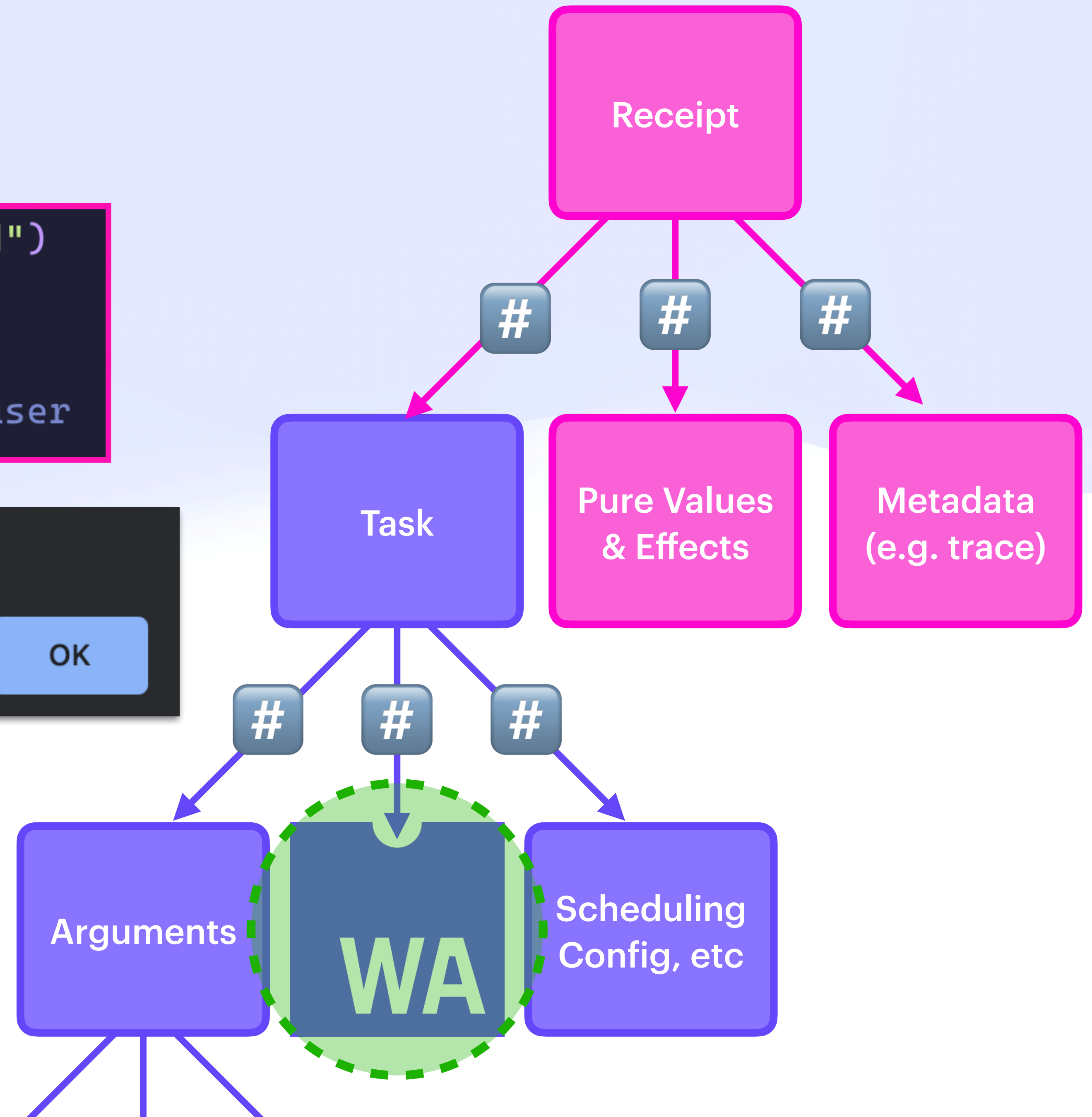
Compute Substrate

Code-as-Data

```
const message = () => alert("hello world")  
message // Nothing happens  
message() // A message interrupts the user
```

hello world

OK



Compute Substrate

Invocation & Distributed Promises

Compute Substrate

Invocation & Distributed Promises

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [42]
  }
}
```


Compute Substrate

Invocation & Distributed Promises

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [42]
  }
}
```

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [{"await/ok": {"/": "bafkreiauharffox63dv2iakndymassol3ryznr32tqii6ijw6ter3ksleu"}}]
  }
}
```


Compute Substrate

Invocation & Distributed Promises

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [42]
  }
}
```

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [{"await/ok": {"":"/": "bafkreiauharffox63dv2iakndymassol3ryznr32tqii6ijw6ter3ksleu"}}]
  }
}
```


Compute Substrate

Invocation & Distributed Promises

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [42]
  }
}
```

```
{
  "uri": "ipfs://bafkreibmj5zo6x2g7kuzcqpsikr5q34rnzgbjkxk6rjf5ibu5szmx74hxy",
  "call": "wasm/run",
  "input": {
    "func": "add_one",
    "args": [{"await/ok": {"/": "bafkreiauharffox63dv2iakndymassol3ryznr32tqii6ijw6ter3ksleu"}}]
  }
}
```


Compute Substrate

Distributed Invocation

Compute Substrate

Distributed Invocation

```
dns:example.com/TYPE=TXT  
crud/update
```


Compute Substrate

Distributed Invocation

```
dns:example.com/TYPE=TXT  
crud/update
```

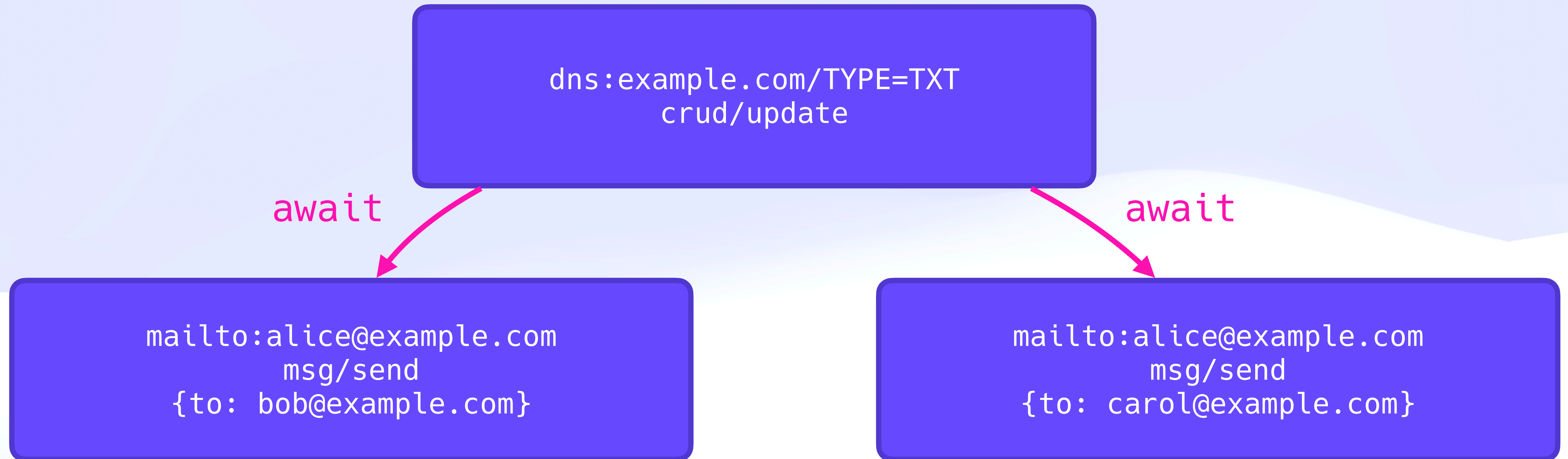
await



```
mailto:alice@example.com  
msg/send  
{to: bob@example.com}
```

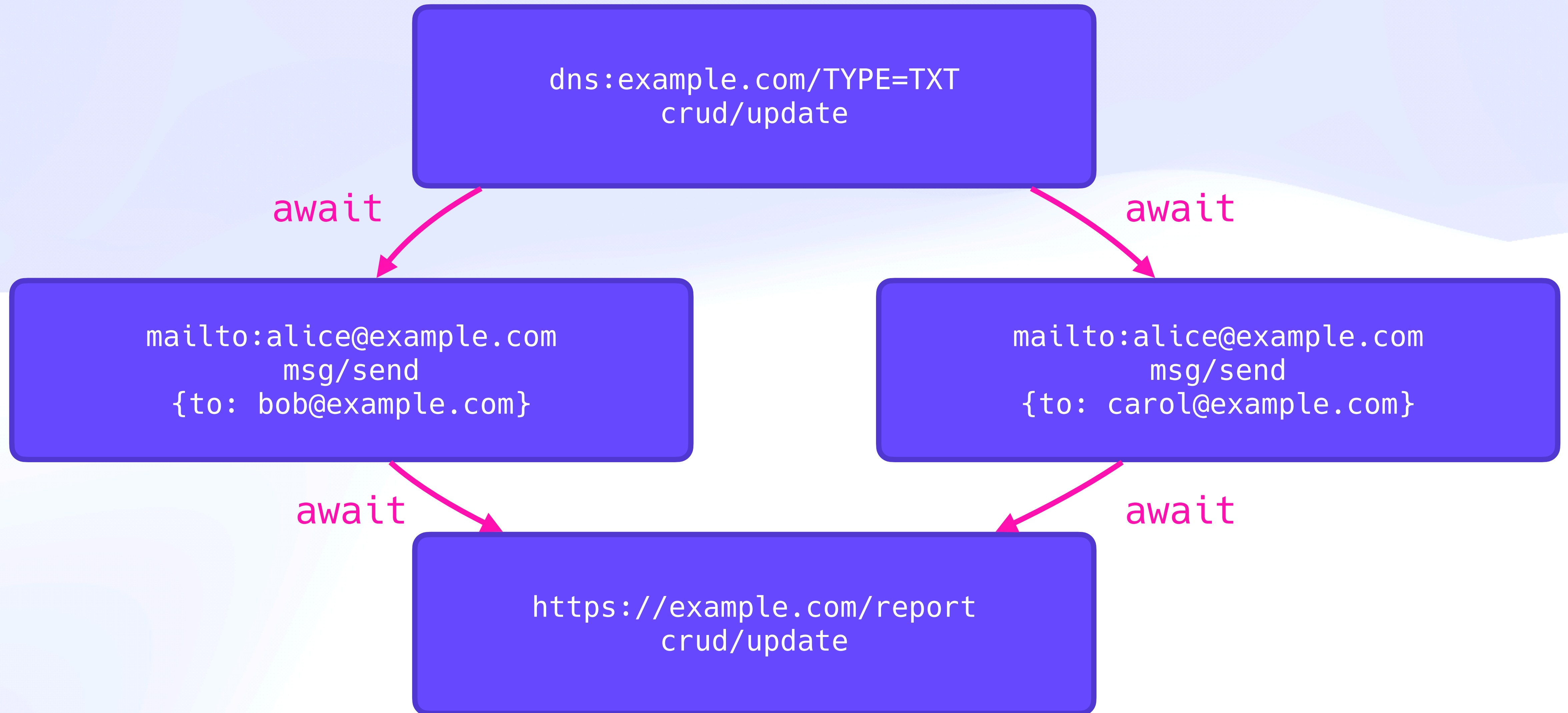

Compute Substrate

Distributed Invocation



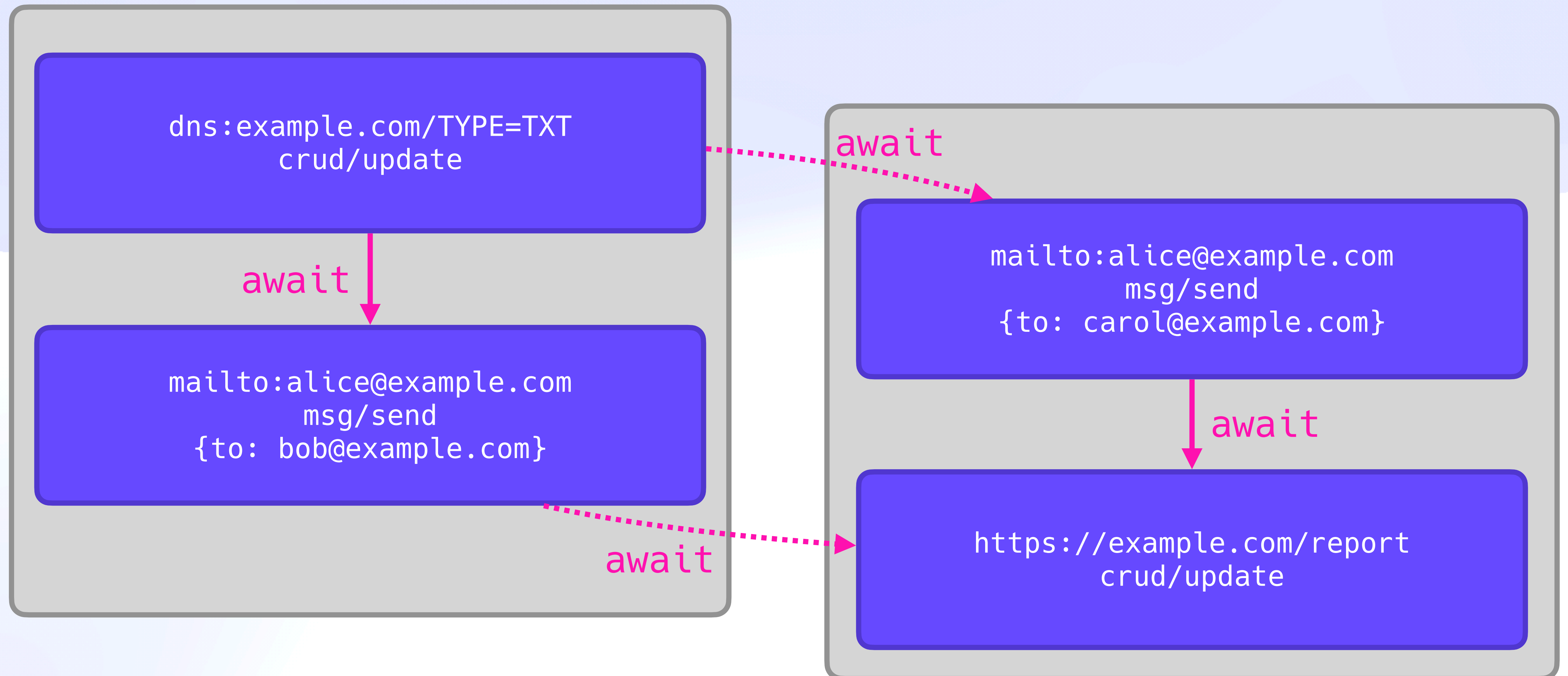
Compute Substrate

Distributed Invocation



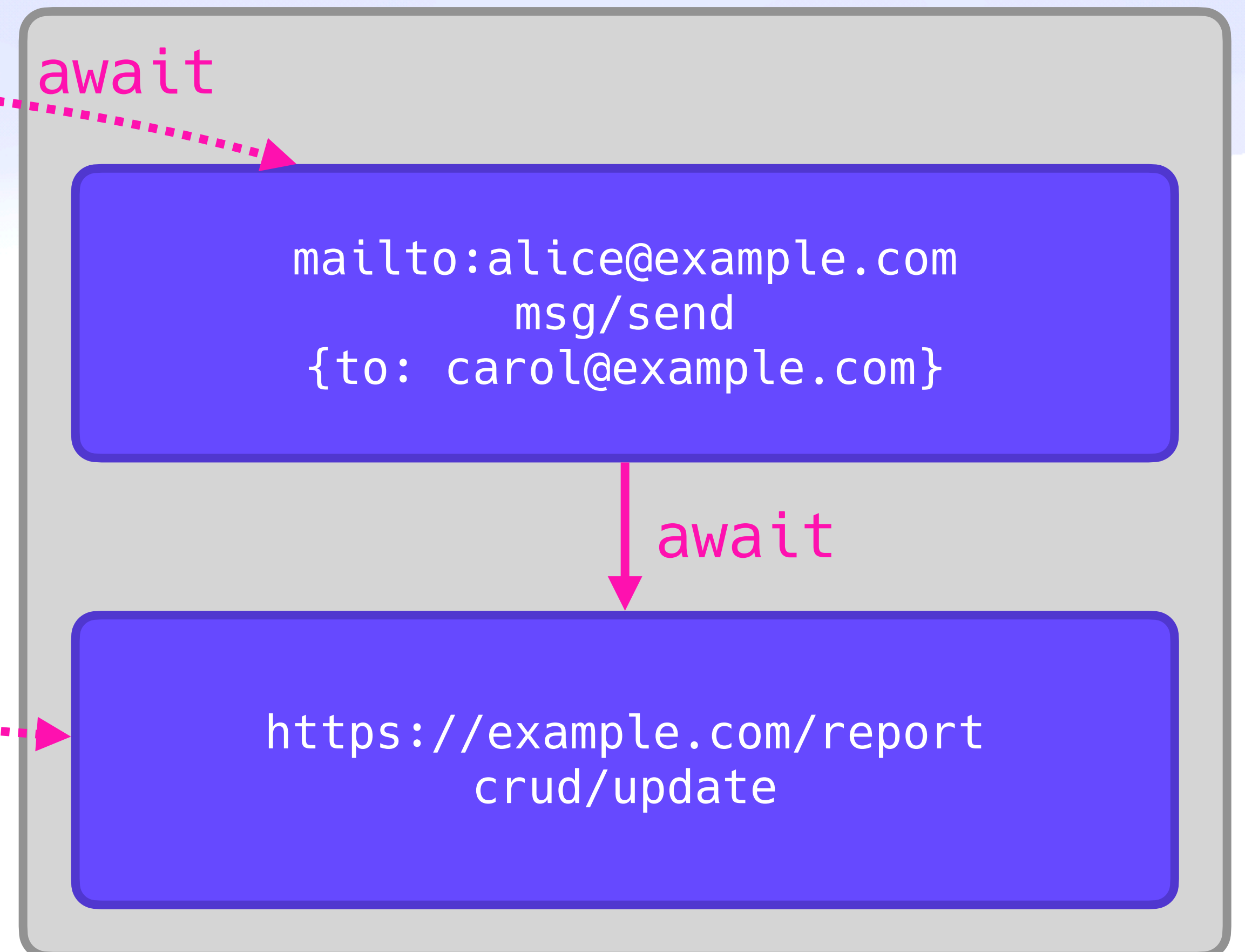
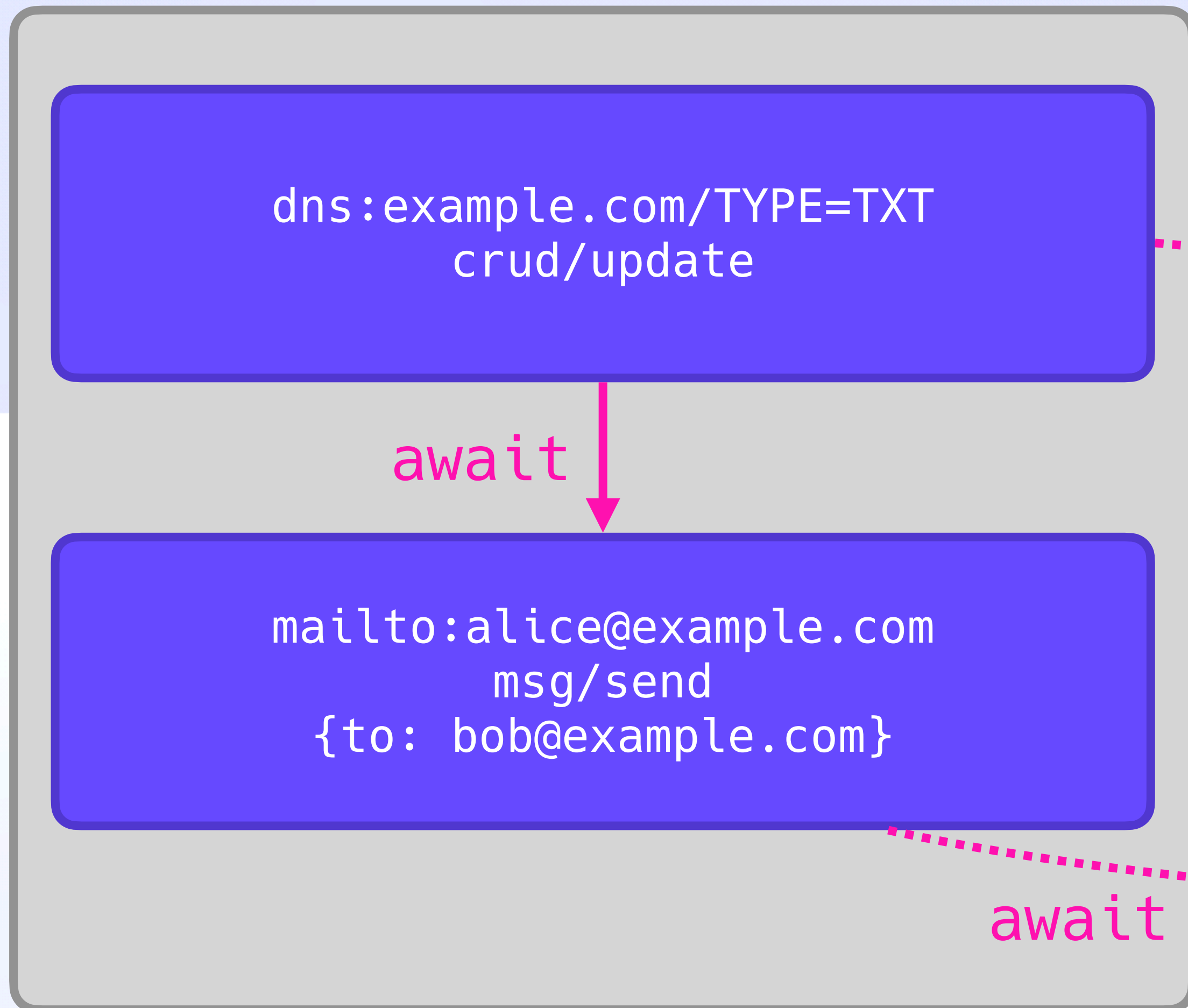
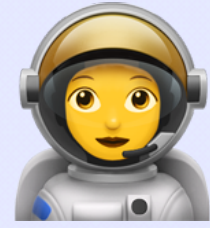
Compute Substrate

