

WebNative File System

Beyond UnixFS: Extending IPFS for Edge Apps & Web3

github.com/WebNativeFileSystem



And now
for something
completely different...



BROOKLYN ZELENKA

@expede
CTO @ Fission



PHILIPP KRÜGER

@matheus23
Protocol Engineer @ Fission



Won't have time to cover everything in depth.

Come talk to us after, we're friendly & happy to share what we've learned along the way!

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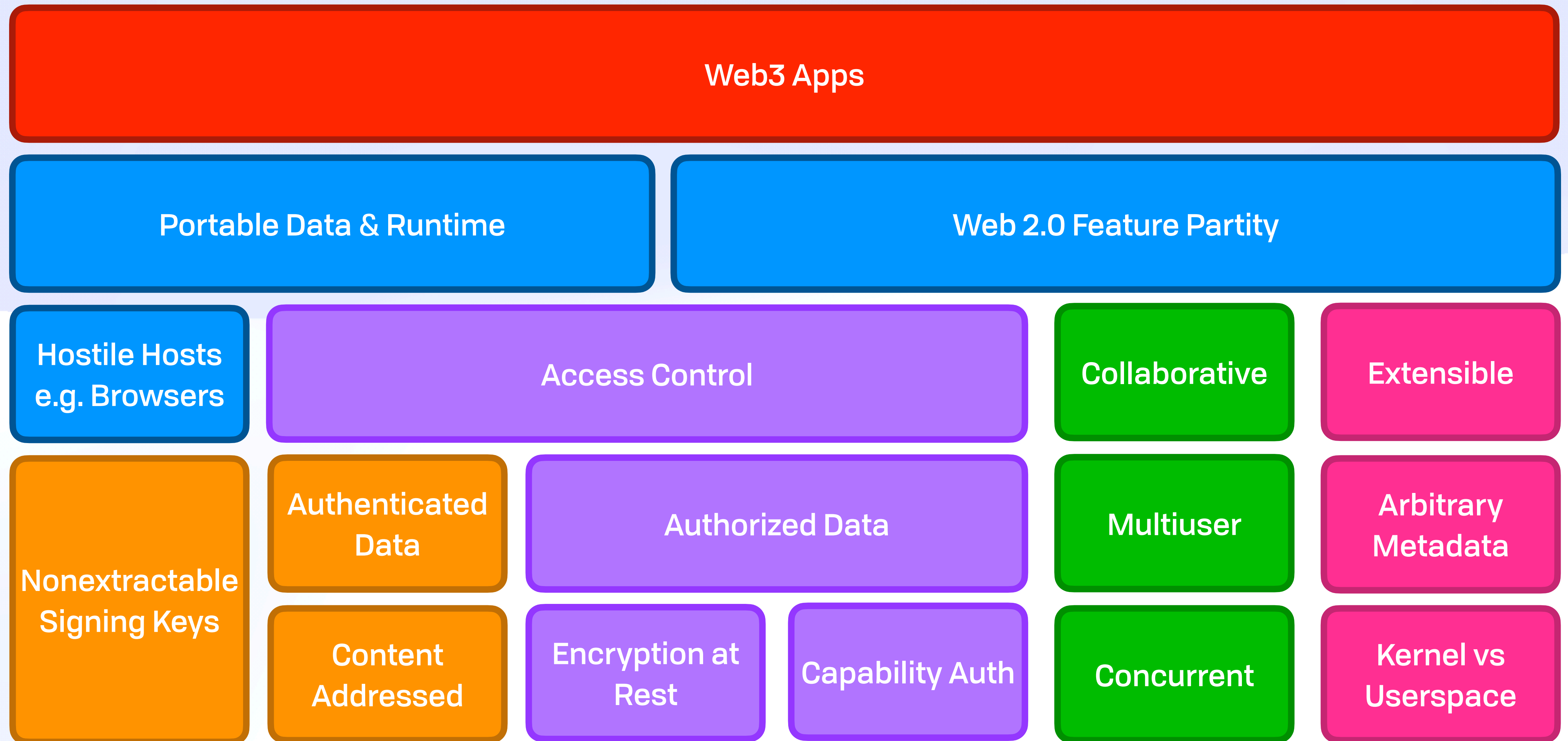
@matheus23
Protocol Engineer @ Fission



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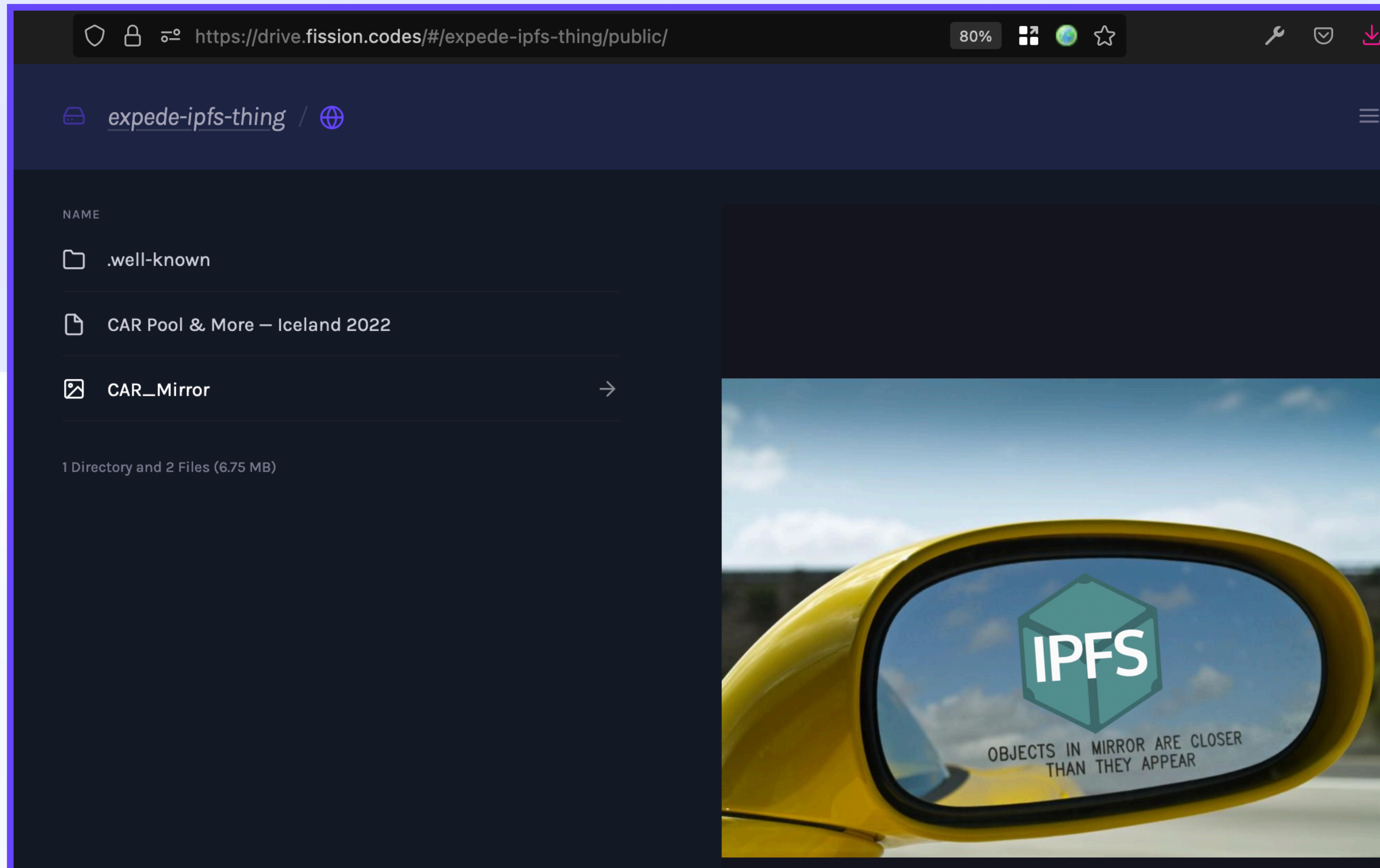
Come talk to us after, we're friendly & happy to share what we've learned along the way!


Requirements Diagram




Beyond UnixFS 🚀

Drive (File Explorer)



