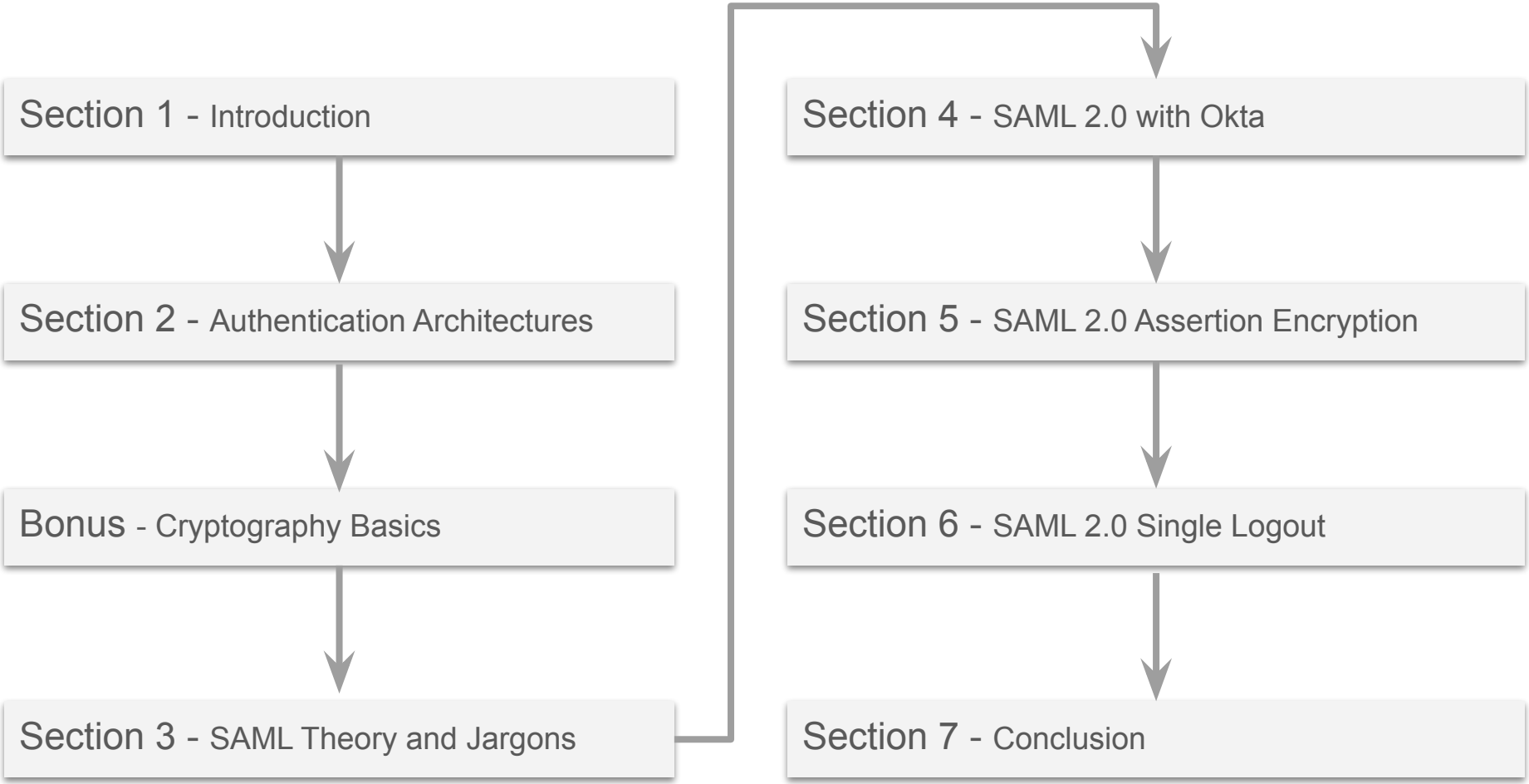
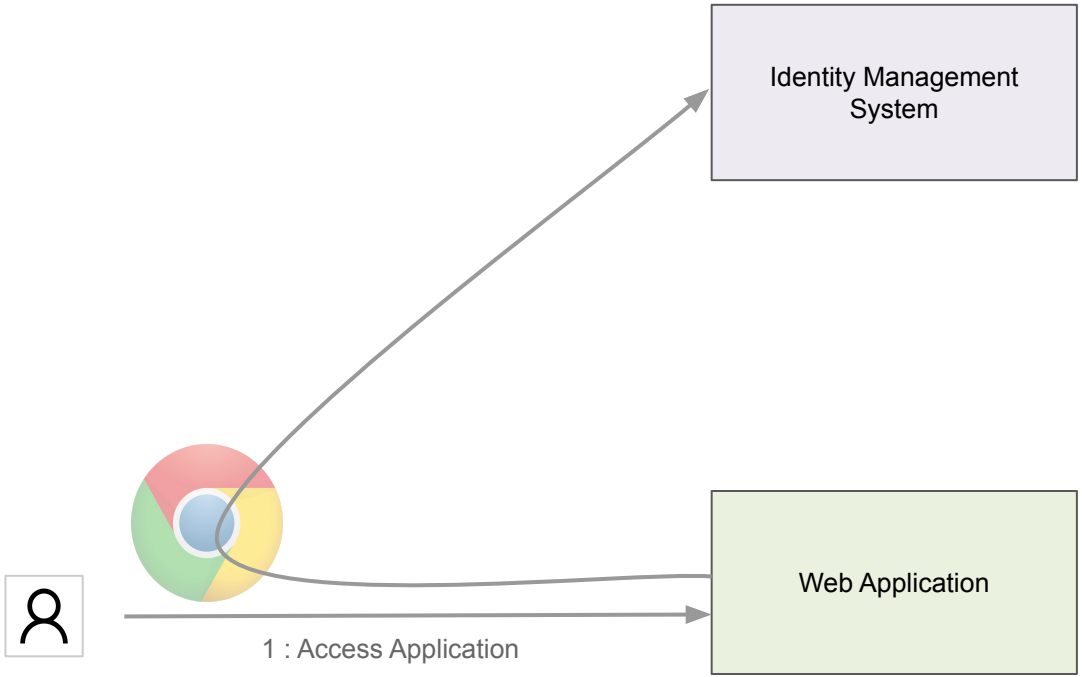
Course Content



Diagrams

The Private key and the Certificate are Base64 encoded so that they can be displayed as text.



Authentication Architectures

- Custom Security Architecture
  - Identity Provisioning, Authentication, Authorization
- Directory Services and LDAP
- LDAP Security Architecture
- Delegated Authentication

Custom Security Architecture

- Identity
- Authentication (AuthN)
- Authorization (AuthZ)
- Identity Provisioning

