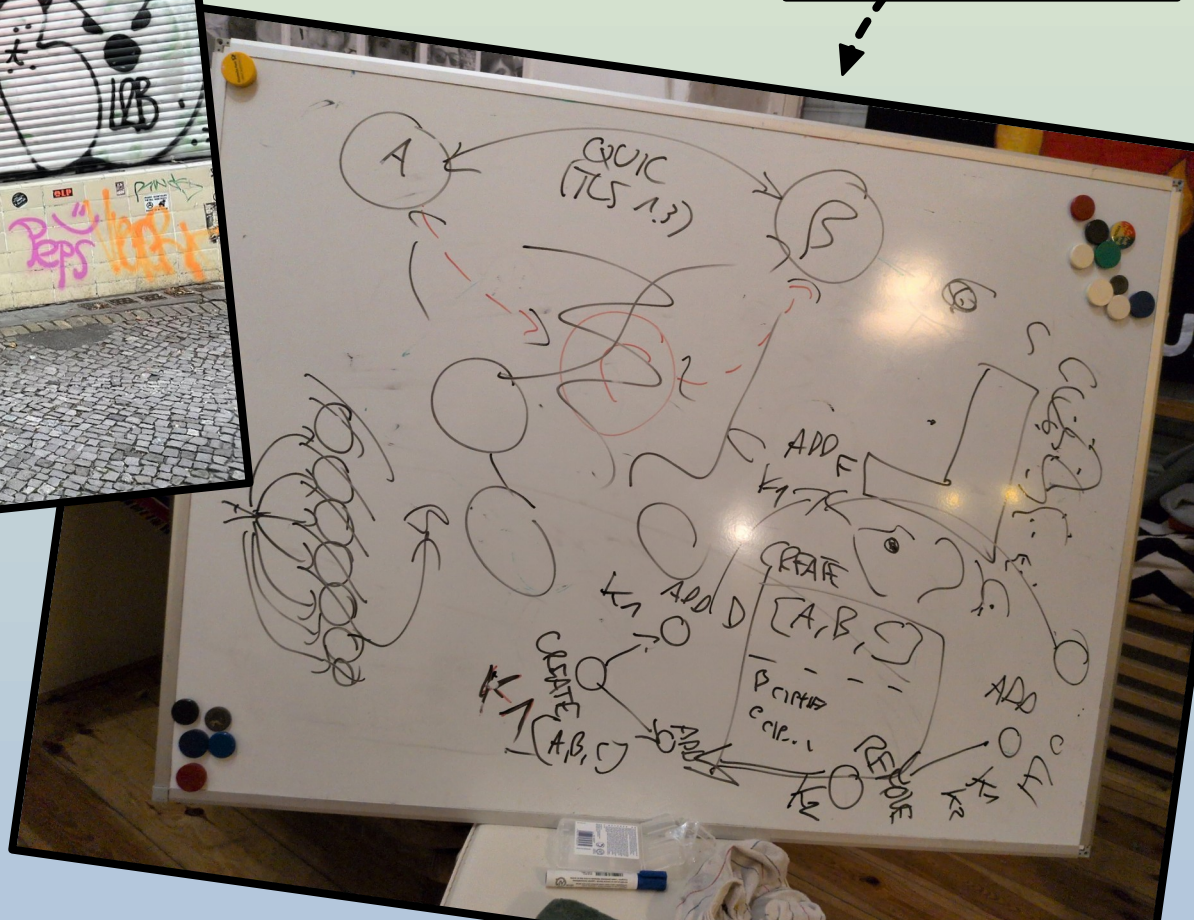
Walkaway Stack

Radical, infrastructure-independent peer-to-peer systems

Andreas Dzialocha
FOSDEM 26, Bruxelles / Brussel

That’s “offline” in Berlin <3

I promise, it made sense back then!



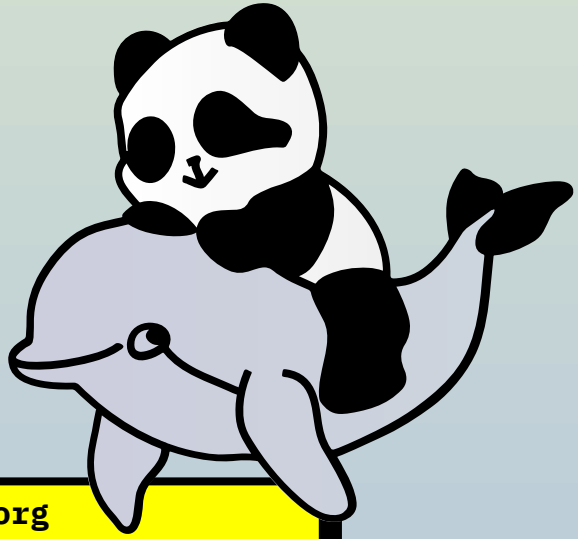
Pad about lectures

Dweb Seminar
13.-17. August
2025, San Francisco

dwebseminar.org

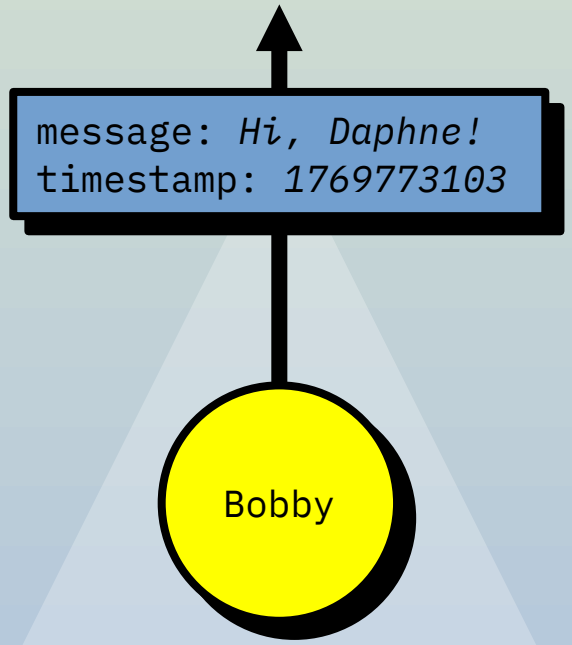
Supported by the
Internet Archive <3

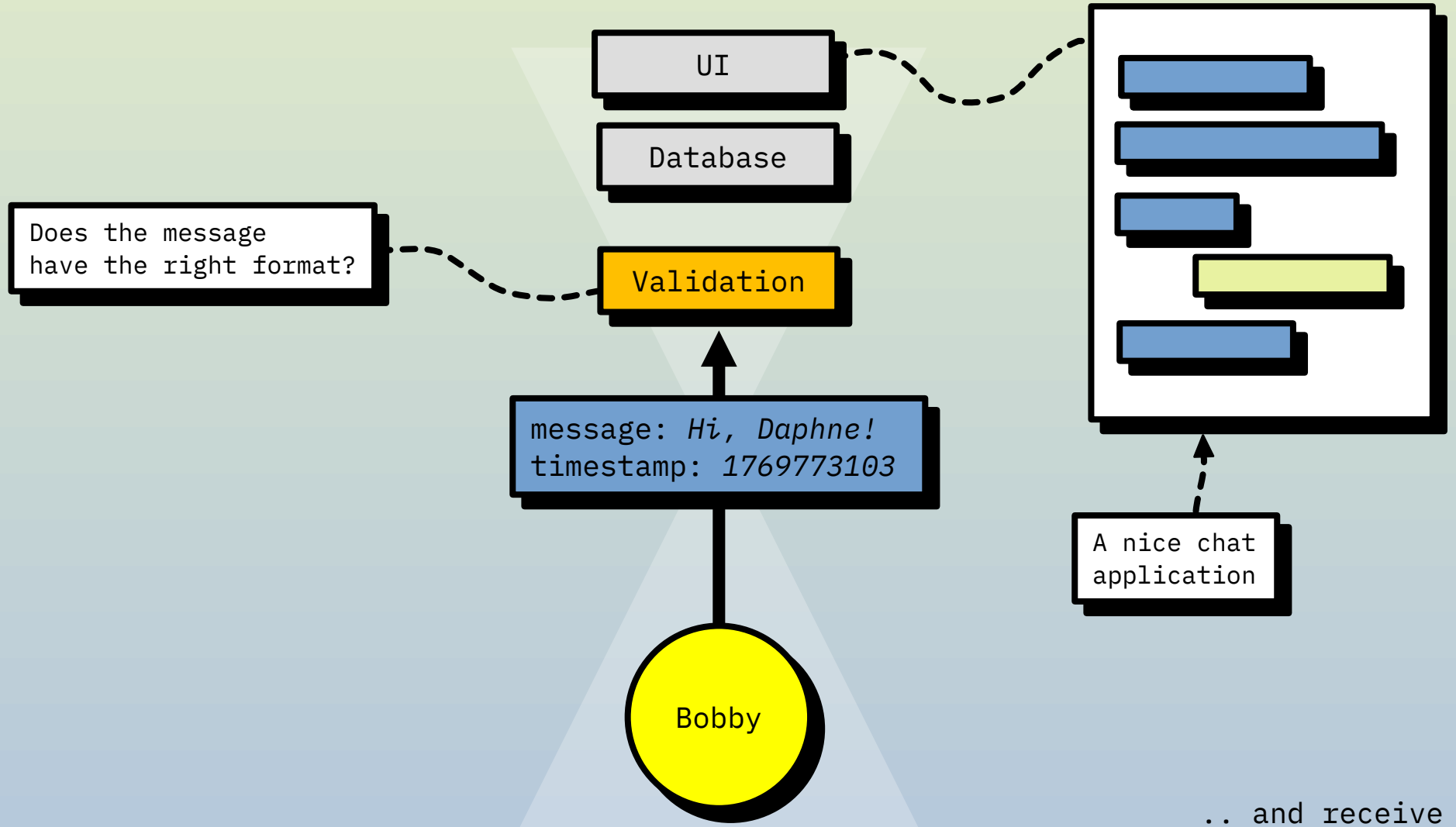
adz.garden
@adz@post.lurk.org
github.com/adzialocha
codeberg.org/adz



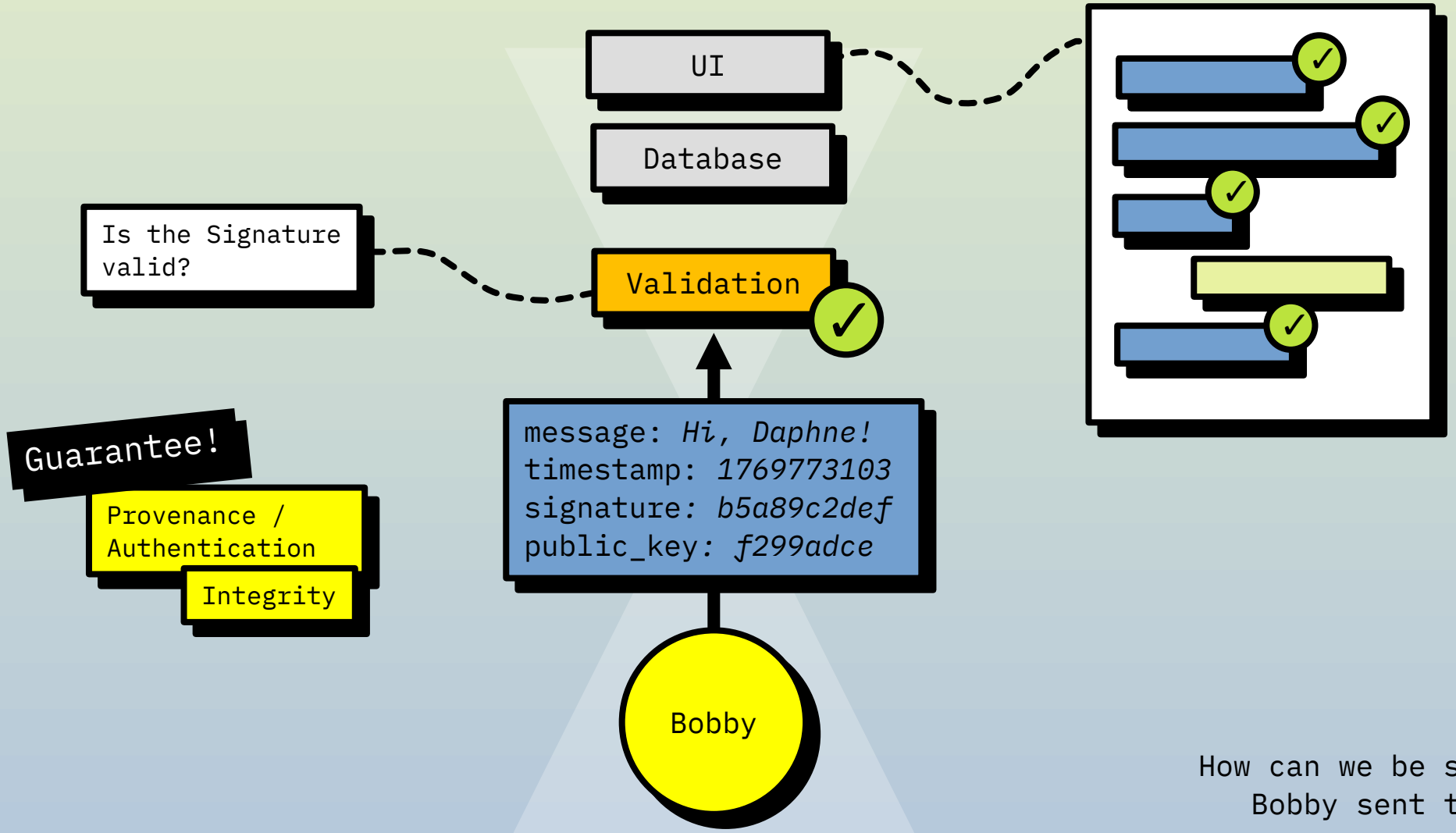
p2panda.org
@p2panda@autonomous.zone
github.com/p2panda

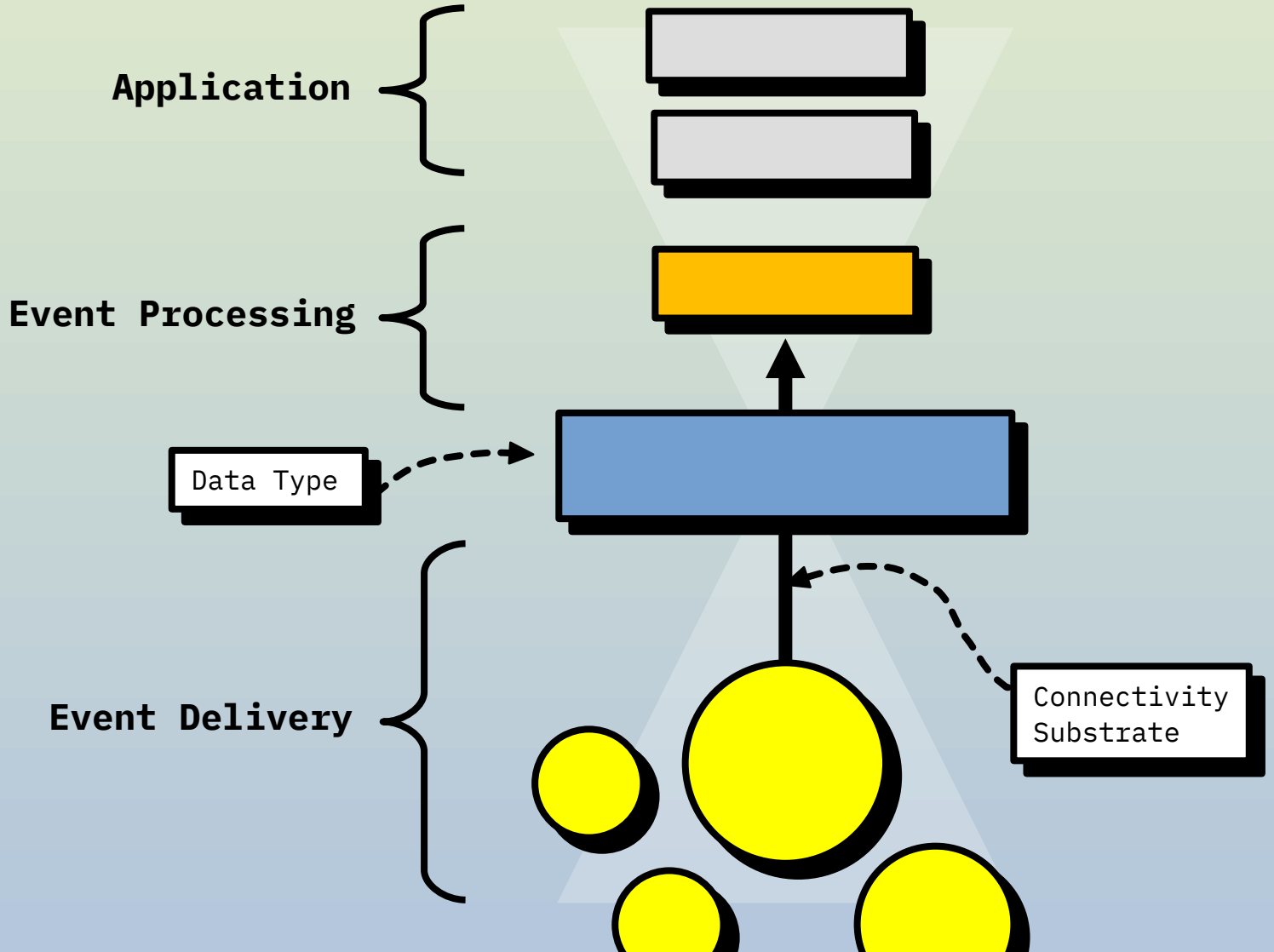
Let’s send a message!