Distributed Invocation



Compute Substrate

Distributed Invocation



Compute Substrate

Matchmaking

Compute Substrate

Matchmaking



Compute Substrate

Matchmaking



Compute Substrate

Matchmaking



Compute Substrate

"Nine Nines" Is So 1999

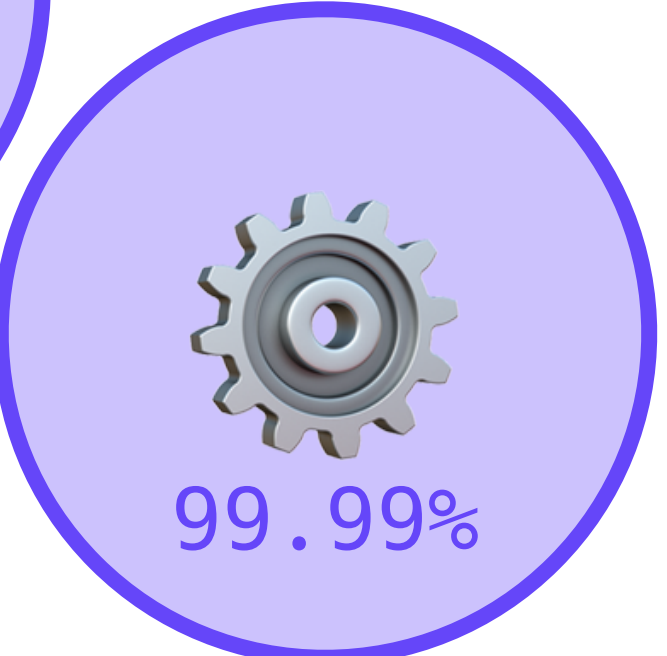
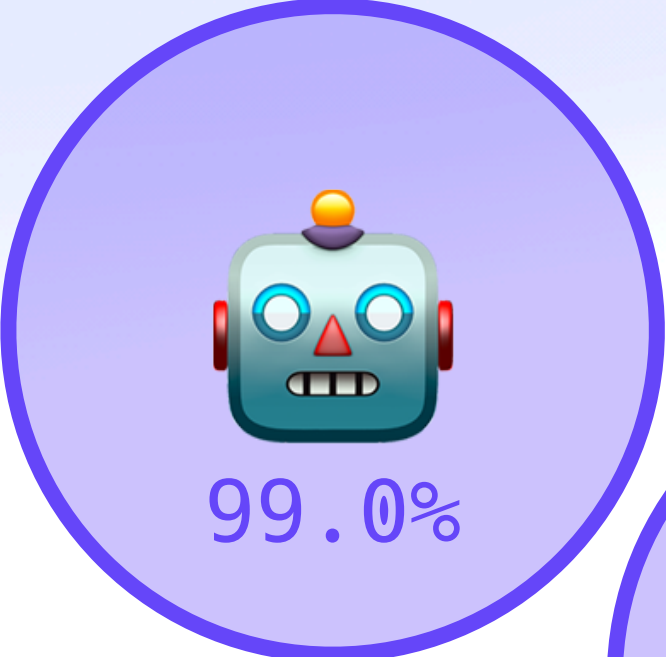
Compute Substrate