Business Logic

User Authentication

User Authorization

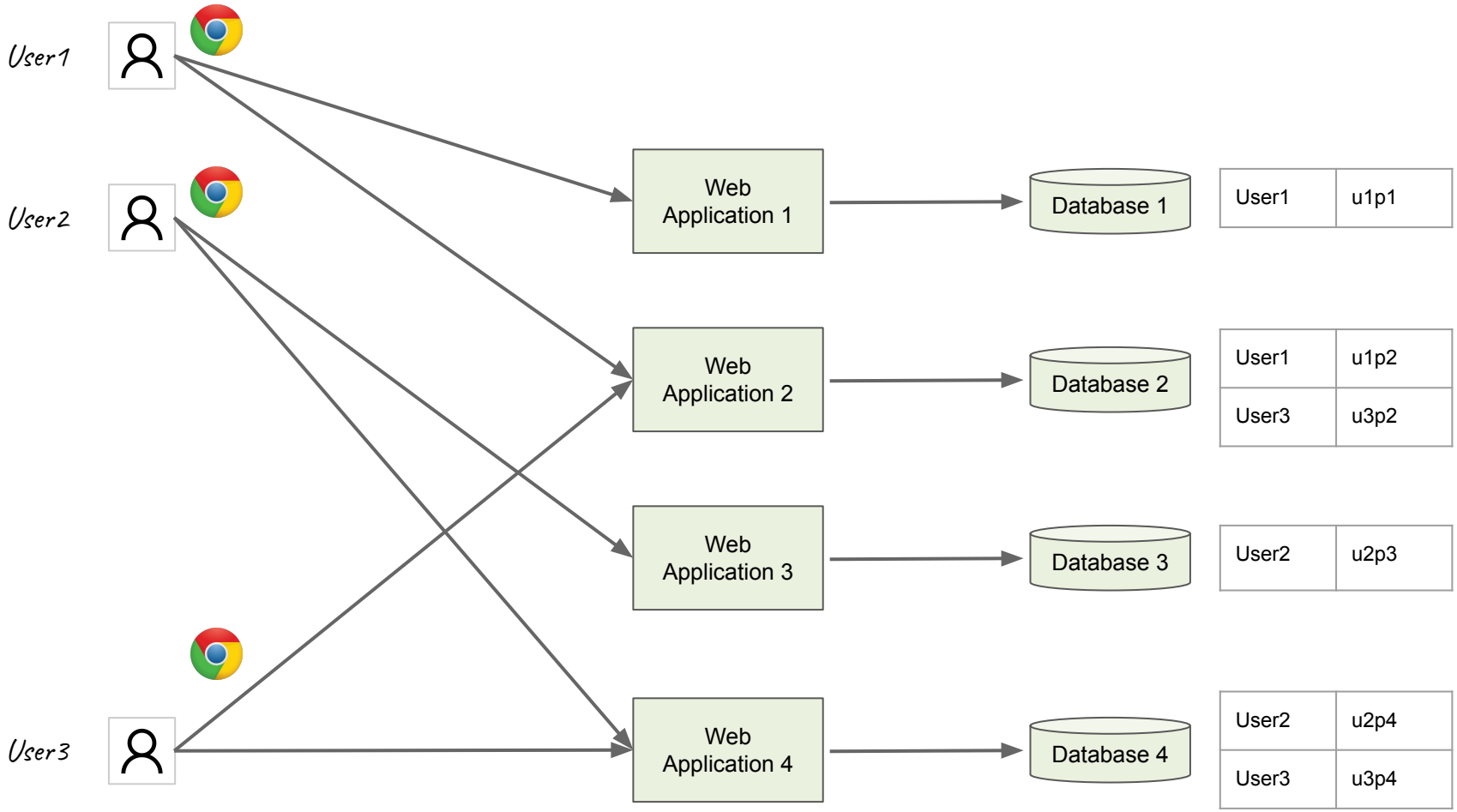
Identity Provisioning

Application Data

User Identity

User Roles

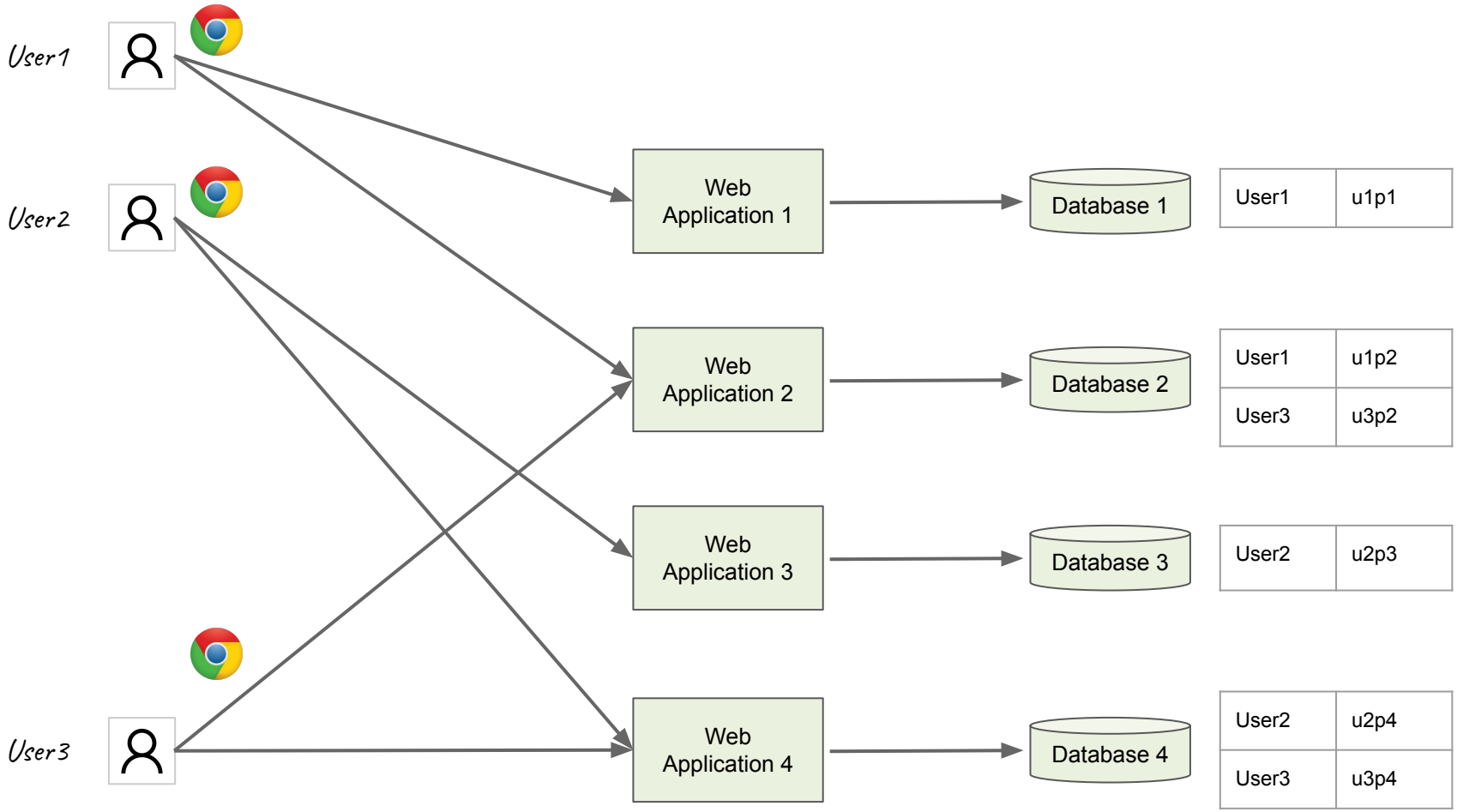
Custom Security Architecture Problems

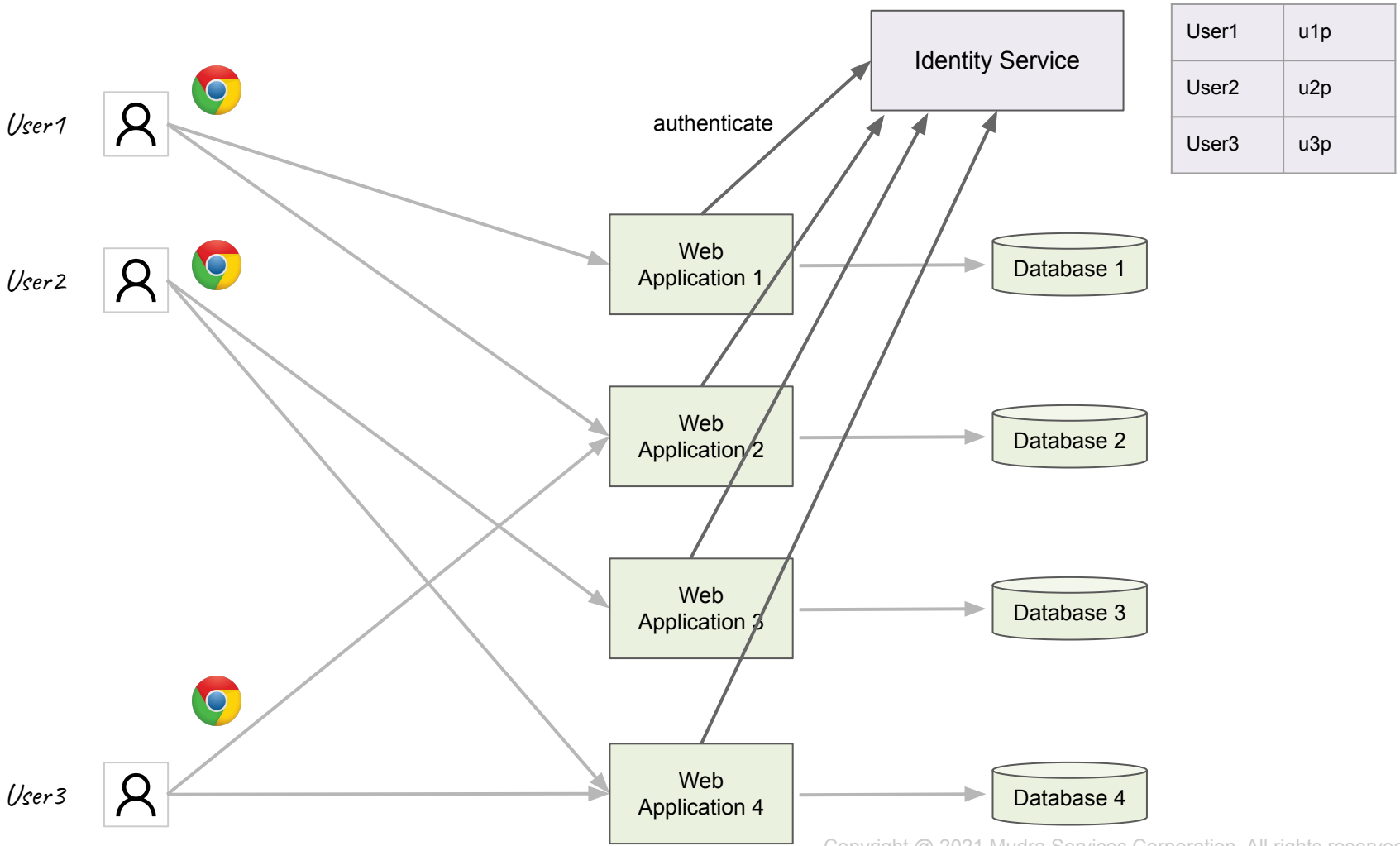


Custom Architecture - Problems

- User Identity is duplicated
- User has to remember too many passwords
- Application is responsible for User provisioning
- Provisioning and Deprovisioning of users is unmanageable
- No Single Sign-On
- Application responsible for Multi Factor Authentication (MFA)
- Credentials are sent to the Application (Security)

Common Identity





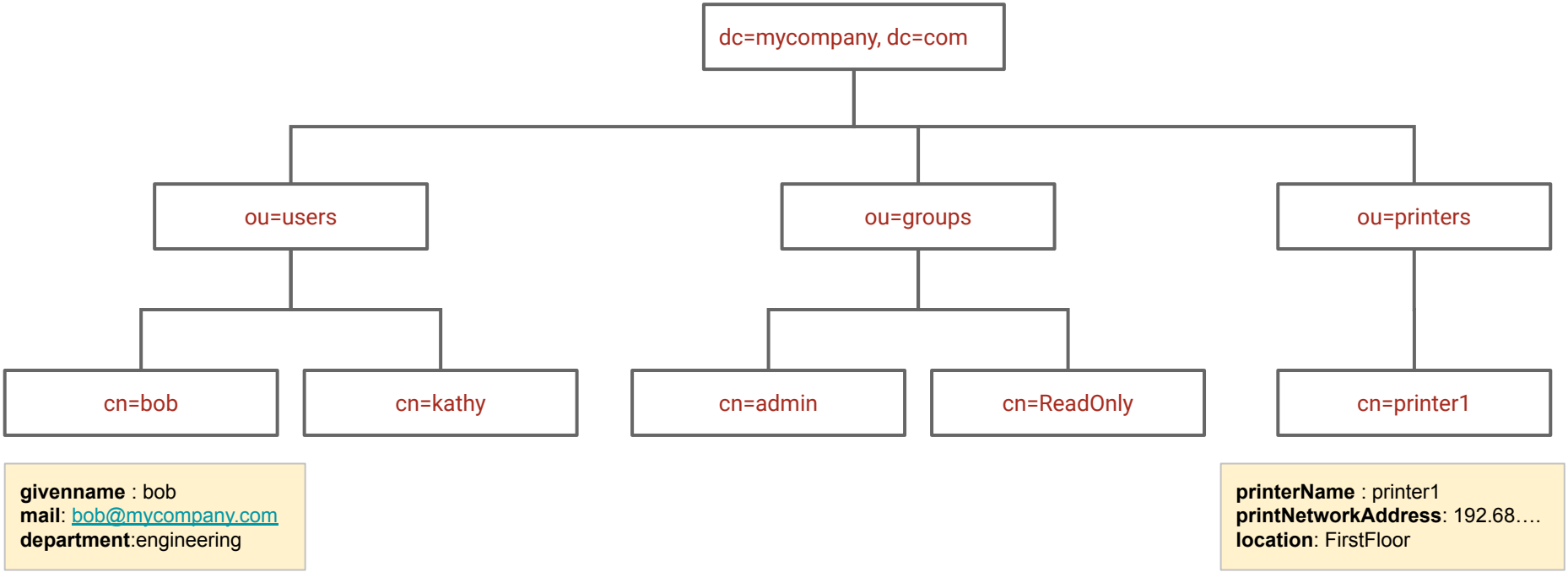
User and Group Data

- User Credentials
- First Name
- Last Name
- Email
- Phone Number
- Picture
- Groups (Application Roles can be mapped to this)
- Manager

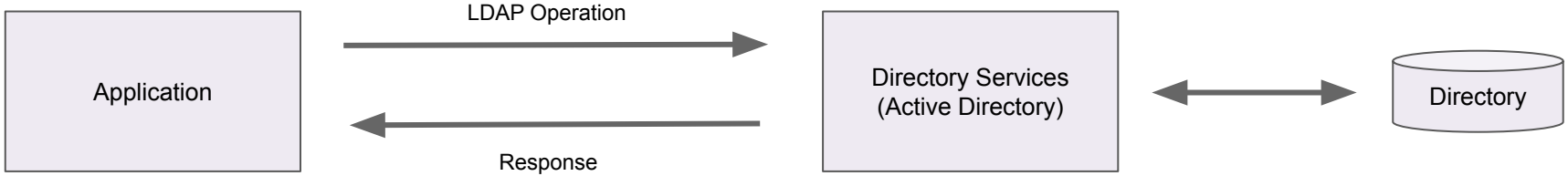
Lightweight Directory Access Protocol (LDAP)

- Directory Services
  - e.g Active Directory, Novell Directory Services
  - Entities (User, Group) stored in a tree structure
  - Fast Retrieval and Searches

- LDAP v3
  - Protocol to access Directory Services
  - Vendor neutral
  - All major languages have an implementation



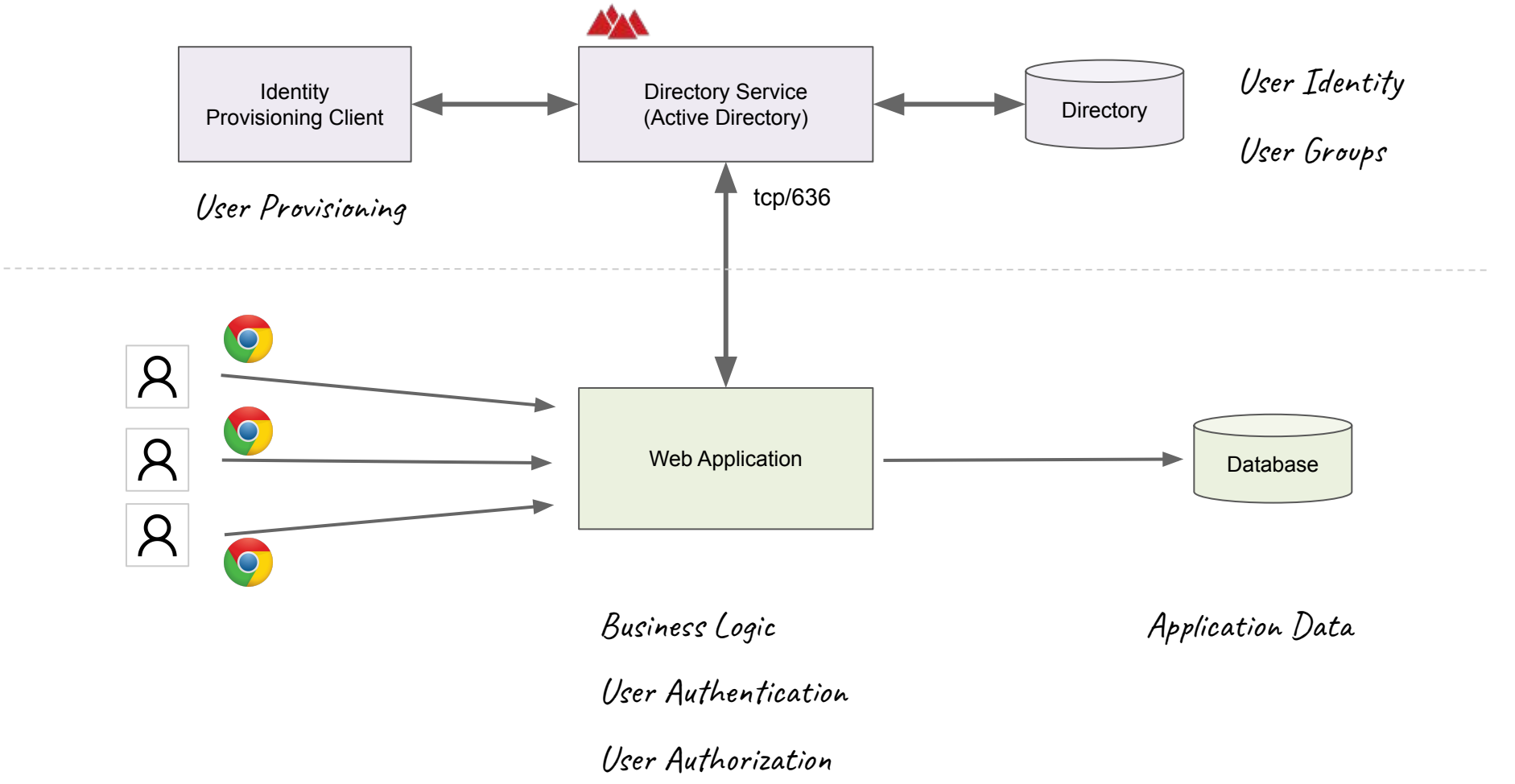
Distinguished Name (**DN**) for Bob	**cn**=bob,**ou**=users,**dc**=mycompany,**dc**=com
Distinguished Name (**DN**) for admin	**cn**=admin,**ou**=groups,**dc**=mycompany,**dc**=com
Distinguished Name (**DN**) for printer1	**cn**=printer1,**ou**=printers,**dc**=mycompany,**dc**=com