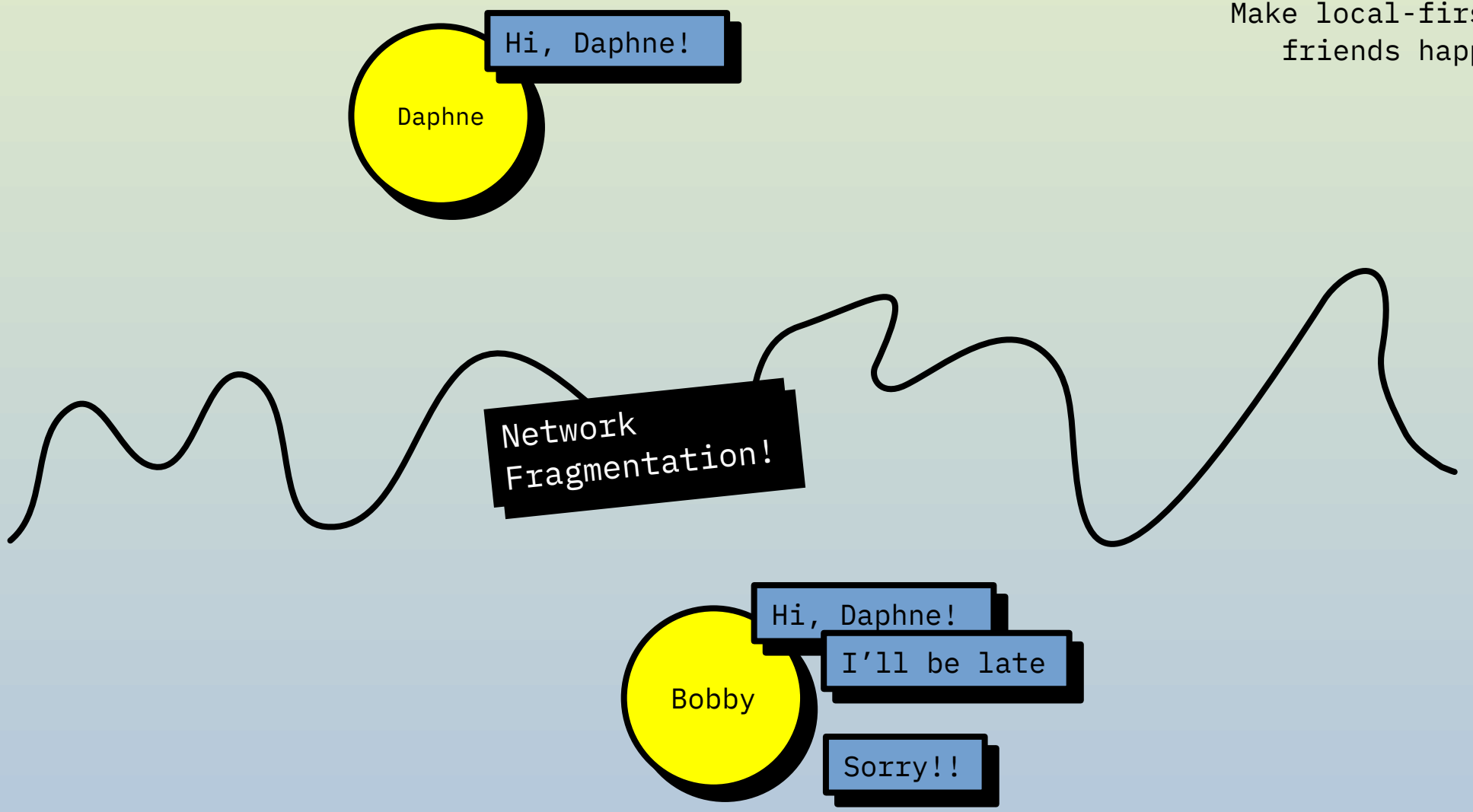
.. and receive it!


UI
Database
Is the Signature valid?
Validation
Guarantee!
Provenance / Authentication
Integrity
message: Hi, Daphne!
timestamp: 1769773103
signature: b5a89c2def
public_key: f299adce
Bobby
How can we be sure Bobby sent this message?

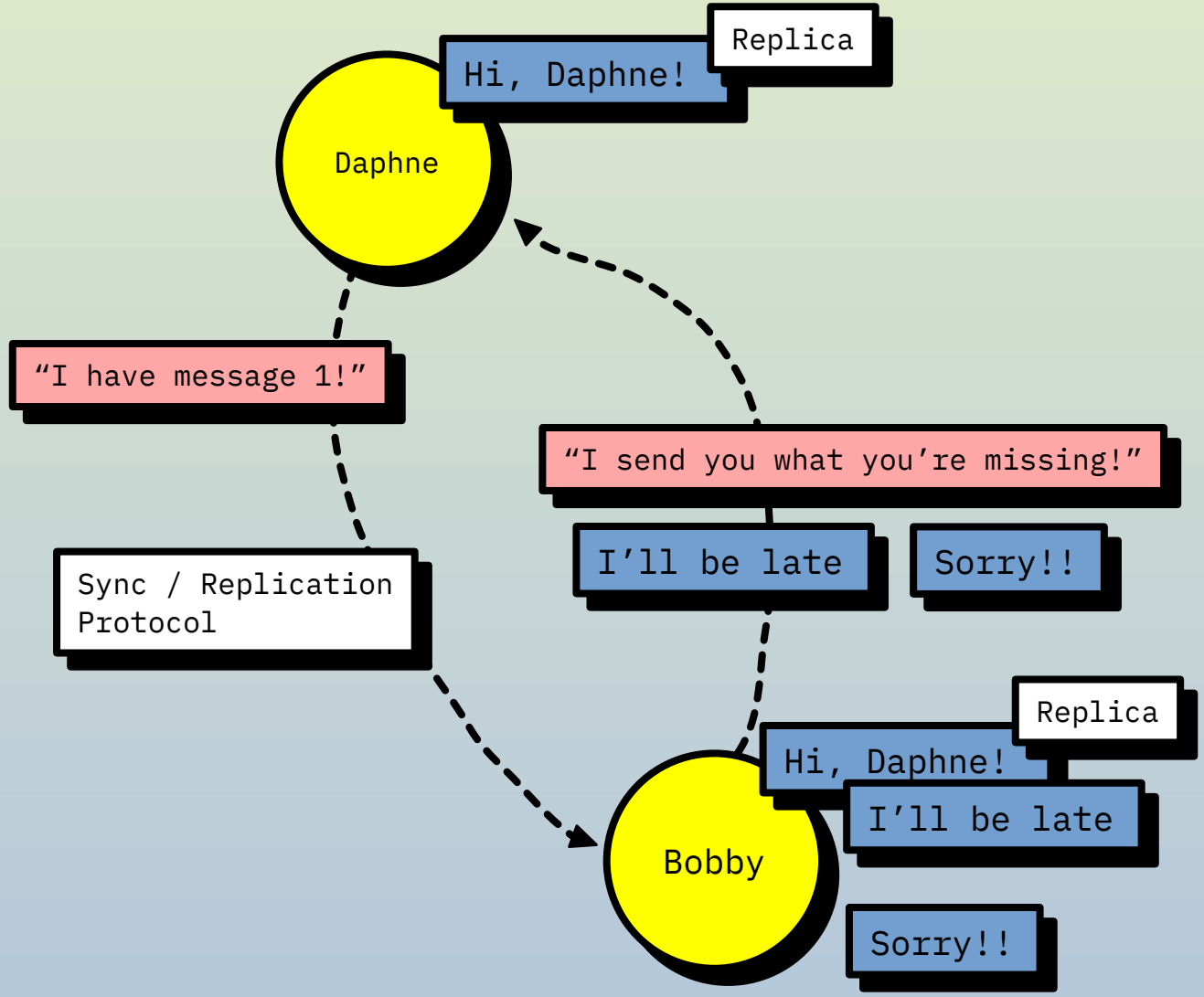


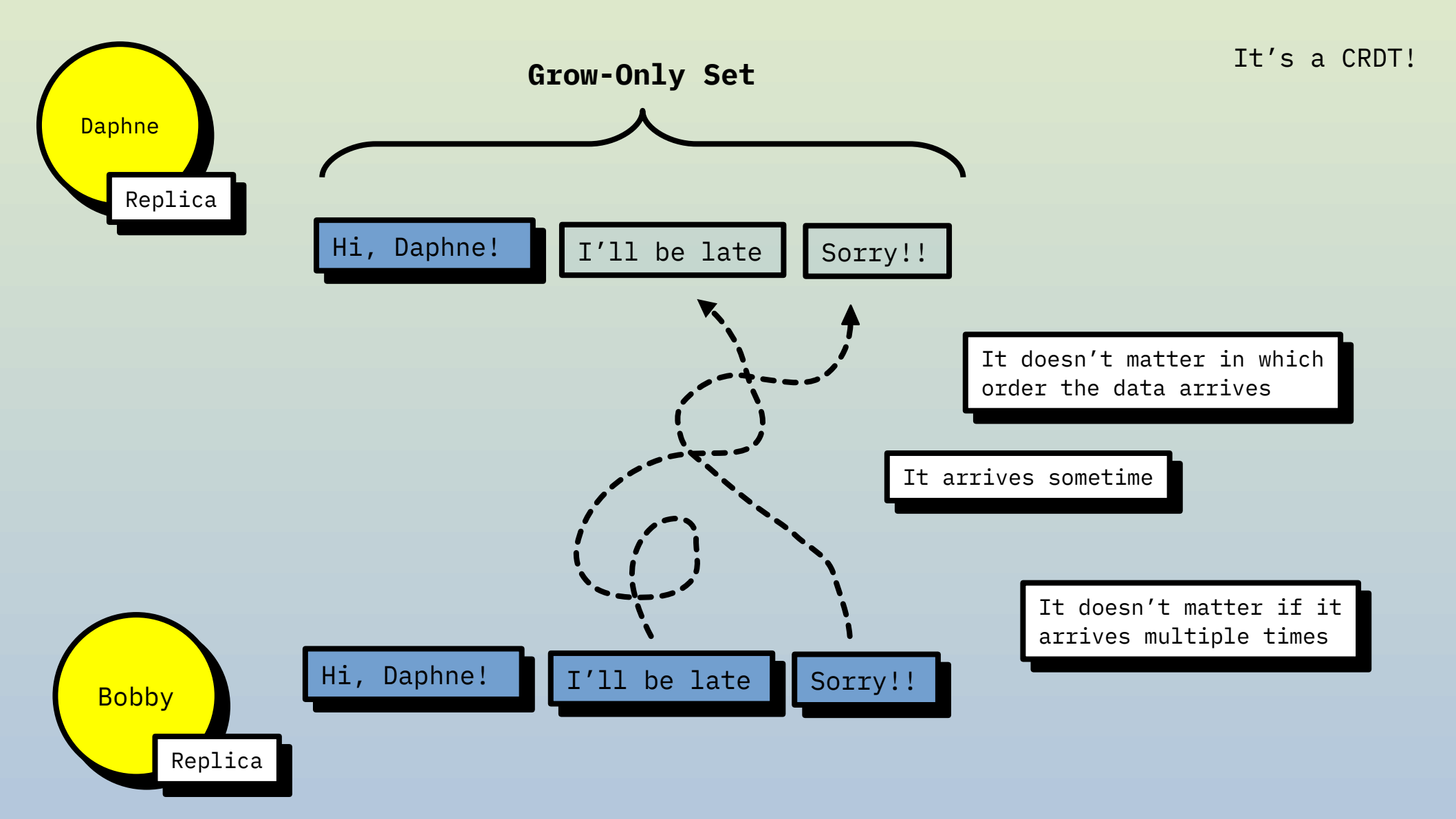
some terminology

Make local-first
friends happy



Make local-first
friends happy




It’s a CRDT!
Grow-Only Set
Daphne
Replica
Hi, Daphne!
I’ll be late
Sorry!!
It doesn’t matter in which order the data arrives
It arrives sometime
It doesn’t matter if it arrives multiple times
Bobby
Replica
Hi, Daphne!
I’ll be late
Sorry!!

It’s a CRDT!

Grow-Only Set

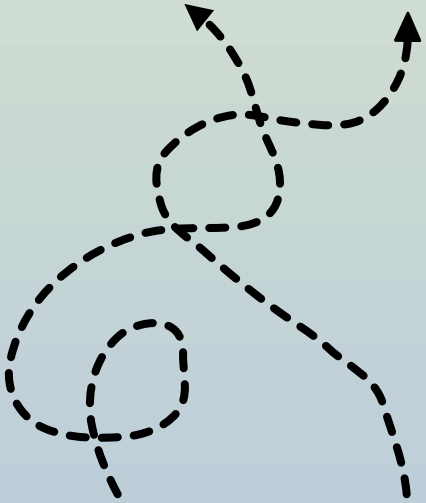
Daphne

Replica

Hi, Daphne!

I’ll be late

Sorry!!



Bobby

Replica

Hi, Daphne!

I’ll be late

Sorry!!

associative

commutative

It doesn’t matter in which order the data arrives

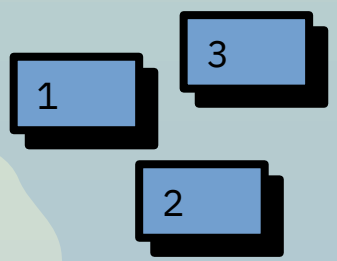
It arrives sometime

eventually consistent

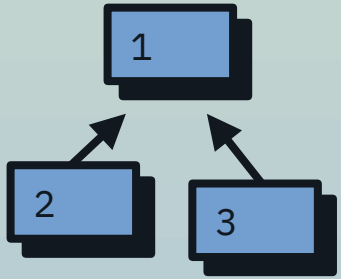
It doesn’t matter if it arrives multiple times

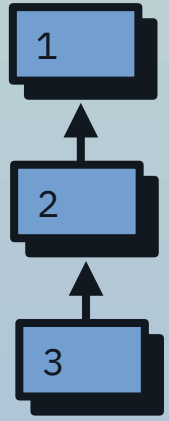
idempotent

Grow-Only Set

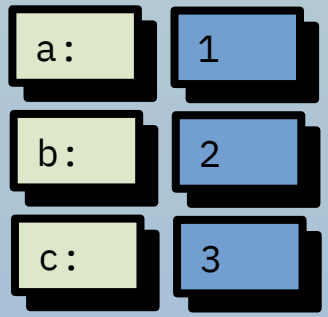


Directed Acyclic Graph (DAG)

