Distributing Secrets

Securely ?

Presented by
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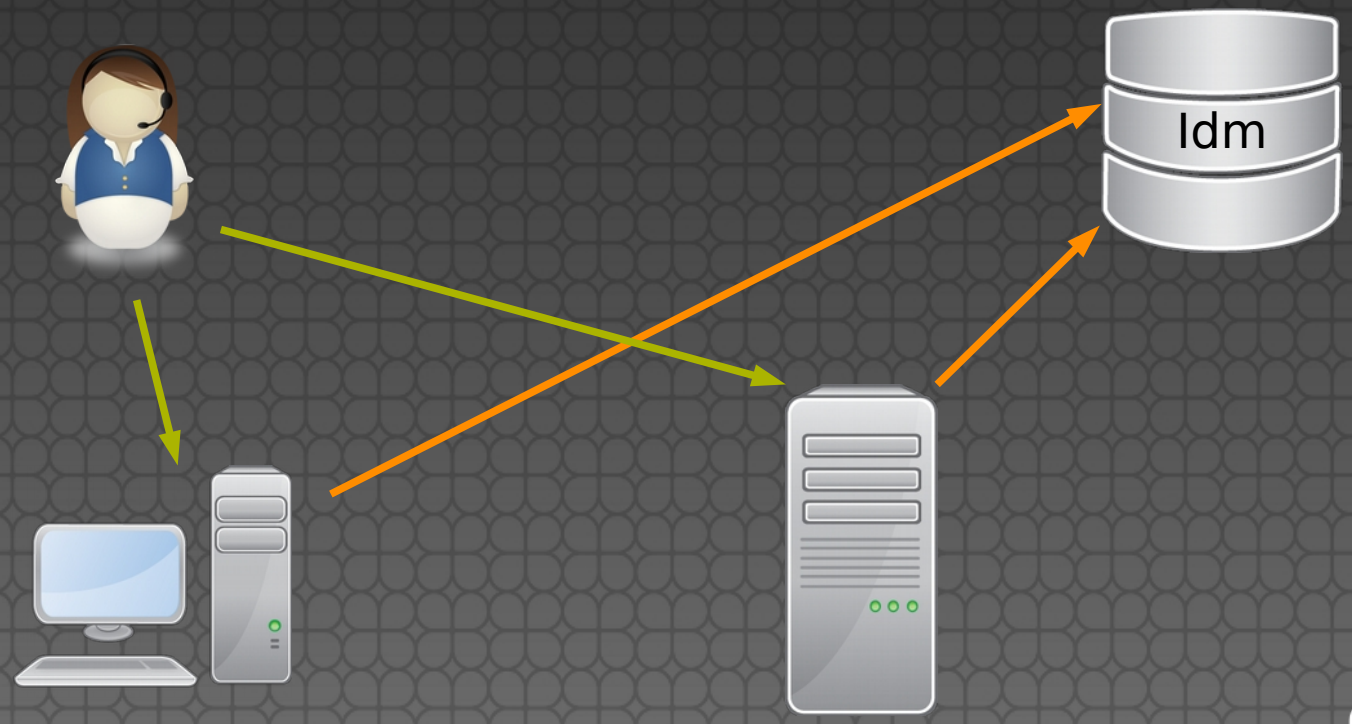
Historically

Monolithic applications on single servers potentially hooked to a central authentication system.



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Distributing Secrets ?

Containers...

it's all their fault! :-)

Not really, most distributed systems need credentials to access resources like databases or 3rd party APIs