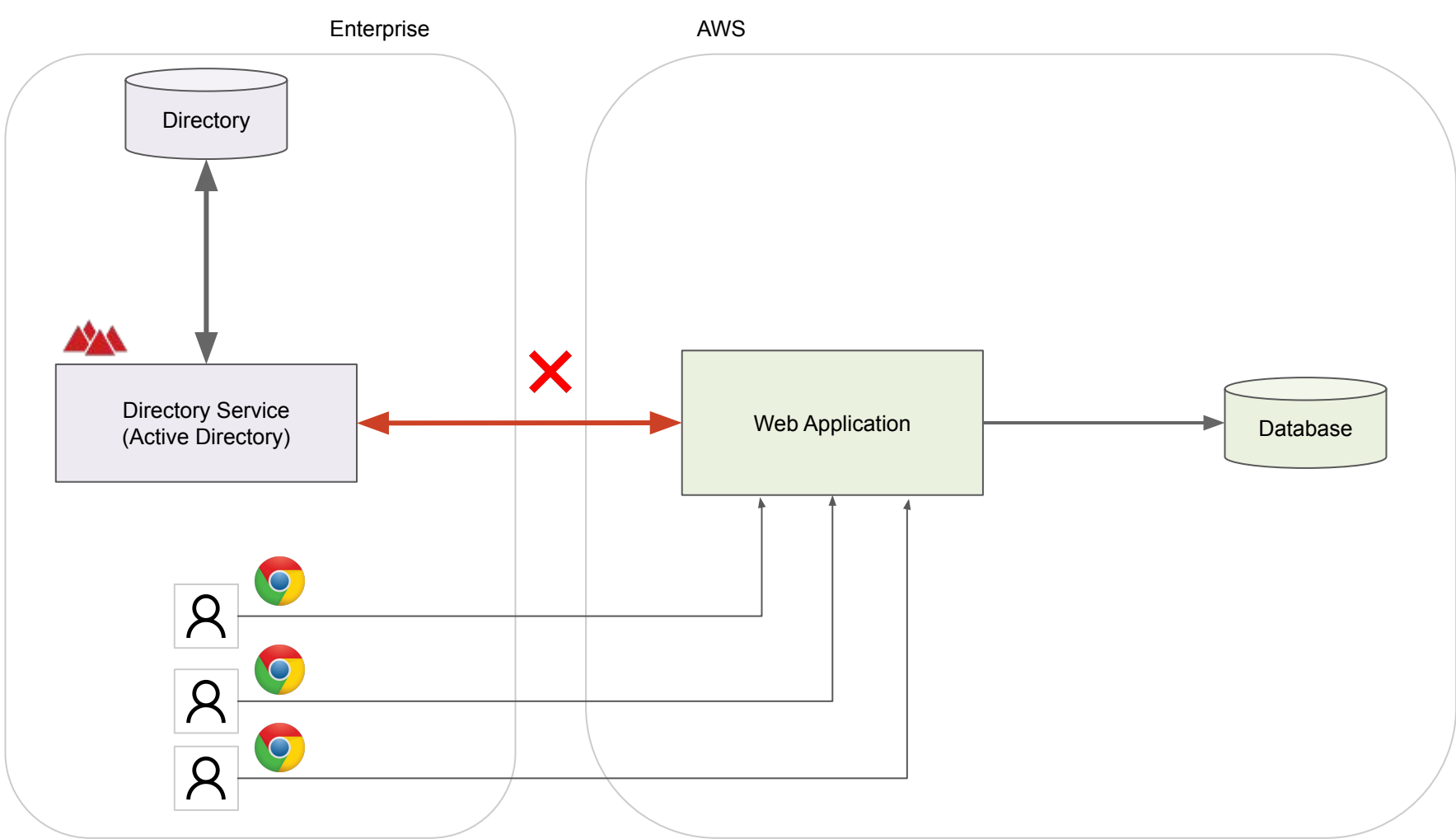


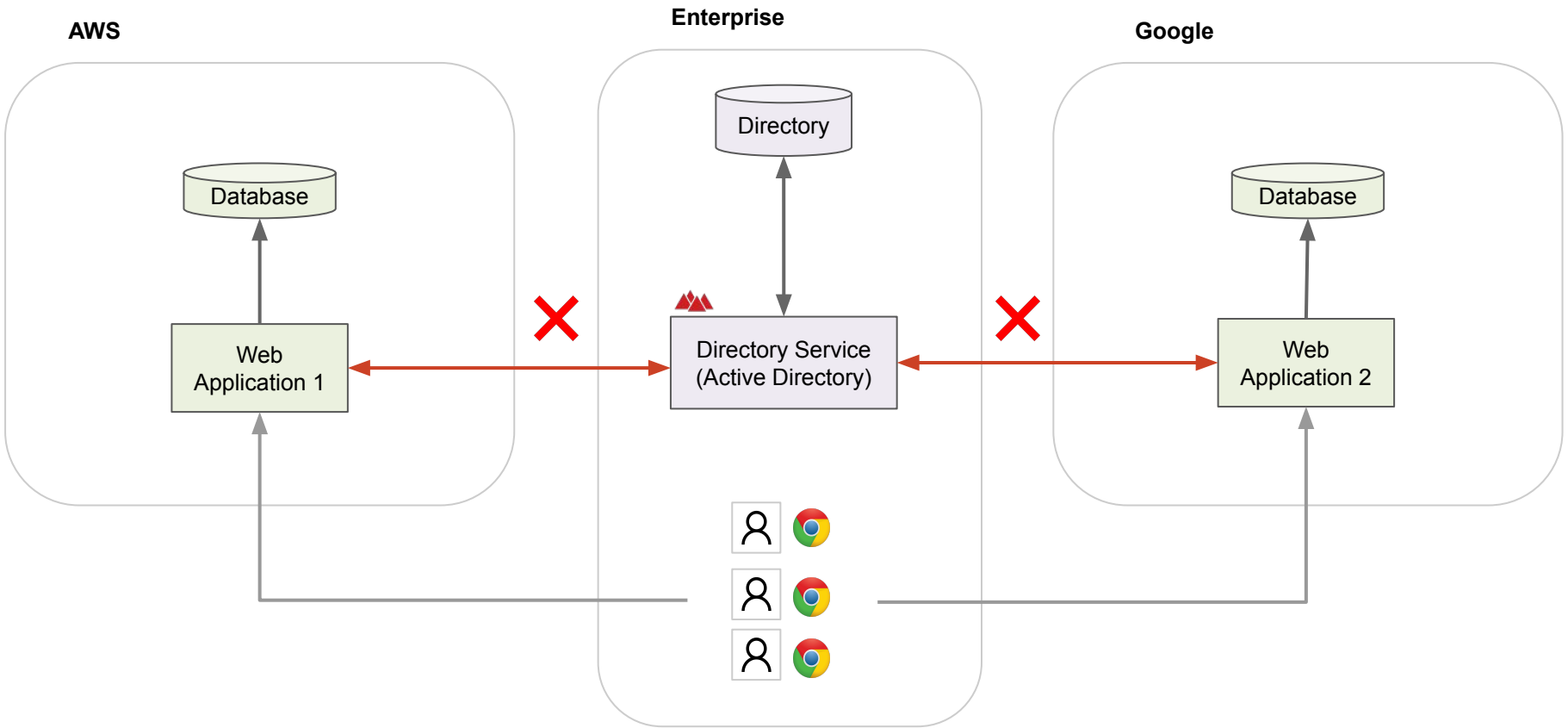
Operation	Explanation
Bind	Authenticate user
Search	Search for and/or retrieve directory entries
Add	Add a new Entry
Delete	Delete an Entry
Modify	Modify an Entry
Unbind	Close connection

Port	389
Port (TLS/SSL)	636
Protocol	TCP
Encoding	BER

LDAP Security Architecture



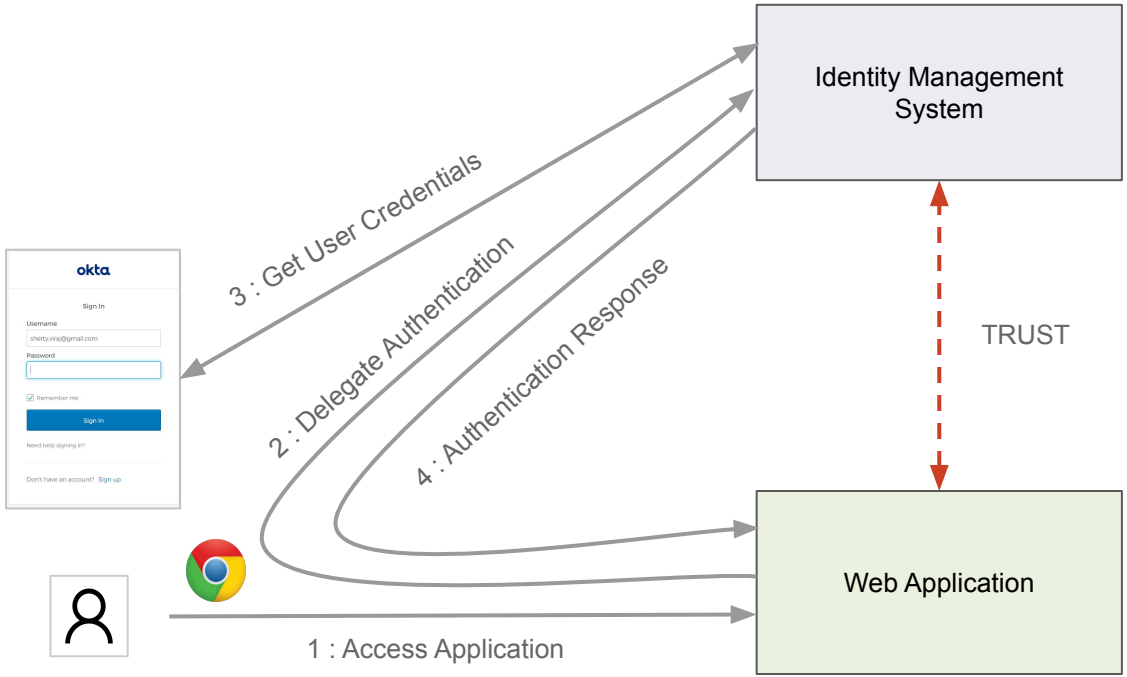




LDAP Architecture - Problems

- Credentials sent to the Application (Security)
- Applications and LDAP Server must be in the same security domain
- No Single Sign-On
- Application responsible for Multi Factor Authentication (MFA)

Delegated Authentication

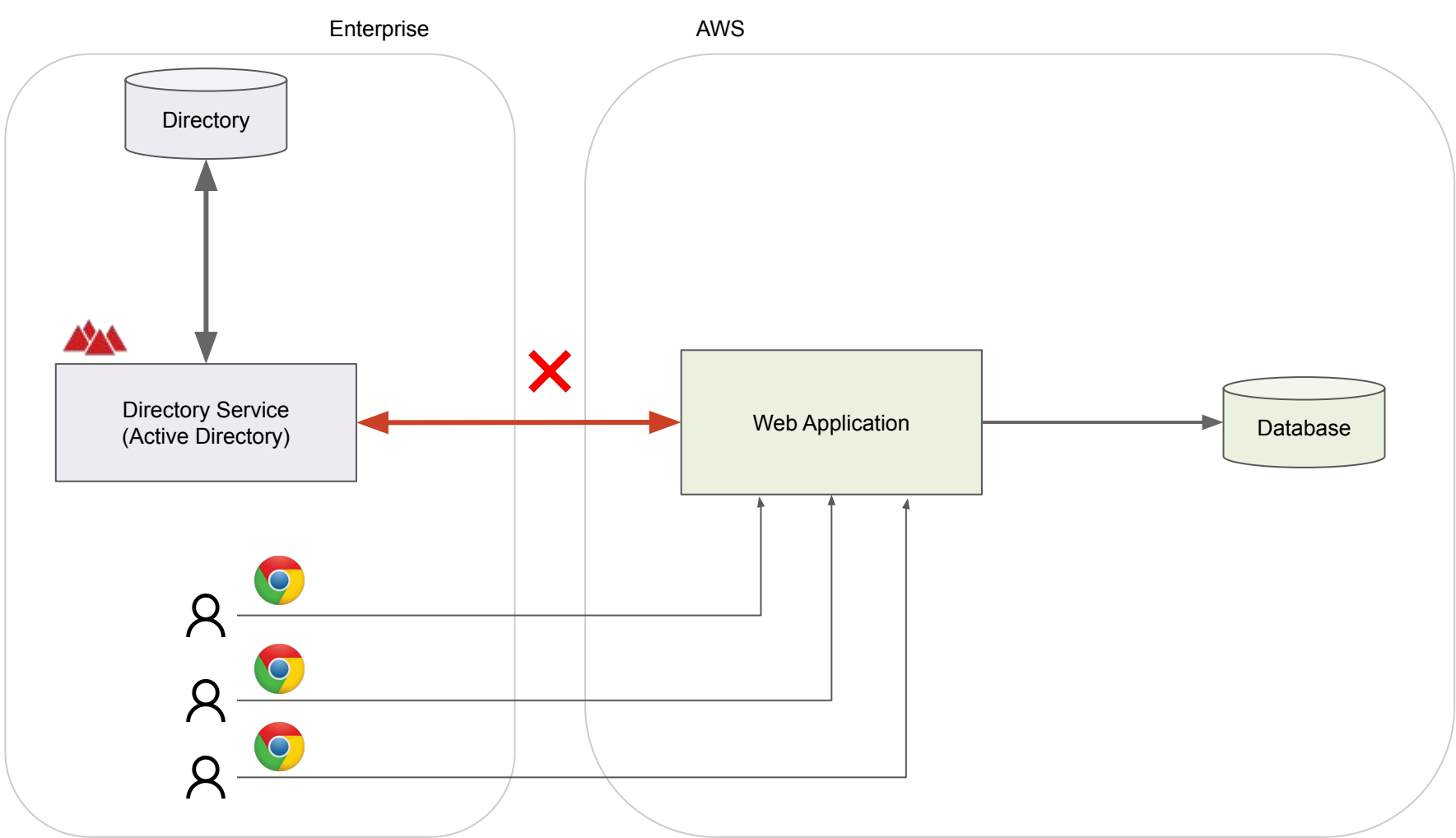


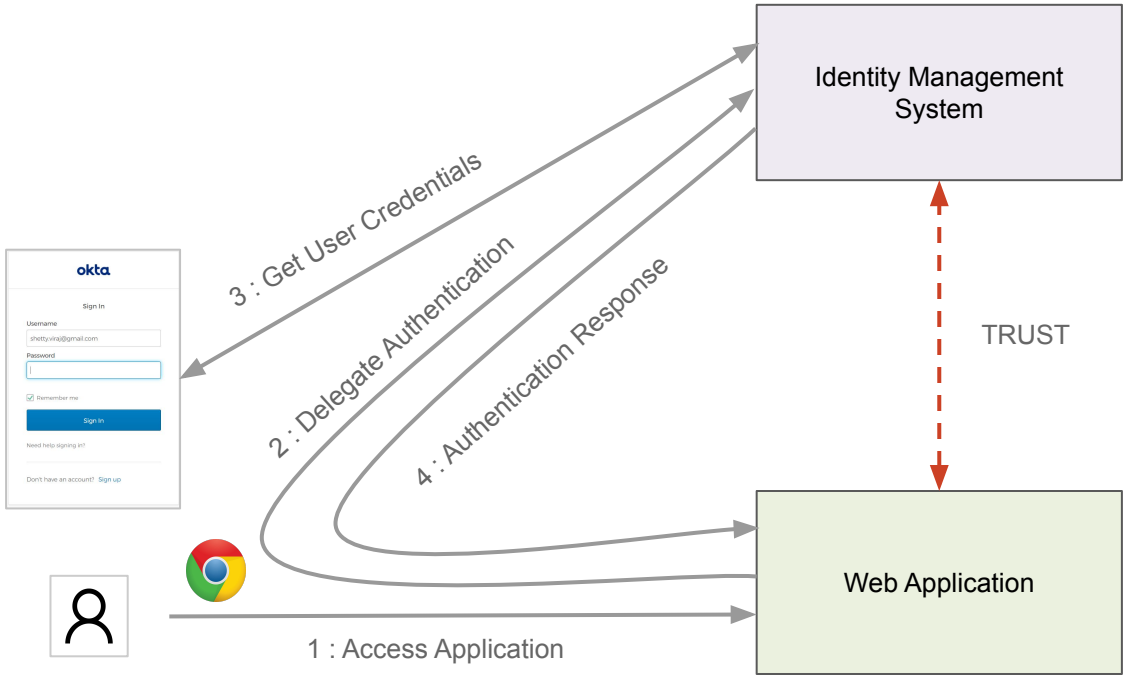
SAML 2.0 Single Sign On

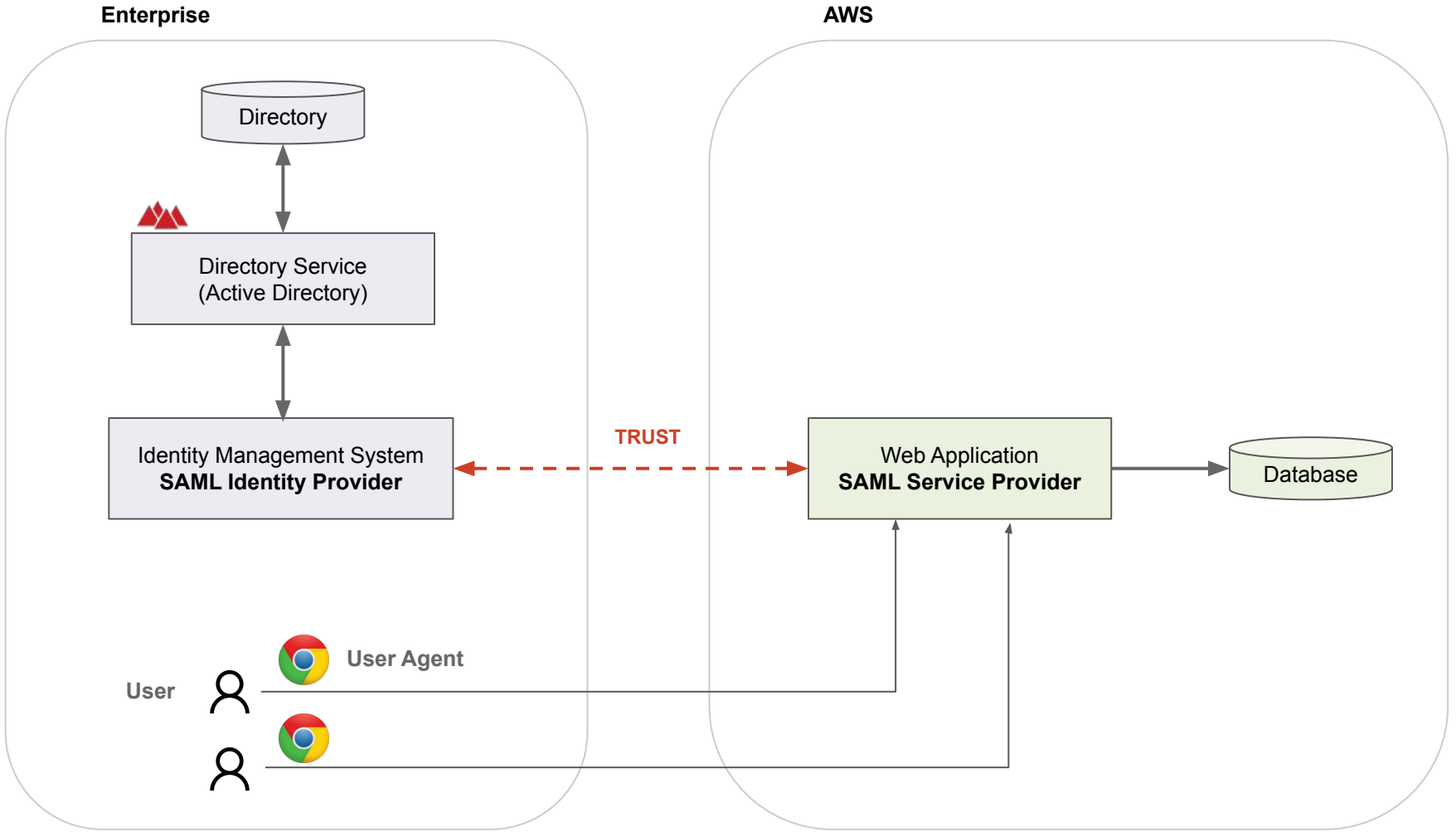
- SAML Theory
  - Identity Provider, Service Provider, Trust
  - SAML Metadata, SAML Assertion
  - Protocol Binding