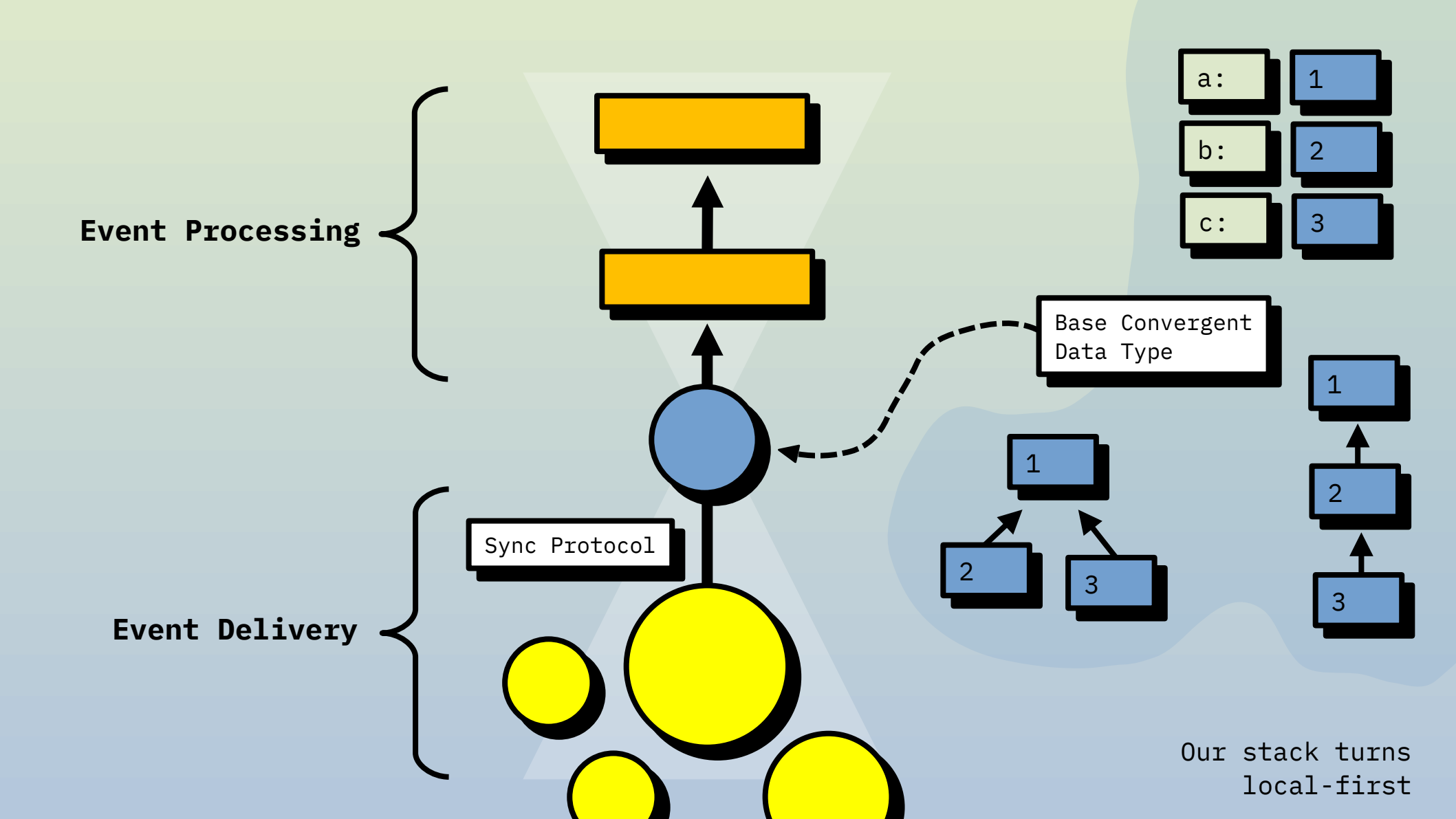


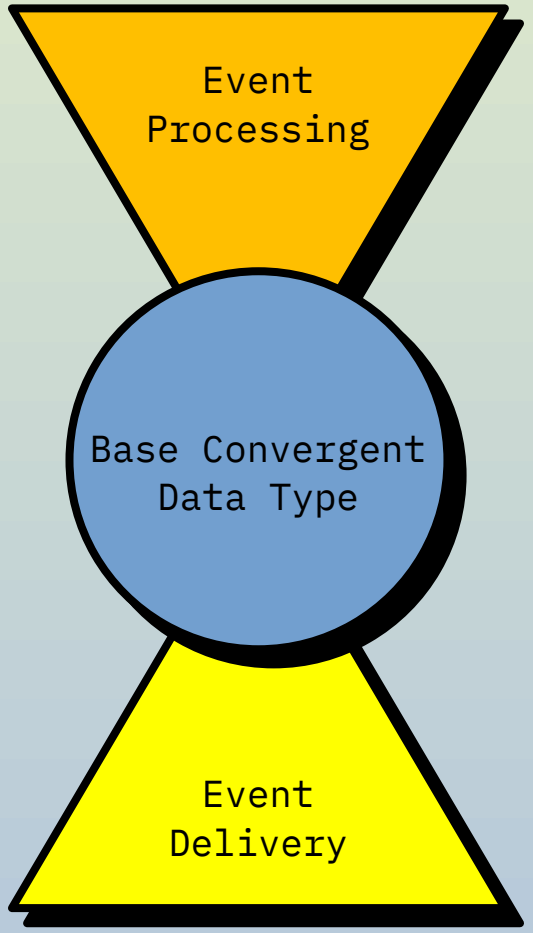


Append-Only Log

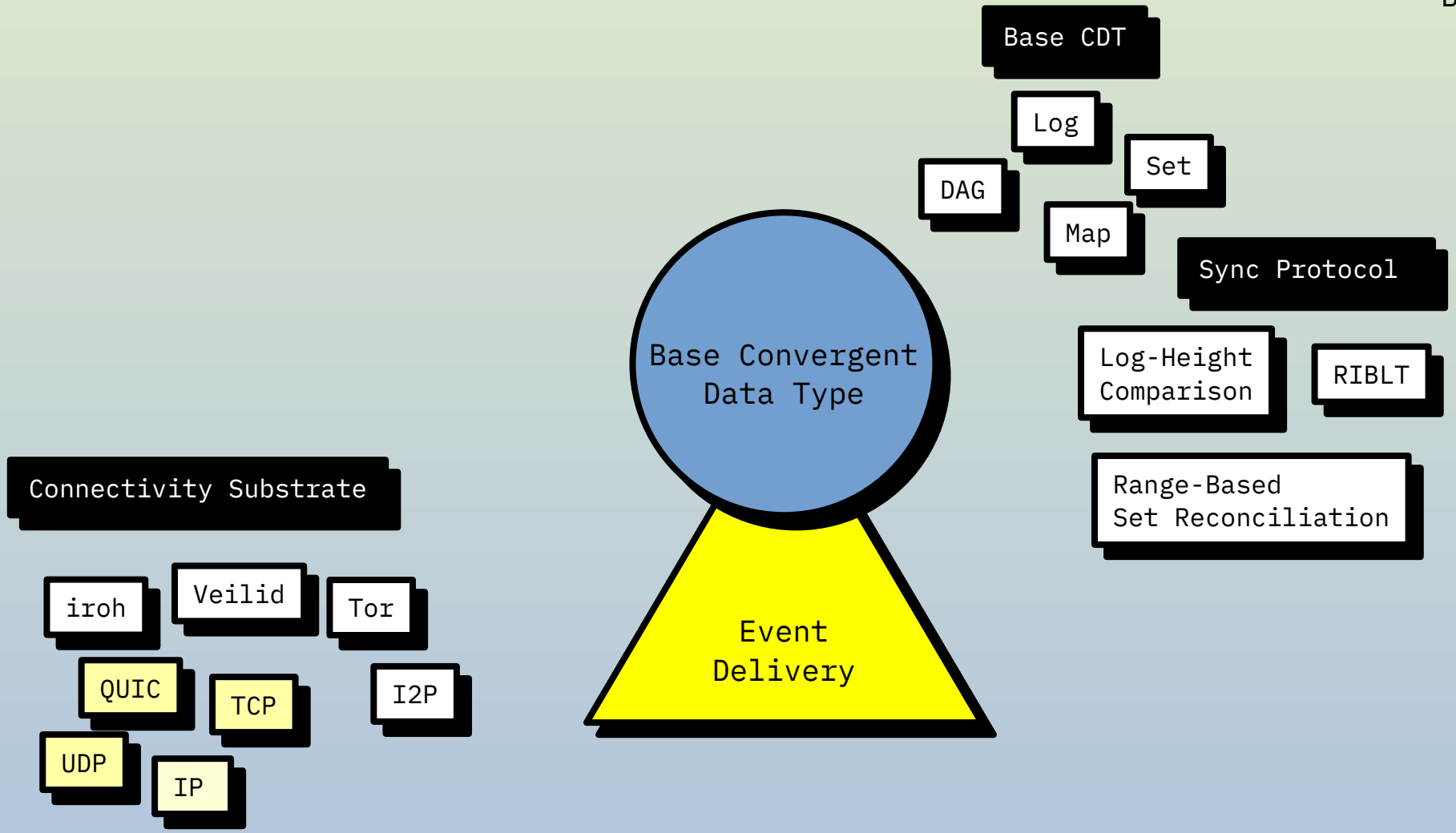


Last-Write-Wins (LWW) Map

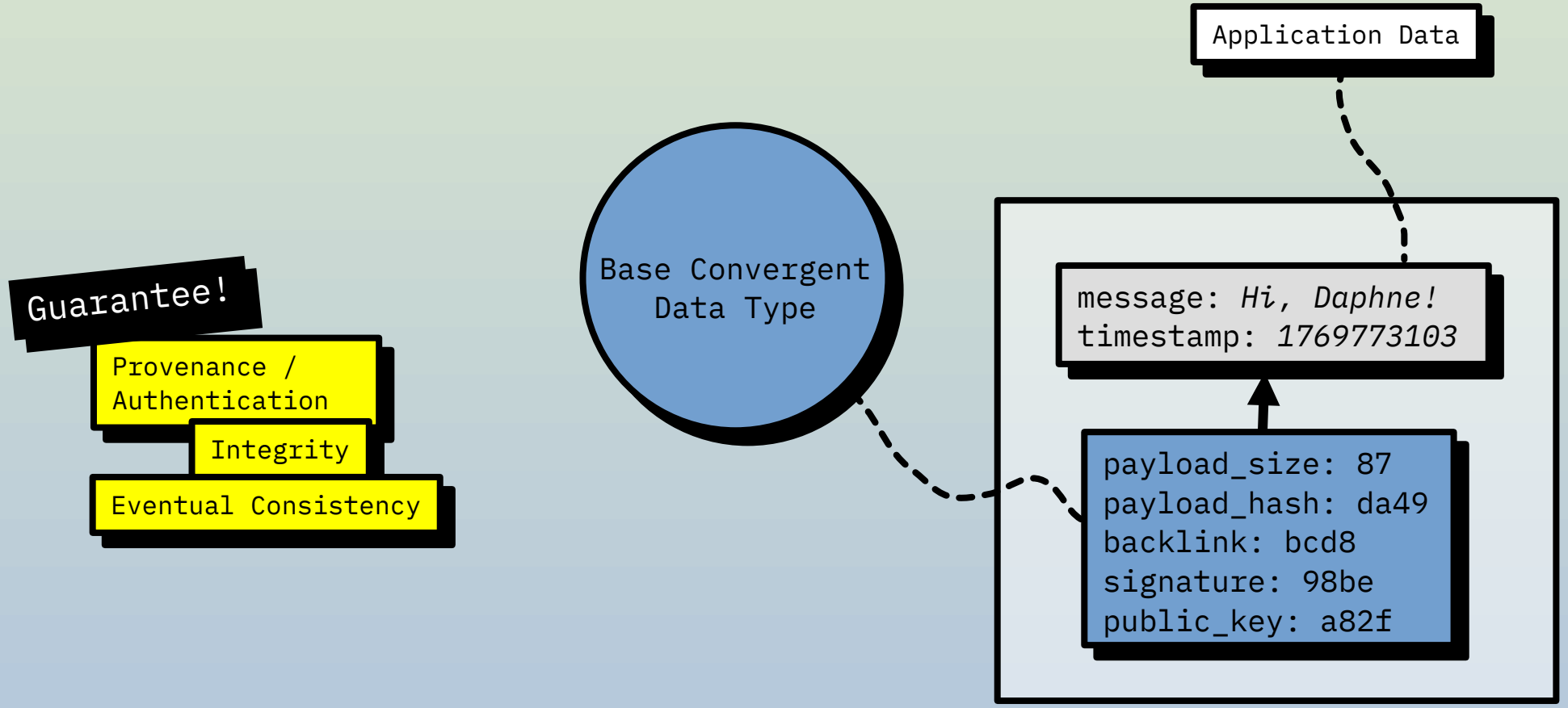

Event Processing
Event Delivery
Sync Protocol
Base Convergent Data Type
a:
1
b:
2
c:
3
1
2
3
1
2
3
Our stack turns local-first