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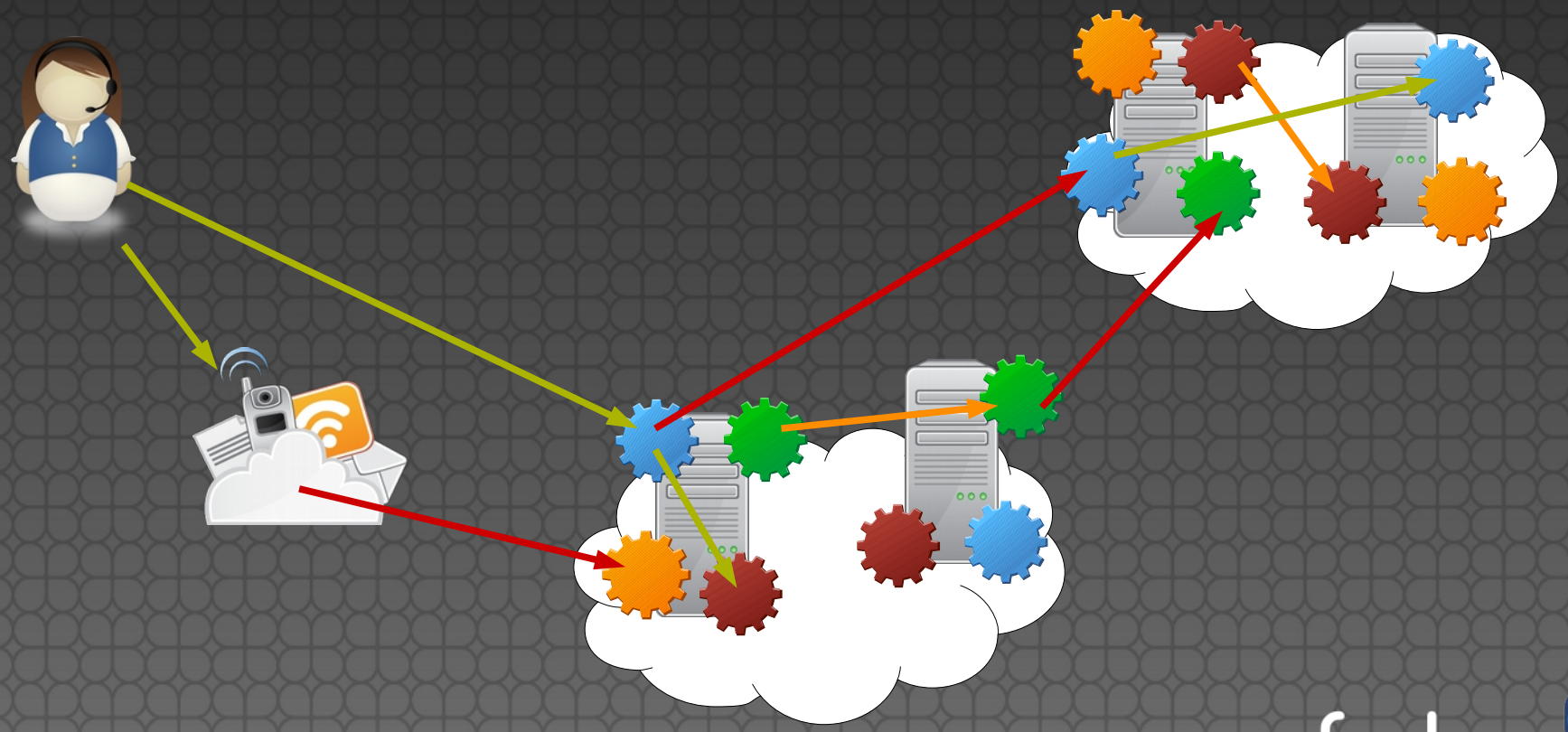
Clouds, microservices

Distributed applications multi-tier services, 3rd party services, clouds...




SECRETS,
SECRETS EVERYWHERE
memegenerator.net

What happens today?

- Provisioning systems like puppet and ansible are used to distribute data, storing credentials in the clear somewhere and pushing them around to various hosts.
- Some people even bake credentials directly in container images or keep them in some version control system directly accessible by images ...