"Nine Nines" Is So 1999



Compute Substrate

"Nine Nines" Is So 1999



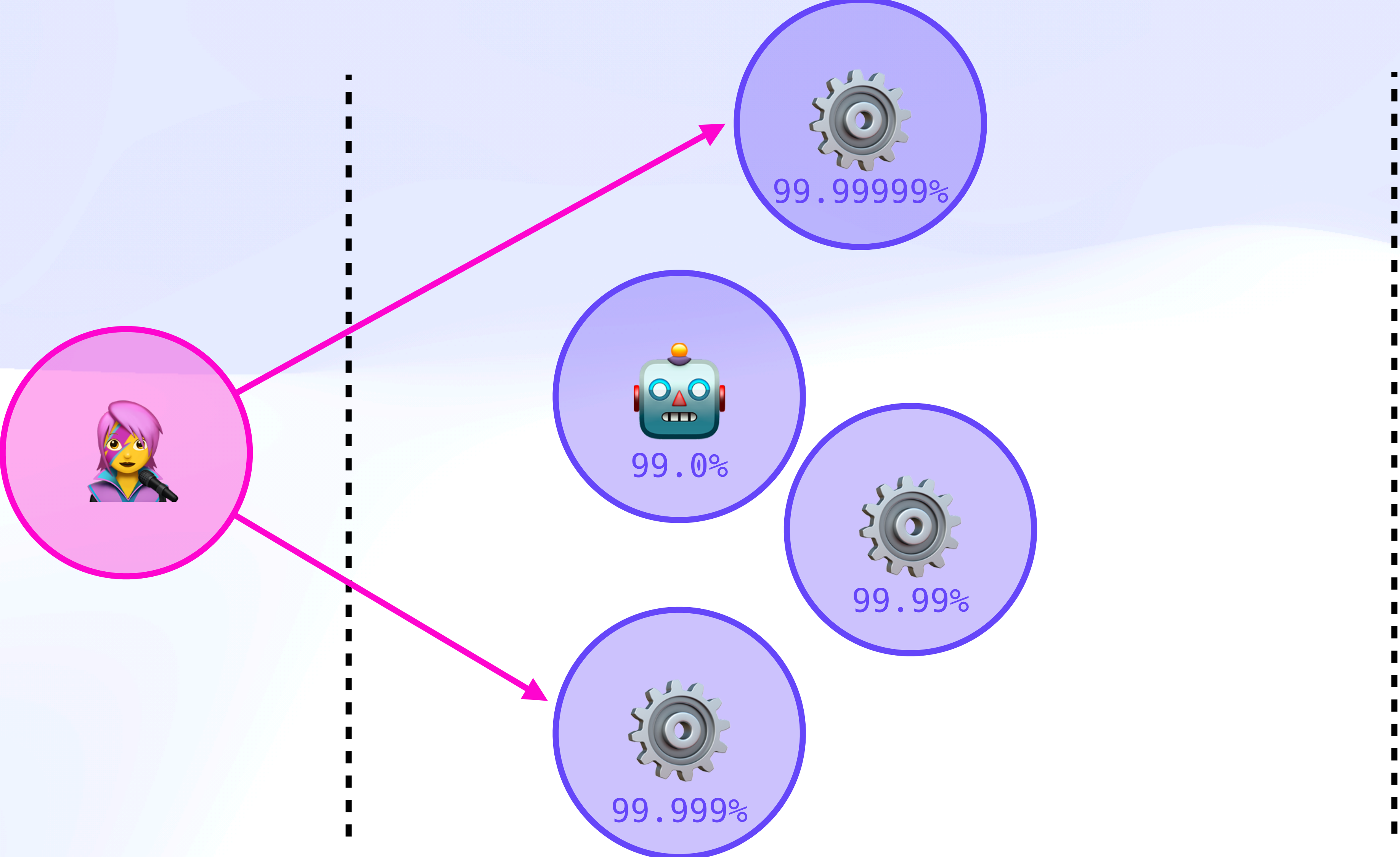
Compute Substrate

"Nine Nines" Is So 1999



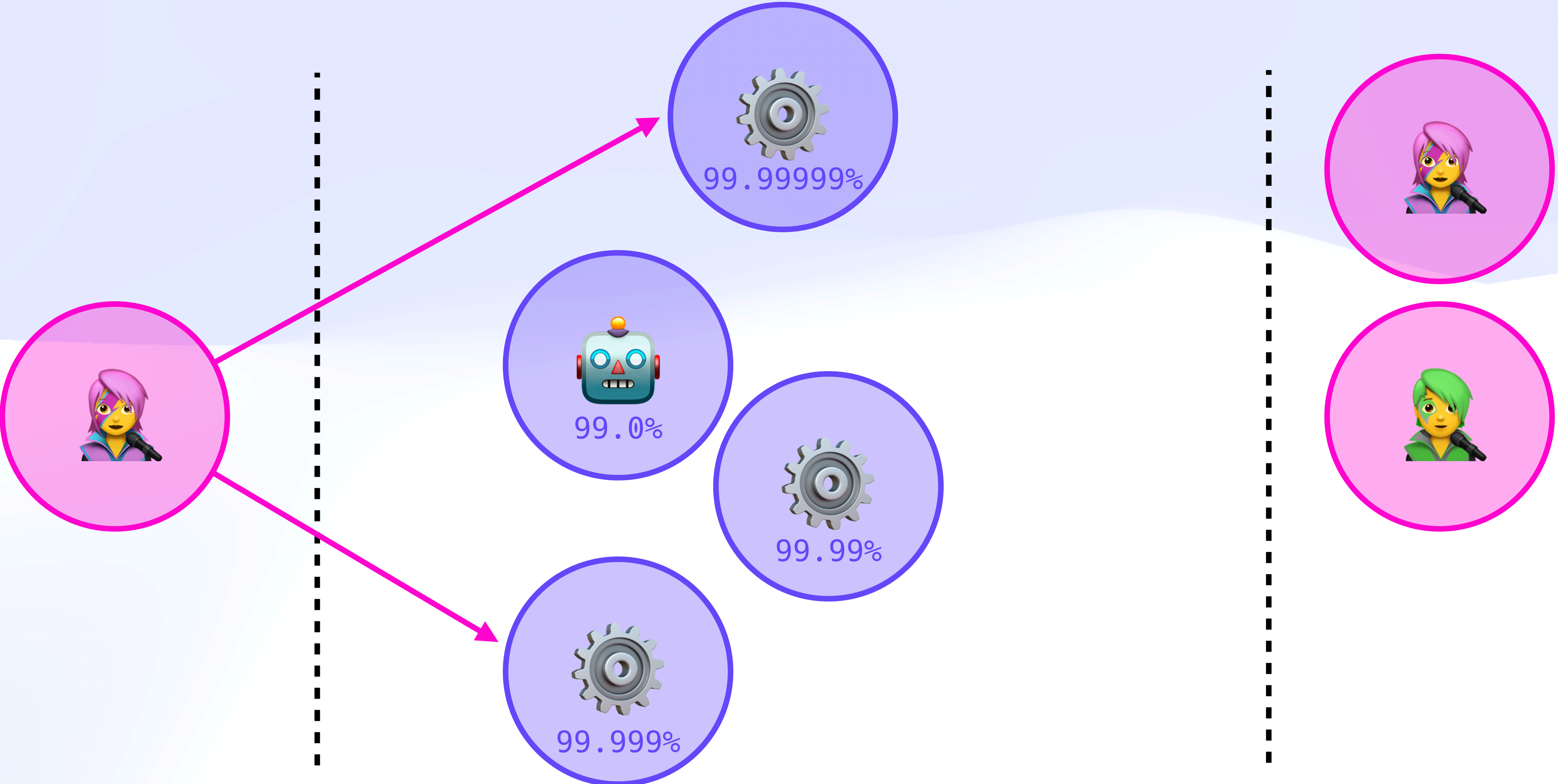
Compute Substrate

"Nine Nines" Is So 1999



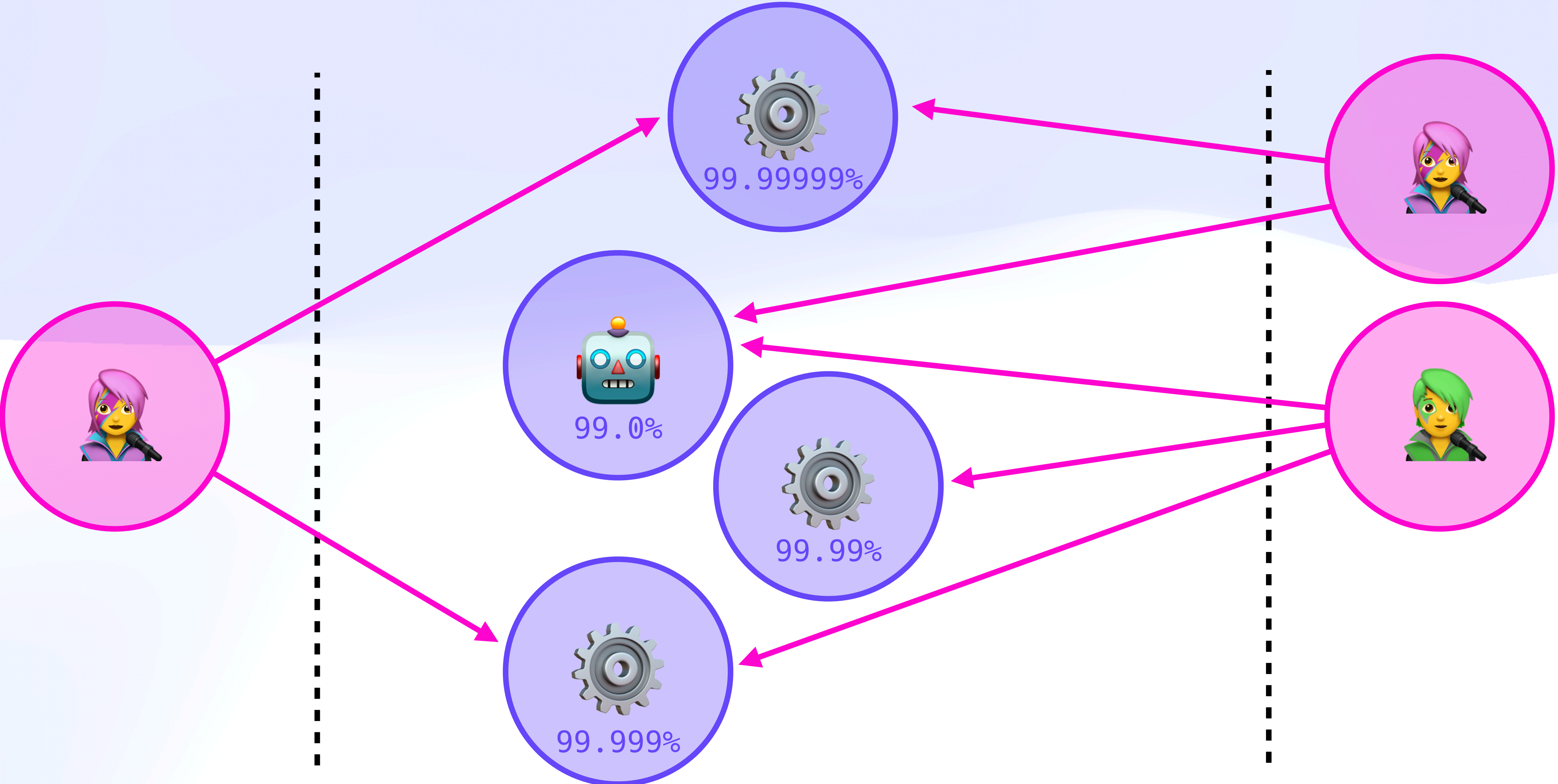
Compute Substrate

"Nine Nines" Is So 1999



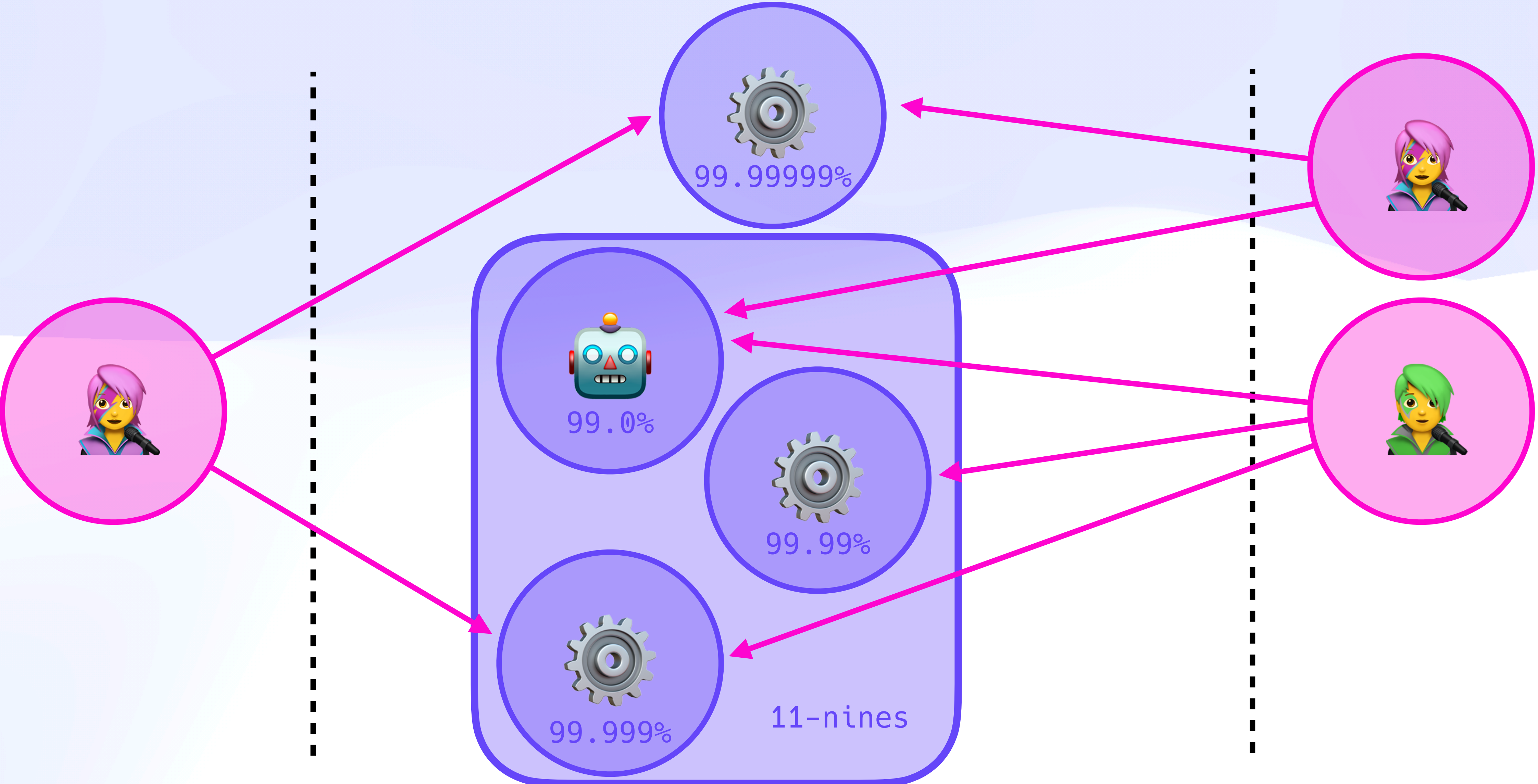
Compute Substrate

"Nine Nines" Is So 1999



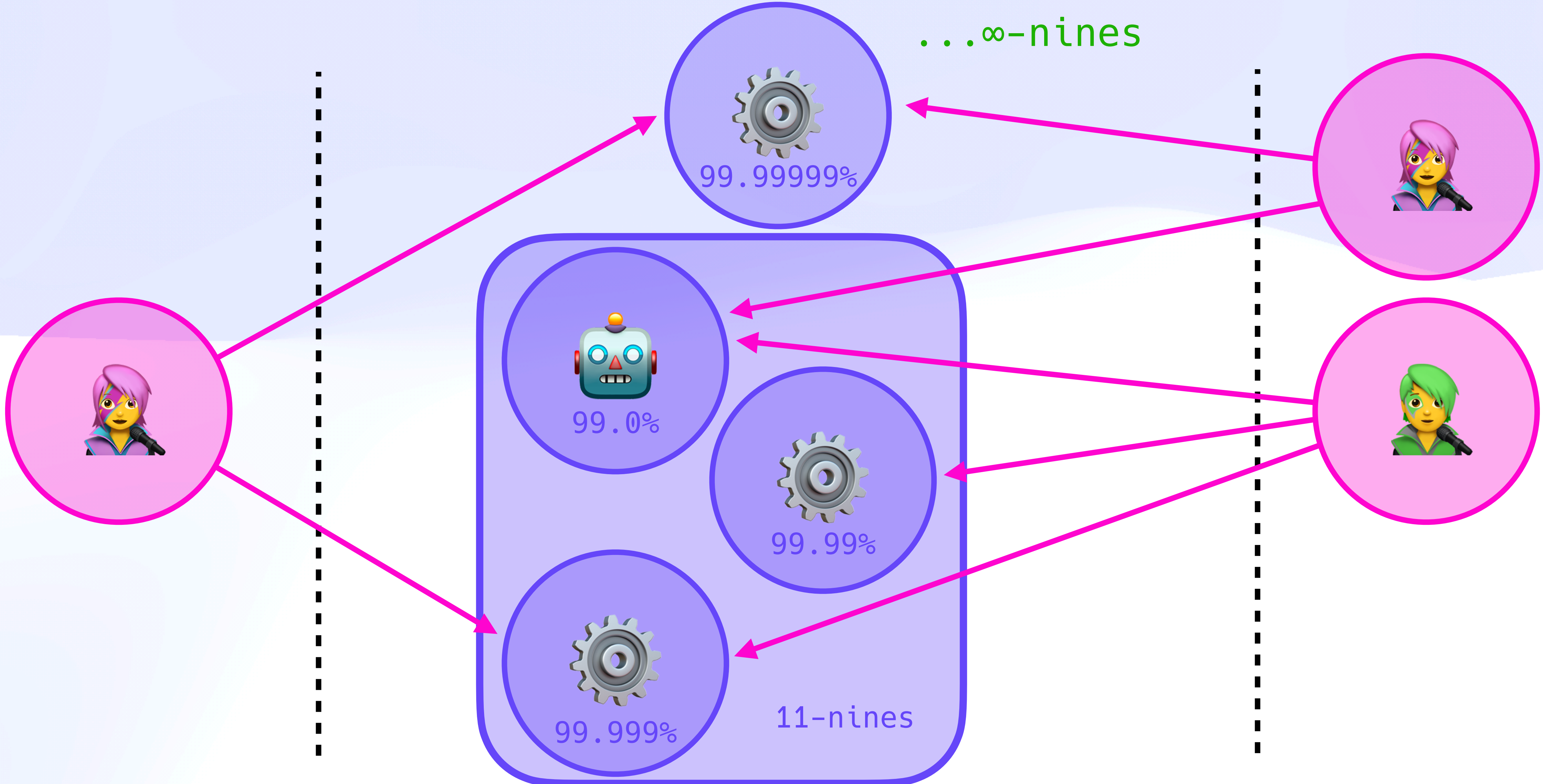
Compute Substrate

"Nine Nines" Is So 1999



Compute Substrate

"Nine Nines" Is So 1999

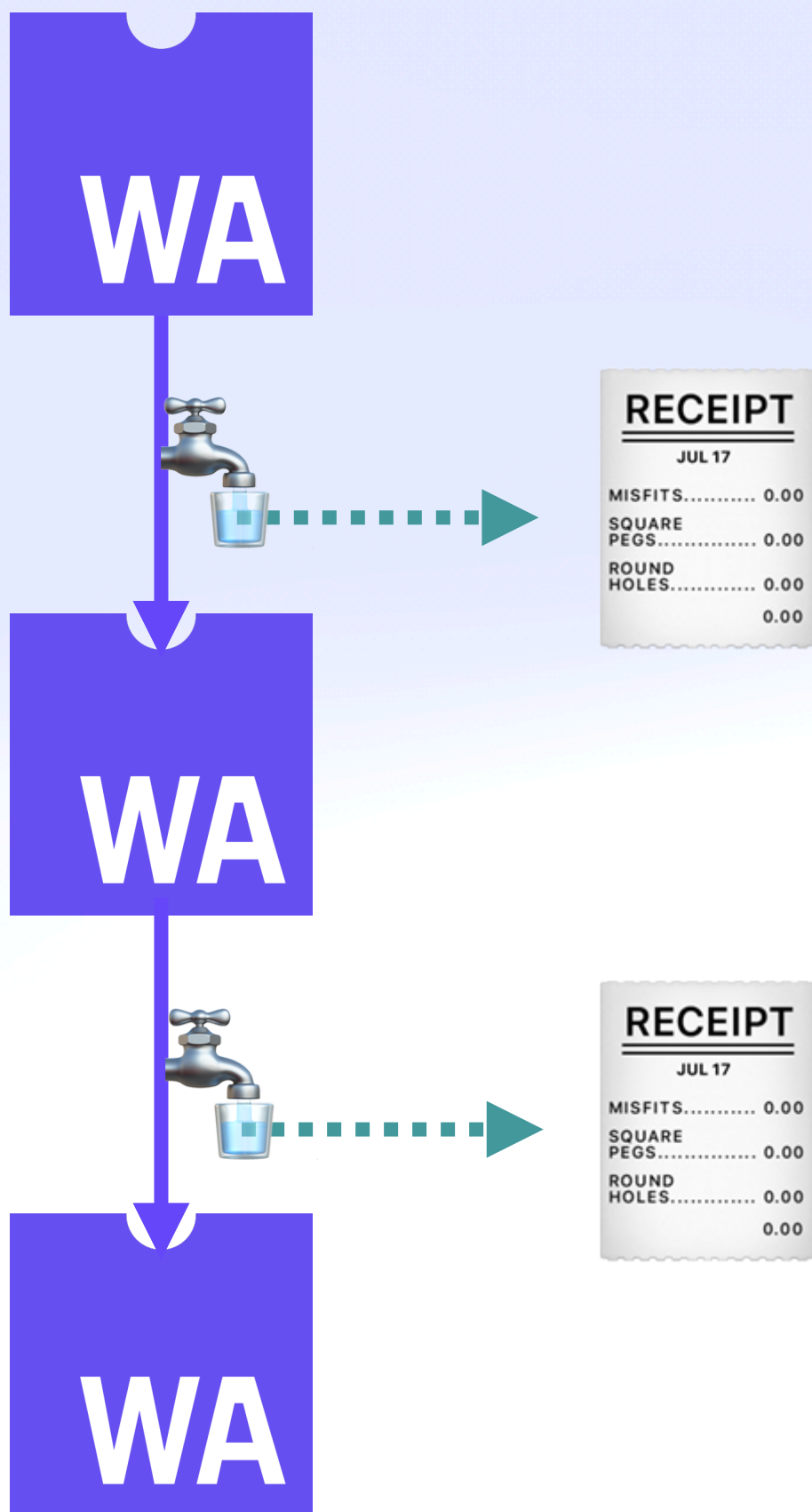


Compute Substrate

Cache, Suspend, Move, Verify

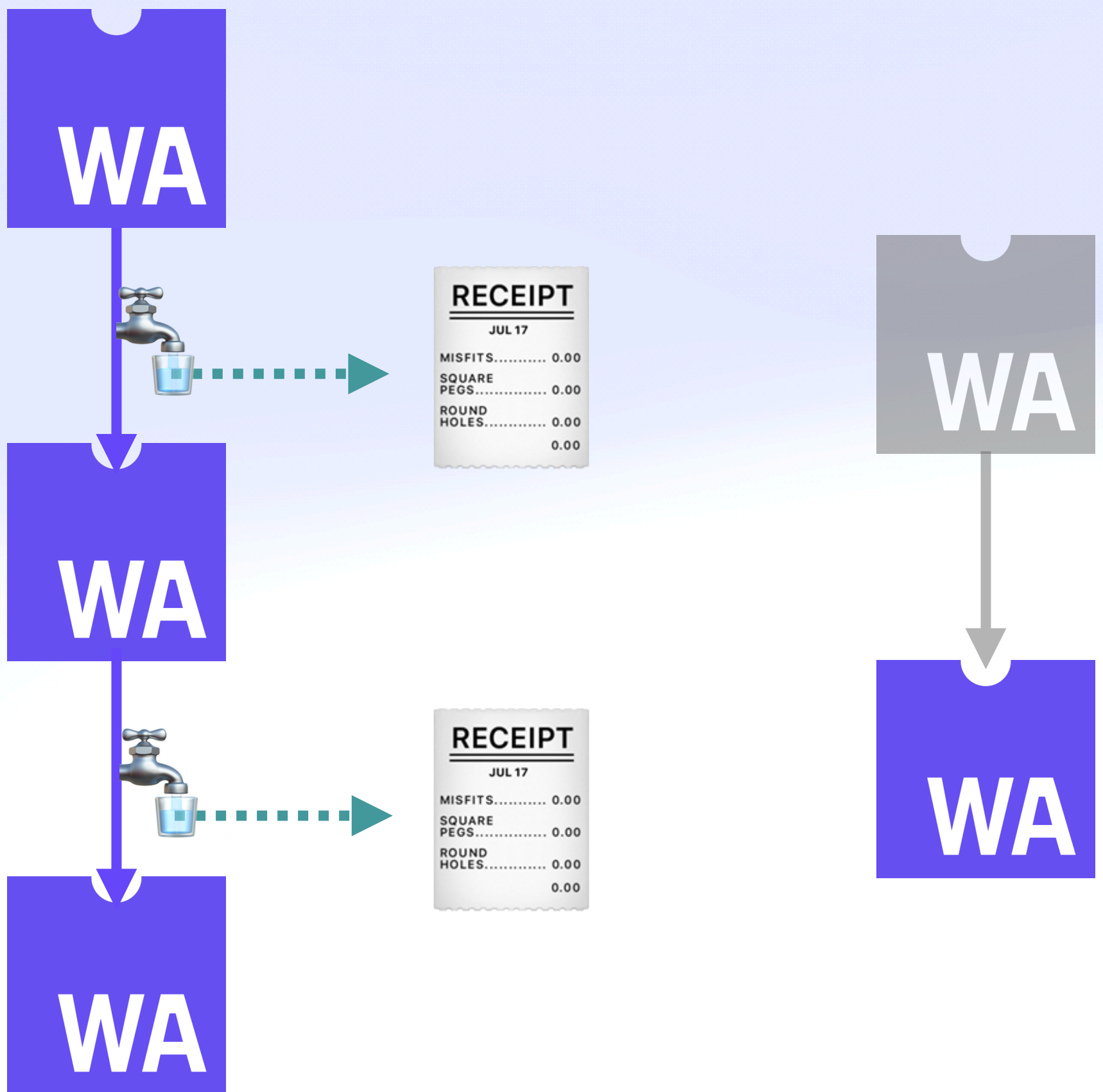
Compute Substrate

Cache, Suspend, Move, Verify



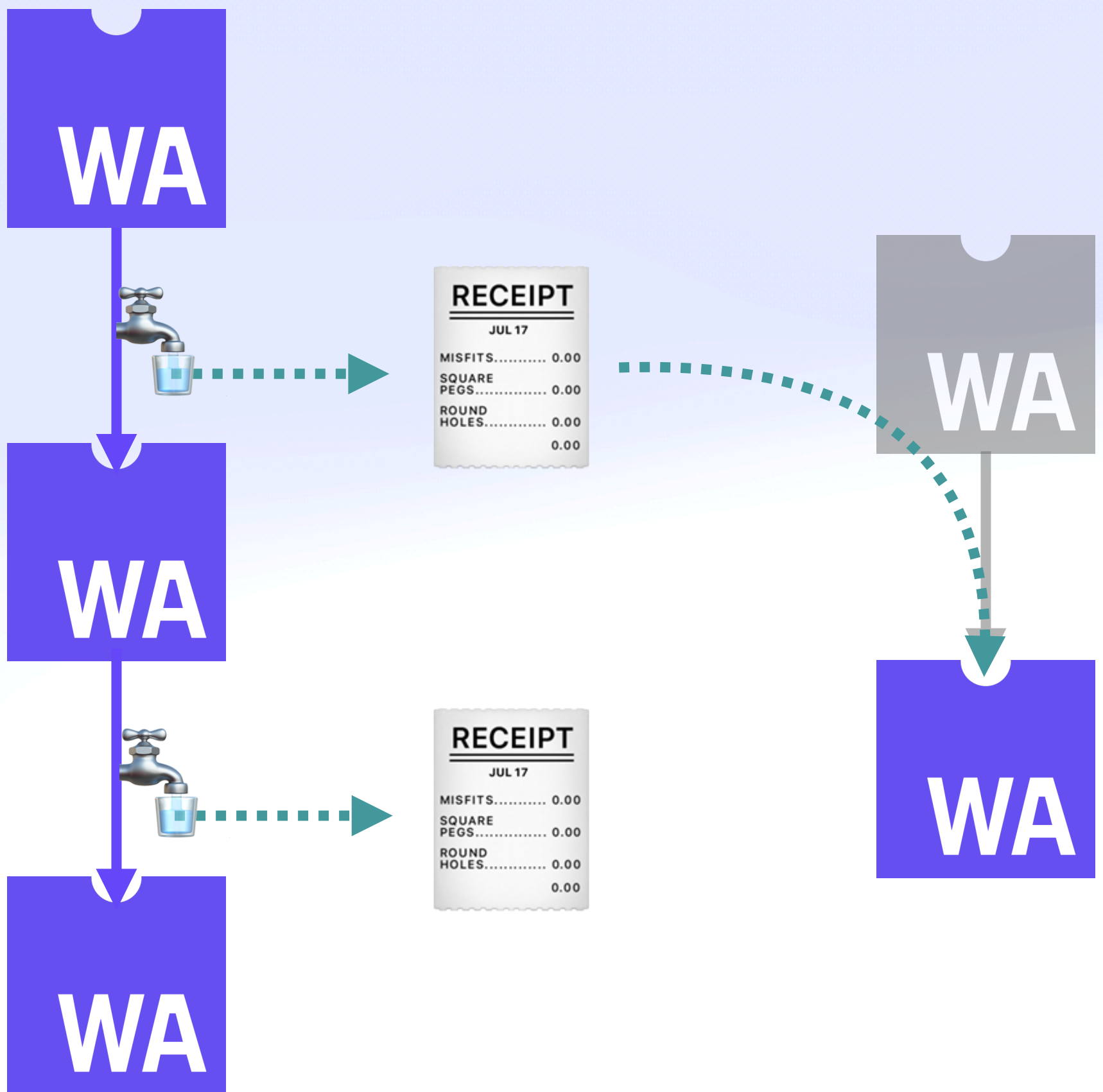
Compute Substrate

Cache, Suspend, Move, Verify



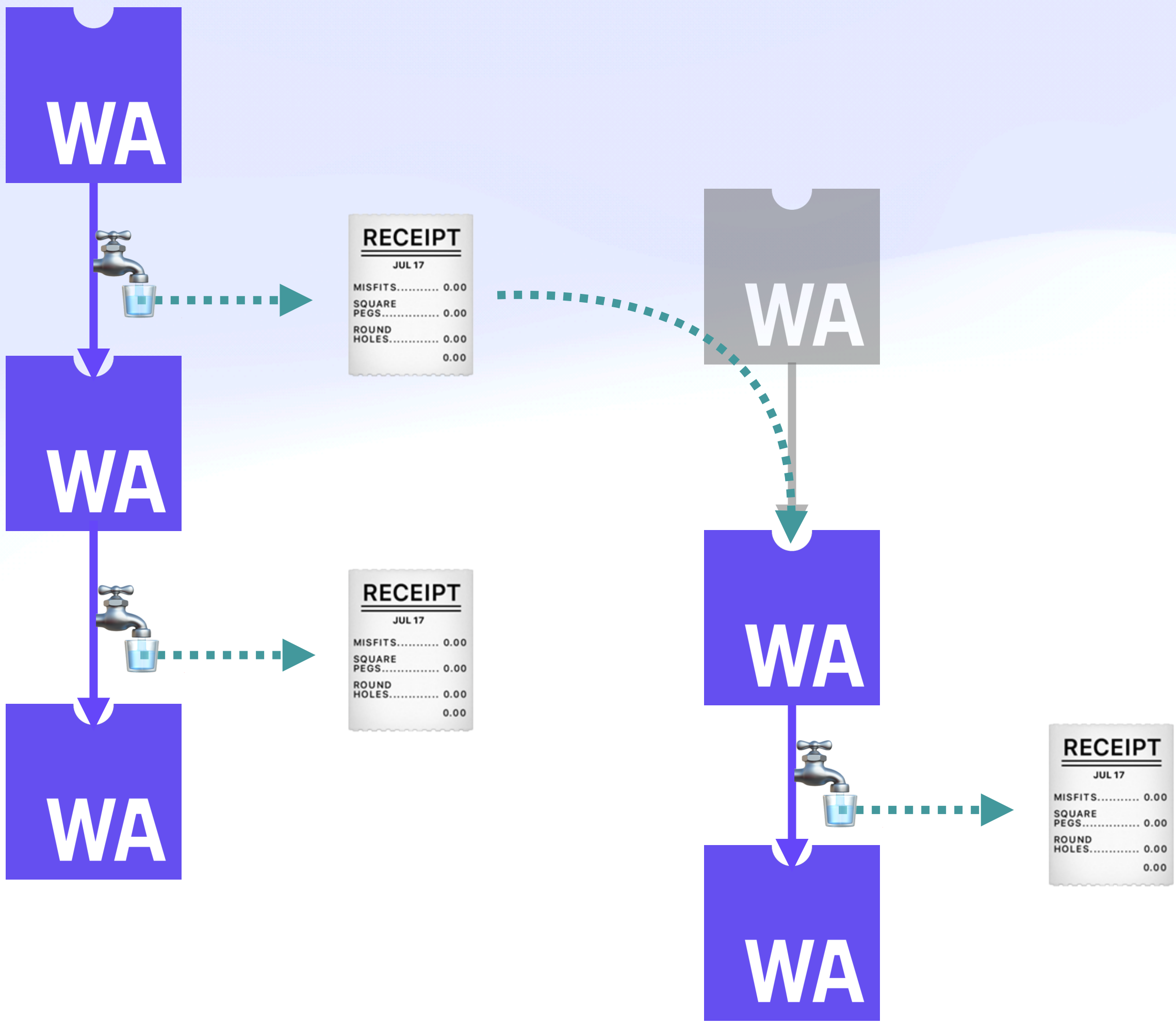
Compute Substrate

Cache, Suspend, Move, Verify



Compute Substrate

Cache, Suspend, Move, Verify

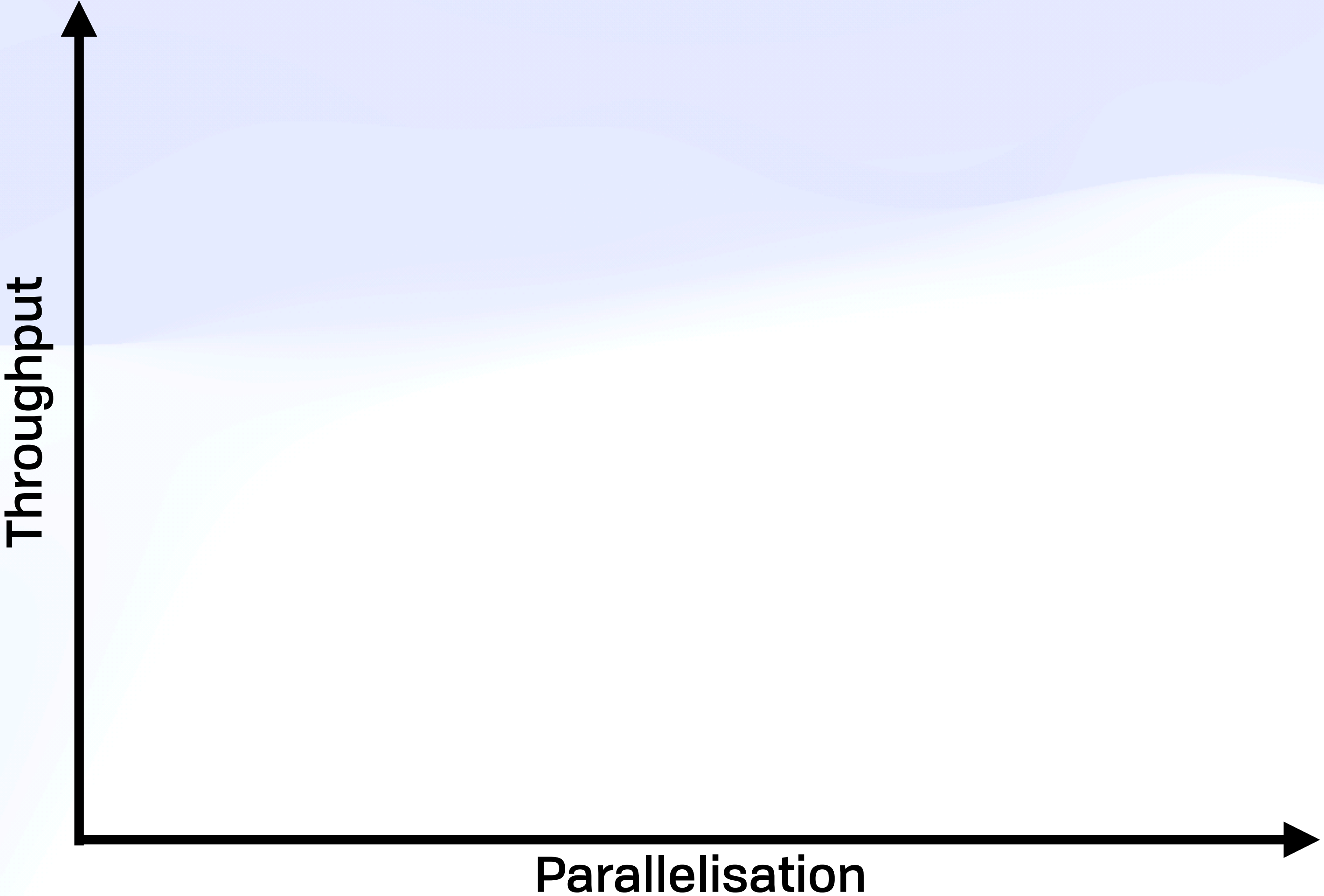


Compute Substrate

With a Little Help From My Friends

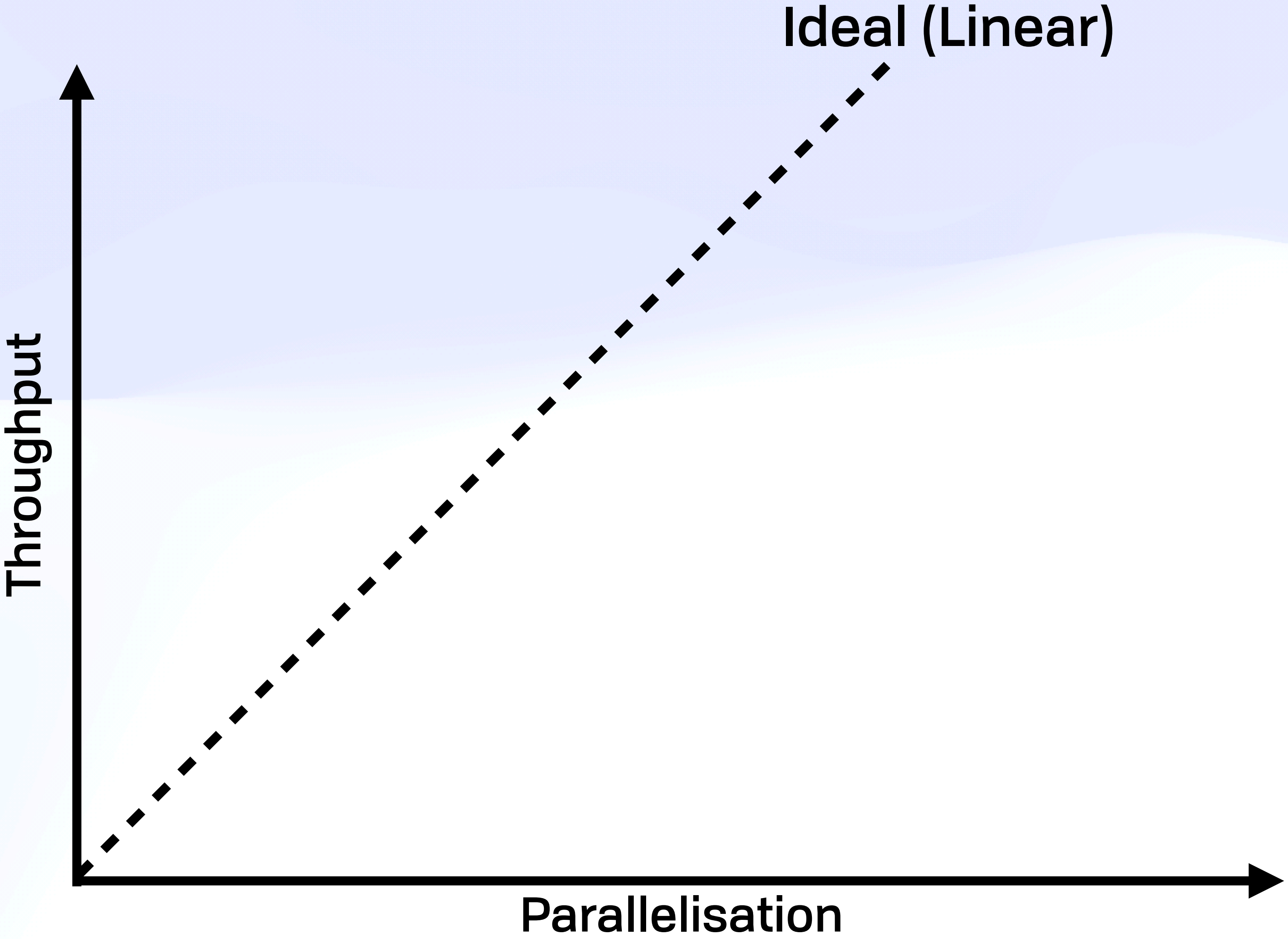
Compute Substrate

With a Little Help From My Friends



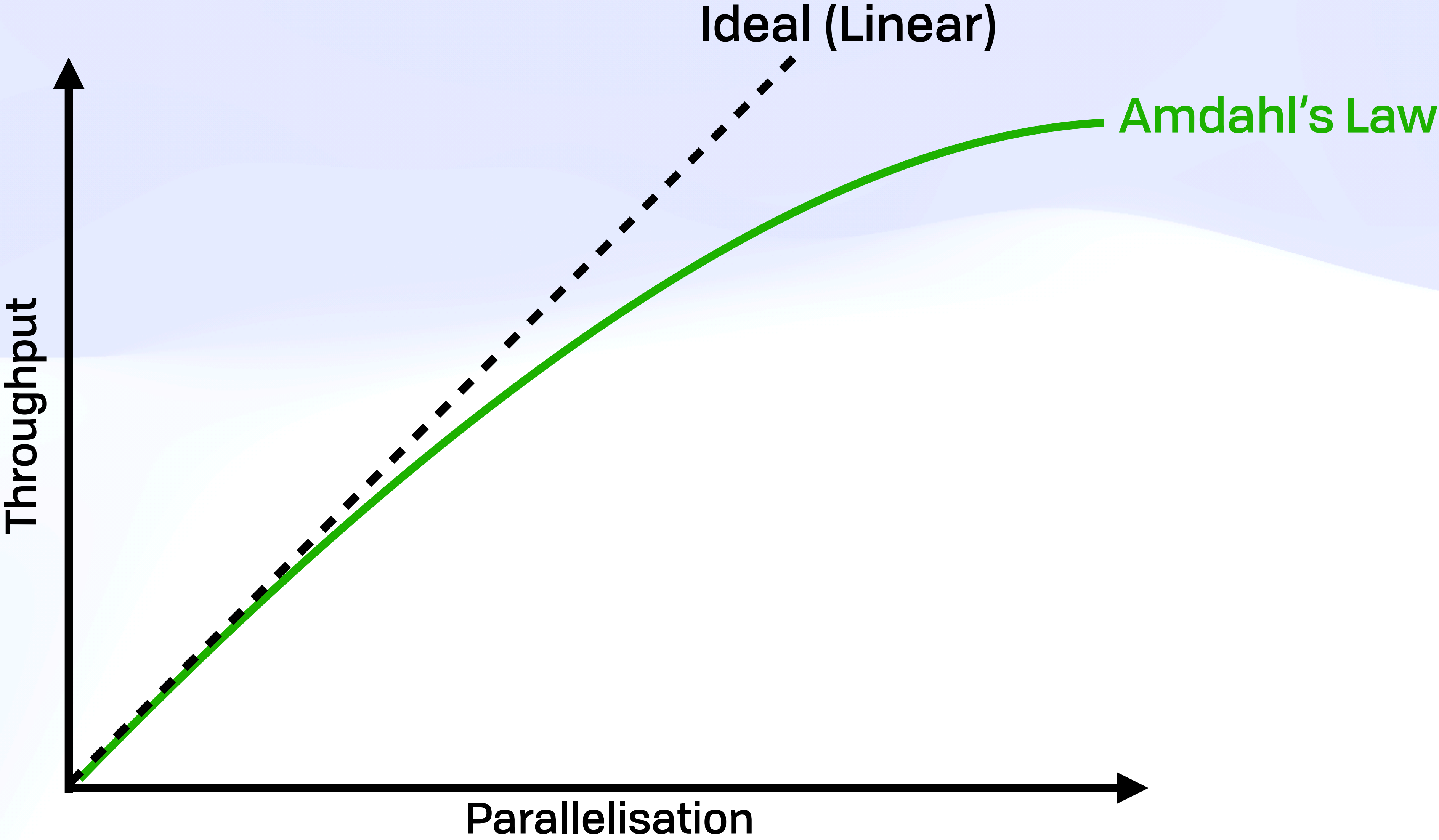
Compute Substrate

With a Little Help From My Friends



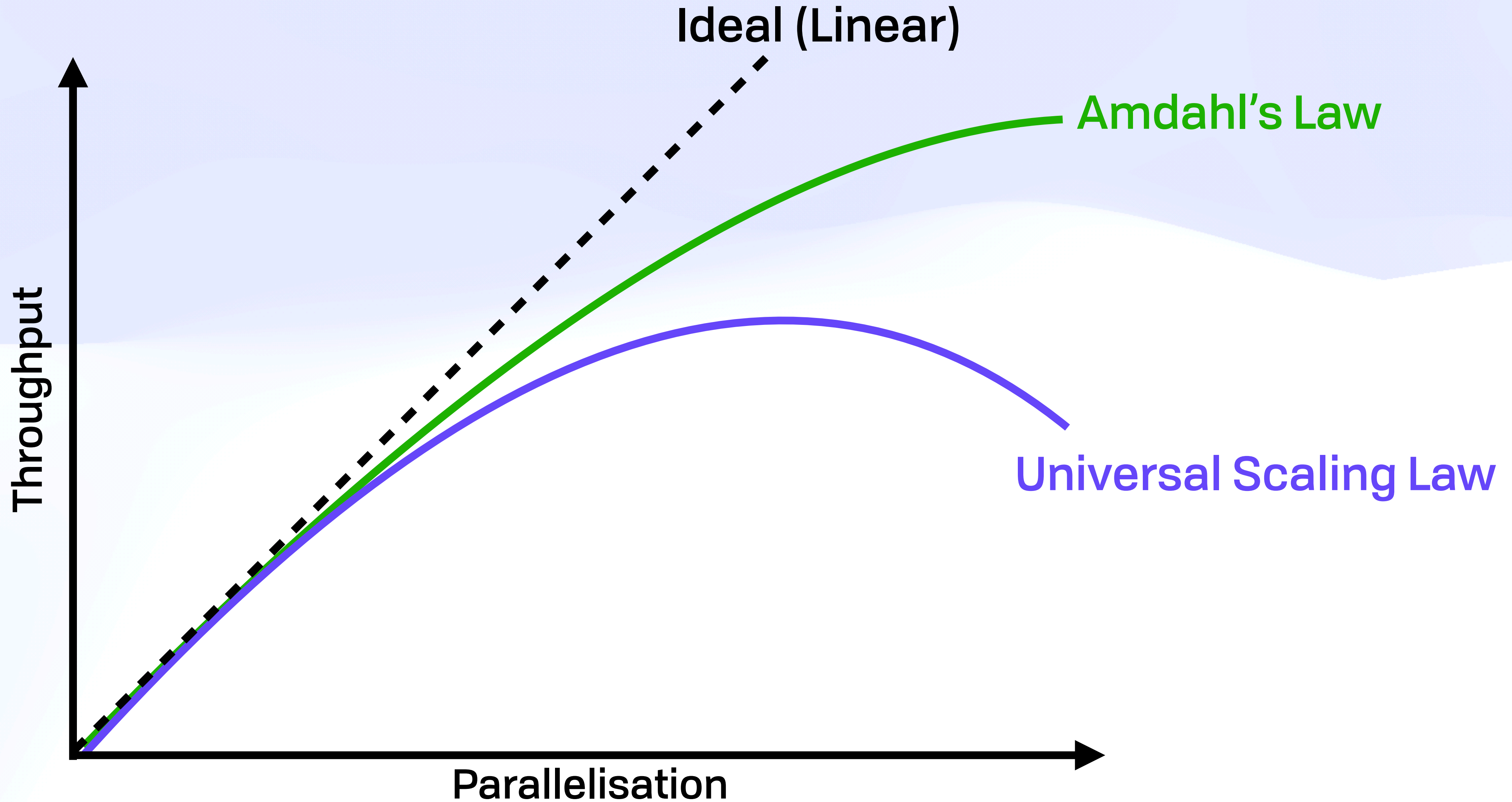
Compute Substrate

With a Little Help From My Friends



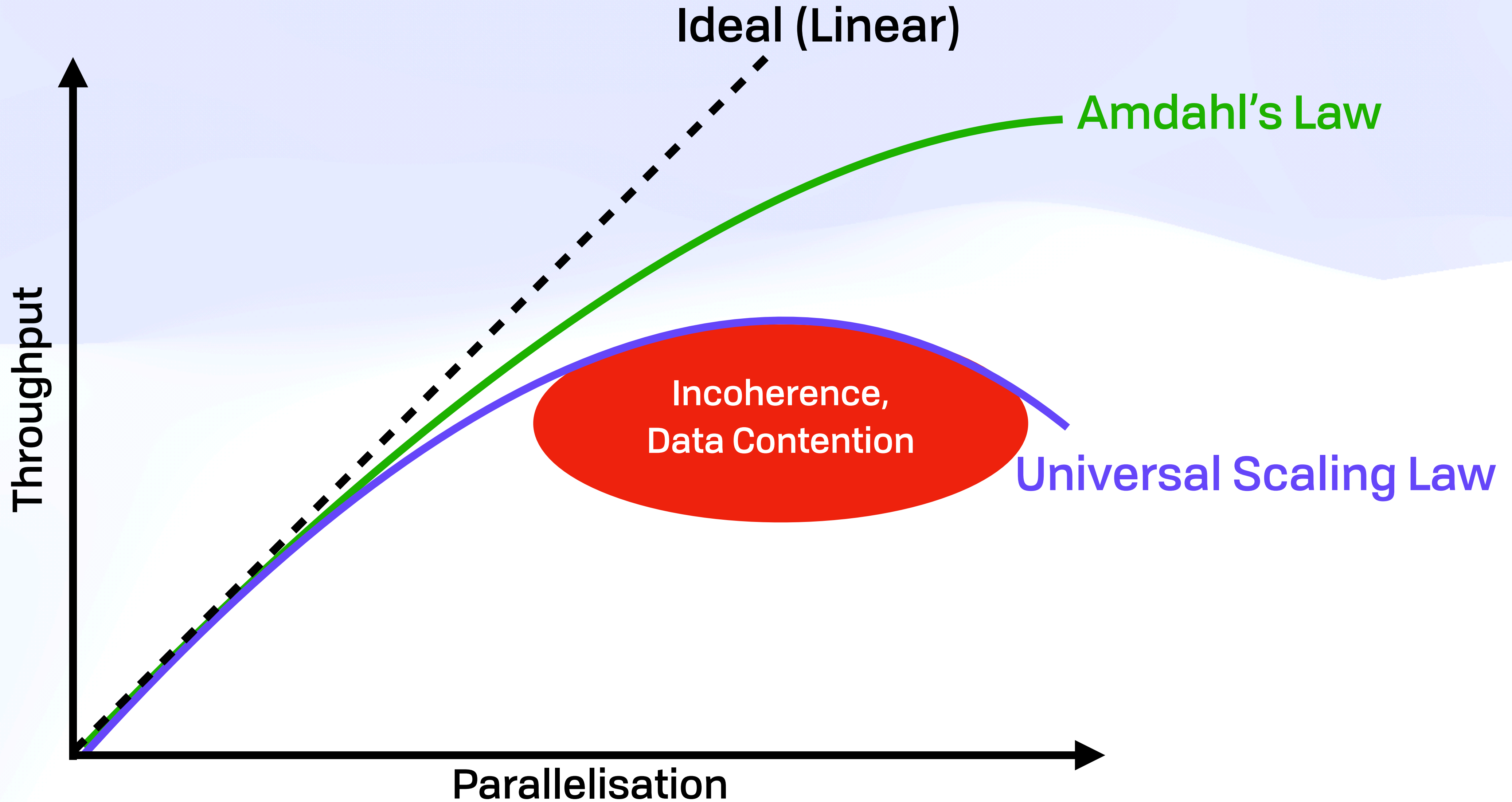
Compute Substrate

With a Little Help From My Friends



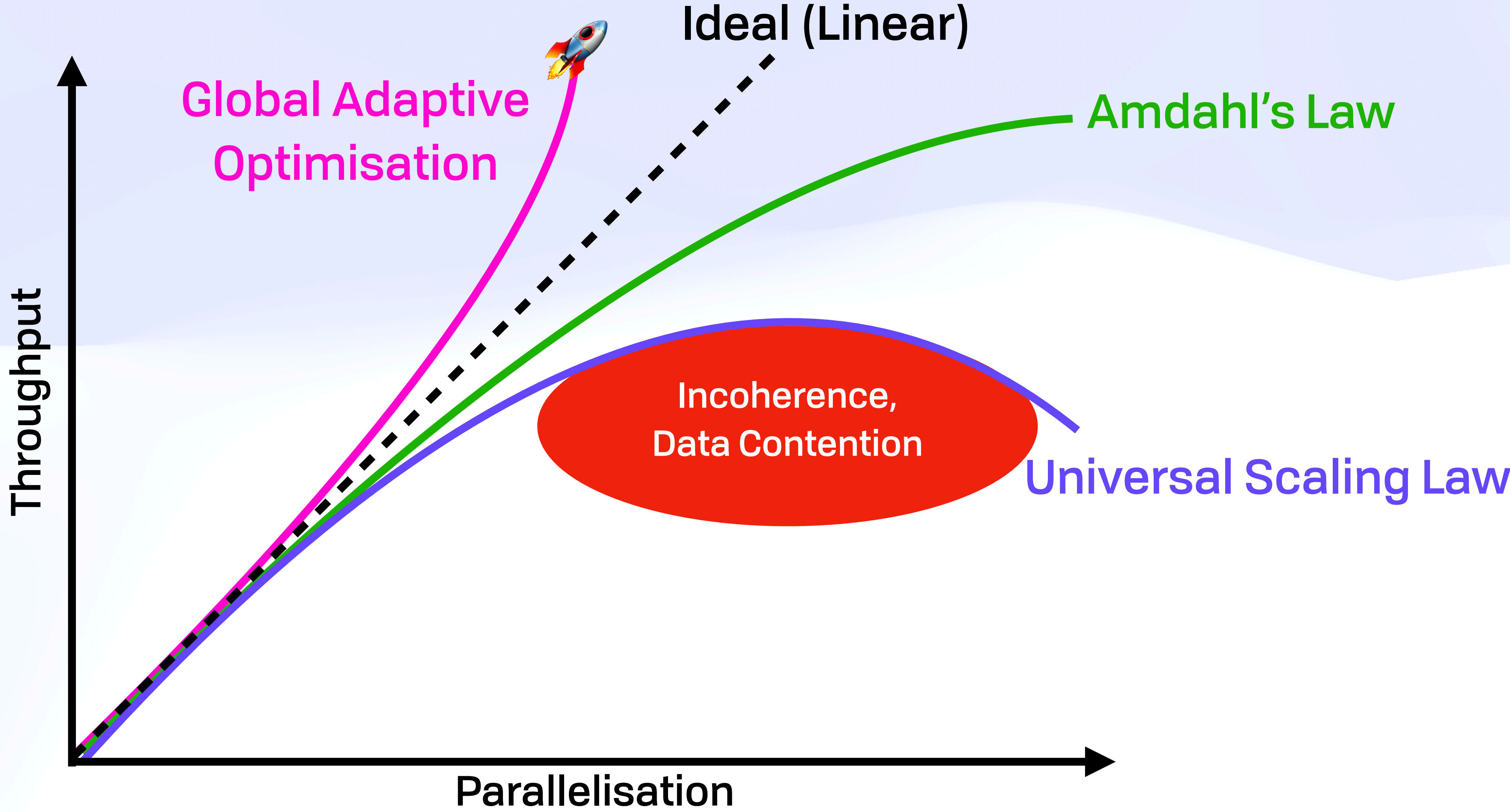