Event
Processing
Base Convergent
Data Type
Event
Delivery

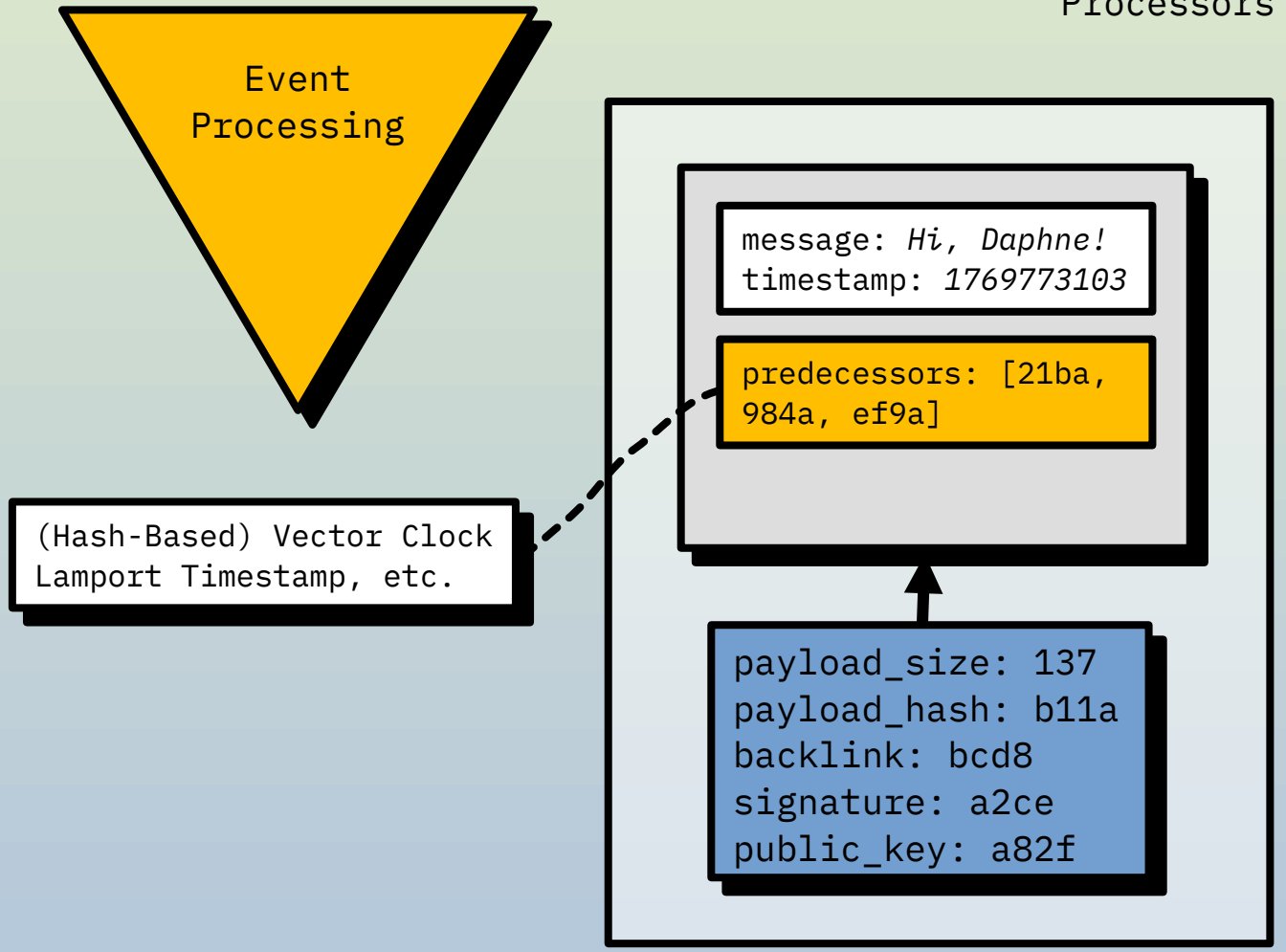
Event Delivery and Base CDTs



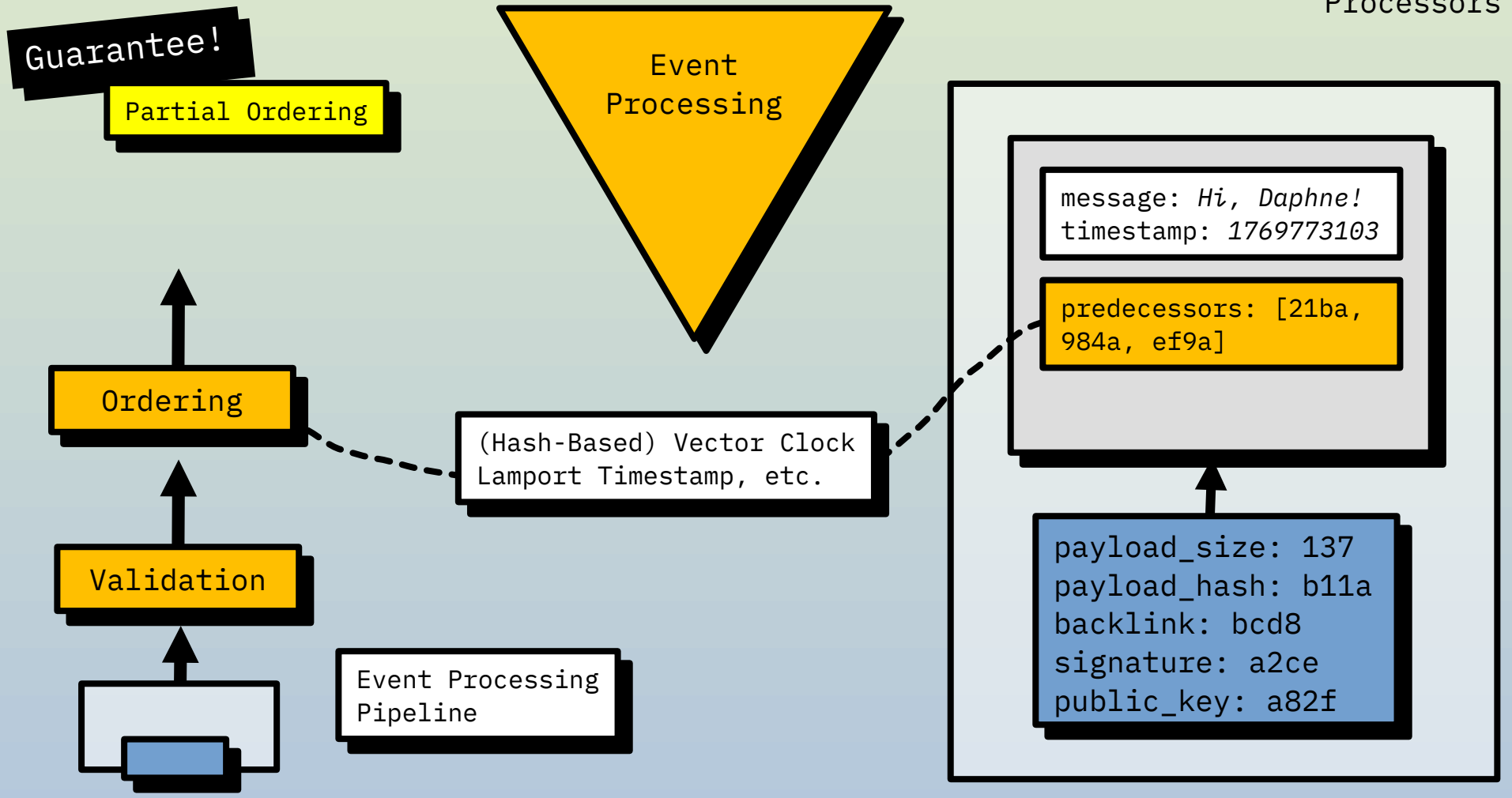
Base CDTs as a carrier

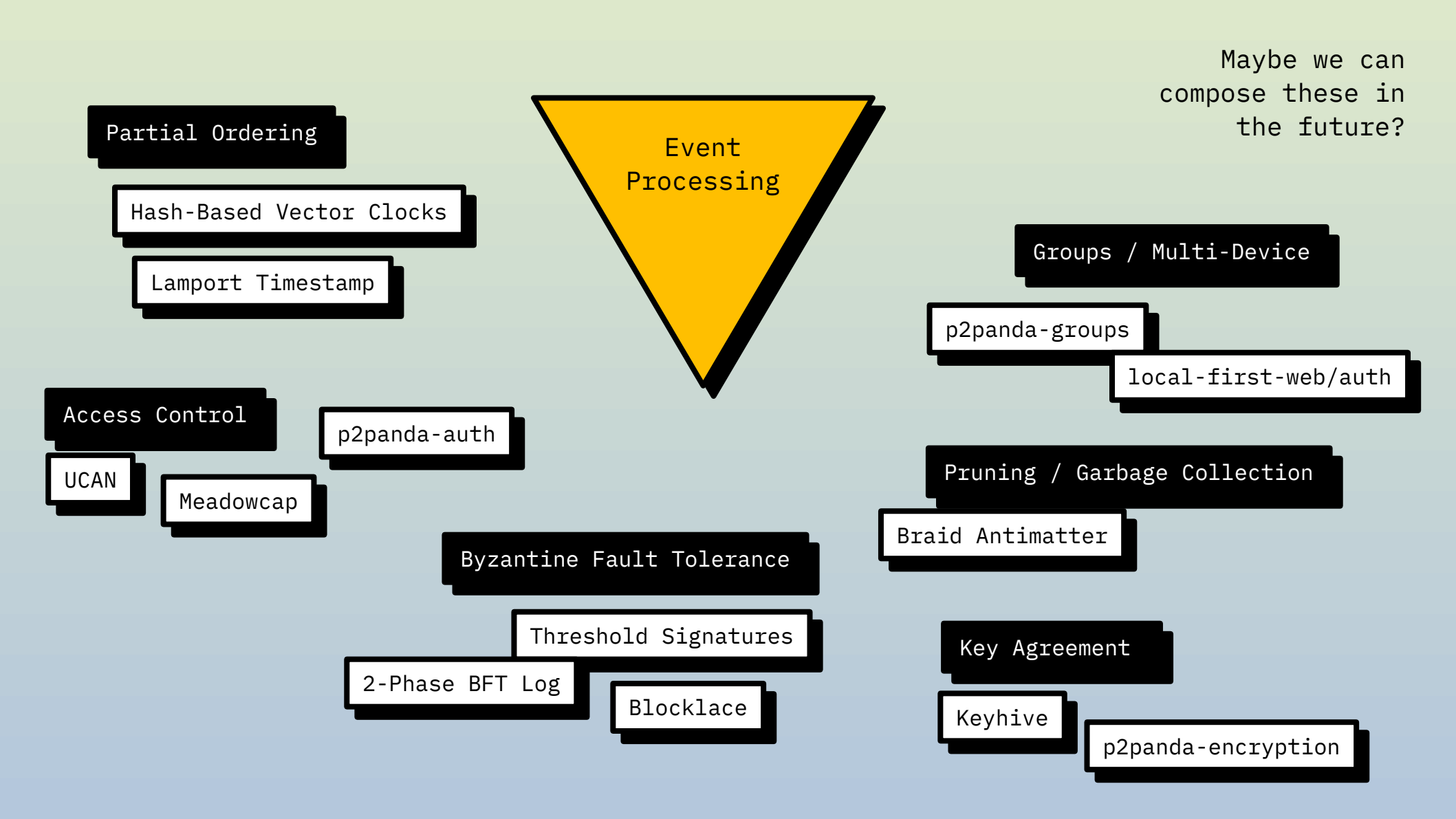


Composing Event Processors

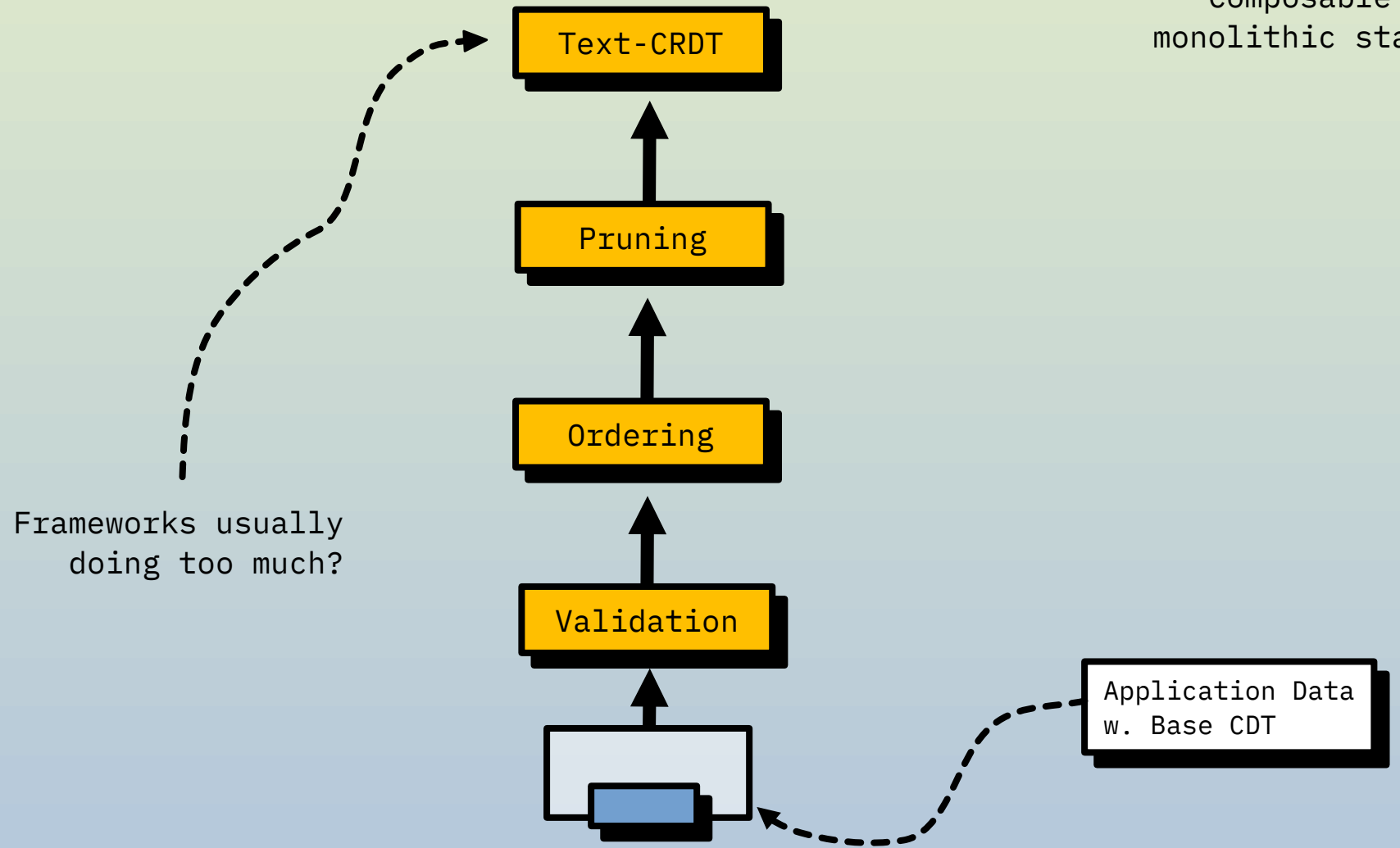


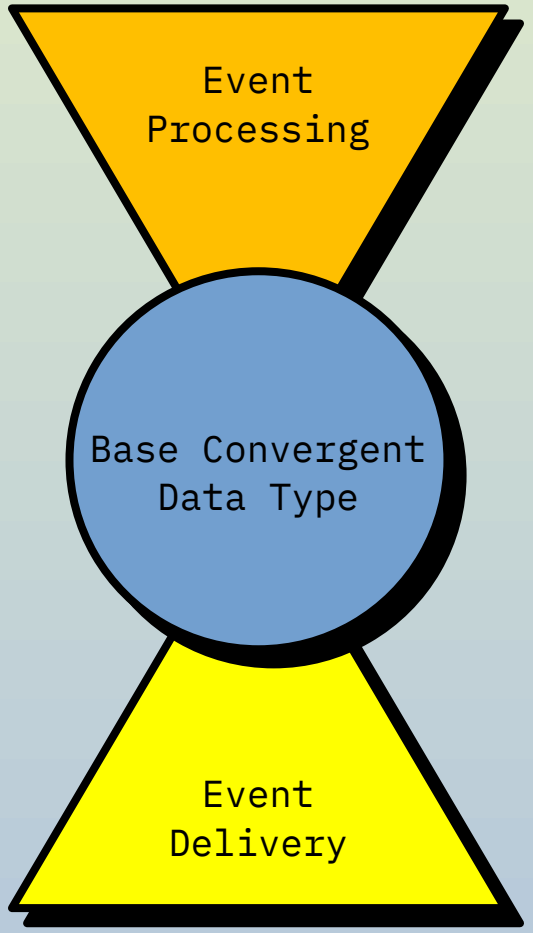
Composing Event Processors

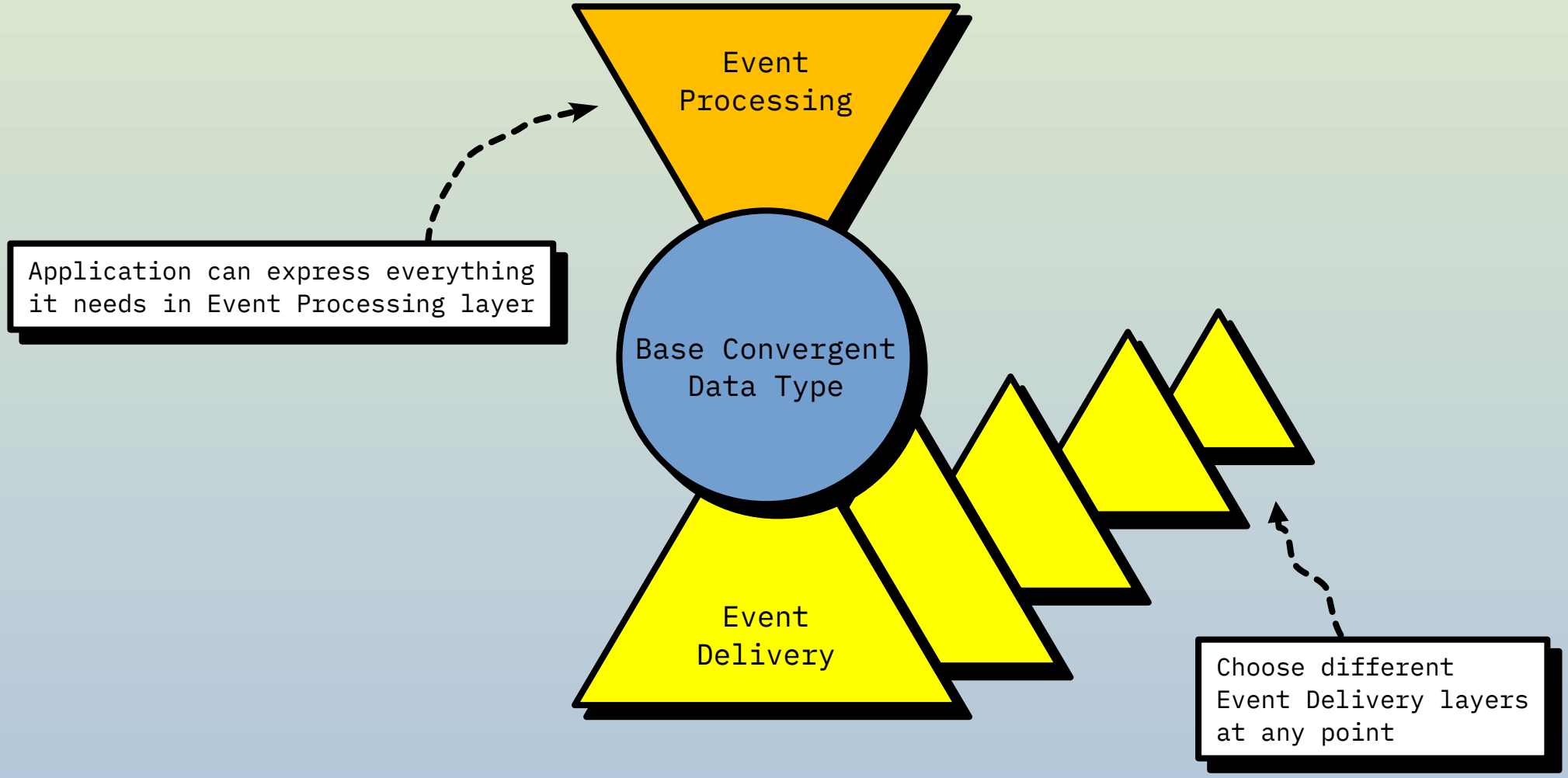


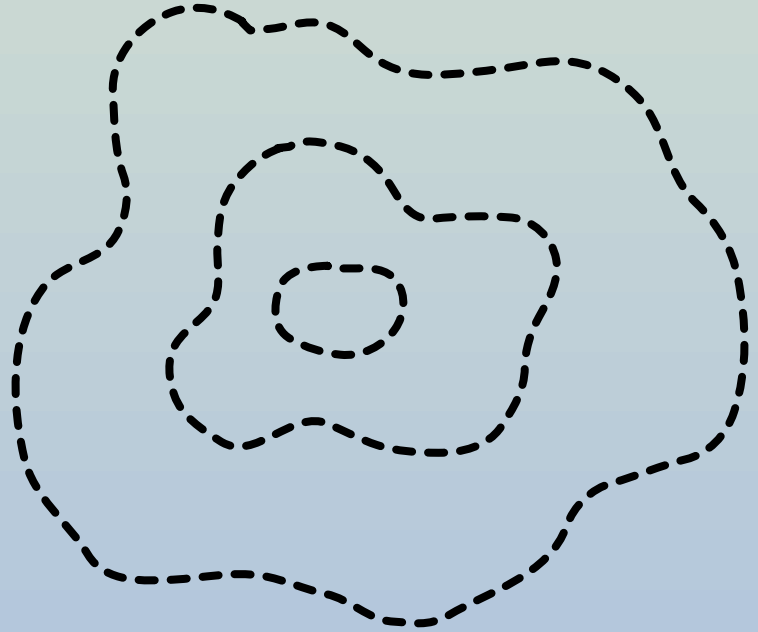

Maybe we can compose these in the future?
Event Processing
Partial Ordering
Hash-Based Vector Clocks
Lamport Timestamp
Groups / Multi-Device
p2panda-groups
local-first-web/auth
Access Control
UCAN
Meadowcap
p2panda-auth
Pruning / Garbage Collection
Braid Antimatter
Byzantine Fault Tolerance
Threshold Signatures
2-Phase BFT Log
Blocklace
Key Agreement
Keyhive
p2panda-encryption