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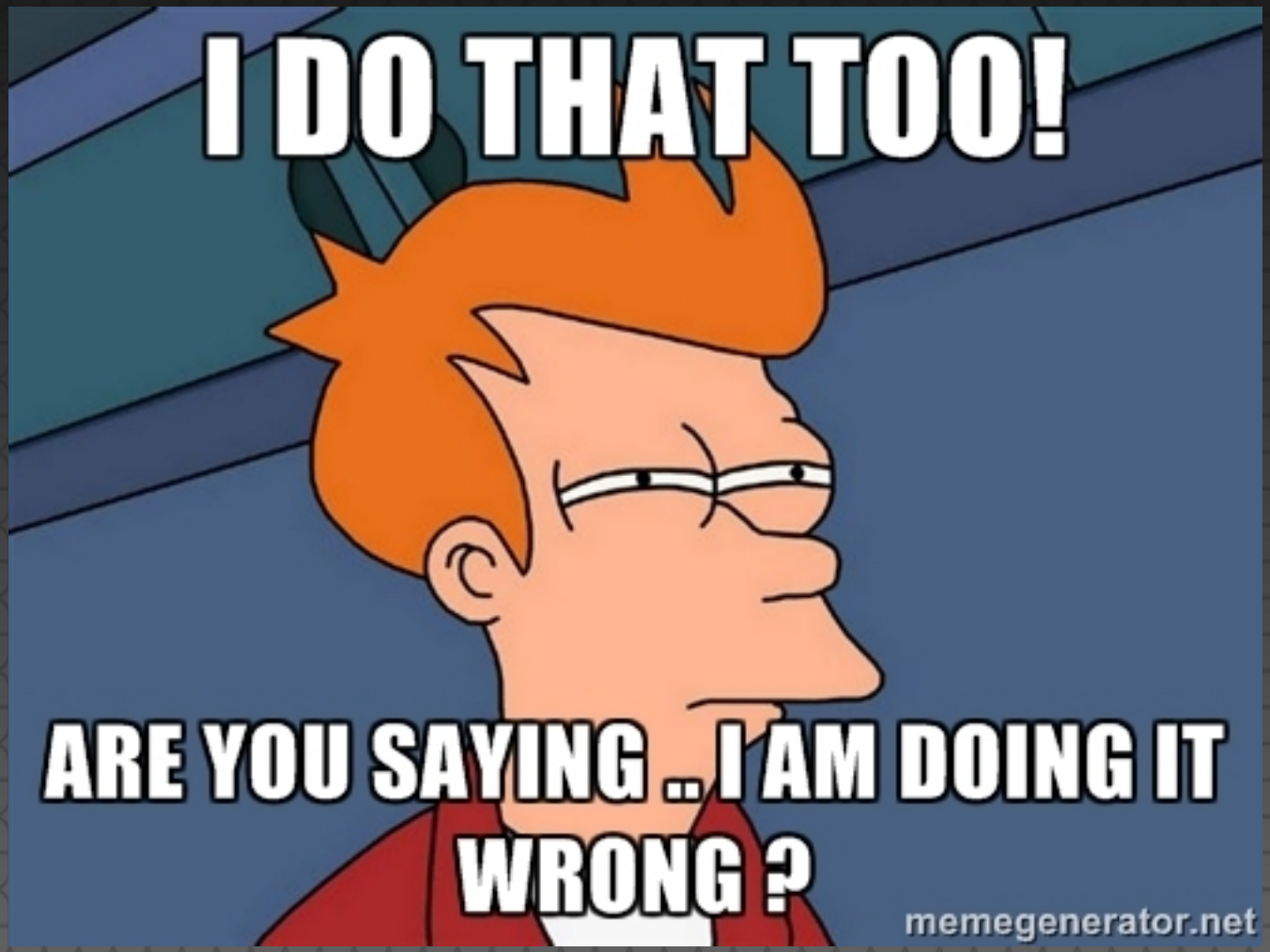
I DO THAT TOO!
ARE YOU SAYING .. I AM DOING IT WRONG ?
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Secrets != configuration

- Configuration in many cases can be public information and it is rarely an issue if it get disclosed

  [security through obscurity?]

- Secrets are never public, and should be treated differently from the rest.

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WHAT IF I TOLD YOU
WE CAN DO BETTER
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Let's define the problem space

- What is that we really need to do with secrets and passwords ?
  - And what options we have ?
  - 5 things we care for: PUPPA
    - Provide, Update, Preserve, Protect, Audit
- On the following slide:

P = provisioning copies of secrets in files

A = Use of an API to retrieve secrets

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Provide

- How do I get a secret for a specific service to a specific application ?