Compute Substrate

With a Little Help From My Friends



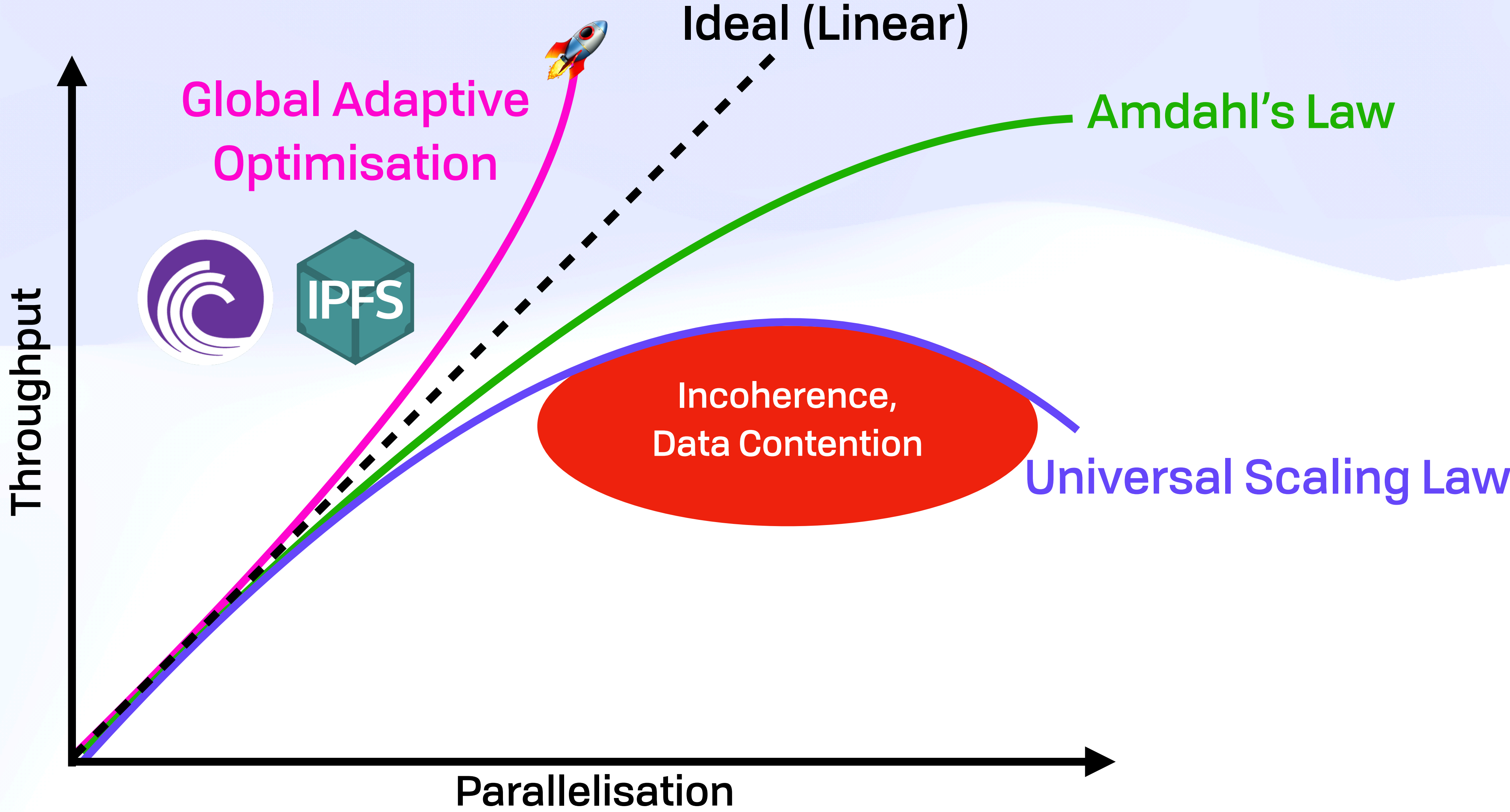
Compute Substrate

With a Little Help From My Friends



Compute Substrate

With a Little Help From My Friends



Compute Substrate

Run Once, And Never Again



Compute Substrate

Run Once, And Never Again



◆ **Input Hash → Cached Output**

Compute Substrate

Run Once, And Never Again



- ◆ **Input Hash → Cached Output**
- ◆ AI moderation & tagging

Compute Substrate

Run Once, And Never Again



- ◆ **Input Hash → Cached Output**
 - ◆ AI moderation & tagging
 - ◆ Distributed JWT/DID validation

Compute Substrate

Run Once, And Never Again



- ◆ **Input Hash → Cached Output**
 - ◆ AI moderation & tagging
 - ◆ Distributed JWT/DID validation
 - ◆ Transitive trust

Compute Substrate

Run Once, And Never Again



- ◆ **Input Hash → Cached Output**
 - ◆ AI moderation & tagging
 - ◆ Distributed JWT/DID validation
 - ◆ Transitive trust
 - ◆ Thumbnails, cropping

IPVM Homestar Demo



Workflow One

Crop

Rotate90

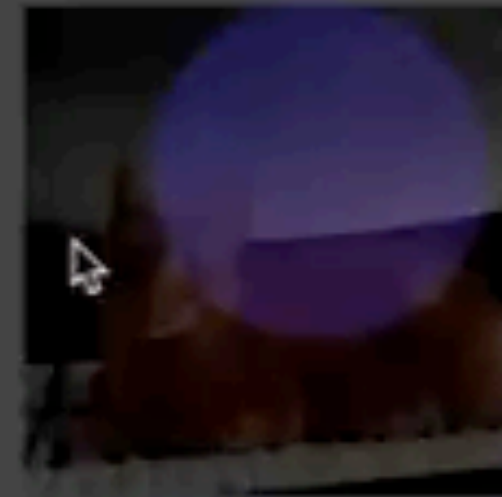
Blur

Workflow Two

Crop

Rotate90

Grayscale



0:00



Loom - Screen Recorder & Screen Capture is sharing your screen. Stop sharing Hide

IPVM Homestar Demo



Workflow One

Crop

Rotate90

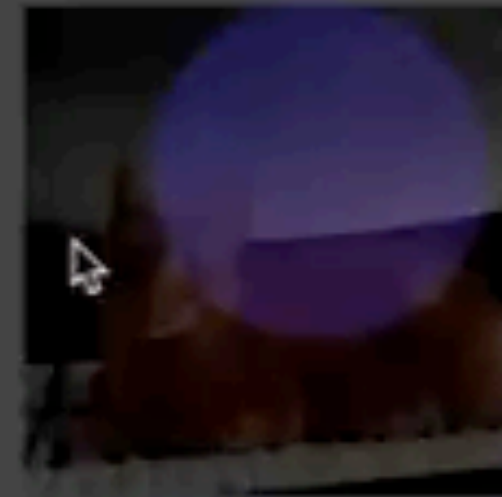
Blur

Workflow Two

Crop

Rotate90

Grayscale



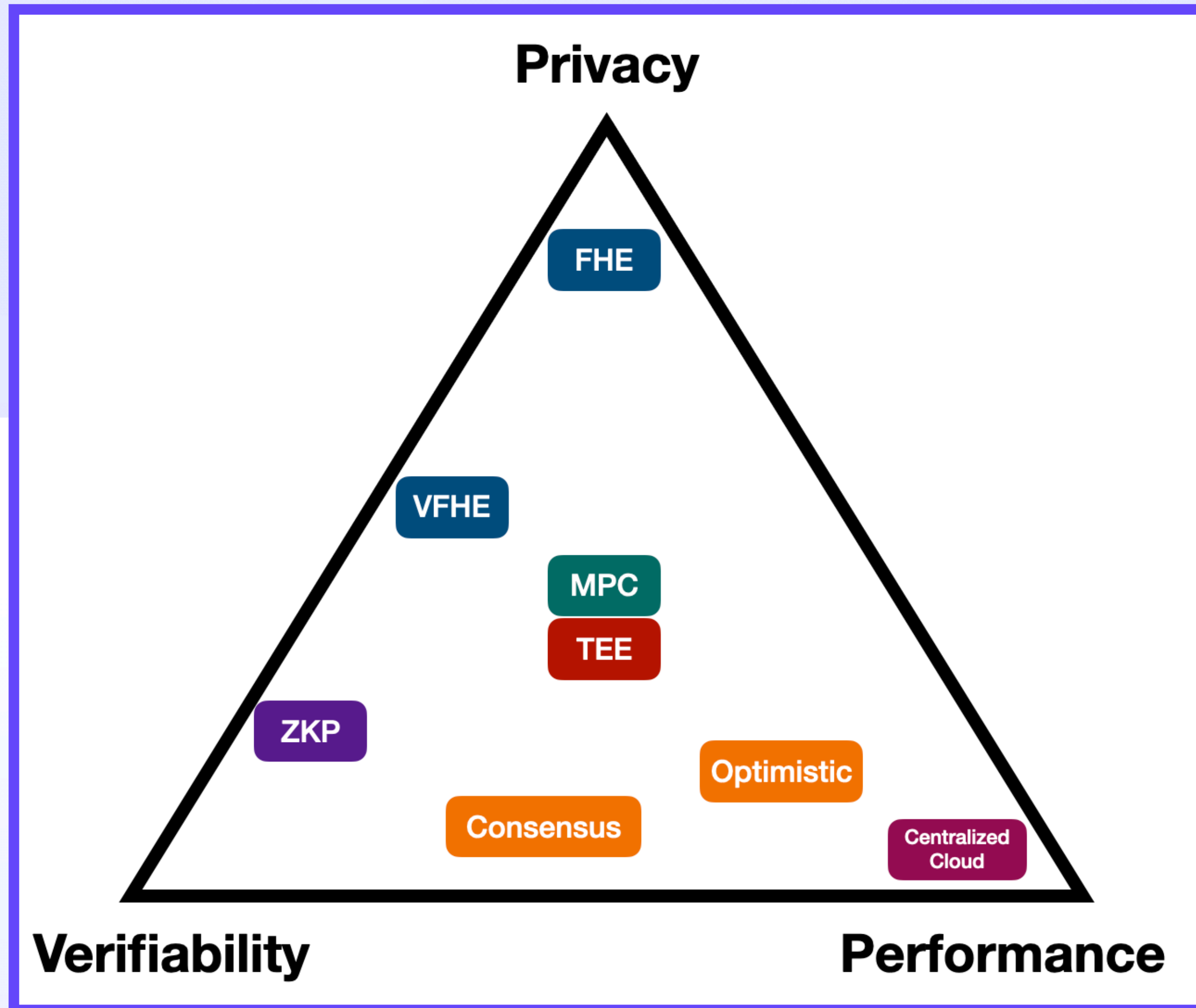
0:00



Loom - Screen Recorder & Screen Capture is sharing your screen. Stop sharing Hide