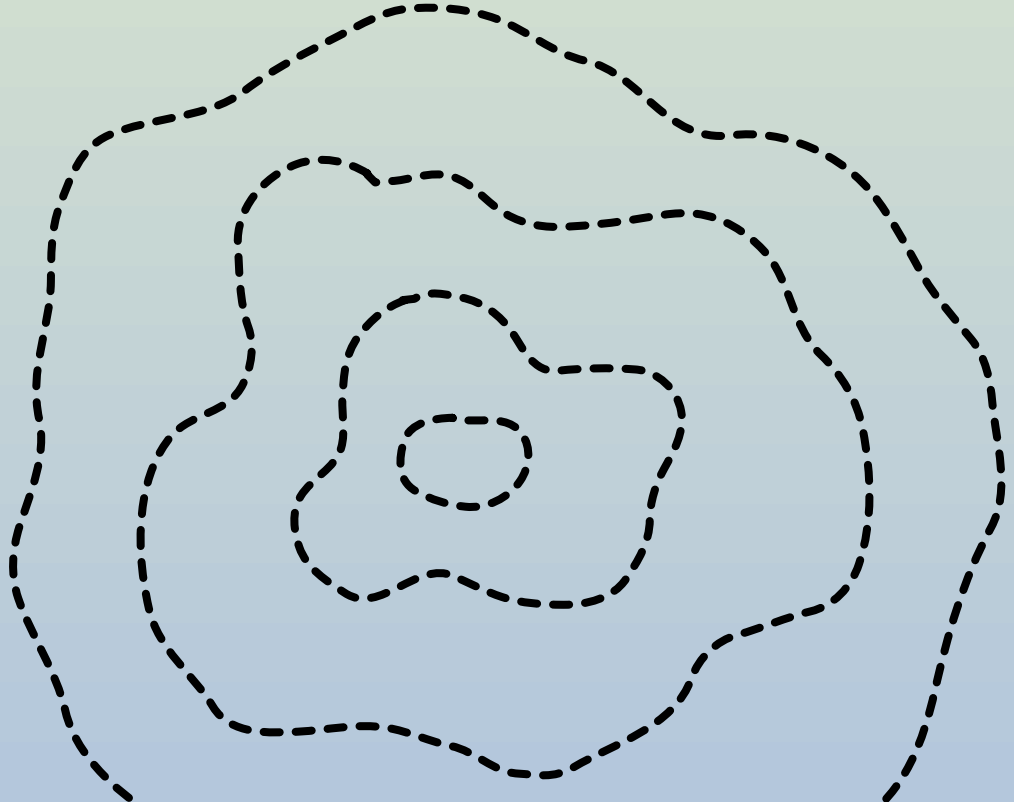
Composable vs.
monolithic stacks

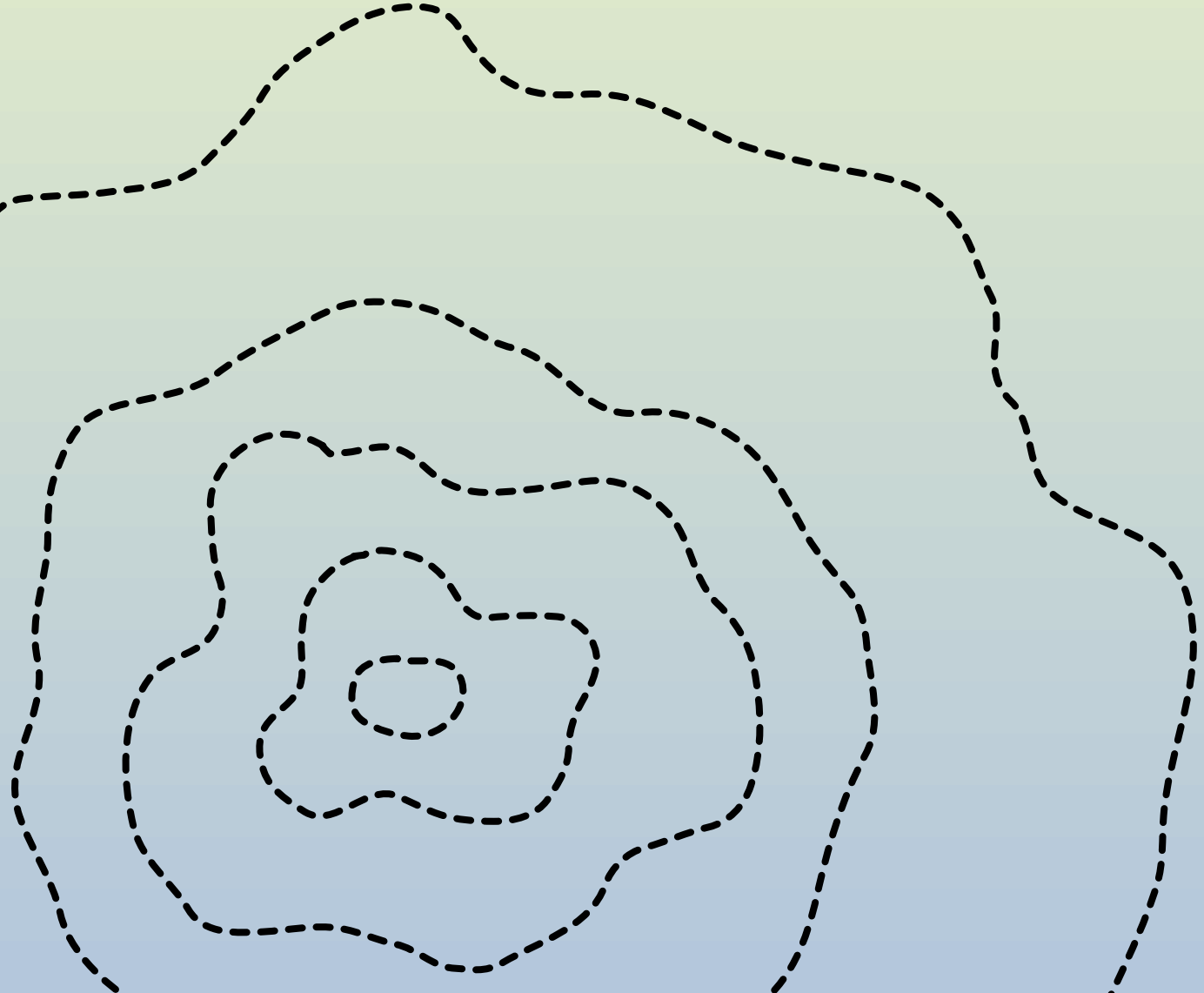


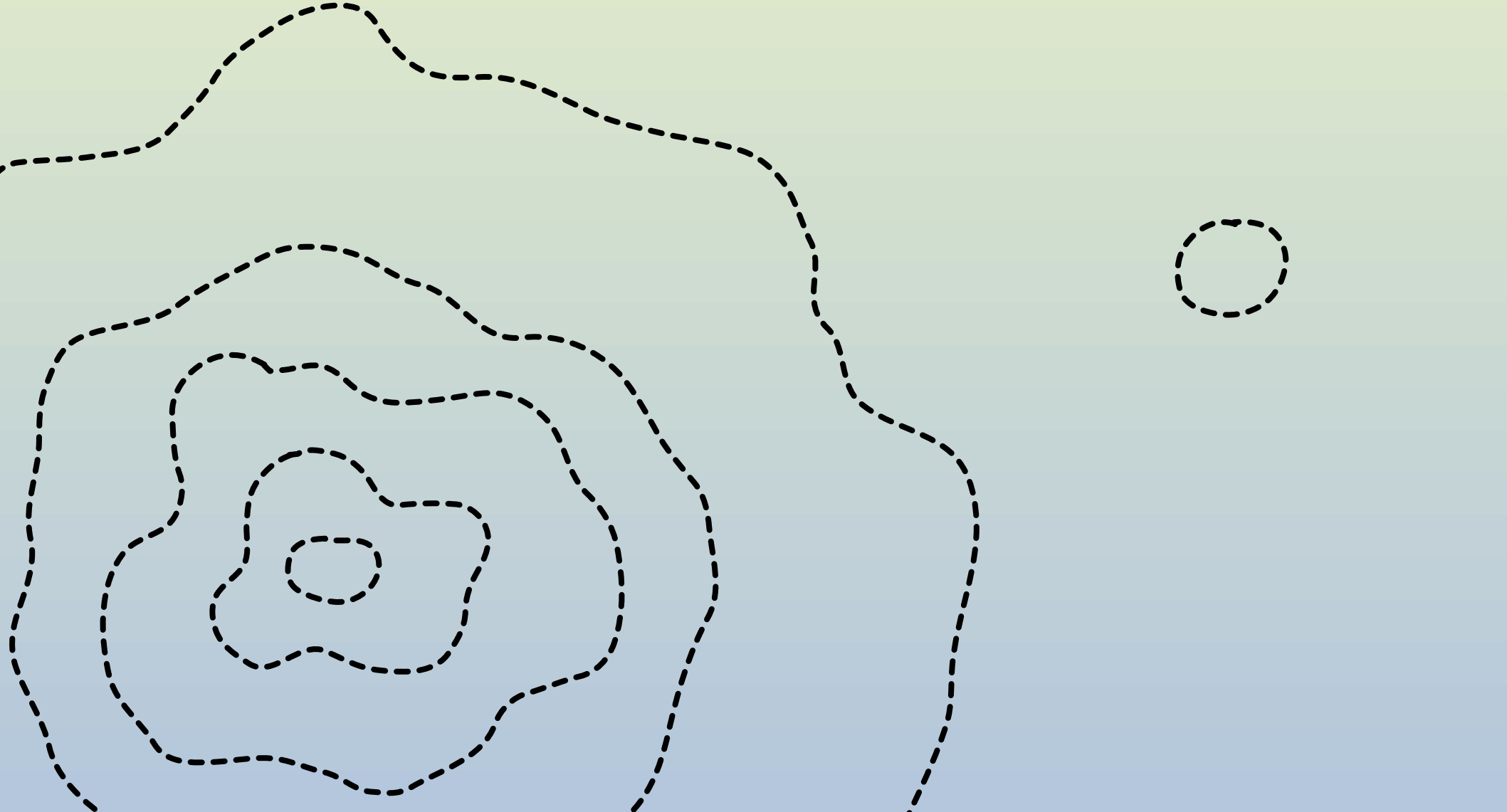

Event
Processing
Base Convergent
Data Type
Event
Delivery

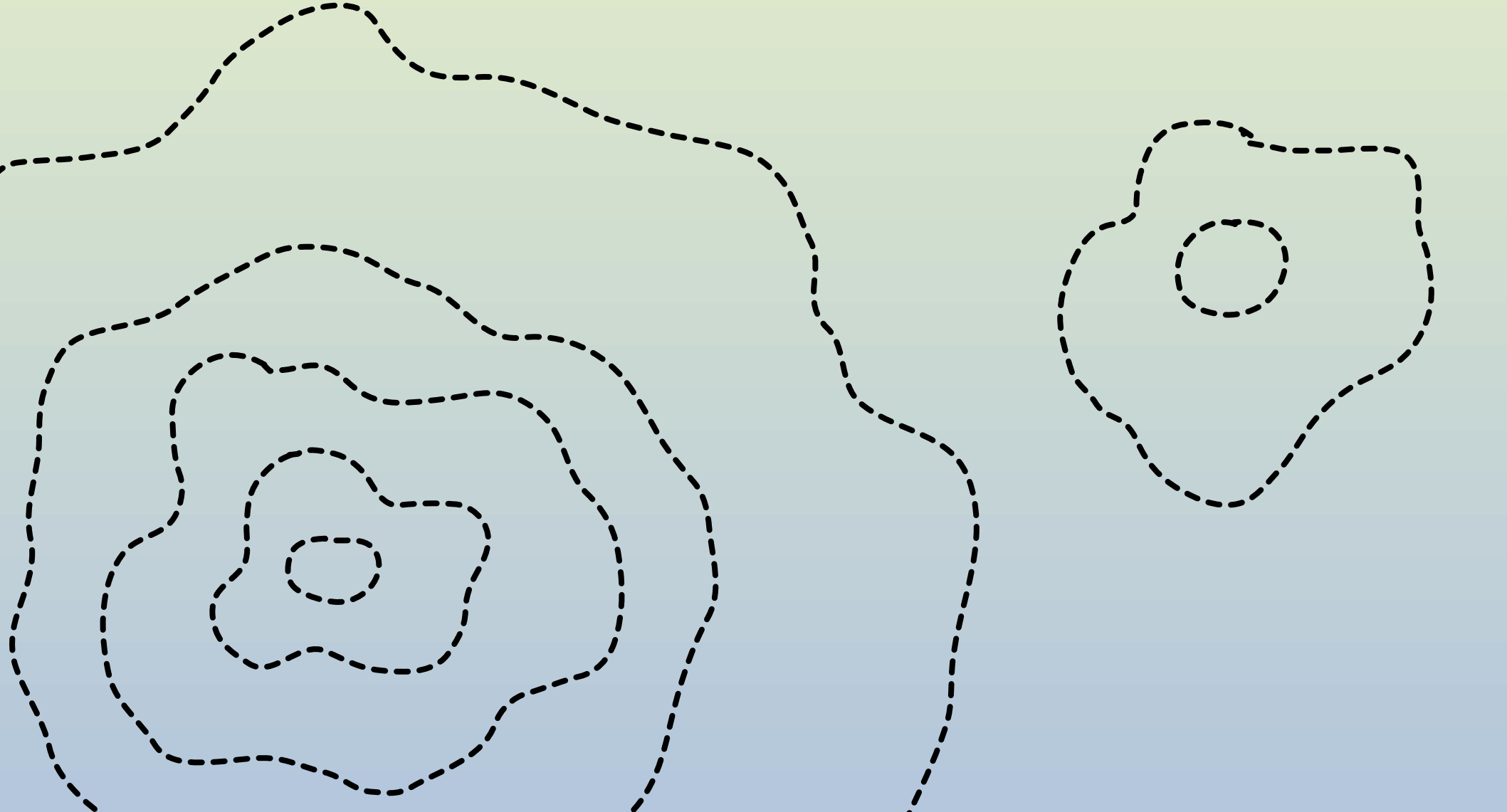

Event
Processing
Application can express everything
it needs in Event Processing layer
Base Convergent
Data Type
Event
Delivery
Choose different
Event Delivery layers
at any point