P) Push secret into application config files from some place that stores them

A) Make the application (or helper) pull the secrets as needed

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Update

- How do I update a secret in all applications when needed ?

P) Push secrets again and/or restart application/container

A) 1. Notify application
2. Application pulls the new secret

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Preserve

- How do I preserve correct credentials when a container image is rebuilt ?

P) Keep side volume with credentials stored there “in the clear” or inject at every startup

A) Let applications pull their secrets

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Protect

- How do I limit access to these credentials exclusively to what needs them ?

P) Trust the provisioning system and all the people involved to get it right.

A) Store secrets encrypted, use Access Controls to limit who gets what.

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Audit

- How do I know who got secrets ?

P) Add auditing capabilities throughout the whole infrastructure.

(LAUGHS)

A) Store secrets encrypted, audit who access what at retrieval time.

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But wait ...

... how do I authenticate to an API if I do not have credentials ?

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That's a GREAT question!
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Trusting the Host ?

- The host itself is trusted by the applications it runs, containers and VMs included.
- Conversely, applications running on the host are (ideally) **not** trusted.
- The host is critical to address bootstrapping issues, and will have to be provisioned accordingly.
  - Give hosts an identity (a x509 cert, a keytab, a password) and a role when provisioning.

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Example use case

- Trying to get FreeIPA domain controllers installed in an automated way.
- Bootstrapping the installation is problematic, as there is a need to transfer passwords, keys, certificates from one server to another.
- Traditionally done manually by preparing and transferring an encrypted install file.
  - Does not scale well in a dynamic environment.

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What's hard about it ?

- Some of these keys change over time, others are created over time, so we cannot just keep a copy “somewhere”
- We needed:
  - A way to fetch a set of credentials from an existing server over the network
  - A secure method to transfer those keys over the wire
  - A way to authorize access to those keys

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What do I need ?

- An API and service to distribute secrets
- Can encrypt information at rest and in transit
- Provides a useful REST API to access/store data
- Modular design allow to configure authentication/authorization and storage methods including proxying requests to other services.

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Custodia

- Built in Python
- Simple HTTP server, can listen on a unix socket and served via a proxy (Apache)
- Uses jwcrypto to implement the JOSE standard for web encryption (uses python-cryptography for crypto ops)
- Very easy to extend (see ipakeys)