Beyond UnixFS 

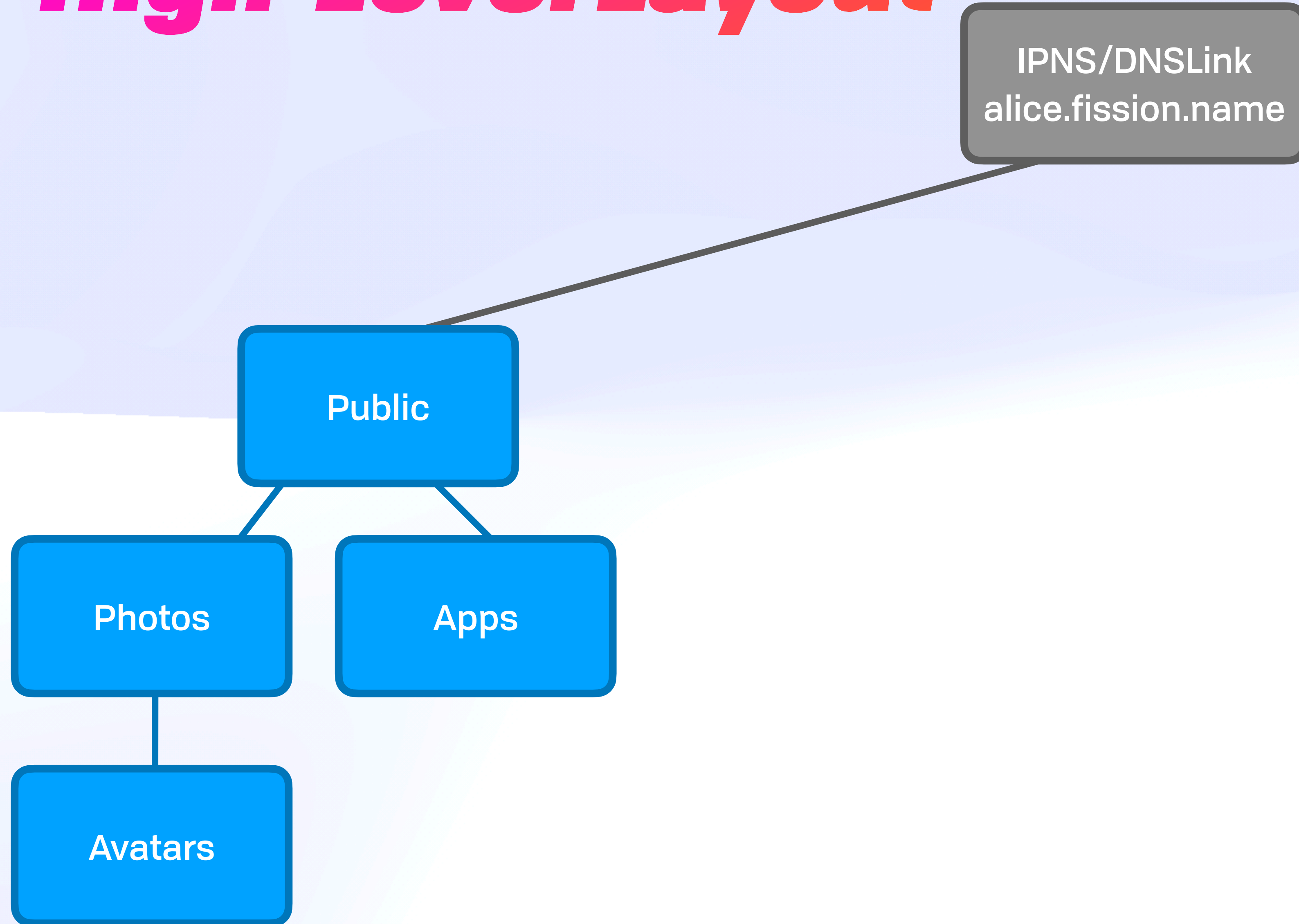
High-Level Layout

Beyond UnixFS 

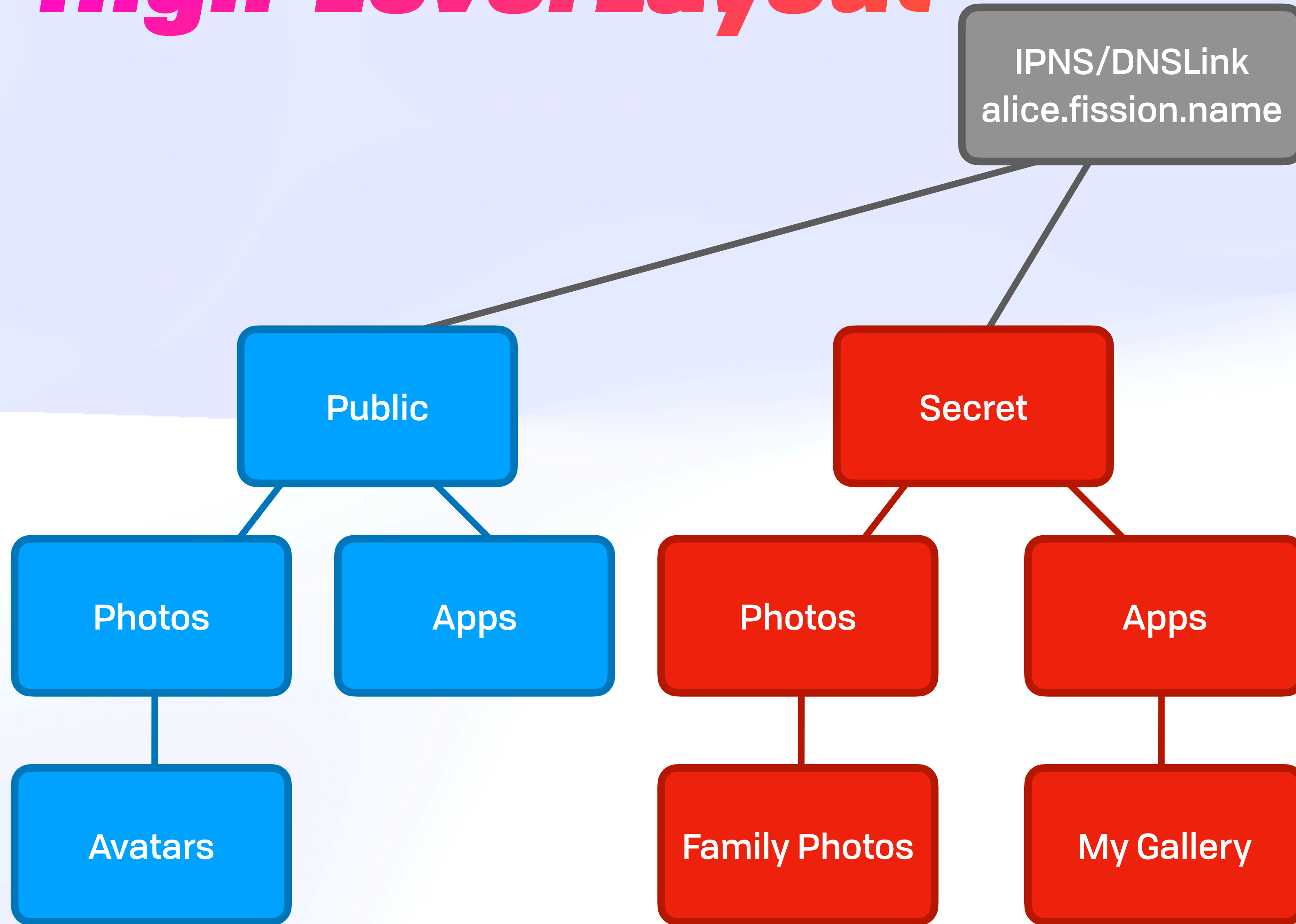
High-Level Layout

IPNS/DNSLink
alice.fission.name

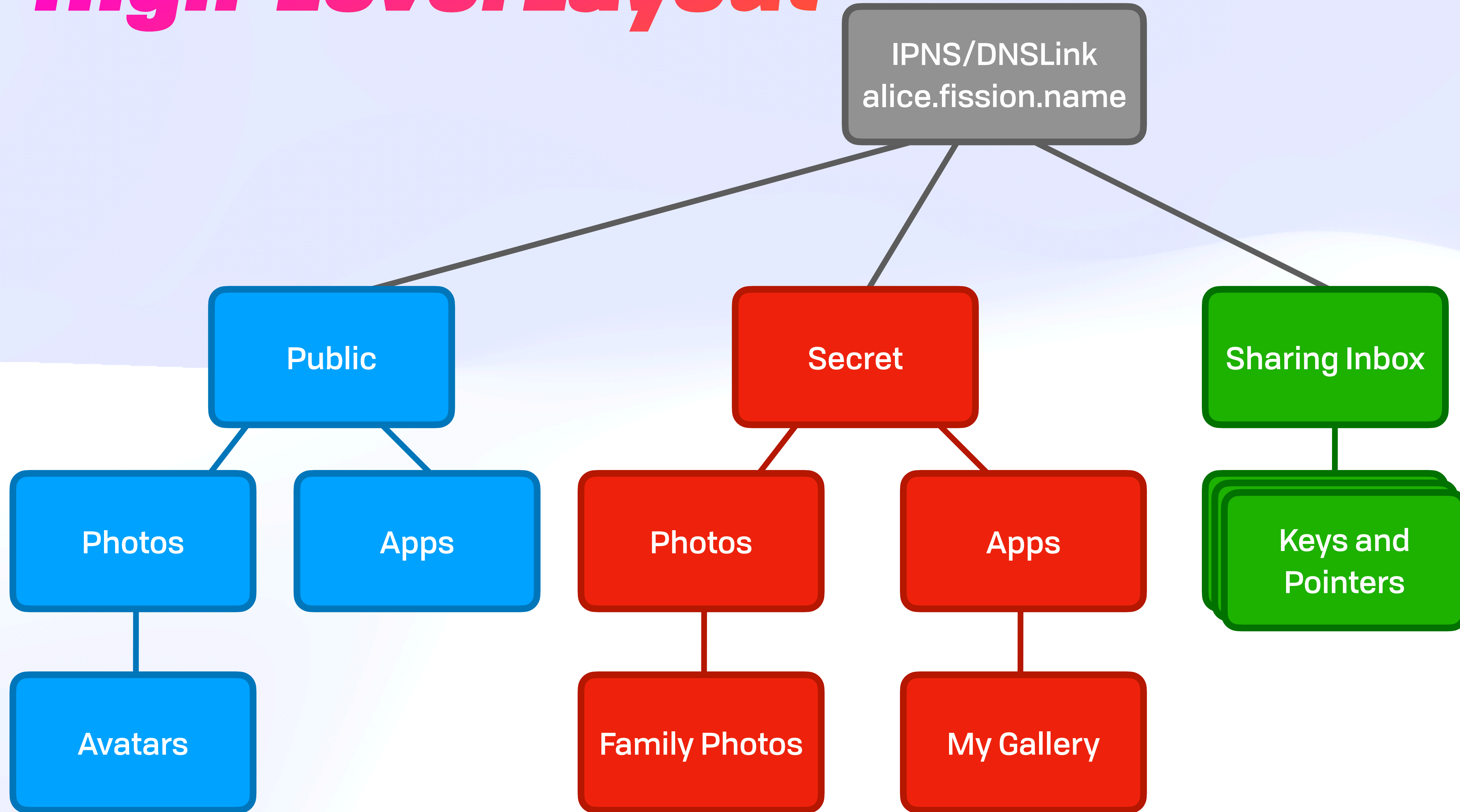
High-Level Layout



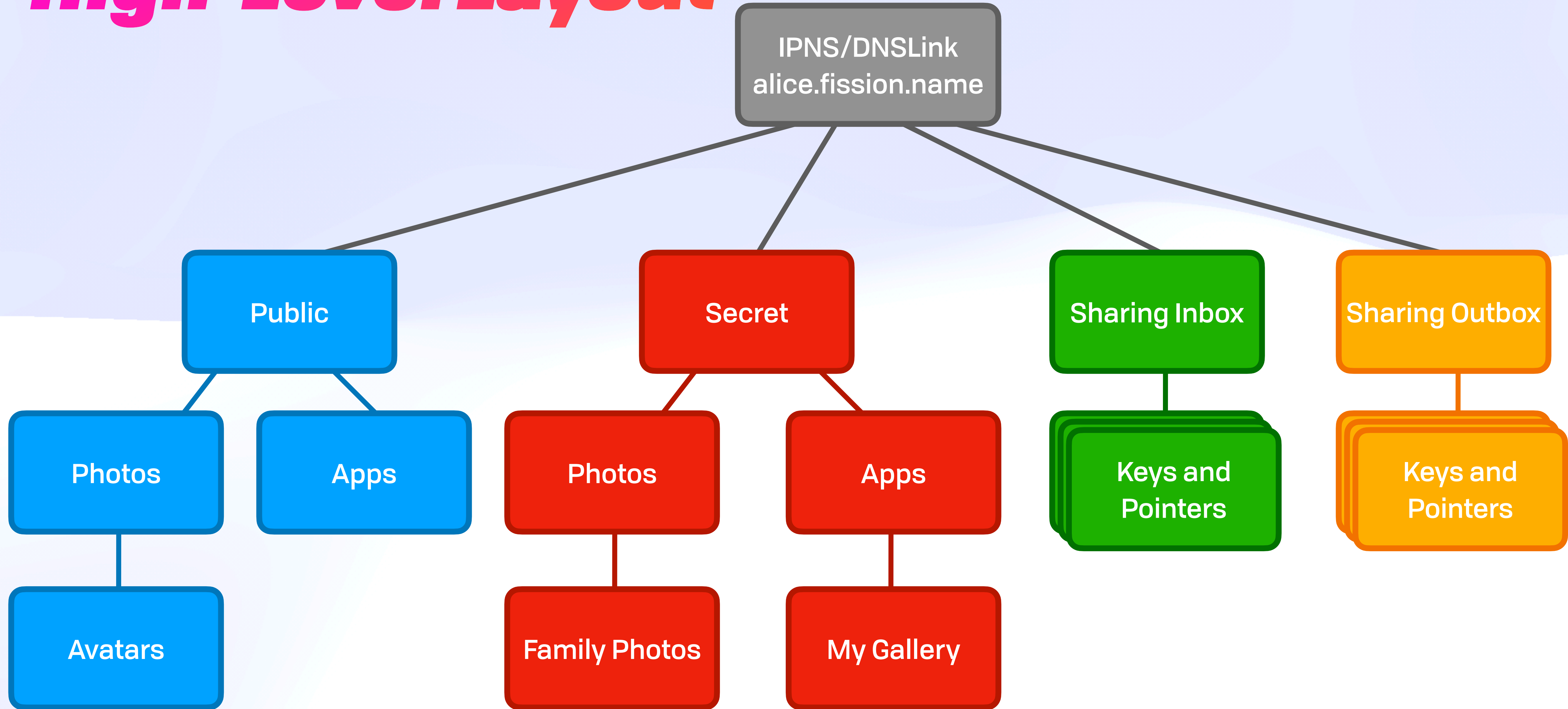
High-Level Layout



High-Level Layout

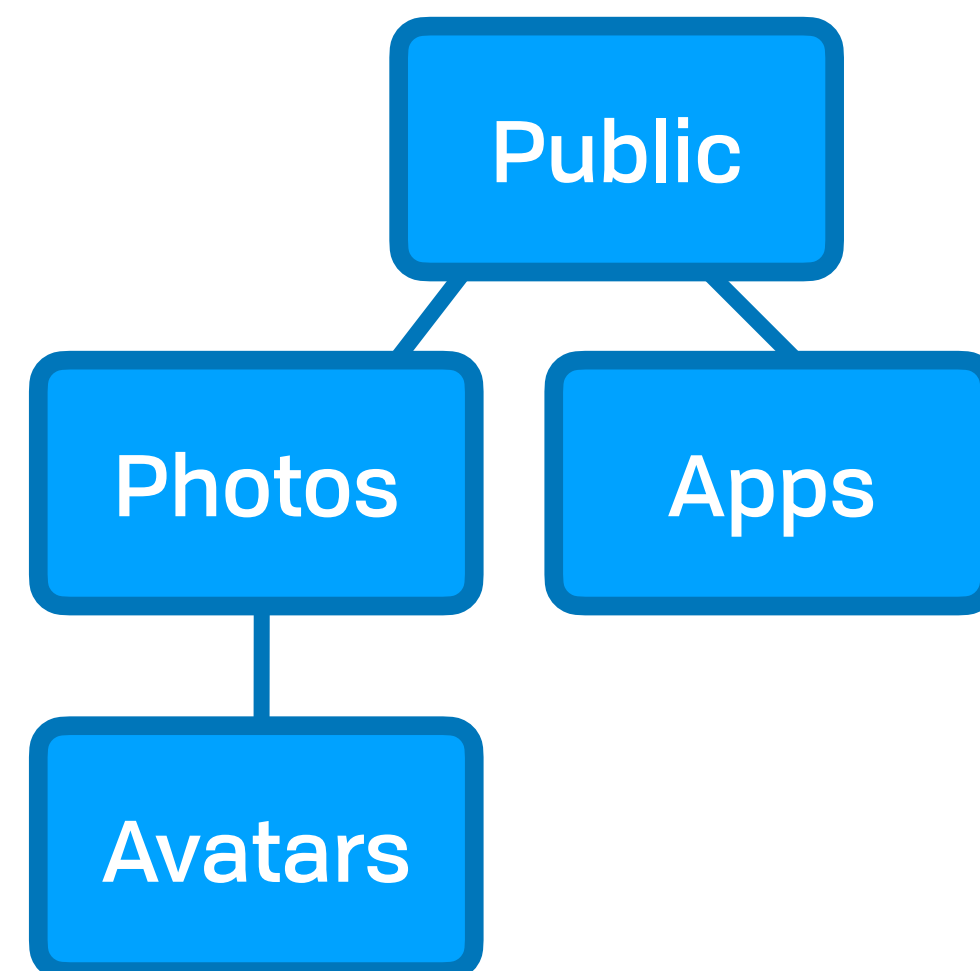


High-Level Layout



Public Files

General WNFS Data Model



Public Files 

Virtual Nodes

Public Files 

Virtual Nodes

Raw IPLD Node

Public Files 

Virtual Nodes

Raw IPLD Node

File Node

Raw Data

Metadata



Public Files 📁

Virtual Nodes

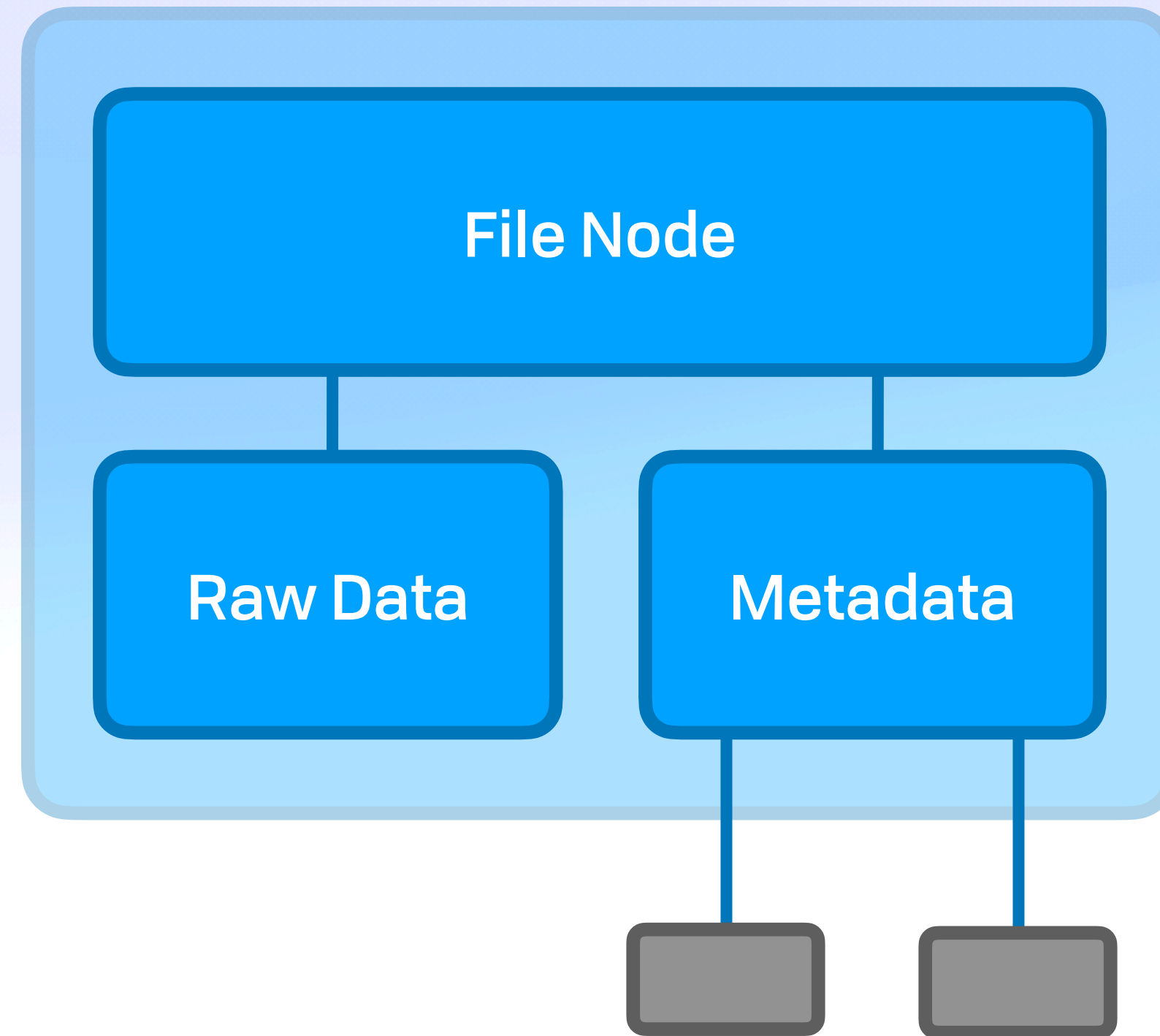
Raw IPLD Node

File Node

Raw Data

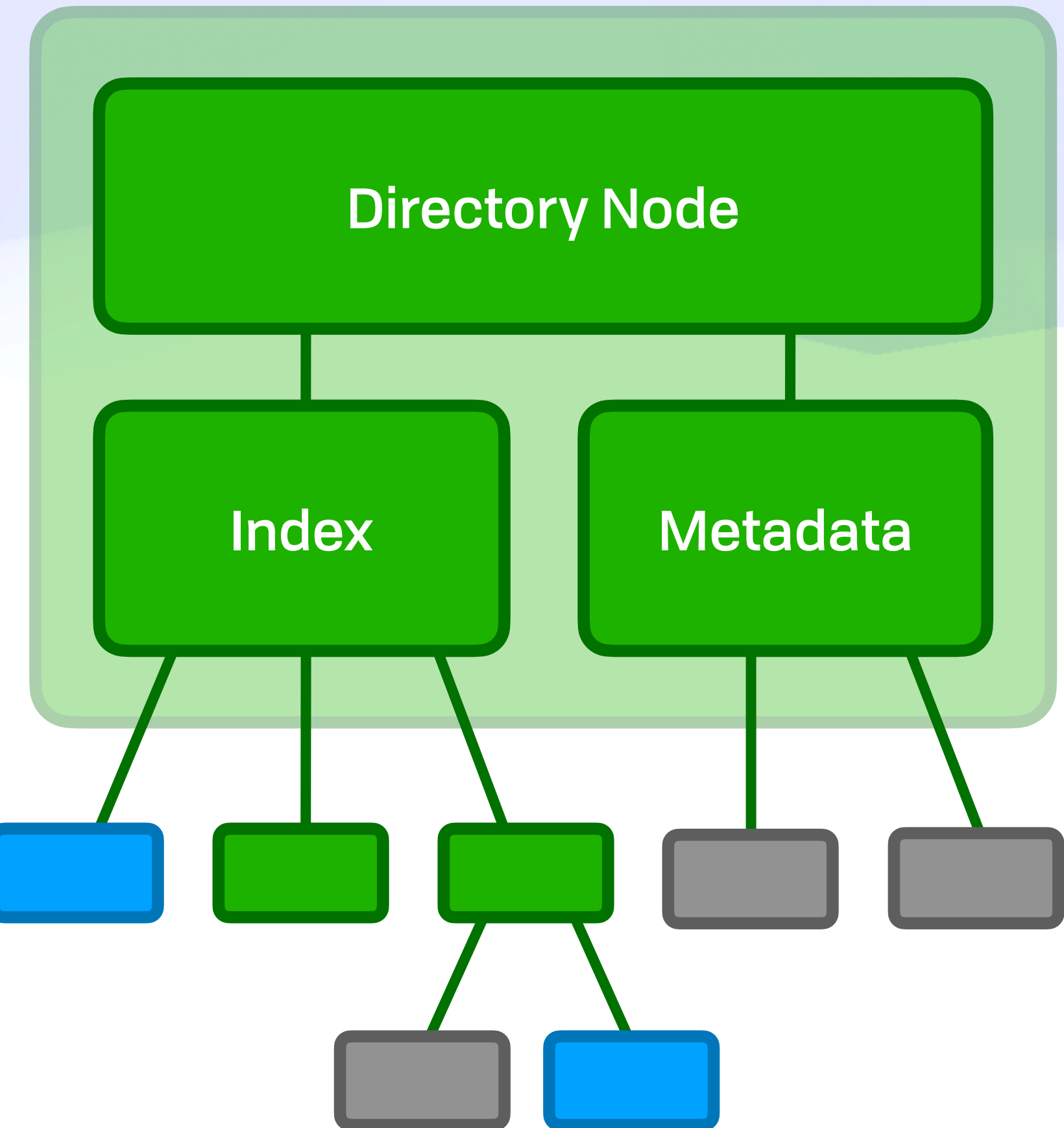
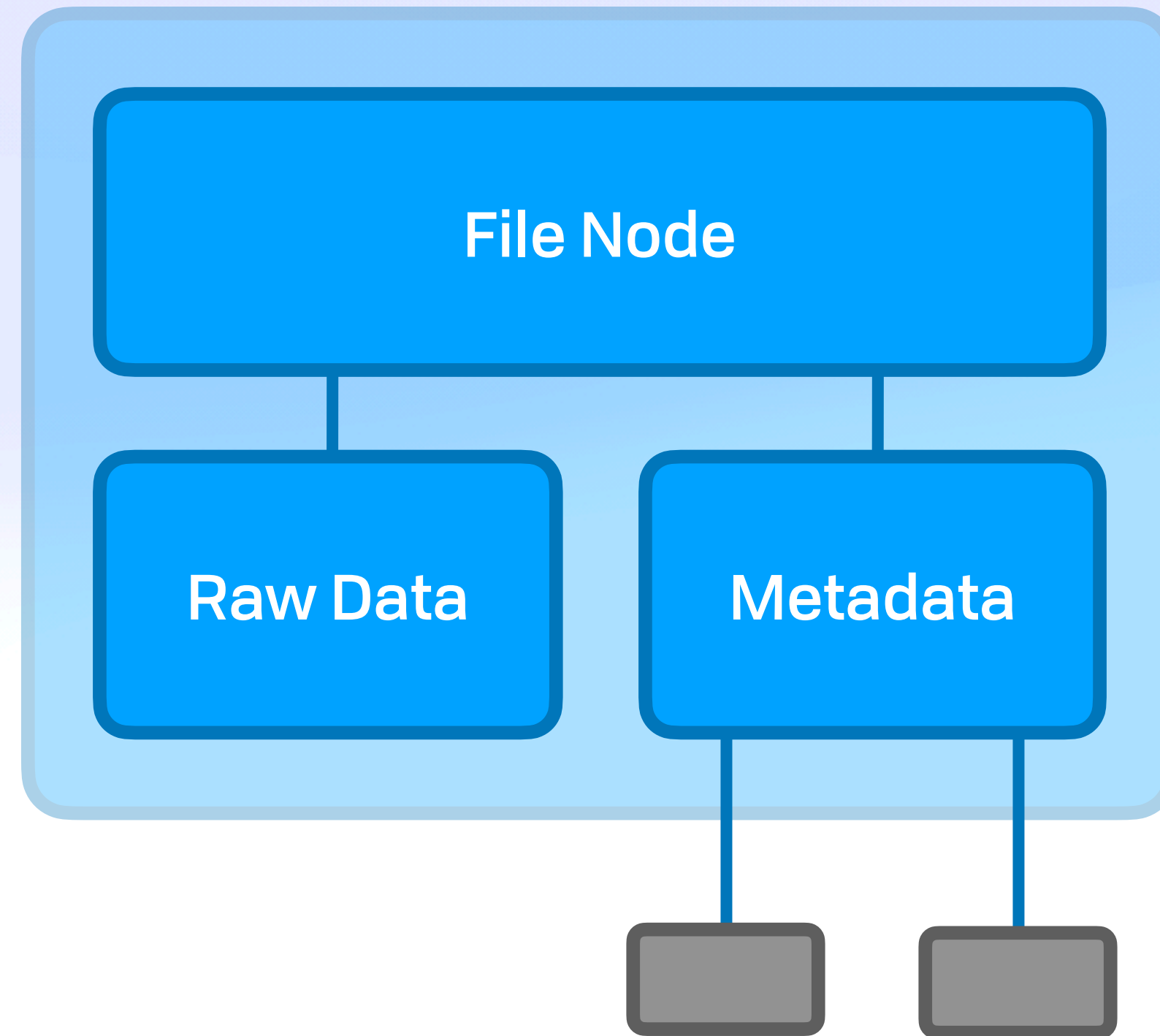
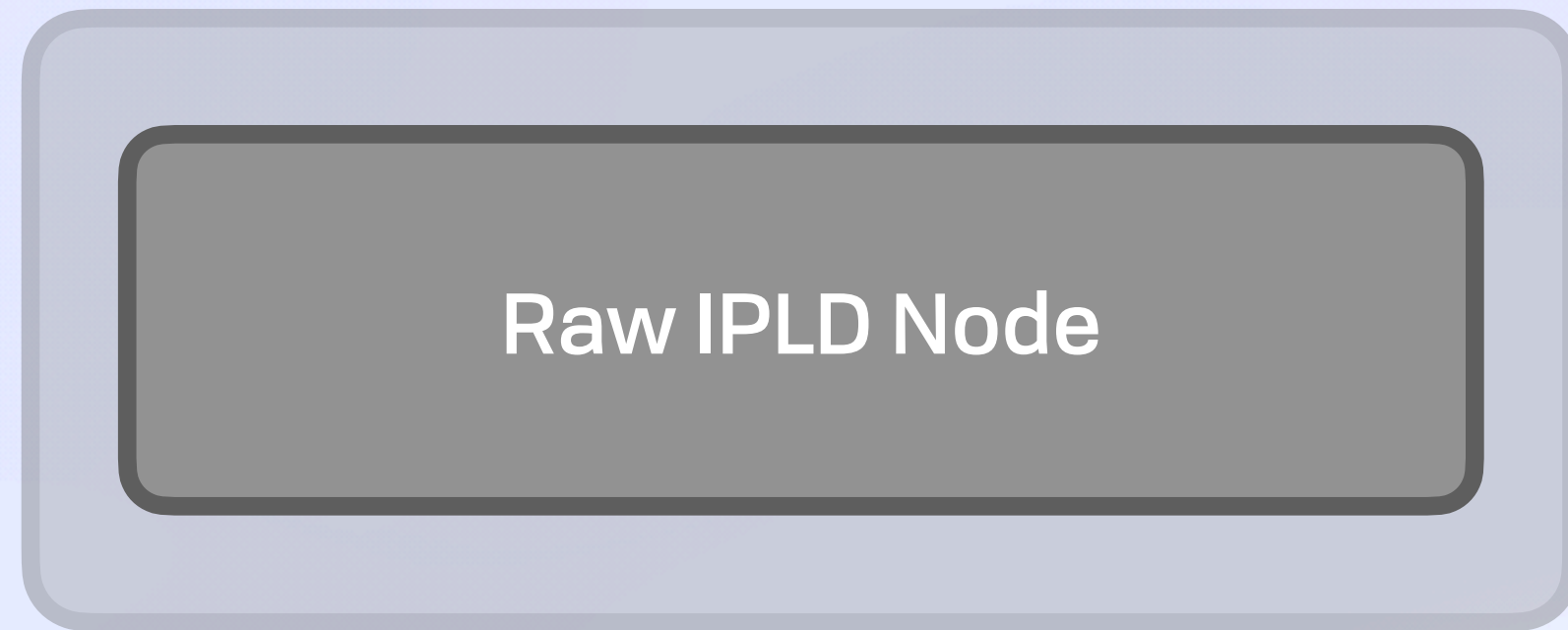
Metadata

- ◆ Virtual Node
 - ◆ Consistent interface
- ◆ Arbitrary metadata
 - ◆ Tags, creators, MIME, sources, &c



Public Files

Virtual Nodes



- ◆ Virtual Node
 - ◆ Consistent interface
- ◆ Arbitrary metadata
 - ◆ Tags, creators, MIME, sources, &c

