Introducing Keto, the open source implementation of Zanzibar

Patrik Neu
Open Source Maintainer @ Ory

May 20, 2021

2021-05-20

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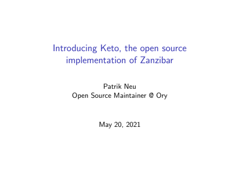

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1. breaking up hydra into separate services to not create yet another monolith trying to solve everything auth*
2. Keto first commit March 2018
3. Keto was build on open policy agent
4. from accumulating performance complains and our own experience we knew it was not a perfect fit
5. In 2019 at USENIX Google Research presented a paper about Google's internal authorization system, code-named Zanzibar.

Ory Design Philosophy

- 12 factor

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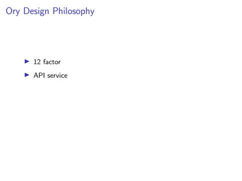
- API service



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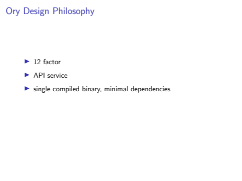
- API service
- single compiled binary, minimal dependencies



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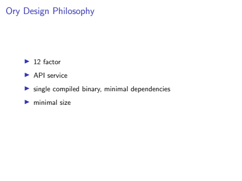
- minimal size



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- 12 factor
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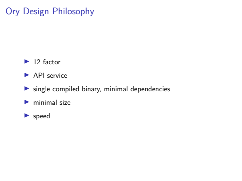
- minimal size
- speed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Requirements for Zanzibar

- flexible

Requirements for Zanzibar

- flexible

1. support all kinds of services, including Calendar, Cloud, Drive, Maps, Photos, and YouTube
2. different data models and permission requirements

Requirements for Zanzibar

- flexible
- fast
- always available

Requirements for Zanzibar

- flexible
- fast
- always available

1. authorization on critical path
2. required for each and every request
3. the best authorization system is never noticed by a regular user: don’t feel overhead, don’t experience errors
4. applications such as search require many authorization checks to serve one result

Requirements for Zanzibar

- flexible
- fast
- always available
- consistent

Requirements for Zanzibar

- flexible
- fast
- always available
- consistent

1. false positives: fatal, users do stuff they are not allowed
2. false negatives: at least annoying if time-bound, can be fatal if important tasks can not be done

Requirements for Zanzibar

- flexible
- fast
- always available
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- Google scale

Requirements for Zanzibar

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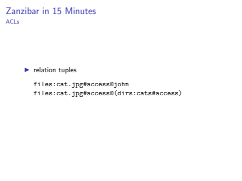
1. quote: "trillions of access control lists; millions of authorization requests per second"
2. distributed across the globe
3. cross-regional RTTs are already too high, handle locally

Zanzibar in 15 Minutes

ACLs

- relation tuples

```
files:cat.jpg#access@john
files:cat.jpg#access@(dirs:cats#access)
```



Zanzibar in 15 Minutes

ACLs

- relation tuples

files:cat.jpg#access@john
files:cat.jpg#access@(dirs:cats#access)

1. basic ACL structure
2. namespace:object#relation@subject
3. translates to "john has access on the cat.jpg file"
4. translates to "everyone who has access to the cats directory has access to the cat.jpg file"

Zanzibar in 15 Minutes

ACLs

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  ```
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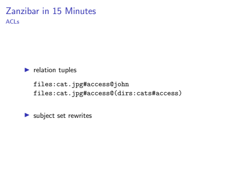
- subject set rewrites


Zanzibar in 15 Minutes
ACLs
- relation tuples
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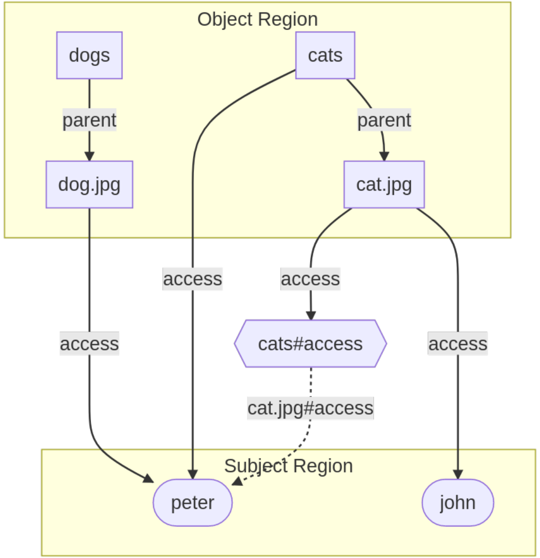
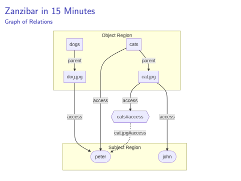
1. defined globally in the namespace config
2. case 1: automatically add tuples; examples: read if you have write
3. case 2: compute effective set; examples: access child if access to parent, only access if you are admin AND got the explicit permission
4. not yet implemented in Keto, but the next big thing to work on as they are important

Zanzibar in 15 Minutes

Graph of Relations



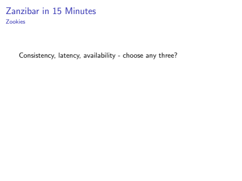


1. not only neat to look at
2. graph algorithms are well studied and common
3. ACL check ≡ reachability of node
4. Expand subject set by some graph traversal algorithm
5. relation tuples will usually result in a clustered/structured graph
6. relation tuples are directed edges

Zanzibar in 15 Minutes

Zookies

Consistency, latency, availability - choose any three?



Zanzibar in 15 Minutes
Zookies

Consistency, latency, availability - choose any three?