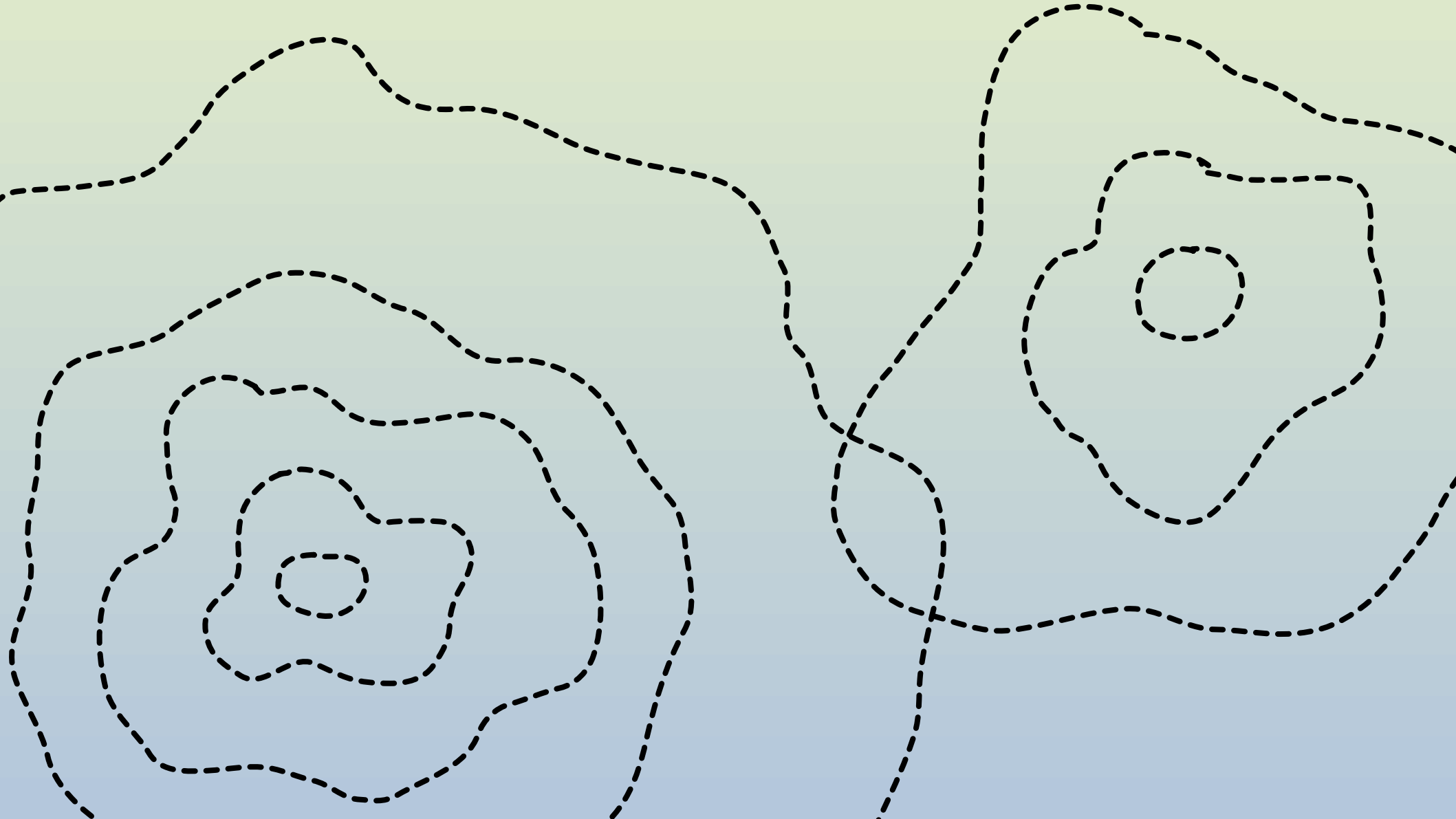


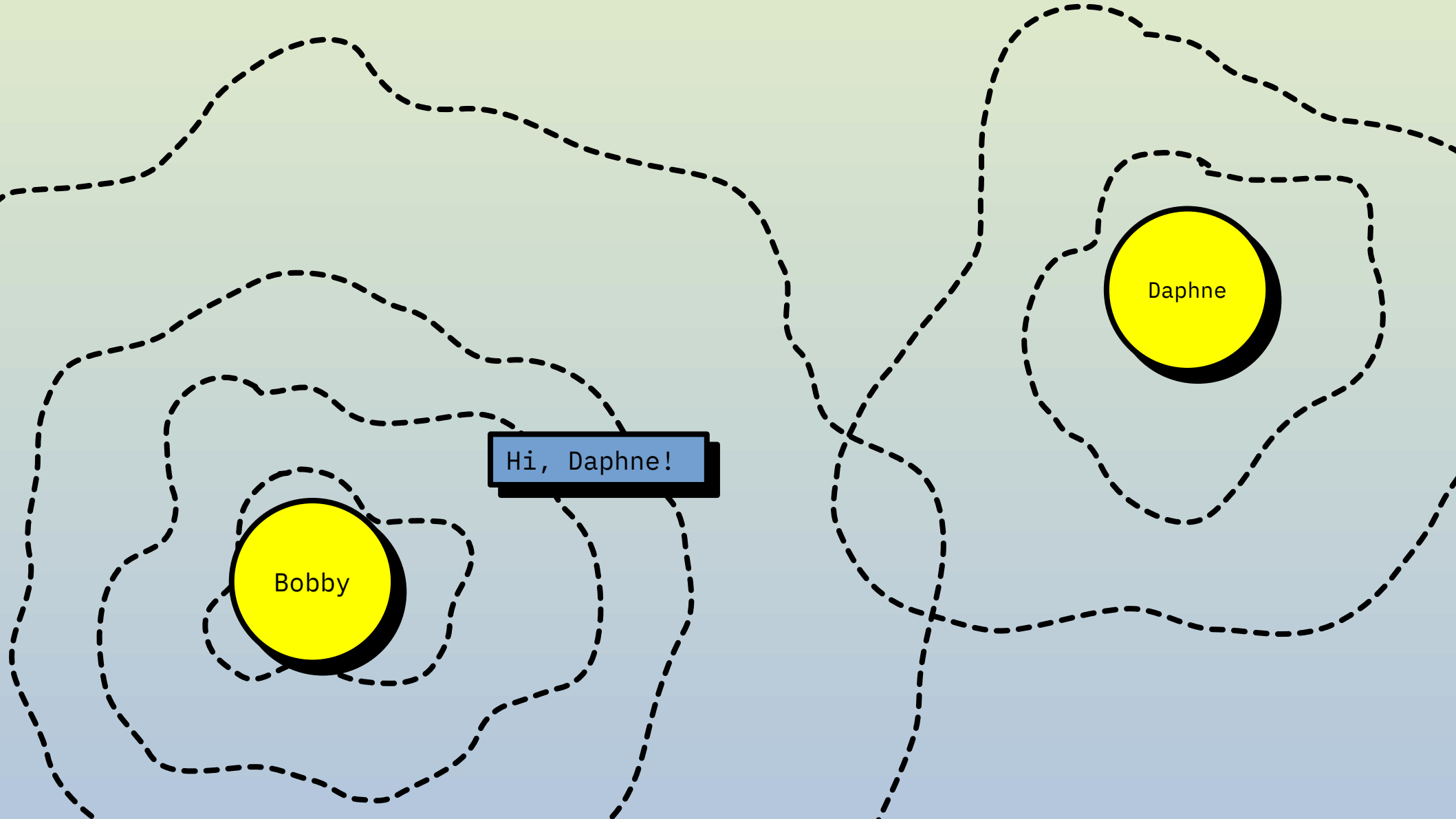




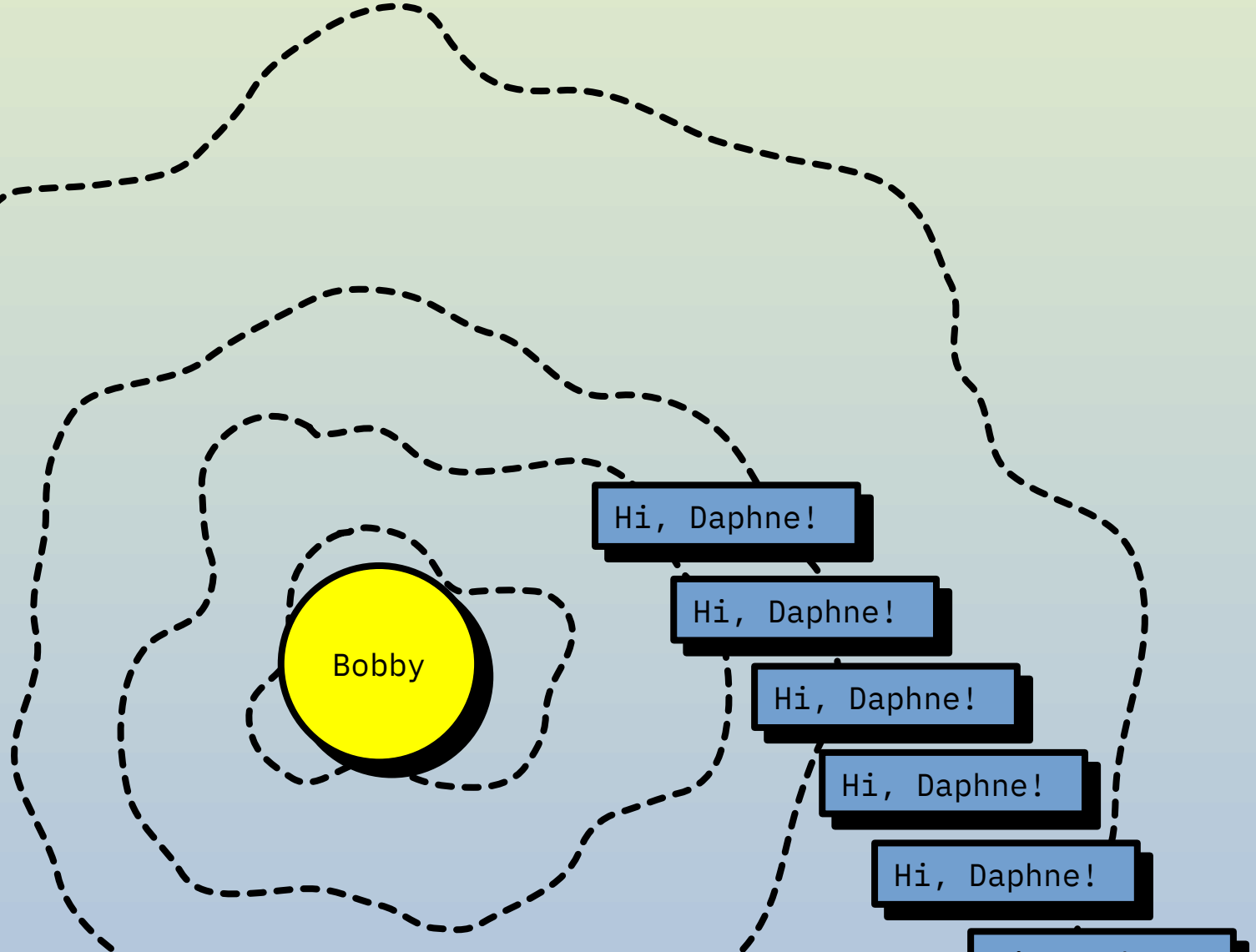


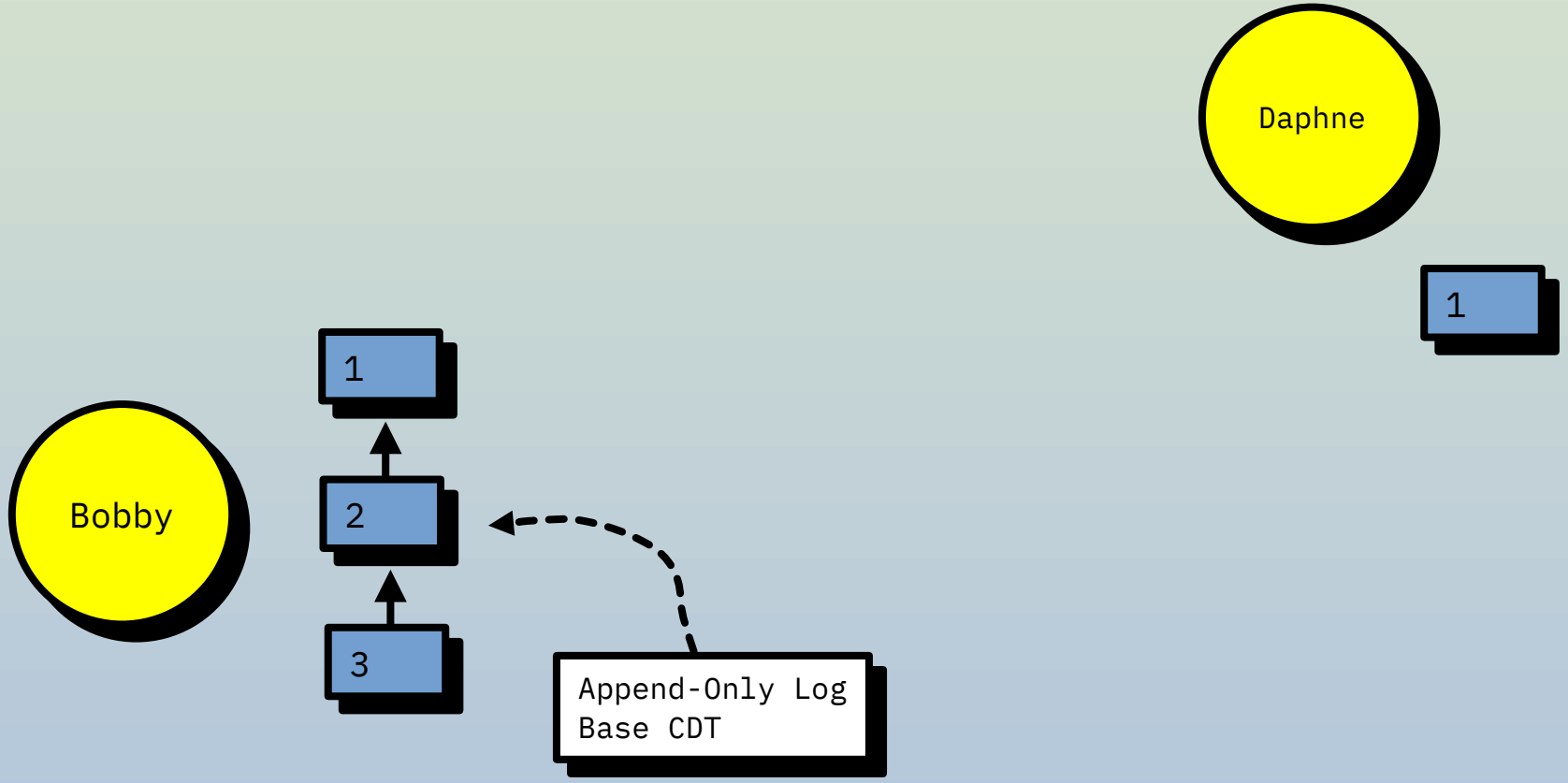




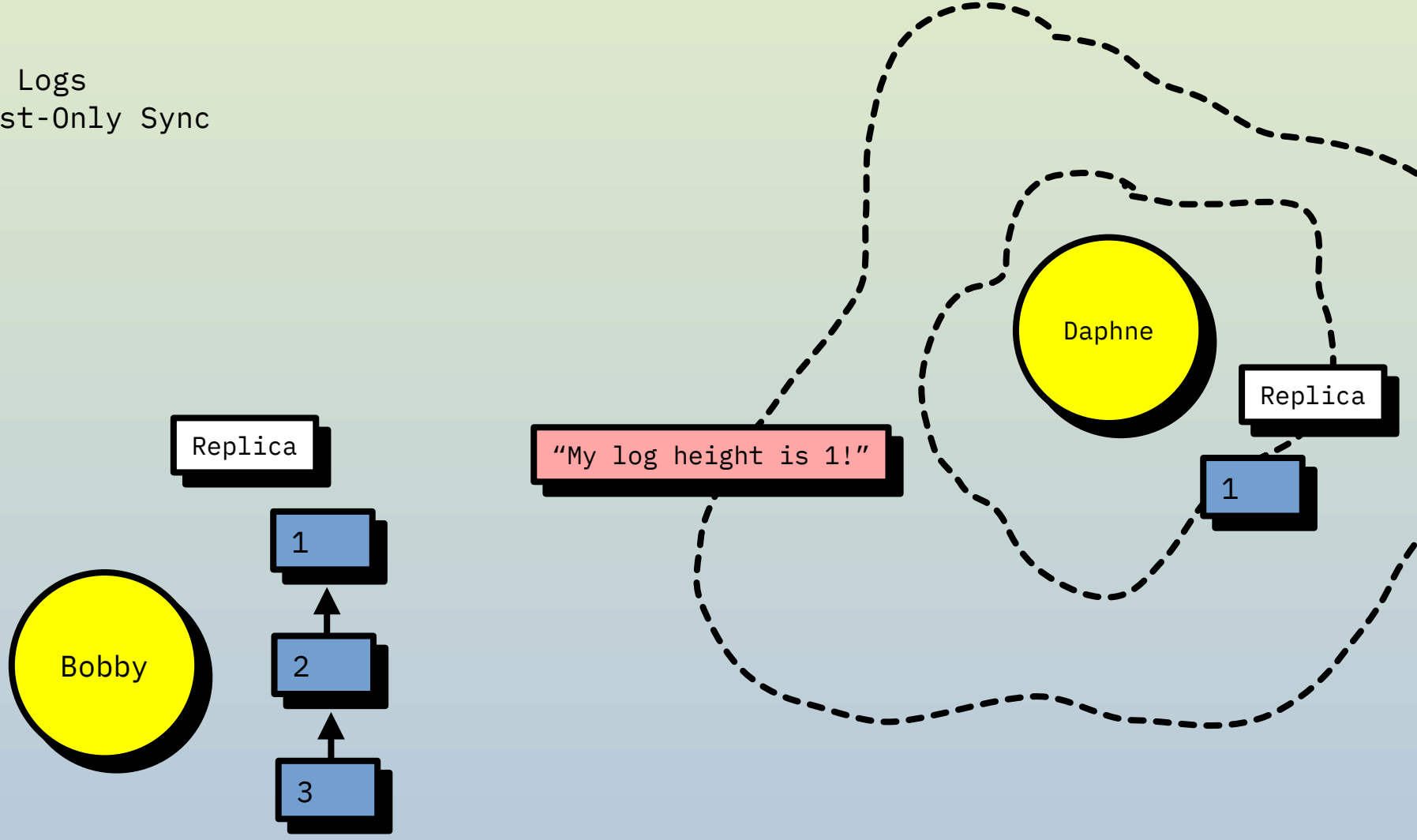

Daphne
Hi, Daphne!
Bobby

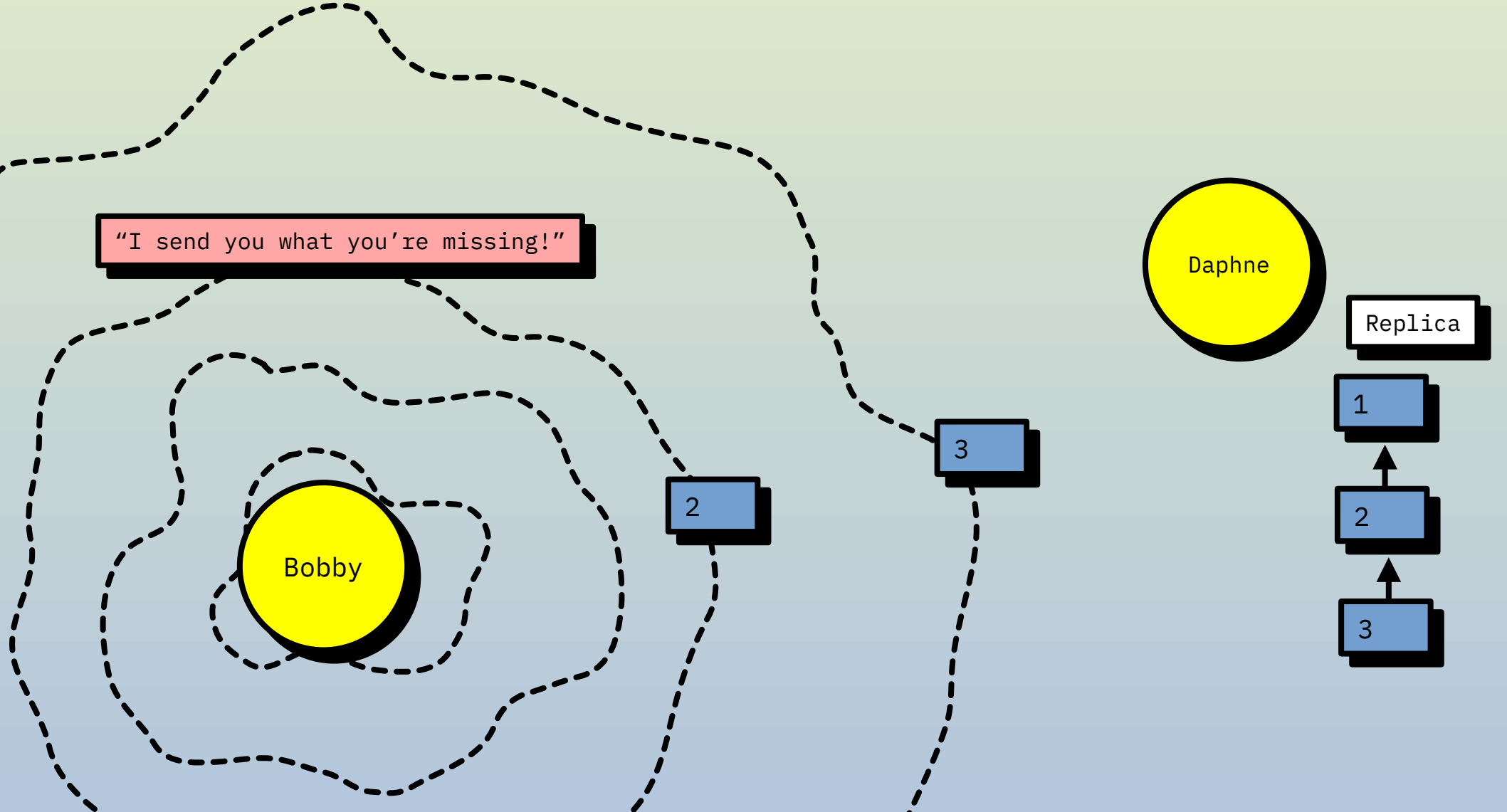
Eventual Consistency
Guarantee?




Daphne
1
Bobby
1
2
3
Append-Only Log
Base CDT

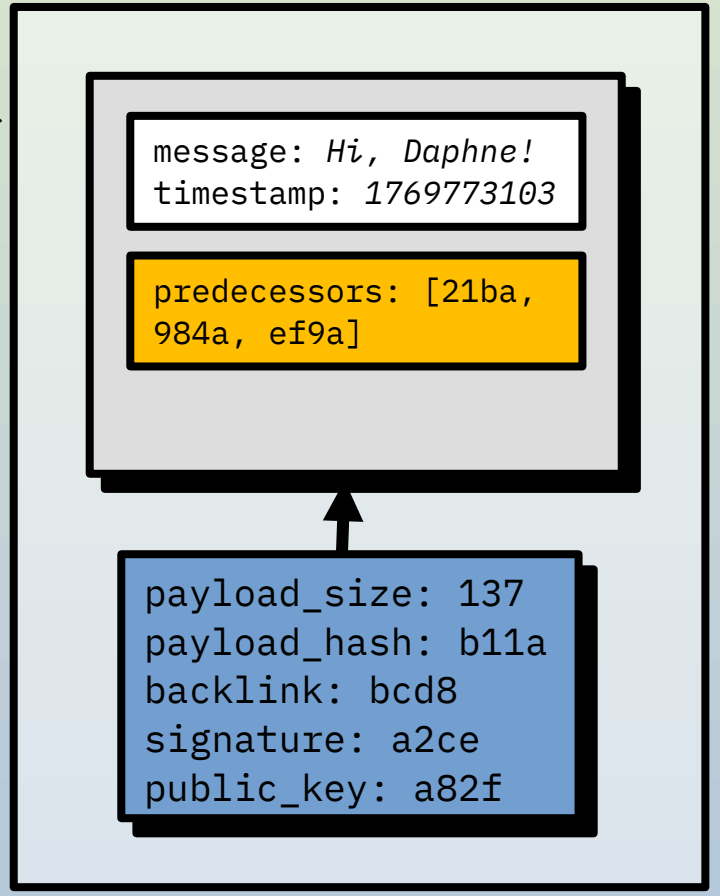
Append-Only Logs
for Broadcast-Only Sync




“I send you what you’re missing!”
Bobby
2
3
Daphne
Replica
1
2
3

Available Bandwidth
can be a problem ..

Data too large?