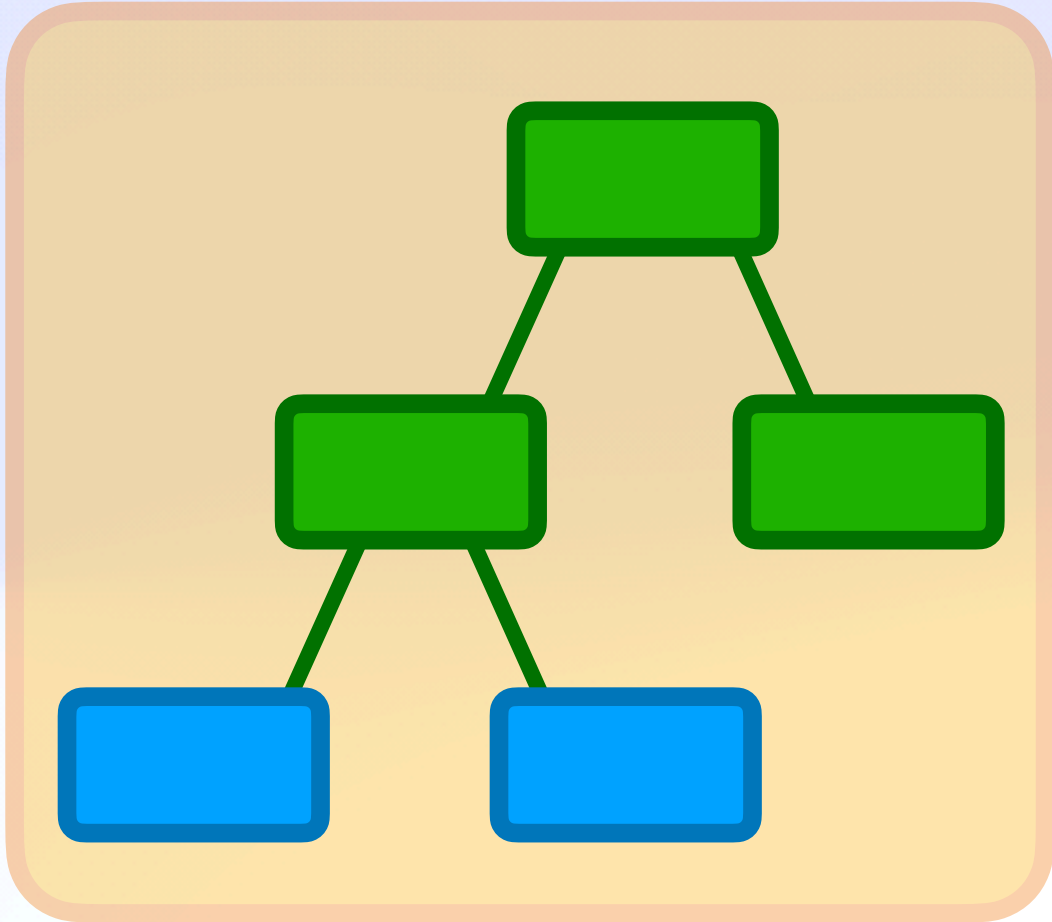
Public Files 

Hard & Soft Links

Public Files 

Hard & Soft Links

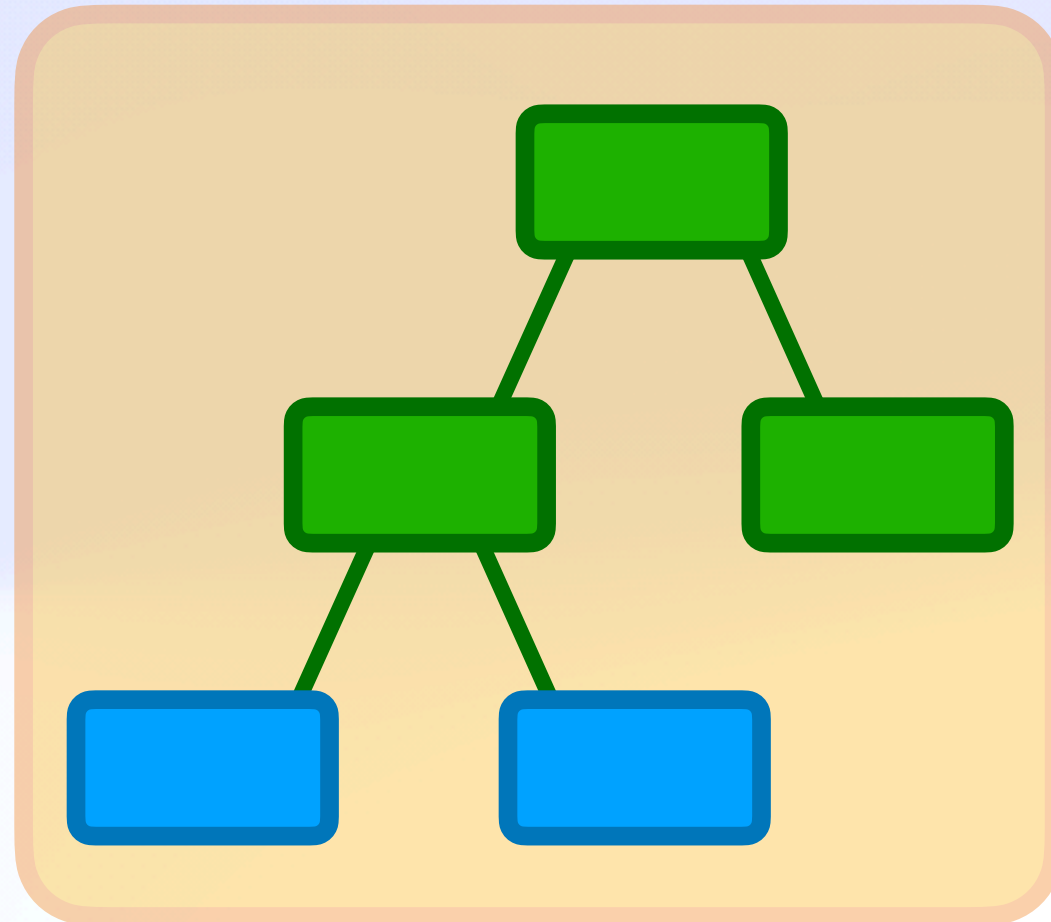
alice.fission.name



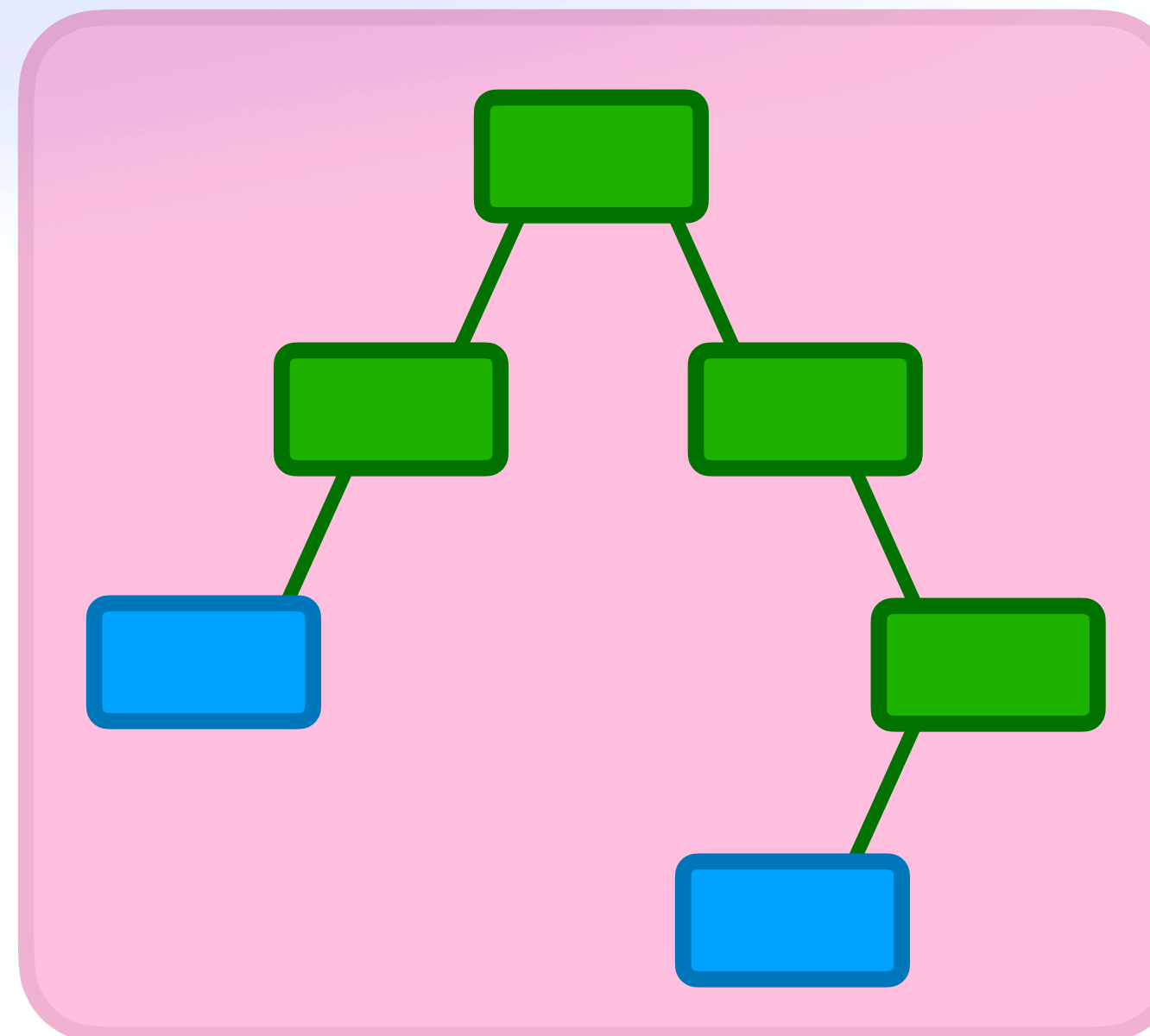
Public Files 

Hard & Soft Links

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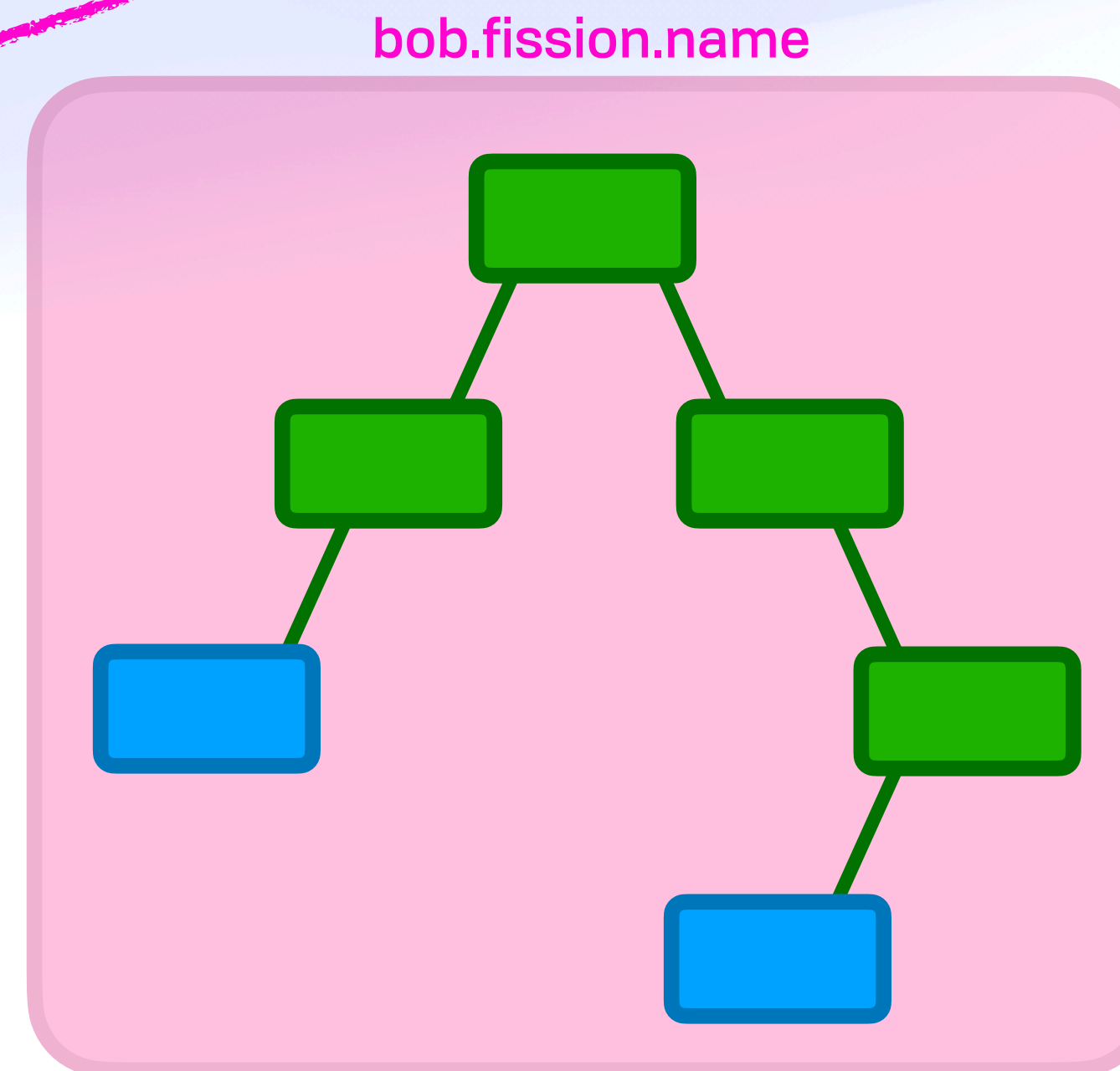
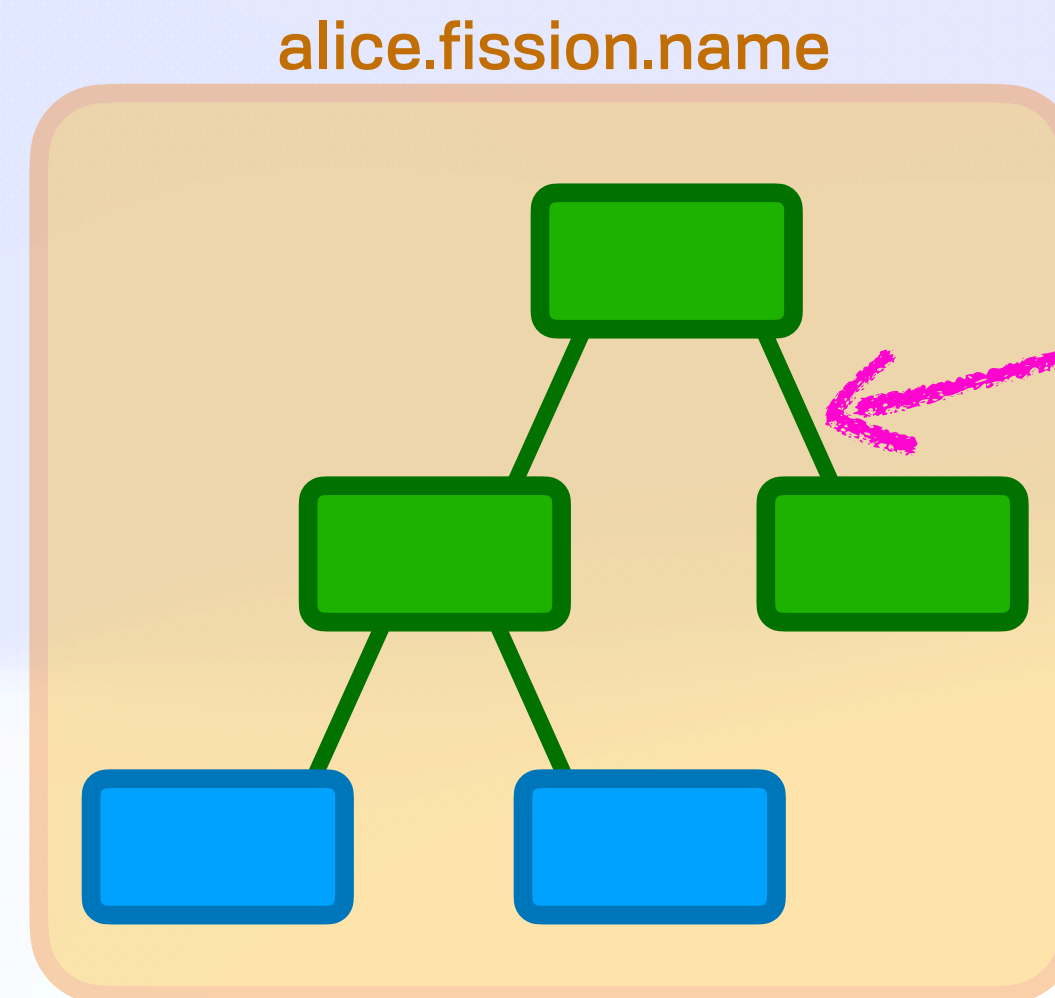
bob.fission.name



Hard & Soft Links

Hard Links

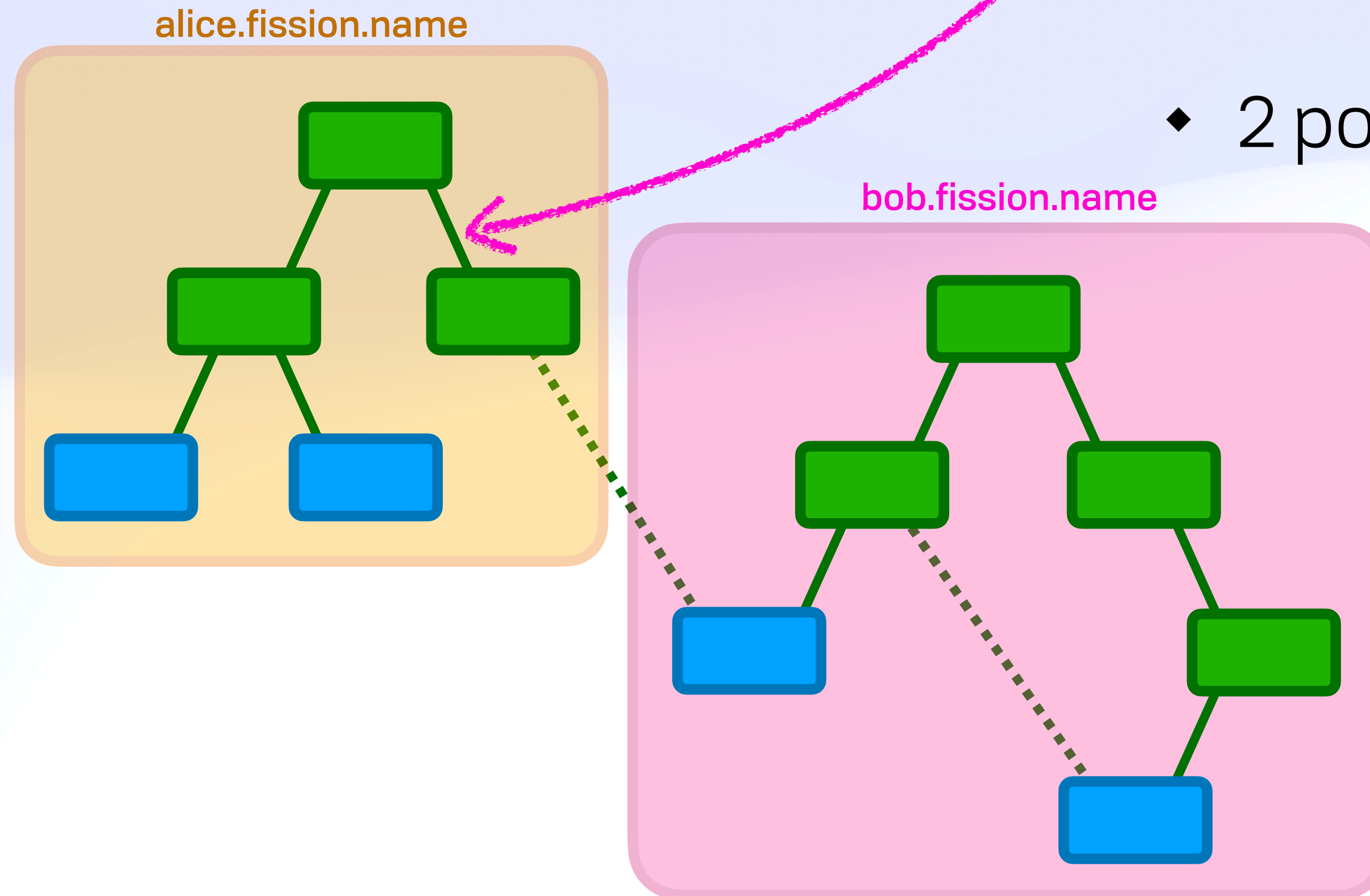
- ◆ New for the web!
- ◆ Direct reference
- ◆ 2 pointers ~ deduplicate



Hard & Soft Links

Hard Links

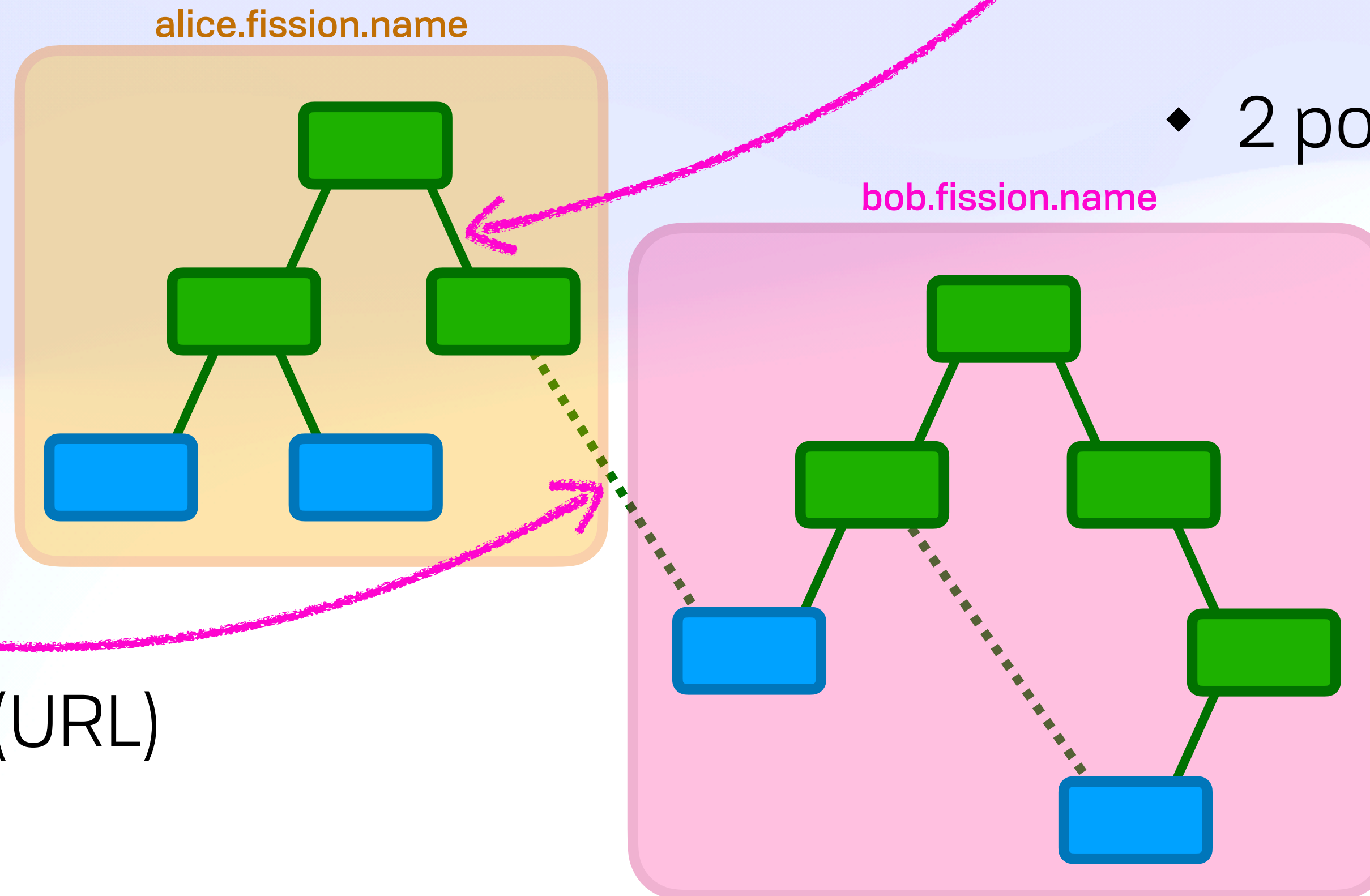
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Hard & Soft Links

Hard Links

- ◆ New for the web!
- ◆ Direct reference
- ◆ 2 pointers ~ deduplicate



Soft Links

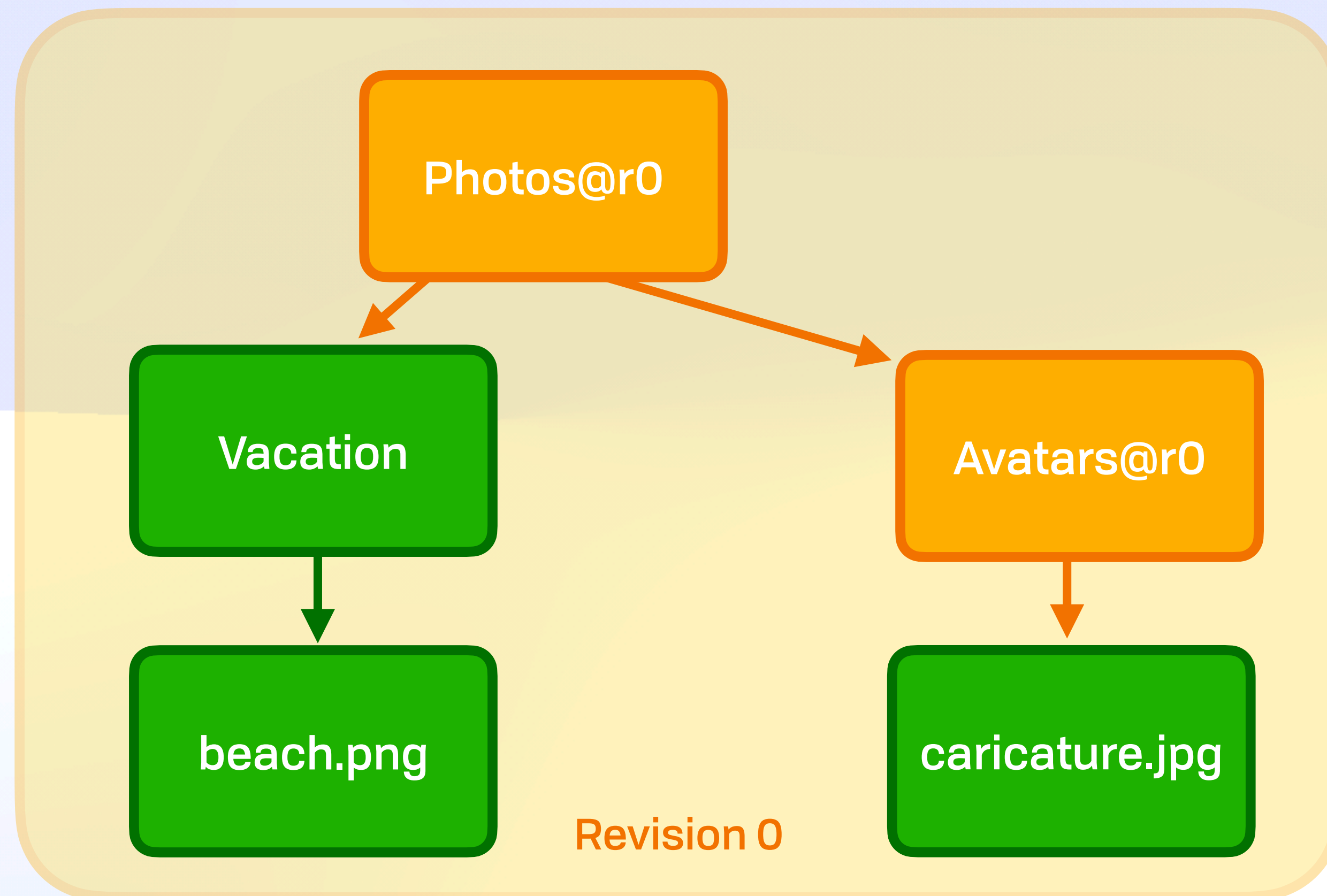
- ◆ Symlink or web link (URL)
- ◆ Pointer ~ latest
- ◆ Latest may break