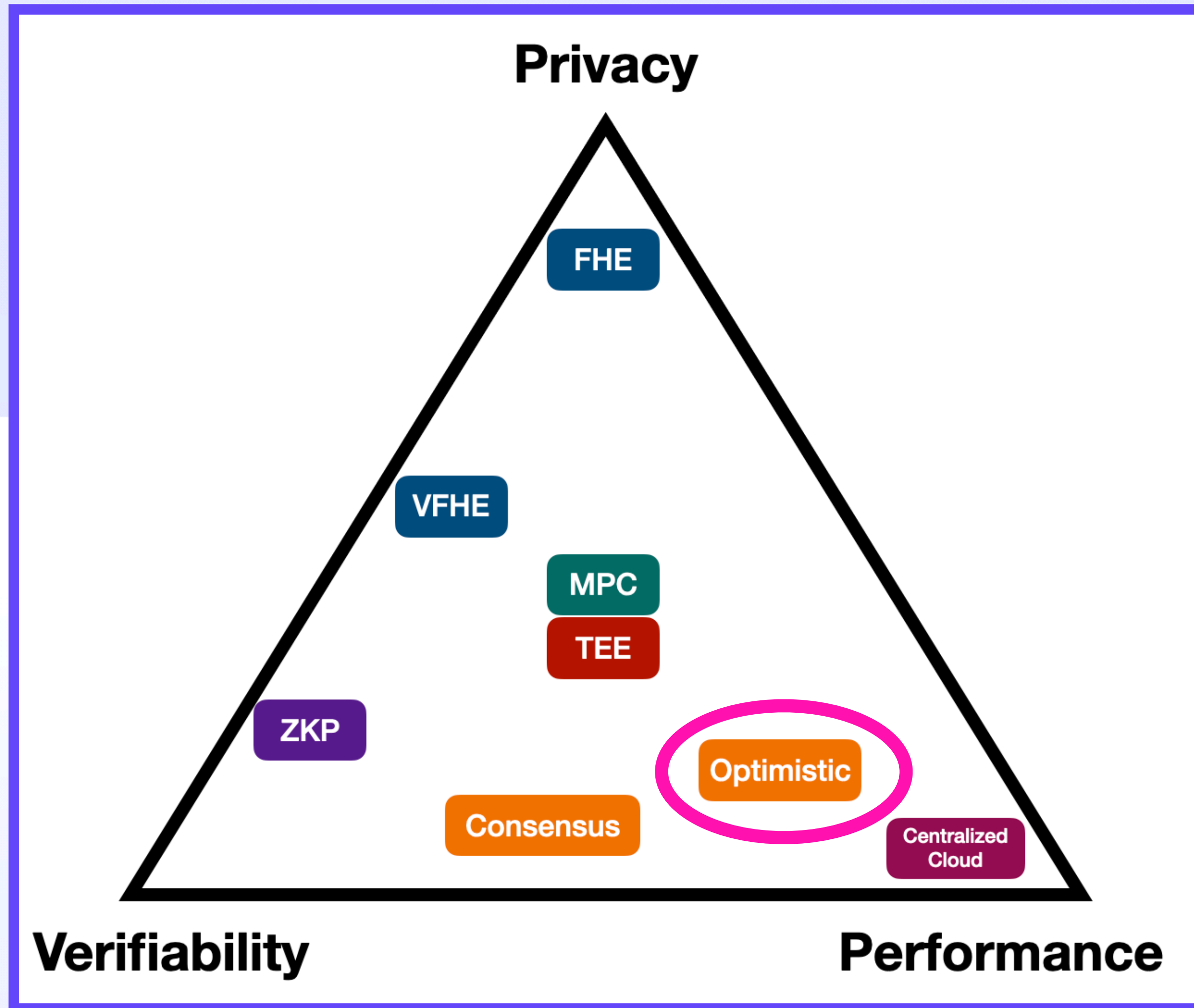
Compute Substrate

Determinism = Verifiable Computation



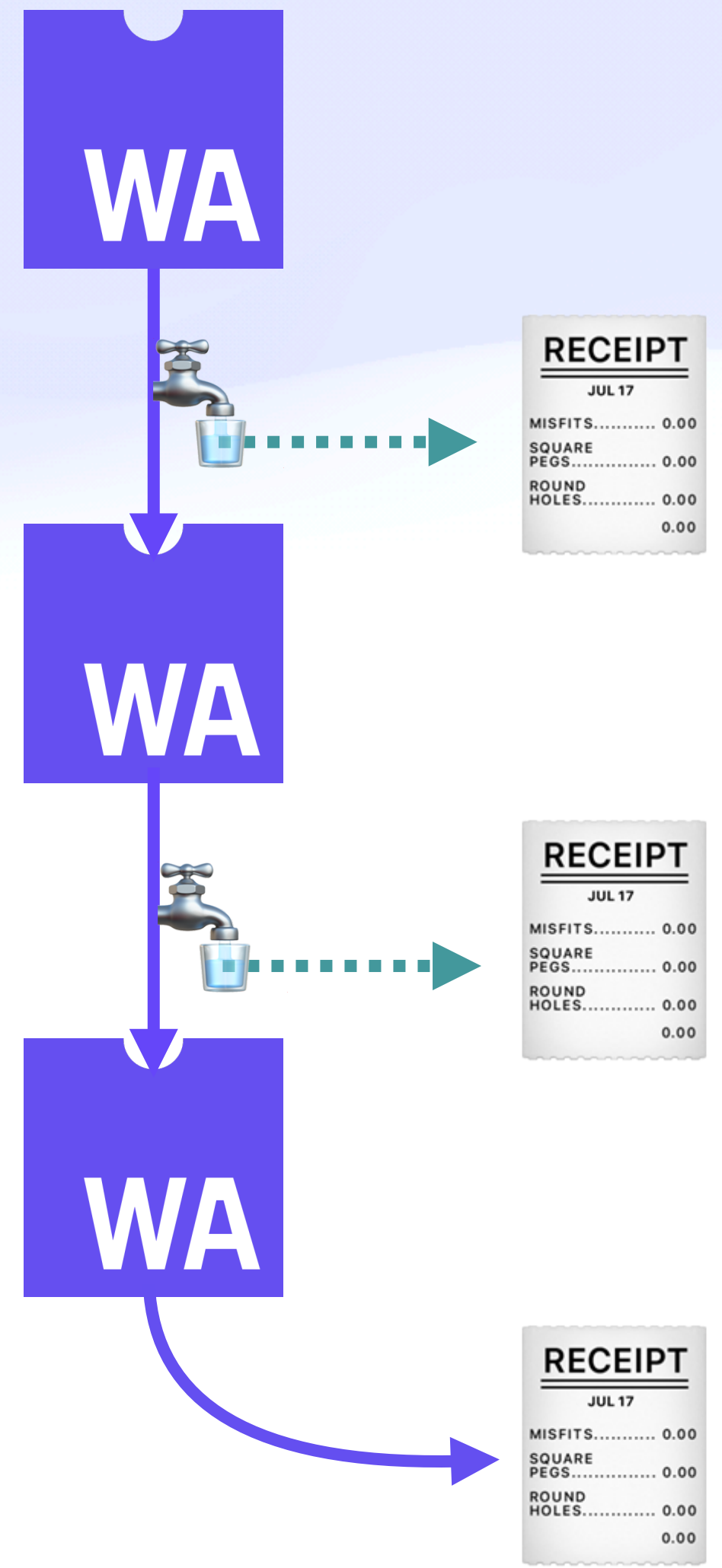
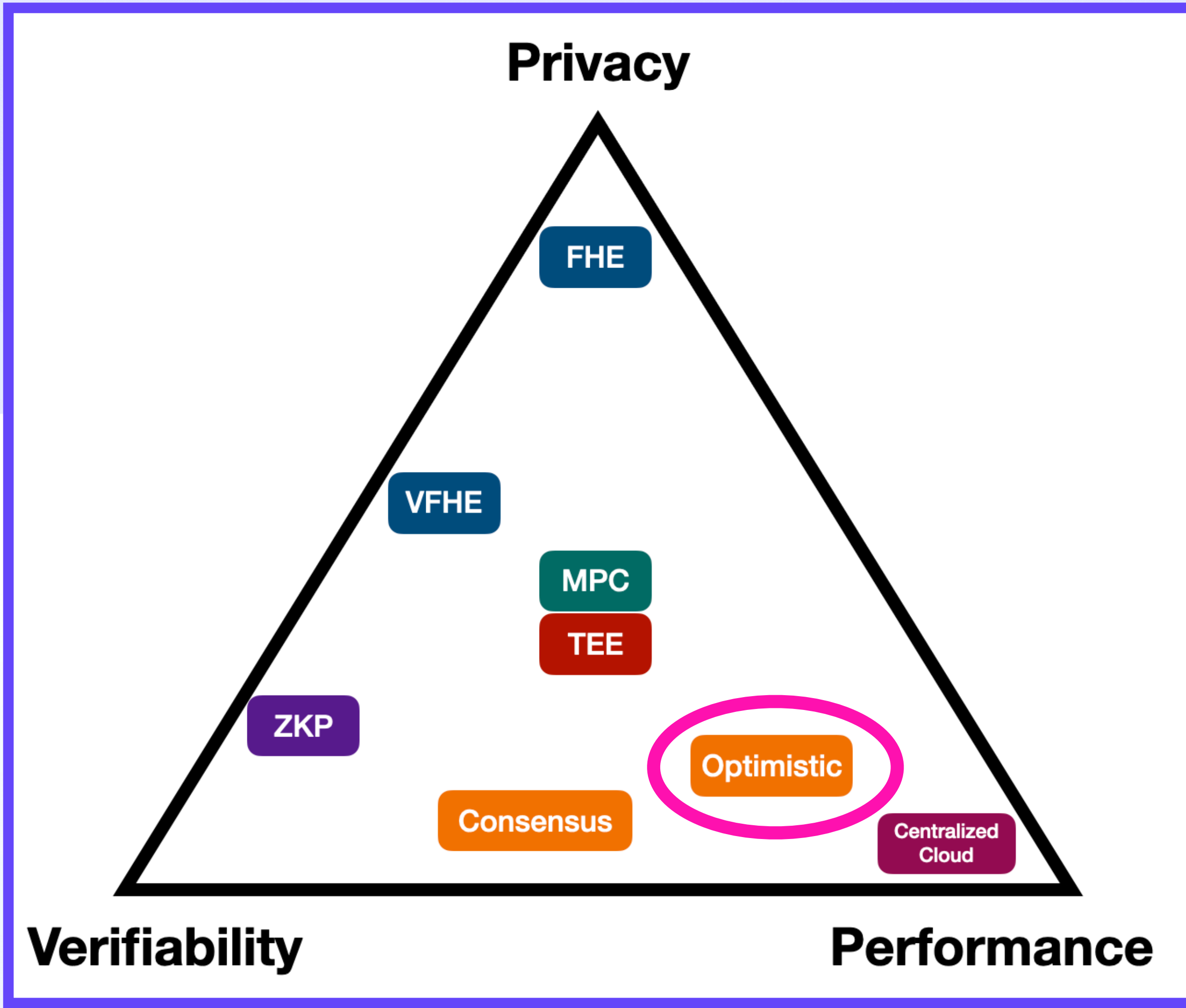
Compute Substrate

Determinism = Verifiable Computation



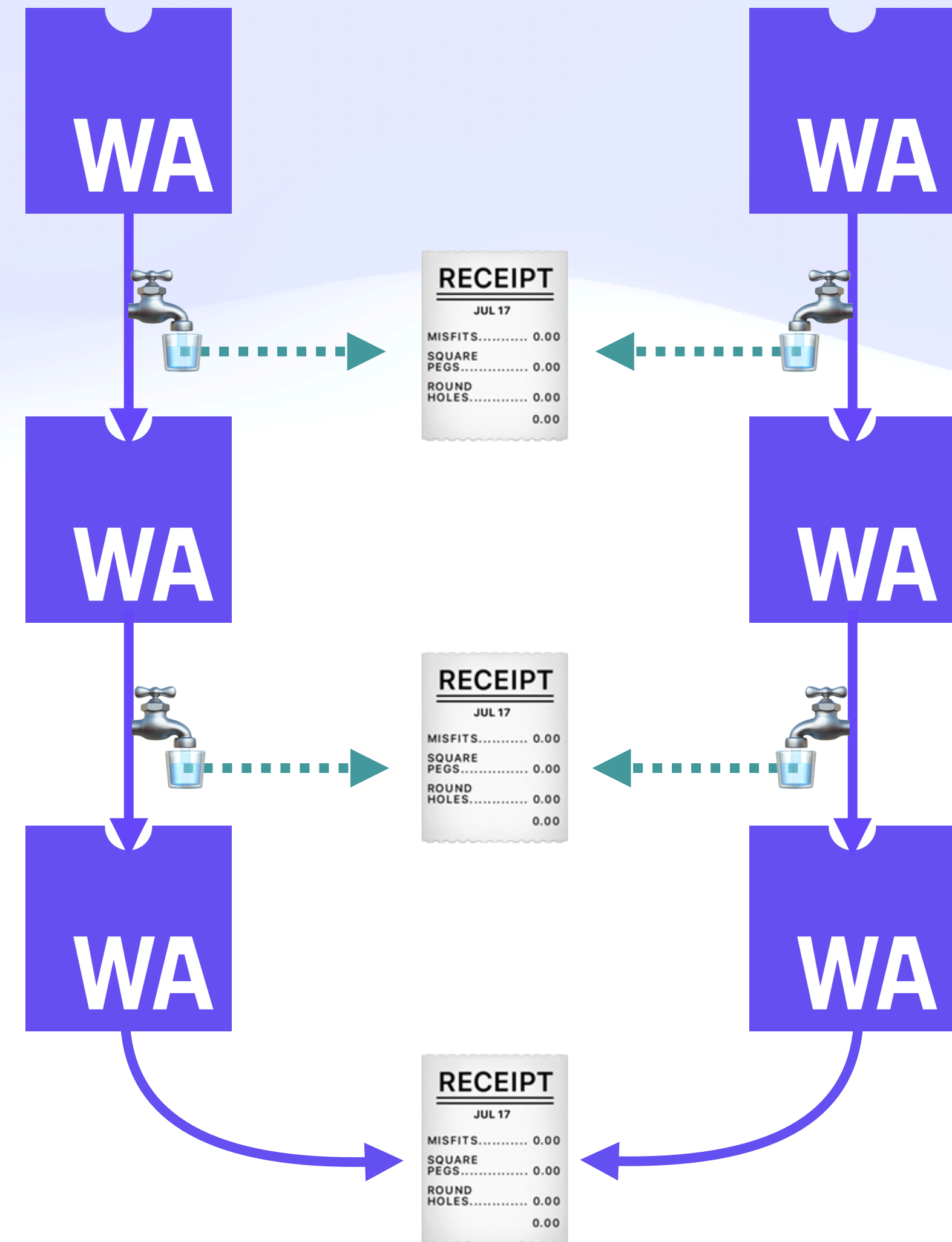
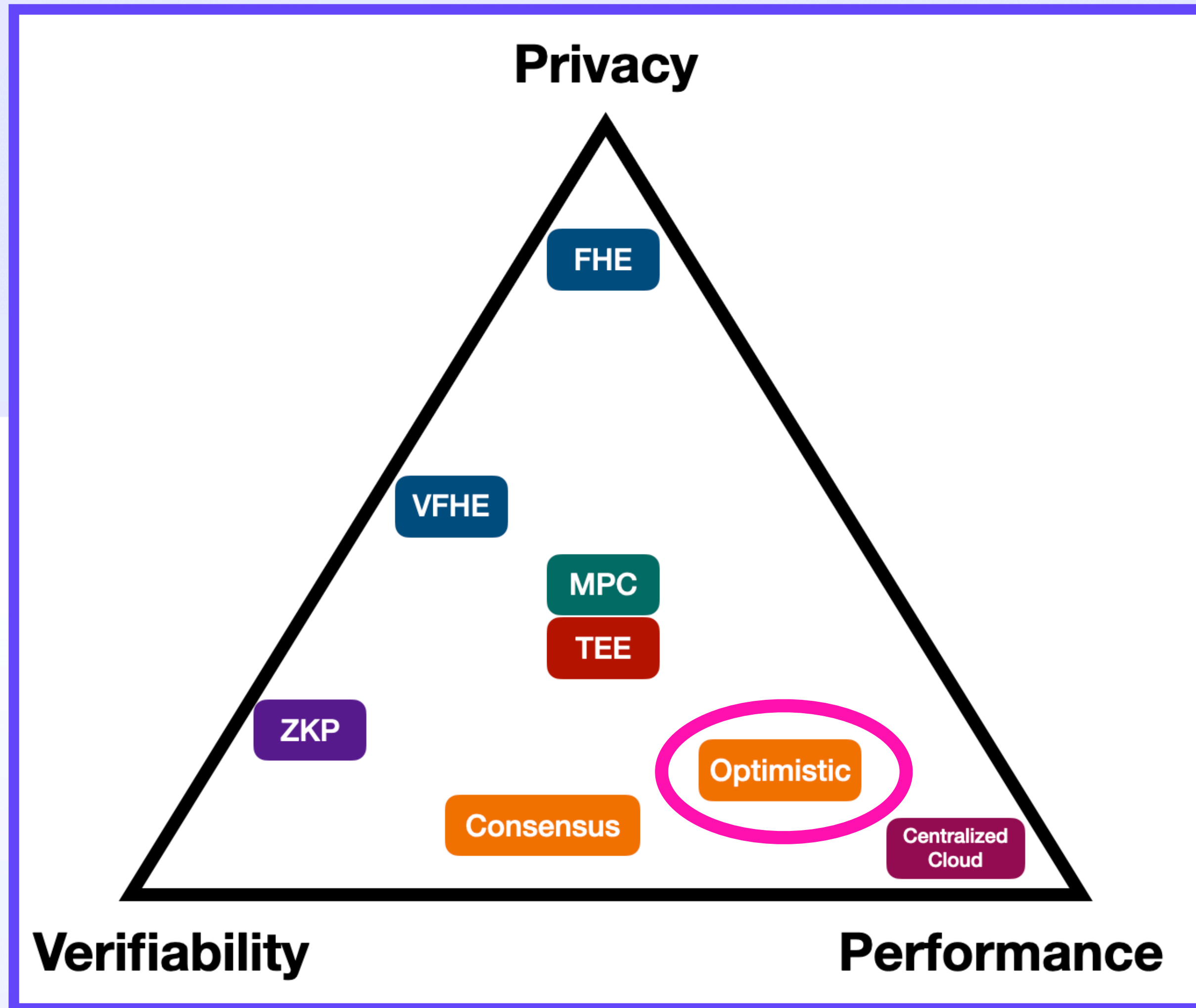
Compute Substrate

Determinism = Verifiable Computation



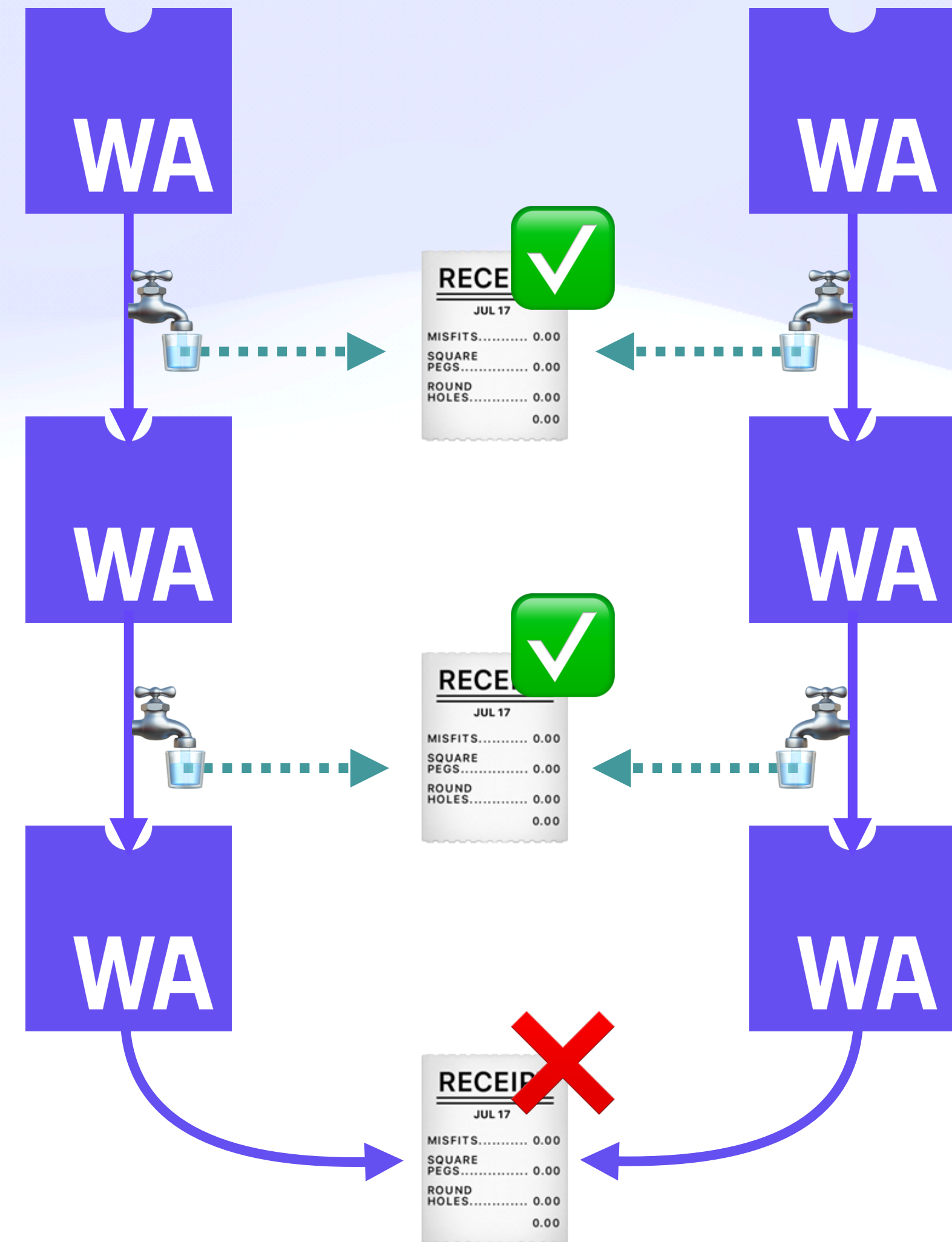
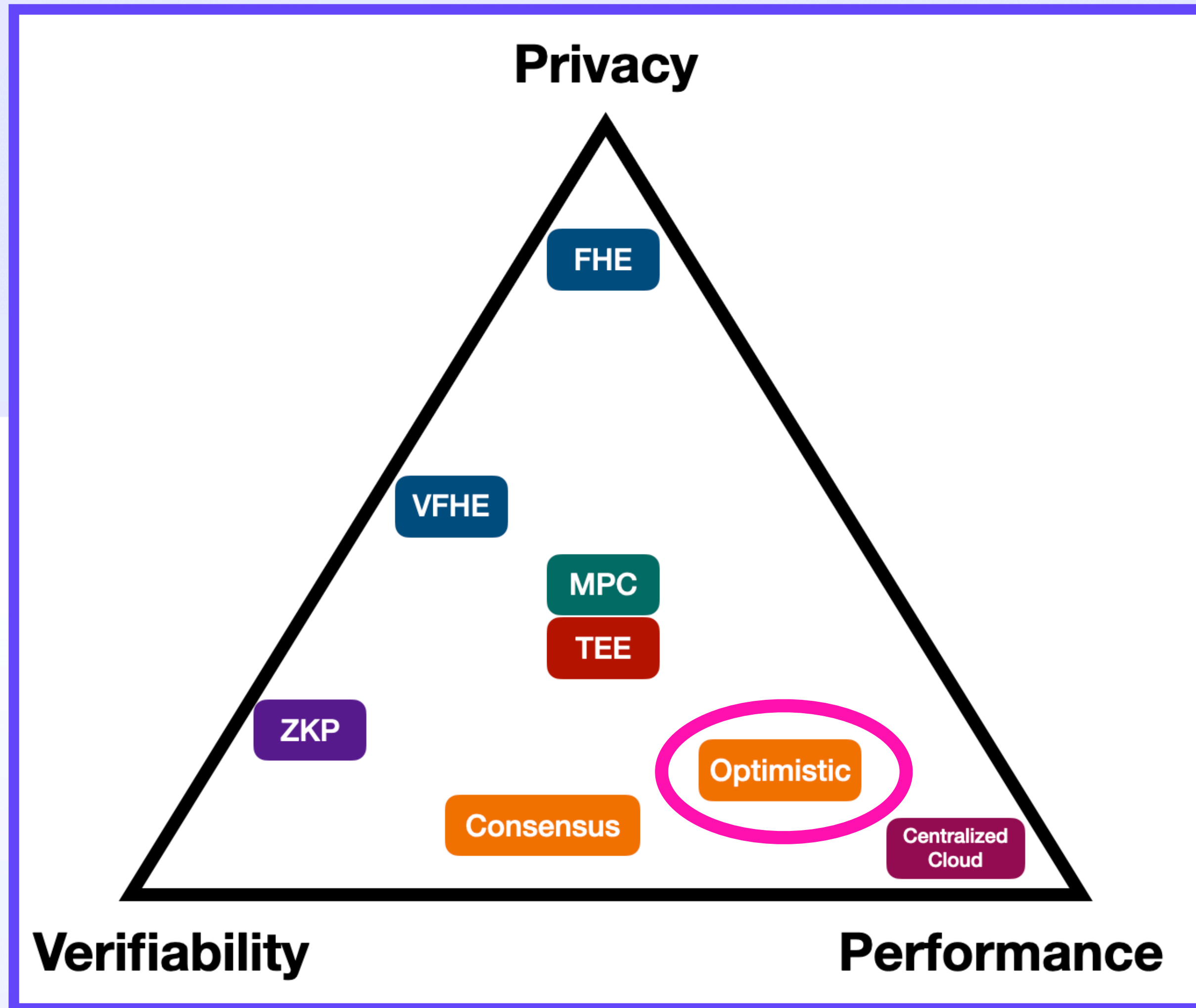
Compute Substrate