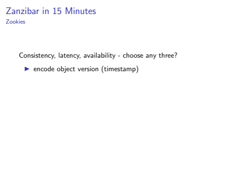
1. background in distributed systems
2. research and theorems show that requirements are in conflict
3. all can be meet at the same time once data are propagated
4. determine whether local data are recent enough

Zanzibar in 15 Minutes

Zookies

Consistency, latency, availability - choose any three?

- encode object version (timestamp)



Zanzibar in 15 Minutes
Zookies
Consistency, latency, availability - choose any three?
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1. distributed systems: clock synchronisation is very hard
2. real-time easy for Google: GPS in datacenters to sync clocks

Zanzibar in 15 Minutes

Zookies

Consistency, latency, availability - choose any three?

- encode object version (timestamp)
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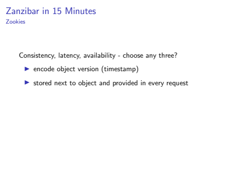

Zanzibar in 15 Minutes
Zookies

Consistency, latency, availability - choose any three?

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1. Local cache ACLs have to be at least as recent as object version

Zanzibar in 15 Minutes

Zookies

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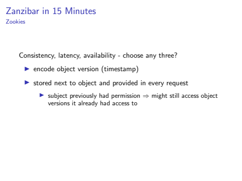
  - subject previously had permission ⇒ might still access object versions it already had access to



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1. only during propagation time
2. new object versions will always be rejected

Zanzibar in 15 Minutes

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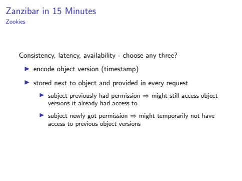

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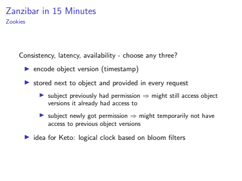

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- idea for Keto: logical clock based on bloom filters

1. zookies not yet implemented (only single node operation)
2. bloom filter based to allow dynamic number of nodes
3. not settled, still searching for ideas

Current State of Keto

- single node operation mode (scaling horizontally possible)

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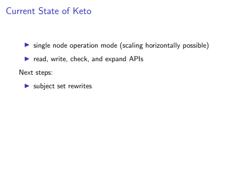
- subject set rewrites



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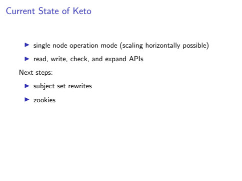

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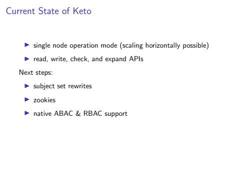
- native ABAC & RBAC support



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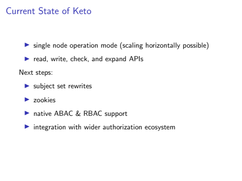
- integration with wider authorization ecosystem



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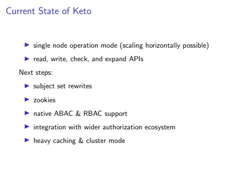
- heavy caching & cluster mode



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How we got here

- announce deprecation of OPA-Keto early on

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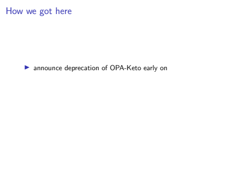

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1. multiple channels
2. no migration path yet

How we got here

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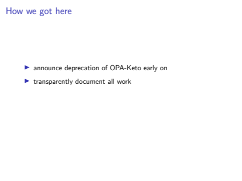
- transparently document all work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instead of developing in the dark and suddenly pushing the new version

How we got here

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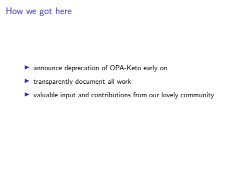
- transparently document all work
- valuable input and contributions from our lovely community



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1. although git shows that I did most work
2. ideas were always discussed with multiple people
3. community members followed me into the rabbit hole
4. jumped on calls to discuss details, ideas and findings

How we got here

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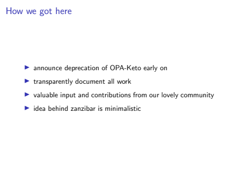
- idea behind zanzibar is minimalistic



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1. check engine currently 39 LoC

Open Source Foundation

- Go
- gRPC
- OpenAPI Spec
- gobuffalo/pop
- Cobra
- Docusaurus
- Docker

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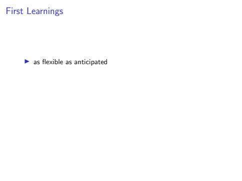
1. like our other open source projects
2.

First Learnings

- as flexible as anticipated



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1. from our own SaaS cloud production system
2. from community feedback

First Learnings

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- subject set rewrites are **very** important

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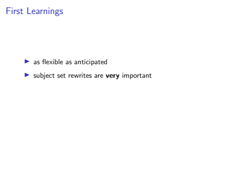

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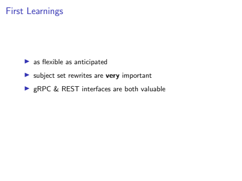

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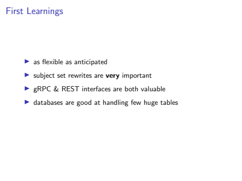

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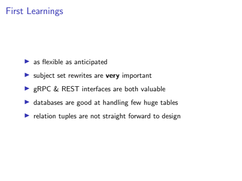

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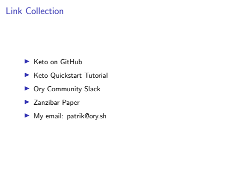
- Zanzibar Paper
- My email: patrik@ory.sh



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