Public Files 

Persistent Versioning

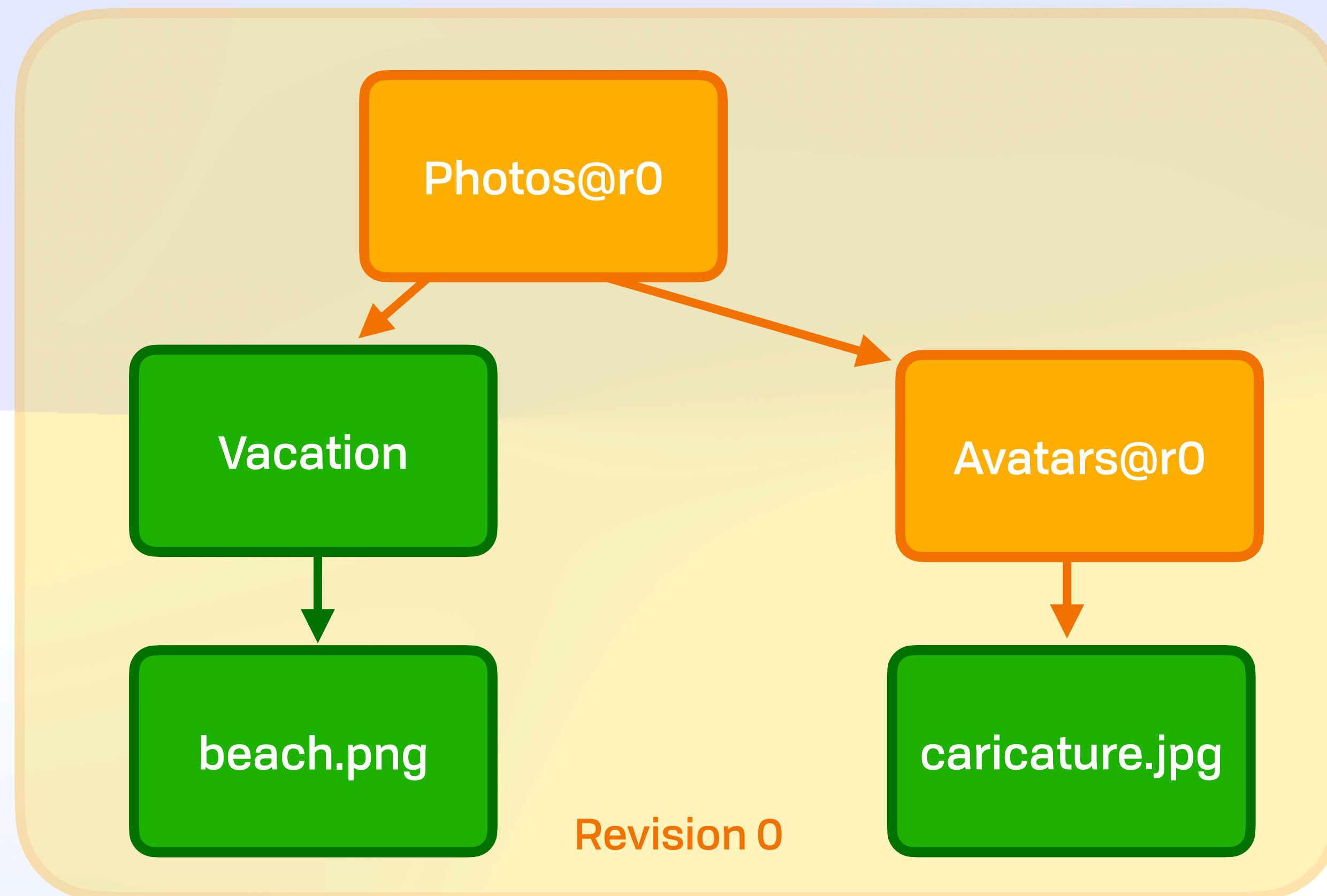
Public Files 

Persistent Versioning

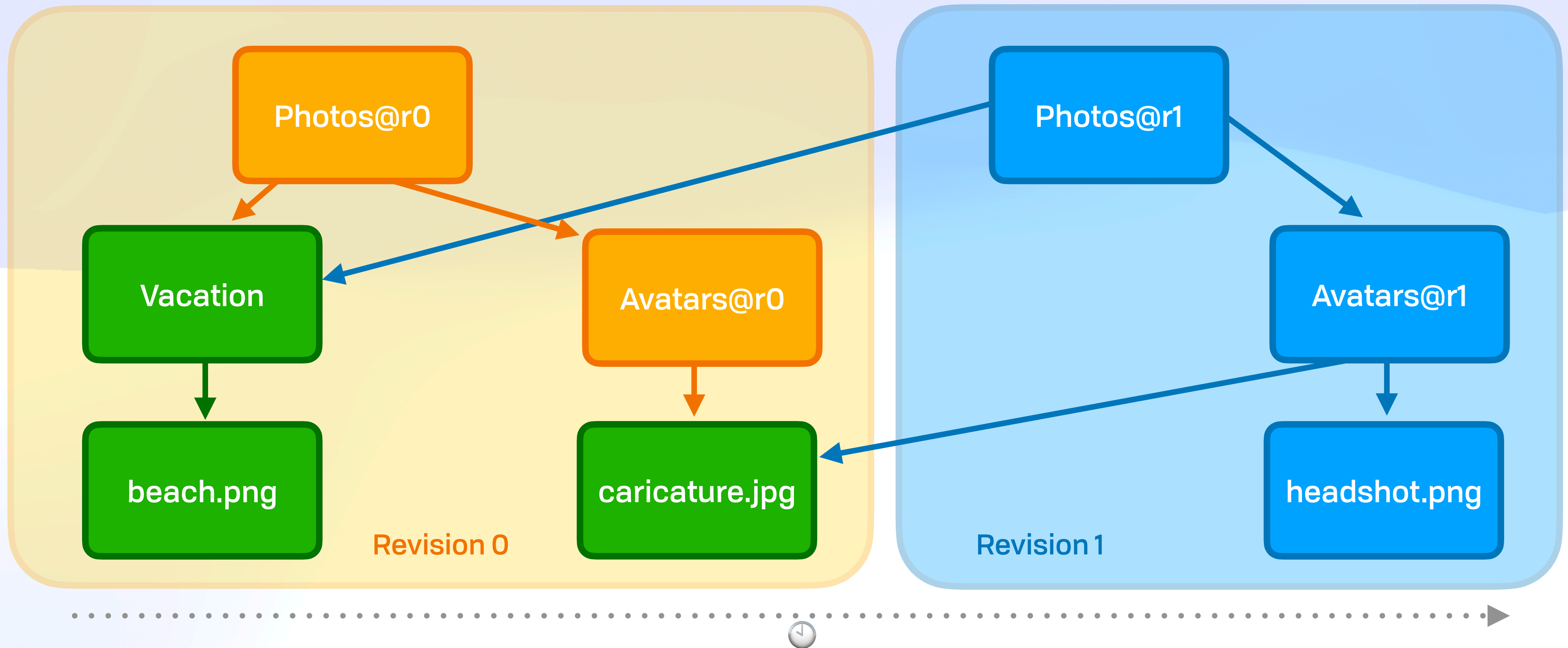


Public Files 

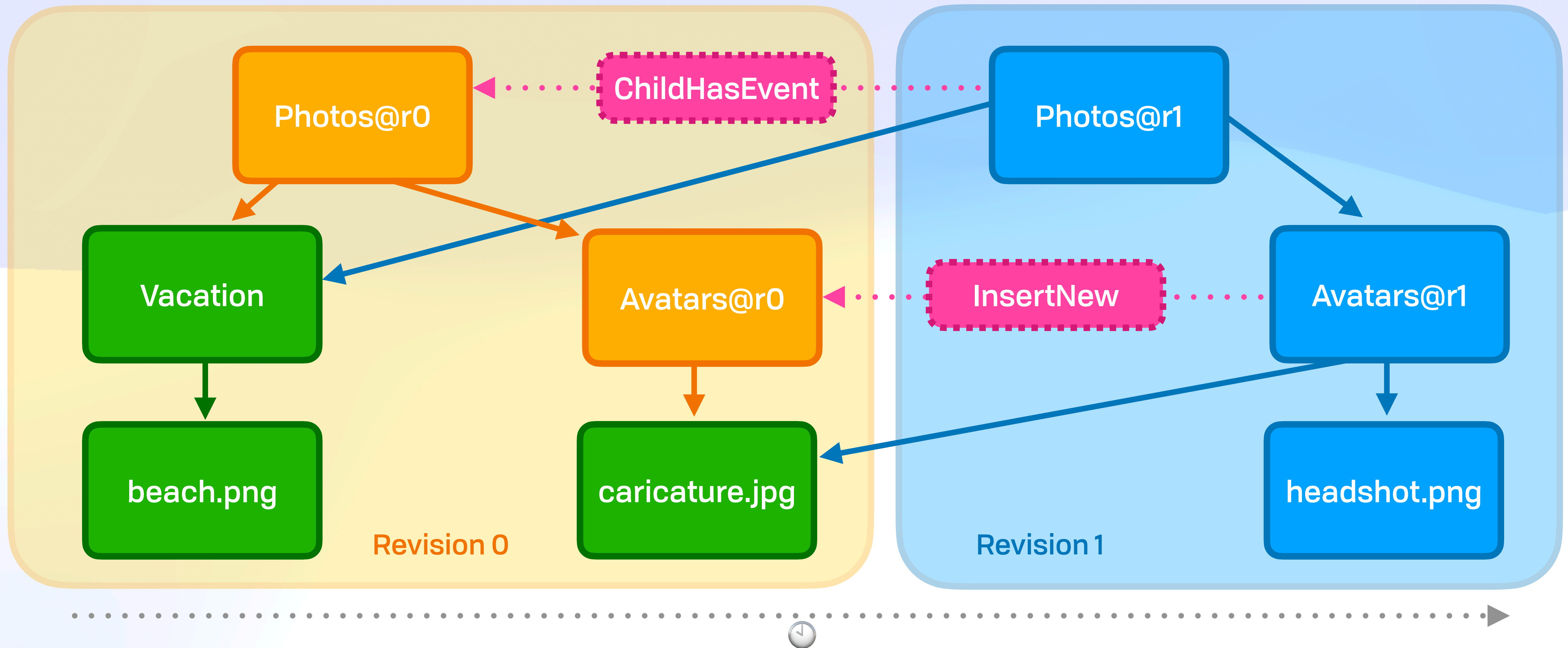
Persistent Versioning



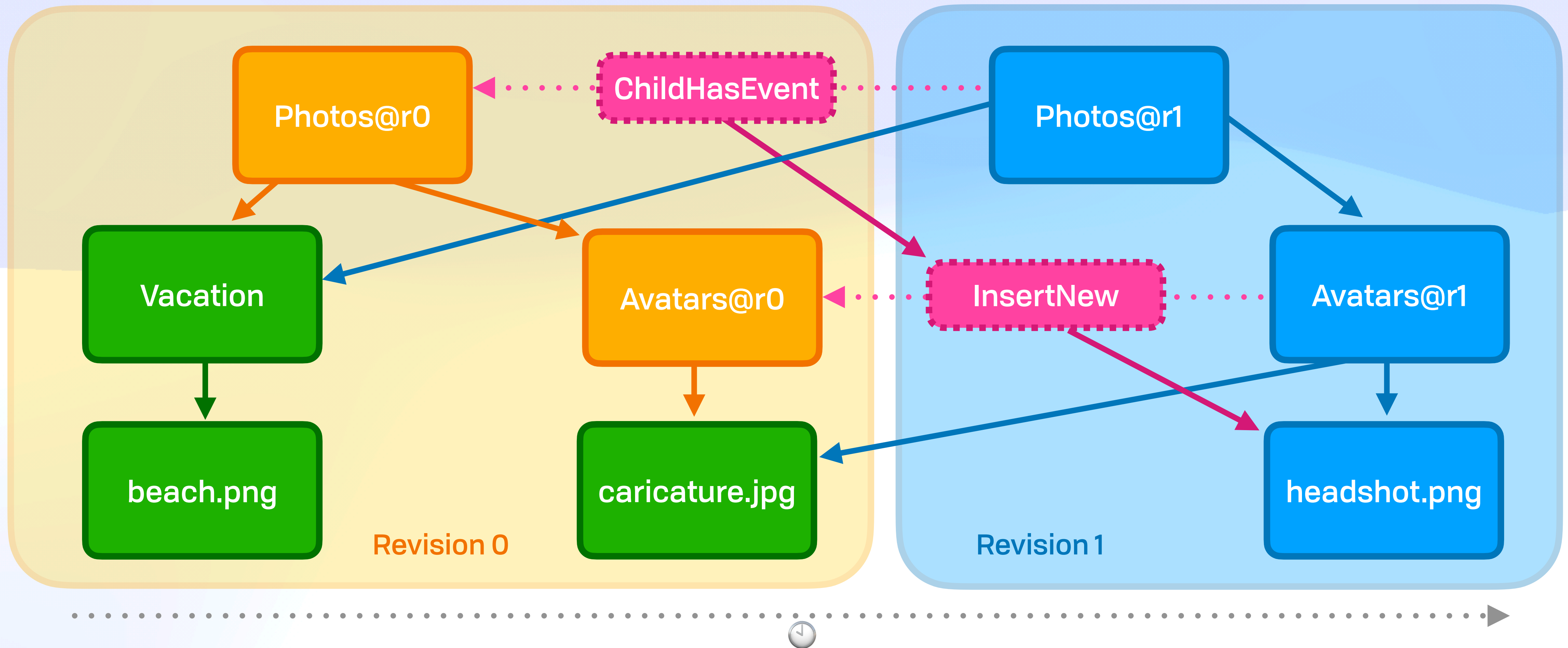
Persistent Versioning



Persistent Versioning

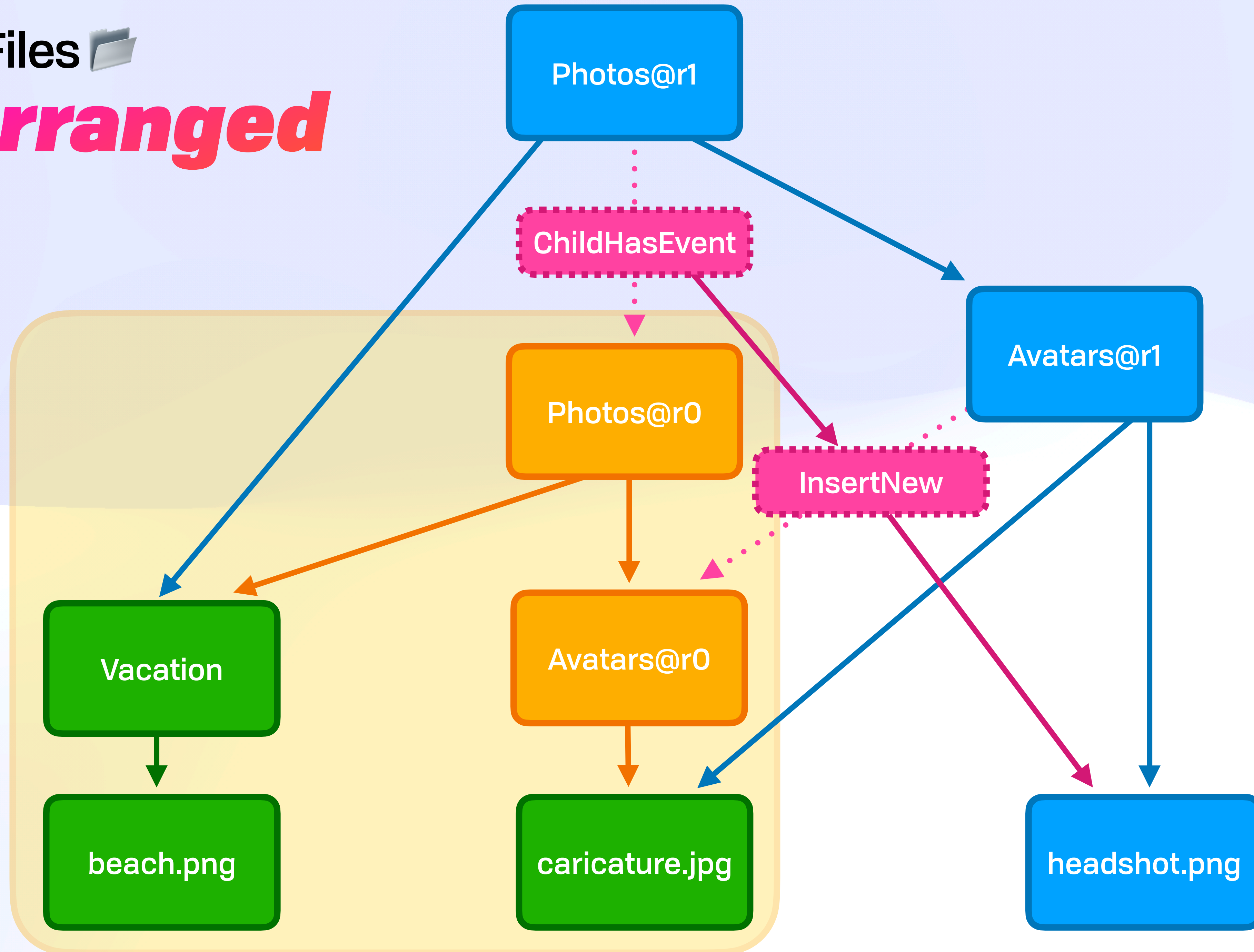


Persistent Versioning



Public Files 

Rearranged





Secret Files 

Confluence



Secret Files 

Confluence

- ◆ One of the first Merkle CRDT papers was from PL 
- ◆ Persistent data structure
- ◆ Automatic file-level reconciliation
- ◆ Pluggable sub-file reconciliation (forthcoming)
- ◆ Basis of upcoming BFT Datalog "at scale" work 

Secret Files 

Confluence

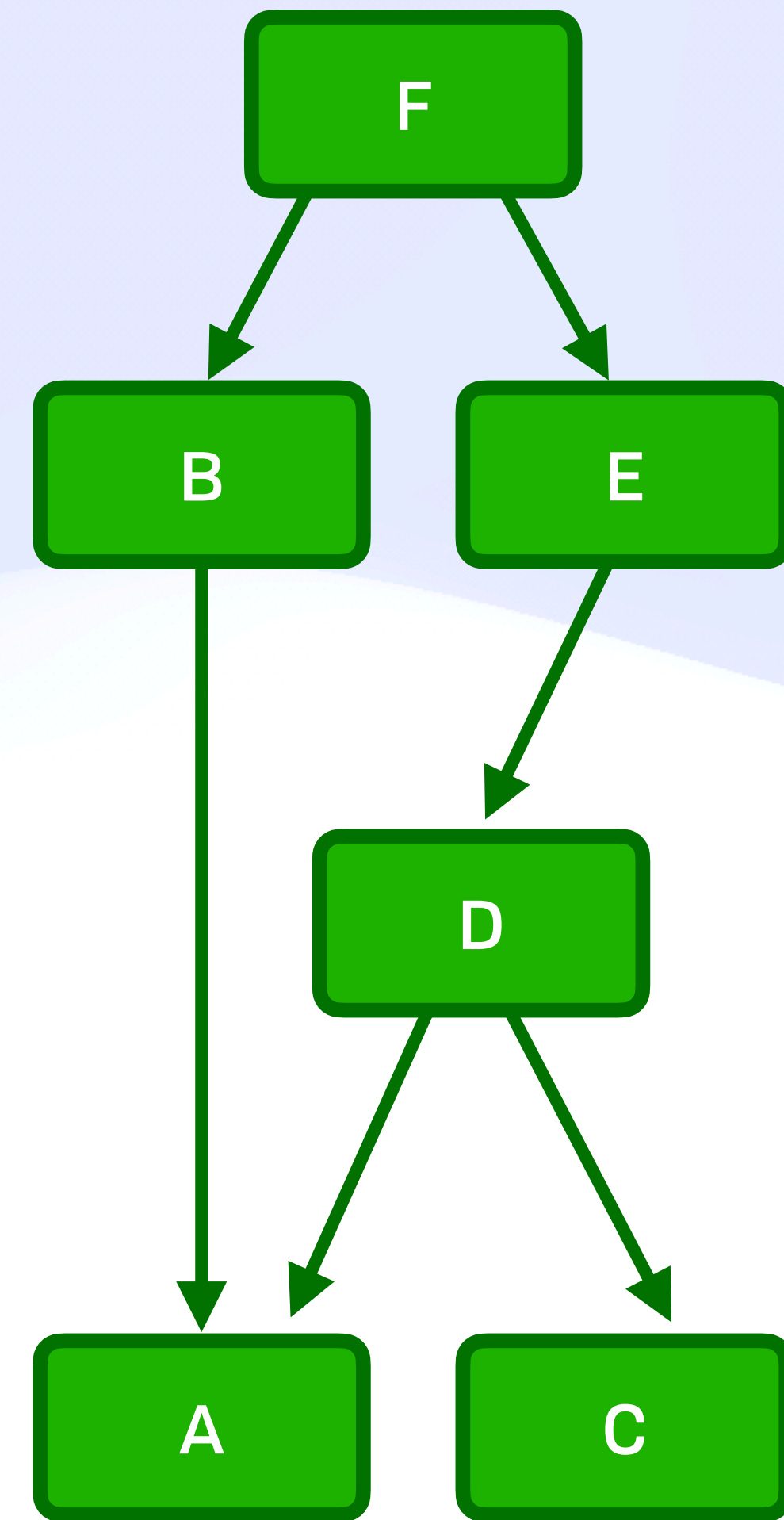
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Single File History / "Causal Shadow"

Secret Files 🥷

Confluence

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Single File History / "Causal Shadow"