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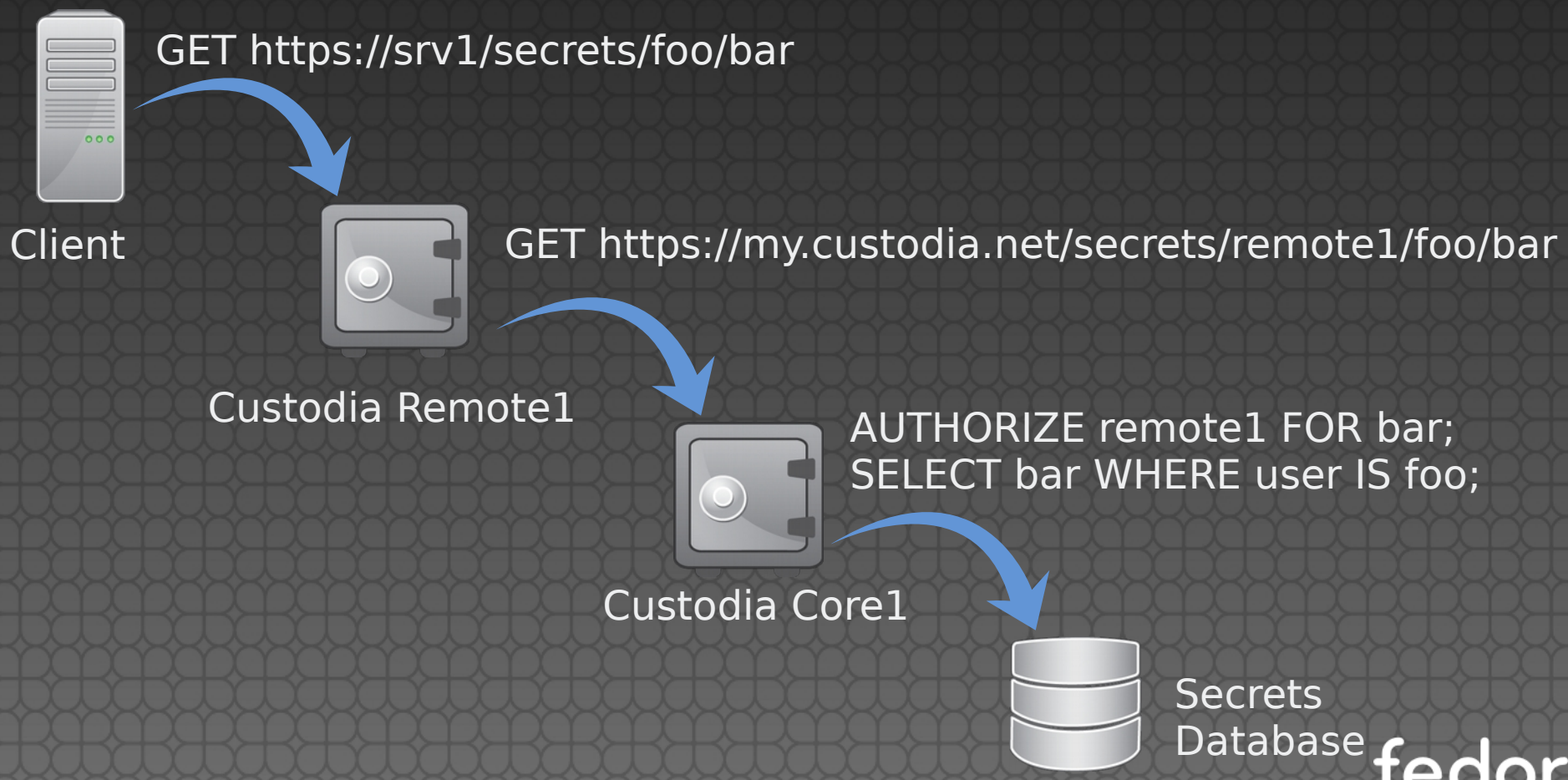
Works as a Pipeline

- The path used to fetch a secret can be munged and composed by intermediaries



Transferring secrets ...

- Simple type (use over TLS, please!):
  - Retrieve a secret:

    → GET /secrets/test/mypassword

    ← 200 OK
    {type: simple, value: “secret” }
  - Store a secret:

    → PUT /secrets/test/mypassword
    {type: simple, value: “secret” }

    ← 201 OK

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… with signing …

- Retrieve using Key Exchange Message:

  → GET /secrets/three/levels/down/mysecret?type=kem&value=aaaaaa.bbbbbb.cccccc

  aaaaaa.bbbbbb.cccccc == Encoded {

```
"protected": {
                "kid": <public-key-dentifier>,
                "alg": <valid alg name> },

"claims": {
                "sub": “mysecret”,
                "exp": <expiration time>,
                "value": <arbitrary> },

"signature": "ABCDEFGHIJKLMNOPQRSTUVXYZ"
}
```

Header

Payload

Signature

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... and sealing ...

- Retrieve using Key Exchange Message:

← 200 OK

aaaaa.bbbbb.ccccc.ddddd.eeeee == {

```
"protected": {
                "kid": <public-key-dentifier>,
                "alg": <valid alg name>,
                "enc": <valid enc type> },

"encrypted_key": <JWE Encrypted Key>,
"iv": <Initialization Vector>,
"ciphertext": <Encrypted JWS token>,
"tag": <Authentication Tag>
}
```

Header

JWE fields

Payload

JWE fields

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Accessing Custodia

- Authentication is normally done via tokens in headers, fully pluggable, determined by configuration statements
- Example Authentication directive:

```
[auth:header]
handler = custodia.httpd.authenticators.SimpleHeaderAuth
name = REMOTE_USER
```

- Example Authorization directive:

```
[authz:kemkeys]
handler = ipakeys.kem.IPAKEMKey
paths = /keys
store = ipa
server_keys = /etc/ipa/custodia/server.keys
```