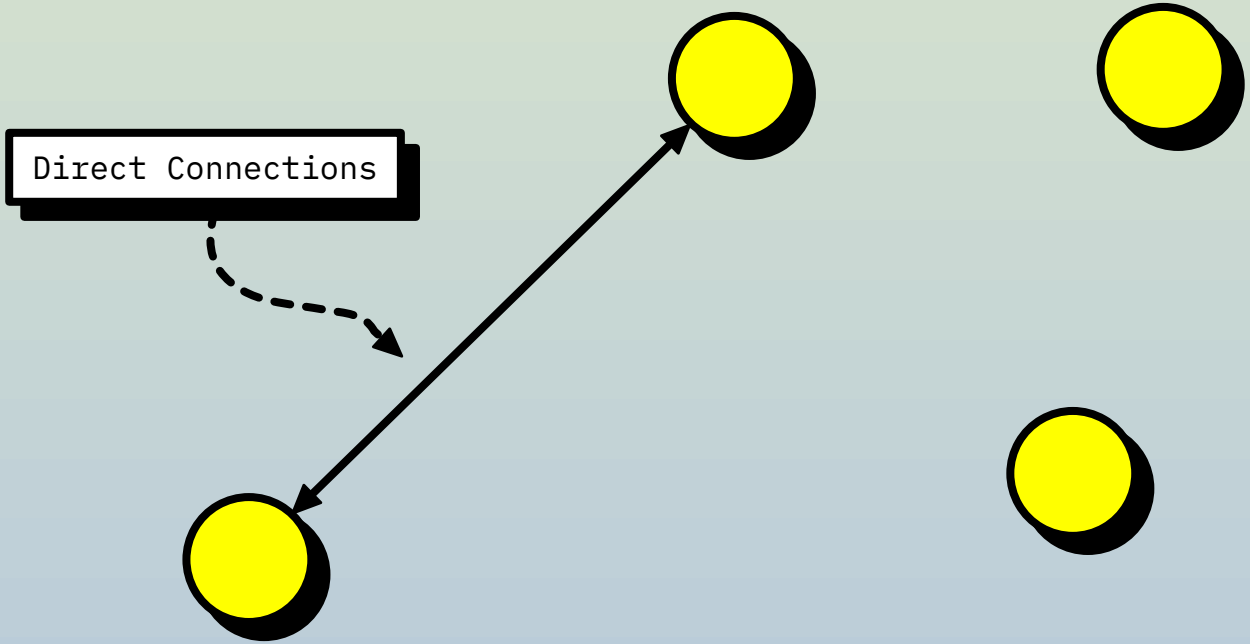
Check out:

tinySSB

Omits “redundant” / deterministic data to reduce payload size

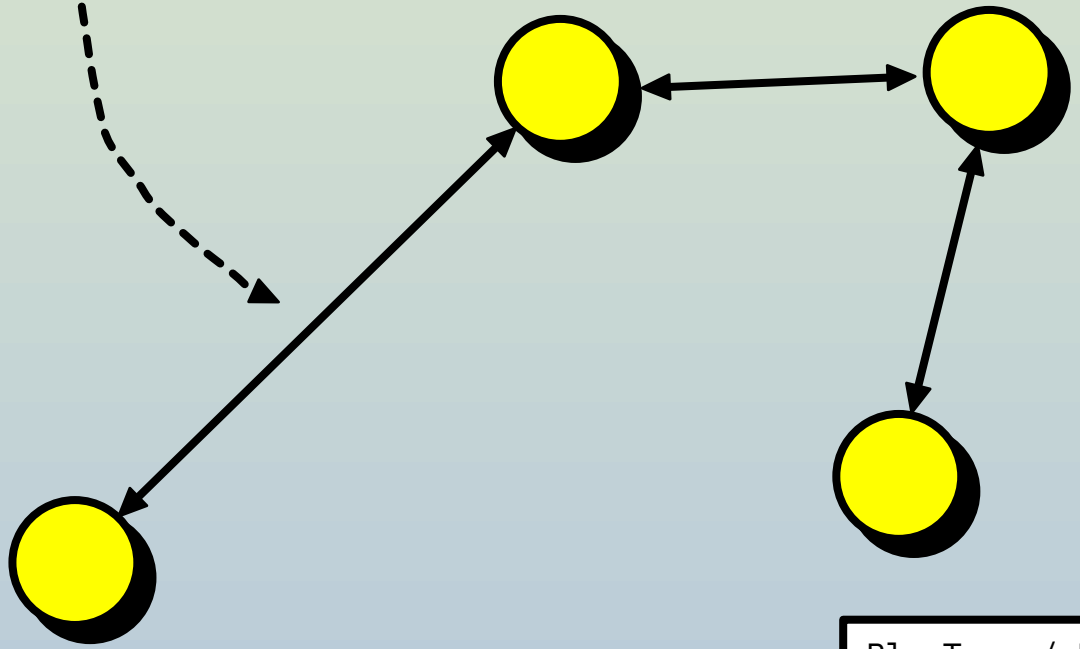
Experiments with syncing via LoRa, BLE and packet radio over Atlantic Ocean

Radio-like
Broadcast Overlays



Radio-like
Broadcast Overlays

Try to establish a Minimum Spanning Tree
to make sure every message reaches everyone
at least once and avoid flooding



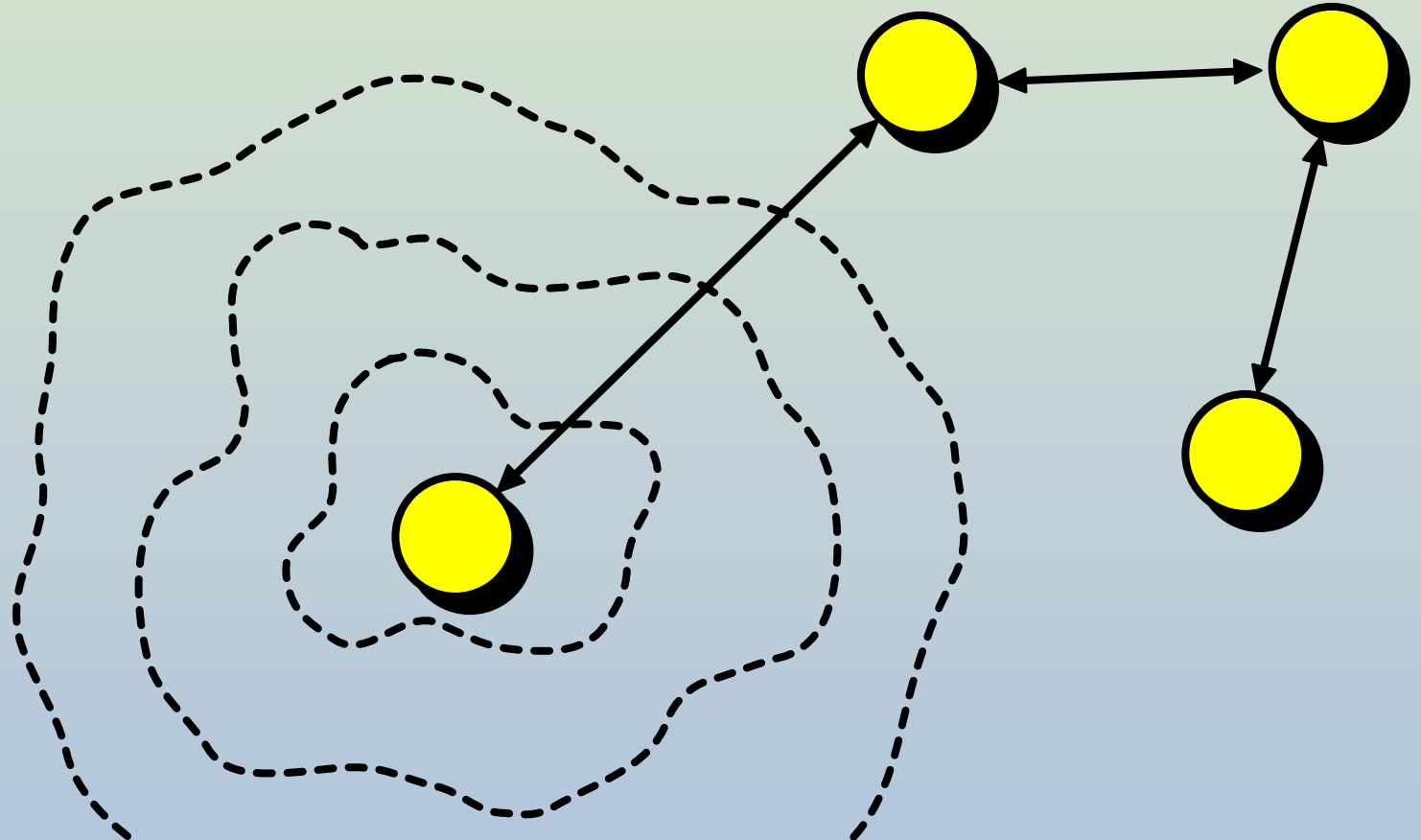
Unreliable Multicast

PlumTree / Epidemic Broadcast Trees

HyParView

It’s the same!

.. not really .. but in Walkaway does the application really need to know?



Eventually Consistent
Publish / Subscribe

stream(topic) → (tx, rx)

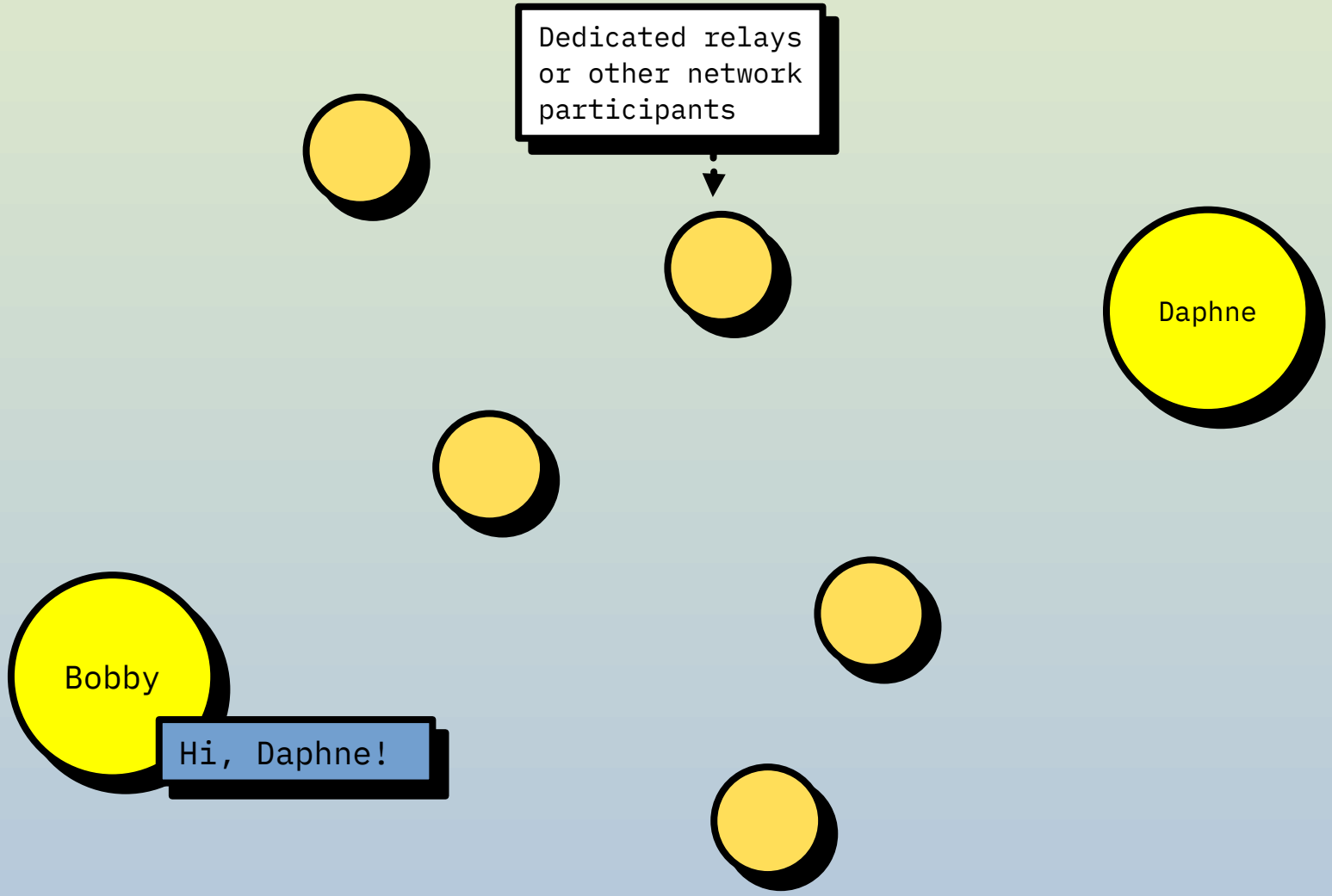
ephemeral_stream(topic) → (tx, rx)

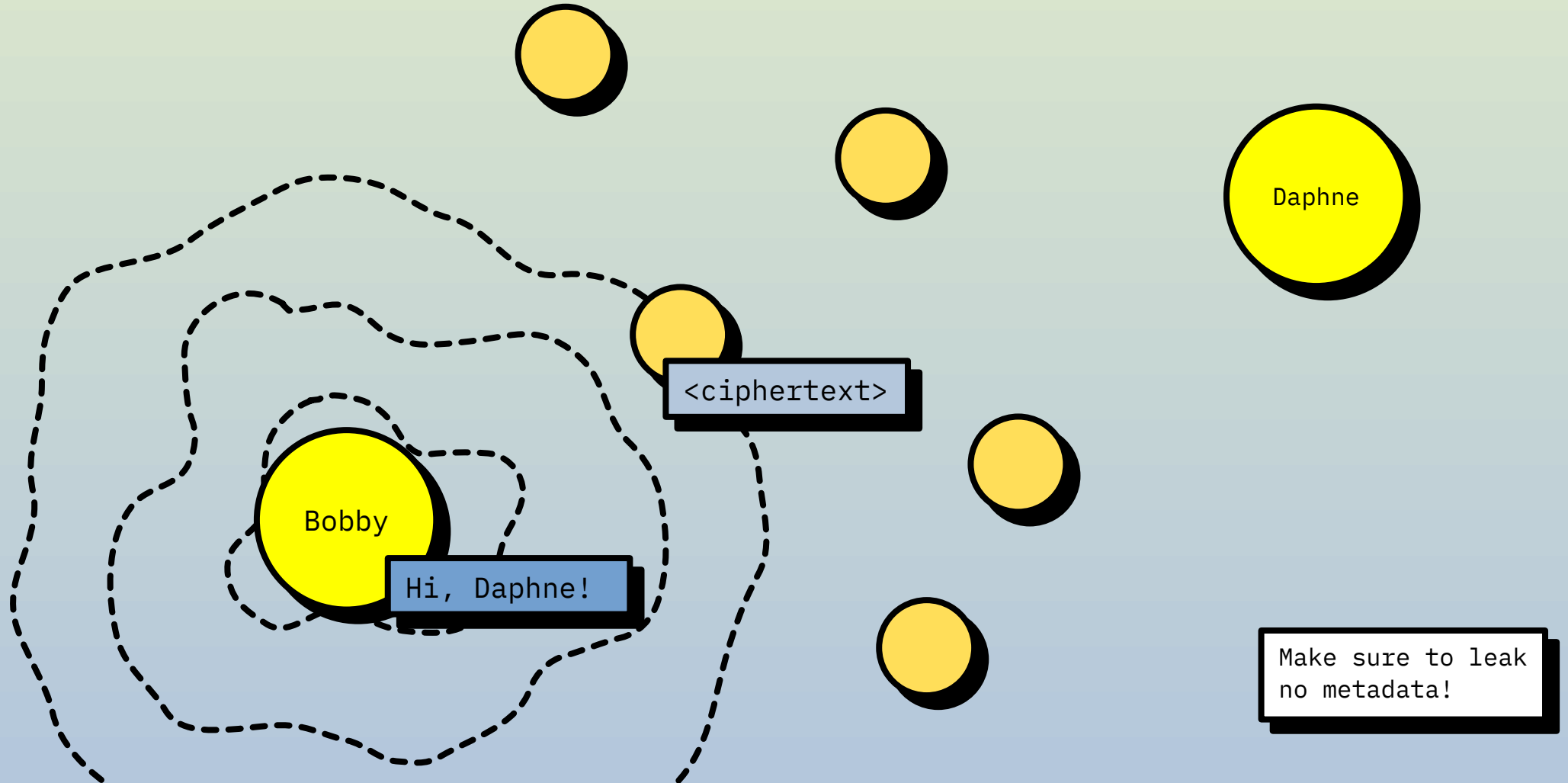
Ephemeral Messaging
Publish / Subscribe

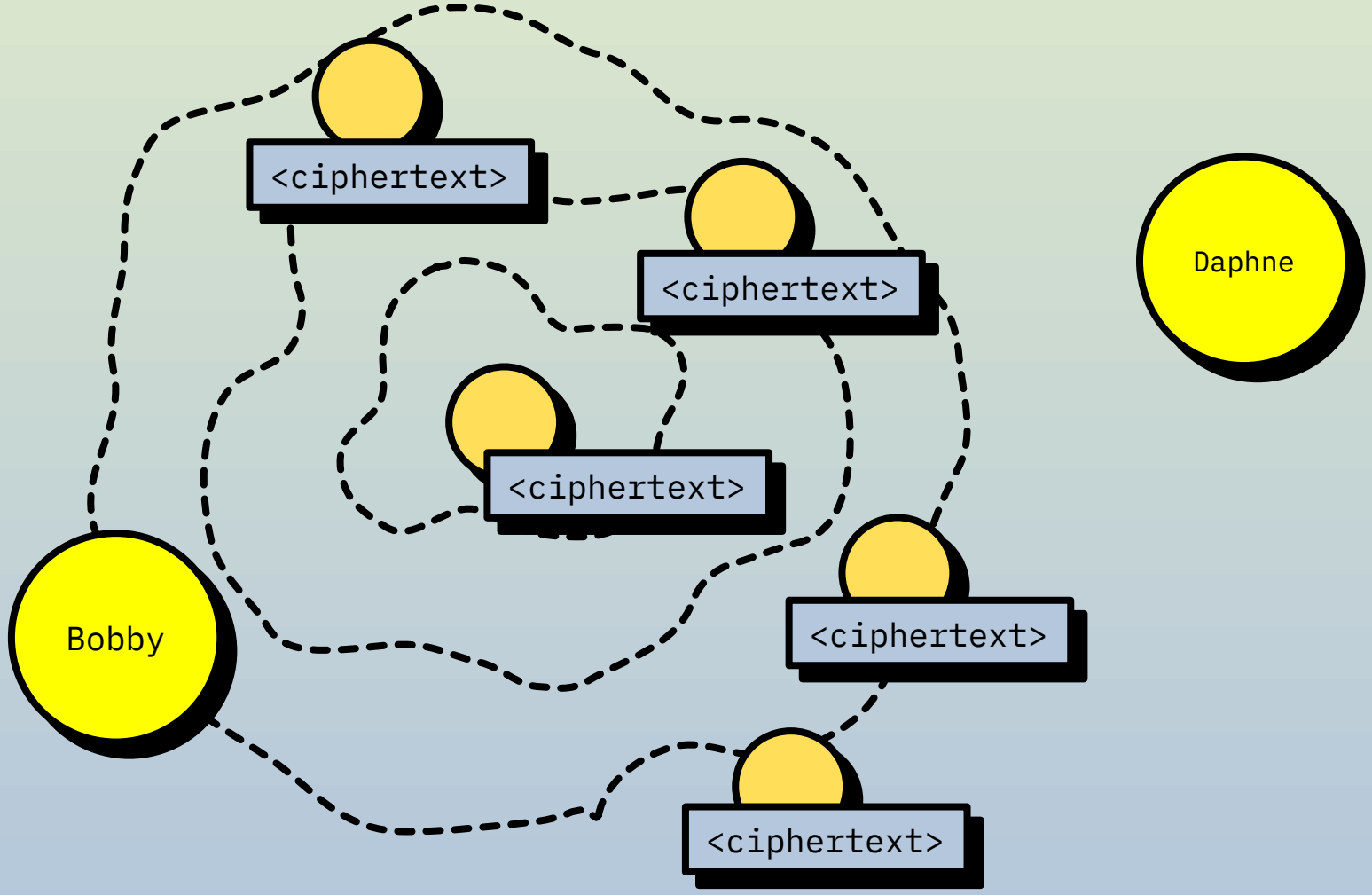
Check out:

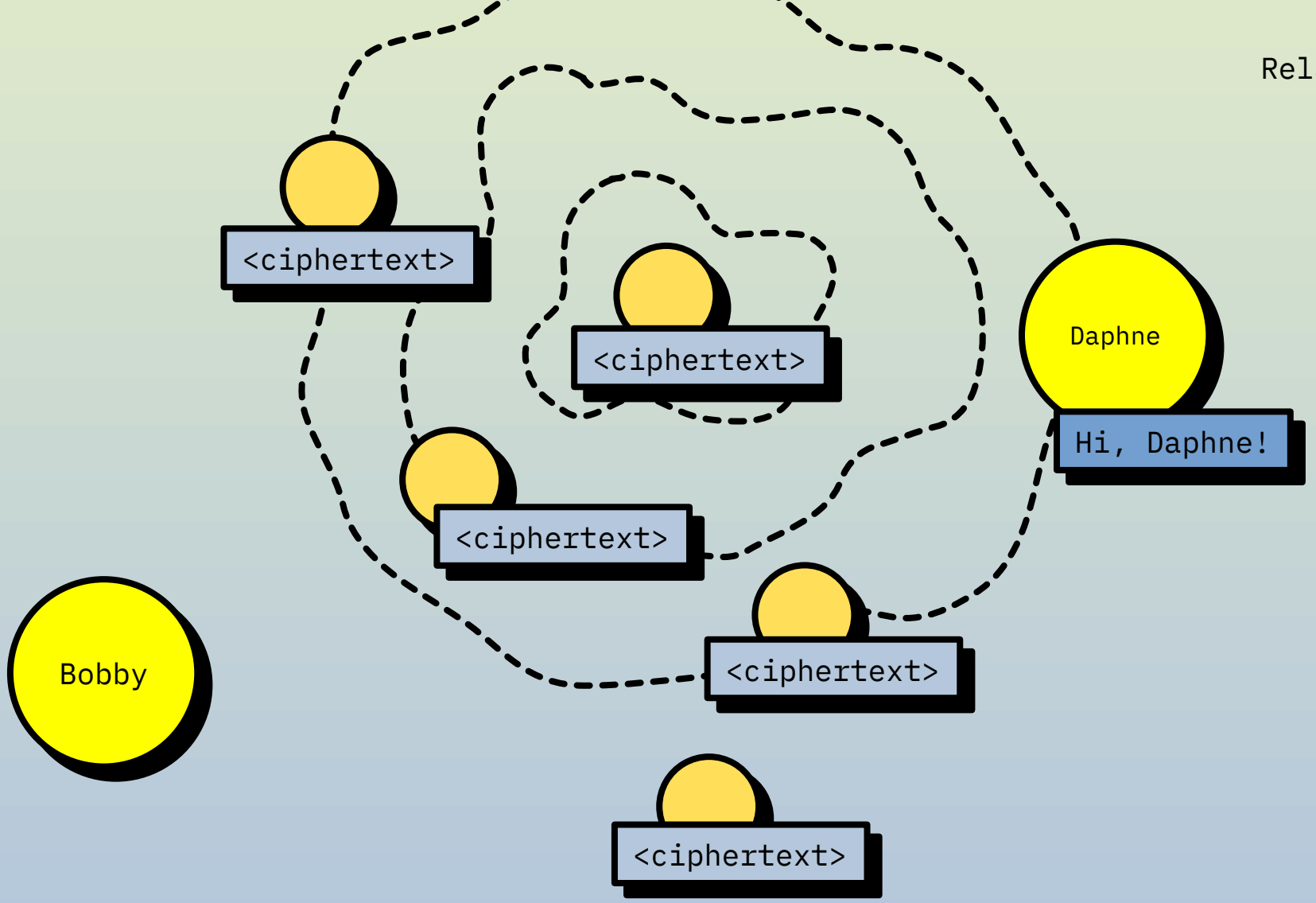
WebXDC

Most Walkaway in town!

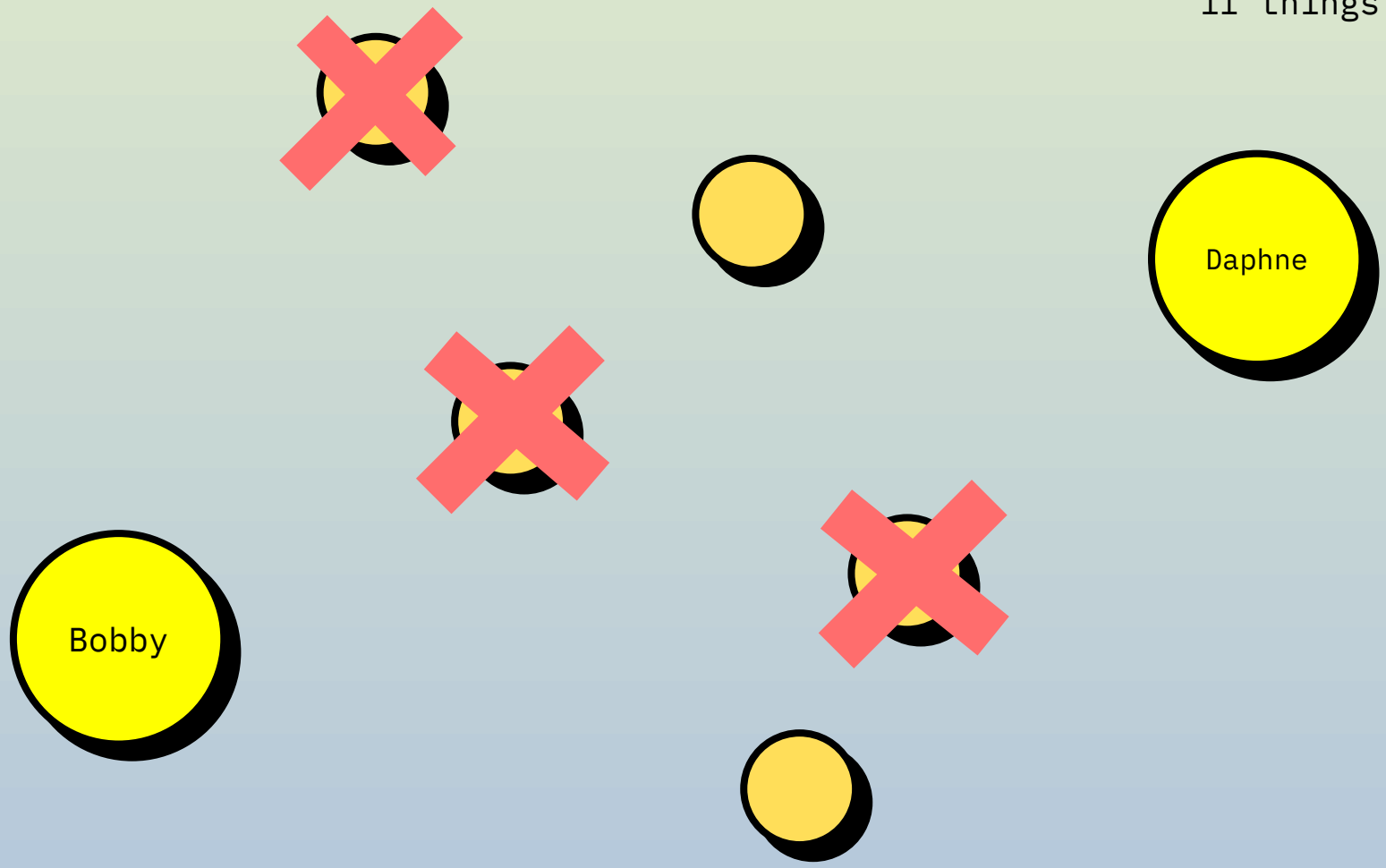

Dedicated relays or other network participants
Daphne
Bobby
Hi, Daphne!


Daphne
<ciphertext>
Bobby
Hi, Daphne!
Make sure to leak no metadata!

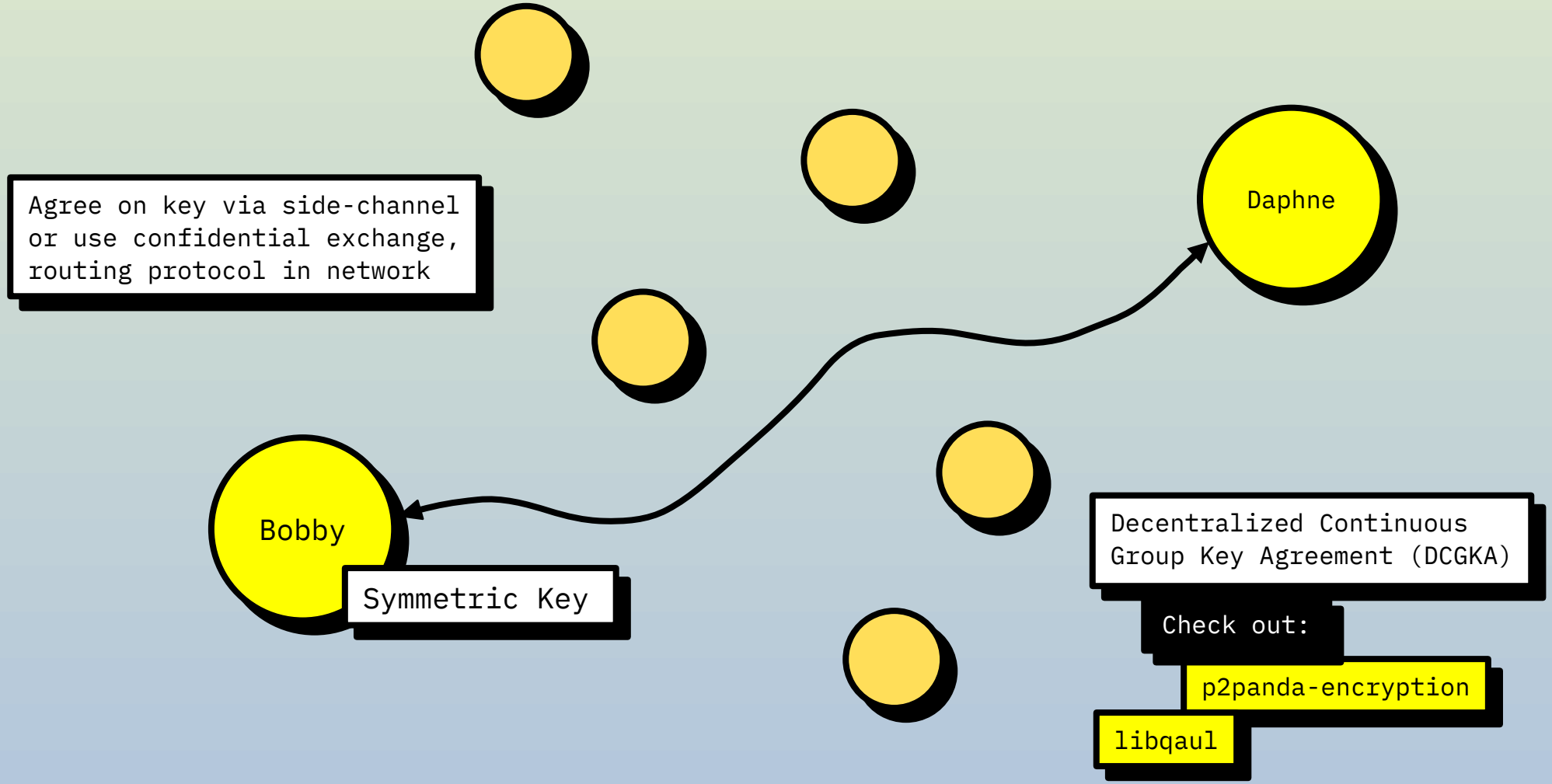

<ciphertext>
<ciphertext>
<ciphertext>
<ciphertext>
<ciphertext>
Bobby
Daphne

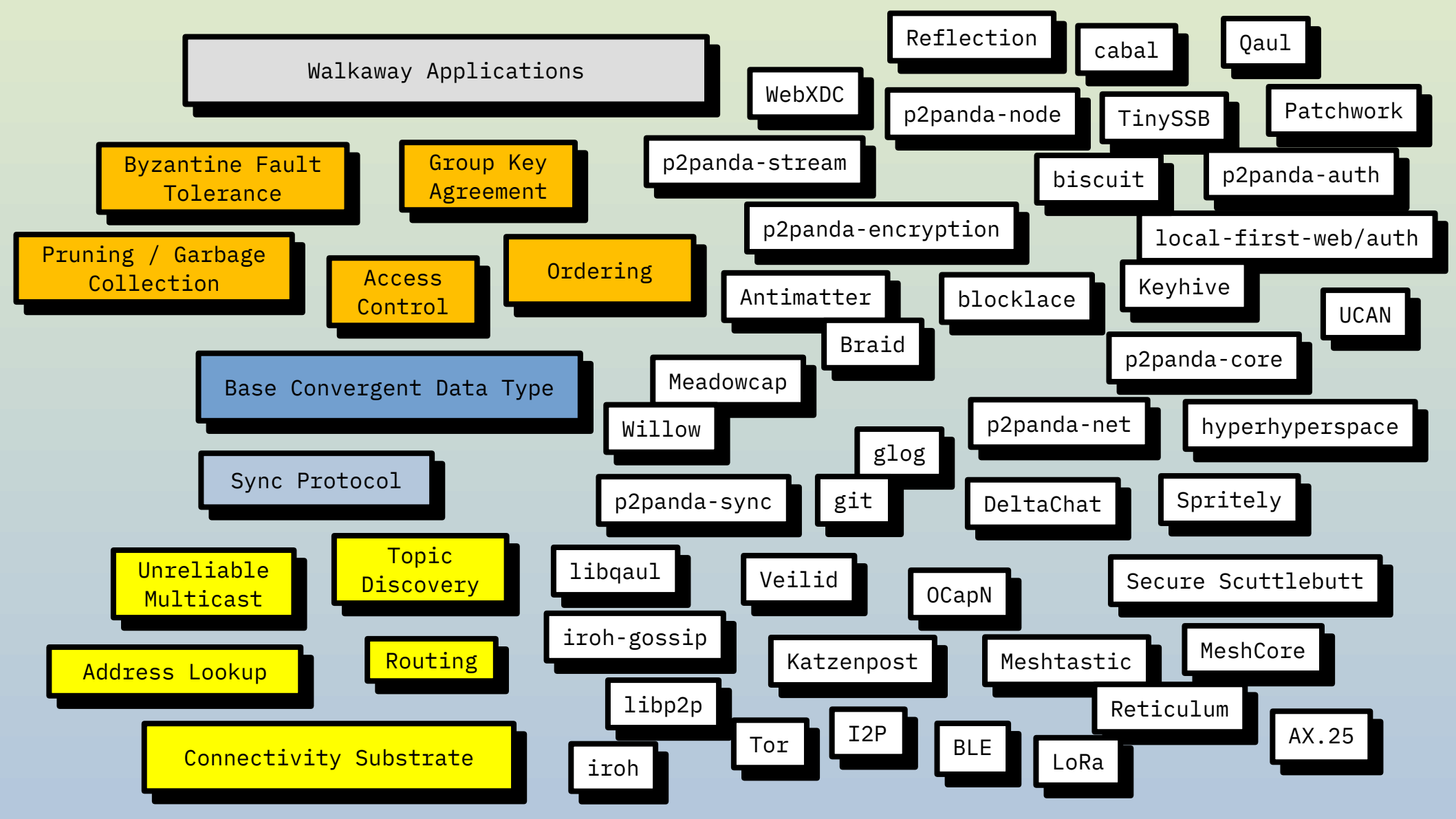

Relays
<ciphertext>
<ciphertext>
Daphne
Hi, Daphne!
<ciphertext>
Bobby
<ciphertext>
<ciphertext>

It shouldn’t matter
if things go down



Agree on a key before




Walkaway Applications
Reflection
cabal
Qaul
WebXDC
p2panda-node
TinySSB
Patchwork
Byzantine Fault Tolerance
Group Key Agreement
p2panda-stream
biscuit
p2panda-auth
p2panda-encryption
local-first-web/auth
Pruning / Garbage Collection
Access Control
Ordering
Antimatter
blocklace
Keyhive
UCAN
Braid
p2panda-core
Base Convergent Data Type
Meadowcap
Willow
p2panda-net
hyperhyperspace
glog
Sync Protocol
p2panda-sync
git
DeltaChat
Spritely
Unreliable Multicast
Topic Discovery
libqaul
Veilid
OCapN
Secure Scuttlebutt
iroh-gossip
Address Lookup
Routing
Katzenpost
Meshtastic
MeshCore
libp2p
Reticulum
Tor
I2P
BLE
AX.25
Connectivity Substrate
iroh
LoRa

Failed attempt to
paint a map

Thank you!

adz.garden
@adz@post.lurk.org

I want to do something {Book, Video Series, ..} with the material from the lecture series. Write me if you have $$$, ideas or feedback to support this work <3