Determinism = Verifiable Computation



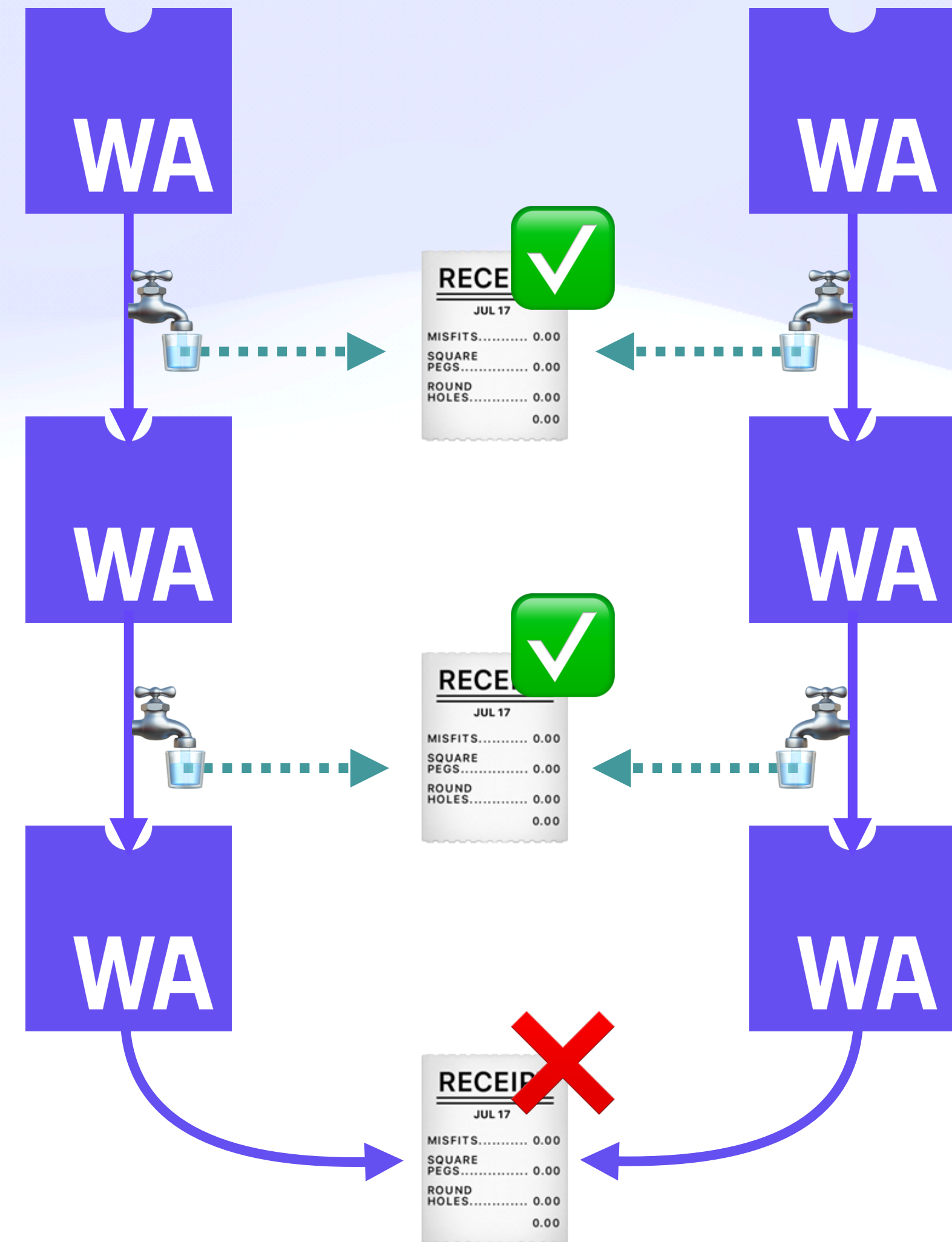
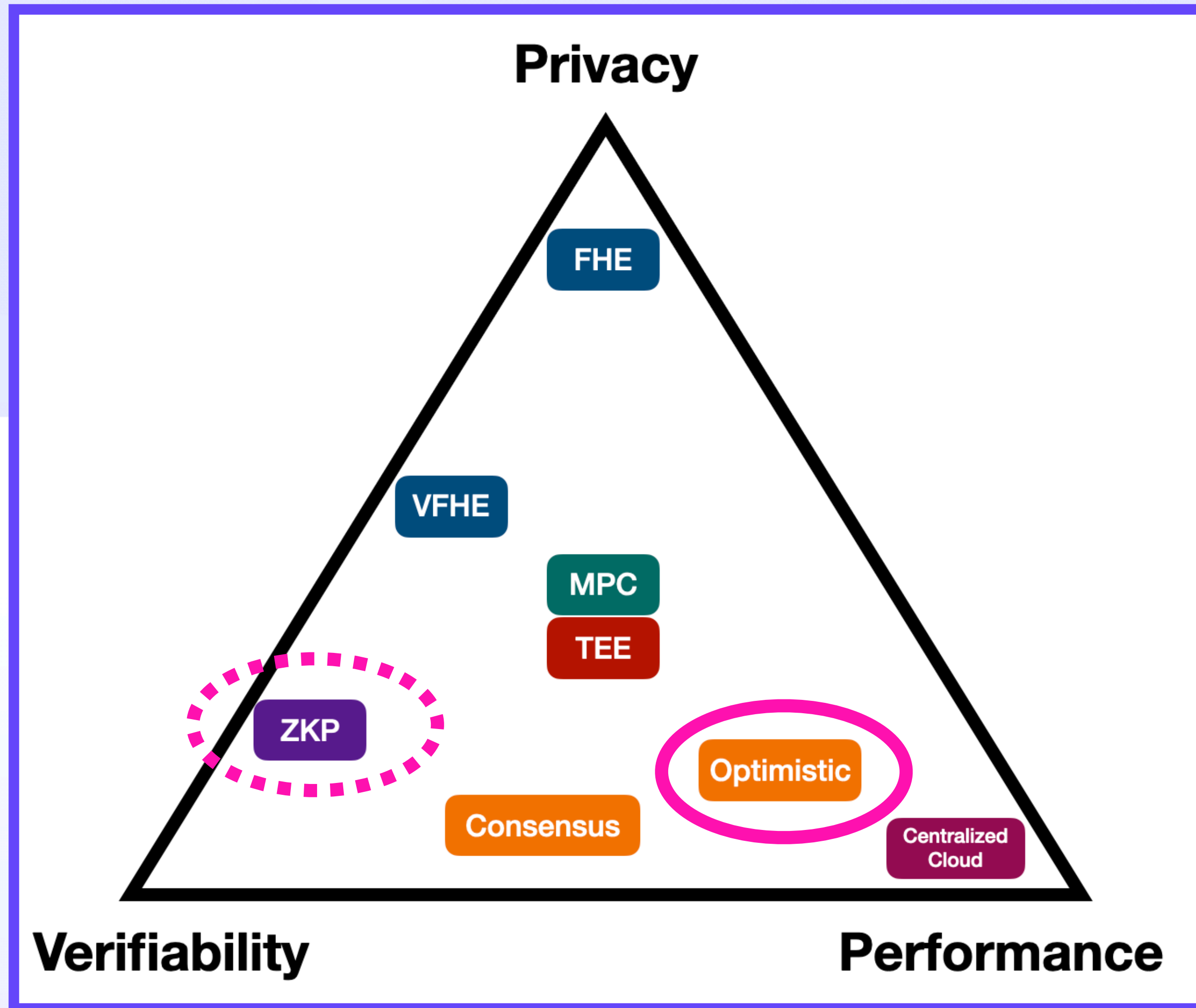
Compute Substrate

Determinism = Verifiable Computation



Compute Substrate

Determinism = Verifiable Computation







The Safety Dance

— Semantics to Climb Out of the Tar Pit —

The Safety Dance 

Description vs Invocation

The Safety Dance 🕺

Description vs Invocation

Impure functions produce **side effects**

Pure functions manipulate **data**

Side effects → **managed** effects

The Safety Dance 🕺

Description vs Invocation

Impure functions produce **side effects**

Pure functions manipulate **data**

Side effects → **managed** effects

function

The Safety Dance 🕺

Description vs Invocation

Impure functions produce **side effects**

Pure functions manipulate **data**

Side effects → **managed** effects



The Safety Dance 🕺

Description vs Invocation

Impure functions produce **side effects**

Pure functions manipulate **data**

Side effects → **managed** effects



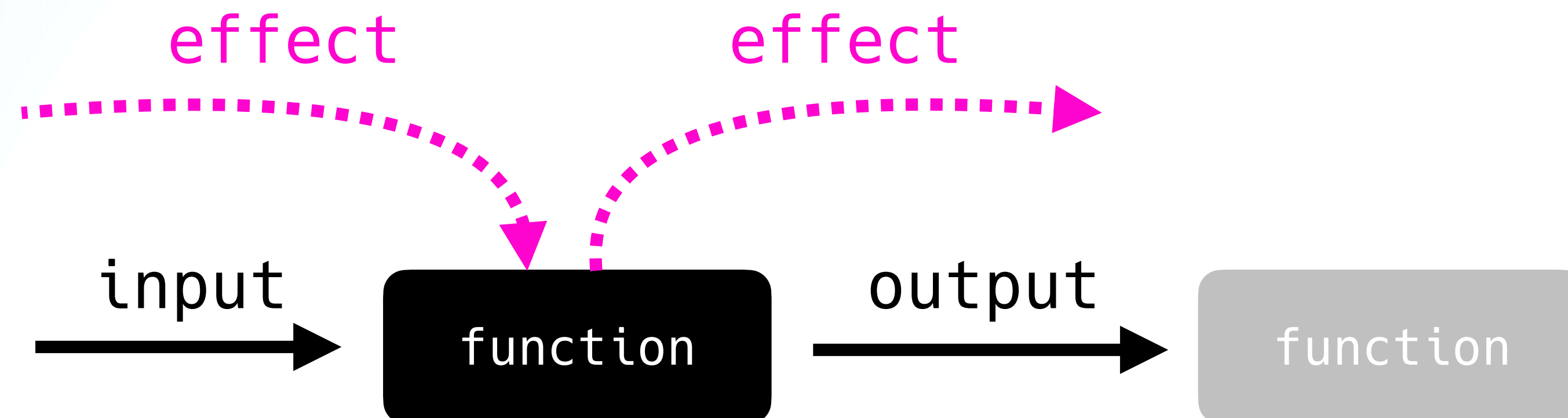
The Safety Dance 🕺

Description vs Invocation

Impure functions produce **side effects**

Pure functions manipulate **data**

Side effects → **managed** effects



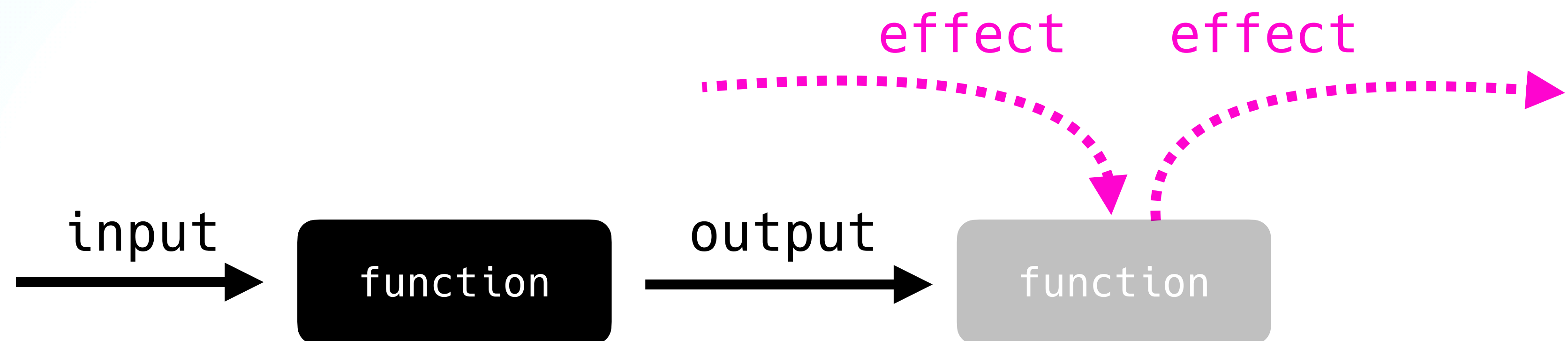
The Safety Dance 🕺

Description vs Invocation

Impure functions produce **side effects**

Pure functions manipulate **data**

Side effects → **managed** effects



The Safety Dance 🕺

Managed Effects

Mutation Effect Stream - - - - -

Query Effect Stream - - - - -

Pure Function Stream - - - - -

Base Event Stream _____

$t \rightarrow$

The Safety Dance 🕺

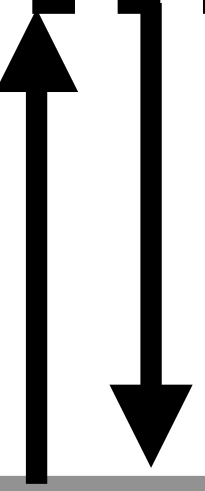
Managed Effects

Mutation Effect Stream - - - - -

Query Effect Stream - - - - -

Pure Function Stream - - - - -

Base Event Stream _____



$t \rightarrow$

The Safety Dance 🕺

Managed Effects

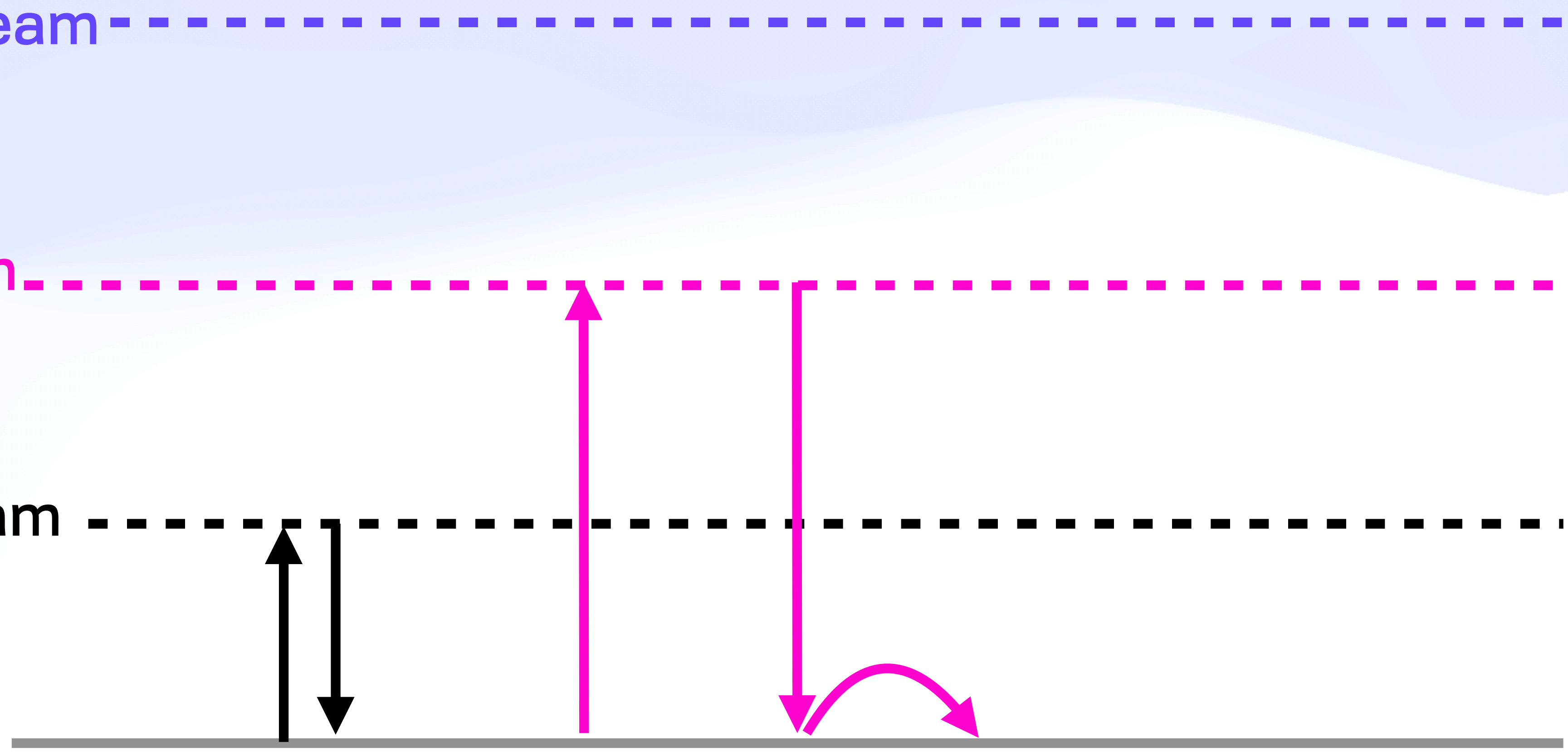
Mutation Effect Stream

Query Effect Stream

Pure Function Stream

Base Event Stream

$t \rightarrow$



The Safety Dance 🕺

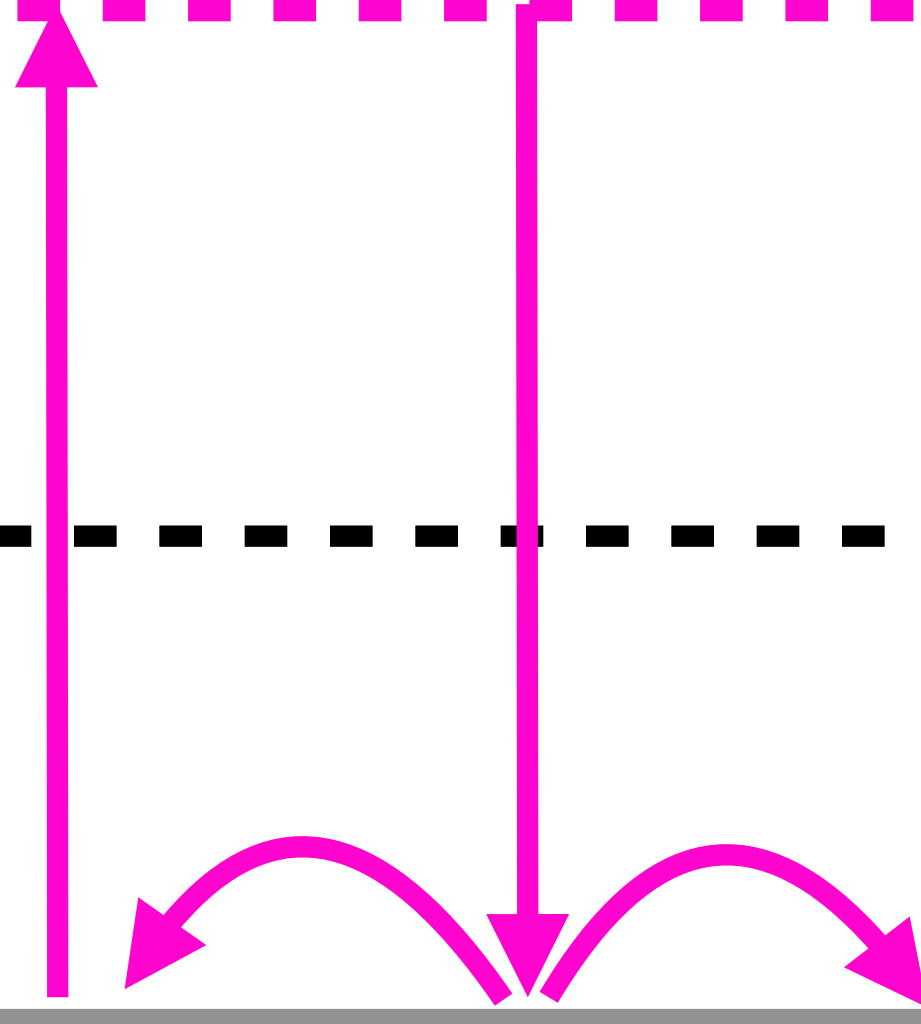
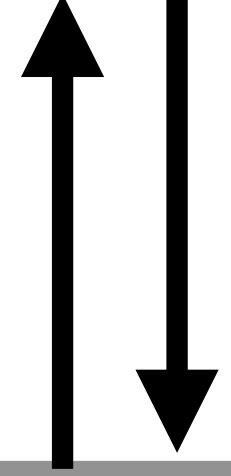
Managed Effects