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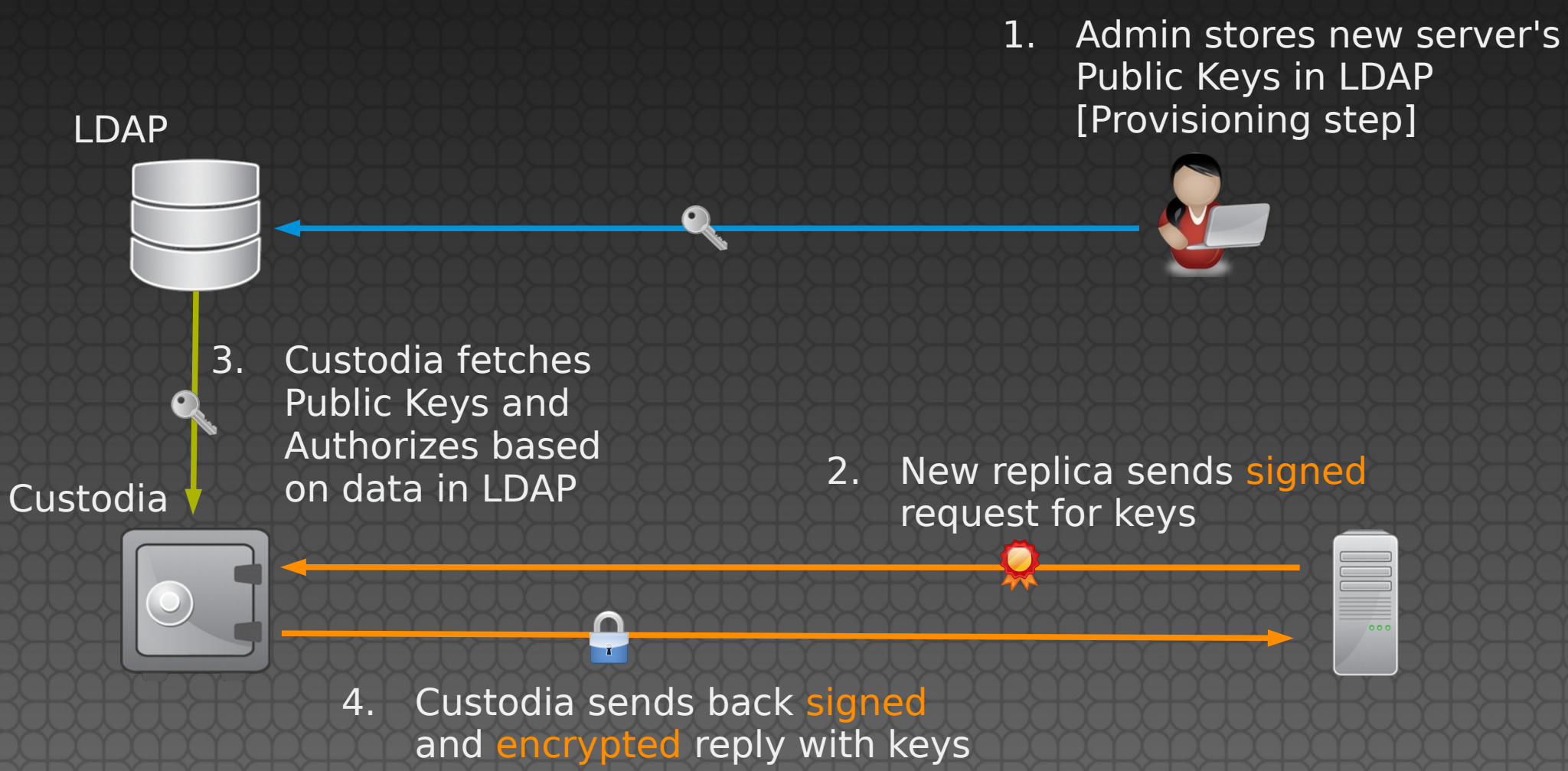
Within FreeIPA



Questions?

Contact:
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