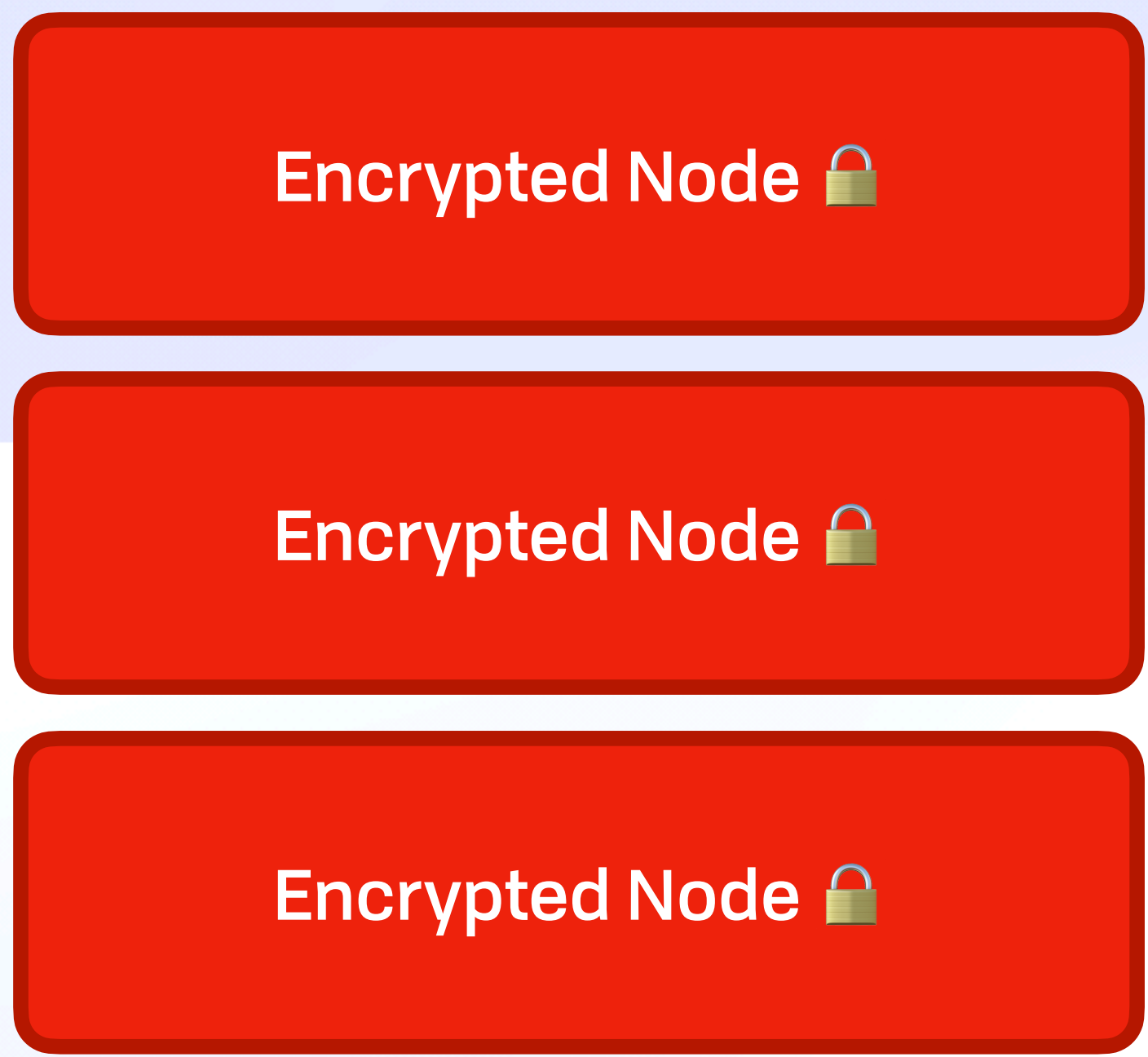
Secret Files 🧑🏿

A Dark Forest of Data

Secret Files 

Private Nodes

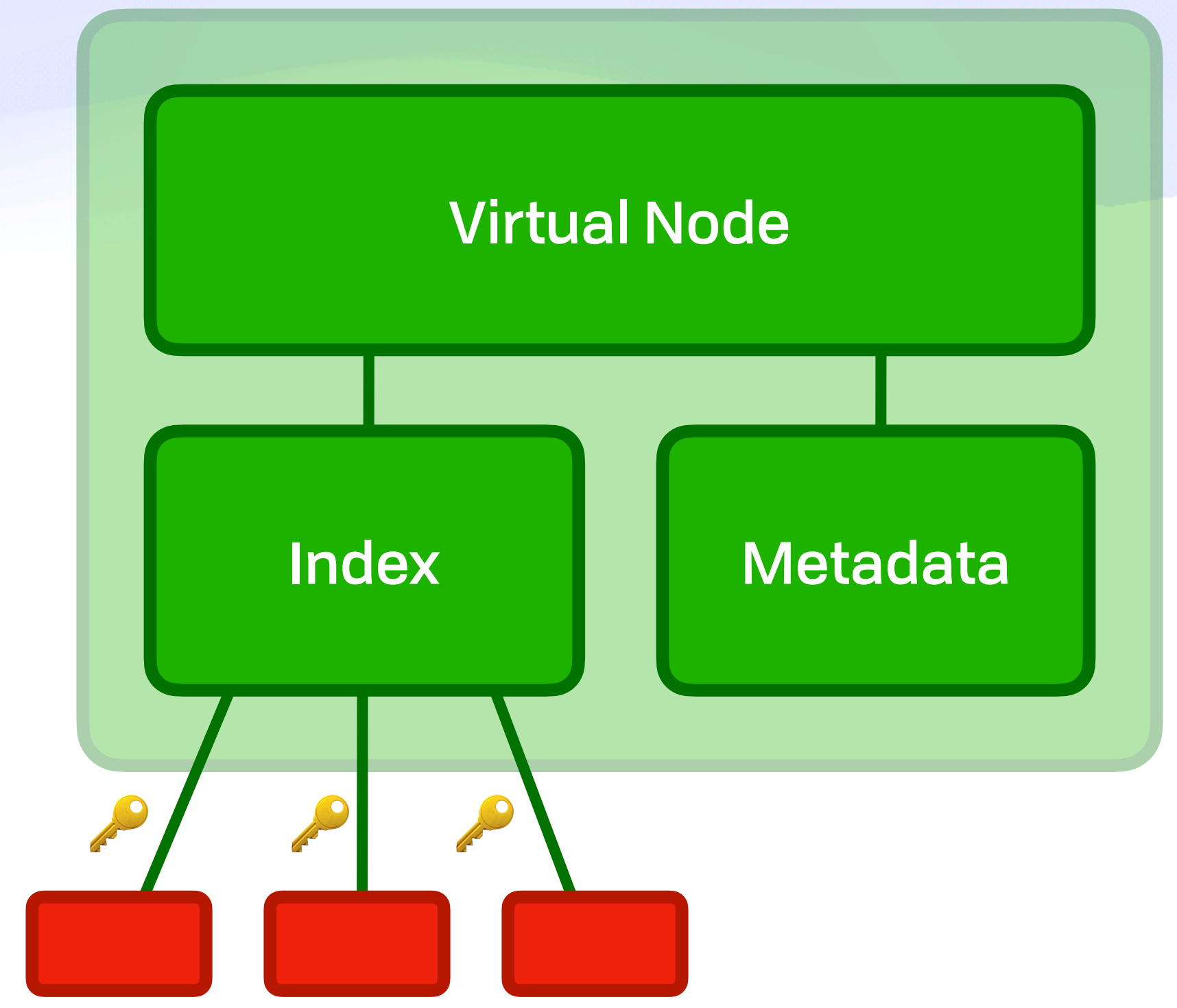
Binary



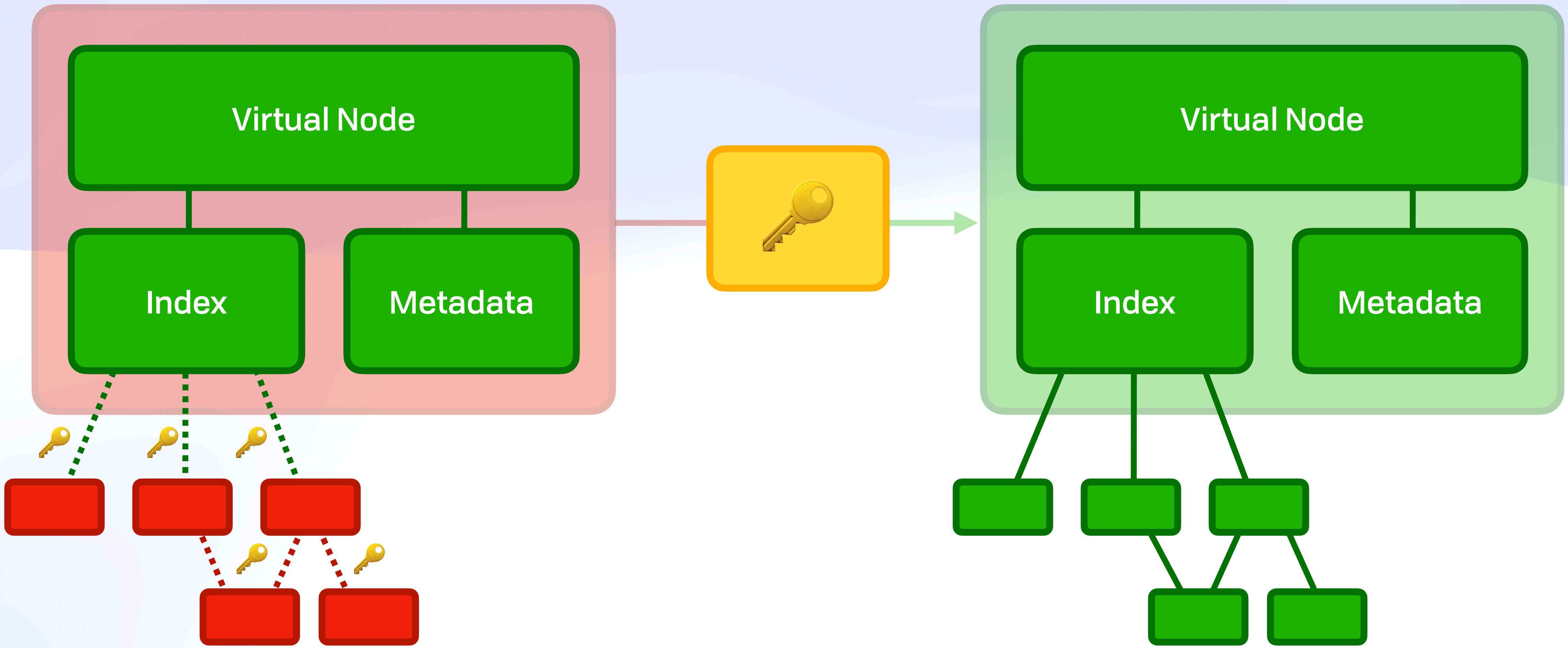
AES256



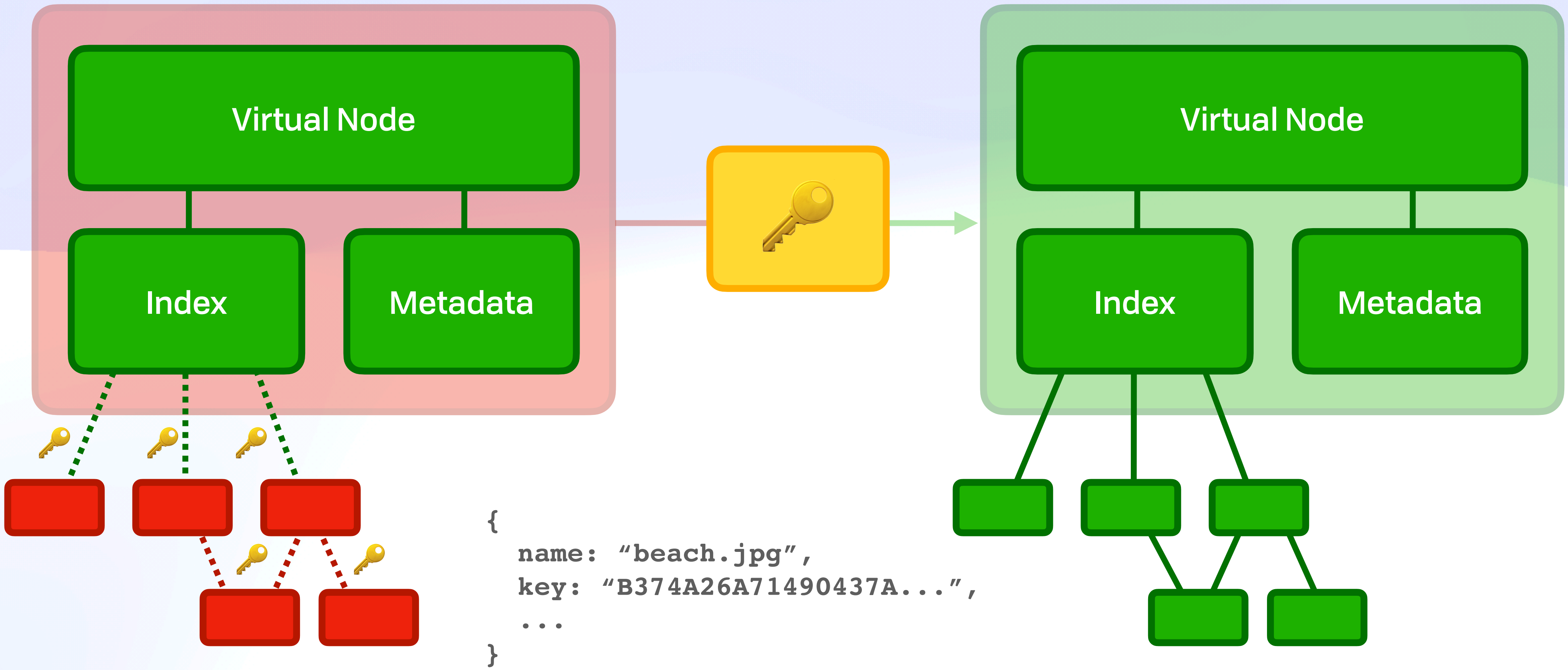
CBOR



Read Window

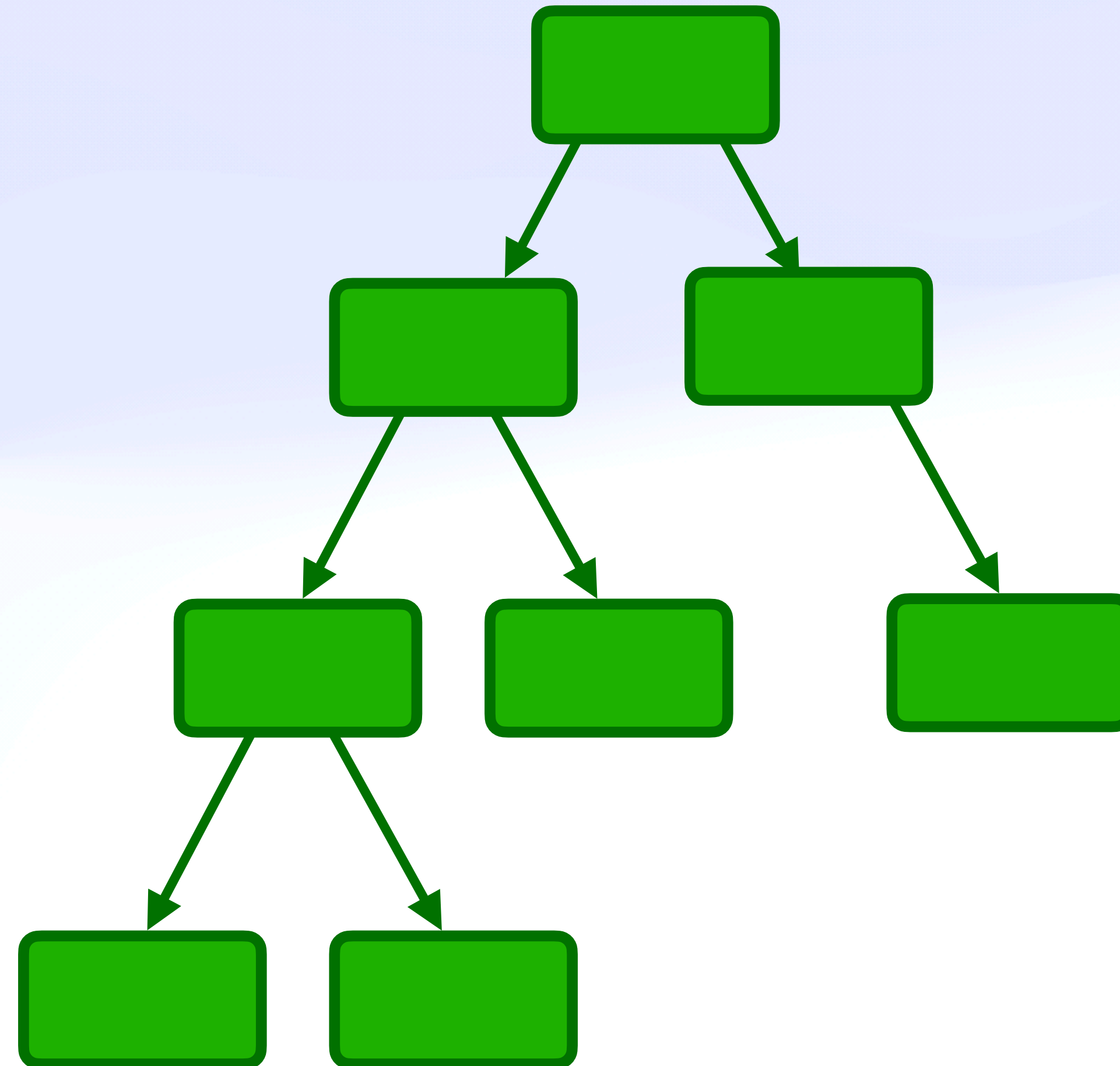


Read Window



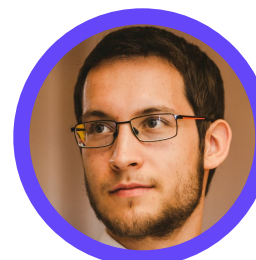
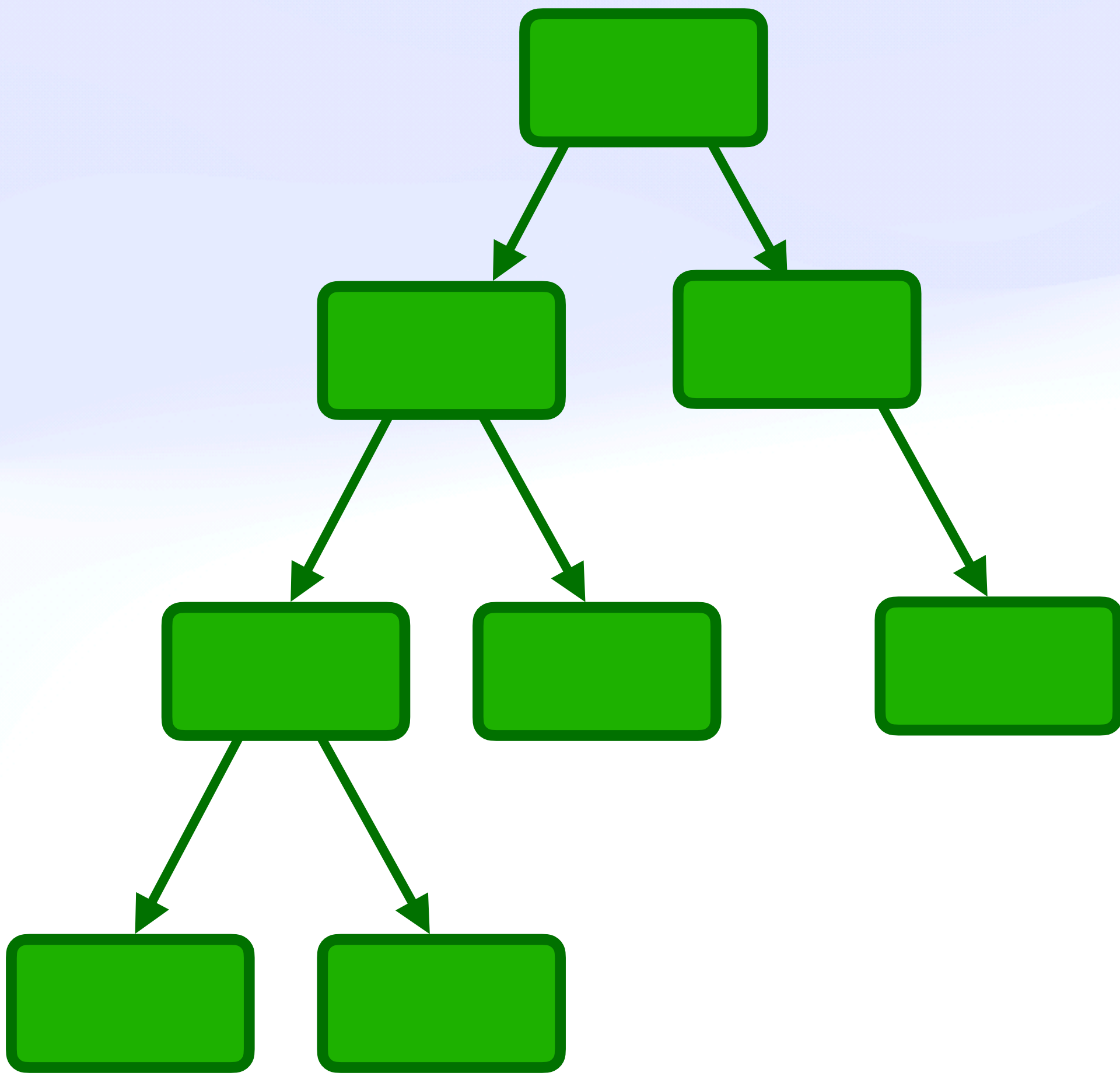
Secret Files 🥷