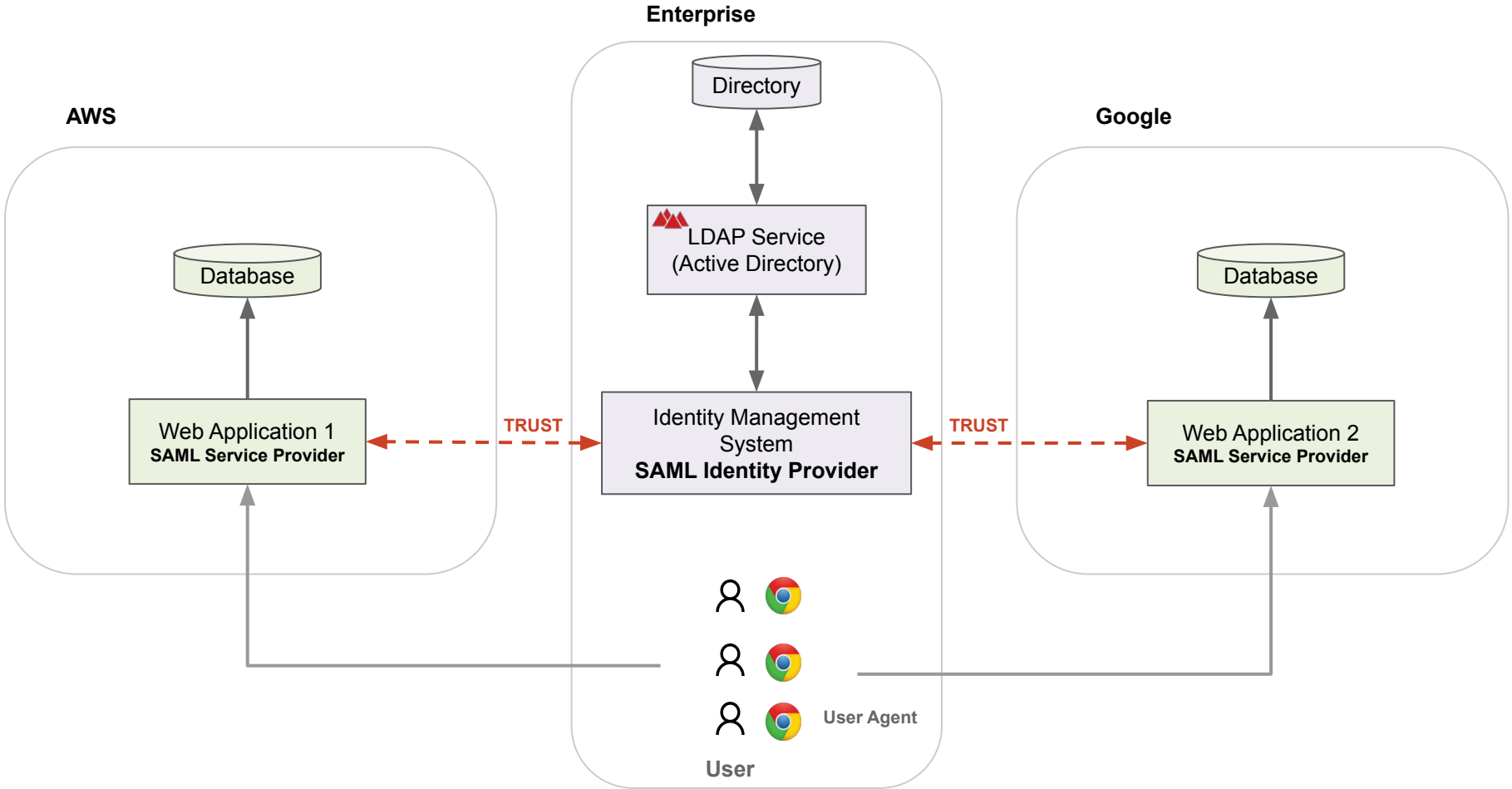
- SAML Authentication Flow
  - SP Initiated SAML Single Sign On
  - IDP Initiated SAML Single Sign On

Introducing SAML 2.0
(Security Assertion Markup Language)









SAML Authentication Flow

Enterprise/Other Cloud

AWS

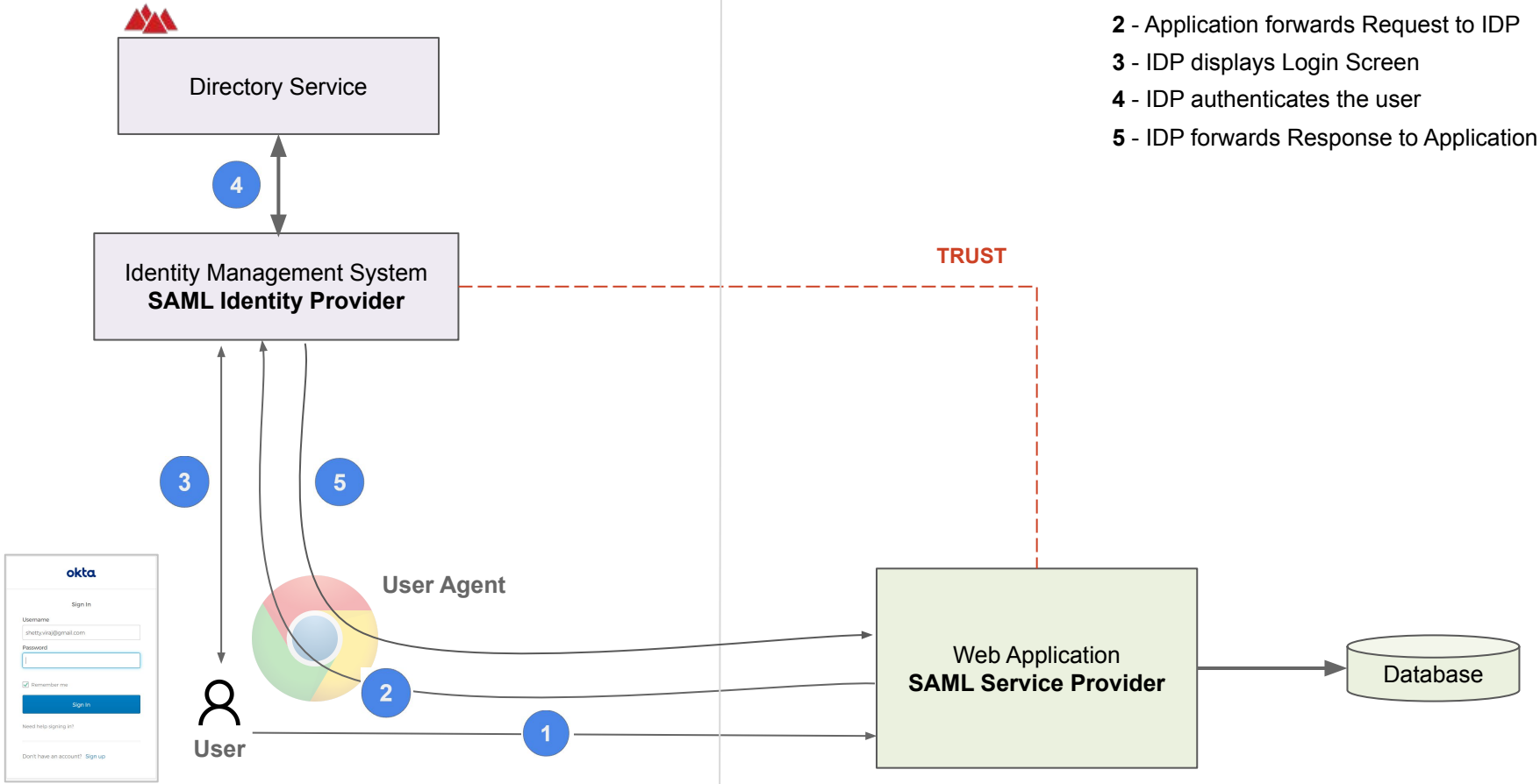
1 - User Accesses Application

2 - Application forwards Request to IDP

3 - IDP displays Login Screen

4 - IDP authenticates the user

5 - IDP forwards Response to Application



SP Initiated SSO Flow

Enterprise/Other Cloud

SP INITIATED SAML SSO

AWS

Directory Service

4

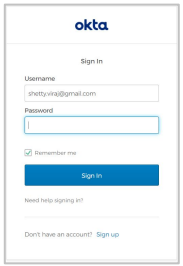
Entity ID

Identity Management System
SAML Identity Provider

TRUST

3

5



User Agent

User

2

1

Entity ID

Web Application
SAML Service Provider

Database

Relying Party

1 - User Accesses Application
2 - Application forwards Request to IDP
3 - IDP displays Login Screen
4 - IDP authenticates the user
5 - IDP forwards Response to Application

IDP INITIATED SAML SSO

Enterprise/Other Cloud

AWS

Directory Service

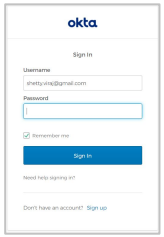
2

Identity Management System
SAML Identity Provider

TRUST

1

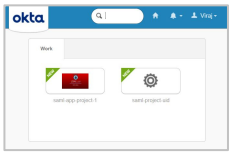
3



User Agent

4

User



5

Web Application
SAML Service Provider

Database

1 - User Accesses and logs into IDP

2 - IDP authenticates the user

3 - IDP displays User Dashboard

4 - IDP forwards Response to Application

5 - Application displays Page

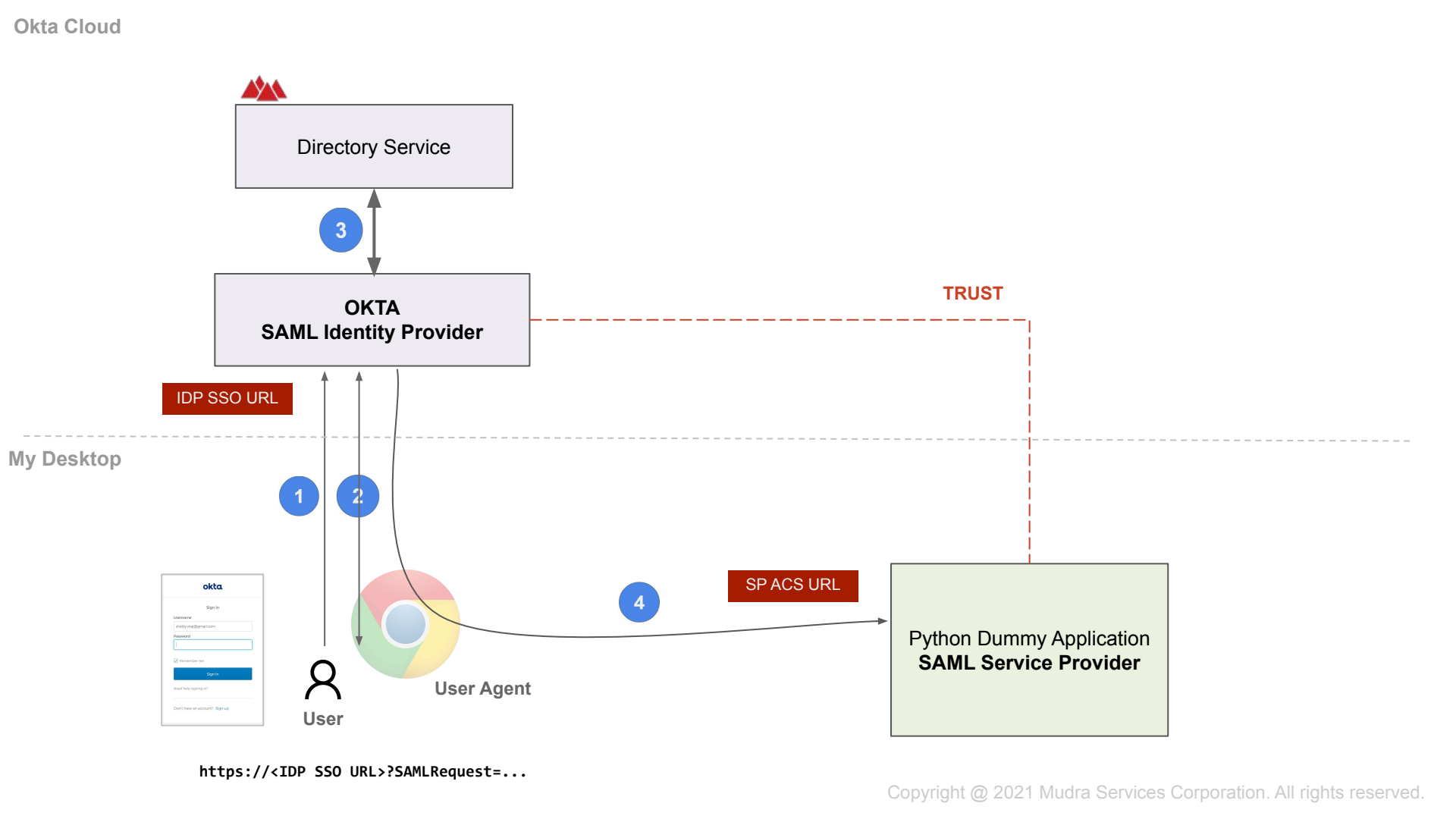
Hands On SAML 2.0 with Okta

- Okta SAML Setup for Project 1
- Hands-On SAML Experimentation with Okta
  - Construct XML SSO Request
  - Analyze XML SSO Response
- Signing Assertion and Response
- SAML Debugging
  - Google Chrome
  - SAML Devtools Extension
  - SAML Developer Tools Website

Okta Setup

Project 1 Explanation

- Use Okta Identity provider
- Use Dummy Python Application
- Construct SAML Request
- Inspect the Signed SAML Response
- No Encryption of SAML Response
- No SAML Groups