Mutation Effect Stream - - - - -

Query Effect Stream - - - - -

Pure Function Stream - - - - -

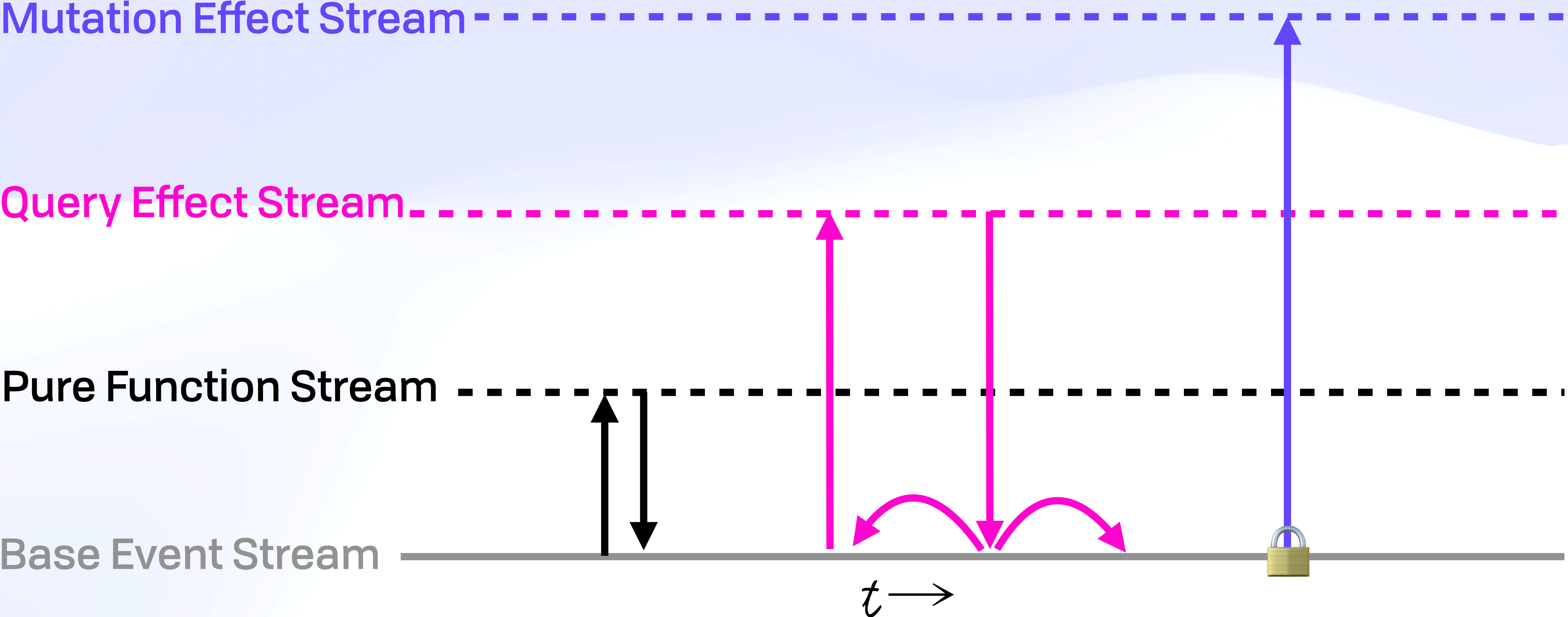
Base Event Stream _____



$t \rightarrow$

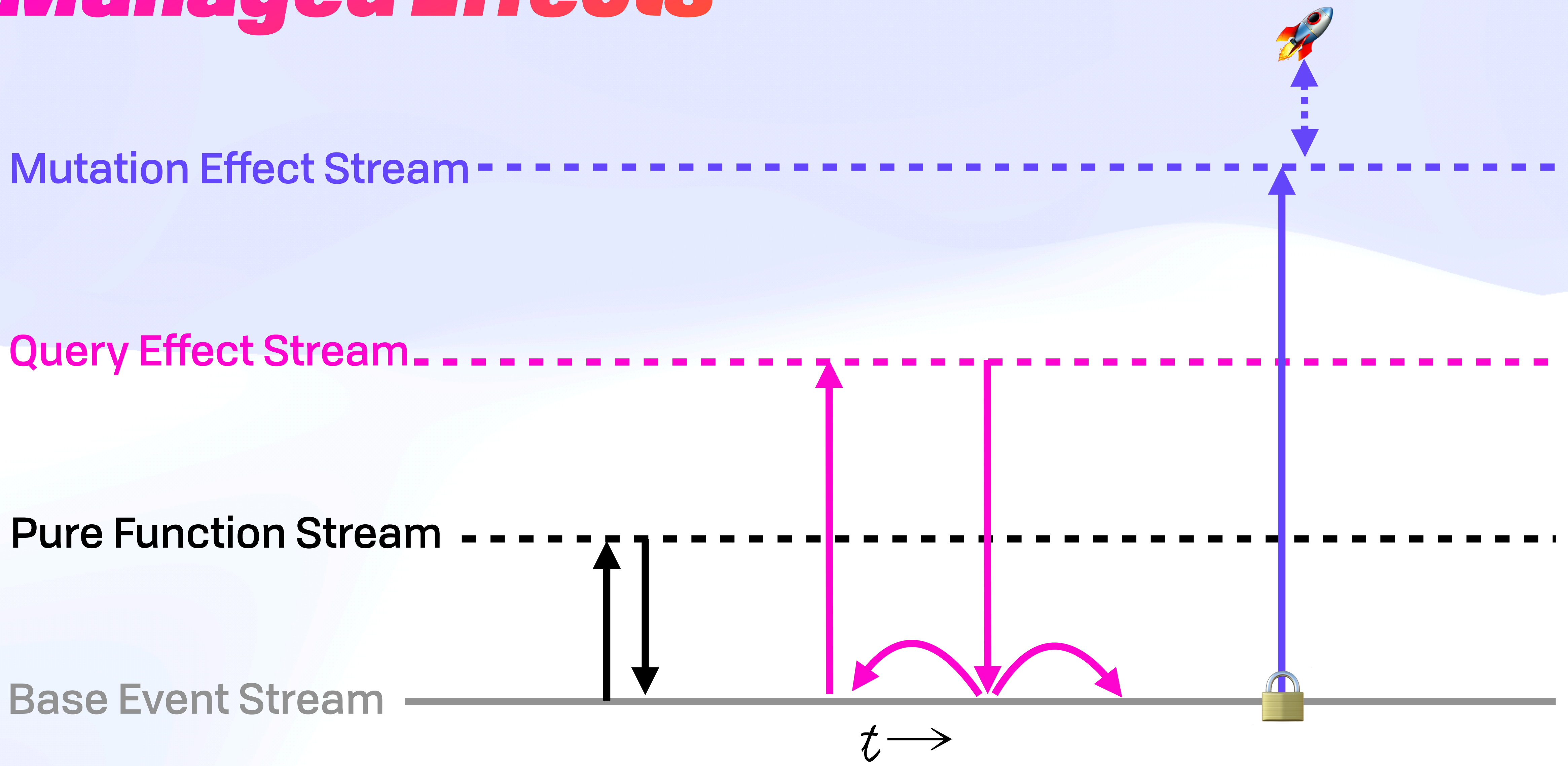
The Safety Dance 🕺

Managed Effects



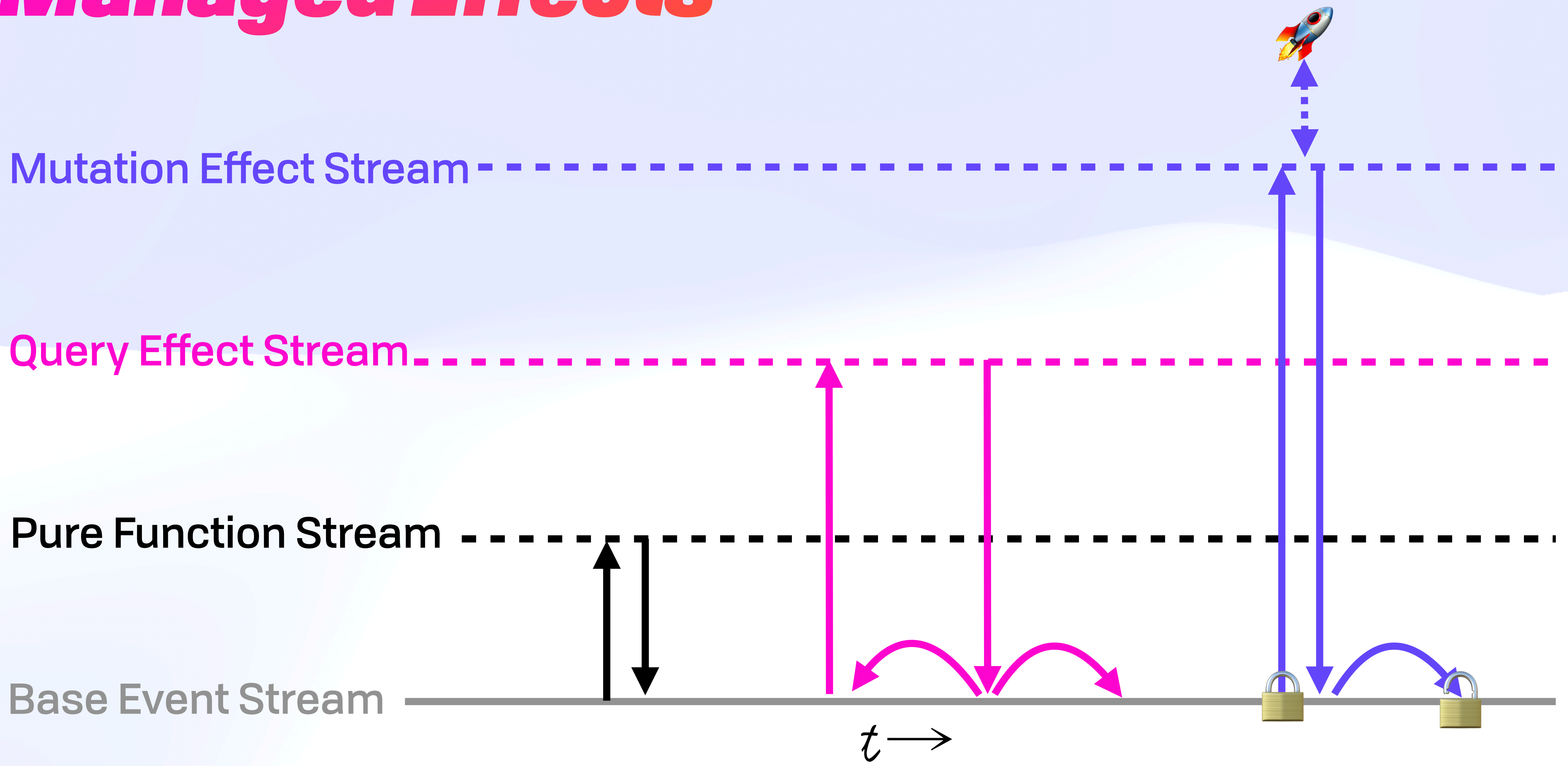
The Safety Dance

Managed Effects



The Safety Dance

Managed Effects



The Safety Dance 

Virtual Resiliency

The Safety Dance 🕺

Virtual Resiliency

Mutable 🦋

Idempotent 🔄

Deterministic 📅
JUL 17

The Safety Dance 🕺

Virtual Resiliency

Query A

Query B

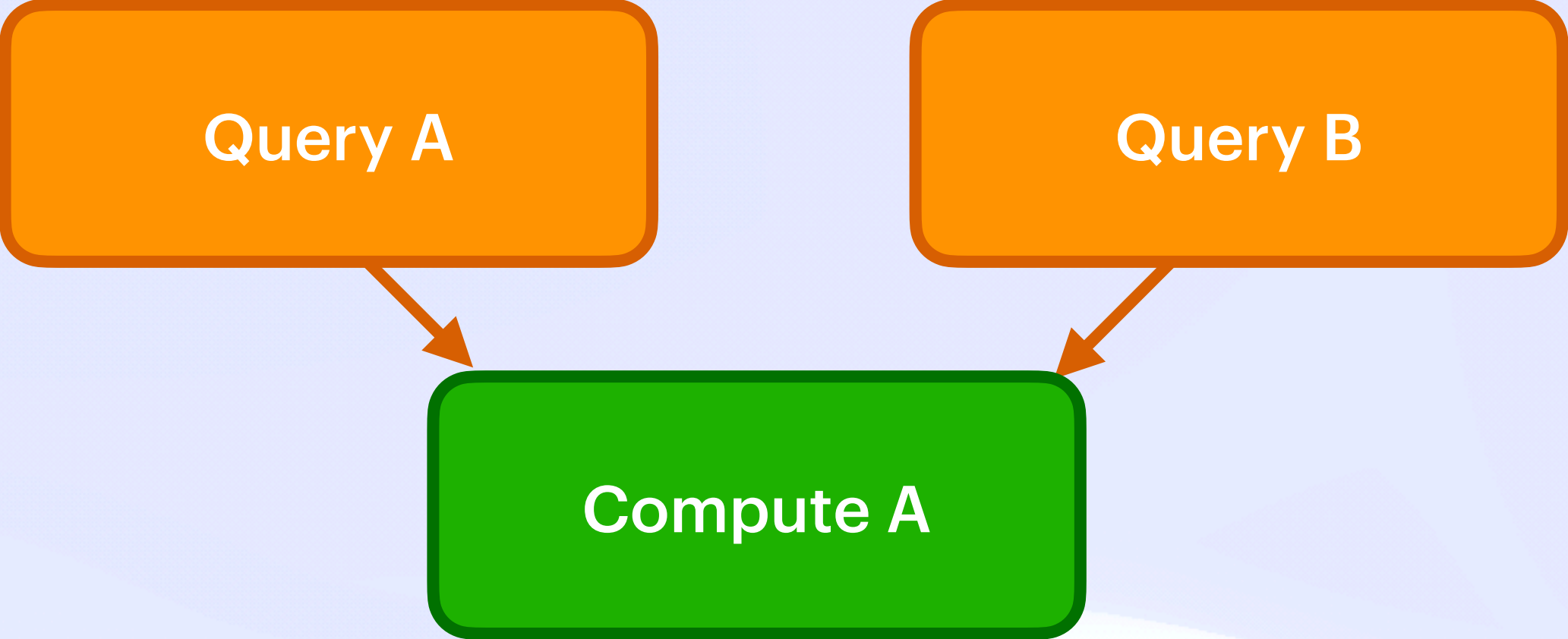
Mutable 🦋

Idempotent 🔄

Deterministic 📅 17

The Safety Dance

Virtual Resiliency



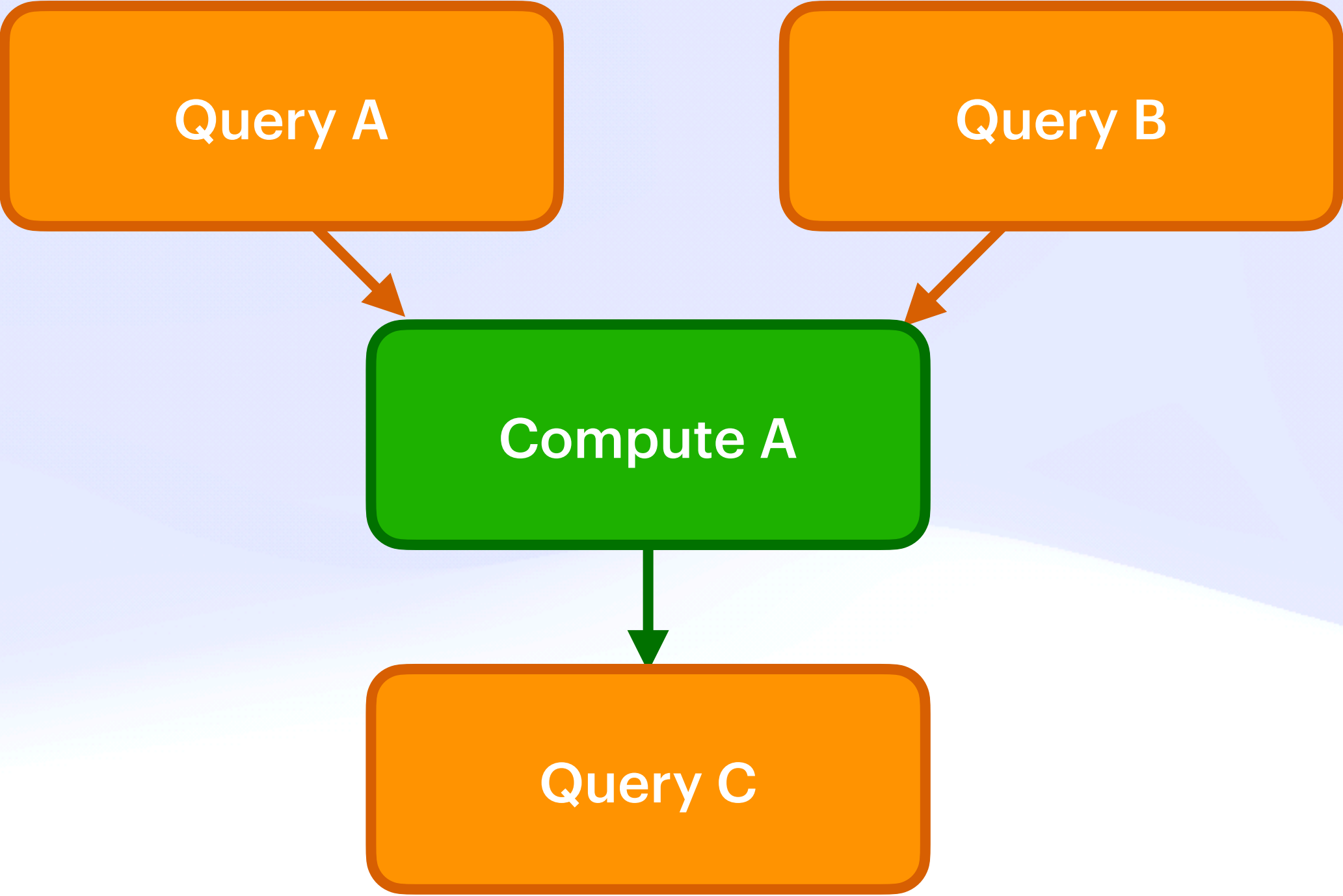
Mutable 

Idempotent 

Deterministic 

The Safety Dance 🧑

Virtual Resiliency



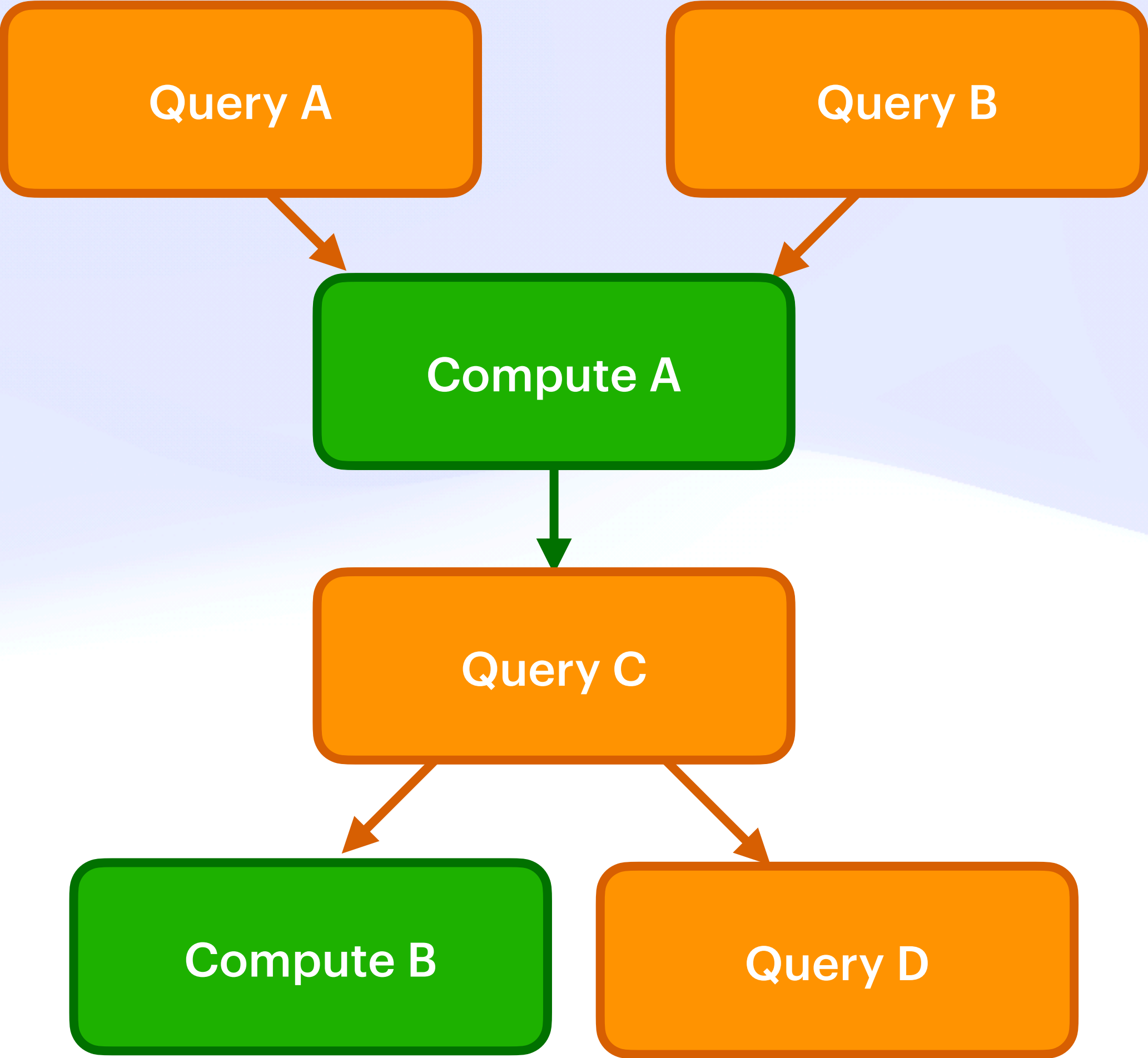
Mutable 🦋

Idempotent 🔄

Deterministic 📅 17

The Safety Dance 🧑

Virtual Resiliency



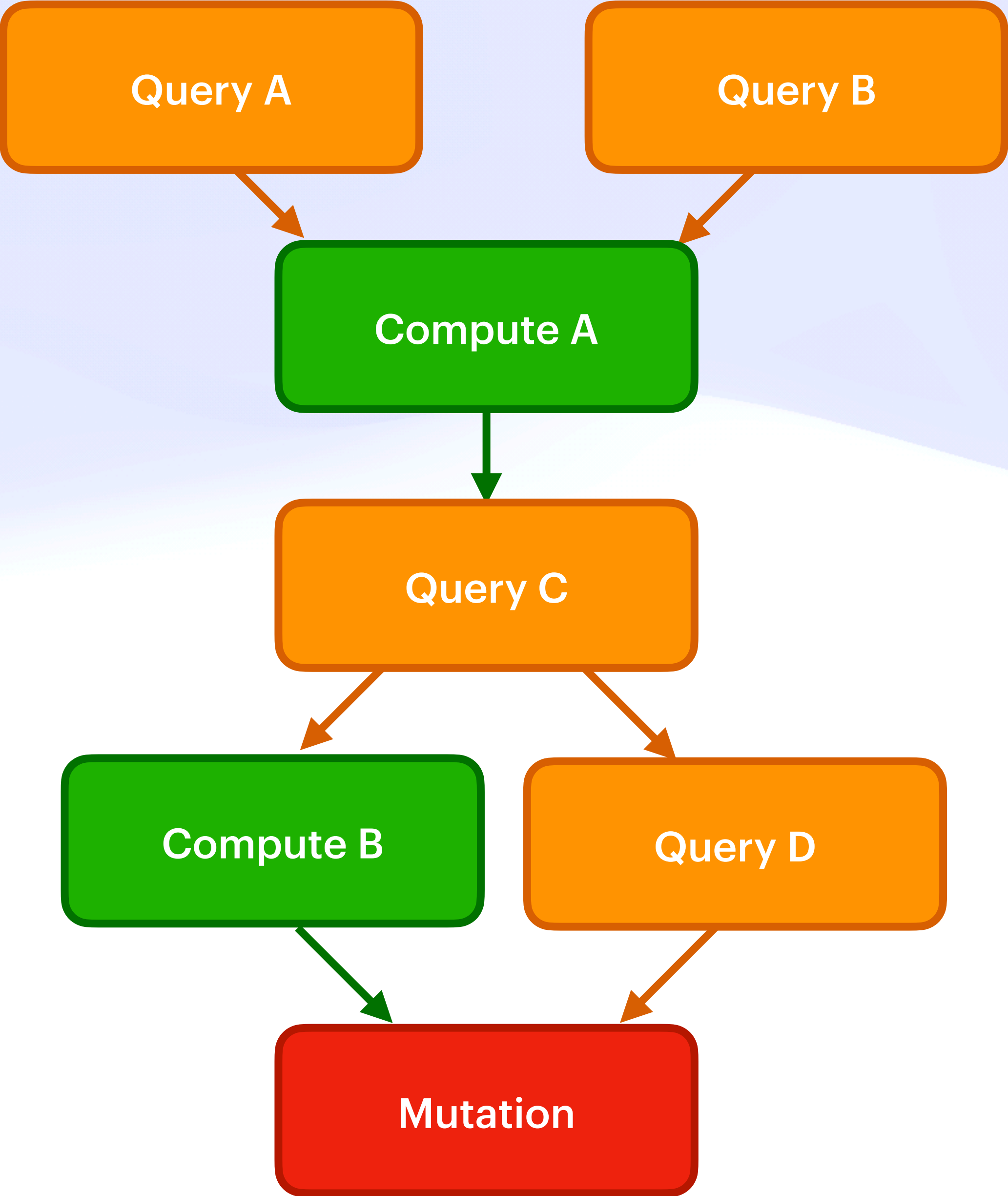
Mutable 🦋

Idempotent 🔄

Deterministic 📅 17

The Safety Dance 🧑

Virtual Resiliency



Mutable 🦋

Idempotent 🔄

Deterministic 📅 17

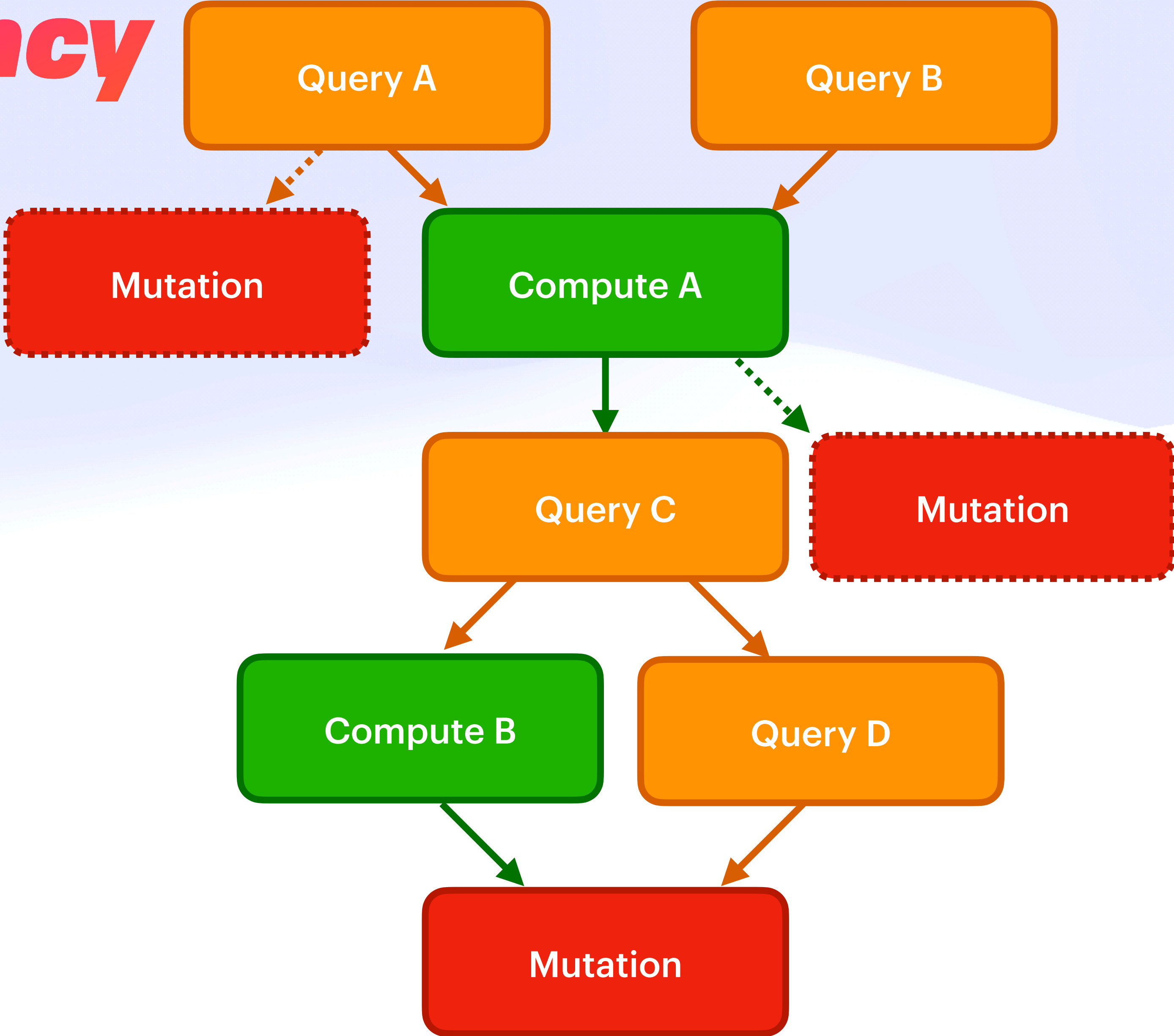
The Safety Dance 🧑

Virtual Resiliency

Mutable 🦋

Idempotent 🔄

Deterministic 📅 17



The Safety Dance 🕺

The Safety Dance

If their application can be cast as ***pure data processing***, they benefit from the past 40-50 years of work from the database community, [and] ***completely isolate the developer from the possibility of failure***

— **Goldstein et al**, AMBROSIA: Providing Performant Virtual Resiliency for Distributed Applications

The Safety Dance 

Simplified Safe Layout

The Safety Dance 