Subgraph Access



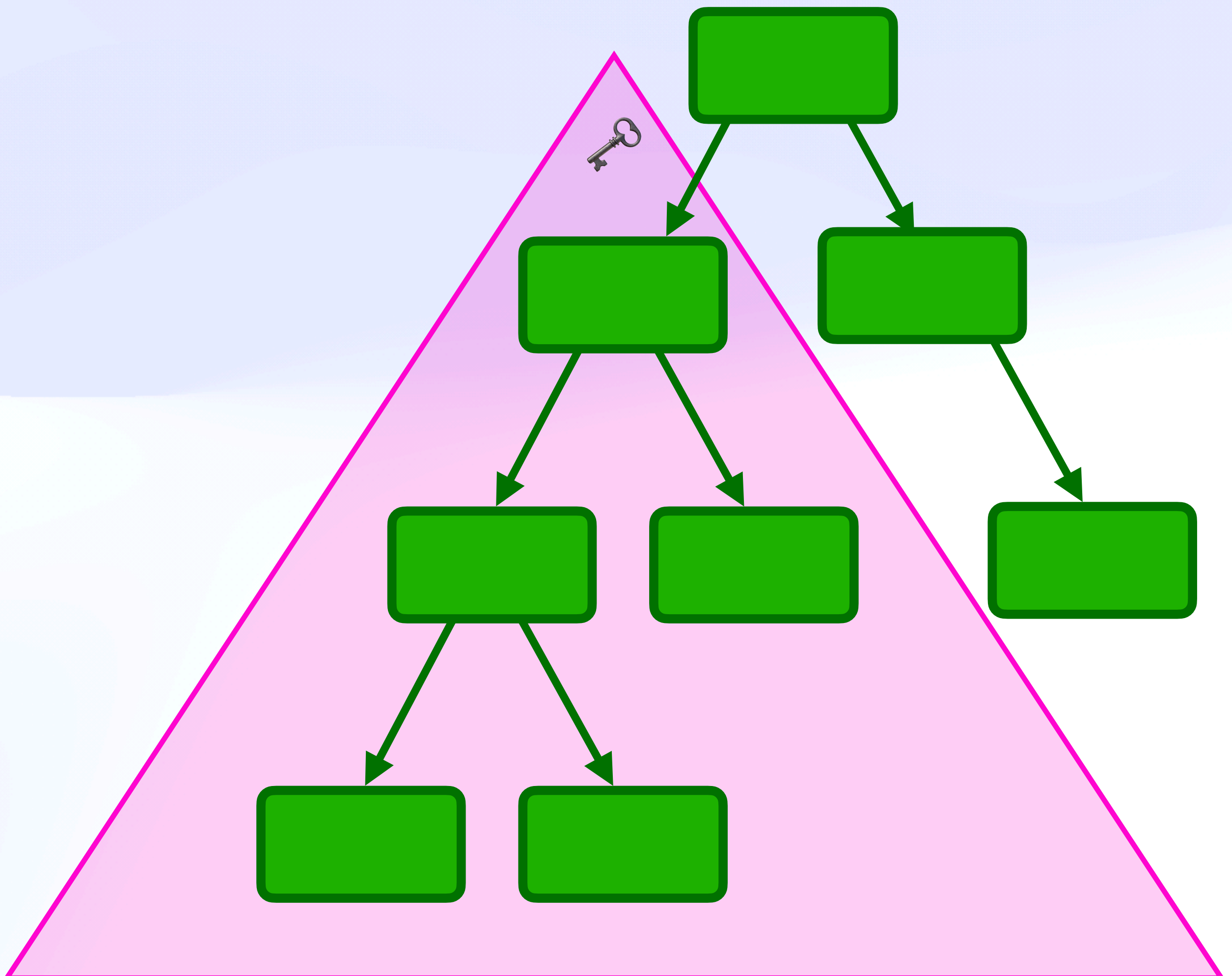
Secret Files 

Subgraph Access



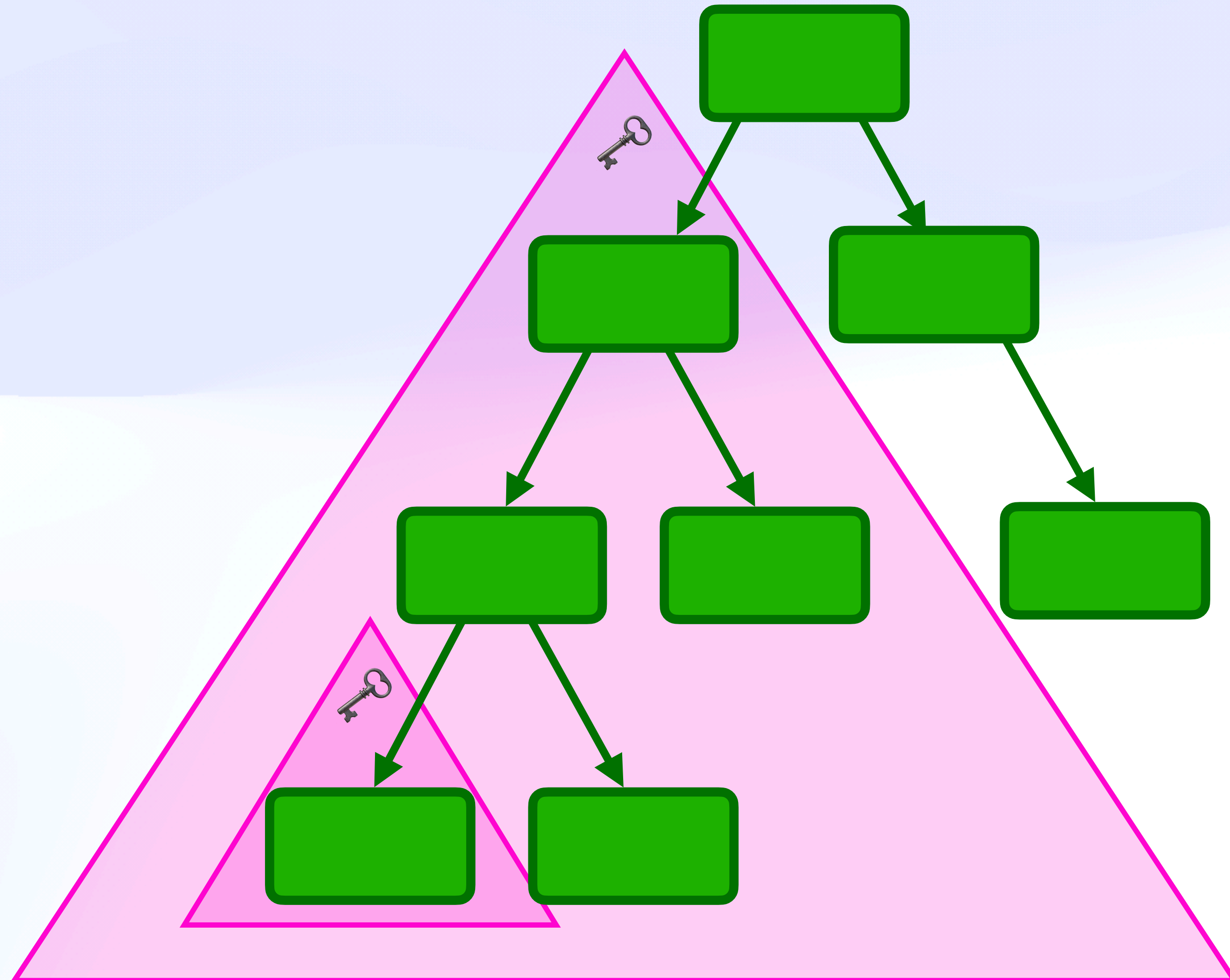
Secret Files 

Subgraph Access

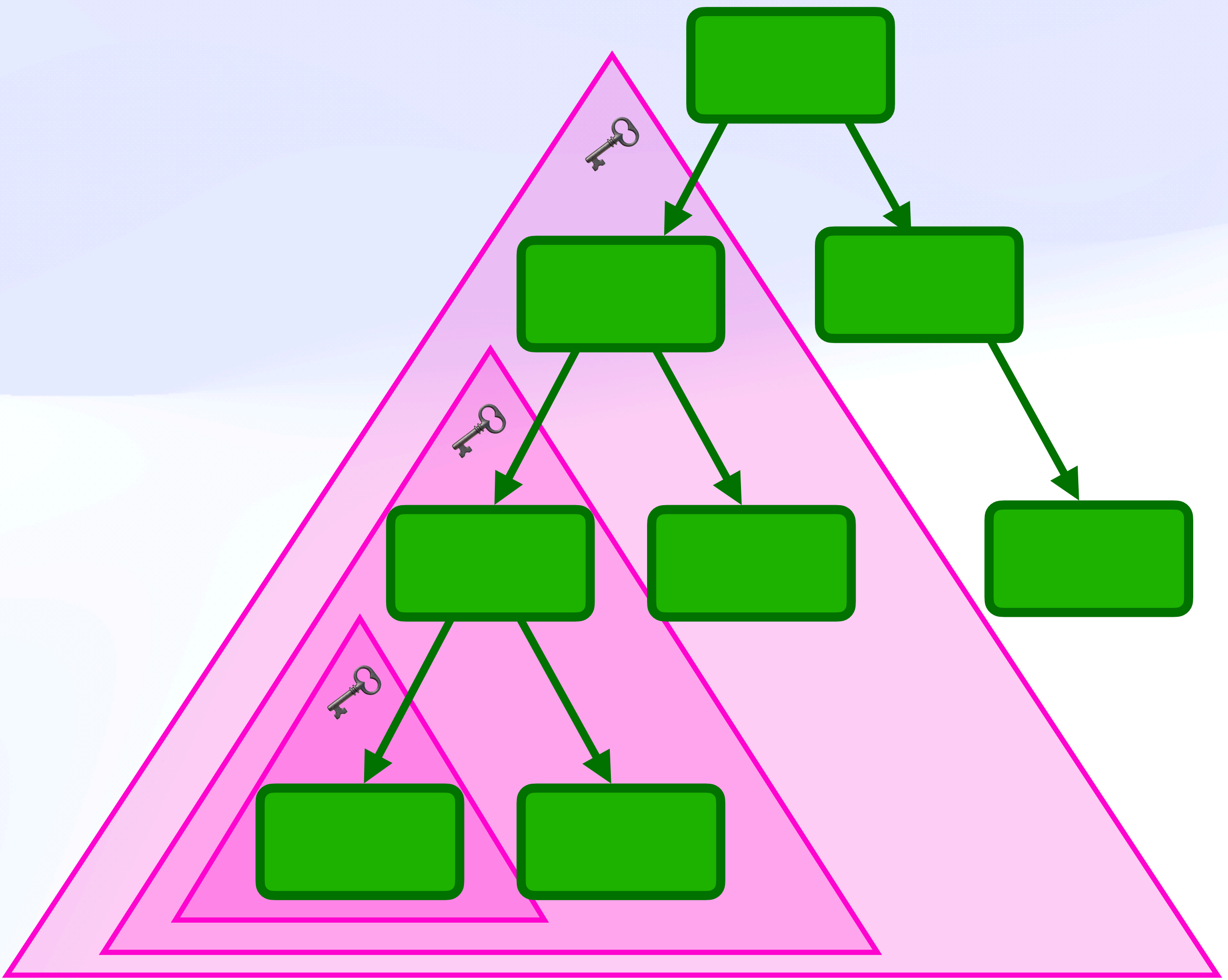


Secret Files 🥷

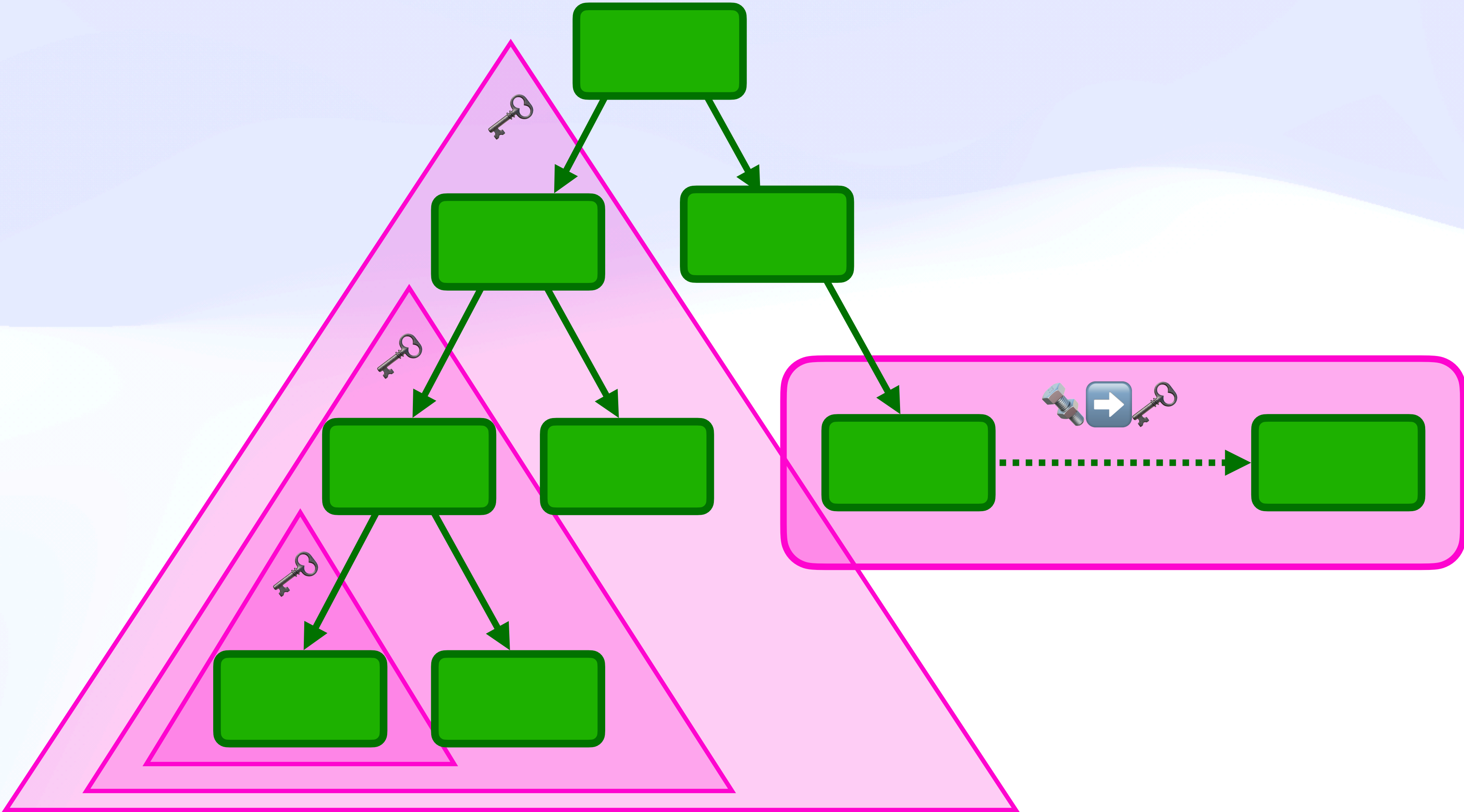
Subgraph Access



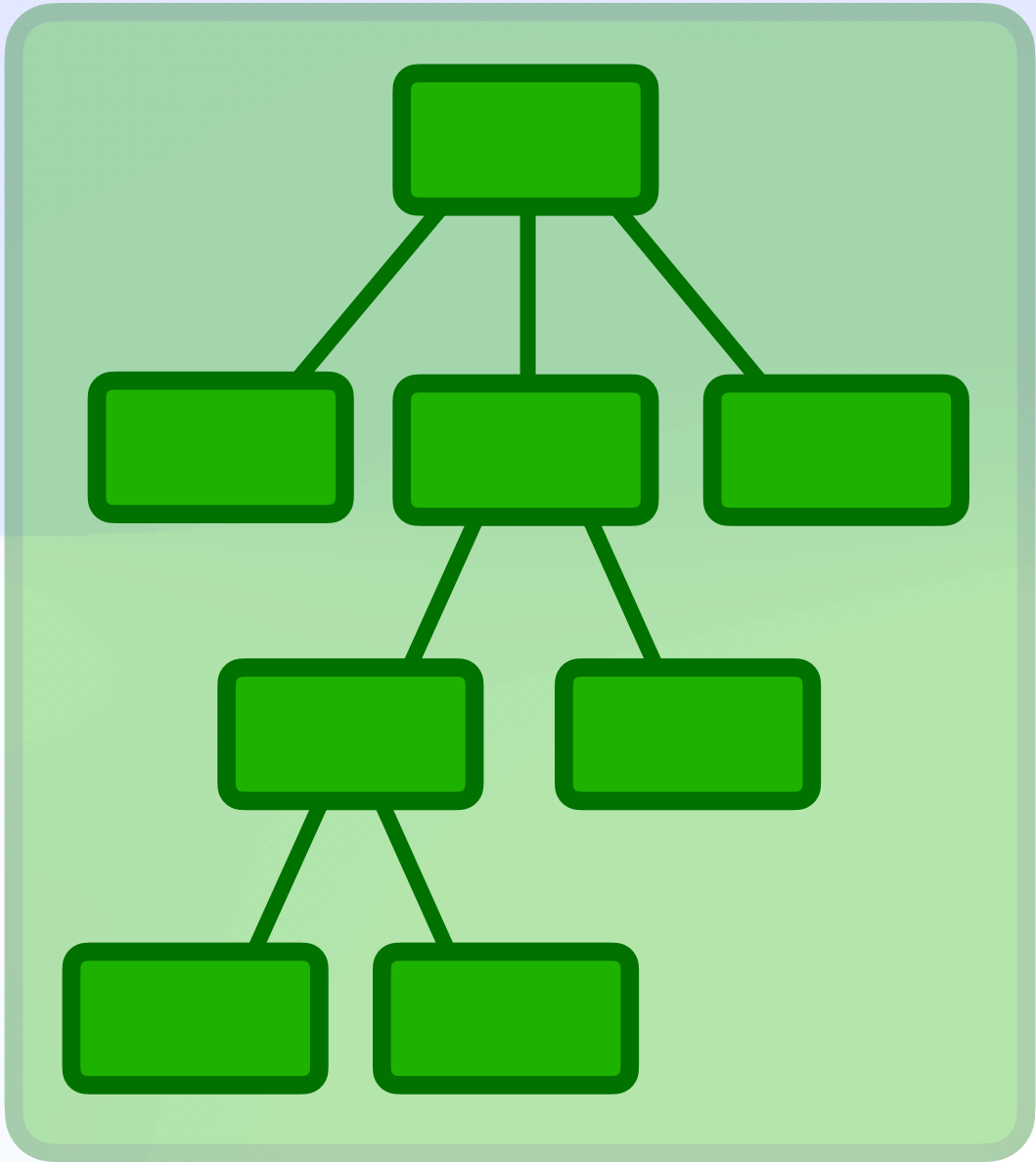
Subgraph Access



Subgraph Access



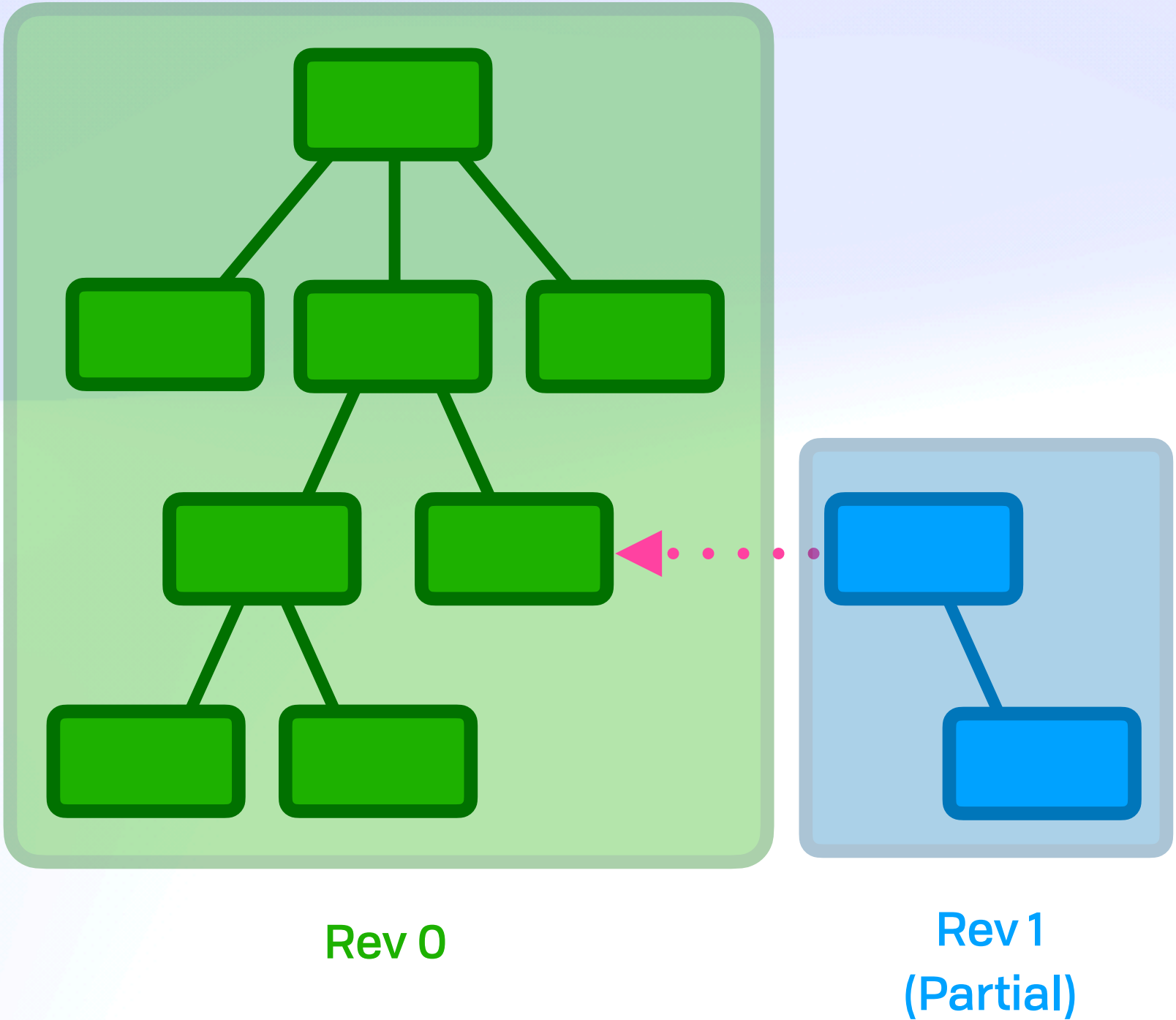
Progressive Fast Forward



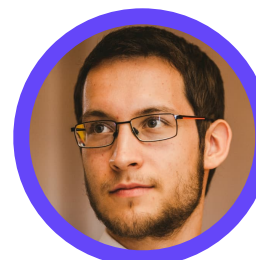
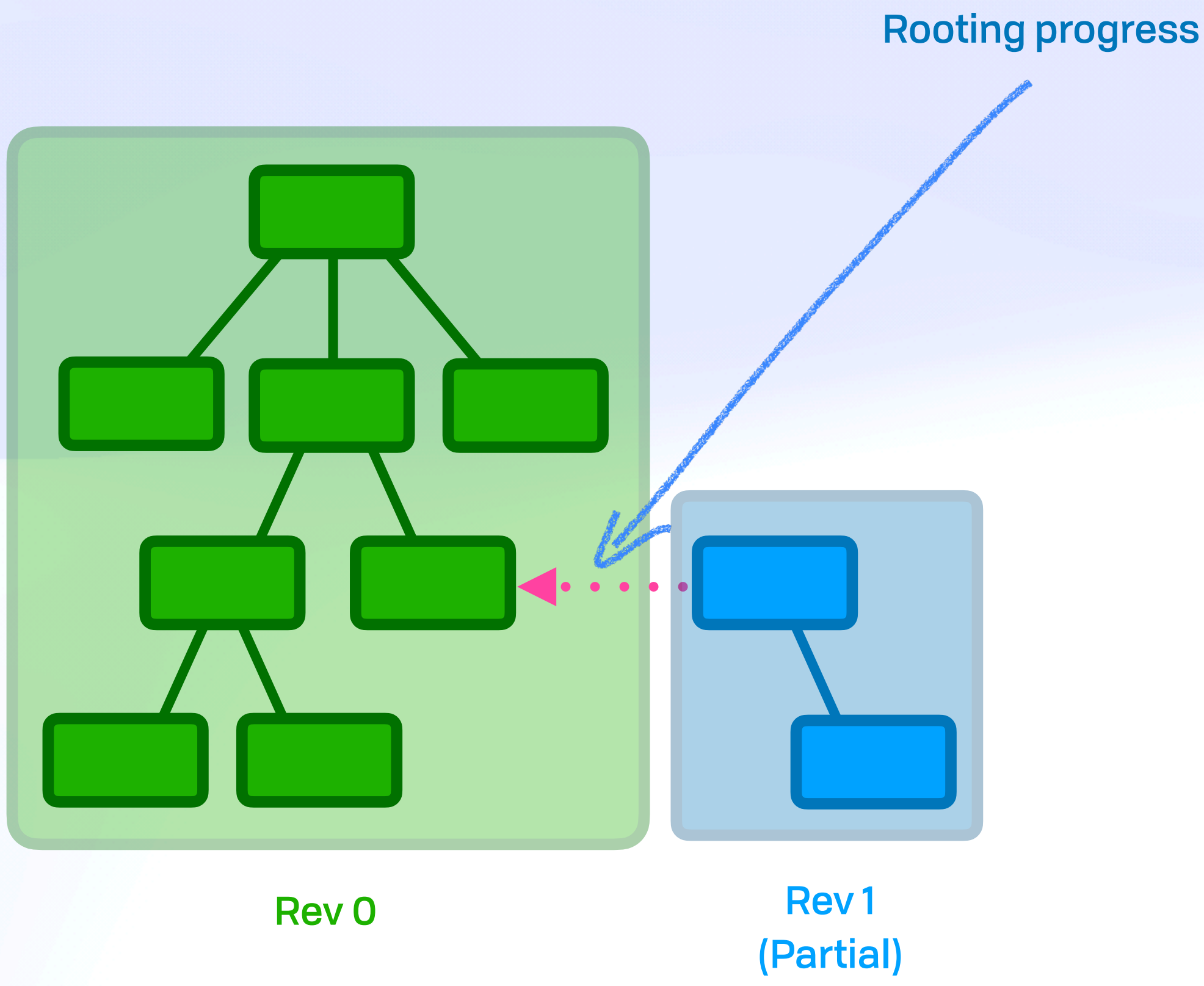
Rev 0