Enterprise/Other Cloud

AWS

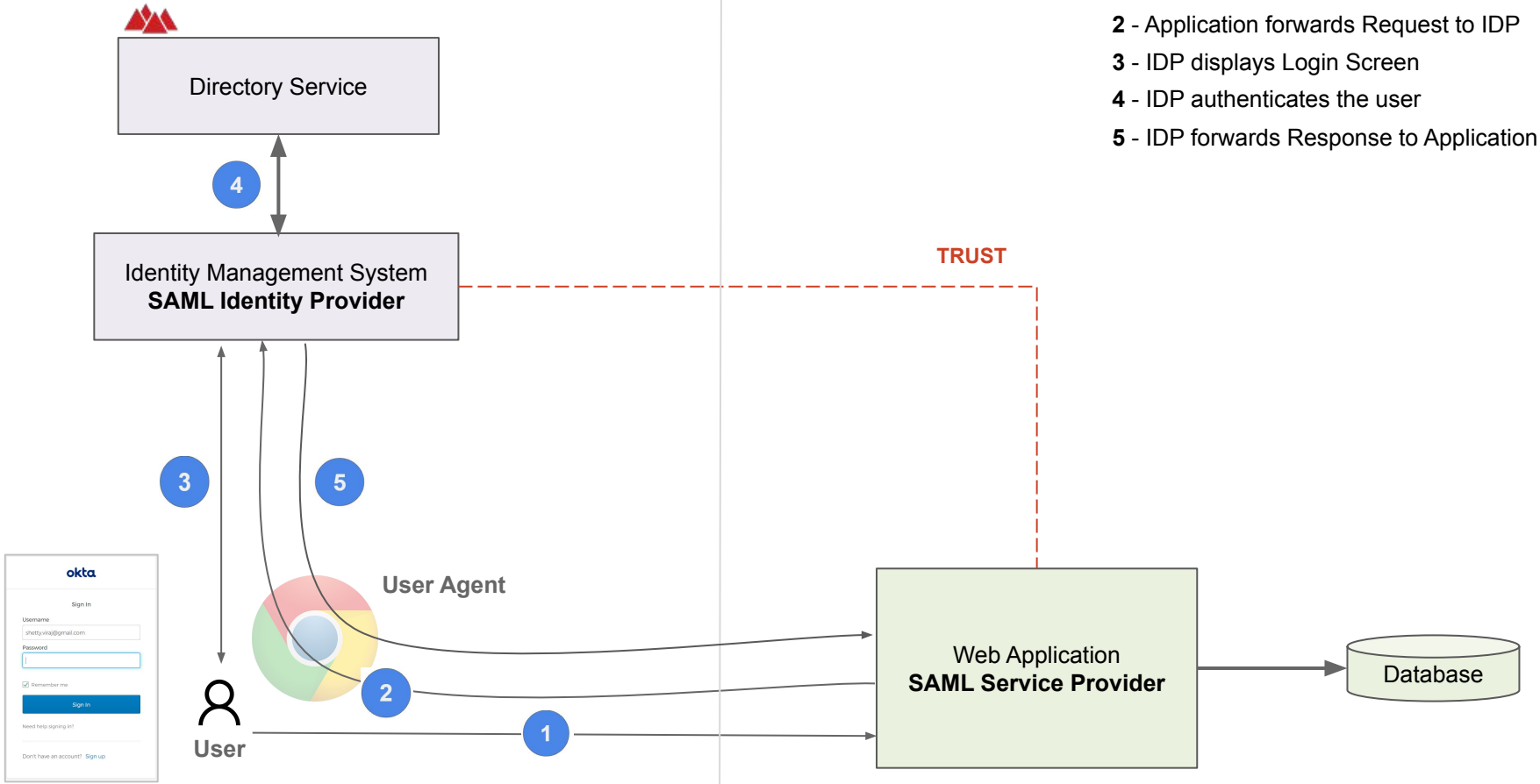
1 - User Accesses Application

2 - Application forwards Request to IDP

3 - IDP displays Login Screen

4 - IDP authenticates the user

5 - IDP forwards Response to Application



Project 1

SAML 2.0 Assertion Encryption

- Okta SAML Setup for Project 2
- Hands-On SAML Experimentation with Okta
  - Construct XML SSO Request
  - Analyze XML SSO Response
- Signing Assertion and Response
- Assertion Encryption
  - Generate RSA Keys and Certificate
- Handling custom user and group claims

Project 2 Explanation

- Run Dummy Python Application at port 8081
- New user field UID
- New Groups and associate with users
- Add encryption to Response
- Inspect the Signed/Encrypted SAML Response

Okta Cloud

Project 2

Directory Service

3

OKTA
SAML Identity Provider

TRUST

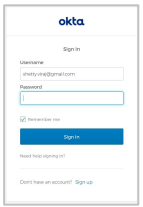
IDP SSO URL

My Desktop

1

2

➔ Encrypted Assertion
➔ Group Claims



User

User Agent

4

SP ACS URL

Python Dummy Application
SAML Service Provider

8081

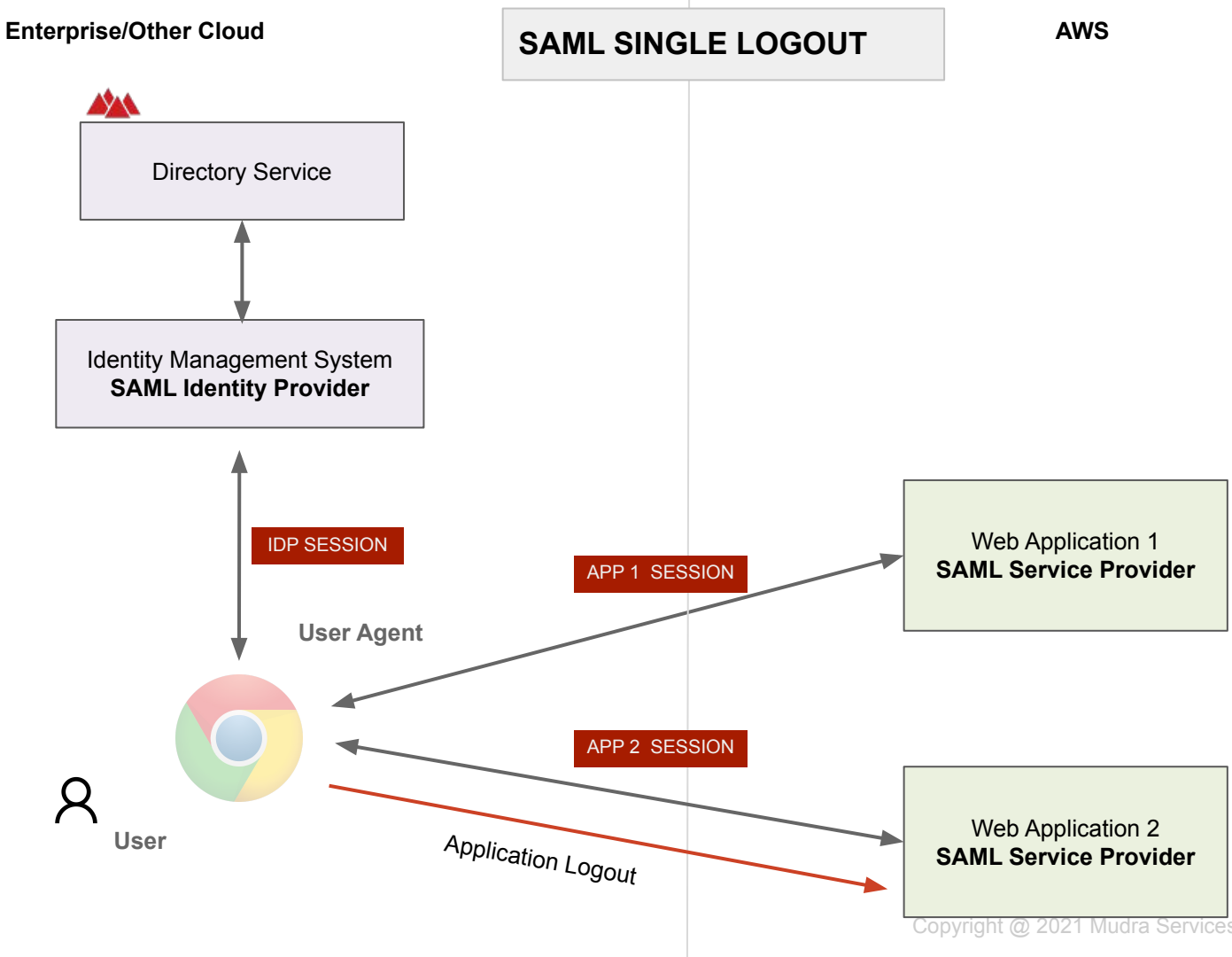
`https://<IDP SSO URL>?SAMLRequest=...`

Project 2

SAML 2.0 Single Logout

- Okta SAML Setup
- Hands-On SAML Experimentation with Okta
  - Construct XML Logout Request
  - Analyze XML Logout Response
- HTTP Sessions
- Okta User Provisioning
- Okta MFA and SAML

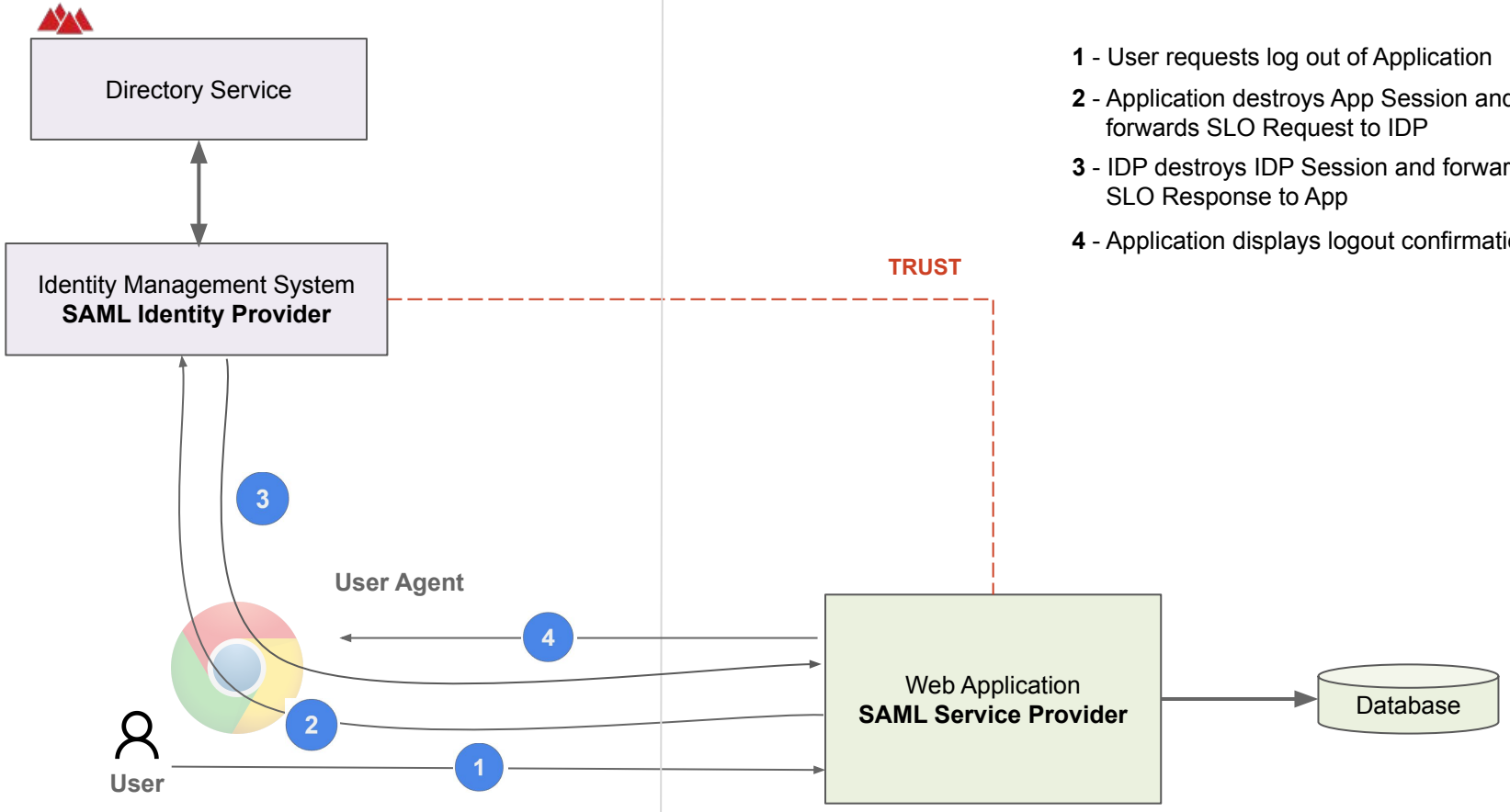
SAML Single Logout



Enterprise/Other Cloud

SP INITIATED SAML SLO

AWS



1 - User requests log out of Application

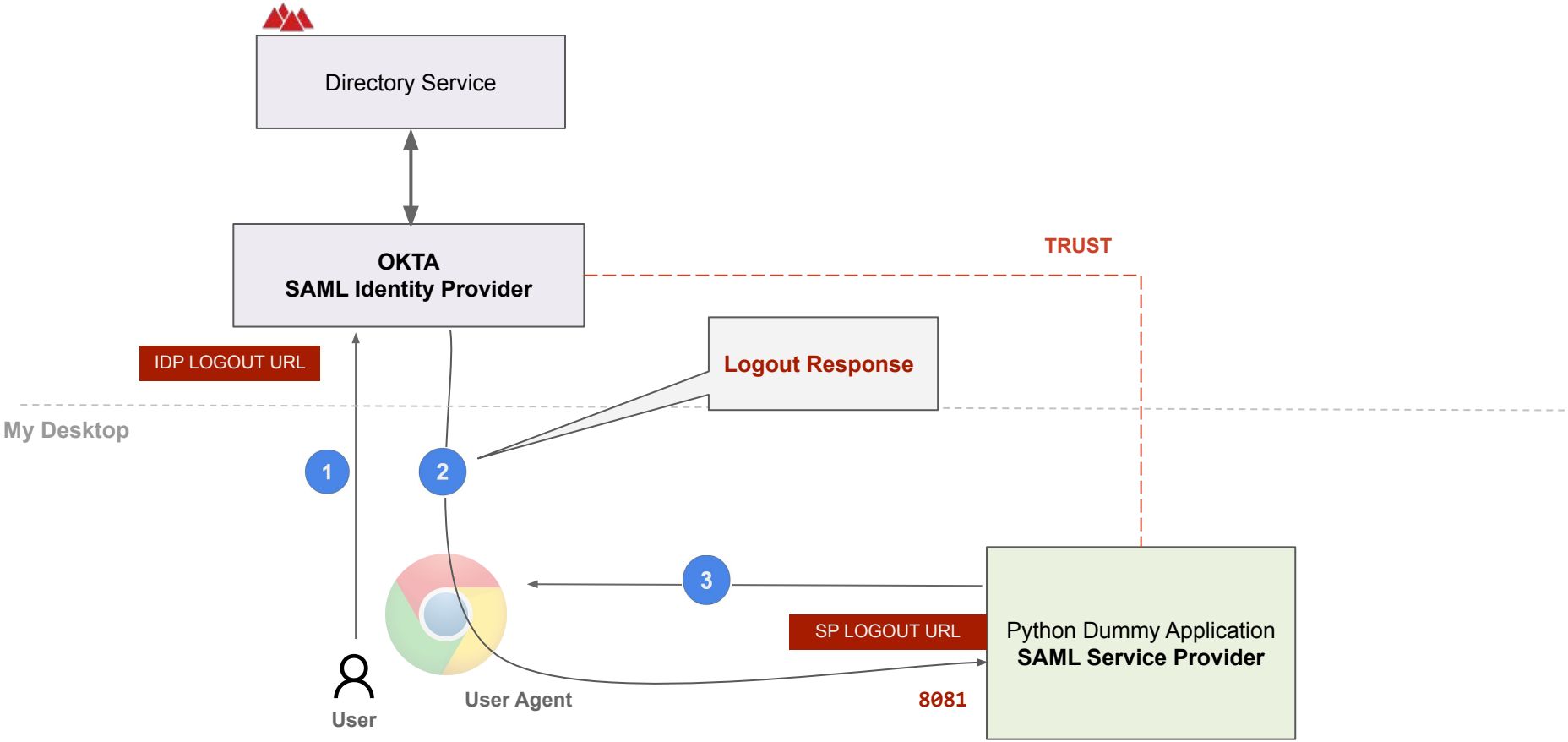
2 - Application destroys App Session and forwards SLO Request to IDP