Simplified Safe Layout

Queries

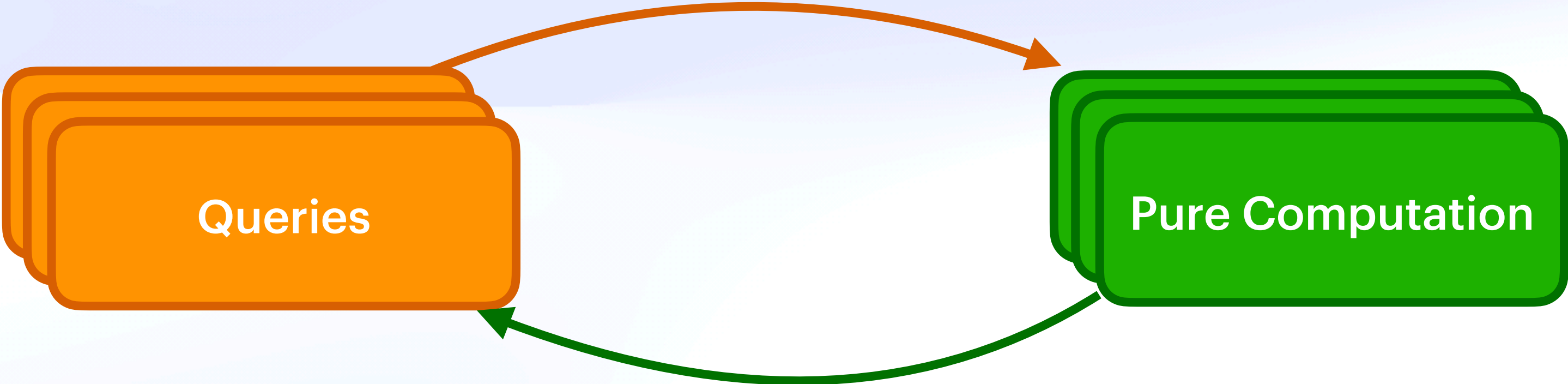
The Safety Dance 🕺

Simplified Safe Layout



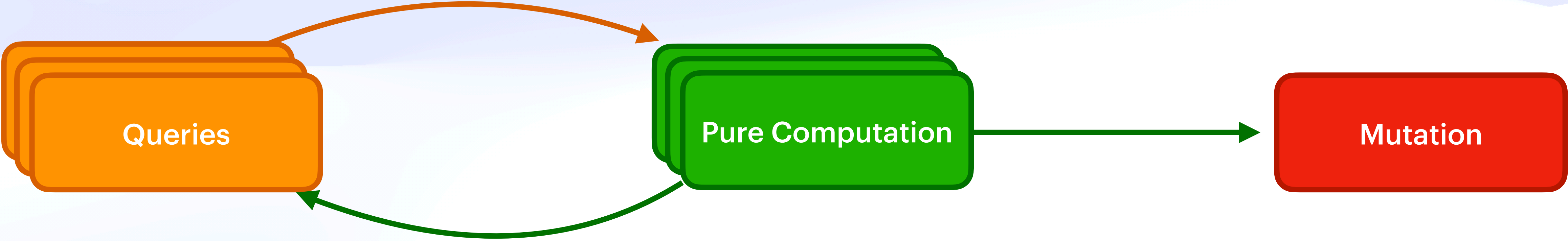
The Safety Dance 🕺

Simplified Safe Layout



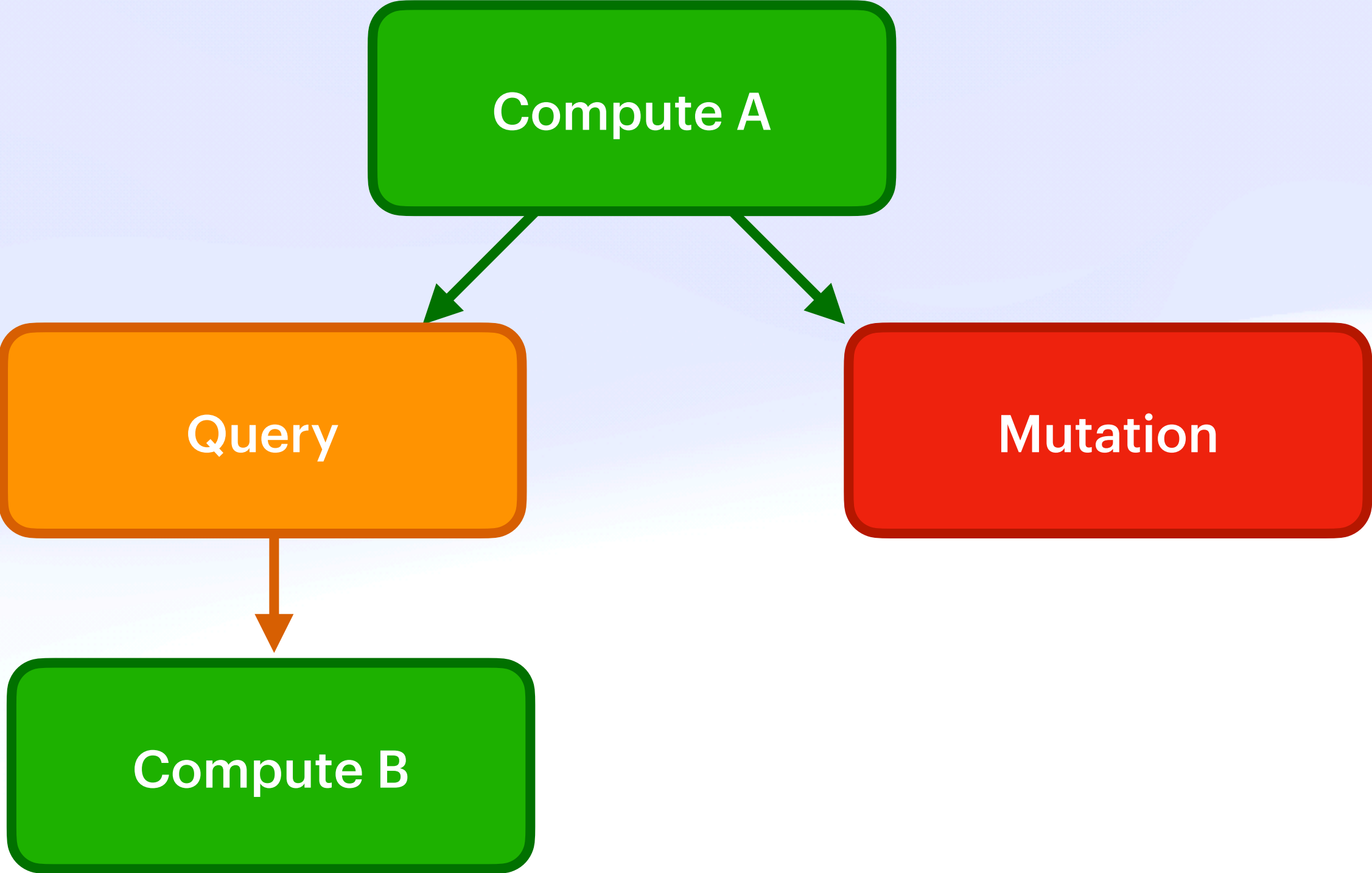
The Safety Dance 🕺

Simplified Safe Layout



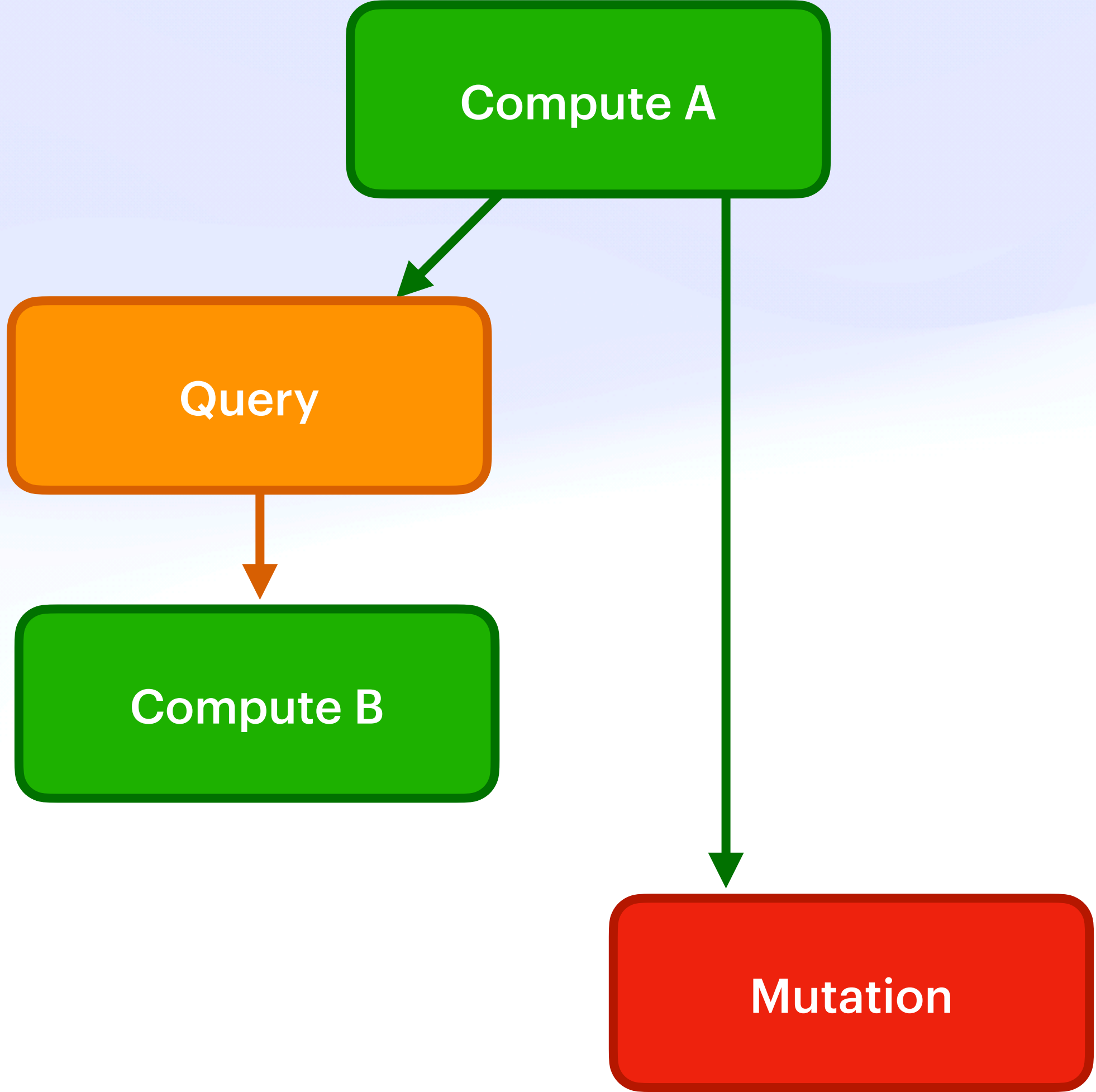
The Safety Dance 🕺

Simple Example



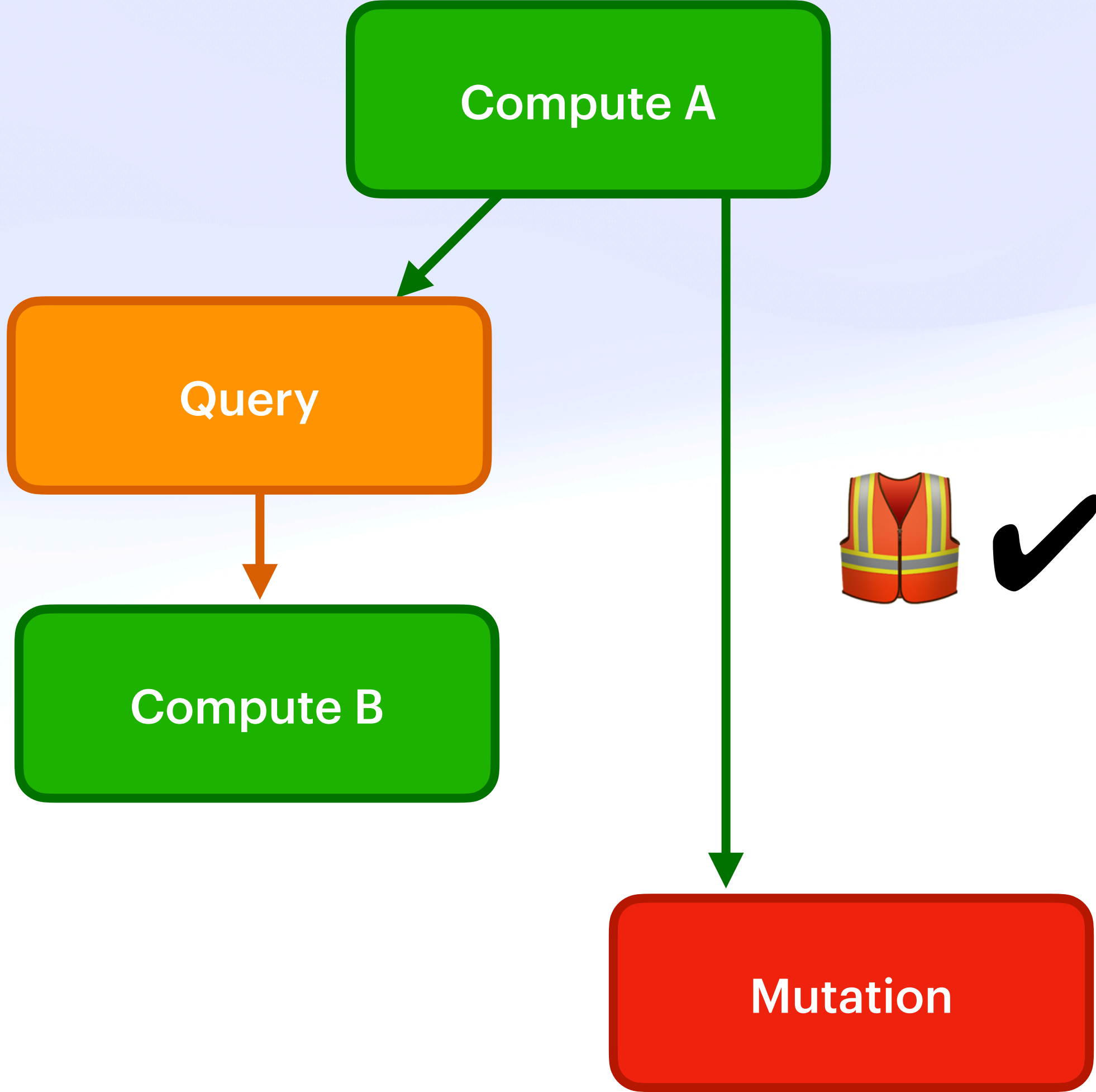
The Safety Dance 🕺

Simple Example



The Safety Dance 

Simple Example





A large, vibrant red gift box is the central focus, wrapped in a shiny, metallic-looking paper. A wide, gold ribbon is wrapped around it, forming a large, elegant bow on the top left. The box is set against a bright, light blue background. At the bottom of the frame, a diverse crowd of people is gathered, looking up at the massive gift. The people are dressed in various styles of clothing, suggesting a public event or celebration. The overall scene conveys a sense of anticipation and excitement.

Wrap Up

Wrap Up

Reusable/Remixable Specs

Wrap Up

Reusable/Remixable Specs

IPVM Workflow 🎮

Transactions, Error Handling, Defaults

IPVM Task ⚙️

VM Config, Verification, etc

UCAN Pipeline 🌊

Call Graph, Awaits, etc

UCAN-Chan / ユーキャンちゃん

Consumable Channels

Receipts

Attestation, Memoization, etc

UCAN Invocation ✨

Input Addressing, Execution, etc

UCAN Core 📄

Distributed Authority

IPLD-WIT ⚙️

IDL

Varsig ✍️

Self-Describing Signatures

github.com/ucan-wg
github.com/ipvm-wg



Thank You, Strange Loop 

 <https://fission.codes>

 brooklyn@fission.codes

 [@expede@octodon.social](https://octodon.social/@expede)

 bsky.app/profile/expede.wtf