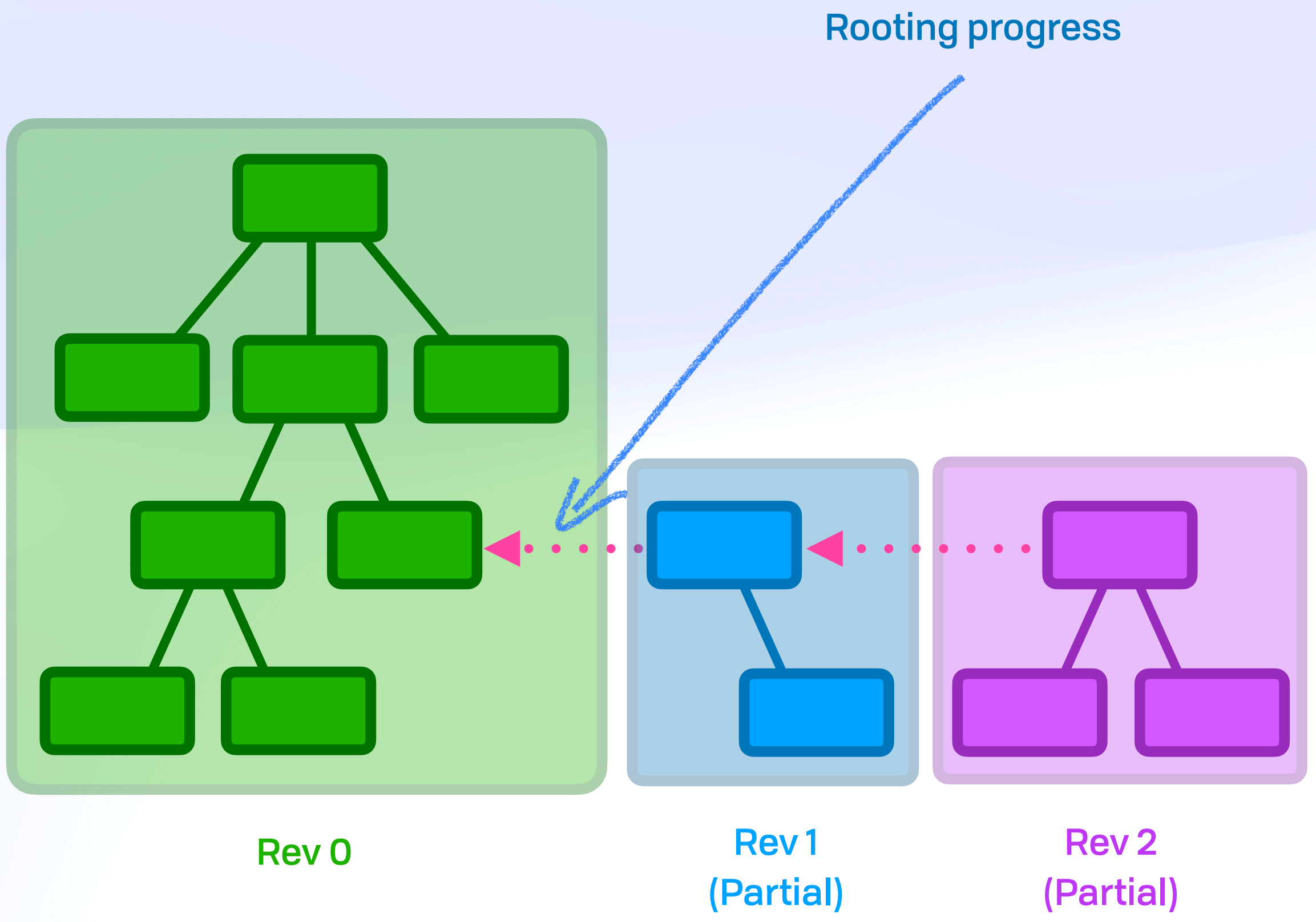
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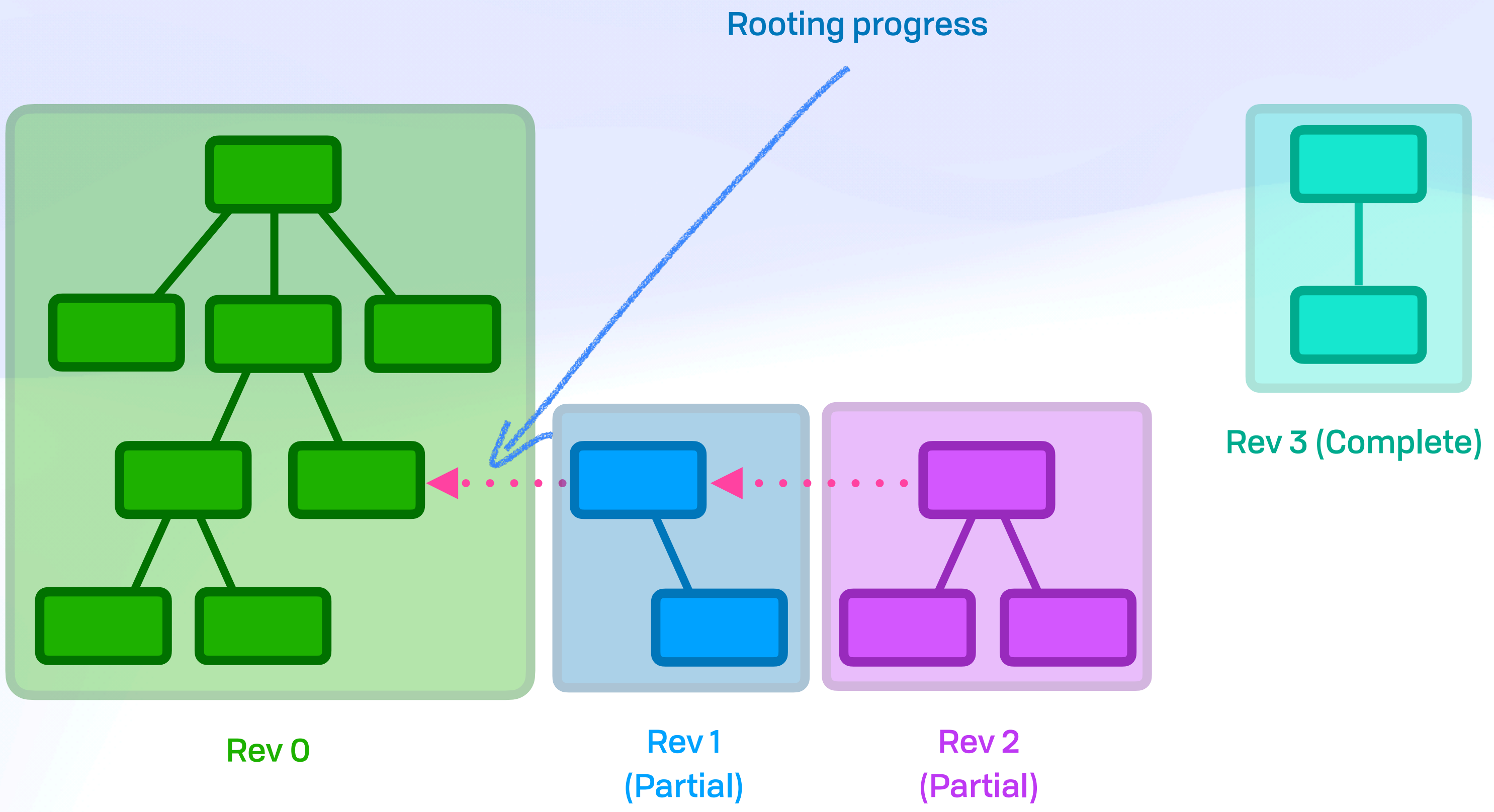
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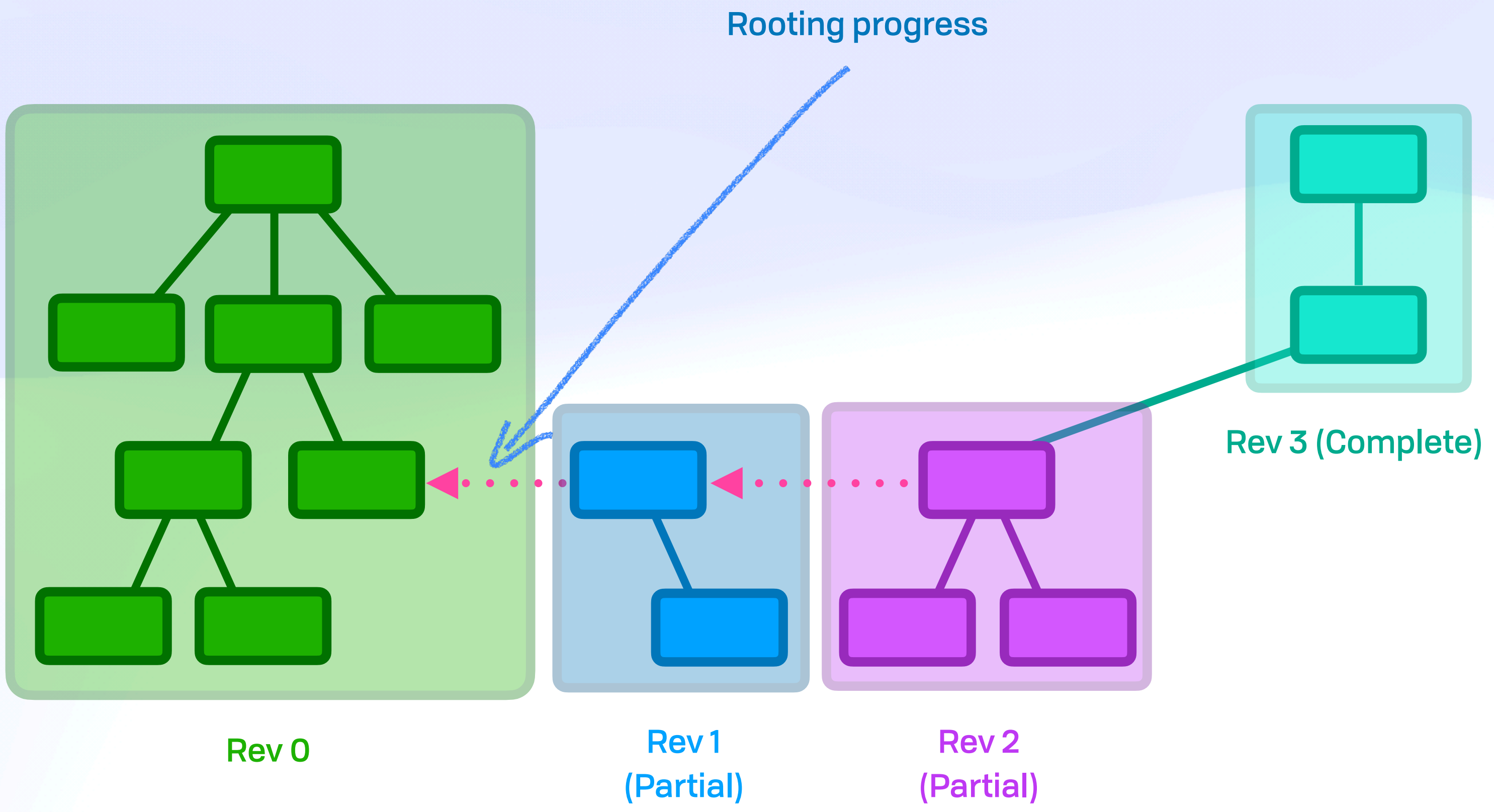
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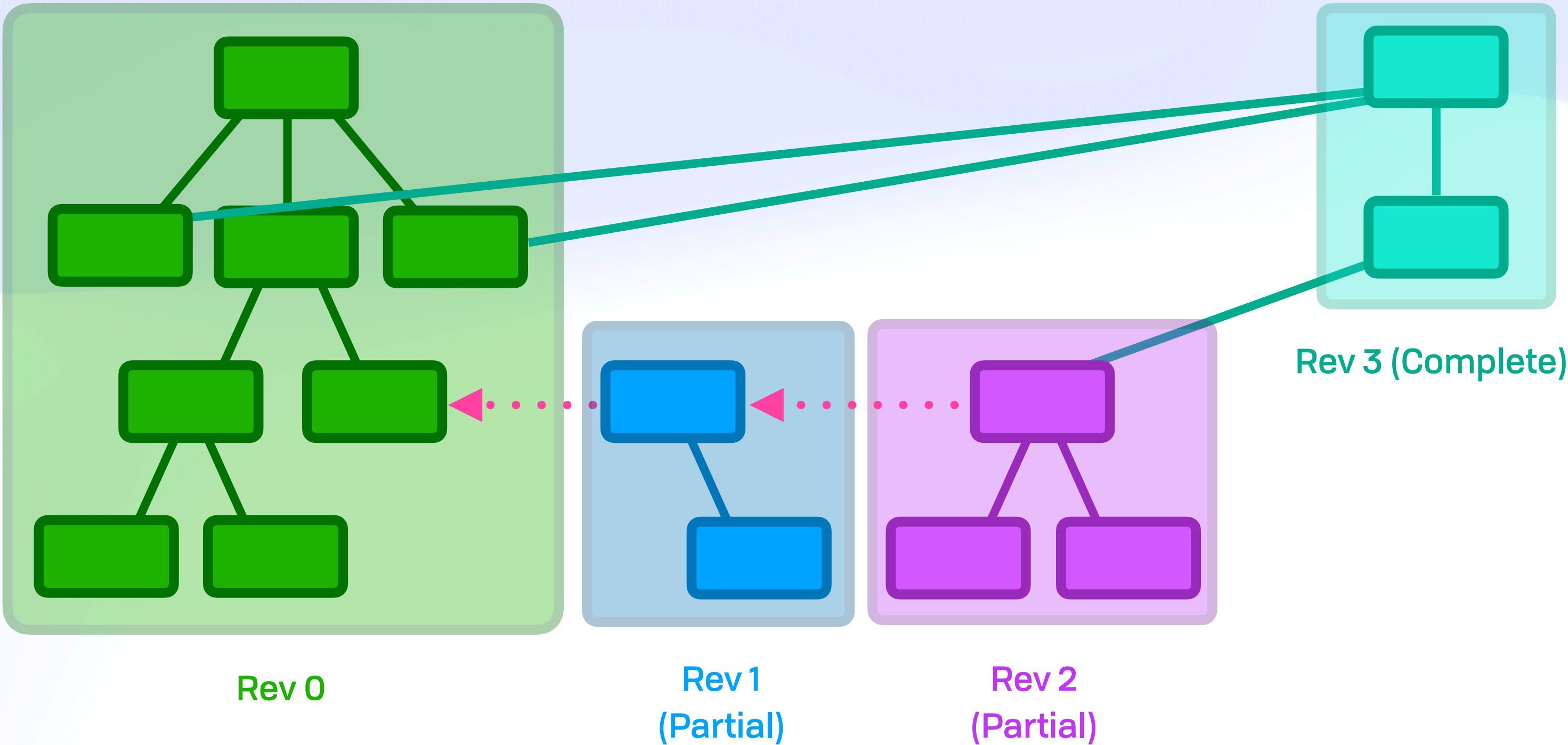
Progressive Fast Forward



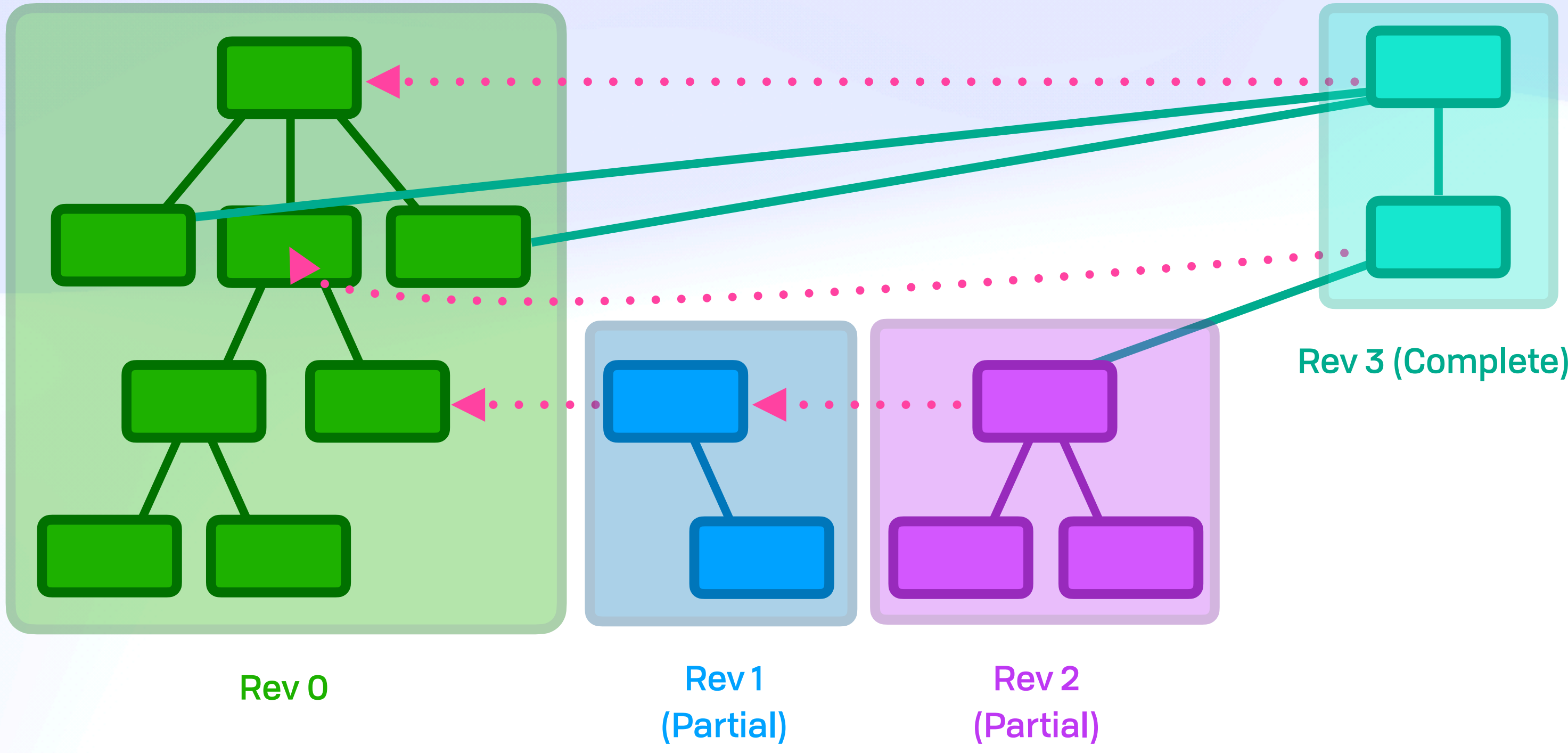
Progressive Fast Forward



Progressive Fast Forward



Progressive Fast Forward



Secret Files 

Skip Ratchet



Secret Files 

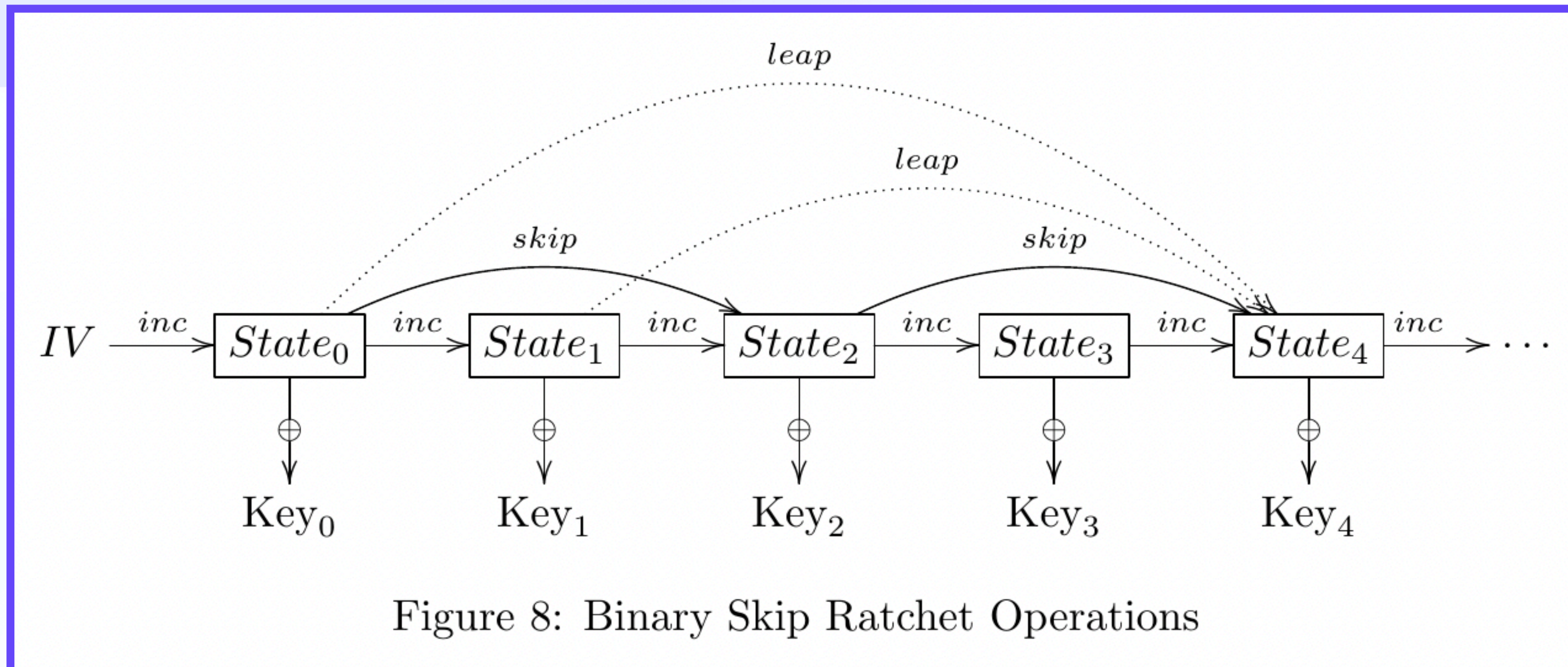
Skip Ratchet

- ◆ Ratchet keys for future (backwards) secrecy
- ◆ Skip ratchet KDF for log-time fast forwards



Skip Ratchet

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Skip Ratchet

- ◆ Ratchet keys for future (backwards) secrecy
- ◆ Skip ratchet KDF for log-time fast forwards