3 - IDP destroys IDP Session and forwards SLO Response to App

4 - Application displays logout confirmation

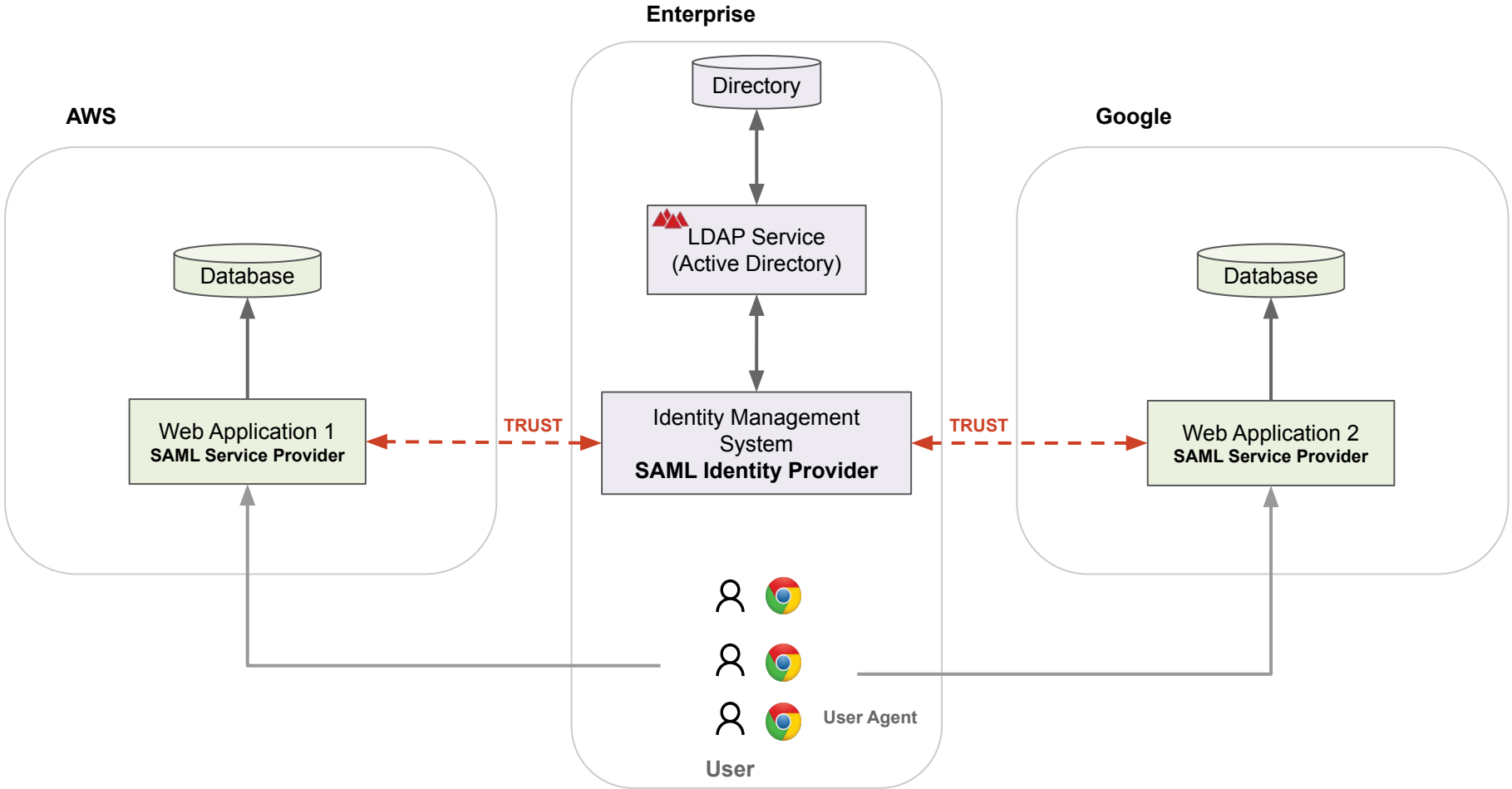
Okta Cloud

Project 2



`https://<IDP LOGOUT URL>?SAMLRequest=...`

User Provisioning



SAML 2.0 and Programming

Enterprise/Other Cloud

AWS

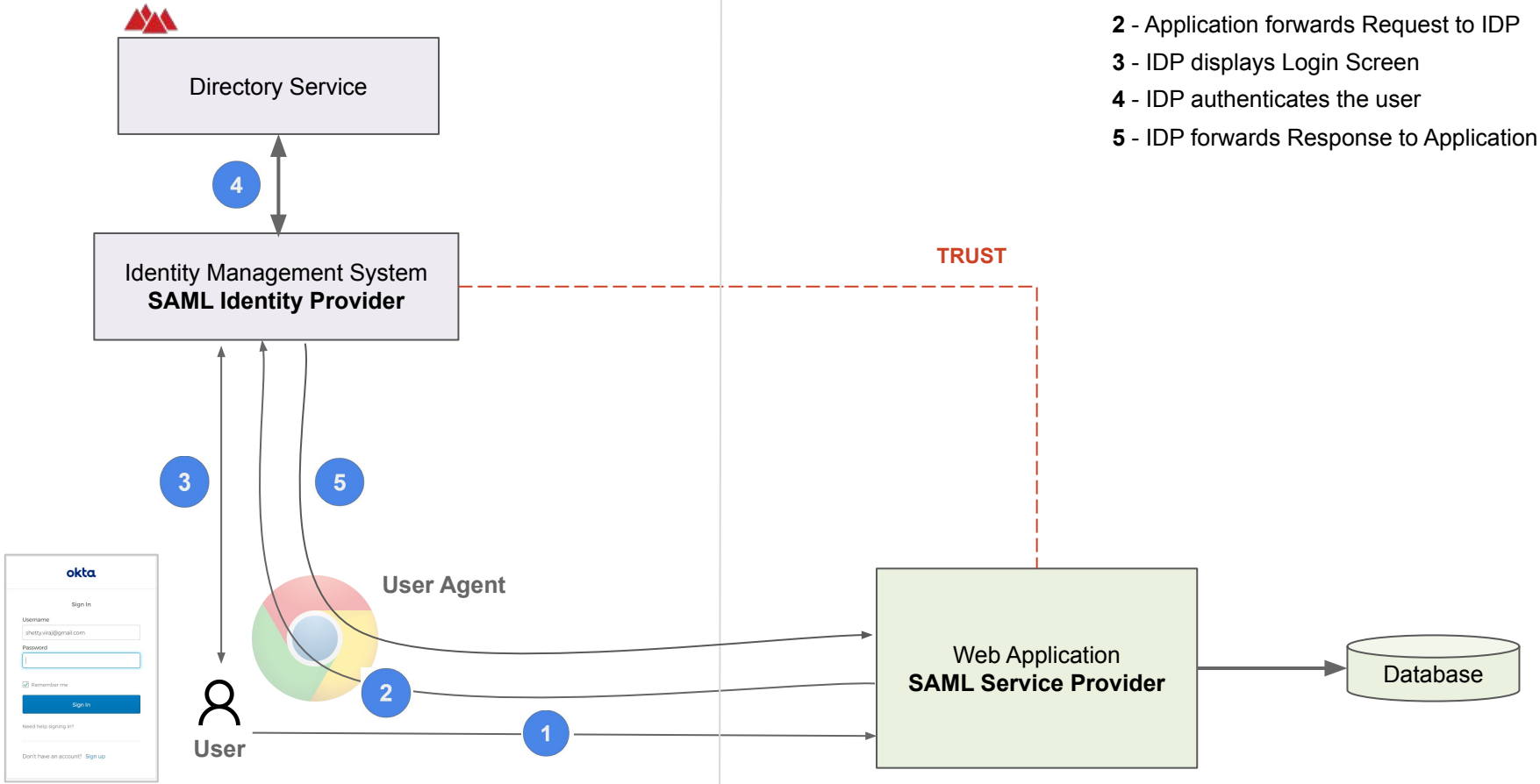
1 - User Accesses Application

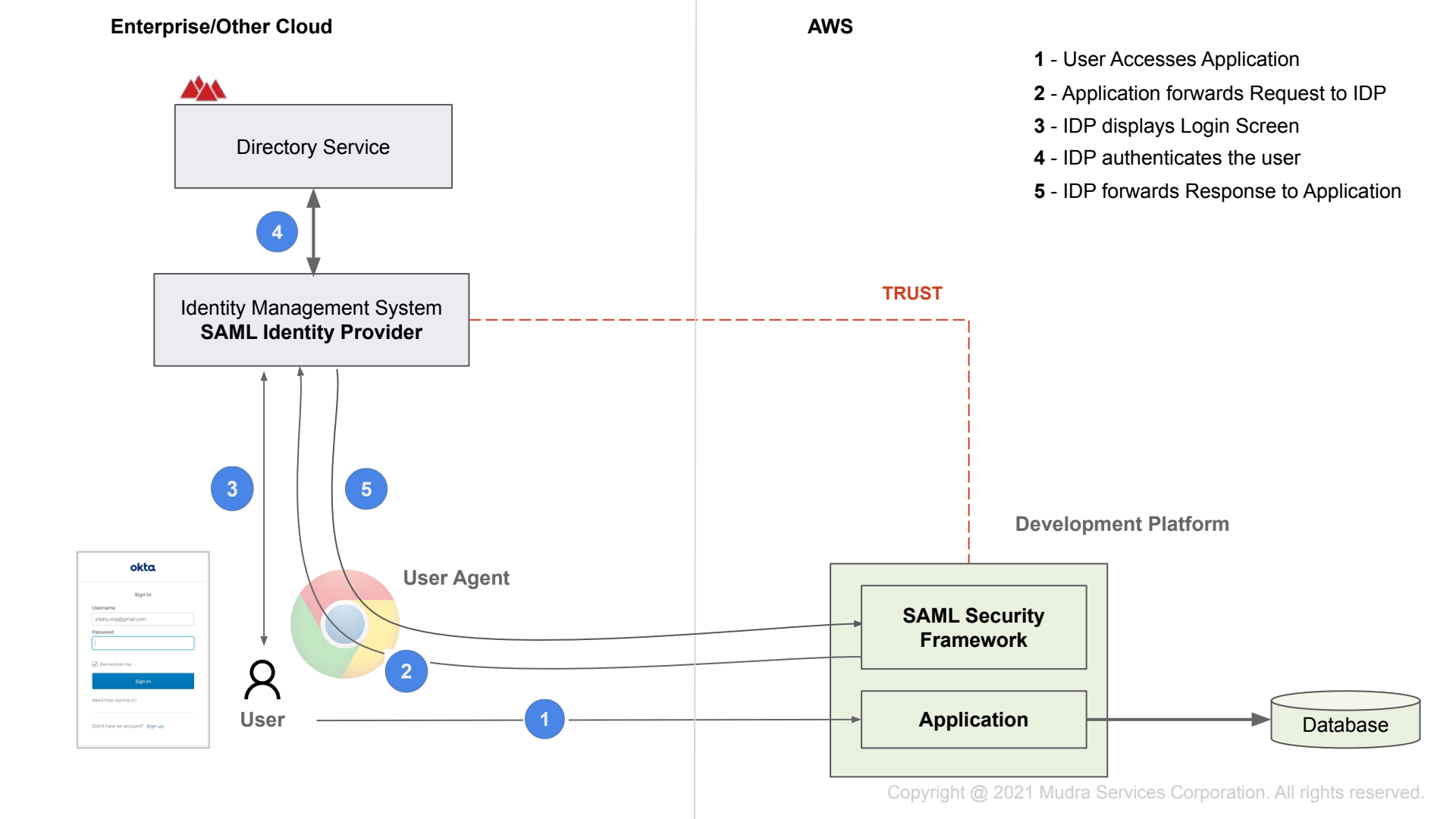
2 - Application forwards Request to IDP

3 - IDP displays Login Screen

4 - IDP authenticates the user

5 - IDP forwards Response to Application




Enterprise/Other Cloud
AWS
1 - User Accesses Application
2 - Application forwards Request to IDP
3 - IDP displays Login Screen
4 - IDP authenticates the user
5 - IDP forwards Response to Application
Directory Service
4
Identity Management System
SAML Identity Provider
TRUST
3
5
Development Platform
okta
Sign In
Username
Password
Remember me
Sign In
Need help signing in?
Don't have an account? Sign up
User Agent
SAML Security Framework
2
User
1
Application
Database
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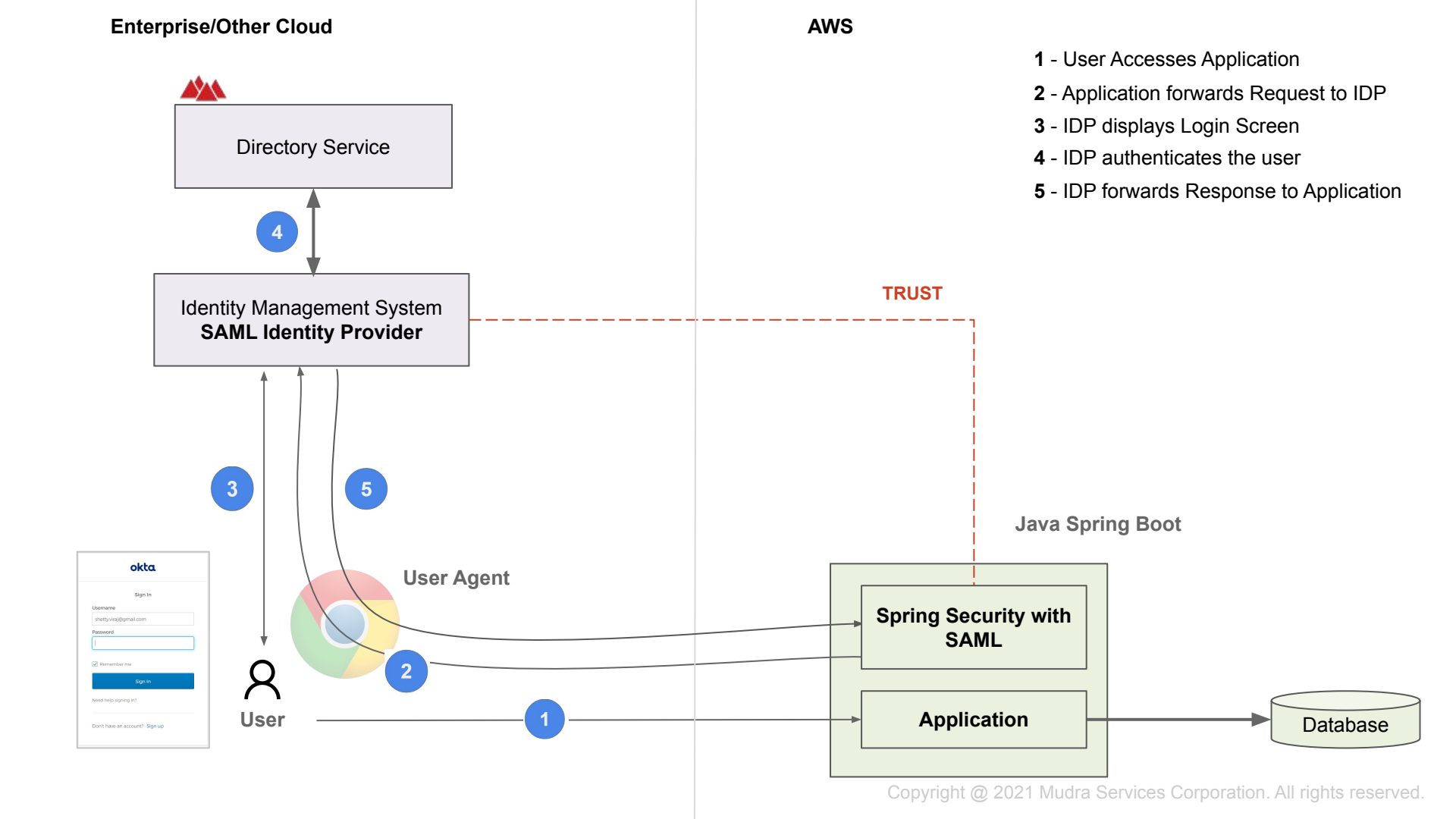
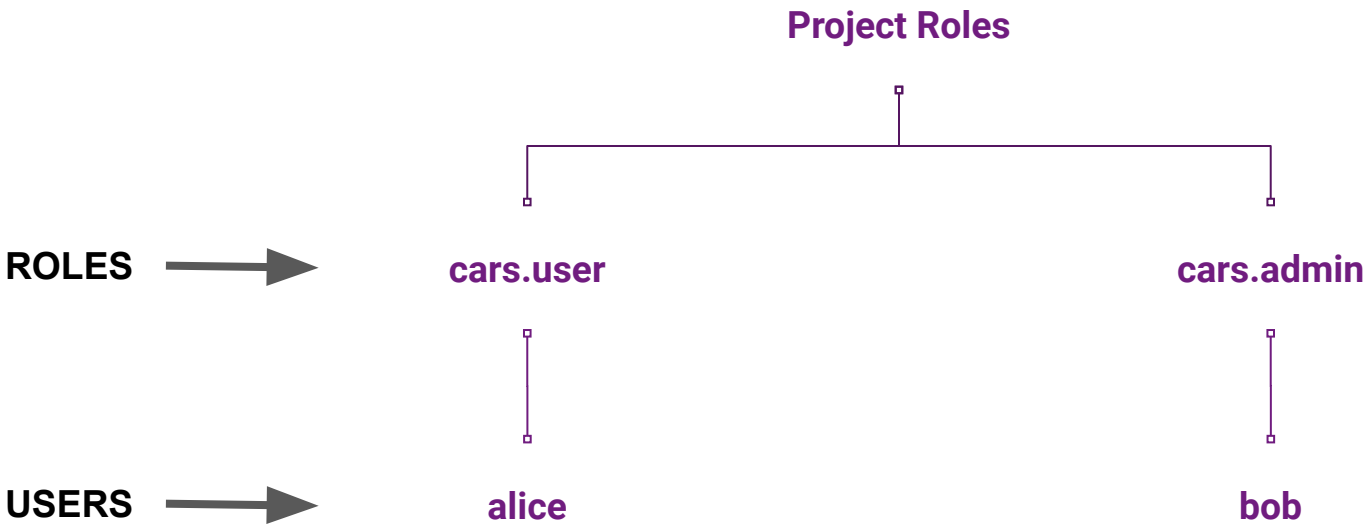


Cryptography Basics

- URL Encoding
- Base64 Encoding
- Hashing (SHA-512, SHA-256)
- Symmetric Encryption (AES, Blowfish)
- Asymmetric Encryption (RSA)
  - RSA Keys, Certificates
- Digital Signatures

PROJECT

Form Based Spring Boot Application



PROJECT

Spring Boot SAML Integration

Okta Cloud

1 - User Accesses Application
2 - Application forwards Request to IDP
3 - IDP displays Login Screen
4 - IDP authenticates the user
5 - IDP forwards Response to Application

Directory Service

4

OKTA
SAML Identity Provider

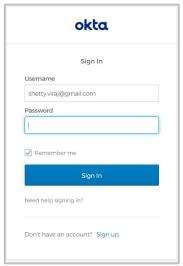
TRUST

My Desktop

3

5

Java Spring Boot



User Agent

2

User

1

Spring Security with SAML

Used Car Portal

Database

https://localhost:8080

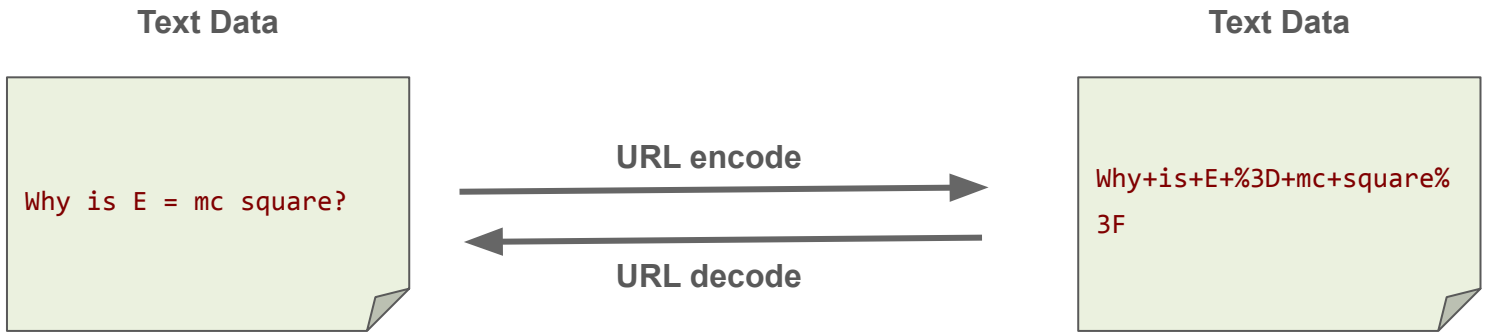
```yaml
spring:
  security:
    saml2:
      relyingparty:
        registration:
          carsonline:
            signing:
              credentials:
                - private-key-location: "classpath:credentials/private.key"
                  certificate-location: "classpath:credentials/certificate.crt"
            decryption:
              credentials:
                - private-key-location: "classpath:credentials/private.key"
                  certificate-location: "classpath:credentials/certificate.crt"
            identityprovider:
              metadata-uri: "classpath:okta-metadata.xml"
```

ACS URL	**<baseurl>**/login/saml2/sso/**<project-name>**
Single Logout URL	**<baseurl>**/logout/saml2/slo
Metadata URL(*)	**<baseurl>**/saml2/service-provider-metadata/**<project-name>**
EntityID	**<baseurl>**/saml2/service-provider-metadata/**<project-name>**

ACS URL	http://localhost:8080/login/saml2/sso/**carsonline**
Single Logout URL	http://localhost:8080/logout/saml2/slo
Metadata URL(*)	http://localhost:8080/saml2/service-provider-metadata/**carsonline**
EntityID	http://localhost:8080/saml2/service-provider-metadata/**carsonline**

URL Encoding

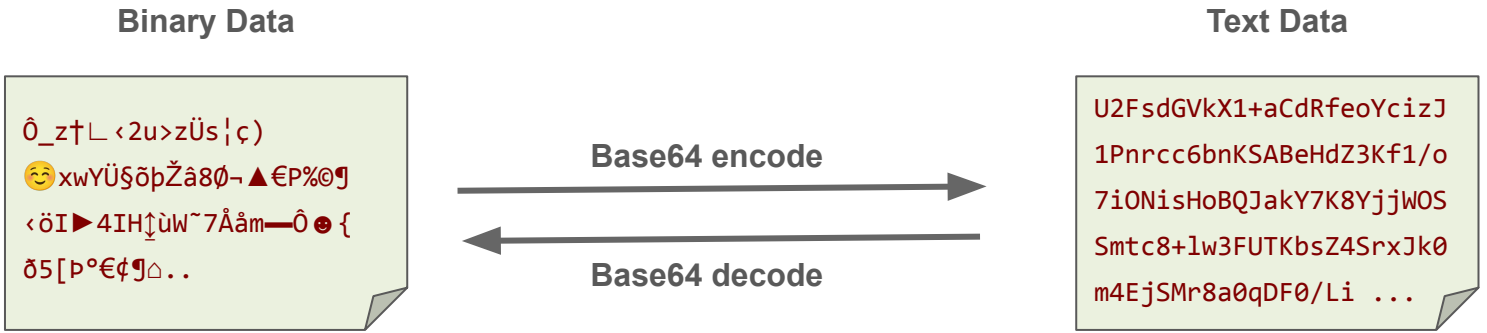
```
<url path>?param1=value1&param2=value2&param3=value3
```



- Conform data to URL rules
- No spaces, special characters

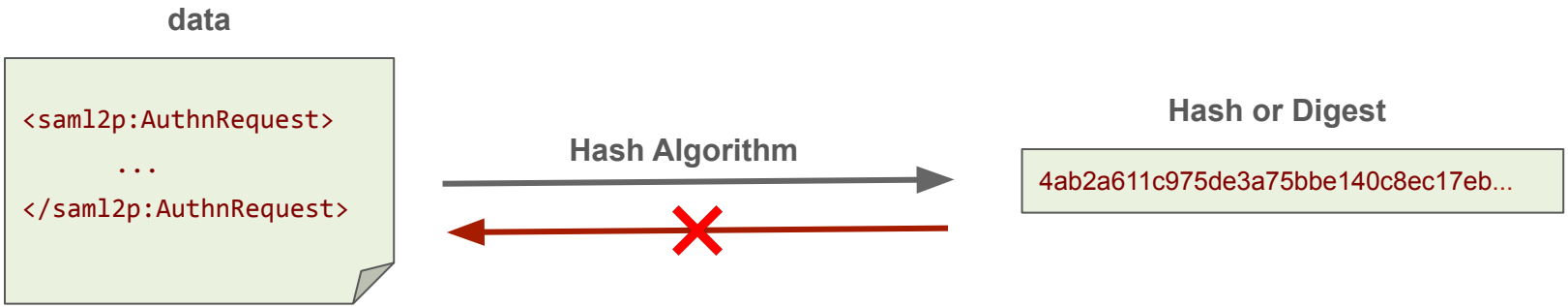
Space	%20 or +
?	%3F
=	%3D

Base64 Encoding



- Binary to text encoding
- Embed binary data (images) in Text (html. xml)
- Send data as HTTP Post

Hashing



- One way
- No collisions
- It's not Encryption

SHA-512

SHA-256

SHA-1

MD5

- Storing Passwords
- Digital Signatures
- Download files

Hashing

Java SE Development Kit 17.0.1 downloads

Thank you for downloading this release of the Java™ Platform, Standard Edition Development Kit (JDK™). The JDK is a development environment for building applications and components using the Java programming language.

The JDK includes tools for developing and testing programs written in the Java programming language and running on the Java platform.

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Arm 64 Compressed Archive	171.13 MB	https://download.oracle.com/java/17/latest/jdk-17_linux-aarch64_bin.tar.gz (sha256)
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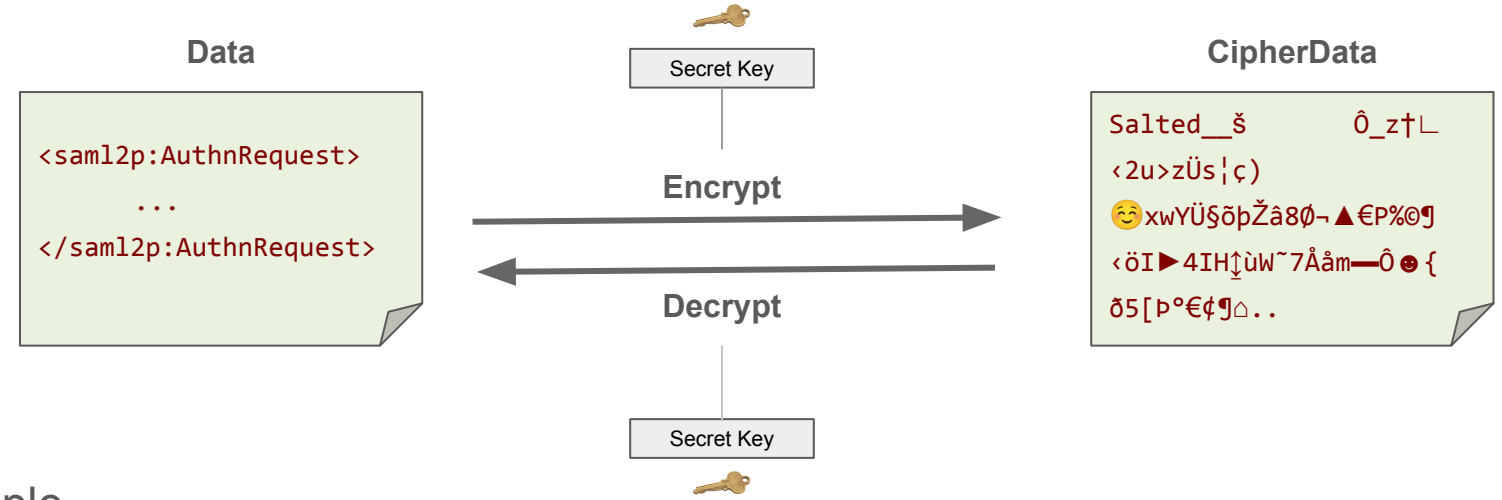
x64 RPM Package	154.78 MB	https://download.oracle.com/java/17/latest/jdk-17_linux-x64_bin.rpm (sha256)

```
a5e954a4e89b50277f20345034aea0ccf06f53705d4ec586b268b14ff42468f7
```