*Interested in the full paper?
Ask Brooklyn for a preprint*

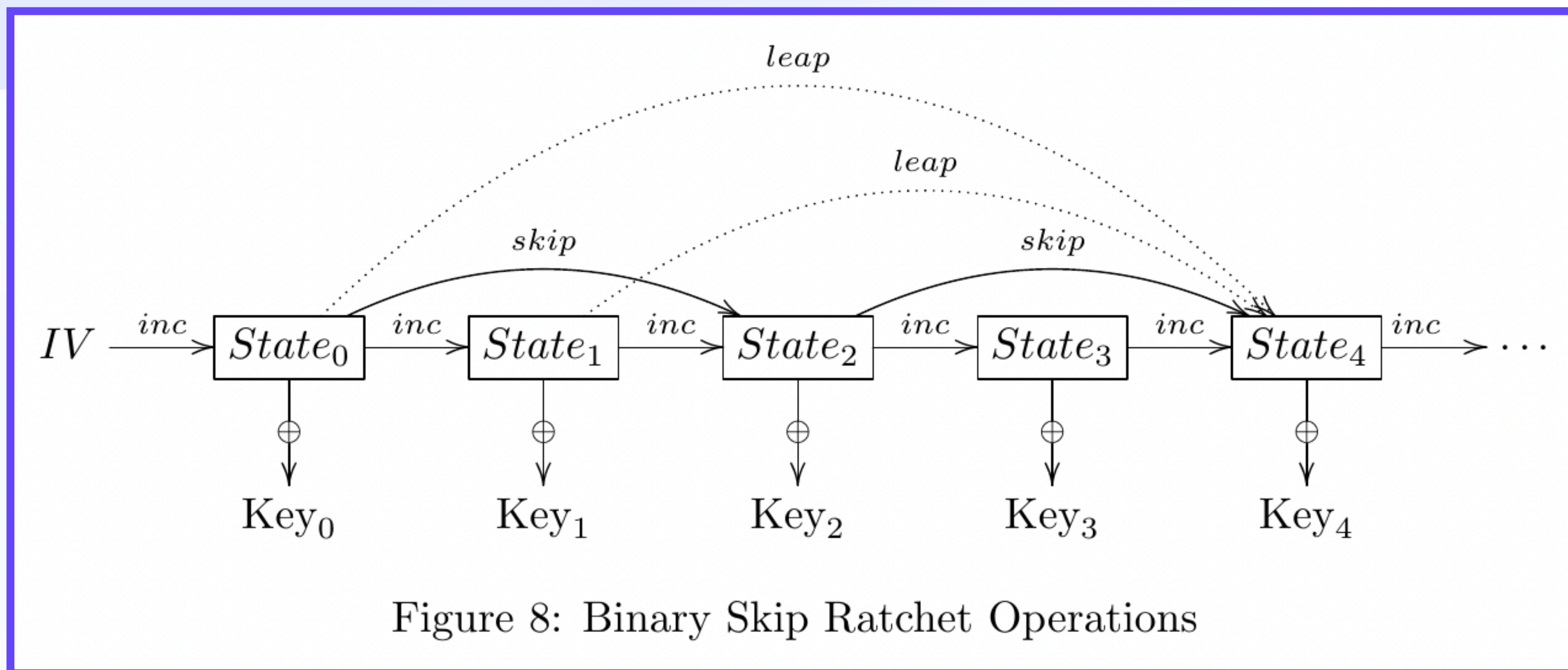
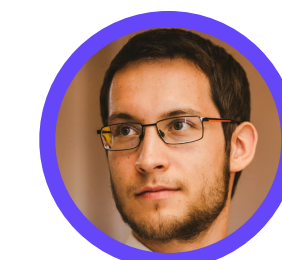


Figure 8: Binary Skip Ratchet Operations



Secret Files 

Write Access



Secret Files

Write Access

- ◆ Bare Filter

- ◆ `simple = Bloom.insert(element: iNumber, into: parentFilter)`
- ◆ `versioned = Bloom.insert(element: hash(aesKey), into: simple)`

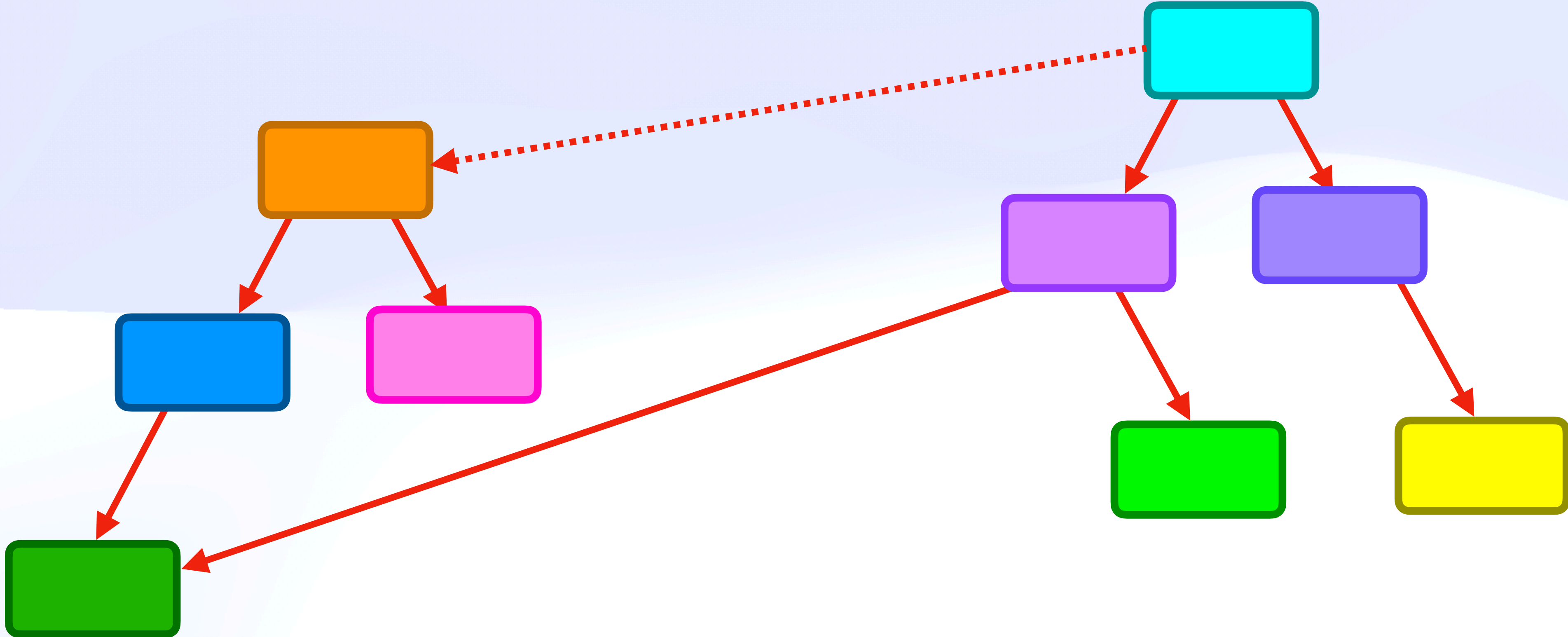
- ◆ Saturation

- ◆ `nextStep = Bloom.insert(element: xof_hash(n++), into: prevStep)`
- ◆ Repeat until threshold bits flipped
- ◆ "Optimal" threshold depends on Bloom configuration, but often ~49% of bits



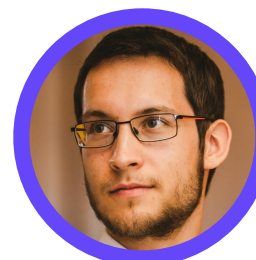
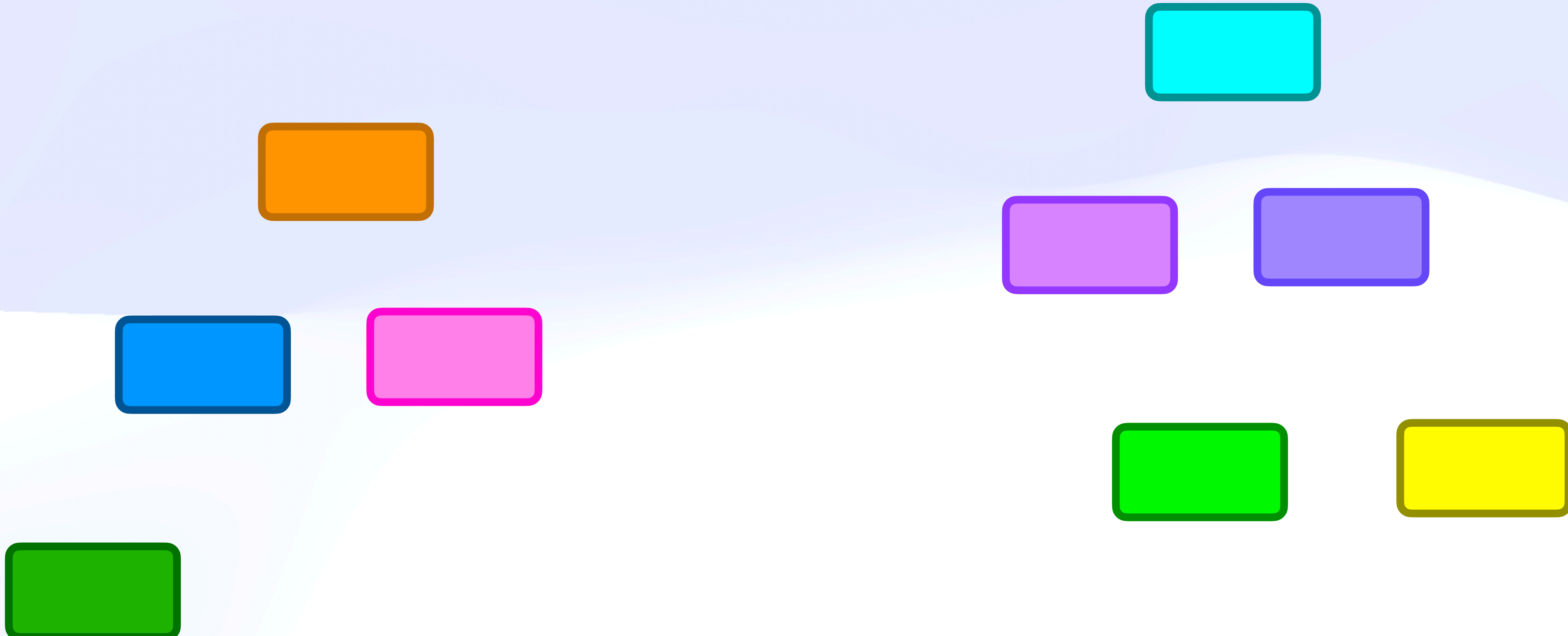
Secret Files 🥷

Dark Forest



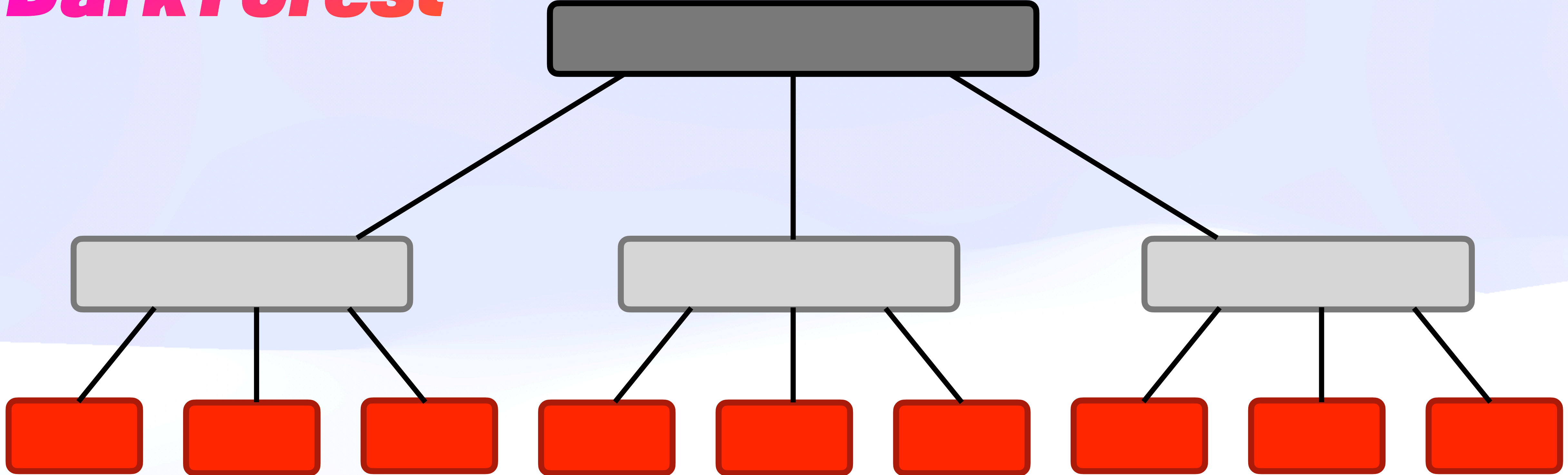
Secret Files 

Dark Forest



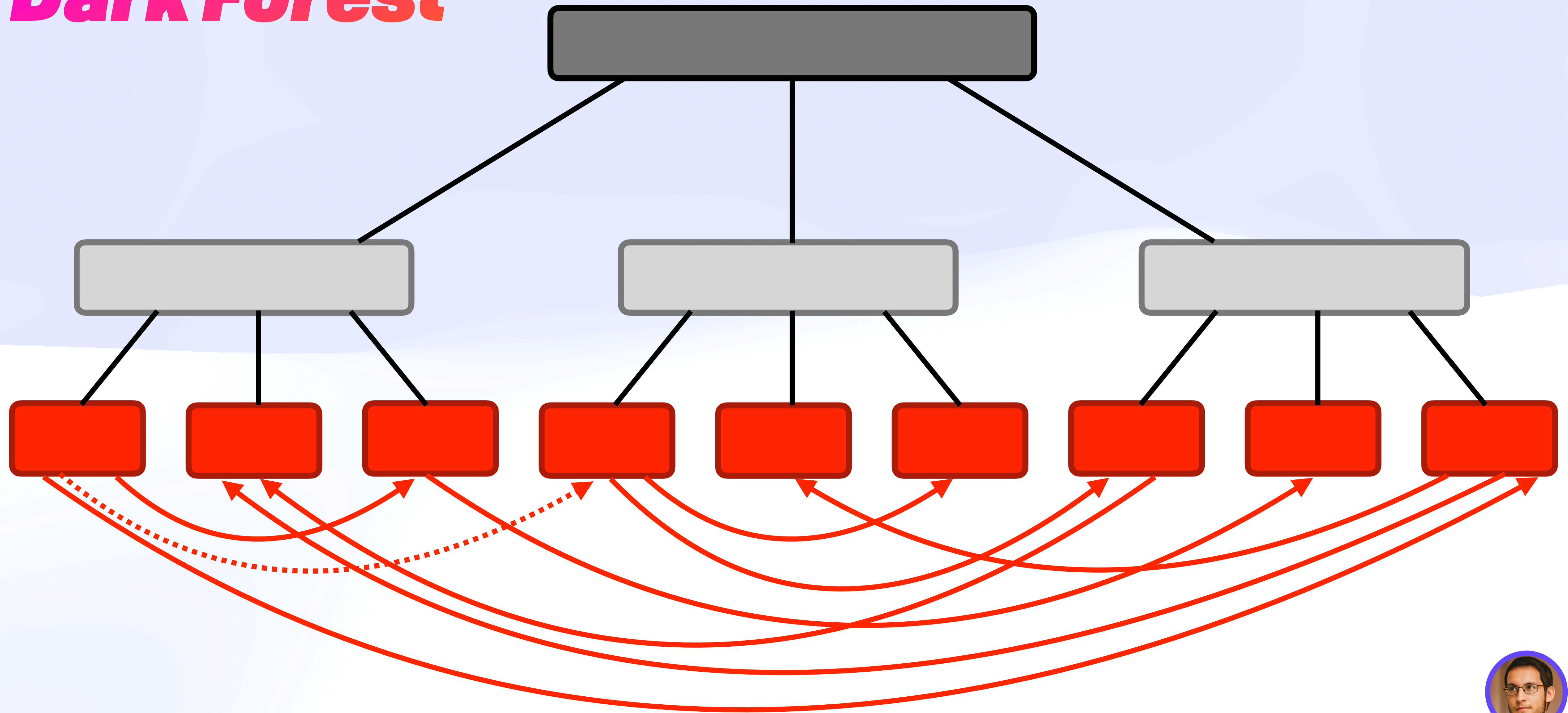
Secret Files 

Dark Forest

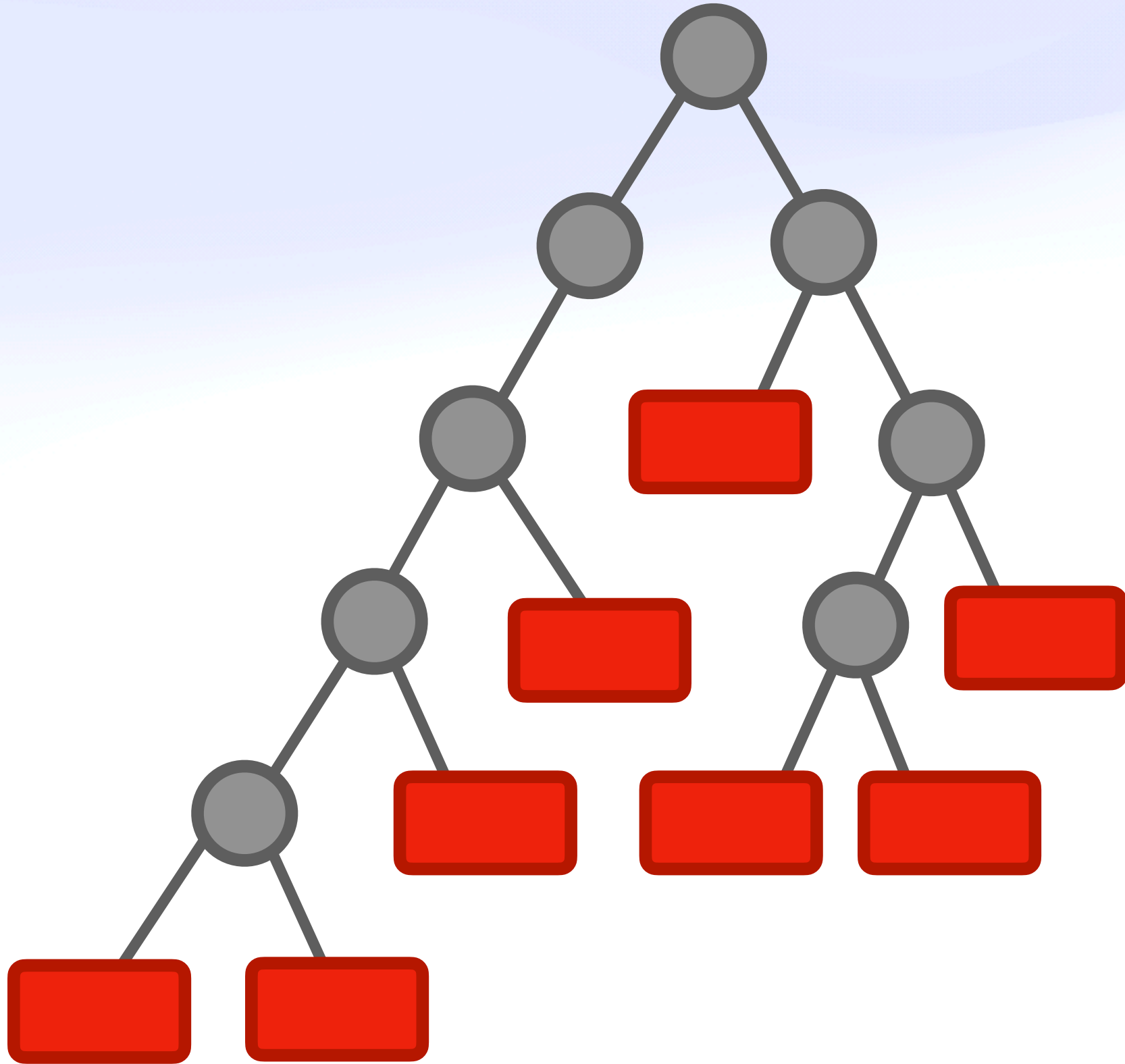


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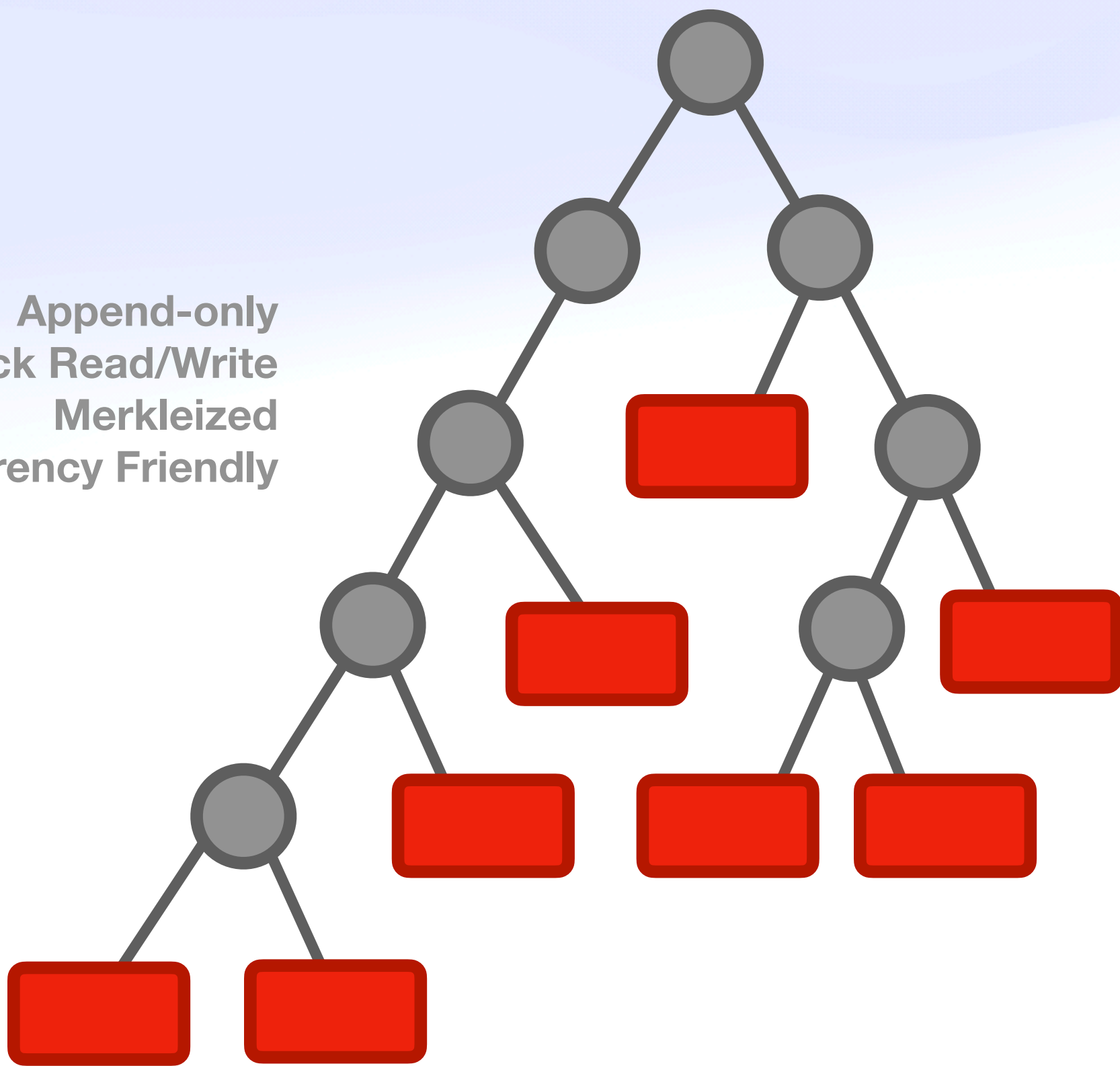
Reasonably Efficient Secret KV



Reasonably Efficient Secret KV

HAMT $16^3 = 4,096$ buckets
(weight 16) $16^4 = 65,536$ buckets

Append-only
Quick Read/Write
Merkleized
Concurrency Friendly





{brooklyn,philipp}@fission.codes
@expede & @matheus23

 ***Thank You, IPFS ping*** 

<https://whitepaper.fission.codes>

✨ [github.com/WebNativeFileSystem\(/spec\)](https://github.com/WebNativeFileSystem(/spec)) ✨

More in-depth at Strange Loop 2022 (or talk to us today)