Symmetric Encryption



- Simple
- Secret Key
- Efficient for large data
- Hard to share secret key

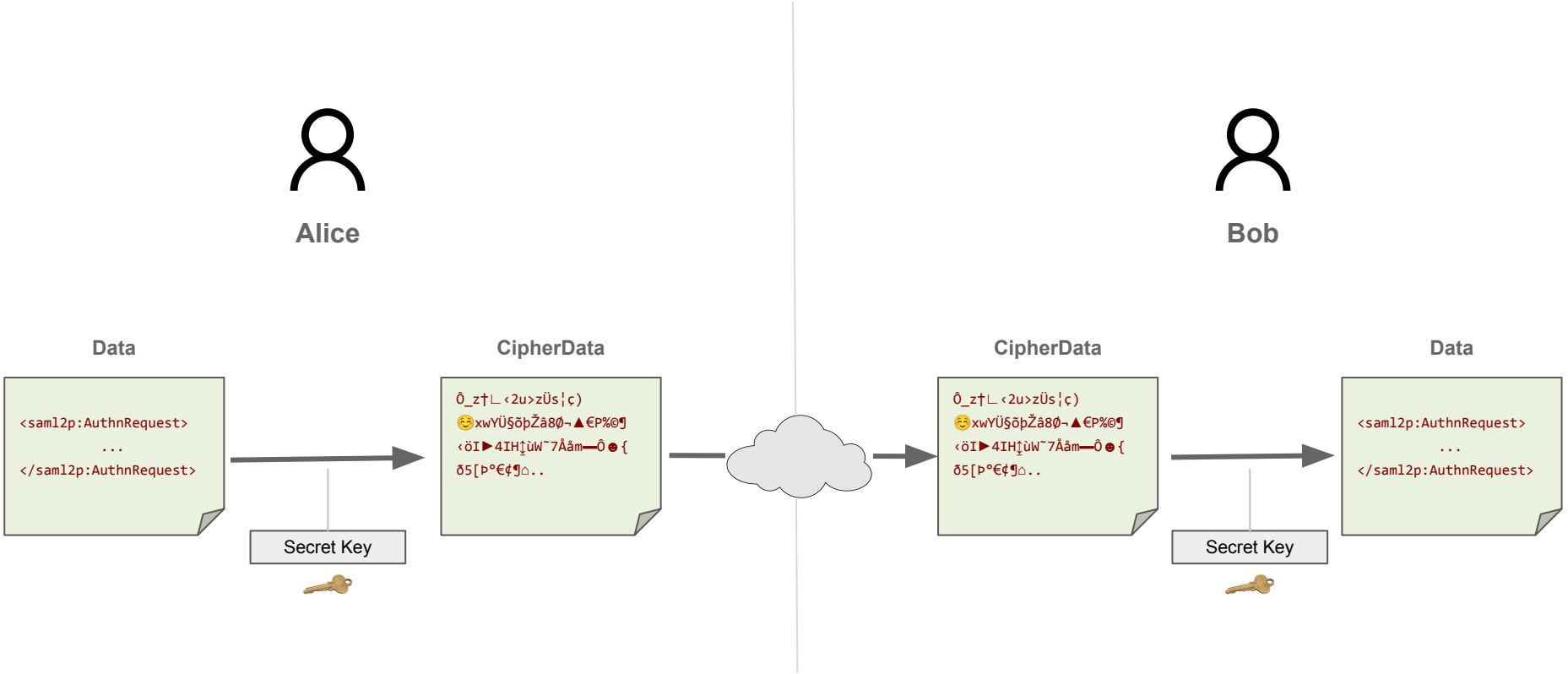
AES-256

AES-128

BlowFish

DES

Symmetric Encryption

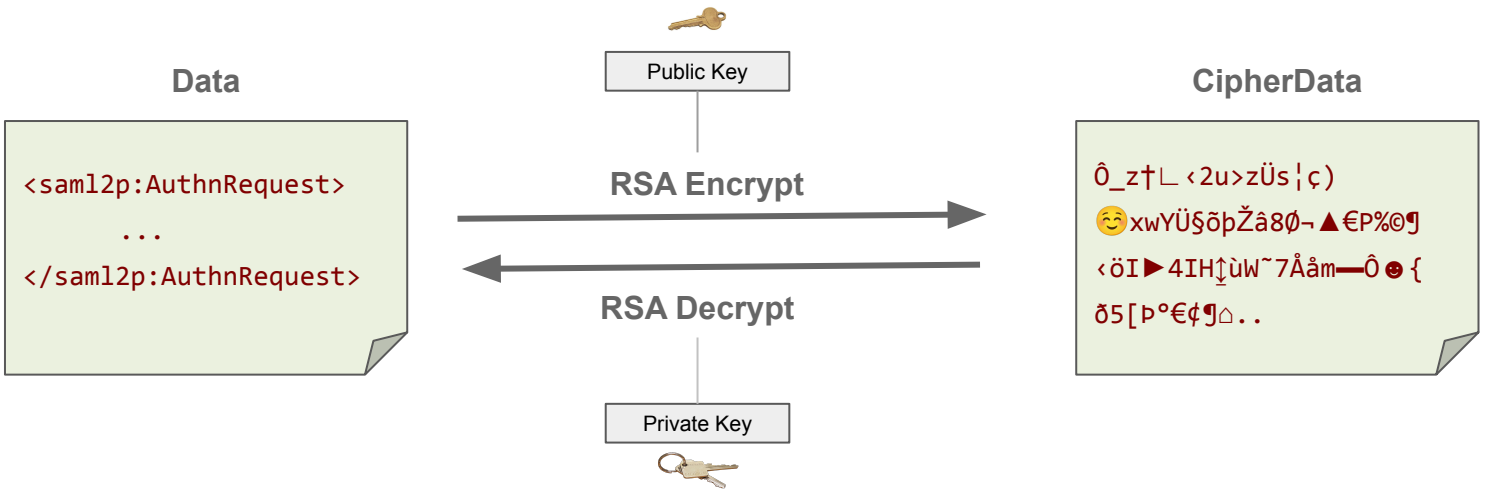


How will Alice share the Secret key with Bob ?

Asymmetric Encryption

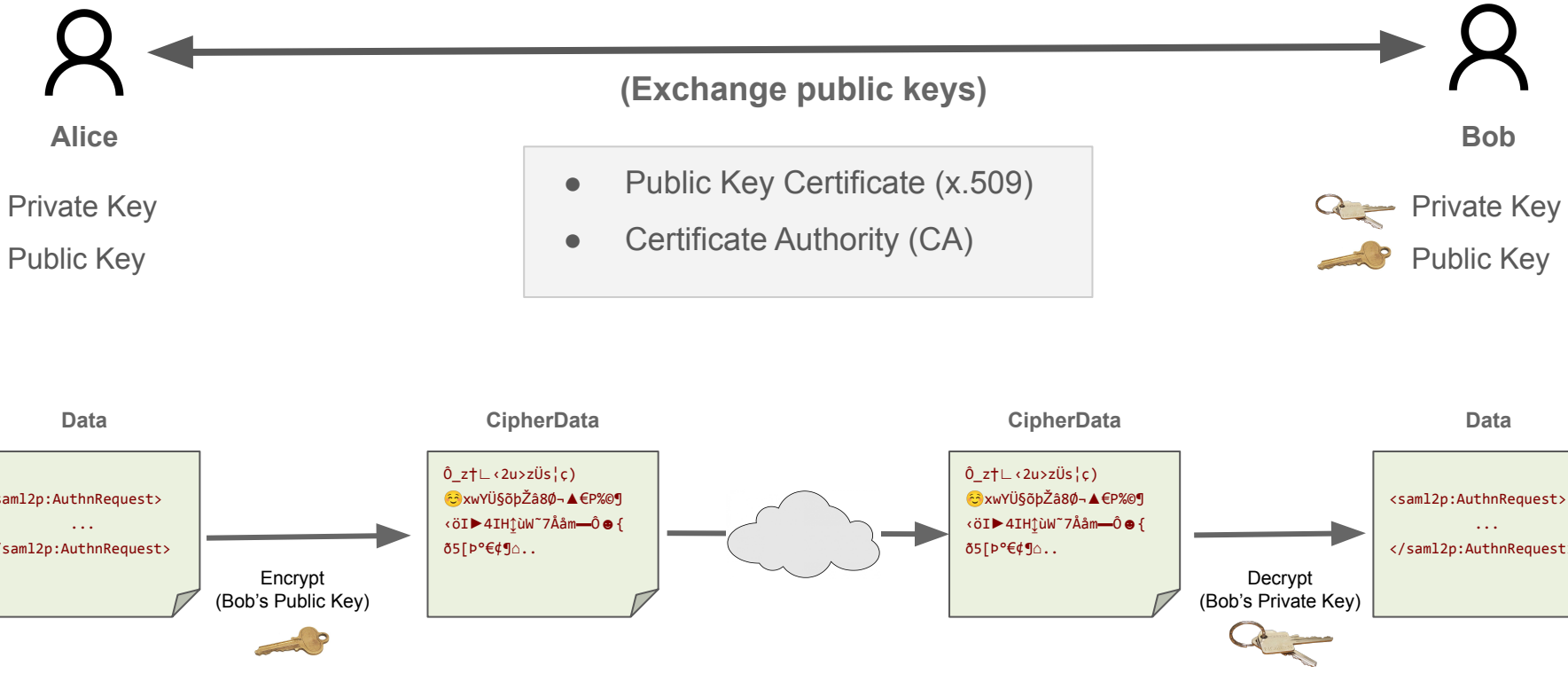

RSA Private Key


RSA Public Key



- Encrypt with Public Key, Decrypt with Private Key
- Sign with Private Key, verify with Public Key (more later)

Asymmetric Encryption



```
openssl req -x509 -nodes -sha256 -days 3650 -newkey rsa:2048 -keyout private.key -out certificate.crt
```

```
-----BEGIN PRIVATE KEY-----
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-----END PRIVATE KEY-----
```

```
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amVjdDJkZW1vMB4XDTIxMTAxODE3MzI1MVoXDTMxMTAxNjE3MzI1MVowcDELMAkG
A1UEBhMCVVMxETAPBgNVBAgMCFZpcmdpbmlhMREwDwYDVQQHDAhTdGVybGluZzEO
MAwGA1UECgwFbXVkcmExFDASBgNVBAsMC2VuZ2luZWVyaW5nMRUwEwYDVQQDDAxw
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0FqjoZHChavPgWl2Z77aavq5EglaC0iEJhY5FRe0A2g3Xbb2SQSr+qFQ
-----END CERTIFICATE-----
```
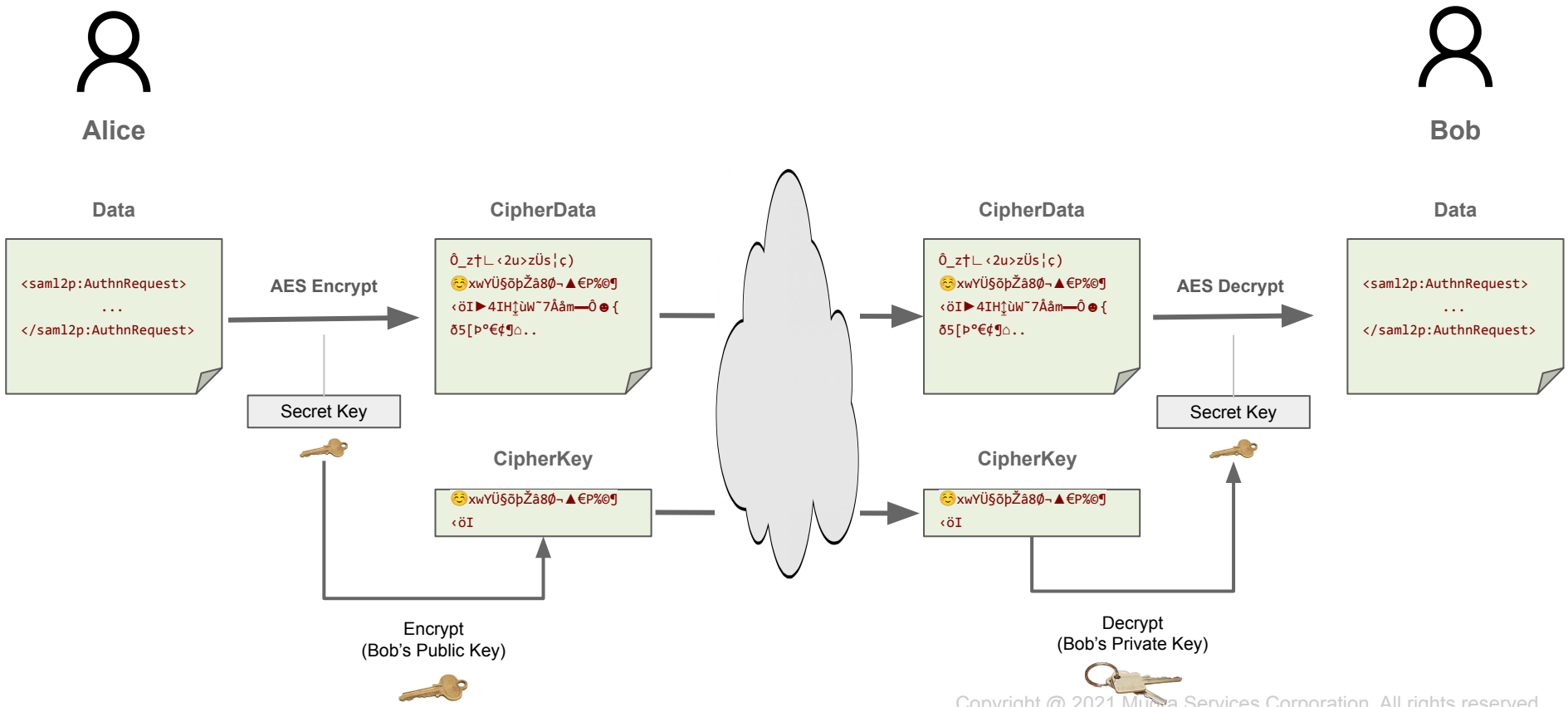
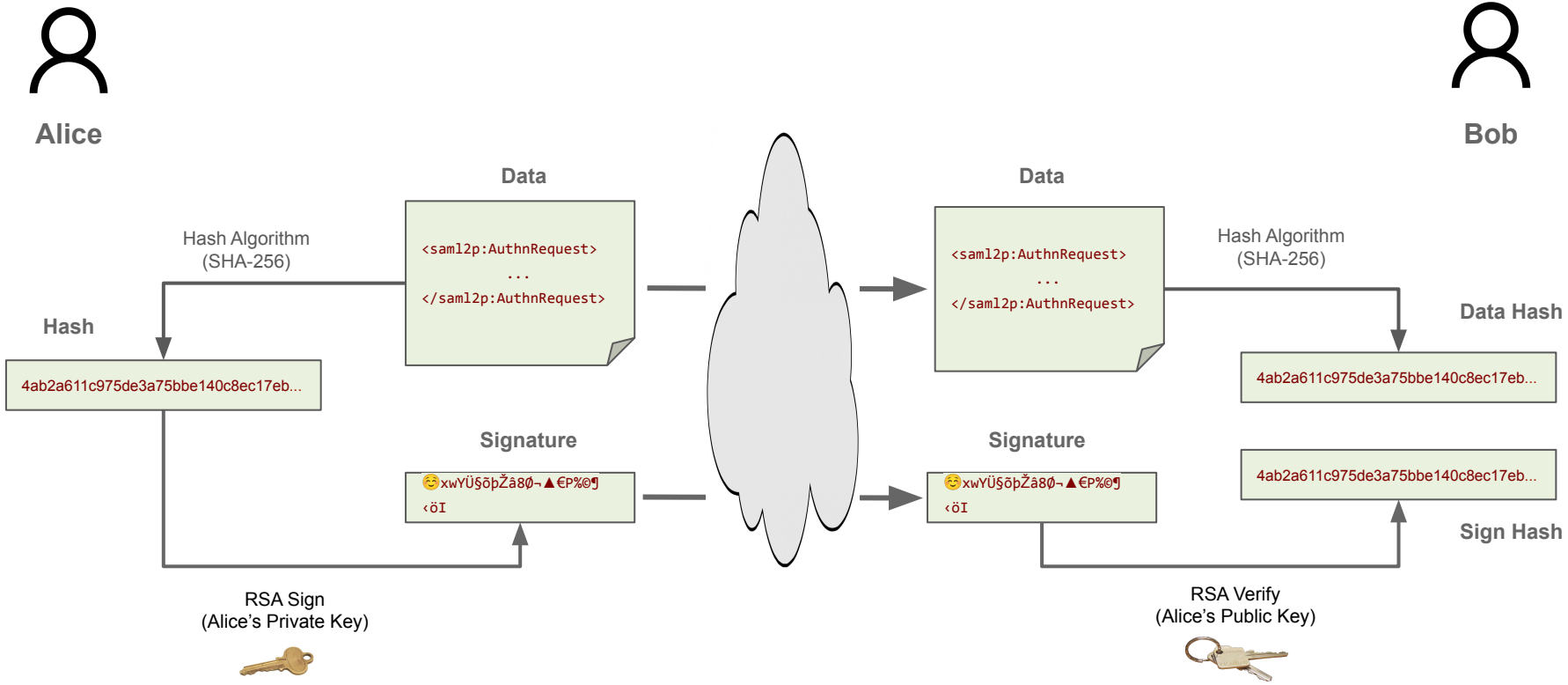

Hybrid Encryption



Digital Signature and Verification



Is **Data Hash = Sign Hash** ?